The following clarifications, additions and/or changes shall be incorporated into the bidding documents, consisting of bidding requirements, conditions of the contract, drawings and specifications, dated October 27, 2017. Insert this addendum number on the bid form for this project, under addenda received.

GENERAL COMMENTS:

1. CHANGE: The date of Substantial Completion shall now be no later than March 31, 2021, subject to authorized adjustments.
2. Time extensions related to COVID-19 may be granted. Provide documentation in the same manner as for weather delays.
3. The paving in the bus loop (roadway adjacent to the project area) is heavy-duty.
4. Temporary electrical and water service can be taken from existing facilities at the school at no charge to the Contractor.
5. An additional showing of the site has been scheduled for 1:00 pm on July 6, 2020. If additional visits to the site are required, contact Jeff Shawver (540.853.6306 – jshawver@rcps.info). A reminder that construction of the school is still underway and under control of Avis Construction as the Contractor/Construction Manager. All visits are subject to their job site rules and COVID-19 protocols. Access to the building will be limited to areas of clinic construction only.
6. A list of manufacturers and colors of relevant products and electrical panel shop drawings are attached as Additional Information Available to Contractors.
7. Soils reports for the site prepared by Froeling & Robertson dated 13 April 2017 and 20 October 2017 are attached as Additional Information Available to Contractors.
8. The structural wall adjacent to the gymnasium (6 in. metal studs with HSS6 x 2 top plate) is already in place.
9. CLARIFICATION: ProPress fittings are not acceptable.
ITEM NO.
1. Section 10 1400 – Signage.
   DELETE 2.01 B Dimensional Letter Signs
   ADD 2.02 C – Signage Applications “A plan identifying room names and numbers will be provided by the Architect for the sign fabricator’s use.” Refer to 2.02B for a description of sign locations. Room names for signs will be the same as room names shown on architectural plans. Tactile exit signs will be required at both exit doors.
   DELETE 2.05 Dimensional Letters
2. DELETE Section 07 2500 Weather Barriers. The correct specification is 07 2500 Weather Resistant Sheathing & Air Barrier System. DensElement Barrier System is the Basis of Design product.
3. DELETE Section 07 9200 Joint Sealants
4. DELETE 2.18 – Fire Department Lock Box from Section 08 7100 – Door Hardware. A Knox-Box for the entire facility is already in place.
5. DELETE the duplicated 5-page Section 08 7100 Door Hardware which immediately precedes Section 08 8800 Glazing

DRAWINGS
ITEM NO.
1. On Detail A5-1.2 DELETE reference to Weather Barrier pointing to the roof. No weather barrier is required on the roof.
2. ADD attached Drawing SK-1 Data Conduit Routing Plan. Per Note 4 on Sheet E2-1 “Provide one (1) empty conduit with pull string from IT X28 Room.”
3. CLARIFICATION: On Sheet E1-1, Note #3 shown in Vestibule X20B states to provide a battery LED driver rated for 90-minute backup. Only provide the battery for the one fixture where the note is shown in the vestibule. No other fixtures in the vestibule require batteries.
4. CLARIFICATION: On Sheet S1-1, Roof framing for the vestibule and entrance canopy are existing. (See architectural drawings for extent of existing construction)

END OF ADDENDUM NO. 001
SEE ENCLOSURES
DATA CONDUIT ROUTING PLAN

1/16" = 1'-0"

COMMUNITY ENTRANCE CANOPY

BUS LOOP

GYMNASIUM

ELECTRICAL

COMM NO.

SUBJECT:

DATE:

PROJECT:

NEW CLINIC FOR

FALLON PARK ELEMENTARY SCHOOL

COMNO.

16046.003

SUBJECT:

DATA CONDUIT ROUTING PLAN

DATE:

07/01/20

SK-1
NEW CLINIC FOR FALLON PARK ELEMENTARY SCHOOL
Comm. No. 16046.003

ADDITIONAL INFORMATION AVAILABLE TO CONTRACTORS

1. Color and Product Matching Schedule
2. Soils Reports Prepared by Froeling & Robertson
3. Electrical Panelboard Submittal For Fallon Park Elementary
New Clinic for Fallon Park Elementary School
Comm. 16046.003

Color and Product Matching

EIFS: STO Color 31335 ‘Jute’ – Stolit X Fine
Roofing: McNeil Roofing
Storefront: Kawneer TriFab VG 451UT, Thermally-Broken, Center Glazed 2” x 4 ½” System Size
Exterior Framing = Redwood Paint
Interior Framing = Colonial White Paint
Glazing: Exterior Units 1” IG Units with Low-E coating
Outboard Lite: ¼” Heat Strengthened Float Glass
Low-E Coating: PPG Solarban 90 on #2 Surface
Tint: Solarblue
Between-Lite filled with Air
Inboard Lite: ¼” Annealed Float Glass
Tint: Clear
Interior Units ¼” Clear Fully Tempered Float Glass

VCT: Armstrong Imperial Texture 51803
Base: Johnsonite Rubber Color 63 Burnt Umber
Acoustical Tile Armstrong Cirrus
Report of Subsurface Exploration
and Geotechnical Engineering Evaluation

Proposed Fallon Park Elementary School Improvements
Roanoke, Virginia
F&R Project No. 62U0551

Prepared For:
Roanoke City Public Schools
40 Douglass Avenue NW
Roanoke, Virginia 24012

Prepared By:
Froehling & Robertson, Inc.
1734 Seibel Drive, N.E.
Roanoke, Virginia 24012
Phone: 540.344.7939
Fax: 540.344.3657

April 2017
F&R Project No.: 62U0551
13 April 2017

Roanoke City Public Schools
40 Douglass Avenue NW
Roanoke, Virginia 24012
c/o Mr. Mark Ayles, Hughes and Associates

Attention: Mr. Steve Barnett

Subject: Report of Subsurface Exploration and Geotechnical Engineering
Proposed Fallon Park Elementary School Improvements
Roanoke, Virginia

Mr. Barnett:

The purpose of this report is to present the results of the subsurface exploration program and
geotechnical engineering evaluation undertaken by Froehling & Robertson, Inc. (F&R) in
connection with the above referenced project. Our services were performed in general
accordance with revised F&R Proposal No. 1762-00223 dated 17 February 2017 as authorized
by Roanoke City Public Schools. The attached report presents our understanding of the project,
reviews our exploration procedures, describes existing site and general subsurface conditions,
and presents our evaluations, conclusions, and recommendations.

We have enjoyed working with you on this project, and we are prepared to assist you with the
recommended quality assurance monitoring and testing services during construction. Please
contact us if you have any questions regarding this report or if we may be of further service.

Sincerely,
FROEHLING & ROBERTSON, INC.

For
Erin K. Phillips, M.S., E.I.T.
Staff Engineer
Stephen D. Hjelle, M.S, P.E.
Geotechnical Department Manager

Distribution: Addressee (1 original/1 digital copy via mayles@hughesae.com)
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APPENDICES

APPENDIX A
GBA Important Information About This Geotechnical Engineering Report
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APPENDIX B
Classification of Soils for Engineering Purposes
Key to Boring Log Soil Classification
Soil Classification Chart
Boring Location Plan (Drawing No. 2)
Composite Subsurface Profile (Drawing No. 3)
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Laboratory Testing Summary Sheet
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APPENDIX C
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EXECUTIVE SUMMARY

This Executive Summary is provided as a brief overview of our geotechnical engineering evaluation for the project and is not intended to replace more detailed information contained elsewhere in this report. As an overview, this summary inherently omits details that could be very important to the proper application of the provided geotechnical design recommendations. This report should be read in its entirety prior to implementation into design and construction. The Project Information section of this report should be particularly reviewed by project designers to confirm that the geotechnical engineer’s understanding of the project concurs with the current project parameters at the time of project design.

- The subsurface exploration program consisted of eight test borings (designated as B-1 through B-8) and five offset borings (designated as B-1A, B-3A, B-4A, B-5A, and B-6A) performed to confirm encountered auger refusal conditions. Our exploration was performed on 21 to 22 March 2017. Site subsurface conditions generally consisted of surficial soils or existing pavement underlain by existing fill materials over residual soils or alluvial deposits, partially weathered rock and auger refusal materials.

- We note that existing fill material was encountered onsite. The depth of fill materials that were encountered ranged from 5 to 8 feet below existing grades. The sampled existing fill materials appeared to be relatively free of organics or other deleterious materials. To eliminate the risks associated with structural support on existing fill materials, the existing fill materials could be completely removed and replaced with new controlled structural fill. However, based on the boring data it appears that controlled fill placement as well as light foundation support on the existing fill materials should be possible provided the recommended engineering evaluations, as well as the recommended minimum fill thickness requirements, are adhered to and the owner is willing to accept some risk.

- The proposed building addition may be supported on shallow foundation systems designed for a maximum allowable bearing pressure of 2,500 pounds per square foot (psf) for footings bearing on approved existing fill, residual soil, or newly placed controlled structural fill subgrades. To reduce the possibility of localized shear failures, spread and strip footings should be a minimum of 3 feet and 2 feet wide, respectively. Exterior footings should be constructed at least 2 feet below adjacent grades to bear below the normal frost depth.

- Based on the provided topographic information, site grades within our exploration area range from 965 to 977 feet. The existing FFE of the building is 979.7 feet. To raise the proposed expansion area to grade, fills of about 3 to 15 feet will be required. The majority of the site can support fill placement at the rate of normal construction practices. The combined fill and building induced settlements are estimated to be 1 inch or less in these areas. However, in the vicinity of Boring B-8, fill and building induced settlements are estimated to be 1.2 inches. We anticipate that over 1 inch of settlement will be unacceptable. Therefore, we recommend that fill be placed prior to foundation construction and be left in-place for 60 days in the vicinity of Boring B-8.

- Based on our subsurface exploration partially weathered rock was encountered at a depth of 3 feet below existing site grades, and auger refusal as shallow as 5 feet. In addition, rock outcrops were observed onsite. However, we understand that fills of up to 15 feet will be required to develop the proposed addition. Therefore the majority of foundations will bear on newly placed controlled structural fill. Though unlikely to be encountered, we have provided general information with respect to the potential for difficult excavation.

- Based on the boring data and in general accordance with the IBC, a Site Class “D” should be used to develop the project’s Seismic Design Category for further evaluations relative to Earthquake Load design.
1.0 INTRODUCTION

1.1 Project Information

Our understanding of the project is based on information provided by Mr. Mark Ayles of Hughes Associates Architects and Engineers (Hughes) and our experience with similar projects. We understand that the Roanoke City Public Schools (RCPS) is planning improvements to Fallon Park Elementary School located at 502 19th Street SE, Roanoke, Virginia (See Site Vicinity Map, Drawing No. 1). Included in the provided information was site plan entitled, “New Construction for Fallon Park Elementary School, Existing Site Layout, Sheet EX-1” prepared by Hughes, dated 19 January 2017, detailing the existing site topography, utilities, and requested bore locations (filename: Fallon Park Eight Numbered Boring Locations.pdf).

Reportedly, these improvements to the school may include a building addition to the north and east of the existing school. No definitive site plans detailing the expansion footprint have been developed at this time. However, we anticipate that the addition will be two stories or fewer. Based on provided topographic information, site grades within our exploration area range from 965 to 977 feet. The existing Finished Floor Elevation (FFE) of the school building is 979.7 feet. To raise the proposed expansion area to grade, fills of about 3 to 15 feet will be required.

Structural loading information has not been provided at this time; however, based on our experience with similar projects, we have assumed maximum column and continuous wall loads on the order of 70 kips and 3 kips per linear foot (klf), respectively.

1.2 Scope of Services

The purposes of our involvement on this project were to 1) provide general descriptions of the subsurface soil conditions at the locations explored, 2) provide foundation design recommendations, and 3) comment on geotechnical aspects of the proposed development including general recommendations regarding site preparation and earthwork. To accomplish the above objectives, we undertook the following scope of services:

1) Visited the site to observe existing surface conditions and features and to mark boring locations.
2) Coordinated utility clearance with Miss Utility services
3) Reviewed and summarized readily available geologic information relative to the project site.
4) Executed the requested subsurface exploration consisting of eight standard penetration test (SPT) borings and five offset borings. The borings were drilled to depths ranging from 5 to 20 feet below existing site grades.
5) Recorded subsurface water levels upon completion of drilling.
6) Performed a laboratory testing program including two soil classification (Atterberg limits, wash #200, natural moisture content) tests.
7) Provided a Seismic Site Class Definition per the International Building Code (IBC) based on interpretation of the standard penetration test data.

8) Evaluated the findings of the test borings and laboratory test results relative to shallow foundation design and provided appropriate design criteria.

9) Prepared this written report summarizing our work on the project, providing foundation design recommendations and discussing geotechnical related aspects of the proposed construction. Copies of the test boring logs are included in the attached Appendices.

Our scope of services did not include rock coring, survey services, quantity estimates, preparation of plans or specifications, pavement design, retaining wall design, slope stability analyses, evaluations of earthquake motions, or the identification and evaluation for presence of gas, wetlands, or other environmental aspects of the project site.
2.0 SUBSURFACE EXPLORATION PROCEDURES

The subsurface exploration program consisted of eight test borings (designated as B-1 through B-8) and five offset borings (designated as B-1A, B-3A, B-4A, B-5A, and B-6A) performed to confirm encountered auger refusal conditions. The exploration was performed on 21 through 22 March 2017 at the approximate locations shown on the attached Boring Location Plan (Drawing No. 2, Appendix B). The planned boring locations were determined and staked in the field by F&R by measuring from existing site features such as building corners, edges of pavement, etc. Ground surface elevations at the boring locations were interpolated to the nearest foot from the provided topographic information. No claim is made as to the accuracy of the information contained in the provided documents. In consideration of the methods used in their determination, the boring locations and elevations shown on the attached Boring Location Plan, Composite Subsurface Profile (Drawing No. 3), and boring logs should be considered approximate.

The test borings were performed in accordance with generally accepted practice using a Truck-mounted CME-55 rotary drill rig equipped with an automatic hammer. Hollow-stem augers were advanced to pre-selected depths, the center plug was removed, and representative soil samples were recovered with a standard split-spoon sampler (1 3/8 in. ID, 2 in. OD) in general accordance with ASTM D 1586, the Standard Penetration Test. In this test, a weight of 140 pounds is freely dropped from a height of 30 inches to drive the split-spoon sampler into the soil. The number of blows required to drive the split-spoon sampler three consecutive 6-inch increments is recorded, and the blows of the last two increments are summed to obtain the Standard Penetration Resistance (N-value). The N-value provides a general indication of in-situ soil conditions and has been correlated with certain engineering properties of soils.

Automatic hammers were used to perform the SPT borings on this project. Research has shown that the Standard Penetration Resistance (N-value) determined by an automatic hammer is different than the N-value determined by the safety hammer method. Most correlations that are published in the technical literature are based on the N-value determined by the safety hammer method. This is commonly termed $N_{60}$ as the rope and cathead with a safety hammer delivers about 60 percent of the theoretical energy delivered by a 140-pound hammer falling 30 inches. Several researchers have proposed correction factors for the use of hammers other than the safety hammer to correct the values to be equivalent to the safety hammer SPT $N_{60}$-values. The correction is made using the following equation:

$$N_{60} = N_{\text{field}} \times C_E$$

$N_{\text{field}}$ in the equation above is the SPT N-value as recorded with the equipment utilized in the field, and for our use of this equation, $C_E$ a relative hammer efficiency ratio, i.e. our automatic hammer efficiency (specifically 86% for the truck-mounted drill rig used on this project) divided by the theoretical $N_{60}$ efficiency (60%). Accordingly, we recommend a correction factor ($C_E$) of approximately 1.43 (truck-mounted rig) for conversion of the recorded $N_{\text{field}}$ values to normalized $N_{60}$ values for the automatic hammer used on this project. We note that the N-values reported on the Boring Logs included in this report are the actual, uncorrected, field derived N-values ($N_{\text{field}}$).
In some soils it is not always practical to drive a split-spoon sampler the full three consecutive 6-inch increments. Whenever more than 50 blows are required to drive the sampler over a 6-inch increment, or the sampler is observed not to penetrate after 50 blows, the condition is called split-spoon refusal. Split-spoon refusal conditions may occur because of obstructions or because the earth materials being tested are very dense or very hard. When split-spoon refusal occurs, often little or no sample is recovered. The SPT N-value for split-spoon refusal conditions is typically estimated as greater than 100 blows per foot (bpf). Where the sampler is observed not to penetrate after 50 blows, the N-value is reported as 50/0. Otherwise, the depth of penetration after 50 blows is reported in inches, i.e. 50/6, 50/1, etc.

Subsurface water level readings were taken in each of the borings immediately upon completion of the soil drilling process. Upon completion of drilling, the boreholes were backfilled with auger cuttings (soil) and capped with asphalt cold patch as applicable. Periodic observation and maintenance of the boreholes should be performed due to potential subsidence at the ground surface, as the borehole backfill could settle over time.

Representative portions of the split-spoon soil samples were placed in glass jars and were transported to our laboratory and classified by a member of our professional staff. In the laboratory, the soil samples were evaluated in general accordance with techniques outlined in the visual-manual identification procedure (ASTM D 2488) and the Unified Soil Classification System (ASTM D 2487). The soil descriptions and classifications discussed in this report and shown on the attached boring logs are generally based on visual observation and should be considered approximate. Copies of the boring logs are provided and classification procedures are further explained in the attached Appendix B.

Split-spoon soil samples recovered on this project will be stored at F&R’s office for a period of sixty days. After sixty days, the samples will be discarded unless prior notification is provided to us in writing.
3.0 SITE AND SUBSURFACE CONDITIONS

3.1 Site Description

The proposed project site is located at 502 19th Street SE in Roanoke, Virginia. The existing Fallon Park Elementary School is north of Dale Avenue SE and west of Fallon Park. Ground cover across the proposed expansion area generally consisted of maintained grass, existing pavement, concrete sidewalks, and some wooded areas. Based on our engineering site visit, existing rock outcrops were observed onsite. Based on observations of utility clearance efforts, buried power, communications, gas, water, and sewer lines are present in the project vicinity. Additional undisclosed buried utilities may also be present.

3.2 Regional Geology

The proposed project site lies within the Valley and Ridge Physiographic province of Virginia. Available geologic references (Geologic Map of the Roanoke and Stewartville Quadrangles Virginia, 1963) indicate that the site is underlain by Cambrian-aged rocks of the Rome Formation. The Rome formation is composed of maroon, green, and gray mudstone interbedded with fine-grained shale, sandstone, and siltstone.

Our experience with the Rome Formation in the vicinity of the site indicates that there are medium-bedded, alternating rock layers oriented nearly vertical. The varying susceptibility to weathering creates seams of soil like material sandwiched between weather resistant rock pinnacles. From an excavation and support point of view, the Rome contains near vertical, very hard, layers that may require blasting to excavate, interbedded with soft clay seams that may require undercutting to some depth to provide adequate structural support. Where the test borings encountered a vertical bed of auger refusal material, direct interpretation of the field data might lead one to envision a rock surface between the auger refusal points. Likewise, where vertical soil seams are encountered, a deep soft soil profile might be anticipated. However, in the Rome Formation our experience is that a combination of both conditions exists. Therefore, the boring data should be viewed as a specific example of the subsurface condition at each explored location rather than a broad interpretation of conditions across the site area.

The Rome also contains numerous carbonate intervals of gray dolomite and/or limestone. Carbonate rocks may decompose in the presence of subsurface water that is slightly acidic. This decomposition may leave subsurface voids that may ravel up to the ground surface and form sinkholes. There are numerous variations on potential sinkhole development. Regardless of the mode of development, it is important to note that changes in soil stress and water regime can greatly accelerate sinkhole development. Natural geologic processes that might otherwise occur over thousands of years can occur within several years or even months. Construction activities such as site grading, building construction, and water impoundment have reportedly caused sinkholes to develop rapidly or to collapse suddenly. This site lies within a geologic formation known to contain solutional features; however, the potential for development of sinkholes, along with the rate at which a sinkhole will develop, are not easily determined or accurately predicted.
3.3 Subsurface Conditions

3.3.1 General
The subsurface conditions discussed in the following paragraphs and those shown on the boring logs and composite subsurface profile represent an estimate of the subsurface conditions based on interpretation of the boring data using normally accepted geotechnical engineering judgments. The transitions between different soil strata are usually less distinct than those shown on the boring logs and subsurface profile. Although individual test borings are representative of the subsurface conditions at the boring locations on the dates shown, they are not necessarily indicative of subsurface conditions at other locations or at other times. Data from the specific test borings are shown on the attached boring logs in Appendix B. In addition, a composite subsurface profile has been provided to conceptually illustrate conditions encountered across the site. Below the existing ground surface, the borings generally encountered surficial soils or existing pavement underlain by existing fill materials over residual soils or alluvial deposits, partially weathered rock and auger refusal materials.

3.3.1 Surficial Soils
Surficial soils were encountered at each of the boring locations except Borings B-2 and B-3 to depths of approximately 2 to 4 inches. Surficial soils are typically a dark-colored soil material containing roots, fibrous matter, and/or other organic components, and are generally unsuitable for engineering purposes. We note that no laboratory testing was performed to determine the organic content or horticultural properties of the observed surficial soil materials. Therefore, the term “surficial soils” is not intended to indicate suitability for landscaping and/or other purposes. The surficial soil depths provided in this report are based on driller observations and should be considered approximate. Actual surficial soil depths should be expected to vary across the site.

3.3.2 Asphalt Pavement and Crushed Stone
An approximate 1 to 1.5 inch thick section of asphalt pavement was encountered in test Borings B-2 and B-3. Beneath the pavement section, a 2 to 3 inch section of crushed stone was encountered. We note that the drilling process tends to disturb pavement sections during penetration and removal of the augers. Therefore, the measured pavement thicknesses should be considered approximate. Actual depths of asphalt pavement and crushed stone may vary in unexplored areas of the site.

3.3.3 Existing Fill and Possible Fill Materials
Existing fill materials include those materials deposited by man. Materials identified as existing fill were encountered in each of the site borings except Boring B-6 and B-8. The existing fill materials were encountered below surficial soils and extended to approximate depths of 5 to 8 feet below current site grades. The sampled fill materials were generally described as sands (SC and SM) and gravels (GM) with standard penetration resistances (N-values) ranging from 7 to 41 blows per foot (bpf).

3.3.4 Alluvial Soils
Alluvial soils, consisting of materials that have been transported and deposited by flowing water, were encountered in B-7 below the existing fill material from 5.5 to 8 feet. Sampled alluvial soils were generally described as clay (CL). The standard penetration resistance (N-values) within the sampled alluvium was 7 bpf.
3.3.5 Residual Soils
Residual soils, formed by the in-place weathering of the parent rock, were encountered in Borings B-6, B-7, and B-8. Sampled residual soils were generally described as sands (SM, SC, SW). Standard penetration resistances (N-values) within the sampled residuum ranged from 3 to 36 bpf with a typical range of 7 to 25 bpf.

3.3.6 Partially Weathered Rock
Partially weathered rock (PWR) is a transitional material between soil and rock, which retains the relic structure of the rock and has very hard or very dense consistencies. PWR is defined for engineering purposes as residual material with standard penetration resistances in excess of 100 bpf. PWR was encountered in test Borings B-2, B-4, B-6 and B-7 at depths ranging from 3 to 12 feet below existing site grades. The sampled PWR was described as sands (SM and SC) with penetration resistances ranging from 50 blows per 6 inches of split-spoon penetration (50/6) to 50/1.

3.3.7 Auger Refusal
Auger refusal occurs when materials are encountered that cannot be penetrated by the soil auger and is normally indicative of a hard or very dense material, such as debris within fill, alluvial cobbles or boulders, rock lenses, pinnacles, or the upper surface of bedrock. Auger refusal was encountered in several of the test boring at depths indicated in the table below.

Auger refusal discussed herein is based on conditions impenetrable to our drilling equipment (CME 55 drill rig). Auger refusal conditions with a CME 55 do not necessarily indicate conditions impenetrable to other equipment. Auger refusal conditions may exist intermediate of the boring locations or in unexplored areas of the site.

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<td>B-4A</td>
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<td>B-5</td>
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<td>B-6</td>
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</tr>
<tr>
<td>B-6A</td>
<td>6</td>
<td>959</td>
</tr>
</tbody>
</table>
3.3.8 Subsurface Water
Subsurface water for the purposes of this report is defined as water encountered below the existing ground surface. Measurable subsurface water was not encountered in any of the borings immediately upon completion of drilling. Fluctuations in subsurface water levels and soil moisture can be anticipated with changes in precipitation, run-off, and season.

3.4 Laboratory Testing Program
Laboratory testing was performed in general accordance with applicable ASTM International (ASTM) standards. Split-spoon samples were tested for moisture content (ASTM D 2216), Atterberg limits (ASTM D 4318), and percent passing #200 sieve (ASTM D 1140). The results of the laboratory tests are summarized in the following tables and a summary sheet is provided in the attachments. Specific results of the Atterberg Limits testing is provided in Appendix B.

**USCS Soil Classification Test Summary**

<table>
<thead>
<tr>
<th>Boring No.</th>
<th>Sample Depth (feet)</th>
<th>Sample Type</th>
<th>Moisture Content (%)</th>
<th>% Retained on No. 4</th>
<th>% Finer than No. 200</th>
<th>Atterberg Limits</th>
<th>USCS Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-7</td>
<td>6 – 7.5</td>
<td>Jar</td>
<td>19.1</td>
<td>0.0</td>
<td>68.0</td>
<td>34 18 16</td>
<td>Brown sandy lean CLAY (CL)</td>
</tr>
<tr>
<td>B-8</td>
<td>1 – 2.5</td>
<td>Jar</td>
<td>20.0</td>
<td>9.0</td>
<td>49.0</td>
<td>33 23 10</td>
<td>Brown clayey SAND (SC)</td>
</tr>
</tbody>
</table>
4.0 DESIGN RECOMMENDATIONS

4.1 General

The following evaluations and recommendations are based on our observations at the site, interpretation of the field data obtained during this exploration, and our experience with similar subsurface conditions and projects. Soil penetration data has been used to evaluate an allowable bearing pressure and associated settlement estimates using established correlations. Subsurface conditions in unexplored locations may vary from those encountered. If the structure locations, loadings, or elevations are changed, we should be notified and requested to confirm and, if necessary, re-evaluate our recommendations.

Determination of an appropriate foundation system for a given structure is dependent on the proposed structural loads, soil conditions, and construction constraints such as proximity to other structures, etc. The subsurface exploration aids the geotechnical engineer in determining the soil stratum appropriate for structural support. This determination includes considerations with regard to both allowable bearing capacity and compressibility of the soil strata. In addition, since the method of construction greatly affects the soils intended for structural support, consideration must be given to the implementation of suitable methods of site preparation, fill compaction, and other aspects of construction.

4.2 Foundation Design

The proposed building addition may be supported on shallow foundation systems bearing on approved existing fill materials, residual soils, or newly placed controlled structural fill. Based on assumed structural loads and the subsurface conditions encountered in our test borings, we recommend that foundations be designed for a maximum allowable bearing pressure of 2,500 pounds per square foot (psf) for footings bearing on approved subgrades. To reduce the possibility of localized shear failures, spread and strip footings should be a minimum of 3 feet and 2 feet wide, respectively. Exterior footings should be constructed at least 2 feet below adjacent grades to bear below the normal frost depth.

We note that partially weathered rock (PWR) and auger refusal was encountered at depths of 3 and 5 feet respectively below the existing ground surface. However, we anticipate the foundation bearing level to be well above this strata due to anticipated filling onsite. Though unlikely to be necessary, the following recommendations are provided for the potential difficult excavation conditions. Where foundation excavation reveals a foundation subgrade with exposures of rock, we recommend over-excavating the rock areas by 12 inches and replacement with a select granular backfill or an alternative backfill material approved by the geotechnical engineer (see Rock Sub-Excavation Detail, Drawing No. 4, Appendix C). The granular backfill placement should reduce the potential for point loading on the foundation from the bedrock and possible structural damage.
In some portions of the proposed development, new foundations may be required in areas that are adjacent or near existing foundations. Where new foundations are constructed adjacent to or near the existing buildings, special care should be taken not to undermine or exert additional stress on the existing foundations. At the time this report was written, the bottom elevation of the existing footings was not definitively known; however, we generally recommend bearing the new footings at approximately the same elevation as the existing footings where adjacent.

4.3 Shrink-Swell Considerations

Based on the conditions encountered during our subsurface exploration, laboratory test results, and our general experience in the project vicinity, we anticipate that the on-site soils have a low to moderate shrink-swell potential. Therefore we do not recommend any construction changes relative to plastic soil conditions.

4.4 Support on Existing Fills

As previously noted, existing fill materials were encountered in each of the test borings except Boring B-8 to depths ranging from 5 to 8 feet below existing site grades. In general, construction on existing fill material requires a building owner to accept some risks due to unforeseen conditions within the material. Associated risks may be additional support related cost (i.e. undercutting, etc.) and excessive settlement. To eliminate the risks associated with structural support on existing fill materials, the existing materials could be completely removed and replaced with new controlled structural fill.

However, based on the boring data obtained during our subsurface exploration, it appears that controlled structural fill placement as well as foundation and slab support on the existing fill materials is possible with a reduced risk to the owner, provided the recommended engineering evaluations provided in this report are performed during construction and with the understanding that some undercutting and/or in-place stabilization may be recommended as a result of those time of construction evaluations.

4.5 Estimated Settlements due to Fill Placement

We understand that the proposed building addition will be supported by foundations constructed on newly placed controlled structural fill for the majority of the site. Based on the lowest existing elevation in our exploration area of approximately 965 feet, we envision that maximum fill placements will be on the order of 15 feet. We estimate that the planned fill placement will result in up to 0.8 inches of settlement due to a compression of the in-situ soil profile under the areal load of the new fill materials. If foundations are constructed before the fill has had time to settle, the proposed addition could also experience this settlement. As discussed in the following section, building load induced settlement is estimated to be up to another 0.4 inches or less.

The majority of the site can support fill placement at the rate of normal construction practices. The combined fill and building induced settlements are estimated to be 1 inch or less in across the majority of the site. However, in the vicinity of Boring B-8, fill and building induced settlements are estimated to be 1.2 inches. We anticipate that over 1 inch of settlement will be unacceptable. Therefore, we recommend that fill be placed prior to foundation construction and be left in-place for 60 days in the vicinity of Boring B-8.
4.6 Estimated Settlements due to Foundation Loads

Based on the boring data as well as the provided grading and assumed structural load information, we estimate total settlements due to foundation loads to be on the order of 0.4 inches or less, with differential settlement of $\frac{1}{2}$ to $\frac{2}{3}$ the estimated total settlement. The magnitude of differential settlements will be influenced by the variation in excavation requirements across the building footprint, the distribution of loads, and the variability of underlying soils.

Our settlement analysis was performed on the basis of structural and grading information discussed in the project information section of this report. Actual settlements experienced by the structure and the time required for these soils to settle will be influenced by undetected variations in subsurface conditions, actual structural loads, final grading plans, the quality of fill placement, and foundation construction.

4.7 Ground Floor Slabs

Ground floor slabs may be designed as a slab-on-grade supported by approved existing fill materials, residual soil, or controlled structural fill subgrades. Slab-on-grade support is contingent upon successful completion of the subgrade evaluation process as described in Site Preparation (Section 5.1).

A vapor retarder should be used beneath ground floor slabs that will be covered by tile, wood, carpet, impermeable floor coatings, and/or if other moisture-sensitive equipment or materials will be in contact with the floor. However, the use of vapor retarders may result in excessive curling of floor slabs during curing. We refer the floor slab designer to ACI 302.1R-96, Sections 4.1.5 and 11.11, for further discussion on vapor retarders, curling, and the means to reduce concrete shrinkage and curling.

Proper jointing of the ground floor slab is also essential to minimize cracking. ACI suggests that unreinforced, plain concrete slabs may be jointed at spacings of 24 to 36 times the slab thickness, up to a maximum spacing of 18 feet. Floor slab construction should incorporate isolation joints along bearing walls and around column locations to allow minor movements to occur without damage. Utility or other construction excavations in the prepared floor subgrade should be backfilled to a controlled fill criterion to provide uniform floor support.

4.8 Seismic Site Classification

The following Seismic Site Class Definition was established per Section 1613.3.2 of the 2012 International Building Code (IBC) and Chapter 20 of ASCE 7. Our scope of services did not include a seismic conditions survey to determine site-specific shear wave velocity information. IBC provides a methodology for interpretation of Standard Penetration Test resistance values (N-values) to determine a Site Classification. However, this method requires averaging N-values over the top 100 feet of the subsurface profile. We note that the test borings for this project were extended to a maximum depth of 20 feet below existing site grades.
The available subsurface data from our exploration indicates an N-value range of 3 bpf to greater than 100 bpf within the upper 20 feet below existing site grades. Based on the boring data and in general accordance with the IBC, a Site Class “D” should be used to develop the project’s Seismic Design Category for further evaluations relative to Earthquake Load design.

We note that the above provided Site Classification is based on information available at the time this report was written. Should this classification be so onerous to the project cost that further study is warranted, we can perform a site-specific geo-physical survey to attain sufficient detail to refine the project’s Seismic Site Classification. This additional testing is beyond the currently authorized scope of services for this project.
5.0 CONSTRUCTION RECOMMENDATIONS

5.1 Site Preparation
Before proceeding with construction, any surficial soils, roots, and/or any other deleterious non-soil materials should be stripped or removed from the proposed construction area. During the clearing and stripping operations, positive surface drainage should be maintained to prevent the accumulation of water. Underground utilities should be re-routed to locations a minimum of 10 feet outside of the proposed new structure footprint.

After stripping, areas intended to support new fill, floor slabs, and foundations should be carefully evaluated by a representative of the geotechnical engineer. At that time, the engineer may require proofrolling of the subgrade with a 20- to 30-ton loaded truck or other pneumatic-tired vehicle of similar size and weight. Proofrolling should be performed during a time of good weather and not while the site is wet, frozen, or severely desiccated. The purpose of the proofrolling is to locate soft, weak, or excessively wet soils present at the time of construction and provides an opportunity for the geotechnical engineer to locate inconsistencies intermediate of our boring locations.

Particular attention should be given to any existing utility trenches within the proposed construction area if encountered. Our experience is that utility trenches are sometimes backfilled with very little compactive effort. Where utility lines are removed, the trench subgrade should be verified by an F&R representative prior to backfilling in accordance with the controlled structural fill recommendations provided in this report. If in-place abandonment is preferred, open conduits, pipes, or culverts should be grouted full and the overlying in-place backfill evaluated prior to at-grade construction.

The proofrolling observation is an opportunity for the geotechnical engineer to locate inconsistencies intermediate of our boring locations in the existing subgrade. Any unsuitable materials observed during the evaluation and proofrolling operations should be undercut and replaced with compacted fill or stabilized in-place. The possible need for, and extent of, undercutting and/or in-place stabilization required can best be determined by the geotechnical engineer at the time of construction. Once the site has been properly prepared, at-grade construction may proceed.

5.2 Foundation Construction
All foundation subgrades should be observed, evaluated, and verified for the design bearing pressure by a representative of the geotechnical engineer after excavation and prior to reinforcement steel placement. Where low consistency soils are encountered during foundation construction, localized undercutting and/or in-place stabilization of foundation subgrades may be required. The actual need for, and extent of, undercutting should be based on field observations made by the geotechnical engineer at the time of construction.
Excavations for footings should be made in such a way as to provide bearing surfaces that are firm and free of loose, soft, wet, or otherwise disturbed soils. Foundation concrete should not be placed on frozen or saturated subgrades. If such materials are allowed to remain below foundations, settlements will increase. Foundation excavations should be concreted as soon as practical after they are excavated. If an excavation is left open for an extended period, a thin mat of lean concrete should be placed over the bottom to minimize damage to the bearing surface from weather or construction activities. Water should not be allowed to pond in any excavation.

5.3 Controlled Structural Fill

Based on the boring data, controlled structural fill may be constructed using the non-organic on-site soils. However, if and/or where encountered CH and MH soils should not be used for below grade wall backfill. If needed, off-site borrow materials should generally have a classification of CL, ML, SM, or SC as defined by the Unified Soil Classification System (USCS). Other materials may be suitable for use as controlled structural fill material and should be individually evaluated by the geotechnical engineer. Controlled structural fill should be free of boulders, organic matter, debris, or other deleterious materials and should have a maximum particle size no greater than 3 inches. In addition, we recommend a minimum Standard Proctor (ASTM D 698) maximum dry density of 90 pounds per cubic feet for fill materials.

Fill materials should be placed in horizontal lifts with maximum height of 8 inches loose measure. New fill should be adequately keyed into stripped and scarified subgrade soils and should, where applicable, be benched into the existing slopes. During fill operations, positive surface drainage should be maintained to prevent the accumulation of water. We recommend that structural fill be compacted to at least 95 percent of the Standard Proctor maximum dry density. In confined areas such as utility trenches, portable compaction equipment and thin lifts of 3 to 4 inches may be required to achieve specified degrees of compaction. Each lift of fill should be tested to confirm that the recommended degree of compaction is attained.

In general, we recommend that the moisture content of fill soils be maintained within three percentage points of the optimum moisture content as determined from the Standard Proctor test. We recommend that the contractor have equipment on site during earthwork for both drying and wetting of fill soils. Moisture control may be especially difficult during winter months or extended periods of rain. Attempts to work the soils when wet can be expected to result in deterioration of otherwise suitable soil conditions or of previously placed and properly compacted fill. Where construction traffic or weather has disturbed the subgrade, the upper 8 inches of soils (or more if warranted) intended for structural support should be scarified and re-compacted.
5.4 Excavation Conditions

Based on our subsurface exploration partially weathered rock was encountered at a depth of 3 feet below existing site grades, and auger refusal as shallow as 5 feet. In addition, rock outcrops were observed onsite. As explained in Regional Geology, the Rome formation consists of a highly variable bedrock surface consisting of troughs and pinnacles which may greatly fluctuate in elevation within short lateral distances. Therefore, we envision that difficult excavation conditions may be encountered in portions of the site. However, we understand that fills of up to 15 feet will be required to develop the proposed addition. Therefore the majority of foundations will likely bear on newly placed controlled structural fill. Though unlikely to be encountered, we have provided the following general information with respect to the potential for difficult excavation.

In mass excavations for general site work, hard or dense soils (soils with standard penetration resistances of 30 or more blows per foot) can usually be removed by ripping with a single-tooth ripper attached to a large crawler tractor or by breaking it out with a large front-end loader. In addition, in mass excavations PWR exhibiting a standard penetration resistance of 50 blows per 6 inches to 2 inches of split-spoon penetration can usually be removed using large backhoes. In confined excavations such as foundations, utility trenches, elevator pits, etc., removal of partially weathered rock typically requires use of large backhoes, pneumatic spades, or light blasting. Refusal materials and PWR exhibiting a penetration resistance of 50 blows per 1 inch or less will normally require blasting for removal in all types of excavations. Any blasting in footing excavations must be done carefully to prevent damage to the bearing materials.

Prior to any blasting operations, we recommend conducting a pre-blast survey for all structures within 300 feet. A written blasting program should then be submitted by the blasting subcontractor for review by the architect/structural engineer. Peak particle velocities produced by blasting should be measured adjacent to the foundations of nearby structures and should be restricted to levels of no more than 0.5 to 1.0 inches per second, depending on the distance from the blasting. Air blast levels should also be monitored and restricted to less than 130 to 140 decibels. Trial blasting should be required to confirm that ground motions are reasonably predictable. All work should be performed by an experienced licensed contractor. To reasonably measure quantities of rock, you may wish to use a land surveyor to cross-section the upper surface of rock prior to blasting.

The definition of rock can be a source of conflict during construction. The following definitions have been incorporated into specifications on other projects and are provided for your general guidance:

GENERAL EXCAVATION:

   Rip Rock - Any material that cannot be removed by scrapers, loaders, pans, dozers, or graders; and requires the use of a single-tooth ripper mounted on a crawler tractor having a minimum draw bar pull rated at not less than 56,000 pounds.
Blast Rock - Any material which cannot be excavated with a single-tooth ripper mounted on a crawler tractor having a minimum draw bar pull rated at not less than 56,000 pounds (Caterpillar D-8K or equivalent) or by a Caterpillar 977 front-end loader or equivalent; and occupying an original volume of at least one (1) cubic yard.

TRENCH EXCAVATION:

Blast Rock - Any material which cannot be excavated with a backhoe having a bucket curling force rated at not less than 25,700 pounds (Caterpillar Model 225 or equivalent), and occupying an original volume of at least one-half (1/2) cubic yard.

5.5 Subsurface Water Conditions

Subsurface water for the purposes of this report is defined as water encountered below the existing ground surface. Based on the subsurface water data obtained during our exploration program, we generally anticipate that subsurface water will not be encountered during anticipated earthwork or shallow foundation excavations at the site. However, the contractor should be prepared to dewater should water levels vary from those encountered during the drilling program. Fluctuations in subsurface water levels and soil moisture can be anticipated with changes in precipitation, runoff, and season.
6.0 CONTINUATION OF SERVICES

We recommend that we be given the opportunity to review the foundation plans, grading plans, and project specifications when construction documents approach completion. This review evaluates whether the recommendations and comments provided herein have been understood and properly implemented. We also recommend that Froehling & Robertson, Inc. be retained for professional and construction materials testing services during construction of the project. Our continued involvement on the project helps provide continuity for proper implementation of the recommendations discussed herein.
7.0 LIMITATIONS

This report has been prepared for the exclusive use of Roanoke City Public Schools or their agent, for specific application to the Proposed Fallon Park Elementary School project in Roanoke, Virginia, in accordance with generally accepted soil and foundation engineering practices. No other warranty, express or implied, is made. Our conclusions and recommendations are based on design information furnished to us, the data obtained from the previously described subsurface exploration program, and generally accepted geotechnical engineering practice. The conclusions and recommendations do not reflect variations in subsurface conditions which could exist intermediate of the boring locations or in unexplored areas of the site. Should such variations become apparent during construction, it will be necessary to re-evaluate our conclusions and recommendations based upon on-site observations of the conditions.

Regardless of the thoroughness of a subsurface exploration, there is the possibility that conditions between borings will differ from those at the boring locations, that conditions are not as anticipated by the designers, or that the construction process has altered the soil conditions. Therefore, experienced geotechnical engineers should evaluate earthwork, pavement, and foundation construction to verify that the conditions anticipated in design actually exist. Otherwise, we assume no responsibility for construction compliance with the design concepts, specifications, or recommendations.

In the event that changes are made in the design or location of the proposed structure, the recommendations presented in the report shall not be considered valid unless the changes are reviewed by our firm and conclusions of this report modified and/or verified in writing. If this report is copied or transmitted to a third party, it must be copied or transmitted in its entirety, including text, attachments, and enclosures. Interpretations based on only a part of this report may not be valid. This report contains 23 pages of text and the attached appendices.
While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Important Information about This Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you — presumably a client representative — interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared solely for the client. Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled. No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. And no one – not even you — should apply this report for any purpose or project except the one originally contemplated.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it in its entirety. Do not rely on an executive summary. Do not read selected elements only. Read this report in full.

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:
- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:
- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, always inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:
- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. If your geotechnical engineer has not indicated an “apply-by” date on the report, ask what it should be, and, in general, if you are the least bit uncertain about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the “Findings” Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed. The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.
This Report’s Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations only after observing actual subsurface conditions revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals’ misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

• confer with other design-team members,
• help develop specifications,
• review pertinent elements of other design professionals’ plans and specifications, and
• be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, but be certain to note conspicuously that you’ve included the material for informational purposes only. To avoid misunderstanding, you may also want to note that “informational purposes” means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, only from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and be sure to allow enough time to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled “limitations,” many of these provisions indicate where geotechnical engineers’ responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a “phase-one” or “phase-two” environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer’s services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, *proper implementation of the geotechnical engineer’s recommendations will not of itself be sufficient to prevent moisture infiltration.* Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. *Geotechnical engineers are not building-envelope or mold specialists.*

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Adapted from the USGS 7.5 minute series topographic quadrangle:
Roanoke, VA (1984)
### Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests

#### COARSE-GRAINED SOILS

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<th>Group Symbol</th>
<th>Description</th>
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<tr>
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<tr>
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<td></td>
</tr>
<tr>
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#### FINE-GRAINED SOILS

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</tr>
<tr>
<td>ML</td>
<td>Silt</td>
<td></td>
</tr>
<tr>
<td>OL</td>
<td>Organic clay</td>
<td></td>
</tr>
<tr>
<td>CH</td>
<td>Fat clay</td>
<td></td>
</tr>
<tr>
<td>MH</td>
<td>Elastic silt</td>
<td></td>
</tr>
<tr>
<td>OH</td>
<td>Organic silt</td>
<td></td>
</tr>
</tbody>
</table>

#### HIGHLY ORGANIC SOILS

<table>
<thead>
<tr>
<th>Group Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT</td>
<td>Peat</td>
</tr>
</tbody>
</table>

---

### Soil Classification

- **Gravel**: More than 50% retained on the No. 200 sieve.
- **Sand**: More than 50% of coarse fraction retained on No. 4 sieve.
- **Clean gravel**: Less than 5% fines.
- **Gravel with fines**: More than 12% fines.
- **Clean sand**: Less than 5% fines.
- **Sand with fines**: More than 12% fines.

### FROEHLING & ROBERTSON, INC.

Engineering Stability Since 1881

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### Laboratory Tests

- **PI**: Plots on or above "A" line.
- **Cu**: If fines classify as CL or CH, use dual symbol GC-GM, or SC-SM.

---

**Notes:**

- **A**: Based on the material passing the 3-in. (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.
- **Cu** = \( \frac{D_{10}}{D_{60}} \) \( \frac{D_{30}}{D_{10}} \), \( \frac{D_{10}}{D_{60}} \).
- **Cc** = \( \frac{D_{10}}{D_{60}} \) \( \frac{D_{30}}{D_{10}} \).
- **D**: If soil contains 15% or more sand, add "with sand" to group name.
- **E**: Gravels with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SC poorly graded sand with clay, SP-SC poorly graded sand with clay.
- **F**: If fines classify as CL or CH, use dual symbol GC-GM, or SC-SM.
- **G**: If fines classify as ML or MH, use dual symbol GC-GM, or SC-SM.
- **H**: Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SC poorly graded sand with silt, SP-SC poorly graded sand with clay.
- **I**: If soil contains 15% or more sand, add "with sand" to group name.
- **J**: If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.
- **K**: PI plots on or above "A" line.
- **L**: If soil contains ≥ 30% plus No. 200, add "with gravel" to group name.
- **M**: If soil contains ≥ 30% plus No. 200, predominantly gravel add "gravelly" to group name.
- **N**: PI ≥ 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.
KEY TO BORING LOG SOIL CLASSIFICATION

Particle Size and Proportion

Visual descriptions are assigned to each soil sample or stratum based on estimates of the particle size of each component of the soil and the percentage of each component of the soil.

<table>
<thead>
<tr>
<th>Boulder</th>
<th>Cobble</th>
<th>Gravel</th>
<th>Sand</th>
<th>Silt</th>
<th>Clay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pass</td>
<td>12 in.</td>
<td>3 in.</td>
<td>#4 M</td>
<td>#200 M</td>
<td></td>
</tr>
<tr>
<td>Retained</td>
<td>3 in.</td>
<td>3/4 in.</td>
<td>#10 M</td>
<td>#200 M</td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1.) Particle size is designated by U.S. Standard Sieve Sizes
2.) Because of the small size of the split-spoon sampler relative to the size of gravel, the true percentage of gravel may not be accurately estimated.

Density or Consistency

The standard penetration resistance values (N-values) are used to describe the density of coarse-grained soils (GRAVEL, SAND) or the consistency of fine-grained soils (SILT, CLAY). Sandy silts of very low plasticity may be assigned a density instead of a consistency.

<table>
<thead>
<tr>
<th>DENSITY</th>
<th>CONSISTENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Term</td>
<td>N-Value</td>
</tr>
<tr>
<td>Very Loose</td>
<td>0 - 4</td>
</tr>
<tr>
<td>Loose</td>
<td>5 - 10</td>
</tr>
<tr>
<td>Medium Dense</td>
<td>11- 30</td>
</tr>
<tr>
<td>Dense</td>
<td>31 - 50</td>
</tr>
<tr>
<td>Very Dense</td>
<td>&gt; 50</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. The N-value is the number of blows of a 140 lb. Hammer freely falling 30 inches required to drive a standard split-spoon sampler (2.0 in. O.D., 1-3/8 in. I.D.) 12 inches into the soil after properly seating the sampler 6 inches.
2. When encountered, gravel may increase the N-value of the standard penetration test and may not accurately represent the in-situ density or consistency of the soil sampled.
<table>
<thead>
<tr>
<th>MAJOR DIVISIONS</th>
<th>SYMBOLS</th>
<th>TYPICAL DESCRIPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COARSE GRAINED SOILS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GRAVEL AND GRAVELLY SOILS</td>
<td>CLEAN GRAVELS</td>
<td>WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES</td>
</tr>
<tr>
<td></td>
<td>(LITTLE OR NO FINES)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GRAVELS WITH FINES</td>
<td>POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES</td>
</tr>
<tr>
<td></td>
<td>(APPRECIABLE AMOUNT OF FINES)</td>
<td></td>
</tr>
<tr>
<td>SAND AND SANDY SOILS</td>
<td>CLEAN SANDS</td>
<td>WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES</td>
</tr>
<tr>
<td></td>
<td>(LITTLE OR NO FINES)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SANDS WITH FINES</td>
<td>POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES</td>
</tr>
<tr>
<td></td>
<td>(APPRECIABLE AMOUNT OF FINES)</td>
<td></td>
</tr>
<tr>
<td><strong>FINE GRAINED SOILS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SILTS AND CLAYS</td>
<td>SILTY SANDS, SAND - SILT MIXTURES</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(LITTLE OR NO FINES)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SANDS WITH FINES</td>
<td>CLAYEY SANDS, SAND - CLAY MIXTURES</td>
</tr>
<tr>
<td></td>
<td>(APPRECIABLE AMOUNT OF FINES)</td>
<td></td>
</tr>
<tr>
<td><strong>EXISTING FILL</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FILL</td>
<td>EXISTING FILL MATERIALS</td>
<td></td>
</tr>
</tbody>
</table>
Adapted from provided site plan entitled “New Construction for Fallon Park Elementary School, Existing Site Layout, Sheet EX-1” by Hughes Associates Architects and Engineers, dated January 19, 2017.

Roanoke City Public Schools
Fallon Park Elementary School Improvements
Roanoke, Virginia

DATE: April 2017
SCALE: As shown (approximate)
DRAWN: EKP
BORING LOCATION PLAN
DRAWING NO. 2
Legend

BT = Boring Terminated
AR = Auger Refusal

Roanoke City Public Schools
Proposed Fallon Park Elementary School Improvements
Roanoke, Virginia
**Froehling & Robertson, Inc.**

**Project No:** 62U0551  
**Client:** Roanoke City Schools  
**Project:** Fallon Park Elementary School  
**City/State:** Roanoke, VA  

**Elevation:** 974  
**Total Depth:** 6.0'  
**Drilling Method:** 2.25" ID HSA  
**Hammer Type:** Automatic  
**Date Drilled:** 3/22/17  
**Driller:** C. Ingo

---

**BORING LOG**  
**Boring:** B-1 (1 of 1)

<table>
<thead>
<tr>
<th>Elevation</th>
<th>Depth</th>
<th>Description of Materials (Classification)</th>
<th>* Sample Blows</th>
<th>Sample Depth (feet)</th>
<th>N-Value (blows/ft)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>973.8</td>
<td>0.3</td>
<td>3&quot; Surficial Soil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>FILL:</strong> Sampled as medium dense, mottled brown and gray, moist, clayey fine to coarse SAND (SC) with gravel</td>
<td>10-10-16</td>
<td>1.0</td>
<td>26</td>
<td>Subsurface water was not encountered immediately upon completion of drilling</td>
</tr>
<tr>
<td>971.0</td>
<td>3.0</td>
<td>Sampled as medium dense, mottled brown, red, and gray, moist, clayey fine to coarse SAND (SC) with gravel</td>
<td>8-7-9</td>
<td>3.5</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>968.0</td>
<td>6.0</td>
<td>Auger refusal at 6 feet</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.*
**Auger Probe**

- Auger refusal at 4 feet

**Drilling Method:** 2.25" ID HSA  
**Hammer Type:** Automatic

**Client:** Roanoke City Schools  
**Project:** Fallon Park Elementary School  
**City/State:** Roanoke, VA  
**Project No:** 62U0551  
**Elevation:** 974  
**Total Depth:** 4.0'  
**Boring Location:** Offset 5' N of B-1  
**Date Drilled:** 3/22/17

<table>
<thead>
<tr>
<th>Elevation</th>
<th>Depth</th>
<th>Description of Materials (Classification)</th>
<th>* Sample Blows</th>
<th>Sample Depth (feet)</th>
<th>N-Value (blows/ft)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>970.0</td>
<td>4.0</td>
<td>Auger Probe</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Auger refusal at 4 feet</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.*
**BORING LOG**

**Boring:** B-2  (1 of 1)

<table>
<thead>
<tr>
<th>Elevation</th>
<th>Depth</th>
<th>Description of Materials (Classification)</th>
<th>* Sample Blows</th>
<th>Sample Depth (feet)</th>
<th>N-Value (blows/ft)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>977.0</td>
<td>0.1</td>
<td>1.5&quot; Asphalt</td>
<td></td>
<td></td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>976.0</td>
<td>0.4</td>
<td>3&quot; Base Stone</td>
<td></td>
<td></td>
<td>1.4</td>
<td></td>
</tr>
<tr>
<td>974.0</td>
<td>3.0</td>
<td><strong>FILL:</strong> Sampled as medium dense, mottled gray, brown, and black, moist, clayey fine to coarse SAND (SC) with gravel</td>
<td>7-8-6</td>
<td>1.0</td>
<td>14</td>
<td>Subsurface water was not encountered immediately upon completion of drilling</td>
</tr>
<tr>
<td>971.5</td>
<td>5.5</td>
<td>Sampled as loose, brown, moist, clayey fine to coarse SAND (SC) with gravel</td>
<td>4-2-5</td>
<td>2.5</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>969.0</td>
<td>8.0</td>
<td>Sampled as dense, mottled brown, orange-brown, and gray, moist, clayey fine to coarse SAND (SC) with gravel</td>
<td>8-16-17</td>
<td>3.5</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>965.0</td>
<td>12.0</td>
<td><strong>PARTIALLY WEATHERED ROCK:</strong> Sampled as very dense, mottled brown, red, and gray, moist, silty fine to coarse SAND (SM) with rock fragments</td>
<td>31-50/5</td>
<td>6.0</td>
<td>100+</td>
<td></td>
</tr>
<tr>
<td>962.0</td>
<td>15.0</td>
<td>Sampled as very dense, gray, and yellow-brown, dry, silty fine to coarse GRAVEL (GM) with sand</td>
<td>50/6</td>
<td>8.5</td>
<td>13.5</td>
<td>Cave in at 13.7 feet</td>
</tr>
</tbody>
</table>

Auger refusal at 15 feet

---

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.*
### BORING LOG

**Elevation:** 973

**Drilling Method:** 2.25" ID HSA

**Date Drilled:** 3/21/17

**Driller:** C. Ingo

#### Project Details

- **Project No:** 62U0551
- **Client:** Roanoke City Schools
- **Project:** Fallon Park Elementary School

#### Boring Details

- **City/State:** Roanoke, VA
- **Total Depth:** 7.0'
- **Boring Location:** See Boring Location Plan

#### Boring Log

<table>
<thead>
<tr>
<th>Elevation</th>
<th>Depth</th>
<th>Description of Materials (Classification)</th>
<th>*Sample Blows</th>
<th>Sample Depth (feet)</th>
<th>N-Value (blows/ft)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>972.9</td>
<td>0.1</td>
<td>1&quot; Asphalt</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>972.8</td>
<td>0.3</td>
<td>2&quot; Base Stone</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>FILL:</strong> Sampled as medium dense to dense, mottled brown and black, moist, clayey fine to coarse SAND (SC) with gravel</td>
<td><strong>5-8-12</strong></td>
<td>1.0</td>
<td>20</td>
<td>Subsurface water was not encountered immediately upon completion of drilling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>967.5</td>
<td>5.5</td>
<td>Sampled as dense, mottled brown, red, and gray, moist, silty fine to coarse GRAVEL (GM) with sand</td>
<td><strong>11-17-14</strong></td>
<td>6.0</td>
<td>31</td>
<td>Cave in at 5.83 feet</td>
</tr>
<tr>
<td>965.5</td>
<td>7.5</td>
<td>Auger refusal at 7.5 feet</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.
**BORING LOG**

**Boring: B-3A (1 of 1)**

**Project No:** 62U0551  
**Client:** Roanoke City Schools  
**Project:** Fallon Park Elementary School  
**City/State:** Roanoke, VA  
**Total Depth:** 6.0'  
**Boring Location:** Offset 5' S from B-3  
**Date Drilled:** 3/21/17  
**Driller:** C. Ingo

<table>
<thead>
<tr>
<th>Elevation</th>
<th>Depth</th>
<th>Description of Materials (Classification)</th>
<th>* Sample Blows</th>
<th>Sample Depth (feet)</th>
<th>N-Value (blows/ft)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>967.0</td>
<td>6.0</td>
<td>Auger Probe</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Auger refusal at 6 feet</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.*
## BORING LOG

**Project No:** 62U0551  
**Client:** Roanoke City Schools  
**Project:** Fallon Park Elementary School  
**City/State:** Roanoke, VA  
**Elevation:** 972  
**Total Depth:** 6.0'  
**Drilling Method:** 2.25" ID HSA  
**Hammer Type:** Automatic  
**Date Drilled:** 3/22/17  
**Driller:** C. Ingo

<table>
<thead>
<tr>
<th>Elevation</th>
<th>Depth</th>
<th>Description of Materials (Classification)</th>
<th>*Sample Blows</th>
<th>Sample Depth (feet)</th>
<th>N-Value (blows/ft)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>971.8</td>
<td>0.2</td>
<td>2&quot; Surficial Soil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>FILL:</strong> Sampled as loose, dark brown, moist, clayey fine to coarse SAND (SC)</td>
<td>3-3-4</td>
<td>1.0</td>
<td>7</td>
<td>Subsurface water was not encountered immediately upon completion of drilling</td>
</tr>
<tr>
<td>969.0</td>
<td>3.0</td>
<td>Sampled as dense, brown and gray, moist, clayey fine to coarse SAND (SC) with rock fragments</td>
<td></td>
<td></td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>966.5</td>
<td>5.5</td>
<td><strong>PARTIALLY WEATHERED ROCK:</strong> Sampled as very dense, brown and gray, moist, silty fine to coarse SAND (SM) with gravel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>965.6</td>
<td>6.4</td>
<td>Auger refusal at 6.4 feet</td>
<td>50/5</td>
<td>6.0</td>
<td>100+</td>
<td></td>
</tr>
</tbody>
</table>

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.*
<table>
<thead>
<tr>
<th>Elevation</th>
<th>Depth</th>
<th>Description of Materials (Classification)</th>
<th>Sample Blows</th>
<th>Sample Depth (feet)</th>
<th>N-Value (blows/ft)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>966.0</td>
<td>6.0</td>
<td>Auger Probe</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Subsurface water was not encountered immediately upon completion of drilling.

Auger refusal at 6 feet

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.
**Elevation:** 977

**Drilling Method:** 2.25" ID HSA

**Hammer Type:** Automatic

**Date Drilled:** 3/21/17

**Driller:** C. Ingo

**Description of Materials (Classification):**

<table>
<thead>
<tr>
<th>Elevation</th>
<th>Depth</th>
<th>Description of Materials (Classification)</th>
<th>* Sample Blows</th>
<th>Sample Depth (feet)</th>
<th>N-Value (blows/ft)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>976.8 -</td>
<td>0.2</td>
<td><strong>2&quot; Surficial Soil</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>976.8 -</td>
<td>0.2</td>
<td><strong>FILL:</strong> Sampled as medium dense, mottled as brown, gray, and black, moist, clayey fine to coarse SAND (SC) with gravel.</td>
<td>6-10-19</td>
<td>1.0</td>
<td>29</td>
<td>Subsurface water was not encountered immediately upon completion of drilling</td>
</tr>
<tr>
<td>974.0 -</td>
<td>3.0</td>
<td>Sampled as dense, brown and gray, moist, silty fine to coarse SAND (SM) with rock fragments</td>
<td>9-33-10</td>
<td>3.5</td>
<td>43</td>
<td>Cave in at 4.7 feet</td>
</tr>
<tr>
<td>972.0 -</td>
<td>5.0</td>
<td>Auger refusal at 5 feet</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.*
# BORING LOG

**Boring:** B-5A (1 of 1)

**Project No:** 62U0551  
**Client:** Roanoke City Schools  
**Project:** Fallon Park Elementary School  
**City/State:** Roanoke, VA  
**Elevation:** 977  
**Total Depth:** 5.0'  
**Drilling Method:** 2.25" ID HSA  
**Hammer Type:** Automatic  
**Date Drilled:** 3/21/17  
**Driller:** C. Ingo

<table>
<thead>
<tr>
<th>Elevation</th>
<th>Depth</th>
<th>Description of Materials (Classification)</th>
<th>* Sample Blows</th>
<th>Sample Depth (feet)</th>
<th>N-Value (blows/ft)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>972.0</td>
<td>5.0</td>
<td>Auger Probe</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Auger refusal at 5 feet</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.*
### Boring Log

**Project No:** 62U0551  
**Client:** Roanoke City Schools  
**Project:** Fallon Park Elementary School  
**City/State:** Roanoke, VA  
**Elevation:** 965  
**Total Depth:** 5.0'  
**Drilling Method:** 2.25" ID HSA  
**Hammer Type:** Automatic  
**Date Drilled:** 3/21/17  
**Driller:** C. Ingo

#### Boring Location: See Boring Location Plan

<table>
<thead>
<tr>
<th>Elevation</th>
<th>Depth</th>
<th>Description of Materials (Classification)</th>
<th>* Sample Blows</th>
<th>Sample Depth (feet)</th>
<th>N-Value (blows/ft)</th>
<th>Remarks</th>
</tr>
</thead>
</table>
| 964.7     | 0.3   | 4" Surficial Soil  
**RESIDUUM:** Medium dense, mottled orange-brown, brown, light brown, and black, moist, fine to coarse SAND (SW) with gravel | 6-8-17 | 1.0 | 25 | Subsurface water was not encountered immediately upon completion of drilling |
| 962.0     | 3.0   | **PARTIALLY WEATHERED ROCK:** Sampled as very dense, mottled light brown and dark brown, moist, clayey fine to coarse SAND (SC) | 50/1 | 3.5 | 100+ | |
| 960.0     | 5.0   | Auger refusal at 5 feet | | | | |

---

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.*
**Project No:** 62U0551  
**Client:** Roanoke City Schools  
**Project:** Fallon Park Elementary School  
**City/State:** Roanoke, VA  

**Elevation:** 965  
**Total Depth:** 6.0'  
**Drilling Method:** 2.25" ID HSA  
**Hammer Type:** Automatic  
**Date Drilled:** 3/21/17  
**Driller:** C. Ingo

### BORING LOG

<table>
<thead>
<tr>
<th>Elevation</th>
<th>Depth</th>
<th>Description of Materials (Classification)</th>
<th>* Sample Blows</th>
<th>Sample Depth (feet)</th>
<th>N-Value (blows/ft)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>959.0</td>
<td>6.0</td>
<td>Auger Probe</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6” increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.*
<table>
<thead>
<tr>
<th>Elevation</th>
<th>Depth</th>
<th>Description of Materials (Classification)</th>
<th>* Sample Blows</th>
<th>Sample Depth (feet)</th>
<th>N-Value (blows/ft)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>976.8</td>
<td>0.3</td>
<td>3&quot; Surficial Soil</td>
<td>4-7-7</td>
<td>1.0</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>FILL:</strong> Sampled as medium dense, mottled gray and brown, moist, clayey fine to coarse SAND (SC) with gravel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>971.5</td>
<td>5.5</td>
<td><strong>POSSIBLE ALLUVIUM:</strong> Firm, brown, moist, sandy CLAY (CL)</td>
<td>5-4-3</td>
<td>6.0</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>969.0</td>
<td>8.0</td>
<td><strong>RESIDUUM:</strong> Dense, mottled gray-brown, brown, maroon, moist, clayey fine to coarse SAND (SC) with gravel</td>
<td>12-17-19</td>
<td>8.5</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>965.0</td>
<td>12.0</td>
<td><strong>PARTIALLY WEATHERED ROCK:</strong> Sampled as very dense, maroon and brown, moist, fine to coarse SAND (SW) with clay and gravel</td>
<td>38-50/3</td>
<td>13.5</td>
<td>100+</td>
<td>Cave in at 14.7 feet</td>
</tr>
<tr>
<td>961.0</td>
<td>16.0</td>
<td>Boring terminated at 16 feet</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Subsurface water was not encountered immediately upon completion of drilling.

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.
<table>
<thead>
<tr>
<th>Elevation</th>
<th>Depth</th>
<th>Description of Materials (Classification)</th>
<th>* Sample Blows</th>
<th>Sample Depth (feet)</th>
<th>N-Value (blows/ft)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>971.8</td>
<td>0.3</td>
<td>3&quot; Surficial Soil</td>
<td>4-4-4</td>
<td>1.0</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>RESIDUUM</strong>: Loose, mottled orange-brown and gray, moist, clayey fine to coarse SAND (SC)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>969.0</td>
<td>3.0</td>
<td>Loose, mottled orange-brown and gray, moist, silty fine to coarse SAND (SM)</td>
<td>4-3-4</td>
<td>3.5</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>964.0</td>
<td>8.0</td>
<td>Very loose, orange-brown, moist, clayey fine to coarse SAND (SC)</td>
<td>3-2-1</td>
<td>8.5</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>960.0</td>
<td>12.0</td>
<td>Medium dense, mottled orange-brown and gray, moist, clayey fine to coarse SAND (SC) with gravel</td>
<td>10-11-14</td>
<td>13.5</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>955.0</td>
<td>17.0</td>
<td>Medium dense, mottled orange-brown and gray, moist, fine to coarse SAND (SW) with clay and gravel</td>
<td>4-6-8</td>
<td>18.5</td>
<td>14</td>
<td>Cave in at 18.1 feet</td>
</tr>
<tr>
<td>952.0</td>
<td>20.0</td>
<td>Boring terminated at 20 feet</td>
<td></td>
<td>20.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.
<table>
<thead>
<tr>
<th>Boring/Sample No.</th>
<th>Depth (ft)</th>
<th>LL</th>
<th>PL</th>
<th>PI</th>
<th>Water Content (%)</th>
<th>% Gravel</th>
<th>% Sand</th>
<th>% Fines</th>
<th>USCS Class.</th>
<th>AASHTO Class.</th>
<th>Maximum Dry Density (pcf)</th>
<th>Optimum Water Content (%)</th>
<th>CBR Value @ 0.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-7</td>
<td>6.0</td>
<td>34</td>
<td>18</td>
<td>16</td>
<td>19.1</td>
<td>0.0</td>
<td>32.0</td>
<td>68.0</td>
<td>CL</td>
<td>A-6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-8</td>
<td>1.0</td>
<td>33</td>
<td>23</td>
<td>10</td>
<td>20.0</td>
<td>9.0</td>
<td>42.0</td>
<td>49.0</td>
<td>SC</td>
<td>A-4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Project No: 62U0551
Client: Roanoke City Schools
Project: Fallon Park Elementary School
City/State: Roanoke, VA

---

<table>
<thead>
<tr>
<th>Boring No.</th>
<th>Depth</th>
<th>LL</th>
<th>PL</th>
<th>PI</th>
<th>Fines</th>
<th>Classification</th>
<th>% Natural Water Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>● B-7</td>
<td>at 6.0</td>
<td>34</td>
<td>18</td>
<td>16</td>
<td>68</td>
<td>SANDY LEAN CLAY (CL),(A-6)</td>
<td>19.1</td>
</tr>
<tr>
<td>□ B-8</td>
<td>at 1.0</td>
<td>33</td>
<td>23</td>
<td>10</td>
<td>49</td>
<td>CLAYEY SAND (SC),(A-4)</td>
<td>20.0</td>
</tr>
</tbody>
</table>
APPENDIX C
Roanoke City Public Schools
Proposed Fallon Park Elementary School Improvements
Roanoke, Virginia

SELECT GRANULAR BACKFILL

Soil to Rock Transition

SELECT GRANULAR BACKFILL

Isolated Rock Pinnacle

FROEHLING & ROBERTSON, INC.
Engineering Stability Since 1881
1734 Seibel Drive, NE
Roanoke, Virginia 24012-5624 | USA
T 540.344.7939 | F 540.344.3657

DATE: April 2017
SCALE: Not to scale
DRAWN: EKP 62U0551

DRAWING NO. 4
F&R Project No.: 62U0551

Roanoke City Public Schools
40 Douglass Avenue NW
Roanoke, Virginia 24012
c/o Mr. Mark Ayles, Hughes and Associates

Attention: Mr. Steve Barnett

Subject: Report of Supplemental Drilling Services
Proposed Fallon Park Elementary School Improvements
Roanoke, Virginia

Mr. Barnett:

Froehling & Robertson, Inc. is pleased to submit this report of contract drilling and boring log preparation for the above referenced project. These services were provided in general accordance with F&R Proposal Number 1862-00253 dated September 2017. This report has been developed on the basis of information provided by Roanoke City Public School (RCPS), Hughes and Associates, and our experience with similar projects.

We understand that RCPS is planning improvements to Fallon Park Elementary School located at 502 19th Street SE, Roanoke, Virginia (See Site Vicinity Map, Drawing No. 1). Included in the provided information was a demolition plan entitled, “NEW FACILITY FOR FALLON PARK ELEMENTARY SCHOOL, Sheet SP-2” by Hughes Associates Architects and Engineers, dated July 27, 2017, showing nine requested boring locations. F&R was requested to advance auger probe borings at these locations to identify potential near surface rock.

The subsurface exploration program consisted of nine test borings (designated as P-1 through P-9). The exploration was performed on 25 through 26 September 2017 at the approximate locations shown on the attached Boring Location Plan (Drawing No. 2). The planned boring locations were determined and staked in the field by F&R by measuring from existing site features such as building corners, edges of pavement, etc. In consideration of the methods used in their determination, the boring locations shown on the attached Boring Location Plan should be considered approximate. Auger probe borings were advanced to depth ranging between 7 and 29 feet below the existing ground surface. Auger refusal was encountered in Borings P-3 and P-4 at depths of 10 feet. Auger refusal occurs when hard or very dense materials are encountered that the augers cannot penetrate. Auger skewing was encountered in Boring P-1 at a depth of 7 feet. Auger skewing occurs when the augers veer off of encountered dense materials to the point where further advancement is not possible.
The auger probe borings were performed in accordance with generally accepted practice using a track-mounted CME 55 rotary drill rig equipped with an automatic hammer. Borings were advanced primarily with auger probes only. At one location (Boring P-9) SPT sampling was performed to evaluate potential soft materials. Hollow-stem augers were advanced to pre-selected depths, the center plug was removed, and representative soil samples were recovered with a standard split-spoon sampler (1 3/8 in. ID, 2 in. OD) in general accordance with ASTM D 1586, the Standard Penetration Test. In this test, a weight of 140 pounds is freely dropped from a height of 30 inches to drive the split-spoon sampler into the soil. The number of blows required to drive the split-spoon sampler three consecutive 6-inch increments is recorded, and the blows of the last two increments are summed to obtain the Standard Penetration Resistance (N-value). The N-values provide a general indication of in-situ soil conditions and have been correlated with certain engineering properties of soils.

An automatic hammer was used to perform the Standard Penetration Test (SPT) on this project. Research has shown that the Standard Penetration Resistance (N-value) determined by an automatic hammer is different than the N-value determined by the safety hammer method. Most correlations that are published in the technical literature are based on the N-value determined by the safety hammer method. This is commonly termed N_{60} as the rope and cathead with a safety hammer delivers about 60 percent of the theoretical energy delivered by a 140-pound hammer falling 30 inches. Several researchers have proposed correction factors for the use of hammers other than the safety hammer to correct the values to be equivalent to the safety hammer SPT N_{60}-values. The correction is made using the following equation:

\[ N_{60} = N_{\text{field}} \times C_E \]

\( N_{\text{field}} \) in the equation above is the SPT N-value as recorded with the equipment utilized in the field, and for our use of this equation, \( C_E \) a relative hammer efficiency ratio, i.e. our automatic hammer efficiency (specifically 90% for the track-mounted drill rig used on this project) divided by the theoretical \( N_{60} \) efficiency (60%). Accordingly, we recommend a correction factor \( (C_E) \) of approximately 1.49 for conversion of the recorded \( N_{\text{field}} \) values to normalized \( N_{60} \) values for the automatic hammer used on this project. We note that the N-values reported on the Boring Logs included in this report are the actual, uncorrected, field derived N-values (\( N_{\text{field}} \)).

A subsurface water level reading was taken in the borings immediately upon completion of the soil drilling process. Upon completion of drilling, the boreholes were backfilled with auger cuttings (soil) and capped with asphalt cold patch as applicable. Periodic observation of the boreholes should be performed to monitor subsidence at the ground surface, as the borehole backfill could settle over time.

The split-spoon soil sample obtained in the exploration program was classified by a member of our professional staff in general accordance with techniques outlined in the visual-manual identification procedure (ASTM D 2488) and the Unified Soil Classification System. Copies of the boring logs are provided and classification procedures are further explained in the attachments to this letter.
Summary of Observed Subsurface Conditions

In Boring B-1 we observed rocky drilling at 6 feet and the auger skewed (on a possible rock pinnacle or large boulder) at 7 feet.

In Boring B-2 we drilled to 15 feet without encountering auger refusal.

In Borings B-3 and B-4 we encountered auger refusal at 10 feet.

In Borings B-5, B-6, B-7, B-8, and B-9 we observed “rocky” drilling conditions (probably due to rocks and small boulders in the soil matrix), but we were able to auger through it. We did not encounter auger refusal on mass rock within 20 feet in Borings B-5, B-6, B-7, and B-9. We did not encounter auger refusal on mass rock within 29 feet in Boring B-8. We advanced the borings to 20 feet, or 29 feet, because several of the borings hit soft/loose material at 15 to 19 feet.

In Boring B-9 we performed SPT boring techniques from 18.5 to 20 feet to obtain an N-value and a soil sample for inspection of the potentially soft/loose material. From the N-value the consistency of the material was not as loose as we anticipated. The sample was visually classified as dense, mottled orange-brown, moist, silt fine to coarse SAND (SM) with gravel.

If and where subsurface water was encountered in the test borings, it is indicated on the attached boring logs. The subsurface conditions shown on the boring logs represent an estimate of the subsurface conditions based on interpretation of the boring data using normally accepted geotechnical engineering judgments. The transitions between different soil strata are usually less distinct than those shown on the boring logs.

The boring logs attached to this letter have been prepared for the exclusive use of RCPS or their agent for specific application to the proposed Fallon Park Elementary School Improvements project in Roanoke, Virginia. Designers should consider the effect of any earthwork that changes site elevations from those present at the time of our exploration. Our scope of services did not include the identification and evaluation of environmental aspects of the project site. No other warranty, express or implied, is made. The provided boring logs were developed as a record of drilling. F&R, Inc. claims no responsibility for the conclusions, opinions, and/or recommendations made by others based on these data.
We appreciate the opportunity to provide contract drilling and boring log preparation services for you on this project. If you have additional questions, please do not hesitate to call.

Sincerely,

FROEHLING & ROBERTSON, INC.

For
Erin K. Phillips, M.S., E.I.T.
Staff Engineer

Stephen D. Hjelle, M.S., P.E.
Geotechnical Department Manager

Attachments:
- Site Vicinity Map
- Classification of Soils for Engineering Purposes
- Key to Boring Log Soil Classification
- Soil Classification Chart
- Boring Location Plan
- Boring Logs (9)

Distribution: Addressee (1 original/1 digital copy via mayles@hughesae.com)
Adapted from the USGS 7.5 minute series topographic quadrangle:
Roanoke, VA (1984)
## Classification of Soils for Engineering Purposes

**ASTM Designation: D 2487**

(Based on the Unified Soil Classification System)

### Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests

| Soil Classification | Group Symbol | Group Name
|--------------------|-------------|-------------
| COARSE-GRAINED SOILS | GW | Well-graded gravel
| | GP | Poorly graded gravel
| | GM | Silty gravel
| | GC | Clayey gravel
| | SW | Well-graded sand
| | SP | Poorly graded sand
| | SM | Silty sand
| | SC | Clayey sand

| FINE-GRAINED SOILS | ML | Silty
| OH | Organic

| HIGHLY ORGANIC SOILS | PT | Peat

**FROELING & ROBERTSON, INC.**

*Engineering Stability Since 1881*

---

### Laboratory Tests

#### A Based on the material passing the 3-in. (75-mm) sieve.

#### B If fines classify as CL or CH

#### C If soil contains ≥ 30 % plus No. 200, add "with gravel" to group name.

#### D If soil contains ≥ 15 % gravel, add "with gravel" to group name.

#### E If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.

#### F If soil contains ≥ 15 % sand, add "with sand" to group name.

#### G PI plots below "A" line.

#### H PI plots on or above "A" line.

#### I If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

#### J If PI > 7 and plots on or above "A" line

#### K If PI < 4 or plots below "A" line

#### L If fines classify as ML or MH

#### M If fines classify as CL or CH

#### N PI ≥ 4 and plots on or above "A" line

---

### Grain Size Analysis

<table>
<thead>
<tr>
<th>Group Name</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>GW</td>
<td>Well-graded gravel</td>
</tr>
<tr>
<td>GP</td>
<td>Poorly graded gravel</td>
</tr>
<tr>
<td>GM</td>
<td>Silty gravel</td>
</tr>
<tr>
<td>GC</td>
<td>Clayey gravel</td>
</tr>
<tr>
<td>SW</td>
<td>Well-graded sand</td>
</tr>
<tr>
<td>SP</td>
<td>Poorly graded sand</td>
</tr>
<tr>
<td>SM</td>
<td>Silty sand</td>
</tr>
<tr>
<td>SC</td>
<td>Clayey sand</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group Name</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML</td>
<td>Silty</td>
</tr>
<tr>
<td>OL</td>
<td>Organic</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Group Name</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT</td>
<td>Peat</td>
</tr>
</tbody>
</table>

---

### Grain Size Distribution

- **Gravels** (More than 50% of coarse fraction retained on No. 4 sieve)
- **Sands** (50% or more of coarse fraction passes No. 4 sieve)
- **Clean Sands** (Less than 5% fines)
- **Gravels with fines** (More than 12% fines)
- **Silts and Clays** (Liquid limit less than 50)
- **Sands with fines** (More than 12% fines)

### Inorganic

- Liquid limit − oven dried
- Liquid limit − not dried

### Organic

- Liquid limit − oven dried
- Liquid limit − not dried

### Calculations

- \( C_u = \frac{D_60}{D_{10}} \)
- \( C_c = \frac{D_{30}}{D_{60} \times D_{10}} \)

---

### Additional Information

- More than 50% retained on the No. 200 sieve:
  - Gravels
  - Sands

- 50% or more passes the No. 200 sieve:
  - Silts and Clays

---

*For classification of fine-grained soils and fine-grained fraction of coarse-grained soils:

- **CL**
- **ML**
- **CH**
- **OH**

*Based on the Unified Soil Classification System*
KEY TO BORING LOG SOIL CLASSIFICATION

Particle Size and Proportion

Visual descriptions are assigned to each soil sample or stratum based on estimates of the particle size of each component of the soil and the percentage of each component of the soil.

<table>
<thead>
<tr>
<th>Boulder</th>
<th>Cobble</th>
<th>Gravel</th>
<th>Sand</th>
<th>Silt</th>
<th>Clay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pass</td>
<td>12 in.</td>
<td>3 in.</td>
<td>3/4 in.</td>
<td>#4 M</td>
<td>#200 M</td>
</tr>
<tr>
<td>Retained</td>
<td>12 in.</td>
<td>3 in.</td>
<td>3/4 in.</td>
<td>#4 M</td>
<td>#200 M</td>
</tr>
</tbody>
</table>

Notes: 1.) Particle size is designated by U.S. Standard Sieve Sizes 2.) Because of the small size of the split-spoon sampler relative to the size of gravel, the true percentage of gravel may not be accurately estimated.

<table>
<thead>
<tr>
<th>&lt; 50% Fines (-200 Mesh)</th>
<th>&gt; 50% Fines (-200 Mesh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comp.</td>
<td>Term</td>
</tr>
<tr>
<td>Major</td>
<td>Uppercase Letters (GRAVEL, SAND)</td>
</tr>
<tr>
<td>Secondary</td>
<td>With sand/gravel Adjective (Clayey, Silty)</td>
</tr>
<tr>
<td>Minor</td>
<td>With clay/silt Do Not Note</td>
</tr>
</tbody>
</table>

Density or Consistency

The standard penetration resistance values (N-values) are used to describe the density of coarse-grained soils (GRAVEL, SAND) or the consistency of fine-grained soils (SILT, CLAY). Sandy silts of very low plasticity may be assigned a density instead of a consistency.

<table>
<thead>
<tr>
<th>DENSITY</th>
<th>CONSISTENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Term</td>
<td>N-Value</td>
</tr>
<tr>
<td>Very Loose</td>
<td>0 - 4</td>
</tr>
<tr>
<td>Loose</td>
<td>5 - 10</td>
</tr>
<tr>
<td>Medium Dense</td>
<td>11 - 30</td>
</tr>
<tr>
<td>Dense</td>
<td>31 - 50</td>
</tr>
<tr>
<td>Very Dense</td>
<td>&gt; 50</td>
</tr>
<tr>
<td>Do Not Note</td>
<td></td>
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</tbody>
</table>

Notes: 1. The N-value is the number of blows of a 140 lb. Hammer freely falling 30 inches required to drive a standard split-spoon sampler (2.0 in. O.D., 1-3/8 in. I.D.) 12 inches into the soil after properly seating the sampler 6 inches. 2. When encountered, gravel may increase the N-value of the standard penetration test and may not accurately represent the in-situ density or consistency of the soil sampled.
### Soil Classification Chart

<table>
<thead>
<tr>
<th>Major Divisions</th>
<th>Symbols</th>
<th>Typical Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COARSE GRAINED SOILS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Gravel and Gravelly Soils</em></td>
<td>GW</td>
<td>Well-graded gravels, gravel - sand mixtures, little or no fines</td>
</tr>
<tr>
<td>More than 50% of coarse fraction</td>
<td>GP</td>
<td>Poorly-graded gravels, gravel - sand mixtures, little or no fines</td>
</tr>
<tr>
<td>retained on No. 4 sieve</td>
<td>GM</td>
<td>Silty gravels, gravel - sand - silt mixtures</td>
</tr>
<tr>
<td><em>Gravels with Fines</em></td>
<td>GC</td>
<td>Clamey gravels, gravel - sand - clay mixtures</td>
</tr>
<tr>
<td><em>Sand and Sandy Soils</em></td>
<td>SW</td>
<td>Well-graded sands, gravelly sands, little or no fines</td>
</tr>
<tr>
<td>More than 50% of coarse fraction</td>
<td>SP</td>
<td>Poorly-graded sands, gravelly sand, little or no fines</td>
</tr>
<tr>
<td>retained on No. 4 sieve</td>
<td>SM</td>
<td>Silty sands, sand - silt mixtures</td>
</tr>
<tr>
<td><em>Sands with Fines</em></td>
<td>SC</td>
<td>Clamey sands, sand - clay mixtures</td>
</tr>
<tr>
<td><strong>FINE GRAINED SOILS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Silts and Clays</em></td>
<td>ML</td>
<td>Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey</td>
</tr>
<tr>
<td>Liquid limit less than 50</td>
<td>CL</td>
<td>Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>lean clays</td>
</tr>
<tr>
<td><em>Silts and Clays</em></td>
<td>OL</td>
<td>Organic silts and organic silty clays of low plasticity</td>
</tr>
<tr>
<td>More than 50% of material is</td>
<td>MH</td>
<td>Inorganic silts, micaceous or diatomaceous fine sand or silty soils</td>
</tr>
<tr>
<td>smaller than No. 200 sieve size</td>
<td>CH</td>
<td>Inorganic clays of high plasticity</td>
</tr>
<tr>
<td>Liquid limit greater than 50</td>
<td>OH</td>
<td>Organic clays of medium to high plasticity, organic silts</td>
</tr>
<tr>
<td><strong>EXISTING FILL</strong></td>
<td>FILL</td>
<td>Existing fill materials</td>
</tr>
</tbody>
</table>
Adapted from provided site plan entitled “NEW FACILITY FOR FALLON PARK ELEMENTARY SCHOOL, DEMOLITION PLAN, Sheet SP-2” by Hughes Associates Architects and Engineers, dated July 27, 2017.
Auger probe only

Boring terminated at 7 feet due to skewing

Subsurface water was not encountered immediately upon completion of drilling

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.
**BORING LOG**

**Boring: P-2 (1 of 1)**

<table>
<thead>
<tr>
<th>Elevation</th>
<th>Depth</th>
<th>Description of Materials (Classification)</th>
<th>* Sample Blows</th>
<th>Sample Depth (feet)</th>
<th>N-Value (blows/ft)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>Auger probe only</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.0</td>
<td>Boring terminated at 15 feet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.*
**Project No:** 62U0551  
**Client:** Roanoke City Schools  
**Project:** Fallon Park Elementary School  
**City/State:** Roanoke, VA

**Elevation:**
**Total Depth:** 10.0’

**Drilling Method:** 2.25” ID HSA  
**Hammer Type:** Automatic  
**Date Drilled:** 9/26/17  
**Driller:** B. Maxson

**Description of Materials (Classification):**
- Auger probe only
- Auger refusal at 10 feet

**Remarks:**
Subsurface water was not encountered immediately upon completion of drilling.

-N-Value = Number of blows required for a 140 lb hammer dropping 30” to drive 2” O.D., 1.375” I.D. sampler a total of 18 inches in three 6” increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.
**Project No:** 62U0551  
**Client:** Roanoke City Schools  
**Project:** Fallon Park Elementary School  
**City/State:** Roanoke, VA

**Total Depth:** 10.0'  
**Date Drilled:** 9/26/17  
**Driller:** B. Maxson

**Drilling Method:** 2.25" ID HSA  
**Hammer Type:** Automatic

**Elevation:**  
10.0  

**Remarks:**  
Subsurface water was not encountered immediately upon completion of drilling

### BORING LOG

<table>
<thead>
<tr>
<th>Elevation</th>
<th>Depth</th>
<th>Description of Materials (Classification)</th>
<th>* Sample Blows</th>
<th>Sample Depth (feet)</th>
<th>N-Value (blows/ft)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.0</td>
<td></td>
<td>Auger refusal at 10 feet</td>
<td></td>
<td></td>
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<td></td>
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</tbody>
</table>

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.*
**Project No:** 62U0551  
**Client:** Roanoke City Schools  
**Project:** Fallon Park Elementary School  
**City/State:** Roanoke, VA

**Elevation:**  
**Total Depth:** 20.0'  
**Drilling Method:** 2.25" ID HSA  
**Hammer Type:** Automatic  
**Date Drilled:** 9/25/17  
**Driller:** B. Maxson

---

<table>
<thead>
<tr>
<th>Elevation</th>
<th>Description of Materials (Classification)</th>
<th>Sample Depth (feet)</th>
<th>N-Value (blows/ft)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>1.75&quot; Asphalt</td>
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<tr>
<td>0.6</td>
<td>6&quot; Aggregate Base Course</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Auger probe only</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.0</td>
<td>Boring terminated at 20 feet</td>
<td></td>
<td></td>
<td></td>
</tr>
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</table>

Subsurface water was not encountered immediately upon completion of drilling.

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.*
**BORING LOG**

**Boring:** P-6 (1 of 1)

---

**Project No:** 62U0551  
**Client:** Roanoke City Schools  
**Project:** Fallon Park Elementary School  
**City/State:** Roanoke, VA  
**Elevation:**  
**Total Depth:** 20.0'  
**Drilling Method:** 2.25" ID HSA  
**Hammer Type:** Automatic  
**Date Drilled:** 9/25/17  
**Driller:** B. Maxson

---

<table>
<thead>
<tr>
<th>Elevation</th>
<th>Depth</th>
<th>Description of Materials (Classification)</th>
<th>* Sample Blows</th>
<th>Sample Depth (feet)</th>
<th>N-Value (blows/ft)</th>
<th>Remarks</th>
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</thead>
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<tr>
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<tr>
<td>0.9</td>
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<td>7&quot; Aggregate Base Course</td>
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<td></td>
<td></td>
<td>Auger probe only</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.0</td>
<td></td>
<td>Boring terminated at 20 feet</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

Subsurface water was not encountered immediately upon completion of drilling.

---

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.*
**BORING LOG**

**Boring:** P-7 (1 of 1)

<table>
<thead>
<tr>
<th>Depth (feet)</th>
<th>Description of Materials (Classification)</th>
<th>Sample Blows (blows/ft)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3</td>
<td>4&quot; Asphalt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.5</td>
<td>2&quot; Aggregate Base Course</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Auger probe only</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.0</td>
<td>Boring terminated at 20 feet</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Remarks:**
Subsurface water was not encountered immediately upon completion of drilling.

---

"Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value."
**BORING LOG**

**Boring:** P-8 (1 of 1)

**Project No:** 62U0551  
**Client:** Roanoke City Schools  
**Project:** Fallon Park Elementary School  
**City/State:** Roanoke, VA

**Elevation:**  
**Total Depth:** 29.0'  
**Drilling Method:** 2.25" ID HSA  
**Hammer Type:** Automatic  
**Date Drilled:** 9/25/17  
**Driller:** B. Maxson

**Elevation** | **Depth** | **Description of Materials (Classification)** | *** Sample Blows** | **Sample Depth (feet)** | **N-Value (blows/ft)** | **Remarks**  
--- | --- | --- | --- | --- | --- | ---  
| | | 3" Asphalt | | | |  
| | | 5" Aggregate Base Course | | | |  
| | | Auger probe only | | | |  

Subsurface water was not encountered immediately upon completion of drilling.

*Number of blows required for a 140 lb hammer dropping 30” to drive 2” O.D., 1.375” I.D. sampler a total of 18 inches in three 6” increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.*
**BORING LOG**

**Boring:** P-9  (1 of 1)

**Client:** Roanoke City Schools  
**Project:** Fallon Park Elementary School  
**City/State:** Roanoke, VA

**Project No:** 62U0551  
**Elevation:**  
**Total Depth:** 20.0'  
**Drilling Method:** 2.25" ID HSA  
**Hammer Type:** Automatic  
**Date Drilled:** 9/25/17  
**Driller:** B. Maxson  

<table>
<thead>
<tr>
<th>Elevation</th>
<th>Depth</th>
<th>Description of Materials (Classification)</th>
<th>* Sample Blows</th>
<th>Sample Depth (feet)</th>
<th>N-Value (blows/ft)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>0.6</td>
<td>1.5&quot; Asphalt</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>6&quot; Aggregate Base Course</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Auger probe only</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18.5</td>
<td></td>
<td><strong>RESIDUUM:</strong> Dense, mottled orange-brown,</td>
<td>5-10-21</td>
<td>18.5</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>moist, silty fine to coarse SAND (SM) with</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>gravel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.0</td>
<td></td>
<td>Boring terminated at 20 feet</td>
<td></td>
<td>20.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Remarks*

Subsurface water was not encountered immediately upon completion of drilling.

---

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.
Fallon Park ES
Approval Drawing Package
Factory Order #: Q-35817
04/09/2018

Contractor/Installer:
H & M ELECTRIC

Consulting Engineer:
ASCENT

David Vest
Sales Representative

Gary Price
Project Manager
North American Operating Division
gary.price@schneiderelectric.com
BILL OF MATERIALS AND DRAWINGS
<table>
<thead>
<tr>
<th>Seq #</th>
<th>Qty</th>
<th>Product Description</th>
</tr>
</thead>
</table>
| 15   | 1   | **Designation**: HM3  
Panelboards  
**Product Details**  
1-NF ML Panel (INTERIOR)-NF Panelboard  
Consisting of  
480Y/277V 3Ph 4W 60Hz  SCCR: 18kA  
Fully Rated  
Main Lug Only: 125A  
Incoming Conductors: 1 - #6 - 2/0 AWG  
Bus: Copper: Silver/Tin Plated  
CU Ground Bar  
30 Circuit Interior  
Type 1,Box: 32H x 20W x 5.75D  
Incoming: Top Trim: Surface - Hinged  
Box Cat No: MH32 Front Cat No: NC32SHR  
Ref. Drawing: PBA550HR  
Feeders:  
18 - 20A/1P EDB  
2 - 15A/3P EDB  
1 - 30A/3P EDB  
1 - 45A/3P EDB  
Optional Features:  
Standard Panel (Box Ahead),Copper Solid  
Neutral,Copper Ground Bar  
Branch User Placement  
**1-MH32-PANELBOARD ENCLOSURE/BOX TYPE 1 32H 20W**  
MH32  
**PANELBOARD ENCLOSURE/BOX TYPE 1 32H 20W**  
**1-NC32SHR-PNLBD COVER/TRIM NF T-1 S 32H 20W**  
NC32SHR  
PNLBD COVER/TRIM NF T-1 S 32H 20W |
| 16   | 1   | **Designation**: HM4  
Panelboards  
**Product Details**  
1-NF ML Panel (INTERIOR)-NF Panelboard  
Consisting of  
480Y/277V 3Ph 4W 60Hz  SCCR: 25kA  
Fully Rated  
Main Lug Only: 400A  
Main Acc. Feed Thru Lugs  
Incoming Conductors: 1 - 1/0 - 750, (2) 1/0 - 350 kcmil  
Bus: Copper: Silver/Tin Plated  
CU Ground Bar  
42 Circuit Interior  
Type 1,Box: 62H x 20W x 5.75D  
Incoming: Bottom Trim: Surface - Hinged  
Box Cat No: MH62 Front Cat No: NC62VSHR  
Ref. Drawing: PBA551HR  
Feeders:  
2 - 45A/3P EGB  
4 - 15A/3P EGB  
24 - 20A/1P EGB  
Optional Features:  
Standard Panel (Box Ahead),Copper Solid  
Neutral,Copper Ground Bar  
Branch User Placement  
**1-MH62-PANELBOARD ENCLOSURE/BOX TYPE 1 62H 20W**  
MH62  
**PANELBOARD ENCLOSURE/BOX TYPE 1 62H 20W**  
**1-NC62VSHR-PNLBD COVER/TRIM NF T-1 S 62H 20W**  
NC62VSHR  
PNLBD COVER/TRIM NF T-1 S 62H 20W |
<table>
<thead>
<tr>
<th>Seq #</th>
<th>Qty</th>
<th>Product Description</th>
</tr>
</thead>
</table>
| 19   | 1   | **Designation**: LM2 Panelboards  
**Product Details**:  
1-NQ ML Panel (INTERIOR)-NQ Panelboard  
Consisting of:  
208V/120V 3Ph 4W 60Hz  
SCCR: 10kA  
Fully Rated  
Main Lug Only: 400A  
Incoming Conductors: 1 - 1/0 - 750, (2) 1/0 - 350 kcmil  
Bus: Copper; Silver/Tin Plated  
CU Ground Bar  
54 Circuit Interior  
Type 1, Box: 56H x 20W x 5.75D  
Incoming: Top Trim: Surface - Hinged  
Box Cat No: MH56 Front Cat No: NC56VSHR  
Ref. Drawing: PBA709HR  
**Feeders**:  
26 - 20A/1P QOB  
7 - 20A/2P QOB  
1 - 40A/2P QOB  
2 - 20A/3P QOB  
2 - 60A/2P QOB  
1 - 50A/2P QOB  
**Optional Features**:  
Standard Panel (Box Ahead), Copper Solid  
Neutral, Copper Ground Bar  
Branch User Placement  
1-MH56-PANELBOARD ENCLOSURE/BOX TYPE 1 56H 20W  
MH56 PANELBOARD ENCLOSURE/BOX TYPE 1 56H 20W  
1-NC56VSHR-PNLBD COVER/TRIM NF T-1 S 56H 20W  
NC56VSHR PNLBD COVER/TRIM NF T-1 S 56H 20W |
| 20   | 1   | **Designation**: LM3 Panelboards  
**Product Details**:  
1-NQ ML Panel (INTERIOR)-NQ Panelboard  
Consisting of:  
208V/120V 3Ph 4W 60Hz  
SCCR: 10kA  
Fully Rated  
Main Lug Only: 225A  
Main Acc: Feed Thru Lugs  
Incoming Conductors: 1 - #6 - 350 kcmil  
Bus: Copper; Silver/Tin Plated  
CU Ground Bar  
42 Circuit Interior  
Type 1, Box: 38H x 20W x 5.75D  
Incoming: Bottom Trim: Surface - Hinged  
Box Cat No: MH38 Front Cat No: NC38VSHR  
Ref. Drawing: PBA701HR  
**Feeders**:  
6 - 20A/2P QOB  
30 - 20A/1P QOB  
**Optional Features**:  
Standard Panel (Box Ahead), Copper Solid  
Neutral, Copper Ground Bar  
Branch User Placement  
1-MH38-PANELBOARD ENCLOSURE/BOX TYPE 1 38H 20W  
MH38 PANELBOARD ENCLOSURE/BOX TYPE 1 38H 20W  
1-NC38VSHR-PNLBD COVER/TRIM NF T-1 S 38H 20W  
NC38VSHR PNLBD COVER/TRIM NF T-1 S 38H 20W |
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<th>Ckt No</th>
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<th>Rating Amp/P</th>
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<th>20/3 QOB</th>
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<tr>
<td>1</td>
<td>QOB</td>
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<td>3</td>
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**PHYSICAL DATA**

ENCLOSURE Type 1
- Surface: Hinged
- FRONT CAT#: NC56VSHR
- BOX CAT#: MH56

DIMENSIONS:
- 56" (1422mm) H x 20" (508mm) W x 5.75" (146mm) D

WIRE BENDING SPACE:
- Top: 17.1" (434mm)
- Bottom: 12.25" (311mm)
- Side: 5.9" (150mm)

PBA: 709HR

BUSSING: COPPER
- Silver/Tin Plated

OPTIONAL FEATURES:
- BRANCH USER PLACEMENT
- Copper GROUND BAR
- COPPER SOLID NEUTRAL

**ELECTRICAL DATA**

SYSTEM: 208Y/120V 3Ph 4W 60Hz
- System Ampacity: 400A
- 10kA SYMS. SCCR

MAIN:
- Main Lugs: 400A
- Top FEED

INCOMING CONDUCTORS(S) PER NEC, CEC, NOM:
- Wire Bending Space:
- Phase Lugs: 1 - 1/0 - 750, (2) 1/0 - 350 kcmil

-------------BRANCH SUMMATION-------------
- 26 - 20A/1P QOB
- 1 - 40A/2P QOB
- 2 - 60A/2P QOB

2 - 60A/2P QOB
- 1 - 50A/2P QOB

---

**JOB NAME:** Fallon Park ES
**EQUIPMENT DESIGNATION:** LM2

**JOB LOCATION:**
**EQUIPMENT TYPE:** NO (Circuit Breaker Type)
**DRAWN BY:** (Q2C)
**DRAWING TYPE:** ONE LINE DIAGRAM

**ENG.:**
**DATE:** April 09 2018
**DRAWING STATUS:** QUOTE

**DWG#: 00-35817-04432756-01**
**PG 1 OF 1 REV -**
I-Line Power Panelboards

Our I-Line® power distribution panel is the most versatile on the market. It’s used to feed NQ and NF lighting and appliance panelboards. I-Line panelboards can also feed large motors and HVAC systems.

Features
- 600Vac, 250Vdc maximum
- 1200A main circuit breaker or main lugs
- 1200A maximum branch circuit breaker
- 200,000A SCCR when using current limiting main or branch circuit breakers
- Fully rated and series rated systems available
- Interiors available in plated copper or aluminum bus
- Suitable for use as service entrance equipment
- Complete line of UL/cUL listed interiors with 200% rated neutrals for non-linear loads
- Sub-feed or through-feed lugs through 1200A
- Interiors accept plug-on thermal magnetic or solid state branch circuit breakers
- Interior, front and most circuit breakers only require a screwdriver for installation
- Branch circuit breaker mounting not restricted by location on bus stack
- Capable of mounting 15A branch circuit breaker across from or next to a 1200A branch circuit breaker
- Branch circuit breakers have no loose mounting hardware and install in as little as 20 seconds with only a screw driver
- Branch circuit breakers are simple to rearrange in the field, limited restrictions on mounting locations
- 100,000A – 240,000A field installable plug-in TVSS units
- Available with or without door, or with hinged trim
- Broad range of field installable kits available from stock

Factory Options
- Split bus bar
- Sub-feed/thru-feed lugs through 1200A
- Optional 200% rated neutrals through 1200A
- Thermal-mag or solid state circuit breakers
- Plated copper or aluminum bus
- Optional customer metering with PowerLogic® power meters or circuit monitors
- Plug-in TVSS modules
- 100,000A – 240,000A plug-in TVSS
- Door in door or hinged trim
- Six circuit QO 240V plug-in distribution module
- Ground fault protection available on main or branch circuit breakers
- Current density-rated panelboard bus
The NF panelboard offers superior performance and application flexibility for commercial and industrial electrical systems up to 600Y/347 Vac. This versatile lighting and power distribution panelboard features a wide selection of circuit breakers, accessories and ready-to-install kits, as well as 200% rated neutrals for non-linear loads.

**Features**
- 600Y/347 Vac maximum
- 600A maximum main circuit breaker, 800A maximum main lugs
- 14,000A through 200,000A SCCR
- Sub-feed circuit breakers are vertically mounted
- 125A maximum branch mounted circuit breakers (110A for 600Y/347V)
- Interiors are field convertible to top or bottom feed
- Bolt-on branch circuit breakers attach with captive screws
- Visi-Trip® indication on branch circuit breakers
- Suitable for use as service equipment
- Complete line of UL/cUL listed interiors with 200% rated neutrals for non-linear loads
- 20” wide trims and boxes common for NF and NQ panelboards
- Mono-flat or hinged trims
- Vertically mounted main breakers available, all amperages
- Branch circuit filler plates provide fast and easy installation

**Factory Options**
- 1P3W or 3P4W – 600A main lugs and 600A main breaker panelboards
- Sub-feed and thru-feed lugs
- Sub-feed circuit breakers
- Optional 200% rated neutrals through 600A
- Split bus bars
- TVSS
  - 100,000A – 240,000A surge current rating
  - All voltage systems
  - Lighting contactors
  - Customer equipment space

“Ready-to-Install” Panels and Kits Available from Stock
- 100A – 600A MLO 3P4W interiors
- Type 1 and 3P/12 enclosures
- 100A – 400A main circuit breaker kits
- 120,000A or 160,000A surge current ratings
- 100A – 400A sub-feed and thru-feed lugs
- Sub-feed circuit breaker kits
  - 1 – 250A sub-feed circuit breaker per 250A panelboard
  - 2 – 250A sub-feed circuit breakers per 400A or 600A panelboard
- 200% neutral kits up to 400A
- Copper neutrals and equipment ground bars
NQ Lighting Panelboards

Developed with electrical contractor input, the NQ family of lighting and appliance panelboards sets new standards for ease of installation and durability. Plus, new design innovations increase the availability of these panelboards by offering complete ready to install products.

Features

- 240Vac, 48Vdc maximum
- 600A maximum main circuit breakers or main lugs
- 150A maximum branch circuit breakers
- 10,000A through 200,000A SCCR
- Both fully rated and series rated systems are available
- Interiors are field convertible to top or bottom feed
- Interiors are available in plated copper or aluminum bus
- Interiors accept both bolt-on and plug-on branch circuit breakers
- Complete line of UL/cUL listed interiors with 200% rated neutrals for non-linear loads
- Suitable for use as service entrance equipment
- 20” wide trim and boxes common for NQ and NF panelboards
- Mono-flat™ or hinged trims

Factory Options

- 1P3W or 3P4W – 600A main lugs and main breaker panelboards
- Sub-feed and thru-feed lugs
- Sub-feed circuit breakers
- Optional 200% rated neutrals up to 400A
- Split bus bars
- TVSS
  - 100,000A – 240,000A surge current rating
  - All voltage systems
  - Lighting contactors
  - Customer equipment space

“Ready-to-Install” Panels and Kits Available from Stock

- 100A – 600A MLO 1P3W and 3P4W Interiors
- NEMA 1 and 3R/12 enclosures
- 100A – 400A main circuit breaker kits
- TVSS interiors
  - 120,000A or 160,000A surge current ratings
- 100A – 400A sub-feed and thru-feed lugs
- Sub-feed circuit breaker kits
  - 1 – 225A sub-feed circuit breaker per 225A panelboard
  - 2 – 225A sub-feed circuit breakers per 400A panelboard
- 200% neutral kit up to 400A
- Copper neutrals and equipment ground bars
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Micrologic trip units

The full range of PowerPact circuit breakers now feature Micrologic electronic trip units (energy model). Micrologic trip units are the intelligence behind a coordinated electrical distribution system that delivers improved operating efficiency and extended equipment life. All Micrologic trip units provide impeccable, electronic circuit protection with adjustable protection settings for maximum system coordination and flexibility. Sophisticated functionality, such as energy and power quality metering capabilities, is integrated in the more advanced trip units. Combined with quality PowerPact accessories, Micrologic trip units also enable circuit breakers to be networked and remotely controlled leading to substantial savings in electrical system operating costs. These interchangeable, microprocessor controlled devices provide the new generation of protection, measurement and control functions, delivering not only greater electrical system safety but also improved system integration and coordination.
Choose the model that meets your needs

The Micrologic trip unit family includes five models with varying levels of functionality. The simplest units provide basic overcurrent protection including long-time, instantaneous, and optional short-time adjustments for overloads and short circuits. Advanced units offer sophisticated functions such as ground fault protection and zone selective interlocking. They also incorporate a variety of communications options and energy metering capabilities — right inside the circuit breaker. With advanced trip units, use a network to communicate breaker information, gather power information and energy usage patterns, monitor events, and remotely control breakers for increased efficiency and savings. The breakers become part of an integrated, coordinated electrical system. For maximum flexibility in product selection, Micrologic trip units consist of five models with progressively increasing levels of functionality.

Choose the right model for each application

<table>
<thead>
<tr>
<th>PowerPact H-, J- and L-Frame</th>
<th>Standard (S)</th>
<th>Ammeter (A)</th>
<th>Energy (E)</th>
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</table>

Motor protection trip units

Also available are Micrologic trip units dedicated to managing motor applications at 600 A or below. Three levels of functionality are available with the motor trip unit offer.

- **1.3M:** Provides cable protection for short-circuits, and must be combined with an external thermal protection relay. This trip unit features an adjustable short-circuit protection threshold and fixed instantaneous protection.
- **2 M:** Provides thermal relay type protection in addition to short-circuit protection. Adjustable settings are included for the thermal protection threshold, the tripping class, and the short-circuit protection. Additional protections include phase unbalance and phase loss protection.
- **6 E-M:** Provides the same protection functions as the Micrologic 2-M units with the addition of ground fault, locked rotor protection, under-load protection and long start protection. They also incorporate energy metering and maintenance indicators similar to the Micrologic Energy trip unit.
Mounting dimensions
Common mounting dimensions across the entire range means that the mounting pattern never has to change even when panel designs change.

PowerPact H- and J-Frame with Micrologic circuit breakers – 15 A to 250 A

Well-suited to a wide range of applications, the Powerpact H- and J-Frame molded case circuit breakers feature a full complement of field installable accessories, field installable trip units, and improved interrupting ratings. These molded case circuit breakers deliver unmatched design flexibility and share identical mounting holes, handle locations, trim dimensions, and accessories, allowing customers to standardize equipment designs for 15 A to 250 A applications.

PowerPact H- and J-Frame circuit breakers come in many interruption ratings and are designed to limit let-through currents to provide better protection for downstream components. Interrupting ratings (AIR) include D-18 kA, G-35 kA, J-65 kA and L-100 kA at 480 Vac. Available as standard or 100% rated circuit breakers, the H-Frame ranges from 15 A to 150 A and the J-Frame from 70 A to 250 A.

Available trip units:
- **Thermal magnetic**: Circuit protection provided by individual thermal (overload) and magnetic (short circuit) sensing elements in each pole.
- **Standard electronic**: Adjustable overcurrent protection including long-time, instantaneous, and optional short-time.
- **Ammeter**: Adjustable long-time, short-time, instantaneous and optional ground fault protection is coupled with integrated current metering and maintenance indicators.
- **Energy**: Power and energy metering is integrated with exceptional long-time, short-time, instantaneous, and optional ground fault protections. Beyond energy metering, this trip unit delivers many advanced functions including power quality (harmonics) measurement.

Choice of terminal options
Terminal options include unique snap-in lugs that make converting between bus bar and lug options easy. If the application calls for lugs on the line side, load side or both, conversions are simple, making the PowerPact H- and J-Frame circuit breakers ideal for applications that require configuring products at the point of use.

The terminal nut or mechanical lug is set on a plastic retainer that slides and snaps into place. Making it possible to easily convert to a distribution lug that provides multiple cable outputs for downstream components.
PowerPact L-Frame with Micrologic circuit breaker – 70 A to 600 A

Designed to accept common accessories and the full range of electronic trip options available for PowerPact H- and J-Frame, the newest addition to the PowerPact family of molded case circuit breakers delivers the same impeccable protection and flexibility. PowerPact L-Frame is also available as standard or 100% rated, and has a choice of many interruption ratings to support different application needs. Interrupting ratings (AIR) include D-18 kA, G-35 kA, J-65 kA and L-100 kA at 480 Vac.

Available trip units:
- **Standard electronic:** Adjustable overcurrent protection including long-time, instantaneous, and optional short-time.
- **Ammeter:** Adjustable long-time, short-time, instantaneous, and optional ground fault protection is coupled with integrated current metering and maintenance indicators.
- **Energy:** Power and energy metering is integrated with exceptional long-time, short-time, instantaneous, and optional ground fault protections. Beyond energy metering, this trip unit delivers many advanced functions including power quality (harmonics) measurement.

PowerPact P- and R-Frame with Micrologic circuit breakers – 100 A to 3000 A

The compact P- and R-Frame circuit breakers permit smaller footprint and higher density installations. These circuit breakers are available in standard and 100% rated construction up to 3000 A to meet a broad range of commercial and industrial application needs. Common accessories make stocking and installation easy.

Built-in Modbus™ protocol provides an open communications platform and can be combined with a selection of four interchangeable Micrologic trip units.
- **Standard:** Adjustable overcurrent protection including long-time, instantaneous, and optional short-time.
- **Ammeter:** Adjustable long-time, short-time, instantaneous, and optional ground fault protection is coupled with integrated current metering and an optional Modbus communication interface.
- **Power:** Combines power monitoring and metering functions, with long-time, short-time, instantaneous/optional ground fault adjustments, and advanced relay functions, and has a standard Modbus communication interface.
- **Harmonics:** All of the functionality of the Power trip unit, plus enhanced monitoring and metering capabilities, basic power quality (harmonics) measurement, and waveform capture.