Geotechnical Data Report

Proposed Industrial Technology Building at Clover Park Technical College

Lakewood, Washington

Prepared for

Schreiber Starling & Lane Architects

June 23, 2016

19220-00

HARTCROWSER

HARTCROWSER

www.hartcrowser.com

Geotechnical Data Report

Proposed Industrial Technology Building at Clover Park Technical College

Lakewood, Washington

Prepared for

Schreiber Starling & Lane Architects

June 23, 2016

19220-00

Prepared by

Hart Crowser, Inc.

Matthew W. Veenstra, PE
Senior Project
Geotechnical Engineer

Barry S. Chen, PhD, PE
Senior Principal

BARRY SHIYO CHEN
STATE OF WASHINGTON
34063
REGISTERED
PROFESSIONAL ENGINEER

6/23/2016

3131 Elliott Avenue, Suite 600
Seattle, Washington 98121
Fax 206.328.5581
Tel 206.324.9530

Contents

PROJECT AND SITE DESCRIPTION 1

REGIONAL AND SITE SEISMIC SETTING 2

REGIONAL AND SITE GEOLOGY 2

SUBSURFACE CONDITIONS 2

Exploration Program **2**

Subsurface Soil Conditions **3**

Groundwater Conditions **3**

REFERENCES 3

FIGURES

1 Vicinity Map

2 Site and Exploration Plan

APPENDIX A

Field Exploration Methods and Analysis

APPENDIX B

Laboratory Testing Program

Geotechnical Data Report

Proposed Industrial Technology Building at Clover Park Technical College

Lakewood, Washington

This data report presents our field and laboratory procedures and resulting data from our subsurface investigation performed for the proposed Industrial Technology Building at Clover Park Technical College in Lakewood, Washington.

Our proposed scope of work included the following:

- Drill four 30 feet deep borings and one 80 feet deep boring
- Sample review and laboratory testing
- Geotechnical data report including the following:
    - Site plan showing the locations of the soil borings
    - Logs of the test borings
    - The results of the field and laboratory testing
    - Summary of observed and interpreted subsurface conditions.

This geotechnical data report has been prepared under the assumption that the design-build procurement method will be used for the design and construction of the project. It is the responsibility of the design-builder to evaluate the information presented in this report and provide geotechnical design and construction recommendations.

We completed this work in general accordance with our proposal signed May 12, 2016 and Additional Service #1 authorized May 25, 2016. This report is for the exclusive use of Schreiber Starling & Lane Architects, and their design consultants, for specific application to this project and site. We completed this work in accordance with generally accepted geotechnical engineering practices for the nature and conditions of the work completed in the same or similar localities, at the time the work was performed. We make no other warranty, express or implied.

PROJECT AND SITE DESCRIPTION

The project consists of demolition of an existing warehouse building and construction of a new building located partially within the footprint of the demolished building. The finished floor of the existing building is about 4 feet above the surrounding ground surface. Plans of the existing building were not provided; however, we expect that there is soil fill below the slab-on-grade floor. The surrounding ground surface is paved with asphalt and varies in elevation from about 266 to 269 feet (NAVD88) based on review of the topographic survey (AHBL 2016). We understand that the new building will not include abasement.

The site vicinity and location are shown on Figures 1 and 2.

REGIONAL AND SITE SEISMIC SETTING

The seismicity of western Washington is dominated by the Cascadia Subduction Zone, where the offshore Juan de Fuca plate subducts beneath the continental North American plate. Three main types of earthquakes are typically associated with subduction zone environments: crustal, intraplate, and interplate earthquakes. Seismic records in the Puget Sound area clearly indicate a distinct shallow zone of crustal seismicity (e.g., the Tacoma Fault Zone), which may have surficial expressions and can extend to depths of 16 to 19 miles. A deeper zone is associated with the subducting Juan de Fuca plate and produces intraplate earthquakes at depths of 25 to 43 miles beneath the Puget Sound region (e.g., the 1949, 1964, and 2001 earthquakes) and interplate earthquakes at shallow depths near the Washington coast (e.g., the 1700 earthquake with an approximate magnitude of 9.0).

Geologic maps indicate that the southern-most splay of the Tacoma Fault Zone is about 6 miles north-northeast of the site in plan view (Washington State DNR 2016).

REGIONAL AND SITE GEOLOGY

The Puget Lowland is nestled between the Cascade Mountains and Olympic Mountains/Coast Range in western Washington. This area has been subjected to several major glaciations, which have left behind a complex sequence of glacially derived and interglacial sediment. These glaciations are characterized by an intricate sequence of lacustrine deposits, glaciomarine drift, till, and recessional outwash.

The geology of the Puget Lowland is further complicated with the erosion and deposition of sediment during succeeding nonglacial and glacial intervals. During the most recent glaciation, the Vashon Glaciation, the Puget Sound area was covered with 3,000 feet of ice about 15,000 years ago.

The project site is located in an area where shallow subsurface soils are typically a recessional outwash unit, referred to as Steilacoom Gravel, which was deposited during the last glacial retreat. Steilacoom Gravel is generally a sandy gravel with cobbles and boulders. The soils we observed in our borings are generally consistent with Steilacoom Gravel.

SUBSURFACE CONDITIONS

Exploration Program

Our understanding of the subsurface conditions is based on our review of mapped geology and the borings we have drilled near the proposed building. Subsurface conditions interpreted from explorations at discrete locations on the site and soil properties inferred from the field and laboratory tests formed the basis of the geotechnical recommendations in this report. The nature and extent of variations between explorations may not become evident until additional explorations are performed or construction begins. General soil and groundwater conditions are addressed below. Refer to exploration logs for more detailed information at specific locations.

Hart Crowser completed four borings near the four corners of the proposed building. Borings HC-1 to HC-3 were drilled to 30 feet below ground surface (bgs) and boring HC-4 was drilled to 40 feet bgs. After completing these initial borings, we later drilled an additional boring, HC-4A, to 75 feet bgs.

The boring locations are shown on Figure 2. The boring logs and laboratory results are provided in Appendices A and B, respectively.

Subsurface Soil Conditions

All of the borings encountered 2 inches of asphalt pavement. Below the pavement is about 1.8 to 4 feet of loose to medium dense, moist, dark gray, slightly silty, sandy gravel to very gravelly sand with organic fines; some portion of this soil layer may include fill transported from other parts of the site. Below about 1.8 to 4 feet bgs, there is loose to medium dense, moist, gray-brown to brown-gray, sandy gravel with trace silt and scattered cobbles to a depth of about 27 to 33 feet bgs. Below this soil layer, Borings HC-3 and HC-4 encountered loose to medium dense, wet, gray-brown to brown-gray, fine to medium sand to slightly silty sand. Through not observed, scattered boulders may also be present throughout these soils layers.

To provide additional, deeper information, HC-4A was later drilled to 75.5 feet bgs. HC-4A is located adjacent to HC-4 and sampling was started at 35 feet bgs. HC-4A encountered medium dense, wet, brown-gray, fine to medium sand to slightly silty sand from 35 feet to about 46.5 feet bgs. Below this layer, we encountered dense to very dense, wet, gray to light gray, sandy to very sandy gravel with zones of gravelly sand and trace silt. Though not observed, scattered cobbles or boulders may also be present in this soil layer.

Groundwater Conditions

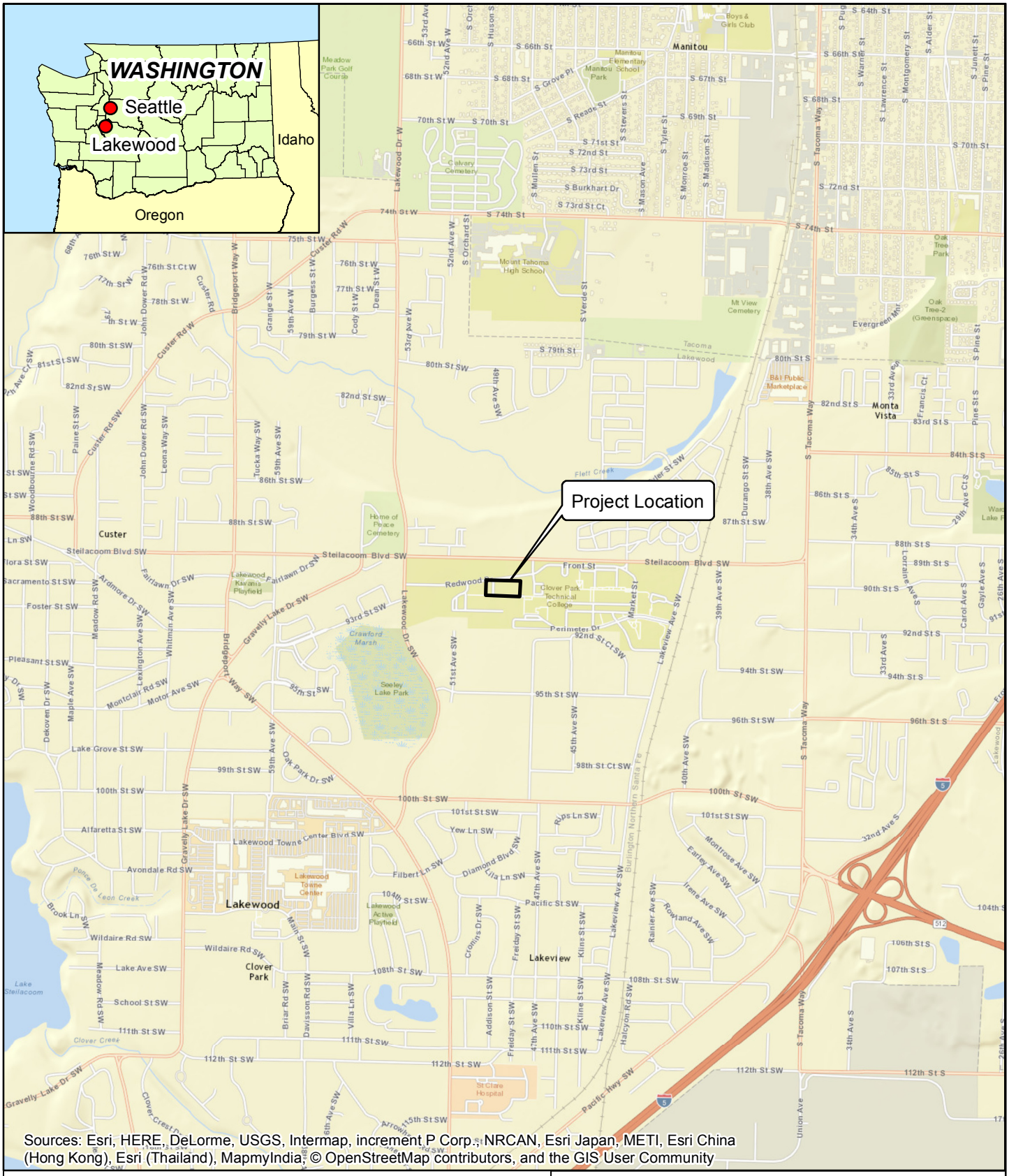
Borings HC-4 and HC-4A encountered groundwater, at the time of drilling, at depths of 33.5 and 34.2 (elevation 234.5 and 233.8) feet, respectively. Monitoring wells were not installed.

REFERENCES

AHBL 2016. Clover Park Technical College Building 22, Topographic Survey. April 27, 2016.

U.S. Geological Survey 1997. Steilacoom Quadrangle, Washington, Pierce County, 7.5 Minute Series (Topographic).

Washington State Department of Natural Resources 2014. Washington State Geologic Information Portal – Washington State Interactive Geologic Map. http//www.dnr.wa.gov/ResearchScience/Topics/GeosciencesData/Pages/geology_portal.aspx. Accessed June 2016.



0 1,000 2,000 4,000 Feet

N

Proposed Industrial Technology Building at
Clover Park Technical College
Lakewood, Washington

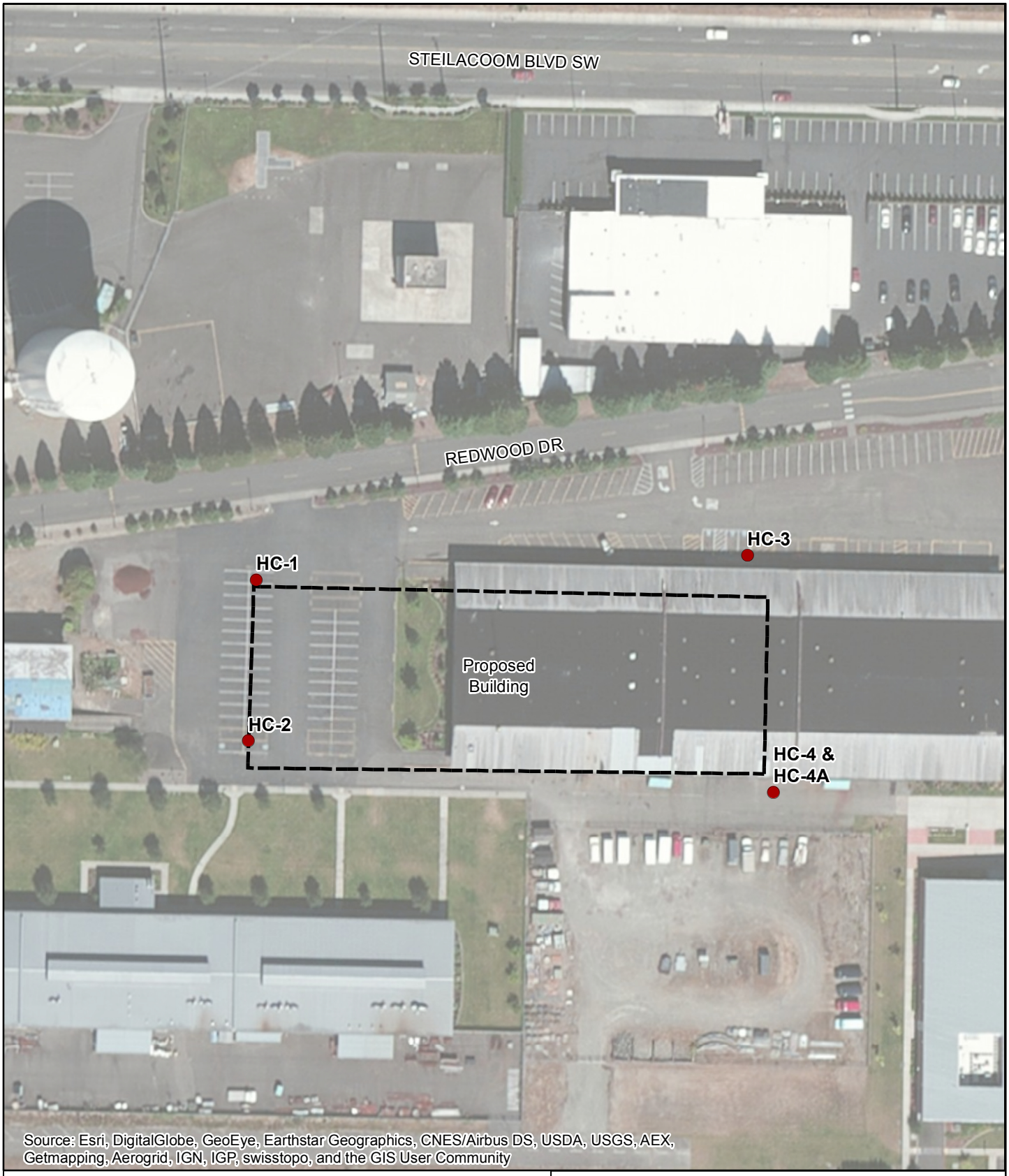
Vicinity Map

19220-00 6/16

HARTCROWSER

Figure
1

Document Path: L:\Notebooks\1922000_Clover Park Technical College\GIS\1922000_VMap.mxd Date: 6/7/2016 User Name: melissaschweitzer



LEGEND

Boring

Proposed Building

0 50 100 200 Feet

Note: Feature locations are appoximate.

N

Proposed Industrial Technology Building at
Clover Park Technical College
Lakewood, Washington

Site and Exploration Plan

19220-00 6/16

HARTCROWSER

Figure

2

Document Path: L:\Notebooks\1922000_Clover Park Technical College\GIS\1922000_SP.mxd Date: 6/7/2016 User Name: melissaschweitzer

APPENDIX A
Field Exploration Methods and Analysis

APPENDIX A

Field Exploration Methods and Analysis

This appendix documents the processes Hart Crowser used to determine the nature of the soils at the project site in the following sections:

- Explorations and Their Locations
- Hollow Stem Auger Borings
- Mud Rotary Boring
- Standard Penetration Test Procedures

Explorations and Their Locations

The exploration logs in this appendix show our interpretation of the drilling, sampling, and testing data. These logs indicate the approximate depth where the soils change. The changes between soil texture, density, moisture, etc., may be gradual and may vary in depth across the site.

In the field, we classified the soil samples according to the methods shown on Figure A-1, Key to Exploration Logs. This figure's legend explains the symbols and abbreviations used on the logs.

Figure 2 in the main report shows the explorations, located by measuring from existing site features with a measuring tape. Elevations are referenced to the North American Vertical Datum of 1988 (NAVD88) and were estimated from elevation contours on a topographic survey by AHBL.

Hollow Stem Auger Borings

Borings HC-1 to HC-4 were drilled with a 4-1/4-inch inside diameter hollow-stem auger advanced by a truck-mounted drill rig subcontracted by Hart Crowser. A representative from Hart Crowser continuously observed the drilling. We prepared a detailed field log of the boring. Because of the anticipated very gravelly soils we used a three-inch diameter split spoon sampler and a 300 pound automatic trip hammer. We obtained samples at 2-1/2- to 5-foot-depth intervals.

Mud Rotary Boring

Boring HC-4A was drilling using mud rotary methods below 35 feet bgs. The boring was drilled using a 3-7/8-inch-diameter tri-cone bit and were advanced with a truck-mounted drill rig subcontracted by Hart Crowser. The drilling was continuously observed by a Hart Crowser representative. Detailed field logs were prepared of each boring. Using the Standard Penetration Test (SPT), we obtained samples at 5-foot-depth intervals.

Standard Penetration Test Procedures

This test was used with Boring HC-4A.

The standard penetration test (SPT) is an approximate measure of soil density and consistency. To be useful, the results must be interpreted in conjunction with other tests. We used the SPT (as described in ASTM D1586) to obtain disturbed soil samples.

This test employs a standard split-spoon sampler with an outside diameter of 2 inches. Using a 140-pound autohammer free-falling 30 inches, the sampler is driven into the soil for 18 inches. The number of blows required to drive the sampler the last 12 inches is the standard penetration resistance. This resistance, or blow count, measures the relative density of granular soils and the consistency of cohesive soils. The blow counts are plotted on the boring logs at their respective sample depths.

Soil samples were recovered from the split-spoon sampler, field classified, and placed into watertight jars. They were taken to Hart Crowser's laboratory for further testing.

Occasionally, very dense materials preclude driving the total 18-inch sample. When this happens, the penetration resistance is entered on logs as described below.

Penetration less than 6 inches. The log indicates the total number of blows over the number of inches of penetration.

Penetration greater than 6 inches. The blow count noted on the log is the sum of the total number of blows completed after the first 6 inches of penetration. This sum is expressed over the number of inches driven that exceed the first 6 inches. The number of blows needed to drive the first 6 inches is not reported. For example, a blow count series of 12 blows for 6 inches, 30 blows for 6 inches, and 50 (the maximum number of blows counted within a 6-inch increment for SPT) for 3 inches would be recorded as 80/9.

Non-Standard Penetration Test Procedures

A 3-inch-diameter split spoon sampler and 300-pound autohammer free-falling 30 inches was used for samples obtained in Borings HC-1 to HC-4. This was done in anticipation of very gravelly soils that would block the opening to a standard 2-inch-diameter sampler. This sampling method is assumed to provide blow counts roughly equivalent to Standard Penetration Test samples using a 2-inch-diameter split spoon sampler and 140-pound autohammer free-falling 30 inches.

Other than the sampler diameter and hammer weight, the procedure and intent are the same as for the standard penetration test described above.

Key to Exploration Logs

Sample Description

Classification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field nor laboratory testing unless presented herein. Visual-manual classification methods of ASTM D 2488 were used as an identification guide.

Soil descriptions consist of the following:
Density/consistency, moisture, color, minor constituents, MAJOR CONSTITUENT, additional remarks.

Density/Consistency

Soil density/consistency in borings is related primarily to the Standard Penetration Resistance. Soil density/consistency in test pits and probes is estimated based on visual observation and is presented parenthetically on the logs.

SAND or GRAVEL Density	Standard Penetration Resistance (N) in Blows/Foot	SILT or CLAY Consistency	Standard Penetration Resistance (N) in Blows/Foot	Approximate Shear Strength in TSF
Very loose	0 to 4	Very soft	0 to 2	<0.125
Loose	4 to 10	Soft	2 to 4	0.125 to 0.25
Medium dense	10 to 30	Medium stiff	4 to 8	0.25 to 0.5
Dense	30 to 50	Stiff	8 to 15	0.5 to 1.0
Very dense	>50	Very stiff	15 to 30	1.0 to 2.0
		Hard	>30	>2.0

Sampling Test Symbols

- 1.5" I.D. Split Spoon
- Grab (Jar)
- 3.0" I.D. Split Spoon
- Shelby Tube (Pushed)
- Bag
- Cuttings
- Core Run

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

Moisture

Dry	Little perceptible moisture
Damp	Some perceptible moisture, likely below optimum
Moist	Likely near optimum moisture content
Wet	Much perceptible moisture, likely above optimum

Minor Constituents

Minor Constituents	Estimated Percentage
Trace	<5
Slightly (clayey, silty, etc.)	5 - 12
Clayey, silty, sandy, gravelly	12 - 30
Very (clayey, silty, etc.)	30 - 50

Laboratory Test Symbols

GS	Grain Size Classification
CN	Consolidation
UU	Unconsolidated Undrained Triaxial
CU	Consolidated Undrained Triaxial
CD	Consolidated Drained Triaxial
QU	Unconfined Compression
DS	Direct Shear
K	Permeability
PP	Pocket Penetrometer Approximate Compressive Strength in TSF
TV	Torvane Approximate Shear Strength in TSF
CBR	California Bearing Ratio
MD	Moisture Density Relationship
AL	Atterberg Limits
PID	Photoionization Detector Reading
CA	Chemical Analysis
DT	In Situ Density in PCF
OT	Tests by Others

Water Content in Percent
Liquid Limit
Natural
Plastic Limit

Groundwater Indicators

- Groundwater Level on Date or (ATD) At Time of Drilling
- Groundwater Seepage (Test Pits)

Sample Key

Sample Type
Sample Recovery
S-1
12
23
50/3"
Sample Number
Blows per 6 inches

HARTCROWSER

19220-00 *5/16*

Figure A-1

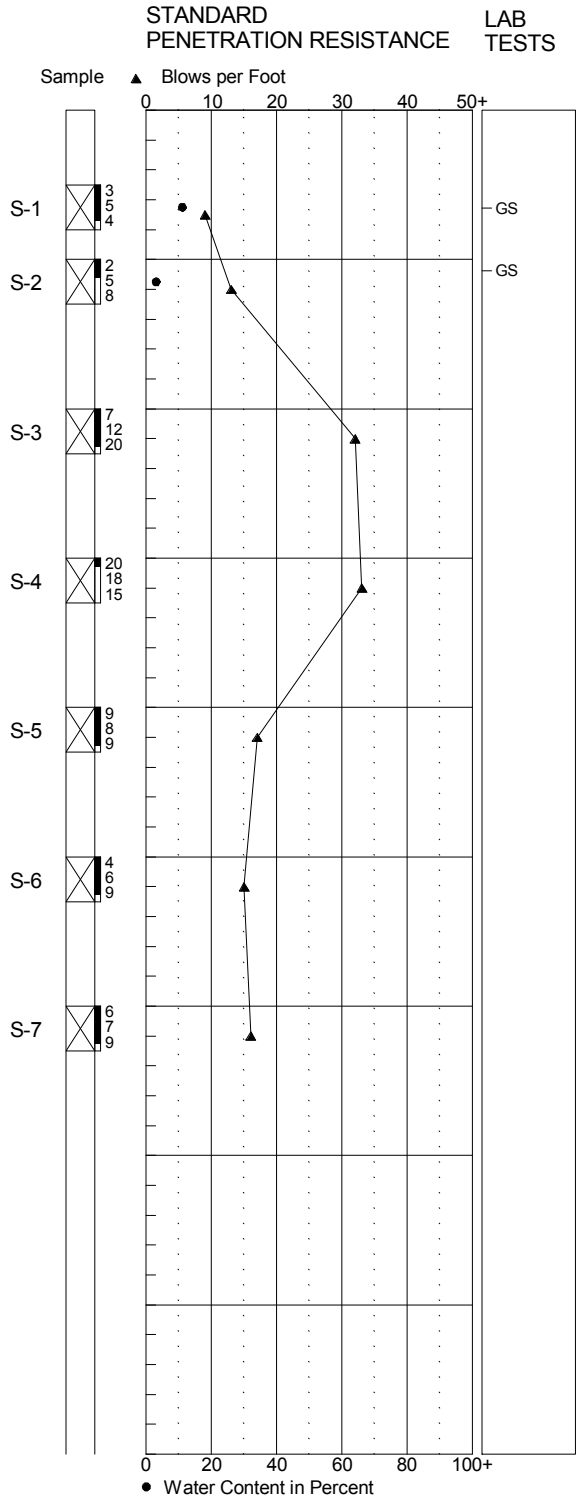
KEY SHEET 1922000-BL.GPJ HC_CORP.GDT 6/5/16

Boring Log HC-1

Location: Lat 47.175446, Lon -122.502625
Approximate Ground Surface Elevation: 267.3 Feet
Horizontal Datum: WGS84
Vertical Datum: NAVD88

Drill Equipment: Mobile B-60/HSA
Hammer Type: 3 inch split spoon with 300 lb. Autohammer
Hole Diameter: 4.25 inches
Logged By: B. McDonald Reviewed By: J. Bruce

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet
GP-GM		2 inches of Asphalt over loose, moist, dark gray to black, slightly silty, sandy GRAVEL with organic fines. (Potential FILL)	0
GW		Medium dense, moist, brown to brown-gray, sandy GRAVEL with trace silt and scattered cobbles.	5
			10
			15
			20
			25
			30
		Bottom of Boring at 31.5 Feet. Started 05/23/16. Completed 05/23/16.	35
			40
			45



NEW BORING LOG 1922000-BL.GPJ HC_CORP.GDT 6/6/16

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

19220-00 *5/16*

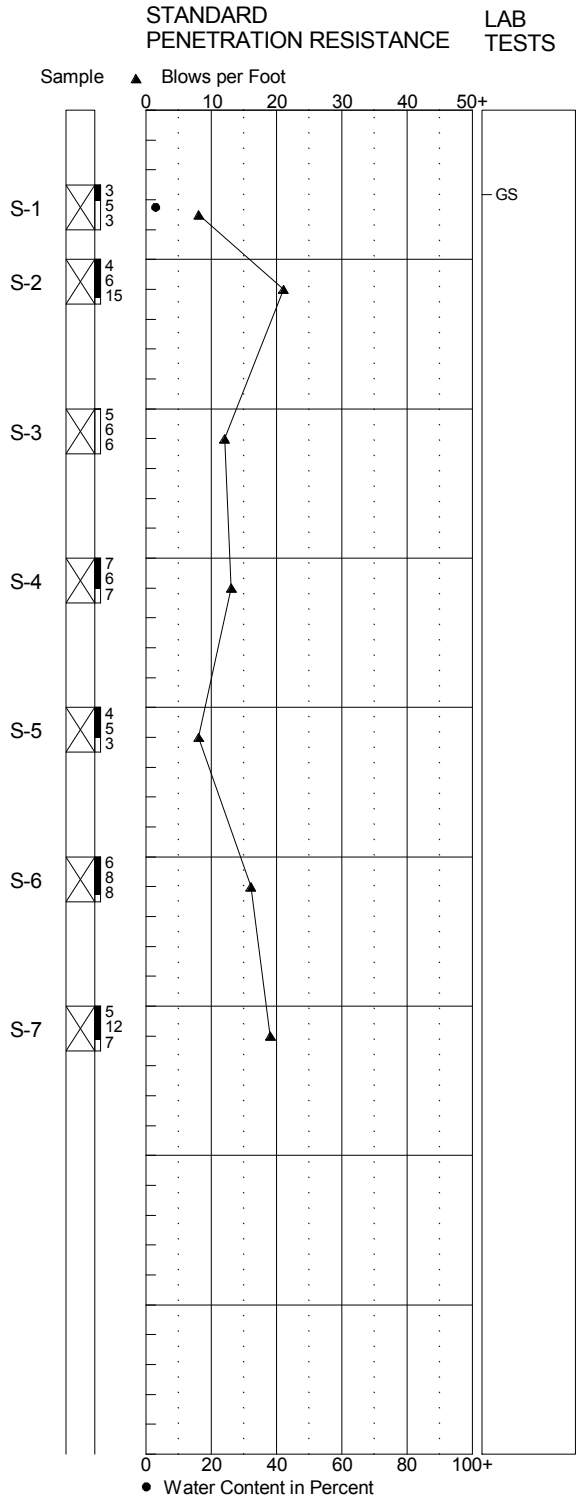
Figure A-2

Boring Log HC-2

Location: Lat 47.175116, Lon -122.502638
Approximate Ground Surface Elevation: 266.5 Feet
Horizontal Datum: WGS84
Vertical Datum: NAVD88

Drill Equipment: Mobile B-60/HSA
Hammer Type: 3 inch split spoon with 300 lb. Autohammer
Hole Diameter: 4.25 inches
Logged By: B. McDonald Reviewed By: J. Bruce

USCS Class	Soil Descriptions	Depth in Feet
GP-GM	2 inches of Asphalt over loose, moist, dark gray to black, slightly silty, sandy GRAVEL with organic fines.	0
GW	Loose to medium dense, moist, gray-brown, sandy GRAVEL to very gravelly SAND with trace silt and scattered cobbles.	5, 10, 15, 20, 25, 30, 35, 40, 45
	Bottom of Boring at 31.5 Feet. Started 05/23/16. Completed 05/23/16.	



NEW BORING LOG 1922000-BL.GPJ HC_CORP.GDT 6/6/16

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

19220-00 *5/16*

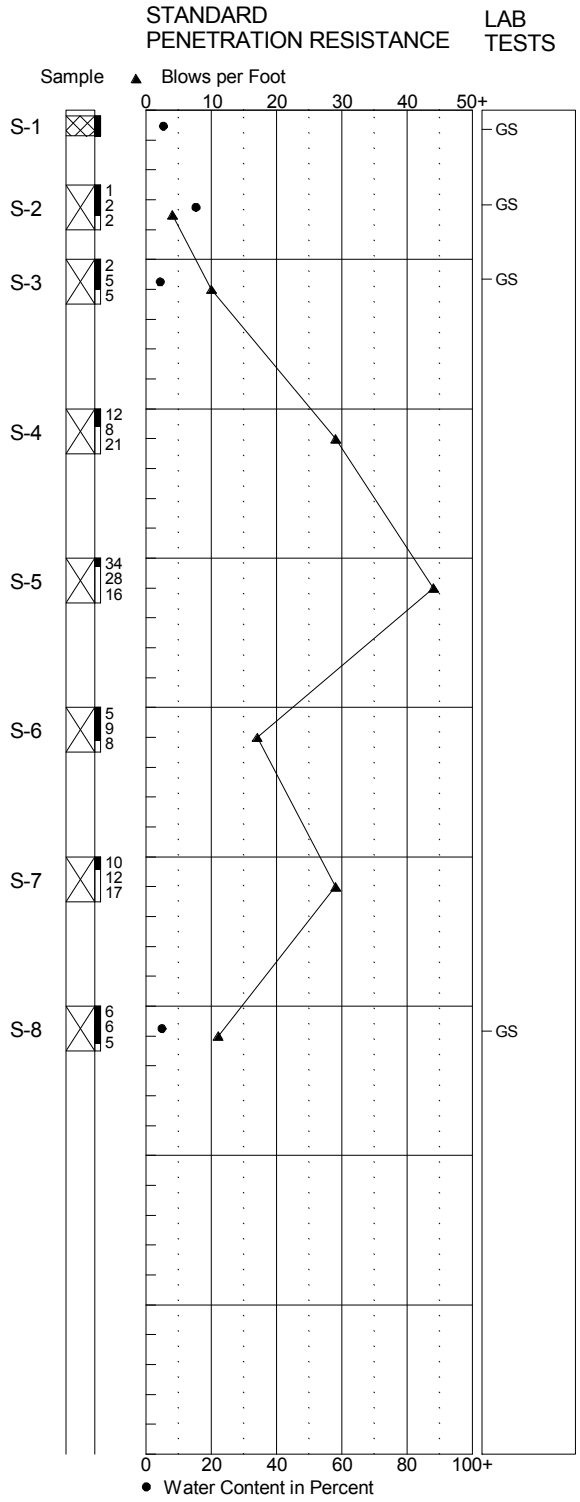
Figure A-3

Boring Log HC-3

Location: Lat 47.175518, Lon -122.501154
Approximate Ground Surface Elevation: 268.7 Feet
Horizontal Datum: WGS84
Vertical Datum: NAVD88

Drill Equipment: Mobile B-60/HSA
Hammer Type: 3 inch split spoon with 300 lb. Autohammer
Hole Diameter: 4.25 inches
Logged By: B. McDonald Reviewed By: J. Bruce

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet
SP-SM		2 inches of Asphalt over brown, slightly silty, very gravelly SAND. (FILL)	0
SM		Loose, moist, dark gray to black, silty, very gravelly SAND with organic fines.	
GW		Loose to medium dense, gray-brown to brown-gray, sandy GRAVEL with trace silt and scattered cobbles.	5
			10
			15
			20
			25
SP		Medium dense, moist, gray-brown to brown-gray, fine to medium SAND with trace silt and gravel.	30
		Bottom of Boring at 31.5 Feet. Started 05/23/16. Completed 05/23/16.	35
			40
			45



NEW BORING LOG 1922000-BL.GPJ HC_CORP.GDT 6/6/16

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

19220-00 *5/16*

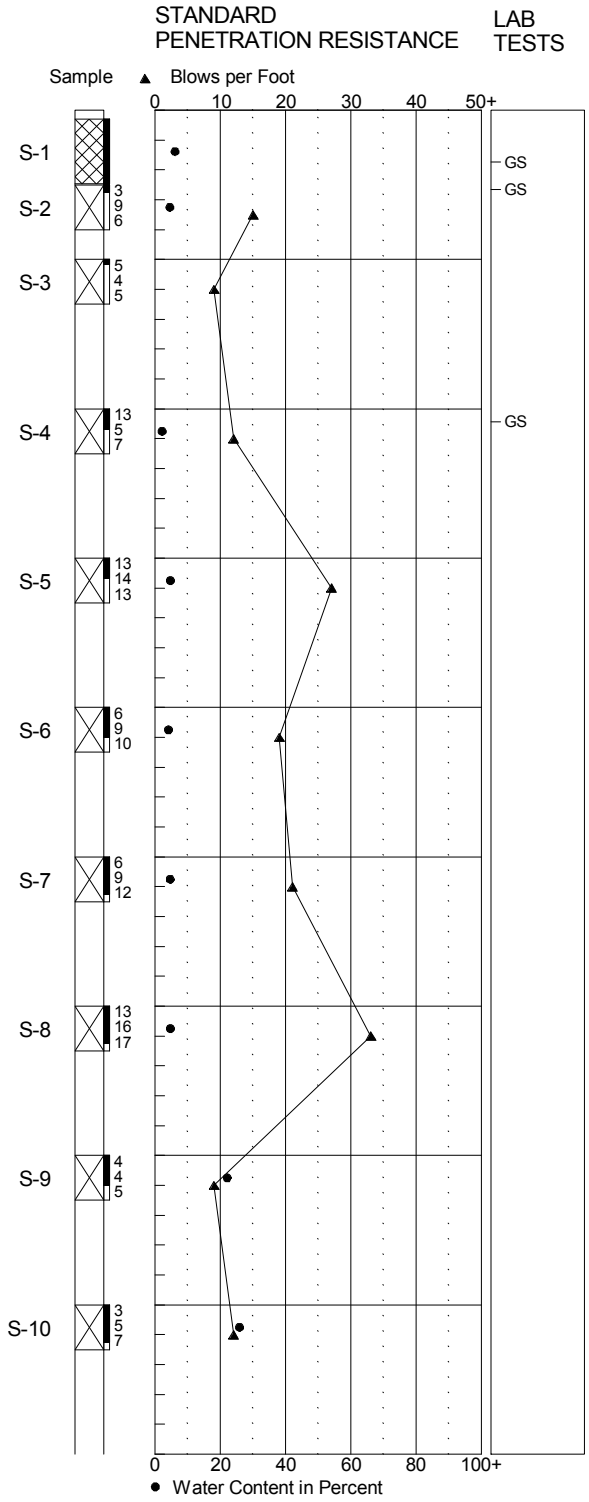
Figure A-4

Boring Log HC-4

Location: Lat 47.175035, Lon -122.501061
Approximate Ground Surface Elevation: 268 Feet
Horizontal Datum: WGS84
Vertical Datum: NAVD88

Drill Equipment: Mobile B-60/HSA
Hammer Type: 3 inch split spoon with 300 lb. Autohammer
Hole Diameter: 4.25 inches
Logged By: B. McDonald Reviewed By: J. Bruce

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet
GW-GM		2 inches of Asphalt over (medium dense) moist, dark gray to black, slightly silty, very sandy GRAVEL with organic fines.	0
GW		Medium dense, moist, gray-brown to brown-gray, sandy GRAVEL with trace silt and scattered cobbles.	5, 10, 15, 20, 25, 30
SP		Loose to medium dense, wet, brown-gray, fine to medium SAND with trace silt and gravel.	ATD, 35, 40
		Bottom of Boring at 41.5 Feet. Started 05/24/16. Completed 05/24/16.	45



NEW BORING LOG 1922000-BL.GPJ HC_CORP.GDT 6/6/16

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

19220-00 *5/16*

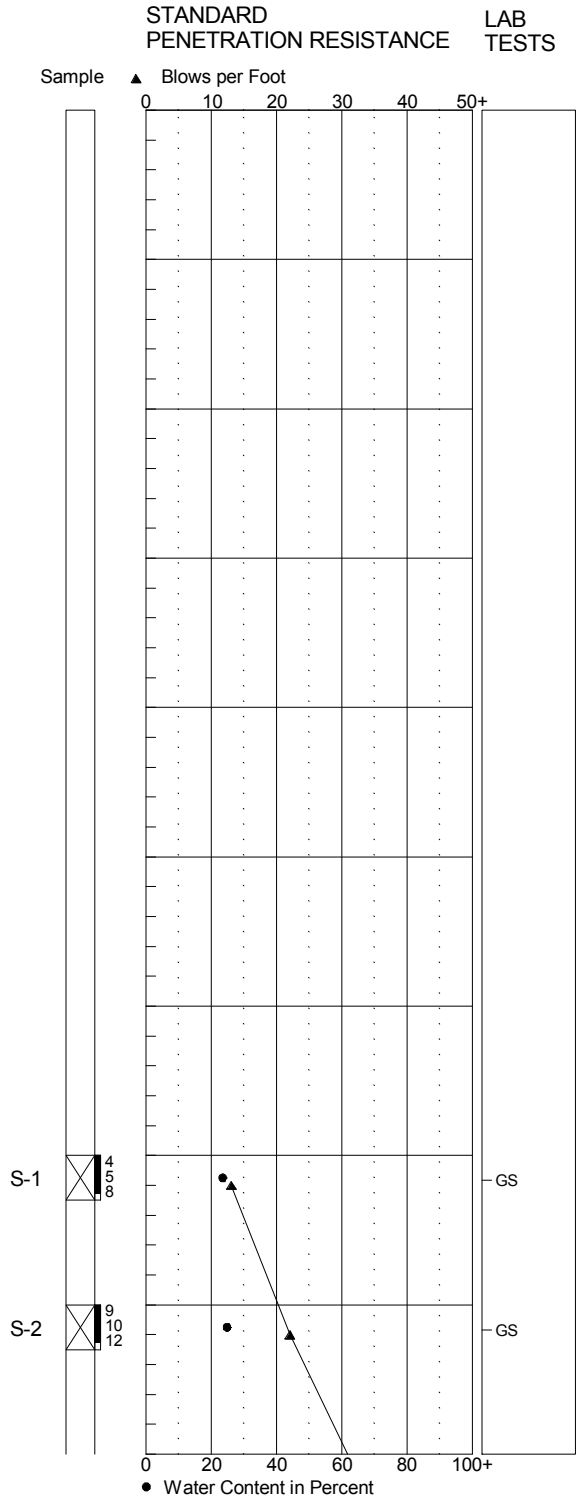
Figure A-5

Boring Log HC-4A

Location: Lat 47.175035, Lon -122.501061
Approximate Ground Surface Elevation: 268 Feet
Horizontal Datum: WGS84
Vertical Datum: NAVD88

Drill Equipment: Mobile B-60/HSA & Mud Rotary
Hammer Type: SPT w/140 lb. Autohammer
Hole Diameter: 4.25/3.9 inches
Logged By: B. McDonald Reviewed By: M. Veenstra

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet
		See HC-4 for data above 35 feet.	0
			5
			10
			15
			20
			25
			30
			ATD
SP-SM		Medium dense, wet, brown-gray, fine to medium SAND to slightly silty SAND.	35
			40
			45



NEW BORING LOG 1922000-BL.GPJ HC_CORP.GDT 6/6/16

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

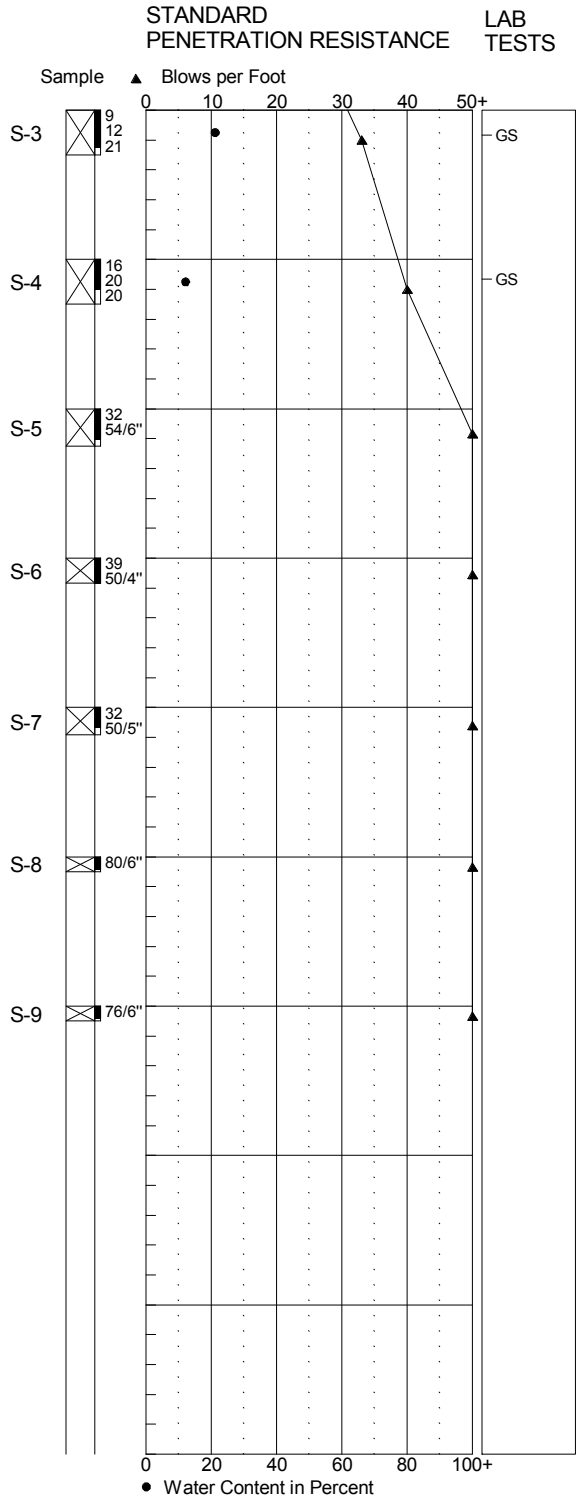
HARTCROWSER

Boring Log HC-4A

Location: Lat 47.175035, Lon -122.501061
Approximate Ground Surface Elevation: 268 Feet
Horizontal Datum: WGS84
Vertical Datum: NAVD88

Drill Equipment: Mobile B-60/HSA & Mud Rotary
Hammer Type: SPT w/140 lb. Autohammer
Hole Diameter: 4.25/3.9 inches
Logged By: B. McDonald Reviewed By: M. Veenstra

USCS Class	Soil Descriptions	Depth in Feet
SP-SM	Light gray SILT seams and partings to 46.5 feet (bottom depth inferred from drill action)	45
GM	Dense to very dense, wet, gray, silty, very sandy GRAVEL.	50
GW	Very dense, wet, light gray, sandy GRAVEL to gravelly SAND.	55
GW	Very dense, wet, gray, sandy to very sandy GRAVEL.	60, 65, 70, 75
	Bottom of Boring at 75.5 Feet. Started 05/31/16. Completed 05/31/16.	80, 85, 90



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

19220-00 *5/16*

Figure A-6 *2/2*

NEW BORING LOG 1922000-BL.GPJ HC_CORP.GDT 6/6/16

APPENDIX B
Laboratory Testing Program

APPENDIX B

Laboratory Testing Program

Laboratory tests were performed for this study to evaluate the basic index and geotechnical engineering properties of the site soils. Both disturbed and relatively undisturbed samples were tested. The tests and procedures are outlined below.

Soil Classification

Soil samples from the explorations were visually classified in the field and then taken to our laboratory, where the classifications were verified in the relatively controlled environment. Field and laboratory observations included density/consistency, moisture condition, and grain size and plasticity estimates.

The classifications of selected samples were checked by laboratory tests such as Atterberg limits determinations and grain size analyses. Classifications were made in general accordance with the Unified Soil Classification (USC) System, ASTM D 2487, as presented on Figure B-1.

Grain Size Analysis

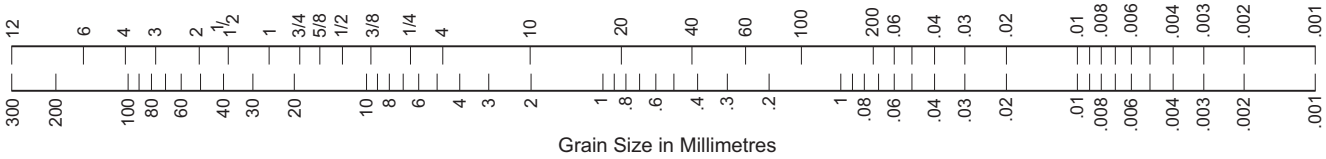
Grain size distribution was analyzed on representative samples in general accordance with ASTM D 422. Wet sieve analysis was used to determine the size distribution greater than the U.S. No. 200 mesh sieve. The size distribution for particles smaller than the No. 200 mesh sieve was determined by the hydrometer method for a selected number of samples. The results of the tests are presented on the figures as curves plotting percent finer by weight versus grain size.

Water Content Determination

Water content was determined for several samples in general accordance with ASTM D2216 as soon as possible following the samples' arrival in our laboratory. Water content was not determined for very small samples or samples in which large gravel content would result in unrepresentative values. The results of these tests are plotted at the respective sample depth on the exploration logs.

Unified Soil Classification (USC) System
Soil Grain Size

Size of Opening In Inches	Number of Mesh per Inch (US Standard)	Grain Size in Millimetres



COBBLES	GRAVEL	SAND	SILT and CLAY
Coarse-Grained Soils			Fine-Grained Soils

Coarse-Grained Soils

G W	G P	G M	G C	S W	S P	S M	S C
Clean GRAVEL <5% fines	*	GRAVEL with >12% fines		Clean SAND <5% fines	*	SAND with >12% fines	
GRAVEL >50% coarse fraction larger than No. 4				SAND >50% coarse fraction smaller than No. 4			
Coarse-Grained Soils >50% larger than No. 200 sieve							

G W and S W $\left(\frac{D_{60}}{D_{10}}\right)$ >4 for G W, >6 for S W & $1 \leq \left(\frac{(D_{30})^2}{D_{10} \times D_{60}}\right) \leq 3$

G P and S P Clean GRAVEL or SAND not meeting requirements for G W and S W

G M and S M Atterberg limits below A line with PI <4

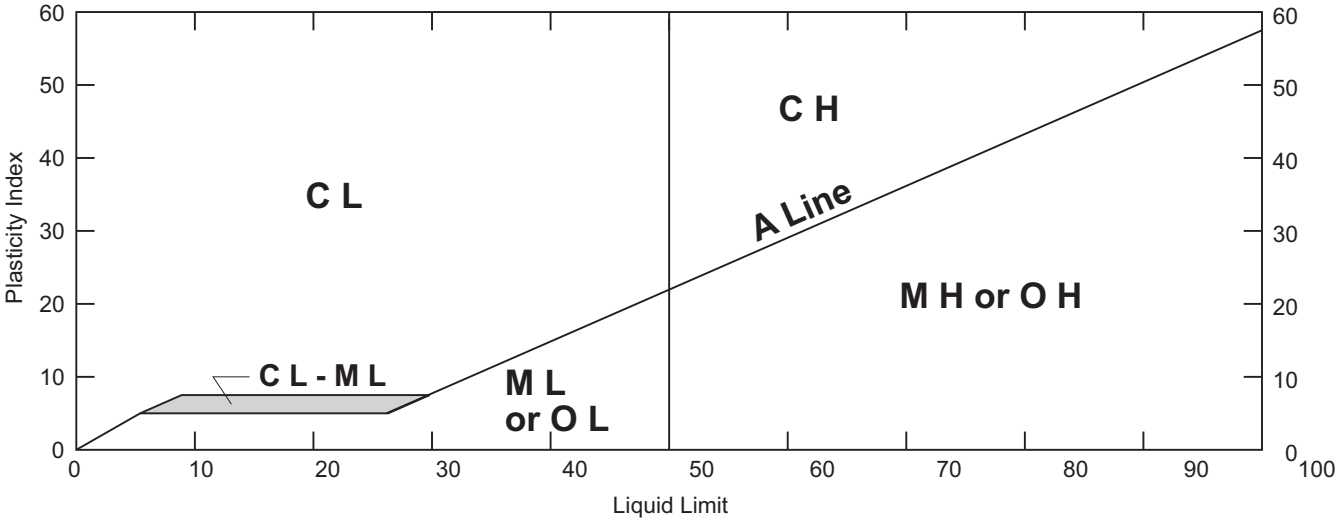
G C and S C Atterberg limits above A Line with PI >7

* Coarse-grained soils with percentage of fines between 5 and 12 are considered borderline cases requiring use of dual symbols.

D_{10}, D_{30}, and D_{60} are the particles diameter of which 10, 30, and 60 percent, respectively, of the soil weight are finer.

Fine-Grained Soils

M L	C L	O L	M H	C H	O H	Pt
SILT	CLAY	Organic	SILT	CLAY	Organic	Highly Organic Soils
Soils with Liquid Limit <50%			Soils with Liquid Limit >50%			
Fine-Grained Soils >50% smaller than No. 200 sieve						



HARTCROWSER

SRF Grain Size (B-1).cdr 3/06

19220-00 5/16

Figure B-1

TABLE B-1: SUMMARY OF LABORATORY RESULTS

HARTCROWSER

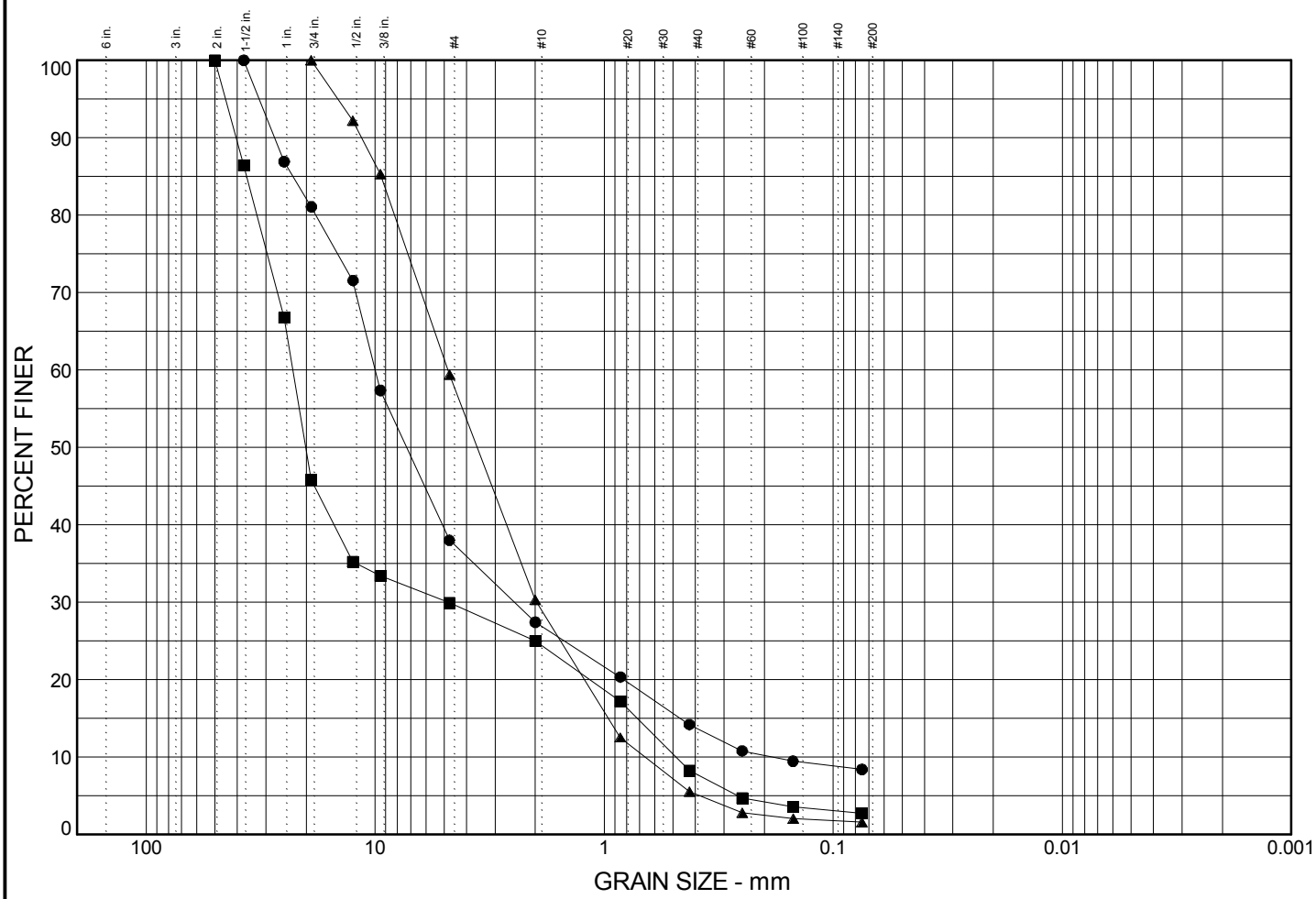
CLIENT Schreiber Starling & Lane Architects **PROJECT NAME** Proposed Industrial Technology Building at Clover Park Technical Col

PROJECT NUMBER 19220-00 **PROJECT LOCATION** Lakewood, Washington

Borehole	Sample ID	Depth	% Gravel	% Sand	% Fines	Liquid Limit	Plastic Limit	Water Content (%)	USCS Group Symbol	Soil Description
HC-1	S-1	2.5	62.0	29.6	8.4			11.0	GP-GM	slightly silty, sandy GRAVEL
HC-1	S-2	5.0	70.1	27.1	2.8			3.0	GW	sandy GRAVEL, trace silt
HC-1	S-3	10.0								
HC-1	S-4	15.0								
HC-1	S-5	20.0								
HC-1	S-6	25.0								
HC-1	S-7	30.0								
HC-2	S-1	2.5	40.6	57.8	1.6			2.9	SW	very gravelly SAND, trace silt
HC-2	S-2	5.0								
HC-2	S-3	10.0								
HC-2	S-4	15.0								
HC-2	S-5	20.0								
HC-2	S-6	25.0								
HC-2	S-7	30.0								
HC-3	S-1	0.2	42.5	50.2	7.3			5.3	SP-SM	slightly silty, very gravelly SAND
HC-3	S-2	2.5	33.2	50.1	16.7			15.2	SM	silty, very gravelly SAND
HC-3	S-3	5.0	75.6	21.3	3.1			4.3	GW	sandy GRAVEL, trace silt
HC-3	S-4	10.0								
HC-3	S-5	15.0								
HC-3	S-6	20.0								
HC-3	S-7	25.0								
HC-3	S-8	30.0	1.7	95.6	2.7			4.8	SP	SAND, trace silt and gravel
HC-4	S-1	0.3	59.1	33.5	7.4			6.0	GW-GM	slightly silty, very sandy GRAVEL
HC-4	S-2	2.5	58.3	35.6	6.1			4.5	GP-GM	slightly silty, very sandy GRAVEL
HC-4	S-3	5.0								
HC-4	S-4	10.0	73.9	23.8	2.3			2.1	GW	sandy GRAVEL, trace silt
HC-4	S-5	15.0						4.6		
HC-4	S-6	20.0						4.0		
HC-4	S-7	25.0						4.6		
HC-4	S-8	30.0						4.6		
HC-4	S-9	35.0						22.0		
HC-4	S-10	40.0						25.8		
HC-4A	S-1	35.0	0.0	92.3	7.7			23.4	SP-SM	slightly silty SAND
HC-4A	S-2	40.0	0.0	92.6	7.4			24.7	SP-SM	slightly silty SAND
HC-4A	S-3	45.0	0.3	47.0	52.7			21.1	ML	very sandy SILT
HC-4A	S-4	50.0	43.1	34.7	22.2			12.0	GM	silty, very sandy GRAVEL
HC-4A	S-5	55.0								
HC-4A	S-6	60.0								
HC-4A	S-7	65.0								
HC-4A	S-8	70.0								
HC-4A	S-9	75.0								

SELECT SUMMARY WITH DESC.MOD01 - GINT STD US LAB.GDT - 6/6/16 11:52 - L:\NOTEBOOKS\1922000_CLOVER PARK TECHNICAL COLLEGE\FIELD DATA\PERM_GINT FILES\1922000-BL.GPJ

Particle Size Distribution Test Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	62.0	29.6	8.4	
■	0.0	70.1	27.1	2.8	
▲	0.0	40.6	57.8	1.6	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			22.85	9.997	7.299	2.47	0.465	0.184	3.31	54.28
■			36.425	22.888	20.074	4.841	0.716	0.486	2.11	47.06
▲			9.423	4.829	3.592	1.969	0.957	0.661	1.21	7.31

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
● slightly silty, sandy GRAVEL	GP-GM	11.0%
■ sandy GRAVEL, trace silt	GW	3.0%
▲ very gravelly SAND, trace silt	SW	2.9%

Remarks:

●

■

▲

Project: Proposed Industrial Tech Bldg at Clover Park Tech College

Client: Schreiber Starling & Lane Architects

● Source: HC-1 Sample No.: S-1 Depth: 2.5 to 4.0
■ Source: HC-1 Sample No.: S-2 Depth: 5.0 to 6.5
▲ Source: HC-2 Sample No.: S-1 Depth: 2.5 to 4.0

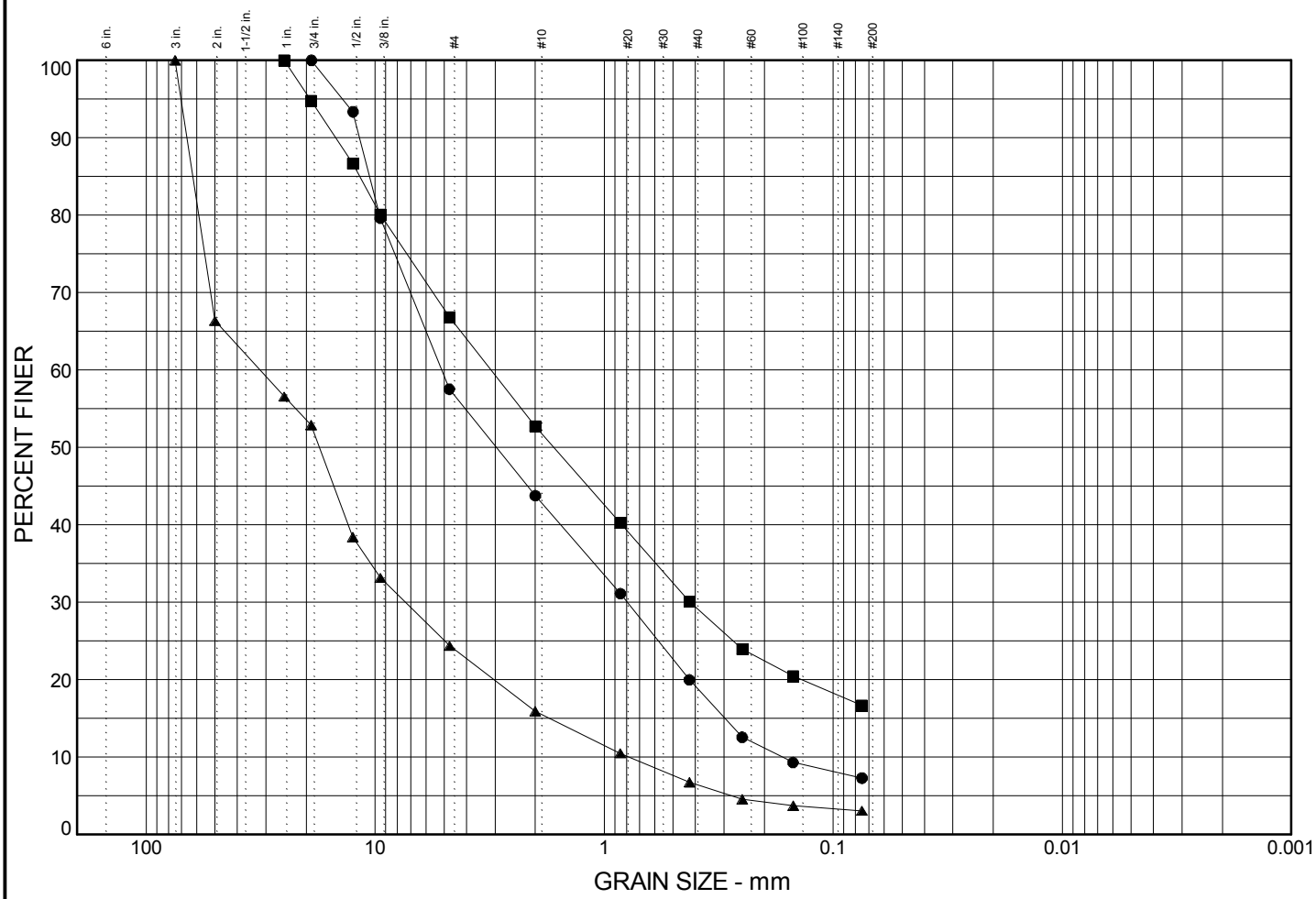
HARTCROWSER

19220-00 *5/16*

Figure B-2

GRAIN SIZE 1922000-BL.GPJ HC_CORP.GDT 6/6/16

Particle Size Distribution Test Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	42.5	50.2	7.3	
■	0.0	33.2	50.1	16.7	
▲	0.0	75.6	21.3	3.1	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			10.578	5.135	2.961	0.793	0.298	0.168	0.73	30.64
■			11.649	3.125	1.657	0.423				
▲			62.601	31.888	17.486	7.404	1.732	0.777	2.21	41.06

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
● slightly silty, very gravelly SAND	SP-SM	5.3%
■ silty, very gravelly SAND	SM	15.2%
▲ sandy GRAVEL, trace silt	GW	4.3%

Remarks:

●

■

▲

Project: Proposed Industrial Tech Bldg at Clover Park Tech College

Client: Schreiber Starling & Lane Architects

● Source: HC-3 Sample No.: S-1 Depth: 0.2 to 0.9
■ Source: HC-3 Sample No.: S-2 Depth: 2.5 to 4.0
▲ Source: HC-3 Sample No.: S-3 Depth: 5.0 to 6.5

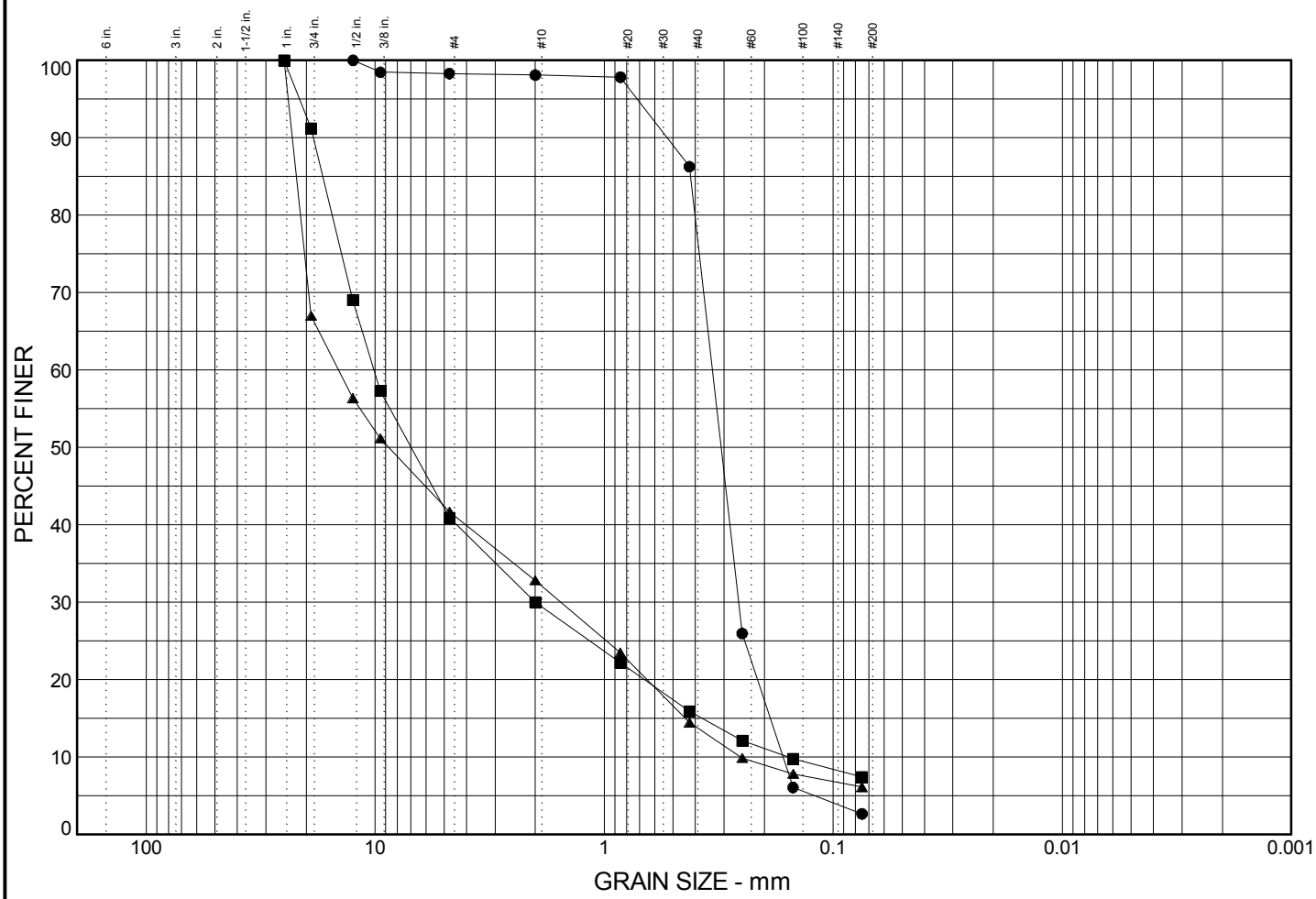
HARTCROWSER

19220-00 *5/16*

Figure B-3

GRAIN SIZE 1922000-BL.GPJ HC_CORP.GDT 6/6/16

Particle Size Distribution Test Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	1.7	95.6	2.7	
■	0.0	59.1	33.5	7.4	
▲	0.0	58.3	35.6	6.1	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.42	0.337	0.309	0.259	0.189	0.166	1.20	2.03
■			16.886	10.122	6.976	2	0.373	0.158	2.50	63.93
▲			22.068	14.421	8.72	1.541	0.443	0.253	0.65	56.96

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
● SAND, trace silt and gravel	SP	4.8%
■ slightly silty, very sandy GRAVEL	GW-GM	6.0%
▲ slightly silty, very sandy GRAVEL	GP-GM	4.5%

Remarks:

●

■

▲

Project: Proposed Industrial Tech Bldg at Clover Park Tech College

Client: Schreiber Starling & Lane Architects

● Source: HC-3	Sample No.: S-8	Depth: 30.0 to 31.5
■ Source: HC-4	Sample No.: S-1	Depth: 0.3 to 2.5
▲ Source: HC-4	Sample No.: S-2	Depth: 2.5 to 4.0

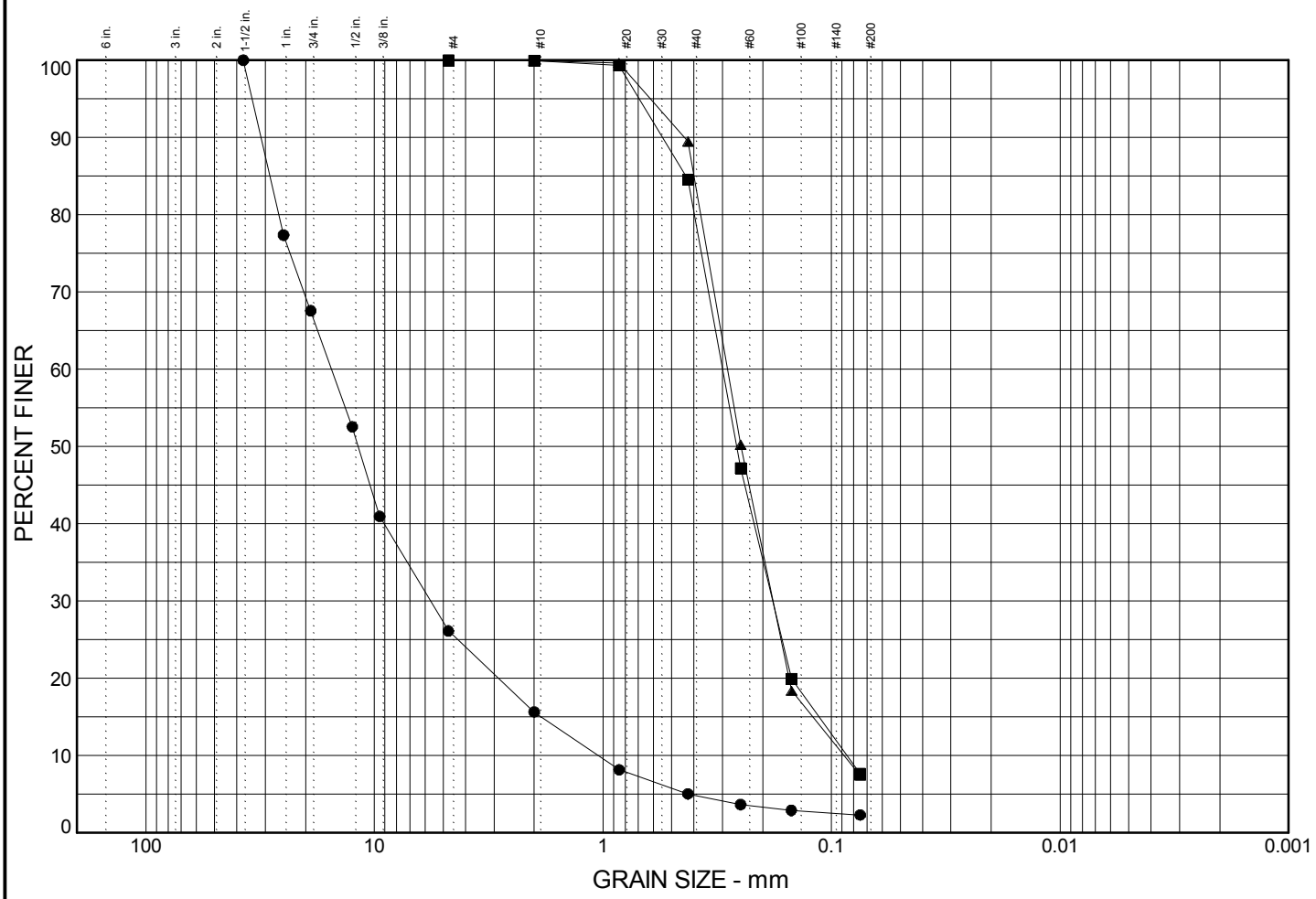
HARTCROWSER

19220-00 *5/16*

Figure B-4

GRAIN SIZE 1922000-BL.GPJ HC_CORP.GDT 6/6/16

Particle Size Distribution Test Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	73.9	23.8	2.3	
■	0.0	0.0	92.3	7.7	
▲	0.0	0.0	92.6	7.4	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			28.665	15.385	11.767	5.694	1.858	1.049	2.01	14.66
■			0.434	0.3	0.26	0.181	0.114	0.086	1.28	3.50
▲			0.4	0.285	0.249	0.181	0.121	0.088	1.30	3.23

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
● sandy GRAVEL, trace silt	GW	2.1%
■ slightly silty SAND	SP-SM	23.4%
▲ slightly silty SAND	SP-SM	24.7%

Remarks:

●

■

▲

Project: Proposed Industrial Tech Bldg at Clover Park Tech College

Client: Schreiber Starling & Lane Architects

● Source: HC-4	Sample No.: S-4	Depth: 10.0 to 11.5
■ Source: HC-4A	Sample No.: S-1	Depth: 35.0 to 36.5
▲ Source: HC-4A	Sample No.: S-2	Depth: 40.0 to 41.5

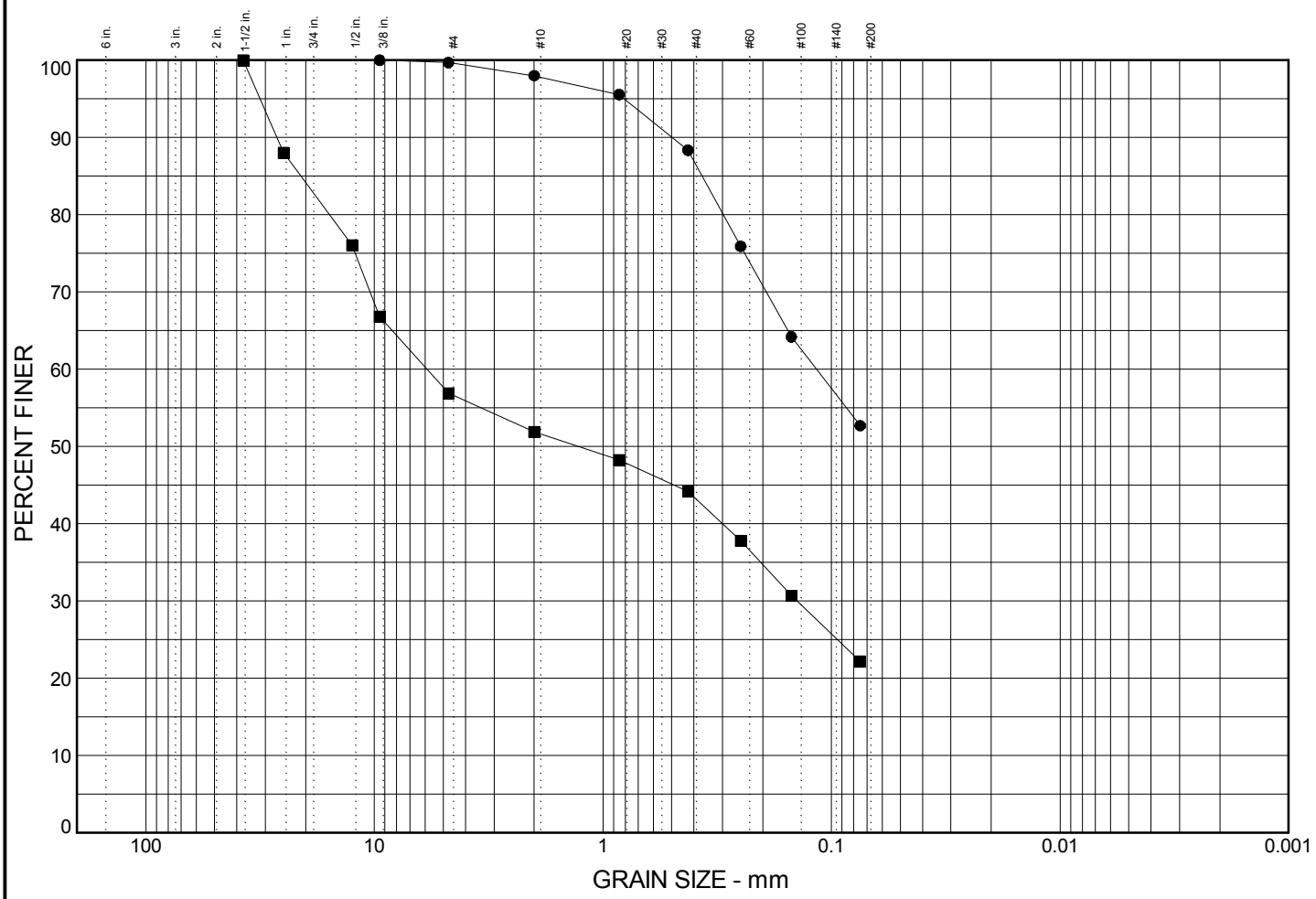
HARTCROWSER

19220-00 *5/16*

Figure B-5

GRAIN SIZE 1922000-BL.GPJ HC_CORP.GDT 6/6/16

Particle Size Distribution Test Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.3	47.0	52.7	
■	0.0	43.1	34.7	22.2	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.368	0.116						
■			20.931	5.894	1.287	0.142				

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
● very sandy SILT	ML	21.1%
■ silty, very sandy GRAVEL	GM	12.0%

Remarks:

●

■

Project: Proposed Industrial Tech Bldg at Clover Park Tech College

Client: Schreiber Starling & Lane Architects

● Source: HC-4A Sample No.: S-3 Depth: 45.0 to 46.5
■ Source: HC-4A Sample No.: S-4 Depth: 50.0 to 51.5

HARTCROWSER

19220-00 *5/16*

Figure B-6

GRAIN SIZE 1922000-BL.GPJ HC_CORP.GDT 6/6/16