CITY OF WORCESTER, MASSACHUSETTS

Administration & Finance
Purchasing Division
455 Main Street – Room 201
Worcester, MA 01608
(508) 799-1220
www.worcesterma.gov

June 1, 2022 To All Bidders:

Subject: **Bid No. 7814-W2, Indian Hill Park Improvements – Phase II / DPWP**

ADDENDUM NO. 5

To Whom It May Concern:

With reference to our bid request relative to the above subject, please refer to the changes/modifications/clarifications to the original proposal request.

- ***PLEASE SEE BELOW BIDDERS QUESTIONS AND RESPONSES FROM CITY***

In the plans the Irrigation Pipe it calls for is Schedule 40 but in the specifications it calls for Class 200.
Irrigation Pipe is Class 200.

For the handrails at the Granite stairs plans call for stainless steel but specs call for Galvanized Pipe painted black.
Handrails are to be Stainless Steel.

What will be the color for the PIP Rubber? The colors of Gray or Yellow will be more money.
See Project Special Condition Article 41, Part 2, 2.01, 3c for Color of PIP Rubber.

Spec Section 312200 Grading references a geotechnical report prepared by GEI Consultants, but I don't see it included with the bid. Can you please provide this document?
See attached report

Bidders are requested to acknowledge and/or include this addendum with bid. All other terms, conditions and specifications remain unchanged.

Very truly yours,

Christopher J. Gagliastro
Purchasing Director

WHITESTONE
An Employee-Owned Company

352 TURNPIKE ROAD
SUITE 320
SOUTHBOROUGH, MA 01772
508.485.0755
whitestoneassoc.com

November 15, 2021

via email

BOHLER ENGINEERING MA, LLC
555 Technology Square
Cambridge, Massachusetts 02139

Attention: Ms. Leslie Fanger
Project Manager

Regarding: LIMITED GEOTECHNICAL INVESTIGATION
PROPOSED INDIAN HILL PARK IMPROVEMENTS
165 ARARAT STREET
MAP 25, BLOCK 2, LOT 1100
WORCESTER, WORCESTER COUNTY, MASSACHUSETTS
WHITESTONE PROJECT NO.: GM2118403.000

Dear Ms. Fanger:

Whitestone Associates, Inc. (Whitestone) has completed a limited geotechnical investigation at the above-referenced site. The results of the investigation and recommendations presented below are based on the soil conditions disclosed from a limited number of soil explorations conducted during Whitestone's field investigation. The purpose of the investigation was to assess subsurface conditions at proposed sports light and netting support pole locations accessible to all-terrain vehicle (ATV) mounted drilling equipment. Recommendations for support of the proposed light and netting support poles and anticipated earthwork requirements are included herein.

1.0 PROJECT DESCRIPTION

1.1 Site Location & Existing Conditions

The subject property, located at 165 Ararat Street in the City of Worcester, Worcester County, Massachusetts, currently is developed as Indian Hill Park, a city playing field.

1.2 Site Geology

Based on a review of the *Surficial Geological Map of the Worcester North Quadrangle, Massachusetts (2008)*, the site is underlain by glacial till within the northeastern portion and artificial fill within the southwestern portion. The *Geologic Map of Massachusetts*, prepared by U.S. Geological Survey, indicates that the site is underlain by the Silurian-aged Paxton Formation, consisting of granofels and schist, part of the Merrimack Belt.

1.3 Proposed Construction

According to the September 23, 2021 *Site Layout Plan* prepared by Bohler Engineering MA, LLC of Southborough, Massachusetts, the improvements pertinent to this report are eight high-mast sports light poles, 60 feet to 70 feet in height, around the perimeter of the eastern portion of the park, which will incorporate two baseball/softball diamonds and a flag football field. Backstop netting approximately 25 feet high will be supported on poles on the western, northern, and part of the eastern sides. No new retaining walls or stormwater management areas are shown on the drawings. The locations and explorations are shown on attached Figure 1 - *Boring Location Plan*.

Detailed structural information was not available at the time of this report, however, based on experience with similar facilities, Whitestone anticipates that vertical loading from the poles will not exceed one kip to two kips. The primary loading will be lateral from wind forces, which will depend primarily on the height of the pole and the number and size of attached fixtures. Foundation design for the poles will be by others.

2.0 EXPLORATION

Field exploration at the project site consisted of advancing seven soil borings (identified as B-1 through B-7) within accessible portions of the site. The borings subsequently were backfilled to the surface with excavated soils from the investigation. The locations of the soil borings are shown on the accompanying *Boring Location Plan* included as Figure 1. *Records of Subsurface Exploration* are provided in Appendix A.

The subsurface tests were conducted in the presence of a Whitestone engineer, who conducted field tests, recorded visual classifications, and collected samples of the various strata encountered. The tests were located in the field using normal taping procedures and estimated right angles. These locations are presumed to be accurate within a few feet.

Soil borings and Standard Penetration Tests (SPTs) were conducted in general accordance with ASTM International (ASTM) designation D1586. The SPT resistance value (N) can be used as an indicator of the consistency of fine-grained soils and the relative density of coarse-grained soils. The N-value for various soil types can be correlated with the engineering behavior of earthworks and foundations.

Groundwater level observations, where encountered, were recorded during and immediately after the completion of field operations prior to backfilling the tests. Seasonal variations, temperature effects, man-made effects, and recent rainfall conditions may influence the levels of the groundwater, and the observed levels will depend on the permeability of the soils. Groundwater elevations derived from sources other than seasonally observed groundwater monitor wells may not be representative of true groundwater levels.

3.0 SUBSURFACE CONDITIONS

The subsurface soil conditions encountered within the subsurface tests conducted by Whitestone consisted of the following generalized strata in order of increasing depth. *Records of Subsurface Exploration* are provided in Appendix A.

Surface Cover Materials: The borings encountered three inches to 12 inches of topsoil at the ground surface. In borings B-2 and B-4, the topsoil was underlain by eight inches and six inches of subsoil with roots, respectively.

Existing Fill: Beneath the surface cover materials, the borings, except B-2, encountered very loose to medium dense (occasionally dense) existing fill, consisting of brown/dark brown, silty sand with gravel to gray/black, silty sand with gravel, asphalt, brick, and ceramic pieces. SPT N-values within the existing fill ranged from two blows per foot (bpf) to 46 bpf. The existing fill extended to depths of 1.5 fbgs to 13.2 fbgs, becoming deeper to the west and south. In borings B-5, B-6, and B-7, a three-inch thick former topsoil layer was encountered directly under the existing fill.

Glacial Till: Beneath the existing fill, former topsoil, or surface cover materials, the borings encountered glacial till, consisting of gray-brown, medium dense to very dense, silty sand with gravel, occasional cobbles (USCS: SM). SPT N-values within the glacial till were variable, ranging from 10 bpf to 100 bpf. The borings terminated in the glacial till at depths of 13.3 to 14 fbgs. Borings B-2 and B-7 encountered practical refusal on a large boulder or bedrock at depths of 13.4 fbgs and 13.3 fbgs, respectively.

Groundwater: Static groundwater was encountered in the borings during the exploration at depths ranging from 6.5 fbgs to 12 fbgs. Perched water was encountered in boring B-5 at a depth of five fbgs. Groundwater levels should be expected to fluctuate seasonally and following periods of precipitation.

4.0 CONCLUSIONS & RECOMMENDATIONS

Contingent upon construction phase evaluation, Whitestone's findings preliminarily indicate that the proposed light and netting support poles may be founded on cylindrical precast or cast-in-place concrete piers deriving support either from the natural glacial till or, with limited risk, from the existing fill. Subsurface conditions vary across the site, with little or no existing fill within the northeastern portion of the site and an increasing thickness of existing fill towards the southwest.

The following recommendations have been developed on the basis of the previously described project characteristics and subsurface conditions encountered within the limited exploration conducted. If there are any significant changes to the project characteristics or if significantly different subsurface conditions are encountered during construction, Whitestone should be consulted, such that the recommendations of this report can be reviewed.

4.1 Foundation Design Criteria

Foundations: Because of the variation on subsurface conditions across the site, concrete pier design approach will depend on the location of the pole. For this purpose, the site has been divided into the northeastern portion in the vicinity of borings B-2 and B-3, which has little or no existing fill, and the remainder of the site, which has an increasing thickness of existing fill towards the southwest. Borings B-2 and B-7 encountered practical refusal on a large boulder or bedrock at a depth of approximately 13 fbgs. Excavations for concrete piers deeper than 13 fbgs should therefore expect to encounter very dense, bouldery glacial till or bedrock.

Vicinity of Borings B-2 and B-3 (Glacial Till)

In this area, Whitestone recommends supporting the proposed poles on concrete pier foundations designed to bear within the glacial till at a minimum depth of six fbgs. Foundations bearing within these materials may be designed using a maximum net allowable bearing pressure of 5,000 pounds per square foot (psf). Regardless of loading conditions, the proposed concrete piers should be sized no less than minimum diameters of 24 inches for light pole foundations and 18 inches for netting support pole foundations.

Should LPile be used for pier design, the site soils should be modeled as SAND with an effective unit weight of 135 pounds per cubic foot and a friction angle of 34 degrees. Cohesion should be ignored. A passive lateral earth pressure coefficient of 3.5 may be used in design. Whitestone considers a horizontal modulus of subgrade reaction, k, of 200 pounds per cubic inch to be appropriate within the likely depth of the pier. Alternatively, an allowable lateral bearing pressure of 150 psf per foot below surface grade may be used to assess lateral support, however, the contribution from the upper 12 inches of the pier should be neglected.

Uplift loads may be resisted by friction between the soil and concrete of the pier. An allowable side friction value of 100 psf may be used, however, the upper three feet of the pier should be neglected in the calculation of uplift resistance.

Remainder of Site (Existing Fill)

In this area, Whitestone recommends supporting the proposed poles on concrete pier foundations designed to bear within the existing fill at a minimum depth of nine fbgs or at least one foot into the natural glacial till, if encountered. Foundations bearing within these materials may be designed using a maximum net allowable bearing pressure of 1,500 pounds per square foot (psf). Regardless of loading conditions, the proposed concrete piers should be sized no less than minimum diameters of 24 inches for light pole foundations and 18 inches for netting support pole foundations.

Should LPile be used for pier design, the site soils should be modeled as SAND with an effective unit weight of 120 pounds per cubic foot and a friction angle of 30 degrees. Cohesion should be ignored. A passive lateral earth pressure coefficient of three may be used in design. Whitestone considers a horizontal modulus of subgrade reaction, k, of 50 pounds per cubic inch to be appropriate within the likely depth of the pier. Alternatively, an allowable lateral bearing pressure of 50 psf per foot below surface grade may be used to assess lateral support, however, the contribution from the upper 12 inches of the pier should be neglected.

Uplift loads may be resisted by friction between the soil and concrete of the pier. An allowable side friction value of 50 psf may be used, however, the upper three feet of the pier should be neglected in the calculation of uplift resistance.

Groundwater Control: Static groundwater was encountered during the exploration at depths that may impact foundation pier construction, particularly in the existing fill areas within which the piers will be deeper. Groundwater, if encountered, accumulating in the pier excavation should be removed by pumping or bailing before concreting. As an alternative to removal of water, concrete could be placed by tremie methods.

Seismic Site Class: Based on a review of the subsurface conditions relevant to the Commonwealth of Massachusetts *State Building Code (Ninth Edition)*, the subject site has been assigned a Site Class D. The site soils are not susceptible to earthquake induced liquefaction.

Inspection/Overexcavation Criteria: Whitestone recommends that the suitability of the bearing soils at the pier bottoms be reviewed by a geotechnical engineer immediately prior to placing concrete. In the event that unsuitable material is encountered, additional excavation may be necessary to provide a suitable pier foundation subgrade.

Frost Coverage: Foundations subject to frost action should be placed at least 48 inches below adjacent exterior grades, in accordance with the Commonwealth of Massachusetts *State Building Code (Ninth*

Edition), to provide protection from frost penetration.

Settlement: Whitestone estimates post construction settlements of proposed foundations of less than one inch, if the recommendations outlined in this report are properly implemented.

4.2 Excavations

The site soils encountered during the investigation generally are most consistent with, at least, Type C Soil Conditions as defined by 29 CFR Part 1926 (OSHA) that require a maximum unbraced excavation angle of 1.5:1 (horizontal:vertical). Actual conditions encountered during construction should be evaluated by a competent person (as defined by OSHA), so that safe excavation methods and/or shoring and bracing requirements are implemented.

5.0 SUPPLEMENTAL POST INVESTIGATION SERVICES

Construction Inspection and Monitoring: The owner's geotechnical engineer with specific knowledge of the site subsurface conditions and design intent should conduct inspection, testing, and consultation during construction as described in previous sections of this report. Monitoring and testing should also be conducted to confirm that:

- the pier is excavated to the appropriate depth;
- any debris and/or loose soil are removed from the excavation;
- water is removed from the excavation or appropriate tremie procedures are adopted;
- the pier reinforcement is aligned correctly; and
- concrete is placed directly into the center of the hole without segregation, or by tremie pipe.

6.0 CLOSING

Whitestone's geotechnical division appreciates the opportunity to be of continued service to Bohler Engineering MA, LLC. Please note that Whitestone has the capability to conduct the additional geotechnical engineering services recommended herein. Please contact us at (508) 485-0755 with any questions regarding this report.

Sincerely,

WHITESTONE ASSOCIATES, INC.

Richard W.M. McLaren, P.E.
Senior Consultant

Ryan R. Roy, P.E.
Vice President

RWM/ri N:\Job Folders\2021\2118403GM\Reports and Submittals\Bohler Indian Hill Park GM2118403 LimGI Worcester MA 11-15-21.doc
Enclosures
Copy: Laurence W. Keller, P.E., Whitestone Associates, Inc.

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FIGURE 1
Boring Location Plan

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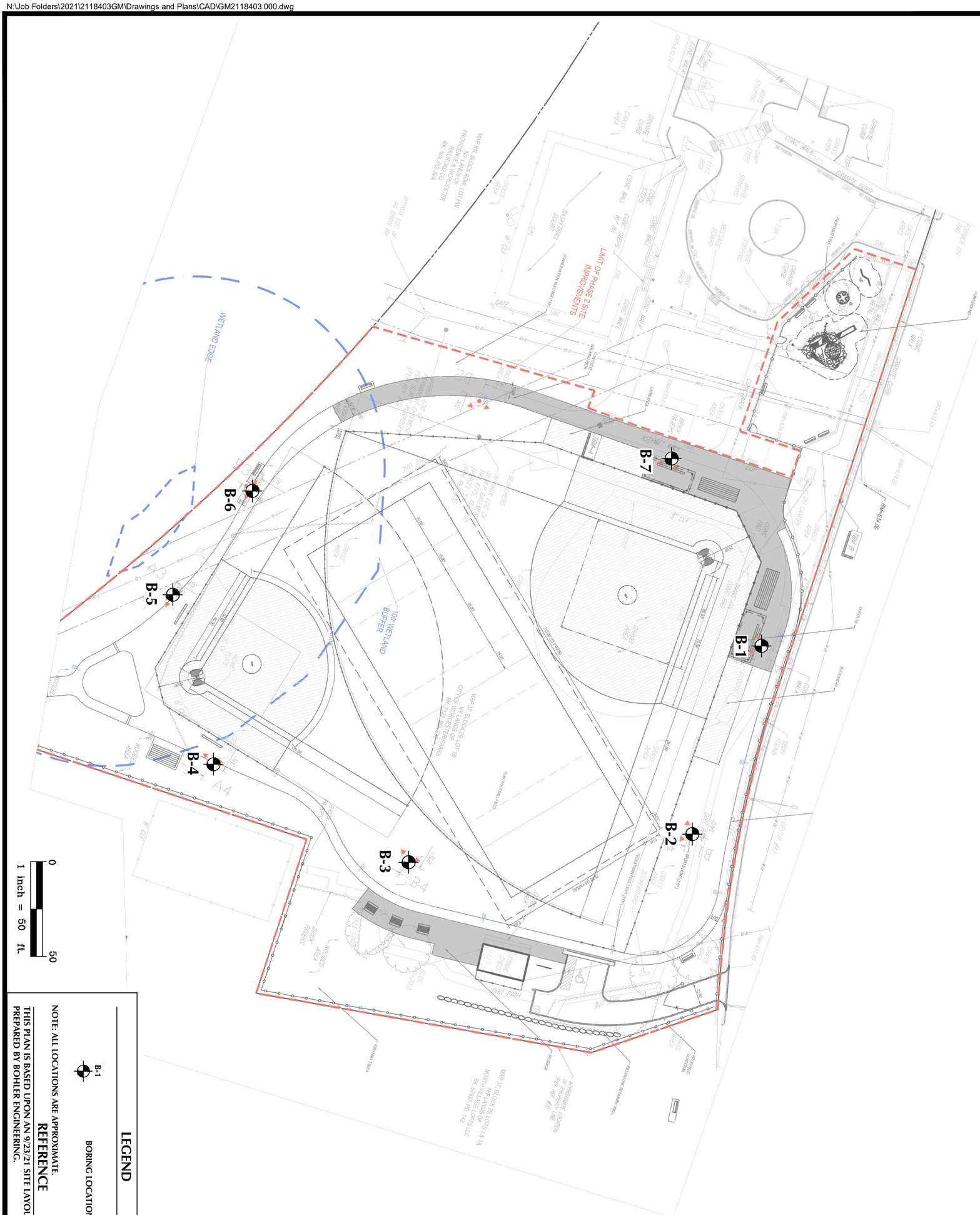

LEGEND

B-1 BORING LOCATION

NOTE: ALL LOCATIONS ARE APPROXIMATE.

REFERENCE

THIS PLAN IS BASED UPON AN 9/23/21 SITE LAYOUT PLAN, PREPARED BY BOHLER ENGINEERING.

PROJECT #: GM2118403.000

DESIGNED BY: MR

DATE: 11/9/21

SCALE: 1" = 50'

PROJ. MGR.: RR

FIGURE: 1

DRAWING TITLE: **BORING LOCATION PLAN**

CLIENT: BOHLER ENGINEERING MA, LLC

PROJECT: INDIAN HILL PARK
ARARAT STREET
WORCESTER, MASSACHUSETTS

WHITESTONE
An Employee-Owned Company
352 TURNPIKE ROAD, SUITE 320, SOUTHBOROUGH, MA 01772
508.485.0755 WHITESTONEASSOC.COM

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APPENDIX A
Records of Subsurface Exploration

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Boring No.: B-1

Page 1 of 1

Project:	Proposed Indian Hill Park Improvements	**WAI Project No.:**	GM2118403.000
Location:	165 Ararat Street, Worcester, Worcester County, Massachusetts	**Client:**	Bohler Engineering MA, LLC

				Water Depth | Elevation (feet bgs) | (ft NAVD88)	Cave-In Depth | Elevation (feet bgs) | (ft NAVD88)
Surface Elevation:	± NS feet Above NAVD88	**Date Started:**	11/4/2021		
Termination Depth:	14.0 feet bgs	**Date Completed:**	11/4/2021		
Proposed Location:	Sports Light Pole	**Logged By:**	RK	**During:** 12.0 | --	
Drill / Test Method:	HSA / SPT	**Contractor:**	DE	**At Completion:** -- | --	**At Completion:** -- | --
		Equipment:	CME 55	**24 Hours:** -- | --	**24 Hours:** -- | --

SAMPLE INFORMATION						DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (feet)	No	Type	Blows Per 6"	Rec. (in.)	N	(feet)				
						0.0				
							TS		6" Topsoil	
0 - 2	S-1		3 - 9 - 9 - 5	6	18		EXISTING FILL		Brown, Medium Dense, Silty Sand with Gravel (FILL)	
2 - 4	S-2		2 - 1 - 1 - 1	16	2				As Above, Very Loose (FILL)	
						5.0				
5 - 7	S-3		1 - 2 - 3 - 6	12	5				As Above, Loose (FILL)	
						7.0				
7 - 9	S-4		9 - 13 - 17 - 20	14	30		GLACIAL TILL		Gray-Brown, Medium Dense to Dense, Silty Sand with Gravel (SM)	
						10.0				
10 - 12	S-5		5 - 4 - 6 - 9	6	10				As Above, Loose to Medium Dense (SM)	
12 - 14	S-6		4 - 8 - 24 - 43	18	32				As Above, Dense (SM)	
						15.0			Boring Log B-1 Terminated at Depth of 14.0 Feet Below Ground Surface.	
						20.0				
						25.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Boring No.: B-2

Page 1 of 1

Project:	Proposed Indian Hill Park Improvements	**WAI Project No.:**	GM2118403.000
Location:	165 Ararat Street, Worcester, Worcester County, Massachusetts	**Client:**	Bohler Engineering MA, LLC
Surface Elevation:	± NS feet Above NAVD88	**Date Started:**	11/4/2021
Termination Depth:	13.4 feet bgs	**Date Completed:**	11/4/2021
Proposed Location:	Sports Light Pole	**Logged By:**	RK
Drill / Test Method:	HSA / SPT	**Contractor:**	DE
		Equipment:	CME 55

	Water Depth (feet bgs)	Elevation (ft NAVD88)	Cave-In Depth (feet bgs)	Elevation (ft NAVD88)
During:	10.0	--		
At Completion:	--	--	**At Completion:** --	--
24 Hours:	--	--	**24 Hours:** --	--

SAMPLE INFORMATION						DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (feet)	No	Type	Blows Per 6"	Rec. (in.)	N	(feet)				
						0.0				
0 - 2	S-1		3 - 3 - 6 - 11	18	9		TS		4" Topsoil	
							SUBSOIL		8" Subsoil, Roots	
									Gray-Brown, Medium Dense, Silty Sand with Gravel (SM)	
2 - 4	S-2		12 - 14 - 26 - 22	14	40				As Above, Dense (SM)	
						5.0				
5 - 7	S-3		10 - 14 - 16 - 11	14	30				As Above, Medium Dense to Dense (SM)	
							GLACIAL TILL			
7 - 9	S-4		13 - 13 - 18 - 22	18	31				As Above, Dense (SM)	
						10.0 ▽				
10 - 12	S-5		11 - 20 - 25 - 40	18	45				As Above (SM)	
12 - 13.4	S-6		44 - 50 - 50/5"	12	100				As Above, Very Dense (SM)	
						15.0			Boring Log B-2 Terminated at Depth of 13.4 Feet Below Ground Surface. Practical refusal on large boulder or bedrock	
						20.0				
						25.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Boring No.: B-3

Page 1 of 1

Project:	Proposed Indian Hill Park Improvements	**WAI Project No.:**	GM2118403.000
Location:	165 Ararat Street, Worcester, Worcester County, Massachusetts	**Client:**	Bohler Engineering MA, LLC

				Water Depth | Elevation (feet bgs) | (ft NAVD88)	Cave-In Depth | Elevation (feet bgs) | (ft NAVD88)
Surface Elevation:	± NS feet Above NAVD88	**Date Started:**	11/4/2021		
Termination Depth:	14.0 feet bgs	**Date Completed:**	11/4/2021		
Proposed Location:	Sports Light Pole	**Logged By:**	RK	**During:** 6.5 | --	
Drill / Test Method:	HSA / SPT	**Contractor:**	DE	**At Completion:** -- | --	**At Completion:** -- | --
		Equipment:	CME 55	**24 Hours:** -- | --	**24 Hours:** -- | --

SAMPLE INFORMATION						DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (feet)	No	Type	Blows Per 6"	Rec. (in.)	N	(feet)				
						0.0				
							TS		6" Topsoil	
0 - 2	S-1		2 - 3 - 4 - 12	16	7		EXISTING FILL		Brown, Loose, Silty Sand with Gravel (FILL)	
						1.5				
2 - 4	S-2		8 - 10 - 9 - 10	18	19				Gray-Brown, Medium Dense, Silty Sand with Gravel (SM)	
									As Above (SM)	
						5.0				
5 - 7	S-3		13 - 15 - 13 - 14	12	28				As Above (SM)	
7 - 8.3	S-4		11 - 30 - 50/4"	10	60		GLACIAL TILL		As Above, Very Dense (SM)	Cobbles
						10.0				
10 - 12	S-5		21 - 19 - 22 - 26	12	41				As Above, Dense (SM)	
12 - 14	S-6		24 - 23 - 35 - 33	14	58				As Above, Very Dense (SM)	
						15.0			Boring Log B-3 Terminated at Depth of 14.0 Feet Below Ground Surface.	
						20.0				
						25.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Boring No.: B-4

Page 1 of 1

Project:	Proposed Indian Hill Park Improvements	**WAI Project No.:**	GM2118403.000
Location:	165 Ararat Street, Worcester, Worcester County, Massachusetts	**Client:**	Bohler Engineering MA, LLC

				Water Depth | Elevation (feet bgs) | (ft NAVD88)	Cave-In Depth | Elevation (feet bgs) | (ft NAVD88)
Surface Elevation:	± NS feet Above NAVD88	**Date Started:**	11/4/2021		
Termination Depth:	14.0 feet bgs	**Date Completed:**	11/4/2021		
Proposed Location:	Sports Light Pole	**Logged By:**	RK	**During:** 7.5 | --	
Drill / Test Method:	HSA / SPT	**Contractor:**	DE	**At Completion:** -- | --	**At Completion:** -- | --
		Equipment:	CME 55	**24 Hours:** -- | --	**24 Hours:** -- | --

SAMPLE INFORMATION						DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (feet)	No	Type	Blows Per 6"	Rec. (in.)	N	(feet)				
						0.0				
0 - 2	S-1		2 - 3 - 4 - 10	22	7		TS		12" Topsoil	
							SUBSOIL		6" Subsoil, Roots	
2 - 4	S-2		11 - 13 - 10 - 10	22	23		EXISTING FILL		Brown, Medium Dense, Silty Sand with Gravel (FILL)	
						5.0			As Above (FILL)	
5 - 7	S-3		8 - 8 - 10 - 10	14	18				As Above (FILL)	
7 - 9	S-4		11 - 19 - 30 - 37	18	49	8.0			As Above, Dense (FILL)	
							GLACIAL TILL		Gray-Brown, Very Dense, Silty Sand with Gravel (SM)	
						10.0				
10 - 12	S-5		18 - 20 - 25 - 27	18	45				As Above, Dense (SM)	
12 - 14	S-6		22 - 28 - 30 - 34	12	58				As Above, Very Dense (SM)	
						15.0			Boring Log B-1 Terminated at Depth of 14.0 Feet Below Ground Surface.	
						20.0				
						25.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Boring No.: B-5

Page 1 of 1

Project:	Proposed Indian Hill Park Improvements	**WAI Project No.:**	GM2118403.000
Location:	165 Ararat Street, Worcester, Worcester County, Massachusetts	**Client:**	Bohler Engineering MA, LLC

				Water Depth | Elevation (feet bgs) | (ft NAVD88)	Cave-In Depth | Elevation (feet bgs) | (ft NAVD88)
Surface Elevation:	± NS feet Above NAVD88	**Date Started:**	11/4/2021		
Termination Depth:	14.0 feet bgs	**Date Completed:**	11/4/2021		
Proposed Location:	Sports Light Pole	**Logged By:**	RK	**During:** 5.0 (P) | --	
Drill / Test Method:	HSA / SPT	**Contractor:**	DE	**At Completion:** 10.0 | --	**At Completion:** -- | --
		Equipment:	CME 55	**24 Hours:** -- | --	**24 Hours:** -- | --

SAMPLE INFORMATION						DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (feet)	No	Type	Blows Per 6"	Rec. (in.)	N	(feet)				
						0.0				
							TS		3" Topsoil	
0 - 2	S-1		9 - 22 - 24 - 31	16	46				Gray-Black, Dense, Silty Sand with Gravel, Asphalt Layers (FILL)	
2 - 4	S-2		17 - 11 - 5 - 4	10	16				As Above, Medium Dense (FILL)	
									Dark Brown, Loose, Silty Sand with Gravel (FILL)	
						5.0				Perched water @ 5 fbgs
5 - 7	S-3		3 - 3 - 3 - 9	10	6		EXISTING FILL		As Above (FILL)	
7 - 9	S-4		15 - 10 - 7 - 6	12	17				As Above, Brown, Medium Dense (FILL)	
						10.0				
10 - 12	S-5		WOH - 3 - 4 - 6	4	7				As Above, Gray-Brown, Loose (FILL)	
12 - 14	S-6		5 - 4 - 2 - 9	12	6	13.2			As Above, Gray (FILL)	
						13.5	TS		3" Former Topsoil	
							TILL		Gray-Brown, Medium Dense, Silty Sand with Gravel (SM)	
									Boring Log B-5 Terminated at Depth of 14.0 Feet Below Ground Surface.	
						15.0				
						20.0				
						25.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Boring No.: B-6

Page 1 of 1

Project:	Proposed Indian Hill Park Improvements	**WAI Project No.:**	GM2118403.000
Location:	165 Ararat Street, Worcester, Worcester County, Massachusetts	**Client:**	Bohler Engineering MA, LLC

				Water Depth | Elevation (feet bgs) | (ft NAVD88)	Cave-In Depth | Elevation (feet bgs) | (ft NAVD88)
Surface Elevation:	± NS feet Above NAVD88	**Date Started:**	11/4/2021		
Termination Depth:	14.0 feet bgs	**Date Completed:**	11/4/2021		
Proposed Location:	Sports Light Pole	**Logged By:**	RK	**During:** 10.0 | --	
Drill / Test Method:	HSA / SPT	**Contractor:**	DE	**At Completion:** -- | --	**At Completion:** -- | --
		Equipment:	CME 55	**24 Hours:** -- | --	**24 Hours:** -- | --

SAMPLE INFORMATION						DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (feet)	No	Type	Blows Per 6"	Rec. (in.)	N	(feet)				
						0.0				
0 - 2	S-1		2 - 3 - 14 - 18	18	17		TS		12" Topsoil	
2 - 4	S-2		15 - 16 - 17 - 12	18	33		EXISTING FILL		Gray-Black, Medium Dense, Silty Sand with Gravel, Asphalt and Brick Pieces (FILL)	
						5.0			As Above, Dense (FILL)	
5 - 7	S-3		5 - 5 - 4 - 5	20	9				Gray-Brown, Loose, Silty Sand with Gravel (FILL)	
7 - 9	S-4		4 - 3 - 5 - 14	16	8	7.7			As Above (FILL)	
						8.0	TS		3" Former Topsoil	
									Gray-Brown, Medium Dense, Silty Sand with Gravel (SM)	
						10.0				
10 - 12	S-5		12 - 14 - 13 - 12	6	27		GLACIAL TILL		As Above (SM)	
12 - 14	S-6		10 - 8 - 12 - 11	6	20				As Above (SM)	
						15.0			Boring Log B-6 Terminated at Depth of 14.0 Feet Below Ground Surface.	
						20.0				
						25.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Boring No.: B-7

Page 1 of 1

Project:	Proposed Indian Hill Park Improvements	**WAI Project No.:**	GM2118403.000
Location:	165 Ararat Street, Worcester, Worcester County, Massachusetts	**Client:**	Bohler Engineering MA, LLC

				Water Depth | Elevation (feet bgs) | (ft NAVD88)	Cave-In Depth | Elevation (feet bgs) | (ft NAVD88)
Surface Elevation:	± NS feet Above NAVD88	**Date Started:**	11/4/2021		
Termination Depth:	13.3 feet bgs	**Date Completed:**	11/4/2021		
Proposed Location:	Sports Light Pole	**Logged By:**	RK	**During:** 6.5 | --	
Drill / Test Method:	HSA / SPT	**Contractor:**	DE	**At Completion:** -- | --	**At Completion:** -- | --
		Equipment:	CME 55	**24 Hours:** -- | --	**24 Hours:** -- | --

SAMPLE INFORMATION						DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (feet)	No	Type	Blows Per 6"	Rec. (in.)	N	(feet)				
						0.0				
							TS		6" Topsoil	
0 - 2	S-1		2 - 3 - 3 - 3	18	6		EXISTING FILL		Dark Brown, Loose, Silty Sand with Gravel, Ceramic and Brick Pieces (FILL)	
2 - 4	S-2		3 - 2 - 1 - 2	16	3				As Above, Very Loose (FILL)	
						5.0				
5 - 7	S-3		2 - 2 - 1 - 2	16	3				Brown, Very Loose, Silty Sand with Gravel (FILL)	
7 - 9	S-4		2 - 2 - 2 - 2	18	4				As Above, Very Loose to Loose (FILL)	
						10.0				
10 - 12	S-5		2 - 1 - 3 - 4	16	4	11.2			As Above, Very Loose (FILL)	
						11.5	TS		3" Former Topsoil	
12 - 14	S-6		8 - 18 - 21 - 50/4"	12	39		GLACIAL TILL		Gray-Brown, Dense, Silty Sand with Gravel (SM)	
						15.0			Boring Log B-7 Terminated at Depth of 13.3 Feet Below Ground Surface. Practical refusal on large boulder or bedrock	
						20.0				
						25.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

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APPENDIX B
Supplemental Information (USCS, Terms & Symbols)

WHITESTONE
An Employee-Owned Company

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UNIFIED SOIL CLASSIFICATION SYSTEM

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	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
	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
	SAND AND SANDY SOILS	CLEAN SAND (LITTLE OR NO FINES)	SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	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 LIMITS 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
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMITS GREATER THAN 50	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			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 FOR SAMPLES WITH 5% TO 12% FINES

GRADATION*

% FINER BY WEIGHT

TRACE..... 1% TO 10%
LITTLE..... 10% TO 20%
SOME..... 20% TO 35%
AND..... 35% TO 50%

COMPACTNESS*
Sand and/or Gravel

RELATIVE DENSITY

LOOSE. ..... 0% TO 40%
MEDIUM DENSE.... 40% TO 70%
DENSE..... 70% TO 90%
VERY DENSE..... 90% TO 100%

CONSISTENCY*
Clay and/or Silt

RANGE OF SHEARING STRENGTH IN POUNDS PER SQUARE FOOT

VERY SOFT..... LESS THAN 250
SOFT..... ..... 250 TO 500
MEDIUM..... 500 TO 1000
STIFF..... 1000 TO 2000
VERY STIFF..... 2000 TO 4000
HARD..... GREATER THAN 4000

** VALUES ARE FROM LABORATORY OR FIELD TEST DATA, WHERE APPLICABLE. WHEN NO TESTING WAS PERFORMED, VALUES ARE ESTIMATED.*

L:\Geotechnical Forms and References\Reports\USCSTRMSSYM MA.docx

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GEOTECHNICAL TERMS AND SYMBOLS

SAMPLE IDENTIFICATION

The Unified Soil Classification System is used to identify the soil unless otherwise noted.

SOIL PROPERTY SYMBOLS

N: Standard Penetration Value: Blows per ft. of a 140 lb. hammer falling 30" on a 2" O.D. split-spoon.
Qu: Unconfined compressive strength, TSF.
Qp: Penetrometer value, unconfined compressive strength, TSF.
Mc: Moisture content, %.
LL: Liquid limit, %.
PI: Plasticity index, %.
δd: Natural dry density, PCF.
▼: Apparent groundwater level at time noted after completion of boring.

DRILLING AND SAMPLING SYMBOLS

NE: Not Encountered (Groundwater was not encountered).
SS: Split-Spoon - 1 ⅜" I.D., 2" O.D., except where noted.
ST: Shelby Tube - 3" O.D., except where noted.
AU: Auger Sample.
OB: Diamond Bit.
CB: Carbide Bit
WS: Washed Sample.

RELATIVE DENSITY AND CONSISTENCY CLASSIFICATION

Term (Non-Cohesive Soils)	Standard Penetration Resistance
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	Over 50

Term (Cohesive Soils)	Qu (TSF)
Very Soft	0 - 0.25
Soft	0.25 - 0.50
Firm (Medium)	0.50 - 1.00
Stiff	1.00 - 2.00
Very Stiff	2.00 - 4.00
Hard	4.00+

PARTICLE SIZE

Boulders	8 in.+	Coarse Sand	5mm-0.6mm	Silt	0.074mm-0.005mm
Cobbles	8 in.-3 in.	Medium Sand	0.6mm-0.2mm	Clay	-0.005mm
Gravel	3 in.-5mm	Fine Sand	0.2mm-0.074mm		

Other Office Locations:

WARREN, NJ 908.668.7777 | CHALFONT, PA 215.712.2700 | ROCKY HILL, CT 860.726.7889 | WALL, NJ 732.592.2101 | PHILADELPHIA, PA 215.848.2323

Environmental & Geotechnical Engineers & Consultants