California
State of the Pavement Report, 1999

California Department of Transportation
Maintenance Program
March 2001

Acknowledgment

The California Department of Transportation, Maintenance Program, Office of Roadway Maintenance, Pavement Management Information Branch, in cooperation with the United State Department of Transportation, Federal Highway Administration prepared this report.

Maintenance Program
Lawrence H. Orcutt, Program Manager

Office of Roadway Rehabilitation
Susan Massey, Chief

Rob Marsh, Program Advisor
Pavement Rehabilitation

Leo Mahserelli, Program Advisor
Pavement Rehabilitation

Brian Weber, Program Advisor
Pavement Rehabilitation

Pavement Management Information Branch
Peter Vacura, Chief
Mark Woerner, Research Program Specialist II
Jeff Duket, Research Program Specialist, Geographic Information Systems
Dario Moreno, Transportation Engineering Technician, Geographic Information Systems
Monica Markel, Research Analyst, Geographic Information Systems
Eric Lau, Research Analyst II

Office of Roadway Maintenance
Lance Brown, Chief Acting

Pavement Condition Survey
John Poppe, Jr., Maintenance Supervisor
William Nie, Pavement Evaluator
Moises Campos, Pavement Evaluator
Daniel Lem, Pavement Evaluator
Ray Lopez, Pavement Evaluator
John McDonald, Pavement Evaluator
Ron Merlott, Pavement Evaluator
Dennis Vonada, Pavement Evaluator
Bob Stapley, Pavement Evaluator

Technical assistance and printing provided by Administration Service Center, Business Services, and Reprographics Unit. Intranet and Internet conversion by Tim Longdon, Maintenance Program

Information about the Pavement Management System is available from:
California Department of Transportation, Maintenance Program, Pavement Information Branch,
1120 'N' Street, Rm. 3100, MS-31, Sacramento CA, 95814, telephone (916) 654-2355 or Calnet 464-2355.

Copies of this report may be obtained by request from:
Email: http://www.dot.ca.gov/hq/maint/99sop.pdf
California State of the Pavement Report, 1999

California, State of the Pavement Report, 1999
Table of Contents

California
1999 State of the Pavement Report

Executive Summary

The 1999 Pavement Condition Survey (PCS) began in April 1999 and was completed in February of 2000. It reported the total miles of pavement with significant repair needs (major maintenance or rehabilitation) at 15,572 lane miles, a 21 percent increase from 12,853 lane miles in 1997. This translates to approximately one-third of the highway system with pavement distress needs versus one fourth in 1997 (Table 1.) However, miles of pavement with a poor ride only represent one fourth of the total increases, from 3,676 in 1997 to 4,883 miles in 1999. As a result, vehicle miles of travel on pavement with a rough ride increased by approximately 21 percent. One of the reasons for the increase may be that the projects needs are developing much faster than treatments can be applied. Caltrans continues to develop and apply performance measures to ensure the best use of available repair funds.

Table 1. California State Highway System Needs

	1997		1999	
	Lane Miles	Percent	Lane Miles	Percent
'Now Needs' Projects (immediate rehabilitation)	5,485	11%	6,995	14%
Other Projects	7,368	15%	8,577	18%
Non-Project (routine maintenance)	36,030	74%	33,311	68%
System Total	48,883	100%	48,883	100%

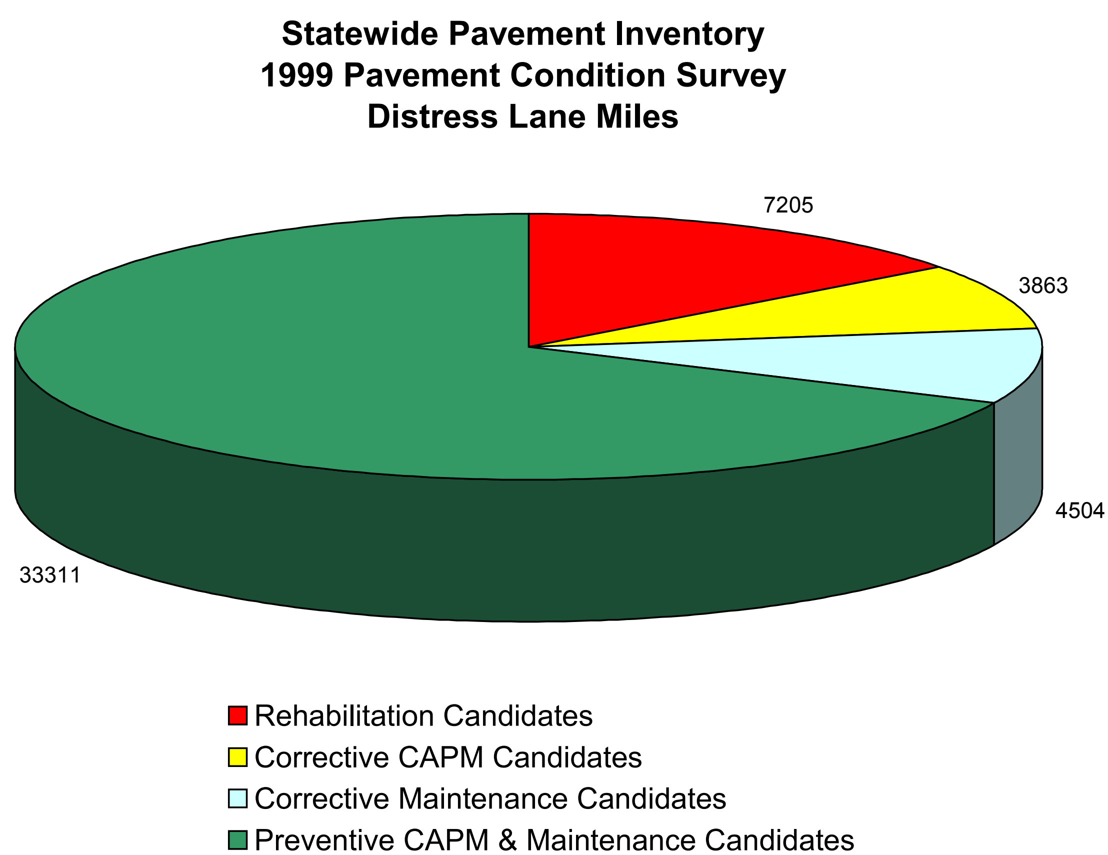
Source: 1997, 1999 Pavement Condition Surveys

Several measures indicate the urbanized areas within District 4 (San Francisco), District 7 (Los Angeles), and District 8 (San Bernardino/Riverside) continued to possess high concentrations of needs. Construction on urban freeways is more challenging due to very high traffic volumes. Needs in the District 6 (Fresno) and District 10 (Stockton) are growing rapidly as they transform into metropolitan areas. Costs to develop and construct projects in these high traffic areas are significantly higher than was estimated as recently as 1997. For example, rehabilitation costs have escalated from $250,000 per lane mile in 1997, to an estimated $400,000 per lane mile in 1999, a 60 percent increase.

Funding allocated to the pavement rehabilitation program in the Ten-Year SHOPP Plan must be maintained through adjustments for increases in construction costs. Those costs depend upon many factors. The materials and construction method are important factors in determining the total cost of pavement repairs. However, factors such as traffic management, FHWA-required improvements to highway appurtenances (for example, realignment, electrical, signs, drainage, and sound mitigation), and construction cost inflation have a major impact on costs. Figures compiled by Caltrans indicate construction costs increased between 8 and 18 percent during Fiscal Year (FY) 1996-97 and FY 1997/98, compared to FY 1995/96. The average cost indicated for pavement rehabilitation budgets jumped from $250,000 per lane mile in FY 1995/96, to an estimated $400,000 per lane mile in the 1998 SHOPP, based on anticipated projects. Rehabilitation costs are expected to continue to increase, to over $500,000 per lane mile by FY 2005/2006. Because pavement repair budgets are established years in advance, unanticipated cost increases will significantly reduce the miles of repairs that can be accomplished with a fixed budget.

Measures that show the dynamic changes in pavement condition on the system include district by district change in pavement needs, analysis of needs by lane configuration (single versus multi-lane facility), rural versus urban setting, Maintenance Service Level (MSL), and importance of the route to economic activity within California (Intermodal Corridors of Economic Significance, ICES).

Expenditures for the roadway rehabilitation (HA22) and major maintenance (HM1) programs in the FY 1998/99 were $437 million and $58 million, respectively. The HA22 program spent approximately 29 percent of its funds on Capital Preventive Maintenance (CAPM) while 66 percent were spent on traditional rehabilitation of pavements. The remaining 5 percent of the HA22 program's funding went into projects that were on bridges and other facilities. In 1999, 206 roadway rehabilitation projects were completed and repaired 3,132 pavement lane miles. The HM1 maintenance contract had 91 projects over the same period that maintained 3,123 lane miles of pavement.



Under the Streets and Highways Code Section 164.6 the Department is required to prepare a Ten-Year State Rehabilitation Plan for rehabilitation and reconstruction of all state highways and bridges. The Ten-Year Plan was transmitted to the CTC in February 1998 and Governor's office in May 1998. It is the basis for the Department's budget request and for the adoption of the State Transportation Improvement Program (STIP) Fund Estimate. Operations, maintenance and rehabilitation of the state highway system will be the first priority for funds. The plan must be updated every two years beginning in 2000. It must include specific milestones and quantifiable accomplishments such as lane miles of highways to be repaved and number of bridges rehabilitated. The Department recommended that traffic safety, roadway rehabilitation, roadside and traffic operations (SHOPP elements) be included in the 2000 Ten-Year Plan. The performance goal of the Ten-Year Plan is to achieve a reduction of pavement needs to 5,500 lane-miles by the FY 2007/08.

In 1999, additional funding was provided to help Caltrans to meet the performance goal of the Ten-Year Plan in reducing the distress lane miles of pavements to 5,500 lane miles (11 percent of the system) by the end of the FY 2007/08. An additional $50 million was provided in the FY 2000/01 for use in preventive maintenance contracts on pavements in good condition. The intent is to perform preventive maintenance on pavements with little or no distress and at the same time repair major distress pavement lane miles. Annual funding for Roadway Rehabilitation also increased from $150 million to $450 million with almost $2 billion available from 1998 to 2002. See Map1 on page 4 for the 1999 State of the Pavement map display.

For urban freeways, the objective of long life pavement is to get in, get out, and stay off the freeways. Caltrans is designing long life pavement to last twice as long as traditional roadway rehabilitation projects. Long Life pavement rehabilitation is proposed on 1,800 lane miles of pavement in the 1998 Ten-Year Plan. Nearly $200 million has been dedicated for this treatment over the next four years. The Long Life pavement concept was first introduced in 1997. The first Long Life project went to construction in October 1999 in Los Angeles County on Route 10. Fast setting hydraulic cement was used and most of the work was completed in a 55-hour window from 5PM Friday to 6AM Monday morning. The result was that the traffic and construction management objectives were attained.

One of the newest technologies being used is the Heavy Vehicle Simulator (HVS), designed in South Africa by the Council for Scientific and Industrial Research, for Accelerated Pavement Testing (APT). APT allows researchers to evaluate new pavement designs under conditions that closely simulate actual truck traffic. Prior to the HVS, it took fifteen to twenty years to verify laboratory test methods under actual truck traffic. Depending on the test being performed, the HVS is capable of simulating up to twenty years of heavy, inter-urban freeway truck traffic in approximately two to three months of operation.

Map 1, 1999 Pavement Condition Survey

Introduction

The California Department of Transportation (Caltrans) is responsible for maintaining a state highway system of 15,161 centerline miles, approximately 50,000 lane-miles of pavement. A Pavement Management System (PMS) analyzes the pavement network and identifies the rate of deterioration on the highway system, measured by the lane-miles of pavements with rehabilitation or maintenance needs. The PMS provides a detailed pavement inventory over time, identifies project needs, prioritizes pavement distress needs and summarizes the condition of the system.

Pavement Condition

Pavements are evaluated by their current and anticipated level of service to the traveling public based on ride quality and structural condition. The resulting classifications for pavement condition reflect both these factors. (See Table 2) Based upon the 1999 Pavement Condition Survey, there were 15,572 lane-miles of pavement needs with respect to ride quality or structural problems. This is a 21 percent increase from the 1997 State of the Pavement Report of 12,853 lane miles of pavement needs. Pavement needs history extending back to 1981 is shown in Table B on pages 24 and 25.

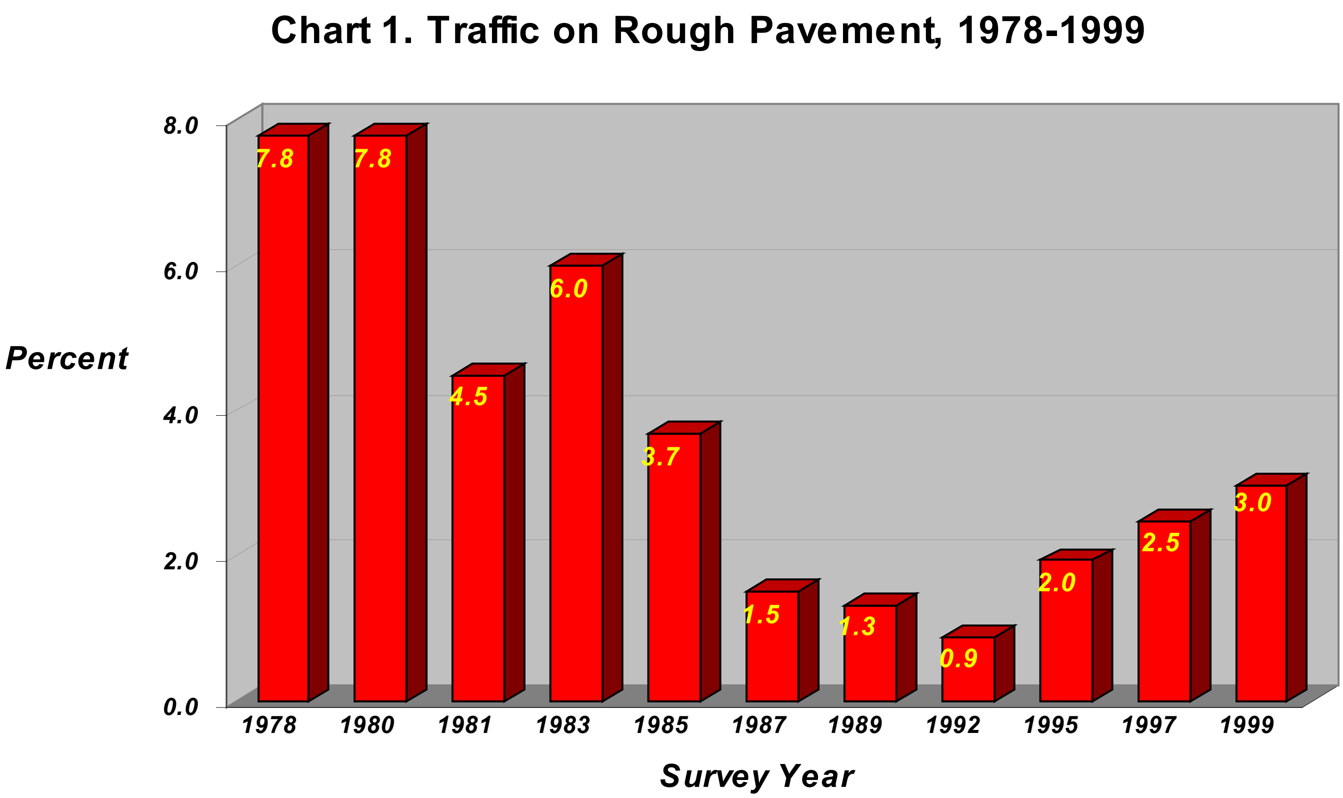
Table 2. Pavement Problem Classification

	1997			1999		
	Lane Miles	Percent of Problems	Percent of System	Lane Miles	Percent of Problems	Percent of System
Ride Quality Problem	3,676	29%	8%	4,883	31%	10%
Major Structural Problem	5,427	42%	11%	6,335	41%	13%
Minor Structural Problem	2,318	18%	5%	2,219	14%	5%
Class 3 Road Problems	1,433	11%	3%	2,135	14%	4%
Totals	12,854	100%	26%	15,572	100%	32%

Since the 1997 Pavement Condition Survey, the total number of distress lane miles increased by 21 percent, from 12,853 in 1997 to 15,572 in 1999. There was a 32 percent increase in lane miles of pavements with a ride quality problem (Table 2). This is important since ride quality is one of the more important features identified by the traveling public. Major structural problems increased to over 6,300 lane miles of pavement in 1999, a 17 percent increase since 1997. On Class 3 roads, predominantly rural roads with Average Daily Traffic (ADT) less than 1000, needs increased to 2,135 lane miles, nearly a 50 percent increase since 1997. Needs on Class 3 roads are identified separately from the same needs on other highways.

Vehicle Miles Traveled on Rough Pavements

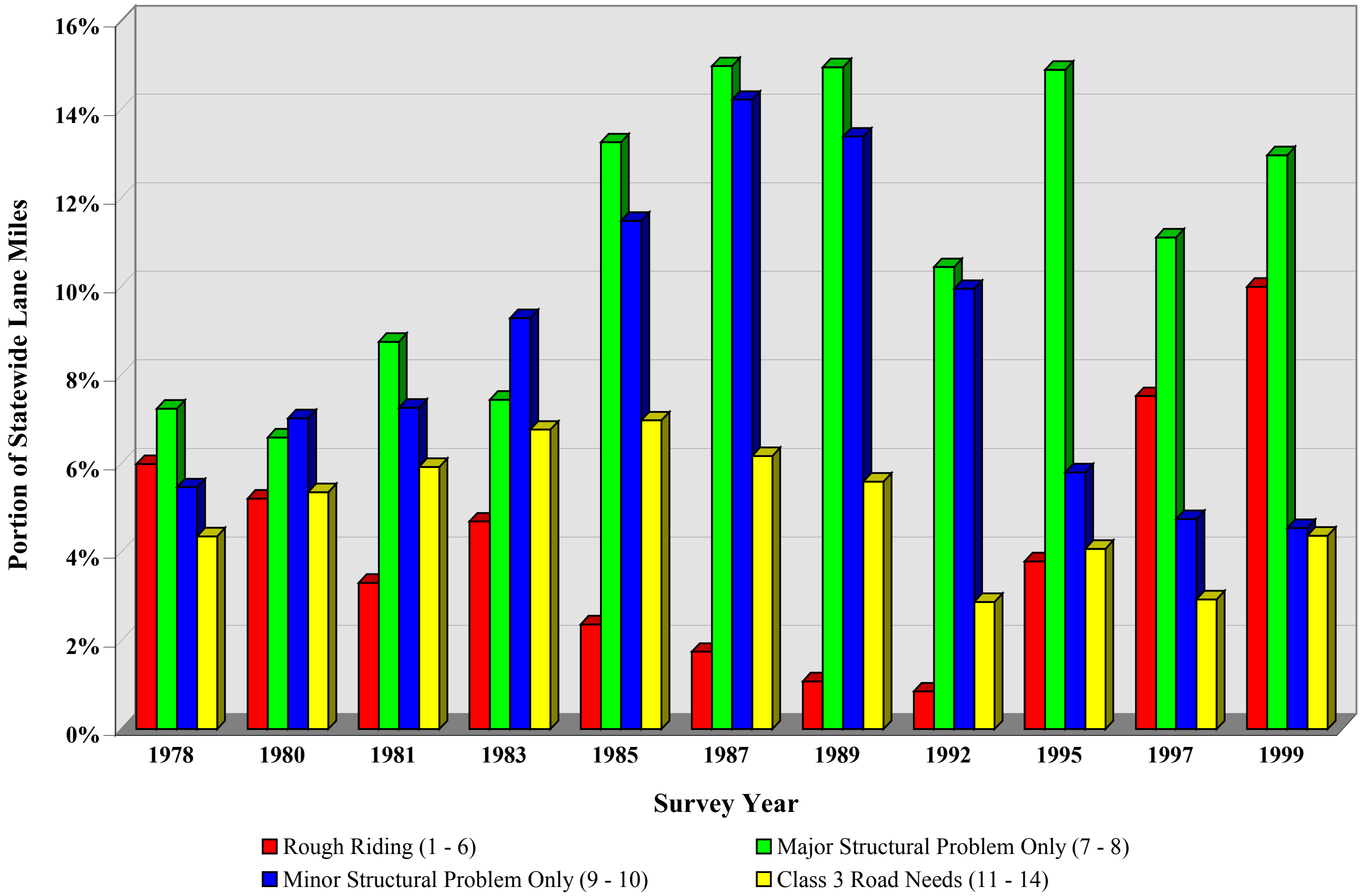
The ride quality of pavements is a primary indicator of customer satisfaction. A long standing measure is the total vehicle miles of travel occurring on pavements with an 'unacceptable' ride. Generally, a pavement with an International Roughness Index (IRI)



score of greater than 210 inches of surface roughness per mile would be considered by most motorists to be uncomfortable or 'unacceptable'.
For comparison purposes, new pavement or recently rehabilitated pavement would provide an 'excellent' ride, which would correspond to less than 60 inches of surface roughness per mile, an IRI score of under 60. Travel on rough-riding pavement increased from 2.5 percent to 3 percent of total vehicle miles between 1997 and 1999 (Chart 1.) This is consistent with the 21 percent increase in lane miles of distressed pavements as shown in table 2.

A time-series of the distribution of lane miles of pavement needs by priority group for the 1978 through 1999 Pavement Condition Surveys is presented in Chart 2. As displayed by the red and green bars, between 1997 and 1999 there were increases in lane miles of roads having a rough ride and major structural problems. However, there was a slight decrease in lane miles of road with minor structural damage as shown by the blue bar. Finally, there is a small increase in Class 3 roads that have low traffic volumes presented by the yellow bar.

Chart 2. Distressed Lane Miles compared to Total Lane Miles, by Problem Type, 1978-1999



Needs Classification

The pavements with the greatest rehabilitation need are classified as 'Now Needs'. This classification includes all pavements with an unacceptable ride and with or without structural problems (Priority 1-6), and approximately one third of the pavements with a major structural problem only (Priority 7-8). These are typically pavements that require immediate attention to correct rough and/or highly distressed pavements to reduce undesirable effects on highway users.

The 1999 Pavement Condition Survey reports the total candidates for rehabilitation have increased since 1997. Approximately 14 percent of total system miles are rehabilitation candidates, which translates to nearly 7,000 lane-miles of Now Needs (Table A.) This is a 27 percent increase from the 1997's figure of 5,485 lane-miles. The increase in 'Now Needs' can be attributed to the major structural problems component, which has increased 21 percent since 1997, to nearly 6,300 lane miles. This group represents 40 percent of total needs for the state. The increase in the pavements with major structural problems creates a challenge for the department in its effort to achieve its pavement performance goal. The reason is that most major structural damages require more costly rehabilitation for long-term correction, and rehabilitation projects require the most time to design and construct. These pavements are also the most expensive to correct. In 1998, funding was increased to four times of the previous amount. However, the lag time from funding to construction takes up to four years for a full rehabilitation project. Therefore, these pavements could have developed an unacceptable ride while waiting for the construction phase. Also, one reason for the rise in these percentages is due to the pavement condition survey being performed prior to the construction being completed on these projects.

Fortunately, some distressed pavements can be maintained during the long lead design by using of the Capital Preventive Maintenance (CAPM) treatment. This CAPM treatment extends the pavement life three to five years for pavement with substructure failure and seven to ten years for pavement with surface distress only. This is another challenge in the Department's efforts to transition from a 'worst first' pavement management strategy to a preventive maintenance strategy.

Pavement Performance

Pavement conditions and performances differ due to factors such as climate, geography, construction methods and material characteristics, traffic volumes, maintenance history, and age of the pavement. Traffic volumes and climate have been the biggest contributors of pavement deterioration on the state highway network. Expected life of pavements in California may be reduced due to excess vehicle loads on the pavement, especially truck traffic. As pavement distress develops, the rate of pavement deterioration accelerates especially if not attended to in a timely manner. In addition, severe wet weather, such as the winters of 1995 and 1996, can further accelerate pavement deterioration. The wet weather conditions, along with inadequate drainage systems, cause the base material supporting pavements to become saturated with water, and thus accelerate pavement deterioration on previously damaged pavements.

The quantity and quality of repair work that reduces pavement needs can also play a major role in the condition of the network. New technology is being researched and implemented. This will help evaluate and report the condition of the pavement so that better project selection decisions can be made. Hence, the right treatment applied at the right place at the right time will definitely improve the quality of the network.

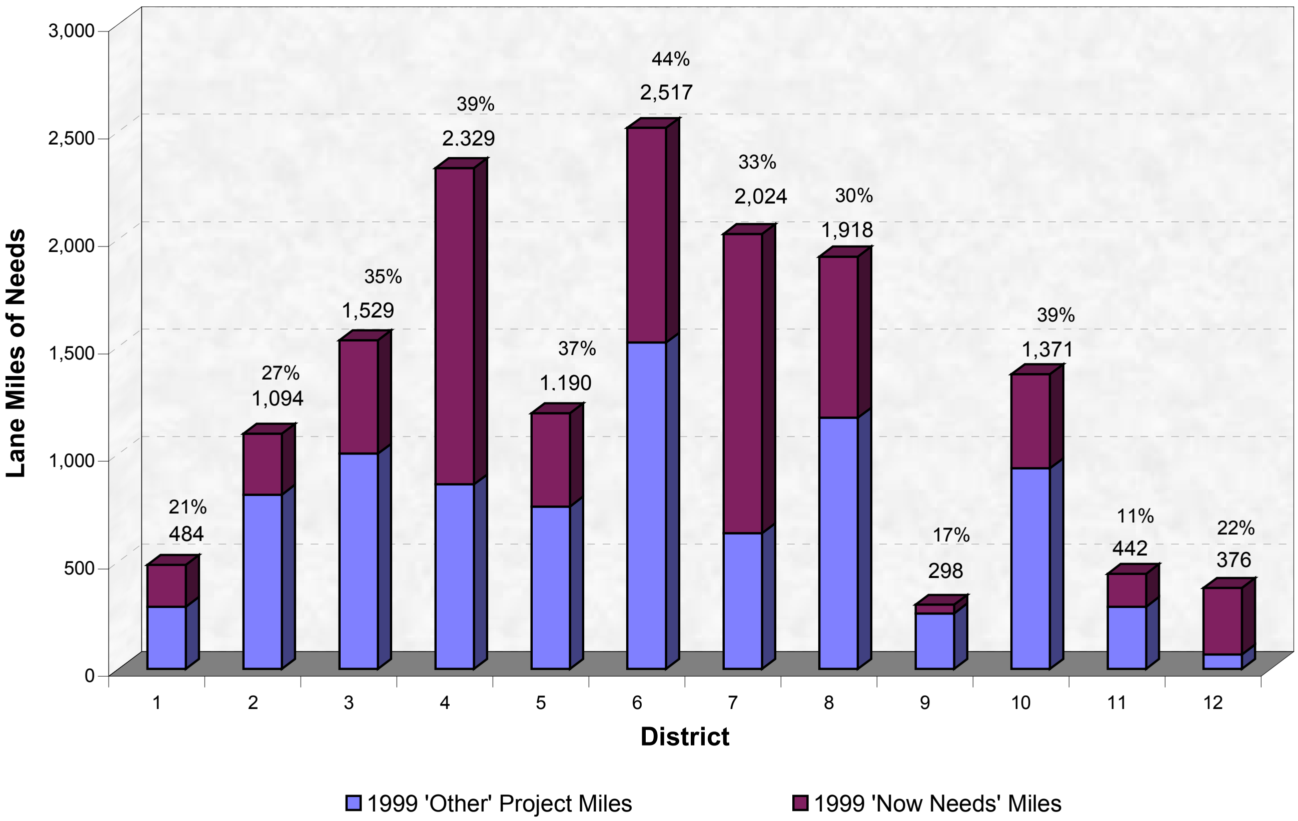
District Pavement Condition

A detailed distribution of percent of pavement 'Now Needs' by district from the 1999 Pavement Condition Surveys is presented in Chart 3. As shown by the red bar, over half the needs were classified as 'Now Needs' for Districts 4 and 7. Total needs, as indicated at the top of the bars, are also high for Districts 3, 4, 6, 7, 8, and 10.

Each of District 3, 4, 6, 7, and 8 have needs of greater than 1,500 lane miles, which is significantly above the statewide average level of 30 percent of lane miles. Efforts to perform rehabilitation work in the urban areas in Districts 4, 7, and 8 are complicated by traffic congestion concerns, the need to complete roadway construction work faster to minimize traffic delays, and the high costs of the rehabilitation projects. This is especially true for Districts 4 and 7 as over half of their needs are rehabilitation and account for over 40 percent of statewide Now Needs.

Chart 3. District Needs in Lane Miles, 1999 PCS

Percentages show portion of district lane miles with needs

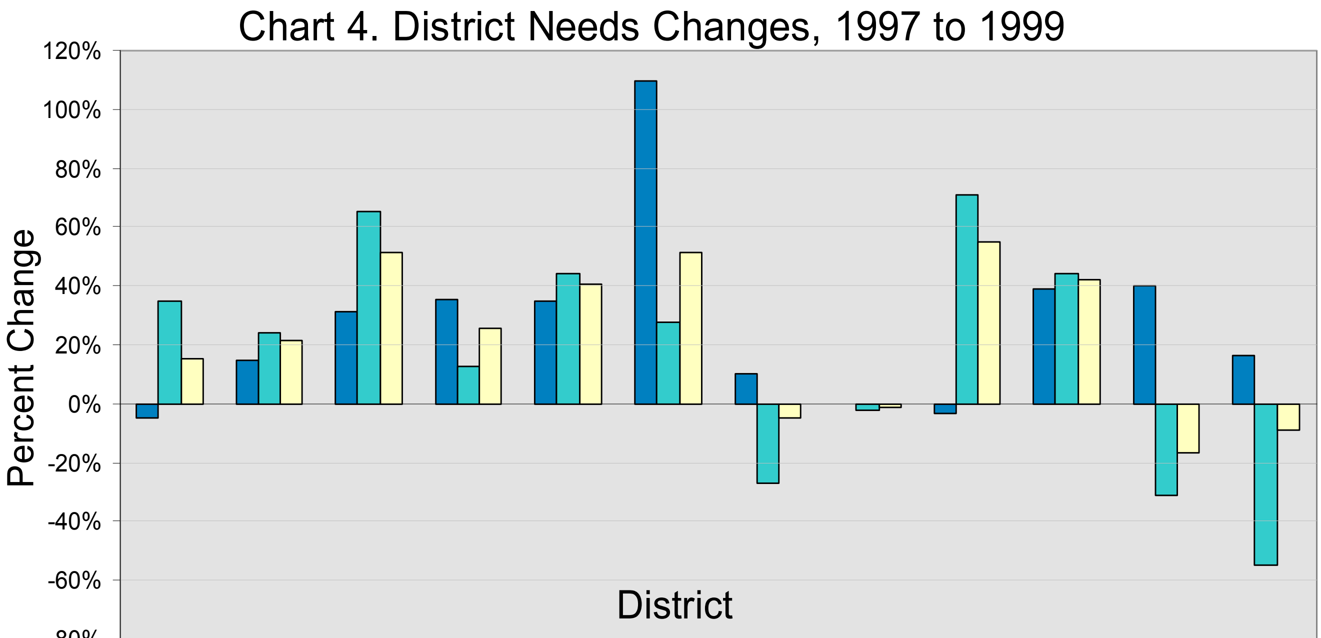


Districts 1, 5, 10, and 12 also have large portions of their needs as 'Now Needs.' However, Districts 1 and 12 have less than one forth of their systems requiring attention. District 2 has just over one quarter of its system requiring maintenance work and one quarter of those total needs are rehabilitation needs.

Districts 9 and 11 have maintained their needs near their 1997 level and close to the performance goal established for FY 2007/08. District 9 has limited rehabilitation needs and should continue to focus on utilizing CAPM or preventive maintenance to reduce its' other needs. District 11 saw an overall reduction of needs but showed an increased portion of rehabilitation needs. It may be the result of increased traffic volume by expanded trade with Mexico via the North American Free Trade Agreement (NAFTA.)

<u>District Allocations and Changes in Needs</u>

Each of the twelve districts review their priorities in order to provide a balance between 'Now Needs" and 'Other Needs'. The challenge is to match their priorities with their allocations. The changes in needs for each district between the 1997 and 1999 surveys are shown in Chart 4. The chart does not include projects delivered after the 1999 Pavement Condition Survey was completed.



	1	2	3	4	5	6	7	8	9	10	11	12
Change, Now Needs	-5%	15%	31%	35%	35%	109%	10%	0%	-3%	39%	40%	16%
Change 'Other' Needs	35%	24%	65%	13%	44%	28%	-27%	-2%	71%	44%	-31%	-55%
Change, All Needs	15%	22%	52%	26%	41%	51%	-5%	-1%	55%	42%	-17%	-9%

In 1999, overall expenditures for the rehabilitation (HA22) and major maintenance (HM1) programs were $437 million and $58 million, respectively. The HA22 program spent approximately 29 percent of its funds on Capital Preventive Maintenance (CAPM) while 66 percent were spent on traditional rehabilitation of pavements.

Table 3. Fiscal Year 98/99 HA22/HM1 Expenditures and Lane Miles Retired

District	Expenditure (In Millions)	Lane Miles
1	$41	446
2	$86	863
3	$94	922
4	$22	626
5	$11	263
6	$35	613
7	$63	744
8	$22	308
9	$17	188
10	$46	437
11	$38	317
12	$21	167
Total	$495	5893

District 1 spent over $37 million in its HA22 program and more than $3 million in its HM1 program in 1999. Its rehabilitation expenditures repaired 335 lane miles; reducing their Now Needs by 5 percent. CAPM strategies were utilized on majority of its rehabilitation repairs. Its HM1 program preserved 110 lane miles of pavement. Its "Other Needs" rose 35 percent, which represents an increase of 74 lane miles.

In 1999, District 2 was expended $80 million for its HA22 program and expended $5 million in its HM1 program. District 2 spent one-third of its HA22 dollars on CAPM strategies, for 115 lane miles, and rehabilitated more than 300 total lane miles in the program. Its HM1 program performed maintenance strategies on just under 600 lane miles of pavement in 1999, second highest district. Although District 2 had an increase of 22 percent in total needs, its focus on rehabilitation strategies kept the increase in Now Needs from escalating. In addition, the survey showed 15 percent of District 2 total needs were attributed to ride quality problems.

Rehabilitation expenditures for District 3 were $90 million and restored nearly 600 lane miles of pavement. Similar to District 2, District 3 also utilized one-third of its dollars in CAPM strategies but produced 230 lane miles. In addition, its HM1 program spent nearly $4 million and maintained nearly 330 lane miles of pavement. Even though District 3 repaired over 900 lane miles of pavement in 1999, its needs increased to 52 percent in total needs. Over 70 percent of its total needs are attributed to structural problems and associated with routes with high traffic volume. The increase in needs may be due to the fact that District 3 is one of the fastest growing regions in California. Many of its counties experienced extremely rapid growth as many high-tech companies moved into the region.

District 4 accumulated most of its deterioration in the 'Now Needs' category. This was due to the shifting of lane miles of 'Other Needs' that became rehabilitation needs from the backlogs of prior years. More than half of the needs in District 4 belong to priority 1-6 where ride problems exist and rehabilitation repairs are necessary. In 1999, District 4 spent $17 million and restored slightly more than 100 lane miles of pavement in its HA22 program. Although District 4 only spent $4 million in its HM1 program, it still perform strategies on more than 500 lane miles of pavement, which was one of the highest among all 12 districts in the HM1 program. District 4 still has a large backlog, over 1200 lane miles, of rehabilitation needs.

District 5 showed significant rise in all needs. Two-thirds of its needs are attributed to structural problems. District 5 expended approximately $7 million and rehabilitated 37 lane miles of pavement. No CAPM strategies were used under the HA22 program. As for its HM1 program, close to 230 lane miles were restored with over $3 million expended in 1999. Although there was a 35 percent increase in 'Now Needs' for this district, the actual increase was only 46 lane miles from the previous survey. On the other hand, the majority of District 5's increases are in the 'Other Needs' category. Like many other districts, most of the pavements that require repair in District 5 are on pavements with an acceptable ride quality.

District 6 has the highest increase in 'Now Needs', with an increase of over 100 percent from the 1997 Pavement Condition Survey. The increase reflected on the number of distressed lane miles in priority 1-6 where it quadrupled within the past two years. Even though 'Other Needs' didn't increase as much as 'Now Needs', it was still considered a substantial increase. Similar to most districts, District 6 had most of its needs on pavements without ride quality distress problems. As for the financial side, District 6 expended $30 million in the HA22 program and rehabilitated just over 130 lane miles of pavement and used CAPM strategies only for one-third of the lane miles treated in 1999. For its HM1 program, District 6 preserved close to 500 lane miles of pavement with $5 million of expenditures.

District 7 managed to reduce ‘Other Needs’, and saw only a very small increase in ‘Now Needs’ since 1997. It expended over $51 million in its HA22 program and repaired over 440 lane miles of pavement with two-thirds of the lane miles repaired utilizing CAPM strategies. As for its HM1 program, $8 million were expended and restored about 300 lane miles of pavement. District 7 has a much higher costs per mile, which can be attributed to increased traffic control costs associated with densely populated areas. Although total needs didn’t increase between the two surveys, District 7 still has a large backlog, over 1200 lane miles, of rehabilitation needs.

District 8 reported a small decrease of “Other” and all needs since the 1997 survey. This shows progress toward the Caltrans performance goal for FY 2007/08. District 8 expended $14 million in its HA22 program and rehabilitated about 110 lane miles of pavement, all of which used traditional rehabilitation strategies. Nearly 200 lane miles were restored with the $7 million expenditures incurred under its HM1 program.

District 9 has the least number of miles of needs in the state. $13 million were expended in its HA22 program to rehabilitate nearly 130 lane miles; 40 lane miles utilized CAPM strategies. There was no change in the ‘Now Needs’ category. An expenditure of over $3 million were spent in its HM1 program and close to 60 lane miles of pavements preserved under the program in 1999. Its ‘Other Needs’ rose sharply since the 1997 survey since District 9 had a small inventory. However, all the needs in District 9 are on pavement with a good ride quality yet with extensive major or minor structural distress.

District 10 saw a significant increase in ‘All Needs’ though only 16 percent was attributed to distressed pavement with a poor ride. District 10’s HA22 program expended $42 million to repair nearly 270 lane miles. Traditional rehabilitation was performed on approximately 180 of those 270 lane miles of pavement in 1999. Close to $4 million was expended under its HM1 program and only about 160 lane miles of pavement were restored. The District’s cost of $26,000 per lane mile is considered one of the highest in the state under the HM1 Program. Some of this can be attributed to the premium maintenance treatments used in rural locations. Majorities of the increase in needs in District 10 were on pavements without ride problems with structural problems and they accounted for 83 percent of the district’s total needs. Similar to District 3, District 10 also experienced rapid urbanization due to the improved economy.

While District 11 showed a decline in ‘All Needs’ and ‘Other Needs’, it also had a sharp increase in its ‘Now Needs’ during the past two years. Overall needs for the district has declined to 442 lane miles or approximately 10 percent of its network. In 1999, District 11 had spent $35 million in its HA22 program to repair 220 lane miles of pavement, which were split between both CAPM and traditional rehabilitation strategies. In addition, District 11 expended $3 million for the HM1 program by preserving 100 lane miles of pavement.

District 12 had showed a 9 percent decline in 'All Needs' yet many of the minor pavement distress migrated into major distressed pavement. Thus a 16 percent increase in 'Now Needs.' However, District 12 still showed some type of needs on 376 lane miles or 25 percent of its network. In 1999, its HA22 expenditures totaled $18 million and rehabilitated nearly 90 lane miles of pavement with less than 30 lane miles in CAPM strategies. Meanwhile, HM1 program expended $2.5 million and preserved nearly 80 lane miles of pavement.

Challenges in Project Planning

Economic growth and wide spread development in the commercial and residential housing markets throughout the State creates additional challenges for the Department in maintaining the highway network. These challenges are realized by the growing concentration of pavement needs in the highly urbanized districts of Los Angeles (District 7), San Francisco (District 4), and Riverside-San Bernardino (District 8.) These districts combined have 40 percent of total pavement needs, and over half of the critical 'Now Needs'. They represent only 38 percent of pavement miles in the state. Meanwhile, the Central Valley districts, District 3 and District 10, are showing increased needs as they transform into metropolitan areas due to the growth. The rapid housing growth is affecting these two districts as high-tech company build new facilities and created thousands of new jobs in Central Valley. In addition, many professionals working in the San Francisco Bay Area are commuting from the Central Valley where housing prices are substantially less than in the Bay Area. The commuters are generating additional vehicle miles traveled on the highway network.

Districts 4, 7, and 8 have some of the highest traffic volumes in the world. Traffic control management during construction could account for as much as 30 percent of the construction cost. Due to the construction restrictions and lack of traffic windows during the day, major urban freeway projects are being constructed at night and on weekends. In order to address the traffic management issues, Caltrans is developing longer-life pavements that will last twice as long as traditional rehabilitation projects. This reduces the traffic delay impacts by minimizing the number of future maintenance and rehabilitation projects. For urban freeways, the longer-life pavement objective is to get in, get out, and stay off the roadway.

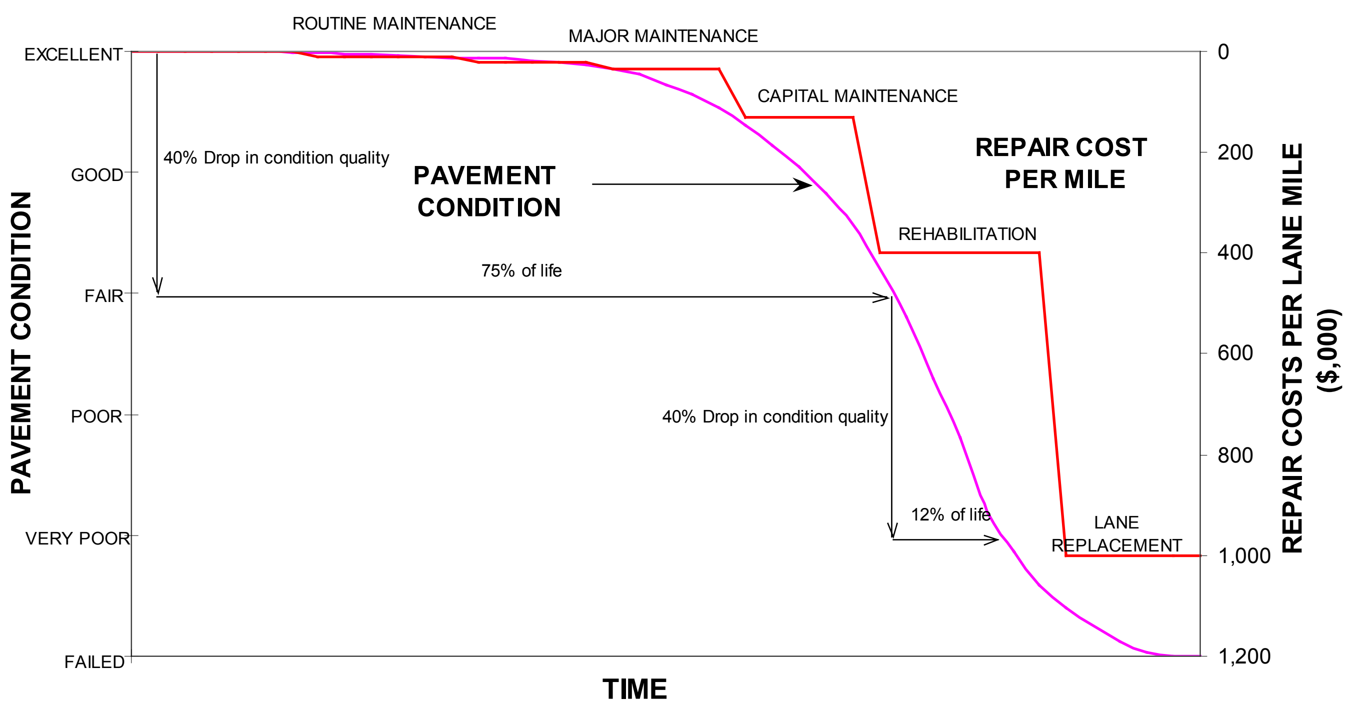
Another challenge imposed on Caltrans in project development is the fact that 56 percent of pavement needs are located on multi-lane divided pavements; 65 percent of these needs are 'Now Needs.' Costs to repair these pavements will increase due to the limited strategies that can be used at these sites. On the other hand, the 1999 Pavement Condition Survey indicates the need on Intermodal Corridors of Economic Significance (ICES), the major routes used for interstate and intra-state commerce, did not increase with the rest of the network. In fact, ICES pavements have improved over the past two years and saw its percentage of 'Now Needs' dropped from 35 percent to 25 percent. This is a 10 percent decrease from needs indicated in the 1997 State of the Pavement Report.

Corrective and Preventive Treatments

Under the 1998 Ten-Year Plan, one of the goals was to move from doing the worst pavements first to preventive maintenance. Under "worst first", pavements in the worst condition (based on ride quality and structural condition) received the highest priority for repair. This limits the number of repairs that can be performed for a given budget. Preventive treatments maintenance keeps pavements in good condition, as shown in Chart 5. They cost six to ten times less than treatments used after the pavement has failed. Some of the projects in the preventive maintenance are CAPM, Major Maintenance, and Routine Maintenance. If the pavement condition deteriorates past the breakpoint where the pavement has failed, then a full reconstruction must be performed, rather than a less expensive surface treatment.

As shown on Chart 5, rehabilitation is the most expensive treatment that corrects the pavement structural section rather than the pavement surface. These projects are below the preventive program line where the pavement failed and needs reconstruction. Cost for a rehabilitation, including upgrade of related facilities, is approximately $250,000 to $400,000 per lane mile. Long life strategies are also available but at a substantially higher cost of between $750,000 to $1 million per lane mile. Long life pavements offer significant user cost savings through reduction of impacts on highway traffic users over the life of the pavement.

Chart 5. Pavement Condition vs. Cost of Repair



Maintaining pavements in good to excellent condition requires frequent, low cost treatments.

Capital Preventive Maintenance (CAPM) was introduced in 1996 as a new class of rehabilitation treatments that is effective in the repair of minor structural problems. CAPM strategies provide moderate structural section improvement or substantial ride quality improvement at moderate cost of $130,000 per lane mile (see Chart 5.) They have been widely adopted due to the moderate cost, ability to correct many minor to moderate structural problems, and ease and speed of project development. However, a CAPM that is used on pavement that has failed provides a service life only three years or less. A CAPM on failed pavement would be considered a corrective treatment. These projects would hold the pavement condition until the full rehabilitation can be constructed.

Major Contract maintenance treatments are used to correct most minor surface problems. These maintenance strategies typically cost between $6,000 and $30,000 per lane mile. A major maintenance contract performed on pavement in good condition is considered preventive. The service life for preventive maintenance varies from five to fifteen years depending on the traffic volumes and environmental conditions. If the pavement has failed, then a maintenance contract project would expect to last about a year on an urban freeway. This maintenance contract would be considered corrective treatment.

Research and experience has shown that a more balanced approach utilizing preventive maintenance will maintain the network in a better condition at a lower total cost. Routine maintenance and preventive maintenance treatments are used to preserve pavements that do not have significant structural or ride quality problems. These treatments reduce development of minor structural problems into major structural problems or ride quality problems. Frequent application of these preventive maintenance treatments provides a very cost-effective alternative to the costly 'worst-first' approach to PMS, and maintains the network in a better overall condition across the state.

Challenges Ahead

Under the Streets and Highways Code Section 164.6 the Department is required to prepare a Ten-Year State Rehabilitation Plan for rehabilitation and reconstruction of all state highways and bridges. The Ten-Year Plan was transmitted to the CTC in February 1998 and Governor's office in May 1998. It must be the basis for the Department's budget request and for the adoption of the State Transportation Improvement Program (STIP) Fund Estimate. Operations, maintenance and rehabilitation of the state highway system will be the first priority for funds. The plan must be updated every two years beginning in the year 2000. It must include specific milestones and quantifiable accomplishments such as lane miles of highways to be repaved and number of bridges rehabilitated. The Department recommended that traffic safety, roadway rehabilitation, roadside and traffic operations (SHOPP elements) be included in the 2000 Ten-Year Plan. The goal of the Ten-Year Plan is to achieve a reduction of pavement needs to 5,500 lane-miles by the FY 2007/08. Over $3 billion was budgeted for pavement rehabilitation and longer-life pavement in the 1998 Ten-Year plan.

In order to achieve significant improvement in pavements with either major structural distress or an unacceptable ride, repair work must focus on the majority of the needs that currently exist on the multi-lane facilities in the highly urbanized areas of the state. These projects will primarily be in the Los Angeles basin and San Francisco Bay area. In addition, Central Valley district needs are also growing and must be attend to before they become unmanageable.

Funding allocated to the pavement rehabilitation program in the Ten-Year SHOPP Plan must be maintained through adjustments for increases in construction costs. Those costs depend upon many factors. The materials and construction method are important factors in determining the total cost of pavement repairs. However, factors such as traffic management, FHWA-required improvements to highway appurtenances (for example, realignment, electrical, signs, drainage, and sound mitigation), and construction cost inflation have a major impact on costs. Figures compiled by Caltrans indicate construction costs increased between 8 and 18 percent during FY 1996/97 and FY 1997/98, compared to FY 1995/96. The average cost indicated for pavement rehabilitation budgets jumped from $250,000 per lane mile in FY1995-96, to an estimated $400,000 per lane mile in the 1998 SHOPP, based on anticipated projects. Rehabilitation costs are expected to continue to increase, to over $500,000 per lane mile by FY 2005/06. Because pavement repair budgets are established years in advance, unanticipated cost increases will significantly reduce the miles of repairs that can be accomplished with a fixed budget.

Departmental funding priorities must continue to emphasize pavement maintenance and rehabilitation. In addition, adequate staffing resources must be provided to plan and deliver the appropriate projects in a timely manner. Funding increases have more than tripled for pavement rehabilitation during the past three fiscal years, and the Ten-Year State Highway Operation and Protection Plan (SHOPP) provides further increases over the next several years. It includes delivery of longer-life pavement projects and major rehabilitation on urban freeways.

Caltrans began to use the Heavy Vehicle Simulator (HVS), designed in South Africa by the Council for Scientific and Industrial Research (CSIR), for Accelerated Pavement Testing (APT). Prior to the HVS, researchers had to wait fifteen to twenty years to see if new laboratory test methods would indeed provide reliable results for pavements under actual truck traffic. In addition, APT allows researchers to evaluate new pavement designs under conditions that closely simulate actual truck traffic. Depending on the test being performed, the HVS is capable of simulating up to twenty years of heavy, inter-urban freeway truck traffic in approximately two to three months of operation. It accomplishes this by trafficking the test pavement 24 hours/day, 7 days/week, and by loading the wheel at up to two and a half times that of a typical truck wheel load. The HVS was relocated from the UC Berkeley lab to District 7, Los Angeles County, on State Route 14 near Palmdale with anticipated results in winter 2000.

The HVS analyses will provide pavement structure design criteria changes to increase pavement performance and determine the types of materials needed to produce a greater than thirty years pavement life. Innovative pavement designs should extend pavement lives substantially beyond conventional asphalt concrete designs. Caltrans will be investing $1.5 million annually for three years on this experiment.

Appendix

Pavement Condition Survey

To effectively manage the state's pavements, the California Department of Transportation (Caltrans) conducts an annual Pavement Condition Survey (PCS). The PCS uses a full-time crew of pavement raters that travel the state to observe and report the condition of pavements using an objective sampling process. The rating crew collects pavement distress information, such as the severity and extent of various structural pavement defects for most lanes. In addition, a 'profile' van travels the highways collecting ride quality information for the pavement. Applying the rating process uniformly to every highway in the state gives an accurate picture of the condition of the network and a useful time-series of data.

The Pavement Condition Survey that provides the data for the PMS has been re-engineered to improve both the quantity and quality of data available to users throughout Caltrans. These updates ensure that pavement condition is continuously monitored and reported through field evaluation of both the ride quality and structural condition. Data collected during the PCS is transferred to Caltrans headquarters and analyzed within the Pavement Management System (PMS).

California Pavement Management System

A pavement management system (PMS) provides a systematic, objective evaluation of pavement condition for identification of maintenance and rehabilitation needs. Significant capabilities of the California PMS include: description of current pavement inventory condition, project identification and prioritization, and estimates of fiscal resources required to repair the system. It is the tool used to measure progress in achieving Caltrans' pavement performance goal of reducing total pavement needs to 5,500 lane-miles by the end of FY 2007/08, and improve the condition of the remaining pavements with needs.

The PMS currently in use in California was developed in the late 1970s. Its original design intent was to repair highway segments with severe problems, a 'worst-first' approach to pavement maintenance and rehabilitation. The approach reduced the number of lane miles that could be repaired, because of the high cost of rehabilitation treatments. Temporary repair using a maintenance strategy must occasionally be substituted for reconstruction of the facility. This substitution prevents treatment of other miles that are appropriate candidates for a maintenance treatment. An update to the California PMS is currently underway.

Pavement locations are classified by the conditions found in each lane, using both ride quality and structural condition criteria. The strengths of the existing system are it's reporting of the inventory condition, and the emphasis it places on maintaining an acceptable ride quality, the key attribute of interest system users. A prioritized list of potential projects is provided to the district offices for review and addition of local information. While the PMS suggests an initial project sequence, district knowledge of local needs and funding availability is used to select specific projects, re-order project priorities, and design pavement projects. The principal factor limiting pavement maintenance and rehabilitation has been lack of funds.

Maintenance Service Level

Caltrans uses a three class system, termed 'Maintenance Service Level' (MSL), to distinguish the role various highways fulfill within the state highway network. Maintenance Service Level 1 (MSL 1 or Class 1) highways consist of Interstate highways, freeways, and other principal arterial routes with high traffic volumes of over 5,000 vehicles per day. Maintenance Service Level 2 (MSL 2 or Class 2) routes are routes with moderate volumes of 1,000 to 5,000 vehicles per day, typically connecting MSL 1 routes or providing route continuity between MSL 1 routes. Maintenance Service Level Class (MSL 3) routes have low traffic volumes, or serve as collectors for MSL 1 and MSL 2 routes. Traffic volumes are usually 1,000 or less per day.

Priority Assignment

Two criteria, ride quality and structural condition, are used to establish the overall condition of an individual segment of pavement. That information is combined with the Maintenance Service Level value to establish the 'Priority Value' assigned to that pavement. The Priority Value indicates the class of work (rehabilitation, CAPM, or major maintenance) likely to be used to repair a pavement. The shift to identifying work by the type of repair, existing needs, and funding identified for a given type of repair has reduced the reliance on the Priority Value as an indicator of the urgency for performing repair work.

If a highway receives no priority value, routine or preventive maintenance is performed to keep pavement in good condition. Preventive maintenance is beginning to receive additional emphasis to delay development of significant structural distress for those highway segments.

The most important criteria for identifying the need to repair highway is ride quality. This is measured by driving a van equipped with a laser profilograph over a pavement at highway speed. Pavement roughness from the profile van is measured using a standardized scale, called the International Ride Index (IRI). The IRI is reported as inches of surface roughness per mile of pavement. The IRI value is interpreted as either an 'acceptable' or 'unacceptable' ride. Unacceptable rides typically have more than 200 inches of roughness per mile.

Pavement structural condition is evaluated by observation of characteristic distress types. Distress types are unique to each of the two predominant pavement types: flexible, Asphalt Concrete pavements, or rigid, Portland Cement Concrete pavements. The combinations of individual distresses observed on a pavement are then evaluated for severity, and broadly classified into overall levels of structural distress, such as 'None', 'Minor', or 'Major'. The combination of ride quality information and detailed structural distress information is also used to identify strategies for repairing the pavement. The actual corrective strategy that will provide the most cost-effective repair of a pavement segment is determined by site reviews and cost analysis.

Finally, the Maintenance Service Level is used to assign a priority value based upon the role the route fulfills within the state highway network. Therefore, MSL 1 highways receive higher priority for repair than MSL 2 highways, pavement conditions being equal. MSL 3 highways receive the lowest priority ranking for rehabilitation. Current policy states that MSL 3 highways may receive rehabilitation by exception only, on a case-by-case basis.

A matrix of 14 values results from the combination of MSL, ride quality, and structural condition. The value each pavement segment receives is used to identify the class of treatment a pavement requires, either maintenance or rehabilitation. In the case of two pavement segments with identical priority values, the site that will receive project development and funding depends upon factors such as traffic volume, safety issues, project costs, and ongoing maintenance expenditures as well as a detailed condition comparison.

The matrix below shows priority values based on ride quality, distress, and road class, and includes the lane miles in each group, the percentage of network needs within the priority group, and the portion of total system lane miles within the priority group.

1999 HA-22 Rehabilitation Program Priority System

Ride Quality	Structural Problem	Needs by Priority Category (lanemiles, percent of needs, percent of system)		
		Highway Class		
		1 AADT>5,000	2 AADT 1,000 to 5,000	3 AADT < 1000
Poor Ride	Major	1 569 ▼ 3.7% 1.2%	2 1538 ▲ 9.9% 3.1%	11 282 ▲ 1.8% 0.6%
	Minor	3 510 ▼ 3.3% 1.0%	4 536 ▲ 3.4% 1.1%	12 77 ▼ 0.5% 0.2%
	None	5 408 ▼ 2.6% 0.8%	6 1322 ▲ 8.5% 2.7%	N/A - - - -
Acceptable Ride	Major	7 4418 ▲ 28.4% 9.0%	8 1917 ▲ 12.3% 3.9%	13 1343 ▲ 8.6% 2.7%
	Minor	9 1586 ▼ 10.2% 3.2%	10 633 4.1% 1.3%	14 432 ▲ 2.8% 0.9%

Symbol Key:

▲ Substantial increase since 1997

▼ Substantial decrease since 1997

Priority values of 1 through 6 include pavements in MSL Class 1 or 2 having a poor ride, with or without structural distress. These pavements are candidates for rehabilitation funding. Priority values 7 and 8 are found on MSL 1 and 2 roads with major structural distress alone. Experience has shown that approximately one-third of these roads require rehabilitation, As a result, all the priority 1-6 needs are combined with one-third of the priority 7 and 8 needs to form the pool of immediate rehabilitation needs, or ‘Now Needs’. The remaining two-thirds of the priority 7-8 pavements can be repaired using major maintenance or capital preventive maintenance (CAPM).

Priority 9 and 10- roads are MSL 1 and 2 highways with minor structural distress. They are candidates for maintenance strategies, or strategies funded under the new Capital Preventive Maintenance Program (CAPM). Previously, some of the priority 9 and 10 level projects could not be repaired adequately and economically with the maintenance strategies that were available. CAPM provides a moderate-cost set of strategies that will provide long-lasting (seven to ten year) repair of selected highways. CAPM strategies were awarded for the first time in FY1995-96.

Priority values of 11 through 14 are assigned to MSL 3 highways. These are roads with major structural distress and a poor ride (11), minor structural distress and a poor ride (12), major structural distress only (13), or minor structural distress only (14). There is no priority assigned to Class 3 pavements having only a poor ride. As stated above, Class 3 roads are not eligible for rehabilitation funding within the current priority system, but may receive rehabilitation funding by exception, on a case-by case basis.

Project Program Assignment

Two programs are used to fund pavement maintenance and rehabilitation: HM1 for maintenance programs, and HA22 for capital improvement programs (rehabilitation). HA 22 program projects are an element of the four-year State Highway Operation and Protection Program (SHOPP), while HM1 programs are funded from Caltrans' annual operating budget. Project expenses are assigned to these programs based on the corrective strategy to be applied to the pavement, derived from the level of distress of a pavement and the corresponding priority value. The relationship between program funding, the general type of work to be performed, and priority is shown in Table 6 above. Long-term corrective strategies such as rehabilitation and capital preventive maintenance are funded within the HA22 program, while Class 3 Road maintenance and routine maintenance are funded within the HM1 program.

Road Type Descriptions

There are four road types defined on the state highway network. Highways within city limits that are subject to traffic controls such as stop signs or signals, also serving as surface streets, are termed 'City highways'. Roads with one lane in each direction, for a total of two lanes are labeled 'Two-lane', and highways with more than one lane in each direction are labeled 'Multi-lane'. Multi-lane highways are subdivided further into those with a median separating the lanes traveling opposite directions, 'Multi-lane Divided', and those without medians, 'Multi-lane Undivided'.

Federal System Classification

The federal classifications system in use in the PMS distinguishes four classes of highway: Interstate, Primary, Secondary, and Urban. There is substantial overlap between the Federal classifications for Primary, Secondary, and Urban highways, and the Maintenance Service Levels. Therefore, Primary, Secondary, and Urban highway needs are not discussed here because MSL analysis of the highways provides more useful data. However, statistics for the federal classifications are presented in Table 7, page 19.

Interstate highways are contained entirely within the MSL 1 highway group, and represent half of that group's lane miles. Interstate highways represent 14,015 lane miles, or 29 percent of the entire system. Interstate highways contain about one-third of total statewide needs, and one-third of statewide 'Now Needs'. This is attributable to the large portion of aging rigid pavement on the interstate system. Caltrans has responded to the developing needs on interstate highways by spending the majority of rehabilitation dollars on interstate routes during the past ten years.

National Highway System

The Federal classification system was recently modified under enabling legislation for the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). That legislation a new 'National Highway System" (NHS) definition. Congress was charged with responsibility for defining the highway segments to be included within a 'National Highway System'. While the definition of the NHS excludes many state highways, the majority of the system, about 60 percent or roughly 30,000 of its lane miles are classified NHS. Applied to California, the new definition results in three highway groups: Interstate NHS highways, non-interstate NHS highways, and non-NHS highways.

How Pavement Ages

Several factors are responsible for the degradation of pavements over time, affecting the service life of the pavement. The initial design of the pavement, based on anticipated traffic volumes and loads is a major factor influencing its life. Cumulative traffic volume, especially truck traffic, is another major factor in aging pavements. Finally, environmental factors such as moisture infiltration into the supporting base, and heat and cold cycles, affect how well the subsurface is able to support the pavement. The routine maintenance effort applied to a pavement also affects pavement life.

Damage appears slowly at first, and then gradually accelerates, accumulating to become visible as structural distress and tangible as reduced ride quality. If damage is observed and corrected in a timely manner, low cost strategies will restore the road to nearly its original condition. However, if early treatment is neglected or postponed, the accumulated damage will require a more costly repair treatment. Recognizing that damage accumulates and accelerates is key to understanding the need for early, low-level, low-cost preventive maintenance treatments.

The bulk of California's pavements, approximately 75 percent, were constructed during the 15-year period between 1959 and 1974. These pavements were designed with a 20-year life expectancy, based on estimates of expected traffic volume and loads.

Strategy Costs and Use

Several types maintenance strategies or treatments are funded within the HM1 program. These treatments typically seal the pavement surface, but do not increase load bearing capacity, and last an average of two to five years. When a rehabilitation or reconstruction project cannot be designed, awarded and constructed in a timely manner, maintenance treatment may be substituted, keeping the pavement serviceable until reconstruction can take place. This diverts maintenance dollars from other more appropriate uses.

Maintenance strategies are used for 8 percent of all treated lane miles. The majority of the miles treated under maintenance contracts receive a 'seal coat', consisting of a polymer asphalt emulsion and with embedded chips or gravel. The cost of these treatments is relatively low. Asphalt rubber emulsions with chips, and slurry seals receive limited use. Asphalt blankets, usually 0.1 thick (about one inch thick) are used to seal and renew the wearing surface. These treatments are used on about 12 percent of treated miles each year.

Rehabilitation strategies funded through the HA22 program are used on both rigid and flexible pavements, and involve major reconstruction of the facility, restoring the pavement to a like-new condition, with superior ride quality and load-bearing capacity. These projects often include other improvements such as widening, shoulder improvements, drainage upgrades, electrical improvements or signs that significantly increase project costs. Rehabilitation involving reconstruction extends the life of the pavement by ten years or more, and is the principal means available to repair 'Now Needs'.

The most common rehabilitation strategy is an asphalt concrete overlay, applied to severely distressed or bad riding pavement surfaces (priority 1-6 and some priority 7-8 highways). Approximately 85 percent of the average of 2,000 lane miles rehabilitated each year receives asphalt overlays. There is a substantial cost differential that is due primarily to the cost of rigid pavement surface preparation, using a 'crack, seat, and overlay' procedure. In that process, the existing pavement is broken into small pieces that are rolled, or 'seated' into the existing roadbed and then overlaid with new asphalt material 0.4 to 0.6 foot thick.

'Step-faulted' rigid pavement, where the slabs are tilted up from the front edge to the back edge, results in a rough and noisy ride. This result in 'thumping' as each set of wheels drops off the back end of one slab onto the front of another slab. Grinding the pavement surface is used to correct faulting when there is little structural damage. Limited slab replacements may also be used in conjunction with grinding. Approximately 15 percent of rehabilitated miles receive grinding treatments.

Slab replacement alone is used sparingly throughout the state. It is used where rigid pavements have a low percentage of severely cracked slabs. Fewer than 1,000 slabs are replaced statewide in a typical year, excluding replacements occurring within other project types.

PMS Enhancement Detail

During 1991, national legislation entitled the "Intermodal Surface Transportation Efficiency Act" (ISTEA) became law. That Act specified minimum standards for systems to manage all major transportation systems. Caltrans recognized that its Pavement Management System, developed during the late 1970's did not meet many of Caltrans existing user needs. A review of user needs was completed during 1995. A study group identified the functional requirements for an 'enhanced' PMS, and a contract has been issued for the changes identified. The updated system is being tested, and should be in operation by the end of 2000. While the national Highway System Act rescinded the original ISTEA mandates in November 1995, the system enhancements will have lasting value to Caltrans users, and will result in improved highway network condition and reduced operating costs.

One example of system enhancement concerns assigning project priorities. As discussed, the original system placed the highest priority on repair of those pavements in the worst physical condition. These would typically be the most costly projects and involve complete pavement reconstruction. The new system will evaluate projects using benefit/cost analysis, and will ensure that projects that provide the greatest improvement in service for the least cost are developed first. Total costs to motorists and Caltrans are minimized under this approach.

Many of the capabilities of the enhanced PMS are already in the existing system, such as inventory description and condition, project identification, and project priority assignment. However, several new tools will be incorporated to provide substantially better pavement management practices. Major improvements will quantify expected service life and life cycle costs in order to optimize highway system condition and improve the level of service. Feedback mechanisms will be developed to evaluate the effectiveness of repair strategies and update future recommendations made by the PMS. District project coordinators will have new tools to improve monitoring of project development and performance.

The improved management tools will be especially important in performing evaluations of impacts of changed funding and management policies on the short term and long term condition of pavements. Other features of the system will improve access to pavement management data and reports.

Map of Caltrans Districts

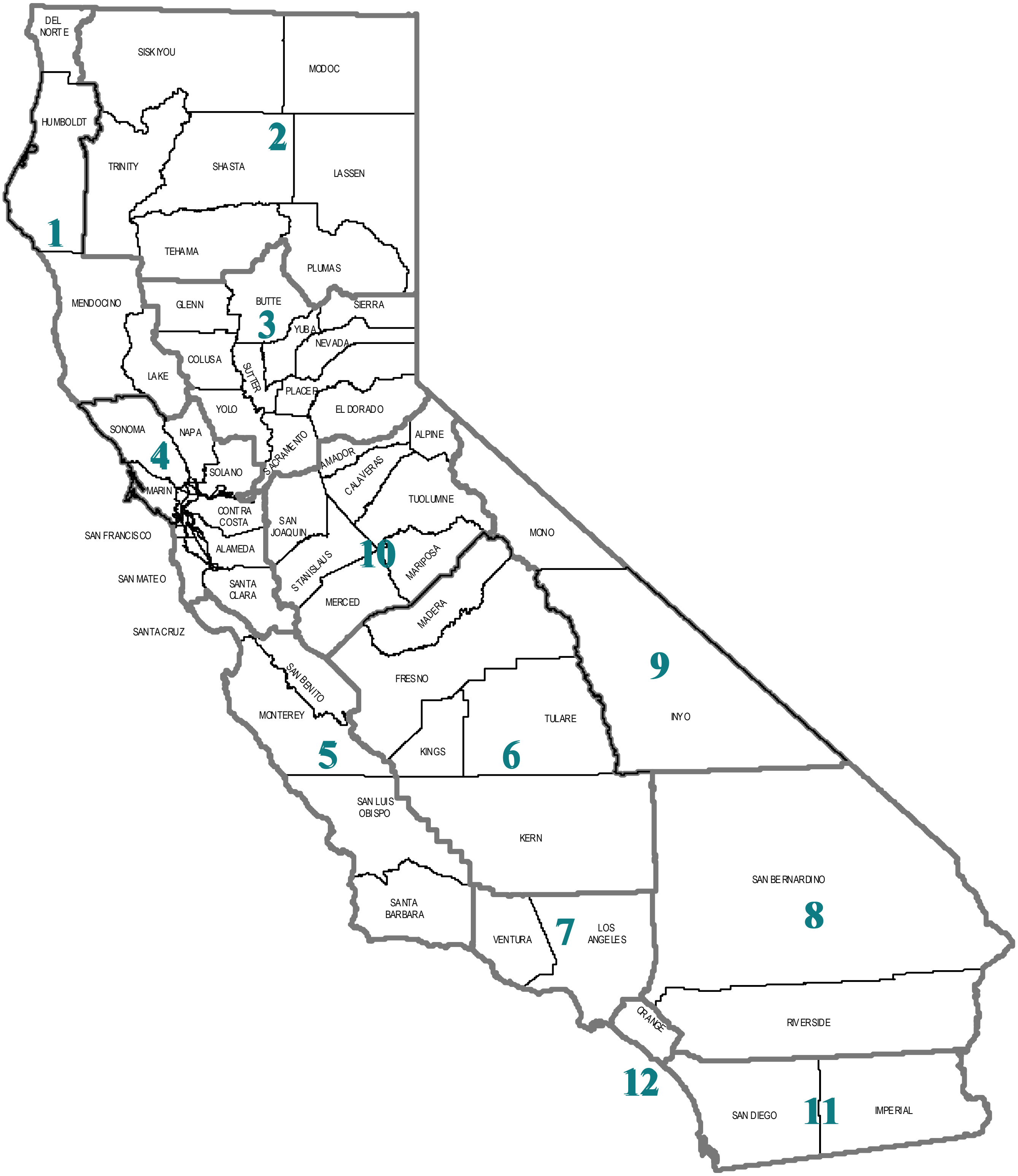


Table A

Distribution of Centerline Miles and Lane miles, 1999

		Center line miles		Lane Miles		Project Lane Miles		Now Needs Lane Miles	
TOTAL		15,161	100%	48,883	100%	15,572	32%	6,995	14%
PRIORITY*									
	1 - 6	835		2,873	6%	4,883	10%	4,883	70%
	7 - 8	1489		3,981	8%	6,335	13%	2,112	30%
	9 - 10	801		1,449	3%	2,219	5%		
	11 - 14	617		1,591	3%	2,135	4%		
NONE		11,418		38,989	80%	33,311	68%		
MSL									
	1	6,135	39%	27,279	56%	7,491	48%	2,960	42%
	2	5,424	35%	14,286	29%	5,946	38%	4,035	58%
	3	3,602	23%	7,318	15%	2,135	14%		
DISTRICT									
	1	930	6%	2,334	5%	484	3%	195	3%
	2	1,735	11%	4,000	8%	1,094	7%	284	4%
	3	1,505	10%	4,311	9%	1,529	10%	528	8%
	4	1,384	9%	5,916	12%	2,329	15%	1,471	21%
	5	1,161	8%	3,197	7%	1,190	8%	434	6%
	6	2,032	13%	5,690	12%	2,517	16%	999	14%
	7	1,149	8%	6,147	13%	2,024	13%	1,393	20%
	8	1,913	13%	6,466	13%	1,918	12%	749	11%
	9	750	5%	1,758	4%	298	2%	40	1%
	10	1,320	9%	3,474	7%	1,371	9%	439	6%
	11	1,021	7%	3,904	8%	442	3%	153	2%
	12	262	2%	1,685	3%	376	2%	310	4%
ROAD TYPE									
Multi-Lane Divided		5,690	38%	29,313	60%	8,786	56%	4,561	65%
Multi-Lane Undivided		284	2%	1,407	3%	348	2%	145	2%
Two-Lane		8,662	57%	17,365	36%	6,136	39%	2,017	29%
City		524	3%	798	2%	301	2%	272	4%
NATIONAL HIGHWAY SYSTEM (New)									
NHS Interstate		2,540	17%	14,015	29%	3,297	21%	1,339	19%
NHS non-Interstate		6,636	44%	20,968	43%	8,438	54%	3,424	49%
Non-NHS roads		5,986	39%	13,902	28%	7,134	46%	3,570	51%
FEDERAL AID CLASSIFICATION (replaced by NHS))									
Interstate		2,540	17%	14,015	29%	3,297	21%	1,339	19%
Primary		10,803	71%	29,476	60%	9,516	61%	3,877	55%
Secondary		951	6%	1,961	4%	722	5%	113	2%
Urban		814	5%	3,230	7%	1,858	12%	1,666	24%
None		53	0.3%	201	0.4%	179	1%		
INTERMODAL CORRIDORS OF ECONOMIC SIGNIFICANCE (ICES - New)									
ICES		3,248	21%	15,966	33%	4,202	27%	1,741	25%
Non-ICES roads		11,913	79%	32,917	67%	11,370	73%	5,254	75%
PAVEMENT TYPE									
Flexible		12,450	82%	33,004	68%	11,622	75%	5,286	76%
Rigid		2,711	18%	15,879	32%	3,950	25%	1,709	24%

* Lane Miles for Priority Group are triggered lane miles.

Table B, Page 1 of 3

1978-1999 Distressed lane miles of pavement by Priority Group, with Percent of State Total, 1999

Rough Riding — Priority 1-6

	1981		1983		1985		1987		1989		1992		1995		1997		1998		1999	
District	Lane Mi.	Pct.	Lane Mi.	Pct.	Lane Mi.	Pct.	Lane Mi.	Pct.	Lane Mi.	Pct.	Lane Mi.	Pct.	Lane Mi.	Pct.	Lane Mi.	Pct.	Lane Mi.	Pct.	Lane Mi.	Pct.
1	263	17%	259	11%	79	7%	126	15%	37	7%	21	5%	162	9%	153	4%	44	1%	144	3%
2	87	5%	61	3%	51	4%	23	3%	7	1%	5	1%	137	7%	59	2%	72	2%	124	3%
3	42	3%	111	5%	50	4%	37	4%	44	8%	34	8%	141	8%	256	7%	149	5%	257	5%
4	381	24%	688	30%	388	34%	277	33%	148	28%	107	26%	263	14%	916	25%	727	23%	1,242	25%
5	81	5%	86	4%	21	2%	8	1%	3	1%	15	4%	158	8%	211	6%	81	3%	249	5%
6	70	4%	88	4%	57	5%	60	7%	27	5%	28	7%	47	3%	115	3%	99	3%	534	11%
7	450	28%	592	26%	287	25%	125	15%	122	23%	54	13%	478	26%	1095	30%	1,240	40%	1,247	26%
8	33	2%	105	5%	25	2%	41	5%	15	3%	27	6%	241	13%	445	12%	334	11%	470	10%
9	0	0%	0	0%	0	0%	1	0%	0	0%	0	0%	4	0%	4	0%	0	0%	0	0%
10	62	4%	69	3%	107	9%	89	10%	49	9%	88	21%	84	4%	129	4%	20	1%	162	3%
11	113	7%	209	9%	81	7%	41	5%	55	11%	7	2%	35	2%	57	2%	36	1%	148	3%
12	- - -		- - -		- - -		23	3%	15	3%	32	8%	120	6%	238	6%	296	10%	307	6%
	1,582		2,268		1,146		851		522		418		1,870		3,676		3,098		4,883	

Major Structural Problem Only — Priority 7-8

	1981		1983		1985		1987		1989		1992		1995		1997		1998		1999	
District	Lane Mi.	Pct.	Lane Mi.	Pct.	Lane Mi.	Pct.	Lane Mi.	Pct.	Lane Mi.	Pct.	Lane Mi.	Pct.	Lane Mi.	Pct.	Lane Mi.	Pct.	Lane Mi.	Pct.	Lane Mi.	Pct.
1	394	9%	69	2%	456	7%	652	9%	605	8%	433	8%	585	8%	157	3%	233	4%	154	2%
2	941	22%	872	24%	832	13%	728	10%	736	10%	476	9%	1017	14%	563	10%	600	9%	479	8%
3	206	5%	199	6%	536	8%	609	8%	505	7%	299	6%	1023	14%	438	8%	430	7%	815	13%
4	245	6%	215	6%	250	4%	632	9%	717	10%	637	12%	447	6%	511	9%	767	12%	684	11%
5	136	3%	130	4%	258	4%	481	7%	627	9%	340	7%	498	7%	336	6%	681	11%	557	9%
6	639	15%	702	20%	788	12%	887	12%	854	12%	768	15%	1649	22%	1086	20%	738	11%	1,396	22%
7	412	10%	310	9%	681	11%	620	8%	637	9%	553	11%	703	10%	500	9%	664	10%	436	7%
8	432	10%	296	8%	956	15%	973	13%	872	12%	696	14%	558	8%	917	17%	1,270	20%	837	13%
9	230	5%	349	10%	389	6%	424	6%	468	6%	93	2%	172	2%	111	2%	34	1%	119	2%
10	355	8%	340	9%	850	13%	859	12%	687	10%	454	9%	619	8%	562	10%	778	12%	831	13%
11	200	5%	118	3%	419	7%	305	4%	227	3%	237	5%	36	0%	158	3%	167	3%	15	0%
12	- - -		- - -		- - -		129	2%	286	4%	133	3%	45	1%	88	2%	81	1%	11	0%
	4,190		3,600		6,415		7,299		7,221		5,119		7,352		5,427		6,442		6,335	

Table B, Page 2 of 3

1978-1999 Distressed lane miles of pavement by Priority Group, with Percent of State Total, 1999

Minor Structural Problem Only — Priority 9-10

	1981		1983		1985		1987		1989		1992		1995		1997		1998		1999	
District	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**
1	468	13%	548	12%	504	9%	500	7%	531	8%	473	10%	43	2%	64	3%	117	4%	74	3%
2	255	7%	479	11%	481	9%	579	8%	712	11%	562	12%	171	6%	94	4%	158	5%	144	6%
3	222	6%	219	5%	516	9%	786	11%	596	9%	313	6%	223	8%	161	7%	128	4%	250	11%
4	359	10%	377	8%	684	12%	770	11%	869	13%	490	10%	627	22%	298	13%	486	16%	307	14%
5	151	4%	171	4%	374	7%	547	8%	407	6%	267	5%	87	3%	140	6%	236	8%	107	5%
6	355	10%	462	10%	585	11%	686	10%	616	10%	568	12%	157	5%	243	11%	247	8%	249	11%
7	229	7%	462	10%	489	9%	380	5%	394	6%	310	6%	959	34%	467	20%	516	17%	222	10%
8	576	17%	717	16%	830	15%	935	13%	741	11%	769	16%	115	4%	354	15%	587	19%	409	18%
9	236	7%	282	6%	313	6%	359	5%	310	5%	161	3%	10	0%	22	1%	16	1%	57	3%
10	403	12%	511	11%	427	8%	677	10%	650	10%	558	11%	73	3%	163	7%	221	7%	138	6%
11	223	6%	265	6%	355	6%	406	6%	456	7%	259	5%	112	4%	226	10%	265	9%	204	9%
12	- - -		- - -		- - -		303	4%	185	3%	146	3%	285	10%	86	4%	125	4%	58	3%
	3,477		4,493		5,558		6,928		6,467		4,876		2,863		2,318		3,103		2,219	

Class 3 Roads — Priority 11-14

	1981		1983		1985		1987		1989		1992		1995		1997		1998		1999	
District	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**
1	464	16%	433	13%	277	8%	223	7%	185	7%	70	5%	85	4%	45	3%	82	5%	111	5%
2	777	27%	824	25%	692	21%	451	15%	437	16%	373	27%	403	20%	184	13%	325	20%	348	16%
3	167	6%	186	6%	369	11%	316	11%	280	10%	80	6%	254	13%	153	11%	158	9%	208	10%
4	66	2%	108	3%	132	4%	188	6%	179	7%	11	1%	191	9%	125	9%	105	6%	95	4%
5	80	3%	120	4%	93	3%	142	5%	150	6%	62	4%	40	2%	158	11%	169	10%	277	13%
6	385	14%	468	14%	336	10%	453	15%	402	15%	232	16%	217	11%	220	15%	131	8%	338	16%
7	123	4%	106	3%	181	5%	197	7%	200	7%	115	8%	337	17%	67	5%	176	11%	119	6%
8	170	6%	264	8%	318	9%	279	9%	238	9%	202	14%	280	14%	228	16%	425	26%	203	9%
9	181	6%	257	8%	304	9%	174	6%	144	5%	63	4%	30	2%	55	4%	0	0%	122	6%
10	309	11%	309	9%	293	9%	341	11%	270	10%	85	6%	101	5%	110	8%	52	3%	240	11%
11	115	4%	197	6%	380	11%	243	8%	215	8%	114	8%	73	4%	90	6%	39	2%	75	4%
12	- - -		- - -		- - -		0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
	2,837		3,272		3,375		3,007		2,700		1,407		2,010		1,433		1,660		2,135	

Table B, Page 3 of 3

District Lane Miles by Pavement Condition Survey Year

	1981		1983		1985		1987		1989		1992		1995		1997		1998		1999	
District	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**
1	2,605	5%	2,596	5%	2,542	5%	2,538	5%	2,531	5%	2,524	5%	2,377	5%	2,334	5%	2,334	5%	2,334	5%
2	4,042	8%	3,974	8%	3,955	8%	3,968	8%	3,961	8%	3,939	8%	4,030	8%	4,001	8%	4,001	8%	4,001	8%
3	4,197	9%	4,220	9%	4,240	9%	4,250	9%	4,235	9%	4,336	9%	4,455	9%	4,311	9%	4,311	9%	4,311	9%
4	5,131	11%	5,226	11%	5,289	11%	5,295	11%	5,355	11%	5,510	11%	6,105	12%	5,917	12%	5,917	12%	5,917	12%
5	2,933	6%	2,934	6%	2,913	6%	2,908	6%	2,916	6%	2,982	6%	3,238	7%	3,197	7%	3,197	7%	3,197	7%
6	4,970	10%	4,984	10%	4,992	10%	5,018	10%	4,998	10%	5,118	10%	5,649	11%	5,691	12%	5,691	12%	5,691	12%
7	7,487	16%	7,714	16%	7,691	16%	6,200	13%	6,069	13%	6,173	13%	6,312	13%	6,147	13%	6,147	13%	6,147	13%
8	5,543	12%	5,670	12%	5,616	12%	5,674	12%	5,543	11%	5,614	11%	6,486	13%	6,464	13%	6,464	13%	6,464	13%
9	2,347	5%	2,340	5%	2,357	5%	2,392	5%	2,396	5%	2,555	5%	1,742	4%	1,758	4%	1,758	4%	1,758	4%
10	4,253	9%	4,232	9%	4,221	9%	4,405	9%	4,201	9%	4,216	9%	3,510	7%	3,474	7%	3,474	7%	3,474	7%
11	4,392	9%	4,509	9%	4,591	9%	4,578	9%	4,597	10%	4,601	9%	3,909	8%	3,904	8%	3,904	8%	3,904	8%
12	- - -		- - -		- - -		1,515	3%	1,511	3%	1,486		1,571	3%	1,686	3%	1,686	3%	1,686	3%
Total	47,900		48,399		48,407		48,741		48,313		49,054		49,384		48,883		48,883		48,883	

* District 12 formed from District 7 in 1985

Statewide Pavement Needs by Survey Year and Priority Group

District	1981		1983		1985		1987		1989		1992		1995		1997		1998		1999	
	Lane Mi.	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**	**Lane Mi.**	**Pct.**
Priority 1-6	1,582	13%	2,268	17%	1,146	7%	851	5%	522	3%	418	4%	1,870	13%	3,676	29%	3,098	22%	4,883	31%
Priority 7-8	4,190	35%	3,600	26%	6,415	39%	7,299	40%	7,221	43%	5,119	43%	7,352	52%	5,427	42%	6,442	45%	6,335	41%
Priority 9-10	3,477	29%	4,493	33%	5,558	34%	6,928	38%	6,467	38%	4,876	41%	2,863	20%	2,318	18%	3,103	22%	2,219	14%
Priority 11-14	2,837	23%	3,272	24%	3,375	20%	3,007	17%	2,700	16%	1,407	12%	2,010	14%	1,433	11%	1,660	12%	2,135	14%
State Total	12,086	25%	13,633	28%	16,494	34%	18,085	37%	16,910	35%	11,820	24%	14,095	29%	12,853	26%	14,303	29%	15,572	32%

Notes:
Source: 1978-1999 Pavement Condition Surveys, Pavement Management System.
Caltrans, Maintenance Program, Office of Roadway Maintenance, Pavement Management Information Branch.

Table C

Cost and Mileage, 1985 - 1999
Maintenance and Rehabilitation

Cost per Lane Mile, by Fiscal Year

	5 Yr. Ave.	85/86	86/87	90/91	87/88	91/92	88/89	92/93	89/90	93/94	94/95	95/96	96/97	97/98	98/99
Maintenance, Contracted															
PME CHIP SEAL	$ 7,990	$ 6,415	$ 7,900	6,290	7,426	[illegible]	7,175	6,593	6,310	6,297	$ 6,481	$ 11,757	$ 11,849	$ 6,895	$ 5,132
PMA CHIP SEAL	$ 9,780	N/A	N/A	13,395	N/A	9,278	N/A	11,441	N/A	14,041	$ 12,039	$ 9,662	$ 7,685	$ 7,423	N/A
AR CHIP SEAL	$ 14,400	N/A	[illegible]	20,342	[illegible]	25,341	[illegible]	20,742	[illegible]	16,807	$ 18,092	$ 16,191	$ 10,533	$ 14,354	N/A
CRACK SEAL*	$ 2,430											$ 2,521	$ 2,215	$ 2,666	$ 1,799
GRINDING*	$ 26,300											$ 25,848	$ 35,714	N/A	N/A
SLURRY SEAL	$ 12,210	N/A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	15,390	$ 12,555	N/A	$ 10,924	$ 12,537	$ 18,945
OPEN GRADE	$ 18,830	$ 18,919	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	17,801	$ 22,495	$ 34,539	$ 18,638	$ 11,092	$ 23,570
THIN BLANKET	$ 21,080	$ 27,921	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	21,923	$ 24,410	$ 19,774	$ 21,937	$ 19,857	$ 24,751
RUBBERIZED AC SURFACING*	$ 38,420											$ 45,924	$ 36,201	$ 27,755	$ 32,266
PCC SLAB EACH**	$ 2,480	$ 1,933	$ 1,769	2,495	2,484	1,827	2,012	2,110	2,641	1,970	$ 1,460	$ 3,486	$ 5,683	$ 4,391	$ 3,517
Rehabilitation, Contracted															
ACOL FLEX, REHABILITATION	$ 189,270	N/A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$ 163,000	$ 154,311	$ 165,820	$ 182,230	$ 196,359
ACOL FLEX, CAPM*	$ 62,060											$ 48,246	$ 60,782	$ 67,693	$ 116,937
MILL AND REPLACE AC*	$ 110,720											$ 184,127	$ 91,834	$ 107,325	$ 150,264
RUBBERIZED AC, CAPM*	$ 44,990											$ 43,208	$ 44,979	$ 45,968	$ 76,032
GRINDING, CAPM*	$ 39,690											$ 21,539	$ 43,383	$ 47,703	$ 55,609
CPR	N/A	$ 29,000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$ 120,000	N/A	N/A	N/A	N/A
ACOL RIGID	$ 207,270	$ 163,000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$ 150,000	$ 273,652	$ 102,614	$ 231,758	$ 172,378
PCC OVERLAY	N/A	N/A	N/A	472,000	$ 535,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$ 646,154	$ 857,200

Lane Miles Treated, by Fiscal Year

	5 Yr. Ave.	85/86	86/87	90/91	87/88	91/92	88/89	92/93	89/90	93/94	94/95	95/96	96/97	97/98	98/99
Maintenance, Contracted															
PME CHIP SEAL	1,089	1,934	4,387	2,551	3,117	1,325	1,189	1,719	1,529	1,379	1,459	568	952	1,152	1,326
PMA CHIP SEAL	135	N/A	N/A	82	N/A	116	N/A	1,323	N/A	54	170	97	220	59	N/A
AR CHIP SEAL	154	N/A	43	170	73	94	25	128	117	151	126	85	254	28	N/A
CRACK SEAL*	367											243	509	350	488
GRINDING*	11											21	1	N/A	N/A
SLURRY SEAL	140	N/A	525	340	269	551	327	97	139	73	126	N/A	220	22	14
OPEN GRADE	225	26	37	186	11	238	6	318	73	300	105	150	345	306	168
THIN BLANKET	765	104	199	460	169	425	190	558	172	656	387	780	1,238	1,530	1,015
RUBBERIZED AC SURFACING*	29											26	53	7	112
PCC SLAB EACH**	1,122	299	344	2,025	1,166	2,208	1,622	1,495	1,408	1,461	1,745	913	368	225	934
TOTAL, CONTRACT MTCE. LANE MILES	2,687	2,064	5,191	3,789	3,639	2,749	1,737	4,143	2,030	2,613	2,373	1,970	3,792	3,454	3,123
Rehabilitation, Contracted															
ACOL FLEX, REHABILITATION	588	290	383	913	281	483	404	564	517	660	459	701	617	504	838
ACOL FLEX, CAPM*	601											131	1,099	572	798
MILL AND REPLACE AC*	130											29	60	301	322
RUBBERIZED AC, CAPM*	65											31	106	57	134
GRINDING, CAPM*	328											190	671	122	102
CPR	60	173	204	5	21	1	37	5	128	164	67	1	N/A	8	N/A
ACOL RIGID	214	196	118	397	399	282	52	219	20	286	37	249	316	180	172
PCC OVERLAY	42	N/A	N/A	7	49	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	42	3
Subtotal, CAPM	993											352	1,876	750	1,034
Subtotal, REHABILITATION	2,026	659	705	1,322	750	766	493	788	665	1,110	563	1,332	2,869	1,785	1,334
TOTAL REHAB/CAPM LANE MILES	3,019	659	705	1,322	750	766	493	788	665	1,110	563	1,684	4,745	2,535	2,368
TOTAL, ALL CONTRACT LANE MILES	5,706	2,723	5,896	5,111	4,389	3,515	2,230	4,931	2,695	3,723	2,936	3,654	8,537	5,989	5,491

N/A - NOT AVAILABLE OR STRATEGY NOT UTILIZED
* NEW REPORTING CATEGORY
**PCC SLABS ARE ACTUAL COUNT OF SLABS OR COST PER SLAB

Table D

PAVEMENT MAINTENANCE AND REHABILITATION EXPENDITURES, 1973-1999

			Nominal Dollars				1996 dollars			
			ACTUAL EXPENDITURES		TREND OF EXPENDITURES		EXPENDITURES		TREND OF EXPENDITURES	
			HM1	HA22	HM1	HA22	HM1	HA22	HM1	HA22
Fiscal Year	CA. Construction Cost Index	Adjusted Index (1996 = 100)	Maintenance	Rehabilitation	Maintenance	Rehabilitation	Maintenance	Rehabilitation	Maintenance	Rehabilitation
'73	30.0	24.9	19.3	17.6	4.9	9.5	77.5	70.6	5.4	9.9
'74	31.2	25.9	22.8	16.8	9.7	19.0	88.0	64.8	10.7	19.8
'75	45.6	37.9	21.6	23.8	14.6	28.5	57.0	62.8	16.1	29.7
'76	46.7	38.8	27.5	16.8	19.5	38.0	70.9	43.3	21.4	39.6
'77	47.7	39.6	25.0	62.4	24.3	47.6	63.1	157.5	26.8	49.5
'78	53.7	44.6	26.7	54.8	29.2	57.1	59.9	122.9	32.1	59.4
'79	62.1	51.6	27.9	55.5	34.1	66.6	54.1	107.6	37.5	69.3
'80	82.1	68.2	31.8	50.0	38.9	76.1	46.6	73.3	42.8	79.2
'81	90.6	75.2	34.6	45.7	43.8	85.6	46.0	60.7	48.2	89.1
'82	81.3	67.5	46.5	43.9	48.7	95.1	68.9	65.0	53.5	99.0
'83	81.9	68.0	54.7	40.0	53.5	104.6	80.4	58.8	58.9	108.9
'84	93.3	77.5	62.2	136.6	58.4	114.1	80.3	176.3	64.2	118.9
'85	92.7	77.0	66.2	126.1	63.3	123.6	86.0	163.8	69.6	128.8
'86	95.0	78.9	70.6	86.3	68.1	133.1	89.5	109.4	74.9	138.7
'87	100.0	83.1	112.4	70.7	73.0	142.7	135.3	85.1	80.3	148.6
'88	104.4	86.7	101.0	161.9	77.9	152.2	116.5	186.7	85.6	158.5
'89	111.3	92.4	87.0	72.4	82.7	161.7	94.1	78.3	91.0	168.4
'90	113.5	94.3	83.1	125.1	87.6	171.2	88.1	132.7	96.3	178.3
'91	108.2	89.9	98.8	228.7	92.5	180.7	109.9	254.4	101.7	188.2
'92	106.8	88.7	117.5	148.9	97.3	190.2	132.5	167.8	107.0	198.1
'93	104.7	87.0	119.7	169.7	102.2	199.7	137.7	195.1	112.4	208.0
'94	119.0	98.8	120.0	171.2	107.1	209.2	121.4	173.3	117.7	217.9
'95	115.0	95.5	94.9	152.5	111.9	218.7	99.4	159.7	123.1	227.8
'96	120.4	100.0	103.2	209.4	116.8	228.2	103.2	209.4	128.4	237.7
'97	142.0	117.9	99.0	336.3	121.6	237.8	84.0	285.2	133.8	247.6
'98	128.6	106.8	116.2	307.5	126.5	247.3	108.8	287.9	139.1	257.5
'99	139.2	115.6	109.6	436.6	131.4	256.8	94.8	377.6	144.5	267.4
'00		118.7	160.0	521.6	136.2	266.3	134.8	439.6	149.8	277.3
'01		121.8	160.0	454.0	141.1	275.8	131.4	372.9	155.2	287.2
'02		125.0	160.0	403.3	146.0	285.3	128.0	322.7	160.5	297.1
'03		128.2	160.0	423.6	150.8	294.8	124.8	330.3	165.9	307.0
'04		131.6	160.0	355.2	155.7	304.3	121.6	269.9	171.2	316.9
'05		135.1	160.0	352.9	160.6	313.8	118.5	261.3	176.6	326.8
'06		138.6	160.0	323.4	165.4	323.4	115.4	233.3	181.9	336.7
'07		142.3	160.0	327.2			112.5	230.0		
'08		146.0	160.0	326.6			109.6	223.7		
'09										

NOTES:

Maintenance expenditures are from MMS 914-6 reports and do not include administrative overhead.
Rehabilitation expenditures are from Contract Award Allotments and do not include engineering and administrative overhead
HA3 (thin blanket) program terminated in 1981; expenditures included in HA22 Rehabilitation Total.
Maintenance 96-06 is equal to the 1991-1995 5-year average of mtce costs, plus $53.3 million supplemental fundng approved in 1998/1999.
Ca. Construction Cost Index available from Construction Program, Office of Office Engineers

Table E

Needs by Highway Class, 1999

	Lane Miles	Percent of Now Needs	Percent of Class Needs	Percent of All Needs	Percent of All System Miles
Class 1 Needs					
Now Needs					
Interstate	1,339	19%	18%	9%	3%
Non-Interstate	1,621	23%	22%	10%	3%
Other Needs					
Interstate	1,958	- - -	26%	13%	4%
Non-Interstate	2,574	- - -	34%	17%	5%
Class 2 Needs					
Now Needs	4,035	58%	68%	26%	8%
Other Needs	1,911	- - -	32%	12%	4%
Class 3 Needs	2,135	- - -	100%	14%	4%
Total	15,572	- - -	- - -	100%	32%

Definitions/Glossary

Annual Average Daily Traffic - AADT - Average daily traffic over an entire year, estimated from a traffic sample collected over a one to seven day time period.

AC - Asphalt Concrete, consisting of sand, gravel, and a petroleum binder; also called ‘bituminous’, ‘flexible’ or black pavement.

ACOL - Asphalt Concrete Overlay - placing layers of asphalt and inner membranes over an existing roadway. Typically, 6 inches of asphalt are added.

AR - Asphalt Rubber, a mixture of asphalt concrete containing rubber ‘crumbs’ and synthetic binders.

Capital Preventive Maintenance (CAPM) - use of maintenance treatments such as intermediate thickness asphalt blankets (flexible pavements), or grinding the pavement surface (rigid pavements) to provide five to eight years of additional pavement life.

center line mile - a mile of highway, without considering the number of lanes in the facility.

corrective maintenance - treatment to correct a significant structural or ride quality problem utilizes less intensive treatments than rehabilitation or CAPM.

CPR - Concrete Pavement Restoration, may involve surface grinding, slab replacements, or full lane replacement.

crack, seat, and overlay - existing pavement is cracked into small pieces that are rolled (seated) into the existing roadbed and overlaid with asphalt. The most common rehabilitation treatment.

discounting - a mathematical process to adjust dollar costs incurred at different points in time to dollars of a constant base year.

grinding - removing the irregularities in the surface of a pavement to improve ride quality, typically on rigid pavement.

faulting - slabs of PCC that are tilted, causing a drop off the back end of one slab onto the front edge of the next slab.

flexible pavement - pavement constructed from asphalt concrete, also known as bituminous, or ‘black’ pavement.

HA22 - the highway program that funds reconstruction or rehabilitation of pavements.

HM1 - the highway program that funds routine maintenance on the state highway network.

International Roughness Index – a standardized method of measuring the roughness of the pavement surface, expressed in inches per mile or centimeters per kilometer, developed by the World Bank.

lane mile - a pavement one mile long and one lane wide. A segment of road one mile long and four lanes wide is four lane miles. The unit of measure used to develop the total cost of pavement projects.

life-cycle cost - the total cost of maintaining a pavement over its useful life, discounted to a reference year. Caltrans assumes a 40-year useful life when designing highways.

Longer-life pavement – a pavement intended to last thirty-five years or more between rehabilitation treatments.

maintenance - use of low-cost to moderate-cost treatments to extend the life of a pavement up to seven years.

Maintenance Program - the program within the California Department of Transportation responsible for preserving the state highway network.

Maintenance Service Level - MSL- A three-value system of indicating the service provided by a route segment within the state highway network, consisting of MSL 1, MSL 2, and MSL 3 highways. A single route may have different MSL values on different segments, largely dependent upon traffic volume.

MSL 1 - Class 1 roads are rural principal arterial highways and their extensions into urbanized areas. Annual average daily traffic (AADT) of over 5,000 vehicles per day. Includes interstate highways and major freeways.

MSL 2 - Class 2 roads are minor arterials. Traffic volume is intermediate, 1,000 to 5,000 vehicles per day.

MSL 3 - Class 3 roads are collectors and low-volume roads, and logical segments added for route continuity. Annual average daily traffic of less than 1,000 vehicles per day.

major maintenance - intermediate-level treatments such as thin or intermediate 'blankets' of asphalt to extend the life of a pavement, usually by four to seven years. Offers moderate improvement in the structural capacity of the pavement.

Now Needs - pavement segments requiring immediate rehabilitation or maintenance to preserve a pavement in serviceable condition.

Open Graded Asphalt, OGAC, Open Graded Blanket - A surface layer of asphalt approximately 1 inch thick, containing few fine particles between the larger pieces of aggregate. This allows water to enter the voids and drain out through the edges of the pavement, reducing standing water on the pavement, and improving skid resistance in wet weather.

Opportunity Cost - the difference between the return on one investment and the return on an alternative.

PCC - Portland Cement Concrete, or 'rigid' pavement.

PCS - Pavement Condition Survey, a biennial survey of the state highway system conducted by the California Department of Transportation.

PMA - Polymer Modified Asphalt binder used in a seal coat.

PME - Polymer Modified Emulsion binder used in a seal coat.

preventive maintenance - intermediate-level treatments, such as thin blankets, open-graded blankets, and grinding to improve the condition of the pavement surface, on pavements with little or no structural distress. Restores the pavement surface, prevents development of cracking and water infiltration.

profilometer - a device for measuring the longitudinal profile of the road surface.

rehabilitation - use of moderate-cost to high-cost treatments to substantially improve the structural condition of a pavement, extending its life by seven to ten years or more.

rigid pavement - pavement constructed from Portland Cement Concrete (PCC).

routine maintenance - low-level maintenance treatments, such as crack sealing, joint sealing, and minor patching.

seal coat - a sealant applied uniformly to the entire pavement surface, usually with embedded sand or gravel 'chips', primarily to prevent water infiltration and improve traction.

slab - a unit of PCC pavement defined by surrounding expansion joints.

slurry seal - a petroleum-based emulsion seal coat without embedded sand or gravel, applied to the pavement surface.

state highway network - the entire system of highways maintained by the California Department of Transportation. For pavement management purposes, excludes bridge decks and ramps.