FOR CONTRACT NO.: 02-3E750**4**

INFORMATION HANDOUT

MATERIALS INFORMATION

LONG LIFE PAVEMENT CONSIDERATIONS

SUMMARY OF CORING DATA

UCPRC TEST DATA

ROUTE: 02-SIS-5-R19.0/R25.3

Long Life Pavement Considerations

At the outset it is important to recognize that for long life pavements significant changes are required in the overall conduct of the execution of a contract by the contractor. These changes include the following: more rigourous material requirements; a different approach for mix design; performance-related laboratory testing of the hot mix asphalt; and more rigourous controls during production and placement of the mix. In addition, timely QA test results are required.

1. Materials and mix design:

- The requirements for the aggregate have been established to recognize the impacts of traffic and environment for a design period of forty years with periodic resurfacing to improve the pavement surface characteristics.
- Mix design for each mix is based on the shear test requirements listed in the Hot Mix Asphalt (HMA) Performance Requirements table in "Hot Mix Asphalt (Long Life)" of the special provisions for the project. The laboratory specimen preparation and test procedures are included in the document Lab Procedure – LLP-AC1 Sample Preparation and Testing for Long-Life Asphalt Concrete Pavements for Caltrans and Materials Tests (CTMs) may be found at the following website: http://www.dot.ca.gov/hq/esc/Translab/ofpm/fpmlab.htm
- The Stabilometer is only used as a **guideline** for selecting the range in binder contents for the shear testing.
- After the shear testing has been completed and the design binder content (target value [TV]) has been selected, test specimens are prepared at the design binder content and beam fatigue and stiffness testing are conducted in accordance with LLP-AC1. Specifications for the fatigue tests are listed in the aforementioned HMA Performance Requirements Table in "Hot Mix Asphalt (Long Life)" of the special provisions.
- Following the test procedure in LLP-AC1, the mix must also satisfy the performance requirements for the Hamburg Wheel Tracking Test (HWTT) in this same HMA Performance Requirements Table.
- If the mix does not meet ALL the performance requirements of the HMA Performance Requirements Table, adjustments in materials and mix proportions may be necessary to accomplish this.
- Separate mix designs meeting the performance requirements must be prepared for both mixes. The use of RAP must to be considered in the mix designs. The time required to prepare specimens and to complete performance testing for a mix is on the order of 3-4 weeks, and may require additional time if the mix does not meet the requirements. It is recommended that contractors obtain information regarding the time and costs of the mix designs when preparing their bid.

2. Target Values for Quality Control

- The Stabilometer value obtained at the design binder content obtained from the final mix design for each mix that meets all of the requirements in the specification in the aforementioned HMA Performance Requirements Table is the TV used for Quality Control.
- The volumetric properties of the mix that meets shear and fatigue will be measured and then used as Target Values for Quality Control. The required Stabilometer and volumetric properties of the mixes are shown in the HMA Mix Quality Requirements Table in "Hot Mix Asphalt (Long Life)" of the special provisions.

3. Construction

- Mix uniformity is extremely important in the production process as is uniform compaction to ensure long term performance.
- The requirements and schedule for Quality Control (QC) and Quality Assurance (QA) testing are listed in tables in "Hot Mix Asphalt (Long Life)" of the special provisions. Timely QC and QA test results are extremely important.
- Specification limits for Percent of Theoretical Maximum Density requirements for HMA compaction shown in the table in "Hot Mix Asphalt (Long Life)" of the special provisions require more rigourous compaction control. It is recommended that the combined effects of the RAP contents in the mixes and the more rigorous compaction requirements be considered when preparing plans for compaction.
- Per the Standard Specifications, tack coats are required between each lift for the HMA construction.

GPS/GPR Source: NPFAs from Photolog

Core Source: Historical Cores

Route	Direction	District	County	Lane	Draw Cores / Ignore Lane # / Draw County	Effective Date	Use Post-Mile / Use Mile-Post	Start/End Range (mi)	Inc	Reports
5	North	District 2	Siskiyou	1	☑ Draw Cores ☑ Ignore Lane # ☑ Draw County	5/12/2011	◉ Use Post-Mile ○ Use Mile-Post	0.000 – 69.293	7.000	Basic

Plan | Pavement Structure

Search GeoCode: Search

Zoom

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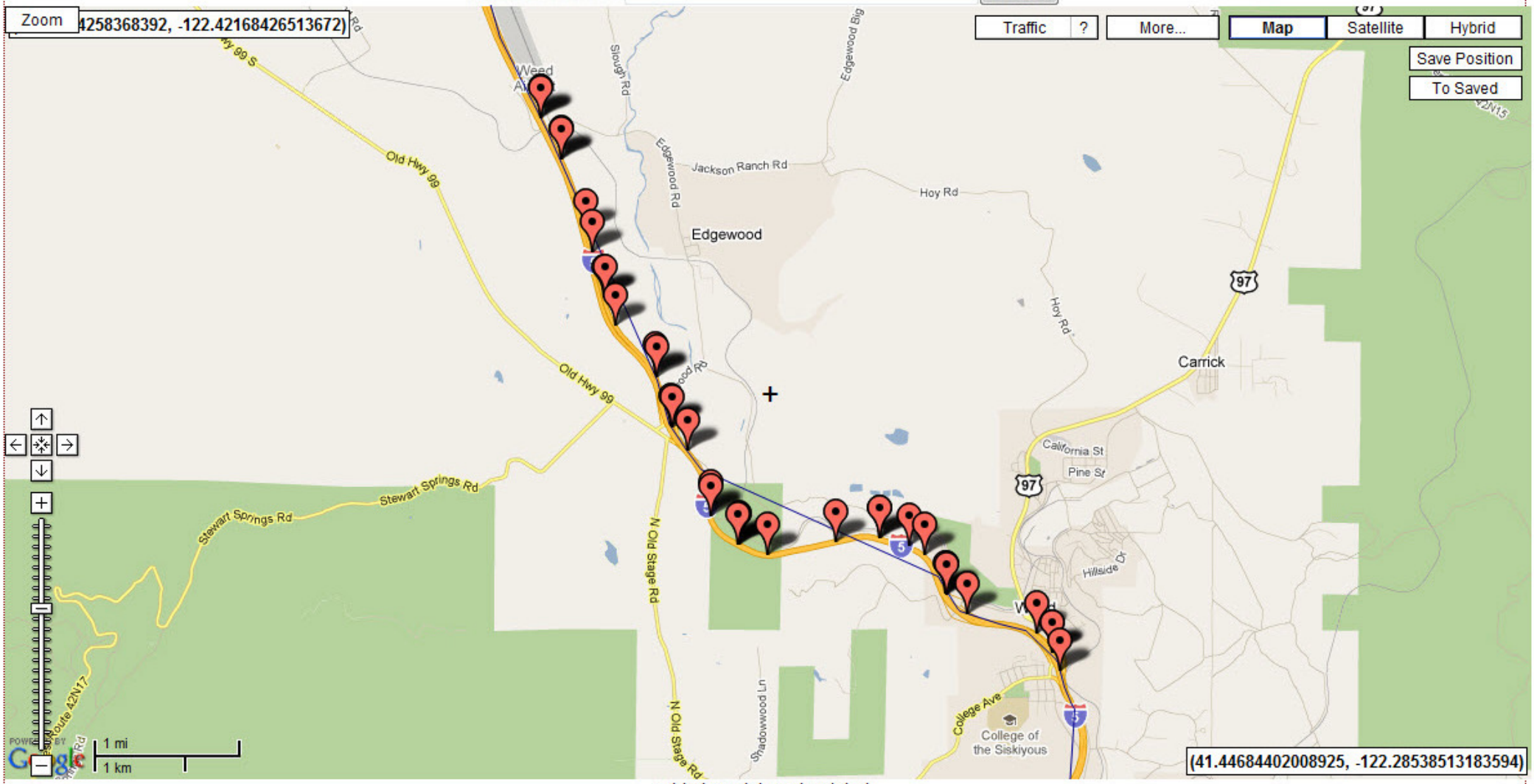
Traffic ? More... Map Satellite Hybrid

Save Position

To Saved



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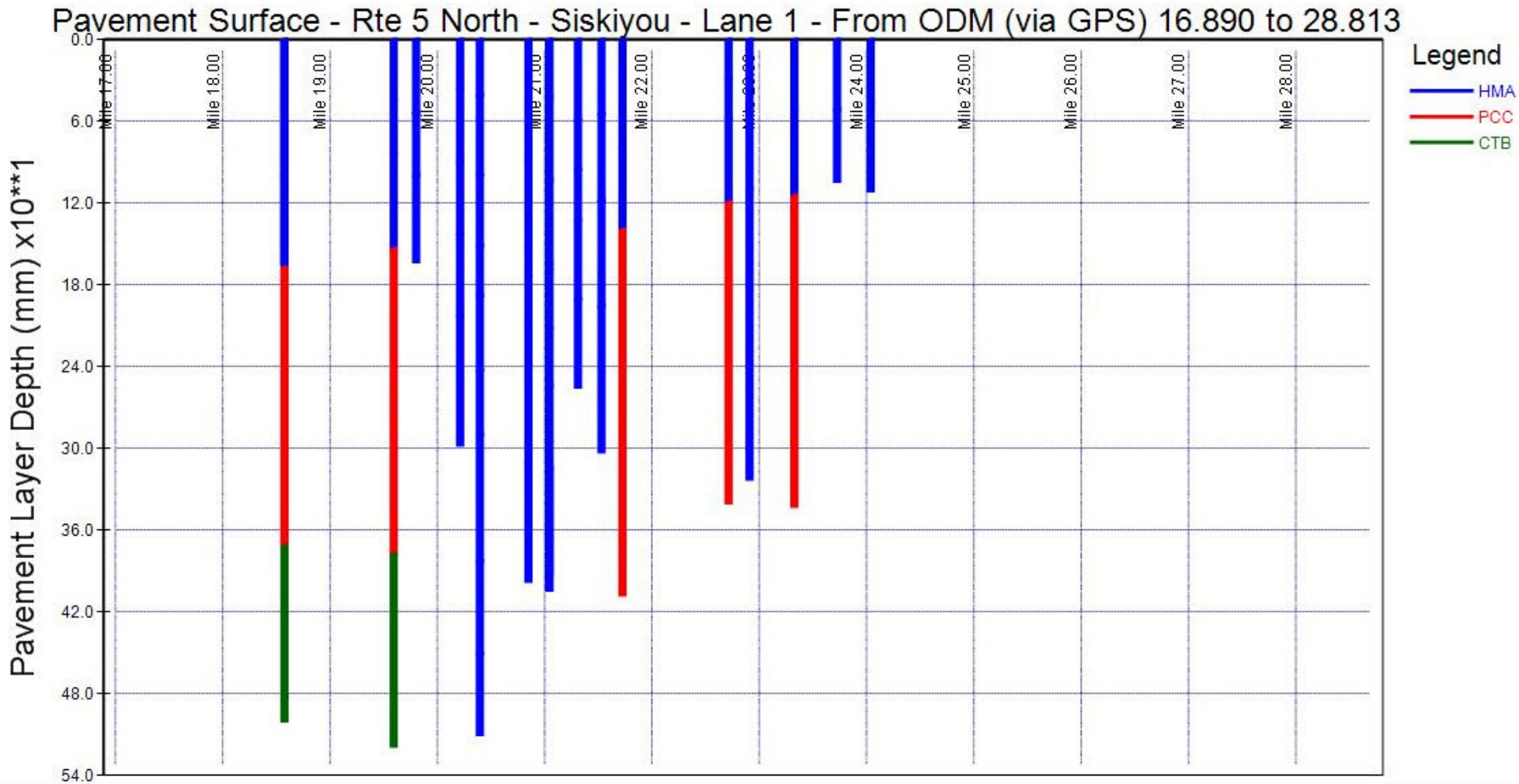
GPS/GPR Source: NPFAs from Photolog | Core Source: Historical Cores

Route	Direction	District	County	Lane	Draw Cores / Ignore Lane # / Draw County	Effective Date	Use Post-Mile / Use Mile-Post	Start/End Range (mi)	Inc	Reports
5	North	District 2	Siskiyou	1	☑ Draw Cores ☑ Ignore Lane # ☑ Draw County	5/12/2011	Use Post-Mile	17.000 – 29.000	7.000	Basic

Plan | Pavement Structure

☐ Bridges/OH ☐ Connectors ☐ Ramps ☐ Lanes ☐ Route Boundaries ☐ Misc ☐ File Markers ☐ General



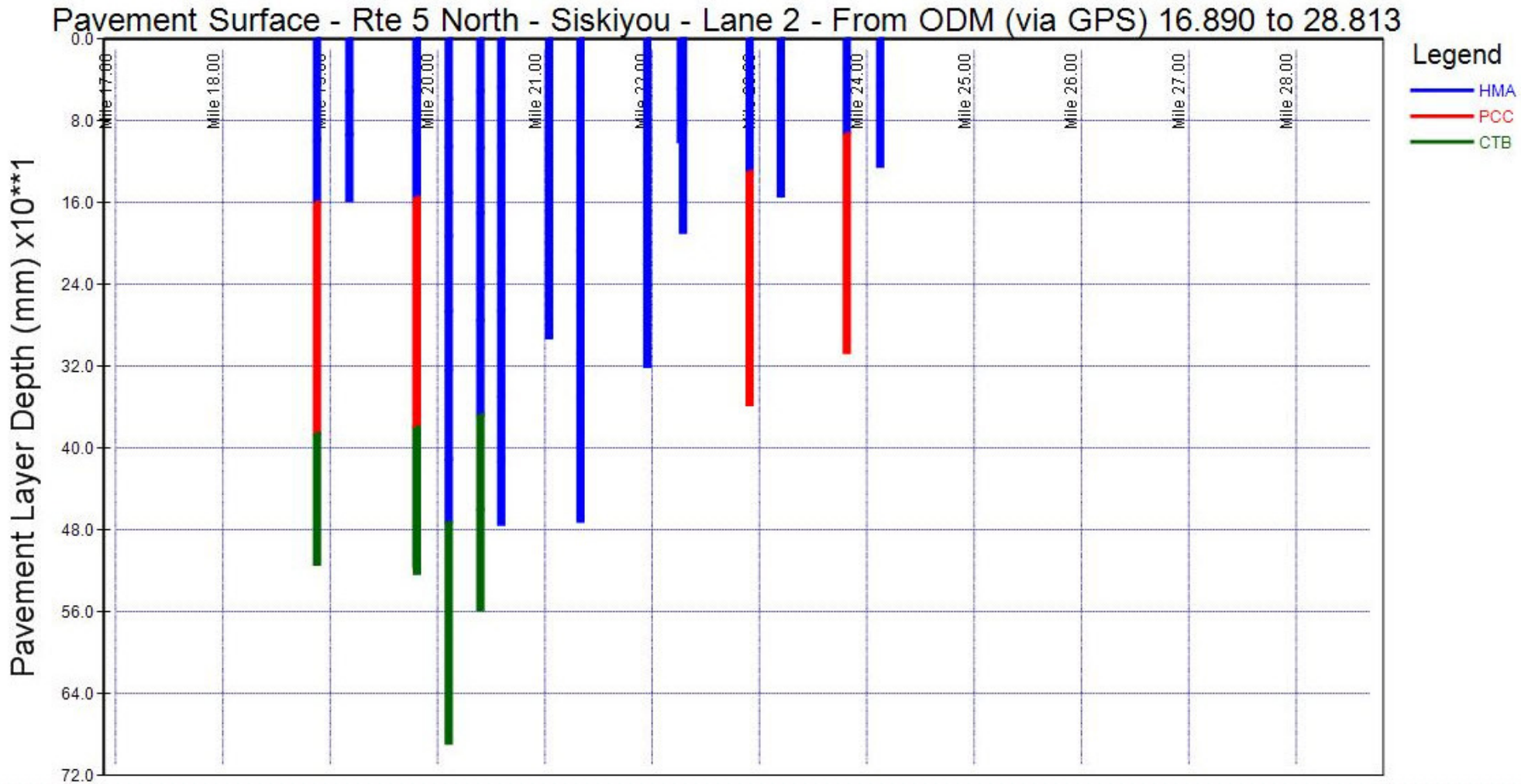
GPS/GPR Source: NPFAs from Photolog

Core Source: Historical Cores

Route	Direction	District	County	Lane	Draw Cores / Ignore Lane # / Draw County	Effective Date	Use Post-Mile / Use Mile-Post	Start/End Range (mi)	Inc	Reports
5	North	District 2	Siskiyou	2	☑ Draw Cores, ☑ Ignore Lane #, ☑ Draw County	5/12/2011	Use Post-Mile	17.000 – 29.000	7.000	Basic

Plan | Pavement Structure

☐ Bridges/OH ☐ Connectors ☐ Ramps ☐ Lanes ☐ Route Boundaries ☐ Misc ☐ File Markers ☐ General



GPS/GPR Source: NPFAs from Photolog

Core Source: Historical Cores

Route	Direction	District	County	Lane	Draw Cores	Ignore Lane #	Draw County	Effective Date	Use Post-Mile	Use Mile-Post	Start/End Range (mi)		Inc	Reports	
5	South	District 2	Siskiyou	1	☑	☑	☑	5/12/2011	◉	○	69.293	0.000	-7.000	Basic	Go

Plan | Pavement Structure

Search GeoCode: Search

Zoom

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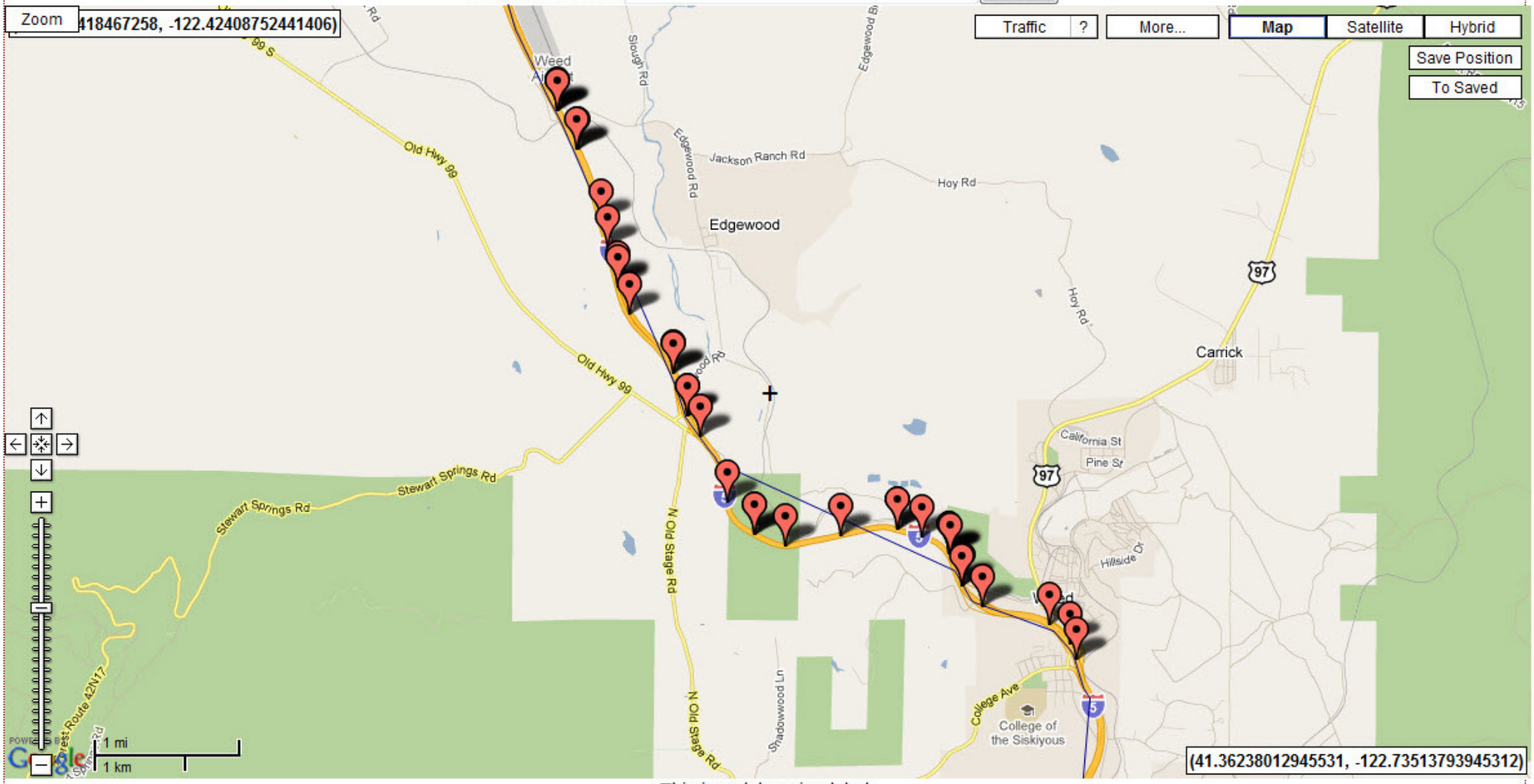
Traffic ? More... Map Satellite Hybrid

Save Position

To Saved



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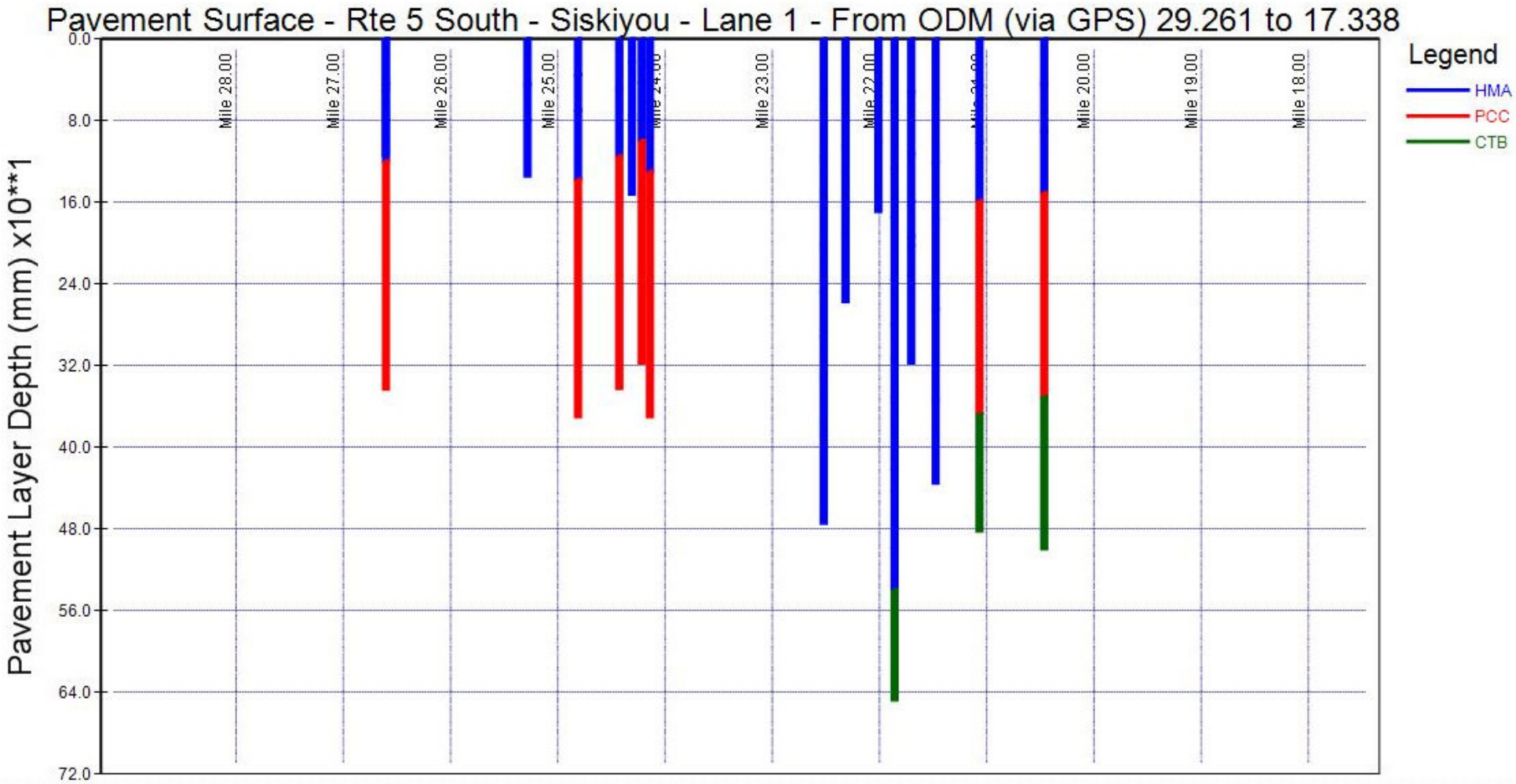
GPS/GPR Source: NPFAs from Photolog | Core Source: Historical Cores

Route	Direction	District	County	Lane	Draw Cores / Ignore Lane # / Draw County	Effective Date	Use Post-Mile / Use Mile-Post	Start/End Range (mi)		Inc	Reports	
5	South	District 2	Siskiyou	1	☑ ☑ ☑	5/12/2011	◉ ○	29.000	17.000	-7.000	Basic	Go

Plan | Pavement Structure

☐ Bridges/OH ☐ Connectors ☐ Ramps ☐ Lanes ☐ Route Boundaries ☐ Misc ☐ File Markers ☐ General

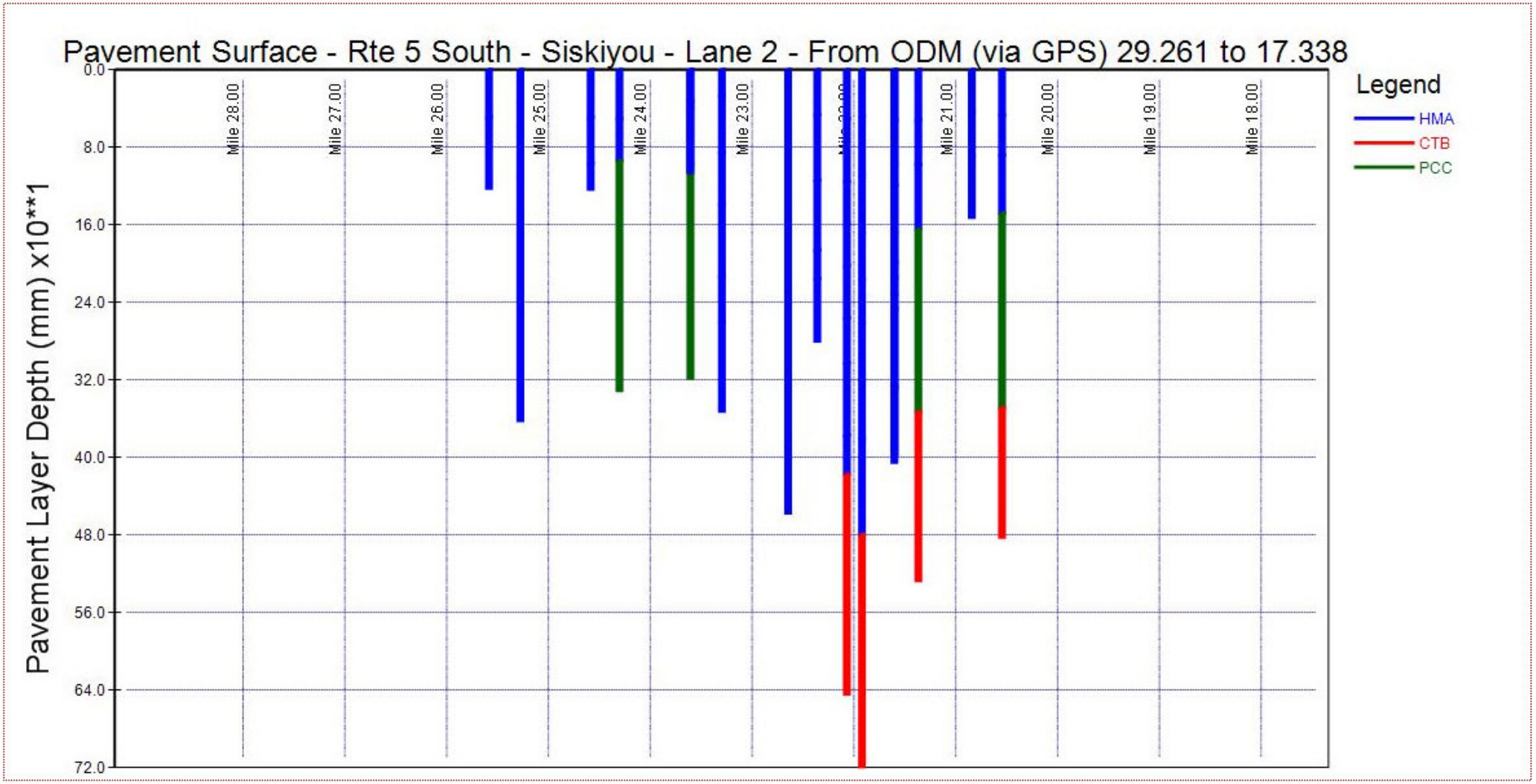


GPS/GPR Source: NPFAs from Photolog | Core Source: Historical Cores

Route	Direction	District	County	Lane	Draw Cores / Ignore Lane # / Draw County	Effective Date	Use Post-Mile / Use Mile-Post	Start/End Range (mi)		Inc	Reports	
5	South	District 2	Siskiyou	2	☑ ☑ ☑	5/12/2011	◉ ○	29.000	17.000	-7.000	Basic	Go

Plan | Pavement Structure

☐ Bridges/OH ☐ Connectors ☐ Ramps ☐ Lanes ☐ Route Boundaries ☐ Misc ☐ File Markers ☐ General



02-3E7504 Weed Pavement Rehab Coring Data

Unique Core ID	Core Date	County	Route	Direction	Lane	Core Location: PM	Corrected Latitude	Corrected Longitude	Elevation	Number of Lifts	Lift 1 Type	Thickness (mm) min:max	Lift 2 Type	Thickness (mm) min:max	Lift 3 Type	Thickness (mm) min:max	Lift 4 Type	Thickness (mm) min:max
3.15-NB-SIS5-L1-19	4/26/2011	Siskiyou	5	North	1	19.12	41.41906667	-122.3840167	3534	3	HMA	47:50	HMA	99:100	HMA	164:166	L1 rubberized, L 2 rubberized, L3D, couldn't extract the whole core	
3.15-NB-SIS5-L1-19(Crack)	4/26/2011	Siskiyou	5	North	1	19.12	41.4191	-122.3840333	3535	5	HMA	50:55	HMA	100:102	HMA	163:165	PCC	370:373
3.15-NB-SIS5-L1-19.85	4/26/2011	Siskiyou	5	North	1	19.79	41.42285	-122.3953833	3434	5	HMA	44:45	HMA	84:85	HMA	152:155	PCC	375:380
3.15-NB-SIS5-L1-20	4/26/2011	Siskiyou	5	North	1	20	41.42493333	-122.3982833	3417	3	HMA	52:55	HMA	99:100	HMA	162:164	L1 Rubberized, L2 rubberized, L3D, Couldn’t extract the whole core	
3.15-NB-SIS5-L1-20.79	4/26/2011	Siskiyou	5	North	1	20.78	41.42968333	-122.4031	3399	5	HMA	35:37	HMA	90:90	HMA	140:145	HMA	201:205
3.15-NB-SIS5-L1-21	4/26/2011	Siskiyou	5	North	1	21	41.43048333	-122.4071333	3376	9	HMA	40:41	HMA	99:100	HMA	150:152	HMA	187:189
3.15-NB-SIS5-L1-21.74	4/26/2011	Siskiyou	5	North	1	21.78	41.42881667	-122.4220167	3248	7	HMA	50:52	HMA	85:90	HMA	150:151	HMA	210:211
3.15-NB-SIS5-L1-22	4/26/2011	Siskiyou	5	North	1	22	41.42988333	-122.4259	3243	9	HMA	44:45	HMA	100:103	HMA	164:165	HMA	210:214
3.15-NB-SIS5-L1-22(Crack)	4/26/2011	Siskiyou	5	North	1	22	41.42991667	-122.42585	3209	6	HMA	40:43	HMA	103:105	HMA	168:170	HMA	254:256
3.15-NB-SIS5-L1-22.29	4/26/2011	Siskiyou	5	North	1	22.28	41.43266667	-122.4295	3161	5	HMA	58:60	HMA	95:96	HMA	130:135	HMA	189:192
3.15-NB-SIS5-L1-23	4/26/2011	Siskiyou	5	North	1	22.783	41.43928333	-122.4326167	3063	4	HMA	54:55	HMA	117:119	HMA	195:196	HMA	295:310
3.15-NB-SIS5-L1-23(crack)	4/26/2011	Siskiyou	5	North	1	22.99	41.44158333	-122.4347833	3070	4	HMA	25:27	HMA	78:80	HMA	139:140	PCC	380:435
3.15-NB-SIS5-L1-23.8	4/27/2011	Siskiyou	5	North	1	23.8	41.45168333	-122.4422167	3043	4	HMA	27:30	HMA	55:60	HMA	119:120	PCC	335:345
3.15-NB-SIS5-L1-24	4/27/2011	Siskiyou	5	North	1	24.5	41.4545	-122.44375	3032	3	HMA	50:52	HMA	109:111	HMA	320:325	L3C	
3.15-NB-SIS5-L1-24.5	4/27/2011	Siskiyou	5	North	1	24.5	41.46116667	-122.4461667	2994	3	HMA	50:52	HMA	114:115	PCC	335:350	L3C	
3.15-NB-SIS5-L1-25	4/27/2011	Siskiyou	5	North	1	25	41.46836667	-122.4494667	2971	2	HMA	50:53	HMA	103:105	L1 Rubberized, L2D, Couldn’t extract the whole core			
3.15-NB-SIS5-L1-25.26	4/27/2011	Siskiyou	5	North	1	25.31	41.47241667	-122.4522	2968	2	HMA	45:48	HMA	110:112	L2D, Couldn’t extract the whole core			
3.15-NB-SIS5-L2-19	4/28/2011	Siskiyou	5	North	2	19	41.41718333	-122.38305	3588	5	HMA	44:46	HMA	98:100	HMA	159:160	PCC	380:392
3.15-NB-SIS5-L2-19.3	4/28/2011	Siskiyou	5	North	2	19.3	41.42093333	-122.3862167	3450	3	HMA	50:52	HMA	90:96	HMA	153:163	Couldn't extract the whole core	
3.15-NB-SIS5-L2-20	4/28/2011	Siskiyou	5	North	2	19.999	41.4249	-122.3982167	3414	5	HMA	45:47	HMA	88:90	HMA	160:161	PCC	372:385
3.15-NB-SIS5-L2-20(Crack)	4/28/2011	Siskiyou	5	North	2	20.002	41.42495	-122.3982333	3435	5	HMA	45:50	HMA	90:92	HMA	150:160	PCC	375:385
3.15-NB-SIS5-L2-20.586	4/28/2011	Siskiyou	5	North	2	20.664	41.42883333	-122.4010833	3407	9	HMA	58:60	HMA	104:107	HMA	150:151	HMA	192:193
3.15-NB-SIS5-L2-21	4/28/2011	Siskiyou	5	North	2	21	41.43045	-122.4070833	3389	8	HMA	50:51	HMA	105:108	HMA	170:170	HMA	240:245
3.15-NB-SIS5-L2-21.31	4/28/2011	Siskiyou	5	North	2	21.297	41.43015	-122.4129667	3316	9	HMA	45:47	HMA	104:105	HMA	160:163	HMA	200:201
3.15-NB-SIS5-L2-22	4/28/2011	Siskiyou	5	North	2	22.001	41.42993333	-122.4258167	3217	6	HMA	65:69	HMA	84:87	HMA	122:125	HMA	159:160
3.15-NB-SIS5-L2-22.3	4/28/2011	Siskiyou	5	North	2	22.3	41.43306667	-122.4296167	3170	9	HMA	45:46	HMA	108:110	HMA	184:185	HMA	205:207
3.15-NB-SIS5-L2-23	4/28/2011	Siskiyou	5	North	2	22.997	41.44175	-122.4348167	3065	6	HMA	33:34	HMA	70:75	HMA	119:120	HMA	164:165
3.15-NB-SIS5-L2-23.3	4/28/2011	Siskiyou	5	North	2	23.3	41.44658333	-122.4367833	3045	2	HMA	47:50	HMA	99:102	L2D, Couldn't extract the whole core			
3.15-NB-SIS5-L2-23.5(Crack)	4/28/2011	Siskiyou	5	North	2	23.381	41.44686667	-122.43695	3056	2	HMA	75:90	HMA	135:243	L1C, L1SB, L2C, L2TS			
3.15-NB-SIS5-L2-24	4/28/2011	Siskiyou	5	North	2	23.998	41.4545	-122.4436167	3032	4	HMA	25:30	HMA	54:56	HMA	129:130	PCC	355:360
3.15-NB-SIS5-L2-24.3	4/28/2011	Siskiyou	5	North	2	24.3	41.45908333	-122.4453333	3014	3	HMA	38:40	HMA	82:85	HMA	152:155	L3D, Couldn't extract the whole core	
3.15-NB-SIS5-L2-25	4/28/2011	Siskiyou	5	North	2	25.001	41.46841667	-122.4494167	2992	3	HMA	25:30	HMA	90:95	PCC	295:318	L2D, L2C	
3.15-NB-SIS5-L2-25.3	4/28/2011	Siskiyou	5	North	2	25.3	41.4726	-122.45225	2986	2	HMA	44:46	HMA	124:125	L2D, Couldn't extract the whole core			
3.15-SB-SIS5-L1-19.08	4/27/2011	Siskiyou	5	South	1	19.12	41.41888333	-122.3841667	3527	5	HMA	43:45	HMA	89:91	HMA	149:152	PCC	350:351
3.15-SB-SIS5-L1-19.85	4/27/2011	Siskiyou	5	South	1	19.8	41.42268333	-122.3957	3448	5	HMA	45:47	HMA	100:103	HMA	157:160	PCC	365:370
3.15-SB-SIS5-L1-20	4/27/2011	Siskiyou	5	South	1	20	41.4248	-122.3984	3430	3	HMA	42:45	HMA	99:102	HMA	168:170	L1 rubberized, L2 rubberized, L3D, L3C, Couldn’t extract the whole core	
3.15-SB-SIS5-L1-20.245(crack)	4/27/2011	Siskiyou	5	South	1	20.23	41.42778333	-122.4	3447	7	HMA	59:60	HMA	120:122	HMA	174:180	HMA	235:250
3.15-SB-SIS5-L1-20.82	4/27/2011	Siskiyou	5	South	1	20.82	41.42965	-122.40375	3406	6	HMA	50:54	HMA	112:114	HMA	158:160	HMA	191:195
3.15-SB-SIS5-L1-21	4/27/2011	Siskiyou	5	South	1	21	41.43035	-122.4071167	3381	12	HMA	60:61	HMA	125:127	HMA	173:175	HMA	235:235
3.15-SB-SIS5-L1-21.85	4/27/2011	Siskiyou	5	South	1	21.79	41.42875	-122.422	3263	5	HMA	48:50	HMA	104:106	HMA	125:132	HMA	189:190
3.15-SB-SIS5-L1-22	4/27/2011	Siskiyou	5	South	1	22	41.4299	-122.4260667	3230	9	HMA	58:60	HMA	114:116	HMA	149:152	HMA	200:203
3.15-SB-SIS5-L1-23	4/27/2011	Siskiyou	5	South	1	22.99	41.44168333	-122.4351	3058	3	HMA	21:23	HMA	75:75	HMA	151:153	L3D, Couldn't extract the whole core	
3.15-SB-SIS5-L1-23(crack)	4/27/2011	Siskiyou	5	South	1	22.83	41.43966667	-122.4333	3043	4	HMA	25:26	HMA	60:61	HMA	129:131	PCC	365:375
3.15-SB-SIS5-L1-23.85	4/27/2011	Siskiyou	5	South	1	23.85	41.45185	-122.4428833	3032	3	HMA	40:45	HMA	99:100	PCC	305:330	L2D	
3.15-SB-SIS5-L1-24	4/26/2011	Siskiyou	5	South	1	24.03	41.45498333	-122.4443833	3030	3	HMA	48:50	HMA	110:119	PCC	330:355		
3.15-SB-SIS5-L1-24.5	4/26/2011	Siskiyou	5	South	1	24.5	41.46115	-122.4465333	2992	4	HMA	34:36	HMA	69:71	HMA	135:140	PCC	350:390
3.15-SB-SIS5-L1-25	4/26/2011	Siskiyou	5	South	1	25	41.46831667	-122.44975	2976	3	HMA	44:45	HMA	78:81	HMA	134:135	L3D, Couldn’t extract the whole core	
3.15-SB-SIS5-L1-25.5	4/26/2011	Siskiyou	5	South	1	25.29	41.47225	-122.4524167	2966	2	HMA	48:52	HMA	113:115	Couldn’t extract the whole core			
3.15-SB-SIS5-L1-25.5(crack)	4/26/2011	Siskiyou	5	South	1	25.28	41.47223333	-122.4524	2969	4	HMA	43:45	HMA	78:80	HMA	119:120	PCC	335:351
3.15-SB-SIS5-L2-19	4/29/2011	Siskiyou	5	South	2	18.999	41.41741667	-122.38325	3550	5	HMA	45:49	HMA	87:89	HMA	147:149	PCC	347:350
3.15-SB-SIS5-L2-19.3	4/29/2011	Siskiyou	5	South	2	19.3	41.42083333	-122.3868667	3512	3	HMA	42:45	HMA	88:90	HMA	150:155	L1 rubberized, L2 rubberized, L3D, Couldn't extract the whole core	
3.15-SB-SIS5-L2-20	4/29/2011	Siskiyou	5	South	2	20	41.42476667	-122.39845	3421	5	HMA	50:53	HMA	95:100	HMA	164:165	PCC	340:365
3.15-SB-SIS5-L2-20.245	4/29/2011	Siskiyou	5	South	2	20.243	41.42788333	-122.40025	3422	7	HMA	51:53	HMA	119:120	HMA	198:200	HMA	214:215
3.15-SB-SIS5-L2-20.245(crack)	4/29/2011	Siskiyou	5	South	2	20.244	41.42791667	-122.40025	3429	5	HMA	95:100	HMA	165:170	HMA	230:233	HMA	325:326
3.15-SB-SIS5-L2-21	4/29/2011	Siskiyou	5	South	2	21	41.43035	-122.40715	3373	9	HMA	48:50	HMA	108:110	HMA	168:170	HMA	215:218
3.15-SB-SIS5-L2-21.39	4/29/2011	Siskiyou	5	South	2	21.375	41.42971667	-122.4147167	3314	9	HMA	50:51	HMA	114:117	HMA	159:160	HMA	200:204
3.15-SB-SIS5-L2-22	4/29/2011	Siskiyou	5	South	2	22	41.42988333	-122.4260833	3238	5	HMA	45:48	HMA	113:115	HMA	185:187	HMA	215:216
3.15-SB-SIS5-L2-22.3	4/29/2011	Siskiyou	5	South	2	22.262	41.43308333	-122.4298167	3168	9	HMA	55:58	HMA	115:119	HMA	163:165	HMA	204:205
3.15-SB-SIS5-L2-23	4/29/2011	Siskiyou	5	South	2	22.989	41.44163333	-122.43515	3076	6	HMA	25:28	HMA	85:86	HMA	137:140	HMA	212:214
3.15-SB-SIS5-L2-23.3	4/29/2011	Siskiyou	5	South	2	23.3	41.44601667	-122.4369333	3053	2	HMA	39:41	HMA	105:107	Couldn't extract the whole core			
3.15-SB-SIS5-L2-23.3(CRACK)	4/29/2011	Siskiyou	5	South	2	23.3	41.446	-122.43695	3056	3	HMA	31:35	HMA	95:102	PCC	310:327	L1C, L2C, L2D	
3.15-SB-SIS5-L2-24	4/29/2011	Siskiyou	5	South	2	24	41.4545	-122.4442667	3047	3	HMA	50:51	HMA	90:97	PCC	310:352	L2D	
3.15-SB-SIS5-L2-24.3	4/29/2011	Siskiyou	5	South	2	24.3	41.45858333	-122.4456667	3020	3	HMA	48:50	HMA	95:98	HMA	120:127	L3D, Couldn't extract the whole core	
3.15-SB-SIS5-L2-25	4/29/2011	Siskiyou	5	South	2	25	41.46826667	-122.4498167	2965	4	HMA	30:35	HMA	59:60	HMA	109:111	HMA	350:374
3.15-SB-SIS5-L2-25.3	4/29/2011	Siskiyou	5	South	2	25.3	41.47231667	-122.45235	2950	2	HMA	48:50	HMA	120:125	L2D, Couldn't extract the whole core			

Unique Core ID	Lift 5 Type	Thickness (mm) min:max	Lift 6 Type	Thickness (mm) min:max	Lift 7 Type	Thickness (mm) min:max	Lift 8 Type	Thickness (mm) min:max	Lift 9 Type	Thickness (mm) min:max
3.15-NB-SIS5-L1-19										
3.15-NB-SIS5-L1-19(Crack)	CTB	485:515	L1C, L2C, L3C, L3D, L4D, L1 Rubberized							
3.15-NB-SIS5-L1-19.85	CTB	500:537	L1 rubberized, L2 rubberized, L3D, L4C							
3.15-NB-SIS5-L1-20										
3.15-NB-SIS5-L1-20.79	HMA	290:305	L3C							
3.15-NB-SIS5-L1-21	HMA	230:255	HMA	285:295	HMA	380:385	HMA	446:455	HMA	500:520
3.15-NB-SIS5-L1-21.74	HMA	245:250	HMA	295:325	HMA	370:425	L3C, L4D, L5D, L6TS, L6SB, L7TS			
3.15-NB-SIS5-L1-22	HMA	252:255	HMA	310:320	HMA	364:366	HMA	400:408	HMA	160:465
3.15-NB-SIS5-L1-22(Crack)	HMA	290:300	HMA	375:411	L1C, L4D, L5C, L5 has tripped material, L6TS, L5D					
3.15-NB-SIS5-L1-22.29	HMA	230:280	T3D, T4D, T5TS, T5SB							
3.15-NB-SIS5-L1-23	L3D									
3.15-NB-SIS5-L1-23(crack)										
3.15-NB-SIS5-L1-23.8	L3D, L4C									
3.15-NB-SIS5-L1-24										
3.15-NB-SIS5-L1-24.5										
3.15-NB-SIS5-L1-25										
3.15-NB-SIS5-L1-25.26										
3.15-NB-SIS5-L2-19	CTB	485:542	L3D, L4C, L4D, L5TS							
3.15-NB-SIS5-L2-19.3										
3.15-NB-SIS5-L2-20	CTB	505:525	L1 rubeberized, L2 rubberized, L3D, L4D							
3.15-NB-SIS5-L2-20(Crack)	CTB	520:525	LL1C, L2C, L3C, L3D, L3SB, L4C, L4D							
3.15-NB-SIS5-L2-20.586	HMA	265:267	HMA	322:325	HMA	410:412	HMA	470:475	CTB	680:697
3.15-NB-SIS5-L2-21	HMA	270:280	HMA	295:440	CTB	380:540	CTB	480:636	L2D, L3D, L5SB, L6TS, L7D, L7SB, THERE IS A GAP BETWEEN L5 AND L6	
3.15-NB-SIS5-L2-21.31	HMA	225:230	HMA	255:275	HMA	347:350	HMA	410:414	HMA	444:505
3.15-NB-SIS5-L2-22	HMA	197:200	HMA	240:344	L5D, L6C, L6TS, core bottom stripped					
3.15-NB-SIS5-L2-22.3	HMA	259:261	HMA	304:308	HMA	349:352	HMA	395:400	HMA	450:493
3.15-NB-SIS5-L2-23	HMA	220:220	HMA	295:345	L4D					
3.15-NB-SIS5-L2-23.3										
3.15-NB-SIS5-L2-23.5(Crack)										
3.15-NB-SIS5-L2-24	L3D, L4C									
3.15-NB-SIS5-L2-24.3										
3.15-NB-SIS5-L2-25										
3.15-NB-SIS5-L2-25.3										
3.15-SB-SIS5-L1-19.08	CTB	480:519	L1 rubberized, L3D, L4D							
3.15-SB-SIS5-L1-19.85	CTB	470:494	L1 rubberized, L2 Rubberized, L3D, L4C, L4D							
3.15-SB-SIS5-L1-20										
3.15-SB-SIS5-L1-20.245(crack)	HMA	265:265	HMA	352:355	HMA	415:455	L1C, L2C, L4D			
3.15-SB-SIS5-L1-20.82	HMA	150:255	HMA	295:340	L3D, Stripped on bottom					
3.15-SB-SIS5-L1-21	HMA	279:281	HMA	310:317	HMA	340:360	HMA	420:423	HMA	440:445
3.15-SB-SIS5-L1-21.85	HMA	240:275	L1D, L3D, L3SB, L5SB, Stripped material on bottom							
3.15-SB-SIS5-L1-22	HMA	247:249	HMA	290:292	HMA	315:348	HMA	379:380	HMA	469:480
3.15-SB-SIS5-L1-23										
3.15-SB-SIS5-L1-23(crack)	L3D, L4C									
3.15-SB-SIS5-L1-23.85										
3.15-SB-SIS5-L1-24										
3.15-SB-SIS5-L1-24.5	L3D									
3.15-SB-SIS5-L1-25										
3.15-SB-SIS5-L1-25.5										
3.15-SB-SIS5-L1-25.5(crack)	L1C, L2C, L3D, L3C, L4C									
3.15-SB-SIS5-L2-19	CTB	470:495	L1 Rubberized, l2 Rubberized, L3D, L4D							
3.15-SB-SIS5-L2-19.3										
3.15-SB-SIS5-L2-20	CTB	490:564	L1 rubberized, L2 rubberized, L5C, stripped material remain in the hole							
3.15-SB-SIS5-L2-20.245	HMA	245:248	HMA	327:330	HMA	395:400	L4D, L5D, L5C			
3.15-SB-SIS5-L2-20.245(crack)	HMA	390:420	L1C, L1D, L4C, L2TS							
3.15-SB-SIS5-L2-21	HMA	260:263	HMA	315:325	HMA	380:380	HMA	479:480	CTB	708:730
3.15-SB-SIS5-L2-21.39	HMA	255:257	HMA	295:310	HMA	375:379	HMA	415:420	CTB	630:658
3.15-SB-SIS5-L2-22	HMA	265:295	L2D							
3.15-SB-SIS5-L2-22.3	HMA	258:260	HMA	270:290	HMA	319:320	HMA	373:375	HMA	440:475
3.15-SB-SIS5-L2-23	HMA	260:261	HMA	330:375	L4D					
3.15-SB-SIS5-L2-23.3										
3.15-SB-SIS5-L2-23.3(CRACK)										
3.15-SB-SIS5-L2-24										
3.15-SB-SIS5-L2-24.3										
3.15-SB-SIS5-L2-25	L4D, L5C									
3.15-SB-SIS5-L2-25.3										

Unique Core ID	Lift 10 Type	Thickness (mm) min:max	Lift 11 Type	Thickness (mm) min:max	Lift 12 Type	Thickness (mm) min:max	Core Log Note
3.15-NB-SIS5-L1-19							
3.15-NB-SIS5-L1-19(Crack)							
3.15-NB-SIS5-L1-19.85							
3.15-NB-SIS5-L1-20							
3.15-NB-SIS5-L1-20.79							
3.15-NB-SIS5-L1-21	L4D, L5SB, L6TS, L6D, L7TS, L7D, L8TS						
3.15-NB-SIS5-L1-21.74							
3.15-NB-SIS5-L1-22	L6SB, L7TS, L8D, L8SB						
3.15-NB-SIS5-L1-22(Crack)							
3.15-NB-SIS5-L1-22.29							
3.15-NB-SIS5-L1-23							
3.15-NB-SIS5-L1-23(crack)							
3.15-NB-SIS5-L1-23.8							
3.15-NB-SIS5-L1-24							
3.15-NB-SIS5-L1-24.5							
3.15-NB-SIS5-L1-25							
3.15-NB-SIS5-L1-25.26							
3.15-NB-SIS5-L2-19							
3.15-NB-SIS5-L2-19.3							
3.15-NB-SIS5-L2-20							
3.15-NB-SIS5-L2-20(Crack)							
3.15-NB-SIS5-L2-20.586	L6D, L7TS						
3.15-NB-SIS5-L2-21							
3.15-NB-SIS5-L2-21.31	L6SB, L7D, L7TS, Stripping between layers 6 and 7						
3.15-NB-SIS5-L2-22							
3.15-NB-SIS5-L2-22.3	L5D, L6C, L6TS, L6D, L7TS						
3.15-NB-SIS5-L2-23							
3.15-NB-SIS5-L2-23.3							
3.15-NB-SIS5-L2-23.5(Crack)							
3.15-NB-SIS5-L2-24							
3.15-NB-SIS5-L2-24.3							
3.15-NB-SIS5-L2-25							
3.15-NB-SIS5-L2-25.3							
3.15-SB-SIS5-L1-19.08							
3.15-SB-SIS5-L1-19.85							
3.15-SB-SIS5-L1-20							
3.15-SB-SIS5-L1-20.245(crack)							
3.15-SB-SIS5-L1-20.82							
3.15-SB-SIS5-L1-21	HMA	495:500	HMA	537:542	CTB	645:650	L3D, L7SB, L8TS
3.15-SB-SIS5-L1-21.85							
3.15-SB-SIS5-L1-22	L7SB, L8TS						
3.15-SB-SIS5-L1-23							
3.15-SB-SIS5-L1-23(crack)							
3.15-SB-SIS5-L1-23.85							
3.15-SB-SIS5-L1-24							
3.15-SB-SIS5-L1-24.5							
3.15-SB-SIS5-L1-25							
3.15-SB-SIS5-L1-25.5							
3.15-SB-SIS5-L1-25.5(crack)							
3.15-SB-SIS5-L2-19							
3.15-SB-SIS5-L2-19.3							
3.15-SB-SIS5-L2-20							
3.15-SB-SIS5-L2-20.245							
3.15-SB-SIS5-L2-20.245(crack)							
3.15-SB-SIS5-L2-21	L3D, L6SB, L7TS, L8D, L9C						
3.15-SB-SIS5-L2-21.39	L6D, L6SB, L7TS, L8D						
3.15-SB-SIS5-L2-22							
3.15-SB-SIS5-L2-22.3	L6SB, L7TS						
3.15-SB-SIS5-L2-23							
3.15-SB-SIS5-L2-23.3							
3.15-SB-SIS5-L2-23.3(CRACK)							
3.15-SB-SIS5-L2-24							
3.15-SB-SIS5-L2-24.3							
3.15-SB-SIS5-L2-25							
3.15-SB-SIS5-L2-25.3							

Layer Types

HMA	Hot Mix Asphalt, seal coats and other surface treatments less than 30 mm in thickness can be included in an HMA lift.
HMA-O	Open Graded Hot Mix Asphalt
ASURF	Seal coats or other surface treatments greater than 30 mm in thickness
PCC	Portland Cement Concrete
AB	Aggregate Base below the surface.
ASB	Aggregate SubBase below aggregate base (when the AB and ASB cannot be differentiated, identify combined layer as AB.)
ACB	Asphalt Concrete Base, bound layers below the surface layer not continuous from asphalt bound surface
CTB/LCB	Cement Treated Base or Lean Concrete Base, bound layers below the surface layer that are not PCC
SGS	SubGrade, Sand
SGC	SubGrade, Clay
SGT	Subgrade, Treated with lime or other admixtures

Layer Notes

Examples: L2TSB means Lift 2 has stripping on the top and bottom of the lift, and L2SMI means a SAMI exists below Lift 2, between Lifts 2 and 3.

TS, SB, or TSB	Stripping of the bound lifts, on the top (TS), bottom (SB), or both (TSB)
SMI	Stress Absorbing Membrane Interlayer (SAMI) at bottom of lift
SMF	Fabric SAMI
SMR	Rubberized SAMI
D	Debonding at bottom of the lift
C	Cracked lift, or broken core
PP	Possibly Patched lift, generally indicated by extreme thickness with no lifts lines (but may indicate great compaction)
NOS	No soil sample was obtained.

UCPRC Test Data
Red Bluff and Weed Long Life Pavement Projects
Test Data Summary

To

Office of Asphalt Pavement
California Department of Transportation

Prepared by

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MATERIALS TEST DATA SUMMARY

Aggregates

Aggregates samples were obtained by District 2 staff from two representative sources, one for the Red Bluff Project (Source 1) and the other for the Weed Project (Source 2). The samples of the virgin aggregates from both sources included four fractions termed: dust, sand, 3/8 in. and 3/4 in. Gradings from representative samples of each of the fractions were determined by wet (washed) sieving; these data were then used to prepare mixes to select binder contents for mix design and performance testing. For the Red Bluff Project two gradings were required, one with and one without RAP; the Weed Project also required two gradings, one with 15 percent RAP and the other with 25 percent RAP. The resulting combined gradings are shown in Figure 1a and Figure 1b. Aggregate physical properties for both aggregates were made available by District 2 Staff and are summarized in Table 1.

Asphalt Binders

Two binders, PG 64-16[1] and PG 64-28PM were supplied by the Valero Refinery in Benicia, California; the test properties for these binders are summarized in Table 2. These data were obtained from the Certificate of Compliance (CoC) Laboratory Reports from the Valero-Benicia Plant. During the investigation it was necessary to obtain more PG 64-28PM binder in order to conduct the required performance tests for the Weed Project. In Table 2 it is noted that the 2010 and 2011 produced binders have essentally the same performance characteristics.

Recycled Asphalt Pavement (RAP) Material

District 2 Staff provided a supply of RAP to the UCPRC. This RAP material was considered to be representative of the HMA in the existing pavement within the vicinity of the proposed Red Bluff project. In addition, a number of 4 in. diameter cores of the HMA pavement layer(s) to be recycled from this project were obtained. Both the cores and the RAP material were sent to the MACTEC Laboratory in Phoenix, Arizona to determine extracted binder properties and approximate binder contents of the RAP millings and cores as well as the gradations of the

[1]The PG 64-16 binder satisfies the specification requirements for the PG 64-10 binder which District 2 Staff stated was the prevalent conventional binder used in the District as noted earlier.

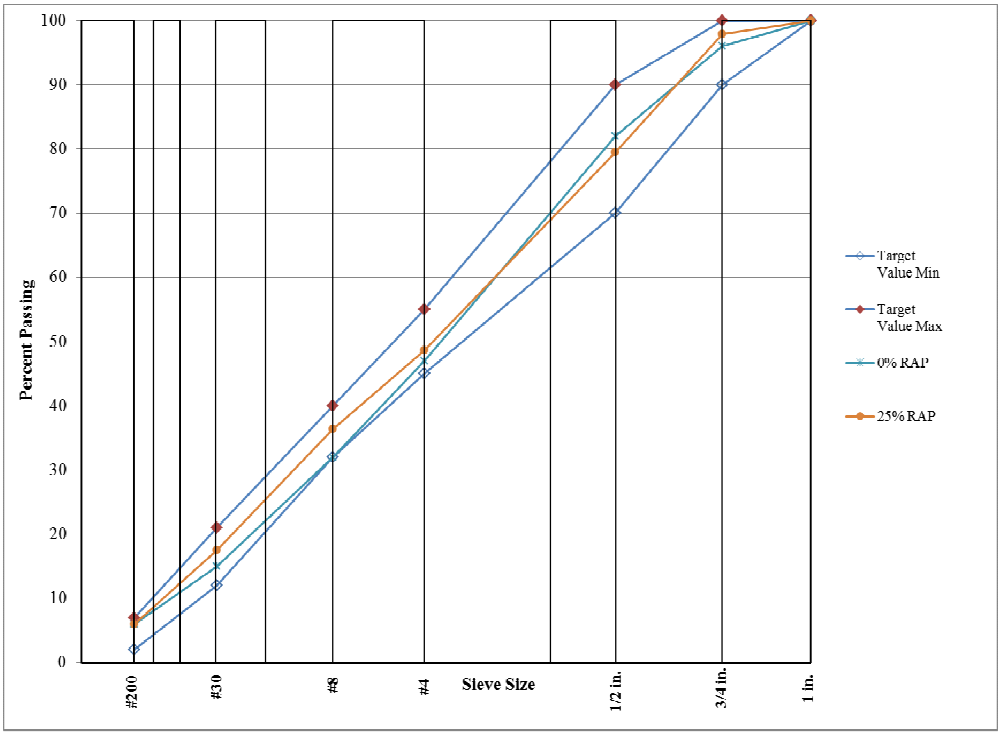
extracted aggregates. In addition, the PG 64-16 binder supplied by Valero was also sent to MACTEC for binder data on blends of the new (virgin) binder and the extracted binders. The binder content(s) for the virgin/RAP HMA mixture(s) were determined based upon percent binder extracted from the cores and RAP millings, estimated available binder content from the RAP, and the proportion of RAP in the mix. Table contains the results of the MACTEC tests on the PG 64-16 binder received from Valero in December 2010 together with tests on the binders extracted from the cores and RAP millings. Tests performed on blends of the original binder and the extracted binders are summarized in Table . Determination of the proportions of the PG 64-16 and extracted binders were based on the following: 1) binder content of the cores determined by extraction (4.77 percent, dry weight of aggregate (DWA). basis), 25 percent of RAP, and 5.0 percent binder (DWA basis) in the resulting materials. Table 3 contains the results of the MACTEC tests on the PG 64-16 binder received from Valero in December 2010.

Lime

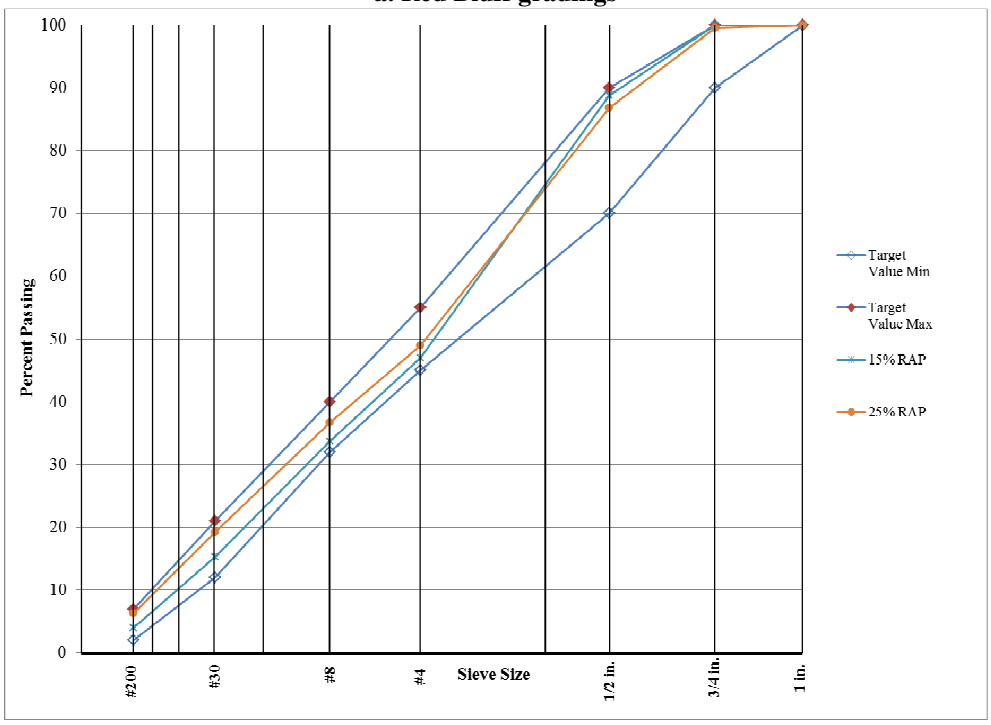
Hydrated lime (high calcium hydrated lime termed "Hi-Cal Hydrate") was supplied by Chemical Lime Company. District 2 Staff recommended a lime content of 1.2 percent by weight of aggregate and that lime treatment should be the marination process rather than addition of dry lime on damp aggregate. Caltrans Test Procedure LP-7 was followed to marinate the aggregate for the preparation of the performance test specimens.

Table 1. Aggregate Properties

	Source	Test Results				
		Source 1			Source 2	
	Date Tested:	6/07	5/08	7/08	5/08	3/09
Test Method	Property					
CT 205	Crushed particles, coarse aggregate One fractured face (%)			98		
	Crushed particles, coarse aggregate Two fractured faces (%)		99	96	100	100
	Crushed particles, fine aggregate (#4x#8) One fractured face (%)		98	97	100	100
CT 211	LA Rattler, loss at 100 rev. (%)	5	5	5	2	3
	LA Rattler, loss at 500 rev. (%)	20	22	23	10	12
CT 217	Sand equivalent (ave.)	52	65	64	62	64
AASHTO T 304 (Method A)	Fine aggregate angularity (%)			45.8		47.6
ASTM D 4791	Flat and elongated particles % by mass @ 3:1					
	Flat and elongated particles % by mass @ 5:1			0		6.0
CT 204	Plasticity index			NP		NP
CT 229	Fine aggregate durability index	79	77		68	74
	Coarse aggregate durability index	80	80		78	82
CT 303	K_c factor (not mandatory until further notice)				1.0	
	K_f factor (not mandatory until further notice)				1.2	
CT 206	Bulk specific gravity (oven dry), coarse aggregate	2.62	2.65	2.639	2.79	2.793
	Absorption, coarse aggregate	1.0	1.3	1.3	1.1	1.0
CT 207	Bulk specific Gravity (SSD) of fine aggregate			2.527		2.702
LP-2	Bulk specific Gravity (oven dry) of fine aggregate			2.451		2.607
CT 207	Absorption of fine aggregate			3.1		3.5
CT 208/LP-2	Apparent specific gravity of supplemental fines			2.381		
LP-2	Bulk specific gravity of aggregate blend			2.575	2.58	2.675
CT 208	Specific gravity of fines apparent	2.64			2.83	2.879



a. Red Bluff gradings



b. Weed gradings

Figure 1. Aggregate gradings without and with RAP for the Red Bluff and Weed Projects.

Table 2. Binder Properties; Red Bluff and Weed Projects

Property	Caltrans Spec PG 64-16	Test Results Red Bluff, Weed	Caltrans Spec PG 6428PM	Test Results		AASHTO Test Method
				Red Bluff	Weed	
	Original Binder					
Flash Point, Min. C.O.C., ºC	230	296	230	276	280	T48
Viscosity at 135 ºC; Pa.s	3.0	0.430	3.0	0.740	0.748	T316
Dynamic Shear: Test Temp, ºC	64	64	64	64	64	T315
Min. G*/sinδ, kPa	1.0	1.61	1.0	1.64	1.89	
Solubility in TCE Percent, Min.	99	100	98.5	99.9	99.8	T44
	RTFO Test Aged Binder					
RTFO Test Mass Loss, Max. %	-1.0	-0.121	-1.0	-0.249	-0.159	T240
Dynamic Shear: Test Temp. ºC	64	64	64	64	64	T315
Min. G*/sinδ, kPa	2.20	3.95	2.20	3.12	3.95	
Max. δ@G*sinδ = 2.2 kPa, degrees	n/a	n/a	80	64	65	
Min. Ductility at 25°C, cm	75	100+	n/a	n/a	n/a	T51
Min. Elastic Recovery@25º %	n/a	n/a	75	84	83	T301
PAV Aging Temperature °C	100	100	100	100	100	R28
	PAV Test Aged Binder					
Dynamic Shear: Test Temp, ºC	28	28	22	22	22	T315
Max. G*sinδ, kPa	5000	2580	5000	1010	1550	
Bending Beam Rheometer:						T313
Test Temp. °C	-6	-6	-18	-18	-18	
Max. S-Value, MPa	300	79	300	72	94	
Min. M-Value	0.300	0.386	0.300	0.356	0.356	

n/a, not applicable

Table 3. Binder Properties MACTEC Tests Red Bluff Binder

Property	Caltrans Spec PG 64-16	Test Results: Original Binder PG 64-16	Binder Extracted from Cores	Binder Extracted from RAP	AASHTO Test Method
	Original Binder				
Flash Point, Min. C.O.C., ºC	230	285	n/a	n/a	T48
Viscosity at 135 ºC; Pa.s	3.0	0.466			T316
Dynamic Shear: Test Temp, ºC	64	64			T315
Min. G*/sinδ, kPa	1.0	1.48			
Solubility in TCE Percent, Min.	99	n/a			T44
	RTFO Test Aged Binder		Tests on Original Recovered Asphalt		
RTFO Test Mass Loss, Max. %	-1.0	-0.124	n/a	n/a	T240
Dynamic Shear: Test Temp. ºC	64	64	70	76	T315
Min. G*/sinδ, kPa	2.20	3.71	10.22	6.89	
Min. Ductility at 25°C, cm	75	150+	9.5	8.0	T51
PAV Aging Temperature °C	100	100	100	100	R28
	PAV Test Aged Binder				
Dynamic Shear: Test Temp, ºC	28	25	37	40	T315
Max. G*sinδ, kPa	5000	3390	3040	2115	
Bending Beam Rheometer:					T313
Test Temp. °C	-6	-12	0	0	
Max. S-Value, MPa	300	187	135	112	
Min. M-Value	0.300	0.384	0.365	0.346	
Classification Based on Test		PG 64-22	PG 70-10	PG 76-10 (or PG 76-16)	

n/a, not applicable

Table 4. MACTEC Binder Test Results

Property	Caltrans Spec	Test Results Valero PG 64-16 (12/13/10) Sample	Test Results, Blend of Valero Binder and Extracted Binders		AASHTO Test Method
			From Core Samples	From Rap Millings	
	Original Binder				
Flash Point, Min. C.O.C., ºC	230	285	n/a	n/a	
Viscosity at 135 ºC; Pa.s	3.0	0.466	3.08	0.762	T316
Dynamic Shear: Test Temp, ºC		64	70	70	T315
Min. G*/sinδ, kPa	1.0	1.48	1.48	2.14	
Solubility in TCE Percent, Min.	99	n/a	n/a	n/a	T44
	RTFO Test Aged Binder				
RTFO Test Mass Loss, Max. %	-1.0	-0.124	-0.250	-0.300	T240
Dynamic Shear: Test Temp. ºC		64	70	70	T315
Min. G*/sinδ, kPa	2.20	3.71	3.15	4..69	
Min. Ductility at 25°C, cm	75	150+	108	34	T51
PAV Aging Temperature °C	100	100	100	100	R28
	PAV Test Aged Binder				
Dynamic Shear: Test Temp, ºC		25	28	28	T315
Max. G*sinδ, kPa	5000	3390	3703	4011	
Bending Beam Rheometer:					T313
Test Temp. °C		-12	-12	-12	
Max. S-Value, MPa	300	187	241	248	
Min. M-Value	0.300	0.344	0.322	0.311	
Performance Grade		PG 64-22	PG 70-22	PG 70-22	
Actual Grade		PG 67-22	PG 73-22	PG75-22	

n/a, not applicable

MIX TEST DATA

Test Methods:

The Repeated Simple Shear Test-Constant Height (RSST-CH)is used to select the design binder content for each of the mixes to be used in the two projects; (based on the test method AASHTO T-320 [ASTM D7312]). To determine mix fatigue response at the selected design binder content, the flexural fatigue test (AASHTO T-321 [ASTM D7460]), was utilized. Moisture sensitivity response of the mixes was evaluated using the Hamburg Wheel Tracking Test (HWTT) (AASHTO T-324). All of the test specimens for the performance tests were prepared using Rolling Wheel Compaction (RWC); the reason being that the aggregate structure prepared by this method is similar to that obtained in mixes during pavement construction. RWC, is in use since the 1970's by organizations in Europe (e.g. Shell and the French LCPC). The procedure which the UCPRC uses was developed during the Strategic Highway Research Program (SHRP) and published as AASHTO PP3-94. The HMA performance requirements were developed using these AASHTO test procedures. The requirements in the performance specifications for both projects include a footnote in the tables with reference to Caltrans Flexible Pavement Test Method LLP-AC1 ("Sample Preparation and Testing for Long-Life Asphalt Concrete Pavements"). The LLP-AC1 contains modifications to the AASHTO procedures which were followed in developing the test data included herein to define the performance requirements.

Shear Test Data Based on temperatures regimes at Red Bluff and Weed, test temperatures for the shear tests of 55ºC and 50ºC respectively were selected. For the Red Bluff Project, initially it was agreed that no lime would be used in the mixes; however, after the initial testing was completed with the PG 64-28PM mix, the decision was changed to add 1.2 percent lime. Because of time constraints, selection of the design binder for the PG 64-28PM was based on the results of the tests without lime. Table 5 contains a summary of the data obtained at three binder contents. Mix Stabilometer test data for a few mixes containing the PG 64-28PM binder were supplied by the District 2 Staff. These data served as the basis for determination of the range in binder contents used for the shear tests. Based on the results of the shear test data in Table 5, a design binder content of 5.0 percent (aggr. basis) was selected since the mix appeared to be a critical mix. These data served as the basis for the mix testing for the PG64-28PM contining lime and the PG 64-16 (or 10) with 25 percent RAP and 1.2 percent lime.

Mix test results were also required by Caltrans for use in the structural section designs based on the mechanistic-empirical (M-E) design procedure *CalME*. This required shear test data at two temperatures and three stress levels. The results of these tests for mix at the design binder content are summarized in Table 6. Results for the PG64-16 mix with lime and 25 percent RAP are summarized in Table 7. Also it should be noted that no shear requirements are required for the rich bottom mix. However there are fatigue test requirements and test data are included in the **Fatigue Test Data** section which follows.

Note: *The specification requirements for the Red Bluff Project require only the results of shear testing at 55ºC with a shear stress of 100 kPa (~14.5 psi).*

For the Weed project Table 8 contains the shear test results for the PG 64-28PM mix design with 15 percent RAP. Table 9 contains the shear test results for this mix for the CalME design at the selected design binder content only at 50ºC (because of time constraints). As noted above, the performance specification requires only the results of testing at 50ºC with a stress of 100 kPa (~14.5 psi).

Shear tests were not performed on the PG 64-16 with 25 percent RAP and lime due to time constraints. As will be seen in the next sections the binder content for the fatigue and HWTT was the same as that selected for the for the PG 64-28PM mix.

Table 5. Summary of Shear RSST-CH Test Results at 50C for the Red Bluff PG64-28PM Mix Design (LMLC without lime added).

Specimen Designation	Aggregate Type	AV (%)	AC (%)	Test Temp. (C)	Test Shear Stress Level (kPa)	Initial Resilient Shear Modulus (MPa)	% Permanent Shear Strain at 5,000 cycles	Cycles to 5% Permanent Shear Strain
315-ME-PG6428PM-45-1-1A-7055	Unknown	3.3	4.5	54.96	72.33	105.59	0.017660	13,995,311*
315-ME-PG6428PM-45-1-2A-7055	Unknown	3.1	4.5	54.96	72.51	102.84	0.015329	32,505,207,041*
315-ME-PG6428PM-45-1-3A-7055	Unknown	3.3	4.5	54.84	71.21	111.69	0.019863	455,594,635*
315-ME-PG6428PM-5-1-1A-7055	Unknown	2.7	5.0	55.10	72.37	84.12	0.023647	24,644,297*
315-ME-PG6428PM-5-1-2A-7055	Unknown	2.7	5.0	55.05	71.13	87.03	0.022686	922,516,778*
315-ME-PG6428PM-5-1-3A-7055	Unknown	2.8	5.0	54.80	71.61	99.85	0.011730	2,152,637,067*
315-ME-PG6428PM-5-2-1B-7055	Unknown	2.0	5.0	54.60	72.63	121.46	0.009092	61,886,570,358*
315-ME-PG6428PM-5-2-3B-7055	Unknown	2.1	5.0	54.52	70.69	106.48	0.013959	6,751,153,484*
315-ME-PG6428PM-55-3-2B-7055	Unknown	2.8	5.5	54.89	73.16	87.11	0.013958	7,035,074,769*
315-ME-PG6428PM-55-3-3B-7055	Unknown	3.1	5.5	54.89	71.60	89.54	0.012185	11,658,996*
315-ME-PG6428PM-55-4-1A-7055	Unknown	3.2	5.5	54.58	70.03	106.56	0.014326	7,105,859*
315-ME-PG6428PM-55-4-2A-7055	Unknown	3.0	5.5	54.57	67.05	71.67	0.023484	3,591,711*

Notes:
1. "*": extrapolation.
2. RICE value: 2.5160 for AC 4.5%; 2.4924 for AC 5.0%; 2.4837 for AC 5.5% (percent AC was calculated by weight of aggregate).
3. All specimens were laboratory-mixed laboratory-compacted without lime.

.

Table 6. Summary of Shear Test Results for PG64-28PM Lime mixes (ME, Red Bluff Project, LMLC).

Specimen Designation	AV (%)	AC* (%)	Test Temp. (C)	Test Shear Stress Level (kPa)	Initial Resilient Shear Modulus (kPa)	% Permanent Shear Strain at 5,000 cycles	Cycles to 5% Permanent Shear Strain
315-PG6428PM-52-1-1A-7045	2.7	5.2	44.58	75.77	139	0.010362	1.2910E+12*
315-PG6428PM-52-1-2B-7045	2.7	5.2	45.48	75.21	118	0.009456	7.7629E+10*
315-PG6428PM-52-2-1D-7045	2.8	5.2	44.65	78.17	161	0.005695	9.1470E+13*
315-PG6428PM-52-1-1B-10045	3.3	5.2	44.84	101.35	159	0.012871	2.3424E+09*
315-PG6428PM-52-1-2A-10045	2.8	5.2	45.41	100.68	125	0.017264	375,064,876*
315-PG6428PM-52-2-3D-10045	3.0	5.2	44.82	100.33	143	0.015439	126,397,444*
315-PG6428PM-52-1-3A-13045	3.2	5.2	44.65	132.20	136	0.013602	1.2157E+09*
315-PG6428PM-52-1-3B-13045	3.3	5.2	45.42	133.55	150	0.015065	645,444,606*
315-PG6428PM-52-2-2B-13045	3.3	5.2	44.60	133.27	148	0.016240	23,450,496*
315-PG6428PM-52-2-2D-7055	2.8	5.2	55.06	74.59	84	0.016417	603,875,381*
315-PG6428PM-52-2-3B-7055	3.5	5.2	55.07	73.40	88	0.022804	13,465,122*
315-PG6428PM-52-3-1B-7055	3.4	5.2	55.25	73.59	103	0.019915	13,413,741*
315-PG6428PM-52-2-3A-10055	3.5	5.2	55.14	100.08	88	0.010583	3.3163E+09*
315-PG6428PM-52-4-1D-10055	3.3	5.2	55.09	100.10	104	0.017181	18,933,919*
315-PG6428PM-52-4-3D-10055	2.9	5.2	55.20	98.07	86	0.021969	10,914,381*
315-PG6428PM-52-3-2B-13055	3.3	5.2	55.16	133.46	121	0.027806	136,871*
315-PG6428PM-52-3-3B-13055	3.5	5.2	55.00	131.59	101	0.031214	364,808*
315-PG6428PM-52-4-2D-13055	2.9	5.2	55.02	133.88	74	0.034528	110,012*

Note:

1. "*": extrapolation.
2. RICE value: 2.4890 for PG64-28PM Lime [1.2% Lime added (by weight of aggregate); AC = 5.2% (by weight of aggregate plus Lime)].
3. Percent air-void content was measured using parafilm method.
4. All specimens were lab-mixed lab-compacted (LMLC).

Table 7. Summary of Shear Test Results for PG64-16, R25, Lime Mixes (ME, Red Bluff Project, LMLC)

Specimen Designation	AV (%)	AC* (%)	Test Temp. (C)	Test Shear Stress Level (kPa)	Initial Resilient Shear Modulus (kPa)	% Permanent Shear Strain at 5,000 cycles	Cycles to 5% Permanent Shear Strain
3.15-ME-RAP6410-538-2-3B-7045	2.8	5.38	44.59	75.43	265	0.006882	3.8189E+09*
3.15-ME-RAP6410-538-4-1B-7045	2.8	5.38	44.52	81.44	414	0.008276	9.8705E+11*
3.15-ME-RAP6410-538-5-3A-7045	2.7	5.38	44.52	75.70	403	0.006433	9.4378E+12*
3.15-ME-RAP6410-538-3-1A-10045	2.7	5.38	44.88	104.37	422	0.005919	3.4102E+12*
3.15-ME-RAP6410-538-3-2A-10045	3.0	5.38	44.54	105.19	358	0.004019	1.4798E+13*
3.15-ME-RAP6410-538-5-3B-10045	2.7	5.38	45.23	108.13	482	0.008137	3.5822E+09*
3.15-ME-RAP6410-538-3-3B-13045	2.7	5.38	44.88	140.35	573	0.011637	2.2743E+10*
3.15-ME-RAP6410-538-4-2B-13045	2.7	5.38	44.58	140.74	415	0.010443	4.3852E+09*
3.15-ME-RAP6410-538-5-1B-13045	3.1	5.38	45.25	140.41	400	0.016747	5,164,249*
3.15-ME-RAP6410-538-1-2A-7055	2.9	5.38	55.08	74.10	236	0.007793	1.2145E+12*
3.15-ME-RAP6410-538-2-1A-7055	2.8	5.38	54.95	71.50	137	0.010686	3.2872E+10*
3.15-ME-RAP6410-538-2-2A-7055	2.7	5.38	55.08	73.98	143	0.011648	6.2681E+10*
3.15-ME-RAP6410-538-1-3A-10055	3.1	5.38	55.03	101.68	242	0.007644	2.8027E+10*
3.15-ME-RAP6410-538-2-1B-10055	2.7	5.38	55.43	97.86	136	0.020728	5,858,407*
3.15-ME-RAP6410-538-3-3A-10055	3.1	5.38	55.06	102.12	211	0.008996	4.8536E+10*
3.15-ME-RAP6410-538-1-1A-13055	2.8	5.38	55.15	133.81	271	0.013382	73,185,861*
3.15-ME-RAP6410-538-2-2B-13055	2.9	5.38	55.18	132.38	123	0.027515	583,819*
3.15-ME-RAP6410-538-2-3A-13055	2.9	5.38	55.18	130.87	127	0.015321	149,427,845*

Note:
1. "*": extrapolation.
2. RICE value: 2.4578 for PG64-10 R25 Lime [25% RAP (by weight of aggregate); 1.2% Lime added (by weight of virgin aggregate); AC* = 5.38% (by weight of virgin aggregate plus Lime)].
3. Percent air-void content was measured using parafilm method.
4. All specimens were lab-mixed lab-compacted (LMLC).

Table 8. Summary of Mix Design Shear Test Results at 50C for Weed Project, for the PG64-28PM, R15, Lime Mix (LMLC).

Specimen Designation	Aggregate Type	AV (%)	AC* (%)	Test Temp. (C)	Test Shear Stress Level (kPa)	Initial Resilient Shear Modulus (MPa)	% Permanent Shear Strain at 5,000 cycles	Cycles to 5% Permanent Shear Strain
315-W-PG6428PM-541-1-1B-7050	Unknown	3.2	5.41	49.6	73.80	181.90	0.014276	22,903,160*
315-W-PG6428PM-541-1-2B-7050	Unknown	3.0	5.41	50.5	74.46	169.20	0.013496	97,100,557*
315-W-PG6428PM-541-1-3B-7050	Unknown	3.2	5.41	49.5	76.19	195.80	0.009540	489,714,330*
315-W-PG6428PM-573-1-1A-7050	Unknown	3.1	5.73	49.5	73.31	157.99	0.007634	5,641,964,621*
315-W-PG6428PM-573-1-2A-7050	Unknown	3.1	5.73	49.7	73.66	149.09	0.014982	17,503,312*
315-W-PG6428PM-573-1-3A-7050	Unknown	3.2	5.73	50.3	73.41	178.90	0.014069	203,629,429*
315-W-PG6428PM-605-1-1A-7050	Unknown	2.9	6.05	50.5	74.53	176.21	0.015081	26,997,661*
315-W-PG6428PM-605-1-2A-7050	Unknown	3.0	6.05	50.3	72.47	145.55	0.019452	6,116,165*
315-W-PG6428PM-605-1-3A-7050	Unknown	3.0	6.05	49.7	74.05	161.58	0.014498	325,438,821*

Note:
4. "*": extrapolation.
5. AC* content: by weight of virgin aggregate plus lime.
6. Lime: 1.2% by weight of virgin aggregate.
7. R15: 15% RAP by weight of aggregate
8. RICE value: 2.5593 for AC* 5.41%; 2.5579 for AC* 5.73%; 2.5403 for AC* 6.05%.
9. All specimens were laboratory-mixed laboratory-compacted with lime added.

Table 9. Summary of shear test results at 50C for Weed Project for PG64-28PM R15 Lime Mix for ME analysis (LMLC).

Specimen Designation	AV (%)	AC* (%)	Test Temp. (C)	Test Shear Stress Level (kPa)	Initial Resilient Shear Modulus (kPa)	% Permanent Shear Strain at 5,000 cycles	Cycles to 5% Permanent Shear Strain
315-W-PG6428PM-573-2-1A-7050	3.1	5.73	50.34	73.29	161	0.009536	2.6321E+16*
315-W-PG6428PM-573-2-3A-7050	3.3	5.73	50.43	78.30	179	0.008564	2.0111E+12*
315-W-PG6428PM-573-3-2B-7050	2.7	5.73	50.45	74.37	155	0.016532	2.4364E+08*
315-W-PG6428PM-573-3-1B-10050	2.8	5.73	50.25	104.38	166	0.015795	2.4219E+08*
315-W-PG6428PM-573-3-3B-10050	3.2	5.73	50.43	104.07	154	0.016764	2,997,166*
315-W-PG6428PM-573-5-2B-10050	3.1	5.73	49.56	105.55	139	0.014793	24,272,276*
315-W-PG6428PM-573-4-1A-13050	3.5	5.73	50.41	134.73	257	0.008438	1.6627E+10*
315-W-PG6428PM-573-5-1B-13050	3.1	5.73	50.39	137.52	137	0.029027	121,564*
315-W-PG6428PM-573-5-3B-13050	3.2	5.73	50.39	136.08	170	0.019577	1,524,011*

Note:
5. "*": extrapolation.
6. Percent air-void content was measured using CoreLok method.
7. All specimens were field-mixed field-compacted.
8. AC: measured binder content.

Fatigue Mix Stiffness Test Data

Fatigue test data were obtained by testing specimens at 20ºC for both the Red Bluff and Weed Projects. These data are summarized in Table 10 for the Red Bluff Project and Table 11 for the Weed Project. Data in these tables were used to established the 95 percent confidence limits for cycles to failure for the lower of the two strain levels for both mixes included in the mix performance requirements. Figure 2 and Figure 3 contain plots of the strain vs. cycle to failure for the Red Bluff and Weed mixes based on the mix test data fo the two projects.

Flexural stiffness measurements on test specimens for the Red Bluff project are summarized in Tables 12, 13, and 14. Flexural stiffness measurements for the Weed project are summarized in Tables 15 and 16. Stiffness measurements for both mixes for the performance requirements were established as follows:

1. For mix stiffneses at 20C,the values are based on the the measurements at 50 load cycles from the fatigue tests.
2. For mix stiffnes at 30C, data are based on the frequency sweep tests.

It should be emphasized that frequency sweep tests are only required for the 30C stiffness values. All of the frequency sweep tests have been included since these data were used to assist in establishing the stiffness limits for the mix test. Also it should be noted that an upper limit as well as a lower limit was set for the stiffness for Weed PG-64-16(10) RAP mix because of the colder winter temperatures there. (There were no data available for binder for the RAP from Weed; hence an upper limit for mix stiffness at 20ºC was set to be on the conservative side).

Table 10. Summary of Fatigue Test Data, Red Bluff Project (20C, LMLC, 1.2% Lime).

Mix Type	Specimen Designation	AV (%)	AC (%)	Test Temp. (C)	Test Strain Level	Initial Phase Angle (Deg.)	Initial Stiffness (MPa)	Fatigue Life Nf
PG64-16RB	ME-64-10-RB-5.5-6A2	2.5	5.5	19.95	0.000201	30.15	5,664	1,265,096,581*
	ME-64-10-RB-5.5-6B1	2.8	5.5	20.02	0.000206	28.72	6,683	20,206,253*
	ME-64-10-RB-5.5-7A1	3.2	5.5	19.84	0.000204	18.89	6,282	10,473,690*
	ME-64-10-RB-5.5-7A2	3.0	5.5	20.10	0.000202	25.85	7,118	4,953,708
	ME-64-10-RB-5.5-8A2	2.3	5.5	19.94	0.000201	23.22	7,959	10,175,552*
	ME-64-10-RB-5.5-1A1	2.8	5.5	20.14	0.000401	31.99	5,017	1,187,203
	ME-64-10-RB-5.5-1B1	2.8	5.5	21.65	0.000398	38.14	4,117	2,910,710
	ME-64-10-RB-5.5-7B1	3.0	5.5	19.92	0.000402	20.17	6,736	306,147
	ME-64-10-RB-5.5-7B2	3.3	5.5	19.87	0.000405	21.76	6,582	282,834
	ME-64-10-RB-5.5-8A1	3.3	5.5	20.16	0.000404	28.02	5,692	309,726
PG64-16RAP	3.15-RAP-6410-5.38-1A1	5.5	5.38	20.14	0.000206	23.78	6,169	6,291,065*
	3.15-RAP-6410-5.38-1C1	6.2	5.38	20.10	0.000207	23.52	6,669	965,516
	3.15-RAP-6410-5.38-2C2	6.2	5.38	21.76	0.000202	23.67	6,120	2,325,347
	3.15-RAP-6410-5.38-3C2	5.9	5.38	21.50	0.000198	21.67	7,247	5,097,139
	3.15-RAP-6410-5.38-1C2	5.9	5.38	19.89	0.000405	18.79	6,009	58,898
	3.15-RAP-6410-5.38-2A1	5.7	5.38	19.78	0.000406	19.60	6,052	137,267
	3.15-RAP-6410-5.38-3C1	6.1	5.38	19.87	0.000406	18.78	7,102	114,469
PG64-28PM	3.15-ME-6428PM-5.2-1D2	5.8	5.2	20.02	0.000204	32.56	3,445	3,693,146,879,174*
	3.15-ME-6428PM-5.2-4A1	5.6	5.2	20.14	0.000206	33.65	3,102	7,616,558,415*
	3.15-ME-6428PM-5.2-4A2	5.5	5.2	20.14	0.000208	34.15	3,120	1,532,850,140*
	3.15-MEP6428PM-5.2-5B1	5.8	5.2	19.87	0.000208	26.06	3,253	19,490,531,682*
	3.15-ME-6428PM-5.2-3D1	5.8	5.2	19.96	0.000411	28.76	3,215	80,792,211*
	3.15-ME-6428PM-5.2-4B1	5.5	5.2	19.83	0.000414	31.60	2,688	115,626,722*
	3.15-ME-6428PM-5.2-5B2	5.7	5.2	19.84	0.000408	27.26	2,960	229,697,271*

Note:

1. RICE values: 2.4704 for PG64-10RB (with lime added; AC = 5.5%); 2.4578 for PG64-10 RAP (with lime added; AC = 5.38% by weight of virgin aggregate); 2.4890 for PG64-28PM (with lime added; AC = 5.2%) .
2. 25% RAP (by weight of dry aggregate) was added to PG64-10RAP mix.
3. 1.2% of lime (by weight of virgin aggregate) was added to PG64-10 RAP mix; 1.2% of lime (by weight of virgin aggregate) was added to both PG64-10RB and PG64-28PM mixes.
4. The source of aggregate is Red Bluff (District 2).
5. The binder source is Valero refinery.
6. The air-void content was measured with the parafilm method.
7. The beam specimens are lab-mixed lab-compacted (LMLC).
8. "*" stands for "extrapolation".
9. Data shaded yellow might be considered outliers.

Table 11. Summary of Fatigue Test Results, Weed Project (20C, LMLC, 1.2% lime).

Mix Type	Specimen Designation	AV (%)	AC* (%)	Test Temp. (C)	Test Strain Level	Initial Phase Angle (Deg.)	Initial Stiffness (MPa)	Fatigue Life Nf
PG64-28PM R15 Lime	3.15-W-PG6428PM-5.73-4B2	5.8	5.73	20.34	0.000209	32.55	3,428	3,077,533,341*
	3.15-W-PG6428PM-5.73-5A2	5.7	5.73	20.03	0.000204	31.37	3,748	71,324,267,818*
	3.15-W-PG6428PM-5.73-8B2	6.4	5.73	20.19	0.000205	31.95	3,283	17,441,256,435*
	3.15-W-PG6428PM-5.73-7A2	5.7	5.73	19.55	0.000409	29.82	3,158	465,349,381*
	3.15-W-PG6428PM-5.73-9A1	5.8	5.73	20.13	0.000409	34.20	3,125	52,589,617*
	3.15-W-PG6428PM-5.73-9A2	6.1	5.73	19.69	0.000411	30.03	3,102	272,058,498*
PG64-16 R25 Lime	3.15-W-PG6416-5.73-2B2	6.1	5.73	19.96	0.000200	21.36	6,700	90,958,157*
	3.15-W-PG6416-5.73-3A2	5.8	5.73	20.28	0.000207	22.11	6,572	192,296,819*
	3.15-W-PG6416-5.73-7B1	6.3	5.73	19.71	0.000203	17.33	7,835	2,634,336,132*
	3.15-W-PG6416-5.73-2B1	5.8	5.73	20.08	0.000399	23.14	6,586	303,119
	3.15-W-PG6416-5.73-6A1	5.6	5.73	19.74	0.000404	17.45	7,997	335,380
	3.15-W-PG6416-5.73-7B2	5.8	5.73	19.75	0.000410	19.39	5,596	594,202

Note:

1. .RICE values: 2.5579 for PG64-28PM R15 [15% RAP (by weight of total aggregate), 1.2% lime added (by weight of virgin aggregate); AC* = 5.73% (by
weight of virgin aggregate plus lime)]; 2.5588 for PG64-16 R25 [25% RAP (by weight of dry aggregate), 1.2% lime added (by weight of virgin aggregate); AC* = 5.73% (by weight of virgin aggregate plus lime)].
2. The binder source is Valero refinery.
3 The air-void content was measured with the parafilm method.
4 The beam specimens are lab-mixed lab-compacted (LMLC).
5 "*" stands for "extrapolation".

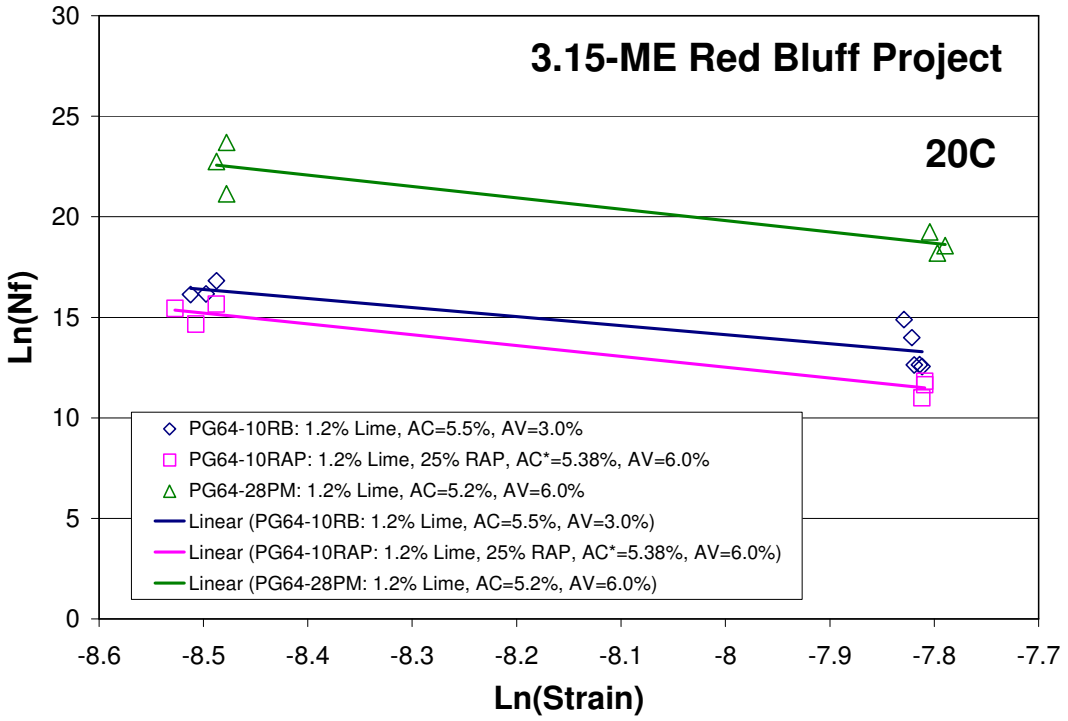


Figure 2. Fatigue Test Summary for Red Bluff Project.

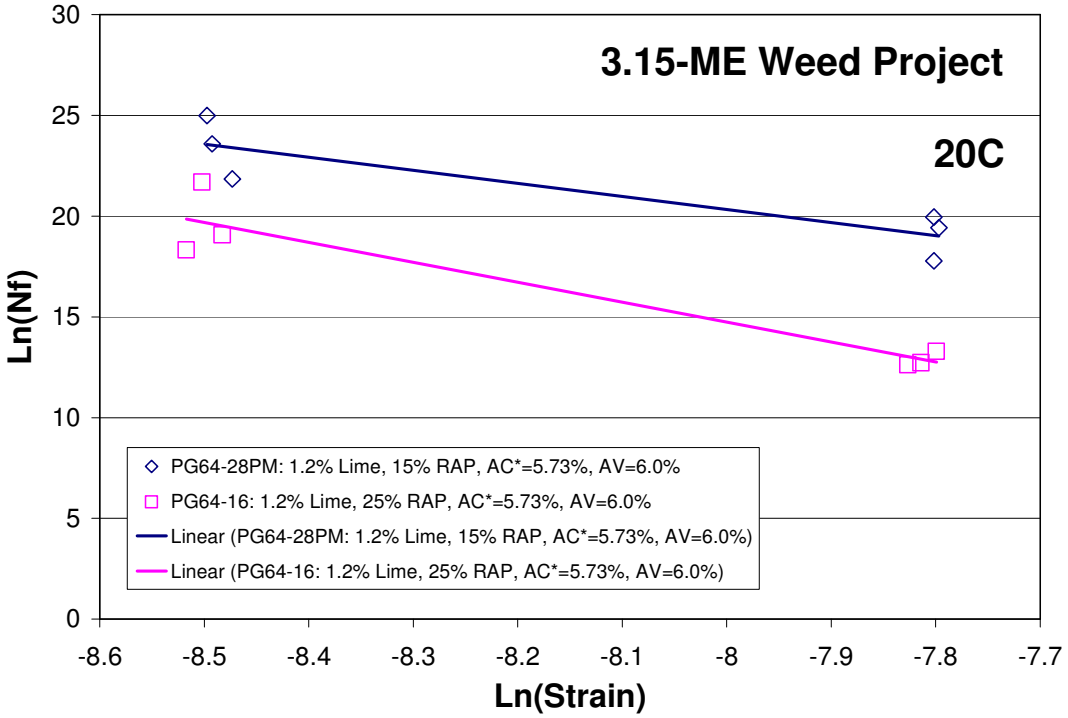


Figure 3. Fatigue Test Summary for Weed Project.

Table 12. Summary of Frequency Sweep test Results, Red Bluff Project, PG64-16RB mix (1.2% lime, AC = 5.5% AV content 3 %)

ME-64-10-RB-5.5-1A2 (AV= 3.0%; 10C)						ME-64-10-RB-5.5-1B2 (AV= 3.3%; 10C)					
Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)	Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)
15.16	0.815218	0.000094	8657	17.97	9.76	15.16	0.744428	0.000078	9542	17.24	9.95
10.00	0.831589	0.000104	8027	18.70	9.73	10.00	0.944201	0.0000105	8958	18.29	9.96
5.01	0.723290	0.000103	7018	19.81	9.69	5.00	0.810441	0.000105	7741	19.27	9.93
2.00	0.587679	0.000102	5766	21.64	9.66	2.00	0.639349	0.000100	6396	21.30	9.92
1.00	0.475488	0.000097	4882	22.50	9.78	1.00	0.517152	0.000096	5410	22.55	9.88
0.50	0.390648	0.000095	4101	25.07	9.85	0.50	0.442861	0.000097	4542	25.56	9.88
0.20	0.314942	0.000099	3181	27.79	9.89	0.20	0.351082	0.000100	3512	27.98	9.85
0.10	0.250108	0.000099	2535	27.74	9.84	0.10	0.274144	0.000098	2800	28.46	9.82
0.05	0.198702	0.000096	2069	30.27	9.73	0.05	0.218798	0.000096	2276	31.27	9.77
0.02	0.149242	0.000095	1563	31.51	9.79	0.02	0.161190	0.000095	1704	33.29	9.83
0.01	0.121558	0.000095	1277	33.38	9.77	0.01	0.129161	0.000094	1379	33.95	9.77

ME-64-10-RB-5.5-2A1 (AV= 3.3%; 20C)						ME-64-10-RB-5.5-6B1 (AV= 2.8%; 20C)					
Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)	Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)
15.17	0.431772	0.000101	4285	26.88	19.56	15.16	0.692986	0.000099	6995	24.22	19.73
10.01	0.401131	0.000104	3860	27.63	19.64	10.01	0.634818	0.000101	6287	25.13	19.65
5.01	0.335121	0.000106	3176	28.97	19.62	5.00	0.534822	0.000103	5207	27.60	19.51
2.00	0.245356	0.000102	2396	30.42	19.55	2.00	0.400920	0.000103	3896	31.71	19.53
1.00	0.190235	0.000100	1905	31.67	19.61	1.00	0.298153	0.000097	3066	33.61	19.64
0.50	0.141209	0.000092	1537	33.85	19.68	0.50	0.230482	0.000098	2348	38.41	19.59
0.20	0.108011	0.000099	1096	35.04	19.67	0.20	0.160854	0.000101	1591	41.35	19.51
0.10	0.084672	0.000099	857	35.94	19.55	0.10	0.113279	0.000097	1164	42.56	19.60
0.05	0.065576	0.000097	676	36.26	19.62	0.05	0.084531	0.000097	870	46.06	19.63
0.02	0.047610	0.000097	493	35.62	19.66	0.02	0.055570	0.000096	579	45.47	19.63
0.01	0.039334	0.000096	410	32.84	19.61	0.01	0.039920	0.000095	420	47.07	19.63

ME-64-10-RB-5.5-6A1 (AV= 2.5%; 30C)						ME-64-10-RB-5.5-6B2 (AV= 2.3%; 30C)					
Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)	Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)
15.14	0.504929	0.000207	2437	41.26	29.93	15.16	0.584690	0.000203	2885	38.85	30.04
10.00	0.422313	0.000202	2088	42.35	29.97	10.00	0.504513	0.000204	2478	40.32	29.87
5.00	0.318595	0.000204	1559	43.83	29.95	5.00	0.386153	0.000205	1885	42.35	29.78
2.00	0.205569	0.000200	1029	46.41	29.83	2.00	0.248202	0.000199	1248	45.09	29.80
1.00	0.149544	0.000202	742	47.07	29.78	1.00	0.181138	0.000201	903	47.55	29.84
0.50	0.106950	0.000201	532	47.59	29.86	0.50	0.130343	0.000201	648	47.94	29.89
0.20	0.069155	0.000199	348	45.84	29.84	0.20	0.080038	0.000198	404	49.75	29.89
0.10	0.049334	0.000200	247	45.12	29.81	0.10	0.057520	0.000198	290	48.10	29.86
0.05	0.037210	0.000198	188	45.13	29.79	0.05	0.042576	0.000197	216	47.17	29.89
0.02	0.027498	0.000198	139	40.70	29.79	0.02	0.028343	0.000197	144	47.52	29.87
0.01	0.022170	0.000197	112	33.34	29.78	0.01	0.022641	0.000196	115	52.49	29.88

Table 13. Summary of Frequency Sweep Test Result, Red Bluff Project, PG64-16 (25%RAP, 1,2% lime, AC = 5.38% [virgin aggregate basis], AV = 6.0%).

3.15-RAP-6410-5.38-3A1 (AV= 6.2%; 10C)						3.15-RAP-6410-5.38-3A2 (AV= 6.2%; 10C)					
Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)	Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)
15.16	0.803457	0.000080	10064	12.26	9.82	15.17	0.648455	0.000052	12588	12.57	9.83
9.99	1.017310	0.000105	9730	11.12	9.73	9.99	1.132050	0.000102	11124	11.56	9.76
5.01	0.963997	0.000104	9239	11.08	9.73	5.01	1.094216	0.000104	10486	10.55	9.79
2.00	0.767282	0.000092	8305	11.57	9.81	1.99	0.719447	0.000077	9398	11.91	9.78
1.00	0.734348	0.000096	7615	11.28	9.79	1.00	0.818730	0.000095	8615	10.73	9.74
0.50	0.685289	0.000096	7107	11.97	9.73	0.50	0.809139	0.000097	8364	12.74	9.81
0.20	0.625003	0.000100	6248	13.09	9.69	0.20	0.735103	0.000100	7343	14.42	9.81
0.10	0.547926	0.000100	5475	15.12	9.83	0.10	0.634387	0.000100	6372	14.96	9.68
0.05	0.481642	0.000099	4875	16.64	9.78	0.05	0.542073	0.000097	5609	18.24	9.71
0.02	0.403610	0.000097	4143	19.07	9.74	0.02	0.456908	0.000095	4788	20.28	9.74
0.01	0.348758	0.000097	3601	22.05	9.77	0.01	0.400954	0.000095	4220	22.48	9.76

3.15-RAP-6410-5.38-2D1 (AV= 5.6%; 20C)						3.15-RAP-6410-5.38-3B2 (AV= 5.5%; 20C)					
Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)	Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)
15.14	0.746613	0.000103	7239	18.32	19.89	15.18	0.608980	0.000073	8375	14.95	19.91
9.97	0.706227	0.000105	6744	17.77	19.99	10.00	0.731474	0.000102	7152	16.87	19.85
5.01	0.636018	0.000105	6045	18.33	20.01	5.01	0.681639	0.000105	6471	17.65	19.93
2.00	0.513747	0.000102	5050	20.70	19.85	2.00	0.529491	0.000097	5467	18.73	19.79
1.00	0.414417	0.000098	4250	20.19	19.80	1.00	0.460262	0.000097	4737	18.83	19.80
0.50	0.383721	0.000103	3709	24.45	19.98	0.50	0.424113	0.000101	4219	22.07	19.89
0.20	0.303372	0.000102	2980	28.59	19.91	0.20	0.333177	0.000100	3346	25.31	19.80
0.10	0.234456	0.000099	2372	30.66	19.90	0.10	0.272468	0.000099	2747	26.89	19.83
0.05	0.181199	0.000097	1875	33.77	19.94	0.05	0.212951	0.000096	2226	30.76	19.84
0.02	0.128708	0.000095	1352	34.77	19.90	0.02	0.156485	0.000095	1654	33.39	19.86
0.01	0.098509	0.000095	1042	39.10	19.92	0.01	0.125158	0.000095	1322	35.85	19.87

3.15-RAP-6410-5.38-2A2 (AV= 5.9%; 30C)						3.15-RAP-6410-5.38-2C1 (AV= 5.9 %; 30C)					
Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)	Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)
15.16	0.667729	0.000212	3147	31.79	29.74	15.14	0.754364	0.000215	3515	28.72	30.02
10.00	0.590212	0.000211	2797	32.62	29.90	10.00	0.652163	0.000208	3138	29.79	29.90
5.00	0.466812	0.000206	2264	34.85	29.87	5.00	0.518391	0.000204	2540	31.02	30.02
2.00	0.336119	0.000203	1656	37.75	29.90	2.00	0.388100	0.000202	1920	34.59	29.92
1.00	0.251373	0.000201	1250	39.55	29.94	1.00	0.309312	0.000200	1547	36.71	29.97
0.50	0.183567	0.000197	932	41.96	29.85	0.50	0.241777	0.000208	1165	40.15	29.90
0.20	0.125193	0.000202	620	43.41	29.85	0.20	0.163669	0.000205	797	41.41	29.96
0.10	0.091882	0.000199	461	44.22	29.90	0.10	0.119527	0.000201	595	42.39	29.93
0.05	0.066158	0.000197	335	42.29	29.86	0.05	0.089291	0.000199	448	41.91	29.94
0.02	0.045793	0.000196	233	42.69	29.84	0.02	0.060209	0.000197	305	42.48	29.90
0.01	0.033585	0.000195	172	41.00	29.88	0.01	0.045086	0.000197	229	43.74	29.88

Table 14. Summary of Frequency Sweep Test Results Red Bluff Project, PG64-28PM (1.2% lime, AC = 5.0%, AV = 6.0%)

3.15-ME-6428PM-5.2-3A2 (AV= 6.2%; 10C)						3.15-ME-6428PM-5.2-3B2 (AV= 5.8%; 10C)					
Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)	Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)
15.15	0.796199	0.000102	7770	16.25	9.86	15.16	0.713504	0.000093	7660	18.98	9.79
10.00	0.748072	0.000103	7260	17.02	9.81	10.00	0.750059	0.000104	7220	18.80	9.74
5.00	0.664736	0.000104	6421	17.99	9.70	5.00	0.656480	0.000103	6390	19.47	9.69
2.00	0.527309	0.000097	5430	19.02	9.68	2.00	0.540756	0.000102	5325	20.57	9.75
1.00	0.458779	0.000098	4678	19.48	9.78	1.00	0.451942	0.000098	4601	20.51	9.70
0.50	0.408513	0.000100	4075	22.22	9.78	0.50	0.384452	0.000098	3912	23.63	9.66
0.20	0.336669	0.000104	3237	23.05	9.69	0.20	0.310748	0.000100	3104	24.35	9.75
0.10	0.267564	0.000101	2655	23.24	9.71	0.10	0.250702	0.000099	2530	25.92	9.79
0.05	0.217317	0.000098	2222	26.10	9.76	0.05	0.209199	0.000097	2161	27.56	9.74
0.02	0.172504	0.000096	1792	26.42	9.79	0.02	0.162095	0.000094	1718	28.10	9.71
0.01	0.143662	0.000096	1496	27.64	9.75	0.01	0.136264	0.000095	1442	28.66	9.76

3.15-ME-6428PM-5.2-3A1 (AV= 5.9%; 20C)						3.15-ME-6428PM-5.2-3D1 (AV= 5.8%; 20C)					
Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)	Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)
15.16	0.492444	0.000106	4635	23.54	20.06	15.14	0.463054	0.000106	4362	25.15	19.99
10.00	0.441040	0.000104	4255	23.60	19.96	10.00	0.418168	0.000106	3962	25.52	20.12
5.00	0.384898	0.000107	3605	24.61	20.02	5.01	0.351936	0.000106	3327	26.40	19.90
2.00	0.298358	0.000105	2841	25.95	19.91	2.00	0.262781	0.000102	2569	28.46	19.99
1.00	0.230329	0.000098	2349	25.56	19.87	1.00	0.206629	0.000099	2091	27.59	20.00
0.50	0.198562	0.000102	1949	27.40	19.88	0.50	0.169748	0.000101	1682	30.18	19.88
0.20	0.148925	0.000101	1481	29.18	19.85	0.20	0.125064	0.000100	1247	32.36	19.95
0.10	0.116680	0.000099	1181	29.95	19.88	0.10	0.096680	0.000098	991	31.17	19.90
0.05	0.094128	0.000097	967	29.95	19.90	0.05	0.076256	0.000097	786	32.18	19.84
0.02	0.071701	0.000095	754	29.50	19.87	0.02	0.057206	0.000096	598	31.60	19.88
0.01	0.057977	0.000095	611	30.09	19.91	0.01	0.045210	0.000095	475	31.31	19.88

3.15-ME-6428PM-5.2-1D1(AV= 5.7%; 30C)						3.15-ME-6428PM-5.2-3D2 (AV= 5.5%; 30C)					
Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)	Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)
15.17	0.189574	0.000106	1783	36.56	30.06	15.15	0.188199	0.000106	1777	36.20	30.32
10.02	0.168260	0.000106	1586	34.82	30.02	9.99	0.166453	0.000106	1573	35.02	30.14
5.00	0.134337	0.000105	1282	34.36	29.92	5.00	0.135708	0.000107	1266	34.64	30.03
2.00	0.095200	0.000103	925	34.31	29.99	2.00	0.096602	0.000104	929	34.86	30.06
1.00	0.072932	0.000098	745	32.41	29.83	1.00	0.073552	0.000100	737	33.24	29.86
0.50	0.055168	0.000094	589	32.53	29.95	0.50	0.051392	0.000090	572	35.69	29.93
0.20	0.042091	0.000098	429	34.00	29.88	0.20	0.041263	0.000099	418	31.99	29.88
0.10	0.033404	0.000097	345	32.35	29.91	0.10	0.031849	0.000098	326	32.64	29.90
0.05	0.025839	0.000096	270	29.69	29.91	0.05	0.026956	0.000097	278	36.52	29.90
0.02	0.020609	0.000093	221	34.90	29.89	0.02	0.021818	0.000096	228	33.44	29.86
0.01	0.018346	0.000095	193	27.65	29.85	0.01	0.018326	0.000095	193	34.28	29.86

Table 15. Summary of Frequency Sweep Test Results Weed Project PG64-28PM (15% RAP with 1.2% lime added, AC* = 5.73% [virgin aggregate plus lime], AV = 6.0%).

3.15-W-PG6428PM-5.73-4B1 (AV= 5.7%; 10C)						3.15-W-PG6428PM-5.73-10B1 (AV= 6.2%; 10C)					
Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)	Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)
15.17	0.654814	0.000094	6960	20.64	9.67	15.16	0.601919	0.000090	6652	19.90	10.57
9.99	0.693594	0.000104	6668	19.03	9.72	10.01	0.638756	0.000103	6206	19.35	10.54
5.00	0.632204	0.000104	6077	18.93	9.78	5.00	0.562558	0.000105	5377	18.83	10.48
1.99	0.500937	0.000099	5085	19.69	9.76	1.99	0.407799	0.000092	4410	20.39	10.46
1.00	0.421738	0.000095	4439	21.39	9.70	1.00	0.376214	0.000096	3921	20.50	10.40
0.50	0.377311	0.000100	3755	23.92	9.67	0.50	0.326455	0.000097	3373	23.37	10.39
0.20	0.295414	0.000100	2960	25.54	9.62	0.20	0.259265	0.000098	2651	25.02	10.34
0.10	0.242309	0.000099	2442	26.12	9.57	0.10	0.194513	0.000096	2029	25.79	10.29
0.05	0.196119	0.000097	2012	28.17	9.75	0.05	0.176153	0.000096	1837	29.09	10.21
0.02	0.152253	0.000098	1551	29.69	9.58	0.02	0.134294	0.000094	1433	29.85	10.06
0.01	0.122761	0.000095	1290	30.58	9.68	0.01	0.111052	0.000093	1189	31.24	9.80

3.15-W-PG6428PM-5.73-5A1 (AV= 5.5%; 20C)						3.15-W-PG6428PM-5.73-6B2 (AV= 6.4%; 20C)					
Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)	Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)
15.15	0.449084	0.000102	4382	24.51	20.01	15.13	0.429492	0.000113	3805	28.90	19.84
10.00	0.431361	0.000106	4054	25.08	20.05	10.00	0.401307	0.000105	3836	27.10	19.77
4.99	0.358646	0.000105	3417	26.02	19.92	5.00	0.330784	0.000105	3145	28.13	19.80
1.99	0.252225	0.000093	2710	27.24	19.77	2.00	0.234618	0.000097	2413	29.81	19.76
1.00	0.217046	0.000098	2221	28.33	19.74	1.00	0.185741	0.000095	1962	29.66	19.74
0.50	0.181515	0.000101	1795	31.85	19.65	0.50	0.153945	0.000096	1602	32.37	19.68
0.20	0.132400	0.000099	1340	31.86	19.80	0.20	0.114980	0.000097	1183	31.78	19.59
0.10	0.105045	0.000096	1089	30.53	19.69	0.10	0.088023	0.000095	930	32.02	19.61
0.05	0.083980	0.000094	891	31.64	19.67	0.05	0.068615	0.000093	735	33.98	19.72
0.02	0.062370	0.000093	668	30.71	19.67	0.02	0.049510	0.000091	544	33.07	19.68
0.01	0.050924	0.000093	549	31.65	19.70	0.01	0.039953	0.000091	440	34.27	19.70

3.15-W-PG6428PM-5.73-1A2 (AV= 5.8%; 30C)						3.15-W-PG6428PM-5.73-10B2 (AV= 6.3%; 30C)					
Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)	Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)
15.22	0.168644	0.000101	1675	36.48	29.94	15.15	0.259693	0.000208	1246	43.51	29.76
10.01	0.161903	0.000107	1514	35.97	29.81	10.00	0.226902	0.000208	1092	41.96	29.74
4.98	0.127771	0.000105	1215	36.84	29.78	5.00	0.176085	0.000209	841	41.53	29.68
1.99	0.083369	0.000094	885	35.68	29.77	2.00	0.122567	0.000208	590	41.37	29.71
1.00	0.068284	0.000097	707	34.51	29.68	1.00	0.092849	0.000200	463	40.94	29.67
0.50	0.053133	0.000096	551	35.10	29.70	0.50	0.067359	0.000194	348	40.83	29.75
0.20	0.039629	0.000097	407	35.57	29.66	0.20	0.049263	0.000200	246	43.39	29.68
0.10	0.031701	0.000096	331	35.93	29.67	0.10	0.037640	0.000199	189	41.11	29.70
0.05	0.025811	0.000095	272	27.45	29.65	0.05	0.030182	0.000197	153	40.95	29.67
0.02	0.021584	0.000093	231	32.80	29.70	0.02	0.024631	0.000196	125	38.52	29.73
0.01	0.019669	0.000093	212	37.60	29.72	0.01	0.021930	0.000197	111	33.88	29.72

Table 16. Summary of Frequency Sweep Test Results Weed Project PG64-16 (25% RAP, 1.2% lime, AC* = 5.73% [virgin aggregate plus lime basis], AV = 6.0%).

3.15-W-PG6416-5.73-4B1 (AV= 6.4%; 10C)						3.15-W-PG6416-5.73-5B1 (AV= 6.2%; 10C)					
Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)	Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)
15.15	0.440800	0.000041	10746	15.65	10.15	15.15	0.382804	0.000033	11697	15.92	10.04
9.99	1.099945	0.000102	10774	2.49	10.13	10.00	1.143222	0.000101	11331	13.34	10.03
5.00	1.049077	0.000106	9897	11.52	10.13	5.01	1.032648	0.000102	10168	12.95	10.03
1.99	0.678555	0.000081	8373	12.93	10.12	2.00	0.849778	0.000096	8844	14.68	10.02
1.00	0.724664	0.000094	7696	11.80	10.11	1.00	0.735876	0.000094	7804	15.61	10.01
0.50	0.632674	0.000090	6993	13.05	10.12	0.50	0.607657	0.000089	6795	16.42	10.00
0.20	0.590248	0.000099	5990	15.70	10.11	0.20	0.553028	0.000099	5575	16.23	10.00
0.10	0.511202	0.000098	5198	16.06	10.10	0.10	0.476948	0.000099	4797	18.84	9.99
0.05	0.435098	0.000096	4510	19.77	10.08	0.05	0.402855	0.000098	4105	20.82	9.97
0.02	0.379808	0.000096	3943	22.31	10.05	0.02	0.320122	0.000095	3356	23.41	9.94
0.01	0.335736	0.000098	3413	23.25	9.97	0.01	0.278778	0.000098	2839	24.22	9.86

3.15-W-PG6416-5.73-3A1 (AV= 5.7%; 20C)						3.15-W-PG6416-5.73-4B2 (AV= 6.1%; 20C)					
Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)	Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)
15.16	0.528767	0.000062	8471	16.51	19.50	15.16	0.614638	0.000095	6450	20.11	19.66
9.99	0.731116	0.000104	7047	17.96	19.59	10.00	0.622690	0.000104	5969	19.98	19.65
5.00	0.662258	0.000106	6255	17.45	19.56	5.00	0.562243	0.000105	5367	19.66	19.53
1.99	0.449283	0.000086	5228	18.94	19.47	1.99	0.394917	0.000088	4484	20.55	19.51
1.00	0.433686	0.000096	4518	19.27	19.54	1.00	0.371069	0.000097	3830	21.81	19.66
0.50	0.388765	0.000101	3845	21.71	19.61	0.50	0.334061	0.000101	3303	25.76	19.63
0.20	0.310730	0.000102	3055	25.09	19.67	0.20	0.259358	0.000101	2556	28.32	19.51
0.10	0.253693	0.000099	2575	27.27	19.51	0.10	0.207271	0.000099	2094	29.41	19.58
0.05	0.209211	0.000097	2155	29.98	19.63	0.05	0.164943	0.000097	1697	31.79	19.55
0.02	0.152984	0.000095	1609	30.88	19.56	0.02	0.124938	0.000096	1307	32.73	19.58
0.01	0.125459	0.000095	1321	32.43	19.57	0.01	0.102882	0.000095	1086	34.47	19.58

3.15-W-PG6416-5.73-1A1 (AV= 5.7%; 30C)						3.15-W-PG6416-5.73-1A2 (AV= 6.2%; 30C)					
Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)	Freq. (Hz)	Tensile Sts. (MPa)	Tensile Stn.	Flex_E* (MPa)	Phase Angle (deg)	Avg. Temp. (C)
15.13	0.721189	0.000209	3451	30.62	29.74	15.16	0.408714	0.000107	3824	28.21	29.74
10.00	0.640369	0.000206	3112	31.68	29.79	10.01	0.360821	0.000105	3452	28.77	29.67
5.01	0.523168	0.000207	2526	31.85	29.63	5.00	0.296703	0.000105	2834	30.37	29.57
2.00	0.381995	0.000204	1870	33.76	29.68	1.99	0.195654	0.000093	2107	32.05	29.72
1.00	0.307193	0.000197	1558	34.83	29.74	1.01	0.163762	0.000098	1669	31.72	29.64
0.50	0.249629	0.000206	1213	38.72	29.67	0.50	0.127605	0.000098	1308	35.94	29.76
0.20	0.174895	0.000204	858	38.46	29.72	0.20	0.092513	0.000098	945	35.25	29.63
0.10	0.133096	0.000200	666	38.91	29.70	0.10	0.071307	0.000096	741	36.54	29.70
0.05	0.102770	0.000197	522	39.09	29.68	0.05	0.056166	0.000095	591	37.98	29.69
0.02	0.076976	0.000195	394	39.23	29.71	0.02	0.042318	0.000094	449	38.17	29.65
0.01	0.064830	0.000195	332	39.60	29.72	0.01	0.037266	0.000094	396	34.06	29.71

Hamburg Wheel Tracking Test (HWTT) Data

The Hamburg Wheel Tracking Test data are in included in Figure 4 and Table 17 for the Red Bluff project and Table 18 for the Weed project.

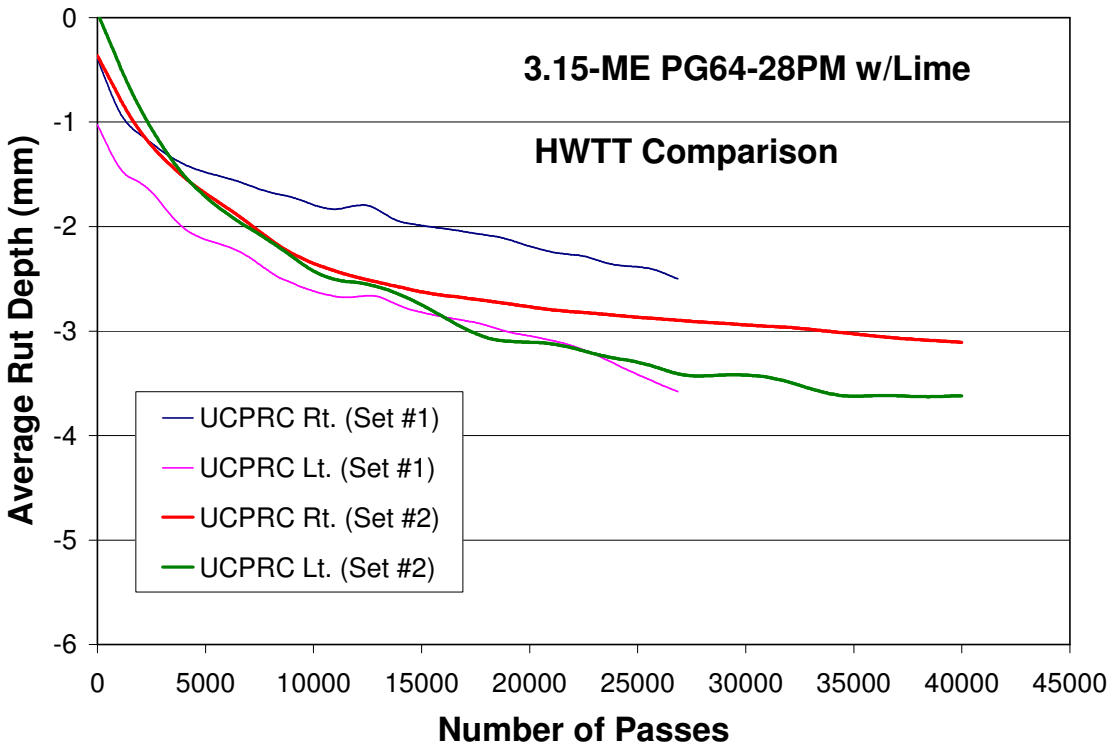


Figure 4. Summary of Average Rut Depth (PG64-28PM w/Lime) for Red Bluff. Note: Average rut depth – average in ruts of three middle profile positions from the smoothed plot.

Table 17. Summary of HWTT Test Results after 20,000 Passes for Red Bluff.

Mix Type	Set	Position	Specimen Name	% AV (Parafilm)	Average Rut Depth (mm)	
					10k Passes	20k Passes
PG64-10RB w/ Lime	1 (UCPRC)	Rt.	3.15-HAM-6410RB-5.5-3-1B	3.0	3.22	3.41
			3.15-HAM-6410RB-5.5-3-1B	3.1		
		Lt.	3.15-HAM-6410RB-5.5-3-1B	3.2	4.13	4.49
			3.15-HAM-6410RB-5.5-3-1B	3.1		
	2 (Caltrans)	Rt.	3.15-HAM-6410RB-5.5-1-3A	3.1	1.20	2.76
			3.15-HAM-6410RB-5.5-4-3A	3.2		
		Lt.	3.15-HAM-6410RB-5.5-1-2A	3.0	1.25	2.69
			3.15-HAM-6410RB-5.5-4-2A	2.9		
PG64-10RAP w/Lime	1 (UCPRC)	Rt.	3.15-HAM-RAP-6410-5.38-2-2D	6.0	2.61	3.16
			3.15-HAM-RAP-6410-5.38-1-3C	5.9		
		Lt.	3.15-HAM-RAP-6410-5.38-1-1C	5.8	2.29	2.89
			3.15-HAM-RAP-6410-5.38-2-1C	5.8		
	2 (Caltrans)	Rt.	3.15-HAM-RAP-6410-5.38-1-1D	5.2	2.80	3.37
			3.15-HAM-RAP-6410-5.38-2-3C	6.1		
		Lt.	3.15-HAM-RAP-6410-5.38-2-2C	5.8	2.82	3.25
			3.15-HAM-RAP-6410-5.38-2-3D	5.7		
PG64-28PM w/ Lime	1 (UCPRC)	Rt.	3.15-HAM-6428PM-5.2-1-1D	6.1	1.79	2.19
			3.15-HAM-6428PM-5.2-2-1D	6.0		
		Lt.	3.15-HAM-6428PM-5.2-2-2D	5.7	2.62	3.05
			3.15-HAM-6428PM-5.2-3-3D	5.9		
	2 (UCPRC)	Rt.	3.15-HAM-6428PM-5.2-2-2C	6.6	2.35	2.77
			3.15-HAM-6428PM-5.2-1-2C	6.8		
		Lt.	3.15-HAM-6428PM-5.2-1-3C	8.1	2.43	3.11
			3.15-HAM-6428PM-5.2-2-3C	7.7		

Note:

1. All the specimens were prepared using rolling wheel compaction.
2. The average rut depth was defined as the average of ruts of three middle profile positions from the smoothed plot.

Table 18 Summary of HWTT test results for Weed Project.

Mix Type	Set	Position	Specimen Name	AV (SSD) (%)	Average Rut Depth @ 10,000 passes (mm)	Average Rut Depth @ 20,000 passes (mm)
PG64-28PM R15 Lime	1	Rt.	3.15-W-PG6428PM-5.73-4	6.9	2.05	2.41
			3.15-W-PG6428PM-5.73-6	6.9		
		Lt.	3.15-W-PG6428PM-5.73-2580	5.8	1.08	1.49
			3.15-W-PG6428PM-5.73-5	6.6		
	2	Rt.	3.15-W-PG6428PM-5.73-3	6.8	1.73	2.21
			3.15-W-PG6428PM-5.73-1	6.6		
		Lt.	3.15-W-PG6428PM-5.73-2560	6.1	1.34	1.67
			3.15-W-PG6428PM-5.73-2570	6.1		
PG64-16 R25 Lime	1	Rt.	3.15-W-PG6416-5.73-D	6.6	2.46	2.70
			3.15-W-PG6416-5.73-3	6.6		
		Lt.	3.15-W-PG6416-5.73-4	6.0	1.94	2.41
			3.15-W-PG6416-5.73-2	6.2		
	2	Rt.	3.15-W-PG6416-5.73-1	6.9	2.27	2.76
			3.15-W-PG6416-5.73-9	6.8		
		Lt.	3.15-W-PG6416-5.73-7	6.4	1.61	1.94
			3.15-W-PG6416-5.73-10	6.3		

Note:

3. 1. All the specimens were prepared using Superpave gyratory compaction.
4. The average rut depth was defined as the average of ruts of three middle profile positions from the smoothed plot.