

FOR REFERENCE ONLY

March 22, 2016

ZCS Engineering, Inc.
Attention: Brandon Smith, P.E.
710 Cardley Avenue, Suite A
Medford, OR 97504

**SUBJECT: GEOTECHNICAL EVALUATION AND SITE-SPECIFIC SEISMIC STUDY,
BANDON HIGH SCHOOL, 550 NINTH STREET SW, BANDON, OREGON**

At your request, Applied Geotechnical Engineering and Geologic Consulting LLC (AGEGC) has conducted a geotechnical evaluation and site-specific seismic study for the existing Bandon High School in Bandon, Oregon. The Vicinity Map, Figure 1, shows the approximate location of the site. Our study included a review of available geotechnical and geologic information for the site and area, a ground-level reconnaissance of the site, subsurface explorations, and engineering analyses. This report summarizes our work and provides our conclusions and recommendations for the seismic evaluation of the existing high school.

SITE DESCRIPTION

A licensed geotechnical engineer/geologist from AGEGC completed a site visit in October 2015, to evaluate existing site conditions and seismic hazards. The site is flat to gently sloping. The site is currently developed with the high school building. The building is supported on spread footing foundations. Some cracks and apparent degradation was observed in the building's external foundations on the east side of the building.

PROJECT DESCRIPTION

We understand the existing high school is considered an essential facility under ORS 455.447. As required in Section 1802.6.1 of the International Building Code (IBC), this report provides the results of a seismic hazard study for this facility.

GEOLOGY

The project area is located in Bandon, Oregon and is within the southern portion of the Coast Range geologic province (Orr and Orr, 1996). The site area is underlain by surficial Quaternary sediments consisting primarily of sand and are underlain at depth by sedimentary rock, typically siltstone and sandstone (Open-File Report 0-14-01).

The nearest mapped fault is a north/south trending normal fault located approximately one mile east of the high school. The fault is not mapped to have displaced recent (Quaternary) deposits.

Based on mapping by the Oregon Department of Geology and Mineral Industries (DOGAMI), the north and west sides of the site are at the wet/dry contact for a tsunami resulting from a maximum seismic event (TIM-Coos-16). This assumes a magnitude 9.1 event occurring on the Cascadia Subduction Zone at high tide. There has been one event of this magnitude in the past 10,000 years (one event out of 19 large seismic events, ones that resulted in full margin rupture) that the DOGAMI model shows would bring a tsunami wave to the school site.

As part of our work, two test pits were completed at the site using a Takauchi mini-excavator provided and operated by Josh Brown Excavation of Bandon, Oregon. Test pit TP-1 was completed on the western side of the existing high school building. The test pit encountered about 3.5 ft of brown silt. The upper portion of the silt may be fill placed during construction of the school building. From a depth of 3.5 ft to 5 ft, the test pit encountered stiff, gray silt with some clay. The silt has a blocky structure. Below a depth of 5 ft, the test pit encountered dense, brown sand. The upper 2 ft of the sand is slightly cemented. The sand contains less fines with depth. The test pit was terminated in the sand at a depth of 11 ft.

Test pit TP-2 was completed on the eastern side of the existing high school building. The test pit encountered about 3 ft of medium stiff, brown silt. The upper foot of the silt is fill, likely placed during construction of the school building. Below a depth of 3 ft, the test pit encountered dense, brown to reddish-brown sand. The upper 2 ft of the sand is slightly cemented. The sand contains less fines with depth. The sand becomes gray below a depth of about 9 ft. The test pit was terminated in the sand at a depth of 11 ft.

Groundwater was not encountered in either test pit. We anticipate that perched groundwater occurs on top of the underlying bedrock.

Based on our review of representative drilling logs for the area, the site is mantled by sand to a depth of about 30 ft. The sand is underlain by siltstone below a depth of about 30 ft. Representative boring logs from the area are attached.

TECTONIC SETTING

Because of the proximity of the site to the Cascadia Subduction Zone, three distinctly different sources of seismic activity contribute to the potential for the occurrence of damaging earthquakes. Each of these sources is generally considered to be capable of producing damaging earthquakes. Two of these sources are associated with deep-seated tectonic activity related to the subduction zone, the third is associated with movement on the regional, relatively shallow faults.

Subduction zone seismic events have occurred off the Oregon coast generating Magnitude 8 to 9 earthquakes. The Cascadia Subduction Zone is located approximately 30 miles west of the project site. Average recurrence intervals for such great earthquakes along the Oregon coast, as determined by recent

investigations, range between 300 and 600 years. The last major earthquake to occur on the Cascadia Subduction Zone has been determined to have occurred on January 26, 1700.

Intraplate seismic events occur within the remnants of the subducting plates. These faults have a relatively deep focus (depths of 25 to 40 miles) and are capable of generating earthquakes of Magnitude 7.0. There is a lack of historical data regarding intraplate seismic events in Oregon; however, the Magnitude 6.8 event in Puget sound in 2001 is considered to be an intraplate event. Additional intraplate events occurred in Puget Sound in 1949 and 1965.

In the Bandon area, crustal earthquakes can occur in the upper plate at depths of 6 to 12 miles. The majority of seismic events in southwestern Oregon are a result of crustal earthquakes with Magnitudes of up to about 6.5.

Summary of Larger Southern Oregon Seismic Events (USGS):

- 1) March 10, 2014; magnitude 6.8, centered 50 miles west/northwest of Ferndale, California.
- 2) June 15, 2005; magnitude 7.2, centered off the coast of northern California.
- 3) Sept. 1, 1994; magnitude 7.1, centered off the coast of northern California.
- 4) Dec. 4, 1993: magnitude 5.1, centered 10 miles northwest of Klamath Falls, light damage to buildings.
- 5) Sept. 20, 1993: magnitude 5.9 and 6.0, 15 miles northwest of Klamath Falls, two deaths and \$10 million in damage, including county courthouse.
- 6) April 25, 1992: magnitude 7.0, Cape Mendocino, California.
- 7) July 12, 1991: magnitude 6.6, 70 miles off the Oregon coast.
- 8) March 13, 1985: magnitude 6.1, off Oregon coast, 140 miles west of Coos Bay.
- 9) Nov. 22, 1981: magnitude 5.7, centered off Oregon coast.
- 10) Nov. 3, 1981: magnitude 6.2, centered off Oregon coast.
- 11) Nov. 8, 1980: magnitude 7.0, off the Oregon coast.
- 12) Nov. 23, 1873: magnitude 6.8, located near Oregon/California border near Brookings.
- 13) Jan. 26, 1700: magnitude of about 9, off the Northwest coast.

CONCLUSIONS AND RECOMMENDATIONS

General. The subsurface explorations indicate the site is mantled with predominately sand soils over sedimentary rock at a relatively shallow depth. In our opinion, the subgrade soils are relatively competent. The following sections of this report provide our conclusions and recommendations for the seismic evaluation of the existing Bandon High School building.

Seismic Considerations. A site-specific seismic hazard study was completed as part of our investigation. The purpose of our study was to evaluate the potential seismic hazards associated with regional and local seismicity and to estimate the effect those hazards might have on the site. Our work was based on the potential for regional and local seismic activity as described in the existing scientific literature and on the subsurface conditions at the site, interpreted from explorations made in the vicinity of the site.

Based upon the above discussion, the recommended design earthquakes for the project area are:

- 1) Magnitude 8.5 (subduction) with source to site distance of 30 miles and a recurrence interval of 300 to 600 years.
- 2) Magnitude 7.0 (intraslab) with source to site distance of 30 miles and a recurrence interval of 500 years.
- 3) Magnitude 6.0 (crustal) with source to site distance of 10 miles and a recurrence interval of 500 years.

We anticipate that existing and (if required) new foundations for the existing high school building are founded on a thin layer of medium stiff silt over dense sand and siltstone/sandstone at shallow depth. In our opinion, based on the current State of Oregon's Structural Specialty Code Amendments and the International Building Code, the subsurface conditions at this site may be classified as a Site Class D for seismic design purposes. In addition, based on United States Geological Survey mapping and a 2 % PE in 50 years, we recommend use of a 0.2 second spectral response acceleration (S_S) of 1.7g and a 1.0 second spectral response acceleration (S_1) of 0.81g for seismic design of the structure. A summary of the seismic response is attached.

Based on the results of our investigation, the location of the site, and the nature of the underlying soil/rock, we anticipate that the potential for earthquake-induced fault displacement, subsidence, liquefaction-induced settlement and/or lateral displacement, or seiches at this site is low. Based on DOGAMI modeling of a worst-case scenario, there is a slight risk of a tsunami wave extending up to the north and west sides of the existing building; however, it is based on an event that has occurred once in 10,000 years with the earthquake occurring at the same time as high tide. In our opinion, the risk of tsunami impact on the site is very low.

Foundation Support Recommendations. If new foundations are required, or for an evaluation of the existing foundations, foundations can be evaluated based on an allowable soil bearing pressure of up to 2,000 psf. For design purposes, the real bearing value refers to the total of dead load plus frequently and/or permanently applied live loads, and can be increased by one-third for the total of all loads; dead, live, and wind or seismic.

For new foundations, the foundations excavations should be competed using a backhoe or trackhoe equipped with a smooth-lip bucket. The amount of the overexcavation should be determined by the geotechnical engineer during excavation for the foundations.

New foundations should be established at a minimum depth of 18 in. below the lowest adjacent finished grade for exterior footings and at least 18 in. below existing grades, whichever results in the deeper excavation. The width of footings should not be less than 12 in. for continuous wall footings and 24 in. for column footings. All footing excavations should be observed by a qualified geotechnical engineer prior to placement of rebar and concrete.

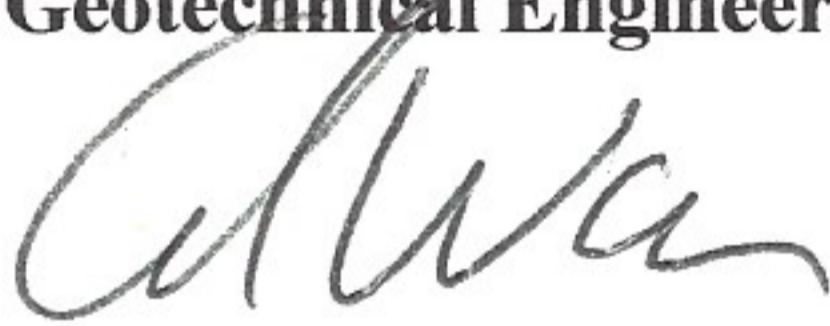
Lateral Load Resistance. Horizontal shear forces can be resisted by frictional forces developed between the base of spread footings and the underlying soil and by passive soil resistance. The total frictional resistance between the footing and the soil is the normal force times the coefficient of friction between the soil and the base of the footing. We recommend an ultimate value of 0.4 for the coefficient of friction; the normal force is the sum of the vertical forces (dead load plus real live load). If additional lateral resistance is required, passive earth resistance against embedded footings or walls can be computed using a pressure based on an equivalent fluid with a unit weight of 300 pcf. This design passive earth pressure is appropriate only if granular structural fill was/is used for the backfill around footings.

LIMITATIONS

This report has been prepared to aid the design team in the seismic evaluation of the existing Bandon High School in Bandon, Oregon. The scope is limited to the specific project and location described herein, and our description of the project represents our understanding of the significant aspects of the project relevant to the seismic evaluation. The conclusions and recommendations submitted in this report are based on the sources of data discussed in this report.

Sincerely,

Applied Geotechnical Engineering and Geologic Consulting, LLC



Robin L. Warren, G.E., R.G.
Principal



Renewal: June 2016

REFERENCES

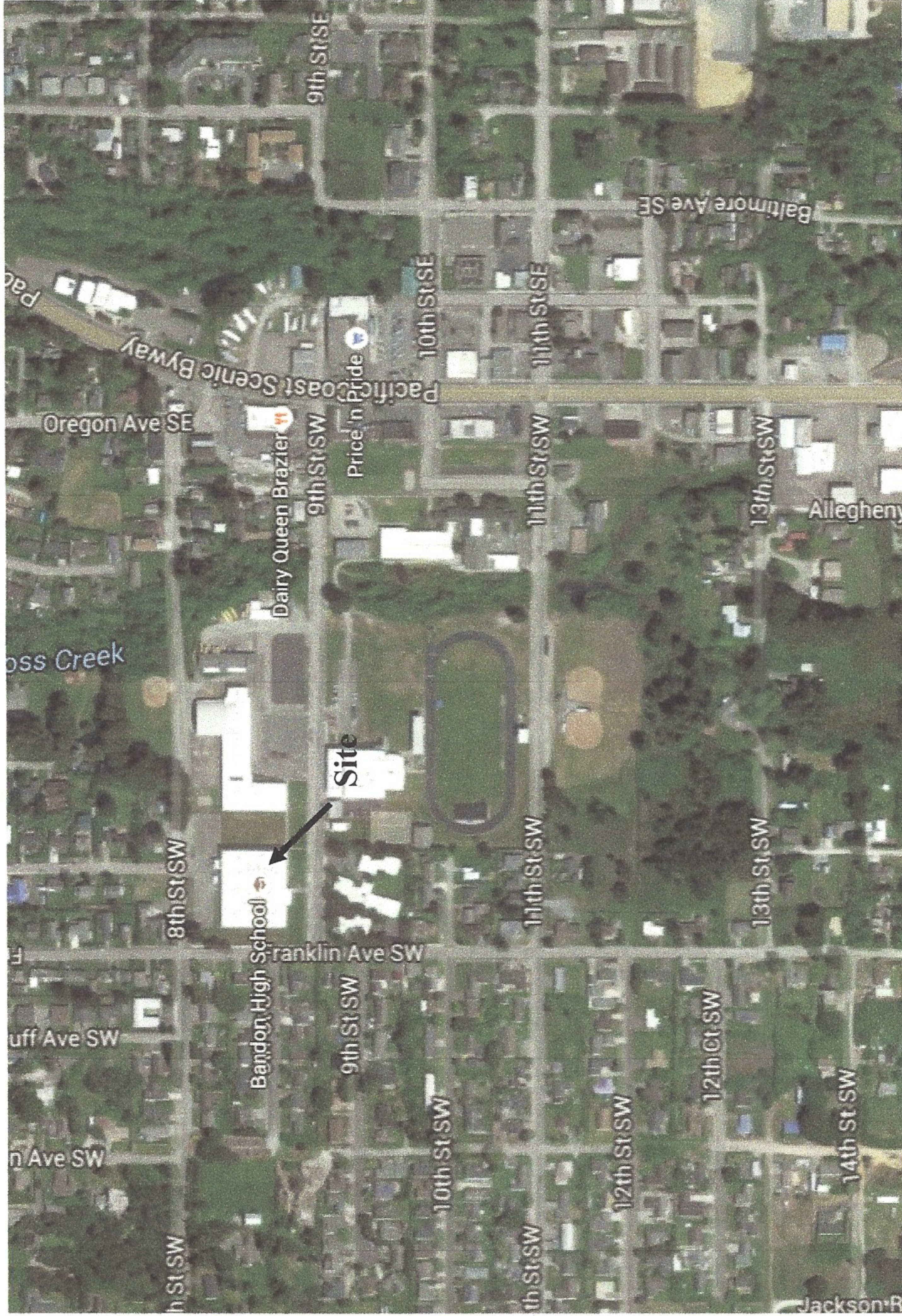
DOGAMI; Oregon Department of Geology and Mineral Resources; Open-File Report 0-14-01, Geologic Map of the Bandon 7.5' Quadrangle, Coos County, Oregon, 2014.

DOGAMI; Oregon Department of Geology and Mineral Resources; TIM-Coos-16, Tsunami Inundation Maps for Bandon, Coos County, Oregon, 2012.

Orr, Elizabeth L., and William N. Orr; Geology of the Pacific Northwest; 1996.

International Building Code; International Code Council, 2012.

State of Oregon Structural Specialty Code Amendments; International Code Council.



Project No. 4123
 Bandon High School
 Bandon, Oregon
 March 2016

Vicinity Map
Figure 1

A pplied
G eotechnical
E ngineering
 & Geologic Consulting

USGS Design Maps Summary Report

User-Specified Input

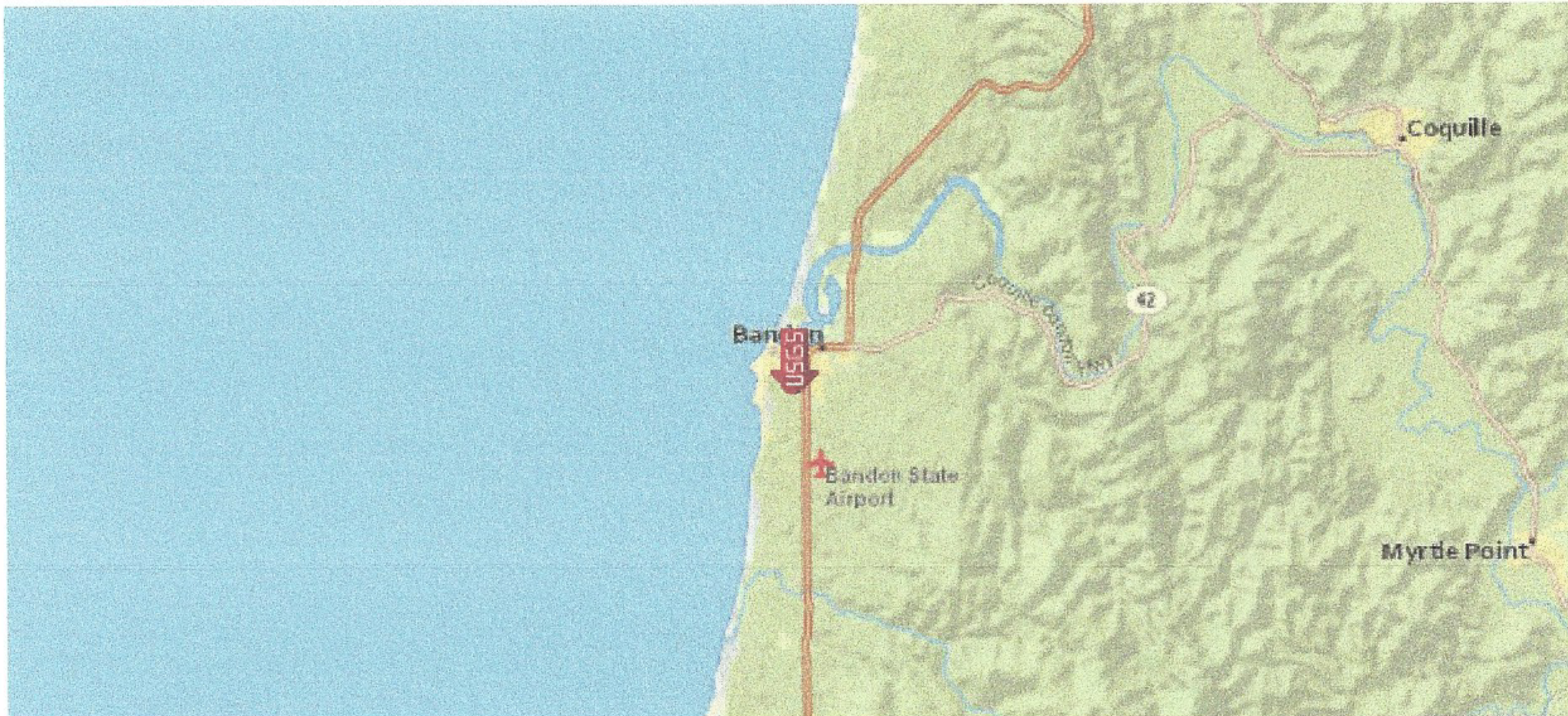
Report Title Bandon High School
Sun March 13, 2016 19:00:54 UTC

Building Code Reference Document 2012 International Building Code
(which utilizes USGS hazard data available in 2008)

Site Coordinates 43.1156°N, 124.42018°W

Site Soil Classification Site Class D – “Stiff Soil”

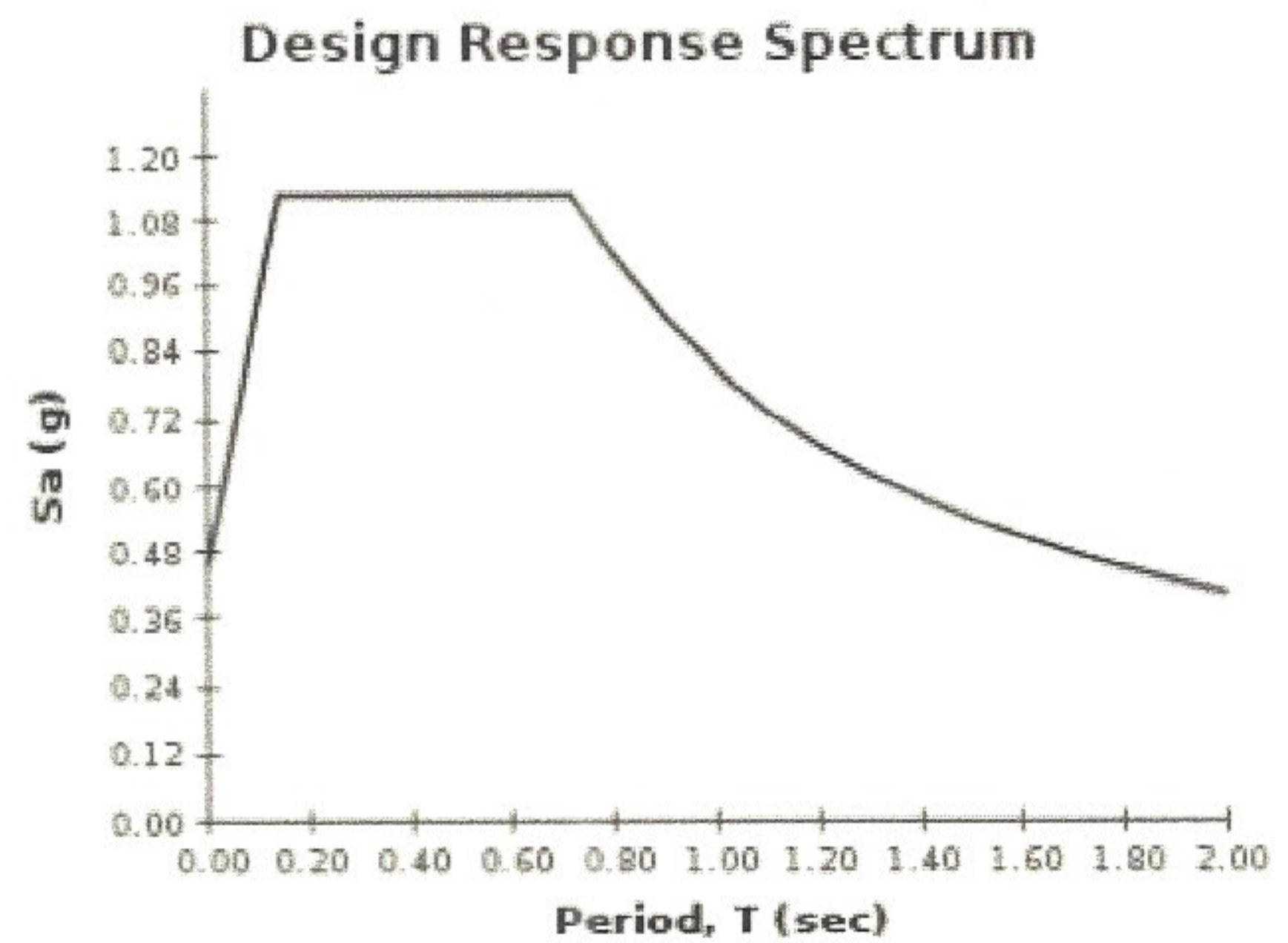
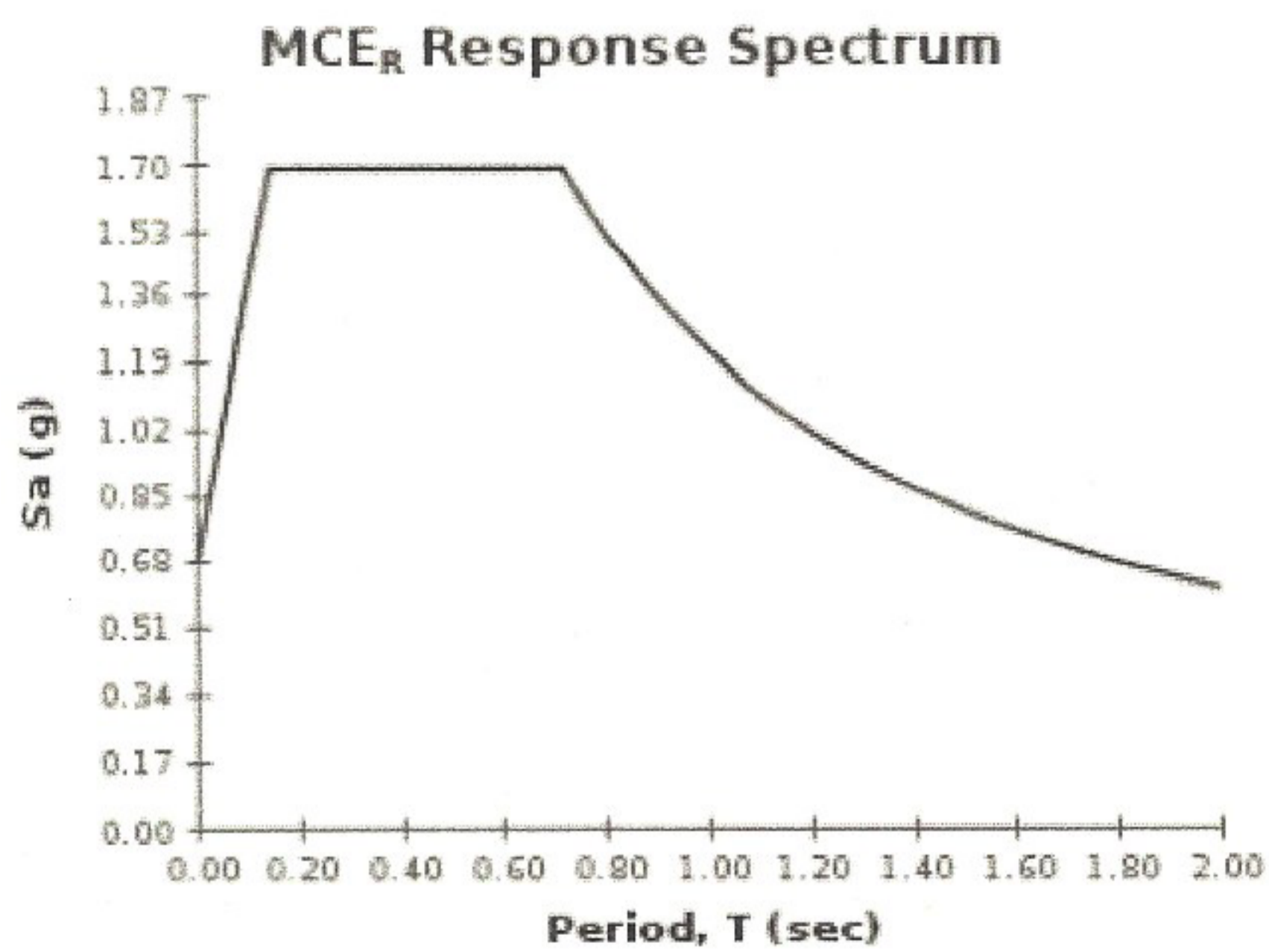
Risk Category IV (e.g. essential facilities)



USGS-Provided Output

$S_s = 1.695 \text{ g}$	$S_{MS} = 1.695 \text{ g}$	$S_{DS} = 1.130 \text{ g}$
$S_1 = 0.809 \text{ g}$	$S_{M1} = 1.213 \text{ g}$	$S_{D1} = 0.809 \text{ g}$

For information on how the S_s and S_1 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.



STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(as required by OAR 690-240-035)

COOS 53514

(1) OWNER/PROJECT: Hole Number B-1
Name BANDON HIGH SCHOOL
Address 445 9TH STREET SW
City BANDON State OREGON Zip 97411

(2) TYPE OF WORK
 New Deepening Alteration (repair/recondition) Abandonment

(3) CONSTRUCTION:
 Rotary Air Hand Auger Hollow Stem Auger
 Rotary Mud Cable Tool Push Probe Other

(4) TYPE OF HOLE:
 Uncased Temporary Cased Permanent
 Uncased Permanent Slope Stability Other

(5) USE OF HOLE: GEOTECHNICAL

(6) BORE HOLE CONSTRUCTION:
Special Construction approval Yes No Depth of Completed Hole 35 ft.

HOLE			SEAL			
Diameter	From	To	Material	From	To	Sacks or pounds
8	35	0	BENT CHIPS	35	0	18 SKS

Backfill placed from _____ ft. to _____ ft. Material _____
Filter Pack placed from _____ ft. to _____ ft. Size of pack _____

(7) CASING/SCREEN:
Diameter From To Gauge Steel Plastic Welded Threaded
Casing: N/A
Screen:
Slot size _____

(8) WELL TEST:
 Pump Bailer Air Flowing Artesian
Permeability _____ Yield _____ GPM _____
Conductivity _____ PH _____
Temperature of water 52 °F Depth artesian flow found _____ ft.
Was water analysis done? Yes No
By whom? _____

Depth of strata analyzed. From _____ ft. to _____ ft.
Remarks: _____

RECEIVED
MAR 17 2006
WATER RESOURCES DEPT
SALEM, OREGON

(9) LOCATION OF HOLE by legal description:
County COOS Latitude _____ Longitude _____
Township 28 S Range 15 W WM.
Section 25 SE 1/4 SE 1/4
Tax Lot 600 Lot _____ Block _____ Subdivision _____
Street Address of Well (or nearest address) SAME

Map with location identified must be attached

(10) STATIC WATER LEVEL:
25 ft. below land surface. Date 2/28/06
Artesian pressure _____ lb. per square inch. Date _____

(11) SUBSURFACE LOG:
Ground Elevation _____

Material Description	From	To	SWL
BROWN SAND	0	30	25
GREY SANDSTONE	30	35	

Date Started 2/28/05 Date Completed 2/28/05

(12) ABANDONMENT LOG:

Material Description	From	To	Sacks or Pounds
BENT CHIPS	35	0	18 SKS

Date started 2/28/05 Date Completed 2/28/05

Professional Certification
(to be signed by a licensed water supply or monitoring well constructor, or registered geologist or civil engineer).

I accept responsibility for the construction, alteration, or abandonment work performed on during the construction dates reported above. All work performed during this time is in compliance with Oregon geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License or Registration Number 10554

Signed Alex McCann Date 3/19/06
ALEX MCCANN

Affiliation SUBSURFACE TECHNOLOGIES

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(as required by OAR 690-240-0035)

10/4/2013

(1) OWNER/PROJECT Hole Number B-1

PROJECT NAME/NBR: JAS 100213

First Name Last Name
Company BANDON SCHOOL DISTRICT NO. 54
Address 471 9TH ST SW
City BANDON State OR Zip 97411

(2) TYPE OF WORK [X] New [] Deepening [X] Abandonment
[] Alteration (repair/recondition)

(3) CONSTRUCTION
[] Rotary Air [] Hand Auger [] Hollow stem auger
[X] Rotary Mud [] Cable [] Push Probe
[] Other

(4) TYPE OF HOLE:
[] Uncased Temporary [] Cased Permanent
[] Uncased Permanent [] Slope Stability
[] Other

(5) USE OF HOLE
GEOTECHNICAL

(6) BORE HOLE CONSTRUCTION Special Standard [] (Attach copy)

Table with columns: Dia, From, To, Material, SEAL From, To, Amt, sacks/lbs. Row 1: 5, 0, 40, Bentonite Chips, 0, 40, 8, S

Backfill placed from 0 ft. to 40 ft. Material BENTONITE CHIPS
Filter pack from ft. to ft. Material Size

(7) CASING/SCREEN
Table with columns: Casing, Screen, Dia, From, To, Gauge, Stl, Plstc, Wld, Thrd

(8) WELL TESTS

Table with columns: Pump, Bailer, Air, Flowing Artesian, Yield gal/min, Drawdown, Drill stem/Pump depth, Duration(hr)

Temperature °F Lab analysis [] Yes By

Supervising Geologist/Engineer

Water quality concerns? [] Yes (describe below) TDS amount

Table with columns: From, To, Description, Amount, Units

(9) LOCATION OF HOLE (legal description)

County coos Twp 28.00 S N/S Range 15.00 W E/W WM
Sec 25 SE 1/4 of the SE 1/4 Tax Lot 0601L
Tax Map Number Lot
Lat " or DMS or DD
Long " or DMS or DD
[] Street address of hole [] Nearest address

550 9TH ST SW, BANDON, OR

(10) STATIC WATER LEVEL

Table with columns: Date, SWL(psi), + SWL(ft)
Existing Well / Predeepening
Completed Well
Flowing Artesian? []
WATER BEARING ZONES
Depth water was first found 15.00
Table with columns: SWL Date, From, To, Est Flow, SWL(psi), + SWL(ft)

(11) SUBSURFACE LOG Ground Elevation

Table with columns: Material, From, To
SAND 0 1
SILT 1 10
SAND 10 30
MUDSTONE 30 40

Date Started 10/2/2013 Completed 10/2/2013

(12) ABANDONMENT LOG:

Table with columns: Material, From, To, Amt, sacks/lbs
Bentonite Chips 0 40 8 S

Date Started 10/2/2013 Completed 10/2/2013

Professional Certification (to be signed by an Oregon licensed water or monitoring well constructor, Oregon registered geologist or professional engineer).

I accept responsibility for the construction, deepening, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License/Registration Number 10570 Date 10/4/2013

First Name JASON Last Name CORRIERI

Affiliation SUBSURFACE TECHNOLOGIES

ORIGINAL - WATER RESOURCES DEPARTMENT

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

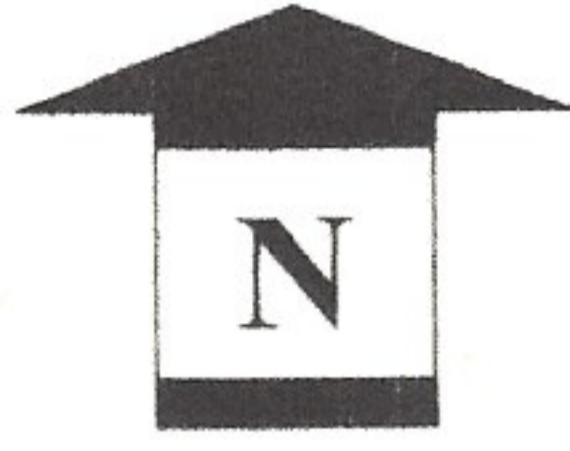
Form Version:

GEOTECHNICAL HOLE REPORT - Map with location identified must be attached and shall include an approximate scale and north arrow

COOS 55377

10/4/2013

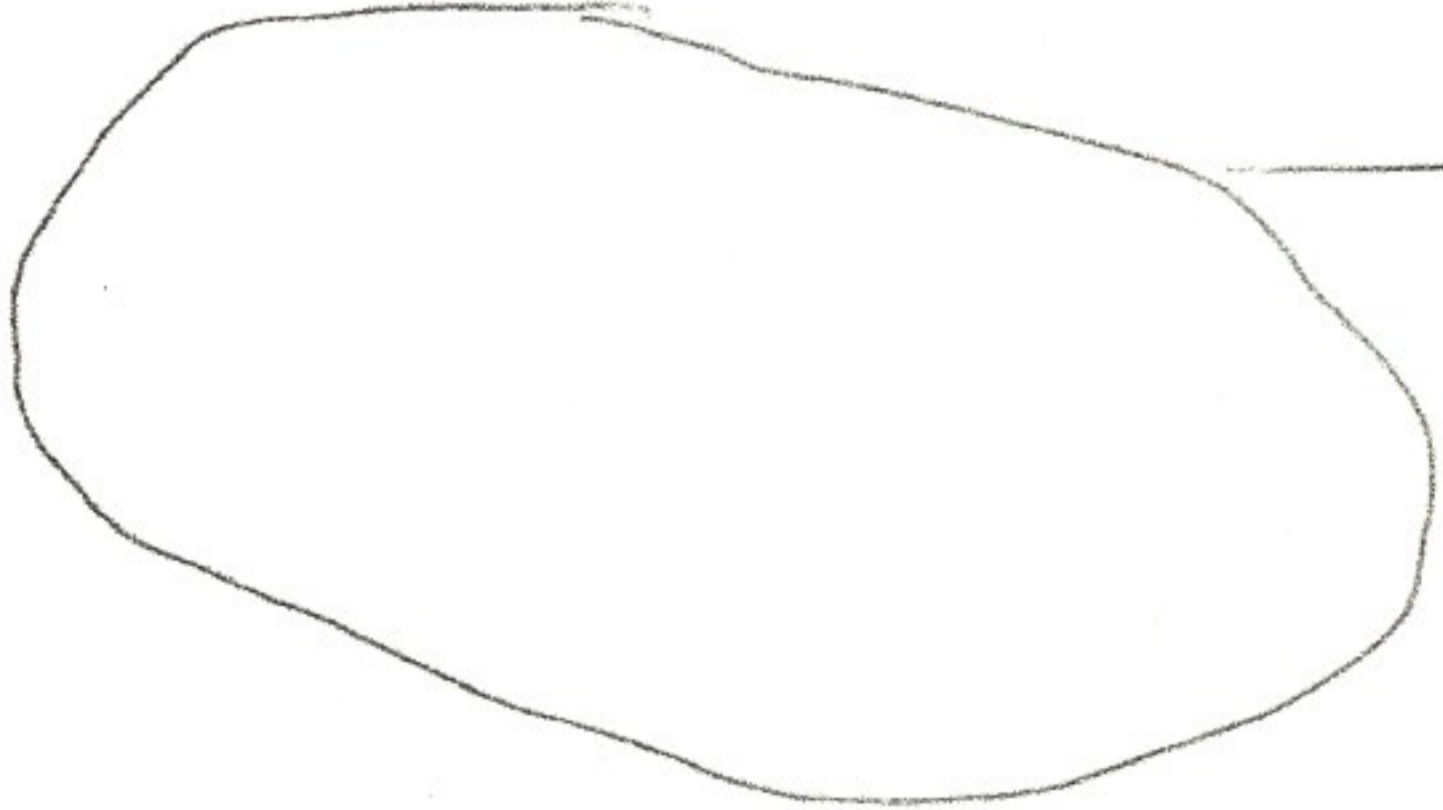
Map of Hole



1" = 50' scale

SW 9th St.

COOS



1
B-1

COOS 54751

STATE OF OREGON GEOTECHNICAL HOLE REPORT (as required by OAR 690-240-035)

(1) OWNER/PROJECT: Hole Number B-1
 Name CITY OF BANDON
 Address PO BOX 67
 City BANDON State OREGON Zip 97411

(2) TYPE OF WORK
 New Deepening Alteration (repair/recondition) Abandonment

(3) CONSTRUCTION:
 Rotary Air Hand Auger Hollow Stem Auger
 Rotary Mud Cable Tool Push Probe Other

(4) TYPE OF HOLE:
 Uncased Temporary Cased Permanent
 Uncased Permanent Slope Stability Other

(5) USE OF HOLE: GEOTECHNICAL

(6) BORE HOLE CONSTRUCTION:
 Special Construction approval Yes No Depth of Completed Hole 37.5 ft.

HOLE			SEAL			
Diameter	From	To	Material	From	To	Sacks or pounds
8"	0	37.5	BENT CHIPS	37.5	0	19 SKS

Backfill placed from _____ ft. to _____ ft. Material _____
 Filter Pack placed from _____ ft. to _____ ft. Size of pack _____

(7) CASING/SCREEN:

Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Screen:				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Slot size _____

(8) WELL TEST:
 Pump Bailer Air Flowing Artesian
 Permeability _____ Yield _____ GPM _____
 Conductivity _____ PH _____
 Temperature of water 52 °F Depth artesian flow found _____ ft.
 Was water analysis done? Yes No
 By whom? _____
 Depth of strata analyzed. From _____ ft. to _____ ft.
 Remarks: _____

(9) LOCATION OF HOLE by legal description:
 County COOS Latitude _____ Longitude _____
 Township 28 S Range 15 W WM.
 Section 25 SW 1/4 NW 1/4
 Tax Lot NONE Lot _____ Block _____ Subdivision _____
 Street Address of Well (or nearest address) BEACH LOOP ROAD & 7TH ST SW, BANDON, OR

Map with location identified must be attached

(10) STATIC WATER LEVEL:
N/A ft. below land surface. Date _____
 Artesian pressure _____ lb. per square inch. Date _____

(11) SUBSURFACE LOG:
 Ground Elevation _____

Material Description	From	To	SWL
SAND	0	32.5	
SILT STONE	32.5	37.5	

Date Started 7/26/10 Date Completed 7/26/10

(12) ABANDONMENT LOG:

Material Description	From	To	Sacks or Pounds
BENT CHIPS	37.5	0	19 SKS

Date started 7/26/10 Date Completed 7/26/10

Professional Certification
 (to be signed by a licensed water supply or monitoring well constructor, or registered geologist or civil engineer).

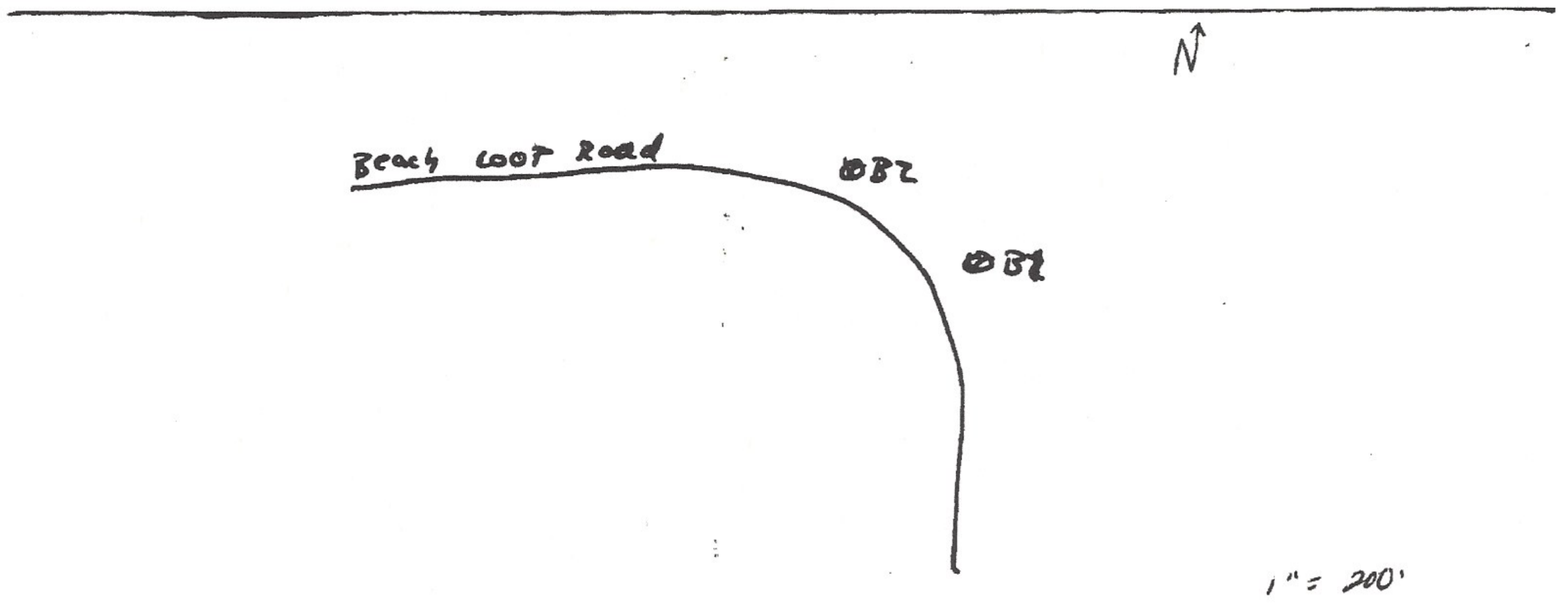
I accept responsibility for the construction, alteration, or abandonment work performed on during the construction dates reported above. All work performed during this time is in compliance with Oregon geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License or Registration Number 10554

Signed Alex McCann Date 8/13/10
ALEX MCCANN
 Affiliation SUBSURFACE TECHNOLOGIES

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER



AUG 3 1 2010