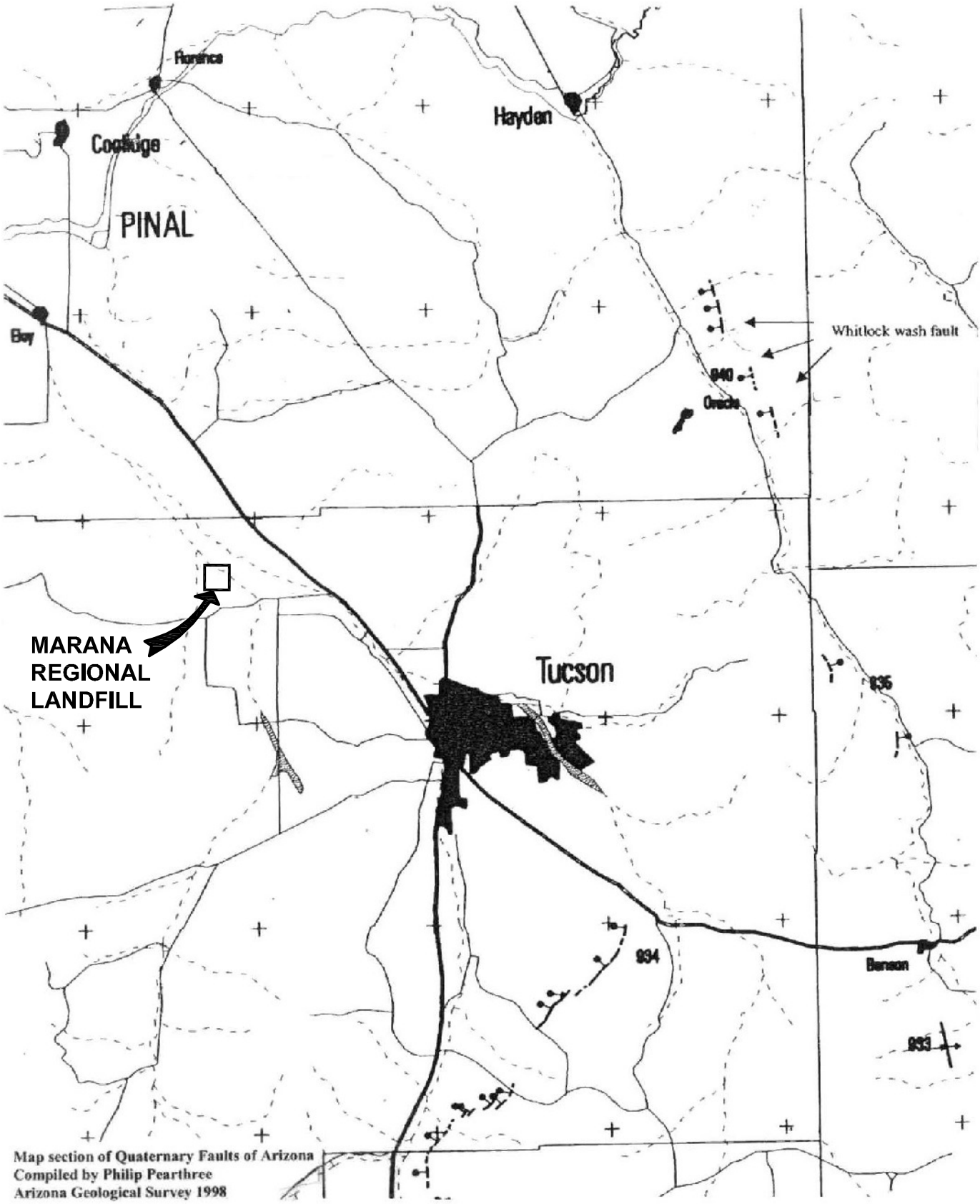
APPENDIX E

SEISMIC INFORMATION



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DKL HOLDINGS
MARANA REGIONAL LANDFILL

QUATERNARY FAULT MAP

FIGURE NO.
E1

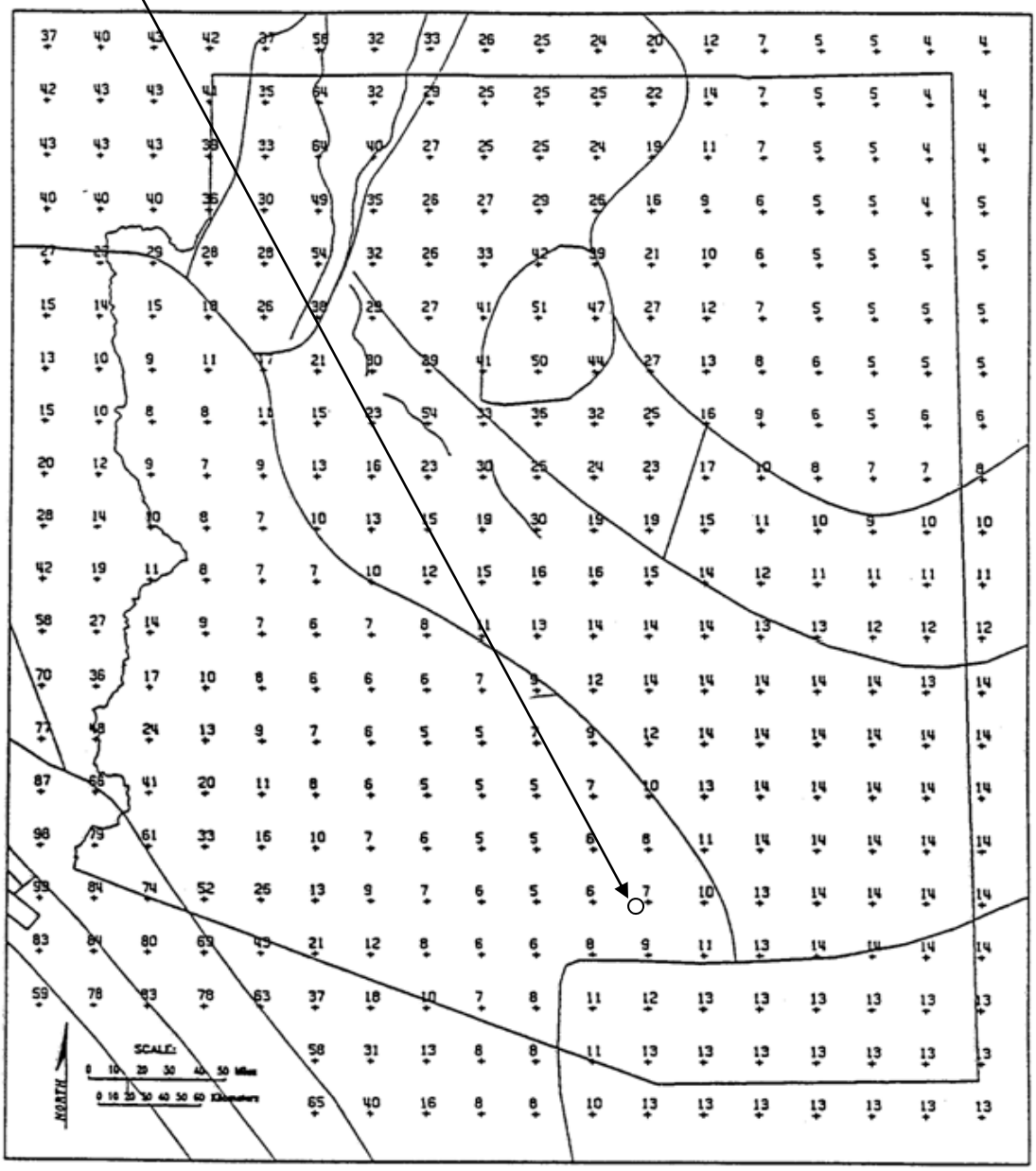
PROJECT NO.
090250.3

File: X:\PROJECTS\MARANA - SWFP - 090250\PROJECT DRAWINGS\SPMSWFPS-FIG E01_QUATERNARY FAULT MAP.dwg Layout: FIG1 User: Mark.Case May 03, 2011 - 2:45pm

FHWA REGION	STATE	PROJECT NUMBER	REPORT NUMBER
9	ARIZ.	HPR-PL-1(37)344	FWHA-AZ92-344

Marana Regional Landfill Site
with coefficient of 7% g

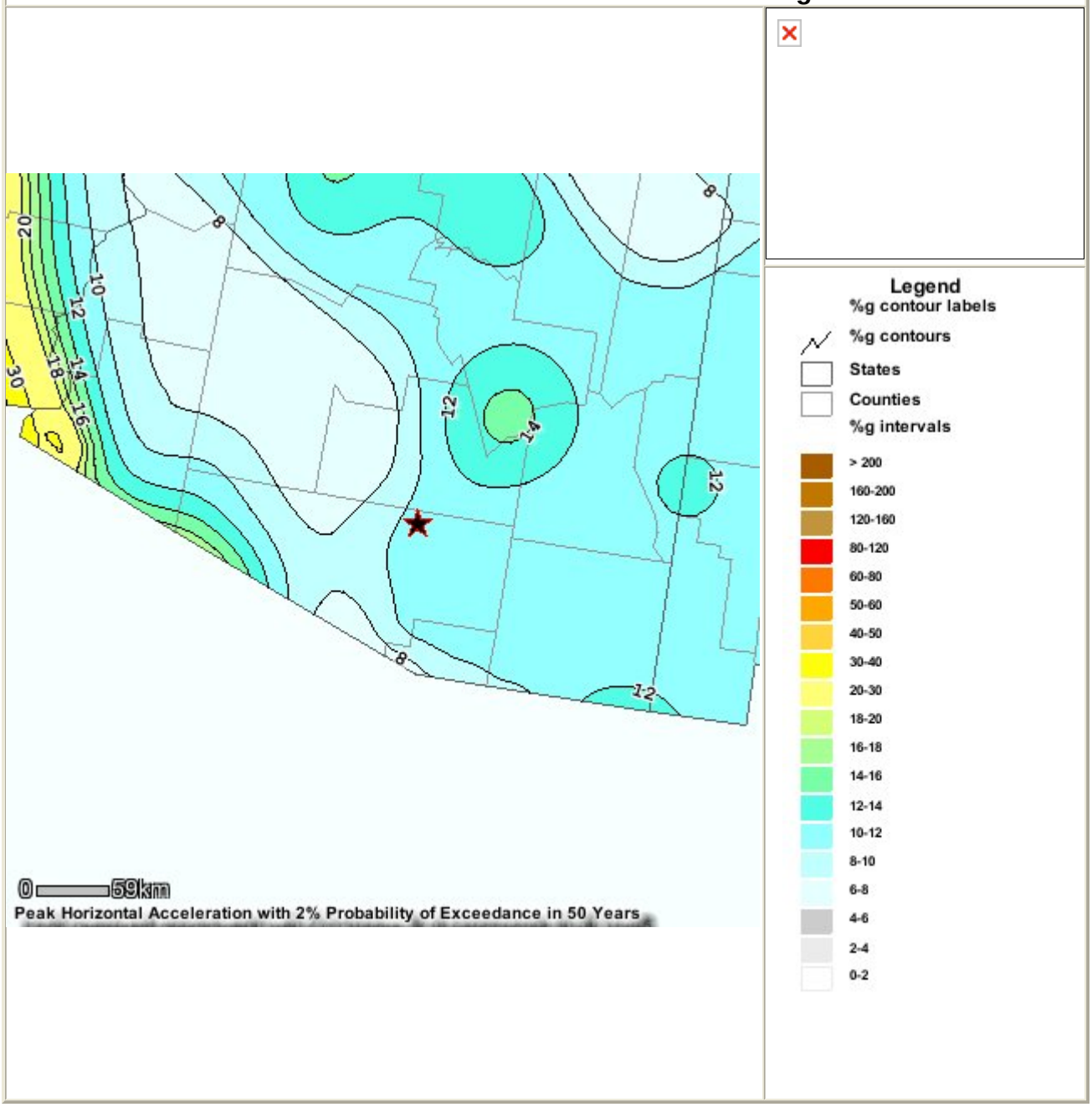
Coefficients in percent g



ARIZONA DEPARTMENT OF TRANSPORTATION
ARIZONA TRANSPORTATION RESEARCH CENTER

FIGURE 51
PGA FOR 90% NON-EXCEEDANCE
IN 250 YEARS

USGS Seismic Hazard Map for Marana Regional Landfill 32.4150 N, 111.2772 W
Calculated Peak Acceleration = 11.231 %g



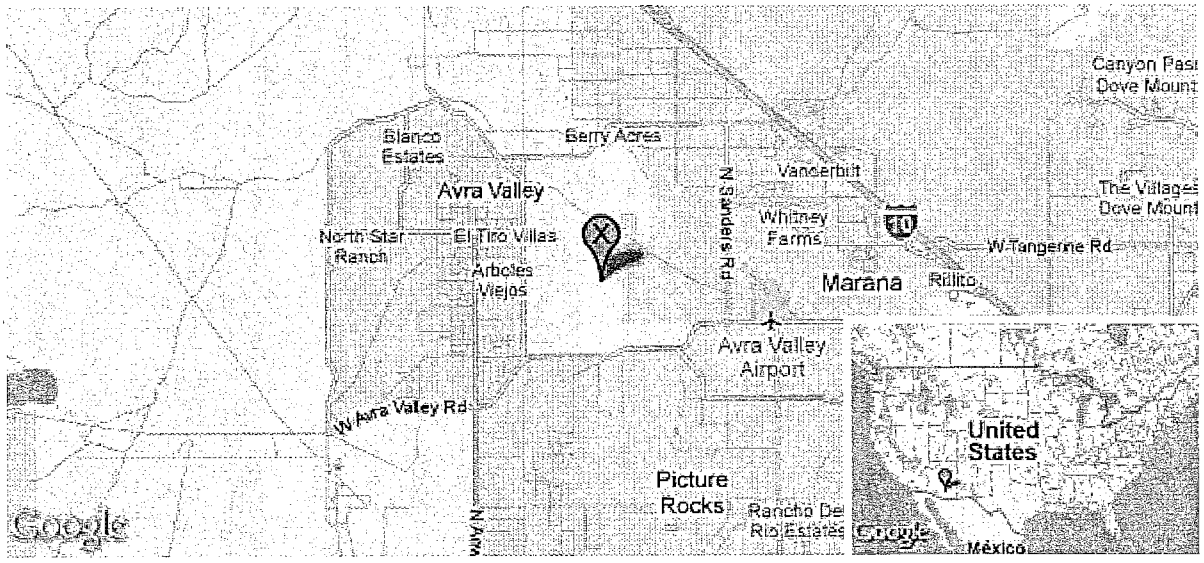
USGS "DesignMaps" Summary Report

User-Specified Input

Building Code Reference Document 2009 NEHRP Recommended Seismic Provisions
(which makes use of 2008 USGS seismic hazard data)

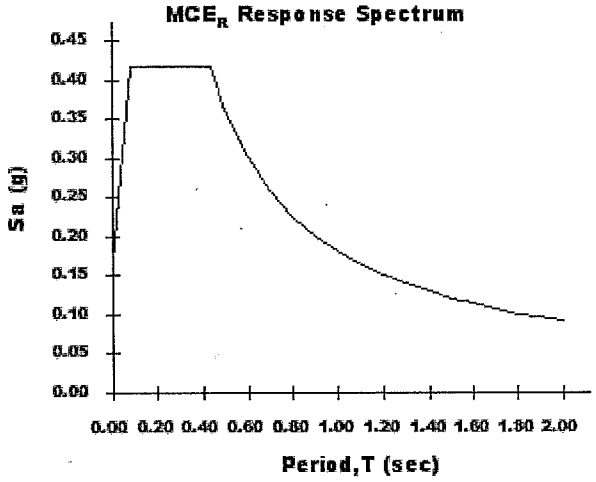
Site Coordinates 32.415°N, 111.2772°W

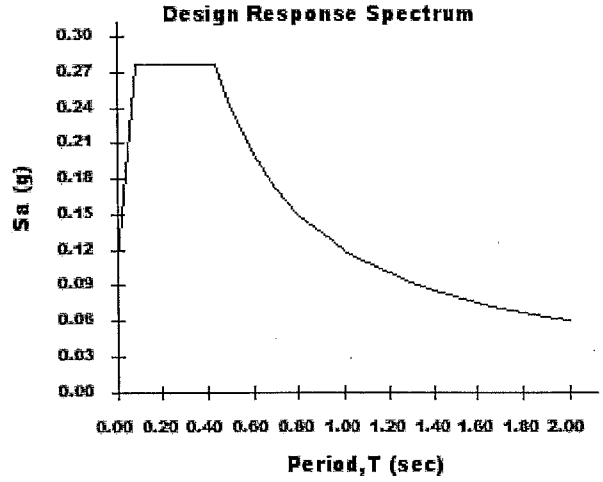
Site Soil Classification Site Class D – "Stiff Soil"



USGS-Provided Output

S_S =	0.26 *(g)*	S_{MS} =	0.42 *(g)*	S_{DS} =	0.28 *(g)*
S_1 =	0.08 *(g)*	S_{M1} =	0.18 *(g)*	S_{D1} =	0.12 *(g)*





For PGA$_M$ and T_L values, please view the detailed report.

Although this information is a product of the U.S. Geological Survey, we provide no warranty, expressed or implied, as to the accuracy of the data contained therein. This tool is not a substitute for technical subject-matter knowledge.

USGS "DesignMaps" Detailed Report

2009 NEHRP Recommended Seismic Provisions (32.415°N, 111.2772°W)

Section 11.4.1 — Mapped Acceleration Parameters and Risk Coefficients

Figure 22-1: Uniform-Hazard (2% in 50-Year) Ground Motions of 0.2-Second Spectral Response Acceleration (5% of Critical Damping), Site Class B

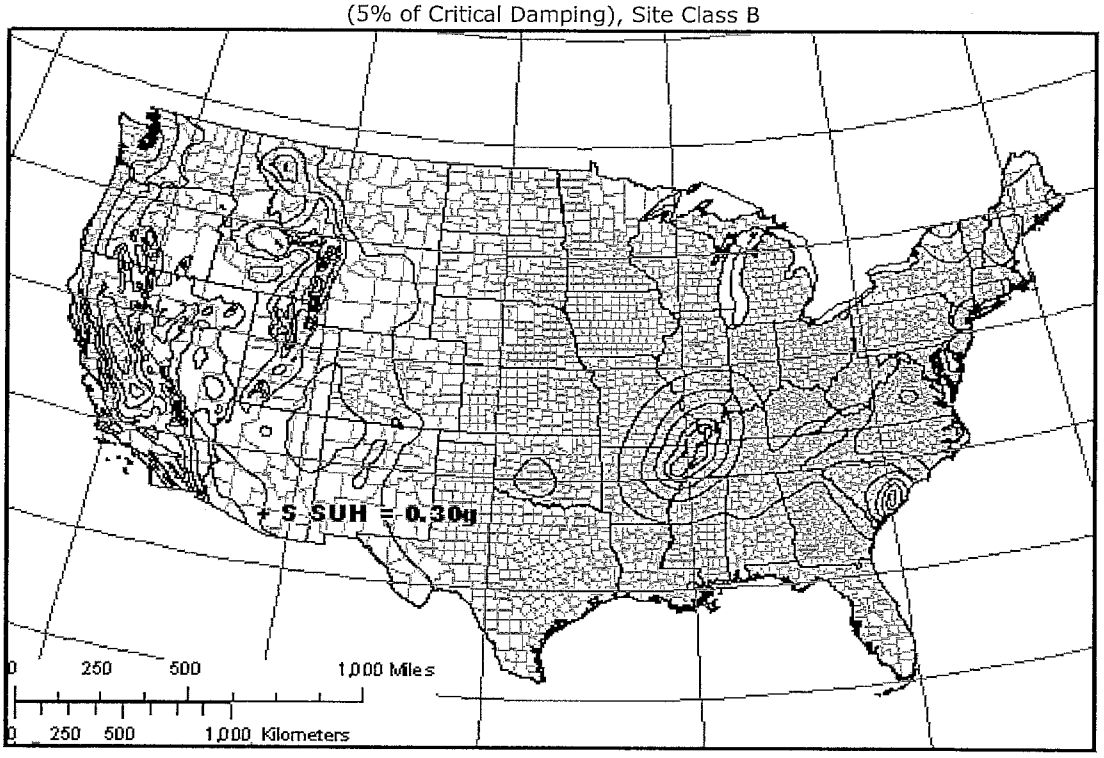


Figure 22-2: Uniform-Hazard (2% in 50-Year) Ground Motions of 1.0-Second Spectral Response Acceleration (5% of Critical Damping), Site Class B

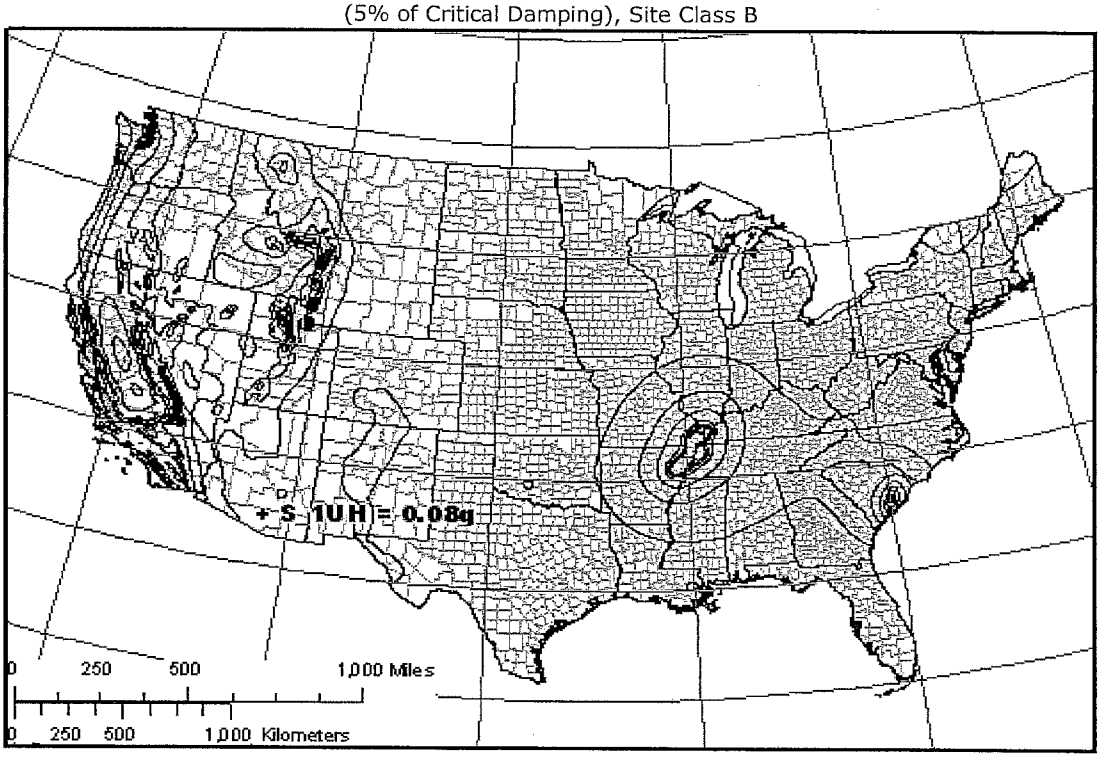


Figure 22-3: Risk Coefficient at 0.2-Second Spectral Response Period

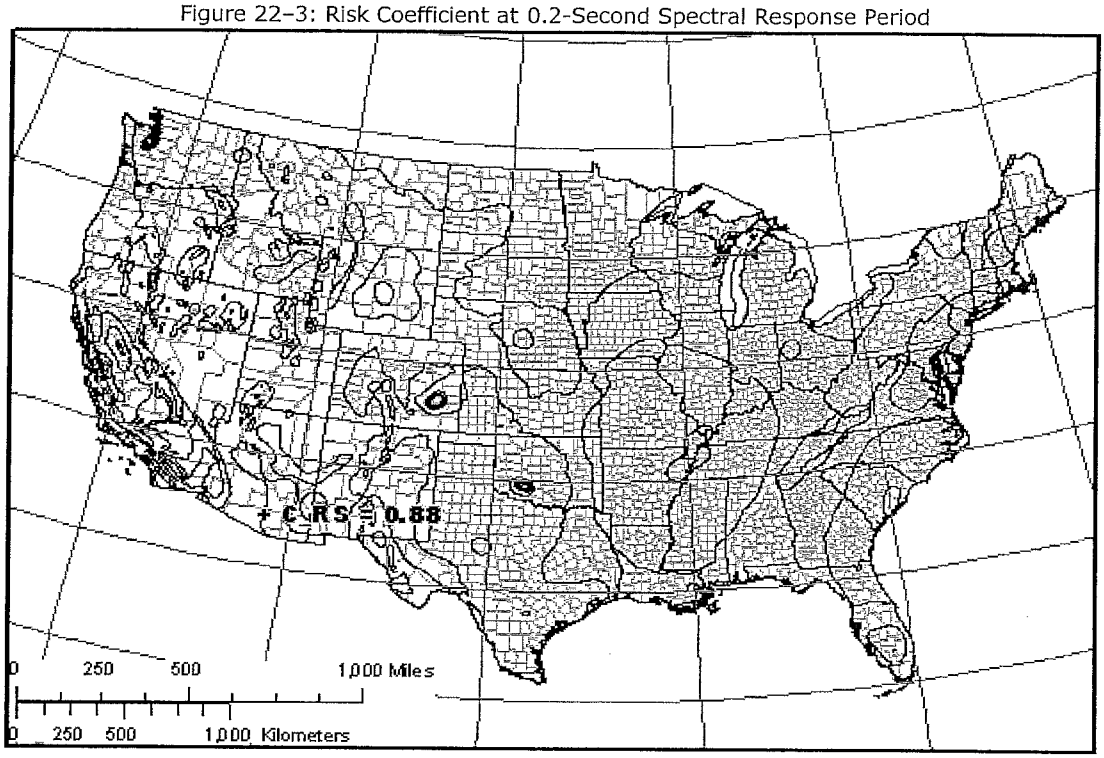


Figure 22-4: Risk Coefficient at 1.0-Second Spectral Response Period

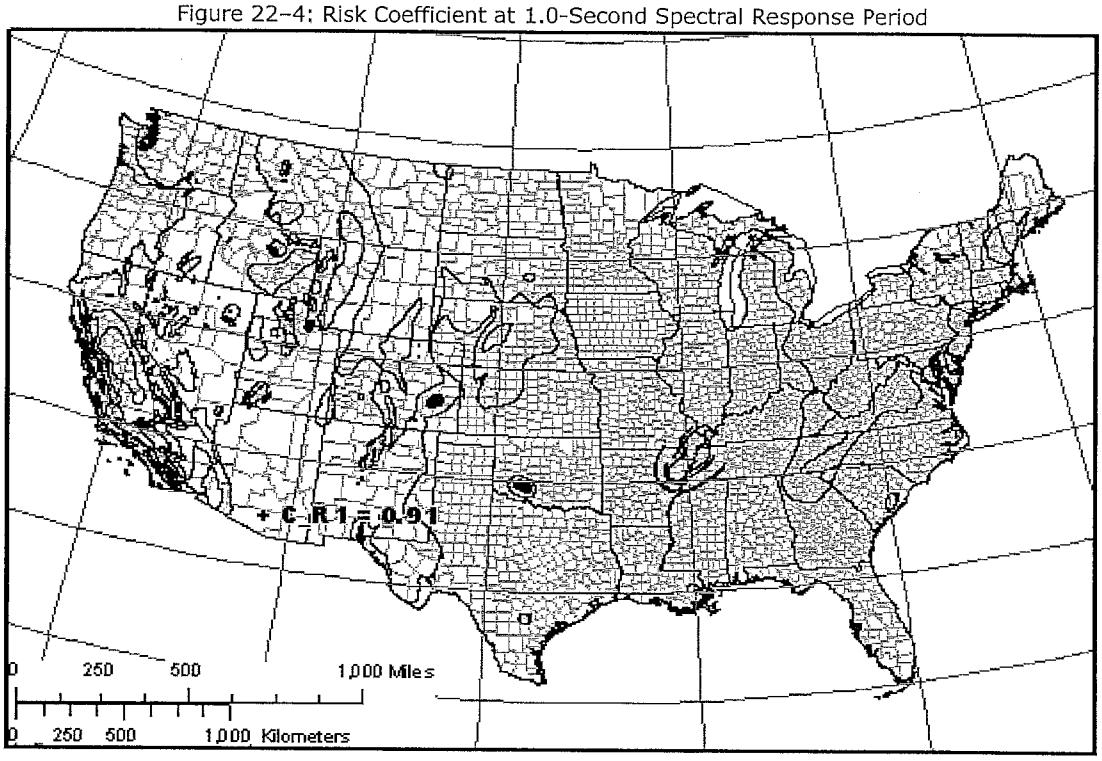


Figure 22-5: Deterministic Ground Motions of 0.2-Second Spectral Response Acceleration (5% of Critical Damping), Site Class B

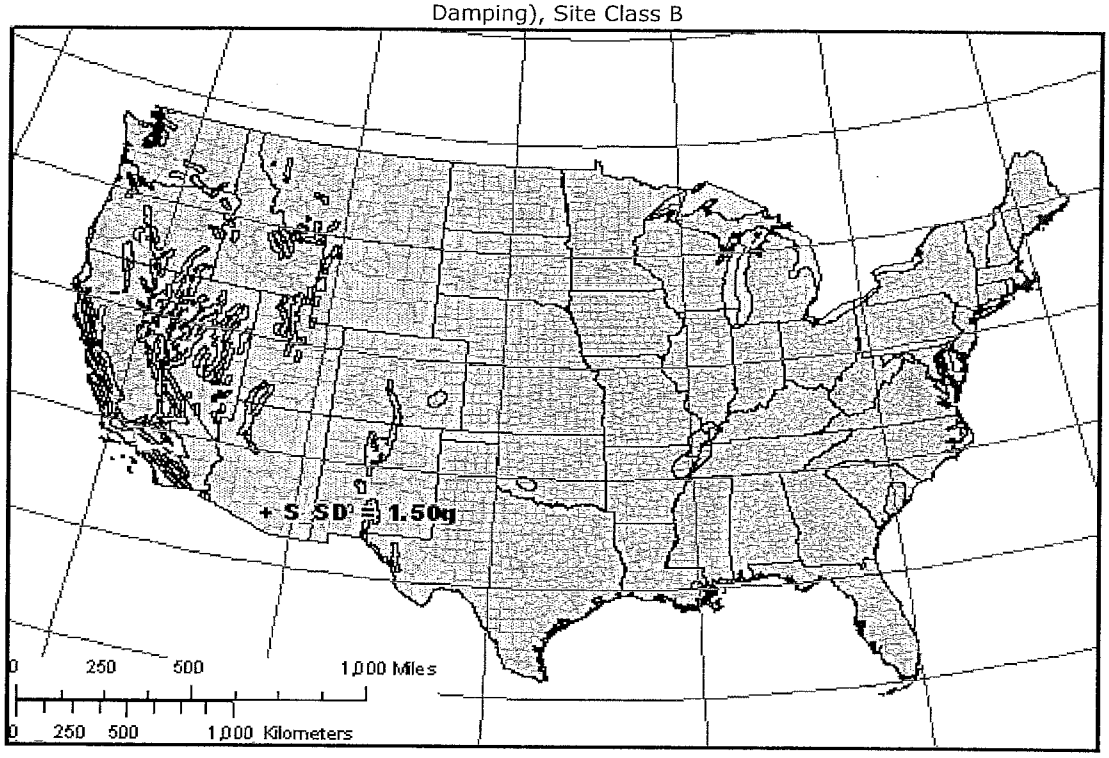
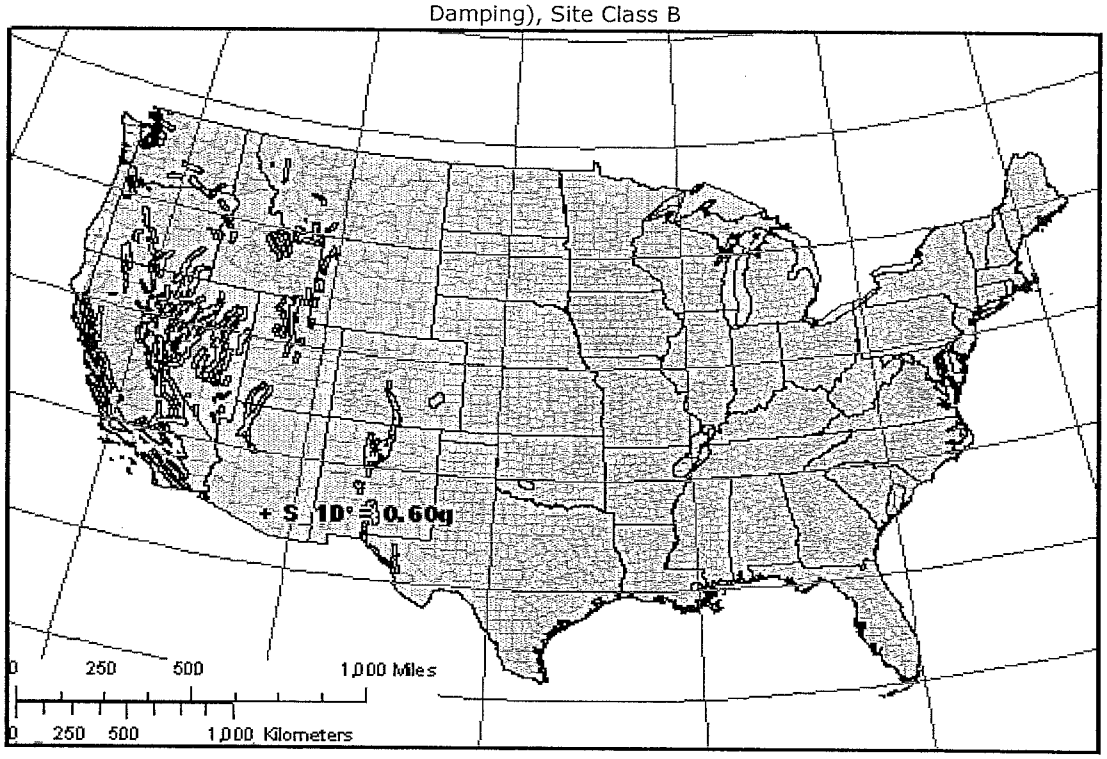


Figure 22-6: Deterministic Ground Motions of 1.0-Second Spectral Response Acceleration (5% of Critical Damping), Site Class B



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 ≥ 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, Risk Coefficients and Risk–Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameters

Equation (11.4–1): $C_{RS}S_{SUH} = 0.88 \times 0.30 = 0.26$ g

Equation (11.4–2): $S_{SD} = 1.50$ g

$S_S \equiv$ "Lesser of values from Equations (11.4–1) and (11.4–2)" = 0.26 g

Equation (11.4–3): $C_{R1}S_{1UH} = 0.91 \times 0.08 = 0.08$ g

Equation (11.4–4): $S_{1D} = 0.60$ g

$S_1 \equiv$ "Lesser of values from Equations (11.4–3) and (11.4–4)" = 0.08 g

Table 11.4-1: Site Coefficient F_a

Site Class	Spectral Response Acceleration Parameter at Short Period				
	$S_S \leq 0.25$	$S_S = 0.5$	$S_S = 0.75$	$S_S = 1$	$S_S \geq 1.25$
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				

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

For Site Class = D and S_s = 0.26, F_a = 1.59

Table 11.4-2: Site Coefficient F_v

Site Class	Spectral Response Acceleration Parameter at 1-Second Period				
	$S_1 \leq 0.1$	$S_1 = 0.2$	$S_1 = 0.3$	$S_1 = 0.4$	$S_1 \geq 0.5$
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				

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

For Site Class = D and S_1 = 0.08, F_v = 2.40

Equation (11.4–5): $S_{MS} = F_a S_S = 1.59 \times 0.26 = 0.42$ g

Equation (11.4–6): $S_{M1} = F_v S_1 = 2.40 \times 0.08 = 0.18$ g

Section 11.4.4 — Design Spectral Acceleration Parameters

Equation (11.4–7): $S_{DS} = \frac{2}{3} S_{MS} = \frac{2}{3} \times 0.42 = 0.28$ g

Equation (11.4–8): $S_{D1} = \frac{2}{3} S_{M1} = \frac{2}{3} \times 0.18 = 0.12$ g

Section 11.4.5 — Design Response Spectrum

Figure 22–7: Long–period Transion Period, T_L (s)

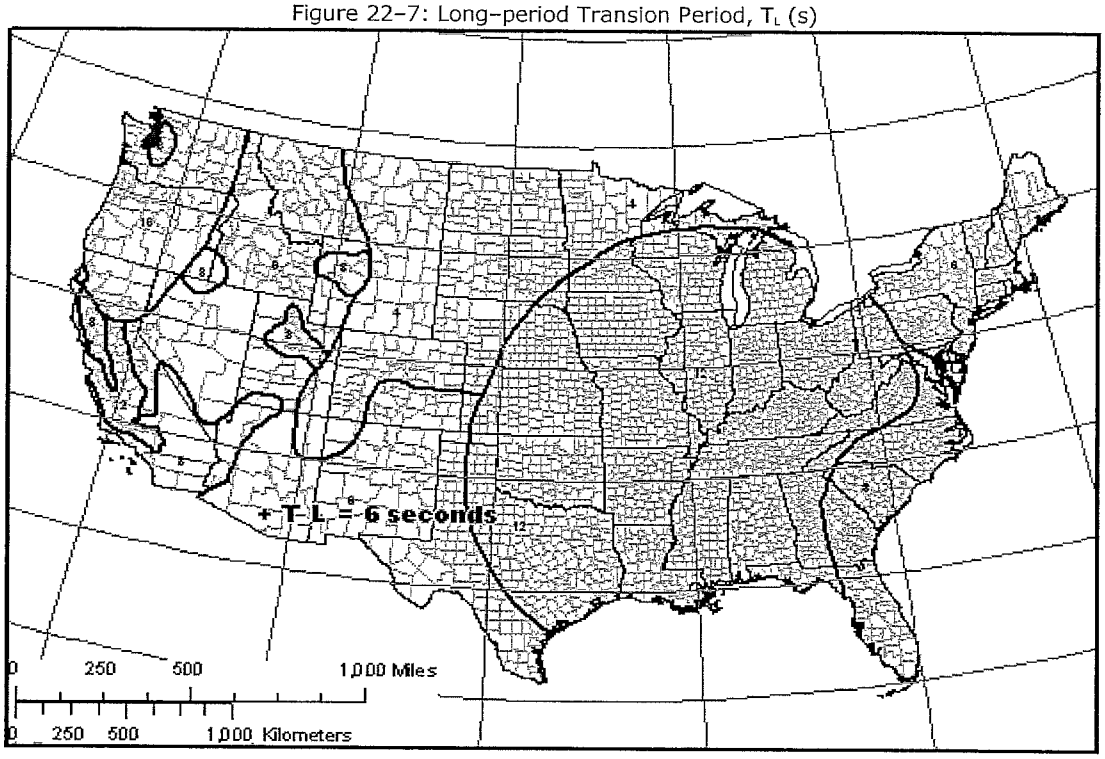
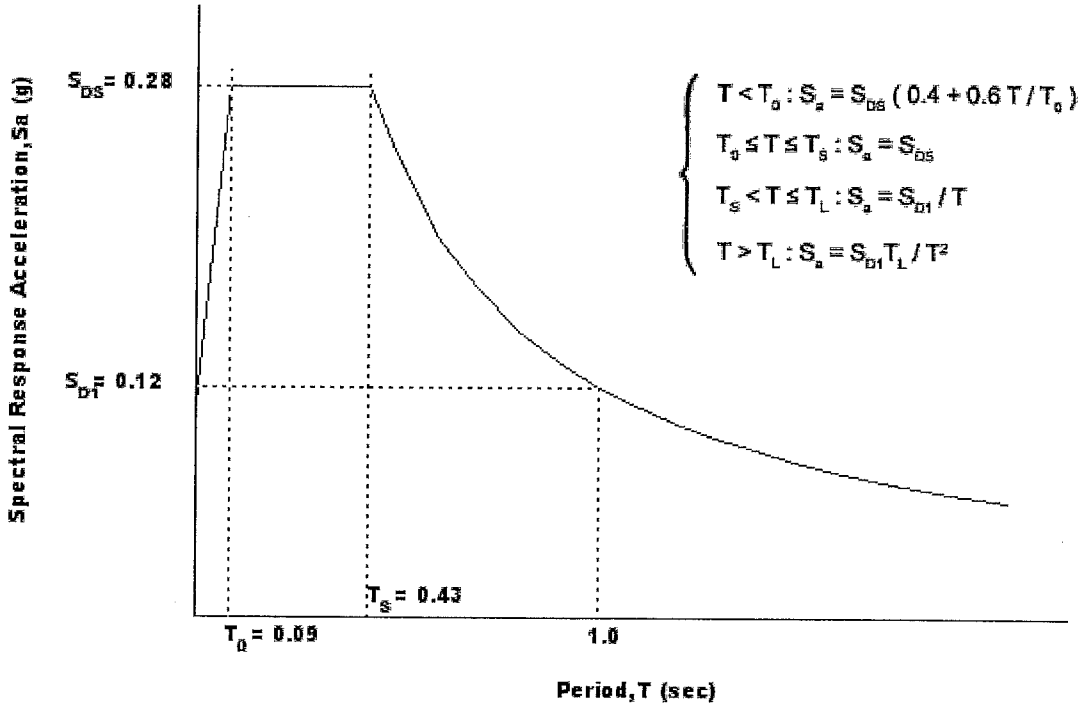
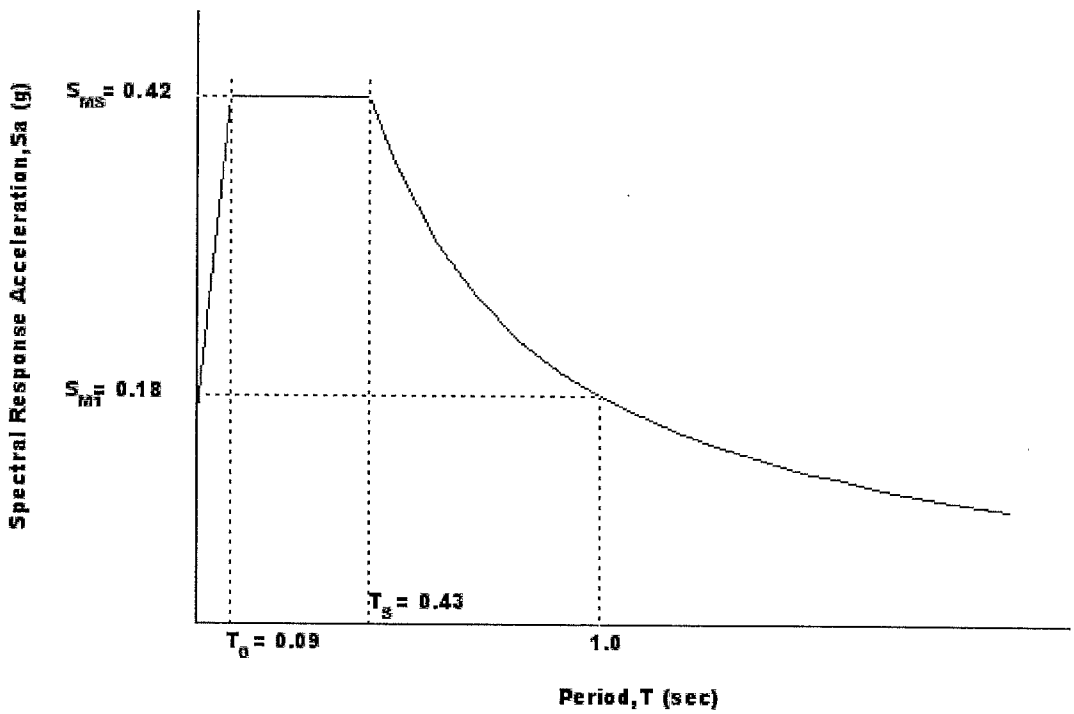


Figure 11.4-1: Design Response Spectrum



Section 11.4.6 — MCE_R Response Spectrum

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



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

Mapped PGA

PGA = 0.11 g

Equation (11.8–1): $PGA_M = F_{PGA}PGA = 1.58 \times 0.11 = 0.18$ g

Table 11.8–1: Site Coefficient F_{PGA}

Site Class	Mapped MCE Geometric Mean Peak Ground Acceleration, PGA				
	PGA ≤ 0.1	PGA = 0.2	PGA = 0.3	PGA = 0.4	PGA ≥ 0.5
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				

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

For Site Class = D and PGA = 0.11, F_{PGA} = 1.58