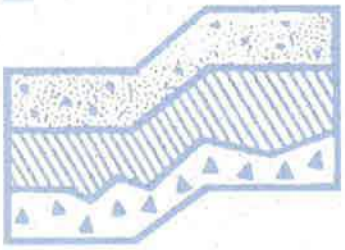
GEOTECHNICAL REPORT

Grass Valley
SE 20th Street and NW Fisher Creek Drive
Camas, Washington

Project No. T-7807



Terra Associates, Inc.

Prepared for:

Holland Partner Group
Vancouver, Washington

February 28, 2018

TERRA ASSOCIATES, Inc.
Consultants in Geotechnical Engineering, Geology
and
Environmental Earth Sciences

February 28, 2018
Project No. T-7807

Mr. Brenner Daniels
Holland Partner Group
1111 Main Street, Suite 700
Vancouver, Washington 98660

Subject: Geotechnical Report
Grass Valley
SE 20th Street and NW Fisher Creek Drive
Camas, Washington

Dear Mr. Daniels:

As requested, we conducted a geotechnical engineering study for the subject project. The attached report presents our findings and recommendations for the geotechnical aspects of project design and construction.

The site soils generally consist of approximately 3 to 12 inches of topsoil overlying 4 to 28 feet of silt, clay, silty clayey sand with gravel, and silty sand with gravel overlying sand with various amounts of silt and gravel. The deeper sand layer was observed in Test Pits TP-3, TP-25, TP-27, TP-28, and TP-29 and was noted to be weakly to moderately cemented. The sand layer was not observed in any of the other test pits. Where the deeper sand layer was encountered with the CPTs, the probe hit refusal due to the density of the material. The majority of the material observed in the test pits was noted to be in a medium dense condition. The upper silt and clay material in the CPTs was noted to be in a loose/soft to dense/hard condition. The deeper sand material was noted to be in a dense to very dense condition. We observed minor to moderate groundwater seepage in Test Pits TP-2, TP-6, TP-11, TP-12, TP-13, TP-14, TP-15, TP-16, TP-17, TP-18, and TP-22 between two and one-half feet to five and one-half feet below existing site grades. We performed two pore water dissipation tests at CPT-12 and CPT-15. Based on the test results, the static groundwater level was indicated to be at two and one-half feet and four and one-half feet in CPT-12 and CPT-15, respectively.

In our opinion, the native soils on the site will be suitable for support of the proposed development, provided the recommendations presented in this report are incorporated into project design and construction.

12220 113th Avenue NE, Ste. 130, Kirkland, Washington 98034
Phone (425) 821-7777 • Fax (425) 821-4334

We trust the information presented in this report is sufficient for your current needs. If you have any questions or require additional information, please call.

Sincerely yours,
TERRA ASSOCIATES, INC.

Alexander Dendy, P.E.
Staff Engineer

2-28-18

Carolyn S. Decker, P.E.
Project Engineer

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1.0 PROJECT DESCRIPTION

The project consists of developing 2 adjoining tax parcels totaling approximately 32.7 acres with 13 apartment buildings, 3 mixed use buildings, and a market building along with associated access and utility improvements. Based on a conceptual site plan, dated October 27, 2017, prepared by Holland Partner Group, the apartment buildings will be located on the western tax parcel and the mixed use and market buildings will be located on the eastern tax parcel. The grading plan prepared by Olson Engineering Inc., dated February 2018 indicates the grading to achieve building lot and roadway elevations on the western side of the site will consist of cuts and fills from 1 to 11 feet with a large fill berm placed on the western side of the site. The grading to achieve building lot and roadway elevations on the eastern side of the site will consist of cuts and fills from one to seven feet.

Site stormwater will be collected and directed to one of two stormwater facilities located in the western portion of the site near the proposed fill berm.

We expect that the structures will be one- to three-story, wood-framed buildings constructed at grade. Structural loading is expected to be light to moderate with bearing walls carrying loads of 1 to 6 kips per foot and isolated columns carrying maximum loads of 100 to 300 kips.

The recommendations contained in the following sections of this report are based on our understanding of the above design features. We should review design drawings as they become available to verify that our recommendations have been properly interpreted and incorporated into project design and to amend or supplement our recommendations, if required.

2.0 SCOPE OF WORK

On December 27 and 28, 2017, we observed the soil and groundwater conditions in 29 test pits excavated to a maximum depth of approximately 8 feet below existing surface grades using a track-mounted mini-excavator. On December 28 and 29, 2017, Oregon Geotechnical Explorations, under subcontract with Terra Associates, Inc., performed 15 cone penetration tests (CPTs) to a maximum depth of 30 feet below existing surface grades. Using the results of our field study and laboratory testing, analyses were undertaken to develop geotechnical recommendations for project design and construction. Specifically, this report addresses the following:

- Soil and groundwater conditions
- Geologic hazards per the City of Camas Municipal Code
- Seismic design parameters per the 2015 International Building Code (IBC)
- Site preparation and grading
- Excavations

- Foundations
- Slab-on-grade floors
- Infiltration feasibility
- Drainage
- Utilities
- Pavements

It should be noted that recommendations outlined in this report regarding drainage are associated with soil strength, design earth pressures, erosion, and stability. Design and performance issues with respect to moisture as it relates to the structure environment are beyond Terra Associates' purview. A building envelope specialist or contactor should be consulted to address these issues, as needed.

3.0 SITE CONDITIONS

3.1 Surface

The project site consists of 2 tax parcels totaling approximately 32.7 acres located southwest of the intersection of SE 20th Street and NW Fisher Creek Drive in Camas, Washington. The approximate location of the site is shown on the Vicinity Map, Figure 1.

The site is currently occupied by two structures in the approximate center with scattered mature trees throughout. The remainder of the site is vacant and predominately covered with brush and weeds. Site topography is generally flat with a slight decline to the west.

3.2 Soils

In general, the soil conditions observed in the test pits and noted in the CPTs consisted of 3 to 12 inches of topsoil overlying 4 to 28 feet of silt, clay, silty clayey sand with gravel, and silty sand with gravel overlying sand with various amounts of silt and gravel. The deeper sand layer was observed in Test Pits TP-3, TP-25, TP-27, TP-28, and TP-29 and was noted to be weakly to moderately cemented. The sand layer was not observed in any of the other test pits. Where the deeper sand layer was encountered with the CPTs, the probe hit refusal due to the density of the material. The majority of the material observed in the test pits was noted to be in a medium dense condition. The upper silt and clay material in the CPTs was noted to be in a loose/soft to dense/hard condition. The deeper sand material was noted to be in a dense to very dense condition.

There were two exceptions to this general condition. In Test Pit TP-21, we observed approximately 3 feet of organic fill overlying the native soils. CPT-15 was terminated in very stiff/hard silts at 30 feet below current site grades. The dense sand layer was not encountered in this CPT.

The *Geologic Map of the Camas Quadrangle, Clark County, Washington, and Multnomah County, Oregon* by R.C. Evarts and J.E. O'Connor (2008) maps the site as Sand and Silt Facies (Qfs). The native soils we observed in the test pits and CPTs are consistent with this geologic map unit.

The preceding discussion is intended to be a general review of the soil conditions encountered. For more detailed descriptions, please refer to the Test Pit and CPT Logs in Appendix A.

3.3 Groundwater

We observed minor to moderate groundwater seepage in Test Pits TP-2, TP-6, TP-11, TP-12, TP-13, TP-14, TP-15, TP-16, TP-17, TP-18, and TP-22 between two and one-half feet to five and one-half feet below existing site grades. We performed two pore water dissipation tests at CPT-12 and CPT-15. Based on the test results, the static groundwater level was indicated to be at two and one-half feet and four and one-half feet in CPT-12 and CPT-15, respectively.

Fluctuations in the static groundwater level will occur seasonally. Typically, groundwater will reach maximum levels during the wet winter months. Based on the time of year the water levels were recorded, the groundwater levels observed at the site likely represent the seasonal high groundwater levels.

3.3.1 Hydrologic Soil Group Classification

We used the soil and groundwater conditions observed at the site to classify onsite soils into a soil group category as defined by the Western Washington Hydrology Model 2012 Manual (WWHM). Laboratory testing classified the native soils as silty SAND and sandy SILT according to USCS classification. Results are in Appendix A. Using the results of the laboratory testing, we calculated the coefficient of permeability (k) for the soils.

According to the National Engineering Handbook Part 630 Hydrology, Chapter 7, Hydrologic Soils Coups, (USDA Natural Resources Conservation Service), four Hydrologic Soil Groups are identified in order to aid in the determination of stormwater runoff from a site. This classification identifies soil Groups A through D, with Group A soils exhibiting the highest permeability and Group D soils exhibiting the least. There are several factors considered when classifying soils according to the USDA system with the predominant criteria being hydraulic conductivity (permeability), depth to static groundwater, and depth to an impermeable layer.

The WWHM uses a combination of the USDA classification and additional permeability criteria to determine an applicable soil group. According to the WWHM, soils in Clark County are divided into five soil groups. In general, soils classified as Group 1 are typically very well drained progressing to less well drained in Group 5. Although permeability is the predominate criteria in selecting an appropriate category, the WWHM classifications also consider regional experience and supplementary attribute information for those soils that are difficult to categorize based on permeability alone.

The surface soils at the site are predominately mapped as Hesson (HcB) and Olympic (OmE). According to the WWHM, the default classifications for these soils are Soil Group 3 and is partially based on an anticipated USDA Hydrologic Soil Group classification of "C/B". However, site-specific testing indicated a coefficient of permeability of approximately 0.10 inches per hour. This value meets the criteria to be considered a USDA Hydrologic Soil Group C and is less than the lower bound rate of 0.2 inches per hour as published in the WWHM for Hesson and Olympic soils. In addition, ponded surface water and shallow groundwater seepage was observed in many areas indicating poorly-drained conditions. As stated qualitatively by the WWHM, Soil Group 4 is denoted as the category that contains the poorly-drained soils. Therefore, based on the site-specific testing and visual observation of shallow groundwater, we recommend that the Hesson and Olympic soils located at the site be classified as Soil Group 4 in accordance with the WWHM.

3.4 Geologic Hazards

3.4.1 Erosion Hazard Areas

Section 16.59.020(A) of the Camas Municipal Code (CMC) defines erosion hazard areas as "areas where there is not a mapped or designated landslide hazard, but where there are steep slopes equal to or greater than 40 percent slope."

During our site reconnaissance, we did not observe any slopes inclined at 40 percent or greater. Therefore, the site would not be considered an erosion hazard per the CMC. Regardless, erosion protection measures as required by the city and state will need to be in place prior to starting grading activities on the site. This would include perimeter silt fencing to contain erosion on-site and cover measures to prevent or reduce soil erosion during and following construction.

3.4.2 Landslide Hazard Areas

Section 16.59.020(B) of the CMC defines landslide hazard areas as "areas potentially subject to landslides based on a combination of geologic, topographic, and hydrologic factors. They include areas susceptible because of any combination of bedrock, soil, slope (gradient), slope aspect, structure, hydrology, or other factors. Examples of these may include, but are not limited to the following:

1. Areas of previous slope failures including areas of unstable old or recent landslides.
2. Areas with all three of the following characteristics:
    a. Slopes steeper than 15 percent.
    b. Hillsides intersecting geologic contacts with permeable sediment overlying a low permeability sediment or bedrock.
    c. Any springs or groundwater seepage.
3. Slopes that are parallel or sub-parallel to planes of weakness, such as bedding planes, joint systems, and fault planes in subsurface materials.

4. Areas mapped by:

    a. Washington Department of Natural Resources Open File Report: Slope Stability of Clark County, 1975, as having potential instability, historical or active landslides, or as older landslide debris.

    b. The Washington Department of Natural Resources Open File Report Geologic Map of the Vancouver Quadrangle, Washington and Oregon, 1987, as landslides.

5. Slopes greater than 80 percent, subject to rock fall during earthquake shaking.

6. Areas potentially unstable as a result of rapid stream incision, stream bank erosion, and stream undercutting the toe of a slope.

7. Areas located in a canyon or on an active alluvial fan, presently or potentially subject to inundation by debris flows, debris torrents, or catastrophic flooding.

During our site reconnaissance, we did not observe any of the above conditions nor did we observe any signs of ongoing slope instability. Therefore, it is our opinion that the site does not contain any landslide hazard areas as defined by the CMC.

3.4.3 Seismic Hazard Areas

Section 16.59.020(C) of the CMC defines a seismic hazard area as "area subject to severe risk of damage as a result of earthquake-induced soil liquefaction, ground shaking amplification, slope failure, settlement, or surface faulting. Relative seismic hazard is mapped on the NEHRP site class map of Clark County, published by the Washington Department of Natural Resources."

Liquefaction is a phenomenon where there is a reduction or complete loss of soil strength due to an increase in water pressure induced by vibrations. Liquefaction mainly affects geologically recent deposits of fine-grained sand that is below the groundwater table. Soils of this nature derive their strength from intergranular friction. The generated water pressure or pore pressure essentially separates the soil grains and eliminates this intergranular friction; thus, eliminating the soil's strength.

Based on the soil and groundwater conditions observed at the site, it is our opinion, that the site poses a low risk for seismically induced settlement and liquefaction. The NEHRP site class map of Clark County, published by the Washington Department of Natural Resources, labels the site as class B to C. Therefore, the site would not be classified as a seismic hazard according to the CMC.

3.5 Seismic Design Parameters

Based on the site soil conditions and our knowledge of the area geology, per the 2015 International Building Code (IBC), site class "D" should be used in structural design. Based on this site class, in accordance with the 2015 IBC, the following parameters should be used in computing seismic forces:

Seismic Design Parameters (IBC 2015)

Spectral response acceleration (Short Period), S_{Ms}	1.043 g
Spectral response acceleration (1 – Second Period), S_{M1}	0.626 g
Five percent damped .2 second period, S_{Ds}	0.695 g
Five percent damped 1.0 second period, S_{D1}	0.417 g

These values were determined using the latitude/longitude coordinates 45.6063°N, 122.4677°W and the United States Geological Survey (USGS) Ground Motion Parameter Calculator accessed on January 5, 2018 at the web site http://earthquake.usgs.gov/designmaps/us/application.php.

4.0 DISCUSSION AND RECOMMENDATIONS

4.1 General

Based on our study, there are no geotechnical conditions that would preclude construction of the planned development. The primary geotechnical concern at the site is the presence of a thick layer of compressible soil strata susceptible to consolidation under the planned building loads. See the areas outlined on Figures 2a and 2b. For the heavier three-story buildings, in our opinion, mitigating potential settlement-related impacts would best be accomplished by supporting the structure on spread footings bearing on ground conditions improved by installation of rammed aggregate piers/stone columns. For lightly loaded one- to two-story buildings, support on conventional spread footings could be considered following completion of a building fill surcharge program.

As an alternative to ground improvement or surcharge, the majority of the buildings in the western half of the property (outside of the areas noted on Figure 2b), can be supported on conventional spread footing foundations bearing on a minimum of four feet of structural fill that replaces the native silts and clays.

The soils observed at the site contain a significant amount of fines and will be difficult to compact as structural fill when too wet. The ability to use native soils from site excavations as structural fill will depend on its moisture content and the prevailing weather conditions at the time of construction. If grading activities will take place during winter, the owner should be prepared to import clean granular material for use as structural fill and backfill. Alternatively, stabilizing the moisture in the native and existing fill soils with cement or lime can be considered.

The following sections provide detailed recommendations regarding the preceding issues and other geotechnical design considerations. These recommendations should be incorporated into the final design drawings and construction specifications.

4.2 Site Preparation and Grading

To prepare the site for construction, all vegetation, organic surface soils, and other deleterious materials should be stripped and removed from below building and pavement areas. We expect that surface stripping depths of approximately 3 to 12 inches will generally be required to remove the organic surface soils. Stripped vegetation debris should be removed from the site. Organic soils will not be suitable for use as structural fill, but may be used for limited depths in nonstructural areas or for landscaping purposes. Demolition of existing structures should include removal of existing foundations and abandonment of underground septic systems and other buried utilities. Abandoned utility pipes that fall outside of new building areas can be left in place provided they are sealed to prevent intrusion of groundwater seepage and soil.

Once stripping operations are complete, cut and fill operations can be initiated to establish desired building grades. Prior to placing fill, all exposed bearing surfaces should be observed by a representative of Terra Associates, Inc. to verify soil conditions are as expected and suitable for support of new fill or building elements. Our representative may request a proofroll using heavy rubber-tired equipment to determine if any isolated soft and yielding areas are present. If excessively yielding areas are observed, and they cannot be stabilized in place by compaction, the affected soils should be excavated and removed to firm bearing and grade restored with new structural fill. If the depth of excavation to remove unstable soils is excessive, the use of geotextile fabrics, such as Mirafi 500X, or an equivalent fabric, can be used in conjunction with clean granular structural fill. Our experience has shown that, in general, a minimum of 18 inches of a clean, granular structural fill place and compacted over the geotextile fabric should establish a stable bearing surface.

For the buildings located on the western portion of the project (outside of the areas noted on Figure 2b), soils suitable for support of the proposed building loads are present within the upper four to six feet of the soil profile. Therefore, it is our opinion that for these buildings, it would be best to overexcavate the upper four feet of material at the foundation locations and restore the site grade with new structural fill placed and compacted as outlined below. The overexcavation should extend two feet laterally from the outside edge of the building foundation. If the overexcavation and replacement is not feasible, the surcharge/preload program can be used as an alternate for this area.

All buildings that use the preload/surcharge program should have footings that obtain support on a minimum of two feet of granular structural fill. The fill should extend laterally from the edge of footing a minimum distance of one-foot.

All slab-on-grade floors should bear on a minimum of 12 inches of structural fill that replaces the native silts and clays.

Our study indicates that the native soils contain a sufficient percentage of fines (silt and clay size particles) that will make them difficult to compact as structural fill if they are too wet or too dry. Accordingly, the ability to use these native soils from site excavations as structural fill will depend on their moisture content and the prevailing weather conditions when site grading activities take place. Native soils that are too wet to properly compact could be dried by aeration during dry weather conditions or mixed with an additive such as cement, cement kiln dust (CKD), or lime to stabilize the soil and facilitate compaction. If cement is used, based on the soil type and moisture content at the time of our exploration, we expect that three to five percent of the soils dry unit weight will be required to obtain a suitable moisture content for structural fill. For pavement subgrades, we expect that four to seven percent of the soils dry unit weight will be required to achieve an acceptable moisture content. If an additive is used, additional BMPs addressing the potential for elevated pH levels will need to be included in the Storm Water Pollution Prevention Program (SWPPP) prepared with the TESC plan.

If grading activities are planned during the wet winter months, or if they are initiated during the summer and extend into fall and winter, the owner should be prepared to import wet weather structural fill. For this purpose, we recommend importing a granular soil that meets the following grading requirements:

U.S. Sieve Size	Percent Passing
6 inches	100
No. 4	75 maximum
No. 200	5 maximum*

*Based on the 3/4-inch fraction.

Prior to use, Terra Associates, Inc. should examine and test all materials imported to the site for use as structural fill.

Structural fill should be placed in uniform loose layers not exceeding 12 inches and compacted to a minimum of 95 percent of the soil's maximum dry density, as determined by American Society for Testing and Materials (ASTM) Test Designation D-698 (Standard Proctor). The moisture content of the soil at the time of compaction should be within two percent of its optimum, as determined by this ASTM standard. In nonstructural areas, the degree of compaction can be reduced to 90 percent.

4.3 Preload/Surcharge

For building column loads of up to 200 kips, in our opinion, the buildings could be supported on conventional spread footing foundations with potential differential foundation settlement mitigated by implementation of a surcharge program. The surcharge program consists of placing fill material over the building footprint to pre-consolidate the compressible soils. The amount and rate of settlement is monitored and once primary settlements have occurred, the surcharge is removed and building construction can commence.

Following preparation of the foundation subgrade as outlined in Section 4.2, we recommend placing a minimum of five feet of fill above the finished floor grade in the building areas. The surcharge fill does not need to meet any special requirements other than having a minimum in place unit weight of 120 pounds per cubic foot (pcf). However, it may be advisable to use a good quality fill that can be used to raise grades in other portions of the site, such as parking and driveway areas, if necessary. The surcharge fill should extend a minimum of five feet beyond the edge of the perimeter building footings.

We estimate that total settlement under the surcharge fill will be in the range of four to five inches. It is estimated that 90 percent of the consolidation settlement will occur in approximately four to six weeks following full application of the surcharge.

To evaluate the amount of settlement and the time rate of movement, the surcharge program should be monitored by installing settlement markers. The settlement markers should be installed on the existing grade prior to placing any surcharge fill. Once installed, elevations of both the fill height and marker should be taken daily until the full height of the surcharge is in place. Once fully surcharged, readings should continue weekly until the anticipated settlements have occurred. Monitoring data should be forwarded to us within two days after it is obtained for review and comment. A typical settlement marking detail is shown on Figure 3.

It is critical that the grading contractor recognize the importance of the settlement marker installations. All efforts must be made to protect the markers from damage during fill placement. It is difficult, if not impossible, to evaluate the progress of the preload program if the markers are damaged or destroyed by construction equipment. If the markers are impacted, it may be necessary to install new markers and extend the surcharging time period in order to ensure that settlements have ceased and building construction can begin.

Following the successful completion of the surcharge program, with foundations supported on a minimum of two feet of granular structural fill and dimensioned as recommended in Section 4.5 of this report, you should expect maximum total and differential post-construction settlement of approximately one-inch and one-half inch, respectively.

4.4 Excavations

All excavations at the site associated with confined spaces, such as utility trenches, must be completed in accordance with local, state, and federal requirements. Based on regulations outlined in the Washington Industrial Safety and Health Act (WISHA), the soils observed at the site would be classified as Type C soil.

Accordingly, temporary excavations in Type C soils should have their slopes laid back at an inclination of 1.5:1 (Horizontal:Vertical) or flatter, from the toe to the crest of the slope. All exposed temporary slope faces that will remain open for an extended period of time should be covered with a durable reinforced plastic membrane during construction to prevent slope raveling and rutting during periods of precipitation.

Groundwater seepage may be encountered in excavations particularly during the wet winter season. We anticipate that the volume of water and rate of flow into the excavation could be light to moderate, however, this seepage is not expected to impact the stability of the excavations when completed as described above. Conventional sump pumping procedures, along with a system of collection trenches, if necessary should be capable of maintaining a relatively dry excavation for construction purposes.

The above information is provided solely for the benefit of the owner and other design consultants, and should not be construed to imply that Terra Associates, Inc. assumes responsibility for job site safety. It is understood that job site safety is the sole responsibility of the project contractor.

4.5 Foundations

In our opinion, following the successful implementation of the surcharge program as outlined in Section 4.3 of this report, the one- and two-story buildings can be supported on conventional spread footing foundations. If the owner is not willing to accept some risk with respect to building settlement, or static dead plus live column loads exceeding 200 kips, then we recommend supporting the building on piles or ground improved using rammed aggregated piers/stone columns.

In our opinion, the buildings located outside of the outlined area on Figures 2a and 2b can be supported on conventional spread footing foundations bearing on a minimum of four feet of structural fill.

Spread Footings

In our opinion, following successful completion of a surcharge program, the one to two-story buildings may be supported on conventional spread footing foundations bearing on a minimum of two feet of structural fill, as recommended in Section 4.2 of this report.

The buildings outside of the outlined area on Figures 2a and 2b may be supported on conventional spread footing foundations bearing on a minimum of four feet of structural fill, as recommended in Section 4.2 of this report.

Foundations exposed to the weather should bear at a minimum depth of 1.5 feet below adjacent grades for frost protection. Interior foundations can be supported at any convenient depth below the floor slab, provided immediate support is obtained on a minimum of two feet of structural fill.

We recommend designing foundations for a net allowable bearing capacity of 3,000 psf. For short-term loads, such as wind and seismic, a one-third increase in this allowable capacity can be used. Following successful completion of the surcharge program with the expected building loads and this bearing stress applied, in general, total and differential settlements should not exceed one-inch and one-half inch, respectively.

For designing foundations to resist lateral loads, a base friction coefficient of 0.35 can be used. Passive earth pressures acting on the sides of the footings can also be considered. We recommend calculating this lateral resistance using an equivalent fluid weight of 300 pcf. We do not recommend including the upper 12 inches of soil in this computation because it can be affected by weather or disturbed by future grading activity. This value assumes the foundation will be backfilled with structural fill, as described in Section 4.2 of this report. The values recommended include a safety factor of 1.5.

Ground Improvement Alternative

As an alternative to surcharge or where the building loads exceed 200 kips per column, consideration can be given to using ground improvement techniques to establish suitable support for conventional spread footing designs. Methods that could be considered include vibrated stone columns or GeoPiers (aggregate rammed piers). Both of these methods create highly densified columns of graded aggregate that would extend through the upper softer soils a short depth into the underlying medium dense to dense sands. Because of the methods used to construct the columns some improvement of the adjacent soils is also realized. Once constructed, conventional spread footing foundations can be designed to bear immediately above the stone column/GeoPier locations.

These ground improvement techniques are typically completed on a design/build approach with both design and construction completed by a specialty contractor. We can assist in contracting and selecting the specialty contractor, if desired.

4.6 Slab-on-Grade Floors

Slab-on-grade floors may be supported on a subgrade prepared as recommended in Section 4.2 of this report. Immediately below the floor slab, we recommend placing a four-inch thick capillary break layer composed of clean, coarse sand or fine gravel that has less than three percent passing the No. 200 sieve. This material will reduce the potential for upward capillary movement of water through the underlying soil and subsequent wetting of the floor slab.

The capillary break layer will not prevent moisture intrusion through the slab caused by water vapor transmission. Where moisture by vapor transmission is undesirable, such as covered floor areas, a common practice is to place a durable plastic membrane on the capillary break layer and then cover the membrane with a layer of clean sand or fine gravel to protect it from damage during construction, and aid in uniform curing of the concrete slab. It should be noted that if the sand or gravel layer overlying the membrane is saturated prior to pouring the slab, it will be ineffective in assisting uniform curing of the slab and can actually serve as a water supply for moisture seeping through the slab and affecting floor coverings. Therefore, in our opinion, covering the membrane with a layer of sand or gravel should be avoided if floor slab construction occurs during the wet winter months and the layer cannot be effectively drained. We recommend floor designers and contractors refer to the current American Concrete Institute (ACI) Manual of Concrete Practice for further information regarding vapor barrier installation below slab-on-grade floors.

4.7 Infiltration Feasibility

Based on the soil conditions observed in our test pits and CPTs, it is our opinion that on-site infiltration is not a viable option for management of site stormwater. Based on our observations of mottling, perched groundwater seepage, and cemented zones observed at the site, it is also our opinion that the site conditions would generally not be suitable for applying other Low Impact Development techniques either.

4.8 Drainage

Surface

Final exterior grades should promote free and positive drainage away from the building areas. We recommend providing a positive drainage gradient away from the building perimeter. If a positive gradient cannot be provided, provisions for collection and disposal of surface water adjacent to the structure should be provided.

Subsurface

We recommend installing a continuous drain along the outside lower edge of the perimeter building foundations. The drains can be laid to grade at an invert elevation equivalent to the bottom of footing grade. The drains can consist of four-inch diameter perforated PVC pipe that is enveloped in washed ½- to ¾-inch gravel-sized drainage aggregate. The aggregate should extend six inches above and to the sides of the pipe. The foundation drains and roof downspouts should be tightlined separately to an approved point of controlled discharge. All drains should be provided with cleanouts at easily accessible locations. These cleanouts should be serviced at least once each year.

4.9 Utilities

Utility pipes should be bedded and backfilled in accordance with American Public Works Association (APWA) or local jurisdictional requirements. At minimum, trench backfill should be placed and compacted as structural fill as described in Section 4.2 of this report. As noted, depending on the soil moisture when excavated most inorganic native soils on the site should be suitable for use as backfill material during dry weather conditions. However, if utility construction takes place during the wet winter months, it will likely be necessary to import suitable wet weather fill for utility trench backfilling.

4.10 Pavements

Pavements should be constructed on subgrades prepared as recommended in Section 4.2 of this report. Regardless of the degree of relative compaction achieved, the subgrade must be firm and relatively unyielding before paving. Proofrolling the subgrade with heavy construction equipment should be completed to verify this condition.

The pavement design section is dependent upon the supporting capability of the subgrade soils and the traffic conditions to which it will be subjected. As we understand, traffic will mainly consist of light passenger and commercial vehicles with only occasional heavy traffic in the form of moving trucks, delivery trucks and trash removal vehicles. Based on this information, with a stable subgrade prepared as recommended, we recommend the following pavement sections:

- Two inches of Hot Mix Asphalt (HMA) over six inches of crushed rock base (CRB)
- Four inches of full depth HMA

Soil cement stabilization or constructing a soil cement base for support of the pavement section can also be considered as an alternate to the above conventional pavement sections. Assuming a properly constructed soil cement base having a minimum thickness of 12 inches and a minimum 7-day compressive strength of 100 pounds per square inch (psi), a minimum HMA pavement thickness of 2 inches would be required for the traffic areas. The final design of the soil cement base should be completed using samples of the subgrade exposed at the time of construction. On a preliminary basis, we would expect that a cement content of five to eight percent of the soils dry unit weight will be required to achieve a suitable soil cement base.

All paving materials should conform to Washington State Department of Transportation (WSDOT) specifications for HMA and CRB.

Long-term pavement performance will depend on surface drainage. A poorly-drained pavement section will be subject to premature failure as a result of surface water infiltrating into the subgrade soils and reducing their supporting capability. For optimum performance, we recommend surface drainage gradients of at least two percent. Some degree of longitudinal and transverse cracking of the pavement surface should be expected over time. Regular maintenance should be planned to seal cracks when they occur.

5.0 ADDITIONAL SERVICES

Terra Associates, Inc. should review the final designs and specifications in order to verify that earthwork and foundation recommendations have been properly interpreted and implemented in project design. We should also provide geotechnical services during construction in order to observe compliance with our design concepts, specifications, and recommendations. This will allow for design changes if subsurface conditions differ from those anticipated prior to the start of construction.

6.0 LIMITATIONS

We prepared this report in accordance with generally accepted geotechnical engineering practices. This report is the copyrighted property of Terra Associates, Inc. and is intended for specific application to the Grass Valley project in Camas, Washington. This report is for the exclusive use of Holland Partner Group and their authorized representatives. No other warranty,

REFERENCE: https://www.bing.com/maps ACCESSED 1/17/18

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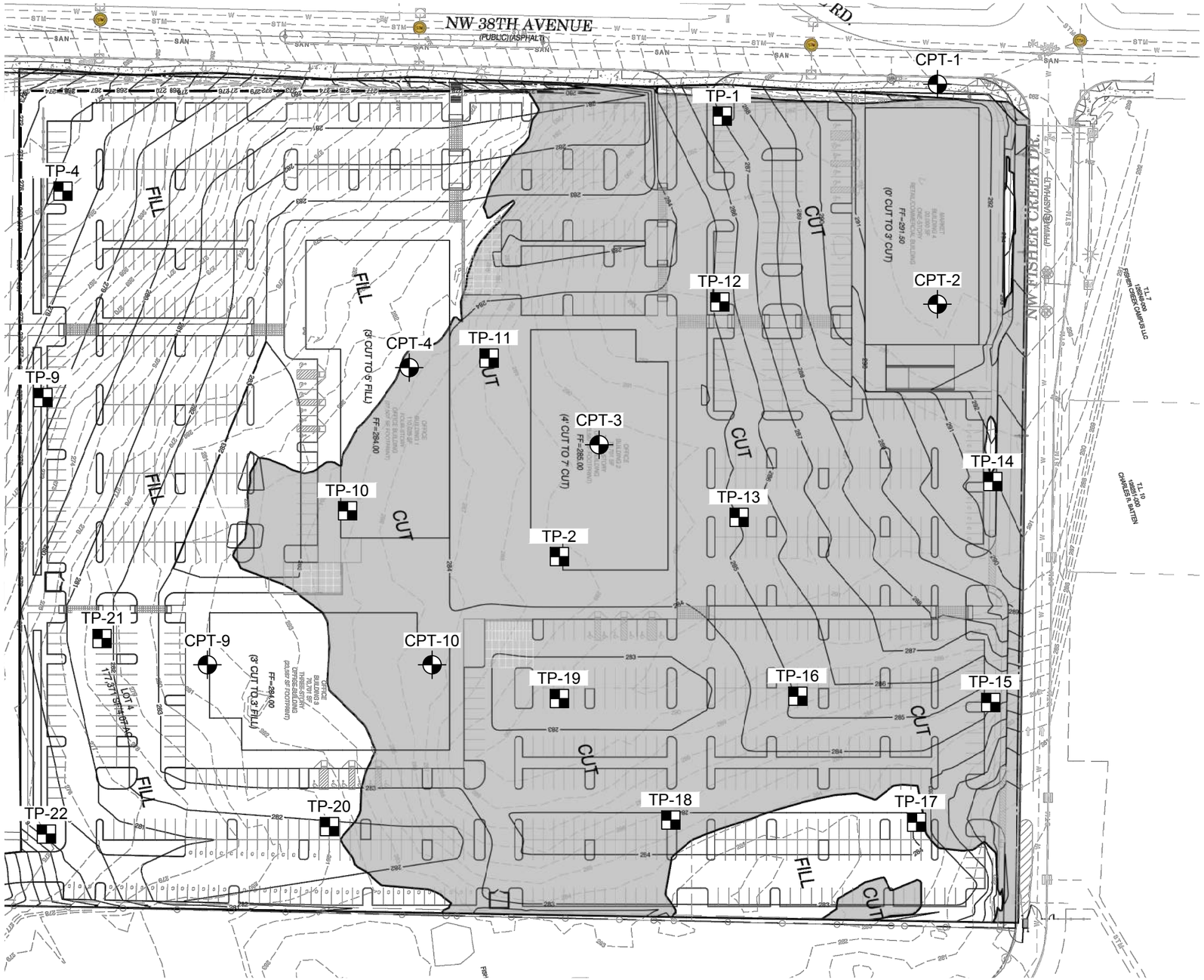
Environmental Earth Sciences

VICINITY MAP
GRASS VALLEY
CAMAS, WASHINGTON

Proj.No. T-7807	Date: FEB 2018	Figure 1



NOTE:

THIS SITE PLAN IS SCHEMATIC. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE. IT IS INTENDED FOR REFERENCE ONLY AND SHOULD NOT BE USED FOR DESIGN OR CONSTRUCTION PURPOSES.

REFERENCE: SITE PLAN PROVIDED BY OLSEN ENGINEERING.

LEGEND:

- APPROXIMATE TEST PIT LOCATION
- APPROXIMATE CONE PENETRATION LOCATION

0 150 300

APPROXIMATE SCALE IN FEET

N

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EXPLORATION LOCATION PLAN
GRASS VALLEY
CAMAS, WASHINGTON

Proj.No. T-7807	Date: FEB 2018	Figure 2A

NOTE:

THIS SITE PLAN IS SCHEMATIC. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE. IT IS INTENDED FOR REFERENCE ONLY AND SHOULD NOT BE USED FOR DESIGN OR CONSTRUCTION PURPOSES.

REFERENCE: SITE PLAN PROVIDED BY OLSEN ENGINEERING.

LEGEND:

- APPROXIMATE TEST PIT LOCATION
- APPROXIMATE CONE PENETRATION LOCATION

0 100 200

APPROXIMATE SCALE IN FEET

TP-29 CPT-15 TP-25 TP-27 TP-6 TP-3 CPT-13 CPT-11 TP-24 CPT-7 CPT-6 TP-28 TP-26 TP-23 TP-7 TP-5 CPT-14 CPT-12 CPT-8 TP-8 CPT-5

NW 38TH AVENUE (PUBLIC/ASPHALT)

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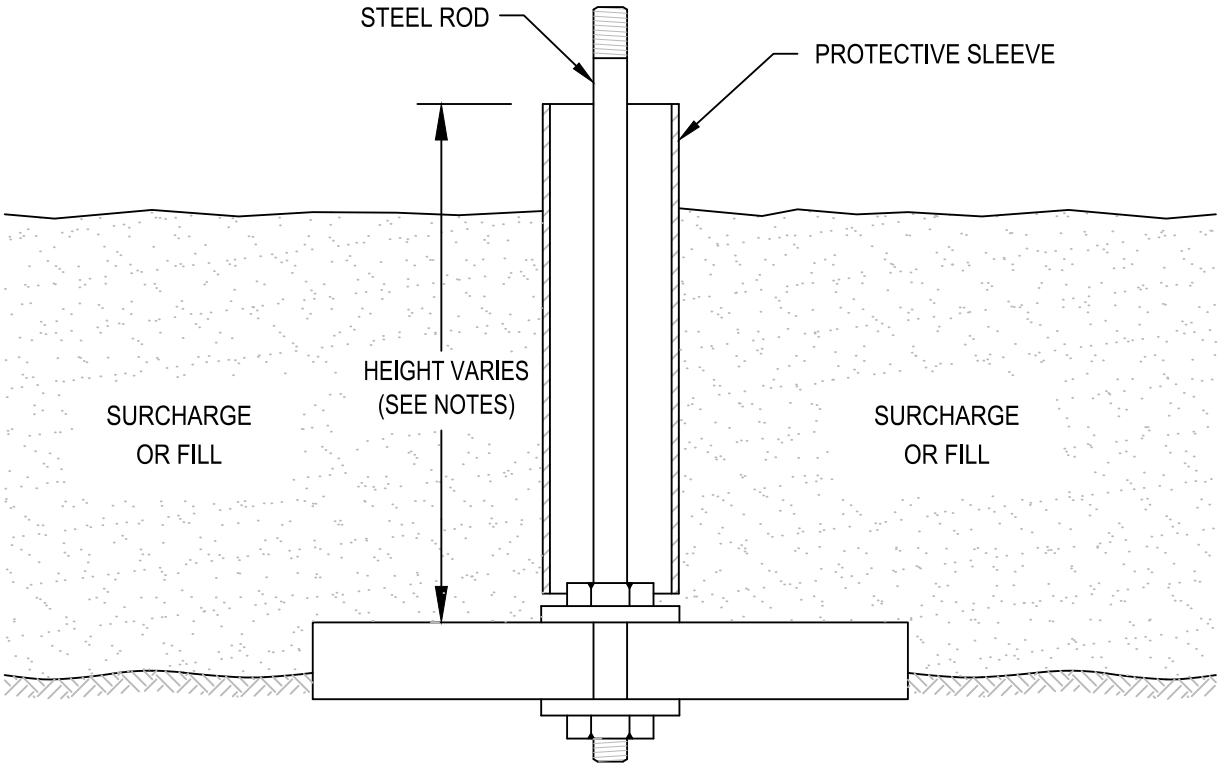
EXPLORATION LOCATION PLAN
GRASS VALLEY
CAMAS, WASHINGTON

Proj.No. T-7807	Date: FEB 2018	Figure 2B



NOT TO SCALE

NOTES:

1. BASE CONSISTS OF 3/4" THICK, 2'x2' PLYWOOD WITH CENTER DRILLED 5/8" DIAMETER HOLE.
2. BEDDING MATERIAL, IF REQUIRED, SHOULD CONSIST OF CLEAN COARSE SAND.
3. MARKER ROD IS 1/2" DIAMETER STEEL ROD THREADED AT BOTH ENDS.
4. MARKER ROD IS ATTACHED TO BASE BY NUT AND WASHER ON EACH SIDE OF BASE.
5. PROTECTIVE SLEEVE SURROUNDING MARKER ROD SHOULD CONSIST OF 2" DIAMETER PLASTIC TUBING. SLEEVE IS NOT ATTACHED TO ROD OR BASE.
6. ADDITIONAL SECTIONS OF STEEL ROD CAN BE CONNECTED WITH THREADED COUPLINGS.
7. ADDITIONAL SECTIONS OF PLASTIC PROTECTIVE SLEEVE CAN BE CONNECTED WITH PRESS-FIT PLASTIC COUPLINGS.
8. STEEL MARKER ROD SHOULD EXTEND AT LEAST 6" ABOVE TOP OF PLASTIC PROTECTIVE SLEEVE.
9. PLASTIC PROTECTIVE SLEEVE SHOULD EXTEND AT LEAST 1" ABOVE TOP OF FILL SURFACE.

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SETTLEMENT MARKER DETAIL
GRASS VALLEY
CAMAS, WASHINGTON

Proj.No. T-7807	Date: FEB 2018	Figure 3

APPENDIX A
FIELD EXPLORATION AND LABORATORY TESTING

Grass Valley
Camas, Washington

On December 27 and 28, 2017, we investigated subsurface conditions at the site by excavating 29 test pits to maximum depths of approximately 8 feet below existing surface grades using a track-mounted mini-excavator. On December 28 and 29, 2017, our subcontractor advanced 15 CPTs to a maximum depth of approximately 30 feet below site grades. The test pit and CPT locations were approximately determined in the field by sighting and measuring from existing surface features as well as by handheld GPS with coordinates obtained from Google Earth. The approximate test pit and CPT locations are shown on Figures 2a and 2b. The Test Pit Logs are presented on Figures A-2 through A-30.

A geotechnical engineer from our office conducted the field explorations. Our representative classified the soil conditions encountered, maintained a log of each test pit, obtained representative soil samples, and recorded water levels observed during excavation. All soil samples were visually classified in accordance with the Unified Soil Classification System (USCS) described on Figure A-1.

Representative soil samples obtained from the test pits were placed in closed containers and taken to our laboratory for further examination and testing. The moisture content of each sample was measured and is reported on the individual Test Pit Logs. Grain size analyses were performed on selected samples. The results of the grain size analyses are shown on Figures A-31 through A-33.

Oregon Geotechnical Services, under subcontract with Terra Associates, Inc. conducted 15 electric CPTs at locations selected by Terra Associates, Inc., which are shown on Figures 2a and 2b. The CPTs were advanced to a maximum depth of 30 feet below the surface. The CPT is an instrumented approximately 1 ½-inch diameter cone that is pushed into the ground at a constant rate. During advancement, continuous measurements are made of the resistance to penetration of the cone and the friction of the outer surface of a sleeve. The cone is also equipped with a porous filter and a pressure transducer for measuring groundwater or pore water pressure generated. Measurements of tip and sleeve frictional resistance, pore pressure, and interpreted soil conditions are summarized in graphical form on the attached CPT Logs.

MAJOR DIVISIONS			LETTER SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS (More than 50% material larger than No. 200 sieve size)	**GRAVELS** More than 50% of coarse fraction is larger than No. 4 sieve	Clean Gravels (less than 5% fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines.
		Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines.
			GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines.
	SANDS More than 50% of coarse fraction is smaller than No. 4 sieve	Clean Sands (less than 5% fines)	SW	Well-graded sands, sands with gravel, little or no fines.
			SP	Poorly-graded sands, sands with gravel, little or no fines.
		Sands with fines	SM	Silty sands, sand-silt mixtures, non-plastic fines.
			SC	Clayey sands, sand-clay mixtures, plastic fines.
FINE GRAINED SOILS (More than 50% material smaller than No. 200 sieve size)	**SILTS AND CLAYS** Liquid Limit is less than 50%		ML	Inorganic silts, rock flour, clayey silts with slight plasticity.
			CL	Inorganic clays of low to medium plasticity. (Lean clay)
			OL	Organic silts and organic clays of low plasticity.
	SILTS AND CLAYS Liquid Limit is greater than 50%		MH	Inorganic silts, elastic.
			CH	Inorganic clays of high plasticity. (Fat clay)
			OH	Organic clays of high plasticity.
HIGHLY ORGANIC SOILS			PT	Peat.

DEFINITION OF TERMS AND SYMBOLS

COHESIONLESS

Density	Standard Penetration Resistance in Blows/Foot
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	>50

COHESIVE

Consistancy	Standard Penetration Resistance in Blows/Foot
Very Soft	0-2
Soft	2-4
Medium Stiff	4-8
Stiff	8-16
Very Stiff	16-32
Hard	>32

I	2" OUTSIDE DIAMETER SPILT SPOON SAMPLER
II	2.4" INSIDE DIAMETER RING SAMPLER OR SHELBY TUBE SAMPLER
▼	WATER LEVEL (Date)
Tr	TORVANE READINGS, tsf
Pp	PENETROMETER READING, tsf
DD	DRY DENSITY, pounds per cubic foot
LL	LIQUID LIMIT, percent
PI	PLASTIC INDEX
N	STANDARD PENETRATION, blows per foot

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UNIFIED SOIL CLASSIFICATION SYSTEM
GRASS VALLEY
CAMAS, WASHINGTON

Proj.No. T-7807	Date: FEB 2018	Figure A-1

LOG OF TEST PIT NO. TP-1

FIGURE A-2

PROJECT NAME: Grass Valley **PROJ. NO:** T-7807 **LOGGED BY:** AJD

LOCATION: Camas, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** N/A

DATE LOGGED: December 28, 2017 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1	1	(4 inches of ORGANIC TOPSOIL) Red-brown sandy SILT, fine to coarse sand, moist to wet. (ML)	Medium Dense	23.9
5	2			28.2
7		Test pit terminated at approximately 7 feet. No groundwater seepage observed.		
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-2

FIGURE A-3

PROJECT NAME: Grass Valley **PROJ. NO:** T-7807 **LOGGED BY:** AJD

LOCATION: Camas, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** N/A

DATE LOGGED: December 28, 2017 **DEPTH TO GROUNDWATER:** 3.5 Feet **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1	1	Red-brown silty clayey SAND, fine to coarse sand, trace fine to coarse gravel, moist to wet. (SC-SM)	Medium Dense	26.3
2				
3				
4	2	Red-brown silty clayey SAND, fine to coarse sand, moist to wet, blockey texture. (SC-SM)		43.0
5		Test pit terminated at approximately 5 feet. Light groundwater seepage observed at 3.5 feet.		
6				
7				
8				
9				
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-3

FIGURE A-4

PROJECT NAME: Grass Valley **PROJ. NO:** T-7807 **LOGGED BY:** AJD

LOCATION: Camas, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** N/A

DATE LOGGED: December 27, 2017 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1	1	(6 inches of ORGANIC TOPSOIL) Red-brown silty SAND with gravel, fine to coarse sand, fine to coarse gravel, moist to wet, trace cobbles to 10 inches in diameter. (SM)	Medium Dense	37.8
4	2	Red-brown-black-yellow silty GRAVEL with sand, medium to coarse sand, fine gravel, moist, weakly cemented. (GM)		54.9
6		Test pit terminated at approximately 6 feet. No groundwater seepage observed.		
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-4

FIGURE A-5

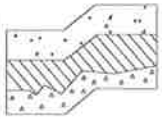
PROJECT NAME: Grass Valley **PROJ. NO:** T-7807 **LOGGED BY:** AJD

LOCATION: Camas, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** N/A

DATE LOGGED: December 28, 2017 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1	1	(4 inches of ORGANIC TOPSOIL) Red-brown sandy silty CLAY, fine to coarse sand, moist. (CL-ML)	Medium Dense	27.4
2		Red-brown silty clayey SAND with gravel, fine to coarse sand, fine to coarse gravel, moist. (SC-SM)	Medium Dense to Dense	
3				
4	2			30.2
5		Test pit terminated at approximately 5 feet. No groundwater seepage observed.		
6				
7				
8				
9				
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



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LOG OF TEST PIT NO. TP-5

FIGURE A-6

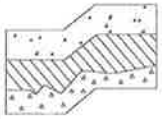
PROJECT NAME: Grass Valley **PROJ. NO:** T-7807 **LOGGED BY:** AJD

LOCATION: Camas, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** N/A

DATE LOGGED: December 28, 2017 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1	1	(10 inches of ORGANIC TOPSOIL) Brown silty clayey SAND with gravel, fine to coarse sand, fine to coarse gravel, moist to wet. (SC-SM)	Medium Dense	27.5
2				
3				
4				
5		Red-brown-black silty SAND with gravel, fine to medium sand, fine to coarse gravel, moist to wet, weakly cemented. (SM)	Medium Dense to Dense	
6				
7	2	Test pit terminated at approximately 7 feet. No groundwater seepage observed.		36.9
8				
9				
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



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LOG OF TEST PIT NO. TP-6

FIGURE A-7

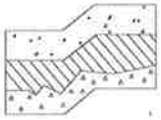
PROJECT NAME: Grass Valley **PROJ. NO:** T-7807 **LOGGED BY:** AJD

LOCATION: Camas, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** N/A

DATE LOGGED: December 28, 2017 **DEPTH TO GROUNDWATER:** 4 Feet **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1	1	(10 inches of ORGANIC TOPSOIL) Brown silty GRAVEL with sand, fine to coarse sand, fine to coarse gravel, scattered cobbles to 6 inches in diameter, moist to wet, weakly cemented below 4 feet. (GM)	Medium Dense to Dense	21.4
2				
3				
▼ 4				
5		Test pit terminated at approximately 5 feet. Moderate groundwater seepage observed at 4 feet.		
6				
7				
8				
9				
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



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LOG OF TEST PIT NO. TP-7

FIGURE A-8

PROJECT NAME: Grass Valley **PROJ. NO:** T-7807 **LOGGED BY:** AJD

LOCATION: Camas, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** N/A

DATE LOGGED: December 28, 2017 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1	1	(10 inches of ORGANIC TOPSOIL) Red-brown silty SAND with gravel, fine to coarse sand, fine to coarse gravel, scattered cobbles to 12 inches in diameter, moist to wet, weakly cemented below 6 feet. (SM) -24-inch diameter boulder observed at 1-foot.	Medium Dense	39.9
6	2		Medium Dense to Dense	48.4
7		Test pit terminated at approximately 7 feet. No groundwater seepage observed.		
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-8

FIGURE A-9

PROJECT NAME: Grass Valley **PROJ. NO:** T-7807 **LOGGED BY:** AJD

LOCATION: Camas, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** N/A

DATE LOGGED: December 28, 2017 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1	1	(6 inches of ORGANIC TOPSOIL) Brown silty SAND with gravel, fine to coarse sand, fine to coarse gravel, scattered cobbles to 12 inches in diameter, trace boulders to 18 inches in diameter, moist. (SM)	Medium Dense	38.0
2				
3				
4	2	Red-brown-black silty SAND with gravel, fine to coarse sand, fine to coarse gravel, moist to wet, trace cobbles to 5 inches in diameter, weakly cemented. (SM)	Medium Dense to Dense	46.4
5				
6				
7		Test pit terminated at approximately 7 feet. No groundwater seepage observed.		
8				
9				
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-9

FIGURE A-10

PROJECT NAME: Grass Valley **PROJ. NO:** T-7807 **LOGGED BY:** AJD

LOCATION: Camas, Washington **SURFACE CONDITIONS:** Wood Chips **APPROX. ELEV:** N/A

DATE LOGGED: December 28, 2017 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
		FILL: WOOD CHIPS and SAWDUST, moist.	Loose	
1		Brown silty clayey SAND with gravel, fine to coarse sand, fine to coarse gravel, scattered cobbles to 6 inches in diameter, moist to wet. (SC-SM)		
2	1			39.5
3			Medium Dense	
4				
5				
6		Red-brown-black-yellow silty SAND with gravel, fine to coarse sand, fine to coarse gravel, moist, most gravel is easily friable. (SM)		
7	2		Medium Dense to Dense	47.9
8		Test pit terminated at approximately 8 feet. No groundwater seepage observed.		
9				
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-10

FIGURE A-11

PROJECT NAME: Grass Valley **PROJ. NO:** T-7807 **LOGGED BY:** AJD

LOCATION: Camas, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** N/A

DATE LOGGED: December 27, 2017 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1	1	(10 inches of ORGANIC TOPSOIL) Red-brown clayey silty SAND with gravel, fine to coarse sand, fine to coarse gravel, moist to wet, trace cobbles to 10 inches in diameter. (SC-SM)	Medium Dense	32.9
2				
3				
4				
5	2	Red-brown-black-yellow-green silty clayey SAND with gravel, fine to coarse sand, fine to coarse gravel, moist to wet, some gravel is easily friable, trace cobbles to 10 inches in diameter. (SC)	Medium Dense to Dense	52.9
6		Test pit terminated at approximately 6 feet. No groundwater seepage observed.		
7				
8				
9				
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-11

FIGURE A-12

PROJECT NAME: Grass Valley **PROJ. NO:** T-7807 **LOGGED BY:** AJD

LOCATION: Camas, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** N/A

DATE LOGGED: December 28, 2017 **DEPTH TO GROUNDWATER:** 4 Feet **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1	1	(3 inches of ORGANIC TOPSOIL) Red-brown silty SAND with gravel, fine to coarse sand, fine to coarse gravel, moist to wet. (SM)	Medium Dense to Dense	25.8
2				
3				
▼ 4		Red-brown-black-yellow silty sandy CLAY with gravel, fine to coarse sand, fine to coarse gravel, trace cobbles to 8 inches, most gravels and cobbles are easily friable, moist to wet. (CL-ML)		
5				
6	2			54.8
7		Test pit terminated at approximately 7 feet. Light groundwater seepage observed at 4 feet.		
8				
9				
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-12

FIGURE A-13

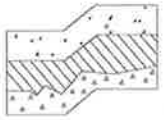
PROJECT NAME: Grass Valley **PROJ. NO:** T-7807 **LOGGED BY:** AJD

LOCATION: Camas, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** N/A

DATE LOGGED: December 27, 2017 **DEPTH TO GROUNDWATER:** 2.5 Feet **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
		(10 inches of ORGANIC TOPSOIL)		
1		Red-brown silty clayey SAND, fine to coarse sand, trace fine to coarse gravel, moist to wet. (SC-SM)		
2				
▼				
3	1		Medium Dense	27.5
4		Red-brown silty SAND to sandy SILT, fine to coarse sand, scattered fine to coarse gravel, moist, blocky texture. (SM/ML)		
5	2			32.1
6		Test pit terminated at approximately 6 feet. Light groundwater seepage observed at 2.5 feet.		
7				
8				
9				
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



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LOG OF TEST PIT NO. TP-13

FIGURE A-14

PROJECT NAME: Grass Valley **PROJ. NO:** T-7807 **LOGGED BY:** AJD

LOCATION: Camas, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** N/A

DATE LOGGED: December 27, 2017 **DEPTH TO GROUNDWATER:** 3 Feet **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1		(8 inches of ORGANIC TOPSOIL) Red-brown silty sandy CLAY, fine to coarse sand, moist to wet, mottled below 3 feet. (CL-ML)	Soft	
2				
▼ 3	1			27.7
4			Medium Stiff to Stiff	
5	2	Red-brown-black-yellow-green silty clayey SAND with gravel, fine to coarse sand, fine to coarse gravel, moist to wet, some gravel is easliy friable. (SC-SM)	Medium Dense	37.9
6				
7		Test pit terminated at approximately 7 feet. Light groundwater seepage observed at 3 feet.		
8				
9				
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-14

FIGURE A-15

PROJECT NAME: Grass Valley **PROJ. NO:** T-7807 **LOGGED BY:** AJD

LOCATION: Camas, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** N/A

DATE LOGGED: December 27, 2017 **DEPTH TO GROUNDWATER:** 5 Feet **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1	1	(8 inches of ORGANIC TOPSOIL) Red-brown silty sandy CLAY, fine to coarse sand, moist to wet, mottled below 3 feet. (CL-ML)	Loose	27.5
2				
3				
4	2			35.0
▼ 5		Gray-brown silty SAND, fine sand, moist to wet, mottled. (SM)	Medium Dense	
6	3			30.7
7		Test pit terminated at approximately 7 feet. Light groundwater seepage observed at 5 feet.		
8				
9				
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-15

FIGURE A-16

PROJECT NAME: Grass Valley **PROJ. NO:** T-7807 **LOGGED BY:** AJD

LOCATION: Camas, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** N/A

DATE LOGGED: December 27, 2017 **DEPTH TO GROUNDWATER:** 3.5 Feet **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1	1	(6 inches of ORGANIC TOPSOIL) Red-brown silty clayey SAND with gravel, fine to coarse sand, fine to coarse gravel, moist to wet. (SC-SM)	Medium Dense	29.3
2				
3				
4				
5				
6	2	Red-brown-black-green-yellow clayey SAND with gravel, fine to coarse sand, fine to coarse gravel, moist, gravel is easily friable. (SC)	Medium Dense to Dense	48.3
7		Test pit terminated at approximately 7 feet. Light groundwater seepage observed at 3.5 feet.		
8				
9				
10				

W

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-16

FIGURE A-17

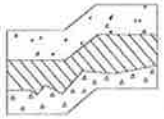
PROJECT NAME: Grass Valley **PROJ. NO:** T-7807 **LOGGED BY:** AJD

LOCATION: Camas, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** N/A

DATE LOGGED: December 27, 2017 **DEPTH TO GROUNDWATER:** 5 Feet **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1	1	(8 inches of ORGANIC TOPSOIL) Red-brown silty clayey SAND with gravel, fine to coarse sand, fine to coarse gravel, moist to wet. (SC-SM)	Medium Dense	25.8
2				
3				
4				
▼ 5	2	Red-brown-black-yellow-green silty clayey SAND with gravel, fine to coarse sand, fine to coarse gravel, moist to wet, gravel is easily friable. (SC-SM)		40.3
6		Test pit terminated at approximately 6 feet. Light groundwater seepage observed at 5 feet.		
7				
8				
9				
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



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LOG OF TEST PIT NO. TP-17

FIGURE A-18

PROJECT NAME: Grass Valley **PROJ. NO:** T-7807 **LOGGED BY:** AJD

LOCATION: Camas, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** N/A

DATE LOGGED: December 27, 2017 **DEPTH TO GROUNDWATER:** 5 Feet **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1	1	(4 inches of ORGANIC TOPSOIL) Red-brown silty clayey SAND, fine to coarse sand, scattered fine to coarse gravel, moist to wet. (SC-SM)	Loose	26.9
2				
3			Medium Dense	
4				
▼ 5				
6	2	Red-brown-black-green-yellow clayey SAND, fine sand, moist. (SC)	Medium Dense to Dense	51.1
7		Test pit terminated at approximately 7 feet. Light groundwater seepage observed at 5 feet.		
8				
9				
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-18

FIGURE A-19

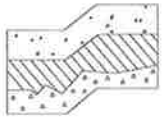
PROJECT NAME: Grass Valley **PROJ. NO:** T-7807 **LOGGED BY:** AJD

LOCATION: Camas, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** N/A

DATE LOGGED: December 27, 2017 **DEPTH TO GROUNDWATER:** 4 Feet **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1	1	(10 inches of ORGANIC TOPSOIL) Red-brown silty clayey SAND with gravel, fine to coarse sand, fine to coarse gravel, moist to wet, trace cobbles to 8 inches in diameter. (SC-SM)	Medium Dense	29.2
2				
3				
▼ 4				
5	2	Red-brown-black-yellow-green silty clayey SAND with gravel, fine to coarse sand, fine to coarse gravel, moist to wet, some gravel is easily friable, trace cobbles to 8 inches in diameter. (SC-SM)		49.3
6				
7		Test pit terminated at approximately 7 feet. Light groundwater seepage observed at 4 feet.		
8				
9				
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



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LOG OF TEST PIT NO. TP-19

FIGURE A-20

PROJECT NAME: Grass Valley **PROJ. NO:** T-7807 **LOGGED BY:** AJD

LOCATION: Camas, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** N/A

DATE LOGGED: December 27, 2017 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1	1	(6 inches of ORGANIC TOPSOIL) Red-brown silty clayey SAND with gravel to silty sandy CLAY with gravel, fine to coarse sand, fine to coarse gravel, moist to wet, trace cobbles to 4 inches in diameter. (SC-SM/CL-ML)	Medium Dense	28.3
7	2	Red-brown-black-yellow-green silty clayey SAND with gravel, fine to coarse sand, fine to coarse gravel, moist to wet, some gravel is easily friable, trace cobbles to 8 inches in diameter. (SC-SM)		44.8
8		Test pit terminated at approximately 7.5 feet. No groundwater seepage observed.		
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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Consultants in Geotechnical Engineering Geology and Environmental Earth Sciences

LOG OF TEST PIT NO. TP-20

FIGURE A-21

PROJECT NAME: Grass Valley **PROJ. NO:** T-7807 **LOGGED BY:** AJD

LOCATION: Camas, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** N/A

DATE LOGGED: December 27, 2017 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1	1	(8 inches of ORGANIC TOPSOIL) Red-brown silty clayey SAND with gravel, fine to coarse sand, fine to coarse gravel, moist to wet, trace cobbles to 4 inches in diameter. (SC-SM)	Medium Dense	40.6
6	2	Red-brown-black-yellow-green silty clayey SAND with gravel, fine to coarse sand, fine to coarse gravel, moist to wet, some gravel is easily friable, trace cobbles to 6 inches in diameter. (SC-SM)		53.8
7		Test pit terminated at approximately 6.5 feet. No groundwater seepage observed.		
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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Consultants in Geotechnical Engineering Geology and Environmental Earth Sciences

LOG OF TEST PIT NO. TP-21

FIGURE A-22

PROJECT NAME: Grass Valley **PROJ. NO:** T-7807 **LOGGED BY:** AJD

LOCATION: Camas, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** N/A

DATE LOGGED: December 27, 2017 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1		(2 inches of ORGANIC TOPSOIL) FILL: Red-brown silty SAND with gravel, fine to coarse sand, fine to coarse gravel, moist to wet, frequent wood debris observed. (SM)	Loose	
2				
3				
4	1	Red-brown-black-yellow-green silty SAND with gravel, fine to coarse sand, fine to coarse gravel, moist to wet, some gravel is easily friable, trace cobbles to 10 inches in diameter. (SM)	Medium Dense	43.8
5				
6		Test pit terminated at approximately 6 feet. No groundwater seepage observed.		
7				
8				
9				
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-22

FIGURE A-23

PROJECT NAME: Grass Valley **PROJ. NO:** T-7807 **LOGGED BY:** AJD

LOCATION: Camas, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** N/A

DATE LOGGED: December 27, 2017 **DEPTH TO GROUNDWATER:** 5.5 Feet **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
		Dark brown silty SAND, fine to coarse sand, moist to wet, frequent fine organics. (SM) (TOPSOIL)	Loose	
1				
		Red-brown silty clayey SAND with gravel, fine to coarse sand, fine to coarse gravel, moist to wet, frequently interbedded with weakly cemented coarse sand with silt seams. (SC-SM)		
2	1			27.1
3				
4			Medium Dense	
5				
▼	2			43.0
6				
		Test pit terminated at approximately 6.5 feet. Light groundwater seepage observed at 5.5 feet.		
7				
8				
9				
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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Consultants in Geotechnical Engineering Geology and Environmental Earth Sciences

LOG OF TEST PIT NO. TP-23

FIGURE A-24

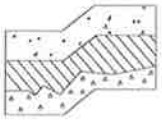
PROJECT NAME: Grass Valley **PROJ. NO:** T-7807 **LOGGED BY:** AJD

LOCATION: Camas, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** N/A

DATE LOGGED: December 28, 2017 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1	1	(4 inches of ORGANIC TOPSOIL) Red-brown silty clayey SAND with gravel, fine to coarse sand, fine to coarse gravel, moist to wet. (SC-SM)		32.0
2		Brown silty clayey GRAVEL with sand, fine to coarse sand, fine to coarse gravel, moist, weakly cemented. (GC-GM)	Medium Dense	
3				
4				
5				
6	2			37.8
7		Test pit terminated at approximately 6 feet. No groundwater seepage observed.		
8				
9				
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



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LOG OF TEST PIT NO. TP-24

FIGURE A-25

PROJECT NAME: Grass Valley **PROJ. NO:** T-7807 **LOGGED BY:** AJD

LOCATION: Camas, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** N/A

DATE LOGGED: December 28, 2017 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1	1	(3 inches of ORGANIC TOPSOIL) Red-brown silty GRAVEL with sand, fine to coarse sand, fine to coarse gravel, trace cobbles to 12 inches in diameter, moist to wet, weakly cemented below 4 feet. (GM)	Medium Dense	38.5
2				
3				
4				
5			Medium Dense to Dense	
6	2	Test pit terminated at approximately 6 feet. No groundwater seepage observed.		29.7
7				
8				
9				
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-25

FIGURE A-26

PROJECT NAME: Grass Valley **PROJ. NO:** T-7807 **LOGGED BY:** AJD

LOCATION: Camas, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** N/A

DATE LOGGED: December 27, 2017 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1	1	(4 inches of ORGANIC TOPSOIL) Red-brown silty GRAVEL with sand, fine to coarse sand, fine to coarse gravel, moist to wet, scattered cobbles to 8 inches in diameter. (GM)	Medium Dense	24.2
2				
3				
4				
5		Red-brown-black-yellow silty SAND with gravel, fine to coarse sand, fine to coarse gravel, moist, weakly to moderately cemented. (SM)	Medium Dense to Dense	
6				
7		Test pit terminated at approximately 7 feet. No groundwater seepage observed.		
8				
9				
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-26

FIGURE A-27

PROJECT NAME: Grass Valley **PROJ. NO:** T-7807 **LOGGED BY:** AJD

LOCATION: Camas, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** N/A

DATE LOGGED: December 27, 2017 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1	1	(6 inches of ORGANIC TOPSOIL) Red-brown silty clayey SAND with gravel, fine to coarse sand, fine to coarse gravel, moist to wet, trace cobbles to 10 inches in diameter. (SC-SM)	Medium Dense	30.6
2				
3				
4		-18-inch diameter boulder encountered at 3 feet.		
5				
6		Test pit terminated at approximately 6 feet. No groundwater seepage observed.		
7				
8				
9				
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-27

FIGURE A-28

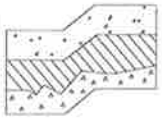
PROJECT NAME: Grass Valley **PROJ. NO:** T-7807 **LOGGED BY:** AJD

LOCATION: Camas, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** N/A

DATE LOGGED: December 27, 2017 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
		(8 inches of ORGANIC TOPSOIL)		
1		Red-brown silty SAND with gravel, fine to coarse sand, fine to coarse gravel, moist to wet, trace cobbles to 10 inches in diameter. (SM)		
2		-24-inch diameter boulder observed at 2 feet.		
3	1			39.2
4			Medium Dense	
5		Red-brown-black-yellow silty SAND with gravel, fine to coarse sand, fine to coarse gravel, moist, weakly to moderately cemented, some gravel is easily friable. (SP-SM)		
6	2			41.6
7		Test pit terminated at approximately 7 feet. No groundwater seepage observed.		
8				
9				
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



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LOG OF TEST PIT NO. TP-28

FIGURE A-29

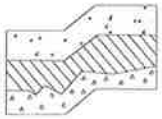
PROJECT NAME: Grass Valley **PROJ. NO:** T-7807 **LOGGED BY:** AJD

LOCATION: Camas, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** N/A

DATE LOGGED: December 27, 2017 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
		(6 inches of ORGANIC TOPSOIL)		
1		Red-brown silty SAND with gravel, fine to coarse sand, fine to coarse gravel, moist to wet. (SM)		
2				
3	1		Medium Dense	35.3
4				
5				
6	2			36.4
		Red-brown-black-yellow silty GRAVEL with sand, fine to coarse sand, fine to coarse gravel, moist, weakly cemented. (GM)		
7		Test pit terminated at approximately 7 feet. No groundwater seepage observed.		
8				
9				
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



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LOG OF TEST PIT NO. TP-29

FIGURE A-30

PROJECT NAME: Grass Valley **PROJ. NO:** T-7807 **LOGGED BY:** AJD

LOCATION: Camas, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** N/A

DATE LOGGED: December 27, 2017 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
	1	(6 inches of ORGANIC TOPSOIL) Red-brown sandy silty CLAY, fine to coarse sand, moist to wet, scattered gravel below 5 feet. (CL-ML)	Medium Dense	28.4
6	2	Red-brown-black-yellow silty SAND with gravel, fine to coarse sand, fine to coarse gravel, moist, weakly to moderately cemented, some gravel is easliy friable. (SM)		52.9
7		Test pit terminated at approximately 7 feet. No groundwater seepage observed.		
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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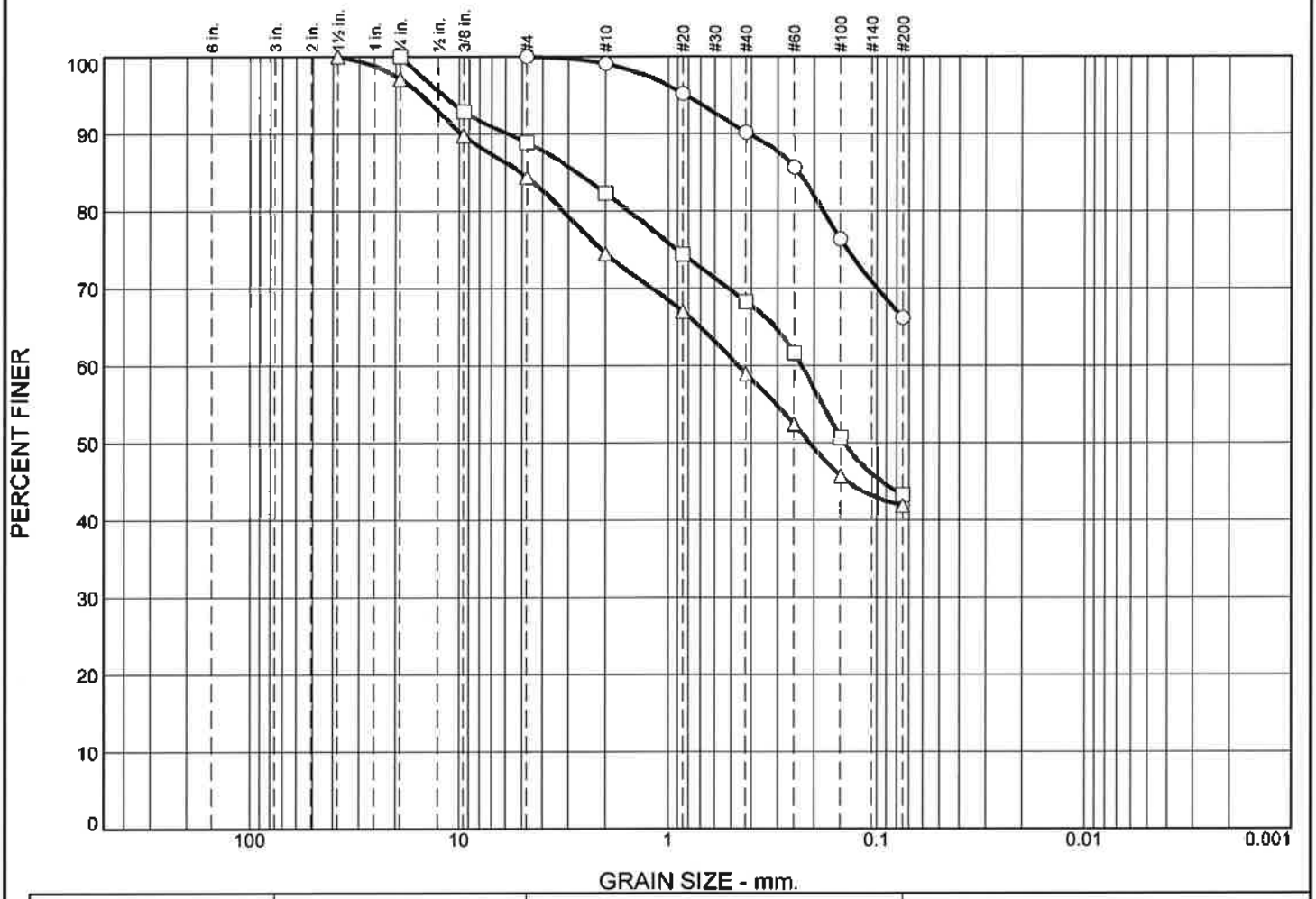
Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.9	8.9	24.0	66.2	
□	0.0	0.0	11.1	6.6	14.0	25.0	43.3	
△	0.0	2.9	12.7	9.9	15.5	17.1	41.9	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.2399							
□			2.7371	0.2296	0.1443					
△			5.0863	0.4614	0.2105					

Material Description	USCS	AASHTO
○ Sandy SILT	ML	
□ Silty SAND	SM	
△ Silty SAND with gravel	SM	

Project No. T-7807 **Client:** Holland Construction

Project: Grass Valley

Camas, Washington

○ **Location:** Test Pit TP-1 **Depth:** -5 feet

□ **Location:** Test Pit TP-2 **Depth:** -1 foot

△ **Location:** Test Pit TP-5 **Depth:** -2.5 feet

Remarks:

○ Tested on 1/9/2018

□ Tested on 1/9/2018

△ Tested on 1/9/2018

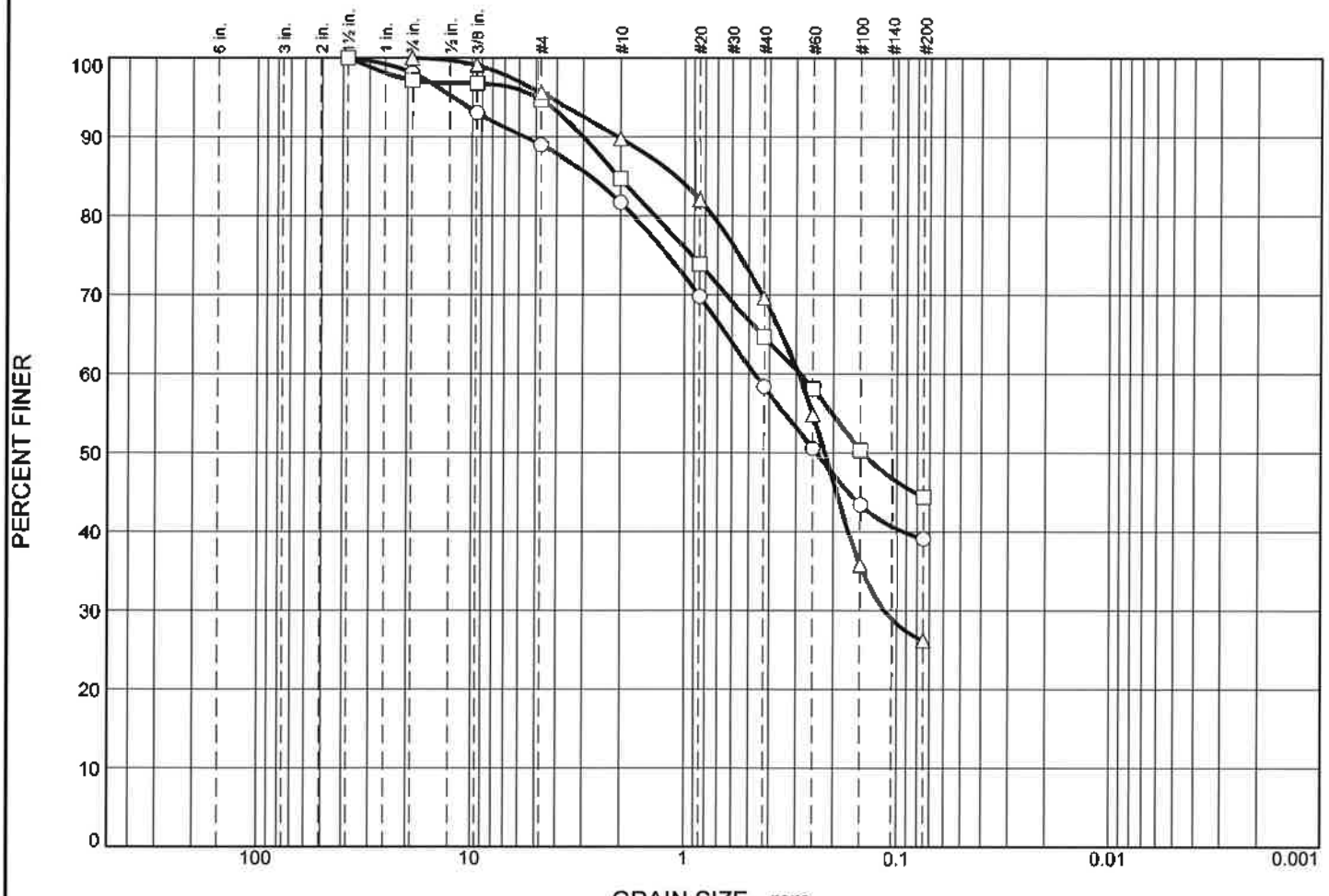
Terra Associates, Inc.

Kirkland, WA

Figure A-31

Tested By: FQ

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	1.9	9.1	7.3	23.3	19.3	39.1	
□	0.0	2.8	2.5	10.0	20.0	20.3	44.4	
△	0.0	0.0	4.4	5.8	20.2	43.4	26.2	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			2.7779	0.4704	0.2402					
□			2.0465	0.2858	0.1454					
△			1.1010	0.2917	0.2199	0.1146				

	Material Description	USCS	AASHTO
○	Silty SAND	SM	
□	Silty SAND	SM	
△	Silty SAND	SM	

Project No. T-7807 **Client:** Holland Construction

Project: Grass Valley

Camas, Washington

○ **Location:** Test Pit TP-10 **Depth:** -2 feet

□ **Location:** Test Pit TP-12 **Depth:** -3 feet

△ **Location:** Test Pit TP-14 **Depth:** -4 feet

Remarks:

○ Tested on 1/9/2018

□ 1/9/2018

△ Tested on 1/9/2018

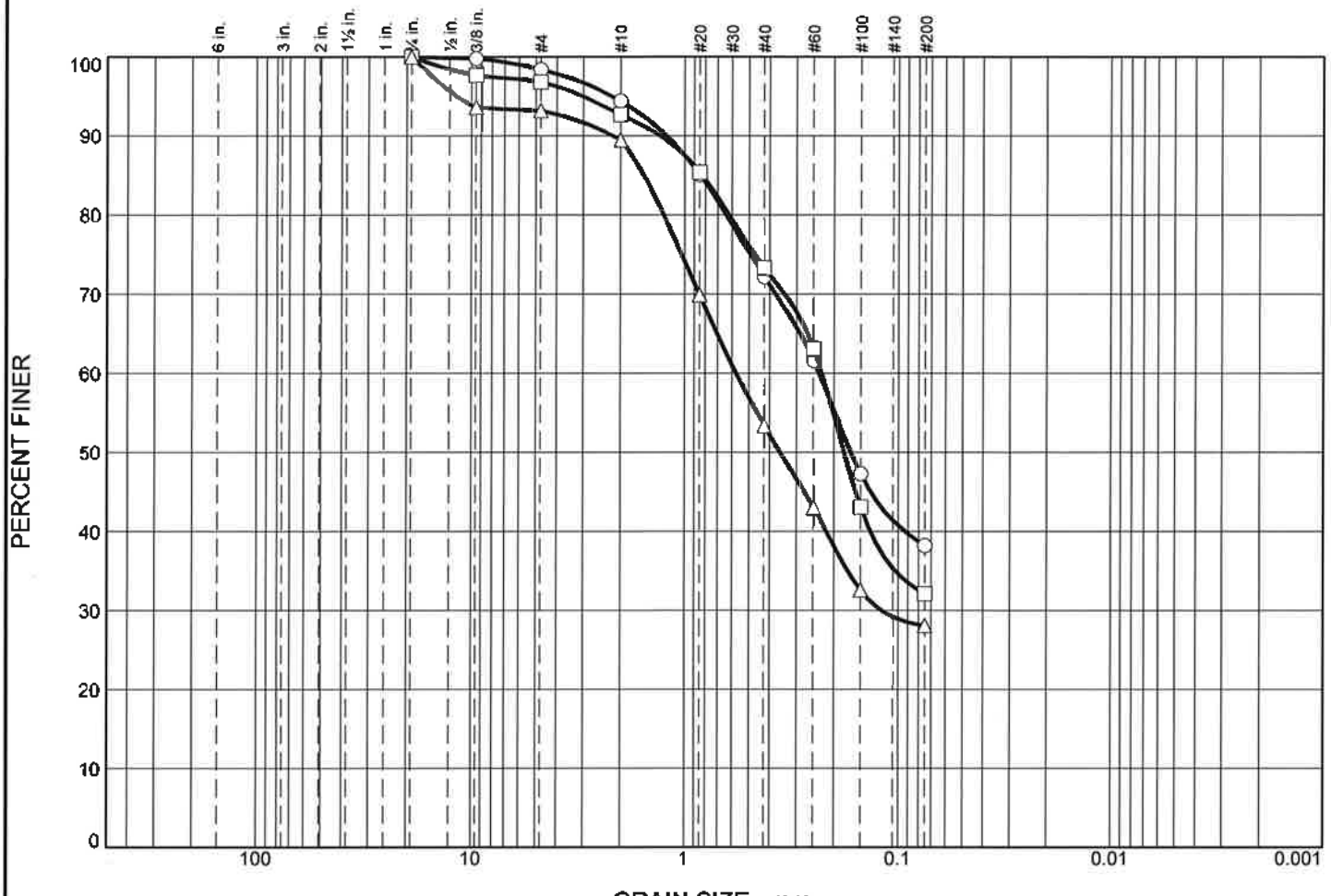
Terra Associates, Inc.

Kirkland, WA

Figure A-32

Tested By: FQ

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	1.6	4.0	22.2	34.0	38.2	
□	0.0	0.0	3.2	4.1	19.4	41.2	32.1	
△	0.0	0.0	6.8	3.7	36.1	25.3	28.1	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.8448	0.2354	0.1667					
□			0.8275	0.2288	0.1796					
△			1.5542	0.5728	0.3575	0.1193				

Material Description	USCS	AASHTO
○ Silty SAND	SM	
□ Silty SAND	SM	
△ Silty SAND	SM	

Project No. T-7807 **Client:** Holland Construction

Project: Grass Valley

Camas, Washington

○ **Location:** Test Pit TP-17 **Depth:** -2 feet

□ **Location:** Test Pit TP-19 **Depth:** -2.5 feet

△ **Location:** Test Pit TP-29 **Depth:** -1 foot

Remarks:

○ Tested on 1/9/2018

□ Tested on 1/9/2018

△ Tested on 1/9/2018

Terra Associates, Inc.

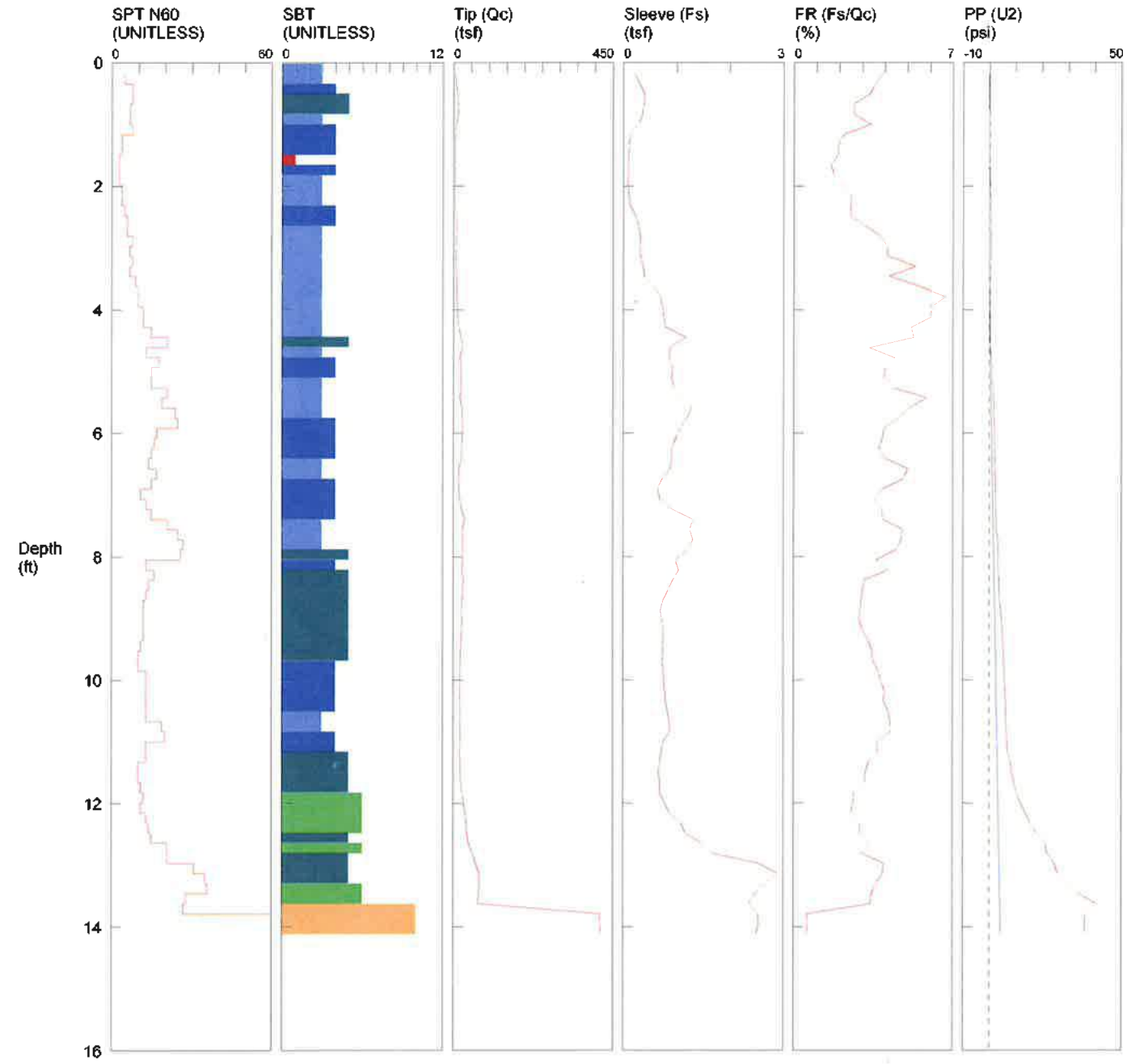
Kirkland, WA

Figure A-33

Tested By: FQ

Terra Associates / CPT-1 / NW Fisher Creek Dr & NW 38th Ave Camas

OPERATOR: OGE DMM
CONE ID: DPG1386
HOLE NUMBER: CPT-1
TEST DATE: 12/29/2017 1:08:21 PM
TOTAL DEPTH: 14.108 ft

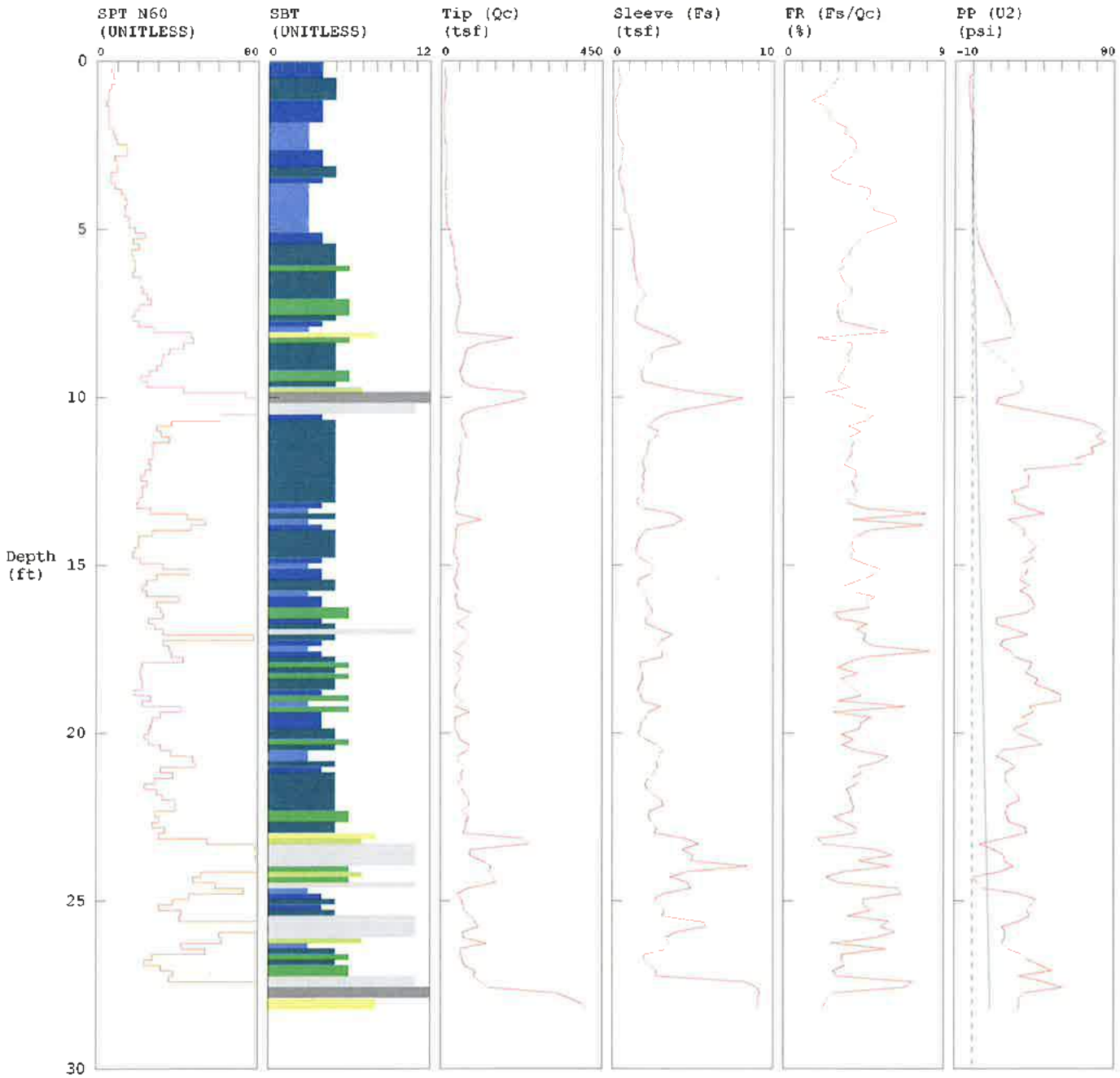


1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

Terra Associates / CPT-2 / NW Fisher Creek Dr & NW 38th Ave Camas

OPERATOR: OGE DMM
CONE ID: DPG1386
HOLE NUMBER: CPT-2
TEST DATE: 12/29/2017 1:25:50 PM
TOTAL DEPTH: 28.215 ft

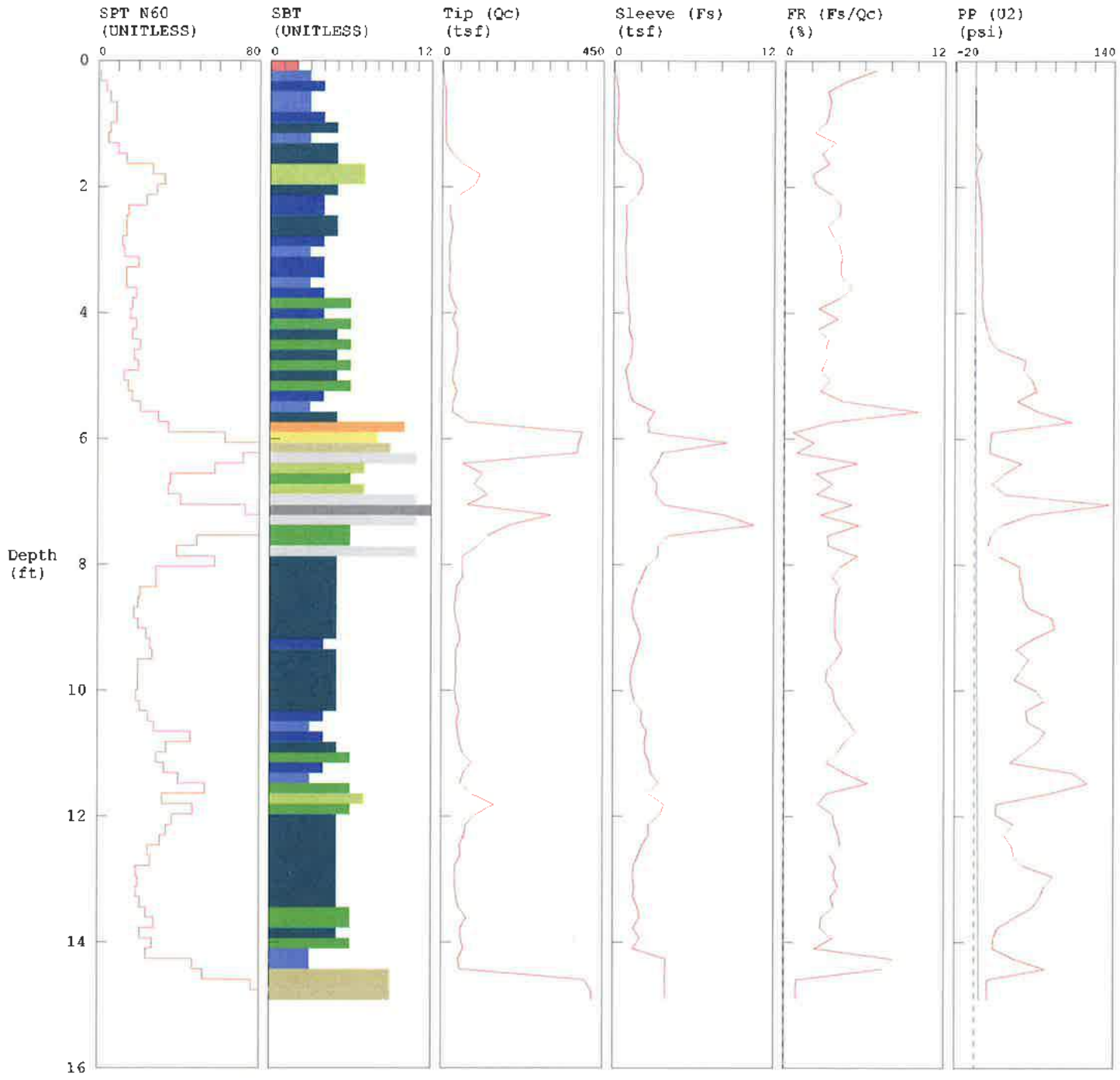


1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty cl
6 sandy silt to clayey si
7 silty sand to sandy si
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

Terra Associates / CPT-3 / NW Fisher Creek Dr & NW 38th Ave Camas

OPERATOR: OGE DMM
CONE ID: DPG1386
HOLE NUMBER: CPT-3
TEST DATE: 12/29/2017 1:55:22 PM
TOTAL DEPTH: 14.928 ft

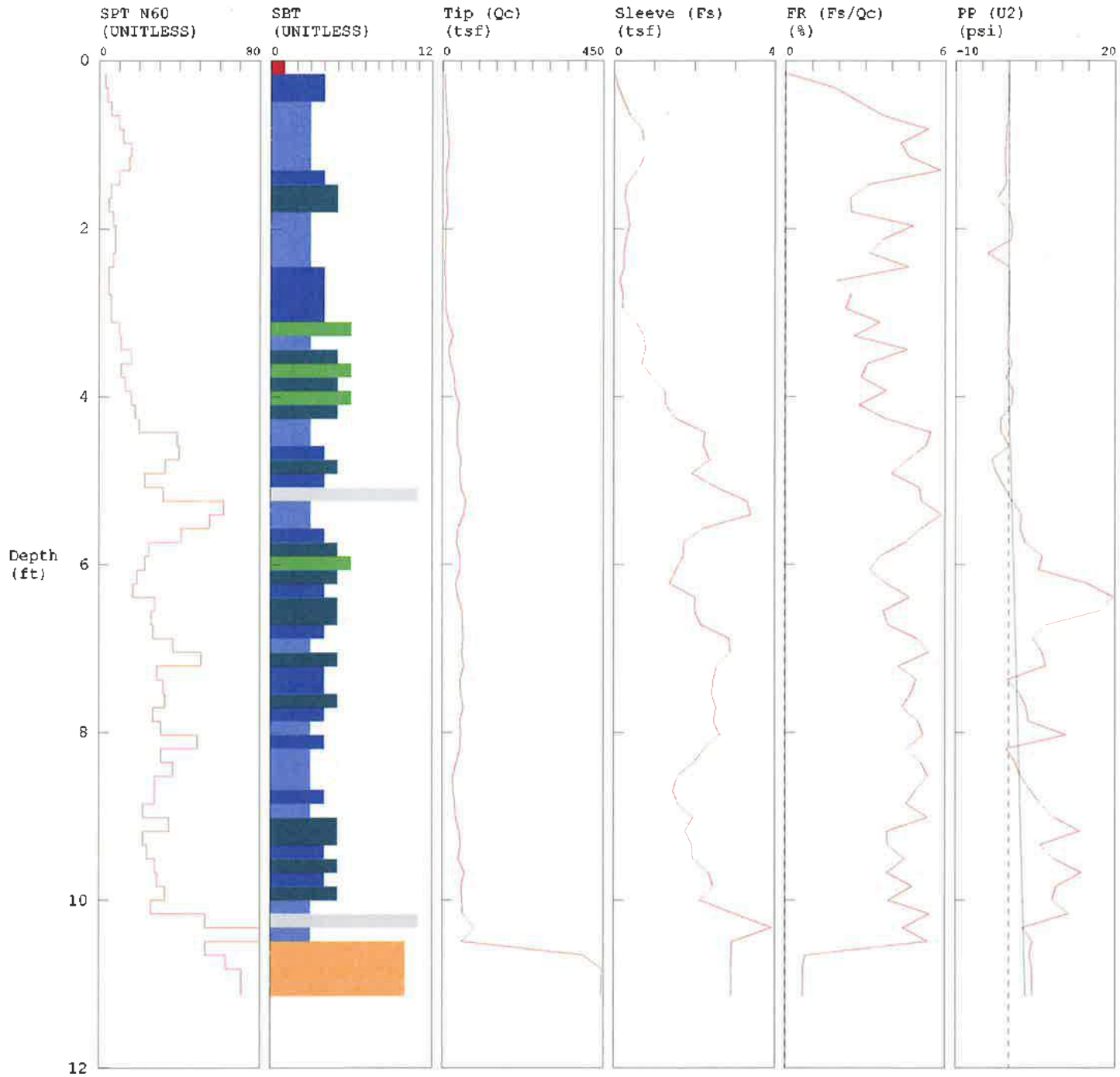


1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty cl
6 sandy silt to clayey si
7 silty sand to sandy si
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

Terra Associates / CPT-4 / NW Fisher Creek Dr & NW 38th Ave Camas

OPERATOR: OGE DMM
CONE ID: DPG1386
HOLE NUMBER: CPT-4
TEST DATE: 12/28/2017 11:43:16 AM
TOTAL DEPTH: 11.155 ft

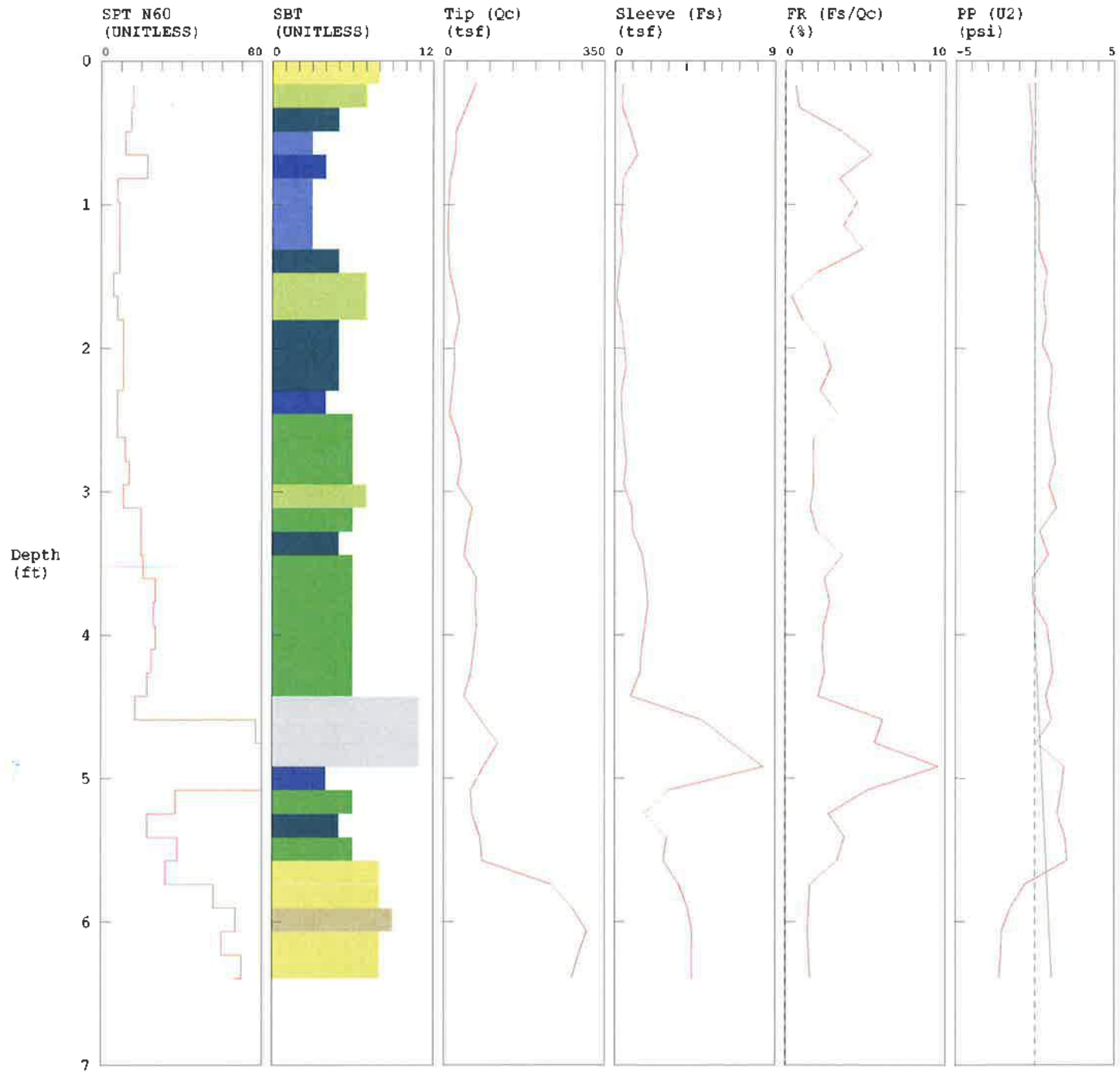


1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty cl
6 sandy silt to clayey si
7 silty sand to sandy si
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

Terra Associates / CPT-5 / NW Fisher Creek Dr & NW 38th Ave Camas

OPERATOR: OGE DMM
CONE ID: DPG1386
HOLE NUMBER: CPT-5
TEST DATE: 12/29/2017 12:21:55 PM
TOTAL DEPTH: 6.398 ft

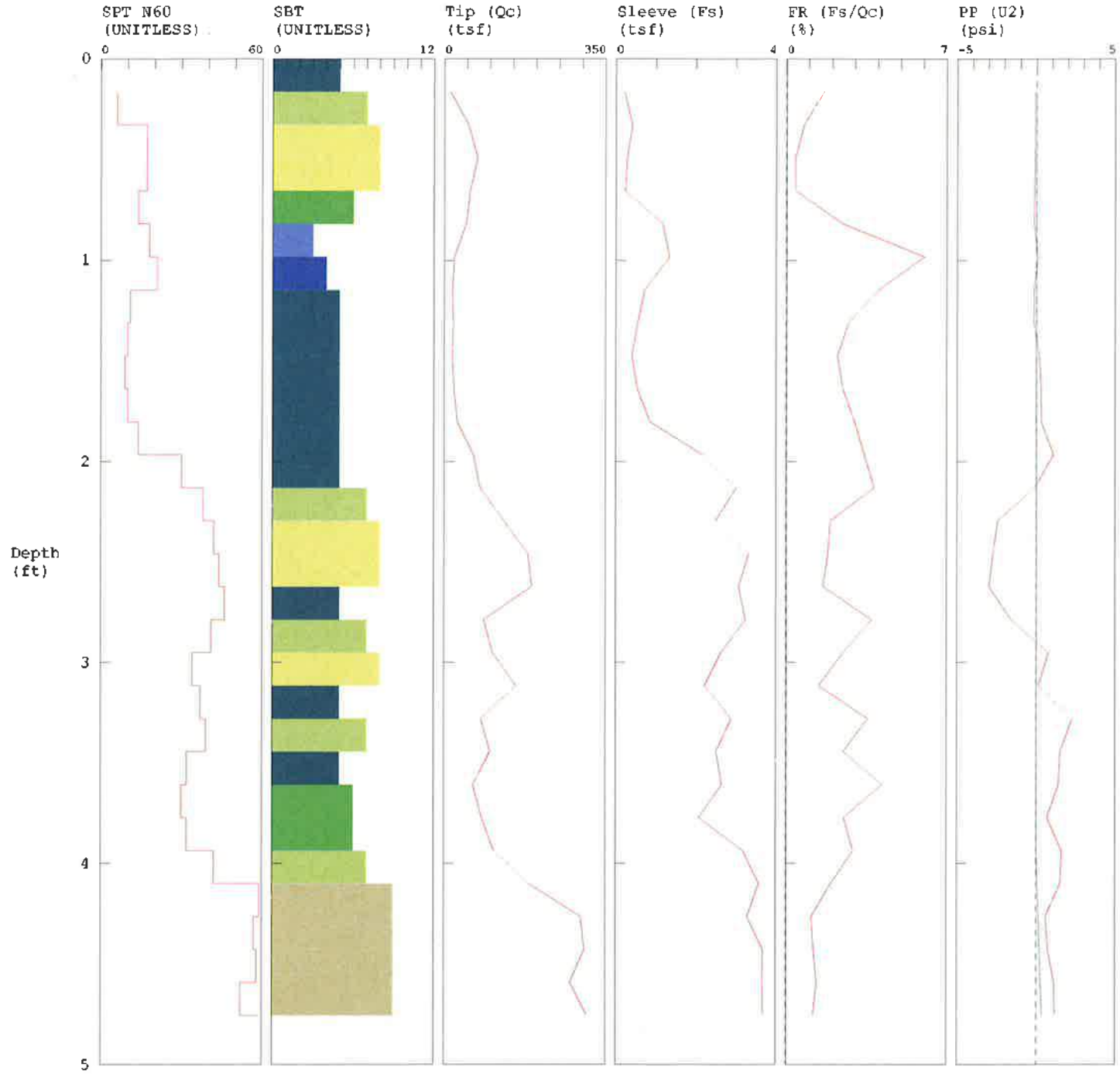


1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty cl
6 sandy silt to clayey si
7 silty sand to sandy sil
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

Terra Associates / CPT-6 / NW Fisher Creek Dr & NW 38th Ave Camas

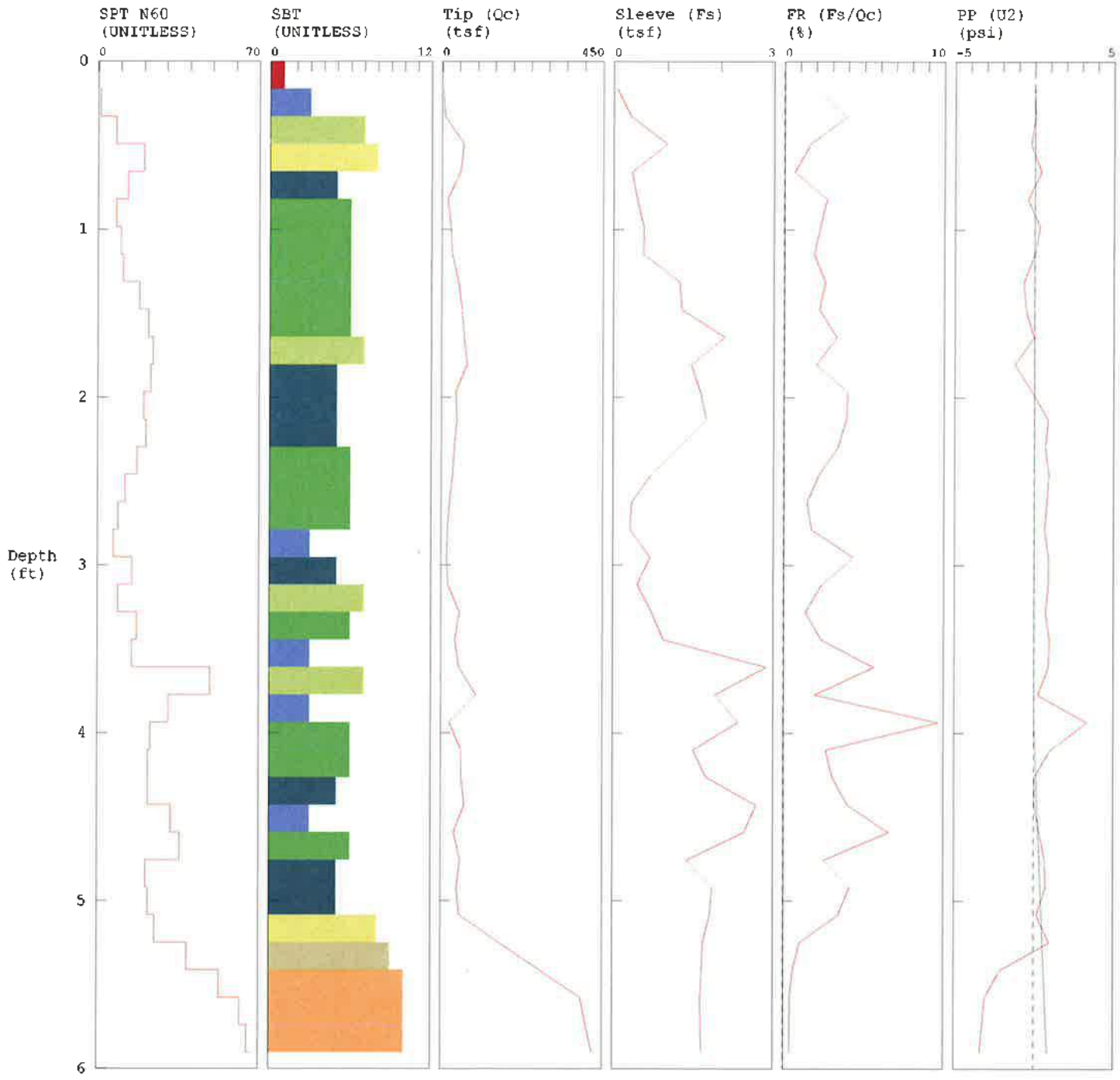
OPERATOR: OGE DMM
CONE ID: DPG1386
HOLE NUMBER: CPT-6
TEST DATE: 12/29/2017 12:04:33 PM
TOTAL DEPTH: 4.757 ft



*SBT/SPT CORRELATION: UBC-1983

Terra Associates / CPT-7 / NW Fisher Creek Dr & NW 38th Ave Camas

OPERATOR: OGE DMM
CONE ID: DPG1386
HOLE NUMBER: CPT-7
TEST DATE: 12/29/2017 11:49:37 AM
TOTAL DEPTH: 5.906 ft

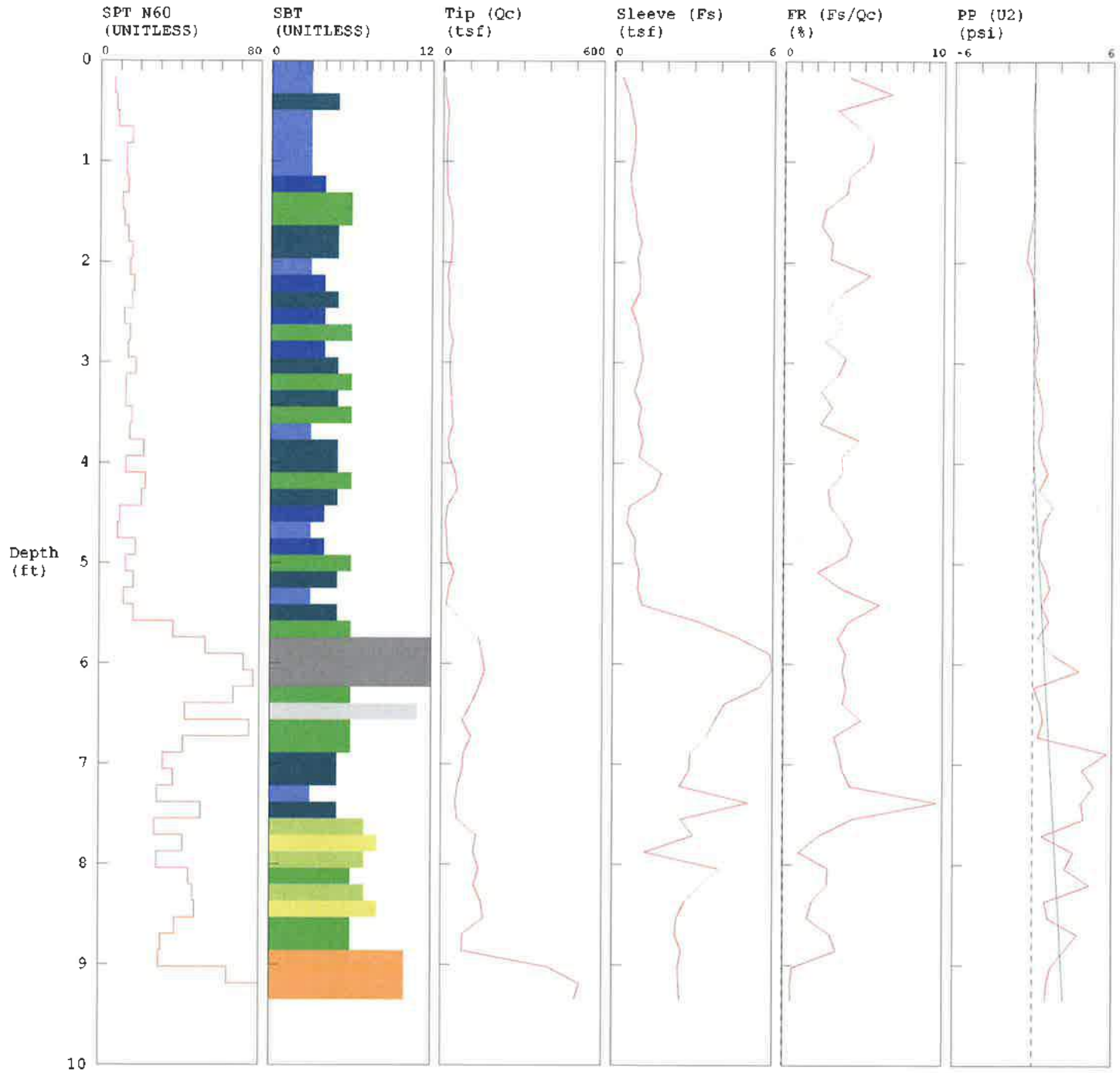


1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty cl
6 sandy silt to clayey s
7 silty sand to sandy sil
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

Terra Associates / CPT-8 / NW Fisher Creek Dr & NW 38th Ave Camas

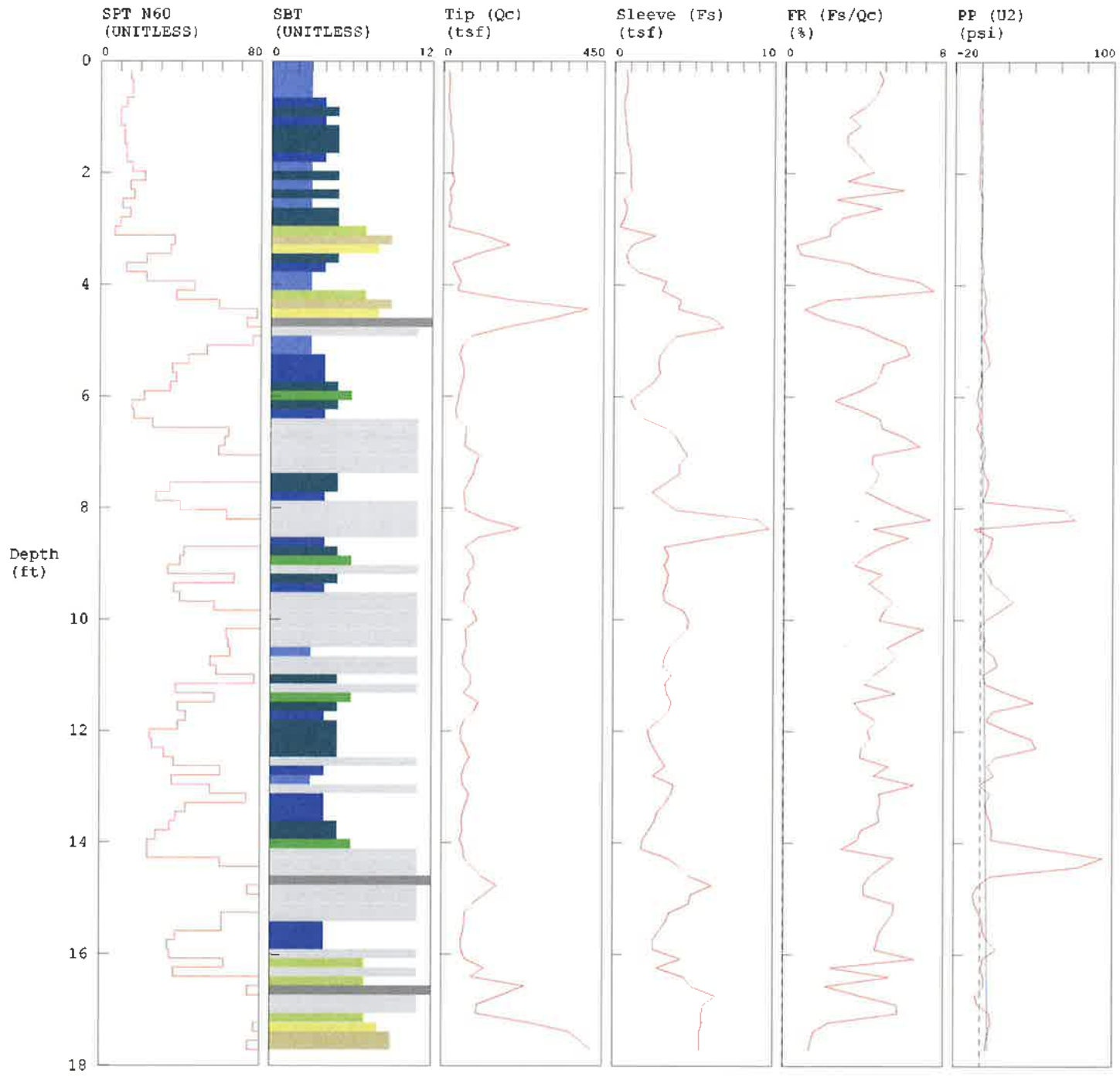
OPERATOR: OGE DMM
CONE ID: DPG1386
HOLE NUMBER: CPT-8
TEST DATE: 12/29/2017 9:09:19 AM
TOTAL DEPTH: 9.350 ft



*SBT/SPT CORRELATION: UBC-1983

Terra Associates / CPT-9 / NW Fisher Creek Dr & NW 38th Ave Camas

OPERATOR: OGE DMM
CONE ID: DPG1386
HOLE NUMBER: CPT-9
TEST DATE: 12/29/2017 8:43:39 AM
TOTAL DEPTH: 17.717 ft

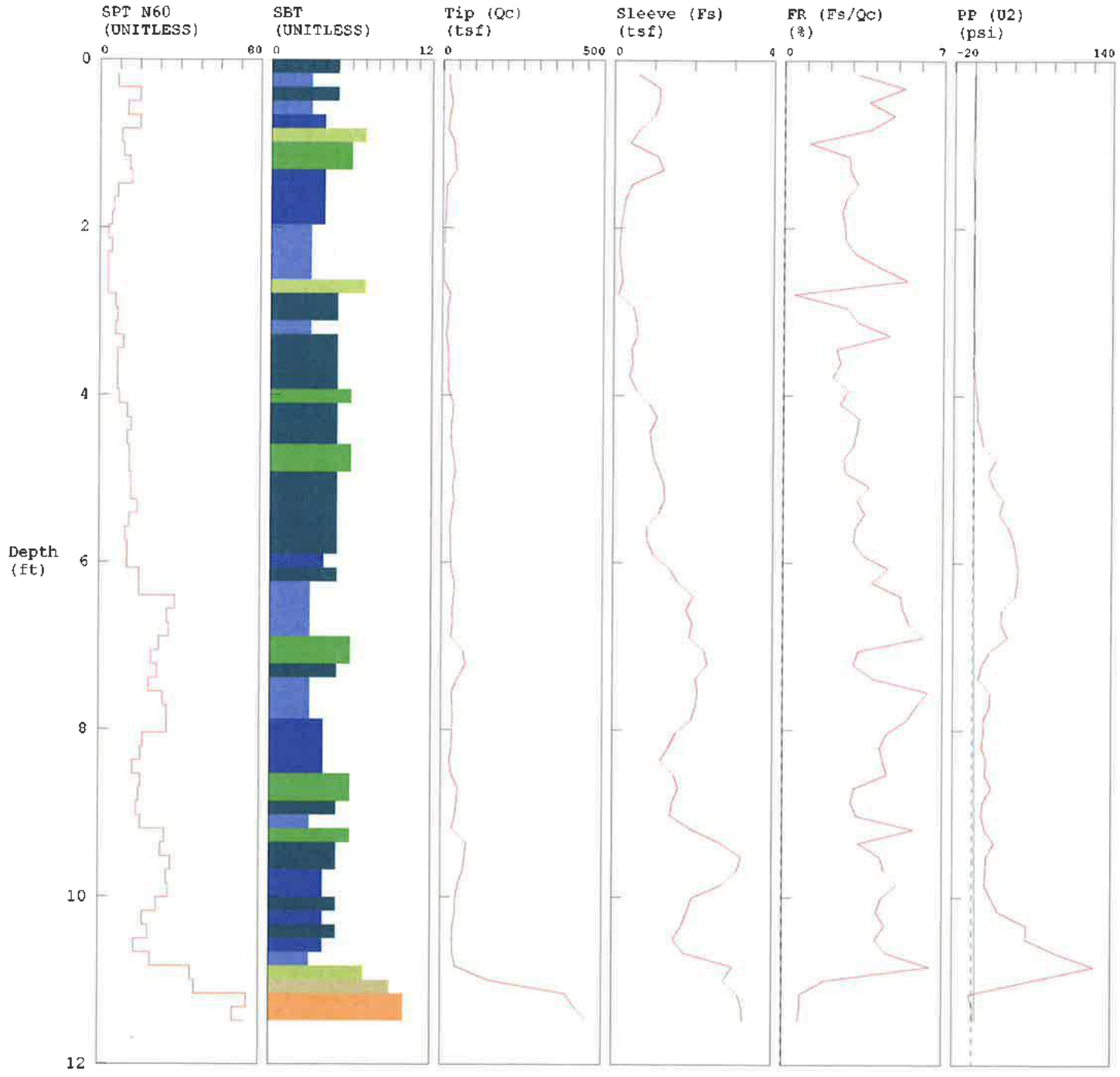


1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty cl
6 sandy silt to clayey s
7 silty sand to sandy si
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

Terra Associates / CPT-10 / NW Fisher Creek Dr & NW 38th Ave Camas

OPERATOR: OGE DMM
CONE ID: DPG1386
HOLE NUMBER: CPT-10
TEST DATE: 12/29/2017 8:13:18 AM
TOTAL DEPTH: 11.483 ft

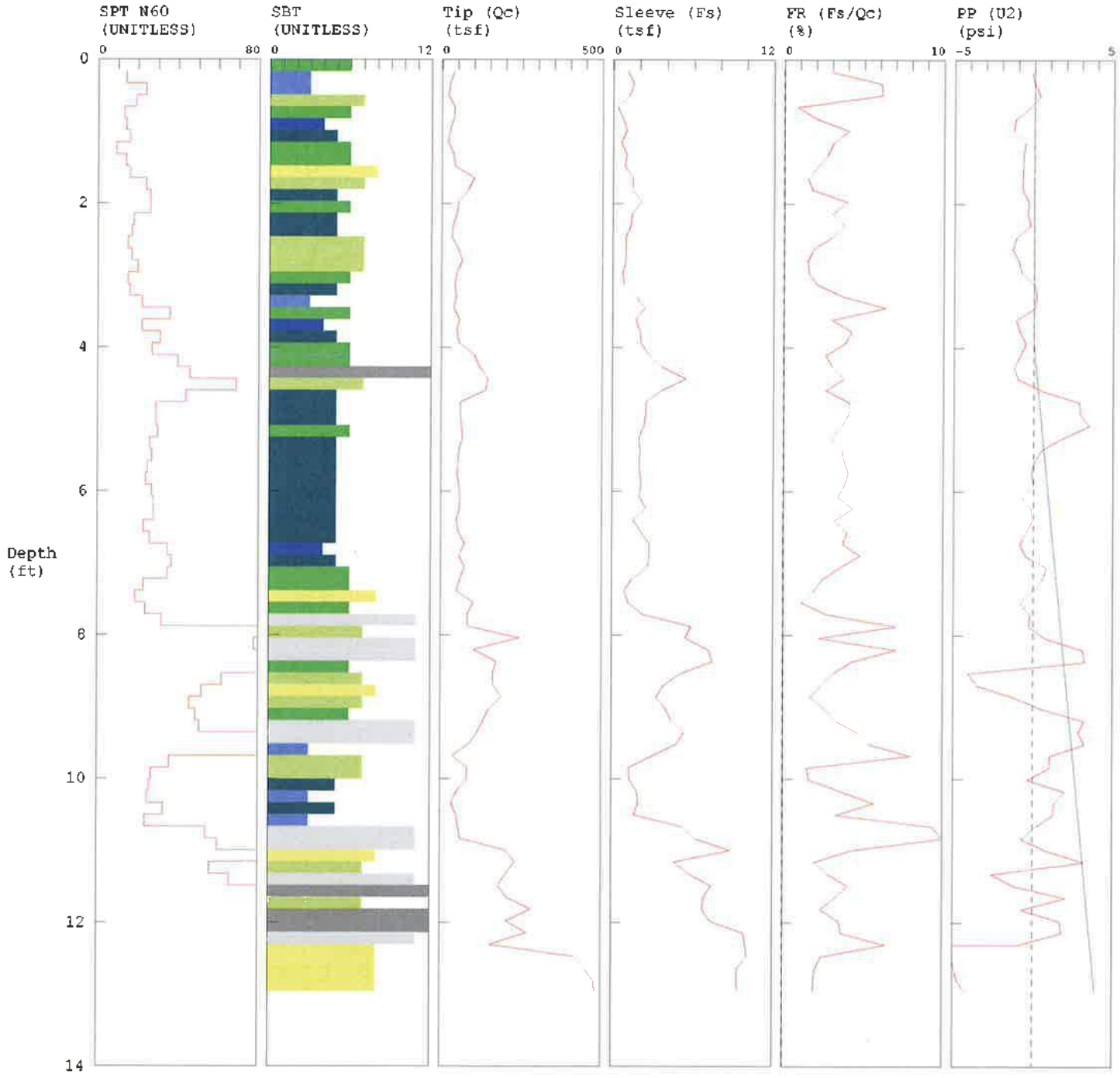


1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty c
6 sandy silt to clayey si
7 silty sand to sandy sil
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

Terra Associates / CPT-11 / NW Fisher Creek Dr & NW 38th Ave Camas

OPERATOR: OGE DMM
CONE ID: DPG1386
HOLE NUMBER: CPT-11
TEST DATE: 12/29/2017 11:30:10 AM
TOTAL DEPTH: 12.959 ft

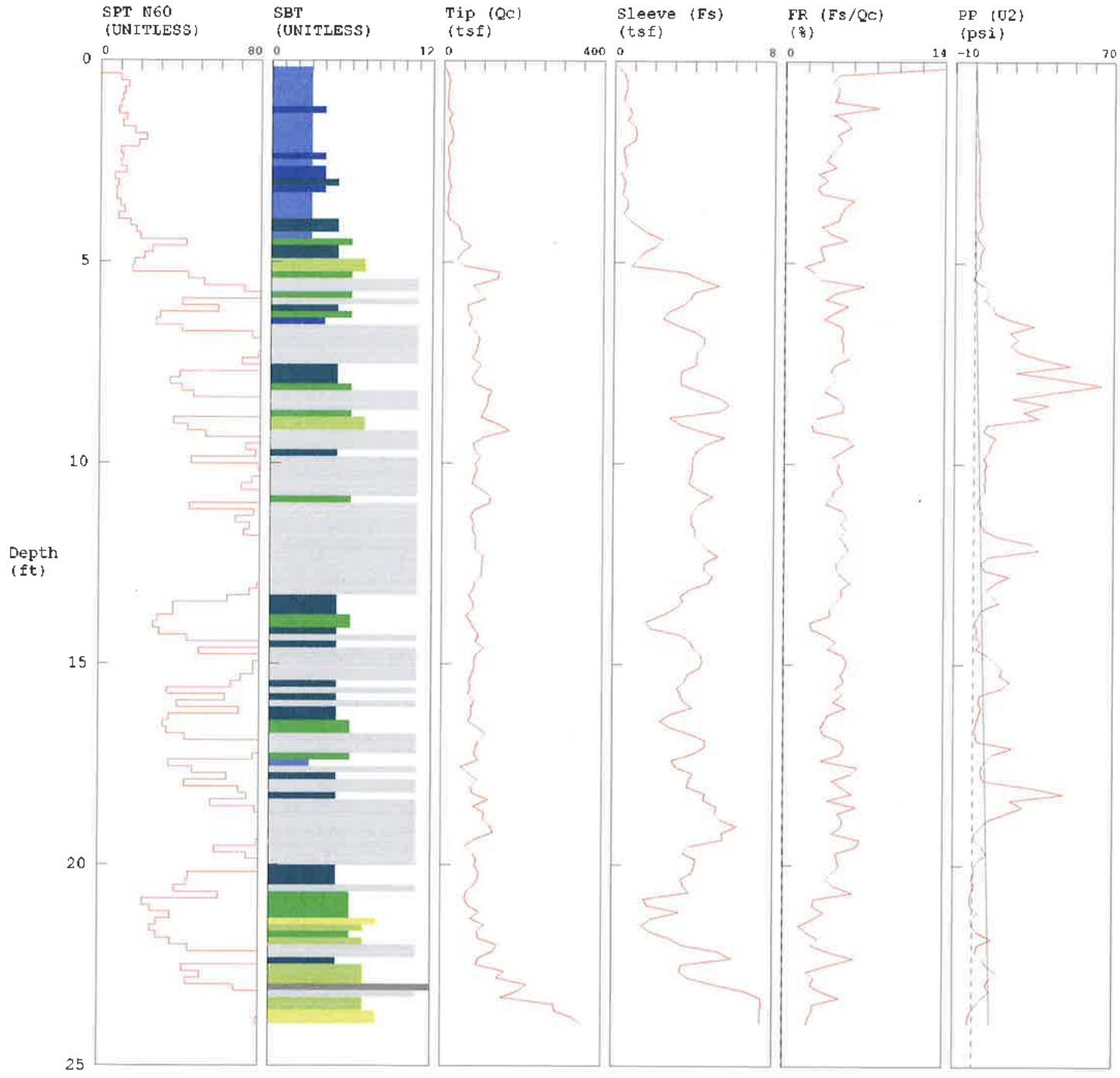


1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty cl
6 sandy silt to clayey si
7 silty sand to sandy si
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

Terra Associates / CPT-12 / NW Fisher Creek Dr & NW 38th Ave Camas

OPERATOR: OGE DMM
CONE ID: DPG1386
HOLE NUMBER: CPT-12
TEST DATE: 12/29/2017 9:26:59 AM
TOTAL DEPTH: 23.950 ft



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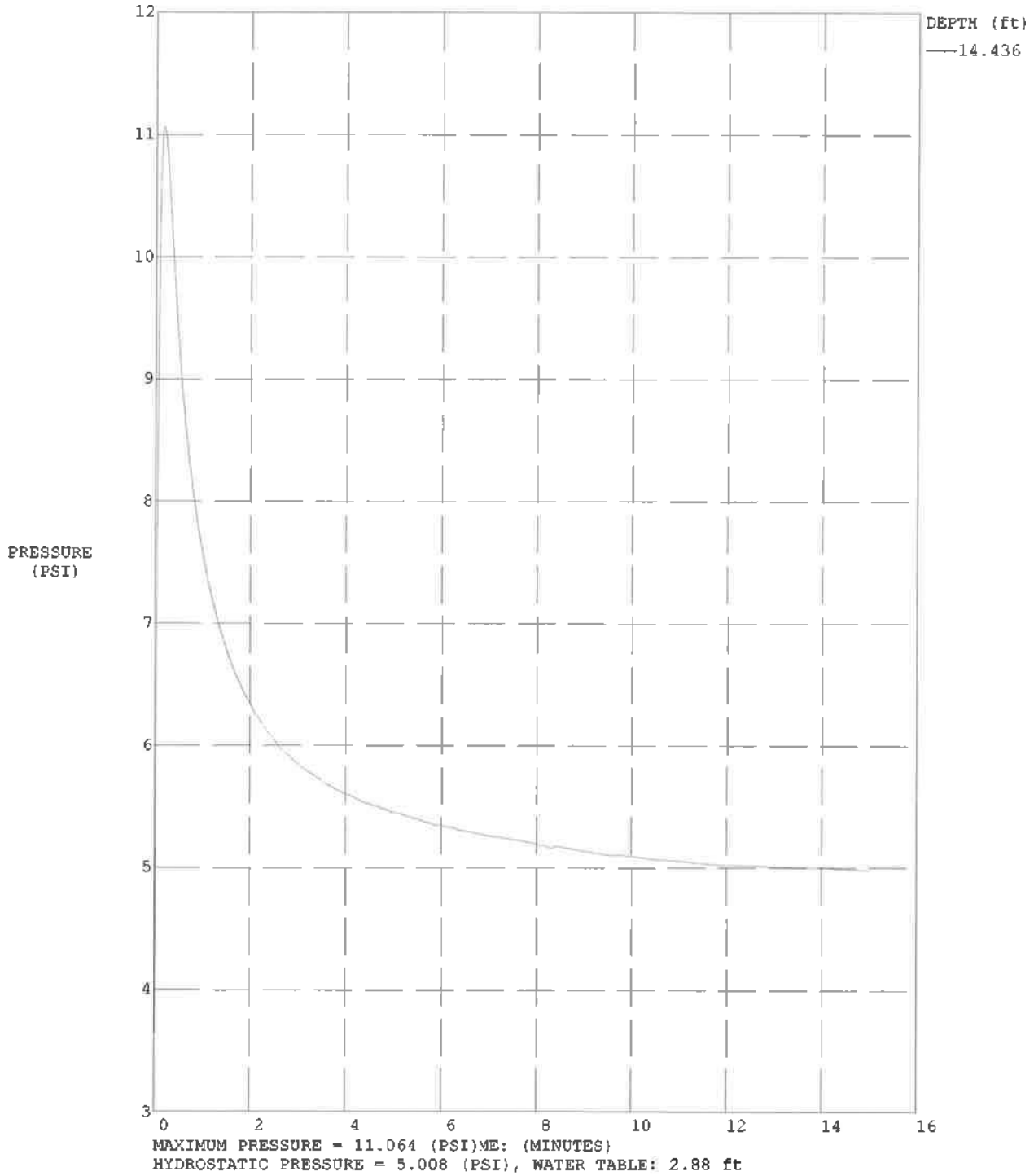
silty sand to sandy sil
sand to silty sand
sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

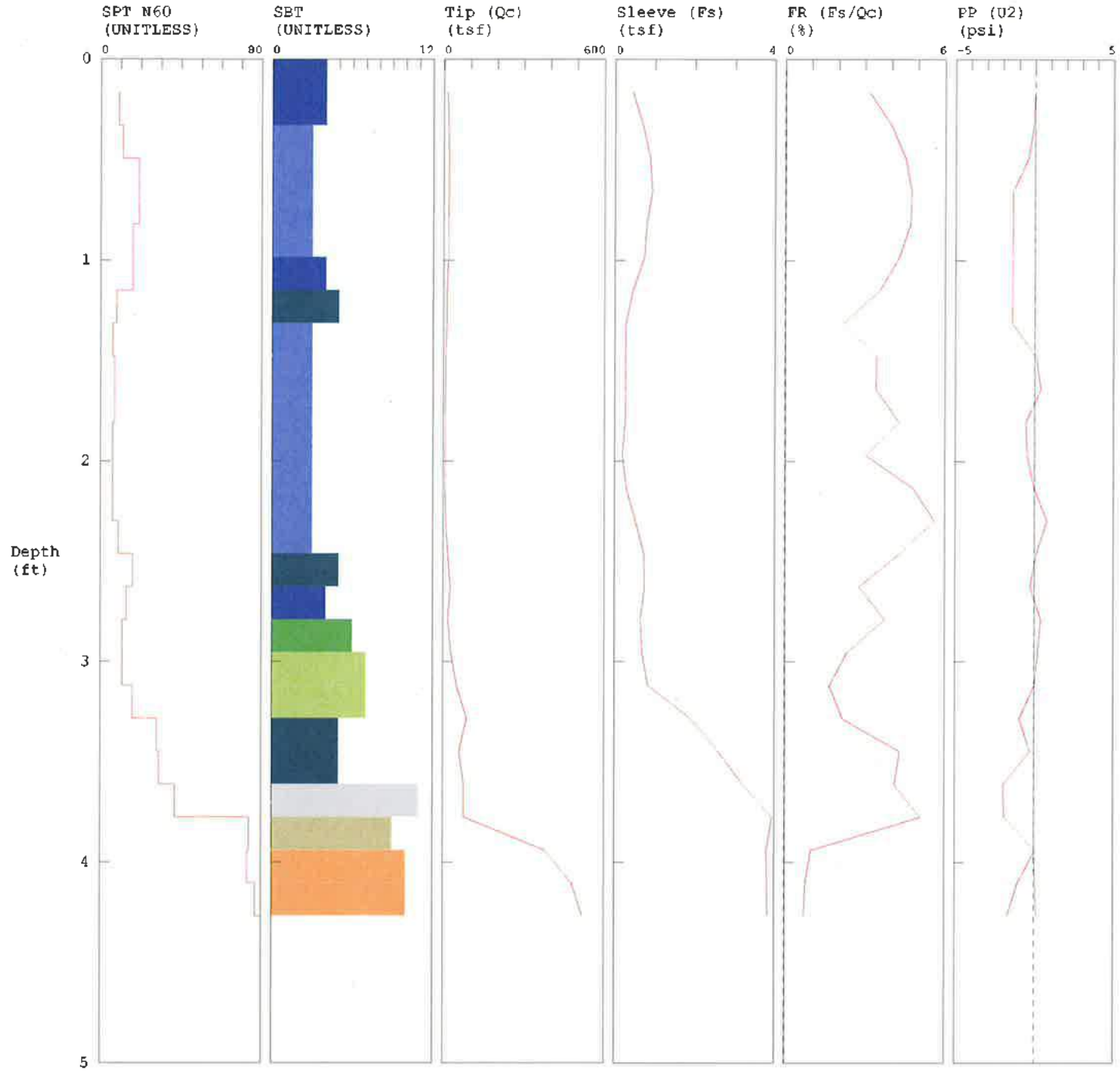
OMMENT: 17227 / Terra Associates / CPT-12 / 1911 SE Bybee Rd Cama

T DATE: 12/29/2017 9:26:59 AM



Terra Associates / CPT-13 / NW Fisher Creek Dr & NW 38th Ave Camas

OPERATOR: OGE DMM
CONE ID: DPG1386
HOLE NUMBER: CPT-13
TEST DATE: 12/29/2017 11:15:29 AM
TOTAL DEPTH: 4.265 ft

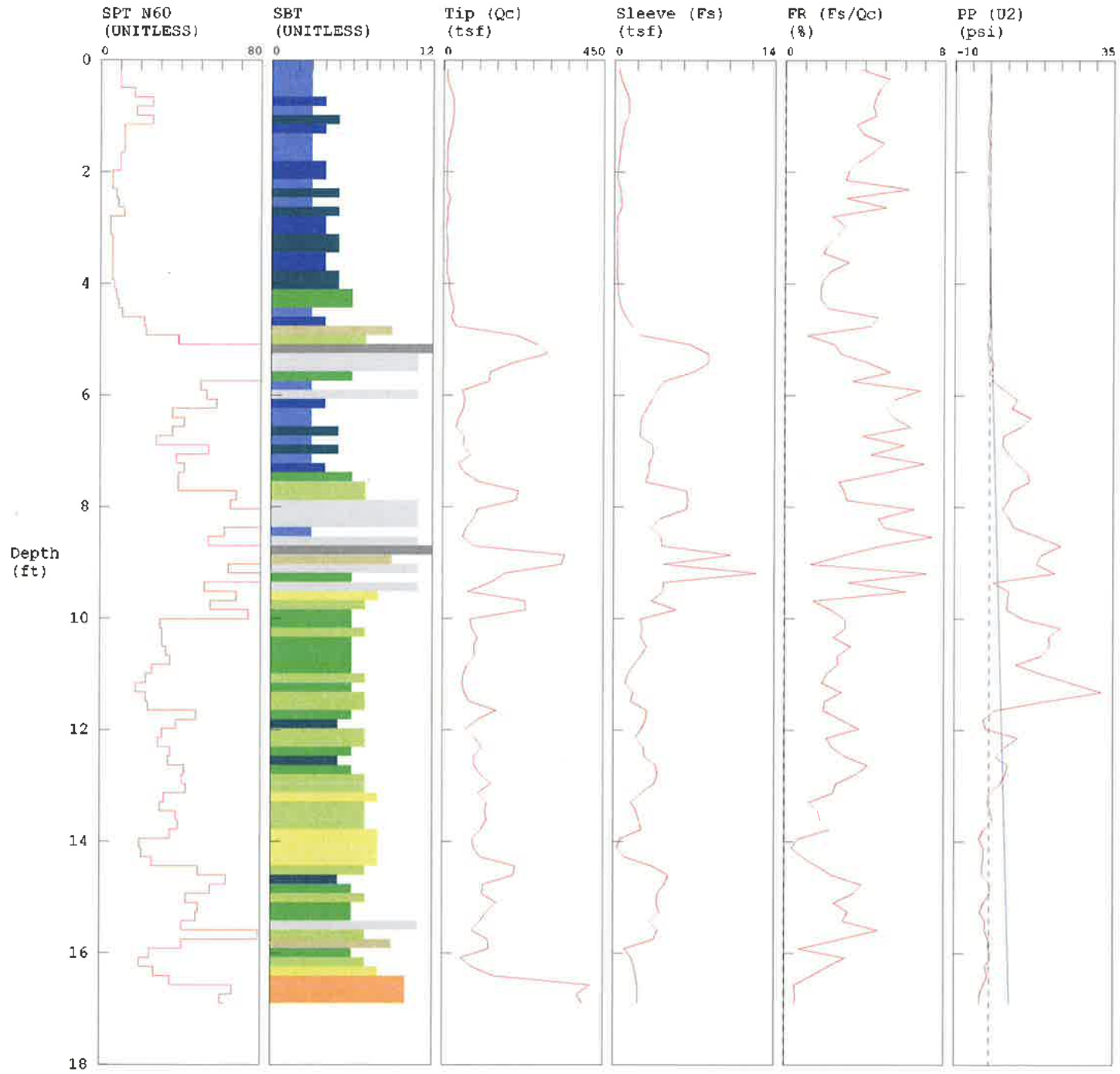


1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty cl
6 sandy silt to clayey si
7 silty sand to sandy sil
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

Terra Associates / CPT-14 / NW Fisher Creek Dr & NW 38th Ave Camas

OPERATOR: OGE DMM
CONE ID: DPG1386
HOLE NUMBER: CPT-14
TEST DATE: 12/29/2017 10:09:58 AM
TOTAL DEPTH: 16.896 ft

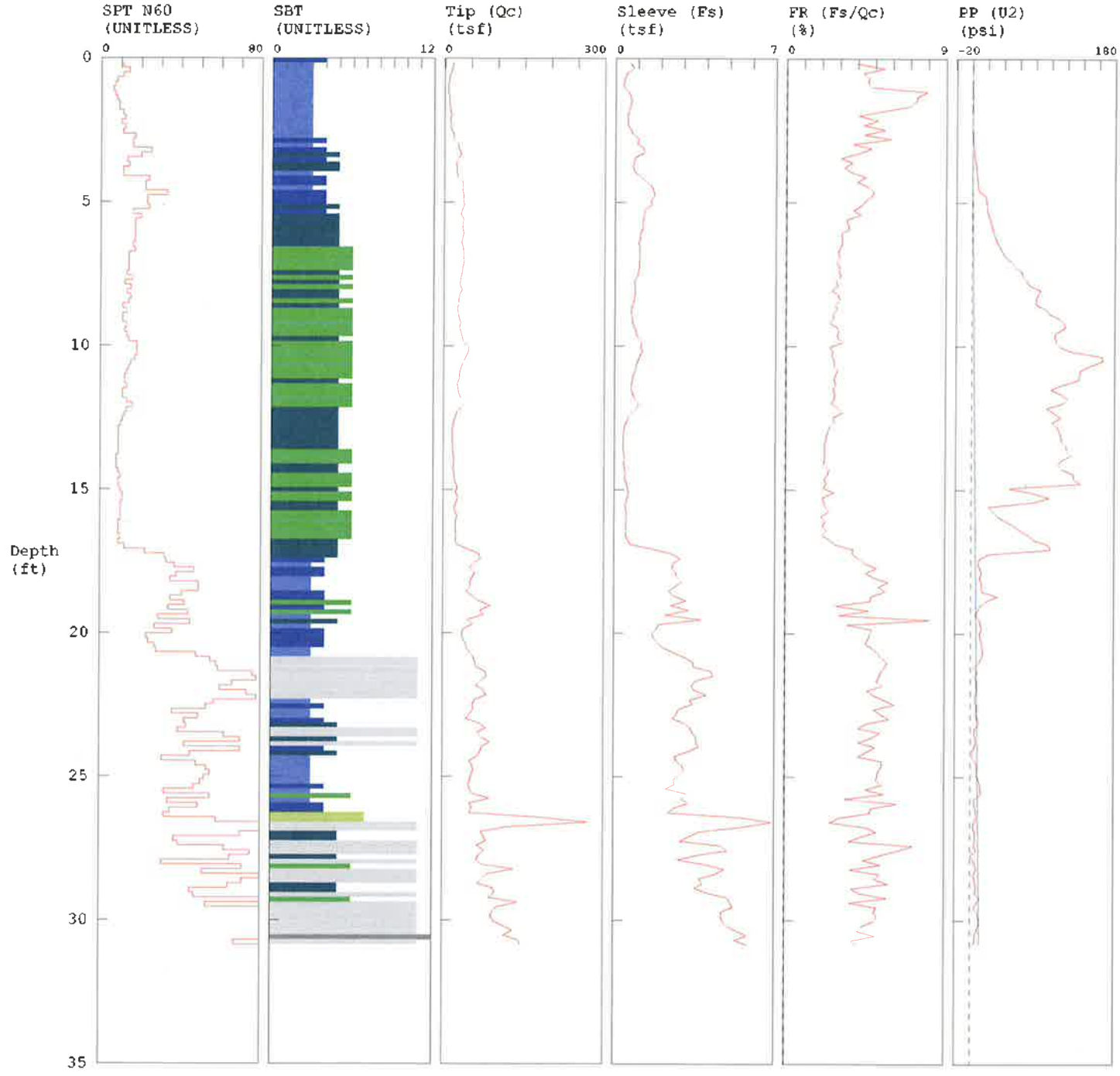


1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty cl
6 sandy silt to clayey si
7 silty sand to sandy sil
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

Terra Associates / CPT-15 / NW Fisher Creek Dr & NW 38th Ave Camas

OPERATOR: OGE DMM
CONE ID: DPG1386
HOLE NUMBER: CPT-15
TEST DATE: 12/29/2017 10:32:09 AM
TOTAL DEPTH: 30.840 ft



1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty cl
6 sandy silt to clayey si
7 silty sand to sandy sil
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

OMMENT: 17227 / Terra Associates / CPT-15 / 1911 SE Bybee Rd Cama

T DATE: 12/29/2017 10:32:09 AM