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Memo

To	Sarah Whitney, Amazon Web Services
From	Ariana Jensen and Michele Barlow, ERM
Date	30 October 2019
Reference	PN 0527032
Subject	SFO069 Camino Arroyo Natural Resources Memorandum

1. INTRODUCTION

Environmental Resources Management Inc. (ERM), in partnership with Arup and Gensler, was retained by Amazon Web Services (the "Client" or "AWS") to complete a natural resources assessment memorandum in respect to SFO069 data center site development in Gilroy, California(the "Site"). This natural resources assessment describes the background to the assessment, the scope of work undertaken by ERM and the significant (as defined below) natural resources issues identified during the assessment.

1.1 Project Background and Objectives

The Client is considering developing a Site in Gilroy, California for the purpose of a multi-story datacenter. ERM has been engaged in partnership with Arup and Gensler to undertake a natural resources assessment for the Site. The objectives of the natural resources assessment are to:

- Identify and depict the boundaries of surface waters and wetland resources at the Site in order to establish potential project effects using aerial photographs, topographic maps, and other available inventory data in addition to field observations.
- If applicable, identify local, state, and federal/national threatened, endangered, or otherwise protected species occurring or potentially occurring at the Site. ERM will also identify the existence of agency, local, state, and federally designated wildlife habitat or critical habitat within the Site boundaries or on property adjacent to the Site.

1.2 Project Scope

The ERM scope of work for this evaluation is as follows:

1. Conduct a desktop evaluation of the following environmental characteristics of the Site area based on readily available data.

- Identify relevant natural resources legislation and policy.
- Identify aquatic resources potentially present in the Site area.

- Identify (if applicable) local, state and federal threatened, endangered, or otherwise protected vegetation species, or state designated significant wildlife habitat potentially present in the Site area or adjacent properties.

2. Conduct a Site visit to visually evaluate the potential presence of species and habitat, particularly those identified during the desktop research.

3. Based on the above evaluation, ERM prepared this natural resources assessment memorandum that compiles and summarizes the findings of the desktop evaluation and documents the identified limitations and constraints in the Site area.

- Summary of relevant legislation, regulations, and timelines.
- Description of and map which identity biodiversity, water resource, and other natural resource constraints.
- Summary of site constraints, including potential risks to Site development and future operations.

2. LOCAL SETTING

The Site consists of one approximately 56.33-acre irregular shaped parcel, east of Arroyo Circle, in the southern portion of Gilroy, California within the Gilroy General Plan (GPA) (Figure 1). The Site consists entirely of agricultural land with two soil piles and remnants of recent tomato crops.

The nearest surface water body is an unnamed irrigation channel running along the southern boundary of the Site. Miller Slough is located approximately 0.17 miles west and Llegas Creek is located approximately 0.75 miles east of the Site.

According to the City of Gilroy Zoning Map, the Site is located within a General Industrial and Shopping Center Commercial area. Surrounding land uses include commercial, industrial, and agricultural properties.

3. PROPOSED DEVELOPMENT

The proposed development of the Site would consist of two approximately 200,000-square foot datacenters, parking areas, a substation, a storm water detention pond, and future water treatment system. The Client is evaluating multiple future development layouts at this time.

4. PLANNING AND LAND USE

4.1 Strategic Framework

The Site is located east of the center of Gilroy. The General Plan (2016) for the City of Gilroy outlines the following priorities for the area:

- Small Town Character: Relatively compact city space surrounded by open space and agricultural lands, with buildings typically one to two stories
- Rural Identify: City's boundaries remain as natural open space and working agricultural lands

- Compact/Integrated Development Pattern: The City will grow inward from its historic core, protecting the boundaries from urban sprawl
- Links between growth and resources: New growth will be planned to account for resource capacity constraints and be coordinated with basic services such as streets, sewer, water, fire, police and schools. New development will be coordinated with funding and necessary infrastructure improvements.

The proposed development of the datacenter would align with the plan by matching the surrounding land use of the present area, along with close coordination with local government regarding the character of the surrounding area.

5. ENVIRONMENTAL CONSTRAINTS

5.1 Water Resources

Methodology

Desktop studies have assessed both the flooding potential and water quality at the Site. Flooding potential was assessed through a review of Santa Clara County Flood Insurance Rate Map (FIRM) low, medium, and high flood risk areas based on waterbodies located within and adjacent to the Site boundary.

Rivers and groundwater monitoring well locations in the vicinity of the Site were evaluated to assess potential water and groundwater quality issues respectively.

Results

Based on a review of aerial imagery and confirmed during the Site visit, the nearest surface water body is an unnamed irrigation channel running along the southern boundary of the Site. Miller Slough is located approximately 0.17 miles west and Llegas Creek is located approximately 0.75 miles east of the Site. According to the FIRM, the northeast and southern portion of the Site are located within Zone X, which is defined as "areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood". According to flood zone and National Wetland Inventory (NWI) data presented in the EDR® Radius Map™ Report, the Site is located within the 500-year flood plain and partially located within the 100-year flood plain. No wetland-delineated areas are mapped on or adjacent to the Site and none were observed during ERM's Site visit.

The development plans for the datacenter have not been finalized, but ERM understands that large-scale grading will be utilized to raise the footprint of the datacenter to a higher elevation to reduce flooding potential.

Storm water at the Site currently infiltrates into the ground throughout the parcel. The proposed development plants would re-direct storm water flows towards a detention pond prior to discharge to the City of Gilroy municipal storm water system. .

Potential Risks

Based on the desktop assessment, the Site lies within the 100- and 500-year flood areas and is therefore at risk of flooding. ERM understands that the Site grading is being evaluated by others to raise the building pad elevations and include storm water drainage features. No natural waterways currently exist at the Site that would require alteration or permitting prior to development. The Site will need to consider storm water drainage management and overland flow to assess and prevent a potential increase to flooding risks to adjacent parcels.

Water quality risks at the Site are expected to be low after appropriate site grading design and implementation. Appropriate measures should be implemented at the future development to reduce potential contaminant run-off into the future detention pond.

5.2 Biological Resources

Methodology

Desktop studies and field assessments were conducted for potential biological resources present at the Site. ERM reviewed the following public resources for the Site:

- City of Gilroy General Plan
- Santa Clara Valley Habitat Conservation Plan (HCP)
- United States Fish and Wildlife Service (USFWS) Critical Habitat
- California Natural Diversity Database (CNDDB), and
- United States Geological Survey (USGS) Biodiversity Information Serving Our Nation (BISON).

Results

The Site is comprised of disturbed (tilled) agricultural land. No wetlands were mapped on the Site on NWI maps or observed by ERM during the Site visit. No USFWS Critical Habitat is listed at the Site. The following species were mapped with CNDDB occurrences within 2-miles of the Site (Figure 2):

- Pallid Bat (*Antrozous pallidus):* The pallid bat is listed as a California Department of Fish and Wildlife (CDFW) Species of Special Concern (SSC). The species habitat includes semi-arid and arid landscapes throughout California within primarily grasslands, shrub-steppe, and desert environments. Bat roosts are most commonly found in rock crevices although bridges, live trees, and snags can also be used. ERM's Biologist did not identify suitable habitat for this species during the site visit.
- Hoary Bat (*Lasiurus cinereus):* The hoary bad is listed as a Western Bat Working Group (WBWG) Medium Priority species. The species habitat includes forested habitats in which roosts can be developed in the dense foliage of trees. Habitat can also include suburbs with older large trees. During migration, males are found in foothills, deserts and mountains while

females are found in lowlands and coastal valleys. ERM's Biologist did not identify suitable habitat for this species during the Site visit.

Additionally, no burrowing owl habitats or burrows were observed at the Site or listed on the natural resources mapper for the Santa Clara Valley Habitat Conservation Plan.

The Site is located within the boundaries of the Santa Clara Valley Habitat Conservation Plan (HCP). The Site is characterized within the Habitat Plan Permit Area, Area 4 (Urban Development), and Fee Zone B for agricultural and valley floor properties. Due to HCP requirements and Site location, potential pre-development requirements, fees, and mitigation requirements may apply to the Site. No significant natural resource issues were identified during the desktop review.

Potential Risks

Based on the desktop assessment, it is unlikely that there will be significant risks to biological resources and biodiversity from proposed development at the Site. Appropriate mitigation measures may be required by the HCP agency to avoid any potential impacts to the Site. The specific mitigation measures potentially required under the HCP should be evaluated well in advance of development to avoid potential project development schedule issues.

6. SUMMARY OF FINDINGS

Detailed in Table 1 is a summary of all the constraints, impacts, and potential opportunities/benefits for the Site from the natural resource assessment.

The assessment has been completed using a risk-weighted approach based on the below definitions:

- Red items indicate high priority risks that would likely have a material impact on the Site development requiring substantial or costly investment and/or mitigation measures
- Amber items indicate medium priority risks that may have material impact on the Site development requiring investment and/or mitigation measures
- Green items indicate lower priority risks that are typically associated with Site development. These items are not considered likely to impact the Site's development, could be managed under investment profiles, and can be mitigated with the implementation of standard measures.

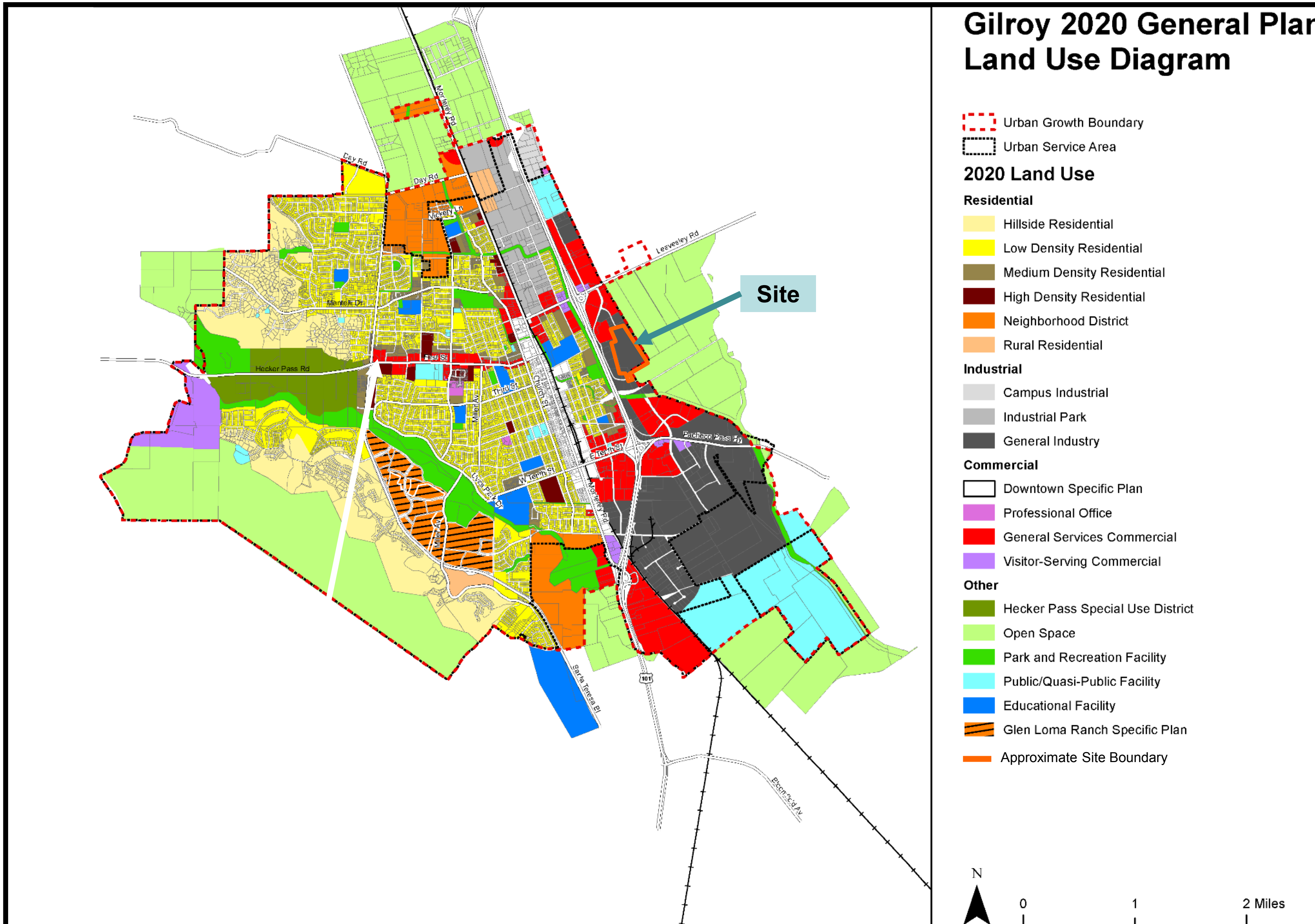
Table 1. Summary of Constraints and Issues

Item	Issues and Constraints	Impacts	Potential Risk Analysis	Risk Level	Next Steps
Planning and Land Use					
General Planning	The development must consider a variety of factors detailed in the Gilroy General Plan.	Unknown at this point. Impacts depend on local planning consultation and design.	The proposed development of the Site would need to consider local planning requirements including: small town character, rural identify, compact/integrated development pattern, and links between growth and resources. The proposed development of the datacenter could align with the plan by matching the surrounding land use of the present area, along with close coordination with local government regarding the character of the surrounding area.	Low Risk	Consult with the GGP and local planning requirements per the proposed project design.
Biological Resource Planning	This development must consider a variety of factors detailed in the Santa Clara Habitat Conservation Plan.	Unknown at this point. Impacts depend on previous land use conversion and discussion with local agency.	The Site is located within the boundaries of the Santa Clara Valley Habitat Conservation Plan (HCP). The Site is characterized within the Habitat Plan Permit Area, Area 4 (Urban Development), and Fee Zone B for agricultural and valley floor properties. Due to HCP requirements and Site location, potential pre-development requirements, fees, and mitigation	Medium Risk	Review previous HCP documentation and/or decision regarding agricultural to industrial land use conversion along with agency discussion.

Item	Issues and Constraints	Impacts	Potential Risk Analysis	Risk Level	Next Steps
			requirements may apply to the Site. No significant natural resource issues were identified during the desktop review.		
Environmental Constraints					
Water Resources	Development of the project could result in potential impacts to current surface water flow at the Site.	N/A	There are significant flood risks to the Site in its current configuration, but these are being evaluated by others with the intent to develop a grading plan that raises the site elevation to mitigate these risks. There are no natural waterways at the Site, therefore it does not appear that waterway risk mitigation or associated permits are required.	Medium Risk for flooding and Low Risk for general water resources	Site grading is being planned by others and is expected to be implemented prior to development. Implement best management practices and follow regulatory requirements to reduce potential storm water runoff impacts (sedimentation controls).
Biological Resources	No constraints were documented from threatened or	N/A	The Site is comprised of disturbed (tilled) agricultural land. No wetlands were mapped on the Site on NWI maps or observed by ERM during the	Low Risk	Comply with any potential requirements per the SCHCP.

Item	Issues and Constraints	Impacts	Potential Risk Analysis	Risk Level	Next Steps
	endangered species that may restrict development of the Site.		Site visit. No USFWS Critical Habitat is listed at the Site. CNDDB shows an occurrence within 2-miles of the Site for the Pallid bat (*Antrozous pallidus)* and Hoary Bat (*Lasiurus cinereus)*; however, no on-Site habitat was observed during ERM's Site visit. Additionally, no burrowing owl habitats or burrows were observed at the Site.		

ATTACHMENT A FIGURES



GILROY GENERAL PLAN
SFO069 Due Diligence
Assessor's parcel number 841-69-039 Camino Arroyo
Gilroy, California

ERM

Figure
1

GILROY Natural Resources
SFO069 Due Diligence
Assessor's Parcel Number 841-69-039 Camino Arroyo
Gilroy, California

Figure
1

"Hands On Tree Care"
ANDERSON'S Tree Care Specialists, Inc.
P.O. Box 2B • San Jose, CA 95109-0002
Tel: (408) 226-TREE (8733) • Fax: (408) 281-8733 • Lic: #705171
www.andersonstreecare.com

8/19/2020

Miles Johnson, P.E.
Kimley-Horn
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miles.johnson@kimley-horn.com

Re: Tree Protection for Proposed Data Center on Camino Arroyo in Gilroy (AWS SFO069)

Dear Miles,

At your request, I have visited the property referenced above to evaluate the trees present with respect to the proposed construction project. The report below contains my analysis.

Summary:

There are 18 trees present on and adjacent to the property: five private non-protected trees on this property; six street trees adjacent to this property; one street tree adjacent to a neighboring property; and six trees overhanging from adjacent properties.

Nine trees are recommended for removal, as they conflict with project features: four private non-protected trees on this property; and five street trees adjacent to this property.

The other nine trees are in good condition and should be retained and protected as detailed in the Recommendations, below. With proper protection, all are expected to survive and thrive during and after construction.

Assignment:

We have been asked to write a report detailing impacts to trees from construction of the proposed data center at this property.

Introduction:

In the City of Gilroy, trees are protected based on size and ownership. All street trees are protected, as are all trees on neighboring properties. Private trees are protected based on trunk diameter. The following guidance document was provided to us by our client, who obtained it from City of Gilroy staff:

City of Gilroy
COMMUNITY DEVELOPMENT DEPARTMENT/PLANNING DIVISION
7351 Rosanna Street, Gilroy CA 95020
(408) 846-0440, main • (408) 846-0429, fax
www.cityofgilroy.org/planning

APPLICATION SUBMITTAL DETAILS

The following list contains clarification and city expectations for Planning Division application submittal checklist items that are listed in an alphabetical order

☐ ARBORIST REPORT

Gilroy City Code section 30.38.40(d) Protected Trees requires preparation of an arborist report for any development project for which the project site includes existing Protected Trees, as defined in section 30.28.270(b). The report must be completed by a certified arborist registered with the International Society of Arboriculture (ISA). The report must include the following information listed below, as required by section 30.38.270(d). Reports that do not include all the information below will not be accepted by staff.

Basic Information

-Prepared by:	-Phone Number:
-Company Name:	-Consultants Name and ISA Certification:
-Address:	-Report Date:

Site and Tree Assessment Information

- Site plan showing location of the tree (include buildings, driveways, etc.)
- Clear pictures of the tree indicating location, details, signs of failure or disease
- Description of species of the tree
- Circumference or diameter at breast height of tree
- Estimated height of tree
- Discussion of general health of the tree
- Discussion of tree's risk
- Discussion of target management
- Discussion of risk management pruning
- Discussion of installation of structural support system
- Discussion of improving site conditions / cultural conditions
- Discussion of implementing integrated pest management programs
- Discussion of why tree cannot be saved (cabling, treatment, other)
- Description of the method to be used for removal of the tree
- Reason for removal
- Proposed replacement tree(s) (species, size, location)

Per our reading of this document, not all items are relevant to all trees, and only those items deemed relevant by the project arborist have been included in this report.

Limits of the Assignment:

All observations were made from the ground with basic equipment. No root collar excavations or aerial inspections were performed. No project features had been staked at the time of my site visit.

Purpose & Use of the Report:

This report is intended to inform tree management decisions for this project, and to provide recommendations to maximize the likelihood of survival for the trees which may reasonably be retained.

Observations:

Trees

There are 18 trees present on and adjacent to the property: five private non-protected trees on this property; six street trees adjacent to this property; one street tree adjacent to a neighboring property; and six trees overhanging from adjacent properties (**Images 1-10**). Six are liquidambars (*Liquidambar styraciflua*), four are London planes (*Platanus* x *acerifolia*), three are California black walnut (*Juglans hindsii*), two are eucalyptus (*Eucalyptus* sp.), one is an almond (*Prunus dulcis*), and one is a coast live oak (*Quercus agrifolia*).

Project Features

Two data center buildings are proposed in the center of the property: one in phase 1 of the project, and one in phase 2. A substation is proposed to the southwest. Two new driveways are proposed: one to the northwest, and one to the southeast. Paved or gravel vehicle access is proposed throughout the property, with parking spaces in several locations. A security fence will be present around the property perimeter. The proposed stormwater retention on the southeast side of the property will require substantial grading.

Tree Conflicts

Tree #1 – the proposed driveway to the northwest, and worker access thereto, lie within a small portion of this tree's tree protection zone (TPZ).[1]

Trees #2-4, 15, and 16 – the proposed driveways and associated hardscape lie within a substantial portion of these trees' TPZ's.

Trees #5-7, 10, and 11– no project features lie within these trees' TPZ's.

Trees #12-14 – the proposed stormwater retention area encompasses all three of these trees' TPZ's.

Trees #8, 9 – the proposed gravel vehicle access route lies within a small portion of these trees' TPZ's.

[1] Defined in the Discussion section, below.

Tree #17 – worker access to the proposed gravel vehicle access route lies within a very small portion of this tree's TPZ.

Tree #18 – the proposed gravel vehicle access route lies within a substantial portion of this tree's TPZ.

Testing & Analysis:

Tree DBHs were taken using a diameter tape measure if trunks were accessible. The DBHs of trees with non-accessible trunks were estimated visually. All trees over 6 inches in DBH were inventoried.

Vigor ratings are based on tree appearance and experiential knowledge of each species.

Tree location data was collected using a GPS smartphone application and processed in GIS software to create the maps included in this report. Due to the error inherent in GPS data collection, and due also to slight differences between GPS data and CAD drawings, tree locations shown on the map below are approximate.

I visited the site three times, on 8/12/2020, 8/14/2020, and 8/17/2020. All observations and photographs in this report were taken at those site visits.

This report is based on the one-page document titled "Preliminary Site Plan," dated 7/17/2020, provided to me electronically by the client.

Discussion:

Tree Protection Zone (TPZ)

Tree roots grow where conditions are favorable, and their spatial arrangement is therefore unpredictable. Favorable conditions vary among species, but generally include the presence of moisture, and soft soil texture with low compaction.

Contrary to popular belief, roots of all tree species grow primarily in the top two feet of soil, with a small number of roots sometimes occurring at greater depths. Some species have taproots when young, but these almost universally disappear with age. At maturity, a tree's root system may extend out from the trunk farther than the tree is tall.

The optimal size of the area around a tree which should be protected from disturbance depends on the tree's size, species, and vigor, as shown in the following table (adapted from *Trees & Construction*, Matheny and Clark, 1998):

Species tolerance	Tree vigor	Distance from trunk (feet per inch trunk diameter)
Good	High	0.5
	Moderate	0.75
	Low	1
Moderate	High	0.75
	Moderate	1
	Low	1.25
Poor	High	1
	Moderate	1.25
	Low	1.5

It is important to note that some roots will almost certainly be present outside the TPZ; however, root loss outside the TPZ is unlikely to cause tree decline.

Conclusions:

Tree #1 – minor impacts from driveway installation are likely.

Trees #2-4, 15, and 16 – trees #2, 4, 15, and 16 are incompatible with the proposed driveways. Major impacts are likely to tree #3 from the proposed driveways, such that retention is infeasible.

Trees #5-7, 10-11 – notable impacts to these trees are unlikely from the project as proposed.

Trees #8, 9, 17 – minor impacts from gravel vehicle access route installation are likely.

Trees #12-14 – these trees are incompatible with the proposed stormwater retention area.

Tree #18 – this tree is incompatible with the proposed gravel vehicle access route.

Recommendations:

Demolition phase

1. Remove trees #2-4, 12-16, and 18, upon receipt of approval by the City of Gilroy.

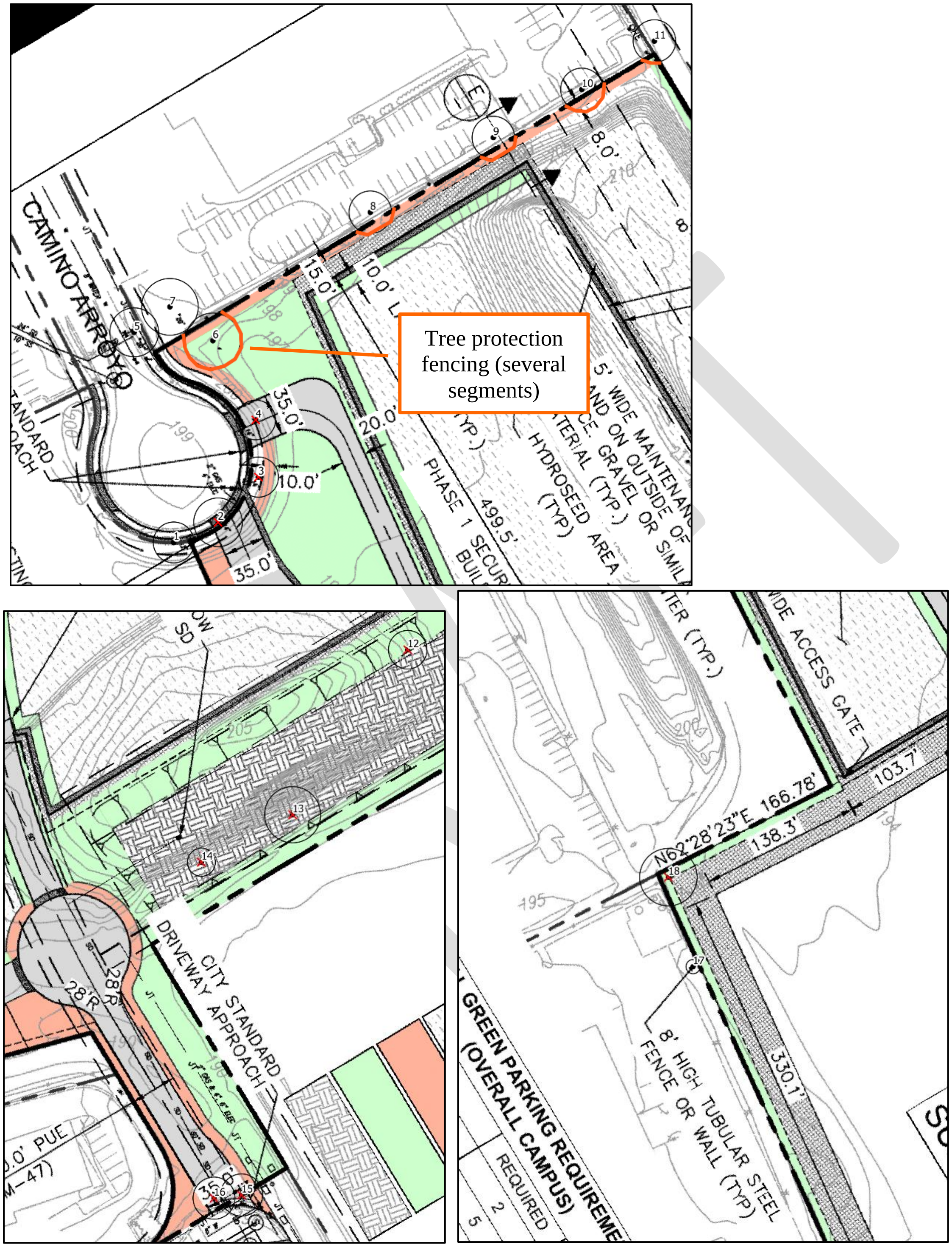
Preconstruction phase

1. Install tree protection fencing for trees #6 and 8-11, approximately as shown on the Tree Map, below.

Construction phase

2. Maintain all tree protection measures throughout construction.
3. Exclude all personnel, vehicles, and materials from TPZ's.
4. If any areas within or at the edge of TPZ's must be excavated (open pits or trenches):
    a. Excavate with pneumatic air or water, or gently with hand tools.
    b. Do not use excavators or other equipment which could pull on roots. If excavating by hand, take care not to shatter or pull on roots with shovels.
    c. Retain as many roots as practical intact, and route conduit under and around roots if feasible.
    d. If tree roots 2-inches or larger must be removed for conduit installation, they must be cleanly cut back to a sound wood lateral root. The end of the root shall be covered with either a plastic bag and secured with tape or rubber band, or be coated with latex paint. All exposed root areas within the TPZ shall be backfilled or covered within one hour. Exposed roots may be kept from drying out by temporarily covering the roots and draping layered burlap or carpeting over the upper 3-feet of trench walls. The materials must be kept wet until backfilled to reduce evaporation from the trench walls.
    e. If many roots must be removed from a single tree, stop work around that tree before removing any roots and contact the project arborist to determine whether the tree can safely remain.
5. All tree protection fencing is to be installed prior to any equipment coming onsite, and is to remain in place through the duration of construction.
6. Grading: minimize grading near trees. Ensure that fill soil used near trees is landscape quality. Do not add more than 6 inches of soil within the TPZ of any tree.

Tree Map


Tree protection fencing (several segments)
CAMINO ARROYO
15.0'
10.0'
8.0'
35.0'
10.0'
20.0'
35.0'
PHASE 1 SECUR
499.5'
HYDROSEED AREA (TYP)
5' WIDE MAINTENANCE
CITY STANDARD DRIVEWAY APPROACH
28'R
28'R
WIDE ACCESS GATE
103.7'
N62°28'23"E 166.78'
138.3'
330.1'
8' HIGH TUBULAR STEEL FENCE OR WALL (TYP)
GREEN PARKING REQUIREME
(OVERALL CAMPUS)
REQUIRED

Tree Inventory Table

Tree #	Common Name	Species	DBH (inches)	Height (estimated visually)	Protected tree?	Vitality (0 = dead, 3 = healthy)	Species Construction Tolerance (1 = poor, 3 = good)	TPZ radius (ideal; feet)	Project Impacts	Disposition	Notes
1	Liquidambar	Liquidambar styraciflua	17.3	35	Y	3	1	17.3	Minor - driveway installation	Retain	Neighbor street tree. Two stems.
2	Liquidambar	Liquidambar styraciflua	16.5	35	Y	2	1	20.6	Major - conflicts with driveway	REMOVE	Street tree.
3	Liquidambar	Liquidambar styraciflua	17.0	35	Y	3	1	17.0	Major - conflicts with driveway	REMOVE	Street tree.
4	Liquidambar	Liquidambar styraciflua	16.8	35	Y	3	1	16.8	Major - conflicts with driveway	REMOVE	Street tree.
5	Liquidambar	Liquidambar styraciflua	20.7	35	Y	3	1	20.7	Negligible	Retain	Neighbor street tree.
6	Eucalyptus	Eucalyptus sp.	23.3	40	-	2	2	23.3	Negligible	Retain	Three main leaders. Many unusual leaders resting on ground. Only upright, large trunks were measured.
7	London plane	Platanus x acerifolia	24.0	55	Y	3	1	24.0	Negligible	Retain	Neighbor tree. DBH estimated.
8	London plane	Platanus x acerifolia	18.0	40	Y	3	1	18.0	Minor - gravel vehicle route	Retain	Neighbor tree. DBH estimated.
9	London plane	Platanus x acerifolia	18.0	45	Y	3	1	18.0	Minor - gravel vehicle route	Retain	Neighbor tree. DBH estimated.

Tree #	Common Name	Species	DBH (inches)	Height (estimated visually)	Protected tree?	Vitality (0 = dead, 3 = healthy)	Species Construction Tolerance (1 = poor, 3 = good)	TPZ radius (ideal; feet)	Project Impacts	Disposition	Notes
10	Eucalyptus	Eucalyptus sp.	18.0	35	Y	2	2	18.0	Negligible	Retain	Neighbor tree. DBH estimated.
11	London plane	Platanus x acerifolia	18.0	25	Y	3	1	18.0	Negligible	Retain	Unclear whether trunk is on this property or neighboring property, as dense ivy is present around the tree. Pruned for overheard utility clearance.
12	Almond	Prunus dulcis	22.0	15	-	3	2	16.5	Major - conflicts with stormwater retention area	REMOVE	Old orchard tree. Two leaders.
13	California black walnut	Juglans hindsii	24.0	35	-	3	1	24.0	Major - conflicts with stormwater retention area	REMOVE	DBH estimated. Significant grade change at edge of property.
14	California black walnut	Juglans hindsii	12.0	15	-	3	1	12.0	Major - conflicts with stormwater retention area	REMOVE	DBH estimated. Significant grade change at edge of property.
15	Liquidambar	Liquidambar styraciflua	18.0	50	Y	3	1	18.0	Major - conflicts with driveway	REMOVE	Street tree. DBH estimated.
16	Liquidambar	Liquidambar styraciflua	18.0	45	Y	3	1	18.0	Major - conflicts with driveway	REMOVE	Street tree. DBH estimated.
17	Coast live oak	Quercus agrifolia	12.0	25	Y	3	3	6.0	Minor - gravel vehicle route	Retain	Neighbor tree. DBH estimated. Some brown

Tree #	Common Name	Species	DBH (inches)	Height (estimated visually)	Protected tree?	Vitality (0 = dead, 3 = healthy)	Species Construction Tolerance (1 = poor, 3 = good)	TPZ radius (ideal; feet)	Project Impacts	Disposition	Notes
											foliage existing in lower right canopy, viewed from this property.
18	California black walnut	Juglans hindsii	24.4	30	-	3	1	24.4	Major - conflicts with gravel vehicle route	REMOVE	Measured at about 18 inches above grade due to presence of low branches and ivy.

Supporting Photographs:

Image 1: liquidambars #1-4 (right to left)

Image 2: liquidambar #5 (left), eucalyptus #6 (right), and London plane #7 (middle)

Image 3: London planes #8 (left foreground) and 9 (right background)

Image 4: eucalyptus #10

Image 5: London plane #11

Image 6: almond #12

Image 7: California black walnuts #13 (right) and 14

Image 8: liquidambars #15 (right) and 16; note broken, hanging branch in tree #15 (lower right and lower center) and large trunk wound in tree #16 (lower left)

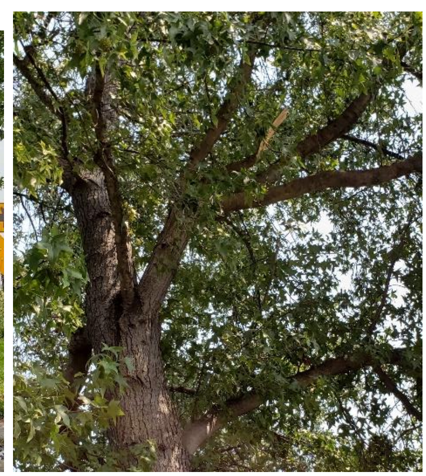


Image 9: coast live oak #17

Image 10: California walnut #18

ASSUMPTIONS AND LIMITING CONDITIONS

1. Any legal description provided to the consultant/appraiser is assumed to be correct. Any titles and ownerships to any property are assumed to be good and marketable. No responsibility is assumed for matters legal in character. Any and all property is appraised or evaluated as though free and clear, under responsible ownership and competent management.

2. It is assumed that any property is not in violation of any applicable codes, ordinances, statutes, or other government regulations.

3. Care has been taken to obtain all information from reliable sources. All data has been verified insofar as possible; however the consultant/appraiser can neither guarantee nor be responsible for the accuracy of information provided by others.

4. The consultant/appraiser shall not be required to give testimony or to attend court by reason of this report unless subsequent contractual arrangements are made, including payment of an additional fee for such services as described in the fee schedule and contract of engagement.

5. Loss, alteration, or reproduction of any part of this report invalidates the entire report.

6. Possession of this report or a copy thereof does not imply right of publication or use for any purpose by any other than the person to whom it is addressed, without the prior expressed written or verbal consent of the consultant/appraiser.

7. Neither all nor any part of this report, nor any copy thereof, shall be conveyed by anyone, including the client, to the public through advertising, public relations, news, sales or other media, without the prior expressed written or verbal consent of the consultant/appraiser particularly as to value conclusions, identity of the consultant/appraiser, or any reference to any professional society or initialed designation conferred upon the consultant/appraiser as stated in his qualification.

8. This report and the values expressed herein represent the opinion of the consult/appraiser, and the consult/appraiser's fee is in no way contingent upon the reporting of a specified value, a stipulated result, the occurrence of a subsequent event, nor upon any finding to be reported.

9. Sketches, diagrams, graphs, and photographs in this report, being intended as visual aids, are not necessarily to scale and should not be construed as engineering or architectural reports or surveys.

10. Unless expressed otherwise: 1) information in this report covers only those items that were examined and reflects the condition of those items at the time of inspection; and 2) the inspection is limited to visual examination of accessible items without dissection, excavation, probing, or coring. There is no warranty or guarantee, expressed or implied, that problems or deficiencies of the plants or property in question may not arise in future.

Respectfully submitted,

Katherine Naegele
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Anderson's Tree Care Specialists, Inc.
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PHASE 2 DATA CENTER BUILDING 2
PHASE 1 SUBSTATION
PROPERTY INFORMATION
DEVELOPMENT STANDARDS
PARKING SUMMARY
LEGEND
VICINITY MAP
PROJECT SITE
CAMINO ARROYO
ARROYO CIRCLE

AWS

SFO069 Due Diligence

Geotechnical Desktop Review

Draft 3 | November 22, 2019

Job number 271590-00

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ARUP

Contents

1 Executive Summary

This report presents the results of a due diligence study undertaken for Amazon Web Services (AWS) by the global Arup engineering and consulting team, in collaboration with the Denver based architecture firm Gensler, local environmental consultants ERM, and local surveyor JMH Weiss. This study identifies critical site development and infrastructure issues that may impact the proposed development of two single-story 12-pod data center buildings and associated infrastructure. The purpose of this study is to outline existing conditions on site, identify red flag issues associated with developing on this site, recommend next steps for further evaluation of site development potential, and inform AWS' decision-making process as to the viability of the Site to support the proposed development.

2 Geotechnical Desktop Review

2.1 Introduction

Arup carried out a preliminary geotechnical evaluation at the Site with the intent to identify and evaluate key geotechnical issues that may impact development of the site. The scope of the geotechnical services included the following:

- Carry out a desktop review of available geotechnical information near the Site and summarize the potential geotechnical hazards in a technical report.
- Manage a subsurface investigation program coordinating all on-site activities, arranging for utility clearance, obtaining samples from the borings, and maintaining a continuous log of each exploration.
- Perform laboratory tests in accordance with current applicable American Society for Testing and Materials (ASTM) international standards.
- Prepare a technical report that includes a discussion and preliminary determination of overall suitability of the Site for construction; a summary of surface and subsurface conditions identified; recommendations of feasible foundation systems/options and likely allowable bearing capacity; recommendations of feasible storm water, industrial wastewater, and sanitary sewer disposal methods; evaluation of anticipated geotechnical issues; suitability of native soils for fill materials; and recommendations for additional subsurface investigation that may be required to inform design level analysis.

Table 1 summarizes the key questions, a brief summary of the geotechnical issues, and the risk rating.

Table 1: Key Questions for the Geotechnical Desktop Review

Key Questions	Summary Statement (Issue and mitigation)	Risk Rating
What are the grading requirements / volumes of cut and fill?	The City of Gilroy Floodplain Management Ordinance requires structures on the Site to be raised at least one foot above the base flood elevation. AWS basis of design requires portions of the Site be raised to the 100-year flood elevation and building finished floor elevations raised to 1.5-feet above the 100-year floodplain. A cut fill analysis was completed to evaluate different scenarios and can be seen in Appendix E.	High
What are the general soil conditions?	The general soil conditions consist of topsoil over a layer of lean clay. Below the lean clay is a granular layer primarily consisting of gravel, below which is another layer of lean clay. Substantial	High

Key Questions	Summary Statement (Issue and mitigation)	Risk Rating
	completion of consolidation due to fill placement of the clay layers could be greater than 1 to 2 years. Mitigation of settlement due to fill placement or foundation loading could involve surcharging the Site prior to construction or use of deep foundations.	
What is the groundwater level? What is the likely flow direction?	The groundwater level was measured at 25 feet below ground surface during the geotechnical investigation. Historical geotechnical information around the Site shows a groundwater level ranging from 17 feet to 25 feet.	N/A

2.1.1 Site Location

The project Site is located near the intersection of Arroyo Circle and Gilman Road in Gilroy, CA. Existing structures along the western boundary of the Site include three single-story office buildings. A hospital and single-story office building are located to the southwest of the Site and an RV service center is located to the northwest of the site. Existing structures near the northern boundary of the Site also include single-story office buildings. Along the eastern boundary of the Site is a dirt road beyond which lies vacant agricultural land.

The northeast corner of the Site is currently occupied by a mound of fill and is actively used by truck traffic. Truck traffic is also present near the southwest corner and along a dirt road-oriented northwest-southeast across the center of the site.

2.1.2 Topography

With the exception of the mound of fill at the north end of the site, the topography is relatively flat, varying by approximately 6 feet across the site.

2.2 Field Exploration Program

Prior to initiating subsurface investigations, Underground Service Alert (USA) was notified of the proposed work. In addition, a private subsurface utility locator was retained to clear the proposed borehole locations of underground utilities. A drilling permit was not required since Santa Clara County does not require permits for geotechnical explorations that do not exceed 45 feet in depth.

The due diligence field exploration program included the following:

- Seven hollow stem auger boreholes to depths of 20 to 45 feet.

- Ten cone penetration tests (CPTs) to depths of 20 to 45 feet.
- Five in-situ resistivity tests.

The geotechnical exploration plan in relation to Test Fit Option 1, Option 2, and Option 3 is shown in Figure 1, Figure 2, and Figure 3, respectively.

2.2.1 Drilling Program

Seven boreholes were drilled at the Site as part of the due diligence geotechnical investigation. Drilling operations were conducted on October 14 and 15, 2019 by Penecore Drilling ('Penecore'). Penecore used a drill rig capable of hollow stem auger drilling and geotechnical sampling. Drilling, sampling, and in-situ testing were executed under the supervision of an Arup engineer who was responsible for monitoring the work and logging the soil samples.

Soil sampling methods utilized during the investigation included the standard penetration test (SPT) sampler and modified-California (Mod-Cal) sampler. SPT and Mod-Cal samplers were driven by an automatic-trip, 140pound hammer, dropping a distance of 30- inches. The number of blows required to advance the samplers for each of three, 6inch-long increments were recorded on the field borehole logs. Blows required to drive the sampler the last 12 inches were recorded as the N-value on the borehole logs presented in Appendix K of this report.

The driven sampling method of the SPT and Mod-Cal samplers results in relatively disturbed samples. Shelby tube samplers were brought to Site but were not utilized due to the relatively stiff nature of the clay. High quality piston sampling (e.g. via Pitcher Samplers) of the clays should be obtained during a design level geotechnical investigation.

2.2.2 Cone Penetration Testing

Ten CPTs were carried out as part of the due diligence geotechnical investigation. Termination depths ranged from approximately 20 to 45 feet. CPTs were carried out by Taber Drilling. The CPTs were advanced on October 15, 2019 under the supervision of an Arup engineer. All CPTs were fully retraction grouted to the surface once the termination depth was reached.

CPTs provide a nearly continuous log of tip resistance, side sleeve friction, and pore pressures generated during penetration. This in-situ information obtained by the instrumented cone can then be converted to various soil engineering properties through empirical correlations. The CPT results are provided in Appendix L.

2.2.3 In-Situ Resistivity Testing

The in-situ resistivity of the soil was measured at five locations at the project Site by JDH Corrosion Consultants, Inc. Resistance measurements were conducted with probe spacings of 2.5, 5, 7.5, 10 and 15-feet at each location with a north/south and east/west orientation. In-situ resistivity testing was carried out on October 15, 2019 under the supervision of an Arup engineer. In-situ resistivity test results are summarized in Appendix M.

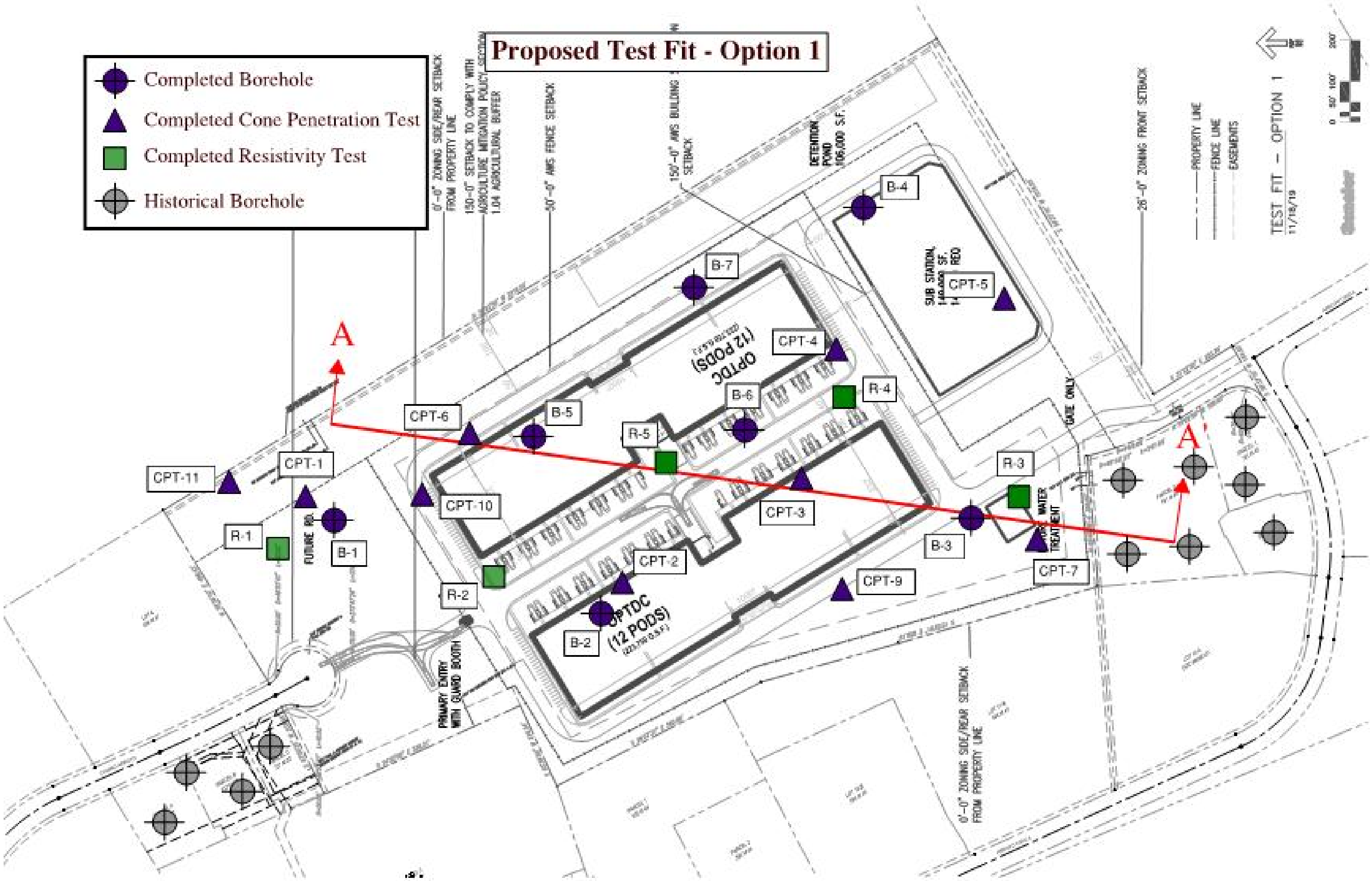


Figure 1: Geotechnical Exploration Plan for Proposed Test Fit – Option 1

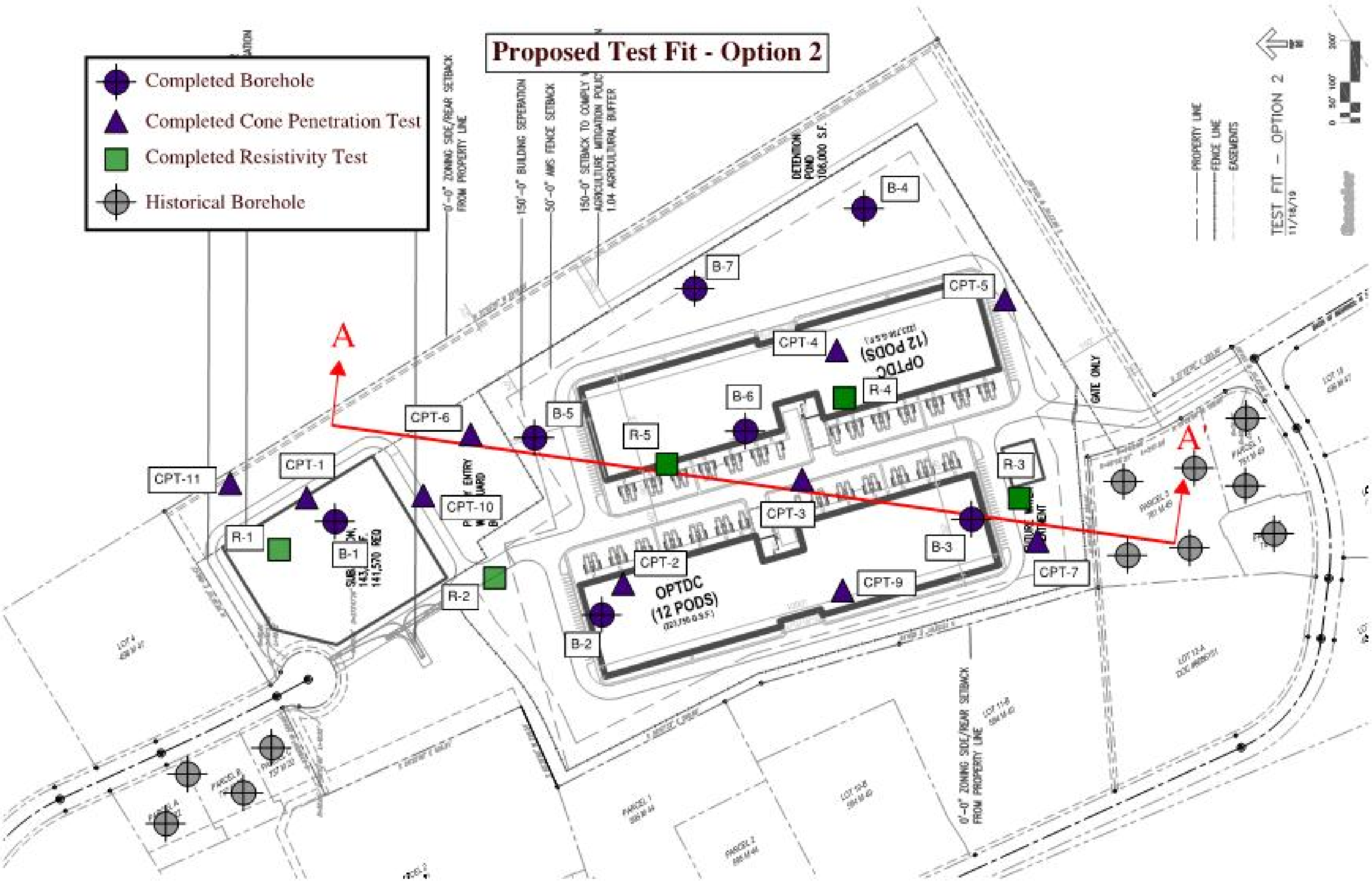


Figure 2: Geotechnical Exploration Plan for Proposed Test Fit – Option 2

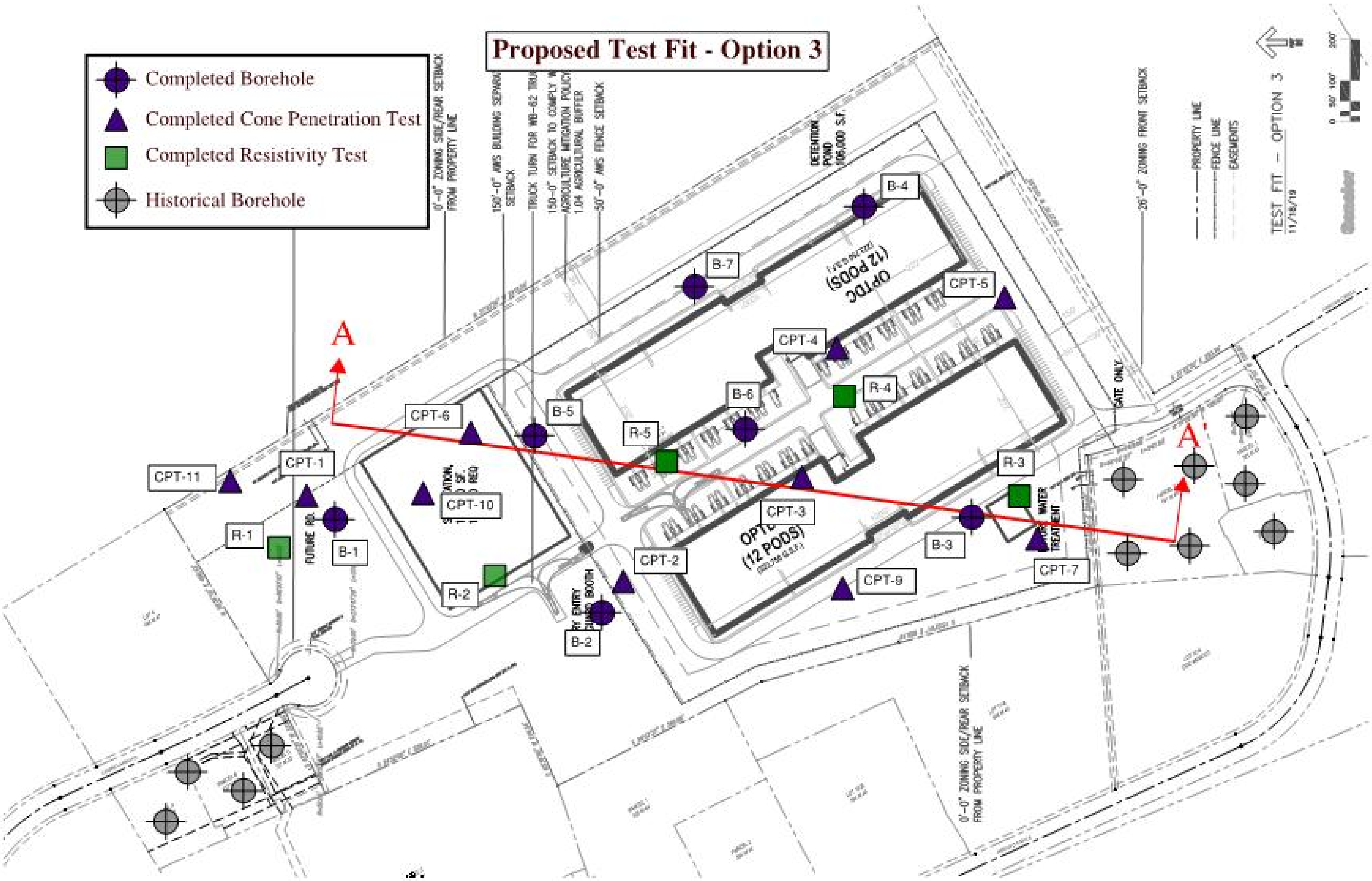


Figure 3: Geotechnical Exploration Plan for Proposed Test Fit – Option 3

2.3 Laboratory Testing Program

Geotechnical laboratory tests were performed on representative samples that were recovered from the field exploration phase to evaluate their physical and engineering characteristics. The laboratory testing was performed by Cooper Testing Laboratory. The types and number of tests performed are summarized in Table 2. The laboratory test results are presented in Appendix N.

Table 2: Summary of Laboratory Tests Performed

Test Type	ASTM Standard Number	Number of Tests
Atterberg Limits	D4318	4
Particle Size Distribution	D422	4
One-Dimensional Incremental Load Consolidation Test	D2435	1
Thermal Conductivity Test (As Received)	D5334	2
Thermal Conductivity Test (As Received & Air Dried)	D5334-14	2
Corrosion Testing	D5334-15	1

2.3.1 Index Testing

Index testing was performed on select samples in accordance with the standards referenced in Table 2. The primary purpose of the index testing is to validate the soil classifications made in the field. In addition, index testing can inform other geotechnical analyses such as liquefaction potential, expansion potential, and soil compressibility. A summary of the index test results is presented in Table 3 and laboratory results are included in Appendix N.

2.3.2 Incremental Load Consolidation

One incremental load consolidation test was carried out with the primary purpose of evaluating the over consolidation ratio (OCR), i.e. the ratio of the apparent maximum past pressure (σ'_p) to the current in-situ effective stress (σ'_v). Note that this test was carried out on a sample obtained by a driven Mod-Cal sampler. It is therefore likely that the apparent maximum past pressure is underestimated due to sample disturbance. An estimate of the compressibility of the in-situ soils is also provided, which is necessary to evaluate the settlement potential at the site. The consolidation test results are included in Appendix N.

2.3.3 Thermal Conductivity Testing

Thermal conductivity testing was carried out over a range of water contents to understand the ease with which heat energy is conducted through on-site soils. The results of the thermal conductivity testing are summarized in

Table 4 and laboratory results are included in Appendix N.

2.3.4 Corrosion Testing

A corrosivity test was carried out to support the assessment of corrosion risk to buried structural elements and utilities. As recommended by Caltrans (2018), these included pH, resistivity, chloride and sulfate tests. The results of the corrosion test are summarized in

Table 5 and full results are included in Appendix N

Table 3 Summary of Index Test Results

Borehole ID	Sample No.	Depth	USCS Symbol	Liquid Limit, w_l	Plastic Limit, w_p	Plasticity Index, I_p	Fines Content
		(ft)		(%)	(%)	(%)	(%)
B-2	3	7.5	CL	44	23	21	
B-3	3	7.5	CL	-	-	-	77.3
B-6	4	10	CL	33	21	12	
B-7	4	10	SC				12.9
Northeast Corner Fill #1	-	-	CL	44	18	26	61.8
Northeast Corner Fill #3	-	-	SC	37	19	18	47.6

Table 4 Summary of Thermal Conductivity Tests

Borehole ID	Sample No.	Depth	Initial Condition		Air Dry	
			Thermal Conductivity	Thermal Resistivity	Thermal Conductivity	Thermal Resistivity
		(ft)	(W/m k)	(°C cm/W)	(W/m k)	(°C cm/W)
B-1	2	5	1.985	50.4	-	-
B-3	2	5	1.630	61.3	0.925	108.1
B-4	2	5	1.838	54.4	-	-
B-5	2	5	1.633	61.2	1.172	85.3

Table 5 Summary of Corrosivity Test

Borehole ID	Sample No.	Depth	pH	Min. Resistivity	Chloride	Sulfate
		(ft)		(ohms-cm)	(mg/kg)	(mg/kg)
B-2	2	5	7.5	1,461	5	128

2.4 Geologic Description

According to the geologic mapping presented in Helley (1979), the Site is underlain by Pleistocene age alluvium. This alluvium consists of moderately consolidated, deeply weathered, poorly sorted, irregularly interbedded clay, silt, sand and gravel. The maximum thickness of these deposits is unknown but are typically on the order of 150 feet or more. These deposits are expected to reach a maximum thickness of 500 feet in some areas under South San Francisco Bay (Helley, 1979).

2.5 Subsurface Conditions

A model of the subsurface conditions has been developed based on the information gathered during the geotechnical investigation. The subsurface conditions encountered were generally consistent with what was anticipated based on the historical geotechnical information and presented in the geotechnical desktop study. Based on the geotechnical investigation, the subsurface ground conditions primarily consist of lean clay with varying amounts of fine sand present in the soil matrix. Separating an upper clay layer from a lower clay layer is typically a coarse granular layer primarily composed of gravel with varying amounts of sand and clay. The soil units encountered are described further in Section 2.5.1 and an interpretive cross-section is shown in Figure 4.

2.5.1 Stratigraphy

Fill: The fill encountered at the Site consists of agricultural topsoil composed of lean clay. The lean clay is generally brown and contains varying amounts of gravel. Organics are also present within the fill, consisting primarily of roots and hay. Encountered fill thickness is on the order of 2.5 feet.

Upper Clay Layer: A layer of lean clay was primarily encountered directly beneath the fill layer. This lean clay is generally medium stiff to very stiff, brown, with varying amounts of sand and gravel present in the soil matrix. The thickness of this layer varies across the site. In B-1, for example, the Upper Clay layer extended to a depth of approximately twenty feet while in B-7 it transitions to the Gravel Layer at approximately five feet.

The potential variability of the thickness of this clay layer is illustrated by borings B-6 and B-7. In B-6, clay to a depth of 15 feet would be expected while in B-7, clay to a depth of 5 feet would be anticipated., even though the borings are relatively close to each other.

Granular Layer: A granular layer, primarily consisting of gravel, was encountered in a majority of the geotechnical explorations. This gravel layer is generally dense and contains varying amounts of sand and clay. The depth and extent of this layer varies across the Site but was generally encountered between the depths of ten and twenty feet. Note that some loose, clayey sand layers were encountered as part of this unit.

Lower Clay Layer: A second layer of lean clay was encountered beneath the Granular Layer. As with the Upper Clay layer, the Lower Clay is generally medium stiff to very stiff, brown, with varying amounts of sand and gravel. Due to the limited boring depths, the extent of this clay layer is not known.

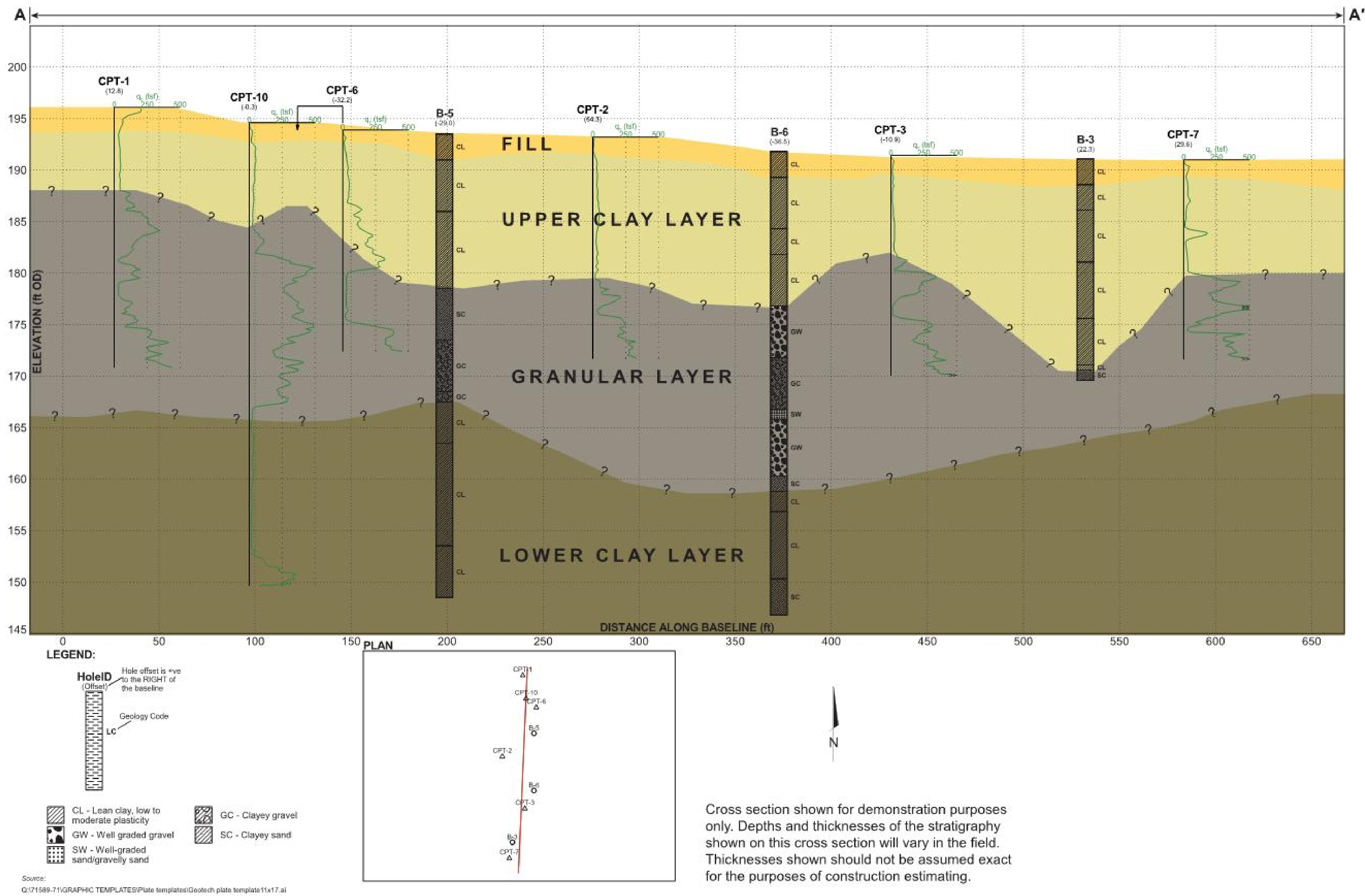


Figure 4: Interpretive Cross-Section A-A' as shown in Figure 1 through Figure 3

2.5.2 Preliminary Design Profile and Parameters

To facilitate the evaluation of feasible foundation options, a simplified ground model was developed for the Site as shown in Table 6. As discussed in Section 2.5.1, the relative thickness of each soil unit is variable across the site. The simplified profile has been developed only to facilitate preliminary engineering analysis, and conditions should be expected to vary from those shown in Table 6. The soil properties were developed using both CPT correlations and laboratory test data.

Table 6 Preliminary Design Profile

Soil Unit	**Top Depth**	**Bottom Depth**	**Total Unit Weight, □t**	**Undrained Shear Strength, su**	**Friction Angle, φ□**
	(ft, bgs)	**(ft, bgs)**	**(pcf)**	**(psf)**	**(°)**
Fill	0	2	120	1,500	–
Upper Clay	2	15	125	2,500	–
Granular Layer	15	30	130	–	38
Lower Clay	30	45	125	2,500	–

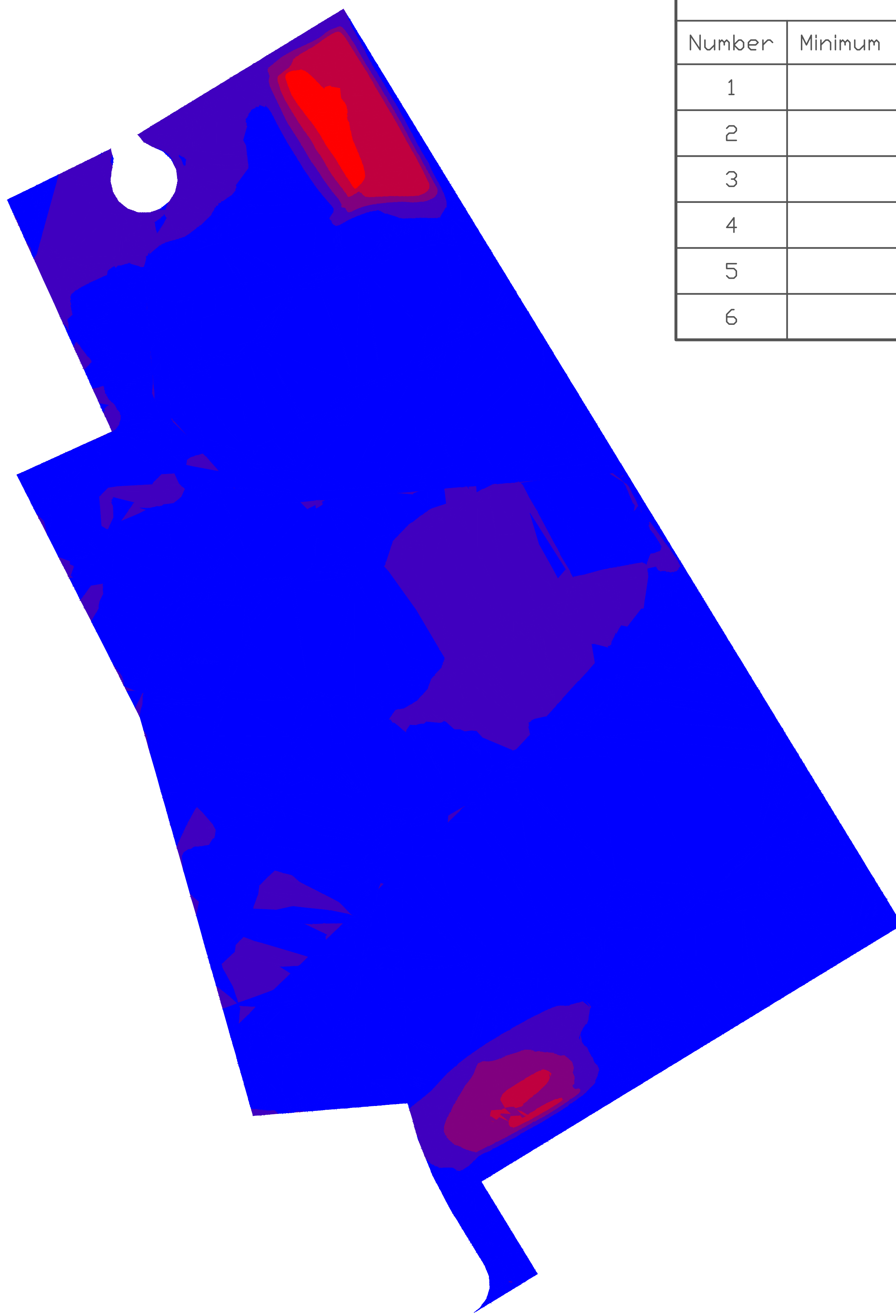
2.5.3 Groundwater

Historical geotechnical information near the Site indicates that the groundwater level may vary between 17 to 39 feet below ground surface (Levine & Frick, 1999). A pore pressure dissipation test, a method for estimating depth to groundwater from CPT, was run on CPT-3 at a depth of 21 feet and indicated that the test was above the groundwater table. The water level was measured at 25 feet below ground surface in B-6 and B-7 using a water level indicator.

Appendix E

Cut Fill Analysis

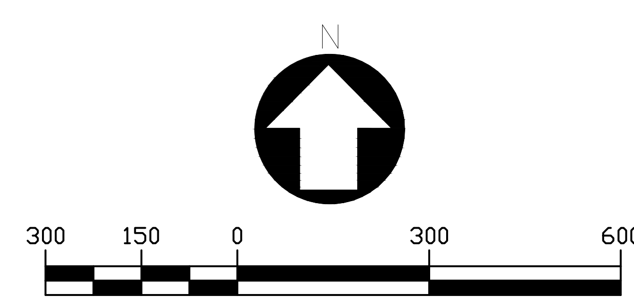
BUILDING GRADING NOT INCORPORATED



Elevations Table			
Number	Minimum Difference (ft)	Maximum Difference (ft)	Color
1	-20	-15	
2	-15	-10	
3	-10	-5	
4	-5	0	
5	0	5	
6	5	10	

CUT	56,000 CY
FILL	107,000 CY
NET	51,000 CY (FILL)

BULKING/SHRINKAGE NOT ACCOUNTED FOR



GRAPHIC SCALE: 1 INCH = 300 FT

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Client
AWS

Job Title
SFO069

Stamp

Drawing Title
CUT FILL ANALYSIS

Scale

File Name

Drawing Status

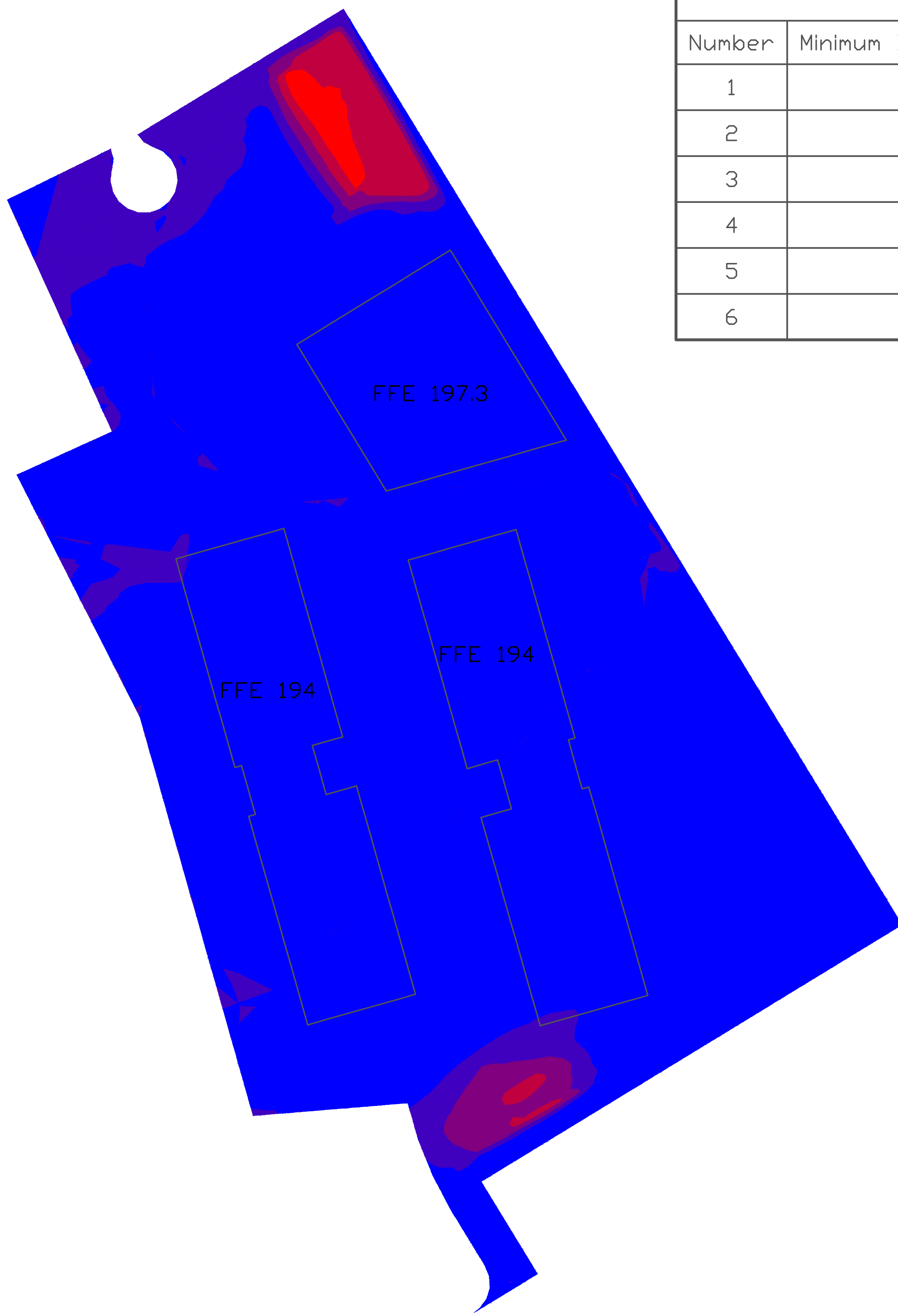
Drawn By

Checked By

Job No

Drawing No

BUILDINGS RAISED 1' ABOVE 100Y FLOODPLAIN



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3	-10	-5	
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5	0	5	
6	5	10	

CUT	54,000 CY
FILL	161,000 CY
NET	107,000 CY (FILL)

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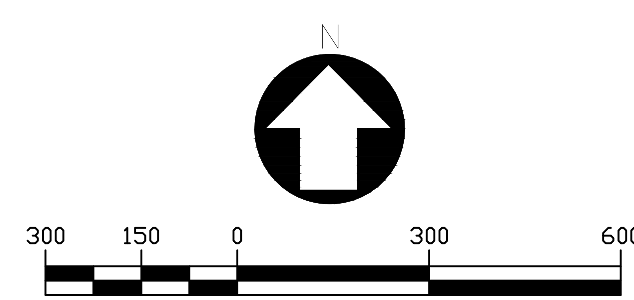

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Drawing Title
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Scale

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Drawing Status

Drawn By

Checked By

Job No

Drawing No

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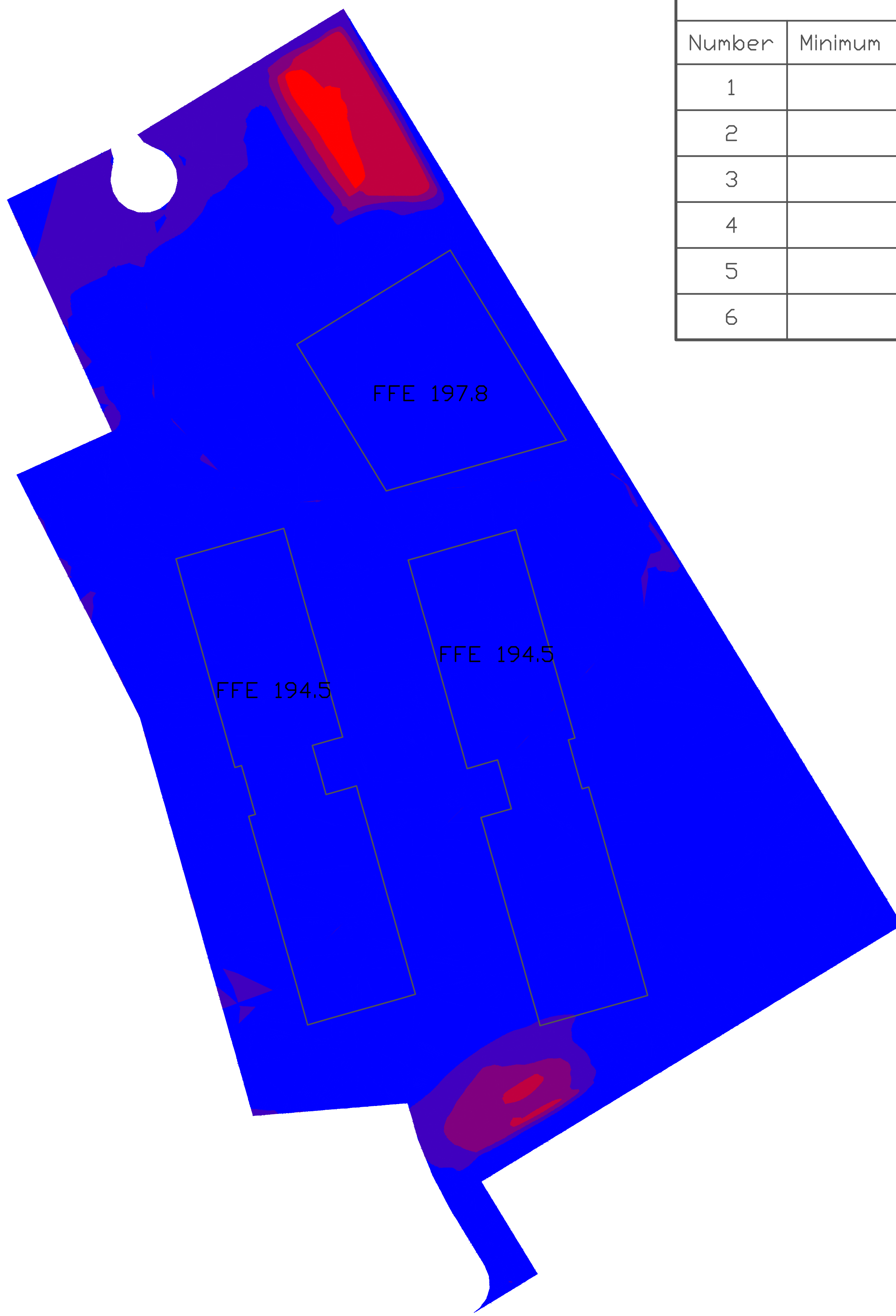
1 2 3 4 5 6

BUILDINGS RAISED 1.5' ABOVE 100Y FLOODPLAIN



Elevations Table			
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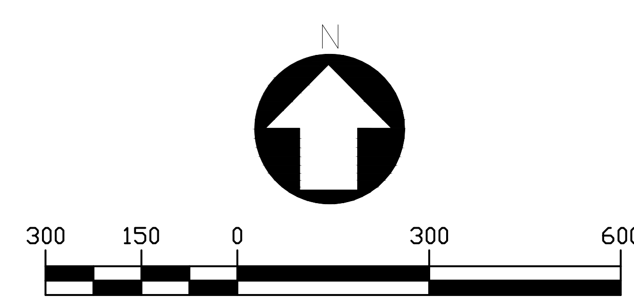
3	-10	-5	
4	-5	0	
5	0	5	
6	5	10	

CUT	53,000 CY
FILL	179,000 CY
NET	126,000 CY (FILL)

BULKING/SHRINKAGE NOT ACCOUNTED FOR



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Drawing Title

CUT FILL ANALYSIS

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Drawing Status

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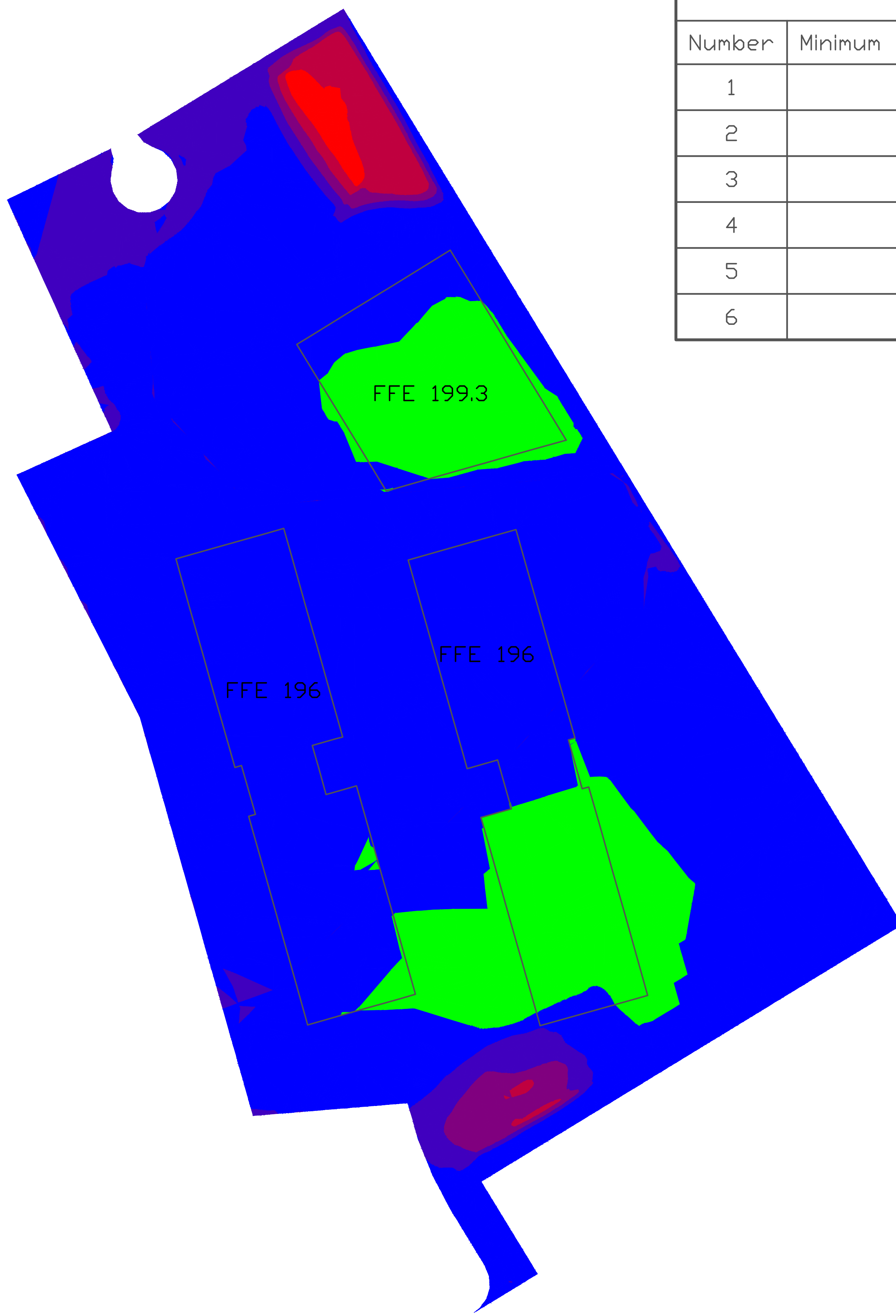
Checked By

Job No

Drawing No

BUILDINGS RAISED 3' ABOVE 100Y FLOODPLAIN



Elevations Table			
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3	-10	-5	
4	-5	0	
5	0	5	
6	5	10	

CUT	51,000 CY
FILL	253,000 CY
NET	202,000 CY (FILL)

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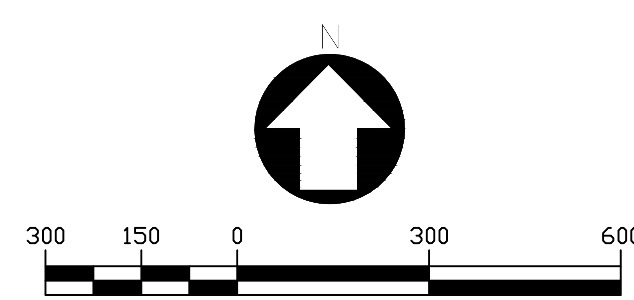

GRAPHIC SCALE: 1 INCH = 300 FT

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CUT FILL ANALYSIS

Scale

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Drawing Status

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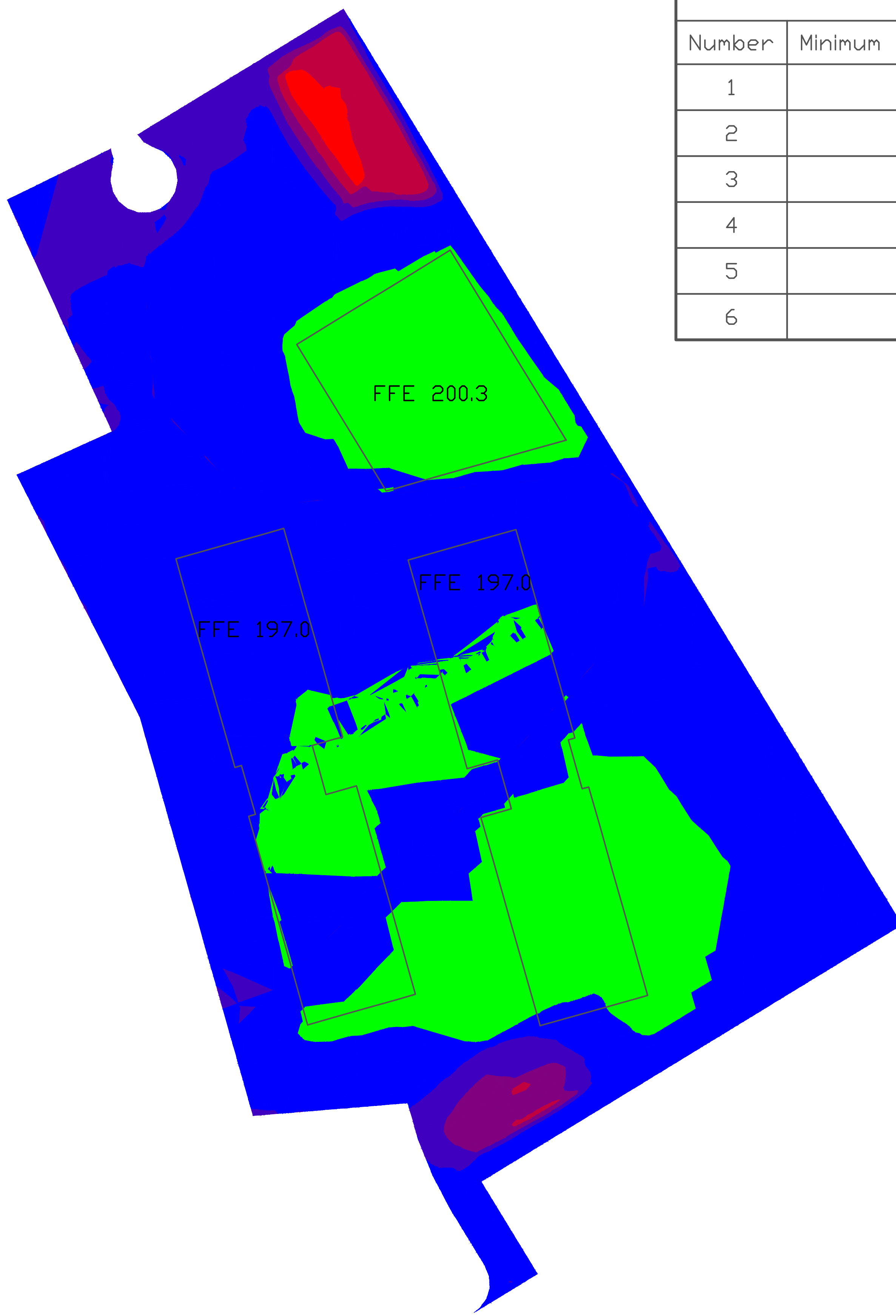
Checked By

Job No

Drawing No

BUILDINGS RAISED 4' ABOVE 100Y FLOODPLAIN



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2	-15	-10	
3	-10	-5	
4	-5	0	
5	0	5	
6	5	10	

CUT	51,000 CY
FILL	300,000 CY
NET	249,000 CY (FILL)

BULKING/SHRINKAGE NOT ACCOUNTED FOR

N

300 150 0 300 600

GRAPHIC SCALE: 1 INCH = 300 FT

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Drawing Title

CUT FILL ANALYSIS

Scale

File Name

Drawing Status

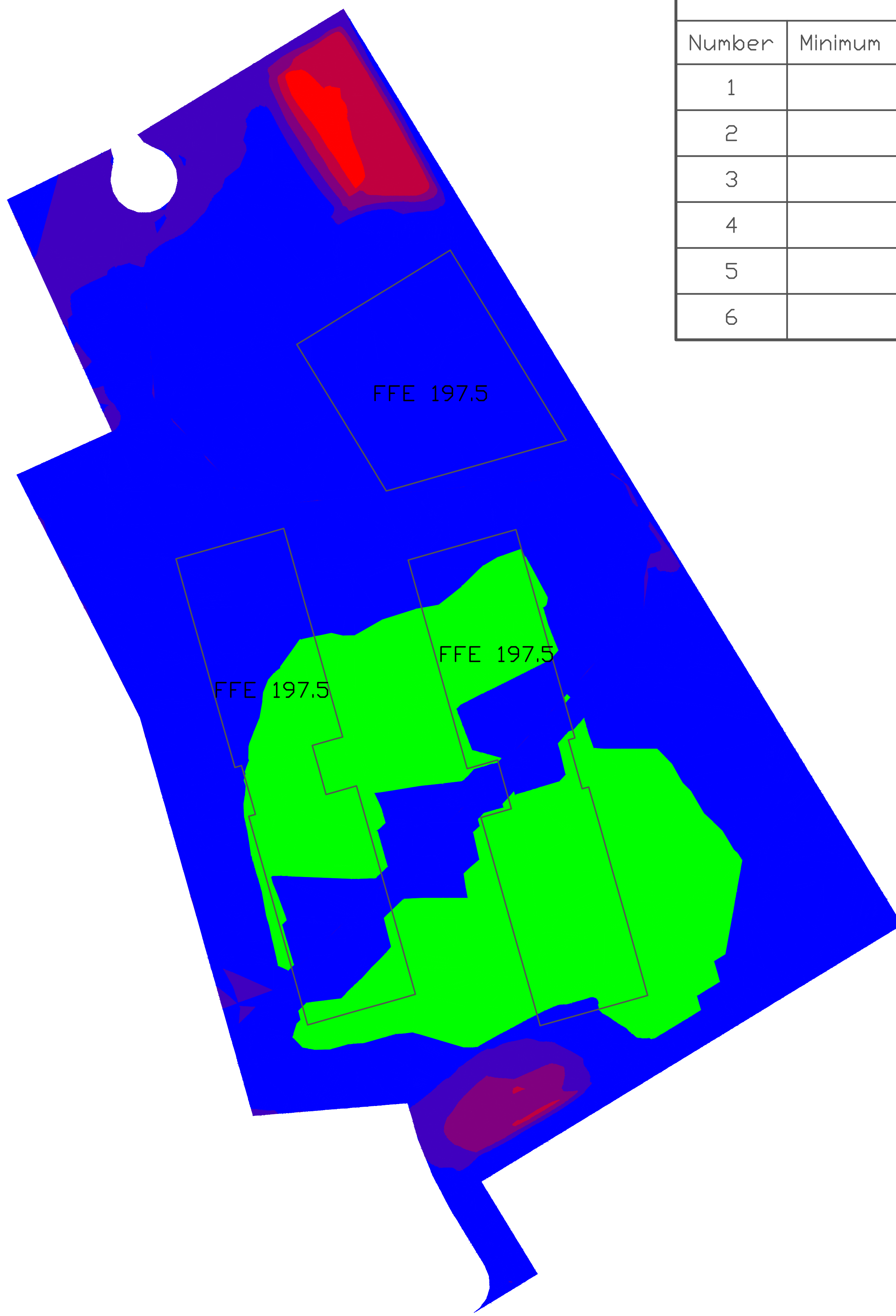
Drawn By

Checked By

Job No

Drawing No

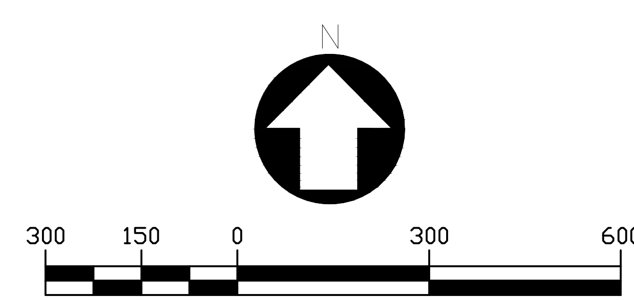
BUILDINGS RAISED TO 500Y FLOODPLAIN



Elevations Table			
Number	Minimum Difference (ft)	Maximum Difference (ft)	Color
1	-20	-15	
2	-15	-10	
3	-10	-5	
4	-5	0	
5	0	5	
6	5	10	

CUT	51,000 CY
FILL	286,000 CY
NET	235,000 CY (FILL)

BULKING/SHRINKAGE NOT ACCOUNTED FOR



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Drawing Title
CUT FILL ANALYSIS

Scale

File Name

Drawing Status

Drawn By

Checked By

Job No

Drawing No

Appendix K

Borehole Logs

PROJECT NAME				PROJECT NUMBER
AWS Gilroy				**271590**
LOGGED BY: J. Villanueva	BEGIN DATE: Oct-14-19	COMPLETION DATE: Oct-14-19	BOREHOLE LOCATION (Lat/Long or North/East and Datum): N4097867.94 / E628214.04 (NAD83)	HOLE ID: B-1
DRILLING CONTRACTOR/DRILLER: PeneCore Drilling/Juan M.			IN-SITU TESTING	SURFACE ELEVATION: 196.1 ft (NAVD88)
DRILLING METHOD: HAND AUGER(0'-5'), HOLLOW STEM AUGER(5'-21.5')			DRILL RIG: Geoprobe 8040DT	BOREHOLE DIAMETER: 6.0 in
SAMPLER TYPE(S) AND SIZE(S) (ID): MC(2-1/2")			SPT HAMMER TYPE/HAMMER ID: Automatic, 40 lbs, 30-inch drop	HAMMER EFFICIENCY, ERi: N/A
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS Depth (Date/Time)	TOTAL DEPTH OF BORING: 21.5 ft

Elevation (ft)	Depth (ft)	Material Graphics	Description	Sample Location	Sampler Type	Sample Number	N-Value (bl/ft)	Penetration (in)	Recovery (in)	200 Wash (%)	Moisture Content (%)	Total Unit Wt. (pcf)	Liquid Limit (%)	Plasticity Index (%)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks/ Other Tests
	0		Lean CLAY with GRAVEL (CL); stiff; brown; dry; some fine to coarse GRAVEL; organics (roots and hay); [TOPSOIL].															
			Lean CLAY (CL); stiff; brown; dry to moist; few GRAVEL; medium plasticity.		MC	S1	18	18	2									
191.10	5		Lean CLAY with GRAVEL (CL); stiff; brown with gray mottling; moist; subrounded; little GRAVEL; medium plasticity.		MC	S2	14	18	18									TC PP: 4.5 tsf
			SANDY lean CLAY (CL); stiff; brown; moist; some fine SAND; trace GRAVEL; medium plasticity.		MC	S3	32	18	16									PP: 3.5 tsf
186.10	10		Lean CLAY with SAND (CL); very stiff; brown; moist; little fine SAND; few coarse GRAVEL; medium plasticity.		MC	S4	34	18	16									PP: 3.5 tsf TV: 1.0 tsf
181.10	15		SANDY lean CLAY (CL); stiff; brown with reddish brown mottling; some SAND; trace GRAVEL; medium plasticity.		MC	S5	13	18	18									PP: 3.5 tsf TV: 1.4 tsf
176.10	20																	

(continued)

ARUP

PROJECT NAME				PROJECT NUMBER
AWS Gilroy				**271590**
LOGGED BY: J. Villanueva	BEGIN DATE: Oct-14-19	COMPLETION DATE: Oct-14-19	BOREHOLE LOCATION (Lat/Long or North/East and Datum): N4097867.94 / E628214.04 (NAD83)	HOLE ID: B-1
DRILLING CONTRACTOR/DRILLER: PeneCore Drilling/Juan M.			IN-SITU TESTING:	SURFACE ELEVATION: 196.1 ft (NAVD88)
DRILLING METHOD: HAND AUGER(0'-5'), HOLLOW STEM AUGER(5'-21.5')			DRILL RIG: Geoprobe 8040DT	BOREHOLE DIAMETER: 6.0 in
SAMPLER TYPE(S) AND SIZE(S) (ID): MC(2-1/2")			SPT HAMMER TYPE/HAMMER ID: Automatic, 40 lbs, 30-inch drop	HAMMER EFFICIENCY, ERi: N/A
BOREHOLE BACKFILL AND COMPLETION:			GROUNDWATER READINGS Depth (Date/Time):	TOTAL DEPTH OF BORING: 21.5 ft

Elevation (ft)	Depth (ft)	Material Graphics	Description	Sample Location	Sampler Type	Sample Number	N-Value (bl/ft)	Penetration (in)	Recovery (in)	200 Wash (%)	Moisture Content (%)	Total Unit Wt. (pcf)	Liquid Limit (%)	Plasticity Index (%)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks/ Other Tests
	20		GRAVELLY lean CLAY (CL); very stiff; brown; some coarse GRAVEL.		MC	S6	37	18	18									
			Borehole terminated at a depth of 21.5 feet. See Borehole Log Legend for soil classification chart and key to test data and sampler type.															
171.10	25																	
166.10	30																	
161.10	35																	
156.10	40																	

ARUP

BOREHOLE NO. B-1

PROJECT NAME		PROJECT NUMBER
AWS Gilroy		**271590**
LOGGED BY: J. Villanueva; BEGIN DATE: Oct-14-19; COMPLETION DATE: Oct-14-19	BOREHOLE LOCATION (Lat/Long or North/East and Datum): N4097671.61 / E628153.3 (NAD83)	HOLE ID: B-2
DRILLING CONTRACTOR/DRILLER: PeneCore Drilling/Juan M.	IN-SITU TESTING:	SURFACE ELEVATION: 193.8 ft (NAVD88)
DRILLING METHOD: HAND AUGER(0'-5'), HOLLOW STEM AUGER(5'-21.5')	DRILL RIG: Geoprobe 8040DT	BOREHOLE DIAMETER: 6.0 in
SAMPLER TYPE(S) AND SIZE(S) (ID): MC(2-1/2"), SPT(1-3/8")	SPT HAMMER TYPE/HAMMER ID: Automatic, 40 lbs, 30-inch drop	HAMMER EFFICIENCY, ERi: N/A
BOREHOLE BACKFILL AND COMPLETION:	GROUNDWATER READINGS Depth (Date/Time):	TOTAL DEPTH OF BORING: 21.5 ft

Elevation (ft)	Depth (ft)	Description	Sampler Type	Sample Number	N-Value (bl/ft)	Penetration (in)	Recovery (in)	200 Wash (%)	Moisture Content (%)	Total Unit Wt. (pcf)	Liquid Limit (%)	Plasticity Index (%)	Shear Strength (tsf)	Remarks/ Other Tests
	0	Lean CLAY with GRAVEL (CL); stiff; brown; dry; some fine to coarse GRAVEL; organics (roots and hay); [TOPSOIL].												Grab bucket of hand auger in upper depth
		Lean CLAY (CL); stiff; brown; dry; medium plasticity.	MC	S1	17	18	10							PP: 4.5 tsf
188.80	5	Lean CLAY with SAND (CL); stiff to very stiff; brown; moist; little fine SAND; medium plasticity.	MC	S2	24	18	18							CORR PP: 4.5 tsf
			SPT	S3	15	18	17				44	21		
183.80	10	- stiff; brown with gray mottling; little SAND.	SPT	S4	11	18	16							
178.80	15	CLAYEY SAND (SC); medium dense; dark brown; moist; some fines.	SPT	S5	18	18	15							
173.80	20													

(continued)

ARUP

PROJECT NAME **AWS Gilroy**				PROJECT NUMBER **271590**
LOGGED BY J. Villanueva	BEGIN DATE Oct-14-19	COMPLETION DATE Oct-14-19	BOREHOLE LOCATION (Lat/Long or North/East and Datum) N4097671.61 / E628153.3 (NAD83)	HOLE ID B-2
DRILLING CONTRACTOR/DRILLER PeneCore Drilling/Juan M.			IN-SITU TESTING	SURFACE ELEVATION 193.8 ft (NAVD88)
DRILLING METHOD HAND AUGER(0'-5'), HOLLOW STEM AUGER(5'-21.5')			DRILL RIG Geoprobe 8040DT	BOREHOLE DIAMETER 6.0 in
SAMPLER TYPE(S) AND SIZE(S) (ID) MC(2-1/2"), SPT(1-3/8")			SPT HAMMER TYPE/HAMMER ID Automatic, 40 lbs, 30-inch drop	HAMMER EFFICIENCY, ERi N/A
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS Depth (Date/Time)	TOTAL DEPTH OF BORING 21.5 ft

Elevation (ft)	Depth (ft)	Material Graphics	Description	Sample Location	Sampler Type	Sample Number	N-Value (bl/ft)	Penetration (in)	Recovery (in)	200 Wash (%)	Moisture Content (%)	Total Unit Wt. (pcf)	Liquid Limit (%)	Plasticity Index (%)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks/ Other Tests
	20		Well-graded GRAVEL with SAND (GW); dense; dark brown; moist; mostly coarse to fine GRAVEL; some fine to coarse SAND; few fines.		SPT	S6	36	18	14									
			Borehole terminated at a depth of 21.5 feet. See Borehole Log Legend for soil classification chart and key to test data and sampler type.															
168.80	25																	
163.80	30																	
158.80	35																	
153.80	40																	

1.0.2A-REV BOREHOLE LOG (SOIL) - US 271590-00_GINT_AWS.GPJ ARUPSFGINTLIBRARY_MASTER.GLB 11/1/19

ARUP

PROJECT NAME **AWS Gilroy**				PROJECT NUMBER **271590**
LOGGED BY J. Villanueva	BEGIN DATE Oct-14-19	COMPLETION DATE Oct-14-19	BOREHOLE LOCATION (Lat/Long or North/East and Datum) N4097388.31 / E628212.14 (NAD83)	HOLE ID B-3
DRILLING CONTRACTOR/DRILLER PeneCore Drilling/Juan M.			IN-SITU TESTING	SURFACE ELEVATION 191.1 ft (NAVD88)
DRILLING METHOD HAND AUGER(0'-5'), HOLLOW STEM AUGER(5'-21.5')			DRILL RIG Geoprobe 8040DT	BOREHOLE DIAMETER 6.0 in
SAMPLER TYPE(S) AND SIZE(S) (ID) MC(2-1/2")			SPT HAMMER TYPE/HAMMER ID Automatic, 40 lbs, 30-inch drop	HAMMER EFFICIENCY, ERi N/A
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS Depth (Date/Time)	TOTAL DEPTH OF BORING 21.5 ft

Elevation (ft)	Depth (ft)	Description	Sample Type	Sample Number	N-Value (bl/ft)	Penetration (in)	Recovery (in)	200 Wash (%)	Remarks/ Other Tests
	0	Lean CLAY with GRAVEl (CL); stiff; brown; dry; some fine to coarse GRAVEL; organics (roots and hay); [TOPSOIL].							
		GRAVELLY lean CLAY (CL); stiff; dark brown with black mottling; moist; some fine to coarse GRAVEL; medium plasticity.	MC	S1	18	18	14		
186.10	5	Lean CLAY with SAND (CL); medium stiff; brown; moist; little fine SAND; few fine GRAVEL; medium plasticity.	MC	S2	10	18	16		TV: 0.65 tsf
		- trace GRAVEL.	MC	S3	12	18	16	77.3	TV: 1.0 tsf
181.10	10	Lean CLAY (CL); stiff; brown wih gray mottling; few GRAVEL; medium plasticity.	MC	S4	17	18	15		TV: 0.75 tsf
176.10	15		MC	S5	11	18	17		
		GRAVELLY lean CLAY (CL); stiff; brown with orange mottling; moist; some fine to coarse GRAVEL; medium plasticity.							
171.10	20								

Column headings with no entries on this sheet: Material Graphics, Sample Location, Moisture Content (%), Total Unit Wt. (pcf), Liquid Limit (%), Plasticity Index (%), Shear Strength (tsf), Drilling Method, Casing Depth.

(continued)

ARUP

PROJECT NAME			PROJECT NUMBER
AWS Gilroy			**271590**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
J. Villanueva	Oct-14-19	Oct-14-19	N4097388.31 / E628212.14 (NAD83)	B-3

DRILLING CONTRACTOR/DRILLER PeneCore Drilling/Juan M.	IN-SITU TESTING	SURFACE ELEVATION 191.1 ft (NAVD88)
DRILLING METHOD HAND AUGER(0'-5'), HOLLOW STEM AUGER(5'-21.5')	DRILL RIG Geoprobe 8040DT	BOREHOLE DIAMETER 6.0 in
SAMPLER TYPE(S) AND SIZE(S) (ID) MC(2-1/2")	SPT HAMMER TYPE/HAMMER ID Automatic, 40 lbs, 30-inch drop	HAMMER EFFICIENCY, ERi N/A
BOREHOLE BACKFILL AND COMPLETION	GROUNDWATER READINGS Depth (Date/Time)	TOTAL DEPTH OF BORING 21.5 ft

Elevation (ft)	Depth (ft)	Material Graphics	Description	Sample Location	Sampler Type	Sample Number	N-Value (bl/ft)	Penetration (in)	Recovery (in)	200 Wash (%)	Moisture Content (%)	Total Unit Wt. (pcf)	Liquid Limit (%)	Plasticity Index (%)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks/ Other Tests
	20		Lean CLAY with GRAVEL (CL); stiff; brown; some coarse to fine GRAVEL.		MC	S6	19	18	17									
			CLAYEY SAND (SC); medium dense; brown; moist; trace GRAVEL; little medium plastic fines.															
			Borehole terminated at a depth of 21.5 feet.															
			See Borehole Log Legend for soil classification chart and key to test data and sampler type.															
166.10	25																	
161.10	30																	
156.10	35																	
151.10	40																	

ARUP

BOREHOLE NO. B-3

PROJECT NAME				PROJECT NUMBER
AWS Gilroy				**271590**
LOGGED BY J. Villanueva	BEGIN DATE Oct-14-19	COMPLETION DATE Oct-14-19	BOREHOLE LOCATION (Lat/Long or North/East and Datum) N4097463.02 / E628448.6 (NAD83)	HOLE ID B-4
DRILLING CONTRACTOR/DRILLER PeneCore Drilling/Juan M.			IN-SITU TESTING	SURFACE ELEVATION 190.4 ft (NAVD88)
DRILLING METHOD HAND AUGER(0'-5'), HOLLOW STEM AUGER(5'-21.5')			DRILL RIG Geoprobe 8040DT	BOREHOLE DIAMETER 6.0 in
SAMPLER TYPE(S) AND SIZE(S) (ID) MC(2-1/2")			SPT HAMMER TYPE/HAMMER ID Automatic, 40 lbs, 30-inch drop	HAMMER EFFICIENCY, ERi N/A
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS Depth (Date/Time)	TOTAL DEPTH OF BORING 21.5 ft

Elevation (ft)	Depth (ft)	Material Graphics	Description	Sample Location	Sampler Type	Sample Number	N-Value (bl/ft)	Penetration (in)	Recovery (in)	200 Wash (%)	Moisture Content (%)	Total Unit Wt. (pcf)	Liquid Limit (%)	Plasticity Index (%)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks/ Other Tests
	0		Lean CLAY with GRAVEL (CL); stiff; brown; dry; some fine to coarse GRAVEL; organics (roots and hay); [TOPSOIL].															
			Lean CLAY (CL); stiff; reddish brown with black mottling; dry; medium plasticity.		MC	S1	17	18	12									PP: 4.5 tsf
185.40	5		- reddish brown with black and gray mottling; trace GRAVEL.		MC	S2	18	18	14									TC PP: 4.5 tsf TV: 1.5 tsf
					MC	S3	46	18	12									
			Well-graded GRAVEL with SAND (GW); dense; brown; moist; mostly coarse to fine GRAVEL; some SAND.															
180.40	10		Well-graded SAND with GRAVEL (SW); medium dense; brown; moist; some coarse to fine GRAVEL.		MC	S4	35	18	17									
175.40	15		- trace plastic fines.		MC	S5	28	18	14									
170.40	20																	

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1.0.2A-REV BOREHOLE LOG (SOIL) - US 271590-00_GINT_AWS.GPJ ARUPSFGINTLIBRARY_MASTER.GLB 11/1/19

ARUP

BOREHOLE NO. B-4

PROJECT NAME **AWS Gilroy**				PROJECT NUMBER **271590**
LOGGED BY J. Villanueva	BEGIN DATE Oct-14-19	COMPLETION DATE Oct-14-19	BOREHOLE LOCATION (Lat/Long or North/East and Datum) N4097463.02 / E628448.6 (NAD83)	HOLE ID B-4
DRILLING CONTRACTOR/DRILLER PeneCore Drilling/Juan M.			IN-SITU TESTING	SURFACE ELEVATION 190.4 ft (NAVD88)
DRILLING METHOD HAND AUGER(0'-5'), HOLLOW STEM AUGER(5'-21.5')			DRILL RIG Geoprobe 8040DT	BOREHOLE DIAMETER 6.0 in
SAMPLER TYPE(S) AND SIZE(S) (ID) MC(2-1/2")			SPT HAMMER TYPE/HAMMER ID Automatic, 40 lbs, 30-inch drop	HAMMER EFFICIENCY, ERi N/A
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS Depth (Date/Time)	TOTAL DEPTH OF BORING 21.5 ft

Elevation (ft)	Depth (ft)	Material Graphics	Description	Sample Location	Sampler Type	Sample Number	N-Value (bl/ft)	Penetration (in)	Recovery (in)	200 Wash (%)	Moisture Content (%)	Total Unit Wt. (pcf)	Liquid Limit (%)	Plasticity Index (%)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks/ Other Tests
	20		Well-graded GRAVEL with SAND (GW); medium dense; brown with orange mottling; moist; mostly coarse to fine GRAVEL; some SAND; trace fines.		MC	S6	36	18	14									
			Borehole terminated at a depth of 21.5 feet. See Borehole Log Legend for soil classification chart and key to test data and sampler type.															
165.40	25																	
160.40	30																	
155.40	35																	
150.40	40																	

1.0.2A-REV BOREHOLE LOG (SOIL) - US 271590-00_GINT_AWS.GPJ ARUPSFGINTLIBRARY_MASTER.GLB 11/1/19

ARUP

PROJECT NAME				PROJECT NUMBER
AWS Gilroy				**271590**
LOGGED BY: J. Villanueva	BEGIN DATE: Oct-14-19	COMPLETION DATE: Oct-14-19	BOREHOLE LOCATION (Lat/Long or North/East and Datum): N4097719.43 / E628277.86 (NAD83)	HOLE ID: B-5
DRILLING CONTRACTOR/DRILLER: PeneCore Drilling/Juan M.			IN-SITU TESTING	SURFACE ELEVATION: 193.5 ft (NAVD88)
DRILLING METHOD: HAND AUGER(0'-5'), HOLLOW STEM AUGER(5'-45')			DRILL RIG: Geoprobe 8040DT	BOREHOLE DIAMETER: 6.0 in
SAMPLER TYPE(S) AND SIZE(S) (ID): MC(2-1/2"), SPT(1-3/8")			SPT HAMMER TYPE/HAMMER ID: Automatic, 40 lbs, 30-inch drop	HAMMER EFFICIENCY, ERi: N/A
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS Depth (Date/Time)	TOTAL DEPTH OF BORING: 41.5 ft

Elevation (ft)	Depth (ft)	Material Graphics	Description	Sample Location	Sampler Type	Sample Number	N-Value (bl/ft)	Penetration (in)	Recovery (in)	200 Wash (%)	Moisture Content (%)	Total Unit Wt. (pcf)	Liquid Limit (%)	Plasticity Index (%)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks/ Other Tests
	0		Lean CLAY with GRAVEL (CL); stiff; brown; dry; some fine to coarse GRAVEL; organics (roots and hay); [TOPSOIL].															
			Lean CLAY (CL); stiff; dark brown; moist; trace GRAVEL; medium plasticity.		MC	S1	19	18	14									PP: 3.0 tsf
188.50	5		- brown.		MC	S2	17	18	16									PP: 3.0 tsf
			SANDY lean CLAY (CL); stiff; brown; moist; some fine SAND; medium plasticity.		MC	S3	18	18	16									PP: 3.0 tsf
183.50	10				MC	S4	16	18	16									TV: 0.5 tsf
178.50	15		CLAYEY SAND (SC); loose; brown with orange mottling; some plastic fines.		MC	S5	10	18	16									
173.50	20																	

(continued)

1.0.2A-REV BOREHOLE LOG (SOIL) - US 271590-00_GINT_AWS.GPJ ARUPSFGINTLIBRARY_MASTER.GLB 11/1/19

ARUP

PROJECT NAME		PROJECT NUMBER
AWS Gilroy		**271590**
LOGGED BY: J. Villanueva; BEGIN DATE: Oct-14-19; COMPLETION DATE: Oct-14-19	BOREHOLE LOCATION (Lat/Long or North/East and Datum): N4097719.43 / E628277.86 (NAD83)	HOLE ID: B-5
DRILLING CONTRACTOR/DRILLER: PeneCore Drilling/Juan M.	IN-SITU TESTING:	SURFACE ELEVATION: 193.5 ft (NAVD88)
DRILLING METHOD: HAND AUGER(0'-5'), HOLLOW STEM AUGER(5'-45')	DRILL RIG: Geoprobe 8040DT	BOREHOLE DIAMETER: 6.0 in
SAMPLER TYPE(S) AND SIZE(S) (ID): MC(2-1/2"), SPT(1-3/8")	SPT HAMMER TYPE/HAMMER ID: Automatic, 40 lbs, 30-inch drop	HAMMER EFFICIENCY, ERi: N/A
BOREHOLE BACKFILL AND COMPLETION:	GROUNDWATER READINGS Depth (Date/Time):	TOTAL DEPTH OF BORING: 41.5 ft

Elevation (ft)	Depth (ft)	Description	Sampler Type	Sample Number	N-Value (bl/ft)	Penetration (in)	Recovery (in)	200 Wash (%)	Moisture Content (%)	Total Unit Wt. (pcf)	Liquid Limit (%)	Plasticity Index (%)	Shear Strength (tsf)	Remarks/ Other Tests
	20	CLAYEY GRAVEL with SAND (GC); medium dense; brown; moist; mostly coarse to fine GRAVEL; little fine SAND; little fines.	MC	S6	37	18	16							
168.50	25	CLAYEY GRAVEL (GC); medium dense; brown; moist; mostly coarse to fine GRAVEL; little fines.	SPT	S7	21	18	12							
		Lean CLAY with SAND (CL); very stiff; brown; moist; medium plasticity.												
163.50	30	Lean CLAY (CL); medium stiff; brown; moist; trace GRAVEL; medium plasticity.	SPT	S8	7	18	18							TV: 0.75 tsf
158.50	35	- stiff.	MC	S9	14	18	18							
153.50	40													

(continued)

ARUP

PROJECT NAME				PROJECT NUMBER
AWS Gilroy				**271590**
LOGGED BY J. Villanueva	BEGIN DATE Oct-14-19	COMPLETION DATE Oct-14-19	BOREHOLE LOCATION (Lat/Long or North/East and Datum) N4097719.43 / E628277.86 (NAD83)	HOLE ID B-5
DRILLING CONTRACTOR/DRILLER PeneCore Drilling/Juan M.			IN-SITU TESTING	SURFACE ELEVATION 193.5 ft (NAVD88)
DRILLING METHOD HAND AUGER(0'-5'), HOLLOW STEM AUGER(5'-45')			DRILL RIG Geoprobe 8040DT	BOREHOLE DIAMETER 6.0 in
SAMPLER TYPE(S) AND SIZE(S) (ID) MC(2-1/2"), SPT(1-3/8")			SPT HAMMER TYPE/HAMMER ID Automatic, 40 lbs, 30-inch drop	HAMMER EFFICIENCY, ERi N/A
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS Depth (Date/Time)	TOTAL DEPTH OF BORING 41.5 ft

Elevation (ft)	Depth (ft)	Material Graphics	Description	Sample Location	Sampler Type	Sample Number	N-Value (bl/ft)	Penetration (in)	Recovery (in)	200 Wash (%)	Moisture Content (%)	Total Unit Wt. (pcf)	Liquid Limit (%)	Plasticity Index (%)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks/ Other Tests
	40		Lean CLAY with SAND (CL); medium stiff; brown with tan mottling; little fine SAND; medium plasticity.		MC	S10	9	18	18									PP: 1.0 tsf
			Borehole terminated at a depth of 41.5 feet. See Borehole Log Legend for soil classification chart and key to test data and sampler type.															
148.50	45																	
143.50	50																	
138.50	55																	
133.50	60																	

1.0.2A-REV BOREHOLE LOG (SOIL) - US 271590-00_GINT_AWS.GPJ ARUPSFGINTLIBRARY_MASTER.GLB 11/1/19

ARUP

PROJECT NAME		PROJECT NUMBER
AWS Gilroy		**271590**
LOGGED BY: J. Villanueva; BEGIN DATE: Oct-15-19; COMPLETION DATE: Oct-15-19	BOREHOLE LOCATION (Lat/Long or North/East and Datum): N4097545.21 / E628277.75 (NAD83)	HOLE ID: B-6
DRILLING CONTRACTOR/DRILLER: PeneCore Drilling/Juan M.	IN-SITU TESTING:	SURFACE ELEVATION: 191.8 ft (NAVD88)
DRILLING METHOD: HAND AUGER(0'-5'), HOLLOW STEM AUGER(5'-45')	DRILL RIG: Geoprobe 8040DT	BOREHOLE DIAMETER: 6.0 in
SAMPLER TYPE(S) AND SIZE(S) (ID): MC(2-1/2")	SPT HAMMER TYPE/HAMMER ID: Automatic, 40 lbs, 30-inch drop	HAMMER EFFICIENCY, ERi: N/A
BOREHOLE BACKFILL AND COMPLETION:	GROUNDWATER READINGS Depth (Date/Time)	TOTAL DEPTH OF BORING: 41.5 ft

Elevation (ft)	Depth (ft)	Material Graphics	Description	Sample Location	Sampler Type	Sample Number	N-Value (bl/ft)	Penetration (in)	Recovery (in)	200 Wash (%)	Moisture Content (%)	Total Unit Wt. (pcf)	Liquid Limit (%)	Plasticity Index (%)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks/ Other Tests
	0		Lean CLAY with GRAVEL (CL); stiff; brown; dry; some fine to coarse GRAVEL; organics (roots and hay); [TOPSOIL].															
			Lean CLAY (CL); stiff; reddish brown with orange and black mottling; dry; medium plasticity.		MC	S1	13	18	12									PP: 2.5 tsf
186.80	5		.		MC	S2	20	18	18									PP: 3.0 tsf TV: 1.0 tsf
			SANDY lean CLAY (CL); stiff; brown; moist; some fine SAND; medium plasticity.		MC	S3	17	18	18									PP: 2.0 tsf
181.80	10		SANDY lean CLAY with GRAVEL (CL); very stiff; brown with gray mottling; moist; some fine SAND; little GRAVEL; medium plasticity.		MC	S4	30	18	18				33	12				PP: 2.0 tsf
176.80	15		Well-graded GRAVEL with SAND (GW); dense; brown; moist; mostly coarse to fine GRAVEL; little SAND.		MC	S5	42	18	10									
171.80	20																	

(continued)

ARUP

PROJECT NAME	PROJECT NUMBER
AWS Gilroy	**271590**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
J. Villanueva	Oct-15-19	Oct-15-19	N4097545.21 / E628277.75 (NAD83)	B-6

DRILLING CONTRACTOR/DRILLER	IN-SITU TESTING	SURFACE ELEVATION
PeneCore Drilling/Juan M.		191.8 ft (NAVD88)
DRILLING METHOD	**DRILL RIG**	**BOREHOLE DIAMETER**
HAND AUGER(0'-5'), HOLLOW STEM AUGER(5'-45')	Geoprobe 8040DT	6.0 in
SAMPLER TYPE(S) AND SIZE(S) (ID)	**SPT HAMMER TYPE/HAMMER ID**	**HAMMER EFFICIENCY, ERi**
MC(2-1/2")	Automatic, 40 lbs, 30-inch drop	N/A
BOREHOLE BACKFILL AND COMPLETION	**GROUNDWATER READINGS** Depth (Date/Time)	**TOTAL DEPTH OF BORING**
		41.5 ft

Elevation (ft)	Depth (ft)	Description	Sampler Type	Sample Number	N-Value (bl/ft)	Penetration (in)	Recovery (in)	Remarks/ Other Tests
	20	CLAYEY GRAVEL (GC); medium dense; brown; moist; mostly coarse to fine GRAVEL; little medium plasticity fines.	MC	S6	44	18	13	
166.80	25	Well-graded SAND (SW); dense; dark brown with white cementation; few coarse GRAVEL.	MC	S7	64	18	15	
		Well-graded GRAVEL (GW); dense; brown with variegated white and orange; moist; mostly coarse to fine GRAVEL; few medium plasticity fines.						
161.80	30		MC	S8	12	18	0	
		CLAYEY SAND (SC); loose; brown; moist; few fine GRAVEL; little fines.	MC	S9	14	18	18	PP: 3.0 tsf
		Lean CLAY with SAND (CL); stiff; brown; moist; medium plasticity.						
156.80	35	Lean CLAY (CL); medium stiff; brown; moist; medium plasticity.	MC	S10	11	18	18	PP: 2.5 tsf TV: 1.0 tsf
151.80	40							

Other columns (Sample Location, Material Graphics, 200 Wash (%), Moisture Content (%), Total Unit Wt. (pcf), Liquid Limit (%), Plasticity Index (%), Shear Strength (tsf), Drilling Method, Casing Depth) carry no printed values.

(continued)

ARUP

PROJECT NAME **AWS Gilroy**				PROJECT NUMBER **271590**
LOGGED BY J. Villanueva	BEGIN DATE Oct-15-19	COMPLETION DATE Oct-15-19	BOREHOLE LOCATION (Lat/Long or North/East and Datum) N4097545.21 / E628277.75 (NAD83)	HOLE ID B-6
DRILLING CONTRACTOR/DRILLER PeneCore Drilling/Juan M.			IN-SITU TESTING	SURFACE ELEVATION 191.8 ft (NAVD88)
DRILLING METHOD HAND AUGER(0'-5'), HOLLOW STEM AUGER(5'-45')			DRILL RIG Geoprobe 8040DT	BOREHOLE DIAMETER 6.0 in
SAMPLER TYPE(S) AND SIZE(S) (ID) MC(2-1/2")			SPT HAMMER TYPE/HAMMER ID Automatic, 40 lbs, 30-inch drop	HAMMER EFFICIENCY, ERi N/A
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS Depth (Date/Time)	TOTAL DEPTH OF BORING 41.5 ft

Elevation (ft)	Depth (ft)	Material Graphics	Description	Sample Location	Sampler Type	Sample Number	N-Value (bl/ft)	Penetration (in)	Recovery (in)	200 Wash (%)	Moisture Content (%)	Total Unit Wt. (pcf)	Liquid Limit (%)	Plasticity Index (%)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks/ Other Tests
	40		- stiff; brown with orange mottling.		MC	S11	16	18	18									
			Borehole terminated at a depth of 41.5 feet.															
			See Borehole Log Legend for soil classification chart and key to test data and sampler type.															
146.80	45																	
141.80	50																	
136.80	55																	
131.80	60																	

ARUP

PROJECT NAME		PROJECT NUMBER
AWS Gilroy		**271590**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
J. Villanueva	Oct-15-19	Oct-15-19	N4097596.16 / E628403.07 (NAD83)	B-7

DRILLING CONTRACTOR/DRILLER	IN-SITU TESTING	SURFACE ELEVATION
PeneCore Drilling/Juan M.		191.3 ft (NAVD88)
DRILLING METHOD	**DRILL RIG**	**BOREHOLE DIAMETER**
HAND AUGER(0'-5'), HOLLOW STEM AUGER(5'-45')	Geoprobe 8040DT	6.0 in
SAMPLER TYPE(S) AND SIZE(S) (ID)	**SPT HAMMER TYPE/HAMMER ID**	**HAMMER EFFICIENCY, ERi**
SPT(1-3/8")	Automatic, 40 lbs, 30-inch drop	N/A
BOREHOLE BACKFILL AND COMPLETION	**GROUNDWATER READINGS** Depth (Date/Time)	**TOTAL DEPTH OF BORING**
		41.5 ft

Elevation (ft)	Depth (ft)	Material Graphics	Description	Sample Location	Sampler Type	Sample Number	N-Value (bl/ft)	Penetration (in)	Recovery (in)	200 Wash (%)	Moisture Content (%)	Total Unit Wt. (pcf)	Liquid Limit (%)	Plasticity Index (%)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks/ Other Tests
	0		Lean CLAY with GRAVEL (CL); stiff; brown; dry; some fine to coarse GRAVEL; organics (roots and hay); [TOPSOIL].															
			Lean CLAY (CL); stiff; brown with black mottling; dry; medium plasticity.		SPT	S1	13	18	12									
186.30	5		CLAYEY GRAVEL (GC); medium dense; dark brown; dry; mostly coarse to fine GRAVEL; some medium plasticity fines.		SPT	S2	24	18	13									
			CLAYEY SAND with GRAVEL (SC); loose; dark brown; moist; little coarse to fine GRAVEL; some fines.		SPT	S3	9	18	13									
181.30	10		medium dense; little coarse to fine GRAVEL; little fines.		SPT	S4	18	18	18	12.9								
176.30	15		CLAYEY GRAVEL (GC); dense; dark brown; moist; mostly coarse to fine GRAVEL; little fines.		SPT	S5	40	18	15									
171.30	20																	

(continued)

ARUP

PROJECT NAME		PROJECT NUMBER
AWS Gilroy		**271590**
LOGGED BY: J. Villanueva; BEGIN DATE: Oct-15-19; COMPLETION DATE: Oct-15-19	BOREHOLE LOCATION (Lat/Long or North/East and Datum): N4097596.16 / E628403.07 (NAD83)	HOLE ID: B-7
DRILLING CONTRACTOR/DRILLER: PeneCore Drilling/Juan M.	IN-SITU TESTING:	SURFACE ELEVATION: 191.3 ft (NAVD88)
DRILLING METHOD: HAND AUGER(0'-5'), HOLLOW STEM AUGER(5'-45')	DRILL RIG: Geoprobe 8040DT	BOREHOLE DIAMETER: 6.0 in
SAMPLER TYPE(S) AND SIZE(S) (ID): SPT(1-3/8")	SPT HAMMER TYPE/HAMMER ID: Automatic, 40 lbs, 30-inch drop	HAMMER EFFICIENCY, ERi: N/A
BOREHOLE BACKFILL AND COMPLETION:	GROUNDWATER READINGS Depth (Date/Time):	TOTAL DEPTH OF BORING: 41.5 ft

Elevation (ft)	Depth (ft)	Description	Sampler Type	Sample Number	N-Value (bl/ft)	Penetration (in)	Recovery (in)	Remarks/ Other Tests
	20	- medium dense.	SPT	S6	24	18	17	
166.30	25		SPT	S7	30	18	12	
161.30	30		SPT	S8	9	18	0	
		Lean CLAY (CL); medium stiff; brown; moist; few fine GRAVEL; medium plasticity.	SPT	S9	6	18	14.5	PP: 1.0 tsf
156.30	35	.	SPT	S10	6	18	18	PP: 0.5 tsf
151.30	40							

Other columns (not filled on this sheet): Material Graphics, Sample Location, 200 Wash (%), Moisture Content (%), Total Unit Wt. (pcf), Liquid Limit (%), Plasticity Index (%), Shear Strength (tsf), Drilling Method, Casing Depth

(continued)

ARUP

PROJECT NAME **AWS Gilroy**				PROJECT NUMBER **271590**
LOGGED BY J. Villanueva	BEGIN DATE Oct-15-19	COMPLETION DATE Oct-15-19	BOREHOLE LOCATION (Lat/Long or North/East and Datum) N4097596.16 / E628403.07 (NAD83)	HOLE ID B-7
DRILLING CONTRACTOR/DRILLER PeneCore Drilling/Juan M.			IN-SITU TESTING	SURFACE ELEVATION 191.3 ft (NAVD88)
DRILLING METHOD HAND AUGER(0'-5'), HOLLOW STEM AUGER(5'-45')			DRILL RIG Geoprobe 8040DT	BOREHOLE DIAMETER 6.0 in
SAMPLER TYPE(S) AND SIZE(S) (ID) SPT(1-3/8")			SPT HAMMER TYPE/HAMMER ID Automatic, 40 lbs, 30-inch drop	HAMMER EFFICIENCY, ERi N/A
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS Depth (Date/Time)	TOTAL DEPTH OF BORING 41.5 ft

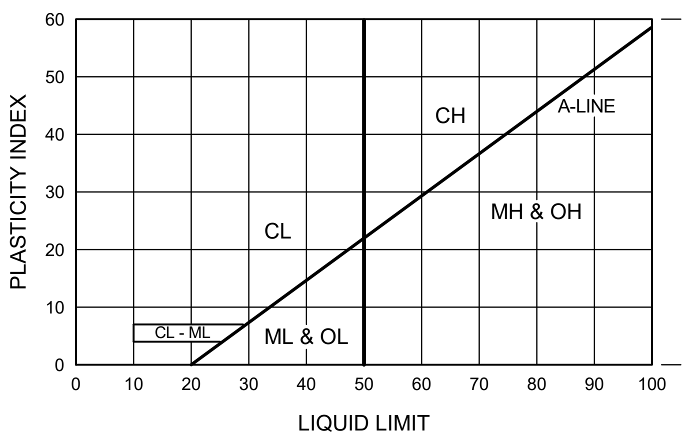
Elevation (ft)	Depth (ft)	Material Graphics	Description	Sample Location	Sampler Type	Sample Number	N-Value (bl/ft)	Penetration (in)	Recovery (in)	200 Wash (%)	Moisture Content (%)	Total Unit Wt. (pcf)	Liquid Limit (%)	Plasticity Index (%)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks/ Other Tests
	40		SANDY lean CLAY (CL); very stiff; brown; moist; some fine SAND; medium plasticity.		SPT	S11	16	18	18									
			Borehole terminated at a depth of 41.5 feet. See Borehole Log Legend for soil classification chart and key to test data and sampler type.															
146.30	45																	
141.30	50																	
136.30	55																	
131.30	60																	

INDEXED SOIL CLASSIFICATIONS

GRAPHIC	SYMBOL	DESCRIPTION	MAJOR DIVISIONS			
	GW	WELL-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	**CLEAN GRAVELS** (LITTLE OR NO FINES)	**GRAVELS** MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO.4 SIEVE SIZE	FOR VISUAL CLASSIFICATION, THE 1/4" SIZE MAY BE USED AS EQUIVALENT TO THE NO.4 SIEVE SIZE	**COARSE-GRAINED SOILS** MORE THAN HALF OF MATERIAL IS LARGER THAN NO.200 SIEVE SIZE
	GP	POORLY-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES				
	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	**GRAVELS WITH FINES** (APPRECIABLE AMOUNT OF FINES)			
	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES				
	SW	WELL-GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES	**CLEAN SANDS** (LITTLE OR NO FINES)	**SANDS** MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO.4 SIEVE SIZE		
	SP	POORLY-GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES				
	SM	SILTY SANDS, SAND-SILT MIXTURES	**SANDS WITH FINES** (APPRECIABLE AMOUNT OF FINES)			
	SC	CLAYEY SANDS, SAND-CLAY MIXTURES				
	ML	INORGANIC SILTS, VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	**SILTS & CLAYS** LIQUID LIMIT LESS THAN 50			**FINE-GRAINED SOILS** MORE THAN HALF OF MATERIAL IS SMALLER THAN NO.200 SIEVE SIZE
	CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS				
	OL	ORGANIC SILTS AND ORGANIC SILT-CLAYS OF LOW PLASTICITY				
	MH	ORGANIC SILTS AND ORGANIC SILT-CLAYS OF HIGH PLASTICITY	**SILTS & CLAYS** LIQUID LIMIT GREATER THAN 50			
	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS				
	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS				
	PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	**HIGHLY ORGANIC SOILS**			
	OS	OILY SEDIMENTS				

THE NO.200 U.S. STANDARD SIEVE IS ABOUT THE SMALLEST PARTICLE VISIBLE TO THE NAKED EYE

PLASTICITY CHART



KEY TO TEST DATA

CONSOL = CONSOLIDATION
CORR = CORROSIVITY
DS = DIRECT SHEAR
ORG = ORGANIC CONTENT
PERM = PERMEABILITY
PP = POCKET PENETROMETER
RV = R-VALUE
TC = THERMAL CONDUCTIVITY
TV = FIELD TORVANE
TXCD = CONSOLIDATED DRAINED TRIAXIAL
TXCU = CONSOLIDATED UNDRAINED TRIAXIAL
UCS = UNCONFINED COMPRESSIVE STRENGTH
UU = UNCONSOLIDATED UNDRAINED TRIAXIAL

KEY TO SAMPLER TYPE

HQ = HQ CORE BARREL SAMPLER
MC = MODIFIED CALIFORNIA SAMPLER
P = DAMES & MOORE PISTON SAMPLER
PS = PITCHER SAMPLER
SPT = STANDARD PENETRATION TEST SAMPLER
ST - SHELBY TUBE SAMPLER
NO RECOVERY

ARUP

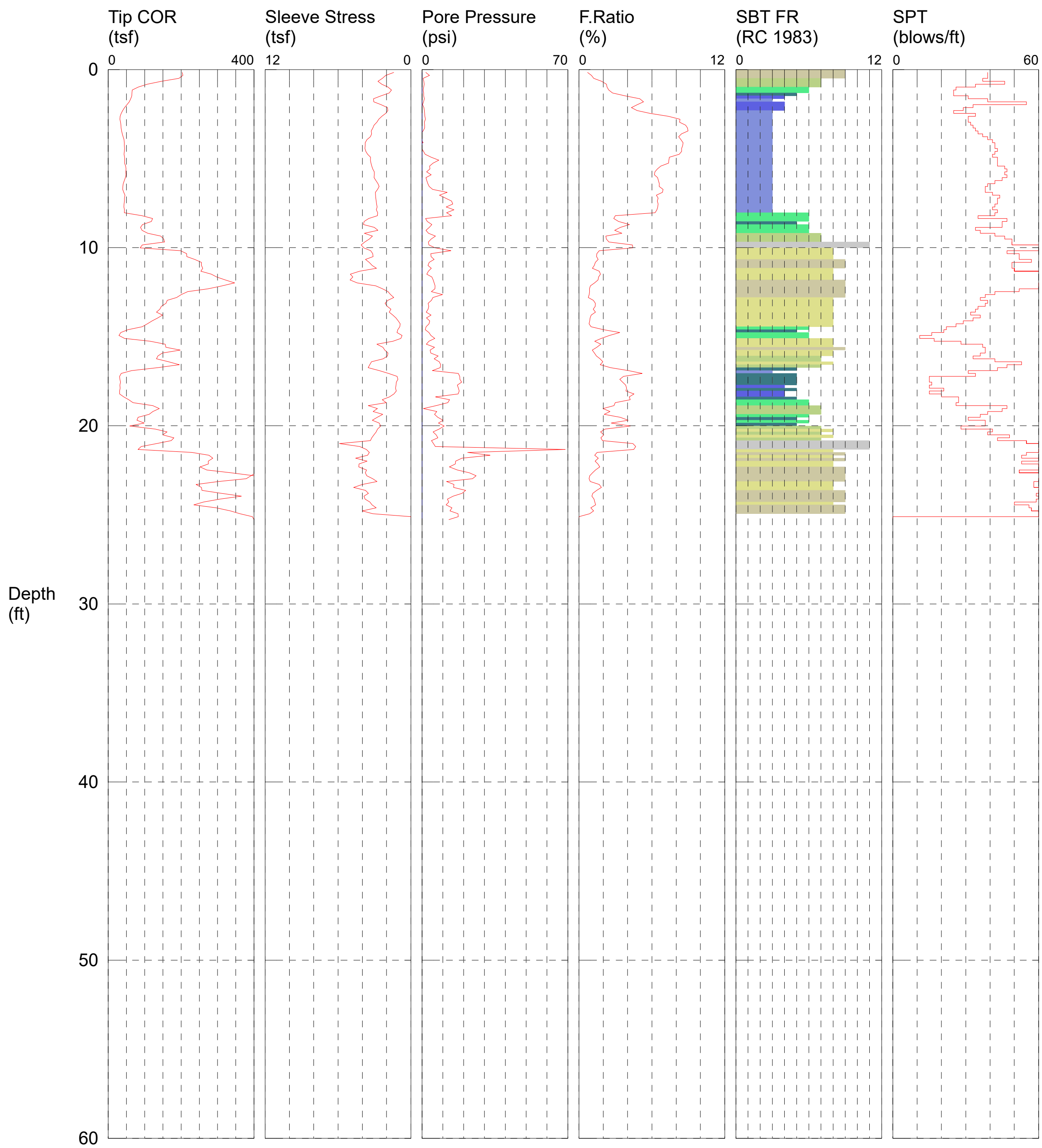
SOIL CLASSIFICATION CHART AND KEY TO TEST DATA

Appendix L

Cone Penetration Testing Results

SOUNDING

SOUNDING	JOB NUMBER: 271590	COMMENT:
CUSTOMER: Taber Drilling	HOLE NUMBER: CPT-1	GPS (LAT,LON,ALT): 0.00,0.00,0.0
OPERATOR: Tim	TEST DATE: 10/15/2019 7:38:35 AM	LOCATION: AWSSFO069
CONE ID: DDG1361	COMMENT: Auto Enhance On	LOCATION: AWSSFO069
LOCATION: AWSSFO069	COMMENT: Filter On	LOCATION: AWSSFO069



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

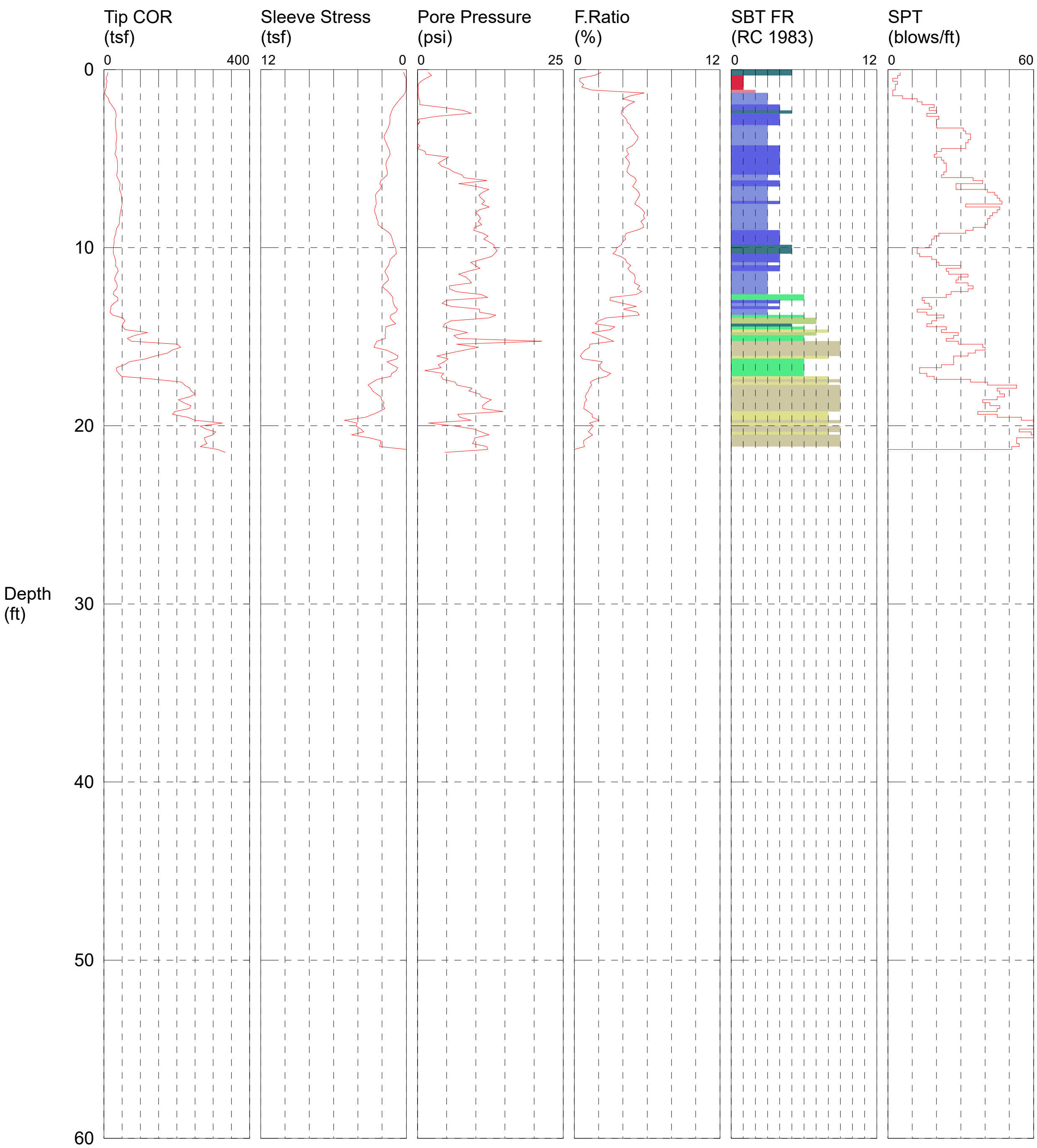
*SBT/SPT CORRELATION: UBC-1983

SOUNDING

SOUNDING
CUSTOMER: Taber Drilling
OPERATOR: Tim
CONE ID: DDG1361
LOCATION: AWSSFO069

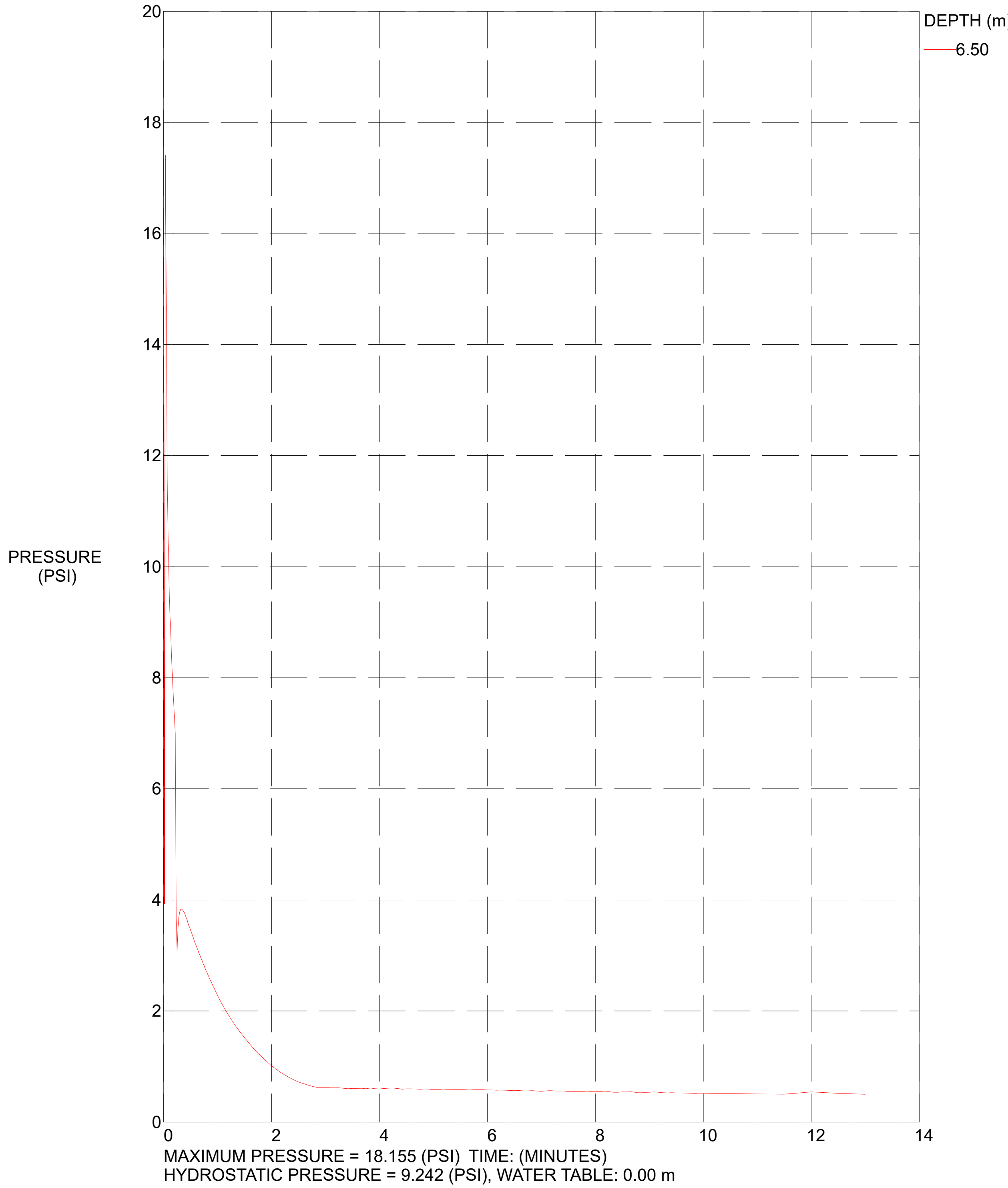
JOB NUMBER: 271590
HOLE NUMBER: CPT-2
TEST DATE: 10/15/2019 9:01:04 AM
COMMENT: Auto Enhance On
COMMENT: Filter On

COMMENT:
GPS (LAT,LON,ALT): 0.00,0.00,0.0
LOCATION: AWSSFO069
LOCATION: AWSSFO069
LOCATION: AWSSFO069



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

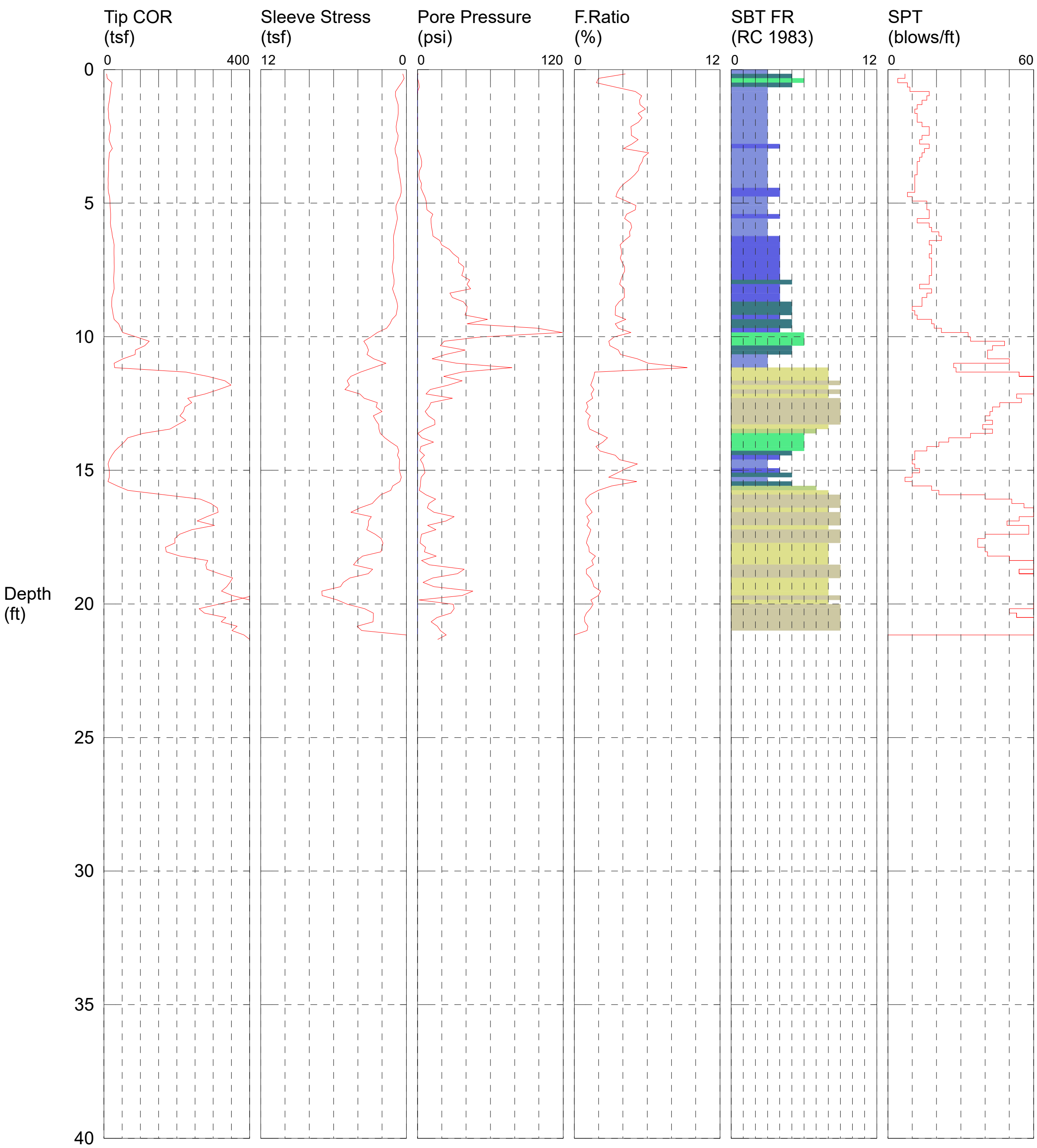

DEPTH (m)
6.50
PRESSURE (PSI)
20
18
16
14
12
10
8
6
4
2
0
0
2
4
6
8
10
12
14
MAXIMUM PRESSURE = 18.155 (PSI) TIME: (MINUTES)
HYDROSTATIC PRESSURE = 9.242 (PSI), WATER TABLE: 0.00 m

SOUNDING

SOUNDING
CUSTOMER: Taber Drilling
OPERATOR: Tim
CONE ID: DDG1361
LOCATION: AWSSFO069

JOB NUMBER: 271590
HOLE NUMBER: CPT-3
TEST DATE: 10/15/2019 9:37:00 AM
COMMENT: Auto Enhance On
COMMENT: Filter On

COMMENT:
GPS (LAT,LON,ALT): 0.00,0.00,0.0
LOCATION: AWSSFO069
LOCATION: AWSSFO069
LOCATION: AWSSFO069



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

*SBT/SPT CORRELATION: UBC-1983

SOUNDING

SOUNDING
CUSTOMER: Taber Drilling
OPERATOR: Tim
CONE ID: DDG1361
LOCATION: AWSSFO069

JOB NUMBER: 271590
HOLE NUMBER: CPT-4
TEST DATE: 10/15/2019 10:18:24 AM
COMMENT: Auto Enhance On
COMMENT: Filter On

COMMENT:
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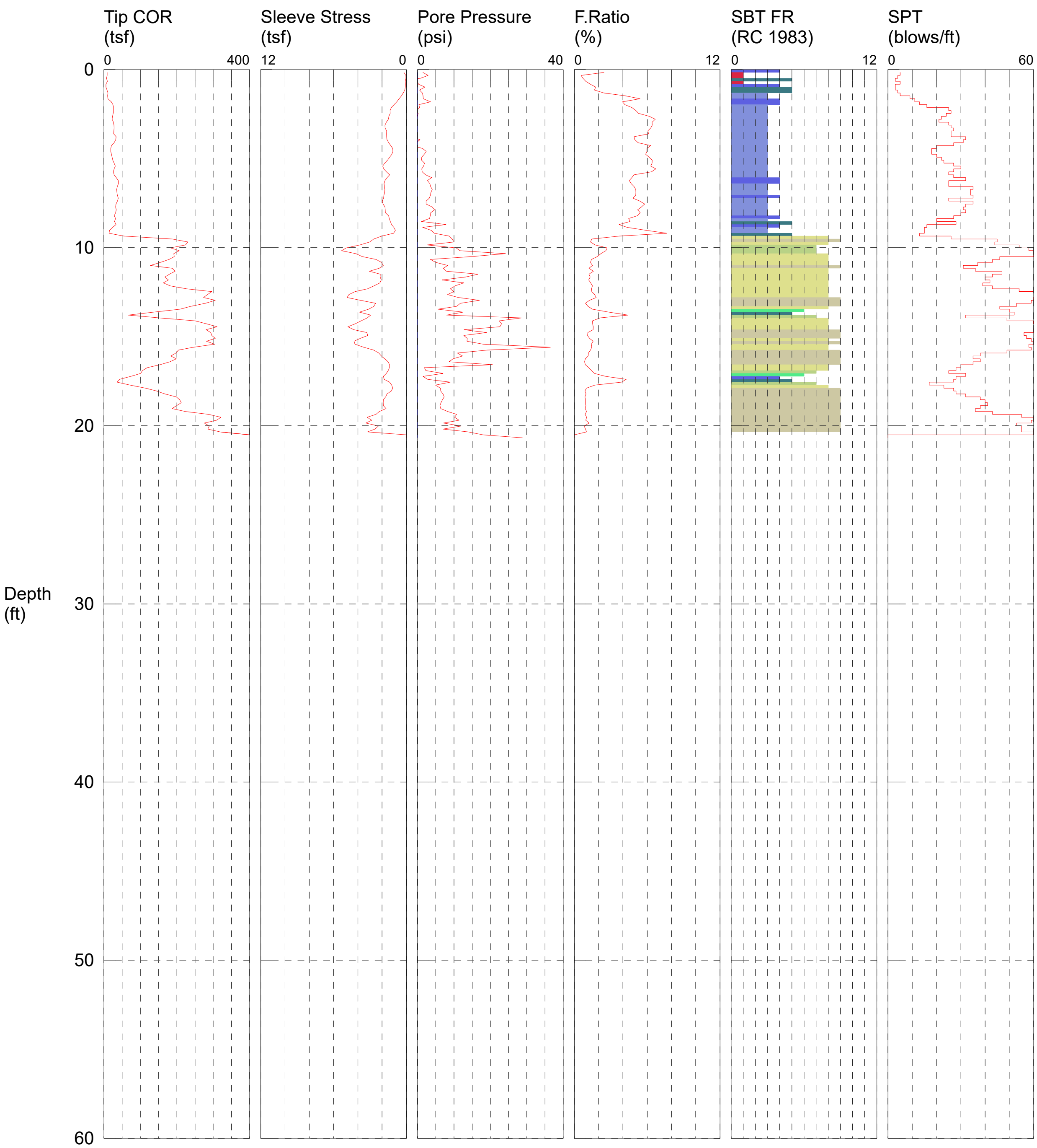
LOCATION: AWSSFO069
LOCATION: AWSSFO069
LOCATION: AWSSFO069

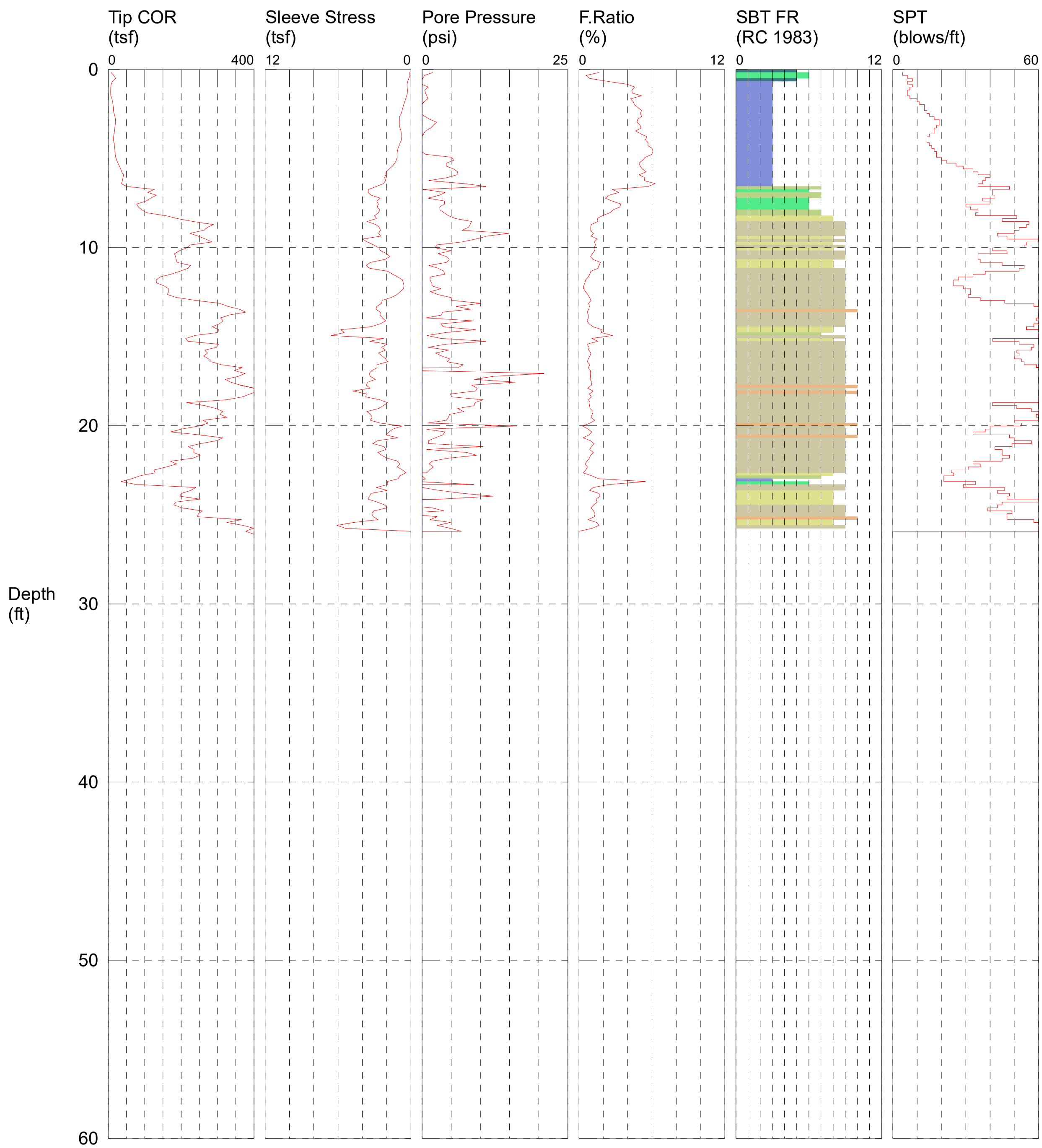


1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

SOUNDING

SOUNDING	JOB NUMBER: 271590	COMMENT:
CUSTOMER: Taber Drilling	HOLE NUMBER: CPT-5	GPS (LAT,LON,ALT): 0.00,0.00,0.0
OPERATOR: Tim	TEST DATE: 10/15/2019 10:54:03 AM	LOCATION: AWSSFO069
CONE ID: DDG1361	COMMENT: Auto Enhance On	LOCATION: AWSSFO069
LOCATION: AWSSFO069	COMMENT: Filter On	LOCATION: AWSSFO069

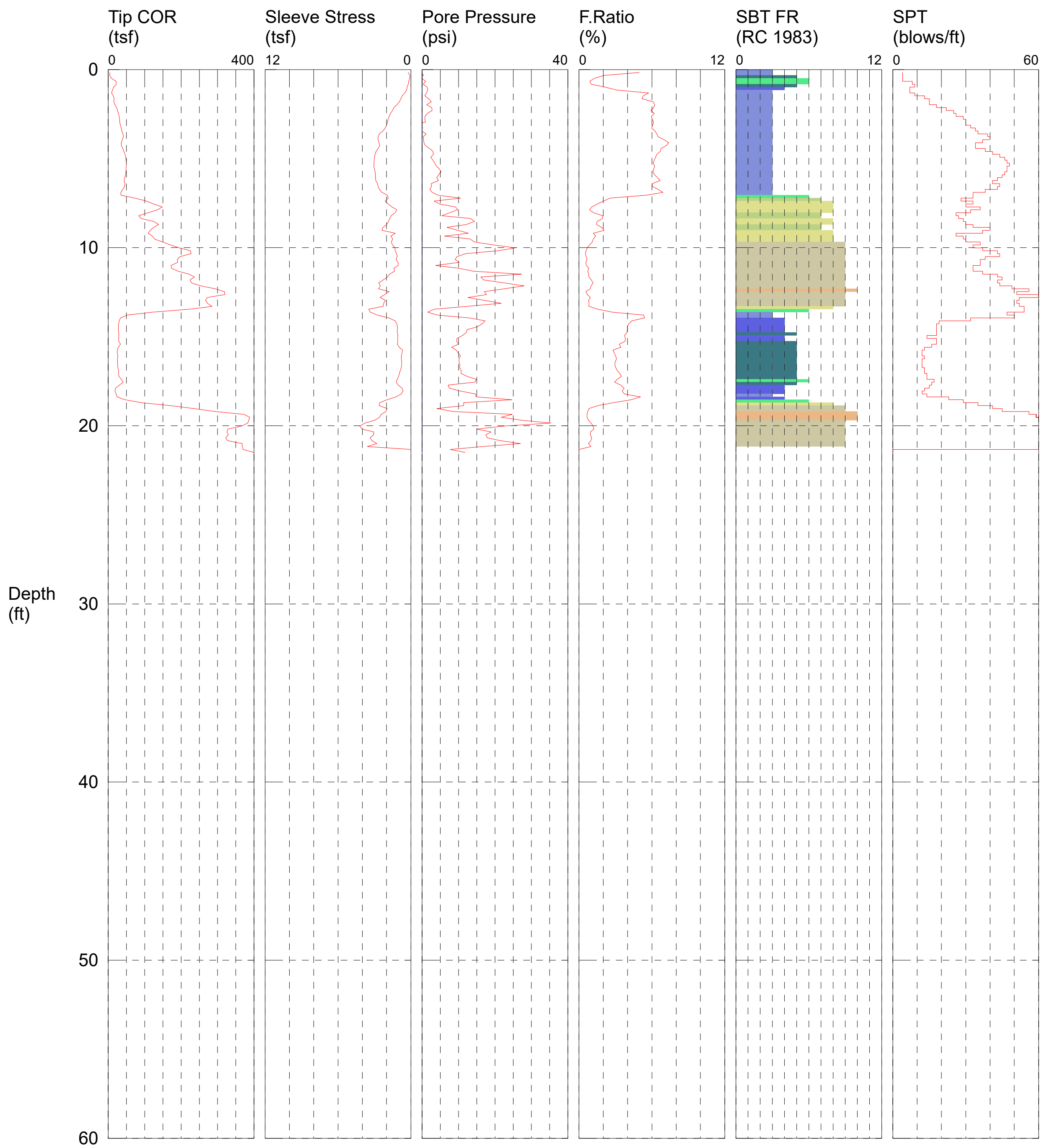


1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

SOUNDING

SOUNDING	JOB NUMBER: 271590	COMMENT:
CUSTOMER: Taber Drilling	HOLE NUMBER: CPT-6	GPS (LAT,LON,ALT): 0.00,0.00,0.0
OPERATOR: Tim	TEST DATE: 10/15/2019 11:38:09 AM	LOCATION: AWSSFO069
CONE ID: DDG1361	COMMENT: Auto Enhance On	LOCATION: AWSSFO069
LOCATION: AWSSFO069	COMMENT: Filter On	LOCATION: AWSSFO069



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

SOUNDING

SOUNDING
CUSTOMER: Taber Drilling
OPERATOR: Tim
CONE ID: DDG1361
LOCATION: AWSSFO069

JOB NUMBER: 271590
HOLE NUMBER: CPT-7
TEST DATE: 10/15/2019 12:20:54 PM
COMMENT: Auto Enhance On
COMMENT: Filter On

COMMENT:
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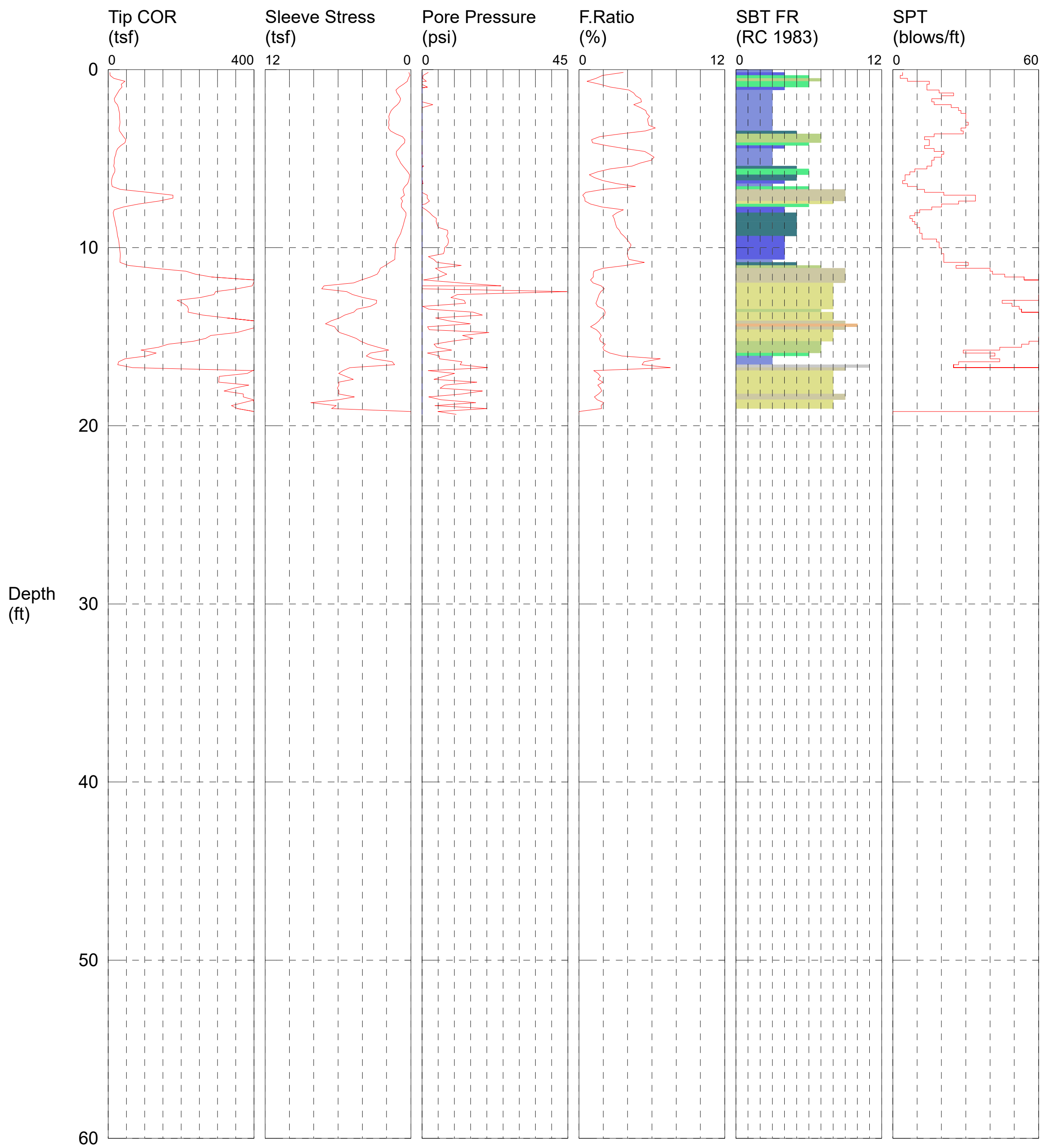
LOCATION: AWSSFO069
LOCATION: AWSSFO069
LOCATION: AWSSFO069



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 (*)

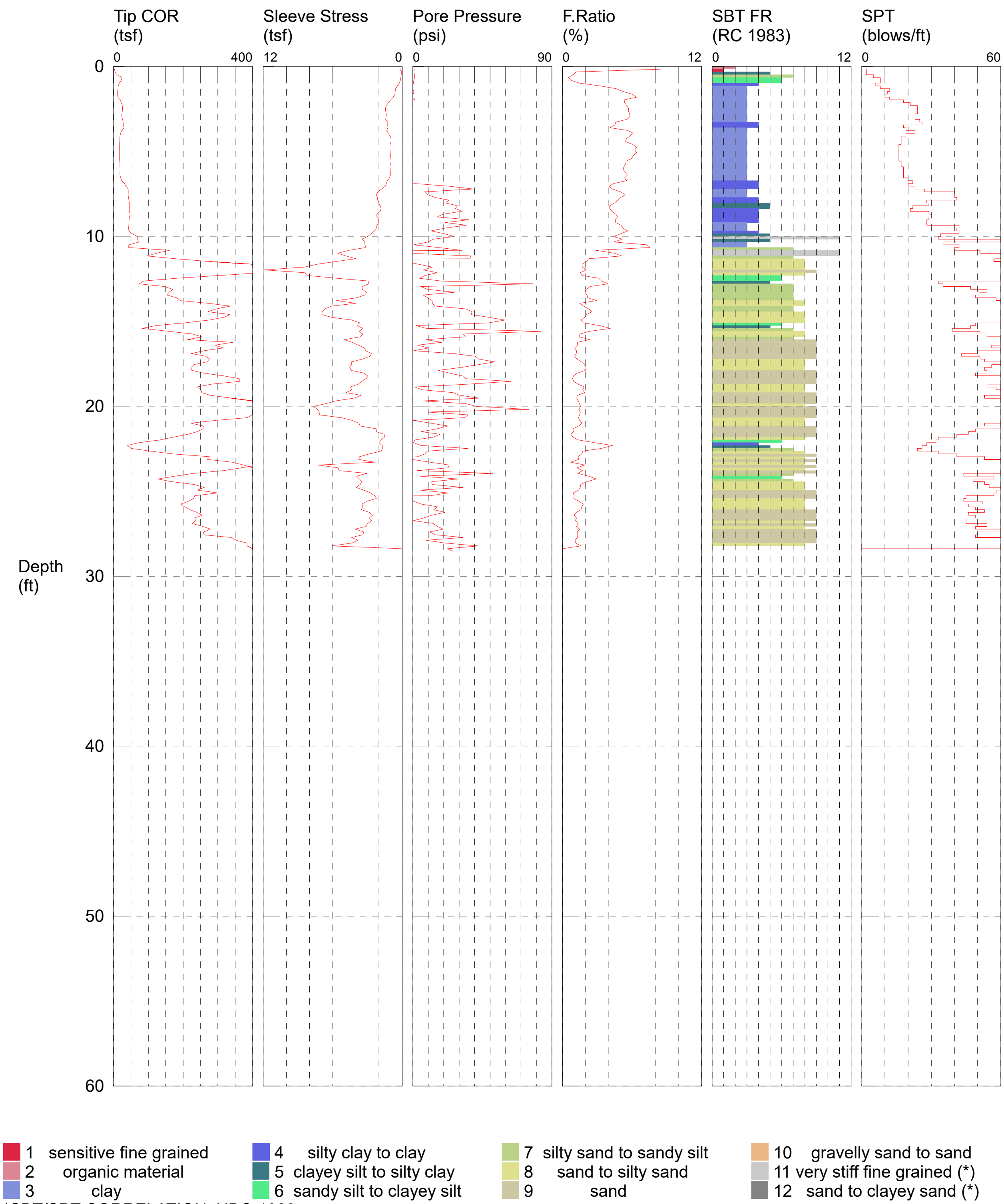
*SBT/SPT CORRELATION: UBC-1983

SOUNDING

SOUNDING
CUSTOMER: Taber Drilling
OPERATOR: Tim
CONE ID: DDG1361
LOCATION: AWSSFO069

JOB NUMBER: 271590
HOLE NUMBER: CPT-9
TEST DATE: 10/15/2019 12:46:28 PM
COMMENT: Auto Enhance On
COMMENT: Filter On

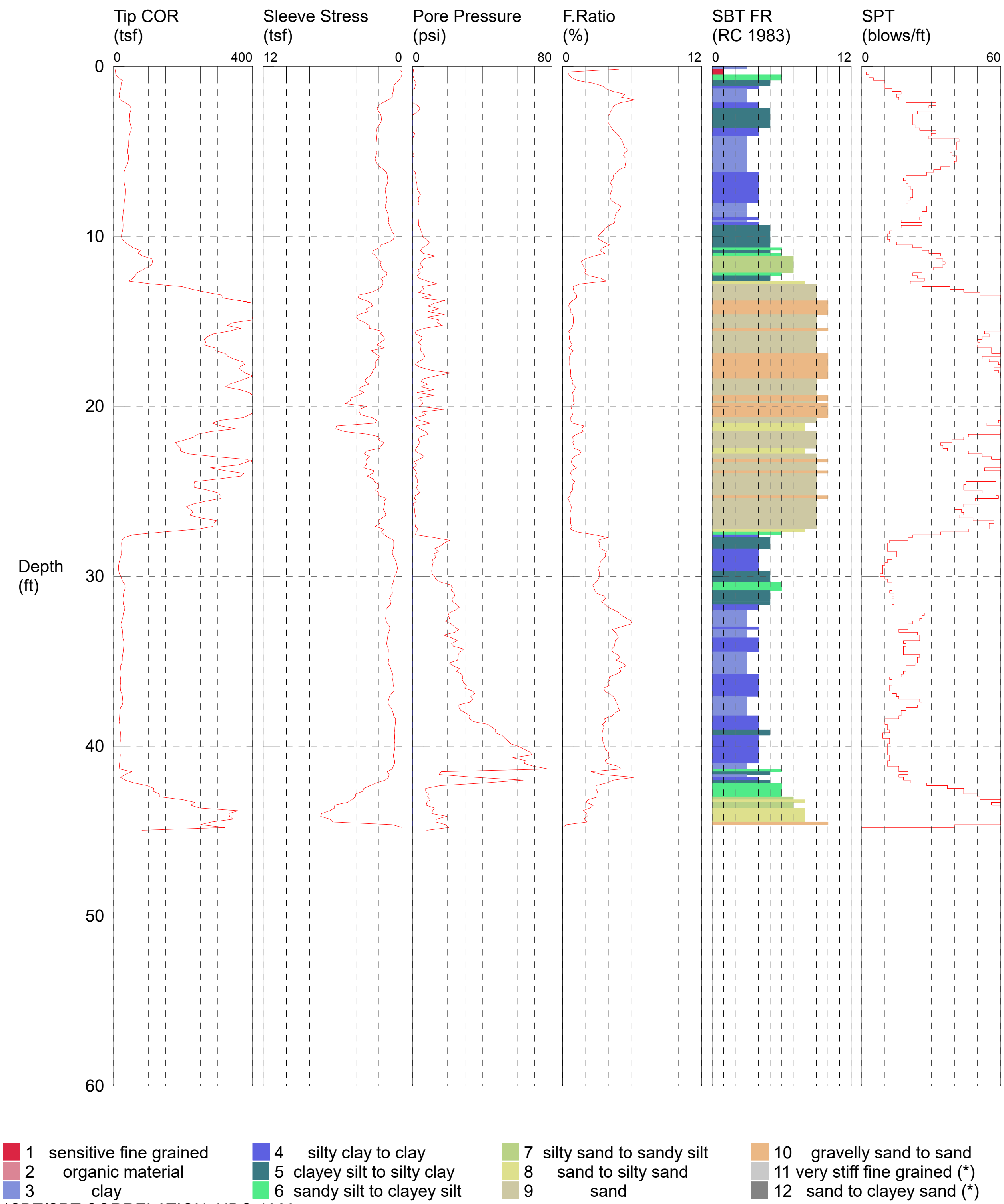
COMMENT:
GPS (LAT,LON,ALT): 0.00,0.00,0.0
LOCATION: AWSSFO069
LOCATION: AWSSFO069
LOCATION: AWSSFO069



*SBT/SPT CORRELATION: UBC-1983

SOUNDING

SOUNDING	JOB NUMBER: 271590	COMMENT:
CUSTOMER: Taber Drilling	HOLE NUMBER: CPT-10	GPS (LAT,LON,ALT): 0.00,0.00,0.0
OPERATOR: Tim	TEST DATE: 10/15/2019 1:18:52 PM	LOCATION: AWSSFO069
CONE ID: DDG1361	COMMENT: Auto Enhance On	LOCATION: AWSSFO069
LOCATION: AWSSFO069	COMMENT: Filter On	LOCATION: AWSSFO069



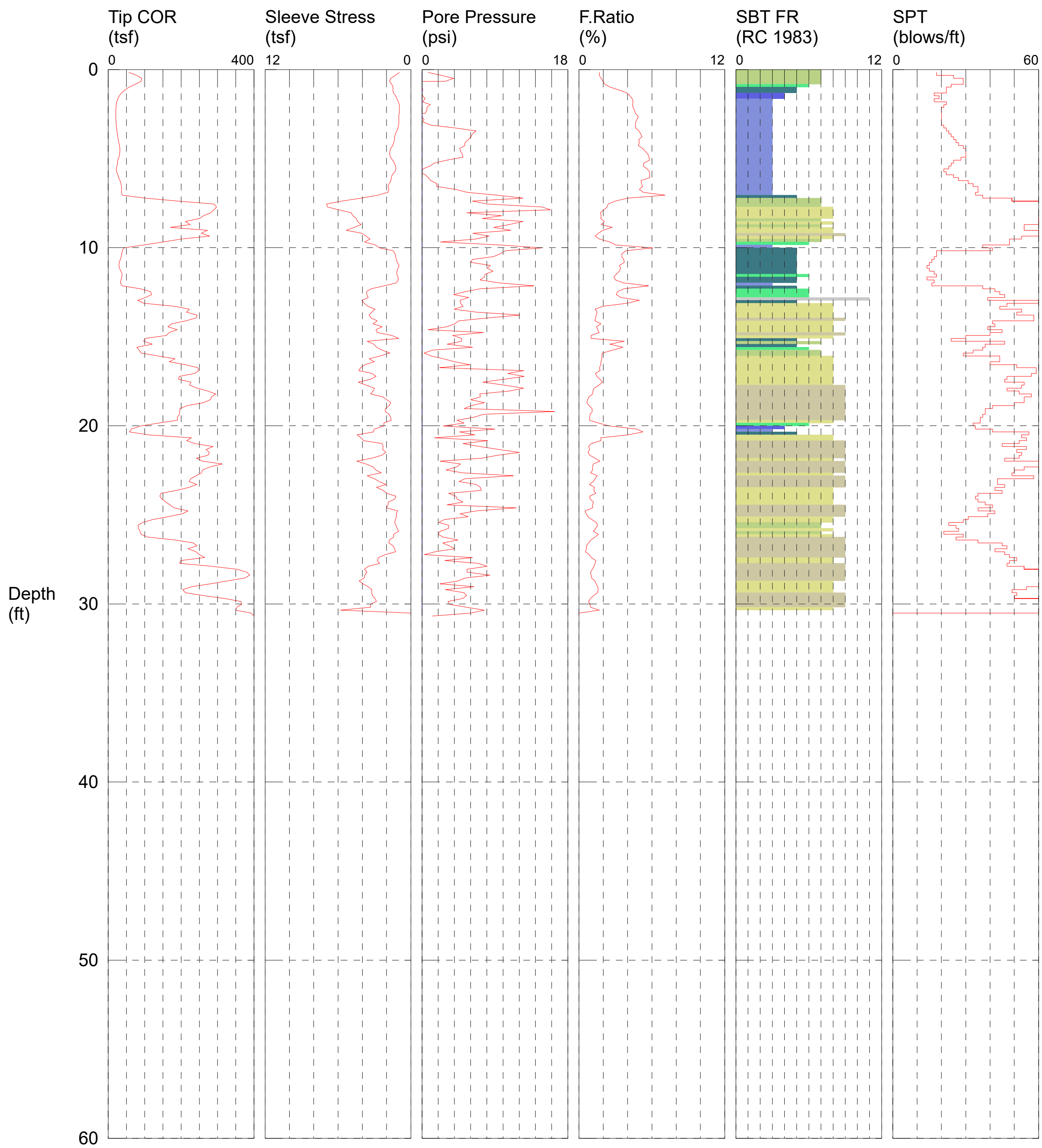
*SBT/SPT CORRELATION: UBC-1983

SOUNDING

SOUNDING
CUSTOMER: Taber Drilling
OPERATOR: Tim
CONE ID: DDG1361
LOCATION: AWSSFO069

JOB NUMBER: 271590
HOLE NUMBER: CPT-11
TEST DATE: 10/15/2019 1:56:57 PM
COMMENT: Auto Enhance On
COMMENT: Filter On

COMMENT:
GPS (LAT,LON,ALT): 0.00,0.00,0.0
LOCATION: AWSSFO069
LOCATION: AWSSFO069
LOCATION: AWSSFO069



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

Appendix M

In-Situ Resistivity Test

October 22, 2019

ARUP
560 Mission Street, Suite 700
San Francisco, CA 94105

Attention: **Ms. Julia Villanueva**
Graduate Engineer/Geotachnics

Subject: **Soil Corrosivity Evaluation & Recommendations for Corrosion Control Underground Water Piping Systems and Grounding Calculations**
Gilroy Resistivities
Gilroy, CA

Dear Ms. Villanueva

Pursuant to your request, **JDH Corrosion Consultants, Inc**. has conducted a site corrosivity evaluation for the above referenced project site and we have provided herein recommendations for long-term corrosion control for the proposed materials of construction for the underground utilities. We have also provided herein the data required for grounding calculations.

Purpose

The purpose for this evaluation is to determine the corrosion potential, resulting from the soils at the subject sites and to provide recommendations for long-term corrosion control for the buried metallic utilities.

Soil Testing and Analysis

In-Situ Soil Resistivity Measurements

The in-situ resistivity of the soil was measured at five (5) locations at the project sites by **JDH Corrosion Consultants, Inc.** field personnel. Resistance measurements were conducted with probe spacing of 2.5, 5, 7.5, 10, and 15-feet at each location with a north/south and east/west orientation. For analysis purposes we have calculated the resistivity of soil layers 0-2.5, 2.5-5, 5-7.5, 7.5-10 and 10-15' using the Barnes Method as follows:

$$\rho_{b\text{-}a} = KR_{(b\text{-}a)}$$

Where;

$\rho_{b\text{-}a}$	=	soil resistivity of layer depth b-a (ohm-cm)
a	=	soil depth to top layer (ft)
b	=	soil depth to bottom layer (ft)
R_a	=	soil resistance read at depth a (ohms)
R_b	=	soil resistance read at depth b (ohms)
$R_{b\text{-}a}$	=	resistance of soil layer from a to b (ft)
K	=	layer constant = $60.96\pi(b\text{-}a)$ (cm)

and

$$\frac{1}{R_{b\text{-}a}} = \frac{1}{R_a} - \frac{1}{R_b}$$

The visual diagrams below describe the Wenner 4-pin testing configuration.

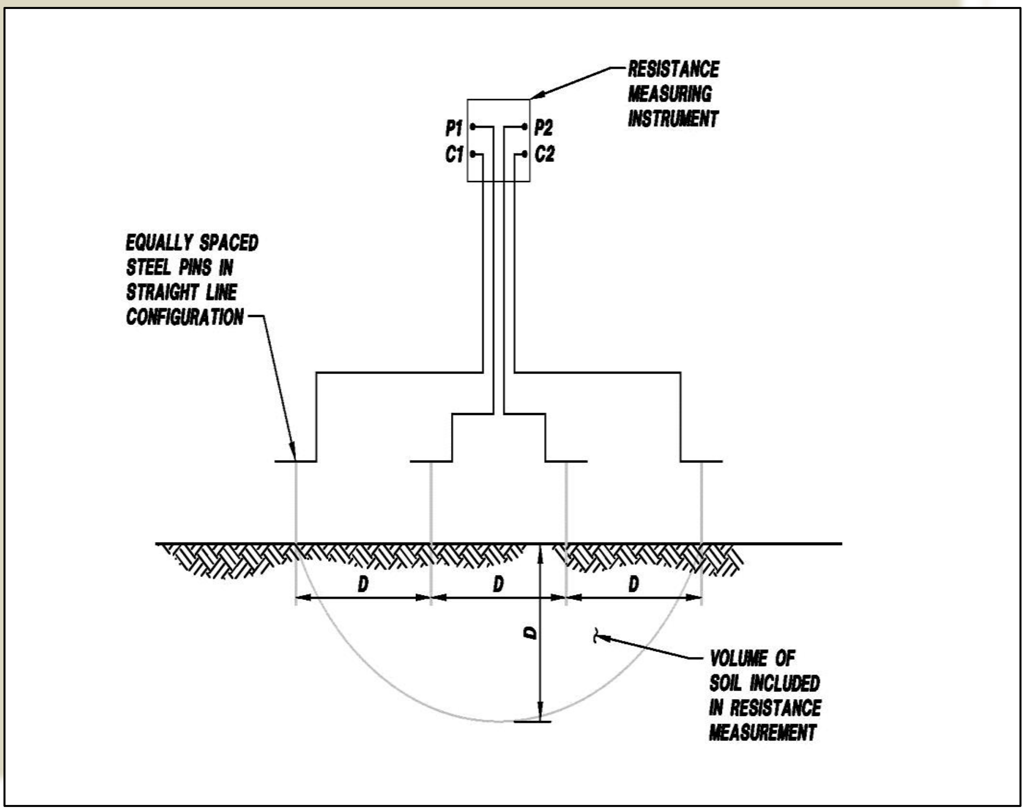


Fig 1: Wenner 4-Pin Resistivity Schematic No.1

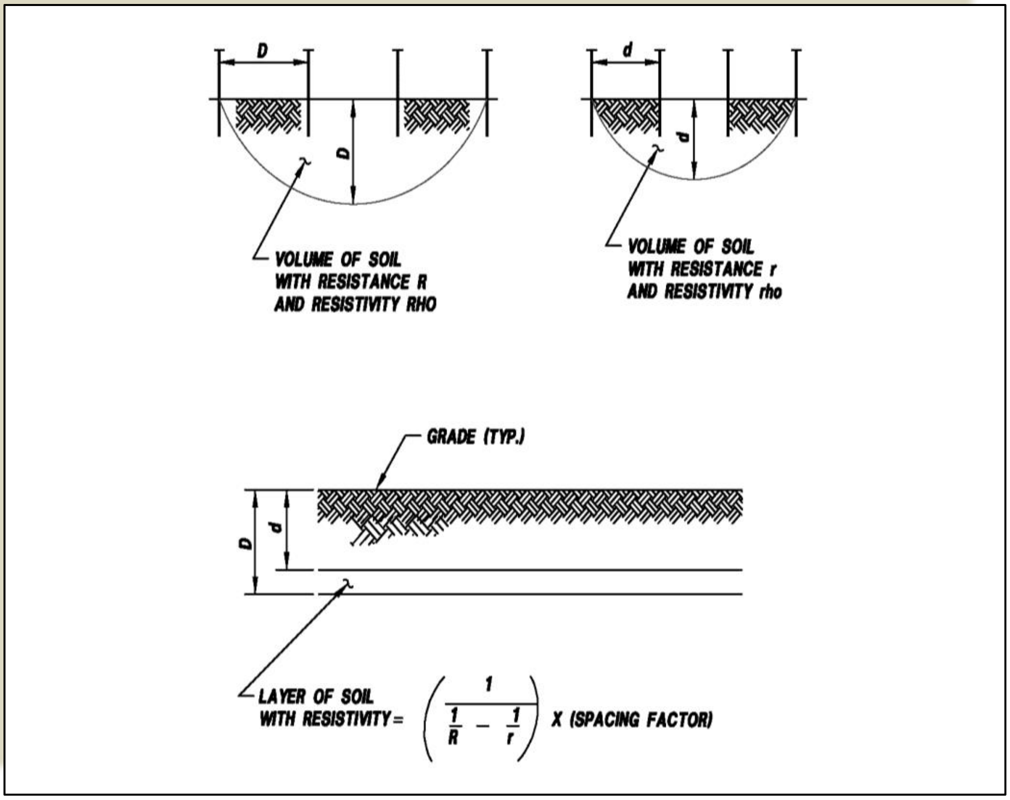


Fig 2: Illustration of Barnes Layer Calculations

In-Situ Soil Resistivity Analysis

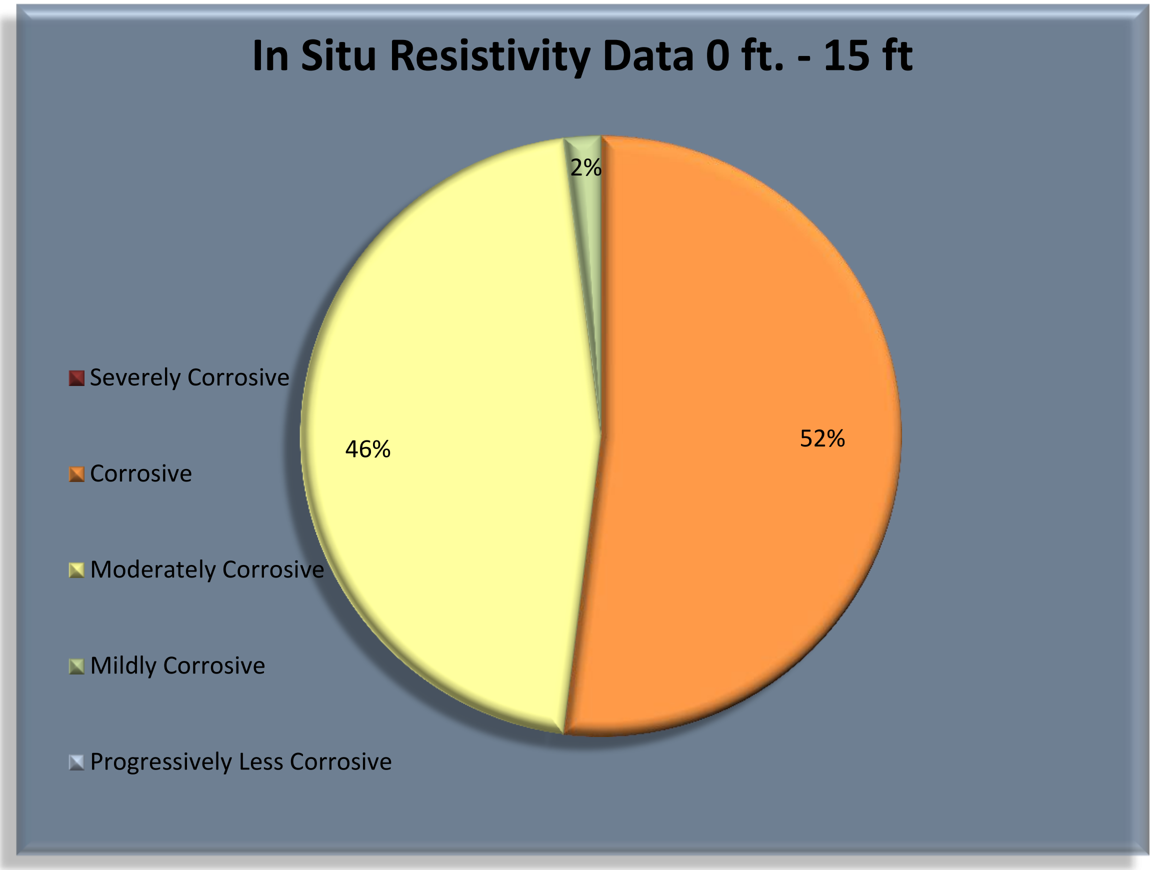
Corrosion of a metal is an electro-chemical process and is accompanied by the flow of electric current. Resistivity is a measure of the ability of a soil to conduct an electric current and is, therefore, an important parameter in consideration of corrosion data. Soil resistivity is primarily dependent upon the chemical content and moisture content of the soil mass.

The greater the amount of chemical constituents present in the soil, the lower the resistivity will be. As moisture content increases, resistivity decreases until maximum solubility of dissolved chemicals is attained. Beyond this point, an increase in moisture content results in dilution of the chemical concentration and resistivity increases. The corrosion rate of steel in soil normally increases as resistivity decreases. Therefore, in any particular group of soils, maximum corrosion will generally occur in the lowest resistivity areas. The following classification of soil corrosivity, developed by William J. Ellis[1], is used for the analysis of the soil data for the project site.

Resistivity (Ohm-cm)	Corrosivity Classification
0 – 500	Very Corrosive
501 – 2,000	Corrosive
2,001 – 8,000	Moderately Corrosive
8,001 – 32,000	Mildly Corrosive
> 32,000	Progressively Less Corrosive

The above classifications are appropriate for the project site and the results are presented in the graph below. In general, the soils are classified as “corrosive to mildly corrosive” with respect to corrosion of buried steel structures throughout the top 0 to 15 feet of the site.

The chart of the in-situ soil resistivity data for the soil layers 0 to 15 feet indicate that 52% of the soils are classified as “corrosive”, 46% of the soils are classified as “moderately corrosive” and 2% of the soils are classified as “mildly corrosive”.



Discussion

Underground Metallic Pipelines

The soils at the project sites are generally considered to be “corrosive to mildly corrosive” to ductile/cast iron, steel and dielectric coated steel. Therefore, special requirements for corrosion control are required for buried metallic utilities at these sites depending upon the critical nature of the piping. Pressure piping systems such as domestic and fire water should be provided with appropriate coating systems and cathodic protection, where warranted. In addition, all underground pipelines should be electrically isolated from above grade structures, reinforced concrete structures and copper lines in order to avoid potential galvanic corrosion problems.

Recommendations

Ductile Iron Pipe (Pressure Piping such as Domestic Water and Fire)

1. Direct buried ductile iron pipe should be encased in 8-mil polyethylene as specified in AWWA specification C-105. Epoxy coatings are also an acceptable alternative type of coating system for the pipe and/or fittings such as valves.

2. All rubber gasket joints, fusion-bonded epoxy coated flanges and flexible couplings on ductile iron pipelines should be bonded with insulated copper cable to insure electrical continuity of the pipeline and fittings.

3. Insulating flanges and/or couplings should be installed to electrically isolate the buried portion of pipeline from other metallic pipelines, reinforced concrete structures and above grade buildings or structures.

4. Test stations shall be installed on all ductile iron pipelines at a spacing of 800 to 1,000 feet. Bonding and test stations shall comply with NACE Standards.

5. A sacrificial type of cathodic protection utilizing ***magnesium*** anodes should be installed to protect the entire length of buried metallic pipeline. Cathodic protection should be designed in accordance with NACE Standard SP0169-13 and applicable local standards and included with the contract documents to permit installation along with the pipeline.

6. As an alternate, non-metallic piping may be used in lieu of ductile iron piping as allowed by State and local codes. Non-metallic piping does not require the implementation of any special type of corrosion prevention measures. However, all metallic valves, fittings and appurtenances on non-metallic piping will require protection as specified below.

Ductile Iron Fittings & Metallic Valves (On Plastic Pressure Piping)

1. All direct buried ductile iron fittings installed on non-metallic piping shall be provided with a bituminous coating from the factory and encased in an 8-mil polyethylene bag in the field in accordance with AWWA Specification C-105. All bolts, restraining rods, etc. shall be coated with bitumastic prior to encasement in the polyethylene bag.

2. All metallic valves shall be coated from the factory (i.e. using powdered epoxy or equivalent type of coating system) and all bolts shall be coated with bitumastic in the field and the entire valve shall be encased in an 8-mil polyethylene bag in accordance with AWWA Specification C-105.

3. A sacrificial type of cathodic protection utilizing ***magnesium*** anodes should be installed to protect the valves and fittings. Cathodic protection should be designed in accordance with NACE Standard SP0169-13 and applicable local standards and included with the contract documents to permit installation along with the pipeline.

Cast Iron (Gravity Sewer and Storm Drain Lines)

1. No special corrosion considerations are required for gravity sewer and storm drain lines, unless they are under the building foundation, then the piping should be encased in 8-mil polyethylene.

Steel Pipelines (Natural Gas Pipelines & Risers)

1. A fusion-bonded epoxy coating system or a suitable tape coating should be applied to all buried steel pipelines in accordance with ANSI/AWWA C214-95, "AWWA Standard for Tape Coating Systems for the Exterior of Steel Water Pipelines." Also, a tape coating per AWWA Standard C209-95 is recommended for special sections, connections and fittings.

2. Insulating flanges and/or couplings should be installed to electrically isolate the buried portions of steel pipelines from other metallic pipelines, reinforced concrete structures and above grade structures.

3. All rubber gasket joints, fusion epoxy coated flanges and flexible couplings should be bonded with insulated copper cable to insure electrical continuity of the pipeline and fittings.

4. A sacrificial type of cathodic protection using ***magnesium*** anodes should be installed to protect the buried portions of steel pipelines used for the natural gas piping systems. Cathodic protection should be designed in accordance with NACE Standard SP0169-13 and applicable local standards and included with the contract documents to permit installation along with the subject pipeline.

5. As an alternate, non-metallic piping may be used in lieu of steel piping as allowed by State and local codes. Non-metallic piping does not require the implementation of any special type of corrosion prevention measures.

Copper Water Pipelines (Service Lines)

1. All copper water laterals shall be provided with a 6-mil polyethylene sleeve to effectively isolate the copper piping from the earth.

2. All copper water laterals shall be electrically isolated from metallic water mains via the use of insulating type corporation stops installed at the water main.

Stainless Steel Risers

1. Direct buried stainless steel risers should be primed and wrapped with Polyguard 'RD-6' coating system.

2. Insulating flanges and/or couplings should be installed to electrically isolate the buried portion of the stainless steel riser from other metallic pipelines, reinforced concrete structures and above grade buildings or structures.

3. A sacrificial type of cathodic protection utilizing ***magnesium*** anodes should be installed to protect the buried portions of the stainless steel riser used for the water piping systems. Cathodic protection should be designed in accordance with NACE Standard SP0169-13 and applicable local standards and included with the contract documents to permit installation along with the subject pipeline.

LIMITATIONS

The conclusions and recommendations contained in this report reflect the opinion of the author of this report and are based on the information and assumptions referenced herein. All services provided herein were performed by persons who are experienced and skilled in providing these types of services and in accordance with the standards of workmanship in this profession. No other warrantees or guarantees either expressed or implied are provided.

We thank you for the opportunity to be of assistance on this important project. If you have any questions concerning this report or the recommendations provided herein, please feel free to contact us at (925) 927-6630.

Respectfully submitted,

Brendon Hurley
JDH CORROSION CONSULTANTS, INC.
Field Technician

Mohammed Ali

Mohammed Ali., P.E.
JDH Corrosion Consultants, Inc.
Senior Corrosion Engineer

REGISTERED PROFESSIONAL ENGINEER
MOHAMMED ALI
No. CR 1035
Exp. June 30, 2021
CORROSION
STATE OF CALIFORNIA

CC: File 19252

jdh corrosion consultants, inc.

REFERENCES

1. *Ellis, William J., Corrosion of Concrete Pipelines, Western States Corrosion Seminar, 1978*

2. *AWWA Manual of Water Supply Practices - M27, First Edition, External Corrosion - Introduction to Chemistry and Control (Denver, CO: 1987)*

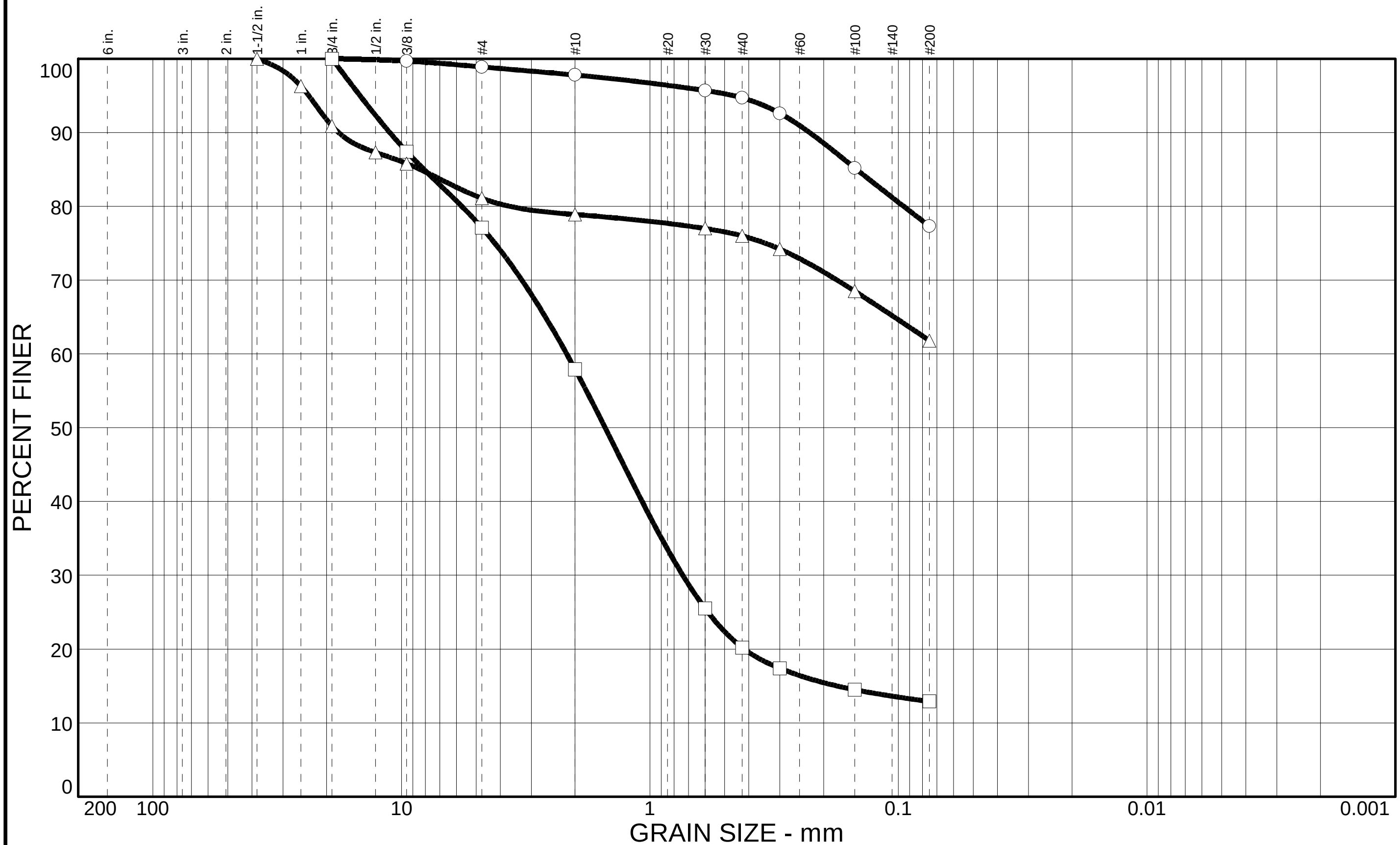
3. *National Association of Corrosion Engineers, Standard Recommended Practice, SP 01-69-13, Control of External Corrosion on Underground or Submerged Pipeline*

Project:		***ARUP*** ***19252: Gilroy Resistivities***						Severely Corrosive					Mildly Corrosive			
Location:		***Gilroy, CA***						Corrosive					Progressively Less Corrosive			
Date:		***10/15/2019***						Moderately Corrosive								
Subject:		***In-Situ Soil Resistivity Data***														
*Test	Location	Resistance Data From AEMC Meter					Soil Resistivities (ohm-cm)					Barnes Layer Analysis (ohm-cm)				
#	Description	2.5	5	7.5	10	15	2.5	5	7.5	10	15	0-2.5'	2.5-5'	5-7.5'	7.5-10'	10-15'
1	R1 N/S	3.11	1.65	1.16	1.03	0.73	1489	1580	1666	1972	2097	1489	1683	1870	4400	2400
2	R1 E/W	3.38	1.75	1.39	1.21	0.98	1618	1676	1996	2317	2815	1618	1737	3235	4473	4937
3	R2 N/S	3.84	1.91	1.26	1.01	0.83	1838	1829	1810	1934	2384	1838	1819	1773	2437	4459
4	R2 E/W	3.14	1.83	1.52	1.03	0.57	1503	1752	2183	1972	1637	1503	2100	4296	1530	1222
5	R3 N/S	4.06	2.03	1.20	0.96	0.80	1944	1944	1724	1838	2298	1944	1944	1405	2298	4596
6	R3 E/W	4.19	2.89	2.26	1.53	1.19	2006	2767	3246	2930	3418	2006	4459	4963	2268	5127
7	R4 N/S	2.30	1.39	1.20	1.06	0.86	1101	1331	1724	2030	2470	1101	1682	4203	4350	4364
8	R4 E/W	2.91	1.68	1.17	0.96	0.85	1393	1609	1680	1838	2442	1393	1903	1845	2561	7103
9	R5 N/S	3.08	1.18	0.88	0.78	0.69	1475	1130	1264	1494	1982	1475	916	1657	3286	5726
10	R5 E/W	2.49	1.42	0.98	0.75	0.70	1192	1360	1408	1436	2011	1192	1582	1514	1530	10054

Appendix N

Laboratory Testing Results

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		1.1	21.6	77.3					
□		22.9	64.2	12.9					
△		18.9	19.3	61.8		CL		18	44

SIEVE inches size	PERCENT FINER ○	□	△
1.5"			100.0
1"			96.3
3/4"	100.0	100.0	90.9
1/2"			87.3
3/8"	99.7	87.4	85.8
GRAIN SIZE			
D_{60}		2.16	
D_{30}		0.738	
D_{10}			
COEFFICIENTS			
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	△
#4	98.9	77.1	81.1
#10	97.8	57.9	78.9
#30	95.7	25.5	77.0
#40	94.7	20.2	76.0
#50	92.6	17.4	74.2
#100	85.2	14.5	68.5
#200	77.3	12.9	61.8

SOIL DESCRIPTION

○ Dark Reddish Brown CLAY w/ Sand

□ Reddish Brown Clayey SAND w/ Gravel

△ Dark Olive Brown Sandy Lean CLAY w/ Gravel

REMARKS:

○

□

△

○ Source: B-3 Sample No.: 3 Elev./Depth: 7.5'

□ Source: B-7 Sample No.: 4 Elev./Depth: 10'

△ Source: Northeast Corner Fill #1

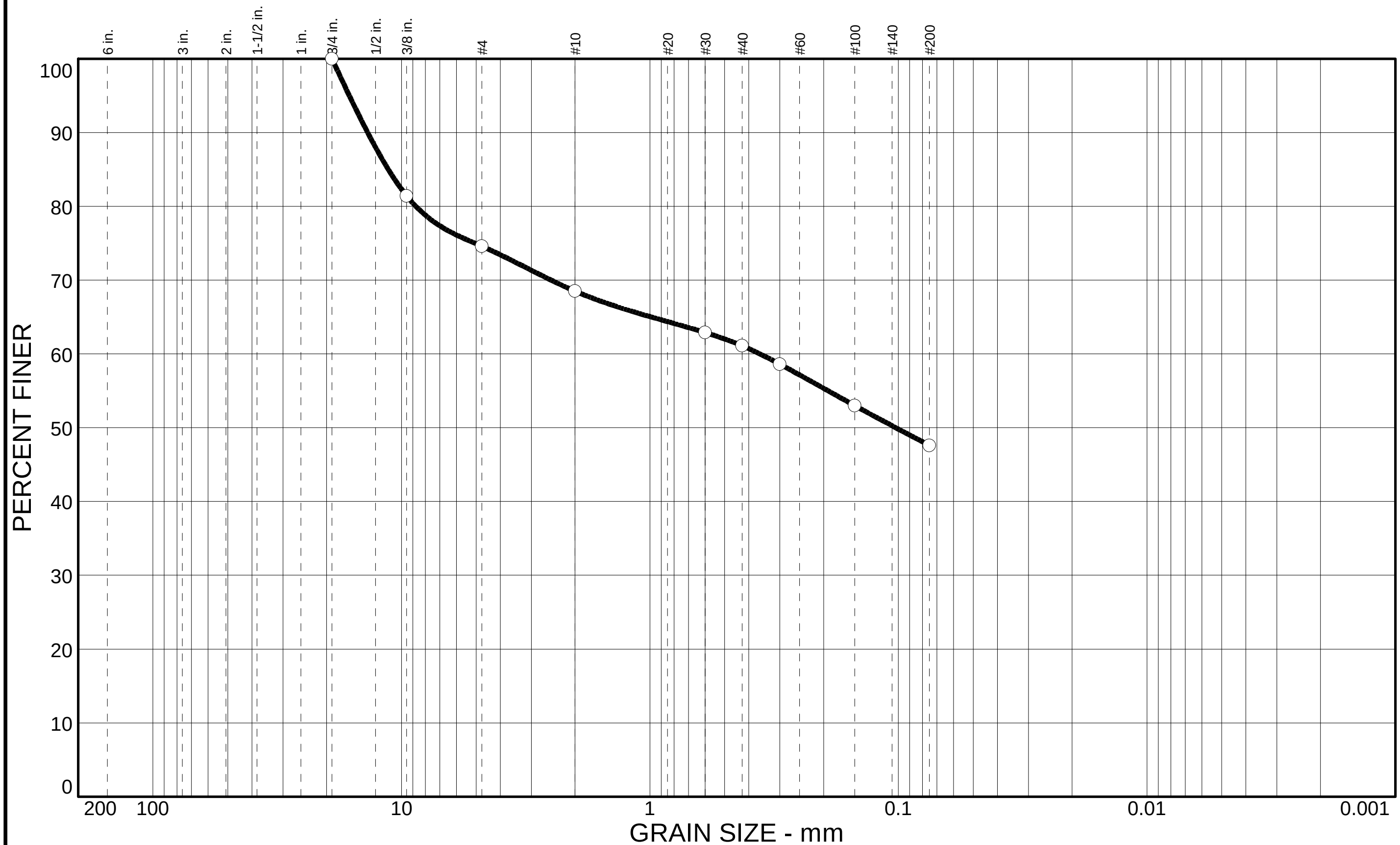
COOPER TESTING LABORATORY

Client: ARUP

Project: 271590

Project No.: 743-014 Figure

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		25.4	27.0	47.6		SC		19	37

SIEVE inches size	PERCENT FINER ○		
3/4"	100.0		
3/8"	81.4		
	GRAIN SIZE		
D_{60}	0.361		
D_{30}			
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○		
#4	74.6		
#10	68.5		
#30	62.9		
#40	61.1		
#50	58.6		
#100	53.0		
#200	47.6		

SOIL DESCRIPTION

○ Reddish Brown Lean Clayey SAND w/ Gravel

REMARKS:

○

○ Source: Northeast Corner Fill #3

COOPER TESTING LABORATORY

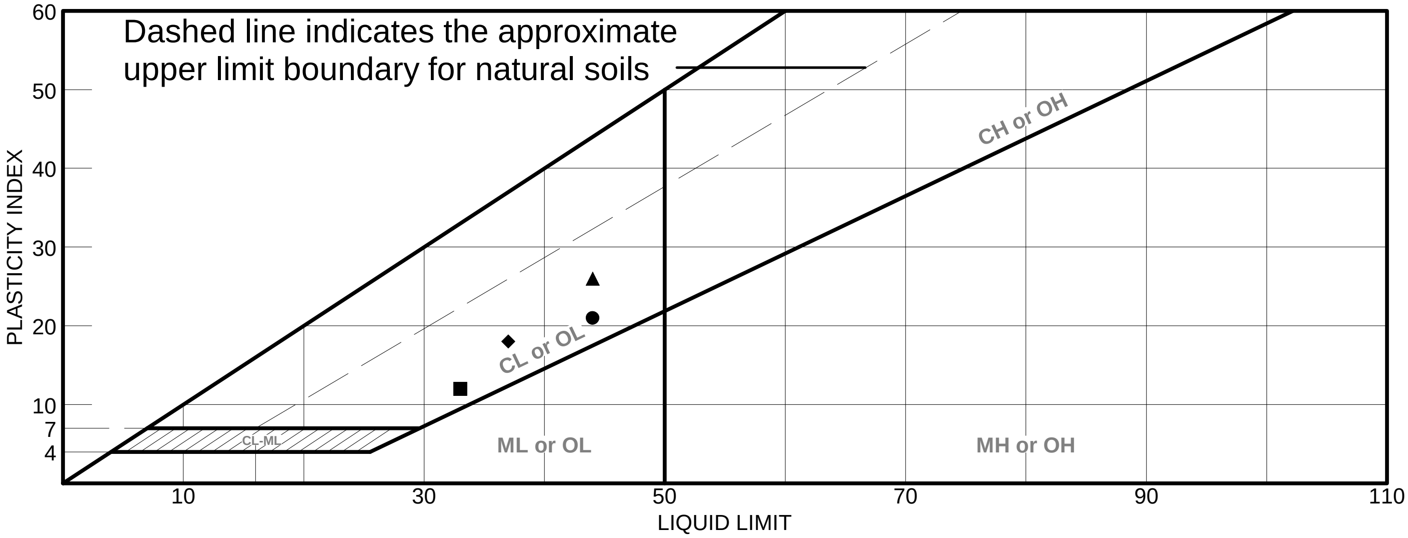
Client: ARUP

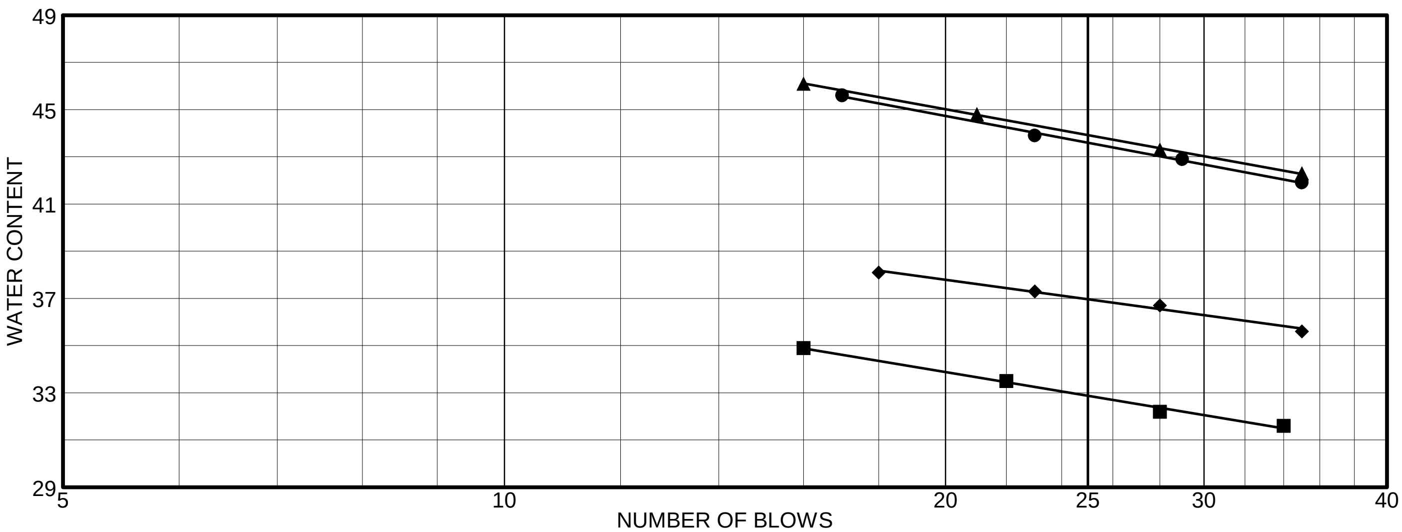
Project: 271590

Project No.: 743-014

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Reddish Brown Sandy Lean CLAY	44	23	21			
■	Yellowish Brown Sandy Lean CLAY w/ Gravel	33	21	12			
▲	Dark Olive Brown Sandy Lean CLAY w/ Gravel	44	18	26	76.0	61.8	CL
◆	Reddish Brown Lean Clayey SAND w/ Gravel	37	19	18	61.1	47.6	SC

Project No. 743-014 **Client:** ARUP

Project: 271590

● **Source:** B-2 **Sample No.:** 3 **Elev./Depth:** 7.5'

■ **Source:** B-6 **Sample No.:** 4 **Elev./Depth:** 10'

▲ **Source:** Northeast Corner Fill #1

◆ **Source:** Northeast Corner Fill #3

Remarks:

● Sample was prepared using the wet prep method.

■ Sample was prepared using the wet prep method.

▲ Sample was prepared using the wet prep method.

◆ Sample was prepared using the wet prep method.

LIQUID AND PLASTIC LIMITS TEST REPORT

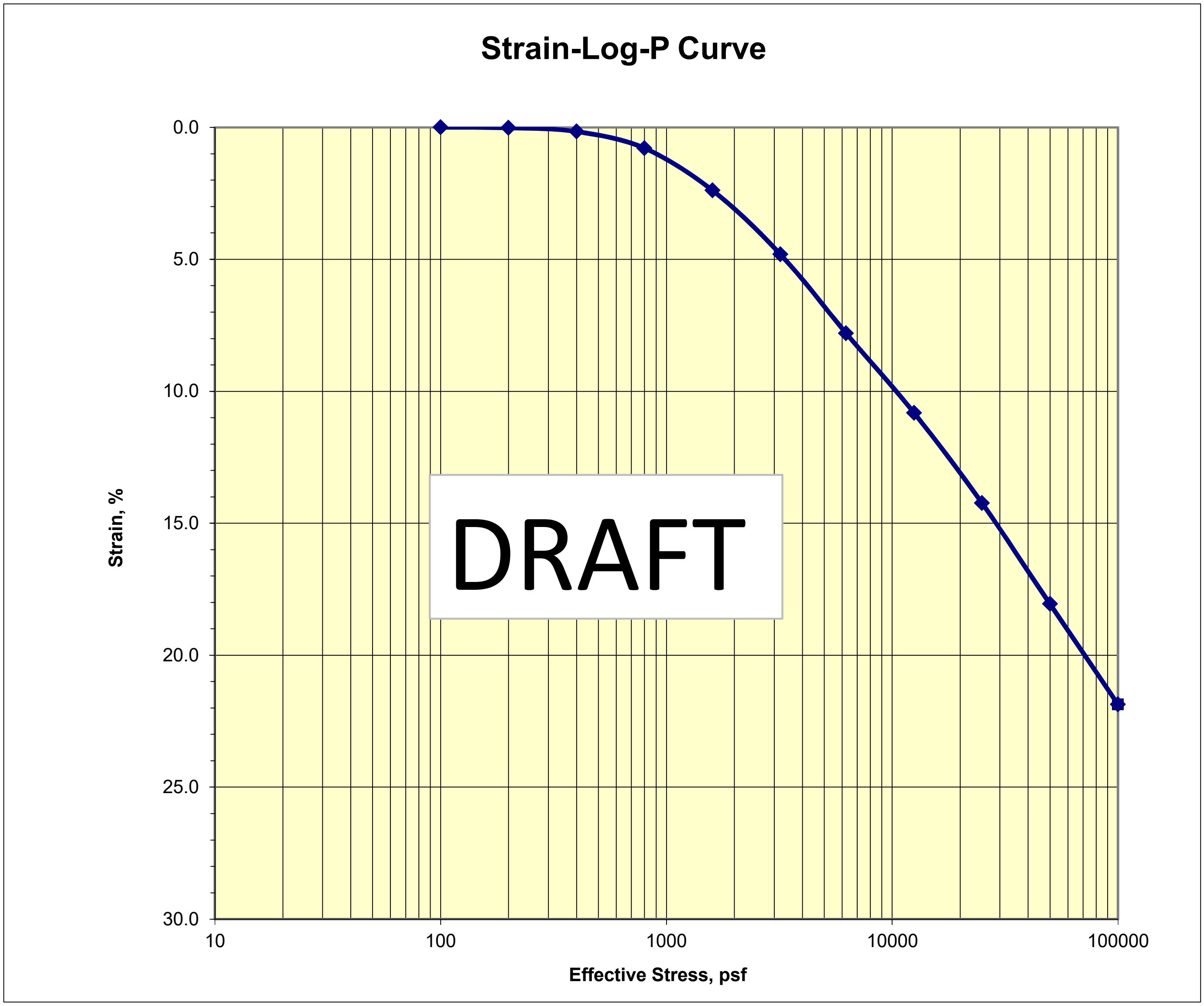
COOPER TESTING LABORATORY

Figure

Consolidation Test
ASTM D2435

COOPER TESTING LABORATORY

Job No.:	743-014	**Boring:**	B-1	**Run By:**	MD
Client:	ARUP	**Sample:**	5	**Reduced:**	PJ
Project:	271590	**Depth, ft.:**	15	**Checked:**	PJ/DC
Soil Type:	Olive Brown Sandy CLAY			**Date:**	10/30/2019



Assumed Gs 2.7	Initial	Final
Moisture %:	#DIV/0!	#DIV/0!
Dry Density, pcf:	#DIV/0!	#DIV/0!
Void Ratio:	#DIV/0!	#DIV/0!
% Saturation:	#DIV/0!	#DIV/0!

Remarks: Final results pending.

COOPER TESTING LABORATORY

Corrosivity Tests Summary

CTL # 743-014 **Date:** 10/22/2019 **Tested By:** PJ **Checked:** PJ
Client: ARUP **Project:** SFO069 **Proj. No:** 271590
Remarks:

Sample Location or ID			Resistivity @ 15.5 °C (Ohm-cm)			Chloride	Sulfate		pH	ORP		Sulfide	Moisture	Soil Visual Description
			As Rec.	Min	Sat.	mg/kg	mg/kg	%		(Redox)		Qualitative	At Test	
						Dry Wt.	Dry Wt.	Dry Wt.		E_H (mv)	At Test	by Lead	%	
Boring	Sample, No.	Depth, ft.	ASTM G57	Cal 643	ASTM G57	ASTM D4327	ASTM D4327	ASTM D4327	ASTM G51	ASTM G200	Temp °C	Acetate Paper	ASTM D2216	
B-2	2	5	-	-	1,461	5	128	0.0128	7.5	495	22	Negative	20.0	Reddish Brown Sandy CLAY

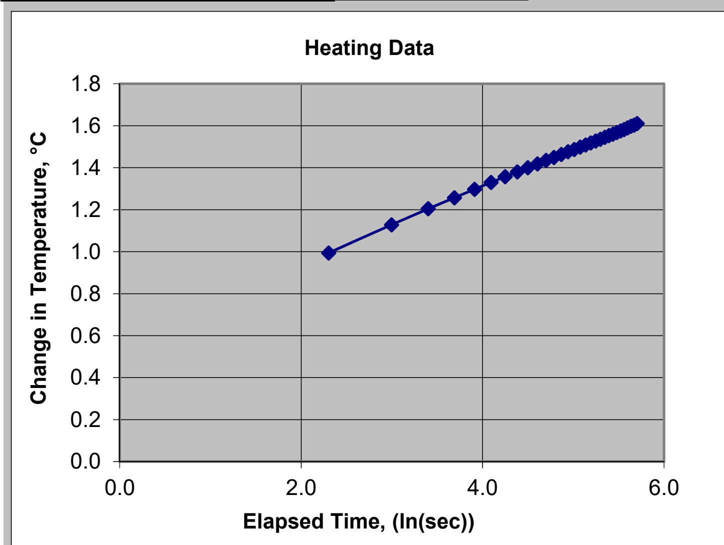
COOPER TESTING LABORATORY

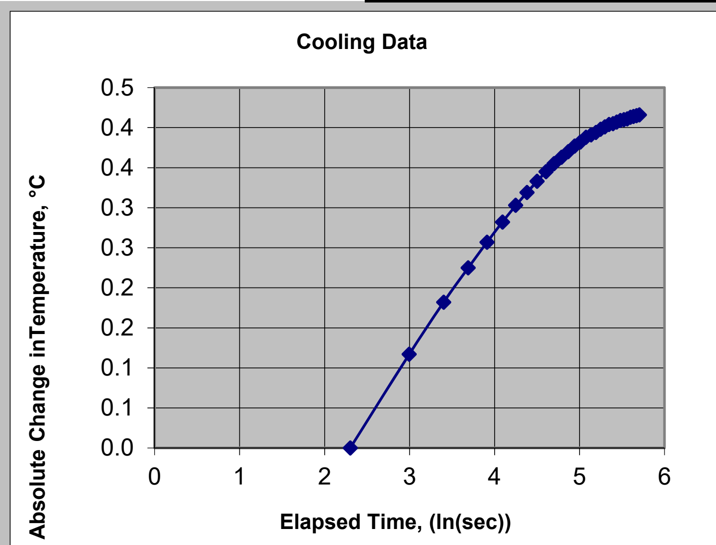
Thermal Conductivity By Thermal Needle Probe (ASTM D5334)

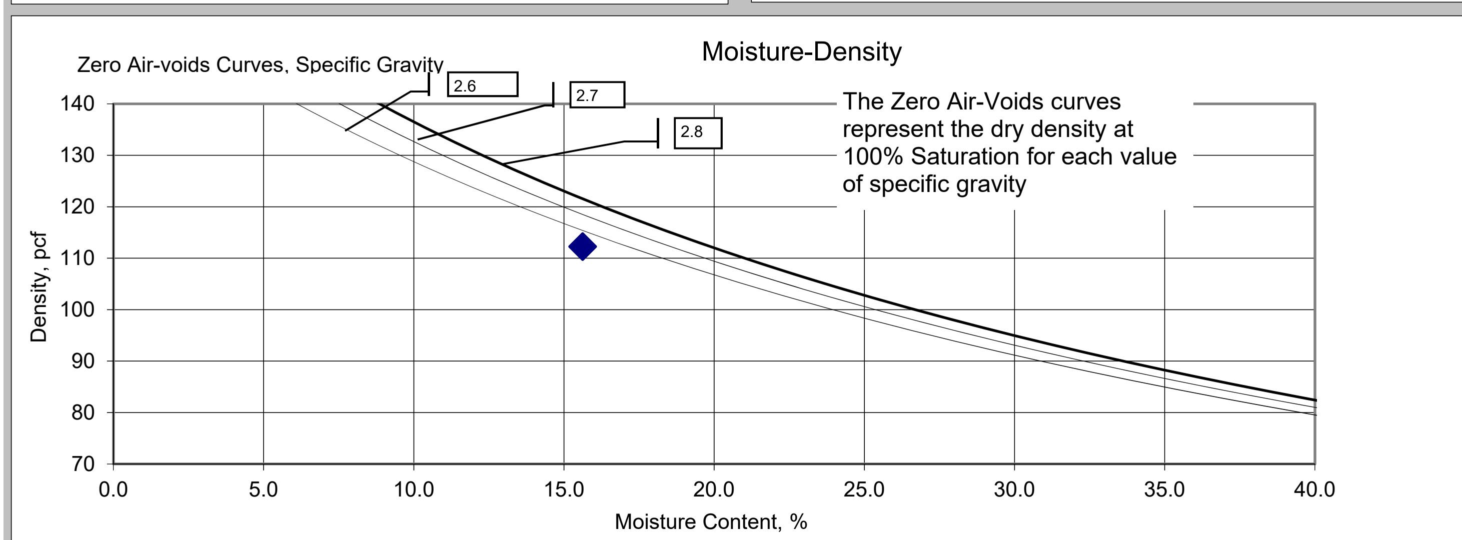
CTL Job No:	743-014	**Boring:**	B-1	**Date:**	10/28/2019
Client:	ARUP	**Sample:**	2	**By:**	PJ
Project Name:	271590 (AWS) /SFO069	**Depth, ft:**	5		
Project No.:		**Sample Type:**	Undisturbed	**Determined Gs**	
Soil Description:	Olive Brown Sandy CLAY			**Assumed Gs**	2.7

TEST RESULTS		TEST INFORMATION	
Thermal Conductivity, K, (W/m·k)	**1.985**	Date and Time:	10/22/19 13:15
Thermal Resistivity, rho, (°C·cm/W)	**50.4**	Thermal Needle Length, mm	100
Moisture, %	15.6	Thermal Needle Dia., mm	2.4
Wet Unit wt, pcf	129.8	Error Value	0.0048
Dry Unit wt, pcf	112.3	Initial Temperature, °C	23.08
Total Porosity, %	33.5	Reading Time, Minutes	10
Saturation, %	83.9	Power, W/min	3.580
Volum. Water Cont,Θw, M^3/M^3	0.281	Current, amps	0.083
Volumetric Water Cont,Θw, %	28.1	Method of Insertion:	Pushed
Volumetric Air Cont., Θa, %	5.4		
Void Ratio	0.50		

Remarks:







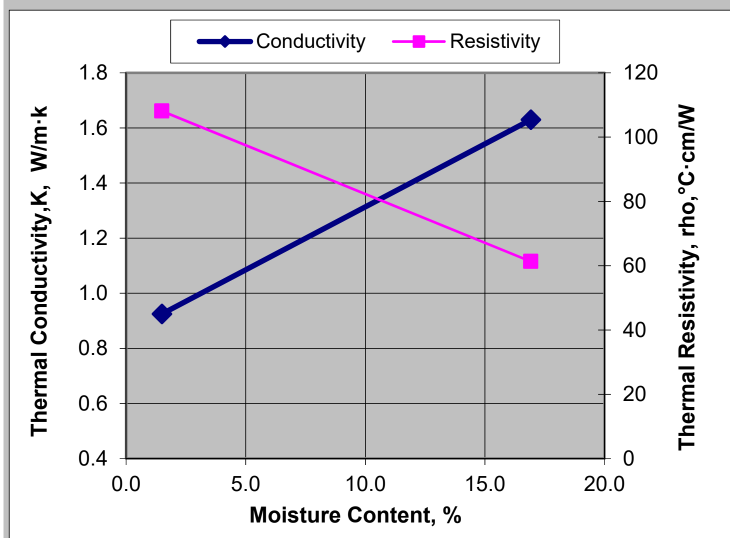
Thermal Conductivity By Thermal Needle Probe (ASTM D5334) - Two-Point Thermal Properties Curve

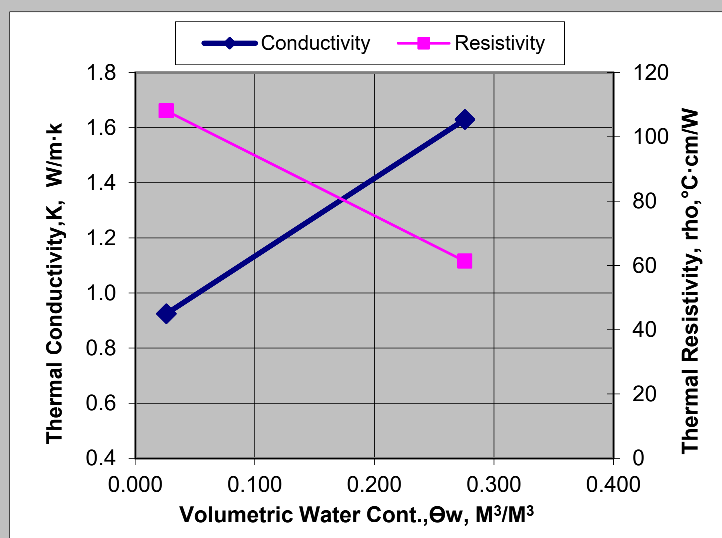
COOPER TESTING LABORATORY

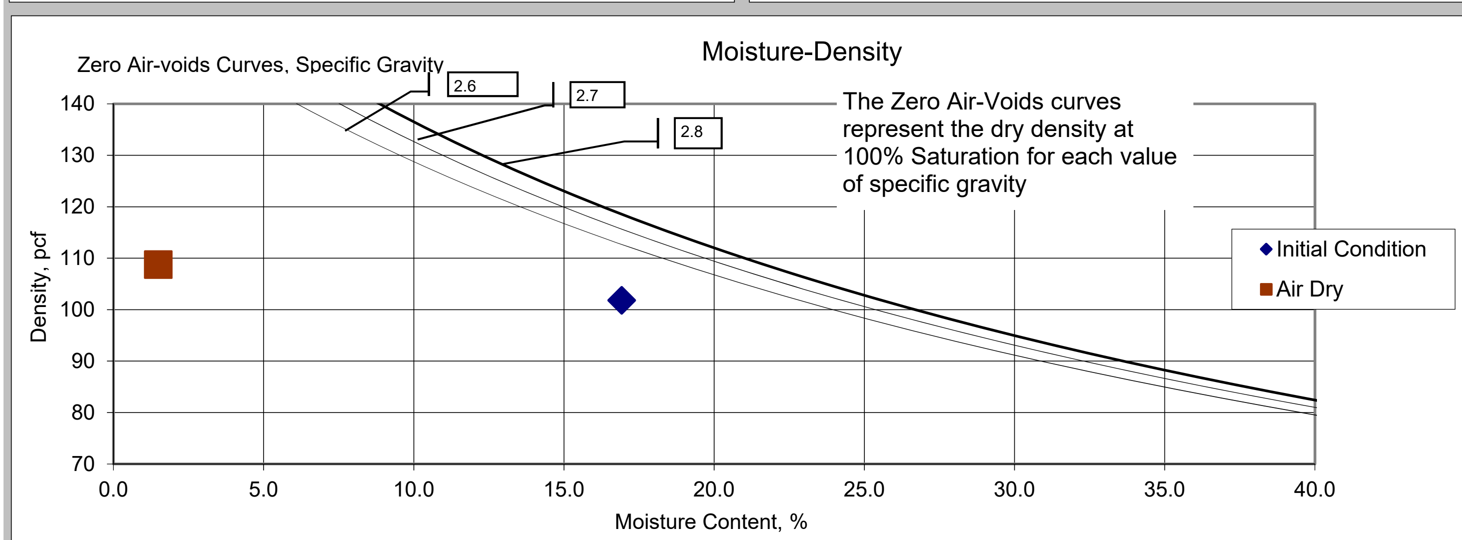
CTL Job No:	743-014	**Boring:**	B-3	**Date:**	10/28/2019
Client:	ARUP	**Sample:**	2	**By:**	PJ
Project Name:	271590 (AWS) /SFO069	**Depth, ft:**	5		
Project No.:		**Sample Type:**	Undisturbed	**Determined Gs**	
Soil Description:	Olive Brown Sandy CLAY			**Assumed Gs**	2.7

	Initial Condition	**Air Dry**
Thermal Conductivity, K, (W/m·k)	**1.630**	**0.925**
Thermal Resistivity, rho, (°C·cm/W)	**61.3**	**108.1**
Moisture, %	16.9	1.5
Wet Unit wt, pcf	119.0	110.4
Dry Unit wt, pcf	101.8	108.7
Total Porosity, %	39.7	35.5
Saturation, %	69.5	7.3
Volum. Water Cont,Θw, M^3/M^3	0.276	0.026
Volumetric Water Cont,Θw, %	27.6	2.6
Volumetric Air Cont., Θa, %	12.1	32.9
Void Ratio	0.66	0.55

Remarks: This sample developed desiccation cracks as it dried. This can have a significant impact on the measured thermal properties and the reported densities.





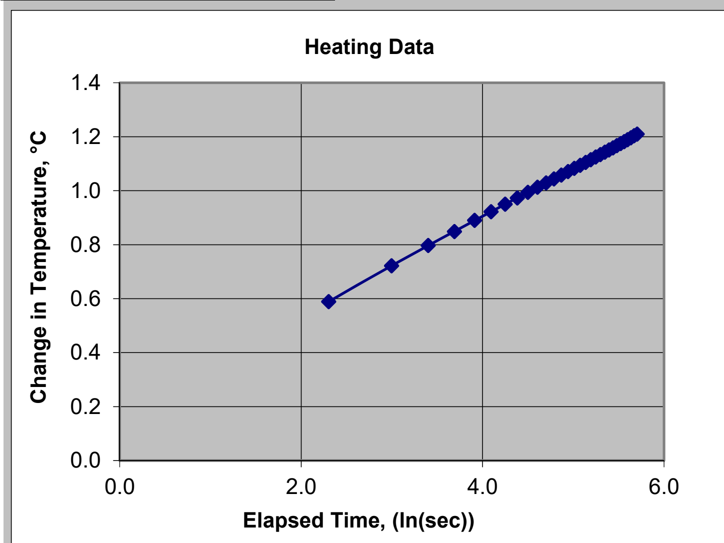


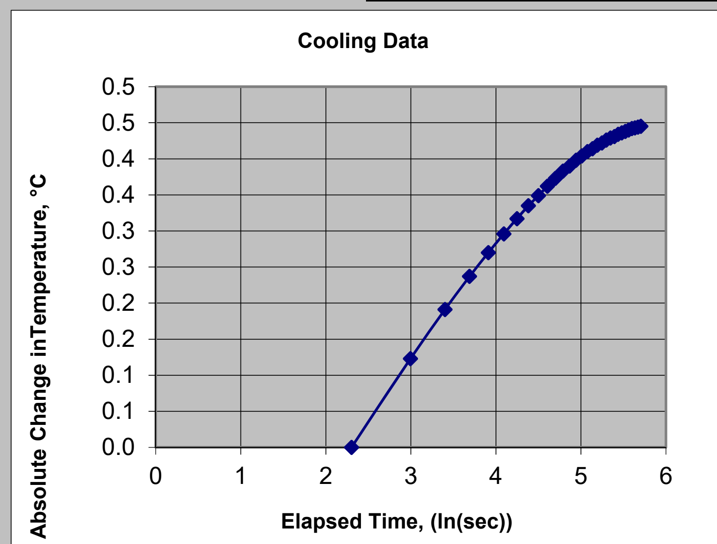
Thermal Conductivity By Thermal Needle Probe (ASTM D5334)

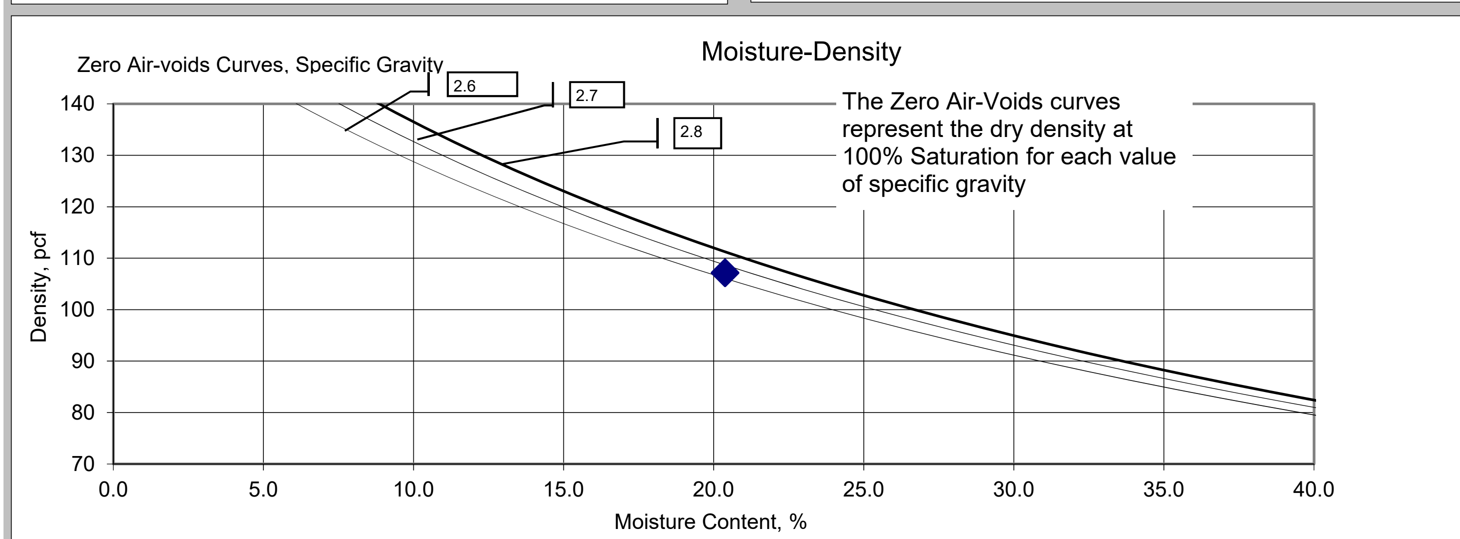
COOPER TESTING LABORATORY

CTL Job No:	743-014	**Boring:**	B-4	**Date:**	10/28/2019
Client:	ARUP	**Sample:**	2	**By:**	PJ
Project Name:	271590 (AWS) /SFO069	**Depth, ft:**	5		
Project No.:		**Sample Type:**	Undisturbed	**Determined Gs**	
Soil Description:	Olive Brown Sandy CLAY			**Assumed Gs**	2.7

TEST RESULTS		TEST INFORMATION		
Thermal Conductivity, K, (W/m·k)	**1.838**	Date and Time:	10/22/19 13:48	Remarks:
Thermal Resistivity, rho, (°C·cm/W)	**54.4**	Thermal Needle Length, mm	100	
Moisture, %	20.4	Thermal Needle Dia., mm	2.4	
Wet Unit wt, pcf	129.0	Error Value	0.0044	
Dry Unit wt, pcf	107.2	Initial Temperature, °C	23.19	
Total Porosity, %	36.5	Reading Time, Minutes	10	
Saturation, %	95.8	Power, W/min	3.570	
Volum. Water Cont,Θw, M^3/M^3	0.349	Current, amps	0.083	
Volumetric Water Cont,Θw, %	34.9	Method of Insertion:	Pushed	
Volumetric Air Cont., Θa, %	1.5			
Void Ratio	0.57			







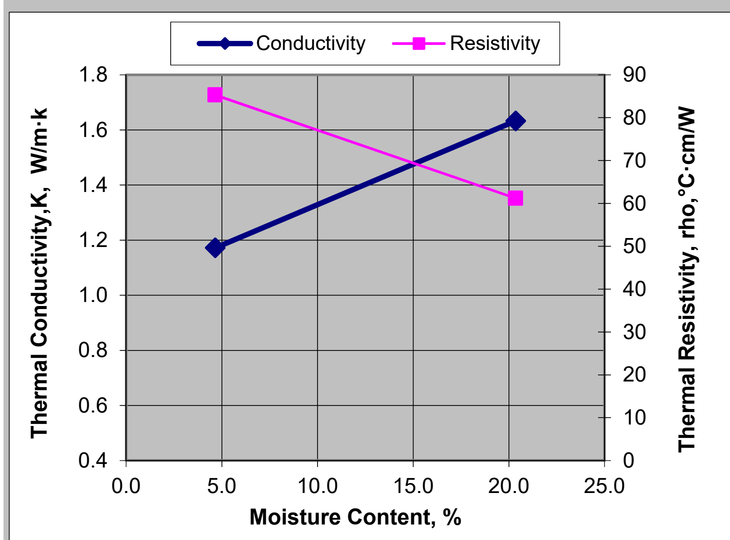
COOPER TESTING LABORATORY

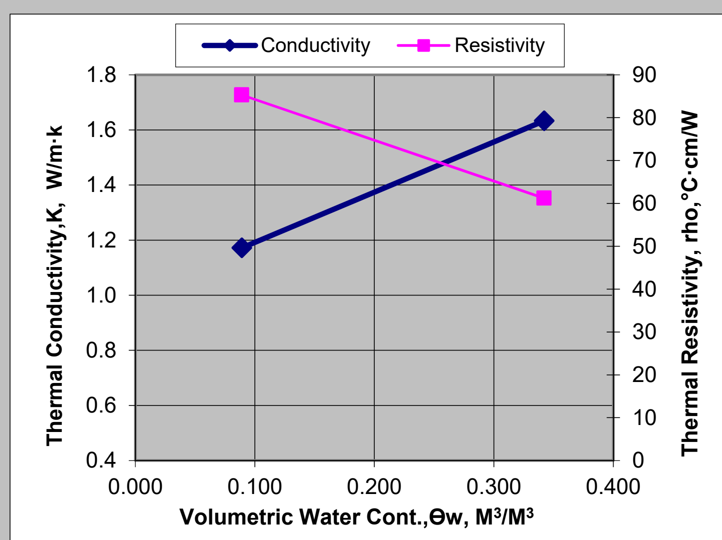
Thermal Conductivity By Thermal Needle Probe (ASTM D5334) - Two-Point Thermal Properties Curve

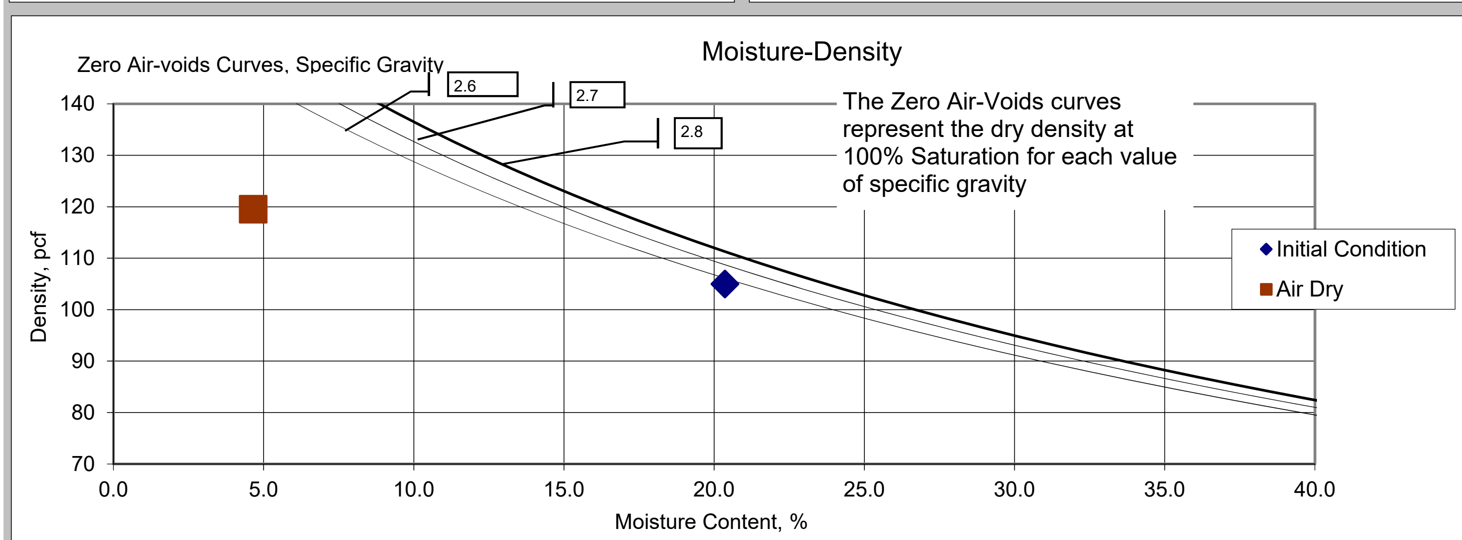
CTL Job No:	743-014	**Boring:**	B-5	**Date:**	10/28/2019
Client:	ARUP	**Sample:**	2	**By:**	PJ
Project Name:	271590 (AWS) /SFO069	**Depth, ft:**	5		
Project No.:		**Sample Type:**	Undisturbed	**Determined Gs**	
Soil Description:	Yellowish Brown Sandy CLAY			**Assumed Gs**	2.7

	Initial Condition	Air Dry
Thermal Conductivity, K, (W/m·k)	**1.633**	**1.172**
Thermal Resistivity, rho, (°C·cm/W)	**61.2**	**85.3**
Moisture, %	20.4	4.7
Wet Unit wt, pcf	126.4	125.1
Dry Unit wt, pcf	105.0	119.5
Total Porosity, %	37.8	29.2
Saturation, %	90.6	30.6
Volum. Water Cont,Θw, M^3/M^3	0.342	0.089
Volumetric Water Cont,Θw, %	34.2	8.9
Volumetric Air Cont., Θa, %	3.6	20.2
Void Ratio	0.61	0.41

Remarks: This sample developed desiccation cracks as it dried. This can have a significant impact on the measured thermal properties and the reported densities.







AWS

SFO069 Due Diligence

Geotechnical Considerations

Draft 3 | November 22, 2019

Job number 271590-00

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ARUP

Contents

1 Executive Summary

This report presents the results of a due diligence study undertaken for Amazon Web Services (AWS) by the global Arup engineering and consulting team, in collaboration with the Denver based architecture firm Gensler, local environmental consultants ERM, and local surveyor JMH Weiss. This study identifies critical site development and infrastructure issues that may impact the proposed development of two single-story 12-pod data center buildings and associated infrastructure. The purpose of this study is to outline existing conditions on site, identify red flag issues associated with developing on this site, recommend next steps for further evaluation of site development potential, and inform AWS' decision-making process as to the viability of the Site to support the proposed development.

2 Discussion of Geotechnical Considerations

Table 1: Key Questions for the Geotechnical Investigation

Key Questions	Summary Statement (Issue and mitigation)	Risk Rating
What type of foundations are recommended? What allowable soil bearing pressure/ capacity is recommended?	The feasibility of shallow foundations will depend on the magnitude of the structural loads, the range of tolerable settlements, and the state of consolidation due to fill placement prior to construction of the foundations. Allowable bearing pressures of 4,000 psf and 1,500 psf have been provided for an isolated spread footing and a mat foundation, respectively, assuming consolidation due to fill placement is substantially completed prior to construction of the building foundations. If the recommended bearing capacities are inadequate to resist the structural loading, if the magnitude of the estimated settlements is above what can be tolerated by the structure, or if the construction timeline is not sufficient to enable substantial completion of consolidation due to fill placement, then deep foundations may be required.	Medium
Are the Site soils and slopes stable?	The topography at and around the Site is relatively flat and no unstable slopes have been identified.	Low
Are expansive, collapsible, deleterious or chemically active soils present?	Site soils may exhibit moderate expansion potential based on Atterberg Limit testing. This can be mitigated through the placement of non-expansive fill to raise the Site grade. The Site investigation had mixed results regarding corrosivity of Site soils. The in-situ resistivity testing showed the soils to be mildly corrosive to corrosive. This can be mitigated using long-term corrosion control for underground utilities.	Medium
Are any subsurface gases present?	No subsurface gases were encountered during the geotechnical investigation.	Low

2.1.1 Liquefaction Potential

Liquefaction occurs when loose, saturated sandy or silty soils are subjected to strong and rapid shaking from a seismic event. Under the cyclic loads imposed by a seismic event, loose soils tend to contract (reduce in volume). As the soil contracts, normal stresses are transferred from the soil skeleton to the pore water increasing the pore pressure. This reduction in effective confining stress results in the loss of a portion, if not all, of the soil shear strength. Susceptibility to soil liquefaction is primarily a function of soil gradation and density, with secondary considerations, including age, cementation, and stress history. Soils that are most susceptible to liquefaction are recently deposited clean, loose, uniformly graded, saturated sands (Idriss and Boulanger, 2008).

In addition to the factor of safety against liquefaction triggering, the liquefaction potential index (LPI) was evaluated. The LPI is a parameter developed by Iwasaki et al. (1978) and is a function of the thickness of the liquefied layer, proximity to the surface, and the factor of safety of that layer. According to Iwasaki et al. (1982), the LPI values may be used to estimate the damage due to liquefaction using the following guidelines:

- LPI < 5, negligible to low liquefaction risk
- 5 < LPI < 15, moderate to high liquefaction risk
- LPI > 15, severe liquefaction risk

Since soil saturation is a necessary requirement to induce liquefaction, the depth of the groundwater table is a key input for the liquefaction analysis. The liquefaction potential at the Site for the design groundwater table depth of 25-feet was evaluated. However, nearby information shows that the depth to groundwater table may vary. The liquefaction potential for a shallow groundwater condition with the groundwater table at 15 feet was also evaluated. The results of the liquefaction assessment assuming a conservative groundwater table at 15-feet is shown in Figure 1.

With the groundwater table at 25 feet, the liquefaction potential appears negligible with the maximum vertical settlement estimated at approximately 0.5 inches. For the shallow groundwater condition, the maximum estimated liquefaction induced settlement increases to approximately 1.1 inches. However, in both cases the maximum LPI is below 5 which indicates that the estimated liquefaction risk is negligible to low. In addition, it is anticipated that fill thickness of 5 to 9 feet will be placed beneath the building footprint. This engineered fill layer should increase confining stresses in the underlying soil and slightly reduce estimated liquefaction settlements.

Based on the results of this preliminary geotechnical investigation, the liquefaction risk is estimated to be low for the site.

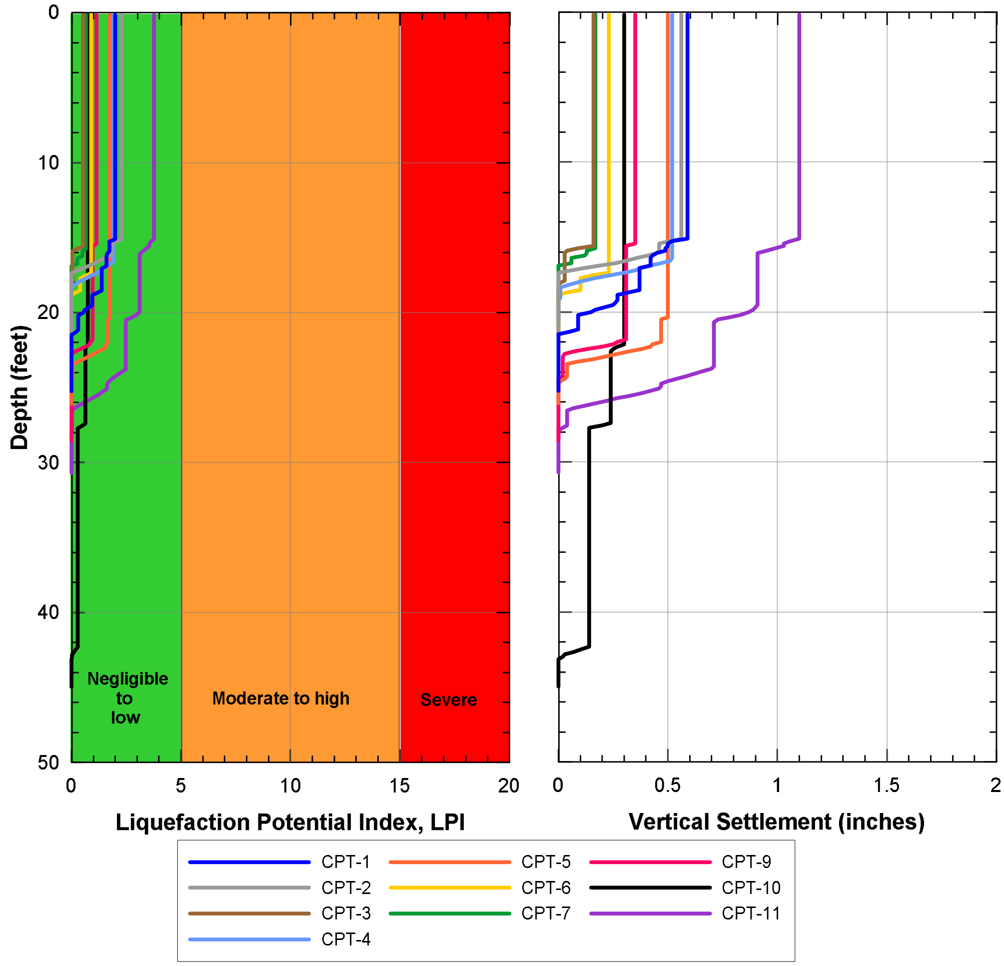


Figure 1: Summary of Liquefaction Results

2.1.2 Expansion Potential

The criteria presented in Holtz (1969) suggests that soils with plasticity index greater than approximately 15% and liquid limit greater than 39 % may have moderate expansion potential. Atterberg Limit tests available from the site-specific ground investigation and nearby investigations suggest that the upper clay at the Site may have moderate expansion potential and therefore could experience some degree of volume change (i.e. shrink/swell) when subjected to changes in moisture content. The anticipated volume change of the upper clay should be lessened due to surcharge surcharge from overlying fill and structures.

In addition, based on available Atterberg Limit testing, the expansion potential of the existing mound of stockpiled fill in the northeast corner of the Site appears to be similar or greater than that of the upper clay. Pavements or shallow foundations directly supported by this fill could experience cycles of shrinking and swelling of the fill material. This risk can be mitigated by using an alternate fill source or through blending of the potentially expansive fill with less expansive material.

2.1.3 Raising Site Grade

It is understood that fill will be placed at the Site to raise Site grades to at least the 100-year flood elevation. Additionally, it is our understanding that finished grade of the structures must be 1.5 feet above the 100-year flood elevation, resulting in approximately 5 feet of fill placement beneath the proposed structures.

A simplified analysis to evaluate the potential settlement associated with placement of conventional fill was carried out. Settlement potential of the design profile was evaluated assuming placement of 5 feet of conventional fill. In addition, a range subsurface conditions were evaluated to account for the variable thickness of compressible layers across the site. Settlement on the order of 3 to 5 inches due to placement of conventional fill is estimated. This estimated range of settlement is based on extrapolation of the geotechnical data that was gathered only to a depth of 45 feet. Unforeseen conditions at depth, such as a highly compressible layer, may increase the range of potential settlement associated with fill placement.

Due to the typically impermeable nature of clay deposits, the duration for substantial completion of primary consolidation (e.g. 90%) could be in excess of 1 to 2 years. The relative permeability of the granular layer will assist with drainage of the Upper Clay layer; however, the thicker Lower Clay layer will also contribute significantly to settlement.

The analysis and estimates discussed above are based on limited consolidation data and should be refined with further geotechnical investigation and laboratory testing. In particular, consolidation and permeability testing on high quality, relatively undisturbed samples of the upper and lower clay layers would assist with refining estimates of settlement and duration.

2.1.4 Foundation Options

Given the stratigraphy identified at the Site during the Stage 1 geotechnical investigation, several foundation options could feasibly provide efficient solutions. The ultimate selection of a preferred foundation type may depend on the structural loading, settlement criteria and the findings of a supplemental ground investigation.

It is possible that a shallow foundation solution may be feasible given the relatively stiff nature of the clay-like soils encountered at the site. Raising the Site grade with compacted fill could provide a good bearing layer that would act to distribute load at the underlying surface of the natural ground and potentially reduce differential settlement. However, long-term settlement due to fill placement could increase the total settlement of the structure. Thus, the feasibility of a shallow foundation solution will likely be controlled by the total and differential settlement criteria as well as the duration over which consolidation settlement may take place after raising Site grade and before construction of the foundations.

A deep foundation solution is feasible, and the options identified as most suitable for the Site are:

- Continuous flight auger (CFA) piles (also referred to as auger-cast-in-place or auger-pressure grouted piles)
- Driven piles

CFA piles are an attractive option due to the high production rates that are typically achievable in combination with the reduced noise and vibration when compared to driven pile alternatives. CFA piles are non-displacement piles, so management of the spoil generated is a consideration if this option is selected. CFA pile lengths of 60 to 80 feet are anticipated for the Site.

A driven pile option can also present an economical solution in situations where driving conditions are favorable, and where the associated installation noise and vibration are acceptable to neighbors. With the Site primarily consisting of clay-like soils and no evidence of buried obstructions at depth, pile driving is assessed to be feasible. It is not anticipated that the gravel layer is dense enough to inhibit pile drivability, but this should be confirmed prior to final design.

Should a pile foundation solution be selected, the piles may need to accommodate the column loads and distributed floor loads as well as additional loads due to downdrag given that the Site is expected to undergo some relatively long-term settlement due to placement of conventional fill.

Given the modest fill thickness anticipated at the site, it is anticipated that deep foundations will be able to accommodate downdrag loads without requiring excessive pile lengths. Nevertheless, one potential option to mitigate downdrag on the piles, if necessary, could be to install them prior to raising the Site grade. Geogrids, load transfer platforms and arching phenomena would help to transfer the load from the fill to the piles; thereby reducing settlement and downdrag. Another potential option could be to use anti-friction coating along a portion of the length of driven piles.

2.1.5 Shallow Foundations

Preliminary bearing capacity calculations have been undertaken assuming an engineered fill thickness beneath the building of 5 feet. Given the relatively competent soil properties assumed for the engineered fill, these demonstrate that the design of either isolated spread footings or a mat foundation will be governed by the acceptability of the associated total and differential settlements and not a potential bearing failure.

In order to inform foundation type selection and preliminary design, the allowable bearing pressures and associated estimated total settlements presented in Table 2 can be used. The allowable bearing capacities have been developed for the dead plus live load case. For temporary load cases, such as seismic, the allowable bearing capacities may be increased by a factor of 1.5.

Table 2: Preliminary Shallow Foundation Allowable Bearing Capacity and Estimated Settlements

Shallow Foundation Type	Allowable Bearing Capacity	Minimum Embedment	Estimated Total Settlement[1]
	(psf)	(ft)	(in)
Isolated spread footing	4,000	2	1 to 2
Mat	1,500	3	5 to 7
[1]Estimated settlement is additional to that induced by fill placement			

It is noted that the settlements in Table 2 are additive to any long-term settlements due to fill placement that may take place after construction of shallow foundations. One option to mitigate long-term settlement due to fill placement at the building locations would involve temporarily surcharging the ground with additional fill to accelerate primary consolidation. Another option could involve the use of lightweight fill in combination with over-excavation to limit the increase in stress on the underlying soils and thus reduce total and differential settlement. Suitable lightweight fill material can consist of a natural or processed material such as pumice, expanded shale aggregate, or controlled-low-strength-mix (CLSM).

Resistance to lateral loads may be provided by friction on the base of footings and/or by the use of shear keys to mobilize passive resistance. Where a footing is cast directly on the engineered fill, a friction coefficient of 0.5 between the concrete and soil can be assumed.

2.1.6 Deep Foundations

This section presents preliminary unfactored axial and lateral capacity estimates for CFA and driven piles. It is anticipated that, should the estimated settlements for shallow foundations be determined to be unacceptable, deep foundations will be used to mitigate this settlement.

Preliminary unfactored unit shaft and base resistance was estimated for a CFA pile using the Alpha-Beta methodology presented in the Federal Highway Administration Manual for the Design and Construction of Continuous Flight Auger Piles (FHWA, 2007). Likewise, preliminary unit capacities for a driven pile were estimated in accordance with the Federal Highway Administration Manual for the Design and Construction of Driven Pile Foundations (FHWA, 2016). Table 3 presents preliminary unfactored unit shaft and base resistance for a CFA pile in the respective soil units identified in this report. Table 4 shows the equivalent unfactored unit shaft and base resistance for a driven pile. As discussed above, final pile design should account for any downdrag forces associated with settlement of the Upper and Lower Clay units.

The unit capacities presented in Table 3 and Table 4 should be refined following additional geotechnical investigation.

Table 3: Preliminary Unfactored Unit Shaft and Base Capacities for CFA Pile

Stratum	Allowable Unit Side Resistance	Unit Base Capacity
	(ksf)	(ksf)
Upper Clay Layer	1.4	-
Granular Layer	0.8	35
Lower Clay Layer	1.4	22

Table 4: Preliminary Unfactored Unit Shaft and Base Capacities for Driven Pile

Stratum	Allowable Unit Side Resistance	Unit Base Capacity
	(ksf)	(ksf)
Upper Clay Layer	1.5	-
Granular Layer	0.9	120
Lower Clay Layer	1.5	22

Ultimate lateral capacities for preliminary analysis of CFA piles (both 18-inch and 24-inch diameter) and pipe piles (14-inch diameter, ½-inch thick walls) were estimated using the program LPILE V10.0 (Ensoft, Inc., 2018), which uses the p-y method to model the behavior of a single pile subjected to lateral loading. Conventional analysis mode with static p-y curves was used. The estimated lateral capacities for fixed and pinned head conditions are presented in Figure 2 and Figure 3.

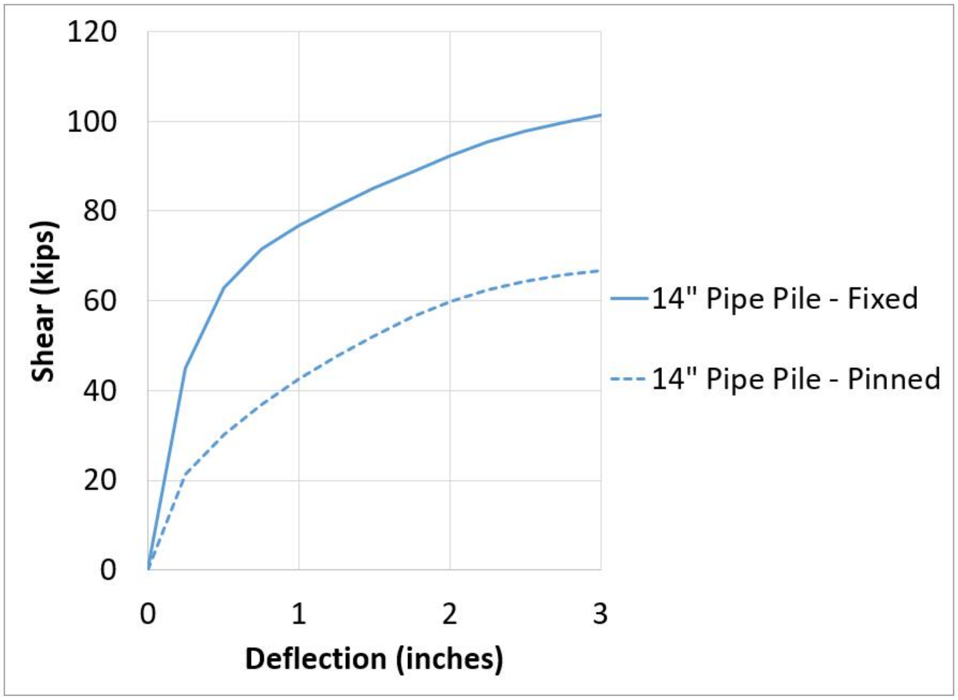


Figure 2: Lateral pile capacity for 14-inch pipe pile with ½-inch thick walls

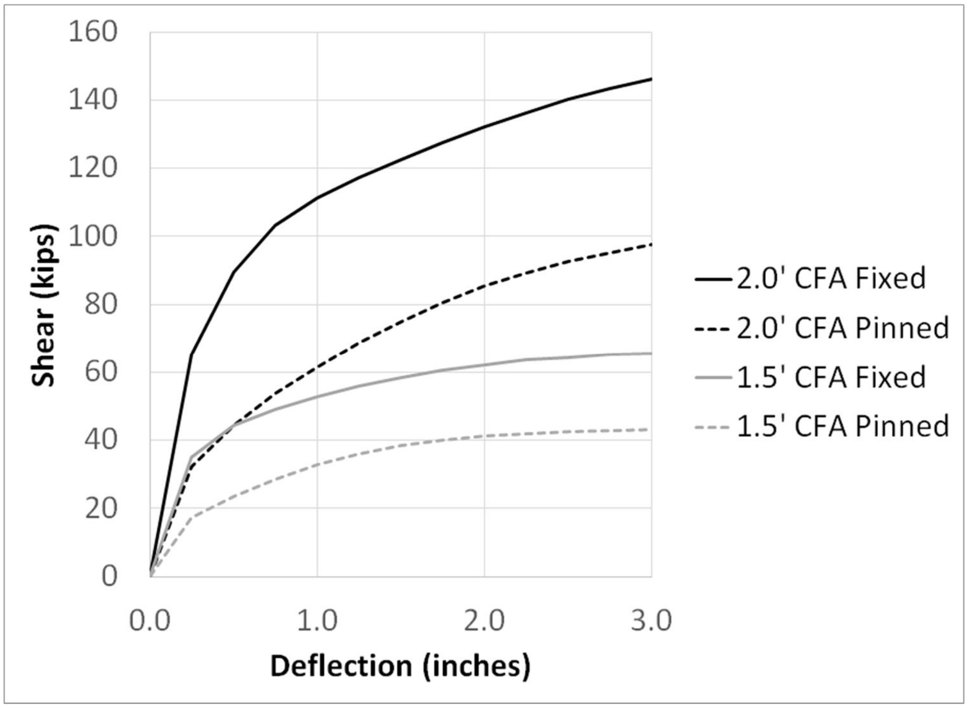


Figure 3: Lateral pile capacity for 18-inch and 24-inch CFA Piles

Should the required center-to-center pile spacing be less than five pile diameters, the appropriate p-multipliers presented in Table 5 shall be applied.

Table 5: Appropriate p-Multipliers per AASHTO (2014)

Center to Center Pile Spacing [1]	p-Multiplier for Lead Row	p-Multiplier for Second Row	p-Multiplier for Third Row [2]
3D	0.8	0.4	0.3
5D	1	0.85	0.7
	[1] Center to center pile spacing as a function of pile diameter, D [2] p-multiplier to be applied to all subsequent rows [3] Linear interpolation may be used for intermediate spacing arrangements. Pile spacing should be at least 3D for pile installation tolerances and lateral performance		

2.2 Preliminary Recommendations

2.2.1 Seismic Design Parameters

The code-mapped design spectral acceleration parameters and associated response spectrum were determined in accordance with ASCE 7-16 Chapter 11. Table 6 presents the ASCE 7-16 Chapter 11 code-mapped design spectral acceleration values. Note that while the Site classification per ASCE 7-16 Chapter 20 is based on the upper 100 feet of material, the site-specific data collected to a depth of 45 feet taken alongside the information collected during the desk study is strongly indicative of Site Class D. The seismic design parameters will need to be refined for final design once the required geotechnical data is obtained.

According to ASCE 7-16 Chapter 11.4.8, *a ground motion hazard analysis shall be performed in accordance with Section 21.2 for structures on Site Class D and E sites with* S_1 *greater than or equal to 0.2*. Therefore, a ground motion hazard analysis in accordance with ASCE 7-16 Chapter 21.2 should be carried out for final design.

Table 6 ASCE 7-16 Chapter 11 Code-Mapped Acceleration Parameters

Latitude: 37° 0'57.64"N Longitude: 121°33'29.88"W	ASCE 7-16 Table/Figure	Factor/ Coefficient	Value
Mapped Peak Ground Acceleration MCEG	Figure 22-9	PGA	0.66g
Short-Period MCER at 0.2s	Figure 22-1	Ss	1.584g
1.0s Period MCER	Figure 22-2	S1	0.6g
Soil Profile Type	Table 20.3-1	Site Class	D1
PGA Site Coefficient	Table 11.8-1	FPGA	1.1
Short Period Site Coefficient	Table 11.4-1	Fa	1.0
1.0s Period Site Coefficient	Table 11.4-2	Fv	-2

Latitude: 37° 0'57.64"N Longitude: 121°33'29.88"W	**ASCE 7-16 Table/Figure**	**Factor/ Coefficient**	**Value**
Adjusted MC Spectral Response Parameters	Equation 11.8-1	PGAM	0.726g
	Equation 11.4-1	SMS	1.584g
	Equation 11.4-2	SM1	-2
Spectral Acceleration Parameters	Equation 11.4-3	SDS	1.056g
	Equation 11.4-4	SD1	-2
Long-Period Transition Period	Figure 22-14	TL	12s
1Determined based on CPT information in the upper 45 feet. 2A ground motion hazard analysis is required per ASCE 7-16 Chapter 11.4.8.			

2.2.2 Suitability of Fill Stockpiled on Site

As discussed in Section **Error! Reference source not found.**, Arup carried out laboratory testing on two samples from the fill material stockpiled at the northeast corner of the site. The field observations and index test results indicate the material is a lean clay to a clayey sand. Fines content, or the percentage of material passing the #200 sieve, ranged from approximately 48% to 62% and the plasticity index ranged from 18% to 26%. Such material may be suitable for some landscaping purposes but may not meet the requirements for structural fill under the buildings or pavements unless blended with more suitable material or otherwise altered.

2.2.3 Fill Placement

In general, fill placed to raise the Site grade above the 100-year flood elevation should be free of debris and organics and similar or better than the in-situ material from the Upper Clay layer. Therefore, satisfactory soils may include soil classification groups GW, GP, GM, SW, SP and SM that is free of rock or gravel larger than 3 inches. Unsatisfactory soil classification groups include: OL, OH, CH, MH or PT. Soil classification groups GC, SC, ML or CL are not preferred as they may have poor drainage characteristics and be difficult to compact; however, they may be suitable for landscaping purposes, subject to additional inspection and testing requirements.

If a shallow foundation system is selected, placement of competent engineered fill will be critical to the performance of the foundation. Among other requirements, material to be used for structural fill under slabs and foundations is generally free of organics (less than ~3% by weight), has a plasticity index less than ~15, and includes less than ~20% material passing a #200 sieve.

For this feasibility level assessment, it is recommended to assume that the upper approximately 1-foot of topsoil material should be stripped and removed within 25 feet of buildings and at other locations where structural fill is to be placed, such as for pavements or exterior flatwork. Structural fill underlying and within 25 feet of buildings should be placed in lifts and compacted to 95% relative compaction as determined by ASTM test method D1557 (ASTM, 2016a). The upper 3 feet of fill for pavements or exterior flatwork should also consist of structural fill that is placed in lifts and compacted to 95% relative compaction. At other portions of the site, fills should be placed in lifts and compacted to approximately 90% relative compaction.

2.2.4 Corrosion Design

The in-situ resistivity testing indicates that the soil at the Site is corrosive to mildly corrosive based on the criteria developed by Ellis (1978). Applicable recommendations with regards to long-term corrosion control for underground utilities can be found in Appendix M. It is worth noting that the Ellis (1978) classification of soil corrosivity differs from that presented in the Caltrans Corrosion Guidelines (2018) and is considered most applicable for underground utilities.

For structural elements, Caltrans (2018) defines a corrosive environment as having one or more of the following conditions:

- Chloride concentration is 500 ppm or greater.
- Sulfate concentration is 1500 or greater.
- pH is 5.5 or less.

The one laboratory corrosion test was carried out as part of this Site investigation did not meet any of the criteria outlined in Caltrans (2018) for a corrosive environment. Should a deep foundation solution be adopted, further corrosion testing should be carried out to confirm whether corrosion mitigation measures are required for structural elements.

2.2.5 Frost Depth

Design issues associated with frozen ground are considered low risk for the following reasons:

- Due to the temperate climate, frost depth is not typically considered for design in the San Francisco Bay Area.
- Silt, the soil type most susceptible to frost action, was not encountered near surface.
- The depth to groundwater of 25 feet implies a source of water close enough to supply capillary water to the frost zone is not present.

2.2.6 Storm Water Disposal Methods

Recommendations for feasible storm water, industrial wastewater, and sanitary sewer disposal methods were provided in the Water Infrastructure Assessment. The stormwater management system generally works to promote stormwater infiltration to limit potential runoff. However, the near surface clay may reduce infiltration and should be considered in low impact development design.

Utilities for storm water, industrial wastewater, and sanitary sewer conveyance may need to be protected against corrosive soils in accordance with the recommendations provided in Appendix M as discussed in Section 2.2.4.

2.2.7 Chemically Active Soils and Presence of Gas

Other than the potential for corrosive soils, no other chemically active soils were encountered during the geotechnical investigation. The presence of gas was not detected during the geotechnical investigation.

2.2.8 Additional Geotechnical Investigation

The project would benefit from additional geotechnical investigation and laboratory testing to confirm and refine the recommendations made in this report. Additional borings should be advanced specifically to: 1) obtain relatively undisturbed samples of the upper and lower clay layers for additional laboratory testing, and 2) characterize the soil to greater depths for assessment of settlements due to fill placement and/or to assess capacities for deep foundation elements.

The following additional geotechnical investigation is proposed to advance the project to final design:

- Three deep geotechnical boreholes to approximately 100 feet.
- One day of test pits to obtain high quality block samples and infiltration testing from the Upper Clay layer.

The following lab testing to refine the analysis and recommendations provided in this report is proposed:

- Unit Weight Testing.
- Unconsolidated Undrained Triaxial Testing.
- Consolidation Testing.
- Permeability Testing.

2.2.9 Cost Estimate

The estimated fee to complete the proposed geotechnical investigation, laboratory testing, and geotechnical analysis and reporting is $56,010. The breakdown of this estimated fee is included in Table 7. This estimated fee would provide the geotechnical investigation and laboratory discussed in Section 2.2.8 and a Geotechnical Engineering Report detailing refined settlement and foundation recommendations. This estimate is based on what the project needs are understood to be at this time. This estimate can be refined should these change.

Table 7: Cost Estimate for Additional Geotechnical Services

Task	Estimated Fee
Task 1 – Coordination of Geotechnical Investigation	$2,160
Task 2 – Geotechnical Investigation	$29,830
Task 3 – Geotechnical Laboratory Testing	$6,560
Task 4 – Geotechnical Analysis and Reporting	$17,460
Total	**$56,010**

Appendix M

In-Situ Resistivity Test

October 22, 2019

ARUP
560 Mission Street, Suite 700
San Francisco, CA 94105

Attention: **Ms. Julia Villanueva**
Graduate Engineer/Geotachnics

Subject: **Soil Corrosivity Evaluation & Recommendations for Corrosion Control**
Underground Water Piping Systems and Grounding Calculations
Gilroy Resistivities
Gilroy, CA

Dear Ms. Villanueva

Pursuant to your request, **JDH Corrosion Consultants, Inc**. has conducted a site corrosivity evaluation for the above referenced project site and we have provided herein recommendations for long-term corrosion control for the proposed materials of construction for the underground utilities. We have also provided herein the data required for grounding calculations.

Purpose

The purpose for this evaluation is to determine the corrosion potential, resulting from the soils at the subject sites and to provide recommendations for long-term corrosion control for the buried metallic utilities.

Soil Testing and Analysis

In-Situ Soil Resistivity Measurements

The in-situ resistivity of the soil was measured at five (5) locations at the project sites by **JDH Corrosion Consultants, Inc.** field personnel. Resistance measurements were conducted with probe spacing of 2.5, 5, 7.5, 10, and 15-feet at each location with a north/south and east/west orientation. For analysis purposes we have calculated the resistivity of soil layers 0-2.5, 2.5-5, 5-7.5, 7.5-10 and 10-15' using the Barnes Method as follows:

$$\rho_{b-a} = KR_{(b-a)}$$

Where;

ρ_{b-a}	=	soil resistivity of layer depth b-a (ohm-cm)
a	=	soil depth to top layer (ft)
b	=	soil depth to bottom layer (ft)
R_a	=	soil resistance read at depth a (ohms)
R_b	=	soil resistance read at depth b (ohms)
R_{b-a}	=	resistance of soil layer from a to b (ft)
K	=	layer constant = $60.96\pi(b-a)$ (cm)

and

$$\frac{1}{R_{b-a}} = \frac{1}{R_a} - \frac{1}{R_b}$$

The visual diagrams below describe the Wenner 4-pin testing configuration.

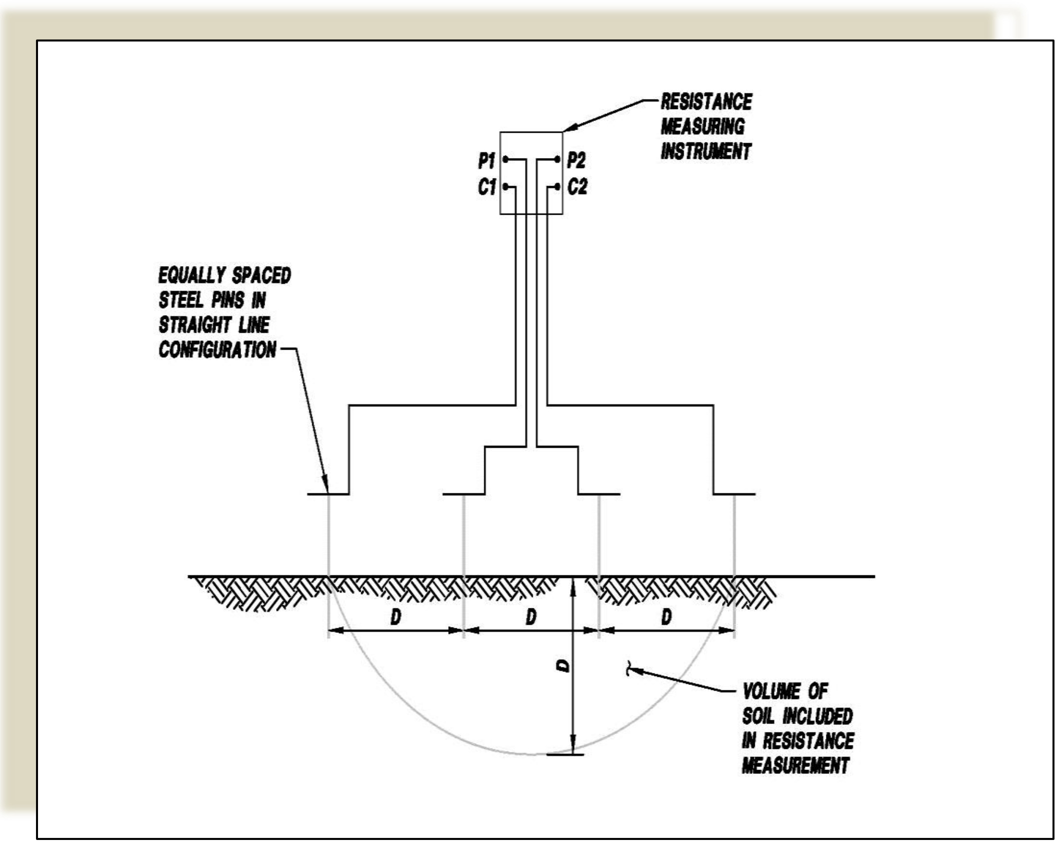


Fig 1: Wenner 4-Pin Resistivity Schematic No.1

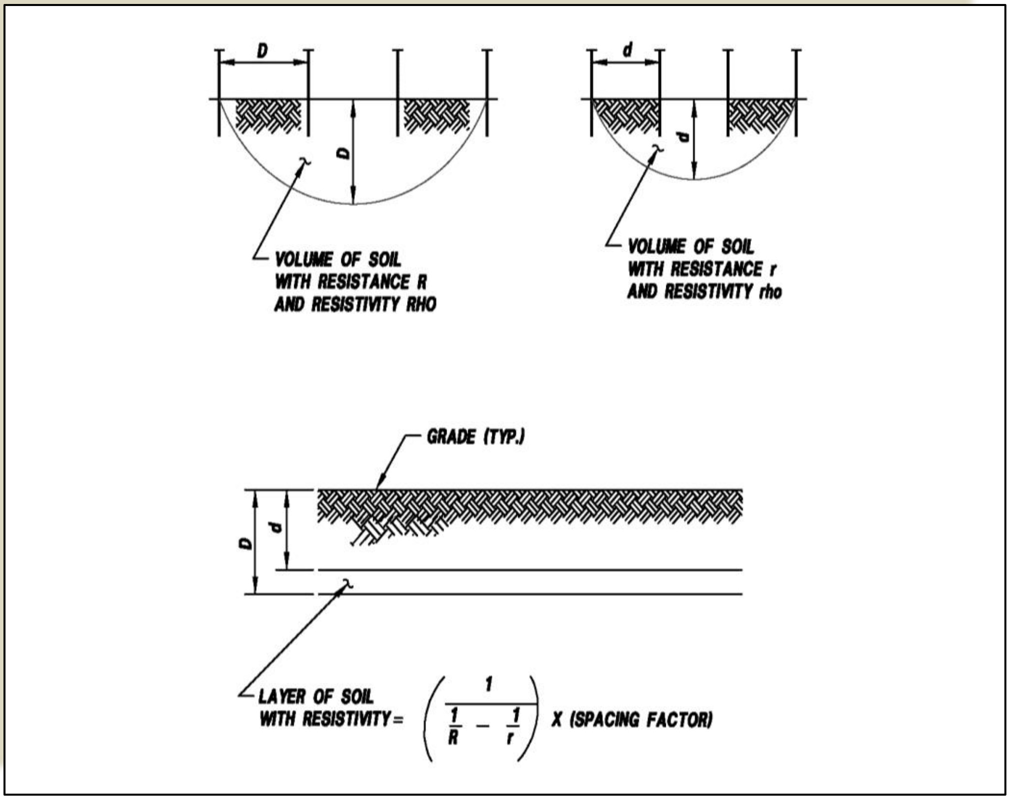


Fig 2: Illustration of Barnes Layer Calculations

In-Situ Soil Resistivity Analysis

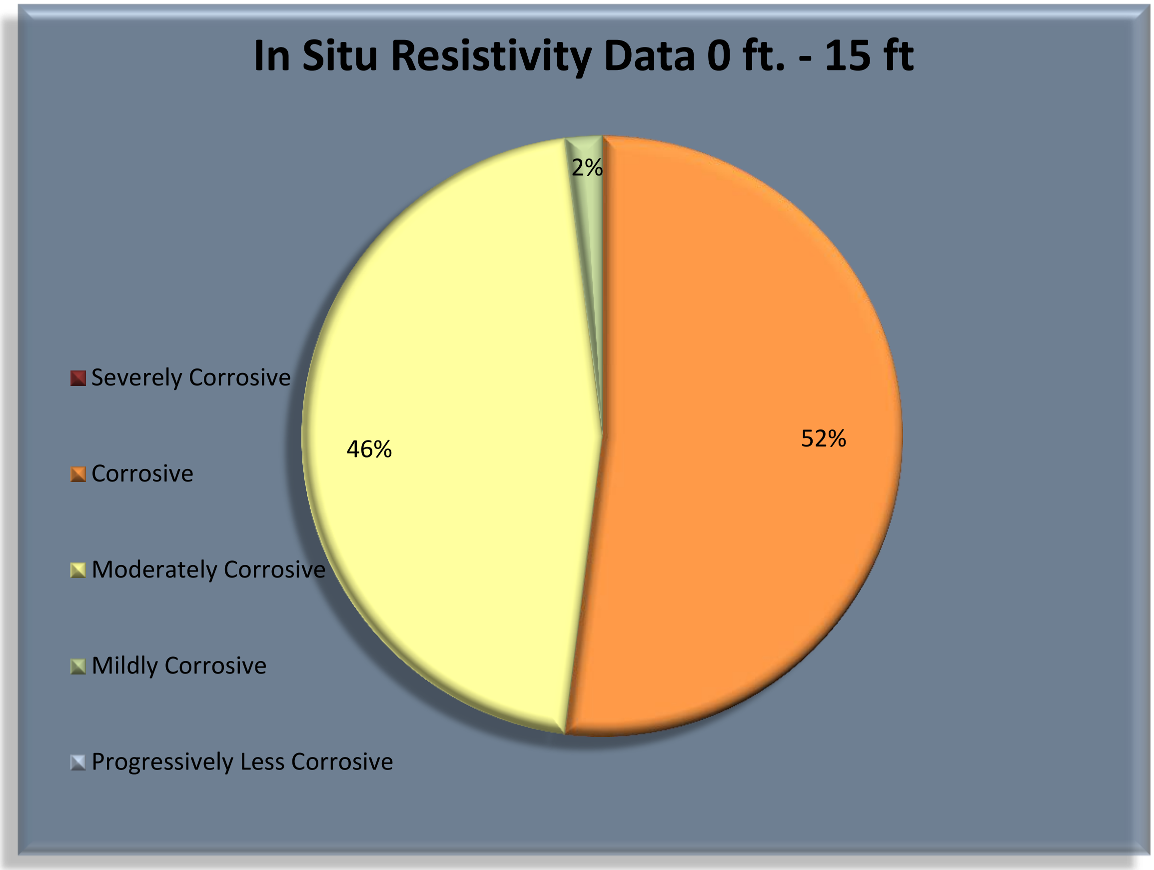
Corrosion of a metal is an electro-chemical process and is accompanied by the flow of electric current. Resistivity is a measure of the ability of a soil to conduct an electric current and is, therefore, an important parameter in consideration of corrosion data. Soil resistivity is primarily dependent upon the chemical content and moisture content of the soil mass.

The greater the amount of chemical constituents present in the soil, the lower the resistivity will be. As moisture content increases, resistivity decreases until maximum solubility of dissolved chemicals is attained. Beyond this point, an increase in moisture content results in dilution of the chemical concentration and resistivity increases. The corrosion rate of steel in soil normally increases as resistivity decreases. Therefore, in any particular group of soils, maximum corrosion will generally occur in the lowest resistivity areas. The following classification of soil corrosivity, developed by William J. Ellis[1], is used for the analysis of the soil data for the project site.

Resistivity (Ohm-cm)	Corrosivity Classification
0 – 500	Very Corrosive
501 – 2,000	Corrosive
2,001 – 8,000	Moderately Corrosive
8,001 – 32,000	Mildly Corrosive
> 32,000	Progressively Less Corrosive

The above classifications are appropriate for the project site and the results are presented in the graph below. In general, the soils are classified as “corrosive to mildly corrosive” with respect to corrosion of buried steel structures throughout the top 0 to 15 feet of the site.

The chart of the in-situ soil resistivity data for the soil layers 0 to 15 feet indicate that 52% of the soils are classified as “corrosive”, 46% of the soils are classified as “moderately corrosive” and 2% of the soils are classified as “mildly corrosive”.



Discussion

Underground Metallic Pipelines

The soils at the project sites are generally considered to be “corrosive to mildly corrosive” to ductile/cast iron, steel and dielectric coated steel. Therefore, special requirements for corrosion control are required for buried metallic utilities at these sites depending upon the critical nature of the piping. Pressure piping systems such as domestic and fire water should be provided with appropriate coating systems and cathodic protection, where warranted. In addition, all underground pipelines should be electrically isolated from above grade structures, reinforced concrete structures and copper lines in order to avoid potential galvanic corrosion problems.

Recommendations

Ductile Iron Pipe (Pressure Piping such as Domestic Water and Fire)

1. Direct buried ductile iron pipe should be encased in 8-mil polyethylene as specified in AWWA specification C-105. Epoxy coatings are also an acceptable alternative type of coating system for the pipe and/or fittings such as valves.

2. All rubber gasket joints, fusion-bonded epoxy coated flanges and flexible couplings on ductile iron pipelines should be bonded with insulated copper cable to insure electrical continuity of the pipeline and fittings.

3. Insulating flanges and/or couplings should be installed to electrically isolate the buried portion of pipeline from other metallic pipelines, reinforced concrete structures and above grade buildings or structures.

4. Test stations shall be installed on all ductile iron pipelines at a spacing of 800 to 1,000 feet. Bonding and test stations shall comply with NACE Standards.

5. A sacrificial type of cathodic protection utilizing ***magnesium*** anodes should be installed to protect the entire length of buried metallic pipeline. Cathodic protection should be designed in accordance with NACE Standard SP0169-13 and applicable local standards and included with the contract documents to permit installation along with the pipeline.

6. As an alternate, non-metallic piping may be used in lieu of ductile iron piping as allowed by State and local codes. Non-metallic piping does not require the implementation of any special type of corrosion prevention measures. However, all metallic valves, fittings and appurtenances on non-metallic piping will require protection as specified below.

Ductile Iron Fittings & Metallic Valves (On Plastic Pressure Piping)

1. All direct buried ductile iron fittings installed on non-metallic piping shall be provided with a bituminous coating from the factory and encased in an 8-mil polyethylene bag in the field in accordance with AWWA Specification C-105. All bolts, restraining rods, etc. shall be coated with bitumastic prior to encasement in the polyethylene bag.

2. All metallic valves shall be coated from the factory (i.e. using powdered epoxy or equivalent type of coating system) and all bolts shall be coated with bitumastic in the field and the entire valve shall be encased in an 8-mil polyethylene bag in accordance with AWWA Specification C-105.

3. A sacrificial type of cathodic protection utilizing ***magnesium*** anodes should be installed to protect the valves and fittings. Cathodic protection should be designed in accordance with NACE Standard SP0169-13 and applicable local standards and included with the contract documents to permit installation along with the pipeline.

Cast Iron (Gravity Sewer and Storm Drain Lines)

1. No special corrosion considerations are required for gravity sewer and storm drain lines, unless they are under the building foundation, then the piping should be encased in 8-mil polyethylene.

Steel Pipelines (Natural Gas Pipelines & Risers)

1. A fusion-bonded epoxy coating system or a suitable tape coating should be applied to all buried steel pipelines in accordance with ANSI/AWWA C214-95, "AWWA Standard for Tape Coating Systems for the Exterior of Steel Water Pipelines." Also, a tape coating per AWWA Standard C209-95 is recommended for special sections, connections and fittings.

2. Insulating flanges and/or couplings should be installed to electrically isolate the buried portions of steel pipelines from other metallic pipelines, reinforced concrete structures and above grade structures.

3. All rubber gasket joints, fusion epoxy coated flanges and flexible couplings should be bonded with insulated copper cable to insure electrical continuity of the pipeline and fittings.

4. A sacrificial type of cathodic protection using ***magnesium*** anodes should be installed to protect the buried portions of steel pipelines used for the natural gas piping systems. Cathodic protection should be designed in accordance with NACE Standard SP0169-13 and applicable local standards and included with the contract documents to permit installation along with the subject pipeline.

5. As an alternate, non-metallic piping may be used in lieu of steel piping as allowed by State and local codes. Non-metallic piping does not require the implementation of any special type of corrosion prevention measures.

Copper Water Pipelines (Service Lines)

1. All copper water laterals shall be provided with a 6-mil polyethylene sleeve to effectively isolate the copper piping from the earth.

2. All copper water laterals shall be electrically isolated from metallic water mains via the use of insulating type corporation stops installed at the water main.

Stainless Steel Risers

1. Direct buried stainless steel risers should be primed and wrapped with Polyguard 'RD-6' coating system.

2. Insulating flanges and/or couplings should be installed to electrically isolate the buried portion of the stainless steel riser from other metallic pipelines, reinforced concrete structures and above grade buildings or structures.

3. A sacrificial type of cathodic protection utilizing ***magnesium*** anodes should be installed to protect the buried portions of the stainless steel riser used for the water piping systems. Cathodic protection should be designed in accordance with NACE Standard SP0169-13 and applicable local standards and included with the contract documents to permit installation along with the subject pipeline.

LIMITATIONS

The conclusions and recommendations contained in this report reflect the opinion of the author of this report and are based on the information and assumptions referenced herein. All services provided herein were performed by persons who are experienced and skilled in providing these types of services and in accordance with the standards of workmanship in this profession. No other warrantees or guarantees either expressed or implied are provided.

We thank you for the opportunity to be of assistance on this important project. If you have any questions concerning this report or the recommendations provided herein, please feel free to contact us at (925) 927-6630.

Respectfully submitted,

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CC: File 19252

REFERENCES

1. *Ellis, William J., Corrosion of Concrete Pipelines, Western States Corrosion Seminar, 1978*

2. *AWWA Manual of Water Supply Practices - M27, First Edition, External Corrosion - Introduction to Chemistry and Control (Denver, CO: 1987)*

3. *National Association of Corrosion Engineers, Standard Recommended Practice, SP 01-69-13, Control of External Corrosion on Underground or Submerged Pipeline*

	ARUP		
Project:	***19252: Gilroy Resistivities***	Severely Corrosive	Mildly Corrosive
Location:	***Gilroy, CA***	Corrosive	Progressively Less Corrosive
Date:	***10/15/2019***	Moderately Corrosive	
Subject:	***In-Situ Soil Resistivity Data***		

*Test	Location	Resistance Data From AEMC Meter					Soil Resistivities (ohm-cm)					Barnes Layer Analysis (ohm-cm)				
#	Description	2.5	5	7.5	10	15	2.5	5	7.5	10	15	0-2.5'	2.5-5'	5-7.5'	7.5-10'	10-15'
1	R1 N/S	3.11	1.65	1.16	1.03	0.73	1489	1580	1666	1972	2097	1489	1683	1870	4400	2400
2	R1 E/W	3.38	1.75	1.39	1.21	0.98	1618	1676	1996	2317	2815	1618	1737	3235	4473	4937
3	R2 N/S	3.84	1.91	1.26	1.01	0.83	1838	1829	1810	1934	2384	1838	1819	1773	2437	4459
4	R2 E/W	3.14	1.83	1.52	1.03	0.57	1503	1752	2183	1972	1637	1503	2100	4296	1530	1222
5	R3 N/S	4.06	2.03	1.20	0.96	0.80	1944	1944	1724	1838	2298	1944	1944	1405	2298	4596
6	R3 E/W	4.19	2.89	2.26	1.53	1.19	2006	2767	3246	2930	3418	2006	4459	4963	2268	5127
7	R4 N/S	2.30	1.39	1.20	1.06	0.86	1101	1331	1724	2030	2470	1101	1682	4203	4350	4364
8	R4 E/W	2.91	1.68	1.17	0.96	0.85	1393	1609	1680	1838	2442	1393	1903	1845	2561	7103
9	R5 N/S	3.08	1.18	0.88	0.78	0.69	1475	1130	1264	1494	1982	1475	916	1657	3286	5726
10	R5 E/W	2.49	1.42	0.98	0.75	0.70	1192	1360	1408	1436	2011	1192	1582	1514	1530	10054