FOR CONTRACT NO.: 10-415804

INFORMATION HANDOUT

PERMITS

MERCED COUNTY WELL PERMIT

AGREEMENTS

UNITED STATES FISH AND WILDLIFE SERVICE (Biological Opinion)

MATERIALS INFORMATION

GEOTECHNICAL DESIGN REPORT No. 1 Part 1

GEOTECHNICAL DESIGN REPORT No. 1 Part 2

GEOTECHNICAL DESIGN REPORT No. 1 Part 3

GEOTECHNICAL DESIGN REPORT No. 2

OPTIONAL DISPOSAL/MATERIAL SITES

STRUCTURES FOUNDATION RECOMMENDATION

ROUTE: 10-Mer-99 PM 0.0/4.6

M e m o r a n d u m

Flex your power!
Be energy efficient!

To: MR. BORIS AYAVIRI
Central Region, Design II-Branch V
Project Development Division

Attention: Mr. Chris Gardner

Date: January 26, 2004

File: 10-Mer-99-KP 0.0/7.4
10-415800
Plainsburg Rd Freeway

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES – MS 5

Subject: Geotechnical Design Report – Basins and Local borrow materials for Embankment/Fill

1. Introduction

Per your request, we are providing geotechnical design recommendations addressing three basins proposed on a segment of State Highway 99 at KP 0.0 to 7.4 (PM 0.0 to 4.6) in Merced County, California. District 10 Project Development is proposing to convert Route 99 from the existing four-lane expressway to a six-lane freeway on a new alignment with an 18.6-m median from the Merced County Line to Buchanan Hollow Road. The purpose of this report is to document subsurface geotechnical conditions, to provide engineering assessments of the borrow material and to recommend design and construction criteria for the proposed basins.

2. Pertinent Reports and Investigations

The following is a list of documents, reports and maps that were utilized in preparing this report.

- Memorandum dated August 12, 2002 "Investigation of Local Material Sources for Possible Embankment/Fill material" from Boris Ayaviri, Senior, Central Region, Design II-Branch V and its attachments for alternative 3 stripmaps and boring locations.
- Preliminary Geotechnical Report dated June 29, 2001 prepared by Eric McGrath, Office of Geotechnical Design North.
- Geologic Map of California, the San Francisco-San Jose Quadrangle published 1991.

- California Seismic Hazard Map prepared by Lalliana Mualchin, Caltrans Engineering Seismologist, dated 1996.
- Statewide Storm Water Quality Practice Guidelines (CTSW-RT-02-009), Section Five dated May 2003 prepared by Caltrans.
- Storm Water Quality Handbooks, Project Planning and Design Guide, Appendix B dated September 2002 prepared by Caltrans.
- Method for determining the percolation rate of soil using 6-inch-diameter-test hole, California Test 750-1986.

3. Existing Facilities and Proposed Improvements

Within this segment, Highway 99 is currently a four-lane conventional expressway paved with asphalt concrete, built on fill, and aligned in a general north/south direction. It is located both inside and outside of a suburban environment and across active agricultural lands. There are several intersections controlled by stop signs within the project area. The existing alignment is constructed on minimal fills placed on relatively flat terrain. There are no significant cuts within the area. (See Location Map attached, **Plate 1**.)

A new alignment is proposed for a six-lane freeway, which will require approximately 1,000,000 cubic meters of import borrow to raise the mainline elevation 1 to 3 meters to elevate the roadway above the 100-year flood event. Three large on-site borrow pits, which will also serve as storm water infiltration or detention basins are planned to supply the needed fill material. A new interchange will be constructed in the vicinity of Plainsburg Road and Sandy Mush Road.

This report addresses the geotechnical issues associated with the construction of the basins and assessment of the local borrow material. Geotechnical considerations for the structure foundations are not addressed in this report.

4. Physical Setting

4.1. Climate

The climatic conditions at the project site are considered temperate with moderate winters and hot summers. Based on the climatic data available for the period between

July 1948 and December 2001, average daily minimum temperature ranges from 1.9º C in December to 15.7º C in July while the average daily maximum temperature ranges from 12.9º C in January to 36.1º C in July.

Nearly 80% of the total annual rainfall falls during the months of November through March. Strong winds and dust storms can occur anytime during the year. Table 1 presents the climatic summary for the Merced Municipal station. Yearly updates are available from the western Regional Climate Center (WRCC) web site.

Table 1: Average Monthly Climate Summary, Merced Municipal ARPT, California, Period of Record: 7/1/1948 to 12/31/2001

Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Ave. Max. Temp ºC	12.9	16.8	19.8	24.2	28.5	32.7	36.1	35.2	32.6	27.1	18.9	12.9	24.8
Ave. Min. Temp ºC	2.4	3.9	5.3	7.1	10.3	13.3	15.7	14.9	12.8	8.7	4.6	1.9	8.4
Ave. Total Precipitation mm	63.3	55.1	50.0	27.7	10.9	2.3	0.5	0.8	4.3	16.5	38.6	44.7	314.7

Source: Western Regional Climate Center, "http://www.wrcc.dri.edu"

4.2. Topography and Drainage

According to the topographic map of the project region (http://www.topozone.com/), as well as visual observations during our site reconnaissance, the topography within the project area is relatively flat with no hills. Within the project boundaries, the ground elevation ascends gradually from the north-end to the south-end by 9 m. The elevations in the area are about 61 m on northern side and 70 m on southern side.

Storm water drains off both sides of the existing highway and infiltrates into the surrounding soils. Water flows through the project area in Dutchman and Deadman Creeks. The area surrounding the highway is mostly rural agricultural land. Man-made drainage facilities such as canals, farming structures and private irrigation pipelines are present throughout the project area. (See Topographic Map attached, **Plate 2**.)

4.3. Geology

The site is situated in the San Joaquin Valley within the Great Valley geomorphic province of California. This province is a large northwest trending valley bounded by the Sierra Nevada province to the east and south, the Klamath Mountains to the north, the Cascade Range province to the northeast, and the Coast Ranges province to the west. The Geologic Map of San Francisco-San Jose quadrangle sheet, California, 1991 published by CDMG, indicates that the site is underlain by Quaternary Modesto-Riverbank formations, which were deposited as fan deposits (gravel, sand, silt and clay) eroded from the Sierra Nevada.

Based on our field investigations, the subsurface materials encountered consist of stiff to very hard combinations of micaceous silt, clay and sand. In general, the materials are more cohesive than non-cohesive. Although the geologic mapping indicates that gravel would be present, we did not encounter gravel in the borings performed. The Regional Geologic Map is attached as **Plate 3**.

4.4. Seismicity

Based upon the Department's California Seismic Hazard Map, dated 1996, the controlling fault is the Prairie Creek-Spenceville-Dentman fault (PSD, Normal) with a maximum credible earthquake moment magnitude of M_w=6.5. The PSD is located about 30 kilometers northeast of the site. The Peak Horizontal Bedrock Acceleration, based on the above-mentioned map, is estimated to be 0.2g at the site. The potential for surface rupture at the site due to fault movement is considered insignificant since there are no known faults projecting towards or passing directly through the project site. Based on the soil information obtained in the field investigation, Soil Profile Type "D" is recommended for design. (See Seismic Hazard Map attached, **Plate 4**.)

5. Groundwater

Groundwater in the project area originates from infiltration of creek/canal water, irrigation (pumped) water and rainwater through the alluvial fans. Groundwater elevations were measured in each boring performed and are presented on the corresponding boring logs. To measure long-term groundwater fluctuations at the site we installed three monitoring wells during our geotechnical investigation as noted in Table 2.

Ground surface elevations are referenced to the contours and benchmarks shown on Plate 2. Our Office will continue to monitor the groundwater levels in each of the monitoring wells at approximate one-month intervals.

Table 2: Groundwater Conditions at Monitoring Wells

Basin Location	Boring No.	Date Measured	Boring Depth Drilled (m)	Approximate Ground Elevation (m)	Approximate Groundwater Elevation (m)
Basin 1	B 1-4	10/09/03	27.9	65.5	45.1
		12/18/03			45.2
Basin 2	B 2-1	10/09/03	27.9	65.0	Not Encountered
		12/18/03			Not Encountered
Basin 3	B 3-3	10/09/03	27.9	64.0	38.90
		12/18/03			39.1

The shallowest ground water levels were measured at 20 to 25 meters below the ground surface in Basins 1 and 3. Both of these proposed basins are close to Dutchman and Deadman Creeks. The water level in Basin 2 is estimated to be greater than the maximum drilled depth 27.89 meters. The California Department of Water Resources (DWR) recorded groundwater data, presented in **Plate 5,** shows an average depth to groundwater in the project area (Segment 1) to be approximately 32 m. Additional information for the historical well data can be found on the DWR web site at: http://well.water.ca.gov/.

6. Subsurface Investigation Program

We performed our subsurface exploration program from September 30, 2003 to October 9, 2003. Twelve borings were drilled to depths up to 27.9 m below the existing ground surface. Table 3 presents the summary of the twelve borings performed. **Plates 6 and 7** show the approximate locations of borings.

The borings were drilled using a trailer-mounted "Mobile Drill" rig and advanced using a 140-mm diameter hollow stem auger. Soil samples were recovered from these borings by driving a 35-mm ID split spoon sampler into the subsurface with 63.5-kg safety hammer dropped 762-mm. The number of hammer blows required to drive the sampler the last 300-mm into the soil formation was recorded and is presented on the boring logs. Samples recovered from the split spoon sampler were used to classify the soil types. Bulk

samples of loose material were randomly collected using canvas bags at depths of 0-1.5m, 1.5-3m and 3-4.5m. The logs of the 12 borings and the associated legends are attached as **Appendix I** (Sheet 1 through 15). There were nine percolation tests performed and three monitoring wells installed as shown in Table 3.

Table 3: Summary of Borings

Basin	Boring	KP (Exit. Rte 99 NB)	Offset from Rte 99 EP (m)	Elevation (m)	Depth drilled (m)	Remarks
Basin 1	B 1-1	3.1	125-m Right	± 67.00	5.03	Percolation Test
	B 1-2	3.4	125-m Right	± 66.00	5.03	Percolation Test
	B 1-3	3.7	125-m Right	± 66.00	5.03	Percolation Test
	B 1-4	4.0	135-m Right	± 65.50	27.89	*Monitoring Well*
Basin 2	B 2-1	5.0	107-m Right	± 65.00	27.89	*Monitoring Well*
	B 2-2	4.9	260-m Right	± 65.50	5.03	Percolation Test
	B 2-3	5.3	220-m Right	± 65.00	5.03	Percolation Test
Basin 3	B 3-1	5.8	125-m Right	± 64.50	5.03	Percolation Test
	B 3-2	6.0	280-m Right	± 65.00	5.03	Percolation Test
	B 3-3	6.3	23-m Right	± 64.00	27.89	*Monitoring Well*
	B 3-4	6.6	180-m Right	± 63.50	5.03	Percolation Test
	B 3-5	7.1	20-m Right	± 63.00	5.03	Percolation Test

7. Laboratory Testing

The following laboratory tests were performed on selected samples obtained from the borings.

- Unit Weight- CTM 212
- Moisture Content- CTM 226
- Mechanical Analysis- CTM 203
- Atterberg Limit- CTM 204
- Compaction Curve- CTM 216
- R-Value- CTM 301
- Corrosion- CTM 201/202/417/422/643
- Chemical Testing- OC/pH/CEC

The referenced tests were used to assist in classifying the soil encountered. The results of the tests are presented on the boring logs at the corresponding sample locations. The test

results are also summarized in Table 4. **Plate 8** is a compendium of the results of grain size analyses of six samples listed in Table 4.

Table 4: Summary of Laboratory Tests

Sample Ref.	Sample Depth (m)	Dry Density kN/m³	Moisture Content %	Atterberg		Relative Compaction		R-Value	Percent Passing # 200 Sieve (Clay & Silt %)	Chemical testing		
				LL	PI	γ_{max} kN/m3	OMC %			Organic %	pH	CEC meq Na /100g of soil
B 1-1-1	0-1.5	18	10	22	6	20	10		55			
B 1-2-5	3-4.5									1.15	7.34	14.8
B 1-4-3	1.5-3							23	58			
B 2-1-5	3-4.5									2.57	7.22	24.8
B 2-2-3	1.5-3	17	12	25	7	20	11		66			
B 2-2-5	3-4.5							22	37			
B 2-3-1	0-1.5	Non-corrosive soil (See Table 5) i.e. pH 9, Resistivity 1200 Ω-cm										
B 3-1-5	3-4.5	16	14	30	11	19	12		71			
B 3-2-1	0-1.5							24	68			
B 3-3-5	3-4.5									1.97	7.31	24.1
B 3-4-3	1.5-3	Non-corrosive soil (See Table 5) i.e. pH 9, Resistivity 1300 Ω-cm										
Average Values @ Proposed Basins									59	1.90	7.29	21.2
Values that promote pollutant capture in the soil are:									<40	>5	6-8	>5

Note: OMC= Optimum Moisture Content-CTM 216, CEC= Cation Exchange Capacity - EPA Test Method 9081

8. Corrosion

Chemical tests were performed to determine the corrosion potential of the soil. The results from the corrosion testing are included in Table 5 below:

Table 5: Corrosion Test Results

Location	Boring	Sample Depth (m)	PH	Resistivity (ohm-cm)	Sulfate Content (PPM)	Chloride Content (PPM)
Basin 2	B 2-3-1	0- 1.5	9.06	1200	N/A	N/A
Basin 3	B 3-4-3	1.5- 3	9.00	1300	N/A	N/A
Corrosive if			<5.5	<1000	>2000	>500

Caltrans currently defines a corrosive area as an area where the soil and/or water contains more than 500 PPM of chlorides, or more than 2000 PPM of sulfates, or has a minimum resistivity of less than 1000 ohm-centimeters, or has a pH of 5.5 or less. With the exception of MSE Walls, chloride and sulfate tests (CTM 422 and CTM 417) are not required (N/A) if the minimum resistivity is greater than 1,000 ohm-cm.

The test results are consistent for soils present in the project area and within the non-corrosive limits established by the Department. Consequently, the soil should be considered non-corrosive with respect to pH and resistivity.

9. Percolation Testing

Nine percolation tests were performed during our field investigation. The tests were performed in general accordance with those set forth in California Test 750, "*Method For Determining The Percolation Rate Of Soils Using A 6-Inch-Diameter-Test Hole*", and procedures developed by this Office. The tests were performed in drilled holes advanced to the depths of 5.0-m. To prepare each hole for testing, the bottom 51-mm of hole was filled with pea gravel, then a perforated plastic pipe (OD 48.3mm, ID 36.8mm) was centered through the tested depth, and select gravel backfill was placed in the resulting annulus.

The test holes were presoaked overnight, and the tests performed the following day. Filling the holes with relatively clean water then monitoring the rate at which the water surface dropped performed the tests. Specifically, the beginning water depth was set at 200 millimeters above the bottom of the hole and the time for a 25 mm water level drop (i.e. 200-mm to 175-mm depth) was monitored until stabilized percolation rates were obtained. The measured percolation rates are presented in Table 6.

We note that the State Storm Water Quality Practice Guidelines defines a *minimum acceptable infiltration rate* of 1.3 cm/hour (0.5 in/hour) and a *maximum allowable infiltration rate* of 6.4 cm/hr (2.5 in/hour).

Table 6: Summary of Percolation Rates

Basin	Boring	KP (Exit. Rte 99 NB)	Offset from EP (m)	Tested Depth (m)	Equivalent Unlined 12-inch Diameter Percolation Rate				Remarks (N= Blow Counts)
					min/in	in/hr	cm/hr		
1	B 1-1	3.1	125-m Rt.	4.5-4.8	Significantly less than a minimum acceptable infiltration rate of 1.3 cm/hr (0.5 in/hour)				Hard Sandy SILT w/ clay (N50+)
	B 1-2	3.4	125-m Rt.	4.5-4.8					Hard Clayey SILT (N34)
	B 1-3	3.7	125-m Rt.	4.5-4.8					Hard Clayey SILT (N57)
2	B 2-2	4.9	260-m Rt.	4.0-4.3	4.46	13.44	34	Avg. 131cm/hr	Loose Silty SAND (N7)
	B 2-3	5.3	220-m Rt.	4.1-4.4	0.67	90.02	229		Dense Silty SAND (N44)
3	B 3-1	5.8	125-m Rt.	3.7-4.0	0.94	63.81	162	Average 297 cm/hr	V.Stiff Sandy SILT (N20)
	B 3-2	6.0	280-m Rt.	4.0-4.3	0.18	336	854		V.Stiff Sandy SILT (N26)
	B 3-4	6.6	180-m Rt.	3.4-3.7	2.4	24.96	63		Stiff Sandy SILT (N14)
	B 3-5	7.1	20-m Rt.	3.4-3.7	1.43	42.01	107		V.Stiff Sandy SILT (N20)

We note that relatively clean water was used to perform the test above. However, highway runoff water will likely contain silt, clay, oil and/or other materials that would eventually decrease the percolation rates.

10. Geotechnical Recommendations

Due to the nature of this investigation, the geotechnical considerations discussed in this section are generally limited to infiltration basin design and borrow material assessment for embankment construction. It is our understanding that the District would like to construct basins that are 4 to 5 meters in depth. The side slope ratio of 1:6 (V: H) proposed by the District is acceptable at all basin locations.

In general, the combined percentage of silt and clay (passing #200 sieve) of the basin invert soils exceeds 50 percent and thus are not recommended for infiltration. However, some percolation tests performed resulted in percolation rates greater than the 1.3-cm/hr minimum allowable. The borings revealed dry and friable sandy soil layers in some of the borings that would significantly increase infiltration. As such, infiltration basins may be constructed at the locations recommended below with the understanding that slow (and variable) infiltration rates will be experienced.

The materials within the limits of the proposed basins consist of roughly 60 to 70 percent cohesive soils and 30 to 40 percent granular soils. Based on our observation and laboratory testing, the excavated material (upper 5 meters) can be used for the planned embankment construction. The R-values of three soils samples tested by this Office are 23, 22 and 24. Thus, we would recommend that the District should propose a "Design R-Value" of not exceeding 22 in use of a borrow material from this basin location. We recommend a grading factor of 90±5 percent be used for material quantity estimates.

The following paragraphs discuss our observations and recommendations for each of the 3 proposed basins:

Basin 1

The soil present in Basin 1 consists of cohesive soils (stiff to hard, dry, sandy silt and clayey silt) with percolation rates of less than 0.35 cm/hr, which is defined as slow to very slow. It is noted that the infiltration rates are significantly less than the minimum acceptable rate of 1.3 cm/hour as stated in the Statewide Storm Water Quality Practice Guidelines. Hence, it is our opinion that a basin constructed at this location will serve more as a detention basin than an infiltration basin. The R-value of the one test performed by this Office at Basin 1 is 23.

Basin 2

The soil present in Basin 2 consists of stiff to hard clayey to sandy silt, and silty sand. The average measured percolation rate of 131 cm/hr exceeds the maximum allowable rate of 6.4 cm/hour as stated in the Statewide Storm Water Quality Practice Guidelines. However, given the types of soil encountered between the planned invert and the ground water table and considering their depositional characteristics, it is reasonable to assume

that the runoff water would pass through soil that meets the infiltration requirements prior to reaching groundwater. The R-value of the one test performed by this Office at Basin 2 is 22.

Basin 3

The soil present in Basin 3 is similar to Basin 2 consisting of stiff to hard, dry, friable, sandy silt. An average percolation rate of 297 cm/hr was measured which also exceeds the maximum acceptable rate 6.4 cm/hour as stated in the State Storm Water Quality Practice Guidelines. Similarly, given the types of soil encountered between the planned invert and the ground water table and considering their depositional characteristics, it is reasonable to assume that the runoff water would pass through soil that meets the infiltration requirements prior to reaching groundwater. The R-value of the one test performed by this Office at Basin 3 is 24.

11. Construction Considerations

As the materials encountered are mostly stiff to hard in consistency, it is anticipated that little settlement will occur during construction. Therefore, a settlement period is not recommended for the main line embankments. Settlement periods for structure approach fills will be addressed in the foundation report(s).

The Relative Compaction (CTM 216) tests performed on soil obtained from bag samples at shallow depths indicated that the samples could be compacted to maximum dry densities of 19 to 20 kN/m^3 (120 and 125 pcf) at optimum moisture contents of 10 to 12%. In general, the in-situ moisture contents are greater than optimum so the soils excavated may need to be dried before used as embankment material.

If you have any questions or comments, please call Myo Naing at (916) 227-7233 or Craig Hannenian at (916) 227-7237.

MYO NAING
Engineering Geologist
Geotechnical Design - North

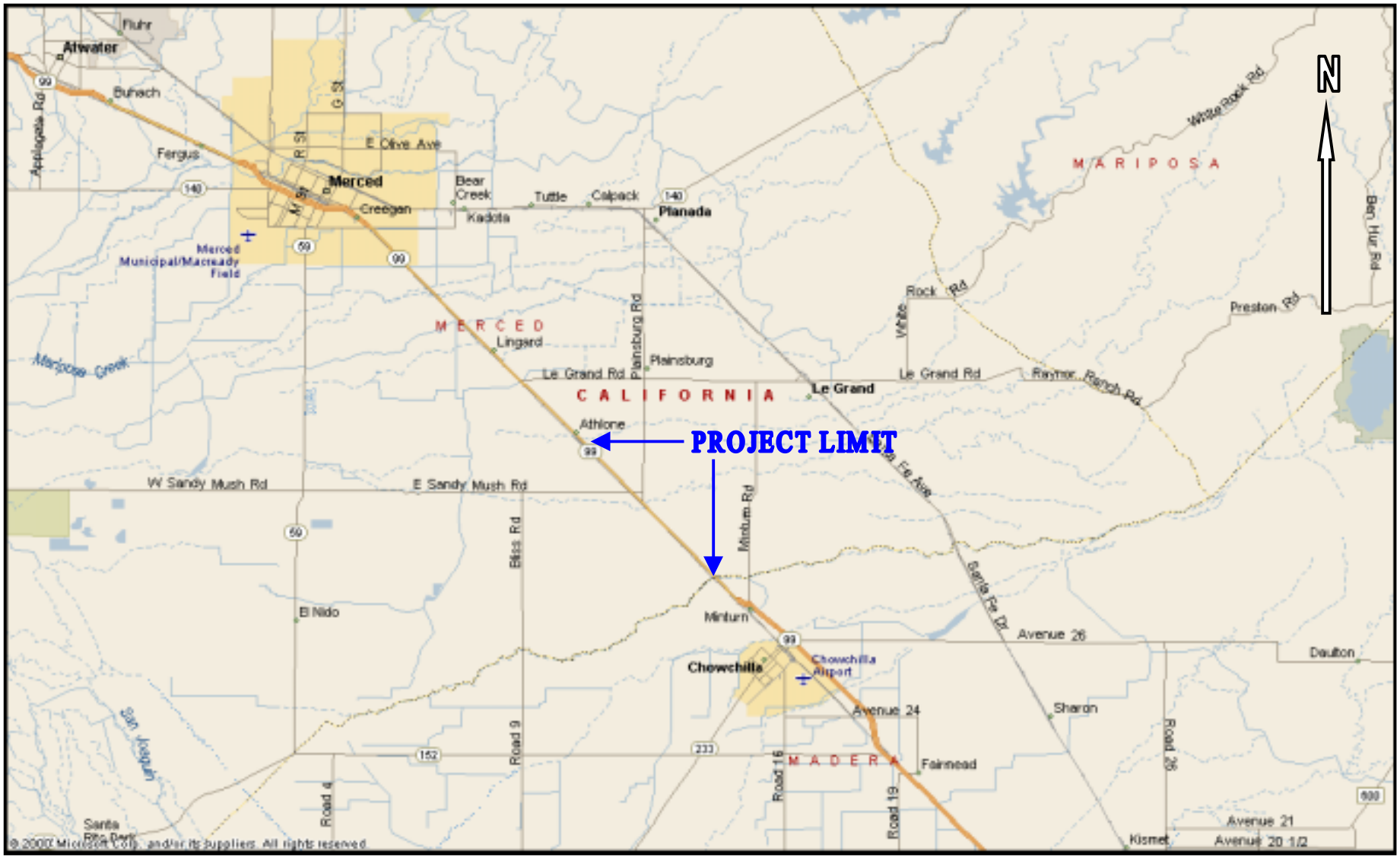
CRAIG HANNENIAN
Senior Materials & Research Engineer
Geotechnical Design - North

Attachments:

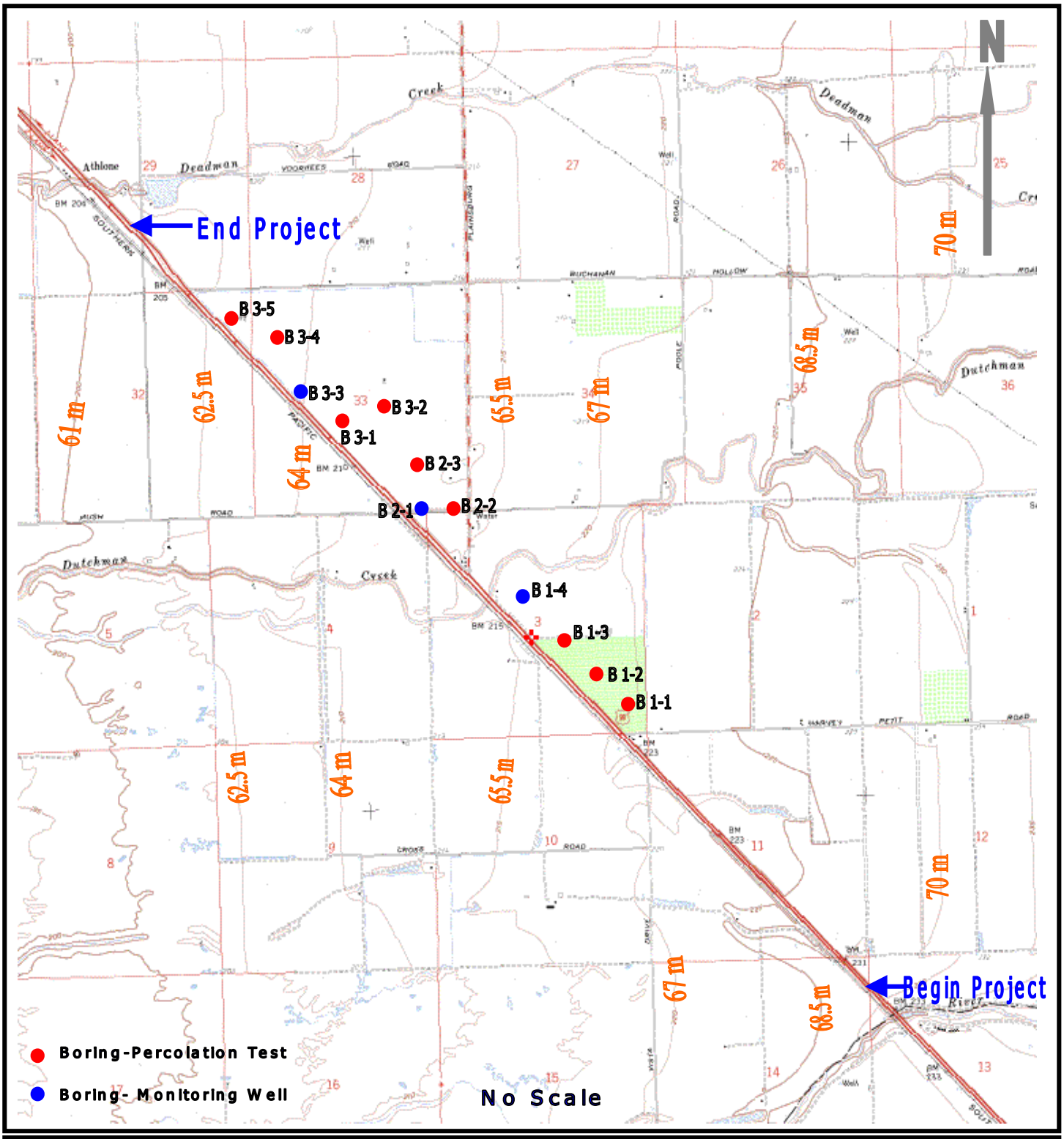
- Plates 1 to 8
- Appendix I

c: RoyBibben
DaveDhillon – D02 (2)
GDN File

REGISTERED PROFESSIONAL ENGINEER
CRAIG T. HANNENIAN
No. C 052335
Exp. 12-06
CIVIL
STATE OF CALIFORNIA



CALTRANS Division of Engineering Services Geotechnical Services Office of Geotechnical Design North	EA: 10-415800 January 2004	**LOCATION MAP** **PLAINSBURG ROAD FREEWAY**
	10-MER-99-KP 0.0/ 7.4 **GEOTECHNICAL DESIGN REPORT**	Plate 1



CALTRANS
Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design North

EA: 10-415800

January 2004

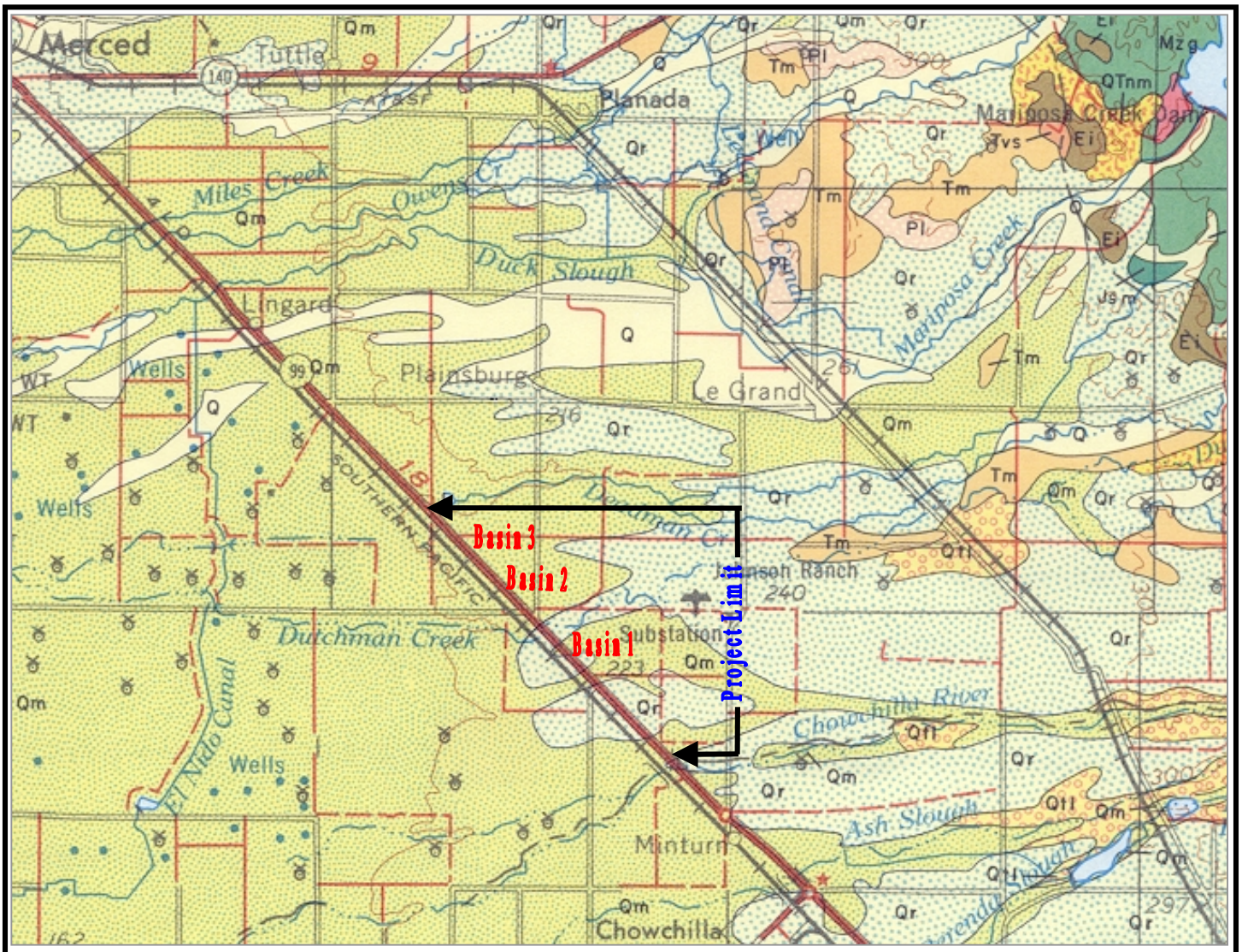
TOPOGRAPHIC MAP

PLAINSBURG ROAD FREEWAY

10-MER-99-KP 0.0/ 7.4

GEOTECHNICAL DESIGN REPORT

Plate 2



Legend

- Q — Alluvium
- Qmr — Modesto-Riverbank Formations Undivided (Arkosic alluvium)
  - Qm — Modesto Formation
  - Qr — Riverbank Formation
- Qo — Older alluvium
- Qtl — Turlock Lake Formation (Nonmarine sand, silt, and gravel)
- QTt — Tulare Formation (Alluvium)
- Tm — Mehrten Formation (Andesitic conglomerate)
- Ei — Ione Formation (Quartzose sandstone and kaolinitic clay; mostly continental)
- Mzg — Granitic rocks
- Jsm — Salt Springs and Merced Falls Slates

Not To Scale

Reference:
REGIONAL GEOLOGIC MAP OF THE SAN FRANCISCO-SAN JOSE QUADRANGLE PUBLISHED 1991
COMPILED BY D.L. WAGNER, E.J.BORTUGNO and R.D. McJUNKIN (CDMG)(Map No. 5A)

N
W E
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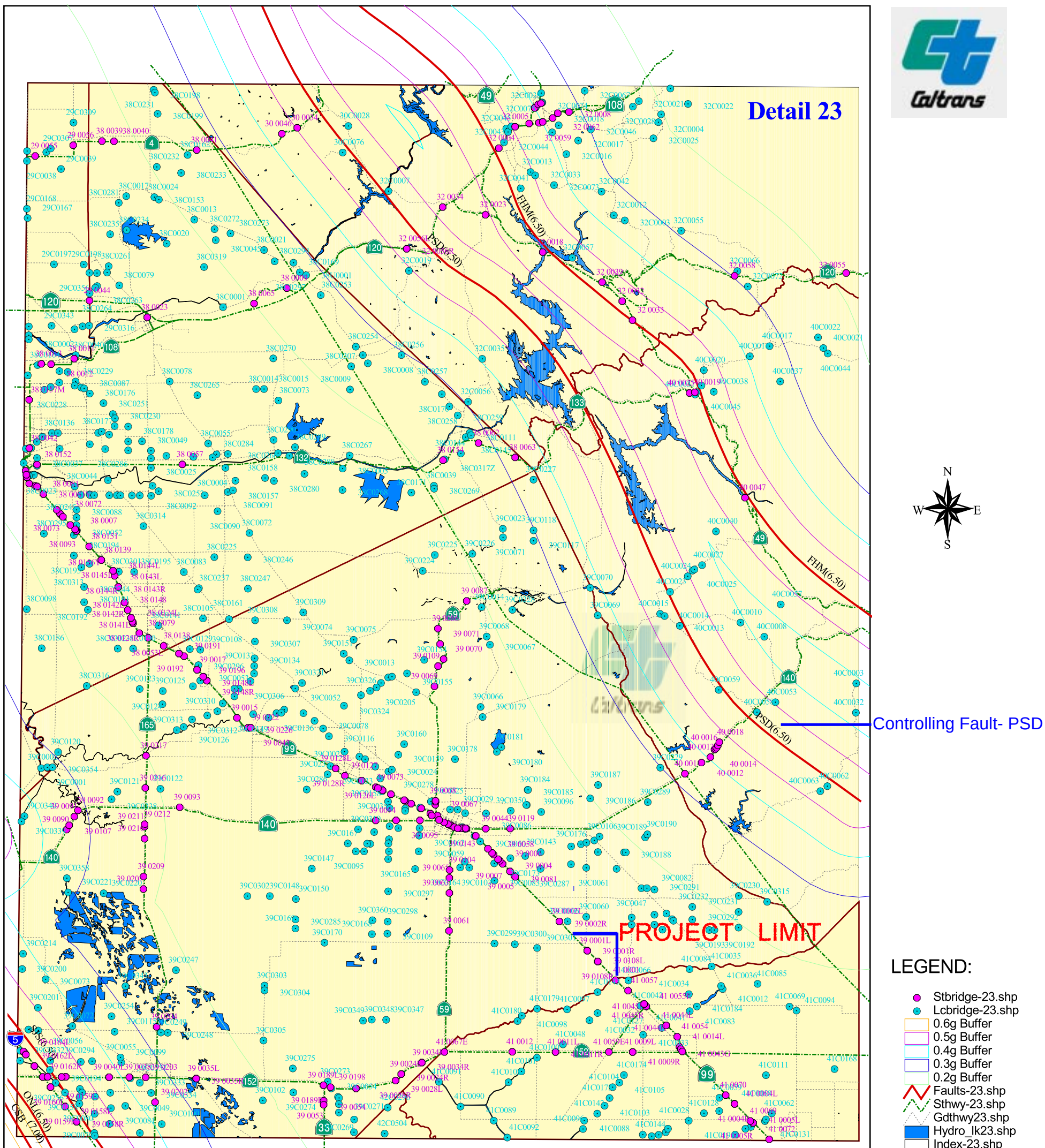
CALTRANS Division of Engineering Services Geotechnical Services Office of Geotechnical Design -North	EA: 10-415800 January 2004	**Regional Geologic Map** Plainsburg Road Freeway
	10-MER-99-KP 0.0/ 7.4 **GEOTECHNICAL DESIGN REPORT**	Plate 3

CALIFORNIA SEISMIC HAZARD MAP 1996 - DETAIL 23

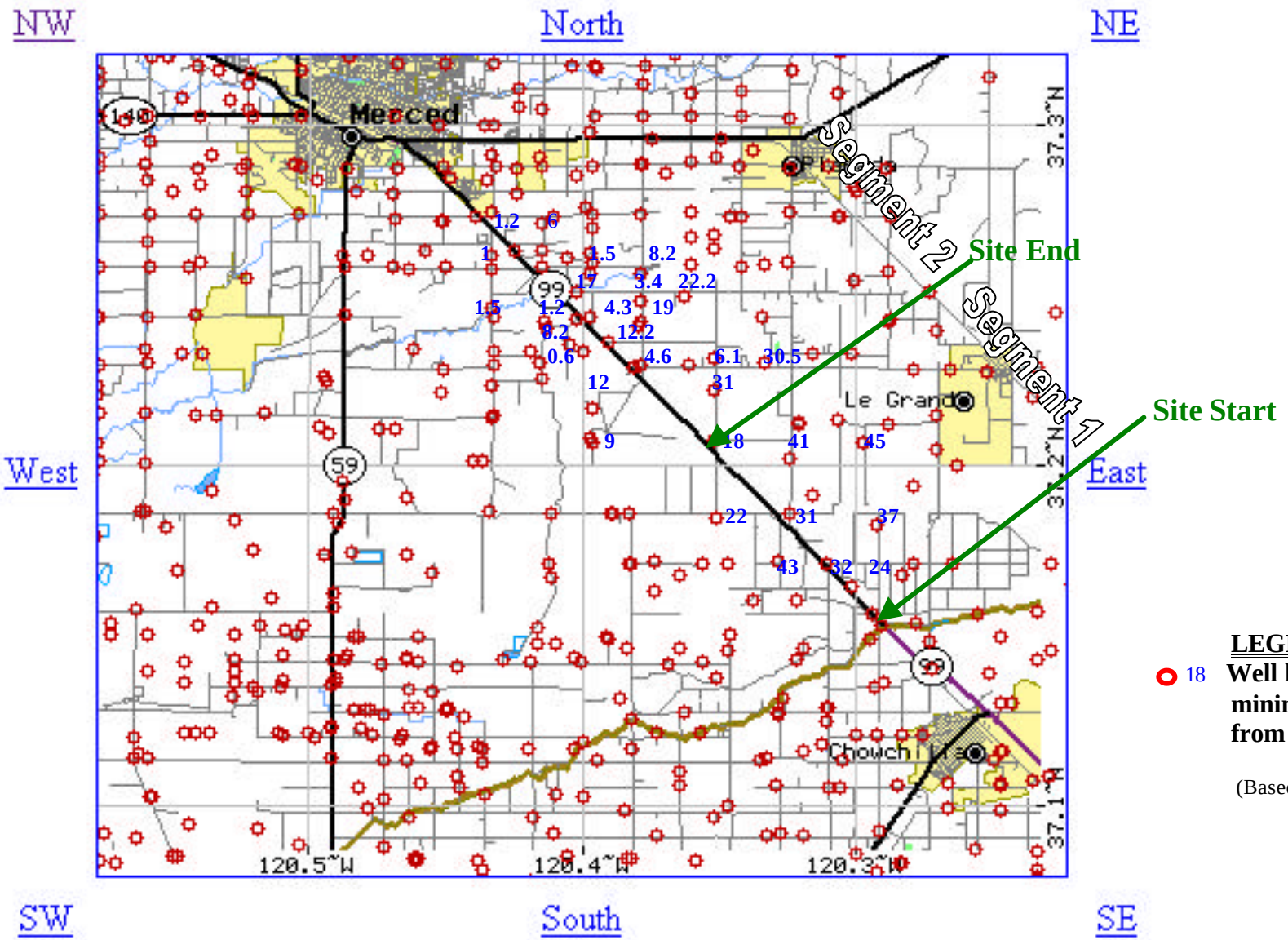
BASED ON MAXIMUM CREDIBLE EARTHQUAKES (MCE)



Division of Engineering Services Geotechnical Services Office of Geotechnical Design North	Plainsburg Road Freeway (EA 10-415800) 10-MER-99-KP 0.0/7.4 Geotechnical Design Report	January 2004 PLATE 4

SCALE

0 10 20 30 40 50 Kilometers

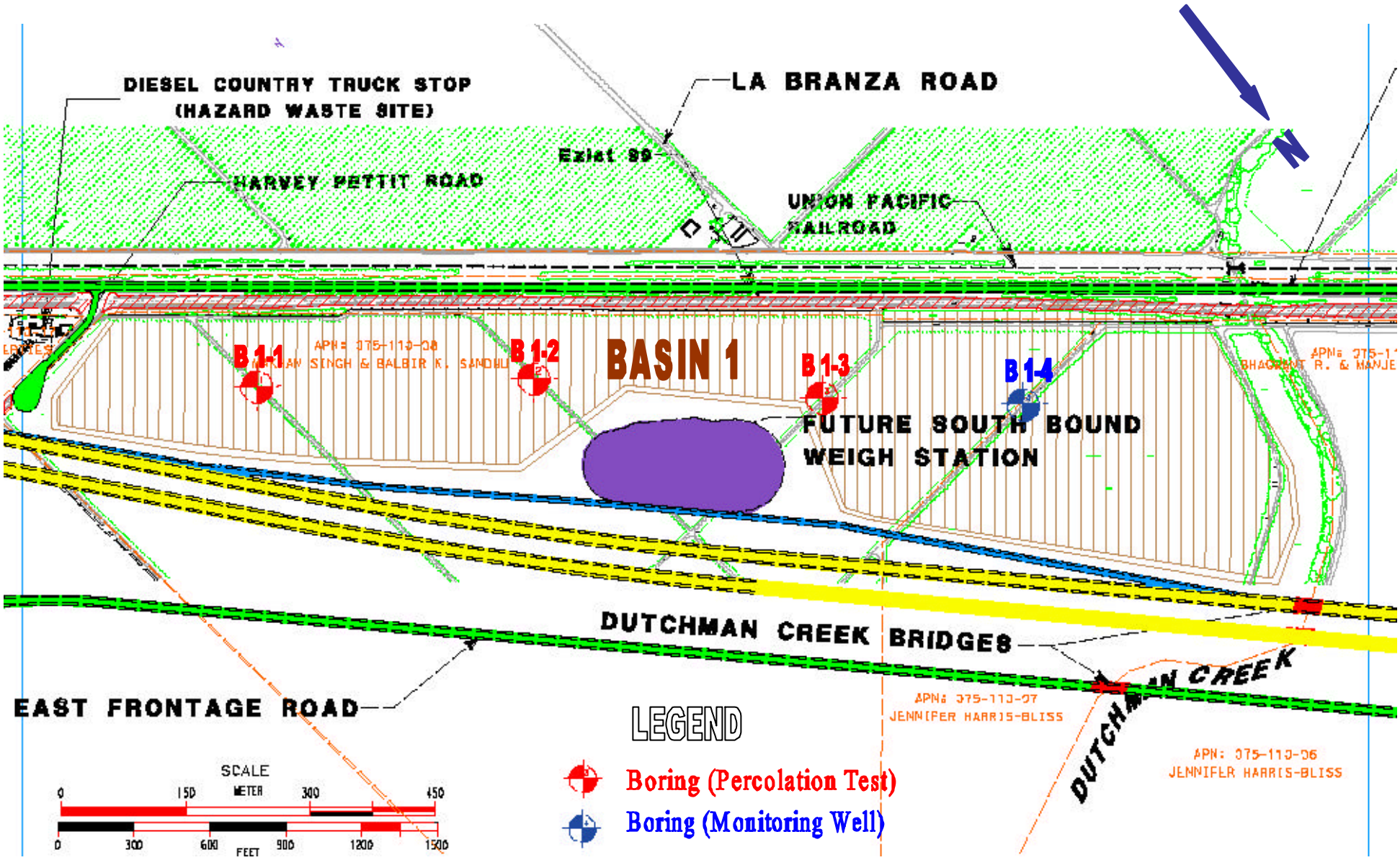


LEGEND

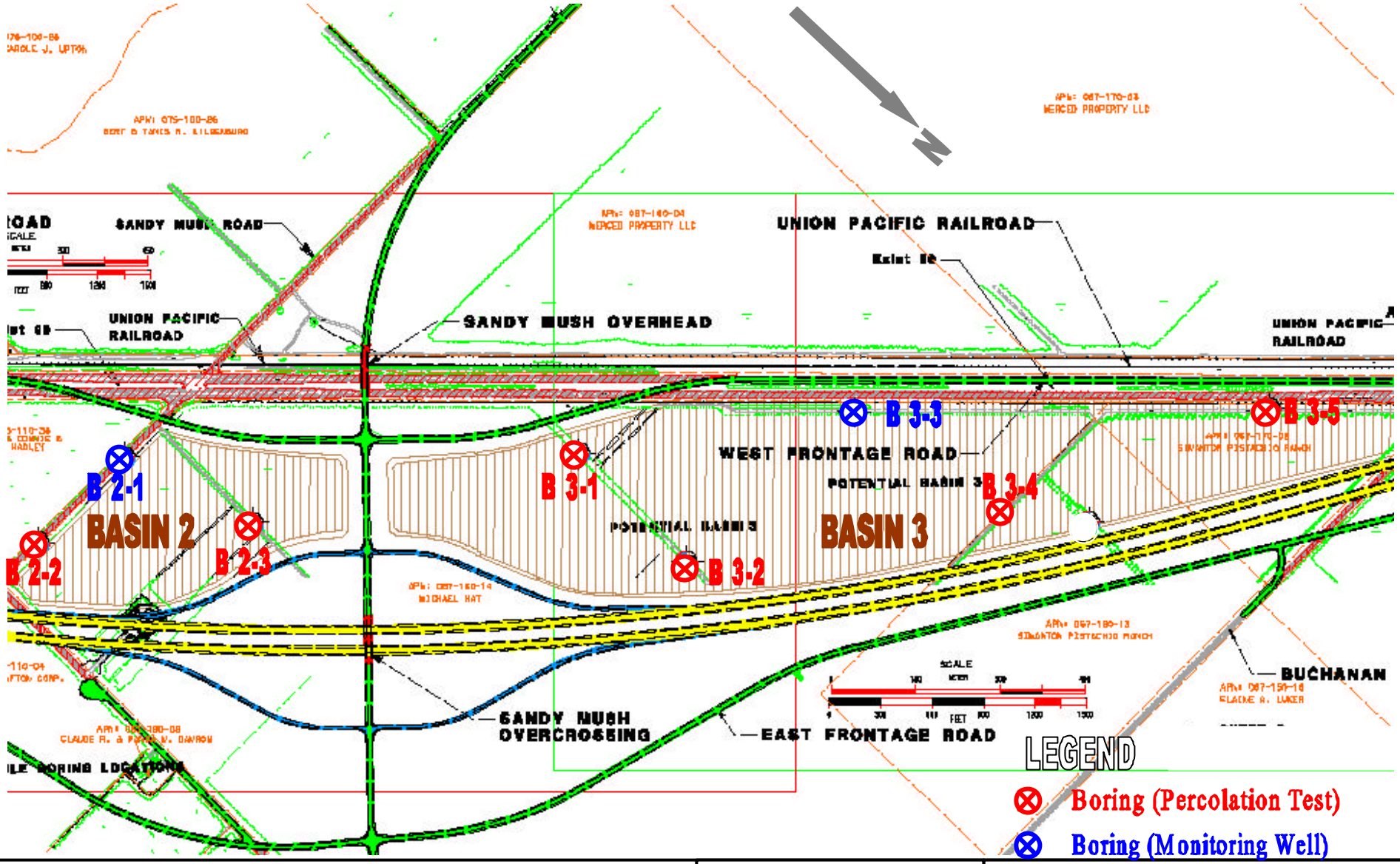
18 **Well location shown minimum depth to water from ground surface (m)**

(Based on Data from DWR)

CALTRANS Division of Engineering Services Geotechnical Services Office of Geotechnical Design North	EA: 10-415800 January 2004	**HISTORICAL WELL DATA MAP** **PLAINSBURG ROAD FREEWAY**
	10-MER-99-KP 0.0/ 7.4 **GEOTECHNICAL DESIGN REPORT**	Plate 5

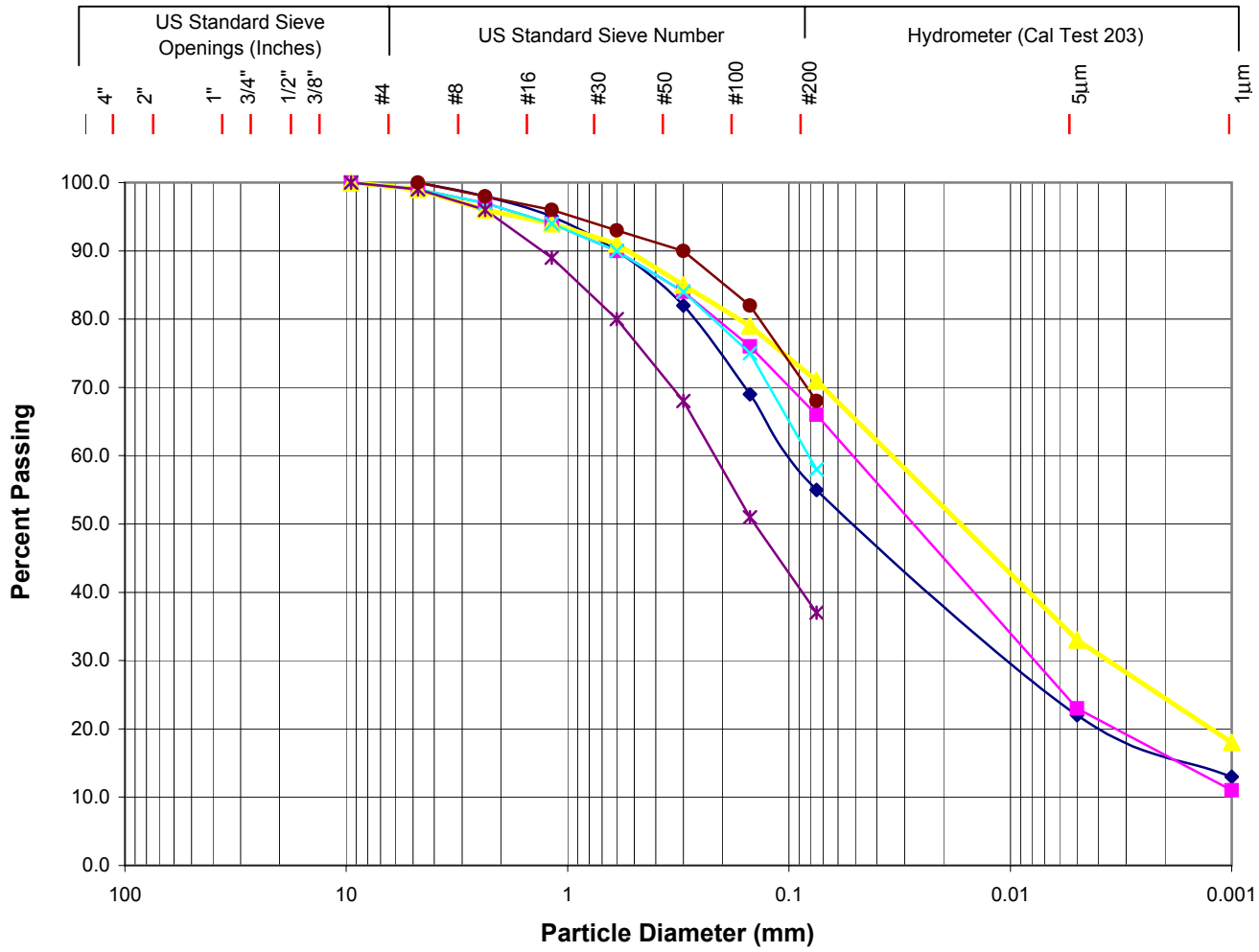


CALTRANS Division of Engineering Services Geotechnical Services Office of Geotechnical Design North	EA: 10-415800 January 2004	**LOCATION OF BORINGS** **Plainsburg Road Freeway- Basin 1**
	10-MER-99-KP 7.4 **GEOTECHNICAL DESIGN REPORT**	Plate 6



CALTRANS Division of Engineering Services Geotechnical Services Office of Geotechnical Design North	EA: 10-415800 January 2004	**LOCATION OF BORINGS** **Plainsburg Road Freeway- Basin 2 & 3**
	10-MER-99-KP 7.4 **GEOTECHNICAL DESIGN REPORT**	Plate 7

Gradation Analysis Test Results



GRAVELS		SANDS			SILT	CLAY
Coarse	Fine	Coarse	Medium	Fine		

Sample ID:

B 1-1-1 — B 2-2-3 — B 3-1-5 — B 1-4-3 — B 2-2-5 — B 3-2-1

Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design North

Project:	PLAINSBURG ROAD FWY
EA:	10-415800
D.-Co.-Rt.-:	10-MER-99-KP0.0/ 7.4
Test Date:	Nov. 5, 2003

Plate 8

Appendix I

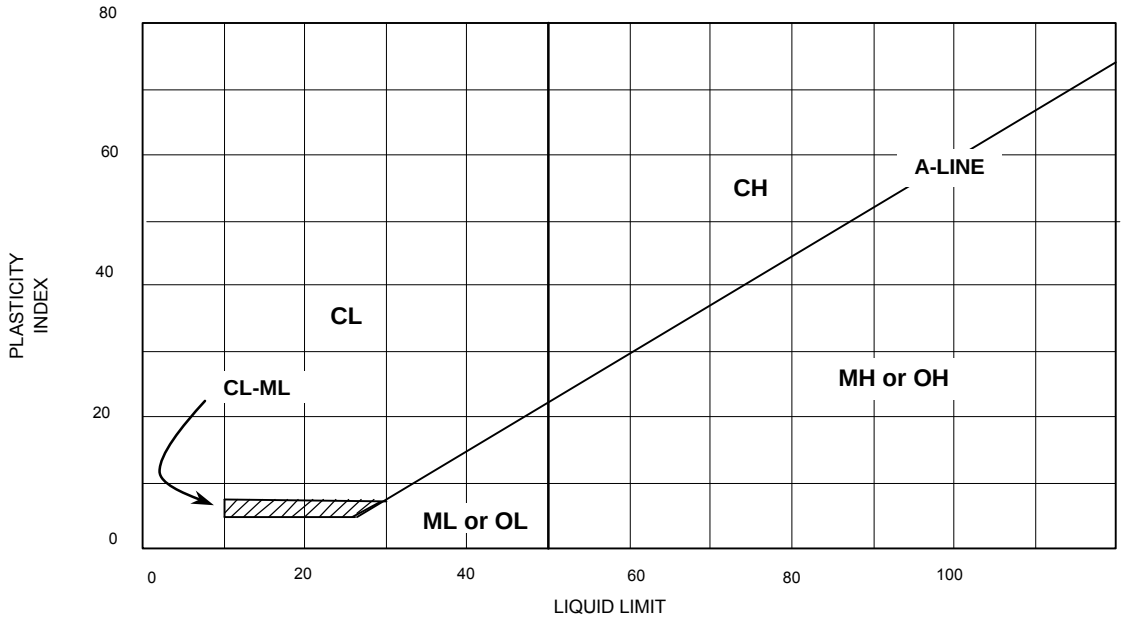
(Logs of Borings)

Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design - North

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISION			SYMBOLS	TYPICAL NAMES
COARSE-GRAINED SOILS Over 50% > #200 sieve	GRAVELS Over 50% > #4 sieve	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES
			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, POORLY GRADED GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES
	SANDS Over 50% < #4 sieve	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL GRADED SANDS, GRAVELLY SANDS
			SP	POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES
			SC	CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES
FINE-GRAINED SOILS Over 50% < #200 sieve	SILTS AND CLAYS Liquid limit < 50		ML	INORGANIC SILTS, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS Liquid limit > 50		MH	INORGANIC SILTS , MICACEOUS OR DIATOMACIOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS

PLASTICITY CHART
(USED FOR CLASSIFICATION OF FINE-GRAINED SOILS)



SOIL GRAIN SIZE

U.S. STANDARD SIEVE		12"		3"	3/4"	4	10	40	200	
	BOULDERS	COBBLES	GRAVEL			SAND			SILT	CLAY
			COARSE	FINE		COARSE	MEDIUM	FINE		
SOIL GRAIN SIZE (in mm)		300		75	19	4.75	2.0	0.425	0.075	0.005

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Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design - North

EA: 10-415800	**SOIL CLASSIFICATION SYSTEM**
Date: Jan-04	
10-MER-99-KP 7.4-Plainsburg Rd Fwy GEOTECHNICAL DESIGN REPORT	**SHEET NO. 1**

SYMBOLS

SANDSTONE	INTRUSIVE	VOLCANIC
CLAYSTONE	ULTRAMAFIC	TUFF
SILTSTONE	GREENSTONE	CONGLOMERATE
MUDSTONE	SCHIST	BRECCIA
SHALE	GRANITIC	METAMORPHIC (general)

DESCRIPTIVE TERMINOLOGY

DEGREE OF WEATHERING

Descriptor	Criteria
Fresh	Crystals are bright. Discontinuities may show some minor surface staining. No discoloration in rock fabric.
Slightly weathered	Rock mass is generally fresh. Discontinuities are stained and may contain clay. Some discoloration in rock fabric. Decomposition extends up to 25.4 mm into rock.
Moderately weathered	Rock mass is decomposed 50% or less. Significant portions of rock show discoloration and weathering effects. Crystals are dull and show visible chemical alteration. Discontinuities are stained and may contain secondary mineral deposits.
Intensely weathered	Rock mass is more than 50% decomposed. Rock can de excavated with geologist's pick. All discontinuities exhibit secondary mineralization. Complete discoloration of rock fabric. Surface of core is friable and usually pitted due to washing out of highly altered minerals by drilling water.
Decomposed	Rock mass is completely decomposed. Original rock "fabric" may be evident. May be reduced to soil with hand pressure.

FRACTURING & FOLIATION(BEDDING)

Fracturing Descriptor*	Foliation (Bedding) Descriptor	Thickness/Spacing Criteria
Unfractured	Massive	None observed
Very slightly fractured		Greater than 3m
	Very thickly foliated	Between 1m and 3m
Slightly fractured	Thickly foliated	Between 300mm and 1m
Moderately fractured	Moderately foliated	Between 100mm and 300mm
Intensely fractured	Thinly foliated	Between 30mm to 100 mm
Very intensely fractured	Very thinly foliated	Between 10mm to 30 mm
	Laminated (or intensely foliated)	Less than 10mm (3/8")

***Note:** Spacing criteria for fracturing can refer to general or average recovery length of core measured along core axis; For other exposures, the criteria is distance measured between fracture (size of blocks).

RELATIVE HARDNESS

Descriptor	Criteria
Extremely hard	Core, fragment, or exposure cannot be scratched with knife or sharp pick; can only be chipped with repeated heavy hammer blows
Very hard	Cannot be scratched with knife or sharp pick. Core or fragment breaks with repeated heavy hammer blows.
Hard	Can be scratched with knife or sharp pick with difficulty (heavy pressure). Heavy hammer blow required to break specimen.
Moderately Hard	Can be scratched with knife or sharp pick with light or moderate pressure. Core or fragment breaks with moderate hammer blow.
Moderately Soft	Can be grooved 2 mm (1/16") deep by knife or sharp pick with moderate or heavy pressure. Core or fragment breaks with light hammer blow or heavy manual pressure.
Soft	Can be grooved or gouged easily by knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very soft	Can be readily indented, grooved or gouged with fingernail, or carved with a knife. Breaks with light manual pressure.

SAMPLING DATA

TYPE

25 mm (1") O.D. Caltrans One Inch Sampler (NT)	25 mm (1") O.D. Caltrans One Inch Sampler (LT)
51 mm (2") O.D. Standard Penetration Test Sampler (NT)	51 mm (2") O.D. Standard Penetration Test Sampler (LT)
64 mm (2.5") O.D. Modified California Sampler (NT)	64 mm (2.5") O.D. Modified California Sampler (LT)
76 mm (3") O.D. California Sampler (NT)	76 mm (3") O.D. California Sampler (LT)
Shelby Tube (NT)	Shelby Tube (LT)
Size	Size
Size	Size
Bulk Sample Collected from Cuttings (NT)	Bulk Sample Collected from Cuttings (LT)

Note: LT=lab testing performed on sample; NT= no lab testing performed on sample

DRIVING DATA

23	23 blows drove sampler 305mm, after initial 152mm of seating
68/203{8}	68 blows drove sampler 203mm {8"}, after initial 152mm of seating
*50/76{3}	50 blows drove sampler 76mm {3"} during seating interval
	(Note: To avoid damage to sampling tools, driving is limited to 50 blows per 152mm interval)
PUSH	Sampler pushed under static load
20@150	20 seconds time @ an average pressure of 150 psi to descend depth interval of 305 mm (1 ft)
	(Note: ## indicates no reading obtained)
NR	Indicates no recovery of material in sampler for entire drive

OTHER SYMBOLS

	Water level encountered while drilling (Time/Date)
	Water level measured in hole after drilling (Time/Date)
	Seepage from sidewall noted
_?_._._?_	Strata boundary inferred without visual confirmation (i.e. no sample or boring cuttings retreval)

TESTING

CONS	Consolidation (Cal Test 219)	L_r	cov
UU	Uncons. Undrained Triaxial (Cal Test 230)	RQD	Rock Quality Designation (%)
CU	Cons. Undrained Triaxial (Cal Test 230)	CP	Compaction Test (Cal Test 216)
DS	Cons. Drained Direct Shear (ASTM D3080)	PERM	Permeability (Cal Test 220))
UCC	Unconfined Compression (Cal Test 221)	COR	Corrosivity Testing (Cal Test 532/643)
LL	Liquid Limit-% (Cal Test 204)	GRAD	Gradation Analysis (Cal Tests 202/203)
PI	Plasticity Index (Cal Test 204)	EP	Expansion Pressure Test (Cal Test 354)
PP	Pocket Penetrometer	TORV	Pocket Torvane Test
S_u	Undrained Shear Strength: From UU, or one-half the unconfined compressive strength per UCC or PP; Intended as a guideline only and does not address clay content or draining charateristics of material.	60°	Dip Angle

GENERAL NOTES

1. Logs represent general subsurface conditions observed at the point of exploration on the date indicated.
2. In general, USCS designations presented on logs were established by visual methods only; Therefore, actual designations (based on laboratory tests) may vary.
3. No warranty is provided as to the continuity of soil conditions between individual sample locations.
4. Lines separating strata on the logs represent approximate boundaries only; actual transitions may be gradual.

DRILL RIG: **Mobile Drill**	GROUND SURFACE ELEVATION: **67.00 m (approximate)**	LOG I.D. **Boring No. B1-1**
BORING DIAMETER: **140 mm**	DEPTH TO GROUND WATER: **not encountered**	DATE PERFORMED: **9/30/2003**
DRILLING METHOD: **Hollow Stem Auger**	SAMPLING METHOD: **Standard Split Spoon Sampler**	LOGGED BY: **M.Naing**
	APPROXIMATE BORING LOCATION (STA;KP;PM): **KP 3.1, Existing RTE 99 NB**	APPROX. DISTANCE FROM ROADWAY CL: **Approx.125 m Right from EP**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION	SOIL TYPE	SAMPLER	SAMPLE NO.	BLOW COUNTS	MOISTURE CONTENT %	DRY DENSITY kN/m^3	PLASTIC INDEX %	Compaction (γ_{max} kN/m^3/ OMC %)	ADDITIONAL COMMENTS AND TESTS
67.00													Percolation Rate at 4.5-4.8m <<1.3cm/hr
65.78	1.22	4		SANDY SILT, hard, light brown, dry, low plasticity	ML		**1-1-1**		10	18	6	20/10	Clay & Silt 55%
							1-1-2	50+					
64.56	2.44	8											
				- excess of SILT contents	ML		**1-1-3**						Bulk sample at 1.5-3 m
							1-1-4	47					
63.34	3.66	12											
							1-1-5						Bulk sample at 3-4.5 m
62.12	4.88	16		- consist of light brown CLAY	ML		**1-1-6**	50+					
61.97	5.03	16.5											
				Bottom of Boring @ depth 5.03 m No groundwater encountered at the time of boring									

DRILL RIG: **Mobile Drill**	GROUND SURFACE ELEVATION: **66.0 m (approximate)**	LOG I.D. **Boring No. B1-2**
BORING DIAMETER: **140 mm**	DEPTH TO GROUND WATER: **not encountered**	DATE PERFORMED: **9/30/2003**
DRILLING METHOD: **Hollow Stem Auger**	SAMPLING METHOD: **Standard Split Spoon Sampler**	LOGGED BY: **M.Naing**
	APPROXIMATE BORING LOCATION (STA;KP;PM): **KP 3.4, Existing RTE 99 NB**	APPROX. DISTANCE FROM ROADWAY CL: **Approx.125 m Right from EP**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION	SOIL TYPE	SAMPLER	SAMPLE NO.	BLOW COUNTS	MOISTURE CONTENT %	DRY DENSITY kN/m^3	PLASTIC INDEX %	Compaction (γ_{max} kN/m^3/ OMC %)	ADDITIONAL COMMENTS AND TESTS
66.00													Percolation Rate at 4.5-4.8m <<1.3cm/hr
64.78	1.22	4		SANDY SILT, stiff, light brown, dry, friable, low plasticity	ML		**1-2-1**						Bulk sample at 0.0-1.5 m
							1-2-2	9					
63.56	2.44	8											
							1-2-3						Bulk sample at 1.5-3 m
				SILTY SAND, medium dense, yellowish brown, dry, fine to medium grained, poorly graded, trace of some fine gravels	SM		**1-2-4**	25					
62.34	3.66	12											
													Chemical test at 3-4.5 m
							1-2-5						Organic 1.15%, pH 7.34,
61.12	4.88	16		CLAYEY SILT, hard, light brown, dry, low plasticity	ML		**1-2-6**	34					CEC 14.81 meq Na/100g
60.97	5.03	16.5											
				Bottom of Boring @ depth 5.03 m No groundwater encountered at the time of boring									

DRILL RIG: **Mobile Drill**	GROUND SURFACE ELEVATION: **66.0 m (approximate)**	LOG I.D. **Boring No. B1-3**
BORING DIAMETER: **140 mm**	DEPTH TO GROUND WATER: **not encountered**	DATE PERFORMED: **9/30/2003**
DRILLING METHOD: **Hollow Stem Auger**	SAMPLING METHOD: **Standard Split Spoon Sampler**	LOGGED BY: **M.Naing**
	APPROXIMATE BORING LOCATION (STA;KP;PM): **KP 3.7, Existing RTE 99 NB**	APPROX. DISTANCE FROM ROADWAY CL: **Approx.125 m Right from EP**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION	SOIL TYPE	SAMPLER	SAMPLE NO.	BLOW COUNTS	MOISTURE CONTENT %	DRY DENSITY kN/m^3	PLASTIC INDEX %	Compaction (γ_{max} kN/m^3/ OMC %)	ADDITIONAL COMMENTS AND TESTS
66.00													Percolation Rate at 4.5-4.8m <<1.3cm/hr
64.78	1.22	4		SANDY SILT, stiff, light brown, dry, friable, very low plasticity	ML		**1-3-1**						Bulk sample at 0-1.5 m
							1-3-2	10					
63.56	2.44	8											
							1-3-3						Bulk sample at 1.5-3 m
				excess of SAND contents and hard	ML		**1-3-4**	60					
62.34	3.66	12											
							1-3-5						Bulk sample at 3-4.5 m
61.12	4.88	16		CLAYEY SILT, hard, light brown, dry, friable, trace of fine SAND	ML		**1-3-6**	57					
60.97	5.03	16.5											

Bottom of Boring @ depth 5.03 m
No groundwater encountered at the time of boring

DRILL RIG: **Mobile Drill**	GROUND SURFACE ELEVATION: **65.5 m (approximate)**	LOG I.D. **Boring No. B1-4**
BORING DIAMETER: **125 mm**	DEPTH TO GROUND WATER: **20.42 m (10/09/03)**	DATE PERFORMED: **9/30/03 to 10/01/03**
DRILLING METHOD: **Hollow Stem Auger**	SAMPLING METHOD: **Standard Split Spoon Sampler**	LOGGED BY: **M.Naing**
	APPROXIMATE BORING LOCATION (STA;KP;PM): **KP 4.0, Existing RTE 99 NB**	APPROX. DISTANCE FROM ROADWAY CL: **Approx.135 m Right from EP**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION	SOIL TYPE	SAMPLER	SAMPLE NO.	BLOW COUNTS	MOISTURE CONTENT %	DRY DENSITY kN/m^3	PLASTIC INDEX %	Compaction (γ_{max} kN/m^3/ OMC %)	ADDITIONAL COMMENTS AND TESTS
65.50	0.00	0											Piezometer installed -Screen bet. 12.2 & 27.4m -38 mm ID PVC
64.28	1.22	4		SANDY SILT, hard, yellowish brown, dry, friable, low plasticity,	ML		**1-4-1**						Bulk samples at 0-1.5 m
							1-4-2	47					
63.06	2.44	8											R-Value 23
							1-4-3						Clay & Silt 58%
							1-4-4	45					
61.84	3.66	12											
							1-4-5						Bulk sample at 3-4.5 m
60.62	4.88	16		excess of CLAY contents	ML		**1-4-6**	15					
59.40	6.10	20		presence of SILTY SAND layer (approx. 0.5m thick) at depth 6.7 m	SM		**1-4-7**	66					
58.18	7.32	24											
56.97	8.53	28											
				hard, yellowish brown, low plasticity	ML		**1-4-8**	62					
55.75	9.75	32											
54.53	10.97	36											
				SILTY CLAY, very stiff, light brown, damp, slightly plasticity	CL								
53.31	12.19	40											

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Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design - North

EA: 10-415800	**LOG OF BORING NO. B1-4**	
Date: January-04		
10-MER-99-KP 7.4-Plainsburg Rd Fwy		**SHEET NO.**
GEOTECHNICAL DESIGN REPORT		**7**

DRILL RIG: **Mobile Drill**	GROUND SURFACE ELEVATION: **65.5 m (approximate)**	LOG I.D. **Boring No. B1-4**
BORING DIAMETER: **125 mm**	DEPTH TO GROUND WATER: **20.42 m (10/09/03)**	DATE PERFORMED: **9/30/03 to 10/01/03**
DRILLING METHOD: **Hollow Stem Auger**	SAMPLING METHOD: **Standard Split Spoon Sampler**	LOGGED BY: **M.Naing**
	APPROXIMATE BORING LOCATION (STA;KP;PM): **KP 4.0, Existing RTE 99 NB**	APPROX. DISTANCE FROM ROADWAY CL: **Approx.135 m Right from EP**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION	SOIL TYPE	SAMPLER	SAMPLE NO.	BLOW COUNTS	MOISTURE CONTENT %	DRY DENSITY kN/m^3	PLASTIC INDEX %	Compaction (γ_{max} kN/m^3/ OMC %)	ADDITIONAL COMMENTS AND TESTS
				CLAYEY SILT, hard, light brown, moist, slightly plasticity	ML	○	**1-4-9**	38					
52.09	13.41	44											
50.87	14.63	48											
				SILTY SAND, medium dense, yellowish brown, moist, fine grained, poorly graded,	SM	○	**1-4-10**	27					
49.65	15.85	52											
48.43	17.07	56											
47.21	18.29	60		CLAYEY SILT, very stiff, light brown, moist, low plasticity	ML	○	**1-4-11**	28					
45.99	19.51	64											
		10/09/03											
45.08	20.42												
44.77	20.73	68											
						○	**1-4-13**	31					
43.55	21.95	72		SILTY CLAY, very stiff, light gray, moist, low plasticity	CL								
42.34	23.16	76											
41.12	24.38	80											

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EA:	10-415800	**LOG OF BORING NO. B1-4**
Date:	January-04	
10-MER-99-KP 7.4-Plainsburg Rd Fwy		**SHEET NO.**
GEOTECHNICAL DESIGN REPORT		**7A**

DRILL RIG: **Mobile Drill**	GROUND SURFACE ELEVATION: **65.5 m (approximate)**	LOG I.D. **Boring No. B1-4**
BORING DIAMETER: **140 mm**	DEPTH TO GROUND WATER: **20.42 m (10/09/03)**	DATE PERFORMED: **9/30/03 to 10/01/04**
DRILLING METHOD: **Hollow Stem Auger**	SAMPLING METHOD: **Standard Split Spoon Sampler**	LOGGED BY: **M.Naing**
	APPROXIMATE BORING LOCATION (STA;KP;PM): **KP 4.0, Existing RTE 99 NB**	APPROX. DISTANCE FROM ROADWAY CL: **Approx.135 m Right from EP**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION	SOIL TYPE	SAMPLER	SAMPLE NO.	BLOW COUNTS	MOISTURE CONTENT %	DRY DENSITY kN/m^3	PLASTIC INDEX %	Compaction (γ_{max} kN/m^3/ OMC %)	ADDITIONAL COMMENTS AND TESTS
				SILTY SAND, very dense, light gray, wet, fine to medium grained,poorly graded,	SM	○	**1-4-13**	50+					
39.90	25.60	84											
38.68	26.82	88											
38.07	27.43	90											
37.61	27.89	91.5		becomes dark gray.	SM	○	**1-4-14**	50+					
				Bottom of Boring @ depth 27.89 m									

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Office of Geotechnical Design - North

EA: 10-415800	**LOG OF BORING NO. B1-4**	
Date: January-04		
10-MER-99-KP 7.4-Plainsburg Rd Fwy		**SHEET NO.**
GEOTECHNICAL DESIGN REPORT		**7B**

DRILL RIG: **Mobile Drill**	GROUND SURFACE ELEVATION: **65.0 m (approximate)**	LOG I.D. **Boring No. B2-1**
BORING DIAMETER: **140 mm**	DEPTH TO GROUND WATER: **Not encountered**	DATE PERFORMED: **10/07/03**
DRILLING METHOD: **Hollow Stem Auger**	SAMPLING METHOD: **Standard Split Spoon Sampler**	LOGGED BY: **M.Naing**
	APPROXIMATE BORING LOCATION (STA;KP;PM): **KP 5.0, Existing RTE 99 NB**	APPROX. DISTANCE FROM ROADWAY CL: **Approx.107 m Right from EP**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION	SOIL TYPE	SAMPLER	SAMPLE NO.	BLOW COUNTS	MOISTURE CONTENT %	DRY DENSITY kN/m^3	PLASTIC INDEX %	Compaction (γ_{max} kN/m^3/ OMC %)	ADDITIONAL COMMENTS AND TESTS
65.00													Piezometer installed -Screen bet. 18.3 & 27.4m -38 mm ID PVC
63.78	1.22	4					2-1-1						
				CLAYEY SILT, hard, light brown, dry, friable, low plasticity	ML		2-1-2	56					
62.56	2.44	8											
							2-1-3						
				presence of some fine grained SAND at depth 3.5m	ML		**2-1-4**	19					
61.34	3.66	12											
							2-1-5						Chemical Test at 3-4.5 m Organic 2.57%, pH 7.22, CEC 24.84 meq Na/100g
60.12	4.88	16					**2-1-6**	35					
				SANDY SILT, hard, reddish to light brown, dry, low plasticity	ML								
58.90	6.10	20											
							2-1-7	38					
				CLAYEY SILT, hard, light brown, damp, low plasticity	ML								
57.68	7.32	24											
56.47	8.53	28											
				as above but very stiff and micaceous	ML		**2-1-8**	22					
55.25	9.75	32											
54.03	10.97	36											
52.81	12.19	40											

DRILL RIG: **Mobile Drill**	GROUND SURFACE ELEVATION: **65.0 m (approximate)**	LOG I.D. **Boring No. B2-1**
BORING DIAMETER: **140 mm**	DEPTH TO GROUND WATER: **Not encountered**	DATE PERFORMED: **10-07-03**
DRILLING METHOD: **Hollow Stem Auger**	SAMPLING METHOD: **Standard Split Spoon Sampler**	LOGGED BY: **M.Naing**
	APPROXIMATE BORING LOCATION (STA;KP;PM): **KP 5.0, Existing RTE 99 NB**	APPROX. DISTANCE FROM ROADWAY CL: **Approx.107 m Right from EP**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION	SOIL TYPE	SAMPLER	SAMPLE NO.	BLOW COUNTS	MOISTURE CONTENT %	DRY DENSITY kN/m^3	PLASTIC INDEX %	Compaction (γ_{max} kN/m^3/ OMC %)	ADDITIONAL COMMENTS AND TESTS
				CLAYEY SILT, as before, but becomes hard	ML	○	**2-1-9**	42					
51.59	13.41	44											
50.37	14.63	48											
				SANDY SILT, hard, yellowish brown, damp, low plasticity, micaceous	ML	○	**2-1-10**	42					
49.15	15.85	52											
47.93	17.07	56											
46.71	18.29	60											
				SILTY SAND, dense, yellowish brown,moist, fine grained, micaceous,	SM	○	**2-1-11**	44					
45.49	19.51	64		excess of SAND contents									
44.27	20.73	68											
				SILTY CLAY, hard, yellowish brown to light gray, damp, low plasticity	CL	○	**2-1-12**	36					
43.05	21.95	72											
41.84	23.16	76											
40.62	24.38	80											

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Office of Geotechnical Design - North

EA: 10-415800	**LOG OF BORING NO. B2-1**	
Date: January-04		
10-MER-99-KP 7.4-Plainsburg Rd Fwy		**SHEET NO.**
GEOTECHNICAL DESIGN REPORT		**8A**

DRILL RIG: **Mobile Drill**	GROUND SURFACE ELEVATION: **65.0 m (approximate)**	LOG I.D. **Boring No. B2-1**
BORING DIAMETER: **140 mm**	DEPTH TO GROUND WATER: **Not encountered**	DATE PERFORMED: **9/30/03 to 10/01/04**
DRILLING METHOD: **Hollow Stem Auger**	SAMPLING METHOD: **Standard Split Spoon Sampler**	LOGGED BY: **M.Naing**
	APPROXIMATE BORING LOCATION (STA;KP;PM): **KP 5.0, Existing RTE 99 NB**	APPROX. DISTANCE FROM ROADWAY CL: **Approx.107 m Right from EP**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION	SOIL TYPE	SAMPLER	SAMPLE NO.	BLOW COUNTS	MOISTURE CONTENT %	DRY DENSITY kN/m^3	PLASTIC INDEX %	Compaction (γ_{max} kN/m^3/ OMC %)	ADDITIONAL COMMENTS AND TESTS
				SILTY SAND, very dense, yellowish brown, damp, fine to medium grained	SM	○	**2-1-13**	56					
39.40	25.60	84											
38.18	26.82	88											
37.57	27.43	90											
37.11	27.89	91.5		as above	SM	○	**2-1-14**	67					
				Bottom of Boring @ depth 27.89 m No groundwater encountered at the time of boring									

Caltrans

Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design - North

EA:	10-415800
Date:	January-04

LOG OF BORING NO. B2-1

10-MER-99-KP 7.4-Plainsburg Rd Fwy

GEOTECHNICAL DESIGN REPORT

SHEET NO.

8B

DRILL RIG: **Mobile Drill**	GROUND SURFACE ELEVATION: **65.5 m (approximate)**	LOG I.D. **Boring No. B 2-2**
BORING DIAMETER: **140 mm**	DEPTH TO GROUND WATER: **not encountered**	DATE PERFORMED: **10/01/03**
DRILLING METHOD: **Hollow Stem Auger**	SAMPLING METHOD: **Standard Split Spoon Sampler**	LOGGED BY: **M.Naing**
	APPROXIMATE BORING LOCATION (STA;KP;PM): **KP 4.9, Existing RTE 99 NB**	APPROX. DISTANCE FROM ROADWAY CL: **Approx. 260 m Right from EP**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION	SOIL TYPE	SAMPLER	SAMPLE NO.	BLOW COUNTS	MOISTURE CONTENT %	DRY DENSITY kN/m^3	PLASTIC INDEX %	Compaction (γ_{max} kN/m^3/ OMC %)	ADDITIONAL COMMENTS AND TESTS
65.50													Percolation Rate at 4-4.3m 34 cm/hr
64.28	1.22	4		CLAYEY SILT, hard, light brown, dry, low plasticity,	ML		**2-2-1**						Bulk sample at 0-1.5 m
							2-2-2	52					
63.06	2.44	8											
							2-2-3		12	17	7	20/11	Clay & Silt 66%
				SANDY SILT, stiff, light brown, dry, low plasticity	ML		**2-2-4**	10					
61.84	3.66	12											
				excess of SAND contents, firm,	ML								R-Value 22
				SILTY SAND loose, reddish brown to light brown, dry	SM		**2-2-5**						Clay & Silt 37%
60.62	4.88	16		fine to medium grained			**2-2-6**	7					
60.47	5.03	16.5											

Bottom of Boring @ depth 5.03 m
No groundwater encountered at the time of boring

DRILL RIG: **Mobile Drill**	GROUND SURFACE ELEVATION: **65.0 m (approximate)**	LOG I.D. **Boring No. B 2-3**
BORING DIAMETER: **140 mm**	DEPTH TO GROUND WATER: **not encountered**	DATE PERFORMED: **10/01/03**
DRILLING METHOD: **Hollow Stem Auger**	SAMPLING METHOD: **Standard Split Spoon Sampler**	LOGGED BY: **M.Naing**
	APPROXIMATE BORING LOCATION (STA;KP;PM): **KP 5.3, Existing RTE 99 NB**	APPROX. DISTANCE FROM ROADWAY CL: **Approx. 220 m Right from EP**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION	SOIL TYPE	SAMPLER	SAMPLE NO.	BLOW COUNTS	MOISTURE CONTENT %	DRY DENSITY kN/m^3	PLASTIC INDEX %	Compaction (γ_{max} kN/m^3/ OMC %)	ADDITIONAL COMMENTS AND TESTS
65.00													Percolation Rate at 4.1-4.4m 229 cm/hr
63.78	1.22	4		CLAYEY SILT, very stiff, light brown, dry, friable, low plasticity	ML		**2-3-1**						Non-corrosive soil at 0-1.5 m pH 9, Resistivity 1200 ohm-cm
							2-3-2	28					
62.56	2.44	8					**2-3-3**						Bulk sample at 1.5-3 m
61.34	3.66	12		SILTY SAND, medium dense, yellowish brown, dry, fine to medium grained, poorly graded	SM		**2-3-4**	11					
				becomes dense, presence of some fine GRAVELS			**2-3-5**						Bulk sample at 3-4.5 m
60.12	4.88	16					**2-3-6**	44					
59.97	5.03	16.5											
				Bottom of Boring @ depth 5.03 m No groundwater encountered at the time of boring									

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Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design - North

EA:	10-415800	**LOG OF BORING NO. B2-3**
Date:	January-04	
10-MER-99-KP 7.4-Plainsburg Rd Fwy		**SHEET NO.**
GEOTECHNICAL DESIGN REPORT		**10**

DRILL RIG: **Mobile Drill**	GROUND SURFACE ELEVATION: **64.5 m (approximate)**	LOG I.D. **Boring No. B 3-1**
BORING DIAMETER: **140 mm**	DEPTH TO GROUND WATER: **not encountered**	DATE PERFORMED: **10/01/03**
DRILLING METHOD: **Hollow Stem Auger**	SAMPLING METHOD: **Standard Split Spoon Sampler**	LOGGED BY: **M.Naing**
	APPROXIMATE BORING LOCATION (STA;KP;PM): **KP 5.8, Existing RTE 99 NB**	APPROX. DISTANCE FROM ROADWAY CL: **Approx. 125 m Right from EP**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION	SOIL TYPE	SAMPLER	SAMPLE NO.	BLOW COUNTS	MOISTURE CONTENT %	DRY DENSITY kN/m^3	PLASTIC INDEX %	Compaction (γ_{max} kN/m^3/ OMC %)	ADDITIONAL COMMENTS AND TESTS
64.50													Percolation Rate at 3.7-4m 162 cm/hr
63.28	1.22	4		SANDY SILT, very stiff,light brown, dry,low plasticity	ML		**3-1-1**						Bulk samples at 0- 1.5 m
						○	**3-1-2**	17					
62.06	2.44	8											
							3-1-3						Bulk samples at 1.5-3 m
				excess of CLAY & SILT contents		○	**3-1-4**	24					
60.84	3.66	12											
							3-1-5		14	16	11	19/12	Clay & Silt 71%
59.62	4.88	16		as above		○	**3-1-6**	20					
59.47	5.03	16.5											
				Bottom of Boring @ depth 5.03 m No groundwater encountered at the time of boring									

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Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design - North

EA:	10-415800	**LOG OF BORING NO. B3-1**
Date:	January-04	
10-MER-99-KP 7.4-Plainsburg Rd Fwy		**SHEET NO.**
GEOTECHNICAL DESIGN REPORT		**11**

DRILL RIG: **Mobile Drill**	GROUND SURFACE ELEVATION: **65.0 m (approximate)**	LOG I.D. **Boring No. B 3-2**
BORING DIAMETER: **140 mm**	DEPTH TO GROUND WATER: **not encountered**	DATE PERFORMED: **10/07/03**
DRILLING METHOD: **Hollow Stem Auger**	SAMPLING METHOD: **Standard Split Spoon Sampler**	LOGGED BY: **M.Naing**
	APPROXIMATE BORING LOCATION (STA;KP;PM): **KP 6.0, Existing RTE 99 NB**	APPROX. DISTANCE FROM ROADWAY CL: **Approx. 280 m Right from EP**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION	SOIL TYPE	SAMPLER	SAMPLE NO.	BLOW COUNTS	MOISTURE CONTENT %	DRY DENSITY kN/m^3	PLASTIC INDEX %	Compaction (γ_{max} kN/m^3/ OMC %)	ADDITIONAL COMMENTS AND TESTS
65.00													Percolation Rate at 4-4.3m 854 cm/hr
63.78	1.22	4											R-Value 24
							3-2-1						Clay & Silt 68%
				SANDY SILT, hard, light brown, dry, friable, low plasticity,	ML		**3-2-2**	40					
62.56	2.44	8											
							3-2-3						Bulk samples at 1.5-3 m
				as above, but very stiff, damp			**3-2-4**	26					
61.34	3.66	12											
							3-2-5						Bulk samples at 3-4.5 m
60.12	4.88	16		as above, firm, very low plasticity			**3-2-6**	8					
59.97	5.03	16.5											
				Bottom of Boring @ depth 5.03 m No groundwater encountered at the time of boring									

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Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design - North

EA:	10-415800
Date:	January-04

LOG OF BORING NO. B3-2

10-MER-99-KP 7.4-Plainsburg Rd Fwy

GEOTECHNICAL DESIGN REPORT

DRILL RIG: **Mobile Drill**	GROUND SURFACE ELEVATION: **64.0 m (approximate)**	LOG I.D. **Boring No. B3-3**
BORING DIAMETER: **140 mm**	DEPTH TO GROUND WATER: **25.10 m (10/09/03)**	DATE PERFORMED: **10/08/03**
DRILLING METHOD: **Hollow Stem Auger**	SAMPLING METHOD: **Standard Split Spoon Sampler**	LOGGED BY: **M.Naing**
	APPROXIMATE BORING LOCATION (STA;KP;PM): **KP 6.3, Existing RTE 99 NB**	APPROX. DISTANCE FROM ROADWAY CL: **Approx. 23 m Right from EP**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION	SOIL TYPE	SAMPLER	SAMPLE NO.	BLOW COUNTS	MOISTURE CONTENT %	DRY DENSITY kN/m^3	PLASTIC INDEX %	Compaction (γ_{max} kN/m^3/ OMC %)	ADDITIONAL COMMENTS AND TESTS
64.00													Piezometer installed -Screen bet. 18.3 & 27.4m -38 mm ID PVC
62.78	1.22	4		SANDY SILT, hard, light bown, dry, friable, low plasticity	ML		3-3-1						
64.00	0.00						3-3-2	40					
61.56	2.44	8					3-3-3						
				as above but excess of clay contents and firm	ML		3-3-4	7					
60.34	3.66	12											Chemical test at 3-4.5 m Organic 1.97%, pH 7.31, CEC 24.10 meq Na/100g
							3-3-5						
59.12	4.88	16		SANDY & CLAYEY SILT, very stiff, light brown, damp, low plasticity	ML		3-3-6	18					
57.90	6.10	20		SILTY SAND, medium dense, light brown, fine grained, graded, micaceous,	SM		3-3-7	26					
56.68	7.32	24											
55.47	8.53	28											
				as above but slightly damp	SM		3-3-8	30					
54.25	9.75	32											
53.03	10.97	36		CLAYEY SILT, very stiff, light brown, low plasticity, micaceous	ML								
51.81	12.19	40											

DRILL RIG: **Mobile Drill**	GROUND SURFACE ELEVATION: **64.0 m (approximate)**	LOG I.D. **Boring No. B3-3**
BORING DIAMETER: **140 mm**	DEPTH TO GROUND WATER: **25.10 m (10/09/03)**	DATE PERFORMED: **10/08/03**
DRILLING METHOD: **Hollow Stem Auger**	SAMPLING METHOD: **Standard Split Spoon Sampler**	LOGGED BY: **M.Naing**
	APPROXIMATE BORING LOCATION (STA;KP;PM): **KP 6.3, Existing RTE 99 NB**	APPROX. DISTANCE FROM ROADWAY CL: **Approx. 23 m Right from EP**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION		SOIL TYPE	SAMPLER	SAMPLE NO.	BLOW COUNTS	MOISTURE CONTENT %	DRY DENSITY kN/m^3	PLASTIC INDEX %	Compaction (γ_{max} kN/m^3/ OMC %)	ADDITIONAL COMMENTS AND TESTS
					as before but SANDY	ML	○	**3-3-9**	20					
50.59	13.41	44												
49.37	14.63	48												
48.15	15.85	52		CLAYEY SILT,	very stiff, light brown, damp, low plasticity	ML	○	**3-3-10**	27					
46.93	17.07	56												
45.71	18.29	60		SANDY SILT,	hard, yellowish brown, damp, nonplastic	ML	○	**3-3-11**	41					
44.49	19.51	64												
43.27	20.73	68												
42.05	21.95	72		SILTY SAND,	dense, yellowish brown, fine grained, poorly graded	SM	○	**3-3-12**	40					
40.84	23.16	76		CLAYEY SILT,	hard, yellowish brown, low plasticity	ML								
39.62	24.38	80												

DRILL RIG: **Mobile Drill**	GROUND SURFACE ELEVATION: **64.0 m (approximate)**	LOG I.D. **Boring No. B3-3**
BORING DIAMETER: **140 mm**	DEPTH TO GROUND WATER: **25.10 m (10/09/03)**	DATE PERFORMED: **10/08/03**
DRILLING METHOD: **Hollow Stem Auger**	SAMPLING METHOD: **Standard Split Spoon Sampler**	LOGGED BY: **M.Naing**
	APPROXIMATE BORING LOCATION (STA;KP;PM): **KP 6.3, Existing RTE 99 NB**	APPROX. DISTANCE FROM ROADWAY CL: **Approx. 23 m Right from EP**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION	SOIL TYPE	SAMPLER	SAMPLE NO.	BLOW COUNTS	MOISTURE CONTENT %	DRY DENSITY kN/m^3	PLASTIC INDEX %	Compaction (γ_{max} kN/m^3/ OMC %)	ADDITIONAL COMMENTS AND TESTS
		10/09/03											
38.90	25.10			SILTY SAND, dense, yellowish brown, moist, fine to medium grained, poorly graded	SM	○	**3-3-13**	39					
38.40	25.60	84											
37.18	26.82	88											
36.57	27.43	90											
36.11	27.89	91.5		SANDY SILT, hard, light brown, wet, nonplastic,	ML	○	**3-3-14**	56					
				Bottom of Boring @ depth 27.89 m									

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Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design - North

EA:	10-415800
Date:	January-04

LOG OF BORING NO. B3-3

10-MER-99-KP 7.4-Plainsburg Rd Fwy

GEOTECHNICAL DESIGN REPORT

SHEET NO.

13B

DRILL RIG: **Mobile Drill**	GROUND SURFACE ELEVATION: **63.5 m (approximate)**	LOG I.D. **Boring No. B3-4**
BORING DIAMETER: **140 mm**	DEPTH TO GROUND WATER: **not encountered**	DATE PERFORMED: **10/09/03**
DRILLING METHOD: **Hollow Stem Auger**	SAMPLING METHOD: **Standard Split Spoon Sampler**	LOGGED BY: **M.Naing**
	APPROXIMATE BORING LOCATION (STA;KP;PM): **KP 6.6, Existing RTE 99 NB**	APPROX. DISTANCE FROM ROADWAY CL: **Approx. 180 m Right from EP**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION	SOIL TYPE	SAMPLER	SAMPLE NO.	BLOW COUNTS	MOISTURE CONTENT %	DRY DENSITY kN/m^3	PLASTIC INDEX %	Compaction (γ_{max} kN/m^3/ OMC %)	ADDITIONAL COMMENTS AND TESTS
63.50													Percolation Rate at 3.4-3.7m 63 cm/hr
62.28	1.22	4		SANDY SILT, hard, light brown, dry, friable, low plasticity	ML		**3-4-1**						Bulk samples at 0.0-1.5 m
						O	**3-4-2**	32					
61.06	2.44	8											Non-corrosive soil at 1.5-3 m pH 9, Resistivity 1300 ohm-cm
							3-4-3						
				as above but stiff and excess of fine grained SAND	ML	O	**3-4-4**	14					
59.84	3.66	12											
							3-4-5						Bulk samples at 3-4.5 m
58.62	4.88	16		as above		O	**3-4-6**	10					
58.47	5.03	16.5											
				Bottom of Boring @ depth 5.03 m No groundwater encountered at the time of boring									

Caltrans

Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design - North

EA: 10-415800

Date: January-04

LOG OF BORING NO. B3-4

10-MER-99-KP 7.4-Plainsburg Rd Fwy

GEOTECHNICAL DESIGN REPORT

SHEET NO.

14

DRILL RIG: **Mobile Drill**	GROUND SURFACE ELEVATION: **63.0 m (approximate)**	LOG I.D. **Boring No. B 3-5**
BORING DIAMETER: **140 mm**	DEPTH TO GROUND WATER: **not encountered**	DATE PERFORMED: **10/08/03**
DRILLING METHOD: **Hollow Stem Auger**	SAMPLING METHOD: **Standard Split Spoon Sampler**	LOGGED BY: **M.Naing**
	APPROXIMATE BORING LOCATION (STA;KP;PM): **KP 7.10, Existing RTE 99 NB**	APPROX. DISTANCE FROM ROADWAY CL: **Approx. 20 m Right from EP**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION	SOIL TYPE	SAMPLER	SAMPLE NO.	BLOW COUNTS	MOISTURE CONTENT %	DRY DENSITY kN/m^3	PLASTIC INDEX %	Compaction (γ_{max} kN/m^3/ OMC %)	ADDITIONAL COMMENTS AND TESTS
63.00													Percolation Rate at 3.4-3.7m 107 cm/hr
61.78	1.22	4		SANDY SILT, stiff, light brown, dry, friable, low plasticity,	ML		**3-5-1**						Bulk samples at 0-1.5 m
							3-5-2	14					
60.56	2.44	8											
							3-5-3						Bulk samples at 1.5-3 m
				as above but very stiff	ML		**3-5--4**	20					
59.34	3.66	12											
							3-5-5						Bulk samples at 3-4.5 m
58.12	4.88	16		as above but hard	ML		**3-5-6**	36					
57.97	5.03	16.5											
				Bottom of Boring @ depth 5.03 m No groundwater encountered at the time of boring									

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Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design - North

EA:	10-415800
Date:	January-04

LOG OF BORING NO. B3-5

10-MER-99-KP 7.4-Plainsburg Rd Fwy

GEOTECHNICAL DESIGN REPORT

310

State of California
Department of Transportation

Business, Transportation and Housing Agency

Memorandum

RECEIVED
BY 9/17 DATE

Flex your power!
Be energy efficient!

To: **BORIS AYAVIRI**
Senior Transportation Engineer
District 6 Design 2 Branch V

Attention: Chris Gardner

Date: September 10, 2009

File: 10-MER-99
PM 0.0/5.1
10-415801
Plainsburg Rd Freeway

2009 SEP 22 AM 8 12

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES – MS 5

Subject: Addendum to Geotechnical Design Report – CMS, Overhead Signs, and Fill Slope

Introduction

Per your request, an addendum to the Geotechnical Design Report (GDR), dated January 26, 2004, is provided for the re-alignment project on Highway 99. This project is located in the south end of Merced County from PM 0.0 to 5.1. See Plate No. 1, Vicinity Map.

This project is proposed to convert the existing roadway from a 4-lane expressway to a 6-lane freeway, and to widen the shoulders. As parts of the proposed improvement, one Model 500 Changeable Message Sign (CMS) at Station 133+85, four standard plan overhead signs, and a 33-feet embankment for the proposed Sandy Mush OH are proposed. This memo adds the geotechnical recommendations for the CMS, overhead signs, and the embankment at the Sandy Mush OH location.

This report includes a review of published data and site visit. No additional subsurface investigation was performed.

Existing Facilities and Proposed Improvements

The proposed project extends from PM 0.0 to PM 5.1 on Highway 99. Along this stretch of the roadway, the highway currently consists of a 4-lane divided roadway paved with asphalt concrete aligned in a generally north-south direction. The roadway is built on level terrain on original ground. There are minor slopes of 4:1 (H:V) or flatter. There are local streets that are directly connected the highway, and access is controlled by stop signs

and turn pockets. This section of roadway is located within mostly farmlands. Utility lines run parallel along the southbound roadway on the right side. Union Pacific Railroad runs along the roadway on the west side.

The proposed work of the project includes widening the roadway to a 6-lane freeway by re-alignment, elevating the roadway to be above the 100-Year Flood Plane, constructing an interchange on Plainsburg Road (Plainsburg OC), and constructing an overhead structure crossing the Union Pacific railroad (Sandy Mush OH). As parts of the improvement of the project, a Model 500 CMS is proposed at Station 133+85 right next to the Chowchilla River Inspection Facility, and four overhead signs, located on Stations 212+90, 261+60, 296+30, and 345+10, are also proposed. Three on-site borrow pits will be converted into storm water infiltration or detention basins, and roadway fill will be constructed utilizing the excavated materials of the pits.

Geotechnical Conditions

Based on the field investigation performed for the original GDR, the subsurface materials consist of medium dense to dense sandy silt, silty sand with layers of clay and sand.

Groundwater

Twelve borings were drilled for the original GDR, and three of them are water level monitoring wells. According to these monitoring wells, groundwater was measured at depths of at least 65.6 feet below existing ground surface. Data collected from the Department of Water Resources (DWR) monitoring wells show even deeper groundwater depths with an average of 105.0 feet. Detailed measurement can be found in original GDR, dated January 26, 2004.

Corrosion

According to the laboratory corrosion tests done for the original GDR, the soil at the site was concluded non-corrosive with respect to pH and resistivity.

Geotechnical Recommendations

Based on the site investigation and analysis, the Office of Geotechnical Design North recommends the proposed standard plan pile foundation for a Model 500 Changeable Message Sign can be constructed as planned. This model should consist of a single cast-in-drilled-hole (CIDH) pile of 22 feet in embedment length and 5 feet in diameter.

All four proposed overhead signs are supported on the standard Type VI Post with structural weight of 12612 lbs. It is recommended that the proposed signs can be constructed as planned. The foundation should consist of a single CIDH pile of 22 feet in embedment length and 5 feet in diameter.

The proposed embankment height is approximately 33 feet on Sandy Mush OH. It is recommended that the fill slope can be constructed as 2:1 (H:V) or flatter.

Due to the silty and sandy nature of the on-site materials, no waiting period is needed. The immediate settlement is estimated at about 6 to 9 inches.

All other recommendations provided in the original GDR, dated January 26, 2004, are still applicable if designs have not been modified.

Construction Considerations

All earthworks shall follow Section 19 of Caltrans Standard Specifications. Loose sand may be encountered during pile construction. Temporary casing may be used for CIDH piles construction if caving occurs.

Project Information

Standard Special Provision S5-280, "Project Information", discloses to bidders and contractors a list of pertinent information available for their inspection prior to bid opening. The following is an excerpt from SSP S5-280 disclosing information originating from Geotechnical Services. Items listed to be included in the Information

Handout will be provided in Acrobat (.pdf) format to the addressee(s) of this report via electronic mail.

Data and information attached with the project plans are:

None

Data and information included in the Information Handout provided to the bidders and contractors are:

-Geotechnical Design Report – Basins and Local Borrow Materials for Embankment/Fill for EA 10-415800, dated January 26, 2004.

-Addendum to Geotechnical Design Report – CMS, Overhead Signs, and Fill Slope for EA 10-415800, dated September 10, 2009.

Data and information available for inspection at the District Office:

None.

Data and information available for inspection at the Transportation Laboratory are:

None.

If any changes are proposed during the final project design, the Office of Geotechnical Design – North should review those changes to determine if the foundation recommendation herein still applies.

If you have any questions or comments, please call Carolyn Zhen at (916) 227-1055 or John Huang at (916) 227-1037.

Report by:
CAROLYN ZHEN
Transportation Engineer, Civil
Office of Geotechnical Design – North
Branch E

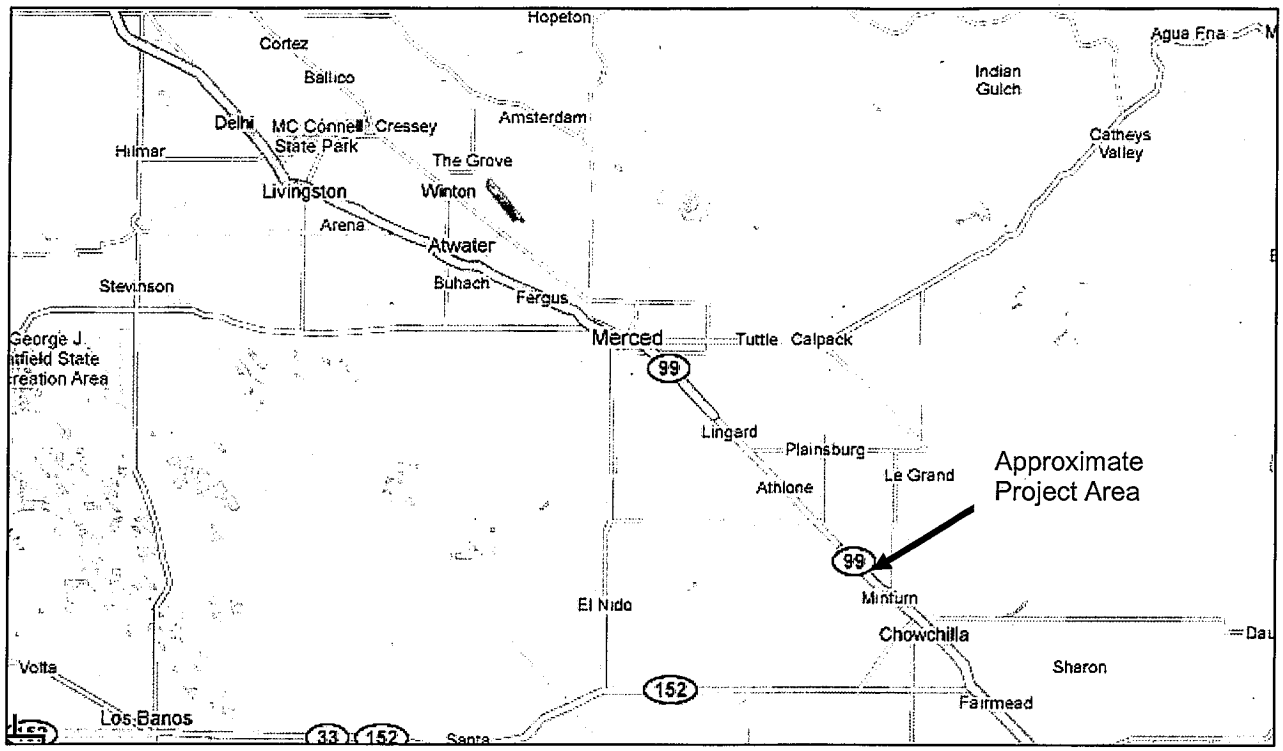
Signed by:
JOHN HUANG, P.E.
Senior Materials and Research Engineer
Office of Geotechnical Design – North
Branch E

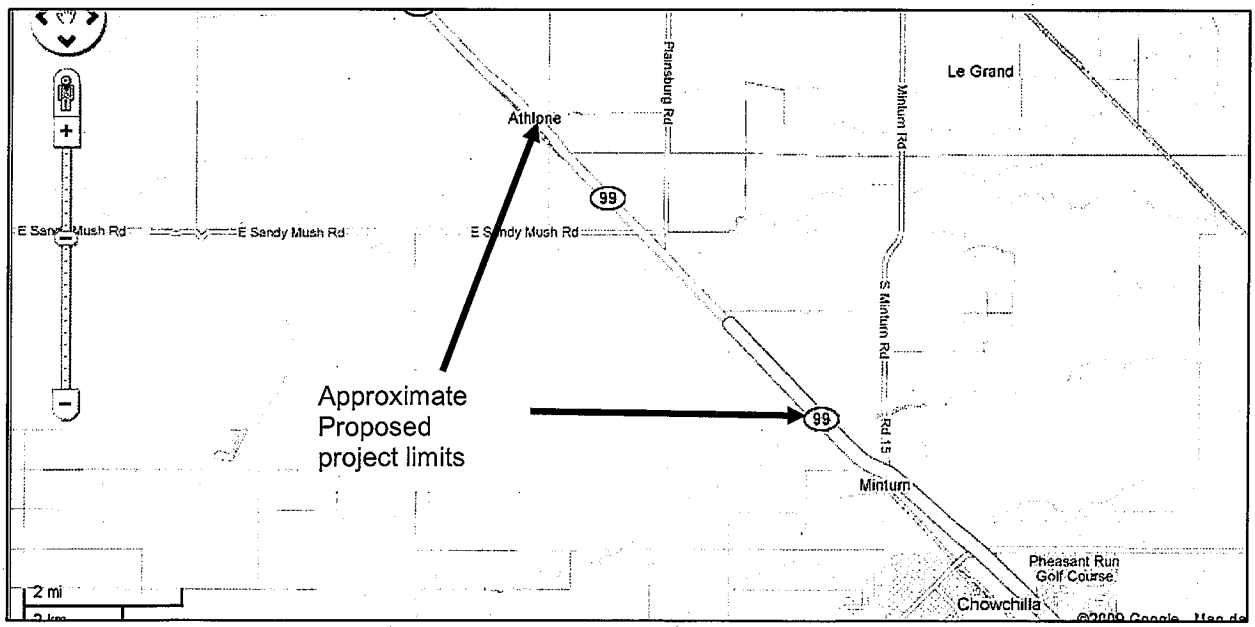
c: JHuang
DME (E-copy)
GDN File
GS File

REGISTERED PROFESSIONAL ENGINEER
QIANG HUANG
No. C055671
Exp. 12/31/10
CIVIL
STATE OF CALIFORNIA

LIST OF ATTACHMENT

Plate 1 Vicinity Map





Scale: No Scale

N

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Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design - North

EA: 10-415801

Date: Sept 2009

VICINITY MAP

10-MER-99-PM 0.0/5.1
GEOTECHNICAL DESIGN REPORT

Plate No. 1

For Contract No. 415801

INFORMATION HANDOUT

MATERIALS INFORMATION

OPTIONAL TEMPORARY STORAGE SITE

For Contract No. 415801
10-Mer-99-0.0/4.6

Materials Information

(Not part of the Contract)

Pavement Grindings

Temporary Disposal Site Information

At the option of the Contractor, one proposed temporary disposal sites will be available for holding concrete grindings generated by this project (see attached map). The temporary disposal site is within the State Right of Way at the following location: in the vicinity of PM 4.82 (SB Rte 99 at WB Athlone Road off ramp). The exact location for the temporary disposal site will be selected by the Resident Engineer.

If the Contractor elects to use this site, the following will apply.

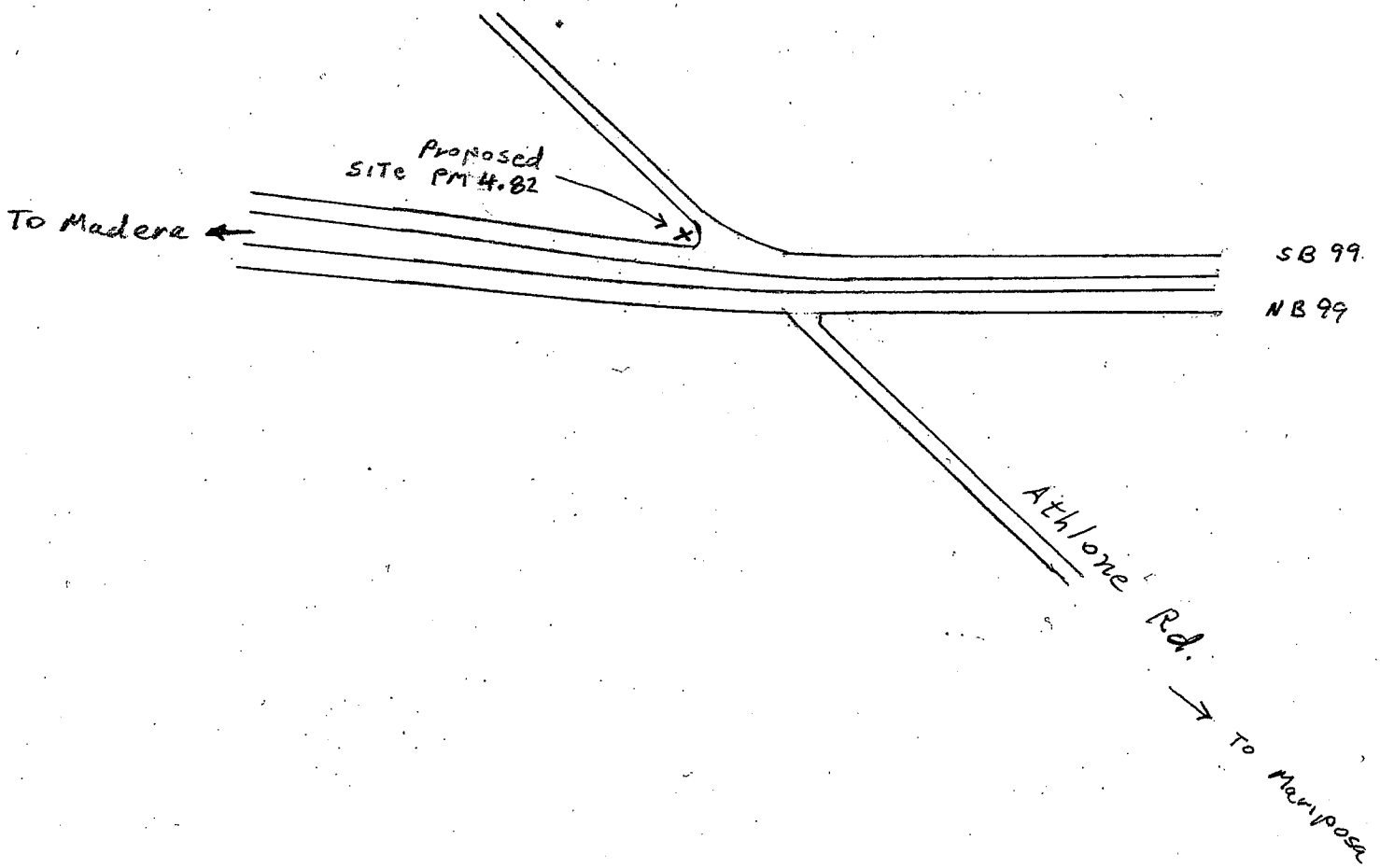
1. Concrete pavement residue (waste water and solid material) shall be confined to a lined basin, trench, or bermed area without overflow to adjacent property or outside of the State Right of Way.

2. Disposal activity shall not occur during periods of rain.

3. At the conclusion of the grinding operation for the project, the solid material shall be disposed of at an appropriate site, and the site restored to original contour.

4. Temporary storage facilities for PCC pavement grinding residue shall be in conformance with WM-8 Concrete Waste Management in the Construction site BMP's Manual or "Temporary Concrete Washout Facility" of the Special Provisions.

For Contract No. 415801
10-Mer-99-0.0/4.6



United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825-1846

In reply refer to:
1-1-03-F-0224

FEB 6 2006

Mr. Gene K. Fong
Federal Highway Administration
U.S. Department of Transportation
650 Capitol Mall Room 4-100
Sacramento, California 95814

Subject: Biological and Conference Opinion on Plainsburg/Arboleda State Route 99 Project in Merced County, California

Dear Mr. Fong:

This is the U.S. Fish and Wildlife Service's (Service) biological and conference opinion on the Plainsburg/Arboleda State Route 99 Project in Merced County, California. Your June 12, 2003, request for formal consultation was received in this office on June13, 2003. At issue are the effects of this proposed project on the endangered San Joaquin kit fox (*Vulpes macrotis mutica*) (kit fox) and the candidate species mountain plover (*Charadrius montanus*). This biological and conference opinion was prepared in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*)(Act).

We have also considered relevant information about the threatened valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) (VELB) that may be affected by the proposed project. Based on the avoidance and minimization measures proposed in the Biological Assessment and subsequent correspondence with the Service, we have determined that the proposed project is not likely to adversely affect the federally listed species VELB.

This biological opinion is based on: (1) *Biological Assessment Plainsburg/Arboleda Freeway Project State Route 99, Merced County, California Chowchilla River to McHenry Road* dated April 2003 (biological assessment), that was prepared by the California Department of Transportation (Caltrans); (2) a letter from the Service to the Federal Highway Administration (FHWA) dated July 11, 2003 requesting additional information; (3) a letter from the FHWA to the Service dated August 7, 2003, that was received by this Field Office on August 8, 2003;, (4) a letter from the Federal Highway Administration to the Service dated November 14, 2003, that was received in this office on November 18, 2003; (5) a telephone conversation between Shannon Holbrook of the Service and Geoff Gray of the Caltrans and (6) other information available to the Service.

TAKE PRIDE IN AMERICA

Consultation History

December 20, 2001. A meeting was held between FHWA, Caltrans and Brian Cypher of ESRP to discuss use of agricultural fields by kit fox and kit fox presence in the Merced area.

January 8, 2002. A meeting was held between FHWA, Caltrans and Dr. Patrick Kelly and Curt Uptain of ESRP to discuss goals of the recovery plan for the kit fox in the Merced region.

February 7, 2002. A Kit Fox Planning and Conservation Recovery Team (KFPACT) meeting was held which included FHWA, Caltrans, Karen Harvey of the Service and Brian Cypher of ESRP. This project was discussed.

June 3, 2002. A meeting was held between FHWA, Caltrans and Kim Forrest, Refuge Manager, San Luis National Wildlife Refuge Complex, Los Banos to discuss the kit fox corridor enhancement project.

August 1, 2002. A site visit was conducted with Karen Harvey and Susan Jones of the Service.

April 1, 2003. A KFPACT meeting was held between FHWA, Caltrans, Sheila Larson and Karen Harvey of the Service, Dr. Brian Cyper of ESRP and Steven Juarez of California Department of Fish and Game to discuss proposed project design and mitigation options.

June 12, 2003. The FHWA sent a letter to the Service requesting initiation of formal Section 7 consultation for the Plainsburg/Arboleda State Hwy 99 Project. The Service also received the *Biological Assessment Plainsburg/Arboleda Freeway Project State Route 99, Merced County, California Chowchilla River to McHenry Road.*

July 11, 2003. The Service sent a letter to the FHWA requesting additional information.

August 7, 2003. The FHWA sent a letter to the Service responding to the request for additional information.

September 17, 2003. An informal meeting was held in Fresno between the Service and Caltrans to discuss the project and compensation features.

October 9, 2003. Electronic mail was sent from Geoffrey Gray of Caltrans to Karen Harvey of the Service concerning VELB avoidance information.

November 18, 2003. The FHWA sent a letter to the Service requesting a response to their August 7, 2003 letter and issuance of a biological opinion.

October 14, 2005. Shannon Holbrook of the Service contacted Geoffrey Gray of Caltrans to discuss the project.

October 17, 2005. Electronic mail was sent from Geoffrey Gray of Caltrans to Shannon Holbrook of the Service providing an electronic copy of the Biological Assessment.

Description of the Proposed Action

FHWA, in cooperation with the Caltrans proposes to convert a 10.5 mile (16.9 km) section of State Route 99 (SR-99) between the Madera/Merced County line and McHenry Road from a four-lane expressway to a six-lane divided freeway (Figure 1). This would occur upon an acquired right-of-way area that can ultimately accommodate eight lanes with a median that ranges between 69-85 ft. (21-25.8 m). A 0.65 mile (1.04 km) median barrier is proposed in the transition zone near the Chowchilla River (Postmile (PM) 0.0 – 0.65 / Kilopost (KP) 0.0 – 1.04).

Current northbound SR-99 would be excavated down to original ground (OG) level, including the removal of all pavement, fill material, and northbound bridges. The proposed freeway would be realigned to the east in order to avoid crossing the Union Pacific railroad and to facilitate the construction of two full interchanges at Plainsburg Road/Sandy Mush Road (southern interchange - project EA 10-415800) and at Arboleda Drive/Le Grand Road (northern interchange - project EA 10-415700) (Appendix C, Caltrans 2003). In order to provide access to SR-99 via the interchanges, existing SR-99 southbound lanes would be resurfaced and designated as a western frontage road while a new frontage road would be constructed east of the proposed freeway.

The new freeway alignment would be constructed at a higher elevation than current SR-99 in order to provide increased protection against 100-year flood events. The required fill material to raise the alignment would be obtained through the excavation of basins within acquired right of way areas.

A preferred alternative has not been selected. Alternative alignment 1B PM 0.0 – 4.6 / KP 0.0 – 7.4) facilitates the southern interchange (EA 415800) while alternative alignment 2 (PM 4.3 – 10.5 / KP 6.9 – 16.9) provides access to the northern interchange (EA 415700) (Appendix C, of Caltrans 2003).

The purpose of the proposed project is to improve SR-99 in accordance with regional transportation plans. In addition, modernized freeway design would eliminate non-standard merge and diverge weaving areas, upgrade non-standard shoulder widths, and significantly improve safety and operating conditions in a region where dense fog is prevalent.

Total acreage studied within the project's potential impact area (PIA) is approximately 2,592 acres. However, project construction is expected to permanently modify approximately 712 acres, which includes the freeway alignment and shoulders, all Caltrans right of way including median, new frontage roads and shoulders, and basins.

According to the biological assessment, parcel utilization surveys conducted in 2001 showed that 97% of the project footprint is utilized for intensive agricultural production. Land use within this acreage as of 2001 includes alfalfa (35.5% / 253 acres), vineyards (29.1% / 207 acres), orchard crops (23.1% / 165 acres), row crops (9.4% / 67 ares), rural residences (1.6% / 12 acres), and ruderal areas (1.3% / 9 acres). Local farmers rotate crops on a regular basis, so these percentages represent

temporally limited data on regional land use. Most non-cultivated plants within the potential impact area are planted ornamentals serving as landscape enhancement on residential parcels or trees and shrubs planted on the periphery of some agricultural lands. Native vegetation is mainly restricted to the narrow banks of local channelized streams (utilized as irrigation canals) and one adjacent wetland.

Proposed Avoidance and Minimization Measures

According to the biological assessment, the Caltans will implement the following actions:

1. Preconstruction surveys would be conducted prior to ground disturbance to locate potential kit fox dens within the PIA.

2. San Joaquin kit fox special provisions would be included in the construction contract and implemented by the Caltrans subcontractor.

   A. Entrance into areas within the right of way not required for construction activities shall be restricted to the highway and associated paved or graded shoulders. Staging, parking, storage and other project related use areas shall be clearly marked on the ground.
   B. Project-related traffic shall observe a 32 kilometer per hour speed limit except on roads or highways open for public use.
   C. At the end of each working day, the Contractor shall take measures to prevent the entrapment of kit foxes in all excavated, steep-walled holes or trenches more than 0.6-(meter) deep. Such measures shall include covering excavations with plywood or providing dirt or plank escape ramps from the trenches.
   D. The Contractor shall inspect all pipes and culverts with a diameter greater than or equal to 100 mm before burying, capping, or other use. If a kit fox is discovered during this inspection, the pipe or culvert shall not be disturbed (other than to move it to a safe location if necessary) until after the fox has escaped.
   E. The Contractor shall immediately notify the Engineer if a dead, injured or entrapped kit fox is found. Work in the immediate area may be temporarily halted while the State's Biologist at the direction of the Engineer consults with the California Department of Fish and Game and the US Fish and Wildlife Service. Any entrapped kit fox shall be permitted to escape. The disposition of any carcasses or recovering animals shall be coordinated through the Engineer.
   F. If a kit fox den is discovered, all construction activity within a 46 m radius of the den will be halted while the State consults with the U.S. Fish and Wildlife Service and California Department of Fish and Game. An Environmental Sensitive Area will be established around the den and entry into the area will be restricted.
   G. The Contractor shall provide closed garbage containers where food-related trash is generated, and garbage shall be disposed of daily.
   H. Pets are prohibited on work site.

State Route 99 / Plainsburg Road / Arboleda Drive Freeway Project

E.A. 10-415700 / 415800

P.M. 0.0 /10.5 K.P. 0.0 / 16.9

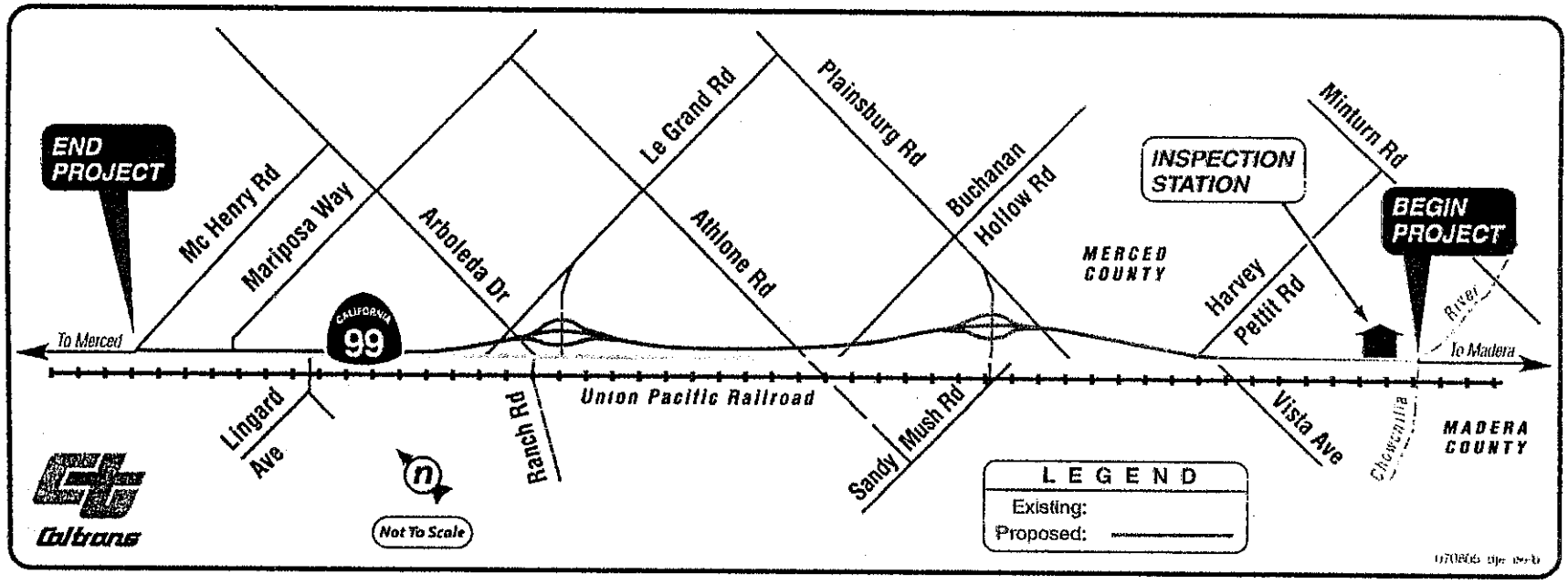


Figure 1-2 Project Location Map

3. Bridges would be constructed with increased vertical clearance over six local streams and overflow areas providing enhanced crossing potential at these locations for kit foxes (Appendix C, Caltrans 2003).

4. At bridge locations, the ROW fence would be designed to direct animals under the alignment by attaching the fence directly to bridge footings. To facilitate kit fox passage, open space within the Caltrans ROW near stream banks or overflow areas would be kept free of vegetation through use of gravel, concrete slurry, or other material. As there are no final designs proposed yet, Caltrans will obtain Service approval for the final design of the footings and fence.

5. Under the entire ROW fence, a suitable material would be buried and/or placed to discourage kit foxes and other canids from digging under the ROW fence and entering trafficked areas.

6. Two large box culverts would be constructed under the proposed alignment along the Sandy Mush Road kit fox corridor. These culverts would serve as additional crossing features specific to kit fox measuring approximately 6 feet high x 10 feet wide x 240 feet long (Appendix K, Caltrans 2003). The bottom of these culverts would be approximately 12 inches above OG and would not carry water during normal precipitation events. For each box culvert, four sections of corrugated metal pipe (CMP), 20 feet long and 10 inches in diameter, would be anchored at equal intervals on the culvert floors. The openings of both ends of all CMPs would be narrowed to a 4-6 inch diameter. Kit foxes would gain temporary refuge opportunity within the CMPs in the event they find themselves in a culvert with a larger predator.

7. Right of way fence gaps, 4-6 inches high and approximately 60 feet wide, would be provided at the bottom of the ROW fence in front of the culvert entrances (Appendix K, Caltrans 2003). A concrete slab, slurry, gravel, or other material, six feet wide, would be placed under the gaps to prevent vegetation growth from obscuring them and to prevent enlargement of the gaps via burrowing. Right of way areas between the ROW fence and the box culvert entrances would be kept vegetation free through use of similar materials.

8. Two overpasses would be constructed over the proposed alignment - one at Plainsburg Road and one at Arboleda Road (Appendix C of Caltrans 2003). Traffic volumes would be relatively low on these overpasses, and they would provide two additional locations kit foxes could utilize to cross SR-99.

9. Conservation easements would be pursued for five proposed buffer areas (40 acres each) on adjacent parcels in front of the entrances of the two box culverts and east of the proposed bridge at Deadman Creek (totaling approximately 200 acres) (Appendix C, Caltrans 2003). The easements would be obtained from willing sellers; any acreage required but not obtained via a willing seller would be procured off-site via conservation easements and/or purchases, the preferable location(s) of which would be consistent with the Sandy-Mush kit fox corridor as identified in the Service Recovery Plan for Upland Species of the San Joaquin Valley (Service 1998) (Recovery Plan). The use of condemnation to obtain easements would be pursued only in the case of demonstrated and defensible necessity. The proposed buffer areas are within the approved expansion boundary for the Grasslands Wildlife Management area, therefore, the

easement would be in the name of the Service (National Wildlife Refuge), who would be responsible for perpetual monitoring. Development within these parcels would be prevented, allowing the areas immediately adjacent to the crossings to remain open to kit fox passage in perpetuity. Union Pacific Railroad property, comprising 56 acres of open grassland, is located west of the proposed Deadman Creek Bridge (Appendix C, Caltans 2003). Development is not expected to occur on this parcel.

10. Large areas within the Caltrans ROW will be the source of fill material (Appendix C, Caltrans 2003). A total of 13 areas, totaling 265 acres, are under consideration for basin creation/subsequent use. These areas would not be intended for use as drainage basins and would not be expected to hold large amounts of water. However, in the larger basins, earthen check dams would be created in several locations to provide animals with elevated dry routes across the basins floors during rain events. The basins would also be seeded with native plants after fill material has been obtained.

11. Of the 13 areas under consideration in #10 above, up to six basins (#3, #6, #8, #9, #10, #11), totaling up to 201 acres, would be relinquished to the Service (Appendix C, Caltrans 2003). It is anticipated that these areas would provide substantial foraging habitat not only for kit fox but other species in the area such as the burrowing owl and Swainson's hawk. Furthermore, such ownership of these basin areas would prevent future urban development from blocking the Sandy Mush Road corridor adjacent to the new alignment. The remaining seven basins, totaling 64 acres, would be retained within the Caltrans ROW, allowing for the perpetual protection of this acreage along State Route 99 (SR 99) as well.

12. The project alignment footprint (excluding basins) would include approximately 437 acres of agricultural land (alfalfa 156 acres, vineyard 129 acres, orchard 87 acres, annual row crop 56 acres, and ruderal areas 9 ac.). The unsuitability of these lands as valuable kit fox denning and foraging habitat is described as follows:

- Annual row crops are plowed frequently, flood irrigated, and treated with pesticides, herbicides, and fertilizers. The value of annual row crops as kit fox foraging and denning habitat is low to none;
- Vineyards are flood irrigated and treated with pesticides, herbicides, and fertilizers. The vegetative understory is sterile. Very little to no foraging and denning opportunity exists for kit foxes;
- Orchards are flood irrigated and treated with pesticides, herbicides, and fertilizers. The vegetative understory is relatively sterile. Orchards provide very little opportunity for foraging and denning for kit foxes. However, kit foxes are known to utilize orchards as cover and limited forage for short periods of time;
- Alfalfa fields are flood irrigated and treated with pesticides, herbicides, and fertilizers. Although alfalfa fields are not plowed every year, they are subject to mechanical harvesting several times per growing season. Because rodents can be relatively abundant in alfalfa fields, kit foxes may utilize alfalfa for some foraging, but the value of these areas as cover and/or denning habitat is little to none. In addition, kit fox predators, namely coyotes, were

observed in proportionally greater numbers in alfalfa fields during two USFWS-protocol kit fox spotlighting surveys in the local region;

- Ruderal areas can provide some foraging and denning opportunity for kit foxes if disturbance is low and edge effect is minimal due to large parcel size. However, the ruderal areas within the potential impact area are very small and fragmented, located next to residential areas, or on road shoulders.

Following the above line of reasoning, Caltrans proposes to compensate for the removal of agricultural land, not because it qualifies as essential kit fox denning and foraging habitat, but in order to compensate for the role it serves as open space for recovery of potential kit fox east-west corridor movement as identified in the Service Recovery Plan for Upland Species. Caltrans proposes to relinquish up to 401 acres to the Service in the form of buffer easements (#9) and basin areas (#11) to enhance kit fox corridor movement.

13. An endowment would be established by Caltrans for the perpetual maintenance and monitoring of the basin acreage (201 acres). Regarding the five buffer areas (200 acres), an endowment is not anticipated should the easement allow for land use to remain in agriculture.

No kit fox mortality is expected to result from project construction. Kit fox crossing locations would include a project-wide total of six bridges, two culverts, and two overpasses. Right of way fences would help to prevent entry of kit foxes into trafficked areas and direct them toward safer crossing points. Up to 401 acres (200 buffer acres plus 201 basin acres) would be relinquished to the Service to maintain as foraging/denning/migration habitat and to prevent urbanization from blocking the Sandy Mush Road kit fox corridor.

Status of the Species

San Joaquin Kit Fox

The San Joaquin kit fox was listed as an endangered species on March 11, 1967 (Service 1967) and was listed by the State of California as a threatened species on June 27, 1971. *The Recovery Plan for Upland Species of the San Joaquin Valley, California* (Recovery Plan) includes this canine (Service 1998).

In the San Joaquin Valley before 1930, the range of the San Joaquin kit fox extended from southern Kern County north to Tracy, San Joaquin County, on the west side, and near La Grange, Stanislaus County, on the east side (Grinnell *et al.* 1937; Service 1998). Historically, this species occurred in several San Joaquin Valley native plant communities. In the southernmost portion of the range, these communities included Valley Sink Scrub, Valley Saltbush Scrub, Upper Sonoran Subshrub Scrub, and Annual Grassland. San Joaquin kit foxes also exhibit a capacity to utilize habitats that have been altered by man. The animals are present in many oil fields, grazed pasturelands, and "wind farms" (Cypher 2000). Kit foxes can inhabit the margins and fallow lands near irrigated row crops, orchards, and vineyards, and may forage occasionally in these agricultural areas (Service 1998). The San Joaquin kit fox seems to prefer more gentle terrain

and decreases in abundance as terrain ruggedness increases (Grinnell *et al.* 1937; Morrell 1972; Warrick and Cypher 1998).

The kit fox is often associated with open grasslands, which form large contiguous blocks within the eastern portions of the range of the animal. The listed canine also utilizes oak savanna and some types of agriculture (e.g. orchards and alfalfa), although the long-term suitability of these habitats is unknown (Jensen 1972; Service 1998). In eastern Merced County, the lands between the urban corridor along Highway 99 and the open grasslands to the east are a mixture of orchards and annual crops, mostly alfalfa. Orchards occur in large contiguous blocks in the northwest portions of the study area and at scattered locations in the southwest portions. Orchards sometimes support prey species if the grounds are not manicured; however, denning potential is typically low and kit foxes can be more susceptible to coyotes predation within the orchards (Orloff 2000). Alfalfa fields provide an excellent prey base (Woodbridge 1987; Young 1989), and berms adjacent to alfalfa fields sometimes provide good denning habitat (Orloff 2000). Kit foxes often den adjacent to, and forage within, agricultural areas (Bell 1994; Scott-Graham 1994). Although agricultural areas are not traditional kit fox habitat and are often highly fragmented, they can offer sufficient prey resources and denning potential to support small numbers of kit foxes.

Adult San Joaquin kit foxes are usually solitary during late summer and fall. In September and October, adult females begin to excavate and enlarge natal dens (Morrell 1972), and adult males join the females in October or November (Morrell 1972). Typically, pups are born between February and late March following a gestation period of 49 to 55 days (Egoscue 1962; Morrell 1972; Spiegel and Tom 1996; Service 1998). Mean litter sizes reported for San Joaquin kit foxes include 2.0 on the Carrizo Plain (White and Ralls 1993), 3.0 at Camp Roberts (Spencer *et al.* 1992), 3.7 in the Lokern area (Spiegel and Tom 1996), and 3.8 at the Naval Petroleum Reserve (Cypher *et al.* 2000). Pups appear above ground at about age 3-4 weeks, and are weaned at age 6-8 weeks. Reproductive rates, the proportion of females bearing young, of adult San Joaquin kit foxes vary annually with environmental conditions, particularly food availability. Annual rates range from 0-100%, and reported mean rates include 61% at the Naval Petroleum Reserve (Cypher *et al.* 2000), 64% in the Lokern area (Spiegel and Tom 1996), and 32% at Camp Roberts (Spencer *et al.* 1992). Although some yearling female kit foxes will produce young, most do not reproduce until age 2 years (Spencer et al. 1992; Spiegel and Tom 1996; Cypher *et al.* 2000). Some young of both sexes, but particularly females may delay dispersal, and may assist their parents in raising in the following year's litter of pups (Spiegel and Tom 1996). The young kit foxes begin to forage for themselves at about four to five months of age (Koopman *et al.* 2000; Morell 1972).

Although most young kit foxes disperse less than 5 miles (Scrivner *et al.* 1987a), dispersal distances of up to 76.3 miles have been documented for the San Joaquin kit fox (Scrivner *et al.* 1993; Service 1998). Dispersal can be through disturbed habitats, including agricultural fields, and across highways and aqueducts. The age at dispersal ranges from 4-32 months (Cypher 2000). Among juvenile kit foxes surviving to July 1 at the Naval Petroleum Reserve, 49% of the males dispersed from natal home ranges while 24% of the females dispersed (Koopman *et al.* 2000). Among dispersing kit foxes, 87% did so during their first year of age. Most, 65.2%, of

the dispersing juveniles at the Naval Petroleum Reserve died within 10 days of leaving their natal home den (Koopman *et al.* 2000). Some kit foxes delay dispersal and may inherit their natal home range.

Kit foxes are reputed to be poor diggers, and their dens are usually located in areas with loose-textured, friable soils (Morrell 1972; O'Farrell 1983). However, the depth and complexity of their dens suggest that they possess good digging abilities, and kit fox dens have been observed on a variety of soil types (Service 1998). Some studies have suggested that where hardpan layers predominate, kit foxes create their dens by enlarging the burrows of California ground squirrels (*Spermophilus beecheyi*) or badgers (*Taxidea taxus*)(Jensen 1972; Morrell 1972; Orloff *et al.* 1986). In parts of their range, particularly in the foothills, kit foxes often use ground squirrel burrows for dens (Orloff *et al.* 1986). Kit fox dens are commonly located on flat terrain or on the lower slopes of hills. About 77 percent of all kit fox dens are at or below midslope (O'Farrell 1983), with the average slope at den sites ranging from 0 to 22 degrees (California Department of Fish and Game 1980; O'Farrell 1983; Orloff *et al.* 986). Natal and pupping dens are generally found in flatter terrain. Common locations for dens include washes, drainages, and roadside berms. Kit foxes also commonly den in human-made structures such as culverts and pipes (O'Farrell 1983; Spiegel *et al.* 1996a).

Natal and pupping dens may include from two to 18 entrances and are usually larger than dens that are not used for reproduction (O'Farrell *et al.* 1980; O'Farrell and McCue 1981). Natal dens may be reused in subsequent years (Egoscue 1962). It has been speculated that natal dens are located in the same location as ancestral breeding sites (O'Farrell 1983). Active natal dens are generally 1.2 to 2 miles from the dens of other mated kit fox pairs (Egoscue 1962; O'Farrell and Gilbertson 1979). Natal and pupping dens usually can be identified by the presence of scat, prey remains, matted vegetation, and mounds of excavated soil (i.e. ramps) outside the dens (O'Farrell 1983). However, some active dens in areas outside the valley floor often do not show evidence of use (Orloff *et al.* 1986). During telemetry studies of kit foxes in the northern portion of their range, 70 percent of the dens that were known to be active showed no sign of use (e.g., tracks, scats, ramps, or prey remains)(Orloff *et al.* 1986). In another more recent study in the Coast Range, 79 percent of active kit fox dens lacked evidence of recent use other than signs of recent excavation (Jones and Stokes Associates 1997).

A kit fox can use more than 100 dens throughout its home range, although on average, an animal will use approximately 12 dens a year for shelter and escape cover (Cypher *et al.* 2001). Kit foxes typically use individual dens for only brief periods, often for only one day before moving to another den (Ralls *et al.* 1990). Possible reasons for changing dens include infestation by ectoparasites, local depletion of prey, or avoidance of coyotes (*Canis latrans*). Kit foxes tend to use dens that are located in the same general area, and clusters of dens can be surrounded by hundreds of hectares of similar habitat devoid of other dens (Egoscue 1962). In the southern San Joaquin Valley, kit foxes were found to use up to 39 dens within a denning range of 320 to 482 acres (Morrell 1972). An average den density of one den per 69 to 92 acres was reported by O'Farrell (1984) in the southern San Joaquin Valley.

Dens are used by kit foxes for temperature regulation, shelter from adverse environmental conditions, and escape from predators. Kit foxes excavate their own dens, use those constructed by other animals, and use human-made structures (culverts, abandoned pipelines, and banks in sumps or roadbeds). Kit foxes often change dens and may use many dens throughout the year; however, evidence that a den is being used by kit foxes may be absent. San Joaquin kit foxes have multiple dens within their home range and individual animals have been reported to use up to 70 different dens (Hall 1983). At the Naval Petroleum Reserve, individual kit foxes used an average of 11.8 dens per year (Koopman *et al.* 1998). Den switching by the San Joaquin kit fox may be a function of predator avoidance, local food availability, or external parasite infestations (e.g., fleas) in dens (Egoscue 1956).

The diet of the San Joaquin kit fox varies geographically, seasonally, and annually, based on temporal and spatial variation in abundance of potential prey. In the portion of their geographic range that includes Merced County, known prey species of the kit fox include white-footed mice (*Peromyscus* spp.), insects, California ground squirrels, kangaroo rats (*Dipodomys* spp.), San Joaquin antelope squirrels, black-tailed hares (*Lepus californicus*), and chukar (*Alectoris chukar*) (Jensen 1972, Archon 1992), listed in approximate proportion of occurrence in fecal samples. Kit foxes also prey on desert cottontails (*Sylvilagus audubonii)*, ground-nesting birds, and pocket mice (*Perognathus* spp.).

The diets and habitats selected by coyotes and kit foxes living in the same areas are often quite similar. Hence, the potential for resource competition between these species may be quite high when prey resources are scarce such as during droughts, which are quite common in semi-arid, central California. Competition for resources between coyotes and kit foxes may result in kit fox mortalities. Coyote-related injuries accounted for 50-87 per cent of the mortalities of radio collared kit foxes at Camp Roberts, the Carrizo Plain Natural Area, the Lokern Natural Area, and the Naval Petroleum Reserves (Cypher and Scrivner 1992; Standley *et al.* 1992).
San Joaquin kit foxes are primarily nocturnal, although individuals are occasionally observed resting or playing (mostly pups) near their dens during the day (Grinnell *et al.* 1937). Kit foxes occupy home ranges that vary in size from 1.7 to 4.5 square miles (White and Ralls 1993). A mated pair of kit foxes and their current litter of pups usually occupy each home range. Other adults, usually offspring from previous litters, also may be present (Koopman *et al.* 2000), but individuals often move independently within their home range (Cypher 2000). Average distances traveled each night range from 5.8 to 9.1 miles and are greatest during the breeding season (Cypher 2000).

Kit foxes maintain core home range areas that are exclusive to mated pairs and their offspring (White and Ralls 1993, Spiegel 1996, White and Garrott 1997). This territorial spacing behavior eventually limits the number of foxes that can inhabit an area owing to shortages of available space and per capita prey. Hence, as habitat is fragmented or destroyed, the carrying capacity of an area is reduced and a larger proportion of the population is forced to disperse. Increased dispersal generally leads to lower survival rates and, in turn, decreased abundance because greater than 65 percent of dispersing juvenile foxes die within 10 days of leaving their natal range (Koopman *et al.* 2000).

Estimates of fox density vary greatly throughout its range, and have been reported as high as 1.3 animals per square mile in optimal habitats in good years (Service 1998). At the Elk Hills in Kern County, density estimates varied from 1.86 animals per square mile in the early 1980s to 0.03 animals per square mile in 1991 (Service 1998). Kit fox home ranges vary in size from approximately 1 to 12 square miles (Spiegel *et al.* 1996b; Service 1998). Knapp (1978) estimated that a home range in agricultural areas is approximately 1 square mile. Individual home ranges overlap considerably, at least outside the core activity areas (Morrell 1972; Spiegel *et al.* 1996b).

Mean annual survival rates reported for adult San Joaquin kit foxes include 0.44 at the Naval Petroleum Reserve (Cypher *et al.* 2000), 0.53 at Camp Roberts (Standley *et al.* 1992), 0.56 at the Lokern area (Spiegel and Disney 1996), and 0.60 on the Carrizo Plain (Ralls and White 1995). However, survival rates widely vary among years (Spiegel and Disney 1996; Cypher *et al.* 2000). Mean survival rates for juvenile San Joaquin kit foxes (<1 year old) are lower than rates for adults. Survival to age 1 year was 0.14 at the Naval Petroleum Reserve (Cypher *et al.* 2000), 0.20 at Camp Roberts (Standley *et al.* 1992), and 0.21 on the Carrizo Plain (Ralls and White 1995). For both adults and juveniles, survival rates of males and females are similar. San Joaquin kit foxes may live to ten years in captivity (McGrew 1979) and 8 years in the wild (Berry et al. 1987), but most kit foxes do not live past 2-3 years of age.

The status (i.e., distribution, abundance) of the kit fox has decreased since its listing in 1967. This trend is reasonably certain to continue into the foreseeable future unless measures to protect, sustain, and restore suitable habitats, and alleviate other threats to their survival and recovery, are implemented. Threats that are seriously affecting kit foxes are described in further detail in the following paragraphs.

Loss of Habitat

Less than 20 percent of the habitat within the historical range of the kit fox remained when the subspecies was listed as federally-endangered in 1967, and there has been a substantial net loss of habitat since that time. Historically, San Joaquin kit foxes occurred throughout California's Central Valley and adjacent foothills. Extensive land conversions in the Central Valley began as early as the mid-1800s with the Arkansas Reclamation Act. By the 1930's, the range of the kit fox had been reduced to the southern and western parts of the San Joaquin Valley (Grinnell *et al.* 1937). The primary factor contributing to this restricted distribution was the conversion of native habitat to irrigated cropland, industrial uses (e.g., hydrocarbon extraction), and urbanization (Laughrin 1970, Jensen 1972; Morrell 1972, 1975). Approximately one-half of the natural communities in the San Joaquin Valley were tilled or developed by 1958 (Service 1980).

This rate of loss accelerated following the completion of the Central Valley Project and the State Water Project, which diverted and imported new water supplies for irrigated agriculture (Service 1995a). Approximately 1.97 million acres of habitat, or about 66,000 acres per year, were converted in the San Joaquin region between 1950 and 1980 (California Department of Forestry and Fire Protection 1988). The counties specifically noted as having the highest wildland conversion rates included Kern, Tulare, Kings and Fresno, all of which are occupied by kit foxes.

From 1959 to 1969 alone, an estimated 34 percent of natural lands were lost within the then-known kit fox range (Laughrin 1970).

By 1979, only approximately 370,000 acres out of a total of approximately 8.5 million acres on the San Joaquin Valley floor remained as non-developed land (Williams 1985, Service 1980). Data from the CDFG (1985) and Service file information indicate that between 1977 and 1988, essential habitat for the blunt-nosed leopard lizard, a species that occupies habitat that is also suitable for kit foxes, declined by about 80 percent – from 311,680 acres to 63,060 acres, an average of about 22,000 acres per year (Biological Opinion for the Interim Water Contract Renewal, Ref. No. 1-1-00-F-0056, February 29, 2000). Virtually all of the documented loss of essential habitat was the result of conversion to irrigated agriculture.

During 1990 to 1996, a gross total of approximately 71,500 acres of habitat were converted to farmland in 30 counties (total area 23.1 million acres) within the Conservation Program Focus area of the Central Valley Project. This figure includes 42,520 acres of grazing land and 28,854 acres of "other" land, which is predominantly comprised of native habitat. During this same time period, approximately 101,700 acres were converted to urban land use within the Conservation Program Focus area (California Department of Conservation 1994, 1996, 1998). This figure includes 49,705 acres of farmland, 20,476 acres of grazing land, and 31,366 acres of "other" land, which is predominantly comprised of native habitat. Because these assessments included a substantial portion of the Central Valley and adjacent foothills, they provide the best scientific and commercial information currently available regarding the patterns and trends of land conversion within the kit fox's geographic range.

In summary, more than one million acres of suitable habitat for kit foxes have been converted to agricultural, municipal, or industrial uses since the listing of the kit fox. In contrast, less than 500,000 acres have been preserved or are subject to community-level conservation efforts designed, at least in part, to further the conservation of the kit fox (Service 1998).

Land conversions contribute to declines in kit fox abundance through direct and indirect mortalities, displacement, reduction of prey populations and denning sites, changes in the distribution and abundance of larger canids that compete with kit foxes for resources, and reductions in carrying capacity. Kit foxes may be buried in their dens during land conversion activities (C. Van Horn, Endangered Species Recovery Program, Bakersfield, personal communication to S. Jones, Fish and Wildlife Service, Sacramento, 2000), or permanently displaced from areas where structures are erected or the land is intensively irrigated (Jensen 1972, Morrell 1975). Furthermore, even moderate fragmentation or loss of habitat may significantly impact the abundance and distribution of kit foxes. Capture rates of kit foxes at the Naval Petroleum Reserve in Elk Hills were negatively associated with the extent of oil-field development after 1987 (Warrick and Cypher 1998). Likewise, the California Energy Commission found that the relative abundance of kit foxes was lower in oil-developed habitat than in nearby undeveloped habitat on the Lokern (Spiegel 1996). Researchers from both studies inferred that the most significant effect of oil development was the lowered carrying capacity for populations of both foxes and their prey species owing to the changes in habitat characteristics or the loss and fragmentation of habitat (Spiegel 1996, Warrick and Cypher 1998).

Dens are essential for the survival and reproduction of kit foxes that use them year-round for shelter and escape, and in the spring for rearing young. Hence, kit foxes generally have dozens of dens scattered throughout their territories. However, land conversion reduces the number of typical earthen dens available to kit foxes. For example, the average density of typical, earthen kit fox dens at the Naval Hills Petroleum Reserve was negatively correlated with the intensity of petroleum development (Zoellick *et al.* 1987), and almost 20 percent of the dens in developed areas were found to be in well casings, culverts, abandoned pipelines, oil well cellars, or in the banks of sumps or roads (Service 1983). These results are important because the California Energy Commission found that, even though kit foxes frequently used pipes and culverts as dens in oil-developed areas of western Kern County, only earthen dens were used to birth and wean pups (Spiegel 1996). Similarly, kit foxes in Bakersfield use atypical dens, but have only been found to rear pups in earthen dens (P. Kelly, Endangered Species Recovery Program, Fresno, personal communication to P. White, Fish and Wildlife Service, Sacramento, April 6, 2000). Hence, the fragmentation of habitat and destruction of earthen dens could adversely affect the reproductive success of kit foxes. Furthermore, the destruction of earthen dens may also affect kit fox survival by reducing the number and distribution of escape refuges from predators. Land conversions and associated human activities can lead to widespread changes in the availability and composition of mammalian prey for kit foxes. For example, oil field disturbances in western Kern County have resulted in shifts in the small mammal community from the primarily granivorous species that are the staple prey of kit foxes (Spiegel 1996), to species adapted to early successional stages and disturbed areas (e.g., California ground squirrels)(Spiegel 1996). Because more than 70 percent of the diets of kit foxes usually consist of abundant leporids (*Lepus, Sylvilagus*) and rodents (e. g., *Dipodomys* spp.), and kit foxes often continue to feed on their staple prey during ephemeral periods of prey scarcity, such changes in the availability and selection of foraging sites by kit foxes could influence their reproductive rates, which are strongly influenced by food supply and decrease during periods of prey scarcity (White and Garrott 1997, 1999).

Extensive habitat destruction and fragmentation have contributed to smaller, more-isolated populations of kit foxes. Small populations have a higher probability of extinction than larger populations because their low abundance renders them susceptible to stochastic (i.e., random) events such as high variability in age and sex ratios, and catastrophes such as floods, droughts, or disease epidemics (Lande 1988, Frankham and Ralls 1998, Saccheri *et al.* 1998). Similarly, isolated populations are more susceptible to extirpation by accidental or natural catastrophes because their recolonization has been hampered. These chance events can adversely affect small, isolated populations with devastating results. Extirpation can even occur when the members of a small population are healthy, because whether the population increases or decreases in size is less dependent on the age-specific probabilities of survival and reproduction than on raw chance (sampling probabilities). Owing to the probabilistic nature of extinction, many small populations will eventually lose out and go extinct when faced with these stochastic risks (Caughley and Gunn 1995).

Oil fields in the southern half of the San Joaquin Valley also continue to be an area of expansion and development activity. This expansion is reasonably certain to increase in the near future

owing to market-driven increases in the price of oil. The cumulative and long-term effects of oil extraction activities on kit fox populations are not fully known, but recent studies indicate that moderate- to high-density oil fields may contribute to a decrease in carrying capacity for kit foxes owing to habitat loss or changes in habitat characteristics (Spiegel 1996, Warrick and Cypher 1998). There are no limiting factors or regulations that are likely to retard the development of additional oil fields. Hence, it is reasonably certain that development will continue to destroy and fragment kit fox habitat into the foreseeable future.

Competitive Interactions with Other Canids

Several species prey upon San Joaquin kit foxes. Predators (such as coyotes, bobcats, non-native red foxes, badgers, and golden eagles [*Aquila chrysaetos*]) will kill kit foxes. Badgers, coyotes, and red foxes also may compete for den sites (Service 1998). The diets and habitats selected by coyotes and kit foxes living in the same areas are often quite similar (Cypher and Spencer 1998). Hence, the potential for resource competition between these species may be quite high when prey resources are scarce such as during droughts (which are quite common in semi-arid, central California). Land conversions and associated human activities have led to changes in the distribution and abundance of coyotes, which compete with kit foxes for resources.

Coyotes occur in most areas with abundant populations of kit foxes and, during the past few decades, coyote abundance has increased in many areas owing to a decrease in ranching operations, favorable landscape changes, and reduced control efforts (Orloff *et al.* 1986, Cypher and Scrivner 1992, White and Ralls 1993, White *et al.* 1995). Coyotes may attempt to lessen resource competition with kit foxes by killing them. Coyote-related injuries accounted for 50-87 percent of the mortalities of radio collared kit foxes at Camp Roberts, the Carrizo Plain Natural Area, the Lokern Natural Area, and the Naval Petroleum Reserves (Cypher and Scrivner 1992, Standley *et al.* 1992, Ralls and White 1995, Spiegel 1996). Coyote-related deaths of adult foxes appear to be largely additive (i.e., in addition to deaths caused by other mortality factors such as disease and starvation) rather than compensatory (i.e., tending to replace deaths due to other mortality factors; White and Garrott 1997). Hence, the survival rates of adult foxes decrease significantly as the proportion of mortalities caused by coyotes increase (Cypher and Spencer 1998, White and Garrott 1997), and increases in coyote abundance may contribute to significant declines in kit fox abundance (Cypher and Scrivner 1992, Ralls and White 1995, White *et al.* 1996). There is some evidence that the proportion of juvenile foxes killed by coyotes increases as fox density increases (White and Garrott 1999). This density-dependent relationship would provide a feedback mechanism that reduces the amplitude of kit fox population dynamics and keeps foxes at lower densities than they might otherwise attain. In other words, coyote-related mortalities may dampen or prevent fox population growth, and accentuate, hasten, or prolong population declines.

Land-use changes also contributed to the expansion of nonnative red foxes into areas inhabited by kit foxes. Historically, the geographic range of the red fox did not overlap with that of the San Joaquin kit fox. By the 1970's, however, introduced and escaped red foxes had established breeding populations in many areas inhabited by San Joaquin kit foxes (Lewis *et al.* 1993). The larger and more aggressive red foxes are known to kill kit foxes (Ralls and White 1995), and

could displace them, as has been observed in the arctic when red foxes expanded into the ranges of smaller arctic foxes (Hersteinsson and Macdonald 1982). The increased abundance and distribution of nonnative red foxes will also likely adversely affect the status of kit foxes because they are closer morphologically and taxonomically, and would likely have higher dietary overlap than coyotes; potentially resulting in more intense competition for resources. Two documented deaths of kit foxes due to red foxes have been reported (Ralls and White 1995), and red foxes appear to be displacing kit foxes in the northwestern part of their range (Lewis *et al.* 1993). At Camp Roberts, red foxes have usurped several dens that were used by kit foxes during previous years (California Army National Guard, Camp Roberts Environmental Office, unpubl. data). In fact, opportunistic observations of red foxes in the cantonment area of Camp Roberts have increased 5-fold since 1993, and no kit foxes have been sighted or captured in this area since October 1997. Also, a telemetry study of sympatric red foxes and kit foxes in the Lost Hills area has detected spatial segregation between these species, suggesting that kit foxes may avoid or be excluded from red fox-inhabited areas (P. Kelly, Endangered Species Recovery Program, Fresno, pers. comm. to P. White, Fish and Wildlife Service, Sacramento, April 6, 2000). Such avoidance would limit the resources available to local populations of kit foxes and possibly result in decreased fox abundance and distribution.

Disease

Wildlife diseases do not appear to be a primary mortality factor that consistently limits kit fox populations throughout their range (McCue and O'Farrell 1988, Standley and McCue 1992). However, central California has a high incidence of wildlife rabies cases (Schultz and Barrett 1991), and high seroprevalences of canine distemper virus and canine parvovirus indicate that kit fox populations have been exposed to these diseases (McCue and O'Farrell 1988; Standley and McCue 1992). Hence, disease outbreaks could potentially cause substantial mortality or contribute to reduced fertility in seropositive females, as was noted in closely-related swift foxes (*Vulpes velox*).

For example, there are some indications that rabies virus may have contributed to a catastrophic decrease in kit fox abundance at Camp Roberts, San Luis Obispo County, California, during the early 1990's. San Luis Obispo County had the highest incidence of wildlife rabies cases in California during 1989 to 1991, and striped skunks (*Mephitis mephitis*) were the primary vector (Barrett 1990, Schultz and Barrett 1991, Reilly and Mangiamele 1992). A rabid skunk was trapped at Camp Roberts during 1989 and two foxes were found dead due to rabies in 1990 (Standley *et al.* 1992). Captures of kit foxes during annual live trapping sessions at Camp Roberts decreased from 103 to 20 individuals during 1988 to 1991. Captures of kit foxes were positively correlated with captures of skunks during 1988 to 1997; suggesting that some factor(s) such as rabies virus was contributing to concurrent decreases in the abundances of these species. Also, captures of kit foxes at Camp Roberts were negatively correlated with the proportion of skunks that were rabid when trapped by County Public Health Department personnel two years previously. These data suggest that a rabies outbreak may have occurred in the skunk population and spread into the fox population. A similar time lag in disease transmission and subsequent population reductions was observed in Ontario, Canada, although in this instance the transmission was from red foxes to striped skunks (Macdonald and Voigt 1985).

Pesticides and Rodenticides

Pesticides and rodenticides pose a threat to kit foxes through direct or secondary poisoning. Kit foxes may be killed if they ingest rodenticide in a bait application, or if they eat a rodent that has consumed the bait. Even sublethal doses of rodenticides may lead to the death of these animals by impairing their ability to escape predators or find food. Pesticides and rodenticides may also indirectly affect the survival of kit foxes by reducing the abundances of their staple prey species.

For example, the California ground squirrel, which is the staple prey of kit foxes in the northern portion of their range, was thought to have been eliminated from Contra Costa County in 1975, after extensive rodent eradication programs. Field observations indicated that the long-term use of ground squirrel poisons in this county severely reduced kit fox abundance through secondary poisoning and the suppression of populations of its staple prey (Orloff *et al.* 1986).

Kit foxes occupying habitats adjacent to agricultural lands are also likely to come into contact with insecticides applied to crops owing to runoff or aerial drift. Kit foxes could be affected through direct contact with sprays and treated soils, or through consumption of contaminated prey. Data from the California Department of Pesticide Regulation indicate that acephate, aldicarb, azinphos methyl, bendiocarb, carbofuran, chlorpyrifos, endosulfan, s-fenvalerate, naled, parathion, permethrin, phorate, and trifluralin are used within one mile of kit fox habitat. A wide variety of crops (alfalfa, almonds, apples, apricots, asparagus, avocados, barley, beans, beets, bok choy, broccoli, cantaloupe, carrots, cauliflower, celery, cherries, chestnuts, chicory, Chinese cabbage, Chinese greens, Chinese radish, collards, corn, cotton, cucumbers, eggplants, endive, figs, garlic, grapefruit, grapes, hay, kale, kiwi fruit, kohlrabi, leeks, lemons, lettuce, melons, mustard, nectarines, oats, okra, olives, onions, oranges, parsley, parsnips, peaches, peanuts, pears, peas, pecans, peppers, persimmons, pimentos, pistachios, plums, pomegranates, potatoes, prunes, pumpkins, quinces, radishes, raspberries, rice, safflower, sorghum, spinach, squash, strawberries, sugar beets, sweet potatoes, Swiss chard, tomatoes, walnuts, watermelons, and wheat), as well as buildings, Christmas tree plantations, commercial/industrial areas, greenhouses, nurseries, landscape maintenance, ornamental turf, rangeland, rights of way, and uncultivated agricultural and non-agricultural land, occur in close proximity to San Joaquin kit fox habitat.

Efforts have been underway to reduce the risk of rodenticides to kit foxes (Service 1993). The Federal government began controlling the use of rodenticides in 1972 with a ban of Compound 1080 on Federal lands pursuant to Executive Order. Above-ground application of strychnine within the geographic ranges of listed species was prohibited in 1988. A July 28, 1992, biological opinion regarding the Animal Damage Control (now known as Wildlife Services) Program by the U.S. Department of Agriculture found that this program was likely to jeopardize the continued existence of the kit fox owing to the potential for rodent control activities to take the fox. As a result, several reasonable and prudent measures were implemented, including a ban on the use of M-44 devices, toxicants, and fumigants within the recognized occupied range of the kit fox. Also, the only chemical authorized for use by Wildlife Services within the occupied

range of the kit fox was zinc phosphide, a compound known to be minimally toxic to kit foxes (Service 1993).

Despite these efforts, the use of other pesticides and rodenticides still pose a significant threat to the kit fox, as evidenced by the death of 2 kit foxes at Camp Roberts in 1992 owing to secondary poisoning from chlorophacinone applied as a rodenticide, (Berry *et al.* 1992, Standley *et al.* 1992). Also, the livers of 3 foxes that were recovered in the City of Bakersfield during 1999 were found to contain detectable residues of the anticoagulant rodenticides chlorophacinone, brodifacoum, and bromadiolone (California Department of Fish and Game 1999).

To date, no specific research has been conducted on the effects of different pesticide or rodent control programs on the kit fox (Service 1998). This lack of information is problematic because Williams (in lit., 1989) documented widespread pesticide use in known kit fox and Fresno kangaroo rat habitat adjoining agricultural lands in Madera County. In a separate report, Williams (in lit., 1989) documented another case of pesticide use near Raisin City, Fresno County, where treated grain was placed within an active Fresno kangaroo rat precinct. Also, farmers have been allowed to place bait on Bureau of Reclamation property to maximize the potential for killing rodents before they entered adjoining fields (Biological Opinion for the Interim Water Contract Renewal, Ref. No. 1-1-00-F-0056, February 29, 2000).

A September 22, 1993, biological opinion issued by the Service to the Environmental Protection Agency (EPA) regarding the regulation of pesticide use (31 registered chemicals) through administration of the Federal Insecticide, Fungicide, and Rodenticide Act found that use of the following chemicals would likely jeopardize the continued existence of the kit fox: (1) aluminum and magnesium phosphide fumigants; (2) chlorophacinone anticoagulants; (3) diphacinone anticoagulants; (4) pival anticoagulants; (5) potassium nitrate and sodium nitrate gas cartridges; and (6) sodium cyanide capsules (Service 1993). Reasonable and prudent alternatives to avoid jeopardy included restricting the use of aluminum/magnesium phosphide, potassium/sodium nitrate within the geographic range of the kit fox to qualified individuals, and prohibiting the use of chlorophacinone, diphacinone, pival, and sodium cyanide within the geographic range of the kit fox, with certain exceptions (e.g., agricultural areas that are greater than 1 mile from any kit fox habitat)(Service 1999).

Endangered Species Act Section 9 Violations and Noncompliance with the Terms and Conditions of Existing Biological Opinions

The intentional or unintentional destruction of areas occupied by kit foxes is an issue of serious concern. Section 9 of the Act prohibits the "take" (e.g., harm, harass, pursue, injure, kill) of federally-listed wildlife species. "Harm" (i.e., "take") is further defined to include habitat modification or degradation that kills or injures wildlife by impairing essential behavioral patterns including breeding, feeding, or sheltering. Congress established two provisions (under sections 7 and 10 of the Act) that allow for the "incidental take" of listed species of wildlife by Federal agencies, non-Federal government agencies, and private interests. Incidental take is defined as "incidental to, and not the purpose of, the carrying out of an otherwise lawful activity." Such take requires a permit from the Secretary of the Interior that anticipates a specific

level of take for each listed species. If no permit is obtained for the incidental take of listed species, the individuals or entities responsible for these actions could be liable under the enforcement provisions of potential section 9 of the Act if any unauthorized take occurs.

Risk of Chance Extinction Owing to Small Population Size, Isolation, and High Natural Fluctuations in Abundance

Historically, kit foxes may have existed in a metapopulation structure of core and satellite populations, some of which periodically experienced local extinctions and recolonization (Service 1998). Today's populations exist in an environment drastically different from the historic one, however, and extensive habitat fragmentation will result in geographic isolation, smaller population sizes, and reduced genetic exchange among populations; all of which increase the vulnerability of kit fox populations to extirpation. Populations of kit foxes are extremely susceptible to the risks associated with small population size and isolation because they are characterized by marked instability in population density. For example, the relative abundance of kit foxes at the Naval Petroleum Reserves, California, decreased 10-fold during 1981 to 1983, increased 7-fold during 1991 to 1994, and then decreased 2-fold during 1995 (Cypher and Scrivner 1992, Cypher and Spencer 1998).

Many populations of kit fox are at risk of chance extinction owing to small population size and isolation. This risk has been prominently illustrated during recent, drastic declines in the populations of kit foxes at Camp Roberts and Fort Hunter Liggett. Captures of kit foxes during annual live trapping sessions at Camp Roberts decreased from 103 to 20 individuals during 1988 to 1991. This decrease continued through 1997 when only three kit foxes were captured (White *et al.* 2000). A similar decrease in kit fox abundance occurred at nearby Fort Hunter Liggett, and only 2 kit foxes have been observed on this installation since 1995 (L. Clark, Wildlife Biologist, Fort Hunter Liggett, pers. comm. to P. White, Service, Sacramento, February 15, 2000). It is unlikely that the current low abundances of kit foxes at Camp Roberts and Fort Hunter Liggett will increase substantially in the near future owing to the limited potential for recruitment. The chance of substantial immigration is low because the nearest core population on the Carrizo Plain is distant (greater than 16 miles) and separated from these installations by barriers to kit fox movement such as roads, developments, and irrigated agricultural areas. Also, there is a relatively high abundance of sympatric predators and competitors on these installations that contribute to low survival rates for kit foxes and, as a result, may limit population growth (White *et al.* 2000). Hence, these populations may be on the verge of extinction.

The destruction and fragmentation of habitat could also eventually lead to reduced genetic variation in populations of kit foxes that are small and geographically isolated. Historically, kit foxes likely existed in a metapopulation structure of core and satellite populations, some of which periodically experienced local extinctions and recolonization (Service 1998). Preliminary genetic assessments indicate that historic gene flow among populations was quite high, with effective dispersal rates of at least one to 4 dispersers per generation (M. Schwartz, University of Montana, Missoula, pers. comm. on March 23, 2000, to P. White, Service, Sacramento, California). This level of genetic dispersal should allow for local adaptation while preventing the loss of any rare alleles. Based on these results, it is likely that northern populations of kit foxes

were once panmictic (i.e., randomly mating in a genetic sense), or nearly so, with southern populations. In other words, there were no major barriers to dispersal among populations.

Current levels of gene flow also appear to be adequate, however, extensive habitat loss and fragmentation continues to form more or less geographically distinct populations of foxes, which could potentially reduce genetic exchange among them. An increase in inbreeding and the loss of genetic variation could increase the extinction risk for small, isolated populations of kit foxes by interacting with demography to reduce fecundity, juvenile survival, and lifespan (Lande 1988, Frankham and Ralls 1998, Saccheri *et al.* 1998).

An area of particular concern is Santa Nella in western Merced County where pending development plans threaten to eliminate the little suitable habitat that remains and provides a dispersal corridor for kit foxes between the northern and southern portions of their range. Preliminary estimates of expected heterozygosity from foxes in this area indicate that this population may already have reduced genetic variation.

Other populations that may be showing the initial signs of genetic isolation are the Lost Hills area and populations in the Salinas-Pajaro River watershed (i.e., Camp Roberts and Fort Hunter Liggett). Preliminary estimates of the mean number of alleles per locus from foxes in these populations indicate that allelic diversity is lower than expected. Although these results may, in part, be due to the small number of foxes sampled in these areas, they may also be indicative of an increase in the amount of inbreeding due to population subdivision (M. Schwartz, University of Montana, Missoula, pers. comm. on March 23, 2000, to P. J. White, Fish and Wildlife Service, Sacramento, California). Further sampling and analyses are necessary to adequately assess the effects of these potential genetic bottlenecks.

Arid ecosystems systems are characterized by unpredictable fluctuations in precipitation, which lead to high frequency, high amplitude fluctuations in the abundance of mammalian prey for kit foxes (Goldingay *et al.* 1997, White and Garrott 1999). Because the reproductive and neonatal survival rates of kit foxes are strongly depressed at low prey densities (White and Ralls 1993; White and Garrott 1997, 1999), periods of prey scarcity owing to drought or excessive rain events can contribute to population crashes and marked instability in the abundance and distribution of kit foxes (White and Garrott 1999). In other words, unpredictable, short-term fluctuations in precipitation and, in turn, prey abundance can generate frequent, rapid decreases in kit fox density that increase the extinction risk for small, isolated populations.

The primary goal of the recovery strategy for kit foxes identified in the Recovery Plan is to establish a complex of interconnected core and satellite populations throughout the species' range. The long-term viability of each of these core and satellite populations depends partly upon periodic dispersal and genetic flow between them. Therefore, kit fox movement corridors between these populations must be preserved and maintained. In the northern range, from the Ciervo Panoche in Fresno County northward, kit fox populations are small and isolated, and have exhibited significant decline. The core populations are the Ciervo Panoche area, the Carrizo Plain area, and the western Kern County population, as shown on Figure 10 (enclosed). Satellite populations are found in the urban Bakersfield area, Porterville/Lake Success area, Creighton

Ranch/Pixley Wildlife Refuge, Allensworth Ecological Reserve, Semitropic/Kern National Wildlife Refuge (NWR), Antelope Plain, eastern Kern grasslands, Pleasant Valley, western Madera County, Santa Nella, Kesterson NWR, and Contra Costa County. Major corridors connecting these population areas are on the east and west side of the San Joaquin Valley, around the bottom of the Valley, and cross-valley corridors in Kern, Fresno, and Merced counties.

In response to the drastic loss of habitat and steadily increasing fragmentation, California Department of Transportation and the Service convened a San Joaquin Kit Fox Conservation and Planning Team to address the rapid decline of kit fox habitat in the northern range, and increasing barriers to kit fox dispersal. Consisting of Federal, State, and local agencies, local land trusts, environmental groups, researchers, and other concerned individuals, the goal of this team was to coordinate agency actions that will recover the species, and troubleshoot threats to San Joaquin kit foxes as they emerge. Between the years 2001-2003, the team addressed connectivity issues at specific points along the west-side corridor north of the Ciervo Panoche core population.

There are recent records of the San Joaquin kit fox in the project area (California Department of Fish and Game 2004). The biological assessment contains data collected by California Department of Transportation biologists who observed San Joaquin kit fox(es) from July 2000 to May 2001 on nine separate occasions within in the project study area. The observations were made near the potential impact area of the project. Suitable foraging habitat for the San Joaquin kit fox in the form of ruderal and agricultural habitat is located within the action area. Given the recent sightings of the listed canine, biology and ecology of the animal, the presence of suitable habitat in the action area, and the fact that San Joaquin kit fox has been documented to move 9 miles or more in a single night, the Service believes that it is reasonable to assume that this species inhabits the action area.

Mountain Plover

The mountain plover was proposed for Federal listing as threatened on February 16, 1999 (64 **FR** 7587). The mountain plover is about 9 inches in length, and is slightly smaller than the killdeer, both of which are in the plover family (Charadriidae). The mountain plover is drab and brownish in winter, the season when it can be found in California's Central Valley. Breeding occurs in the summer in the western plains states. California lists the mountain plover as a Species of Special Concern.

The mountain plover is associated with shortgrass and shrub-steppe landscapes throughout its breeding and wintering range. Mountain plovers evolved on grasslands populated by large numbers of grazing animals such as the bison, pronghorn, and elk, and inhabited by burrowing animals such as kangaroo rats, badgers, and prairie dogs (Knopf 1996a). These herbivores dominated both the wintering and breeding areas, and their grazing, wallowing, and burrowing activities created and maintained a mosaic of vegetated and bare areas to which the mountain plover became adapted (Dobkin 1994, Knopf 1996a). Unlike most plovers, mountain plovers are rarely found near water. Habitat in its wintering grounds includes open fields, heavily denuded areas, and other open areas. Mountain plovers forage for insects and can be seen running rapidly

along the ground and suddenly stopping. Although cultivated land is used by plovers, Knopf and Rupert (1995) found that plovers showed a preference for alkali flats, burned grasslands, and grazed annual grasslands to cultivated sites. Mountain plovers spend about five months in wintering habitat, and begin leaving winter habitat about mid-march (Knopf and Rupert 1995, 1996).

In California, mountain plovers are use habitat that is also commonly used by the federally listed giant kangaroo rat and blunt-nosed leopard lizard. Mountain plovers also occur on cultivated lands and so farms. However, research in the San Joaquin, California has determined that while mountain plovers are commonly seen on agricultural lands, they actually prefer the remaining natural landscapes to the agricultural lands.

Historical and current distribution: Mountain plovers spend the summer in the Great Plains, and migrate across the Rocky Mountains in both spring and fall. Historically, mountain plovers have been observed wintering in California, Arizona, Texas, Nevada, the coastal islands of San Clemete Island, Santa Rosa Island and the Farallon Islands (Strecker 1912, Swarth 1914, Alcorn 1946, Jurek 1973, Garrett and Dunn 1981, Jorenson and Ferguson 1984). In Mexico, wintering mountain plovers have been spotted in Baja California, Chihuahua, Coahilla, Sonora, Nuevo Leon, and San Luis Potosi (Russell and Lamm 1978).

Winter range of the mountain plover is primarily in the Sacramento, San Joaquin, and Imperial valleys of California and approximately 90 percent of mountain plovers are frequently reported from two areas – the Central Valley west of Highway 99 and south of Sacramento, and the Imperial Valley of southern California. Throughout these areas, sightings occur on agricultural fields and noncultivated sites; noncultivated sites are preferred habitat (Knopf and Rupert 1995). 0Within the Central Valley, flocks of up to 1,100 birds have been seen recently in Tulare County (Knopf and Rupert 1995). The Carrizo Plain Natural Area in San Luis Obispo County also is recognized as an important wintering site, with wintering birds reliably reported from the west side of the Carrizo Plain Natural Area since 1971 (S. Fitton, in litt., 1992). The Sacramento Valley portion of the Central Valley also provides wintering habitat for flocks of mountain plovers within Solano and Yolo Counties. During the 1998 census, 230 and 187 mountain plovers were observed within each of these counties, respectively (Hunting and Fitton, in press). Wintering populations of plovers in California have been declining (Garrett and Dunn 1981, Andrews and Righter 1992).

Reasons for decline: Breeding Bird Surveys from 1966-1987 show a 61 percent range wide decline in mountain plover populations. Conversions of grassland habitat, agricultural practices (including heavy pesticide use), livestock management practices, and the decline of native herbivores are factors that have likely contributed to the decline of mountain plover populations. In particular, pesticides are applied to mountain plover wintering areas while plovers are present (Knopf 1996b). Secondary effects of pesticides on breeding behavior and reproductive success may also be contributing to the population decline. Shorebird and mountain plover habitat contamination in the San Joaquin valley and the Grasslands Ecological Area has occurred from agricultural drain water used to flood wetlands and resulted in biological accumulation of

selenium sufficient to harm reproduction of shorebirds and other wildlife (Ohlendorf et al. 1987).

Mountain plovers are attracted to sites that are heavily disturbed by grazing and burning. Consequently, mountain plovers are found on sites that are heavily grazed, have been burned to manipulate the vegetative structure and composition, or that have been cultivated in the spring. The most recent data show that the type of implement used for tillage and the timing of tillage are important factors in mountain plover survival on cultivated lands.

Environmental Baseline: Most of the California wintering mountain plovers, principally in the San Joaquin Valley, an area experiencing high rates of human population growth. Today, the mountain plover is considered endangered in Canada, a species of special interest or concern in Montana and Oklahoma, extirpated in North Dakota and South Dakota, on the watch list in Kansas, threatened in Nebraska, and proposed as threatened in California. The U. S. Fish and Wildlife Service is considering listing the mountain plover as endangered or threatened throughout its range. Current population trends estimate mountain plover numbers to be less that 10,000, and the population has declined by at least 50 percent since 1966, according to 30 years of Breeding Bird Survey data, which is the highest rate of decline of any other grassland bird.

On wintering grounds in California, as many as 10,000 mountain plovers were repeatedly counted in the San Joaquin Valley during the 1960's (J. Engler, U.S. Fish and Wildlife Service, in litt., 1992). The 1998 California Bird Census found a total of 2,179 mountain plovers in 10 California counties, including Imperial, Kings, Los Angeles, Monterey, Riverside, San Benito, San Luis Obispo, San Bernardino, Solano, and Yolo Counties (Hunting and Fitton, 1999). Plovers are believed also to winter in portions of Kern County.

Effects of the Proposed Action

San Joaquin kit fox

Limited-value foraging habitat for the San Joaquin kit fox exists within the potential impact area. However, denning habitat or other refugia is not widely available. San Joaquin kit foxes have recently been sighted to the east and west of the PIA, but no evidence exists to date that shows kit foxes are migrating across the valley floor. Large, unplowed grassland habitat blocks are located along Sandy Mush Road west of the proposed project. (Appendix B) These habitat blocks are some of the last remaining in this portion of the Central Valley. For this reason, the USFWS has proposed to recover a kit fox east-west migration corridor identified as a Level 2 recovery priority in the USFWS Recovery Plan for Upland Species (USFWS 1998). Through parcel acquisition and easement agreements with local farmers USFWS plans to provide the kit fox with a patchwork of safe haven parcels that would allow populations on each side of the valley to merge. The proposed Plainsburg/Arboleda Freeway Project would potentially restrict kit fox migration across the valley floor unless appropriate mitigation measures are implemented.

The San Joaquin kit fox will be adversely affected by the construction of the roadway and associated structures on 700 acres of its foraging, denning, and travel corridor habitat. San Joaquin kit foxes inhabiting the project area and surrounding vicinity (for purposes of this

biological opinion the surrounding vicinity is described as 1000 feet outside and adjacent to the project footprint) are likely to be subject to indirect effects including temporary harassment from noise associated with project activities and human presence, and a reduction in natural food sources as a result of habitat disturbance.

The likelihood of direct mortality to San Joaquin kit foxes from either crushing or entombment in dens is low because of avoidance measures included in the project description. San Joaquin kit foxes may be adversely affected by vehicle strikes, and harassment from noise and vibration. The listed canine also may be adversely affected by construction activities temporarily blocking travel corridors in grassland and agricultural areas, or by evening construction activities disturbing night time foraging, falling into trenches or pits, being shot, being buried after becoming trapped in pipes, injured or killed by pet cats or dogs owned by construction related personnel, poisoned by rodenticides, and injured or killed by predators attracted to construction-related food or trash at the site.

The range-wide habitat loss, fragmentation, and degradation from multiple factors are the primary threat to the survival and recovery of the San Joaquin kit fox (U.S. Fish and Wildlife Service 1998). Approximately 95% of native habitat for the kit fox in the San Joaquin Valley has been destroyed by agricultural, industrial, and urban development (Service 1998). Loss of natural lands continues to occur, further reducing its habitat.

The amount of habitat loss directly attributable to roads has not been calculated. Estimates of the area occupied by roads under the jurisdiction of California Department of Transportation include 3,669 acres for Kern County, 591 acres for Kings County, 1,065 acres for Merced County, and 2,019 acres for Fresno County (Cypher 2000). These estimates are based on a standard lane width of 11.8 feet. Though not all areas included in this estimate are kit fox habitat, the estimates may nonetheless under represent the effects of roads as these totals do not include road shoulders, medians, or associated developments (e.g., interchanges, signs, drain facilities, weigh stations); nor do they include the area occupied by county and city roads. Furthermore, the above totals do not reflect the arrangement or density of San Joaquin Valley roads or the traffic volume on these roads.

The importance of road density to the ecological effects on species is indicated by research coordinated at the national level. The National Academy of Science (NAS) has formed a committee to review the scientific findings pertaining to road density. The NAS committee is focusing on hard-surfaced roads and will assess data and ecological indicators needed to measure effects, including cumulative effects. The NAS committee will produce a conceptual framework for the development of a rapid assessment methodology that transportation and regulatory agencies can use to assess and measure the ecological impact of road density (NAS 2003). The project is being sponsored by the Federal Highways Administration.

Although the effects of road density are unstudied relative to the San Joaquin kit fox, road density appears to adversely affect other diminishing species, for example wolves (*Canus lupis*) and mountain lions (*Felis concolor*). According to Forman *et al.* (2003), wolves in Minnesota, Wisconsin, and Michigan and mountain lions in Utah appear to thrive only where road density is

less than 1.0 mile/square mile. In an examination of radio-collared wolves in Wisconsin, a total of 60% of human-induced mortality occurred at road densities above 1.0 mile/square mile (Wydeven *et al.* 2001). In areas where road density is high, San Joaquin kit fox are likely to be adversely affected by several factors including direct mortality due to vehicle strikes, alteration of behavior patterns due to road and road zone avoidance, road barrier effects which reduce reproductive potential due to the inaccessibility of mates, prey, and shelter. Additionally roads are documented as serving as conduits for invasion by non-native plants and animals as well as the means by which contaminants and toxins are introduced to habitat.

Habitat Fragmentation

The area or diameter of patches enclosed within a network, referred to by Forman *et al.* (2003) as mesh size, is inversely related to road density. As road density increases, mesh size decreases. As the landscape becomes more fragmented, the fragments become progressively smaller (Forman *et al.* 2003). Patches within dense road networks are constrained in terms of ecosystem functioning and are thus degraded. As patches become progressively smaller, they become unsuitable to support the San Joaquin kit fox and its prey.

If a habitat fragment is too small to support a home range, animals may abandon it. Abandonment increases the probability that the animals will be extirpated from each patch. Estimates of home range size for the San Joaquin kit fox vary from 1.7 square miles to 4.5 square miles (White and Ralls 1993). Typically, a mated pair will share a home range. As mesh size becomes smaller, the patches themselves can function as barriers with habitat degraded to the point that it offers little in the way of foraging grounds or refuge from predators. These remnant patches interrupt dispersal corridors and reduce genetic exchange and mating opportunities.

Road density and mesh size are directly related to the total surface area occupied by roads in a given region. On a local scale, the surface area of a road may be the major contributor to adverse effects to San Joaquin kit foxes depending on lane width and kit fox occupation of or dispersal through adjacent habitat.

Direct Mortality

San Joaquin kit fox mortality and injury occurs when the animals attempt to cross roads and are hit by cars, trucks, or motorcycles. The majority of strikes likely occur at night when the animals are most active. Such strikes are usually fatal for an animal the size of a kit fox. If vehicle strikes are sufficiently frequent in a given locality, they could result in reduced kit fox abundance. The death of kit foxes during the December through March breeding season could result in reduced reproductive success. Death of females during gestation or prior to pup weaning could result in the loss of an entire litter of young, and therefore, reduced recruitment of new individuals into the population.

The local and range-wide effects of vehicle strikes on San Joaquin kit foxes have not been adequately assessed. Vehicle strikes appear to occur most frequently where roads transverse areas where kit foxes are abundant. However, the linear quantity of roads in a given area may not

be directly related to the number of vehicle strikes in a given area. The type of road (e.g., number of lanes) traffic volume, and average speed of vehicles likely all influence the number of vehicle strikes for which San Joaquin kit foxes are as risk. The number of strikes likely increases with road size, traffic volume, and average speed (Clevenger and Waltho 1999). Another factor influencing the number of vehicles striking San Joaquin kit foxes, but for which little data is available, is the frequency with which the animals cross roads and are therefore at risk. The proportion of successful road crossings by these animals likely declines with increasing road size, traffic volume and density, and vehicle speeds. The proportion of San Joaquin kit foxes successfully crossing roads may increase in areas where they obtain more experience crossing roads, such as in and near urban areas.

Occurrences of vehicle strikes involving San Joaquin kit foxes have been well documented, and such strikes occur throughout the range of the species. Sources of kit fox mortality were examined during the period 1980-1995 at the Naval Petroleum Reserves in California in western Kern County (Cypher *et al.* 2000). During this period, 341 adult San Joaquin kit foxes were monitored using radio telemetry, and 225 of these animals were recovered dead. Of these, 20, or 9% were struck and killed by vehicles. During this same period, 184 juvenile (<1 year old) kit foxes were monitored. Of these, 142 were recovered dead and 11 or 8%were killed by vehicles. For both adults and juveniles, vehicle strikes accounted for less than 10% of all San Joaquin kit fox deaths in most years. However, in some years, vehicles accounted for about 20% of deaths. Predators, primarily coyotes and bobcats, were the primary source of mortality at the Naval Petroleum Reserves. In addition, 70 kit foxes, both radio collared and non-collared, were found dead on roads in and around the Naval Petroleum Reserves during the period 1980-1991 (Scrivner *et al.* 1993). Of these, 34 were hit by vehicles on the approximately 1,600 km (990 miles) of roads at the Reserve, and 36 were struck on the approximately 80 km (50 miles) of State and County roads (e.g., State Route 119, Elk Hills Road), where traffic volumes and average vehicle speeds were higher than those on the Reserve.

In other areas of western Kern County, 49 kit foxes were radio-collared in the highly developed Midway-Sunset oil field, and 54 kit foxes were radio-collared in the Lokern Natural Area, a nearby undeveloped area, during the period 1989-1993 (Spiegel and Disney 1996). Of these animals, 60 were recovered dead; 1 (2%) was killed by a vehicle, and it was found in an undeveloped area along the access road adjacent to the California Aqueduct. Though six non-collared kit foxes were killed by vehicles on the access road, predators, primarily coyotes, bobcats, and feral dogs were responsible for most deaths in this study. Forty-one San Joaquin kit foxes were radio-collared and monitored during 1989-1991 on the Carrizo Plain National Monument in eastern San Luis Obispo County (Ralls and White 1995). Twenty-two were found dead; 1 (5%) was attributed to a vehicle strike. At the Camp Roberts National Guard Training Facility in Monterey and San Luis Obispo counties, 94 San Joaquin kit foxes were radio-collared during the period 1988-1992 (Standley *et al.* 1992). Forty-nine were found dead of which two were attributed to vehicle strikes. In western Merced County, 28 San Joaquin kit foxes were radio-collared during the period 1985-1987 (Briden *et al.* 1992). Seventeen were found dead and two (12%) of these deaths were attributed to vehicles.

According to Morrell (1970), "The automobile is by far the major cause of reported San Joaquin kit fox deaths - 128 of 152 deaths reported were caused by automobiles." Morrell acknowledged that the numbers were based on non-radio-collared kit foxes and therefore were biased because road-killed foxes are conspicuous and easily observed compared to animals dying from other causes. Though predators such as coyotes, bobcats, non-native red foxes, and domestic dogs likely constitute a higher source of mortality than vehicle strikes (Service 1998; Cypher 2000), predation as a source of mortality is likely dependent upon local conditions. Where abundance of predators has also been reduced due to road density and loss of habitat, vehicle strikes may present a significant threat to kit fox survival and recovery.

Based on a study of another kit fox subspecies, Egoscue (1962) reported that eight tagged foxes (*Vulpes macrotis nevadensis*) in Utah were killed by vehicles, and five of these were pups. Pups appeared to be more vulnerable to vehicle strikes. Many of the foxes killed were residents that were using dens located near roads. O'Neal *et al.* (1987) examined 23 dead kit foxes in western Utah in 1983. None were killed by vehicles, possibly due to the remoteness of the study site.

The swift fox (*Vulpes velox*) is closely related to the San Joaquin kit fox, and is listed as endangered in Canada. They show numerous ecological similarities with the San Joaquin kit fox. Hines (1980) reported that roads were a major source of swift fox mortality in Nebraska. In Alberta, where the swift fox was extirpated and recently reintroduced, vehicles were responsible for five of 89 (6%) of the foxes found dead (Carbyn *et al.* 1994). Pups appeared to be especially vulnerable, particularly if the natal dens were located near roads (Carbyn 1998). In western Kansas, 41 adults and 24 juvenile swift foxes were radio collared and monitored during 1996-97 on two study sites (Sovada *et al.* 1998). Among the adults, 18 were found dead, but none were killed by vehicles. Among the juveniles, 14 were found dead and four (29%) of these had been struck by vehicles. All seven of the juveniles killed by vehicles were found on the same study site. This study site had 90% more roads compared to the other study site where no foxes were killed by vehicles (78 mi vs. 41 mi). At a remote site in Colorado with few roads and restricted public access, swift foxes were rarely struck by vehicles (Covell 1992; Kitchen *et al.* 1999).

Vehicle-related mortality has significantly affected other listed or rare species. Vehicles caused 49% of the mortality documented among endangered Florida panthers (*Felis concolor coryi*) (Maehr *et al.* 1991). With a remaining population of 20-30 animals, the loss of any to vehicles likely constitutes a significant population effect. Similarly, Tubak in 1999 estimated at least 15% of the remaining 250-300 key deer (*Odocileus virginianus clavium*) are killed annually by vehicles, and this mortality is considered to be a limiting factor for this endangered species (Service 1985). Mortality from vehicles was the primary source of mortality for endangered ocelots (*Felis pardalis*) in Texas (Tubak 1999), and also contributed to the failure of a lynx (*Lynx lynx*) reintroduction project in New York (Aubrey *et al.* 1999). Rudolph *et al.* (1999) estimated that road-associated mortality may have depressed populations of Louisiana pine snakes (*Pituophis ruthveni*) and timber rattlesnakes (*Crotalus horridus*) by over 50% in eastern Texas, and this mortality may be a primary factor in local extirpations of timber rattlesnakes (Rudolph *et al.* 1998). Mortality from vehicles also is contributing to the reduction in the status of the prairie garter snake (*Thamnophis radix radix*) in Ohio (Dalrymple and Reichenbach 1984), and was a limiting factor in the recovery of the endangered American crocodile (*Crocodylus acutus*) in

Florida (Kushland 1998). In Florida, threatened Florida scrub-jays (*Aphelocoma coerulescens*) suffered higher mortality in territories near roads, as well as reduced productivity due to vehicle strikes of both breeding adults and young (Mumme *et al.* 1999).

Barrier Effects

Roads constitute barriers to San Joaquin kit fox movements, dispersal, and gene flow. Movements and dispersal corridors are critical to kit fox population dynamics, particularly because the animals currently persist as metapopulations with multiple disjunct population centers. Movement and dispersal corridors are important for alleviating over-crowding and intraspecific competition during years when San Joaquin kit fox abundance is high, and also they are important for facilitating the recolonization of areas where the animal has been extirpated. Movement between population centers maintains gene flow and reduced genetic isolation. Genetically isolated populations are at greater risk of deleterious genetic effects such as inbreeding, genetic drift, and founder effects.

Roads have been documented to act as barriers to a number of species. Bobcats in Wisconsin readily crossed dirt roads, but were reluctant to cross paved roads (Lovallo and Anderson 1996). Lynx also exhibit a reluctance to cross roads (Barnum 1999) as do mountain lions (Van Dyke *et al.* 1986). In a study in North Carolina, the number of road crossings by black bears (*Ursus americanus*) was inversely related to traffic volume, and bears almost never crossed an interstate highway (Brody and Pelton 1989). Endangered Sonoran pronghorn (*Antilocarpa americana*) in Mexico are reluctant to cross a 2-lane highway, and the planned expansion of the road could further restrict movements (Castillo-Sanchez 1999). Many rodents are reluctant to cross roads (Oxley *et al.* 1974). Forman *et al.* (2003) suggests that road crossings are as much about individual behavior as they are about habitat requirements and reports that a four-lane divided highway in Canada served as a complete barrier to adult female grizzly bears (*Ursus arctos*) and a partial filter-barrier for adult male grizzlies.

Roads were found to be significant barriers to gene flow among common frogs (*Rana temporaria*) in Germany and this has resulted in genetic differentiation among populations separated by roads (Reh and Seitz 1990). Similarly, significant genetic subdivision was detected in bank vole (*Clethrionomys glarelous*) populations separated by a 164 foot wide highway in Germany (Gerlach and Musolf 2000). In California, local extinctions of mountain lions have occurred when roads and other developments fragmented habitat in small patches and blocked movement corridors thereby isolating the patches and preventing recolonization (Beier 1993).

Traffic Volume

Traffic volume influences the permeability (the likelihood of crossings) of roads and the probability for mortality due to vehicle strikes. Factors such as the width of the road, the presence of a median with or without Jersey or "K" rail concrete barriers, the velocity of the traffic, the physical nature of the approach and shoulder of the road, and the behavior of the animals attempting to cross determine probabilities for mortality. Clevenger *et al.* (2003) studying roads in Canada found that a low volume road (1,068 to 3,231 vehicles per day) resulted

in higher mortalities of small vertebrate fauna than high volume roads (14,000 to 35,000 vehicles per day). These and other results indicate that the disturbance generated from roads with high traffic volume may deter animal movements onto or across the roadway. Multi-lane roads with high traffic volume may produce the greatest barrier effect to the San Joaquin kit fox.

Knapp (1978) monitored movements of radio-collared San Joaquin kit foxes in the vicinity of Interstate 5, a divided four-lane freeway in Kern County. Many of the foxes used areas within three km (two miles) of the highway, and most exhibited movement and home range patterns that paralleled the highway, but did not cross it. Only on two occasions were animals located on the opposite side of the highway from their primary area of use.

Noise Harassment

Disturbance from the construction of minor transportation projects and from roads and road networks could induce stress in the San Joaquin kit fox which may affect physiological parameters or behavior. The resulting effects could include increased energetic requirements, decreased reproductive output, decreased immunological functions, altered space use patterns, displacement, or possibly death. Observations from a variety of sources and situations suggest that San Joaquin kit foxes may not be significantly affected by disturbance, even when the source is prolonged or continuous (Cypher 2000). However, individual animals may be more affected than others, and it is unknown whether different types of disturbance may result in reduced local abundance.

One type of disturbance that may adversely affect San Joaquin kit foxes is an increase in the ambient noise level. Minor transportation projects may result in an increase in the ambient noise level during and after project construction. Harassment from long-term noise may cause kit foxes to eventually vacate the project site and adjacent areas. Projects that have the effect of enhancing traffic flow or increasing traffic volume have the potential to result in higher associated noise levels. When traffic volume increases up to 1,000 vehicles per day, noise rises to over 50 decibels (dBA). As the speed of traffic flow increases, noise levels increase. Noise levels also increase as a result of increased truck usage. Traffic flow that includes medium to heavy trucks (i.e., six or more tires on two axles to three or more axles) noticeably increases the noise level. A heavy truck passing produces approximately 10 dBA more noise than a passing automobile (Forman *et al.* 2003). Traffic noise likely contributes to San Joaquin kit fox behaviors with regard to road avoidance and decisions as to when and where to attempt road crossings.

No specific research on the physiological effects of noise on San Joaquin kit foxes has been conducted, but a "safe, short-term level" for humans has been determined to be 75 decibels by the National Institutes of Health (NIH)(NIH 1990, Burglund and Lindvall 1995). The mechanisms leading to permanent hearing damage are the same for all mammals (NIH 1990). However, the enlarged pinna and reduced tragi of kit foxes indicate that their hearing is more acute than that of humans (Jameson and Peeters 1988). However, variation in response to intense noise has been found to vary, in humans, by as much as 30 to 50 dBA between individuals (NIH 1990). Similar variation has been found in animal studies as well (NIH 1990).

Also, younger animals have been shown to be more susceptible to noise-induced hearing loss (NIH 1990). The ability to habituate to noise appears to vary widely between species (U.S. National Park Service 1990). Typical construction machinery produces noise in the range of 75 dBA (arc-welder) to 85 dBA (bulldozer) (Burglund and Lindvall 1995).

Long-term noise levels of 85 dBA are recognized to cause permanent hearing damage in humans (NIH 1990). Noise at the 85 dBA level has been correlated with hypertension in Rhesus monkeys (*Macaca fasicularis*)(Cornman 2001). Increased reproductive failure in laboratory mice (*Mus musculus*) was found to occur after a level of 82-85 dBA for one week (Cornman 2001). However, measurable loss of hearing was found to occur in chinchillas (*Chinchilla laniger*) at a sustained level of 70 dBA (Peters 1965). Hearing loss from motorcycle traffic has been documented for the kangaroo rat (*Dipodomys* species) (Bondello and Brattstrom 1979) and desert kangaroo rats (*Dipodomys deserti*) showed a significant reduction in reaction distance to the sidewinder (*Crotalus cerastes*) after exposure to 95 dBA (Cornman 2001). Other desert mammals appear to sustain the same impacts from noise (Bondello and Brattstrom 1979). Aircraft noise has produced accelerated heart-rates in pronghorn (*Antilocapra americana*), bighorn sheep (*Ovis canadensis*), and elk (*Cervus elaphus*) (MacArthur 1976; Workman *et al.* 1992; all in U.S. National Park Service 1994).

Hearing loss is correlated with distance from the source of the noise. At a level of 110 dBA, guinea pigs (*Cavia porcellus*) suffered long-term hearing loss at distances of 25 and 50 meters, temporary loss at a distance of 100 meters, and no measurable loss at 1,500 meters (Gonzales *et al.* 1970). Over clear (i.e. unobstructed) land as in San Joaquin fox habitat, sound diminishes slightly more quickly at 6 dBA per doubling of distance:

$$(\text{noise at }) D = D_1 - 19.93 [\log (D/D_{land})],$$

(Komanoff & Shaw 2000). The effects of cumulative noise (α) are computed as the sum of the log of each component, multiplied by a magnitude of 10:

$$\alpha = 10 [\Sigma (\log A + \log B + \log C \ldots\ldots)],$$

where A, B, C, etc. are individual components of the total ambient noise. Thus, the total synergistic impact from noise will be greater than the sum of the individual components (Komanoff & Shaw 2000).

Contaminants

The presence of roads in an area could result in the introduction of chemical contaminants to the site. Contaminants could be introduced in several ways. Substances used in road building materials or to recondition roads can leach out or wash off roads adjacent to habitat. Vehicle exhaust emissions can include hazardous substances which may concentrate in soils along roads. Heavy metals such as lead, aluminum, iron, cadmium, copper, manganese, titanium, nickel, zinc, and boron are all emitted in vehicle exhaust (Trombulak and Frissell 2000). Concentrations of

organic pollutants (i.e. dioxins, polychlorinated biphenyls) are higher in soils along roads (Benfenati *et al.* 1992). Ozone levels are higher in the air near roads (Trombulak and Frissell 2000). Vehicles may leak hazardous substances such as motor oil and antifreeze. Although the quantity leaked by a given vehicle may be minute, these substances can accumulate on roads and may be washed into the adjacent environment by runoff during rain storms. An immense variety of substances, including fertilizers, pesticides, and herbicides from vehicles traveling through agricultural zones, could be introduced during accidental spills of materials. Such spills can result from small containers falling off passing vehicles, or from accidents resulting in whole loads being spilled. Large spills may be partially or completely mitigated by clean-up efforts, depending on the substance.

San Joaquin kit foxes using areas adjacent to roads could be exposed to any contaminants that are present at the site. Exposure pathways include inhalation, dermal contact, direct ingestion, ingestion of contaminated soil or plants, or consumption of contaminated prey. Exposure to contaminants may cause short- or long-term morbidity, possibly resulting in reduced productivity or mortality. Carcinogenic substances may cause genetic damage resulting in sterility, reduced productivity, or reduced fitness among progeny. Contaminants also may have the same effect on kit fox prey species. This could result in reduced prey abundance and diminished local carrying capacity for the kit fox.

Little information is available on the effects of contaminants on the San Joaquin kit fox. The effects may be difficult to detect. Morbidity or mortality likely would occur after the animals had left the contaminated site, and more subtle effects such as genetic damage could only be detected through intensive study and monitoring. However, effects have been detected on some occasions. At the Naval Petroleum Reserve, three kit foxes are known to have been killed by drowning in spills of crude oil (Cypher *et al.* 2000). Spiegel and Disney (1996) reported that a kit fox was found covered with crude oil at the Midway-Sunset oil field, and this individual died despite treatment. Other animals, some of which were prey species for the kit fox, were found drowned in crude oil at the Naval Petroleum Reserve (Scrivner *et al.* 1993). Such spills potentially can cause local reductions in the abundance of kit foxes and their prey.

Invasive Species

Construction of roads can facilitate the invasion and establishment by species not native to the area. Disturbance and alteration of habitat adjacent to roads may create favorable conditions for non-native plants and animals. Non-native plants can spread along roadsides and then into adjacent habitat (Gelbard and Harrison 2003). Non-native animals may use modified habitats adjacent to road to disperse into kit fox habitat. These exotic animals could compete with kit foxes for resources such as food or dens, or directly injure or kill kit foxes. Non-native plants and animals may reduce habitat quality for kit foxes or their prey, and reduce the productivity or the local carrying capacity for the kit fox. Introductions of non-native species could cause kit foxes to alter behavioral patterns by avoiding or abandoning areas near roads (Cypher 2000).

Disturbed areas adjacent to roads provide favorable habitat conditions for a number of non-native plant species. Some of these taxa are aggressively invasive and they can alter natural

communities and potentially affect habitat quality. A problematic species within the range of the San Joaquin kit fox is yellow star thistle (*Centaurea solstitialis*). Dense stands of this plant can form along roadsides and then spread into adjacent habitat. This plant displaces native vegetation, competes with native plants for resources, does not appear to be used by kit fox prey, exhibits dense growth, and may be difficult for kit foxes to move through due its large size (up to 3.3 feet tall), and numerous sharp spines (Cypher 2000). Other species that may disperse along roads and invade adjacent habitat include mustards (*Brassica* spp.) and Russian thistle (*Salsola tragus*)(Tellman 1997).

Disturbed soils and reduced competition from native plants are some of the conditions that facilitate invasion along roads by non-native plant species. Nitrogen from vehicle exhaust is deposited in habitats adjacent to roads, and the resulting enhanced nitrogen levels appear to promote growth of non-native species, particularly non-native grasses (Weiss 1999). These grasses, such as red brome (*Bromus madritensis rubens*) create dense ground cover in the San Joaquin Valley, and this dense cover appears to reduce habitat quality for various small mammal species, such as kangaroo rats, which are an important prey for kit foxes (Goldingay *et al.* 1997, Cypher 2000).

Roads may serve as travel corridors for non-native red foxes. Red foxes can kill San Joaquin kit foxes (Ralls and White 1995, Service 1998), and likely compete with kit foxes for food and dens. Red foxes are considered a threat to the swift fox in Canada (Carbyn 1989). Red foxes are infrequently observed in large blocks of undisturbed habitat within the range of the San Joaquin kit fox, possibly due to the absence of permanent water or the presence of coyotes which prey upon red foxes. Along roads, water availability may be higher due to pooling of precipitation runoff or human development, and coyotes may be less abundant due to the presence of humans. Roads may facilitate movements of red foxes and increase access to kit fox habitat. Non-native red foxes and feral cats (*Felis catus*) are reported to use roads as movement corridors in Australia (Bennett 1991).

Road Effect Zone

Adverse effects to wildlife populations from roads may extend some distance from the actual road. The phenomenon can result from any of the effects already described in this biological opinion (e.g. vehicle-related mortality, habitat degradation, invasive exotic species, etc.). Forman and Deblinger (2000) described the effect as the "road effect" zone. Along a 4-lane road in Massachusetts, they determined that this zone extend for an average of approximately 980 ft to either side of the road for an average total zone width of approximately 1970 feet. However, in places they detected an effect > 0.6 miles from the road. Rudolph *et al.* (1999) detected reduced snake abundance up to 2,790 feet from roads in Texas. They estimated snake abundance out to 2,790 feet, so the effect may have been greater. Extrapolating to a landscape sale, they concluded the effect of roads on snake populations in Texas likely was significant, given that approximately 79% of the land area of Texas is within 1,640 feet of a road.

Effects within the road zone can be subtle. Van der Zande *et al.* (1980) reported that lapwings (*Vanellus vanellus*) and black-tailed godwits (*Limosa limosa*) feeding at 1,575-6,560 feet from

roads were disturbed by passing vehicles. The heart rate, metabolic rate and energy expenditure of female bighorn sheep (*Ovis canadensis*) increases near roads (MacArthur *et al.* 1979). Trombulak and Frissell (2000) described another type of road zone effect. Heavy metal concentrations from vehicle exhaust were greatest within 66 feet of roads, but elevated levels of metals in both soil and plants were detected at ≥660 feet of roads. The road effect zone apparently varies with habitat type and traffic volume. Based on responses by birds, Forman (2000) estimated the effect zone along primary roads at 1,000 feet in woodlands, 1,197 feet in grasslands, and 2,657 feet in natural lands near urban areas. Along secondary roads with lower traffic volumes, the effect zone was 656 feet. The road effect zone and the San Joaquin kit fox have not been adequately investigated; however, it is possible it exists given the effects of roads on the animal.

Mountain Plover

Limited-value foraging habitat for the mountain plover exists within the potential impact area. No mountain plovers were observed during biological surveys, therefore, no mountain plover mortality is expected to result from project construction. Approximately 67 acres of suitable winter foraging habitat (annual row crops) would be permanently affected by proposed construction activities. Compensation for the San Joaquin kit fox would include land suitable as winter foraging habitat for the mountain plover.

The mountain plover will be adversely affected by the construction of the roadway and associated structures on 67 acres of its foraging habitat. Mountain plover utilizing the habitat as winter foraging areas within the project area and surrounding vicinity are likely to be subject to indirect effects including temporary harassment from noise associated with project activities and human presence, and a reduction in natural food sources as a result of habitat disturbance.

The likelihood of direct mortality to mountain plover from crushing is low because of avoidance measures included in the project description. Mountain plover may be adversely affected by vehicle strikes, and harassment from noise and vibration. This candidate species also may be adversely affected by construction activities in grassland and agricultural areas, or being injured or killed by pet cats or dogs owned by construction related personnel, poisoned by pesticides, and injured or killed by predators attracted to construction-related food or trash at the site.

Cumulative Effects

Cumulative effects include the effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Numerous non-Federal activities continue to eliminate habitat for the San Joaquin kit fox in the action area. Loss and degradation of habitat affecting both animals and plants with or without Service authorization continues as a result of: urbanization; oil and gas development on private lands; road and utility right-of-way management; flood control and water banking projects that

may not be funded, permitted, or constructed by a Federal agency; overgrazing by livestock; and continuing agricultural expansion including the building of new dairies and stockyards. Listed and proposed animal species are also affected by poisoning, shooting, increased predation associated with human development, ground squirrel reduction efforts, mosquito control, and reduction of food sources. Unauthorized take may be occurring, and the Service continues to request re-initiation of projects when project descriptions have changed markedly since the original biological opinion were issued, and Service Law Enforcement continues to investigate potential violations of the Act.

Existing habitat is so fragmented in the San Joaquin Valley that extirpation of certain remaining populations of San Joaquin kit fox appears likely, due to chance fluctuation of small populations, unusual climatic events, the loss of genetic fitness commonly associated with very small populations, and other factors discussed previously. The cumulative effects of these threats pose a significant impediment to the survival and recovery of these species.

San Joaquin kit fox. Several unpermitted projects are likely to sever the north-south kit fox corridor at Patterson on the west side of Stanislaus County in the next year, effectively cutting off kit fox in the Contra Costa/Alameda satellite population north of Patterson from satellite and core populations south of Patterson. The expansion of the urban areas north of Highway 145 in Madera County, north of the City of Fresno, and to the east of the City of Porterville threatens the north-south kit fox corridor on the east side of the valley. Growth around the City of Merced that is induced by the selection of a new University of California campus in that city is threatening to cut off kit fox that inhabit the valley edge north of the City of Merced. Expanding development in the Santa Nella area also threatens the north-south corridor on the west side, although the Service has had initial discussions with some landowners concerning a regional HCP for the area.

The following list provides the names or descriptors of projects in Merced County for which the Service has received limited information. The project descriptions when initially provided to the Service, lacked a Federal nexus and were therefore not considered Federal projects that would be subject to a section 7 consultation under the Act. Some of these projects may eventually become Federal projects whereas others may be abandoned for reasons unknown to the Service. The list therefore provides an example of the projects that are representative of development throughout Merced County. The size of such projects and the habitat loss consequential to each is often unknown; however, some of the projects listed are known to range in size from less than 25 acres to more than 100 acres. If habitat conservation plans were in place in this county or around growing urban areas such as Merced, they would provide a locally-designed mechanism for complying with the Act and for project proponents to make targeted and effective contributions to the survival and recovery of listed species.

Merced County

Surface mining
Dairy, new
Subdivisions, major and minor
New orchards

As the human population of central California increases, and land continues to be converted to municipal and industrial uses, the amount and quality of habitat suitable for the species considered in this biological opinion will decrease. Between 1970 and 2000, California's total population increased by approximately 71% while the Central Valley's population increased 200%. Of the Sacramento and San Joaquin Valleys within the Central Valley, the San Joaquin Valley had the greater population growth (California Department of Finance (CDF) 2002). Among counties in the San Joaquin Valley, Tulare experienced the least increase percentage in population at 226% from 1940 to 1995, while Stanislaus experienced the greatest increase at 453% during the same period. Also during the period 1940 to 1995, the increase in population for Fresno was 322%; for Kern and Madera: 356% each, for Kings: 227%, for Merced: 322% (CDF 2002). (Information for the valley portions of Mariposa and Tuolumne was unavailable). During the period 1988 to 1998, 82,756 acres in the San Joaquin Valley were converted to urban and built-up land uses (California Department of Conservation 2000). Although not each of the converted acres can be considered habitat, this trend indicates that habitat loss continues to threaten the survival and recovery of listed species.

The cumulative effects of all the future State, Tribal, local, and private actions that are reasonably certain to occur in the action area will continue to have a deleterious effect on the reproduction, numbers, and distribution of the species considered herein. The adverse cumulative effects described in this section serve to magnify the adverse effects of the proposed action and diminish any beneficial effects.

Conclusion

Listed species:
After reviewing the current status of the San Joaquin kit fox, the environmental baseline for the action area, the effects of the proposed Plainsburg/Arboleda State Route 99 Project, and the cumulative effects, it is the Service's biological opinion that the project, as proposed, is not likely to jeopardize the continued existence of the San Joaquin kit fox. No critical habitat has been designated or proposed for this species; therefore, none will be affected.

Proposed species:
After reviewing the current status of the mountain plover, the environmental baseline for the action area, the effects of the proposed Plainsburg/Arboleda State Route 99 Project, and the cumulative effects, it is the Service's conference opinion that the project, as proposed, is not likely to jeopardize the continued existence of the mountain plover. No critical habitat has been designated or proposed for this species; therefore, none will be affected.

INCIDENTAL TAKE STATEMENT

Section 9(a)(1) of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered and threatened fish and wildlife species without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to

engage in any such conduct. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. Harm is defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by impairing behavioral patterns including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with this Incidental Take Statement.

The measures described below are non-discretionary, and must be implemented by the agency so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, in order for the exemption in section 7(o)(2) to apply. The Federal Highway Administration has a continuing duty to regulate the activity covered by this incidental take statement. If the Federal Highway Administration (1) fails to require the California Department of Transportation to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

Amount or Extent of Take

Incidental take of the San Joaquin kit fox and mountain plover is anticipated to occur as a result of the proposed project. However, incidental take will be difficult to detect or quantify for the following reasons: 1) The San Joaquin kit fox lives for a portion of its life in dens or burrows, it has a wide ranging territory, is primarily active at night, is often is extremely shy in its behavior around humans, and losses of this animal may be difficult to quantify due to seasonal fluctuations in its numbers; and 2) due to the secretive nature of the mountain plover, losses may be masked by seasonal fluctuations in numbers or other causes, and the species occurs in habitat that makes them difficult to detect. For these reasons, the Service is quantifying take incidental to the proposed action as the number of acres of habitat that will become unsuitable for the San Joaquin kit fox and the mountain plover as a result of the action. Loss of habitat is a reasonable surrogate for expressing the amount or extent of take because it accurately reflects the biological effects to this species. Therefore, the Service estimates that all San Joaquin kit foxes inhabiting 700 acres and all mountain plover inhabitation 67 acres will be subject to take in the form of harm and harassment as a result of the proposed action.

Effect of Take

The Service has determined that this level of anticipated take is not likely to result in jeopardy to the San Joaquin kit fox or the mountain plover. Critical habitat for this species has not been designated or proposed; therefore none will be affected.

Reasonable and Prudent Measures

The following reasonable and prudent measures are necessary and appropriate to minimize the effects of the Plainsburg/Arboleda State Route 99 Project on the San Joaquin kit fox and the mountain plover.

1. The California Department of Transportation shall implement conservation measures for the San Joaquin kit fox and the mountain plover to minimize (1) the effects of the loss of habitat that will occur as a result of the project; (2) the potential for harassment, harm, injury, and mortality to the San Joaquin kit fox and mountain plover; and (3) the potential for inadvertent capture or inadvertent capture or entrapment of this listed wildlife species during construction activities.

2. The California Department of Transportation shall ensure their compliance with this biological opinion.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the Federal Highway Administration shall ensure the California Department of Transportation complies with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are nondiscretionary.

1. The following Terms and Conditions implement Reasonable and Prudent Measure one (1):

   A. The California Department of Transportation shall minimize the potential for harm or harassment of the San Joaquin kit fox and mountain plover resulting from the project related activities by implementation of the conservation measures as described in the biological assessment and the *Project Description* of this biological opinion.

   B. The California Department of Transportation shall include Special Provisions that include the avoidance and minimization measures of this biological opinion in the solicitation for bid information. The California Department of Transportation will educate and inform contractors involved in the project as to the requirements of the biological opinion.

   C. Prior to initiation of any site preparation/construction activities, the California Department of Transportation biologist or Service-approved biologist will conduct an education and training session for all construction personnel. All available individuals who will be involved in the site preparation or construction will be present, including the project representative(s) responsible for reporting take to the Service and the California Department of Fish and Game. Training sessions will be repeated for all new employees before they are allowed to access the project site. Sign up sheets identifying attendees and the contractor/company they represent will

be provided to the Service with the post-construction compliance report. At a minimum, the training will include a description of the natural history of the San Joaquin kit fox and its habitat and the mountain plover and its habitat. Training will include the general measures that are being implemented to conserve these species as they relate to the project, the penalties for non-compliance, and the boundaries (work area) within which the project must be accomplished. To ensure that employees and contractors understand their roles and responsibilities, training may have to be conducted in languages other than English.

D. The resident engineer or their designee shall be responsible for implementing these conservation measures and shall be the point of contact for each project.

E. If borrow material is going to be used for the Plainsburg/Arboleda State Route 99 Project, the California Department of Transportation shall follow the procedures outlined below:

1. California Department of Transportation shall require as part of the construction contract that all contractors comply with the Act in the performance of the work necessary for project completion performed inside and outside the project right-of-way.

2. California Department of Transportation shall require documentation from the contractor that aggregate, fill, or borrow material provided for each project, if different than the 13 areas addressed in this consultation, was obtained in compliance with the Act. Evidence of compliance with the Act shall be demonstrated by providing the Resident Engineer (RE) any one of the following:

   a. a letter from the Service stating use of the borrow pit area will not result in the incidental take of listed species;
   b. an incidental take permit for contractor-related activities issued by the Service pursuant to section 10(a)(1)(B) of the Act;
   c. a biological opinion or a letter concurring with a "not likely to adversely affect" determination issued by the Service to the Federal agency having jurisdiction over contractor-related activities;
   d. a letter from the Service concurring with the "no effect" determination for contractor-related activities; or
   e. Contractor submittal of information to the California Department of Transportation Resident Engineer indicating compliance with the State Mining and Reclamation Act (SMARA) and provide the County land use permits and CEQA clearance.
   f. If a borrow site that is in compliance with the Act is not available, the California Department of Transportation will either:

      i. identify/select a site that the Service has concurred with the "no effect" determination, or;

ii. request reinitiation of formal consultation on the action considered herein based on new information.

F. The California Department of Transportation biologist shall have oversight over implementation of all the measures described in the *Terms and Conditions* of this biological opinion, and he/she shall have the authority to stop project activities, through communication with the California Department of Transportation Resident Engineer, if any of the requirements associated with these measures are not being fulfilled. If the biologist/construction liaison has requested a stop work order due to take of any of the listed species, the Service and Fish and Game will be notified within one (1) day via email or telephone.

G. Prior to any ground disturbance, pre-construction surveys shall be conducted for the San Joaquin kit fox. These surveys will consist of walking surveys of the project limits and adjacent areas accessible to the public to determine presence of this species (i.e., kit fox dens and related sign).

H. Project employees shall be directed to exercise caution when commuting within the habitat of the San Joaquin kit fox. A 20-mile per hour speed limit will be strongly encouraged on unpaved roads within the habitat of this species. Cross-country travel by vehicles will be prohibited, unless authorized by the Service. Project employees shall be provided with written guidance governing vehicle use, speed limits on unpaved roads, fire prevention, and other hazards.

I. A litter control program shall be instituted at each project site. All workers shall ensure their food scraps, paper wrappers, food containers, cans, bottles, and other trash from the project area are deposited in covered or closed trash containers. The trash containers shall be removed from the project area at the end of each working day.

J. No canine or feline pets or firearms (except for Federal, State, or local law enforcement officers and security personnel) shall be permitted on construction sites to avoid harassment or killing or injuring of listed species.

K. Maintenance and construction excavations greater than 2 feet deep either shall be covered, filled in at the end of each working day, or have earthen escape ramps no greater than 200 feet apart provided to prevent entrapment of the San Joaquin kit fox.

L. All construction activity shall be confined within the project site, which may include temporary access roads, haul roads, and staging areas specifically designated and marked for these purposes. At no time shall equipment or personnel be allowed to adversely affect habitat areas outside the project site without authorization from the Service.

M. The project construction area shall be delineated with high visibility temporary fencing at least five (5) feet in height, flagging, or other barrier to prevent encroachment of construction personnel and equipment onto any sensitive areas during project work activities. Such fencing shall be inspected and maintained daily until completion of the project. The fencing will be removed only when all construction equipment is removed from the site.

N. Only Service-approved workers holding valid permits issued pursuant to section 10(a)(1)(A) of the Act are allowed to trap or capture the San Joaquin kit fox. Any relocation plan will be approved by the Service prior to release of any kit foxes.

O. All grindings and asphaltic-concrete waste shall be stored within previously disturbed areas absent of habitat and at a minimum of 150 feet from any culvert, wash, pond, vernal pool, or stream crossing

P. Because dusk and dawn are often the times when the San Joaquin kit fox is most actively foraging, all construction activities will cease one half hour before sunset and will not begin prior to one half hour before sunrise. Except when necessary for driver or pedestrian safety, lighting of a project site by artificial lighting during night time hours is prohibited.

Q. Use of rodenticides and herbicides at the project site shall be utilized in such a manner to prevent primary or secondary poisoning of the San Joaquin kit fox, and the depletion of prey populations on which its depends. All uses of such compounds hall observe label and other restrictions mandated by the U.S. Environmental Protection Agency, California Department of Pesticide Regulation, and other appropriate State and Federal regulations, as well as additional project-related restrictions deemed necessary by the Service or the California Department of Fish and Game.

R. The following actions shall be taken to minimize the effect on denning San Joaquin kit foxes:

1. Determine the presence of kit fox dens (natural or in pipes and culverts).

   a. Pre-construction surveys within the project area shall be conducted no more than 30 calendar days prior to the start of construction in accordance with the most current protocols approved by the Service and the California Department of Fish and Game.

   b. Surveys for dens shall be conducted by qualified biologists with demonstrated experience in identifying San Joaquin kit fox dens.

2. Protect all San Joaquin kit fox dens to the maximum extent practicable as determined by the on-site biologist.

3. Identify type of den (natal or non-natal) and its status (occupied or unoccupied) based on the current Service guidance (Service 1999). Identify and execute appropriate action(s) regarding notification, buffers, excavation and fill, or seal-off:

   a. Occupied natal den: if an occupied natal den is visible or encountered within the project limits, or other accessible land, or on publicly accessible land within1000 feet of the project construction area, the project will be constructed between August 1 and November 30 and the Service shall be contacted immediately, before any project action occurs.

   b. A buffer or exclusion zone shall be established to protect the physical den and surrounding habitat of unoccupied natal dens and all non-natal dens that can be avoided:

      i. unoccupied natal dens shall be surrounded with a 200 foot buffer and the Service will be contacted. Occupied and unoccupied non-natal dens shall be surrounded with a 100 foot buffer.

      ii When occupied dens have been found on or near the project site, ground disturbing activities shall be restricted during the period December 1 to July 31.

      iii During this period, project activities within 0.3 mi of occupied natal dens are prohibited. Buffer zones shall be delineated with a temporary fence or other suitable barrier that does not prevent disbursal of the fox. Alternately, the project construction area can be delineated with temporary fence, flagging, or other barrier.

S. Pipes or culverts with a diameter greater than 4 inches shall be capped or taped closed when it is ascertained that no San Joaquin kit fox is present. Any kit fox found in a pipe or culvert shall be allowed to escape unimpeded.

T. If a natural den cannot be avoided and must be destroyed, the following guidelines shall be followed:

   1. Prior to the destruction of any den, the den shall be monitored for at least 3 consecutive days to determine its current status. Activity at the den shall be monitored by placing tracking medium at the entrance and by standard spotlighting detection techniques. If no kit fox activity is observed during this period, the den shall be destroyed immediately to preclude subsequent use. If kit fox activity is observed at the den during this period, the den shall be monitored for at least 5 consecutive days from the time of observation to allow any resident animal to move to another den during its normal activities. Use of

the den can be discouraged during this period by partially plugging the entrance(s) with soil in such a manner that any resident animal can escape easily. Destruction of the den may begin when, in the judgment of a Service or Service-approved biologist, the animal has moved to a different den. The biologist shall be trained and familiar with kit fox biology. If the animal is still present after five or more consecutive days of plugging and monitoring, the den may be excavated when, in the judgment of the Service-approved biologist, it is temporarily vacant, for example during the animal's normal foraging activities.

2. All dens shall be excavated by hand, by or under the supervision of, a Service-approved biologist.

3. The den shall be fully excavated and then filled with dirt and compacted to ensure that kit foxes cannot reenter or use the den during the construction period. If, at any point during excavation a kit fox is discovered inside the den, the excavation activity shall cease immediately and monitoring of the den shall be resumed. Destruction of the den may be resumed, when in the judgment of the Service-approved biologist, the animal has escaped from the partially destroyed den.

4. Non-natal dens may be excavated at any time of the year. Natal dens shall be excavated only between August 15 and November 1.

5. Within ten (10) working days of the completion of earthmoving, California Department of Transportation will replace all excavated kit fox dens with artificial dens on a 2:1 basis. The location and design of the artificial dens will be approved by the Service prior to installation

U. Restoration and revegetation work associated with temporary effects shall be done using California endemic plant material from on-site or local sources (i.e., local ecotype). Plant materials from non-local sources shall be allowed only with written authorization from the Service. To the maximum extent practical (i.e., presence of natural lands), topsoil shall be removed, cached, and returned to the site according to successful restoration protocols. Loss of soil from run-off or erosion shall be prevented with straw bales, straw wattles, or similar means provided they do not entangle, block escape or dispersal routes of the San Joaquin kit fox.

V. As described in biological assessment and the *Project Description* of this biological opinion, transfer of surplus lands to a conservatory agency shall be completed by the California Department of Transportation for 201 acres of habitat for the San Joaquin kit fox and mountain plover. The California Department of Transportation shall obtain the written approval of the Service of the agency that will receive the surplus lands.

W. If conservation easements are used by the California Department of Transportation, they shall include, but not be limited to, provisions and responsibilities of the project proponent and the land trust organization approved by the Service for the protection of all habitats set aside including any future transfers of the easements or fee interest that may be anticipated. The easements shall specify the purposes for which it is established (*i.e.*, measures to minimize effects to the San Joaquin kit fox associated with the Plainsburg/Arboleda State Route 99 project). The California Department of Transportation shall provide the Service with a true copy of the recorded conservation easements within thirty (30) calendar days of its recordation. The conservation easements shall be held by a third party approved by the Service. The conservation easement shall include a list of prohibited activities that are inconsistent with the maintenance of the preserve for the listed species including, but not limited to:

1. leveling, grading, landscaping, cultivation, or any other alterations of existing topography for any purposes, including the exploration for, or development of, mineral resources;
2. placement of any new structures on the preserve, including buildings and billboards;
3. discharge, dumping, burning, or storing of rubbish, garbage, grass clippings, dredge material, household chemicals, or any other wastes or fill materials within the preserve;
4. building of any roads or trails within the preserve areas;
5. killing, removal, alteration, or replacement of any existing native vegetation except in Service-approved prescribed burning situations, or as otherwise authorized in writing by the Service;
6. activities that may alter the hydrology of the preserve and the associated watersheds, including but not limited to: excessive pumping of groundwater, manipulation or blockage of natural drainages, inappropriate water application or placement of storm water drains, etc. unless authorized in writing by the Service;
7. incompatible fire protection activities;
8. use of pesticides, herbicides, or rodenticides on the preserve or within the watershed that can contaminate the preserve except as authorized in writing by the Service; and
9. introduction of any exotic species or species not native to the area, including aquatic species, except as approved by the Service.

X. In the event the California Department of Transportation seeks to obtain a conservation easement in lieu of fee title acquisitions for the purposes of satisfying the requirements of the terms and conditions of this biological opinion, the California Department of Transportation shall provide the language of the proposed conservation easements to the Service for prior review and approval. The conservation easements shall include language establishing a right of entry by the Service to determine compliance with the terms and conditions of this biological opinion and the terms of the conservation easements, as well as identifying the

Service as a third party beneficiary with the standing to take whatever legal action is necessary to enforce the terms of this conservation easement. Should the California Department of Transportation make fee title acquisition of lands to satisfy the terms and conditions of this biological opinion, the California Department of Transportation shall encumber such lands with restrictive covenants that provide the same rights to the Service as will be established under the conservation easement described above. Such restrictive covenants shall be provided to the Service for prior review and approval before they are recorded against the conservation lands.

Y. If the California Department of Transportation plans to acquire fee title or a conservation easement for lands that are not in a Service-approved conservation bank, then at least sixty (60) calendar days prior to the date of initial ground breaking at the proposed Plainsburg/Arboleda State Route 99 project, the California Department of Transportation shall endow a Service-approved fund for monitoring and perpetual management and maintenance of the 201 acres for the San Joaquin kit fox. The principal in the endowment must generate sufficient revenue to fully cover the costs of ongoing operations and management actions as described in the Service-approved management plan and this biological opinion, without the need to make use of the principal to adequately fund such expenditures. Specific actions funded by the endowment shall be addressed in the Service-approved management plan. The California Department of Transportation shall utilize an appropriate third party who has been approved by the Service to determine what amount of money is necessary for an endowment fund to adequately finance the monitoring and perpetual management and maintenance of the preserve for the San Joaquin kit fox. The California Department of Transportation shall empower the Service to access and expend such funds to implement Service-approved remedial measures in the event the responsible preserve managers fail to adequately implement the Service-approved management plan. The final determination of success or failure of the management plan shall be made solely by the Service. Prior to the date of initial groundbreaking at the Plainsburg/Arboleda State Route 99 project, the California Department of Transportation shall provide the Service with documentation that: (1) funds for the perpetual management and maintenance of the 201 acres for the San Joaquin kit fox have been transferred to the appropriate third party approved by the Service; (2) the third party has accepted the funds and considers them adequate; and (3) that these funds have been deposited in an account (*i.e.*, endowment) that will provide adequate financing for the monitoring and perpetual management and maintenance of the 201 acres for the San Joaquin kit fox.

Z. If the Refuge Division of the Service becomes the responsible manager of the compensation lands, the endowment amount shall be approved by them.

2. The following Terms and Conditions implement Reasonable and Prudent Measure two (2):

A. If requested, before, during, or upon completion of ground breaking and construction activities, the California Department of Transportation shall allow

access by Service and/or California Department of Fish and Game personnel to the project site to inspect project effects to the San Joaquin kit fox and its habitat.

B. The California Department of Transportation shall comply with the *Reporting Requirements* of this biological opinion.

Reporting Requirements

1. Before construction starts on a project, the Service shall be provided with the final documents, including but not limited to, recorded conservation easements, PAR analyses, management plans, or proof of purchase of credits. Please see draft guidance from the Service, *Draft Selected Review Criteria for Conservation Banks and Section 7 Off Site Compensation* dated August 4, 2004, or Service guidance that supercedes this document.

2. A post-construction report detailing compliance with the project design criteria described under the *Description of the Proposed Action* section of this biological opinion shall be provided to the Service within 30 calendar days of completion of the project.

3. The California Department of Transportation shall notify the Service via electronic mail and telephone within one (1) working day of the death or injury to a San Joaquin kit fox and/or other listed species that occurs due to project related activities or is observed at the project site. Notification must include the date, time, location of the incident or of the finding of a dead or injured animal, and photographs of the specific animal. In the case of an injured animal, the animal shall be cared for by a licensed veterinarian or other qualified person. In the case of a dead animal, the individual animal should be preserved, as appropriate, and held in a secure location until instructions are received from the Service regarding the disposition of the specimen or the Service takes custody of the specimen. The Service contacts are Chief of the Endangered Species Division (Central Valley) at 916/414-6600, and Scott Heard, Resident Agent-in-Charge of the Service's Law Enforcement Division at 916/414-6660. The California Department of Fish and Game contact is Mr. Ron Schlorff at 916/654-4262.

4. Any contractor or employee who, during routine operations and maintenance activities inadvertently kills or injures a State listed wildlife species shall immediately report the incident to her or his supervisor or representative. The supervisor or representative must contact the California Department of Fish and Game immediately in the case of a dead or injured State listed wildlife species. The California Department of Fish and Game contact for immediate assistance is State Dispatch at (916) 445-0045.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and

threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

The Service has developed the following conservation recommendations based, in part, on the Recovery Plan (Service 1998).

1. Sightings of any sensitive animal species should be reported to the California Natural Diversity Database of the California Department of Fish and Game. A copy of the reporting form and a topographic map clearly marked with the location the animals were observed also should be provided to the Service.
2. Locate, map, and protect existing populations of the San Joaquin kit fox (Recovery Plan Tasks 2.2.17 and 2.2.24).
3. Protect and create additional habitat for the San Joaquin kit fox in key portions of its range (Recovery Plan Tasks 2.1.19 and 5.1.5).
4. Gather additional data on population responses to environmental variation at representative sites in the San Joaquin kit fox's geographic range (Recovery Plan Tasks 3.2.21 and 3.2.22).
5. Determine appropriate habitat management and compatible land uses for the San Joaquin kit fox (Recovery Plan Task 4.5.7).

In order for the Service to be kept informed of conservation actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, we request notification of the implementation of any of the conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation and conference on the Plainsburg/Arboleda State Route 99 Project. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

You may ask the Service to confirm the conference opinion as a biological opinion issued through formal consultation if the mountain plover is listed or critical habitat is designated. The request must be in writing. If the Service reviews the proposed action and finds that there have been no significant changes in the action as planned or in the information used during the conference, the Service will confirm the conference opinion as the biological opinion on the project and no further section 7 consultation will be necessary.

After listing of the mountain plover or designation of critical habitat and any subsequent adoption of this conference opinion, the Federal agency shall request reinitiation of consultation if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this conference opinion; (3) the agency action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in this conference opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

The incidental take statement provided in this conference opinion does not become effective until the species is listed and the conference opinion is adopted as the biological opinion issued through formal consultation. At that time, the project will be reviewed to determine whether any take of the mountain plover or its habitat has occurred. Modifications of the opinion and incidental take statement may be appropriate to reflect that take. No take of the mountain plover or its habitat may occur between the listing of the species and the adoption of the conference opinion through formal consultation, or the completion of a subsequent formal consultation.

If you have any questions concerning this biological opinion on the Plainsburg/Arboleda State Route 99 Project, please contact Susan Jones at the letterhead address or at telephone 916/414-6630.

Sincerely,

Peter A. Cross

for Ken Sanchez
Acting Field Supervisor

cc:
Geoffrey Gray, California Department of Transportation, Fresno, California
Clarence Mayott, California Department of Fish and Game, Fresno, California

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WELL CONSTRUCTION & DESTRUCTION – APPLICATION & PERMIT

Merced County Code Chapter 9.28

Merced County Division of Environmental Health
777 W. 22nd Street, Merced, CA 95340 (209) 381-1100 fax: (209) 384-1593
415 "F" Street, Los Banos, CA 93635 (209) 710-6095 fax: (209) 826-4433

PERMIT # _____

OWNER INFORMATION & DECLARATION

_____ (____)_____
name of property owner phone

_____
mailing address

_____
city state zip

Purpose of Well & Declaration (√ **all** that apply)**:**

Initial Well ☐ Additional Well ☐

Multiple Homes, School, or Business Well ☐

Replacement of Failed Well ☐

As property owner, I give permission to drill the well(s) indicated by this application. A plot plan indicating each existing and proposed well will be included. An application involving Additional Well, Replacement of Failed Well, or an out-of-service well will be accompanied by a Letter of Intent, signed by myself, for each existing well.

_____ _____
signature of property owner or trustee date

CONTRACTOR INFORMATION & DECLARATION

_____ (____)_____
name of contractor phone

_____
mailing address

_____
city state zip

Declaration:

I hereby affirm that I have a C-57 license in full force and effect under the provisions of the Business and Professions Code, Chapter 9, Division 3 (commencing with Section 7000).

_____ _____
signature of contractor license #

CONSTRUCTION INFORMATION

Rotary/Rev. Rotary ☐ Cable Tool ☐ Other _____

Estimated Depth _____ ft. Casing Diameter _____ in.

Conductor Casing ☐

FEES

Total $_____ Check # _____

Date Paid _____ Invoice # IN_____

WELL LOCATION

_____ - _____ - _____ _____ / _____ / _____
APN township range section

_____ _____
street address city

_____ _____
subdivision name lot #

A plot plan shall be submitted with each application.

TYPE OF WELL

√ **all** squares and circles that apply

Test Well – Private (T) ☐

Test Well – Public (T) ☐

Domestic Well – Private (DO) ☐
For Dairy? ○

Domestic Well – Public (DO) ☐
For Dairy? ○

Irrigation Well (IR) ☐

Reconstruction (RE) ☐

Well Destruction (WD) ☐

Monitoring Well (M) ☐
To Check For Contamination? ○

Soil Boring (B) ☐
To Check For Contamination? ○

Hydro Punch (HP) ☐
To Check For Contamination? ○

Cathodic Protection Well (CP) ☐

PERMIT CONDITIONS & COMMENTS

Letter(s) of Intent required ☐; Letter(s) received ☐

Maintain all setbacks. Request an inspection, with permit number, at least 24 hours prior to desired time.

_____

_____

_____

_____

Permit is valid for 180 days from the date of issuance.

APPROVAL

_____ _____
Signature of Environmental Health Official Date

Memorandum

Flex your power!
Be energy efficient!

To: DAN ADAMS
Chief
Bridge Design Branch 10
Office of Bridge Design – South 2
Division of Engineering Services

Attention: Larry Wu

Date: March 4, 2009

File: 10-MER-99-0.0/4.9
EA: 10-415801
Sandy Mush OH
39-0236
(new)

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES – MS 5

Subject: Foundation Recommendations

Introduction

Per your request, we are providing final foundation recommendations for the bridge project referenced above. This bridge is part of the Plainsburg/Sandy Mush Interchange project. This report is for use by the project design engineer, construction personnel, bidders and contractors.

Pertinent Plans and Data

The following resources were used in the assessment of the site conditions for these recommendations:

1. The preliminary and General plans for the proposed new bridge.
2. A preliminary foundation recommendation report dated August 10, 2007 by this Office.
3. Two exploratory borings conducted in June, 2008.
4. Groundwater level data (2006), Department of Water Resources (DWR), California.
5. Caltrans Seismic Hazard Map 1996.

Site Geology

The subsurface formations in the project area are alluvium and flood plain deposits. These materials consist of interbedded sands, silts, clayey silts, silty sands and clay which vary in consistency from loose to very dense.

Groundwater

Groundwater not encountered during the June 2008 field investigation. DWR records show that the depth of groundwater below the project site ranged between 180 and 210 feet in 2006 (DWR Well Nos. 09S15E14A001M, 09S15E11F001M and 09S15E10A001M). Some localized thin lenses of perched water may be present at the site. Groundwater is not expected to be a factor during construction.

Seismicity

Based on the 1996 Caltrans Seismic Hazard Map, the controlling fault for the project alignment is the Prairie Creek-Spenceville-Dentman (PSD, normal) fault. This fault possesses a Maximum Credible Earthquake magnitude of Mw = 6.5, and is located approximately 18 miles from the project site to the northeast. Based on the referenced map, the peak bedrock acceleration for the new bridge is estimated to be 0.2g. The soil profile is classified as type "D" per the Department's Seismic Design Criteria (SDC).

Based on the Log of Test Borings a final Caltrans Seismic Design Criteria (CSDC) Acceleration Response Spectrum (ARS) Curve corresponding to soil profile Type D is recommended for design. The recommended ARS Curve may be found in Figure B.7 of CSDC Version 1.4 of June 2006.

Liquefaction Potential

The site is not located in an area shown as potentially liquefiable on the State Seismic Hazard Map. Since the project location has a deep groundwater condition, the potential for liquefaction under the proposed bridge is considered very low. The potential for seismically induced settlement and lateral spreading is also considered very low.

Surface Fault Rupture Hazard

Surface fault rupture is defined as displacement that occurs along the surface trace of a fault. The site is not located within any Earthquake Fault Zone (EFZ) as defined by the California Department of Conservation (Special Publication 42, 1997). There are no known faults crossing

beneath or extending directly toward the site. Therefore, the potential hazard due to ground rupture is considered to be very low.

Corrosivity

Composite soil samples were taken from the recent exploratory borings. The test results indicate that the foundation materials are non-corrosive to construction materials or structural elements.

Scour

The bridge site will not be subjected to stream instability.

Geotechnical Recommendations

Based on the recent foundation investigation and review of the General plan, precast, prestressed Standard Class 140 driven piles using Alternative X are the optimum foundation type for the abutments and bent support. Tables 1 and 2 list the foundation recommendation parameters. Table 3 is the pile data table to be included in the project contract documents.

Table 1. Foundation Recommendations for Abutments
Class 140, Alt. "X"

Abutment Foundation Design Recommendations									
Support Location	Pile Type	Cut-off Elevation (ft)	LRFD Service-I Limit State Load Per Support (kips)		LRFD Service-I Limit State Total Load Per Pile (kips)	Nominal Resistance (kips)	Design Tip Elevation (ft)	Specified Tip Elevation (ft)	Nominal Driving Resistance Required (kips)
			Total	Permanent	Compression				
Abut 1	Class 140 Alt. X	228.3	1680	1268	140	280	183.0 (a)	183.0	280
Abut 3	Class 140 Alt. X	228.3	1300	936	140	280	183.0 (a)	183.0	280

Note: 1) Design tip elevations are controlled by (a) compression.

Table 2. Foundation Recommendations for Bent
Class 140, Alt. "X"

Bent Foundation Design Recommendations											
Support Location	Pile Type	Cut-off Elevation (ft)	Service Limit State I Load (kips)	Total Permissible Support Settlement (inches)	Required Factored Nominal Resistance (kips)				Design Tip Elevation (ft)	Specified Tip Elevation (ft)	Nominal Driving Resistance Required (kips)
					Strength Limit		Extreme Event				
					Comp. φ=0.7	Tension φ=0.7	Comp. φ=1.0	Tension φ=1.0			
Bent 2	Class 140 Alt. X	204.0	2400	1	160	0	270	80	183.0 (a) 180.0 (b) 198.0 (c)	180.0	270

Note: Design tip elevations are controlled by:
(a) compression (Strength Limit)
(b) compression (Extreme Event)
(c) tension (Extreme Event)

Table 3. Pile Data Table

Support Location	Pile Type (ft)	Nominal Resistance (kips)		Design Tip Elevations (ft)	Specified Tip Elevation (ft)	Nominal Driving Resistance Required (kips)
		Compression	Tension			
Abut 1	Class 140, Alt. X	280	N/A	183.0	183.0	280
Bent 2	Class 140, Alt. X	270	80	183.0 (a) 180.0 (b) 198.0 (c)	180.0	270
Abut 3	Class 140, Alt. X	280	N/A	183.0	183.0	280

Note: Design tip elevations are controlled by:
(a) compression (Strength Limit)
(b) compression (Extreme Event)
(c) tension (Extreme Event)

Construction Considerations

The Class 140, Alternative X piles at both abutment locations are to be driven in predrilled holes through any newly constructed embankment fills. The predrilling shall be in accordance with section 49-1.06 of the Standard Specifications and shall not extend below an elevation of 212 feet.

Due to the granular nature of the upper soil at the site, primary settlement is expected to occur immediately and concurrent with embankment fill placement. No waiting period is required prior to installing piles through the new embankment fills.

If any conceptual changes are proposed during final project design, the Office of Geotechnical Design-North should review those changes to determine if the recommendations contained herein are still applicable.

Project Information

Standard Special Provision S5-280, "Project Information", discloses to bidders and contractors a list of pertinent information available for their inspection prior to bid opening. The following is an excerpt from SSP S5-280 disclosing information originating from Geotechnical Services. Items listed to be included in the Information Handout will be provided in Acrobat (.pdf) format to the addressee(s) of this report via electronic mail.

Data and information attached with the project plans are:
One Log of Test Borings (2 borings).

Data and information included in the Information Handout provided to the bidders and contractors are:
None.

Data and information available for inspection at the District Office:
None.

Data and information available for inspection at the Transportation Laboratory are:
Foundation recommendations, Sandy Mush OH Bridge 39-0236, March 4, 2009

If you have any questions or comments, or need additional information please contact Christopher Koepke at (916) 227-1040.

Report by:

Chris Koepke

REGISTERED GEOLOGIST
CHRISTOPHER W. KOEPKE
No. 2207
CERTIFIED ENGINEERING GEOLOGIST
Exp. 10/10
STATE OF CALIFORNIA

Christopher Koepke, C.E.G.
Engineering Geologist
Office of Geotechnical Design – North
Branch E

cc: Qiang Huang, R.E., Pending, Structures OE (E-copy), GDN File, D10 PCE – Angela Ezekiel, D10 DME – Dave Dhillon
GS File Room

Memorandum

Flex your power!
Be energy efficient!

To: DAN ADAMS
Chief
Bridge Design Branch 10
Office of Bridge Design – South 2
Division of Engineering Services

Attention: Larry Wu

Date: March 4, 2009

File: 10-MER-99-0.0/4.9
EA: 10-415801
Plainsburg OC
39-0237
(new)

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES – MS 5

Subject: Foundation Recommendations

Introduction

Per your request, we are providing final foundation recommendations for the bridge project referenced above. This bridge is part of the Plainsburg/Sandy Mush Interchange project. This report is for use by the project design engineer, construction personnel, bidders and contractors.

Pertinent Plans and Data

The following resources were used in the assessment of the site conditions for these recommendations:

1. The preliminary and General plans for the proposed new bridge.
2. A preliminary foundation recommendation report dated August 10, 2007 by this Office.
3. Two exploratory borings conducted in June, 2008.
4. Groundwater level data (2006), Department of Water Resources (DWR), California.
5. Caltrans Seismic Hazard Map 1996.

Site Geology

The subsurface formations in the project area are alluvium and flood plain deposits. These materials consist of interbedded sands, silts, clayey silts, silty sands and clay which vary in consistency from loose to hard. Very stiff to hard clay exists at a depth of 54 feet below the existing ground surface.

Groundwater

Groundwater was not encountered during the June 2008 field investigation. DWR records show that the depth of groundwater below the project site ranged between 180 and 210 feet in 2006 (DWR Well Nos. 09S15E14A001M, 09S15E11F001M and 09S15E10A001M). Some localized thin lenses of perched water may be present at the site. Groundwater is not expected to be a factor during construction.

Seismicity

Based on the 1996 Caltrans Seismic Hazard Map, the controlling fault for the project alignment is the Prairie Creek-Spenceville-Dentman (PSD, normal) fault. This fault possesses a Maximum Credible Earthquake magnitude of Mw = 6.5, and is located approximately 18 miles from the project site to the northeast. Based on the referenced map, the peak bedrock acceleration for the new bridge is estimated to be 0.2g. The soil profile is classified as type "D" per the Department's Seismic Design Criteria (SDC).

Based on the Log of Test Borings a final Caltrans Seismic Design Criteria (CSDC) Acceleration Response Spectrum (ARS) Curve corresponding to soil profile Type D is recommended for design. The recommended ARS Curve may be found in Figure B.7 of CSDC Version 1.4 of June 2006.

Liquefaction Potential

The site is not located in an area shown as potentially liquefiable on the State Seismic Hazard Map. Since the project location has a deep groundwater condition, the potential for liquefaction under the proposed bridge is considered very low. The potential for seismically induced settlement and lateral spreading is also considered very low.

Surface Fault Rupture Hazard

Surface fault rupture is defined as displacement that occurs along the surface trace of a fault. The site is not located within any Earthquake Fault Zone (EFZ) as defined by the California Department of Conservation (Special Publication 42, 1997). There are no known faults crossing

beneath or extending directly toward the site. Therefore, the potential hazard due to ground rupture is considered to be very low.

Corrosivity

Composite soil samples were taken from the recent exploratory borings. The test results indicate that the foundation materials are non-corrosive to construction materials or structural elements.

Scour

The bridge site will not be subjected to stream instability.

Geotechnical Recommendations

Based on the recent foundation investigation and review of the General plan, precast, prestressed Class 140, Alternative "X" driven piles the optimum foundation type for the abutment and bent supports. Tables 1 and 2 list the foundation recommendation parameters. Table 3 is the pile data table to be included in the project contract documents.

Table 1. Foundation Recommendations for Abutments
Class 140, Alt. "X"

Abutment Foundation Design Recommendations									
Support Location	Pile Type	Cut-off Elevation (ft)	LRFD Service-I Limit State Load Per Support (kips)		LRFD Service-I Limit State Total Load Per Pile (kips)	Nominal Resistance (kips)	Design Tip Elevation (ft)	Specified Tip Elevation (ft)	Nominal Driving Resistance Required (kips)
			Total	Permanent	Compression				
Abut 1	Class 140 Alt. "X"	226.3	1550	1162	140	280	178.0 (a)	178.0	280
Abut 3	Class 140 Alt. "X"	227.3	1500	1116	140	280	178.0 (a)	178.0	280

Note: 1) Design tip elevations are controlled by (a) compression.

Due to the granular nature of the upper 54 feet of soil at the site, primary settlement is expected to occur immediately and concurrent with embankment fill placement. No waiting period is required prior to installing piles through the new embankment fills.

If any conceptual changes are proposed during final project design, the Office of Geotechnical Design-North should review those changes to determine if the recommendations contained herein are still applicable.

Project Information

Standard Special Provision S5-280, "Project Information", discloses to bidders and contractors a list of pertinent information available for their inspection prior to bid opening. The following is an excerpt from SSP S5-280 disclosing information originating from Geotechnical Services. Items listed to be included in the Information Handout will be provided in Acrobat (.pdf) format to the addressee(s) of this report via electronic mail.

Data and information attached with the project plans are:
One Log of Test Borings (2 borings).

Data and information included in the Information Handout provided to the bidders and contractors are:
None.

Data and information available for inspection at the District Office:
None.

Data and information available for inspection at the Transportation Laboratory are:
Foundation Recommendations report. Plainsburg OC Bridge, 39-0237
March 4, 2009

If you have any questions or comments, or need additional information please contact Christopher Koepke at (916) 227-1040.

Report by:

Chris Koepke

REGISTERED GEOLOGIST
CHRISTOPHER W. KOEPKE
No. 2207
CERTIFIED ENGINEERING GEOLOGIST
Exp. 10/10
STATE OF CALIFORNIA

Christopher Koepke, C.E.G.
Engineering Geologist
Office of Geotechnical Design – North
Branch E

cc: Qiang Huang, R.E., Pending, Structures OE (E-copy), GDN File, D10 PCE – Angela Ezekiel, D10 DME – Dave Dhillon
GS File Room

Table 2. Foundation Recommendations for Bent
Class 140, Alt. "X"

Bent Foundation Design Recommendations											
Support Location	Pile Type	Cut-off Elevation (ft)	Service Limit State I Load (kips)	Total Permissible Support Settlement (inches)	Required Factored Nominal Resistance (kips)				Design Tip Elevation (ft)	Specified Tip Elevation (ft)	Nominal Driving Resistance Required (kips)
					Strength Limit		Extreme Event				
					Comp. φ=0.7	Tension φ=0.7	Comp. φ=1.0	Tension φ=1.0			
Bent 2	Class 140 Alt. "X"	204.0	1600	1	180	0	270	60	182.0 (a) 180.0 (b) 201.0 (c)	180.0	270

Note: Design tip elevations are controlled by:
(a) compression (Strength Limit)
(b) compression (Extreme Event)
(c) tension (Extreme Event)

Table 3. Pile Data Table
Class 140, Alt. "X"

Support Location	Pile Type (ft)	Nominal Resistance (kips)		Design Tip Elevations (ft)	Specified Tip Elevation (ft)	Nominal Driving Resistance Required (kips)
		Compression	Tension			
Abut 1	Class 140 Alt. "X"	280	N/A	178.8	178.0	280
Bent 2	Class 140 Alt. "X"	270	60	182.0 (a) 180.0 (b) 201.0 (c)	180.0	270
Abut 3	Class 140 Alt. "X"	280	N/A	178.8	178.0	280

Note: Design tip elevations are controlled by:
(a) compression (Strength Limit)
(b) compression (Extreme Event)
(c) tension (Extreme Event)

Construction Considerations

The Class 140, Alternative "X" driven concrete piles at both abutment locations are to be driven in predrilled holes through any newly constructed embankment fills. The predrilling shall be in accordance with section 49-1.06 of the Standard Specifications and shall not extend below an elevation of 212 feet.

Memorandum

Flex your power!
Be energy efficient!

To: DAN ADAMS
Chief
Bridge Design Branch 10
Office of Bridge Design – South 2
Division of Engineering Services

Attention: Larry Wu

Date: March 4, 2009

File: 10-MER-99-0.0/4.9
EA: 10-415801
Dutchman Creek Bridge
39-0238 (L/R)
(new)

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES – MS 5

Subject: Foundation Recommendations

Introduction

Per your request, we are providing foundation recommendations for the bridge project referenced above. This bridge is part of the Plainsburg/Sandy Mush Interchange project. This report is for use by the project design engineer, construction personnel, bidders and contractors.

Pertinent Plans and Data

The following resources were used in the assessment of the site conditions for these recommendations:

1. The preliminary and General plans for the proposed new bridge.
2. A preliminary foundation recommendation report dated August 10, 2007 by this Office.
3. Two exploratory boring conducted in May, 2008.
4. Groundwater level data (2006), Department of Water Resources (DWR), California.
5. Caltrans Seismic Hazard Map 1996.

Site Geology

The subsurface formations in the project area are alluvium and flood plain deposits. These materials consist of primarily granular interbedded sands, silts, clayey silts, silty sands and minor amounts of clay. These deposits vary in consistency from loose to medium dense.

Groundwater

Groundwater was not encountered during the June 2008 field investigation. DWR records show that the depth of groundwater below the project site ranged between 180 and 210 feet in 2006 (DWR Well Nos. 09S15E14A001M, 09S15E11F001M and 09S15E10A001M). Some localized thin lenses of perched water may be present at the site. Groundwater is not expected to be a factor during construction.

Seismicity

Based on the 1996 Caltrans Seismic Hazard Map, the controlling fault for the project alignment is the Prairie Creek-Spenceville-Dentman (PSD, normal) fault. This fault possesses a Maximum Credible Earthquake magnitude of Mw = 6.5, and is located approximately 18 miles from the project site to the northeast. Based on the referenced map, the peak bedrock acceleration for the new bridge is estimated to be 0.2g. The soil profile is classified as type "D" per the Department's Seismic Design Criteria (SDC).

Based on the Log of Test Borings a final Caltrans Seismic Design Criteria (CSDC) Acceleration Response Spectrum (ARS) Curve corresponding to soil profile Type D is recommended for design. The recommended ARS Curve may be found in Figure B.7 of CSDC Version 1.4 of June 2006.

Liquefaction Potential

The site is not located in an area shown as potentially liquefiable on the State Seismic Hazard Map. Since the project location has a deep groundwater condition, the potential for liquefaction under the proposed bridge is considered very low. The potential for seismically induced settlement and lateral spreading is also considered very low.

Surface Fault Rupture Hazard

Surface fault rupture is defined as displacement that occurs along the surface trace of a fault. The site is not located within any Earthquake Fault Zone (EFZ) as defined by the California Department of Conservation (Special Publication 42, 1997). There are no known faults crossing

beneath or extending directly toward the site. Therefore, the potential hazard due to ground rupture is considered to be very low.

Corrosivity

Composite soil samples were taken from the recent exploratory borings. The test results indicate that the foundation materials are non-corrosive to construction materials or structural elements.

Scour

The bridge site will be subjected to both long term short term scour at the bent support locations. The design scour elevation has been identified as 205feet.

Geotechnical Recommendations

Based on the recent foundation investigation and review of the General plan, precast, prestressed Class 90, Alternative "X" driven piles are the optimum foundation type for the abutments and precast, prestressed concrete pile extensions are the optimum foundation type at the bent supports. Tables 1 and 2 list the foundation recommendation parameters. Table 3 is the pile data table to be included in the project contract documents.

Table 1. Foundation Recommendations for Abutments
Class 90, Alt. "X"

Abutment Foundation Design Recommendations									
Support Location	Pile Type	Cut-off Elevation (ft)	LRFD Service-I Limit State Load Per Support (kips)		LRFD Service-I Limit State Total Load Per Pile (kips)	Nominal Resistance (kips)	Design Tip Elevations (ft)	Specified Tip Elevation (ft)	Nominal Driving Resistance Required (kips)
			Total	Permanent	Compression				
Abut 1	Class 90 Alt. "X"	216.3	500	180	90	180	191.3 (a)	191.3	180
Abut 4	Class 90 Alt. "X"	216.1	500	180	90	180	191.3 (a)	191.3	180

Note: 1) Design tip elevations are controlled by (a) compression.

Table 2. Foundation Recommendations for Bents

Precast/Prestressed 16-inch diameter concrete pile extensions

Bent Foundation Design Recommendations											
Support Location	Pile Type	Cut-off Elevation (ft)	Service Limit State I Load (kips)	Total Permissible Support Settlement (inches)	Required Factored Nominal Resistance (kips)				Design Tip Elevations (ft)	Specified Tip Elevation (ft)	Nominal Driving Resistance Required (kips)
					Strength Limit		Extreme Event				
					Comp. φ=0.7	Tension φ=0.7	Comp. φ=1.0	Tension φ=1.0			
Bent 2	PC/PS concrete	N/A	129	1	169	0	82	0	189.7 (a) 197.0 (b)	189.7	260 (2)
Bent 3	PC/PS concrete	N/A	129	1	169	0	82	0	189.7 (a) 197.0 (b	189.7	260 (2)

Notes: 1) Design tip elevations are controlled by:
(a) compression (Strength Limit)
(b) compression (Extreme Event)
2) The nominal driving resistance required is the result of additional resistance from unsuitable soil layers. Unsuitable, scourable soil layers at Bents 2 and 3 extend to elevation 205.2

Table 3. Pile Data Table

Support Location	Pile Type (ft)	Nominal Resistance (kips)		Design Tip Elevations (ft)	Specified Tip Elevation (ft)	Nominal Driving Resistance Required (kips)
		Compression	Tension			
Abut 1	Class 90 Alt. "X"	180	N/A	191.3	191.3	180
Bent 2	PC/PS concrete (3)	240	0	189.7 (a) 197.0 (b)	189.7	260 (2)
Bent 3	PC/PS concrete (3)	240	0	189.7 (a) 197.0 (b)	189.7	260 (2)
Abut 4	Class 90 Alt. "X"	180	N/A	191.3	191.3	180

Notes: 1) Design tip elevations are controlled by:
(a) compression (Strength Limit)
(b) compression (Extreme Event)
2) The nominal driving resistance required is the result of additional resistance from unsuitable soil layers. Unsuitable, scourable soil layers at Bents 2 and 3 extend to elevation 205.2
3) See "SLAB BRIDGE PILES DETAILS" sheet.

Construction Considerations

The Class 90, Alt. "X" concrete piles at both abutment locations are to be driven in predrilled holes through any newly constructed embankment fills. The predrilling shall be in accordance with section 49-1.06 of the Standard Specifications and shall not extend below an elevation of 214 feet.

Due to the granular nature of the soil at the site, primary settlement is expected to occur immediately and concurrent with embankment fill placement. No waiting period is required prior to installing piles through the new embankment fills.

If any conceptual changes are proposed during final project design, the Office of Geotechnical Design-North should review those changes to determine if the recommendations contained herein are still applicable.

Project Information

Standard Special Provision S5-280, "Project Information", discloses to bidders and contractors a list of pertinent information available for their inspection prior to bid opening. The following is an excerpt from SSP S5-280 disclosing information originating from Geotechnical Services. Items listed to be included in the Information Handout will be provided in Acrobat (.pdf) format to the addressee(s) of this report via electronic mail.

Data and information attached with the project plans are:

One Log of Test Borings (2 borings).

Data and information included in the Information Handout provided to the bidders and contractors are:

None.

Data and information available for inspection at the District Office:

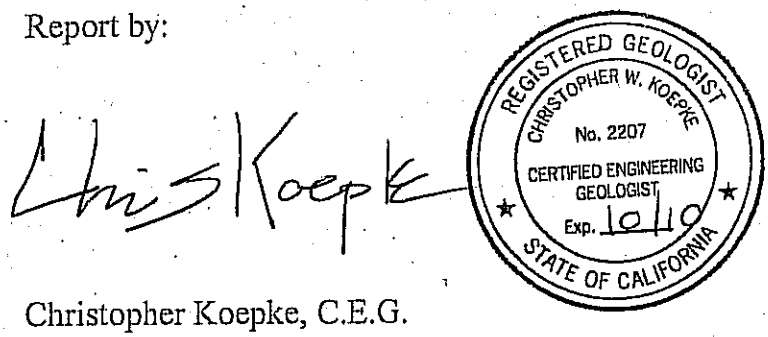
None.

Data and information available for inspection at the Transportation Laboratory are:

Foundation Recommendations report. Dutchman Creek Bridge, 39-0238 (L/R)
March 4, 2009

If you have any questions or comments, or need additional information please contact Christopher Koepke at (916) 227-1040.

Report by:



Christopher Koepke, C.E.G.
Engineering Geologist
Office of Geotechnical Design – North
Branch E

cc: Qiang Huang
R.E., Pending
Structures OE (E-copy)
GDN File
D10 PCE – Angela Ezekiel
D10 DME – Dave Dhillon
GS File Room

Memorandum

Flex your power!
Be energy efficient!

To: DAN ADAMS
Chief
Bridge Design Branch 10
Office of Bridge Design – South 2
Division of Engineering Services

Attention: Larry Wu

Date: March 4, 2009

File: 10-MER-99-0.0/4.9
EA: 10-415801
Dutchman Creek Bridge
East Frontage Road
39-0239
(new)

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES – MS 5

Subject: Foundation Recommendations

Introduction

Per your request, we are providing foundation recommendations for the bridge project referenced above. This bridge is part of the Plainsburg/Sandy Mush Interchange project. This report is for use by the project design engineer, construction personnel, bidders and contractors.

Pertinent Plans and Data

The following resources were used in the assessment of the site conditions for these recommendations:

1. The preliminary and General plans for the proposed new bridge.
2. A preliminary foundation recommendation report dated August 10, 2007 by this Office.
3. Two exploratory borings conducted in May, 2008.
4. Groundwater level data (2006), Department of Water Resources (DWR), California.
5. Caltrans Seismic Hazard Map 1996.

Site Geology

The subsurface formations in the project area are alluvium and flood plain deposits. These materials consist of primarily granular interbedded sands, silts, clayey silts, silty sands and minor amounts of clay. These deposits vary in consistency from loose to medium dense.

Groundwater

Groundwater was not encountered during the June 2008 field investigation. DWR records show that the depth of groundwater below the project site ranged between 180 and 210 feet in 2006 (DWR Well Nos. 09S15E14A001M, 09S15E11F001M and 09S15E10A001M). Some localized thin lenses of perched water may be present at the site. Groundwater is not expected to be a factor during construction.

Seismicity

Based on the 1996 Caltrans Seismic Hazard Map, the controlling fault for the project alignment is the Prairie Creek-Spenceville-Dentman (PSD, normal) fault. This fault possesses a Maximum Credible Earthquake magnitude of Mw = 6.5, and is located approximately 18 miles from the project site to the northeast. Based on the referenced map, the peak bedrock acceleration for the new bridge is estimated to be 0.2g. The soil profile is classified as type "D" per the Department's Seismic Design Criteria (SDC).

Based on the Log of Test Borings a final Caltrans Seismic Design Criteria (CSDC) Acceleration Response Spectrum (ARS) Curve corresponding to soil profile Type D is recommended for design. The recommended ARS Curve may be found in Figure B.7 of CSDC Version 1.4 of June 2006.

Liquefaction Potential

The site is not located in an area shown as potentially liquefiable on the State Seismic Hazard Map. Since the project location has a deep groundwater condition, the potential for liquefaction under the proposed bridge is considered very low. The potential for seismically induced settlement and lateral spreading is also considered very low.

Surface Fault Rupture Hazard

Surface fault rupture is defined as displacement that occurs along the surface trace of a fault. The site is not located within any Earthquake Fault Zone (EFZ) as defined by the California Department of Conservation (Special Publication 42, 1997). There are no known faults crossing

Department of Conservation (Special Publication 42, 1997). There are no known faults crossing beneath or extending directly toward the site. Therefore, the potential hazard due to ground rupture is considered to be very low.

Corrosivity

Composite soil samples were taken from the recent exploratory borings. The test results indicate that the foundation materials are non-corrosive to construction materials or structural elements.

Scour

The bridge site will be subjected to both long term short term scour at the bent support locations. The design scour elevation has been identified as 206 feet.

Geotechnical Recommendations

Based on the recent foundation investigation and review of the General plan, precast, prestressed Class 90, Alternative "X" driven piles are the optimum foundation type for the abutments and precast, prestressed concrete slab bridge pile extensions are the optimum foundation type at the bent supports. Tables 1 and 2 list the foundation recommendation parameters. Table 3 is the pile data table to be included in the project contract documents.

Table 1. Foundation Recommendations for Abutments
Class 90, Alt. "X"

Abutment Foundation Design Recommendations									
Support Location	Pile Type	Cut-off Elevation (ft)	LRFD Service-I Limit State Load Per Support (kips)		LRFD Service-I Limit State Total Load Per Pile (kips)	Nominal Resistance (kips)	Design Tip Elevation (ft)	Specified Tip Elevation (ft)	Nominal Driving Resistance Required (kips)
			Total	Permanent	Compression				
Abut 1	Class 90 Alt. "X"	216.8	390	150	90	180	193.5 (a)	193.5	180
Abut 4	Class 90 Alt. "X"	216.8	390	150	90	180	193.5 (a)	193.5	180

Note: 1) Design tip elevations are controlled by (a) compression.

Table 2. Foundation Recommendations for Bents

Precast/Prestressed 16-inch diameter concrete pile extensions

Bent Foundation Design Recommendations											
Support Location	Pile Type	Cut-off Elevation (ft)	Service Limit State I Load (kips)	Total Permissible Support Settlement (inches)	Required Factored Nominal Resistance (kips)				Design Tip Elevations (ft)	Specified Tip Elevation (ft)	Nominal Driving Resistance Required (kips)
					Strength Limit		Extreme Event				
					Comp. φ=0.7	Tension φ=0.7	Comp. φ=1.0	Tension φ=1.0			
Bent 2	PC/PS concrete	N/A	136	1	178	0	91	0	188.2 (a) 195.5 (b)	188.2	270 (2)
Bent 3	PC/PS concrete	N/A	136	1	178	0	91	0	188.2 (a) 195.5 (b)	188.2	270 (2)

Notes: 1) Design tip elevations are controlled by:
(a) compression (Strength Limit)
(b) compression (Extreme Event)
2) The nominal driving resistance required is the result of additional resistance from unsuitable soil layers. Unsuitable, scourable soil layers at Bents 2 and 3 extend to elevation 205.8

Table 3. Pile Data Table

Support Location	Pile Type (ft)	Nominal Resistance (kips)		Design Tip Elevations (ft)	Specified Tip Elevation (ft)	Nominal Driving Resistance Required (kips)
		Compression	Tension			
Abut 1	Class 90 Alt. "X"	180	N/A	193.5	193.5	180
Bent 2	PC/PS concrete (3)	250	0	188.2 (a) 195.5 (b)	188.2	270 (2)
Bent 3	PC/PS concrete (3)	250	0	188.2 (a) 195.5 (b)	188.2	270 (2)
Abut 4	Class 90 Alt. "X"	180	N/A	193.5	193.5	180

Notes: 1) Design tip elevations are controlled by:
(a) compression (Strength Limit)
(b) compression (Extreme Event)
2) The nominal driving resistance required is the result of additional resistance from unsuitable soil layers. Unsuitable, scourable soil layers at Bents 2 and 3 extend to elevation 205.8
3) See "SLAB BRIDGE PILES DETAILS" sheet.

Construction Considerations

The Class 90, Alt. "X" concrete piles at both abutment locations are to be driven in predrilled holes through any newly constructed embankment fills. The predrilling shall be in accordance with section 49-1.06 of the Standard Specifications and shall not extend below an elevation of 213 feet.

Due to the granular nature of the soil at the site, primary settlement is expected to occur immediately and concurrent with embankment fill placement. No waiting period is required prior to installing piles through the new embankment fills.

If any conceptual changes are proposed during final project design, the Office of Geotechnical Design-North should review those changes to determine if the recommendations contained herein are still applicable.

Project Information

Standard Special Provision S5-280, "Project Information", discloses to bidders and contractors a list of pertinent information available for their inspection prior to bid opening. The following is an excerpt from SSP S5-280 disclosing information originating from Geotechnical Services. Items listed to be included in the Information Handout will be provided in Acrobat (.pdf) format to the addressee(s) of this report via electronic mail.

Data and information attached with the project plans are:

One Log of Test Borings (2 borings).

Data and information included in the Information Handout provided to the bidders and contractors are:

None.

Data and information available for inspection at the District Office:

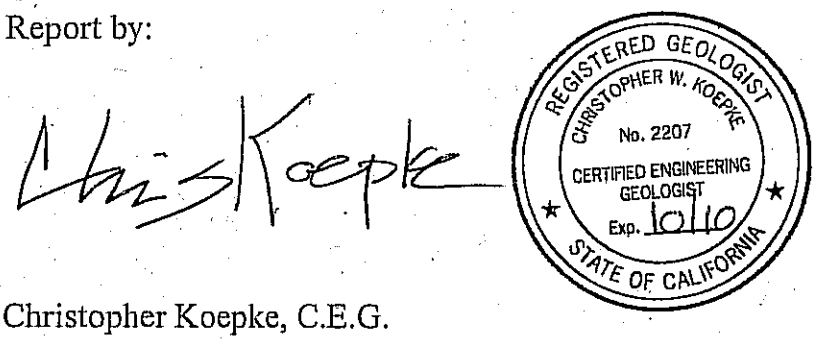
None.

Data and information available for inspection at the Transportation Laboratory are:

Foundation recommendations, Dutchman Creek Bridge, East Frontage Road 39-0239, March 4, 2009

If you have any questions or comments, or need additional information please contact Christopher Koepke at (916) 227-1040.

Report by:



Christopher Koepke, C.E.G.
Engineering Geologist
Office of Geotechnical Design – North
Branch E

cc: Qiang Huang
R.E., Pending
Structures OE (E-copy)
GDN File
D10 PCE – Angela Ezekiel
D10 DME – Dave Dhillon
GS File Room

Memorandum

Flex your power!
Be energy efficient!

To: DAN ADAMS
Chief
Bridge Design Branch 10
Office of Bridge Design – South 2
Division of Engineering Services

Attention: Larry Wu

Date: March 8, 2010

File: 10-MER-99-0.0/4.9
EA: 10-415801
South Dutchman Creek Bridge
39-0240
(new)

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES – MS 5

Subject: Foundation Recommendations

Introduction

Per your request, we are providing foundation recommendations for the bridge project referenced above. This bridge is part of the Plainsburg/Sandy Mush Interchange project. This report is for use by the project design engineer, construction personnel, bidders and contractors.

Pertinent Plans and Data

The following resources were used in the assessment of the site conditions for these recommendations:

1. The preliminary and General plans for the proposed new bridge.
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3. Two exploratory borings conducted in May, 2008.
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5. Caltrans Seismic Hazard Map 1996.

Site Geology

The subsurface formations in the project area are alluvium and flood plain deposits. These materials consist of primarily granular interbedded sands, silts, clayey silts, silty sands and minor amounts of clay. These deposits vary in consistency from loose to medium dense.

Groundwater

Groundwater was not encountered during the June 2008 field investigation. DWR records show that the depth of groundwater below the project site ranged between 180 and 210 feet in 2006 (DWR Well Nos. 09S15E14A001M, 09S15E11F001M and 09S15E10A001M). Some localized thin lenses of perched water may be present at the site. Groundwater is not expected to be a factor during construction.

Seismicity

Based on the 1996 Caltrans Seismic Hazard Map, the controlling fault for the project alignment is the Prairie Creek-Spenceville-Dentman (PSD, normal) fault. This fault possesses a Maximum Credible Earthquake moment magnitude of Mw = 6.5, and is located 18 miles from the project site to the northeast. Based on the referenced map, the peak bedrock acceleration for the new bridge is estimated to be 0.2g.

Based on the Log of Test Borings a final Caltrans Seismic Design Criteria (CSDC) Acceleration Response Spectrum (ARS) Curve corresponding to soil profile Type D is recommended for design. The recommended ARS Curve may be found in Figure B.7 of CSDC Version 1.4 of June 2006.

Liquefaction Potential

The site is not located in an area shown as potentially liquefiable on the State Seismic Hazard Map. Since the project location has a deep groundwater condition, the potential for liquefaction under the proposed bridge is considered very low. The potential for seismically induced settlement and lateral spreading is also considered very low.

Surface Fault Rupture Hazard

Surface fault rupture is defined as displacement that occurs along the surface trace of a fault. The site is not located within any Earthquake Fault Zone (EFZ) as defined by the California Department of Conservation (Special Publication 42, 1997). There are no known faults crossing

beneath or extending directly toward the site. Therefore, the potential hazard due to ground rupture is considered to be very low.

Corrosivity

Composite soil samples were taken from the recent exploratory borings. The test results indicate that the site soils are non-corrosive to construction materials or structural elements.

Scour

The bridge site will not be subjected to stream instability.

Geotechnical Recommendations

Based on the recent foundation investigation and review of the General plan, spread footings are the optimum foundation type for the abutment support locations. Table 1 lists the foundation recommendation parameters. Table 2 is the spread footing data table to be included in the project contract documents.

Table 1
Spread Footing Data Table

Support Location	Footing Size (ft)		Bottom of Footing Elevation (ft)	Minimum Footing Embedment Depth (ft)	Total Permissible Settlement (in)	WSD (LRFD) Service-I Limit Load State Combination		LRFD		
								Service	Strength $\phi_b = 0.45$	Extreme $\phi_b = 1.0$
	B	L				Permissible Gross Contact Stress (ksf)	Allowable Gross Bearing Capacity (ksf)	Permissible Net Contact Stress (ksf)	Factored Gross Nominal Bearing Resistance (ksf)	Factored Gross Nominal Bearing Resistance (ksf)
Abut 1	6.0	60.5	218.0	3	1	7.1	4.4	N/A	N/A	N/A
Abut 2	6.0	60.5	218.0	3	1	7.1	4.4	N/A	N/A	N/A

Table 1 Notes: 1) Recommendations are based on the foundation geometry and the loads provided by Structure Design in the Foundation Data Sheet. The footing contact area is taken as equal to the effective footing area, where applicable.
2) See MTD 4-1 for definitions and applications of the recommended design parameters.

Footing bottoms shall be embedded a minimum of 3 feet below finished grade.

Table 2
Spread Footing Data for Contract Plans

Support Location	Working Stress Design (WSD)		Load and Resistance Factor Design (LRFD)		
			Service	**Strength**	**Extreme**
	Permissible Gross Contact Stress (Settlement) (ksf)	Allowable Gross Bearing Capacity (ksf)	Permissible Net Contact Stress (ksf)	Factored Gross Nominal Bearing Resistance $\phi_b = 0.45$ (ksf)	Factored Gross Nominal Bearing Resistance $\phi_b = 1.0$ (ksf)
Abut. 1	7.1	4.4	N/A	N/A	N/A
Abut. 2	7.1	4.4	N/A	N/A	N/A

If any conceptual changes are proposed during final project design, the Office of Geotechnical Design-North should review those changes to determine if the recommendations contained herein are still applicable.

Project Information

Standard Special Provision S5-280, "Project Information", discloses to bidders and contractors a list of pertinent information available for their inspection prior to bid opening. The following is an excerpt from SSP S5-280 disclosing information originating from Geotechnical Services. Items listed to be included in the Information Handout will be provided in Acrobat (.pdf) format to the addressee(s) of this report via electronic mail.

Data and information attached with the project plans are:
One Log of Test Borings (2 borings).

Data and information included in the Information Handout provided to the bidders and contractors are:
None.

Data and information available for inspection at the District Office:
None.

Data and information available for inspection at the Transportation Laboratory are:
Foundation recommendations, South Dutchman Creek Bridge, 39-0240, March 4, 2009.

If you have any questions or comments, or need additional information please contact Christopher Koepke at (916) 227-1040.

Report by:

Chris Koepke

REGISTERED GEOLOGIST
CHRISTOPHER W. KOEPKE
No. 2207
CERTIFIED ENGINEERING GEOLOGIST
Exp. 10/10
STATE OF CALIFORNIA

Christopher Koepke, C.E.G.
Engineering Geologist
Office of Geotechnical Design – North
Branch E

cc: Qiang Huang
R.E., Pending
Structures OE (E-copy)
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