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Mr. Corey Jones
South End Development, LLC
45 Hudson Ave. #213,
Albany, NY 12201

August 3, 2020

Re: The Seventy-Six, Mixed-Use Redevelopment
Geotechnical Interpretive Report – Addendum No. 1
South End Neighborhood, Albany, Albany County, New York
Chazen Job #: 32019.00

Dear Mr. Jones:

At your request, Chazen oversaw the surface wave seismic measurements performed at the project site to reevaluate the previously reported Seismic Site Class of E referenced in our Geotechnical Interpretive Report dated July 13, 2020. Chazen coordinated with Hager-Richter Geoscience, Inc. (HRGS) to perform the testing.

The original Site Class was determined using the acceptable standard penetration resistance method in accordance with ASCE/SEI 7-16, "Minimum Design Loads for Buildings and Other structures". For the reevaluation, Chazen coordinated with HRGS, Inc. to perform four passive shear wave seismic tests at the locations identified on their Figure 2 pVs Test Line Location Plan, included with **Attachment A** "Shear Wave Velocity Testing The Seventy-Six Development Albany, New York".

The average shear wave velocities were calculated as; 841 ft/s (Test Line 1), 989 ft/s (Test Line 2), 876 ft/s (Test Line 3), and 886 ft/s (Test Line 4). In accordance with the aforementioned reference standard and considering the calculated average shear wave velocity, the planned structures can be designed using a Seismic Site Class of D.

If you have any comments, questions, or require additional information, please contact our office.

Sincerely,

Dean Anderson Jr.
Assistant Project Geotechnical Engineer

Reviewed and approved by;

Matthew A. Korn, P.E.
Principal
Manager of Geotechnical Engineering Services

STATE OF NEW YORK · MATTHEW ANTHONY KORN · 095161 · LICENSED PROFESSIONAL ENGINEER

Attachment A: [HRGS Geophysical Services Report]

HAGER-RICHTER
GEOSCIENCE, INC.

SHEAR WAVE VELOCITY TESTING
THE SEVENTY-SIX DEVELOPMENT
ALBANY, NEW YORK

Prepared for:

The Chazen Companies
547 River Street
Troy, New York 12180

Prepared by:

Hager-Richter Geoscience, Inc.
dba HR Geological Services in New York
8 Industrial Way, Unit D10
Salem, New Hampshire 03079

File 20J62
July 2020

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APPENDIX

1. INTRODUCTION

Hager-Richter Geoscience, Inc. (HRGS), dba HR Geological Services in New York, conducted surface shear wave velocity testing in support of a geotechnical investigation of a planned development for The Chazen Companies (Chazen) of Troy, New York in July 2020. The area of interest and scope of work were specified by Chazen.

The site is a predominantly residential area located on both sides of Scott Street between Krank Street and Leonard Street in Albany, New York. The general location of the site is shown in Figure 1. According to information provided by Chazen, the design of a new mixed-use development requires site specific shear wave velocity information as a function of depth for the soil and bedrock to a depth of 100 feet.

Chazen provided logs for two (2) borings installed at the Site: boring B1, located about 15 feet north of the center of Scott Street, and boring B8, located about 15 feet north of the intersection of Krank and Seymore Streets. From the top down, B1 encountered 5 feet of silty sand, about 70 feet of fat clay, and at least 12 feet of silty sand. B1 terminated at 87 feet without encountering bedrock. From the top down, B8 encountered 5 feet of silty sand, about 40 feet of fat clay, and about 17 feet of silts and sands before auger refusal on probable bedrock at 62 feet. Blow counts at all intervals within the overburden sequences are less than 10 blows/ft, except for the bottom 5-10 feet of the lower silts and sands, which range from 10-23 blows/ft. Copies of the boring logs provided by Chazen are provided in Appendix 1.

The surface shear wave velocity testing was conducted using the passive shear wave seismic (pVs) or ReMi method. pVs data were acquired along four (4) test lines identified as pVs Lines 1 through 4. Photograph 1 shows typical conditions at the site. Figure 2 shows the location of the pVs test lines. The positions of the pVs survey lines were determined by measuring the relative positions of existing structures.

Steven Grant, P.G., and Sean Reid of HRGS conducted the seismic testing on July 14, 2020. The fieldwork was coordinated with Mr. Dean Anderson Jr. of Chazen, who was present at the initiation of the survey and specified the pVs line locations. Data analysis and interpretation were completed at the HRGS offices. Original data and field notes will be retained in the HRGS files for a minimum of three (3) years.

Photograph 1. Typical conditions at the site, view to the east along Scott Street. The array for Seismic Line 1 is located along the measuring tape in the center left of photograph.

2. EQUIPMENT AND PROCEDURES

2.1 Method

The passive shear wave seismic (pVs) method is a geophysical method to determine a vertical shear-wave velocity profile at a single location by analyzing a particular type of seismic wave recorded on a multichannel record. The name pVs is derived from p for passive and Vs for velocity of shear waves. The pVs method, also called the Refraction Microtremor method, or ReMi™, uses Rayleigh waves, a particular kind of wave first described by Lord Rayleigh in 1885. Such waves are dispersive (meaning that the velocity is a function of the wavelength), and the amplitude of such waves decreases with depth. The Rayleigh wave velocity depends primarily on the shear wave velocities and layering of the subsurface material.

Rayleigh waves are a significant part of the ambient subsurface noise at most, if not all, sites. There are many sources of such noise, including, but not limited to, wind, pedestrian and vehicular traffic, surface and subway trains, and construction activities. Although such noise can be troublesome for most seismic methods, it is the source of signals for the pVs method, and the higher the noise level, the better the results for this method.

Low frequency (4.5 Hz) geophones are installed 4 to 10 ft apart along a straight line and connected to a seismograph. The ambient noise is recorded for 30 seconds two or three times and examined to be sure that noise of sufficiently low frequency is present. If the noise is sufficient, then 10 to 15 such records are acquired. If the noise spectra do not reach sufficiently low frequencies, then one walks or runs along the test line during data acquisition to add low frequency noise to the ambient noise. The surface waves used in the pVs method, considered noise in seismic refraction and reflection surveys, are enhanced during data acquisition and processing for the pVs method. The seismic data are analyzed using SeisOpt® ReMi™, a commercially licensed software package developed by Optim, Inc. located at the University of Nevada at Reno. Results are normally presented as 1-D plots or in tabular form showing shear wave velocity as a function of depth at the center of the seismic line.

It should be noted that the method produces a single velocity profile (V_s as a function of depth Z) at one location (namely, the center of the line) for each line. The software also calculates the average shear wave velocity using the following equation (taken from the International Building Code):

$$V_{avg} = \left(\sum_{i=1}^{N} d_i\right) / \sum_{i=1}^{N} d_i / V_i \qquad \text{Eq 1}$$

where V_{avg} is average shear wave velocity
d_i is thickness of the ith layer
V_i is the shear wave velocity of the ith layer
N is the number of layers

The Seismic Site Class, based solely on average shear wave velocity, is defined by the IBC as follows:

Site Class	Soil Profile Name	Soil Shear Wave Velocity (ft/s)
A	Hard rock	$V_s > 5000$
B	Rock	$2500 < V_s \leq 5000$
C	Very dense soil and soft rock	$1200 < V_s \leq 2500$
D	Stiff soil profile	$600 \leq V_s \leq 1200$
E	Soft soil profile	$V_s < 600$

Although the IBC provides other methods to determine the Site Class, such as standard penetration resistance (blow counts) and soil undrained shear strength, this report provides site specific data for shear wave velocity only. Furthermore, there is no consideration of other factors that may affect a site such as liquefaction. The final determination of seismic site class should be made by the project engineer.

2.2 Equipment

We use a 48-channel digital seismograph (Geometrics Geode) coupled to as many as 48 geophones to acquire the pVs data. We used 4.5-Hz frequency vertical geophones for the subject shear wave velocity testing.

2.3 Limitations of the Method

As with all physical measurements, there is experimental error in the velocities that are determined using the passive shear wave velocity seismic method. For the pVs method, the accuracy of V_{avg} is stated by Optim, Inc. to be 5-15%.

The depth of investigation is a function of the noise spectrum, and long wave lengths (low frequencies) are required to determine velocity at large depths. Noise levels can be improved by a person running along the seismic spread during data acquisition.

2.4 Site Specific

The locations of the four test lines are shown in Figure 2. The pVs data were acquired using 48 geophones spaced 5 feet apart for all lines. The pVs method yields a single vertical velocity profile at the mid points of the test lines, shown in Figure 2. The seismic source for the pVs test was ambient noise and random hammer striking while acquiring the data to enhance the high frequency content of the seismic signal.

3. RESULTS AND DISCUSSION

The surface shear wave velocity testing was conducted along four seismic lines, designated as pVs Test Lines 1 through 4. The seismic test line locations and center points for the velocity profiles are shown in Figure 2.

The results of the pVs testing are reported in Table 1. For modeling purposes, the subsurface stratigraphy was broken into three discrete units based on shear wave velocity (V_s) and are identified according to approximately correlated units indicated on the boring logs provided. The modeled layers include Silty Sand / Clay, with moderately low V_s values; Fat Clay / Silts and Sands, with slightly higher V_s values; and possible till or bedrock, with higher V_s values. Results from the four pVs test lines are relatively consistent with one another and with blow counts reported in the boring logs.

The velocity units in the provided models do not necessarily correlate with specific lithologic units. The number of layers and the thickness that provides the best statistical fit to the respective dispersion curve was used for each line independently. The root mean square error for the fit of the dispersion curve versus the measured data using the model velocities varies between 1.4 and 1.7% for the four pVs Test Lines.

No attempt was made to “force” a specific model to the data. The velocities for the units to the maximum depth investigated are reported in Table 1 below.

TABLE 1
pVs TEST RESULTS

Geologic Unit *	**pVs Test Line 1**	
	Depth Interval (ft)	**Vs** (ft/s)**
Silty Sand / Clay	0 – 21	437
Fat Clay / Silts and Sands	21 - 75.5	879
Possible Till and/or Bedrock	75.5 - 100	2,764
$V_{S\ 100}$ (ft/s)	841	
RMS (%)	1.8	
Geologic Unit *	**pVs Test Line 2**	
	Depth Interval (ft)	**Vs** (ft/s)**
Silty Sand / Clay	0 – 23	553
Fat Clay / Silts and Sands	23 – 59	830
Possible Till and/or Bedrock	59 - 100	2,548
$V_{S\ 100}$ (ft/s)	989	
RMS (%)	1.4	
Geologic Unit *	**pVs Test Line 3**	
	Depth Interval (ft)	**Vs** (ft/s)**
Silty Sand / Clay	0 – 14.5	614
Fat Clay / Silts and Sands	14.5 – 72.5	767
Possible Till and/or Bedrock	72.5 - 100	2,772
$V_{S\ 100}$ (ft/s)	876	
RMS (%)	1.7	
Geologic Unit *	**pVs Test Line 4**	
	Depth Interval (ft)	**Vs** (ft/s)**
Silty Sand / Clay	0 – 17	614
Fat Clay / Silts and Sands	17 – 75.5	767
Possible Till and/or Bedrock	75.5 - 100	2,772
$V_{S\ 100}$ (ft/s)	886	
RMS (%)	1.4	

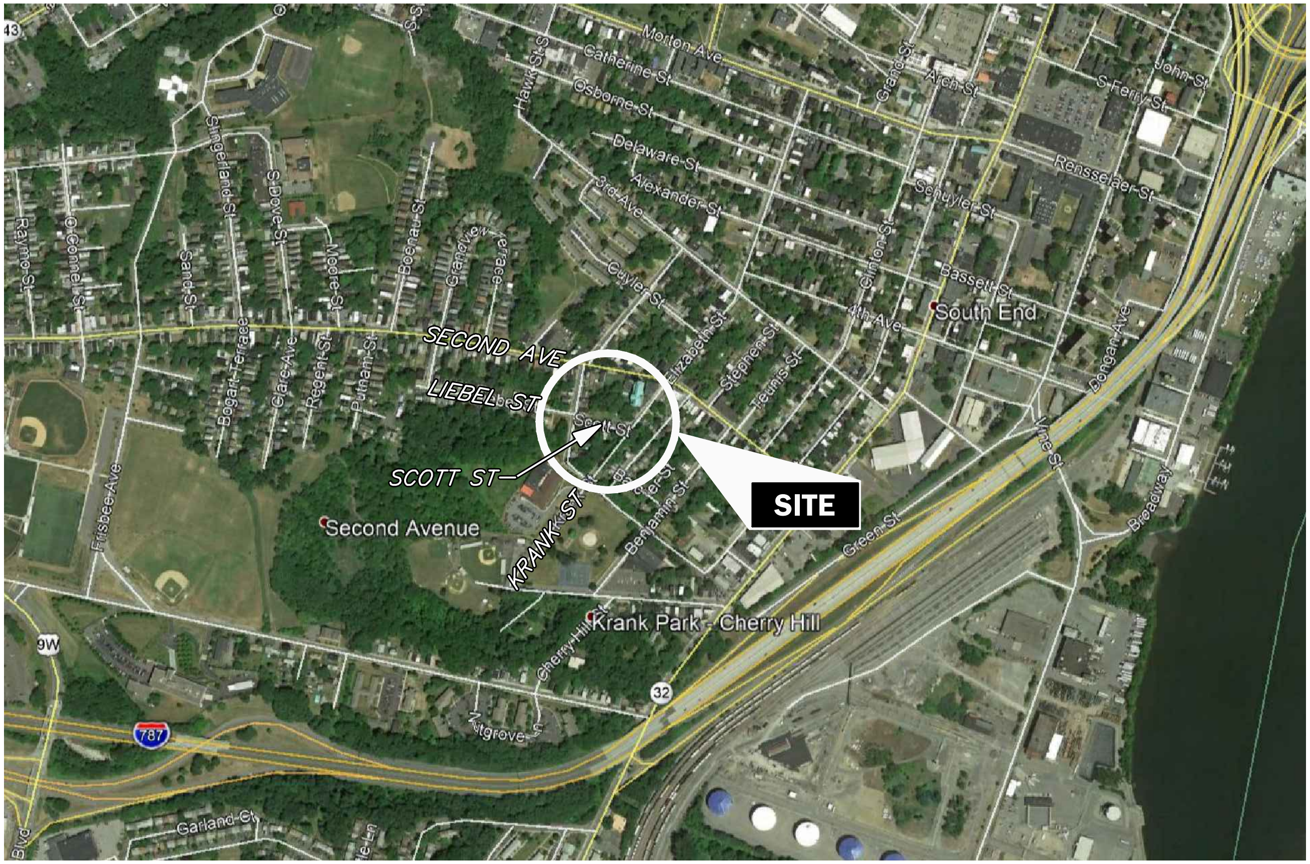
* Stratigraphy is generalized and based on shear wave values and boring logs provided by Chazen
** Shear wave velocity profile is determined for the midpoint of the pVs Test line

4. LIMITATIONS

This report was prepared for the exclusive use of The Chazen Companies (Client). No other party shall be entitled to rely on this Report, or any information, documents, records, data, interpretations, advice, or opinions given to Client by Hager-Richter Geoscience, Inc. (HRGS) in the performance of its work. The Report relates solely to the specific project for which HRGS has been retained and shall not be used or relied upon by Client or any third party for any variation or extension of this project, any other project or any other purpose without the express written permission of HRGS. Any unpermitted use by Client or any third party shall be at Client's or such third party's own risk and without any liability to HRGS.

HRGS has used reasonable care, skill, competence, and judgment in the preparation of this Report consistent with professional standards for those providing similar services at the same time, in the same locale, and under like circumstances. Unless otherwise stated, the work performed by HRGS should be understood to be exploratory and interpretational in character and any results, findings or recommendations contained in this Report or resulting from the work proposed may include decisions which are judgmental in nature and not necessarily based solely on pure science or engineering. It should be noted that our conclusions might be modified if subsurface conditions were better delineated with additional subsurface exploration including, but not limited to, coring and laboratory testing.

Except as expressly provided in this limitations section, HRGS makes no other representation or warranty of any kind whatsoever, oral or written, expressed or implied; and all implied warranties of merchantability and fitness for a particular purpose, are hereby disclaimed.



N

H-R

APPROXIMATE SCALE (feet)

0 1000 2000

LOCATION

NOTE:

Modified from Google Earth Pro aerial photograph.

* DBA HR Geological Services in New York

Figure 1 General Site Location The Seventy-Six Development Albany, New York	
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N

H-R

LEGEND

pVs TEST LINE WITH MIDPOINT

BORING

SCALE (feet)

0 80 160

NOTE:

Modified from Google Earth Pro aerial photograph.

* DBA HR Geological Services in New York

Figure 2
pVs Test Line Locations
The Seventy-Six Development
Albany, New York

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