triad/holmes associates
civil engineering
land surveying
mammoth lakes • bishop • redwood city
napa • san luis obispo

September 13, 2016

Freeman & Associates
Attention: Verne Freeman
990 San Antonio Road
Palo Alto, California 94303

Subject: Old Monterey Road

Reference: AASHTO-Geometric Design of Highways and Streets 4th Ed.

Dear Verne,

This letter report presents the traffic operations analysis and traffic index recommendations required by the Santa Clara County Roads and Airports Department in their memorandum dated July 13, 2016 for that portion of Old Monterey Road serving the proposed Sargent Ranch Quarry.

Project Description Traffic Generation

The Sargent Ranch Quarry will utilize approximately 3,000 feet of Old Monterey Road from the U.S. 101 south to the existing property line of Sargent Ranch.

When in full operation the quarry will generate the following average daily truck Vehicle Trips as taken from Section 1.6.5 Vehicle Trips of the project description for the quarry:

Average Daily Vehicle Trip Generation

Uses	Number of Axles	Maximum Daily Trips at Peak Day Production		AM (Daily Peak-Hour)		PM (Daily Peak-Hour)	
		One-Way Trips	*Two-Way (Round) Trips*	*Entering*	*Exiting*	*Entering*	*Exiting*
Facility Employees[1]	2	30	15	20	20	10	10
Aggregate Sales	5	340	170	210	210	130	130
Maintenance Vehicles	2	1	2	1	1	0	0
Maximum Trips	N/A	371	187	231	231	140	140

All vehicles including empty trucks entering the quarry will use Old Monterey Road. Only Highway 101 southbound loaded trucks carrying aggregate will use Old Monterey Road accessing Highway 101 via an acceleration lane at the intersection. Northbound trucks and vehicles will travel under the Sargent undercrossing of Highway 101 entering onto Highway 101 via a new acceleration lane to be constructed by the quarry operator. The majority of the aggregate from the quarry will be shipped on northbound 101 to the south bay. Therefore a much lower volume of loaded trucks than the ADT of 170 presented in the table will use Old Monterey Road. For geometric pavement section design purposes the ADT was used as a conservative basis for design.

Geometric Design Recommendations

The Sargent Quarry will be the only regular traffic generator on Old Monterey Road since the Freeman Quarry just south of Highway 101 has been reclaimed and is no longer in operation. Therefore Old Monterey Road is a local rural road based on the AASHTO description of a Rural Road.

The width of Old Monterey Road averages 24 feet with little or no shoulder. AASHTO recommends a minimum pavement width of 20 feet for a local rural road with an ADT under 400 vehicles at a design speed of 45 mph. However a paved width of 24 feet minimum is recommended. The Federal Highway Administration (FHWA) published a lane width safety Design Exception Criteria on its web page in October 2014. A copy of the Safety Criteria is attached in Appendix A. The publication provides minimum lane widths for trucks based on the Average Daily Traffic Volume with a lane width of 12 feet being the original basis of design for lane width. Table 5 in the publication provides the reduction in free flow speed based on lane width and shoulder provided for rural lane highways. The reduction in free flow speed for lane width of 12 feet with a shoulder width of 3 feet is 2.6 mph.

Based on the FHWA publication a roadway section of 24 feet with a shoulder width of 3 feet on each side of the road is adequate for Old Monterey Road. This section is the County Standard for a minor cul-de-sac serving 6 or more lots. A posted speed limit of 45 mph will compensate for the reduction in free flow speed which is 55 mph less the 2.6 mph or 52 mph.

Recommendations for the geometric road design, striping and signage are provided as follows:

1. Posted maximum speed limit of 45 mph
2. Minimum design curve radius of 800 feet
3. Double yellow no passing striping on centerline
4. Two way traffic signs (MUTCD W6.3) placed southbound 100 feet past the exit from Highway 101 and for northbound traffic at the beginning of the County right of way.
5. A W1-11 sign with a 5 mph speed limit should be posted prior to the turn onto Highway 101

Pavement Section

Coring of the existing pavement was accomplished in August 2016 by Sierra Geotechnical Services, Inc. A copy of the results are provided in Appendix B. The investigation included the sampling and R value testing of representative subgrade soils.

Based on the R value test results of 35 for the subgrade soil a pavement section of 6 inches Hot Mix Asphalt on 13 inches Class II aggregate base is recommended. The pavement section was calculated using a TI of II calculated by generating Equivalent Single Axle Loads (ESAL) over a 20 year design period and the pavement design formulas presented in Section 600 of the Caltrans Highway Design Manual.

The results of the coring revealed the southerly 600 feet of Old Monterey Road consisted of 2.5 to 6.5 inches of asphalt underlain by concrete about 3.5 inches thick. The asphalt in this area has significantly wide longitudinal cracking indicative of concrete cracking below the AC as well. The northerly 1,020 feet of the roadway coring reflected a 5.5 inch thickness of AC on base. The depth of the base was not determined however the AC is in good condition. The rest of the roadway length of approximately 1,250 feet consists of 8 to 9 inches of AC with no base underlying the AC.

Based on the coring it is expected that the southerly 1,850 feet of County Road will need a new pavement section installed. A 1-inch overlay may be necessary on the northerly 1,000 feet of roadway unless further investigation determines that the overall existing pavement section will adequately support the traffic loading.

Sincerely,

Thomas A. Platz
PE C41039

REGISTERED PROFESSIONAL ENGINEER
THOMAS A. PLATZ
NO. C 41039
CIVIL
STATE OF CALIFORNIA

APPENDIX A

U.S. Department of Transportation
Federal Highway Administration
1200 New Jersey Avenue, SE
Washington, DC 20590
202-366-4000

Safety

Lane Width

The adopted criteria describe design values for through travel lanes, auxiliary lanes, ramps, and turning roadways. There are also recommended widths for special-purpose lanes such as continuous two-way left-turn lanes. AASHTO also provides guidance for widening lanes through horizontal curves to provide for the off-tracking requirements of large trucks. Lane width does not include shoulders, curbs, and on-street parking areas. Table 3 summarizes the range of lane widths for travel lanes and ramps.

TABLE 3

Ranges for Lane Width

Type of Roadway	**Rural**		**Urban**	
	US (feet)	**Metric (meters)**	**US (feet)**	**Metric (meters)**
Freeway	12	3.6	12	3.6
Ramps (1-lane)	12-30	3.6-9.2	12-30	3.6-9.2
Arterial	11-12	3.3-3.6	10-12	3.0-3.6
Collector	10-12	3.0-3.6	10-12	3.0-3.6
Local	9-12	2.7-3.6	9-12	2.7-3.6

(Source: A Policy on Geometric Design of Highways and Streets, AASHTO)

It is FHWA policy that the requirement of a formal design exception for lane width is applicable for all travel lanes, including auxiliary lanes and ramps. With respect to the practice of widening lanes through horizontal curves, a formal design exception is not necessary for cases not providing additional lane width, but the decision should be documented in project records. Exhibit 7-3 in the *Green Book* describes minimum lane widths for two-lane rural highways for a range of design speeds and design-year traffic. The table entries show a 24-foot traveled way (12-foot lanes) for most conditions. Careful inspection of this table (see subnote [a]) shows that 11-foot lanes are acceptable and within policy for reconstruction projects in which an existing 22-foot dimension is operating in a satisfactory manner. For such cases the designer should document this is the case, but retention of the 11-foot width would not require a design exception.

Safety

Speed is a primary consideration when evaluating potential adverse impacts of lane width on safety. On high-speed, rural two-lane highways, an increased risk of cross-centerline head-on or cross-centerline sideswipe crashes is a concern because drivers may have more difficulty staying within the travel lane. On any high-speed roadway, the primary safety concerns with reductions in lane width are crash types related to lane departure, including run-off-road crashes. The mitigation strategies for lane width presented in Chapter 4 focus on reducing the probability of these crashes.

In a reduced-speed urban environment, the effects of reduced lane width are different. On such facilities, the risk of lane-departure crashes is less. The design objective is often how to best distribute limited cross-sectional width to maximize safety for a wide variety of roadway users. Narrower lane widths may be chosen to manage or reduce speed and shorten crossing distances for pedestrians. Lane widths may be adjusted to incorporate other cross-sectional elements, such as medians for access control, bike lanes, on-street parking, transit stops, and landscaping. The adopted ranges for lane width in the urban, low-speed environment normally provide adequate flexibility to achieve a desirable urban cross section without a design exception.

Designers should understand the interrelationships among lane width and other design elements. On high-speed roadways with narrow lanes that also have narrow shoulders, the risk of severe lane-departure crashes increases. Drivers on rural two-lane highways may shift even closer to the centerline as they become less comfortable next to a narrow shoulder. At other times, they may shift closer to the shoulder edge and are at greater risk of driving off the paved portion of the roadway (and over potential edge drop-offs) as they meet oncoming traffic.

Horizontal alignment is another factor that can influence the safety of lane width reductions. Curvilinear horizontal alignments increase the risk of lane departure crashes in general, and when combined with narrow lane widths, the risk will further increase for most high-speed roadways. In addition, trucks and other large vehicles can affect safety and operations by off-tracking into adjacent lanes or the shoulder. This affects the safety of other drivers, as well as non-motorized users such as bicyclists who may be using the adjacent lane or shoulder. It is important to understand this interaction of design elements when a design exception for lane with is being evaluated.

Substantive Safety

Figure 6 shows accident modification factors for variations in lane width on rural two-lane highways. Note that there is little difference between 11- and 12-foot lanes.

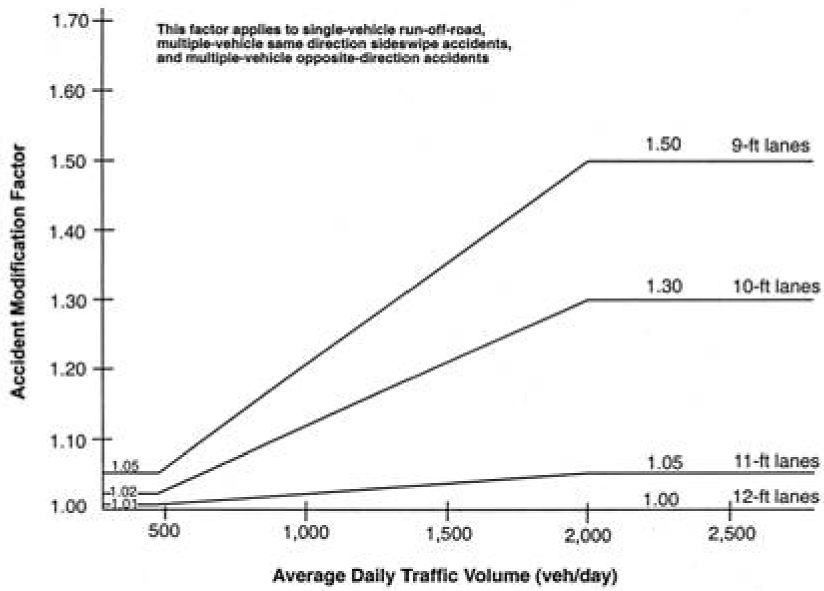

FIGURE 6

Accident Modification Factors for Lane Width on Rural Two-Lane Highways.

(Source: Prediction of the Expected Safety Performance of Rural Two-Lane Highways, FHWA)

Figure 6 is a graph. The "x" axis is labeled "Average Daily Traffic Volume (veh/day)," and is marked in increments of 500; 1,000; 1,500; 2,000; and 2,500. The "y" axis is "labeled Accident Modification Factor," and is marked in decimal increments of 1.00, 1.10, etc., through 1.70. A note at the top of the "x" axis states, "This factor applies to single-vehicle run-off-road, multiple-vehicle same direction sideswipe accidents, and multiple-vehicle opposite-direction accidents." The accident modification factors for the various lane widths begin as horizontal lines showing a very minor difference in crash risk. As traffic exceeds 500 vpd, the AMFs increase linearly and at 2000 vpd, the AMFs return to horizontal lines. At this point the AMF for 12-foot lanes is 1.00, for 11-foot lanes is 1.05, for 10-foot lanes is 1.30, and for 9-foot lanes is 1.50, illustrating that the expected crash risk is significantly higher for 9- and 10-foot lanes on rural two-lane highways.

For multilane urban arterials and multilane rural arterials, the expected difference in substantive safety for variations in lane width is much lesson the order of a few percentage points when comparing lane widths of 10 to 12 feet.

Traffic Operations

Lane width has an effect on traffic operations and highway capacity, particularly for high-speed roadways. The interaction of lane width with other geometric elements, primarily shoulder width, also affects operations.

When determining highway capacity, adjustments are made to reflect the effect of lane width on free-flow speeds. Lane widths of less than 12 feet (3.6 meters) reduce travel speeds on high-speed roadways, as summarized in Tables 4 and 5.

TABLE 4

Operational Effects of Freeway Lane Widths

Lane width (ft)	**Reduction in Free-Flow Speed (mi/h)**
12	0.0
11	1.9
10	6.6
Lane width (m)	**Reduction in Free-Flow Speed (km/h)**
3.6	0.0
3.5	1.0
3.4	2.1
3.3	3.1
3.2	5.6
3.1	8.1
3.0	10.6

Source: Highway Capacity Manual

TABLE 5

Operational Effects of Lane and Shoulder Width on Two-Lane Highways

	Reduction in Free-Flow Speed (mi/h)			
Lane width (ft)	**Shoulder Width (ft)**			
	≥0<2	≥2<4	≥4<6	≥6
9<10	6.4	4.8	3.5	2.2
≥10<11	5.3	3.7	2.4	1.1
≥11<12	4.7	3.0	1.7	0.4
≥3.6	4.2	2.6	1.3	0.0

	Reduction in Free-Flow Speed (km/h)			
Lane width (m)	**Shoulder Width (m)**			
	≥0.0<0.6	≥0.6<1.2	≥1.2<8	≥1.8
2.7<3.0	10.3	7.7	5.6	3.5
≥3.0<3.3	8.5	5.9	3.8	1.7
≥3.3<3.6	7.5	4.9	2.8	0.7
≥3.6	6.8	4.2	2.1	0.0

Source: Highway Capacity Manual

Summary

Table 6 summarizes the potential adverse impacts to safety and operations for a design exception for lane width.

TABLE 6

Lane Width: Potential Adverse Impacts to Safety and Operations

Safety & Operational Issues	**Freeway**	**Expressway**	**Rural Two-Lane**	**Urban Arterial**
Run-off-road crashes	X	X	X	
Cross-median crashes	X	X		
Cross-centerline crashes			X	
Sideswipe (same direction) crashes	X	X		X
Rear-end crashes if operations deteriorate (abrupt speed reduction)	X	X	X	
Reduced free-flow speeds	X	X	X	X
Large vehicles off-tracking into adjacent lane or shoulder	X	X	X	X

Freeway: high-speed, multi-lane divided highway with interchange access only (rural or urban).
Expressway: high-speed, multi-lane divided arterial with interchange and at-grade access (rural or urban).
Rural 2-Lane: high-speed, undivided rural highway (arterial, collector, or local).
Urban Arterial: urban arterials with speeds 45 mi/h (70 km/h) or less.

Lane Width Resources

- *A Policy on Design Standards Interstate System*, AASHTO, 2005.
- *A Policy on Geometric Design of Highways and Streets*, AASHTO, 2004.
- *Guide for the Planning, Design, and Operation of Pedestrian Facilities*, AASHTO, 2004.

- *A Guide for Reducing Collisions on Horizontal Curves*, NCHRP Report 500, Volume 7, Transportation Research Board, 2004.
- *A Guide for Reducing Collisions Involving Pedestrians*, NCHRP Report 500, Volume 10, Transportation Research Board, 2004.
- *A Guide for Reducing Collisions Involving Heavy Trucks*, NCHRP Report 500, Volume 13, Transportation Research Board, 2004.
- *A Guide for Addressing Head-On Collisions*, NCHRP Report 500, Volume 4, Transportation Research Board, 2003.
- *A Guide for Addressing Run-Off-Road Collisions*, NCHRP Report 500, Volume 6, Transportation Research Board, 2003.
- *Roadside Design Guide,* AASHTO, 2002.
- *Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT ≤ 400)*, AASHTO, 2001.
- *Highway Capacity Manual*, Transportation Research Board, 2000.
- *Guide for the Development of Bicycle Facilities*, AASHTO, 1999.
- *Highway Safety Design and Operations Guide*, AASHTO, 1997.
- *Use of Shoulders and Narrow Lanes to Increase Freeway Capacity*, NCHRP Report 369, Transportation Research Board, 1995.
- *Roadway Widths for Low-Traffic Volume Roads*, NCHRP Report 362, Transportation Research Board, 1994.
- *Effective Utilization of Street Width on Urban Arterials*, NCHRP Report 330, Transportation Research Board, 1990.
- *FHWA Roadside Hardware Web site* http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/

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Page last modified on October 15, 2014.

APPENDIX B

Freeman Associates LLC
994 San Antonio Road
Palo Alto CA 94303

September 6, 2016

Attention: Mr. Verne Freeman

Subject: **RESULTS OF ASPHALT CORING**
Old Monterey Road
Sargent, California

In accordance with your request, Sierra Geotechnical Services, Inc. (SGSI) is pleased to submit the results of our asphalt coring on Old Monterey Road between U.S. Route 101 and the access gate leading into the Sargent Ranch project, distance of approximately 2890 feet (Figure 1). SGSI was retained to evaluate the thickness of the Asphalt and identify if possible the underlayment soils as part of a roadway traffic study.

A field coring investigation was performed in August 2016, and included the logging of six 6-inch diameter cores within the pavement areas, as well as collection of a bulk sample of representative subgrade soils for laboratory R-Value testing. Approximate locations of the cores are shown on the Core Location Map (Figure 2 and 3). The R-value test result is included herein.

We appreciate the opportunity to be of service to you. Should you have any questions regarding this report, please do not hesitate to contact us.

Respectfully,

SIERRA GEOTECHNICAL SERVICES, INC.

Joe Adler

Joseph A. Adler
Principal Geologist
CEG 2198 (exp 3/31/2017)

SIERRA GEOTECHNICAL SERVICES INC. SGSI

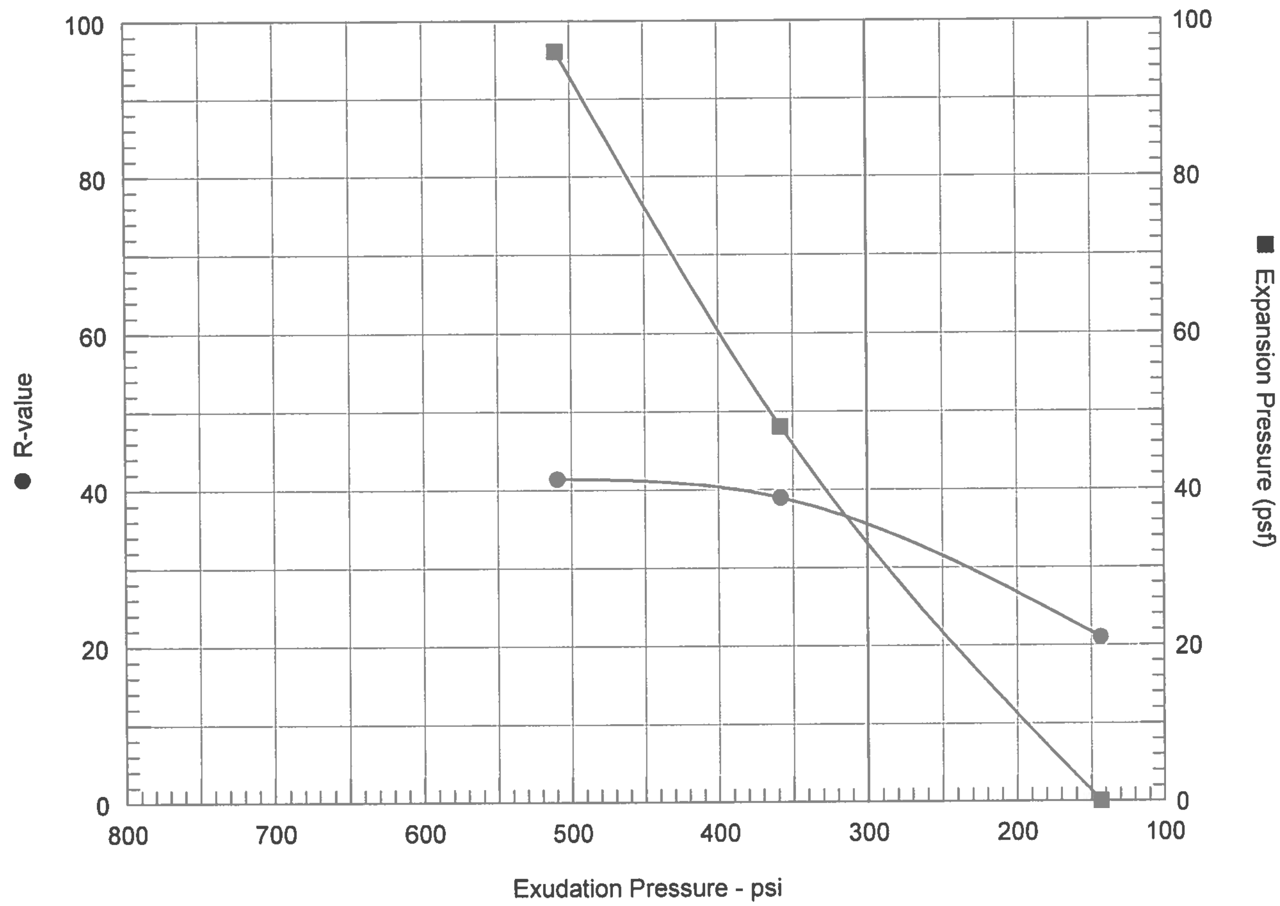
RESULTS OF CORING

Old Monterey Road

Project No. 3.31274

Core Number	Diameter	Location	Average AC Thickness (in)	Material Below Core Thickness (in)
1	6"	North Bound Lane, 100' N of Gate	2.50	Concrete - 3.5"
2	6"	South Bound Lane, 160' N of Gate	3.50	Concrete - 3.5"
3	6"	North Bound Lane, 590' N of Gate	6.50	Concrete - depth unknown
4	6"	South Bound Lane 1260' N of Gate	8	N/A
5	6"	North Bound Lane 1850' N of Gate	9	N/A
6	6"	South Bound Lane 2460' N of Gate	5.5	Class II Base - Depth N/A

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psf	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	250	113.5	17.0	0	117	2.50	143	21.0	21.0
2	300	118.5	15.2	96	83	2.62	509	38.5	41.4
3	325	116.6	16.2	48	90	2.56	358	37.5	38.9

Test Results

R-value at 300 psi exudation pressure = 35.5

Exp. pressure at 300 psi exudation pressure = 33 psf

Material Description

Brown silty, clayey sand (SC-SM)

Project No.: 4437.07I

Project: Sierra Geotechnical Services

Location: Sargent Ranch - 3.31274; Road subgrade

Sample Number: 16-260

Date: 8/31/2016

Tested by:

Checked by:

Remarks:

R-VALUE TEST REPORT

PEZONELLA ASSOCIATES, INC.

Plate ______

LEGEND

AREA INVESTIGATED

NOT TO SCALE

PROJECT: ASPHALT CORING LOCATION MAP SARGENT RANCH	
COORD: 36.9169; -121.5647	DATE: 9/2016
DRAWING: FIGURE 2.DWG	DRAWN BY: JAA
JOB NO.: 3.31274	FIGURE: FIGURE 1

SIERRA GEOTECHNICAL SERVICES INC.

<u>*LEGEND*</u>

C-4 ● APPROXIMATE LOCATION OF ASPHALT CORE

NOT TO SCALE

PROJECT: ASPHALT CORING LOCATION MAP *SARGENT RANCH*	
COORD: *36.9169;-121.5647*	DATE: *9/2016*
DRAWING: *FIGURE 2.DWG*	DRAWN BY: *JAA*
JOB NO.: *3.31274*	FIGURE: ***FIGURE 2***

SIERRA GEOTECHNICAL SERVICES INC.

LEGEND

C-6 ● APPROXIMATE LOCATION OF ASPHALT CORE

NOT TO SCALE

PROJECT: ASPHALT CORING LOCATION MAP *SARGENT RANCH*	
COORD: *36.9169;-121.5647*	DATE: *9/2016*
DRAWING: *FIGURE 3.DWG*	DRAWN BY: *JAA*
JOB NO.: *3.31274*	FIGURE: *FIGURE 3*

SIERRA GEOTECHNICAL SERVICES INC.

SITE PHOTOGRAPHS

Photos 1 and 2 – Core 2, South Lane.

Photos 3 and 4 – Core 3, North Lane

Photo 5 and 6 – Cores 5 and 6. Note overlay in Core 5 (on right).

Old Monterey Rd- Sargent Quarry

Traffic Index Calculaton sheet

20 year design period			
		Each lane	
vehicle type	ESAL 20 year constants	expanded average daily trucks	total 20 year ESAL (col.2 * col.3)
2-axle trucks	1380	15	20700
3-axle trucks	3680	1	3680
4-axle trucks	5880	0	0
5-axle trucks	13780	170	2342600
totals (ESAL)			2366980
traffic index ($TI=9.0*(ESAL/10^6)^{0.119}$)		**10**	

Structural Section
Old Monterey Rd

TI	**10**	
	Proposed Secction	
R asph	100	
R AB	78	
R subgrade	35	
GE total	2.08	
GE Asphalt	0.70	
Safety factor	0.20	
GE with safety	0.90	
equation calculations		
Gf of asphalt	1.79	
calculated thickness	0.50	
in inches	6.1	
set asphalt thickness	**6.00**	ac
GE of set asphalt	0.90	
GE base	1.18	
Gf of AB	1.10	
calculated thickness	1.08	
in inches	**13.00**	base

Calculations are based on CalTrans Highway Design Manual - Section
Design assumption of R-value =78 for the local base material.