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# Work Plan for "Third Year Field Evaluation of Tire/Pavement Noise, IRI, Macrotexture and Surface Condition of Flexible Pavements"

PPRC Strategic Plan Item 4.19: A Framework for Implementing Innovative Contracting Methods for Transportation Infrastructure Rehabilitation/Reconstruction

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## 1.0 PURPOSE OF PROJECT

The purpose of this research is to perform a third year of measurement of tire/pavement noise, surface condition, ride quality and macrotexture of 74 flexible pavement sections to recognize trends that would allow for identification of more durable, smoother, and quieter pavement types. The three years of data collected on the sections will be used to provide a preliminary table of estimated design lives for different treatments with respect to the variables measured. The first two years of data were collected on these sections as part of PPRC Strategic Plan Element 4.16. In addition, the same measurements will be performed on 10 additional sections identified by Caltrans with strategies or conditions not included in the previous testing.

## 2.0 BACKGROUND

The smoothness and quietness of pavements have received increasing attention and importance as quality of life issues for highway users and neighboring residents[1]. Since a variety of strategies and materials are available for pavement maintenance and rehabilitation, Caltrans would like to identify the life of current strategies, as well as new strategies and materials, capable of maintaining smoothness and quietness for the longest time.

A factorial was developed for current strategies, including dense-graded asphalt concrete, RAC-G, open-graded asphalt concrete, and RAC-O. Note that names of materials have changed in the new Standard Specifications Section 39; the previous names are used in this work plan. That factorial includes 51 sections, referred to as the Quieter Pavement (QP) sections. These sections have been tested for two years. The first two years of data included coring, permeability, and friction tests within traffic closures. The factorial included sections that were less than one year old, one to four years old, and 4 to 8 years old. In addition, 23 sections with new materials and control sections placed next to them have also been tested for two years.

A first year report has been submitted to Caltrans. Second year testing has been completed and is being analyzed. A report summarizing the first two years of data will be submitted to Caltrans in October 2007. The changes from the first year to the second year are not that large. A third year of data will provide more definition to the trends, and some of the older sections should begin reaching failure.

[1] Deputy Directive on smoother and quieter pavement (draft July 2007).

# 3.0 GOALS, OBJECTIVES, AND DELIVERABLES

## 3.1 Goals

The primary goal of this research is to recognize pavement types that are the most durable, smooth, and quiet. The following objectives will lead to completion of this goal.

## 3.2 Objectives

### 3.2.1 Objective 1. Perform third year of noise, smoothness, and condition survey monitoring of 4.16 sections.

In July 2007, the UCPRC completed the field work of the second year surface property monitoring of the 4.16 sections. The UCPRC will conduct a third year data collection campaign on these sections. Cores will not be taken, and the work will not require traffic closures. Noise, smoothness and macrotexture, and surface condition of each section will be monitored using the California On-Board Sound Intensity (OBSI) method, laser profilometer, and visual condition survey (walking), respectively. There are 74 sections from PPRC SPE 4.16 sections, comprised of "ES" sections (Environmental) and QP sections (Quieter Pavements). They are listed in Appendix A.

### 3.2.2 Objective 2. Conduct noise, smoothness, and condition survey monitoring on new field sections identified to have the potential to be the most durable, smooth, and quiet, or performing under conditions not include in the previous testing.

The same methods mentioned in Objective 1 will be used to evaluate sections not previously included in PPRC SPE 4.16. This refers to asphalt and concrete sections, either new construction or existing pavements. An estimated maximum of 10 sections selected by Caltrans will be included as part of this objective. In the case of new sections, measurements will be conducted before and after construction, as much as scheduling will allow.

### 3.2.3 Objective 3. Develop pavement temperature correction for OBSI data and upgrades to the instrumented noise car.

This objective involves measurement of some sections at various temperatures within a short period, in order to quantify the effect of pavement temperature on in the noise levels, and to determine correction formulas to normalize OBSI measurements. The transition from a single to a double sound intensity probe will be done as part of this project, as well as any software development and updates associated to improved data collection practices.

### 3.2.4 Objective 4. Analyze results, model where applicable.

Analyze results of the measurements, investigate trends, classify pavements with respect to durability, smoothness, and noise levels, and attempt predictive models if applicable. The database generated during PPRC SPE 4.16 will be used in this part of the study.

### 3.2.5 Objective 5. Develop preliminary table of expected lives for flexible pavement surfaces.

Analyze the results of Objective 4 and develop a preliminary table of estimated design lives for flexible pavement surfaces tested with respect to durability, smoothness, and noise levels. Traffic and climate condition effects on life will be included in the table where data is available.

## 3.3 Deliverables

The deliverables of this project will be two reports:

1. The first report will present the finding regarding pavement temperature corrections, which corresponds to Objective 3.
2. The second report will present the results as described in Objectives 4 and 5, which in turn are based on Objectives 1 and 2.

# 4.0 COST

| | |
|---|---|
| Upgrade sound intensity equipment | $ 8,000 |
| Third year of monitoring PPRC SPE 4.16 sections | $60,000 |
| Identify and monitor ten new sections | $10,000 |
| Temperature correction testing | $ 5,000 |
| Analysis and report writing | $17,000 |
| TOTAL | $100,000 |

## 5.0 SCHEDULE

Objective 1: August 2007 to April 2008

Objective 2: August 2007 to June 2008

Objective 3: July 2007 to November 2007

Objective 4: April 2008 to June 2008.

Objective 5: May 2008 to June 2008

Delivery of Report 1 (temperature correction): February 2008

Delivery of Report 2 (final report): June 2008.

# APPENDIX: LIST OF SECTIONS

## Table A1: QP Sections List, Open-graded Asphalt Concrete (OGAC)

| Age | Rainfall | Traffic | DIST/CTY/RTE/PM | Site ID | Age (in 2005) |
|---|---|---|---|---|---|
| Less than 1 year old | High Rainfall | High Traffic | 03-PLA-80-1.4/2.6 | QP-44 | <1 |
| | | Low Traffic | No sections found to fit this cell | | |
| | Low Rainfall | High Traffic | 03-Yol-80-0.0/0.4 | QP-45 | <1 |
| | | Low Traffic | 05-SCR-152-7.6/8.0 | QP-20 | <1 |
| 1-4 years old | High Rainfall | High Traffic | 04-Mrn-101-0.0/2.5 | QP-28 | 4 |
| | | Low Traffic | 04-Son-121-3.4/7.3 | QP-4 | 4 |
| | Low Rainfall | High Traffic | 04-SCl-237-R3.8/7.10 | QP-23 | 5 |
| | | Low Traffic | 08-SBd-38-S0.0/R5.0 | QP-13 | 5 |
| 5-8 years old | High Rainfall | High Traffic | 04-Mrn-37-12.1/14.4 | QP-3 | 5 |
| | | Low Traffic | 01-MEN-1-0.1/15.2 | 01-N103, 01-N104, 01-N105 | 5 |
| | Low Rainfall | High Traffic | 04-SCl-237-R1.0/2.3 | QP-22 | 8 |
| | | Low Traffic | 03-Sac-16-6.9/20.7 | QP-29 | 8 |

## Table A2: QP Sections List, Rubberized Open-graded Asphalt Concrete (RAC-O)

| Age | Rainfall | Traffic | DIST/CTY/RTE/PM | Site ID | Age (in 2005) |
|---|---|---|---|---|---|
| Less than 1 year old | High Rainfall | High Traffic | 03-Pla-80-14.3/33.3 | QP-51 | <1 |
| | | Low Traffic | 01-MEN-20-R37.9/43.0 | QP-41 | <1 |
| | | | 01-LAK-29-R37.3/R37.6 | QP-42 | <1 |
| | Low Rainfall | High Traffic | 06-TUL-99-42.0/47.0 | QP-35 | <1 |
| | | Low Traffic | 06-TUL-63-19.8/R30.1 | QP-34 | <1 |
| 1-4 years old | High Rainfall | High Traffic | 03-Sac-50-16.10/17.30 | QP-8 | 5 |
| | | Low Traffic | 10-Ama-49-14.7/17.6 | QP-17 | 3 |
| | Low Rainfall | High Traffic | 07-LA-710-6.8/9.7 | QP-1 | 3 |
| | | | 04-CC-680-23.9/24.9 | QP-36 | 3 |
| | | Low Traffic | 06-Tul-65-21/29 | 06-N466, 06-N467, 06-N468 | 3 |
| 5-8 years old | High Rainfall | High Traffic | No sections found to fit this cell | | |
| | | Low Traffic | 04-Nap-128-5.1/7.4 | QP-32 | 8 |
| | Low Rainfall | High Traffic | 04-SCl-85-1.9/4.7 | QP-24 | 8 |
| | | Low Traffic | 08-SBD-58-R0.0/5.3 | QP-12 | 5 |

## Table A3: QP Sections List, Rubberized Gap -graded Asphalt Concrete (RAC-G)

| Age | Rainfall | Traffic | DIST/CTY/RTE/PM | Site ID | Age (in 2005) |
|---|---|---|---|---|---|
| Less than 1 year old | High Rainfall | High Traffic | No sections found to fit this cell | | |
| | | Low Traffic | 01-MEN-20-R37.9/43.0 | QP-39 | <1 |
| | Low Rainfall | High Traffic | 04-SCl-280-R0.0/R2.7 | QP-26 | <1 |
| | | Low Traffic | 06-TUL-63-19.8/R30.1 | QP-33 | <1 |
| 1-4 years old | High Rainfall | High Traffic | 04-Mrn-101-18.9/23.1 | QP-2 | 4 |
| | | Low Traffic | 04-Son-1-0.0/8.4 | QP-31 | 5 |
| | Low Rainfall | High Traffic | 08-Riv-15-33.8/38.4 | QP-14 | 5 |
| | | Low Traffic | 05-SLO-46-R10.8/R22.0 | QP-19 | 4.5 |
| 5-8 years old | High Rainfall | High Traffic | 04-Mrn-101-2.5/8.5 | QP-5 | 9 |
| | | Low Traffic | 10-Cal-4-0/18.8 | QP-18 | 6 |
| | Low Rainfall | High Traffic | 11-SD-8-0.8/1.9 | QP-46 | 6 |
| | | Low Traffic | 07-Ven-34-4.3/6.3 | QP-10 | 5 |

## Table A4: QP Sections List, Dense-graded -graded Asphalt Concrete (DGAC)

| Age | Rainfall | Traffic | DIST/CTY/RTE/PM | Site ID | Age (in 2005) |
|---|---|---|---|---|---|
| Less than 1 year old | High Rainfall | High Traffic | 03-Pla-80-14.3/33.3 | QP-27 | <1 |
| | | Low Traffic | 01-MEN-20-R37.9/43.0 | QP-40 | <1 |
| | Low Rainfall | High Traffic | 06-FRE-99-10.7/15.9 | QP-6 | <1 |
| | | Low Traffic | 07-LA-138-60.2/61.6 | QP-15 | <1 |
| 1-4 years old | High Rainfall | High Traffic | 03-ED-50-17.3/18.3 | QP-21 | 3 |
| | | Low Traffic | 03-ED-50-18.5/20.3 | QP-30 | 4 |
| | Low Rainfall | High Traffic | 06-KER-99-R29.5/R31.0 | QP-7 | 5 |
| | | Low Traffic | 04-SOL-113-0.1/18.0 | QP-43 | 1 |
| 5-8 years old | High Rainfall | High Traffic | 04-SM-280-9.6/10.8 | QP-9 | 5 |
| | | Low Traffic | 01-Men-1-20.8/38.7 | 01-N114, 01-N121 | 7 |
| | Low Rainfall | High Traffic | 04-Ala-92-6.6/8.8 | QP-16 | 14 |
| | | Low Traffic | 06-KER-65-R0.0/2.9 | 06-N434, 06-N436 | 6 |
| | | | 07-LA-60-R25.4/R30.5 | QP-11 | 7 |
| | | | 04-CC-680-23.9/24.9 | QP-25 | 8 |

## Table A5: QP Sections List, F-mixes

| Binder | Age | Rainfall | Traffic | DIST/CTY/RTE/PM | Site ID | Age (in 2005) |
|---|---|---|---|---|---|---|
| RAC | Less than 1 year old | High Rainfall | Low Traffic | 01-Men-101-37.4/38.8 | QP-52 | 1 |
| RAC | 1-4 years old | High Rainfall | Low Traffic | 01-Men-101-50.8/ 51.5 | QP-47 | 3 |
| | | | | 01-HUM-101-111.1/111.5 | QP-50 | 4 |
| Conventional | 5-8 years old | High Rainfall | Low Traffic | 01-Men-20-21.19/21.69 | QP-48 | 8 |
| | | | | 01-Men-20-22.18 /22.68 | QP-49 | 8 |

## Table A6: ES Section List

| Site Name | Site Location | Surface Types | Construction Date |
|---|---|---|---|
| Los Angeles 138<br>(LA 138)<br>(near Lancaster) | 07-LA-138/PM 16.0-21.0 | OGAC, 30 mm<br>OGAC, 75 mm<br>RAC-O, 30 mm<br>BWC, 30 mm<br>DGAC, 30 mm | Spring 2002 |
| Los Angeles 19<br>(LA 19)<br>(Rosemead Blvd, near Pasadena) | 07-LA-19/ PM 3.4 | European Gap-graded, 30mm | May 2005 |
| Yolo-80<br>(near Davis) | 03-Yolo-80/PM 2.9-5.8 | OGAC, 20 mm | Summer 1998 |
| Fresno 33<br>(Fre-33)<br>(near Firebaugh) | 06-Fre-33/PM 70.9-75.08 | RAC-G, 45 mm<br>RAC-G, 90 mm<br>RUMAC-GG, 45 mm<br>RUMAC-GG, 90 mm<br>Type-G MB, 45 mm<br>Type-G MB, 90 mm<br>Type-D MB, 45 mm<br>Type-D MB, 90 mm<br>DGAC, 90 mm | Summer 2004 |
| San Mateo 280<br>(SM-280)<br>(near Redwood) | 04-SM-280/PM R0.0-R5.6 | RAC-O, 45 mm | Fall 2002 |
| Sacramento 5<br>(Sac-5)<br>(near Florin Road) | 03-Sac-5/PM 17.2-17.9 | OGAC, 30 mm | Summer 2004 |