REPORT OF GEOTECHNICAL ENGINEERING SERVICES

Woodburn Museum and Theater
Woodburn, Oregon

Geotech Solutions Inc.

January 31, 2018

GSI Project: woodburn-17-1-gi

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REPORT OF GEOTECHNICAL ENGINEERING SERVICES
Museum and Bungalow Theater, 455 N Front Street, Woodburn, Oregon

As authorized, this report summarizes our geotechnical engineering services for the proposed Museum and Bungalow Theater seismic upgrade in Woodburn, Oregon. From our communications with DECA we understand that plans include an ASCE 41-13 seismic upgrade, and that the structural engineer needs foundation support information for new moment frames or shear walls including possible helical piers or a deep foundation alternative. The purpose of our work will be to investigate subsurface conditions and provide geotechnical recommendations for this foundation support design by others. Our specific scope of work will include the following:

- Provide principal-level project management including management of field and subcontracted services, report writing, analyses, and invoicing.
- Review geologic maps and vicinity geotechnical information in our files as indicators of subsurface conditions.
- Complete a site reconnaissance to observe surface features relevant to geotechnical issues, such as surface materials, access, and evidence of previous grading.
- Complete a one-call and private utility locate for locatable utilities.
- Explore subsurface conditions by advancing one CPT probe in the alleyway behind the building to a depth of up to 60 feet or refusal with one PPD test and maintain a detailed log of the exploration. Grout the hole and patch the pavement when done.
- Evaluate liquefaction potential of site soils and estimate deformations and provide qualitative means to address improved support.
- Provide recommendations for support of shallow foundations, including an allowable bearing pressure and related settlement estimates, sliding coefficients, lateral earth pressures, site class for seismic design, and embedment depths.
- Provide foundation support recommendations for deep foundations for both vertical and horizontal load support.
- Provide a written report summarizing the results of our geotechnical evaluation.

SITE OBSERVATIONS AND CONDITIONS

Surface Conditions

The single story facility is located at 455 N Front Street in Woodburn, Oregon. The site is relatively flat, with sidewalks along Front Street and a paved alley to the back. The building abuts other similar structures on each side. The general site appearance from a recent aerial photo is shown on the attached ***Site Plan***.

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Subsurface Conditions

General – Subsurface conditions at the site were explored on the building frontage on January 19th, 2018 by advancing one cone penetrometer probes to a depth of 60 feet. Our approximate exploration location is shown on the attached ***Site Plan.*** Specific subsurface conditions observed in the exploration are described in the attached ***CPT Logs.***

In general, subsurface conditions in our explorations generally included asphalt concrete pavement and base rock underlain by medium stiff silt and stiff layered silts with variable sand and clay content. The upper silt extended to depths of roughly 16 feet with CPT raw tip resistance generally less than 30 tsf, and raw friction ratios of 2-4%. Stiffer layered silts with variable sand and clay content are present below depths of roughly 16 feet to the depths explored, and with tip resistance of generally 30-140 tsf and friction ratios of generally 3 to 6%.

Site soil conditions are consistent with mapped soil deposits.

Groundwater – Pore pressure back calculation from the CPT's indicates ground water levels of roughly 7 feet below the ground surface. Perched ground water may exist shallower after heavy rainfall events.

CONCLUSIONS AND RECOMMENDATIONS

General

Based on the results of our explorations, laboratory testing, and engineering analyses, it is our opinion that the site can be developed following the recommendations contained herein. Key geotechnical issues include support of moment frame foundations. Specific geotechnical recommendations are provided in the following sections.

Seismic Design

General - In accordance with the International Building Code (IBC) as adapted by State of Oregon Structural Specialty Code (SOSSC) and based on our explorations and experience in the site vicinity, the subject project is Class F, but for this low rise structure can be evaluated using the parameters associated with Site Class D.

Liquefaction - Liquefaction occurs in loose, saturated, granular soils. Strong shaking, such as that experienced during earthquakes, causes the densification and the subsequent settlement of these soils. Our CPT based analyses indicates that an overall liquefaction induced settlement on the site is roughly 1/2 inch, primarily from low strain associated with sandy layers. Given this low settlement, unsaturated near surface soils, and the relatively flat local ground conditions, there is a low risk of liquefaction related structurally damaging deformations to the buildings.

Shallow Foundations

Medium stiff silt was encountered in our explorations to depths of roughly 11 feet and when undisturbed is suitable for support of shallow foundations for the anticipated loads.

Footings must be embedded at least 18 inches below the lowest adjacent, exterior grade. Footings can be designed for an allowable net bearing pressure of 2,500 psf. The preceding bearing pressure can be increased to 5,000 psf for temporary wind and seismic loads.

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Continuous footings must be no less than 18 inches wide, and pad footings must be no less than 24 inches wide. Resistance to lateral loads can be obtained by a passive equivalent fluid pressure of 350 pcf against suitable footings or grade beams, ignoring the top 12 inches of embedment, and by a footing base friction coefficient of 0.38. Base friction should not be used for grade beams. Properly founded footings are expected to settle less than a total of 1 inch, with less than ½ inch differentially.

If footing construction is to occur in wet conditions, a few inches of crushed rock must be placed at the base of footings to reduce subgrade disturbance and softening during construction.

Helical Piers

Helical piers can be used to support foundation loads in uplift or compression. Piers are generally installed in 5 to 8 foot long sections and threaded, or sleeved and triple bolted, pier shaft connections are required to reduce lateral deflection. A hydraulic motor mounted to an excavator is typically used for installation and torque during installation is monitored and used to confirm pier capacity.

Piers must be installed to minimum embedment listed below into medium stiff or better silt. The ability to meet this embedment must be verified by the contractor. Torque criteria must also be met after the required embedment is met. Torque alone is not a suitable criteria. We recommend piers with the following allowable capacities for design (using a torque factor of 9 and 8 for 2-7/8 and 3.5" shafts, respectively, and an FOS of 2 for installations we observe), with a minimum pier spacing of three helix diameters. All helical piers must be galvanized or corrosion protected. Piers embedded in grade beams can be used for 1.5 kips allowable lateral resistance for the 2-7/8", and 2 kips for the 3.5".

Helical Pier Type	Inclination (to vertical)	Design Embedment (ft - unit)	Allowable Load* (kips)
10", 12": 3/8" plates, Double with 2-7/8" pipe	Vertical	19 – stiff silt	30(C), 24 (T)
10", 12": 3/8" plates, Double with 3.5" pipe	Vertical	24 – stiff silt	40 (C), 33 (T)

* C – Compression T – Tension

Capacities for additional pier sizes or embedment can be provided upon request. We recommend that we be retained to review pier support design and be called to the site to observe installation of representative helical piers as "proof piers", as well as being provided all installation logs of production piers.

LIMITATIONS AND OBSERVATION DURING CONSTRUCTION

We have prepared this report for use by the City of Woodburn and the design and construction teams for this project only. The information herein could be used for bidding or estimating purposes but must not be construed as a warranty of subsurface conditions. We have made observations only at the aforementioned locations and only to the stated depths. These observations do not reflect soil types, strata thicknesses, water levels or seepage that may exist between observations. We must be consulted to observe all foundation bearing surfaces, subgrade stabilization, proof rolling of slab and pavement

subgrades, installation of structural fill, subsurface drainage, and cut and fill slopes. We must be consulted to review final design and specifications in order to see that our recommendations are suitably followed. If any changes are made to the anticipated locations, loads, configurations, or construction timing, our recommendations may not be applicable, and we must be consulted. The preceding recommendations must be considered preliminary, as actual soil conditions may vary. In order for our recommendations to be final, we must be retained to observe actual subsurface conditions encountered. Our observations will allow us to interpret actual conditions and adapt our recommendations if needed.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with the generally accepted practices in this area at the time this report was prepared. No warranty, expressed or implied, is given.

We appreciate the opportunity to work with you on this project and look forward to our continued involvement. Please contact us if you have any questions.

Sincerely,

Don Rondema, MS, PE, GE
Principal

Attachments –
Site Plan, CPT Analyses and Logs

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NOT TO SCALE

BASE PHOTO FROM GOOGLE EARTH 2017 AERIAL

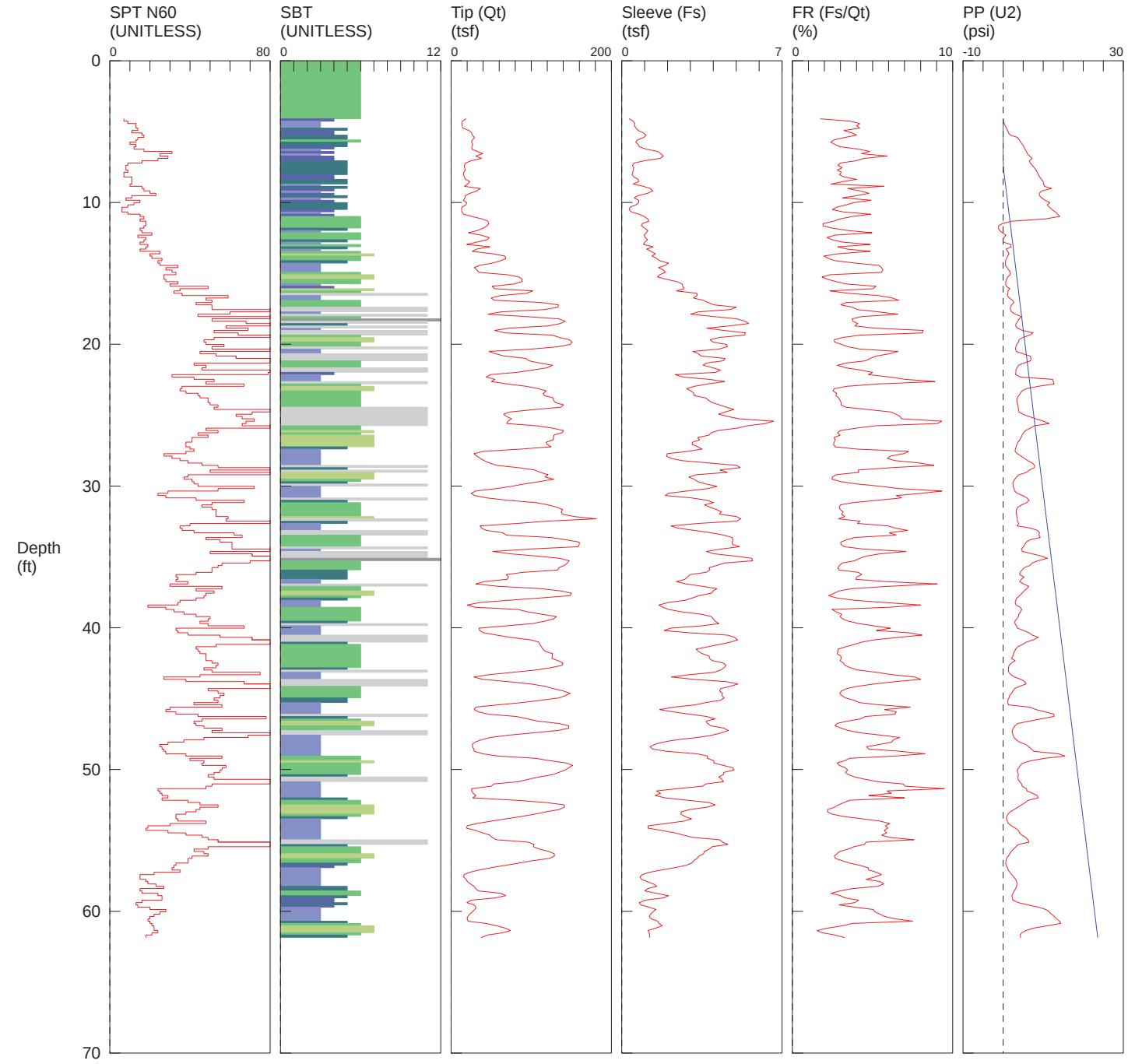
Geotech Solutions Inc.

SITE PLAN

woodburn-17-1-gi

Geotech Solutions / CPT-1 / 455 N Front st. Woodburn

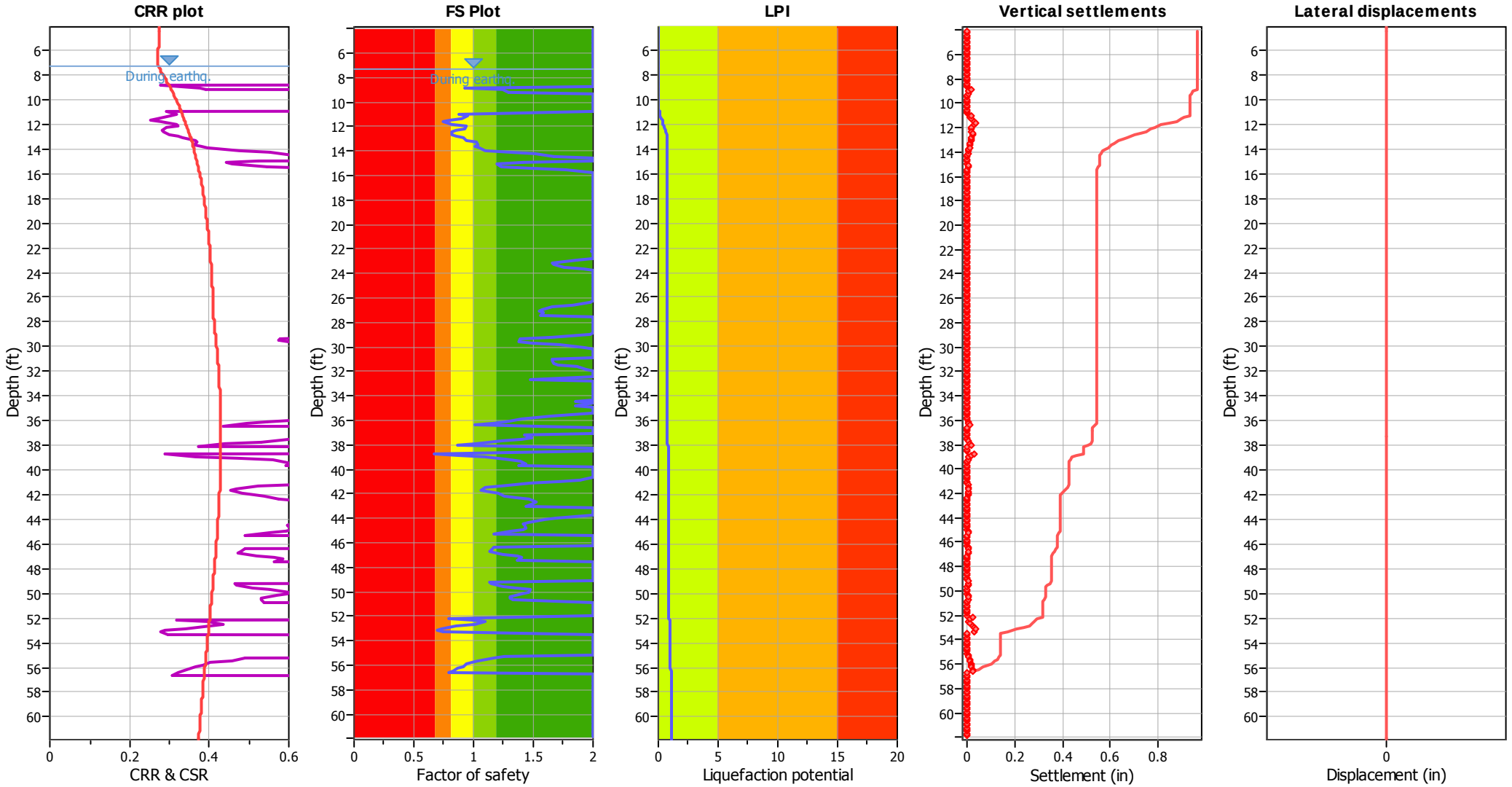
OPERATOR: OGE BB
CONE ID: DPG1323
HOLE NUMBER: CPT-1
TEST DATE: 1/19/2018 12:47:34 PM
TOTAL DEPTH: 61.844 ft



1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.30 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.29	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	7.30 ft	Fill height:	N/A	Limit depth:	60.00 ft

F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk