Appendix I-2 Geotechnical Update Report (December 2014)

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Geotechnical Update Report

Proposed 55-Lot Residential Subdivision
661 Bear Valley Parkway
Escondido, California
(A.P.N. 237-131-01 & -02)

December 17, 2014

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Job #13-116-P

GEOTECHNICAL UPDATE REPORT
PROPOSED 55-LOT RESIDENTIAL SUBDIVISION
661 BEAR VALLEY PARKWAY, ESCONDIDO, CALIFORNIA
(A.P.N. 237-131-01 & -02)

I. INTRODUCTION

The project property consists largely of a natural ridgeline located on the east side of Bear Valley Parkway, south of Highway 78 in the eastern limits of the city of Escondido. The approximate site coordinates are 33.10°N latitude and -117.06°W longitude.

Development plans, by Hunsaker & Associates, have been provided to us for geotechnical review and comment. A copy of the plans is reproduced and included with this transmittal as a Geotechnical Map (Plate 1). As shown, the property is planned for the support of a 55-lot residential subdivision with interior roadways and associated improvements.

Geotechnical conditions at the property were previously studied by this office with our findings, conclusions and recommendations summarized in the following published technical report:

"Geotechnical Investigation, Proposed Residential Subdivision, 661 Bear Valley Parkway, Escondido, California (A.P.N. 237-131-01 & -02)," Job #13-116-P, report dated April 13, 2013.

The preceding report was reviewed in connection with this effort and is enclosed with this update report as an Attachment.

The purpose of this work was to review the current development plans (Plate 1) and ensure its compatibility with the referenced report (Attachment) and provide updated conclusions and recommendations that are consistent with the project most current codes and engineering standards. Updated and/or amended recommendations provided in the following sections will supplement or supersede those given in the referenced report, where specifically indicated.

II. SITE DESCRIPTION / BACKGROUND

A detailed description of the site is given in the Attachment. Generally, the property is characterized by a large hilltop and a north-south trending ridgeline that enters the northeast area of the property and transitions into descending hillside terrain in the southern reaches of the property. Site natural topography largely approaches 3:1 (horizontal to vertical) maximum. Locally, steeper terrain occurs in association with the southern and southeastern flowlines.

More recently, the property was used for agricultural purposes. Prior to that, the property was impacted by gold mining activities that are thought to date back as much as 100 years. Details of the mining activities are not available. However, our field investigation conducted in 2013 revealed four mining excavation locations. The locations are indicated on the Geotechnical Map (Plate 1), and described as follows:

1. A nearly horizontal mine tunnel (adit) was exposed at the bottom of Test Pit 4, (TP-4) excavated through the underlying bedrock. The exposed excavation measured approximately 6 feet high by 7 feet wide trending in an N15°E direction. No supports were present, and the extent of the mine tunnel is unknown.

2. A nearly horizontal fille shaft was encountered at the Test Pit 7, (TP- 7) location, on the south side of the existing detached garage. The shaft excavation measured 9 feet square with the bottom of shaft extending beyond the 16-foot limit of our backhoe into crystalline bedrock. A secondary filled excavation appeared to the present on the westerly side of the shaft at 9 feet below the surface. This excavation appeared to trend slightly downward in an N75°W direction.

3. A well-developed horizontal mine tunnel (adit) was exposed 4 feet below the surface at the Test Pit 9, (TP- 9) location, near the upper beginning of the southwest canyon flowline. The hillside opening to this horizontal mine excavation measured 17 feet wide by 7 feet high and extended due west into the hillside for 17 feet. At this point, the mine tunnel narrows to approximately 3 feet wide and continues for an estimated 50-60 feet due west where it appears to trend northward. The entire mine tunnel was excavated into crystalline bedrock with no evidence of artificial support.

4. A filled mine excavation was identified at the Test Pit 15, (TP-15) location. This excavation originates on the south facing hillside with the mine opening measured 7 feet high by 4 feet wide and was exposed at 7 feet below the surface. The excavation appears to be nearly horizontal and trending N25°E into the hillside.

Additional mine-related excavations may be present at the property. All known mine excavations, and those encountered during site development will require mitigation as outlined in following sections.

III. PROPOSED DEVELOPMENT

Significant grading efforts will be required to complete the subdivision configuration as shown on the attached Geotechnical Map. Vertical cuts and fills approaching 25 feet and 35 feet respectively will be needed to achieve planned pad and roadway grades. Large perimeter and interior graded fill embankments are programmed for 2:1 gradients and will approach nearly 56 feet in vertical height. All new fill slopes more than 30 in height are proved with appropriate drainage terraces placed at mid-slope height. New cut slopes will approach nearly 35 feet in vertical height and are also programmed for 2:1 gradients. New graded embankments will locally include fill over cut slopes.

A large bio-retention basin for runoff is planned in the lower west-central are of the property. Specific hydro modification designs are currently unavailable. Bio-retention and filtration systems consisting of vegetated buffers or strips and self-contained retention/detention areas with impermeable liners on sides and bottom, special engineered sand filter media and perforated pipe(s) which discharge into approved storm water facilities are typical methods for the stormwater Best Management Practices (BMP). Additional and more specific recommendations should be provided by the project geotechnical consultant at the final plans review phase, as necessary.

Detailed construction plans are not yet available for review. However, conventional wood-frame buildings with exterior stucco supported on shallow foundations with stem-walls and slab-on-grade floors, or slab-on-ground with turned-down footings are anticipated.

IV. GEOTECHNICAL CONDITIONS

Geotechnical conditions at the project property remain as reported in detail in the referenced report (see Attachment).

A. Earth Materials

Bedrock - The property and surrounding hillside terrain are underlain by dark-colored gabbroic rocks intruded by felsic quartz-rich veins and lighter granitic rocks. The gabbroic rocks are typically deeply weathered and grade harder with depth. Spherical corestones are also locally expected within the bedrock.

Excavations into the project bedrock are expected to largely produce good quality gravelly sandy granular soils suitable for site new fills and backfills. Project bedrock are competent units which will provide excellent support for planned new fills, structures, and improvements.

Colluvium - Colluvial soils are present in the lower terrain and local hillside areas. The colluvium thickens in the southern margin of the property where it appears ancient and occurs in a consolidated and dense condition. Elsewhere, shallow deposits of site colluvium generally occur in a loose condition.

Alluvium - Alluvium deposits are present within the canyon flowlines in the southern area of the property. Overall, site alluvium was found in a very loose condition and may be more than 10 feet in depth.

Topsoil - Shallow topsoil deposits occur along ridgelines and hilltops at the property. Site topsoil consists of silty sand that occurs in a very loose condition overall.

Fill - Minor existing fill deposits are associated with an existing building and hillside drainage terraces. More significant fill deposits occur with a flowline crossing in the southwest area of the property and the covering or filling of old mine excavations. All existing fills, where present, should be entirely removed as part of the site grading operations.

Added details of the site earth materials are included on the exploratory excavation logs attached as Plates 4 through 30 in the Attachment. The approximate distribution of earth deposits at the site are shown on the enclosed Geotechnical Map, Plate 1. Cross-Sections depicting subsurface conditions and planned finish grades are included as Plates 2 and 3.

B. Groundwater and Surface Drainage

Subsurface water was not encountered in the test pits at the time of our field investigation. However, toe drains may be appropriate for cut slopes exposing weathered or fractured bedrock, which could transmit water from upslope terrain. The final decision for toe drains should be provided by the geotechnical engineer based on the actual cut exposures.

Canyon subdrains are recommended within the two prominent flowlines in the southern area of the property as shown on Plate 1.

The large flowline that traverses the southeast portion of the site has evidence of scouring and erosion. In order to limit the erosion and protect new fill slopes developed above the flowline, sidewall armor protection such as rip-rap or gabions will be necessary.

C. Slope Stability / Rock Hardness

The property is underlain by competent crystalline bedrock units which typically perform well in natural and graded slope conditions. Slope instability is not in evidence at the property. The oversteepened cut slopes along Bear Valley Parkway will be removed or laid back at 2:1 gradients as part of the widening of Bear Valley Parkway and construction of a new graded embankment. Future graded cut embankments exposing crystalline bedrock are expected to be grossly stable to planned design heights. New fill slopes will also be grossly stable to design heights provided our keyway development and grading recommendations are adhered to. All graded slopes should be provided with well-developed brow ditches. Runoff should not be allowed over slope faces.

In order to determine rock hardness within anticipated cut areas, six seismic refraction lines were run along hilltops and ridgelines by SubSurface Surveys using a Bison 9024 signal enhancement seismograph. The locations of the surveys are shown on the Geotechnical Map, Plate 1. Graphic results of the surveys are included in the attached report.

In general, the seismic lines indicate that the planned cut areas are underlain by weathered rock which may be rippable up to 40 feet below the surface using a Caterpiller D9 or equivalent. The survey also indicates that buried corestones can be expected in the area of Line 2, where large residual boulders are exposed at the surface. Very hard rocks that will require blasting are currently not indicated along the seismic lines.

D. Seismic Ground Motion Values

Seismic ground motion values were determined as part of this investigation in accordance with Chapter 16, Section 1613 of the 2013 California Building Code (CBC) and ASCE 7-10 Standard using the web-based United States Geological Survey (USGS) ground motion calculator. Generated results including the Mapped (S_s, S_1), Risk-Targeted Maximum Considered Earthquake (MCE_R) adjusted for site Class effects (S_{Ms}, S_{M1}) and Design (S_{Ds}, S_{D1}) Spectral Acceleration Parameters as well as Site Coefficients (F_a, F_v) for short periods (0.20 second) and 1-second period, Site Class, Design and Risk-Targeted Maximum Considered Earthquake (MCE_R) Response Spectrums, Mapped Maximum Considered Geometric Mean (MCE_G) Peak Ground Acceleration adjusted for Site Class effects (PGA_M) and Seismic Design Category based on Risk Category and the severity of the design earthquake ground motion at the site are summarized in the enclosed Appendixes A and B.

V. HYDRO MODIFICATION

Project hydro-modification for stormwater management should be designed and constructed considering the site indicated geotechnical conditions. The design and implemented management practice(s) should also have no short and long term impacts on the site building pads, graded surfaces, natural embankments and graded slopes, fills and backfills, structures, and onsite and nearby off improvements. Specific details for stormwater runoff are unknown, however, the current plans indicate that two bio-retention basins are planned adjacent to Bear Valley Parkway. The northerly basin is also where a mine tunnel was exposed which is suspected to extend beneath the planned basin. The mine excavation should be exposed and filled as outlined in a following section.

VI. CONCLUSIONS AND RECOMMENDATIONS

The project property remains substantially unchanged from conditions presented in the referenced report (included herein as an Attachment).

All conclusions and recommendations provided in the referenced report including, but not limited to, keyway/graded embankment construction, pad transition undercuts, foundation/slab recommendations, PCC/asphalt pavement design, canyon subdrain construction, grading/earthwork recommendations, and mine excavation mitigation, remain valid and should be considered in the project designs and implemented during the construction phase except where specifically superceded or amended in the following section:

1. All grading and earthworks should be completed in accordance with the Chapter 18 and Appendix "J" of the California Building Code (CBC), City of Escondido Grading Ordinances, the Standard Specifications for Public Works Construction, and the requirements of the referenced soil report (Appendix) and this update transmittal.

2. The most significant geotechnical concern at the property is the existing mine excavations. Four specific locations were identified during our field investigation in 2013. Additional mine-related excavations may be present at the property and should be expected during grading operations. Generally, mine related excavations with 10 feet minimum of competent bedrock overburden are determined not to be susceptible to future collapse (as inspected and approved by the project geotechnical consultant), and may be sealed and capped. Based on the current development plan for the property (Plate 1), the following mitigation procedures are appropriate for the four known mine excavations:

    A. The top of the horizontal mine tunnel (adit) exposed at the Test Pit 4 location is 4 feet to 6 feet below the surface with 1 foot of bedrock cover. The tunnel appeared to be horizontal and trend in a N15°E direction and likely extends beneath Lot 1 and the northerly basin. Due to the shallow nature of the excavation, the mine tunnel should be exposed at the Test Pit 4 location and then exposed in both directions using a large track hoe or suitable excavating equipment. The northern portion of the mine tunnel (north of TP-4) should be exposed to its end and backfilled with 90% compacted soil. Should the north end of the mine excavation extend beyond the property line (and possibly beneath Bear Valley Parkway) additional mitigation recommendations will be provided after consultation with the City of Escondido engineering department. The south portion of the mine tunnel (south of TP-4) should be continuously exposed to its end or until a minimum covering of 10 feet of competent bedrock is exposed. The open excavation should be backfilled with compacted soil (90% minimum). The open mine excavation, if exposed with a minimum of 10 feet of competent bedrock cover, should be capped as outlined in the attached report after approval of the geotechnical engineer.

B. The nearly horizontal mine shaft and associated secondary mine excavations exposed at the Test Pit 7 location are located within a planned deep cut area, and are expected to be completely removed as part of the cut grading operation. If the shaft continues below finish grade, it should be completely excavated and backfilled with 90% compacted soil, as approved by the geotechnical engineer.

C. The well-developed horizontal mine tunnel (adit) at the Test Pit 9 location is in a planned fill slope area below Lots 47 and 48. The entrance to the mine tunnel should be exposed and the overburden removed until there is a minimum of 10 feet of competent bedrock above the top of the tunnel. The opening should then be sealed, as approved by the geotechnical engineer, as outlined in the attached report.

D. The mine excavation exposed at the Test Pit 15 location is located in a deep fill area beneath Lots 33-34. The entrance to this mine excavation should be exposed and the overburden removed until there is a minimum of 10 feet of competent bedrock above the mine excavation. The excavation may then be sealed as outlined in the attached report, as approved by the geotechnical engineer.

All mine-related excavation mitigation procedures should be continuously monitored by the project geotechnical engineer, geologist, or their representative and documented in daily reports. All mine excavations should be accurately surveyed and located on the As-Built plans indicating the portions that were exposed and backfilled, trend of excavations left in-place with more than 10 feet of competent bedrock overburden, and location where sealing materials were used.

3. All site surficial soils in areas of planned new fills, embankments, structures and improvements plus 10 feet outside the perimeter where possible, and as approved in the field, should be removed to the underlying competent bedrock or dense natural ground and placed back as properly compacted fills. Dense natural ground is defined as having in-place densities of 90% or more (as tested in the field), and may be expected in the southerly margin of the property only where ancient colluvial soils were encountered.

4. Added care should be given for the development of keyways for fill slopes constructed on cut slopes to ensure recommended keyway widths and embedment into bedrock are met.

5. All fills in excess of 20 feet vertical thickness and fills/backfills placed with flowline areas or where subject to potential saturation or inundation should be mechanically compacted to a minimum of 95% of the corresponding laboratory maximum dry density per ASTM D-1557, unless otherwise specified. The upper 12 inches of subgrade soil beneath pavement base layers should also be compacted to 95% levels. Elsewhere, fills less than 20 feet in vertical thickness may be compacted a minimum of 90% per ASTM D-1557 (see attached report).

6. Soil design parameters including bearing and lateral earth pressures will also remain the same as specified in the referenced report (see Attachment, April 3, 2013 report).

7. Final grading and foundation plans should reflect preliminary recommendations given in this report and reviewed and approved by the project geotechnical consultant. Additional or more specific recommendations may be necessary and should be provided at that time, as required.

VII. GEOTECHNICAL ENGINEER OF RECORD (GER)

Vinje & Middleton Engineering, Inc. is the geotechnical engineer of record (GER) for a specific scope of work or professional service under a contractual agreement unless it is terminated or canceled by either the client or our firm. In the event a new geotechnical consultant or soils engineering firm is hired to provide added engineering services, professional consultations, engineering observations and compaction testing, Vinje & Middleton Engineering, Inc. will no longer be the geotechnical engineer of record. Project transfer should be completed in accordance with the California Geotechnical Engineering Association (CGEA) Recommended Practice for Transfer of Jobs Between Consultants.

The new geotechnical consultant or soils engineering firm should review all previous geotechnical documents, conduct an independent study, and provide appropriate confirmations, revisions or design modifications to his own satisfaction. The new geotechnical consultant or soils engineering firm should also notify in writing Vinje & Middleton Engineering, Inc. and submit proper notification to the County of San Diego for the assumption of responsibility in accordance with the applicable codes and standards (1997 UBC Section 3317.8).

If you have any questions or need further clarification, please do not hesitate to contact the undersigned. Reference to our **Job #13-116-P** will help to expedite our response to your inquiries.

We appreciate this opportunity to be of service to you.

VINJE & MIDDLETON ENGINEERING, INC.

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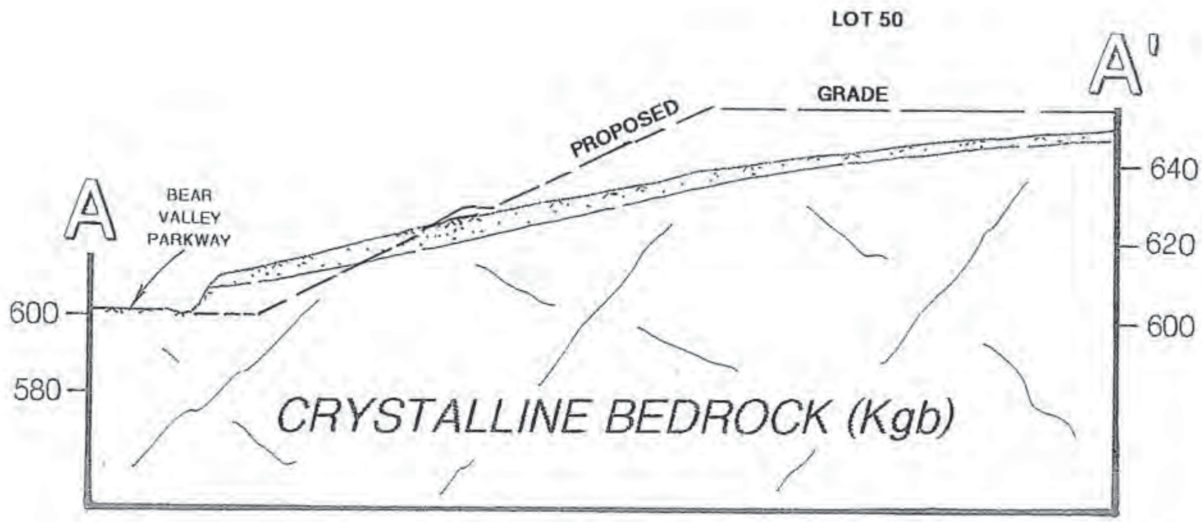
Attachments

Distribution: Addressee (5, e-mail)

GEOLOGIC CROSS-SECTIONS

SCALE: 1" = 50'



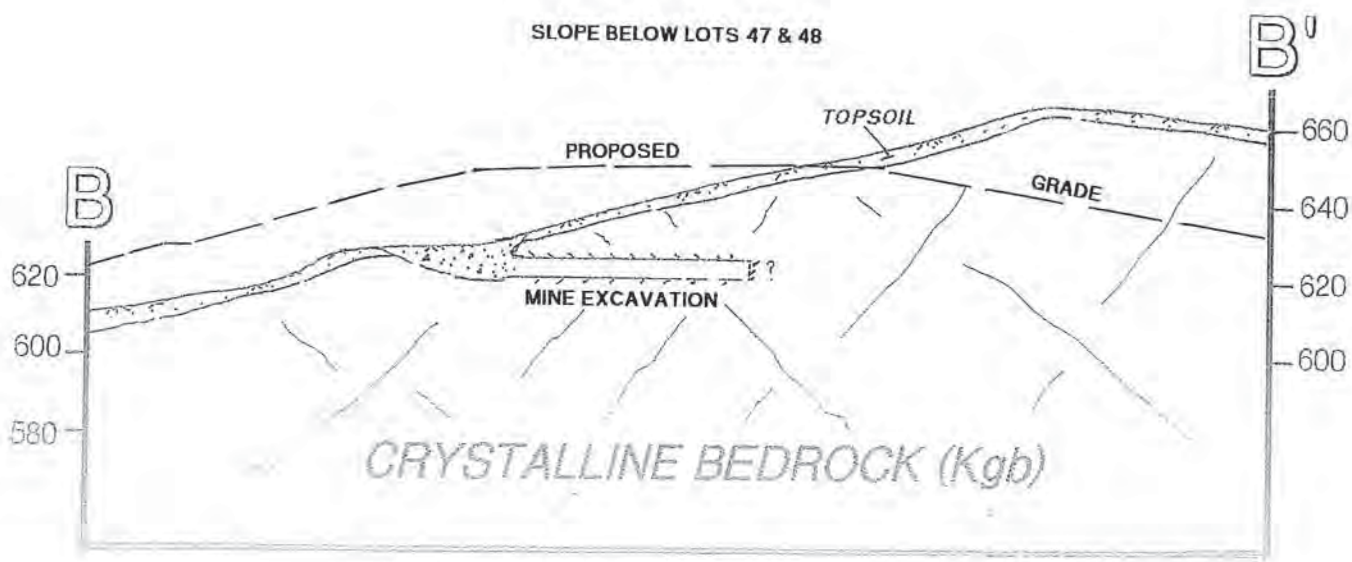
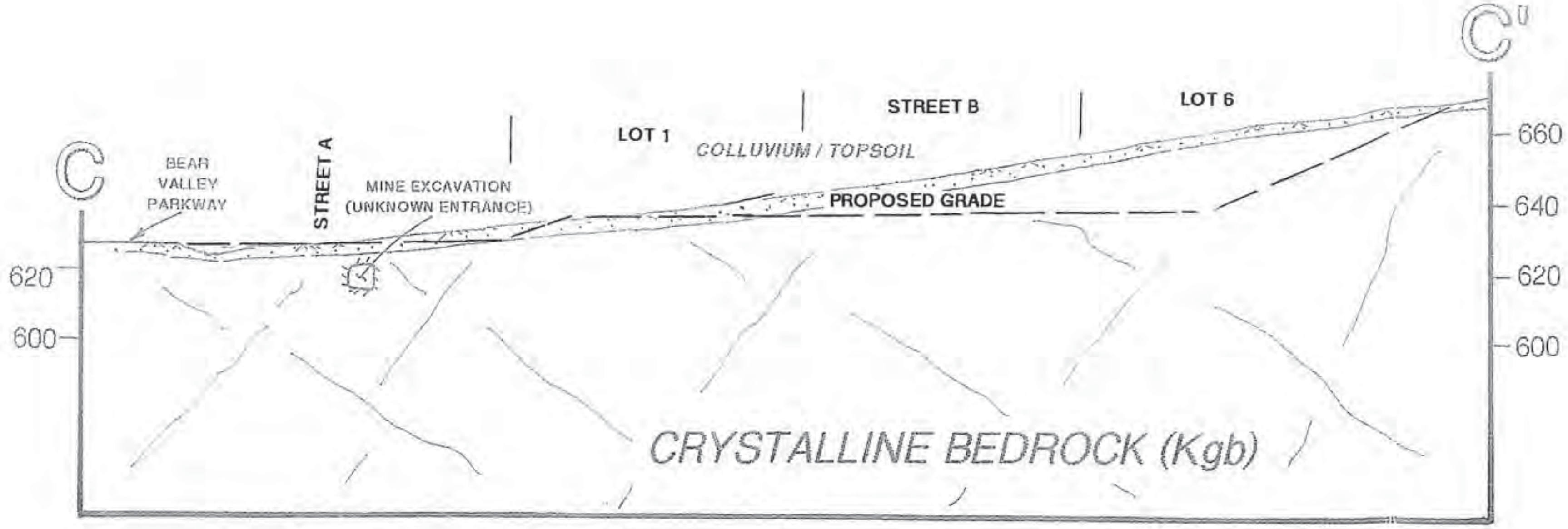
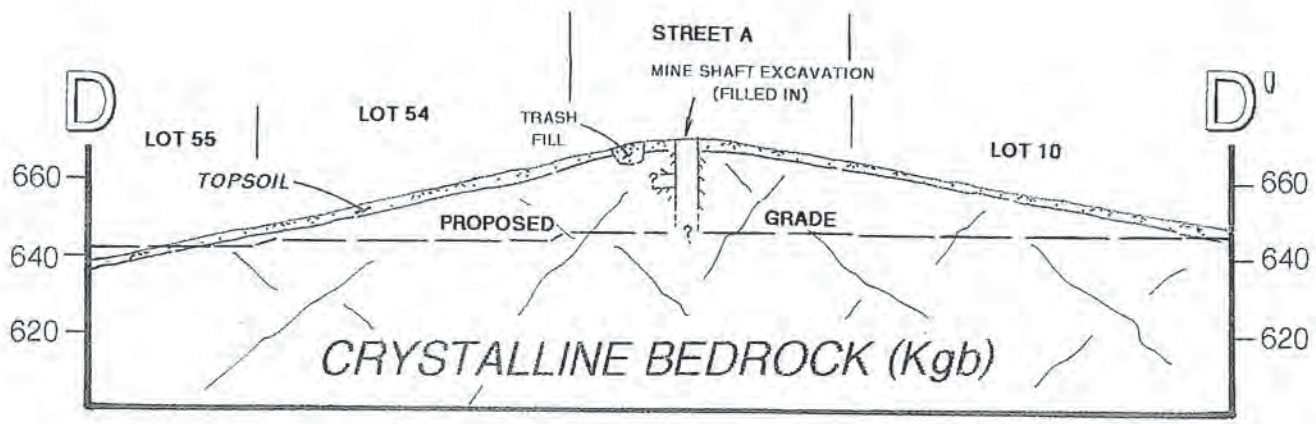


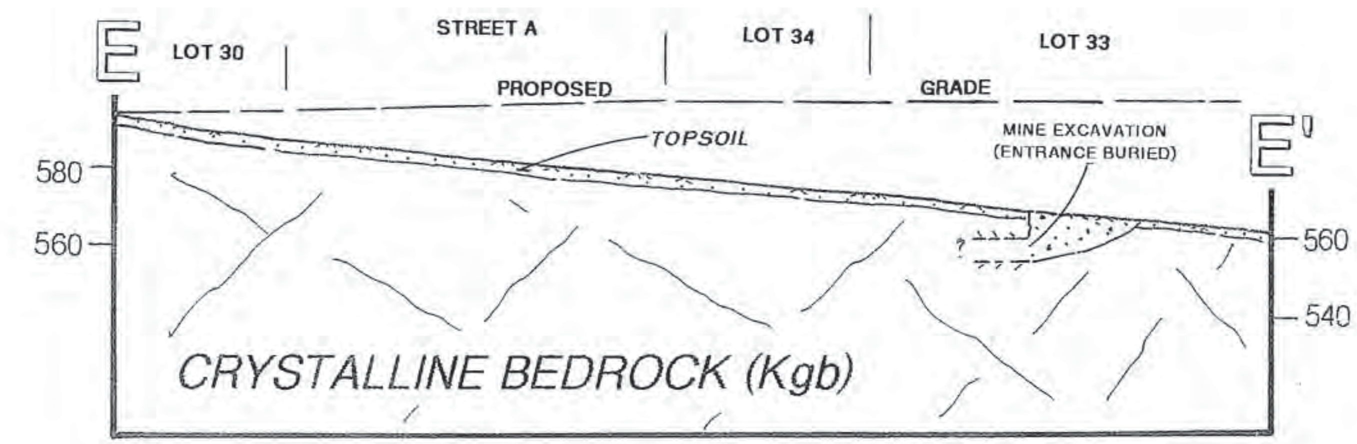
PLATE 2
V&M JOB #13-116-P

GEOLOGIC CROSS-SECTIONS

SCALE: 1" = 50'







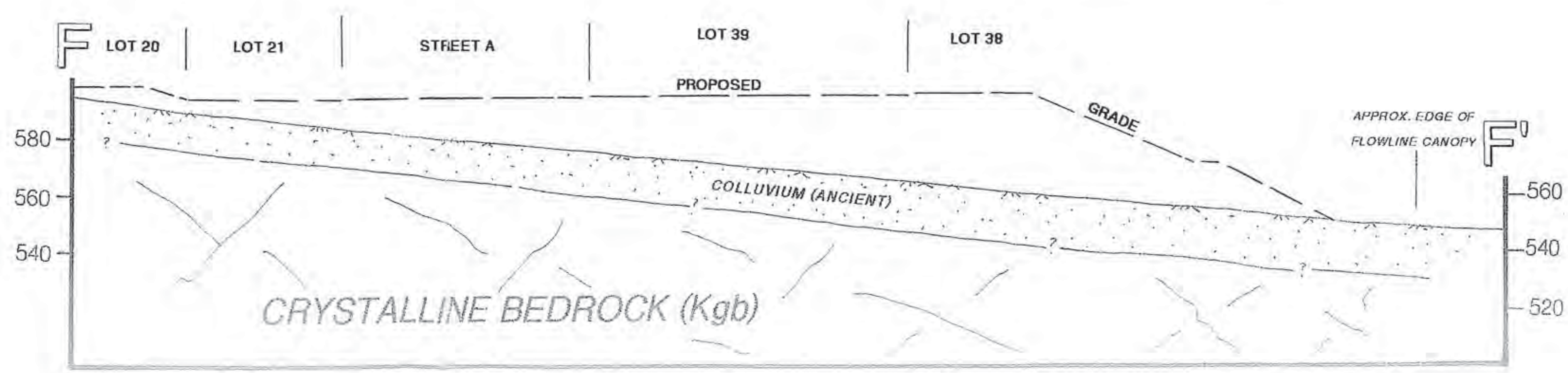


PLATE 3
V&M JOB #13-116-P

Appendix A

Site Class B
Bedrock or less than 10 feet of fill beneath building foundations

USGS Design Maps Summary Report

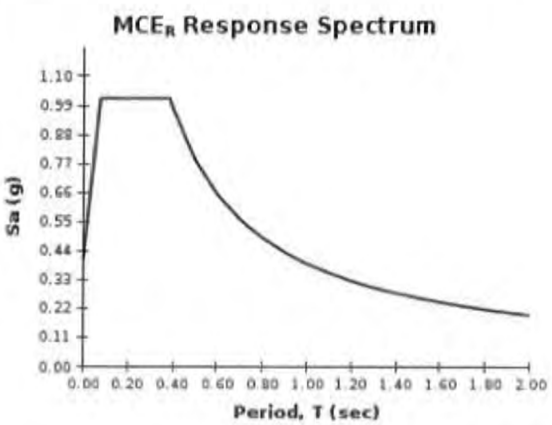
User–Specified Input

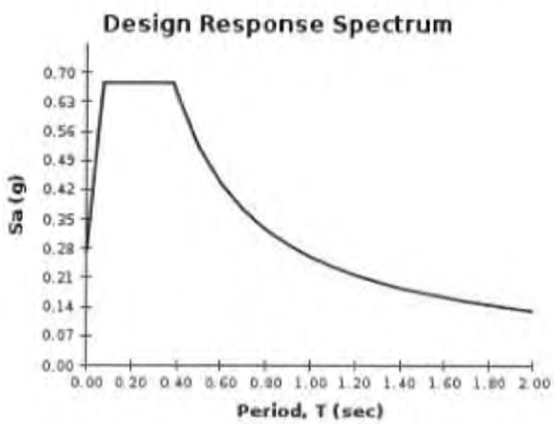
Report Title	Bear Valley Parkway Fri December 12, 2014 19:26:04 UTC
Building Code Reference Document	ASCE 7-10 Standard (which utilizes USGS hazard data available in 2008)
Site Coordinates	33.1°N, 117.06°W
Site Soil Classification	Site Class B – "Rock"
Risk Category	I/II/III

USGS–Provided Output

S_S =	1.016 g	S_{MS} =	1.016 g	S_{DS} =	0.677 g
S_1 =	0.391 g	S_{M1} =	0.391 g	S_{D1} =	0.261 g

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.





For PGA_M, T_L, C_{RS}, and C_{R1} values, please view the detailed report.

USGS Design Maps Detailed Report

ASCE 7-10 Standard (33.1°N, 117.06°W)

Site Class B – "Rock", Risk Category I/II/III

Section 11.4.1 — Mapped Acceleration Parameters

Note: Ground motion values provided below are for the direction of maximum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain S_s) and 1.3 (to obtain S_1). Maps in the 2010 ASCE-7 Standard are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 11.4.3.

From Figure 22-1 [1] $S_s = 1.016$ g

From Figure 22-2 [2] $S_1 = 0.391$ g

Section 11.4.2 — Site Class

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class B, based on the site soil properties in accordance with Chapter 20.

Table 20.3-1 Site Classification

Site Class	$\bar{v}_s$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index $PI > 20$, • Moisture content $w \geq 40\%$, and • Undrained shear strength $\bar{s}_u < 500$ psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

Section 11.4.3 — Site Coefficients and Risk–Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameters

Table 11.4–1: Site Coefficient F_a

Site Class	Mapped MCE $_R$ Spectral Response Acceleration Parameter at Short Period				
	$S_S \le 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S \ge 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_S

For Site Class = B and S_S = 1.016 g, F_a = 1.000

Table 11.4–2: Site Coefficient F_V

Site Class	Mapped MCE $_R$ Spectral Response Acceleration Parameter at 1–s Period				
	$S_1 \le 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \ge 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_1

For Site Class = B and S_1 = 0.391 g, F_v = 1.000

Equation (11.4-1): $S_{MS} = F_aS_S = 1.000 \times 1.016 = 1.016$ g

Equation (11.4-2): $S_{M1} = F_vS_1 = 1.000 \times 0.391 = 0.391$ g

Section 11.4.4 — Design Spectral Acceleration Parameters

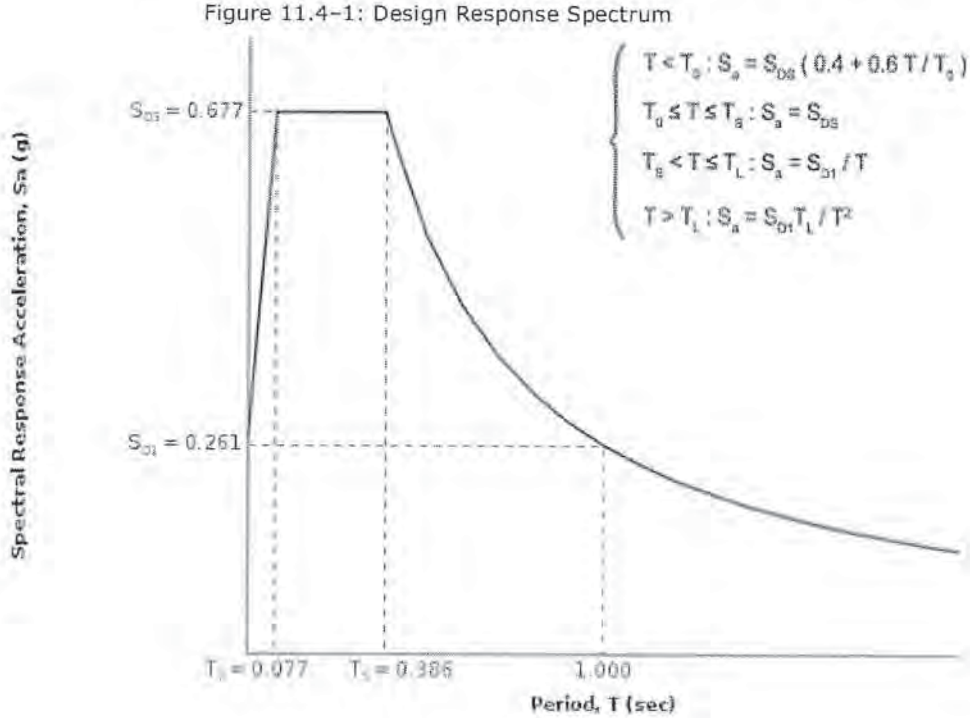
Equation (11.4-3): $S_{DS} = ⅔\ S_{MS} = ⅔ \times 1.016 = 0.677$ g

Equation (11.4-4): $S_{D1} = ⅔\ S_{M1} = ⅔ \times 0.391 = 0.261$ g

Section 11.4.5 — Design Response Spectrum

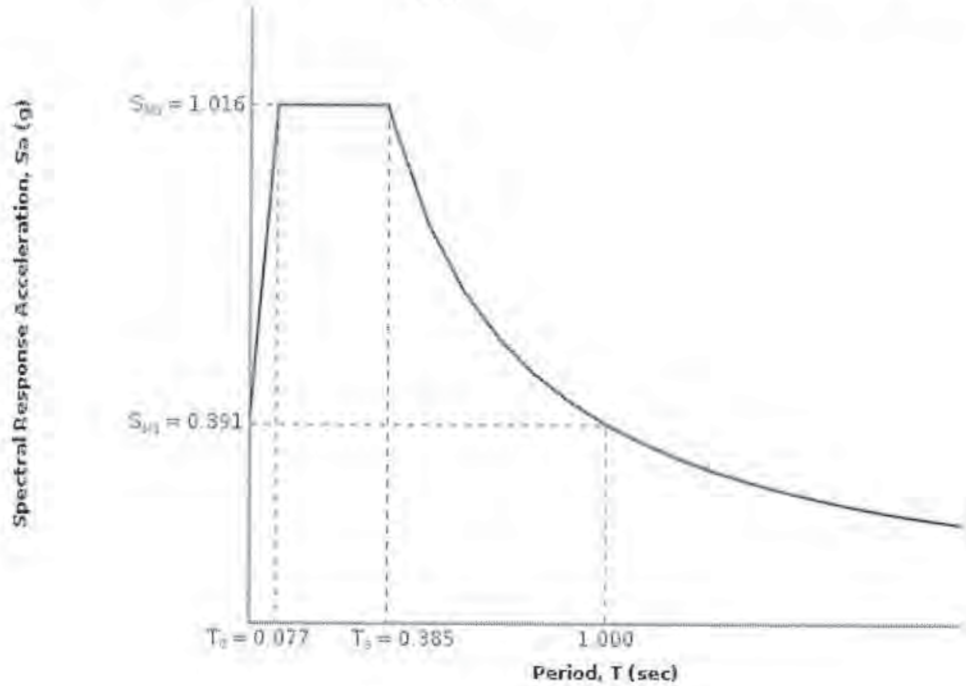
From Figure 22-12 [3] T_L = 8 seconds

Figure 11.4-1: Design Response Spectrum



Section 11.4.6 — Risk-Targeted Maximum Considered Earthquake (MCE_R) Response Spectrum

The MCE_R Response Spectrum is determined by multiplying the design response spectrum above by 1.5.



Section 11.8.3 — Additional Geotechnical Investigation Report Requirements for Seismic Design Categories D through F

From Figure 22-7 [4] PGA = 0.378

Equation (11.8–1): $PGA_M = F_{PGA}PGA = 1.000 \times 0.378 = 0.378$ g

Table 11.8–1: Site Coefficient F_{PGA}

Site Class	Mapped MCE Geometric Mean Peak Ground Acceleration, PGA				
	PGA ≤ 0.10	PGA = 0.20	PGA = 0.30	PGA = 0.40	PGA ≥ 0.50
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of PGA

For Site Class = B and PGA = 0.378 g, F_{PGA} = 1.000

Section 21.2.1.1 — Method 1 (from Chapter 21 – Site-Specific Ground Motion Procedures for Seismic Design)

From Figure 22-17 [5] C_{RS} = 1.038

From Figure 22-18 [6] C_{R1} = 1.079

Section 11.6 — Seismic Design Category

Table 11.6-1 Seismic Design Category Based on Short Period Response Acceleration Parameter

VALUE OF S_{DS}	RISK CATEGORY		
	I or II	III	IV
$S_{DS} < 0.167g$	A	A	A
$0.167g \le S_{DS} < 0.33g$	B	B	C
$0.33g \le S_{DS} < 0.50g$	C	C	D
$0.50g \le S_{DS}$	D	D	D

For Risk Category = I and S_{DS} = 0.677 g, Seismic Design Category = D

Table 11.6-2 Seismic Design Category Based on 1-S Period Response Acceleration Parameter

VALUE OF S_{D1}	RISK CATEGORY		
	I or II	III	IV
$S_{D1} < 0.067g$	A	A	A
$0.067g \le S_{D1} < 0.133g$	B	B	C
$0.133g \le S_{D1} < 0.20g$	C	C	D
$0.20g \le S_{D1}$	D	D	D

For Risk Category = I and S_{D1} = 0.261 g, Seismic Design Category = D

Note: When S_1 is greater than or equal to 0.75g, the Seismic Design Category is **E** for buildings in Risk Categories I, II, and III, and **F** for those in Risk Category IV, irrespective of the above.

Seismic Design Category ≡ "the more severe design category in accordance with Table 11.6-1 or 11.6-2" = D

Note: See Section 11.6 for alternative approaches to calculating Seismic Design Category.

References

1. *Figure 22-1*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-1.pdf
2. *Figure 22-2*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-2.pdf
3. *Figure 22-12*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-12.pdf
4. *Figure 22-7*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-7.pdf
5. *Figure 22-17*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-17.pdf
6. *Figure 22-18*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-18.pdf

Appendix B

Site Class D
10 feet or more of fill
beneath building foundations

USGS Design Maps Summary Report

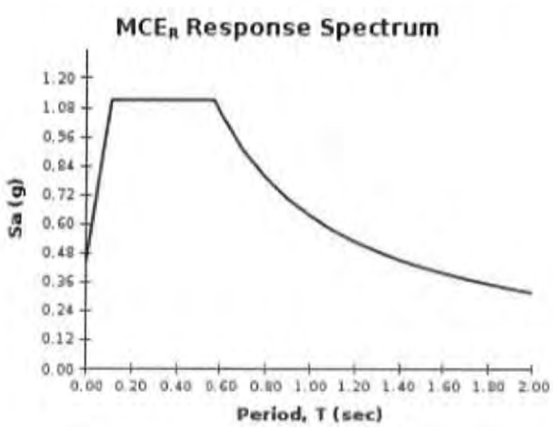
User–Specified Input

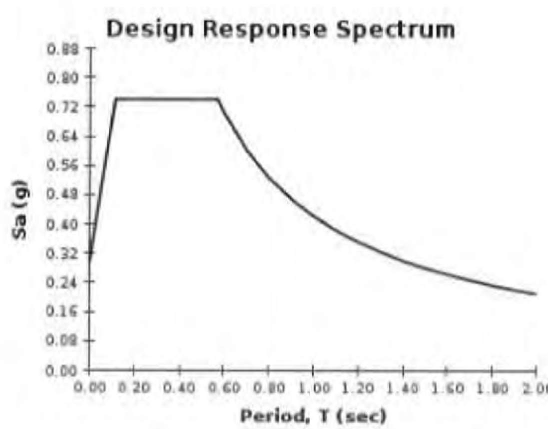
Report Title	Bear Valley Parkway Fri December 12, 2014 19:27:55 UTC
Building Code Reference Document	ASCE 7-10 Standard (which utilizes USGS hazard data available in 2008)
Site Coordinates	33.1°N, 117.06°W
Site Soil Classification	Site Class D – "Stiff Soil"
Risk Category	I/II/III

USGS–Provided Output

S_S =	1.016 g	S_{MS} =	1.111 g	S_{DS} =	0.741 g
S_1 =	0.391 g	S_{M1} =	0.633 g	S_{D1} =	0.422 g

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.





For PGA_M, T_L, C_{RS}, and C_{R1} values, please view the detailed report.

USGS Design Maps Detailed Report

ASCE 7-10 Standard (33.1°N, 117.06°W)

Site Class D – "Stiff Soil", Risk Category I/II/III

Section 11.4.1 — Mapped Acceleration Parameters

Note: Ground motion values provided below are for the direction of maximum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain S_S) and 1.3 (to obtain S_1). Maps in the 2010 ASCE-7 Standard are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 11.4.3.

From Figure 22-1 [1] $S_S = 1.016$ g

From Figure 22-2 [2] $S_1 = 0.391$ g

Section 11.4.2 — Site Class

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class D, based on the site soil properties in accordance with Chapter 20.

Table 20.3–1 Site Classification

Site Class	$\bar{v}_s$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index $PI > 20$, • Moisture content $w \geq 40\%$, and • Undrained shear strength $\bar{s}_u < 500$ psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

Section 11.4.3 — Site Coefficients and Risk-Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameters

Table 11.4-1: Site Coefficient F_a

Site Class	Mapped MCE $_R$ Spectral Response Acceleration Parameter at Short Period				
	$S_S \le 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S \ge 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight-line interpolation for intermediate values of S_S

For Site Class = D and S_S = 1.016 g, F_a = 1.094

Table 11.4-2: Site Coefficient F_V

Site Class	Mapped MCE $_R$ Spectral Response Acceleration Parameter at 1-s Period				
	$S_1 \le 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \ge 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7 of ASCE 7				

Note: Use straight-line interpolation for intermediate values of S_1

For Site Class = D and S_1 = 0.391 g, F_v = 1.617

Equation (11.4-1):	$S_{MS} = F_aS_S = 1.094 \times 1.016 = 1.111$ g
Equation (11.4-2):	$S_{M1} = F_vS_1 = 1.617 \times 0.391 = 0.633$ g

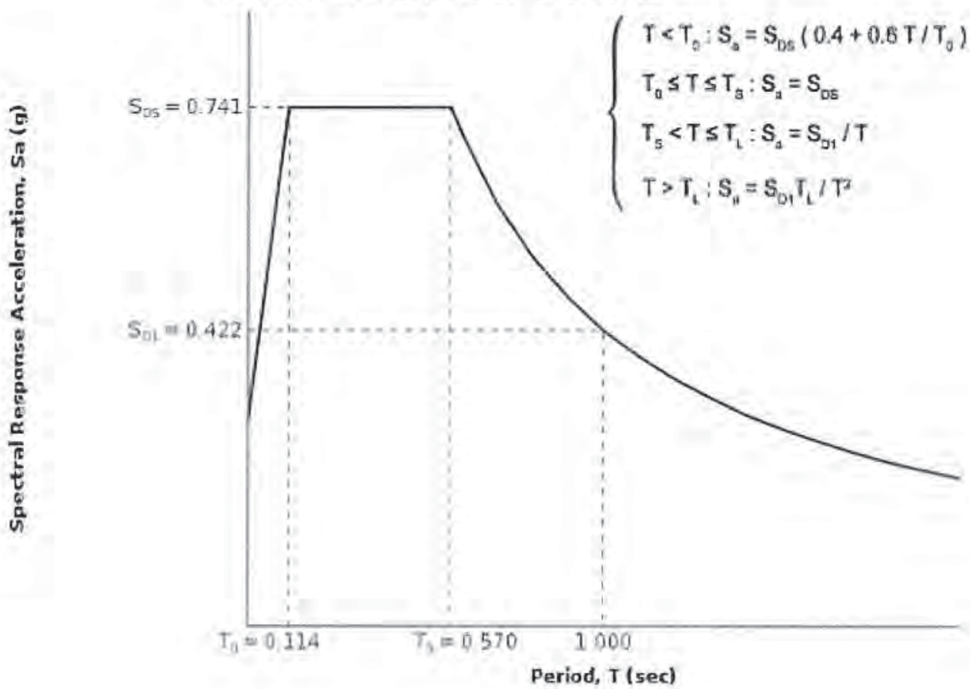
Section 11.4.4 — Design Spectral Acceleration Parameters

Equation (11.4-3):	$S_{DS} = ⅔\, S_{MS} = ⅔ \times 1.111 = 0.741$ g
Equation (11.4-4):	$S_{D1} = ⅔\, S_{M1} = ⅔ \times 0.633 = 0.422$ g

Section 11.4.5 — Design Response Spectrum

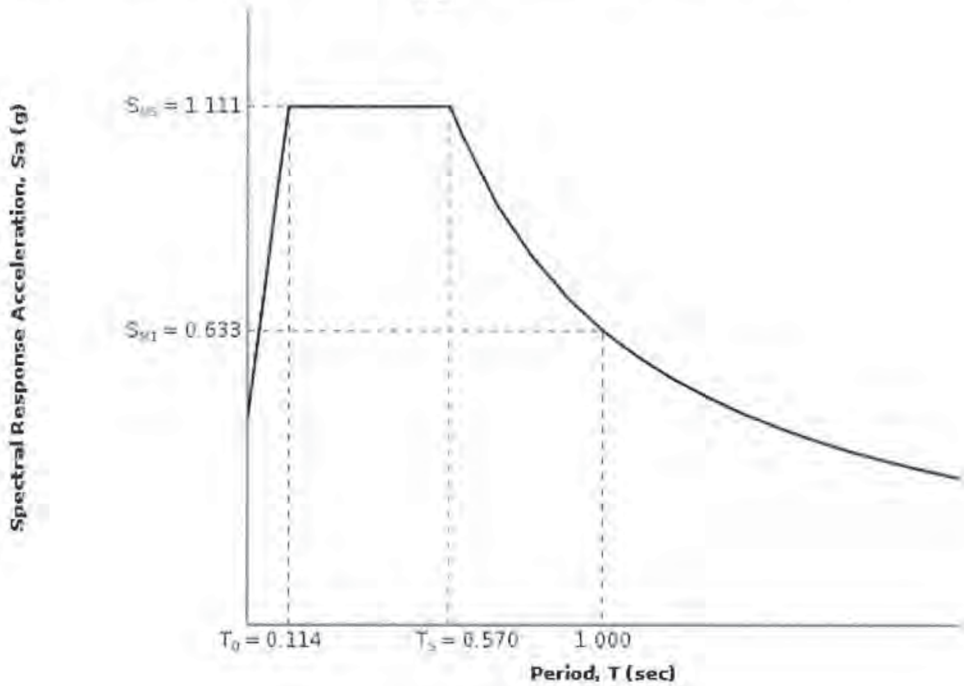
From Figure 22-12 [3]	T_L = 8 seconds

Figure 11.4-1: Design Response Spectrum



Section 11.4.6 — Risk-Targeted Maximum Considered Earthquake (MCE_R) Response Spectrum

The MCE_R Response Spectrum is determined by multiplying the design response spectrum above by 1.5.



Section 11.8.3 — Additional Geotechnical Investigation Report Requirements for Seismic Design Categories D through F

From Figure 22-7 [4] PGA = 0.378

Equation (11.8–1): $PGA_M = F_{PGA}PGA = 1.122 \times 0.378 = 0.424$ g

Table 11.8–1: Site Coefficient F_{PGA}

Site Class	Mapped MCE Geometric Mean Peak Ground Acceleration, PGA				
	PGA ≤ 0.10	PGA = 0.20	PGA = 0.30	PGA = 0.40	PGA ≥ 0.50
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of PGA

For Site Class = D and PGA = 0.378 g, F_{PGA} = 1.122

Section 21.2.1.1 — Method 1 (from Chapter 21 – Site-Specific Ground Motion Procedures for Seismic Design)

From Figure 22-17 [5] C_{RS} = 1.038

From Figure 22-18 [6] C_{R1} = 1.079

Section 11.6 — Seismic Design Category

Table 11.6-1 Seismic Design Category Based on Short Period Response Acceleration Parameter

VALUE OF S_{DS}	RISK CATEGORY		
	I or II	III	IV
$S_{DS} < 0.167g$	A	A	A
$0.167g \le S_{DS} < 0.33g$	B	B	C
$0.33g \le S_{DS} < 0.50g$	C	C	D
$0.50g \le S_{DS}$	D	D	D

For Risk Category = I and S_{DS} = 0.741 g, Seismic Design Category = D

Table 11.6-2 Seismic Design Category Based on 1-S Period Response Acceleration Parameter

VALUE OF S_{D1}	RISK CATEGORY		
	I or II	III	IV
$S_{D1} < 0.067g$	A	A	A
$0.067g \le S_{D1} < 0.133g$	B	B	C
$0.133g \le S_{D1} < 0.20g$	C	C	D
$0.20g \le S_{D1}$	D	D	D

For Risk Category = I and S_{D1} = 0.422 g, Seismic Design Category = D

Note: When S_1 is greater than or equal to 0.75g, the Seismic Design Category is **E** for buildings in Risk Categories I, II, and III, and **F** for those in Risk Category IV, irrespective of the above.

Seismic Design Category ≡ "the more severe design category in accordance with Table 11.6-1 or 11.6-2" = D

Note: See Section 11.6 for alternative approaches to calculating Seismic Design Category.

References

1. *Figure 22-1*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-1.pdf
2. *Figure 22-2*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-2.pdf
3. *Figure 22-12*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-12.pdf
4. *Figure 22-7*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-7.pdf
5. *Figure 22-17*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-17.pdf
6. *Figure 22-18*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-18.pdf