THE APPROVED CONSTRUCTION PLANS AND ALL ENGINEERING DOCUMENTS MUST BE POSTED ON THE JOB AT ALL INSPECTIONS IN A VISIBLE AND READILY ACCESSIBLE LOCATION.

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# GEOTECHNICAL REPORT

## East Main Industrial
## East Main Street and Shaw Road
## Puyallup, Washington

**Project No. T-8222**

**Terra Associates, Inc.**

**Prepared for:**

**Panattoni Development Company**
**Tacoma, Washington**

**April 6, 2020**
**Revised July 13, 2020**

PRRWF20220381

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

April 6, 2020
Revised July 13, 2020
Project No. T-8222

Mr. Brian Mattson
Panattoni Development Company
1821 Dock Street, Suite 100
Tacoma, Washington 98402

Subject: Geotechnical Report
East Main Industrial
East Main Street and Shaw Road
Puyallup, Washington

Dear Mr. Mattson:

As requested, we have 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.

In general, the site soils generally consisted of alluvial silts and sands to the termination of the test pits. The upper soil conditions noted in the CPTs are generally consistent with the soils observed in the test pits. CPT data indicates the highly variable interbedded alluvial soils composed of silts, clays, and silty sand layers are present to the total depth of the CPT. The exception to this was noted in CPT-1 where the alluvial soils are present to a depth of 32 feet followed by very dense gravel. In general, where fine grained sediments (silt and clay soils) are indicated, correlated $N_{60}$ values, indicate consistencies in the soft to medium stiff range. Where cohesionless (sand) sediments are indicated, correlated $N_{60}$ values indicate relative densities in the medium dense range.

In Test Pits TP-3, TP-4, TP-5, and TP-10, we observed minor to moderate amounts of logs and other organic material within the upper eight to ten feet of the soil profile.

Potential post construction settlements under static spread footing loads can be mitigated by implementing a fill surcharge program at the site. Alternatively, if soil liquefaction-related building impacts are unacceptable, spread footings can be constructed directly on subgrades improved by the installation of stone columns or rammed aggregate piers.

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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.**

Stephanie King

Stephanie L. King, E.I.T.
Staff Engineer

Carolyn S Decker 7-13-2020

Carolyn S. Decker, P.E.
Project Engineer

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## 1.0 PROJECT DESCRIPTION

The project consists of developing the property with an approximately 199,000 square-foot industrial building along with associated infrastructure improvements. Based on the Grading and Drainage Plan, prepared by Barghausen Consulting Engineers dated March 24, 2020, the building will be located in the southern portion of the site with dock high loading on the north side of the building. The building has a finish floor elevation of 59.5 feet. Grading to achieve the building lot and roadway elevations will consist of cuts and fills from one to four feet. The grade transition from East Main Avenue to the project site will be supported with a fill slope and retaining wall.

Site stormwater will be collected and directed to a stormwater detention vault in the northern portion of the site. The vault is 536 feet by 70 feet with a bottom elevation of 48.70 feet. Excavations to achieve the bottom elevation will range from seven to eight feet below current site grades.

We expect the structure will be constructed using precast concrete tilt-up perimeter wall panels with interior columns supporting the roof structure. The floor slab will be constructed at grade with dock high loading on the north side of the structure. Structural loading is expected to be light, with isolated columns carrying loads of 50 to 70 kips and bearing walls carrying 4 to 6 kips per foot. Maximum product loading on the floors is not expected to exceed 350 pounds per square foot (psf).

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

## 2.0 SCOPE OF WORK

Our work was completed in accordance with our authorized proposal, dated August 14, 2019. Accordingly, on September 5, 2019, we explored subsurface conditions at the site by excavating 14 test pits to maximum depths of approximately 11 feet below existing ground surface using a track-mounted excavator. On September 13, 2019, InSitu Engineering under Terra's direction completed 5 Cone Penetration Tests (CPTs) to depths of 35 to 60 feet below current site grades. Using this data along with results of laboratory testing, we performed analyses to develop geotechnical recommendations for project design and construction. Specifically, this report addresses the following:

- Soil and groundwater conditions.
- Seismic design parameters per the 2018 International Building Code (IBC).
- Site preparation and grading including recommendations for building preload or surcharge to mitigate floor and foundation settlement.
- Foundations
- Floor slabs

- Lateral earth pressures for wall design.
- Stormwater detention vault.
- Subsurface 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 contractor 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 10 acres located south of East Main Avenue between 101 – 23rd Street SE and 2606 East Main Avenue in Puyallup, Washington. The approximate location of the site is shown on Figure 1.

Both parcels are undeveloped and used for agricultural purposes. The western parcel is currently covered with several rows of raspberry bushes and the eastern parcel is mostly clear with one small building and a gravel parking lot. Site topography is relatively flat with a slight slope from the east to the west.

### 3.2 Soils

In general, the upper soil conditions at the site consisted of alluvial silts and sands to the termination of the test pits. The upper soil conditions noted in the CPTs are generally consistent with the soils observed in the test pits. CPT data indicates the highly variable interbedded alluvial soils composed of silts, clays, and silty sand layers are present to the total depth of the CPT. The exception to this was noted in CPT-1 where the alluvial soils are present to a depth of 32 feet followed by very dense gravel. In general, where fine grained sediments (silt and clay soils) are indicated, correlated $N_{60}$ values, indicate consistencies in the soft to medium stiff range. Where cohesionless (sand) sediments are indicated, correlated $N_{60}$ values indicate relative densities in the medium dense range.

In Test Pits TP-3, TP-4, TP-5, and TP-10, we observed minor to moderate amounts of logs and other organic material within the upper eight to ten feet of the soil profile.

The *Geologic Map of the Tacoma 1:100,000-scale Quadrangle, Washington,* by J.E. Schuster, A.A. Cabibbo, J.F. Schilter, and I.J. Hubert (2015) maps the site as Alluvium (Qa). The soils we observed in our test pits and CPTs are consistent with this mapped soil unit.

The preceding discussion is intended to be a brief review of the soil conditions observed at the site. More detailed descriptions of the subsurface conditions we recorded are summarized on the Test Pit Logs and CPT Logs attached in Appendix A. The approximate location of the Test Pits and CPTs are shown on Figure 2.

### 3.3 Groundwater

We observed light to moderate groundwater seepage in 6 of the 14 test pits at depths ranging from 7.5 to 10 feet below existing site grades. Additionally, we observed wet soil from 7.5 to 10 feet in 8 of the test pits. We performed two pore water dissipation tests. One at CPT-1 and one at CPT-5. Based on the test results, the static groundwater level was indicated to be at a depth of four to seven feet below current site grades. Fluctuations in the static groundwater level will occur seasonally. Based on the time of year of our testing, we expect the groundwater levels indicated to be near their seasonal lows. Typically, groundwater will reach maximum levels during the wet winter months.

### 3.4 Seismic

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 sands underlying 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.

We completed a liquefaction analysis using the computer program LiquefyPro published by CivilTech Corporation. The analysis was completed using a ground acceleration value of 0.55g, which is the ASCE 7-16 site-modified peak ground acceleration value ($PGA_M$) determined using the map-based online ground motion parameter calculator at https://seismicmaps.org/ for Latitude 47.191033ºN and Longitude 122.261465ºW. The results of the liquefaction analysis are attached in Appendix B.

The results of our analysis indicate soil liquefaction could occur during the design earthquake event. Analysis indicates that liquefaction of the alluvial soil layers could result in total settlements between three and three and one half inches, half of which could be differential. If unmitigated, these settlements would result in some cracking of building walls and floor slabs, as well as distortion of doors and windows, but would not structurally impair the building's use, in our opinion. If the Owner is not willing to accept the risk associated with the potential settlements due to liquefaction of the site soils, the building should be supported on densified aggregate piers.

Based on the soil conditions encountered and the local geology, the 2018 International Building Code (IBC) indicates that site class "E" should be used in structural design.

## 4.0 DISCUSSION AND RECOMMENDATIONS

### 4.1 General

Based on our study, in our opinion, development of the site as proposed is feasible from a geotechnical engineering standpoint. The primary geotechnical concern at the site is the presence of compressible soil strata susceptible to consolidation under the planned fill placement and building loads. If unmitigated, compression of these soft soils under project loads would result in unacceptable levels of differential settlement.

In our opinion, the potential post construction settlements under static building loads can be mitigated by implementing a fill surcharge program. This would entail raising site grades to finish floor elevation, followed by placing a surcharge fill pad to induce settlements prior to application of building loads. Though a surcharge program will mitigate settlements under static loads, as noted above, the risk of some building cracking and distortion resulting from soil liquefaction during the design earthquake would remain. If that risk is unacceptable to the Owner, the building will need to be supported on ground improved by installing vibrated stone columns or densified aggregate piers. The stone columns/aggregate piers subgrade option would preclude the need for a fill surcharge program.

Based on the CPT data and the materials encountered in the test pits, the soils contain a sufficient amount of soil fines that will make it difficult to compact as structural fill when too wet. The ability to use these native soils from site excavations as structural fill will depend on its moisture content and the prevailing weather conditions at the time of construction.

Detailed recommendations regarding these issues and other geotechnical design considerations are provided in the following sections. 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 and organic surface soils, and other deleterious material should be stripped and removed from the site. Surface stripping depths of approximately four to ten inches should be expected to remove the organic/disturbed surficial soils. Soil containing organic material will not be suitable for use as structural fill but may be used for limited depths in nonstructural areas. For the existing small building, demolition should include removal of existing foundations and abandonment of underground septic systems and other buried utilities, as applicable. 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 and demolition 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.

Some of the site soils will quickly degrade under construction traffic if shallow groundwater is encountered or rainy weather occurs during site clearing and subgrade preparation activities. Where this condition exists, consideration should be given to overexcavating to a depth of 2 feet, placing a geotextile fabric such as Mirafi 500X or equal on the overexcavated subgrade, and replacing with 2- to 4-inch recycled concrete or quarry spalls. Based on our experience, this will provide a stable surface for areas subject to heavy equipment and construction traffic.

We recommend that all building footings and vault retaining walls 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.

Our study indicates that the soils contain a sufficient percentage of fines (silt and clay size particles) that may 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 or lime to stabilize the soil and facilitate compaction. If an additive is used, additional Best Management Practices (BMPs) for its use will need to be incorporated into the Temporary Erosion and Sedimentation Control plan (TESC) for the project. Soils that are dry of optimum should be moisture conditioned by controlled addition of water and blending prior to material placement.

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 ¾-inch fraction.

Prior to use, Terra Associates, Inc. should observe 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.

### *Surcharge Program*

The surcharge program consists of placing fill material above finish floor elevation 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.

We recommend placing a minimum of four 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). 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 building structural fill and surcharge fill will be in the range of six to eight inches. It is estimated that 90 percent of the consolidation settlement will occur in about five to eight weeks following full application of the surcharge.

To verify 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 marker 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/surcharge 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 4.4 of this report, estimated post construction settlement due to primary consolidation is less than one-inch.

### 4.3 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 on-site soils 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 below depths of about four to seven feet should be anticipated within excavations at the site. If the excavation only extends two to three feet below the groundwater, the volume of water and rate of flow into the excavation is expected to be moderate and are not expected to impact the stability of the excavations when completed, as described. 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. Deeper excavations for utilities and detention pond wall construction that will require worker entry will likely require pre-draining using deep pump wells or closely spaced well points.

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.

## 4.4 Foundations

### *Spread Footings*

The industrial building may be supported on conventional spread footing foundations bearing on foundation subgrade prepared as recommended in Section 4.2 of this report. Perimeter foundations exposed to the weather should bear at a minimum depth of 1.5 feet below final exterior grades for frost protection. Interior foundations can be constructed at any convenient depth below the floor slab.

Following the completion of a successful surcharge program, we recommend designing foundations for a net allowable bearing capacity of 2,500 pounds per square foot (psf). For short-term loads, such as wind and seismic, a one-third increase in this allowable capacity can be used in design. Following successful completion of the surcharge program, with structural loading as anticipated and this bearing stress applied, estimated immediate foundation settlements of about 1-inch and differential settlement of ½-inch should be expected.

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 pounds per cubic foot (pcf). We recommend not 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 foundations 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*

As discussed above, as a foundation support alternative in lieu of implementing a surcharge fill program, we recommend using ground improvement techniques to establish support for conventional spread footing designs. Methods that could be considered include vibrated stone columns or aggregate rammed piers. Both of these methods create highly densified columns of graded aggregate that would extend through the upper softer soils into the underlying medium dense soils.

Because of the methods used to construct the columns, some improvement of the adjacent soils is also realized. Moreover, these methods can provide liquefaction mitigation by providing drainage paths and reduced pore pressures during ground shaking, and by constructing relatively high strength, non-liquefiable inclusions in the soils. Once constructed, conventional spread footing foundations can be designed to bear immediately above the stone column/aggregate pier 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 selecting the specialty contractor, if desired.

## 4.5 Slab-on-Grade Floors

Slab-on-grade floors may be supported on a subgrade as recommended in Section 4.2. 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 to 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 not be effective in assisting uniform curing of the slab and can actually serve as a water supply for moisture bleeding through the slab, potentially 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.

## 4.6 Infiltration Feasibility

Based on our study, it is our opinion that subsurface conditions are generally not favorable for infiltration of site stormwater. The native soils observed at the site contain a high percentage of soil fines that would impede any downward migration of site stormwater. Additionally, mottling was observed that indicates a shallow groundwater table develops at the site that would further impede any stormwater migration. Even low impact development (LID) techniques would likely fill up and overtop during rain events and cause minor local flooding. The USDA Natural Resources Conservation Service (NRSC) categorizes the soils at the lower southern portion of the site as Briscot loam. These soils fall into Hydrologic Group C as outlined in Table B.5 in Appendix III-B of the *2015 Pierce County Stormwater and Site Development Manual (PCSSDM)* and are classified as having low infiltration rates when wetted. Based on these soil conditions, it is our opinion that the stormwater should be managed using a conventional system.

## 4.7 Lateral Earth Pressures

The magnitude of earth pressure development on retaining walls will partly depend on the quality of wall backfill. Where fill is placed behind retaining walls, we recommend placing and compacting it as structural fill as described in Section 4.2. To guard against the build-up of hydrostatic pressure, wall drainage must also be installed. We recommend that wall drainage consist of a minimum 12-inch thick layer of washed gravel placed adjacent to the wall. Alternatively, a composite drainage panel such as Mirafi G100N or equal can be used. A four-inch diameter perforated pipe should be placed on a bed of gravel along the base of the wall footing and directed to a suitable outlet. A typical wall drainage detail is attached as Figure 4.

With granular backfill placed and compacted as recommended and drainage properly installed, we recommend designing restrained (not free to deflect) retaining walls for an at-rest earth pressure equivalent to a fluid weighing 50 pcf. A value of 35 pcf may be used for the case where the wall is unrestrained. These values do not include other surcharge loading such as from fill backslopes or adjacent footings that may act on the wall. If such conditions will exist, then the imposed loading must be included in wall design. Values of friction at the base of wall foundations and passive earth pressure that are used in design to resist lateral loads are provided in Section 4.4 of this report.

## 4.8 Stormwater Detention Vault

As noted above, site stormwater will be collected and directed to a 536-foot by 70-foot stormwater detention vault in the northern portion of the site. The bottom of the vault is at elevation 48.7 feet which will require excavations between 7 and 8 feet below current site grades. The soils exposed at this elevation are expected to be loose to medium dense alluvial silts and sands. Vault foundations should be supported on two feet of structural fill that replaces the native alluvial soils. The structural fill should extend 1-foot beyond the edge of the foundation. Vault foundations should be designed using the parameters outlined in Section 4.4. Friction at the base of foundations and passive earth pressure will provide resistance to lateral loads. Values for these parameters are provided in Section 4.4.

The magnitude of earth pressures developing on the vault walls will depend in part on the quality and compaction of the wall backfill. We recommend placing and compacting wall backfill as structural fill, as recommended in the Section 4.2 of this report. Lateral earth pressures recommended in Section 4.7 can be used in designing the below-grade vault walls. If it is not possible to discharge collected water at the footing elevation, we recommend setting the invert elevation of the wall drainpipe equivalent to the outfall invert and connecting the drain to the outfall pipe for discharge. For any portion of the wall that falls below the invert elevation of the wall drain, an earth pressure equivalent to a fluid weighing 85 pcf should be used.

The vault structure will be subject to uplift pressures. The weight of the structure and the weight of the backfill soil above its foundation will provide resistance to uplift. A soil unit weight of 120 pcf can be used for the vault backfill provided the backfill is placed and compacted as structural fill as recommended above.

## 4.9 Drainage

### *Surface*

Final exterior grades should promote free and positive drainage away from the site at all times. Water must not be allowed to pond or collect adjacent to foundations or within the immediate building areas. We recommend providing a positive drainage gradient away from the building perimeters. If this gradient cannot be provided, surface water should be collected adjacent to the structures and disposed to appropriate storm facilities.

***Subsurface***

With positive drainage away from the building provided and with paved surfaces extending to the building perimeter, in our opinion, customary installation of the perimeter foundation drains would not be required. Foundation drains should be installed, where positive drainage is not provided or where soft landscaping will occur at the building perimeter. The drains can consist of 4-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 drains can be laid to grade at an invert elevation equivalent to the bottom of footing grade. The foundation drains and roof downspouts should be tight-lined 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.

## 4.10 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, soils excavated on-site should generally be suitable for use as backfill material. However, the soils observed across the site are fine grained and moisture sensitive; therefore, moisture conditioning may be necessary to facilitate proper compaction. If utility construction takes place during the winter, it may be necessary to import suitable wet weather fill for utility trench backfilling.

Depending on final utility grades, the utility contractor should also be prepared for encountering unstable soft soils below the pipe invert elevations. If not removed from below the pipe and replaced with crushed rock or additional bedding material, pipe deflections will occur as a result of the soil yielding and compressing in response to loading imposed by the trench backfill.

## 4.11 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. We expect traffic at the facility will consist of cars and light trucks, along with heavy traffic in the form of tractor-trailer-rigs. For design considerations, we have assumed traffic in parking and in car/light truck access pavement areas can be represented by an 18-kip Equivalent Single Axle Loading (ESAL) of 50,000 over a 20-year design life. For heavy traffic pavement areas, we have assumed an ESAL of 300,000 would be representative of the expected loading. These ESALs represent loading approximately equivalent to 3 and 18, loaded (80,000 pound GVW) tractor-trailer rigs traversing the pavement daily in each area, respectively.

With a stable subgrade prepared as recommended for the design ESAL values, we recommend the following pavement sections:

Light Traffic/Car Access:

- Two inches of hot mix asphalt (HMA) over four inches of crushed rock
- Full depth HMA – 4 inches

Heavy Traffic/Truck Access:

- Three inches of HMA over six inches of crushed rock
- Full depth HMA – 5.5 inches

For exterior Portland cement concrete (PCC) pavement, we recommend the following:

- 6 inches of PCC over two inches of crushed surfacing top course
    - 28-day compressive strength – 4,000 psi
    - Control joints spaced at a maximum of 15 feet

The paving materials used should conform to the Washington State Department of Transportation (WSDOT) specifications for ½-inch class HMA, PCC, and CRB.

Long-term pavement performance will depend on surface drainage. A poorly-drained pavement section will be subject to premature failure resulting from surface water infiltrating 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 as they occur.

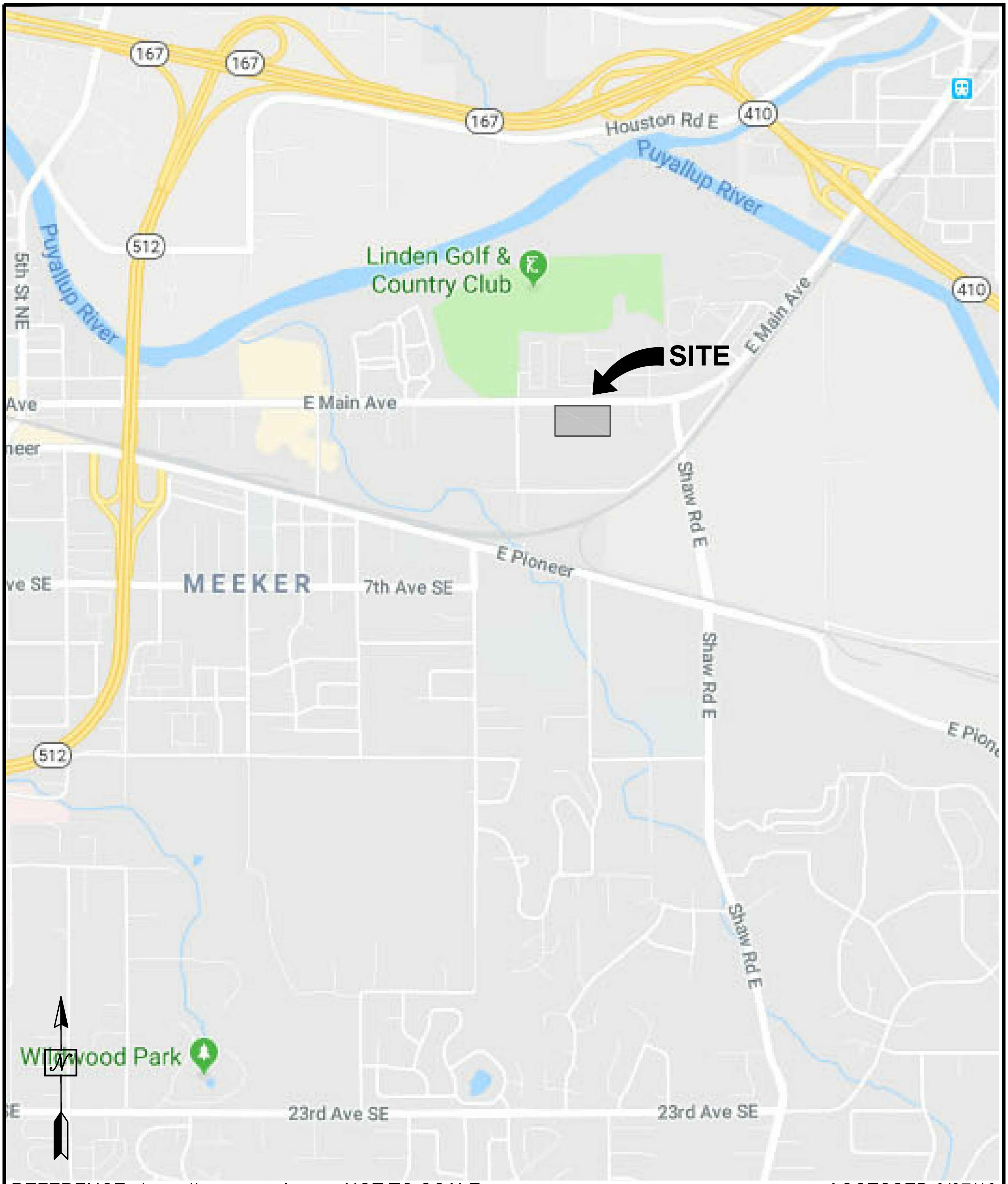
## 5.0 ADDITIONAL SERVICES

Terra Associates, Inc. should review the final design drawings 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 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. No other warranty, expressed or implied, is made. This report is the copyrighted property of Terra Associates, Inc. and is intended for specific application to the East Main Industrial project in Puyallup, Washington. This report is for the exclusive use of Panattoni Development Company. and their authorized representatives.

The analyses and recommendations presented in this report are based on data obtained from the subsurface explorations completed on-site. Variations in soil conditions can occur, the nature and extent of which may not become evident until construction. If variations appear evident, Terra Associates, Inc. should be requested to reevaluate the recommendations in this report prior to proceeding with construction.



REFERENCE: https://www.google.com NOT TO SCALE

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**Terra Associates, Inc.**
Consultants in Geotechnical Engineering
Geology and
Environmental Earth Sciences

VICINITY MAP
EAST MAIN INDUSTRIAL
PUYALLUP, WASHINGTON

| | | |
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| Proj.No. T-8222 | Date:JULY 2020 | Figure 1 |

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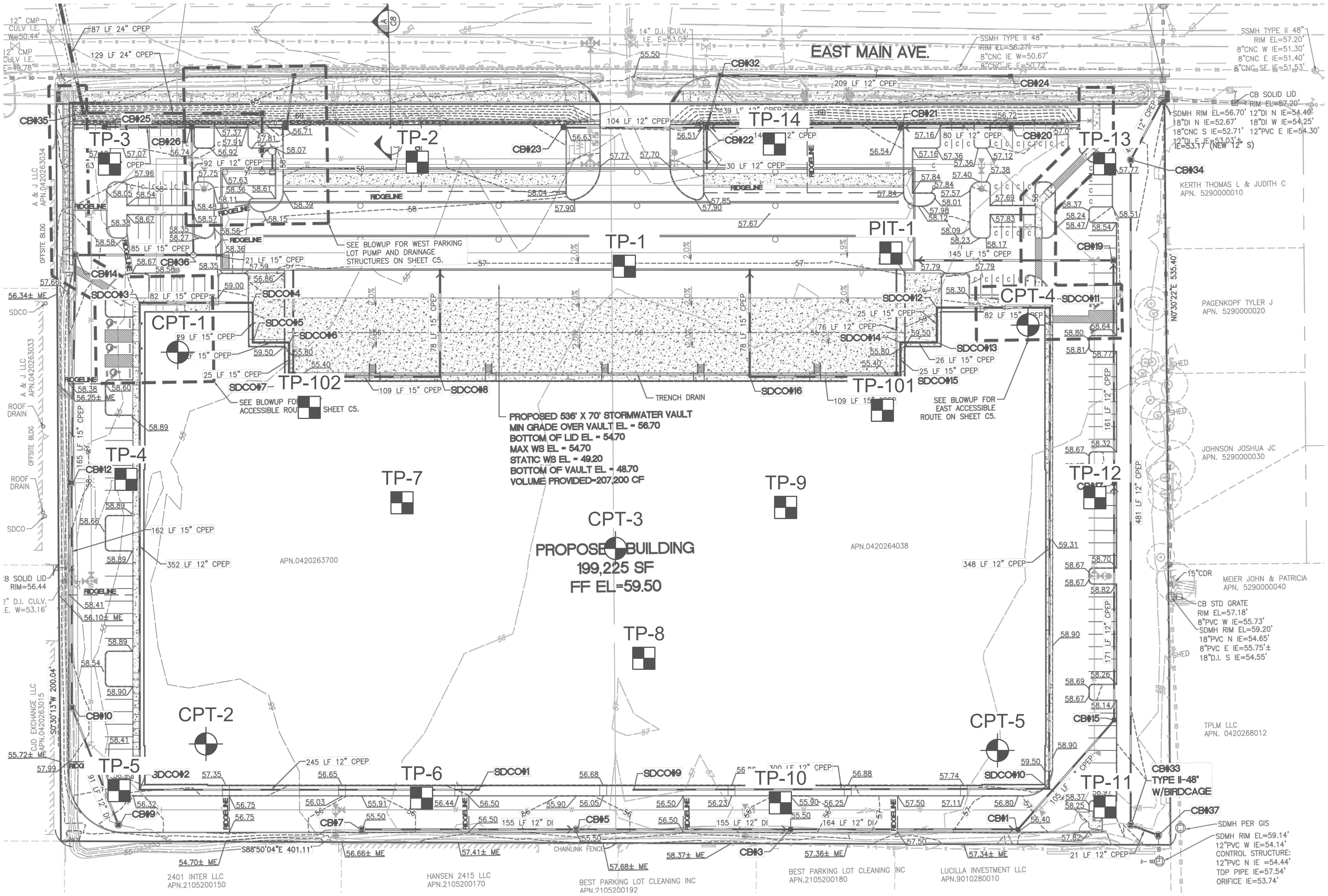

**NOTE:**

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 BARGHAUSEN

**LEGEND:**

◪ APPROXIMATE TEST PIT/INFILTRATION TEST LOCATION

⊕ APPROXIMATE CONE PENETRATION TEST LOCATION

NOT TO SCALE

N

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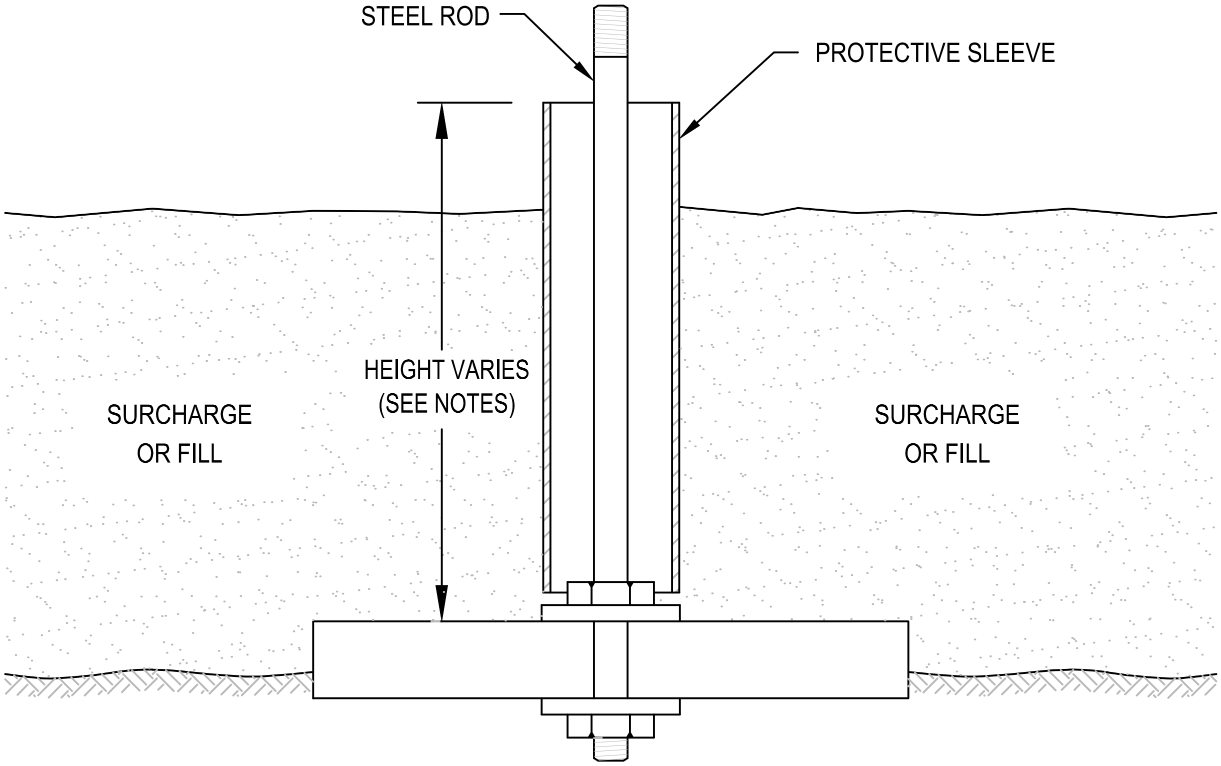
EXPLORATION LOCATION PLAN
EAST MAIN INDUSTRIAL
PUYALLUP, WASHINGTON

| | | |
|---|---|---|
| Proj.No. T-8222 | Date:JULY 2020 | Figure 2 |



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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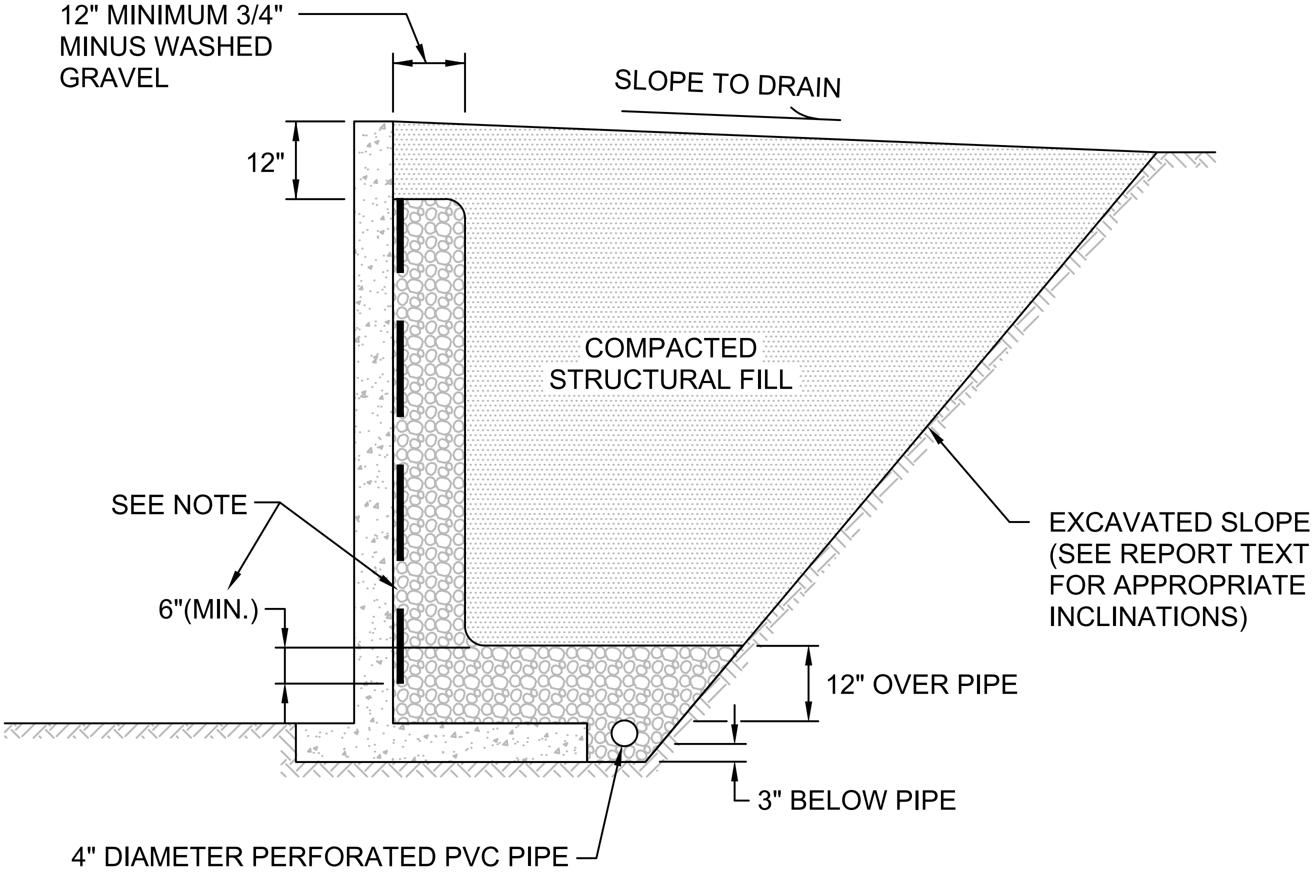
SETTLEMENT MARKER DETAIL
EAST MAIN INDUSTRIAL
PUYALLUP, WASHINGTON

Proj.No. T-8222 | Date:JULY 2020 | Figure 3



**NOT TO SCALE**

**NOTE:**

MIRADRAIN G100N PREFABRICATED DRAINAGE PANELS OR SIMILAR PRODUCT CAN BE SUBSTITUTED FOR THE 12-INCH WIDE GRAVEL DRAIN BEHIND WALL. DRAINAGE PANELS SHOULD EXTEND A MINIMUM OF SIX INCHES INTO 12-INCH THICK DRAINAGE GRAVEL LAYER OVER PERFORATED DRAIN PIPE.

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TYPICAL WALL DRAINAGE DETAIL
EAST MAIN INDUSTRIAL
PUYALLUP, WASHINGTON

| | | |
|---|---|---|
| Proj.No. T-8222 | Date:JULY 2020 | Figure 4 |

# APPENDIX A
# FIELD EXPLORATION AND LABORATORY TESTING

## East Main Industrial
## Puyallup, Washington

On September 5, 2019, we completed our site exploration by observing soil and groundwater conditions at 14 test pits. The test pits were excavated using a trackhoe to a maximum depth of approximately 9.5 to 11 feet below existing site grades. Test pit locations were determined in the field by measurements from existing site features. The approximate location of the test pits is shown on the attached Exploration Location Plan, Figure 2. The Test Pit Logs are attached as Figures A-2 through A-15.

A geotechnical engineer from our office conducted the field exploration. Our representative classified the soil conditions encountered, maintained a log of the 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.

InSitu Engineering, under subcontract with Terra Associates, Inc. conducted five electric CPTs at locations selected by Terra Associates, Inc., which are shown on Figure 2. The CPTs were advanced to a depth of 35 to 60 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**<br>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**<br>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**<br>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**<br>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

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

| | Consistancy | Standard Penetration Resistance in Blows/Foot |
|---|---|---|
| **COHESIVE** | 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 |
| ‖ | 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
EAST MAIN INDUSTRIAL
PUYALLUP, WASHINGTON

| Proj.No. T-8222 | Date:JULY 2020 | Figure A-1 |
|---|---|---|

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# LOG OF TEST PIT NO. TP-1

**FIGURE** A-2

**PROJECT NAME:** East Main Industrial **PROJ. NO:** T-8222 **LOGGED BY:** KPR

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

**DATE LOGGED:** September 5, 2019 **DEPTH TO GROUNDWATER:** 10.5 Feet **DEPTH TO CAVING:** N/A

| Depth (ft) | Sample No. | Description | Consistency/ Relative Density | W (%) |
|---|---|---|---|---|
| 0 | | | | |
| 1 | | (2 inches SOD)<br>Light brown SILT with fine sand, non-plastic, moist. (ML) | | |
| 2 | | | | 15.8 |
| 3 | | | Loose | |
| 4 | | | | |
| 5 | | Brown SAND with silt, fine to medium sand, moist. (SP-SM) | | |
| 6 | | | | 9.5 |
| 7 | | Dark gray SAND, medium sand, moist. (SP) | Medium Dense | |
| 8 | | | | 4.7 |
| 9 | | | | |
| 10 | | Gray SILT with clay, slight plasticity, wet. (ML) | Soft | 54.2 |
| ▼ | | | | |
| 11 | | Test pit terminated at approximately 11 feet.<br>Light groundwater seepage observed at 10.5 feet.<br>No caving. | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |

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:** East Main Industrial **PROJ. NO:** T-8222 **LOGGED BY:** KPR

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

**DATE LOGGED:** September 5, 2019 **DEPTH TO GROUNDWATER:** 9.5 Feet **DEPTH TO CAVING:** N/A

| Depth (ft) | Sample No. | Description | Consistency/ Relative Density | W (%) |
|---|---|---|---|---|
| 0 | | | | |
| 1 | | (1-inch SOD)<br>Light brown SILT with fine sand, non-plastic, moist, mottled. (ML) | | |
| 2 | | | Medium Dense | |
| 3 | | | | 14.7 |
| 4 | | Dark gray SAND, fine sand, moist. (SP) | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | Loose | |
| 8 | | | | |
| 9 | | | | 18.6 |
| ▼ | | | | |
| 10 | | | | |
| 11 | | Test pit terminated at approximately 10 feet.<br>Light groundwater seepage observed at 9.5 feet.<br>No caving. | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |

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:** East Main Industrial **PROJ. NO:** T-8222 **LOGGED BY:** KPR

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

**DATE LOGGED:** September 5, 2019 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

| Depth (ft) | Sample No. | Description | Consistency/ Relative Density | W (%) |
|---|---|---|---|---|
| 0 | | | | |
| 1 | | (1-inch of SOD)<br>Light brown SILT with fine sand, non-plastic, moist, mottled. (ML) | | |
| 2 | | | Medium Dense | |
| 3 | | | | 11.2 |
| 4 | | Dark gray SAND with scattered wood pieces, fine sand, moist, thin silt layers. (SP) | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | Loose | |
| 8 | | | | 10.5 |
| 9 | | | | |
| 10 | | Test pit terminated at approximately 9.5 feet.<br>No groundwater.<br>No caving. | | |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |

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:** East Main Industrial **PROJ. NO:** T-8222 **LOGGED BY:** KPR

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

**DATE LOGGED:** September 5, 2019 **DEPTH TO GROUNDWATER:** 9.5 Feet **DEPTH TO CAVING:** N/A

| Depth (ft) | Sample No. | Description | Consistency/ Relative Density | W (%) |
|---|---|---|---|---|
| 0 | | | | |
| 1 | | (1-inch SOD)<br>Light brown SILT with fine sand, non-plastic, moist, mottled. (ML) | Medium Dense | |
| 2 | | | | 6.2 |
| 3 | | Dark gray interbeds of SAND, silty SAND and SILT with scattered wood pieces, fine sand, moist. (SP, SM, ML) | | |
| 4 | | | | |
| 5 | | | | 26.8 |
| 6 | | | Loose/Soft | |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| ▼ | | | | |
| 10 | | | | 45.5 |
| 11 | | Test pit terminated at approximately 10 feet.<br>Light groundwater seepage observed at 9.5 feet.<br>No caving. | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |

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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Environmental Earth Sciences

# LOG OF TEST PIT NO. TP-5

**FIGURE** A-6

**PROJECT NAME:** East Main Industrial **PROJ. NO:** T-8222 **LOGGED BY:** KPR

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

**DATE LOGGED:** September 5, 2019 **DEPTH TO GROUNDWATER:** 8.5 Feet **DEPTH TO CAVING:** 6.5 Feet

| Depth (ft) | Sample No. | Description | Consistency/ Relative Density | W (%) |
|---|---|---|---|---|
| 0 | | | | |
| 1 | | (1-inch SOD)<br>Light brown SILT with fine sand, non-plastic, moist, mottled. (ML) | | |
| 2 | | | Medium Dense | 14.8 |
| 3 | | | | |
| 4 | | Dark gray interbeds of SAND, silty SAND and slightly plastic SILT, fine to medium sand, abundant organics (branches, small logs), moist. (SP, SM, ML) | | |
| 5 | | | | |
| 6 | | | | 20.3 |
| 7 | | *6.5 feet: Large log | Loose/Medium Stiff | |
| 8 | | *8 feet: Wet | | |
| ▼ | | | | |
| 9 | | | | |
| 10 | | | | |
| 11 | | Test pit terminated at approximately 10 feet.<br>Moderate groundwater seepage observed at 8.5 feet.<br>Caving at 6.5 feet. | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |

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:** East Main Industrial **PROJ. NO:** T-8222 **LOGGED BY:** KPR

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

**DATE LOGGED:** September 5, 2019 **DEPTH TO GROUNDWATER:** 7.5 Feet **DEPTH TO CAVING:** N/A

| Depth (ft) | Sample No. | Description | Consistency/ Relative Density | W (%) |
|---|---|---|---|---|
| 0 | | | | |
| | | (1-inch SOD) | | |
| 1 | | Light brown SILT with fine sand, non-plastic, moist, mottled. (ML) | | |
| 2 | | | | 20.2 |
| | | | Medium Dense | |
| 3 | | | | |
| 4 | | | | |
| | | *4.5 feet: Rust stained, medium sand pockets. | | |
| 5 | | Dark gray SAND, fine to medium sand, moist. (SP) | | |
| 6 | | | | |
| | | | Loose | |
| 7 | | | | 13.9 |
| ▼ | | *7.5 feet: Wet | | |
| 8 | | | | |
| 9 | | Dark gray SILT with fine sand, non-plastic, wet. (ML) | Medium Dense | 28.0 |
| 10 | | Test pit terminated at approximately 10 feet.<br>Light groundwater seepage observed at 7.5 feet.<br>No caving. | | |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |

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:** East Main Industrial **PROJ. NO:** T-8222 **LOGGED BY:** KPR

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

**DATE LOGGED:** September 5, 2019 **DEPTH TO GROUNDWATER:** 9.5 Feet **DEPTH TO CAVING:** N/A

| Depth (ft) | Sample No. | Description | Consistency/ Relative Density | W (%) |
|---|---|---|---|---|
| 0 | | | | |
| | | Light brown SILT with fine sand, non-plastic, moist, mottled. (ML) | | |
| 1 | | | | |
| 2 | | | Medium Dense | 34.8 |
| 3 | | | | |
| 4 | | | | |
| | | Dark gray interbeds of SAND, silty SAND and slightly plastic SILT, fine to medium sand, moist, mottled. (SP, SM, ML) | | |
| 5 | | | | 6.0 |
| 6 | | | | |
| 7 | | | Loose/Medium Stiff | |
| 8 | | | | 26.0 |
| 9 | | | | |
| ▼ | | | | |
| 10 | | | | |
| | | Test pit terminated at approximately 10 feet.<br>Moderate groundwater seepage observed at 9.5 feet.<br>No caving. | | |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |

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:** East Main Industrial **PROJ. NO:** T-8222 **LOGGED BY:** SK

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

**DATE LOGGED:** September 5, 2019 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

| Depth (ft) | Sample No. | Description | Consistency/ Relative Density | W (%) |
|---|---|---|---|---|
| 0 | | (1-inch of SOD) | | |
| 1 | | Light brown SILT with fine sand, moist, mottled. (ML) | | |
| 2 | | | | 33.8 |
| 3 | | | | |
| 4 | | Dark gray silty SAND, fine sand, moist. (SM) | Medium Dense | |
| 5 | | | | 22.6 |
| 6 | | | | |
| 7 | | | | |
| 8 | | Gray SILT with clay, slight plasticity, wet. (ML) | | 38.9 |
| 9 | | | Medium Stiff | |
| 10 | | | | |
| 11 | | Test pit terminated at approximately 11 feet.<br>No groundwater.<br>No caving. | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |

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:** East Main Industrial **PROJ. NO:** T-8222 **LOGGED BY:** SK

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

**DATE LOGGED:** September 5, 2019 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

| Depth (ft) | Sample No. | Description | Consistency/ Relative Density | W (%) |
|---|---|---|---|---|
| 0 | | (1-inch of SOD) | | |
| 1 | | Light brown SILT with fine sand, moist, heavily mottled. (ML) | | |
| 2 | | | | 33.5 |
| 3 | | | | |
| 4 | | | | |
| 5 | | Interbedded dark gray SAND with silt to SILT with sand, fine sand, moist. (SM, ML) | Medium Dense | |
| 6 | | | | 30.1 |
| 7 | | *Mottling becomes faint. | | |
| 8 | | | | 31.5 |
| 9 | | | | |
| 10 | | Test pit terminated at approximately 10 feet.<br>No groundwater.<br>No caving. | | |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |

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:** East Main Industrial **PROJ. NO:** T-8222 **LOGGED BY:** SK

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

**DATE LOGGED:** September 5, 2019 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

| Depth (ft) | Sample No. | Description | Consistency/ Relative Density | W (%) |
|---|---|---|---|---|
| 0 | | (3 inches of SOD)<br>Light brown SILT, heavily mottled, moist. (ML) | Medium Dense | |
| 1 | | | | |
| 2 | | | | 33.0 |
| 3 | | Interbedded dark gray SAND with silt to SILT with sand, fine sand, moist. (SM, ML) | | |
| 4 | | | | |
| 5 | | | | 51.6 |
| 6 | | *Large logs encountered from 6 to 9 feet. | | |
| 7 | | | | |
| 8 | | Dark gray to black SILT with clay, wet. (ML) | Soft | 60.6 |
| 9 | | | | |
| 10 | | Test pit terminated at approximately 9.5 feet.<br>No groundwater.<br>No caving. | | |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |

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:** East Main Industrial **PROJ. NO:** T-8222 **LOGGED BY:** SK

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

**DATE LOGGED:** September 5, 2019 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

| Depth (ft) | Sample No. | Description | Consistency/ Relative Density | W (%) |
|---|---|---|---|---|
| 0 | | | | |
| | | (2 inches of SOD) | | |
| 1 | | Light brown SILT, moist, mottled. (ML) | | |
| 2 | | | | 12.6 |
| 3 | | | | |
| 4 | | | | |
| 5 | | Interbedded dark gray SAND with silt to gray SILT with sand, fine sand, moist. (SM, ML) | Medium Dense | |
| 6 | | | | 40.6 |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | 42.6 |
| 10 | | *Dark gray, increase in silt content. | | |
| 11 | | Test pit terminated at approximately 11 feet.<br>No groundwater.<br>No caving. | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |

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:** East Main Industrial **PROJ. NO:** T-8222 **LOGGED BY:** SK

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

**DATE LOGGED:** September 5, 2019 **DEPTH TO GROUNDWATER:** 9.5 Feet **DEPTH TO CAVING:** N/A

| Depth (ft) | Sample No. | Description | Consistency/ Relative Density | W (%) |
|---|---|---|---|---|
| 0 | | (2 inches of SOD) | | |
| 1 | | Light brown SILT with fine sand, moist, heavily mottled. (ML) | | |
| 2 | | | | 27.7 |
| | | | Medium Dense | |
| 3 | | | | |
| 4 | | | | |
| 5 | | Interbedded dark gray SAND with silt to gray SILT with sand, fine sand, moist. (SM, ML) | | 27.1 |
| 6 | | | | |
| 7 | | *Becomes wet. | | 17.2 |
| | | | Loose | |
| 8 | | | | |
| 9 | | | | |
| ▼ | | | | |
| 10 | | Test pit terminated at approximately 10 feet.<br>Observed groundwater at 9.5 feet<br>No caving. | | 38.0 |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |

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:** East Main Industrial **PROJ. NO:** T-8222 **LOGGED BY:** SK

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

**DATE LOGGED:** September 5, 2019 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

| Depth (ft) | Sample No. | Description | Consistency/ Relative Density | W (%) |
|---|---|---|---|---|
| 0 | | | | |
| 1 | | (2 inches of SOD)<br>Light brown SILT with fine gray sand, moist, mottled. (ML) | | |
| 2 | | | | 21.3 |
| 3 | | | | |
| 4 | | | | 36.5 |
| 5 | | Dark gray SILT with lenses and pockets of SAND interbedded SAND with silt, fine sand, moist, mottled. (ML, SM) | Medium Dense | |
| 6 | | | | |
| 7 | | | | |
| 8 | | *Soil becomes wet. | | |
| 9 | | | | |
| 10 | | Test pit terminated at approximately 10 feet.<br>No groundwater.<br>No caving. | | 34.0 |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |

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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Environmental Earth Sciences

# LOG OF TEST PIT NO. TP-14

**FIGURE** A-15

**PROJECT NAME:** East Main Industrial **PROJ. NO:** T-8222 **LOGGED BY:** SK

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

**DATE LOGGED:** September 5, 2019 **DEPTH TO GROUNDWATER:** 9 Feet **DEPTH TO CAVING:** N/A

| Depth (ft) | Sample No. | Description | Consistency/ Relative Density | W (%) |
|---|---|---|---|---|
| 0 | | | | |
| 1 | | (2 inches of SOD)<br>Light brown SILT with fine gray sand, moist, mottled. (ML) | | |
| 2 | | | | 26.4 |
| 3 | | | | |
| 4 | | | | |
| 5 | | Interbedded dark gray SAND with silt and SILT with sand, fine sand, moist. (SP-SM/ML) | Medium Dense | |
| 6 | | | | |
| 7 | | | | 4.1 |
| 8 | | | | |
| ▼ 9 | | *Soil becomes wet. | | 35.6 |
| 10 | | Test pit terminated at approximately 10 feet.<br>Observed groundwater at 9 feet upon 10 minute delay.<br>No caving. | | |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |

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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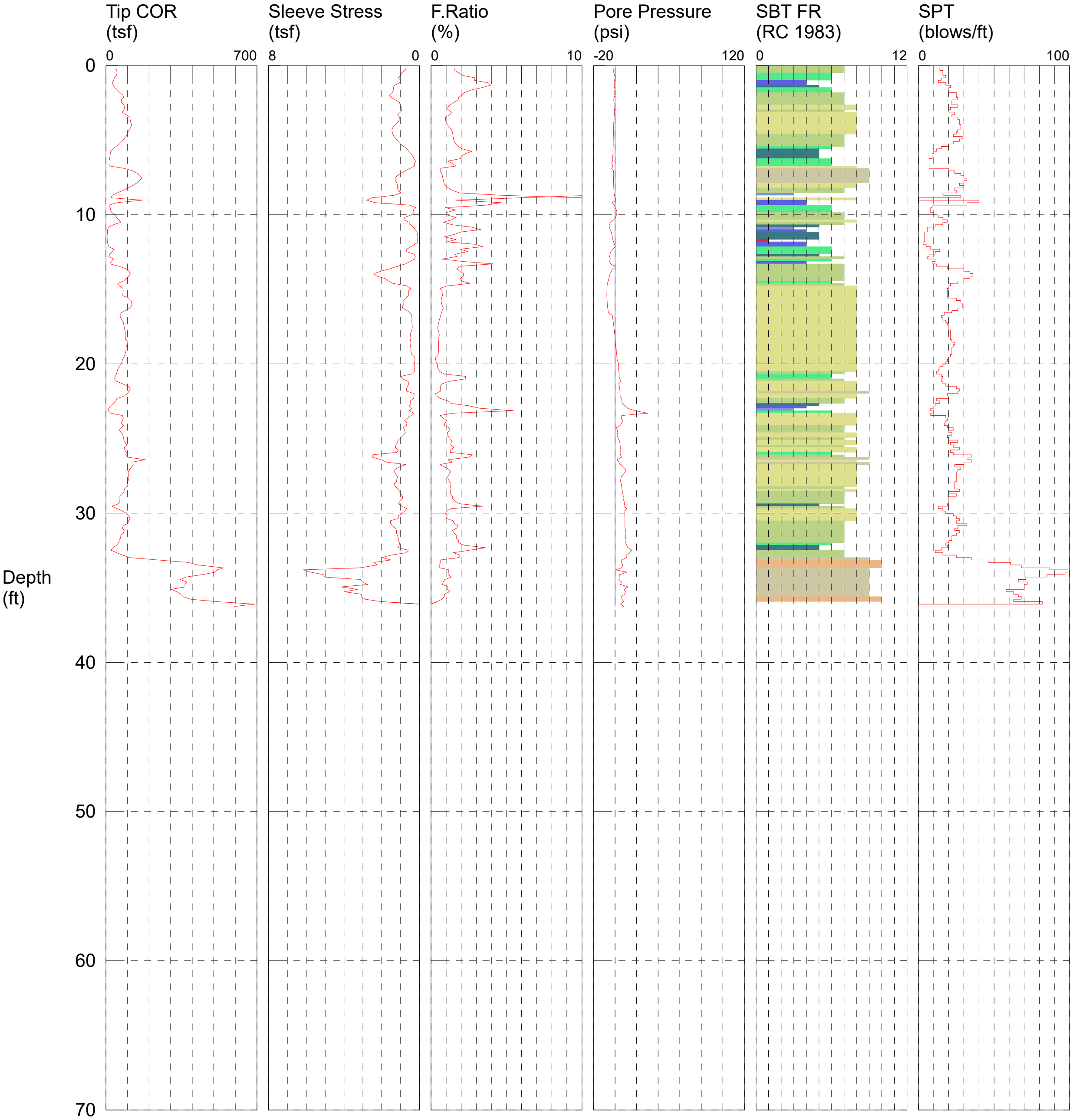
Environmental Earth Sciences

# CPT- 01

CPT CONTRACTOR: In Situ Engineering
CUSTOMER: Terra Associates
LOCATION: Puyallup
JOB NUMBER: T-8222
TEST DATE: 9/13/2019 11:31:47 AM

OPERATOR: OKBAY
CONE ID: DDG1369
PREDRILL : N/A
BACKFILL: 20% Bentonite Grout + Chips
SURFACE PATCH: N/A



TOTAL DEPTH: 36.253 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 (*)

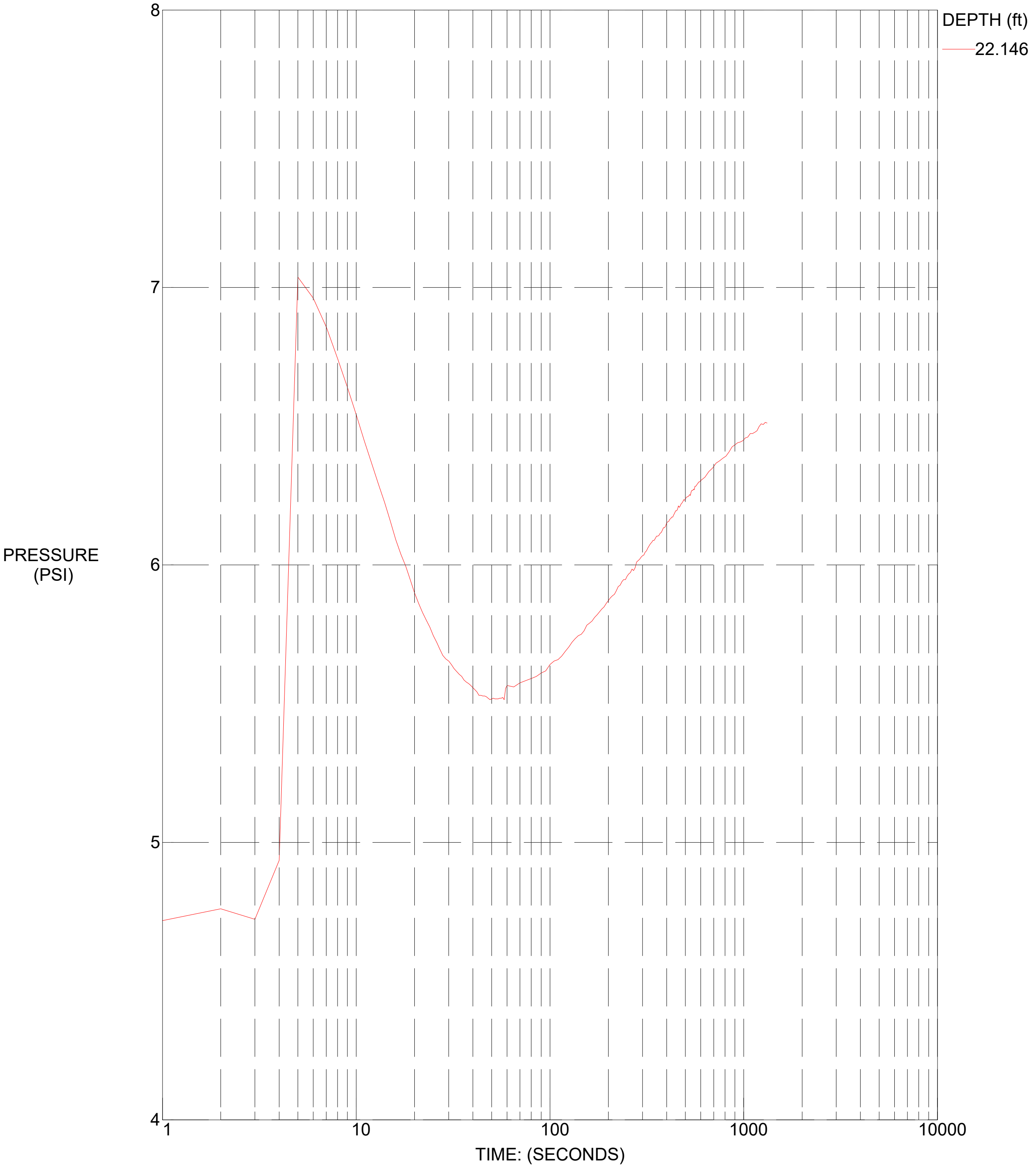
*SBT/SPT CORRELATION: UBC-1983

PRRWF20220381

# CPT- 01

CPT CONTRACTOR: In Situ Engineering
CUSTOMER: Terra Associates
LOCATION: Puyallup
JOB NUMBER: T-8222
TEST DATE: 9/13/2019 11:31:47 AM

OPERATOR: OKBAY
CONE ID: DDG1369
PREDRILL : N/A
BACKFILL: 20% Bentonite Grout + Bentonite Chips
SURFACE PATCH: N/A

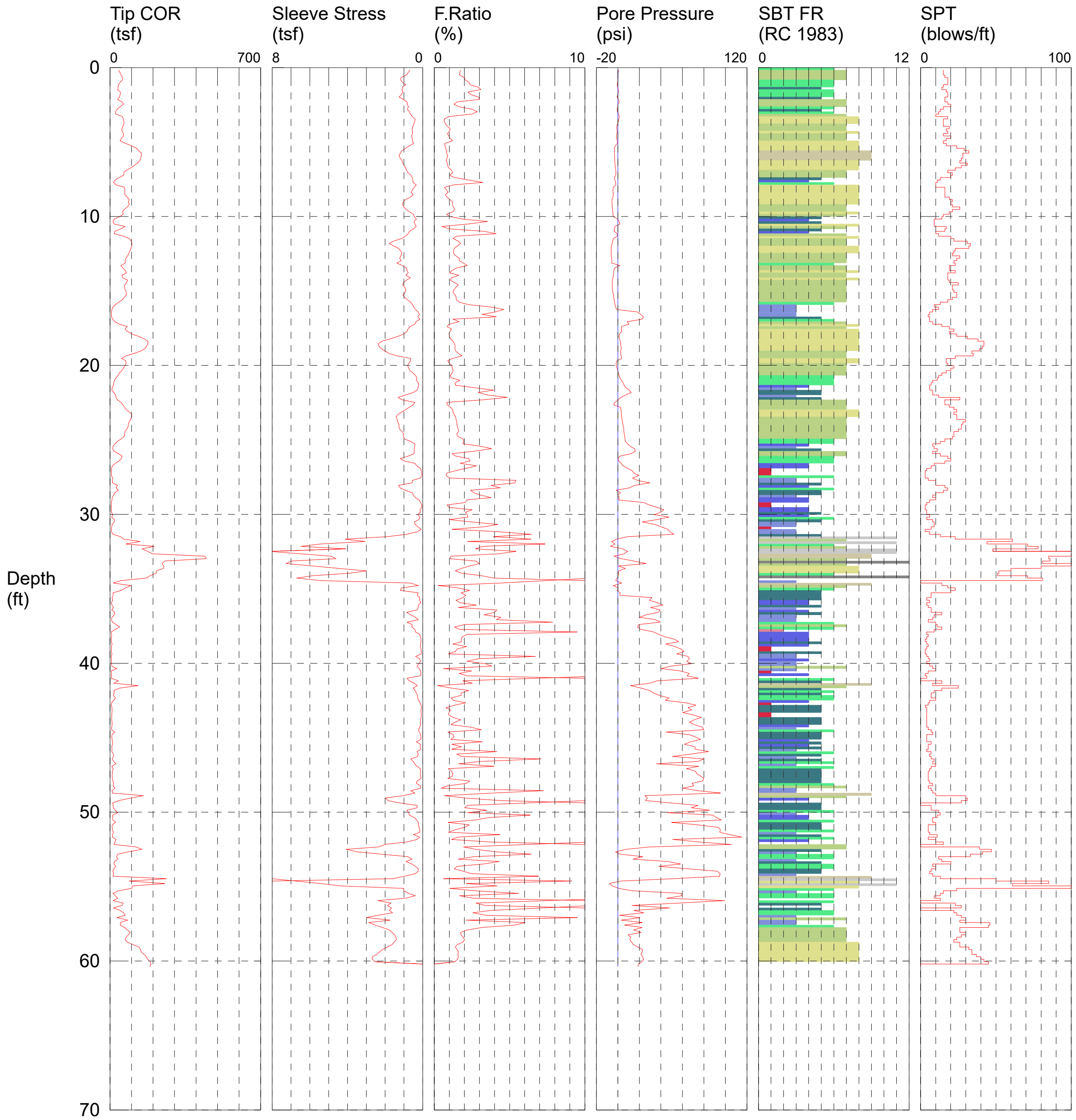


DISSIPATION

# CPT- 02

CPT CONTRACTOR: In Situ Engineering
CUSTOMER: Terra Associates
LOCATION: Puyallup
JOB NUMBER: T-8222
TEST DATE: 9/13/2019 12:37:53 PM

OPERATOR: OKBAY
CONE ID: DDG1369
PREDRILL : N/A
BACKFILL: 20% Bentonite Grout + Chips
SURFACE PATCH: N/A



TOTAL DEPTH: 60.367 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 (*)

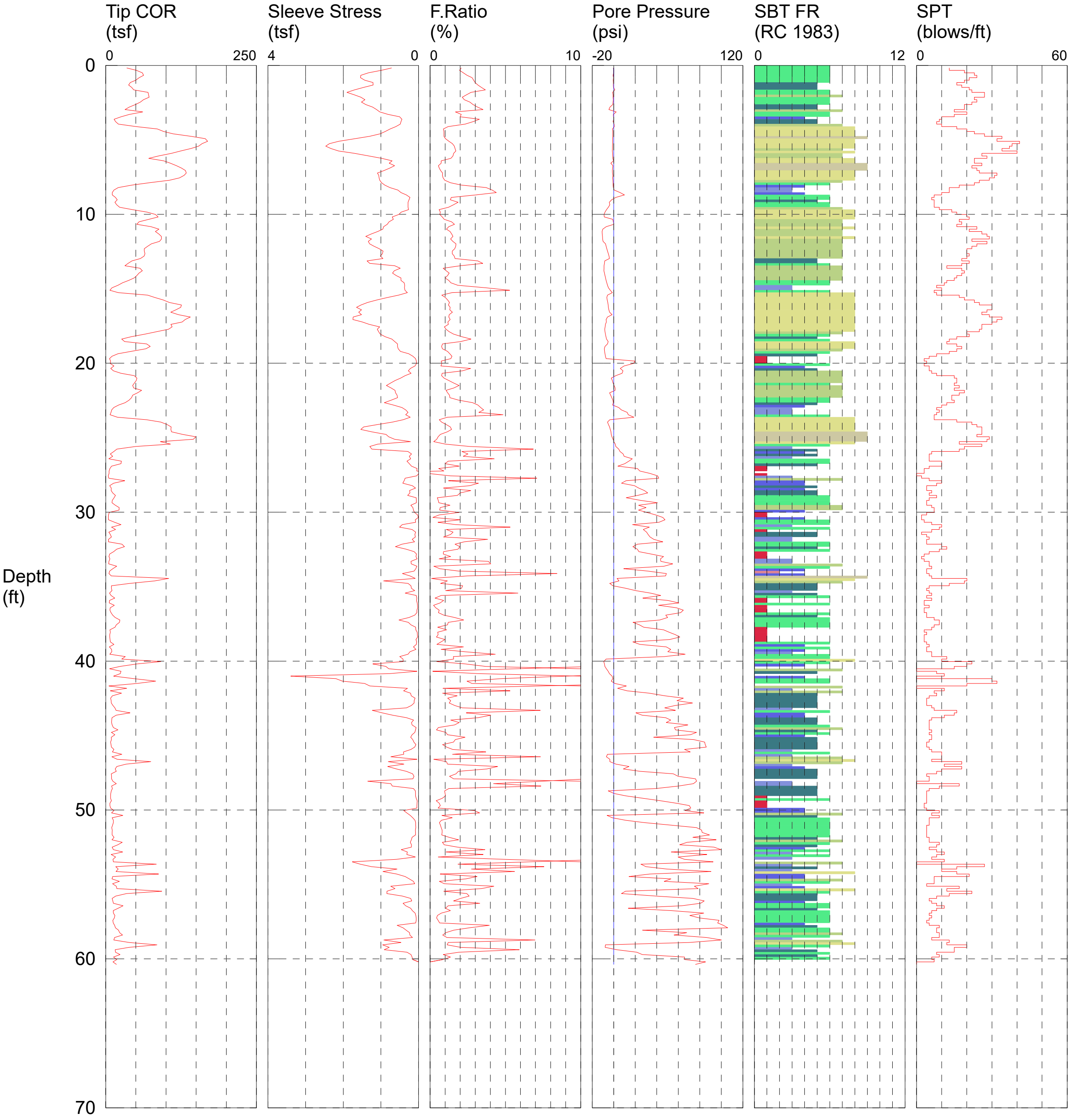
*SBT/SPT CORRELATION: UBC-1983

PRRWF20220381

# CPT- 03

CPT CONTRACTOR: In Situ Engineering
CUSTOMER: Terra Associates
LOCATION: Puyallup
JOB NUMBER: T-8222
TEST DATE: 9/13/2019 7:32:16 AM

OPERATOR: OKBAY
CONE ID: DDG1369
PREDRILL : N/A
BACKFILL: 20% Bentonite Grout + Chips
SURFACE PATCH: N/A



TOTAL DEPTH: 60.367 ft

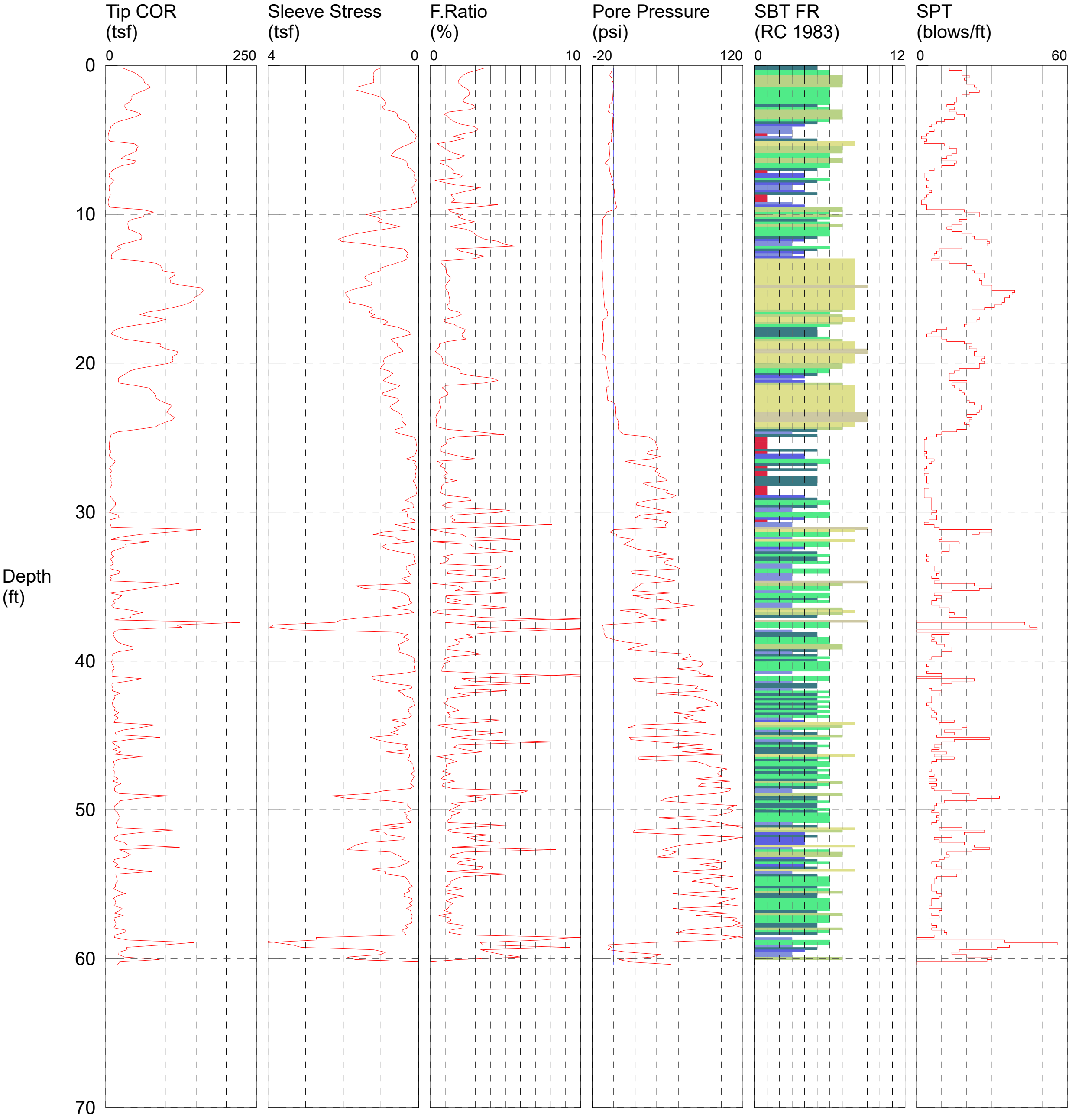
- 🟥 1 sensitive fine grained
- 🟥 2 organic material
- 🟦 3 clay
- 🟦 4 silty clay to clay
- 🟩 5 clayey silt to silty clay
- 🟩 6 sandy silt to clayey silt
- 🟩 7 silty sand to sandy silt
- 🟨 8 sand to silty sand
- 🟫 9 sand
- 🟧 10 gravelly sand to sand
- ⬜ 11 very stiff fine grained (*)
- ⬛ 12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

# CPT- 04

CPT CONTRACTOR: In Situ Engineering
CUSTOMER: Terra Associates
LOCATION: Puyallup
JOB NUMBER: T-8222
TEST DATE: 9/13/2019 10:04:47 AM

OPERATOR: OKBAY
CONE ID: DDG1369
PREDRILL : N/A
BACKFILL: 20% Bentonite Grout + Chips
SURFACE PATCH: N/A



TOTAL DEPTH: 60.367 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 (*)

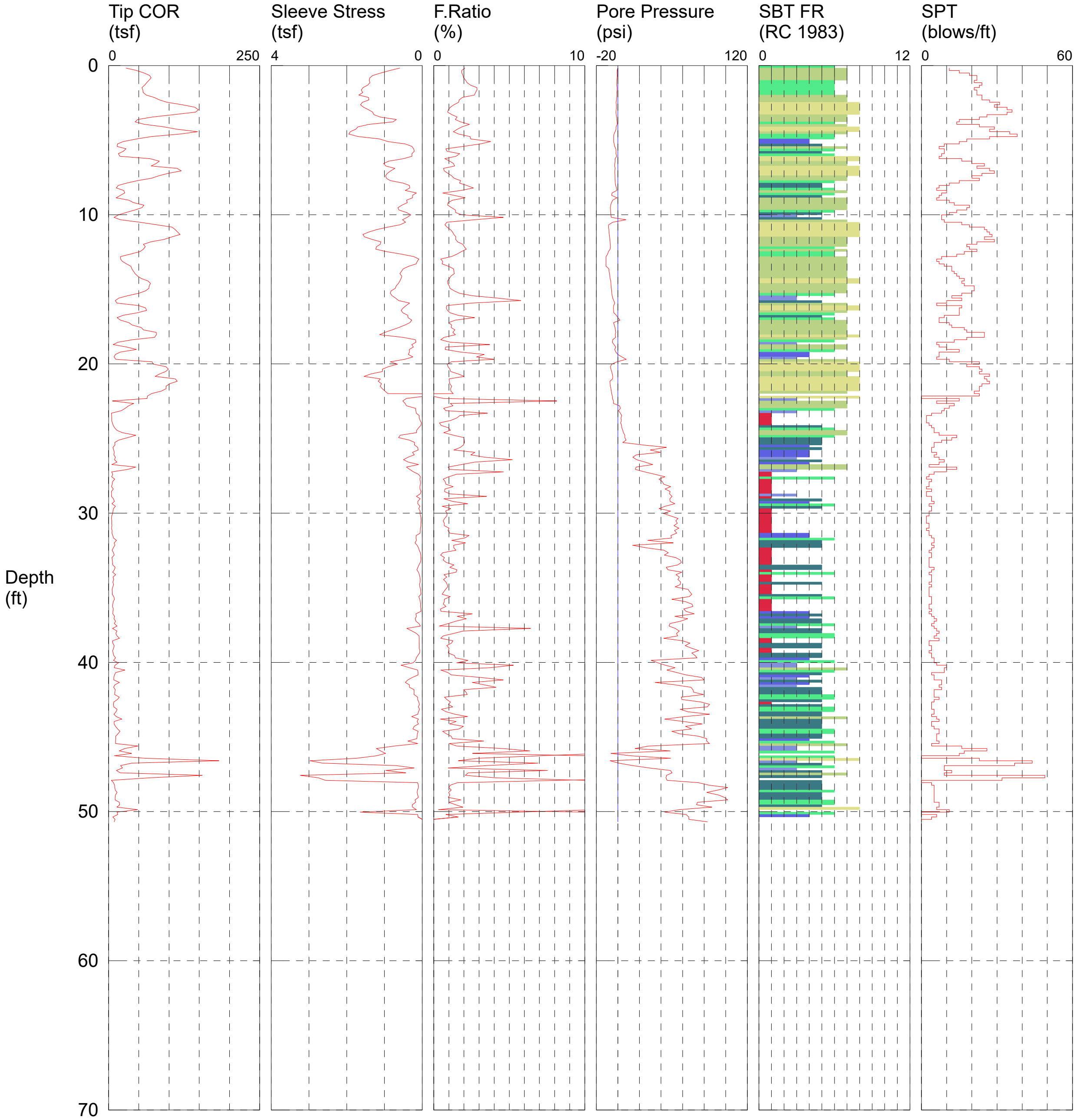
*SBT/SPT CORRELATION: UBC-1983

PRRWF20220381

# CPT- 05

CPT CONTRACTOR: In Situ Engineering
CUSTOMER: Terra Associates
LOCATION: Puyallup
JOB NUMBER: T-8222
TEST DATE: 9/13/2019 8:43:44 AM

OPERATOR: OKBAY
CONE ID: DDG1369
PREDRILL : N/A
BACKFILL: 20% Bentonite Grout + Chips
SURFACE PATCH: N/A



TOTAL DEPTH: 50.689 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

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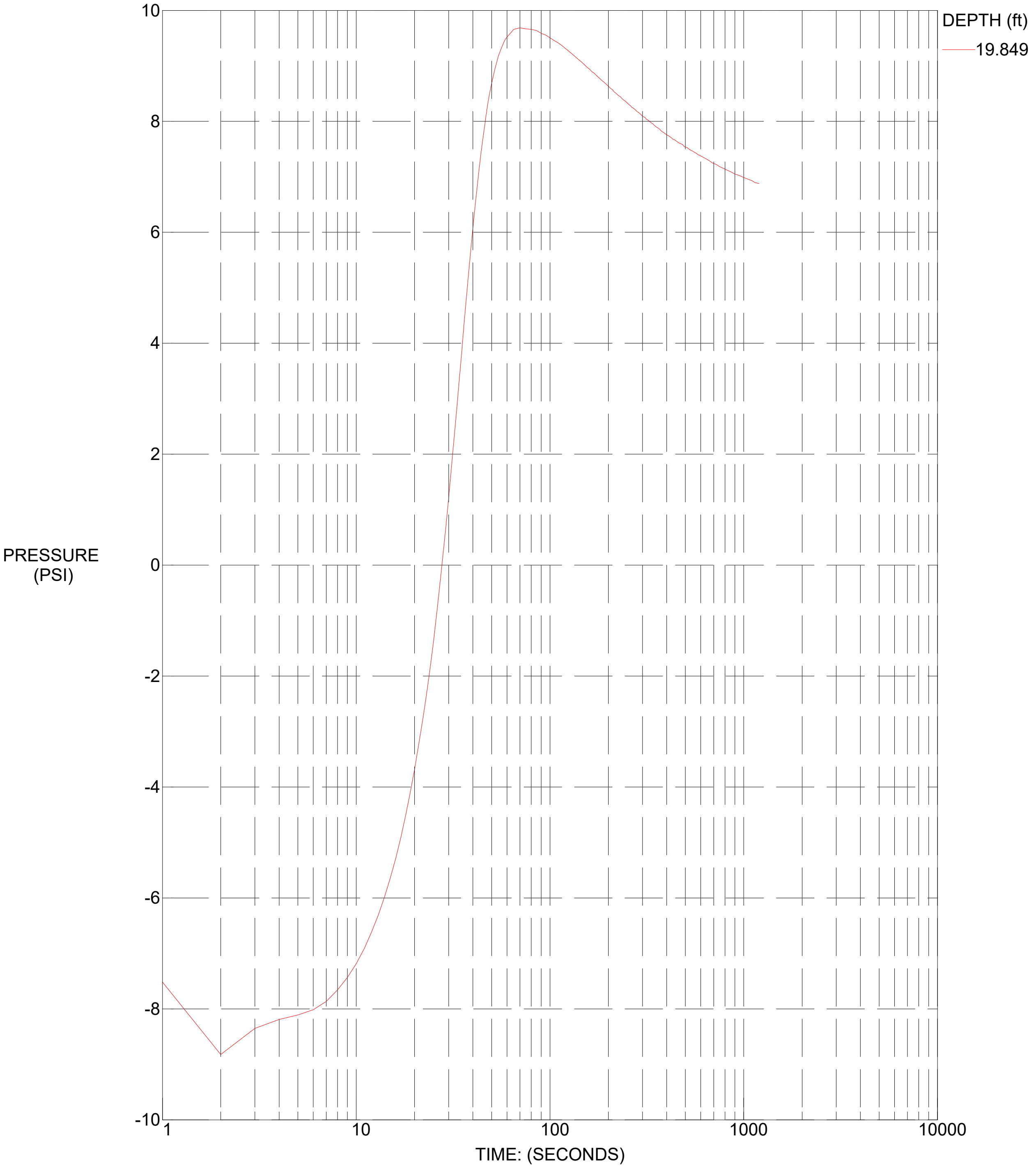
# CPT- 05

CPT CONTRACTOR: In Situ Engineering
CUSTOMER: Terra Associates
LOCATION: Puyallup
JOB NUMBER: T-8222
TEST DATE: 9/13/2019 11:31:47 AM

OPERATOR: OKBAY
CONE ID: DDG1369
PREDRILL : N/A
BACKFILL: 20% Bentonite Grout + Bentonite Chips
SURFACE PATCH: N/A



DISSIPATION

# APPENDIX B

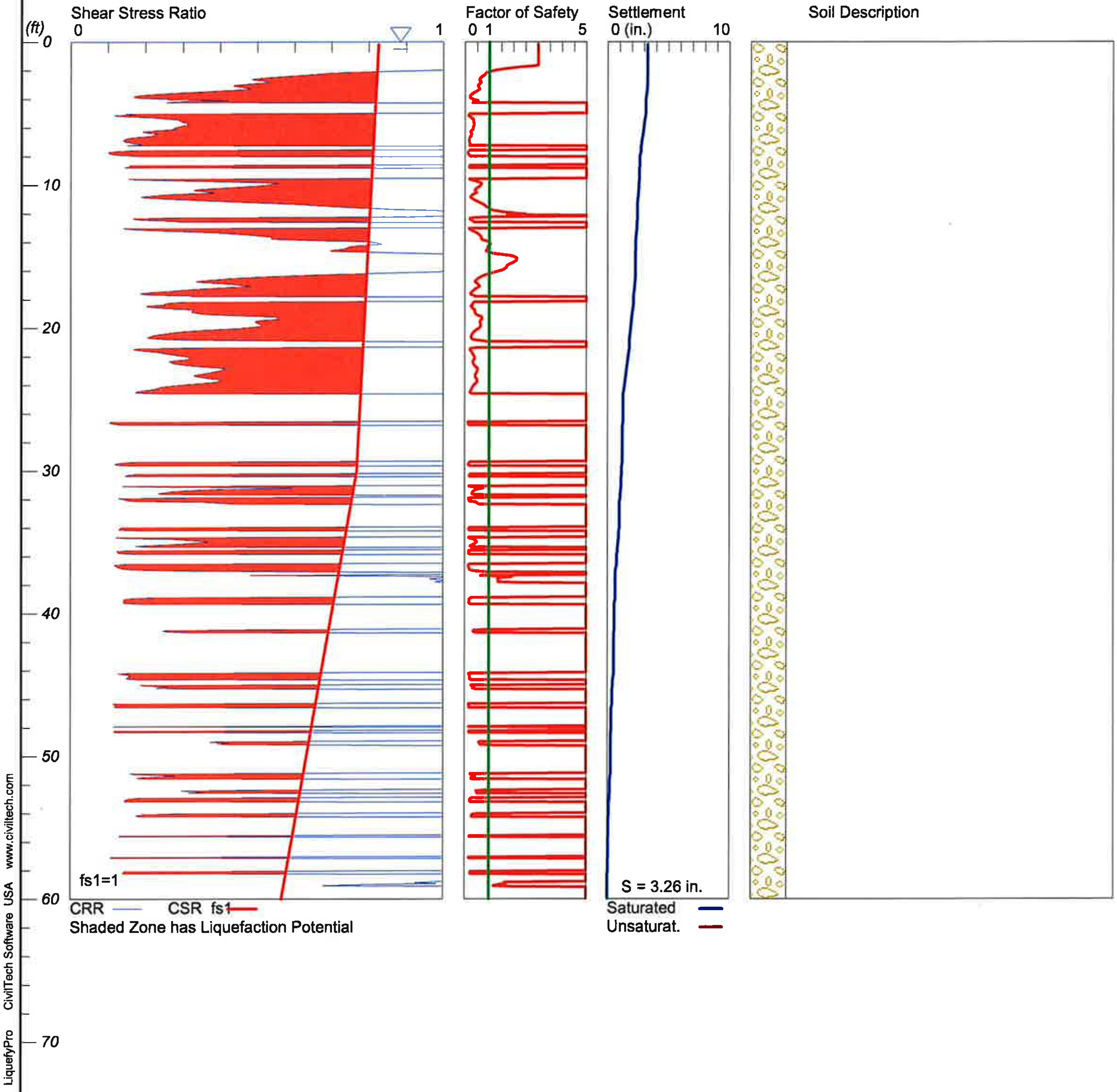
# LIQUEFACTION ANALYSIS RESULTS

# LIQUEFACTION ANALYSIS

## East Main Industrial

***Hole No.=CPT-4    Water Depth=0 ft***

***Magnitude=7***
***Acceleration=0.55g***

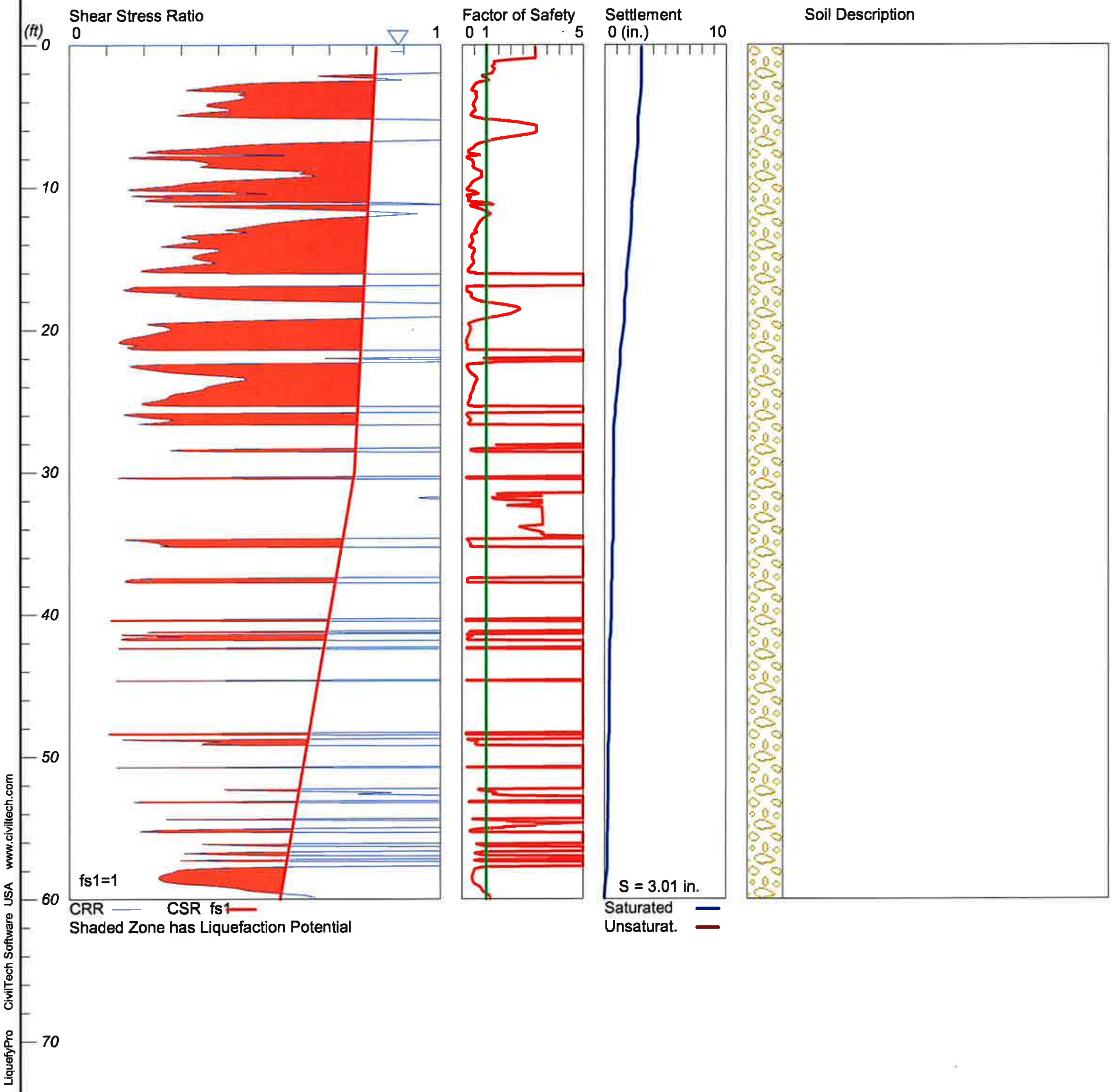


# LIQUEFACTION ANALYSIS

## East Main Industrial

***Hole No.=CPT-2 Water Depth=0 ft***

***Magnitude=7***
***Acceleration=0.55g***

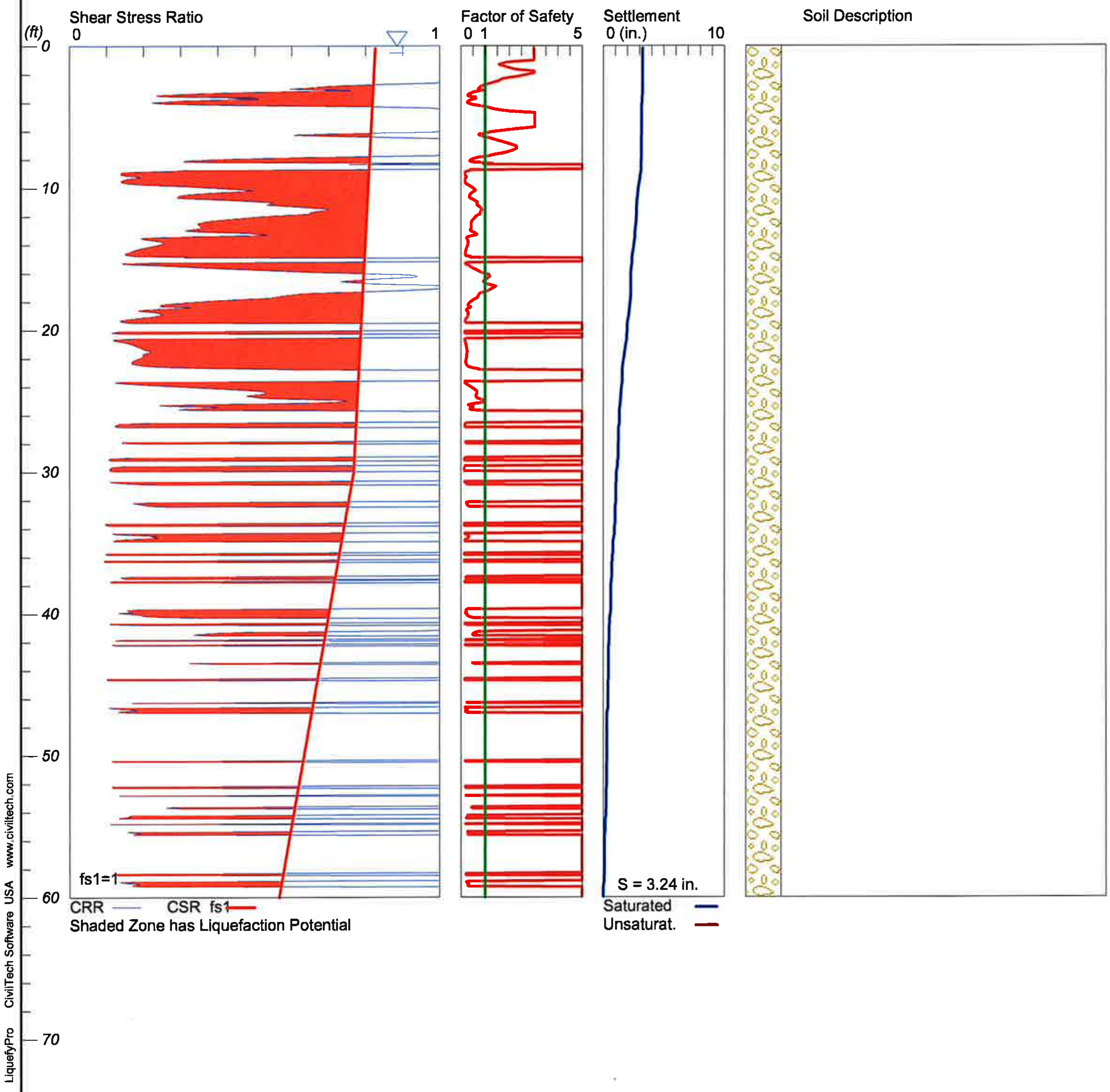


# LIQUEFACTION ANALYSIS

## East Main Industrial

***Hole No.=CPT-3 Water Depth=0 ft***

***Magnitude=7***
***Acceleration=0.55g***



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