Terracon
GeoReport

Geotechnical Engineering Report

West River Wall Reconstruction Project – Segment 2
City of Rochester Project #12236
NYSDOT Contract # C007067
Rochester, New York

May 9, 2018
Terracon Project No. J5185038

Prepared for:
Nature’s Way Environmental Consultants and Contractors, Inc.
Alden, New York

Prepared by:
Terracon Consultants-NY, Inc.
Rochester, New York

New York State
DOS
Department of State

This document was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.

terracon.com
Terracon

Environmental ■ Facilities ■ Geotechnical ■ Materials

May 9, 2018

Nature’s Way Environmental Consultants and Contractors, Inc.
200 E. Broad Street, Suite 200
Alden, New York 14004

Attn: Mr. Dale Gramza
P: 716.937.6527
E: dgramza@natureswayenv.com

Re: Geotechnical Engineering Report
West River Wall Reconstruction Project – Segment 2
Rochester, New York
Terracon Project No. J5185038

Dear Mr. Gramza:

We have completed the Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Task Order No. J5185038 dated February 27, 2018. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of structures for the proposed project, based upon the findings of the subsurface exploration program completed by Nature’s Way Environmental Consultants and Contractors, Inc. (NWECC). This report is subject to **General Comments**.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants-NY, Inc.

5/9/18

MICHELE A. FIORILLO
085888

Michele A. Fiorillo, P.E.
Geotechnical Department Manager

Lawrence J. Dwyer
Principal

Terracon Consultants-NY, Inc. 15 Marway Circle, Suite 2B Rochester, New York 14624
P (585) 247 3471 F (585) 363 7025 terracon.com

Environmental ■ Facilities ■ Geotechnical ■ Materials

REPORT TOPICS

Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

Geotechnical Engineering Report

West River Wall Reconstruction Project – Segment 2

Rochester, New York

Terracon Project No. J5185038

May 9, 2018

INTRODUCTION

This report presents the results of the subsurface exploration and geotechnical engineering services performed for the proposed West River Wall – Segment 2 in Rochester, New York. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil and rock conditions
- Groundwater conditions
- Site preparation and earthwork
- Excavation considerations
- Rock anchor design
- Foundation design and construction
- Seismic site classification
- Lateral earth pressures
- Dewatering considerations

The field testing program, performed by Nature's Way Environmental Consultants and Contractors, Inc. (NWECC) consisted of advancing eight test borings to depths ranging from approximately 15.1 to 50.6 feet below existing site grades. Test boring logs were prepared by NWECC and provided to Terracon.

Terracon did not monitor drilling, therefore we are relying on the accuracy and completeness of the information presented in the subsurface logs prepared by NWECC. Terracon is not responsible for the data or conclusions drawn from it if the data is flawed. If conditions encountered during construction are different than represented on NWECC's boring logs, Terracon should be immediately notified so that further evaluation and supplemental recommendations can be provided.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included as separate graphs in the **Exploration Results** section of this report.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic, aerial, and topographic maps.

Item	Description
Parcel Information	The site consists of an area located along the west side of the Genesee River from approximately Ford Street to the existing Genesee Riverway Trail pedestrian bridge crossing the Genesee River to the south. See **Site Location**
Existing Improvements	Existing wall located along the west side of the Genesee River; landscaped areas; trails
Current Ground Cover	Grass; scattered trees; brushes; asphalt
Existing Topography (from Google Earth)	Generally level with small landscaped berms. Ground surface elevations (EL) along the alignment behind the existing wall range from approximately El 511 feet to 522 feet
Physiography and Geology	The project site is located within the Ontario Lowlands physiographic province. The soil deposits within this province generally consist of glacially-derived deposits, such as glacial till (i.e. terminal moraines and ground moraine), granular deposits (i.e. kame, glacial outwash, and beach ridges), and glaciolacustrine deposits (i.e. varved silts, clay, and fine sand deposits). Mapping of surficial soils by the Surficial Geologic Map of New York, Finger Lakes Sheet, 1986 identifies surficial native deposits at the project site as outwash sand and gravel or glaciolacustrine deposits. The rock stratigraphy of the region generally consists of sedimentary rocks dipping slightly southward and striking approximately east-west. Generally, only minor folding and faulting are found in western New York. Based upon the *Geologic Map of New York, Finger Lakes Sheet, 1970,* the bedrock underlying the project area should consist of dolomite of the Lockport Group. This information is generally consistent with the data obtained from the recovered rock cores completed at the site. The Lockport Formation in western New York State extends in an east-west direction from Niagara Falls to Ilion for approximately 200 miles. The Lockport Formation is a resistant unit, forming the crests of Niagara Falls and the upper falls of the Rochester gorge, and is generally underlain by the Rochester Shale (middle Silurian Clinton Group) and overlain by the Upper Silurian Salina Group. The Lockport Formation is mostly dolomite with a brownish-gray to dark-gray color with medium granularity, medium to thick bedding, which commonly contains small cavities lined with dolomite and other crystals.

PROJECT DESCRIPTION

Our understanding of the project conditions is as follows:

Item	Description
Information Provided	Verbal conversations and emails with Mr. Josh Repp, P.E., Project Manager with Bergmann. Record drawings titled “Contract No. 59” dated July 28, 1916. Construction plans were not available at the time of the preparation of this report.
Project Description	Reconstruction and preservation of portions of the existing 3,700 feet long West River Wall.
Proposed Structures	New concrete wall. As part of the construction, new pre-stressed/post-tensioned (PT) rock anchor systems may be required for the portions of the reconstructed wall.
Maximum Loads	Not available
Grading/Slopes	Not available
Below Grade Structures	None
Free-Standing Retaining Walls	Site plans not available
Below Grade Areas	None
Estimated Start of Construction	Unknown

GEOTECHNICAL CHARACTERIZATION

Subsurface Profile

We have developed a general characterization of the subsurface soil and groundwater conditions based upon our review of the data and our understanding of the geologic setting and planned construction. The following table provides our geotechnical characterization.

The geotechnical characterization forms the basis of our geotechnical calculations and evaluation of site preparation and foundation options. As noted in **General Comments**, the characterization is based upon widely spaced exploration points across the site, and variations are likely.

Subsurface conditions at the boring locations can be generalized as follows:

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/Density
Surface	0.1 to 0.5	**Topsoil:** dark-brown, friable and contained significant organic matter	N/A
1	1.0 to 14.0 (average 7.5)	**In-Place Fill:** Mixtures of sand, silt, and gravel; occasional pockets of clay/clayey-silt; occasional debris (concrete; bricks; slag); occasionally mottled; brown to gray	N/A
2	15.0 to 19.4 [1] (average 17.5)	**Native Lake Sediments**: Soil deposits consisting of mixtures of silt and sand with occasional layers/lenses of clayey-silt; occasionally mottled; brown, gray, olive-gray, olive-brown	Very loose to loose or soft
3	14.2 to 29.3 [2]	**Native Dense Soil:** Water sorted and deposited sand and gravel mixtures with silt; brown, gray	Medium dense to very dense
4	Borings terminated within this stratum at depths of approximately 15 to 50.6 [3]	**Bedrock:** Dolostone; very hard; very thin to thinly bedded, 0.5 to 8-inch thick; vuggy with numerous dolomite crystal filled vugs; occasional fossils and fractured; light/medium gray to gray	N/A

1. Not encountered in B-1
2. Not encountered in B-2, B-3, B-4, and B-5
3. Variations in the depths/elevations and the quality of the bedrock were noted. This could result in encountering bedrock in localized areas which may be slightly shallower or deeper, or sounder, than the trend.

At each boring location, top of dense native soil and bedrock was encountered as follows:

Boring	**Approximate Ground Surface Elevation[1] (feet)**	**Approximate Top of Native Dense Soil[2] (feet)**		**Approximate Top of Bedrock[2] (feet)**	
		Depth	**Elevation**	**Depth**	**Elevation**
B-1	512	13	499	14.2	498
B-2	514	Not encountered	Not encountered	15.1	499
B-3	516	Not encountered	Not encountered	15.6	500
B-4	517	Not encountered	Not encountered	18.5	499
B-5	520	Not encountered	Not encountered	19.4	501
B-6	518	18	500	20.0	498
B-7	519	18	501	25.7	493
B-8	519	18	501	29.3	490

1. Based upon information provided by Bergmann.
2. Below ground surface. Elevations rounded to nearest foot.

Rock core run recoveries generally ranged from 90 to 100 percent, and RQD values generally ranged from 70 to 100 percent, indicating rock of fair to excellent quality. However, rock cores recovered in the upper 4.5 to 5 feet at the location of B-3 and B-5 had RQD values of 34 to 46 percent, indicating poor rock quality.

Conditions encountered at each boring location are indicated on the individual boring logs shown in the **Exploration Results** section and are attached to this report. Stratification boundaries on the boring logs represent the approximate location of changes in native soil types; in situ, the transition between materials may be gradual.

Groundwater Conditions

The boreholes were observed while drilling and after completion for the presence and level of groundwater. The water levels observed in the boreholes can be found on the boring logs in **Exploration Results**, and are summarized below.

Boring Number	Groundwater or Wet Samples Encountered while Drilling (feet) [1]		Approximate Groundwater after Drilling (feet) [1]	
	Depth	Elevation	Depth	Elevation
B-1	4	508	Not encountered	Not encountered
B-2	4	510	Not encountered	Not encountered
B-3	10	506	Not encountered	Not encountered
B-4	16	501	16.7	500
B-5	14	506	19.0	501
B-6	18	500	18.7	499
B-7	18	501	Not encountered	Not encountered
B-8	8	511	22.3	497

1. Below ground surface. Elevations rounded to nearest foot

The water levels summarized above should not be considered stable groundwater levels. A relatively long period may be necessary for a groundwater level to develop and stabilize in a borehole. Long term observations in piezometers or observation wells sealed from the influence of surface water are required to define groundwater levels in materials of this type.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project. We anticipate groundwater is likely located very close to the elevation of the water level in the Genesee River, and excavations extending to top of bedrock may experience rapid inflow of groundwater. We also anticipate trapped water may be encountered in isolated pervious pockets within the existing fill.

Laboratory Testing Results of Rock Cores

Specimens obtained from the rock cores were tested for uniaxial compressive strength in accordance with ASTM D7012 – *Standard Test Methods for Compressive Strength of Intact Rock Core Specimens.* The results of the compressive strength testing are presented in the following table:

Boring Number	Approximate Depth of Tested Specimen [1]	Compressive Strength (psi)
B-1	16	4,550
B-1	22	14,150
B-3	17.5	13,830
B-3	21	10,000
B-5	23	13,990
B-7	26.5	8,660
Mean value of uniaxial compressive strength from laboratory tests:		10,860

1. Below ground surface

GEOTECHNICAL OVERVIEW

In-place fill is generally encountered beneath the topsoil at the boring locations. The in-place fill generally consists of mixtures of sand, silt, and gravel (in varying proportions) with occasional pockets of clay/clayey-silt soil, and debris. Native soils are anticipated to consist of loose or soft lake sediments consisting of mixtures of silt and sand with occasional layers/lenses of clayey-silt over dolostone bedrock. At the locations of B-1, B-6, B-7, and B-8 the bedrock is overlain by dense to very dense sand and gravel deposits. The top of this dense native soil was generally encountered at depths of 13 to 18 feet below ground surface, or at elevations ranging from 499 to 501 feet.

At the boring locations, bedrock was generally encountered at depths of 14.2 to 29.3 feet, or at elevations ranging from 498 to 501 feet. In general, it appears bedrock dips slightly southward.

Based upon our conversation with Mr. Josh Repp, Project Manager with Bergmann Associates, the project will consist of reconstruction and preservation of portions of the existing 3,700 feet long West River Wall, which we understand is supported in part on bedrock and in part on soil. As part of the construction, new pre-stressed/post-tensioned (PT) rock anchors with double corrosion protection may be required for the portions of the reconstructed wall. Recommendations for design of the new wall and rock anchors are discussed in detail in the **Shallow Foundations** section.

Depending on design and construction sequencing, temporary excavation support may be required for demolition of the existing wall. Additional site preparation recommendations including subgrade improvement and fill placement are provided in the **Site Preparation** section. The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

Earthwork will include clearing, excavations, and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria as necessary to render the site in the state considered in our geotechnical engineering evaluation for foundations.

Temporary Excavation Support and Cofferdams

Prior to demolishing the existing structure, temporary excavation support may need to be installed to support existing grades and protect existing structures and utilities during construction of the new walls. Contractor should note that a portion of the river wall is founded on bedrock, which will inhibit driving of sheet piling in the work area.

The design should include surcharge load from construction equipment and vehicle traffic, if the bridge is built in stages. The excavation support systems may require tieback anchors or internal bracing. Design should also consider excavation base stability, possible overexcavation to remove soils disturbed during the pile driving operation.

A temporary cofferdam system may be required in the river to allow for construction of the proposed structures. Cofferdam enclosures may also be required to control debris from the demolition of the existing wall foundations. We expect the cofferdams would consist of a braced steel sheet-pile system that encloses the excavation for the pier, and will keep out water and soil so as to permit dewatering and construction of the pier and foundations in the dry.

The design of the cofferdams should accommodate unbalanced soil pressures from the bottom of new footing level on the inside of the cofferdams and the mudline on the outside, unbalanced hydrostatic pressures considering the dewatered level on the inside of the cofferdams and the mean high water level on the outside, wave action, water flow pressure, and impact loading from vessels, barges, or ice. Due to the unbalanced water pressure from outside to inside of the cofferdams, water seepage may occur. A concrete mud mat seal may likely be required below the bottom of footing level using tremie methods prior to dewatering.

The excavation support systems and cofferdams should be designed by a specialty contractor or engineer specializing in the design of these systems.

The temporary excavation support, cofferdams, and dewatering systems are considered major components to the earthwork operations for this project. The approach to these systems should be coordinated between the owner, geotechnical engineer, structural engineer, and contractor

Site Preparation

Prior to placing fill, soils disturbed during the demolition of the existing structures and otherwise unsuitable materials should be removed. Soil subgrades should be proof-rolled with a minimum 10-ton (static weight) smooth drum roller compactor. We recommend a minimum of two overlapping passes in one direction, followed by two overlapping passes in a direction perpendicular to the first passes. The intent is to compact areas with relatively loose surficial soil, to re-compact areas loosened by stripping operations, and to identify unacceptable subgrade areas.

Proof-rolling should be performed under the direction of the Geotechnical Engineer. Areas which excessively deflect under the proof-roll should be delineated and subsequently addressed by the Geotechnical Engineer. Unstable subgrades, as identified by the Geotechnical Engineer, should be over-excavated to competent material and replaced with compacted Structural Fill.

Fill Material Types

Fill required to achieve design grade should be classified as Structural Fill, Embankment Fill, and Wall Backfill. Structural Fill is material used below foundations for new structures. Wall Backfill is material used behind the wall extending up from the base of the wall foundation to the ground surface at a 1.5H:1V slope. Embankment Fill is material used to achieve grade outside of these areas. Earthen materials used for Fill should meet the following material property requirements:

Soil Type [1]	USCS Classification	Acceptable Location for Placement
Wall Backfill	GW	All locations and elevations. Imported material should meet the requirements of NYSDOT Select Structure Fill (733-14)
Structural Fill [2]	GW, GW-GM, SW, SW-SM, SP, GP	Below Foundation. NYSDOT Item 733-0402, Type 2 is suitable to be used as Structural Fill.
General or Embankment Fill	GW, GP, GM, SW, SP, SM	For general site grading or as Embankment Fill where finished grade is no steeper than (3H:1V). Excavated soils may be selectively re-used as Embankment Fill, provided they are generally granular in composition, are free of deleterious materials, have a maximum particle size of 6 inches, and contain less than 15 percent passing the No. 200 sieve.
Crushed Stone	GP	For use as on wet subgrades and as drainage fill. Should be uniform ¾-inch angular crushed stone.

Soil Type [1]	USCS Classification	Acceptable Location for Placement

1. Compacted fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site.
2. Imported Structural Fill should meet the following gradation specifications:

	Percent Passing by Weight
Sieve Size	**Structural Fill**
4″	-
3″	-
2″	100
¼ in	25-60
No. 40	5-40
No. 200	0 - 10

Fill Compaction Requirements

Structural and General Fill should meet the following compaction requirements.

Item	Structural Fill
Maximum Lift Thickness	12 inches or less in loose thickness when heavy, self-propelled compaction equipment is used 6 to 8 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used
Minimum Compaction Requirement [1]	95 percent of maximum theoretical density below foundations and walls. 92 percent of maximum theoretical density all other areas.
Water Content Range [1]	-3% to +3% of optimum

1. Maximum density and optimum water content as determined by the modified Proctor test (ASTM D 1557).

Grading and Drainage

In conjunction with the proposed new wall, we expect permanent slopes may be constructed to transition to finished grade. Design of permanent soil slopes should be based on a grade no steeper than 3H:1V, which would be suitable for slopes in the native soils or for fill slopes of embankment fill. Steeper slopes should be evaluated by the Geotechnical Engineer and would likely require stone slope protection and/or reinforcement.

We recommend permanent slope surfaces not subjected to possible scour be vegetated to reduce erosion. Vegetated slopes should be protected with erosion mats until the vegetation is established. Permanent slopes subject to scour potential should be covered with riprap stone underlain by bedding material and a geotextile separation fabric (Mirafi 140N, or equivalent). Temporary sedimentation and erosion control methods should be implemented during construction and left in place until the slope surfaces have become stabilized. Site grading should direct surface water away from the wall.

Earthwork Construction Considerations

Shallow excavations, for the proposed structures, are anticipated to be accomplished with conventional construction equipment. Removal of the bedrock material will be difficult and will likely require very high capacity excavating equipment, in conjunction with use of pneumatic breakers or blasting to shatter the bedrock prior to removal.

Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water that collects over, or adjacent to, construction areas should be promptly removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or these materials should be scarified, moisture conditioned, and recompacted, prior to foundation construction. These processes should be observed by the Geotechnical Engineer.

The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project. We anticipate that groundwater is likely located very close to the elevation of the water level in the nearby Genesee River, and excavations extending to top of bedrock may experience rapid inflow of groundwater. We also anticipated trapped water may be encountered in isolated pervious pockets within the existing in-place fill. The groundwater table could affect over-excavation efforts. Dewatering may be required during excavation for the foundations and for utility construction based on the conditions encountered at the time of drilling. The contractor should select a dewatering method to lower groundwater to minimize bearing surface disturbance during construction of footings and utilities. Dewatering, if required, can likely be accomplished using filtered pumps placed in crushed stone. If ¾-inch crushed stone is used, a geotextile separation fabric (Mirafi 140N, or equivalent) should be placed between the crushed stone and native soil.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, “Excavations” and its appendices, and in accordance with any applicable local, and/or state regulations. The contractor should be aware that slope height, slope inclination, and excavation depth should in no instance exceed OSHA regulations. OSHA regulations are strictly enforced and if they are not followed, the owner, contractor, and/or earthwork and utility subcontractor could be liable and subject to substantial penalties.

Removal of existing structures and construction of new foundations may require staged construction methods, earth support systems, or shoring and bracing. The contractor shall select the means and methods for providing support of excavations in accordance with safety requirements, plans, and project specifications. The contractor must evaluate soil conditions during excavations since variations in the soil can occur across the site. We recommend that the excavations be monitored continuously for signs of deterioration such as seepage of water or sloughing of soil into the excavation. Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming any responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Observation and Testing

Earthwork efforts should be monitored by the Geotechnical Engineer. This monitoring should include documentation of adequate removal of unsuitable material (if encountered), proof-rolling and mitigation of areas delineated by the proof-rolling.

Each lift of compacted fill should be tested, evaluated, and reworked as necessary until approved by the Geotechnical Engineer prior to placement of additional lifts. In areas of foundation excavations, the bearing subgrade should be evaluated under the direction of the Geotechnical Engineer. If unanticipated conditions are encountered, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer’s evaluation of subsurface conditions, including assessing variations and associated design changes.

SHALLOW FOUNDATIONS

Based upon our review of the Contract No. 59 (record documents) dated July 26, 1916, we understand the existing West River Wall is bearing in part directly on bedrock (Type “O” and “P”) and in part on soil (Type “Q), as shown on page 23 of the record documents. We also understand the portion of the wall supported on soil is protected against scour by a cut-off 3/8-inch thick steel sheet pile extending to top of bedrock and embedded into the concrete wall foundation (“to form a seal satisfactory to the engineer”, as described in the notes). Our review of drawings indicated the bottom of the existing foundation is at approximately El 500 feet. As discussed in the **Geotechnical Characterization** section of this report, the top of the dense native soil, where encountered, was at approximately El 499 to 501 feet, and top of bedrock was at approximately

El. 498 to 501 feet. Therefore, we anticipate the portion of the existing wall bearing on-soil is likely supported on dense native soil.

We recommend foundations be proportioned to provide stability against bearing capacity failure, overturning, and sliding. Application of permanent and transient loads are specified in AASHTO LRFD Bridge Design Article 11.5.5. The stress distribution for footings bearing upon competent bedrock may be assumed to be a triangular or trapezoidal distribution over the effective base as indicated in AASHTO LRFD Bridge Design Figure 11.6.3.2-2.

The following design parameters are applicable for shallow foundations.

Design Parameters – Load Resistance Factor Design (LRFD)

Item	Description / Values
Foundation Type	Conventional strip footings
Bearing Materials	Competent dolostone bedrock or native dense soil (soil)
Nominal Bearing Resistance	
Footings on Rock: (AASTHO LRFD Art. 0.6.3.2)	120 kips per square foot (ksf)
Footings on Native Dense Soil: (AASTHO LRFD Art. 10.6.3.1	12 ksf
Factored Bearing Resistance at Strength Limit State [1]	
Footings on Rock:	50 ksf
Footings on Native Dense Soil:	5 ksf
Factored Bearing Resistance at Service Limit State [2]	
Footings on Rock:	30 ksf
Footings on Native Dense Soil:	4 ksf
Bearing Resistance Factor:	
at Strength Limit State, φ_b (AASHTO LRFD 10.5.5.2.2)	0.45 (footings on rock or soil)
at Service Limit State, φ_b (AASHTO LRFD 10.5.5.1)	1.0 (footings on rock or soil)
Sliding Resistance Factor:	
for Passive Earth Pressure of Component of Sliding Resistance φ_{ep} (AASHTO LRFD Table 10.5.5.2.2-1)	0.5
Nominal Sliding Resistance, R_τ (AASHTO LRFD 10.6.3.4)	
Cast-in-place Concrete on Bedrock [3]	0.7 * Total Vertical Force, V (kips)
Cast-in-place Concrete on Soil [3]	0.4 * Total Vertical Force, V (kips)
Sliding Resistance Factor, φ_τ (AASHTO LRFD 10.5.5.2.2)	
Cast-in-place Concrete on Bedrock [5]	0.90 (estimate)
Cast-in-place Concrete on Soil (Sand)	0.80

Item	Description / Values
Moist Unit Weight	Refer to section **Soil Properties for Design of the River Wall and Excavation Support Structures** of this report.
Minimum Footing Embedment Below Finished Grade for Frost Protection [4]	4 feet
Settlement [2]	Negligible

1. In no instance, shall the bearing stress exceed the nominal structural resistance of the structural concrete, which may be taken as 0.3 f'c. For foundations on bedrock, the eccentricity of loading at the Strength Limit State, based on factored loads, shall not exceed 0.45 of the corresponding footing dimensions, in either dimension (AASHTO LRFD Article 10.6.3.3).
2. Based on our knowledge of geological conditions near the structure site, the bearing resistance value at Service Limit State was obtained from Table C10.6.2.6.1-1 - Presumptive Bearing Resistance for Spread Footing Foundations at the Service Limit State Modified after U.S. Department of the Navy (1982). These bearing resistances are settlement limited, e.g., 1.0 in., and apply only at the service limit state.
3. Nominal sliding resistance for cast-in-place concrete on rock or soil (AASHTO Table C3.11.5.3-1).
4. Bedrock formation that is massive, dense, and intact below the footing, is typically not considered frost susceptible. For such bedrock, heave due to frost is typically not a design issue, provided the foundation is "pinned" with rock anchors to the bedrock.
5. AASHTO LRFD Table 10.5.5.2.2-1 does not present resistance factor for cast-in-place concrete on bedrock.

Design Parameters – Allowable Stress Design (ASD)

Based upon our conversation with Bergmann, we understand the design and stability of the existing river wall may be performed using ASD methodology. The following design parameters are presented below for structures to be designed using ASD standards:

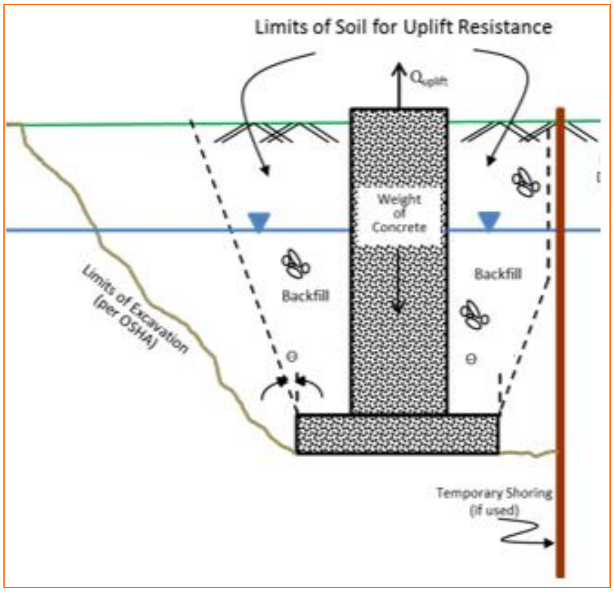
Item	Description
Foundation Type	Conventional strip footings
Bearing Material	Competent dolostone bedrock or native dense soil (soil)
Maximum Net Allowable Bearing Pressure [1]	
Footings on Rock	40 ksf
Footings on Native Dense Soil	4 ksf
Ultimate Coefficient of Sliding Friction - tan(δ) [2]	
Cast-in-place Concrete on Bedrock	0.7
Cast-in-place Concrete on Soil	0.4
Minimum Embedment Below Finished Grade [3]	4 feet

Item	Description

1. The maximum net allowable bearing pressure is the pressure more than the minimum surrounding overburden pressure at the footing base elevation. An appropriate factor of safety has been applied. These bearing pressures can be increased by 1/3 for transient loads unless those loads have been factored to account for transient conditions. Values assume that exterior grades are no steeper than 20% within 10 feet of structure.
2. Can be used to compute sliding resistance where foundations are placed on suitable soil/materials. Should be neglected for foundations subject to net uplift conditions. Refer to NAVFAC DM7-02, Table 1 (U.S. Department of the Navy).
3. Embedment necessary to minimize the effects of frost and/or seasonal water content variations.

Design Parameters - Uplift Loads

Uplift resistance of footings can be developed from the effective weight of the footing and the overlying soils. As illustrated on the subsequent figure, the effective weight of the soil prism defined by diagonal planes extending up from the top of the perimeter of the foundation to the ground surface at an angle, θ, of 20 degrees from the vertical can be included in uplift resistance. The maximum allowable uplift capacity should be taken as a sum of the effective weight of soil plus the dead weight of the foundation, divided by an appropriate factor of safety. A maximum total unit weight of 130 pcf should be used for the backfill. This unit weight should be reduced to 60 pcf for portions of the backfill or natural soils below the groundwater elevation.



Foundation Construction Considerations

As noted in **Earthwork**, footing excavations (if any) should be evaluated by the Geotechnical Engineer. The base of all foundation excavations should be free of water and loose rock, prior to placing concrete. The procedures described in the current AASHTO LRFD Bridge Design Specifications were utilized to assess the values for bearing resistance and resistance factors to be used for the design of the proposed foundations.

The following recommendations are herein presented for your consideration:

- New foundations shall be placed directly on stable native soil, clean competent bedrock, or compacted Structural Fill placed upon stable native soil or bedrock.
- If unsuitable bearing soils are encountered at the base of the planned footing excavation, the excavation should be extended deeper to suitable soils, and the footings could bear directly on these soils at the lower level or on compacted Structural Fill placed on stable native soil or bedrock.
- Rock excavation should be advanced to form level bearing grades at the bottom of the foundation excavation. Loose or shattered rock layers should be removed to provide a sound and unshattered base for foundations. Where the top of bedrock is uneven, it would be acceptable to use a minus ¾-inch crushed stone or lean concrete to create a level working surface for the foundation.
- A qualitative estimate of the degree of surface weathering can be obtained by striking the bedrock with a sledge hammer. Weathered bedrock surfaces produce a dull sound and a weaker recoil than competent and sounder bedrock, which generates a sharp ring and strong hammer rebound.
- We recommend a qualified geotechnical representative observe and approve bearing grades and subgrades (prior to the placement of reinforcing steel and concrete forms) to make sure they are free of mud, shattered rock, water or frost, and meet the minimum requirements for bearing resistances presented in this report.
- The recommendations presented in this report are based in part upon the assumption that the bearing grades are not susceptible to scour (i.e. consist of scour resistant material, or are protected from scour, or are located below the scour depth).

Rock Anchors

As part of the construction, new pre-stressed/post-tensioned (PT) rock anchors with double corrosion protection are proposed for the portions of the reconstructed wall. Based upon the visual observation of the recovered rock cores, laboratory testing results, and our local experience with the regional geology and bedrock, the following engineering properties are recommended for competent dolostone bedrock encountered at the location of the recovered rock cores:

Competent Rock - Engineering Properties [1]

Parameter	Description	Unit	Value
RQD	Mean value of Rock Quality Designation	%	80
γ	Unit weight of rock (above groundwater)	pcf	160
γ'	Effective unit weight of rock (below groundwater)	pcf	100
q_u	Mean value of uniaxial compressive strength (UCS) from laboratory tests	ksf MPa	1,560 75
τ_n	Nominal unit grout-rock bond stress (AASHTO LRFD Bridge Design Table C11.9.4.2-3) [2]	ksf	30
Ei	Elastic modulus of intact rock (estimated)	psi	6E+06
Em	Elastic modulus of rock mass or Rock Mass Modulus ≤ Ei (AASHTO LRFD Bridge Design Table 10.4.6.5-1)	psi	3E+06
Em/Ei	Ratio		0.5
GSI	Geological Strength Index (AASHTO LRFD Bridge Section 10.4.6.4)		60 to 70
RMR	Rock Mass Strength (AASHTO LRFD Bridge Design Article 10.4.6.4)		70
α_E	Reduction factor to account for jointing in rock (AASHTO LRFD Bridge Design Table 10.8.3.5.4b-1)		0.90
ν	Poisson Ratio (estimated)		0.30

1. These values are based on the assumption that the foundations are extended down to or into competent bedrock.
2. The presumptive ultimate anchor bond stress values presented in Table C11.9.4.2-3 are intended for evaluation of the feasibility of straight shaft anchors installed in small diameter holes. Pressure-grouted anchors may achieve much higher capacities.

We recommend the design, installation, and proof testing of rock anchors be completed in accordance with the *Recommendations for Prestressed Rock and Soil Anchors* by the Post-Tensioning Institute (PTI), *Geotechnical Engineering Circular No. 4 Ground Anchors and Anchored Systems* by the Federal Highway Administration (FHWA), and manufacturer's recommendations. The following recommendations are presented for your consideration:

- The minimum horizontal spacing of anchors should be the larger of three times the diameter of the bonded zone or 5 feet, whichever is greater. The minimum bond length should be 10 feet, regardless of calculated design requirement, in order to engage higher quality rock and avoid excessive creep and reduction in tensioning as bonds weaken in upper highly fractured rock zones. Longer bonded or unbonded lengths may be needed to satisfy design requirements.

- The anchor depths should be such that a safety factor of at least 2 is provided against a pull-out failure of the rock mass. A conical failure surface should be assumed to extend from the tip of each anchor at a central angle of 90 degrees. A buoyant rock density, no greater than 100 pounds per cubic foot, should be used. No shear strength, along the failure surface, should be assumed. Two or more anchors should not "share" the same rock mass.
- The nominal unit grout-rock bond stress to be used for design of the anchors is presented in the table above. Resistance factors for pullout resistance of anchors are presented in AASHTO LRFD Bridge Design Table 11.5.7-1. For anchors in rock a resistance factor of 0.5 may be used for presumptive ultimate unit bond stresses estimated from Article C11.9.4.2.
- Anchor holes should be drilled at specified locations and tolerances as shown on the approved plans. Common practice is to drill at least 6-inches beyond the design length to permit better drill hole cleaning. The minimum drilled anchor hole diameter should be 2.5 inches, and a minimum of ½-inch of grout cover should be provided between the rock and the anchor.
- We recommend anchor grout with a minimum compressive strength of 5,000 psi be used.
- At least 10 percent of the anchors should be performance tested prior to production installation of anchors. Pending satisfactory results of performance tests, all anchors need to be proof-tested and locked off to at least the design load. Performance testing will help evaluate load, unload behavior and creep potential. Proof testing will effectively load test the remaining anchors and verify the capacity of each anchor prior to casting the foundations. If performance testing field capacities do not meet design capacities, greater anchor lengths will be required and/or the fractured bedrock could be pre-grouted to improve the rock mass integrity.

SEISMIC CONSIDERATIONS

The seismic design requirements for bridges and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength. Seismic design parameters in accordance with AASHTL LRFD methodology are recommended, for both foundations bearing over rock or over soil, in the following table:

Description	Value
Reference Used	AASHTO
Site Class[1]	D (AASHTO LRFD Article 3.10.3.1)
Seismic Zone	1 (AASHTO LRFD Article 3.10.6)
Acceleration Coefficient, As	0.084g
Site Latitude	43.1381°N
Site Longitude	77.6191°W
S_{DS} Spectral Acceleration for a Short Period [2]	0.182g
S_{D1} Spectral Acceleration for a 1-Second Period[2]	0.083g

1. In general accordance with the *American Association of State Highway and Transportation Officials LRFD Bridge Design Specifications 8th Edition, 2016* (AASHTO), Site Class is based on the average characteristics of the upper 100 feet of the subsurface profile. The current scope requested does not include the required 100-foot soil profile determination. The borings extended to a maximum depth of approximately 51 feet, and this seismic site class definition considers bedrock continues below the maximum depth of the exploration.
2. Acceleration coefficients were obtained using online seismic design maps and tools provided by the USGS (http://earthquake.usgs.gov/hazards/designmaps/).

Seismic design parameters in accordance with Section 20.4 of ASCE 7-10 are recommended in the table below:

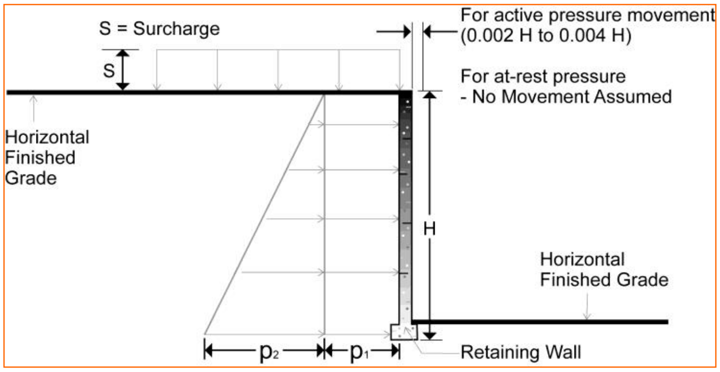
Description	Value
2015 International Building Code Site Classification	D [1,2]
S_{DS} Spectral Acceleration for a Short Period [3]	0.175g
S_{D1} Spectral Acceleration for a 1-Second Period [3]	0.095g

1. Seismic site classification in general accordance with the *2015 International Building Code*, which refers to ASCE 7-10.
2. The 2015 International Building Code (IBC) uses a site profile extending to a depth of 100 feet for seismic site classification. The borings extended to a maximum depth of approximately 51 feet, and this seismic site class definition considers bedrock continues below the maximum depth of the exploration.
3. These values were obtained using online seismic design maps and tools provided by the USGS (http://earthquake.usgs.gov/hazards/designmaps/).

LATERAL EARTH PRESSURES

Design Parameters

The proposed structure will be subjected to lateral earth pressure exerted by the soil placed behind the walls. The lateral earth pressure recommendations provided in the following paragraphs are applicable to the design of rigid retaining walls subject to slight rotation. Reinforced concrete walls with unbalanced backfill levels due to using structural backfill should be designed for earth pressures at least equal to those indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. Active earth pressure is commonly used for design of freestanding cantilever retaining walls and assumes wall movement. The "at-rest" condition assumes no wall movement. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls, and assume compacted granular backfill with unit weight of 130 pcf and friction angle of 32 degrees.



Lateral Earth Pressure Design Parameters

Earth Pressure Condition [1]	Coefficient for Backfill Type [2]	Surcharge Pressure [3, 4, 5, 7] p_1 (psf)	Effective Fluid Pressures (psf) [2, 4, 5]	
			Unsaturated [6]	Submerged [6]
Active (Ka)	Granular - 0.31	(0.31)S	(40)H	(80)H
At-Rest (Ko)	Granular - 0.47	0.47)S	(60)H	(90)H
Passive (Kp) [8]	Granular - 3.25	---	(420)H	(280)H

1. For active earth pressure, wall must rotate about base, with top lateral movements 0.002 H to 0.004 H, where H is wall height. For passive earth pressure, wall must move horizontally to mobilize resistance.
2. Uniform, horizontal backfill, compacted to at least 95 percent of the ASTM D 1557 maximum dry density, rendering a maximum unit weight of 130 pcf. Within 4 feet of back of wall, hand operated equipment should be used.
3. Uniform surcharge, where S is surcharge pressure. Other surcharge loads should be considered where they are located within a horizontal distance behind the wall equal to 1.5 times the height of the wall.

Lateral Earth Pressure Design Parameters

Earth Pressure Condition [1]	Coefficient for Backfill Type [2]	Surcharge Pressure [3, 4, 5, 7] p_1 (psf)	Effective Fluid Pressures (psf) [2, 4, 5]	
			Unsaturated [6]	Submerged [6]

Surcharge stresses due to point loads, line loads, and those of limited extent, such as compaction equipment, should be evaluated in accordance with Article 3.11.6 of the AASHTO LRFD specifications.

4. Loading from heavy compaction equipment not included; heavy equipment should not operate within a distance closer than the exposed height of retaining walls.
5. No safety factor is included in these values.
6. In order to achieve "Unsaturated" conditions, follow guidelines in **Subsurface Drainage for Below Grade Walls** below. "Submerged" conditions are recommended when drainage behind walls is not incorporated into the design.
7. Hydrostatic pressures acting on wall should be taken into account as appropriate. Retaining structures should be backfilled evenly to the extent practical. Temporary bracing should be specified if walls, that are designed to be supported by other structural elements, are permitted to be backfilled before the permanent support is in place.
8. Passive pressure should be ignored because of the amount of movement required to mobilize resistance.

Backfill placed against structures should consist of granular soils. For the granular values to be valid, the granular backfill must extend out and up from the base of the wall at an angle of at least 45 and 60 degrees from vertical for the active and passive cases, respectively.

Subsurface Drainage for Below Grade Walls

A perforated rigid plastic drain line installed behind the base of walls, which extend below adjacent grade is recommended to prevent hydrostatic loading on the walls. The outlet of a drain line around the retaining wall should be placed just above finished grade and normal water levels. The drain line should be sloped to provide positive gravity drainage to daylight. The drain line should be surrounded by clean, free-draining granular material having less than 5 percent passing the No. 200 sieve, such as Crushed Stone. The Crushed Stone should be encapsulated in a filter fabric. The granular fill should extend to within 2 feet of final grade, where it should be capped with rigid or flexible pavement or low permeable fill to reduce infiltration of surface water into the drain system.

Soil Properties for Design of the River Wall and Excavation Support Structures

The above parameters are not applicable to the design of temporary excavation support or cofferdam systems for the project. For soils consistent with those encountered in our explorations, the design of the river wall, excavation support, and cofferdams may be based on the following parameters:

Description [1]	**Value**
Estimated Angle of Internal Friction	
Stratum 1 – In-Place Fill	28 degrees
Stratum 2 – Native Lake Sediment [2]	26 degrees
Stratum 3 – Native Dense Soil	34 degrees
Stratum 4 – Bedrock	40 degrees
Estimated Cohesion	
All soils	Negligible
Estimated *In-situ* Soil Unit Weight	
Stratum 1 – In-Place Fill	120 pcf (above water level) 58 pcf (below water level)
Stratum 2 – Native Lake Sediment	110 pcf (above water level) 48 pcf (below water level)
Stratum 3 – Native Dense Soil	130 pcf (above water level) 68 pcf (below water level)
Stratum 4 - Bedrock	160 pcf (above water level) 100 pcf (below water level)

1. Refer to Subsurface Profile Section of this report for a description of Stratums 1, 2, 3, 4
2. For the river sediment built-up on the river side of the wall use a preliminary reduced value for friction angle of 24 degrees. We understand future exploration may include sampling of the river sediment. Therefore, strength properties of the river sediment deposit may change based upon visual observation and laboratory testing of the samples.

GENERAL COMMENTS

As the project progresses, we address assumptions by incorporating information provided by the design team, if any. Revised project information that reflects actual conditions important to our services is reflected in the final report. The design team should collaborate with Terracon to confirm these assumptions and to prepare the final design plans and specifications. This facilitates the incorporation of our opinions related to implementation of our geotechnical recommendations. Any information conveyed prior to the final report is for informational purposes only and should not be considered or used for decision-making purposes.

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from the site exploration completed by Nature's Way Environmental Consultants & Contractors, Inc. (NWECC). Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in the final report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our scope of services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third party beneficiaries intended. Any third party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Exploration Number	Boring Depth (feet)	Location
Eight - (B-1 through B-8)	15.1 to 50.6	Behind (Landside) of Existing West River Wall

Exploration Layout and Elevations: The boring layout was performed by others.

Subsurface Exploration Procedures: NWECC performed the soil subsurface explorations. The borings were drilled with a rotary drilling rig using continuous flight, hollow-stemmed augers to advance the boreholes. Samples were obtained using split-barrel sampling procedures. In the split-barrel sampling procedure, a standard 2-inch O.D. split-barrel sampling spoon is driven into the ground with a 140-pound hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the middle 12 inches of a normal 24-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths.

When auger refusal was encountered upon bedrock, rock cores were obtained at B-1, B-3, B-5, and B-7 to investigate the nature and quality of the underlying bedrock. The percent recovery and the Rock Quality Designation (RQD) for the recovered sample were recorded. The percent recovery is the ratio of the length of rock recovered over the length of coring. The RQD is the ratio of the sum of the length of recovered rock core 4 inches or greater in length, over the length of rock core recovered. The RQD is useful is providing a qualitative and quantitative evaluation of the engineering quality of bedrock. Representative portions of the soil samples and rock cores recovered from the test borings were transported to our office for visual classification by a geotechnical engineer and select portions of the rock cores were laboratory tested for compressive strength.

Upon completion the rock holes were backfilled and sealed with bentonite chips; auger cutting were then used to backfill the remained of the borehole up to existing grades.

The sampling depths, penetration distances, and other sampling information are recorded on the field boring logs. The samples are placed in appropriate containers and taken to our soil laboratory for laboratory testing.

Laboratory Testing

Terracon reviewed the field data and assigned various laboratory tests to better understand the engineering properties of the various soil and rock strata as necessary for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods are applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D6913 Standard Test Method for Particle-Size Distribution (Gradation) of Soil Using Sieve Analysis
- ASTM D7012 Standard Test Methods for Compressive Strength and Elastic Modulus of Intact Rock Core Specimens

Soil and rock classification and borings logs were prepared by NWEEC. The soils samples and rock cores recovered from the borings were transported to Terracon laboratory for visual observations by a geotechnical engineer and laboratory testing. Rock classification was conducted using locally accepted practices for engineering purposes; petrographic analysis may reveal other rock types. Rock core samples typically provide an improved specimen for this classification. Boring log rock classification was determined using the Description of Rock Properties.

SITE LOCATION AND EXPLORATION PLANS

SITE LOCATION

West River Wall - Segment 2 ■ Rochester, NY
May 9, 2018 ■ Terracon Project No. J5185038

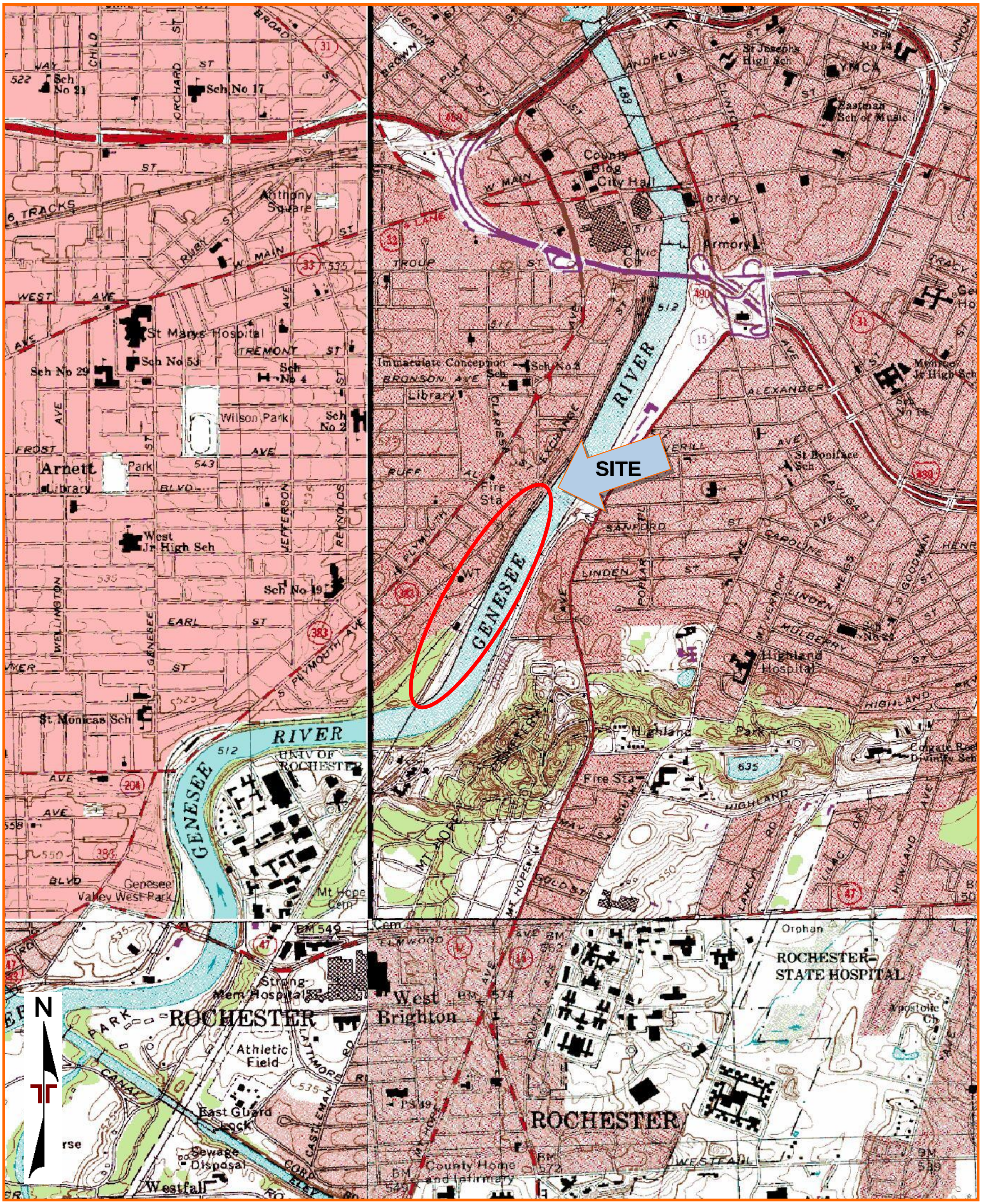


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY QUADRANGLES INCLUDE: ROCHESTER WEST, NY (1/1/1994), ROCHESTER EAST, NY (1/1/1978), WEST HENRIETTA, NY (1/1/1978) and PITTSFORD, NY (1/1/1994).

EXPLORATION PLAN

West River Wall - Segment 2 ■ Rochester, NY
May 9, 2018 ■ Terracon Project No. J5185038

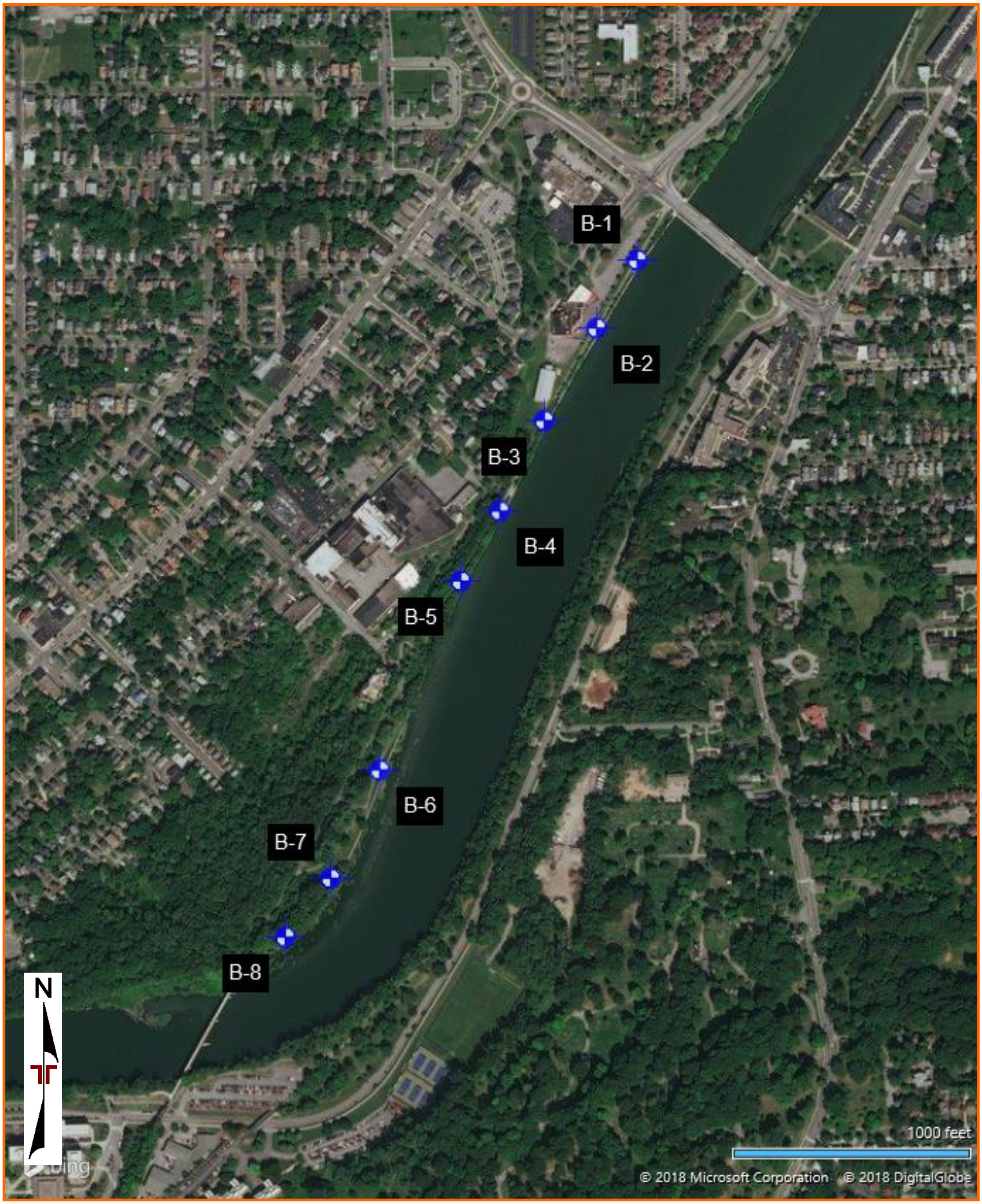


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS
NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED
BY MICROSOFT BING MAPS

EXPLORATION RESULTS

NATURE'S WAY ENVIRONMENTAL
Consultants & Contractors, Inc.

3553 Crittenden Road
Alden, NY 14004
(716) 937- 6527
www.natureswayenvironmental.com

Hole Number: B 1

DATE: 12/5/17

ELEVATION:

PROJECT: Subsurface Investigation for the Proposed West River Retaining Wall Renovations - Former Vacuum Oil Bike Path, Rochester, NY

PREPARED FOR: Bergmann Associates

BORING LOCATION:

	SN	0/ 6	6/ 12	12/ 18	18/ 24	N	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
0	1	2	5	7	5	12		Moist, dark brown (SILT) topsoil / fill with trace very fine size sand, compact 0.5 Moist, brown, gravelly (SANDY-SILT) fill with 15 to 25% gravel, little very fine size sand, compact 2.0	0.7'	Topsoil to 0.5 foot over silty soil fill with little gravel to 2.0 feet over sandy soil fill with trace gravel to 4.0 feet over silty soil fill with trace gravel to 13.0 feet over water sorted and deposited sand with some gravel to 14.2 feet over dolostone bedrock to end of coring
	2	1	3	6	7	9		Extremely moist, brown (SILTY-SAND) fill with 10 to 15% gravel, very fine size sand, little silt, loose 4.0	0.6'	
5	3	7	6	2	2	8		Extremely moist to wet, gray (SILT) fill with 5 to 10% gravel, occasional concrete fragments, trace very fine size sand, loose	1.0'	
	4	1	4	3	3	7			1.0'	
	5	2	3	7	5	10			1.2'	
10								13.0		
	6	28	24	50/2"		>74		Wet, faintly mottled, brown, gravelly (SILTY-SAND) with 20 to 40% gravel, very fine to fine size sand, little silt, very dense in place, loose when disturbed, stratified 14.2	1.1'	
15			RUN	#1				Dolostone bedrock, very hard, thinly bedded, 4" to 8" thick, vuggy with numerous dolomite crystal filled vugs		No Water at Completion prior to Coring
20			RUN #2							

LOGGED BY: Dale M. Gramza / Senior Geologist

PAGE 1 of 2

NATURE'S WAY ENVIRONMENTAL
Consultants & Contractors, Inc.

3553 Crittenden Road
Alden, NY 14004
(716) 937- 6527
www.natureswayenvironmental.com

Hole Number: B 1

DATE: 12/5/17

ELEVATION:

PROJECT: Subsurface Investigation for the Proposed West River Retaining Wall Renovations - Former Vacuum Oil Bike Path, Rochester, NY

PREPARED FOR: Bergmann Associates

BORING LOCATION:

	SN	0/ 6	6/ 12	12/ 18	18/ 24	N	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
			RUN	**#2**				Dolostone bedrock, very hard, thinly bedded, 4" to 8" thick, vuggy with numerous dolomite crystal filled vugs		
								23.2		
			RUN	**#3**				Dolostone bedrock, medium gray, very hard, thinly bedded, succrosic with numerous fossils		
								24.2		
25								Dolostone bedrock, gray, very hard, thin to medium bedded, 1" to 8" thick		
			RUN	**#4**						
30										
			RUN	**#5**						
35										
								37.6		
								Coring Completed at 37.6' bgs		Note: Entire open rock hole backfilled and sealed with Bentonite Chips at Completion
40										

Core Data

Run #	Interval (ft)	Length (ft)	Rec (ft)	% Rec	RQD %
1	14.2 to 19.2	5.0	4.8	96	80
2	19.2 to 23.2	4.0	4.0+	100	100
3	23.2 to 28.2	5.0	5.0	100	96
4	28.2 to 33.2	5.0	5.0	100	94
5	33.2 to 37.6	4.4	4.4	100	93

LOGGED BY: Dale M. Gramza / Senior Geologist

PAGE 2 of 2

Nature's Way Environmental
Consultants & Contractors, Inc.

3553 Crittenden Road
Alden, NY 14004
(716) 937- 6527
www.natureswayenvironmental.com

Hole Number: B 2

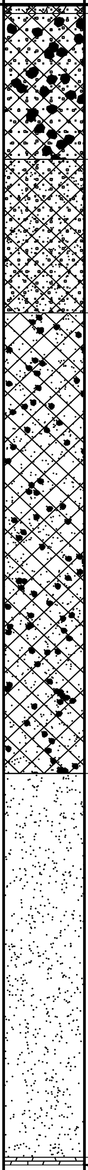
DATE: 12/6/17

ELEVATION:

PROJECT: Subsurface Investigation for the Proposed West River Retaining Wall Renovations - Former Vacuum Oil Bike Path, Rochester, NY

PREPARED FOR: Bergmann Associates

BORING LOCATION:



	SN	0/ 6	6/ 12	12/ 18	18/ 24	N	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
0	1	3				10		Moist, dark brown (SANDY-SILT) topsoil / fill with little very fine size sand, loose, with fine size roots 0.1	0.7'	Topsoil / fill to 0.1 foot over sand and gravel fill to 2.0 feet over coarse silty soil fill with little sand to 4.0 feet over apparent silty soil fill with trace sand to 10.0 feet over silty lake sediment to 15.0 feet over dolostone rock to refusal
			6							
				4				Moist, dark gray, very gravelly (SILTY-SAND) fill with 40 to 50% gravel, very fine size sand, loose 2.0		
					7					
	2	6				12		Extremely moist, faintly mottled, brown (SANDY-SILT) fill with little very fine size sand, compact 4.0	1.1'	
			7							
				5						
					3					
	3	7				7		Extremely moist to wet, mixed brown and dark gray (SILT) fill with 3 to 5% gravel, trace very fine size sand, loose 10.0	0.5'	
			4							
5				3						
					3					
	4	2				5			0.4'	
			2							
				3						
					3					
	5	6				7			0.4'	
			5							
				2						
					1					
10	6	2				2		Extremely moist to wet, faintly mottled, olive brown to brown (SILT) with trace very fine size sand, very loose to loose, weakly thinly bedded 15.0	1.3'	
			1							
				1						
					1					
	7	1				6			2.0'	
			2							
				4						
					4					
	8	4				>53			0.8'	
			3							
15				50/1"				Dolostone rock 15.1		No Water at Completion
								Auger Refusal at 15.1' bgs		
20										

LOGGED BY: Dale M. Gramza / Senior Geologist

NATURE'S WAY ENVIRONMENTAL
Consultants & Contractors, Inc.

3553 Crittenden Road
Alden, NY 14004
(716) 937- 6527
www.natureswayenvironmental.com

Hole Number: B 3

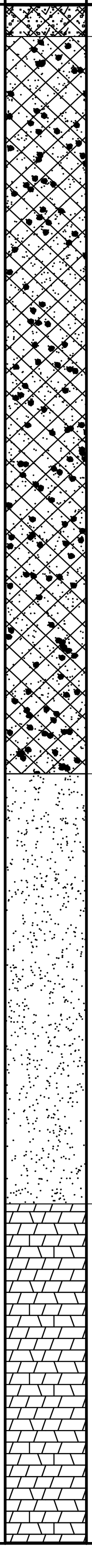
DATE: 12/6/17

ELEVATION:

PROJECT: Subsurface Investigation for the Proposed West River Retaining Wall Renovations - Former Vacuum Oil Bike Path, Rochester, NY

PREPARED FOR: Bergmann Associates

BORING LOCATION:

	SN	0/ 6	6/ 12	12/ 18	18/ 24	N	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
0	1	2				6		Moist, dark brown (SANDY-SILT) topsoil / fill with little very fine size sand, loose 0.4 Moist, brown (SILT) fill with 5 to 10% gravel with occasional brick fragments, trace very fine size sand, loose to compact, with occasional pockets of (CLAYEY-SILT) soil fill	1.2'	Topsoil to 0.4 foot over silty soil fill with trace gravel to 10.0 feet over apparent silty lake sediment with trace sand to 15.6 feet over dolostone bedrock to end of boring
			2							
				4						
					4					
	2	6				12			0.3'	
			7							
				5						
					4					
	3	3				5			0.9'	
			3							
5				2						
					2					
	4	3				5			1.0'	
			2							
				3						
					5					
	5	5				4			1.0'	
			3							
				1						
					2			10.0		
10	6	4				5		Extremely moist to wet, grayish brown to brown (SILT) with trace very fine size sand, loose, weakly thinly bedded, with occasional (CLAYEY-SILT) lenses	1.4'	
			3							
				2						
					2					
	7	2				6			0.3'	
			2							
				4						
					6					
	8	9				7			0.4'	
			5							
15				2				15.6		
					50/1"			Dolostone bedrock, gray, very hard, very thin to thinly bedded, 1/2" to 6" thick		No Water at Completion prior to Coring
		↑	RUN							
				#1						
20										

LOGGED BY: Dale M. Gramza / Senior Geologist

PAGE 1 of 3

NATURE'S WAY
ENVIRONMENTAL
Consultants & Contractors, Inc.

3553 Crittenden Road
Alden, NY 14004
(716) 937- 6527
www.natureswayenvironmental.com

Hole Number: B 3

DATE: 12/6/17

ELEVATION:

PROJECT: Subsurface Investigation for the Proposed West River Retaining Wall Renovations - Former Vacuum Oil Bike Path, Rochester, NY

PREPARED FOR: Bergmann Associates

BORING LOCATION:

	SN	0/ 6	6/ 12	12/ 18	18/ 24	N	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
			RUN #1							
			RUN	#2				Dolostone bedrock, gray, very hard, very thin to thinly bedded, 1/2" to 6" thick		
25										
			RUN	#3						
30										
								30.8		
			RUN	#4				Dolostone bedrock, light gray to gray, very hard, thin to medium bedded, 2" to 8" thick, with numerous dolomite crystal filled vugs		
35										
			RUN	#5						
40										

Core Data

Run #	Interval (ft)	Length (ft)	Rec (ft)	% Rec	RQD %
1	15.6 to 20.8	5.2	5.0	96	46
2	20.8 to 25.8	5.0	5.0	100	52
3	25.8 to 30.8	5.0	5.0	100	86
4	30.8 to 35.4	4.6	4.6	100	65
5	35.4 to 40.4	5.0	5.0	100	98

LOGGED BY: Dale M. Gramza / Senior Geologist

NATURE'S WAY ENVIRONMENTAL
Consultants & Contractors, Inc.

3553 Crittenden Road
Alden, NY 14004
(716) 937- 6527
www.natureswayenvironmental.com

Hole Number: B 3

DATE: 12/6/17

ELEVATION:

PROJECT: Subsurface Investigation for the Proposed West River Retaining Wall Renovations - Former Vacuum Oil Bike Path, Rochester, NY

PREPARED FOR: Bergmann Associates

BORING LOCATION:

	SN	0/ 6	6/ 12	12/ 18	18/ 24	N	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
		↓	RUN #5				▨	See previous sheet 40.4		
								Coring Completed at 40.4' bgs		Note: Entire open rock hole backfilled and sealed with Bentonite Chips at Completion
45										
50										
55										
60										

LOGGED BY: Dale M. Gramza / Senior Geologist

PAGE 3 of 3

3553 Crittenden Road
Alden, NY 14004
(716) 937- 6527
www.natureswayenvironmental.com

Consultants & Contractors, Inc.

Hole Number: B 4

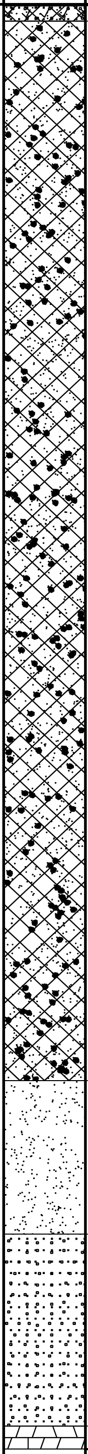
DATE: 12/7/17

ELEVATION:

PROJECT: Subsurface Investigation for the Proposed West River Retaining Wall Renovations - Former Vacuum Oil Bike Path, Rochester, NY

PREPARED FOR: Bergmann Associates

BORING LOCATION:

	SN	0/ 6	6/ 12	12/ 18	18/ 24	N	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
0	1	4				11		Moist, dark brown (SANDY-SILT) topsoil / fill with little very fine size sand, compact, with fine size roots 0.2 Moist, brown (SILT) fill with 10 to 15% gravel with slag fragments, trace very fine size sand, loose to compact	0.8'	Topsoil / fill to 0.2 foot over silty soil fill with trace gravel to 14.0 feet over silty lake sediment with trace clay to 16.0 feet over sandy lake sediment with little to some silt to 18.5 feet over dolostone rock to refusal
			5							
				6						
					4					
	2	4				10			1.1'	
			4							
				6						
					7					
	3	7				13			1.3'	
			6							
5				7						
					8					
	4	7				27			0.5'	
			15							
				12						
					8					
	5	11				13			1.1'	
			7							
				6						
					17					
10	6	11				16			1.3'	
			8							
				8						
					9					
	7	6				12			0.3'	
			6							
				6						
					7			14.0		
	8	3				5		Extremely moist, olive brown (SILT) with trace clay, loose, thinly bedded	1.0'	
			2							
15				3						
					2			16.0		
	9	3				7		Wet, olive gray to gray (SILTY-SAND) with very fine size sand, little to some silt, loose, thinly bedded	1.5'	
			4							▼ Water Level at 16.7' bgs at Completion
				3						
					5			18.5		
	10	4				>50		Dolostone rock 18.8 Auger Refusal at 18.8' bgs	0.3'	
			50/3"							No Water at Completion
20										

LOGGED BY: Dale M. Gramza / Senior Geologist

NATURE'S WAY
ENVIRONMENTAL
Consultants & Contractors, Inc.

3553 Crittenden Road
Alden, NY 14004
(716) 937- 6527
www.natureswayenvironmental.com

Hole Number: B 5

DATE: 12/7/17

ELEVATION:

PROJECT: Subsurface Investigation for the Proposed West River Retaining Wall Renovations - Former Vacuum Oil Bike Path, Rochester, NY

PREPARED FOR: Bergmann Associates

BORING LOCATION:

	SN	0/ 6	6/ 12	12/ 18	18/ 24	N	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
0	1	3				7		Moist, dark brown (SILTY-SAND) fill with 5 to 10% gravel, very fine size sand, little silt, loose	1.0'	Sandy fill with trace gravel to 1.0 foot over silty lake sediment with trace sand to 13.0 feet over clayey lake sediment with some clay to 14.0 feet over water sorted and deposited sand with little silt to 16.0 feet over silty lake sediment with little clay to 18.0 feet over water sorted and deposited sand with little silt to 19.4 feet over dolostone bedrock to end of coring
			4							
				3				1.0 Moist to extremely moist, brown (SILT) with trace very fine size sand, loose to compact, weakly thinly bedded		
					3					
	2	4				9			0.8'	
			4							
				5						
					6					
	3	8				11			1.2'	
			6							
5				5						
					5					
	4	5				12			1.3'	
			6							
				6						
					8					
	5	6				13			1.1'	
			6							
				7						
					8					
10	6	6				14			1.0'	
			7							
				7						
					5					
	7	4				4			0.9'	
			2							
				2				13.0 Moist, olive brown (CLAYEY-SILT) with some clay, soft, thinly laminated with very thin coarse silt lenses		
					2					
	8	1				1		14.0 Wet, olive gray (SILTY-SAND) with very fine size sand, little silt, very loose, thinly bedded	1.4'	
			0							
15				1						
					1					
	9	1				7		16.0 Extremely moist, olive gray (CLAYEY-SILT) with little clay, firm, thinly laminated with very thin coarse silt lenses	1.7'	
			2							
				5						
					3					
	10	4				7		18.0 Wet, olive gray (SILTY-SAND) with very fine size sand, little silt, thinly bedded	1.1'	
			4							
				3						▼ Water Level at 19.0' bgs at Completion prior to Coring
		↑	RUN #1		50/1"			19.4 (PETROLEUM ODOR) See next sheet		
20										

LOGGED BY: Dale M. Gramza / Senior Geologist

Hole Number: B 5

DATE: 12/7/17

ELEVATION:

PROJECT: Subsurface Investigation for the Proposed West River Retaining Wall Renovations - Former Vacuum Oil Bike Path, Rochester, NY

PREPARED FOR: Bergmann Associates

BORING LOCATION:

	SN	0/ 6	6/ 12	12/ 18	18/ 24	N	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
			RUN	#1				Dolostone bedrock, gray, very hard, very thin to thinly bedded, 1" to 5" thick, fractured between 19.9' and 20.2'		
25			RUN	#2						
30			RUN	#3						
35			RUN	#4						
40			RUN #5							

Core Data

Run #	Interval (ft)	Length (ft)	Rec (ft)	% Rec	RQD %
1	19.4 to 24.4	5.0	4.5	90	34
2	24.4 to 29.4	5.0	5.0	100	82
3	29.4 to 34.4	5.0	5.0	100	78
4	34.4 to 39.4	5.0	5.0	100	90
5	39.4 to 44.4	5.0	4.8	96	72

LOGGED BY: Dale M. Gramza / Senior Geologist

NATURE'S WAY
ENVIRONMENTAL
Consultants & Contractors, Inc.

3553 Crittenden Road
Alden, NY 14004
(716) 937- 6527
www.natureswayenvironmental.com

Hole Number: B 5

DATE: 12/7/17

ELEVATION:

PROJECT: Subsurface Investigation for the Proposed West River Retaining Wall Renovations - Former Vacuum Oil Bike Path, Rochester, NY

PREPARED FOR: Bergmann Associates

BORING LOCATION:

	SN	0/ 6	6/ 12	12/ 18	18/ 24	N	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
		↓	RUN	#5			▨	Dolostone bedrock, gray, very hard, very thin to thinly bedded, 1" to 5" thick 44.4		
								Coring Completed at 44.4' bgs		Note: Entire open rock hole backfilled and sealed with Bentonite Chips at Completion
45										
50										
55										
60										

LOGGED BY: Dale M. Gramza / Senior Geologist

3553 Crittenden Road
Alden, NY 14004
(716) 937- 6527
www.naturesswayenvironmental.com

Hole Number: B 6

DATE: 5/15/17

ELEVATION:

PROJECT: Subsurface Investigation for the Proposed West River Retaining Wall Renovations - Former Vacuum Oil Bike Path, Rochester, NY

PREPARED FOR: Bergmann Associates

BORING LOCATION:

	SN	0/ 6	6/ 12	12/ 18	18/ 24	N	LITH	DESCRIPTION AND CLASSIFICATION		REC	COMMENTS
0	1	2						Moist, dark brown (SILT) topsoil / fill with trace very fine size sand, loose, with fine size roots	0.4	1.1'	Topsoil / fill to 0.4 foot over silty soil fill to 2.0 feet over silty slack water sediment with trace clay to 8.0 feet over silty slack water sediment with trace sand to 18.0 feet over water sorted and deposited sand and gravel to 20.0 feet over fractured dolostone rock to refusal
			4			9		Moist, faintly mottled, brown (SILT) fill with 3 to 5% gravel, trace very fine size sand, loose	2.0		
				5							
					5						
	2	2						Extremely moist, distinctly mottled, brown (SILT) with trace clay, loose to very loose, thinly bedded, with occasional (CLAYEY-SILT) lenses		1.3'	
			2			4					
				2							
					2						
	3	1								1.2'	
			1			2					
5				1							
					1						
	4	2								1.3'	
			2			4					
				2							
					2				8.0		
	5	1						Extremely moist, gray (SILT) with trace very fine size sand, very loose, weakly thinly bedded		1.1'	
			1			2					
				1							
					1						
10	6	1								1.5'	
			1			2					
				1							
					1						
	7	1								1.4'	
			1			3					
				2							
					1						
	8	1								1.6'	
			1			3					
15				2							
					2						
	9	1								1.2'	
			2			5					
				3							
					2				18.0		
	10	20						Wet, gray, very gravelly (SAND) with 40 to 50% gravel, very fine to coarse size sand, trace silt, very dense, stratified		0.3'	
			50/2"			>50					▼ Water Level at 18.7' bgs at Completion
20									20.0		

LOGGED BY: Dale M. Gramza / Senior Geologist

NATURE'S WAY
ENVIRONMENTAL
Consultants & Contractors, Inc.

3553 Crittenden Road
Alden, NY 14004
(716) 937- 6527
www.natureswayenvironmental.com

Hole Number: B 6

DATE: 5/15/17

ELEVATION:

PROJECT: Subsurface Investigation for the Proposed West River Retaining Wall Renovations - Former Vacuum Oil Bike Path, Rochester, NY

PREPARED FOR: Bergmann Associates

BORING LOCATION:

	SN	0/ 6	6/ 12	12/ 18	18/ 24	N	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
	11	**50/3"**				**>50**	▨	Dolostone rock, gray, very hard, fractured, wet 21.0	0.2'	
								Auger Refusal at 21.0' bgs		
25										
30										
35										
40										

LOGGED BY: Dale M. Gramza / Senior Geologist

NATURE'S WAY ENVIRONMENTAL
Consultants & Contractors, Inc.

3553 Crittenden Road
Alden, NY 14004
(716) 937- 6527
www.natureswayenvironmental.com

Hole Number: B 7

DATE: 12/11/17

ELEVATION:

PROJECT: Subsurface Investigation for the Proposed West River Retaining Wall Renovations - Former Vacuum Oil Bike Path, Rochester, NY

PREPARED FOR: Bergmann Associates

BORING LOCATION:

	SN	0/ 6	6/ 12	12/ 18	18/ 24	N	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
0	1	2				7		Extremely moist, dark brown (SILT) topsoil / fill with trace very fine size sand, loose, with fine size roots 0.2 Moist, brown (SANDY-SILT) fill with 5 to 15% gravel, little very fine size sand, loose to compact	0.3'	Topsoil / fill to 0.2 foot over silty soil fill with trace gravel to 4.0 feet over silty lake sediment with trace sand to 18.0 feet over water sorted and deposited sand and gravel with little silt to 21.0 feet over silty glacial till to 25.7 feet over dolostone bedrock to end of coring
			3							
				4						
					7					
	2	7				11			0.2'	
			7							
				4						
					3			4.0		
	3	3				9		Extremely moist, faintly mottled, brown (SILT) with trace very fine size sand, loose to very loose, thinly bedded	1.1'	
			4							
5				5						
					5					
	4	4				8			1.3'	
			4							
				4						
					5					
	5	3				8			0.7'	
			4							
				4						
					4					
10	6	2				2			0.1'	
			1							
				1						
					2					
	7	3				5			1.2'	
			2							
				3						
					2					
	8	3				2			0.1'	
			1							
15				1						
					2					
	9	2				2			0.3'	
			1							
				1						
					1			18.0		
	10	18				36		Wet, gray, very gravelly (SILTY-SAND) with 40 to 60% gravel, very fine to medium size sand, little silt, dense in place	0.9'	
			17							
				19						
					21					
20										

LOGGED BY: Dale M. Gramza / Senior Geologist

NATURE'S WAY ENVIRONMENTAL
Consultants & Contractors, Inc.

3553 Crittenden Road
Alden, NY 14004
(716) 937- 6527
www.natureswayenvironmental.com

Hole Number: B 7

DATE: 12/11/17 ELEVATION:

PROJECT: Subsurface Investigation for the Proposed West River Retaining Wall Renovations - Former Vacuum Oil Bike Path, Rochester, NY

PREPARED FOR: Bergmann Associates

BORING LOCATION:

	SN	0/ 6	6/ 12	12/ 18	18/ 24	N	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
	11	**15**						Wet, gray, very gravelly (SILTY-SAND) with 40 to 60% gravel, very fine to medium size sand, little silt, dense in place	0.8'	
			50/5"							
						>50		21.0		No Water at Completion prior to Coring
								Moist, grayish brown, gravelly (SILT) with 15 to 30% gravel with cobbles, trace very fine size sand, very dense, massive soil structure		
	12	**100/5"**							0.1'	
						>100				
	13	**100/3"**							0.1'	
25						**>100**				
								25.7		
								Dolostone bedrock, gray, very hard, very thin to medium bedded, 2" to 8" thick, with occasional small vugs		
			RUN							
				#1						
30										
			RUN							
				#2						
35										
			RUN							
				#3						
40										

Core Data

Run #	Interval (ft)	Length (ft)	Rec (ft)	% Rec	RQD %
1	25.7 to 30.7	5.0	5.0	100	70
2	30.7 to 35.7	5.0	4.8	96	90
3	35.7 to 40.7	5.0	5.0	100	92
4	40.7 to 45.7	5.0	5.0	100	78
5	45.7 to 50.6	4.9	4.9	100	94

LOGGED BY: Dale M. Gramza / Senior Geologist

NATURE'S WAY ENVIRONMENTAL
Consultants & Contractors, Inc.

3553 Crittenden Road
Alden, NY 14004
(716) 937- 6527
www.natureswayenvironmental.com

Hole Number: B 7

DATE: 12/11/17

ELEVATION:

PROJECT: Subsurface Investigation for the Proposed West River Retaining Wall Renovations - Former Vacuum Oil Bike Path, Rochester, NY

PREPARED FOR: Bergmann Associates

BORING LOCATION:

	SN	0/ 6	6/ 12	12/ 18	18/ 24	N	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
			RUN #3					Dolostone bedrock, gray, very hard, very thin to medium bedded, 2" to 8" thick, with occasional small vugs		
			RUN							
				#4						
45										
			RUN							
				#5						
50										
								50.6		
								Coring Completed at 50.6' bgs		Note: Entire open rock hole backfilled and sealed with Bentonite Chips at Completion
55										
60										

LOGGED BY: Dale M. Gramza / Senior Geologist

NATURE'S WAY ENVIRONMENTAL
Consultants & Contractors, Inc.

3553 Crittenden Road
Alden, NY 14004
(716) 937- 6527
www.natureswayenvironmental.com

Hole Number: B 8

DATE: 5/15/17

ELEVATION:

PROJECT: Subsurface Investigation for the Proposed West River Retaining Wall Renovations - Former Vacuum Oil Bike Path, Rochester, NY

PREPARED FOR: Bergmann Associates

BORING LOCATION:

	SN	0/ 6	6/ 12	12/ 18	18/ 24	N	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
0	1	1	1	2	3	3		Moist, dark brown (SILT) topsoil / fill with trace very fine size sand 0.4 Moist, brown (SANDY-SILT) fill with 3 to 5% gravel, little very fine size sand, loose	0.7'	Topsoil / fill to 0.4 foot over apparent silty soil fill with little sand to 6.0 feet over silty slack water sediment with little sand to 8.0 feet over silty slack water sediment with trace sand to 18.0 feet over water sorted and deposited sand and gravel to 22.0 feet over silty lake sediment with little clay to 24.0 feet over water sorted and deposited sand with little silt to refusal
	2	3	5	7	6	12			0.7'	
5	3	2	2	2	2	4		6.0	0.2'	
	4	1	2	2	3	4		Wet, distinctly mottled, brown (SANDY-SILT) with little very fine size sand, loose, thinly bedded 8.0	0.7'	
	5	2	1	1	1	2		Wet, gray to olive gray (SILT) with trace very fine size sand, very loose, thinly bedded with fine size roots	1.0'	
10	6	WR	WR	WR	WR	<2			1.0'	WR - Sampler Penetration with weight of Rods
	7	1	1	1	2	2			1.1'	
15	8	1	1	1	2	2			1.1'	
	9	1	1	1	2	2		18.0	1.2'	
	10	22	50/3"			>50		Wet, gray, very gravelly (SILTY-SAND) with 40 to 50% gravel, very fine to medium size sand, little silt, very dense in place, loose when disturbed, stratified	0.7'	
20										

LOGGED BY: Dale M. Gramza / Senior Geologist

NATURE'S WAY
ENVIRONMENTAL
Consultants & Contractors, Inc.

3553 Crittenden Road
Alden, NY 14004
(716) 937- 6527
www.natureswayenvironmental.com

Hole Number: B 8

DATE: 5/15/17

ELEVATION:

PROJECT: Subsurface Investigation for the Proposed West River Retaining Wall Renovations - Former Vacuum Oil Bike Path, Rochester, NY

PREPARED FOR: Bergmann Associates

BORING LOCATION:

	SN	0/ 6	6/ 12	12/ 18	18/ 24	N	LITH	DESCRIPTION AND CLASSIFICATION	REC	COMMENTS
	11	17	21	21	25	42		Wet, gray, very gravelly (SILTY-SAND) with 40 to 50% gravel, very fine to medium size sand, little silt, very dense in place, loose when disturbed, stratified 22.0	0.3'	
	12	5	4	4	5	8		Extremely moist, brown (CLAYEY-SILT) with little clay, loose, weakly thinly laminated 24.0	1.7'	▼ Water Level at 22.3' bgs at Completion
25	13	4	5	7	9	12		Wet, brown (SILTY-SAND) with 3 to 5% gravel, very fine size sand, compact, weakly thinly bedded	1.7'	
	14	5	7	10	12	17			2.0'	
	15	50/3"				>50		29.3	0.3'	
								Auger Refusal at 29.3' bgs		
30										
35										
40										

LOGGED BY: Dale M. Gramza / Senior Geologist

PAGE 2 of 2


Core Data
B1 RUN 1
B1 RUN 2
B1 RUN 3
B1 RUN 4
B1 RUN 4


Core Data
B1 RUN 5
B3 RUN 1
B3 RUN 2
B3 RUN 3

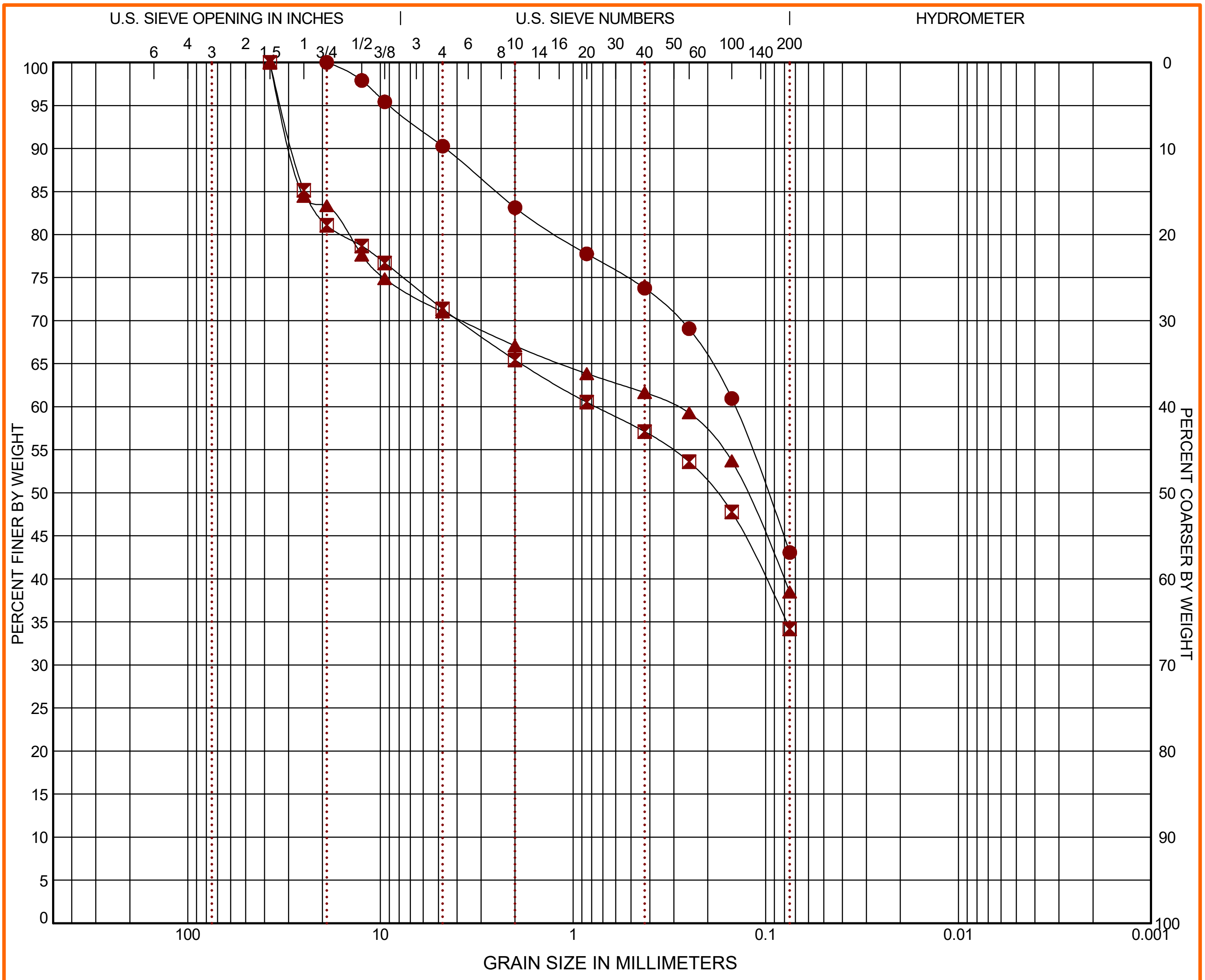

Core Data
B3 RUN 4
B3 RUN 5
B3 RUN 5
B5 RUN 1
B5 RUN 2


B5 RUN 3
B5 RUN 4
B5 RUN 4
B5 RUN 5
B5 RUN 5
B7 RUN 1


B7 RUN 1
B7 RUN 2
B7 RUN 2
B7 RUN 3
B7 RUN 3
B7 RUN 4
B7 RUN 4
B7 RUN 5
B7 RUN 5

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	B-2	2	0.0	9.7	47.2		43.1		
☒	B-2	4	0.0	28.6	37.2		34.2		
▲	B-4	2	0.0	29.0	32.6		38.5		

GRAIN SIZE			
	●	☒	▲
D_{60}	0.145	0.764	0.293
D_{30}			
D_{10}			

COEFFICIENTS			
	●	☒	▲
C_C			
C_U			

●		☒		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
3/4"	100.0	1 1/2"	100.0	1 1/2"	100.0
1/2"	97.9	1"	85.14	1"	84.44
3/8"	95.42	3/4"	81.07	3/4"	83.35
#4	90.27	1/2"	78.68	1/2"	77.63
#10	83.13	3/8"	76.71	3/8"	74.87
#20	77.76	#4	71.37	#4	71.02
#40	73.77	#10	65.43	#10	67.08
#60	69.06	#20	60.53	#20	63.85
#100	60.96	#40	57.11	#40	61.65
#200	43.07	#60	53.61	#60	59.29
		#100	47.77	#100	53.71
		#200	34.2	#200	38.47

SOIL DESCRIPTION	
●	
☒	
▲	

REMARKS	
●	
☒	Composite Sample, 4'-10'
▲	Composite Sample, 2'-10'

PROJECT: West River Wall

SITE: 700 exchange Street
Rochester, NY

Terracon
15 Marway Cir Ste 2B
Rochester, NY

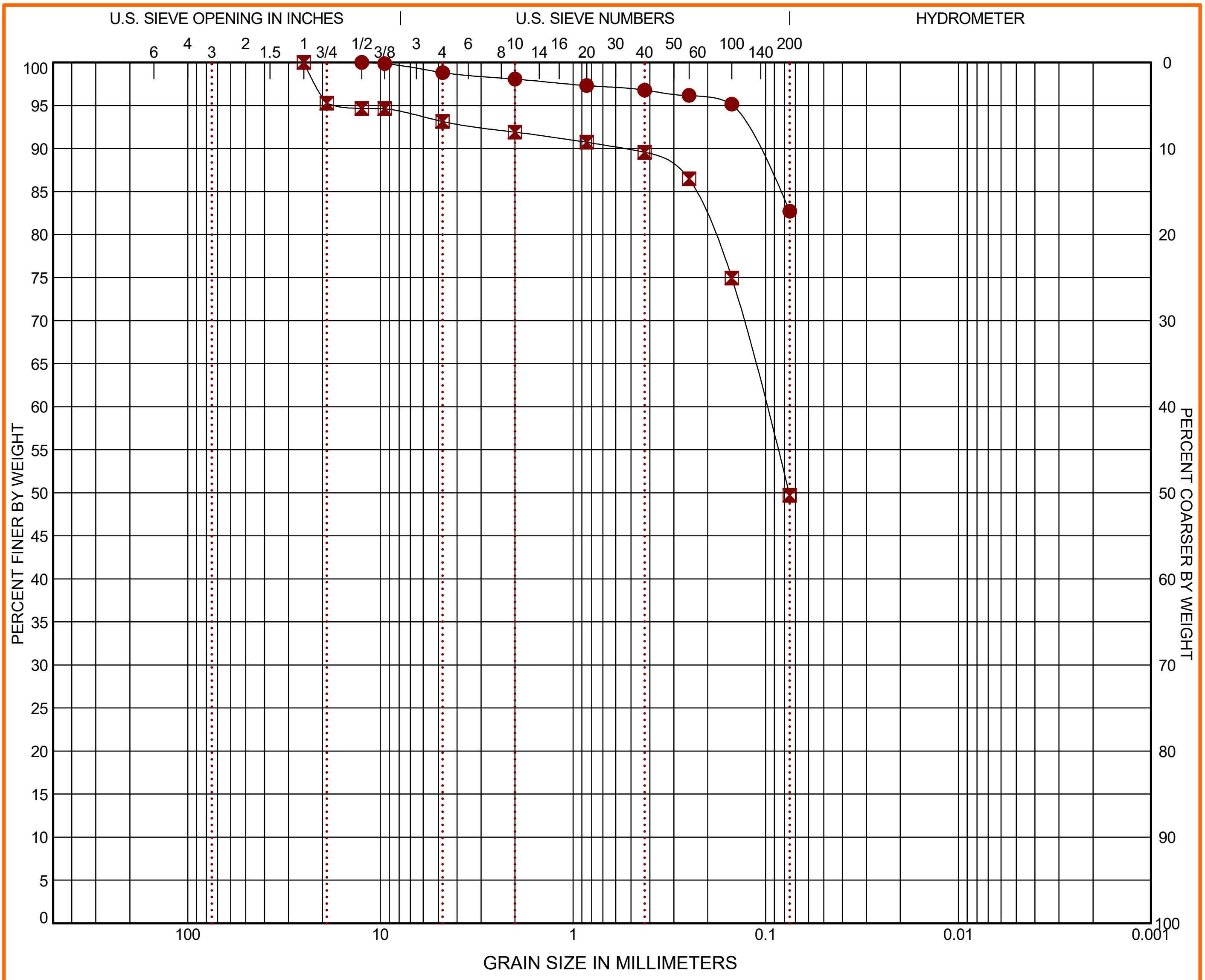
PROJECT NUMBER: J5185038

CLIENT: Nature's Way Environmental
Alden, NY

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 J5185038 WEST RIVER WALL.GPJ TERRACON_DATATEMPLATE.GDT 3/6/18

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	B-5	2	0.0	1.2	16.1		82.7		
☒	B-7	4	0.0	6.9	43.4		49.7		

GRAIN SIZE			
	●	☒	
D_{60}		0.099	
D_{30}			
D_{10}			

COEFFICIENTS			
	●	☒	
C_C			
C_U			

●		☒			
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
1/2"	100.0	1"	100.0		
3/8"	99.86	3/4"	95.27		
#4	98.81	1/2"	94.63		
#10	98.07	3/8"	94.63		
#20	97.31	#4	93.13		
#40	96.78	#10	91.9		
#60	96.17	#20	90.72		
#100	95.15	#40	89.56		
#200	82.71	#60	86.46		
		#100	74.96		
		#200	49.72		

SOIL DESCRIPTION	
●	
☒	

REMARKS	
●	Composite Sample, 2'-10'
☒	Composite Sample, 4'-10'

PROJECT: West River Wall

PROJECT NUMBER: J5185038

SITE: 700 exchange Street
Rochester, NY

Terracon
15 Marway Cir Ste 2B
Rochester, NY

CLIENT: Nature's Way Environmental
Alden, NY

SUPPORTING INFORMATION

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING

▯ Auger Cuttings

▮ Rock Core

⊠ Standard Penetration Test

WATER LEVEL

▽ **Water Initially Encountered**

▽ **Water Level After a Specified Period of Time**

▼ **Water Level After a Specified Period of Time**

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

N	**Standard Penetration Test Resistance (Blows/Ft.)**
(HP)	**Hand Penetrometer**
(T)	**Torvane**
(DCP)	**Dynamic Cone Penetrometer**
UC	**Unconfined Compressive Strength**
(PID)	**Photo-Ionization Detector**
(OVA)	**Organic Vapor Analyzer**

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no ctual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		**CONSISTENCY OF FINE-GRAINED SOILS** (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (tsf)**	**Standard Penetration or N-Value Blows/Ft.**
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

RELATIVE PROPORTIONS OF SAND AND GRAVEL		**RELATIVE PROPORTIONS OF FINES**	
Descriptive Term(s) of other constituents	Percent of Dry Weight	**Descriptive Term(s) of other constituents**	**Percent of Dry Weight**
Trace	<15	Trace	<5
With	15-29	With	5-12
Modifier	>30	Modifier	>12

GRAIN SIZE TERMINOLOGY		**PLASTICITY DESCRIPTION**	
Major Component of Sample	**Particle Size**	**Term**	**Plasticity Index**
Boulders	Over 12 in. (300 mm)	Non-plastic	0
Cobbles	12 in. to 3 in. (300mm to 75mm)	Low	1 - 10
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)	Medium	11 - 30
Sand	#4 to #200 sieve (4.75mm to 0.075mm	High	> 30
Silt or Clay	Passing #200 sieve (0.075mm)		

UNIFIED SOIL CLASSIFICATION SYSTEM

West River Wall Reconstruction Project – Segment 2 ■ Rochester, New York
May 9, 2018 ■ Terracon Project No. J5185038

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F, G, H]
			Fines classify as CL or CH		GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G, H, I]
			Fines classify as CL or CH		SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	$PI > 7$ and plots on or above “A”		CL	Lean clay [K, L, M]
			$PI < 4$ or plots below “A” line [J]		ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K, L, M, N]
			Liquid limit - not dried			Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above “A” line		CH	Fat clay [K, L, M]
			PI plots below “A” line		MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K, L, M, P]
			Liquid limit - not dried			Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add “with cobbles or boulders, or both” to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains $\geq$ 15% sand, add “with sand” to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add “with organic fines” to group name.

[I] If soil contains $\geq$ 15% gravel, add “with gravel” to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add “with sand” or “with gravel,” whichever is predominant.

[L] If soil contains $\geq$ 30% plus No. 200 predominantly sand, add “sandy” to group name.

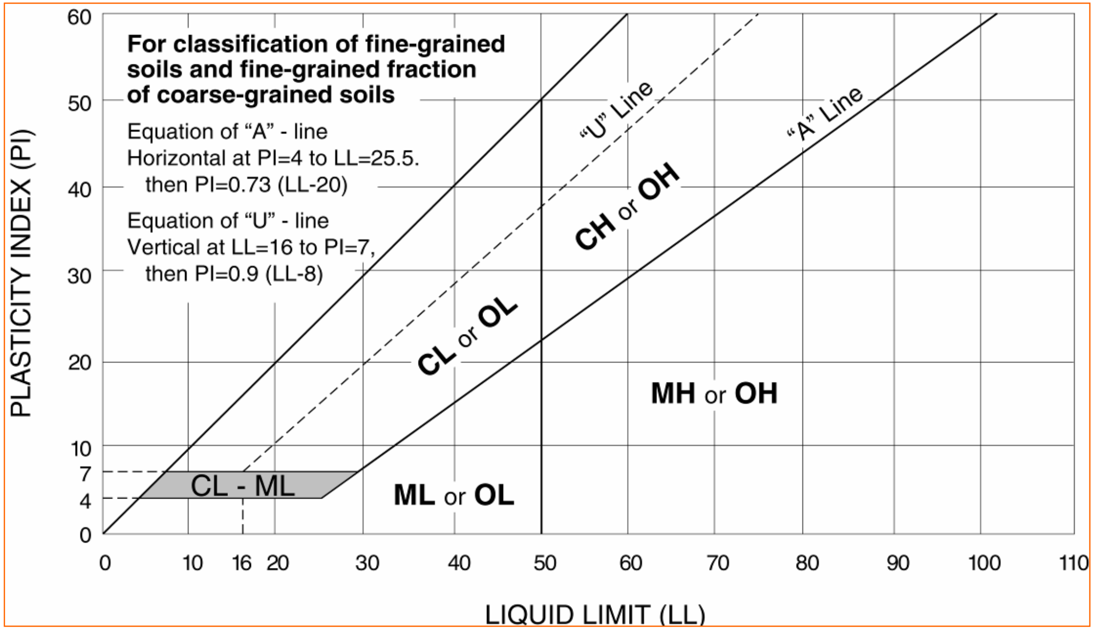
[M] If soil contains $\geq$ 30% plus No. 200, predominantly gravel, add “gravelly” to group name.

[N] $PI \geq 4$ and plots on or above “A” line.

[O] $PI < 4$ or plots below “A” line.

[P] PI plots on or above “A” line.

[Q] PI plots below “A” line.



DESCRIPTION OF ROCK PROPERTIES

WEATHERING

Term	Description
Unweathered	No visible sign of rock material weathering, perhaps slight discoloration on major discontinuity surfaces.
Slightly weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than in its fresh condition.
Moderately weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as corestones.
Highly weathered	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.
Completely weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.
Residual soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

STRENGTH OR HARDNESS

Description	Field Identification	Uniaxial Compressive Strength, psi (MPa)
Extremely weak	Indented by thumbnail	40-150 (0.3-1)
Very weak	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	150-700 (1-5)
Weak rock	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	700-4,000 (5-30)
Medium strong	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer	4,000-7,000 (30-50)
Strong rock	Specimen requires more than one blow of geological hammer to fracture it	7,000-15,000 (50-100)
Very strong	Specimen requires many blows of geological hammer to fracture it	15,000-36,000 (100-250)
Extremely strong	Specimen can only be chipped with geological hammer	>36,000 (>250)

DISCONTINUITY DESCRIPTION

Fracture Spacing (Joints, Faults, Other Fractures)		Bedding Spacing (May Include Foliation or Banding)	
Description	**Spacing**	**Description**	**Spacing**
Extremely close	< ¾ in (<19 mm)	**Laminated**	< ½ in (<12 mm)
Very close	¾ in – 2-1/2 in (19 - 60 mm)	**Very thin**	½ in – 2 in (12 – 50 mm)
Close	2-1/2 in – 8 in (60 – 200 mm)	**Thin**	2 in – 1 ft. (50 – 300 mm)
Moderate	8 in – 2 ft. (200 – 600 mm)	**Medium**	1 ft. – 3 ft. (300 – 900 mm)
Wide	2 ft. – 6 ft. (600 mm – 2.0 m)	**Thick**	3 ft. – 10 ft. (900 mm – 3 m)
Very Wide	6 ft. – 20 ft. (2.0 – 6 m)	**Massive**	> 10 ft. (3 m)

Discontinuity Orientation (Angle): Measure the angle of discontinuity relative to a plane perpendicular to the longitudinal axis of the core. (For most cases, the core axis is vertical; therefore, the plane perpendicular to the core axis is horizontal.) For example, a horizontal bedding plane would have a 0-degree angle.

ROCK QUALITY DESIGNATION (RQD) [1]

Description	RQD Value (%)
Very Poor	0 - 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 - 100

1. The combined length of all sound and intact core segments equal to or greater than 4 inches in length, expressed as a percentage of the total core run length.

Reference: U.S. Department of Transportation, Federal Highway Administration, Publication No FHWA-NHI-10-034, December 2009 Technical Manual for Design and Construction of Road Tunnels – Civil Elements