Report of Trip to SR-86, District 11, Near Brawley, California

Work Conducted under Strategic Plan Task 4.14

Technical Memorandum Prepared For

CALIFORNIA DEPARTMENT OF TRANSPORTATION

By:

Charles Lee

Technical Memorandum TM-UCB-PRC-2005-1

February 15, 2005

Pavement Research Center
Institute of Transportation Studies
University of California Berkeley and University of California Davis

INTRODUCTION

A rubberized asphalt chip seal project on SR-86 in District 11 exhibited flushing and rutting shortly after construction. These defects occurred within the 1-year performance warranty period specified in Section 10-1.22 of the Special Provisions of Contract No. 11-241104. Results of California Test 342 performed by Caltrans have confirmed that the coefficient of friction for the flushing segment were less than 0.30, which is less than the minimum required by contract. The contractor refuses to perform the specified repair at contractor's expense, saying they followed Caltrans specifications and, therefore, are not responsible for a defect due to an "inadequate specification" (given the project condition). On Dec. 17, 2004, Caltrans Headquarters Maintenance and the Pavement Research Center agreed on a study to address the following four objectives:

1. Investigate if the causes of failure of the asphalt rubber chip seal project in District 11 can be determined.
    - Determine compliance with prescriptive specifications and relate prescriptive specifications to failure or success.
    - Collect test and construction records and investigate if the cause of failure can be determined.

- No lab testing is required unless it is apparent that lab testing will help determine causes of failure. Lab testing will be subject to costs and scheduling constraints, availability of resources, and further discussion. Core samples collected to perform lab testing by Caltrans District 11.

2. Determine the effectiveness of the materials and workmanship warranty on this project.
   - Critique the concept of combining prescriptive specifications and performance criteria and provide a preliminary statement about the efficacy of combining these criteria.
3. Evaluate and critique the planned 2-year performance warranty if the cause of rutting and flushing is identified.
4. Determine whether the Department should move toward performance warranties instead of materials and workmanship based on discussions with various experts and available information.

   Note: Gerry Huber (Heritage Research Group) and Steven Krebs (WI DOT) have agreed to provide advice. Other sources for advice suggested by Shakir have not yet responded at the time of this writing.

Project History

The following project history was made available in the *Rubber Chip Seal – Route 86, EA 11 – 241101* report provided by Ron Jones, Caltrans HQ Maintenance:

- July 2002: First inspection for being considered a warranty pilot project candidate.
- May 2003: Second inspection for being considered a warranty pilot project candidate.
- Sept 2003: Preventative maintenance work performed (rubber AC chipseal) based on 1-year materials and workmanship + performance warranty.
- Mar 2004: Post-construction review of the 6-mile section conducted; signs of bleeding were evident. Caltrans decides to wait after summer to see how temperature might further affect the pavement.
- Sept 2004: Re-evaluation. Severe bleeding and rutting in #2 lane NB. Note: by this time, the Resident Engineer has already issued a Construction Change Order (CCO) to fix a part of the section. Contractor blames bad design from Caltrans as cause of the pavement distress and is not willing to fix the defect at contractor's cost. Caltrans has agreed to pay for the overlay rip and replacement, which will be carried out in early 2005 (unconfirmed) and the contractor has agreed to provide a 2-year performance warranty.

Warranty Pilot Project Selection Process

The Warranty Review Committee reviews the 4-year performance history data (percent cracked, percent patched, IRI, etc.) of the proposed road section then makes a condition survey to ensure the section is structurally sound. One or more 1-year preventative warranty pilot projects are then selected and actions taken at the first sign of any minor distress on dry pavement.

CORING TRIP SUMMARY

In an attempt to address Objective 1 (presented in the Introduction), a coring session was undertaken by Caltrans on January 20, 2005. Basic information from the trip is presented in Table 1.

Table 1 Details of PRC Coring Effort

Pavement Research Center – University of California	
Date of trip	01/20/2005
Location	District 11 Imperial County State Route 86 PM 37.3-43.4, Northbound
Weather	Sunny/clear sky 70–76ºF
Core Diameter	4.5 in.
Pavement Type	AC
Core Method	Wet

A total of 35 wet cores were collected at 9 different locations. The thickness of the RAC layer is measured based on the average of 4 measurements around the perimeter of each cylinder. No chip seal sample was available, however Shawn Rizzutto (District 11 CE) indicated that chip seal binder samples are available. Also, because the cores were 4.5 in. diameter instead of the 6-in. diameter originally calculated by the Pavement Research Center as adequate to obtain enough sample quantity for the "finger-print" binder testing, Shawn Rizzuto offered to perform the scraping and collect the chip seal sample for the PRC before the contractor performs the repair. The numbering system for the cores is shown in Table 2 (refer to Figure 1).

The core location numbering system was developed by District 11 personnel with respect to the station numbering system that was setup during the RAC chip seal construction. The station number at the beginning of construction starts with Station 609+07 (Postmile 37.3) and continues to Station 705+19 (Postmile 43.3) at the end of construction section. The station numbers are marked in 40-m intervals, e.g. 610+40, 610+80, 611+20, etc. Figure 2 shows a map of the site location; Figure 3 presents the project plans.

The 9 stations at which cores were extracted were: 610+40, 616+21, 616+37, 617+60, 618+00, 652+40, 654+00, 688+40, 696+00 (from south to north). Station 688+40 is located in the second 0.5-mile section south of the Immigration and Naturalization Service (INS) station where a CCO was issued to apply a layer of RAC chip seal over the OGAC. The last station, 696+00, is

Table 2 Core Location Numbering System

Core Label	Location (Shown in Figure 1)
Location 1	Left shoulder
Location 2	#1 lane, left wheelpath
Location 3	#1 lane, between wheelpaths
Location 4	Lane dividing line
Location 5	#2 lane, left wheelpath
Location 6	#2 lane, between wheelpaths
Location 7	#2 lane, right wheelpath
Location 8	Right shoulder

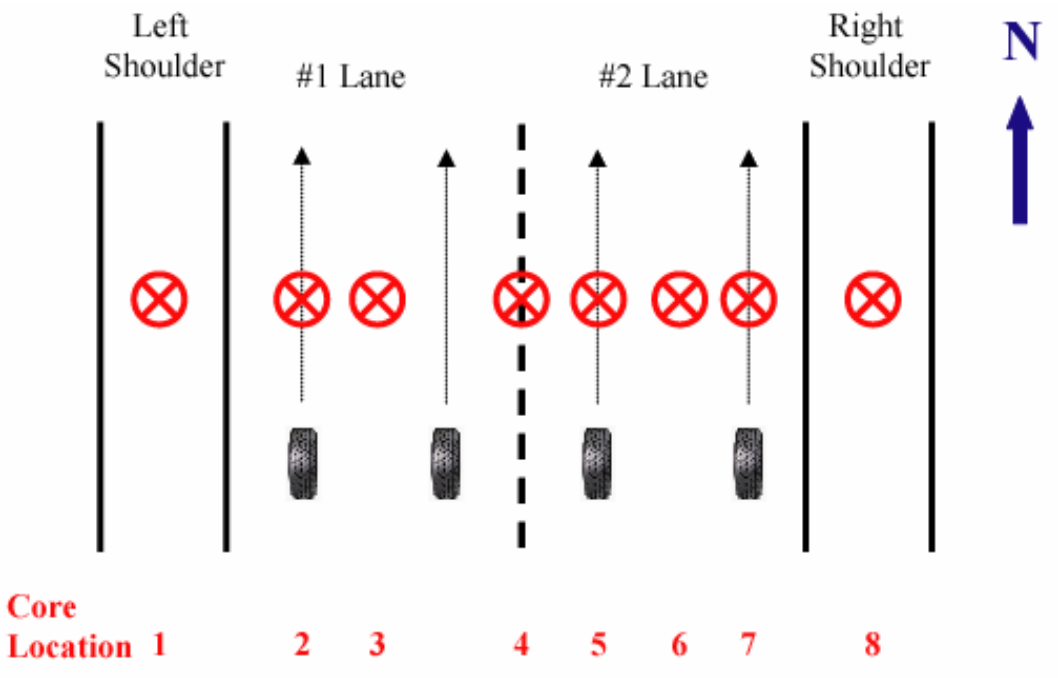


Figure 1. Core locations on section.

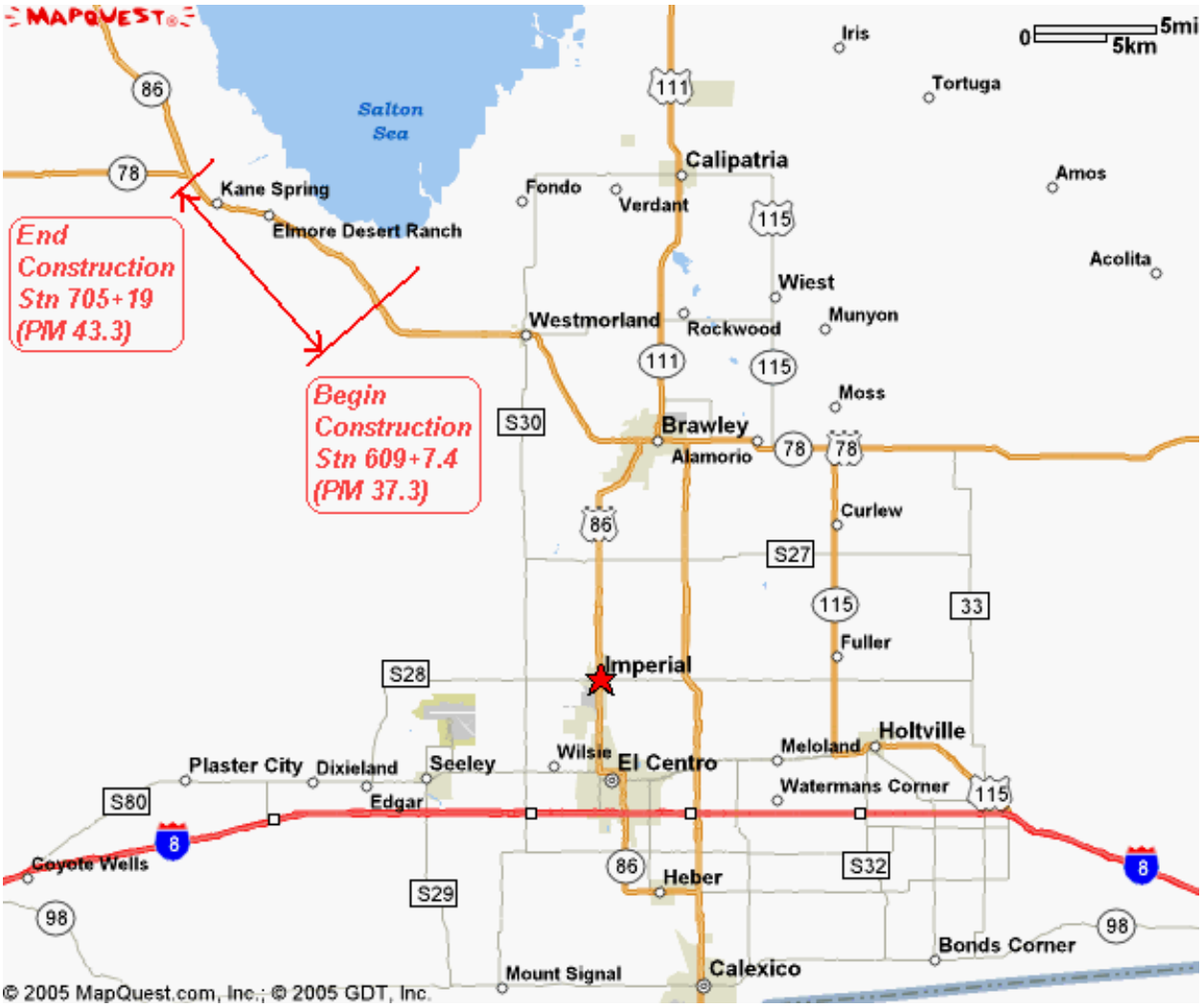


Figure 2. Site location.[1]

[1] MapQuest.com, Inc. http://www.mapquest.com/directions/main.adp. Website accessed February, 2005.

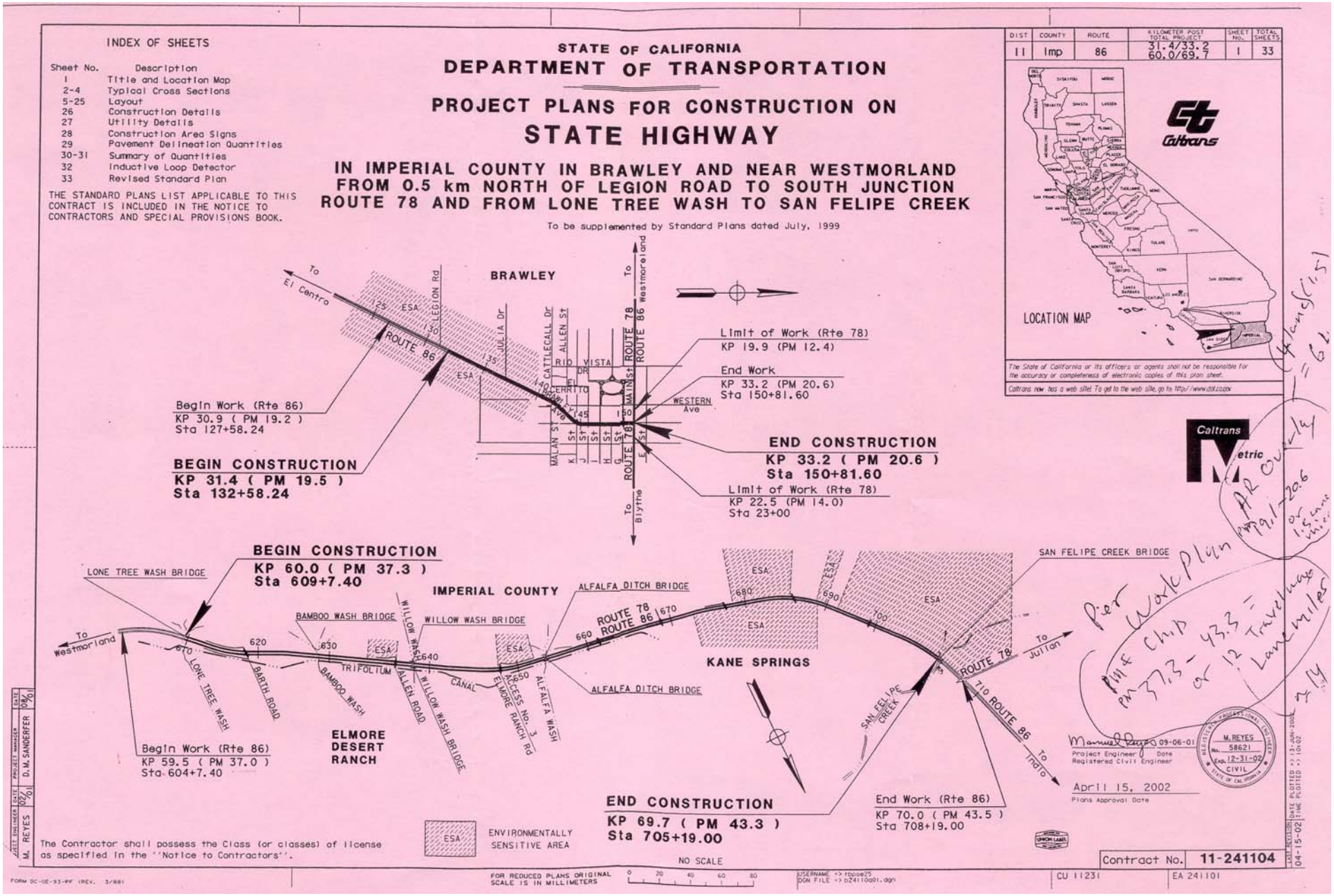


Figure 3. Site plan.

located in the half-mile section just south of the INS station where no RAC chip seal was applied, rather just a layer of OGAC was paved.

Summary of Findings

In short, flushing exists throughout the entire pavement section except for the 1-mile section south of the INS station. An OGAC layer was paved in this area because of braking and the extended duration of heavy loading near the INS inspection station. Figures 4-13 show that severe flushing starts at Station 606 (300 m ahead south of the beginning of construction according to the *Title and Location Map*) and lasts all the way until the OGAC section (1 mi. south of the INS station). Throughout the same section, wheelpath rutting ranges from 2 to 38 mm (measured during the first week of December 2004).

Table 2 Core Measurements

	Chip Seal Thickness at Core Location, mm							Rut Depth in Wheelpath, mm	
Station	2	3	4	5	6	7	8	Left Wheelpath	Right Wheelpath
610+40	11	10		9	10	13		2	2
616+21				14	13	14		23	33
616+37	11	11	13	12	15	10	13	18	38
617+60				12	13	11		6	16
618+00				10	10	10		11	16
652+40	10	11		10	11	9		12	18
654+00				10	12	10		2	11
688+40				10	10	10		0	0

* Rut depths were measured January 20, 2005.

Figure 4. Station 606, facing south; RAC chip seal construction starts at this point.

Figure 5. Station 606, facing north – RAC chip-sealed section starts here.

Figure 6. Station 608 (PM 37.3), facing north—flushing evident in #2 lane.

Figure 7. Station 610+40, facing south—flushing evident in #2 lane.

Figure 8. Station 612, facing north—flushing evident in #2 lane.

Figure 9. Station 616+37, facing south—note that #1 lane is clear of flushing and rutting while #2 lane shows clear evidence of flushing and rutting.

Figure 10. Station 616+21, facing north—note rutting and flushing.

Figure 11. Station 617+60, facing south—clear evidence of flushing in #2 lane.

Figure 12. Station 652+40, facing south—flushing evident in #2 lane.

Figure 13. Station 688, facing south—OGAC + RAC chip sealed #2 lane without evidence of distress.

Summary of Findings

There is no apparent correlation of RAC chip seal thickness with the measured rut depth. The northbound roadway was built in the 1920's (approximately). Some of the cores have as many as 8+ identifiable layers of AC. Hence, past maintenance treatment/rehabilitation should also be considered when evaluating possible causes of current distress.

Current Status

The contractor will not start the overlay and rip and replacement operation until the cause of the distress is identified and corrective actions are determined.

Last updated during late January 2005, District 11 has not begun testing on the cores. District 11 said that the PRC can evaluate leftover cores after District 11 completes their tests. It is currently unknown which cores District 11 plans to test; consequently, the date for the PRC to pick up the cores is not set.

Action Items Proposed:

1. PRC to send personnel and truck to District 11 to bring back the cores when District 11 identifies available cores.
2. Caltrans District 11 to provide PRC with a copy of all historical working documentation for this project.

APPENDIX A: DATA FOR THE CORES EXTRACTED JANUARY 20, 2005

Station 610+40

Core Location	610+40 No. 2	
Overall Core Thickness	258 mm	
Chip Seal Thickness	11 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	N/A	N/A

Core Location	610+40 No. 3	
Thickness (1st layer beneath chip seal only)	118 mm	
Chip Seal Thickness	10 mm	
Rut Depth	Left Wheelpath	Left Wheelpath
	N/A	N/A

Core Location	610+40 No. 5	
Overall Core Thickness	165 mm	
Chip Seal Thickness	9 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	2 mm	2 mm

Core Location	610+40 No. 6	
Thickness (1st layer beneath chip seal only)	154 mm	
Chip Seal Thickness	10 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	2 mm	2 mm

Core Location	610+40 No. 7	
Overall Core Thickness	157 mm	
Chip Seal Thickness	13 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	2 mm	2 mm

Station 616+21

Core Location	Station 616+21, Location 5	
Overall Core Thickness	199 mm	
Chip Seal Thickness	14 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	23 mm	33 mm

Core Location	616+21, Location 6	
Overall Core Thickness	211 mm	
Chip Seal Thickness	13 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	23 mm	33 mm

Core Location	616+21, Location 7	
Overall Core Thickness	190 mm	
Chip Seal Thickness	14 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	23 mm	33 mm

Station 616+37

Core Location	Station 616+37, Location 2	
Overall Core Thickness	209 mm	
Chip Seal Thickness	11 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	N/A	N/A

Core Location	Station 616+37, Location 3	
Overall Core Thickness	209 mm	
Chip Seal Thickness	11 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	N/A	N/A

Core Location	Station 616+37, Location 4	
Overall Core Thickness	211 mm	
Chip Seal Thickness	13 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	18 mm	38 mm

Core Location	Station 616+37, Location 5	
Overall Core Thickness	194 mm	
Chip Seal Thickness	12 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	18 mm	38 mm

Core Location	Station 616+37, Location 6	
Overall Core Thickness	196 mm	
Chip Seal Thickness	15 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	18 mm	38 mm

Core Location	Station 616+37, Location 7	
Overall Core Thickness	170 mm	
Chip Seal Thickness	10 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	18 mm	38 mm

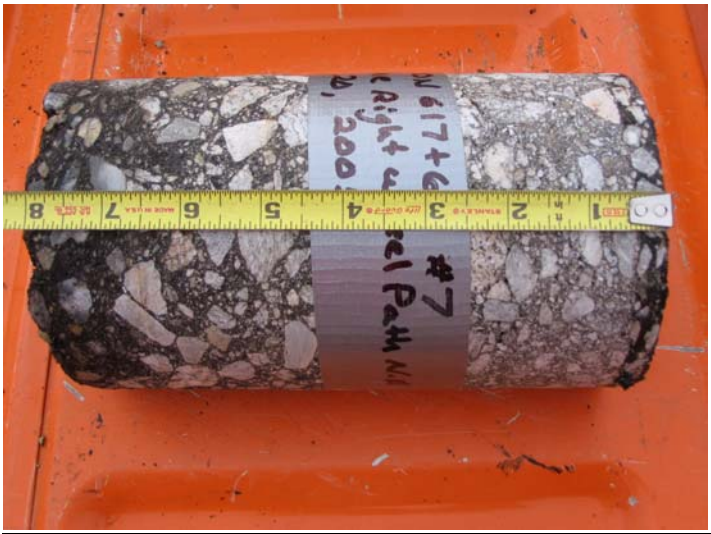
Image not available

Core Location	Station 616+37, Location 8	
Overall Core Thickness	124 mm	
Chip Seal Thickness	13 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	18 mm	38 mm

Station 617+60

Core Location	Station 617+60, Location 5	
Overall Core Thickness	206 mm	
Chip Seal Thickness	12 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	6 mm	16 mm

Core Location	Station 617+60, Location 6	
Overall Core Thickness	215 mm	
Chip Seal Thickness	12 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	6 mm	16 mm

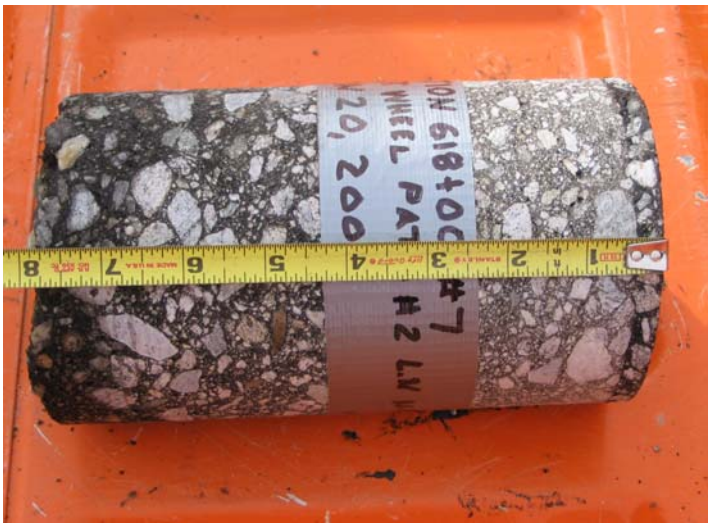


Core Location	Station 617+60, Location 7	
Overall Core Thickness	206 mm	
Chip Seal Thickness	11 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	6 mm	16 mm

Station 618+00

Core Location	Station 618+00, Location 5	
Overall Core Thickness	201 mm	
Chip Seal Thickness	10 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	11 mm	16 mm

Core Location	Station 618+00, Location 6	
Overall Core Thickness	207 mm	
Chip Seal Thickness	10 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	11 mm	16 mm



Core Location	Station 618+00, Location 7	
Overall Core Thickness	202 mm	
Chip Seal Thickness	10 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	11 mm	16 mm

Station 652+40

Core Location	Station 652+40, Location 2	
Overall Core Thickness	210 mm	
Chip Seal Thickness	10 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	N/A	N/A

Core Location	Station 652+40, Location 3	
Overall Core Thickness	217 mm	
Chip Seal Thickness	11 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	N/A	N/A

Core Location	Station 652+40, Location 5	
Overall Core Thickness	198 mm	
Chip Seal Thickness	10 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	12 mm	18 mm

Core Location	Station 652+40, Location 6	
Overall Core Thickness	216 mm	
Chip Seal Thickness	11 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	12 mm	18 mm

Core Location	Station 652+40, Location 7	
Overall Core Thickness	199 mm	
Chip Seal Thickness	9 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	12 mm	18 mm

Station 654+00

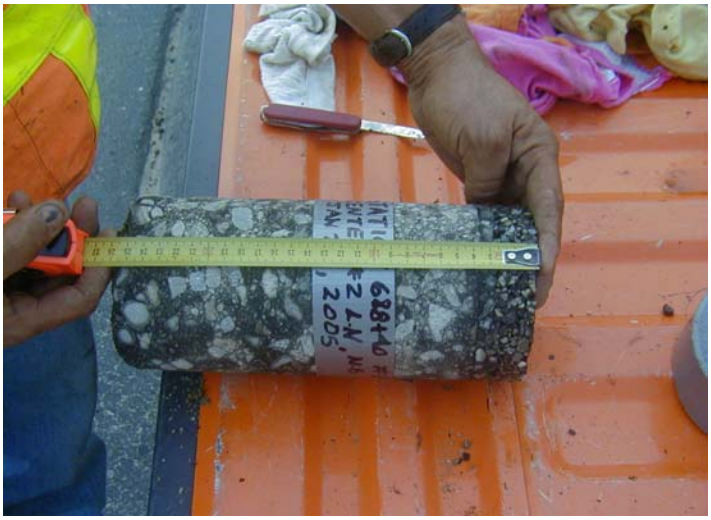
Core Location	Station 654+00, Location 5	
Overall Core Thickness	191 mm	
Chip Seal Thickness	10 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	2 mm	11 mm

Core Location	Station 654+00, Location 6	
Overall Core Thickness	206 mm	
Chip Seal Thickness	12 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	2 mm	11 mm

Core Location	Station 654+00, Location 7	
Overall Core Thickness	204 mm	
Chip Seal Thickness	10 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	2 mm	11 mm

Station 688+40

Core Location	Station 688+40, Location 5	
Overall Core Thickness	261 mm	
OG / Chip Seal Thickness	28 mm / 10 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	0 mm	0 mm



Core Location	Station 688+40, Location 6	
Overall Core Thickness	257 mm	
OG / Chip Seal Thickness	27 mm / 10 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	0 mm	0 mm

Core Location	Station 688+40, Location 7	
Overall Core Thickness	250 mm	
OG / Chip Seal Thickness	29 mm / 10 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	0 mm	0 mm

Station 696+00

Core Location	Station 696+00, Location 5	
Overall Core Thickness	324 mm	
OG Layer Thickness	12 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	N/A	N/A

Core Location	Station 696+00, Location 6	
Overall Core Thickness	335 mm	
OG Layer Thickness	7 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	N/A	N/A

Core Location	Station 696+00, Location 7	
Overall Core Thickness	290 mm	
OG Layer Thickness	17 mm	
Rut Depth	Left Wheelpath	Right Wheelpath
	N/A	N/A