

README_Boise_Area_NEHRP_Site_Class_Map.pdf

NEHRP Site Class Map for the Boise Metro Area, Idaho

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Version 5.2013.2: A new text field “ClassExp” has been added to Attribute Tables for BoiseMetroAreaLiquefaction.shp and BoiseMetroAreaLiquefaction_and_Geology.shp. The field contains the same explanatory data for the Class field as is shown on the PDF map images. Metadata for the files has also been updated.

Version 7.2011.1
Idaho Geological Survey Digital Database 5

WHAT ARE NEHRP SITE CLASSES?

The intensity of ground shaking during an earthquake varies according to the nature of near-surface materials. For example, shaking intensity is generally greater in areas underlain by unconsolidated materials than in those underlain by firm bedrock. Engineers and architects incorporate these local site conditions into their designs to reduce damage from earthquakes. In 1997, the National Earthquake Hazards Reduction Program (NEHRP) established procedures for placing building sites into classes based upon the geotechnical properties of near-surface materials (Table 1; Building Seismic Safety Council, 1997). For each NEHRP site class, coefficients adjust expected earthquake motions for local ground conditions. Earthquake ground motion parameters are produced by the U.S. Geological Survey for all parts of the United States and are available as national seismic hazard maps (<http://earthquake.usgs.gov/hazards/products/>). NEHRP site classes are not shown on the national seismic hazard maps because local conditions are frequently too variable to accurately depict at the hazard map scale, and/or because the required geotechnical information is unavailable. Both NEHRP site classes and USGS national seismic hazard maps are incorporated into the International Building Code (e.g. IBC, 2012, p. 366-376).

HOW THIS MAP WAS PRODUCED

Site Classification Methods

The most recent procedures for determining NEHRP site classes are described in Chapter 20 of ASCE/SEI standard 7-10 (ASCE/SEI, 2010, p. 203-205). Site classes (A-F) are determined in engineering studies with geotechnical properties of earth materials within 100 feet (30 m) of the ground surface. Geotechnical properties (Table 1) include average shear wave velocity (V_{s30}), average standard penetration resistance (N_{av}) and average undrained shear strength (s_u). These geotechnical properties are defined and methods of measurement described in Liu and Evett (2008). The ASCE/SEI 7-10 procedures cannot be followed strictly in regional screening studies such as this one because of the lack of geotechnical data for the entire project area. Instead, geologic mapping and soil surveys are used along with available geotechnical data to estimate site classes. This approach has been used to produce regional NEHRP site class maps in a number of areas in the western United States (e.g. Palmer and others, 2004; Wills and others, 2000).

Source of Geologic Mapping and Soil Surveys

This NEHRP site class map was produced in the area geologically mapped by Othberg and Stanford (1992). This map was chosen because it contains all major cities and towns of the Boise

region, and because it is the most complete geologic mapping available at a scale (1:100,000) sufficient for estimating site classes with good precision. County soil surveys for the project area are by Collett (1980), Priest and others (1972), Harkness (1998), Rasmussen (1976), and Troeh and others (1965).

Site Classes A, B, and BC

Shear wave velocity measurements in bedrock are required to classify bedrock (Sections 20.3.4 and 20.3.5, ASCE/SEI 7-10). No such measurements were found for bedrock within the project area. Classification is based on unit descriptions from the geologic map, field observations of bedrock exposures, and correlation with units from similar geologic settings. Class A (hard rock) units are probably not present in the project area because of the high degree of fracturing and/or weathering commonly observed in bedrock. Therefore, Class A is not used on the map. Volcanic and plutonic bedrock geologic units (e.g. basalt, rhyolite, and granitic rocks) are assigned to Class B (rock), while tuff and volcanoclastic sediments were assigned to Site Class BC (rock--very dense soil-soft rock). These assignments are supported by velocity measurements in similar lithologies in the western United States (Wills and others, 2000; Palmer and others, 2004; Payne, 2006). Areas of Class B bedrock overlain by >10 ft (3 m) of soils, loess, gravels, or other surficial units are classified as Class BC as per section 20.1, ASCE/SEI 7-10. Where available, water well logs (IDWR, 2010) were used together with geologic map unit descriptions to estimate the thickness of surficial materials over bedrock units.

Site Classes C, D, E

Tertiary sediments and Quaternary deposits were assigned to classes C, D, or E based on geotechnical data compiled from foundation studies in the project area, or by correlation with similar deposits with geotechnical information. Making new geotechnical measurements was beyond the scope of this project. Data sources include the Idaho Transportation Department (ITD, 2011), Ada County Highway District (ACHD, 2011), and the City of Boise (COB, 2011). Only N data are widely available in the study area. Therefore, classification is largely based on N_{av} values. These data are supplemented in a few areas by V_{s30} data and estimates made by registered professional engineers during the course of foundation studies. Data were compiled for 52 sites in the project area. These data permit mean N values to be estimated for the sedimentary units of Tertiary and Quaternary age. The location of the borehole sites are shown on the NERHP site class map and given in Table 3.

The borehole logs used for classification typically consist of multiple lithologic layers, each with one or more measured N values. An arithmetic mean was computed for layers with multiple N values. Refusals were assigned $N=100$. Partial advancements (defined in section 7.2 of ASTM, 2008) were assigned $N=75$. For units penetrated by boreholes with depths of ~100 ft (~30 m), site classes were assigned with Equation 20.4-2 and Table 20.3-1 of ASCE/SEI (2010, p. 204). An example showing this classification procedure is given in Charney (2010, p. 11-18),

For shallow boreholes <100 ft (<30 m), an additional layer was added to the base of the hole so that total depth is 100 ft (30 m). The added layer is assigned a lithology based upon neighboring water well logs and other geologic data. An N value for the layer is assigned from the mean N for the

lithology calculated for the project area. Classification then proceeds using Equation 20.4-2 and Table 20.3-1 of ASCE/SEI (2010, p. 204).

Suitable geotechnical information is not available for all regions and map units within the project area. In these cases, classification is based upon correlation with similar deposits.

Soft Clay Site Class E

Section 20.3.2 of SCE/SEI 7-10 assigns soft clays >10 ft (>3 m) thick to Class E. County soil maps and the geologic map were examined for areas containing materials similar to those described in the section. No soils or geologic units with these properties were located in the project area.

Class F

Section 20.3.1 of ASCE/SEI 7-10 assigns some peats, highly organic clays, and thick clays with very high plasticity to Class F. County soil maps and the geologic map were examined for areas containing materials similar to described in the section. No soils or geologic units with properties similar to the requirements of section 20.3.1 were found in the project area. Therefore, Class F is not used on the map.

LIMITATIONS ON THE USE OF THIS MAP

This map is based largely on correlation of geotechnical properties between widely separated localities. Site-specific geotechnical investigations are required to determine actual ground conditions for specific building sites. This map is intended to be used at a scale of 1:100,000. As with all maps, users should not apply this map, either digitally or on paper, at more detailed scales.

SPREADSHEETS, DIGITAL IMAGE FILES, AND ARCGIS FILES

NEHRP site classes for each geologic unit in the study area are listed in Table 2. This information is also provided as a digital spreadsheet together with a PDF version of the NEHRP site class map, spreadsheet of borehole information, digital copies of the foundation reports, and ArcGIS files. All of these files are available for free download at the Idaho Geological Survey website, www.idahogeology.org.

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ACKNOWLEDGMENTS

Funded under Task Order 001-FY-2010 from the Idaho Bureau of Homeland Security and by the Idaho Geological Survey. We thank Matt Farrar (Idaho Transportation Department), Rob Bousfield (City of Boise), and Ruth Miller and Darrin Carroll (Ada County Highway District) for their assistance obtaining geotechnical data. Collette Gantenbein and Loudon Stanford assisted with digital cartography and GIS.

PLATE

Plate 1: NEHRP Site Class Map for the Boise Metro Area, Idaho, scale 1:100,000.

TABLES

Table 1. NEHRP Site Classes (after ASCE/SEI, 2010, p. 205).

Table 2. NEHRP site classes for geologic units.

Table 3. Borehole and foundation study sites.

DIGITAL FILES

Table2_NEHRP_site_classes_for_geologic_units.xlsx
Site classes assigned for each geologic unit

Table3_Borehole_and_foundation_study_sites.xlsx
Borehole and other foundation study locations and site classes.

ACHD_Reports (folder of pdf files)
Scanned foundation studies showing borehole logs and associated geotechnical provided by ACHD.

COB_Reports (folder of pdf files)
Scanned foundation reports showing borehole logs and associated geotechnical data provided by the City of Boise.

ITD_Scans (folder with one pdf file)
Bridge foundation plan drawings from ITD listed by site ID

Table 1. NEHRP Site Classification (after ASCE/SEI, 2010, p. 205).

Site Class	V _{s30}	N _{av}	S _u
A. Hard Rock	>5000 ft/s	NA	NA
B. Rock	2500-5000 ft/s	NA	NA
C. Very dense soil and soft rock	1200-2500 ft/s	>50	>2000 psf
D. Stiff Soil	600-1200 ft/s	15-50	1000-2000 psf
E. Soft Soil	<600 ft/s	<15	<1000 psf
F. Soils susceptible to potential failure under seismic loading, such as liquefiable soils or sensitive clays, peats, or organic lays thicker than 10 ft; thick sections of clays	See Section 20.3.1 of ASCE/SEI 7-10.		

Table 2. NEHRP site classes for geologic units.

Unit	Name	CLASS	Notes
Qa	Alluvium of Boise and Snake River	D	C and E in some boreholes
Ql	Landslide deposits	D	no data; default to class D
Qt	Talus	D	no data; default to class D
Qfg	Alluvial fan gravel	D	no data; default to class D
Qas	Sandy alluvium of side-stream valleys and gulches	E	D in some boreholes
Qfs	Sand of incised alluvial fans	D	no data; default to class D
Qds	Sand of Dry Creek terrace	C	class correlated with Qbg
Qfrg	Gravel of alluvial-fan remnants	C	class correlated with Qgd, etc.
Qbgc	Clay of Bonneville flood slack water	D	C in some boreholes
Qs	Sandy silt of Bonneville flood slack water overlying Tertiary Sediments	D	class correlated with Qwig
Qbfg	Gravel of the Bonneville flood-scoured Boise terrace and Boise floodplain complex	C	class correlated with Qwg, etc.
Qwgs	Sandy silt of Bonneville flood slack water	D	class correlated with Qwig
Qwfg	Gravel of the Bonneville flood-scoured Whitney Terrace	C	class correlated with Qwg, etc.
Qwig	Sandy silt of Bonneville flood slack water	D	borehole data
Qbg	Gravel of the Boise terrace	C	D in some boreholes
Qg	Gravel of Boise Front terraces, undivided	C	class correlated with Qgb
Qwg	Gravel of Whitney terrace	C	borehole data
Qsg	Gravel of Sunrise terrace	C	borehole data
Qgg	Gravel of Gowen terrace	C	class correlated with Qwg, etc.
Qag	Gravel of Amity terrace	C	class correlated with Qwg, etc.
Qdg	Gravel of Deer Flat terrace	C	class correlated with Qwg, etc.
Qpdg	Gravel of Deer Flat and pre-Deer Flat terraces, undivided	C	class correlated with Qwg, etc.
QTtg	Tenmile Gravel	C	class correlated with Qwg, etc.
Tps	Sand of the Pierce Gulch Formation	C	D in some locations: locally lacks cohesion
Tgf	Glenns Ferry Formation	C	D in some boreholes
Tbg	Gravel of Bonneville Point	C	class correlated with Qwg, etc.
Tf	Alluvial fan deposit	C	class correlated with Qwg, etc.
Ts	Sand and mudstone of stream and lake sediments	C	class correlated with Tgf
Qmb	Basalt of Mores Creek	B	bedrock
Qgb	Basalt of Gowen Terrace	B	bedrock
Qlp	Basalt of Lucky Peak	B	bedrock
Qkb	Basalt of Kuna Butte	B	bedrock
Qfb	Basalt of Fivemile Creek	B	bedrock
Qib	Basalt flows of Indian Creek, undivided	BC	bedrock buried by more than 10 ft surficial deposits

Qibs	Basalt flows of Indian Creek buried by loess and stream sediments	BC	bedrock buried by more than 10 ft surficial deposits
Qudb	Basalt flows of Upper Deer Flat, undivided	BC	bedrock buried by more than 10 ft surficial deposits
Qb	Basaltic vents, undivided	B	bedrock
Tpb	Basalt of Picket Pin Canyon	B	bedrock
Tbt	Tuff and volcanoclastic sediments	BC	class correlated with other units in western US
Tbv	Basalt volcanic assemblage	BC	class correlated with other units in western US
Tba	Basalt and andesite of Graveyard Point area	B	bedrock
Tr	Rhyolite of the Boise Front	B	bedrock
Tjc	Jump Creek Rhyolite	B	bedrock
Th	Hornblende-biotite rhyolite	B	bedrock
g	Granitic rocks of the Idaho Batholith	B	bedrock

Table 3. Borehole and foundation study sites.

ID	SOURCE	FEATURES	NAME	LAT	LONG	CLASS	TYPE	N_VALUE
1	ITD	BOISE RIVER	IN BOISE;BOISE CONNECTOR	43.61833	-116.22889	C	SPT_N	54
2	ITD	SMA 9083;27TH STREET	IN BOISE;BOISE CONNECTOR	43.61889	-116.22389	C	SPT_N	72
3	ITD	UPRR;NEW YORK CANAL	1 S. BOISE;BROADWAY AVE	43.56889	-116.19500	C	SPT_N_A	65
4	ITD	AMERICANA BLVD;15TH ST.	IN BOISE; FRONT STREET	43.61889	-116.21472	C	SPT_N_A	71
5	ITD	WILSON DRAIN	BETWEEN NAMPA & CALDWELL	43.64361	-116.65972	E	SPT_N_A	8
6	ITD	BIKE & PEDESTRIAN UP	IN BOISE	43.66056	-116.28000	D	SPT_N_A	58
7	ITD	BOISE RIVER; GLENWOOD BR	IN BOISE	43.66083	-116.27944	D	SPT_N_A	20
8	ITD	DRY CREEK	EAGLE BYPASS	43.69194	-116.36944	D	SPT_N_A	21
9	ITD	LOW LINE CANAL	3.5 N. MARSING	43.59444	-116.79222	D	SPT_N_A	42
10	ITD	HIGH LINE CANAL	4.5 N. MARSING	43.60306	-116.78417	D	SPT_N_A	30
11	ITD	LOW LINE CANAL	5.5 N. MARSING	43.60333	-116.76306	D	SPT_N_A	38
12	ITD	NORTH CANAL	7 N. MARSING	43.60333	-116.73417	D	SPT_N_A	34
13	ITD	BURRIS LATERAL CANAL	6.0 W. NAMPA;US 30	43.60361	-116.72250	C	SPT_N_A	53
14	ITD	DEER FLAT CANAL	3.5 W. NAMPA	43.60444	-116.67389	D	SPT_N_A	42
15	ITD	WILSON DRAIN	2 W. NAMPA	43.60472	-116.64444	D	SPT_N_A	34
16	ITD	ELIJAH DRAIN	1.6 W. NAMPA	43.60500	-116.61667	D	SPT_N_A	26
17	ITD	UPRR	IN NAMPA	43.60750	-116.59972	D	SPT_N	19
18	ITD	INDIAN CREEK	IN NAMPA	43.60861	-116.59778	D	SPT_N	16
19	ITD	INDIAN CREEK	IN NAMPA	43.60861	-116.59750	D	SPT_N	17
20	ITD	I 84;KARCHER IC	IN NAMPA	43.61000	-116.59639	E	SPT_N	15
21	ITD	DRY CREEK CANAL FARMERS UNION CANAL	SH 44/SH 55 INTERSECTION 1.2 N. OF SH 44	43.68472	-116.31972	D	SPT_N_A	36
22	ITD	DRY CREEK CANAL FARMERS UNION CANAL	SH 44/SH 55 INTERSECTION 1.2 N. OF SH 44	43.70083	-116.31889	D	SPT_N_A	33

23	ITD	DRY CREEK	8.1 NW BOISE WCL	43.73250	-116.30389	D	SPT_N_A	17
24	ITD	NORTH SLOUGH	5.4 NE MERIDIAN	43.64333	-116.35333	C	SPT_N_A	53
25	ITD	BOISE RIVER; S.CHANNEL	1.4 S. EAGLE	43.67500	-116.35417	D	SPT_N_A	27
26	ITD	BOISE RIVER; N.CHANNEL	0.7 S. EAGLE	43.68583	-116.35361	D	SPT_N_A	29
27	ITD	FARMERS SEBREE CANAL	IN CALDWELL	43.68528	-116.69083	D	SPT_N_A	35
28	ITD	BOISE RIVER; CALDWELL BR.	IN CALDWELL	43.68139	-116.68972	D	SPT_N_A	24
29	ITD	STP 7773;10TH AVE IC	IN CALDWELL;10TH AVE	43.67083	-116.67833	D	SPT_N_A	29
30	ITD	BOISE RIVER; RAMP DA BR	IN CALDWELL	43.68167	-116.68889	D	SPT_N_A	15
31	ITD	BOISE RIVER; RAMP AB BR	IN CALDWELL	43.68111	-116.69056	D	SPT_N_A	25
32	ITD	I 84 EB-WB;EAGLE RD IC	1.7 E. MERIDIAN	43.59611	-116.35472	C	SPT_N_A	54
33	ITD	SNAKE RIVER; HOMEDALE BR.	At HOMEDALE ECL	43.61944	-116.92222	C	SPT_N_A	55
34	ITD	BOISE RIVER NOTUS BRIDGE	0.2 S NOTUS	43.72083	-116.79806	C	SPT_N_A	60
35	ITD	BOISE RIVER	1.2 S. 0.3 W. PARMA	43.77000	-116.95194	D	SPT_N_A	30
36	ACHD	9th St Bridge 422	9th St	43.60926	-116.20825	C	SPT_N_A	51
37	ACHD	Star Road Bridge Over Boise River 072	Star Rd	43.68032	-116.49263	C	SPT_N_A	51
38	ACHD	Fairview 18AA GeoTech Report	Fairview Ave	43.61962	-116.22808	C	SPT_N	63
39	ACHD	Linder Bridges 80- 81-82	Linder Rd N Channel	43.68849	-116.41269	C	SPT_N_A	52
40	ACHD	Linder Bridges 80- 81-82	Linder Rd Middle Channel	43.67382	-116.41249	D	SPT_N_A	43
41	ACHD	Linder Bridges 80- 81-82	Linder Rd S Channel	43.67270	-116.41243	C	SPT_N_A	53
42	ACHD	West Parcenter 368	West Parkcenter	43.60010	-116.18858	D	SPT_N_A	49
43	ACHD	East Parkcenter_2 Boise River Bridge	East Parkcenter	43.57600	-116.15100	C	SPT_N	55

44	COB	Idaho and 6th St	Boise City Hall	43.61528	-116.20083	C	Vs30	1418
45	COB	401 W Front St	401 Front St Geo Tech Report	43.61167	-116.20150	C	SPT_N_A	60
46	COB	11405 W Fairview	Pawn I Building	43.61904	-116.32484	D	Expert	
47	COB	S 12 St and River St	Mercy Housing	43.61410	-116.21294	C	Expert	
48	COB	501 Front St	Concordia University Law School	43.61186	-116.20235	D	Expert	
49	COB	Jefferson - 12 St	Boise Plaza Parking Garage	43.62032	-116.20677	C	SPT_N_A	57
50	COB	South Parkcenter	Pilot Place Subdivision	43.58536	-116.17396	D	Expert	
51	COB	801 Parkcenter	Gold's Gym	43.58399	-116.17400	D	Expert	
52	COB	S 18 St at S 23 St	Terry Reilly Medical Clinic	43.61968	-116.21752	D	Expert	