Geotechnical Engineering Services Report Addendum

Firgrove Elementary School
Puyallup, Washington

for
Puyallup School District

May 5, 2017

GeoEngineers
Earth Science + Technology

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Geotechnical Engineering Services
Report Addendum

Firgrove Elementary School
Puyallup, Washington

File No. 2017-006-00

May 5, 2017

Prepared for:

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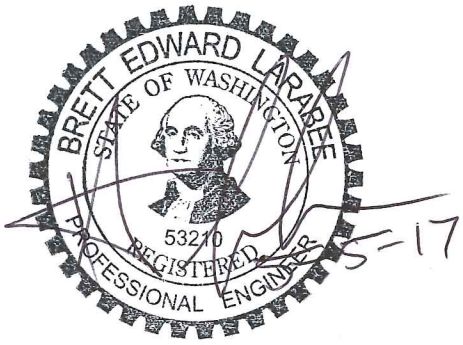

5-17

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INTRODUCTION AND SCOPE OF SERVICES

This report addendum presents the results of our supplemental stormwater infiltration evaluation for the Firgrove Elementary School Project. The project site is located at 13918 Meridian Avenue East in Puyallup, Washington, as shown on the Vicinity Map, Figure 1. Our services are provided in accordance with our original signed agreement dated October 6, 2016 and revised to include this scope of services on April 12, 2017. We previously prepared a geotechnical engineering report dated November 17, 2016 for this project, which included preliminary infiltration rates for the site soils based on sieve analysis of select samples.

We understand that the project plans will include stormwater infiltration facilities. As part of the facility design, a long-term infiltration rate is required. Stormwater design is being conducted in general accordance with the 2015 Pierce County Stormwater and Site Development Manual (2015 Stormwater Manual).

The purpose of our services was to perform small-scale pilot infiltration tests (PITs) to establish a long-term infiltration rate(s) for the site soils. Our specific scope of services included the following:

1. Coordinating with the project team to identify PIT locations and depths.
2. Visiting the project site to mark out locations for our PITs and contact the "One-Call" Utility Notification Center, as required by Washington State law.
3. Obtaining a permit to refill the water truck and trailer necessary for the PITs at a nearby water fill station.
4. Conducting eight small-scale PITs in general accordance with the 2015 Stormwater Manual.
5. Conducting geotechnical laboratory testing on selected soil samples collected in the PIT excavations. We budgeted for six sieve analysis tests. At the request of LPD Engineers (project Civil Engineer) we also submitted samples to an off-site laboratory for cation exchange capacity (CEC) and organic content (OC) testing.
6. Providing our recommendation for a long-term design infiltration rate(s) for site soils based on the results of our PITs and the guidelines presented in the 2015 Stormwater Manual.
7. Preparing this report addendum presenting our findings, test results, conclusions and recommendations.

PILOT INFILTRATION TEST BACKGROUND AND THEORY

General

Eight small scale PITs were conducted at the project site following GeoEngineers' standard methodology for stormwater facilities in Western Washington. Our methodology is a synthesis of the standard practices and current local jurisdictional procedures set forth by Pierce County and the Washington State Department of Ecology (Ecology).

The PIT consists of a relatively large-scale infiltration test to better measure infiltration rates for design of stormwater infiltration facilities. The PIT reduces some of the scale errors associated with relatively small-scale tests, such as the double ring infiltrometer, EPA Borehole Method, or "stove-pipe" infiltration tests. It

is not a standard test but rather a practical field procedure based on the methods recommended by Ecology's Technical Advisory Committee that are designed to achieve full saturation of the subgrade such that the infiltration rate measured approaches the saturated hydraulic conductivity of the subgrade material.

Infiltration into unsaturated soils initially occurs at a rate that can be much higher than the saturated hydraulic conductivity of the soil. As the saturation of the soil increases the hydraulic conductivity of the soil decreases. The intent of both GeoEngineers' method and the method described in the 2015 Stormwater Manual is to fully saturate the soils before measuring the hydraulic conductivity. The PIT procedure we follow has been developed to provide increased confidence that the infiltration rate calculated toward the end of the test is representative of the hydraulic conductivity under fully saturated conditions.

GeoEngineers' Test Procedure

Upon reaching the target depth for the PITs, graduated yard sticks are driven into the floor of the test pit as visual references for monitoring water levels during testing. Piezoelectric pressure transducers are secured to the bottoms of the yard sticks to provide accurate water level records at 30-second intervals throughout the duration of the tests.

Initial filling and maintaining of the water levels in the test pits is done by measuring inflow and water level in a series of stages. The PIT is filled to a predetermined water level and then allowed to drain to a lower pre-determined level, and then is refilled to the initial level again. This draining and refilling process is repeated as many times as practical during the test duration. During each refill/drain cycle (or stage), the infiltration rate is measured manually and using the pressure transducer. The decline of water level recorded for each stage is used to calculate the hydraulic conductivity throughout the test. Once saturation of the subgrade has been achieved (methodology described below) the PIT is allowed to drain and the saturated hydraulic conductivity is measured.

Justification for Modified PIT Methodology

In our opinion the significant difference between the GeoEngineers' PIT methodology and the Small-Scale PIT methodology described in the 2015 Stormwater Manual relates to how the subgrade soils are saturated and how the two methods attempt to verify that saturation has been achieved.

In the 2015 Stormwater Manual, saturation is accomplished by holding water at a constant depth in the test pit for the designated 6-hour pre-soak period. After the 6-hour pre-soak period the water inflow rate into the PIT is adjusted in order to maintain a specific depth. Once this balance is achieved over a period of 1 hour, the soil is assumed to be saturated and the data collected during the test can be used to calculate the short-term infiltration rate of the soil. In the 2015 Stormwater Manual test, only one measurement of infiltration rate is made at the end of the test duration.

In our methodology, we conduct a series of refill/drain cycles during the pre-soak period while holding the water level above a minimum depth. The refill and drain cycles allow us to monitor the saturation progress of the soil by measuring the decline in apparent infiltration rate progressively through each refill/drain cycle as saturation increases and the hydraulic gradient decreases. In ideal conditions the apparent infiltration rate asymptotically approaches a constant value through the pre-soak period as the refill/drain cycles occur. Our method allows us to increase the pre-soak period if a constant apparent infiltration rate(s) has

not been achieved in 6 hours. Once a near constant value is achieved we consider the soil saturated and proceed with a final measurement of the short-term infiltration rate.

The water depth in the PIT during the refill/drain cycles is selected based on the operational anticipated water depth in the proposed facility. If the operational water depth in the proposed facility is expected to be less than the minimum water depth maintained in the test, it may be necessary to factor down the short-term infiltration rate measured during the test before the correction factors are applied.

TEST PIT EXCAVATIONS

Eight test pits (PIT-1 through PIT-8) were excavated at the approximate locations shown on the Site Plan, Figure 2. Test pits were advanced using a backhoe to intermediate depths between 2 and 4.5 feet below ground surface (bgs) to perform the infiltration tests. After testing was complete, the test pit excavations were deepened to between about 7 and 9 feet bgs. The explorations were continuously monitored by an engineer or geologist from our firm who examined and classified the soil encountered, obtained representative soil samples, and maintained a detailed log of the explorations. Soil encountered was classified in general accordance with ASTM International (ASTM) D 2488 and the classification chart listed in the Key to Exploration Logs, Figure A-1 in Appendix A. Logs of the explorations are presented as Figures A-2 through A-9. Exploration logs for the borings shown on the Site Plan are provided in our November 17, 2016 Geotechnical Report.

Conditions encountered in our test pits were generally consistent with those encountered in our borings and described in the "Subsurface Conditions" section of our November 17, 2016 Geotechnical Report. This report should be reviewed for additional explanation of soil units described. PIT-1 was conducted within intact glacial till soil around 4.5 feet bgs. PIT-2, PIT-3, and PIT-5 though PIT-8 were conducted within weathered glacial till soils between 2 and 4.5 feet bgs. PIT-4 was conducted within what we interpret to be lacustrine ice-contact deposits (lacustrine soils) around 4 feet bgs.

We encountered intact glacial till soils in all our PIT explorations. The depth to intact glacial till ranged from 3 to 8.5 feet bgs. The depth to dense or stiff glacial till-like soils observed in our test pit explorations are generally consistent with what we observed in our borings and the approximate depth contour lines provided on Figure 2.

Groundwater or clear evidence of groundwater (such as mottling or water marks) were not observed in any of the test pits.

LABORATORY TESTING

Selected samples from our excavations were tested in order to evaluate engineering properties and to confirm or modify field classifications. Our testing program consisted of six grain-size distribution analysis and six cation exchange capacity (CEC) and organic content (OC) tests. Grain-size analyses were performed on selected soil samples in general accordance with ASTM Test Method D 6913. Figures A-10 and A-11 present the results of the grain-size analyses. CEC and OC tests were performed at a subcontracted laboratory. Results of the CEC and OC tests are presented on Figure A-12.

PIT RESULTS

Recorded water level data from the PITs and plots of the measured (unfactored) infiltration rates calculated during each stage of the PITs are presented in Figures 3 through 10. The short-term infiltration rate is determined by extrapolating the declining trend in apparent infiltration rate over successive stages of the test. The resulting asymptotic value provides the best estimate of short-term infiltration rate at each PIT location. In instances where two or fewer stages were completed during the test duration (PIT-1 and PIT-2), the lowest apparent infiltration rate was selected as the short-term infiltration rate.

DESIGN INFILTRATION RATE

The 2015 Stormwater Manual recommends that correction factors be applied to the PIT results to estimate long-term design infiltration rates. The correction factors account for uncertainties in testing procedures, the geometry of the proposed facilities and long-term reductions in permeability due to biological activity and accumulation of fines (siltation and biofouling). The table below provides a summary of the correction factors provided in the 2015 stormwater manual that are, in our opinion, appropriate for use in determining the long-term design infiltration rate.

TABLE 1. MEASURED HYDRAULIC SATURATED CONDUCTIVITY RATE REDUCTION FACTORS

Issue	Partial Correction Factor
Test Method	$F_{TESTING}$ = 0.50 (for small scale PITs)
Plugging	$F_{PLUGGING}$ = 0.7 (for loams and sandy loams)
Facility Geometry	0.25< $F_{GEOMETRY}$< 1.0 (depends on facility geometry and subsurface conditions) $F_{GEOMETRY}$ = 4 D/W +0.5 Where: D = depth from bottom of proposed facility to maximum wet season water level or nearest impervious layer W = width of facility

The total correction factor (CF) is based on these partial correction factors and equal to $F_{TESTING}$ x $F_{PLUGGING}$ x $F_{GEOMETRY}$. The total correction factor for this site ranges between 0.0875 to 0.35 depending on the geometry factor. We were not provided the geometry of the proposed facilities and, therefore, were not able to calculate the exact geometry reduction factor. When calculating the geometry factor for a specific location we recommend that intact glacial till be considered an impervious layer. The depth and elevation of the intact glacial till is presented on the PITs and boring logs at the exploration locations. When interpreting between exploration locations we recommend that the depth to dense glacial till-like contours presented on the Site Plan be used for guidance. Ultimately, we recommend that we be consulted as the facility geometries are developed to verify that the appropriate geometry factor applied.

The table below summarizes the soil conditions at each PIT location, the short-term infiltration rates measured in our PITs and the recommended design long-term infiltration rate for each test considering a correction factor, CF = 0.0875. This value is the lower value in the range indicated above.

TABLE 2. PIT RESULT SUMMARY

Test	Test Elevation (Feet NGVD 29)	Soil Unit at Test Depth	Elevation of Intact Glacial Till at PIT Location (Feet NGVD 29)	Short-Term Infiltration Rate (inch/hour)	Design Long-Term Infiltration Rate (inch/hour)
PIT-1	457.5	Intact Glacial Till	458.8	0.15	0.01
PIT-2	457.5	Weathered Glacial Till	457	0.20	0.01
PIT-3	464	Weathered Glacial Till	462	1.7	0.15
PIT-4	460	Lacustrine Soils	455.5	11.4	1.0
PIT-5	460	Weathered Glacial Till	455	3.5	0.3
PIT-6	460	Weathered Glacial Till	458	4.6	0.40
PIT-7	461	Weathered Glacial Till	456	5.0	0.43
PIT-8	462	Weathered Glacial Till	460	1.0	0.1

PIT CONCLUSIONS AND RECOMMENDATIONS

Based on our analysis of the PITs performed at the site, it is our opinion that stormwater infiltration is feasible in some soil types at the site. The most rapid infiltration rate at the site was observed in PIT-4, which was performed within lacustrine soils. Based on our understanding of the site geology, the lacustrine soils appear to be present only in the very southwest corner of the site near the location of PIT-4 and B-10. We do not recommend that facilities outside of this area be designed using the infiltration rate determined in PIT-4. Further, if a large footprint infiltration facility is planned for this area, additional subsurface explorations should be performed to identify the extent of the lacustrine soils.

Infiltration into the weathered glacial till soils appears to be feasible. The design infiltration rate of facilities located within the weathered glacial till should consider the distance between the base of the facility and the low permeability intact glacial till soils. If intact glacial till is located within a few feet of the bottom of the facility the infiltration rate of the soils could be reduced. For example, in our opinion the relatively low infiltration rate observed in PIT-2 is partially a result of the proximity of the test location to the intact glacial till. We should be consulted if the base of the infiltration facilities will be located within 2 feet of intact glacial till.

Based on the results of PIT-1 we do not recommend that infiltration facilities be located within intact glacial till.

We recommend that GeoEngineers review the proposed stormwater infiltration facilities designed for this site to confirm that the anticipated performance can be achieved based on the soil conditions encountered. We also recommend that we be retained during construction to observe soil conditions at the base of the

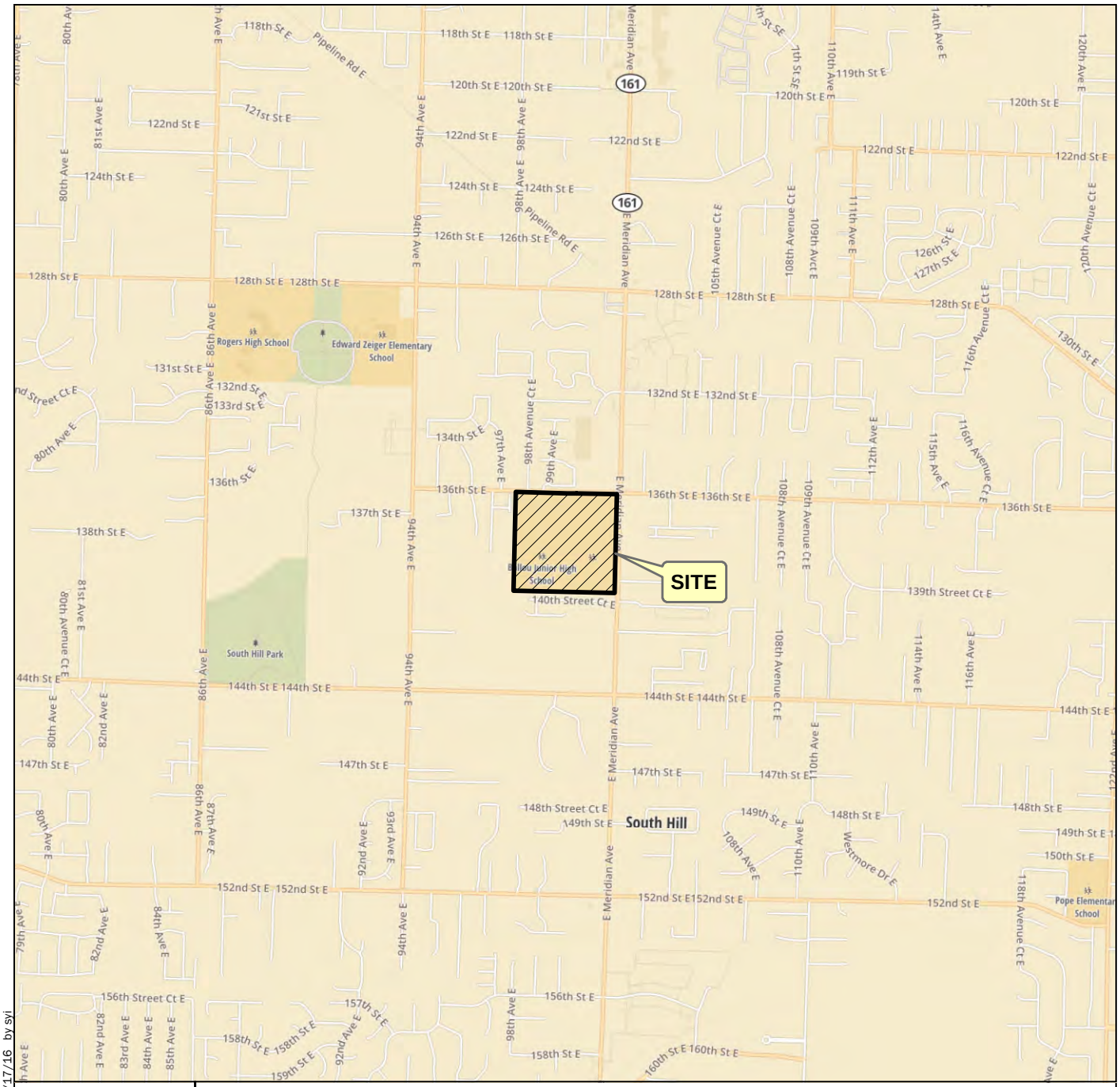
infiltration facilities and verify that soil conditions present are suitable for the proposed design. Additional recommendations for design and construction of infiltration facilities is provided in our November 17, 2016 Geotechnical Report.

LIMITATIONS

We have prepared this report addendum for the Puyallup School District, for Firgrove Elementary School. Puyallup School District may distribute copies of this report to owner's authorized agents and regulatory agencies as may be required for the Project.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices for geotechnical engineering services in this area at the time this report addendum was prepared. The conclusions, recommendations, and opinions presented in this report addendum are based on our professional knowledge, judgment and experience. No warranty, express or implied, applies to the services or this report addendum.

Except as modified herein, the conclusions, recommendations and limitations (Appendix C) presented in our previous report dated November 17, 2016 also apply to this report addendum.



Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Mapbox Open Street Map, 2015

Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Vicinity Map

Firgrove Elementary School
Puyallup, Washington

GeoEngineers

Figure 1

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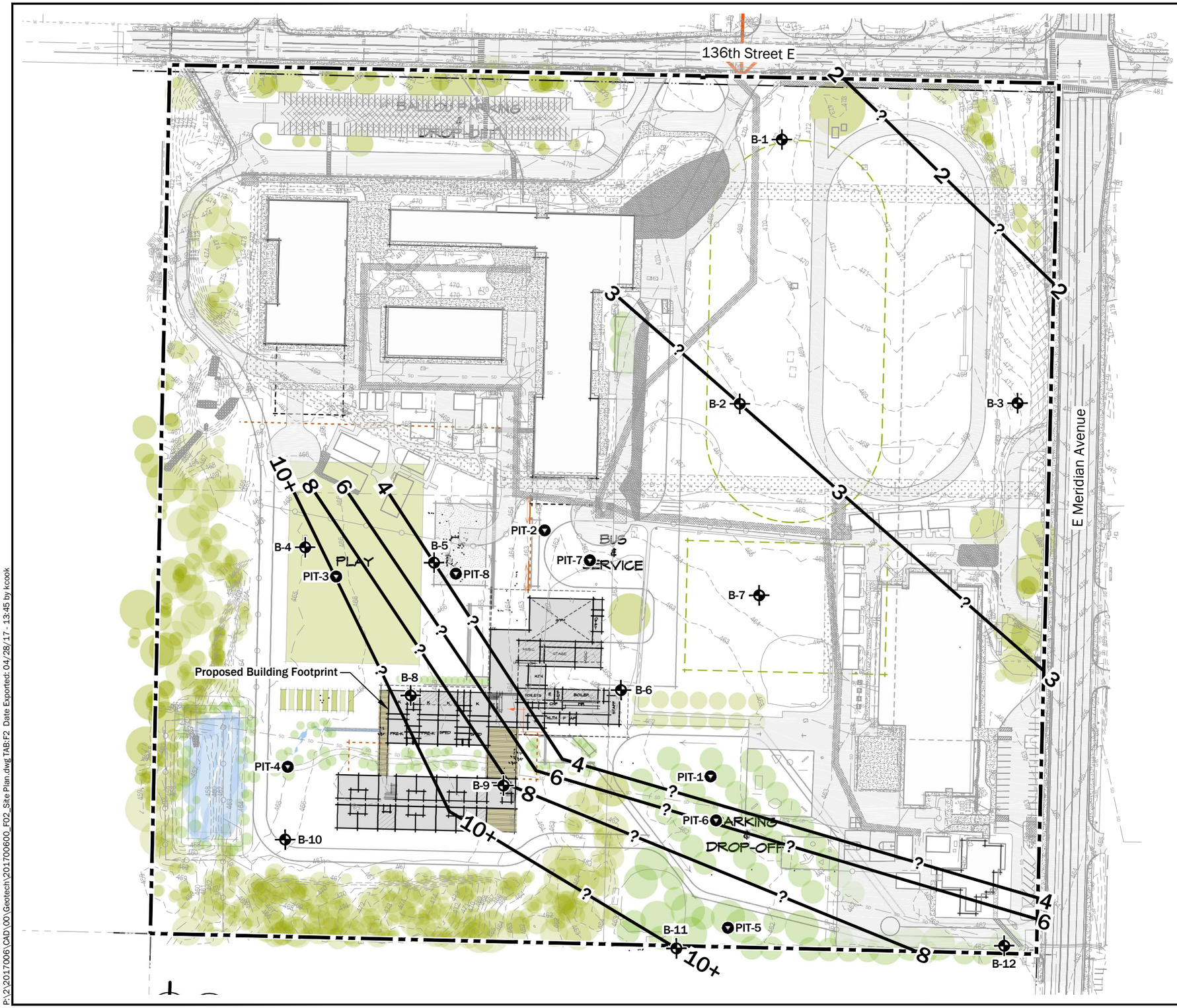

Legend

- Site Boundary
- PIT-1 — Pilot Infiltration Test by GeoEngineers, 2017
- B-1 — Boring by GeoEngineers, 2016
- Existing Ground Surface Contour
- ?—4—? Approximate Depth to Dense Glacial Till-Like Soils

N W E S

150 0 150
Feet

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Vertical Datum: NGVD 29.

Projection: NAD83 Washington State Planes, South Zone, US Foot.

Data Source:
Base drawing provided by Mahlum Architects, Inc. dated 11/16/16.

Site Plan

Firgrove Elementary School
Puyallup, Washington

GeoEngineers

Figure 2

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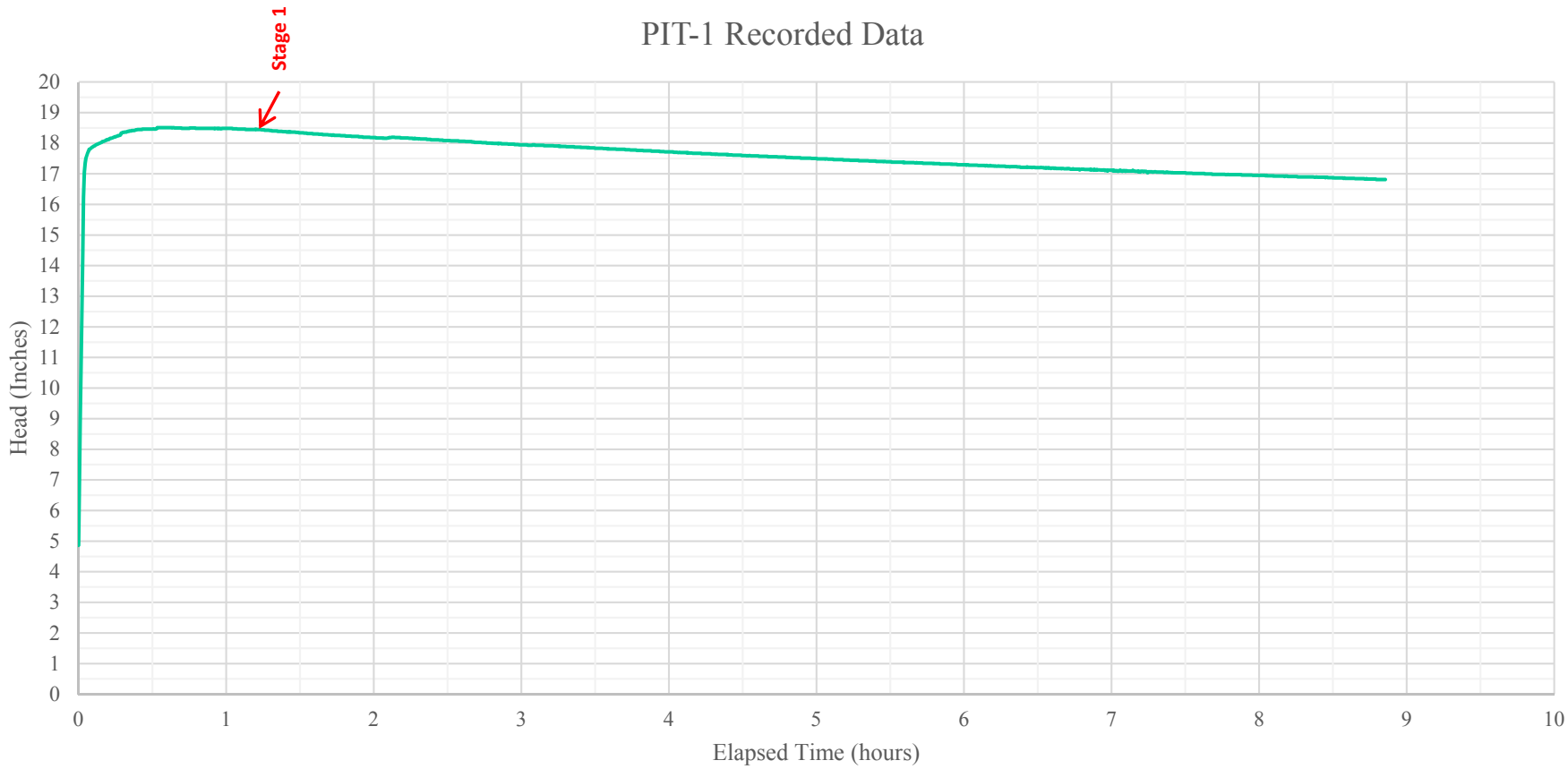

Pilot Infiltration Test Results – PIT-1

Firgrove Elementary School
Puyallup, Washington

GeoEngineers

Figure 3

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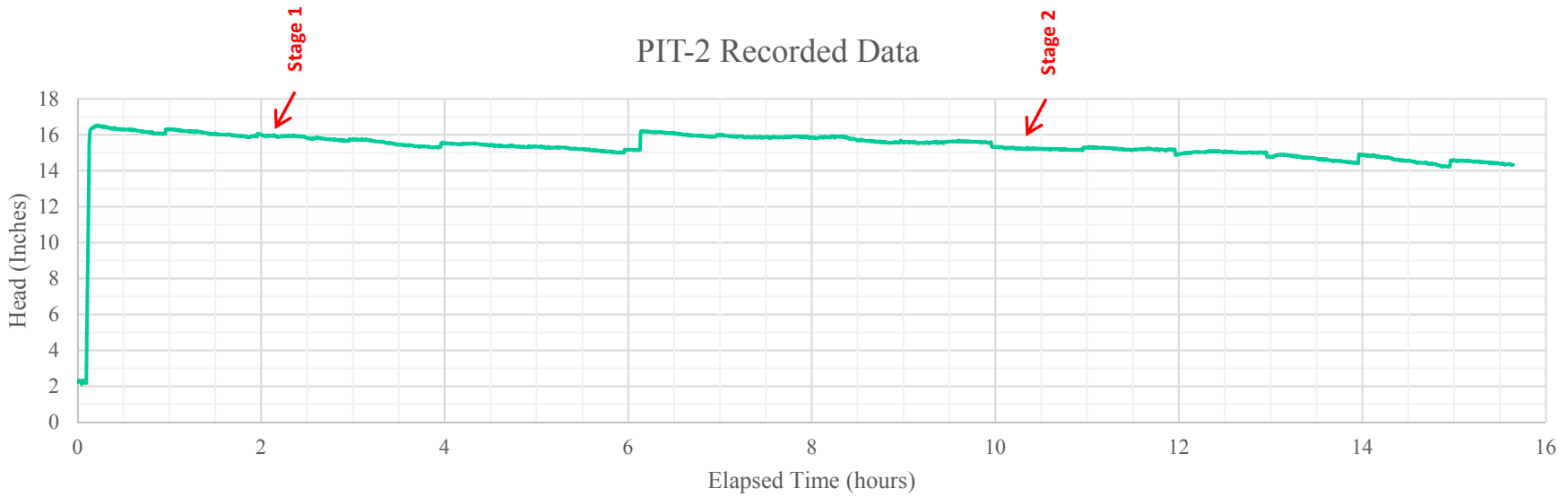

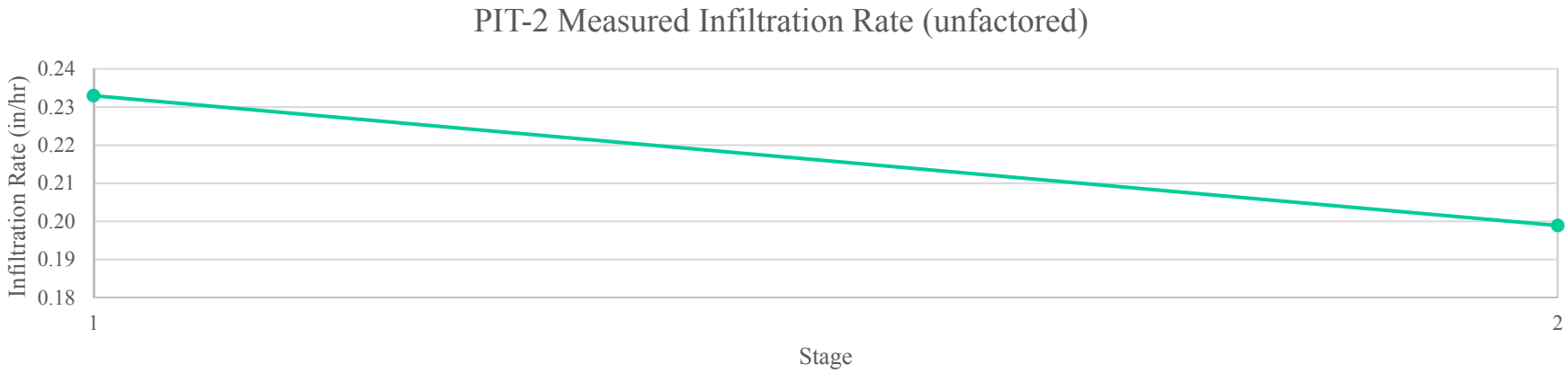

Pilot Infiltration Test Results – PIT-2	
Firgrove Elementary School Puyallup, Washington	
GeoEngineers	Figure 4

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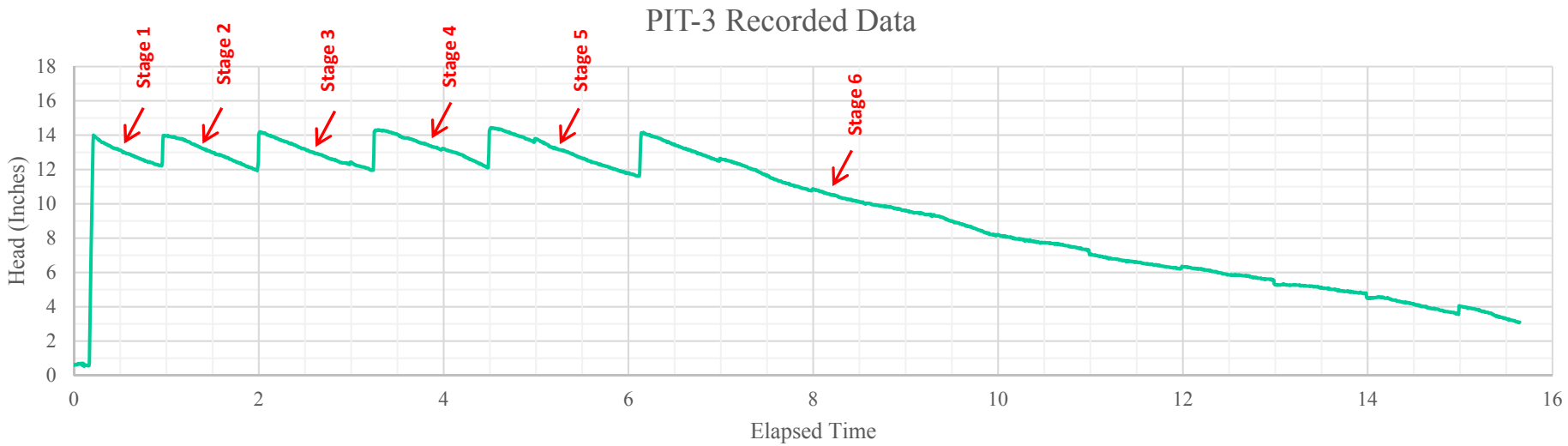

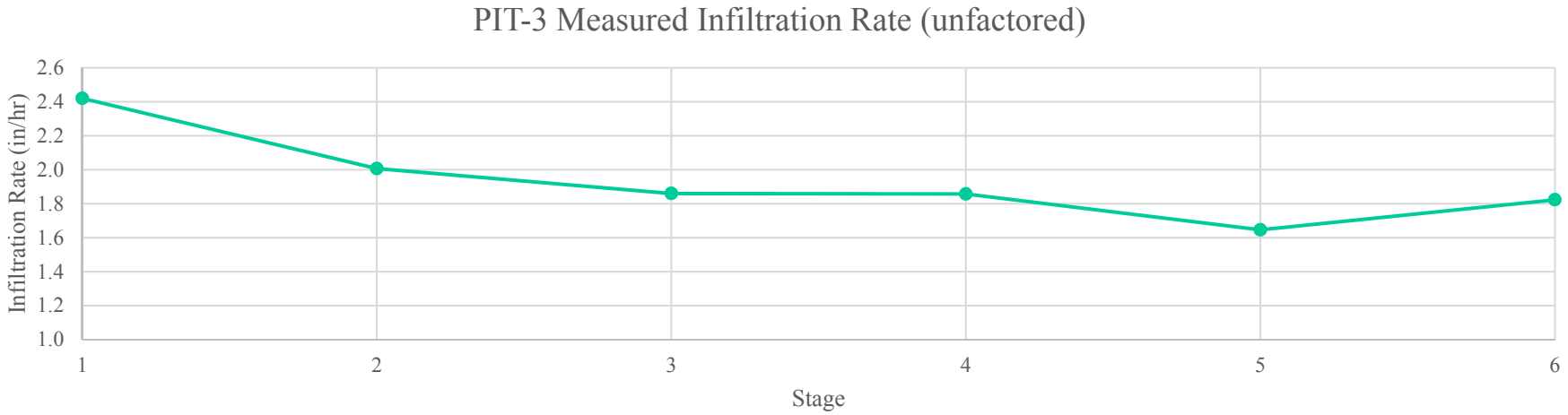

Pilot Infiltration Test Results – PIT-3

Firgrove Elementary School
Puyallup, Washington

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Figure 5

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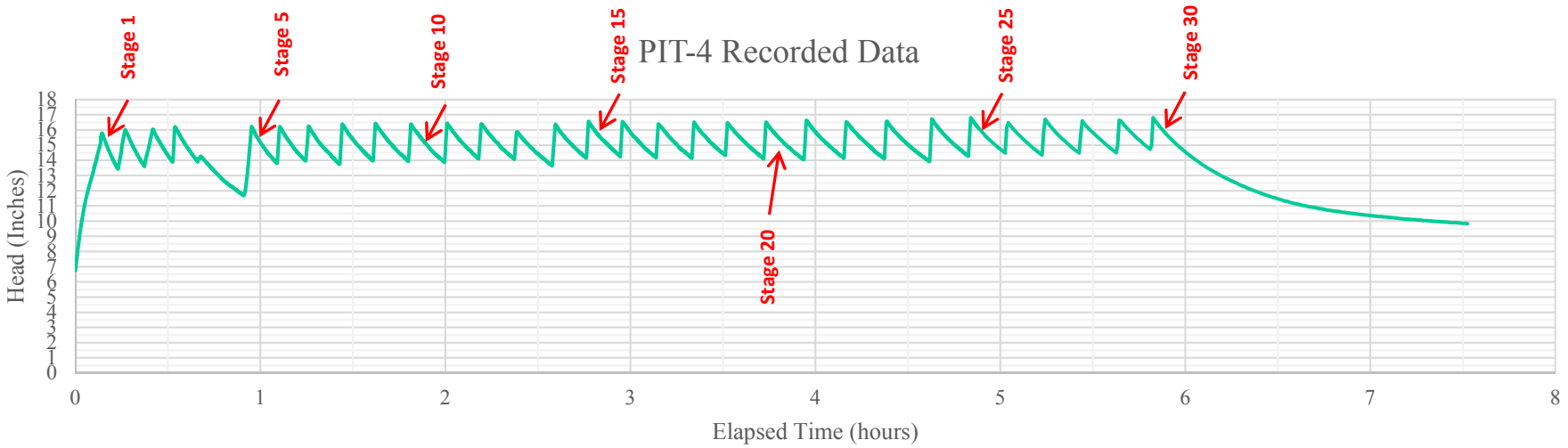

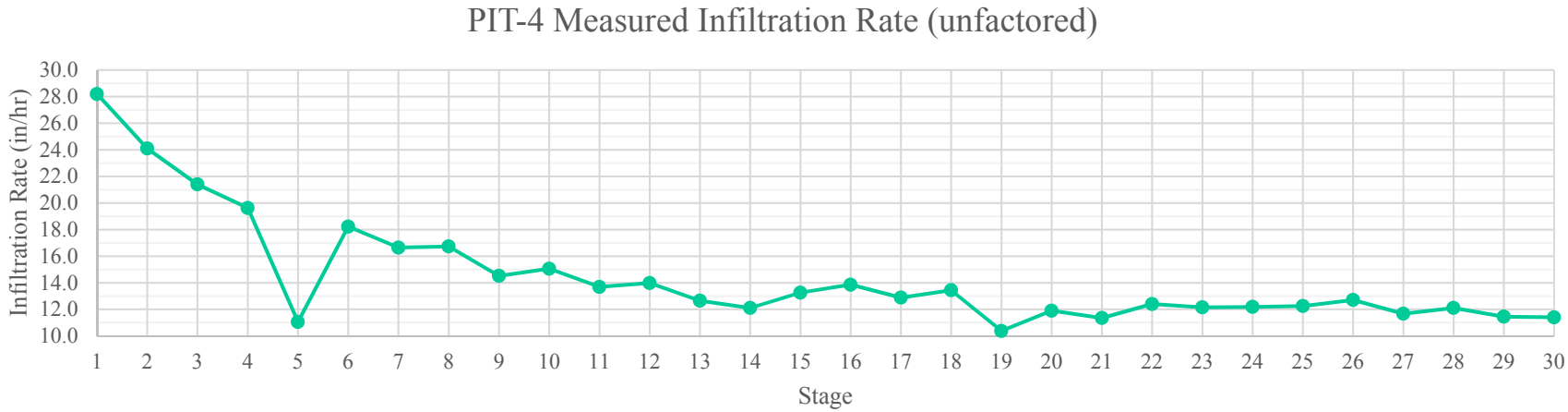

Pilot Infiltration Test Results – PIT-4	
Firgrove Elementary School Puyallup, Washington	
GeoEngineers	Figure 6

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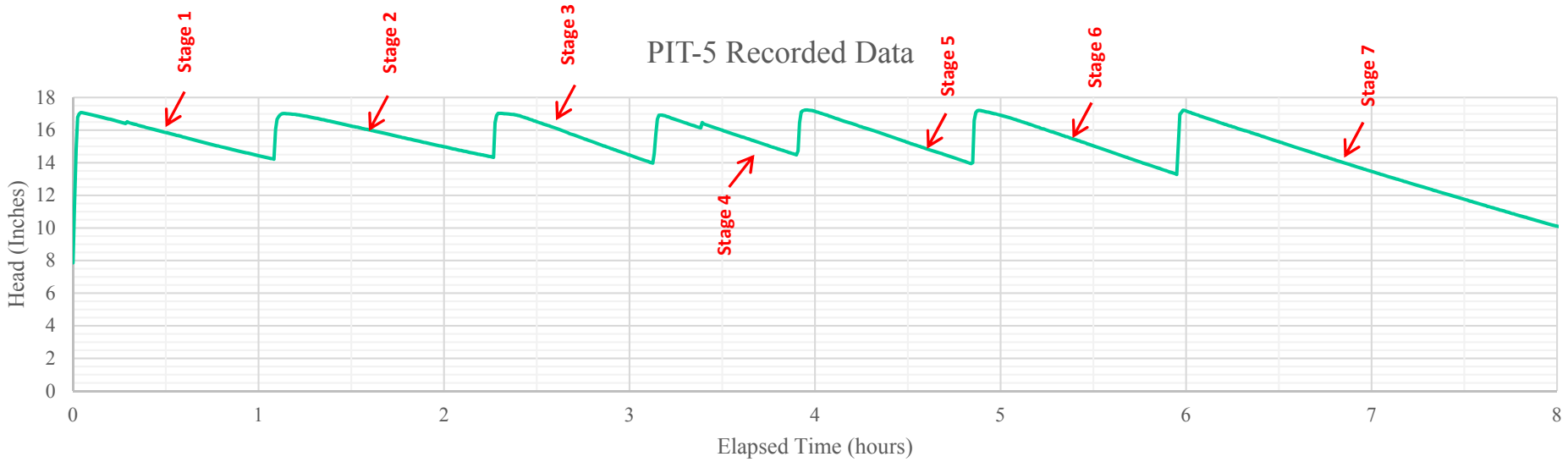

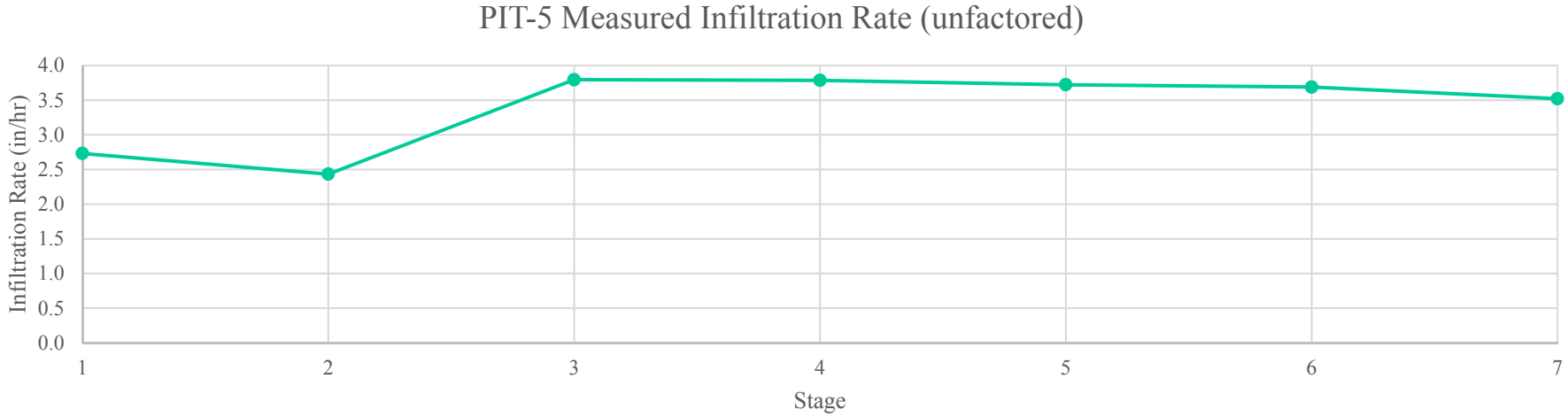

Pilot Infiltration Test Results – PIT-5	
Firgrove Elementary School Puyallup, Washington	
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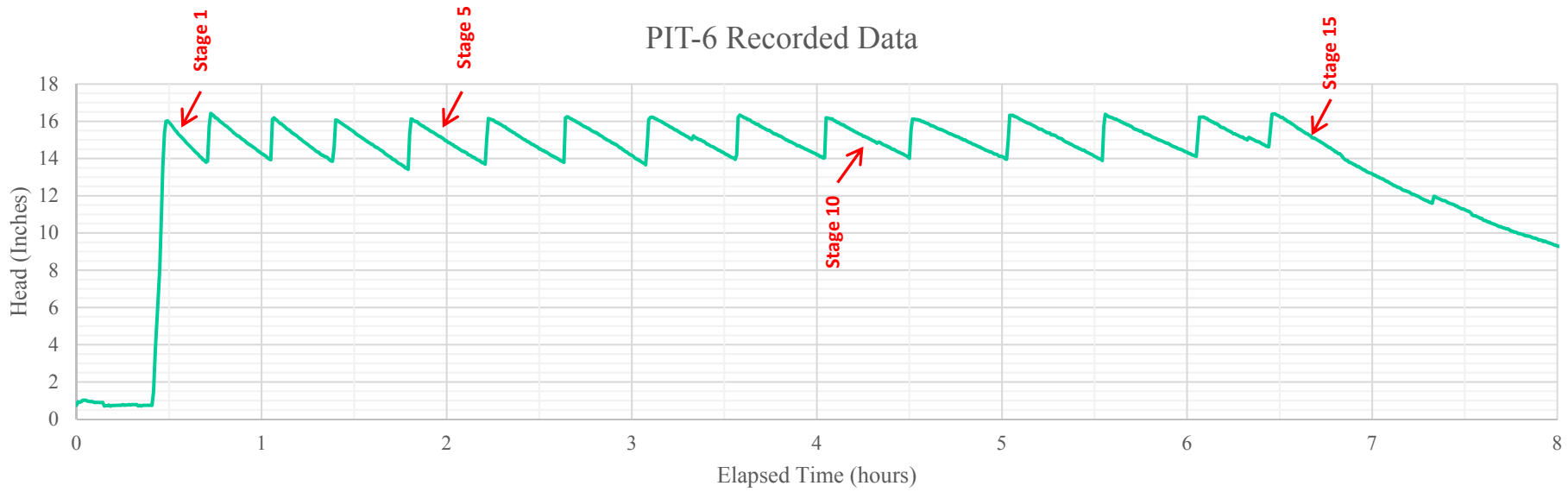

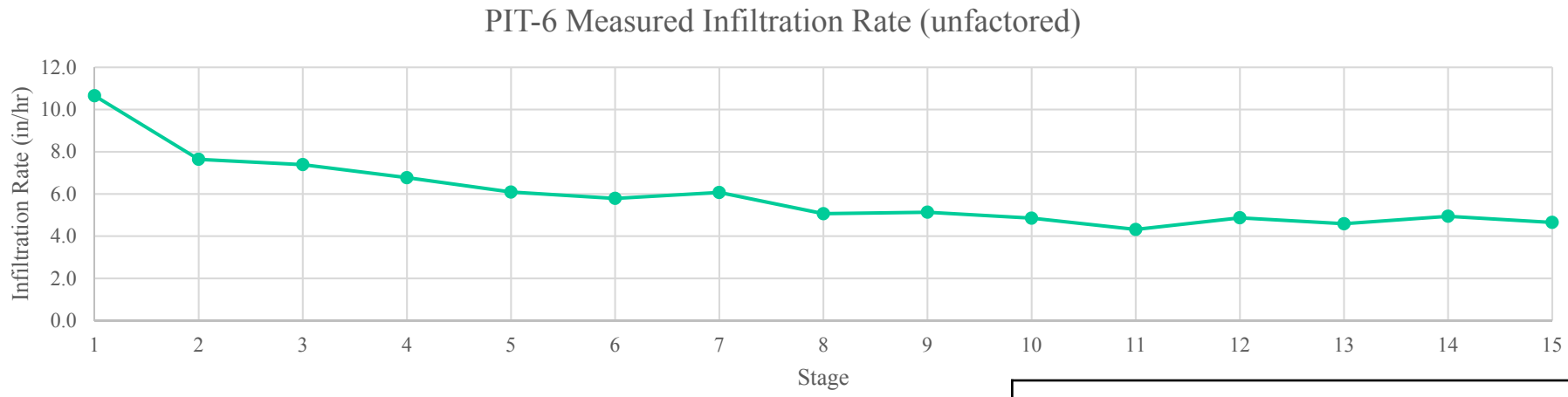

Pilot Infiltration Test Results – PIT-6	
Firgrove Elementary School Puyallup, Washington	
GeoEngineers	Figure 8

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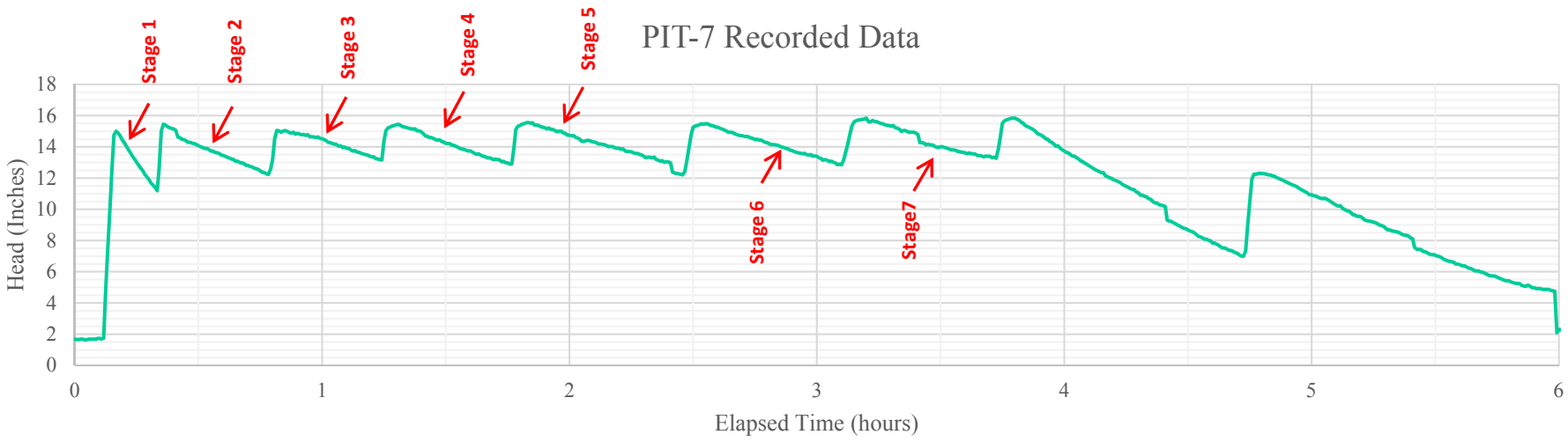

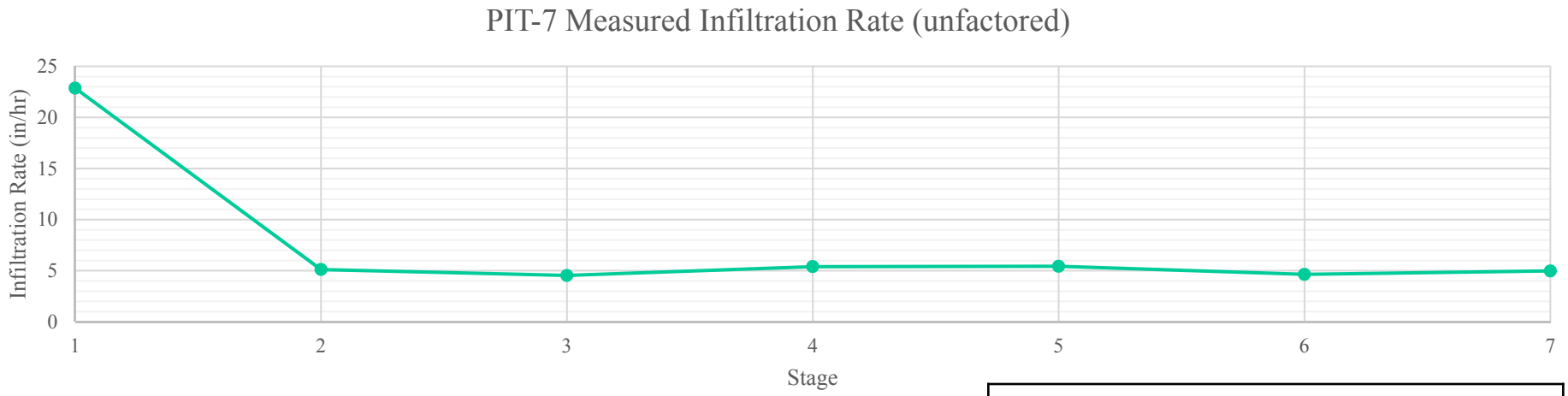

Pilot Infiltration Test Results – PIT-7	
Firgrove Elementary School Puyallup, Washington	
GeoEngineers	Figure 9

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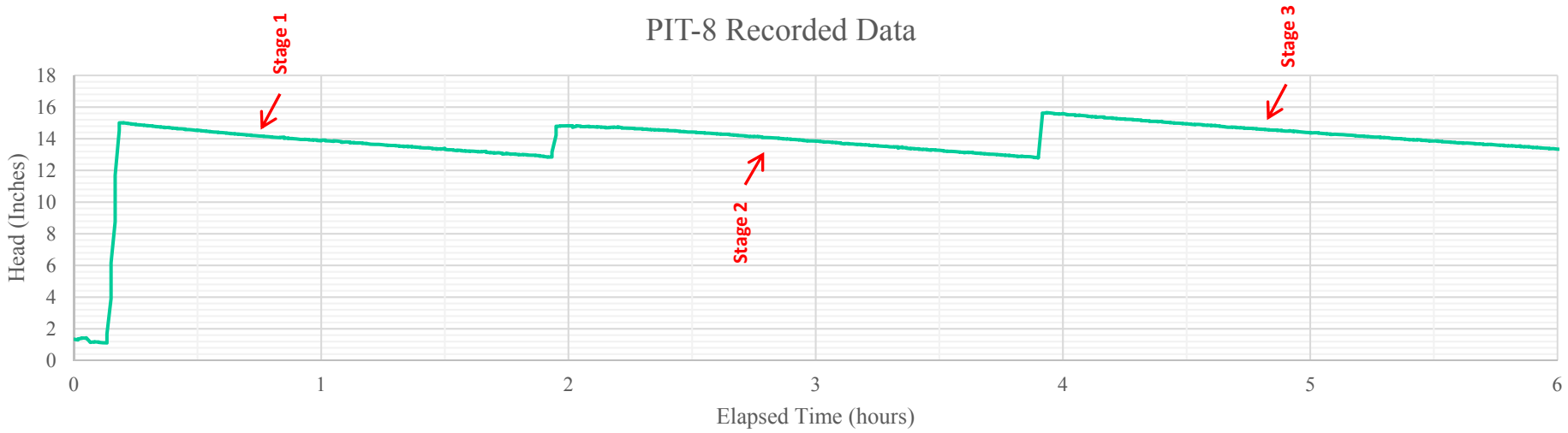

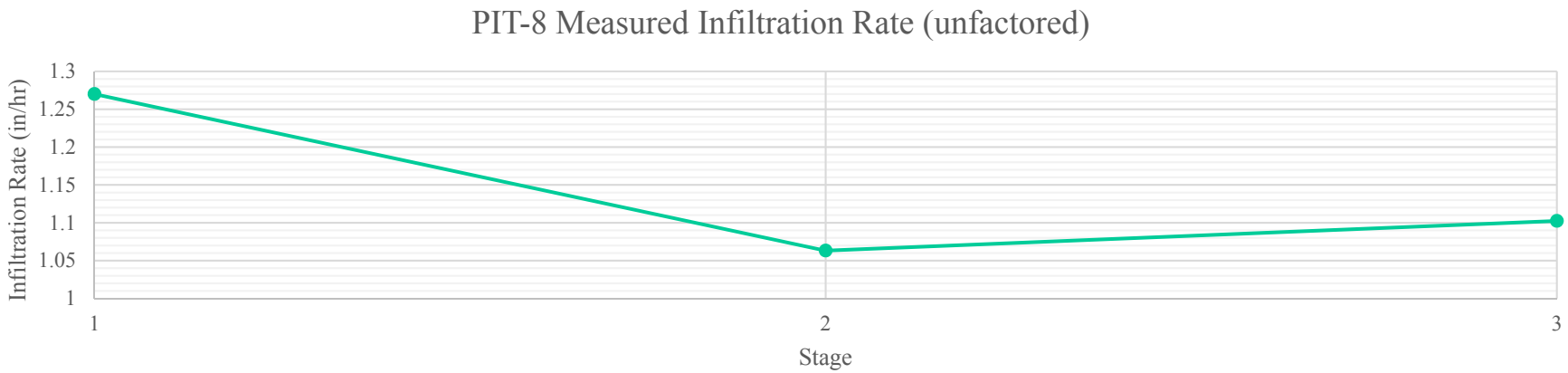

Pilot Infiltration Test Results – PIT-8	
Firgrove Elementary School Puyallup, Washington	
GeoEngineers	Figure 10

APPENDIX A
PIT Explorations and Laboratory Testing

SOIL CLASSIFICATION CHART

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

NOTE: Multiple symbols are used to indicate borderline or dual soil classifications

ADDITIONAL MATERIAL SYMBOLS

SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
	AC	Asphalt Concrete
	CC	Cement Concrete
	CR	Crushed Rock/ Quarry Spalls
	TS	Topsoil/ Forest Duff/Sod

Groundwater Contact

Measured groundwater level in exploration, well, or piezometer

Measured free product in well or piezometer

Graphic Log Contact

Distinct contact between soil strata

Approximate contact between soil strata

Material Description Contact

Contact between geologic units

Contact between soil of the same geologic unit

Sampler Symbol Descriptions

2.4-inch I.D. split barrel

Standard Penetration Test (SPT)

Shelby tube

Piston

Direct-Push

Bulk or grab

Continuous Coring

Blowcount is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted). See exploration log for hammer weight and drop.

A "P" indicates sampler pushed using the weight of the drill rig.

A "WOH" indicates sampler pushed using the weight of the hammer.

Laboratory / Field Tests

%F	Percent fines
%G	Percent gravel
AL	Atterberg limits
CA	Chemical analysis
CP	Laboratory compaction test
CS	Consolidation test
DS	Direct shear
HA	Hydrometer analysis
MC	Moisture content
MD	Moisture content and dry density
OC	Organic content
PM	Permeability or hydraulic conductivity
PI	Plasticity index
PP	Pocket penetrometer
PPM	Parts per million
SA	Sieve analysis
TX	Triaxial compression
UC	Unconfined compression
VS	Vane shear

Sheen Classification

NS	No Visible Sheen
SS	Slight Sheen
MS	Moderate Sheen
HS	Heavy Sheen
NT	Not Tested

NOTE: The reader must refer to the discussion in the report text and the logs of explorations for a proper understanding of subsurface conditions. Descriptions on the logs apply only at the specific exploration locations and at the time the explorations were made; they are not warranted to be representative of subsurface conditions at other locations or times.

KEY TO EXPLORATION LOGS

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FIGURE A-1

Rev. 02/16

Date Excavated 4/5/2017	Total Depth (ft) 9.5	Logged By MWB Checked By BEL	Excavator Kellys Excavating	Excavation Equipment	Komatsu Tire Backhoe
Surface Elevation (ft) Vertical Datum	462 NAVD88	Easting (X) Northing (Y)	1193620 660286	Coordinate System Horizontal Datum	WA State Plane,South NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					SOD	Grass field surface			
461	1	X	1		ML	Brown sandy silt with organic matter (roots) (medium stiff, moist) (fill)			
460	2	X	2			Grades to with gravel			
					SM	Gray-brown silty fine sand with gravel (medium dense, moist) (weathered till)			
459	3								
		X	3		SM	Gray fine to coarse silty sand with gravel and cobbles (very dense, moist) (glacial till)			
458	4								
		X	4			Grades to wet			PIT performed at 4.5 feet, soil wet to approximately 7 feet after completion of PIT
457	5								
456	6								
455	7					Grades to moist			
454	8								
453	9								

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.

Log of PIT 1

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Project: Firgrove Elementary School
Project Location: Puyallup, Washington
Project Number: 2017-006-00

Figure A-2
Sheet 1 of 1

Date Excavated	4/4/2017	Total Depth (ft)	7.5	Logged By MWB Checked By BEL	Excavator Kellys Excavating	Excavation Equipment	Komatsu Tire Backhoe
Surface Elevation (ft) Vertical Datum	462 NAVD88	Easting (X) Northing (Y)	1193372 660654	Coordinate System Horizontal Datum	WA State Plane,South NAD83 (feet)		

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					SOD	Grass field surface			
461	1		1		SM	Brown silty fine sand, trace gravel and organic matter (roots) (loose, moist) (fill)			
460	2		2		ML	Light brown to gray sandy silt with occasional gravel (stiff, moist) (weathered till)			
459	3								
			3						
458	4					Grades to very stiff			
			4			Grades to wet			PIT performed at 4.5 feet, soil wet to approximately 7 feet after completion of PIT
457	5				SM	Gray silty fine sand with gravel and cobbles (very dense, wet) (glacial till)			
456	6								
455	7					Grades to moist			Practical refusal at 7.5 feet

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.

Log of PIT 2

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Project: Firgrove Elementary School
Project Location: Puyallup, Washington
Project Number: 2017-006-00

Figure A-3
Sheet 1 of 1

Date Excavated	4/3/2017	Total Depth (ft)	7	Logged By MWB Checked By BEL	Excavator Kellys Excavating	Excavation Equipment	Komatsu Tire Backhoe
Surface Elevation (ft) Vertical Datum	466 NAVD88	Easting (X) Northing (Y)	1193059 660585	Coordinate System Horizontal Datum	WA State Plane,South NAD83 (feet)		

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					SM	Black-dark brown silty fine sand with organic matter (roots) (loose, moist) (fill)			
			1		ML	Gray-tan with orange mottle silty sand with trace gravel (stiff, moist) (weathered till)			
465	1								
			2						
			3						
464	2		4 SA; CEC			Grades to wet	31	74	PIT performed at 2 feet, soil wet to 4 feet after PIT completed
463	3								
462	4				SM	Gray silty fine to coarse sand with gravel (very dense, moist) (glacial till)			
461	5								
460	6								
459	7								

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.

Log of PIT 3

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Project: Firgrove Elementary School
Project Location: Puyallup, Washington
Project Number: 2017-006-00

Figure A-4
Sheet 1 of 1

Date Excavated	4/3/2017	Total Depth (ft)	9	Logged By / Checked By	MWB / BEL	Excavator	Kellys Excavating	Excavation Equipment	Komatsu Tire Backhoe
Surface Elevation (ft) / Vertical Datum	464 NAVD88	Easting (X) / Northing (Y)	1192987 660300	Coordinate System / Horizontal Datum	WA State Plane,South NAD83 (feet)				

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
463	1	X	1		SM	Dark brown silty fine sand with gravel and cobbles (loose, moist) (fill)			
462	2	X	2		SM	Gray to brown silty fine to coarse sand with gravel (medium dense, moist) (lacustrine soils)			
		X	3						
461	3	X	4						
460	4	X	5,6 SA; CEC		SM	Gray to brown silty fine sand (loose, wet)	18	44	PIT performed at 4 feet; soil wet to approximately 7.5 feet after PIT
						Grades to moist			
459	5								
458	6								
457	7								
		X	7						
456	8								
		X	8		SM	Gray to brown with orange mottle sandy silt (medium stiff, moist) (glacial till)			
455	9								

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.

Log of PIT 4

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Project: Firgrove Elementary School
Project Location: Puyallup, Washington
Project Number: 2017-006-00

Figure A-5
Sheet 1 of 1

Date Excavated	4/6/2017	Total Depth (ft)	8	Logged By / Checked By	MWB / BEL	Excavator	Kellys Excavating	Excavation Equipment	Komatsu Tire Backhoe
Surface Elevation (ft) / Vertical Datum	462 NAVD88	Easting (X) / Northing (Y)	1193646 660059	Coordinate System / Horizontal Datum	WA State Plane,South NAD83 (feet)				

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					SOD	Grass field surface			
461	1	X	1		SM	Light brown with orange mottle silty fine to medium sand (medium dense, moist) (weathered till)			
460	2	X	2 SA; CEC			Grades to wet	14	26	PIT performed at 2 feet bgs; soil wet to approximately 5 feet after PIT
459	3								
458	4	X	3						
457	5				ML	Light brown sandy silt (medium stiff, moist)			
456	6								
455	7				SM	Light gray to brown silty fine to coarse sand with gravel and occasional cobbles (very dense, moist) (glacial till)			
454	8								

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.

Log of PIT 5

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Project: Firgrove Elementary School
Project Location: Puyallup, Washington
Project Number: 2017-006-00

Figure A-6
Sheet 1 of 1

Date Excavated	4/6/2017	Total Depth (ft)	7	Logged By MWB Checked By BEL	Excavator Kellys Excavating	Excavation Equipment	Komatsu Tire Backhoe
Surface Elevation (ft) Vertical Datum	462 NAVD88	Easting (X) Northing (Y)	1193628 660220	Coordinate System Horizontal Datum	WA State Plane,South NAD83 (feet)		

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					SOD	grass field surface			
461	1		1		SM	Light brown with orange staining silty fine to coarse sand, occasional gravel and cobbles (medium dense, moist) (weathered till)			
460	2		2 SA; CEC			Grades to wet	25	42	PIT performed at 2 feet; soil wet to approximately 6 feet after PIT
459	3								
458	4				SM	Light gray silty fine to coarse sand with gravel (dense, wet) (glacial till)			
457	5								
456	6					Grades to moist			
455	7								

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.

Log of PIT 6

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Project: Firgrove Elementary School
Project Location: Puyallup, Washington
Project Number: 2017-006-00

Figure A-7
Sheet 1 of 1

Date Excavated 4/5/2017	Total Depth (ft) 8	Logged By MWB Checked By BEL	Excavator Kellys Excavating	Excavation Equipment	Komatsu Tire Backhoe
Surface Elevation (ft) 463 Vertical Datum NAVD88		Easting (X) 1193439 Northing (Y) 660610		Coordinate System WA State Plane,South Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
462	1				SM	Brown silty fine to medium sand with occasional gravel and organic matter (roots) (loose, moist) (fill)			
					SM	Brown silty fine to coarse sand with gravel (loose, moist)			
461	2	X	1 SA; CEC		SM	Light brown to tan silty fine to medium sand with gravel (loose, wet) (weathered till)	22	42	PIT performed at 2 feet; soil wet to approximately 4 feet after PIT
460	3								
459	4	X	2			Grades to medium dense			
458	5								
					SM	Light brown silty fine to medium sand (medium dense, wet)			
457	6	X	3						
456	7				SM	Gray silty fine to coarse sand with gravel and occasional cobbles (very dense, moist) (glacial till)			
455	8								

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.

Log of PIT 7

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Project: Firgrove Elementary School
Project Location: Puyallup, Washington
Project Number: 2017-006-00

Figure A-8
Sheet 1 of 1

Date Excavated 4/7/2017	Total Depth (ft) 7	Logged By MWB Checked By BEL	Excavator Kellys Excavating	Excavation Equipment	Komatsu Tire Backhoe
Surface Elevation (ft) 464 Vertical Datum NAVD88		Easting (X) 1193239 Northing (Y) 660589		Coordinate System WA State Plane,South Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
463	1				SM	Dark brown silty fine to medium sand with occasional gravel and organic matter (roots) (loose, wet) (fill) Grades to without organic matter			
462	2	X	1 SA; CEC		SM	Light brown-tan silty fine to medium sand with occasional gravel (stiff, wet) (weathered till)	19	30	PIT performed at 2 feet; soil wet to approximately 6 feet after PIT
461	3	X	2		SM	Light gray to brown silty fine to coarse sand with gravel and cobbles (dense, wet) (glacial till)			
460	4								
459	5								
458	6					Grades to moist			
457	7	X	3			Grades to very dense at 7 feet			

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.

Log of PIT 8

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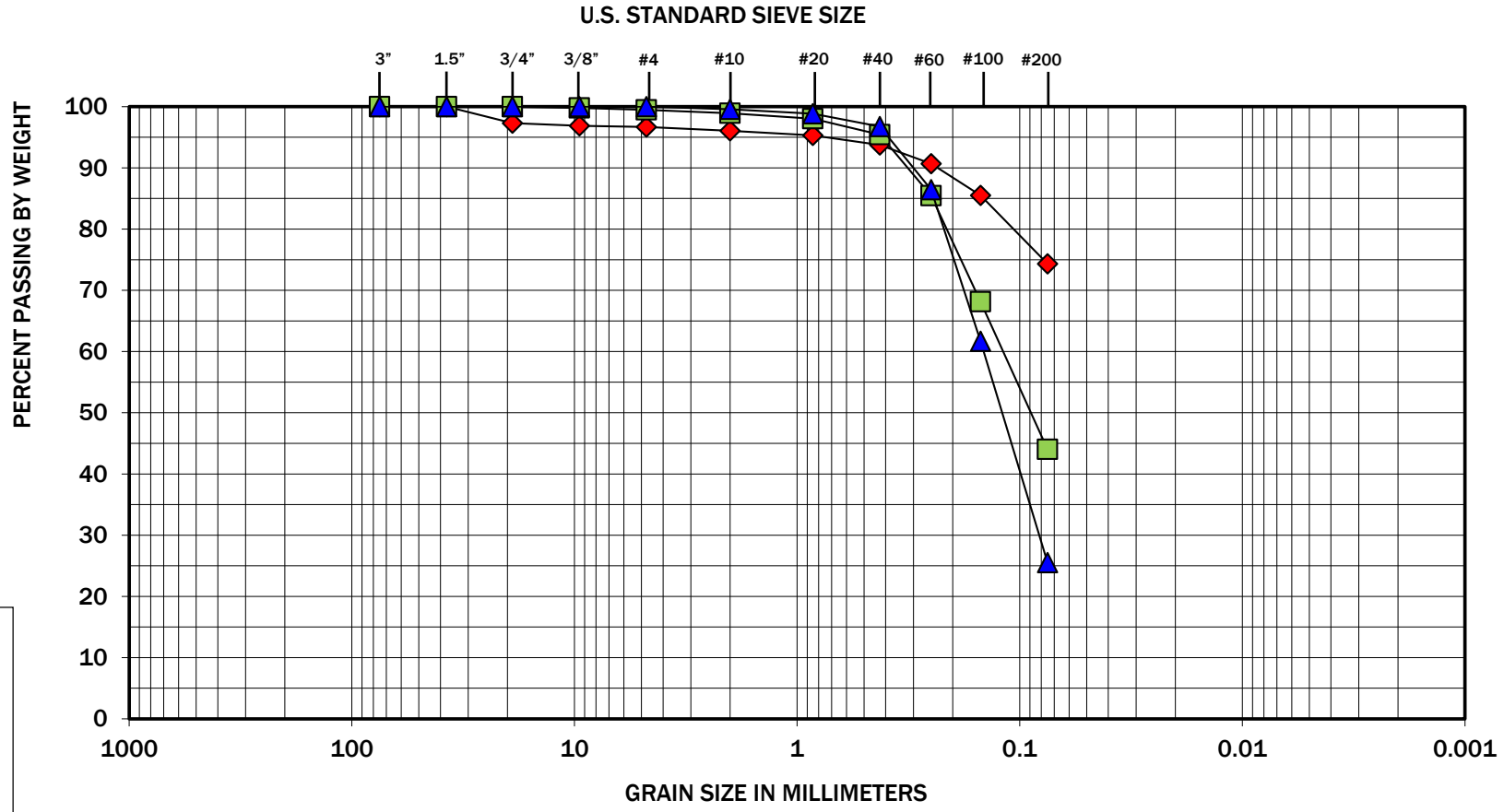
Project: Firgrove Elementary School
Project Location: Puyallup, Washington
Project Number: 2017-006-00

Figure A-9
Sheet 1 of 1



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Symbol	Exploration Number	Depth (feet)	Moisture (%)	Soil Description
◆	PIT-3	2	30.8	Silt with sand (ML)
■	PIT-4	4	18.2	Silty sand (SM)
▲	PIT-5	2	19.1	Silty sand (SM)

The grain size analysis results were obtained in general accordance with ASTM D 6913.

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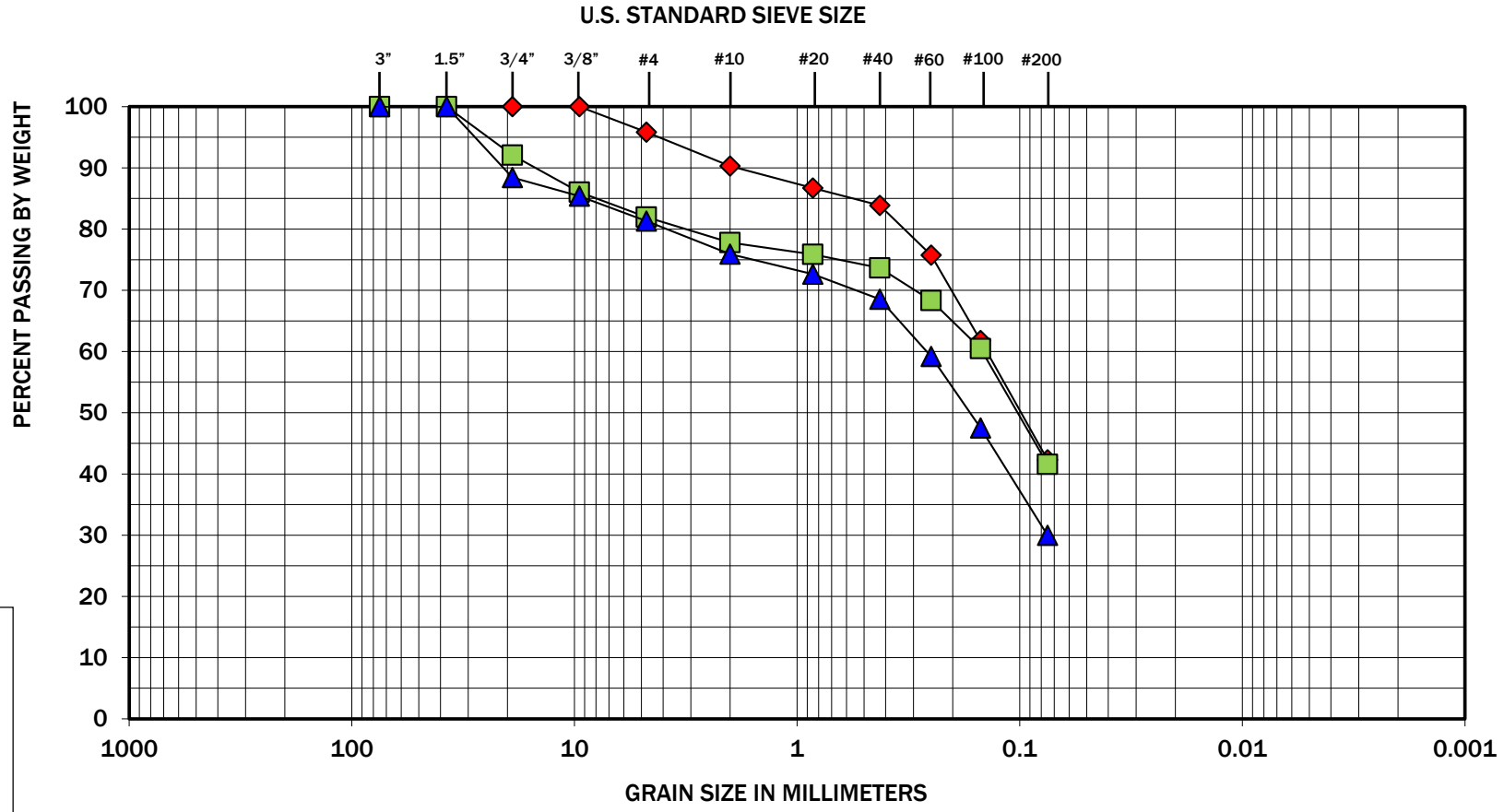
Figure A-10

Firgrove Elementary School
Puyallup, Washington

Sieve Analysis Results



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Symbol	Exploration Number	Depth (feet)	Moisture (%)	Soil Description
◆	PIT-6	2	25.2	Silty sand (SM)
■	PIT-7	2	22.3	Silty sand with gravel (SM)
▲	PIT-8	2	19.1	Silty sand with gravel (SM)

The grain size analysis results were obtained in general accordance with ASTM D 6913.

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Figure A-11

Firgrove Elementary School
Puyallup, Washington

Sieve Analysis Results

Exploration	Test Elevation (feet NGVD 29)	Soil Unit at Test Depth	Cation Exchange Capacity (meq/100g)	Organic Content (%)
PIT-3	463	Weathered Glacial Till	15.6	0.4
PIT-4	460	Lacustrine Soil	8.9	0.2
PIT-5	460	Weathered Glacial Till	5.7	0.3
PIT-6	460	Weathered Glacial Till	10.6	1.5
PIT-7	461	Weathered Glacial Till	12.3	3.4
PIT-8	462	Weathered Glacial Till	10.2	2.3

CEC and Organic Content Test Results

Firgrove Elementary School
Puyallup, Washington

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Figure A-12