README_Boise_Area_Liquefaction_Susceptibility_Map.pdf

Liquefaction Susceptibility 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 mapimages.
Metadata for the files has also been updated.

version 7.2011.1
Idaho Geological Survey Digital Database 5

WHAT IS LIQUEFACTION?

Liquefaction occurs during strong earthquake ground shaking when saturated, cohesionless earth materials lose strength due to high excess pore-water pressure. The consequences of liquefaction can be catastrophic, including destruction of roads, railways, bridge abutments, canals, sewer and water lines, and building foundations. Liquefaction susceptibility is highest in artificial fills and loose, sandy deposits that are saturated with water. Such deposits may occur even in a semi-arid region like southwestern Idaho. Irrigation can increase liquefaction susceptibility by saturating deposits.

HOW THESE MAPS WERE PRODUCED

These maps were produced using a combination of: 1) a standard methodology that relates deposit age, texture (grain size and sorting), and environment of deposition to liquefaction susceptibility; and, 2) depth to the local water table.

Age-Texture-Environment (ATE) Classification

Liquefaction susceptibility is related to deposit age, texture, and environment of deposition (Federal Emergency Management Administration, 2009, Table 4-10, p. 4-22; Youd and Perkins, 1978). A classification process similar to that employed in Washington State (Palmer and others, 2004) was used to relate these factors to deposits. Earth materials within about 100 ft (30 m) of the surface were classified using a 1:100,000-scale geologic map (Othberg and Stanford, 1992) of the Boise metro area. For each geologic map unit, a score between 0-5 was assigned for each classifying factor based upon unit descriptions (Table 1). Equal weighting was given to age, texture, and environment. The scores were summed to give an age-texture-environment (ATE) score (Table 2). Liquefaction cannot occur in bedrock, so these units were given a score of zero although they were classified as to age, texture, and environment.

Depth to Local Water Table

Since liquefaction occurs only in saturated earth materials, it is essential to determine areas subject to high water tables. Static water level data from over 1400 well logs were obtained from the Idaho Department of Water Resources (IDWR, 2010). These data were used with Kriging tools in Geostatistical Analyst of ESRI ArcMap to construct a model of average water table depths throughout the project area. Well locations in the database are known, at worst, to within the dimensions of ¼ of ¼ of a township section (about 40 acres). Only wells with total depths of <100 ft were used in order to avoid data influenced by confined aquifers. Since water tables in the Boise Valley area experience seasonal fluctuations on the order of 5-15 ft, high water tables are defined as static water levels of ≤15 ft below the ground surface. Irrigation practices, multi-year droughts or wet cycles, dam operation, and local pumping may also influence water table levels. These factors make it difficult to precisely estimate water table depths. Therefore, areas identified as subject to high water tables should be viewed as guidelines to focus further investigation of liquefaction susceptibility rather than definitive measures of the depth-to-water.

EXPLANATION OF LIQUEFACTION SUSCEPTIBILITY CLASSES

Class 5: Subject to at least annual saturation. Underlain by Holocene alluvium that likely contains some cohesionless sediments.

Class 4: Subject to at least annual saturation. Underlain by late Pleistocene Bonneville flood deposits that may contain cohesionless sediments in some areas.

Class 3: Subject to at least annual saturation. Underlain by materials that generally do not contain cohesionless sediments.

Class 2: Not subject to saturation under ordinary conditions. Underlain by materials that may contain cohesionless sediments. Liquefaction not expected except in exceptional circumstances where saturation occurs.

Class 1: Not subject to saturation under ordinary conditions. Underlain by materials that generally do not contain cohesionless sediments. Liquefaction not expected.

Class 0: Underlain by bedrock. Liquefaction will not occur even where saturated except in the case of undocumented cohesionless materials.

LIMITATIONS ON THE USE OF THESE MAPS

This map is a general guide to outlining areas with the potential for liquefaction. Because this map is based on regional geological and hydrological data, detailed 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.

REFERENCES CITED

Federal Emergency Management Agency, 2009, Multi-Hazard Loss Estimation Methodology Earthquake Model, HAZUS-MH MR4, Technical Manual (available at http://www.fema.gov/library/viewRecord.do?id=3731).

IDWR, 2010, Water well logs: Idaho Department of Water Resources, Boise. [Available at http://www.idwr.idaho.gov/GeographicInfo/GISdata/wells.htm]

Palmer, S.P. and others, 2004, Liquefaction susceptibility and site class maps of Washington State by county: Washington Department of Natural Resources, Division of Geology and Earth Resources Open File Report 2004-20 (available at ftp://198.187.344/geology/pubs/ofr04-20/).

Othberg, Kurt L. and Loudon R. Stanford, 1992, Geologic map of the Boise Valley and surrounding area, western Snake River Plain, Idaho: Idaho Geological Survey GM-18, 1 sheet, scale 1:100,000 [available at www.idahogeology.org).

Youd, T.L. and M. Perkins, 1978, Mapping liquefaction-induced ground failure potential: Journal of the Geotechnical Engineering Division-ASCE, v. 104(4), pp. 433-446.

ACKNOWLEDGMENTS

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PLATE

Plate 1. Liquefaction susceptibility map of the Boise metro area, scale 1:100,000.

TABLES

Table 1. Age-Texture-Environment (ATE) symbols for the Boise project area.
Table 2. Age-Texture-Environment scores for geologic units of the Boise project area.

DIGITAL FILES

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Table1_ATE_symbols.xlsx

Table2_ATE_scores_for_geologic_units_Boise_area.xlsx

TABLES

Table 1. Age-Texture-Environment (ATE) symbols for the Boise project area.

Age Classes and Symbols			
Symbol	Age	Description	Score
K	145-65.5 Ma	Cretaceous	0
T	65.5-2.6 Ma	Tertiary	1
HoP	2.6 Ma - 0 ka	Quaternary undivided (H + oP)	2
oP	2.6 Ma - 25 ka	older Pleistocene (early to start last glacial period)	2
yP	25 ka - 11 ka	younger Pleistocene (last glacial period)	3
HyP	0 - 25 ka	Holocene-younger Pleistocene	4
H	11 ka - 0 ka	Holocene	5

Texture (Grain Size) Classes and Symbols			
Symbol		Description	Score
c		coarse, predominantly gravel and sand	3
s		sandy, predominantly sand and silt	5
f		fine, predominantly silt and clay	2
u		unknown or texturally diverse	2
b		bedrock	0

Environment Classes and Symbols			
Symbol	Environment	Description	Score
asm	alluvial	side stream, meandering	5
asb	alluvial	side stream, braided	3
amb	allluvial	main stream, braided	3
amm	alluvial	main stream, meandering	5
af	alluvial	alluvial fan	3
mw	mass wasting	landslide deposits, undivided	1
mwt	mass wasting	talus	1
el	eolian	loess	2
l	lake	deposits of lakes and deltas	4
la	lake/alluvial	mixed deposits of lakes and streams	3
v	volcanic	basalt lava flows, rhyolite tuffs and flows	0
p	plutonic	intrusive igneous rocks, e.g. granite, dike rocks	0

Table 2. Age-Texture-Environment Scores for geologic units of the Boise project area.

Map Unit	Name	Age	A-score	Texture	T-score	Environment	E-score	ATE-score	Ref
g	Granitic rocks of the Idaho Batholith	K	0	b	0	p	0	0	1
Qa	Alluvium of Boise River and Snake River	H	5	s	5	amm	5	15	1,3
Qag	Gravel of Amity terrace	oP	2	c	3	amb	3	8	1
Qas	Sandy alluvium of side-stream valleys and gulches	HyP	4	s	5	asm	5	14	1,3
Qb	Basaltic vents, undivided	oP	2	b	0	v	0	0	1
Qbfg	Gravel of the Bonneville flood-scoured Boise terrace and Boise floodplain complex	yp	3	c	3	amb	3	9	1
Qbg	Gravel of the Boise terrace	yP	3	c	3	amb	3	9	1,3
Qbgc	Clay of Bonneville flood slack water	yP	3	f	2	l	4	9	1
Qdg	Gravel of Deer Flat terrace	oP	2	c	3	amb	3	8	1
Qds	Sand of Dry Creek terrace	oP	2	s	5	asb	3	10	1
Qfb	Basalt of Fivemile Creek	oP	2	b	0	v	0	0	1
Qfg	Alluvial fan gravel	HyP	4	c	3	af	3	10	1
Qfrg	Gravel of alluvial-fan remnants	oP	2	c	3	af	3	8	1
Qfs	Sand of incised alluvial fans	oP	2	s	5	af	3	10	1
Qg	Gravel of Boise Front terraces, undivided	oP	2	c	3	amb	3	8	1
Qgb	Basalt of Gowen Terrace	oP	2	b	0	v	0	0	1
Qgg	Gravel of Gowen terrace	oP	2	c	3	amb	3	8	1
Qib	Basalt flows of Indian Creek, undivided	oP	2	b	0	v	0	0	1
Qibs	Basalt flows of Indian Creek buried by loess and stream sediments	oP	2	f	2	asm	5	9	1
Qkb	Basalt of Kuna Butte	oP	2	b	0	v	0	0	1
Ql	Landslide deposits	HyP	4	c	3	mw	1	8	1
Qlp	Basalt of Lucky Peak	oP	2	b	0	v	0	0	1
Qmb	Basalt of Mores Creek	oP	2	b	0	v	0	0	1
Qpdg	Gravel of Deer Flat and pre-Deer Flat terraces, undivided	oP	2	c	3	amb	3	8	1
Qs	Sandy silt of Bonneville flood slack water overlying Tertiary Sediments	yP	3	s	5	l	4	12	1
Qsg	Gravel of Sunrise terrace	oP	2	c	3	amb	3	8	1,3
Qt	Talus	HyP	4	c	3	mw	1	8	1
QTtg	Tenmile Gravel	oP	2	c	3	amb	3	8	1,2

Qudb	Basalt flows of Upper Deer Flat, undivided	oP	2	b	0	v	0	0	1
Qwfg	Gravel of the Bonneville flood-scoured Whitney Terrace	oP	2	c	3	amb	3	8	1
Qwg	Gravel of Whitney terrace	oP	2	c	3	amb	3	8	1,3
Qwgs	Sandy silt of Bonneville flood slack water	yP	3	s	5	l	4	12	1
Qwig	Sandy silt of Bonneville flood slack water	yP	3	s	5	l	4	12	1
Tba	Basalt and andesite of Graveyard Point area	T	1	b	0	v	0	0	1
Tbg	Gravel of Bonneville Point	T	1	c	3	amb	3	7	1
Tbt	Tuff and volcaniclastic sediments	T	1	b	0	v	0	0	1
Tbv	Basalt volcanic assemblage	T	1	b	0	v	0	0	1
Tf	Alluvial fan deposit	T	1	c	3	af	3	7	1
Tgf	Glenns Ferry Formation	T	1	s	5	la	3	9	1,3
Th	Hornblende-biotite rhyolite	T	1	b	0	v	0	0	1
Tjc	Jump Creek Rhyolite	T	1	b	0	v	0	0	1
Tpb	Basalt of Picket Pin Canyon	T	1	b	0	v	0	0	1
Tps	Sand of the Pierce Gulch Formation	T	1	s	5	l	4	10	1,3
Tr	Rhyolite of the Boise Front	T	1	b	0	v	0	0	1
Ts	Sand and mudstone of stream and lake sediments	T	1	s	5	la	3	9	1

Reference	Citation
1	Othberg and Stanford (1992)
2	Othberg and Burhnam (1990)
3	Phillips, unpublished field observations