STRATA
A Professional Services Corporation
Integrity from the Ground Up

September 30, 2016
File: SP16088A

Mr. Jeff Warner, AIA
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Spokane, Washington 99201
Email: jwarner@alscarchitects.com

RE: **Geotechnical Engineering Evaluation**
Building 1 Expansion Project
Spokane Community College
1810 North Greene Street
Spokane, Washington

Dear Mr. Warner:

Strata, A Professional Services Corporation (STRATA) is pleased to present our geotechnical engineering evaluation for the Building 1 Expansion Project to be located immediately northeast of the intersection of East Mission Avenue and North Ralph Street, adjacent to Building 1 on the Spokane Community College (SCC) campus in Spokane, Washington. Our geotechnical engineering evaluation's purpose was to explore the subsurface conditions within the development area and provide geotechnical opinions and recommendations to assist project planning, design, and construction. We accomplished our geotechnical services referencing our authorized proposal dated June 1, 2016.

The following report provides specific geotechnical recommendations for earthwork activities, shallow foundation design, and concrete slab-on-grade floors based on the conditions we encountered and observed. The geotechnical recommendations presented herein must be read and implemented in their entirety; portions or individual sections of our report cannot be relied upon without the supporting text.

Our opinion is that project construction success will depend, in part, upon the design team and contractor following our report recommendations, the contractor adhering to good construction practices, and the owner and/or contractor providing the necessary construction monitoring, testing, and geotechnical consultation to verify the work has been accomplished as recommended herein. As such, we recommend STRATA be retained to provide observation, testing, and consultation services to verify our report recommendations are being followed. If we are not given the opportunity to provide geotechnical continuity during construction, we cannot be responsible for designer or contractor errors, omissions, or report misinterpretations.

We appreciate the opportunity to continue to work with ALSC Architects (ALSC) and the design team on this project. Please do not hesitate to contact us if you have any questions or comments.

Sincerely,
STRATA

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Geotechnical Engineering Evaluation
Building 1 Expansion Project
Spokane Community College
1810 North Greene Street
Spokane, Washington

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September 30, 2016

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Geotechnical Engineering Evaluation
Building 1 Expansion Project
Spokane Community College
1810 North Greene Street
Spokane, Washington

INTRODUCTION

Our geotechnical engineering evaluation's purpose was to assess subsurface soil conditions within the proposed project area and to prepare geotechnical recommendations to assist final design and construction document development. We accomplished the following services referencing our authorized proposal dated June 1, 2016:

1. Coordinated exploration with ALSC Architects (ALSC) to help delineate exploration schedules, locations, utility issues, cleanup expectations, site access issues, and other exploration-specific considerations. Performed a site visit to stake and paint exploration locations.
2. Coordinated exploration with the Washington Utility Notification Center to help reduce potential for damage to existing utilities.
3. Performed 2 site visits in coordination with Coffman Engineers (Coffman) who assisted with the identification of existing utilities.
4. Performed subsurface exploration at the site by coordinating with a subcontracted backhoe operator, to accomplish 2 exploratory test pits at the project site to depths of up to 7.0 feet below existing site grades. We loosely backfilled test pits approximately level with the ground surface. See *Test Pit Remediation* section.
5. We visually described and classified the soil encountered referencing the *American Society for Testing and Materials International* (ASTM) Test Designation D2488 and obtained select soil samples for laboratory testing.
6. Documented test pit locations using a commercially-available global positioning system (GPS) device. Prior to departing the site, we staked and labeled the exploration locations for future surveying.
7. Performed laboratory testing on select soil samples obtained during exploration, referencing ASTM test standards.
8. Discussed current project plans with you and Mr. Karl Kolb, S.E., LEED AP, project structural engineer with Coffman Engineers (Coffman).
9. Reviewed subsurface conditions, laboratory test results, and the proposed construction. Conducted geotechnical analyses, and provided geotechnical recommendations to assist project design and construction for the following:
   - Earthwork;
   - Shallow foundation design; and
   - Concrete slab-on-grade floors.
10. Prepared and provided a draft report version for design team review, including exploration logs, laboratory test results, and a site plan illustrating exploration locations, dated September 7, 2016.
11. Upon receipt of team comments, we prepared and provide 3 hard copies and 1 electronic copy of our formal geotechnical report including exploration logs, laboratory test results, and a site plan illustrating exploration locations.

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PROJECT UNDERSTANDING

We base our project understanding on our conversations with Mr. Karl Kolb, S.E., LEED AP, the project structural engineer with Coffman, and reviewing the following documents:

- Our electronic mail conversations with ALSC on May 26, 2016 and to date;
- *Topographic Survey* (Sheet C1) provided by Coffman, dated August 9, 2016;
- Reviewing the Spokane Community College (SCC) campus map ALSC provided via electronic mail on May 26, 2016; and
- Our experience near this site and with similar soil conditions.

We understand ALSC Architects (ALSC) and their design team have been selected to accomplish preliminary/conceptual design for the Building 1 Expansion Project to be located immediately NE of the intersection of East Mission Avenue and North Ralph Street, adjacent to Building 1 on the Spokane Community College (SCC) campus in Spokane, Washington. We understand the architect is preparing the bridging documents for the design-build project. The design-build contractor has not been selected at this time. We understand the expansion area location may change from the current location (reference Plate 1). **As such, a supplemental geotechnical evaluation will be required. Additionally, the recommendations presented herein cannot be used for other development locations beyond the location illustrated on Plate 1. For further discussion, please reference the *Geotechnical Design Continuity* section**.

The Building 1 Expansion Project site is located immediately adjacent to the west wing of Building 1 on the west side of the building on the SCC campus, immediately NE of the intersection of East Mission Avenue and North Ralph Street in an undeveloped area covered with grass. Asphalt-paved parking areas are located immediately west and south of Building 1 on the SCC campus. Asphalt-paved parking areas and landscape areas covered with grass, bushes, and trees surround Building 1 to the north and east. Topographically, the site is relatively flat with vertical relief on the order of 1.0 foot across the west wing of Building 1 sloping slightly upward to the north.

Construction for the Phase I Expansion Project generally will include:

- Main Building Expansion – approximately 10,000 square-foot, 1-story building connected to the south and west of the existing west wing of Building 1. We anticipate concrete slab-on-grade floor and shallow perimeter spread-footing foundations. We anticipate the building addition will share existing building foundations along the east and south foundation walls and final floor elevations will match the existing Building 1 floor elevation; no below-grade structures are planned. We anticipate the building construction will comprise either steel framed walls or wood-framed construction, lightly to moderately loaded structure. Although currently unavailable, we estimate structural loads to be on the order of 2 to 3 kips per lineal foot with isolated column loads of less than 50 kips;
- Landscaping and exterior concrete improvements including curb and gutter.

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We understand at this time the building expansion is currently in conceptual phase. As such no specific design drawings, structural loading information or finished-floor elevation information is available for the building expansion at the time of this report. Site grades are expected to be minimal with required cuts on the order of 2.0-feet below existing site grades to match existing Building -1 grades.

FIELD AND LABORATORY EVALUATION

Site Exploration

We evaluated subsurface conditions within the proposed project area by observing 2 exploratory test pits on August 17, 2016. We coordinated exploration with a subcontracted backhoe operator and advanced test pits to depths ranging from 6.0- to 7.0-feet below the existing ground surface. Test pits were advanced using a CAT 426C backhoe equipped with a 2.0-foot wide bucket and standard excavation teeth. We obtained select soil samples within test pits for laboratory testing and to assist soil classification. We loosely backfilled test pits to approximately level with the surrounding ground surface elevation. We staked test pits to allow for surveying and remediation during construction, as further discussed in this report's *Site Preparation* section. We recommend test pits be located and reviewed by STRATA during site grading to determine whether additional remediation (i.e. removing backfill and replacing with *Structural Fill*) is necessary as further discussed in this report's *Test Pit Remediation* section.

Plate 1, *Exploration Location Plan*, illustrates approximate exploration locations documented in the field using a commercially available global positioning system (GPS). A STRATA Geoprofessional visually described, classified, and logged the subsurface conditions encountered during exploration referencing ASTM D2488). Appendix A presents exploratory test pit logs and a *Unified Soil Classification System* (USCS) explanation, which should be used to help interpret soil terms used throughout this report and on the exploratory logs.

<u>Subsurface Conditions</u>

We encountered silty sand (topsoil) at the ground surface; consisting of significant vegetation and organics to a depth of 4 inches beneath the ground surface. The soil was generally dark brown, loose, and moist. Furthermore, moderate rootlets were observed in both test pits to a depth of up to 4 inches beneath the ground surface. Beneath the silty sand (topsoil), we encountered 2 primary subsurface units:

- <u>Undocumented Fill – Silty Gravel with Cobbles and Boulders (GM):</u> Encountered in both exploratory test pits beneath topsoil; generally, 3.0 to 4.0-feet thick to native alluvium, light to

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dark brown, loose to medium dense, and moist. This soil contained cobbles and boulders up to 15 inches in diameter.

- Alluvium – Poorly Graded Gravel with Silt, Sand, Cobbles and Boulders (GP-GM): Generally encountered below a depth of 3.0 to 4.0 feet; brown, loose to medium dense, and moist. This soil contained cobbles and boulders up to 15 inches in diameter. This soil unit extended to test pit termination depths.

We did not encounter groundwater or bedrock during exploration. Based on our review of Washington State Ecology (Ecology) well logs, and our local exploration experience in Spokane, we anticipate static groundwater levels within the proposed project area are greater than 30.0 feet below the existing ground surface. Furthermore, well logs indicate bedrock is greater than 50.0 feet below ground surface.

Although soil conditions encountered in locations explored were somewhat consistent with respect to soil type, exploratory excavations only allow observation of a relatively small sample of the subsurface conditions at the site. Variations may exist between and beyond exploration locations. Such variations will not be apparent until construction, and may impact project schedules and costs. Where such variations exist, it may affect the opinions and recommendations presented in this report as well as construction timing and costs, and we must be contacted to review the encountered conditions and our recommendations to make any necessary revisions.

Laboratory Testing

We performed laboratory testing on select soil samples collected in the field referencing ASTM procedures. We used laboratory test results to verify soil classification and to estimate soil engineering properties. Exploration logs in Appendix A include index laboratory test results; Appendix B provides graphical and analytical laboratory test results. Laboratory tests included:

- Percent passing the No. 200 sieve; and
- Natural moisture content

GEOTECHNICAL OPINIONS AND RECOMMENDATIONS

The following geotechnical recommendations are presented to assist final design and construction document development for the main building (Building 1) expansion project to be located immediately NE of the intersection of East Mission Avenue and North Ralph Street, adjacent to Building 1 on the Spokane Community College (SCC) campus in Spokane, Washington. We base our geotechnical recommendations on our experience with similar soil and geologic conditions, findings from our field and laboratory evaluation, and our understanding of the proposed construction. If development plans change, we should be contacted to review the project modifications and revise our recommendations, as necessary. Additionally, if subsurface conditions exposed during

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construction are different than what we encountered during exploration, STRATA should be contacted to review our recommendations and provide any necessary revisions or modifications.

Earthwork

Site Preparation

Site Stripping

We recommend soil containing vegetation and organics be removed from beneath any planned buildings and structural fill areas. Soil containing vegetation and organics was approximately 4 inches thick in our explorations. Furthermore, moderate rootlets were observed in all test pits to a depth of up to 4 inches beneath the ground surface. However, varying thicknesses of vegetation and organic deposits should be expected. We recommend the selected earthwork contractor assume an average 6-inch topsoil stripping depth across the site. Stripping must extend laterally at least 5.0 feet outside of planned structural improvement areas. Soil containing vegetation and organics should be disposed off-site or may be reused on-site for landscaping, but may not be re-used as *Structural Fill*.

Test Pit Remediation

We recommend all test pits located beneath the planned Building 1 be remediated during earthwork construction. Test pits shall be backfilled with either on-site native gravel or imported fill meeting the requirements stated in this report's *Soil Product Specifications and Required Compaction* section. We require all test pits within the proposed construction areas be reviewed by STRATA and the contractor, following site stripping, to determine whether full-depth remediation is necessary based on conditions observed during construction and planned improvements overlying test pit areas.

Undocumented Fill Removal

We encountered undocumented fill beneath silty sand (topsoil) in the proposed main building expansion area, adjacent to the existing Building 1 within the upper 3.0- to 4.0-feet of the soil profile in Test Pits TP-1 and TP-2. The undocumented fill STRATA encountered at the site is predominately loose, unconsolidated, and variable in density. This data suggests the fill was placed in an uncontrolled manner and is not suitable to support the building development. Aligned with geotechnical standard-of-care, and to reduce the risk of foundation and slab settlement, we recommend any undocumented fill encountered be removed beneath planned foundations and slabs to sufficient depth to expose undisturbed native poorly-graded gravel with silt and sand (GP-GM) subgrade. Based on exploration findings, we anticipate undocumented fill removal will require excavations on the order of 4.0 feet underneath the proposed main building expansion area to

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expose undisturbed native subgrade. We recommend any undocumented fill removal extend a minimum lateral distance away from foundations and slabs equal to the thickness of the undocumented fill layer. For example, if 4.0 feet of undocumented fill is removed near a continuous exterior footing, we recommend the contractor remove undocumented fill within 4.0 lateral feet of the footing. The undocumented fill should be replaced with compacted *Structural Fill*, as stipulated in the following sections. See *General Project Considerations Discussion* section of this report for further discussion on variability and risk assessment.

Establishing Subgrades

Following site stripping, excavating to achieve site grades, removal of any undocumented fill, and prior to fill placement; prepare subgrades to receive fill, concrete or other site improvements as outlined in the following bullets:

- <u>Building and foundation subgrades:</u>
  - Prior to placing embankment fill for site grading, concrete for foundations, or aggregate support sections beneath slabs, compact the exposed native subgrade soil to at least 95 percent of the soil's maximum dry density, referencing ASTM D1557. To accomplish subgrade compaction, we expect moisture conditioning (i.e., wetting or drying the soil) to near optimum moisture content will be required.
- <u>All other subgrades (i.e., exterior hardscapes & landscape areas):</u>
  - Prior to placing embankment fill, *Structural Fill* or other improvements, outside the planned building footprint, prepare subgrades by rolling the exposed native surface with heavily loaded construction equipment, under the project geotechnical engineer's observation to identify soft, pumping areas. Where soft areas are identified, they must be scarified, moisture conditioned, and recompacted to 95 percent ASTM D1557. Prepare landscape areas by compacting the exposed native subgrade soil to at least 90 percent of the soil's maximum dry density, referencing ASTM D1557. To accomplish subgrade compaction, we expect moisture conditioning (i.e. wetting or drying the soil) to near optimum moisture content will be required.

After preparing subgrades, it is the contractor's sole responsibility to protect subgrades from degradation, freezing, saturation, or other disturbance. Our opinion is careful construction and earthwork procedures will be critical to achieving adequate subgrade preparation and reducing over-excavation. Specifically, these procedures could include, but are not limited to, carefully staging equipment and/or stockpiles, routing construction equipment away from subgrades, and implementing aggressive site drainage procedures to help reduce saturating subgrades during wet weather conditions. As stated above, it is the contractor's responsibility to protect subgrades throughout construction. Subgrade disturbance that occurs due to the contractor's means and methods must be repaired at no cost to the Owner. STRATA will remain available to consult with the owner, the project team, and the contractor as the project moves forward regarding subgrade preparation procedures.

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Excavation Characteristics

We anticipate the on-site soil may be excavated using conventional soil excavation techniques. In general, slopes and excavations must be excavated, shored, or braced in accordance with the *Washington Industrial Safety and Health Act* (WISHA) regulations and local codes. The near-surface on-site soil generally is classified as a "C" type soil according to WISHA requirements. As such, we recommend provisions be made to allow temporary excavations of any type, and soil to be sloped back to at least 1.5H:1V (horizontal to vertical) or as otherwise determined to be safe according to the selected contractor's competent person. Ultimately, the selected contractor is responsible for site safety, and determining appropriate excavations for the conditions and soil types encountered during construction. STRATA accepts no responsibility for temporary excavation stability. **The contractor should be prepared to encounter cobbles up to 15 inches in diameter. Isolated larger particles may also be encountered. Furthermore, the contractor should be prepared to encounter caving conditions at depths greater than 6.0 feet below the existing ground surface.**

The on-site native soil is moderately moisture-sensitive and susceptible to disturbance when moist or wet. Soil disturbance will negatively impact the soil's performance below slabs, pavement, and foundations. **Disturbed and/or uncompacted soil shall not be allowed beneath any structure.** Equipment with large tracks, lugs, or having toothed buckets has a significant potential to disturb the site soil prior to, or following compaction. Rubber-tired transport vehicles should not access prepared subgrades unless the subgrade is sufficiently stiff to allow construction traffic without disturbance. We recommend project earthwork specifications specifically outline that the contractor is required to maintain the subgrade in a compacted condition and protect subgrades from construction traffic disturbance after they have been prepared and meet compaction requirements. Further information can be found in this report's *Wet Weather, Wet Soil Construction and Over-Excavation*.

Soil Product Specifications

We recommend all fill placed beneath anticipated structures consist of *Structural Fill* meeting the requirements presented in Table 1. The on-site native silty gravel with cobbles (GM), native poorly-graded gravel with silt, sand and cobbles (GP-GM) and undocumented fill soil is expected to be suitable for re-use as *Structural Fill*, but will require moisture-conditioning prior to placement.

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Table 1. Soil Fill Specifications and Allowable Use

Soil Fill Product	Allowable Use	Material Specifications
Structural Fill[1]	• Site grading fills • Foundation wall backfill • Utility trench backfill • Over-excavations	Soil must be classified as GP, GM, GW, SP, SM, or SW according to the USCS. Soil may not contain particles larger than 6 inches in median diameter. Soil must contain less than 3 percent (by weight) of organics, vegetation, wood, metal, plastic or other deleterious substances.
Crushed Surfacing[2]	• Structural fill uses • Slab support aggregate • Pavement section aggregate	Soil meeting requirements stated in *Section 9-03.9(3) – Crushed Surfacing* of WSDOT Standards.
Bedding Course	• Utility pipe bedding	Soil meeting requirements stated in *Section 9-03.12(3)-Gravel Backfill for Pipe Zone Bedding* of WSDOT Standards.
Unsatisfactory Soil	• NONE	Soil classified as CH, MH, OH, OL or PT may not be used at the project site. Any soil type not maintaining moisture contents within 5 percent of optimum during compaction. Any soil containing more than 3 percent (by weight) of organics, vegetation, wood, metal, plastic or other deleterious substances.

1. The on-site native GM, GP-GM and undocumented fill soil generally meets the intent of our recommendations for *Structural Fill*.
2. *Crushed Surfacing* includes both "top course" and "base course" *Crushed Surfacing* according to WSDOT Standards. *Crushed Surfacing* meets the *Structural Fill* requirements presented in Table 1 above and can be used as *Structural Fill*.

All soil fill products should be moisture-conditioned to near optimum moisture content and be placed in maximum 12-inch-thick loose lifts. If site access precludes the use of large (10 ton or greater) compaction equipment and smaller or lighter equipment is used, a reduction in fill lift thickness and adjustment in compaction effort must be used.

Required Compaction

Table 2 summarizes soil product compaction requirements.

Table 2. Required Soil Products for Designated Project Areas

Project Area	Required Soil Product	Compaction Requirement[1]
Building footprint areas and final 2.0 feet of utility trench backfill	Native Soil or *Structural Fill*	95%
Directly beneath pavements, slabs & sidewalks	*Crushed Surfacing*	95%

1. Reference ASTM D1557 modified Proctor

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Place *Soil Products* over approved subgrades. Never place *Soil Products* over frozen, saturated, or soft subgrades. *Soil Products* must be moisture conditioned to near optimum moisture content and placed in maximum 12-inch-thick, loose lifts, providing compaction equipment weighs at least 10 tons. If smaller or lighter compaction equipment is provided, reduce the lift thickness to meet the compaction requirements presented herein. The contractor is responsible for selecting compaction equipment suitable for achieving compaction.

Imported *Structural Fill* may be too coarse for conventional Proctor testing if it contains more than 30 percent particles retained on the No. ¾ sieve (i.e., oversize material). If excessive oversize material is present within the imported *Structural Fill*, we recommend oversize material be compacted using a "method specification". Method compaction should occur by applying at least 5 complete passes over the soil using vibratory compaction equipment with a drum energy rating of at least 10 tons. We do not recommend smaller compaction equipment for method compaction. Method compaction should be observed on a full-time basis by STRATA and should achieve a firm, unyielding and interlocking *Structural Fill* surface.

Wet Weather, Wet Soil Construction and Over-Excavations

We strongly recommend earthwork construction take place during dry weather conditions. In soft or wet soil areas and during wet weather conditions, earthwork contractors must be familiar with the hazards of using rubber-tired equipment, which exerts a point load on the subgrade. Staggering wheel paths, using tracked equipment to traverse exposed subgrades and other techniques are important processes that reduce the potential for subgrade pumping, rutting, and contractor rework. We strongly recommend construction traffic be controlled in a manner that reduces traffic directly on the sensitive soil subgrade.

Earthwork should not be performed immediately after rainfall, or until soil can dry sufficiently to allow construction traffic without disturbing the subgrade. Potential disturbance and the moderately moisture-sensitive soil (silty gravel) at the project site will likely require isolated removal and replacement during construction. We recommend any soil exhibiting pumping, rutting, weaving, or otherwise exhibiting unstable performance be moisture-conditioned (typically drying) and recompacted to *Structural Fill* requirements, or removed at the contractor's and/or owner's discretion. Moisture-conditioning the on-site soil could be difficult. If moisture-conditioning is impractical or may create project delays, the soil should be removed to undisturbed native soil using smooth-blade equipment and *Structural Fill* placed to desired grades. We recommend the "over-excavation" process occur as follows:

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1. STRATA and/or the selected contractor should identify and delineate unstable subgrade soil conditions. STRATA must review the affected area and provide the contractor and the design-build contractor feedback to help facilitate the over-excavation process.
2. After attempting proper moisture conditioning, remove unstable areas using smooth-blade equipment to a minimum depth of 1.0 foot below the subgrade surface. Extend the over-excavation a minimum of 2.0 feet laterally beyond the delineated unstable area.
3. STRATA shall verify the over-excavation base consists of undisturbed native soil.
4. Place *Structural Fill* in the over-excavation to desired grades in accordance with the *Soil Product Specifications* and *Required Compaction* report sections.

In some instances, a 1.0-foot deep over-excavation may not be sufficient to expose suitable native soil; additional over-excavation depth may be needed. We recommend STRATA be present to observe all over-excavations to verify they have been constructed according to the above criteria, but also to provide immediate on-site feedback and discussion with the project team regarding soft soil conditions to help facilitate the construction schedule.

Shallow Foundation Design

If our recommendations are followed, the foundation design criteria presented herein can be applied to project building foundations, assuming the loading conditions stated in our *Project Understanding* report section are accurate. We recommend any foundation for the main building (Building 1) expansion bear on compacted native gravel, or *Structural Fill* placed over compacted native gravel, prepared per the *Earthwork* report section. We recommend foundation subgrades remain in a compacted condition during foundation preparations, construction of concrete formwork, and reinforcing steel placement. All foundation bearing surfaces should be free of loose soil and debris and be compacted to requirements presented in the *Required Compaction* report section.

<u>Design Parameters</u>

Based on preparing the foundation bearing soil units as described herein, the following items provide our recommended shallow foundation design parameters:

- Maximum allowable bearing pressure: 4,000 psf
  - Maximum 30 percent increase allowed for short term load increases such as wind or seismic.
- Estimated foundation vertical settlement:
  - Total settlement: Less than 1.0-inch.
  - Differential settlement: Less than 0.75 inches in 30.0-foot horizontal span or between adjacent, differently loaded footings.
- Lateral load resistance:
  - Foundation base friction coefficient:
    - 0.5 for foundations cast directly on prepared native gravel subgrade or *Structural Fill* soil.
  - Passive soil resistance on foundation sides:
    - Equivalent fluid pressure: 350 pcf (requires ¾-inch lateral movement to mobilize full resistance).

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- Neglect upper 12-inches of wall backfill due to frost action.

- Footing embedment:
  - Exterior footings (or footings in non-heated areas) must extend at least 24 inches below the final, exterior ground surface to help protect against frost action.

Seismicity

STRATA utilized site soil and geologic data, the project location, the *2012 International Building Code* (IBC), the *National Earthquake Hazards Reduction Program* (NEHRP), and Table 20.3-1 *Site Classification* from Chapter 20 of the *American Society of Civil Engineers* (ASCE) 7-10 to establish a Seismic Site Classification of "D" at the project site. We recommend seismic design reference the seismic parameters provided in Table 3 based on the soil conditions and project location. The risk-targeted maximum considered earthquake (MCE_R) spectral response acceleration parameters provided in Table 3, column 4 have been modified from a Site Class B to a Site Class D (standard acceleration coefficients for Site Class B multiplied by the Site Class Factors for Site Class D). The design spectral acceleration parameters provided in Table 3, column 5 are equal to 67 percent of the Risk Targeted MCE_R acceleration parameters.

Table 3. Seismic Response Criteria (2012 IBC)[1,2,3]

Period (seconds)	Standard Acceleration Coefficients for Site Class B (g)	Site Factor for Site Class D	MCE_R Spectral Acceleration Parameters for Site Class D (g)	Design Spectral Acceleration Parameters for Site Class D (g)
0.0 (Peak)	PGA = 0.145	F_{PGA} = 1.510	PGA_M = 0.219 ($PGA*F_{PGA}$)	-
0.2 (Short)	S_S = 0.335	F_a = 1.532	S_{MS} = 0.513 (F_a*S_S)	S_{DS} = 0.342 (⅔ S_{MS})
1.0	S_1 = 0.115	F_v = 2.340	S_{M1} = 0.269 (F_v*S_1)	S_{D1} = 0.179 (⅔ S_{M1})

1. Values for location Latitude 47.67247°N and Longitude -117.36147°W.
2. Acceleration coefficients based on 2% probability of exceedance in 50 years.
3. Values for an IBC occupancy category I, II, or III (low hazard, other, substantial hazard)

Foundation Drainage

Maintaining uniformly drained conditions is critical to long-term foundation system performance. We recommend foundation drains be installed around the building perimeter to route nuisance water away from foundation subgrades to dedicated stormwater disposal areas. Based on the well-drained native soil conditions at the site and the low potential for shallow groundwater (i.e. less than 5.0 feet deep), the design and ownership team may elect to omit foundation drains from proposed improvements. Omitting the drainage system does not pose a great risk of damage to improvements so long as hardscaped surfaces adequately route surface runoff water away from

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structure subgrades. Plate 2, *Foundation Drain Schematic* presents an example of a foundation and wall drainage system.

Concrete Slab-On-Grade Floors

We recommend concrete slab-on-grade floors be supported by a minimum of 6 inches of C*rushed Surfacing* meeting the requirements shown in Table 1. The recommendations provided in this section assume compacted *Structural Fill* subgrades will be prepared per the *Earthwork* report section. C*rushed Surfacing* below slab support should be placed directly over compacted subgrade reviewed by STRATA meeting the requirements specified in this report's *Establishing Subgrades* and *Structural Fill* sections.

Slabs must be designed for the anticipated use and equipment or storage loading conditions. Based on correlations to our field and laboratory test results, if our recommendations are followed, we recommend concrete slab design utilize an allowable modulus of subgrade reaction (k) of 250 pci. To realize the estimated subgrade modulus, drained conditions and a minimum of 6 inches of *Crushed Surfacing* must be provided.

Moisture Protection

Interior floor slabs may be susceptible to moisture migration caused by subsurface capillary action and vapor pressure. Moisture migration through floor slabs can break down a floor covering, its adhesive, or cause various other floor covering performance problems. Specifically, STRATA has participated in numerous projects where inadequate vapor protection caused significant damage to moisture-susceptible flooring systems. Often, these moisture problems were associated with either no moisture protection below the slab or, alternatively, with improperly sealed sub-slab penetrations that allowed vapor migration and damage to the flooring system. Plumbing penetrations are notoriously problematic for under-slab vapor protection.

Vapor retarders must consist of thick, puncture-resistant polyethylene sheeting placed immediately below the floor slab. An example of this material is Stego Wrap™, a 15-mil retarder. Alternatively, the vapor barrier may be covered with an additional 2-inch-thick layer of clean, coarse sand placed between the aggregate base course and the concrete slab-on-grade floors, if the base material and slabs are placed with a waterproofing system in-place. Vapor barrier installation options are outlined in Figure 1, following.

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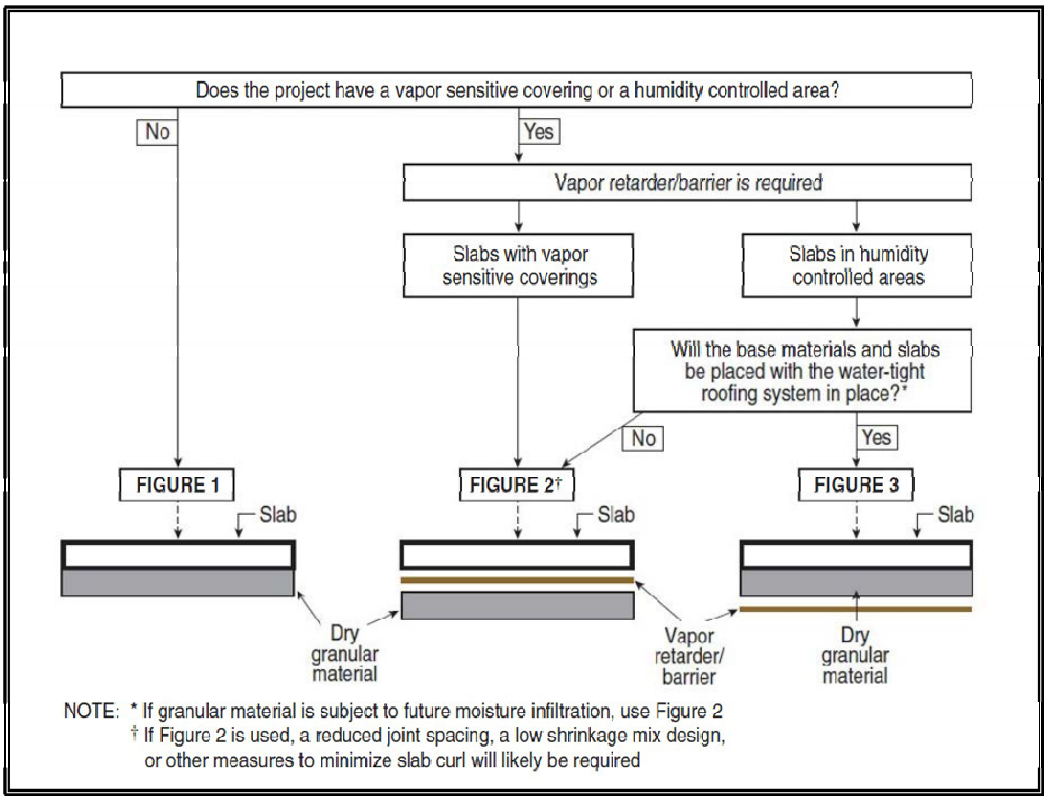

Figure 1: Vapor Retarder Flowchart
(Adapted from Figure 3-1 of ACI 302.1R-04)

Form stakes, piping, or other sub-slab penetrations must never penetrate the vapor retarder. Carefully design and construct any vapor retarder penetrations to reduce vapor transport through such penetrations. Even if these recommendations are used, water vapor migration through the concrete floor slab is still possible. Floor covering should be selected accordingly. Manufacturer's recommendations should be strictly followed. Where vapor retarders are utilized, the flooring and concrete slab contractors, as well as the plastic sheeting manufacturer, should be consulted regarding additional slab cure time requirements and/or the potential for slab curling.

SCC may desire to reduce the project budget by omitting a vapor retarder system below the concrete slab-on-grade floors. However, buildings and associated utilities can act as conduits for moisture and water vapor that exists in the soil to migrate vertically. We recommend you strongly consider the risks of excluding a vapor barrier prior to omitting such a system. Where floor coverings or equipment must be protected from damage by moist floor conditions, we strongly suggest a vapor retarder be installed.

Ultimately, the location of the vapor retarder (if specified) should be carefully considered by you and your design team. ASTM E1643 and American Concrete Institute (ACI) Committee 302 are

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2 publications that provide considerations for vapor retarder locations. Studies have shown that decreased water cement ratios, higher strength concrete, and good construction finishing practices significantly decrease any negative impacts associated with the above options for vapor retarder locations.

Site Grading Considerations

Runoff from precipitation or snowmelt must be routed away from structures to the maximum extent practical and must not be allowed to infiltrate, or be diverted towards slopes, retaining walls (excluding the proposed retaining walls adjacent to the bio-infiltration swale near the southwest corner of the site), foundations, exterior flatwork, or slab subgrades. Runoff or water migrating along the ground surface must be conveyed away from slopes and structures by an appropriately designed series of ditches, swales, or other surface water management procedures.

We recommend the ground surface outside any structure be sloped at least 5 percent away for a minimum of 10.0 feet to rapidly convey surface water or roof runoff away from foundations. Site grades beyond 10.0 feet from structures should slope at least 2 percent away and toward acceptable areas, as determined via our recommendations and site grading design. *Americans with Disabilities Act* (ADA) hardscapes may not meet the above site grading recommendations adjacent to structures. We recommend ADA-pertinent hardscapes be sloped away from structures to the maximum extent practical. We recommend elastomeric sealant be considered between hardscapes and foundation walls to reduce moisture infiltration at joints near building structures. Well-designed site drainage and careful final grading will help limit moisture infiltration near building and paved areas, which will help reduce impacts from frost heave, vapor intrusion to interior spaces and help improve long-term performance of such structures.

Building 1 currently routes water from 2 existing roof drains. We recommend re-routing the existing roof drainage system away from the new Building 1 expansion. Roof downspouts must not be connected to foundation or wall drains. Stormwater should be routed away from disturbed soil areas and should be disposed of in a suitable location as determined by site grading design. We recommend bio-infiltration swales, drywells, or other infiltration facilities be located at least 25.0 lateral feet from any structure or the overflow invert be established a minimum of 2.0 feet below the final finished floor elevation.

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ADDITIONAL RECOMMENDED SERVICES

Geotechnical Design Continuity

The information contained in this report is based on development plans provided by ALSC for the proposed Building 1 Expansion Project planned on the Spokane Community College (SCC) campus in Spokane, Washington. The expansion area location and structural loads are presently conceptual. As such, this geotechnical report only addresses the initial proposed location as presented on Plate 1. **An additional geotechnical evaluation will be required if the final expansion location differs from the area explored for this evaluation, as detailed on Plate 1**. Additionally, conditions encountered following demolition of the existing developments, the final floor elevation, floor configuration, loading conditions, as well as site geometry, can significantly alter our opinions and design recommendations. Specifically, changes in structural design loads and planned site grading may require additional foundation and earthwork evaluations specific to the actual anticipated construction conditions. We should be contacted to observe conditions following demolition, and once final design is completed to review our opinions and design recommendations contained herein.

Plan and Specification Review

We recommend STRATA be retained to review geotechnical related plan and specification sections prior to issuance of the construction documents for bidding. It has been our experience that having the geotechnical consultants from the design team review the construction documents reduces the potential for errors and reduces costly changes to the contract during construction.

Geotechnical Observation During Construction

We recommend STRATA be retained to provide construction observation and testing to document the report recommendations have been followed. If for some reason we are not retained to provide the recommended construction observation services, we cannot be responsible for soil engineering-related construction errors or omissions. Providing these services during construction will help to identify potential earthwork and foundation construction issues, thus allowing the contractor to proactively remedy problems and reduce the potential for errors and omissions.

EVALUATION LIMITATIONS

This geotechnical engineering report has been prepared to assist in planning, design, and construction for the for the main building (Building 1) expansion project to be located immediately northeast of the intersection of East Mission Avenue and North Ralph Street, adjacent to Building 1 on the Spokane Community College campus in Spokane, Washington. Our scope does not include an

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engineering evaluation for deep foundations, lateral earth pressures, site drainage/stormwater disposal, surveying, rigid or flexible pavement, landscaping, or any other services not explicitly discussed above. Variation in subsurface conditions may exist between or beyond our explorations, which can necessitate changes to the geotechnical recommendations in this report. Also, changes to the planned development can drastically affect our recommendations. If the improvement plans change from those described herein, we must be notified so that we may make modifications to our recommendations with respect to the modified improvements. If unforeseen conditions are encountered during earthwork, STRATA must be afforded the opportunity to review our recommendations and provide necessary consultation, revision, or modifications to information contained herein. We recommend STRATA be retained to review the final project plans and specifications, to provide geotechnical continuity throughout construction, and to identify any soil variations which could impact our recommendations.

This report was prepared for the exclusive use of ALSC and their project design team, for the specific project referenced herein. STRATA cannot be held responsible for unauthorized duplication or reliance upon this report or its contents without written authorization. The geotechnical recommendations provided herein are based on the premise that an adequate program of tests and observations will be conducted by STRATA during construction in order to verify compliance with our recommendations and to confirm conditions between exploration locations. Subsurface conditions may vary from the locations explored and the extent of variation may only be known at the time of construction. Where variations occur, it is critical STRATA be afforded the opportunity to modify our report to reflect the site conditions exposed. This acknowledgment is in lieu of all warranties either express or implied.

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LEGEND

EXPLORATION TEST PITS - AUGUST 17, 2016. OBSERVED UNDOCUMENTED FILL DEPTH IS IN BRACKETS.

EXPLORATION PLAN
Spokane Community College
Building - 1 Expansion Project
1810 North Greene Street, Spokane WA

STRATA
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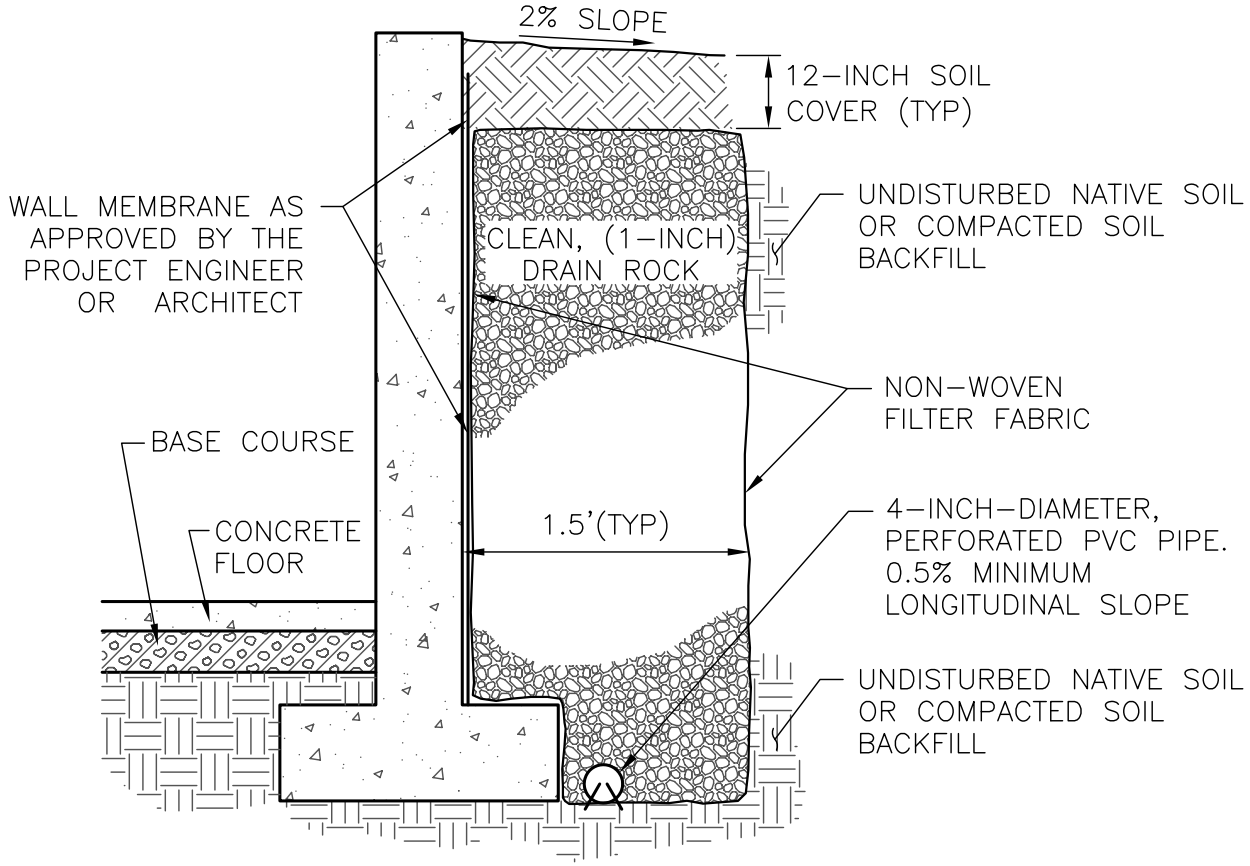
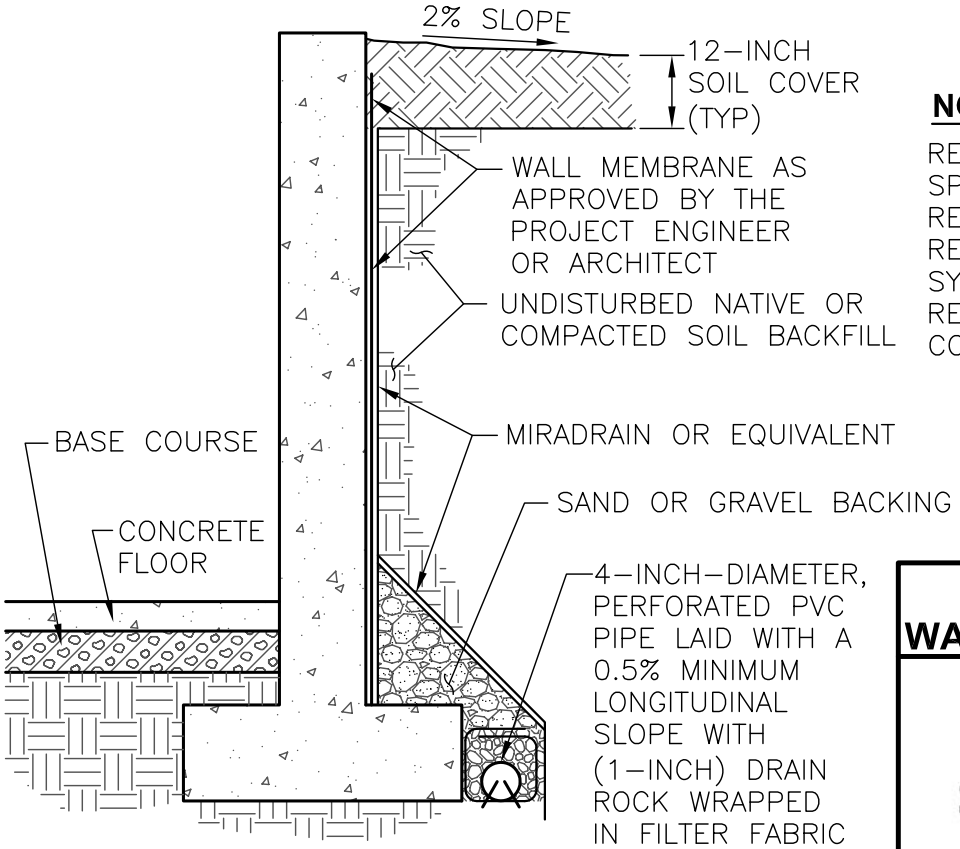
Integrity from the Ground Up

SP16068A	AUGUST 30, 2016	PLATE 1

NOTE:

THIS DRAWINGS' CROSS-SECTIONS MAY BE USED FOR GRAVITY WALLS. THIS IS NOT A STRUCTURAL DETAIL.





NOTE:

REFER TO MANUFACTURER'S SPECIFICATIONS AND TEXT OF REPORT FOR INFORMATION REGARDING DRAINAGE SYSTEM, WALL DESIGN AND RELATED GEOTECHNICAL CONSIDERATIONS.

INFORMATIONAL ONLY (NOT TO SCALE)

FOUNDATION AND WALL DRAIN SCHEMATIC

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SP16068A

PLATE 2

Appendix A

USCS Explanation and
Exploration Logs

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL NAMES
COARSE GRAINED SOIL	GRAVEL	CLEAN GRAVEL		GW	Well–Graded Gravel, Gravel–Sand Mixtures.
				GP	Poorly–Graded Gravel, Gravel–Sand Mixtures.
		GRAVEL WITH FINES		GM	Silty Gravel, Gravel–Sand–Silt Mixtures.
				GC	Clayey Gravel, Gravel–Sand–Clay Mixtures.
	SAND	CLEAN SAND		SW	Well–Graded Sand, Gravelly Sand.
				SP	Poorly–Graded Sand, Gravelly Sand.
		SAND WITH FINES		SM	Silty Sand, Sand–Silt Mixtures.
				SC	Clayey Sand, Sand–Clay Mixtures.
FINE GRAINED SOIL	SILT AND CLAY LIQUID LIMIT LESS THAN 50%			ML	Inorganic Silt, Sandy or Clayey Silt.
				CL	Inorganic Clay of Low to Medium Plasticity, Sandy or Silty Clay.
				OL	Organic Silt and Clay of Low Plasticity.
	SILT AND CLAY LIQUID LIMIT GREATER THAN 50%			MH	Inorganic Silt, Micaceous Silt, Plastic Silt.
				CH	Inorganic Clay of High Plasticity, Fat Clay.
				OH	Organic Clay of Medium to High Plasticity.
				PT	Peat, Muck and Other Highly Organic Soil

BORING LOG SYMBOLS	GROUNDWATER SYMBOLS	TEST PIT LOG SYMBOLS
Standard 2–Inch OD Split–Spoon Sample	Groundwater After 24 Hours	BG Baggie Sample
California Modified 3–Inch OD Split–Spoon Sample	(7–3–07) Indicates Date of Reading	BK Bulk Sample
Rock Core	Groundwater at Time of Drilling	RG Ring Sample
Shelby Tube 3–Inch OD Undisturbed Sample		

Shorthand Notation:
BGS = Below Existing Ground Surface
N.E. = None Encountered

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Integrity from the Ground Up

USCS Description	Depth (ft)	U.S.C.S. Class	Symbol	Sample Type	% Passing No. 200 Sieve	Dry Density (pcf)	Moisture Content (%)	Pocket Pen. (tsf)	Atterberg Limits LL PI	Remarks Note: BGS = Below Ground Surface
(SM) TOPSOIL - Silty SAND, (4") dark brown, loose, moist.	0.0	SM								Observed grass with moderate vegetation, organics and rootlets to 4.0 inches BGS.
(GM) UNCONTROLLED FILL - Silty GRAVEL with Cobbles and Boulders, light to dark brown, loose to medium dense, moist.	2.5	GM		BK BG	12.0 13.0		6.5 5.8			Observed cobbles and boulders up to 15 inches in diameter from 1.0 feet BGS to test pit termination depth. Abandoned metal pipe observed at 1.25 feet BGS and metal pipe debris observed at 1.5 feet BGS.
(GP-GM) ALLUVIUM - Poorly Graded GRAVEL with Silt, Sand, Cobbles, and Boulders, brown, loose to medium dense, moist.	5.0	GP-GM		BG						Test pit terminated at 6.0 feet BGS due to caving and sloughing conditions.

Test Pit Terminated at 6.0 Feet.

Client: ALSC Architects	**Test Pit Number:** TP-1	STRATA A Professional Services Corporation Integrity from the Ground Up	**EXPLORATORY TEST PIT LOG**
Project: SP16068A	**Date Excavated:** 08-17-2016		
Backhoe: CAT 416C	**Bucket Width:** 2.0 feet		
Depth to Groundwater: N.E.	**Logged By:** HRK		Sheet 1 Of 1

STRATA TEST PIT - STRATA.GDT - 8/29/16 15:40 - V:\ENGINEERING\SOFTWARE\GINT\PROJECTS\SP16068A TP-1 TO TP-2 SCC MAIN BUILDING RENOVATION.GPJ

USCS Description	Depth (ft)	U.S.C.S. Class	Symbol	Sample Type	% Passing No. 200 Sieve	Dry Density (pcf)	Moisture Content (%)	Pocket Pen. (tsf)	Atterberg Limits LL PI	Remarks Note: BGS = Below Ground Surface
(SM) TOPSOIL - Silty SAND, (4") dark brown, loose, moist.	0.0	SM								Observed grass with moderate vegetation, organics and rootlets to 4.0 inches BGS.
(GM) UNCONTROLLED FILL - Silty GRAVEL with Cobbles and Boulders, light to dark brown, loose to medium dense, moist.		GM		BG BG	19.0		7.2			Observed cobbles and boulders up to 15 inches in diameter from 1.0 feet BGS to test pit termination depth.
	2.5									
(GP-GM) ALLUVIUM - Poorly Graded GRAVEL with Silt, Sand, Cobbles, and Boulders, brown, loose to medium dense, moist.		GP-GM		BG	7.0		4.2			
	5.0			BG	6.3		4.2			Test pit terminated at 7.0 feet BGS due to caving and sloughing conditions.

Test Pit Terminated at 7.0 Feet.

Client: ALSC Architects	**Test Pit Number:** TP-2	STRATA A Professional Services Corporation Integrity from the Ground Up	**EXPLORATORY TEST PIT LOG**
Project: SP16068A	**Date Excavated:** 08-17-2016		
Backhoe: CAT 416C	**Bucket Width:** 2.0 feet		
Depth to Groundwater: N.E.	**Logged By:** HRK		Sheet 1 Of 1

STRATA TEST PIT - STRATA.GDT - 8/29/16 15:41 - V:\ENGINEERING\SOFTWARE\GINT\PROJECTS\SP16068A TP-1 TO TP-2 SCC MAIN BUILDING RENOVATION.GPJ