# The Evaluation of the Expert System for Pavement Evaluation and Rehabilitation (EXPEAR) in Washington State

WA-RD 169.1

Final Report April 1989



### **Final Report**

Research Project GC8286, Task 31 "EXPEAR" Evaluation

### THE EVALUATION OF THE EXPERT SYSTEM FOR PAVEMENT EVALUATION AND REHABILITATION (EXPEAR) IN WASHINGTON STATE

by

Holly A. Simmons Research Assistant University of Washington

Linda M. Pierce
Transportation Engineer 2
Materials Laboratory
Washington State Department
of Transportation

Joe P. Mahoney
Professor of Civil Engineering
University of Washington

Newton C. Jackson
Pavement and Soils Engineer
Materials Laboratory
Washington State Department
of Transportation

### **Washington State Transportation Center (TRAC)**

University of Washington The Corbet Building, Suite 204 4507 University Way N.E. Seattle, Washington 98105

Washington State Department of Transportation
Technical Monitor
Newton C. Jackson
WSDOT Pavement and Soils Engineer

Prepared for

**Washington State Transportation Commission** 

Department of Transportation and in cooperation with U.S. Department of Transportation Federal Highway Administration

# WASHINGTON STATE DEPARTMENT OF TRANSPORTATION TECHNICAL REPORT STANDARD TITLE PAGE

1. REPORT NO.	2. GOVERNMENT ACCE	SSION NO.	3. RECIPIENTS CATALOG NO	).
WA-RD 169.1				
4. TITLE AND SUBTITLE			5. REPORT DATE	
THE EVALUATION OF THE EXPER	T SYSTEM FOR		April 17, 1989	
PAVEMENT EVALUATION AND REHABILITATION (EXPEAR) IN WASHINGTON STATE			6. PERFORMING ORGANIZATI	ON CODE
7. AUTHOR(S)			8. PERFORMING ORGANIZATI	ION REPORT NO.
Holly A. Simmons, Linda M. Pierce, Jo	be P. Mahoney, and Ne	wton C. Jackson	WA-RD 169.1	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Washington State Transportation Center			10. WORK UNIT NO.	
University of Washington, JE-10			11. CONTRACT OR GRANT NO	D.
The Corbet Building, Suite 204; 4507 U	Jniversity Way N.E.		GC8286, Task 31	
Seattle, Washington 98105			13. TYPE OF REPORT AND PE	RIOD COVERED
12. SPONSORING AGENCY NAME AND ADDRESS			D 6 T 1 1 1 D	
Washington State Department of Trans	portation		Draft Technical Repo	rt
Transportation Building, KF-10			14. SPONSORING AGENCY CO	ODE
Olympia, Washington 98504				
15. SUPPLEMENTARY NOTES				
This study was conducted in cooperation				
Administration. The contract monitor Fairbank Research Center.	ioi ule fri w A was Jan	nes Beanar of the	Office of Implementat	ion, Turner-
16. ABSTRACT				
The EXpert system for Pavement Evaluation And Rehabilitation (EXPEAR) is an advisory system to assist the practicing engineer in evaluating a specific pavement section and selecting pavement rehabilitation alternatives. The objectives of this study were both to evaluate EXPEAR by using Washington state project data to determine the reasonableness of the program's output in comparison to WSDOT's current procedures, and to identify any existing program "bugs" and/or desirable program enhancements.  To evaluate EXPEAR program output, pavement design and condition data were entered from four test sections in Washington. After the pavement data were input, the EXPEAR output results were reviewed subjectively for reasonableness and compared to the state's current procedures for determining appropriate rehabilitation.  Although EXPEAR offers several positive attributes, this study found problems with its output. For example, the transverse cracking model predicted cracking that was more severe than WSDOT has observed. Often EXPEAR predicted distress trends that were not reasonable. Also, a test of the risk of the different rehabilitation options appeared to be missing from the program.  The researchers concluded that the high level of effort expended in creating EXPEAR is commendable and that a system of this type can be a useful tool not only for pavement design but also as a scoping and planning tool for pavement rehabilitation. However, WSDOT will probably not use EXPEAR in its present form because the performance predictions of both existing pavements and and rehabilitation strategies were generally inconsistent with what has been observed in Washington.				
17. KEY WORDS		18. DISTRIBUTION STAT	EMENT	
annual contains a second of the body of			This document is avail	
expert system, pavement, rehabilitation, portland cement concrete			e National Technical I	information
		Service, Springfi	eld, VA 22616	
19. SECURITY CLASSIF. (of this report)	20. SECURITY CLASSIF. (of thi	s page)	21. NO. OF PAGES	22. PRICE
None	None		270	

### DISCLAIMER

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Washington State Transportation Commission, Department of Transportation, or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

### TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
Executive Summary	1
Introduction	1
EXPEAR	2
Methodology	3
	2 3 4 5
Findings	5
Chapter 1. Introduction and Research Approach	7
Objectives	8
Report Overview	8
Expert Systems	8 9 9
History	9
Structure	10
General Applications	10
Pavement Applications	12
EXPEAR	14
Operation Summary	15
Decision Trees	16
Pavement Performance Predictions without Rehabilitation	16
Selection of Major Rehabilitation Approaches	18
Development of a Rehabilitation Strategy	18
Rehabilitation Strategy Performance Predictions	20
	20
Methodology	
Site Descriptions	21
Existing Forms of Distress	21
Chapter 2. Findings	35
Comparison of EXPEAR Results and WSDOT Practices	35
EXPEAR Rehabilitation Results	37
	44
EXPEAR Rehabilitation Output Summary	44
Chapter 3. Appraisal and Application	48
Introduction Positive Attributes of EXPEAR	48
Positive Attributes of EXPEAR	48
EASE OF OPERATION AN USER FRIENDLINESS	49
Ability of User to Specify Performance Period	49
Printing EXPEAR's Various Documents	49
Ability to View Filenames of Existing Projects	49
Requests for Irrelevant Data	49
Dunlicate Data	50
Duplicate DataAbility to Output Evaluations Directly to Printer	50
Documentation of Rehabilitation Strategies Evaluated	50
Inputting the Number of Lanes on the Project	50

# TABLE OF CONTENTS (Continued)

Section	<u>Page</u>
Chapter 3. Appraisal and Application (Continued)	
EXPEAR Manual	50
Include Calibration Variables in PSR and Pumping Models	50
Specification Deterioration Refers to Transverse Cracking	50
Specify that Cracking Model Refers to Transverse Cracking	50
Cite that AVGMT is Equivalent to the Average Annual	<b>5</b> 1
Tomporatura	51
Include "Tally Sheets" for the I10191 Sample Project	51 51
Include an Annual Precipitation Chart of Useful Scale	51
Program Bugs	31
An Execution Error Results if More than Two Lanes are Input	51
for Analysis	31
A Calculation Error Exists in the Restoration Future Distress	51
Predictions Subroutine	51
Provide Cost Analysis for the Various Rehabilitation Strategies	51
Provide Cost Analysis for the Various Rehabilitation Strategies	JI
Provide the Ability to Delay Rehabilitation for Analysis	52
Purposes	J.
Improve the Program's Capability to Explain its Line of	52
Reasoning  Include a Graphics Package	52
Include a Graphics Package	
Chapter 4. Conclusions and Recommendations	53
Complysions	53
Conclusions Recommendations	53
Recommendations	
References	56

### LIST OF APPENDICES

<u>Appendix</u>		Page
A.	I-5 North (MP 176) Seattle EXPEAR Output	58
B.	I-90 West (MP 278) Spokane EXPEAR Output	104
C.	I-90 East (MP 55) Snoqualmie Pass EXPEAR Output	149
Ď.	I-90 West (MP 61) Snoqualmie Pass EXPEAR Output	197
Ĕ.	Survey Data (Seattle and Spokane)	255
F.	Traffic Data	260

### LIST OF FIGURES

<u>Figure</u>		<u>Page</u>
1.	Basic Structure of an Expert System	11
2.	Sample Decision Tree - IPCP Structural Deficiency	17
2. 3.	Main Dehabilitation Approach Decision Tree for JPCP	19
3. 4.	Inventory Data, I-5 North (Milepost 176.35-176.43), Seattle,	
4.	Washington	22
5.	Condition Data, I-5 North (Milepost 176.35-176.43), Seattle,	
٦.	Washington	23
6.	Inventory Data, I-5 North (Milepost 176.35-176.43), Seattle,	
0.	Washington	24
7.	Inventory Data, I-90 West (Milepost 278.60-278.75), Spokane,	
, ·	Washington	25
8.	Condiion Data, I-90 West (Milepost 278.60-278.75), Spokane,	
0.	Washington	26
9.	Inventory Data, I-90 West (Milepost 278.60-278.75), Spokane,	25
· ·	Washington	27
10.	Inventory Data I-90 East (Milepost 55.50-63.99),	•
10.	Snogualmie Pass, Washington	28
11.	Condition Data, I-90 East (Milepost 55.50-63.99),	••
11.	Snogualmie Pass. Washington	29
12.	Inventory Data, I-90 East (Milepost 55.50-63.99),	••
12.	Snogualmie Pass, Washington	30
13.	Inventory Data, I-90 West (Milepost 61.00-61.01),	
10.	Snogualmie Pass, Washington	31
14.	Condition Data, I-90 West (Milepost 61.00-61.01),	
<b></b>	Snogualmie Pass, Washington	32
15.	Inventory Data, I-90 West (Milepost 61.00-61.01),	22
	Snoqualmie Pass, Washington	33

### LIST OF TABLES

<u>Table</u>		<u>Page</u>
1.	EXPEAR Rehabilitation Summary for I-90 West, MP 278	38
2.	EXPEAR Rehabilitation Summary for I-5 North, MP 176	39
3.	EXPEAR Rehabilitation Summary for I-90 East, MP 55	40
4.	EXPEAR Rehabilitation Summary for I-90 West, MP 61	42

	•	

### **EXECUTIVE SUMMARY**

### INTRODUCTION

The Washington State Department of Transportation (WSDOT) alone is responsible for a highway system consisting of 7,057 centerline miles of pavement, approximately six percent of which are portland cement concrete (PCC) pavements. The majority of these pavements are quickly approaching or, in some cases, have exceeded their design life. Prolonging the lives of pavements through various rehabilitation techniques has become a major concern of not only the WSDOT but many other state highway agencies as well.

The selection of a feasible rehabilitation strategy that will not only remedy the existing distresses but possess the structural capacity and integrity to support future increased traffic volumes is a difficult and critical task that requires a thorough understanding of how pavements perform. While some aspects of rehabilitation design may be solved deterministically using mechanistic models and established principles and procedures, others must be solved heuristically, using subjective knowledge, opinions, beliefs, and judgment possessed by the individual engineer.

While deterministic knowledge is easily obtained and preserved in textbooks and other published literature, heuristic knowledge is not. Often, as in the case of pavement engineering, heuristic knowledge is possessed by a limited number of experienced engineering specialists who are found only in some state and federal agencies, private companies, and universities. Furthermore, since it is acquired by individual engineers through experience, it is not easily transferred, and as these engineers retire, it may be lost. These concerns spurred the development of "knowledge-based systems" and, more specifically, the subset of these systems called "expert systems." These computer programs attempt to capture the knowledge of

experts and use it to solve difficult problems within a specifically defined subject range.

EXPEAR is such a system. It was developed to help knowledgeable pavement engineers solve the difficult problem of selecting an appropriate rehabilitation strategy for specific projects.

The objectives of this study were both to evaluate EXPEAR using Washington state project data to determine the reasonableness of the program's output in comparison to WSDOT's current procedures, and to identify any existing program "bugs" and/or desirable program enhancements.

### **EXPEAR**

The <u>EXpert</u> system for <u>Pavement Evaluation And Rehabilitation</u> (EXPEAR) is an advisory system to assist the practicing engineer in evaluating a specific pavement section and selecting pavement rehabilitation alternatives. EXPEAR consists of three separate programs; they include Jointed Plain Concrete Pavements (JPCP), Continuously Reinforced Concrete Pavements (CRCP), and Jointed Reinforced Concrete Pavements (JRCP). The program was written with Borland International, Inc.'s Turbo-Pascal and is designed to operate on any IBM PC or compatible with a 256 Kilobyte memory.

The evaluation of a candidate rehabilitation project begins with the collection of some basic inventory and survey data. The inventory data include such things as the pavement cross-section, subgrade classification, joint spacing, lane widths, climate and traffic data. The survey data quantify the present pavement condition and are taken for a number of sample units within the project based on the pavement distress classification system found in NCHRP Report No. 277. The monitoring data also include the present serviceability rating (PSR) as determined by a team of two engineers who drive over the entire length of the project and rate

the ride. This information is then input to EXPEAR, which extrapolates the conditions described in the sample units to cover the entire project length.

The program then evaluates the existing pavement condition in twelve specific areas of pavement performance including structural adequacy, roughness, drainage, joint deterioration, foundation movement, joint sealant condition, skid resistance, joint construction, concrete durability, load transfer, loss of support, and shoulders. The evaluation uses decision trees to compare the pavement's condition with predetermined critical distress levels for each of the 12 categories. At this point, EXPEAR also predicts future performance without rehabilitation, based on a number of models from the <u>COncrete Pavement Evaluation System</u> (COPES), as well as a few recommendations for further physical testing.

Finally, EXPEAR provides the major rehabilitation techniques that it considers to be feasible for the project. The principle techniques include reconstruction of both lanes, reconstruction of the outer lane with restoration of the inner lane, restoration of both lanes, asphalt concrete (AC) structural overlay, portland cement concrete (PCC) bonded overlay, or (PCC) unbonded overlay. The engineer may then select one or more of these strategies for evaluation and EXPEAR predicts its performance for the next 20 years, based on another group of predictive models that include those from the COPES as well as some from the Development of Illinois Pavement Feedback System, an ongoing study being conducted for the Illinois Department of Transportation.

### **METHODOLOGY**

To evaluate the reasonableness of EXPEAR program output, pavement design and condition data were entered from four test sections within Washington state. The evaluation was limited to the EXPEAR JCP program, since there are few CRCP or JRCP pavements in Washington state. After pavement data were input, the EXPEAR output and results were then reviewed subjectively for

reasonableness and compared to the findings of that study, as well as the state's current procedures for determining appropriate rehabilitation. The projects used for input included the PCC rehabilitation test sites on I-5 in Spokane, as well as two other sites worthy of investigation located on I-90 near Snoqualmie Pass (about 50 to 60 miles east of Seattle). The EXPEAR output was then compared with the pavement's present condition (1988). The analysis was limited on all test sites to the outside or truck lane, since in all case studies the pavement distresses were relatively insignificant in adjacent lanes.

### **FINDINGS**

In general the transverse cracking model predicted cracking that was much more severe than WSDOT observed. The transverse cracking model was insensitive to existing cracks that would be expected to return in PCC bonded overlays. The EXPEAR models predicted premature failures for newly reconstructed pavements that the WSDOT has observed to perform very well for performance periods greater than 20 years. EXPEAR predicted the severity of reflection cracking to be greater in a pavement that had undergone cracking and seating before overlaying than in one that had not, even though it predicted more total reflection cracking in the latter pavement.

Often, EXPEAR predicted distress trends that were not reasonable, such as the improvement (self-healing effect) of the PSR over time. The reflection cracking model was not especially sensitive to AC overlay thicknesses. EXPEAR did not distinguish asphalt treated bases from other stabilized bases, such as cement or lime stabilized bases, which are known to perform differently. In addition, EXPEAR did not account for the unique material properties found in Washington, such as the strength and durability of asphalt concrete mixes used in overlays, or asphalt treated bases used beneath concrete pavements.

A test of the risk of rehabilitation options, as well as the human element, appeared to be missing from the program, which relied heavily on predictive models. Finally, EXPEAR did not address longitudinal cracking, which is a significant distress type in Washington, in its predictive models.

Despite its problems, the EXPEAR system did have several positive attributes, including the following.

- EXPEAR incorporates some of the information known about pavement rehabilitation options and assembles it in a useful manner.
- . The estimates of future pavement performance could be useful in the scoping and planning stages of rehabilitation projects.
- EXPEAR provides an automated procedure for organizing survey inventory and monitoring data that did not previously exist.
- By allowing the user to manipulate and analyze a variety of rehabilitation options that are applicable to a particular project, different geographical locations are accommodated while the analysis of other options is encouraged.
- EXPEAR provides a standardized method of evaluating concrete pavements and classifying distresses (COPES).
- EXPEAR addresses the problem of documenting the heuristic knowledge possessed by pavement engineers that is necessary for successful rehabilitation design.
- . In its current form, EXPEAR (version 1.1) is a relatively "bug-free" program that functions smoothly and quickly.

### CONCLUSIONS AND RECOMMENDATIONS

The models primarily used in EXPEAR are from the COPES. Because of local conditions these models had little chance of producing reasonable predictions. However, because of various factors, the exact duplication of field observations and

test results is impractical. While the first condition should be investigated by the developers of EXPEAR, the last reason suggests that both the developers and users of EXPEAR will have to develop a level of tolerable and acceptable differences if EXPEAR and systems like it are to become an integral part of pavement engineering.

The researchers concluded that the obvious high level of effort expended in creating EXPEAR is commendable. A system of this type can be a useful tool not only for pavement design but also as a scoping and planning tool for pavement rehabilitation. In addition, it provides an automated, practical means of recording pavement survey and monitoring data, which did not previously exist.

However, the Washington State DOT will probably not use EXPEAR in its present form. The performance predictions of both existing pavements and rehabilitation strategies are generally inconsistent with what has been observed in Washington state. For the near term, individual performance models that are found to be representative of Washington's conditions will be used where applicable (mostly for rehabilitation scoping or planning).

### CHAPTER 1. INTRODUCTION AND RESEARCH APPROACH

Over the last few decades, many of the United States' high type pavements, including those that make up the vital Interstate System, have been exposed to volumes of heavy truck traffic far in excess of that for which they were designed. This combined with age (many of the Interstate pavements are 20 to 30 years old) is resulting in deteriorated pavement structures [1]. The Washington State Department of Transportation (WSDOT) alone is responsible for a highway system consisting of 7,057 centerline miles of pavement, approximately six percent of which are portland cement concrete (PCC) pavements mostly located in urban areas with high traffic volumes [2]. The majority of these pavements are quickly approaching or, in some cases, have exceeded their design life. Prolonging the lives of pavements through various rehabilitation techniques has become a major concern of not only the WSDOT but many other state highway agencies as well.

The selection of a feasible rehabilitation strategy that will not only remedy the existing distresses but possess the structural capacity and integrity to support future increased traffic volumes is a difficult and critical task that requires a thorough understanding of how pavements perform. In addition, the task is complicated by uncertainty about future traffic volumes, truck weights, and construction costs, as well as factors relating to construction, design, material properties, and the environment that affect pavements in ways which are not clearly defined. So while some aspects of rehabilitation design may be solved deterministically using mechanistic models and established principles and procedures, others must be solved heuristically, using subjective knowledge, opinions, beliefs, and judgment possessed by the individual engineer.

While deterministic knowledge is easily obtained and preserved in textbooks and other published literature, heuristic knowledge is not. Often, as in the case of pavement engineering, heuristic knowledge is possessed by a limited number of experienced engineering specialists who are found only in some state and federal agencies, private companies, and universities. Furthermore, since it is acquired by individual engineers through experience, it is not easily transferred, and as these engineers retire, it may be lost. These concerns spurred the development of "knowledge-based systems" and, more specifically, the subset of these systems called "expert systems." These computer programs attempt to capture the knowledge of experts and use it to solve difficult problems within a specifically defined subject range. EXPEAR is such a system, and was developed to help knowledgeable pavement engineers solve the difficult problem of selecting an appropriate rehabilitation strategy for specific projects [2].

### **OBJECTIVES**

The objectives of this study are as follows:

- to evaluate EXPEAR using Washington state project data to determine the reasonableness of the program's output in comparison to WSDOT's current procedures; and
- 2. to identify any existing program "bugs" and/or desirable program enhancements before its distribution.

### REPORT OVERVIEW

This report consists of four additional chapters. Chapter 1 contains a general introduction to expert systems, an introduction to the EXPEAR system, and a review of the case studies used in the evaluation of the EXPEAR system, including the methodology used, site descriptions, and the data input to the system. Chapter 2 discusses the results of the EXPEAR analysis and compares EXPEAR output and WSDOT practices and procedures. Chapter 3 discusses the use of EXPEAR, including its user friendliness, the user's manual, bugs detected, and suggested enhancements. Finally, Chapter 4 contains the conclusions and recommendations of the study.

### **EXPERT SYSTEMS**

With the rapid increase in capability and decrease in price of mini-and microcomputers, a great deal of interest in expert system technology has been generated in many industries. Recently, the Federal Highway Administration (FHWA) and others in the highway community have been considering the potential application for this technology in highway engineering.

### **History**

Expert systems research, which is a branch of the field of artificial intelligence, began in the late 1950s as an attempt to automate the thought processes of scientists [3]. The early programs were run on mainframe computers and were usually written using LISP, which is the common language for artificial intelligence. Eventually a program called "MYCIN" was developed by Feigenbaum and Shortliffe through the Heuristic Programming Project at Stanford University [4]. This program was designed to help doctors diagnose bacteriological diseases. MYCIN is still in use today and became a landmark in expert system technology for two reasons. First, it was the first expert system that had the ability to explain why decisions were made. Secondly, it was the first system that was able to separate the decision making process from the rules and data [3].

As this and other expert systems evolved, it became increasingly apparent that the decision process contained in these programs was largely independent of the type of expert system, rules, and data. Researchers found that the logic could be applied to create other expert systems using different rules and data sets. As a result, "EMYCIN" was developed, which is basically the decision making process used in MYCIN stripped from the rules and data sets contained in that program. EMYCIN was termed a "shell" program, which could be used to develop other expert systems in different fields [3].

Although the development of shell programs greatly facilitated the development of expert systems in various applications, expert systems were still used

almost exclusively in the university setting because they were run on mainframe computers [3]. Only after a great deal of research were shell programs made capable of operation on mini-and microcomputers, which is why members of the engineering community have only recently taken interest in the development of expert systems [5].

### **Structure**

An expert system consists of three major components. These include the knowledge base, the inference engine, and the user interface [5]. The knowledge base consists of rules and facts that capture an expert's or group of experts' knowledge, opinions, beliefs, rules of thumb, intuition, and experience. inference engine is the part of the program that combines rules and data to make decisions, assertions, hypotheses, and conclusions. It is through the inference engine that the reasoning strategy (or method of solutions) is controlled [4]. The part of the program extracted from MYCIN to create EMYCIN (the shell) is an inference engine, which combines information supplied by the user with information and facts contained in the knowledge base to advise the user on how to solve a specific problem or attain a goal [3]. The inference engine may also make decisions about what additional information may be needed or what conclusions may be drawn The user interface then translates the based on the information supplied. information contained in the knowledge base and processed by the inference engine to a form that is comprehendible and useful to the user [5]. This structure is illustrated in Figure 1.

### **General Applications**

Expert systems may be applied in several different situations, but they are primarily applicable to situations that require special knowledge, experience, or judgment to diagnosis, analyze, and provide a feasible solution strategy [6]. The following have been offered as criteria for implementation of an expert system to any given situation:

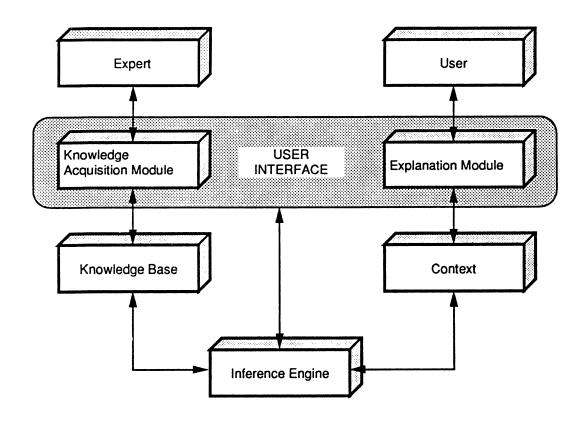


Figure 1. Basic Structure of an Expert System [after ref. 6]

### **Technical Considerations**

- Both the problem to be addressed and the expected output from the advisory system can be clearly defined.
- . There are recognized experts in the field, and there is general agreement among these experts on the knowledge required to solve the problem.
- Experts need private knowledge (experience, heuristics, etc.) in addition to technical tools (such as handbooks and computers) to identify the problem, make inferences about it, and analyze it.

### Management and Human Requirements

- The end users must be identified and their needs and skills considered. The transfer to and application by the end users of the completed system must be major factors in the system planning and design.
- . Someone in the organization must be an advocate of the advisory system. Ideally this includes both a developer and a user [5].

Some may argue that the conditions that exist in the design and analysis of pavement rehabilitation strategy meet most of the above criteria, and therefore it is a potential candidate for the implementation of an expert system. However, in the field of highway technology there have been a relatively small number of expert systems developed for pavement applications. The shortage of good, practical pavement Knowledge-Based Expert Systems (KBES) in this field is due not so much to the limitations of present KBES frameworks as to the difficulty of compiling, organizing, and formalizing the huge body of heuristic expertise that characterizes the profession [4]. However, a few useful pavement systems do exist.

### **Pavement Applications**

SCEPTRE (A Surface Condition Expert System for Pavement Rehabilitation) is one such example. This prototype system for the rehabilitation of

flexible pavements was developed cooperatively by the University of California (Irvine), the University of Washington, and the WSDOT under a partial grant by the National Science Foundation. The system is capable of deducing a set of feasible project rehabilitation strategies for subsequent detailed analysis and design based on a knowledge-base representing several human experts and user inputs. In addition, SCEPTRE can explain its line of reasoning and is easily modified, making it potentially valuable to a broad range of users. The program utilizes a shell program called "EXSYS," which is an expert system development package for IBM PC and compatible microcomputers [6].

Another pavement related expert system was developed as part of a joint investigation conducted by Purdue University in cooperation with the Indiana Department of Highways and the FHWA. The program is entitled "An Expert System to Estimate Highway Pavement Routine Maintenance Work Load." The program was written in LISP and may be used to estimate highway pavement routine maintenance needs at a subdistrict level. The system contains a knowledge-base that was prepared by from the experience and judgment of unit foremen and requires user input relating to the general features of the highway section and its existing distresses. The output gives specific recommendations as to the type and quantity of activities to be performed, as well as the expected costs for these activities [7].

"Pavement Expert" is an expert system that was developed in the United Kingdom to aid in the evaluation of concrete pavements. This system is intended to operate on a portable microcomputer mounted to a surveying car. It is designed to guide the user through the pavement evaluation process, to present information for error checking and to provide pertinent help at any time. The program builds a model representing the general condition of the road being evaluated as information is input during the survey. This model is then used to calculate the Structural Damage Index and the Pavement Condition Rating (PCR), which relate

to the structural capacity and the general riding condition of the pavement, respectively. Pavement Expert is then able to present the pavement condition information graphically, as well as make some general conclusions. The knowledge-base contained in this system was extracted from the documents for the PCR, as well as some experts in this field. The knowledge-base is represented by a rule base expert system shell called "Savoir" and runs on any IBM or compatible microcomputer [8].

Pavement management may also be an excellent application for expert systems. Currently the data requirements are fairly well established, and in general there is agreement on how to quantify pavement serviceability and failure. However, many of the rules regarding breakpoints for pavement distress severities and extents need further definition and development [3].

In addition to those mentioned previously, several other pavement-related expert systems exist. Some of these systems will be presented and/or demonstrated at a Workshop on Expert Systems in Pavement Engineering to be held before the TRB Annual meeting in January of 1989. The workshop will focus on the development, operation, performance, and benefits of expert systems, as well as their limitations [9].

### **EXPEAR**

The <u>EXpert</u> system for <u>Pavement Evaluation And Rehabilitation</u> (EXPEAR) was originally developed by Kathleen T. Hall and Michael I. Darter at the University of Illinois for the Federal Highway Administration [1]. Currently, the system is being further developed for the Illinois Department of Transportation (IDOT). According to the FHWA, "EXPEAR is an advisory system to assist the practicing engineer in evaluating a specific pavement section and selecting pavement rehabilitation alternatives" [9]. EXPEAR consists of three separate programs; they include Jointed Plain Concrete Pavements (JPCP), Continuously

Reinforced Concrete Pavements (CRCP), and Jointed Reinforced Concrete Pavements (JRCP). The program was written with Borland International, Inc.'s Turbo-Pascal and is designed to operate on any IBM PC or compatible with a 256 Kilobyte memory [1].

### **Operation Summary**

The evaluation of a candidate rehabilitation project begins with the collection of some basic inventory and survey data. The inventory data include such things as the pavement cross-section, subgrade classification, joint spacing, lane widths, climate and traffic data. The survey data quantify the present pavement condition and are taken for a number of sample units within the project based on the pavement distress classification system found in NCHRP Report No. 277 [10]. The monitoring data also include the present serviceability rating (PSR) as determined by a team of two engineers who drive over the entire length of the project and rate the ride. This information is then input to EXPEAR, which extrapolates the conditions described in the sample units to cover the entire project length.

The program then evaluates the existing pavement condition in twelve specific areas of pavement performance including structural adequacy, roughness, drainage, joint deterioration, foundation movement, joint sealant condition, skid resistance, joint construction, concrete durability, load transfer, loss of support, and shoulders. The evaluation uses decision trees to compare the pavement's condition with predetermined critical distress levels for each of the 12 categories. At this point, EXPEAR also predicts future performance without rehabilitation, based on a number of models from the Concrete Pavement Evaluation System (COPES) [11], as well as a few recommendations for further physical testing.

Finally, EXPEAR provides the major rehabilitation techniques that it considers to be feasible for the project. The principle techniques include reconstruction of both lanes, reconstruction of the outer lane with restoration of the

inner lane, restoration of both lanes, asphalt concrete (AC) structural overlay, portland cement concrete (PCC) bonded overlay, or (PCC) unbonded overlay. The engineer may then select one or more of these strategies for evaluation and EXPEAR predicts its performance for the next 20 years, based on another group of predictive models that include those from the COPES as well as some from the Development of Illinois Pavement Feedback System, an ongoing study being conducted for the Illinois Department of Transportation [2].

### **Decision Trees**

EXPEAR uses a decision tree format to perform the diagnostic activities of concrete pavement evaluation. A sample decision tree is shown in Figure 2. The decision trees consist of a configuration of nodes, branches, and conclusions. Nodes represent bits of information related to the pavement in question that are input to the system by the user. At each node, EXPEAR must decide which branch of the tree should be followed, according to the values for the choice shown for the branches. By proceeding down the branches of the tree, a conclusion is eventually reached that determines the presence or absence of specific deficiencies within one major problem area. Decision trees exist for each of the 12 pavement performance areas. Each of the evaluation conclusions is accompanied by one or more possible rehabilitation techniques that could be performed to correct the deficiency concluded to exist. Although these techniques are not used at this point to develop a rehabilitation strategy, they do give the engineer an idea of the types of repairs that may be appropriate for correcting any specific deficiency irrespective of other deficiencies that may exist [1].

### Pavement Performance Predictions without Rehabilitation

The performance prediction models used to evaluate the pavement's future condition without rehabilitation were, as mentioned previously, developed under NCHRP Project 1-19 [10] with data from 418 pavement sections representing over 1,305 miles of mostly heavily trafficked interstate highways. The data represent

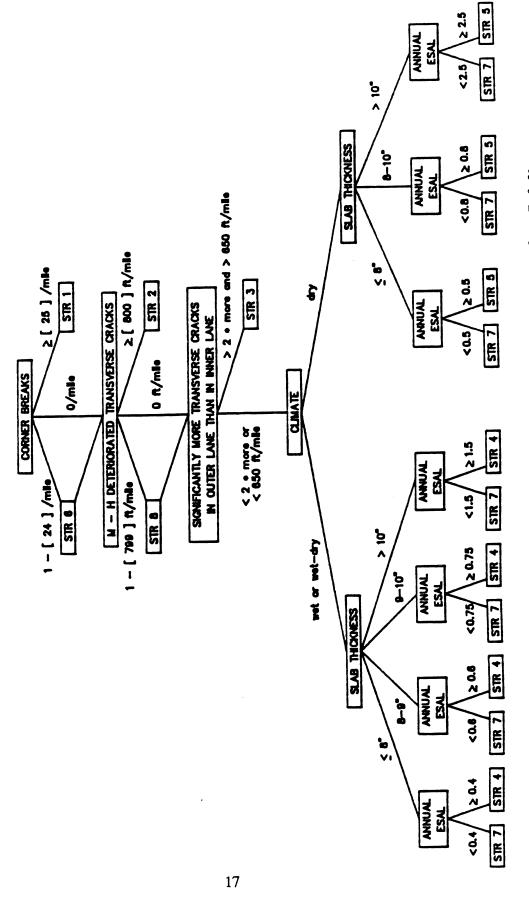


FIGURE 2. Sample Decision Tree--JPCP Structural Deficiency [from Ref. 2]

Annual ESAL in millions

seven states, including Illinois, Georgia, Utah, Minnesota, Louisiana, and California, and to a lesser extent, Nebraska [10]. The performance of the pavement is predicted for key distress types, including faulting, cracking, joint deterioration, pumping, and for the PSR. The program uses the extrapolated input values of these distresses to calculate future distresses and displays one or more sentences describing the deficiencies predicted to occur and the years in which the critical values of these deficiencies are triggered. These critical values can be the system's default values or they can be values specified by the engineer.

### Selection of Major Rehabilitation Approaches

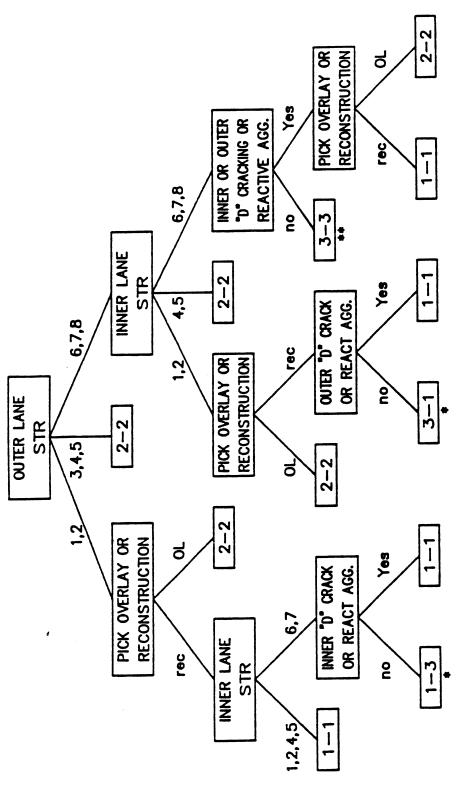
On the basis of user inputs and the evaluation results, the major rehabilitation approaches are selected using another decision tree, shown in Figure 3. This decision tree is based on the following guidelines:

- . Substantial load-related distress indicates a structural deficiency and may be corrected by either a structural overlay or reconstruction.
- . Structural overlays are used to correct structural deficiencies indicated by design and traffic factors.
- . High-severity D-cracking or reactive aggregate distress indicates a durability deficiency and is correctable by either a structural overlay (unbonded PCC only) or reconstruction.
- . All other pavement deficiencies are corrected by restoration techniques [1].

### Development of a Rehabilitation Strategy

Once the major rehabilitation approaches have been established, the user interacts with the system to develop a rehabilitation strategy for the project. The strategy includes specific techniques to be performed on each lane and on each shoulder. EXPEAR uses a different decision tree for each of the main rehabilitation approaches to determine the specific deficiencies that must be corrected on each lane and shoulder.

# Main Rehabilitation Approach for JPCP



\*\* Option to go to 1-1, 1-3, or 2-2 provided Option to go to 1-1 provided

Reconstruct Outer, Reconstruct Inner Restore Outer, Reconstruct Inner Reconstruct Both Lanes Overlay Both Lanes 3-1 2-2 3-3 1-3

Restore Both Lanes

FIGURE 3. Main Rehabilitation Approach Decision Tree for JPCP [from Ref. 2]

### Rehabilitation Strategy Performance Predictions

As was done for the evaluation of the future performance of the pavement without rehabilitation, the future performance of the selected rehabilitation strategy is predicted in terms of levels of distress for key distress types. Future performance is calculated for a 20-year period and assumes rehabilitation occurs in the present year. The COPES models, along with models developed within the state of Illinois, are used to perform these calculations.

The key distress types predicted for AC overlays include rutting and reflective cracking, which is predicted in two ways: "total" feet of reflective cracking per mile as well as feet of "medium to high severity" reflective cracking. For both bonded and unbonded overlays the models predict faulting, transverse cracking, and joint deterioration. In the cases of reconstruction and restoration, the quantities of faulting, transverse cracking, joint deterioration and pumping are predicted. Full depth repair faulting is also included for the restoration case.

### **METHODOLOGY**

To evaluate the reasonableness of EXPEAR program output, pavement design and condition data were entered from four test sections within Washington state. The evaluation was limited to the EXPEAR JPCP program, since there are few CRCP or JRCP pavements in Washington state. Two of the four test sections were also test sites in the PCC Rehabilitation Study (a WSDOT/FHWA HP&R research activity) [12]. After pavement data were input, the EXPEAR output and results were then reviewed subjectively for reasonableness and compared to the findings of that study, as well as the state's current procedures for determining appropriate rehabilitation. The projects used for input included the PCC Rehabilitation test sites on I-5 (MP 176, north) in Seattle and I-90 (MP 278, west) in Spokane, as well as two other sites worthy of investigation. These were located on I-90 near Snoqualmie Pass at MP 55 eastbound and MP 61 westbound. The I-90 (MP

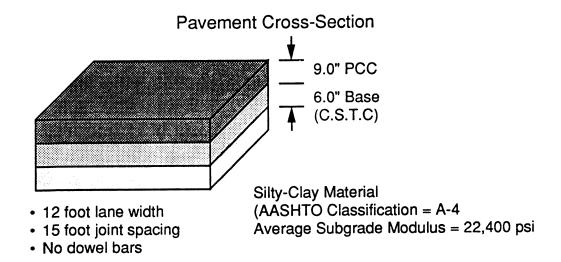
55, east) Snoqualmie Pass project was somewhat unique because it was restored in 1986 and its condition prior to restoration was used as input to EXPEAR. The EXPEAR output was then compared with its present condition (1988). The analysis was limited on all test sites to the outside or truck lane ("lane one" as defined by EXPEAR), since in all case studies the pavement distresses were relatively insignificant in adjacent lanes. A summary of the pavement design and condition data is shown for each of these test sections in the following figures. (Figures 4 through 6 for I-5, MP 176, Figures 7 through 9 for I-90, MP 278, Figures 10 through 12 for I-90, MP 55, and Figures 13 through 15 for I-90, MP 61.)

### **Site Descriptions**

Much of the inventory data needed as input to the program were available for all four test sites from the Pavement Management System developed by the WSDOT, with the exception of the climate information, which was obtained from records of the Gale Research Company and the National Weather Bureau [13,14]. Existing pavement condition survey data were collected from several sources. For the Seattle and Spokane test sites, faulting surveys and distress mappings were obtained from the PCC Rehabilitation study. (Detailed survey information is contained in Appendix E). Faulting measurements, which are the only distress form on the I-90 west (MP 61) test site in Snoqualmie Pass, were taken specifically for this study. The data available for the I-90 east (MP 55) project were unique because the project was rehabilitated in 1986, but extensive distress mapping had been done before rehabilitation. This 1986 mapping, as well as faulting measurements, were available for input to this study. In addition, load transfer measurements, taken with a WSDOT Falling Weight Deflectometer (FWD), were available for all test sites.

### **Existing Forms of Distress**

The primary forms of distress on I-5 through Seattle included longitudinal cracking and wheelpath wear. In addition, the joint sealant was in poor condition over most of the sample units surveyed. Faulting was not a major problem on this



### Climate

Climate Zone	= Wet non-freeze
Average Annual Temperature	= 53 °F
Average Annual Temperature Range	= 39 °F
Mean Annual Precipitation	= 39 inches
Corps of Engineers Mean Freezing Index	= 25 °F-days

### Traffic

Estimated two-way ADT	= 145,900
% Trucks (single and combination units)	= 4

Figure 4. Inventory Data, I-5 North (Milepost 176.35 -176.43)
Seattle, Washington

# **CURRENT FORMS OF DISTRESS**

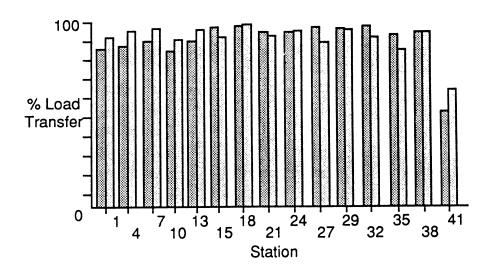
Distress Type	Lane 1 (Outer)	Lane 2 (Inner)
Longitudinal Cracking	2200 feet/mile	1467 feet/mile
Joint Faulting	0.10 in./mile	0 in/mile
Surface Polishing	yes	yes
Concrete Surface Wear (Rutting)	yes	yes

WSDOT PCR = 40

PSR (Lane 1) = 3.4PSR (Lane 2) = 3.4

Figure 5. Condition Data, I-5 North (Milepost 176.35 -176.43) Seattle, Washington

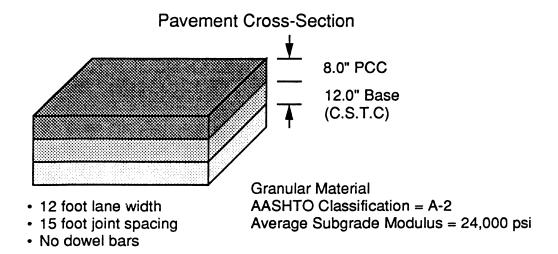
# **JOINT LOAD TRANSFER**



"Approach" Slab

"Leave" Slab

Figure 6. Inventory Data, I-5 North (Milepost 176.35 -176.43)
Seattle, Washington



# Climate

Climate Zone	= Wet-dry freeze
Average Annual Temperature	= 47 °F
Average Annual Temperature Range	= 65 °F
Mean Annual Precipitation	= 17 inches
Corps of Engineers Mean Freezing Index	= 667 °F-days

#### Traffic

Estimated two-way ADT	= 38,300
% Trucks (single and combination units)	= 13

Figure 7. Inventory Data, I-90 West (Milepost 278.60 - 278.75) Spokane, Washington

# **CURRENT FORMS OF DISTRESS**

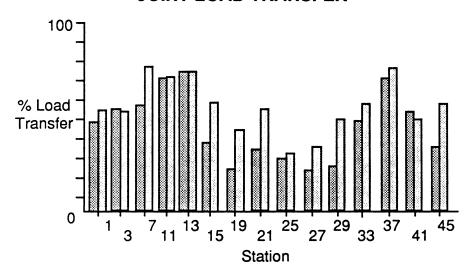
Distress Type	Lane 1 (Outer)	Lane 2 (Inner)
Joint Faulting	0.20 in./mile	0 in./mile
No. of Deter. Trans. Cracks	235/mile	0/mile
Longitudinal Cracking	440 ft/mile	0 ft/mile
Surface Polishing	yes	yes
Conc. Surface Wear (Rutting)	yes	yes

WSDOT PCR = 20

PSR (Lane 1) = 2.5PSR (Lane 2) = 2.5

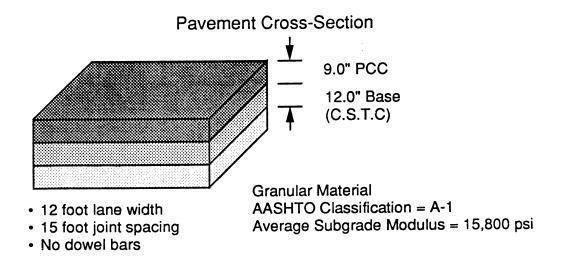
Figure 8. Condition Data, I-90 West (Milepost 278.60 - 278.75) Spokane, Washington

# **JOINT LOAD TRANSFER**



- "Approach" Slab
- "Leave" Slab

Figure 9. Inventory Data, I-90 West (Milepost 278.60 - 278.75) Spokane, Washington



# Climate

Climate Zone	= Wet freeze-thaw
Average Annual Temperature	= 42° F
Average Annual Temperature Range	= 50° F
Mean Annual Precipitation	= 108 inches
Corps of Engineers Mean Freezing Index	= 937 °F-days

# Traffic

Estimated two-way ADT	= 17,300
% Trucks (single and combination units)	= 19

Figure 10. Inventory Data, I-90 East (Milepost 55.50 - 63.99) Snoqualmie Pass, Washington

# 1986 FORMS OF DISTRESS (Pre-CPR)

Distress Type	Lane 1 (Outer)	Lane 2 (Inner)
Joint Faulting	0.25 in./mi.	0 in./mile
No. of Deter. Trans. Cracks	17/mile	4/mile
Longitudinal Cracking	577 ft/mi.	95 ft/mile
Joints w/ Trans. Cracks w/in 2 ft.	1/mile	1/mile
Number of Corner Breaks	4/mile	1/mile
Surface Polishing	yes	yes

Estimated PSR (Lane 1) = 2.5Estimated PSR (Lane 2) = 2.5

# CURRENT 1988 FORMS OF DISTRESS (Two years after CPR)

Distress Type	Lane 1 (Outer)	Lane 2 (Inner)
Joint Faulting	0.10 in./mi.	0 in./mile

WSDOT PCR = 63PSR (Lane 1) = 2.5PSR (Lane 2) = 2.5

Figure 11. Condition Data, I-90 East (Milepost 55.50 - 63.99) Snoqualmie Pass, Washington

# **JOINT LOAD TRANSFER**

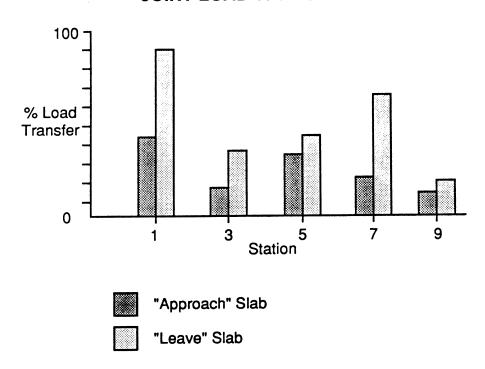
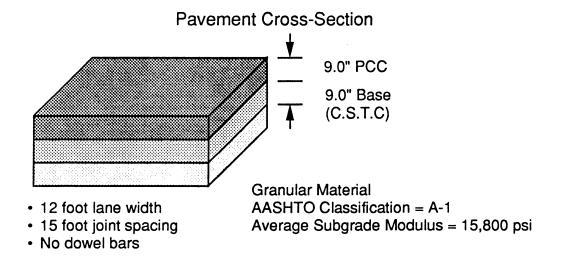


Figure 12. Inventory Data, I-90 East (Milepost 55.50 - 63.99) Snoqualmie Pass, Washington



# Climate

Climate Zone	= Wet freeze-thaw
Average Annual Temperature	= 42 °F
Average Annual Temperature Range	= 50 °F
Mean Annual Precipitation	= 108 inches
Corps of Engineers Mean Freezing Index	= 937 °F-days

# Traffic

Estimated two-way ADT	= 17,300
% Trucks (single and combination units)	= 19

Figure 13. Inventory Data, I-90 West (Milepost 61.00 – 61.01) Snoqualmie Pass, Washington

# **CURRENT FORMS OF DISTRESS**

Distress Type	Lane 1 (Outer)	Lane 2 (Inner)
Joint Faulting	0.13 in./mile	0 in./mile
Surface Polishing	yes	yes

WSDOT PCR = 50

PSR (Lane 1) = 2.5

PSR (Lane 2) = 2.5

Figure 14. Condition Data, I-90 West (Milepost 61.00 – 61.01) Snoqualmie Pass, Washington

# **JOINT LOAD TRANSFER**

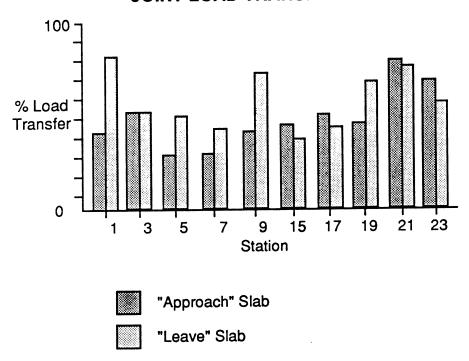


Figure 15. Inventory Data, I-90 West (Milepost 61.00 – 61.01) Snoqualmie Pass, Washington

site; the average was about 0.10 inch, which is why the pavement still rode fairly well at a PSR of 3.4. (All PSR values were subjectively determined by two people who drove over the project site at the posted speed limit, as prescribed in the EXPEAR manual [11].) Faulting was a much more significant distress form on the I-90 Spokane project (MP 278), which also had a large number of deteriorated transverse cracks. The PSR for this pavement was only 2.5. This pavement is also worn in the wheelpaths (studded tire wear), and the joint sealant is in poor condition. Both the I-90 Spokane and I-5 Seattle pavements showed signs of fatigue and were expected to deteriorate over the coming years until rehabilitation could take place.

Before its restoration in 1986, the eastbound lanes of I-90 near Snoqualmie Pass (MP 55) had some transverse cracking, an average faulting at the joints of 0.25 inch, extensive full depth repairs, and a few corner breaks. The PSR was 2.5. The forms of pavement distress on the remaining I-90 westbound site (MP 61) included a modest amount of faulting (0.13 inch) and a number of deteriorated transverse joints.

#### **CHAPTER 2. FINDINGS**

#### COMPARISON OF EXPEAR RESULTS AND WSDOT PRACTICES

The above inventory and monitoring data were input using EXPEAR's full screen editor. These inputs, as well as the future performance predictions without rehabilitation, are shown in Appendices A, B, C, and D for the Seattle, Spokane, Snoqualmie westbound, and Snoqualmie eastbound test sites, respectively.

For the I-90 eastbound (MP 55) test section in Snoqualmie Pass, EXPEAR suggested four major rehabilitation options. These options included restoration of both lanes, overlaying both lanes, reconstruction of the outer lane with restoration of the inner lane, and reconstruction of both lanes. In 1986, the WSDOT essentially This restoration included some full and partial slab restored both lanes. replacements, subsealing of the slabs, resealing of the transverse joints, and diamond grinding of the pavement surface. EXPEAR recommended that restoration include resealing of the longitudinal centerline joint, full depth repair (FDR) of cracks and corner breaks, sealing of cracks, resealing of transverse joints, and grinding. The restoration performance predicted by EXPEAR was better in some respects than what was actually achieved. For example, EXPEAR predicted that the average faulting at the transverse joints would not be 0.10 inches until after ten years, when the actual faulting reached 0.10 inches only two years after restoration. (Compare Appendix C2.1 with Figure 11.) However, EXPEAR did predict that the PSR would be below the acceptable level of 3.0 in 1989, and since it actually was 2.5 in 1988, the estimate was reasonable. In addition, EXPEAR predicted that the pavement would have transverse cracking, pumping and faulting of the FDRs in the early 1990s. This may be true, but there is no evidence of these distresses as of November 1988.

EXPEAR suggested the same four rehabilitation techniques for both the I-90 westbound (MP 61) and the I-90 eastbound, (MP 55) Snoqualmie Pass test sections.

However, the WSDOT would probably rehabilitate the westbound site (MP 61) with a totally different technique. The probable rehabilitation would include removing the outer lane and replacing it with a full depth asphalt concrete pavement, approximately 10 inches thick, and restoring the inner lane. The reasoning behind this strategy is that while the outer lane could be replaced with PCC, the inner lane still has another ten years (estimated) of useful life. By replacing the outer lane with AC which will deteriorate within approximately the same amount of time, the reconstruction or overlaying of both lanes at the same time is facilitated. The WSDOT feels that this is the most cost-effective solution to remedy the current conditions at this site.

Replacement of the outer lane with a full depth AC concrete pavement is also a possible rehabilitation strategy for the Spokane test site; however, it is more likely that WSDOT policies will cause this section to be reconstructed with 12-inch PCC pavement over a 4-inch asphalt treated base (ATB) with new PCC tied shoulders (if funding allows). Reconstruction of both lanes was also an option considered in the PCC Rehabilitation study, although the full depth AC concrete option was not considered. Another possibility under the WSDOT's consideration is an AC overlay with cracking and seating. EXPEAR recommends two major rehabilitation strategies for this pavement. These include overlay and reconstruction.

EXPEAR's recommendation to overlay the I-5 Seattle (MP 176) agreed with one of the WSDOT's options to rehabilitate this section. The WSDOT AC overlay option is to overlay the existing concrete pavement with 4.2 inches of AC concrete. However, as on the Spokane project, it is viable for the WSDOT to remove and replace the existing pavement with 12 or more inches of concrete, if funding is available.

#### EXPEAR REHABILITATION RESULTS

After EXPEAR provided the major rehabilitation options, various runs of the program were conducted for each of these options. The tables on the following pages summarize these runs, giving the predicted performance of the major rehabilitation techniques prescribed by EXPEAR (Table 1 for I-90, MP 278, Table 2 for I-5, MP 176, Table 3 for I-90, MP 55, Table 4 for I-90, MP 61). The summary displays the techniques applied and the predicted performance within a 20-year period for that design. What is actually shown is the year in which a particular distress type reaches an unacceptable level, based on the following critical values:

Medium-high severity reflective cracking (M-H sev crks)---125 per mile

Total reflective cracking (ref crks)---250 per mile

Rutting (rutting)---0.5 inch

Joint faulting (faulting)---0.13 inch average per mile

Transverse cracking (trns crks)---800 feet per mile

PSR (PSR)---3.0

Joint deterioration (jt deter)---55 joints per mile

Pumping (pumping)---1.0 (low severity)

FDR faulting (FDR faulting)---0.13 inch

The actual EXPEAR output from each of these runs is contained in Appendices A, B, C, and D. (It should be noted that some of the input values contained in these appendices and in Tables 1-4, such as the 7/8" dowels and the 0.5" bonded overlays, were used only to "exercise" EXPEAR and thus may not be realistic.)

# TABLE 1. EXPEAR REHABILITATION SUMMARY FOR I-90 WEST, MP 278

#### 1. Location

I-90 Westbound, Spokane Starting Milepost: 278.60 Ending Milepost: 278.75

# 2. Current (1988)Pavement Distress Types

Faulting, Transverse and Longitudinal Cracking, Surface Polishing, Surface Wear

#### 3. WSDOT Rehabilitation Options

Reconstruction
12" PCC pavement
4" Asphalt Treated Base
PCC tied shoulders
Crack and Seat with AC Overlay

## 4. EXPEAR Major Rehabilitation Options:

Overlay Reconstruction

#### 5. EXPEAR Rehabilitation Performance Summary

(a)AC	Structura	l Overlay

4.2" AC rutting--1998 ttl ref crks--2000 M-H sev ref crks--1989

# (b) AC Overlay with Crack and Seat

2.5'X 2.5' pieces, 15 ton roller	
0.5" AC	rutting1998
1.0" AC	rutting1998
3.0" AC	rutting1998
4.2" AC	rutting1998

#### (c)PCC Bonded Overlay

2.0" PCC	jt deter2005
	trans crks1996
3.0" PCC	jt deter2005
	trans crks1996
6.0" PCC	jt deter2005
	trans crks1996

## (d)PCC Unbonded Overlay

1 CC Onbonded Overray	
5.0" PCC	trans crks1989
7.0" PCC	trans crks1990
10.0" PCC	trans crks2000
11.4" PCC	trans crks2007
11.5" PCC	no failure20 yrs

#### (e)Reconstruction

Stabilized Base, 15' Joint Spacing	
12" PCC	faulting2007
12.1" PCC	faulting2007
12.2" PCC	no failure20 yrs

Granular Base, 15' Joint Spacing 12" PCC

faulting--1992

#### TABLE 2. EXPEAR REHABILITATION SUMMARY FOR I-5 NORTH, MP 176

#### 1. Location

I-5 North, Seattle

Starting Milepost: 176.35 Ending Milepost: 176.43

#### 2. Current (1988) Pavement Distress Types

Longitudinal Cracking, Faulting, Surface Polishing, Surface Wear

#### 3. WSDOT Rehabilitation Options

Overlay

4.2" AC overlay

Reconstruction

12" PCC pavement 4" Asphalt Treated Base PCC tied shoulders

#### 4. EXPEAR Major Rehabilitation Options

Overlay

#### 5. EXPEAR Rehabilitation Performance Summary

(a)AC Structural Overlay	
1.0" AC	
4.2" AC	

4.2" AC rutting--2006 10.0" AC rutting--2005

rutting--2006

# (b) AC Overlay with Crack and Seat

2.5 X 2.5 pieces, 15 ton roller	
5.0" AC	rutting2006
4.2" AC	rutting2006
3.0" AC	rutting2006

# 2'X 2' pieces, 15 ton roller

5.0" AC	rutting2006
4.2" AC	rutting2006

6'X 5' pieces, 15 ton roller

4.2" AC rutting--2006 2'X 2' pieces, 20 ton roller

5.0" AC rutting--2006

6'X 5' pieces, 20 ton roller 4.2" AC rutting--2006

#### (c)PCC Bonded Overlay

0.5" PCC	no failure20 yrs
1.0" PCC	no failure20 yrs
2.0" PCC	no failure20 yrs
3.0" PCC	no failure20 yrs

#### (d)PCC Unbonded Overlay

2.0"PCC	trans crks1989
7.0"PCC	trans crks1994
8.5"PCC	trans crks2007
8.6"PCC	no failure20 yrs

# TABLE 3. EXPEAR REHABILITATION SUMMARY FOR I-90 EAST, MP 55

#### 1. Location

I-90 Eastbound, Snoqualmie Pass

Starting Milepost: 55.50 Ending Milepost: 63.99

2. Pavement Distress Types (prior to 1986)

Faulting, Longitudinal and Transverse Cracking, Corner Breaks, Surface Polishing

#### 3. WSDOT Rehabilitation Options

Concrete Pavement Restoration

Full and partial slab replacements, reseal transverse joints subsealing, grinding

#### 4. EXPEAR Major Rehabilitation Options

Restore both lanes
Overlay both lanes
Reconstruct outer lane, restore inner lane
Reconstruct both lanes

## 5. EXPEAR Rehabilitation Performance Summary

(a) Restore Both Lanes

Reseal longitudinal CL joint, FDR cracks and corner breaks, seal cracks, reseal transverse joints, grinding

faulting at joints--2003 FDR faulting--1993 trans crks--1995 pumping--1990 PSR--1989

#### (b) AC Structural Overlay

Ottucturur Overray	
1.4" AC	M-H sev crks2007
1.5" AC	no failure20 yrs
2.0" AC	no failure20 yrs
4.2" AC	no failure20 yrs

#### (c) AC Overlay with Crack and Seat

2.5'X 2.5' pieces, 15 ton roller	
1.4" AC	rutting2007
1.5" AC	no failure20 yrs
4.2" AC	no failure20 yrs

#### (d)PCC Bonded Overlay

12" PCC	trans crks1994, jt deter2005
18" PCC	trans crks1994, jt deter2005

# TABLE 3. EXPEAR REHABILITATION SUMMARY FOR I-90 EAST, MP 55 (Continued)

```
(e) PCC Unbonded Overlay
 No Dowels
      8" PCC
                                        trans crks--1995
      10.5" PCC
                                        trans crks--2007
       10.6" PCC
                                        no failure--20 yrs
* 7/8" Dowels
                                        trans crks--2007
       10.5" PCC
       10.6" PCC
                                        no failure--20 yrs
(f)Reconstruct Both Lanes
 No Dowels, Stabilized Base
       12" PCC
                           faulting--2007,pump--1990, PSR--1993
       18" PCC
                           pump--1991, PSR--1995
 No Dowels, Granular Base
       12" PCC
                           faulting--1992, pump--1990, PSR--1993
                           faulting--1997, pump--1991, PSR--1995
       18" PCC
* 7/8" Dowels, Stabilized Base
                           pump--1990, PSR--1993
       12" PCC
      18" PCC
                          pump--1991, PSR--1995
* 7/8" Dowels, Granular Base
      12" PCC
18" PCC
                          faulting--2005, pump--1990, PSR--1993
                          pump--1991, PSR--1995
```

<sup>\*</sup> Actually, larger diameter dowels would be specified by WSDOT, if used.

# TABLE 4. EXPEAR REHABILITATION SUMMARY FOR I-90 WEST, MP 61

#### 1. Location

I-90 Westbound, Snoqualmie Pass

Starting Milepost: 61.00 Ending Milepost: 61.01

#### 2. Current (1988) Pavement Distress Types

Faulting, Surface Polishing

## 3. WSDOT Rehabilitation Options

Full Depth Asphalt Concrete Pavement Replacement of Truck Lane 4.2" overlay

# 4. EXPEAR Major Rehabilitation Options

Restore Both Lanes Overlay Both Lanes

Reconstruct Outer, Restore Inner

(not shown since analysis is includes outer lane only)

Reconstruct Both Lanes

# 5. EXPEAR Rehabilitation Performance Summary

#### (a) Restore Both Lanes

reseal longitudinal CL joint, FDR cracks and corner breaks, seal cracks, reseal transverse joints, grinding

jt faulting--2003 FDR faulting--1993 trans crks--1995 jt deter--1989 pump--1990 PSR--1989

# AC nonstructural overlay, reseal longitudinal CL joint, FDR joints

reseal transverse joints

1" AC ref crks--2000, rutting--2006 M-H sev ref crks--1989 2" AC M-H sev ref crks--1990

#### (b) AC Structural Overlay

2" AC M-H sev ref crks--1991 4.2" AC M-H sev ref crks--1990 10" AC M-H sev ref crks--1990

# (c) AC Overlay with Crack and Seat

2.5'X 2.5' pieces, 15 ton roller 1.4" AC

1.4" AC rutting--2007 1.5" AC no failure--20 yrs 4.2" AC no failure--20 yrs

#### 6'X 5' pieces, 15 ton roller

1.4" AC rutting--2007 1.5" AC no failure--20 yrs 4.2" AC no failure--20 yrs

# TABLE 4. EXPEAR REHABILITATION SUMMARY FOR I-90 WEST, MP 61 (Continued)

(d) PCC Bonded Overlay  3" PCC  5" PCC  7" PCC  12" PCC  12" PCC  24" PCC  trans crks1994, jt deter2005  trans crks1994, jt deter2005  trans crks1994, jt deter2005  trans crks1994, jt deter2005	
(e) PCC Unbonded Overlay No Dowels, 15' joint spacing 10.5" PCC trans crks2007 10.6" PCC no failure20 yrs	
No Dowels, 13' joint spacing 10.5" PCC 10.6" PCC trans crks2007 no failure20 yrs	
No Dowels, 10' joint spacing 10.5" PCC trans crks2007 10.6" PCC no failure20 yrs	
(f)Reconstruction No Dowels, 15' joint spacing, stabilized base, 650 psi PCC modulus 12" PCC faulting2007, pump1990, PSR1995 18" PCC pump1991, PSR1995	s of rupture
No Dowels, 15' joint spacing, stabilized base, 750 psi PCC modulu 12" PCC faulting2007, pump1990, PSR199 pump1991, PSR1995	s of rupture 3
7/8" Dowels, 15' joint spacing, stabilized base, 650 psi PCC modul 12" PCC pump1990, PSR1993 18" PCC pump1991, PSR1995	us of rupture
7/8" Dowels, 15' joint spacing, stabilized base, 750 psi PCC modul 12" PCC faulting2007, pump1990, PSR199 18" PCC pump1991, PSR1995	us of rupture 3
No Dowels, 15' joint spacing, granular base, 750 psi PCC modulus 12" PCC faulting1992, pump1990, PSR199 faulting1997, pump1991, PSR199	3

# EXPEAR REHABILITATION OUTPUT SUMMARY

(The following is based mostly on trends observed in Washington State.)

Although in general the transverse cracking model predicts cracking that is much more severe than WSDOT observed, the predicted distress trend for the I-90 (MP 278) Spokane project without rehabilitation was found to be reasonable. This could be because transverse cracking already exists on this site and the model is calibrated more appropriately than when no cracking is present. In addition, the amounts of transverse cracking predicted for unbonded overlays were both reasonable and sensitive to overlay thicknesses.

The transverse cracking model is insensitive to existing cracks that would be expected to return in PCC bonded overlays. For example, the 2-inch bonded overlay on the I-90 (MP 278) Spokane project is given too much integrity in regard to its ability to resist transverse cracking. Although EXPEAR assumes full depth repairs (FDR) of cracks before they are overlaid, the remaining life of the old pavement underneath the overlay is questionable and could reasonably be expected to crack.

The EXPEAR models predict premature failures for newly reconstructed pavements that the WSDOT has observed to perform very well for performance periods greater than 20 years. For example, consider the I-90 westbound (MP 61) Snoqualmie Pass project. Newly reconstructed pavements of both 12 and 18 inches with stabilized bases are predicted to have significant amounts of pumping and a PSR of 3.0 or less in the early 1990's--only a few years after reconstruction (Appendices D7.1-D7.8). The same is basically true for the reconstructed pavements proposed for the I-90 eastbound (MP 55) Snoqualmie Pass project (Appendices C7.1,C7.2,C7.5,C7.6). This is not representative of what has been observed in Washington state. Pavements only 8 or 9 inches thick with granular bases have been known to have a useful life of 30 years. A 12-inch thick pavement with an asphalt treated base would be expected to have a useful life of 35 to 40 years

in Seattle, where the climate is a little milder but the traffic volume is much greater than that at Snoqualmie Pass. In addition, EXPEAR's predicted performance of these new pavements seems to be inconsistent with the AASHTO Design Guide [15].

EXPEAR predicts the severity of reflection cracking to be greater in a pavement that has undergone cracking and seating before overlaying than in one that has not, even though it predicts more total reflection cracking in the latter pavement. For example, consider the following 20-year quantities of reflection cracking predicted for these proposed I-5 northbound (MP 176) Seattle rehabilitation designs (Appendix A3.2 and A2.2):

	Cracking	
	M-H	Total
	Severity	
4.2" AC overlay with cracking and seating	158	573
4.2" AC overlay (no cracking and seating)	0	1089

One would expect just the opposite to be true; that is, while there may be more reflective cracking in an overlay with cracking and seating (primarily because there are more cracks that can be reflected) the severity level of those cracks should be less than in the overlay without cracking and seating. Reducing the slab size reduces the relative vertical movement because of at least the following two reasons: First, if any voids exist beneath the pavement that may cause the uncracked panel to rock when it is loaded, the seating process will drive the smaller pieces into the base/subgrade, eliminating the potential for rocking. Secondly, the slab curling, which commonly occurs in slabs subject to varying temperatures, will be reduced in a shorter slab [16].

Often, EXPEAR predicts distress trends that are not reasonable, such as the improvement (self-healing effect) of the PSR over time. Specifically this occurred on the 12.2-inch newly reconstructed PCC pavement for the I-90 westbound (MP 278) Spokane project (Appendix B6.3). EXPEAR predicted the PSR to be 4.5 in

the present year and by the year 2007, up to 4.6. It is not apparent why the PSR model calculated these predictions. Another example of an unreasonable prediction is the forecast that the depth of rutting will exceed the thickness of an AC overlay. This occurred on the 0.5 inch and 1.0 inch overlays with cracking and seating on the I-90, (MP 278) Spokane project (Appendices B3.1, B3.2). The predicted 20-year rutting depths were 1.34 inch and 0.5 inch for the 0.5 and 1.0 inch overlays, respectively.

Another concern is that the PSR is often predicted to reach a level of "0". One expects that few, if any, of the EXPEAR models were based on a PSR level of "0" (or approaching "0").

The reflection cracking model is not especially sensitive to AC overlay thicknesses. This was demonstrated in the predictions for the I-90 (MP 278) Spokane AC overlays with cracking and seating. Both the 4.2-inch and 0.5-inch overlays (also the 3-inch and 1-inch) were predicted to have exactly the same amount of reflection cracking over the 20-year period (Appendices B3.4, B3.1). This does not seem reasonable since, in general, thicker overlays provide better load transfer across the joints, reducing the amount of reflection cracking.

EXPEAR does not distinguish asphalt treated bases from other stabilized bases, such as cement or lime stabilized bases, which are known to perform differently. In addition, EXPEAR does not account for the unique material properties found in Washington, such as the strength and durability of asphalt concrete mixes used in overlays, or asphalt treated bases used beneath concrete pavements.

A test of the risk of rehabilitation options, as well as the human element, appears to be missing from the "expert" program, which relies heavily on predictive models. This is best shown by the example in which the user may input unreasonable overlay thicknesses for evaluation, such as the 0.5-inch PCC bonded overlay which was predicted to perform successfully for 20 years on the I-5

northbound (MP 176) Seattle project (Appendix A4.1). Not only would a bonded overlay be a poor rehabilitation strategy candidate for this project because it is not structurally sound, but it clearly would not perform as EXPEAR predicts. The same may be said for the 1.5-inch AC overlay with cracking and seating on the I-90 eastbound (MP 55) Snoqualmie Pass project (Appendix C4.2). This was predicted not to fail within 20 years as well, which is very unlikely. An expert system should have some minimum standards that prevent the input of unreasonable thicknesses.

Finally, EXPEAR does not address longitudinal cracking, which is a significant distress type in Washington state, in its predictive models.

## CHAPTER 3. APPRAISAL AND APPLICATION

#### INTRODUCTION

Based on the research team's experience with the EXPEAR program, a number of observations regarding the user friendliness, the EXPEAR manual, program bugs, and opportunities for program enhancement were made. The following chapter summarizes these findings.

#### POSITIVE ATTRIBUTES OF EXPEAR

The following items were considered to be some of the positive attributes of the EXPEAR system:

- EXPEAR incorporates some of the information known about pavement rehabilitation options and assembles it in a useful manner.
- . The estimates of future pavement performance could be useful in the scoping and planning stages of rehabilitation projects.
- EXPEAR provides an automated procedure for organizing survey inventory and monitoring data that did not previously exist.
- . By allowing the user to manipulate and analyze a variety of rehabilitation options that are applicable to a particular project, different geographical locations are accommodated while the analysis of other options is encouraged.
- EXPEAR provides a standardized method of evaluating concrete pavements and classifying distresses (COPES).
- EXPEAR addresses the problem of documenting the heuristic knowledge possessed by pavement engineers that is necessary for successful rehabilitation design.
- . In its current form, EXPEAR (version 1.1) is a relatively "bug-free" program, that functions smoothly and quickly.

#### EASE OF OPERATION AN USER FRIENDLINESS

The following items refer to items in the EXPEAR system which either hampered the ease of operation or detracted from the user friendliness of the program. Also noted are possible ways by which these problems could be addressed.

# Ability of User to Specify Performance Period

Currently, concrete pavements are often designed for 30-year initial performance periods, but EXPEAR only uses a 20-year analysis period. The ability of the user to specify the performance period would accommodate the analysis of pavements that are known to last longer than 20 years.

# **Printing EXPEAR's Various Documents**

In the program's present form, it is difficult to print the various output documentation EXPEAR generates. Print options are generally found only at the end of a program input session, making it impossible to retrieve old outputs without running through the input sequences again or exiting the program completely and printing from the disk operating system (DOS). A print menu that lists the various documents in the directory would be very helpful.

# Ability to View Filenames of Existing Projects

When asked for a filename as input, the user should be able to view those that are available and not have to rely on memory or exit the program to view the DOS directory.

# **Requests for Irrelevant Data**

When the toggle item "uniform joint spacing" is selected, the program should skip the question, "Transverse joint sequence, if random (feet):". Likewise, the request for "dowel bar diameter" should be skipped when "aggregate interlock" has been input as the load transfer mechanism. These types of requests for irrelevant data should be eliminated.

The ability to copy information that is likely to be identical for all sample units on a given project (drainage, loss of support, surface condition, joint sealant condition, concrete durability, previous repair) would be a time-saving enhancement. Likewise, the climate information that is requested by EXPEAR when it evaluates the performance of AC overlays should be retrieved from the initial project information file (including monthly temperature range).

# **Ability to Output Evaluations Directly to Printer**

The user should be able to obtain a hard copy of the output without viewing it on the screen, which can be tedious and time-consuming.

#### **Documentation of Rehabilitation Strategies Evaluated**

Rehabilitation performance prediction output should be labeled with the material thicknesses, dowel bar diameters, joint spacings, material properties, project name, and other pertinent data.

#### Inputting the Number of Lanes on the Project

The toggle item should be for one or two lanes only, since the input of three or more lanes will result in an execution error.

#### **EXPEAR MANUAL**

# **Include Calibration Variables in PSR and Pumping Models**

Pages 303 and 302 [2] should be corrected to show the calibration variables that the EXPEAR program uses to account for the present levels of distress.

# Specify that "Joint Deterioration" Refers to Transverse Cracking

The manual, which refers to NCHRP 277 [11] for definitions of distress, should cite that a "deteriorated joint" refers to spalling of various severities (not faulting or joint sealant condition).

# Specify that Cracking Model Refers to Transverse Cracking

Page 299 should cite that cracking refers to the total length of transverse cracking and does not include longitudinal cracking.

#### Cite that AVGMT is Equivalent to the Average Annual Temperature

In the PSR model, page 303, it should be pointed out that the average monthly temperature (AVGMT) is actually the same as the average annual temperature that EXPEAR requests as input.

#### Include "Tally Sheets" for the I10191 Sample Project

The inclusion of tally sheets for the sample project would be helpful in extending the procedures to other projects.

#### **Include an Annual Precipitation Chart of Useful Scale**

The annual precipitation chart included on page 260 should be blown up by sections to a legible scale.

#### **PROGRAM BUGS**

Only two "bugs" were found in EXPEAR. These are listed below.

#### An Execution Error Results if More than Two Lanes are Input for Analysis

This problem could be corrected if a toggle item that limited the number to one or two lanes only was used to input the value.

#### <u>A Calculation Error Exists in the Restoration Future Distress Predictions</u> <u>Subroutine</u>

When restoration has been selected as a rehabilitation technique, the program calculates the age of the pavement to be thousands of years older than it is (See Appendices D2.1,C2.1).

#### **ENHANCEMENTS**

In addition to the minor improvements to the program suggested above, several opportunities for significant enhancement exist. Some of these enhancements may have already been incorporated into new versions of EXPEAR that were not available for review, but they are mentioned here to underscore their importance.

#### Provide Cost Analysis for the Various Rehabilitation Strategies

Without a cost analysis, it is impossible to select the most appropriate and cost-effective rehabilitation strategy. A subroutine in the program to calculate

construction and life cycle costs would facilitate this analysis, at least on a preliminary level. The program should allow the user to specify unit prices of construction and maintenance materials, as well as the analysis period.

# Provide the Ability to Delay Rehabilitation for Analysis Purposes

Although EXPEAR addresses the condition of the pavement if no rehabilitation occurs by predicting the distresses for the next 20 years, it does not address the common situation in which rehabilitation cannot occur until some time later than the present year. The system would be more valuable if it could accept the distress values predicted at some specified point in time in the future and then use those values as input for the rehabilitation strategies.

# Improve the Program's Capability to Explain its Line of Reasoning

One advantage of expert systems in general is their ability to explain the reasoning employed to reach conclusions. An inference engine should have the ability not only to use the rules and data in the knowledge-base to make conclusions, but also to retrace its path to explain which rules and data were critical to the conclusions. Although EXPEAR makes some references as to the critical values that caused it to select certain branches within decision trees, its overall transparency could be greatly improved. The benefits of explanation are threefold. First, erroneous, inconsistent or inappropriate rules are revealed. Secondly, the user has more confidence in the answers received from the system. Finally, the system could be used as a learning tool [3].

# **Include a Graphics Package**

The capability of the system to plot distress trends for the purposes of comparing rehabilitation techniques, as well as to show the future conditions of a pavement without rehabilitation, would be a significant enhancement to the output obtained from EXPEAR.

# CHAPTER 4. CONCLUSIONS AND RECOMMENDATIONS

#### **CONCLUSIONS**

The obvious high level of effort expended in creating EXPEAR, a unique system to aid in the design of pavement rehabilitation, is commendable. A system of this type can be a useful tool not only for pavement design but also as a scoping and planning tool for pavement rehabilitation. In addition, it provides an automated, practical means of recording pavement survey and monitoring data, which did not previously exist.

However, the Washington State DOT will probably not use EXPEAR in its present form. The performance predictions of both existing pavements and rehabilitation strategies are generally inconsistent with what has been observed in Washington state. For the near term, individual performance models that are found to be representative of Washington's conditions will be used where applicable (mostly for rehabilitation scoping or planning).

#### RECOMMENDATIONS

The models primarily used in EXPEAR are from the COPES. Because of local conditions (such as the independent variables being zero in multiplicative models, such as the joint deterioration model) these models had little chance of producing reasonable predictions. However, because of various factors, the exact duplication of field observations and test results is impractical. While the first condition should be investigated by the developers of EXPEAR, the last reason suggests that both the developers and users of EXPEAR will have to develop a level of tolerable and acceptable differences if EXPEAR and systems like it are to become an integral part of pavement engineering.

Perhaps the most beneficial aspect of an expert system is the separation of the inference engine and the knowledge base, since once the mechanics of the should ideally never need to be rewritten whenever new rules or data are added. Once the program has been written, the programmer should be relieved of the burden of system maintenance. It should be placed in the hands of the experienced engineer, since the pavement engineer is most familiar with the data and is responsible for the answers produced by the system. Therefore this person should appropriately be entrusted with the structure of the system [3]. In addition, this would facilitate continual improvements and customization of the knowledge-base.

There are basically two ways to accommodate this, and really only one that may be appropriate. One option that should be avoided is to make the program source code available to all users. A completely "open" system presents several problems. First, an inexperienced programmer attempting to improve or correct the program, may aggravate existing errors with additional errors by not employing defensive programming techniques. The result of this action is that the program may produce results anywhere from slightly incorrect to absurd and could conceivably become unexecutable. Secondly, the EXPEAR developers could not provide support to programs that had been significantly modified.

However, another possibility is to create a system with completed shells so that rules may be introduced by the various users of EXPEAR. If the system could be created so that the user could introduce new rules for given computer runs, the system would not permanently incorporate the rules until they were authorized by an EXPEAR developer [17]. This could be a powerful tool in the hands of a competent pavement engineer, while it would also prevent possible damage to the system. In addition, if significant interest in improving the system existed among state highway agencies, an annual national workshop could be established at which proposals for enhancements, changes, and additions to the system could be made.

Since the program source code was not available for review in this study, it is not apparent that EXPEAR would lend itself to this kind of situation. However, it

does not seem that it would be too difficult to make the coefficients of variables contained in various distress models modifiable to become more representative of local conditions.

In light of the above comments, this author recommends that further development of the inference engine and the definition of the rule structure be undertaken, for it is essential that the program be dynamic and have the capability to be customized to meet individual state requirements and conditions.

#### REFERENCES

- 1. "Key Facts: A Summary of Useful Transportation Data," Washington Department of Transportation, Olympia, Washington, September 1985.
- 2. "Development of an Expert System for Concrete Pavement Evaluation and Rehabilitation," Proceedings, Second North American Conference on Managing Pavements, 1987.
- 3. Flanagan, P.R. and Halbach, D.S., "Expert Systems as a Part of Pavement Management," Transportation Research Record 1123, January 1987.
- 4. Finn, G.A. and Reinschmidt, K.F., "Expert Systems in an Engineering-Construction Firm," <u>Expert Systems in Civil Engineering</u>, ASCE, 1986, pp. 40-54.
- 5. Wentworth, J.A., "Advisory (Expert) Systems--An Assessment of Opportunities in the Federal Highway Administration," Public Roads Vol. 51, No.2, September 1987, pp. 36-41.
- 6. Ritchie, S.G., Yeh, C-I, Mahoney, J.P., Jackson, N.C., "A Surface Condition Expert System For Pavement Rehabilitation," California University, Irvine Institute of Transportation Studies Irvine California 92717, August 1986.
- 7. Tandon, R.P. and Sinha, K.C., "An Expert System to Estimate Highway Pavement Routine Maintenance Work Load," National Research Council Transportation Research, Washington D.C., 1988.
- 8. Alshawi, M. and Cabrera, J.G., "An Expert System to Evaluate Concrete Pavements," Microcomputers in Civil Engineering, VOL 3, 1988, Elsevier Science Publishing Co., Inc., United Kingdom, pp. 191-197.
- 9. Transportation Research Board, Announcement of "Workshop on Expert Systems in Pavement Engineering," November, 1988.
- Hall, K.T. and Darter, M.I., "User's Guide for EXPEAR, Expert System for Concrete Pavement Evaluation and Rehabilitation," University of Illinois at Urbana-Champaign, November 2, 1988.
- Darter, M. I., Becker, J.M., Snyder, M.B., and Smith, R.E., "Concrete Pavement Evaluation System (COPES)," NCHRP Report No. 277, Transportation Research Board, 1984.
- 12. Pierce, L.M., "A Life-Cycle Cost Analysis for the Rehabilitation of Portland Cement Concrete Pavement in Washington State," (Thesis) University of Washington, 1988.

- 13. <u>Climates of the States</u>, Vol. 2, 3rd Edition, 1985, Gale Research Co., pp.1199, 1200.
- 14. <u>U.S. Weather Bureau Climatological Summary, Washington State,</u> 1964, p. R60-20.
- 15. American Association of State Highway and Transportation Officials, <u>AASHTO Guide for Design of Pavement Structures</u>, Washington, D.C., 1986, pp.II-37-II-49.
- 16. Federal Highway Administration, "Crack and Seat Performance," Review Report, Washington D.C. April 1987.
- 17. Kostem, C.N. (Fritz Engineering Laboratory) "Attributes and Characteristics of Expert Systems," Expert Systems in Civil Engineering, ASCE, 1986, pp. 30-39.

## APPENDIX A

## I-5 NORTH (MP 176) SEATTLE EXPEAR OUTPUT

# APPENDIX A I-5 NORTH (MP 176) SEATTLE EXPEAR OUTPUT

			<u>Page</u>
Al.	Input Da	ta and Performance Predictions without	
	<u>Rehabilita</u>	ation	60
A2.	AC Struc	ctural Overlay	
	A2 1	1.0" AC	85
	A2.2	4.2" AC	86
		10.0" AC	87
A3.	AC Over	rlay with Crack and Seat	
	2.5'X	2.5' pieces, 15 ton roller	
	A3.1	•	88
	A3.2		89
	A3.3		90
	2'X 2'	pieces, 15 ton roller	
	A3.4	5.0" AC	91
	A3.5		92
	6'X 5'	pieces, 15 ton roller	
	A3.6	4.2" AC	93
	2'X 2'	piece, 20 ton roller	
	A3.7	5.0" AC	94
	6'X 5'	pieces, 20 ton roller	
	A3.8	4.2" AC	95
A4.	PCC Bor	nded Overlay	
	A4.1	0.5" PCC	96
	A4.2	1.0" PCC	97
	A4.3	2.0" PCC	98
	A4.4	3.0" PCC	99
A5.	PCC Un	bonded Overlay	
	A5.1	2.0"PCC	100
	A5.2	7.0"PCC	10
	A5.3	8.5"PCC	102
	A 5 A	8 6"PCC	10:

		<u>Page</u>
Al.	Input Data and Performance Predictions without	
	Rehabilitation	. 60

# PROJECT EVALUATION AND REHABILITATION RECOMENDATIONS

### FOR: seattle

- 1. Project Summary
- 2. Current Evaluation
- 3. Physical Testing Recommendations
- 4. Future Distress Predictions

```
Design engineer: Holly Simmons
                                                 Date of survey: 07/22/88
  PROJECT IDENTIFICATION
     dighway designation:
    State: washington
    Dinection of survey: North
    Starting milepost: 176.35
    Enoing mileoost: 176.43
    Number of sample units: 3
  DLIMATE
    Climatic zone: wet nonfreeze
    Estimated annual temperature range (F): 38.7
    Mean annual precipitation (inches): 38.5
    Corps of Engineers freezing index (Fahrenheit decree-days):
                                                                 25.0
    Average Annual Temperature (degrees Fahrenheit):
                                                                  52.70
- SLAB CONSTRUCTION
    Year constructed: 1965
    Slab thickness (inches): 9.0
    width of traffic lanes (feet): 12.00
    Concrete 28-day modulus of rupture (psi): 650.00
 TRANSVERSE AND LONGITUDINAL JOINTS
    Pattern of joint spacing: uniform
       Transverse joint spacing if uniform (feet): 15.0
       Transverse joint sequence if random (feet):
    Type of sealant: liquid
    Average transverse joint reservoir dimensions:
              width (inches): 0.25
              depth (inches): 1.50
    Method used to form transverse joints: sawing
    Transverse joint sawed depth (inches): 1.5
    Type of load transfer system: apprepate interlock
    Dowel bar diameter (inches): 0.00
    Method used to form longitudinal joints between lanes: sawing
    Longitudinal joint sawed or formed depth (inches): 2.3
 FASE
    Base type: dense-praced untreated appregate
    Modulus of subgrade reaction (psi/inch): 200.00
 SUBSRADE
    Precominant subgrade soil AASHTO classification: A4
    Are swelling soils a problem in area: no
    were steps taken to prevent the swelling soils problem: n/a
```

SHOULDER

Type of shoulder: AD

Width of shoulders (feet): inner: 4.0 outer: 10.0

Inner lane slope direction: toward inner shoulder

TRAFFIC

Estimated current through two-way ADT: 145900

Percent commercial trucks: 4.0

Total number of lanes in direction of survey: 2

Future 18-kip ESAL growth rate (percent per year): 2.5

Thurk traffic volume growth rate: approximately same as in past

Total accumulated 18-kip ESAL (millions):	Lame two 2.74	Lane one 13.70
RIDE GUALITY	3.5	3.4

62

70 e e

	SAMPLE UNIT IDENTIFICATION		
	Sample unit number: 1/ Start	ing milepost: 1	76.3 <b>63</b>
	Length of sample unit (feet): 60.0		03
		Lane two	Lane one
	Number of deteriorated transverse cracks. L-N	1-н: Ø	Ø
	(say faulting at thansvense chacks (inches):	ଅ. ଅହ	0.22
	Number of deteriorated transverse joints:	Ø	Ø
	Mean faulting at transverse joints (inches):	ଅ <b>. ଉପ</b>	₹.₽7
	Number of transverse joints:	4	4
	wamber of FDRS & slab replacements:	<b>Ø</b>	ZI
	Mean faulting at FDR & slab nebl. ints (inche	es): 0.00	Ø. 22
	Number of FDR & slab replacement joints:	₹1	Ø.
	Number of conner breaks:	<b>⊘</b>	Z
	Length of long. cracking, M-H only (feet):	Ø. Ø	30.0
	Length of spalling of longit. Joint, M-H only	/:	0. C
	CRACKING AT TRANSVERSE JOINTS		
	Total joints with trans. cracks within 2 feet	: Ø	Ø:
	FOUNDATION MOVEMENT		
•	Number of settlements (M-H severity):	Ø	Ø
٠.	Number of heaves (M-H severity):	Ø	Ø
-			
	DRAINAGE		
	Are longitudinal subdrains present and functi		
	What is the typical height of the pavement ab		e: 10.0
	Do ditches have standing water or cattails in	them: no	
*			
	LOSS OF SUPPORT		
	Extent of evidence of bumbing or water bleedi	ng: none	none
	SURFACE CONDITION		
	Method used to texture the pavement at constr		
	Is the surface polished in the wheelpaths:	yes	yes
	Is significant time mutting in the wheelpaths	s: yes	yes
	AND DESCRIPTION		
`. *	JOINT SEALANT CONDITION		
	Condition of the transverse joint sealant:	high	high
	Condition of the longitudinal joint sealant:		high
-	Are substantial amnts of incompressibles in j	nts: no	no
	PONOBETT BURGET ITY	•	
	DONORETE DURABILITY		
	Extent of "D" cracking at joints on cracks:	none	none
	Extent of reactive apprepate distress:	rione	none
	Extent of scaling:	none	none
	PREVIOUS REPAIR		
	Are full-cepth repairs placed with dowels:	yes	yes
	Are partial depth repairs present at most joi	rits: rio	no

no

rio

no no

mas clamond grinding been done: Has prodving been cone:

40	SHOULDERS	Inner	Duter
	Alligator cracking:	rione	<b>64</b> none
	Linear Gracking:	none	none
	Weathering/mavelling:	none	none
	Lame/shoulder joint dropoff:	none none	none
	Settlements or heaves along outer edge:	non <b>e</b>	none
	Blownoles at transverse joints:	none	some
	Lane/Shoulder joint condition:	poor	poor

The second secon

SAMPLE UNIT IDENTIFICATION		
	milebost: 1	75.4 <b>65</b>
Length of sample unit (feet): 60.0		05
	ane two	Lane one
Number of deteriorated transverse cracks, L-M-H:	Ø	<b>(Z</b> )
fean faulting at thansvense chacks (inches):	2.20	Ø. ØØ
Number of detenionated transverse joints:	Ø	Ø
Mear faulting at transverse joints (inches):	0.00	Ø. 11
Number of thansvense joints:	4	4
Number of FDRB & slab replacements:	<b>Q</b> , , , ,	Ę.
Mean faulting at FDR & slab mepl. ints (inches):	Ø. ØØ	ପ. ଅଧ
Number of FDR & slab replacement joints:	Ø	Ø
Number of corner breaks:	₹	<b>2</b>
Length of long. cracking, M-H only (feet):	Ø. Ø	30.0
Length of spalling of longit. joint, M-H only:		ଡ.ଡ
CRACKING AT TRANSVERSE JOINTS		
Total joints with trans. cracks within 2 feet:		
otal joints with thans. Chacks within a feet:	Ø	Ø
FOUNDATION MOVEMENT		
Number of settlements (M-H severity):	Ø	<b>2</b>
Number of heaves (M-H severity):	Ø Ø	Ø Ø
- Manual of Meaves the Figure 1047.	•	v
DRAINAGE		
Are longitudinal subbrains present and functional	: no	
What is the typical height of the pavement above		e: 10.0
Do ditches have standing water or cattails in the	m: no	
LOSS OF SUPPORT		
Extent of evidence of pumping or water bleeding:	none	none
•		
SURFACE CONDITION		
Method used to texture the pavement at constructi	on: other	
Is the surface polished in the wheelpaths:	yes	yes
Is significant tire rutting in the wheelpaths:	y <b>e</b> s	yes
TOTAL DEC CAS MONDITION		
1 JOINT SEALANT CONDITION		
Condition of the transverse joint sealant:	high	high
Concition of the longitudinal joint sealant:		high
Are substantial amnts of incompressibles in jnts:	no	no.
CONCRETE DURABILITY		pr - 10
Extent of "D" chacking at joints on chacks: Extent of reactive aggregate distress:	riorie	none
Extent of reactive appregate distress: Extent of scaling:	none	none
Excent or secting.	riorie	none
PREVIOUS REPAIR		
Are full-depth repairs placed with dowels:	n/a	n/a
Are partial depth repairs present at most joints:	· · · · · · · · · · · · · · · · · · ·	riza ric
Has diamond grinding been cone:	no	no
Has grooving been done:	no	rio
•• • • • • • • • • • • • • • • • • • •	· · <del>-</del>	

Inner	Outer
none	<b>66</b> Yr⊐ ≅ €
none	Move
riorie	ric Tie
none	rior:E
non <b>e</b>	none
none	riorie
poor	boor
	none none none none none

•

SAMPLE UNIT IDENTIFICATION		
Sample unit number: 3/ Stanting	milepost:	176.4 67
wength of sample unit (feet): 60.0		07
i	lane two	Lane one
Number of deteriorated transverse cracks, L-M-H:	Ø	Ø.
Mean faulting at transverse cracks (inches):	0.0Z	ଡ.ଡେଡ
Number of deteriorated transverse joints:	Ø	Ø
Mean faulting at transverse joints (inches):	0.00	Ø.13
Number of thansverse joints:	4	4
Number of FDRS & slab replacements:	<b>©</b>	Z:
Mean faulting at FDR & slab repl. ints (inches):		Z. 212
Number of FDR & slab replacement joints:	Ø	Ø
Number of correr breaks:	Z	Ø
Length of long. chacking, M-H only (feet):	50.0	45. Ø
Length of spalling of longit. joint, M-H only:		Ø. Ø
DRADKING AT TRANSVERSE JOINTS		
Total noints with trans. cracks within 2 feet:	Zi	Ø
		-
FOUNDATION MOVEMENT		
Number of settlements (M-H severity):	Ø	0
Number of heaves (M-H severity):	Ø	<b>Ø</b>
*		
DRAINAGE		
Are longitudinal subdrains present and functional What is the typical height of the pavement above Do citches have standing water or cattails in the	the ditchli	ne: 10.0
<u> 4.</u>		
LOSS OF SUPPORT		
Extent of evidence of pumping or water bleeding:	none	none
SURFACE CONDITION		
Method used to texture the pavement at constructi	on: other	
Is the surface polished in the wheelpaths:	yes	yes
Is significant tire rutting in the wheelpaths:	yes	yes
	,	,
F JOINT SEALANT CONDITION		
Condition of the transverse joint sealant:	high	high
Concition of the longitudinal joint sealant:		high
Are substantial amnts of incompressibles in jnts:	no	no
CONCRETE DURABILITY		
Extent of "D" cracking at joints on cracks:	none	none
Extent of reactive apprepate distress:	none	none
Extent of scaling:	none	none
PREVIOUS REPAIR		
Are full-deoth repairs placed with dowels:	n/a	n/a
Are partial depth repairs present at most joints:	no	rio
Has diamond grinding been cone:	rio	no
has grooving been done:	no	YIO

AC	SHOULDERS	Inner	Outer
	Alligator chacking:	none	<b>68</b> none
	Linear Cracking:	none	none
	Weathering/navelling:	none ÷	rione
	_ane/shoulder joint propoff:	none	none
	Settlements or heaves along outer ecge:	rione -	none
	Elowholes at transverse joints:	none	riorie
	Lane/Shoulder joint condition:	poor	poor

•

\* ;

# Extrapolated (Per Mile) Values For seattle

	Lane two	Lane one
Number of ceteriorated transverse chacks:	Ø	⊘:
Mean faulting at deten. thans. chacks (inches)	. 0.00	Ø. ØØ
Number of deteriorated transverse joints:	Ø	i <b>Z</b> i
Mean faulting at transverse joints (inches):	0.00	Ø. 1Ø
Number of transverse joints:	352	352
Number of full-depth repairs:	Ø	Ø
Mear faulting at FDR joints (inches):	0.00	Ø. ØØ
Number of full-depth repair joints:	Ø	Ø
Number of corner breaks:	Ø	Ø
Length of long. cracking, M-H only (feet):	1466.7	3080.0
Length of spalling of longit. Joint, M-H only:		Ø. Ø
Total joints with trans. cracks within 2 feet:	Ø	Ø
Number of settlements (M-H sevenity):	Ø	0
Number of beaves (M-H severity):	Ø	Ø

**************************************
JOINT CONSTRUCTION DEFICIENCY:
A longitudinal joint construction deficiency in lane 1, likely due to an inacecuate depth of saw cut, is indicated by longitudinal chacking.
a. seal longitudinal cracks b. stitch longitudinal cracks
The pavement in lane 1 shows no indications of a transverse joint construction deficiency.
a. do nothing
JOINT SEALANT DEFICIENCY:
A transverse joint sealant deficiency is indicated in lane 1 by medium- to high-severity joint sealant damage and an inadequate joint sealant reservoir shape factor for the existing sealant type.
a. reseal transverse joints
ROUGHNESS:
Rideability in lane 1 is acceptable.
a. do nothing
DURABILITY DEFICIENCY:
The pavement in lane 1 shows no indications of significant surface or concrete durability problems.
a. do nothing
JOINT DETERIORATION:
Joint deterioration or other pavement deterioration in lane 1 may be accelerated by water infiltration permitted by poor longitudinal joint sealant condition.
a. reseal longitudinal centerline joint
No goint deterioration exists in lane 1.
a. co nothing

Structural deficiency of the pavement in lane 1 is indicated by a wet

STRUCTURAL DEFICIENCY:

or wet-dry climate, a slab thickness of 9.0 inches and 0.44 million annual 18-kip ESALs.

- a. AC structural overlay
- b. chack and seat and AC structural overlay
- c. PCC benses overlav
- c. PCC unbonces overlay

SKID RESISTANCE DEFICIENCY:

less of skid resistance and potential for hydroplaning are indicated in lane 1 by polished wheel paths and studded time nutting of  $\emptyset.25$  inches on more.

- a. grinding
- b. AC nonstructural overlay

\_\_\_\_\_\_\_

#### LOAD TRANSFER DEFICIENCY:

 $\overset{\sim}{\sim}$ No load transfer deficiency is indicated at transverse joints in lane 1.

a. do nothing

A potential load transfer deficiency exists at undowelled full-depth repairs in lane 1, but mean full-depth repair faulting is not significant.

a. do nothing

\_\_\_\_\_\_

#### FOUNDATION MOVEMENT:

a. do nothing

LOSS OF SUPPORT:

The pavement in the lane 1 shows no indications of loss of slab support.

a. do nothing

DRAINAGE DEFICIENCY:

The pavement in lane 1 shows no indications of a drainage deficiency.

a. do nothing

**************************************	**************************************
**************************************	********
JOINT CONSTRUCTION DEFICIENCY:	
The pavement in lane 2 shows no indications of a transverse construction deficiency.	e goint
a. do nothing	
JOINT SEALANT DEFICIENCY:	the titler deals diets exits was deals diets diets aller alles diets
A transverse joint sealant deficiency is indicated in lane to high-severity joint sealant damage and an inadequate joineservoir shape factor for the existing sealant type.  a. reseal transverse joints	
ROUGHNESS:	
Rideability in lane 2 is acceptable.	
a. do nothing	
DURABILITY DEFICIENCY:	
The pavement in lane 2 shows no indications of significant concrete durability problems.	surface or
a. do nothing	
JOINT DETERIORATION:	
No joint deterioration exists in lane 2.	
a. do nothing	
STRUCTURAL DEFICIENCY:	
SKID RESISTANCE DEFICIENCY:	
loss of skid resistance and potential for hydroplaning are in lane 2 by polished wheel paths and studded tire rutting of 0.25 inches or more.	indicated
a. grinding o. AC nonstructural overlay	
_OAD TRANSFER DEFICIENCY:	•
No load transfer deficiency is indicated at transverse join	nts in lane 2.

a. do nothing

A potential load transfer deficiency exists at undowelled full-depth repairs in lane 2, but mean full-depth repair faulting is not significant.

#### a. co mothing

-----

FOUNDATION MOVEMENT:

A potential for frost heave is indicated by a mean Freezing Index greater than  $\emptyset$ .

a. co nothing

LOSS OF SUPPORT:

The pavement in the lane 2 shows no indications of loss of slab support.

#### a. do nothing

- DRAINAGE DEFICIENCY:

The pavement in lane 2 shows no indications of a drainage deficiency.

a. dr nothing

****	<del>- &gt; * * * * * * * * * * * * * * * * * * </del>
INNER	SHOULDER
*****	*********************************

Excessive infiltration of water beneath the bavement and inner AC shoulder is indicated by poor lane/shoulder joint sealant condition.

- a. reseal lame/shoulder joint
- b. do nothing

Excessive infiltration of water beneath the pavement and outer AC shoulder is indicated by poor lane/shoulder joint sealant condition.

- a. reseal lane/shoulder joint
- b. du nothing

\_\_\_\_\_ NONDESTRUCTIVE DEFLECTION TESTING -----

Nondestructive deflection testing (NDT) of the pavement is recommended to funther investigate deficiencies observed in the preliminary evaluation of the pavement. Use a Falling Weight Deflectometer or other NDT device capable of applying cynamic loads to the pavement over a range of load levels comparable to actual truck wheel loads (i.e., 9000 to 16000 pounds).

Noncestructive deflection testing should be conducted in a 0.1-mile section randomly selected within each mile of the project. Deflection testing should onlibe conducted when the ambient temperature is between 50 and 80 degrees Fabrenhel to avoid joint and crack lock-up and excessive curling.

Testing should be performed at the following locations:

Center of the slab: Measure deflection basin in the center of the traffic lane in order to backcalculate elastic modulus of slab and effective k value be the slab. This information may be used in a structural analysis of the pavement in cetermining uniformity of support along the project (see NCHRP Report No. 281 Lane edge: Measure deflections at the outer edge of the traffic lane (next to the shoulder). If the pavement has a tied concrete shoulder, also measuredeflections across lane/shoulder joint. This information may be used in a structural analysis of the pavement.

Corner of the slab: Measure deflections across transverse joints and cracks and compute their load transfer efficiencies. This information will be used in a structural analysis of the pavement.

Destrictive testing (obtaining samples of material from the pavement structure) is represented to further investigate deficiencies observed in the preliminary ematerial samples must be obtained by coring through the concrete surface and base with a core bit (6-inch diameter unless specified otherwise). Chandlar base bulk samples should be obtained. Stabilized base samples should be obtained from coring, if possible. Where undisturbed soil samples are required they should be obtained by sampling the soil beneath the pavement and base a thir-walled Shelpy tube.

Each type of destructive testing required should be conducted on at least one and preferably three or more slabs in each 0.1-mile section randomly selecte within each mile of the project. For reasons of efficiency and safety, nondestructing and destructive testing should be conducted concurrently.

The following types of destructive testing are recommended:

Obtain cores from the center of the traffic lane.

Obtain cores through selected transverse joints.

At locations along the longitudinal joint with significant spalling or nearby longitudinal chacks, core through the longitudinal joint (and sadjacent chacks, if present). Examine the cores visually to determine whether the joint or one or more of the chacks is functioning as a joint.

Visual inspection and possibly laboratory testing of material samples obtained from destructive testing (coring) is recommended. The following types of information should be obtained from the material samples:

The strength of the cores obtained from the concrete slab should be determined by indirect tension testing in the laboratory. This information may be used in a structural analysis of the pavement. In the case of concrete deterioration due to poor durability (e.g., D cracking or reactive apprepate), the strength of the concrete is an indicator of the extent of the deterioration.

Examine the cores obtained from the center of the slab and through the transverse joints to determine the thickness and soundness of the concrete.

Determine the thickness of the base layer by examining the base material obtained from the coring operation.

No skill testing of the pavement is warranted because a structural deficiency exists and surface will likely be overlaid on reconstructed. Roughness testing is not warranted.

#### FUTURE DISTRESS PREDICTIONS

### DISTRESS AND PSR PROJECTIONS FOR LANE 1

Durulative ESAL	Annual ESAL	Year	Dumbing	Faulting	Det <b>e</b> r. Joi <b>nts</b>	Transverse Cracking	PSR
1.3.7	Ø.79	1988	Ø. Ø	Ø. 10	Ø	Ø	3.4
14.5	0.81	1989	2.0	0.12	Z:	20	3.3
::5.3	Ø.83	1990	Ø. 1	Ø. 12	Ø	41	3.2
16.2	Ø.85	1991	0.1	0.11	Ø	€3	3.2
17.2	Ø.87	1992	₽.2	0.11	Ø	88	3.1
17.9	Ø.89	1993	∅.≘	0.11	Ø	114	3.0
18.8	Ø.91	1994	Ø.3	Ø. 11	Ø	142	2.5
15.8	0.93	1995	<b>0.</b> 3	0.11	<b>©</b>	173	2.8
20.7	Ø. 96	1996	Ø.3	0.11	Ø	207	2.7
21.7	<b>0.</b> 98	1997	Ø.4	Ø. 11	Ø:	243	2.6
aa.7	1.01	1998	Ø. 4	Ø. 11	Ø.	282	2.5
E3.8	1.23	1999	0.5	Ø. 11	Ø	325	€.4
24.8	1.26	ଅବସବ	Ø.5	Ø. 11	Ø	372	2.3
25.9	1.08	2001	Ø.5	0.11	Ø	422	2.2
27.Ø	1.11	മതതമ	Ø. E	Ø. 11	Ø	477	2.1
25.2	1.14	2003	Ø. E	0.12	<b>(Z</b> i	537	2.0
£9.3	1.17	2004	Ø. 7	0.12	<b>2</b> 1	602	1.9
30.5	1.20	2005	Ø. 7	0.12	Ø	672	1.8
31.7	1.23	2005	0.7	0.12	Ø	749	1.€
33.0	1.28	2227	₢.8	₹.12	Ø.	833	1.5
18-kip	18-kip		Ø = none	Inches	Joints	Feet	Ø-5
millions	millions		1 = low		per	per	
			2 = mediu 3 = high	m	mile	mile	

NGTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

-

#### FUTURE DISTRESS PREDICTIONS

DISTRESS AND PER PROJECTIONS FOR LANE 2

Dagalative	Armual	Year	Pumbing	Faulting	Deter.	Thansvense	= 5 4
ESAL	<b>E</b> 53_				Joints	Chacking	
<b>2.</b> 7	Q.44	.966	2. Z	Z1. Z1Z	0	i <b>2</b>	3,5
3.2	2.45	1989	Ø. 1	2.02	ž	12	3,4
3.6	2.48	1992	۷	2.00	Ž.	20	3.4
4.1	2.47	1991	0.2	0.01	Ž.	30	3.3
*** = 6	2.48	1992	0.2	Z. 21	ē.	4.V	3.3
5.1	0.50	1993	Ø.3	0.01	Ø	50	3. E
	Ø.50 Ø.51	1994	v. 3	Ø. Ø1	Z,	59	3.:
5.€	Ø.51 Ø.53	1995	Ø.3	2.21	Ø.	E <b>9</b>	3.1
6.1			Ø. 4	0.01	2	79	3.0
6.7	Ø.53	1996				89	2.9
7.2	Ø. 55	1997	Ø. 4	Ø. Ø1	Ø Ø		2.9
7.8	2.56	1998	0.5	Ø. ØE		100	
6.3	a.58	1999	0.5	Ø. Ø2	Ø	111	2.8
8.9	e.59	ଅବହର	Ø. E	0.0E	Ø	122	2.7
9.5	Ø.60	2001	Ø. E	0.02	Ø	133	2.7
10.E	Ø.63	2002	Ø.€	Ø. Ø2	Ø	146	2.9
10.8	Ø.63	2003	Ø.7	0.0E	Ø	159	2.5
11.4	Ø.65	2004	0.7	0.02	Ø	172	≥.4
12.1	Ø. 67	2005	Ø. E	Ø. Ø2	Ø	186	≥.4
12.8	Ø.68	2006	Ø.8	0.03	Ø	201	2.3
13.5	2.72	2007	<b>⊘.</b> 8	0.03	Ø	218	2.2
18-kip	18-kio		Ø = none	Inches	Joints	Feet	Ø-5
millions			1 = low		per	per	
			2 = mediu	n	mile	mile	
			3 = high				

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

**************************************	
*******************	
RDUE-NEBB:	A CONTRACTOR OF THE PROPERTY O
Poon mideability in lane 1 occurs in 1993 as i low predicted PSR for the pavement's ADT level	ndicated by an unacceptably •
a. gminding b. AC nonstructural overlay	
JOINT DETERIORATION:	
No significant joint deterioration in lane 1 o	cours over the next 20 years.
STRUCTURAL DEFICIENCY:	
Structural deficiency of the pavement in lane indicated by 800 feet or more of deteriorated	1 occurs in 2007 as transverse cracks per mile.
a. full-depth repair of cracks, AC structural (b. full-depth repair of cracks, crack and seat c. full-depth repair of cracks, PCC bonded over d. full-depth repair of cracks. PCC unbonded of cracks.	ano AC structural overlay
LOAD TRANSFER DEFICIENCY:	
No load transfer deficiency at transverse joint on predicted joint faulting over the next 20 years.	ears.
LOSS OF SUPPORT:	
No loss of slab support in lane 1 occurs based faulting over the next 20 years.	
DRAINAGE DEFICIENCY:	·
No chainage deficiency in lane 1 occurs over the predicted level of pumping.	ne next 20 years, based on

##************************************
ROUGHNESS:
Poor rideability in lane 2 occurs in 1995 as indicated by <b>an unacc</b> eptably low predicted PSR for the pavement's ADT level.
a. grinding b. AC nonstructural overlay
JOINT DETERIORATION:
No significant joint deterioration in lane 2 occurs over the next 20 years
STRUCTURAL DEFICIENCY:
No structural deficiency in lane 2 occurs based on oredicted transverse cracking over the next 20 years.
LOAD TRANSFER DEFICIENCY:
No load transfer deficiency at transverse joints in lane 2 occurs based on predicted joint faulting over the next 20 years.
LUSS OF SUPPORT:
No loss of slab support in lane 2 occurs based on predicted joint faulting over the next 20 years.
DRAINAGE DEFICIENCY:
No drainage deficiency in lane 2 occurs over the next 20 years, based on the predicted level of pumping.

			<u>Page</u>
A2.	AC Struc	ctural Overlay .	
		1.0" AC	
	A2.2	4.2" AC	86
	A2.3	10.0" AC	87

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING AC OVERLAY

				TOTAL	MEDIUM-HIGH	
	YEAR	AGE	CUM	REFLECTIVE	REFLECTIVE	RUTTING
			ESALs	CRACKING	CRACKING	
	1000	(7)	ଡ. ଡଡ	Ø	20	<b>0.0</b> 0
	1988	Ø		1025		0.00
	1989	1	Ø.81	1064	ø	0.00
	1990	2 3	1.63		0	Ø. Ø2
	1991		2.48 2.75	1067	0	0.05
	1992	4	3.35	1104		
	1993	5	4.24	1118	Ø	0.08
	1994	ε	5.15	1129	0	0.11
	1995	7	6.08	1139	0	0.14
	1996	8	7.04	1147	0	0.17
	1997	9	8. <b>0</b> 2	1155	0	0.21
	1998	10	9.03	1161	Ø	0.24
· 一	1999	11	10.06	1168	0	Ø. 27
Table 1	2000	12	11.12	1173	0	0.30
	2001	13	12.20	1179	0	<b>0.</b> 34
1-62	2002	14	13.32	1183	<b>Ø</b>	Ø <b>.</b> 37
PAGE TO STATE OF THE STATE OF T	2003	15	14.46	1188	Ø	<b>0.40</b> .
<u>.</u>	2004	16	15.62	1193	0	0.44
<u></u>	2005	17	16.82	1197	0	0.47
	2006	18	18,05	1201	0	0.51
<u>.</u>	2007	19	19.30	1204	0	<b>0.5</b> 5
			18-kip	Feet	Feet	Inches
Е			millions	per mile	per mile	

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

#### \*Summary:

Total reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Medium- to high-severity reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

			18-kip millions	Feet per mile	Feet per mile	Inches
•				_		
	2007	19	19.30	1089	Ø	Ø. 55
	2006	18	18.05	1086	<b>Ø</b>	<b>0.</b> 52
	2005	17	16.82	1082	0	C. 48
	2024	:6	15.62	1079	Ø	Ø. 44
	2003	15	14.46	1075	Ø	Ø. 41
-	2002	14	13.32	1070	Ø	0.37
	2001	13	12.20	1066	0	<b>0.</b> 34
	2000	12	11.12	1061	0	Ø.31
	1999	11	10.06	1056	0	Ø. 27
	1998	10	9.Ø3	1050	Ø	0.24
	1997	Э	8.02	1044	0	0.21
	1996	8	7.04	1037	Ø	0.18
	1995	7	€.⊘೨	1029	Ø	Ø. 15
	: 994	6	5.15	1021	Ø	Ø. 1€
	1993	5	4.24	1010	2	0.09
	1993	4	3.35	998	ø <sup>*</sup> .	<b>7</b> 7 0.06
	1991	3	2.48	583	Ø	Ø. ez
	: 99ø	≘ 3	1.63	961	Ø ;	⊕® 0.0∂
	1989	i	Ø.81	925	Ø	0.62
	1988	Ø	<b>0.</b> 00	. Ø	Q	
			ESALs	CRACKING	CRACKING	
	YEAR	AGE	CUM	REFLECTIVE	REFLECTIVE	RUTTING
				TOTAL	MEDIUM-HIGH	

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

#### Summary:

.

Total reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Medium- to high-severity reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

YEAR	AGE	CUM ESALs	TOTAL REFLECTIVE CRACKING	MEDIUM-HIGH REFLECTIVE CRACKING	RUTTING
1988	Ø	0.00	Ø	Ø · · ·	୍ଲିଲ <b>ଡ.ଡ</b> ଡ
1989	1	0.81	870	Ø 3	· · · · · · · · · · · · · · · · · · ·
1990	2	1.63	903	Ø ,	w. v.
1991	3	2.48	924	Ø	0.05
1992	4	3.35	939	Ø	Ø. Ø8
1993	5	4.24	950	Ø	Ø. 11
1994	6	5.15	960	Ø	0.14
1995	7	6.08	968	2	Ø. 17
1996	8	7.04	975	@	<b>0.</b> 20
1997	9	8.02	982	Ø	<b>0.</b> 23
1998	10	9.03	988	0	0.26
1999	11	10.06	993	0	ø. 29
2000	12	11.12	998	0	<b>0.</b> 33
2001	13	12.20	1003	0	Ø.3E
2002	14	13.32	1007	Ø	Ø.39
2003	15	14.46	1011	Ø	<b>0.</b> 43
2004	16	15.62	1015	0	Ø.4E
2005	17	16.82	1018	0	0.50
2006	18	18.05	1022	0	<b>0.5</b> 3
2007	19	19.30	1025	Ø	Ø <b>. 5</b> 7
		18-kip	Feet	Feet	Inches
		millions	per mile	per mile	

NDTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

## Summary:

Total reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Medium- to high-severity reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

	Page
A3. AC Overlay with Crack a	nd Seat
2.5'X 2.5' pieces, 15 tor	n roller
	88
	89
	90
2'X 2' pieces, 15 ton ro	iller
A3.4 5.0" AC	91
	92
6'X 5' pieces, 15 ton ro	iller
	93
2'X 2' piece, 20 ton rol	ler
	94
6'X 5' pieces, 20 ton ro	ller
	95
	***************************************

YEAR.	AGE	CUM ESALs	TOTAL REFLECTIVE CRACKING	MEDIUM-HIGH REFLECTIVE CRACKING	RUTTING
1988	Ø	0.00	Ø	Ø	0.00
1989	1	Ø. B1	38	Ø	0.00
1990	2	1.63	43	<b>Ø</b>	0.00
1991	3	2.48	49	0	<b>0.0</b> 3
1992	4	3.35	55	0	0.06
1993	5	4.24	61	Ø	0.09
1994	6	5.15	67	Ø	0.1E
1995	7	6.08	74	0	0.15
1996	8	7.04	80	Ø	<b>0.</b> 18
1997	9	8.02	87	0	Ø. 21
1998	10	9.03	94	<b>Ø</b>	0.24
1999	11	10.06	101	0	ø. 28
2000	12	11.12	108	Ø	0.31
2001	13	12.20	115	0	0.34
2002	14	13.32	137	14	ø. 38
2003	15	14.46	160	29	0.41
2004	16	15.62	183	44	Ø. 45
2005	17	16.82	206	59	<b>0.</b> 48
2006	18	18.05	230	74	0.52
2007	19	19.30	253	89	<b>0.</b> 55
		18-kip	Feet	Feet	Inches
		millions	per mile	per mile	

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

#### ·Summary:

Total reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Medium- to high-severity reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

## PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING CRACK & SEAT

			18-kip millions	Feet per mile	Feet per mile	Inches
<u>.</u>						
	2007	19	19.30	253	89	Ø. 55
	2 <b>0</b> 06	18	18.05	230	74	0.52
	2005	17	16.82	206	59	Ø. 48
	2004	16	15.62	183	44	0.44
••	2003	15	14.46	160	29	0.41
<b>A</b> .	2002	14	13.32	137	14	0.37
نځ	2001	13	12.20	115	0	<b>0.</b> 34
	2000	12	11.12	108	Ø	0.31
	1999	11	10.06	101	0	0.27
	1998	10	9.03	94	0	0.24
	1997	9	8.02	87	0	<b>0.</b> 21
	1996	8	7.04	80	0	0.18
	1995	7	6.08	74	0	0.15
	1994	€	5.15	67	Ø	Ø.12
	1993	5	4.24	61	_ 17.	0.09
	1992	4	3.35	55	<b>a</b> •.	. 0.0E
	1991	3	2.48	49	0 🖫	0.03
	1992	2	1.63	43	Ø	0.00
	1989	1	0.81	38	<b>0</b> =	· . 0. 00
	1958	Ø	ଅ. ଅପ	z)	0	f <b>0.0</b> 0
			ESALs	CRACKING	CRACKING	
	YEAR	AGE	CUM	REFLECTIVE	REFLECTIVE	RUTTING
				TOTAL	MEDIUM-HIGH	

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

# Summary:

Total reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

- Medium- to high-severity reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

		millions	per mile	per mile	
		18-kip	Feet	Feet Inc	hes
2007	19	19.30	253	89 0.	55
2026	18	18.05	230		51
2005	17	16.82	206		48
2004	16	15.62	183		44
2003	15	14.46	160		41
<b>50</b> 05	14	13.32	137		37
2001	13	12.20	115		34
2000	12	11.12	108	•	30
1999	11	10.06	101		27
1998	10	9.03	94		24
1997	9	8.02	87		21
1996	8	7.04	80		18
1995	7	6.08	74		15
1 <b>9</b> 94	٤	5. 15	67		11
1993	5	4.24	61		<b>0</b> 8
1992	4	3 <b>. 3</b> 5	55		<b>0</b> E
1991	3	2.48	49	Ø	
1990	2	1.63	43		<b>0</b> 0
1989	1	Ø. 81	38		00
1988	0	0.00	Ø	0 - 2.	<b>0</b> 0
		ESALs	CRACKING	CRACKING	
YEAR	AGE	CUM	REFLECTIVE	REFLECTIVE RUTT	ING
			TOTAL	MEDIUM-HIGH	

NDTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

# Summary:

Total reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Medium- to high-severity reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

	YEAR	AGE	TOUM ESALs	TOTAL REFLECTIVE CRACKING	MEDIUM-HIGH REFLECTIVE CRACKING	RUT ING	9
	1988	<b>W</b>	0.00	نه	2	0.00	
	1989	1	₢.81	Ø	Ø 🔎	0.00	
	1990	2 3	1.63	Ø	0	0.00	
	1991	3	2.48	Ø	Ø	0.00	
	: 335	4	3.35	<b>2</b> 1	<b>2</b> 1	0.05	
	1953	5	4.24	Ø	ø ÷	0.09	
	1994	6	5.15	Ø	Ø	0.12	
	1995	7	E.Ø8	3	0	Ø. 15	
	1995	8	7.04	10	Ø	Ø. 18	
	1997	9	8.02	16	0	0.21	
	1998	10	9.03	23	0	0.24	
	1999	11	10.06	30	Ø	Ø. 28	
	<u>ଅ</u> ବସର	12	11.12	38	Ø	0.31	
	2001	13	12.20	58	13	Ø. 34	
팙	2002	14	13.32	81	28	Ø. 38	
TA A OTHER O	2003	15	14.45	104	44	Ø. 41	
- <del>Industra</del>	2004	16	15.62	127	59	0.45	-
<u>.</u>	2005	17	16.82	150	74	Ø. 48	
,	2026	18	18.05	174	89	0.52	
3	2007	19	19.30	198	104	Ø. 55	
53 			18-kip millions	Feet per mile	Fe <b>et</b> per mile	Inches	

NOTE: These projections are estimates of expected performance based on predictive mocels. They should not be taken as exact values, but instead as relative indicators of performance.

#### Summany:

Total reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Medium- to high-severity reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Rutting on the AC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 0.52 inches in 2008.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING CRACK & SEAT

			TOTAL	MEDIUM-HIGH	!
YEAR	AGE	CUM	REFLECTIVE	REFLECTIVE	RUTTING
		ESALS	CRACKING	CRACKING	***
					and a
1988	Ø	0.00	Ø	Ø.	0. OZ
1989	1	Ø.81	2	ج، 🛭	0.02
1990	2	1.63	Ø	Ø	0.00
1991	3	2.48	Ø	Ø	0.03
1992	4	3.35	Ø	Ø	Ø. ØE
1993	5	4.24	0	Ø	0.09
1994	6	5.15	Ø	0	Ø.12
1995	7	6.08	3	0	Ø. 15
1996	8	7.04	10	Ø	Ø. 18
1997	9	8. Ø2	16	. 0	0.21
1998	10	9.03	23	Ø	Ø. 24
1999	11	10.06	30	Ø	Ø. 27
2000	12	11.12	38	0	Ø. 31
2001	13	12.20	58	13	<b>0.</b> 34
2002	14	13.32	81	28	0.37
2003	15	14.46	104	44	0.41
2004	16	15.62	127	59	Ø. 44
2005	17	16.82	150	74	Ø. 48
2006	18	18.05	174	89	<b>0.</b> 52
2007	19	19.30	198	104	<b>0.</b> 55
		18-kip	Feet	Feet	Inches
		millions	per mile	per mile	

# Summary:

Total reflective cracking of the AC overlay in lane 1 is not spredicted to reach an unacceptable level within the next twenty years.

Medium- to high-severity reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the mext twenty years.

Rutting on the AC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 0.50 inches in 2006.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING CRACK & SEAT

YEAR	AGE	CUM ESALs	TOTAL REFLECTIVE CRACKING	MEDIUM-HIGH REFLECTIVE CRACKING	RUTTING
1988	Z <sup>a</sup>	ଡ.ଡଡ	Ø	Ø	T 0.00
1989	i	Ø.81	289	Ø	0.02
1992	<i>≣</i> 3	1.63	295	Ø	<b>0.0</b> 0
1991	3	2.48	301	Ø	0.03
: 992	4	3.35	307	Ø	Ø. ØE
1993	53	4.E4	313	Ø	0.09
1994	E	5.15	319	Ø	0.12
1995	7	6. Ø8	325	0	0.15
: 996	8	7.04	332	Ø	Ø. 18
1997	9	8.Ø2	345	E	0.21
1998	10	9.03	367	21	0.24
1993	11	10.06	389	36	0.27
ଅବରତ	1≥	11.12	411	52	0.31
2001	13	12.20	434	67	Ø.34
<b>ವರ್</b> ಶವ	14	13.32	457	82	Ø.37
2003	15	14.46	480	<del>9</del> 7	Ø. 41
2004	16	15.62	503	112	0.44
2005	17	16.82	526	127	Ø. 48
2006	18	18.05	550	143	0.52
2007	19	19.30	573 <sub>,</sub>	158	0.55
		18-kip	Feet	Feet	Inches
		millions	per mile	per mile	

# Summary:

Total reflective chacking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Medium- to high-severity reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Rutting of the AC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 0.50 inches in 2006.

YEAR	AGE	CUM ESALs	TOTAL REFLECTIVE CRACKING	MEDIUM-HIGH REFLECTIVE CRACKING	RUTTING
1988	Ø	0.00	Ø	Ø .	<b>0.0</b> 0
1989	1	0.81	55	Ø	<b>0. 0</b> 2
1990	2	1.63	EØ	Ø 🚉	
1991	3	2.48	66	Ø 🍜	<b></b>
1992	4	3.35	72	Ø	<b>0.0</b> 6
1993	5	4.24	78	Ø ·	<b>0.0</b> 9
1994	6	5.15	84	Ø	0.12
1995	7	6.08	91	0	Ø. 15
1996	8	7.04	97	Ø	Ø. 18
1997	9	8.02	104	Ø	0.21
1998	10	9.03	111	Ø	Ø. 24
1999	11	10.06	118	0	ø. 28
2000	12	11.12	125	Ø	Ø. 31
2001	13	12.20	133	0	<b>0.</b> 34
2002	14	13.32	153	13	<b>0.</b> 38
2003	15	14.46	176	28	0.41
2004	16	15.62	199	43	Ø. 45
2005	17	16.82	223	58	Ø. 48
2006	18	18.05	246	74	Ø. 52
2007	19	19.30	270	89	Ø. 55
		18-kip millions	Feet per mile	Feet per mile	Inches

## Summary:

Total reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Medium- to high-severity reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Rutting on the AC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 0.50 inches in 2006.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING CRACK & SEAT

				TOTAL	MEDIUM-HIGH	
	YEAR	AGE	CUM	REFLECTIVE	REFLECTIVE	RUTTING
			ESALs	CRACKING	CRACKING	
	1988	Ø	Ø. ØØ	Ø	Ø	7 <b>0.0</b> 2
	1989	:	0.81	<b>377</b>	Ø	0.02
	1992	2	1.63	363	Ø	Ø. Ø2
	1991	3	≥.48	388	Ø	0.03
	1 <b>9</b> 93	4	3.35	394	Ø	Ø. Ø6
	1993	5	4. E4	400	Ø	Ø. Ø9
	1994	6	5.15	407	Ø	0.12
	1995	7	6.08	413	2	0.15
	1996	8	7.04	420	Ø	Ø. 18
	1997	9	8.Ø2	426	Ø	0.21
	1998	10	9.03	439	6	0.24
	1999	11	10.06	461	21	0.27
*	<b>ଅ</b> ହେଉ	12	11.12	484	36	0.31
TO THE TOTAL STATE OF T	2001	13	12.20	506	51	Ø. 34
7.	. 2 <b>0</b> 02	14	13.32	529	67	0.37
	2003	15	14.4E	552	82	Ø. 41
**	<b>巴黎</b> 德4	16	15.62	575	97	Ø. 44
	2005	17	16.82	598	112	Ø. 48
•	2006	18	18.05	622	127	0.52
-	2007	19	19.30	646	142	Ø. <b>5</b> 5
-			18-kip	Feet	Feet	Inches
			millions	per mile	per mile	

# Summary:

Total reflective cracking of the AC overlay in lane 1 is not spredicted to reach an unacceptable level within the next twenty years.

Medium to high-sevenity reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Rutting on the AD overlay in lane 1 is predicted to equal or exceed an unacceptable level of 0.50 inches in 2006.

		<u>Page</u>
4. PCC Bo	nded Overlay	
A4.1	0.5" PCC	96
A4.2	1.0" PCC	97
A4.3	2.0" PCC	98
A4.4	3.0" PCC	99

# PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING BONDED PCC OVERLAY

	YEAR	AGE	CUMULATIVE	JOINT	TAIOL	TRANSVERSE
			ESALs	FAULTING	DETERIORATION	CRACKING
						e de la
	1988	Ø.	0.00	0.00	Ø. Ø	The state of the s
	1989	1	Ø.81	Ø. ØØ	Ø. 1	- €1
	1990	2	1.63	0.00	Ø. 3	35
	1991	3	2.48	0.00	Ø.8	47
	1992	4	3.35	0.00	1.5	59
	1993	5	4.24	0.00	2.5	69
	1994	6	5.15	Ø. ØØ	3.8	79
	1995	7	6.08	0.00	5.4	89
	1996	8	7.04	0.00	7.4	98
	1997	9	8.02	0.00	9.7	108
***	1998	10	9.03	0.00	12.4	116
	1999	11	10.06	0.00	15.4	125
3	2000	12	11.12	0.00	18.9	134
	2001	13	12.20	0.00	22.7	142
<u>.</u>	2002	14	13.32	0.00	27.0	150
	2003	15	14.46	0.00	31.6	158
# F,	2004	16	15.62	0.00	36.7	166
	2005	17	16.82	0.00	42.3	174
	2006	18	18.05	0.00	48.3	182
	2007	19	19.30	0.00	54.8	189
			18-kip	Inches	Joints	Feet
			millions		per mile	per mile

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

#### -SUMMARY:

T.

Joint faulting on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Transverse cracking of the PCC overlay is not predicted to reach an unacceptable level within the next twenty years.



PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING BONDED PCC OVERLAY

	YEAR	AGE	CUMULATIVE	JOINT	JOINT	TRANSVERSE
			ESALs	FAULTING	DETERIORATION	CRACKING
		_				
	1988	Ø	0.00	0.00	0.0	· · · · · · · · · · · · · · · · · · ·
	1989	1	0.81	0.00	0.1	21
	1990	2	1.63	0.00	Ø. 3	35
	1991	3	2.48	0.00	Ø.8	47
	1992	4	3 <b>. 3</b> 5	0.00	1.5	59
	1993	5	4.24	0.00	2.5	69
	1994	6	5.15	0.00	3 <b>.</b> 8	79
	1995	7	6.08	0.00	5.4	89
	1996	8	7.04	0.00	7.4	98
····	1997	9	8.02	0.00	9.7	108
	1998	10	9.03	0.00	12.4	116
-	1999	11	10.06	0.00	15.4	125
-	2000	12	11.12	0.00	18.9	134
	2001	13	12.20	0.00	22.7	142
	2002	14	13.32	0.00	27.0	150
***	2003	15	14.46	0.00	31.6	158
Ž.	2004	16	15.62	0.00	36.7	166
*	2005	17	16.82	0.00	42.3	174
-	2006	18	18.05	0.00	48.3	182
	2007	19	19.30	0.00	54.8	189
i.			18-kip	Inches	Joints	Feet
			millions		per mile	per mile

# \_SUMMARY:

Joint faulting on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Transverse cracking of the PCC overlay is not predicted to reach an unacceptable level within the next twenty years.

	YEAR	AGE	CUMULATIVE ESALs	JOINT FAULTING	JOINT DETERIORATION	TRANSVERSE CRACKING
	1988	Z.	ଡ.ଡଡ	ଅ.ଅଅ	Ø. Ø	
	:989	1	Ø. 81	ଡ. ଡେଡ	₹. 1	~ 21
	1990	2	1.63	0.00	Ø.3	35
	1991	2 3	€.48	ଡ.ଡେ	Ø. 8	47
	1992	4	3 <b>.3</b> 5	Ø. ØØ	1.5	59
	:993	5	4.24	ଡ. ଡଡ	2.5	69
	1994	6	5.15	0.00	3.8	79
	1995	7	6.08	0.00	5.4	89
	1996	8	7.04	ଡ.ଡଡ	7.4	98
	1997	Э	8.02	ଡ. ଡଡ	9.7	108
	1998	10	9.03	0.00	12.4	116
	1999	11	10.06	0.00	15.4	125
rs#	2000	12	11.12	0.00	18.9	134
	ිවුවු1	13	12.20	0.00	22.7	142
	2002	14	13.32	0.00	27.0	150
	2003	15	14.46	0.00	31.6	158
д. 27	2004	16	15.62	0.00	36.7	166
	2005	17	16.82	2.00	42.3	174
<b>E</b>	2005	18	18.05	0.00	48.3	182
<u>*</u>	2027	19	19.30	0.00	54.8	189
			18-kip	Inches	Joints	Feet
			millions		pen mile	per mile

## SUMMARY:

Joint faulting on the PSC overlay in lame 1 is not predicted to reach an unacceptable level within the next twenty years.

distributed innersons on the ADD ovenlay in lane I is not precipted to reach an unacceptable level within the next twenty years.

Thankverse chacking of the PSC overlay is not precipted to reach an unacceptable level within the next twenty years.



# PREDIOTED PERFORMANCE FOR LANE : FOLLOWING BOXDED POO OVERLAY

	YEAR	AGE	JUMULATIVE ESALs	JOINT FAULTING	JOINT DETERIORATION	TRANSVERSE CRACKING
	1588	2	e. 92	Ø. 22	Ø. Ø	
	1989	4	0.81	ଡ. ଡଡ	Ø. 1	21
	: 352	Ė	1.63	2.22	0.3	35
	91.1	3	2.48	Ø. Ø.	2.8	47
	1992	<u> </u>	3.35	2.22	1.5	59
	1993	5	4.24	Ø. ØØ	2.5	69
	1334	É	5.15	છે. છેટ	3.8	79
	1995	7	5.28	ଡ. ଉଡ	5.4	89
	1991	ب	7.04	2.22	7.4	98
	1227	9	ಕಿ. <b>ಪ</b> ತ	2.22	9. 7	108
	1998	ıē	9.03	0.00	12.4	116
	1999	11	10.05	0.00	15.4	125
-	<u>ଅ</u> ଜ୍ଞର	12	11.12	0.00	18.9	134
-A1.	žāci	13	12.20	ଡ. ହେହ	22.7	142
	2233	14	13.32	v. ve	27.0	150
	EDES	4 27	14.46	æ. øæ	31.6	158
•	2224	18	15.62	2.22	36.7	166
**	2005	17	16.82	0.00	42.3	174
	2025	18	18.05	Ø. ØØ	48.3	182
-		19	15.32	0.00 0.00	54. S	189
	2707	1 3	. D. OK	er a terter	<b>⊒</b> 7. ∵	200
			18-415	laches	Joirts	Feet
•			millions		per mile	per mile

NOTE: These projections are estimates of expected performance based on predictive midels. They should not be taken as exact values, but instead as relative indicators of performance.

## SUMMERY:

Joint faulting on the PCD overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joseph decemberation on the PDD overlay in lame 1 is not predicted to read an unacceptable level within the next twenty years.

Thansvense chacking of the PCD ovenlay is not predicted to reach an acceptable level within the next twenty years.

		<u>Page</u>
A5. PCC Uni	oonded Overlay	
	2.0"PCC	
A5.2	7.0"PCC	101
	8.5"PCC	
A5.4	8.6"PCC	103

YEAR	AGE	CUMULATIVE	JOINT	JOINT	TRANSVERSE
		ESALS	FAULTING	DETERIORATION	CRACKING
1988	Ø	0.00	0.00	Ø. Ø	Ø
1989	1	Ø. B1	Ø. Ø3	Ø. Ø	<b>621<i>0</i>35</b> 9
1992	a	1.63	0.03	ø.ø	<b>4327</b> 4927
1991	2 3	2.48	0.04	Ø. Ø	<b>13679</b> 9822
1992	4 '	3.35	0.05	Ø. Ø	312747757
1993	5	4.24	0.05	Ø. Ø	<b>5986</b> 61994
1994	E	5.15	0.05	Ø. Ø	1024242840
1995	7	6.08	0.06	Ø. Ø	1621762199
1996	8	7.04	0.06	Ø. Ø	2426422211
1997	9	8.02	0.06	Ø. Ø	3476696524
1998	10	9.03	0.07	Ø. Ø	4814672066
1999	11	10.06	0.07	Ø. Ø	6486401193
2000	12	11.12	0.07	Ø. Ø	8542270519
2001	13	12.20	0.08	Ø. Ø	11037390988
2002	14	13.32	0.08	Ø. Ø	14032012908
2003	15	14.46	0.08	0.0	17591969193
2004	16	15.62	0.08	Ø. Ø	21789149877
2005	17	16.82	0.09	0.0	26702010905
2006	18	18.05	0.09	Ø. Ø	32416120242
2007	19	19.30	0.09	0.0	39024744426
		18-kip	Inches	Joints	Feet
		millions		per mile	per mile

#### SUMMARY:

Joint faulting on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Transverse cracking of the PCC overlay is predicted to equal or exceed an unacceptable level of 800 feet per mile in 1989.

YEAR	AGE	CUMULATIVE ESALs	JOINT FAULTING	JOINT DETERIORATION	TRANSVERSE CRACKING
1988	Ø.	Ø. ØØ	ଡ.ଡେଡ	ē. C	Z)
1989	1	Ø. 81	0.03	Ø. Ø	220
1990	2	1.63	0.03	Ø. Ø	322
1991	3	2.48	0.04	ଉ.ଉ	417
1992	4	3.35	0.05	Ø. 0	522
1 <b>9</b> 93	5	4.24	0.05	Ø. Ø	<b>54</b> 8
1994	Ē	5.15	a.05	Ø. Ø	803
1995	7	6.08	0.0E	Ø. Ø	996
1995	8	7.04	Ø. Ø6	Ø. Ø	1238
1997	9	8.02	0.06	Ø. Ø	1536
1998	10	9.03	0.07	Ø. Ø	1902
1999	11	10.06	Ø. Ø7	ଡ.ଡ	2348
2000	12	11.12	Ø. Ø7	Ø. Ø	2885
2001	13	12.20	0.08	Ø. Ø	3526
2002	14	13.32	0.08	Ø. Ø	4288
2003	15	14.46	0.08	Ø. Ø	5184
2004	16	15.62	0.08	0.0	6233
2005	17	16.82	0.09	0.0	7454
2006	18	18.05	0.09	Ø. Ø	8866
2007	19	19.30	0.09	0.0	10493
		18-kip	Inches	Joints	Feet
		millions		per mile	per mile

#### SUMMARY:

Joint faulting on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Transverse cracking of the PCC overlay is predicted to equal or exceed an unacceptable level of 800 feet per mile in 1994.

# PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING UNBONDED PCC OVERLAY

	YEAR	AGE	CUMULATIVE ESALs	JOINT FAULTING	JOINT DETERIORATION	TRANSVERSE CRACKING
	1988	Ø	0.00	ଡ.ଡଡ	0.0	· · <b>②</b>
	1989	1	Ø.81	0.03	0.0	30
	1990	2	1.63	0.03	0.0	128
	1991	3	2.48	0.04	Ø. Ø	159
	1992	4	3.35	0.05	Ø. Ø	186
	1993	5	4.24	0.05	Ø. Ø	212
	1994	٤	5.15	0.05	0.0	238
	1995	7	6.08	0.06	Ø. Ø	265
	1996	8	7.04	0.06	0.0	293
	1997	9	8.02	0.06	ଡ.ଡ	322
3.	1998	10	9.03	0.07	0.0	<b>35</b> 5
***	1999	11	10.06	0.07	0.0	390
error	2000	12	11.12	0.07	0.0	429
	2001	13	12.20	0.08	0.0	473
unak.	2002	14	13.32	0.08	0.0	<b>52</b> 2
- <del> </del>	2003	15	14.46	0.08	0.0	577
	2004	16	15.62	0.08	0.0	639
نيه د سهير مورد	2005	17	16.82	0.09	0.0	708
ે. ડ્રૄ*્ર	2006	18	18.05	0.09	0.0	786
	2007	19	19.30	0.09	0.0	874
e			18-kip	Inches	Joints	Feet
•			millions		per mile	per mile

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

## SUMMARY:

Joint faulting on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Transverse cracking of the PCC overlay is predicted to equal or exceed an unacceptable level of 800 feet per mile in 2007.

# PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING UNBONDED PCC OVERLAY

	YEAR	AGE	CUMULATIVE	JOINT	JOINT	TRANSVERSE
			ESALs	FAULTING	DETERIORATION	CRACKING
	1988	Ø	0.00	0.00	Ø. Ø	0
	1989	1	Ø.81	0.03	0.0	<b>35</b>
	1990	2	1.63	0.03	0.0	121
	1991	3	2.48	0.04	0.0	150
	1992	4	3.35	0.05	0.0	176
	1993	5	4.24	0.05	<b>0.0</b>	200
	1994	6	5. 15	0.05	0.0	224
	1995	7	6.08	0.06	0.0	248
	1996	8	7.04	0.06	0.0	274
*	1997	9	8.02	0.06	0.0	300
- <b>-</b>	1998	10	9.03	0.07	0.0	329
#	1999	11	10.06	0.07	0.0	360
	2000	12	11.12	0.07	0.0	395
any:	2001	13	12.20	0.08	0.0	433
	2002	14	13.32	0.08	0.0	475
,	2 <b>0</b> 03	15	14.46	<b>0.0</b> 8	0.0	<b>5</b> 23
	2004	16	15.62	0.08	0.0	575
<del>-</del> -	2005	17	16.82	0.09	0.0	635
\$	2006	18	18.05	0.09	0.0	701
٠,	2007	19	19.30	0.09	0.0	775
35 * 35.			18-kip	Inches	Joints	Feet
.*			millions		per mile	per mile

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

# **SUMMARY:**

Joint faulting on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Transverse cracking of the PCC overlay is not predicted to reach an unacceptable level within the next twenty years.

# APPENDIX B

# I-90 WEST (MP 278) SPOKANE EXPEAR OUTPUT

# APPENDIX B I-90 WEST (MP 278) SPOKANE EXPEAR OUTPUT

			Page
Bl.	Input Da	ta and Performance Predictions without	106
	Rehabilita	ation	100
B2.	AC Struc	ctural Overlay	
	B2.1	4.2" AC	132
В3.	AC Over	lay with Crack and Seat	
	2.5'X	2.5' pieces, 15 ton roller	
	B3.1	0.5" AC	133
	B3.2	1.0" AC	134
	B3 3	3.0" AC	135
	B3.4	4.2" AC	136
B4.	PCC Bon	nded Overlay	
	B4.1	2.0" PCC	137
	B4.2	3.0" PCC	138
	B4.3	6.0" PCC	139
B5.	PCC Unl	bonded Overlay	
	B5.1	5.0" PCC	140
	B5.2	7.0" PCC	141
	B5.3	10.0" PCC	142
	B5.4	11.4" PCC	143
	B5.5	11.5" PCC	144
B6.	Reconstr	uction	
	Stabili	zed Base, 15' Joint Spacing	
	B6.1	12" PCC	145
	B6.2	12.1" PCC	146
	B6.3	12.2" PCC	147
	Granu	llar Base, 15' Joint Spacing	
		13" DCC	148

		<u>Page</u>
Bl.	Input Data and Performance Predictions without	
	Rehabilitation	106

# EXPEAR 1.1

# PROJECT EVALUATION AND REHABILITATION RECOMENDATIONS

# FOR: spokane

- Project Summary
   Current Evaluation
- 3. Physical Testing Recommendations
  4. Future Distress Predictions

Project Survey Summary For JRCP 107 Date of survey: 07/07/88 Design engineer: HOLLY SIMMONS PROJECT IDENTIFICATION I-90 -lonway designation: State: WASHINGTON Direction of survey: West 278.60 Starting milepost: 278.75 Endino milepost: Number of sample units: 3 CLIMATE wet-dry freeze Climatic zone: Estimated annual temperature range (F): 64.0 Mean annual precipitation (inches): 16.7 Corps of Engineers freezing index (Fahrenheit degree-days): 667.0 47.20 Average Annual Temperature (degrees Fahrenheit): SLAB CONSTRUCTION Year constructed: 1965 Slab thickness (inches): 8.0 Width of traffic lanes (feet): 12.00 Concrete 28-day modulus of rupture (psi): 650.00 TRANSVERSE AND LONGITUDINAL JOINTS Pattern of joint spacing: uniform Transverse joint spacing if uniform (feet): 15.0 Transverse joint sequence if random (feet): Type of sealant: liquid Average transverse joint reservoir dimensions: width (inches): 0.25 depth (inches): 1.50 Method used to form transverse joints: sawing

Transverse joint sawed depth (inches): 1.5

Type of load transfer system: aggregate interlock Dowel bar diameter (inches): 0.00 Method used to form longitudinal joints between lanes: sawing Longitudinal joint sawed or formed depth (inches): 2.3

#### BASE

Base type: dense-graded untreated aggregate Modulus of subgrade reaction (psi/inch): 200.00

# SUBGRADE

predominant subgrade soil AASHTO classification: A2 Are swelling soils a problem in area: no Were steps taken to prevent the swelling soils problem: n/a

108

SHOULDER

Type of shoulder: AD

Width of shoulders (feet): inner: 2.0 outer: 10.0

Inner lane slope direction: toward inner shoulder

TRAFFIC

Estimated current through two-way ADT: 38300

Percent commercial trucks: 13.0

Total number of lanes in direction of survey: 2

Future 18-kip ESAL growth rate (percent per year): 8.2

Truck traffic volume growth rate: approximately same as in past

Total accumulated 18-kip ESAL (	 ne two La 1.26	ne one 6.30
RIDE QUALITY PSR	2.5	2.5

Starting milepost: 278.6

•	Owning to the second se	tarting	milepost:	278.6
	Length of sample unit (feet): 60.0			
		_	ane two	Lane one
	Number of deteriorated transverse cracks,	L-M-H:	0	5
	Mean faulting at transverse cracks (inche	s):	0.00	0.10
	Number of deteriorated transverse joints:		Ø ** ***	0
	Mean faulting at transverse joints (inche	s):	0.00	0.19
	Number of transverse joints:		4	4
	Number of FDRS & slab replacements:		0	•
	Mean faulting at FDR & slab repl. jnts (i	nches):		0.00
	Number of FDR & slab replacement joints:		0	Ø
	Number of corner breaks:		0	0
	Length of long. cracking, M-H only (feet)	:	0.0	0.0
	Length of spalling of longit. Joint, M-H	only:		0.0
	CRACKING AT TRANSVERSE JOINTS			
	Total joints with trans. cracks within 2	feet:	Ø	Ø
<b></b> ≅	FOUNDATION MOVEMENT			
-	Number of settlements (M-H severity):		0	0
*	Number of heaves (M-H severity):		Ø	0
	DRAINAGE Are longitudinal subdrains present and fu What is the typical height of the pavemen Do ditches have standing water or cattail	t above	the ditchl	ine: 0.5
_	LOSS OF SUPPORT  Extent of evidence of pumping or water bl	eedino:	none	none
	Extent of coldence of bumpling of water pr	eeding.	770770	
	SURFACE CONDITION			
	Method used to texture the pavement at co			
	Is the surface polished in the wheelpaths	•	yes	yes
•	Is significant tire rutting in the wheelp	aths:	yes	yes
	JOINT SEALANT CONDITION			
	Condition of the transverse joint sealant	:	high	high
	Condition of the longitudinal joint seala	nt:		high
	Are substantial amnts of incompressibles	in jnts	: yes	yes
	CONCRETE DURABILITY			
	Extent of "D" cracking at joints or crack	s:	none	rione
	Extent of reactive aggregate distress:		none	none
	Extent of scaling:		none	none
	PREVIOUS REPAIR			
	Are full-depth repairs placed with dowels	. :	n/a	rı/a
	Are partial depth repairs present at most		: no	no
	Has diamond grinding been done:	<del>-</del>	no	no
	Has grooving been done:		no	no
	······································			

SHOULDERS	Inner	Outer110
Alligator cracking:	none	none
Linear Cracking:	none	none
Weathering/ravelling:	none	none
Lane/shoulder joint dropoff:	none "	none
Settlements or heaves along outer edge:	none	none
Blowholes at transverse joints:	none	riorie
Lane/Shoulder joint condition:	poor	poor

, AC

Sample UNIT IDENTIFICATION Sample unit number: 2/ Starting milepost: 278.1

	Length of sample unit (feet): 60.0	•	
		Lane two	Lane one
	Number of deteriorated transverse cracks, L-M-H:		2
	Mean faulting at transverse cracks (inches):	0.00	0.09
	Number of deteriorated transverse joints:	0	Ø
	Mean faulting at transverse joints (inches):	0.00	0.24
	Number of transverse joints:	4	4
	Number of FDRS & slab replacements:	0	Ø
	Mean faulting at FDR & slab repl. jnts (inches):	0.00	0.00
	Number of FDR & slab replacement joints:	0	Ø
	Number of corner breaks:	Ø	Ø
	Length of long. cracking, M-H only (feet):	Ø. Ø	Ø. Ø
	Length of spalling of longit. joint, M-H only:		0.0
	CRACKING AT TRANSVERSE JOINTS		
	Total joints with trans. cracks within 2 feet:	Ø	Ø
	FOUNDATION MOVEMENT		
	Number of settlements (M-H severity):	Ø	ø
	Number of heaves (M-H severity):	Ø	Ø
	Namber of Heaves to the second		
	DRAINAGE		
	Are longitudinal subdrains present and functiona	l: no	
	What is the typical height of the pavement above	the ditchlin	e: 0.5
	Do ditches have standing water or cattails in th	em: no	
	LOSS OF SUPPORT	v.m.v.m	none
	Extent of evidence of pumping or water bleeding:	none	none
	SURFACE CONDITION		
	Method used to texture the pavement at construct	ion: other	
	Is the surface polished in the wheelpaths:	yes	yes
	Is significant tire rutting in the wheelpaths:	yes	yes
	is significant tire identity in the widelpasses	,	,
	JOINT SEALANT CONDITION		
•	Condition of the transverse joint sealant:	high	high
***	Condition of the longitudinal joint sealant:	_	high
7	Are substantial amnts of incompressibles in jnts	: no	no
	CONCRETE DURABILITY		
	Extent of "D" cracking at joints or cracks:	none	none
	Extent of reactive aggregate distress:	none	none
	Extent of scaling:	none	none
	PREVIOUS REPAIR		
	Are full-depth repairs placed with dowels:	n/a	n/a
	Are partial depth repairs present at most joints	: no	no
	Has diamond grinding been done:	no	no
	Has prooving been done:	no	no
	has greening seem series		

, AC	SHOULDERS	Inner	Outer <sub>112</sub>
	Alligator cracking:	none	none
	Linear Cracking:	none	none
	Weathering/ravelling:	none	none
	Lane/shoulder joint dropoff:	none	none
	Settlements or heaves along outer edge:	none	none
	Flowholes at transverse joints:	none	none
	Lane/Shoulder joint condition:	poor	poor

, SAMPLE UNIT IDENTIFICATION

Sample unit number: 3/ Starting milepost: 278.1

Sample unit		Starting Mi	lepost: 2	78.1
Length of sa	ample unit (feet): 60.0			
			ne two	Lane one
Number of de	eteriorated transverse crack	ks, L-M-H:	0	4
Mean faultir	ng at transverse cracks (ind	ches): «	0.00	0.08
Number of de	eteriorated transverse join	ts:	0	0
Mean faultir	ng at transverse joints (inc	ches): (	0.00	0.19
Number of tr	ransverse joints:		4	4
Number of FD	RS & slab replacements:		0 "	Ø
Mean faultir	ng at FDR & slab repl. jnts	(inches): 0	0.00	0.00
Number of FD	R & slab replacement joints	5:	Ø	Ø
	orner breaks:		0	0
	ong. cracking, M-H only (fee	et): @	0.0	15.0
Length of sp	palling of longit. joint, M	-H only:		0.0
CRACKING AT TRA	ANSVERSE JOINTS with trans. cracks within	2 feet:	0	Ø
FOUNDATION MOVE			_	_
Number of se	ettlements (M-H severity):		0	0
Number of he	eaves (M-H severity):		Ø	Ø
What is the	dinal subdrains present and typical height of the pave have standing water or catt	ment above th	ne ditchlin	e: 0.5
LOSS OF SUPPORT Extent of <b>e</b> v	T vidence of bumbing or water	bleeding: r	none	none
SURFACE CONDITI	ION			
Method used	to texture the pavement at	construction	n: other	
Is the surfa	ace polished in the wheelpa	ths:	yes	yes
Is significa	ant tire rutting in the whe	elpaths: )	yes	yes
JOINT SEALANT (	CONDITION			
Condition of	f the transverse joint seal	ant: h	nigh	high
Condition of	f the longitudinal joint se	alant:		high
Are substant	tial amnts of incompressible	es in jnts: 1	no	no
	T. T.			
CONCRETE DURABI	D" cracking at joints or cr	arke:	none	none
			none	none
Extent of re Extent of so	eactive aggregate distress: caling:		none	none
PREVIOUS REPAIR				
	oth repairs placed with dow	els:	n/a	n/a
Are partial	depth repairs present at m	ost joints:	no	no
	grinding been done:		no	no
	g been done:		no 📜	no

AC	SHOULDERS	Inner	Duter114,
	Alligator cracking:	none	rione
	Linear Cracking:	no <b>ne</b>	none
	Weathering/ravelling:	none	none
	Lane/shoulder joint dropoff:	no <b>ne</b>	none
	Settlements or heaves along outer edge:	none	none
	Blowholes at transverse joints:	none	none
	Lane/Shoulder joint condition:	poor	poor

# Extrapolated (Per Mile) Values For spokane

	Lane two	Larie orie
Number of deteriorated transverse cracks:	0	235
Mean faulting at deter. trans. cracks (inches)	0.00	0.09
Number of deteriorated transverse joints:	Ø	Ø
Mean faulting at transverse joints (inches):	0.00	0.21
Number of transverse joints:	352	352
Number of full-depth repairs:	0	0
Mean faulting at FDR joints (inches):	Ø. ØØ	0.00
Number of full-depth repair joints:	0	0
Number of corner breaks:	0	Ø
Length of long. cracking, M-H only (feet):	0.0	440.0
Length of spalling of longit. Joint, M-H only:		0.0
Total joints with trans. cracks within 2 feet:	Ø.	ø
Number of settlements (M-H severity):	0	0
Number of heaves (M-H severity):	Ø	Ø

# CURRENT PAVEMENT EVALUATION

**************************************	
JOINT CONSTRUCTION DEFICIENCY:	
A longitudinal joint construction deficiency in an inadequate depth of saw cut, is indicated by	n lane 1, likely due to y longitudinal cracking.
<ul><li>a. seal longitudinal cracks</li><li>b. stitch longitudinal cracks</li></ul>	
The pavement in lane 1 shows no indications of construction deficiency.	a transverse joint
a. do nothing	ago ato con may may man san san san san san san san san san s
JOINT SEALANT DEFICIENCY:	
A transverse joint sealant deficiency is indicate to high-severity joint sealant damage and an increservoir shape factor for the existing sealant	nadequate joins seminor
a. reseal transverse joints	
ROUGHNESS:	
Poor rideability in lane 1 is indicated by total inches per mile at joints, cracks, and full-department of the pavements of t	ptn repairs (ii present), and
a. grinding b. AC nonstructural overlay	
DURABILITY DEFICIENCY:	
The pavement in lane 1 shows no indications of concrete durability problems.	significant surface or
a. do nothing	
JOINT DETERIORATION:	
Joint deterioration or other pavement deterior accelerated by water infiltration permitted by Joint sealant condition.	ation in la <b>ne 1 ma</b> y be poor longit <b>udina</b> l
a. reseal longitudinal centerline joint	e .
No joint deterioration exists in lane 1.	
a. do nothing	

#### STRUCTURAL DEFICIENCY:

Structural deficiency of the pavement in lane 1 is indicated by 800 or more feet of deteriorated transverse cracks per mile.

- a. full-depth repair of cracks, AC structural overlay
- b. full-depth repair of cracks, crack and seat and AC structural overlay
- c. full-depth repair of cracks, PCC bonded overlay
- d. full-depth repair of cracks, PCC unbonded overlay
- e. reconstruct

#### SKID RESISTANCE DEFICIENCY:

Loss of skid resistance and potential for hydroplaning are indicated in lane 1 by polished wheel paths and studded tire rutting of 0.25 inches or more.

🖏. grinding

-b. AC nonstructural overlay

LOAD TRANSFER DEFICIENCY:

Aggregate interlock is providing inadequate load transfer in lane 1 at the transverse joints, as indicated by mean transverse joint faulting of more than 0.13 inches.

a. load transfer restoration at joints

No load transfer deficiency is indicated at deteriorated transverse cracks in lane 1.

a. do nothing

No undowelled full-depth repairs are present in lane 1.

a. do nothing

FOUNDATION MOVEMENT:

A potential for frost heave is indicated by a mean Freezing Index greater than  $\boldsymbol{\theta}_{\bullet}$ 

a. do nothing

LOSS OF SUPPORT:

Loss of slab support in the lane 1 is indicated by faulting greater than 0.13 inches at joints and cracks.

a. subseal at joints and cracks

DRAINAGE DEFICIENCY:

A drainage deficiency is indicated in lane 1 by faulting greater than 0.13 inches occurring in a wet or wet-dry climate.

- a. Install or repair longitudinal subdrains
- b. install or repair longitudinal subdrains, seal all joints and cracks

	119
***************	***********

LANE E

JOINT CONSTRUCTION DEFICIENCY:

The pavement in lane 2 shows no indications of a transverse joint construction deficiency.

a. do nothing

JOINT SEALANT DEFICIENCY:

A transverse joint sealant deficiency is indicated in lane 2 by mediumto high-severity joint sealant damage and an inadequate joint sealant reservoir shape factor for the existing sealant type.

a. reseal transverse joints

## \_ ROUGHNESS:

Poor rideability in lane 2 is indicated by an unacceptably low PSR for the pavement's ADT level.

- a. grinding
  - b. AC nonstructural overlay

------

#### DURABILITY DEFICIENCY:

The pavement in lane 2 shows no indications of significant surface or concrete durability problems.

a. do nothing

JOINT DETERIORATION:

No joint deterioration exists in lane 2.

a. do nothing

STRUCTURAL DEFICIENCY:

SKID RESISTANCE DEFICIENCY:

Loss of skid resistance and potential for hydroplaning are indicated in lane 2 by polished wheel paths and studded tire rutting of 0.25 inches or more.

- a. grinding
- b. AC nonstructural overlay

LOAD TRANSFER DEFICIENCY:

No load transfer deficiency is indicated at transverse joints in lane 2.

a. Co nocurry	
No undowelled full-depth repairs are present in lane 2.	
a. do nothing	T AT AT AN
FOUNDATION MOVEMENT:	
A potential for frost heave is indicated by a mean Freezing preater than $\pmb{\vartheta}$ .	Index
a. do nothing	جندن مثلث منت جندن جندن منت منت منت الله
LOSS OF SUPPORT:	

The pavement in the lane 2 shows no indications of loss of slab support.

DRAINAGE DEFICIENCY:

The pavement in lane 2 shows no indications of a drainage deficiency.

a. do nothing

a. do nothing

Excessive infiltration of water beneath the pavement and inner AC shoulder is indicated by poor lane/shoulder joint sealant condition.

- a. reseal lane/shoulder joint
- b. do nothing

•

Excessive infiltration of water beneath the pavement and outer AC shoulder is indicated by poor lane/shoulder joint sealant condition.

- a. reseal lame/shoulder joint
- b. do nothing

#### PHYSICAL TESTING RECOMMENDATIONS

----- NONDESTRUCTIVE DEFLECTION TESTING ------

Nondestructive deflection testing (NDT) of the pavement is recommended to further investigate deficiencies observed in the preliminary evaluation of the pavement. Use a Falling Weight Deflectometer or other NDT device capable of applying dynamic loads to the pavement over a range of load levels comparable to actual truck wheel loads (i.e., 9000 to 16000 pounds).

Nondestructive deflection testing should be conducted in a 0.1-mile section randomly selected within each mile of the project. Deflection testing should only be conducted when the ambient temperature is between 50 and 80 degrees Fahrennei to avoid noint and crack lock-up and excessive curling.

Testing should be performed at the following locations:

Center of the slab: Measure deflection basin in the center of the traffic where in order to backcalculate elastic modulus of slab and effective k value be the slab. This information may be used in a structural analysis of the pavement in determining uniformity of support along the project (see NCHRP Report No. 281 Lane edge: Measure deflections at the outer edge of the traffic lane (next to the shoulder). If the pavement has a tied concrete shoulder, also measu deflections across lane/shoulder joint. This information may be used in a structural analysis of the pavement.

Corner of the slab: Measure deflections across transverse joints and cracks and compute their load transfer efficiencies. This information will be used in a structural analysis of the pavement.

Corner of the slab over a range of load levels: Measure deflections at the corne the slab using a range of load levels between 9000 and 16000 pounds. When the me deflections are plotted on a load versus deflection graph and straight lines are through points, the lines which do not intersect the deflection axis within 0.00 of the origin will indicate corners with loss of support beneath the slab (see NCHRP Report No. 281).

# ----- DESTRUCTIVE DEFLECTION TESTING -----

estructive testing (obtaining samples of material from the pavement structure) recommended to further investigate deficiencies observed in the preliminary exterial samples must be obtained by coming through the concrete surface and base with a core bit (6-inch diameter unless specified otherwise). ranular base bulk samples should be obtained. Stabilized base samples should sobtained from coming, if possible. Where undisturbed soil samples are required to base a thin-walled Shelby tube.

ach type of destructive testing required should be conducted on at least ne and preferably three or more slabs in each 0.1-mile section randomly selecte ithin each mile of the project. For reasons of efficiency and safety, nondestrusting and destructive testing should be conducted concurrently.

me following types of destructive testing are recommended:

stain cores from the center of the traffic lane.

stain cores through selected transverse joints.

; locations along the longitudinal joint with significant spalling or earby longitudinal cracks, core through the longitudinal joint (and ijacent cracks, if present). Examine the cores visually to determine bether the joint or one or more of the cracks is functioning a joint.

Visual inspection and possibly laboratory testing of material samples obtained from destructive testing (coring) is recommended. The following types of information should be obtained from the material samples:

The strength of the cores obtained from the concrete slab should be determined by incinect tension testing in the laboratory. This information may be used in a structural analysis of the pavement. In the case of concrete ceterioration due to poor durability (e.g., D cracking or reactive aggregate), the strength of the concrete is an indicator of the extent of the deterioration.

Examine the cores obtained from the center of the slab and through the transverse joints to determine the thickness and soundness of the concrete.

Determine the thickness of the base layer by examining the base material obtained from the coring operation.

Determine the permeability of the granular base. This information may be used to verify the pavement subdrainage capability and the need for a drainage improv

Determine the Attemberg limits (liquid limit, plastic limit, and plasticity index) of the subgrade soil in the laboratory. This information is needed to determine the permeability of the subgrade soil, and the susceptibility of the soil to foundation movement (swelling, frost heave, and localized consolidation.)

Determine the classification of the subgrade soil (proportions of gravel, sand, silt and clay) in the laboratory using either the AASHTO or Unified soil classification systems. This information is needed to estimate the permeability of the subgrade soil, and the susceptibility of the soil to foundation movement (swelling, frost heave, and localized consolidation).

No skid testing of the pavement is warranted because a structural deficiency exists and surface will likely be overlaid on reconstructed.

. . .

\*\*

. .

;. ;

.

Roughness testing is recommended in each traffic lane to verify that the pavement is excessively rough and to determine the cause of the roughness. Roughness testing should be performed over the entire length of the pavement and the roughness measured at each 0.1 mile segment.

Test the pavement with roughness equipment capable of producing either a response-type measurement of the pavement's roughness (e.g., Mays Meter) or a profile measurement device. Compare the measured roughness to your agency's standard for an acceptable level of roughness. Prepare a profile of the roughness index along the project for each traffic lane to identify points of significant roughness that need special attention.

# FUTURE DISTRESS PREDICTIONS

# DISTRESS AND PSR PROJECTIONS FOR LANE 1

Cumulative ESAL	Annual ESAL	Year	Pumping	Faulting	Deter. Joints	Transverse Cracking	254
6.3	Ø. 79	1988	0.0	0.21	Ø	2816	2.5
7.2	0.85	1989	0.1	0.21	Ø	3054	2.4
8.1	0.92	1990	0.2	0.21	Ø	3344	2.4
9.1	1.00	1991	0.3	Ø. 21	20	3700	€.3
10.1	1.08	1992	0.5	0.22	Ø	4137	2.3
11.3	1.17	1993	0.6	0.22	Ø	4675	2.2
12.6	1.26	1994	0.7	0.22	0	5337	2.1
13.9	1.37	1995	0.8	Ø. 23	Ø	61 <b>5</b> 2	2.0
15.4	1.48	1996	1.0	0.23	Ø	7156	2.0
17.0	1.60	1997	1.1	0.23	Ø	8392	1.9
18.7	1.73	1998	1.2	0.23	Ø	9912	1.8
20.6	1.87	1999	1.4	0.24	Ø	11781	1.7
22.6	2.02	2000	1.5	0.24	Ø	14077	1.6
24.8	2.19	2001	1.7	0.24	0	16895	1.5
27.2	2.37	2002	1.8	0.24	Ø	20350	1.3
29.8	2.56	2003	2.0	Ø. 25	Ø	24584	1.2
32.5	2.78	2004	2.1	Ø. 25	Ø	29768	1.1
35.5	3.00	2005	2.3	Ø. 25	Ø	36111	0.9
38.8	3.25	2006	2 <b>.5</b>	0.25	Ø	43864	0.8
42.3	3.52	2007	2.6	ø. 26	0	53337	0.6
18-kip	18-kip		0 = none	Inches	Jöints	Feet	@ <b>-</b> 5
millions	millions		1 = low		per	per	
			2 = mediu 3 = high	ım	mile	mile	

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

## FUTURE DISTRESS PREDICTIONS

# DISTRESS AND PSR PROJECTIONS FOR LANE 2

					3. 1		
Cumulative ESAL	Annual ESAL	Year	Pumping	Faulting	Deter. Joints	Tr <b>a</b> nsverse Cracking	PSR
1.3	Ø.26	1988	0.0	0.00	0	Ø	2.5
1.5	0.28	1989	0.1	0.00	Ø	49	2.5
1.8	0.30	1990	0.2	0.01	Ø	100	2.4
2.2	0.33	1991	0.3	0.01	0	155	2.4
2.5	0.35	1992	0.4	0.01	0	213	2.4
2.9	0.38	1993	0.4	0.02	Ø	278	2.3
3.3	0.41	1994	0.5	0.02	0	350	2.3
3.8	0.45	1995	0.6	0.02	Ø	431	2.2
4.3	0.49	1996	0.7	0.02	0	524	2.2
4.8	0.53	1997	0.8	0.03	0	631	2.2
5.4	0.57	1998	0.9	0.03	0	757	2.1
6.0	0.62	1999	1.0	0.03	Ø	905	2.1
6.6	Ø. 67	2000	1.1	0.03	Ø	1080	2.0
7.4	0.72	2001	1.2	0.04	0	1289	2.0
8. 1	0.78	2002	1.3	0.04	0	1539	1.9
9.0	0.84	2003	1.4	0.04	0	1839	1.8
9.9	0.91	2004	1.5	0.04	Ø	2202	1.8
10.9	0.99	2005	1.6	0.05	Ø	2640	1.7
11.9	1.07	2006	1.7	0.05	<b>Ø</b>	3170	1.6
13.1	1.16	2007	1.8	0.05	Ø	3813	1.5
18-kip	18-kip		0 = none	Inches	Joints	Feet	0-5
millions	millions	•	1 = low		per	per	
			2 = mediu	m	mile	mile	
			3 = high				

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

# FUTURE PAVEMENT EVALUATION

**************************************	
ROUGHNESS:	
Poor rideability in lane 1 occurs in 1988 as indicated by an unacceptably low predicted PSR for the pavement's ADT level.	
a. grinding b. AC nonstructural overlay	
JOINT DETERIORATION:	
No significant joint deterioration in lane 1 occurs over the next 20 years.	
STRUCTURAL DEFICIENCY:	
Structural deficiency of the pavement in lane 1 occurs in 1988 as indicated by 800 feet or more of deteriorated transverse cracks per mile.	
a. full-depth repair of cracks, AC structural overlay b. full-depth repair of cracks, crack and seat and AC structural overlay c. full-depth repair of cracks, PCC bonded overlay d. full-depth repair of cracks, PCC unbonded overlay e. reconstruct	
LOAD TRANSFER DEFICIENCY:	
Inadequate load transfer at transverse joints in lane 1 occurs in 1988 as indicated by predicted faulting of 0.13 inches or more.	
a. load transfer restoration at joints b. do nothing	
LOSS OF SUPPORT:	
Loss of slab support in lane 1 occurs in 1988 as indicated by predicted faulting greater than 0.13 inches at transverse joints.	
and the same and example	

<del>********************************</del>
LANE 2
<del>*************************************</del>

\_\_\_\_\_\_

#### ROUGHNESS:

Poor rideability in lane 2 occurs in 1988 as indicated by an unacceptably low predicted PSR for the pavement's ADT level.

- a. gminding
- b. AC nonstructural overlay

#### JOINT DETERIORATION:

No significant joint deterioration in lane 2 occurs over the next 20 years.

# STRUCTURAL DEFICIENCY:

Structural deficiency of the pavement in lane 2 occurs in 1999 as indicated by 800 feet or more of deteriorated transverse cracks per mile.

- a. full-depth repair of cracks, AC structural overlay
- b. full-depth repair of cracks, crack and seat and AC structural overlay
- c. full-depth repair of cracks, PCC bonded overlay
- d. full-depth repair of cracks, PCC unbonded overlay
- e. reconstruct

\_\_\_\_\_

#### LOAD TRANSFER DEFICIENCY:

No load transfer deficiency at transverse joints in lane 2 occurs based on predicted joint faulting over the next 20 years.

#### LOSS OF SUPPORT:

No loss of slab support in lane 2 occurs based on predicted joint faulting over the next 20 years.

## DRAINAGE DEFICIENCY:

A drainage deficiency in lane 2 occurs in 1999 as indicated by predicted pumping reaching the low severity level.

a. install or repair longitudinal subdrains

....

b. install or repair longitudinal subdrains, seal all joints and cracks

			•		
					Page
					1 450
B2.	AC Struc	tural Overlay			
	B2.1	4.2" AC	• • • • • • • • • • • • • • • • • • • •	 	 132

		millions	per mile	per mile	
		18-kip	Feet	Feet	Inches
2007	19	36.01	3093	3093	1.08
2006	18	32.49	3082	3082	1.00
2005	17	29.24	3070	3070	<b>0.</b> 92
2004	16	26.24	3058	3 <b>058</b>	0.85
2003	15	23.47	3045	3045	<b>0.</b> 78
2002	14	20.90	3032	3032	<b>0.</b> 72
2001	13	18.53	3018	3018	<b>0.</b> 67
2000	12	16.34	3003	3003	0.61
1999	11	14.32	2987	2987	Ø. 56
1998	10	12.44	2970	2970	0.51
1997	9	10.71	2 <b>95</b> 2	2952	Ø. 46
1996	8	9.12	2932	2932	Ø. 42
1995	7	7.64	2910	2910	Ø. 38
1994	6	6.27	2885	2885	0.34
1993	5	5.01	2856	2856	Ø <b>.</b> 31
1992	4	3.85	2822	2811	Ø. 27
1991	3	2.77	2779	2496	<b>0.</b> 24
1990	2	1.77	2720	2119	<b>0.</b> 21
1989	1	0.85	2624	1610	<b>0.1</b> 8
1988	Ø	Ø. ØØ	Ø	Ø	Ø. ØØ
		ESALs	CRACKING	CRACKING	
YEAR	AGE	CUM	REFLECTIVE	REFLECTIVE	RUTTING
			TOTAL	MEDIUM-HIGH	

# - Summary:

Total relfective cracking of the AC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 3000 feet per mile in 2000.

Medium- to high-severity reflective cracking of the AC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 1500 feet per mile in 1989.

Rutting on the AC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 0.50 inches in 1998.

			Page
В3.	AC Over	ay with Crack and Seat	
		2.5' pieces, 15 ton roller	122
	B3.1	0.5" AC	
	B3.2	1.0" AC	134
	B3.3	3.0" AC	135
	B3.4	4.2" AC	136

YEGR	AGE	CLX ESALS	TOTAL REFLECTIVE CRACKING	MEDIUM-HIGH REFLECTIVE ORACKINE	RUTTING
1985	Z.	0.00	<b>©</b>	(? *	ଅ.ଅ୬
1929	1	@.85	358	<u> </u>	Ø. 44
392	Ξ	1.77	384	Ø	Ø. 47
193	3	≥.77	4.E.Z	Q:	Ø. 50
1932	4	3.85	455	Ÿ	Ø.54
1993	5	5. Ø.	50.1	Q.	ø. <b>5</b> 7
: 994	E,	5. E7	546	Ø.	2.61
1995	7	7.64	598	₹	Z.EE
1956	Ē	9.12	649	₹.	Ø.59
1997	9	12.71	727	Z.	Ø. 73
1998	10	12.44	769	₹:	Ø.78
1959	11	14.32	837	<b>∠</b> .	Ø.88
±21212	12	16.34	910	<b>₹</b>	₹.88
2021	13	18.53	989	نڌ	ø.93
2002	- 4-	20.90	1075	<b>2</b> /	ø.99
2003	15	E3.47	1167	<b>⊘</b>	1.05
2024	16	25.24	1268	Ø	1.12
2225	17	29.24	1376	Z	1.19
2006	18	32.49	1493	₹:	1.26
2227	19	38.Ø1	1680	Ø	1.34
		18-kip	Feet	=eet	Inches
		millions	per mile	per mile	

#### Summary:

Total reflective chacking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

regions to high-sevenity reflective chacking of the AC overlay in lane 1 is not inecloted to read, an unacceptable level within the rest twenty years.

Factory on the AD overlay in lane 1 is predicted to equal or exceed an anacceptable level of  $\emptyset.5\emptyset$  inches in 1991.

			TOTAL	MEDILM1GH	
VEER	age	CUM	REFLECTIVE	REFLECTIVE	RUTTING
		ESALE	CRACKING	CRACKING	
1988	Z	2.02	Ø	2	0.02
1367		∂.85	350	<b>3</b>	Ø. 2E
:990	Ē	1.77	384	Ø	** <b>0.</b> 29
1981	-	2.77	420	Z.	<sup>2</sup> . Ø.3≥
1531	 ب	3.85	459	2	0.35
	<u> </u>	5.Ø1	521	ē	ø.39
1994	<u>۔</u> ق	6.E7	546	2	Ø. 43
1995	7	7.64	59£	ē	Ø. 47
	<u>5</u>	9.12	64 <b>9</b>	Ø	Ø. 51
: 998 : 997	9 9	10.71	767	ø	Ø. 55
		12.44	769	ø	0.60
1996	10		837	ž.	z. 65
1555	11	14.32	910	0	Ø. 7Ø
8000	12	16.34		Ø	Ø. 75
2001	13	18.53	989		Ø. 75 Ø. 81
2002 2	14	2 <b>0.</b> 90	1075	0	
2003	15	23.47	1167	Ø	0.87
1204	15	25.24	1268	2	Z. 94
2705	1.7	25.24	137€	Ø.	1.01
2225	18	32.49	1493	Ø:	1.08
2007	19	36.01	1620	Ø.	1.16
		18-kip	Feet	Feet	Inches
		millions	per mile	per mile	

## Summary:

Total reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Medium- to high-severity reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Rutting on the AD overlay in lane 1 is predicted to equal or exceed an unacceptable level of 0.50 inches in 1995.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING CRACK & SEAT

			TOTAL	MEDIUM-HIGH	
YEAR	AGE	CUM	REFLECTIVE	REFLECTIVE	RUTTING
		ESALs	CRACKING	CRACKING	
				٠	er en
1988	Ø	0.00	Ø	0	Ø. Ø2
1989	1	0.85	350	Ø ,	0.17
1990	2	1.77	384	0	0.20
1991	3	2.77	420	0	Ø. 23
1992	4	3 <b>.8</b> 5	459	0	0.27
1993	5	5.01	501	0	0.30
1994	ε	6.27	546	0	0.34
1995	7	7.64	596	0	0.38
1996	8	9.12	649	Ø	Ø. 42
1997	9	10.71	707	0	0.46
1998	10	12.44	769	0	0.51
1999	11	14.32	· 837	0	<b>0.5</b> 6
2000	12	16.34	910	Ø	0.61
2001	13	18.53	989	0	0.66
2002	14	20.90	1075	Ø	0.72
2003	15	23.47	1167	0	<b>0.</b> 78
2004	16	26.24	1268	Ø	0.85
2005	17	29.24	1376	Ø	Ø. 92
2006	18	32.49	1493	0	Ø. 99
2007	19	36.01	1620	Ø	1.07
		18-kip	Feet	Feet	Inches
		millions	per mile	per mile	

#### \*Summary:

14 数

Total reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Medium- to high-severity reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Rutting on the AC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 0.50 inches in 1998.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING CRACK & SEAT

YËAR	AGE	CUM ESALs	TOTAL REFLECTIVE CRACKING	MEDIUM-HIGH REFLECTIVE CRACKING	RUTTING
1988	Ø	Ø. ØØ	Ø	Ø	Ø. ØØ
1989	1	0.85	350	Ø	Ø. 18
1990	2	1.77	384	Ź	Ø. 21
1991	3	2.77	420	Ø	Ø. 24
1992	4	3.85	459	Ø	0.27
1993	5	5.01	501	Ø	ø. 31
1994	6	6. 27	546	Ø	Ø. 34
1995	7	7.64	596	Ø	Ø. 38
1996	Ė	9.12	649	Ø	Ø. 42
1997	9	10.71	ブダブ	Ø	Ø. 46
1998	10	12.44	769	<b>Ø</b>	Ø. 51
1999	11	14.32	837	0	Ø. 56
2000	12	16.34	910	Ø	0.61
2001	13	18.53	989	Ø	Ø. 67
2002	14	20.90	1075	Ø	0.72
2003	15	23.47	1167	Ø	Ø. 78
2004	16	26.24	1268	Ø	Ø. 85
2005	17	29. £4	1376	Ø	Ø. 92
2006	18	32.49	1493	Ø	1.00
2007	19	36.01	1620	Ø	1.08
		18-kis	Feet	Feet	Inches
		milliöns	për milë	per mile	

# Summary:

Total reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Medium- to high-severity reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Rutting on the AC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 0.50 inches in 1998.

			Page
B4.	PCC Bon	ded Overlay	
	B4.1	2.0" PCC	137
	B4.2	3.0" PCC	138
	B4.3	6.0" PCC	139

•

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING BONDED PCC OVERLAY

YEAR	AGE	CUMULATIVE ESALS	JOINT FAULTING	JOINT DETERIORATION	TRANSVERSE CRACKING
1988	Ø	Ø. ØØ	ଡ. ୭୭	Ø. Ø	· - · · •
1989	1	Ø.85	0.03	Ø. 1	183
1990	2.	1.77	0.03	0.4	308
1991	3	2.77	0.04	1.0	417
1992	4	3.85	0.04	1.9	518
1993	5	5.01	0.04	3.2	614
1994	6	6.27	0.04	4.9	7.05
1995	7	7.64	0.05	7.0	794
1996	8	9.12	0.05	9.6	880
1997	9	10.71	0.05	12.7	963
1998	10	12.44	0.05	16.2	1045
1999	11	14.32	0.05	<b>20.</b> 3	1126
2000	12	16.34	0.05	25.0	1206
2001	13	18.53	0.06	30.2	1284
2002	14	20.90	0.06	36.1	1361
2003	15	23.47	0.06	42.6	1438
2004	16	26.24	0.06	49.7	1514
2005	17	29.24	0.06	57.5	1590
2006	18	32.49	0.06	66.0	1665
2007	19	36.01	0.07	75.2	1740
		18-kip	Inches	Joints	Feet
		millions		per mile	per mile

## SUMMARY:

Joint faulting on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the PCC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 55.00 joints per mile in 2005.

Transverse cracking of the PCC overlay is predicted to equal or exceed an unacceptable level of 800 feet per mile in 1996.

## PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING BONDED PCC OVERLAY

	YEAR	AGE	CUMULATIVE ESALs	JOINT FAULTING	JOINT DETERIORATION	TRANSVERSE CRACKING
	1988	Ø	ଡ.ଡଡ	0.00	0.0	<b>.</b> 0
	1989	1	Ø.85	0.03	Ø. 1	183
	1990	2	1.77	0.03	Ø. 4	308
	1991	3	2.77	0.04	1.0	417
	1992	4	3.85	0.04	1.9	518
	1993	5	5.01	0.04	3.2	614
	1994	6	6.27	0.04	4.9	705
	1995	7	7.64	0.05	7.0	794
	1996	8	9.12	0.05	9.6	880
	1997	9	10.71	0.05	12.7	963
<b>3</b>	1998	10	12.44	0.05	16.2	1045
	1999	11	14.32	0.05	20.3	1126
380	2000	12	16.34	0.05	25.Ø	1206
	2001	13	18.53	0.06	30.2	1284
	2002	14	20.90	0.06	36.1	1361
	2003	15	23.47	0.06	42.E	1438
Ŧ.	2004	16	26.24	0.06	49.7	1514
•	2005	17	29.24	0.06	57.5	1590
	2006	18	32.49	0.06	66.0	1665
	2007	19	36.01	0.07	75.2	1740
<u>.</u>						
			18-kip	Inches	Joints	Feet
			millions		per mile	per mile

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

# SUMMARY:

Joint faulting on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the PCC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 55.00 joints per mile in 2005.

Transverse cracking of the PCC overlay is predicted to equal or exceed an unacceptable level of 800 feet per mile in 1996.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING BONDED PCC OVERLAY

YEAR	AGE	CUMULATIVE ESALs	JOINT FAULTING	JOINT DETERIORATION	TRANSVERSE CRACKING
1986	Z:	0.00	Ø. ØØ	Ø. Ø	
1989	1	0.85	0.03	Ø. 1	183
1990	2	1.77	0.03	0.4	308
1991	3	2.77	0.04	1.0	417
1992	4	3.85	0.04	1.9	518
1993	5	5.01	0.04	<b>3.</b> 2	614
1994	6	6.27	0.04	4.9	705
1995	7	7.64	0.05	7.0	794
1996	8	9.12	0.05	9.6	880
1997	9	10.71	0.05	12.7	963
1998	10	12.44	0.05	16.2	1045
1999	11	14.32	0.05	20. 3	1126
2000	12	16.34	0.05	25.0	1206
2001	13	18.53	0.06	3Ø.2	1284
2002	14	20.90	0.06	36.1	1361
2003	15	23.47	0.06	42.6	1438
2004	16	26.24	0.06	<b>49.</b> 7	1514
2005	17	29.24	0.06	<b>57.</b> 5	1590
2006	18	32.49	0.06	66.0	1665
2007	19	36.01	0.07	<b>75.</b> 2	1740
		18-kip	Inches	Joints	Feet
		millions		per mile	per mile

# SUMMARY:

Joint faulting on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the PCC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 55.00 joints per mile in 2005.

Transverse cracking of the PCC overlay is predicted to equal or exceed an unacceptable level of 800 feet per mile in 1996.

<u>Page</u>
140
141
142
143
144

YEAR	AGE	CUMULATIVE ESALs	JOINT FAULTING	JOINT DETERIORATION	TRANSVERSE CRACKING
1988	Ø.	Ø. ØØ	Ø. Ø2	Ø. Ø	
1989	1	0.85	0.03	Ø. Ø	3290
1990	2	1.77	0.04	Ø. Ø	7929
1991	3	2.77	0.04	Ø. Ø	17030
1992	4	3.85	0.05	Z.Ø	32894
1993	5	5.01	0.05	Ø. Ø	58250
1994	6	6.27	0.06	Ø. Ø	96456
1995	7	7.64	0.06	Ø. Ø	151682
1996	8	9.12	0.07	ଡ.ଡ	229:12
1997	9	10.71	0.07	Ø. Ø	335189
1998	10	12.44	0.08	0.0	477902
1999	11	14.32	0.08	0.0	667141
2000	12	16.34	0.09	0.0	915128
2001	13	18.53	0.09	0.0	1236936
2002	14	20.90	0.09	0.0	1651123
2003	15	23.47	0.10	Ø. Ø	2180509
2004	16	26.24	Ø. 10	0.0	2853108
2005	17	29.24	0.11	Ø. Ø	3703271
2006	18	32.49	0.11	0.0	4773072
2007	19	36.01	0.12	0.0	6,113,986
		18-kip	Inches	Joints	Feet
		millions		per mile	per mile

## SUMMARY:

Joint faulting on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Transverse cracking of the PCC overlay is predicted to equal or exceed an unacceptable level of 800 feet per mile in 1989.

M. J. L. . 173

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING UNBONDED PCC OVERLAY

	YEPR	AGE	CUMULATIVE ESALs	JOINT FAULTING	JOINT DETERIGRATION	TRANSVERSE CRACKING
	1988	z.	ଡ.ଡେଡ	ଦ. ହେଉ	0.0	· · · · · · · · · · · ·
	1366	-	Ø.85	Ø. Ø3	0. Q	· · · · · · · · · · · · · · · · · · ·
	1992	-				633
		2 3	1.77	Ø. Ø4	0.0	995
	1991		2.77	Ø. Ø4	Ø. Ø	1429
	:892	4	3.85	ø. Ø5	0.0	2016
	1993	5	5.01	0.05	Ø. Ø	2839
	1994	E	€. 27	Ø.ØE	0.0	3987
	: 995	7	7 <b>.</b> 64	0.06	Ø. Ø	<b>557</b> 3
	1996	8	9.12	0.07	0.0	7732
	1997	9	10.71	0.07	0.0	10633
	1998	10	12.44	0.08	0.0	14484
-127	1999	1 i	14.32	0.08	0.0	19543
	2000	12	16.34	0.09	0.0	26127
***	2001	13	18.53	0.09	0.0	34626
	2002	14	20.90	0.09	0.0	45524
<u>.</u>	2 <b>0</b> 03	15	23.47	0.10	Ø. Ø	59412
*K	2004	16	26.24	0.10	0.0	77017
*	2005	17	29.24	0.11	0.0	99230
	2006	18	32.49	0.11	0.0	127143
	2007	19	36.01	Ø.12	0.0	162090
			18-kip	Inches	Joints	Feet
			millions		per mile	per mile

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

#### SUMMARY:

Joint faulting on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Transverse chacking of the PCC overlay is predicted to equal or exceed an unacceptable level of 800 feet per mile in 1990.

# PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING UNBONDED POS OVERLAY

	YEAR	AGE	CUMULATIVE	TAIDL	JOINT	TRANSVERSE
			ESALs	FAULTING	DETERIORATION	CRACKING
	1988	Ø	Ø. ØØ	0.00	Ø. Ø	Ø
	1989	<u>.</u>	Ø.85	Ø.Ø3	Ø. Ø	115
	1990	Ξ	1.77	Ø. Ø4	e. e	: <b>6</b> 8
	1991	3	2.77	0.04	Ø. Ø	E13
	1992	4	3 <b>.8</b> 5	0.05	Ø. Ø	255
	1993	5	5.01	0.05	Ø. Ø	299
	1994	6	6.27	0.06	0.0	346
	1995	7	7.64	0.06	Ø. Ø	398
	1996	8	9.12	0.07	Ø. Ø	458
	1997	9	10.71	0.07	Ø. Ø	529
	1998	10	12.44	0.08	0.0	612
ř	1999	11	14.32	0.08	Ø. <b>Ø</b>	713
~ ×	2000	12	16.34	0.09	Ø. Ø	836
	2001	13	18.53	Ø. Ø9	Ø. Ø	987
ž.,	2002	14	20.90	0.09	Ø. Ø	1171
:	2003	15	23.47	0.10	Ø. Ø	1399
_	2004	16	26.24	0.12	0.0	1679
	2005	17	29.24	Ø. 11	Ø. Ø	2026
	2006	18	32.49	0.11	0.0	2453
	2027	19	36.01	0.12	Ø. Ø	2981
			18-kip	Inches	Joints	Feet
			millions		per mile	per mile

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

## SUMMARY:

Joint faulting on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Transverse cracking of the PCC overlay is predicted to equal or exceed an unacceptable level of 800 feet per mile in 2000.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING UNBONDED POO OVERLAY

	YEAR	AGE	CUMULATIVE ESALs	JOINT FAULTING	JOINT DETERIGRATION	TRANSVERSE CRACKING
	1988	Z)	Ø. ØØ	2.02	Ø. Ø	<b>2</b>
	1989	1	Ø. 85	Ø. Ø3	Ø. Ø	- :60
	1992	÷		Ø. Ø4	₹. ₹	87
		<u> </u>	1.77			
	1991		2.77	0.04	Ø. Ø	109
	1992	4	3.85	Ø. Ø5	ଡ.ଡ	130
	1993	5	5.01	0.05	Ø. Ø	150
	1994	Æ	6.27	0.0E	v. v	169
	: 995	7	7.64	Ø. ØE	Ø. Ø	190
	1996	8	9.12	0.07	Ø. Ø	212
	:997	9	10.71	0.07	Ø. Ø	236
•	1998	10	12.44	0.08	0.0	262
	1999	11	14.32	0.08	0.0	292
-	2000	12	16.34	0.09	0.0	326
1	2001	13	18.53	0.09	ଡ.ଡ	366
	2002	14	20.90	0.09	Ø. Ø	412
	2003	15	23.47	0.10	Ø. Ø	466
À-	2004	16	26.24	0.10	Ø. Ø	531
<b>.</b>	2005	17	29.24	0.11	Ø. Ø	609
	2006	18	32.49	0.11	Ø. Ø	7 <b>0</b> 2
	2007	19	36.01	Ø. 12	Ø. Ø	814
			18-kio	Inches	Joints	Feet
			millions		per mile	per mile

## SUMMARY:

Joint faulting on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Transverse cracking of the PCC overlay is predicted to equal or exceed an unacceptable level of 800 feet per mile in 2007.



	YEAR	AGE	CUMULATIVE ESALs	JOINT FAULTING	JOINT DETERIORATION	TRANSVERSE CRACKING
	1988	Ø	ଡ. ଉତ	0.00	Ø. Ø	Ø
	1989	ı	0.85	0.03	Ø. Ø	58
	1990	2	1.77	C. 04	e. Ø	83
	1991	3	2.77	0.04	Ø. Ø	105
	1992	4	3.85	0.05	Ø. Ø	124
	1993	5	5.01	0.05	Ø. Ø	143
	1994	6	6.27	0.06	Ø. Ø	162
	1995	7	7.64	0.06	Ø. Ø	181
	1996	8	9.12	0.07	0.0	202
	1997	9	10.71	Ø. Ø7	Ø. Ø	224
	1998	10	12.44	0.08	0.0	249
	1999	11	14.32	<b>0.0</b> 8	Ø. Ø	277
	2000	12	16.34	Q. Q9	0.0	308
# 2 h m	2001	13	18.53	0.09	Ø. Ø	344
	2002	14	20.90	0.09	0.0	387
	<i>ലതത</i> ദ	15	23.47	0.10	Ø. Ø	437
	2004	16	26.24	0.10	0.0	496
	2005	17	29.24	Ø. 11	Ø. Ø	566
	2006	18	32.49	Ø. 11	0.0	651
÷	2007	19	36.01	0.12	Ø. Ø	753
			18-kio	Inches	Joints	Feet
•			millions		per mile	per mile

#### SUMMARY:

Joint faulting on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Transverse chacking of the PCC overlay is not predicted to reach an unacceptable level within the next twenty years.

			<u>Page</u>
В6.	Reconstr	ruction	
	Stabil	ized Base, 15' Joint Spacing	
	B6.1	12" PCC	145
	B6.2	12.1" PCC	146
	B6.3	12.2" PCC	147
	Granı	ular Base, 15' Joint Spacing	
		12" PCC	148

	YEAR	AGE	CUMULATIVE ESALs	JOINT FAULTING	TRANSVERSE CRACKING	JOINT DETERIORATIO	PUMPING N	PSR
	1986	2	e.00	0.00	Ø	e. e	0.0	4.5
	:989	1	Ø. 85	0.07	4E	0.0	0.2	4.1
	1990	2	1.77	0.08	67	0.0	2 (** <b>6.2</b>	4.1
	1991	3	£.77	Ø. Ø9	84	0.0	0.3	4.1
	1992	4	3 <b>.85</b>	0.09	99	0.0	0.3	4.1
	1993	5	5.01	0.09	114	Ø. Ø	Ø. 4	4.1
	1994	É	6.27	0.10	129	0.0	Ø. 4	4.1
	1995	7	7. <b>6</b> 4	0.10	144	0.0	<b>0.</b> 4	4.1
	1996	8	9.12	0.10	160	0.0	0.5	4.0
	1997	9	10.71	Ø. 11	176	0.0	Ø. 5	4.0
	1998	10	12.44	0.11	194	0.0	0.5	3.9
	1999	11	14.32	0.11	214	0.0	Ø. 6	3.9
	2000	12	16.34	0.11	235	0.0	0.E	3.B
	2001	13	18.53	0.11	260	0.0	Ø. 6	3.8
<b>=</b>	2002	14	20.90	0.12	288	0.0	0.7	3.7
-	2003	15	23.47	0.12	321	0.0	0.7	3.6
-	2004	16	26.24	0.12	359	0.0	0.7	3.6
	2005	17	29.24	Ø. 12	403	0.0	Ø. 8	3.5
Ť.	2006	18	32.49	0.12	456	0.0	0.8	3.4
	2007	19	36.01	Ø. 13	519	0.0	0.9	3.3
	•		18-kip	Inches	feet	Joints	0 = none	0-5
÷ •			millions		per mile	per mile	1 = low 2 = medium 3 = high	

## SUMMARY:

Joint faulting on the reconstructed pavement in lane 1 is predicted to requal or exceed an unacceptable level of 0.13 inches per mile in 2007.

Transverse cracking of the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Pumping on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

PSR on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING RECONSTRUCTION

	NEAS	203	CUMULATIVE ESALs	JOINT FAULTING	TRANSVERSE CRACKING		<b>ĐUMPI</b> NG	-54
	1988	2	<b>₹.</b> Ø3	Ø. ØØ	Ø	Ø. Ø	: 0.0	4.5
	1945	-	₹.85	a. 07	44	2.0	0.2	4.3
	1552	Ξ	1.77	0.08	€4	2.2	₹.2	4.1
	133:	3	€.77	Ø. Ø9	80	2. Ø	Ø.3	4.1
	1992	4	3.85	Ø. Ø9	95	Ø. Ø	Ø.3	4.1
	1993	Ξ	5.01	Ø. Ø9	109	Ø. Ø	Ø.3	4.1
	1954	5	6.27	0.10	123	Ø. Ø	Ø. 4	4.1
	1995	7	7.64	Ø. 1Ø	138	Ø. Ø	Ø. 4	4.1
	1956	à	9. ia	0.10	152	0.0	<b>@.</b> 4	4.2
	1997	9	10.71	Ø. 11	168	0.0	Ø.5	4.0
•	1998	10	12.44	0.11	185	0.0	0.5	4.0
	1993	1:	14.3E	Ø. 11	203	Ø. 2	Ø. 5	3.9
	2000	13	16.34	0.11	224	0.0	0.E	3.9
	2021	13	18.53	Z.11	≘47	0.0	Ø.6	3.8
	2002	14	20.90	0.12	273	Ø. Ø	0.E	3.7
	2003	: =	23,47	Ø. i 🗈	373	Ø. Ø	Ø. 7	3.7
• ; 724	2024	iε	26.24	0.12	338	Ø. Ø	0.7	3.6
735	2325	17	29.24	Ø.12	379	Ø. Ø	<b>2</b> .7	3.5
	2006	18	32.49	0.12	427	0.0	Ø.8	3.4
	<b>≘き</b> ひフ	19	36.Ø1	0.13	485	ø. e	0.8	3.3
			18-kip	Inches	feet	Joints		05
			millioms		ber mile	per mile	1 = 10w	
							2 = medium	
							3 = high	

#### SUMMARY:

Joint faulting on the reconstructed pavement in lane 1 is predicted to equal on exceed an unacceptable level of 0.13 inches per mile in 2007.

Transverse chacking of the reconstructed pavenent in lane 1 is not predicted to react an unacceptable level within the next twenty years.

Joint deterioration or the reconstructed bavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Auroring or the recorstructed pavement in lame I is not predicted to reach ar unadopptable level within the next twenty years.

TRANSPORT THE REDEVISION OF DAVENERS IN LANGE 1 is not predicted to reach as a pactitable level within the next twenty years.

PREDICTED PERFORMANCE TOR LANC 1 FOLLEAUNG RECONSTRUCTION

YEAT	<b>435</b>	OUMULATIVE EEGLE	JOINT TO TOTAL	TRANSVERSE DEADKING	JOINT DETERIORATION	PUMPINI	757
				C (176 (2.46)			
1858	ø.	e. 22	2.72	Ę	۷.0	0.0	4.5
: 32.9	1	2. E	Ø. ØE	5	Z. Ø	-Ø. ≘	ے ۔ د
159Z	Ė	1.77	0.27	Ē	Ø. Ø	-0. I	4.7
1991	3	Ē. 77	Ø. <b>2</b> 7	10	Ø. Ø	-Ø. 3	4.8
1952	4	3.65	0.07	1 1	0.0	-2. 3	4.8
1993	= =	5.Ø1	2.28	:3	Ø. Ø	-Z1. 4	4.5
	E	5.27	2.28	15	Ø. Ø	-Ø.4	4.9
1994	7	7.64	0.08	16	Ø. Ø	- Č. 4	4. E
1995		7.64 9.12	Ø. Ø3	18	Ø. Ø	-2.5	4.9
1596	<u> </u>	12.71	ହ.ଜୁପ ହା.ଜୁପ	19	@. D	-a. 5	<b>∴.</b> ∋
1397		.2.7. 12.44	2.25 2.25	21 21	₹.₹	-2.5	4.3
1338	12		2.09	<u> </u>	2.2	-Ø. €	4.9
1939	11	. 4. 32	0.09 0.09	24 24	Ø. Ø	-Ø. E	4.9
2000	12	15.34		25	2. £	-2.E	4.9
2221	13	18.53	Ø. 29	20 27	₹.₹	-e.7	4.8
EZZE	14	20.90	Z. Ø9		2.2	-0.7	٠. ن
$\mathbb{E} Z \subset \mathbb{S}$	:5	E3.47	Č. 12	<u> </u>		-ē.7	S
2004	15	25.24	Ø. 10	3.Z	Ø. Ø		4.7
色される	17	29.24	Ø. 12	32	₹. ₹	-Z. B	
2026	18	32.49	Ø. 12	34	C. C	-Ø. B	4.E
2207	19	35.81	Ø. 10	35	చి. లే	-Ø.8	÷. ≛
		18-415	Inches	feet	Joints	0 = none	2-5
		millions		ber mile	per mile	1 = 10W	
						2 = medius	
						3 = nign	

#### SUMMARY:

Count facilizing on the reporstructed paverent in lare 1 is not objectived to reach an unappentable level within the next twenty years.

Inamevense pracking of the reportsonucted pavement in lame lite not predicted to reach ar unappentable level within the next twenty years.

Clint deterioration on the recorstructed bavenert in lane 1 is not unellosed to reach an unaccaptable level within the next twenty years.

Divident on the reconstructed beverent in lare 1 is not predicted to reson as theoretically level within the next twenty years.

NER or the reconstructed bavement in lane 1 is not bredicted to readan unaddecidable level within the next twenty years.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING RECONSTRUCTION

	YEAR	AGE	CUMULATIVE	JOINT	TRANSVERSE	JOINT	PUMPING	PSR
			ESALs	FAULTING	CRACKING	DETERIORATION	•	
						, <del>s</del>	· 'E	
	1988	Ø	0.00	0.00	0	0.0	<u> </u>	4.5
	1989	1	Ø.85	0.10	46	0.0	<b>0.</b> 2	4.1
	1990	2	1.77	0.11	67	0.0	0.2	4.1
	1991	3	2.77	0.12	84	0.0	Ø.3	4.1
	1992	4	3.85	0.13	99	0.0	0.3	4.1
	1993	5	5.01	0.13	114	0.0	0.4	4.1
	1994	6	6.27	0.14	129	0.0	0.4	4.1
	1995	7	7.64	Ø. 14	144	0.0	Ø. 4	4.1
•	1996	8	9.12	0.14	160	0.0	0.5	4.0
. Trans	1 <b>9</b> 97	9	10.71	0.15	176	0.0	0.5	4.0
<u></u>	1998	10	12.44	0.15	194	0.0	0.5	3.9
	1999	11	14.32	_ 0.15	214	0.0	0.6	3.9
1	2000	12	16.34	0.15	235	0.0	0.6	3.8
***	2001	13	18.53	0.16	260	0.0	0.6	3.8
额	2002	14	20.90	0.16	288	0.0	0.7	3.7
#	2003	15	23.47	0.16	321	0.0	<b>0.</b> 7 "	<b>3.</b> 6
	2004	16	26.24	0.17	359	0.0	0.7	3.6
-	2005	17	<b>29.</b> 24	0.17	403	0.0	0.8	3.5
	2006	18	32.49	0.17	456	0.0	0.8	3.4
4.	2007	19	36.01	0.17	519	0.0	0.9	3.3
¥ .			18-kip	Inches	feet	Joints	0 = none	0-5
æ.			millions		per mile	per mile	1 = low	
<b>Á</b> n		,			·	·	2 = medium	n
-							3 = high	
*							- ·	
<b>E</b>	NOTE:	These	projections	are estin	nates of exp	pected perform	ance baséd	on
F						taken as exac		
₹			ad as relati				•	
100		· <del>-</del>			•			

# \_\_SUMMARY:

Joint faulting on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 0.13 inches per mile in 1992.

Transverse cracking of the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

4

Pumping on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

PSR on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

# APPENDIX C

# I-90 EAST (MP 55) SNOQUALMIE PASS EXPEAR OUTPUT

# APPENDIX C I-90 EAST SNOQUALAMIE PASS EXPEAR OUTPUT

			<u>Page</u>
C1.	Input D	ata and Performance Predictions	1.50
	witho	ut Rehabilitation	132
C2.	Restorat	tion .	
	C2.1	Restore Both Lanes	174
C3.	Structur	al Overlay	
	C3.1	1.4" AC	175
	C3.2	1.5" AC	176
		2.0" AC	
		4.2" AC	
C4.	AC Ove	rlay with Crack and Seat	
	2.5'X	2.5' pieces, 15 ton roller	
	C4.1	1.4" AC	179
	C4.2	1.5" AC	180
	C4.3	4.2" AC	181
C5.	PCC Bo	nded Overlay	
	C5.1	12" PCC	182
	C5.2	18" PCC	183
C6.	PCC Un	bonded Overlay	
	No D	owels	
	C6.1	8" PCC	184
	C6.2	10.5" PCC	185
	C6.3	10.6" PCC	
		Dowels	
		10.5" PCC	
	C6.5	10.6" PCC	188
C7.	Reconsti	ruct Both Lanes	
	No De	owels, Stabilized Base	
	C7.1	12" PCC	
	C7.2	18" PCC	190
		owels, Granular Base	
	C7.3	12" PCC	191
	CZA	18" PCC	192

# APPENDIX C I-90 EAST SNOQUALAMIE PASS EXPEAR OUTPUT (continued)

7/8" 1	Dowels, Stabilized Base	Page
C7.5	12" PCC	193
C7.6	18" PCC	194
	Dowels, Granular Base	195
-	18" PCC	196

		<u>Page</u>
C1.	Input Data and Performance Predictions without Rehabilitation	152

•

# EXPEAR 1.1

# PROJECT EVALUATION AND REHABILITATION RECOMENDATIONS

# FOR: presno

- 1. Project Summary
- 2. Current Evaluation
- 3. Physical Testing Recommendations
- 4. Future Distress Predictions

### Project Survey Summary For JRCP

Date of survey: 08/26/88 Design engineer: Holly Simmons PROJECT IDENTIFICATION I-90 Highway designation: State: Washington Direction of survey: **Se**st 55.50 Starting milepost: 63.99 Ending milepost: Number of sample units: 1 CLIMATE wet freeze-thaw Climatic zone: Estimated annual temperature range (F): 49.5 Mean annual precipitation (inches): 107.6 Corps of Engineers freezing index (Fahrenheit degree-days): 937.0 Average Annual Temperature (degrees Fahrenheit): 41.80 SLAB CONSTRUCTION Year constructed: 1959 Slab thickness (inches): 9.0 Width of traffic lanes (feet): 12.00 Concrete 28-day modulus of rupture (psi): 650.00 TRANSVERSE AND LONGITUDINAL JOINTS Pattern of joint spacing: uniform Transverse joint spacing if uniform (feet): 15.0 Transverse joint sequence if random (feet): Type of sealant: liquid Average transverse joint reservoir dimensions: width (inches): 0.25 depth (inches): 1.50 Method used to form transverse joints: sawing Transverse joint sawed depth (inches): 1.5 Type of load transfer system: aggregate interlock Dowel bar diameter (inches): 0.00 Method used to form longitudinal joints between lanes: sawing Longitudinal joint sawed or formed depth (inches): 2.3 BASE Base type: open-graded drainage layer Modulus of subgrade reaction (psi/inch): 200.00 SUBGRADE Predominant subgrade soil AASHTO classification: A1 Are swelling soils a problem in area: no Were steps taken to prevent the swelling soils problem: n/a

ŕ.

SHOULDER

Type of shoulder: AC

Width of shoulders (feet): inner: 4.0 outer: 10.0

Inner lane slope direction: toward inner shoulder

TRAFFIC

Estimated current through two-way ADT: 17300

Percent commercial trucks: 19.0

Total number of lanes in direction of survey: 2

Future 18-kip ESAL growth rate (percent per year): 6.6

Truck traffic volume growth rate: approximately same as in past

Total accumulated 18-kip ESAL (millions):

RIDE QUALITY
PSR

Lane two Lane one
0.82 8.19

	Samble urit number • • •	milepost: 55.5	;
	E.	Bille Uliu	ane one
	Number of deteriorated transverse cracks, L-M-H:	33	144
	Mean faulting at transverse cracks (inches):	0.00	0.00
	Number of deteriorated transverse joints:	<b>Ø</b>	Ø
	Mean faulting at transverse joints (inches):	0.00	0.25
	Mean faulting at transverse Johnson	2988	2988
	Number of transverse joints: Number of FDRS & slab replacements:	Ø	Ø
	Mean faulting at FDR & slab repl. jnts (inches):	0.00	0.00
	Mean faulting at ruk & slab rept. July to	Ø	Ø
	Number of FDR & slab replacement joints:	10	33
	Number of corner breaks:	810.0	4900.0
	Length of long. cracking, M-H only (feet): Length of spalling of longit. Joint, M-H only:		0.0
.2.	TRONGUERRE TOTATS		
小学の世界中の 子を奉み いないもでる	CRACKING AT TRANSVERSE JOINTS  Total joints with trans. cracks within 2 feet:	11	6
***	FOUNDATION MOVEMENT		
ž	Number of settlements (M-H severity):	0	Ø
*	Number of heaves (M-H severity):	Ø	0
7	DRAINAGE Are longitudinal subdrains present and functional What is the typical height of the pavement above Do ditches have standing water or cattails in the	Cite discussion	5.0
36.	LOSS OF SUPPORT  Extent of evidence of pumping or water bleeding:	none	none
	SURFACE CONDITION		
	Method used to texture the pavement at construct:	ion: other	
3	to the sunface nolished in the wheelpaths:	yes	yes
Jan G	Is significant tire rutting in the wheelpaths:	no	no
•	S JOINT SEALANT CONDITION		
	Condition of the transverse joint sealant:	high	high
	organization of the longitudinal loint searant:		high
	Are substantial amnts of incompressibles in jnts:	: yes	yes
	CONCRETE DURABILITY		
	Evtent of "D" cracking at joints or cracks:	none	none
	Extent of reactive aggregate distress:	none	none
	Extent of scaling:	none	none
	PREVIOUS REPAIR		
	one full-death repairs placed with dowels:	no	no
	Are partial depth repairs present at most joints	: no	no
	Has diamond grinding been done:	yes	yes
	Has grooving been done:	no	no

AC	SHOULDERS	Inner	Outer
	Alligator cracking:	none	none
	Linear Cracking:	none	riorie
	Weathering/ravelling:	none	none
	Lane/shoulder joint dropoff:	none	none
	Settlements or heaves along outer edge:	none	some
	Blowholes at transverse joints:	none	none
	(Shoulden loint condition:	good	good

## Extrapolated (Per Mile) Values For presno

		4.04.5	
	Lane two		Larie one
Number of deteriorated transverse cracks:	4		17
Mean faulting at deter, trans, cracks (inches)	. 0.00		୭. ୧୧
Mean faulting at oeter, trans, cracks trans	Ø		Ø
Number of deteriorated transverse joints;	0.00		Ø. 25
Mean faulting at transverse joints (inches):	352		352
Number of transverse joints:	2		Ø
Number of full-depth repairs:	0.20		0.00
Mean faulting at FDR joints (inches):	Ø		Ø
Number of full-depth repair joints:	1		4
Number of corner breaks:	95. 4		577.1
Length of long. cracking, M-H only (feet):	<del>-</del>		0.0
Length of spalling of longit. joint, M-H only;			0.0
	4		1
Total joints with trans. cracks within 2 feet:	<b>.</b>		-
			Ø
Number of settlements (M-H severity):	Ø		
Number of heaves (M-H severity):	Ø		Ø

om (**gr**iss) Light die

## CURRENT PAVEMENT EVALUATION

**************************************	 <b>F#####</b> ##*******
JOINT CONSTRUCTION DEFICIENCY:	
A longitudinal joint construction deficiency in lane 1, li an inadequate depth of saw cut, is indicated by longitudina	kely due to al cracking.
a. seal longitudinal cracks .b. stitch longitudinal cracks	. a com
A transverse joint construction deficiency in lane 1, like an inadecuate depth of saw cut, is indicated by transverse within 2 feet of transverse joints.	ly due to
a. seal cracks near transverse joints b. load transfer restoration at cracks near transverse joi near transverse joints	
JOINT SEALANT DEFICIENCY:	
A transverse joint sealant deficiency is indicated in lane to high-severity joint sealant damage and an inadequate jo reservoir shape factor for the existing sealant type.  a. reseal transverse joints	1 by medium- int sealant
ROUGHNESS:	
Poor rideability in lane 1 is indicated by total faulting inches per mile at joints, cracks, and full-depth repairs an unacceptably low PSR (3.0) for the pavement's ADT level	(if present), ar
a. grinding b. AC nonstructural overlay	
DURABILITY DEFICIENCY:	
The pavement in lane 1 shows no indications of significant concrete durability problems.	surface or
a. do nothing	
JOINT DETERIORATION:	
Joint deterioration or other pavement deterioration in lar accelerated by water infiltration permitted by poor longit	ne 1 may be udinal

Joint sealant condition.

a. reseal longitudinal centerline joint

No joint deterioration exists in lane 1.

a.	Н	0	n	o	t	h	i	n	o
----	---	---	---	---	---	---	---	---	---

STRUCTURAL DEFICIENCY:

The pavement in lane 1 exhibits some load-associated distress (between 1 and 24 corner breaks per mile) which requires repair but does not indicate a structural deficiency.

a. full-depth repair of corner breaks

The pavement in lane 1 exhibits some load-associated distress (between 1 and 799 feet of deteriorated transverse cracks per mile) which requires repair but does not indicate a structural deficiency.

# a. full-depth repair of cracks

SKID RESISTANCE DEFICIENCY:

Loss of skid resistance in lane 1 is indicated by polished wheel paths.

- a. grinding
- b. grooving
- to. AC nonstructural overlay

LOAD TRANSFER DEFICIENCY:

Aggregate interlock is providing inadequate load transfer in lane 1 at the transverse joints, as indicated by mean transverse joint faulting of more than 0.13 inches.

a. load transfer restoration at joints

No load transfer deficiency is indicated at deteriorated transverse cracks in lane 1.

a. do nothing

A potential load transfer deficiency exists at undowelled full-depth repairs in lane 1, but mean full-depth repair faulting is not significant.

#### a. do nothing

FOUNDATION MOVEMENT:

A potential for frost heave is indicated by a mean Freezing Index greater than 0.

a. do rothing

LOSS OF SUPPORT:

The pavement in the lane 1 shows no indications of loss of slab support.

#### DRAINAGE DEFICIENCY:

The pavement in lane 1 shows no indications of a drainage deficiency.

a. do nothing

.

--

3

, · · · · · · · · · · · · · · · · · · ·
····
LANE 2
JOINT CONSTRUCTION DEFICIENCY:
A transverse joint construction deficiency in lane 2, likely due to an inadequate depth of saw cut, is indicated by transverse cracking within 2 feet of transverse joints.
<ul> <li>a. seal cracks near transverse joints</li> <li>b. load transfer restoration at cracks near transverse joints, seal crack</li> <li>near transverse joints</li> </ul>
JOINT SEALANT DEFICIENCY:
A transverse joint sealant deficiency is indicated in lane 2 by medium- to high-severity joint sealant damage and an inadequate joint sealant reservoir shape factor for the existing sealant type.
a. reseal transverse joints
ROUGHNESS:
Poor rideability in lane 2 is indicated by an unacceptably low PSR for the pavement's ADT level.
a. grinding b. AC nonstructural overlay
DURABILITY DEFICIENCY:
The pavement in lane 2 shows no indications of significant surface or concrete durability problems.
a. do nothing
JOINT DETERIORATION:
No joint deterioration exists in lane 2.
a. do nothing
STRUCTURAL DEFICIENCY:
The pavement in lane 2 exhibits some load-associated distress (between 1 and 24 corner breaks per mile) which requires repair but does not

The pavement in lane 2 exhibits some load-associated distress (between 1 and 799 feet of deteriorated transverse cracks per mile) which requires repair but does not indicate a structural deficiency.

indicate a structural deficiency.

a. full-depth repair of corner breaks

a. full-depth repair of cracks	
SKID RESISTANCE DEFICIENCY:	
Loss of skid resistance in lane 2 is indicated by paths.	polish <b>ed whee</b> l
a. grinding b. grooving c. AC monstructural overlay	
LOAD TRANSFER DEFICIENCY:	
No load transfer deficiency is indicated at transv	verse joints in lane 2.
a. do nothing	
 A potential load transfer deficiency exists at und repairs in lane 2, but mean full-depth repair fau significant.	dowelled full-depth lting is not
a. do nothing	o a o o a u o o o o o o o o o o o o o o
FOUNDATION MOVEMENT:	
A potential for frost heave is indicated by a mean greater than $oldsymbol{0}_{oldsymbol{\cdot}}$	n Freezing Index
a. do nothing	
LOSS OF SUPPORT:	
The pavement in the lane 2 shows no indications o	f loss of slab support.
a. do nothing	
DRAINAGE DEFICIENCY:	
The pavement in lane 2 shows no indications of a	drainage deficiency.
a. do nothing	

\*

OUTER SHOULDER

The outer AC shoulder shows no indications of significant deterioration.

a. do nothing

· 2

.

The inner AC shoulder shows no indications of significant deterioration.

a. do nothing

#### FUTURE DISTRESS PREDICTIONS

## DISTRESS AND PSR PROJECTIONS FOR LANE 1

Annual ESAL	Year	Pumping	Faulting	Deter. Joints	Transverse Cracking	PS
Ø 56	1988	ø. ø	Ø. 25	0	204	2.
		1.0	0.25	4	288	Ø.:
			0.25	8	386	0.:
			0.26	13	499	₽.∶
			0.26	18	630	0.:
			0.26	23	783	0.
			0.25	29	960	Ø. ·
			0.26	35	1165	0.
				41	1405	Ø.
<del></del>			0.27	47	1683	Ø.
			0.27	54	2008	0.
				62	2386	0.
				70	2827	0.
				78	3342	0.
				86	3943	Ø.
				95	4644	0.
				104	5462	0.
				114	6417	Ø.
		<del></del>		124	7533	0.1
				135	8836	ø.
1. 50	Lee	<b>U. U</b>				
18-kip		0 = none	Inches	Joints	Feet	0-
<u>.</u>		1 = low		per.	per	
		2 = mediu	τw	mile	mile	
		3 = high				
		ESAL  0.56 1988 0.60 1989 0.64 1990 0.68 1991 0.73 1992 0.78 1993 0.83 1994 0.88 1995 0.94 1996 1.00 1997 1.07 1998 1.14 1999 1.22 2000 1.30 2001 1.38 2002 1.30 2001 1.38 2002 1.57 2004 1.67 2005 1.78 2006 1.90 2007	ESAL  0.56	######################################	######################################	######################################

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

**36** 

FUTURE DISTRESS PREDICTIONS

# DISTRESS AND PSR PROJECTIONS FOR LANE 2

Cumulative ESAL	Annual ESAL	Year	Pumping	Faulting	Deter. Joints	Transverse Cracking	PSR
Ø. 8	Ø.13	1988	0.0	0.00	Ø	47	2.5
1.0	0.13	1989	0.1	0.00	4	56	2.3
1.1	0.14	1990	0.2	0.01	8	66	2.1
1.2	0.15	1991	<ul><li>Ø.3</li></ul>	0.01	13	76	1.9
1.4	Ø. 16	1992	0.4	0.01	18	86	1.7
1.6	0.17	1993	0.5	0.01	23	<del>9</del> 6	1.5
1.8	0.18	1994	0.6	0.01	29	107	1.3
2.0	0.20	1995	0.7	0.02	35	119	1.1
2.2	0.21	1996	ø. 8	0.02	41	132	0.8
2.4	0.22	1997	0.8	0.02	47	145	Ø. E
2.6	0.24	1998	0.9	0.02	54	159	Ø. 3
2.9	0.25	1999	1.0	0.02	62	175	0.0
3.2	0.27	2000	1.1	0.03	70	192	0.0
3.4	0.29	2001	1.2	0.03	78	211	0.0
3.8	0.31	2002	1.3	0.03	86	232	0.0
4. 1	0.33	2003	1.4	0.03	95	255	0.0
4.4	0.35	2004	1.5	0.03	104	281	0.0
4.8	0.37	2005	1.7	0.03	114	311	0.0
5.2	0.40	2006	1.8	0.04	124	344	0.0
5.6	<b>0.</b> 42	2007	1.9	0.04	135	382	0.0
18-kip	18-kip		0 = none	Inches	Joints	Feet	Ø-5
millions	millions		1 = low		per	per	
			2 = mediu 3 = high	ım	mile	mile	

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

.

÷.

## FUTURE PAVEMENT EVALUATION

	profession and the second seco
<del>*************************************</del>	******
LANE 1 ************************************	
	hy am unaccentably
Poor rideability in lane 1 occurs in 1988 as indicated low predicted PSR for the pavement's ADT level.	by an unacceptably
a. grinding b. AC nonstructural overlay	
JOINT DETERIORATION:	
Significant joint deterioration in lane 1 occurs in 19 55 or more deteriorated joints per mile.	199 as indicated by
a. full-depth repair at joints	
STRUCTURAL DEFICIENCY:	
Structural deficiency of the pavement in lane 1 occurs indicated by 800 feet or more of deteriorated transve	; in 1994 as erse cracks per mile.
<ul> <li>a. full-depth repair of cracks, AC structural overlay</li> <li>b. full-depth repair of cracks, crack and seat and AC</li> <li>c. full-depth repair of cracks, PCC bonded overlay</li> <li>d. full-depth repair of cracks, PCC unbonded overlay</li> <li>e. reconstruct</li> </ul>	
LOAD TRANSFER DEFICIENCY:	- <del>-</del>
Inadequate load transfer at transverse joints in lane indicated by predicted faulting of 0.13 inches or more	1 occurs in 1988 as
a. load transfer restoration at joints b. do nothing	
LOSS OF SUPPORT:	
Loss of slab support in lane 1 occurs in 1988 as indic faulting greater than 0.13 inches at transverse joints	cated by predicted s.
a. subseal at joints and cracks	2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
DRAINAGE DEFICIENCY:	
A drainage deficiency in lane 1 occurs in 1989 as ind pumping reaching the low severity level.	icated by predicted

a. install or repair longitudinal subdrainsb. install or repair longitudinal subdrains, seal all joints and cracks

ROUGHNESS:
Poor rideability in lane 2 occurs in 1988 as indicated by an unacceptably low predicted PSR for the pavement's ADT level.
a. grinding b. AC nonstructural overlay
JOINT DETERIORATION:
Significant joint deterioration in lane 2 occurs in 1999 as indicated by 55 or more deteriorated joints per mile.
a. full-depth repair at joints
STRUCTURAL DEFICIENCY:
No structural deficiency in lane 2 occurs based on predicted transverse cracking over the next 20 years.
LOAD TRANSFER DEFICIENCY:
No load transfer deficiency at transverse joints in lane 2 occurs based on predicted joint faulting over the next 20 years.
LOSS OF SUPPORT:
No loss of slab support in lane 2 occurs based on predicted joint faulting over the next 20 years.
DRAINAGE DEFICIENCY:
A drainage deficiency in lane 2 occurs in 1999 as indicated by predicted pumping reaching the low severity level.

b. install or repair longitudinal subdrains, seal all joints and cracks

a. Install or repair longitudinal subdrains

## PHYSICAL TESTING RECOMMENDATIONS

			The same of the sa
 NONDESTRUCTIVE	DEFLECTION	TESTING	

Nondestructive deflection testing (NDT) of the pavement is recommended to further investigate deficiencies observed in the preliminary evaluation of the pavement. Use a Falling Weight Deflectometer or other NDT device capable of applying dynamic loads to the pavement over a range of load levels comparable to actual truck wheel loads (i.e., 9000 to 16000 pounds).

Nondestructive deflection testing should be conducted in a 0.1-mile section randomly selected within each mile of the project. Deflection testing should on be conducted when the ambient temperature is between 50 and 80 degrees Fahrenhe to avoid joint and crack lock-up and excessive curling.

Testing should be performed at the following locations:

Center of the slab: Measure deflection basin in the center of the traffic lane in order to backcalculate elastic modulus of slab and effective k value be the slab. This information may be used in a structural analysis of the pavement determining uniformity of support along the project (see NCHRP Report No. 28 Lane edge: Measure deflections at the outer edge of the traffic lane (next to the shoulder). If the pavement has a tied concrete shoulder, also meas deflections across lane/shoulder joint. This information may be used in a structural analysis of the pavement.

Corner of the slab: Measure deflections across transverse joints and cracks and compute their load transfer efficiencies. This information will be used in a structural analysis of the pavement.

an Est

## ----- DESTRUCTIVE DEFLECTION TESTING -----

Destructive testing (obtaining samples of material from the pavement structure) is recommended to further investigate deficiencies observed in the preliminary of material samples must be obtained by coring through the concrete surface and base with a core bit (6-inch diameter unless specified otherwise). Granular base bulk samples should be obtained. Stabilized base samples should be obtained from coring, if possible. Where undisturbed soil samples are required they should be obtained by sampling the soil beneath the pavement and base a thin-walled Shelby tube.

Each type of destructive testing required should be conducted on at least one and preferably three or more slabs in each 0.1-mile section randomly selected within each mile of the project. For reasons of efficiency and safety, nondestructive testing should be conducted concurrently.

The following types of destructive testing are recommended:

Obtain cores from the center of the traffic lane.

no Obtain cores through selected transverse joints.

At locations along the longitudinal joint with significant spalling or nearby longitudinal cracks, core through the longitudinal joint (and adjacent cracks, if present). Examine the cores visually to determine whether the joint or one or more of the cracks is functioning as a joint.

Visual inspection and possibly laboratory testing of material samples obtained from destructive testing (coring) is recommended. The following types of information should be obtained from the material samples:

The strength of the cores obtained from the concrete slab should be determined by indirect tension testing in the laboratory. This information may be used in a structural analysis of the pavement. In the case of concrete deterioration due to poor durability (e.g., D cracking or reactive aggregate), the strength of the concrete is an indicator of the extent of the deterioration.

Examine the cores obtained from the center of the slab and through the transverse joints to determine the thickness and soundness of the concrete.

Determine the thickness of the base layer by examining the base material obtained from the coring operation.

東京 これいとの 大学の 大学 大学の大学の かい

----- SKID TESTING ------

Physical testing is recommended to further investigate and quantify the causes of poor skid resistance observed in the preliminary evaluation. The following types of testing are recommended:

Measure the skid resistance of the pavement with either a ribbed tire (ASTM E 501) or a bald tire (ASTM E 524) mounted on a locked-wheel skid trailer. Testing with both types of tires is preferred in order to obtain good estimates of both the macrotexture and microtexture of the pavement surface. If only one type of tire can be used, the bald tire is recommended. Measure skid resistance with the skid trailer over a section of pavement at least 1500 feet long (approximately 0.3 mile) within each mile of the project to obtain an estimate of the overall skid resistance of the pavement surface.

-

--

 ROUGHNESS	TESTING	

Roughness testing is recommended in each traffic lane to **verify that** the pavement is excessively rough and to determine the cause of the roughness. Roughness testing should be performed over the entire length of the pavement and the roughness measured at each  $\emptyset$ .1 mile segment.

Test the pavement with roughness equipment capable of producing either a response-type measurement of the pavement's roughness (e.g., Mays Meter) or a profile measurement device. Compare the measured roughness to your agency's standard for an acceptable level of roughness. Prepare a profile of the roughness index along the project for each traffic lane to identify points of significant roughness that need special attention.

			<u>Page</u>
C2.	Restora	tion	
	C2.1	Restore Both Lanes	174

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING RESTORATION

1988 2937 8.19 0.00 0.00 0.00 0.00 0.00 4.5 1989 2938 8.79 0.03 0.06 85 352.0 0.9 2.4 1990 2939 9.43 0.04 0.08 182 352.0 1.4 2.3 1991 2940 10.12 0.05 0.10 296 352.0 1.9 2.2 1992 2941 10.85 0.06 0.11 427 352.0 2.8 2.1 1993 2942 11.62 0.05 0.13 579 352.0 2.8 2.1 1994 2943 12.45 0.07 0.15 756 352.0 3.0 2.0 1995 2944 13.33 0.08 0.16 962 352.0 3.0 1.9 1996 2945 14.28 0.08 0.18 1201 352.0 3.0 1.9 1997 2946 15.28 0.09 0.20 1480 352.0 3.0 1.9 1997 2946 15.28 0.09 0.22 1804 352.0 3.0 1.7 1999 2948 17.49 0.10 0.23 2183 352.0 3.0 1.6 2000 2949 18.70 0.11 0.25 2624 352.0 3.0 1.5 2000 2950 20.00 0.11 0.27 3139 352.0 3.0 1.5 2001 2950 20.00 0.11 0.27 3139 352.0 3.0 1.4 2002 2951 21.38 0.12 0.29 3739 352.0 3.0 1.4 2004 2953 24.42 0.13 0.31 4440 352.0 3.0 1.4 2005 2954 26.09 0.14 0.36 6214 352.0 3.0 0.6 2006 2955 27.88 0.14 0.38 7330 352.0 3.0 0.6 2007 2956 29.78 0.15 0.40 8632 352.0 3.0 0.4		YEAR	AGE	CUMULATIVE ESALS	JOINT FAULTING	FDR FAULTING	TRANSVERSE CRACKING	JOINT DETERIOR.	PUMPING	PSR
2007 2956 29.78 0.15 0.40 8632 332.0 3.0 $0.40$ 8632 332.0 $0.40$		1988 1989 1991 1993 1993 1993 1996 1999 2001 2000 2000 2000 2000 2000 2000	2937 29330 29412 29445 29445 29445 2945 2955 2955 2955	8.19 8.19 9.43 10.12 10.85 11.62 12.45 13.38 14.28 15.35 17.49 18.70 20.00 21.38 22.85 24.42 26.09 27.88	FAULTING  0.00 0.03 0.04 0.05 0.06 0.06 0.07 0.08 0.09 0.10 0.11 0.11 0.12 0.13 0.14 0.14	FAULTING  0.00 0.06 0.08 0.10 0.11 0.13 0.15 0.16 0.20 0.22 0.23 0.25 0.27 0.29 0.31 0.33 0.36 0.38	CRACKING 85 182 296 427 579 756 962 1201 1480 1804 2183 2624 3139 3739 4440 5259 6214 7330	DETERIOR.  0.0 352.0 352.0 352.0 352.0 352.0 352.0 352.0 352.0 352.0 352.0 352.0 352.0 352.0 352.0 352.0 352.0	0.0 0.9 1.4 1.9 2.8 3.0 3.0 3.0 3.0 3.0 3.0 3.0 3.0 3.0 3.0	4.3211099876541.086.6
18-kip Inches Inches Feet Joints $0 = \text{none } 0-5$ millions per per $1 = \text{low}$ mile mile $2 = \text{medium}$	A Company of the Comp	2002 2003 2004 2005 2006	2951 2952 2953 2954 2955	22.85 24.42 26.09 27.88	0.13 0.13 0.14 0.14	0.31 0.33 0.36 0.38	4440 5259 6214 7330	352.0 352.0 352.0 352.0	3.0 3.0 3.0 3.0	1.1 1.0 0.8 0.6
k; ••• tu / ⊥tu				29.78 18-kip	0.15	0.40	Feet per	Joints per	0 = none 1 = low 2 = mediu	Ø-5

## SUMMARY:

Joint faulting on the restored pavement in lane 1 is predicted to equal or exceed an unacceptable level of 0.13 inches in 2003.

Full-depth repair faulting on the restored pavement in lane 1 is predicted to equal or exceed an unacceptable level of 0.13 inches in 1993.

Cracking on the restored pavement in lane 1 is predicted to equal or exceed an unacceptable level of 800 feet per mile in 1995.

Joint ceterioration on the restored pavement in lane 1 is predicted to equal or exceed an unacceptable level of 55 joints per mile in 1989.

Pumping on the restored pavement in lane 1 is predicted to equal or exceed an unacceptable level of 1.0 in 1990.

PSR on the restored pavement in lane 1 is predicted to equal or fall below an unacceptable level of 3.0 in 1989.

			<u>Page</u>
C3.	Structura	l Overlay	
	C3.1	1.4" AC	175
	C3.2	1.5" AC	176
	C3.3	2.0" AC	177
		4.2" AC	178

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING AC OVERLAY

			TOTAL	MEDIUM-HIGH	
YEAR	AGE	CUM	REFLECTIVE	REFLECTIVE	RUTTING
1 = 1711		ESALS	CRACKING	CRACKING	
				•	<b>5</b>
1988	Ø	ଡ. ଡଡ	Ø	Ø	Ø. Ø2
1989	1	Ø.60	1465	432	Ø. ØØ
1990	2	1.24	1519	568	ଅ.ଅଫ
1991	3	1.93	1553	668	ଡ. ଡଥ
1992	4	2.66	1577	751	ଡ. ଡଟ
1993	5	3.43	1597	824	ଡ. ଡଟ
1994	6	4.26	1613	890	0.01
1995	7	5.14	1627	950	Ø. Ø4
1996	8	6.09	1640	1007	0.07
1997	9	7.09	1651	1061	0.10
1998	10	8.16	1661	1112	0.13
1999	11	9.30	1670	1162	<b>0.</b> 17
2000	12	10.51	1679	1210	0.20
2001	13	11.81	1687	1256	0.24
2002	14	13.19	1695	1302	Ø. 28
2003	15	14.66	1702	1347	<b>0.3</b> 2
2004	16	16.23	1709	1390	Ø. 36
2025	17	17.90	1716	1434	Ø. 41
2006	18	19.69	1722	1476	Ø <b>.</b> 45
2007	19	21.59	1728	1518	0.50
	<del>-</del> -				
		18-kip	Feet	Feet	Inches
		millions	per mile	per mile	

#### Summary:

Total reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Medium- to high-severity reflective cracking of the AC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 1500 feet per mile in 2007.

Rutting on the AC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 0.50 inches in 2007.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING AC OVERLAY

			TOTAL	MEDIUM-HIGH	1
YEAR	AGE	CUM	REFLECTIVE	REFLECTIVE	RUTTING
		ESALs	CRACKING	CRACKING	are the second
1988	Ø	0.00	Ø	<b>ø</b> .	0.02
1989	1	Ø. EØ	1458	426	<b>0.</b> 02
1990	2	1.24	1512	560	0.00
1991	3	1.93	1546	658	0.00
1992	4	2.66	1570	740	ଡ. <b>ଡ</b> ଡ
1993	5	3.43	1589	812	0.00
1994	6	4.26	1606	877	ଡ.ଡେ
1995	7	5.14	1620	937	0.02
1996	8	6.09	1632	993	0.05
1997	Э	7.09	1643	1046	0.09
1998	10	8.16	1653	1096	<b>0.</b> 12
1999	11	9.30	1663	1145	0. 15
2000	12	10.51	1671	1192	Ø <b>.</b> 19
2001	13	11.81	1679	1238	ø. 23
2002	14	13.19	1687	1283	0.27
2003	15	14.66	1694	1327	<b>0.</b> 31
2004	16	16.23	1701	1370	Ø. 35
2005	17	17.90	1708	1413	Ø. 39
2006	18	19.69	1714	1 455	0.44
2007	19	21.59	1720	1496	<b>0.</b> 49
		18-kip	Feet	Feet	Inches
		millions	per mile	per mile	

#### Summary:

Total reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Medium- to high-severity reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Rutting on the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

## PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING AC OVERLAY

				TOTAL	MEDIUM-HIGH	
	YEAR	AGE	CUM	REFLECTIVE	REFLECTIVE	RUTTING
			ESALs	CRACKING	CRACKING	
	1988	ø	ଅ. ଅପ	Ø	ø	0.00
	1989	/1	0.60	1429	401	0.00
	1990	2	1.24	1483	527	Ø. ØØ
	1991	3	1.93	1515	620	Ø. ØØ
	1992	4	2.66	1539	697	ଡ. ଡଡ
	1993	5	3.43	1558	764	0.00
	1994	6	4.26	1574	825	0.00
	1995	7	5.14	1588	881	0.00
	1996	a	6.09	1600	934	0.01
	1997	9	7.09	1611	984	0.04
****	1998	10	8.16	1621	1032	0.08
-	1999	11	9.30	1630	1077	0.11
	2000	12	10.51	1639	1122	0.15
	2001	13	11.81	1647	1165	0.18
A	2002	14	13.19	1654	1207	0.22
	2003	15	14.66	1661	1249	0.26
manager 15 - All Carlos	2004	16	16.23	1668	1289	0.31
Section 1	2005	17	17.90	1675	1329	<b>0.35</b>
1	2006	18	19.69	1681	1369	0.40
	2007	19	21.59	1687	1408	<b>0.</b> 45
	2001					
			18-kip	Feet	Feet	Inches
			millions	per mile	per mile	

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

## **≲Summary:**

Total reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Medium- to high-severity reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Rutting on the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

< <u>Σ</u> ΩR	4.3E	DUM ESALS	TOTAL REFLECTIVE CRACKINS	MEDIUM-HIGH REFLECTIVE CRACKING	RUTTING
283	Ø1	2.42	<u>ē</u>	Ø	Ø. ØZ
1359	ì	e.60	1358	343	0.02
1557	<u>=</u>	1.24	1429	45 <b>2</b>	<b>0.0</b> 0
1991	3	1.93	1442	530	<b>0.0</b> 2
395	4	3.65	1453	595	- <b>0.0</b> 0
1953	5	3.43	1481	653	0.00
19.74	E	4,86	1496	705	0.00
1995	7	5.14	1509	753	0.00
1996	8	6.29	1521	798	0.00
1537	9	7.09	1532	541	0.02
:938	10	8.16	1541	882	0.02
1999	11	9.30	1550	921	0.05
£ 2 2 2	12	10.51	1558	959	0.09
2001	13	11.81	1566	996	0.12
2002	14	13.19	1573	1032	0.16
2003	15	14.66	1580	1067	Ø. 23
E 2024	:6	16.23	1586	1102	ø. 25
2005	17	17.90	1592	1136	0.29
2226	18	19.69	1598	1170	0.34
2007	:3	21.59	1604	1203	Ø. 39
		18-kip	Feet	Feet	Inches
		millions	per mile	per mile	

#### Summary:

Total reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Medium- to high-severity reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Resting on the PD overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

			<u>Page</u>
C4.	AC Over	lay with Crack and Seat	
	2.5'X	2.5' pieces, 15 ton roller	170
	C4.1	1.4" AC 1.5" AC	180
	C4.2 C4.3	4.2" AC	181

#### PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING CRACK & SEAT

				TOTAL	MEDIUM-HIGH		
	YEAR	AGE	CUM	REFLECTIVE	REFLECTIVE	RUTTING	
			ESALs	CRACKING	CRACKING -		
	1988	Ø	0.00	0	0	9.00	•
	1989	1	0.60	789	789	0.00	
	1990	2	1.24	799	799	0.00	
	1991	3	1.93	807	807	0.00	
	1992	4	2.66	816	816	0.00	
	1993	5	3.43	824	824	0.00	
	1994	6	4.26	831	831	0.01	
	1995	7	5.14	838	838	0.04	
	1996	8	6.09	844	844	0.07	
	1997	9	7.09	850	850	0.10	
	1998	10	8.16	855	855	0.13	
_ '	1999	11	9.30	<b>859</b>	859	0, 17	
	2000	12	10.51	863	863	0.20	
	2001	13	11.81	866	866	<b>0.</b> 24	
	2002	14	13.19	868	868	<b>0.</b> 28	
	2003	15	14.65	869	869	0.32	
	2004	16	16.23	869	869	<b>0.</b> 36	
	2005	17	17.90	869	869	0.41	
	2006	18	19.69	867	867	0.45	
	2007	19	21.59	864	864	<b>0.</b> 50	
			18-kip	Feet	Feet	Inches	
			millions	per mile	per mile		

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

#### Summary:

انده توهور در مغور

Total reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Medium- to high-severity reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Rutting on the AC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 0.50 inches in 2007.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING CRACK & SEAT

YEAR	AGE	CUM ESALs	TOTAL REFLECTIVE CRACKING	MEDIUM-HIGH REFLECTIVE CRACKING	- RUTTING
1988	Ø	0.00	Ø	0	· 0.00
1989	1	0.60	789	789 ·	<b>0. 0</b> 0
1990	2	1.24	799	799	ଅ. ଅଫ
1991	3	1.93	807	807	0.00
1992	4	2.66	816	816	Ø. ØØ
1993	5	3.43	824	824	Ø. Ø2
1994	6	4.26	831	831	0.00
1995	7	5.14	838	838	Ø. Ø2
1996	8	6.09	844	844	Ø. 05
1997	9	7.09	850	850	0.09
1998	. 10	8.16	855	855	0.12
1999	11	9.30	859	859	<b>0.</b> 15
2000	12	10.51	863	863	0.19
2001	13	11.81	866	866	<b>0.</b> 23
2002	14	13.19	868	868	Ø. 27
2003	15	14.66	869	869	Ø. 31
2004	16	16.23	869	869	ø. 35
2005	17	17.90	869	869	Ø. <u>3</u> 9
2006	18	19.69	867	867	0.44
2007	19	21.59	864	864	0.49
- K.K. 1	<b>.</b> -	<b>—</b>			
		18-kip	Feet	Feet	Inches
		millions	per mile	per mile	

## Summary:

%Total reflective cracking of the AC overlay in lane 1 is not % predicted to reach an unacceptable level within the next twenty years.

Medium- to high-severity reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Rutting on the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING CRACK & SEAT

	YEAR	AGE	OUM ESALs	TOTAL REFLECTIVE CRACKING	MEDIUM-HIGH REFLECTIVE CRACKING	RUTTING
	1988	2	0.00	Ø	Ø	<b>0.0</b> 0
	1989	1	0.60	789	789	0.0Z
	1990	2	1.24	799	7 <b>99</b>	Ø. 00
	1991	3	1.93	807	807	0.00
	:992	4	2.66	816	816	0.00
	1993	5	3.43	824	824	0.00
	1994	E	4.26	831	831	ଡ.ଡେଅ
	1995	7	5.14	838	838	0.00
	1996	8	6.09	844	844	0.00
	1997	9	7 <b>.0</b> 9	850	850	0.00
	1998	10	8.16	855	855	0.02
<del>-</del> -",	1999	11	9.30	859	859	0.05
	2000	12	10.51	863	863	0.09
	2001	13	11.81	866	866	0.12
	2002	14	13.19	868	868	0.15
distriction of the second of t	2003	15	14.66	869	869	0.20
7	<b>≘</b> ∂∂4	16	16.23	869	869	0.25
	2005	17	17.90	869	869	Ø. 29
<u> </u>	2006	18	19.69	867	867	Ø.34
	2007	19	21.59	864	864	Ø. 39
			18-kip	Feet	Feet	Inches
			millions	per mile	per mile	

#### Summary:

Total reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

medium- to nigh-severity reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Rutting on the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

			Page Page	
C5.	PCC Bor	ided Overlay		
	C5.1	12" PCC	 182	
	C5.2	18" PCC	 103	

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING BONDED PCC OVERLAY

	YEAR	AGE	CUMULATIVE ESALs	JOINT FAULTING	JOINT DETERIORATION	TRANSVERSE CRACKING
	1988	Ø	0.00	0.00	0.0	
	1989	1	0.60	0.05	Ø. 1	224
	1990	2	1.24	0.06	Ø. 4	376
	1991	3	1.93	0.07	1.0	509
	1992	4	2.66	0.08	2.0	633
	1993	5	3.43	0.08	3.3	749
	1994	6	4.26	0.09	5.0	860
	1995	7	5.14	0.09	7.2	967
	1996	a	6.09	0.09	9.9	1071
4.	1997	9	7.09	0.10	13.0	1172
<i></i>	1998	10	8.16	0.10	16.6	1271
Section 1	1999	11	9.30	0.10	20.8	1368
	2000	12	10.51	0.11	25.5	1463
*	2001	13	11.81	0.11	30.8	1557
	2002	14	13.19	0.11	36.7	1650
	2003	15	14.66	0.12	43.2	1742
.4	2004	16	16.23	0.12	50.4	1833
	2005	17	17.90	0.12	58.2	1923
	2006	18	19.69	0.12	66.7	2012
_	2007	19	21.59	0.13	75.9	2101
ż	-					
· ·			18-kip	Inches	Joints	Feet
τ,•			millions		per mile	per mile

#### SUMMARY:

Z

Joint faulting on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the PCC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 55.00 joints per mile in 2005.

Transverse cracking of the PCC overlay is predicted to equal or exceed an unacceptable level of 800 feet per mile in 1994.

120

## PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING BONDED PCC OVERLAY

	YEAR	AGE	CUMULATIVE ESALs	JOINT FAULTING	JOINT DETERIORATION	TRANSVERSE CRACKING
			2.00		Ø. Ø	<b>ੌ</b> Ø
	1988	Ø	0.00	0.00	Ø. 1	224
	1989	1	0.60	0.05	Ø. 4	376
	1990	2	1.24	0.06		509
	1991	3	1.93	0.07	1.0	633
	1992	4	2.66	Ø. Ø8	2.0	749
	1993	5	3.43	0.08	3.3	
	1994	E	4.26	0.09	5.0	860
	1995	7	5. 14	0.09	7.2	967
	1996	8	6.09	0.09	9. 9	1071
279 24 <b>48</b> 6	1997	9	7.09	0.10	13.0	1172
4	1998	10	8.16	0.10	16.6	1271
	1999	11	9.30	0.10	20.8	1368
	5000	12	10.51	0.11	25.5	1463
	2001	13	11.81	0.11	30.8	1557
		14	13.19	0.11	36.7	1650
	2002		14.66	0.12	43.2	1742
Jan 1	2003	15	16.23	0.12	50.4	1833
A STATE OF THE PERSON NAMED IN	2004	16		0.12	58.2	1923
	2005	17	17.90		66.7	2012
7.	2006	18	19.69	Ø. 12	75.9	2101
•	2007	19	21.59	0.13	73., 3	
			40 1.4-	Inches	Joints	Feet
1.5			18-kip	THUITES	per mile	per mile
A			millions		he: mrre	<b>F</b>

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

#### SUMMARY:

Joint faulting on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the PCC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 55.00 joints per mile in 2005.

Transverse cracking of the PCC overlay is predicted to equal or exceed an unacceptable level of 800 feet per mile in 1994. 

			<u>Page</u>
C6.	PCC Un	bonded Overlay	
	No Do	wels	
	C6.1	8" PCC	184
	C6.2	10.5" PCC	185
	C6.3	10.6" PCC	186
	7/8" E	Powels	
	C6.4	10.5" PCC	187
	C6.5	10.6" PCC	188

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING UNBONDED PCC OVERLAY

	YEAR	AGE	CUMULATIVE ESALs	JOINT FAULTING	JOINT DETERIORATI <b>ON</b>	TRANSVERSE CRACKING
					0.0	.5 <del>~</del>
	1988	ıZı	ଡ. ଡଡ	Ø. ØØ	Ø. Ø	=
	1989	1	Ø. 60	0.02	Ø. Ø	771
	1990	2	1.24	0.03	0.0	~2 <b>5</b> 8
	1991	3	1.93	Ø. Ø4	Ø. Ø	349
	1992	4	2.66	0.04	Ø. 1	457
	1993	5	3.43	0.05	Ø. 2	595
	1994	6	4.26	0.05	Ø. 3	773
	1995	7	5.14	0.05	Ø. 5	1005
	1996	8	6.09	0.0E	0.7	1305
	1997	9	7.09	0.05	1.1	1690
	1998	10	8.16	0.06	1.5	2182
1. Sept. 1.	1999	11	9.30	0.07	2.0	2805
-	2000	12	10.51	<b>0.0</b> 7	2.6	3588
÷	2001	13	11.81	0.08	3.3	4565
	2002	14	13.19	0.08	4.1	5778
	2003	15	14.66	0.08	5.0	7275
•	2004	16	16.23	0.09	6. 1	9113
*	2005	17	17.90	0.09	7.4	11360
7		18	19.69	0.09	8.8	14097
•	2006		21.59	0.10	10.3	17419
	2007	19	E1. J3	0.10		
			18-kio	Inches	Joints	Feet
			millions		per mile	per mile

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

# SUMMARY:

Joint faulting on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Transverse cracking of the PCC overlay is predicted to equal or exceed an unacceptable level of 800 feet per mile in 1995.

. ?

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING UNBONDED PCC OVERLAY

YEAR	AGE	CUMULATIVE ESALs	JOINT FAULTING	JOINT DETERIORATION	TRANSVERSE CRACKING
1988	Ø	Ø. ØØ	0.00	0.0	• 0
1989	1	0.60	0.02	Ø. Ø	46
1990	2	1.24	0.03	0.0	<b>6</b> 6
1991	3	1.93	0.04	Ø. Ø	83
1992	4	2.66	0.04	Ø. 1	100
1993	5	3.43	0.05	0.2	116
1994	6	4.26	0.05	Ø <b>.</b> 3	1 33
1995	7	5.14	0.05	Ø <b>.</b> 5	152
1996	8	6.09	0.06	0.7	173
1997	9	7.09	0.06	1.1	197
1998	10	8.16	0.06	1.5	224
1999	11	9.30	0.07	2.Ø	257
2000	12	10.51	0.07	2.6	2 <b>95</b>
2001	13	11.81	0.08	3.3	340
2002	14	13.19	0.08	4. 1	393
2003	15	14.66	0.08	5.0	457
2004	16	16.23	0.09	6. 1	534
2005	17	17.90	0.09	7.4	625
2006	18	19.69	0.09	8.8	734
2007	19	21.59	0.10	10.3	864
		18-kio	Inches	Joints	Feet
		millions		per mile	per mile

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

#### SUMMARY:

Joint faulting on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Transverse cracking of the PCC overlay is predicted to equal or exceed an unacceptable level of 800 feet per mile in 2007.

# PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING UNBONDED POO OVERLAY

	YEAR	AGE	CUMULATIVE ESALs	JOINT FAULTING	JOINT DETERIORATION	TRANSVERSE CRACKING
	1000	Ø	Ø. ØØ	0.00	Ø. Ø	
	1988	1	0.60	0.02	Ø. Ø	44
	1989		1.24	0.03	Ø. Ø	63
	1992	2 3	1.93	0.04	Ø. Ø	79
	1991	4	2.66	0.04	Ø. 1	95
	1992	5	3.43	0.05	Ø. 2	110
	1993	6	4.26	0.05	Ø.3	126
	1994	7	5.14	0.05	0.5	144
	1995	É	6.09	0.06	Ø. 7	163
	1996	9	7.09	0.06	1.1	185
2.00 2.00 2.00	1997 1998	10	8.16	0.06	1.5	210
	1999	11	9.30	0.07	- 2 <b>.0</b>	240
3	<b>500</b> 0	12	10.51	0.07	2.6	274
Series .	2000	13	11.81	0.08	3.3	315
*		14	13.19	0.08	4.1	363
The state of the s	2002	15	14.65	0.08	5.0	421
=	2003 2004	16	16.23	0.09	6.1	489
*		17	17.90	0.09	7.4	571
- <b>3</b> 7. - ₹	2005	18	19.69	0.09	8.8	668
	<b>2006</b> 2027	19	21.59	0.10	10.3	785
•			10-1:5-	Inches	Joints	Feet
4			18-kip millions	11101162	per mile	per mile
<b>X</b>			millions		<b>52</b>	•

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

# SUMMARY:

Joint faulting on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Transverse cracking of the PCC overlay is not predicted to reach an unacceptable level within the next twenty years.

عجاد المداولي موالي والك

# PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING UNBONDED PCC OVERLAY

	YEAR	AGE	CUMULATIVE	JOINT	JCINT	TRANSVERSE
			ESALs	FAULTING	DETERIORATION	CRACKING
	4 0 0 0		Ø. ØØ	0.00	Ø. Ø	: 1:: ::::::::: <b>::</b>
	1988	0				******
	1989	1	0.60	0.02	Ø. Ø	, - <del>-</del>
	1990	2	1.24	0.02	0.0	66
	1991	3	1.93	Ø. Ø3	Ø. Ø	83
	1992	4	2.66	0.03	Ø. 1	100
	1993	5	<b>3.</b> 43	0.03	0.2	116
	1994	6	4.26	Ø. Ø4	Ø. 3	133
	1995	7	5.14	0.04	0.5	152
	1996	8	6.09	Ø. Ø4	Ø.7	173
	1997	9	7.09	0.04	1.1	197
<b>4.</b>	1998	10	8.16	0.05	1.5	224
*	1999	11	9.30	0.05	2.0	257
200	2000	12	10.51	0.05	2.6	295
Z	2001	13	11.81	0.05	3.3	340
	2002	14	13.19	0.06	4. 1	393
4	2003	15	14.66	0.06	5.0	457
* -	2004	16	16.23	0.06	6.1	534
	2005	17	17.90	0.06	7.4	625
- L	2006	18	19.69	0.07	8.8	734
	2007	19	21.59	0.07	10.3	864
			18-kip	Inches	Joints	Feet
			millions		per mile	per mile

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

# SUMMARY:

Joint faulting on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Transverse cracking of the PCC overlay is predicted to equal or exceed an unacceptable level of 800 feet per mile in 2007.



# PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING UNBONDED PCC OVERLAY

	YEAR	AGE	CUMULATIVE ESALs	JOINT FAULTING	JOINT DETERIORATION	TRANSVERSE CRACKING
	4668	(3)	0.00	0.00	0.0	ø
	1988	Ø	Ø.60	0.02	0.0	44
	1989	1		0.02	0.0	63
	1990	2	1.24		v. 0	79
	1991	3	1.93	0.03		95
	1992	4	2.66	0.03	0.1	110
	1993	5	3.43	0.03	0.2	
	1994	E	4.26	0.04	0.3	126
	1995	7	5.14	0.04	0.5	144
	1996	8	6.09	0.04	0.7	163
	1997	9	7.09	0.04	1.1	185
<u></u>	1998	10	8.16	0.05	1.5	210
**************************************	1999	11	9.30	0.05	2.0	240
-42-5	2000	12	10.51	0.05	2.6	274
-	2001	13	11.81	0.05	3 <b>. 3</b>	315
2.7	2002	14	13.19	0.06	4. 1	363
<b></b> .	2003	15	14.66	0.06	5.0	421
		16	16.23	0.06	6.1	489
1	2004		17.90	0.06	7. 4	571
-	2005	17		0.07	8.8	668
	2006	18	19.69		10.3	785
i.	2007	19	21.59	0.07	10.0	, 00
2				<b>9 .</b>	Taimta	Feet
-			18-kip	Inches	Joints	
.7"			millions		per mile	per mile

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

# SUMMARY:

Joint faulting on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Transverse cracking of the PCC overlay is not predicted to reach an unacceptable level within the next twenty years.

			Page
C7.	Reconstr	uct Both Lanes	
	No Do	owels, Stabilized Base	
	C7.1	12" PCC	189
	C7.2	18" PCC	190
	No Do	owels, Granular Base	
	C7.3	12" PCC	191
	<i>C/1</i> 84 D	OotelsPS@bilized.Base	192
	C7.5	12" PCC	193
	C7.6	18" PCC	194
	7/8" Г	Dowels, Granular Base	
	Ċ7.7	12" PCC	195
	C7.8	18" PCC	196

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING RECONSTRUCTION

	YEAR	AGE	CUMULATIVE ESALs	JOINT FAULTING	TRANSVERSE CRACKING	JOINT DETERIORATIO		PSR
	1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 2001 2002 2004 2005 2006 2007	0123456789011231456789	0.00 0.60 1.24 1.93 2.66 3.43 4.26 5.14 6.09 7.09 8.16 9.30 10.51 11.81 13.19 14.66 16.23 17.90 19.69 21.59	0.00 0.07 0.08 0.09 0.10 0.10 0.10 0.11 0.11 0.11 0.11	0 23 34 42 50 57 64 71 79 87 96 106 116 128 142 157 175 195 219 246	Ø. Ø	0.9 1.4 1.7 1.9 2.4 2.6 2.9 3.0 3.0 3.0 3.0	4.5974183.3.3.3.2.2.0.6.1 0.1.0.6.2.9.6.4 -1.0.6.2.9.6.4.2.5.2
Section 18	2001		18-kip millions	Inches	feet per mile	Joints per mile	0 = none 1 = low 2 = mediu 3 = high	Ø-5

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

# SUMMARY:

Joint faulting on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 0.13 inches per mile in 2007.

Transverse cracking of the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Pumping on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 1.0 in 1990.

PSR on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 3.00 in 1993.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING RECONSTRUCTION

					T001/01/5005	TOTAL	DIMOTNO	PSR
	YEAR	AGE	CUMULATIVE	JOINT	TRANSVERSE	JOINT	PUMPING	PSK
			ESALs	FAULTING	CRACKING	DETERIORATI	DN	
							A STATE OF THE STA	
	1988	Ø	0.00	Ø. ØØ	Ø	0.0	0.0	4.5
	1989	1	0.60	0.0E	3	0.0	0.6	4.3
	1990	ē	1.24	0.07	4	0.0	0.8	4.2
	1991	3	1.93	0.07	5	0.0	1.0	4.0
	1992	4	2.66	0.08	E	0.1	1.1	3.7
	1993	5	3.43	0.08	6	0.2	1.2	3.5
	1994	6	4.26	0.08	7	0.3	1.4	3.1
		7	5.14	0.08	ė	0.5	1.5	2.8
	1995	é	6.09	0.09	9	0.7	1.6	2.4
	1996			0.09	ģ	1.1	1.7	2.0
	1997	9	7.09		10	1.5	1.8	1.5
*	1998	10	8.16	0.09				1.0
Agencies	1999	11	9.30	0.09	11	2.0	1.9	
**	2000	12	10.51	0.09	11	2. <b>6</b>	2.1	0.5
نخ <del>ننڌ</del> . ان	2001	13	11.81	0.09	12	3.3	2.2	-0.0
	2002	14	13.19	0.10	13	4.1	2.3	-0.6
	2003	15	14.66	0.10	14	5.0		-1.2
	2004	16	16.23	0.10	14	6. 1	2.5	-1.9
	2005	17	17.90	0.10	15	7.4	2.6	-2.6
-	2006	18	19.69	0.10	16	8.8	2.7	-3.3
	2007	19	21.59	0.10	17	10.3	2.8	-4.1
	2001	•						
-			18-kip	Inches	feet	Joints	0 = none	0-5
6.			millions		per mile	per mile	1 = low	
•					•	•	2 = mediu	m
_							3 = high	
-								

.NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

#### SUMMARY:

Joint faulting on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Transverse cracking of the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Rumping on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 1.0 in 1991.

PSR on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 3.00 in 1995.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING RECONSTRUCTION

	YEAR	AGE	CUMULATIVE	JOINT	TRANSVERSE	JOINT	PUMPING	PSR
	TEHN	HUL	ESALS	FAULTING	CRACKING	DETERIORATION		
							e de la companya de l	
	1988	Ø	0.00	Ø. ØØ	Ø	0.0	0.0	4.5
	1989	1	0.60	0.10	23	0.0	0.9	3.9
	1990	ė	1.24	0.11	34	0.0	1.2	3.7
	1991	3	1.93	0.12	42	0.0	1.4	3.4
	1992	4	2.66	0.13	50	0.1	1.7	3.1
	1993	5	3.43	0.13	57	0.2	1.9	2.8
	1994	6	4.26	0.13	64	Ø. 3	2.0	2.4
	1995	7	5.14	0.14	71	0.5	2.2	2.0
	1996	é	6.09	0.14	79	Ø.7	2.4	1.6
	1997	9	7.09	0.14	87	1.1	2.6	1.1
::	1998	10	8.16	0.15	96	1.5	2.7	0.6
	1999	11	9.30	0.15	106	2.0	2.9	0.1
	2000	12	10.51	0.15	116	2.6	3.0	-0.4
	2001	13	11.81	0.16	128	3.3	3.0	-1.0
	2002	14	13.19	0.16	142	4. 1	3.0	-1.6
	2003	15	14.66	0.16	157	5.0	3.0	-2.2
	2004	16	16.23	0.16	175	6.1	3.0	-2.9
140 140 140	2005	17	17.90	0.17	195	7.4	3.0	-3.6
3	2006	18	19.69	0.17	219	8.8	3.0	-4.4
	2007	19	21.59	0.17	246	10.3	3.0	-5.2
•	2007	13						
			18-kip	Inches	feet	Joints	0 = none	0-5
			millions	222	per mile	per mile	1 = low	
			militations		F-:	•	2 = mediu	TLU
di di							3 = high	

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

#### SUMMARY:

Joint faulting on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 0.13 inches per mile in 1992.

Transverse cracking of the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Pumping on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 1.0 in 1990.

PSR on the reconstructed pavement in lane 1 is precipted to equal or exceed an unacceptable level of 3.00 in 1993.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING RECONSTRUCTION

	YEAR	AGE	CUMULATIVE ESALs	JOINT FAULTING	TRANSVERSE CRACKING	JOINT DETERIORATI <b>ON</b>	PUMPING	PSR
			COMES	. HOLITIGO	SKI ISKI I I I			
	. 200		ଡ. ଡଡ	0.00	Ø	Ø. Ø	0.0	4.5
	:388	<b>2</b> 1			3	0.0	0.6	4.3
	1989	1	Ø. EØ	Ø. Ø9		Ø. Ø	0.8	4.2
	1990	2	1.24	0.10	4			
	1991	3	1.93	Ø. 10	5	0.0	1.0	4.0
	1992	4	2.66	0.11	E	<b>6.</b> 1	1.1	3.7
	1993	5	3.43	0.11	6	<b>0.</b> 2	1.2	3.5
	1994	6	4.26	0.12	7	<b>0.</b> 3	1.4	3.1
	1995	7	5.14	0.12	8	Ø <b>.</b> 5	1.5	2.8
	1996	8	6.09	0.12	9	Ø. 7	1.6	2.4
	1997	9	7.09	0.13	9	1.1	1.7	2.0
	1998	10	8.16	0.13	10	1.5	1.8	1.5
<del>9</del>	1999	11	9.30	0.13	11	2.0	1.9	1.0
-	5000	12	10.51	0.13	11	2.6	2.1	0.5
			11.81	0.13	12	3.3	2.2	-0.0
	2001	13		0.14	13	4. 1	2.3	-0.6
	2002	14	13.19		14	5.0	2.4	-1.2
	2003	15	14.66	0.14			2.5	-1.9
<u> </u>	2004	16	16.23	0.14	14	6.1		-2.6
-	2005	17	17.90	0.14	15	7.4	2.6	
-	2006	18	19.69	0.15	16	8.8	2.7	-3.3
	2007	19	21.59	0.15	17	10.3	2.8	-4.1
•			18-kip	Inches	feet	Joints	0 = none	0-5
			millions		per mile	per mile	1 = low	
			militions		P=:		2 = mediu	ım
							3 = high	
***								

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

### SUMMARY:

Joint faulting on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 0.13 inches per mile in 1997.

Transverse cracking of the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Pumping on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 1.0 in 1991.

DSR on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of  $3.00\,$  in 1995.

# PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING RECONSTRUCTION

	YEAR	AGE	CUMULATIVE ESALs	JOINT FAULTING	TRANSVERSE CRACKING	JOINT DETERIORATIO	PUMPING N	PSR
	YEAR 1988 1990 1991 1992 1993 1995 1996 1998 1999 2001 2004 2006 2007	AGE 012345678901123456789					N	4.3.7.4.1.8.4.0.6.1.6.1.4.0.6.2.9.6.4.2.1.0.0.0.1.4.0.6.2.9.6.4.2.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0
· · · · · · · · · · · · · · · · · · ·			18-kip millions	Inches	feet per mile	Joints per mile	0 = none 1 = low 2 = medic 3 = high	0-5 um

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

#### SUMMARY:

Joint faulting on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Transverse cracking of the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Pumping on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 1.0 in 1990.

PSR on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 3.00 in 1993.

# PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING RECONSTRUCTION

	YEAR	AGE	CUMULATIVE	JOINT	TRANSVERSE	JOINT	PUMPING	PSR
			ESALs	FAULTING	CRACKING	DETERIORATION		
		-	2 22	2 22		0.0		4.5
	1988	Ø	0.00	0.00	0	<del></del> -		
	1989	1	ଡ. ଡେ	2. <b>0</b> 4	3	0.0	()	4.3
	:992	2	1.24	Ø. <b>Ø</b> 4	4	0.0	0.0	4.2
	1991	3	1.93	0.04	5	۵.0	1.0	4.12
	1992	4	2.66	0.05	٤	Ø. 1	1.1	3.7
	1993	5	3.43	0.05	6	0.2	1.2	3.5
	1994	6	4.26	0.05	7	0.3	1.4	3.1
	1995	7	5.14	0.05	8	0.5	1.5	2.8
	1996	8	6.09	0.05	9	0.7	1.6	2.4
	1997	9	7.09	0.05	9	1.1	1.7	2.0
	1998	10	8.16	0.05	10	1.5	1.8	1.5
	1999	11	9.30	0.06	11	2.0	1.9	1.0
<b>E</b> 4.	2000	12	10.51	0.06	11	2.6	2.1	0.5
und.	2001	13	11.81	0.06	12	3.3	2.2	-0.0
	2002	14	13.19	0.06	13	4.1	2.3	-0.6
	2003	15	14.66	0.0E	14	5.0	2.4	-1.2
, .	2004	16	16.23	0.06	14	6.1	2.5	-1.3
3	2005	17	17.90	0.06	15	7.4	2.6	-2.6
₹- ¥	2006	18	19.69	0.06	16	8.8	2.7	-3.3
••	2007	19	21.59	0.06	17	10.3	2.8	-4.1
			18-kip	Inches	feet	Joints	0 = none	Ø-5
•			millions		per mile	per mile	1 = low	
							2 = mediu	เรด
							3 = high	

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

# ESUMMARY:

Joint faulting on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Transverse cracking of the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Pumping on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 1.0 in 1991.

PSR on the reconstructed pavement in lame 1 is predicted to equal or exceed an unacceptable level of 3.00 in 1995.

The state of the s

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING RECONSTRUCTION

		005	CUMULATIVE	JOINT	TRANSVERSE	JOINT -	PUMPING	PSR
	YEAR	AGE	ESALS	FAULTING	CRACKING	DETERIORATION	* 1	
			EDHLB	1 102 12110		•		
	4000	179	0.00	0.00	Ø	0.0	0.0	4.5
	1988	Ø	Ø. 60	0.08	23	0.0	0.9	3.9
	1989	1	1.24	0.03	34	0.0	1.2	3.7
	1990	2	1.93	0.09	42	0.0	1.4	3.4
	1991	3	2.66	0.10	50	Ø. 1	1.7	3.1
	1992	4	3.43	0.10	57	<b>0.</b> 2	1.9	2.8
	1993	5 6	4.26	0.10	64	0.3	2.0	2.4
	1994	7	5.14	0.11	71	0.5	2.2	2.0
	1995		6.09	0.11	79	Ø.7	2.4	1.6
	1996	8 9	7.09	0.11	87	1.1	2.6	1.1
	1997	10	8.16	0.11	96	1.5	2.7	0.6
	1998	11	9.30	0.11	106	2.0	2.9	0.1
	1999	12	10.51	0.12	116	2.6	3.0	-0.4
<b>5</b> 4 ·	2000	13	11.81	0.12	128	3.3	3.0	-1.0
	2001		13.19	0.12	142	4.1	3.0	-1.6
-	2002	14 15	14.66	0.12	157	5.0	3.0	-2.2
	2003		16.23	0.12	175	6.1	3.0	-2.9
	2004	16	17.90	0.13	195	7.4	3.0	-3.6
	2005	17	19.69	0.13	219	8.8	3.0	-4.4
	2006	18	21.59	0.13	246	10.3	3.0	-5.2
	2007	19	E1. UJ	0				
4			18-kip	Inches	feet	Joints	0 = none	0-5
•			millions	21,0,0	per mile	per mile	1 = low	
			MITITIONS		F	•	2 = mediu	ım
							3 = high	

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

# NOTE:

\*

Joint faulting on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 0.13 inches per mile in 2005.

Transverse cracking of the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Pumping on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 1.0 in 1990.

PSR on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 3.00 in 1993.

The State was

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING RECONSTRUCTION

					TRANSUEDCE	JOINT	PUMPING	PSR
	YEAR	AGE	CUMULATIVE	JOINT	TRANSVERSE		A STATE OF THE STA	-311
			ESALs	FAULTING	CRACKING	DETERIORATI	UN	
	:988	Ø	0.00	0.00	Ø	0.0	0.0	4.5
	1989	1	Ø. 6Ø	0.06	3	0.0	0.6	<b>4.</b> 3
	1990	ē	1.24	0.07	4	0.0	Ø. 8	4.2
	1991	3	1.93	0.08	5	0.0	1.0	4.0
	1992	4	2.66	0.08	6	0.1	1.1	3.7
	1993	5	3.43	0.08	6	0.2	1.2	3.5
	1994	6	4.26	0.08	7	0.3	1.4	3.1
	1995	7	5.14	0.09	8	0.5	1.5	2.8
	1996	8	6.09	0.09	9	0.7	1.6	2.4
	1997	9	7.09	0.09	. 9	1.1	1.7	2.0
	1998	10	8.16	0.09	10	1.5	1.8	1.5
-	1999	11	9. 30	0.09	. 11	2.0	1.9	1.0
3	2000	12	10.51	0.10	11	2.6	2.1	0.5
4	2001	13	11.81	0.10	12	3.3	2.2	-0.0
-25-	0000	14	13.19	0.10	13	4. 1	2.3	-0.6
-	2003	15	14.66	0.10	14	5.0	2.4	-1.2
1	2004	16	16.23	0.10	14	6. 1	2.5	-1.9
7	2005	17	17.90	0.10	15	7.4	2.6	-2.6
÷	2006	18	19.69	0.11	16	8.8	2.7	-3.3
•	2007	19	21.59	0.11	17	10.3	2.8	-4.1
300 44								
3			18-kip	Inches	feet	Joints	0 = none	0-5
**			millions		per mile	per mile	1 = low	
44.	17 • • •				•		2 = mediu	ım
							3 = high	
7								

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

## SUMMARY:

Joint faulting on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Transverse cracking of the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the reconstructed pavement in lane 1, is not predicted to reach an unacceptable level within the next twenty years.

Pumping on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 1.0 in 1991.

PSR on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 3.00 in 1995.

# APPENDIX D

# I-90 WEST (MP 61) SNOQUALMIE PASS EXPEAR OUTPUT

# APPENDIX D I-90 WEST (MP 61) SNOQUALAMIE PASS EXPEAR OUTPUT

D1.	Input Da withou	ta and Performance Predictions  t Rehabilitation	<u>Page</u> 200
D2			
D2.	Restorati	<u>on</u>	
	D2.1	Restore Both Lanes	222
	AC no	onstructural overlay	
	D2.2	1" AC	223
	D2.3	2" AC	224
D3.	AC Struc	ctural Overlay	
	D3.1	2" AC	225
	D3.2	4.2" AC	226
	D3.3	10" AC	227
D4.	AC Over	rlay with Crack and Seat	
	2.5 <b>'</b> X	2.5' pieces, 15 ton roller	
	D4.1	1.4" AC	228
	D4.2	1.5" AC	229
	D4.3		230
	6'X 5'	pieces, 15 ton roller	
	D4.4	1.4" AC	231
	D4.5	1.5" AC	232
	D4.6	4.2" AC	233
D5.	PCC Bor	nded Overlay	
	D5.1	3" PCC	234
	D5.2	5" PCC	235
	D5.3	7" PCC	236
	D5.4	12" PCC	237
	D5.5	24" PCC	238
D6.	PCC Un	bonded Overlay	
	No Do	owels, 15' joint spacing	
	D6.1	10.5" PCC	
	D6.2	10.6" PCC	
	No Do	owels, 13' joint spacing	
	D6.3	10.5" PCC	241
	D6.4	10.6" PC	242

# APPENDIX D I-90 WEST (MP 61) SNOQUALAMIE PASS EXPEAR OUTPUT (continued)

			<u>Page</u>
	No Do	wels, 10' joint spacing	
	D6.5	10.5" PCC	243
		10.6" PCC	
D7.	Reconstr	uction	
	No Do	wels, 15' joint spacing, stabilized base, 650 psi PCC mod	ulus of rupture
		12" PCC	
		18" PCC	
	No Do	wels, 15' joint spacing, stabilized base, 750 psi PCC mod	ulus of rupture
		12" PCC	
		18" PCC	
	7/8" D	owels, 15' joint spacing, stabilized base, 650 psi PCC mo	dulus of rupture
		12" PCC	
	D7.6	18" PCC	250
	7/8" D	owels, 15' joint spacing, stabilized base, 750 psi PCC mo	dulus of rupture
		12" PCC	
		18" PCC	
	No Do	wels, 15' joint spacing, granular base, 750 psi PCC modu	llus of rupture
		12" PCC	
		18" PCC	

D1.	Input Data and Performance Predictions	Page
	without Rehabilitation	

# EXPEAR 1.1

# PROJECT EVALUATION AND REHABILITATION RECOMENDATIONS

# FOR: snosub

- 1. Project Summary
- 2. Current Evaluation
- 3. Physical Testing Recommendations
- 4. Future Distress Predictions

# Project Survey Summary For JRCP

Date of survey: 08/26/88 Design engineer: Holly Simmons PROJECT IDENTIFICATION I-90 Highway designation: Washington State: Direction of survey: West Starting milepost: 61.01 Ending milepost: Number of sample units: 1 CLIMATE Climatic zone: wet freeze-thaw Estimated annual temperature range (F): 49.5 Mean annual precipitation (inches): 107.6 Corps of Engineers freezing index (Fahrenheit degree-days): 937.0 Average Annual Temperature (degrees Fahrenheit): 41.80 SLAB CONSTRUCTION Year constructed: 1959 Slab thickness (inches): 9.0 Width of traffic lanes (feet): 12.00 Concrete 28-day modulus of rupture (psi): 650.00 TRANSVERSE AND LONGITUDINAL JOINTS Pattern of joint spacing: uniform Transverse joint spacing if uniform (feet): 15.0 Transverse joint sequence if random (feet): Type of sealant: liquid Average transverse joint reservoir dimensions: width (inches): 0.19 depth (inches): 1.50 Method used to form transverse joints: sawing Transverse joint sawed depth (inches): 1.5 Type of load transfer system: aggregate interlock Dowel bar diameter (inches): 0.00 Method used to form longitudinal joints between lanes: sawing Longitudinal joint sawed or formed depth (inches): 2.3 BASE Base type: open-graded drainage layer Modulus of subgrade reaction (psi/inch): 200.00 SUBGRADE Predominant subgrade soil AASHTO classification: A1

Are swelling soils a problem in area: no

Were steps taken to prevent the swelling soils problem: n/a

7

SHOULDER

Type of shoulder: AC

width of shoulders (feet): inner: 4.0 outer: 10.0

Inner lane slope direction: toward inner shoulder

TRAFFIC

Estimated current through two-way ADT: 17300

Percent commercial trucks: 19.0

Total number of lanes in direction of survey: 2

Future 18-kip ESAL growth rate (percent per year): 6.6

Truck traffic volume growth rate: approximately same as in past

Total accumulate	ed 18-kip ESAL	(millions):	Lane two 0.82	Lane one 8.19
RIDE QUALITY PSR			2.5	2.5

	DANGIE WILL HOWEN .	milepost: 6	1.0
	earth of sample unit (feet): 60.0	ane two	Lane one
	<del></del>		0
	Number of deteriorated transverse cracks, L-M-H:	0	Ø. ØØ
	Mean faultino at transverse cracks (inches):	0.00	
	Number of deteriorated transverse joints:	0	2
	Mean faulting at transverse joints (inches):	0.00	Ø. 13
	Number of transverse joints:	4	4
	Number of FDRS & slab replacements:	0	0
	Mean faulting at FDR & slab repl. jnts (inches):	Ø. ØØ	Ø. ØØ
	Number of FDR & slab replacement joints:	0	Ø
	Number of corner breaks:	0	Ø
	Length of long. cracking, M-H only (feet):	0.0	0.0
	Length of spalling of longit. Joint, M-H only:		Ø. Ø
	Length of spalling of longit. Joint, Art only.		
	TOTAL		
-	CRACKING AT TRANSVERSE JOINTS	Ø	0
	Total joints with trans. cracks within 2 feet:	•	
. 11			
7.	FOUNDATION MOVEMENT	Ø	Ø
	Number of settlements (M-H severity):	Ø	ø
	Number of heaves (M-H severity):	v	•
``````````````````````````````````````	Are longitudinal subdrains present and functional What is the typical height of the pavement above Do ditches have standing water or cattails in the	tue dirculi	ne: 5.0
	LOSS OF SUPPORT Extent of evidence of pumping or water bleeding:	none	none
	SURFACE CONDITION		
	Method used to texture the pavement at construct:	ion: other	
	Is the surface polished in the wheelpaths:	yes	yes
•	Is significant tire rutting in the wheelpaths:	no	no
÷	Is significant tire factoring and the		•
	JOINT SEALANT CONDITION		
Ξ.	Condition of the transverse joint sealant:	high	high
	Condition of the longitudinal joint sealant:	_	high
	Are substantial amnts of incompressibles in jnts	: yes	yes
	Are substantial amints of incompletions	•	
	SOMOPETE DUDOBILITY		
	CONCRETE DURABILITY  Extent of "D" cracking at joints or cracks:	none	none
	Extent of "D" chacking at joints of chacks.	none	none
	Extent of reactive aggregate distress:	none	none
	Extent of scaling:		
	TOTAL PERMIT	•	
	PREVIOUS REPAIR	no	no
	Are full-depth repairs placed with dowels:		no
	Are partial depth repairs present at most joints		yes
	Has diamond grinding been done:	yes	no
	Has grooving been done:	rio .	

Outer

none

none

rione

none

some

rione

good

Inner

	Alligator cracking:	none
	Linear Cracking:	none
	Weathering/ravelling:	none 🧓
	Lane/shoulder joint dropoff:	none
	Settlements or heaves along outer edge:	none
	Blowholes at transverse joints:	none
	Lane/Shoulder joint condition:	good
ē.		

AC SHOULDERS

# Extrapolated (Per Mile) Values For snosub

	Lane two	Lane one
Number of deteriorated transverse cracks:	Ø	Ø
Mean faulting at deter. trans. cracks (inches)	: 0.00	0.00
Number of deteriorated transverse joints:	Ø	176
Mean faulting at transverse joints (inches):	0.00	0.13
Number of transverse joints:	<b>35</b> 2	352
Number of full-depth repairs:	Ø	0
Mean faulting at FDR joints (inches):	0.00	0.00
Number of full-depth repair joints:	<b>Ø</b>	0
Number of corner breaks:	0	<b>@</b>
Length of long. cracking, M-H only (feet):	0.0	0.0
Length of spalling of longit. Joint, M-H only:		0.0
Total joints with trans. cracks within 2 feet:	Ø	<b>Ø</b>
Number of settlements (M-H severity):	Ø	0
Number of heaves (M-H severity):	Ø	0

# CURRENT PAVEMENT EVALUATION

**************************************
JOINT CONSTRUCTION DEFICIENCY:
The pavement in lane 1 shows no indications of a longitudinal joint construction deficiency.
a. do nothing
The pavement in lane 1 shows no indications of a transverse joint construction deficiency.
a. do nothing
JOINT SEALANT DEFICIENCY:
A transverse joint sealant deficiency is indicated in lane 1 by medium- to high-severity joint sealant damage and an inadequate joint sealant reservoir shape factor for the existing sealant type.
a. reseal transverse joints
ROUGHNESS:
Poor rideability in lane 1 is indicated by 55 or more deteriorated joints per mile and an unacceptably low PSR for the pavement's ADT level.
a. full-depth repair of joints
DURABILITY DEFICIENCY:
The pavement in lane 1 shows no indications of significant surface or concrete durability problems.
a. do nothing
JOINT DETERIORATION:
Joint deterioration or other pavement deterioration in lane 1 may be accelerated by water infiltration permitted by poor longitudinal
joint sealant condition.
a. reseal longitudinal centerline joint
Extensive joint deterioration exists ( 55 joints per mile) in lane 1, likely due poor joint sealant condition permitting infiltration of water and incompressibles.

a. full-depth repair of joints, reseal transverse joints

STRUCTURAL DEFICIENCY:

SKID RESISTANCE DEFICIENCY:

Loss of skid resistance in lane 1 is indicated by polished wheel paths.

- a. grinding
- b. grooving
- c. AC monstructural overlay

LOAD TRANSFER DEFICIENCY:

No load transfer deficiency is indicated at transverse joints in lane 1.

a. do nothing

A potential load transfer deficiency exists at undowelled full-depth repairs in lane 1, but mean full-depth repair faulting is not significant.

## a. do nothing

# FOUNDATION MOVEMENT:

 $^{\circ}$  A potential for frost heave is indicated by a mean Freezing Index greater than 0.

# a. do nothing

LOSS OF SUPPORT:

The pavement in the lane 1 shows no indications of loss of slab support.

.a. do nothing

#### DRAINAGE DEFICIENCY:

The pavement in lane 1 shows no indications of a drainage deficiency.

a. do nothing

	<u>.</u>
**************************************	e vieto is
**************************************	<b>***</b> *****
DINT CONSTRUCTION DEFICIENCY:	
he pavement in lane 2 shows no indications of a transverse onstruction deficiency.	joint
. do nothing	
DINT SEALANT DEFICIENCY:	
transverse joint sealant deficiency is indicated in lane of the high-severity joint sealant damage and an inadequate joi eservoir shape factor for the existing sealant type.	
. reseal transverse joints	
OUGHNESS:	
oor rideability in lane 2 is indicated by an unacceptably he pavement's ADT level.	low PSR for
. grinding . AC nonstructural overlay	
URABILITY DEFICIENCY:	
he pavement in lane 2 shows no indications of significant oncrete durability problems.	surface or
. do nothing	
DINT DETERIORATION:	
o joint deterioration <b>exists in lane 2.</b>	
. do nothing	
TRUCTURAL DEFICIENCY:	الله الله الله الله الله الله الله الله
KID RESISTANCE DEFICIENCY:	
oss of skid resistance in lane 2 is indicated by polished (aths.	wheel
. grinding . prooving	

No load transfer deficiency is indicated at transverse joints in lane 2.

a.	ے ہے	noth	inc
<b>a</b> .		1100	

A potential load transfer deficiency exists at undowelled full-depth repairs in lane 2, but mean full-depth repair faulting is not significant.

#### a. do nothing

FOUNDATION MOVEMENT:

A potential for frost heave is indicated by a mean Freezing Index greater than  $\boldsymbol{0}$ .

a. do nothing

LOSS OF SUPPORT:

The pavement in the lane 2 shows no indications of loss of slab support.

a. do nothing

DRAINAGE DEFICIENCY:

The pavement in lane 2 shows no indications of a drainage deficiency.

a. do nothing

The inner AC shoulder shows no indications of significant deterioration.

a. do nothing

<del>--</del>

11.

The outer AC shoulder shows no indications of significant deterioration.

a. do nothing

PHYSICAL TESTING RECOMMENDATIONS	
NONDESTRUCTIVE DEFLECTION TESTING	STREET STREET
The pavement coes not have any deficiencies warranting	nondestructive
deflection testing.	er er e <del>r regita</del> .

DESTRUCTIVE DEFLECTION TESTING

	MATERIALS	EVALUATION	
--	-----------	------------	--

No laboratory testing or other inspection of material samples is warranted.

\_\_\_\_\_ SKID TESTING -----

Physical testing is recommended to further investigate and quantify the causes of poor skid resistance observed in the preliminary evaluation. The following types of testing are recommended:

Measure the skid resistance of the pavement with either a ribbed tire (ASTM E 501) or a bald tire (ASTM E 524) mounted on a locked-wheel skid trailer. Testing with both types of tires is preferred in order to obtain good estimates of both the macrotexture and microtexture of the pavement surface. If only one type of tire can be used, the bald tire is recommended. Measure skid resistance with the skid trailer over a section of pavement at least 1500 feet long (approximately 0.3 mile) within each mile of the project to obtain an estimate of the overall skid resistance of the pavement surface.

Roughness testing is recommended in each traffic lane to **verify** that the pavement is excessively rough and to determine the cause **of the** roughness. Roughness testing should be performed over the entire length of the pavement and the roughness measured at each 0.1 mile segment.

Test the pavement with roughness equipment capable of producing either a response-type measurement of the pavement's roughness (e.g., Mays Meter) or a profile measurement device. Compare the measured roughness to your agency's standard for an acceptable level of roughness. Prepare a profile of the roughness index along the project for each traffic lane to identify points of significant roughness that need special attention.

小学生 大学 のまでいまではなってん

#### FUTURE DISTRESS PREDICTIONS

## DISTRESS AND PSR PROJECTIONS FOR LANE 1 - ---

Cumulative ESAL	Annual ESAL	Year	Pumping	Faulting	Deter. Joints	Transverse Cracking	PSR
8.2	Ø.56	1988	0.0	0.13	176	0	2.5
8.8	0.60	1989	1.0	<b>0.</b> 13	180	85	0.0
9.4	0.54	1990	1.1	0.13	184	182	0.0
10.1	Ø. 68	1991	1.2	Ø.13	189	2 <b>9</b> 6	0.0
10.8	Ø.73	1992	1.4	0.13	194	427	Ø. Ø
11.6	Ø.78	1993	1.5	Ø. 14	199	579	0.0
12.5	Ø. 83	1994	1.6	0.14	205	756	0.0
13.3	ø. 88	1995	1.8	0.14	211	962	0.0
14.3	Ø. 94	1996	1.9	0.14	217	1201	0.0
15.3	1.00	1997	2.1	Ø. 14	223	1480	0.0
16.3	1.07	1998	2.2	0.15	230	1804	0.0
17.5	1.14	1999	2.4	0.15	238	2183	0.0
18.7	1.22	2000	2.6	0.15	246	2624	0.0
20.0	1.30	2001	2.7	0.15	254	31 <b>3</b> 9	0.0
21.4	1.38	2002	2.9	0.15	262	3739	0.0
22.9	1.47	2003	3.0	0.15	271	4440	Ø. Ø
24.4	1.57	2004	3.0	0.16	280	5259	0.0
26.1	1.67	2005	3.0	0.16	290	6214	Ø. Ø
27.9	1.78	2006	3.0	<b>0.</b> 16	300	7330	0.0
29.8	1.90	2007	3.0	0.16	311	8632	0.0
27.0	1. 50						
18-kip	18-kip		0 = none	Inches	Joints	Feet	0-5
millions	millions		1 = low		per	per	
			2 = mediu	m	mile	mile	
			3 = high				

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

• •

#### FUTURE DISTRESS PREDICTIONS

## DISTRESS AND PSR PROJECTIONS FOR LANE 2

Dumulative ESAL	Annual ESAL	Year	Pumping	Faulting	Deter. Joints	Transverse Cracking	PS
Ø. 8	Ø. 13	1988	0.0	0.00	ø	Ø	2.
1.0	0.13	1989	Ø. 1	0.00	4	9	2.
1.1	Ø. 14	1990	0.2	0.01	8	19	2.
i. a	0.15	1991	0.3	0.01	13	29	1.
1.4	0.16	1992	0.4	0.01	18	39	1.
1.6	0.17	1993	0.5	0.01	23	50	1.
1.8	0.18	1994	0.6	0.01	29	61	1.
2.0	0.20	1995	0.7	0.02	35	72	1.
2.2	0.21	1996	0.8	0.02	41	85	ø.
2.4	0.22	1997	0.8	0.02	47	98	0.
2.6	0.24	1998	0.9	0.02	54	113	0.
2.9	ø. 25	1999	1.0	0.02	62	128	0.
3.2	0.27	2000	1.1	<b>0.</b> 03	70	145	0.
3.4	0.29	2001	1.2	0.03	78	164	0.
3.8	0.31	2002	1.3	0.03	86	185	Ø.:
4.1	Ø. 33	2003	1.4	0.03	95	209	0.1
4.4	Ø.35	2004	1.5	0.03	104	. 235	0
4.8	Ø.37	2005	1.7	0.03	114	264	0.
5.2	0.40	2006	1.8	0.04	124	298	0.
5.6	0.42	2007	1.9	0.04	135	335	<b>0.</b> (
18-kip	18-kip		0 = none	Inches	Joints	Feet	<b>0</b> -:
millions	millions		1 = low		per	per	
			2 = mediu 3 = high	m	mile	mile	
						,	

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

## FUTURE PAVEMENT EVALUATION

**************************************
ROUGHNESS:
Poor rideability in lane 1 occurs in 1988 as indicated by an unacceptably low predicted PSR for the pavement's ADT level.
a. grinding b. AC nonstructural overlay
JOINT DETERIORATION:
Significant joint deterioration in lane 1 occurs in 1988 as indicated by 55 or more deteriorated joints per mile.
a. full-depth repair at joints
STRUCTURAL DEFICIENCY:
Structural deficiency of the pavement in lane 1 occurs in 1995 as indicated by 800 feet or more of deteriorated transverse cracks per mile.
a. full-depth repair of cracks, AC structural overlay b. full-depth repair of cracks, crack and seat and AC structural overlay c. full-depth repair of cracks, PCC bonded overlay d. full-depth repair of cracks, PCC unbonded overlay e. reconstruct
LOAD TRANSFER DEFICIENCY:
Inadequate load transfer at transverse joints in lane 1 occurs in 1988 as indicated by predicted faulting of 0.13 inches or more.
a. load transfer restoration at joints b. do nothing
LOSS OF SUPPORT:
Loss of slab support in lane 1 occurs in 1988 as indicated by predicted faulting greater than 0.13 inches at transverse joints.
a. subseal at joints and cracks
DRAINAGE DEFICIENCY:
A drainage deficiency in lane 1 occurs in 1989 as indicated by predicted pumping reaching the low severity level.

b. install or repair longitudinal subdrains, seal all joints and cracks

a. install or repair longitudinal subdrains

-4 <del>(j.</del>

**************************************
ROUGHNESS:
Poor rideability in lane 2 occurs in 1988 as indicated by an unacceptably low predicted PSR for the pavement's ADT level.
a. grinding b. AC nonstructural overlay
JOINT DETERIORATION:
Significant joint deterioration in lane 2 occurs in 1999 as indicated by 55 or more deteriorated joints per mile.
a. full-depth repair at joints
STRUCTURAL DEFICIENCY:
No structural deficiency in lane 2 occurs based on predicted transverse cracking over the next 20 years.
LOAD TRANSFER DEFICIENCY:
No load transfer deficiency at transverse joints in lane 2 occurs based on predicted joint faulting over the next 20 years.
LOSS OF SUPPORT:
No loss of slab support in lane 2 occurs based on predicted joint faulting over the next 20 years.
DRAINAGE DEFICIENCY:
A drainage deficiency in lane 2 occurs in 1999 as indicated by predicted pumping reaching the low severity level.
a. install or repair longitudinal subdrains b. install or repair longitudinal subdrains, seal all joints and cracks

			Page
D2.	Restora	<u>tion</u>	
	D2.1	Restore Both Lanes	 222
	AC n	onstructural overlay	222
	D2.2	1" AC	 223
	D2.3	2" AC	 224

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING RESTORATION

	YEAR	AGE	CUMULATIVE ESALs	JOINT FAULTING		TRANSVERSE CRACKING	DETERIOR		PSR
The second secon	101234587890123458 1012345878900000000000000000000000000000000000	2612	ESALS  8.19  8.79  9.42  10.85  11.62  12.45  13.38  15.28  15.39  18.70  20.38  22.85  24.49  27.88  18-kip  millions	FAULTING  0.00 0.00 0.00 0.00 0.00 0.00 0.10 0.11 0.11 0.11 0.12 0.13 0.14 0.15 Inches	FAULTING  Ø. Ø6  Ø. Ø6  Ø. Ø6  Ø. 10  Ø. 13  Ø. 15  Ø. 16  Ø. 22  Ø. 23  Ø. 25  Ø. 27  Ø. 33  Ø. 36  Ø. 38  Ø. 40  Inches	85 182 296 427 556 261 1280 1804 2183 2623 3739 4459 6233 8633 8633 862 7332	A CALL SUPPLY	0.9 1.4 2.4 2.0 2.0 2.0 2.0 2.0 3.0 3.0 3.0 3.0 3.0 3.0 3.0 3.0 3.0 3	433310987654310875300 
'. <b>d.</b> '.						mile	mile	2 = mediu 3 = high	វភ

# SUMMARY:

Joint faulting on the restored pavement in lane 1 is predicted to equal or exceed an unacceptable level of 0.13 inches in 2003.

Full-depth repair faulting on the restored pavement in lane 1 is predicted to equal or exceed an unacceptable level of 0.13 inches in 1993.

Chacking on the restored pavement in lane 1 is predicted to equal or exceed an unacceptable level of 800 feet per mile in 1995.

Joint deterioration on the restored pavement in lane 1 is predicted to equal or exceed an unacceptable level of 55 joints per mile in 1989.

Pamping on the restored pavement in lane 1 is credicted to equal or exceed an unacceptable level of 1.0 in 1990.

TSR on the restored pavement in lame 1 is predicted to equal or fall below an unacceptable level of 3.0 in 1989.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING AC NONSTRUCTURAL OVERLAY

			TOTAL	MEDIUM-HIGH	W .
YEAR	AGE	CUM	REFLECTIVE	REFLECTIVE	RUTTING
		ESALs	CRACKING	CRACKING .	4 -
1988	121	0.00	2	Ø	0.00
1989	1	Ø. EØ	2637	1711	<b>0.</b> 00
1990	2	1.24	2733	2249	0.00
1991	3	1.93	2791	2645	ହା. ହାଡ
1992	4	2.66	2834	2834	0.02
1993	5	3.43	2868	2868	0.05
1994	6	4.26	2896	2896	Ø. Ø8
1995	7	5.14	2 <b>9</b> 21	2921	Ø. 11
1996	8	6.09	2943	2943	Ø. 14
1997	9	7.09	2962	2962	Ø. 17
1998	10	8.16	2980	2980	ø. 20
1999	11	9.30	2996	2936	0.24
2000	12	10.51	3012	3012	Ø. 27
2001	13	11.81	3026	3026	<b>0.</b> 31
2002	14	13.19	3039	3039	ø. 35
2003	15	14.66	3052	3052	0.39
2004	16	16.23	3064	3064	Ø. 43
2005	17	17.90	3076	3076	Ø. 48
2006	18	19.69	3087	3087	<b>0.</b> 53
2007	19	21.59	3098	3098	Ø.58
		18-kip	Feet	Feet	Inches

## **Summary:**

E

Total relfective cracking of the AC overlay in lane 1 is appredicted to equal or exceed an unacceptable level of 3000 feet open mile in 2000.

Medium- to high-severity reflective cracking of the AC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 1500 feet per mile in 1989.

Rutting on the AC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 0.50 inches in 2006.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING AC NONSTRUCTURAL OVERLAY

	YEAR	AGE	CUM ESALs	TOTAL REFLECTIVE CRACKING	MEDIUM-HIGH REFLECTIVE CRACKING	RUTTING
	1988	Ø	0.00	Ø	<b>©</b>	0.00
	1989	1	0.60	2518		O. OO
	1990	2	1.24	2610	1942	ି ହାଇ
	1991	3	1.93	2666	2285	0.00
	1992	4	2.66	2706	25 <b>69</b>	0.00
	1993	5	3.43	2739	2739	0.00
	1994	6	4.26	2766	2766	0.00
	1995	7	5.14	2790	2790	0.00
	1996	8	6.09	2810	2810	0.01
	1997	9	7.09	2829	2829	0.04
in the second se	1998	10	8.16	2846	2846	0.08
The second secon	1999	11	9.30	2862	2862	0.11
7	2000	12	10.51	2876	2876	0.15
web	2001	13	11.81	2890	2890	0.18
7. U.S.	2002	14	13.19	2903	2903	Ø. 22
us .	2003	15	14.66	2915	2915	Ø. 26
	2004	16	16.23	2927	2927	Ø. 31
Ĉ.	2005	17	17.90	2938	2938	<b>0.</b> 35
••••••••••••	2006	18	19.69	2948	2948	0.40
Server	2007	19	21.59	2959	2959	Ø. 45
<del>-</del>			18-kip	Feet	Feet	Inches
			millions	per mile	per mile	

## Summary:

Total reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Medium- to high-severity reflective cracking of the AC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 1500 feet per mile in 1990.

			<u>Page</u>
D3.	AC Struc	ctural Overlay	
	D3 1	2" AC	225
	D3.2	4.2" AC	226
	D3.3	10" AC	227

•

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING AC OVERLAY

				TOTAL	MEDIUM-HIGH	
	YEAR	AGE	CUM	REFLECTIVE	REFLECTIVE:	RUTTING
			ESALS	CRACKING	CRACKING	in verse real
					iga." N	in 150 m Lindowan
	1986	iZi	Ø. ØØ	Ø	Ø	<b>0.0</b> 0
	1989	1	0.60	2518	1478	<b>. 0.0</b> 0
	1992	2	1.24	2610	1942	0.00
	199:	3	1.93	2666	2285	0.00
	1992	4	2.66	2706	2569	ଡ.ଡଡ
	1993	5	3.43	2739	2739	Ø. ØØ
	1994	6	4.26	2766	2766	0.00
	1995	7	5.14	2790	2790	0.00
	1996	8	6.09	2810	2810	0.01
	1997	9	7.09	2829	2829	0.04
3:	1998	10	8.16	2846	2846	0.08
2:	1999	11	9.30	2862	2862	0.11
在	2000	12	10.51	2876	2876	Ø. 15
	2001	13	11.81	2890	2890	0.18
差:	2002	14	13.19	2903	2903	ø. 22
	2003	15	14.66	2915	2915	<b>0.</b> 26
#	2004	16	16.23	2927	2927	0.31
7.	2005	17	17.90	2938	2938	<b>0.</b> 35
<del>-</del>	2006	18	19.69	2948	2948	0.40
	2007	19	21.59	2959	2959	0.45
<del>*</del>			18-kip	Feet	Feet	Inches
			millions	per mile	per mile	27

## Summary:

Total reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Medium- to high-severity reflective cracking of the AC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 1500 feet per mile in 1990.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING AC OVERLAY

YEAR	AGE	CUM ESALs	TOTAL REFLECTIVE CRACKING	MEDIUM-HIGH REFLECTIVE CRACKING	RUTTING
1988	21	Ø. ØØ	Ø	0	0.00
1989	1	Ø. 60	2396	1263	0.00
1990	Ē	1.24	2484	1660	Q. QQ
1991	3	1.93	2537	1953	v. 00
1992	4	2.66	2576	2195	0.00
1993	Ś	3.43	2607	2408	Ø. ØØ
1994	6	4.26	2633	2600	ଡ. ଡଡ
1995	7	5.14	2655	2655	0.00
1996	8	6.09	2675	2675	Ø. ØØ
1997	9	7.09	2693	2693	0.00
1998	10	8.16	2709	2709	0.02
1999	11	9.30	2724	2724	0.05
2000	12	10.51	2738	2738	0.09
2001	13	11.81	2751	2751	0.12
2002	14	13.19	2763	2763	0.16
2003	15	14.66	2775	2775	0.20
2003 2004	16	16.23	2786	2786	0.25
	17	17.90	2797	2797	Ø. 29
2005	18	19.69	2807	2807	0.34
2006	19	21.59	2817	2817	0.39
2007	13	E1. 02			
		18-kip	Feet	Feet	Inches
		millions	per mile	per mile	

#### Summary:

Total reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Medium- to high-severity reflective cracking of the AC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 1500 feet per mile in 1990.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING AC OVERLAY

				TOTAL	MEDIUM-HIGH	1
	YEAR	AGE	CUM	REFLECTIVE	REFLECTIVE.	RUTTING
			ESALs	CRACKING	CRACKING *	All contracts
					1.	-
	1988	2	0.00	2	Ø	0.02
	1989	1	0.60	2261	1051	<b>7. 0.0</b> 0
	1990	2	1.24	2344	1381	0.00
	1991	3	1.93	2394	1625	Ø. ØØ
	1992	4	2.66	2431	1827	0.00
	1993	5	3.43	2460	2004	0.00
	1994	6	4.26	2485	2164	0.00
	1995	7	5.14	2506	2311	Ø. ØØ
	1996	8	6.09	2525	2450	0.00
	1997	9	7.09	2542	2542	0.00
	1998	10	8.16	2557	2557	0.00
Ž,	1999	11	9.30	2571	2571	0.03
18V	2000	12	10.51	2584	2584	0.07
AP.	2001	13	11.81	2597	2597	0.11
100 44	2002	14	13.19	2608	2608	0.15
	2003	15	14.66	2619	2619	0.19
1	2004	16	16.23	2630	2630	Ø. 23
<u>.</u>	2005	17	17.90	2640	2640	<b>0.</b> 27
	2006	18	19.69	2650	2650	<b>0.</b> 32
•	2007	19	21.59	2659	2659	<b>0.</b> 37
			18-kip	Feet	Feet	Inches
			millions	per mile	per mile	*1161163
			MILLITONS	he: mrre	pe: mile	

#### Summary:

Total reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Medium- to high-severity reflective cracking of the AC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 1500 feet per mile in 1991.

	<u>Page</u>
erlay with Crack and Seat	
2.5' pieces, 15 ton roller	
1.4" AC	228
1.5" AC	229
4.2" AC	230
5' pieces, 15 ton roller	
1.4" AC	231
	1.5" AC

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING CRACK & SEAT

				TOTAL	MEDIUM-HIGH	
	YEAR	AGE	CUM	REFLECTIVE	REFLECTIVE	RUTTING
			ESALs	CRACKING	CRACKING	- migration
					بة. معر	
	1958	Ø	Ø. Ø&	Ø	Ø 🗓	0.00
	1989	i	Ø.6Ø	789	789 ·	0.00
	1990	2	1.24	799	799	0.00
	1991	3	1.93	807	8&7	0.00
	1992	4	2.66	816	816	2.02
	1993	5	3.43	824	824	Ø. ØØ
	1994	6	4.26	831	831	0.01
	1995	7	5.14	838	838	0.04
	1996	8	6.09	844	844	0.07
	1997	9	7.09	850	850	0.10
***	1998	10	8.16	<b>85</b> 5	855	0.13
	1999	11	9.30	859	859	0.17
-	2000	12	10.51	863	863	0.20
<u> </u>	2001	13	11.81	866	866	<b>0.</b> 24
	2002	14	13.19	868	868	Ø. 28
<u>.</u>	2003	15	14.66	869	869	<b>0.3</b> 2
ž.	2004	16	16.23	869	869	<b>0.</b> 36
# <b>.</b>	2005	17	17.90	869	869	Ø. 41
ž.	2006	18	19.69	867	867	<b>0.</b> 45
	2007	19	21.59	864	864	<b>0.</b> 50
<u>x</u>					<b>.</b> .	
			18-kip	Feet	Feet	Inches
			millions	per mile	per mile	

# Summary:

Total reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Medium- to high-severity reflective cracking of the AC overlay in lane i is not predicted to reach an unacceptable level within the next twenty years.

Rutting on the AC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 0.50 inches in 2007.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING CRACK & SEAT

		millions	per mile	per mile	
		18-kip	Feet	Feet	Inches
2007	19	21.59	864	864	W. #7
2006	18	19.69	867	867	Ø. 44 Ø. 49
2005	17	17.90	869	869	Ø. 39
2004	16	16.23	869	869	
2003	15	14.66	869	869	Ø. 35
2002	14	13.19	868	<b>86</b> 8	Ø. 31
2001	13	11.81	866	86E	Ø. 23 Ø. 27
2000	12	10.51	863	<b>86</b> 3	0.19 0.23
1999	11	9.30	859	8 <b>5</b> 9	Ø. 15
1998	10	8.16	855	<b>85</b> 5	0.12
1997	9	7.09	850	850	Ø. Ø9
1995	8	6.09	844	844	Ø. Ø5
1995	7	5.14	838	838	Ø. Ø2 8. Ø5
1994	6	4.26	831	831	Ø. ØØ
1993	5	3.43	824	824	Ø. ØØ
1992	4	2.66	816	816	0.00
1991		1.93	8 <b>0</b> 7	807	Ø. ØØ
1990	<u>2</u> 3	1.24	799	799	Ø. ØØ
1989	1	Ø.60	7 <b>8</b> 9	789	
:988	Ø	0.00	Ø	Ø .	2.00 2.00
		ESALs	CRACKING	CRACKING	e Mr.
YEAR	AGE	CUM	REFLECTIVE	REFLECTIVE	RUTTING
			TOTAL	MEDIUM-HIGH	

## Summary:

Total reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Medium- to high-severity reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING CRACK & SEAT

			millions	per mile	per mile	
÷			18-kip	Feet	Feet	Inches
	2007	19	21.59	864	864	Ø. 39
-	2୬୬୫	18	19.69	867	867	Ø. 34
	2005	17	17.90	869	869	Ø. 29
	<b>≘@</b> ∅4	16	16.23	869	869	0.25
	2003	15	14.66	869	869	0.20
	<b>2002</b>	14	13.19	868	868	<b>0.</b> 16
	2001	13	11.81	866	866	0.12
	2000	12	10.51	863	863	0.09
	1999	11	9.30	859	859	0.05
	1998	10	8.16	855	855	0.02
	1997	Э	7.09	850	850	0.00
	1996	8	6. <b>09</b>	844	844	ଡ. ଡଡ
	1995	7	5.14	838	838	0.00
	1994	6	4.26	831	831	ଡ. ଡଡ
	1993	5	3.43	824	824	0.00
	1992	4	2.66	816	816	0.00
	1991	3	1.93	807	807	0.00
	1992	2	1.24	799	799	0.00
	1989	1	Ø. 60	789	789	<b>0.0</b> 2
	1986	Ø	ଡ. ହେଉ	Ø	Ø -	0.00
			COMES	CRACKING	CHENTRO	<b>-</b> 1 ⋅ 1
	7 = H ~	HUE	ESALS	CRACKING	CRACKING	ROTTING
	YEAR	AGE	CUM	REFLECTIVE	REFLECTIVE	RUTTING
				TOTAL	MEDIUM-HIGH	

#### Summary:

Total reflective chacking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

medium- to high-severity reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING DRACK & SEAT

	YEAR	AGE	CUM ESALs	TOTAL REFLECTIVE CRACKING	MEDIUM-HIGH REFLECTIVE CRACKING	RUTTING
	1988	Ē	e.00	Ø	Ø	(j. 0.00
	1989	1	0.60	858	858	5 <b>0.0</b> 2
	1990	2	1.24	867	867	0.00
	1991	3	1.93	876	876	Ø. ØØ
	: 992	4	2. <b>6</b> 6	884	884	ଡ. ଡେଟ
	1993	5	3.43	892	892	0.00
	1994	6	4.26	899	899	0.01
	1995	7	5.14	906	906	<b>0.</b> 04
	: 996	8	6.09	913	913	Ø. Ø7
	1997	9	7.09	918	918	0.10
	1998	10	8.16	923	923	<b>0.</b> 13
Total Control	1999	11	9.30	928	928	0.17
***	2000	12	10.51	931	931	0.20
Separate Sep	2001	13	11.81	934	934	<b>0.</b> 24
	2002	14	13.19	936	936	0.28
Ties Order Andreas	2003	15	14.66	937	937	<b>0.</b> 32
TT.	<b>2004</b>	16	16.23	938	938	0.3E
·	2005	17	17.90	937	<b>9</b> 37	0.41
	2006	18	19.69	935	935	Ø. 45
	2007	19	21.59	932	932	0.50
<u></u>			18-kip	Feet	Feet	Inches
			millions	per mile	per mile	

## \_Summary:

Total reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Medium- to high-severity reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Rutting on the AC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 0.50 inches in 2007.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING CRACK & SEAT

			millions	per mile	per mile	
			18-kip	Feet	Feet	Inches
	2 <b>0</b> 07	19	21.59	932	932	Ø <b>.</b> 49
	2006	18	19.69	935	935	0.44
	2005	17	17.90	937	937	0.39
	<b>≘</b> ₹204	16	16.23	938	938	0.35
	2003	15	14.66	937	937	Ø. 31
	2002	14	13.19	936	936	Ø. 27
	2001	13	11.81	934	934	Ø. 23
1.	2000	12	10.51	931	931	0.19
	1999	11	9.30	928	928	0.15
	1998	10	8.16	923	923	0.12
	1997	9	7.09	918	918	0.09
	<b>:9</b> 96	8	6.09	913	913	0.05
	1955	7	5.14	906	906	0.02
	1994	£	4.26	899	899	0.00
	1993	5	3.43	892	892	0.00
	::992	4	2.66	884	884	ଡ.ଡଡ
	1551	3	1.93	876	876	Ø. ØØ
	: 990	2	1.≘4	867	867	2.22
	1589	1	0.60	858	858	0.00
	:988	Z.	ଡ.ଡଡ	Ø:	Ø	. <b>0.0</b> 0
			ESALs	CRACKING	CRACKING	****
	<b>マミニネ</b>	46E	CUM	REFLECTIVE	REFLECTI <b>VE</b>	RUTTING
				TOTAL	MEDIUM-HI <b>GH</b>	•

#### Summary:

Total reflective cracking of the AC overlay in lane 1 is not precipted to reach an unacceptable level within the next twenty years.

Medium- to high-severity reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING CRACK & SEAT

			TOTAL	MEDIUM-HIGH	
YEAR	AGE	SUM	REFLECTIVE	REFLECTIVE	RUTTINE
		ESALs	CRACKING	CRACKING	The second secon
					<u></u>
: 982	ę	2.22	Z	Ø	0.03
1989		2.52	858	858	0.00
1.392	<u>.</u>	1.24	867	8 <b>5</b> 7	C. CC
1951	3	1.93	87E	87€	Z. 72
1951	4	2.65	834	£84	0.0Z
1993	5	3.43	892	892	0.00
1994	£	4.26	899	899	0.00
1995	7	5.14	50E	906	0.02
1996	8	6.09	913	913	0.00
1997	Э	7.09	918	918	0.00
1998	10	8.16	923	923	0.02
1999	1 1	9.30	928	928	0.05
2000	12	10.51	931	931	0.09
2001	13	11.81	934	934	0.12
2022	: 4	13.19	936	936	0.15
2003	15	14.66	937	937	0.20
<b>≘</b> 2∂4	16	16.23	938	938	Ø. 25
2005	17	17.90	937	937	0.29
2026	18	19.69	935	935	0.34
2007	19	21.59	932	932	<b>0.</b> 39
		16-Rip	Feet	Feet	Inches
					inches
		millions	per mile	per mile	

#### Summary:

Total reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Medium- to high-severity reflective cracking of the AC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

			Page
D5	DCC Por	adad Overlay	
DS.	PCC BUI	nded Overlay	
	D5.1	3" PCC	234
	D5.2	5" PCC	235
	D5.3	7" PCC	236
	D5.4	12" PCC	
	D5.5	24" PCC	238

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING BONDED PCC OVERLAY

YEAR .	ASE	CUMULATIVE ESALs	JOINT FAULTING	JOINT DETERIORATION	TRANSVERSE CRACKING
1956	Z:	0.00	0.00	ø. ø	-0
:989	1	0.60	0.05	Ø. 1	224
1990	<u>ء</u>	1.24	0.06	Ø. 4	376
:591	3	1.93	0.07	1.0	509
1992	4	≥.66	0.08	2.0	633
1993	5	3.43	0.08	<b>3.</b> 3	749
1994	ã	4.26	0.09	5.0	BEZ
1995	7	5.14	0.09	7.2	967
1996	8	6.09	0.09	9.9	1071
1997	9	7.09	0.10	13.0	1172
1998	10	8. 16	0.10	16.6	1271
1999	11	9.30	0.10	20.8	1368
2000	12	10.51	0.11	25.5	1463
2001	13	11.81	0.11	30.8	1557
2002	14	13.19	0.11	36.7	1650
2003	15	14.66	0.12	43.2	1742
2004	16	16.23	0.12	50.4	1833
2005	17	17.90	0.12	<b>58.</b> 2	1923
2006	18	19.69	0.12	66.7	2012
2007	19	21.59	0.13	75.9	2101
		18-kip	Inches	Joints	Feet
		millions		per mile	per mile

#### SUMMARY:

 $\hat{\mathbb{T}}$ Joint faulting on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the PCC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 55.00 joints per mile in 2005.

Transverse cracking of the PCC overlay is predicted to equal or exceed an unacceptable level of 800 feet per mile in 1994.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING BONDED PCC OVERLAY

	YEAR	AGE	CUMULATIVE ESALs	JOINT FAULTING	JOINT DETERIORATION	TRANSVERSE CRACKING
	1988	Ø	ଓ. ହାଦ	0.00	Ø. Ø	0
•	:: 989	1	Ø.60	0.05	Ø. 1	224
	1990	2 3	1.24	0.06	Ø. 4	376
	1991	3	1.93	Ø. Ø7	1.0	509
	1992	4	2.66	0.08	≥.Ø	633
	: 993	5	<b>3.</b> 43	Ø. Ø8	3.3	749
	1994	6	4.26	0.09	5.0	860
	1595	7	5.14	0.09	7.2	<b>9</b> 67
	1996	8	6.09	0.09	9. 9	1071
	1997	9	7.09	0.10	13.0	1172
a.	1998	10	8.16	0.10	16.6	1271
f.,	1999	11	9.30	0.10	20.8	1368
	2000	12	10.51	0.11	25.5	1463
va .	2001	13	11.81	0.11	30.8	1557
	2002	14	13.19	0.11	36.7	1650
2-	<b>200</b> 3	15	14.65	Ø.12	43.2	1742
	2004	16	16.23	0.12	50.4	1833
¥.	2005	17	17.90	0.12	58.2	1923
	2006	18	19.69	0.12	66.7	2012
	2007	19	21.59	Ø. 13	75.9	2101
<del>*</del>			18-kip	Inches	Joints	Feet
			millions		per mile	per mile

#### : SUMMARY:

Joint faulting on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the PCC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 55.00 joints per mile in 2005.

Transverse cracking of the PCC overlay is predicted to equal or exceed an unacceptable level of 800 feet per mile in 1994.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING BONDED PCC OVERLAY

YEAR	AGE	CUMULATIVE ESALs	JOINT FAULTING	JOINT DETERIORATION	TRANSVERSE CRACKING
1988	<b>Z</b> i	ପ. ପଦ	e. 00	Ø. Ø	<b>2</b>
1989	1	0.60	0. <b>0</b> 5	Ø. 1	224
1990	Ž	1.24	Ø. ØE	Ø. 4	376
1991	3	1.93	0.07	1.0	5Ø9
1992	4	2.66	0.08	2.0	633
1993	5	3.43	0.08	3.3	749
1994	E	4.26	0.09	5.0	860
1995	7	5.14	0.09	7.2	<del>9</del> 67
1996	é	6.09	0.09	9.9	1071
1997	9	7.09	0.10	13.0	1172
1998	10	8.16	0.10	16.6	1271
1999	11	9.30	0.10	20.B	1368
	12	10.51	0.11	25.5	1463
2000	13	11.81	0.11	30.8	1557
2001	14	13.19	0.11	36.7	1650
2002	15	14.66	0.12	43.2	1742
2003		16.23	Ø. 12	50.4	1833
2004	16	17.90	0.12	58.2	1923
2005	17			66.7	2012
200E	18	19.69	0.12	7 <b>5.</b> 9	2101
2027	19	21.59	0.13	/ J. 3	
		18-kip	Inches	Joints	Feet
		millions	<b>-</b>	per mile	per mile

## SUMMARY:

Joint faulting on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the PCC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 55.00 joints per mile in 2005.

Transverse cracking of the PCC overlay is predicted to equal or exceed an unacceptable level of 800 feet per mile in 1994.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING BONDED PCC OVERLAY

					4 2
YEAR	AGE	CUMULATIVE	JOINT	JOINT	TRANSVERSE
		ESA_s	FAULTING	DETERIORATION	CRACKING
. 388	ē	Ø. ØØ	ଡ. ଉଷ	ø. ø	· · · · · · · · · · · · · · · · · · ·
1353	-	Ø. 60	0.05	Ø. 1	224
1992	2	1.24	Ø. ØE	Ø <b>.</b> 4	37€
1991	2 3	1.93	0.07	1.0	509
1992	4	2.66	0.08	2.0	633
1993	5	3.43	0.08	3.3	749
1994	£	4.26	0.09	5.0	862
1935		5.14	Ø. Ø9	7.2	967
1996	8	6.09	Ø. <b>Ø</b> 9	9.9	1071
1997	9	7.09	0.10	13.0	1172
1998	10	8.1E	Ø. 10	16.6	1271
1999	11	9.30	0.10	2 <b>0.</b> 8	1368
2000	12	10.51	0.11	25.5	1463
2001	13	11.81	Ø. 11	30.B	1557
2002	14	13.19	0.11	36.7	1650
2003	15	14.66	Ø.12	43. ĉ	1742
2004	16	16.23	0.12	50.4	1 <b>83</b> 3
2005	17	17.90	0.12	58.2	1923
2006	18	19.69	0.12	66.7	2012
2007	19	21.59	Ø. 13	75.9	2101
		18-kip	Inches	Joints	Feet
		millions		per mile	per mile

#### SUMMARY:

Joint faulting on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the PCC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 55.00 joints per mile in 2005.

Transverse cracking of the PCC overlay is predicted to equal or exceed an unacceptable level of 800 feet per mile in 1994.

4.5

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING BONDED PCC OVERLAY

YEAR	AGE	CUMULATIVE	JOINT	JOINT	TRANSVERSE
		ESALS	FAULTING	DETERIORATION	CRACKING
1988	Ø	ହ. ହେ	0.00	Ø. Ø	<b>Ø</b>
1989	1	0.60	0.05	Ø. 1	224
1990	2	1.24	0.06	Ø. 4	37€
:991	3	1.93	Ø. Ø7	1. Ø	509
1992	4	2 <b>.6</b> 6	0.08	2.Ø	<b>63</b> 3
1993	5	3.43	0.08	3 <b>.</b> 3	749
1994	6	4.26	0.09	5.0	860
1995	7	5.14	0.09	7.2	<b>9</b> 67
1996	8	6.09	0.09	9.9	1071
1997	9	7.09	0.10	13.0	1172
1998	10	8.16	0.10	16.6	1271
1999	11	9.30	0.10	20.8	1368
2000	12	10.51	Ø. 11	25.5	1463
2001	13	11.81	Ø. 11	30.8	1557
2002	14	13.19	Ø. 11	36.7	1650
2003	15	14.66	0.12	43. ĉ	1742
2004	16	16.23	0.12	<b>50.</b> 4	1833
2005	17	17.90	0.12	58. 2	1923
2006	18	19.69	0.12	<b>66.</b> 7	2012
2007	19	21.59	Ø.13	75.9	2101
		18-kip	Inches	Joints	Feet
		millions		per mile	per mile

## SUMMARY:

Joint faulting on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the PCC overlay in lane 1 is predicted to equal or exceed an unacceptable level of 55.00 joints per mile in 2005.

Transverse cracking of the PCC overlay is predicted to equal or exceed an unacceptable level of 800 feet per mile in 1994.

			<u>Page</u>
D6.	PCC Un	bonded Overlay	
	No Do	wels, 15' joint spacing	
	D6.1		239
	D6.2	10.6" PCC	240
	No Do	wels, 13' joint spacing	
	D6.3	10.5" PCC	241
	D6.4	10.6" PC	242
	No Do	wels, 10' joint spacing	
	D6.5	10.5" PCC	243
	D6.6	10.6" PCC	244

PREDICTED PERFORMANCE FOR LANE : FOLLOWING UNBONDED POD OVERLAY

YEAR	PGE	DUMULATIVE ESALE	JOINT FAULTING	JOINT DETERIORATION	TRANSVERSE CRACKING
: 566	<b>(2</b> )	ē. 00	Ø. 22	Ø. Z	Ø
1983	1	2.62	Ø.02	Z. Z	46
1950	E	1.24	Ø. Ø3	e.e	66
	3	1.93	Z . <b>Z</b> 4	Ø. Ø	à3
:952	4	<b>≘.6</b> 6	0.24	2.1	100
1993	5	3.43	Ø.05	Ø. 2	116
1994	E	4.26	e.05	Ø.3	133
: 995	7	5.14	0.05	Ø.5	:52
1998	8	6.09	e.ee	Ø. 7	173
:: 397	Э	7.23	Ø. ØE	1.1	197
1998	10	8.15	0.06	1.5	224
1999	11	9.30	0.07	2.0	257
2000	12	10.51	0.07	2. <b>6</b>	295
1 221	13	11.51	ଡ. ଡ8	3.3	340
2002	14	13.19	ø. Ø8	4.1	393
2023	15	14.56	Ø. Ø8	5.0	457
2004	16	16.23	0.05	6.1	534
2005	: 7	17.90	Ø. Ø9	7.4	625
2226	16	19.69	Ø. Ø3	8.8	734
E227	19	21.59	0.10	10.3	864
		18-415	Incres	Joints	Feet
		millions		per mile	pen mile

## - SUMMARY:

Joint faulting on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Court deterioration on the PCC overlay in lane 1 is not predicted to reach ar unacceptable level within the next twenty years.

Thansversa chacking of the PCC overlay is predicted to equal or exceed an unacceptable level of 800 feet per mile in 8007.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING UNBONDED POO OVERLAY

	YEAR	EGE	CUMULATIVE ESALs	JOIN <sup>T</sup> FAULTING	JOINT DETERIORATION	TRANSVERSE C <b>RAC</b> KING
		_				to added to
	1985	Ø.	ହ. ଉଥ	e. 00	Ø. Ø	0
	1923	1	Z.EZ	e.ee	21. Z	44
	1962	± 3	1.E4	Z. ZZ	Ø. Ø	. 63
	1971	3	1.93	Ø. Ø4	Ø. Ø	79
	1952	4	೭.6€	2.24	Ø. 1	95
	1993	5	3.43	0.05	Ø.2	110
	1994	6	4.26	0.05	Ø. 3	126
	1995	7	5.14	0.05	0.5	144
	1996	Ē	6.09	0.06	Ø.7	163
	1997	9	7.09	Ø. ØE	1.1	185
	1998	10	8.16	0.06	1.5	210
•	1999	11	9.30	0.07	2.0	240
	2000	12	10.51	0.07	2 <b>.6</b>	274
<b>*</b> 4**	ലതമെ:	13	11.81	0.08	3.3	315
	2002	14	13.19	0.08	4. 1	<b>36</b> 3
	E ಶಿಲಿತ	15	14.66	0.08	5.0	421
	2004	16	16.23	0.09	6.1	489
.,	2005	17	17.90	0.09	7.4	571
	2006	18	19.69	0.09	8.8	668
Y	2007	19	21.59	0.10	10.3	785
			18-kip	Inches	Joints	Feet
			millions		per mile	per mile

#### SUMMARY:

Joint faulting on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the PSC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Thansvense chacking of the PCC overlay is not predicted to reach an unacceptable level within the next twenty years.



## PREDICTED DERFORMANCE FOR LANE 1 FOLLEWING UNBONDED FOO IMERLAN

	YEAR	PBE	CLMULPTIVE ESALs	JOINT FAULTING	CLINT DETERIGRATION	TRANSVERSE CRACKING
	1985	Z	Ø. ØØ	હ. છેટ	€.€	Ø
	1989	1	0.50	2. ZE	₹. ₹	» <del>* 4</del> 5
	1990	Ξ	1.24	Ø. Ø3	Q. 2	<b>6</b> 6
	1971	3	1.93	0.04	Ø. Ø	ē 3
	1992	4	2.66	C. 04	₹. 1	122
	1993	. 5	3.43	0.05	Ø. 2	115
	1994	6	4.26	0.05	₽.3	133
	1995	7	5.14	0.05	Ø.5	152
	1996	8	6.09	0.06	<b>0.</b> 7	: 73
	1997	9	7.09	Ø. Ø6	1.1	197
	1998	10	8.16	0.06	1.5	224
	1999	11	9.30	Ø. Ø7	2.0	257
****	2000	12	10.51	0.07	2.6	295
-	2001	13	11.81	0.08	3.3	340
- 7	2002	14	13.19	ଡ. ଡଞ	4. 1	<b>39</b> 3
	2003	15	14.66	0.08	5.0	457
Zi.	2004	:€	16.23	0.09	6.1	534
*	2005	17	17.90	0.09	7.4	625
<b>T</b>	2006	18	19.69	0.09	<b>8.</b> 8	734
	2007	19	21.59	0.10	10.3	864
			18-kip	Inches	Joints	Feet
490			millions		per mile	per mile

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

#### SUMMARY:

Joint faulting on the PCC overlay in lane 1 is not predicted at a reach an unacceptable level within the next twenty years.

Joint deterioration on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Transverse chacking of the PCC overlay is predicted to equal or exceed an unacceptable level of 800 feet per mile in 2007.

YEPR	AGE	CUMULATIVE ESALs	JOINT FAULTING	JOINT DETERIORATION	T <b>RANSVE</b> RSE C <b>RAC</b> KING
1988	Ø	ଡ. ଅପ	ଡ. ଡଡ	Ø. Ø	Ø
1989	1	ଡ. ୧୬	0.02	Ø. Ø	44
1990	2	1.24	0.03	0.0	÷ <b>6</b> 3
1951	3	1.93	0.04	ଡ. ଫ	79
1992	4	2. <b>6</b> 6	0.04	Ø. 1	95
1993	5	3 <b>.</b> 43	Ø. Ø5	ø.e	110
1994	6	4.25	Ø. Ø5	Ø.3	126
1995	7	5.14	0.05	Ø.5	144
:996	8	6.09	0.06	Ø. 7	163
1997	Э	7.09	0.06	1.1	185
1998	10	8.16	0.06	1.5	210
1999	11	9.30	0.07	2.0	240
2000	12	10.51	0.07	2.6	274
2001	13	11.81	Ø. Ø8	3.3	315
2002	14	13.19	0.08	4. 1	363
<b>ലമമ</b> ദ	15	14.66	Ø. Ø8	5.0	421
2004	16	16.23	0.09	<b>6.</b> 1	489
2005	17	17.90	0.09	7.4	571
2006	18	19.69	0.09	8.8	668
2007	19	21.59	0.10	10.3	785
		18-615	Inches	Joints	Feet
		millions	211C.1ED	per mile	per mile
		111777777113		her mirre	

## \*SUMMARY:

--- ·--

Joint faulting on the PCD overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Transverse chacking of the PCC overlay is not predicted to reach an unacceptable level within the next twenty years.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING UNBONDED POR OVERLAY

V Z 2 %	ABE	DUMULATIVE EBALS	JOINT FAULTING	CCINT DETERIORATION	TRANSVERSE CRACKING
. 155	Z	2.22	2.22	2.2	Ø
12.2	~	2.62	2.22	2.2	46
1994	Ė	1.24	2.23	Z. Z	66
731	3	1.93	2.24	Ø. Ø	೮૩
1391	ت 44	2.65	2.24	2. 1	102
1553	=	3.43	a. 05	Ø.2	i1E
	 E	4.26	Ø. Ø5	Ø. E	1.33
1594	~;	E.14	2.25	Ø.5	152
1995	12	6.03	Ø. Ø6	ç. 7	: 73
1998	9	7.29	Ø. Ø6	1.1	197
1997	10	8.16	Ø. Ø6	1.5	224
1998		9.30	2.27	2.0	257
:999	11	10.51	0.27	2.6	295
2000	12	11.81	0.08	3.3	340
2001	13		Ø. Ø8	4. 1	393
2022	14	13.19	2.28	5. 2	457
2023	15	14.65	2.29	£. 1	534
2004	16	15.23		7.4	625
出るでき	:7	17.92	Ø. 29	e. 8	734
2005	18	19.69	Ø. Ø9		864
2027	: 9	21.59	C. 12	10.3	054
		.8-x15	Inches	Joints	Feet
		millions		per mile	per mile

#### SUMMARY:

Joint faulting on the PCD overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

doint detenioration on the ROD ovenlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Transverse chacking of the PCD overlay is predicted to equal or exceed an unacceptable level of 800 feet per mile in 2007.

12

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING UNBONDED PCC OVERLAY

	YEAR	AGE	CUMULATIVE	JOINT	JOINT	TRANSVERSE
			ESALs	FAULTING	DETERIORATION	CRACKING
		_				*
	1953	Ø.	0.00	0.00	Ø. Ø	·
	1959	1	Ø. 60	0.02	Ø. Ø	<b>44</b>
	1952	Ξ	1.24	0.03	0.0	63
	1931	3	1.93	Q. Q4	Ø. Ø	79
	1992	4	2.66	0.04	<b>0.</b> 1	<b>9</b> 5
	1993	5	3.43	0.05	Ø. 2	110
	1994	6	4.26	0.05	Ø. 3	126
	1995	7	5.14	0.05	Ø. 5	144
	1996	8	6.09	0.06	0.7	163
	1997	9	7.09	0.06	1.1	185
	1998	10	8.16	0.06	1.5	210
	1999	11	9.30	0.07	2.0	240
	2000	12	10.51	0.07	2.6	274
and the second	2001	13	11.81	0.08	3.3	315
:	2002	14	13.19	0.08	4. 1	363
	2003	15	14.66	0.08	5.0	421
<b>4</b>	2004	16	16.23	0.09	6. 1	489
	2005	17	17.90	0.09	7. 4	571
3	2006	18	19.69	0.09	8.8	668
	2007	19	21.59	0.10	10.3	785
			18-kip	Inches	Joints	Feet
			millions		per mile	per mile

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

## \_ SUMMARY:

Joint faulting on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the PCC overlay in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Transverse chacking of the PCC overlay is not predicted to reach an unacceptable level within the next twenty years.

## D7. Reconstruction

No Dov	wels, 15' joint spacing, stabilized base, 650 psi PCC modulus of 12" PCC	rupture 245
D7.2	18" PCC	246
No Dov	wels, 15' joint spacing, stabilized base, 750 psi PCC modulus of	rupture
D7.3	12" PCC	247
D7.4	18" PCC	248
D7.5	owels, 15' joint spacing, stabilized base, 650 psi PCC modulus of 12" PCC	249
D7.6	18" PCC	250
7/8" Do	owels, 15' joint spacing, stabilized base, 750 psi PCC modulus of	of rupture
D7.7	12" PCC	251
D7.8	18" PCC	252
No Dov	wels, 15' joint spacing, granular base, 750 psi PCC modulus of	rupture
D7.9	12" PCC	253
D7.10	18" PCC	254

	YEAR	AGE	CUMULATIVE	JOINT	TRANSVERSE	JOINT	PUMPING	PSR
			ESALS	FAULTING	CRACKING	DETERIORATION		
							The second secon	
	1958	ų.	0.00	0.00	Ø	Ø. Ø	0.0	4.5
	:989	1	Ø.6Ø	0.07	23		<b>0.</b> 9	3.9
	1990	Ē	1.E4	0.08	34	0.0	1.2	3.7
	1991	3	1.93	Ø. Ø9	42	Ø. Ø	1.4	3.4
	1592	4	2.66	Ø. Ø9	50	0.1	1.7	3. i
	1993	5	3.43	0.10	57	0.2	1.9	2.8
	1994	Ē	4.26	0.10	64	Ø. 3	2.0	≥.4
	1995	7	5.14	0.10	71	0.5	2.2	2.0
	1996	8	6.09	0.10	79	0.7	2.4	1.6
	1997	9	7.09	0.11	87	1.1	2.6	1.1
	1998	10	8.16	0.11	96	1.5	2.7	0.6
	1999	11	9.30	0.11	106	2.0	2.9	0.1
	2000	12	10.51	0.11	116	2.6	3.0	-0.4
-	2001	13	11.81	0.12	128	3.3	3.0	-1.0
	2002	14	13.19	0.12	142	4.1	3.0	-1.6
	2003	15	14.66	0.12	157	5.0	3.0	-2.2
	2004	16	16.23	0.12	175	6.1	3.0	-2.9
	2005	17	17.90	0.12	195	7.4	3.0	-3.€
	2006	18	19.69	0.12	219	8.8	3.0	-4.4
	2007	19	21.59	0.13	246	10.3	3.0	-5.2
			18-kip	Inches	feet	Joints	@ = none	0-5
			millions		per mile	per mile	1 = low	
							2 = mediu	ıra
							3 = high	
							_	

#### SUMMARY:

Joint faulting on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 0.13 inches per mile in 2007.

Transverse cracking of the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Pumbing on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 1.0 in 1990.

psq on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 3.00 in 1993.

and the same of th

. . . .

	YEAR	AGE	CUMULATIVE ESALs	JOINT FAULTING	TRANSVERSE CRACKINS	JOINT DETERIORATI <b>ON</b>	PUMPING	PSR
	1988	Ø	0.00	0.00	Ø	Ø. Ø	Ø. Ø	4.5
	1989	•	Ø.60	Ø. Ø6	3	Ø. Ø	Ø.E	4.3
	1990	ž	1.24	0.07	4	0.0	0.8	4.2
	1991	3	1.93	0.07	5	0.0	1.0	4.0
		ت 4	2.66	Ø. Ø8	E	Ø. 1	1.1	3.7
	1992	5	3.43	Ø. Ø8	É	0.2	1.2	3.5
	1993	€	4.26	0.08	7	0.3	1.4	3.1
	1994	7	5.14	0.08	ė	0.5	1.5	2.8
	1995		6.09	ø. ø3	9	0.7	1.6	2.4
	1996	8	7.09	0.09	à	1.1	1.7	2.0
	1997	_		0.03	10	1.5	1.8	1.5
	1998	10	8.16	0.09	11	2.0	1.9	1.0
-	1999	11	9.30	Ø. Ø9	11	2.6	2.1	0.5
4.4.	2000	12	10.51		12	3.3	2.2	-0.0
	2001	13	11.81	0.09		4. 1	2.3	-0.6
	2002	14	13.19	0.10	13		2.4	-1.2
	2003	15	14.66	0.10	14	5.0	2.5	-1.9
	2004	16	16.23	0.10	14	6.1		
-	2005	17	17.90	0.10	15	7.4	2.6	-2.6
	2006	18	19.69	0.10	16	8.8	2.7	-3.3
	2007	19	21.59	0.10	17	10.3	2.8	-4.1
			18-kip	Inches	feet	Joints	0 = none	0-5
			millions		per mile	per mile	1 = low	
•							2 = mediu	ıra
							3 = high	
							_	

## SUMMARY:

Joint faulting on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Transverse cracking of the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Pumping on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 1.0 in 1991.

PSR on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 3.00 in 1995.

	v gas	SE	DUMLLATIVE	JOINT	TRANSVERSE	JOINT	PUMPING	PSR
			25125	EVITING	CRACKING	DETERIORATI	ON	
							S III C	,
	1935	ĵ	ટ. ⊉ટ	2.22	<b>v</b> č	Ø. Ø	0.0	4.5
	. 5.5.F	:	₹. £0	2.27	:5	0.0	.0.9	4.2
	1552	تے	1.24	Ø. Ø8	££.	0.0	1.2	3.7
	. 9 <del>5</del> 1	.3	1.63	<b>2.2</b> 9	£8	0.0	1.4	3.5
	1993	<b>-</b>	2.56	0.09	33	Ø. 1	1.7	3.2
	12-3	5	3.43	₹.10	37	Ø.2	1.9	2.9
	1994	6	4.25	2.10	42	e. 3	2.0	2.5
	: 955	7	5.14	0.10	46	Ø.5	2.2	2.1
	1996	9	6.09	0.10	51	Ø. 7	2.4	1.7
	1997	9	7.09	ē. 11	56	1.1	2.6	1.3
	1998	10	8.16	0.11	60	1.5	2.7	0.8
	1999	11	9.30	0.11	66	2.0	2.9	0.3
	2000	12	10.51	0.11	71	2.6	3.0	-0.3
	2001	13	11.81	0.12	77	<b>3.</b> 3	3.0	-0.8
÷		14	13.19	0.12	84	4.1	3.0	-1.4
	±೩೪૩	15	14.E5	Ø.12	91	5.0	3.0	-2.1
	2004	16	16.23	0.12	99	6.1	3.0	-2.8
	EDEE	17	17.90	Ø.12	108	7.4	3.0	-3.5
-	2006	18	19.69	0.12	118	8.8	3.0	-4.2
	2 <b>0</b> 27	19	21.59	0.13	130	10.3	3.0	-5.Ø
			18-kip	Inches	feet	Joints	Ø = none	Ø-5
			millions		per mile	per mile	1 = low	
						,	2 = mediu	.rn
							3 = high	

#### SUMMARY:

Joint faulting on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 0.13 inches per mile in 2007.

Transverse chacking of the reconstructed pavement in lane 1 is not oreclicted to reach an unacceptable level within the next twenty years.

Joint getenigration on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Figure on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 1.0 in 1990.

93R on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of  $3.0\delta$  in 1993.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING RECONSTRUCTION

	YERR	ASE	DUMULATIVE BEALS	JOINT FAULTING	TRANSVERSE CRACKING	JOINT S. DETERIORATI <b>ON</b>	D <b>PUMPI</b> NG	PSR
			* m.=	Ø. <b>Ø</b> Ø	₽	Ø. Ø	 Ø. Ø	4.E
	1988	2	₹. ØØ	2.26	2	Ø. Ø	0.6	4.4
	1599	-	2.EZ		3	0.0	٥.8	4.3
	1992	٤	1.24	0.07		Ø. Ø	1.0	4.1
	1991	3	1.93	2.27	3		1.1	3.5
	1991	4+	£.65	0.28	4	Ø. 1		3.5
	1993	5	3.43	ଡ. ଡ8	4	0.2	1.2	
	1994	٤	4.26	Ø. Ø8	5	Ø. 3	1.4	3.3
	1995	7	5.14	Ø. 08	5	Ø. 5	1.5	3.₺
	1996	8	6.09	0.09	6	Ø. 7	1.6	2.6
	1997	9	7.09	0.09	£	1.1	1.7	2.2
	1998	10	8.16	0.09	7	1.5	1.8	1.7
	1999	11	9.30	0.09	7	2.0	1.9	1.3
	2000	12	10.51	0.09	8	2.6	2.1	0.8
	2021	13	11.81	Ø. Ø9	8	3.3	2.2	0.2
	2002	14	13.19	0.10	8	4.1	2.3	-0.4
	2003	15	14.65	0.10	9	5.0	2.4	-1.0
	2004	16	16.23	0.10	9	6.:	2.5	-1.E
		17	17.90	0.10	10	7.4	2.6	-2.3
•	2005	18	19.69	0.10	10	8.8	2.7	-3.0
	2006			0.10	11	10.3	2.8	-3.8
	2027	19	21.59	¢. 1¢	<b>.</b> .	10.0		
			18-KiD	Inches	feet	Joints	Ø = none	Ø-5
			millions	THEILES	per mile	per mile	1 = low	
			mililons		per mile		2 = mediu	เถต
							3 = high	

#### SUMMARY:

Joint faulting on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Thansverse chacking of the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Purpling on the reconstructed pavement in lane 1 is predicted to equal on exceed an unacceptable level of 1.0 in 1991.

oss on the reposstructed pavement in lane 1 is predicted to equal or exceed an unappentable level of 3.00 in 1995.

3 = high

9.3

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING RECONSTRUCTION

	YEAR	AGE	CUMULATIVE	JOINT	TRANSVERSE	JOINT	PUMPING	ÁSA
			ESALS	FAULTING	DRAEKING	DETERIORATIO	N	
	1988	Z:	ବ. ଅଧ	ଡ.ଡେଡ	Ø	Ø. Ø	0.0	4.5
	1939	1	Ø.60	Ø. Ø5	23	Ø. Ø	Ø.9	3.9
	1990	Ē	1.24	0.06	34	Ø. Ø	1.2	3.7
	1991	÷	1.93	ಳು.ಥಾಟ	4⊇	Ø. Ø	1.4	3.4
	1952	4	E.66	0.06	52	Ø. 1	1.7	3.1
	1993	5	3.43	0.07	57	0. Z	1.9	ā.8
	1994	ε	4.26	0.07	64	Ø.3	2.0	€.4
	1995	7	5.14	0.07	71	Ø.5	2.2	2.0
	1996	6	6.09	Ø. Ø7	79	Ø.7	2.4	1.6
	1997	· 9	7.09	0.07	87	1.1.	2.6	1.1
FV.	1998	10	8.1 <b>6</b>	0.07	96	1.5	2.7	Ø. E
- 14 miles	1999	11	9.30	ଡ.ଡେବ	106	2.0	2.9	Ø. 1
 	2000	12	10.51	0.08	116	2.6	3.Ø	-0.4
	2001	13	11.61	ଡ. ହ8	128	3.3	3.0	-1.0
	2002	14	13.19	0.08	142	4.1	3.0	-1.6
	2003	1 =	14.66	ଫ.ଡ଼ୀଷ	157	5.0	3.∅	-2.2
÷	2004	16	16.23	0.08	175	E. 1 .	3.0	-2.9
	2005	17	17.90	ø. <b>ø</b> 8	195	7.4	3.0	-3.6
•	2006	18	19.69	ଡ.ଡେଞ	215	8.8	3.0	-4.4
	2027	:3	21.59	Ø. <b>Ø</b> 9	246	10.3	3.0	-5.2
•								
•			18-kip	Inches	feet	Joints	0 = none	Ø-5
			millions		per mile	per mile	1 = 1 cw	
							2 = mediu	m ,

NOTE: These projections are estimates of expected performance based on predictive models. They should not be taken as exact values, but instead as relative indicators of performance.

#### SUMMARY:

Joint faulting in the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Thansverse chacking of the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joirt deterioration on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Padding on the reconstructed pavement in lane 1 is predicted to equal on except an unacceptable level of 1.0 in 1990.

PSR or the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 3.00 in 1993.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING RECONSTRUCTION

	YEAR	AGE	CUMULATIVE ESALs	JOINT FAULTING	TRANSVERSE CRACKING	JOINT DETERIORATI <b>ON</b>	PUMPING	PSR
	1558	v.	Z. &Z	ଡ. ଅପ	₹.	Ø. Ø	0.0	4, E
	1989	-	z.63	0.04	3	Ø. Ø	∅. €	4.3
	1992	Ē	1.64	2.04	4	ø.c	2. B	4.2
	1991	3	1.93	2.24	5	Ø. Ø	1.0	4.0
	1952	4	2.66	0.05	Ē	Ø. 1	1.1	3.7
	1993	5	3.43	0.05	Ē	Ø. 2	1.2	3.5
	1994	É	4.26	0.05	7	0.3	1.4	3.1
	1995	7	5.14	0.05	8	Ø.5	1.5	2.8
	1996	6	6.09	a. 05	Э	0.7	1.€	Ξ.4
	1997	9	7.09	0.05	9	1.1	1.7	E. 2
	1998	10	8.16	0.05	10	1.5	1.8	1.5
**	1999	11	5.30	Ø. Ø5	11	2.0	1.9	1.0
***	EDDO	12	10.51	0. QE	11	2.6	2.1	Ø.5
***	2001	13	11.81	0.05	12	3.3	2.2	-0.0
	2002	14	13.19	Ø.ZE	13	4.1	2.3	-2.E
100	2003	15	14.66	0.05	14	5.0	2.4	-1.2
-	2024	16	16.23	0. 2E	14	6. ↓	2.5	-1.5
	EØØE	17	17.90	0.0E	15	7.4	≥.6	-2.E
	EDDE	18	19.65	Ø. ØE	16	8.8	2.7	-3.3
	2007	19	21.59	0.06	17	10.3	2.8	-4.1
			18-815	Inches	feet	Joints	Ø = none	Ø-5
			millions		per mile	per vile	1 = low	
							2 = mediu	ım
							3 = high	

#### SUMMARY:

Joint faulting on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Transverse cracking of the reconstructed pavement in lane 1 is not credicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Subsing on the reconstructed pavement in lane 1 is predicted to equal or excess an unacceptable level of 1.0 in 1991.

PSR on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 3.00 in 1995.

PREDUCTED PERFORMANCE FOR LAME 1 FOLLOWING RECONSTRUCTION

	YEAR	AGE	SUMULATIVE	JOINT	TRANSVERSE	JOINT	PUMPING	PSR
	•		234_s	FALLTING	CRACKING	DETERIORATION	**************************************	
	1988	2	Ø. Ø2	2. DZ	Zi	ø. Ø	0.0	4.5
	1223	-	Ø. <del>6</del> 2	a. 05	15	ð. Ø	Ø. 9	4. Z
	1992		1.24	0.06	22	Q. Q	1.2	3.7
	1 3.	-	1.93	0.26	28	0.2	1.4	3.5
	1932	4	2.66	Z. ZE	33	Ø. 1	1.7	3.2
	1993	Ξ	3.43	0.07	37	Ø.2	1.9	2.9
	1994	E	4.26	Ø. Ø7	42	Ø.3	2.0	2.5
	1995	7	5.14	2.27	46	Ø.5	2.2	2.1
	1996	8	6.09	0.07	-51	Ø.7	2.4	1.7
	1997	5	7.29	0.07	56	1.1	2.6	1.3
۔ ند	1998	10	8.16	0.07	60	1.5	2.7	0.8
<u></u> ,	1999	11	9.30	Ø. Ø8	66	2.0	2.9	0.3
***	2000	12	10.51	0.08	71	2.6	3.0	-Ø.3
2	2001	13	11.81	0.08	77	3.3	3.0	-0.8
	2002	:4	13.19	Ø. ØB	84	4.1	3.0	-1.4
	2003	15	14.65	0.08	91	5.0	3.0	-2.1
-	2224	1 E	16.23	0.08	99	€.1	3.₡	-2.8
	E225	17	17.90	0.08	108	7.4	3.0	-3.5
	2006	18	19.69	0.08	118	8 <b>.8</b>	૩.છ	-4.2
	2027	:9	£1.59	ø. ø9	130	10.3	3.0	-5.0
			18-415	Inches	feet	Joints	@ = none	<b>2</b> 1-5
			millions		per mile	per mile	1 = low	
							2 = mediu	เรก
							3 = high	

#### SUMMARY:

Joint faulting on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Transverse chacking of the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

desire deterioration on the reconstructed bavement in lane 1 is not onecicted to reach an unacceptable level within the next twenty years.

Pursuing on the reconstructed pavement in lane 1 is predicted to equal on exceed an unacceptable level of 1.0 in 1990.

FBR on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 3.00 in 1993.

PREDICTED PERFORMANCE FOR LANE 1 FOLLOWING RECONSTRUCTION

	YEAR	ASE	CUMULATIVE	JOINT	TRANSVERSE	JOINT	PUMPIKS	FSR
	. =		EEALs	FAULTING	CRACKING	DETERIORATION		
	1988	Z:	ହ. ହେବ	0.00	Z.	₽. ₹	Ø. Ø	4.5
	1929	1	Ø. €Z	C. C4	2	⊘. ⊘	Ø. E.	4. 4
	1992	Ξ	1.24	2.24	3	Ø. Ø	∅.ε	4.3
	1991	3	1.93	2.24	3	C.Z	I. Z	4.1
	1993	4	3.6E	0.05	4	€.1		3.9
	1993	5	3.43	Ø. Ø5	4	0.2	1.2	3.€
	1994	6	4.26	0.05	5	Ø.3	1.4	3.3
	1995	7	5.14	Q. Q5	5	₹.5	1.5	3.€
	1996	8	6.05	C. Q5	£	₹.7	1.€	2.6
	1937	9	7.29	0.05	Ē	1.1	1.7	Ē.Ē
	1998	10	8.16	0.05	7	1.5	1.8	1.7
4-	1999	11	9.3ð	0.06	7	2. Ø	i.9	1.3
	2000	12	10.51	0.06	8	2.6	2.1	Ø. 8
	2001	13	11.81	Ø. ØE	8	3.3	€. €	Ø. 2
	2002	14	13.19	Ø. ØE	٤	4.1	2.3	-0.4
	2023	15	14.66	0.06	9	5.0	2.4	-1.0
	2224	15	16.23	0.00	.S	<b>6.</b> i	2.5	-1.E
	2005	17	17.90	0.06	10	7.4	2.6	-2.3
	2225	18	19.69	0.06	10	8.8	2.7	-3.0
	2007	:9	21.59	Ø. Ø6	11	10.3	2.8	-3.8
			16-810	lnches	f <b>ee</b> τ	Joints	@ = none	Ø-5
			millions	a. 1 * tau 1 * tau 127	per mile	per mile	1 = 10w	
			11:12220713				2 = mediu	ពេក
							3 = high	

#### SUMMARY:

Joint faulting on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Transverse chacking of the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Functing on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 1.0 in 1991.

PSR on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of  $3.00\,\mathrm{mm}$  in 1995.

	YEAR	AGE	CUMULATIVE	JOINT	TRANSVERSE	TAIGL	PUMPING	PSR
			ES4_s	FAULTING	CRACKING	DETERIORATI	מכ	
	1954	₹	2. QQ	C. CC	Ø	Ø. Ø	0.0	4.5
	1 PA B	<b>.</b>	Ø.63	Ø. 12	. 5	Ø. Ø	0.9	4.2
	1992	ت	1.24	0.11	22	0.0	1.2	3.7
	9.1	3	1.93	Ø. 1E	28	0.0	1.4	3.5
	1993	4	2.66	0.13	33	Ø. 1	1.7	3.2
	3 31.3	5	3.43	₹.13	37	Ø.2	1.9	2.9
	1994	£	4.26	Ø.13	42	0.3	2.0	2.5
	1995	7	5.14	Ø. 14	46	Ø.5	2.2	2.1
	1996	8	6.09	Ø. 14	<b>5</b> 1	Ø.7	2.4	1.7
	1997	9	7.09	0.14	56	1.1	2.6	1.3
	1998	10	8.16	0.15	60	1.5	2.7	0.8
44	1999	11	9.30	0.15	66	2.0	··· 2.9	0.3
3.	2000	12	10.51	0.15	71	2.6	3.0	-0.3
5	2001	13	11.81	0.16	77	3.3	3.0	-0.8
	2002	14	13.19	0.16	84	4.1	3.0	-1.4
	2003	15	14.65	Ø. 16	91	5.0	3.0	-2.1
	2004	16	16.23	0.16	99	6.1	3.0	-2.8
•••	2225	17	17.90	Ø. 17	108	7.4	3.0	-3.5
	2006	18	19.69	0.17	118	8.8	3.0	-4.2
	2007	19	21.59	Ø. 17	130	10.3	3.0	-5.0
			4.5	7 h	£+	To i wh -	13 - was-	Ø-5
			18-kip	Inches	feet	Joints	Ø = none	w-3
			millions		per mile	per mile	1 = low	
							2 = mediu	m
							3 = high	

#### SUMMARY:

Joint faulting on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 0.13 inches per mile in 1992.

Transverse cracking of the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Joint deterioration on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Pumbing on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 1.0 in 1990.  $\sim 10^{10}$ 

TSR on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 3.00 in 1993.

	YEAR	AGE	CUMULATIVE	JOINT	TRANSVERSE	JOINT	PUMPING	PSR
			ESALs	FAULTING	CRACKING	DETERIORATI		
							Sulf Contract	
	1988	Ø	ଡ. ୧୭	ଡ. ହେଉ	Ø	0.0	0.0	4.5
	<u>. 989</u>	4	2.E2	0.09	2	Ø. Ø	0.6	4.4
	1950	æ	1.24	0.10	3	0.0	0.8	4.3
	0.591	3	1.93	0.10	3	0.0	1.0	4.1
	1992	4	2.66	Ø.11	4	0.1	1.1	3.9
	: 593	Ξ	3.43	Ø. 11	4	0.2	1.2	3.6
	1994	€	4.26	0.12	5	0.3	1.4	3.3
	1995	7	5.14	0.12	5	0.5	1.5	3.0
	1996	8	6.09	0.12	6	0.7	1.6	2.6
	1997	9	7.09	0.13	6	1.1	1.7	2.2
	1998	10	8.16	0.13	7	1.5	1.8	1.7
4.	1999	11	9.30	0.13	7	2.0	1.9	1.3
	2000	12	10.51	0.13	8	2.€	2.1	.0.8
	2001	13	11.81	0.13	8	3.3	2.2	0.2
3	2002	14	13.19	0.14	8	4.1	2.3	-0.4
	2003	15	14.66	0.14	9	5.0	2.4	-1.0
	2004	16	16.23	<b>0.</b> 14	- 9	6.1	2.5	-1.6
	2005	17	17.90	0.14	10	7.4	2.6	-2.3
	2006	18	19.69	0.15	10	8.8	2.7	-3.0
*	2007	19	21.59	0.15	11	10.3	2.8	-3.8
			18-kip	Inches	feet	Joints	0 = none	Ø-5
			millions		per mile	per mile	1 = low	
							2 = mediu	ra
٠							3 = high	

#### SUMMARY:

Joint faulting on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 0.13 inches per mile in 1997.

Transverse cracking of the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

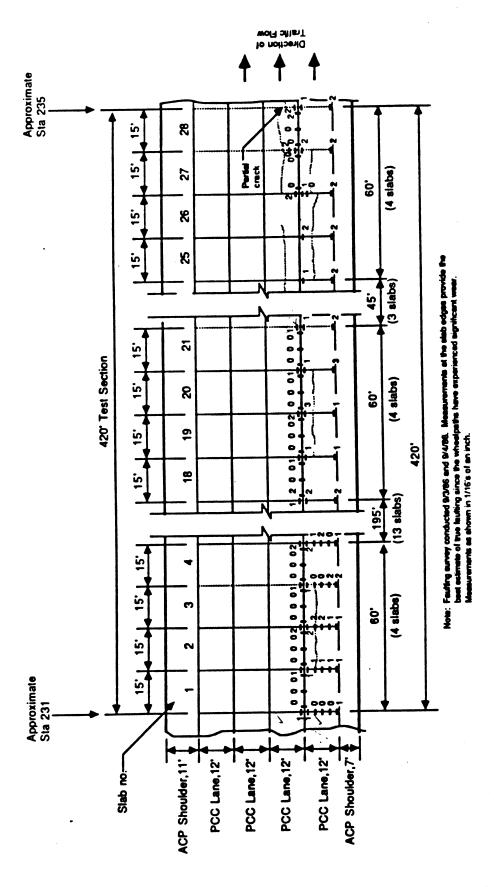
Joint deterioration on the reconstructed pavement in lane 1 is not predicted to reach an unacceptable level within the next twenty years.

Pumping on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 1.0 in 1991.

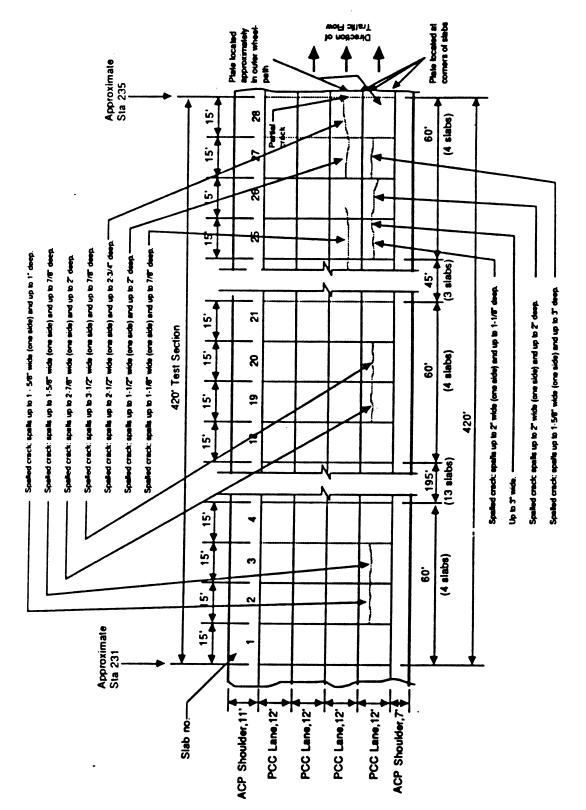
PSR on the reconstructed pavement in lane 1 is predicted to equal or exceed an unacceptable level of 3.00 in 1995.

# APPENDIX E SURVEY DATA

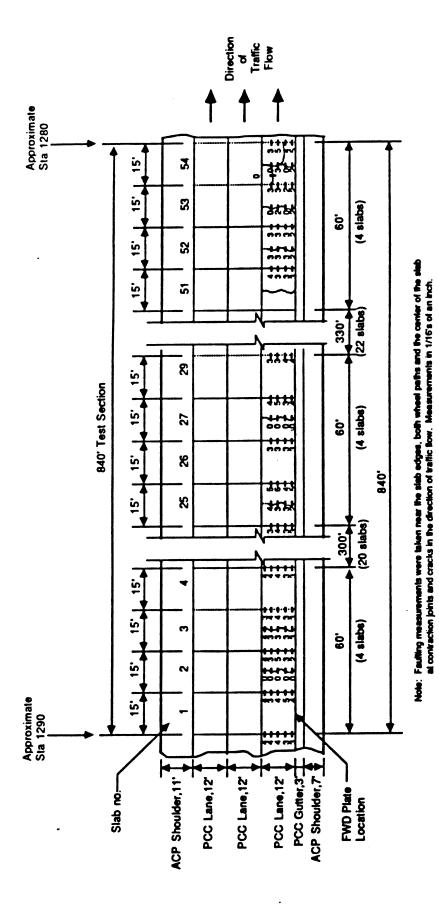
·				



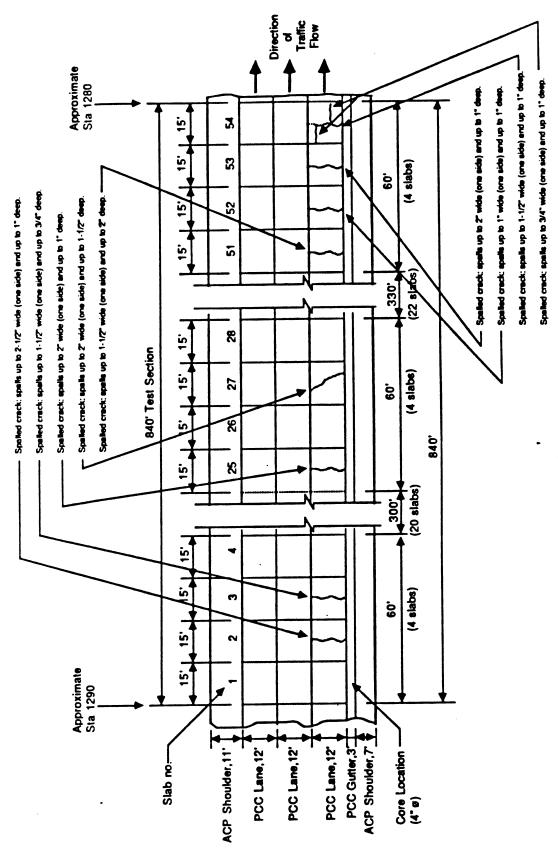
E1--Faulting Survey I-5 North (MP 176) Seattle [from Ref. 12]



E2--Crack Survey I-5 North (MP 176) Seattle [from Ref. 12]



E3--Faulting Survey I-90 West (MP 278) Spokane [from Ref. 12]



E4--Crack Survey I-90 West (MP 278) Spokane [from Ref. 12]

# APPENDIX F TRAFFIC DATA

### Equivalent Axle Load Estimate I-5, NE 175th (MP 176.35)

Percent Trucks

YEAR	ADT (two way)	Single Units	Comb. Trucks	Daily Single Units	E.F.	Daily Comb. Trucks	E.F.	ESAL's
1965	52,000	 3	2	7 <b>8</b> 0	0.13	520	0.91	209,824
1966	57,700	3	2	866	0.17	577	0.91	245,144
1967	59,400	3	2	891	0.17	594	0.91	252,367
1968	66,600	3	2	999	0.17	666	0.91	282,957
1969	72,100	3	2	1,082	0.17	721	0.84	288,166
1970	71,400	3	2	1,071	0.17	714	0.84	285,368
1971	68,700	2	3	687	0.17	1.031	0.84	358.580
1972	76,400	2	3	764	0.18	1,146	0.88	418,011
1973	76,900	2	3	769	0.18	1,154	0.88	420,747
1974	72,200	2	3	722	0.20	1,083	0.90	408,208
1975	78,000	2	3	780	0.20	1,170	0.90	441.000
1976	81,000	2	3	810	0.23	1,215	1.02	520,492
1977	85,900	2	3	859	0.23	1,289	1.02	551,978
1978	90,500	2	3	905	0.13	1,358	1.04	557,589
1979	101,800	2	3	1,018	0.23	1,527	1.16	730,692
1980	129,200	2	3	1,292	0.24	1,938	1.11	894,351
1981	133,100	2	3	1,331	0.24	1,997	1.11	923,291
1982	135,800	2	3	1,358	0.24	2,037	1.11	942,021
1983	113,200	2	3	1,132	0.24	1,698	0.99	713,355
1984	142,800	2	3	1,428	0.24	2,142	0.99	899,886
1985	147,000	2	3	1,470	0.24	2,205	0.99	926,354
1986	137,500	2	3	1,375	0.24	2,063	0.99	866,487
1987	144,400	2	3	1,444	0.24	2,166	0.99	909,969
1982	145,900	2	2	1,459	0.24	1,459	0.99	655,551

TOTAL ESAL'S = 13,702.388

F1--Traffic Data, I-5 (MP 176) Seattle

## Equivalent Axle Load Estimate I-90, (MP 2<del>79.26</del>) 21**5**.60

Percent Trucks

YEAR	ADT (two way)	Single Units	Comb. Trucks	Daily Single Units	E.F.	Daily Comb. Trucks	E.F.	ESAL's per yr.
 1965	11,200	2	7	112	0.13	392	0.91	135,415
1966	16,500	2	7	165	0.17	578	0.91	201,844
1967	17,800	2	7	178	0.17	623	0.91	217,747
1968	18,300	2	5	183	0.17	458	0.91	163,147
1969	19,400	2	5	194	0.17	485	0.84	160,739
1970	23,000	2	5	230	0.17	575	0.84	190,567
1971	24,300	4	4	486	0.17	486	0.84	179,164
1972	26,000	4	4	520	0.18	520	0.88	201,188
1973	28,200	4	4	564	0.18	564	0.88	218,212
1974	29,600	4	4	592	0.20	592	0.90	237,688
1975	28,600	4	4	572	0.20	572	0.90	229,658
1976	30,600	4	4	612	0.23	612	1.02	279,002
1977	32,200	4	4	644	0.23	644	1.02	293,590
1978	35,700	4	4	714	0.13	714	1.04	304,132
1979	36,000	3	3	540	0.23	540	1.16	273,772
1980	34,500	3	3	518	0.24	518	1.11	253,676
1981	35,300	3	3	530	0.24	530	1.11	260,331
1982	33,900	3	3	509	0.24	509	1.11	250,007
1983	34,000	4	4	680	0.24	680	0.99	305,534
1984	34,000	4	4	680	0.24	680	0.99	305,534
1985	34,000	4	4	680	0.24	680	0.99	305,534
1986	38,300	4	4	766	0.24	766	0.99	344,175
1987	33,300	4	4	666	0.24	666	0.99	299,244
1988	38,300	4	9	766	0.24	1,724	0.99	690,517

TOTAL ESAL'S = 6,300,416

F2--Traffic Data, I-90 (MP 278) Spokane

Equivalent Axle Load Estimate I-90, Snoqualmie Pass (MP 61.35)

YEAR	ADT (two way)	Percent Single Units	Trucks Comb. Trucks	Daily Single Units	E.F.	Daily Comb. Trucks	E.F.	ESAL's per yr.
 1960	5,300	8	5	212	0.06	133	0.62	4,333
1961	6,000	В	5	240	0.28	150	0.88	24,703
1962	6,800	8	5	272	0.28	170	0.88	27,997
1963	6,600	8	5	264	0.28	165	0.88	64,754
1964	6,600	8	5	264	0.28	165	0.93	B0,220
1965	7,700	5	9	193	0.13	347	0.91	121.00
1966	8,400	5	9	210	0.17	378	0.91	134,996
1967	8,700	5	9	218	0.17	392	0.91	143.390
1968	9,200	5	9	230	0.17	414	0.91	151,630
1969	10,000	4	7	200	0.17	350	0.84	119,72
1970	11,700	4	7	234	6.17	410	0.84	140,07
1971	13,200	4	7	264	0.17	462	0.84	158,03
1972	13,100	4	17	262	0.18	1,114	0.88	374,24
1973	13,100	4	17	262	0.18	1,114	0.88	374,24
1974	13,100	4	17	262	0.20	1,114	0.90	384,28
1975	13,400	4	17	268	0.20	1,139	0.90	393,09
1976	14,800	4	17	296	0.23	1,258	1.02	494,14
1977	15,300	4	17	306	0.23	1,301	1.02	510,84
1978	16,300	4	17	326	0.13	1,386	1.04	541,82
1979	15,100	4	17	302	0.23	1,284	1.16	566,88
1980	13,380	3	5	201	0.24	335	1.11	152,44
1981	14,098	3	5	211	0.24	3,52	1.11	160,93
1982	14,970	3	5	225	0.24	374	1.11	170,88
1983	17,000	5	13	425	0.24	1,105	0.99	436,92
1984	17,000	5	13	425	0.24	1,105	0.99	436,92
1985	17,000	5	13	425	0.24	1,105	0 <b>.9</b> 9	436,92
1986	19,500	4	15	390	0.24	1,463	0.99	563,17
1987	18,000	4	15	360	0.24	1,350	0.99	519,8
1988	17,300	4	15	346	0.24	1,298	0.99	499,6

+ Estimate (missing data)

1965 - 1968 MP 61.53 used

1968 - 1979 MP 62.71 used

1979 - 1983 MP 35.30 used

1983 - 1986 MP 63.17 used

F3--Traffic Data, I-90 (MP 61) Snoqualmie Pass

TOTAL ESAL'S = 8,188,124