June 2005

Technical Memorandum: UCPRC-TM-2005-07

Report of Field Site Visit District 3, Sacramento Interstate 5, PM 17.2-17.9 RAC-O Overlay

Authors:
A. Ongel, N. Santero, and J. Harvey

Work Conducted Under Partnered Pavement Research Contract

Strategic Plan Task 4.16: Investigation of Improved Open-graded Mix Designs including Quiet Pavement-AC

PREPARED FOR:

California Department of Transportation (Caltrans), Division of Research and Innovation, Office of Roadway Research
Division of Environmental Analysis

PREPARED BY:

University of California
Pavement Research Center
Berkeley and Davis

DISCLAIMER

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

TABLE OF CONTENTS

LIST OF FIGURES

1.0 INTRODUCTION

Route 5 near the Florin Road overcrossing (PM 17.2/17.9) in Sacramento County is one of the eight quiet pavement test sections where traffic noise measurements are being conducted by the Caltrans Division of Environmental Analysis Team. This section is a rubberized asphalt concrete open graded (RAC-O) overlay of PCC built in summer 2004.

According to a slide in a PowerPoint presentation prepared by Caltrans Environmental (Figure 1), noise measurements were conducted on the section by Caltrans Environmental between approximately Station 55+40 and Station 60+80 on the southbound lanes and between Station 54+40 and Station 59+60 on the northbound lanes. According to the presentation sent to the Pavement Research Center (PRC) by Caltrans Environmental (Figure 1), both the northbound and southbound directions were divided into three segments of roughly equal lengths (exact stationing of measurements cannot be read from the presentation) and noise levels were obtained for each segment. The total distance over which noise measurements were made for each direction, as approximately read from the presentation, are shown in Figure 2 against the total length of the project. Measurements were repeated three times for each segment to account for measurement errors. According to the presentation, the segments are separated by gaps.

According to the noise levels reported by Caltrans Environmental, noise performance differences exist within the southbound segments as well as between the northbound and southbound directions, though the mix designs of all the segments were the same. Caltrans Environmental reported the following results:

- On the northbound direction, the variation among segments was as small as the difference between run-to-to run.

- On the southbound direction, run-to-run differences for each sample segment were smaller than the differences between the segments, indicating that differences were related to variation in the pavement condition of each segment rather than measurement techniques.
- Over the project, as much as 3.5-dB variation in noise levels was measured for averages of six different pavement sections. Noise performance differences were significant at lower frequencies (1250 Hz and below).
- The overall noise level of the northbound pavement is on average higher than southbound.

PRC evaluation of the results presented in the Caltrans Environmental presentation (Figures 3 and 4) indicate that the maximum difference within the southbound direction is about 3.5 dB, and the difference between the average north and southbound directions is less than 1.5 dB. Verbal communication with Caltrans Environmental indicated that all sound intensity measurements were taken in the outside lane.

On January 26, 2005, in response to questions from Caltrans about effects of visible pavement condition on sound intensity measurements, a team from the PRC performed a field survey of the project with the following objectives:

- Investigate visual differences in surface condition between northbound and southbound directions
- Investigate visual differences in surface condition of different segments of southbound direction where the noise measurements were taken,
- Locate any distresses on both directions

It was raining during the visit, which enabled the water handling ability of the pavement to be observed.

2.0 FIELD SURVEY

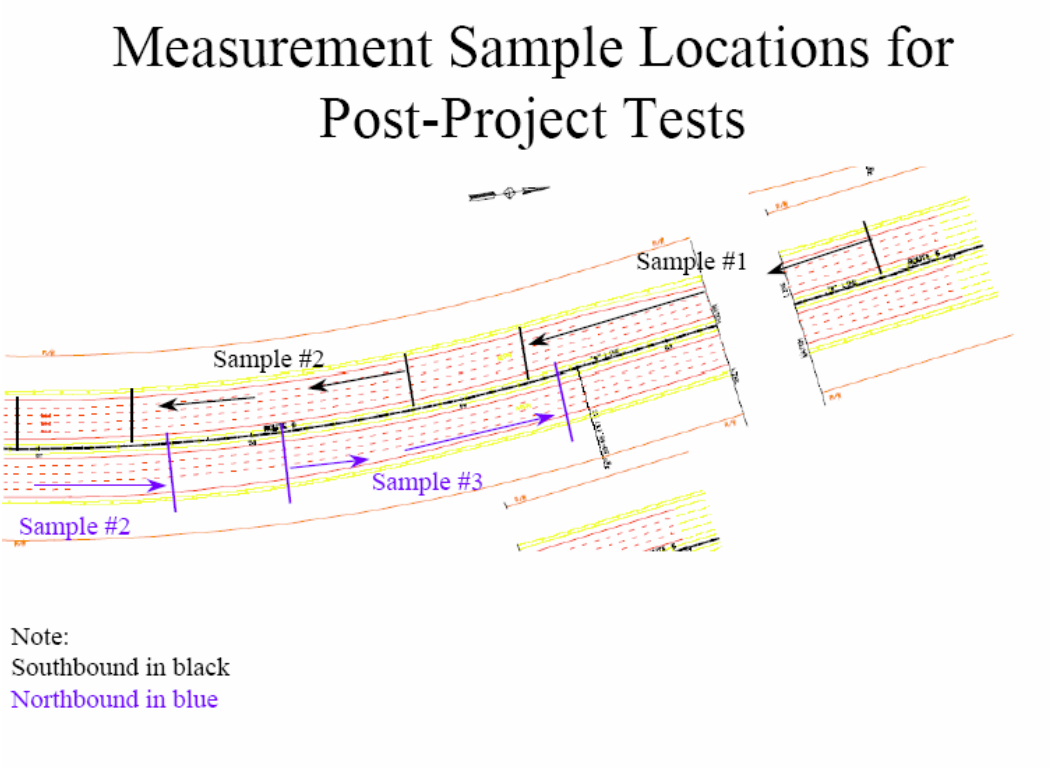
The south end of the overlay is at the Florin Road overcrossing. The condition survey was conducted first on the southbound direction and then on the northbound direction. During the southbound survey, it was raining and this allowed observation of permeability and flow. The southbound condition survey was conducted between approximately Station 50+00 and Station 57+00 while the northbound condition survey was conducted between Station 50+00 and Station 61+00 (where the open graded overlay section ends and PCC starts), as shown in Figure 2. Due to a sound wall on the southbound direction, access farther than Station 57+00 was not possible. Thus, Segments (Samples) 1 and 2 of the southbound direction where noise measurements were conducted, shown in Figure 1, could not be visually evaluated by walking. Windshield survey showed no significant distresses.

2.1 Southbound Observations:

Reflection cracking was evident in the outside lanes on the south end of the southbound direction. The cracking was less frequent in the northern portion. Figures 5 and 6 show examples of the reflection cracking between Station 51+00 and Station 52+00.

Ponding was present in the same locations as the reflection cracking. Water flowed easterly (from outside to inside lanes) on the southern portion of the project as shown in Figure 2. Moving northward against traffic in the southbound lane, the section climbs a mild hill, and then descends and the super-elevation reverses in the middle of the section, with water in the northern part of the southbound direction flowing westerly (from inside to outside lanes). Figures

7 through 12 show the pavement and ponding on the southbound direction of the site as the viewer progresses against traffic.



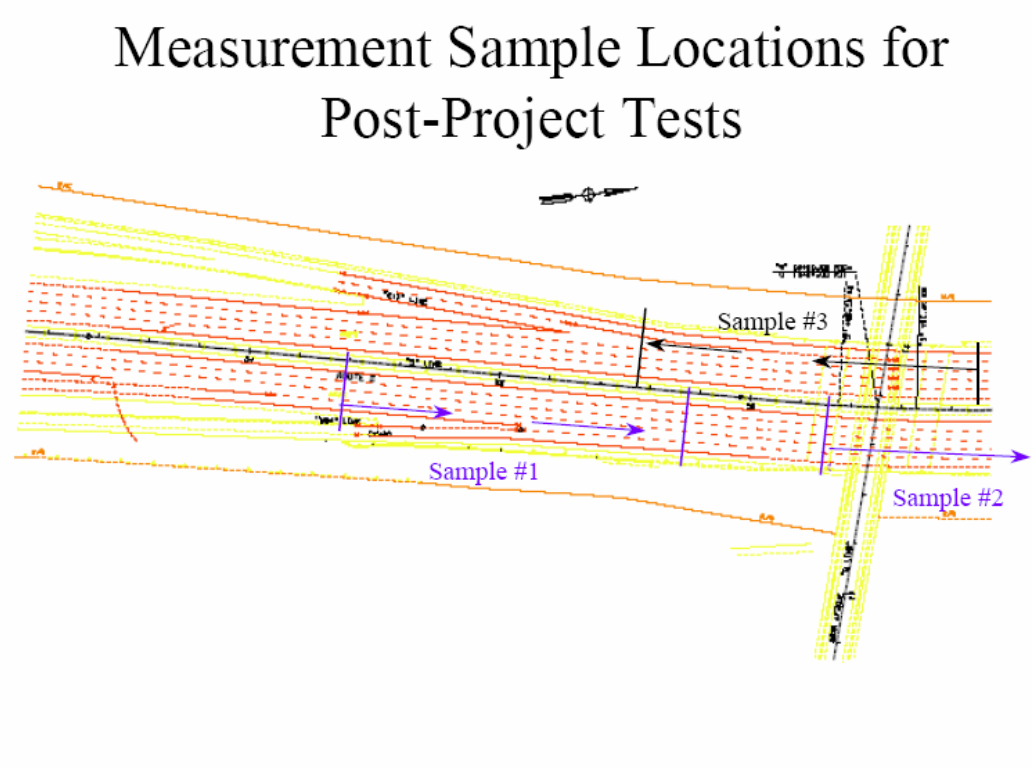


Figure 1. Caltrans Environmental Division noise measurement sections.

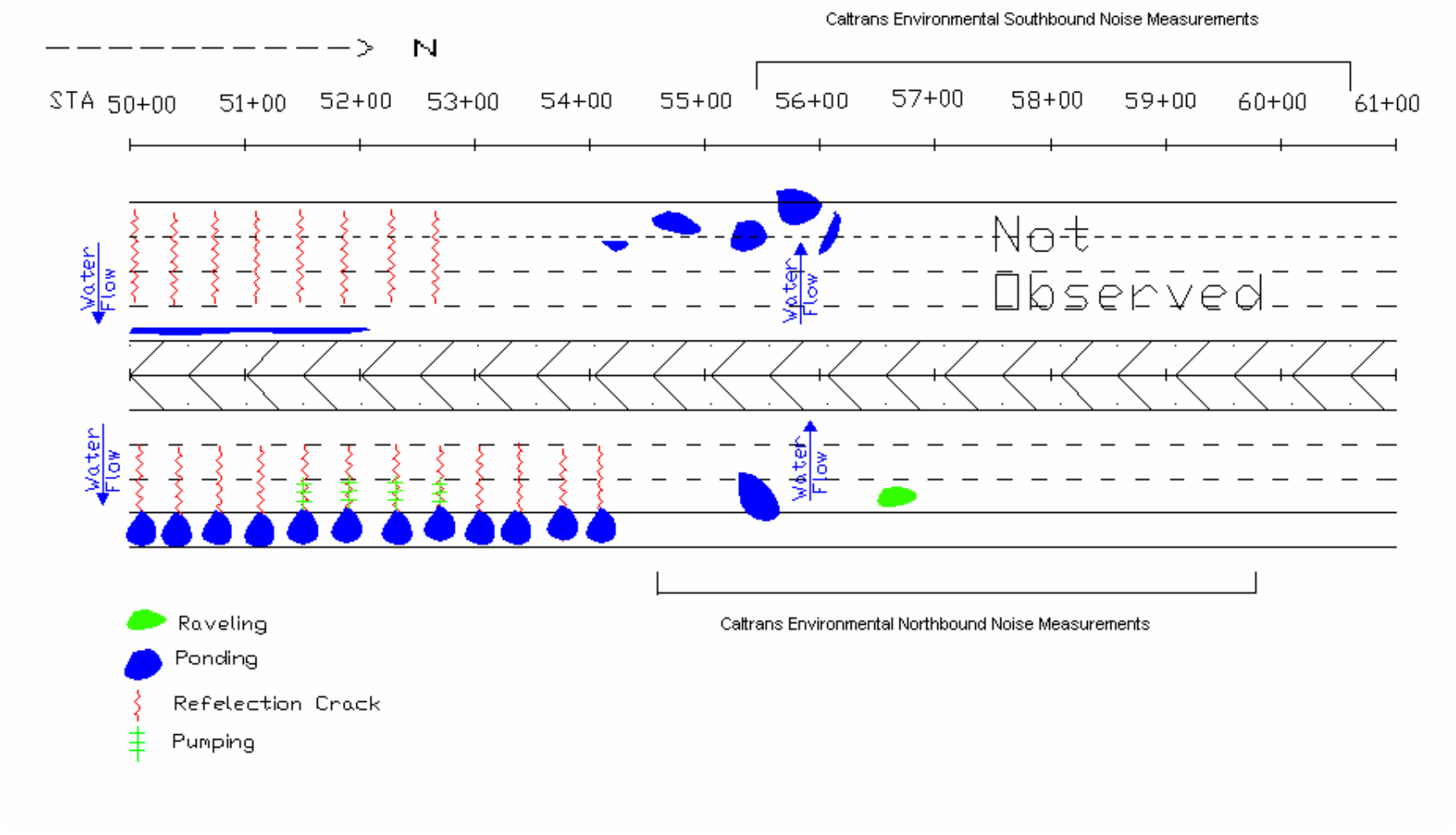


Figure 2. Plan of the section and the distresses (from Caltrans Environmental).

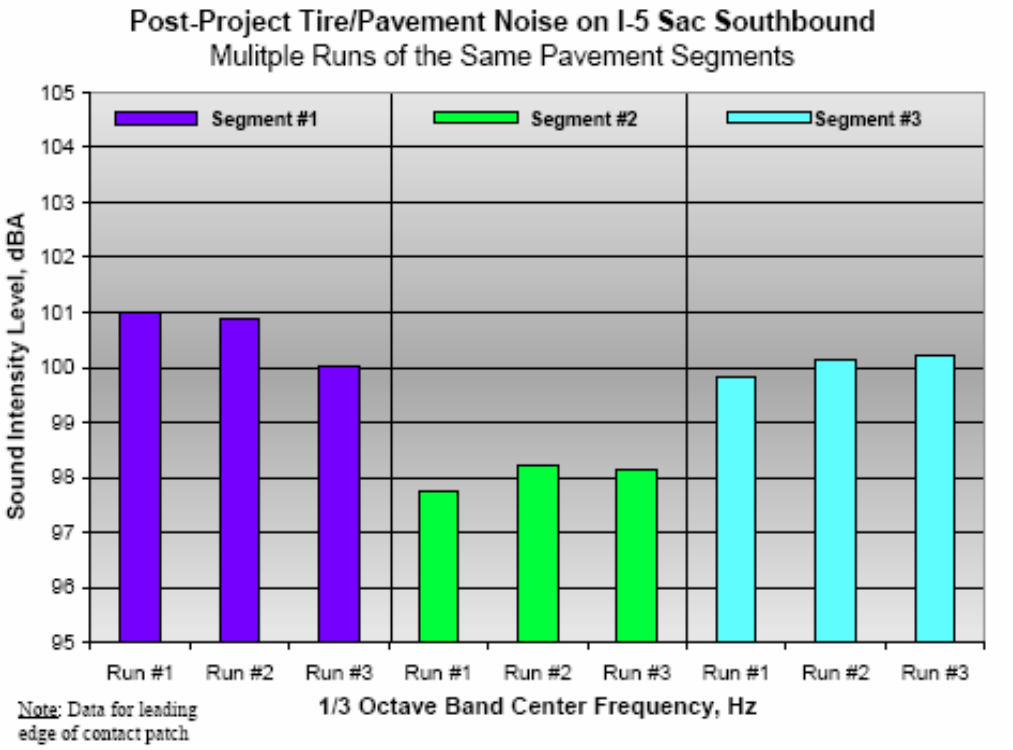


Figure 3. Tire pavement noise on I-5 Sacramento southbound (from Caltrans Environmental presentation).

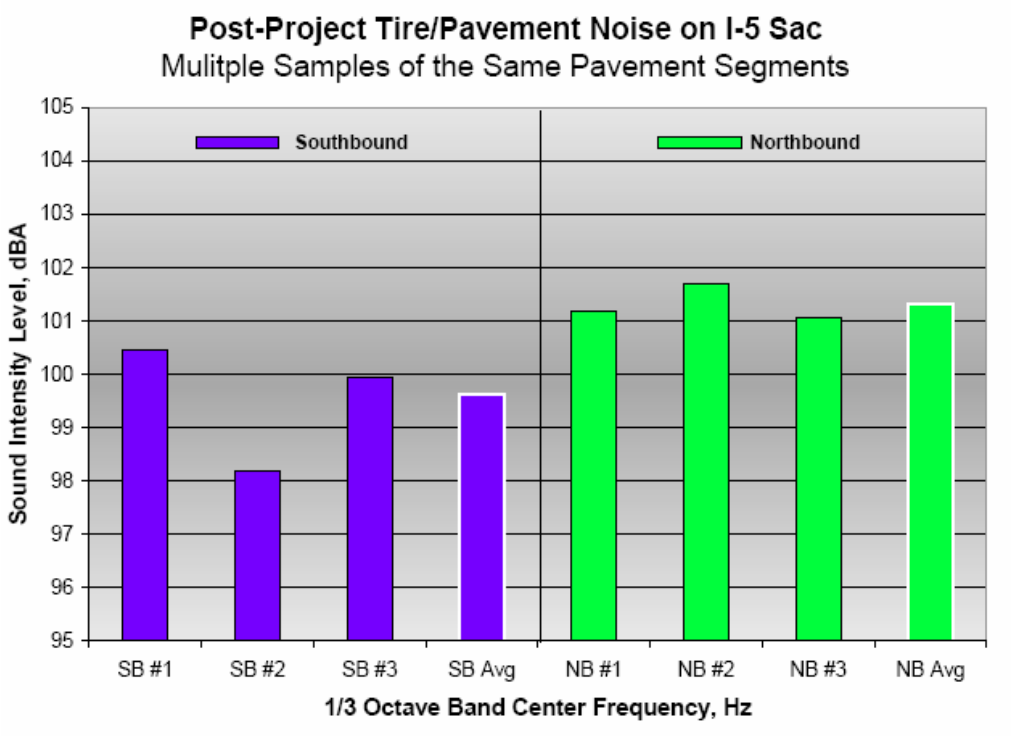


Figure 4. Tire pavement noise on I-5 Sacramento southbound and northbound (from Caltrans Environment presentation).

Figure 5. Reflection cracking between Station 51+00 and Station 52+00(southbound lanes).

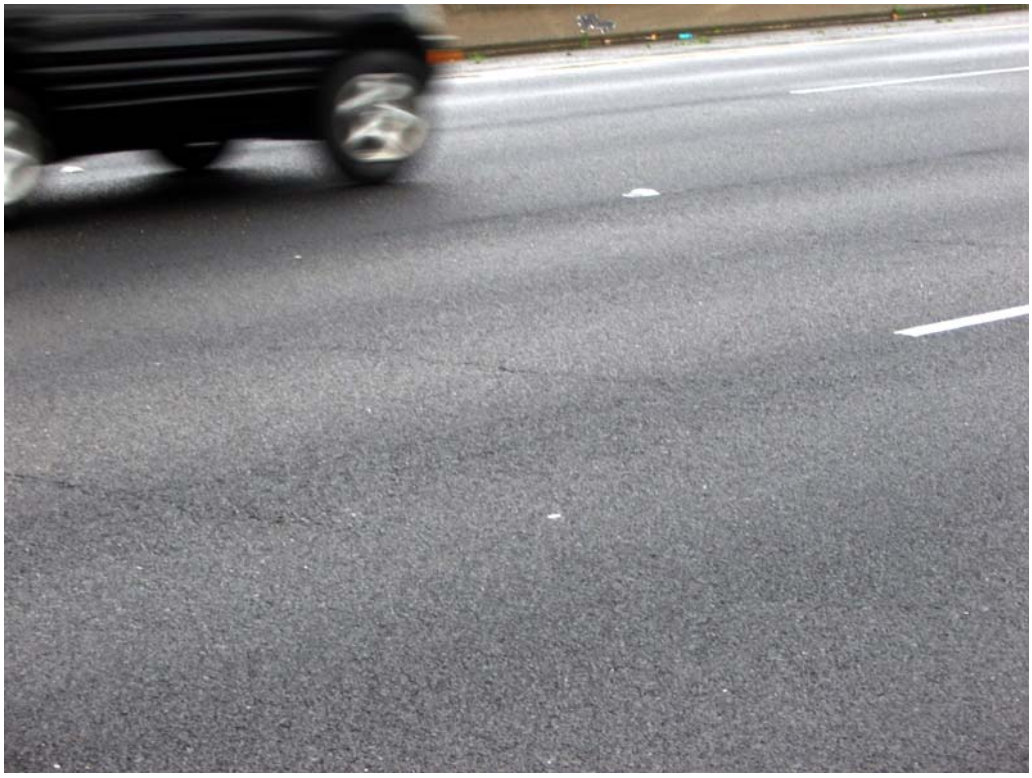


Figure 6. Reflection cracking between Station 51+00 and Station 52+00 (southbound lanes).

Figure 7 . Ponding at Station 50+40 (inside lanes, southbound).

Figure 8. Ponding at Station 51+00 (inside lanes, southbound).

Figure 9. Ponding between Station 51+00 and Station 51+60 (inside lanes, southbound).

Figure 10. Ponding between Station 51+00 and Station 51+60 (inside lanes, southbound).

Figure 11. Ponding at Station 51+60 (inside lanes, southbound).

Figure 12. Ponding looking north from Station 55+00 (outside lanes, southbound).

Polishing and mild rutting were observed in the truck lanes. Figure 13 shows the polishing and mild rutting on the outer lane of the southbound direction.

2.2 Northbound Observations

As in the southbound direction, reflection cracking was evident in the outside lanes on the south end of the northbound direction and were less frequent in the northern portion. Also, pumping of fines was evident at some transverse joints in the south end of the northbound direction. Figure 14 shows the reflection cracking while Figures 15 and 16 show reflection cracking and pumping of fines.

As in the southbound direction, water flow was easterly on the southern portion of the project and westerly on the northern portion of the project. Therefore, in the northbound direction, ponding occurred on the outside lanes at the southern portion and inside lanes in the northern portion .Figures 17 through 21 show the ponds on the northbound direction.

Raveling and a 1-2 inch diameter hole were observed at Station 56+80 on the northbound direction (Figures 22–24).

It was also observed that splash and spray decreased immediately after rain stopped in southbound direction; however it continued for about 30 minutes after the rain stopped in the northbound direction.

The end point of the condition survey was Station 61+00 northbound, where the open graded section ends. Figure 25 shows the end of the open graded section and the start of PCC section.

Figure 13. Polishing and mild rutting near Station 54+50 (outside lanes, southbound).

Figure 14. Reflection cracking between Station 51+00 and 52+00 (northbound lanes).

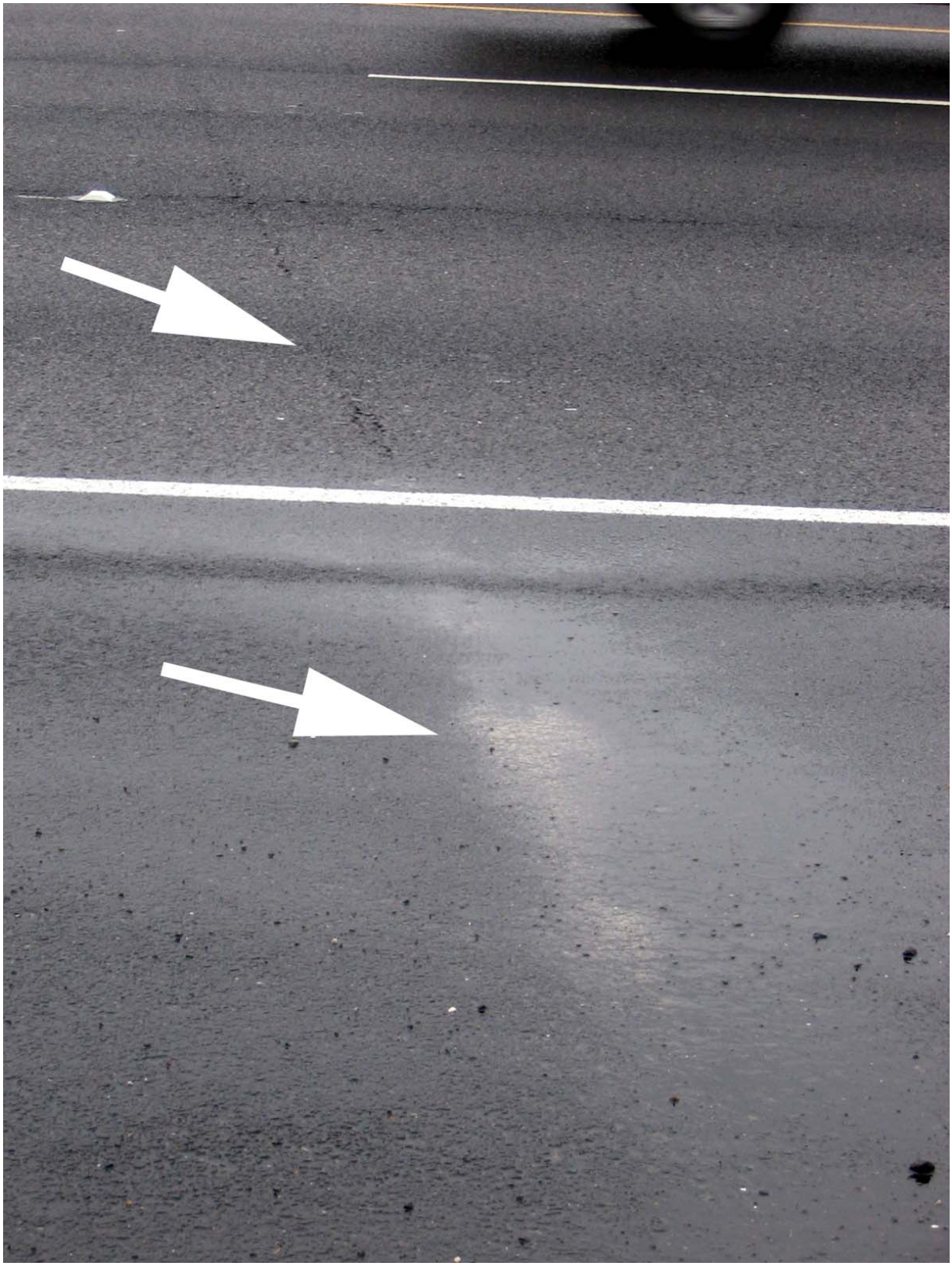


Figure 15. Reflection cracking and pumping of fines between Station 52+00 and 53+00 (northbound lanes).

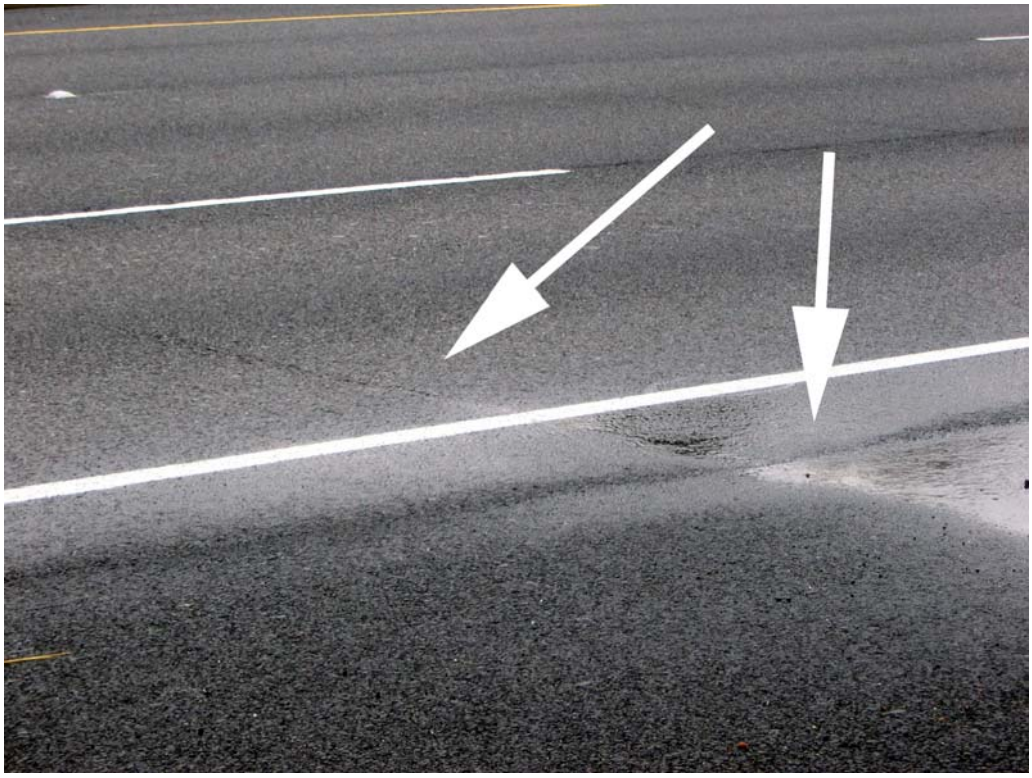


Figure 16. Reflection cracking and pumping of fines between Station 52+00 and 53+00 (northbound lanes).

Figure 17. Ponding at Station 50+00 (outside lanes, northbound).

Figure 18. Ponding starting at Station 50+00 (outside lanes, northbound).

Figure 19. Ponding between Station 53+00 and Station 54+00 (outside lanes, northbound)

Figure 20. Ponding between at Station 54+44 (inside lanes, northbound).

Figure 21. Ponding between between Station 54+00 and 56+00 (inside lanes, northbound).

Figure 22. Raveling at Station 56+80 (northbound direction).

Figure 23. Hole at Station 56+80 (northbound direction).

Figure 24. Raveling at Station 56+80 (northbound direction).

Figure 25. End of open graded section (northbound direction)

3.0 SUMMARY OF FINDINGS

- The PPRC was not able to determine the exact stations of the noise measurement segments either from the presentation or discussion with Caltrans Environmental. To be able to compare field pavement data with noise measurement data, the exact stations of the noise measurements must be known.
- The two directions appeared to have nothing distinctly different about them based on visual inspection. From this, it was concluded that a more detailed pavement investigation of northbound and southbound would be needed to accurately analyze what is contributing to the sound level discrepancy between them. Permeability measurements may indicate differences that were not apparent from visual inspection. Determining surface cross-slope profile might provide useful information.
- Since there was no access to Segments 1 and 2 of the southbound direction due to safety concerns, the pavement condition relative to the noise level differences could not be evaluated by walking survey. Windshield survey showed no perceptible difference in condition from the rest of the southbound direction.
- It is hypothesized that water flow and the resulting ponding and pumping of fines may be contributing to premature clogging of the pores resulting in different noise performance through the southbound section, and the slight difference between the average northbound and southbound direction measurements. However, from the Caltrans Environmental presentation it appears that the section of the northbound lanes with pumping was not included in the noise measurements.

4.0 RECOMMENDATIONS

To test the hypothesis that water flow, ponding, and pumping are contributing to differences in clogging within the project, it is recommended that the following additional work (as well as determination of surface cross-slope profile) be performed within a lane closure on the northbound and southbound directions and the segments of the noise study in each direction:

- Permeability evaluation.
- Extraction of cores to test for air-void content and overlay thickness.

This recommendation should only be implemented if sound intensity measurements are repeated over the entire section with the segmentation clearly defined against the stationing of the project, or the exact stations of the existing data are clearly identified and the field pavement testing is done within those stations. Otherwise, the field pavement testing cannot be matched up against the sound intensity data to confirm or reject the hypothesis.