APPENDIX A

Boring Logs

Geosphere Consultants, Inc.
AN ETS COMPANY
Geotechnical Engineering • Engineering Geology
Environmental Management • Water Resources

BORING NUMBER B-1

CLIENT Albany Unified School District
PROJECT NAME Albany High School - Aquatic Center
PROJECT NUMBER 91-02320-A
PROJECT LOCATION Albany, California
DATE STARTED 11/15/08 **COMPLETED** 11/15/08
GROUND ELEVATION **HOLE SIZE** 6"
DRILLING CONTRACTOR Exploration Geoservices
GROUND WATER LEVELS:
DRILLING METHOD Mobile B-56
∇ **AT TIME OF DRILLING** 15.00 ft
LOGGED BY MAH **CHECKED BY** MAH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0		(CH) CLAY - Dark brown, sandy, fat with gray sand, medium stiff, moist. Unconfined Compressive Strength = 1,550 psf at 7.3% strain							59	18	41	
5			MC 1-1		3-5-6 (11)		92	23				
		(CL) CLAY - Mottled orange, grayish, and moderate brown, lean with sand, very stiff, slightly moist.							33	12	21	
10			MC 1-2		3-11-12 (23)	3	114	15				
		(SP) SAND - Medium to coarse, clayey, gravelly, dense, wet.										
15		∇	MC 1-3		16-25-22 (47)	3.75	120	12				23
		SILTSTONE/CLAYSTONE - Light brown, weathered, friable.	MC 1-4		25-50	3.5						
20		Becoming dark grayish brown.					118	10				
25			MC 1-5		36-50							
		Much less weathered.										
30			ST 1-6		34-32-50 (82)							

Bottom of borehole at 30.0 feet.

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BORING NUMBER B-2

CLIENT Albany Unified School District
PROJECT NAME Albany High School - Aquatic Center
PROJECT NUMBER 91-02320-A
PROJECT LOCATION Albany, California
DATE STARTED 11/15/08 **COMPLETED** 11/15/08
GROUND ELEVATION **HOLE SIZE** 6"
DRILLING CONTRACTOR Exploration Geoservices
GROUND WATER LEVELS:
DRILLING METHOD Mobile B-56
AT TIME OF DRILLING ---
LOGGED BY MAH **CHECKED BY** MAH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		(CH) CLAY - Dark brown, sandy, fat, very stiff, moist.										
		Unconfined Compressive Strength = 3,475 psf at 6.72% strain.	MC 2-1		5-9-13 (22)		96	27				
5												
		(CH) CLAY - Mottled orange and grayish brown, sandy, lean with gravel, very stiff, slightly moist.	MC 2-2		8-9-11 (20)	3.25	119	13				
10												
		(SC) SAND - Moderate brown, clayey, gravelly, medium to coarse, moist to wet, very dense.	MC 2-3		36-50	4.5	125	6				

Bottom of borehole at 13.5 feet.

Geosphere Consultants, Inc.
AN ETS COMPANY
Geotechnical Engineering • Engineering Geology
Environmental Management • Water Resources

BORING NUMBER B-3

CLIENT Albany Unified School District
PROJECT NAME Albany High School - Aquatic Center
PROJECT NUMBER 91-02320-A
PROJECT LOCATION Albany, California
DATE STARTED 11/15/08 **COMPLETED** 11/15/08
GROUND ELEVATION **HOLE SIZE** 6"
DRILLING CONTRACTOR Exploration Geoservices
GROUND WATER LEVELS:
DRILLING METHOD Mobile B-56
AT TIME OF DRILLING ---
LOGGED BY MAH **CHECKED BY** MAH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		(SP) Bedding Sand - undetected underground utility.										
		Bottom of borehole at 3.0 feet.										

Geosphere Consultants, Inc.
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Geotechnical Engineering • Engineering Geology
Environmental Management • Water Resources

BORING NUMBER B-4

CLIENT Albany Unified School District
PROJECT NAME Albany High School - Aquatic Center
PROJECT NUMBER 91-02320-A
PROJECT LOCATION Albany, California
DATE STARTED 11/15/08 COMPLETED 11/15/08
GROUND ELEVATION HOLE SIZE 6"
DRILLING CONTRACTOR Exploration Geoservices
GROUND WATER LEVELS:
DRILLING METHOD Mobile B-56
AT TIME OF DRILLING ---
LOGGED BY MAH CHECKED BY MAH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		(CH) CLAY - Dark brown, sandy, fat, stiff, moist. Unconfined Compressive Strength = 4,496 psf at 9.87% strain.										
5			MC 4-1		3-7-11 (18)	2	87	34				
		(CL) CLAY - Mottled orange and grayish brown, sandy, lean, very stiff, slightly moist.										
10			MC 4-2		7-12-15 (27)	4.5	109	16				
		(SP) SAND - Mottled orange and grayish brown, fine to medium, poorly graded, with gravel, very dense, slightly moist. Weathered bedrock.										
15			MC 4-3		11-50	4.5	108	25				
		SANDSTONE - Moderately hard, moderately weathered, moderately strong, graywacke.	MC 4-4		50							
20												

Bottom of borehole at 20.0 feet.

Geosphere Consultants, Inc.
AN ETS COMPANY
Geotechnical Engineering • Engineering Geology
Environmental Management • Water Resources

BORING NUMBER B-5

CLIENT Albany Unified School District
PROJECT NAME Albany High School - Aquatic Center
PROJECT NUMBER 91-02320-A
PROJECT LOCATION Albany, California
DATE STARTED 11/15/08 COMPLETED 11/15/08
GROUND ELEVATION HOLE SIZE 6"
DRILLING CONTRACTOR Exploration Geoservices
GROUND WATER LEVELS:
DRILLING METHOD Mobile B-56
AT TIME OF DRILLING ---
LOGGED BY MAH CHECKED BY MAH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0		(CH) CLAY - Dark brown, sandy, fat, very stiff, moist.										
		Unconfined Compressive Strength = 3,035 psf at 7.56% strain.	MC 5-1		3-8-11 (19)	1.25	89	30				
5		(CL) CLAY - Moderate brown, sandy, lean with gravel, stiff, moist.										
			MC 5-2		4-6-8 (14)	1	113	17				
10		(SC) SAND - Mottled black, orange, and grayish brown, clayey, very dense, moist. Weathered bedrock.	MC 5-3		14-34-35 (69)	4.5	120	12				
15		SILTSTONE - Grayish brown, friable, weathered.	SPT 5-4		30-50							

Bottom of borehole at 18.5 feet.

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Geosphere Consultants, Inc.
AN ETS COMPANY
Geotechnical Engineering • Engineering Geology
Environmental Management • Water Resources

BORING NUMBER B-6

CLIENT Albany Unified School District
PROJECT NAME Albany High School - Aquatic Center
PROJECT NUMBER 91-02320-A
PROJECT LOCATION Albany, California
DATE STARTED 11/15/08 **COMPLETED** 11/15/08
GROUND ELEVATION **HOLE SIZE** 6"
DRILLING CONTRACTOR Exploration Geoservices
GROUND WATER LEVELS:
DRILLING METHOD Mobile B-56
AT TIME OF DRILLING ---
LOGGED BY MAH **CHECKED BY** MAH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		(CH) CLAY - Dark brown, fat with sand, very stiff, moist.										
5			MC 6-1		4-8-13 (21)	1.75	103	21				
		(CL) CLAY - Mottled orange and grayish brown, lean with sand, very stiff, moist.										
10			MC 6-2		7-14-18 (32)	3	116	15				
15			MC 6-3		5-12-23 (35)	4.5	128	13				
		SANDSTONE - Dark grayish brown, fine, moderately strong, moderately hard, graywacke.										
20			SPT 6-4		50							

Bottom of borehole at 20.0 feet.

APPENDIX B

LABORATORY TEST RESULTS
Moisture/Density
Sieve Analysis
Atterberg Limits
Unconfined Compression
Corrosion

Date: 11/27/08
CEL No.: 91-02320A
Project: Albany High School
Lab No.: S-1121-01

Moisture Content & Density per ASTM D2937

Sample Number	Depth feet	Munsell Remarks	Visual Description	Moisture Content %	Dry Density pcf	Pocket Penetrometer tons per sqft (top / bottom)
1-2	9.5	5/6 2.5Y	middle	15.2	114.3	3
1.3	14.5	5/4 2.5Y	light olive brn clay w/dg	12.3	119.9	3.75
1-4	19.5	6/4 2.5Y	light yellowish brn clay w/sand, silt, grav	10.1	118.2	3.5
2-2	8	5/4 2.5Y	sand 1"	12.6	118.5	3.25
2-3	13	6/4 2.5Y	light yellowish brn sand, rock/dg, w/clay	6.0	124.5	>4.5
4-2	9.5	5/6 2.5Y	light olive brn clay w/sand	15.5	109.1	4.5
4-3	14.5	5/6 2.5Y	light olive brn f-m sand w/grav	25.1	107.9	>4.5
5-2	8	4/4 2.5Y	olive brn clay w/sand, shale/rock	16.6	113.0	1
5-3	13	5/4 | 5/6 2.5Y	light olive brn clay w/sand | clay	12.1	119.5	>4.5 | 2.5
6-1	4.5	2.5/1 2.5Y	black clay	21.0	102.9	1.75
6-2	9.5	4/4 2.5Y	olive brn clay w/f-m sand	15.4	116.3	3
6-3	14.5	5/6 2.5Y	light olive brn f-m sand w/clay, grav	12.7	127.7	>4.5
1-1	5	2.5/1 5YR	black clay w some sand, grav--lg void to 1/2' dp	23.3	92.3	1.5 | >4.5
2-1	3	2.5/1 5Y	black clay	27.4	95.8	1.5 | 2.0
4-1	5	2.5/1 5Y	black clay	33.5	86.9	1.75 | 2.0
5-1	3	2.5/1 5Y	black clay	30.3	89.0	1.25

Note 1: The sample was too granular to perform the test.

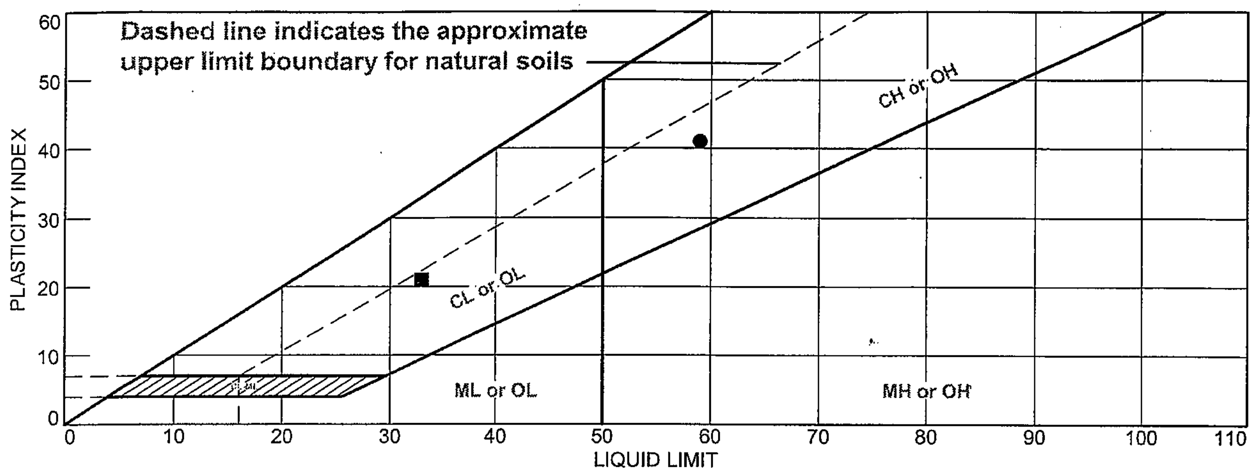
PERCENT FINER THAN NO. 200
ASTM C117-03

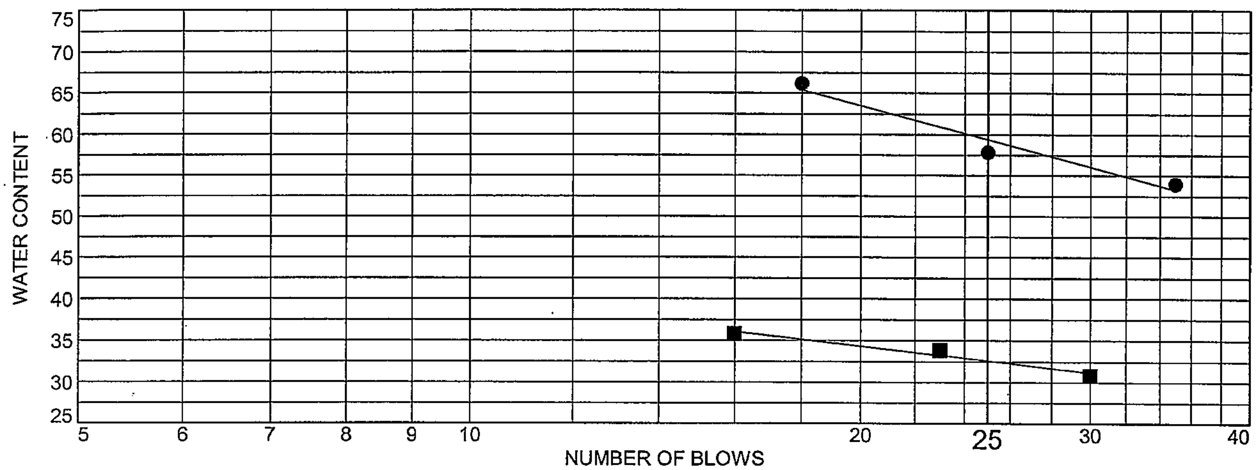
Sample Date:
Sampled By: Marc Hachey
Sample Location: 1-3, 14.5'-15'
Material Description : Lt olive brn sand, dg & grav w clay

TEST PROCEDURE: PROCEDURE A : ☐ PROCEDURE B : ✓

% of Material Finer Than No. 200
23

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	2/1 YR, Black Clay	59	18	41			
■	4/4 7.5YR, Brn Clay w/f-m sand	33	12	21			

Project No. 91-02320A **Client:**

Project: Albany High School

● **Location:** Bulk #1 **Depth:** 0'-5' **Sample Number:** S1121-01 Bulk #1

■ **Depth:** 5'-10' **Sample Number:** S1121-01 Bulk #2

Remarks:

Consolidated Engineering Laboratories

Oakland, California

Figure

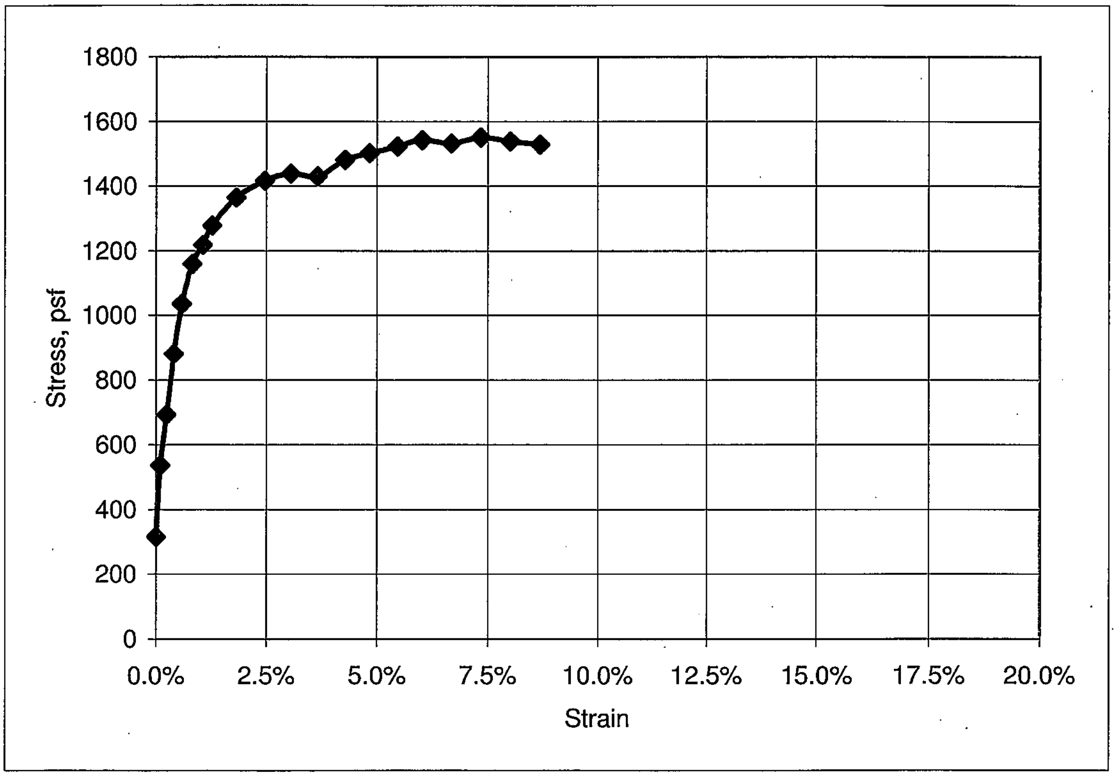
Tested By: Bill Coletto **Checked By:** Bill Coletto

Date	11/26/08
CEL#	91-02320A
Project:	Albany High School
Lab No.:	S1121-01A

Unconfined Compressive Strength of Cohesive Soil per ASTM D2166

Sample:	1-1	Moisture Content, %:	23.3
Depth, feet:	5'	Dry Density, pcf:	92.3
Description:	Black clay w/sand, gravel		

Height of Sample, in.: 5.98
Diameter of Sample, in.: 2.41
Area of Sample, sqin.: 4.56
Height to Diam. Ratio, %: 2.48



Final Results at Maximum

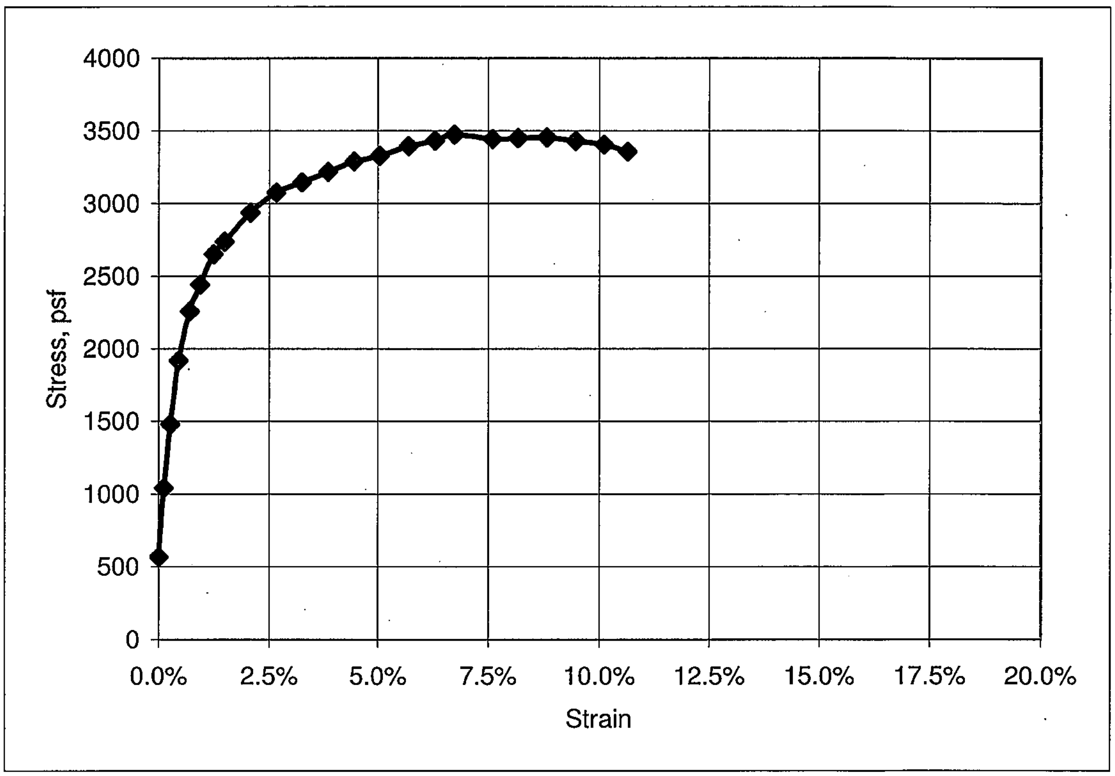
Load:	53	lbs
Strain:	7.34	%
Area :	4.92	sqin
Compressive Strength:	1550	psf
	0.70	ton/sf

Date	11/26/08
CEL#	91-02320A
Project:	Albany High School
Lab No.:	S1121-01B

Unconfined Compressive Strength of Cohesive Soil per ASTM D2166

Sample:	2-1	Moisture Content, %:	27.4
Depth, feet:	3'	Dry Density, pcf:	95.8
Description:	Black clay w/sand		

Height of Sample, in.:	5.98
Diameter of Sample, in.:	2.41
Area of Sample, sqin.:	4.56
Height to Diam. Ratio, %:	2.48



Final Results at Maximum

Load:	118 lbs
Strain:	6.72 %
Area :	4.89 sqin
Compressive Strength:	3475 psf
	1.57 ton/sf

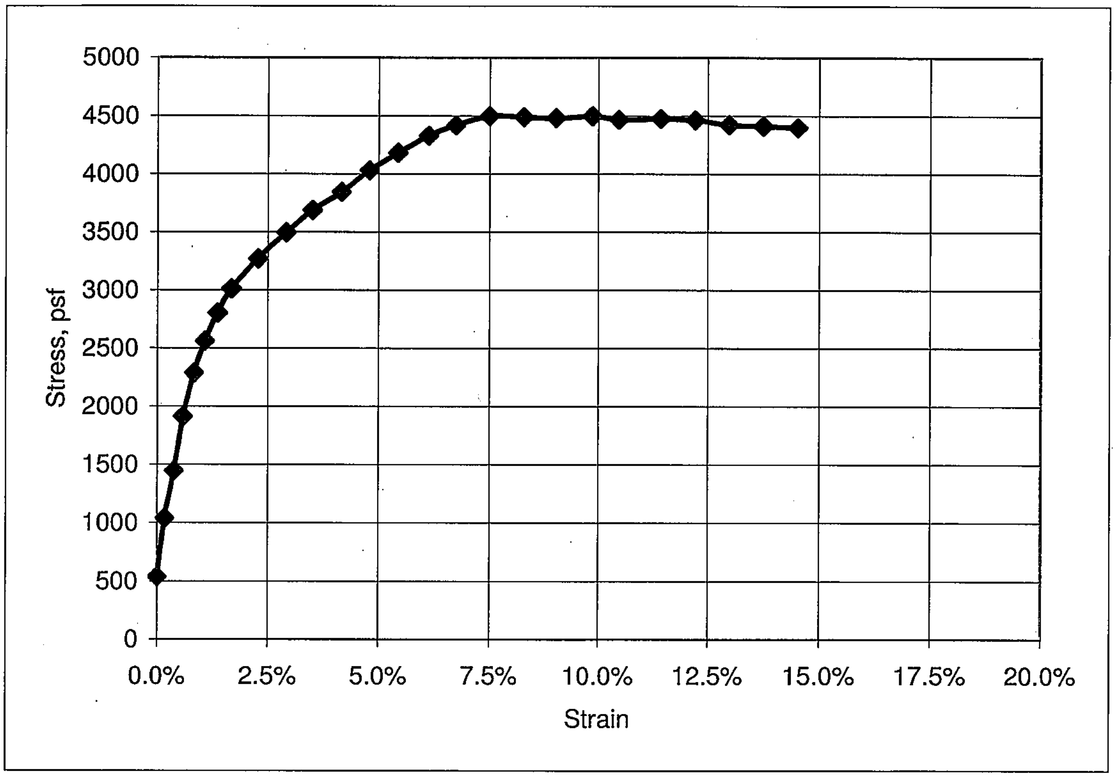
Consolidated Engineering Laboratories, Inc.

Date	11/26/08
CEL#	91-02320A
Project:	Albany High School
Lab No.:	S1121-01C

Unconfined Compressive Strength of Cohesive Soil per ASTM D2166

Sample:	4-1	Moisture Content, %:	33.5
Depth, feet:	3'	Dry Density, pcf:	86.9
Description:	Black clay w/sand		

Height of Sample, in.:	5.23
Diameter of Sample, in.:	2.41
Area of Sample, sqin.:	4.56
Height to Diam. Ratio, %:	2.17



Final Results at Maximum

Load:	158 lbs
Strain:	9.87 %
Area :	5.06 sqin
Compressive Strength:	4496 psf
	2.04 ton/sf

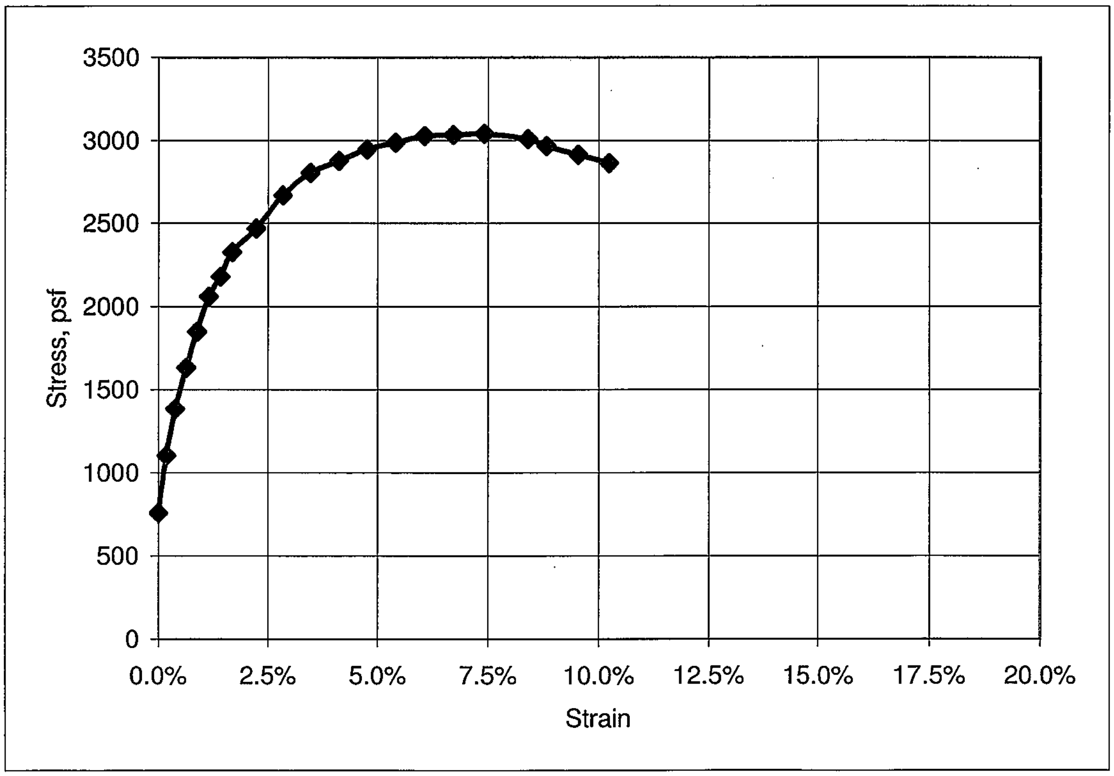
Consolidated Engineering Laboratories, Inc.

Date	11/26/08
CEL#	91-02320A
Project:	Albany High School
Lab No.:	S1121-01C

Unconfined Compressive Strength of Cohesive Soil per ASTM D2166

Sample:	S -1	Moisture Content, %:	30.3
Depth, feet:	3'	Dry Density, pcf:	89.0
Description:	Black clay w/sand		

Height of Sample, in.:	5.98
Diameter of Sample, in.:	2.41
Area of Sample, sqin.:	4.56
Height to Diam. Ratio, %:	2.48



Final Results at Maximum

Load:	104	lbs
Strain:	7.56	%
Area :	4.93	sqin
Compressive Strength:	3035	psf
	1.37	ton/sf

Consolidated Engineering Laboratories, Inc.

ETS

Environmental Technical Services

-Soil, Water & Air Testing & Monitoring
-Analytical Labs
-Technical Support

975 Transport Way, Suite 2
Petaluma, CA 94954
(707) 778-9605/FAX 778-9612

Serving people and the environment so that both benefit.

COMPANY: Consolidated Engineering Labs, 2001 Crow Canyon Road, San Ramon, CA 94583			ANALYST(S)	SUPERVISOR
ATTN: Marc Hachey		DATE of	D. Salinas	D. Jacobson
JOB SITE: Albany High Schol, Albany, California	DATE RECEIVED	COMPLETION	S. Santos	LAB DIRECTOR
JOB #: 91-02320-A	11/24/2008	12/3/2008		.G.S. Conrad PhD

LAB SAMPLE NUMBER	SAMPLE ID	DESCRIPTION of SOIL and/or SEDIMENT	SOIL pH -log[H+]	MINIMUM RESISTIVITY ohm-cm	ELECTRICAL CONDUCTIVITY µmhos/cm	SULFATE SO4 ppm	CHLORIDE Cl ppm
03386-1	AHS1/A	Grab	**7.83**	**1,590**	**[630]**	**138**	**113**
Method	Detection	Limits —>	—	1	0.1	1	1

LAB SAMPLE NUMBER	SAMPLE ID	DESCRIPTION of SOIL and/or SEDIMENT	PERCENT MOISTURE %	SOLUBLE SULFIDES (S=) ppm	SOLUBLE CYANIDES (CN=) ppm	REDOX mV	GROSS TEXTURAL CLASS
03386-1	AHS1/A	Grab		**0.027**		**+352.2**	
Method	Detection	Limits —>	0.01	0.001	0.1	1	-

COMMENTS

Resistivity is over 1,500 ohm-cm which is mediocre, and soil reaction (i.e., pH) is mildly alkaline which does help; sulfate and chloride are low; sulfides are very low; and soil is only very mildly reduced. The standard CalTrans times to perforation are as follows: for 18 ga steel the time is ≈30 yrs, and for 12 ga it goes to >66 yrs. For steel the calculated average pitting rate is at ≈0.095 mm/yr, putting to 2 mm depth time at ≈21 yrs, and the 4 mm depth time at ≈42 yrs. Chloride is low enough that it should not have any significant impact on concrete steel reinforcement; and sulfate is low enough that it should not have an adverse impact on concrete and related materials. Sulfides are very low (@ <0.1 ppm), thus this should not be an issue. And soil redox is so mild that this should not be an issue either. Alkaline treatment of this soil would not be of any benefit as the pH is already alkaline enough. Therefore, to increase metals longevity in this soil any more would require either metals upgrading (e.g. increased gauge or to more resistant steels, etc.); and/or taking other actions (e.g. wrapping steel, increased engineering fill, cathodic protection, coatings, plastic or fiberglas pipe, etc.). Last, standard concrete and related construction materials should be acceptable in this soil based on these results.

\\\\NOTES: Methods are from following sources: extractions by Cal Trans protocols as per Cal Test 417 (SO4), 422 (Cl), and 532/643 (pH & resistivity); &/or by ASTM Vol. 4.08 & ASTM Vol. 11.01 (=EPA Methods of Chemical Analysis, or Standard Methods); pH - ASTM G 51; Spec. Cond. - ASTM D 1125; resistivity - ASTM G 57; redox - Pt probe/ISE; sulfate - extraction Title 22, detection ASTM D 516 (=EPA 375.4); chloride - extraction Title 22, detection ASTM D 512 (=EPA 325.3); sulfides - extraction by Title 22, and detection EPA 376.2 (= SMEWW 4500-S D); cyanides - extraction by Title 22, and detection by ASTM D 4374 (=EPA 335.2).

APPENDIX C

Site Specific Ground Response and Seismic Hazard Report

CONSOLIDATED ENGINEERING LABORATORIES
dba GEOSPHERE CONSULTANTS INC.
2001 CROW CANYON ROAD, SUITE 100
SAN RAMON, CALIFORNIA 94583

SUPPLEMENTAL SITE-SPECIFIC GROUND RESPONSE & SEISMIC HAZARD EVALUATION REPORT ALBANY HIGH SCHOOL 603 KEY ROUTE BOULEVARD PLEASANTON, CALIFORNIA

November 24, 2008

File No.: 11412-08
Document No.: 08-11-783

Earth Systems
Southwest

79-811B Country Club Drive
Bermuda Dunes, CA 92201
(760) 345-1588
(800) 924-7015
FAX (760) 345-7315

November 24, 2008

File No.: 11412-08
Document No.: 08-11-783

Consolidated Engineering Laboratories
dba Geosphere Consultants, Inc.
2001 Crow Canyon Road, Suite 100
San Ramon, California 94583

Attention: Mr. Marc Hachey

Project: **Albany High School**
603 Key Route Boulevard
Pleasanton, California

Subject: Supplemental Site-Specific Ground Response & Seismic Hazard Evaluation Report

Dear Mr. Hachey:

We take pleasure to present this Supplemental Site-Specific Ground Response & Seismic Hazard Evaluation Report for the new gymnasium addition at Albany High located in the City of Albany, California.

This report presents our findings and recommendations for design ground motions for seismic evaluation to comply with CBC Chapter 18A, Section 1802A.6.2. This report should stand as a whole, and no part of the report should be excerpted or used to the exclusion of any other part.

This report completes our scope of services in accordance with our agreement, dated April 1, 2008. Unless requested in writing, the client is responsible to distribute this report to the appropriate governing agency or other members of the design team.

We appreciate the opportunity to provide our professional services. Please contact our office if there are any questions or comments concerning this report or its recommendations.

Respectfully submitted,
EARTH SYSTEMS SOUTHWEST

Shelton L. Stringer
Principal Geotechnical Engineer
& Engineering Geologist
GE 2266, EG 2417

Distribution: 1/ Consolidated Engineering Laboratories, 1/RC File, 2/BD File

TABLE OF CONTENTS

Section 1
INTRODUCTION

1.1 Project Description

This Supplemental Site-Specific Ground Response & Seismic Hazard Evaluation Report for the Albany High School located at 603 Key Route Boulevard in the City of Albany, California. The project site is located at about 37.8958° N Latitude, 122.2913° W Longitude at an elevation at about 80 feet above mean sea level. The terrain is nearly level around the school campus.

1.2 Purpose and Scope of Work

The purpose for our services is to provide site-specific seismic hazards evaluation and design ground motions for the school facility. The intent of this report is to satisfy the 2007 California Building Code (CBC) Chapter 18A, Section 1802A.6.2 and ASCE 7-05 Chapter 21.2. According to the 2007 CBC Section 1614A.1.2 a site-specific ground motion hazard analysis is required for building sites that lie within 10 kilometers of an active fault as the site does. The scope of work included the following:

- Review of selected published technical literature pertaining to the site.
- Engineering analysis and evaluation of the acquired data and information.
- A summary of our findings in this written report.

This report contains discussions on the following:

- Regional and local geologic conditions.
- Geologic and seismic hazards.
- A site-specific probabilistic seismic hazard analysis (PSHA) (excluding time histories).
- Design parameters for seismic ground motions.

Not Contained In This Report: Although available through Earth Systems Southwest, the current scope of our services does not include:

- An environmental assessment or investigation
- Site-specific geotechnical engineering report. We understand that Consolidated Engineering Laboratories is the geotechnical engineer and engineering geologist of record for this project and is providing this required report.
- ***This report is not intended to serve as a Geotechnical Engineering and Geologic Report to satisfy CGS Note 48, but serves as only a supplement.***

1.3 Literature Search

As part of our study we have conducted a literature search of available geotechnical, geologic and seismological information and data. Considerable advances have been made over the last 30 years in regard to seismic hazards. A list of references directly used or cited in this report is included at the end of this report.

Section 2
DISCUSSION

2.1 Geologic Setting

The site is located on the flatlands between the San Francisco Bay and the Berkeley Hills to the east that are part of the Coast Range Geomorphic province. These northwest-trending mountain ranges are the result of an orogeny (the formation of mountains by the process of tectonic uplift).

The predominant structural feature in the California Coast Ranges is the San Andreas fault zone, which is the structural boundary between two tectonic plates: the Pacific Plate to the west of the San Andreas fault zone and the North American Plate east of the fault. The Hayward and Calaveras faults, located on the east side are interpreted to be part of the San Andreas fault system.

Holocene alluvial fan deposits (Qhf) underlie the site. Historic high groundwater levels are estimated to be approximately 10 feet deep based on the Seismic Hazard Zone Report for the Richland Quadrangle.

No known active faults underlie the site. The nearest active fault is the Hayward fault, located approximately 1.5 miles easterly of the site.

Site Characterization: In developing site-specific seismic design criteria, the characteristics of the earth units underlying the site are an important input to evaluate the site response at a given site. Based on site explorations conducted as well as published data, the school site soil profile classifies for seismic site response as Site Class D according to Table 1613A.5.5 of the 2007 CBC and this is the default classification by the CBC and corresponds to the same from published maps from the California Geological Survey. Seismic Site Class D is defined as a soil profile consisting of stiff soil with shear wave velocities between 180 and 360 m/s or SPT N = 15 to 50 in the top 30 meters.

2.2 Geologic Hazards

Geologic hazards that may affect the region include seismic hazards (surface fault rupture, ground shaking, soil liquefaction, and other secondary earthquake-related hazards), slope instability, flooding, ground subsidence, and erosion. A discussion follows on the specific hazards to this site.

2.2.1 Seismic Hazards

Seismic Sources: Our research of regional faulting indicates that several distant active faults or seismic zones lie within 62 miles (100 kilometers) of the project site as shown on Figure 2 and listed on Table 1 in the Appendix. The primary seismic hazard to the site is strong ground shaking from earthquakes from the nearby Hayward fault and moderate ground shaking other nearby faults. The Maximum Magnitude Earthquake (M_{max}) listed is from published geologic information available for each fault (Cao et al., CGS, 2003). The M_{max} corresponds to the maximum earthquake believed to be tectonically possible.

Historic Seismicity: Table 2 lists historic earthquakes above magnitude 5 that have affected the site region since 1800.

Surface Fault Rupture: The project site does not lie within a currently delineated State of California, *Alquist-Priolo* Earthquake Fault Zone (Hart, 1997). Therefore, active fault rupture is unlikely to occur at the project site. While fault rupture would most likely occur along previously established fault traces, future fault rupture could occur at other locations.

Seismic Risk: While accurate earthquake predictions are not possible, various agencies have conducted statistical risk analyses. In 2002, the California Geological Survey (CGS) and the United States Geological Survey (USGS) completed the latest generation of probabilistic seismic hazard maps. We have used these maps in our evaluation of the seismic risk at the site.

Additionally, drawing on new data and new methodologies, the Working Group on California Earthquake Probabilities (WG02) has concluded that there is a 62% probability of a strong earthquake (Magnitude 6.7 or greater) striking the greater San Francisco Bay Region over the next 30 years (2003–2032). The probability of a strong earthquake along the nearby Hayward fault during this time period is 27% alone. The recent Working Group of California Earthquake Probabilities (WGCEP, 2008) estimated a 31% conditional probability that a magnitude 6.7 or greater earthquake may occur between 2008 and 2038 along the Rodgers-Hayward fault system.

2.2.2 Secondary Hazards

Secondary seismic hazards related to ground shaking include soil liquefaction, ground subsidence, landslides, tsunamis, and seiches. The site is elevated inland so the hazard from tsunamis is low. At the present time, no water storage reservoirs are located in the immediate vicinity of the site. Therefore, hazards from seiches are considered negligible at this time.

Soil Liquefaction: Liquefaction is the loss of soil strength from sudden shock (usually earthquake shaking), causing the soil to become a fluid mass. In general, for the effects of liquefaction to be manifested at the surface, groundwater levels must be within 50 feet of the ground surface and the soils within the saturated zone must also be susceptible to liquefaction.

The site is mapped by both CGS and USGS as having a high potential for soil liquefaction because of the shallow groundwater and recent Holocene fan deposits. The evaluation of soil liquefaction and recommended mitigation is the responsibility of our client, Geosphere Consultants, Inc.

Seismic Hazard Zones: The site **lies** within liquefaction hazard zone as mapped by the California Seismic Hazard Mapping Act (Ca. PRC 2690 to 2699) for the Richland Quadrangle.

Slope Instability: The site area is relatively flat. Therefore, potential hazards from slope instability, landslides, or debris flows are considered negligible.

2.3 Ground Motion Potential from Future Earthquakes

To assess the potential intensity of ground motion, we have estimated the horizontal peak ground acceleration (PGA). Included in Table 1 are deterministic estimates of site acceleration from possible earthquakes at nearby faults. Deterministic estimates are useful to evaluate various "scenario" earthquakes.

The increasing database of seismic data recorded in the world, and particularly in the western United States, has allowed researchers to develop more reliable empirical attenuation equations that are used to model the ground motions generated during an earthquake. Ground motions are dependent primarily on the earthquake magnitude and distance to the seismogenic (rupture) zone.

Accelerations also are dependent upon attenuation by rock and soil deposits, direction of rupture, and type of fault. For these reasons, ground motions may vary considerably in the same general area. This variability can be expressed statistically by a standard deviation about a mean relationship. For instance, mean+1σ represents a 14% risk of exceedance level of ground motion. For most attenuation relationships, this corresponds to about 1.5 times the mean ground motion.

In our evaluation of peak ground acceleration (PGA), we averaged four attenuation relationships: Boore et al., 1997; Sadigh et al., 1997; Abrahamson and Silva, 1997; and Campbell, 2003. Each attenuation relationship has its strengths and limitations. For this reason, the USGS used an equally weighted average of these four in their National Strong Motion Mapping Program (Frankel et al., 2002).

The PGA alone is an inconsistent scaling factor and is generally a poor indicator of potential structural damage during an earthquake. Important factors influencing the structural performance are the duration and frequency of strong ground motion, local subsurface conditions, soil-structure interaction, and structural details. Because of these factors, spectral accelerations (Sa) are used in structural design. Spectral ground acceleration is directly related to the dynamic forces that earthquakes induce on structures.

2.4 Site Specific, Probabilistic Seismic Hazard Analysis

We have conducted a site specific, Probabilistic Seismic Hazard Analysis (PSHA) to evaluate the likelihood of future earthquakes and provide design ground motions. Completing the PSHA requires defining the location and geometry of potentially damaging earthquake sources (faults and seismic zones) and defining the geoseismic characteristics of these earthquake sources. Geoseismic characteristics required for the analysis include:

- Type of deformation (strike slip, dip slip, reverse, thrust)
- Fault segmentation
- Length of fault segments, and depth of rupture
- Fault slip rate (average rate of deformation-estimate in mm/yr)
- Maximum earthquake magnitude
- Site-specific response characteristics (soil or rock condition)

Faults within 100 km are expected to be significant to the seismic hazard. Table 1 provides a summary of the geoseismic characteristics based primarily on the fault parameters from the California Division of Mines and Geology (Cao et al., 2003).

Our probabilistic site-specific acceleration estimates were developed using the USGS Interactive Strong Motion Deaggregation website. The USGS PSHA results for soft rock (Site Class B/C) were adjusted by a site factor varying from about 1.0 for PGA to 1.36 for spectral accelerations of 1.0 second based on the NEHRP soil correction factors. The contributions of various seismic sources by deaggregation to the total seismic hazard at the site are also shown on Figure 5 along with the output data files from the analysis.

Horizontal Response Spectra: Horizontal response spectral curves for the project site were computed using the values from the PSHA. Horizontal response spectral curves for 5% viscous damping are presented on Figure 3 for a risk of exceedance of 10% in 50 years and the MCE. For comparison, the new 2007 CBC equivalent static response spectrum is also shown. Figure 4 shows the CBC response spectrum, DBE, and MCE spectral curves using an arithmetic scale. Table 3 presents tabulated values of spectral acceleration for comparison. Vertical accelerations may be taken as equal to ⅔ of the horizontal acceleration.

Based on the PSHA, the modal magnitude event is about 6.9 acting at a modal distance of about 1.5 km. The mean period of ground motion is about 0.49 seconds with a bracketed duration, D_{5-95}, of about 13 seconds.

The following table provides the probabilistic estimate of the PGA and spectral acceleration taken from the USGS Interactive Deaggregation webpage for a site-specific seismic hazard analysis.

PGA and Spectral Acceleration from 2002 USGS Probabilistic Seismic Hazard Analysis

Risk [2]	Equivalent Return Period (years)	PGA (g) [1]	Spectral Acceleration Sa (0.2 sec.) [1]	Spectral Acceleration Sa (1.0 sec.) [1]
10% exceedance in 50 years	475	0.74	1.70	0.99
2% exceedance in 50 years	2475	1.24	3.05	1.76
MCE – with Deterministic Limit	---	0.86	1.93	1.18

Notes:
[1] Based on a soft rock site (Site Class B/C) adjusted with soil amplification factors of 1.0 and 1.5 for Site Class D for short and long periods, respectively.
[2] MCE – maximum considered earthquake based on Magnitude 6.9 at 1.5 km distance.

Justification for Method of Analyses: A reasonable, site-specific, spectral response curve may be developed from the USGS Java program or interactive deaggregation web page and adjusted by site factors from the Site Class B/C values derived by these tools. The elegance of the USGS Java program or interactive deaggregation is that all of the 2002 USGS/CGS working group consensus methodologies are preserved and adapted in the output for base ground motion for 7 spectral ordinates from 0 to 2 seconds to construct a smooth curve. The Java program is based on interpolated gridded values from nearby coordinates, whereas the interactive webpage appears to be a precise calculation based on site coordinates. The USGS interactive deaggregation spectral values generally agree very well with precise site-specific values obtained from other programs such as OpenSHA or EZ-FRISK for the same model and attenuation relationships, generally within about 5% or better. The one remaining step is, of course, to modify the spectral curve according geologic site conditions.

ESSW uses the same methodology for site factors as CGS does in their Probabilistic Seismic Hazards Mapping Ground Motion Page wherein they state, "NEHRP Soil Corrections were used to calculate Soft Rock [Site Class C] and Alluvium [Site Class D]". The NEHRP Soil Corrections are the equations found in Figure C3.3.2-7 in the 2003 NEHRP Commentary (FEMA 450) based on Borcherdt, 1994 for short period and long period site factors dependent on shear wave velocity. While, it may be more theoretically "pure" to run a seismic hazard analysis with site class appropriate attenuation relationships, this approach produces reasonable and conservative results.

The Deterministic values are derived using the modal magnitude and distance from the critical seismic fault source and averaging four attenuation relationships: Boore et al., 1997; Sadigh et al., 1997; Abrahamson and Silva, 1997; and Campbell, 2003.

At present, ESSW has chosen not to use the NGA (Next Generation Attenuation) relationships on which the recent 2008 USGS National Seismic Hazard Maps are derived for spectral response in that the older attenuation relationships are more conservative. A principal advantage in the NGA relationships is that the Site Vs30 is used directly for site specific analysis rather than the NEHRP site corrections. The NGA results in significantly lower long period, rock ground motion (typically 65 to 75%). However, regardless of how state of the art, ASCE 7-05 will permit values no lower than 80% of the simple code spectrum for design.

2.5 Seismic Design Criteria

2007 CBC Seismic Coefficients: The California Building Code (CBC) seismic design parameters criteria are based on a Design Earthquake that has an earthquake ground motion $^2/_3$ of the lesser of 2% probability of occurrence in 50 years or 150% of mean deterministic limit. The seismic and site coefficients given in Chapter 16 of the 2007 California Building Code are provided below and in Appendix A.

Engineered design and earthquake-resistant construction increase safety and allow development of seismic areas. The *minimum* seismic design should comply with the 2007 edition of the California Building Code and ASCE 7-05 using the seismic coefficients given in the table below.

2007 CBC (ASCE 7-05) Seismic Parameters

			Reference
Seismic Category:	D		Table 1613A.5.6
Seismic Class:	D		Table 1613A.5.2
Maximum Considered Earthquake (MCE) Ground Motion			
Short Period Spectral Response S_s:	1.933 g		Figure 1613A.5
1 second Spectral Response, S_1:	0.744 g		Figure 1613A.5
Site Coefficient, F_a:	1.00		Table 1613A.5.3(1)
Site Coefficient, F_v:	1.50		Table 1613A.5.3(2)
S_{MS}	1.933 g	$= F_a * S_s$	
S_{M1}	1.116 g	$= F_v * S_1$	

Design Earthquake Ground Motion

Short Period Spectral Response, S_{DS}	1.289 g
1 second Spectral Response, S_{D1}	0.744 g

The intent of the CBC lateral force requirements is to provide a structural design that will resist collapse to provide reasonable life safety from a major earthquake, but may experience some structural and nonstructural damage. A fundamental tenet of seismic design is that inelastic yielding is allowed to adapt to the seismic demand on the structure. In other words, *damage is allowed.* The CBC lateral force requirements should be considered a *minimum* design. The owner and the designer may evaluate the level of risk and performance that is acceptable. Performance based criteria could be set in the design. The design engineer should exercise special care so that all components of the design are fully met with attention to providing a continuous load path. An adequate quality assurance and control program is urged during project construction to verify that the design plans and good construction practices are followed. This is especially important for sites lying close to the major seismic sources.

Section 3
CONCLUSIONS AND RECOMMENDATIONS

The following is a summary of our conclusions and professional opinions based on the data obtained from a review of selected technical literature and our evaluations.

- The primary geologic hazard relative to the existing school is strong ground shaking from earthquakes originating on the Calaveras or other nearby regional faults.
- Other geologic hazards including ground rupture, liquefaction, seismically induced flooding, and landslides are considered low or negligible on the school site.
- The school facilities should be designed in accordance with the 2007 California Building Code and ASCE 7-05 using the seismic coefficients and the site-specific probabilistic hazard analysis presented in this report.

Section 4
LIMITATIONS

Our findings in this report are based on published geotechnical, geologic, and seismological information and analytical procedures. The findings of this report are valid as of the issued date of the report. Changes in applicable or appropriate standards occur whether they result from legislation or broadening of knowledge. Accordingly, findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of one year.

This report is issued with the understanding that the owner, or the owner's representative, has the responsibility to bring the information and recommendations contained herein to the attention of the architect and engineers for the project so that they are incorporated into the plans and specifications for the project. It is further understood that the owner or the owner's representative is responsible for submittal of this report to the appropriate governing agencies.

Earth Systems Southwest has striven to provide our services in accordance with generally accepted geotechnical engineering practices in this locality at this time. No warranty or guarantee is express or implied. This report was prepared for the exclusive use of the Client and the Client's authorized agents.

Appendices as cited are attached and complete this report.

REFERENCES

Abrahamson, N., and Shedlock, K., *editors*, 1997, Ground motion attenuation relationships: Seismological Research Letters, v. 68, no. 1, January 1997 special issue, 256 p.

American Society of Civil Engineers (ASCE), 2006, Minimum Design Loads for Buildings and Other Structures, ASCE 7-05.

California Geologic Survey, 2008, Seismic Hazard Zones Map, Livermore Quadrangle, release August 27, 2008.

California Geologic Survey, 2003, Seismic Hazard Evaluation for Richland 7.5 Minute Quadrangle, Alameda County, Seismic Hazard Zone Report 070.

California Geologic Survey, 1997, Guidelines for Evaluating and Mitigating Seismic Hazards in California, Special Publication 117.

Cao, T, Bryant, W.A., Rowhandel, B., Branum. D., and Wills, C., 2003, The Revised 2002 California Probabilistic Seismic Hazard Maps, California Geologic Survey (CGS), June 2003.

Federal Emergency Management Agency (FEMA), 2004, NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures (FEMA 450), Part 1 – Provisions and Part 2 – Commentary.

Frankel, A.D., et al., 2002, Documentation for the 2002 Update of the National Seismic Hazard Maps, USGS Open-File Report 02-420.

Hart, E.W., 1997, Fault-Rupture Hazard Zones in California: California Division of Mines and Geology Special Publication 42.

International Code Council (ICC), 2007, California Building Code, 2007 Edition.

Jennings, C.W, 1994, Fault Activity Map of California and Adjacent Areas: California Division of Mines and Geology, Geological Data Map No. 6, scale 1:750,000.

Petersen, M.D., Bryant, W.A., Cramer, C.H., Cao, T., Reichle, M.S., Frankel, A.D., Leinkaemper, J.J., McCrory, P.A., and Schwarz, D.P., 1996, Probabilistic Seismic Hazard Assessment for the State of California: California Division of Mines and Geology Open-File Report 96-08.

USGS National Strong Ground Motion Interactive Deaggregation Website, available at: http://eqint.cr.usgs.gov/deaggint/2002/index.php, viewed November 10, 2008

United States. Geological Survey, (1999), Earthquake Probabilities in the San Francisco Bay Region: 2000 to 2030—A Summary of Findings, Working Group on California Earthquake Probabilities, Open-File Report 99-517

United States. Geological Survey, (2003), Earthquake Probabilities in the San Francisco Bay

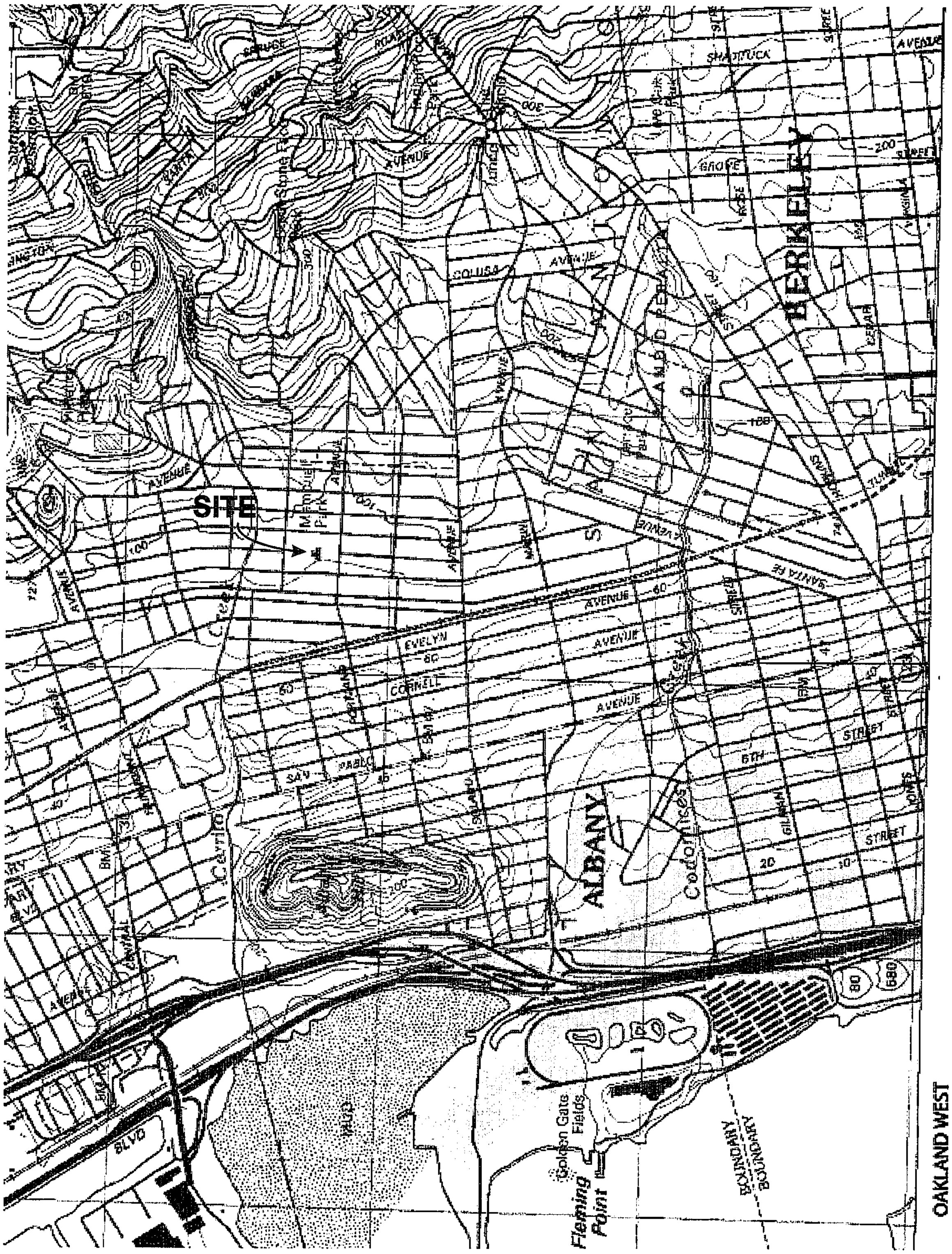
Region: 2002 to 2032, Working Group on California Earthquake Probabilities, Open-File Report 03-214

United States Geological Survey, 2008, Documentation for the 2008 Update of the United States National Seismic Hazard Maps: U.S. Geological Survey Open-File Report 2008–1128, 61 p.

United States Geological Survey, 2006, Maps of Quaternary Deposits and Liquefaction Susceptibility in the Central San Francisco Bay Region, California: U.S. Geological Survey Open-File Report 2006-1037.

Working Group on California Earthquake Probabilities, 2008, The Uniform California Earthquake Rupture Forecast, Version 2 (UCERF 2): U.S. Geological Survey Open-File Report 2007-1437 and California Geological Survey Special Report 203, 104 p.

APPENDIX



Base Map: Seismic Hazard Zones Maps, Richland Quadrangle, 2003, CGS
Blue Areas - Landslide Prone Areas
Green Areas - Liquefaction Prone Areas

Scale 1 inch = 2000 feet

Figure 1
Site Location Map

Albany High School
Albany, California

Earth Systems
Southwest

11/24/08 | 11412-08

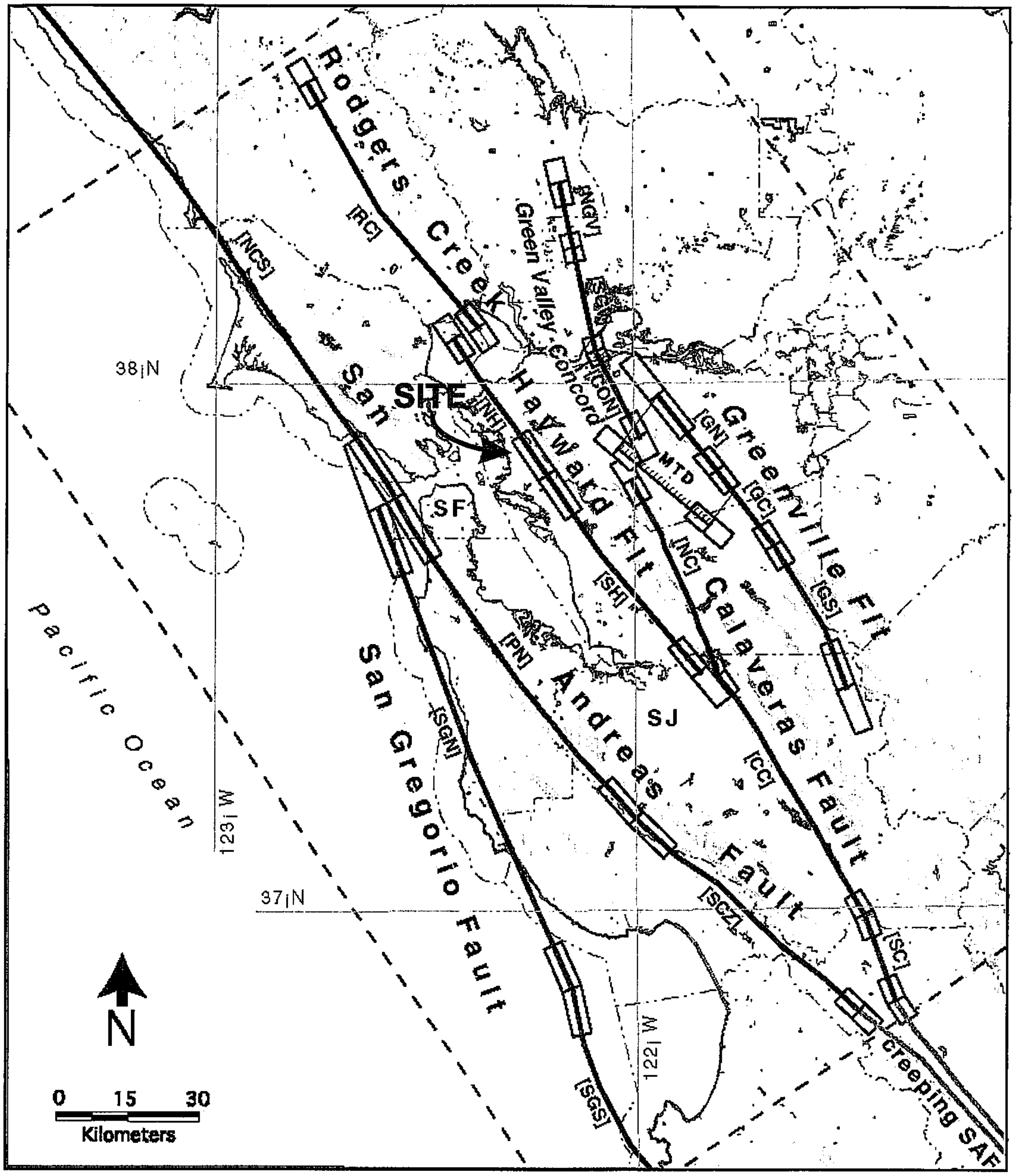
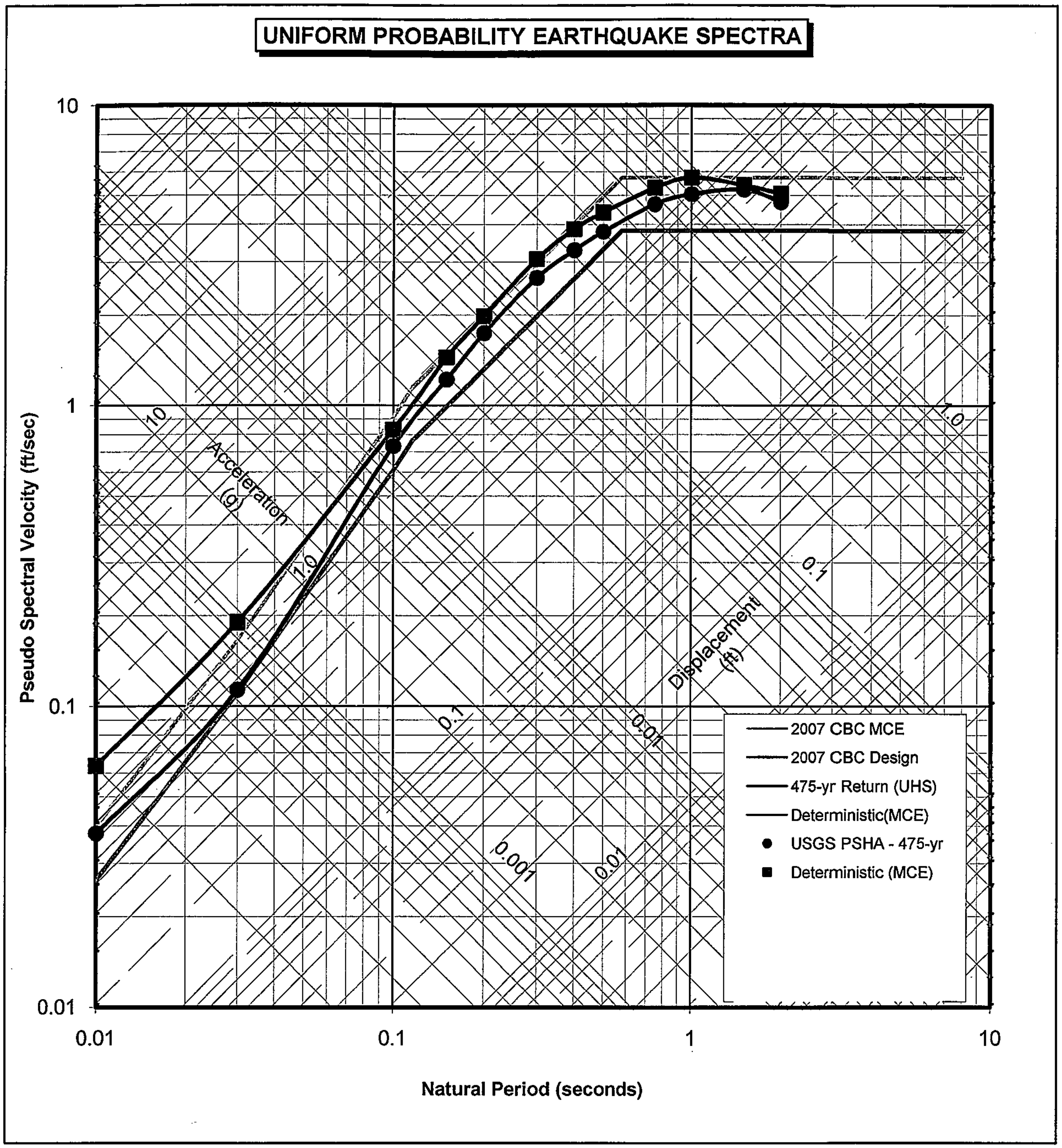


Figure 2. *B*, Enlarged view of Working Group 99 box.

Reference: U.S. Geological Survey, (1999), Earthquake Probabilities in the San Francisco Bay Region: 2000 to 2030-A Summary of Findings, Working Group on California Earthquake Probabilities, Open-File Report 99-517	**Figure 1** **Regional Fault Map** Albany High School Albany, California **Earth Systems** **Southwest**
	11/24/08 | 11412-08



Based on USGS National Strong Ground Motion Interactive Deaggregation Website using 2002 Parameters
Attenuation relationship from:
Average of Boore et al (1997), Sadigh (1997), Campbell & Borzognia (2003), and Abrahamson & Silva (1997)

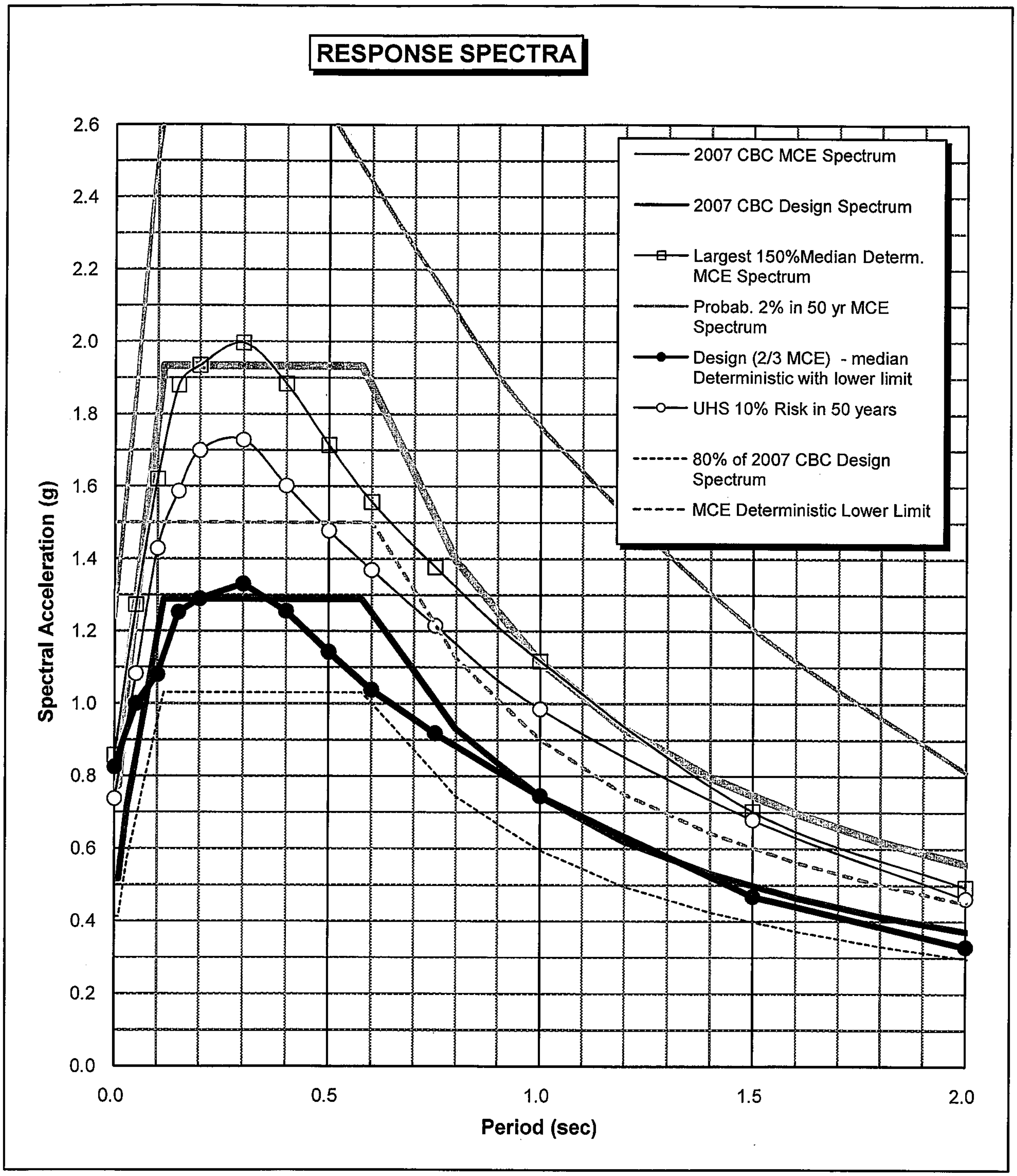
Site Class: D
Latitude: 37.896
Longitude: -122.291

Date: 9/8/08

Figure 3 - Earthquake Spectra

Albany High School
File No.: 11412-08

Earth Systems Southwest

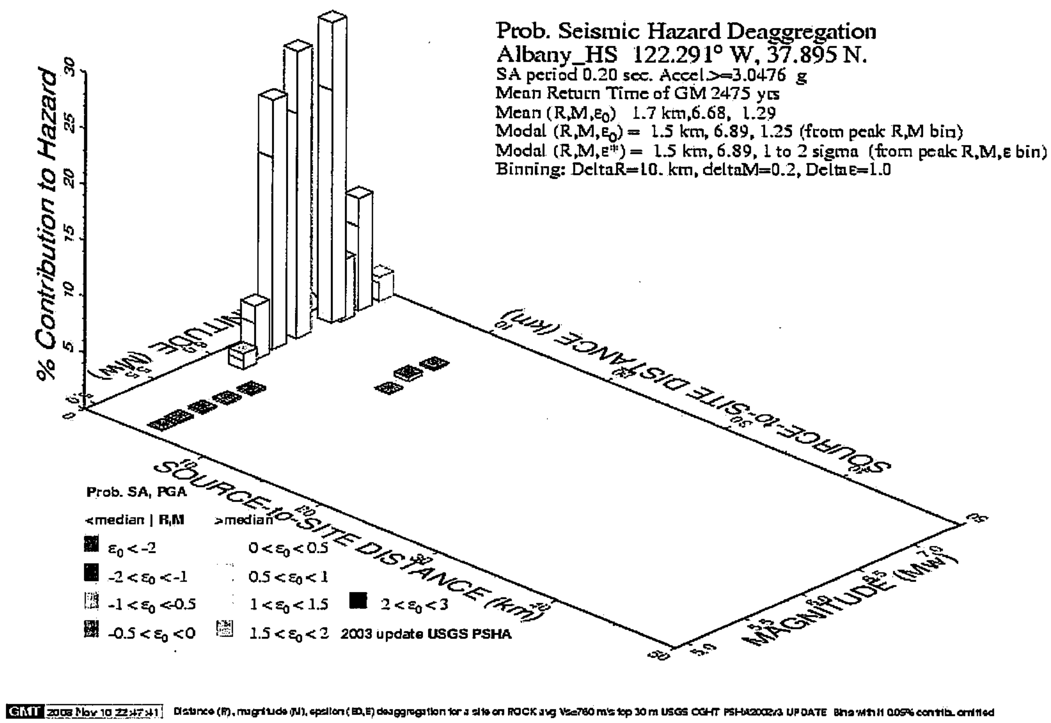


Site Class: D
Latitude: 37.8958
Longitude: -122.2913

Figure 4 - Response Spectra

Albany High School
File No.: 11412-08

Earth Systems Southwest



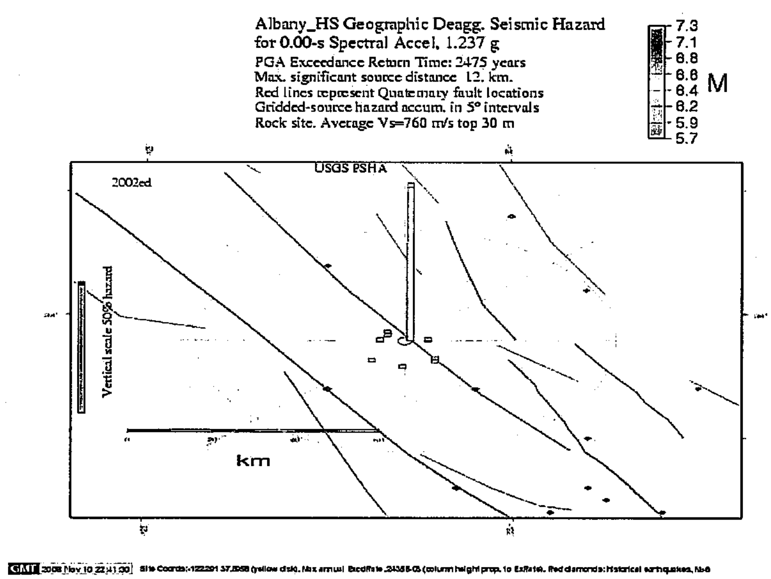


Figure 5 - Seismic Hazard Deaggregation

Albany High School
File No.: 11412-08

Earth Systems
Southwest

Table 1
Fault Parameters
& Deterministic Estimates of Mean Peak Ground Acceleration (PGA)

Fault Name or Seismic Zone	Distance from Site (mi)	(km)	Fault Type		Maximum Magnitude Mmax (Mw)	Avg Slip Rate (mm/yr)	Avg Return Period (yrs)	Fault Length (km)	Mean Site PGA (g)
Reference Notes: (1)			(2)	(3)	(4)	(2)	(2)	(2)	(5)
Hayward (Total Length)	**0.9**	1.5	SS	A	**6.9**	9	161	86	**0.52**
Hayward (North)	**0.9**	1.5	SS	A	**6.4**	9	155	35	**0.46**
Hayward (South)	**3.7**	6.0	SS	A	**6.7**	9	161	53	**0.38**
Mount Diablo Thrust	**13.6**	22.0	BT	C	**6.6**	2	389	25	**0.20**
Calaveras (North)	**14.5**	23.3	SS	B	**6.8**	6	187	45	**0.16**
Concord	**15.3**	24.7	SS	B	**6.2**	4	219	17	**0.11**
Rodgers Creek	**15.4**	24.8	SS	A	**7.0**	9	205	62	**0.17**
Green Valley (South)	**15.8**	25.4	SS	B	**6.2**	5	210	25	**0.11**
San Andreas -1906	**17.4**	28.0	SS	A	**7.9**	24	225	473	**0.25**
San Andreas (Peninsula)	**17.8**	28.7	SS	A	**7.1**	17	229	85	**0.16**
West Napa	**18.7**	30.1	SS	B	**6.5**	1	701	30	**0.11**
San Gregorio (North)	**20.2**	32.5	SS	A	**7.2**	7	392	110	**0.15**
Greenville (North)	**25.2**	40.5	SS	B	**6.6**	2	644	27	**0.09**
Great Valley 5	**26.2**	42.2	BT	C	**6.5**	1.5	501	28	**0.10**
Green Valley (North)	**26.3**	42.3	SS	B	**6.2**	5	201	14	**0.07**
Point Reyes	**29.4**	47.4	RV	B	**7.0**	0.3	3503	47	**0.12**
Great Valley 4	**30.2**	48.6	BT	C	**6.6**	1.5	472	42	**0.10**
Monte Vista - Shannon	**31.7**	51.1	RV	B	**6.7**	0.4	2410	45	**0.10**
Hayward (Se Extension)	**36.7**	59.0	SS	B	**6.4**	3	220	26	**0.05**
Greenville (South)	**36.8**	59.2	SS	B	**6.6**	2	623	24	**0.06**
Hunting Creek - Berryessa	**38.8**	62.5	SS	B	**7.1**	6	194	60	**0.08**
Calaveras (Central)	**40.5**	65.2	SS	B	**6.2**	15	54	59	**0.04**
Great Valley 7	**40.7**	65.6	BT	C	**6.7**	1.5	622	45	**0.08**
Maacama (South)	**51.8**	83.3	SS	B	**6.9**	9	220	41	**0.05**
Maacama-Garberville	**51.8**	83.3	SS	B	**7.5**	9	220	182	**0.08**
Great Valley 3	**52.1**	83.8	BT	C	**6.8**	1.5	718	55	**0.06**
San Andreas (Santa Cruz Mtn.)	**52.1**	83.8	SS	A	**7.0**	17	224	62	**0.06**
Sargent	**55.7**	89.6	SS	B	**6.8**	3	1200	53	**0.05**
Zayante-Vergeles	**58.4**	94.0	SS	B	**7.0**	0.1	8821	58	**0.05**

Notes:
1. Jennings (1994) and California Geologic Survey (CGS) (2003)
2. CGS (2003), SS = Strike-Slip, RV = Reverse, DS = Dip Slip (normal), BT = Blind Thrust
3. 2001 CBC, where Type A faults: Mmax > 7 & slip rate >5 mm/yr & Type C faults: Mmax <6.5 & slip rate < 2 mm/yr
4. CGS (2003)
5. The estimates of the mean Site PGA are based on the following attenuation relationships:
   Average of: (1) 1997 Boore, Joyner & Fumal; (2) 1997 Sadigh et al; (3) 1997 Campbell, (4) 1997 Abrahamson & Silva
   (mean plus sigma values are about 1.5 to 1.6 times higher)
   Based on Site Coordinates: 37.896 N Latitude, 122.291 W Longtude and Site Soil Type D

Site Coordinates: 37.896 N 122.291 W

Table 2
Historic Earthquakes in Vicinity of Project Site, M > 5.5

Day	*Year*	*Epicenter* *Latitude* (Degrees)	*Longitude*	*Distance from Site (mi)*	*Magnitude* M_W
4/2	1870	37.90	122.30	0.6	**5.8**
7/31	*1889	37.80	122.20	8.3	**5.6**
4/3	1827	37.75	122.50	15.2	**5.5**
10/21	*1868	37.70	122.10	17.1	**7.0**
6/2	*1899	37.70	122.50	17.7	**5.6**
4/18	1906	37.70	122.50	17.7	**7.8**
6/21	1808	37.80	122.60	18.1	**5.5**
8/27	*1855	38.10	122.50	18.1	**5.5**
7/4	*1861	37.75	121.95	21.2	**5.8**
3/31	*1898	38.20	122.50	23.9	**6.4**
2/15	*1856	37.50	122.30	27.3	**5.9**
10/12	1891	38.30	122.40	28.5	**5.8**
1/24	1980	37.84	121.77	28.7	**5.8**
5/21	*1864	37.60	121.90	29.6	**5.8**
5/19	*1889	38.10	121.80	30.2	**6.0**
5/19	1902	38.30	122.00	32.1	**5.5**
3/5	1864	37.55	121.86	33.5	**6.0**
4/19	*1892	38.40	122.00	38.2	**6.6**
11/26	*1858	37.50	121.80	38.3	**6.2**
8/9	*1893	38.40	122.70	41.3	**5.6**
6/99	*1838	37.30	122.15	41.9	**7.4**
1/2	*1856	37.30	122.50	42.7	**5.7**
3/31	1986	37.48	121.69	43.6	**5.6**
4/30	*1892	38.40	121.80	43.9	**5.6**
10/2	1969	38.46	122.69	44.6	**5.7**
10/2	1969	38.47	122.69	45.2	**5.6**
7/15	*1866	37.70	121.50	45.2	**6.0**
9/5	1955	37.37	121.78	45.8	**5.5**
4/21	*1892	38.50	121.90	46.8	**6.4**
1/2	*1891	37.30	121.80	49.1	**5.8**
8/3	*1903	37.30	121.80	49.1	**6.2**
10/9	1781	37.20	122.00	50.6	**5.5**
4/24	1984	37.31	121.68	52.5	**6.2**
11/9	*1914	37.17	122.00	52.6	**5.5**
10/8	*1865	37.20	121.90	52.6	**6.5**
7/1	*1911	37.25	121.75	53.5	**6.4**
9/0	1825	37.10	122.30	54.9	**5.5**
6/11	*1903	37.20	121.80	55.1	**6.1**
2/17	*1870	37.10	122.00	57.2	**5.9**
6/27	*1882	37.10	121.90	59.0	**5.8**

From full earthquake catalog in USGS OFR 2007-1437h. For events with an asterisk, alternate solutions are given in the OFR.

Table 3 - Spectral Response Values

Probabilistic and Deterministic Response Spectra for MCE compared to Code Spectra

for 5% Viscous Damping Ratio

Natural Period T (seconds)	Probab. 10% in 50yr Spectrum (1) 475-yr	Probab. 2% in 50 yr MCE Spectrum (2) 2475-yr	Largest 150%Median Determ. MCE Spectrum (3)	Determ. Lower Limit MCE Spectrum (4)	Determ. MCE Spectrum (5) max(3,4)	**Site Specific MCE Spectrum** (6) min(2.5)	**2007 CBC MCE Spectrum** (7)	Site Specific Design Spectrum (8) 2/3*(6)*	2007 CBC Design Spectrum (9) 2/3*(7)
0.00	0.737	1.237	0.857	1.500	1.500	**1.237**	**0.774**	0.825	0.516
0.05	*1.082*	*1.872*	1.272	1.500	1.500	**1.500**	**1.275**	1.000	0.850
0.10	1.428	2.507	1.619	1.500	1.619	**1.619**	**1.778**	1.080	1.185
0.15	*1.587*	*2.823*	1.878	1.500	1.878	**1.878**	**1.933**	1.252	1.289
0.20	1.699	3.048	1.934	1.500	1.934	**1.934**	**1.933**	1.289	1.289
0.30	1.728	3.065	1.996	1.500	1.996	**1.996**	**1.933**	1.330	1.289
0.40	1.602	2.849	1.883	1.500	1.883	**1.883**	**1.933**	1.256	1.289
0.50	1.478	2.634	1.714	1.500	1.714	**1.714**	**1.933**	1.143	1.289
0.60	*1.369*	*2.442*	*1.557*	1.500	1.557	**1.557**	**1.860**	1.038	1.240
0.75	1.215	2.171	1.377	1.200	1.377	**1.377**	**1.488**	0.918	0.992
1.00	0.985	1.764	1.117	0.900	1.117	**1.117**	**1.116**	0.745	0.744
1.50	*0.679*	*1.207*	0.702	0.600	0.702	**0.702**	**0.744**	0.468	0.496
2.00	0.463	0.811	0.494	0.450	0.494	**0.494**	**0.558**	0.329	0.372

Red font is CGS Interpretation * > 80% of (9)

Probabilistic Spectrum from USGS Ground Motion Mapping Program for soft rock B/C and adjusted for site conditions using the following NEHRP amplification factors, F below.

Average of Boore et al (1997), Sadigh (1997), Campbell & Borzognia (2003), and Abrahamson & Silva (1997)

Reference: ASCE 7-05, Chapters 21.2, 21.3, 21.4 and 11.4

Period (sec)	F	Mapped Acceleration Values			Site Coefficients		Site-Specific Design Acceleration Values		
PGA	1.00								
0.2	1.00	Ss	1.933	g	F_a	1.00	S_{DS}	1.289	g
1.0	1.50	S_1	0.744	g	F_v	1.50	S_{D1}	0.745	g

Spectral Amplification Factor for different viscous damping, D (%): After Idriss (1993)

1.517-0.321*Ln(D) for 0.1 < T < 0.4 seconds

1.400-0.248*Ln(D) for 0.3 < T < 2.0 seconds

1 g = 980.6 cm/sec^2 =32.2 ft/sec^2

PSV (ft/sec) = 32.2(Sa)T/(2π)

Key: Probab. = Probabilistic, Determ. = Deterministic, MCE = Maximum Considered Earthquake

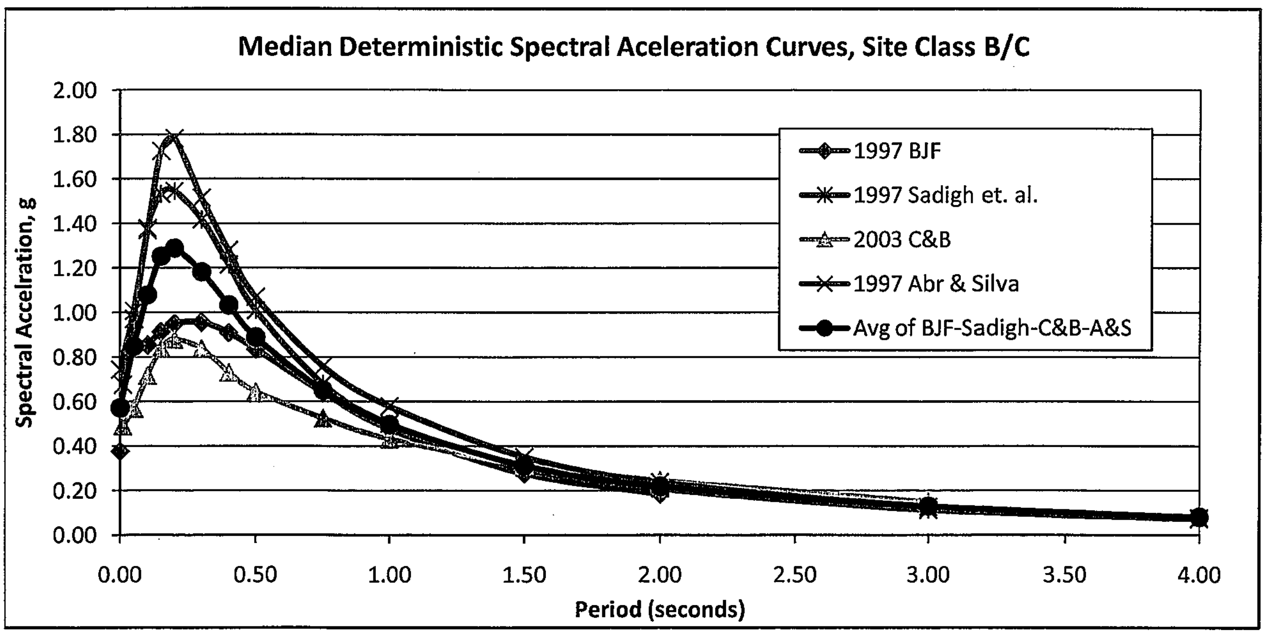
Table 4 - Spectral Response Values
Deterministic Response Spectra for Largest Median Earthquake Ground Motion

Average of Boore Joyner, Fumal (1997), Sadigh (1997) et. al., Campbell & Borzognia (2003), and Abrahamson & Silva

Max. Magnitude	**6.90**		Site Class	**D**	
DIstance (km):	**1.5**	km	Vs30:	**270**	m/sec
Fault Type:	**0**	Strike-Slip			

Mean Spectra Response from Attentuation Relationships for Site Class B/C (Rock), Vs30 = 760 m/sec.

1997 BJF		1997 Sadigh et. al.		2003 C&B		1997 Abr & Silva		Avg of BJF-Sadigh-C&B-A&S		
Period (sec)	Mean Sa (g)	Period (sec)	Mean Sa (g)	Period (sec)	Mean Sa (g)	Period (sec)	Mean Sa (g)	**Period (sec)**	Mean Sa (g)	**150% Mean Sa (g)**
0.00	0.38	0.01	0.68	0.01	0.49	0.00	0.74	**0.00**	0.57	**0.86**
		0.05	0.97	0.05	0.57	0.05	1.01	**0.05**	0.85	**1.27**
0.10	0.85	0.10	1.38	0.10	0.72	0.10	1.37	**0.10**	1.08	**1.62**
0.15	0.91	0.15	1.53	0.15	0.84	0.15	1.72	**0.15**	1.25	**1.88**
0.20	0.95	0.20	1.55	0.20	0.88	0.20	1.78	**0.20**	1.29	**1.93**
0.30	0.96	0.30	1.42	0.30	0.84	0.30	1.51	**0.30**	1.18	**1.77**
0.40	0.91	0.40	1.21	0.40	0.73	0.40	1.28	**0.40**	1.03	**1.55**
0.50	0.83	0.50	1.01	0.50	0.64	0.50	1.07	**0.50**	0.89	**1.33**
0.75	0.64	0.75	0.68	0.75	0.53	0.75	0.76	**0.75**	0.65	**0.98**
1.00	0.48	1.00	0.50	1.00	0.43	1.00	0.58	**1.00**	0.50	**0.74**
1.50	0.28	1.50	0.30	1.50	0.32	1.50	0.35	**1.50**	0.31	**0.47**
2.00	0.18	2.00	0.21	2.00	0.25	2.00	0.24	**2.00**	0.22	**0.33**
		3.00	0.11	3.00	0.15	3.00	0.13	**3.00**	0.13	**0.20**
		4.00	0.07	4.00	0.09	4.00	0.08	**4.00**	0.08	**0.12**



*** Deaggregation of Seismic Hazard for PGA & 2 Periods of Spectral Accel. ***
*** Data from U.S.G.S. National Seismic Hazards Mapping Project, 2002 version ***

PSHA Deaggregation. %contributions. site: Albany_HS long: 122.291 W., lat: 37.895 N.
USGS 2002-03 update files and programs. dM=0.2. Site descr:ROCK
Return period: 2475 yrs. Exceedance PGA =1.2372 g.
#Pr[at least one eq with median motion>=PGA in 50 yrs]=0.00000

DIST(KM)	MAG(MW)	ALL_EPS	EPSILON>2	1<EPS<2	0<EPS<1	-1<EPS<0	-2<EPS<-1	EPS<-2
5.0	5.05	0.071	0.071	0.000	0.000	0.000	0.000	0.000
5.0	5.20	0.153	0.153	0.000	0.000	0.000	0.000	0.000
5.0	5.40	0.164	0.164	0.000	0.000	0.000	0.000	0.000
5.1	5.60	0.178	0.177	0.001	0.000	0.000	0.000	0.000
5.2	5.80	0.189	0.154	0.035	0.000	0.000	0.000	0.000
2.8	5.99	0.826	0.439	0.386	0.000	0.000	0.000	0.000
1.9	6.17	5.576	1.993	3.583	0.000	0.000	0.000	0.000
1.7	6.37	23.025	6.011	17.014	0.000	0.000	0.000	0.000
1.6	6.59	26.115	6.682	19.433	0.000	0.000	0.000	0.000
10.9	6.60	0.087	0.087	0.000	0.000	0.000	0.000	0.000
1.6	6.88	8.405	2.911	5.494	0.000	0.000	0.000	0.000
1.7	6.91	23.148	7.705	15.443	0.000	0.000	0.000	0.000
1.6	7.14	9.819	3.257	6.562	0.000	0.000	0.000	0.000
1.6	7.32	2.178	0.732	1.445	0.002	0.000	0.000	0.000

Summary statistics for above PSHA PGA deaggregation, R=distance, e=epsilon:
Mean src-site R= 1.7 km; M= 6.67; eps0= 1.35. Mean calculated for all sources.
Modal src-site R= 1.6 km; M= 6.59; eps0= 1.27 from peak (R,M) bin
Gridded source distance metrics: Rseis Rrup and Rjb
MODE R*= 1.5km; M*= 6.58; EPS.INTERVAL: 1 to 2 sigma % CONTRIB.= 19.433

Principal sources (faults, subduction, random seismicity having >10% contribution)

Source Category:	% contr.	R(km)	M	epsilon0 (mean values)
California SS faults	98.15	1.7	6.68	1.34
Individual fault hazard details if contrib.>1%:				
12 nh -- hn 2-2 12 mags	50.42	1.6	6.43	1.29
9 sh+nh -- hs+hn 2-5 9mags	32.51	1.7	6.88	1.42
6 nh+rc-- hn+rc 2-9 6 mags	9.80	1.6	7.07	1.30
6 sh+nh+rc-- hs+hn+rc 2-10 6mags	3.94	1.6	7.25	1.39
floating sh+nh+rc	1.35	2.0	6.85	1.46

******************** Northern California
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PSHA Deaggregation. %contributions. ROCK site: Albany_HS long: 122.291 d W., lat: 37.895 N.
USGS 2002-2003 update files and programs. Analysis on DaMoYr:10/11/2008
Return period: 2475 yrs. 1.00 s. PSA =1.1763 g.
#Pr[at least one eq with median motion>=PSA in 50 yrs]=0.00000

DIST(km)	MAG(Mw)	ALL_EPS	EPSILON>2	1<EPS<2	0<EPS<1	-1<EPS<0	-2<EPS<-1	EPS<-2
2.4	5.99	0.208	0.199	0.009	0.000	0.000	0.000	0.000
1.8	6.18	2.280	1.652	0.627	0.000	0.000	0.000	0.000
1.7	6.37	12.980	6.653	6.327	0.000	0.000	0.000	0.000
1.7	6.60	20.417	8.819	11.598	0.000	0.000	0.000	0.000
10.8	6.63	0.581	0.581	0.000	0.000	0.000	0.000	0.000
2.1	6.89	17.380	8.157	9.222	0.000	0.000	0.000	0.000
10.9	6.83	0.412	0.412	0.000	0.000	0.000	0.000	0.000
1.5	6.93	22.538	4.922	17.616	0.000	0.000	0.000	0.000
11.0	6.93	0.144	0.144	0.000	0.000	0.000	0.000	0.000
1.7	7.14	16.895	3.623	13.023	0.248	0.000	0.000	0.000
1.7	7.33	4.405	0.787	3.296	0.323	0.000	0.000	0.000
27.6	7.67	0.106	0.106	0.000	0.000	0.000	0.000	0.000
27.5	7.89	1.271	1.271	0.000	0.000	0.000	0.000	0.000
27.5	8.00	0.169	0.169	0.000	0.000	0.000	0.000	0.000
27.5	8.11	0.160	0.160	0.000	0.000	0.000	0.000	0.000

Summary statistics for above 1.0s PSA deaggregation, R=distance, e=epsilon:
Mean src-site R= 2.3 km; M= 6.83; eps0= 1.48. Mean calculated for all

sources.
Modal src-site R= 1.5 km; M= 6.93; eps0= 1.27 from peak (R,M) bin
Gridded source distance metrics: Rseis Rrup and Rjb
MODE R*= 1.5km; M*= 6.93; EPS.INTERVAL: 1 to 2 sigma % CONTRIB.= 17.616

Principal sources (faults, subduction, random seismicity having >10% contribution)

Source Category:	% contr.	R(km)	M	epsilon0 (mean values)
California SS faults	99.48	2.3	6.83	1.48
Individual fault hazard details if contrib.>1%:				
6 scz+pn+ncs+ncn --sas+sap+san+sa	1.51	27.5	7.93	2.58
10 sh -- hs 2-1 10 mags	1.12	10.8	6.73	2.62
12 nh -- hn 2-2 12 mags	31.89	1.7	6.47	1.61
9 sh+nh -- hs+hn 2-5 9mags	40.19	1.8	6.90	1.46
6 nh+rc-- hn+rc 2-9 6 mags	15.46	1.7	7.09	1.18
6 sh+nh+rc-- hs+hn+rc 2-10 6mags	7.48	1.7	7.25	1.16
floating sh+nh+rc	1.63	2.2	6.88	1.52

******************** Northern California
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PSHA Deaggregation. %contributions. ROCK site: Albany_HS long: 122.291 d W., lat: 37.895 N.
USGS 2002-2003 update files and programs. Analysis on DaMoYr:10/11/2008
Return period: 2475 yrs. 0.20 s. PSA =3.0476 g.
#Pr[at least one eq with median motion>=PSA in 50 yrs]=0.00000

DIST(km)	MAG(Mw)	ALL_EPS	EPSILON>2	1<EPS<2	0<EPS<1	-1<EPS<0	-2<EPS<-1	EPS<-2
5.0	5.05	0.078	0.078	0.000	0.000	0.000	0.000	0.000
5.0	5.20	0.165	0.165	0.000	0.000	0.000	0.000	0.000
5.1	5.40	0.176	0.176	0.000	0.000	0.000	0.000	0.000
5.2	5.60	0.190	0.186	0.004	0.000	0.000	0.000	0.000
5.3	5.80	0.199	0.158	0.041	0.000	0.000	0.000	0.000
2.3	6.04	1.384	0.618	0.765	0.000	0.000	0.000	0.000
1.9	6.18	4.822	1.559	3.264	0.000	0.000	0.000	0.000
1.6	6.37	22.257	5.140	17.117	0.000	0.000	0.000	0.000
11.3	6.40	0.063	0.063	0.000	0.000	0.000	0.000	0.000
1.6	6.59	25.610	5.605	20.005	0.000	0.000	0.000	0.000
10.9	6.61	0.371	0.371	0.000	0.000	0.000	0.000	0.000
1.5	6.89	26.807	6.055	20.753	0.000	0.000	0.000	0.000
10.9	6.84	0.176	0.176	0.000	0.000	0.000	0.000	0.000
1.8	6.95	5.441	2.599	2.813	0.029	0.000	0.000	0.000
1.5	7.14	10.023	2.518	7.205	0.300	0.000	0.000	0.000
1.5	7.32	2.185	0.564	1.551	0.070	0.000	0.000	0.000

Summary statistics for above 0.2s PSA deaggregation, R=distance, e=epsilon:
Mean src-site R= 1.7 km; M= 6.68; eps0= 1.29. Mean calculated for all sources.
Modal src-site R= 1.5 km; M= 6.89; eps0= 1.25 from peak (R,M) bin
Gridded source distance metrics: Rseis Rrup and Rjb
MODE R*= 1.5km; M*= 6.89; EPS.INTERVAL: 1 to 2 sigma % CONTRIB.= 20.753

Principal sources (faults, subduction, random seismicity having >10% contribution)

Source Category:	% contr.	R(km)	M	epsilon0 (mean values)
California SS faults	97.99	1.6	6.69	1.27
Individual fault hazard details if contrib.>1%:				
12 nh -- hn 2-2 12 mags	48.90	1.6	6.43	1.24
9 sh+nh -- hs+hn 2-5 9mags	33.17	1.6	6.88	1.32
6 nh+rc-- hn+rc 2-9 6 mags	9.95	1.5	7.07	1.18
6 sh+nh+rc-- hs+hn+rc 2-10 6mags	4.00	1.5	7.25	1.24
floating sh+nh+rc	1.40	1.9	6.85	1.36

******************** Northern California
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