

March 8, 2024

Lynwood Unified School District
11321 Bullis Road
Lynwood, California 90262

Attention: Dr. Gretchen Janson
Asst. Superintendent Business Services

Subject: Results of Field Infiltration Testing
Baseball Field at Lynwood High School
4050 E Imperial Highway
Lynwood, California
GPI Project No. 3226.I

Dear Dr. Janson:

This report presents the results of field infiltration testing performed by Geotechnical Professionals Inc. (GPI) for the design of a proposed stormwater infiltration system for the baseball field at Lynwood High School. The testing was coordinated with Rikki Perez of Huckabee and performed in accordance with the County of Los Angeles requirements (COLA, 2021). GPI previously performed a geotechnical investigation and geologic/seismic assessment for the replacement of Classroom Building G at the high school and presented our findings in a report dated November 12, 2021 (GPI, 2021).

Based on preliminary information provided by Huckabee, we understand that a new stormwater infiltration system is planned along the south side of the baseball field near the southwest corner of the high school campus. We understand that shallow storm chamber and/or deeper injection wells are being considered by the project Civil Engineer, CIVILTEC Engineering Inc. Additional details of the proposed stormwater infiltration system have not been established.

SCOPE OF SERVICES

Our scope of services for the current infiltration testing consisted of a review of prior nearby explorations, field investigation, installation of test wells, field infiltration testing, laboratory testing, and the preparation of this report. The locations of the study area and Lynwood High School are shown on Figure 1, Site Location Map.

The field investigation consisted of one exploratory boring and installation of two field infiltration test wells. The boring (B-1) was performed to a depth of approximately 55½ feet below existing grades. Based on the soils encountered in our boring and discussions with the project Civil Engineer, GPI installed the wells at depths of

approximately 13 feet (I-1) and 32 feet (I-2) below existing grades. The approximate location of Boring B-1 and Infiltration Test Wells I-1 and I-2, along with prior explorations by GPI on the high school campus are shown on the Site Plan, Figure 2. Details of the field procedures and a detailed log of the soil conditions encountered within Boring B-1 are in the Appendix.

The infiltration testing was performed in general accordance with the County of Los Angeles requirements (COLA, 2021) and the results are presented in subsequent sections of this report.

SUBSURFACE CONDITIONS

The soils encountered in Boring B-1 consisted of interbedded layers of medium dense to dense silty sands and stiff to very stiff silts and clays within the 55-foot depth explored. Based on the soils encountered during drilling of Boring 1, two preferred zones of more granular (sandy) soils were identified that would potentially have more favorable infiltration rates than layers of fine-grained soils (silts and clays) that were also encountered in the boring. These two zones are described below:

- Zone 1: Between 10 feet and 14 feet below existing grades:
 - These soils consisted of medium dense silty sands and very stiff silts. This approximately 4-foot-thick zone was confined by stiff clayey silts shallower than 10 feet and very stiff to hard silty clays and silts deeper than 14 feet.
 - Fines contents of the soils encountered between depths of 10 and 14 feet ranged from approximately 39 to 76 percent. The confining layers (clays and silts) had fines contents of approximately 88 percent.
 - Moisture contents of soils between depths of 10 and 14 feet ranged from approximately 17 to 34 percent.
- Zone 2: Between 30 feet and 48 feet below existing grades:
 - These soils consisted of dense and slightly moist to moist silty sands. This layer was confined by very stiff clays and silts above 30 feet. Since ground water was measured at a depth of approximately 42 feet below existing site grades, Zone 2 was confined to this depth.
 - Fines contents of the sandy soils encountered between depths of 30 and 40 feet ranged from approximately 33 to 49 percent.
 - Moisture contents of the sandy soils between depths of 30 and 40 feet ranged from approximately 9 to 25 percent.

Groundwater was encountered at a depth of approximately 42 feet in Boring B-1. Based on data from the State of California (CGS, 1998), the historical shallowest depth to groundwater within the site vicinity is approximately 8 feet below existing grades.

RESULTS OF LABORATORY TESTING

GPI performed laboratory testing to determine the percent fines (silts and clays) for select samples of the soils encountered. For determination of fines contents, selected soil samples were dried, weighed, soaked in water until individual soil particles were separated, and then washed on the No. 200 sieve. That portion of the material retained on the No. 200 sieve was oven-dried and weighed to determine the percentage of the material passing the No. 200 sieve. The results of the tests are shown in the table below:

Fines Content of Selected Samples

BORING NO.	DEPTH (ft)	SOIL DESCRIPTION	PERCENT PASSING No. 200 SIEVE
B-7	10	Silty Sand (SM)	39
B-7	12	Silt (ML) with Sand	76
B-7	14	Silty Clay (CL)	88
B-7	30	Silty Sand (SM)	49
B-7	34	Silty Sand (SM)	33
B-7	38	Silty Sand (SM)	43

Moisture contents were determined for a number of the samples. The samples were weighed and then dried in accordance with ASTM D2216. After drying, the weight of each sample was measured, and moisture content was calculated. Moisture content values are presented on the boring logs in the appendix.

RESULTS OF INFILTRATION TESTING

To evaluate the infiltration characteristics for the subsurface soils, GPI performed two field infiltration tests in the existing baseball/softball field area of the high school campus. Based on the subsurface soils encountered and our conversations with CIVILTEC Engineering, the Project Civil Engineer, we performed the field infiltration tests at approximate depths of 13 feet (I-1) and 32 feet (I-2) below grade. The infiltration tests were performed in general accordance with methods established by the County of Los Angeles guidelines (GS200.1, June 30, 2021).

The test wells were installed in boreholes drilled using truck-mounted hollow-stem auger drill equipment. The wells consisted of 2-inch diameter PVC casing installed in 8-inch diameter boreholes. The casing was slotted. Packing material around the slotted well casing consisted of well sand.

Prior to testing, the wells were presoaked in accordance with the requirements of the County. Evaluation of the infiltration rate began during the initial soak. However, the final preadjusted rate did not take the initial readings into consideration as they occurred during the soak period. Based on the rate of infiltration during the pre-soak periods, GPI measured the rates of infiltration in the test wells over 30-minute intervals.

The test wells were filled with at least 2 feet of water at the initiation of the tests. The tests were repeated until a stabilized rate of drop in water level was determined. Once

the stabilized field flowrate (volume per unit time) or drop was determined, we calculated the raw percolation rate by dividing the volume of water discharged by the wetted surface area of the test section in a given amount of time. The wetted area is composed of the sidewalls and bottom of the infiltration test well. The lowest stabilized raw percolation rate over the last three consecutive readings is the *measured percolation rate* at the test location and is typically expressed in units of inches per hour.

A summary of the measured percolation rates is provided below:

WELL NO.	Approximate Depth (feet)	Measured Percolation Rate (inches/hour)
I-1	13	0.26
I-2	32	0.04

The above measured percolation rates must be reduced to determine the design infiltration rate for the proposed infiltration BMP. Reduction factors (RF) account for the test method, site variability, and long-term siltation of the proposed system and should be determined during the design phase of the project. Typical values for these reduction factors are provided in the following table:

DESCRIPTION	REDUCTION FACTORS (RF)*
Small Diameter Boring	$RF_t = 1 \text{ to } 3$
Site variability and thoroughness of subsurface investigation	$RF_v = 1 \text{ to } 3$
Long-term siltation and maintenance	$RF_s = 1 \text{ to } 3$

* Range of values provided in "Guidelines for Geotechnical Investigation and Reporting Low Impact Development Stormwater Infiltration," GS200.1, dated June 30, 2021

It is our opinion that the reduction factor for the test method, RF_t , of 2 may be used (small diameter boring). Based on the number of borings performed and the subsurface conditions, it is our opinion that a reduction factor for site variability, RF_v , of 1 may be used. The Project Designer should determine the appropriate reduction factor for long-term siltation and maintenance (RF_s). Provided the Project Civil Engineers require that maintenance be implemented to prevent long-term siltation as part of the proposed design, an RF_s reduction factor of 1 would be applicable. A more conservative value such as 2 or 3 would be applicable if regular maintenance would be unlikely.

The Design Infiltration Rates based on the reduction factors and assumptions above are summarized in the following table. The Project Designer should confirm the reduction factors used and update the Design Infiltration Rates, as necessary.

Well No. and Approximate Depth	Well I-1 (13 feet)	Well I-2 (32 feet)
Measured Percolation Rate (inches/hour)	0.26	0.04
Test Method: RF_t	2	2
Site Variability and Thoroughness of Subsurface Investigation: RF_v	1	1
Long-term Siltation and Maintenance: RF_s	1	1
Total Reduction Factor: $RF = RF_t + RF_v + RF_s$	4	4
Design Infiltration Rate (inches/hour)	0.07	0.01

The results of the infiltration tests are presented in the attached Tables 1 and 2, Borehole Infiltration Test Results.

CONCLUSIONS AND RECOMMENDATIONS

In general, the measured percolation rates at each depth tested appear to correlate well with the density of the soils and the soil types, where higher density and higher fine content soils result in lower percolation/infiltration rates.

Based on County guidelines, it is recommended that the corrected (design) infiltration rate be equal to or greater than 0.3 inches per hour. The corrected infiltration rates of 0.07 and 0.01 inches per hour are significantly lower than the minimum required 0.3 inches per hour. Note that the volume of water applied during our testing was relatively low as compared to the planned stormwater system.

County guidelines limit the potential zones of stormwater infiltration to at least 10 feet above the design groundwater elevation (GS200.1). Specifically, the County guidelines state the following:

- *The invert of stormwater infiltration shall be at least 10 feet above the design groundwater elevation. Procedures for determining the design groundwater elevation are described later in these guidelines.*
- *The design groundwater elevation must be at least 10 feet above the highest groundwater elevation determined in the groundwater evaluation and shall be evaluated on a case-by-case basis dependent on site-specific conditions.*

We noted that groundwater was encountered at an approximate depth of 42 feet below site grades. Using the County guidelines where the design groundwater elevation is at least 10 feet above the highest groundwater elevation determined, the resulting design

groundwater level would be approximately 32 feet below the ground surface. Based on this guideline, the design groundwater depth would limit infiltration to depths above approximately 22 feet from the existing site grades.

In addition to the groundwater limitations detailed above, the silty sand lens encountered between depths of 10 and 12 feet below existing grades was confined by higher fine content silts and clays. As such, there is a potential for long-term mounding or perched conditions.

Based on the above design infiltration rates, the potential for long-term mounding, the groundwater depths encountered, it is our opinion that stormwater infiltration is not feasible at the location tested. The Civil Engineer should evaluate the feasibility of subsurface infiltration using the rates provided and the County guidelines.

It should be noted that these infiltration rates are for clean, clear water and do not include effects of sediment, fines, dissolved solids, or other debris, as these materials will significantly reduce the infiltration rates of the subsurface soils. Prior to infiltration, water should be cleaned of sediment or other deleterious materials to help reduce the potential for clogging and reduced percolation rates. Maintenance of the storm water system should be performed on a regular basis as recommended by the system designer or manufacturer. These issues should be considered when selecting the reduction factors (RFs) in the design of the system.

LIMITATIONS

The report, exploration logs, and other materials resulting from GPI's efforts were prepared exclusively for use by the Lynwood Unified School District and their consultants in designing the proposed development. The report is not suitable for a project other than the currently proposed development.

Soil deposits may vary in type, strength, and many other important properties between points of exploration due to non-uniformity of the geologic formations or to man-made cut and fill operations. While we cannot evaluate the consistency of the properties of materials in areas not explored, the conclusions drawn in this report are based on the assumption that the data obtained in the field and laboratory are reasonably representative of field conditions and are conducive to interpolation and extrapolation.

Furthermore, our recommendations were developed with the assumption that a proper level of field observation and construction review will be provided during grading, excavation, and construction by GPI. If field conditions during construction appear to be different than is indicated in this report, we should be notified immediately so that we may assess the impact of such conditions on our recommendations. If construction phase services are performed by others, they must accept full responsibility for geotechnical aspects of the project, including this report.

Our investigation and evaluations were performed using generally accepted engineering approaches and principles available at this time and the degree of care and skill ordinarily exercised under similar circumstances by reputable Geotechnical Engineers practicing in this area. No other representation, either express or implied, is included or intended in our report.

Respectfully submitted,
Geotechnical Professionals Inc.

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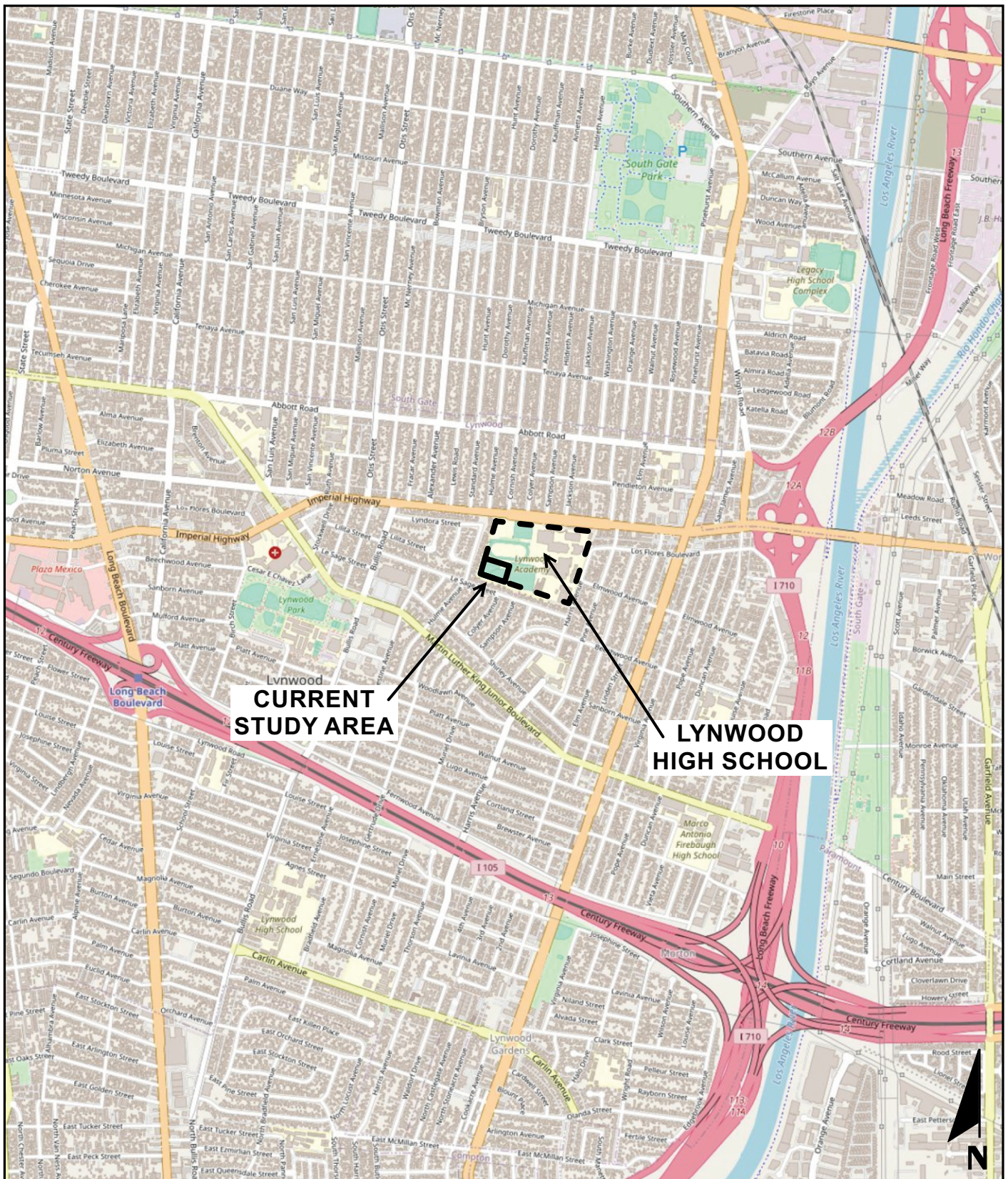
Attachments: References

- | | |
|------------|--------------------------------------|
| Figure 1 | - Site Location Map |
| Figure 2 | - Site Plan |
| Tables 1-2 | - Borehole Infiltration Test Results |
| Appendix A | - Exploratory Boring |
| Figure A-1 | - Log of Boring |

Distribution: Addressee
Rikki Perez and Edwin Munguia, Huckabee

REFERENCES

- American Society of Civil Engineers (2017), "Minimum Design Loads and Associated Criteria for Buildings and Other Structures," ASCE/SEI 7-16.
- American Society of Civil Engineers (2018), "Minimum Design Loads and Associated Criteria for Buildings and Other Structures, Supplement 1" ASCE/SEI 7-16, effective December 12, 2018.
- California Department of Conservation, Division of Mines and Geology (1998), "Seismic Hazard Zone Report for the Southgate 7.5-Minute Quadrangle, Los Angeles County, California", Seismic Hazard Zone Report 034".
- County of Los Angeles, Department of Public Works, Geotechnical and Materials Engineering Division (2021), "Guidelines for Geotechnical Investigation and Reporting Low Impact Development Stormwater Infiltration," Administrative Manual GS200.1, dated June 30, 2021.
- Geotechnical Professionals Inc. (2021), "Geotechnical Investigation, Proposed Classroom Building G Replacement, Lynwood High School, 4050 E Imperial Highway, Lynwood, California," GPI Project No. 3070.I, dated November 12, 2021.



BASE MAP REPRODUCED FROM USGS 7.5' TOPO MAPS © CALTOPO



GEOTECHNICAL
PROFESSIONALS, INC.

LYNWOOD HIGH SCHOOL - INFILTRATION TESTING

GPI PROJECT NO.: 3226.I

SCALE: 1" = 2000'

SITE LOCATION MAP

FIGURE 1



EXPLANATION

- B-1** APPROXIMATE LOCATION AND NUMBER OF EXPLORATORY BORING
- I-2** APPROXIMATE LOCATION AND NUMBER OF INFILTRATION WELLS
- B-6** APPROXIMATE LOCATION AND NUMBER OF EXPLORATORY BORING (GPI, 2021)
- C-4** APPROXIMATE LOCATION AND NUMBER OF CPT (GPI, 2021)
- B-1** APPROXIMATE LOCATION AND NUMBER OF PRIOR BORING (GPI, 2015)
- C-2** APPROXIMATE LOCATION AND NUMBER OF PRIOR CPT (GPI, 2013)
- B-1** APPROXIMATE LOCATION AND NUMBER OF PRIOR BORING (GPI, 2013)

BASE MAP REPRODUCED FROM GOOGLE EARTH © 2021

0 150 300 FEET





GEOTECHNICAL
PROFESSIONALS, INC.

LYNWOOD HIGH SCHOOL - INFILTRATION TESTING

GPI PROJECT NO.: 3226.I

SCALE: 1" = 150'

SITE PLAN

FIGURE 2

TABLE 1

BOREHOLE INFILTRATION TEST RESULTS

- Boring Percolation Test Method

Los Angeles County Guidelines - Low Impact Design (GS200.2, 06/30/17)

Project Name: LYNWOOD HS
 Project No: 3226.I
 Technician: BM

Date: 3/8/2024
 Test Date: 2/16/2024

Test Well (west)	Test Duration (min)	Depth of Well (ft)	Depth to Water Initial* (ft)	Depth to Water Final (ft)	Initial Water Depth (ft)	Final Water Depth (ft)	Water Level Drop (ft)	Hole Diameter (inches)	Volume of Water Discharged (in ³)	Wetted Area (in ²)	Measured Percolation Rate** (in/hr)
	Δt				d_i	d_f	Δd	DIA			
I-1	30.00	13.00	11.77	11.85	1.23	1.16	0.07	8	45.2	398.6	0.23
I-1	30.00	13.00	11.55	11.67	1.45	1.34	0.11	8	69.4	452.9	0.31
I-1	30.00	13.00	11.41	11.55	1.59	1.45	0.14	8	84.4	487.6	0.35
I-1	30.00	13.00	11.50	11.62	1.50	1.39	0.12	8	69.4	468.0	0.30
I-1	30.00	13.00	11.42	11.54	1.58	1.47	0.12	8	69.4	492.1	0.28
I-1	30.00	13.00	11.51	11.62	1.49	1.39	0.11	8	63.3	468.0	0.27
I-1	30.00	13.00	11.54	11.65	1.46	1.36	0.11	8	63.3	458.9	0.28
I-1	30.00	13.00	11.55	11.65	1.45	1.35	0.10	8	60.3	457.4	0.26

* Test well pipe may be higher than ground surface

** Must be reduced to determine design infiltration rate. Recommended reduction factors (RF_t , RF_v , RF_s) included in report.

TABLE 2

BOREHOLE INFILTRATION TEST RESULTS

- Boring Percolation Test Method

Los Angeles County Guidelines - Low Impact Design (GS200.2, 06/30/17)

Project Name: LYNWOOD HS
 Project No: 3226.I
 Technician: BM

Date: 3/8/2024
 Test Date: 2/22/2024

Test Well (west)	Test Duration (min)	Depth of Well (ft)	Depth to Water Initial* (ft)	Depth to Water Final (ft)	Initial Water Depth (ft)	Final Water Depth (ft)	Water Level Drop (ft)	Hole Diameter (inches)	Volume of Water Discharged (in ³)	Wetted Area (in ²)	Measured Percolation Rate** (in/hr)
	Δt				d_i	d_f	Δd	DIA			
I-2	30.00	32.00	28.75	28.81	3.25	3.19	0.06	8	36.2	1012.3	0.07
I-2	30.00	32.00	28.75	28.81	3.25	3.19	0.06	8	36.2	1012.3	0.07
I-2	30.00	32.00	28.68	28.73	3.32	3.28	0.05	8	27.1	1038.0	0.05
I-2	30.00	32.00	28.70	28.75	3.30	3.25	0.05	8	30.2	1030.4	0.06
I-2	30.00	32.00	28.73	28.78	3.27	3.23	0.04	8	27.1	1022.9	0.05
I-2	30.00	32.00	28.75	28.80	3.25	3.21	0.05	8	27.1	1016.9	0.05
I-2	30.00	32.00	28.73	28.77	3.27	3.23	0.04	8	24.1	1024.4	0.05
I-2	30.00	32.00	28.72	28.76	3.28	3.25	0.04	8	21.1	1028.9	0.04

* Test well pipe may be higher than ground surface

** Must be reduced to determine design infiltration rate. Recommended reduction factors (RF_t , RF_v , RF_s) included in report.

APPENDIX

EXPLORATORY BORING

The subsurface conditions at the site were investigated by drilling one exploratory boring to a depth of approximately 55½ feet below existing ground surface. The location of the boring is shown on Figure 2.

The boring was drilled using truck-mounted hollow-stem auger equipment. At selected locations, disturbed soil samples were obtained using a split-spoon sampler by means of the Standard Penetration Test (SPT, ASTM D 6066). The spoon sampler was driven into the soil by a 140-pound hammer dropping 30 inches, employing the “free-fall” hammer described above. After an initial seating drive of 6 inches, the number of blows needed to drive the sampler into the soil a depth of 12 inches was recorded as the penetration resistance. These values are the raw uncorrected blowcounts.

The boring was drilled under the continuous technical supervision of GPI's representative, who visually inspected the site, maintained a detailed log of the boring, classified the soils encountered, and obtained relatively undisturbed samples for examination and laboratory testing. The soils encountered in the boring were classified in the field and through further examination in the laboratory in accordance with the Unified Soils Classification System. A detailed log of Boring B-1 is presented as Figure A-1 in this appendix.

The boring location was laid out in the field by measuring from existing site features. Ground surface elevations at the exploration location was estimated from internet sources (Google Earth) and should be considered approximate.

	MOISTURE (%)	DRY DENSITY (PCF)	PENETRATION RESISTANCE (BLOWS/FOOT)	SAMPLE TYPE	DEPTH (FEET)	DESCRIPTION OF SUBSURFACE MATERIALS		ELEVATION (FEET)
						This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.		
					0		Fill: SILTY SAND (SM)/SANDY SILT (ML) light brown, slightly moist, loose/firm	
	20.4	88	10	D				
					5		@ 5 feet, medium dense/very stiff	80
	33.9	80	25	D				
	33.3	83	21	D			CLAYEY SILT (ML) dark brown, moist, stiff	
					10		SILTY SAND (SM) brown, moist, medium dense	75
	16.9		17	S				
	26.9		20	S			SILT (ML) brown, moist, very stiff, with sand	
	34.3		17	S			SILTY CLAY (CL) brown, moist, very stiff	70
					15			
	18.6		30	S			SANDY SILT (ML) brown, moist, very stiff to hard	
	40.3						CLAY (CL) brown, moist, very stiff to hard	
	25.6		23	S			CLAYEY SILT (ML) brown, moist, very stiff	
					20			65
	21.8		24	S				
	25.9		37	S			SILTY SAND (SM) brown, slightly moist, dense	
	16.4							
	32.1		25	S			CLAYEY SILT (ML) brown, moist, very stiff	60
					25			
	35.7		17	S			SILTY CLAY (CL) grey brown, moist, very stiff	
	31.6		16	S				
					30		SILTY SAND (SM) dark brown, slightly moist, dense	55
	20.6		38	S				
	20.9		41	S				
	13.4		41	S			@ 34 feet, less fines	50
					35			
	9.3		47	S				
	25.2		48	S			@ 38 feet, more fines	
								45

SAMPLE TYPES

- [C] Rock Core
- [S] Standard Split Spoon
- [D] Drive Sample
- [B] Bulk Sample
- [T] Tube Sample

DATE DRILLED:
2-15-24

EQUIPMENT USED:
8 " Hollow Stem Auger

GROUNDWATER LEVEL (ft):
42

PROJECT NO.: 3226.I
LYNWOOD HIGH SCHOOL

LOG OF BORING NO. B-1

FIGURE A-1

	MOISTURE (%)	DRY DENSITY (PCF)	PENETRATION RESISTANCE (BLOWS/FOOT)	SAMPLE TYPE	DEPTH (FEET)	DESCRIPTION OF SUBSURFACE MATERIALS		ELEVATION (FEET)
						This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.		
	24.3		48	S	40		SILTY SAND (SM) grey, wet, dense	40
	26.7		50	S				
	24.8		43	S	45		CLAYEY SILT (ML) grey, moist, hard	
	29.2		59	S			SILTY SAND (SM) grey, wet, dense	
	31.5		36	S			@ 47 feet, very dense	
	39.5						SILT (ML) grey, slightly moist, hard	
	28.3		35	S	50		SILTY CLAY (CL) grey, slightly moist, hard	35
							SANDY SILT (ML) grey, slightly moist, hard	
	25.7		32	S			CLAYEY SILT (ML) grey, slightly moist, hard	
	23.4		46	S	55			30
						Total Depth 55.5 feet		