REPORT OF GEOTECHNICAL ENGINEERING SERVICES

Cannon Beach City Hall Improvements
163 Gower Street, Cannon Beach, Oregon

Geotech Solutions Inc.

July 31, 2023

GSI Project: cannon-22-2-gi

July 31, 2023 *cannon-22-2-gi*

City of Cannon Beach
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REPORT OF GEOTECHNICAL ENGINEERING SERVICES
City Hall Improvements, 163 E Gower Street
Cannon Beach, Oregon

As authorized, herein we present our report of geotechnical engineering services for the proposed improvements to City Hall at 163 East Gower Street in Cannon Beach, Oregon. We understand that the facility is to be one-story 10,500 square feet building that will not be housing emergency services as the police function is planned to move to another site. A previous geotechnical exploration by others from 2011 was provided (attached) and also included a seismic hazard evaluation. The logs and data from that report were used as background for our analyses. Tsunami modeling and mapping has been updated since that report but did not change the scenario that inundation is likely even in a moderate design CSZ interface earthquake.

The purpose of our work was to conduct additional explorations to the east of the existing buildings and analyze the conditions to provide upgraded recommendations for building foundations and related building seismic design. Specifically, our scope included the following:

- Provide principal level geotechnical project management including a site reconnaissance, review of provided information, client communications, and review of analyses, reports, and standard format invoicing.
- Explore subsurface conditions by advancing two CPT probes in the east lot gravel area to depths of up to 40 feet or refusal with ppd testing and shear wave velocity readings in each.
- Complete detailed liquefaction analyses of site soils and estimate liquefaction induced deformations and provide qualitative means to reduce or address deformations as needed.
- Provide recommendations for earthwork including suitable fill materials, seasonal material usage, compaction criteria, utility trench backfill, and need for subsurface drainage.
- Provide recommendations for asphalt concrete subgrade preparation and pavement thickness for parking and driveways.
- As appropriate, provide recommendations for deep foundation support for either deep helical piers or a drilled or drilled piles, or a qualitative approach for dual-purpose ground improvement and foundation support application (such as stone columns, deep mixing, etc.). Include vertical capacity versus embedment, allowable lateral loads and related deflection, installation criteria, and geotechnical design parameters for pile caps and grade beams.
- Provide a PE/GE stamped written report summarizing the results of our geotechnical evaluation.

SITE OBSERVATIONS AND CONDITIONS

Surface Conditions

The site is located at 163 E Gower Street in Cannon Beach, Oregon, and includes the single-story building in the western portion of the property with abutting planters, sidewalks, and pavement. East of the existing building includes paved and gravel parking and drives and a few trees. That area has

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evidence of slope cuts of several feet in the east and south side of the parking area (based on visual observations and bare earth LIDAR mapping). The overall site slopes gently roughly 1% down to the west, and the existing building is roughly 750 feet east of the ocean beach and its access off Ecola Court.

Subsurface Conditions

The site was explored on July 12, 2023 with two CPT probes that are in addition to the two borings and CPT probe completed for the site in 2011. The approximate locations of our explorations are shown on the attached Site Plan, with explorations by others summarized in their attached report. According to geologic maps of the area the site is underlain by coastal terrace deposits with alluvial deposits to the west and "fingers" of alluvial deposits to the northwest and southeast. The 2011 report by others includes a detailed geological mapping description by the CEG and is appended to this report for reference and not repeated or part of the scope herein but was reviewed in a geotechnical engineering context. Soil conditions encountered are generally consistent with the marine terrace mapping, overlying older siltstone of the Astoria Formation at depth. No landslides are mapped on site, with a low risk of dynamic instability.

Subsurface conditions under gravel and pavement sections generally encountered stiff silt and fill up to 2 feet in depth, overlying soft to very soft organic silt to depths of 18 to 25 feet, in turn underlain by dense to very dense fine sand with gravel layers to depths of roughly 100 feet. Below roughly 100 feet the borings encountered massive siltstone with inferred layers of basalt intrusion in B-1 to the 121 foot depths explored.

Surface Fill - This includes the pavement and base rock and mixed fill which extended to depths of up to 2 feet in explorations. The material was generally stiff below the rock with moderate dry strength and low compressibility.

Silt with Organics - The silt unit generally transitioned from medium stiff in the top several feet to soft to very soft below that and contained organics for a discontinuous vertical extent of about 8 feet which included matted sediment/decayed material as well as intact wood at discrete layers. The total layer thickness averages about 20 feet. Organic layers were non-plastic, and inorganic portions had a moderate to high plasticity with some clay content. Moisture contents ranged from 61% to 63%. Where small dispersed organics are present, testing in this unit at the Pelican Pub 600 feet S-SW of the site ranged from 6-13% organics (a range of trace to some), and is obviously higher in actual buried wood. CPT tip resistance in this unit ranged from generally 6-20 tsf in the silt, with sand layers in P-1 ranging from 100 to 300 tsf. Blow counts from the borings (auto hammer N85) ranged from 9 to 2, generally lower with depth. Measured shear wave velocities in our CPT's ranged from 400-650 ft/sec in the silt, and up to 1100 ft/sec in some sand layers in P-1. The averaged shear wave velocity in the unit was 638 ft/sec.

The silt has low strength and high initial and long-term compressibility. A few feet of the silts sandy layers lower in P-1 were analyzed as susceptible to liquefaction or at least strength decrease in design level seismic events at moderate to low strains, primarily at depths of 13-18 feet.

Sand - The organic silt unit was underlain by dense sand that extended below roughly 18 to 25 feet to depths to near 100 feet. CPT tip resistance in the sand was generally over 200 tsf with refusal at 500 tsf

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or more in gravelly sand at depths of 18 to 21 feet in the recent CPT probes. Blow counts ranged from 35 to well over 50, with the exception of one sample at 45 feet in B-1 that had a blow count of 17. Shear wave velocities in this unit measured at nearby sites and correlated from SPT blow-counts range from 1100 to 1300 ft/sec. The sand has a high static strength and low compressibility.

Siltstone - At depths of 100-101 feet in the previous borings marine siltstone was encountered that was interpreted as Astoria Formation by the CEG. Blow counts in this unit ranged from 35 to over 50 for a few inches or 30 for zero inches where inferred basalt intrusions were present below 105 feet in B-1. This material has a high strength and is not susceptible to liquefaction.

Groundwater - Pore pressure dissipation testing and free water in CPT probe holes prior to grouting indicated ground water at roughly 11 feet below the ground surface. Previous explorations noted ground water near 21 feet in depth.

CONCLUSIONS AND RECOMMENDATIONS

General

Based on our explorations and analyses, development of the site is feasible by following recommendations provided herein. Surficial soils at the site consist of thin fills over soft silt with organics and dense to very dense sand. The silt soils are unsuitable for foundation or slab support and must be founded on piles penetrating into the very dense sand unit. Liquefaction is calculated to occur in thin layers generally near the top of the sand interface, with some near 45 feet, but at calculated low strains and low to laterally moderate deformations. Specific recommendations for site design are detailed in the following sections.

Earthwork

Preparation - Site preparation for earthwork will require removal of vegetation, existing utilities to be abandoned and existing pavements and unsuitable fill within proposed building and new pavement or hardscaping areas. Root balls from trees may extend several feet and grubbing operations can cause considerable subgrade disturbance. All disturbed material should be removed to undisturbed subgrade and backfilled with structural fill. In general, roots greater than one-inch in diameter should be removed.

Stabilization and Soft Areas - After stripping, we should be contacted to evaluate the exposed subgrade. This evaluation can be done by proof rolling or probing. Soft areas will require overexcavation and backfilling with well graded, clean angular gravel or clean sand compacted as structural fill.

Working Blankets and Haul Roads - Construction equipment should not operate directly on the subgrade when wet, as it is susceptible to disturbance and softening. Existing gravel and pavement, or new rock working blankets and haul roads placed over a the preceding geosynthetic can be used to protect subgrades. We recommend that sound, angular, pit run or crushed basalt with no more than 6 percent passing a #200 sieve be used to construct haul roads and working blankets. Working blankets should be at least 12 inches thick, and haul roads at least 18 inches thick. These can be reduced to 9 and 14 inches, respectively, with the use of the preceding geogrid.

The preceding rock thicknesses are the minimum recommended. Subgrade protection is the responsibility of the contractor and thicker sections may be required based on subgrade conditions and type and frequency of construction equipment.

Imported Granular Fill - Imported granular fill, such as clean sand or rock, should have a maximum particle size of 6-inches, be well graded, and have less than 6 percent passing the #200 sieve. This material should be compacted to 95 percent relative to ASTM D 1557.

Trenches - Utility trenches may encounter groundwater seepage and severe caving and flowing should be expected where seepage is present and in soft and/or loose soils. Shoring of utility trenches will be required for depths greater than 4 feet. We recommend that the type and design of the shoring system be the responsibility of the contractor, who is in the best position to choose a system that fits the overall plan of operation.

Pipe bedding should be installed in accordance with the pipe manufacturers' recommendations. If groundwater seepage is present in the base of the utility trench excavation, we recommend over-excavating the trench by 12 to 18 inches and placing trench stabilization material in the base. Trench stabilization material should consist of well-graded, crushed rock or crushed gravel with a maximum particle size of 4 inches and be free of deleterious materials. The percent passing the U.S. Standard #200 Sieve shall be less than 6 percent by weight when tested in accordance with ASTM C 117.

Trench backfill above the pipe zone should consist of well graded, angular crushed rock or sand fill with no more than 7 percent passing a #200 sieve. Trench backfill should be compacted to 92 percent relative to ASTM D 1557, and construction of hard surfaces, such as sidewalks or pavement, should not occur within one week of backfilling.

Slopes - Temporary slopes may be inclined up to 2H:1V for slopes up to 8 feet high. Such slopes should be expected to erode somewhat, depending on weather conditions and duration of exposure, and in the winter should be covered with weighted plastic sheeting. Permanent slopes should be inclined no steeper than 2H:1V for slopes up to 6 feet high. Erosion control is critical to maintaining slopes and drainage must be routed away from slope faces.

Seismic Issues

Liquefaction - The critical liquefaction triggering event at the site is a Cascadia subduction zone earthquake with an expected Magnitude of 8.5 to 9.0 and PGA_M of 1.02g with a 2% chance of being exceeded in 50 years. Strains at that level of shaking become asymptotic, so similar liquefaction deformation is also expected with much lower and higher CSZ interface quakes and accelerations. Using the CPT and B-1 profiles, we analyzed liquefaction and deformations using several methods incorporated into the CLiq software program and SPT methods by authors Idriss, Tokimatsu, Seed, Seed and Fear, and others. We evaluated sensitivity to fines content, relative density, unit weight, slope and free face dimensions and proximity, and several other variables to estimate site deformations. An example calculation output for P1 is attached for reference. Based on this, liquefaction and strength reduction induced settlement can occur in layers at depths between 13 and 19 feet in P-1, and less in other explorations, and in a thin layer represented by one sample near 45 feet in B-1. Free field settlement is estimated at less than 1 inch (roughly 0.5 inches from the 45-foot-deep layer), with lateral

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spreading toward the ocean calculated to be up to 3.5 inches. Differential lateral spreading is likely half of that. Controlling lateral spreading was the "gently sloping" model versus the "free face" model of the distant ocean and low walls 750 feet west. Previous reporting used appropriate methods for that time, which are super-ceded by methods used in our analyses. Use of more detailed (with no more detailed input) finite element models of deformation are not a part of this scope and in our opinion are not justified due to the modest movement and resulting recommendations to structural systems which are not likely to be improved by such analyses.

Seismic Site Class - We used procedures from ASCE 7-22 to determine the seismic site class. Site soils technically correspond to Site Class F although liquefaction is limited. However, in accordance with the building code for short appropriate response periods the subject project soils could have structural seismic lateral forces evaluated using the parameters associated with Site Class D. Other code criteria may impact this classification.

Shear wave velocities in the upper silt unit were measured, and in the sand were obtained from nearby experience and correlation with the SPT blow counts in the borings. The weighted average of the velocities in the top 30 meters (approx. 100 feet) is used to determine the "Vs_{30}" site class, as well as other criteria to capture the site response character. As the organic vertical extent was less than 10 feet, and the soft silt less than 25 feet, other criteria for Class E were not met. The calculation sheet for Vs_{30} is attached. We calculated site class to be Class CD near the margin of Class D, and we therefore recommend using Class D as it is more conservative and would capture the variability in the profile.

Tsunamis and Coseismic Subsidence - DOGAMI 2013 tsunami mapping indicates the site will be inundated by a "medium slip" CSZ interface event or larger, and a distant Alaskan event, which is consistent with the information in the 2011 report. The existing ground surface may drop an estimated 6 to 7 feet (ASCE 7-22) in elevation after a design level earthquake. This may impact flood elevations and tsunami inundation, as well as re-occupancy/rebuilding.

Pile/Pier Foundations

General - Due to the presence of highly compressible silt soils all foundations and slabs must be supported on piles embedded into the lower dense sand unit. Based on our explorations, the top of the lower sand unit ranged from 19 to 25 feet below the ground surface. Capacities listed herein may be limited by the structural capacity of the pile and must be evaluated by a structural engineer. Piles/piers must be spaced a minimum of 3 pile diameters apart. Closer spacing will result in a reduction in pile/pier capacity resulting from group effects and we must be consulted. Fills greater than two feet above existing grades will induce down-drag on the piles and are not recommended.

Piles in a fixed condition in pile caps or within continuous grade beams are recommended. Due to the risk of long-term settlement in the silt with organics, as well as differential lateral movement from liquefaction, we recommend floors be designed as structural to free span between grade beams or be directly pile supported. Interior unsupported slabs-on-grade are not recommended.

Helical piers may be the most economical approach if they can reach suitable penetration. Grouted micropiles are more expensive but would have greater capacity and are more likely to advance through larger organics. The following sections discuss helical piers and grouted micropiles in more detail.

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Helical Piers - Installation of helical piers may not be feasible to the required depths, and reaching these depths must be proven with the use of indicator piers. These depths must include both helixes being interpreted as being embedded in dense or better sand. If penetration is proven feasible, helical piers can be used to support vertical loads, and inclined piers can be used to provide greater lateral resistance. 3.5-inch diameter shafts are recommended due to penetration, efficient load use, lateral resistance, seismic motions, and related scour. Piers are generally installed in 5- to 7-foot-long sections and threaded or sleeved and double/triple bolted pier shaft connections are required to reduce lateral deflection. A hydraulic motor mounted to an excavator is typically used for installation and observed torque during installation (with calibrated load devices) is used to confirm capacity, typically with a K factor of 7 for 3.5" shafts. Indicator piers are required prior to final design and construction to evaluate the feasibility of penetration to the required depths. Organics or the high density of the sand unit may present refusal short of the required depths, in which case predrilling or modification of the pier helixes may be required.

We recommend vertical piers with the following allowable capacities be used for design, with a minimum pier spacing (vertical and horizontal) of three helix diameters. Resistance to lateral loading of 2 kips per pile is allowed for vertical piles, and piles battered up to 30 degrees from vertical can be designed to the horizontal vector of the preceding loads in the direction of downward batter, and 90% in the opposite direction. All helical piers must be galvanized, or corrosion protected. Again, the following can only be used if the dense sand unit is penetrated to develop the needed torque. Plates larger than 12 inches are not recommended due to anticipated penetration issues, unless proved otherwise by indicator piling.

Helical Pier Type	Inclination	Est. Length (ft)	Allowable Load* (kips)
8" and 10" Double with 3-1/2" pipe with threaded or sleeved and double bolted connection	Vertical	25-30	40 (C), 36 (T)

* C – Compression T – Tension

Capacities for additional pier sizes and inclinations can be provided upon request. We recommend that we be retained to review pier support design and be called to the site to observe pier installation.

Grouted Micropiles - Grouted micro-piles are a higher capacity option for building and slab support that can often penetrate obstructions and reach suitable embedment better than helical piers. As building loads are expected to be modest for a two-story building, 6-inch diameter grouted Titan 40/16 micropiles would be a reasonable approach, although other types and sizes can be proposed and may be viable. Embedment for the 40/16 grouted piles must be at least 10 feet into the dense lower sand unit. At 10 feet into the sand unit, a downward vertical allowable load of 70 kips can be used for design, at estimated total lengths of 30-35 feet. For the preceding pile, an allowable uplift capacity of 60 kips may be used. Higher capacities of 100 kips downward and 90 kips in uplift can be obtained from penetration of 30 feet into the sand (depths of 50-55 feet), which would also be below the one thin liquefaction layer in B-1 near 45 feet (that has one-half inch of calculated settlement). Resistance to lateral loading of 3

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kips per pile is allowed for vertical piles, and for piles battered up to 30 degrees from vertical the horizontal vector of the preceding loads could be used in the direction of downward batter, with 90% of that in the opposite direction.

Capacities for additional pile sizes and inclinations can be provided upon request. We must be retained to review pile support design and called to the site to observe installation of piles.

Grade Beams - Isolated pile caps are not allowed. All piles must be embedded into self-supporting grade beams (with no long-term lateral soil restraint or subgrade support except during placement) or be pile-columns properly connected with beams for lateral continuity. We recommend perimeter grade beams or a continuous pile cap around the building perimeter to help resist tsunami scour damage and aid in post tsunami egress. These beams/caps should be embedded at least 3 feet below exterior perimeter grade. To improve tsunami scour, exterior perimeter abutting grades should be paving or sidewalk a distance of at least 4 feet out from the building perimeter, or alternatively have a wire mesh gabion rock mattress installed below surface features and at least 6 feet in width. Lateral load resistance of a 200 pcf equivalent fluid can be used below the top foot of the side of grade beams for wind and seismic forces, but not tsunami forces. Grade beam base friction must be neglected due to long term settlement.

Slabs - Slabs must be structural and designed to free span between pile caps and pile supported grade beams. A vapor barrier is required on the base rock – refer to ***Ground Moisture*** herein.

Hardscaping

Exterior perimeter abutting grades should be paving or sidewalk a distance of at least 4 feet out from the building perimeter on each side to reduce tsunami scour. Abutting planters are not recommended unless an underlying gabion rock mattress is used below it out past it and to a distance of 6 feet from the building. Due to modest expected deformations, abutting hardscaping such as sidewalks and parking aprons do not need pile support. A minimum of six inches of clean, angular crushed rock with no more than 6 percent passing a #200 sieve is recommended for use under hardscaping. Prior to rock placement the subgrade will need to be evaluated by us via probing. Rock under hard-scaping should be compacted to 92 percent compaction relative to ASTM D 1557. In addition, any areas contaminated with fines must be removed and replaced with clean rock. If the base rock is saturated or trapping water, this water must be removed prior to slab placement.

Ground Moisture

General - The perimeter ground surface and hard-scaping should be sloped to drain away from all structures. Gutters should be tight-lined to a suitable discharge and maintained as free-flowing. Due to shallow groundwater anticipated at the site and expected very soft conditions below a few feet, basements are not recommended. We should be consulted to evaluate moisture, drainage and stabilization impacts for finished floor embedment greater than 2 feet below existing grade.

Perimeter Foundation Drains - We recommend installing perimeter foundation drains around all exterior foundations/grade beams. The foundation drains should consist of a two-foot-wide zone of drain rock encompassing a 4-inch diameter perforated pipe, all enclosed with a non-woven filter fabric. The drain rock should have no more than 2 percent passing a #200 sieve and should extend to within one foot of the ground surface. The geosynthetic should be a Mirafi 160n or equivalent. One foot of

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low permeability soil prepared as structural fill should be placed over the fabric at the top of the drain to isolate the drain from surface runoff. Foundation drains must be routed to a suitable discharge.

Vapor Flow Retardant - A continuous, impervious 10-15 mil vapor barrier must be installed over the ground surface under all slabs. Barriers should be installed per the manufacturer's recommendations.

Pavement

Design - We have developed asphalt concrete pavement thickness at the site for 3 trucks per day (with a truck factor of 0.6) and a 20-year design life. These volumes can be revised if specific traffic data is available. Designs are also suitable to support a 75,000 pound fire truck. Our analyses are based on AASHTO methods and subgrade of undisturbed medium stiff silt or better native silt or fill having a resilient modulus of 3,000 psi. Construction will likely require protection and stabilization of subgrades as recommended in the ***Stabilization and Soft Areas and Working Blankets*** and ***Haul Roads*** sections of this report, and a Propex Geotex 801 (or equivalent) separation geosynthetic is required. The results of our analyses based on these parameters are provided in the following table.

Based on the results of our analyses we recommend a minimum of 3.0 inches of asphalt concrete (AC) over 9 inches of crushed rock base (CRB). Areas exposed to only car traffic can be constructed of 3 inches of AC over 8 inches of CRB.

Subgrade Preparation - The pavement subgrade should be prepared in accordance with the ***Earthwork*** recommendations presented in this report. All pavement subgrades will need to pass a proof roll prior to paving. Soft areas should be repaired by overexcavating the areas, installing a separation geosynthetic and geogrid, and brought to-grade with well graded, angular crushed rock compacted as structural fill. For a separation geosynthetic we recommend a Propex Geotex 801 or equivalent, and the geogrid a Hanes Egrid 2020 or equivalent.

Base Rock - The recommended thicknesses are intended to be the minimum acceptable. Crushed rock should conform to ODOT base rock standards and have less than 6 percent passing the #200 sieve. Asphalt concrete should be compacted in lifts no greater than 3 inches in thickness to 91 percent of a Rice Density, or to 98 percent of the maximum density from a test strip.

LIMITATIONS AND OBSERVATION DURING CONSTRUCTION

We have prepared this report for use by the City of Cannon Beach and members of their design and construction teams for this project only. The information herein can be used for bidding or estimating purposes but should not be construed as a warranty of subsurface conditions. We have made observations only at the surface and have drawn from adjacent personal experience and explorations reported by others, only at the stated locations and to the stated depths. These observations do not reflect soil types, strata thicknesses, water levels or seepage that may exist between observations. We should 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 should be consulted. The preceding recommendations should be considered preliminary, as actual soil conditions may vary. In order for our recommendations to be final, we must be retained to review final building plans, to observe actual subsurface conditions encountered, and to observe foundation subgrades and pile driving.

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Our observations will allow us to adapt to actual conditions and to update our recommendations if needed.

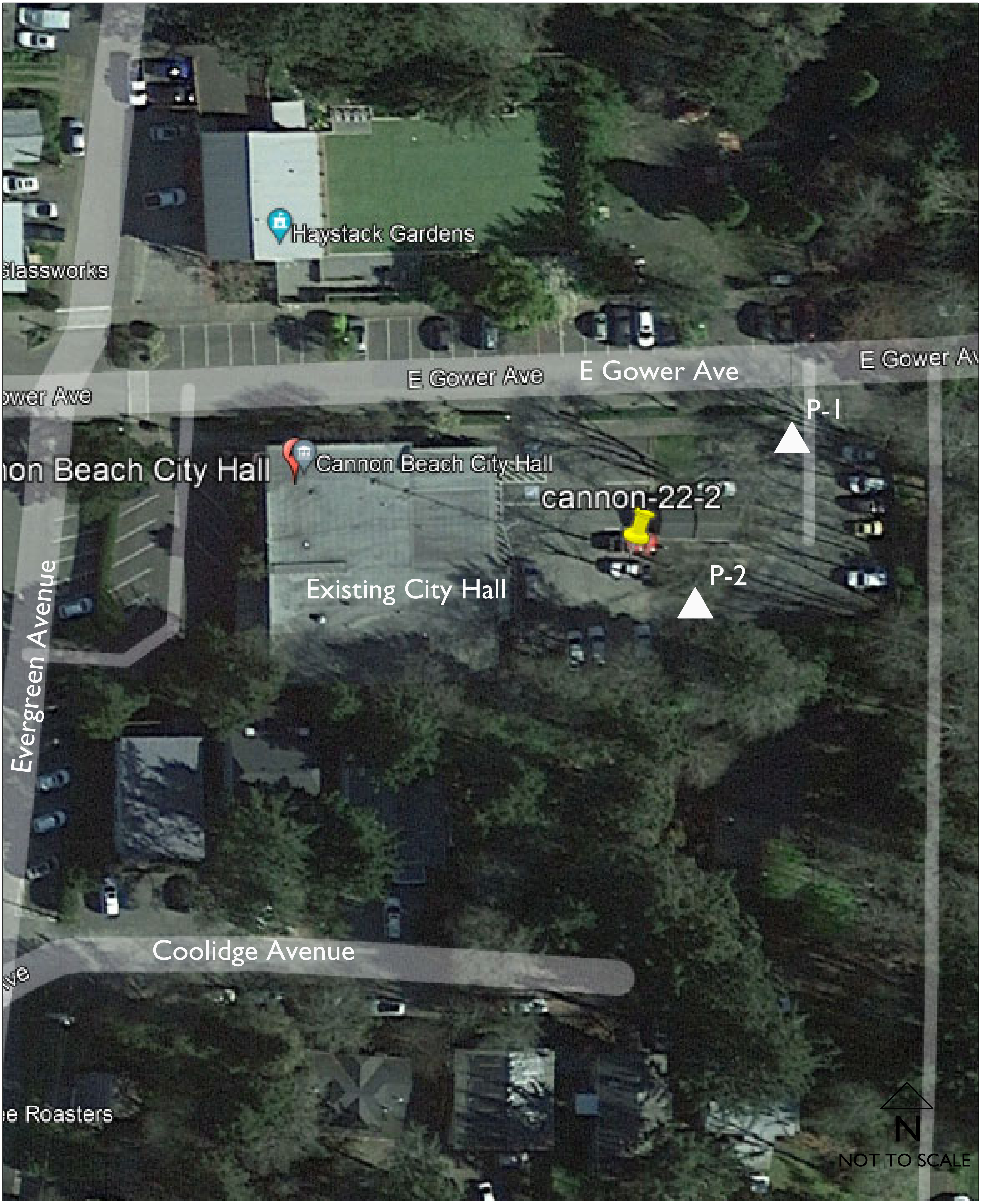
Within the limitations of scope, schedule and budget, our services have been executed in accordance with the generally accepted practices in this area at the time this report was prepared. No warranty, expressed or implied, is given.

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 logs, Vs30 calculation sheet, liquefaction calculation example, ASCE 7-22 Hazard Tool, 2011 Chinook Geoservices Report



BASE PHOTO FROM GOOGLE EARTH 2021 AERIAL

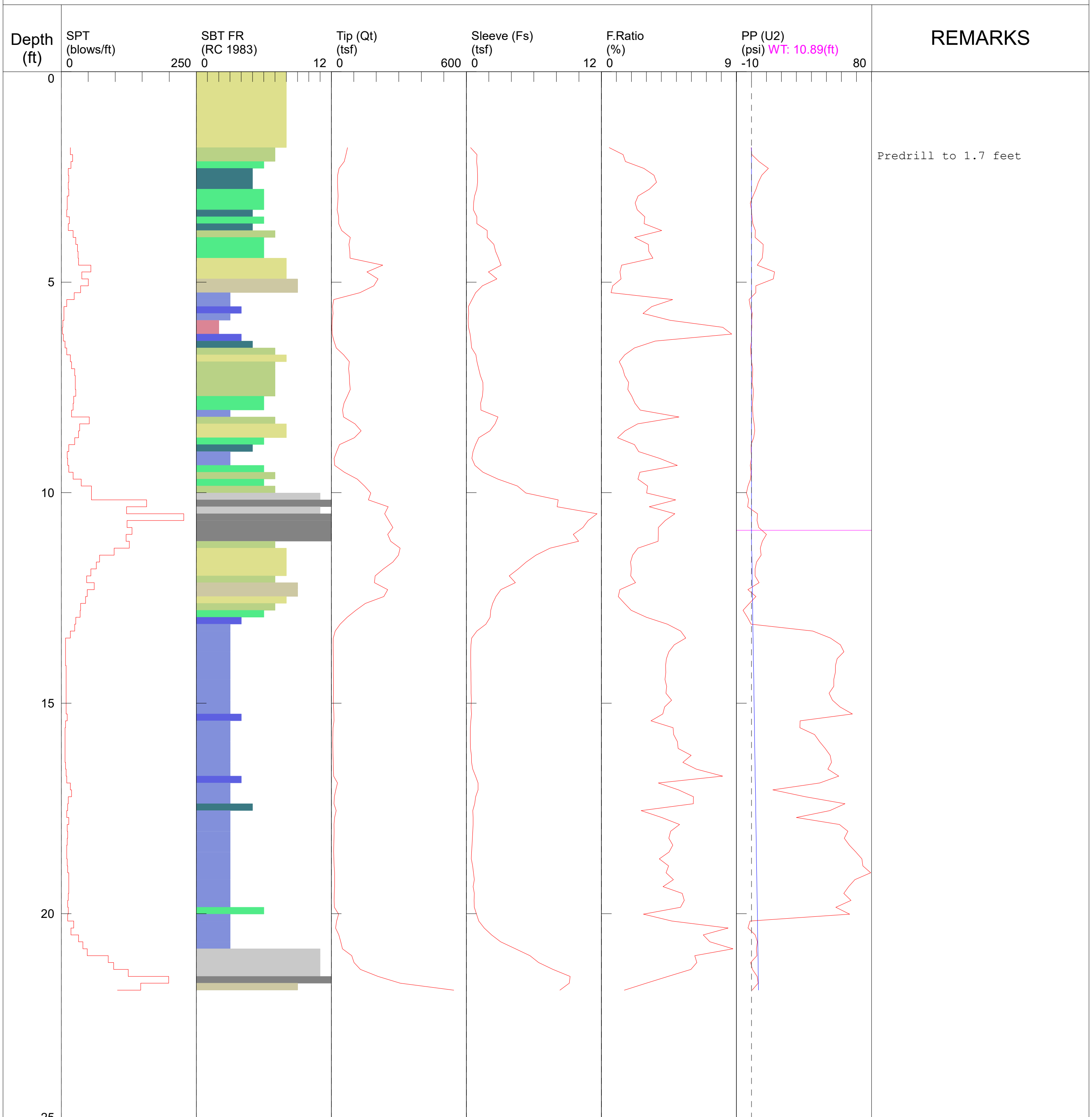
Geotech Solutions Inc.

SITE PLAN

cannon-22-2-gi

Geotech Solutions / CPT-1 / 163 E Gower Street Cannon Beach

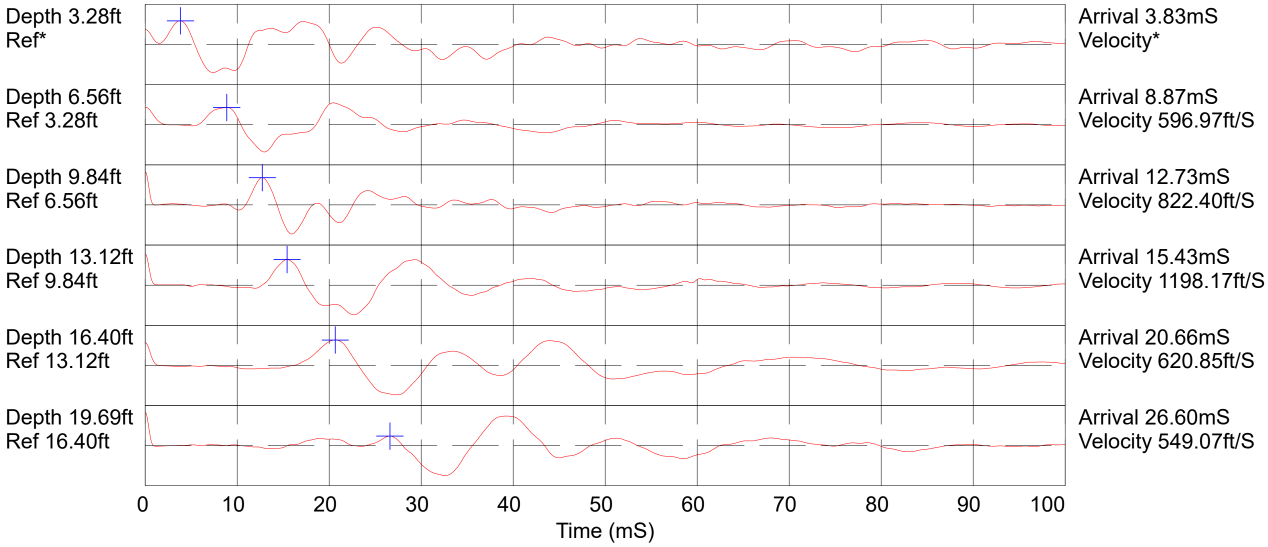
OPERATOR: OGE BAK
CONE ID: DDG1296
TEST DATE: 7/12/2023 9:08:58 AM
TOTAL DEPTH: 21.818 ft



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

COMMENT: Geotech Solutions / CPT-1 / 163 E Gower Street Cannon Beach



Hammer to Rod String Distance (ft): 2.04
* = Not Determined

Geotech Solutions / CPT-1 / 163 E Gower Street Cannon Beach

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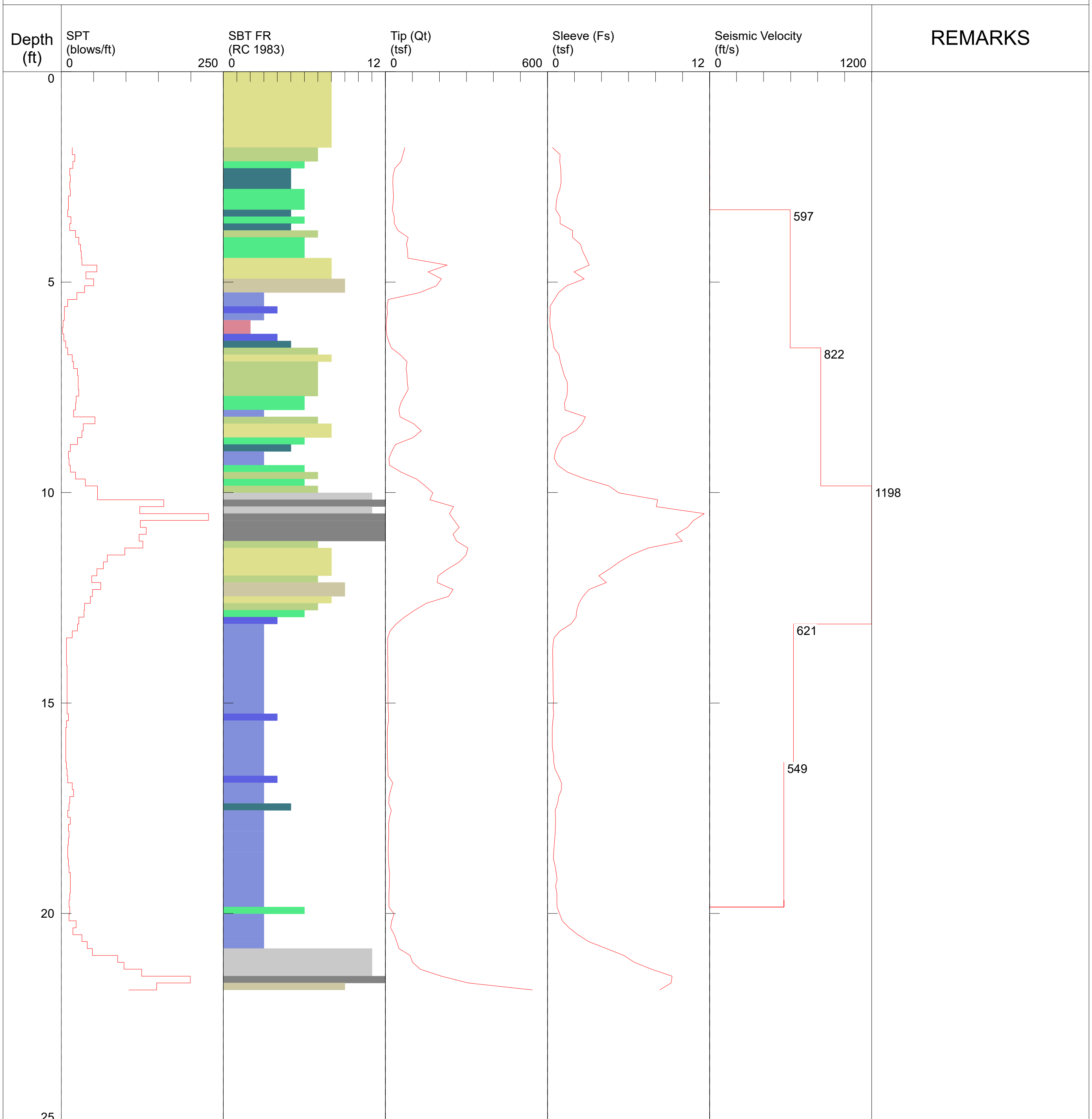

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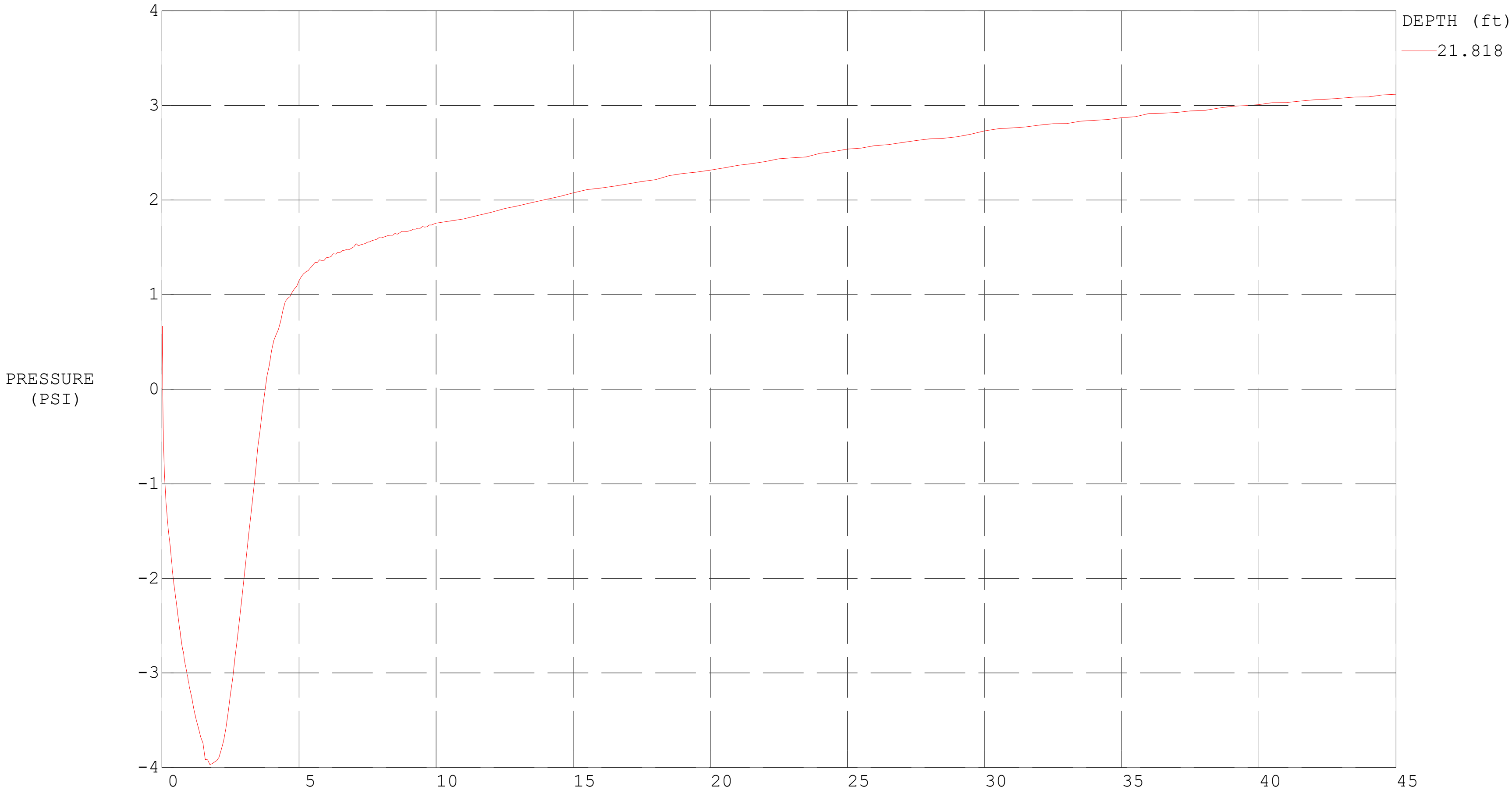


MAXIMUM PRESSURE = 3.118 (PSI) TIME: (MINUTES)
HYDROSTATIC PRESSURE = 4.735 (PSI), WATER TABLE: 10.89 ft

Geotech Solutions / CPT-1 / 163 E Gower Street Cannon Beach

OPERATOR: OGE BAK
CONE ID: DDG1296
TEST DATE: 7/12/2023 9:08:58 AM
TOTAL DEPTH: 21.818 ft

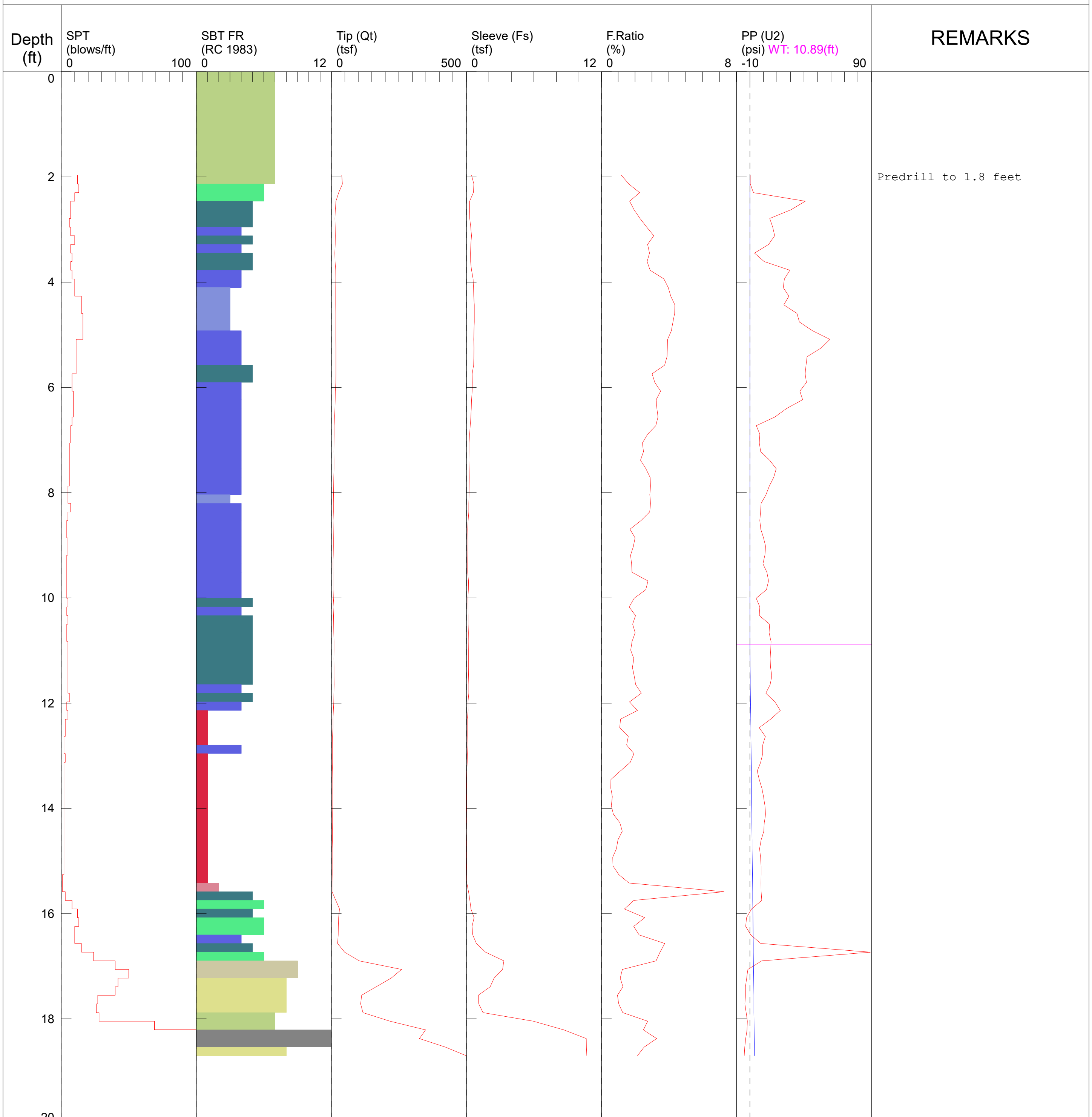
Depth ft	Tip (Qt) (tsf)	Sleeve (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
1.804	71.87	0.3755	0.523	-0.231	17	8	sand to silty sand
1.969	64.66	0.9340	1.444	0.284	21	7	silty sand to sandy silt
2.133	57.23	0.9119	1.593	4.979	18	7	silty sand to sandy silt
2.297	34.46	0.9747	2.828	11.323	13	6	sandy silt to clayey silt
2.461	28.37	0.9946	3.506	6.831	14	5	clayey silt to silty clay
2.625	27.26	1.0014	3.673	4.639	13	5	clayey silt to silty clay
2.789	28.73	0.9185	3.197	3.084	14	5	clayey silt to silty clay
2.953	29.83	0.7287	2.442	1.031	11	6	sandy silt to clayey silt
3.117	28.67	0.6464	2.255	-0.775	11	6	sandy silt to clayey silt
3.281	25.70	0.6126	2.383	-0.036	10	6	sandy silt to clayey silt
3.445	32.22	0.9319	2.892	0.312	15	5	clayey silt to silty clay
3.609	32.81	0.9317	2.839	0.919	13	6	sandy silt to clayey silt
3.773	46.11	1.8550	4.023	2.613	22	5	clayey silt to silty clay
3.937	83.87	1.8567	2.214	2.466	27	7	silty sand to sandy silt
4.101	78.06	2.4438	3.131	7.807	30	6	sandy silt to clayey silt
4.265	82.09	2.5886	3.153	7.628	31	6	sandy silt to clayey silt
4.429	83.01	2.8487	3.432	7.188	32	6	sandy silt to clayey silt
4.593	228.46	3.0823	1.349	3.892	55	8	sand to silty sand
4.757	158.01	1.9609	1.241	15.415	38	8	sand to silty sand
4.921	207.27	2.7152	1.310	14.621	50	8	sand to silty sand
5.085	188.57	1.4247	0.756	2.920	36	9	sand
5.249	126.91	0.8205	0.646	2.942	24	9	sand
5.413	10.60	0.5035	4.750	-1.557	10	3	clay
5.577	5.45	0.1831	3.360	-0.808	5	3	clay
5.741	7.40	0.2056	2.777	0.532	5	4	silty clay to clay
5.906	3.54	0.1623	4.585	0.176	3	3	clay
6.070	2.46	0.1994	8.091	0.248	2	2	organic material
6.234	3.83	0.3323	8.684	-0.167	4	2	organic material
6.398	11.51	0.4126	3.585	0.078	7	4	silty clay to clay
6.562	21.68	0.4760	2.195	-0.596	10	5	clayey silt to silty clay
6.726	54.60	0.8528	1.562	-0.312	17	7	silty sand to sandy silt
6.890	80.11	0.9508	1.187	0.145	19	8	sand to silty sand
7.054	76.77	1.0923	1.423	0.775	25	7	silty sand to sandy silt
7.218	80.15	1.2434	1.551	0.708	26	7	silty sand to sandy silt
7.382	80.69	1.4671	1.818	0.457	26	7	silty sand to sandy silt
7.546	84.34	1.4795	1.754	1.245	27	7	silty sand to sandy silt
7.710	70.53	1.4274	2.024	1.114	23	7	silty sand to sandy silt
7.874	56.41	1.2573	2.229	0.674	22	6	sandy silt to clayey silt
8.038	50.02	1.2937	2.586	0.805	19	6	sandy silt to clayey silt
8.202	54.25	2.8047	5.170	1.036	52	3	clay
8.366	105.14	2.5466	2.422	1.808	34	7	silty sand to sandy silt
8.530	132.63	2.0874	1.574	2.223	32	8	sand to silty sand
8.694	102.42	1.1063	1.080	1.463	25	8	sand to silty sand
8.858	36.73	0.8101	2.206	-0.237	14	6	sandy silt to clayey silt
9.022	23.58	0.5863	2.487	-0.184	11	5	clayey silt to silty clay
9.186	12.71	0.4925	3.874	0.047	12	3	clay

Depth ft	Tip (Qt) (tsf)	Sleeve (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
9.350	14.99	0.7581	5.056	-0.833	14	3	clay
9.514	57.98	1.4826	2.557	-0.248	22	6	sandy silt to clayey silt
9.678	115.19	2.8017	2.432	-0.649	37	7	silty sand to sandy silt
9.843	147.45	4.5385	3.078	-2.307	56	6	sandy silt to clayey silt
10.007	175.15	5.2861	3.018	-3.335	56	7	silty sand to sandy silt
10.171	164.65	8.1563	4.954	-1.886	158	11	very stiff fine grained (*)
10.335	252.45	8.0568	3.191	-2.533	121	12	sand to clayey sand (*)
10.499	237.24	11.6048	4.891	4.062	227	11	very stiff fine grained (*)
10.663	254.58	10.8200	4.250	3.744	122	12	sand to clayey sand (*)
10.827	273.25	10.3557	3.790	4.887	131	12	sand to clayey sand (*)
10.991	250.30	9.5000	3.795	9.952	120	12	sand to clayey sand (*)
11.155	263.82	9.9730	3.780	7.244	126	12	sand to clayey sand (*)
11.319	305.65	7.4451	2.436	5.867	98	7	silty sand to sandy silt
11.483	298.04	6.1876	2.076	6.458	71	8	sand to silty sand
11.647	273.43	5.3124	1.943	3.396	65	8	sand to silty sand
11.811	231.42	4.6064	1.990	2.396	55	8	sand to silty sand
11.975	194.91	3.8040	1.952	2.466	47	8	sand to silty sand
12.139	191.57	4.3514	2.271	5.104	61	7	silty sand to sandy silt
12.303	250.67	3.0684	1.224	-2.354	48	9	sand
12.467	233.40	2.6272	1.126	2.992	45	9	sand
12.631	150.95	2.3288	1.543	-1.410	36	8	sand to silty sand
12.795	109.07	2.1640	1.984	-5.575	35	7	silty sand to sandy silt
12.959	70.33	2.1131	3.005	-2.719	27	6	sandy silt to clayey silt
13.123	39.48	1.7360	4.398	-0.217	25	4	silty clay to clay
13.287	17.60	0.9289	5.279	40.886	17	3	clay
13.451	8.47	0.4762	5.622	52.593	8	3	clay
13.615	8.26	0.4010	4.858	59.285	8	3	clay
13.780	8.51	0.3824	4.496	61.609	8	3	clay
13.944	8.85	0.3836	4.333	57.170	8	3	clay
14.108	9.03	0.3861	4.277	56.011	9	3	clay
14.272	9.32	0.4001	4.294	55.947	9	3	clay
14.436	9.67	0.4092	4.232	54.877	9	3	clay
14.600	9.63	0.4189	4.347	54.897	9	3	clay
14.764	9.69	0.4169	4.304	51.707	9	3	clay
14.928	9.47	0.4431	4.678	54.011	9	3	clay
15.092	9.90	0.4164	4.206	59.001	9	3	clay
15.256	11.27	0.4603	4.086	67.250	11	3	clay
15.420	11.94	0.3945	3.303	32.424	8	4	silty clay to clay
15.584	7.40	0.3533	4.772	32.305	7	3	clay
15.748	7.19	0.3465	4.818	42.073	7	3	clay
15.912	6.91	0.3503	5.067	45.360	7	3	clay
16.076	7.12	0.3638	5.112	49.172	7	3	clay
16.240	7.52	0.4502	5.983	52.484	7	3	clay
16.404	8.48	0.4601	5.426	53.312	8	3	clay
16.568	8.89	0.5616	6.320	50.916	9	3	clay
16.732	10.06	0.8112	8.066	58.129	10	3	clay
16.896	27.21	1.0327	3.796	45.477	17	4	silty clay to clay
17.060	20.16	1.0346	5.132	14.265	19	3	clay
17.224	13.41	0.8226	6.133	35.926	13	3	clay
17.388	12.17	0.7455	6.125	62.277	12	3	clay
17.552	21.50	0.5677	2.641	52.197	10	5	clayey silt to silty clay
17.717	14.82	0.5957	4.019	29.939	14	3	clay
17.881	11.47	0.5971	5.205	58.619	11	3	clay
18.045	12.35	0.5697	4.611	64.264	12	3	clay
18.209	11.99	0.5382	4.490	61.818	11	3	clay
18.373	10.55	0.5017	4.756	65.269	10	3	clay
18.537	10.29	0.4639	4.510	69.591	10	3	clay

Depth ft	Tip (Qt) (tsf)	Sleeve (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
18.701	11.26	0.4351	3.863	73.611	11	3	clay
18.865	12.44	0.5572	4.480	74.207	12	3	clay
19.029	14.80	0.6376	4.308	79.465	14	3	clay
19.193	14.70	0.7053	4.798	68.969	14	3	clay
19.357	14.55	0.5974	4.106	64.774	14	3	clay
19.521	13.05	0.7035	5.388	61.475	13	3	clay
19.685	12.49	0.6895	5.522	66.378	12	3	clay
19.849	13.37	0.7056	5.276	56.226	13	3	clay
20.013	32.03	0.8997	2.809	65.364	12	6	sandy silt to clayey silt
20.177	23.55	1.1050	4.691	-0.983	23	3	clay
20.341	18.85	1.5922	8.446	-2.312	18	3	clay
20.505	33.08	2.2454	6.787	2.535	32	3	clay
20.669	42.13	3.0459	7.230	3.953	40	3	clay
20.833	49.73	4.3588	8.765	3.318	48	3	clay
20.997	90.81	5.6496	6.221	3.594	87	11	very stiff fine grained (*)
21.161	100.99	6.4220	6.359	-0.571	97	11	very stiff fine grained (*)
21.325	129.13	7.6998	5.963	0.680	124	11	very stiff fine grained (*)
21.490	207.82	9.2211	4.437	3.772	199	11	very stiff fine grained (*)
21.654	306.01	9.1524	2.991	4.388	147	12	sand to clayey sand (*)
21.818	543.94	8.3122	1.528	0.390	104	9	sand

Geotech Solutions / CPT-2 / 163 E Gower Street Cannon Beach

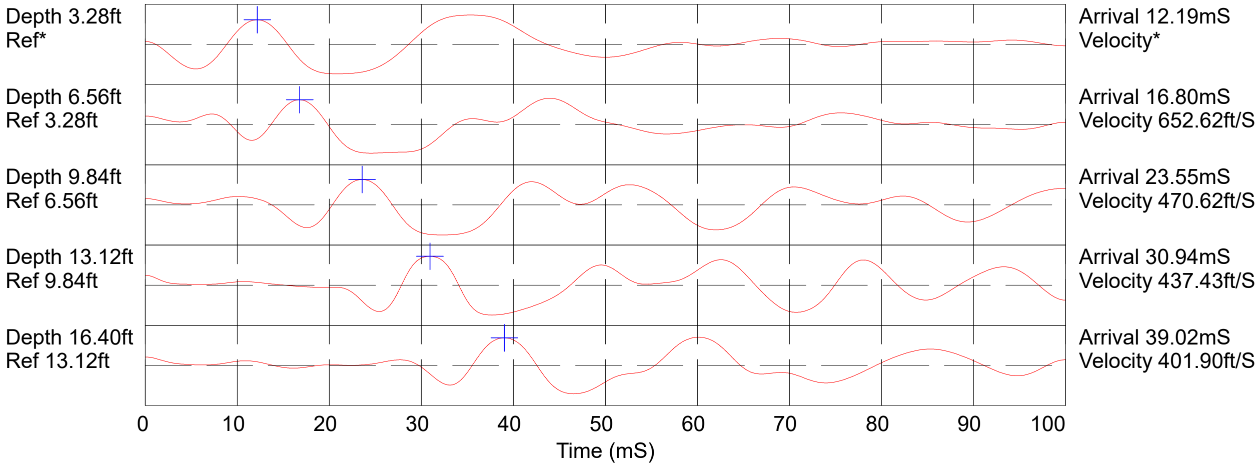
OPERATOR: OGE BAK
CONE ID: DDG1296
TEST DATE: 7/12/2023 10:44:55 AM
TOTAL DEPTH: 18.701 ft



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

*SBT/SPT CORRELATION: UBC-1983

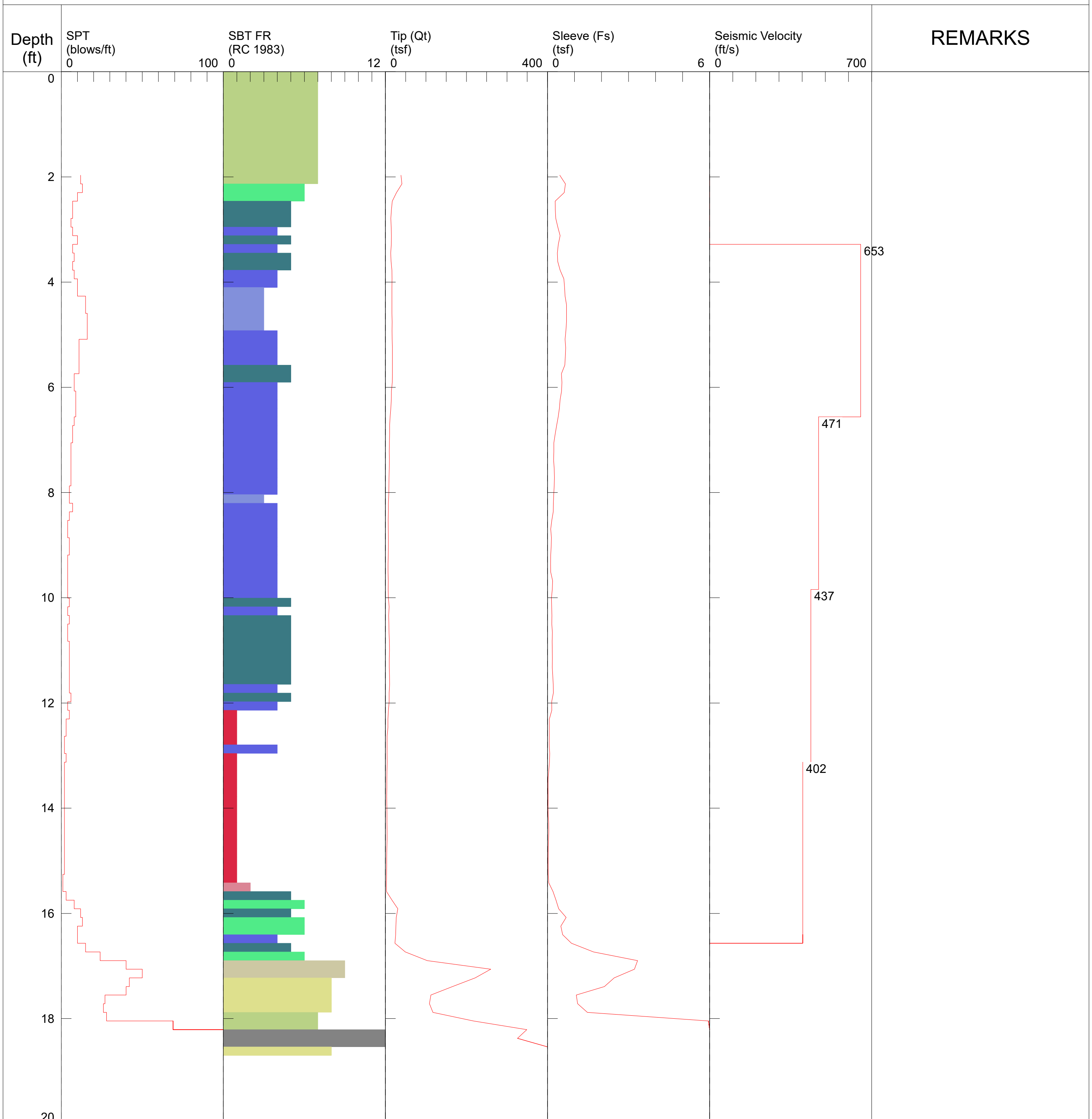
COMMENT: Geotech Solutions / CPT-2 / 163 E Gower Street Cannon Beach



Hammer to Rod String Distance (ft): 2.04
* = Not Determined

Geotech Solutions / CPT-2 / 163 E Gower Street Cannon Beach

OPERATOR: OGE BAK
CONE ID: DDG1296
TEST DATE: 7/12/2023 10:44:55 AM
TOTAL DEPTH: 18.701 ft

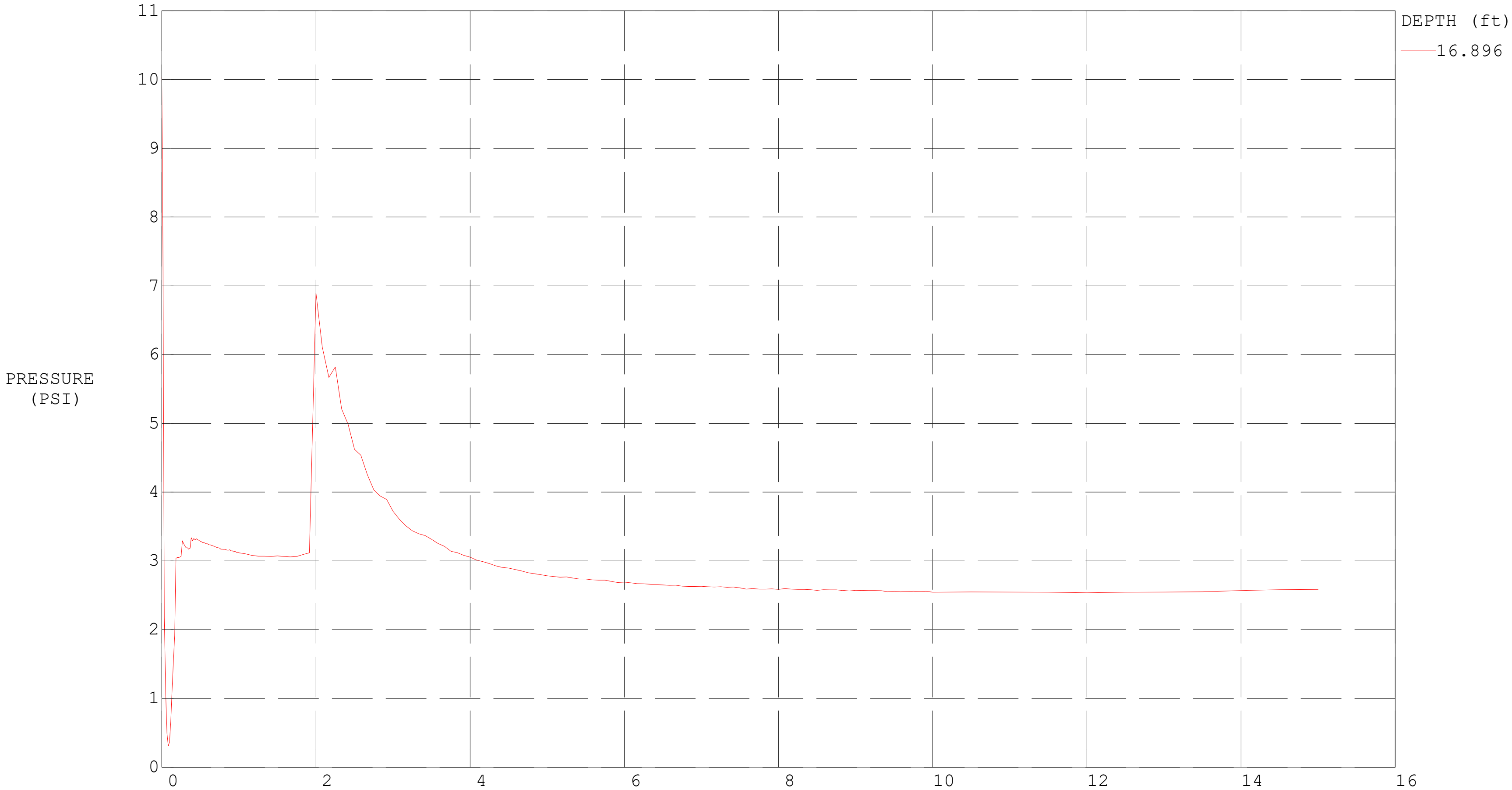


1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

COMMENT: Geotech Solutions / CPT-2 / 163 E Gower Street Cannon Beach

CONE ID: DDG1296
TEST DATE: 7/12/2023 10:44:55 AM



MAXIMUM PRESSURE = 10.038 (PSI)
HYDROSTATIC PRESSURE = 2.602 (PSI), WATER TABLE: 10.89 ft

Geotech Solutions / CPT-2 / 163 E Gower Street Cannon Beach

OPERATOR: OGE BAK
CONE ID: DDG1296
TEST DATE: 7/12/2023 10:44:55 AM
TOTAL DEPTH: 18.701 ft

Depth ft	Tip (Qt) (tsf)	Sleeve (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
1.969	38.24	0.4536	1.186	0.192	12	7	silty sand to sandy silt
2.133	40.81	0.6616	1.621	0.293	13	7	silty sand to sandy silt
2.297	27.23	0.6167	2.265	2.552	10	6	sandy silt to clayey silt
2.461	16.97	0.2840	1.673	40.986	7	6	sandy silt to clayey silt
2.625	14.78	0.2858	1.934	30.379	7	5	clayey silt to silty clay
2.789	13.30	0.3046	2.290	14.660	6	5	clayey silt to silty clay
2.953	14.19	0.3814	2.688	16.917	7	5	clayey silt to silty clay
3.117	15.01	0.4647	3.096	18.263	10	4	silty clay to clay
3.281	14.53	0.3970	2.732	13.799	7	5	clayey silt to silty clay
3.445	12.85	0.3660	2.848	3.421	8	4	silty clay to clay
3.609	13.91	0.3765	2.708	10.487	7	5	clayey silt to silty clay
3.773	16.18	0.4667	2.885	29.546	8	5	clayey silt to silty clay
3.937	16.28	0.6020	3.698	25.543	10	4	silty clay to clay
4.101	15.93	0.6310	3.960	24.637	10	4	silty clay to clay
4.265	15.83	0.6509	4.112	28.786	15	3	clay
4.429	16.14	0.7032	4.357	25.036	15	3	clay
4.593	16.23	0.7043	4.338	34.859	16	3	clay
4.757	16.59	0.7030	4.238	36.620	16	3	clay
4.921	16.40	0.6795	4.144	46.241	16	3	clay
5.085	16.63	0.6532	3.928	59.196	11	4	silty clay to clay
5.249	17.17	0.6708	3.907	52.752	11	4	silty clay to clay
5.413	17.02	0.6606	3.882	42.326	11	4	silty clay to clay
5.577	17.11	0.6415	3.749	41.499	11	4	silty clay to clay
5.741	17.12	0.5140	3.003	40.880	8	5	clayey silt to silty clay
5.906	16.78	0.5308	3.163	41.755	8	5	clayey silt to silty clay
6.070	14.85	0.5209	3.509	36.968	9	4	silty clay to clay
6.234	14.36	0.4663	3.248	39.000	9	4	silty clay to clay
6.398	13.34	0.4384	3.286	27.265	9	4	silty clay to clay
6.562	11.78	0.3951	3.353	18.458	8	4	silty clay to clay
6.726	10.46	0.3371	3.221	4.739	7	4	silty clay to clay
6.890	10.41	0.2846	2.733	7.294	7	4	silty clay to clay
7.054	9.68	0.2350	2.429	6.987	6	4	silty clay to clay
7.218	9.38	0.2343	2.499	7.912	6	4	silty clay to clay
7.382	9.72	0.2247	2.312	14.524	6	4	silty clay to clay
7.546	9.52	0.2506	2.632	19.514	6	4	silty clay to clay
7.710	8.96	0.2584	2.884	17.586	6	4	silty clay to clay
7.874	8.61	0.2509	2.913	14.365	5	4	silty clay to clay
8.038	8.10	0.2322	2.866	11.802	5	4	silty clay to clay
8.202	7.40	0.2156	2.913	8.258	7	3	clay
8.366	7.44	0.2127	2.858	7.784	5	4	silty clay to clay
8.530	6.74	0.1583	2.349	7.252	4	4	silty clay to clay
8.694	6.95	0.1178	1.694	8.010	4	4	silty clay to clay
8.858	7.36	0.1464	1.989	10.013	5	4	silty clay to clay
9.022	7.32	0.1388	1.896	11.615	5	4	silty clay to clay
9.186	7.00	0.1208	1.726	11.064	4	4	silty clay to clay
9.350	6.43	0.1150	1.788	9.609	4	4	silty clay to clay

Depth ft	Tip (Qt) (tsf)	Sleeve (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
9.514	6.57	0.1190	1.812	12.549	4	4	silty clay to clay
9.678	6.84	0.1887	2.760	13.786	4	4	silty clay to clay
9.843	6.73	0.1766	2.625	12.186	4	4	silty clay to clay
10.007	7.49	0.1455	1.943	4.575	5	4	silty clay to clay
10.171	9.19	0.1512	1.645	7.252	4	5	clayey silt to silty clay
10.335	8.02	0.1621	2.021	6.965	5	4	silty clay to clay
10.499	8.55	0.1577	1.844	14.602	4	5	clayey silt to silty clay
10.663	8.93	0.1784	1.999	14.226	4	5	clayey silt to silty clay
10.827	9.56	0.1730	1.809	15.591	5	5	clayey silt to silty clay
10.991	10.08	0.1745	1.732	15.312	5	5	clayey silt to silty clay
11.155	9.42	0.1805	1.916	15.020	5	5	clayey silt to silty clay
11.319	9.55	0.1752	1.835	15.215	5	5	clayey silt to silty clay
11.483	10.01	0.1941	1.940	16.123	5	5	clayey silt to silty clay
11.647	10.47	0.2122	2.026	14.945	5	5	clayey silt to silty clay
11.811	9.19	0.2172	2.364	11.777	6	4	silty clay to clay
11.975	9.08	0.1508	1.662	18.430	4	5	clayey silt to silty clay
12.139	7.33	0.1565	2.136	22.484	5	4	silty clay to clay
12.303	6.20	0.0704	1.136	15.312	3	1	sensitive fine grained
12.467	6.26	0.0677	1.082	6.840	3	1	sensitive fine grained
12.631	4.27	0.0680	1.593	11.370	2	1	sensitive fine grained
12.795	4.30	0.0643	1.496	9.445	2	1	sensitive fine grained
12.959	4.32	0.0834	1.929	9.414	3	4	silty clay to clay
13.123	4.38	0.0747	1.704	7.915	2	1	sensitive fine grained
13.287	3.84	0.0432	1.127	5.413	2	1	sensitive fine grained
13.451	3.53	0.0197	0.558	6.854	2	1	sensitive fine grained
13.615	3.38	0.0188	0.556	8.854	2	1	sensitive fine grained
13.780	3.35	0.0218	0.651	10.133	2	1	sensitive fine grained
13.944	3.45	0.0202	0.584	11.108	2	1	sensitive fine grained
14.108	3.61	0.0256	0.710	11.610	2	1	sensitive fine grained
14.272	3.64	0.0397	1.092	10.618	2	1	sensitive fine grained
14.436	4.01	0.0495	1.235	10.222	2	1	sensitive fine grained
14.600	3.99	0.0390	0.976	8.289	2	1	sensitive fine grained
14.764	3.52	0.0315	0.895	7.160	2	1	sensitive fine grained
14.928	3.33	0.0224	0.673	7.899	2	1	sensitive fine grained
15.092	3.14	0.0216	0.687	8.266	2	1	sensitive fine grained
15.256	2.91	0.0300	1.032	8.238	1	1	sensitive fine grained
15.420	2.79	0.0457	1.638	8.180	1	1	sensitive fine grained
15.584	2.75	0.1996	7.264	8.269	3	2	organic material
15.748	16.41	0.3153	1.922	8.798	8	5	clayey silt to silty clay
15.912	30.44	0.4148	1.363	1.215	12	6	sandy silt to clayey silt
16.076	26.74	0.6875	2.571	-2.574	13	5	clayey silt to silty clay
16.240	25.91	0.4962	1.915	-3.159	10	6	sandy silt to clayey silt
16.404	25.19	0.5623	2.232	0.607	10	6	sandy silt to clayey silt
16.568	23.56	0.8840	3.752	8.049	15	4	silty clay to clay
16.732	49.09	1.7038	3.471	89.166	24	5	clayey silt to silty clay
16.896	103.17	3.3367	3.234	8.746	40	6	sandy silt to clayey silt
17.060	259.68	3.2177	1.239	-1.557	50	9	sand
17.224	221.48	2.4684	1.114	-2.374	42	9	sand
17.388	165.54	2.1064	1.272	-3.388	40	8	sand to silty sand
17.552	112.06	1.0629	0.948	-3.343	27	8	sand to silty sand
17.717	108.72	1.1122	1.023	-3.761	26	8	sand to silty sand
17.881	117.15	1.4765	1.260	-2.797	28	8	sand to silty sand
18.045	217.08	5.9547	2.743	-1.895	69	7	silty sand to sandy silt
18.209	348.96	8.6677	2.484	-2.215	111	7	silty sand to sandy silt
18.373	326.04	10.6558	3.268	-3.143	156	12	sand to clayey sand (*)
18.537	422.63	10.6728	2.525	-3.917	202	12	sand to clayey sand (*)
18.701	499.60	10.6928	2.140	-4.257	120	8	sand to silty sand

Depth ft	Tip (Qt) (tsf)	Sleeve (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983

SITE CLASS

Project	**cannon-22-2-gi**
Location	gower city hall

profile from site measurements and vicinty info

Soil Type	Thick (ft)	Vs-ave	Vs-low	N
silt - ave of measured in CPT	21	638	500	5
dense sand	79	1200	1100	50
siltstone	0	1900	1900	100

total depth	100	ave	low
weighted Vs 100 =		**1082.0**	974

ASCE 7-22 Site Class Table

Table 20.2-1. Site Classification.

Site Class	$\bar{v}_s$ Calculated Using Measured or Estimated Shear Wave Velocity Profile (ft/s)
A. Hard rock	>5,000
B. Medium hard rock	>3,000 to 5,000
BC. Soft rock	>2,100 to 3,000
C. Very dense sand or hard clay	>1,450 to 2,100
CD. Dense sand or very stiff clay	>1,000 to 1,450
D. Medium dense sand or stiff clay	>700 to 1,000
DE. Loose sand or medium stiff clay	>500 to 700
E. Very loose sand or soft clay	≥500
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.2.1

Note: For SI: 1 ft = 0.3048 m; 1 ft/s = 0.3048 m/s.

Geotech Solutions Inc.

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Geotech Solutions Inc.

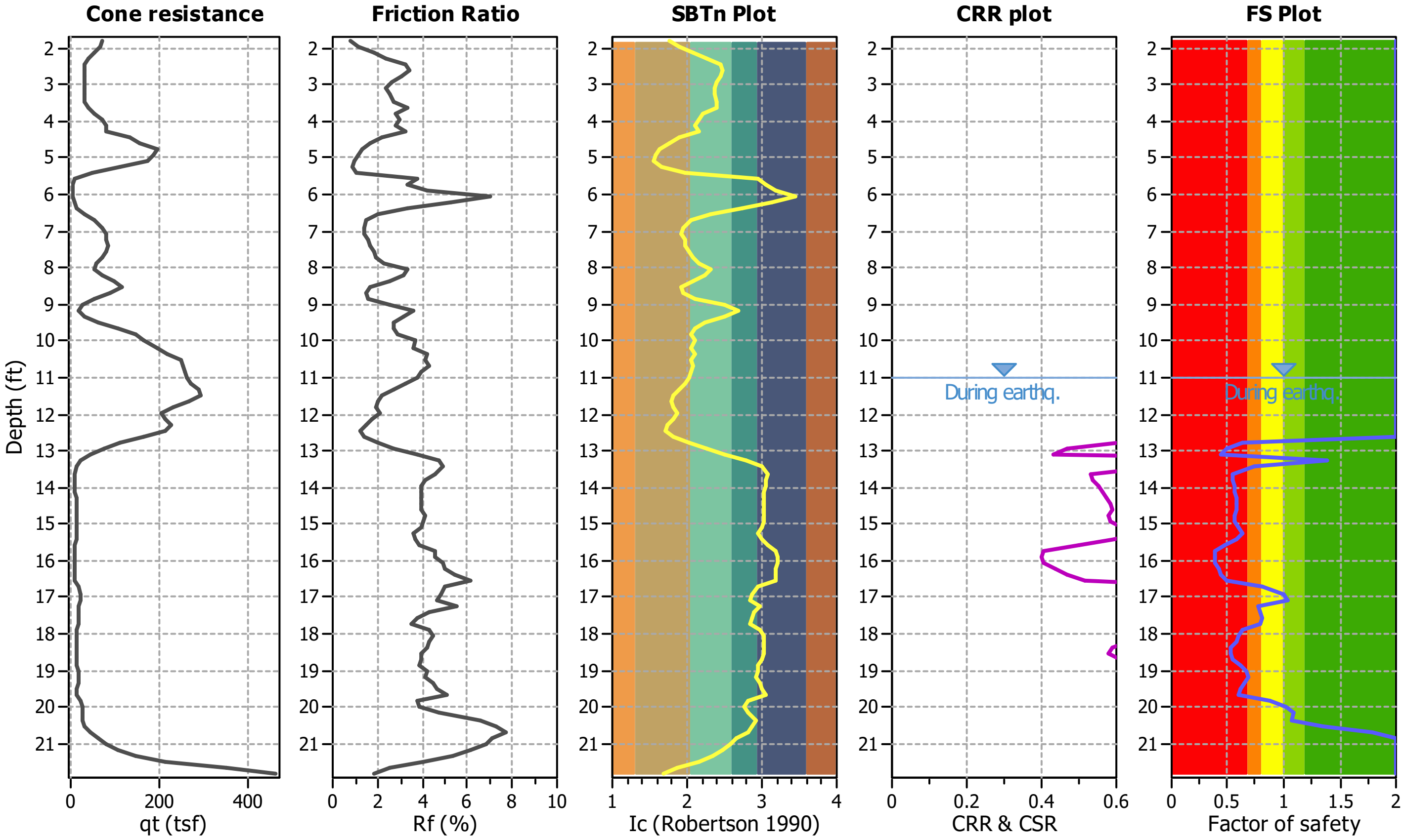
LIQUEFACTION ANALYSIS REPORT

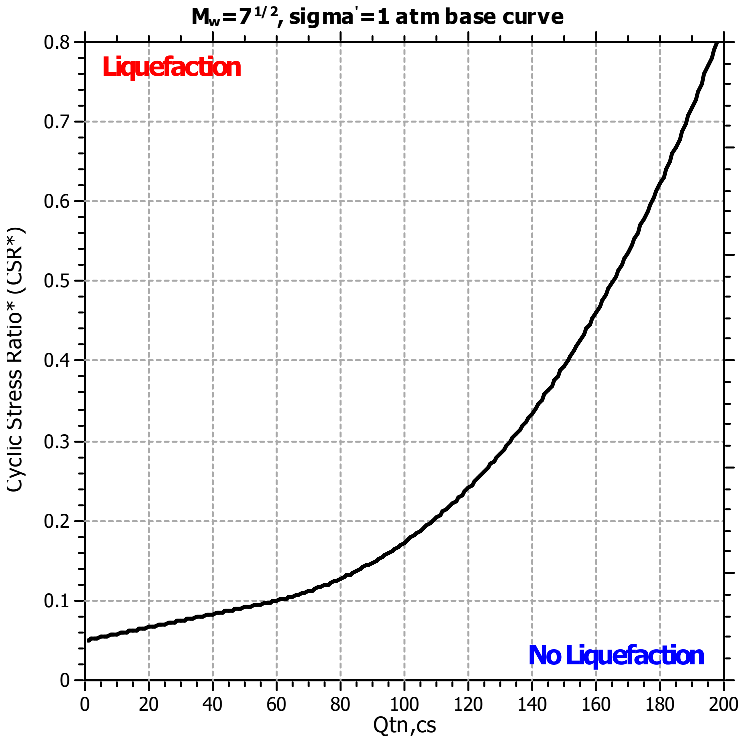
Project title : cannon beach gower city hall **Location :**

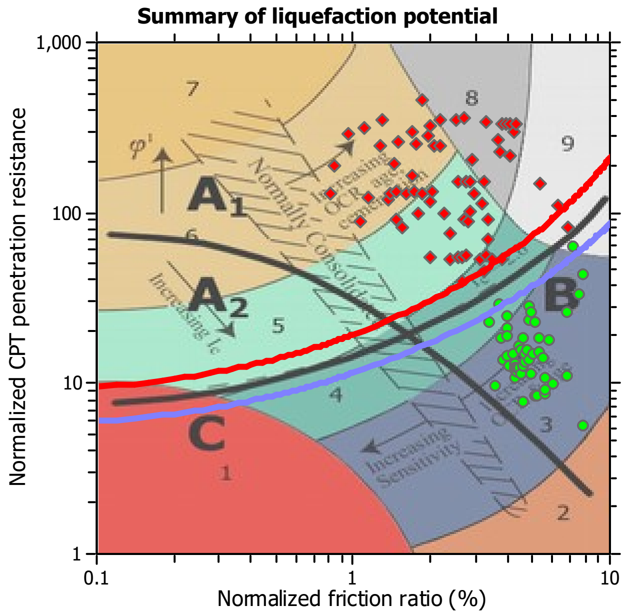
CPT file : 23092 CPT-1 Text File

Input parameters and analysis data

Analysis method:	Robertson (2009)	G.W.T. (in-situ):	11.00 ft	Use fill:	No	Clay like behavior applied:	All soils
Fines correction method:	Robertson (2009)	G.W.T. (earthq.):	11.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	8.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	1.02	Unit weight calculation:	Based on SBT	K_σ applied:	No		

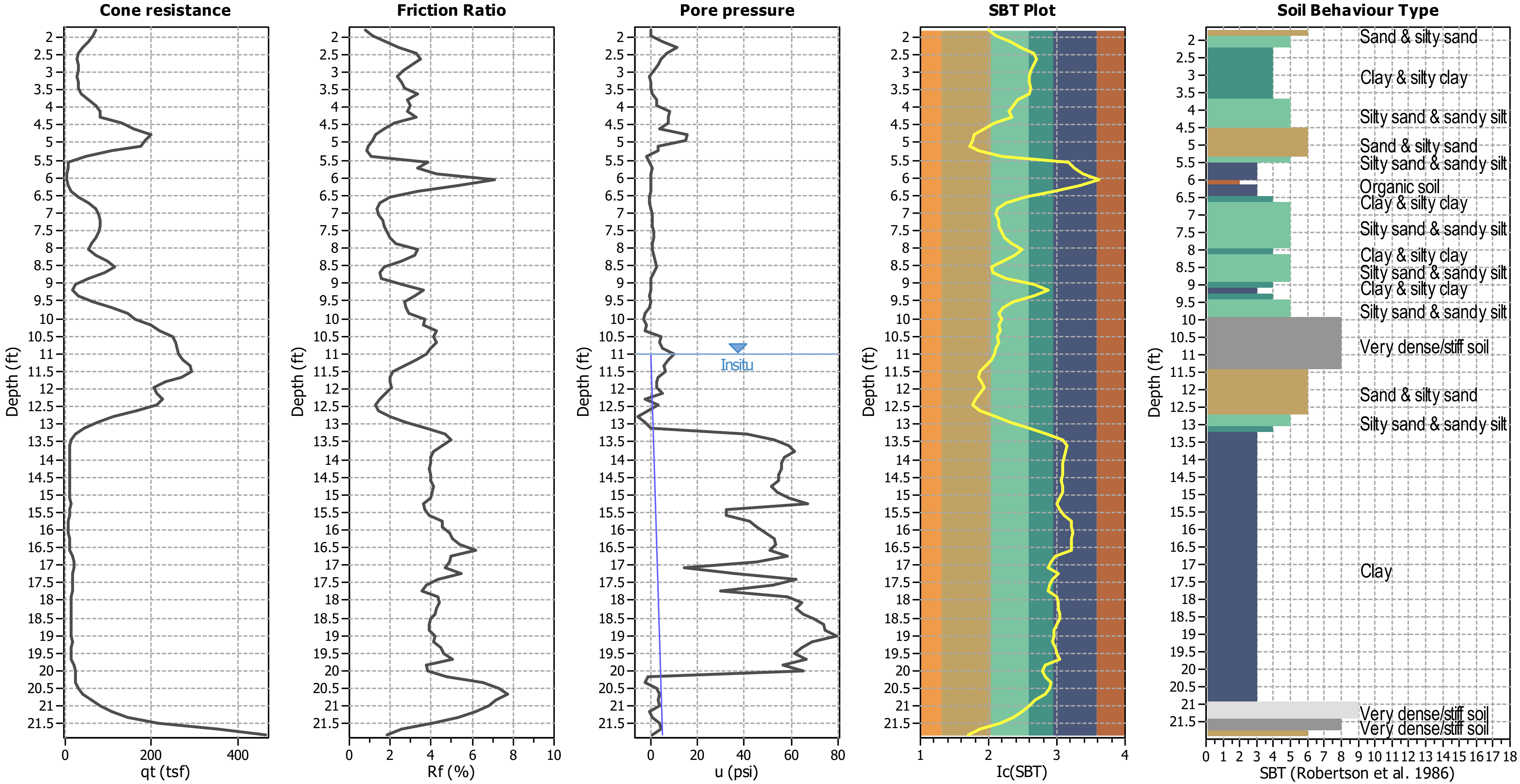






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



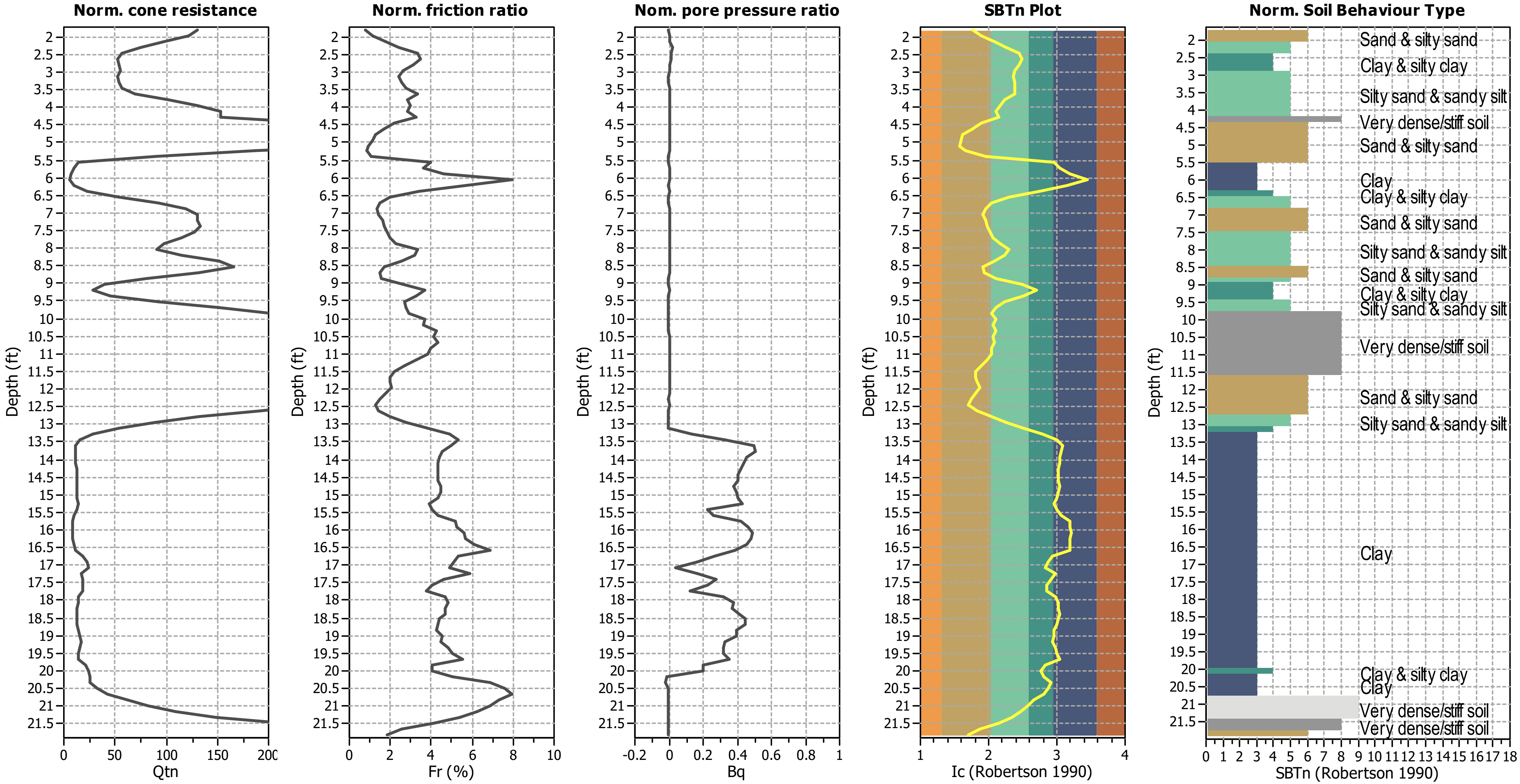
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	8.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	1.02	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

- 1. Sensitive fine grained
- 2. Organic material
- 3. Clay to silty clay
- 4. Clayey silt to silty
- 5. Silty sand to sandy silt
- 6. Clean sand to silty sand
- 7. Gravely sand to sand
- 8. Very stiff sand to
- 9. Very stiff fine grained

CPT basic interpretation plots (normalized)



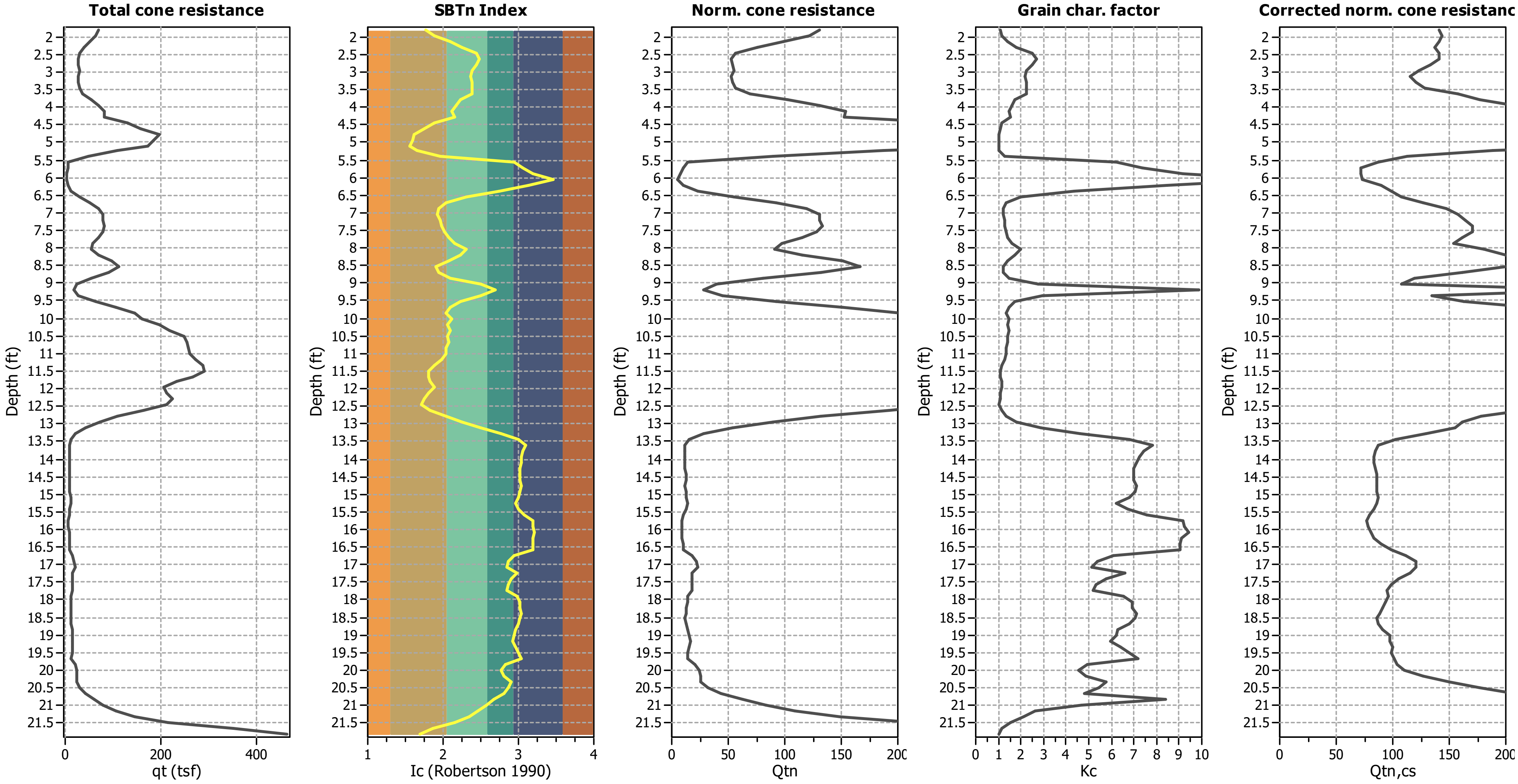
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	8.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	1.02	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

- 1. Sensitive fine grained
- 2. Organic material
- 3. Clay to silty clay
- 4. Clayey silt to silty
- 5. Silty sand to sandy silt
- 6. Clean sand to silty sand
- 7. Gravely sand to sand
- 8. Very stiff sand to
- 9. Very stiff fine grained

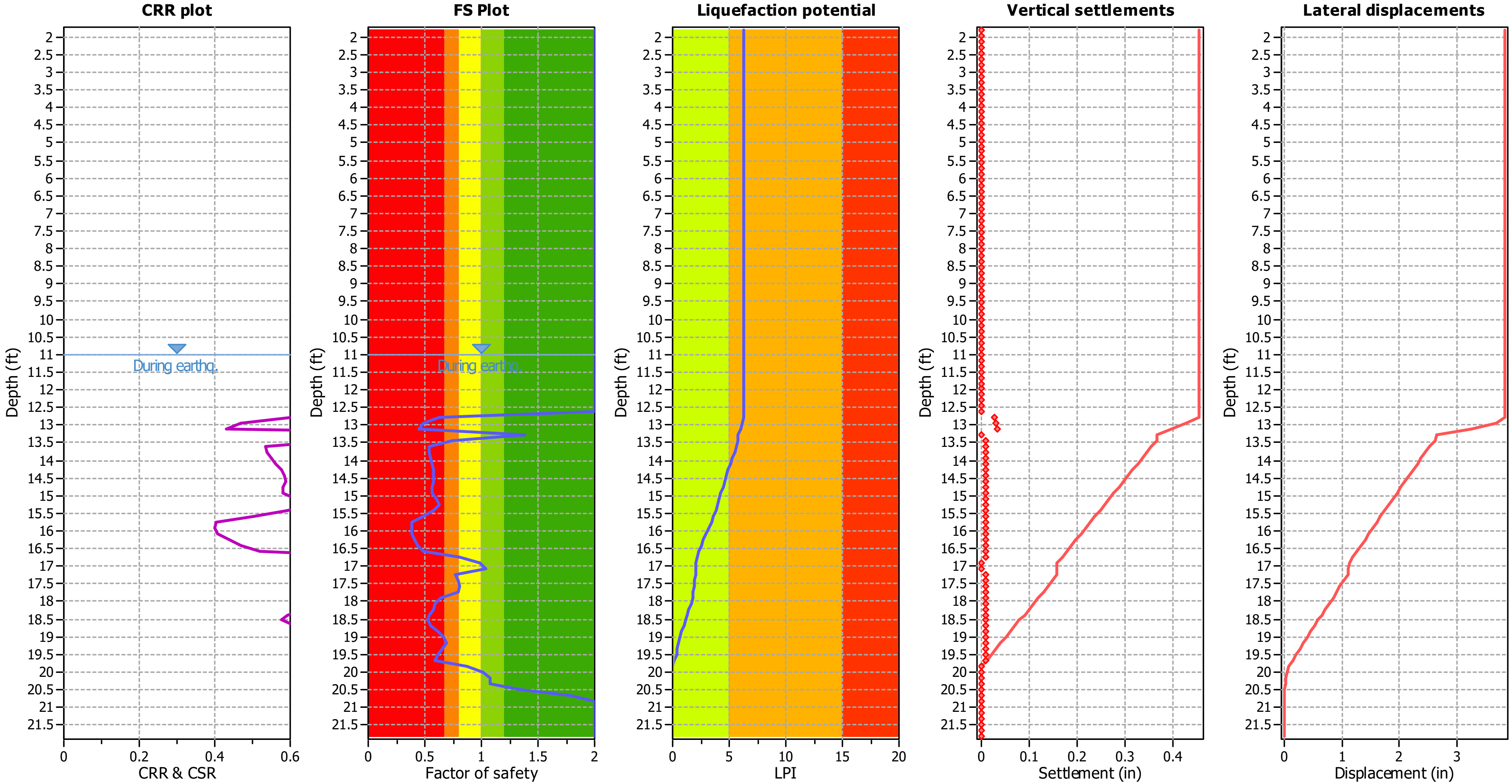
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	8.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	1.02	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	8.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	1.02	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

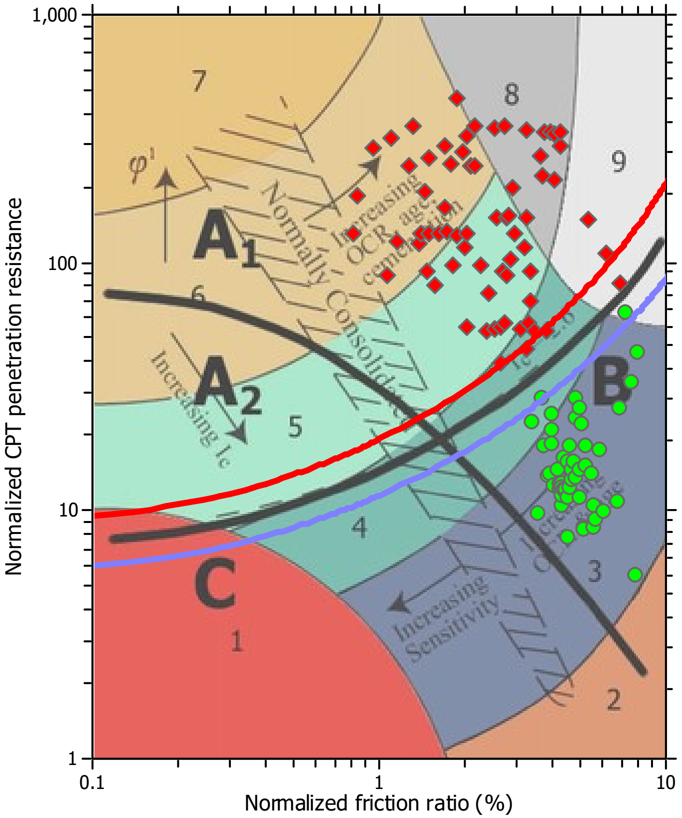
F.S. color scheme

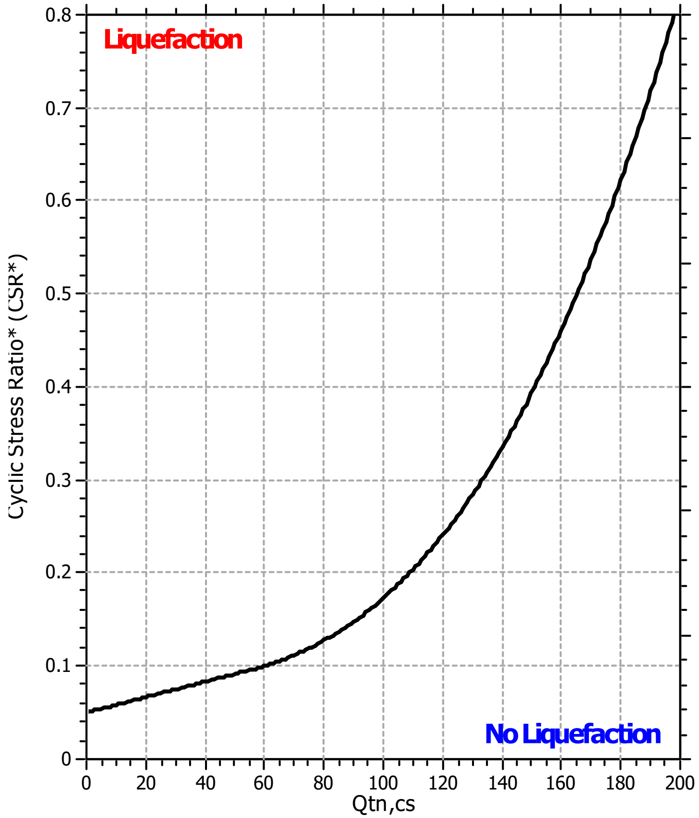
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

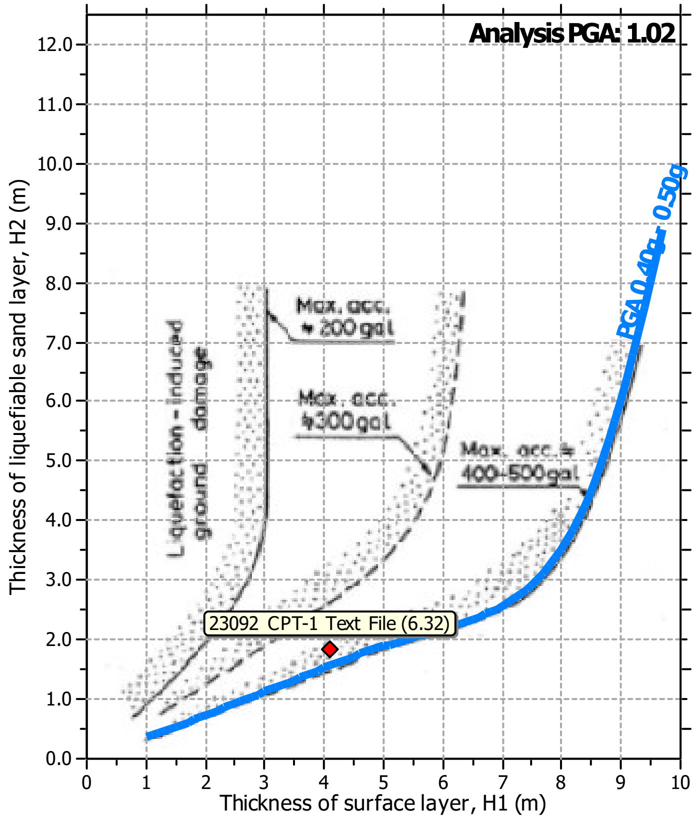
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



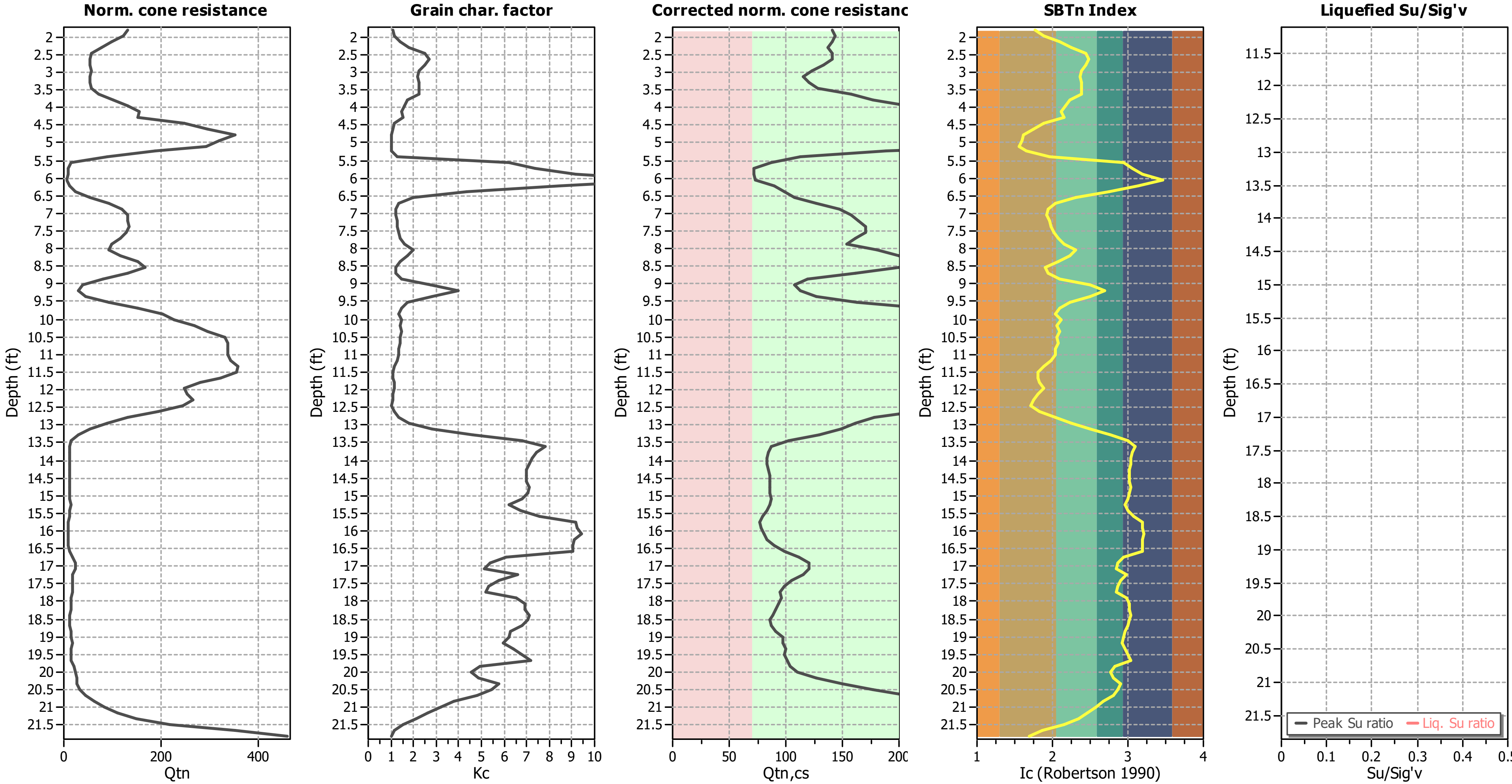




Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	8.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	1.02	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	8.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	1.02	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

:: Field input data ::

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
1	1.80	71.87	0.38	-0.23	7.32	116.39
2	1.97	64.66	0.93	0.28	10.04	118.24
3	2.13	57.23	0.91	4.98	15.46	119.47
4	2.30	34.46	0.97	11.32	20.96	118.98
5	2.46	28.37	0.99	6.83	28.21	118.51
6	2.63	27.26	1.00	4.64	29.74	118.20
7	2.79	28.73	0.92	3.08	28.06	117.54
8	2.95	29.83	0.73	1.03	25.88	116.53
9	3.12	28.67	0.65	-0.78	25.09	115.39
10	3.28	25.70	0.61	-0.04	25.55	116.17
11	3.44	32.22	0.93	0.31	25.86	117.18
12	3.61	32.81	0.93	0.92	25.89	120.65
13	3.77	46.11	1.85	2.61	19.80	123.21
14	3.94	83.87	1.86	2.47	17.90	125.87
15	4.10	78.06	2.44	7.81	16.05	127.09
16	4.26	82.09	2.59	7.63	17.57	128.06
17	4.43	83.01	2.85	7.19	10.20	129.80
18	4.59	228.46	3.08	3.89	7.24	129.67
19	4.76	158.01	1.96	15.41	4.76	130.12
20	4.92	207.27	2.72	14.62	4.21	128.19
21	5.08	188.57	1.42	2.92	3.79	126.54
22	5.25	126.91	0.82	2.94	5.37	121.07
23	5.41	10.60	0.50	-1.56	12.00	114.66
24	5.58	5.45	0.18	-0.81	55.08	106.41
25	5.74	7.40	0.21	0.53	62.12	102.01
26	5.91	3.54	0.16	0.18	72.38	101.74
27	6.07	2.46	0.20	0.25	94.65	102.46
28	6.23	3.83	0.33	-0.17	68.69	106.16
29	6.40	11.51	0.41	0.08	42.99	109.82
30	6.56	21.68	0.48	-0.60	22.79	114.53
31	6.73	54.60	0.85	-0.31	14.21	117.91
32	6.89	80.11	0.95	0.14	11.56	120.39
33	7.05	76.77	1.09	0.78	10.94	121.60
34	7.22	80.15	1.24	0.71	12.05	122.67
35	7.38	80.69	1.47	0.46	12.42	123.46
36	7.55	84.34	1.48	1.25	13.48	123.67
37	7.71	70.53	1.43	1.11	14.92	123.05
38	7.87	56.41	1.26	0.67	17.71	122.28
39	8.04	50.02	1.29	0.81	22.82	124.22
40	8.20	54.25	2.80	1.04	19.93	126.45
41	8.37	105.14	2.55	1.81	15.13	128.08
42	8.53	132.63	2.09	2.22	10.71	126.56
43	8.69	102.42	1.11	1.46	11.32	123.37
44	8.86	36.73	0.81	-0.24	15.91	118.69
45	9.02	23.58	0.59	-0.18	30.34	114.67
46	9.19	12.71	0.49	0.05	40.19	113.61
47	9.35	14.99	0.76	-0.83	31.08	117.76
48	9.51	57.98	1.48	-0.25	20.14	124.16

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
49	9.68	115.19	2.80	-0.65	15.91	129.56
50	9.84	147.45	4.54	-2.31	14.21	132.94
51	10.01	175.15	5.29	-3.33	16.08	135.79
52	10.17	164.65	8.16	-1.89	14.73	137.28
53	10.34	252.45	8.06	-2.53	15.89	137.28
54	10.50	237.24	11.60	4.06	14.79	137.28
55	10.66	254.58	10.82	3.74	15.19	137.28
56	10.83	273.25	10.36	4.89	14.26	137.28
57	10.99	250.30	9.50	9.95	13.84	137.28
58	11.15	263.82	9.97	7.24	12.22	137.28
59	11.32	305.65	7.45	5.87	10.23	137.28
60	11.48	298.04	6.19	6.46	8.29	137.28
61	11.65	273.43	5.31	3.40	8.17	136.20
62	11.81	231.42	4.61	2.40	8.71	134.69
63	11.97	194.91	3.80	2.47	9.81	133.86
64	12.14	191.57	4.35	5.10	8.45	132.99
65	12.30	250.67	3.07	-2.35	6.98	132.33
66	12.47	233.40	2.63	2.99	6.28	130.53
67	12.63	150.95	2.33	-1.41	8.56	129.04
68	12.79	109.07	2.16	-5.58	13.94	127.51
69	12.96	70.33	2.11	-2.72	20.82	125.82
70	13.12	39.48	1.74	-0.22	30.94	122.83
71	13.29	17.60	0.93	40.89	44.72	118.18
72	13.45	8.47	0.48	52.59	58.75	112.65
73	13.62	8.26	0.40	59.28	64.73	109.35
74	13.78	8.51	0.38	61.61	62.68	108.83
75	13.94	8.85	0.38	57.17	61.42	108.79
76	14.11	9.03	0.39	56.01	60.71	108.97
77	14.27	9.32	0.40	55.95	60.06	109.19
78	14.44	9.67	0.41	54.88	59.84	109.43
79	14.60	9.63	0.42	54.90	59.80	109.56
80	14.76	9.69	0.42	51.71	60.76	109.74
81	14.93	9.47	0.44	54.01	60.40	109.75
82	15.09	9.90	0.42	59.00	58.63	110.13
83	15.26	11.27	0.46	67.25	55.35	110.01
84	15.42	11.94	0.39	32.42	58.33	109.43
85	15.58	7.40	0.35	32.30	63.50	108.35
86	15.75	7.19	0.35	42.07	72.50	107.58
87	15.91	6.91	0.35	45.36	72.98	107.65
88	16.08	7.12	0.36	49.17	73.98	108.38
89	16.24	7.52	0.45	52.48	72.34	109.21
90	16.40	8.48	0.46	53.31	71.91	110.43
91	16.57	8.89	0.56	50.92	71.91	112.26
92	16.73	10.06	0.81	58.13	54.66	115.44
93	16.90	27.21	1.03	45.48	49.97	117.24
94	17.06	20.16	1.03	14.27	48.27	117.39
95	17.22	13.41	0.82	35.93	57.48	115.96
96	17.39	12.17	0.75	62.28	52.33	114.61

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
97	17.55	21.50	0.57	52.20	49.53	113.85
98	17.72	14.82	0.60	29.94	48.91	113.22
99	17.88	11.47	0.60	58.62	57.21	112.75
100	18.05	12.35	0.57	64.26	59.41	112.36
101	18.21	11.99	0.54	61.82	59.46	111.89
102	18.37	10.55	0.50	65.27	60.83	111.26
103	18.54	10.29	0.46	69.59	60.39	110.70
104	18.70	11.26	0.44	73.61	58.68	111.12
105	18.86	12.44	0.56	74.21	55.61	112.23
106	19.03	14.80	0.64	79.47	55.12	113.54
107	19.19	14.70	0.71	68.97	53.81	113.80
108	19.36	14.55	0.60	64.77	56.40	113.94
109	19.52	13.05	0.70	61.48	58.65	113.76
110	19.68	12.49	0.69	66.38	61.21	114.07
111	19.85	13.37	0.71	56.23	47.17	115.64
112	20.01	32.03	0.90	65.36	44.31	117.23
113	20.18	23.55	1.10	-0.98	46.74	119.46
114	20.34	18.85	1.59	-2.31	52.50	121.79
115	20.50	33.08	2.25	2.54	50.28	124.75
116	20.67	42.13	3.05	3.95	46.20	127.92
117	20.83	49.73	4.36	3.32	38.87	131.06
118	21.00	90.81	5.65	3.59	34.31	133.42
119	21.16	100.99	6.42	-0.57	29.40	135.47
120	21.32	129.13	7.70	0.68	24.16	137.28
121	21.49	207.82	9.22	3.77	17.50	137.28
122	21.65	306.01	9.15	4.39	9.65	137.28
123	21.82	543.94	8.31	0.39	6.00	137.28

Abbreviations

Depth: Depth from free surface, at which CPT was performed (ft)
q_c: Measured cone resistance (tsf)
f_s: Sleeve friction resistance (tsf)
u: Pore pressure (tsf)
Fines content: Percentage of fines in soil (%)
Unit weight: Bulk soil unit weight (pcf)

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data ::

Point ID	Depth (ft)	σ_v (tsf)	u_0 (tsf)	σ_v' (tsf)	r_d	CSR	MSF	CSR_{eq}	K_σ	User FS	CSR^*	Belongs to transition
1	1.80	0.10	0.00	0.10	1.00	0.662	0.73	0.912	1.00	1.00	2.000	No
2	1.97	0.11	0.00	0.11	1.00	0.661	0.73	0.911	1.00	1.00	2.000	No
3	2.13	0.12	0.00	0.12	1.00	0.661	0.73	0.911	1.00	1.00	2.000	No
4	2.30	0.13	0.00	0.13	1.00	0.661	0.73	0.911	1.00	1.00	2.000	No
5	2.46	0.14	0.00	0.14	1.00	0.661	0.73	0.910	1.00	1.00	2.000	No
6	2.63	0.15	0.00	0.15	1.00	0.660	0.73	0.910	1.00	1.00	2.000	No
7	2.79	0.16	0.00	0.16	1.00	0.660	0.73	0.910	1.00	1.00	2.000	No
8	2.95	0.17	0.00	0.17	1.00	0.660	0.73	0.909	1.00	1.00	2.000	No
9	3.12	0.18	0.00	0.18	0.99	0.659	0.73	0.909	1.00	1.00	2.000	No
10	3.28	0.19	0.00	0.19	0.99	0.659	0.73	0.909	1.00	1.00	2.000	No
11	3.44	0.20	0.00	0.20	0.99	0.659	0.73	0.908	1.00	1.00	2.000	No
12	3.61	0.21	0.00	0.21	0.99	0.659	0.73	0.908	1.00	1.00	2.000	No
13	3.77	0.22	0.00	0.22	0.99	0.658	0.73	0.907	1.00	1.00	2.000	No
14	3.94	0.23	0.00	0.23	0.99	0.658	0.73	0.907	1.00	1.00	2.000	No
15	4.10	0.24	0.00	0.24	0.99	0.658	0.73	0.907	1.00	1.00	2.000	No
16	4.26	0.25	0.00	0.25	0.99	0.658	0.73	0.906	1.00	1.00	2.000	No
17	4.43	0.26	0.00	0.26	0.99	0.657	0.73	0.906	1.00	1.00	2.000	No
18	4.59	0.27	0.00	0.27	0.99	0.657	0.73	0.906	1.00	1.00	2.000	No
19	4.76	0.28	0.00	0.28	0.99	0.657	0.73	0.905	1.00	1.00	2.000	No
20	4.92	0.30	0.00	0.30	0.99	0.657	0.73	0.905	1.00	1.00	2.000	No
21	5.08	0.31	0.00	0.31	0.99	0.656	0.73	0.905	1.00	1.00	2.000	No
22	5.25	0.32	0.00	0.32	0.99	0.656	0.73	0.904	1.00	1.00	2.000	No
23	5.41	0.32	0.00	0.32	0.99	0.656	0.73	0.904	1.00	1.00	2.000	No
24	5.58	0.33	0.00	0.33	0.99	0.656	0.73	0.904	1.00	1.00	2.000	No
25	5.74	0.34	0.00	0.34	0.99	0.655	0.73	0.903	1.00	1.00	2.000	No
26	5.91	0.35	0.00	0.35	0.99	0.655	0.73	0.903	1.00	1.00	2.000	No
27	6.07	0.36	0.00	0.36	0.99	0.655	0.73	0.903	1.00	1.00	2.000	No
28	6.23	0.37	0.00	0.37	0.99	0.655	0.73	0.902	1.00	1.00	2.000	No
29	6.40	0.38	0.00	0.38	0.99	0.654	0.73	0.902	1.00	1.00	2.000	No
30	6.56	0.39	0.00	0.39	0.99	0.654	0.73	0.902	1.00	1.00	2.000	No
31	6.73	0.40	0.00	0.40	0.99	0.654	0.73	0.901	1.00	1.00	2.000	No
32	6.89	0.41	0.00	0.41	0.99	0.654	0.73	0.901	1.00	1.00	2.000	No
33	7.05	0.42	0.00	0.42	0.99	0.653	0.73	0.901	1.00	1.00	2.000	No
34	7.22	0.43	0.00	0.43	0.99	0.653	0.73	0.900	1.00	1.00	2.000	No
35	7.38	0.44	0.00	0.44	0.98	0.653	0.73	0.900	1.00	1.00	2.000	No
36	7.55	0.45	0.00	0.45	0.98	0.653	0.73	0.900	1.00	1.00	2.000	No
37	7.71	0.46	0.00	0.46	0.98	0.652	0.73	0.899	1.00	1.00	2.000	No
38	7.87	0.47	0.00	0.47	0.98	0.652	0.73	0.899	1.00	1.00	2.000	No
39	8.04	0.48	0.00	0.48	0.98	0.652	0.73	0.899	1.00	1.00	2.000	No
40	8.20	0.49	0.00	0.49	0.98	0.652	0.73	0.898	1.00	1.00	2.000	No
41	8.37	0.50	0.00	0.50	0.98	0.652	0.73	0.898	1.00	1.00	2.000	No
42	8.53	0.51	0.00	0.51	0.98	0.651	0.73	0.898	1.00	1.00	2.000	No
43	8.69	0.52	0.00	0.52	0.98	0.651	0.73	0.897	1.00	1.00	2.000	No
44	8.86	0.53	0.00	0.53	0.98	0.651	0.73	0.897	1.00	1.00	2.000	No
45	9.02	0.54	0.00	0.54	0.98	0.651	0.73	0.897	1.00	1.00	2.000	No
46	9.19	0.55	0.00	0.55	0.98	0.650	0.73	0.896	1.00	1.00	2.000	No
47	9.35	0.56	0.00	0.56	0.98	0.650	0.73	0.896	1.00	1.00	2.000	No
48	9.51	0.57	0.00	0.57	0.98	0.650	0.73	0.896	1.00	1.00	2.000	No

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data :: (continued)

Point ID	Depth (ft)	σ_v (tsf)	u_0 (tsf)	σ_v' (tsf)	r_d	CSR	MSF	CSR_{eq}	K_σ	User FS	CSR^*	Belongs to transition
49	9.68	0.58	0.00	0.58	0.98	0.650	0.73	0.895	1.00	1.00	2.000	No
50	9.84	0.59	0.00	0.59	0.98	0.649	0.73	0.895	1.00	1.00	2.000	No
51	10.01	0.60	0.00	0.60	0.98	0.649	0.73	0.895	1.00	1.00	2.000	No
52	10.17	0.61	0.00	0.61	0.98	0.649	0.73	0.894	1.00	1.00	2.000	No
53	10.34	0.62	0.00	0.62	0.98	0.649	0.73	0.894	1.00	1.00	2.000	No
54	10.50	0.63	0.00	0.63	0.98	0.648	0.73	0.894	1.00	1.00	2.000	No
55	10.66	0.64	0.00	0.64	0.98	0.648	0.73	0.893	1.00	1.00	2.000	No
56	10.83	0.65	0.00	0.65	0.98	0.648	0.73	0.893	1.00	1.00	2.000	No
57	10.99	0.67	0.00	0.67	0.98	0.648	0.73	0.893	1.00	1.00	2.000	No
58	11.15	0.68	0.00	0.67	0.98	0.652	0.73	0.899	1.00	1.00	0.899	No
59	11.32	0.69	0.01	0.68	0.98	0.657	0.73	0.905	1.00	1.00	0.905	No
60	11.48	0.70	0.02	0.68	0.98	0.661	0.73	0.911	1.00	1.00	0.911	No
61	11.65	0.71	0.02	0.69	0.98	0.666	0.73	0.918	1.00	1.00	0.918	No
62	11.81	0.72	0.03	0.70	0.98	0.670	0.73	0.924	1.00	1.00	0.924	No
63	11.97	0.73	0.03	0.70	0.97	0.674	0.73	0.929	1.00	1.00	0.929	No
64	12.14	0.74	0.04	0.71	0.97	0.679	0.73	0.935	1.00	1.00	0.935	No
65	12.30	0.75	0.04	0.71	0.97	0.683	0.73	0.941	1.00	1.00	0.941	No
66	12.47	0.77	0.05	0.72	0.97	0.687	0.73	0.947	1.00	1.00	0.947	No
67	12.63	0.78	0.05	0.73	0.97	0.691	0.73	0.952	1.00	1.00	0.952	No
68	12.79	0.79	0.06	0.73	0.97	0.695	0.73	0.957	1.00	1.00	0.957	No
69	12.96	0.80	0.06	0.74	0.97	0.699	0.73	0.963	1.00	1.00	0.963	No
70	13.12	0.81	0.07	0.74	0.97	0.702	0.73	0.968	1.00	1.00	0.968	No
71	13.29	0.82	0.07	0.75	0.97	0.706	0.73	0.973	1.00	1.00	0.973	No
72	13.45	0.83	0.08	0.75	0.97	0.710	0.73	0.979	1.00	1.00	0.979	No
73	13.62	0.83	0.08	0.75	0.97	0.714	0.73	0.984	1.00	1.00	0.984	No
74	13.78	0.84	0.09	0.76	0.97	0.718	0.73	0.989	1.00	1.00	0.989	No
75	13.94	0.85	0.09	0.76	0.97	0.721	0.73	0.994	1.00	1.00	0.994	No
76	14.11	0.86	0.10	0.76	0.97	0.725	0.73	0.999	1.00	1.00	0.999	No
77	14.27	0.87	0.10	0.77	0.97	0.729	0.73	1.004	1.00	1.00	1.004	No
78	14.44	0.88	0.11	0.77	0.97	0.732	0.73	1.009	1.00	1.00	1.009	No
79	14.60	0.89	0.11	0.78	0.97	0.736	0.73	1.014	1.00	1.00	1.014	No
80	14.76	0.90	0.12	0.78	0.97	0.739	0.73	1.019	1.00	1.00	1.019	No
81	14.93	0.91	0.12	0.78	0.97	0.743	0.73	1.024	1.00	1.00	1.024	No
82	15.09	0.92	0.13	0.79	0.97	0.746	0.73	1.028	1.00	1.00	1.028	No
83	15.26	0.92	0.13	0.79	0.97	0.749	0.73	1.033	1.00	1.00	1.033	No
84	15.42	0.93	0.14	0.80	0.97	0.753	0.73	1.037	1.00	1.00	1.037	No
85	15.58	0.94	0.14	0.80	0.97	0.756	0.73	1.042	1.00	1.00	1.042	No
86	15.75	0.95	0.15	0.80	0.97	0.759	0.73	1.047	1.00	1.00	1.047	No
87	15.91	0.96	0.15	0.81	0.97	0.763	0.73	1.051	1.00	1.00	1.051	No
88	16.08	0.97	0.16	0.81	0.97	0.766	0.73	1.055	1.00	1.00	1.055	No
89	16.24	0.98	0.16	0.81	0.97	0.769	0.73	1.060	1.00	1.00	1.060	No
90	16.40	0.99	0.17	0.82	0.97	0.772	0.73	1.064	1.00	1.00	1.064	No
91	16.57	1.00	0.17	0.82	0.97	0.775	0.73	1.068	1.00	1.00	1.068	No
92	16.73	1.01	0.18	0.83	0.96	0.778	0.73	1.072	1.00	1.00	1.072	No
93	16.90	1.02	0.18	0.83	0.96	0.781	0.73	1.076	1.00	1.00	1.076	No
94	17.06	1.02	0.19	0.84	0.96	0.784	0.73	1.080	1.00	1.00	1.080	No
95	17.22	1.03	0.19	0.84	0.96	0.787	0.73	1.084	1.00	1.00	1.084	No
96	17.39	1.04	0.20	0.84	0.96	0.789	0.73	1.088	1.00	1.00	1.088	No

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data :: (continued)

Point ID	Depth (ft)	σ_v (tsf)	u_0 (tsf)	σ_v' (tsf)	r_d	CSR	MSF	CSR_{eq}	K_σ	User FS	CSR^*	Belongs to transition
97	17.55	1.05	0.20	0.85	0.96	0.792	0.73	1.092	1.00	1.00	1.092	No
98	17.72	1.06	0.21	0.85	0.96	0.795	0.73	1.096	1.00	1.00	1.096	No
99	17.88	1.07	0.21	0.86	0.96	0.798	0.73	1.099	1.00	1.00	1.099	No
100	18.05	1.08	0.22	0.86	0.96	0.800	0.73	1.103	1.00	1.00	1.103	No
101	18.21	1.09	0.22	0.87	0.96	0.803	0.73	1.107	1.00	1.00	1.107	No
102	18.37	1.10	0.23	0.87	0.96	0.806	0.73	1.110	1.00	1.00	1.110	No
103	18.54	1.11	0.24	0.87	0.96	0.808	0.73	1.114	1.00	1.00	1.114	No
104	18.70	1.12	0.24	0.88	0.96	0.811	0.73	1.118	1.00	1.00	1.118	No
105	18.86	1.13	0.25	0.88	0.96	0.814	0.73	1.121	1.00	1.00	1.121	No
106	19.03	1.14	0.25	0.89	0.96	0.816	0.73	1.125	1.00	1.00	1.125	No
107	19.19	1.15	0.26	0.89	0.96	0.818	0.73	1.128	1.00	1.00	1.128	No
108	19.36	1.15	0.26	0.89	0.96	0.821	0.73	1.131	1.00	1.00	1.131	No
109	19.52	1.16	0.27	0.90	0.96	0.823	0.73	1.135	1.00	1.00	1.135	No
110	19.68	1.17	0.27	0.90	0.96	0.826	0.73	1.138	1.00	1.00	1.138	No
111	19.85	1.18	0.28	0.91	0.96	0.828	0.73	1.141	1.00	1.00	1.141	No
112	20.01	1.19	0.28	0.91	0.96	0.830	0.73	1.144	1.00	1.00	1.144	No
113	20.18	1.20	0.29	0.92	0.96	0.832	0.73	1.147	1.00	1.00	1.147	No
114	20.34	1.21	0.29	0.92	0.96	0.834	0.73	1.150	1.00	1.00	1.150	No
115	20.50	1.22	0.30	0.93	0.96	0.836	0.73	1.153	1.00	1.00	1.153	No
116	20.67	1.23	0.30	0.93	0.96	0.838	0.73	1.156	1.00	1.00	1.156	No
117	20.83	1.24	0.31	0.94	0.95	0.840	0.73	1.158	1.00	1.00	1.158	No
118	21.00	1.25	0.31	0.94	0.95	0.842	0.73	1.160	1.00	1.00	1.160	No
119	21.16	1.27	0.32	0.95	0.95	0.844	0.73	1.163	1.00	1.00	1.163	No
120	21.32	1.28	0.32	0.95	0.95	0.845	0.73	1.165	1.00	1.00	1.165	No
121	21.49	1.29	0.33	0.96	0.95	0.847	0.73	1.167	1.00	1.00	1.167	No
122	21.65	1.30	0.33	0.97	0.95	0.849	0.73	1.169	1.00	1.00	1.169	No
123	21.82	1.31	0.34	0.97	0.95	0.850	0.73	1.172	1.00	1.00	1.172	No

Abbreviations

Depth: Depth from free surface, at which CPT was performed (ft)
σ_v: Total overburden pressure at test point (tsf)
u_0: Water pressure at test point (tsf)
σ_v': Effective overburden pressure based on GWT during earthquake (tsf)
r_d: Nonlinear shear mass factor
CSR: Cyclic Stress Ratio
MSF: Magnitude Scaling Factor
CSR_{eq}: CSR adjusted for M=7.5
K_σ: Effective overburden stress factor
CSR^*: CSR fully adjusted

:: Cyclic Resistance Ratio (CRR) calculation data ::

Point ID	Depth (ft)	q_t (tsf)	I_c	Fr (%)	n	Q_{tn}	K_c	$Q_{tn,cs}$	$CRR_{7.5}$	Belongs to trans. layer	Clay-like behaviour	FS
1	1.80	69.47	1.76	0.81	0.53	131.10	1.08	141.50	4.000	No	No	2.00
2	1.97	64.61	1.89	1.15	0.57	121.91	1.18	143.26	4.000	No	No	2.00
3	2.13	52.20	2.09	1.81	0.65	98.42	1.43	141.16	4.000	No	No	2.00
4	2.30	40.13	2.26	2.40	0.72	75.60	1.82	137.46	4.000	No	No	2.00
5	2.46	30.14	2.44	3.30	0.79	56.70	2.50	141.60	4.000	No	No	2.00
6	2.63	28.19	2.48	3.47	0.80	52.99	2.66	141.14	4.000	No	No	2.00
7	2.79	28.65	2.44	3.10	0.79	53.84	2.48	133.63	4.000	No	No	2.00
8	2.95	29.09	2.39	2.64	0.77	54.66	2.26	123.54	4.000	No	No	2.00
9	3.12	28.07	2.37	2.38	0.76	52.71	2.18	115.04	4.000	No	No	2.00
10	3.28	28.86	2.38	2.55	0.77	54.19	2.23	120.71	4.000	No	No	2.00
11	3.44	30.25	2.39	2.75	0.77	56.79	2.26	128.25	4.000	No	No	2.00
12	3.61	37.07	2.39	3.36	0.77	69.66	2.26	157.47	4.000	No	No	2.00
13	3.77	54.29	2.22	2.86	0.71	102.20	1.73	176.48	4.000	No	No	2.00
14	3.94	69.41	2.17	2.97	0.69	130.76	1.59	207.84	4.000	No	No	2.00
15	4.10	81.43	2.11	2.83	0.66	153.45	1.47	225.43	4.000	No	No	2.00
16	4.26	81.16	2.16	3.25	0.68	152.93	1.57	239.59	4.000	No	No	2.00
17	4.43	131.28	1.89	2.17	0.58	247.64	1.18	292.53	4.000	No	No	2.00
18	4.59	156.62	1.76	1.68	0.53	295.52	1.08	318.24	4.000	No	No	2.00
19	4.76	198.08	1.62	1.31	0.48	352.44	1.00	352.44	4.000	No	No	2.00
20	4.92	184.77	1.59	1.10	0.47	317.63	1.00	317.63	4.000	No	No	2.00
21	5.08	174.35	1.56	0.95	0.46	291.27	1.00	291.27	4.000	No	No	2.00
22	5.25	108.71	1.66	0.85	0.50	186.86	1.01	188.66	4.000	No	No	2.00
23	5.41	47.66	1.96	1.06	0.61	89.46	1.26	112.35	4.000	No	No	2.00
24	5.58	7.81	2.95	3.98	0.99	14.13	6.19	87.43	4.000	No	Yes	2.00
25	5.74	5.46	3.05	3.59	1.00	9.68	7.35	71.17	4.000	No	Yes	2.00
26	5.91	4.47	3.19	4.59	1.00	7.79	9.14	71.19	4.000	No	Yes	2.00
27	6.07	3.28	3.45	7.92	1.00	5.52	13.27	73.21	4.000	No	Yes	2.00
28	6.23	5.93	3.14	5.65	1.00	10.52	8.49	89.29	4.000	No	Yes	2.00
29	6.40	12.34	2.75	3.40	0.91	22.61	4.35	98.35	4.000	No	Yes	2.00
30	6.56	29.26	2.31	2.01	0.75	54.58	1.97	107.65	4.000	No	No	2.00
31	6.73	52.13	2.05	1.47	0.65	92.58	1.36	126.30	4.000	No	No	2.00
32	6.89	70.50	1.95	1.38	0.61	119.02	1.24	147.19	4.000	No	No	2.00
33	7.05	79.02	1.92	1.39	0.60	130.41	1.21	157.91	4.000	No	No	2.00
34	7.22	79.21	1.97	1.61	0.62	130.88	1.26	164.68	4.000	No	No	2.00
35	7.38	81.74	1.98	1.72	0.62	133.80	1.28	170.63	4.000	No	No	2.00
36	7.55	78.53	2.02	1.87	0.64	128.36	1.33	170.21	4.000	No	No	2.00
37	7.71	70.44	2.07	1.98	0.66	115.32	1.40	161.80	4.000	No	No	2.00
38	7.87	59.00	2.16	2.27	0.70	97.85	1.58	154.26	4.000	No	No	2.00
39	8.04	53.57	2.31	3.36	0.75	91.48	1.97	180.64	4.000	No	No	2.00
40	8.20	69.82	2.23	3.19	0.72	114.81	1.74	199.41	4.000	No	No	2.00
41	8.37	97.36	2.08	2.56	0.66	151.32	1.42	214.14	4.000	No	No	2.00
42	8.53	113.42	1.91	1.69	0.60	166.22	1.20	199.72	4.000	No	No	2.00
43	8.69	90.61	1.94	1.48	0.61	131.97	1.23	161.89	4.000	No	No	2.00
44	8.86	54.25	2.10	1.55	0.68	81.32	1.46	118.81	4.000	No	No	2.00
45	9.02	24.34	2.49	2.65	0.82	39.39	2.73	107.54	4.000	No	No	2.00
46	9.19	17.09	2.70	3.70	0.90	28.43	9.88	280.73	4.000	No	No	2.00
47	9.35	28.56	2.51	3.25	0.83	45.23	2.97	134.43	4.000	No	No	2.00
48	9.51	62.71	2.23	2.70	0.73	92.63	1.75	162.41	4.000	No	No	2.00

:: Cyclic Resistance Ratio (CRR) calculation data :: (continued)

Point ID	Depth (ft)	q_t (tsf)	I_c	Fr (%)	n	Q_{tn}	K_c	$Q_{tn,cs}$	$CRR_{7.5}$	Belongs to trans. layer	Clay-like behaviour	FS
49	9.68	106.86	2.10	2.77	0.68	151.70	1.46	221.60	4.000	No	No	2.00
50	9.84	145.90	2.05	2.90	0.66	202.19	1.36	275.83	4.000	No	No	2.00
51	10.01	162.38	2.11	3.70	0.68	225.50	1.47	331.69	4.000	No	No	2.00
52	10.17	197.38	2.06	3.64	0.66	268.31	1.39	373.54	4.000	No	No	2.00
53	10.34	218.11	2.10	4.26	0.68	295.40	1.46	431.12	4.000	No	No	2.00
54	10.50	248.12	2.07	4.11	0.67	329.76	1.40	460.31	4.000	No	No	2.00
55	10.66	255.08	2.08	4.29	0.67	336.02	1.42	476.66	4.000	No	No	2.00
56	10.83	259.47	2.05	3.95	0.66	335.93	1.37	459.13	4.000	No	No	2.00
57	10.99	262.56	2.03	3.80	0.66	335.32	1.34	450.82	4.000	No	No	2.00
58	11.15	273.37	1.97	3.29	0.63	343.43	1.27	434.68	4.000	No	No	2.00
59	11.32	289.26	1.89	2.73	0.60	356.57	1.18	421.60	4.000	No	No	2.00
60	11.48	292.45	1.81	2.16	0.57	353.56	1.11	393.31	4.000	No	No	2.00
61	11.65	267.69	1.80	2.01	0.57	321.65	1.11	356.44	4.000	No	No	2.00
62	11.81	233.29	1.83	1.97	0.58	279.98	1.13	315.49	4.000	No	No	2.00
63	11.97	206.01	1.88	2.07	0.60	247.83	1.17	289.16	4.000	No	No	2.00
64	12.14	212.41	1.82	1.77	0.58	251.98	1.12	281.70	4.000	No	No	2.00
65	12.30	225.24	1.74	1.49	0.55	263.24	1.07	281.15	4.000	No	No	2.00
66	12.47	211.67	1.71	1.27	0.53	244.98	1.04	255.66	4.000	No	No	2.00
67	12.63	164.45	1.82	1.45	0.58	192.45	1.12	215.90	4.000	No	No	2.00
68	12.79	110.07	2.04	2.01	0.66	131.91	1.35	178.07	0.605	No	No	0.63
69	12.96	72.92	2.25	2.78	0.74	89.30	1.81	161.37	0.471	No	No	0.49
70	13.12	42.65	2.51	3.81	0.84	53.37	2.91	155.46	0.429	No	No	0.44
71	13.29	22.30	2.78	4.87	0.94	28.26	4.60	129.95	1.348	No	Yes	1.39
72	13.45	12.18	3.00	5.30	1.00	15.15	6.79	102.84	0.723	No	Yes	0.74
73	13.62	9.25	3.09	4.99	1.00	11.17	7.80	87.08	0.533	No	Yes	0.54
74	13.78	9.39	3.06	4.55	1.00	11.30	7.45	84.13	0.539	No	Yes	0.54
75	13.94	9.64	3.04	4.37	1.00	11.55	7.23	83.51	0.551	No	Yes	0.55
76	14.11	9.88	3.03	4.32	1.00	11.79	7.11	83.90	0.563	No	Yes	0.56
77	14.27	10.14	3.02	4.30	1.00	12.06	7.01	84.52	0.575	No	Yes	0.57
78	14.44	10.34	3.02	4.33	1.00	12.24	6.97	85.34	0.584	No	Yes	0.58
79	14.60	10.44	3.02	4.35	1.00	12.30	6.96	85.66	0.587	No	Yes	0.58
80	14.76	10.37	3.03	4.50	1.00	12.14	7.12	86.48	0.579	No	Yes	0.57
81	14.93	10.48	3.03	4.45	1.00	12.21	7.06	86.22	0.582	No	Yes	0.57
82	15.09	11.08	3.00	4.33	1.00	12.90	6.77	87.31	0.615	No	Yes	0.60
83	15.26	11.80	2.95	3.90	1.00	13.73	6.23	85.59	0.655	No	Yes	0.63
84	15.42	10.84	3.00	4.07	1.00	12.45	6.72	83.63	0.594	No	Yes	0.57
85	15.58	9.36	3.07	4.34	1.00	10.53	7.59	79.86	0.502	No	Yes	0.48
86	15.75	7.74	3.19	5.15	1.00	8.46	9.16	77.47	0.403	No	Yes	0.39
87	15.91	7.73	3.20	5.22	1.00	8.39	9.25	77.58	0.400	No	Yes	0.38
88	16.08	7.89	3.21	5.61	1.00	8.54	9.43	80.49	0.407	No	Yes	0.39
89	16.24	8.45	3.19	5.68	1.00	9.18	9.13	83.79	0.438	No	Yes	0.41
90	16.40	9.05	3.19	6.09	1.00	9.85	9.05	89.21	0.470	No	Yes	0.44
91	16.57	9.92	3.19	6.84	1.00	10.85	9.06	98.30	0.518	No	Yes	0.48
92	16.73	16.13	2.94	5.30	1.00	18.29	6.12	111.96	0.873	No	Yes	0.81
93	16.90	19.71	2.87	5.13	0.98	22.39	5.38	120.54	1.068	No	Yes	0.99
94	17.06	20.72	2.84	4.89	0.97	23.41	5.12	119.92	1.116	No	Yes	1.03
95	17.22	15.79	2.99	5.88	1.00	17.56	6.58	115.53	0.838	No	Yes	0.77
96	17.39	16.42	2.91	4.63	1.00	18.19	5.75	104.60	0.868	No	Yes	0.80

:: Cyclic Resistance Ratio (CRR) calculation data :: (continued)

Point ID	Depth (ft)	q_t (tsf)	I_c	Fr (%)	n	Q_{tn}	K_c	$Q_{tn,cs}$	$CRR_{7.5}$	Belongs to trans. layer	Clay-like behaviour	FS
97	17.55	16.86	2.86	4.03	0.98	18.54	5.32	98.55	0.884	No	Yes	0.81
98	17.72	16.61	2.85	3.78	0.98	18.13	5.22	94.67	0.865	No	Yes	0.79
99	17.88	13.61	2.98	4.68	1.00	14.64	6.53	95.62	0.698	No	Yes	0.64
100	18.05	12.82	3.01	4.84	1.00	13.64	6.90	94.06	0.651	No	Yes	0.59
101	18.21	12.55	3.01	4.68	1.00	13.25	6.91	91.47	0.632	No	Yes	0.57
102	18.37	11.89	3.03	4.65	1.00	12.41	7.13	88.56	0.592	No	Yes	0.53
103	18.54	11.70	3.03	4.41	1.00	12.13	7.06	85.66	0.579	No	Yes	0.52
104	18.70	12.37	3.00	4.31	1.00	12.83	6.78	86.96	0.612	No	Yes	0.55
105	18.86	13.92	2.96	4.25	1.00	14.52	6.27	91.11	0.693	No	Yes	0.62
106	19.03	15.05	2.95	4.55	1.00	15.71	6.20	97.36	0.750	No	Yes	0.67
107	19.19	15.71	2.93	4.44	1.00	16.37	5.98	97.96	0.781	No	Yes	0.69
108	19.36	15.04	2.97	4.82	1.00	15.53	6.40	99.45	0.741	No	Yes	0.65
109	19.52	14.29	3.00	5.06	1.00	14.61	6.77	98.96	0.697	No	Yes	0.61
110	19.68	13.85	3.04	5.52	1.00	14.05	7.20	101.17	0.670	No	Yes	0.59
111	19.85	20.20	2.82	4.02	0.97	20.87	4.96	103.48	0.995	No	Yes	0.87
112	20.01	23.56	2.77	4.04	0.95	24.36	4.54	110.57	1.162	No	Yes	1.02
113	20.18	25.11	2.81	5.02	0.97	25.97	4.90	127.14	1.239	No	Yes	1.08
114	20.34	25.16	2.91	6.88	1.00	26.01	5.78	150.25	1.241	No	Yes	1.08
115	20.50	31.37	2.87	7.61	0.99	32.52	5.43	176.59	1.551	No	Yes	1.35
116	20.67	41.69	2.80	7.95	0.96	43.24	4.81	208.19	2.063	No	Yes	1.79
117	20.83	60.94	2.67	7.29	0.91	63.05	8.43	531.44	4.000	No	No	2.00
118	21.00	80.54	2.58	6.91	0.88	82.93	4.70	389.64	4.000	No	No	2.00
119	21.16	106.99	2.47	6.23	0.84	109.49	2.63	287.52	4.000	No	No	2.00
120	21.32	146.00	2.34	5.38	0.79	148.32	2.10	310.83	4.000	No	No	2.00
121	21.49	214.36	2.15	4.08	0.72	215.77	1.56	337.06	4.000	No	No	2.00
122	21.65	352.63	1.87	2.53	0.61	350.70	1.16	407.01	4.000	No	No	2.00
123	21.82	464.65	1.69	1.85	0.54	458.19	1.03	473.63	4.000	No	No	2.00

Abbreviations

Depth: Depth from free surface, at which CPT was performed (ft)
q_t: Total cone resistance
I_c: Soil behavior type index
Fr: Normalized friction ratio (%)
n: Stress exponent
Q_{tn}: Normalized cone resistance
K_c: Cone resistance correction factor due to fines
$Q_{tn,cs}$: Normalized and adjusted cone resistance
$CRR_{7.5}$: Cyclic resistance ratio for M_w=7.5
FS: Factor of safety against soil liquefaction

:: Liquefaction Potential Index calculation data ::

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
1.80	2.00	0.00	9.73	0.17	0.00	1.97	2.00	0.00	9.70	0.17	0.00
2.13	2.00	0.00	9.67	0.16	0.00	2.30	2.00	0.00	9.65	0.16	0.00
2.46	2.00	0.00	9.62	0.16	0.00	2.63	2.00	0.00	9.60	0.16	0.00
2.79	2.00	0.00	9.57	0.16	0.00	2.95	2.00	0.00	9.55	0.16	0.00
3.12	2.00	0.00	9.52	0.16	0.00	3.28	2.00	0.00	9.50	0.16	0.00
3.44	2.00	0.00	9.47	0.16	0.00	3.61	2.00	0.00	9.45	0.16	0.00
3.77	2.00	0.00	9.42	0.16	0.00	3.94	2.00	0.00	9.40	0.16	0.00
4.10	2.00	0.00	9.38	0.16	0.00	4.26	2.00	0.00	9.35	0.16	0.00
4.43	2.00	0.00	9.33	0.16	0.00	4.59	2.00	0.00	9.30	0.16	0.00
4.76	2.00	0.00	9.28	0.16	0.00	4.92	2.00	0.00	9.25	0.16	0.00
5.08	2.00	0.00	9.23	0.16	0.00	5.25	2.00	0.00	9.20	0.16	0.00
5.41	2.00	0.00	9.18	0.16	0.00	5.58	2.00	0.00	9.15	0.16	0.00
5.74	2.00	0.00	9.13	0.16	0.00	5.91	2.00	0.00	9.10	0.17	0.00
6.07	2.00	0.00	9.07	0.16	0.00	6.23	2.00	0.00	9.05	0.16	0.00
6.40	2.00	0.00	9.02	0.16	0.00	6.56	2.00	0.00	9.00	0.16	0.00
6.73	2.00	0.00	8.97	0.16	0.00	6.89	2.00	0.00	8.95	0.16	0.00
7.05	2.00	0.00	8.92	0.16	0.00	7.22	2.00	0.00	8.90	0.16	0.00
7.38	2.00	0.00	8.87	0.16	0.00	7.55	2.00	0.00	8.85	0.16	0.00
7.71	2.00	0.00	8.82	0.16	0.00	7.87	2.00	0.00	8.80	0.16	0.00
8.04	2.00	0.00	8.78	0.16	0.00	8.20	2.00	0.00	8.75	0.16	0.00
8.37	2.00	0.00	8.73	0.16	0.00	8.53	2.00	0.00	8.70	0.16	0.00
8.69	2.00	0.00	8.68	0.16	0.00	8.86	2.00	0.00	8.65	0.16	0.00
9.02	2.00	0.00	8.63	0.16	0.00	9.19	2.00	0.00	8.60	0.16	0.00
9.35	2.00	0.00	8.58	0.16	0.00	9.51	2.00	0.00	8.55	0.16	0.00
9.68	2.00	0.00	8.53	0.16	0.00	9.84	2.00	0.00	8.50	0.16	0.00
10.01	2.00	0.00	8.47	0.16	0.00	10.17	2.00	0.00	8.45	0.16	0.00
10.34	2.00	0.00	8.42	0.16	0.00	10.50	2.00	0.00	8.40	0.16	0.00
10.66	2.00	0.00	8.37	0.16	0.00	10.83	2.00	0.00	8.35	0.16	0.00
10.99	2.00	0.00	8.32	0.16	0.00	11.15	2.00	0.00	8.30	0.16	0.00
11.32	2.00	0.00	8.27	0.16	0.00	11.48	2.00	0.00	8.25	0.16	0.00
11.65	2.00	0.00	8.22	0.16	0.00	11.81	2.00	0.00	8.20	0.16	0.00
11.97	2.00	0.00	8.18	0.16	0.00	12.14	2.00	0.00	8.15	0.16	0.00
12.30	2.00	0.00	8.13	0.16	0.00	12.47	2.00	0.00	8.10	0.16	0.00
12.63	2.00	0.00	8.08	0.16	0.00	12.79	0.63	0.37	8.05	0.16	0.15
12.96	0.49	0.51	8.03	0.16	0.21	13.12	0.44	0.56	8.00	0.16	0.22
13.29	1.39	0.00	7.98	0.16	0.00	13.45	0.74	0.26	7.95	0.16	0.10
13.62	0.54	0.46	7.93	0.16	0.18	13.78	0.54	0.46	7.90	0.16	0.18
13.94	0.55	0.45	7.87	0.16	0.18	14.11	0.56	0.44	7.85	0.16	0.17
14.27	0.57	0.43	7.82	0.16	0.17	14.44	0.58	0.42	7.80	0.16	0.16
14.60	0.58	0.42	7.77	0.16	0.16	14.76	0.57	0.43	7.75	0.16	0.17
14.93	0.57	0.43	7.72	0.16	0.17	15.09	0.60	0.40	7.70	0.16	0.15
15.26	0.63	0.37	7.67	0.16	0.14	15.42	0.57	0.43	7.65	0.16	0.16
15.58	0.48	0.52	7.62	0.16	0.20	15.75	0.39	0.61	7.60	0.16	0.23
15.91	0.38	0.62	7.58	0.16	0.23	16.08	0.39	0.61	7.55	0.16	0.23
16.24	0.41	0.59	7.53	0.16	0.22	16.40	0.44	0.56	7.50	0.16	0.21
16.57	0.48	0.52	7.48	0.16	0.19	16.73	0.81	0.19	7.45	0.16	0.07
16.90	0.99	0.01	7.43	0.16	0.00	17.06	1.03	0.00	7.40	0.16	0.00
17.22	0.77	0.23	7.38	0.16	0.08	17.39	0.80	0.20	7.35	0.16	0.07

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
17.55	0.81	0.19	7.33	0.16	0.07	17.72	0.79	0.21	7.30	0.16	0.08
17.88	0.64	0.36	7.27	0.16	0.13	18.05	0.59	0.41	7.25	0.16	0.15
18.21	0.57	0.43	7.22	0.16	0.15	18.37	0.53	0.47	7.20	0.16	0.17
18.54	0.52	0.48	7.17	0.16	0.17	18.70	0.55	0.45	7.15	0.16	0.16
18.86	0.62	0.38	7.12	0.16	0.14	19.03	0.67	0.33	7.10	0.16	0.12
19.19	0.69	0.31	7.07	0.16	0.11	19.36	0.65	0.35	7.05	0.16	0.12
19.52	0.61	0.39	7.02	0.16	0.14	19.68	0.59	0.41	7.00	0.16	0.14
19.85	0.87	0.13	6.98	0.16	0.04	20.01	1.02	0.00	6.95	0.16	0.00
20.18	1.08	0.00	6.93	0.16	0.00	20.34	1.08	0.00	6.90	0.16	0.00
20.50	1.35	0.00	6.88	0.16	0.00	20.67	1.79	0.00	6.85	0.16	0.00
20.83	2.00	0.00	6.83	0.16	0.00	21.00	2.00	0.00	6.80	0.16	0.00
21.16	2.00	0.00	6.78	0.16	0.00	21.32	2.00	0.00	6.75	0.16	0.00
21.49	2.00	0.00	6.72	0.16	0.00	21.65	2.00	0.00	6.70	0.16	0.00
21.82	2.00	0.00	6.67	0.16	0.00						

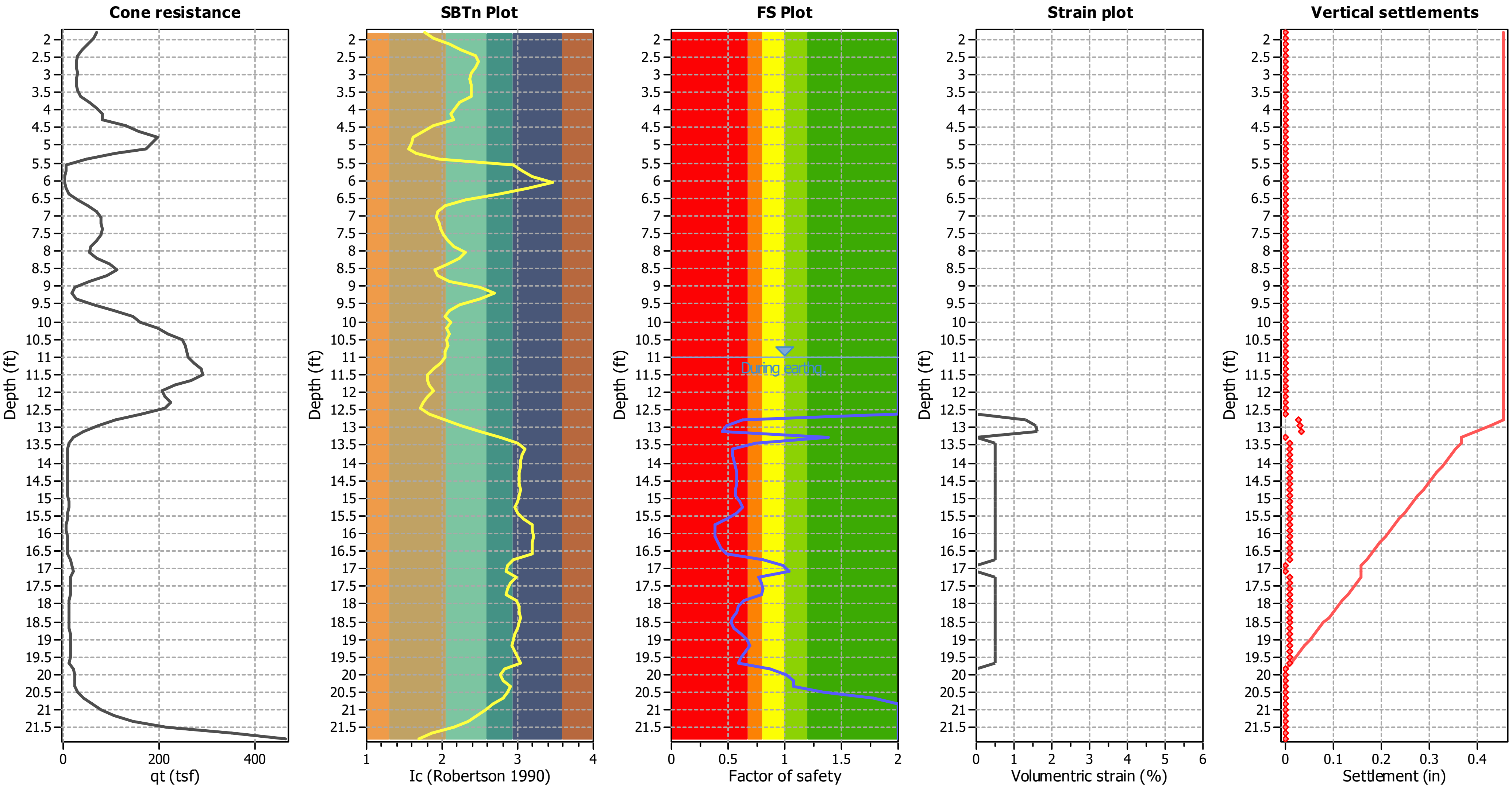
Overall liquefaction potential: 6.32

LPI = 0.00 - Liquefaction risk very low
LPI between 0.00 and 5.00 - Liquefaction risk low
LPI between 5.00 and 15.00 - Liquefaction risk high
LPI > 15.00 - Liquefaction risk very high

Abbreviations

FS: Calculated factor of safety for test point
F_L: 1 - FS
w_z: Function value of the extend of soil liquefaction according to depth
d_z: Layer thickness (ft)
LPI: Liquefaction potential index value for test point

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
11.15	434.68	2.00	0.00	1.00	0.00
11.48	393.31	2.00	0.00	1.00	0.00
11.81	315.49	2.00	0.00	1.00	0.00
12.14	281.70	2.00	0.00	1.00	0.00
12.47	255.66	2.00	0.00	1.00	0.00
12.79	178.07	0.63	1.31	1.00	0.03
13.12	155.46	0.44	1.63	1.00	0.03
13.45	102.84	0.74	0.50	1.00	0.01
13.78	84.13	0.54	0.50	1.00	0.01
14.11	83.90	0.56	0.50	1.00	0.01
14.44	85.34	0.58	0.50	1.00	0.01
14.76	86.48	0.57	0.50	1.00	0.01
15.09	87.31	0.60	0.50	1.00	0.01
15.42	83.63	0.57	0.50	1.00	0.01
15.75	77.47	0.39	0.50	1.00	0.01
16.08	80.49	0.39	0.50	1.00	0.01
16.40	89.21	0.44	0.50	1.00	0.01
16.73	111.96	0.81	0.50	1.00	0.01
17.06	119.92	1.03	0.01	1.00	0.00
17.39	104.60	0.80	0.50	1.00	0.01
17.72	94.67	0.79	0.50	1.00	0.01
18.05	94.06	0.59	0.50	1.00	0.01
18.37	88.56	0.53	0.50	1.00	0.01
18.70	86.96	0.55	0.50	1.00	0.01
19.03	97.36	0.67	0.50	1.00	0.01
19.36	99.45	0.65	0.50	1.00	0.01
19.68	101.17	0.59	0.50	1.00	0.01
20.01	110.57	1.02	0.01	1.00	0.00
20.34	150.25	1.08	0.01	1.00	0.00
20.67	208.19	1.79	0.00	1.00	0.00
21.00	389.64	2.00	0.00	1.00	0.00
21.32	310.83	2.00	0.00	1.00	0.00
21.65	407.01	2.00	0.00	1.00	0.00
11.32	421.60	2.00	0.00	1.00	0.00
11.65	356.44	2.00	0.00	1.00	0.00
11.97	289.16	2.00	0.00	1.00	0.00
12.30	281.15	2.00	0.00	1.00	0.00
12.63	215.90	2.00	0.00	1.00	0.00
12.96	161.37	0.49	1.58	1.00	0.03
13.29	129.95	1.39	0.00	1.00	0.00
13.62	87.08	0.54	0.50	1.00	0.01
13.94	83.51	0.55	0.50	1.00	0.01
14.27	84.52	0.57	0.50	1.00	0.01
14.60	85.66	0.58	0.50	1.00	0.01
14.93	86.22	0.57	0.50	1.00	0.01
15.26	85.59	0.63	0.50	1.00	0.01
15.58	79.86	0.48	0.50	1.00	0.01
15.91	77.58	0.38	0.50	1.00	0.01
16.24	83.79	0.41	0.50	1.00	0.01
16.57	98.30	0.48	0.50	1.00	0.01
16.90	120.54	0.99	0.01	1.00	0.00
17.22	115.53	0.77	0.50	1.00	0.01
17.55	98.55	0.81	0.50	1.00	0.01
17.88	95.62	0.64	0.50	1.00	0.01
18.21	91.47	0.57	0.50	1.00	0.01
18.54	85.66	0.52	0.50	1.00	0.01
18.86	91.11	0.62	0.50	1.00	0.01
19.19	97.96	0.69	0.50	1.00	0.01
19.52	98.96	0.61	0.50	1.00	0.01
19.85	103.48	0.87	0.01	1.00	0.00
20.18	127.14	1.08	0.01	1.00	0.00
20.50	176.59	1.35	0.01	1.00	0.00
20.83	531.44	2.00	0.00	1.00	0.00
21.16	287.52	2.00	0.00	1.00	0.00
21.49	337.06	2.00	0.00	1.00	0.00
21.82	473.63	2.00	0.00	1.00	0.00

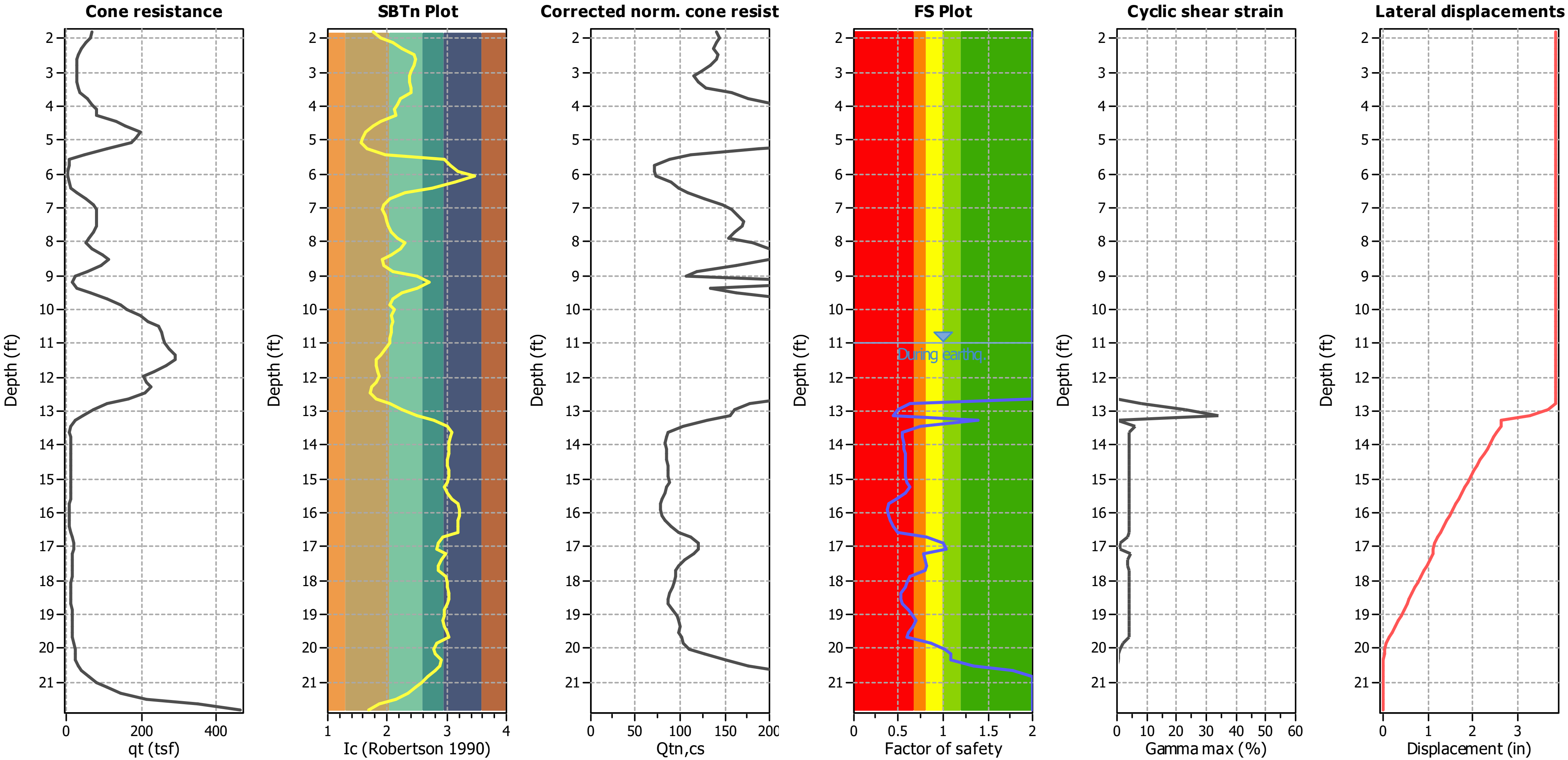
Total estimated settlement: 0.45

Abbreviations

$Q_{tn,cs}$: Equivalent clean sand normalized cone resistance
FS: Factor of safety against liquefaction
e_v (%): Post-liquefaction volumentric strain
DF: e_v depth weighting factor
Settlement: Calculated settlement

Estimation of post-earthquake lateral Displacements

Geometric parameters: Gently sloping ground without free face (Slope 1.00 %)

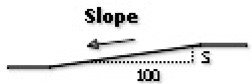


Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$Q_{tn,cs}$: Equivalent clean sand normalized CPT total cone resistance

F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

Surface condition



:: Lateral displacement index calculation ::

Depth (ft)	q_t (tsf)	Q_{tn}	R_f (%)	$Q_{tn,cs}$	FS	D_r	$Gamma_{max}$ (%)	Lat. disp. (in)
11.15	273.37	343.43	3.28	434.68	2.00	100.00	0.00	0.00
11.32	289.26	356.57	2.72	421.60	2.00	100.00	0.00	0.00
11.48	292.45	353.56	2.16	393.31	2.00	100.00	0.00	0.00
11.65	267.69	321.65	2.01	356.44	2.00	100.00	0.00	0.00
11.81	233.29	279.98	1.96	315.49	2.00	100.00	0.00	0.00
11.97	206.01	247.83	2.06	289.16	2.00	96.96	0.00	0.00
12.14	212.41	251.98	1.76	281.70	2.00	97.50	0.00	0.00
12.30	225.24	263.24	1.49	281.15	2.00	98.95	0.00	0.00
12.47	211.67	244.98	1.26	255.66	2.00	96.57	0.00	0.00
12.63	164.45	192.45	1.44	215.90	2.00	88.61	0.00	0.00
12.79	110.07	131.91	2.00	178.07	0.63	76.14	8.36	0.15
12.96	72.92	89.30	2.75	161.37	0.49	63.27	22.70	0.42
13.12	42.65	53.37	3.73	155.46	0.44	46.27	34.10	0.63
13.29	22.30	28.26	4.70	129.95	1.39	25.29	0.22	0.00
13.45	12.18	15.15	4.94	102.84	0.74	4.71	5.90	0.11
13.62	9.25	11.17	4.54	87.08	0.54	0.00	4.00	0.07
13.78	9.39	11.30	4.14	84.13	0.54	0.00	4.00	0.07
13.94	9.64	11.55	3.99	83.51	0.55	0.00	4.00	0.07
14.11	9.88	11.79	3.95	83.90	0.56	0.00	4.00	0.07
14.27	10.14	12.06	3.93	84.52	0.57	0.00	4.00	0.07
14.44	10.34	12.24	3.96	85.34	0.58	0.00	4.00	0.07
14.60	10.44	12.30	3.98	85.66	0.58	0.00	4.00	0.07
14.76	10.37	12.14	4.11	86.48	0.57	0.00	4.00	0.07
14.93	10.48	12.21	4.06	86.22	0.57	0.00	4.00	0.07
15.09	11.08	12.90	3.97	87.31	0.60	0.00	4.00	0.07
15.26	11.80	13.73	3.59	85.59	0.63	1.47	4.00	0.07
15.42	10.84	12.45	3.72	83.63	0.57	0.00	4.00	0.07
15.58	9.36	10.53	3.90	79.86	0.48	0.00	4.00	0.07
15.75	7.74	8.46	4.52	77.47	0.39	0.00	4.00	0.07
15.91	7.73	8.39	4.57	77.58	0.38	0.00	4.00	0.07
16.08	7.89	8.54	4.92	80.49	0.39	0.00	4.00	0.07
16.24	8.45	9.18	5.03	83.79	0.41	0.00	4.00	0.07
16.40	9.05	9.85	5.42	89.21	0.44	0.00	4.00	0.07
16.57	9.92	10.85	6.16	98.30	0.48	0.00	4.00	0.07
16.73	16.13	18.29	4.97	111.96	0.81	10.93	3.38	0.06
16.90	19.71	22.39	4.87	120.54	0.99	17.60	1.20	0.02
17.06	20.72	23.41	4.65	119.92	1.03	19.07	0.97	0.02
17.22	15.79	17.56	5.50	115.53	0.77	9.58	4.38	0.07
17.39	16.42	18.19	4.34	104.60	0.80	10.75	3.71	0.06
17.55	16.86	18.54	3.77	98.55	0.81	11.38	3.42	0.06
17.72	16.61	18.13	3.53	94.67	0.79	10.64	3.89	0.06
17.88	13.61	14.64	4.32	95.62	0.64	3.57	4.00	0.07
18.05	12.82	13.64	4.43	94.06	0.59	1.24	4.00	0.07
18.21	12.55	13.25	4.28	91.47	0.57	0.28	4.00	0.07
18.37	11.89	12.41	4.22	88.56	0.53	0.00	4.00	0.07
18.54	11.70	12.13	3.99	85.66	0.52	0.00	4.00	0.06
18.70	12.37	12.83	3.92	86.96	0.55	0.00	4.00	0.06
18.86	13.92	14.52	3.90	91.11	0.62	3.32	4.00	0.06

:: Estimation of post-earthquake lateral Displacements :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	R_f (%)	$Q_{tn,cs}$	FS	D_r	$Gamma_{max}$ (%)	Lat. disp. (in)
19.03	15.05	15.71	4.21	97.36	0.67	5.92	4.00	0.06
19.19	15.71	16.37	4.12	97.96	0.69	7.27	4.00	0.06
19.36	15.04	15.53	4.45	99.45	0.65	5.53	4.00	0.06
19.52	14.29	14.61	4.64	98.96	0.61	3.52	4.00	0.06
19.68	13.85	14.05	5.05	101.17	0.59	2.23	4.00	0.06
19.85	20.20	20.87	3.79	103.48	0.87	15.28	2.25	0.04
20.01	23.56	24.36	3.83	110.57	1.02	20.39	1.01	0.02
20.18	25.11	25.97	4.78	127.14	1.08	22.50	0.72	0.01
20.34	25.16	26.01	6.55	150.25	1.08	22.55	0.73	0.01
20.50	31.37	32.52	7.31	176.59	1.35	29.92	0.21	0.00
20.67	41.69	43.24	7.72	208.19	1.79	39.33	0.04	0.00
20.83	60.94	63.05	7.14	531.44	2.00	51.77	0.00	0.00
21.00	80.54	82.93	6.80	389.64	2.00	60.82	0.00	0.00
21.16	106.99	109.49	6.16	287.52	2.00	69.99	0.00	0.00
21.32	146.00	148.32	5.33	310.83	2.00	80.01	0.00	0.00
21.49	214.36	215.77	4.05	337.06	2.00	92.38	0.00	0.00
21.65	352.63	350.70	2.52	407.01	2.00	100.00	0.00	0.00
21.82	464.65	458.19	1.85	473.63	2.00	100.00	0.00	0.00

Total estimated displacement: 3.85

Abbreviations

q_t: Total cone resistance
Q_{tn}: Adjusted cone resistance to an effective overburden stress of 1 atm
R_f: Friction ration
$Q_{tn,cs}$: Adjusted and corrected cone resistance due to fines
FS: Calculated factor of safety against liquefaction
D_r: Calculated relative density
$Gamma_{max}$: Calculated maximum cyclic shear strain
Lat. disp.: Lateral displacement

:: Strength loss calculation (Robertson (2009) ::

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
1.80	69.47	131.10	1.08	141.50	1.76	N/A	N/A
1.97	64.61	121.91	1.18	143.26	1.89	N/A	N/A
2.13	52.20	98.42	1.43	141.16	2.09	N/A	N/A
2.30	40.13	75.60	1.82	137.46	2.26	N/A	N/A
2.46	30.14	56.70	2.50	141.60	2.44	N/A	N/A
2.63	28.19	52.99	2.66	141.14	2.48	N/A	N/A
2.79	28.65	53.84	2.48	133.63	2.44	N/A	N/A
2.95	29.09	54.66	2.26	123.54	2.39	N/A	N/A
3.12	28.07	52.71	2.18	115.04	2.37	N/A	N/A
3.28	28.86	54.19	2.23	120.71	2.38	N/A	N/A
3.44	30.25	56.79	2.26	128.25	2.39	N/A	N/A
3.61	37.07	69.66	2.26	157.47	2.39	N/A	N/A
3.77	54.29	102.20	1.73	176.48	2.22	N/A	N/A
3.94	69.41	130.76	1.59	207.84	2.17	N/A	N/A
4.10	81.43	153.45	1.47	225.43	2.11	N/A	N/A
4.26	81.16	152.93	1.57	239.59	2.16	N/A	N/A
4.43	131.28	247.64	1.18	292.53	1.89	N/A	N/A
4.59	156.62	295.52	1.08	318.24	1.76	N/A	N/A
4.76	198.08	352.44	1.00	352.44	1.62	N/A	N/A
4.92	184.77	317.63	1.00	317.63	1.59	N/A	N/A
5.08	174.35	291.27	1.00	291.27	1.56	N/A	N/A
5.25	108.71	186.86	1.01	188.66	1.66	N/A	N/A
5.41	47.66	89.46	1.26	112.35	1.96	N/A	N/A
5.58	7.81	14.13	6.19	87.43	2.95	N/A	N/A
5.74	5.46	9.68	7.35	71.17	3.05	N/A	N/A
5.91	4.47	7.79	9.14	71.19	3.19	N/A	N/A
6.07	3.28	5.52	13.27	73.21	3.45	N/A	N/A
6.23	5.93	10.52	8.49	89.29	3.14	N/A	N/A
6.40	12.34	22.61	4.35	98.35	2.75	N/A	N/A
6.56	29.26	54.58	1.97	107.65	2.31	N/A	N/A
6.73	52.13	92.58	1.36	126.30	2.05	N/A	N/A
6.89	70.50	119.02	1.24	147.19	1.95	N/A	N/A
7.05	79.02	130.41	1.21	157.91	1.92	N/A	N/A
7.22	79.21	130.88	1.26	164.68	1.97	N/A	N/A
7.38	81.74	133.80	1.28	170.63	1.98	N/A	N/A
7.55	78.53	128.36	1.33	170.21	2.02	N/A	N/A
7.71	70.44	115.32	1.40	161.80	2.07	N/A	N/A
7.87	59.00	97.85	1.58	154.26	2.16	N/A	N/A
8.04	53.57	91.48	1.97	180.64	2.31	N/A	N/A
8.20	69.82	114.81	1.74	199.41	2.23	N/A	N/A
8.37	97.36	151.32	1.42	214.14	2.08	N/A	N/A
8.53	113.42	166.22	1.20	199.72	1.91	N/A	N/A
8.69	90.61	131.97	1.23	161.89	1.94	N/A	N/A
8.86	54.25	81.32	1.46	118.81	2.10	N/A	N/A
9.02	24.34	39.39	2.73	107.54	2.49	N/A	N/A
9.19	17.09	28.43	3.96	112.59	2.70	N/A	N/A
9.35	28.56	45.23	2.81	127.24	2.51	N/A	N/A
9.51	62.71	92.63	1.75	162.41	2.23	N/A	N/A

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
9.68	106.86	151.70	1.46	221.60	2.10	N/A	N/A
9.84	145.90	202.19	1.36	275.83	2.05	N/A	N/A
10.01	162.38	225.50	1.47	331.69	2.11	N/A	N/A
10.17	197.38	268.31	1.39	373.54	2.06	N/A	N/A
10.34	218.11	295.40	1.46	431.12	2.10	N/A	N/A
10.50	248.12	329.76	1.40	460.31	2.07	N/A	N/A
10.66	255.08	336.02	1.42	476.66	2.08	N/A	N/A
10.83	259.47	335.93	1.37	459.13	2.05	N/A	N/A
10.99	262.56	335.32	1.34	450.82	2.03	N/A	N/A
11.15	273.37	343.43	1.27	434.68	1.97	1.02	1.02
11.32	289.26	356.57	1.18	421.60	1.89	1.02	1.02
11.48	292.45	353.56	1.11	393.31	1.81	1.02	1.02
11.65	267.69	321.65	1.11	356.44	1.80	1.01	1.01
11.81	233.29	279.98	1.13	315.49	1.83	0.98	0.98
11.97	206.01	247.83	1.17	289.16	1.88	0.96	0.96
12.14	212.41	251.98	1.12	281.70	1.82	0.97	0.97
12.30	225.24	263.24	1.07	281.15	1.74	0.97	0.97
12.47	211.67	244.98	1.04	255.66	1.71	0.96	0.96
12.63	164.45	192.45	1.12	215.90	1.82	0.92	0.92
12.79	110.07	131.91	1.35	178.07	2.04	0.87	0.87
12.96	72.92	89.30	1.81	161.37	2.25	0.81	0.81
13.12	42.65	53.37	2.80	149.31	2.51	0.74	0.74
13.29	22.30	28.26	4.60	129.95	2.78	2.06	2.06
13.45	12.18	15.15	6.79	102.84	3.00	1.08	1.08
13.62	9.25	11.17	7.80	87.08	3.09	0.80	0.80
13.78	9.39	11.30	7.45	84.13	3.06	0.81	0.81
13.94	9.64	11.55	7.23	83.51	3.04	0.82	0.82
14.11	9.88	11.79	7.11	83.90	3.03	0.84	0.84
14.27	10.14	12.06	7.01	84.52	3.02	0.86	0.86
14.44	10.34	12.24	6.97	85.34	3.02	0.87	0.87
14.60	10.44	12.30	6.96	85.66	3.02	0.88	0.88
14.76	10.37	12.14	7.12	86.48	3.03	0.87	0.87
14.93	10.48	12.21	7.06	86.22	3.03	0.87	0.87
15.09	11.08	12.90	6.77	87.31	3.00	0.92	0.92
15.26	11.80	13.73	6.23	85.59	2.95	0.98	0.98
15.42	10.84	12.45	6.72	83.63	3.00	0.89	0.89
15.58	9.36	10.53	7.59	79.86	3.07	0.75	0.75
15.75	7.74	8.46	9.16	77.47	3.19	0.60	0.60
15.91	7.73	8.39	9.25	77.58	3.20	0.60	0.60
16.08	7.89	8.54	9.43	80.49	3.21	0.61	0.61
16.24	8.45	9.18	9.13	83.79	3.19	0.66	0.66
16.40	9.05	9.85	9.05	89.21	3.19	0.70	0.70
16.57	9.92	10.85	9.06	98.30	3.19	0.78	0.78
16.73	16.13	18.29	6.12	111.96	2.94	1.31	1.31
16.90	19.71	22.39	5.38	120.54	2.87	1.61	1.61
17.06	20.72	23.41	5.12	119.92	2.84	1.68	1.68
17.22	15.79	17.56	6.58	115.53	2.99	1.25	1.25
17.39	16.42	18.19	5.75	104.60	2.91	1.30	1.30

:: Strength loss calculation (Robertson (2009) :: (continued)

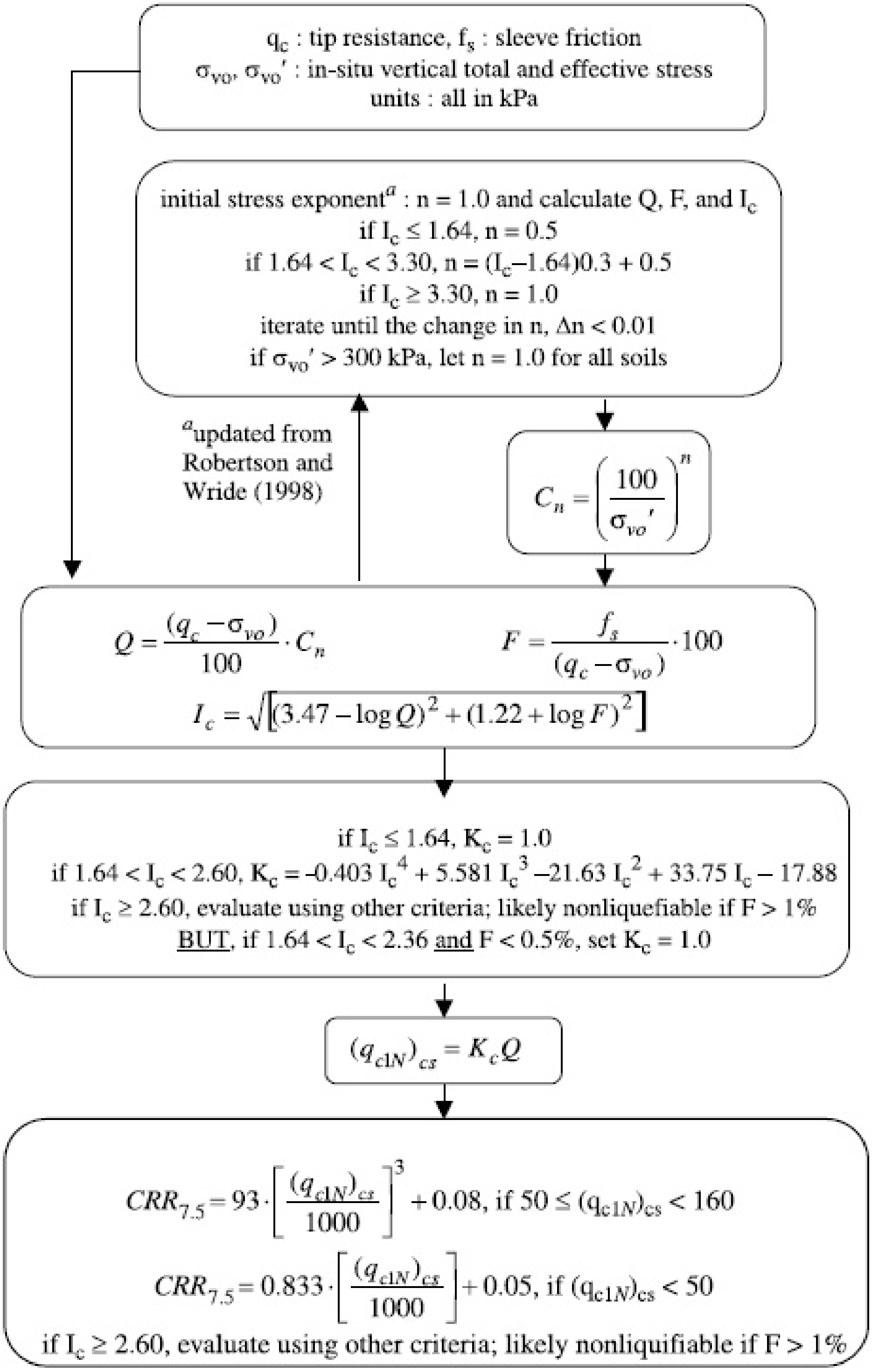
Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
17.55	16.86	18.54	5.32	98.55	2.86	1.33	1.33
17.72	16.61	18.13	5.22	94.67	2.85	1.30	1.30
17.88	13.61	14.64	6.53	95.62	2.98	1.05	1.05
18.05	12.82	13.64	6.90	94.06	3.01	0.97	0.97
18.21	12.55	13.25	6.91	91.47	3.01	0.95	0.95
18.37	11.89	12.41	7.13	88.56	3.03	0.89	0.89
18.54	11.70	12.13	7.06	85.66	3.03	0.87	0.87
18.70	12.37	12.83	6.78	86.96	3.00	0.92	0.92
18.86	13.92	14.52	6.27	91.11	2.96	1.04	1.04
19.03	15.05	15.71	6.20	97.36	2.95	1.12	1.12
19.19	15.71	16.37	5.98	97.96	2.93	1.17	1.17
19.36	15.04	15.53	6.40	99.45	2.97	1.11	1.11
19.52	14.29	14.61	6.77	98.96	3.00	1.04	1.04
19.68	13.85	14.05	7.20	101.17	3.04	1.00	1.00
19.85	20.20	20.87	4.96	103.48	2.82	1.50	1.50
20.01	23.56	24.36	4.54	110.57	2.77	1.75	1.75
20.18	25.11	25.97	4.90	127.14	2.81	1.86	1.86
20.34	25.16	26.01	5.78	150.25	2.91	1.86	1.86
20.50	31.37	32.52	5.43	176.59	2.87	2.33	2.33
20.67	41.69	43.24	4.81	208.19	2.80	3.10	3.10
20.83	60.94	63.05	3.78	238.40	2.67	4.55	4.55
21.00	80.54	82.93	3.20	265.05	2.58	0.80	0.80
21.16	106.99	109.49	2.63	287.52	2.47	0.84	0.84
21.32	146.00	148.32	2.10	310.83	2.34	0.88	0.88
21.49	214.36	215.77	1.56	337.06	2.15	0.94	0.94
21.65	352.63	350.70	1.16	407.01	1.87	1.02	1.02
21.82	464.65	458.19	1.03	473.63	1.69	1.07	1.07

Abbreviations

q_t: Total cone resistance
K_c: Cone resistance correction factor due to fines
$Q_{tn,cs}$: Adjusted and corrected cone resistance due to fines
I_c: Soil behavior type index
$S_{u(liq)}/\sigma'_v$: Calculated liquefied undrained strength ratio
$S_{u(peak)}/\sigma'_v$: Calculated peak undrained strength ratio

Procedure for the evaluation of soil liquefaction resistance, NCEER (1998)

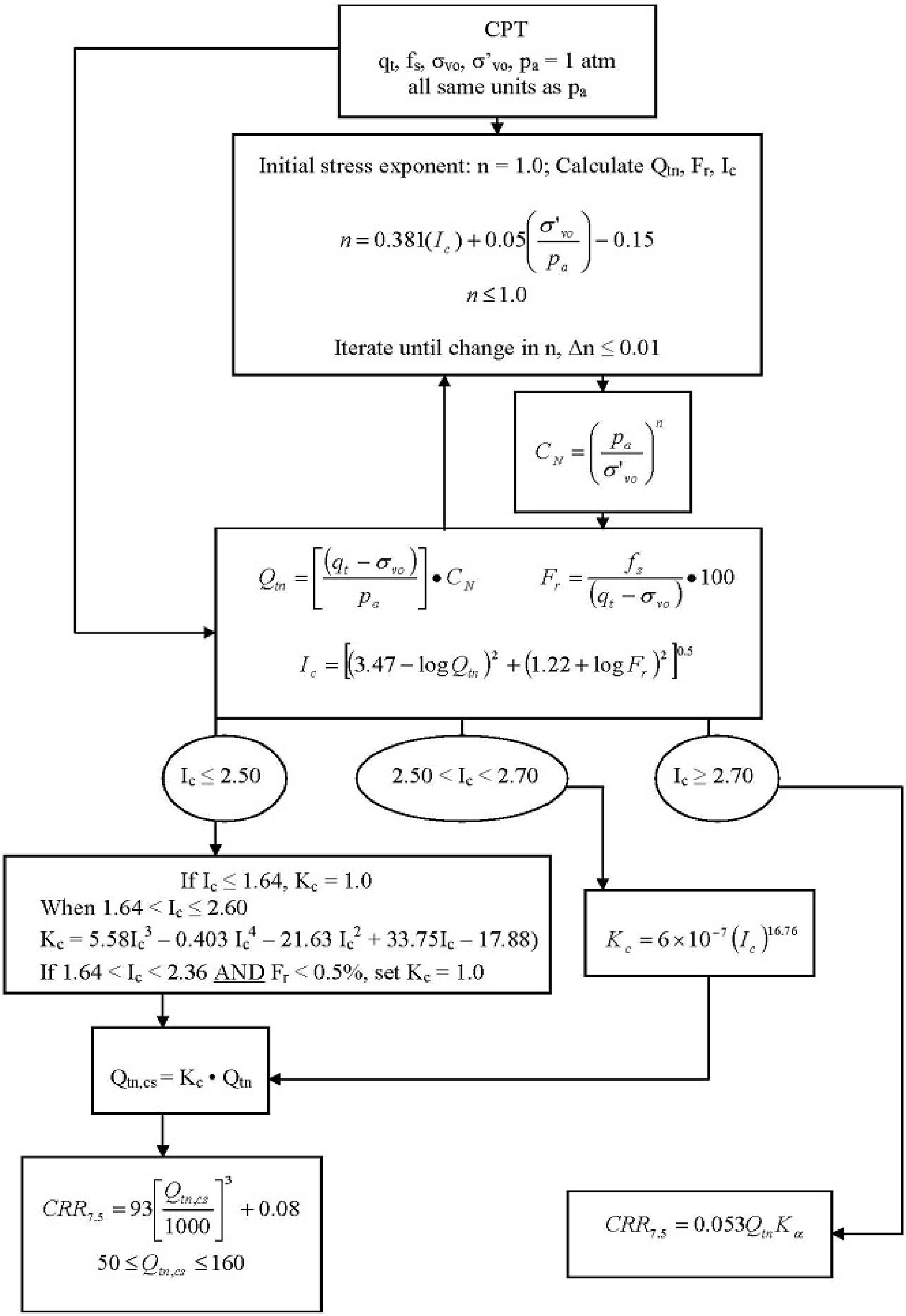
Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. The procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils). The revised procedure is presented below in the form of a flowchart[1]:



[1] "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

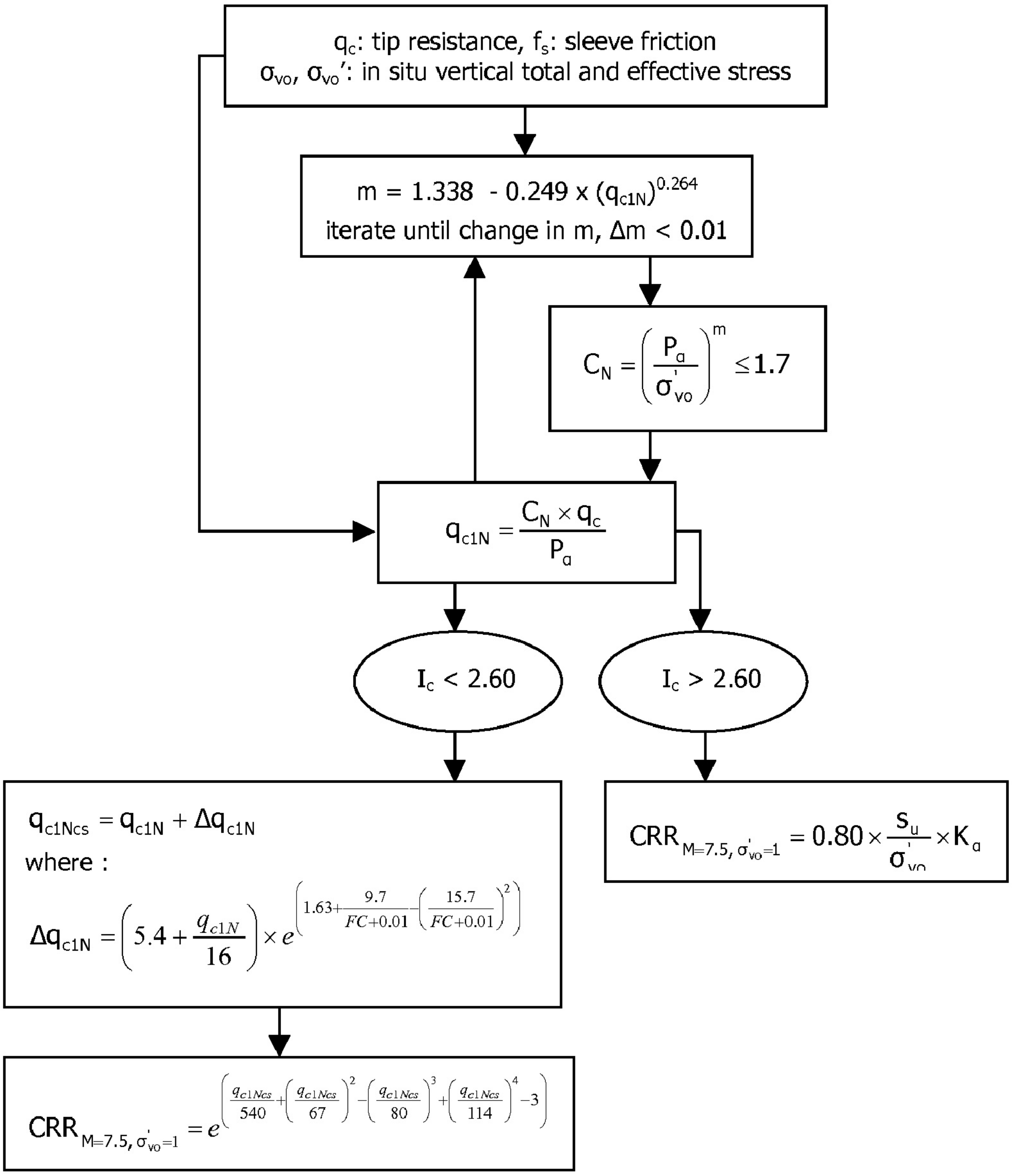
Procedure for the evaluation of soil liquefaction resistance (all soils), Robertson (2010)

Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. This procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils). The revised procedure is presented below in the form of a flowchart[1]:

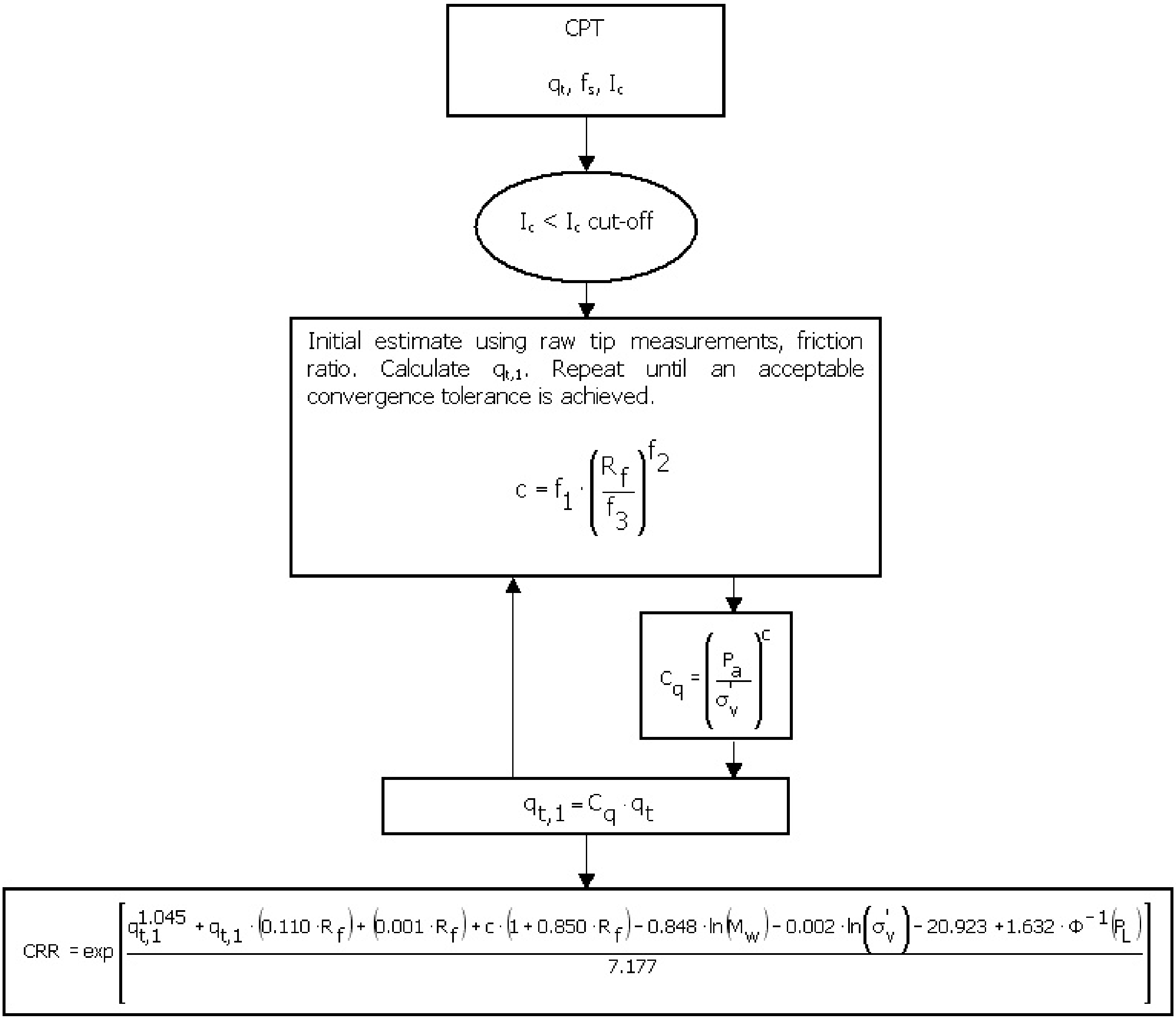


[1] P.K. Robertson, 2009. "Performance based earthquake design using the CPT", Keynote Lecture, International Conference on Performance-based Design in Earthquake Geotechnical Engineering – from case history to practice, IS-Tokyo, June 2009

Procedure for the evaluation of soil liquefaction resistance, Idriss & Boulanger (2008)



Procedure for the evaluation of soil liquefaction resistance (sandy soils), Moss et al. (2006)



Procedure for the evaluation of soil liquefaction resistance, Boulanger & Idriss(2014)

$$FS_{liq} = \frac{CRR_{M=7.5,\sigma'_v=1atm}}{CSR_{M=7.5,\sigma'_v=1atm}}$$

$$CSR_{M=7.5,\sigma'_v=1atm} = 0.65\frac{\sigma_v}{\sigma'_v}\frac{a_{max}}{g}r_d\frac{1}{MSF}\frac{1}{K_\sigma}$$

$$r_d = \exp\left[\alpha(z)+\beta(z)\cdot M\right]$$

$$\alpha(z) = -1.012-1.126\sin\left(\frac{z}{11.73}+5.133\right)$$

$$\beta(z) = 0.106+0.118\sin\left(\frac{z}{11.28}+5.142\right)$$

$$K_\sigma = 1-C_\sigma\ln\left(\frac{\sigma'_v}{P_a}\right)\le 1.1$$

$$C_\sigma = \frac{1}{37.3-8.27\left(q_{c1Ncs}\right)^{0.264}}\le 0.3$$

$$MSF = 1+\left(MSF_{max}-1\right)\left(8.64\exp\left(\frac{-M}{4}\right)-1.325\right)$$

$$MSF_{max} = 1.09+\left(\frac{q_{c1Ncs}}{180}\right)^3\le 2.2$$

σ'_v *and* σ_v *at start of earthquake shaking*

$$CRR_{M=7.5,\sigma'_v=1atm} = \exp\left(\frac{q_{c1Ncs}}{113}+\left(\frac{q_{c1Ncs}}{1000}\right)^2-\left(\frac{q_{c1Ncs}}{140}\right)^3+\left(\frac{q_{c1Ncs}}{137}\right)^4-2.80\right)$$

$$q_{c1Ncs} = q_{c1N}+\Delta q_{c1N}$$

$$\Delta q_{c1N} = \left(11.9+\frac{q_{c1N}}{14.6}\right)\exp\left(1.63-\frac{9.7}{FC+2}-\left(\frac{15.7}{FC+2}\right)^2\right)$$

$$q_{c1N} = C_{N\sigma}\frac{q_c}{P_a}$$

$$C_{N\sigma} = \left(\frac{P_a}{\sigma'_v}\right)^m\le 1.7$$

$$m = 1.338-0.249\left(q_{c1Ncs}\right)^{0.264}\quad with\quad 0.264\le m\le 0.782$$

$$FC = 80\left(I_C+C_{FC}\right)-137\quad with\quad 0\%\le FC\le 100\%$$

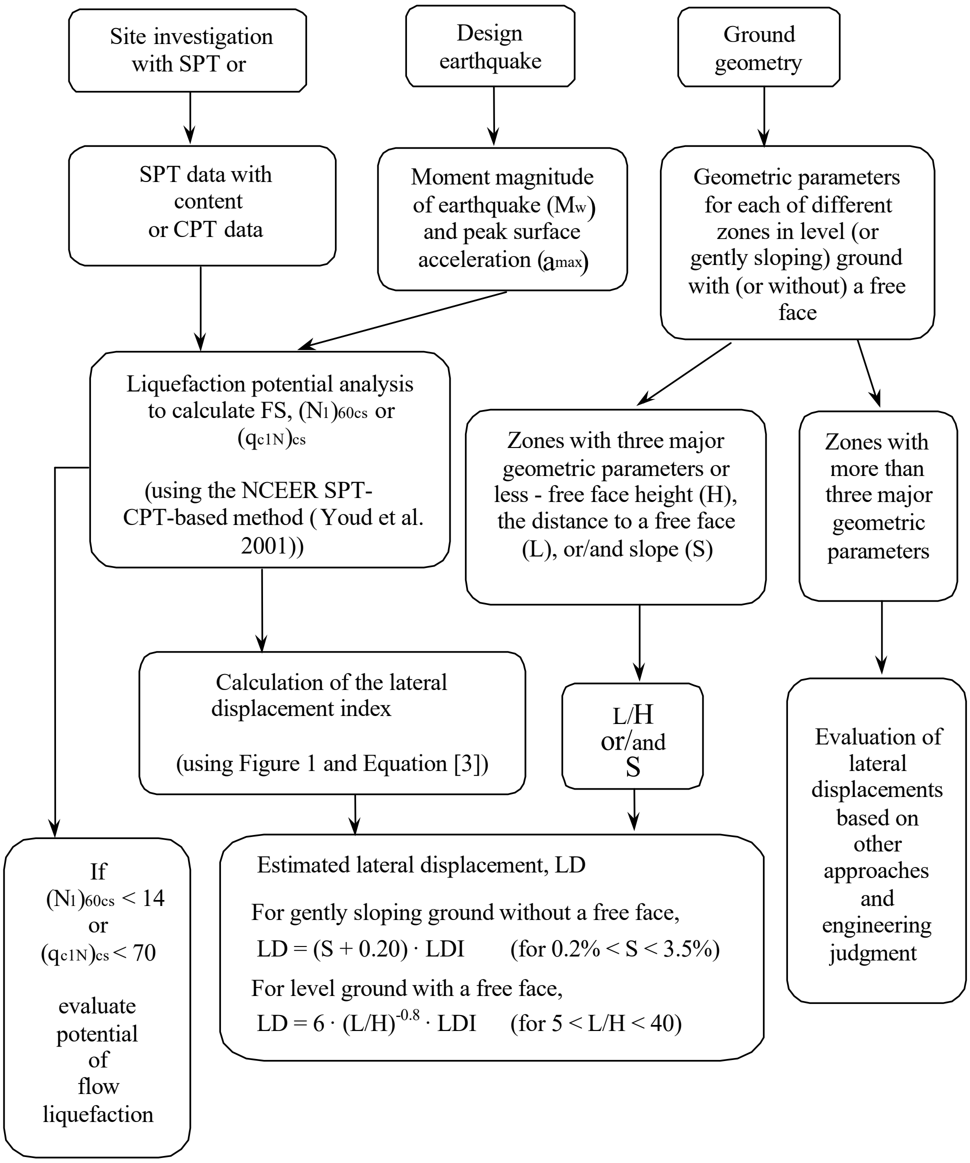
$$I_c = \left[\left(3.47-\log(Q)\right)^2+\left(1.22+\log(F)\right)^2\right]^{0.5}$$

$$Q = \left(\frac{q_c-\sigma_{vc}}{P_a}\right)\left(\frac{P_a}{\sigma'_{vc}}\right)^n\ with\ 0.5\le n\le 1.0\ per\ Robertson\ \&\ Wride\ (1998)$$

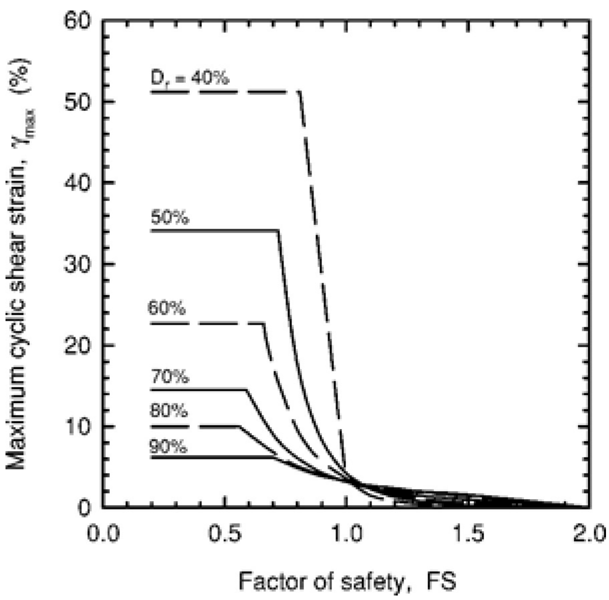
$$F = \left(\frac{f_s}{q_c-\sigma_{vc}}\right)\cdot 100\%$$

σ'_v *at time of CPT sounding*

Procedure for the evaluation of liquefaction-induced lateral spreading displacements



[1] Flow chart illustrating major steps in estimating liquefaction-induced lateral spreading displacements using the proposed approach



[1] **Figure 1**

$$\mathrm{LDI} = \int_0^{Z_{\max}} \gamma_{\max}\, dz$$

[1] **Equation [3]**

[1] "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

Procedure for the estimation of seismic induced settlements in dry sands

Average shear stress, τ_{av}

$$\tau_{av} = CSR^{*} \cdot \sigma_{v0}' = 0.65 \cdot \frac{a_{max}}{g} \cdot \sigma_{v0} \cdot \tau_{a}$$

Estimate small shear strain modulus, G_0

$$G_0 = 0.0188 \cdot \left[10^{(0.55 I_c - 1.68)}\right] \cdot (q_t - \sigma_v)$$

Estimate shear strain amplitude, γ (based on Pradel (1998))

$$\gamma = \left[\frac{1 + a \cdot e^{bR}}{1 + a}\right] \cdot R \cdot 100 \ (\%)$$

$$R = \frac{\tau_{av}}{G_0} \text{ (Note } \tau_{av} \text{ and } G_0 \text{ same units)}$$

$$a = 0.0389 \cdot \left(\frac{\sigma_v}{p_a}\right) + 0.124$$

$$b = 6400 \cdot \left(\frac{\sigma_v}{p_a}\right)$$

Estimate volumetric strain in 15 cycles

$$\varepsilon_{vol(15)} = \gamma \cdot \left[\frac{(N_1)_{60,cs}}{20}\right]^{-1.20}$$

$$(N_1)_{60,cs} = \frac{Q_{tn,cs}}{8.5 \cdot \left[1 - \frac{I_c}{4.6}\right]}$$

Volumetric strain in design earthquake

$$\Sigma_{vol} = \varepsilon_{vol(15)} \cdot \left[\frac{N_c}{15}\right]^{0.45}$$

$$N_c = (M - 4)^{2.17}$$

Seismic settlement, s

$$s = 2 \cdot \int_0^{GWT} \Sigma_{vol} \cdot dz$$

Robertson, P.K. and Lisheng, S., 2010, "Estimation of seismic compression in dry soils using the CPT" FIFTH INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN GEOTECHNICAL EARTHQUAKE ENGINEERING AND SOIL DYNAMICS, Symposium in honor of professor I. M. Idriss, San Diego, CA

Liquefaction Potential Index (LPI) calculation procedure

Calculation of the Liquefaction Potential Index (LPI) is used to interpret the liquefaction assessment calculations in terms of severity over depth. The calculation procedure is based on the methology developed by Iwasaki (1982) and is adopted by AFPS.

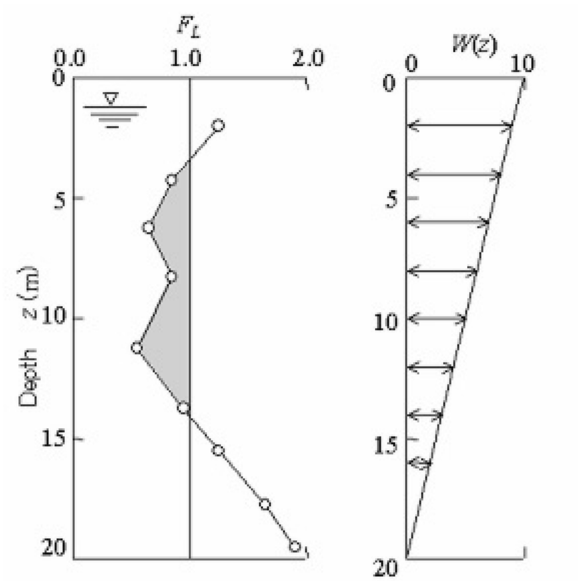
To estimate the severity of liquefaction extent at a given site, LPI is calculated based on the following equation:

$$\textbf{LPI} = \int_{0}^{20} (10 - 0{,}5_{z}) \times F_{L} \times d_{z}$$

where:
F_L = 1 - F.S. when F.S. less than 1
F_L = 0 when F.S. greater than 1
z depth of measurment in meters

Values of LPI range between zero (0) when no test point is characterized as liquefiable and 100 when all points are characterized as susceptible to liquefaction. Iwasaki proposed four (4) discrete categories based on the numeric value of LPI:

- LPI = 0 : Liquefaction risk is very low
- 0 < LPI <= 5 : Liquefaction risk is low
- 5 < LPI <= 15 : Liquefaction risk is high
- LPI > 15 : Liquefaction risk is very high



Graphical presentation of the LPI calculation procedure

Shear-Induced Building Settlement (Ds) calculation procedure

The shear-induced building settlement (Ds) due to liquefaction below the building can be estimated using the relationship developed by Bray and Macedo (2017):

$$Ln(Ds) = c1 + c2 * LBS + 0.58 * Ln\left(Tanh\left(\frac{HL}{6}\right)\right) +$$
$$4.59 * Ln(Q) - 0.42 * Ln(Q)^2 - 0.02 * B +$$
$$0.84 * Ln(CAVdp) + 0.41 * Ln(Sa1) + \varepsilon$$

where Ds is in the units of mm, c1= -8.35 and c2= 0.072 for LBS ≤ 16, and c1= -7.48 and c2= 0.014 otherwise. Q is the building contact pressure in units of kPa, HL is the cumulative thickness of the liquefiable layers in the units of m, B is the building width in the units of m, CAVdp is a standardized version of the cumulative absolute velocity in the units of g-s, Sa1 is 5%-damped pseudo-acceleration response spectral value at a period of 1 s in the units of g, and ε is a normal random variable with zero mean and 0.50 standard deviation in Ln units. The liquefaction-induced building settlement index (LBS) is:

$$LBS = \sum W * \frac{\varepsilon_{shear}}{z} dz$$

where z (m) is the depth measured from the ground surface > 0, W is a foundation-weighting factor wherein W = 0.0 for z less than Df, which is the embedment depth of the foundation, and W = 1.0 otherwise. The shear strain parameter (ε_shear) is the liquefaction-induced free-field shear strain (in %) estimated using Zhang et al. (2004). It is calculated based on the estimated Dr of the liquefied soil layer and the calculated safety factor against liquefaction triggering (FSL).

References

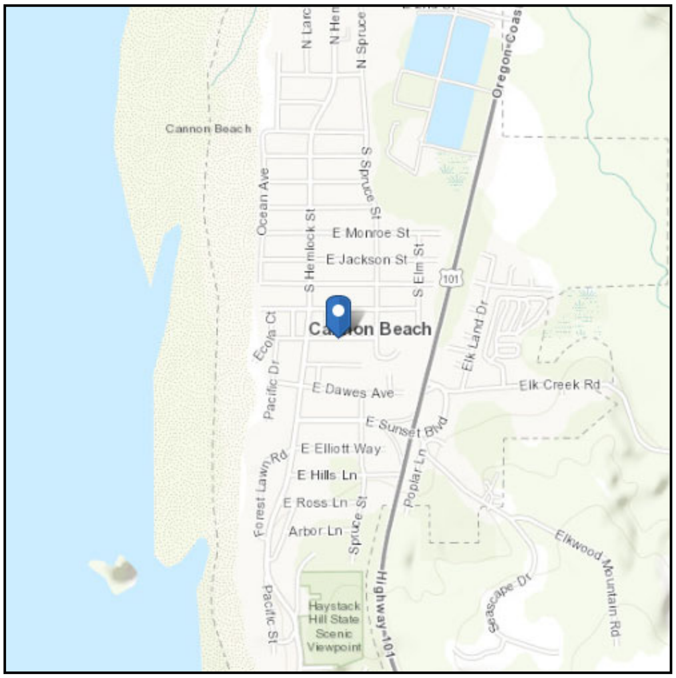
- Lunne, T., Robertson, P.K., and Powell, J.J.M 1997. Cone penetration testing in geotechnical practice, E & FN Spon Routledge, 352 p, ISBN 0-7514-0393-8.
- Boulanger, R.W. and Idriss, I. M., 2007. Evaluation of Cyclic Softening in Silts and Clays. ASCE Journal of Geotechnical and Geoenvironmental Engineering June, Vol. 133, No. 6 pp 641-652
- Boulanger, R.W. and Idriss, I. M., 2014. CPT AND SPT BASED LIQUEFACTION TRIGGERING PROCEDURES. DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING COLLEGE OF ENGINEERING UNIVERSITY OF CALIFORNIA AT DAVIS
- Robertson, P.K. and Cabal, K.L., 2007, Guide to Cone Penetration Testing for Geotechnical Engineering. Available at no cost at http://www.geologismiki.gr/
- Robertson, P.K. 1990. Soil classification using the cone penetration test. Canadian Geotechnical Journal, 27 (1), 151-8.
- Robertson, P.K. and Wride, C.E., 1998. Cyclic Liquefaction and its Evaluation based on the CPT Canadian Geotechnical Journal, 1998, Vol. 35, August.
- Youd, T.L., Idriss, I.M., Andrus, R.D., Arango, I., Castro, G., Christian, J.T., Dobry, R., Finn, W.D.L., Harder, L.F., Hynes, M.E., Ishihara, K., Koester, J., Liao, S., Marcuson III, W.F., Martin, G.R., Mitchell, J.K., Moriwaki, Y., Power, M.S., Robertson, P.K., Seed, R., and Stokoe, K.H., Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshop on Evaluation of Liquefaction Resistance of Soils, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 127, October, pp 817-833
- Zhang, G., Robertson. P.K., Brachman, R., 2002, Estimating Liquefaction Induced Ground Settlements from the CPT, Canadian Geotechnical Journal, 39: pp 1168-1180
- Zhang, G., Robertson. P.K., Brachman, R., 2004, Estimating Liquefaction Induced Lateral Displacements using the SPT and CPT, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 130, No. 8, 861-871
- Pradel, D., 1998, Procedure to Evaluate Earthquake-Induced Settlements in Dry Sandy Soils, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 124, No. 4, 364-368
- Iwasaki, T., 1986, Soil liquefaction studies in Japan: state-of-the-art, Soil Dynamics and Earthquake Engineering, Vol. 5, No. 1, 2-70
- Papathanassiou G., 2008, LPI-based approach for calibrating the severity of liquefaction-induced failures and for assessing the probability of liquefaction surface evidence, Eng. Geol. 96:94–104
- P.K. Robertson, 2009, Interpretation of Cone Penetration Tests - a unified approach., Canadian Geotechnical Journal, Vol. 46, No. 11, pp 1337-1355
- P.K. Robertson, 2009. "Performance based earthquake design using the CPT", Keynote Lecture, International Conference on Performance-based Design in Earthquake Geotechnical Engineering - from case history to practice, IS-Tokyo, June 2009
- Robertson, P.K. and Lisheng, S., 2010, "Estimation of seismic compression in dry soils using the CPT" FIFTH INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN GEOTECHNICAL EARTHQUAKE ENGINEERING AND SOIL DYNAMICS, *Symposium in honor of professor I. M. Idriss,* SAN diego, CA
- R. E. S. Moss, R. B. Seed, R. E. Kayen, J. P. Stewart, A. Der Kiureghian, K. O. Cetin, CPT-Based Probabilistic and Deterministic Assessment of In Situ Seismic Soil Liquefaction Potential, Journal of Geotechnical and Geoenvironmental Engineering, Vol. 132, No. 8, August 1, 2006
- I. M. Idriss and R. W. Boulanger, 2008. Soil liquefaction during earthquakes, Earthquake Engineering Research Institute MNO-12
- Jonathan D. Bray & Jorge Macedo, Department of Civil & Environmental Engineering, Univ. of California, Berkeley, CA, USA, Simplified procedure for estimating liquefaction -induced building settlement, *Proceedings of the 19th International Conference on Soil Mechanics and Geotechnical Engineering, Seoul 201*

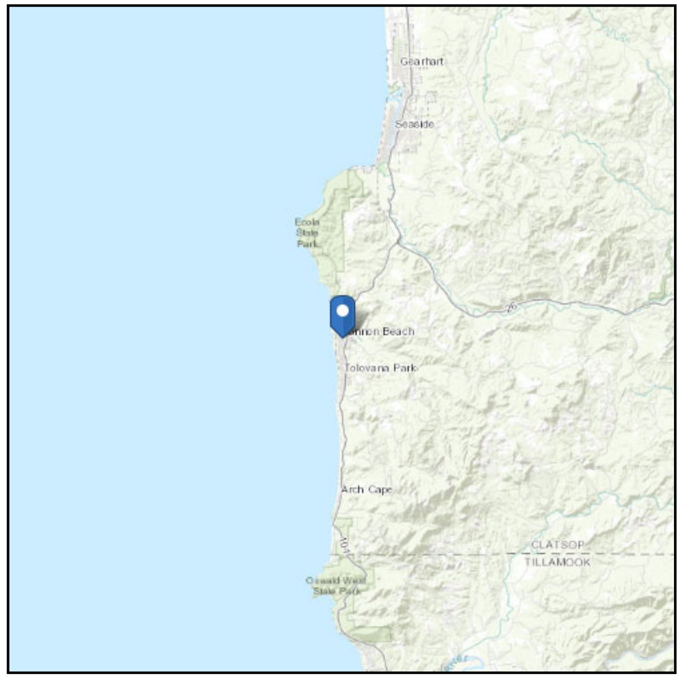
ASCE 7 Hazards Report

Address:
Cannon Beach Police Department - 163 E Gower St Cannon Beach,

Standard: ASCE/SEI 7-22
Risk Category: IV
Soil Class: D - Stiff Soil

Latitude: 45.88997
Longitude: -123.96076
Elevation: 33.006202949243075 ft (NAVD 88)





Seismic

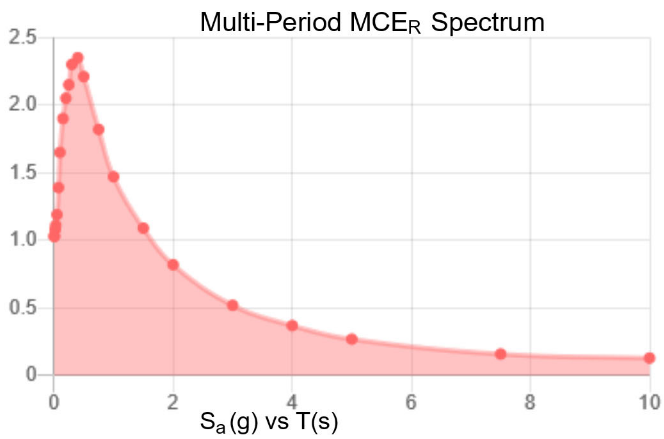
D - Stiff Soil

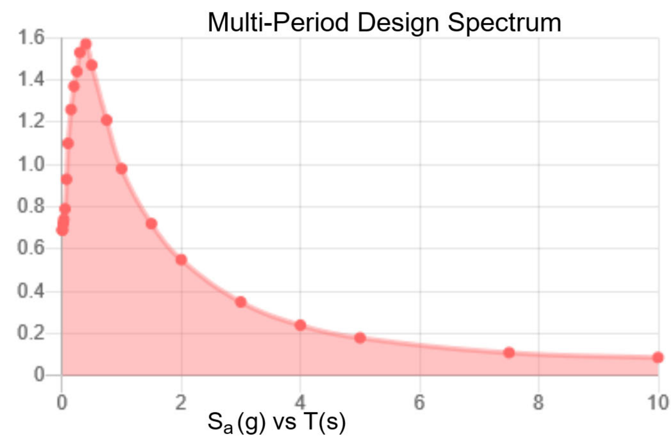
Site Soil Class:

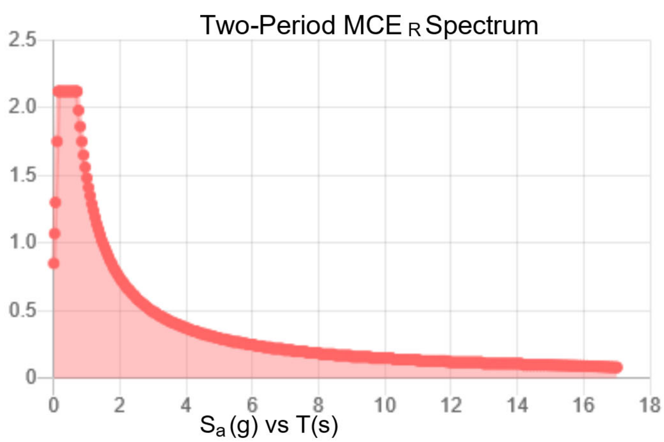
Results:

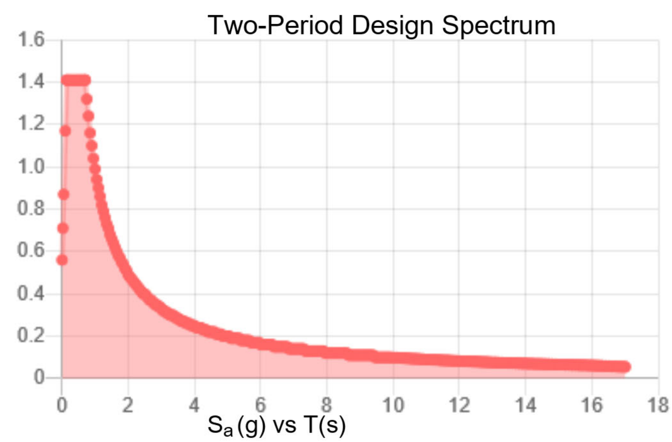
PGA_M :	1.02	T_L :	16
S_{MS} :	2.12	S_S :	1.71
S_{M1} :	1.48	S_1 :	0.72
S_{DS} :	1.41	V_{S30} :	260
S_{D1} :	0.99		

Seismic Design Category: D









MCE_R Vertical Response Spectrum

Vertical ground motion data has not yet been made available by USGS.

Design Vertical Response Spectrum

Vertical ground motion data has not yet been made available by USGS.

Data Accessed: **Sun Jul 30 2023**

Date Source:

USGS Seismic Design Maps based on ASCE/SEI 7-22 and ASCE/SEI 7-22 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-22 Ch. 21 are available from USGS.

The ASCE 7 Hazard Tool is provided for your convenience, for informational purposes only, and is provided “as is” and without warranties of any kind. The location data included herein has been obtained from information developed, produced, and maintained by third party providers; or has been extrapolated from maps incorporated in the ASCE 7 standard. While ASCE has made every effort to use data obtained from reliable sources or methodologies, ASCE does not make any representations or warranties as to the accuracy, completeness, reliability, currency, or quality of any data provided herein. Any third-party links provided by this Tool should not be construed as an endorsement, affiliation, relationship, or sponsorship of such third-party content by or from ASCE.

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Geotechnical Engineering Report and
Site Specific Seismic Hazard Investigation

For the

Proposed New City Hall/Tsunami Evacuation Building
163 East Gower Street
Cannon Beach, Oregon

Prepared for

Mr. Mark See
Public Works Director
City of Cannon Beach
163 East Gower Street
P.O. Box 368
Cannon Beach, Oregon 97110

Prepared by

Chinook GeoServices, Inc.
1701 Broadway #105
Vancouver, Washington 98663
Telephone (360) 695-8500
Fax (360) 695-8510

CGI Report No. 11-022-1

May 4, 2011

Chinook GeoServices, Inc.

REGISTERED PROFESSIONAL ENGINEER
16,590
OREGON
JULY 20, 1996
MARCELLA M. BOYER
5/4/11
EXPIRES 12/31/11

Marcella Boyer, P.E., G.E.
Principal Geotechnical Engineer

R. Warren Krager, R.G., C.E.G.
Principal Engineering Geologist

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OREGON
R. WARREN KRAGER
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ENGINEERING GEOLOGIST
Exp 12-31-2011

Chinook GeoServices Inc.

May 4, 2011

Mr. Mark See
Public Works Director
City of Cannon Beach
163 East Gower Street
P.O. Box 368
Cannon Beach, Oregon 97110
see@ci.cannon-beach.or.us

Subject: **Geotechnical Engineering Report and**
Site-Specific Seismic Hazard Evaluation
Proposed New City Hall/Tsunami Evacuation Building
163 East Gower Street
Cannon Beach, Oregon
CGI Report No. 11-022-1

Dear Mr. See:

Chinook GeoServices, Inc. (CGI) is pleased to submit our Geotechnical Engineering Report and Site-Specific Seismic Hazard Evaluation for the proposed new City Hall/Tsunami Evacuation Building (TEB) located at 163 East Gower Street in Cannon Beach, Oregon. This report includes the results of our field and laboratory testing, geotechnical engineering analysis, recommendations for site development, and results of our site-specific seismic hazard evaluation.

We appreciate the opportunity to perform this evaluation and look forward to continued participation during the remaining design and construction phases of this project. Please contact Marcy Boyer at (360) 695-8500 if you have any questions or if we may be of further service.

Respectfully submitted,

CHINOOK GEOSERVICES, INC.

Marcella Boyer, P.E., G.E.
Principal Geotechnical Engineer

R. Warren Krager, R.G., C.E.G.
Principal Engineering Geologist

Distribution: Addressee
Oregon Department of Geology and Mineral Industries

TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY

CGI has completed a geotechnical engineering study and seismic site hazard investigation to evaluate the feasibility of the proposed City of Cannon Beach, City Hall/Tsunami Evacuation Building (TEB) that is proposed at 163 East Gower Street in Cannon Beach, Oregon. The seismic site hazard investigation was conducted in general accordance with the Oregon Structural Specialty Code (OSSC) Chapter 1802.4.2.

The geotechnical subsurface exploration consisted of one 28-foot deep cone penetrometer test (CPT-1) and two mud rotary soil borings (B-1 and B-2) to depths of 115.5 feet and 121 feet using a subcontracted truck mounted drill rig. In general, the subsurface conditions consisted of medium stiff to soft silt and clay in the approximately upper 25 feet, which included abundant organic material below 15 feet. Below 25 feet, we encountered medium dense to dense gray sand. Multiple thin gravel layers were observed in the two borings at various depths. At an approximate depth of 100 feet below the ground surface we encountered siltstone bedrock. Static groundwater was encountered at about 21 feet below the ground surface based on interpretation of the pore-water pressure dissipation test conducted in CPT-1.

Based on the results of the field exploration and engineering analyses, it is our opinion that the proposed project is geotechnically feasible, based on the assumptions stated in this report.

In our opinion, the greatest geotechnical constraints at this site include the dynamic response of the subsurface conditions to earthquakes and the significant depth required for the foundations. Deep foundations that are embedded into the underlying siltstone bedrock are recommended for the proposed Tsunami Evacuation Building (TEB).

The owner and/or designer should not rely solely on this Executive Summary and must read and evaluate the entire contents of this report prior to using our engineering recommendations to prepare the design/construction documents.

2.0 PROJECT INFORMATION

2.1 Project Authorization

Chinook GeoServices, (CGI) has completed a geotechnical engineering evaluation and a site specific seismic hazard study to evaluate the feasibility of the proposed City Hall/Tsunami Evacuation Building (TEB) that may be located at 163 East Gower Street in Cannon Beach, Oregon. The site specific seismic hazard evaluation is included as Appendix A of this report. Our work was completed in general accordance with the March 7, 2011 Personal Services Contract with the City of Cannon Beach.

2.2 Project Description

Our understanding of the project is based on a September 2010 site visit with Mark See, our review of the RFP and our participation in the Ad-Hoc Committee for the Tsunami Evacuation Building at City Hall during 2009 and 2010. The proposed City Hall/TEB is proposed to be in the same location as the existing City Hall. The current conceptual design consists of the main city hall offices on the main floor with a flat roof for evacuation during a tsunami. The main offices would be elevated on robust concrete posts above the anticipated tsunami inundation elevation established by computer modeling. Stairs and a flat roof will be constructed for public access if a tsunami occurs. We anticipate that the new structure will be supported on concrete piers founded below the anticipated liquefaction depth and scour depth.

The geotechnical recommendations presented in this report are based on the available project information, and the subsurface conditions described in this report. If any of the project information is known to be incorrect, the client or authorized representatives should advise CGI in writing so that we may amend the recommendations as appropriate based on the corrected information. CGI will not be responsible for the applicability of its recommendations when not notified of changes in the project.

2.3 Purpose and Scope of Services

The purpose of our services was to provide geotechnical engineering design recommendations and conduct a site-specific seismic hazard study to evaluate the feasibility of development for the proposed new City Hall/TEB. Our general scope of work for this project was outlined in Exhibit A of the March 7, 2011 Personal Services Contract between the City of Cannon Beach and CGI.

Our scope of services included two mud rotary soil borings, one cone penetration test, soil laboratory testing, and engineering analyses to evaluate the soil properties for deep foundation support, seismic characteristics and hazards and other geotechnical engineering concerns for subsurface materials underlying the site. This geotechnical engineering report provides our recommendations for site earthwork, deep foundation design, subsurface drainage, slab support, pavement design, and other geotechnical engineering design and construction considerations. Appendix A includes the results of our Site-Specific Seismic Hazard Evaluation, which was prepared in general conformance with Exhibit A and the 2010 Oregon Structural Specialty Code (OSSC).

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 Site Location and Description

The site location is shown on Figure 1, Site Location Plan, attached to the back of this report. The site address is 163 East Gower Street, Cannon Beach, Oregon. The site is comprised of Tax Lots 11100, 12000, and 11900, of T5N R10W Section 30-AD in Clatsop County. Lots 12000 and 11900 are adjacent and are bordered on the north by East Gower Street, on the west by Evergreen Avenue, on the east by the undeveloped Harding Avenue right-of-way, and on the south by developed residential properties. The combined lot dimensions are approximately 325 feet east to west and 100 feet north to south. Lot 11100 across the street to the west of the other lots is bordered on the north by East Gower Street, on the west by South Hemlock Avenue, on the east by Evergreen Avenue, and on the south by Coolidge Avenue. The approximate lot dimensions are 100 feet east to west and 200 feet north to south.

Lot 12000 is currently developed with a single story structure housing the City of Cannon Beach municipal offices. Lot 12000 also includes paved parking areas east and west of the developed structure. Lot 11900 is currently undeveloped. Lot 11100 is developed with a paved municipal parking lot. It is our understanding that the proposed structure will be located on Lot 12000, which is referred to in this report as the project site.

Based on an aerial topographic survey of The City of Cannon Beach dated December 28, 2004, the project site elevation is roughly 30 feet above mean sea level (MSL). The area of the project site is relatively level, with a minor descending slope toward the west. Site specific topographic mapping was not available at the time of this report.

3.2 Soil and Geologic Setting

Soils mapped in the project area by the United States Department of Agriculture (USDA), Natural Resource Conservation Service Web Soil Survey (http://websoilsurvey.nrcs.usda.gov) consist of Walluski silt loam, 0 to 7 percent slopes. This mapped unit consists of very deep, moderately well drained soils found on fluviomarine and stream terraces. The soil formed from mixed alluvium and/or fluviomarine deposits derived from sedimentary rock. A typical soil profile consists of medial silt loam to a depth of 13 inches, underlain by silty clay loam to a depth of 60 inches.

Geologic mapping for the project area is included in the 2009 Oregon Department of Geology and Mineral Industries (DOGAMI) open file report O-09-06 “Coastal Erosion Hazard Zones in Southern Clatsop County, Oregon: Seaside to Cape Falcon”. This publication maps the geology in the project area as late Pleistocene age (126,000 years to 10,000 years ago) coastal terrace deposits (unit Qpt). This unit is described as unconsolidated to moderately consolidated gravel, beach, and dune sand; locally containing minor consolidated clay-rich paleosol, colluvium, debris flows, and alluvial sand, silt, and gravel deposited in channel and point bar environments. The 1985 Geologic Map of the Astoria Basin, Clatsop and Northernmost Tillamook Counties, Northwest Oregon, Oil and Gas Investigation 14 prepared by DOGAMI similarly maps the site as Pleistocene age (1.8 million years to 10,000 years ago) coastal marine-terrace deposits (Qmt). This unit is described as predominantly laminated to cross-bedded beach sand and crudely stratified rounded basalt gravels with some discontinuous paleosols, mud beds, and layers of partially carbonized tree trunks and limbs. The 1972 Environmental Geology of the Coastal Region of Tillamook and Clatsop Counties, Oregon, Bulletin 74 prepared by DOGAMI also maps the geology at the site as Pleistocene age Marine Terraces (Qmt).

The DOGAMI O-09-06 geologic map also shows undifferentiated Holocene age (10,000 years ago to present) alluvial deposits (Qha) directly west of the site. This unit is described as unconsolidated sand, silt, and gravel deposited in alluvial fan, stream terrace, or basin environments. The mapped geologic unit may represent an old stream channel in the vicinity of the project.

The uplands to the south of the subject site are mapped by Bulletin 81 as Oligocene to Miocene Sedimentary Rocks (unit Toms) and by Oil and Gas Investigation 14 as middle to lower Miocene Cannon Beach member of the Astoria Formation (unit Tac). The Toms unit consists of thin bedded to massive, medium to dark gray (orange to white where weathered), tuffaceous siltstone, with lesser amounts of sandstone and claystone. Unit Tac is described as well bedded, laminated to massive micaceous mudstone with subordinate rhythmically thin bedded feldspathic sandstone and mudstone in the lower part of the unit. Numerous outcrops of Intrusive Grande Ronde Basalt (unit Tgri) are mapped within unit Tac south of the site. Unit Tgri is described as a Tertiary middle

Miocene age, invasive sills, dikes, and irregular bodies of massive to columnar-jointed, aphyric to rarely phyric basalt and peperite or intrusive bodies related to Grande Ronde Basalt.

3.3 Subsurface Soil Conditions

Subsurface soil conditions were explored by CGI Geologic Associate Chuck Bolduc, G.I.T., who visited the site on March 29 and March 30, 2011. We observed advancement of two mud rotary soil borings (B-1 and B-2) to depths of 115.5 feet and 121 feet using a subcontracted truck mounted drill rig and one cone penetrometer test (CPT-1) to a depth of 28 feet using a subcontracted rig. The borings and CPT were located in the general vicinity of the proposed structure and were selected in the field by Mark See, the Public Works Director with the City of Cannon Beach, Oregon. The approximate boring and CPT locations are shown on Figure 2. Detailed boring and CPT logs are included in the attached Appendix B.

Boring B-1 was drilled on March 29, 2011 and with sample intervals between 0 feet and 5 feet and took more than 1 day to drill. Because we observed primarily sand that was similar in gradation between 25 feet and 100 feet and bedrock at 100 feet, we recommended to Mr. See that we expand the sample intervals to between 10 feet and 25 feet so that we could get better information for foundation design in the bedrock. Mr. See agreed with the recommendation and boring B-2 was drilled on March 30, 2011 using the expanded sample intervals.

In general, the subsurface conditions consisted of medium stiff to soft silt and clay in the approximately upper 25 feet, which included abundant organic material below 15 feet. Below 25 feet, we encountered medium dense to very dense gray sand. Multiple thin gravel layers were observed in the two borings at various depths. At approximately 100 feet below the ground surface, we encountered siltstone bedrock. A more detailed description of the soils encountered in the borings is included below:

Clay and Organic Debris - The clay was stiff in the near surface becoming softer with depth. Clay was tan with rust mottling with minor inclusions of rust concretions. Some sandy texture was observed but sand particles were not present. In boring B-2, the drill cuttings were observed to be significantly more orange in color than in boring B-1. Wood fiber was observed in the cuttings from boring B-2 at a depth of 10 feet and again at 15 feet. A sample in boring B-2 encountered a log or stump oriented vertically based on the vertical wood grain, which was relatively fresh to minimally decomposed. Other samples encountered gray clay with decomposed wood debris and gray clayey sand with decomposed wood debris. We interpret this sequence of sediments were deposited in an alluvial environment. Based on the CPT data, the shear wave velocity was between 402 feet per second and 582 feet per second in this soil layer.

Beach and Dune Sand - Dense, wet, gray sand was encountered at a depth of 25 feet in boring B-1 and dense sand to silty sand was found in CPT-1 below 26 feet. The sand was fine-grained, poorly-sorted sand with abundant micaceous flakes at selected depths. The micaceous material may have been derived from weathering of local mica-bearing sandstones of the Astoria Formation and deposited as alluvial sands. Very dense basaltic gravel and sand was encountered in boring B-1 at 55 feet below the ground surface, and ended at 57.5 feet below the ground surface based on drilling characteristics. Thin layers of gravel were also interpreted at 61.5 feet in boring B-1 and 65 feet in boring B-2 based on drilling characteristics. Based on the limited thickness and variable depth, we interpret the gravel to be discontinuous. We interpret the sands and gravel deposits to be consistent with the geologic mapping of marine terrace deposits. The CPT met refusal near the top of the contact of the upper dense sand layer at 26 feet and shear wave velocities were not obtained below 25 feet. However, based on our blow count data, we estimate that the beach and dune sand has a shear wave velocity between 650 feet per second and 1,300 feet per second.

Siltstone Bedrock - Hard siltstone bedrock was encountered in boring B-1 at 100 feet below the ground surface and in boring B-2 at 101 feet below the ground surface. The siltstone observed in each boring differed in blow counts, drilling characteristics, and cutting return. The siltstone in boring B-1 had very high blow counts, variably hard and easy drilling and black fragments of basaltic rock returned in the drill cuttings. The siltstone in boring B-2 had relatively lower blow counts, consistent drilling characteristics, and no basaltic cuttings were observed. We interpret that the siltstone in boring B-1 also included a minor basalt intrusion, which is consistent with the abundantly mapped basaltic intrusives within the Astoria Formation in the area. In boring B-1, we drilled 15 feet into the formation and in boring B-2,we drilled 20 feet into the formation. According to a Madin and Wang 1999 paper, the shear wave velocity of the siltstone bedrock was estimated to be 1,870 feet per second.

The above subsurface description is of a generalized nature to highlight the major subsurface stratification features and material characteristics. The boring logs included in Appendix B should be reviewed for specific information at individual boring locations. These records include soil descriptions, stratifications, and test data. The stratifications shown on the boring logs represent the conditions only at the actual boring locations. Variations may occur and should be expected between boring locations. The stratifications represent the approximate boundary between subsurface materials and the actual transition may be gradual. The samples that were not altered by laboratory testing will be retained for 60 days from the date of this report and then will be discarded.

3.4 Groundwater Information

The static groundwater elevation in the project area was interpreted to be approximately 25 feet to 30 feet below the ground surface based on our observation of soil samples recorded during mud rotary drilling. The cone penetrometer test conducted a pore-water dissipation test within the dense gray sand at a depth of approximately 27.5 feet. Results of the pore-water dissipation test indicated a static water level of approximately 21 feet below the ground surface. We have assumed a groundwater depth of 21 feet below the ground surface for the purpose of this report.

4.0 GEOTECHNICAL ENGINEERING EVALUATION

4.1 Geotechnical Engineering Discussion

Based on the results of the field exploration and engineering analyses, it is our opinion that the proposed project is geotechnically feasible based on assumptions and preliminary design criteria discussed below. However, this report may not include geotechnical analyses and design recommendations sufficient for final design.

In our opinion, the greatest geotechnical constraints at this site include the dynamic response of the subsurface conditions to earthquakes and the significant depth required for the foundations. Deep foundations that are embedded into the underlying siltstone bedrock are recommended for this development.

4.2 Site Preparation and Earthwork Recommendations

We anticipate that the proposed building footprint and related parking areas, sidewalks, and other site improvements will be located in areas that are currently developed with the existing city building and paved parking areas. We recommend that the existing pavement and foundations be completely removed from the site in areas that will be developed with structures or pavement. The existing base rock could remain in-place if it is below finished subgrade elevation. Based on our subsurface explorations, the thickness of the asphalt pavement was 1.5 inches in boring B-1. The depths of the existing foundations for the city building are unknown; therefore, the depth of removal in this area is unknown. In areas where there are trees, soft disturbed soil, or manmade fill, additional stripping may be necessary. A representative of the geotechnical engineer should determine the depth of removal at the time of construction.

The existing asphaltic pavement and stripped soils may not be suitable for re-use as structural fill and should be exported from the site. The base rock gravel could re-used as structural fill. Additionally, the removed concrete foundations could potentially be crushed for re-use as structural fill. A representative of the geotechnical engineer should be contacted to review and approve the onsite materials for re-use as structural fill at the time of construction. Our recommendations for structural fill and compaction are included below in section 4.6.

Wet weather and construction equipment could severely disturb the upper several feet of the clayey subgrade during initial phases of site clearing. We recommend dry weather construction to protect the subgrade from disturbance. If the subgrade becomes wet or is exposed to significant construction traffic, the subgrade may soften and require additional stripping prior to construction. After stripping, a granular working pad consisting of crushed rock should be placed over the subgrade to protect it from disturbance and provide access for construction equipment. The thickness of the working pad would depend on the use of the stripped area (haul road, material storage, etc.) We can provide thickness recommendations prior to construction when construction sequencing and staging is known.

Alternately, the site could be stripped in phases. The proposed building area could be prepared for placement of foundations and the existing pavement could be used for construction access and staging during construction. The paved areas could then be stripped for construction of the new parking areas and other related improvements outside the building area. We are providing these considerations solely for your use in developing a plan for your project. It is the ultimate responsibility of the contractor to determine the construction methods that are most appropriate for the site.

Following subgrade preparation, and prior to placement of structural fill or base course, we recommend that the site be proof rolled with a fully loaded 10 yard to 12 yard dump truck or other suitably loaded rubber-tired construction vehicle. Any areas that pump, weave, or appear exceptionally soft or muddy should be overexcavated to a depth determined by the geotechnical engineer and backfilled with compacted granular fill. If significant time passes between completion of subgrade preparation and commencement of other construction activities, or if significant traffic has been routed across the site, we recommend that the site be similarly proof rolled before placement of base rock or paving. A representative of our firm should observe this operation.

4.3 Temporary Excavations

Stability of temporary excavations is the responsibility of the contractor, who must maintain safe excavation slopes and/or shoring. Excavations must comply with the current requirements of OSHA and the State of Oregon. We are providing the information below solely as a service to our client. Under no circumstances should the information provided be interpreted to mean that CGI is assuming responsibility for construction site safety or the contractor's compliance with local, state, and federal safety or other regulations.

The contractor should be aware that slope height, slope inclination, or excavation depths (including utility trench excavations) should in no case exceed those specified in local, state, and/or federal safety regulations (e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations). Such regulations are strictly enforced and, if they are not followed, the Owner, Contractor, and/or earthwork and utility subcontractors could be liable for substantial penalties.

We recommend that the temporary excavations not encroach below a 2H:1V line extended downward from the existing utilities to reduce the risk of settlement and/or collapse of existing features, such as the sidewalk and street pavement. If this setback cannot be maintained, we recommend installing temporary shoring. We should be contracted to review the final documents for construction.

The near surface soils generally consist of medium stiff fine-grained cohesive soils, which are considered a Type B soil when applying the OSHA regulations. For Type B soils, the maximum recommended temporary slope inclination is 1 Horizontal to 1 Vertical (1H:1V). Flatter slopes and/or trench shields may be required if loose soils, debris, voids, and/or water are encountered along the slope face. The recommended maximum inclination for temporary slopes is based on the assumption that the ground surface behind the cut slope is level, that surface loads from equipment and materials are kept a sufficient distance away from the top of the slope (typically at least half the slope height), and that utility trench excavations are completed and backfilled prior to the construction of structures adjacent to the excavations. If these assumptions are not valid, we should be contacted for additional recommendations.

4.4 Construction Dewatering

Groundwater was estimated to be approximately 21 feet below the ground surface during our explorations, which were conducted in March, when groundwater is typically at higher levels in response to the wet season. However, it is possible that shallow perched water within the fine-grained soils may be encountered during construction. If shallow water is encountered during construction, for most excavations, pumping from a sump inside or outside the limits of the excavation should adequately control seepage and surface water ponding. As an alternative, dewatering wells may be installed outside of the excavation is water seepage is significant. During wet weather, earthen berms or other methods should be used to prevent runoff water from entering excavations. All runoff water and groundwater encountered within the excavation(s) should be collected and disposed of outside the construction limits.

4.5 Permanent Cut and Fill Slopes

We do not expect significant cut or fill slopes will be associated with this project based on the relatively level topography in the area. If any are planned, we recommend that permanent slopes in native soils or engineered fill be graded no steeper than 2H:1V and be protected from erosion by civil engineer designed and approved methods.

4.6 Structural Fill Materials

Imported structural fill should only be installed on a subgrade that has been prepared in accordance with the preceding recommendations. Fill materials should be free of organic or other deleterious materials have a maximum particle size less than 3 inches, be relatively well graded, and have a liquid limit less than 45 and plasticity index less than 25. The suitability of soil for use as compacted structural fill will depend on the gradation and moisture content of the soil when it is placed. As the amount of fines (that portion finer than the US Standard No. 200 sieve) increases, soil becomes increasingly sensitive to small changes in moisture content and compaction becomes more difficult to achieve. Soils containing more than about 5 percent fines cannot consistently be compacted to a dense, non-yielding condition when the water content is significantly greater (or significantly less) than optimum. The onsite clay soil will not be acceptable for re-use as structural fill. The existing base rock will likely be acceptable for re-use as structural fill provided it meets the specifications above, is free of organic material, and is separated from the asphalt pavement. The demolished concrete foundations can potentially be processed to create a crushed rock product meeting the above specifications for use as structural fill.

On-site base rock and imported granular material that are used for engineered fill should be uniformly moisture conditioned to within ± 2 percent of the optimum moisture content and compacted in thin lifts using suitable mechanical compaction equipment. We recommend that fill intended to support foundations, slabs or pavements be placed in horizontal lifts in thickness from 8 inches to 12 inches, and be compacted to at least 95 percent of the maximum dry density as determined by the modified Proctor compaction test method (AASHTO T-180 or ASTM D1557).

4.7 Deep Foundation Recommendations

Deep foundations and a structural slab are recommended for this development. At this time, 2-foot diameter concrete auger cast-in-place piles would be generally compatible with the site subsurface conditions and earthquake performance criteria for this project. No structural load information was available at the time of this evaluation and our foundation analysis is intended for a feasibility evaluation only.

The results of our liquefaction analysis (included in Appendix A) indicate the presence of up to 75 feet of unconsolidated clayey silt, sand and gravel that may liquefy and/or strain soften during the modeled earthquakes. Based on the thickness of liquefiable soils we anticipate that deep foundations will need to be embedded in the bedrock. For feasibility evaluation purposes we have calculated the axial capacity of 2-foot diameter concrete auger cast-in-place piles embedded 10 feet into the underlying siltstone bedrock at an approximate depth of 100 feet below the ground surface. Other pile sizes and types could be used, subject to structural design and constructability criteria.

We assumed a cohesion value of 2,500 pounds per square foot (psf) for the blue-gray siltstone. A friction angle is not appropriate for the siltstone bedrock material.

Estimated Axial Pile Capacity – We expect that the static and transient compressive loads on the piles will be achieved through a combination of end bearing and skin friction. Our estimated allowable compressive capacities are based on a static factor of safety of 3.0 for end bearing, side friction and uplift. The capacities can be increased by 1/3 for transient loads. Axial pile capacities were determined using the computer program AllPile 7. The pile has an axial downward capacity of approximately 975 kips and an allowable uplift capacity of 230 kips under static conditions. The results of the analysis are included in Appendix D.

Estimated Downdrag – Downdrag is the additional load caused by adhesion or friction between the pile and the surrounding settling soil. Downdrag loads are caused by negative skin friction. Some negative skin friction would occur during settlement of the clay with organics layer between 15 feet and 25 feet below the ground surface. In addition, we expect that the pile will be subjected to negative skin friction from liquefaction during the modeled earthquakes. The earthquake ground motions will strain soften the clayey soils and liquefy the saturated sand. The structural capacity of piles is affected by downdrag loads. Downdrag increases the stresses in the pile and pile cap and has the potential for creating settlement. For a single pile, the downward load transferred to a pile is equal to the shearing resistance along the pile. This may be calculated using the formula on the following page.

$Q_{nf} = s * L * P^1$ Where Q_{nf} = Average downward load transferred to the pile
s = Shear resistance of the soil
L = Length of embedment above the bottom of the compressible layer
P^1 = Perimeter of the Pile

Then, the average downward load, Q_{nf} is then added to the total live load and dead load, Q, applied to the pile, according to the following equation:

$Q_T = Q + Q_{nf}$ Where Q_T = Total applied load
Q = Live load plus dead load
Q_{nf} = Average downward load transferred to the pile

For this site, we estimate that the load transferred to the pile (Q_{nf}) for consolidating organics would be approximately 46 kips. The downward load transferred to the pile (Q_{nf}) from liquefaction during the modeled earthquake is estimated to be 450 kips, assuming the upper 75 feet contributes to the downdrag load.

Estimated Lateral Pile Capacities – Lateral loads on piles could be imposed by wind and seismic events and by liquefied soil. These loads are resisted primarily by horizontal bearing support of the soils adjacent to the pile shafts. The lateral capacity of a pile depends on its length, stiffness in the direction of loading, proximity to other piles and degree of zero moment, as well as the engineering properties of the soil. Lateral pile capacities were estimated using the computer program LPILE Plus V5.0. The results are included in Appendix D.

Our model included liquefied sand that could be present during the modeled earthquakes.

We have presented our estimated lateral pile top capacities for free and fixed head conditions in Table 1 on the following page. These include a factor of safety of 3 applied to the lateral load.

Table 1 – Lateral Load Information

Lateral Load Information for ½-inch Deflection				
Pile Length (feet)	Pile Head Condition	Allowable Lateral Load (kips)	Maximum Bending Moment (feet-kips)	Depth of Zero Moment (feet)
110	Free	12.0	253	0, 50
	Fixed	21.2	663	17
Lateral Load Information for 1-inch Deflection				
110	Free	16.4	408	0, 54
	Fixed	31.2	1,153	18

Pile Spacing and Group Effects – The above mentioned values for compressive, uplift and lateral capacity refer to single piles unaffected by group interactions. To reduce or eliminate group effects, we recommend that the pile spacing not be less than three pile diameters measured center to center. If piles are at least three diameters apart, group effects can be neglected for compressive, uplift and perpendicularly applied lateral loads. For in-line lateral loads, however, group effects reduce the lateral load capacity of the pile at a pile spacing less than eight diameters. The following reduction factors should be applied to in-line laterally loaded piles with a center-to-center spacing between three and eight diameters as shown in the following table.

Table 2 – Reduction Factors for In-Line Laterally Loaded Piles

Pile Spacing Center to Center	In-line Load Reduction Factor
3 pile widths	.25
4 pile widths	.4
6 pile widths	.7
8 pile widths	1.0

Estimated Settlements – We estimate that total post-construction static settlements of pile-supported elements will not exceed 1 inch. Differential settlements could approach ½ of the actual total settlement amount.

Installation Monitoring – CGI should be retained to continuously monitor installation of the piles. CGI will verify that the suitable tip depths are reached. The monitoring program would include observation and documentation of installation procedures, construction equipment, pile materials, drilling conditions and sequencing and load testing.

4.8 Seismic Design

The seismic analysis for the feasibility study was conducted using historic earthquakes with shorter duration than the 5 minutes to 6 minutes of shaking that the scientific community believes may be possible. In our opinion, the selected ground motions were adequate for this feasibility study and showed that seismic hazards do exist at the site. Longer duration ground motions may need to be considered during the final design phase of this project.

According to the site specific seismic hazard feasibility summary, we recommend using the site specific values of S_{DS} and S_{D1}, which are recommended to be 0.52g and 1.41g, respectively. Both values exceed the IBC response spectrum. The analysis was conducted for shorter duration earthquakes and these values could change.

4.9 Drainage

All roof, landscape, and other upland surface water should be directed to approved discharge points away from foundations and retaining walls. In our opinion, underslab and perimeter drains are not needed for this project. We do not expect that infiltration of stormwater into the underlying clay soils will be feasible for this site. A professional civil engineer should be consulted to provide grading plans for drainage, stormwater management options, and utility design.

4.10 Floor Slabs

Because of the intended function of the proposed building as an essential facility, we do not recommend conventional floor slab on grade. We have concern that a conventional floor slab would provide performance liabilities during an earthquake and/or subsequent tsunami event. Liquefaction under a concrete floor slab may cause it to heave or tilt and become more susceptible to tsunami shear forces or scour. A non structural slab could potentially damage foundation components during an earthquake and tsunami.

We recommend that any required floor slabs be designed as structural slabs that would not rely on near surface soil for support and would be engineered to remain intact during the design seismic event.

4.11 Pavement Design

Our scope of services did not include extensive sampling and CBR testing for the existing subgrade, or testing of potential sources of imported fill, for the specific purpose of detailed pavement analysis. Instead, we have assumed pavement related design parameters that are considered to be typical for the area soil types. The pavement recommendations presented in this report are limited to the on-site parking areas and driveways. A more detailed analysis of the subgrade and traffic conditions should be made for street improvements to the existing right-of-way or where pavements are subject to significant traffic loading conditions. The results of such a study would provide information necessary to design an economical and serviceable pavement.

We anticipate that stiff to medium stiff clay will remain underlying proposed driveway and parking areas. We recommend that the subgrade be prepared in accordance with Section 4.2, Site Preparation and Earthwork Recommendations, of this report. Pavement may be placed after the subgrade has been properly prepared, fine-graded and proof rolled.

The thickness recommendations presented below are considered minimum for the assumed parameters. We understand that budgetary considerations sometimes warrant thinner pavement sections than those presented. However, the project team should be aware that thinner pavement sections might result in increased maintenance costs and lower than anticipated pavement life.

We have estimated the near surface subgrade soils will be have a CBR of at least 4. Our recommended pavement sections are outlined in Table 3. The pavement materials and installation procedures should be completed in accordance with Oregon Department of Transportation guidelines.

Table 3 – Pavement Section Recommendations

	Car Parking and Driveways
Asphalt Surface Course	2.5
Granular Base Course	8

Rigid concrete pavements are not recommended for this site because of potentially poor performance during an earthquake event.

5.0 REPORT LIMITATIONS

The recommendations submitted in this report are based on the available subsurface information obtained by CGI and project information provided by Mark See of the City of Cannon Beach, Oregon for the feasibility study for the proposed City Hall/Tsunami Evacuation Building. We will be available to provide further geotechnical analysis and design services as the project progresses.

The geotechnical engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed. This report has been prepared for the exclusive use of the client or their authorized agents for the specific application to the proposed project.

APPENDIX A:

SITE-SPECIFIC SEISMIC HAZARD EVALUATION

APPENDIX A

SITE-SPECIFIC SEISMIC HAZARD EVALUATION

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FIGURES

SITE-SPECIFIC SEISMIC HAZARD EVALUATION

Chinook GeoServices, (CGI) has completed this site specific seismic hazard evaluation for the proposed City Hall/Tsunami Evacuation Building (TEB) located at 163 East Gower Street in Cannon Beach, Oregon to determine the feasibility of the project. This study is an attachment to our geotechnical engineering report titled “Proposed New City Hall/Tsunami Evacuation Building, 163 East Gower Street, Cannon Beach, Oregon”, CGI Report No. 11-022-1 dated May 4, 2011. Our work was completed in general accordance with the March 7, 2011 Personal Services Contract with the City of Cannon Beach.

Site Location and Description

The site location is shown on Figure A-1, Site Location Plan, attached to the back of this report. The site address is 163 East Gower Street, Cannon Beach, Oregon. The site is comprised of Tax Lots 11100, 12000, and 11900, of T5N R10W Section 30-AD in Clatsop County. Lots 12000 and 11900 are adjacent and are bordered on the north by East Gower Street, on the west by Evergreen Avenue, on the east by the undeveloped Harding Avenue right-of-way, and on the south by developed residential properties. The combined lot dimensions are approximately 325 feet east to west and 100 feet north to south. Lot 11100 lies across the street to the west of the other lots is bordered on the north by East Gower Street, on the west by South Hemlock Avenue, on the east by Evergreen Avenue, and on the south by Coolidge Avenue. The approximate lot dimensions are 100 feet east to west and 200 feet north to south. The approximate site layout is included in Figure A-2.

Lot 12000 is currently developed with a single story structure housing the City of Cannon Beach municipal offices. Lot 12000 also includes paved parking areas east and west of the developed structure. Lot 11900 is currently undeveloped. Lot 11100 is developed with a paved municipal parking lot. It is our understanding that the proposed structure will be located on Lot 12000, which is referred to in this report as the project site.

Based on an aerial topographic survey of The City of Cannon Beach dated December 28, 2004, the project site elevation is roughly 30 feet above mean sea level (MSL). The area of the project site is relatively level, with a minor descending slope toward the west. Site specific topographic mapping was not available at the time of this report.

Regional Geology

Much of Oregon’s geologic history is defined by its location on a convergent plate tectonic boundary (subduction zone). The oceanic crust west of Oregon has collided with and subducted beneath the continental crust, a process which continues to the present day. As the oceanic crust moved toward the continent, material that could not be subducted was accreted onto the continent. The subducting oceanic plate melted as it plunged deeper into the earth and magma migrated to the surface, creating a volcanic arc; known today as the Cascade Range. Other local and massive volcanic episodes, large earthquakes, tectonic shifting, continued erosion and sedimentation, catastrophic flooding and other geologic processes further defined Oregon's landscape. Oregon can be generally divided into geologic provinces, which share similar geologic histories, landforms, and composition. The subject site is generally located in the geologic province known as the Coast Range.

Marine sedimentary formations make up the primary bedrock in the Coast Range, which began forming approximately 65 million years ago (early Paleocene) when forearc sedimentation built a thick wedge of marine sediments off the coast. Silt, sand, and mud were deposited on the Pacific Ocean floor off the coast of Oregon and were compressed into thick layers of sedimentary rocks. As the ocean sediments were steadily accumulating, the two tectonic plates continued to collide. Uplift, folding, and faulting associated with the plate convergence continued to push the marine sedimentary rock upward to form much of the Coast Range. Accumulation of marine sediments and convergence of the plates continues to the present day.

Approximately 45 million years to 36 million years ago (middle Eocene age), the North American continental plate drifted west over a hot spot. The hot spot fed magma through the submarine Coast Range sediments and erupted lava that built up along the coast. These volcanic and intrusive rocks make up the Tillamook Highlands. Hot spot volcanism again influenced the Coast Range province between 17 million years and 15 million years ago (middle Miocene age). This period of highly active volcanism produced a series of gigantic lava floods originating from great fissures near the current Oregon-Idaho-Washington border. The thick and widespread deposits are collectively known as the Columbia River Basalts. Some basalt flows travelled all the way to the Oregon coast.

Marine sediment accumulation, lithification, and uplift were taking place before, during, and after the intermittent volcanic episodes. Where the marine sedimentary formations are older, intrusive sills and dykes, and flows of younger volcanics are sometimes present within and overlying the sedimentary rock. Basalt flows were also deposited along with the marine sediments in shallow marine environments, creating intermittent layers of marine sedimentary rock and submarine basalt formations. Large flows of basalt, such as the Columbia River Basalt, also created injection sills and dikes in the underlying sedimentary formations, which are abundant in the northwest Coast Range.

<u>Soil and Geologic Setting</u>

Soils mapped in the project area by the United States Department of Agriculture (USDA), Natural Resource Conservation Service Web Soil Survey (http://websoilsurvey.nrcs.usda.gov) consist of

Walluski silt loam, 0 to 7 percent slopes. This mapped unit consists of very deep, moderately well drained soils found on fluviomarine and stream terraces. The soil formed from mixed alluvium and/or fluviomarine deposits derived from sedimentary rock. A typical soil profile consists of medial silt loam to a depth of 13 inches, underlain by silty clay loam to a depth of 60 inches.

Geologic mapping for the project area is included in the 2009 Oregon Department of Geology and Mineral Industries (DOGAMI) open file report O-09-06 "Coastal Erosion Hazard Zones in Southern Clatsop County, Oregon: Seaside to Cape Falcon". This publication maps the geology in the project area as late Pleistocene age (126,000 years to 10,000 years ago) coastal terrace deposits (unit Qpt). This unit is described as unconsolidated to moderately consolidated gravel, beach, and dune sand; locally containing minor consolidated clay-rich paleosol, colluvium, debris flows, and alluvial sand, silt, and gravel deposited in channel and point bar environments. The 1985 Geologic Map of the Astoria Basin, Clatsop and Northernmost Tillamook Counties, Northwest Oregon, Oil and Gas Investigation 14 prepared by DOGAMI similarly maps the site as Pleistocene age (1.8 million years to 10,000 years ago) coastal marine-terrace deposits (Qmt). This unit is described as predominantly laminated to cross-bedded beach sand and crudely stratified rounded basalt gravels with some discontinuous paleosols, mud beds, and layers of partially carbonized tree trunks and limbs. The 1972 Environmental Geology of the Coastal Region of Tillamook and Clatsop Counties, Oregon, Bulletin 74 prepared by DOGAMI also maps the geology at the site as Pleistocene age Marine Terraces (Qmt).

The DOGAMI O-09-06 geologic map also shows undifferentiated Holocene age (10,000 years ago to present) alluvial deposits (Qha) directly west of the site. This unit is described as unconsolidated sand, silt, and gravel deposited in alluvial fan, stream terrace, or basin environments. The mapped geologic unit may represent an old stream channel in the vicinity of the project.

The uplands to the south of the subject site are mapped by Bulletin 81 as Oligocene to Miocene Sedimentary Rocks (unit Toms) and by Oil and Gas Investigation 14 as middle to lower Miocene Cannon Beach member of the Astoria Formation (unit Tac). The Toms unit consists of thin bedded to massive, medium to dark gray (orange to white where weathered), tuffaceous siltstone, with lesser amounts of sandstone and claystone. Unit Tac is described as well bedded, laminated to massive micaceous mudstone with subordinate rhythmically thin bedded feldspathic sandstone and mudstone in the lower part of the unit. Numerous outcrops of Intrusive Grande Ronde Basalt (unit Tgri) are mapped within unit Tac south of the site. Unit Tgri is described as a Tertiary middle Miocene age, invasive sills, dikes, and irregular bodies of massive to columnar-jointed, aphyric to rarely phyric basalt and peperite or intrusive bodies related to Grande Ronde Basalt. A figure illustrating the geologic maps is included in Figure A-3.

Subsurface Soil Conditions

Subsurface soil conditions were explored by CGI Geologic Associate Chuck Bolduc, G.I.T., who visited the site on March 29 and March 30, 2011. We observed advancement of two mud rotary soil borings (B-1 and B-2) to depths of 115.5 feet and 121 feet using a subcontracted truck mounted drill rig and one cone penetrometer test (CPT-1) to a depth of 28 feet using a subcontracted rig. The borings and CPT were located in the general vicinity of the proposed structure and were selected in the field by Mark See, the Public Works Director with the City of Cannon Beach, Oregon. The approximate boring and CPT locations are shown on Figure A-2. Detailed boring and CPT logs are included in the attached Appendix B.

Boring B-1 was drilled on March 29, 2011 and with sample intervals between 0 feet and 5 feet and took more than 1 day to drill. Because we observed primarily sand that was similar in gradation between 25 feet and 100 feet and bedrock at 100 feet, we recommended to Mr. See that we extend the sample intervals to between 10 feet and 25 feet so that we could get better information for foundation design in the bedrock. Mr. See agreed with the recommendation and boring B-2 was drilled on March 30, 2011 using the extended sample intervals.

In general, the subsurface conditions consisted of medium stiff to soft silt and clay in the approximately upper 25 feet, which included abundant organic material below 15 feet. Below 25 feet, we encountered medium dense to very dense gray sand. Multiple thin gravel layers were observed in the two borings at various depths. At approximately 100 feet below the ground surface, we encountered siltstone bedrock. A more detailed description of the soils encountered in the borings is included below:

Clay and Organic Debris
The clay was stiff in the near surface becoming softer with depth. Clay was tan with rust mottling with minor inclusions of rust concretions. Some sandy texture was observed but sand particles were not present. In boring B-2, the drill cuttings were observed to be significantly more orange in color than in boring B-1. Wood fiber was observed in the cuttings from boring B-2 at a depth of 10 feet and again at 15 feet. A sample in boring B-2 encountered a relatively fresh to minimally decomposed log or stump oriented vertically based on the vertical wood grain recovered in the sampler. Other samples encountered gray clay with decomposed wood debris and gray clayey sand with decomposed wood debris. We interpret this sequence of sediments were deposited in an alluvial environment. Based on the CPT data, the shear wave velocity was between 402 feet per second and 582 feet per second in this soil layer.

Beach and Dune Sand
Dense, wet, gray sand was encountered at a depth of 25 feet in boring B-1 and dense sand to silty sand was interpreted in CPT-1 below 26 feet. The sand was generally fine-grained poorly-sorted with abundant micaceous flakes in select samples. The micaceous material may have been derived from weathering of local mica-bearing sandstones of the Astoria Formation and deposited as alluvial sands. Very dense basaltic gravel and sand was encountered in boring B-1 at 55 feet below the ground surface, and ended at 57.5 feet below the ground surface based on drilling characteristics. Thin layers of gravel were also interpreted at 61.5 feet in boring B-1 and 65 feet in boring B-2 based on drilling characteristics. Based on the limited thickness and variable depth, we interpret the gravel to be discontinuous. We interpret the sands and gravel deposits to be consistent with the geologic mapping of marine terrace deposits. The CPT met refusal near the top of the contact of the upper dense sand layer at 26 feet and shear wave velocities were not obtained below 25 feet. However, based on our blow count data, we estimate that the beach and dune sand has a shear wave velocity between 650 feet per second and 1,300 feet per second.

Siltstone Bedrock
Hard siltstone bedrock was encountered in boring B-1 at 100 feet below the ground surface and in boring B-2 at 101 feet below the ground surface. The siltstone observed in each boring differed in blow counts, drilling characteristics, and cutting return. The siltstone in boring B-1 had very high blow counts, variably hard and easy drilling and black fragments of basaltic rock returned in the drill cuttings. The siltstone in boring B-2 had relatively lower blow counts, consistent drilling characteristics, and no basaltic cuttings were observed. We interpret that the siltstone in boring B-1 also included a minor basalt intrusion, which is consistent with the abundantly mapped basaltic intrusives within the Astoria Formation in the area. In boring B-1, we drilled 15 feet into the formation and in boring B-2, we drilled 20 feet into the formation. According to a Madin and Wang 1999 paper, the shear wave velocity of the siltstone bedrock was estimated to be 1,870 feet per second.

The above subsurface description is of a generalized nature to highlight the major subsurface stratification features and material characteristics. The boring logs included in Appendix B should be reviewed for specific information at individual boring locations. These records include soil descriptions, stratifications, and test data. The stratifications shown on the boring logs represent the conditions only at the actual boring locations. Variations may occur and should be expected between boring locations. The stratifications represent the approximate boundary between subsurface materials and the actual transition may be gradual. The samples that were not altered by laboratory testing will be retained for 60 days from the date of this report and then will be discarded.

Groundwater Information

The static groundwater elevation in the project area was interpreted to be approximately 25 feet to 30 feet below the ground surface based on our observation of soil samples recorded during mud rotary drilling. The cone penetrometer test conducted a pore-water dissipation test within the dense gray sand at a depth of approximately 27.5 feet. Results of the pore-water dissipation test indicated a static water level of approximately 21 feet below the ground surface. We have assumed a groundwater depth of 21 feet below the ground surface for the purpose of this report.

Seismic Setting

The Oregon Coast is located near the western margin of the North American tectonic plate. The Pacific and Juan de Fuca tectonic plates that form the ocean floor are converging upon, and being subducted beneath, the North American Plate off the Oregon coastline. This zone of tectonic plate convergence, called the Cascadia Subduction Zone, has created a complex set of stress regimes that influence the tectonic and volcanic activity of the Pacific Northwest.

The moment magnitude (M_w) scale, rather than the Richter magnitude (M_L) scale, is now being used by seismologists to provide more accurate information. Moment magnitude measures an earthquake in terms of energy released and takes into account the rigidity of the earth, the average amount of slip on the fault and the size of the area that slipped. Richter magnitude is a base-10 logarithmic scale where the magnitude is calculated based on the combined shaking amplitude and the largest displacement from zero on a particular type of seismometer. The effective limit of measurement on the Richter scale is about M_L equal to 6.8. The size of an earthquake measured by moment magnitude and Richter magnitude are similar up to about 6.8.

The following paragraphs describe the distinct seismic sources that could potentially generate earthquakes affecting the subject site.

Cascadia Subduction Zone

The Cascadia Subduction Zone, located approximately 50 miles to 60 miles off the Oregon and Washington coastlines, is an immense thrust fault and a potential source of earthquakes large enough to cause significant ground shaking at the subject site and potentially throughout western Oregon and Washington. Research over the last several years has shown that this offshore fault zone has repeatedly produced large earthquakes every 300 years to 700 years. Geologic research of ancient Japanese tsunami records along with dendrochronology (tree ring dating techniques) has established that the last large Cascadia Subduction Zone earthquake occurred in January of 1700 AD. Although researchers do not fully agree on the likely magnitude of the next Cascadia Subduction Zone thrust fault earthquake, it is widely believed that earthquakes of moment magnitude (M_w) 8.0 to 9.0 are possible. The scientific community believes that the duration of strong ground shaking may be as long as 5 minutes to 6 minutes, with minor shaking lasting on the order of several minutes longer. Subduction zone earthquake aftershocks could continue to occur for hours or days after the initial rupture.

Intra-Slab Seismic Sources
Additional earthquake sources in this region include fault ruptures within the subducting oceanic plates. Earthquakes occurring within the subducting oceanic plates are called intraplate earthquakes. Originating at depths on the order of 20 miles to 30 miles within the remains of the subducting Juan de Fuca Plate, these large earthquakes have occurred with historical frequency in western Washington and to a lesser extent in western Oregon. These earthquakes range up to about Mw 7.5 and have caused widespread damage in the southern Puget Sound and northwest Oregon region in 1949, 1965, and 2001.

Crustal Seismic Sources
Crustal earthquakes are relatively shallow, occurring within approximately 6 miles to 12 miles of the earth's surface as a result of localized tectonic stresses. Oregon has experienced at least two significant crustal earthquakes in the past 18 years—the Scotts Mills (Mt. Angel) earthquake (Mw 5.6) on March 25, 1993 and the Klamath Falls earthquake (Mw 6.0) on September 21, 1993. Although there are no mapped crustal faults in the immediate vicinity of the project site that pose a surface rupture hazard, there may be yet undiscovered faults capable of generating significant ground motion and capable of influencing local relative seismic hazards. Based on limited data available in Oregon, it would be reasonable to assume Mw 6.0 to 6.6 crustal earthquakes may occur in Oregon.

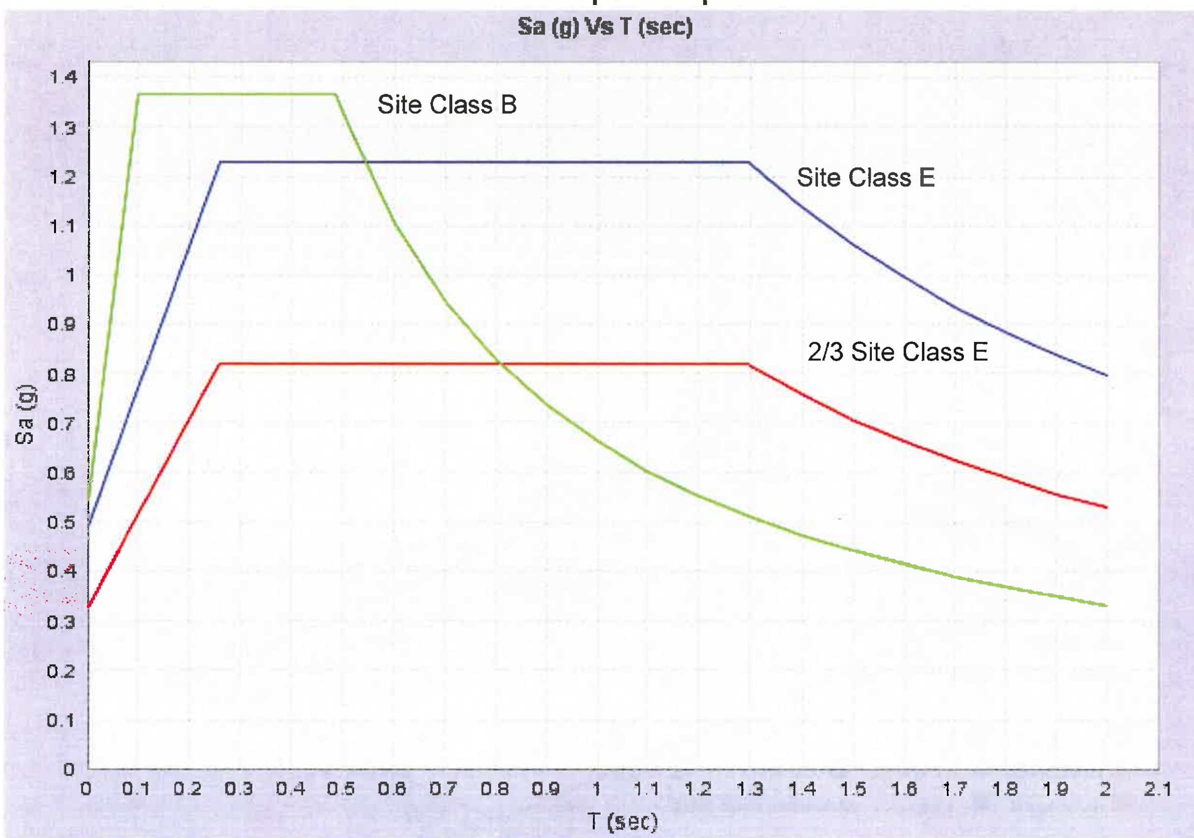
Ground Shaking

The peak horizontal ground acceleration (PGA) is the standard quantitative method of describing ground motion associated with propagating seismic waves in bedrock. The PGA is based on empirical attenuation relationships of seismic wave energy with distance from the seismic source. PGA's are expressed as a fraction of the acceleration due to gravity (g). Both Probabilistic Seismic Site Hazard (PSHA) and Deterministic Seismic Site Hazard (DSHA) were used to determine the PGA's for the site. The results are summarized in the following sections.

Probabilistic Seismic Hazard Analysis (PSHA)

The PSHA uses a response spectrum that is based on the chance that a particular ground motion will be exceeded in a defined recurrence interval (typically the lifetime of the planned development) due to earthquakes on numerous nearby and distant sources. We used the USGS National Seismic Hazard Mapping Program to obtain the ground motions evaluated for this study. Based on the exploration logs, we classified this site as a Site Class E in accordance with the 2010 Oregon Structural Specialty Code (OSSC) Table 1613.5.6(1) and (2). The probabilistic response is based on a return interval of 2 percent probability of exceedance within 50 years as described by ASCE 7-10 Section 21.2.1. The values determined in the PSHA assessment are shown and discussed on the below.

General Response Spectra



In accordance with Table 1613.5.2 of the 2010 OSSC, which is an amendment to the 2009 International Building Code (IBC), we recommend a Site Class E (stiff soil profile) for this site. According to the USGS Java Ground Motion Parameter Calculator using the ASCE 7-05, the maximum considered earthquake (MCE) ground motions for the site are S_S=1.379g and S_1=0.676g (for Site Class B and 5 percent critical damping). The USGS values are a more accurate interpolation of the values presented in Figure 1613.5(1) and 1613.5(2) of the OSSC. Site Coefficients F_a and F_v are 0.9 and 2.4, respectively for Site Class E. Therefore the adjusted MCE ground motions are S_{MS}=1.241g and S_{M1}=1.623g (for Site Class E). The return interval for these ground motions is 2 percent probability of exceedance in 50 years.

In addition, we performed a seismic deaggregation for the site. The estimated ground surface PGA is approximately 0.5778g for a Site Class B based on that evaluation. The seismic deaggragation is included on the following page.

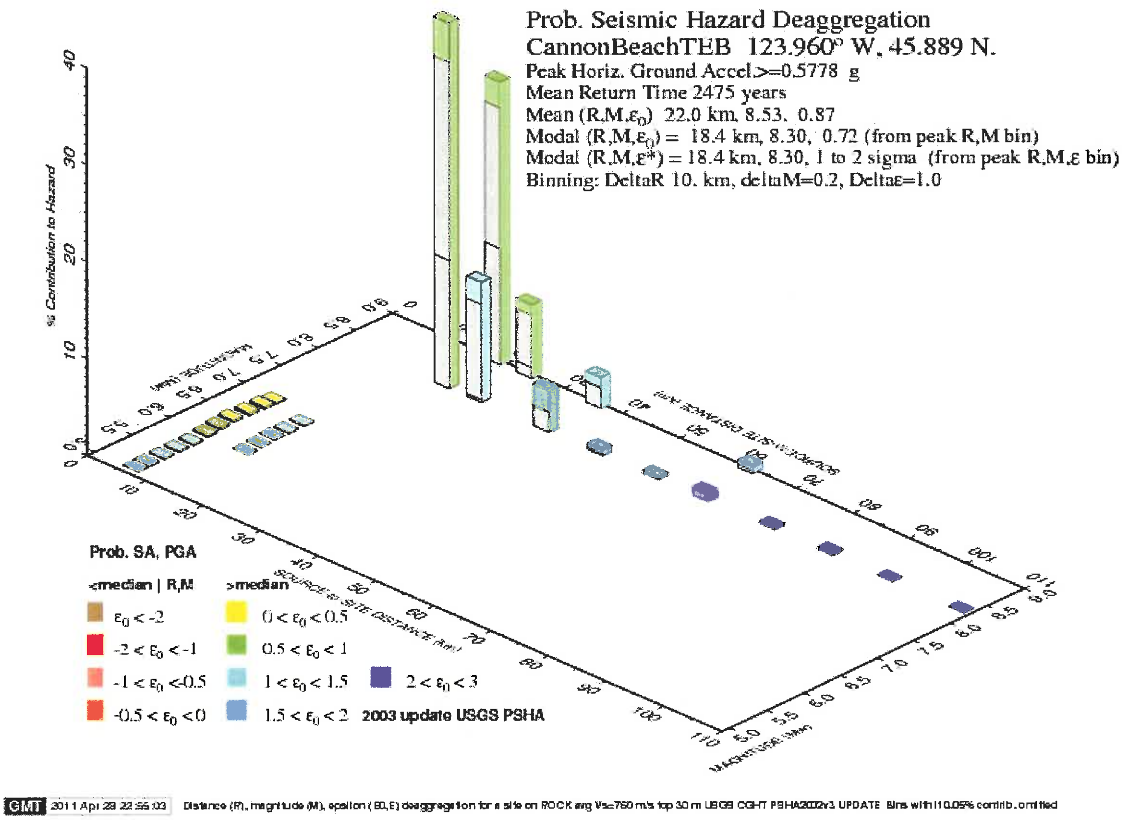


Table A-1: Principal Seismic Sources with Greater than 10 Percent Contribution to the Probabilistic Hazard at the Site

Earthquake Source	Percent Contribution	Probabilistic Magnitude
Cascadia M8.3	57 percent	8.3
Cascadia Megathrust	41 percent	9.0

Deterministic Seismic Hazard Analysis (DSHA)

A DSHA calculates the ground motions due to a specific maximum characteristic earthquake magnitude that is defined as the largest earthquake that could be expected to occur for a particular seismic source, regardless of the frequency of occurrence. The maximum characteristic earthquake is defined as the maximum earthquake that appears capable of occurring under the known tectonic framework (Kramer 1996). The size of the maximum characteristic earthquakes are discussed above in the Seismic Setting section of this appendix and are M_W 6.0 to 6.6 for shallow crustal earthquakes, M_W 7.5 for intraplate earthquakes and M_W 8.0 to 9.0 for the interface (subduction) zone earthquakes. These magnitudes are also reflected in the probabilistic analysis used by the USGS.

For the DSHA, we only conducted seismic analysis for the interface zone earthquake because that is the controlling earthquake at this site. The results of the DSHA are summarized in the following paragraphs.

Historical Seismicity
For historical seismicity within a 20 kilometer (12 mile) radius of the site, we reviewed the DOGAMI 2002 open-file report O-03-02, Map of Selected Earthquakes for Oregon, 1841 through 2002. The publication shows the location of earthquakes greater than magnitude 2.0 between 1841 and 2002. Based on our review, no earthquakes have been recorded within a 12 mile radius. No earthquakes greater than 5.9 were shown on the map. A copy of the pertinent section of the DOGAMI O-03-02 map is included in Figure A-4.

Local and Regional Potentially Active Faults
Based on review of the USGS 2006 (updated November 3, 2010) Quaternary Fault and Fold Database of the United States website, there are both on-shore and off-shore potentially active fault zones present in northwestern Oregon. The nearest potentially active fault, Fault "H", is mapped by the USGS offshore of Cannon Beach. Fault "H" consists of multiple fault strands, the eastern most of which is approximately 5.6 kilometers (3.5 miles) east of the site, although the reliability of the location is poor. The USGS describes Fault "H" as a 30 mile long northwest-striking, normal and/or left-lateral fault, which offsets accretionary wedge sediment of unknown age that underlies the continental shelf in the forearc of the Cascadia Subduction Zone. Similarities with other faults suggest most recent movement in the late Pleistocene and Holocene (<15,000 years ago). As with other folds and faults located in the Cascadia forearc, it is unknown if coseismic displacements on these faults are always related to great megathrust earthquakes on the subduction zone, or whether some displacements are related to smaller earthquakes in the North American Plate.

The known faults within 100 kilometers (62 miles) of the site have been listed in Table A-2 on the following page.

Table A-2: Class A Seismic Sources within 100-km (62 mile) Radius of the Site

Fault Name or Zone	USGS ID No.	Approximate Distance from Site (km)	Slip Rate (mm/yr)	Fault Length (km)	Most Recent Deformation
Fault "H" (offshore)	790	5.6	>5.0	49	<15Ka
Nehalem Bank Fault	789	19.0	1.0 to 5.0	101	<15Ka
Unnamed Offshore Faults	785	20.7	1.0 to 5.0	300	<15Ka
Gales Creek Fault Zone	718	22.5	<0.2	73	<1.6Ma
Tillamook Bay Fault Zone	881	35.0	<0.2	32	<1.6Ma
Cascadia Fold and Fault Belt	784	46.0	1.0 to 5.0	484	<15Ka
Fault "G" (offshore)	791	46.0	>5.0	56	<15Ka
Fault "J" (offshore)	788	48.6	1.0 to 5.0	8	<15Ka
Happy Camp Fault	882	49.5	<0.2	3	<1.6Ma
Willapa Bay fault zone	592	57.5	0.2 to 1.0	37	<15Ka
Portland Hills Fault	877	82.1	<0.2	49	<1.6Ma
Helvetia Fault	714	84.0	<0.2	7	<1.6Ma
Beaverton Fault Zone	715	88.9	<0.2	15	<750Ka
Unnamed fault set offshore of mouth of Willapa Bay	590	92.1	<0.2	26	<130Ka
Stonewall Anticline	786	92.3	1.0 to 5.0	80	<15Ka
East Bank Fault	876	94.9	<0.2	29	<15Ka
Oatfield Fault	875	95.1	<0.2	29	<1.6Ma
Unnamed fault zone offshore of Cape Shoalwater	591	95.8	<0.2	6	<1.6Ma
Newberg Fault	717	98.0	<0.2	5	<1.6Ma

USGS 2006 (updated November 3, 2010) Quaternary Fault and Fold Database of the United States.

Site Response Model

CGI used the computer program SHAKE2000 version 8.1.0 to perform dynamic analysis of a model soil profile created from subsurface information obtained in our field exploration and sol laboratory testing. Troy Hull, P.E., G.E. of Earth Engineers, Inc. provided technical expertise with the SHAKE2000 modeling. We modeled subsurface conditions represented by boring B-1 with 5 foot thick layers that extended to the bedrock. The dynamic model consisted of five different types of soil.

The following dynamic properties were selected for the model; shear modulus/maximum shear modulus (G/Gmax) and damping curves. We used soil with PI=15 (Vucetic and Dobry, JGE, 1/91) for the upper clay layer; soil with PI=50 (Vucetic and Dobry, JGE, 1/91) for the clay with organics; average sand (Seed and Idriss, 1970) for the dense to very dense sand; G/Gmax curves for sand CP>3.0ksc 3/11 1988 and damping curves for deep cohesionless soil 21 to 50 feet for the medium dense sand; G/Gmax curves for sand CP>3.0ksc 3/11 1988 and damping curves for deep cohesionless soil 21 to 50 feet for the lower dense sand layer between 60 feet and 65 feet below the ground surface; and EPRI, 1993 for rock 51 to 120 feet for the siltstone bedrock. Shear wave velocities were determined in the field in the CPT or correlated with the N_{60} value calculated from the corrected blow counts in the boring log for B-1. The shear wave velocity of the bedrock was estimated to be 1,870 feet per second (Madin and Wang 1999).

The horizontal PGAs were calculated using three attenuation relationships for a M_W of either 8.5 or 9 because the some of the models are reliable only to that magnitude. The source to site distance was 80 kilometers (50 miles) and a depth of 20 kilometers (13 miles) was assumed for this site. The calculated PGAs are summarized in Table A-3 below.

Table A-3: Calculated PGA at Bedrock, g

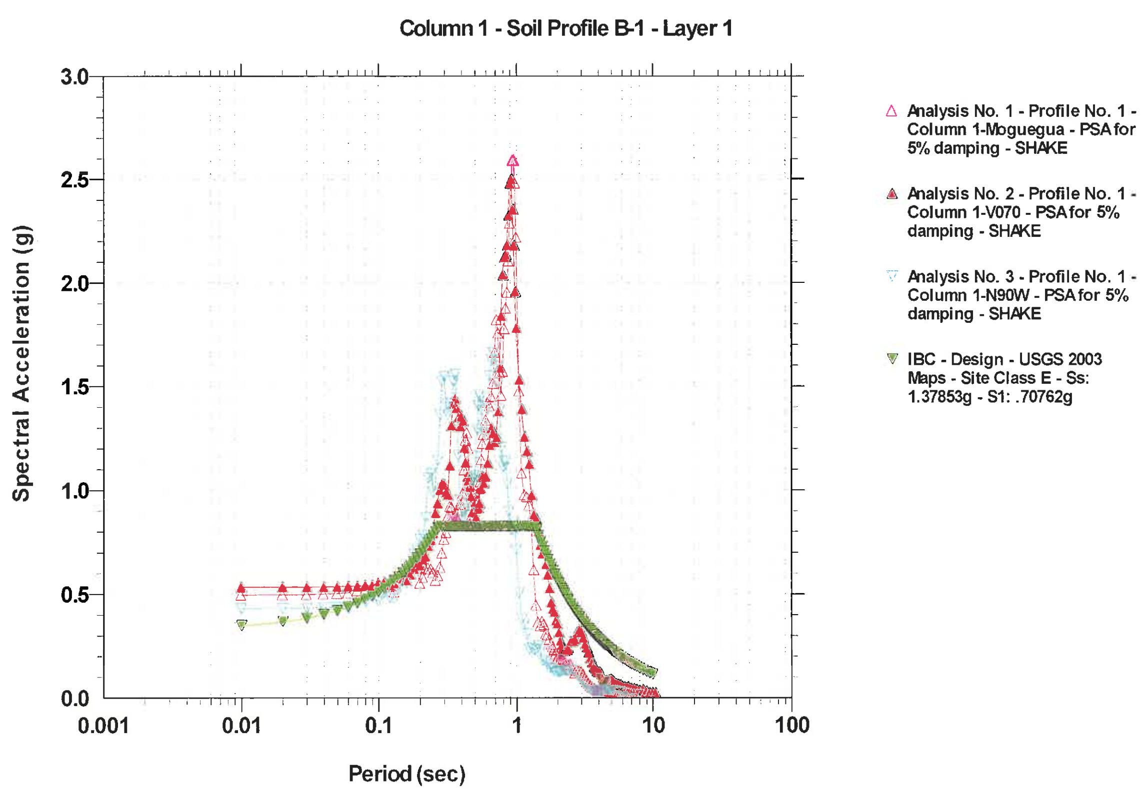
Relationship	Calculated PGA
Gregor, et.al (2002)	0.349
Youngs, et.al (1997)	0.437
Atkinson and Boore (2003)	0.165

We modeled only the interface or subduction zone earthquake because that is the principal seismic source for this site based on the research obtained during the PSHA analysis. We selected three historic earthquakes to complete the analysis. The length of recorded shaking for these earthquakes varied from 1 minute to over 3 minutes. Longer records were not available to us. However, the analysis showed that liquefaction and lateral spreading would occur at the site during the shorter duration ground motions. In our opinion, the selected ground motions were adequate for this feasibility study. Longer duration ground motions may need to be considered during the final design phase of this project. The earthquakes were scaled so that their response spectrum is, on average, approximately at the level of the targeted base spectrum over the anticipated range of significance to the structure. The details of the earthquake records are listed in Table A-4 on the next page.

Table A-4: Earthquake Motions Used In Analysis

Earthquake	Earthquake Type	Station	Magnitude	Source to Site Distance	Recorded PGA	Scaling Factor
2001 Peru	Subduction Zone, Interface	Moquegua	8.4	--	0.30	1.2
1985 Valparaiso (Chili)	Subduction Zone, Interface	Valparaiso (VALU) 70	7.8	109 km (80 miles)	0.23	1.4
1985 Michoacan (Mexico)	Subduction Zone, Interface	Caleta de Campos, N90W	8.1	38 km (23 miles)	0.14	1.6

The response spectrum for the earthquake motions and the IBC code values for reference are provided in the figure included below.



Site Specific Acceleration Parameters for Design

As specified in ASCE 7-10, the design spectral response acceleration parameter at short periods (S_{DS}) obtained from a site specific procedure should be taken at the 0.2 second spectral acceleration, but should not be less than 80 percent of the peak spectral acceleration at any period larger than 0.2 seconds. ASCE 7-10 requires that the parameter S_{D1}, the design spectral response acceleration at a period of 1 second, shall be taken as the greater of the spectral acceleration values at 1 second or two times the spectral acceleration value at 2 seconds. Based on these procedures, the site specific values of S_{DS} and S_{D1} are recommended to be 0.52g and 1.41g, respectively. These values were obtained from the average of the three earthquake response spectrums shown above. Both values exceed the IBC response spectrum. The analysis was conducted for 1 to 3 minute duration earthquakes and these values could change under longer duration earthquakes.

Site Specific Seismic Hazard Summary

The following section of this report presents out evaluation of the site-specific seismic hazards including:

- Liquefaction and Lateral Spread
- Fault Rupture Hazard
- Tsunami Hazard
- Co-Seismic Ground Subsidence
- Earthquake-Induced Landslide Hazard
- Settlement Mitigation and Scour Protection

Liquefaction and Lateral Spread Hazard

Liquefaction occurs when saturated deposits of loose to medium dense, cohesionless, fine-grained soils, generally sands and sand-silt mixtures, are subjected to strong earthquake shaking. If these deposits are saturated and cannot drain rapidly, there will be an increase in pore water pressure. With increasing seismic shaking, the pore water pressure can increase to the value of the overburden pressure. The shear strength of a cohesionless soil is directly proportional to the effective stress, which is equal to the difference between the overburden pressure and the pore water pressure. Therefore, when the pore water pressure increases to the value of the overburden pressure, the shear strength of the soil reduces to zero, and the soil deposits turn to a liquefied state. Liquefaction typically occurs when very loose to loose, saturated sediments are subjected to large earthquake motions. Ground surface response to seismic liquefaction could include softening or settlement of soil grades, loss of foundation support, tipping or tilting of taller structures founded on shallow footings, and a form of slope stability failure called lateral spreading.

Simplified empirical field methods were used to assess liquefaction. These methods are effective to depths of 75 feet. Cyclic laboratory testing and additional ground response analysis would need to be completed to assess the liquefaction potential below depths of 75 feet.

For our liquefaction analysis, we assumed that groundwater would be at a depth of 21 feet below the ground surface. We found that the clay layer will strain soften in the upper 25 feet of boring B-1 and underlying sand could liquefy at all depths except for the between 35 feet and 40 feet and below 75 feet. Based on our soil explorations, laboratory testing and analysis, we estimated that 9 to 15 inches of liquefaction induced settlement in the sand layers and strain softening in the upper clay layers could occur within the upper 75 feet of the site soil profile during the earthquakes modeled. Liquefaction could result in softening or deformation of surface grades or expulsion of water and sediment from the subsurface. Liquefaction can also reduce soil support and pile foundation capacity during an earthquake. Between 1 foot and 4 feet of lateral spreading could occur at the site during the earthquakes modeled with the anticipated direction of movement toward the Pacific Ocean beaches.

Fault Rupture Hazard

There are no mapped crustal faults in the immediate vicinity of the project site. We also reviewed available LIDAR imagery and bathymetry for the project area and did not observe significant signs or trends of any unmapped fault traces, such as lineaments, off-set topographic features, or off-set drainages. However, there may be yet undiscovered faults capable of generating significant ground motion and capable of influencing local relative seismic hazards.

Tsunami Hazards

Due to the relatively low elevation of the site above sea level, tsunami inundation and scour are considered likely seismic hazards at this site. A tsunami, or seismic sea wave, is produced when a fault under the ocean floor shifts vertically, displacing the seawater above it. Based on the DOGAMI Special Paper 41, 2009, the City Hall site lies within in a zone predicted to be inundated by between 50 percent and 70 percent of possible Cascadia Tsunami scenarios as shown on Figure A-5. The site is also subject to inundation by the maximum distant tsunami scenario modeled from Gulf of Alaska seismic source. Lines of 50 percent, 70 percent, 90 percent, and 99 percent lines on Figure A-5 correspond to inundation depths of 9 meters (29 feet), 11meters (36 feet), 16 meters (52 meters), and 30 meters (100 feet), where tsunamis were amplified by local topography. Scour from a tsunami could remove several feet of surface soil from the site, potentially eroding parking and street grades, damaging shallow underground utilities and undermining shallow foundations.

Co-Seismic Ground Subsidence

Co-seismic ground subsidence occurs when large areas of the coastline release built up strain during a large earthquake. The historical and geologic evidence suggest that 2 meters (6 feet) or more of rapid co-seismic subsidence could occur in this area during a strong Cascadia Suduction zone earthquake. Site affects could include immediate flooding of low lying or coastal areas and relatively higher tsunami inundation levels.

Earthquake Induced Landslide Hazard
The risk of earthquake induced landslides on the site is negligible because the site slopes are mild to level.

Settlement Mitigation and Scour Protection
A building supported on concrete piles with a structural slab would not be affected by dynamic settlement and lateral spreading. However, the ground surface, surrounding structures and utilities will be affected by the dynamic settlement and lateral spreading. Ground improvement techniques, such as deep soil mixing and installation of vertical drains could reduce the risk of liquefaction and lateral spreading.

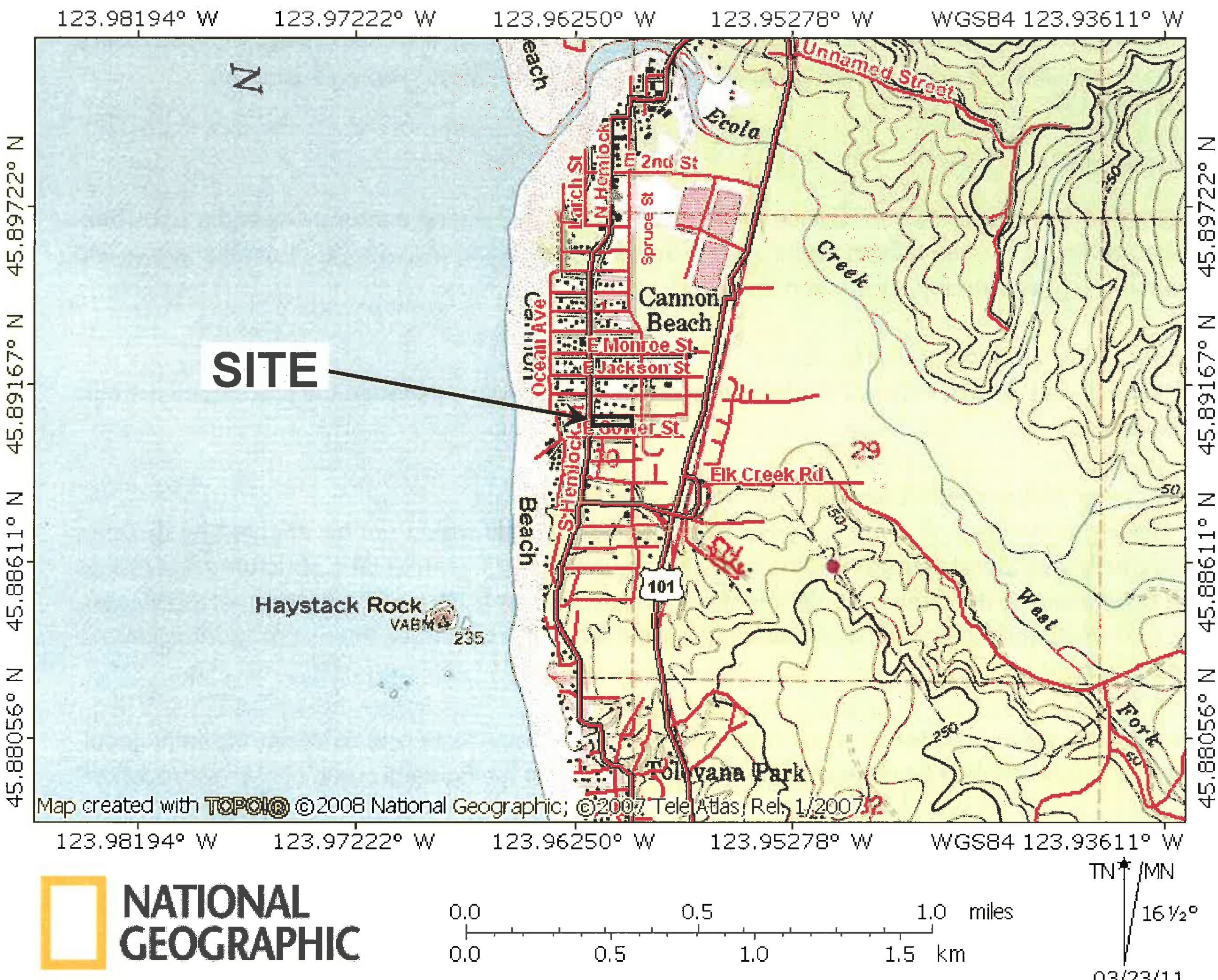
Foundation elements should be constructed of cast-in-place concrete to resist tsunami scour. Placing the rectangular building with the long axis parallel to the tsunami surge could reduce forces. Bearing walls or structural walls should be placed perpendicular to the water flow. Tsunami forces could be reduced by allowing non-structural elements at lower levels to break away

<u>Limitations</u>

This feasibility study showed that seismic hazards do exist at the site. Final design may need to consider different earthquake scenarios for longer duration ground motions than were considered for this analysis.

The geotechnical engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed. This report has been prepared for the exclusive use of the client or their authorized agents for the specific application to the proposed project.

FIGURE A-1: SITE LOCATION PLAN



Scale: 1 inch = 2,000 feet

Approximate Scale: 1 inch = 2,000 feet

Chinook GeoServices Inc.	**Proposed New City Hall** **Tsunami Evacuation Building** **163 East Gower Street** **Cannon Beach, Oregon**	**Report No.** **11-022-1** **Date:** **May 4, 2011**

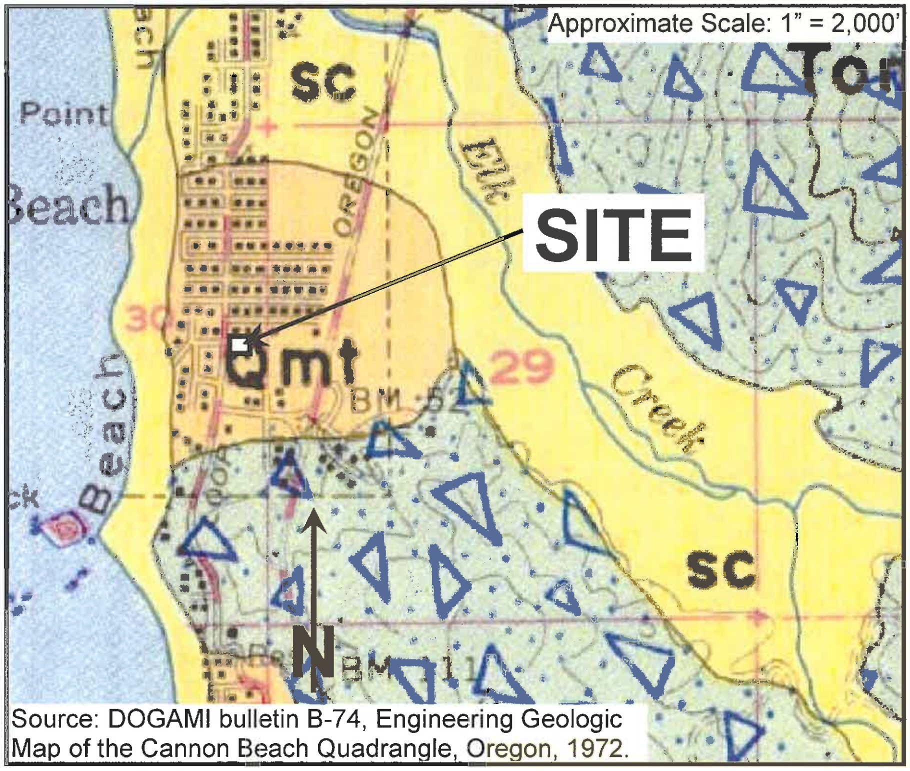
FIGURE A-2: SITE PLAN WITH EXPLORATION LOCATIONS

Approximate Scale: 1 inch = 80 feet

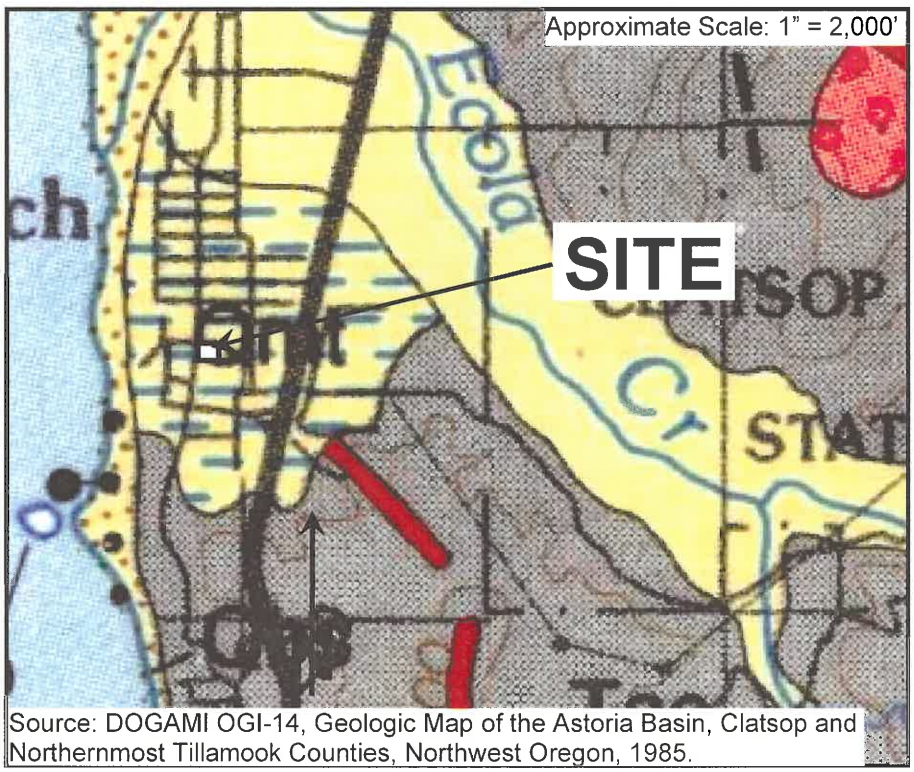
Source: City of Cannon Beach GIS Website (http://www.ci.cannon-beach.or.us/docs/Planning/GIS_2010/MASTER/index4.htm)

Chinook GeoServices Inc.	**Proposed New City Hall** **Tsunami Evacuation Building** **163 East Gower Street** **Cannon Beach, Oregon**	**Report No.** **11-022-1** **Date:** **May 4, 2011**

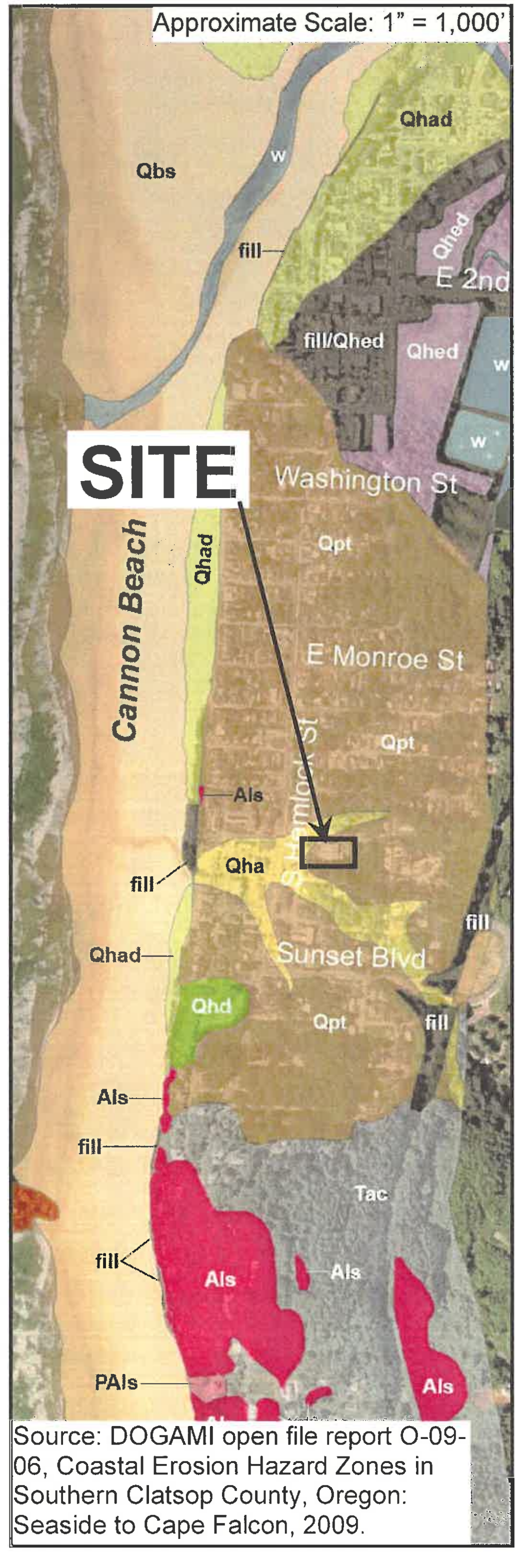
FIGURE A-3: GEOLOGIC MAPS



Source: DOGAMI bulletin B-74, Engineering Geologic Map of the Cannon Beach Quadrangle, Oregon, 1972.



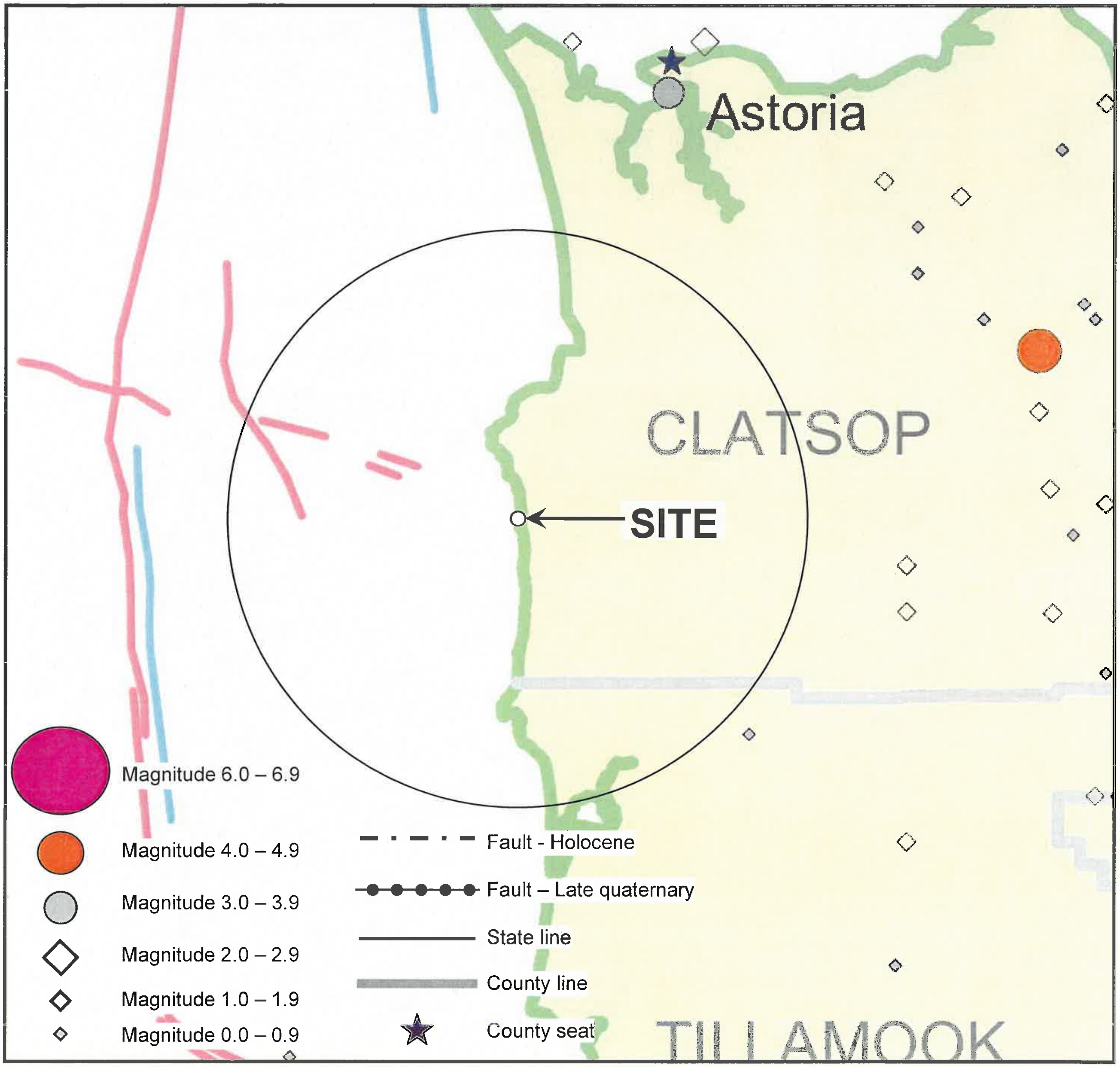
Source: DOGAMI OGI-14, Geologic Map of the Astoria Basin, Clatsop and Northernmost Tillamook Counties, Northwest Oregon, 1985.



Source: DOGAMI open file report O-09-06, Coastal Erosion Hazard Zones in Southern Clatsop County, Oregon: Seaside to Cape Falcon, 2009.

Chinook GeoServices Inc.	**Proposed New City Hall** **Tsunami Evacuation Building** **163 East Gower Street** **Cannon Beach, Oregon**	**Report No.** **11-022-1** **Date:** **May 4, 2011**

FIGURE A-4: HISTORIC EARTHQUAKES AND FAULT MAP

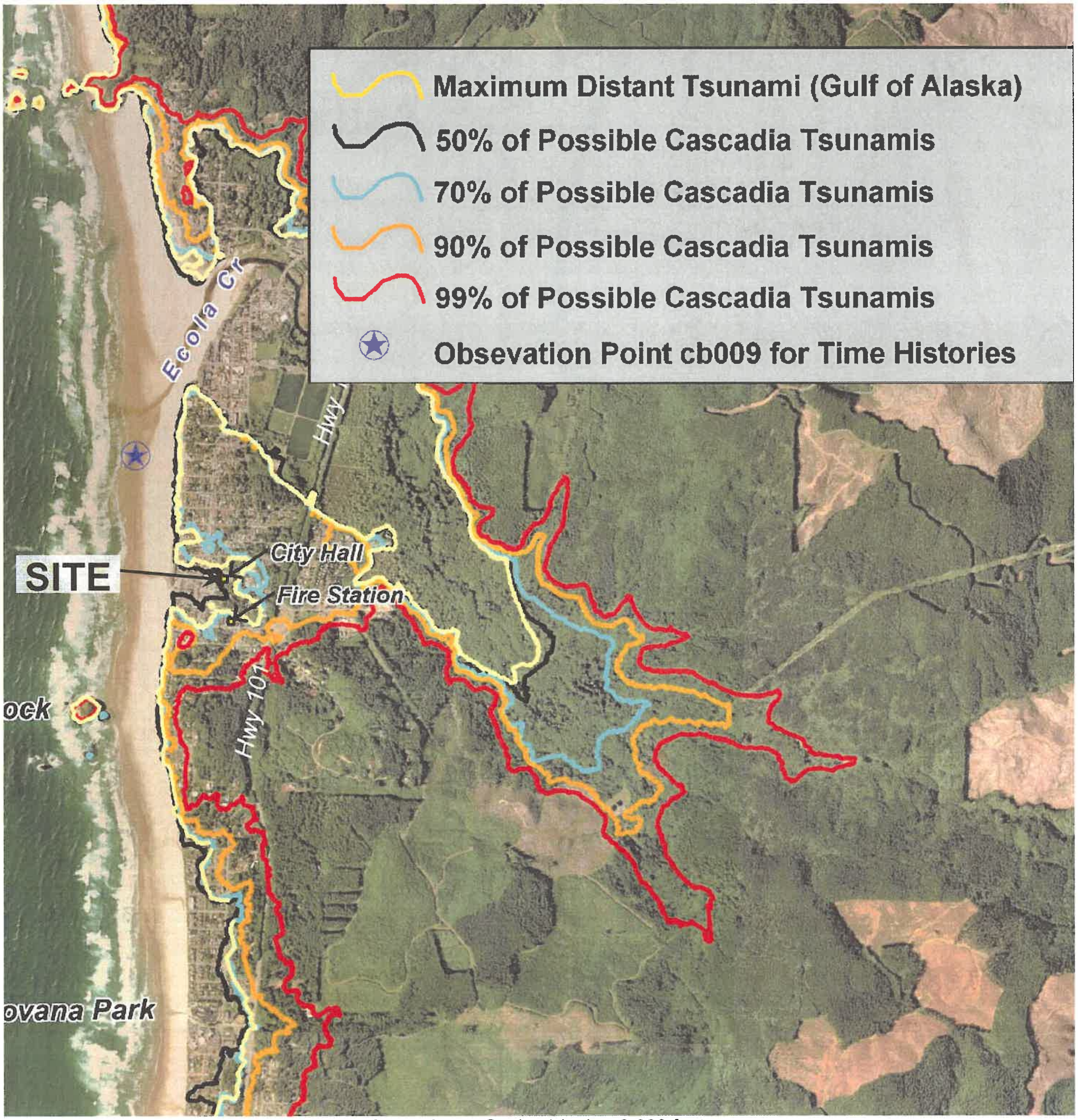


Approximate Scale: 1 inch = 10 kilometers

Source: DOGAMI 0-03-02 Map of Selected Earthquakes for Oregon 1841 through 2002

Chinook GeoServices Inc.	**Proposed New City Hall Tsunami Evacuation Building 163 East Gower Street Cannon Beach, Oregon**	**Report No. 11-022-1** **Date: May 4, 2011**

FIGURE A-5: TSUNAMI INUNDATION MAP



Approximate Scale: 1 inch = 2,000 feet

Source: DOGAMI SP-41, Tsunami hazard assessment of the northern Oregon coast: a multi-deterministic approach tested at Cannon Beach, Clatsop County, Oregon, Figure 50 page 73.

Chinook GeoServices Inc.	Proposed New City Hall Tsunami Evacuation Building 163 East Gower Street Cannon Beach, Oregon	Report No. 11-022-1 Date: May 4, 2011

APPENDIX B:

FIELD EXPLORATION PROCEDURES AND LOGS

APPENDIX B

FIELD EXPLORATION PROCEDURES AND LOGS

Chinook GeoServices, Inc. (CGI) explored subsurface conditions on March 29 and 30, 2011, during which time two soil borings (B-1 and B-2) were drilled and one cone penetrometer (CPT-1) was advanced.

Drilled Borings

Our two soil borings (B-1 and B-2) were drilled and sampled using mud rotary drilling equipment. The drill rig was operated by Subsurface Technologies of North Plains, Oregon under contract to CGI. Boring locations were selected in the field by the Client in the general vicinity of proposed structure. Field measurements from site features were used to locate the borings on the site plan. A qualified representative from CGI continuously observed the borings, logged the subsurface conditions and collected representative soil samples. All samples were stored in watertight containers and later transported to a subcontracted laboratory for further testing. After each boring was completed, the borehole was backfilled with bentonite chips and patched with asphalt cold patch.

Throughout the drilling operation, soil samples were generally obtained at 5-foot intervals in boring B-1 and 25-foot to 10-foot intervals in boring B-2 using a Standard Penetration Test (SPT) in accordance with ASTM D1586 using an automatic hammer. The testing and sampling procedure consists of driving a 2-inch diameter steel split spoon sampler 18 inches into the soil with a 140 pound hammer free-falling a distance of 30 inches. The number of blows required to drive the sampler through each 6-inch interval are counted, and the total number of blows struck during the final 12 inches is recorded as the SPT blow count (N-value). If the total blow count of 50 blows is recorded for any 6-inch interval, the driving is stopped and the blow count is recorded as 50 blows for the actual penetration distance. The resulting SPT resistance values indicate the relative density of granular soils and the relative consistency of cohesive soils.

The automatic hammer produces lower blow counts and SPT N-values than the traditional safety hammer. Studies have generally shown that penetration resistances may vary by a factor of 1.5 to 2 between the two methods. We have not adjusted the numbers recorded on the boring logs, and therefore the SPT values should be considered conservative.

The enclosed Boring Logs describe the vertical sequence of soils and materials encountered in each boring, based primarily on field classifications and supported by our subsequent laboratory examination and testing. Where a soil contact was observed to be gradational, our logs indicate the average contact depth. Where the soil type changed between sample intervals, we inferred the contact depth. Our logs graphically present the blow count per 6-inch interval, the sample number, and approximate depth of each soil sample obtained from the borings, as well as any laboratory tests performed on these samples. If any ground water was encountered in a boring, the approximate ground water depth is shown in the boring log. Ground water depth estimates were determined by visual examination of the samples.

Cone Penetrometer Test Probe

One cone penetrometer test probe (CPT) (CPT-1) was advanced using electronic cone equipment. The CPT rig was a Hogentogler Seismic/Pore Pressure 10 ton Subtraction Electronic Cone Penetrometer operated by Subsurface Technologies of North Plains, Oregon under contract to CGI. The exploration location was selected in the field by the Client in the general vicinity of proposed structure. Field measurements from site features were used to locate the CPT probe on the site plan. The exploration was advanced in general conformance with ASTM D3441. The test method consists of pushing an instrumented cone, with the tip facing down, into the ground at a controlled rate.

Seismic shear wave velocity testing was obtained at 2 meter intervals. The seismic shear wave testing equipment consists of hammer, a static load and a field computer all connected with a trigger that serves as the seismic source. The time for the shear wave to arrive at the seismic cone is measured. The shear wave velocity is calculated based on the information obtained in the field.

Pore pressure dissipation was also measured within the sand material present at a depth of 27.5 feet. The testing is conducted by allowing the excess pore water pressure to dissipate from the test depth. Pore pressure dissipation testing allows for calculation of the static water table. Results of the pore-water dissipation test indicated a static water level of approximately 21 feet below the ground surface.

Boring Log B-1

Chinook GeoServices Inc.

CLIENT: Mark See, Public Works Director, City of Cannon Beach	CGI PROJECT NO.: 11-022
PROJECT: Proposed New City Hall / Tsunami Evacuation Building	BORING TYPE: Mud rotary using truck mounted rig equipped with automatic SPT hammer
LOCATION: 163 East Gower Street, Cannon Beach, Oregon	ELEVATION: Approximately 30 feet above mean sea level
DATE DRILLED: March 29, 2011	LOGGED BY: Chuck Bolduc, G.I.T.

DEPTH (ft)	SAMPLE NO.	SOIL DESCRIPTION	BLOWS PER 6 INCHES	SPT "N" Value	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT (%)	UNIT DRY WT. (p.c.f.)	REMARKS
		1.5 inches asphalt underlain by approximately 7.5 inches base rock							
	S-1	Stiff, moist, gray-brown with rust mottling, clay with sand texture	3 4 5	9					
	S-2	Becomes medium stiff.	2 3 4	7	53	35	61.5		
5	S-3	Becomes light tan.	2 2 3	5					
10	S-4	Becomes soft.	1 1 1	2	62	36	63.1		
15	S-5	Tree or stump in upright position. Wood core had grains orientec vertically. Fresh to partially decomposed.	3 5 6	11					
20	S-6	Soft, moist to wet, gray clay with sand texture and decomposec wood debris and organics.	0 2 1	3					
25	S-7	Dense, wet, gray fine-grained sand.	10 15 20	35					▼ Estimated Static Groundwater
30	S-8	Becomes tan.	16 20 19	39					
35	S-9		18 22 27	49					
40	S-10		14 18 17	35					
45	S-11	Becomes medium dense, wet, gray and tan sand with abundan micaceous grains.	7 8 9	17					
50									

Boring Log B-1 Continued

Chinook GeoServices Inc.

CLIENT: Mark See, Public Works Director, City of Cannon Beach	CGI PROJECT NO.: 11-022
PROJECT: Proposed New City Hall / Tsunami Evacuation Building	BORING TYPE: Mud rotary using truck mounted rig equipped with automatic SPT hammer
LOCATION: 163 East Gower Street, Cannon Beach, Oregon	ELEVATION: Approximately 30 feet above mean sea level
DATE DRILLED: March 29, 2011	LOGGED BY: Chuck Bolduc, G.I.T.

DEPTH (ft)	SAMPLE NO.	SAMPLE	SOIL DESCRIPTION	BLOWS PER 6 INCHES	SPT "N" Value	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT (%)	UNIT DRY WT. (p.c.f.)	REMARKS
	S-12		Becomes dense.	10 14 20	34					
55	S-13		Very dense, wet, gray sand and basaltic gravel.	45 50 for 3"	>50					
			Base of gravel layer, based on driling characteristics.							
60	S-14		Dense, wet, gray fine-grained sand with micaceous flakes and trace rounded black gravel.	8 20 15	35					
			Layer of gravel infered from drilling characteristics.							
65	S-15		Very dense, wet, gray fine-grained sand with no micaceous flakes	16 47 42	89					
70	S-16			20 31 31	62					
75	S-17			20 26 33	59					
80	S-18		Becomes dense with some micaceous flakes.	15 17 25	42					
85	S-19		More abundant micaceous flakes.	22 24 18	42					
90	S-20			16 23 25	48					
95	S-21		Becomes very dense.	22 27 26	53					
100										

Boring Log B-1 Continued

Chinook GeoServices Inc.

CLIENT: Mark See, Public Works Director, City of Cannon Beach	CGI PROJECT NO.: 11-022
PROJECT: Proposed New City Hall / Tsunami Evacuation Building	BORING TYPE: Mud rotary using truck mounted rig equipped with automatic SPT hammer
LOCATION: 163 East Gower Street, Cannon Beach, Oregon	ELEVATION: Approximately 30 feet above mean sea level
DATE DRILLED: March 29, 2011	LOGGED BY: Chuck Bolduc, G.I.T.

DEPTH (ft)	SAMPLE NO.	SAMPLE	SOIL DESCRIPTION	BLOWS PER 6 INCHES	SPT "N" Value	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT (%)	UNIT DRY WT. (p.c.f.)	REMARKS
	S-22		Hard, moist, purplish-brown siltstone.	36 50 for 3"	>50					
	S-23		No sample recovery.	30 for 0"	>50					
			Fragments of black basalt observed in the drill cuttings.							
105	S-24		No sample recovery.	30 for 0"	>50					
			Drilling indicated contact between harder and softer material							
110	S-25		Hard, moist, purplish-brown siltstone.	50 for 4"	>50					
			Drill cuttings continue to bring up black basalt fragments							
115	S-26			50 for 6"	>50					
			Boring terminated at 115.5 feet below the ground surface and backfilled with bentonite/cement grout and bentonite chip hole-plug							
120										
125										
130										
135										
140										
145										
150										

Boring Log B-2

Chinook GeoServices Inc.

CLIENT: Mark See, Public Works Director, City of Cannon Beach	CGI PROJECT NO.: 11-022
PROJECT: Proposed New City Hall / Tsunami Evacuation Building	BORING TYPE: Mud rotary using truck mounted rig equipped with automatic SPT hammer
LOCATION: 163 East Gower Street, Cannon Beach, Oregon	ELEVATION: Approximately 30 feet above mean sea level
DATE DRILLED: March 30, 2011	LOGGED BY: Chuck Bolduc, G.I.T.

DEPTH (ft)	SAMPLE NO.	SAMPLE	SOIL DESCRIPTION	BLOWS PER 6 INCHES	SPT "N" Value	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT (%)	UNIT DRY WT. (p.c.f.)	REMARKS
5										
10			Woody debris observed in cuttings.							
15			Woddy debris observed in cuttings.							
20										
25	S-1		Stiff, moist, gray clayey sand with wood and organic debris	4 6 8	14					
30										
35										
40										
45										
50										

Boring Log B-2 Continued

Chinook GeoServices Inc.

CLIENT: Mark See, Public Works Director, City of Cannon Beach	CGI PROJECT NO.: 11-022
PROJECT: Proposed New City Hall / Tsunami Evacuation Building	BORING TYPE: Mud rotary using truck mounted rig equipped with automatic SPT hammer
LOCATION: 163 East Gower Street, Cannon Beach, Oregon	ELEVATION: Approximately 30 feet above mean sea level
DATE DRILLED: March 30, 2011	LOGGED BY: Chuck Bolduc, G.I.T.

DEPTH (ft)	SAMPLE NO.	SAMPLE	SOIL DESCRIPTION	BLOWS PER 6 INCHES	SPT "N" Value	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT (%)	UNIT DRY WT. (p.c.f.)	REMARKS
	S-2		Medium dense, wet gray sand with layers of mica and micaceous sand.	4 8 15	23					
55										
60										
65			Layer of gravelly material based on drilling characteristics							
70										
75	S-3		Medium dense, wet, tan and gray fine-grained sand with no mica	8 12 15	27					
80										
85	S-4		Becomes dense with layers of concetrated micaceious flakes.	12 16 20	36					
90			Alternately hard and easier drilling between 90 and 95 feet							
95	S-5			13 19 24	43					
100										

Boring Log B-2 Continued

Chinook GeoServices Inc.

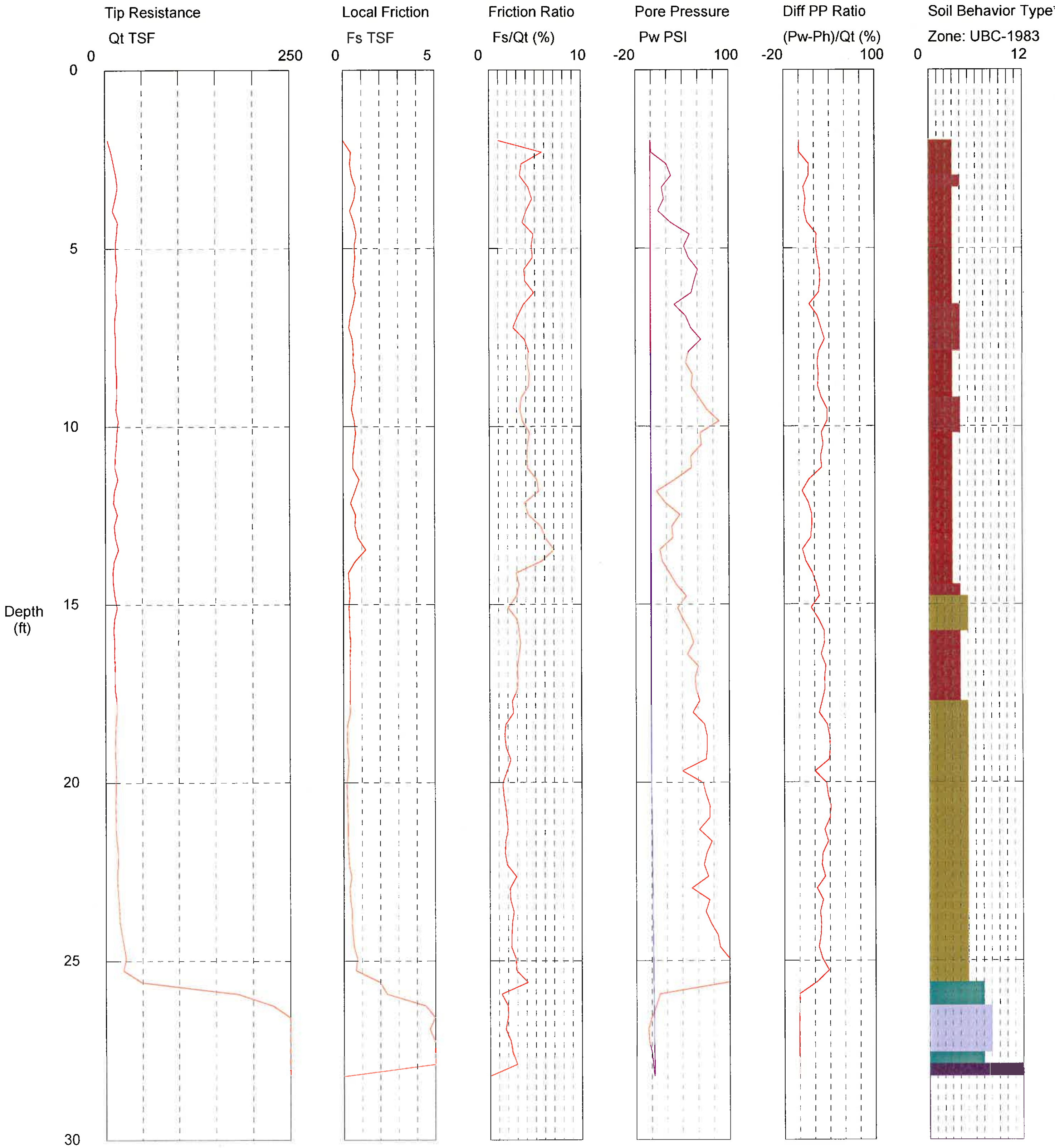
CLIENT: Mark See, Public Works Director, City of Cannon Beach	CGI PROJECT NO.: 11-022
PROJECT: Proposed New City Hall / Tsunami Evacuation Building	BORING TYPE: Mud rotary using truck mounted rig equipped with automatic SPT hammer
LOCATION: 163 East Gower Street, Cannon Beach, Oregon	ELEVATION: Approximately 30 feet above mean sea level
DATE DRILLED: March 30, 2011	LOGGED BY: Chuck Bolduc, G.I.T.

DEPTH (ft)	SAMPLE NO.	SAMPLE	SOIL DESCRIPTION	BLOWS PER 6 INCHES	SPT "N" Value	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT (%)	UNIT DRY WT. (p.c.f.)	REMARKS
			Contact with bedrock based on drilling characteristics.							
	S-6	■	Hard, moist, grayish brown siltstone.	50 for 4"	>50					
105										
110	S-7	■		32 43 50 for 5"	>50					
115										
120	S-8	■		48 50 for 5"						
			Boring terminated at 121 feet below the ground surface anc backfilled with bentonite/cement grout and bentonite chip hole-plug							
125										
130										
135										
140										
145										
150										

Subsurface Technologies

Operator: SAM
Sounding: P-1
Cone Used: DSG1021

CPT Date/Time: 3/29/2011 9:24:20 AM
Location: CANNON-CITY HALL
Job Number: 11-022



Maximum Depth = 28.22 feet

Depth Increment = 0.328 feet

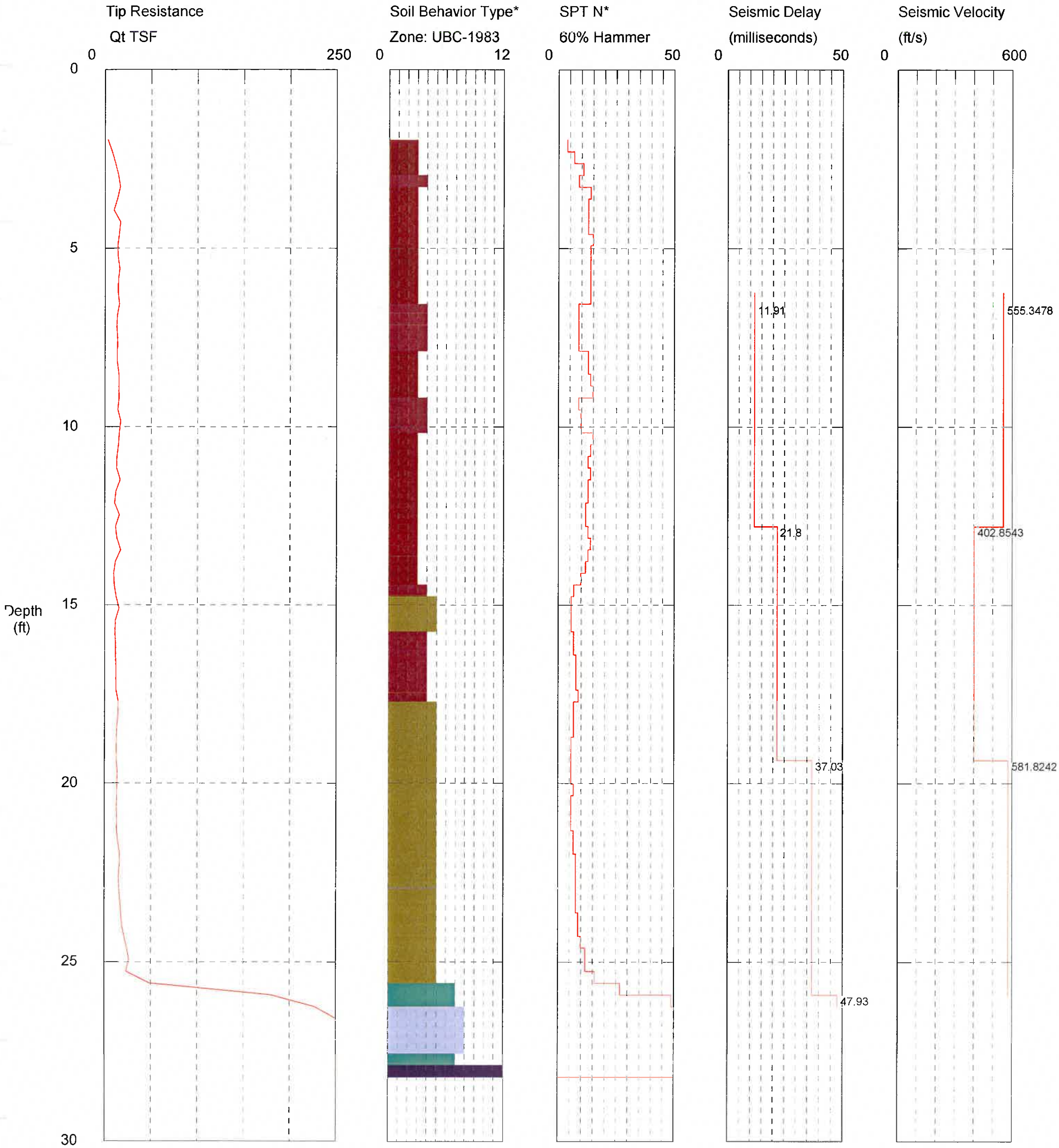
1	sensitive fine grained
2	organic material
3	clay
4	silty clay to clay
5	clayey silt to silty clay
6	sandy silt to clayey silt
7	silty sand to sandy silt
8	sand to silty sand
9	sand
10	gravelly sand to sand
11	very stiff fine grained (*)
12	sand to clayey sand (*)

Soil behavior type and SPT based on data from UBC-1983

Subsurface Technologies

Operator: SAM
Sounding: P-1
Cone Used: DSG1021

CPT Date/Time: 3/29/2011 9:24:20 AM
Location: CANNON-CITY HALL
Job Number: 11-022



Maximum Depth = 28.22 feet

Depth Increment = 0.328 feet

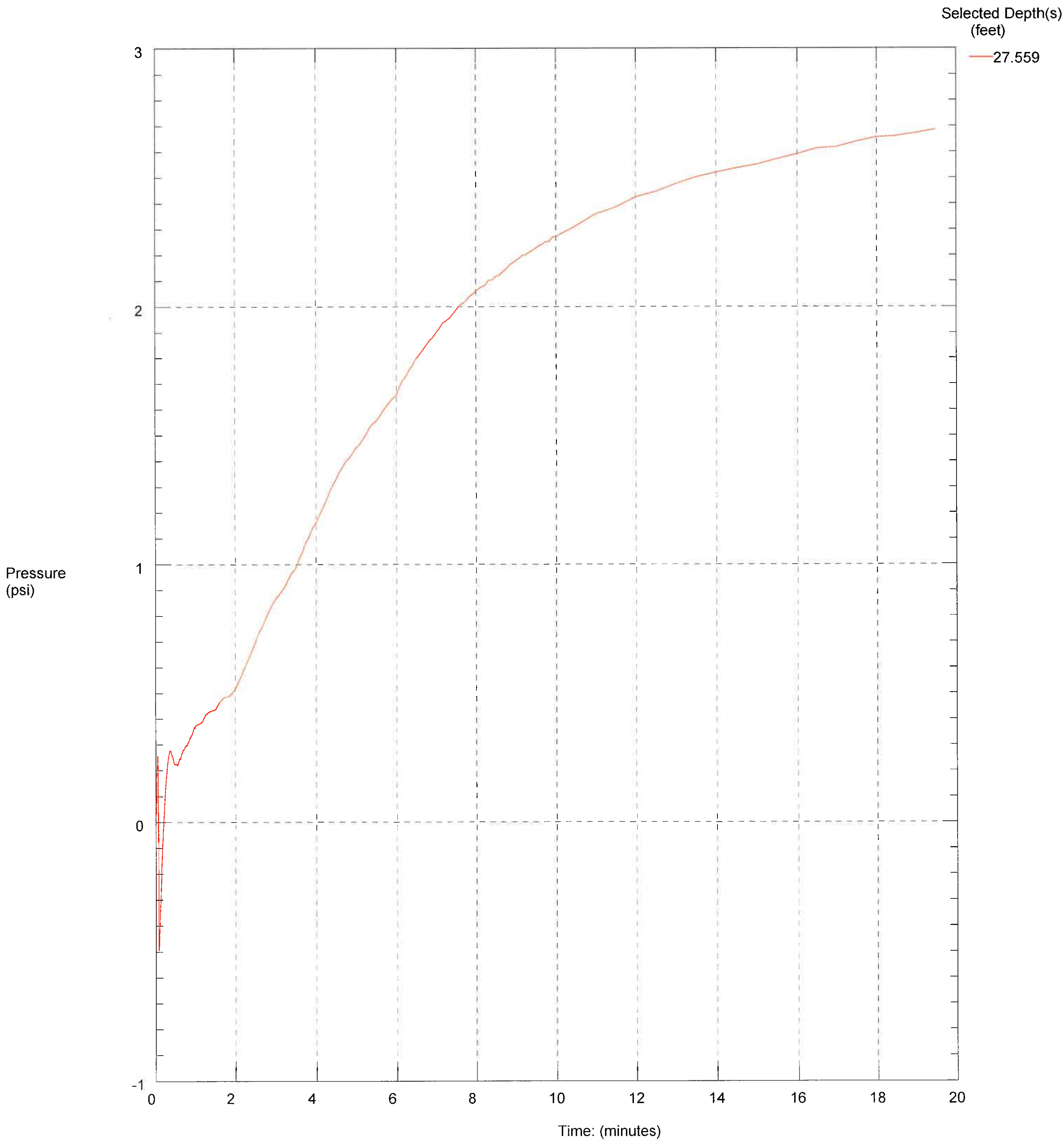
1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*Soil behavior type and SPT based on data from UBC-1983

Subsurface Technologies

Operator SAM
Sounding: P-1
Cone Used: DSG1021

CPT Date/Time: 3/29/2011 9:24:20 AM
Location: CANNON-CITY HALL
Job Number: 11-022



Maximum Pressure = 2.686 psi
Hydrostatic Pressure = 3.417 psi

APPENDIX C:

LABORATORY TEST PROCEDURES AND RESULTS

APPENDIX C

LABORATORY TEST PROCEDURES AND RESULTS

The following paragraphs describe the procedures associated with the laboratory testing that we conducted for this project. Graphic results of certain laboratory tests are enclosed with this appendix.

Visual Classification Procedures

Visual soil classifications were conducted on all samples in the field and on selected samples in the laboratory. All soils were classified in general accordance with ASTM D2488 and the Unified Soil Classification System. The resulting classifications are included in our boring logs included in Appendix B.

Moisture Content Determination Procedures

Moisture content determinations were performed on representative samples to aid in identification and correlation with soil types. All determinations were made in general accordance with ASTM D2216. The results of these tests are shown on the boring logs included in Appendix B.

Atterberg Limits Testing

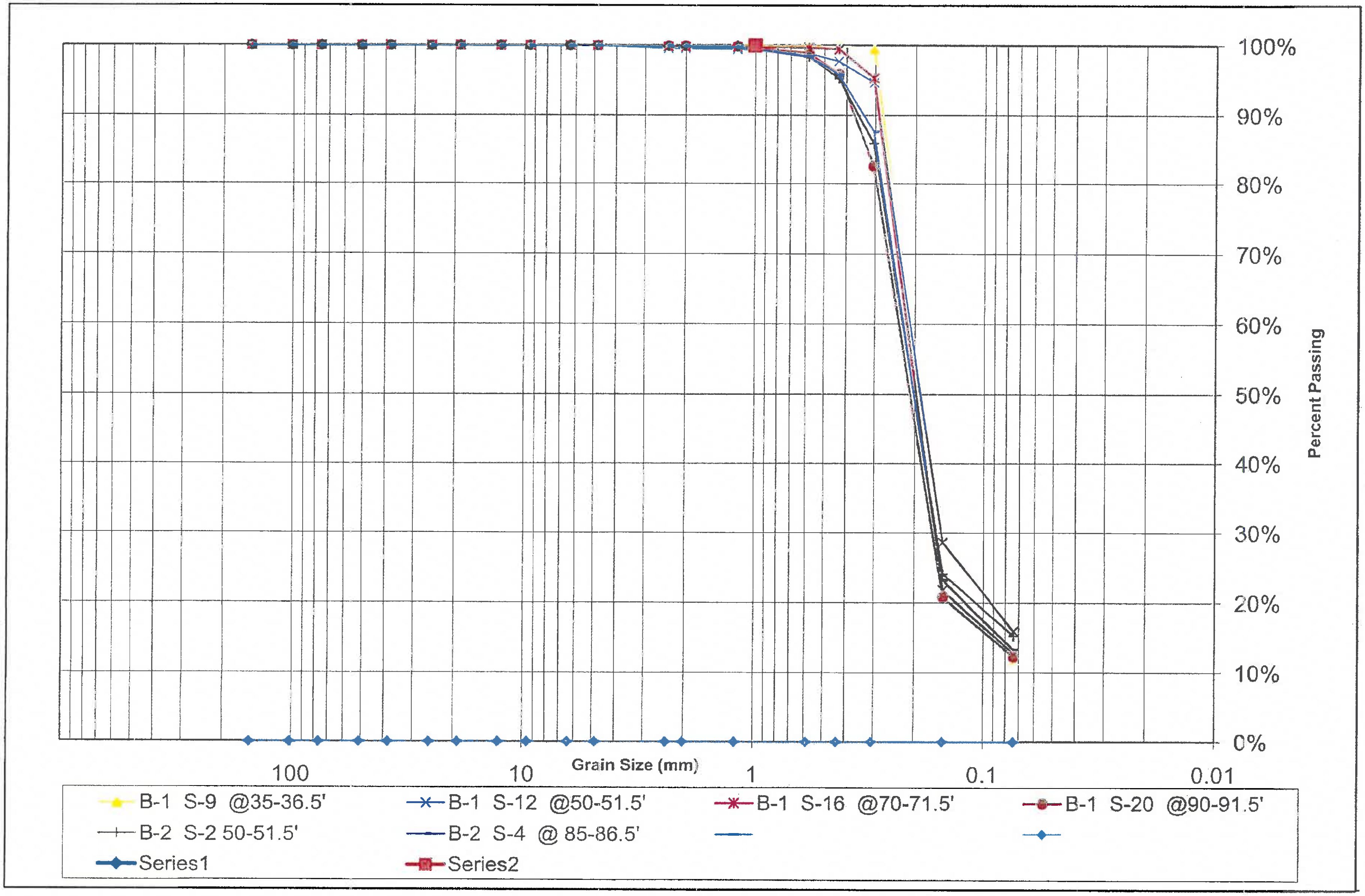
The plastic limit, liquid limit and plasticity index were determined on selected soil samples in general accordance with ASTM D4318. The results are shown on the boring logs included in Appendix B.

Grain Size Analysis Procedure

A grain size analysis indicates the range of soil particle diameters included in a particular sample. Grain size analyses were performed on representative samples in general accordance with ASTM D422. The results are included with this appendix and were used to classify the soils described in the boring logs.

PROJECT:	CANNON BEACH TEB		JOB NO:	11-3303-000
LOCATION:	CANNON BEACH		WORK ORDER NO:	
SAMPLE SOURCE:	SEE BELOW	REVISED CHART TO ADD IN SERIES	DATE SAMPLED:	3/29/11 & 3/30/11

MECHANICAL SIEVE ANALYSIS



APPENDIX D:

PILE DESIGN COMPUTER OUTPUT

VERTICAL ANALYSIS

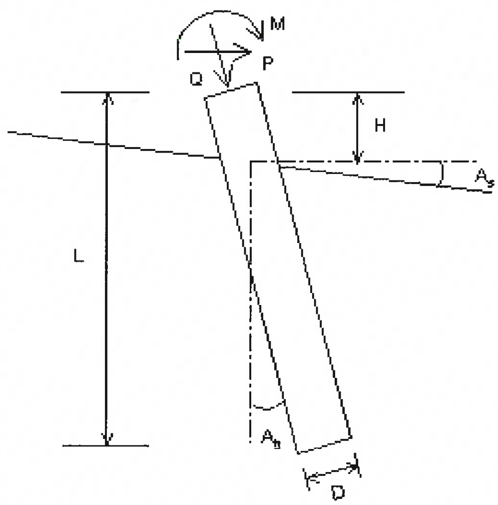
Loads:

Load Factor for Vertical Loads= 1.0
Load Factor for Lateral Loads= 1.0
Loads Supported by Pile Cap= 0 %
Shear Condition: Static

Vertical Load, Q= 975.0 -kp
Shear Load, P= 0.0 -kp
Moment, M= 0.0 -kp-f

Profile:

Pile Length, L= 110.0 -ft
Top Height, H= 0 -ft
Slope Angle, As= 0
Batter Angle, Ab= 0



Drilled Pile (dia <=24 in. or 61 cm)

Soil Data:

Depth -ft	Gamma -lb/f3	Phi	C -kp/f2	K -lb/i3	e50 or Dr %	Nspt
0	105	0	1.0	0	0	
7.5	105	0	1.00	0	0	
15	100	0	0.25	0	0	
21	37.6	0	.25	0	0	
25	42.6	38	0.00	0	0	
45	42.6	35	0.00	0	0	
50	42.6	38	0.00	0	0	
100	77.6	0	2.5	0	0	
150	77.6	0	2.5	0	0	

Pile Data:

Depth -ft	Width -in	Area -in2	Per. -in	I -in4	E -kp/i2	Weight -kp/f
0.0	24	452.4	75.4	16286.0	3000	0.471
110.0	24	452.4	75.4	16286.0	3000	0.471

Vertical capacity:

Weight above Ground= 0.00 Total Weight= 34.39-kp *Soil Weight is not included
Side Resistance (Down)= 908.260-kp Side Resistance (Up)= 587.619-kp
Tip Resistance (Down)= 70.688-kp Tip Resistance (Up)= 0.000-kp
Total Ultimate Capacity (Down)= 978.948-kp Total Ultimate Capacity (Up)= 622.013-kp
Total Allowable Capacity (Down)= 326.316-kp Total Allowable Capacity (Up)= 230.267-kp
N/G! Qallow < Q

Settlement Calculation:

At Q= 975.00-kp Settlement= 0.83467-in
At Xallow= 1.00-in Qallow= 976.87335-kp

Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.

****

ALLPILE 7
VERTICAL ANALYSIS DETAILED OUTPUT
Copyright by CivilTech Software
www.civiltechsoftware.com

****

Licensed to Marcella M Boyer Chinook GeoServices, Inc.
Date: 4/29/2011 File: P:\2011 Projects\11-022 (Cannon Beach TEB)\Pile Analysis\Allpile\TEB24.alp 1.0

Title 1: TEB/City Hall Cannon Beach, OR
Title 2: 2 ft diameter piles

Pile Profile and Loading:
Piletype: Drilled Pile (dia <=24 in. or 61 cm)
Pile Length, L= 110.0 -ft
Top Height, H= 0 -ft
Slope Angle, As= 0
Batter Angle, Ab= 0.00

Single Pile, Vertical Analysis:
Vertical Load, Q: 975.0 -kp
Load Factor for Vertical Loads: 1.0

Bearing stratum from pile tip extending to 10 Diameter of pile, which is=20.0-ft Starting from Pile Tip= 110.0-ft
From Ztip=110.0 to 130.0-ft Average Properties: Es= 937.50-kp/f2
C=2.50-kp/f2 Friction=0.00 Cp=0.14 Ksand=1.00
Limits of Max. tip resistance, q_lim= N/A
Batter Angle, Ab= 0.00 Batter Factor, Kbat= 1.00
Qtip_dw=70.7-kp based on qult=22.5-kp/f2 and Base Area=3.1-ft2
Qtip_up=0.0-kp and Base Area=0.0-ft2

TIP RESISTANCE (Down) CALCULATION:
Tip Depth= 110.0-ft Critical Depth Ratio Z/D= 20 Critical Depth= 40.0-ft
Effective Width of Tip= 2.00-ft, Tip Area= 3.14-ft2
Bearing stratum from pile tip extending to 10 Diameter of pile. Bearing stratum= 20.00-ft
Btip: width at pile tip= 2.00-ft
Phi & C are average value in bearing stratum
Batter Angle= 0.00, Batter Factor for Tip and Side= 1.00

Ztip	Z/D	Z_lim	q_lim	Width	Area	Phi	C	Nq	Nc	Sv	qult	Qtip_dw
-ft		-ft	-kp/f2	-ft	-ft2	- o	-kp/f2			-kp/f2	-kp/f2	-kp
110.0	20.0	40.0	N/A	2.0	3.14	0.0	2.50	0.0	9.0	3.0	22.5	70.7

Ztip - Depth of pile tip from ground surface
D - Pile average diameter (below ground) for calculation of critical depth. D=2.00-ft
Z/D - Critical depth (for tip resistances) as ratio of depth/diameter. Vertical stress will be constant below critical depth
Z_lim - Critical depth (for tip resistances)
q_lim - Limit of Max. tip resistance
Btip: width or diameter at pile tip
Bearing stratum: A stratum from pile tip extending to some depth. Average soil properties in the stratum are used for bearing calclation

SIDE RESISTANCE (Up & Down) CALCULATION:

D	Z/D	Z_lim	Sf_lim	K_dw	K_up	dz
-ft		-ft	-kp/f2			-ft
2.00	20.0	40.00	N/A	0.8	0.4	0.220

D - Pile average diameter for calculation of critical depth
Z/D - Critical depth (for side resistances) as ratio of depth/diameter. Vertical stress will be constant below critical depth
Z_lim - Critical depth (for side resistances)
Sf_lim - Limit of Max. side resistance

Users Setting: Ka=1, which is constant. Ca=KcKaC=KcC

SIDE RESISTANCE (Up & Down) CALCULATION vs DEPTH:
Calculation is based on segment dZ= 0.22

Zs	Prem	Sv	Phi	Kf(<2)	Delta	f_dw	f_up	C	Ka
Kc(<2)	Ca_dw	Ca_up	Sf_dw	Sf_up	Weight	Qneg	Q_dw	Q_up	
-ft	-ft	-kp/f2	- o	Delta	- o	-kp/f2	-kp/f2	-kp/f2	
Ca	-kp/f2	-kp/f2	-kp/f2	-kp/f2	-kp	-kp	-kp	-kp	
110.00	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	0.00	0.00	0.00	0.00	70.7	0.0	
109.78	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.06	0.00	74.2	3.5	
109.56	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.12	0.00	77.6	7.0	
109.34	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.18	0.00	81.1	10.6	
109.12	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.24	0.00	84.5	14.1	
108.90	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.30	0.00	88.0	17.6	
108.68	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.36	0.00	91.5	21.1	
108.46	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.42	0.00	94.9	24.7	
108.24	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.48	0.00	98.4	28.2	
108.02	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.55	0.00	101.9	31.7	
107.80	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.61	0.00	105.3	35.2	
107.58	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.67	0.00	108.8	38.8	
107.35	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.73	0.00	112.2	42.3	
107.13	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.79	0.00	115.7	45.8	
106.91	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.85	0.00	119.2	49.3	
106.69	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.91	0.00	122.6	52.9	
106.47	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.97	0.00	126.1	56.4	
106.25	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.03	0.00	129.6	59.9	
106.03	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.09	0.00	133.0	63.4	
105.81	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.15	0.00	136.5	66.9	
105.59	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.21	0.00	139.9	70.5	
105.37	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.27	0.00	143.4	74.0	

105.15	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.33	0.00	146.9	77.5	
104.93	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.39	0.00	150.3	81.0	
104.71	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.45	0.00	153.8	84.6	
104.49	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.52	0.00	157.3	88.1	
104.27	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.58	0.00	160.7	91.6	
104.05	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.64	0.00	164.2	95.1	
103.83	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.70	0.00	167.6	98.7	
103.61	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.76	0.00	171.1	102.2	
103.39	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.82	0.00	174.6	105.7	
103.17	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.88	0.00	178.0	109.2	
102.95	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.94	0.00	181.5	112.7	
102.73	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	2.00	0.00	185.0	116.3	
102.51	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	2.06	0.00	188.4	119.8	
102.28	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	2.12	0.00	191.9	123.3	
102.06	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	2.18	0.00	195.3	126.8	
101.84	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	2.24	0.00	198.8	130.4	
101.62	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	2.30	0.00	202.3	133.9	
101.40	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	2.36	0.00	205.7	137.4	
101.18	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	2.42	0.00	209.2	140.9	
100.96	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	2.49	0.00	212.7	144.5	
100.74	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	2.55	0.00	216.1	148.0	
100.52	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	2.61	0.00	219.6	151.5	
100.30	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	2.67	0.00	223.0	155.0	
100.08	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	2.73	0.00	226.5	158.6	
99.86	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	2.79	0.00	228.5	159.6	
99.64	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	2.85	0.00	230.4	160.6	
99.42	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	2.91	0.00	232.3	161.6	
99.20	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	2.97	0.00	234.3	162.7	
98.98	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.03	0.00	236.2	163.7	
98.76	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.09	0.00	238.1	164.7	
98.54	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.15	0.00	240.1	165.8	
98.32	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.21	0.00	242.0	166.8	
98.10	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.27	0.00	244.0	167.8	

97.88	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.33	0.00	245.9	168.9	
97.66	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.39	0.00	247.8	169.9	
97.43	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.45	0.00	249.8	170.9	
97.21	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.52	0.00	251.7	171.9	
96.99	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.58	0.00	253.7	173.0	
96.77	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.64	0.00	255.6	174.0	
96.55	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.70	0.00	257.5	175.0	
96.33	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.76	0.00	259.5	176.1	
96.11	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.82	0.00	261.4	177.1	
95.89	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.88	0.00	263.3	178.1	
95.67	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.94	0.00	265.3	179.2	
95.45	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.00	0.00	267.2	180.2	
95.23	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.06	0.00	269.2	181.2	
95.01	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.12	0.00	271.1	182.2	
94.79	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.18	0.00	273.0	183.3	
94.57	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.24	0.00	275.0	184.3	
94.35	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.30	0.00	276.9	185.3	
94.13	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.36	0.00	278.9	186.4	
93.91	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.42	0.00	280.8	187.4	
93.69	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.49	0.00	282.7	188.4	
93.47	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.55	0.00	284.7	189.5	
93.25	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.61	0.00	286.6	190.5	
93.03	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.67	0.00	288.6	191.5	
92.81	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.73	0.00	290.5	192.5	
92.59	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.79	0.00	292.4	193.6	
92.36	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.85	0.00	294.4	194.6	
92.14	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.91	0.00	296.3	195.6	
91.92	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.97	0.00	298.2	196.7	
91.70	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.03	0.00	300.2	197.7	
91.48	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.09	0.00	302.1	198.7	
91.26	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.15	0.00	304.1	199.8	
91.04	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.21	0.00	306.0	200.8	
90.82	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.27	0.00	307.9	201.8	

90.60	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.33	0.00	309.9	202.8	
90.38	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.39	0.00	311.8	203.9	
90.16	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.46	0.00	313.8	204.9	
89.94	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.52	0.00	315.7	205.9	
89.72	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.58	0.00	317.6	207.0	
89.50	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.64	0.00	319.6	208.0	
89.28	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.70	0.00	321.5	209.0	
89.06	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.76	0.00	323.5	210.1	
88.84	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.82	0.00	325.4	211.1	
88.62	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.88	0.00	327.3	212.1	
88.40	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.94	0.00	329.3	213.1	
88.18	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.00	0.00	331.2	214.2	
87.96	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.06	0.00	333.1	215.2	
87.74	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.12	0.00	335.1	216.2	
87.52	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.18	0.00	337.0	217.3	
87.29	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.24	0.00	339.0	218.3	
87.07	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.30	0.00	340.9	219.3	
86.85	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.36	0.00	342.8	220.4	
86.63	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.42	0.00	344.8	221.4	
86.41	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.49	0.00	346.7	222.4	
86.19	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.55	0.00	348.7	223.4	
85.97	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.61	0.00	350.6	224.5	
85.75	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.67	0.00	352.5	225.5	
85.53	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.73	0.00	354.5	226.5	
85.31	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.79	0.00	356.4	227.6	
85.09	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.85	0.00	358.3	228.6	
84.87	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.91	0.00	360.3	229.6	
84.65	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.97	0.00	362.2	230.7	
84.43	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.03	0.00	364.2	231.7	
84.21	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.09	0.00	366.1	232.7	
83.99	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.15	0.00	368.0	233.7	
83.77	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.21	0.00	370.0	234.8	
83.55	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.27	0.00	371.9	235.8	

83.33	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.33	0.00	373.9	236.8	
83.11	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.39	0.00	375.8	237.9	
82.89	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.46	0.00	377.7	238.9	
82.67	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.52	0.00	379.7	239.9	
82.44	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.58	0.00	381.6	241.0	
82.22	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.64	0.00	383.6	242.0	
82.00	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.70	0.00	385.5	243.0	
81.78	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.76	0.00	387.4	244.0	
81.56	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.82	0.00	389.4	245.1	
81.34	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.88	0.00	391.3	246.1	
81.12	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.94	0.00	393.2	247.1	
80.90	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.00	0.00	395.2	248.2	
80.68	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.06	0.00	397.1	249.2	
80.46	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.12	0.00	399.1	250.2	
80.24	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.18	0.00	401.0	251.3	
80.02	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.24	0.00	402.9	252.3	
79.80	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.30	0.00	404.9	253.3	
79.58	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.36	0.00	406.8	254.3	
79.36	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.43	0.00	408.8	255.4	
79.14	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.49	0.00	410.7	256.4	
78.92	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.55	0.00	412.6	257.4	
78.70	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.61	0.00	414.6	258.5	
78.48	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.67	0.00	416.5	259.5	
78.26	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.73	0.00	418.5	260.5	
78.04	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.79	0.00	420.4	261.6	
77.82	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.85	0.00	422.3	262.6	
77.60	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.91	0.00	424.3	263.6	
77.37	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.97	0.00	426.2	264.6	
77.15	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.03	0.00	428.1	265.7	
76.93	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.09	0.00	430.1	266.7	
76.71	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.15	0.00	432.0	267.7	
76.49	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.21	0.00	434.0	268.8	
76.27	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.27	0.00	435.9	269.8	

76.05	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.33	0.00	437.8	270.8	
75.83	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.39	0.00	439.8	271.9	
75.61	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.46	0.00	441.7	272.9	
75.39	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.52	0.00	443.7	273.9	
75.17	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.58	0.00	445.6	274.9	
74.95	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.64	0.00	447.5	276.0	
74.73	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.70	0.00	449.5	277.0	
74.51	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.76	0.00	451.4	278.0	
74.29	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.82	0.00	453.3	279.1	
74.07	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.88	0.00	455.3	280.1	
73.85	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.94	0.00	457.2	281.1	
73.63	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.00	0.00	459.2	282.2	
73.41	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.06	0.00	461.1	283.2	
73.19	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.12	0.00	463.0	284.2	
72.97	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.18	0.00	465.0	285.2	
72.75	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.24	0.00	466.9	286.3	
72.53	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.30	0.00	468.9	287.3	
72.30	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.36	0.00	470.8	288.3	
72.08	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.43	0.00	472.7	289.4	
71.86	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.49	0.00	474.7	290.4	
71.64	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.55	0.00	476.6	291.4	
71.42	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.61	0.00	478.6	292.5	
71.20	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.67	0.00	480.5	293.5	
70.98	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.73	0.00	482.4	294.5	
70.76	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.79	0.00	484.4	295.5	
70.54	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.85	0.00	486.3	296.6	
70.32	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.91	0.00	488.2	297.6	
70.10	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.97	0.00	490.2	298.6	
69.88	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.03	0.00	492.1	299.7	
69.66	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.09	0.00	494.1	300.7	
69.44	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.15	0.00	496.0	301.7	
69.22	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.21	0.00	497.9	302.8	
69.00	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.27	0.00	499.9	303.8	

68.78	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.33	0.00	501.8	304.8	
68.56	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.40	0.00	503.8	305.8	
68.34	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.46	0.00	505.7	306.9	
68.12	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.52	0.00	507.6	307.9	
67.90	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.58	0.00	509.6	308.9	
67.68	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.64	0.00	511.5	310.0	
67.45	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.70	0.00	513.5	311.0	
67.23	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.76	0.00	515.4	312.0	
67.01	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.82	0.00	517.3	313.1	
66.79	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.88	0.00	519.3	314.1	
66.57	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.94	0.00	521.2	315.1	
66.35	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.00	0.00	523.1	316.1	
66.13	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.06	0.00	525.1	317.2	
65.91	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.12	0.00	527.0	318.2	
65.69	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.18	0.00	529.0	319.2	
65.47	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.24	0.00	530.9	320.3	
65.25	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.30	0.00	532.8	321.3	
65.03	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.36	0.00	534.8	322.3	
64.81	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.43	0.00	536.7	323.4	
64.59	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.49	0.00	538.7	324.4	
64.37	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.55	0.00	540.6	325.4	
64.15	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.61	0.00	542.5	326.4	
63.93	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.67	0.00	544.5	327.5	
63.71	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.73	0.00	546.4	328.5	
63.49	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.79	0.00	548.3	329.5	
63.27	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.85	0.00	550.3	330.6	
63.05	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.91	0.00	552.2	331.6	
62.83	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.97	0.00	554.2	332.6	
62.61	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.03	0.00	556.1	333.7	
62.38	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.09	0.00	558.0	334.7	
62.16	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.15	0.00	560.0	335.7	
61.94	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.21	0.00	561.9	336.7	
61.72	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.27	0.00	563.9	337.8	

61.50	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.33	0.00	565.8	338.8	
61.28	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.40	0.00	567.7	339.8	
61.06	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.46	0.00	569.7	340.9	
60.84	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.52	0.00	571.6	341.9	
60.62	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.58	0.00	573.6	342.9	
60.40	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.64	0.00	575.5	344.0	
60.18	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.70	0.00	577.4	345.0	
59.96	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.76	0.00	579.4	346.0	
59.74	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.82	0.00	581.3	347.0	
59.52	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.88	0.00	583.2	348.1	
59.30	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.94	0.00	585.2	349.1	
59.08	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.00	0.00	587.1	350.1	
58.86	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.06	0.00	589.1	351.2	
58.64	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.12	0.00	591.0	352.2	
58.42	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.18	0.00	592.9	353.2	
58.20	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.24	0.00	594.9	354.3	
57.98	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.30	0.00	596.8	355.3	
57.76	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.37	0.00	598.8	356.3	
57.54	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.43	0.00	600.7	357.3	
57.31	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.49	0.00	602.6	358.4	
57.09	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.55	0.00	604.6	359.4	
56.87	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.61	0.00	606.5	360.4	
56.65	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.67	0.00	608.5	361.5	
56.43	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.73	0.00	610.4	362.5	
56.21	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.79	0.00	612.3	363.5	
55.99	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.85	0.00	614.3	364.6	
55.77	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.91	0.00	616.2	365.6	
55.55	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.97	0.00	618.1	366.6	
55.33	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.03	0.00	620.1	367.6	
55.11	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.09	0.00	622.0	368.7	
54.89	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.15	0.00	624.0	369.7	
54.67	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.21	0.00	625.9	370.7	
54.45	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.27	0.00	627.8	371.8	

54.23	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.33	0.00	629.8	372.8	
54.01	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.40	0.00	631.7	373.8	
53.79	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.46	0.00	633.7	374.9	
53.57	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.52	0.00	635.6	375.9	
53.35	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.58	0.00	637.5	376.9	
53.13	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.64	0.00	639.5	377.9	
52.91	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.70	0.00	641.4	379.0	
52.69	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.76	0.00	643.3	380.0	
52.46	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.82	0.00	645.3	381.0	
52.24	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.88	0.00	647.2	382.1	
52.02	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.94	0.00	649.2	383.1	
51.80	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	16.00	0.00	651.1	384.1	
51.58	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	16.06	0.00	653.0	385.2	
51.36	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	16.12	0.00	655.0	386.2	
51.14	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	16.18	0.00	656.9	387.2	
50.92	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	16.24	0.00	658.9	388.2	
50.70	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	16.30	0.00	660.8	389.3	
50.48	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	16.37	0.00	662.7	390.3	
50.26	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	16.43	0.00	664.7	391.3	
50.04	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	16.49	0.00	666.6	392.4	
49.82	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	16.55	0.00	668.4	393.3	
49.60	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	16.61	0.00	670.1	394.2	
49.38	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	16.67	0.00	671.9	395.2	
49.16	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	16.73	0.00	673.6	396.1	
48.94	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	16.79	0.00	675.4	397.1	
48.72	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	16.85	0.00	677.2	398.0	
48.50	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	16.91	0.00	678.9	398.9	
48.28	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	16.97	0.00	680.7	399.9	
48.06	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	17.03	0.00	682.4	400.8	
47.84	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	17.09	0.00	684.2	401.8	
47.62	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	17.15	0.00	685.9	402.7	
47.39	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	17.21	0.00	687.7	403.6	
47.17	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	17.27	0.00	689.5	404.6	

46.95	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	17.34	0.00	691.2	405.5	
46.73	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	17.40	0.00	693.0	406.4	
46.51	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	17.46	0.00	694.7	407.4	
46.29	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	17.52	0.00	696.5	408.3	
46.07	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	17.58	0.00	698.2	409.3	
45.85	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	17.64	0.00	700.0	410.2	
45.63	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	17.70	0.00	701.8	411.1	
45.41	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	17.76	0.00	703.5	412.1	
45.19	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	17.82	0.00	705.3	413.0	
44.97	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	17.88	0.00	707.2	414.1	
44.75	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	17.94	0.00	709.1	415.1	
44.53	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.00	0.00	711.1	416.1	
44.31	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.06	0.00	713.0	417.1	
44.09	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.12	0.00	715.0	418.2	
43.87	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.18	0.00	716.9	419.2	
43.65	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.24	0.00	718.8	420.2	
43.43	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.30	0.00	720.8	421.3	
43.21	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.37	0.00	722.7	422.3	
42.99	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.43	0.00	724.7	423.3	
42.77	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.49	0.00	726.6	424.4	
42.55	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.55	0.00	728.5	425.4	
42.32	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.61	0.00	730.5	426.4	
42.10	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.67	0.00	732.4	427.4	
41.88	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.73	0.00	734.4	428.5	
41.66	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.79	0.00	736.3	429.5	
41.44	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.85	0.00	738.2	430.5	
41.22	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.91	0.00	740.2	431.6	
41.00	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.97	0.00	742.1	432.6	
40.78	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	19.03	0.00	744.0	433.6	
40.56	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	19.09	0.00	746.0	434.7	
40.34	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	19.15	0.00	747.9	435.7	
40.12	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	19.21	0.00	749.9	436.7	
39.90	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	19.27	0.00	751.8	437.7	

39.68	6.28	2.97	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	19.34	0.00	753.7	438.8	
39.46	6.28	2.96	38.0	0.80	30.40	1.39	0.70	0.0	1.00
1.0	0.00	0.00	1.39	0.70	19.40	0.00	755.7	439.8	
39.24	6.28	2.95	38.0	0.80	30.40	1.39	0.69	0.0	1.00
1.0	0.00	0.00	1.39	0.69	19.46	0.00	757.6	440.8	
39.02	6.28	2.94	38.0	0.80	30.40	1.38	0.69	0.0	1.00
1.0	0.00	0.00	1.38	0.69	19.52	0.00	759.5	441.8	
38.80	6.28	2.94	38.0	0.80	30.40	1.38	0.69	0.0	1.00
1.0	0.00	0.00	1.38	0.69	19.58	0.00	761.4	442.8	
38.58	6.28	2.93	38.0	0.80	30.40	1.37	0.69	0.0	1.00
1.0	0.00	0.00	1.37	0.69	19.64	0.00	763.3	443.9	
38.36	6.28	2.92	38.0	0.80	30.40	1.37	0.68	0.0	1.00
1.0	0.00	0.00	1.37	0.68	19.70	0.00	765.2	444.9	
38.14	6.28	2.91	38.0	0.80	30.40	1.36	0.68	0.0	1.00
1.0	0.00	0.00	1.36	0.68	19.76	0.00	767.1	445.9	
37.92	6.28	2.90	38.0	0.80	30.40	1.36	0.68	0.0	1.00
1.0	0.00	0.00	1.36	0.68	19.82	0.00	769.0	446.9	
37.70	6.28	2.89	38.0	0.80	30.40	1.36	0.68	0.0	1.00
1.0	0.00	0.00	1.36	0.68	19.88	0.00	770.9	447.9	
37.47	6.28	2.88	38.0	0.80	30.40	1.35	0.68	0.0	1.00
1.0	0.00	0.00	1.35	0.68	19.94	0.00	772.7	448.9	
37.25	6.28	2.87	38.0	0.80	30.40	1.35	0.67	0.0	1.00
1.0	0.00	0.00	1.35	0.67	20.00	0.00	774.6	449.9	
37.03	6.28	2.86	38.0	0.80	30.40	1.34	0.67	0.0	1.00
1.0	0.00	0.00	1.34	0.67	20.06	0.00	776.5	450.9	
36.81	6.28	2.85	38.0	0.80	30.40	1.34	0.67	0.0	1.00
1.0	0.00	0.00	1.34	0.67	20.12	0.00	778.3	451.8	
36.59	6.28	2.84	38.0	0.80	30.40	1.33	0.67	0.0	1.00
1.0	0.00	0.00	1.33	0.67	20.18	0.00	780.2	452.8	
36.37	6.28	2.83	38.0	0.80	30.40	1.33	0.66	0.0	1.00
1.0	0.00	0.00	1.33	0.66	20.24	0.00	782.0	453.8	
36.15	6.28	2.82	38.0	0.80	30.40	1.32	0.66	0.0	1.00
1.0	0.00	0.00	1.32	0.66	20.31	0.00	783.8	454.8	
35.93	6.28	2.81	38.0	0.80	30.40	1.32	0.66	0.0	1.00
1.0	0.00	0.00	1.32	0.66	20.37	0.00	785.7	455.8	
35.71	6.28	2.80	38.0	0.80	30.40	1.32	0.66	0.0	1.00
1.0	0.00	0.00	1.32	0.66	20.43	0.00	787.5	456.7	
35.49	6.28	2.79	38.0	0.80	30.40	1.31	0.66	0.0	1.00
1.0	0.00	0.00	1.31	0.66	20.49	0.00	789.3	457.7	
35.27	6.28	2.79	38.0	0.80	30.40	1.31	0.65	0.0	1.00
1.0	0.00	0.00	1.31	0.65	20.55	0.00	791.1	458.7	
35.05	6.28	2.78	38.0	0.80	30.40	1.30	0.65	0.0	1.00
1.0	0.00	0.00	1.30	0.65	20.61	0.00	792.9	459.6	
34.83	6.28	2.77	38.0	0.80	30.40	1.30	0.65	0.0	1.00
1.0	0.00	0.00	1.30	0.65	20.67	0.00	794.7	460.6	
34.61	6.28	2.76	38.0	0.80	30.40	1.29	0.65	0.0	1.00
1.0	0.00	0.00	1.29	0.65	20.73	0.00	796.5	461.5	
34.39	6.28	2.75	38.0	0.80	30.40	1.29	0.64	0.0	1.00
1.0	0.00	0.00	1.29	0.64	20.79	0.00	798.3	462.5	
34.17	6.28	2.74	38.0	0.80	30.40	1.29	0.64	0.0	1.00
1.0	0.00	0.00	1.29	0.64	20.85	0.00	800.1	463.5	
33.95	6.28	2.73	38.0	0.80	30.40	1.28	0.64	0.0	1.00
1.0	0.00	0.00	1.28	0.64	20.91	0.00	801.8	464.4	
33.73	6.28	2.72	38.0	0.80	30.40	1.28	0.64	0.0	1.00
1.0	0.00	0.00	1.28	0.64	20.97	0.00	803.6	465.3	
33.51	6.28	2.71	38.0	0.80	30.40	1.27	0.64	0.0	1.00
1.0	0.00	0.00	1.27	0.64	21.03	0.00	805.4	466.3	
33.29	6.28	2.70	38.0	0.80	30.40	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	21.09	0.00	807.1	467.2	
33.07	6.28	2.69	38.0	0.80	30.40	1.26	0.63	0.0	1.00
1.0	0.00	0.00	1.26	0.63	21.15	0.00	808.9	468.2	
32.85	6.28	2.68	38.0	0.80	30.40	1.26	0.63	0.0	1.00
1.0	0.00	0.00	1.26	0.63	21.21	0.00	810.6	469.1	
32.63	6.28	2.67	38.0	0.80	30.40	1.25	0.63	0.0	1.00
1.0	0.00	0.00	1.25	0.63	21.27	0.00	812.4	470.0	

32.40	6.28	2.66	38.0	0.80	30.40	1.25	0.62	0.0	1.00
1.0	0.00	0.00	1.25	0.62	21.34	0.00	814.1	470.9	
32.18	6.28	2.65	38.0	0.80	30.40	1.25	0.62	0.0	1.00
1.0	0.00	0.00	1.25	0.62	21.40	0.00	815.8	471.9	
31.96	6.28	2.64	38.0	0.80	30.40	1.24	0.62	0.0	1.00
1.0	0.00	0.00	1.24	0.62	21.46	0.00	817.5	472.8	
31.74	6.28	2.63	38.0	0.80	30.40	1.24	0.62	0.0	1.00
1.0	0.00	0.00	1.24	0.62	21.52	0.00	819.2	473.7	
31.52	6.28	2.63	38.0	0.80	30.40	1.23	0.62	0.0	1.00
1.0	0.00	0.00	1.23	0.62	21.58	0.00	821.0	474.6	
31.30	6.28	2.62	38.0	0.80	30.40	1.23	0.61	0.0	1.00
1.0	0.00	0.00	1.23	0.61	21.64	0.00	822.7	475.5	
31.08	6.28	2.61	38.0	0.80	30.40	1.22	0.61	0.0	1.00
1.0	0.00	0.00	1.22	0.61	21.70	0.00	824.3	476.4	
30.86	6.28	2.60	38.0	0.80	30.40	1.22	0.61	0.0	1.00
1.0	0.00	0.00	1.22	0.61	21.76	0.00	826.0	477.3	
30.64	6.28	2.59	38.0	0.80	30.40	1.21	0.61	0.0	1.00
1.0	0.00	0.00	1.21	0.61	21.82	0.00	827.7	478.2	
30.42	6.28	2.58	38.0	0.80	30.40	1.21	0.61	0.0	1.00
1.0	0.00	0.00	1.21	0.61	21.88	0.00	829.4	479.1	
30.20	6.28	2.57	38.0	0.80	30.40	1.21	0.60	0.0	1.00
1.0	0.00	0.00	1.21	0.60	21.94	0.00	831.1	480.0	
29.98	6.28	2.56	38.0	0.80	30.40	1.20	0.60	0.0	1.00
1.0	0.00	0.00	1.20	0.60	22.00	0.00	832.7	480.9	
29.76	6.28	2.55	38.0	0.80	30.40	1.20	0.60	0.0	1.00
1.0	0.00	0.00	1.20	0.60	22.06	0.00	834.4	481.8	
29.54	6.28	2.54	38.0	0.80	30.40	1.19	0.60	0.0	1.00
1.0	0.00	0.00	1.19	0.60	22.12	0.00	836.0	482.7	
29.32	6.28	2.53	38.0	0.80	30.40	1.19	0.59	0.0	1.00
1.0	0.00	0.00	1.19	0.59	22.18	0.00	837.7	483.6	
29.10	6.28	2.52	38.0	0.80	30.40	1.18	0.59	0.0	1.00
1.0	0.00	0.00	1.18	0.59	22.24	0.00	839.3	484.5	
28.88	6.28	2.51	38.0	0.80	30.40	1.18	0.59	0.0	1.00
1.0	0.00	0.00	1.18	0.59	22.31	0.00	841.0	485.4	
28.66	6.28	2.50	38.0	0.80	30.40	1.17	0.59	0.0	1.00
1.0	0.00	0.00	1.17	0.59	22.37	0.00	842.6	486.2	
28.44	6.28	2.49	38.0	0.80	30.40	1.17	0.59	0.0	1.00
1.0	0.00	0.00	1.17	0.59	22.43	0.00	844.2	487.1	
28.22	6.28	2.48	38.0	0.80	30.40	1.17	0.58	0.0	1.00
1.0	0.00	0.00	1.17	0.58	22.49	0.00	845.8	488.0	
28.00	6.28	2.48	38.0	0.80	30.40	1.16	0.58	0.0	1.00
1.0	0.00	0.00	1.16	0.58	22.55	0.00	847.4	488.8	
27.78	6.28	2.47	38.0	0.80	30.40	1.16	0.58	0.0	1.00
1.0	0.00	0.00	1.16	0.58	22.61	0.00	849.0	489.7	
27.56	6.28	2.46	38.0	0.80	30.40	1.15	0.58	0.0	1.00
1.0	0.00	0.00	1.15	0.58	22.67	0.00	850.6	490.6	
27.33	6.28	2.45	38.0	0.80	30.40	1.15	0.57	0.0	1.00
1.0	0.00	0.00	1.15	0.57	22.73	0.00	852.2	491.4	
27.11	6.28	2.44	38.0	0.80	30.40	1.14	0.57	0.0	1.00
1.0	0.00	0.00	1.14	0.57	22.79	0.00	853.8	492.3	
26.89	6.28	2.43	38.0	0.80	30.40	1.14	0.57	0.0	1.00
1.0	0.00	0.00	1.14	0.57	22.85	0.00	855.4	493.1	
26.67	6.28	2.42	38.0	0.80	30.40	1.14	0.57	0.0	1.00
1.0	0.00	0.00	1.14	0.57	22.91	0.00	857.0	494.0	
26.45	6.28	2.41	38.0	0.80	30.40	1.13	0.57	0.0	1.00
1.0	0.00	0.00	1.13	0.57	22.97	0.00	858.5	494.8	
26.23	6.28	2.40	38.0	0.80	30.40	1.13	0.56	0.0	1.00
1.0	0.00	0.00	1.13	0.56	23.03	0.00	860.1	495.6	
26.01	6.28	2.39	38.0	0.80	30.40	1.12	0.56	0.0	1.00
1.0	0.00	0.00	1.12	0.56	23.09	0.00	861.6	496.5	
25.79	6.28	2.38	38.0	0.80	30.40	1.12	0.56	0.0	1.00
1.0	0.00	0.00	1.12	0.56	23.15	0.00	863.2	497.3	
25.57	6.28	2.37	38.0	0.80	30.40	1.11	0.56	0.0	1.00
1.0	0.00	0.00	1.11	0.56	23.21	0.00	864.7	498.1	
25.35	6.28	2.36	38.0	0.80	30.40	1.11	0.55	0.0	1.00
1.0	0.00	0.00	1.11	0.55	23.28	0.00	866.3	499.0	

25.13	6.28	2.35	38.0	0.80	30.40	1.10	0.55	0.0	1.00
1.0	0.00	0.00	1.10	0.55	23.34	0.00	867.8	499.8	
24.91	6.28	2.34	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	23.40	0.00	868.1	500.2	
24.69	6.28	2.34	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	23.46	0.00	868.5	500.6	
24.47	6.28	2.33	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	23.52	0.00	868.8	501.0	
24.25	6.28	2.32	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	23.58	0.00	869.2	501.4	
24.03	6.28	2.31	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	23.64	0.00	869.5	501.8	
23.81	6.28	2.30	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	23.70	0.00	869.9	502.2	
23.59	6.28	2.30	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	23.76	0.00	870.2	502.6	
23.37	6.28	2.29	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	23.82	0.00	870.6	503.1	
23.15	6.28	2.28	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	23.88	0.00	870.9	503.5	
22.93	6.28	2.27	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	23.94	0.00	871.3	503.9	
22.71	6.28	2.26	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	24.00	0.00	871.6	504.3	
22.48	6.28	2.25	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	24.06	0.00	871.9	504.7	
22.26	6.28	2.25	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	24.12	0.00	872.3	505.1	
22.04	6.28	2.24	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	24.18	0.00	872.6	505.5	
21.82	6.28	2.23	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	24.24	0.00	873.0	505.9	
21.60	6.28	2.22	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	24.31	0.00	873.3	506.3	
21.38	6.28	2.21	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	24.37	0.00	873.7	506.7	
21.16	6.28	2.20	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	24.43	0.00	874.0	507.1	
20.94	6.28	2.18	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	24.53	0.00	874.4	507.6	
20.72	6.28	2.16	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	24.63	0.00	874.7	508.0	
20.50	6.28	2.14	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	24.74	0.00	875.1	508.5	
20.28	6.28	2.12	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	24.84	0.00	875.4	508.9	
20.06	6.28	2.09	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	24.95	0.00	875.8	509.4	
19.84	6.28	2.07	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	25.05	0.00	876.1	509.8	
19.62	6.28	2.05	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	25.15	0.00	876.4	510.3	
19.40	6.28	2.03	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	25.26	0.00	876.8	510.7	
19.18	6.28	2.01	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	25.36	0.00	877.1	511.2	
18.96	6.28	1.98	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	25.47	0.00	877.5	511.6	
18.74	6.28	1.96	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	25.57	0.00	877.8	512.1	
18.52	6.28	1.94	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	25.67	0.00	878.2	512.5	
18.30	6.28	1.92	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	25.78	0.00	878.5	513.0	
18.08	6.28	1.90	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	25.88	0.00	878.9	513.4	

17.86	6.28	1.87	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	25.98	0.00	879.2	513.9	
17.64	6.28	1.85	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	26.09	0.00	879.6	514.3	
17.41	6.28	1.83	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	26.19	0.00	879.9	514.8	
17.19	6.28	1.81	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	26.30	0.00	880.3	515.2	
16.97	6.28	1.79	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	26.40	0.00	880.6	515.7	
16.75	6.28	1.76	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	26.50	0.00	880.9	516.1	
16.53	6.28	1.74	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	26.61	0.00	881.3	516.6	
16.31	6.28	1.72	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	26.71	0.00	881.6	517.0	
16.09	6.28	1.70	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	26.81	0.00	882.0	517.5	
15.87	6.28	1.67	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	26.92	0.00	882.3	517.9	
15.65	6.28	1.65	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	27.02	0.00	882.7	518.4	
15.43	6.28	1.63	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	27.13	0.00	883.0	518.8	
15.21	6.28	1.61	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	27.23	0.00	883.4	519.3	
14.99	6.28	1.59	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	27.33	0.00	884.8	520.8	
14.77	6.28	1.56	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	27.44	0.00	886.1	522.3	
14.55	6.28	1.54	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	27.54	0.00	887.5	523.7	
14.33	6.28	1.52	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	27.65	0.00	888.9	525.2	
14.11	6.28	1.49	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	27.75	0.00	890.3	526.7	
13.89	6.28	1.47	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	27.85	0.00	891.7	528.2	
13.67	6.28	1.45	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	27.96	0.00	893.1	529.7	
13.45	6.28	1.42	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	28.06	0.00	894.5	531.2	
13.23	6.28	1.40	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	28.16	0.00	895.8	532.7	
13.01	6.28	1.38	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	28.27	0.00	897.2	534.2	
12.79	6.28	1.35	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	28.37	0.00	898.6	535.7	
12.57	6.28	1.33	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	28.48	0.00	900.0	537.1	
12.34	6.28	1.31	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	28.58	0.00	901.4	538.6	
12.12	6.28	1.28	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	28.68	0.00	902.8	540.1	
11.90	6.28	1.26	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	28.79	0.00	904.2	541.6	
11.68	6.28	1.24	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	28.89	0.00	905.5	543.1	
11.46	6.28	1.22	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	29.00	0.00	906.9	544.6	
11.24	6.28	1.19	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	29.10	0.00	908.3	546.1	
11.02	6.28	1.17	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	29.20	0.00	909.7	547.6	
10.80	6.28	1.15	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	29.31	0.00	911.1	549.1	

10.58	6.28	1.12	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	29.41	0.00	912.5	550.5	
10.36	6.28	1.10	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	29.51	0.00	913.8	552.0	
10.14	6.28	1.08	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	29.62	0.00	915.2	553.5	
9.92	6.28	1.05	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	29.72	0.00	916.6	555.0	
9.70	6.28	1.03	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	29.83	0.00	918.0	556.5	
9.48	6.28	1.01	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	29.93	0.00	919.4	558.0	
9.26	6.28	0.98	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	30.03	0.00	920.8	559.5	
9.04	6.28	0.96	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	30.14	0.00	922.2	561.0	
8.82	6.28	0.94	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	30.24	0.00	923.5	562.5	
8.60	6.28	0.91	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	30.34	0.00	924.9	563.9	
8.38	6.28	0.89	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	30.45	0.00	926.3	565.4	
8.16	6.28	0.87	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	30.55	0.00	927.7	566.9	
7.94	6.28	0.84	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	30.66	0.00	929.1	568.4	
7.72	6.28	0.82	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	30.76	0.00	930.5	569.9	
7.49	6.28	0.80	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	30.86	0.00	931.9	571.4	
7.27	6.28	0.78	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	30.97	0.00	933.2	572.9	
7.05	6.28	0.75	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	31.07	0.00	934.6	574.4	
6.83	6.28	0.73	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	31.18	0.00	936.0	575.9	
6.61	6.28	0.71	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	31.28	0.00	937.4	577.3	
6.39	6.28	0.68	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	31.38	0.00	938.8	578.8	
6.17	6.28	0.66	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	31.49	0.00	940.2	580.3	
5.95	6.28	0.64	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	31.59	0.00	941.5	581.8	
5.73	6.28	0.61	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	31.69	0.00	942.9	583.3	
5.51	6.28	0.59	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	31.80	0.00	944.3	584.8	
5.29	6.28	0.57	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	31.90	0.00	945.7	586.3	
5.07	6.28	0.54	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	32.01	0.00	947.1	587.8	
4.85	6.28	0.52	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	32.11	0.00	948.5	589.3	
4.63	6.28	0.50	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	32.21	0.00	949.9	590.7	
4.41	6.28	0.47	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	32.32	0.00	951.2	592.2	
4.19	6.28	0.45	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	32.42	0.00	952.6	593.7	
3.97	6.28	0.43	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	32.53	0.00	954.0	595.2	
3.75	6.28	0.41	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	32.63	0.00	955.4	596.7	
3.53	6.28	0.38	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	32.73	0.00	956.8	598.2	

3.31	6.28	0.36	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	32.84	0.00	958.2	599.7	
3.09	6.28	0.34	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	32.94	0.00	959.6	601.2	
2.87	6.28	0.31	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	33.04	0.00	960.9	602.7	
2.65	6.28	0.29	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	33.15	0.00	962.3	604.1	
2.42	6.28	0.27	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	33.25	0.00	963.7	605.6	
2.20	6.28	0.24	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	33.36	0.00	965.1	607.1	
1.98	6.28	0.22	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	33.46	0.00	966.5	608.6	
1.76	6.28	0.20	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	33.56	0.00	967.9	610.1	
1.54	6.28	0.17	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	33.67	0.00	969.3	611.6	
1.32	6.28	0.15	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	33.77	0.00	970.6	613.1	
1.10	6.28	0.13	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	33.88	0.00	972.0	614.6	
0.88	6.28	0.10	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	33.98	0.00	973.4	616.1	
0.66	6.28	0.08	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	34.08	0.00	974.8	617.5	
0.44	6.28	0.06	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	34.19	0.00	976.2	619.0	
0.22	6.28	0.03	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	34.29	0.00	977.6	620.5	
0.00	6.28	0.01	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	34.39	0.00	978.9	622.0	

DEPTH - SETTLEMENT RELATION by Vesic Method (1977):
Ztip=110.00 Btip= 2.00 Cp= 0.135 Cs= 0.286
Xpp=2.545 Xps= 1.258
Cp & Cs are average value at bearing stratum from pile tip extend to 10 Btip

Zs -ft	Qdw -kp	Area' -ft2	E -kp/i2	dXs -in	Xall -in
110.00	70.7	3.142	3000.0	0.0000	3.803
109.78	74.2	3.142	3000.0	0.0001	3.803
109.56	77.6	3.142	3000.0	0.0002	3.803
109.34	81.1	3.142	3000.0	0.0002	3.804
109.12	84.5	3.142	3000.0	0.0002	3.804
108.90	88.0	3.142	3000.0	0.0002	3.804
108.68	91.5	3.142	3000.0	0.0002	3.804
108.46	94.9	3.142	3000.0	0.0002	3.804
108.24	98.4	3.142	3000.0	0.0002	3.804
108.02	101.9	3.142	3000.0	0.0002	3.805
107.80	105.3	3.142	3000.0	0.0002	3.805
107.58	108.8	3.142	3000.0	0.0002	3.805
107.35	112.2	3.142	3000.0	0.0002	3.805
107.13	115.7	3.142	3000.0	0.0002	3.805
106.91	119.2	3.142	3000.0	0.0002	3.806
106.69	122.6	3.142	3000.0	0.0002	3.806
106.47	126.1	3.142	3000.0	0.0002	3.806
106.25	129.6	3.142	3000.0	0.0003	3.806
106.03	133.0	3.142	3000.0	0.0003	3.807
105.81	136.5	3.142	3000.0	0.0003	3.807
105.59	139.9	3.142	3000.0	0.0003	3.807
105.37	143.4	3.142	3000.0	0.0003	3.808
105.15	146.9	3.142	3000.0	0.0003	3.808
104.93	150.3	3.142	3000.0	0.0003	3.808
104.71	153.8	3.142	3000.0	0.0003	3.808

104.49	157.3	3.142	3000.0	0.0003	3.809
104.27	160.7	3.142	3000.0	0.0003	3.809
104.05	164.2	3.142	3000.0	0.0003	3.809
103.83	167.6	3.142	3000.0	0.0003	3.810
103.61	171.1	3.142	3000.0	0.0003	3.810
103.39	174.6	3.142	3000.0	0.0003	3.810
103.17	178.0	3.142	3000.0	0.0003	3.811
102.95	181.5	3.142	3000.0	0.0004	3.811
102.73	185.0	3.142	3000.0	0.0004	3.811
102.51	188.4	3.142	3000.0	0.0004	3.812
102.28	191.9	3.142	3000.0	0.0004	3.812
102.06	195.3	3.142	3000.0	0.0004	3.813
101.84	198.8	3.142	3000.0	0.0004	3.813
101.62	202.3	3.142	3000.0	0.0004	3.813
101.40	205.7	3.142	3000.0	0.0004	3.814
101.18	209.2	3.142	3000.0	0.0004	3.814
100.96	212.7	3.142	3000.0	0.0004	3.815
100.74	216.1	3.142	3000.0	0.0004	3.815
100.52	219.6	3.142	3000.0	0.0004	3.815
100.30	223.0	3.142	3000.0	0.0004	3.816
100.08	226.5	3.142	3000.0	0.0004	3.816
99.86	228.5	3.142	3000.0	0.0004	3.817
99.64	230.4	3.142	3000.0	0.0004	3.817
99.42	232.3	3.142	3000.0	0.0005	3.818
99.20	234.3	3.142	3000.0	0.0005	3.818
98.98	236.2	3.142	3000.0	0.0005	3.819
98.76	238.1	3.142	3000.0	0.0005	3.819
98.54	240.1	3.142	3000.0	0.0005	3.819
98.32	242.0	3.142	3000.0	0.0005	3.820
98.10	244.0	3.142	3000.0	0.0005	3.820
97.88	245.9	3.142	3000.0	0.0005	3.821
97.66	247.8	3.142	3000.0	0.0005	3.821
97.43	249.8	3.142	3000.0	0.0005	3.822
97.21	251.7	3.142	3000.0	0.0005	3.822
96.99	253.7	3.142	3000.0	0.0005	3.823
96.77	255.6	3.142	3000.0	0.0005	3.823
96.55	257.5	3.142	3000.0	0.0005	3.824
96.33	259.5	3.142	3000.0	0.0005	3.824
96.11	261.4	3.142	3000.0	0.0005	3.825
95.89	263.3	3.142	3000.0	0.0005	3.825
95.67	265.3	3.142	3000.0	0.0005	3.826
95.45	267.2	3.142	3000.0	0.0005	3.826
95.23	269.2	3.142	3000.0	0.0005	3.827
95.01	271.1	3.142	3000.0	0.0005	3.827
94.79	273.0	3.142	3000.0	0.0005	3.828
94.57	275.0	3.142	3000.0	0.0005	3.829
94.35	276.9	3.142	3000.0	0.0005	3.829
94.13	278.9	3.142	3000.0	0.0005	3.830
93.91	280.8	3.142	3000.0	0.0005	3.830
93.69	282.7	3.142	3000.0	0.0006	3.831
93.47	284.7	3.142	3000.0	0.0006	3.831
93.25	286.6	3.142	3000.0	0.0006	3.832
93.03	288.6	3.142	3000.0	0.0006	3.832
92.81	290.5	3.142	3000.0	0.0006	3.833
92.59	292.4	3.142	3000.0	0.0006	3.834
92.36	294.4	3.142	3000.0	0.0006	3.834
92.14	296.3	3.142	3000.0	0.0006	3.835
91.92	298.2	3.142	3000.0	0.0006	3.835
91.70	300.2	3.142	3000.0	0.0006	3.836
91.48	302.1	3.142	3000.0	0.0006	3.836
91.26	304.1	3.142	3000.0	0.0006	3.837
91.04	306.0	3.142	3000.0	0.0006	3.838
90.82	307.9	3.142	3000.0	0.0006	3.838
90.60	309.9	3.142	3000.0	0.0006	3.839
90.38	311.8	3.142	3000.0	0.0006	3.839
90.16	313.8	3.142	3000.0	0.0006	3.840

89.94	315.7	3.142	3000.0	0.0006	3.841
89.72	317.6	3.142	3000.0	0.0006	3.841
89.50	319.6	3.142	3000.0	0.0006	3.842
89.28	321.5	3.142	3000.0	0.0006	3.843
89.06	323.5	3.142	3000.0	0.0006	3.843
88.84	325.4	3.142	3000.0	0.0006	3.844
88.62	327.3	3.142	3000.0	0.0006	3.844
88.40	329.3	3.142	3000.0	0.0006	3.845
88.18	331.2	3.142	3000.0	0.0006	3.846
87.96	333.1	3.142	3000.0	0.0006	3.846
87.74	335.1	3.142	3000.0	0.0007	3.847
87.52	337.0	3.142	3000.0	0.0007	3.848
87.29	339.0	3.142	3000.0	0.0007	3.848
87.07	340.9	3.142	3000.0	0.0007	3.849
86.85	342.8	3.142	3000.0	0.0007	3.850
86.63	344.8	3.142	3000.0	0.0007	3.850
86.41	346.7	3.142	3000.0	0.0007	3.851
86.19	348.7	3.142	3000.0	0.0007	3.852
85.97	350.6	3.142	3000.0	0.0007	3.852
85.75	352.5	3.142	3000.0	0.0007	3.853
85.53	354.5	3.142	3000.0	0.0007	3.854
85.31	356.4	3.142	3000.0	0.0007	3.854
85.09	358.3	3.142	3000.0	0.0007	3.855
84.87	360.3	3.142	3000.0	0.0007	3.856
84.65	362.2	3.142	3000.0	0.0007	3.857
84.43	364.2	3.142	3000.0	0.0007	3.857
84.21	366.1	3.142	3000.0	0.0007	3.858
83.99	368.0	3.142	3000.0	0.0007	3.859
83.77	370.0	3.142	3000.0	0.0007	3.859
83.55	371.9	3.142	3000.0	0.0007	3.860
83.33	373.9	3.142	3000.0	0.0007	3.861
83.11	375.8	3.142	3000.0	0.0007	3.862
82.89	377.7	3.142	3000.0	0.0007	3.862
82.67	379.7	3.142	3000.0	0.0007	3.863
82.44	381.6	3.142	3000.0	0.0007	3.864
82.22	383.6	3.142	3000.0	0.0007	3.865
82.00	385.5	3.142	3000.0	0.0008	3.865
81.78	387.4	3.142	3000.0	0.0008	3.866
81.56	389.4	3.142	3000.0	0.0008	3.867
81.34	391.3	3.142	3000.0	0.0008	3.868
81.12	393.2	3.142	3000.0	0.0008	3.868
80.90	395.2	3.142	3000.0	0.0008	3.869
80.68	397.1	3.142	3000.0	0.0008	3.870
80.46	399.1	3.142	3000.0	0.0008	3.871
80.24	401.0	3.142	3000.0	0.0008	3.871
80.02	402.9	3.142	3000.0	0.0008	3.872
79.80	404.9	3.142	3000.0	0.0008	3.873
79.58	406.8	3.142	3000.0	0.0008	3.874
79.36	408.8	3.142	3000.0	0.0008	3.875
79.14	410.7	3.142	3000.0	0.0008	3.875
78.92	412.6	3.142	3000.0	0.0008	3.876
78.70	414.6	3.142	3000.0	0.0008	3.877
78.48	416.5	3.142	3000.0	0.0008	3.878
78.26	418.5	3.142	3000.0	0.0008	3.879
78.04	420.4	3.142	3000.0	0.0008	3.879
77.82	422.3	3.142	3000.0	0.0008	3.880
77.60	424.3	3.142	3000.0	0.0008	3.881
77.37	426.2	3.142	3000.0	0.0008	3.882
77.15	428.1	3.142	3000.0	0.0008	3.883
76.93	430.1	3.142	3000.0	0.0008	3.884
76.71	432.0	3.142	3000.0	0.0008	3.884
76.49	434.0	3.142	3000.0	0.0008	3.885
76.27	435.9	3.142	3000.0	0.0008	3.886
76.05	437.8	3.142	3000.0	0.0009	3.887
75.83	439.8	3.142	3000.0	0.0009	3.888
75.61	441.7	3.142	3000.0	0.0009	3.889

75.39	443.7	3.142	3000.0	0.0009	3.890
75.17	445.6	3.142	3000.0	0.0009	3.890
74.95	447.5	3.142	3000.0	0.0009	3.891
74.73	449.5	3.142	3000.0	0.0009	3.892
74.51	451.4	3.142	3000.0	0.0009	3.893
74.29	453.3	3.142	3000.0	0.0009	3.894
74.07	455.3	3.142	3000.0	0.0009	3.895
73.85	457.2	3.142	3000.0	0.0009	3.896
73.63	459.2	3.142	3000.0	0.0009	3.897
73.41	461.1	3.142	3000.0	0.0009	3.898
73.19	463.0	3.142	3000.0	0.0009	3.898
72.97	465.0	3.142	3000.0	0.0009	3.899
72.75	466.9	3.142	3000.0	0.0009	3.900
72.53	468.9	3.142	3000.0	0.0009	3.901
72.30	470.8	3.142	3000.0	0.0009	3.902
72.08	472.7	3.142	3000.0	0.0009	3.903
71.86	474.7	3.142	3000.0	0.0009	3.904
71.64	476.6	3.142	3000.0	0.0009	3.905
71.42	478.6	3.142	3000.0	0.0009	3.906
71.20	480.5	3.142	3000.0	0.0009	3.907
70.98	482.4	3.142	3000.0	0.0009	3.908
70.76	484.4	3.142	3000.0	0.0009	3.909
70.54	486.3	3.142	3000.0	0.0009	3.910
70.32	488.2	3.142	3000.0	0.0010	3.911
70.10	490.2	3.142	3000.0	0.0010	3.911
69.88	492.1	3.142	3000.0	0.0010	3.912
69.66	494.1	3.142	3000.0	0.0010	3.913
69.44	496.0	3.142	3000.0	0.0010	3.914
69.22	497.9	3.142	3000.0	0.0010	3.915
69.00	499.9	3.142	3000.0	0.0010	3.916
68.78	501.8	3.142	3000.0	0.0010	3.917
68.56	503.8	3.142	3000.0	0.0010	3.918
68.34	505.7	3.142	3000.0	0.0010	3.919
68.12	507.6	3.142	3000.0	0.0010	3.920
67.90	509.6	3.142	3000.0	0.0010	3.921
67.68	511.5	3.142	3000.0	0.0010	3.922
67.45	513.5	3.142	3000.0	0.0010	3.923
67.23	515.4	3.142	3000.0	0.0010	3.924
67.01	517.3	3.142	3000.0	0.0010	3.925
66.79	519.3	3.142	3000.0	0.0010	3.926
66.57	521.2	3.142	3000.0	0.0010	3.927
66.35	523.1	3.142	3000.0	0.0010	3.928
66.13	525.1	3.142	3000.0	0.0010	3.929
65.91	527.0	3.142	3000.0	0.0010	3.930
65.69	529.0	3.142	3000.0	0.0010	3.931
65.47	530.9	3.142	3000.0	0.0010	3.932
65.25	532.8	3.142	3000.0	0.0010	3.933
65.03	534.8	3.142	3000.0	0.0010	3.935
64.81	536.7	3.142	3000.0	0.0010	3.936
64.59	538.7	3.142	3000.0	0.0010	3.937
64.37	540.6	3.142	3000.0	0.0011	3.938
64.15	542.5	3.142	3000.0	0.0011	3.939
63.93	544.5	3.142	3000.0	0.0011	3.940
63.71	546.4	3.142	3000.0	0.0011	3.941
63.49	548.3	3.142	3000.0	0.0011	3.942
63.27	550.3	3.142	3000.0	0.0011	3.943
63.05	552.2	3.142	3000.0	0.0011	3.944
62.83	554.2	3.142	3000.0	0.0011	3.945
62.61	556.1	3.142	3000.0	0.0011	3.946
62.38	558.0	3.142	3000.0	0.0011	3.947
62.16	560.0	3.142	3000.0	0.0011	3.948
61.94	561.9	3.142	3000.0	0.0011	3.949
61.72	563.9	3.142	3000.0	0.0011	3.951
61.50	565.8	3.142	3000.0	0.0011	3.952
61.28	567.7	3.142	3000.0	0.0011	3.953
61.06	569.7	3.142	3000.0	0.0011	3.954

60.84	571.6	3.142	3000.0	0.0011	3.955
60.62	573.6	3.142	3000.0	0.0011	3.956
60.40	575.5	3.142	3000.0	0.0011	3.957
60.18	577.4	3.142	3000.0	0.0011	3.958
59.96	579.4	3.142	3000.0	0.0011	3.960
59.74	581.3	3.142	3000.0	0.0011	3.961
59.52	583.2	3.142	3000.0	0.0011	3.962
59.30	585.2	3.142	3000.0	0.0011	3.963
59.08	587.1	3.142	3000.0	0.0011	3.964
58.86	589.1	3.142	3000.0	0.0011	3.965
58.64	591.0	3.142	3000.0	0.0012	3.966
58.42	592.9	3.142	3000.0	0.0012	3.968
58.20	594.9	3.142	3000.0	0.0012	3.969
57.98	596.8	3.142	3000.0	0.0012	3.970
57.76	598.8	3.142	3000.0	0.0012	3.971
57.54	600.7	3.142	3000.0	0.0012	3.972
57.31	602.6	3.142	3000.0	0.0012	3.973
57.09	604.6	3.142	3000.0	0.0012	3.975
56.87	606.5	3.142	3000.0	0.0012	3.976
56.65	608.5	3.142	3000.0	0.0012	3.977
56.43	610.4	3.142	3000.0	0.0012	3.978
56.21	612.3	3.142	3000.0	0.0012	3.979
55.99	614.3	3.142	3000.0	0.0012	3.980
55.77	616.2	3.142	3000.0	0.0012	3.982
55.55	618.1	3.142	3000.0	0.0012	3.983
55.33	620.1	3.142	3000.0	0.0012	3.984
55.11	622.0	3.142	3000.0	0.0012	3.985
54.89	624.0	3.142	3000.0	0.0012	3.987
54.67	625.9	3.142	3000.0	0.0012	3.988
54.45	627.8	3.142	3000.0	0.0012	3.989
54.23	629.8	3.142	3000.0	0.0012	3.990
54.01	631.7	3.142	3000.0	0.0012	3.991
53.79	633.7	3.142	3000.0	0.0012	3.993
53.57	635.6	3.142	3000.0	0.0012	3.994
53.35	637.5	3.142	3000.0	0.0012	3.995
53.13	639.5	3.142	3000.0	0.0012	3.996
52.91	641.4	3.142	3000.0	0.0013	3.998
52.69	643.3	3.142	3000.0	0.0013	3.999
52.46	645.3	3.142	3000.0	0.0013	4.000
52.24	647.2	3.142	3000.0	0.0013	4.001
52.02	649.2	3.142	3000.0	0.0013	4.003
51.80	651.1	3.142	3000.0	0.0013	4.004
51.58	653.0	3.142	3000.0	0.0013	4.005
51.36	655.0	3.142	3000.0	0.0013	4.007
51.14	656.9	3.142	3000.0	0.0013	4.008
50.92	658.9	3.142	3000.0	0.0013	4.009
50.70	660.8	3.142	3000.0	0.0013	4.010
50.48	662.7	3.142	3000.0	0.0013	4.012
50.26	664.7	3.142	3000.0	0.0013	4.013
50.04	666.6	3.142	3000.0	0.0013	4.014
49.82	668.4	3.142	3000.0	0.0013	4.016
49.60	670.1	3.142	3000.0	0.0013	4.017
49.38	671.9	3.142	3000.0	0.0013	4.018
49.16	673.6	3.142	3000.0	0.0013	4.019
48.94	675.4	3.142	3000.0	0.0013	4.021
48.72	677.2	3.142	3000.0	0.0013	4.022
48.50	678.9	3.142	3000.0	0.0013	4.023
48.28	680.7	3.142	3000.0	0.0013	4.025
48.06	682.4	3.142	3000.0	0.0013	4.026
47.84	684.2	3.142	3000.0	0.0013	4.027
47.62	685.9	3.142	3000.0	0.0013	4.029
47.39	687.7	3.142	3000.0	0.0013	4.030
47.17	689.5	3.142	3000.0	0.0013	4.031
46.95	691.2	3.142	3000.0	0.0013	4.033
46.73	693.0	3.142	3000.0	0.0014	4.034
46.51	694.7	3.142	3000.0	0.0014	4.036

46.29	696.5	3.142	3000.0	0.0014	4.037
46.07	698.2	3.142	3000.0	0.0014	4.038
45.85	700.0	3.142	3000.0	0.0014	4.040
45.63	701.8	3.142	3000.0	0.0014	4.041
45.41	703.5	3.142	3000.0	0.0014	4.042
45.19	705.3	3.142	3000.0	0.0014	4.044
44.97	707.2	3.142	3000.0	0.0014	4.045
44.75	709.1	3.142	3000.0	0.0014	4.046
44.53	711.1	3.142	3000.0	0.0014	4.048
44.31	713.0	3.142	3000.0	0.0014	4.049
44.09	715.0	3.142	3000.0	0.0014	4.051
43.87	716.9	3.142	3000.0	0.0014	4.052
43.65	718.8	3.142	3000.0	0.0014	4.053
43.43	720.8	3.142	3000.0	0.0014	4.055
43.21	722.7	3.142	3000.0	0.0014	4.056
42.99	724.7	3.142	3000.0	0.0014	4.058
42.77	726.6	3.142	3000.0	0.0014	4.059
42.55	728.5	3.142	3000.0	0.0014	4.060
42.32	730.5	3.142	3000.0	0.0014	4.062
42.10	732.4	3.142	3000.0	0.0014	4.063
41.88	734.4	3.142	3000.0	0.0014	4.065
41.66	736.3	3.142	3000.0	0.0014	4.066
41.44	738.2	3.142	3000.0	0.0014	4.068
41.22	740.2	3.142	3000.0	0.0014	4.069
41.00	742.1	3.142	3000.0	0.0014	4.071
40.78	744.0	3.142	3000.0	0.0015	4.072
40.56	746.0	3.142	3000.0	0.0015	4.073
40.34	747.9	3.142	3000.0	0.0015	4.075
40.12	749.9	3.142	3000.0	0.0015	4.076
39.90	751.8	3.142	3000.0	0.0015	4.078
39.68	753.7	3.142	3000.0	0.0015	4.079
39.46	755.7	3.142	3000.0	0.0015	4.081
39.24	757.6	3.142	3000.0	0.0015	4.082
39.02	759.5	3.142	3000.0	0.0015	4.084
38.80	761.4	3.142	3000.0	0.0015	4.085
38.58	763.3	3.142	3000.0	0.0015	4.087
38.36	765.2	3.142	3000.0	0.0015	4.088
38.14	767.1	3.142	3000.0	0.0015	4.090
37.92	769.0	3.142	3000.0	0.0015	4.091
37.70	770.9	3.142	3000.0	0.0015	4.093
37.47	772.7	3.142	3000.0	0.0015	4.094
37.25	774.6	3.142	3000.0	0.0015	4.096
37.03	776.5	3.142	3000.0	0.0015	4.097
36.81	778.3	3.142	3000.0	0.0015	4.099
36.59	780.2	3.142	3000.0	0.0015	4.100
36.37	782.0	3.142	3000.0	0.0015	4.102
36.15	783.8	3.142	3000.0	0.0015	4.103
35.93	785.7	3.142	3000.0	0.0015	4.105
35.71	787.5	3.142	3000.0	0.0015	4.106
35.49	789.3	3.142	3000.0	0.0015	4.108
35.27	791.1	3.142	3000.0	0.0015	4.109
35.05	792.9	3.142	3000.0	0.0015	4.111
34.83	794.7	3.142	3000.0	0.0015	4.113
34.61	796.5	3.142	3000.0	0.0016	4.114
34.39	798.3	3.142	3000.0	0.0016	4.116
34.17	800.1	3.142	3000.0	0.0016	4.117
33.95	801.8	3.142	3000.0	0.0016	4.119
33.73	803.6	3.142	3000.0	0.0016	4.120
33.51	805.4	3.142	3000.0	0.0016	4.122
33.29	807.1	3.142	3000.0	0.0016	4.123
33.07	808.9	3.142	3000.0	0.0016	4.125
32.85	810.6	3.142	3000.0	0.0016	4.127
32.63	812.4	3.142	3000.0	0.0016	4.128
32.40	814.1	3.142	3000.0	0.0016	4.130
32.18	815.8	3.142	3000.0	0.0016	4.131
31.96	817.5	3.142	3000.0	0.0016	4.133

31.74	819.2	3.142	3000.0	0.0016	4.135
31.52	821.0	3.142	3000.0	0.0016	4.136
31.30	822.7	3.142	3000.0	0.0016	4.138
31.08	824.3	3.142	3000.0	0.0016	4.139
30.86	826.0	3.142	3000.0	0.0016	4.141
30.64	827.7	3.142	3000.0	0.0016	4.143
30.42	829.4	3.142	3000.0	0.0016	4.144
30.20	831.1	3.142	3000.0	0.0016	4.146
29.98	832.7	3.142	3000.0	0.0016	4.147
29.76	834.4	3.142	3000.0	0.0016	4.149
29.54	836.0	3.142	3000.0	0.0016	4.151
29.32	837.7	3.142	3000.0	0.0016	4.152
29.10	839.3	3.142	3000.0	0.0016	4.154
28.88	841.0	3.142	3000.0	0.0016	4.156
28.66	842.6	3.142	3000.0	0.0016	4.157
28.44	844.2	3.142	3000.0	0.0016	4.159
28.22	845.8	3.142	3000.0	0.0016	4.161
28.00	847.4	3.142	3000.0	0.0017	4.162
27.78	849.0	3.142	3000.0	0.0017	4.164
27.56	850.6	3.142	3000.0	0.0017	4.166
27.33	852.2	3.142	3000.0	0.0017	4.167
27.11	853.8	3.142	3000.0	0.0017	4.169
26.89	855.4	3.142	3000.0	0.0017	4.171
26.67	857.0	3.142	3000.0	0.0017	4.172
26.45	858.5	3.142	3000.0	0.0017	4.174
26.23	860.1	3.142	3000.0	0.0017	4.176
26.01	861.6	3.142	3000.0	0.0017	4.177
25.79	863.2	3.142	3000.0	0.0017	4.179
25.57	864.7	3.142	3000.0	0.0017	4.181
25.35	866.3	3.142	3000.0	0.0017	4.182
25.13	867.8	3.142	3000.0	0.0017	4.184
24.91	868.1	3.142	3000.0	0.0017	4.186
24.69	868.5	3.142	3000.0	0.0017	4.187
24.47	868.8	3.142	3000.0	0.0017	4.189
24.25	869.2	3.142	3000.0	0.0017	4.191
24.03	869.5	3.142	3000.0	0.0017	4.192
23.81	869.9	3.142	3000.0	0.0017	4.194
23.59	870.2	3.142	3000.0	0.0017	4.196
23.37	870.6	3.142	3000.0	0.0017	4.198
23.15	870.9	3.142	3000.0	0.0017	4.199
22.93	871.3	3.142	3000.0	0.0017	4.201
22.71	871.6	3.142	3000.0	0.0017	4.203
22.48	871.9	3.142	3000.0	0.0017	4.204
22.26	872.3	3.142	3000.0	0.0017	4.206
22.04	872.6	3.142	3000.0	0.0017	4.208
21.82	873.0	3.142	3000.0	0.0017	4.209
21.60	873.3	3.142	3000.0	0.0017	4.211
21.38	873.7	3.142	3000.0	0.0017	4.213
21.16	874.0	3.142	3000.0	0.0017	4.215
20.94	874.4	3.142	3000.0	0.0017	4.216
20.72	874.7	3.142	3000.0	0.0017	4.218
20.50	875.1	3.142	3000.0	0.0017	4.220
20.28	875.4	3.142	3000.0	0.0017	4.221
20.06	875.8	3.142	3000.0	0.0017	4.223
19.84	876.1	3.142	3000.0	0.0017	4.225
19.62	876.4	3.142	3000.0	0.0017	4.226
19.40	876.8	3.142	3000.0	0.0017	4.228
19.18	877.1	3.142	3000.0	0.0017	4.230
18.96	877.5	3.142	3000.0	0.0017	4.232
18.74	877.8	3.142	3000.0	0.0017	4.233
18.52	878.2	3.142	3000.0	0.0017	4.235
18.30	878.5	3.142	3000.0	0.0017	4.237
18.08	878.9	3.142	3000.0	0.0017	4.238
17.86	879.2	3.142	3000.0	0.0017	4.240
17.64	879.6	3.142	3000.0	0.0017	4.242
17.41	879.9	3.142	3000.0	0.0017	4.244

17.19	880.3	3.142	3000.0	0.0017	4.245
16.97	880.6	3.142	3000.0	0.0017	4.247
16.75	880.9	3.142	3000.0	0.0017	4.249
16.53	881.3	3.142	3000.0	0.0017	4.250
16.31	881.6	3.142	3000.0	0.0017	4.252
16.09	882.0	3.142	3000.0	0.0017	4.254
15.87	882.3	3.142	3000.0	0.0017	4.256
15.65	882.7	3.142	3000.0	0.0017	4.257
15.43	883.0	3.142	3000.0	0.0017	4.259
15.21	883.4	3.142	3000.0	0.0017	4.261
14.99	884.8	3.142	3000.0	0.0017	4.263
14.77	886.1	3.142	3000.0	0.0017	4.264
14.55	887.5	3.142	3000.0	0.0017	4.266
14.33	888.9	3.142	3000.0	0.0017	4.268
14.11	890.3	3.142	3000.0	0.0017	4.269
13.89	891.7	3.142	3000.0	0.0017	4.271
13.67	893.1	3.142	3000.0	0.0017	4.273
13.45	894.5	3.142	3000.0	0.0017	4.275
13.23	895.8	3.142	3000.0	0.0017	4.276
13.01	897.2	3.142	3000.0	0.0017	4.278
12.79	898.6	3.142	3000.0	0.0018	4.280
12.57	900.0	3.142	3000.0	0.0018	4.282
12.34	901.4	3.142	3000.0	0.0018	4.283
12.12	902.8	3.142	3000.0	0.0018	4.285
11.90	904.2	3.142	3000.0	0.0018	4.287
11.68	905.5	3.142	3000.0	0.0018	4.289
11.46	906.9	3.142	3000.0	0.0018	4.290
11.24	908.3	3.142	3000.0	0.0018	4.292
11.02	909.7	3.142	3000.0	0.0018	4.294
10.80	911.1	3.142	3000.0	0.0018	4.296
10.58	912.5	3.142	3000.0	0.0018	4.298
10.36	913.8	3.142	3000.0	0.0018	4.299
10.14	915.2	3.142	3000.0	0.0018	4.301
9.92	916.6	3.142	3000.0	0.0018	4.303
9.70	918.0	3.142	3000.0	0.0018	4.305
9.48	919.4	3.142	3000.0	0.0018	4.307
9.26	920.8	3.142	3000.0	0.0018	4.308
9.04	922.2	3.142	3000.0	0.0018	4.310
8.82	923.5	3.142	3000.0	0.0018	4.312
8.60	924.9	3.142	3000.0	0.0018	4.314
8.38	926.3	3.142	3000.0	0.0018	4.316
8.16	927.7	3.142	3000.0	0.0018	4.317
7.94	929.1	3.142	3000.0	0.0018	4.319
7.72	930.5	3.142	3000.0	0.0018	4.321
7.49	931.9	3.142	3000.0	0.0018	4.323
7.27	933.2	3.142	3000.0	0.0018	4.325
7.05	934.6	3.142	3000.0	0.0018	4.326
6.83	936.0	3.142	3000.0	0.0018	4.328
6.61	937.4	3.142	3000.0	0.0018	4.330
6.39	938.8	3.142	3000.0	0.0018	4.332
6.17	940.2	3.142	3000.0	0.0018	4.334
5.95	941.5	3.142	3000.0	0.0018	4.336
5.73	942.9	3.142	3000.0	0.0018	4.337
5.51	944.3	3.142	3000.0	0.0018	4.339
5.29	945.7	3.142	3000.0	0.0018	4.341
5.07	947.1	3.142	3000.0	0.0018	4.343
4.85	948.5	3.142	3000.0	0.0018	4.345
4.63	949.9	3.142	3000.0	0.0019	4.347
4.41	951.2	3.142	3000.0	0.0019	4.348
4.19	952.6	3.142	3000.0	0.0019	4.350
3.97	954.0	3.142	3000.0	0.0019	4.352
3.75	955.4	3.142	3000.0	0.0019	4.354
3.53	956.8	3.142	3000.0	0.0019	4.356
3.31	958.2	3.142	3000.0	0.0019	4.358
3.09	959.6	3.142	3000.0	0.0019	4.360
2.87	960.9	3.142	3000.0	0.0019	4.362

2.65	962.3	3.142	3000.0		0.0019	4.363
2.42	963.7	3.142	3000.0		0.0019	4.365
2.20	965.1	3.142	3000.0		0.0019	4.367
1.98	966.5	3.142	3000.0		0.0019	4.369
1.76	967.9	3.142	3000.0		0.0019	4.371
1.54	969.3	3.142	3000.0		0.0019	4.373
1.32	970.6	3.142	3000.0		0.0019	4.375
1.10	972.0	3.142	3000.0		0.0019	4.377
0.88	973.4	3.142	3000.0		0.0019	4.379
0.66	974.8	3.142	3000.0		0.0019	4.380
0.44	976.2	3.142	3000.0		0.0019	4.382
0.22	977.6	3.142	3000.0		0.0019	4.384
0.00	978.9	3.142	3000.0		0.0019	4.386

LOAD - SETTLEMENT RELATION (from t-z, and q-w curves):
Based on Vesic Method (1977)

Xall -in	Qtip -kp	Qside -kp	Qtotal -kp
0.006099	0.1	16.2	16.4
0.293557	2.5	566.8	569.3
0.383112	3.6	685.1	688.7
0.454502	4.8	764.0	768.8
0.513476	6.0	819.3	825.3
0.563530	7.2	859.1	866.3
0.606961	8.3	888.2	896.6
0.645368	9.5	909.6	919.1
0.679915	10.7	925.3	936.0
0.711477	11.8	936.8	948.6
0.740729	13.0	945.0	958.0
0.768197	14.2	950.7	964.9
0.794294	15.3	954.6	969.9
0.819346	16.4	957.0	973.4
0.843609	17.6	958.3	975.9
0.867278	18.7	958.8	977.5
0.890503	19.8	958.7	978.5
0.913391	20.9	958.0	978.9
0.936017	22.0	956.9	978.9
0.958429	23.1	955.5	978.6
0.980657	24.2	953.6	977.8
1.002710	25.2	951.5	976.7
1.024592	26.3	949.1	975.4
1.046300	27.3	946.4	973.7
1.067839	28.4	943.4	971.8
1.089218	29.4	940.4	969.7
1.110424	30.4	937.1	967.5
1.131452	31.4	933.7	965.1
1.152316	32.4	930.2	962.6
1.173033	33.3	926.6	959.9
1.193618	34.3	922.8	957.1
1.214123	35.2	919.1	954.3
1.234598	36.2	915.4	951.6
1.255109	37.1	911.8	948.9
1.275730	38.0	908.5	946.5
1.296541	38.9	905.5	944.4
1.317638	39.8	902.9	942.7
1.339099	40.7	900.8	941.5
1.361022	41.5	899.3	940.8
1.383932	42.3	898.9	941.3
1.406152	43.2	897.8	940.9
1.428362	44.0	896.6	940.6
1.450562	44.8	895.5	940.3
1.472752	45.6	894.4	940.0
1.494934	46.4	893.4	939.7
1.517105	47.1	892.4	939.5
1.539268	47.9	891.4	939.2

1.561422	48.6	890.4	939.0
1.583568	49.3	889.5	938.8
1.605704	50.1	888.5	938.6
1.627829	50.8	887.6	938.4
1.649945	51.5	886.7	938.2
1.672052	52.1	885.8	937.9
1.694145	52.8	884.8	937.6
1.716225	53.5	883.7	937.2
1.738290	54.1	882.5	936.6
1.760338	54.7	881.3	936.0
1.782370	55.3	880.2	935.6
1.804396	56.0	879.2	935.1
1.826415	56.6	878.2	934.7
1.848434	57.1	877.3	934.4
1.870454	57.7	876.5	934.2
1.892463	58.3	875.6	933.9
1.914466	58.8	874.8	933.6
1.936466	59.4	874.0	933.4
1.958451	59.9	873.2	933.1
1.980430	60.5	872.3	932.8
2.002402	61.0	871.5	932.5
2.024363	61.5	870.7	932.2
2.046318	62.0	869.9	931.9
2.068265	62.5	869.0	931.5
2.090204	63.0	868.2	931.2
2.112136	63.4	867.4	930.8
2.134058	63.9	866.6	930.5
2.155979	64.4	865.7	930.1
2.177890	64.8	864.9	929.7
2.199789	65.3	864.1	929.4
2.221689	65.7	863.3	929.0
2.243581	66.1	862.4	928.6
2.265468	66.6	861.6	928.2
2.287346	67.0	860.8	927.8
2.309220	67.4	860.0	927.4
2.331088	67.8	859.1	926.9
2.352950	68.2	858.3	926.5
2.374807	68.6	857.5	926.1
2.396659	69.0	856.7	925.7
2.418506	69.4	855.8	925.2
2.440348	69.7	855.0	924.8
2.462187	70.1	854.2	924.3
2.484020	70.5	853.4	923.9
2.505852	70.8	852.5	923.4
2.527674	71.2	851.7	922.9
2.549495	71.5	850.9	922.5
2.571310	71.9	850.1	922.0
2.702132	73.9	845.1	919.0
3.137424	79.7	828.7	908.4
3.571583	84.2	812.3	896.5
4.004045	86.8	795.9	882.7
4.433840	86.5	779.5	866.0
4.860473	82.6	763.2	845.7

At Qwork= 975.00-kp Settlement= 0.83467-in
At Qwork= 975.00-kp Secant Stiffness Kqx= 1168.13-kp/-in
At Xallow= 1.00-in Qallow= 976.87-kp
Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.

SUMMARY:
Total Ultimate Capacity (Down)= 978.948-kp Total Ultimate Capacity (Up)= 622.013-kp
Total Allowable Capacity (Down)= 326.316-kp Total Allowable Capacity (Up)= 230.267-kp

Weight above Ground= 0.00 Total Pile Weight= 34.39-kp
*Soil Weight is not included
Side Resistance (Down)= 908.260-kp Side Resistance (Up)= 587.619-kp
Tip Resistance (Down)= 70.688-kp Tip Resistance (Up)= 0.000-kp
Negative Friction, Qneg= 0.000-kp, which has been subtracted from Total Ultimate Capacity (Down)
Negative friction does not affect Total Uplift Ultimate Capacity (Up)

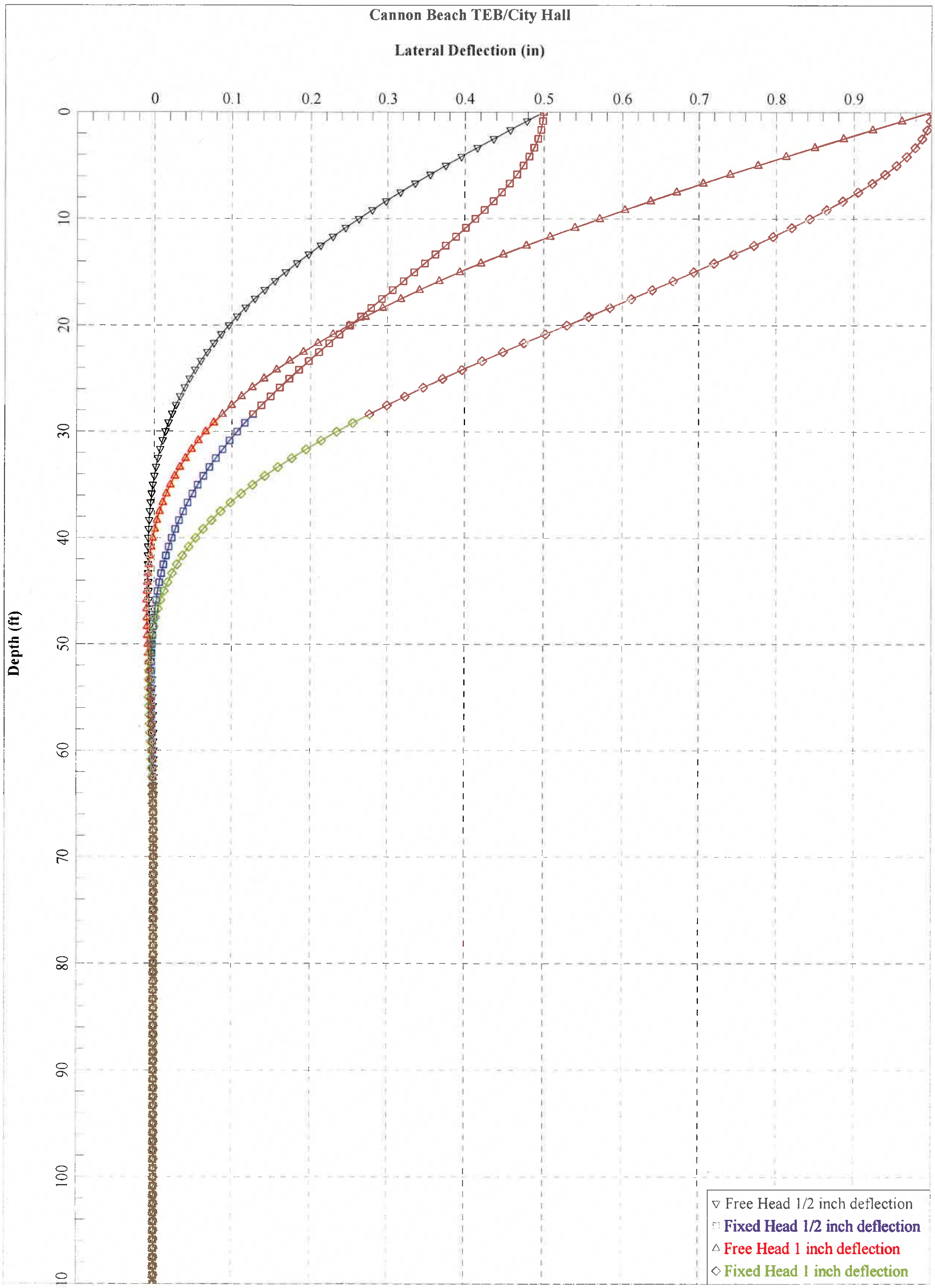
N/G! Qallow < Q * Vertical Load, Q= 975.0 -kp

FACTOR OF SAFETY:

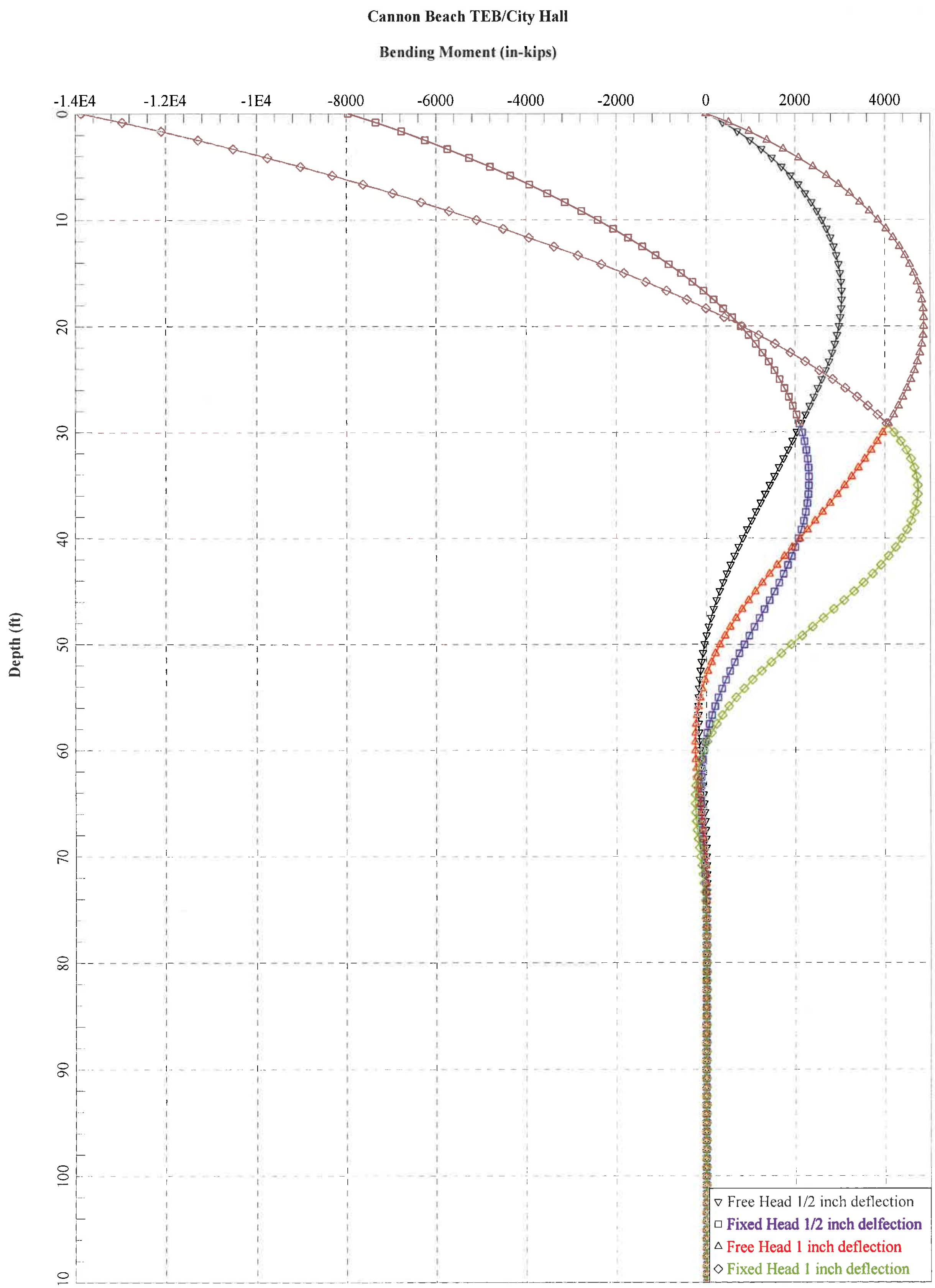
FSside	FStip	FSup	FSweight
3.0	3.0	3.0	1.0

Notes:
* Settlement in the program is Elastic Settlement only. Consolidation Settlement is not calculated!
Length - Pile length, distance from pile top to tip (not from ground surface)

Width or D - Width of pile shaft (pile diameter)
Ds and Dl - Short Side and Long Side of Footing
Area - Section area of pile shaft or tip area of pile
Sv - Vertical stress in soils (It may be limited based on critical depth, Z_lim or Z/D
qult - Ultimate tip resistance (pressure)
Qtip_dw - Ultimate downward tip resistance (Force or Capacity)
Qtip_up - Ultimate uplift tip resistance for belled pile or uplift plate (Force or Capacity)
dz - Small Segment of Depth for Calculation
Zs - Soil Depth, Depth from ground surface
Zp - Pile Depth, Depth from pile top
Prem - Primer of pile shaft
Phi - Soil internal friction angle (between soils)
Kf - Friction factor to convert Phi to Delta
Delta - Ski friction between soil and pile (function of Phi. It is different from Phi)
f_dw - Resistance between soil and pile from Delta
f_up - Resistance between soil and pile from Delta
C - Soil cohesion (between soils)
Ca - Adhesion between soil and pile (function of C. It is different from C) Ca=KaKcC
Ka - Adhesion ratio, C/Ca
Kc - Adhesion factor defended by users
Ca_dw - Downward adhesion between pile and soil
Ca_up - Uplift adhesion between pile and soil
Sf_dw - Downward side resistance (sum of friction and adhesion, f_dw + Ca_dw)
Sf_up - Uplift side resistance (sum of friction and adhesion, f_up + Ca_up)
Weight - Weight of Pile shaft
Qneg - negative friction Resistance
Qside - Ultimate side resistance (Qside_dw or Qside_up)
Qtip - Ultimate tip resistance (Qtip_dw or Qtip_up for uplift plate)
Q_dw - Ultimate downward capacity (Qtip + Qside_dw)
Q_up - Ultimate uplift capacity (Weight + Qside_up)
E - Elastic modules
dXs - Axial deformation of pile shaft in each segment, dz
Xs - Settlement due to axial deformation of pile shaft
Xpp - Settlement due to point load from pile tip
Xps- Settlement due to load from pile shaft
Xall - Total Settlement, Xs + Xpp + Xps
Xallow - Allowable settlement specified by users
Qwork - Vertical working load applied to pile
Qallow - Vertical allowable load, Qult/F.S.

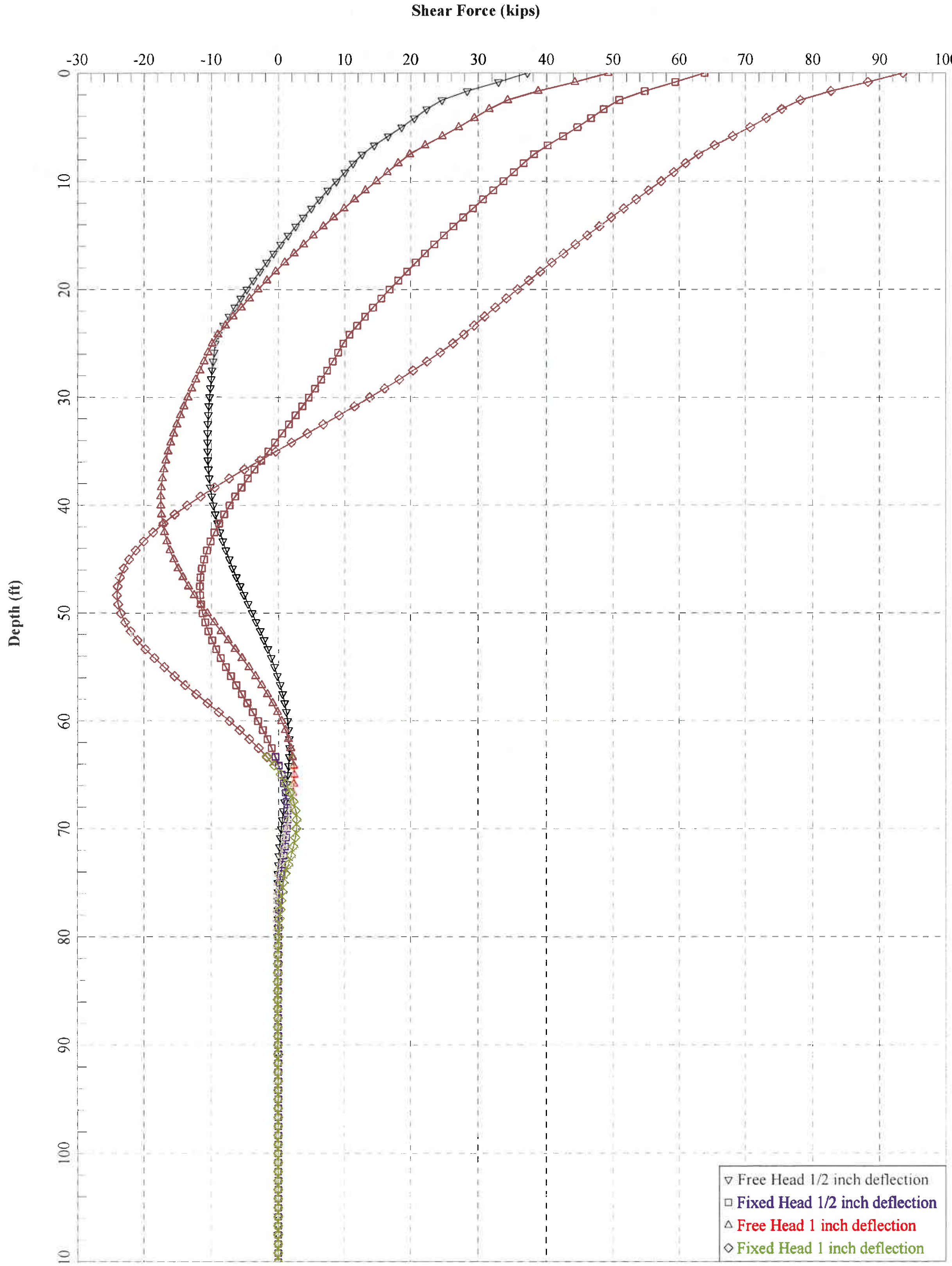


Cannon Beach TEB/City Hall
Lateral Deflection (in)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
Free Head 1/2 inch deflection
Fixed Head 1/2 inch deflection
Free Head 1 inch deflection
Fixed Head 1 inch deflection



Cannon Beach TEB/City Hall
Bending Moment (in-kips)
-1.4E4
-1.2E4
-1E4
-8000
-6000
-4000
-2000
0
2000
4000
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
Free Head 1/2 inch deflection
Fixed Head 1/2 inch delfection
Free Head 1 inch deflection
Fixed Head 1 inch deflection

Cannon Beach TEB/City Hall



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LPILE Plus for Windows, Version 5.0 (5.0.46)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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This program is licensed to:

Marcella Boyer
Chinook GeoServices, Inc.

Files Used for Analysis

Path to file locations: P:\2011 Projects\11-022 (Cannon Beach TEB)\Pile Analysis\Lpile\
Name of input data file: Conc24.lpd
Name of output file: Conc24.lpo
Name of plot output file: Conc24.lpp
Name of runtime file: Conc24.lpr

Time and Date of Analysis

Date: April 28, 2011 Time: 15:47:47

Problem Title

TEB/City Hall, Cannon Beach 2 ft dia concrete

Program Options

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile

- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments = 132
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 1320.00 in

Depth of ground surface below top of pile = 0.00 in

Slope angle of ground surface = 0.00 deg.

Structural properties of pile defined using 2 points

Point No.	Point Depth in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	24.00000000	16286.0000	452.0000	30000000.
2	1320.0000	24.00000000	16286.0000	452.0000	30000000.

Soil and Rock Layering Information

The soil profile is modelled using 8 layers

Layer 1 is stiff clay without free water
Distance from top of pile to top of layer = 0.000 in
Distance from top of pile to bottom of layer = 30.000 in

Layer 2 is stiff clay without free water
Distance from top of pile to top of layer = 30.000 in
Distance from top of pile to bottom of layer = 90.000 in

Layer 3 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 90.000 in
Distance from top of pile to bottom of layer = 180.000 in

Layer 4 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 180.000 in
Distance from top of pile to bottom of layer = 252.000 in

Layer 5 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 252.000 in
Distance from top of pile to bottom of layer = 300.000 in

Layer 6 is liquefiable sand, by Rollins et al, 2004
Distance from top of pile to top of layer = 300.000 in
Distance from top of pile to bottom of layer = 900.000 in

Warning : The depth of this layer is deeper than the recommended depth limit

for using the p-y criteria for liquefied sand.
Please consult the LPile Technical Manual for additional background information regarding limitations on the use of the liquefied sand criteria.

Layer 7 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 900.000 in
Distance from top of pile to bottom of layer = 1200.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 8 is stiff clay without free water
Distance from top of pile to top of layer = 1200.000 in
Distance from top of pile to bottom of layer = 1440.000 in

(Depth of lowest layer extends 120.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 16 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	0.00	0.06076
2	30.00	0.06076
3	30.00	0.06076
4	90.00	0.06076
5	90.00	0.06076
6	180.00	0.06076
7	180.00	0.05787
8	252.00	0.05787
9	252.00	0.02176
10	300.00	0.02176
11	300.00	0.02465
12	900.00	0.02465
13	900.00	0.02465
14	1200.00	0.02465
15	1200.00	0.04491
16	1440.00	0.04491

Shear Strength of Soils

Shear strength parameters with depth defined using 16 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	0.000	10.00000	0.00	0.00500	0.0
2	30.000	10.00000	0.00	0.00500	0.0
3	30.000	5.00000	0.00	0.04000	0.0
4	90.000	5.00000	0.00	0.04000	0.0
5	90.000	2.00000	0.00	0.02000	0.0
6	180.000	2.00000	0.00	0.02000	0.0
7	180.000	2.00000	0.00	0.02000	0.0
8	252.000	2.00000	0.00	0.02000	0.0
9	252.000	2.00000	0.00	0.02000	0.0
10	300.000	2.00000	0.00	0.02000	0.0
11	300.000	0.00000	0.00	------	------

12	900.000	0.00000	0.00	------	------
13	900.000	0.00000	38.00	------	------
14	1200.000	0.00000	38.00	------	------
15	1200.000	15.00000	0.00	0.00500	0.0
16	1440.000	15.00000	0.00	0.00500	0.0

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

Loading Type

Static loading criteria was used for computation of p-y curves.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 4

Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 0.500 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 1100000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = 0.500 in
Slope at pile head = 0.000 in/in
Axial load at pile head = 1100000.000 lbs

Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 1.000 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 1100000.000 lbs

Load Case Number 4

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = 1.000 in
Slope at pile head = 0.000 in/in
Axial load at pile head = 1100000.000 lbs

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (Pile-head Condition

Type 4)
Specified deflection at pile head = 0.500000 in
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 1100000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in	Es*h F/L lbs/in
0.000	0.500000	0.0000	37185.2215	-0.0021226	2433.6283	-409.0390	4090.3897
10.000	0.478774	374749.	32935.4190	-0.0021187	2709.7540	-440.9215	9209.3825
20.000	0.457625	705321.	28371.5292	-0.0021077	2953.3292	-471.8564	10310.9802
30.000	0.436621	988548.	24622.3410	-0.0020904	3162.0195	-277.9812	6366.6548
40.000	0.415818	1243755.	22346.1725	-0.0020675	3350.0635	-177.2525	4262.7403
50.000	0.395270	1480957.	20521.7645	-0.0020396	3524.8406	-187.6291	4746.8549
60.000	0.375026	1699062.	18595.5057	-0.0020071	3685.5469	-197.6226	5269.5761
70.000	0.355129	1897023.	16571.2785	-0.0019703	3831.4100	-207.2228	5835.1451
80.000	0.335620	2073834.	14453.0676	-0.0019296	3961.6897	-216.4194	6448.3436
90.000	0.316536	2228536.	12613.5847	-0.0018856	4075.6788	-151.4772	4785.4659
100.000	0.297908	2367589.	11243.6883	-0.0018386	4178.1370	-122.5021	4112.0789
110.000	0.279764	2493859.	9993.5380	-0.0017888	4271.1762	-127.5280	4558.4064
120.000	0.262131	2606814.	8705.4553	-0.0017366	4354.4049	-130.0885	4962.7235
130.000	0.245032	2706174.	7419.0312	-0.0016823	4427.6160	-127.1963	5191.0097
140.000	0.228486	2792204.	6161.7167	-0.0016260	4491.0059	-124.2666	5438.6910
150.000	0.212512	2865180.	4933.8801	-0.0015681	4544.7763	-121.3007	5707.9424
160.000	0.197124	2925380.	3735.8785	-0.0015088	4589.1335	-118.2996	6001.2648
170.000	0.182336	2973091.	2568.0592	-0.0014485	4624.2889	-115.2643	6321.5476
180.000	0.168155	3008607.	1430.7602	-0.0013873	4650.4580	-112.1955	6672.1451
190.000	0.154590	3032226.	324.3123	-0.0013254	4667.8611	-109.0941	7056.9719
200.000	0.141646	3044253.	-750.9600	-0.0012632	4676.7228	-105.9604	7480.6248
210.000	0.129326	3044998.	-1794.7362	-0.0012009	4677.2720	-102.7949	7948.5358
220.000	0.117628	3034779.	-2806.6980	-0.0011387	4669.7419	-99.5975	8467.1717
230.000	0.106551	3013916.	-3786.5260	-0.0010768	4654.3697	-96.3681	9044.2928
240.000	0.096092	2982738.	-4733.8965	-0.0010154	4631.3968	-93.1060	9689.2975
250.000	0.086242	2941578.	-5648.4771	-0.0009548	4601.0688	-89.8101	10413.6841
260.000	0.076995	2890775.	-6529.9211	-0.0008951	4563.6354	-86.4787	

```
11231.6854
270.000   0.068340     2830672.   -7377.8601   -0.0008366    4519.3504     -83.1091
12161.1542
280.000   0.060264     2761622.   -8191.8946   -0.0007793    4468.4720     -79.6978
13224.8304
290.000   0.052753     2683980.   -8971.5811   -0.0007236    4411.2632     -76.2395
14452.2001
300.000   0.045791     2598110.   -9430.0334   -0.0006696    4347.9916     -15.4509
 3374.1990
310.000   0.039362     2510110.   -9583.2752   -0.0006173    4283.1505     -15.1974
 3860.9742
320.000   0.033446     2420025.   -9732.9913   -0.0005668    4216.7732     -14.7458
 4408.8856
330.000   0.028025     2327920.   -9877.1301   -0.0005182    4148.9080     -14.0820
 5024.7852
340.000   0.023081     2233884.  -10013.5061   -0.0004716    4079.6189     -13.1932
 5716.1147
350.000   0.018594     2138025.  -10139.8164   -0.0004268    4008.9872     -12.0688
 6490.7802
360.000   0.014544     2040477.  -10253.6606   -0.0003841    3937.1115     -10.7000
 7356.7785
370.000   0.010913     1941401.  -10352.5639   -0.0003433    3864.1089      -9.0806
 8321.1880
380.000   0.007678     1840979.  -10434.0062   -0.0003046    3790.1152      -7.2078
 9387.3084
390.000   0.004821     1739422.  -10495.4629   -0.0002680    3715.2849      -5.0835
10545.1442
400.000   0.002319     1636965.  -10534.4774   -0.0002334    3639.7916      -2.7194
11726.0968
410.000   0.000153     1533867.  -10548.9834   -0.0002010    3563.8263   -0.1817719
11912.6095
420.000  -0.001700     1430406.  -10536.5534   -0.0001706    3487.5931       2.6678
15692.7726
430.000  -0.003260     1326890.  -10492.8923   -0.0001424    3411.3193       6.0644
18603.6458
440.000  -0.004548     1223681.  -10413.5145   -0.0001163    3335.2721       9.8111
21572.1538
450.000  -0.005586     1121178.  -10295.3304  -9.2304E-05    3259.7449      13.8257
24751.3651
460.000  -0.006394     1019805.  -10136.0115  -7.0394E-05    3185.0504      18.0381
28210.3809
470.000  -0.006994      920006.   -9933.9202  -5.0542E-05    3111.5158      22.3802
32000.4314
480.000  -0.007405      822239.   -9688.1042  -3.2713E-05    3039.4777      26.7830
36168.9707
490.000  -0.007648      726964.   -9398.3057  -1.6859E-05    2969.2766      31.1767
40764.6603
500.000  -0.007742      634643.   -9064.9728  -2.9242E-06    2901.2520      35.4899
45839.8845
510.000  -0.007706      545729.   -8689.2653   9.1554E-06    2835.7372      39.6516
51452.4796
520.000  -0.007559      460657.   -8273.0529   1.9455E-05    2773.0535      43.5909
57667.2481
530.000  -0.007317      379840.   -7818.9033   2.8056E-05    2713.5053      47.2390
64557.5094
540.000  -0.006998      303661.   -7330.0593   3.5051E-05    2657.3748      50.5298
72206.8300
550.000  -0.006616      232467.   -6810.4046   4.0537E-05    2604.9171      53.4012
80711.0500
560.000  -0.006187      166561.   -6264.4167   4.4621E-05    2556.3556      55.7964
90180.7234
570.000  -0.005724      106197.   -5697.1089   4.7412E-05    2511.8777      57.6651
   100744.
580.000  -0.005239   51576.1302   -5113.9599   4.9027E-05    2471.6311      58.9647
   112551.
590.000  -0.004743    2839.6628   -4520.8325   4.9584E-05    2435.7207      59.6608
```

125777.

600.000	-0.004247	-39931.3604	-3923.8822	4.9204E-05	2463.0509	59.7292	140630.
610.000	-0.003759	-76720.4717	-3329.4574	4.8010E-05	2490.1582	59.1557	157358.
620.000	-0.003287	-107577.	-2743.9916	4.6124E-05	2512.8940	57.9374	176260.
630.000	-0.002837	-132615.	-2173.8905	4.3666E-05	2531.3429	56.0828	197696.
640.000	-0.002414	-152015.	-1625.4162	4.0753E-05	2545.6376	53.6121	222113.
650.000	-0.002022	-166020.	-1104.5698	3.7499E-05	2555.9567	50.5572	250066.
660.000	-0.001664	-174932.	-616.9780	3.4009E-05	2562.5230	46.9612	282260.
670.000	-0.001342	-179108.	-167.7839	3.0386E-05	2565.6001	42.8776	319610.
680.000	-0.001056	-178956.	238.4507	2.6722E-05	2565.4881	38.3693	363336.
690.000	-0.000807	-174927.	597.8268	2.3100E-05	2562.5193	33.5060	415129.
700.000	-0.000594	-167507.	907.1659	1.9596E-05	2557.0527	28.3619	477458.
710.000	-0.000415	-157214.	1164.0285	1.6273E-05	2549.4685	23.0106	554208.
720.000	-0.000269	-144585.	1366.6649	1.3184E-05	2540.1627	17.5166	652248.
730.000	-0.000152	-130171.	1513.8222	1.0373E-05	2529.5422	11.9148	786404.
740.000	-6.11E-05	-114537.	1604.1009	7.8684E-06	2518.0222	6.1409	1004985.
750.000	5.86E-06	-98262.2175	1630.0099	5.6907E-06	2506.0308	-0.9591394	1637411.
760.000	5.27E-05	-82061.6110	1592.0588	3.8453E-06	2494.0937	-6.6311	1258070.
770.000	8.28E-05	-66505.6372	1505.8067	2.3249E-06	2482.6316	-10.6193	1283102.
780.000	9.92E-05	-51996.6245	1384.9328	1.1122E-06	2471.9409	-13.5554	1366396.
790.000	0.000105	-38831.4494	1239.2139	1.8264E-07	2462.2405	-15.5883	1484516.
800.000	0.000103	-27216.3640	1077.2550	-4.9328E-07	2453.6821	-16.8035	1633646.
810.000	9.51E-05	-17275.4965	906.8649	-9.4859E-07	2446.3574	-17.2746	1815690.
820.000	8.39E-05	-9058.1976	735.1032	-1.2181E-06	2440.3027	-17.0777	2035810.
830.000	7.08E-05	-2546.6343	568.2386	-1.3368E-06	2435.5048	-16.2952	2302263.
840.000	5.71E-05	2335.9860	411.6883	-1.3390E-06	2435.3495	-15.0149	2627290.
850.000	4.40E-05	5716.5889	269.9722	-1.2566E-06	2437.8405	-13.3283	3029236.
860.000	3.20E-05	7763.0753	146.7056	-1.1186E-06	2439.3484	-11.3250	3537090.
870.000	2.16E-05	8675.3106	44.6517	-9.5042E-07	2440.0205	-9.0857	4201320.
880.000	1.30E-05	8677.0185	-34.1197	-7.7284E-07	2440.0218	-6.6685	5125890.
890.000	6.17E-06	8009.9187	-87.8413	-6.0207E-07	2439.5303	-4.0758	6606752.
900.000	9.68E-07	6933.4386	-108.8849	-4.4915E-07	2438.7371	-0.1329555	1373373.
910.000	-2.81E-06	5842.1020	-107.5999	-3.1840E-07	2437.9329	0.3899579	1385873.
920.000	-5.40E-06	4788.4458	-101.8745	-2.0961E-07	2437.1566	0.7551183	

1398373.						
930.000	-7.01E-06	3809.2234	-93.1566	-1.2163E-07	2436.4351	0.9884681
1410873.						
940.000	-7.83E-06	2927.9901	-82.6399	-5.2680E-08	2435.7857	1.1149
1423373.						
950.000	-8.06E-06	2157.5837	-71.2793	-6.3579E-10	2435.2181	1.1573
1435873.						
960.000	-7.85E-06	1502.4182	-59.8115	3.6820E-08	2434.7353	1.1363
1448373.						
970.000	-7.32E-06	960.5427	-48.7809	6.2025E-08	2434.3361	1.0698
1460873.						
980.000	-6.60E-06	525.4348	-38.5661	7.7232E-08	2434.0155	0.9731238
1473373.						
990.000	-5.78E-06	187.5211	-29.4073	8.4528E-08	2433.7665	0.8586329
1485873.						
1000.	-4.91E-06	-64.5716	-21.4325	8.5787E-08	2433.6759	0.7363258
1498373.						
1010.	-4.06E-06	-243.0172	-14.6816	8.2639E-08	2433.8074	0.6138543
1510873.						
1020.	-3.26E-06	-360.0226	-9.1282	7.6467E-08	2433.8936	0.4968319
1523373.						
1030.	-2.53E-06	-427.2638	-4.6984	6.8411E-08	2433.9431	0.3891231
1535873.						
1040.	-1.89E-06	-455.4965	-1.2871	5.9377E-08	2433.9639	0.2931353
1548373.						
1050.	-1.35E-06	-454.3131	1.2290	5.0066E-08	2433.9631	0.2100984
1560873.						
1060.	-8.92E-07	-432.0175	2.9811	4.0995E-08	2433.9466	0.1403238
1573373.						
1070.	-5.26E-07	-395.5924	4.0999	3.2526E-08	2433.9198	0.0834366
1585873.						
1080.	-2.41E-07	-350.7344	4.7100	2.4888E-08	2433.8867	0.0385767
1598373.						
1090.	-2.84E-08	-301.9399	4.9257	1.8209E-08	2433.8508	0.0045687
1610873.						
1100.	1.23E-07	-252.6205	4.8489	1.2534E-08	2433.8145	-0.0199393
1623373.						
1110.	2.22E-07	-205.2382	4.5673	7.8480E-09	2433.7795	-0.0363671
1635873.						
1120.	2.80E-07	-161.4463	4.1549	4.0954E-09	2433.7473	-0.0461192
1648373.						
1130.	3.04E-07	-122.2301	3.6717	1.1924E-09	2433.7184	-0.0505268
1660873.						
1140.	3.04E-07	-88.0390	3.1650	-9.5948E-10	2433.6932	-0.0508092
1673373.						
1150.	2.85E-07	-58.9089	2.6707	-2.4633E-09	2433.6717	-0.0480522
1685873.						
1160.	2.54E-07	-34.5709	2.2144	-3.4200E-09	2433.6538	-0.0432010
1698373.						
1170.	2.17E-07	-14.5452	1.8131	-3.9226E-09	2433.6390	-0.0370626
1710873.						
1180.	1.76E-07	1.7776	1.4762	-4.0533E-09	2433.6296	-0.0303167
1723373.						
1190.	1.36E-07	15.0683	1.2070	-3.8809E-09	2433.6394	-0.0235323
1735873.						
1200.	9.83E-08	26.0023	0.7575505	-3.4606E-09	2433.6475	-0.0663511
6750000.						
1210.	6.64E-08	30.2954	0.2018522	-2.8844E-09	2433.6506	-0.0447886
6750000.						
1220.	4.06E-08	30.1028	-0.1591479	-2.2663E-09	2433.6505	-0.0274115
6750000.						
1230.	2.10E-08	27.1623	-0.3671713	-1.6803E-09	2433.6483	-0.0141932
6750000.						
1240.	7.00E-09	22.7964	-0.4617756	-1.1690E-09	2433.6451	-0.0047276
6750000.						
1250.	-2.35E-09	17.9525	-0.4774710	-7.5201E-10	2433.6415	0.0015885

```
6750000.
1260. -8.04E-09      13.2635  -0.4424060 -4.3255E-10    2433.6381    0.0054245
6750000.
1270. -1.10E-08       9.1139  -0.3781438 -2.0355E-10    2433.6350    0.0074280
6750000.
1280. -1.21E-08       5.7051  -0.3001423 -5.1893E-11    2433.6325    0.0081723
6750000.
1290. -1.20E-08       3.1122  -0.2186380  3.8341E-11    2433.6306    0.0081285
6750000.
1300. -1.13E-08       1.3315  -0.1397217  8.3817E-11    2433.6293    0.0076547
6750000.
1310. -1.04E-08    0.3159236  -0.0664630  1.0068E-10    2433.6286    0.0069970
6750000.
1320. -9.33E-09       0.0000      0.0000  1.0391E-10    2433.6283    0.0062956
3375000.
```

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

```
Pile-head deflection              =     0.50000000 in
Computed slope at pile head       =    -0.00212257
Maximum bending moment            =       3044998. lbs-in
Maximum shear force               =    37185.22152 lbs
Depth of maximum bending moment   =      210.00000 in
Depth of maximum shear force      =        0.00000 in
Number of iterations              =             10
Number of zero deflection points  =              5
```

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 2

Pile-head boundary conditions are Displacement and Slope (Pile-head Condition Type 5)

```
Specified deflection at pile head   =       0.500000 in
Specified slope at pile head        =      0.000E+00 in/in
Specified axial load at pile head   =     1100000.000 lbs

  Depth    Deflect.     Moment       Shear        Slope        Total       Soil Res.
   Es*h
    X         y           M            V            S          Stress          p
    F/L
   in        in         lbs-in        lbs          Rad.      lbs/in**2      lbs/in
  lbs/in
-------- --------- ----------- ----------- ----------- ----------- -----------
-----------
  0.000  0.500000    -7961505.   63879.8610      0.0000    8299.8972   -409.0390
 4090.3897
 10.000  0.499185    -7344087.   59424.3892  -0.0001566    7844.9660   -445.5472
 8925.4878
 20.000  0.496867    -6769571.   54788.3465  -0.0003011    7421.6457   -481.6614
 9693.9635
 30.000  0.493164    -6241697.   50947.1717  -0.0004342    7032.6926   -286.5736
 5810.9202
 40.000  0.488183    -5741075.   48591.7734  -0.0005569    6663.8196   -184.5061
 3779.4457
 50.000  0.482027    -5257610.   46683.3891  -0.0006694    6307.5891   -197.1708
 4090.4527
```

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90.000	0.447573	-3522453.	38194.2104	-0.0010267	5029.0743	-170.0164	3798.6314
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110.000	0.425677	-2765403.	35218.9055	-0.0011552	4471.2578	-146.6775	3445.7496
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130.000	0.401514	-2064261.	32220.9999	-0.0012539	3954.6357	-149.9551	3734.7453
140.000	0.388763	-1735523.	30729.4710	-0.0012928	3712.4122	-148.3507	3815.9664
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160.000	0.362261	-1121283.	27796.5704	-0.0013511	3259.8221	-144.9001	3999.8820
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180.000	0.334838	-563982.	24935.7299	-0.0013855	2849.1867	-141.1476	4215.3999
190.000	0.320926	-306378.	23534.1665	-0.0013944	2659.3768	-139.1651	4336.3660
200.000	0.306950	-62622.2391	22152.7660	-0.0013982	2479.7702	-137.1150	4467.0094
210.000	0.292962	167436.	20792.1918	-0.0013971	2557.0004	-134.9998	4608.0931
220.000	0.279009	383957.	19453.0849	-0.0013914	2716.5394	-132.8216	4760.4815
230.000	0.265134	587110.	18136.0652	-0.0013815	2866.2280	-130.5824	4925.1533
240.000	0.251379	777072.	16841.7333	-0.0013675	3006.1975	-128.2840	5103.2191
250.000	0.237783	954030.	15570.6715	-0.0013498	3136.5858	-125.9283	5295.9408
260.000	0.224382	1118181.	14323.4456	-0.0013286	3257.5370	-123.5169	5504.7560
270.000	0.211210	1269729.	13100.6057	-0.0013042	3369.2017	-121.0511	5731.3068
280.000	0.198298	1408886.	11902.6883	-0.0012768	3471.7364	-118.5324	5977.4750
290.000	0.185675	1535872.	10730.2170	-0.0012466	3565.3035	-115.9619	6245.4254
300.000	0.173366	1650916.	9779.5116	-0.0012140	3650.0714	-74.1792	4278.7705
310.000	0.161394	1758170.	9015.6672	-0.0011791	3729.0996	-78.5897	4869.4175
320.000	0.149783	1857170.	8208.6056	-0.0011421	3802.0456	-82.8226	5529.5080
330.000	0.138552	1947470.	7360.3779	-0.0011032	3868.5808	-86.8229	6266.4626
340.000	0.127719	2028648.	6473.5929	-0.0010625	3928.3955	-90.5341	7088.5376
350.000	0.117301	2100317.	5551.4268	-0.0010203	3981.2029	-93.8991	8004.9398
360.000	0.107314	2162122.	4597.6256	-0.0009766	4026.7432	-96.8611	9025.9631
370.000	0.097769	2213755.	3616.5006	-0.0009319	4064.7877	-99.3639	10163.1479
380.000	0.088677	2254953.	2612.9167	-0.0008861	4095.1436	-101.3529	11429.4721

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400.000	0.071884	2305271.	560.4664	-0.0007927	4132.2193	-103.5848	14410.0573
410.000	0.064193	2314156.	-476.1286	-0.0007454	4138.7663	-103.7342	16159.7683
420.000	0.056976	2312147.	-1510.7219	-0.0006981	4137.2859	-103.1845	18110.2707
430.000	0.050232	2299299.	-2536.1531	-0.0006509	4127.8190	-101.9018	20286.3331
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460.000	0.032802	2197427.	-5481.6746	-0.0005124	4052.7565	-93.4169	28478.9232
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480.000	0.023443	2079847.	-7257.7420	-0.0004247	3966.1200	-83.7932	35743.6079
490.000	0.019408	2007518.	-8065.7274	-0.0003829	3912.8259	-77.8039	40088.0879
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580.000	-0.000673	1084188.	-11624.1441	-9.2729E-05	3232.4898	8.9155	132413.
590.000	-0.001490	969291.	-11476.1631	-7.1714E-05	3147.8299	20.6806	138829.
600.000	-0.002108	856243.	-11214.7900	-5.3032E-05	3064.5329	31.5940	149905.
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620.000	-0.002840	640079.	-10386.0340	-2.2447E-05	2905.2573	50.8189	178923.
630.000	-0.002999	538935.	-9837.2430	-1.0381E-05	2830.7311	58.9393	196514.
640.000	-0.003048	443563.	-9212.8918	-3.2681E-07	2760.4582	65.9310	216316.
650.000	-0.003006	354684.	-8524.6961	7.8422E-06	2694.9698	71.7082	238568.
660.000	-0.002891	272896.	-7785.1375	1.4265E-05	2634.7062	76.2035	263584.
670.000	-0.002720	198667.	-7007.2644	1.9091E-05	2580.0122	79.3711	291754.
680.000	-0.002509	132331.	-6204.4670	2.2478E-05	2531.1336	81.1884	323558.
690.000	-0.002271	74083.5156	-5390.2360	2.4590E-05	2488.2152	81.6578	359580.
700.000	-0.002017	23985.2138	-4577.9110	2.5594E-05	2451.3013	80.8072	400544.
710.000	-0.001759	-18037.7703	-3780.4271	2.5655E-05	2446.9191	78.6896	447344.

720.000	-0.001504	-52187.7335	-3010.0647	2.4936E-05	2472.0818	75.3829	501103.
730.000	-0.001260	-78787.6598	-2278.2102	2.3596E-05	2491.6814	70.9880	563255.
740.000	-0.001032	-98271.0450	-1595.1344	2.1784E-05	2506.0373	65.6271	635661.
750.000	-0.000825	-111170.	-969.7970	1.9640E-05	2515.5413	59.4403	720801.
760.000	-0.000640	-118099.	-409.6870	1.7294E-05	2520.6472	52.5817	822084.
770.000	-0.000479	-119744.	79.2909	1.4860E-05	2521.8590	45.2139	944397.
780.000	-0.000342	-116840.	492.8643	1.2439E-05	2519.7196	37.5008	1095194.
790.000	-0.000230	-110160.	828.3484	1.0116E-05	2514.7975	29.5960	1286899.
800.000	-0.000140	-100496.	1084.4411	7.9601E-06	2507.6765	21.6225	1543434.
810.000	-7.08E-05	-88646.4743	1260.6640	6.0245E-06	2498.9456	13.6220	1924648.
820.000	-1.96E-05	-75415.0228	1355.4163	4.3455E-06	2489.1963	5.3284	2718074.
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840.000	3.93E-05	-48334.0115	1276.9887	1.8176E-06	2469.2422	-11.1057	2829009.
850.000	5.25E-05	-36133.9646	1144.8998	9.5321E-07	2460.2529	-15.3120	2917323.
860.000	5.83E-05	-25456.9863	977.4729	3.2290E-07	2452.3858	-18.1733	3116096.
870.000	5.89E-05	-16591.6102	786.7020	-1.0741E-07	2445.8535	-19.9808	3389761.
880.000	5.62E-05	-9720.5828	582.0233	-3.7668E-07	2440.7907	-20.9549	3730444.
890.000	5.14E-05	-4942.8565	370.8491	-5.2674E-07	2437.2704	-21.2800	4139178.
900.000	4.56E-05	-2292.0128	233.1105	-6.0078E-07	2435.3171	-6.2678	1373373.
910.000	3.94E-05	-267.4302	174.4731	-6.2698E-07	2433.8254	-5.4597	1385873.
920.000	3.31E-05	1211.2423	124.0327	-6.1732E-07	2434.5208	-4.6284	1398373.
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940.000	2.15E-05	2860.2381	47.4584	-5.3007E-07	2435.7358	-3.0539	1423373.
950.000	1.64E-05	3187.6339	20.3804	-4.6818E-07	2435.9771	-2.3617	1435873.
960.000	1.21E-05	3278.1456	-0.1848069	-4.0201E-07	2436.0438	-1.7514	1448373.
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1100.	-1.56E-06	1.4238	-7.6910	2.6224E-08	2433.6294	0.2540137
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1220.	3.70E-08	-44.1393	1.5379	1.0527E-09	2433.6608	-0.0249843
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1230.	4.30E-08	-30.0161	1.2678	2.9382E-10	2433.6504	-0.0290411
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1240.	4.29E-08	-18.7902	0.9778178	-2.0565E-10	2433.6422	-0.0289509
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1250.	3.89E-08	-10.4552	0.7017391	-5.0494E-10	2433.6360	-0.0262648
6750000.						
1260.	3.28E-08	-4.7444	0.4597438	-6.6049E-10	2433.6318	-0.0221343
6750000.						
1270.	2.57E-08	-1.2458	0.2623314	-7.2179E-10	2433.6292	-0.0173482
6750000.						
1280.	1.84E-08	0.5181501	0.1136398	-7.2924E-10	2433.6287	-0.0123901
6750000.						
1290.	1.11E-08	1.0430	0.0141716	-7.1326E-10	2433.6291	-0.0075035
6750000.						
1300.	4.09E-09	0.8172739	-0.0371515	-6.9422E-10	2433.6289	-0.0027611
6750000.						
1310.	-2.77E-09	0.3152493	-0.0416146	-6.8263E-10	2433.6286	0.0018685
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1320.	-9.56E-09	0.0000	0.0000	-6.7941E-10	2433.6283	0.0064545
3375000.						

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection = 0.50000000 in
Computed slope at pile head = -0.00000632

Maximum bending moment = -7961505. lbs-in
Maximum shear force = 63879.86102 lbs
Depth of maximum bending moment = 0.00000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 7
Number of zero deflection points = 5

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (Pile-head Condition Type 4)
Specified deflection at pile head = 1.000000 in
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 1100000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in	Es*h F/L lbs/in
0.000	1.000000	0.0000	49286.3543	-0.0037684	2433.6283	-486.4321	2432.1603
10.000	0.962316	509994.	44229.2033	-0.0037631	2809.4067	-524.9981	5455.5667
20.000	0.924737	967373.	38791.2992	-0.0037480	3146.4170	-562.5827	6083.7029
30.000	0.887356	1368276.	34318.8645	-0.0037241	3441.8142	-331.9043	3740.3733
40.000	0.850255	1735681.	31599.5468	-0.0036924	3712.5287	-211.9592	2492.8904
50.000	0.813509	2081499.	29416.0894	-0.0036533	3967.3375	-224.7322	2762.5046
60.000	0.777189	2404375.	27106.8756	-0.0036074	4205.2420	-237.1105	3050.8726
70.000	0.741361	2702999.	24675.9034	-0.0035551	4425.2767	-249.0839	3359.8179
80.000	0.706087	2976106.	22127.2709	-0.0034970	4626.5098	-260.6426	3691.3664
90.000	0.671422	3222478.	19850.9275	-0.0034336	4808.0442	-194.6261	2898.7172
100.000	0.637416	3448662.	18088.5317	-0.0033653	4974.7034	-157.8530	2476.4532
110.000	0.604116	3658285.	16475.1032	-0.0032926	5129.1595	-164.8327	2728.4949
120.000	0.571565	3850601.	14807.5033	-0.0032157	5270.8633	-168.6873	2951.3254
130.000	0.539802	4025181.	13136.5526	-0.0031351	5399.4990	-165.5028	3065.9941
140.000	0.508862	4182304.	11497.6462	-0.0030511	5515.2722	-162.2785	3189.0448
150.000	0.478779	4322258.	9891.1768	-0.0029641	5618.3945	-159.0154	3321.2694
160.000	0.449581	4445338.	8317.5253	-0.0028744	5709.0830	-155.7149	3463.5595
170.000	0.421292	4551845.	6777.0612	-0.0027823	5787.5605	-152.3779	3616.9213
180.000	0.393935	4642089.	5270.1436	-0.0026882	5854.0553	-149.0056	

							3782.4946
190.000	0.367528	4716388.	3797.1213	-0.0025924	5908.8008	-145.5989	3961.5744
200.000	0.342086	4775065.	2358.3338	-0.0024953	5952.0357	-142.1586	4155.6379
210.000	0.317622	4818451.	954.1122	-0.0023971	5984.0039	-138.6857	4366.3769
220.000	0.294144	4846884.	-415.2201	-0.0022982	6004.9539	-135.1808	4595.7367
230.000	0.271658	4860707.	-1749.3460	-0.0021989	6015.1394	-131.6444	4845.9655
240.000	0.250167	4860272.	-3047.9540	-0.0020994	6014.8186	-128.0772	5119.6742
250.000	0.229670	4845935.	-4310.7361	-0.0020000	6004.2544	-124.4793	5419.9121
260.000	0.210166	4818058.	-5537.3864	-0.0019011	5983.7143	-120.8508	5750.2626
270.000	0.191647	4777012.	-6727.5985	-0.0018030	5953.4703	-117.1916	6114.9648
280.000	0.174107	4723171.	-7881.0634	-0.0017057	5913.7988	-113.5013	6519.0719
290.000	0.157533	4656917.	-8997.4655	-0.0016097	5864.9807	-109.7791	6968.6572
300.000	0.141912	4578636.	-9839.3142	-0.0015152	5807.3012	-58.5907	4128.6665
310.000	0.127228	4493466.	-10430.1489	-0.0014224	5744.5450	-59.5763	4682.6331
320.000	0.113464	4401326.	-11028.8450	-0.0013314	5676.6536	-60.1630	5302.3773
330.000	0.100601	4302179.	-11631.2307	-0.0012423	5603.5991	-60.3142	5995.3838
340.000	0.088618	4196032.	-12232.7787	-0.0011553	5525.3868	-59.9954	6770.0864
350.000	0.077495	4082940.	-12828.6312	-0.0010706	5442.0577	-59.1751	7636.0242
360.000	0.067207	3963012.	-13413.6304	-0.0009883	5353.6912	-57.8247	8604.0346
370.000	0.057730	3836409.	-13982.3526	-0.0009084	5260.4065	-55.9197	9686.4960
380.000	0.049038	3703351.	-14529.1493	-0.0008313	5162.3650	-53.4396	10897.6365
390.000	0.041104	3564114.	-15048.1906	-0.0007569	5059.7717	-50.3686	12253.9413
400.000	0.033900	3419039.	-15533.5133	-0.0006854	4952.8757	-46.6959	13774.7032
410.000	0.027395	3268524.	-15979.0705	-0.0006170	4841.9719	-42.4155	15482.8041
420.000	0.021560	3113031.	-16378.7813	-0.0005517	4727.4005	-37.5266	17405.8866
430.000	0.016361	2953085.	-16726.5782	-0.0004896	4609.5477	-32.0327	19578.2549
440.000	0.011767	2789271.	-17016.4446	-0.0004308	4488.8447	-25.9406	22044.3273
450.000	0.007744	2622235.	-17242.4339	-0.0003755	4365.7676	-19.2573	24866.0441
460.000	0.004258	2452683.	-17398.6399	-0.0003235	4240.8365	-11.9839	28143.9022
470.000	0.001274	2281380.	-17479.0214	-0.0002751	4114.6156	-4.0924	32128.6709
480.000	-0.001244	2109154.	-17476.5770	-0.0002302	3987.7147	4.5813	36837.6606
490.000	-0.003329	1936912.	-17384.7886	-0.0001887	3860.8014	13.7764	41378.7978
500.000	-0.005019	1765611.	-17199.6024	-0.0001509	3734.5820	23.2608	46349.2819
510.000	-0.006346	1596239.	-16918.9833	-0.0001165	3609.7835	32.8630	

							51781.3792
520.000	-0.007348	1429793.	-16542.5676	-8.5485E-05	3487.1417	42.4202	57732.8805
530.000	-0.008056	1267268.	-16071.5912	-5.7884E-05	3367.3883	51.7751	64267.4525
540.000	-0.008505	1109635.	-15508.8388	-3.3560E-05	3251.2397	60.7754	71455.4411
550.000	-0.008727	957829.	-14858.5907	-1.2402E-05	3139.3850	69.2743	79375.6607
560.000	-0.008753	812736.	-14126.5565	5.7175E-06	3032.4758	77.1326	88117.3548
570.000	-0.008613	675173.	-13319.7918	2.0944E-05	2931.1152	84.2204	97782.3909
580.000	-0.008335	545879.	-12446.5937	3.3440E-05	2835.8481	90.4192	108488.
590.000	-0.007944	425505.	-11516.3778	4.3381E-05	2747.1528	95.6240	120369.
600.000	-0.007467	314597.	-10539.5328	5.0955E-05	2665.4328	99.7450	133583.
610.000	-0.006925	213593.	-9527.2575	5.6361E-05	2591.0101	102.7100	148315.
620.000	-0.006340	122812.	-8491.3797	5.9803E-05	2524.1200	104.4655	164781.
630.000	-0.005729	42450.0593	-7444.1596	6.1495E-05	2464.9068	104.9785	183238.
640.000	-0.005110	-27423.8308	-6398.0816	6.1648E-05	2453.8350	104.2371	203995.
650.000	-0.004496	-86867.8353	-5365.6368	6.0479E-05	2497.6351	102.2518	227423.
660.000	-0.003900	-136067.	-4359.1002	5.8197E-05	2533.8865	99.0555	253975.
670.000	-0.003332	-175330.	-3390.3073	5.5010E-05	2562.8167	94.7031	284210.
680.000	-0.002800	-205083.	-2470.4358	5.1117E-05	2584.7398	89.2712	318826.
690.000	-0.002310	-225863.	-1609.7954	4.6707E-05	2600.0511	82.8568	358717.
700.000	-0.001866	-238307.	-817.6361	4.1957E-05	2609.2198	75.5750	405043.
710.000	-0.001471	-243139.	-101.9781	3.7030E-05	2612.7804	67.5565	459359.
720.000	-0.001125	-241161.	530.5222	3.2074E-05	2611.3229	58.9435	523825.
730.000	-0.000829	-233234.	1074.6611	2.7219E-05	2605.4823	49.8842	601600.
740.000	-0.000581	-220267.	1526.7039	2.2578E-05	2595.9273	40.5243	697646.
750.000	-0.000378	-203197.	1884.2859	1.8244E-05	2583.3498	30.9921	820690.
760.000	-0.000216	-182982.	2146.0763	1.4292E-05	2568.4551	21.3660	989231.
770.000	-9.18E-05	-160590.	2310.7513	1.0776E-05	2551.9557	11.5690	1260388.
780.000	-4.61E-07	-137004.	2369.4366	7.7307E-06	2534.5772	0.1680595	3643296.
790.000	6.28E-05	-113371.	2319.0476	5.1684E-06	2517.1636	-10.2459	1630849.
800.000	0.000103	-90737.2222	2183.7674	3.0797E-06	2500.4862	-16.8102	1633520.
810.000	0.000124	-69763.7196	1992.4044	1.4371E-06	2485.0323	-21.4624	1725018.
820.000	0.000132	-50920.7511	1762.3502	2.0208E-07	2471.1482	-24.5484	1864670.
830.000	0.000128	-34521.1622	1508.2468	-6.7231E-07	2459.0645	-26.2722	2045168.
840.000	0.000118	-20741.0246	1242.8487	-1.2379E-06	2448.9109	-26.8074	

```
   2267889.
850.000   0.000104   -9636.9559    977.1835 -1.5487E-06    2440.7291    -26.3257
   2538562.
860.000   8.72E-05   -1163.2832    720.5342 -1.6593E-06    2434.4855    -25.0042
   2866484.
870.000   7.05E-05    4810.2314    480.3935 -1.6219E-06    2437.1726    -23.0239
   3264978.
880.000   5.48E-05    8480.2702    262.4639 -1.4859E-06    2439.8768    -20.5620
   3752821.
890.000   4.08E-05   10092.1997     70.7640 -1.2959E-06    2441.0645    -17.7780
   4357414.
900.000   2.89E-05    9924.0589    -37.9530 -1.0910E-06    2440.9407     -3.9654
   1373373.
910.000   1.90E-05    9357.1415    -70.9314 -8.9370E-07    2440.5229     -2.6303
   1385873.
920.000   1.10E-05    8525.0920    -91.7735 -7.1070E-07    2439.9099     -1.5382
   1398373.
930.000   4.77E-06    7537.3071   -102.8258 -5.4632E-07    2439.1820  -0.6722967
   1410873.
940.000   7.33E-08    6480.5956   -106.2394 -4.0286E-07    2438.4034  -0.0104305
   1423373.
950.000  -3.29E-06    5421.3820   -103.9280 -2.8106E-07    2437.6230   0.4727091
   1435873.
960.000  -5.55E-06    4408.2188    -97.5467 -1.8047E-07    2436.8764   0.8035478
   1448373.
970.000  -6.90E-06    3474.4178    -88.4879 -9.9798E-08    2436.1884      1.0082
   1460873.
980.000  -7.54E-06    2640.6564    -77.8893 -3.7218E-08    2435.5740      1.1115
   1473373.
990.000  -7.65E-06    1917.4504    -66.6514  9.4282E-09    2435.0412      1.1361
   1485873.
   1000.  -7.36E-06    1307.4202    -55.4605  4.2431E-08    2434.5917      1.1021
   1498373.
   1010.  -6.80E-06     807.3060    -44.8152  6.4072E-08    2434.2232      1.0270
   1510873.
   1020.  -6.07E-06     409.7076    -35.0539  7.6527E-08    2433.9302   0.9252803
   1523373.
   1030.  -5.27E-06     104.5450    -26.3830  8.1790E-08    2433.7054   0.8088975
   1535873.
   1040.  -4.44E-06    -119.7515    -18.9026  8.1634E-08    2433.7166   0.6871835
   1548373.
   1050.  -3.63E-06    -275.3025    -12.6305  7.7591E-08    2433.8312   0.5672238
   1560873.
   1060.  -2.89E-06    -374.0693     -7.5238  7.0946E-08    2433.9039   0.4541194
   1573373.
   1070.  -2.22E-06    -427.3398     -3.4968  6.2744E-08    2433.9432   0.3512875
   1585873.
   1080.  -1.63E-06    -445.3854  -0.4365619  5.3813E-08    2433.9565   0.2607580
   1598373.
   1090.  -1.14E-06    -437.2550      1.7845  4.4780E-08    2433.9505   0.1834538
   1610873.
   1100.  -7.36E-07    -410.6807      3.2990  3.6103E-08    2433.9309   0.1194466
   1623373.
   1110.  -4.17E-07    -372.0692      4.2371  2.8092E-08    2433.9025   0.0681822
   1635873.
   1120.  -1.74E-07    -326.5558      4.7214  2.0943E-08    2433.8689   0.0286732
   1648373.
   1130.   2.06E-09    -278.1016      4.8631  1.4755E-08    2433.8332  -0.0003420
   1660873.
   1140.   1.21E-07    -229.6189      4.7600  9.5589E-09    2433.7975  -0.0202723
   1673373.
   1150.   1.93E-07    -183.1118      4.4958  5.3351E-09    2433.7632  -0.0325772
   1685873.
   1160.   2.28E-07    -139.8212      4.1394  2.0303E-09    2433.7313  -0.0386971
   1698373.
   1170.   2.34E-07    -100.3688      3.7459 -4.2777E-10    2433.7023  -0.0400074
```

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1710873.
1180.   2.19E-07    -64.8945        3.3569 -2.1190E-09   2433.6761   -0.0377923
1723373.
1190.   1.91E-07    -33.1849        3.0017 -3.1227E-09   2433.6528   -0.0332352
1735873.
1200.   1.57E-07     -4.7913        2.3062 -3.5114E-09   2433.6318   -0.1058654
6750000.
1210.   1.21E-07     13.0169        1.3677 -3.4272E-09   2433.6379   -0.0818326
6750000.
1220.   8.83E-08     22.6388     0.6605795 -3.0623E-09   2433.6450   -0.0595981
6750000.
1230.   6.00E-08     26.2958     0.1601320 -2.5615E-09   2433.6477   -0.0404913
6750000.
1240.   3.71E-08     25.8978    -0.1674120 -2.0274E-09   2433.6474   -0.0250175
6750000.
1250.   1.94E-08     22.9922    -0.3581068 -1.5271E-09   2433.6453   -0.0131215
6750000.
1260.   6.52E-09     18.7693    -0.4457244 -1.0997E-09   2433.6421   -0.0044020
6750000.
1270.  -2.55E-09     14.1019    -0.4591127 -7.6330E-10   2433.6387    0.0017244
6750000.
1280.  -8.74E-09      9.6038    -0.4209784 -5.2070E-10   2433.6354    0.0059025
6750000.
1290.  -1.30E-08      5.6938    -0.3476967 -3.6415E-10   2433.6325    0.0087538
6750000.
1300.  -1.60E-08      2.6579    -0.2498349 -2.7868E-10   2433.6303    0.0108185
6750000.
1310.  -1.85E-08   0.7032109    -0.1331620 -2.4428E-10   2433.6288    0.0125160
6750000.
1320.  -2.09E-08      0.0000        0.0000 -2.3709E-10   2433.6283    0.0141164
3375000.
```

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 3:

```
Pile-head deflection              =     1.00000000 in
Computed slope at pile head       =    -0.00376836
Maximum bending moment            =       4860707. lbs-in
Maximum shear force               =    49286.35427 lbs
Depth of maximum bending moment   =      230.00000 in
Depth of maximum shear force      =        0.00000 in
Number of iterations              =              9
Number of zero deflection points  =              5
```

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 4

Pile-head boundary conditions are Displacement and Slope (Pile-head Condition Type 5)

```
Specified deflection at pile head    =        1.000000 in
Specified slope at pile head         =       0.000E+00 in/in
Specified axial load at pile head    =     1100000.000 lbs
```

```
  Depth     Deflect.      Moment        Shear         Slope        Total         Soil Res.
   Es*h
    X          y            M             V             S          Stress            p
    F/L
```

in	in	lbs-in	lbs	Rad.	lbs/in**2	lbs/in	lbs/in
0.000	1.000000	-1.3866E+07	93591.8876	0.0000	12650.3251	-486.4321	2432.1603
10.000	0.998581	-1.2955E+07	88293.1297	-0.0002745	11979.0841	-529.8758	5306.2875
20.000	0.994511	-1.2094E+07	82779.2164	-0.0005308	11344.7367	-572.9069	5760.6918
30.000	0.987965	-1.1288E+07	78209.9991	-0.0007701	10750.5966	-340.9366	3450.8986
40.000	0.979109	-1.0513E+07	75407.4671	-0.0009932	10179.7051	-219.5698	2242.5479
50.000	0.968101	-9757513.	73136.0055	-0.0012006	9623.2482	-234.7225	2424.5667
60.000	0.955096	-9023583.	70714.1457	-0.0013928	9082.4677	-249.6495	2613.8677
70.000	0.940244	-8312587.	68144.2435	-0.0015702	8558.5852	-264.3310	2811.3015
80.000	0.923691	-7626153.	65428.8474	-0.0017334	8052.8003	-278.7482	3017.7647
90.000	0.905577	-6965876.	62959.9273	-0.0018827	7566.2893	-215.0358	2374.5724
100.000	0.886037	-6325535.	61003.9044	-0.0020187	7094.4672	-176.1688	1988.2771
110.000	0.865203	-5701387.	59194.0684	-0.0021418	6634.5764	-185.7984	2147.4556
120.000	0.843201	-5094534.	57304.9230	-0.0022523	6187.4299	-192.0306	2277.3995
130.000	0.820157	-4505738.	55393.4443	-0.0023505	5753.5876	-190.2651	2319.8613
140.000	0.796191	-3934954.	53500.1514	-0.0024369	5333.0172	-188.3935	2366.1846
150.000	0.771419	-3382123.	51626.0888	-0.0025118	4925.6754	-186.4190	2416.5725
160.000	0.745955	-2847173.	49772.2692	-0.0025755	4531.5085	-184.3449	2471.2591
170.000	0.719909	-2330016.	47939.6757	-0.0026285	4150.4522	-182.1738	2530.5131
180.000	0.693385	-1830552.	46129.2642	-0.0026711	3782.4326	-179.9085	2594.6406
190.000	0.666487	-1348667.	44341.9648	-0.0027036	3427.3654	-177.5514	2663.9895
200.000	0.639312	-884233.	42578.6842	-0.0027265	3085.1571	-175.1048	2738.9541
210.000	0.611957	-437111.	40840.3066	-0.0027400	2755.7042	-172.5708	2819.9810
220.000	0.584512	-7146.9715	39127.6955	-0.0027445	2438.8944	-169.9514	2907.5758
230.000	0.557066	405823.	37441.6952	-0.0027405	2732.6507	-167.2486	3002.3110
240.000	0.529703	801977.	35783.1315	-0.0027281	3024.5485	-164.4641	3104.8353
250.000	0.502504	1181504.	34152.8132	-0.0027078	3304.1951	-161.5996	3215.8851
260.000	0.475547	1544605.	32551.5324	-0.0026799	3571.7385	-158.6566	3336.2968
270.000	0.448906	1891493.	30980.0657	-0.0026447	3827.3354	-155.6367	3467.0231
280.000	0.422652	2222391.	29439.1745	-0.0026026	4071.1508	-152.5415	3609.1506
290.000	0.396853	2537535.	27929.6051	-0.0025539	4303.3578	-149.3724	3763.9213
300.000	0.371573	2837170.	26272.0033	-0.0024989	4524.1376	-182.1480	4902.0723

310.000	0.346874	3117951.	24403.4961	-0.0024380	4731.0256	-191.5535	5522.2706
320.000	0.322814	3378875.	22443.4695	-0.0023715	4923.2822	-200.4518	6209.5208
330.000	0.299444	3618993.	20397.5652	-0.0022999	5100.2083	-208.7290	6970.5415
340.000	0.276816	3837424.	18272.5680	-0.0022236	5261.1543	-216.2704	7812.7870
350.000	0.254973	4033364.	16076.4043	-0.0021430	5405.5283	-222.9623	8744.5483
360.000	0.233955	4206099.	13818.1277	-0.0020587	5532.8046	-228.6930	9775.0708
370.000	0.213799	4355018.	11507.8889	-0.0019711	5642.5324	-233.3547	10914.6936
380.000	0.194533	4479621.	9156.8916	-0.0018807	5734.3436	-236.8447	12175.0151
390.000	0.176185	4579531.	6777.3332	-0.0017880	5807.9601	-239.0670	13569.0899
400.000	0.158774	4654503.	4382.3296	-0.0016935	5863.2018	-239.9338	15111.6668
410.000	0.142315	4704434.	1985.8256	-0.0015977	5899.9924	-239.3671	16819.4779
420.000	0.126820	4729369.	-397.5100	-0.0015012	5918.3653	-237.3001	18711.5936
430.000	0.112292	4729509.	-2752.4031	-0.0014044	5918.4686	-233.6786	20809.8638
440.000	0.098733	4705217.	-5063.1062	-0.0013078	5900.5693	-228.4621	23139.4740
450.000	0.086136	4657019.	-7313.5424	-0.0012120	5865.0556	-221.6252	25729.6585
460.000	0.074493	4585610.	-9487.4587	-0.0011174	5812.4394	-213.1581	28614.6312
470.000	0.063788	4491853.	-11568.5873	-0.0010245	5743.3563	-203.0676	31834.8311
480.000	0.054002	4376777.	-13540.8116	-0.0009338	5658.5655	-191.3772	35438.6348
490.000	0.045113	4241579.	-15388.3324	-0.0008456	5558.9474	-178.1269	39484.7925
500.000	0.037091	4087613.	-17095.8298	-0.0007603	5445.5008	-163.3725	44046.0417
510.000	0.029906	3916389.	-18648.6117	-0.0006784	5319.3382	-147.1839	49214.7544
520.000	0.023523	3729566.	-20032.7401	-0.0006002	5181.6811	-129.6418	55112.3600
530.000	0.017903	3528938.	-21235.1129	-0.0005259	5033.8528	-110.8327	61906.4671
540.000	0.013006	3316433.	-22243.4701	-0.0004558	4877.2727	-90.8387	69845.7188
550.000	0.008787	3094097.	-23046.2485	-0.0003902	4713.4491	-69.7170	79343.1078
560.000	0.005201	2864093.	-23632.0905	-0.0003292	4543.9753	-47.4514	91231.5093
570.000	0.002202	2628698.	-23988.2738	-0.0002730	4370.5300	-23.7852	108024.
580.000	-0.000259	2390334.	-24088.6704	-0.0002217	4194.8960	3.7059	142823.
590.000	-0.002232	2151802.	-23920.4812	-0.0001752	4019.1386	29.9319	134130.
600.000	-0.003763	1915778.	-23503.2703	-0.0001336	3845.2297	53.5103	142192.
610.000	-0.004903	1684675.	-22859.7635	-9.6715E-05	3674.9457	75.1911	153364.
620.000	-0.005698	1460711.	-22009.2106	-6.4526E-05	3509.9226	94.9195	166597.
630.000	-0.006193	1245910.	-20971.9356	-3.6827E-05	3351.6512	112.5355	181705.

640.000	-0.006434	1042082.	-19769.9227	-1.3413E-05	3201.4649	127.8671
198734.						
650.000	-0.006462	850807.	-18426.7916	5.9588E-06	3060.5275	140.7592
217841.						
660.000	-0.006315	673415.	-16967.5586	2.1557E-05	2929.8204	151.0874
239255.						
670.000	-0.006030	510981.	-15418.2941	3.3678E-05	2810.1342	158.7655
263275.						
680.000	-0.005641	364309.	-13805.7215	4.2636E-05	2702.0615	163.7491
290266.						
690.000	-0.005178	233929.	-12156.7804	4.8758E-05	2605.9939	166.0392
320681.						
700.000	-0.004666	120100.	-10498.1707	5.2381E-05	2522.1217	165.6828
355071.						
710.000	-0.004130	22812.9678	-8855.8907	5.3843E-05	2450.4376	162.7732
394116.						
720.000	-0.003589	-58202.1234	-7254.7807	5.3481E-05	2476.5133	157.4488
438660.						
730.000	-0.003060	-123459.	-5718.0843	5.1622E-05	2524.5967	149.8905
489764.						
740.000	-0.002557	-173699.	-4267.0399	4.8581E-05	2561.6152	140.3184
548789.						
750.000	-0.002089	-209869.	-2920.5138	4.4656E-05	2588.2658	128.9868
617505.						
760.000	-0.001664	-233092.	-1694.6916	4.0123E-05	2605.3775	116.1776
698284.						
770.000	-0.001286	-244645.	-602.8431	3.5234E-05	2613.8901	102.1921
794412.						
780.000	-0.000959	-245924.	344.8144	3.0213E-05	2614.8324	87.3394
910652.						
790.000	-0.000682	-238414.	1141.1202	2.5257E-05	2609.2985	71.9217
1054382.						
800.000	-0.000454	-223657.	1781.7739	2.0528E-05	2598.4256	56.2090
1238208.						
810.000	-0.000272	-203230.	2264.7830	1.6159E-05	2583.3740	40.3928
1487411.						
820.000	-0.000131	-178717.	2589.0385	1.2251E-05	2565.3124	24.4583
1870338.						
830.000	-2.66E-05	-151719.	2748.7665	8.8689E-06	2545.4190	7.4873
2819627.						
840.000	4.66E-05	-123937.	2722.6428	6.0479E-06	2524.9488	-12.7120
2727397.						
850.000	9.44E-05	-97398.8211	2537.1238	3.7828E-06	2505.3946	-24.3918
2583757.						
860.000	0.000122	-73277.8188	2252.1003	2.0362E-06	2487.6216	-32.6129
2667394.						
870.000	0.000135	-52401.6105	1897.1908	7.5000E-07	2472.2394	-38.3690
2839460.						
880.000	0.000137	-35350.5022	1494.4462	-1.4803E-07	2459.6756	-42.1799
3072883.						
890.000	0.000132	-22509.4294	1061.4268	-7.4016E-07	2450.2139	-44.4239
3361198.						
900.000	0.000122	-14105.6834	755.2141	-1.1149E-06	2444.0218	-16.8186
1373373.						
910.000	0.000110	-7380.6197	594.9885	-1.3348E-06	2439.0666	-15.2265
1385873.						
920.000	9.58E-05	-2176.5481	451.8970	-1.4326E-06	2435.2321	-13.3918
1398373.						
930.000	8.12E-05	1688.8364	327.6437	-1.4375E-06	2434.8727	-11.4589
1410873.						
940.000	6.70E-05	4407.9511	222.6549	-1.3752E-06	2436.8762	-9.5388
1423373.						
950.000	5.37E-05	6172.1885	136.3965	-1.2669E-06	2438.1762	-7.7128
1435873.						
960.000	4.17E-05	7163.7520	67.6495	-1.1304E-06	2438.9068	-6.0366
1448373.						

970.000	3.11E-05	7550.0474	14.7449	-9.7983E-07	2439.1914	-4.5444	1460873.
980.000	2.21E-05	7480.2058	-24.2442	-8.2601E-07	2439.1400	-3.2534	1473373.
990.000	1.46E-05	7083.3359	-51.3486	-6.7697E-07	2438.8475	-2.1674	1485873.
1000.	8.54E-06	6468.1273	-68.5854	-5.3829E-07	2438.3942	-1.2799	1498373.
1010.	3.82E-06	5723.4696	-77.8717	-4.1353E-07	2437.8455	-0.5773265	1510873.
1020.	2.72E-07	4919.7906	-80.9652	-3.0461E-07	2437.2534	-0.0413767	1523373.
1030.	-2.27E-06	4110.8662	-79.4282	-2.1219E-07	2436.6573	0.3487911	1535873.
1040.	-3.97E-06	3335.8955	-74.6090	-1.3598E-07	2436.0863	0.6150366	1548373.
1050.	-4.99E-06	2621.6774	-67.6390	-7.5012E-08	2435.5600	0.7789629	1560873.
1060.	-5.47E-06	1984.7653	-59.4392	-2.7870E-08	2435.0908	0.8610094	1573373.
1070.	-5.55E-06	1433.5073	-50.7349	7.1113E-09	2434.6846	0.8798373	1585873.
1080.	-5.33E-06	969.9102	-42.0760	3.1707E-08	2434.3430	0.8519574	1598373.
1090.	-4.91E-06	591.2906	-33.8584	4.7684E-08	2434.0640	0.7915546	1610873.
1100.	-4.38E-06	291.6933	-26.3483	5.6720E-08	2433.8432	0.7104646	1623373.
1110.	-3.78E-06	63.0768	-19.7047	6.0351E-08	2433.6748	0.6182646	1635873.
1120.	-3.17E-06	-103.7275	-14.0011	5.9935E-08	2433.7047	0.5224439	1648373.
1130.	-2.58E-06	-218.2640	-9.2458	5.6640E-08	2433.7891	0.4286244	1660873.
1140.	-2.04E-06	-289.8890	-5.3986	5.1439E-08	2433.8419	0.3408085	1673373.
1150.	-1.55E-06	-327.3678	-2.3864	4.5123E-08	2433.8695	0.2616353	1685873.
1160.	-1.13E-06	-338.6094	-0.1150591	3.8307E-08	2433.8778	0.1926300	1698373.
1170.	-7.86E-07	-330.5118	1.5203	3.1460E-08	2433.8718	0.1344376	1710873.
1180.	-5.05E-07	-308.8959	2.6276	2.4916E-08	2433.8559	0.0870323	1723373.
1190.	-2.87E-07	-278.5073	3.3123	1.8905E-08	2433.8335	0.0498998	1735873.
1200.	-1.27E-07	-243.0660	3.9901	1.3567E-08	2433.8074	0.0856689	6750000.
1210.	-1.61E-08	-199.0031	4.4729	9.0431E-09	2433.7749	0.0108815	6750000.
1220.	5.39E-08	-153.8073	4.3452	5.4325E-09	2433.7416	-0.0364125	6750000.
1230.	9.25E-08	-112.2180	3.8509	2.7101E-09	2433.7110	-0.0624571	6750000.
1240.	1.08E-07	-76.8492	3.1736	7.7520E-10	2433.6849	-0.0729983	6750000.
1250.	1.08E-07	-48.7630	2.4440	-5.1028E-10	2433.6642	-0.0729223	6750000.
1260.	9.79E-08	-27.9579	1.7488	-1.2954E-09	2433.6489	-0.0661095	6750000.
1270.	8.21E-08	-13.7576	1.1411	-1.7223E-09	2433.6385	-0.0554341	6750000.
1280.	6.35E-08	-5.0975	0.6496662	-1.9153E-09	2433.6321	-0.0428580	6750000.
1290.	4.38E-08	-0.7221200	0.2874881	-1.9748E-09	2433.6289	-0.0295776	6750000.

```
1300.   2.40E-08   0.6956832   0.0586121 -1.9751E-09   2433.6288  -0.0161975
6750000.
1310.   4.32E-09   0.4935751  -0.0369434 -1.9629E-09   2433.6287  -0.0029136
6750000.
1320.  -1.53E-08      0.0000      0.0000 -1.9579E-09   2433.6283   0.0103022
3375000.
```

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 4:

```
Pile-head deflection              =    1.00000000 in
Computed slope at pile head       =   -0.00000932
Maximum bending moment            =    -13865760. lbs-in
Maximum shear force               =   93591.88759 lbs
Depth of maximum bending moment   =       0.00000 in
Depth of maximum shear force      =       0.00000 in
Number of iterations              =             7
Number of zero deflection points  =             5
```

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

```
Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
Type 5 = Deflection and Slope,      R = Rot. Stiffness of Pile-head in-lbs/rad
```

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
4	y= 0.500000	M= 0.000	1100000.	0.5000000	3044998.	37185.2215
5	y= 0.500000	S= 0.000	1100000.	0.5000000	-7961505.	63879.8610
4	y= 1.000000	M= 0.000	1100000.	1.0000000	4860707.	49286.3543
5	y= 1.000000	S= 0.000	1100000.	1.0000000	-1.3866E+07	93591.8876

The analysis ended normally.

Summary of Warning Messages

APPENDIX E:

REFERENCES

APPENDIX E

REFERENCES

American Society of Civil Engineers (ASCE), 2010, ASCE 7-10, Minimum Design Loads for Buildings and Other Structures.

Atkinson, G.M. and Boore, D.M., Empirical Ground-Motion Relationships for Subduction-Zone Earthquakes and Their Application to Cascadia and Other Regions, Bulletin of the Seismological Society of America, Vol. 93, No. 4, August 2003.

Electric Power Research Institute, 1993, Guidelines for Determining Deign Basis Ground Motions, EPRI TR-102293, Electric Power Institute, Palo Alto California

Geomatrix Consultants, Inc., Final Report, Seismic Design Mapping, State of Oregon: Prepared for Oregon Department of Transportation, Project No. 2442, published January 1995.

Gregor, N.J., Silva, W.J., Wong, I.G., and Youngs, R.R., Ground Motion Attenuation Relationships for Cascadia Subduction Zone Megathrust Earthquakes Based on Stochastic Finite-Fault Model, Bulliten of Seismological Society of America, Vol 92, No. 5, June 2002.

International Code Council, Inc., Oregon Structural Specialty Code, Based on the 2009 International Building Code: International Code Council published 2010.

Kramer, S.L., 1996, Geotechnical Earthquake Engineering: Prentice Hall.

Madin, I.P. and Z. Wang, 1999, Relative Earthquake Hazard Maps for Selected Urban Areas in Western Oregon, Seaside, Gearhart, Cannon Beach Urban Area, DOGAMI. Intrepretative Map Series IMS 10, map scale 1:24,000.

Niem, A.R., and Niem, W.A., Geologic Map of the Astoria Basin, Clatsop and Northernmost Tillamook Counties, Northwest Oregon: DOGAMI Oil and Gas Investigation OGI-14 published 1985, map scale 1:100,000.

Niewendorp, C.A., and Neuhaus, M.E., Map of Selected Earthquakes for Oregon, 1841 though 2002: DOGAMI Open File Report O-03-02 published 2003.

Ordonez, Gustavo, A., SHAKE2000: A Computer Progam for the 1-D Analysis of Geotechnical Earthquake Engineering Problems, Version 8.3.0

Priest, G.R., et al., Tsunami hazard assessment of the northern Oregon coast: A multi deterministic approach tested at Cannon Beach, Clatsop County, Oregon: DOGAMI Special Paper SP-41 published 2009.

Schlicker, H.G., et al., Engineering Geologic Map of the Cannon Beach Quadrangle, Oregon: DOGAMI Bulletin B-74 published 1972, map scale 1:62,500.

Seed, R.B., Cetin, K.O., Moss, R.E.S., Kammerer, A.M., Wu, J, Pestana, J.M., Riemer, M.F., Sancio, R.B., Bray, J.D., Kayen, R.E., and Faris, A, Recent Advances in Soil Liquefaction Engineering: A Unified and Consistent Framework, 26th Annual ASCE Los Angeles Geotechnical Spring Seminar, Keynote Presentation, H.M.S. Queen Mary, Long Beach, California, April 30, 2003.

Seed, H.B. and Idriss, I.M, Soil Moduli and Damping Factors for Dynamic Analysis.

Silver, M.L., and Seed, H.B., Deformation characteristics of sands under cyclic loading, Journal of Soil Mechanics and Foundations, ASCE, Vol. 97, No. 8, August 1971

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture, Web Soil Survey, http://websoilsurvey.nrcs.usda.gov/ accessed April 2011.

U.S. Geological Survey, 2002, Interactive Hazard Maps for the conterminous United States, from USGS website: http://gldims.cr.usgs.gov/website/nshmp2002/ viewer.htm.

U.S. Geological Survey, 2006 (updated November 3, 2010), Quaternary fault and fold database for the United States, accessed April 2011 from USGS web site: http//earthquakes.usgs.gov/regional/qfaults/.

Vucetic, M. and Dobry, R., Effect of Soil Plasticity on Cyclic Response, Journal of Geotechnical Engineering, Vol. 117, No. 1, January 1991

Witter, R.C., et al., Prehistoric Cascadia tsunami inundation and runup at Cannon Beach, Clatsop County, Oregon: DOGAMI Open-File Report O-08-12 published 2008.

Witter, R.C., Horning, T., and Allan, J.C., Coastal Erosion Hazard Zones in Southern Clatsop County, Oregon: Seaside to Cape Falcon: DOGAMI Open File Report O-09-06 published 2009, map scale 1:9,600.

Youd, T.L., Hansen, C.M., and Bartlett, S.F. Revised Multilinear Regression Equations for Prediction of Lateral Spread Displacement, Journal of Geotechnical and Geoenviromental Engineering, ASCE, December 2002.

Youngs, R.R., Chiou, S.J., Silva, W.J., and Humphrey, J.R. Strong Ground Motion Attenuation Relationships for Subduction Zone Earthquakes, Seismological Research Letters, Vol. 68, No. 1, January/February 1997.