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A PROFESSIONAL SERVICES CORPORATION
Integrity from the Ground Up

October 13, 2016
File: BO16176A

Mr. Robert E. Reed, Jr.
Development Director
Affordable Housing Solutions
1276 River Street, Suite 300
Boise, Idaho 83702

RE: **Geotechnical Engineering Evaluation**
Proposed Sandhill Crane Apartments
West Moore Street and 32nd Street
Boise, Idaho 83702

Dear Mr. Reed:

STRATA, A Professional Services Corporation (STRATA) is pleased to present our authorized Geotechnical Engineering Evaluation for the proposed Sandhill Crane Apartments to be located near the intersection of Moore Street and 32nd Street in Boise, Idaho. Our evaluation's purpose was to explore the subsurface conditions in the proposed development area and provide geotechnical recommendations to assist project planning, design and construction. The attached report summarizes our field and laboratory test results and presents our geotechnical engineering opinions and recommendations.

The following report provides specific geotechnical recommendations for preparing the site, including earthwork site preparation, foundation and pavement section design. The project site is underlain by collapsible loess silty sand to a depth of 2.5 to 5.0 feet which will require remediation beneath building areas. The project design, owner, and construction team must read, understand and implement this report in its entirety. Portions of the report cannot be relied upon individually without the supporting text of remaining sections, appendices and plates. Our opinion is the success of the proposed construction will depend on following the report recommendations, good construction practices, and providing the necessary construction monitoring, testing and consultation to verify that work has been constructed as recommended. We recommend STRATA be retained to provide monitoring, testing, and consultation services to verify our report recommendations.

We appreciate the opportunity to work with Affordable Housing Solutions. We look forward to our continued involvement on this project throughout construction. Please do not hesitate to contact us if you have any questions or comments.

Sincerely,
STRATA

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Geotechnical Engineering Evaluation

Proposed Sandhill Crane Apartments
West Moore Street and 32nd Street
Boise, Idaho 83702

Prepared For:

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October 13, 2016

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INTRODUCTION

STRATA, A Professional Services Corporation (STRATA) has performed our geotechnical engineering evaluation for the Sandhill Crane Apartments planned near the intersection of West Moore Street and 32nd Street in Boise, Idaho. The project site location is illustrated on Plate 1, *Test Pit Location Plan*. STRATA accomplished our services referencing the scope of services presented in our June 8, 2016 proposal. Our evaluation's purpose was to assess subsurface conditions within the proposed project area and to provide geotechnical recommendations to assist project planning, design, and construction. Below, we outline the services accomplished in providing our geotechnical engineering evaluation:

1. Coordinated exploration with the Idaho Utility Notification Center and Mr. Reed, to help reduce the potential for damage to existing subsurface utilities due to exploration.
2. Accomplished subsurface exploration at the site via 5 exploratory test pits extending up to 12 feet below the existing ground surface. Approximate test pit locations are provided on the attached Plate 1.
3. Performed 2 infiltration tests referencing the *Ada County Highway District Stormwater Policy.*
4. Installed two groundwater observation wells in the test pits to evaluate groundwater level fluctuation.
5. Accomplished laboratory testing on select soil samples obtained during exploration referencing *ASTM International* (ASTM) procedures.
6. Performed engineering analyses to provide geotechnical recommendations for the planned development, including foundation, concrete slab-on-grade, pavement and subsurface stormwater disposal recommendations.
7. Prepared and provided this geotechnical deliverable including our engineering opinions and recommendations, exploration and laboratory test results. Site exploration plans and illustrative schematics are also provided.

PROJECT UNDERSTANDING

We understand 2 to 3-story, multi-family apartment buildings are planned to be constructed on the approximate 3-acre, undeveloped site located south of the intersection of West Moore and North 32nd Streets. North Whitewater Park Boulevard forms the west boundary and the extension of 32nd Street forms the north boundary for the project site. As part of this project, 32nd Street is planned to be extended from Moore Street to North Whitewater Park Boulevard. Currently the site is undeveloped and has a number of mature trees and vegetation. An open irrigation ditch with 12-inch culvert sections traverses the property from southeast to northwest. A sewer line traverses through the north portion of the site from N. 32nd Street to N. Whitewater Park Boulevard. Based on our review of historical aerial photographs, previous residential structures existed on the north portion of the site.

We understand Glancey Rockwell & Associates is the architect for this project. From our conversation with Jim Glancey, we understand the apartment structures will be predominantly 2 to 3-story, wood-frame structures with slab-on-grade with a 1-level community structure. Paved parking is planned in the interior of the site development. We anticipate stormwater will be retained on-site via subsurface seepage trenches. We anticipate the building loads will be relatively light (2 to 3 kips per lineal foot) for the apartment structures. We anticipate earthwork grading of less than 2 feet will be required to establish building floor level.

The extension of 32nd street from West Moore Street to North Whitewater Boulevard will require the installation of subsurface stormwater disposal trenches and the construction of a pavement section per Ada County Highway District ACHD requirements. Therefore, we performed infiltration testing, groundwater monitoring and R-value subgrade testing to support roadway design.

SUBSURFACE EVALUATION PROCEDURES

STRATA accomplished subsurface exploration on September 1, 2016, via 5 exploratory test pits extending up to approximately 12 feet below existing ground surface. The approximate exploration locations are illustrated on Plate 1, *Test Pit Location Plan,* which also delineates the proposed development area.

A staff geologist from our office visually evaluated the soil encountered in each test pit and logged the soil profile referencing the USCS. We provide a brief USCS explanation in Appendix A to help interpret the terms on the test pit logs. We also provide individual test pit logs in Appendix A. A piezometer for groundwater monitoring was installed in test pits TP-2 and TP-4. The test pits were backfilled with the excavated material to the ground surface following the completion of the excavations.

We performed in-situ infiltration testing to assist in evaluating stormwater disposal infiltration rates in the gravel subsoil. We accomplished infiltration testing referencing the *Ada County Highway District Stormwater Policy.*

SUBSURFACE CONDITIONS

Subsurface conditions encountered in test pits comprised near surface silty sand loess overlying poorly-graded sand or poorly-graded gravel with sand at depth. We observed limited vegetation and organics in the exploratory test pits up to approximately 6 inches below the ground surface. Beneath the surficial vegetation and organics, we encountered 3 subsurface soil units:

- Silty Sand (Loess) (SM): In test pits TP-1, TP-3, TP-4 and TP-5 we observed silty sand windblown loess at the ground surface across the site. The loess silty sand is collapsible when wetted and subject to load. The silty sand is brown, stiff and dry to moist and was observed to a depth of 2.5 to 5 feet beneath the surface. In test pit TP-2 we encountered sandy silty clay at the ground surface to a depth of 3 feet. The lean clay was brown, stiff and dry.
- Poorly-Graded Sand (SP): Underlying the silty sand in TP-1 we encountered brown to yellowish orange, dry, poorly-graded sand. The sand was observed from 5 to 7 feet and was loose and dry.
- Poorly-Graded Gravel with Sand (GP): Below depths of 2.5 to 5 feet, we encountered light brown, moist to wet, medium dense poorly-graded gravel with sand and cobbles. We observed fine to coarse sand and increasing cobbles with depth in the test pits. The gravel alluvium extended beyond the termination depth of the test pits. The gravel deposit is known to extend to depths of over 25 feet based on our observations at Ester Simplot Park to the west.

We encountered groundwater during exploration in all of the test pits at depths of 10.5 to 12.5 feet beneath the surface. We installed an observation well in TP-2 and TP-4 to allow for future groundwater monitoring at the project site. Groundwater monitoring for September and October showed the groundwater level to be 11 to 11.5 feet beneath the ground surface.

LABORATORY TESTING

We tested select soil samples obtained during exploration referencing ASTM procedures. Laboratory test results for moisture, dry density, grain size, Atterberg Limits R value and consolidation are summarized on the *Exploratory Logs* in Appendix A and the in Appendix B. We used test results to correlate soil design factors such as consolidation settlement, R value pavement subgrade and infiltration rates.

GEOTECHNICAL OPINIONS AND RECOMMENDATIONS

General

We present the following geotechnical recommendations to assist planning, design and construction of the proposed Sandhill Crane Apartments community planned at West Moore and North 32nd Streets in Boise, Idaho as illustrated on Plate 1 attached to this report. This report provides specific foundation and other geotechnical design criteria for the development which the structural and civil design and construction teams must review to verify the applicability to the planned structure as design is underway presently. We base our recommendations on the results of our field evaluation, laboratory testing, our experience with similar soil conditions and our understanding of the proposed construction. If design plans change or if the subsurface conditions encountered during construction vary from those observed during our field evaluation, we must be notified to review the report recommendations and make necessary revisions.

Geotechnical Constraints

Based on field exploration results, laboratory testing and engineering analysis, we have identified the following primary geotechnical concern associated with the proposed apartment development.

- **Collapsible Windblown Silty Sand- Loess:** The site is underlain by collapsible loess silty sand to a depth of approximately 2.5 to 5.0 feet where sand or gravel with sand is encountered. This loess will undergo collapse consolidation when loaded and wetted. Strain collapse of 1.3 percent under loading of 500 pounds per square foot (psf) and collapse of over 2 percent under loading of 2000 psf has been measured via collapse consolidation testing. Based on the consolidation test results settlement of over 1 inch is expected which can cause damage to the planned structures, floor slabs and flat work. Accomplishing limited excavation/backfill soil improvements beneath foundations and flatwork improvements can reduce, but not eliminate, the risk of collapse settlement of the underlying silty sand. If unforeseen water enters the loess silty sand below the soil improvements, settlement could occur which could cause distress to the overlying improvements. Alternately, removing all the loess silty sand to the underlying sand or gravel can mitigate future settlement of the loess, however, this is a costly solution. The owner has elected to accomplish the less costly limited soil improvements and accept the risk described above.

Our report specifically outlines our opinions and recommendations regarding these soil conditions and relies on geotechnical continuity, communication between project team members specific to risk and cost-based decisions, and good construction practices to achieve the desired project outcome for the project design team.

Earthwork

Excavation Characteristics

We anticipate site soil may be excavated using conventional excavation techniques. Carefully plan and implement temporary excavations to be sloped, shored, or braced in accordance with the OSHA excavation regulations, *Document 29, CFR Part 1926, Occupation Safety and Health Standards – Excavations; Final Rule*.

Regulations outlined by OSHA provide temporary construction slope requirements for various soil types and slopes up to 20 feet high. Based on our exploration results, we anticipate the silty sand and gravel encountered at the site is typically classified as Type C soil, which can be temporarily sloped as steep as 1.5H:1V (horizontal to vertical), when in a dry condition. Due to the potential for varying soil conditions during construction, we recommend earthwork contractors evaluate each slope configuration specific to *OSHA* guidelines and to seek appropriate professional guidance to create safe and stable excavations.

Construction vibrations can cause excavations to slough or cave. We do not recommend stockpiling materials adjacent to or within 10 feet of excavations, which may cause a surcharge and contribute to excavation instability. Ultimately, the contractor is solely responsible for site safety and excavation configurations factoring in water infiltration, construction access, adjacent loading, and other factors that contribute to excavation stability.

The earthwork contractor shall plan excavations with water collection points and utilize conventional sumps and pumps to remove groundwater and nuisance water from runoff, seeps, or precipitation. If site soil excavations are not immediately backfilled, they may degrade when exposed to runoff and require over-excavation and replacement with granular structural fill. We recommend construction activities and excavation backfilling be performed as rapidly as possible following excavation to reduce the potential for subgrades to degrade under construction traffic.

Establishing Subgrades (Building, Flatwork and Pavement Areas)

We provide the following recommendations for site preparation beneath building, flatwork and pavement areas. Please note that uncontrolled fill may be encountered associated with previous building and utility construction on the site. Previous sanitary drain fields from former residential construction may also be encountered. Removal and replacement with structural fill will be required where uncontrolled fill/drain fields are encountered beneath planned improvements.

- Excavate loose backfill from existing test pit locations and replace as structural fill for all test pits located below proposed buildings, flatwork or pavements.
- Excavate the exposed subgrade to the project design elevations and tolerances. Existing vegetation and organic soil must be completely removed below all foundation, slab and pavement areas. We encountered roots to depths of up to approximately 6 inches during exploration, however, we anticipate stripping depths will be greater near tree locations to remove tree roots and organic matter.

- Over excavate the loess silty sand to a depth of 2 feet beneath building foundations. The width of the over excavation should extend at least 1 foot beyond the edge of the foundation. The depth of over excavation should be 1 foot below floor slabs, flatwork and pavement areas.
- In foundation trenches moisture condition and proof compact the subgrade with a large vibratory hoe pack. In flatwork and pavement areas, moisture condition and proof roll the underlying excavated subgrade with a minimum of 5 passes of a 5 ton static drum weight vibratory roller. If weaving or unstable areas are observed by STRATA during proof compaction, these unstable areas should be removed and replaced with granular structural fill.

Earthwork contractors must expect substantial moisture-conditioning and compaction efforts to achieve a stable subgrade. If the subgrade is wet at the time of construction and compaction and moisture-conditioning is not practical, STRATA should be contacted to evaluate the use of a woven geotextile, as discussed in this report's *Geosynthetics* section. STRATA must observe and approve subgrade conditions and we recommend STRATA work with the earthwork and general contractors to help identify uncontrolled fill areas and provide quantity estimates.

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 project team and the contractor as the project moves forward regarding subgrade preparation procedures.

Structural Fill

All fill for this project must be placed as structural fill. Site soil (excluding topsoil containing vegetation and organics) may be re-used as *General Structural Fill* for site grading provided it meets the requirements in this report. The on-site silty sand loess can be reused as structural fill provided it can be moisture conditioned to near optimum moisture for compaction. Various imported fill materials will also be required throughout construction.

Our recommended material requirements for structural fill are provided, referencing the latest *Idaho Standards for Public Works Construction (ISPWC)* specifications. Project structural fill products are described in Table 1, below.

Table 1: Structural Fill Specifications and Allowable Use

Soil Fill Product	Allowable Use	Material Specifications
General Structural Fill	• Site grading, Over-excavations, temporary haul/access roads	• Soil must be classified as silt, sand, or gravel (GP, GM, GW, SP, SM, SW, or ML) according to the USCS. • Soil may not contain particles larger than 6-inches in median diameter. • Soil must consist of inert earth materials with less than 3 percent organics or other deleterious substances (wood, metal, plastic, waste, etc.).
Granular Structural Fill (Granular Subbase)	• Over-excavations, soil improvements, temporary haul roads, temporary platforms, Granular subbase, general structural fill	• 6-inch minus granular subbase meeting the latest requirements in *ISPWC*[1] *Section 801-Uncrushed Aggregates.*
Aggregate Base Course	• Foundation and slab support, soil improvements, asphalt pavement section aggregate, general structural fill	• Type 1 Crushed Aggregate meeting the latest requirements in *ISPWC*[1] *Section 802– Crushed Aggregates.*
Pipe Bedding	• Utility pipe bedding within 6 inches of the pipe invert	• Soil meeting requirements for Type I bedding as stated in the latest edition of the *ISPWC*[1]*, Section 305 – Pipe Bedding.*
Drainage Aggregate	• Infiltration features	• Aggregate meeting the latest requirements for 3-inch Drain Rock in *ISPWC*[1] *Section 801-Uncrushed Aggregates.*
Unsatisfactory Soil	• NONE	• Soil classified as MH, OH, CL, CH, OL, or PT may not be used at the project site. • Excess moisture does not render a soil unsatisfactory. Contractors must attempt moisture conditioning (i.e. wetting or drying) prior to soil disposal. However, soil not moisture conditioned to within 3 percent of optimum during compaction is unsatisfactory soil and requires additional moisture-conditioning. • Any soil containing more than 3 percent (by weight) of organics, vegetation, wood, metal, plastic or other deleterious substances.

[1] Idaho Standards for Public Works Construction

Other than topsoil encountered, the site soil is expected to be suitable for reuse as general structural fill, providing it can meet the criteria presented in Table 1 above and can be properly moisture conditioned for compaction.

Required Compaction

Place structural fill only over subgrades reviewed and approved by STRATA. Never place structural fill over frozen, saturated, or soft subgrades. Fill placed exclusively in landscape areas, not including fill embankments, can be placed as non-structural fill (i.e. landscape fill) providing there are no structures (sidewalk, curbs, utilities, signs, etc.) or embankments planned directly above the landscape fill. Structural fill products must be moisture conditioned to near optimum moisture content as defined by ASTM D1557 and placed in maximum 10-inch-thick, loose lifts. This lift thickness requires compaction equipment with energy ratings of at least 5 tons. If smaller or lighter compaction equipment is used, reduce the lift thickness to meet the compaction and moisture content requirements presented in Table 2: *Required Compaction for Designated Project Areas.*

Table 2: Required Compaction for Designated Project Areas

Project Area	Required Structural Fill Product	Compaction Requirement[1]
• Pavement and slab support aggregate • Foundation soil improvements • Site grading • Trench backfilling	• General structural fill • Granular subbase • Aggregate base	95 Percent

[1] Relative compaction and moisture content requirement compared to the maximum dry density of the soil as determined by ASTM D1557 (Modified Proctor).

Wet Weather/Wet Soil Construction

Once the subgrade elevation is achieved, it is the contractor's responsibility to protect the soil from degrading under construction traffic, freezing and/or wet weather. The condition of the subgrade and careful construction procedures are critical to embankment and subsequent foundation and slab stability and long-term performance.

We strongly recommend earthwork construction take place during dry weather conditions. The majority of the near surface on-site soil (silty sand and lean clay) will be susceptible to pumping or rutting from heavy loads such as rubber-tired equipment or vehicles any time of the year. If construction commences before soil can dry after precipitation or during wet periods of the year (November through April), the contractor must be prepared to achieve project requirements with respect to subgrades and structural fill placement. This may require earthwork to be completed by low pressure, track-mounted equipment that spreads and reduces vehicle load, or other means and methods.

Utility Trench Construction

Structural fill for utility trench backfill must be placed and compacted to the structural fill requirements presented herein. Loose soil must be removed from the base of utility trenches prior to placing pipe bedding. In addition, if water is encountered, it must be removed from the base of the utility trench before placing pipe bedding. We recommend utility pipes be placed on at least 4 inches of bedding conforming to *Table 1 – Pipe Bedding*, placed over undisturbed native soil, structural fill or otherwise supported according to the pipe manufacturer's specifications.

After bedding the pipe, place structural fill and compact it from the pipe invert to 1 foot above the top of the pipe with tamping bars and/or plate compactors to render the backfill in a firm and unyielding condition. Thoroughly place and compact bedding below pipe haunches or the zone between the pipe invert and the spring line. To accomplish backfilling, the distance between the side of the pipe at the spring line and the trench wall should be at least 12 inches. The remainder of the utility trench should be backfilled in accordance with this report's Structural *Fill* section.

Geotextiles

Non-woven geosynthetics are required for drainage facility construction. Additionally, geosynthetic fabrics can facilitate constructability over soft, wet subgrades. Geogrid reinforcement is not expected to be required unless extremely soft subgrades are encountered during construction. If or where required, geotextiles shall meet the minimum properties shown in Table 3 below:

Table 3: Geotextile Specifications

Geosynthetic Type	Use	Minimum Material Specifications
• Non-Woven Geosynthetic	• Surrounding drain rock in infiltration facilities	• Grab tensile strength: 120 pounds (ASTM D4632) • Puncture resistance: 3100 pounds (ASTM D6241) • Apparent opening size: US Sieve #70 (ASTM D4751) • Permittivity: 1.7 seconds^{-1} (ASTM D4491)
• Woven Geosynthetic	• Soft subgrade conditions	• Grab tensile strength: 350 pounds (ASTM D4632) • Puncture resistance: 1000 pounds (ASTM D6241)

Apply geosynthetics directly on approved subgrades, taut, free of wrinkles, and overlapped at least 12 inches. Consult STRATA to review geosynthetic applications or other subgrade improvement alternatives.

Foundation Design

We recommend shallow foundations bear on a minimum of 2 feet of structural fill over proof compacted native subgrade as described in the *Earthwork Section* of this report. Footing design must conform to the following criteria and the current IBC edition. The following foundation design parameters are based on the loads referenced in our *Project Understanding* and bearing foundations on soil improvements as described below. The following text presents our geotechnical recommendations, design requirements, and construction criteria for soil improvements and shallow foundations for the proposed buildings.

General

We recommend STRATA be retained to observe the foundation system installation including reviewing soil improvements, geosynthetics placement and subgrade compaction prior to placing concrete forms or concrete. Reviewing the soil improvement process and final foundation bearing surfaces helps confirm our allowable bearing pressures and settlement estimates and is an important part of the geotechnical design process.

Footings must extend at least 24 inches below the final exterior ground surface to help protect against frost action. Foundations must be structurally designed to conform to the latest edition of the *International Building Code* (IBC). The foundation bearing pressures presented below can be increased 30 percent to account for transitory live loads such as seismic and wind. In our opinion, long-term live loads such as equipment, fixtures, storage shelving, etc. should be considered in the total dead structural loads for the project. Our analysis utilizes a factor of safety against bearing capacity failure of 3.0 or greater. Settlement estimates and other design criteria are unfactored. Based on the estimated foundation loading conditions, the text below provides recommended design and construction criteria.

Bearing Soil

We recommend foundations be supported by a minimum of 2 feet of structural fill over proof compacted native subgrade as recommended in this report's *Establishing Subgrades* section to help provide a uniform bearing surface, improve constructability, and reduce foundation settlements. Structural fill must be placed below foundations and shall extend 1 foot laterally beyond the foundation edges.

Design Criteria

Foundations constructed on soil improvements as presented in this report may be designed using a maximum allowable bearing pressure of 2,500 pounds per square foot (psf). Mass concrete placed on soil improvements over compacted subgrades can utilize a friction coefficient (fs) of 0.40 to resist lateral loads. This coefficient must be reduced by 1/3 if concrete is not cast directly on soil such as for pre-cast panels. Interior foundations must maintain at least 4 inches of soil cover between top of the footing and the bottom of the concrete slab. Due to their propensity for reflective cracking, thickened slabs should be avoided if possible.

Using good construction practices and constructing during good weather, we estimate foundations bearing on subgrades prepared as recommended herein will realize up to 1 inch total and approximately 0.7 inches of differential settlement in a 30-foot span, assuming similarly loaded footings. Our settlement estimates rely on maximum 50 kip column loads and maximum 3 kips per lineal foot wall loads. Foundation loads greater than these should be analyzed for changes in settlement potential.

Where water accumulates at the foundation elevation, settlement may be in excess of our estimates and the building tolerances. Therefore, we recommend exterior grading provide adequate drainage away from the building.

Seismic Design Criteria

STRATA utilized, site soil, geologic data, the project location, the International Building Code (IBC), ASCE - 7 and the National Earthquake Hazards Reduction Program (NEHRP) to establish a Seismic Site Classification of “D” at the project site. We recommend seismic design reference the seismic parameters provided in Table 4 based on the soil conditions and project location. Furthermore, we consider the potential for liquefaction and lateral spread to be low.

Table 4: Seismic Response Criteria (2012 IBC/ ASCE 7)

Period (seconds)	Standard Acceleration Coefficients (g)	Site Factor for Site Class D	Modified Acceleration Coefficient for Site Class D (g)
0.0 (Peak)	PGA = 0.117	F_{PGA} = 1.566	PGA_M = 0.183
0.2 (Short)	S_S = 0.297	F_a = 1.562	S_{DS} = 0.310
1.0	S_1 = 0.104	F_v = 2.386	S_{D1} = 0.165

Concrete Slabs-On-Grade

Aggregate Support Section

Concrete slab-on-grade floors subjected to light loading (i.e. interior pedestrian floors) should be supported by at least 4 inches of aggregate base, as defined in Table 1, to provide a leveling course and capillary break for the slab. Aggregate base for slab support shall be placed over a compacted subgrade reviewed by STRATA conforming to the *Establishing Subgrades* and *Structural Fill* requirements in this report. Subgrade areas that become soft, loose, wet, or disturbed must be over-excavated to firm soil and replaced with granular structural fill. Place aggregate base and vapor retarders once the majority of under-slab plumbing and utilities are completed.

Floor slabs must be structurally 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 175 pounds per cubic inch (pci) for the compacted silty sand with 4 inches of aggregate base. However, if the subgrade is disturbed, wet or unstable, this value can be drastically less. Contrarily, if additional aggregate will be placed below the slab, the modulus of subgrade reaction may be higher.

Exterior Slab Considerations

Exterior slabs-on-grade exposed to higher loading may include dumpster pads, exterior slabs at entryways or other such high-traffic features. The project team should consider using an increased aggregate base support section below these exterior, high-traffic slabs, which is at least 12-inches thick and extends laterally at least 5 feet outside the where heavy equipment may operate.

Exterior slabs are susceptible to frost action which can generate substantial frost heave at certain times of the year. The potential for frost heave may not be acceptable at entries, work bays or other critical areas adjacent to the building that will be exposed to weather. One approach to provide partial frost protection requires removing 65 percent of material within the frost depth (approximately 16 inches) and replacing it with granular structural fill. If this method is employed, the over-excavated soil must be replaced with aggregate base course as specified in the *Structural Fill* section. Alternatively, if partial frost protection is unacceptable, over-excavation and aggregate base course replacement must be accomplished to the anticipated frost depth (24 inches).

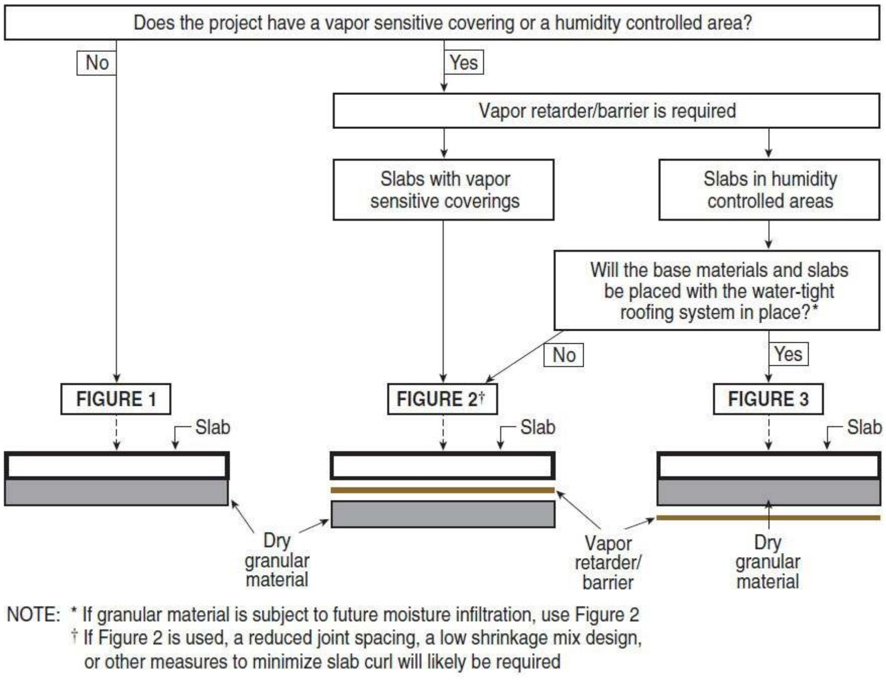
Vapor Retarder Use

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 floor coverings. Often, these moisture problems were associated with either no moisture protection below the slab or, alternatively, un- or inadequately 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-proof polyethylene sheeting placed immediately below the floor slab. An example of this material is Stego Wrap™, a 15-mil retarder. Alternatively, the vapor retarder may be covered with an additional 2-inch thick layer of clean, coarse sand placed between the crushed surfacing support layer and the concrete slab-on-grade floors. The subject of vapor retarder placement has been widely studied and discussed and a number or opinions regarding their applicable uses and placement exist. Extrapolated from American Concrete Institute (ACI) Figure 3-1 of ACI 302.1R-04, vapor retarder installation options are outlined in Figure 1: *Flow Chart to Evaluate Vapor Retarder Installation*, below.

Figure 1: Flow Chart to Evaluate Vapor Retarder Installation

(Adapted from Figure 3-1 of ACI 302.1R-04)



NOTE: * If granular material is subject to future moisture infiltration, use Figure 2
† If Figure 2 is used, a reduced joint spacing, a low shrinkage mix design, or other measures to minimize slab curl will likely be required

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. Where floor coverings or equipment must be protected from damage by moist floor conditions, we strongly suggest a vapor retarder be installed. 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, latent slab moisture, and/or the potential for slab curling.

Pavement Section Design

General

We understand North 32nd Street will be extended to North Whitewater Park Boulevard along the north portion of the site. Paved parking is planned to service the apartment development. The following flexible asphalt pavement section design is provided referencing the *Idaho Transportation Department (ITD) Gravel Equivalent Design Method* using *Ada County Highway District* (ACHD) substitution ratios. STRATA estimated traffic loading and design parameters based on our proposed construction understanding and our understanding of the subsurface conditions.

Traffic and Subgrade

The following tables present our traffic loading, geotechnical design parameters and references, as well as the resulting flexible pavement section design recommendations.

Table 6. Pavement Design Parameters

Design Parameter	Value Used	References
Traffic Loading	33,000 ESALS[1] (Local Road, TI=6)	Ada County Highway District Standard
Design Life	20 years	Assumed
Subgrade R-value	12	sandy clay subgrade
Asphalt Layer Substitution Ratio	1.95	Ada County Highway District Standard
Base Course Substitution Ratio	1.1	Ada County Highway District Standard
Subbase Course Substitution Ratio	1.0	Ada County Highway District Standard

[1] Equivalent Single Axle Loads (ESALs).

We anticipate subgrade soil for the North 32nd Street extension will vary from lean sandy clay based on TP-2 and silty sand based on TP-1. We have conservatively based our pavement design on the laboratory R-value of 12 for the sandy clay subgrade for roadway subgrade. To help improve subgrade characteristics and to meet the design requirements, the pavement subgrade should be prepared as recommended in this report's *Establishing Subgrades* section. Subgrades must be shaped (crowned) and graded to facilitate positive drainage and inverted crowns must be avoided.

Asphalt, Aggregate Base Course and Subbase Materials

Crushed aggregate base course and granular subbase shall conform to the *Structural Fill* requirements in Table 1 and be placed directly over a properly prepared subgrade. STRATA has been retained to observe final subgrade preparations, geotextile placement and all aggregate placements.

Compact asphalt concrete to between 92 and 96 percent of the maximum density for a Hveem or Superpave mix design. The final traveling surface of asphalt concrete shall meet ACHD asphalt mix design requirements. Asphalt mix designs and all appropriate aggregate source certificates should be accepted by STRATA at least 5 days prior to initiating asphalt paving. Asphalt construction and final surface smoothness, joints and density should meet ACHD specifications.

Pavement Section Thickness

STRATA evaluated the pavement sections utilizing the ITD pavement method with ACHD substitution ratios, correlated soil-engineering parameters from laboratory testing, and the estimated traffic-loading conditions. Based on subgrades prepared as recommended and the traffic criteria provided, Table 7 provides the recommended asphalt section for the anticipated private road pavement application. If subgrade conditions change as design is finalized or during construction, or traffic loading is different than we have assumed, STRATA must review our pavement analyses and resulting sections.

Table 7. Asphalt Pavement Design Section

Asphalt Pavement Application	Asphalt Concrete (inches)	Aggregate Base (inches)	Granular Subbase (inches)
N. 32nd Street (TI = 6)	2.5	4.0	12.0
Parking Area	2.5	4.0	9.0

Pavement Maintenance Considerations

We recommend crack maintenance be accomplished on all pavement surfaces every 3 to 5 years to reduce the potential for surface water infiltration into the underlying pavement subgrade. Surface and subgrade drainage are extremely important to the pavement section's performance. Therefore, we recommend the subgrade, aggregate base, and asphalt/concrete surfaces slope at no less than 2 percent to an appropriate stormwater disposal system or other appropriate location that does not impact adjacent buildings or properties. The pavement's life is dependent on achieving adequate drainage throughout the section and especially at the subgrade. Water that ponds at the pavement subgrade surface induces heaving during the freeze-thaw process, which can readily damage pavement.

Site Drainage

Stormwater Disposal

We performed infiltration testing within native, poorly-graded gravel with sand and cobbles encountered at depth across the site. We measured an infiltration rate of greater than 20 inches per hour during testing. Considering the relatively permeable gravel soil, we recommend all infiltration facilities extend a minimum of 1 foot into native, poorly-graded gravel soil. Approximate excavation depths of 4 to 5 feet below existing grade should be anticipated to expose native gravel alluvium. We recommend all subsurface infiltration facilities that extend into poorly-graded gravel with sand be designed using an allowable infiltration rate of 8 inches per hour, which includes a factor of safety of 2 or greater.

We encountered groundwater during exploration in all of the test pits at depths of 10.5 to 12.5 feet beneath the surface. We installed an observation well in TP-2 and TP-4 to allow for future groundwater monitoring at the project site. Groundwater monitoring for September and October 2016 showed the groundwater level to be 11 to 11.5 feet beneath the ground surface.

Groundwater in the site vicinity can be impacted by irrigation and can fluctuate seasonally with flow stage in the Boise River. Based on our experience in the area, we estimate typical seasonal high groundwater may occur at an approximate depth of 9 to 10 feet. Accomplishing groundwater monitoring during spring runoff from March to June 2017 can assist in accurately measuring seasonal high groundwater.

Exterior Grading

The underlying loess silty sand is susceptible to collapse settlement when wetted and load is applied, therefore, mitigating infiltration of surface water into the subgrade soil beneath buildings, flatwork and pavement is critical to future performance. Other than areas governed by ADA requirements, we recommend the ground surface outside of any structure be sloped a minimum of 5 percent away for 10 feet to rapidly convey surface water or roof runoff away from foundations. Remaining landscapes should slope at least 2 percent away from structures. Roof downspouts must be provided and connected to a solid pipe placed away from structures and not allowed to infiltrate into the collapsible loess silty sand underlying structures. Stormwater should be routed away from disturbed soil areas and should be disposed of in stormwater disposal facilities located at least 25 feet from the proposed building foundations. Irrigation within 10 feet of the buildings is discouraged.

ADDITIONAL RECOMMENDED SERVICES

Geotechnical Design Continuity

The information contained in this report is based on anticipated structural loads and current development plans provided the design team. 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 once final designs are completed to review our opinions and design recommendations contained herein.

Plan and Specification Review

We recommend STRATA be retained by the project owner 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. 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. If STRATA is not retained to provide these design verification services during construction, then we will no longer have geotechnical engineer-of-record continuity and cannot be responsible for design or construction errors or omissions. Consistent with the standard of care in the industry, the firm retained to accomplish this work will assume the responsibility as the geotechnical engineer-of-record.

EVALUATION LIMITATIONS

This geotechnical engineering report has been prepared to assist in planning, design, and construction for the proposed Sandhill Crane Apartments community at West Moore and North 32nd Streets in Boise, Idaho. Our scope does not include an engineering evaluation for deep foundations or concrete section pavement design. Variation in subsurface conditions may exist between or beyond our exploration locations, which can necessitate changes to the geotechnical recommendations in this report. Also, changes to the planned development can significantly 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.

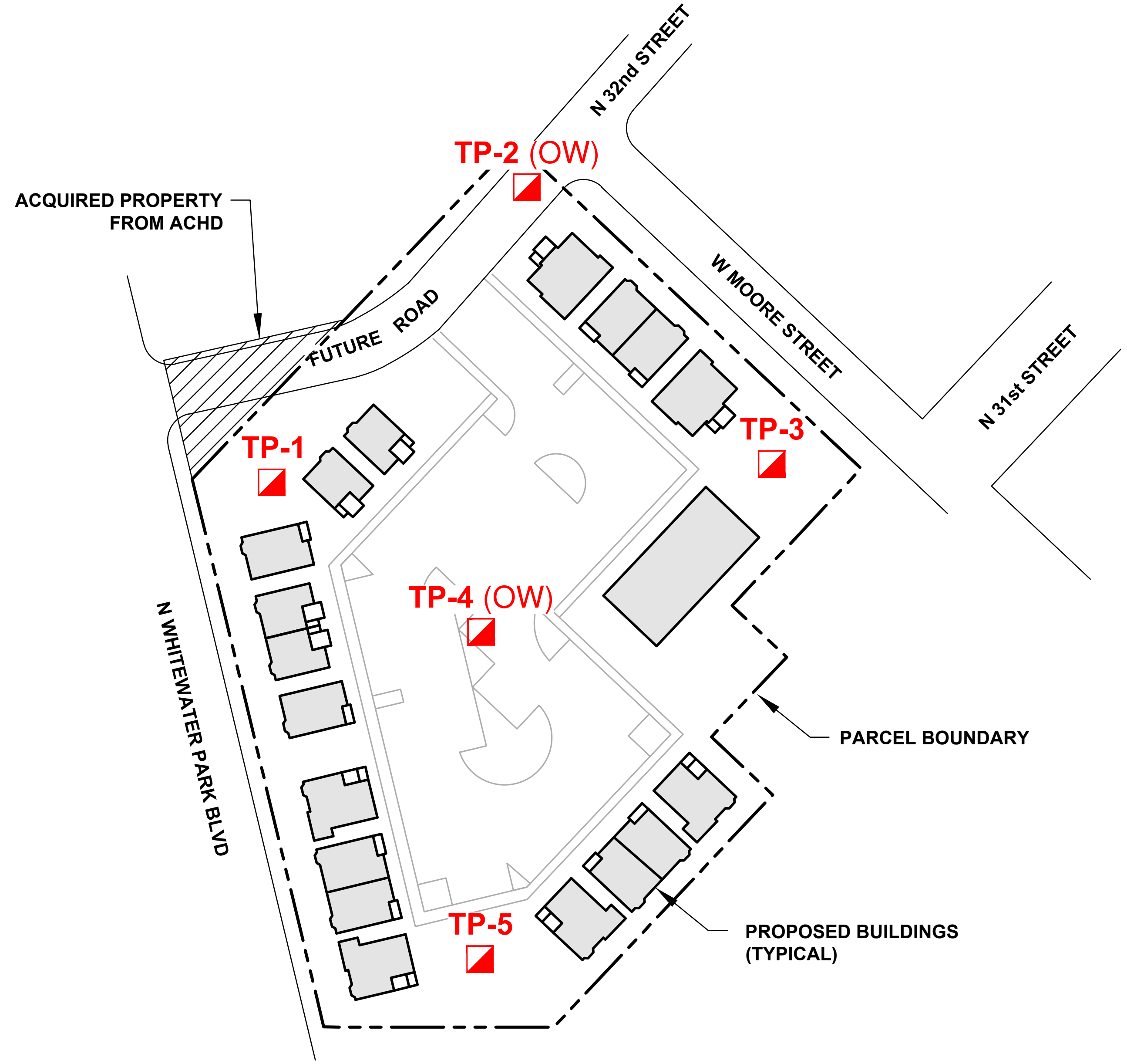
Exploration allows observing only a small portion of the site's subsurface conditions. Subsurface variations may not be apparent until construction. We recommend STRATA be retained to provide continuity throughout project design and construction to review site preparations, specifically slab and foundation excavations to verify the conditions encountered in exploration and relied on for design exist in the field and to identify any undocumented fill not encountered during exploration. If subsurface variations exist, they may impact the opinions and recommendations presented in this report, as well as construction timing and costs.

This report was prepared for the exclusive use of Affordable Housing Solutions 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.

The following plates accompany this report.

Plate 1: Test Pit Location Plan
Appendix A: Test Pit Logs and Unified Soil Classification System (USCS)
Appendix B: Laboratory Test Results

9/14/2016 12:30:10 PM - V:\STRATA - IDAHO PROJECTS\STRATA - BOISE PROJECTS\2016 PROJECTS\BO16176A - SANDHILL CRANE APTS\DRAFTING\BO16176A PLATE 1.DWG - MARIE TAYLOR



LEGEND

TP-2 🟥	Approximate test pit excavation location observed by STRATA on September 1, 2016.
(OW)	Indicates Observation Well

TEST PIT LOCATION MAP
Geotechnical Engineering Evaluation
Proposed Sandhill Crane Apartments
3099, 3101, 3113, & 3119 W, Moore Street
Boise, Idaho

N

0 50 100 200

SCALE: 1 inch = 100 ft

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DRAWN BY: MAT	CHECKED BY: AP
PROJECT NO: BO16176A	PLATE 1

THIS FIGURE COMPRIMISES A PORTION OF STRATA'S REPORT AND THE TEXT OF THE REPORT CONTAINS ESSESNTIAL INFORMATION: BEFORE UTILIZING THIS PLAN FOR ANY PURPOSE WHATSOEVER, THE REPORT SHOULD BE READ COMPLETELY. THIS FIGURE IS INTENDED TO HELP VISUALIZE THE INFORMATION PROVIDED BY OTHERS AND NO CHECK OF ACCURACY, CURRENCY, APPROPRIATENESS, ETC., OF INFORMATION PROVIDED BY OTHERS WAS PERFORMED, SINCE SUCH CHECKS WERE NOT PART OF STRATA'S SCOPE OF SERVICES.

APPENDIX A

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
SILTY SAND (LOESS), (SM) brown, hard, dry	0.0									Roots in upper 0.5 feet
				RG						
				BK	46.4		2.8	>4.5		
	2.5	SM								
POORLY GRADED SAND, (SP) yellowish orange, loose, dry	5.0									
		SP								
POORLY GRADED GRAVEL, With Sand And Cobbles, (GP) yellowish orange, loose to medium dense, dry to wet										
	7.5			BG	1.0		2.0			
	10.0	GP								
	12.5 ▽									

Test Pit Terminated at 13.0 Feet.

Client: Affordable Housing Solutions	**Test Pit Number:** TP-1	**EXPLORATORY TEST PIT LOG**
Project: BO16176A	**Date Excavated:** 09-01-2016	
Backhoe: CASE Extendahoe	**Bucket Width:** 3'	
Depth to Groundwater: 12.5'	**Logged By:** AP	Sheet 1 Of 1

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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	Atterberg Limits PI	Remarks Note: BGS = Below Ground Surface
SANDY SILTY LEAN CLAY, (CL) brown, stiff to very stiff, dry	0.0	CL	▨	RG							Roots in upper 0.5 - 1.0 feet
				BK	58.3	86.4	8.8	>4.5	25	6	R=12
	2.5										
POORLY GRADED GRAVEL, With Sand And Cobbles, (GP) light brown, loose to medium dense, moist to wet		GP	○	BG	2.5						Increasing cobbles, fine to coarse sand with depth
	5.0										Infiltration rate > 20 inches per hour at 5.0-6.5 feet
	7.5										
	10.0										
	▽										
	12.5										
Test Pit Terminated at 13.0 Feet.											Piezometer installed to 13 feet

Client: Affordable Housing Solutions	**Test Pit Number:** TP-2
Project: BO16176A	**Date Excavated:** 09-01-2016
Backhoe: CASE Extendahoe	**Bucket Width:** 3'
Depth to Groundwater: 11'	**Logged By:** AP

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EXPLORATORY TEST PIT LOG

Sheet 1 Of 1

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
SILTY SAND (LOESS), (SM) light brown, stiff, dry, with organics (tree roots)	0.0	SM		**BK**				>4.5			Roots in upper 0.5 feet
POORLY GRADED GRAVEL, With Sand And Cobbles, (GP) light brown, loose to medium dense, dry to wet	2.5	GP		**BG**	2.6						Increasing cobbles, coarsening sand with depth
	5.0										
	7.5										
	10.0										
	12.5										

Test Pit Terminated at 13.0 Feet.

Client: Affordable Housing Solutions

Project: BO16176A

Backhoe: CASE Extendahoe

Depth to Groundwater: 11.5'

Test Pit Number: TP-3

Date Excavated: 09-01-2016

Bucket Width: 3'

Logged By: AP

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EXPLORATORY TEST PIT LOG

Sheet 1 Of 1

STRATA TEST PIT - STRATA.GDT - 10/5/16 15:31 - V:\STRATA - IDAHO PROJECTS\STRATA - BOISE PROJECTS\2016 PROJECTS\BO16176A - SANDHILL CRANE APTS\GINT LOGS\BO16176A TP LOGS 10-4-16.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	Atterberg Limits PI	Remarks Note: BGS = Below Ground Surface
SILTY SAND (LOESS), (SM) brown, hard, dry, very fine sand	0.0	SM									Roots in upper 0.5 feet PID >4.5ppm
	2.5										
POORLY GRADED GRAVEL, With Sand And Cobbles, (GP) brown, medium dense to dense, dry to wet											Increasing cobbles, coarsening sand with depth
	5.0			**BG**	2.4		0.6				
											Infiltration rate > 20 inches per hour at 6 feet
	7.5	GP									
	10.0										

Test Pit Terminated at 12.0 Feet.

Piezometer installed to 12 feet

Client: Affordable Housing Solutions	**Test Pit Number:** TP-4
Project: BO16176A	**Date Excavated:** 09-01-2016
Backhoe: CASE Extendahoe	**Bucket Width:** 3'
Depth to Groundwater: 11'	**Logged By:** AP

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EXPLORATORY TEST PIT LOG

Sheet 1 Of 1

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	Atterberg Limits PI	Remarks Note: BGS = Below Ground Surface
SILTY SAND (LOESS), (SM) brown, stiff, dry, some organics	0.0 2.5	SM		RG				>4.5			Roots to 1 foot
POORLY GRADED GRAVEL, With Sand And Cobbles, (GP) light brown, medium dense, dry to wet	5.0 7.5 10.0 ▽	GP		BG							Increasing cobbles with depth

Test Pit Terminated at 12.0 Feet.

Client: Affordable Housing Solutions	**Test Pit Number:** TP-5	STRATA A Professional Services Corporation Integrity from the Ground Up	**EXPLORATORY TEST PIT LOG**
Project: BO16176A	**Date Excavated:** 09-01-2016		
Backhoe: CASE Extendahoe	**Bucket Width:** 3'		
Depth to Groundwater: 10.5'	**Logged By:** AP		Sheet 1 Of 1

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, Mica–ceous 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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APPENDIX B

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Summary of Test Results

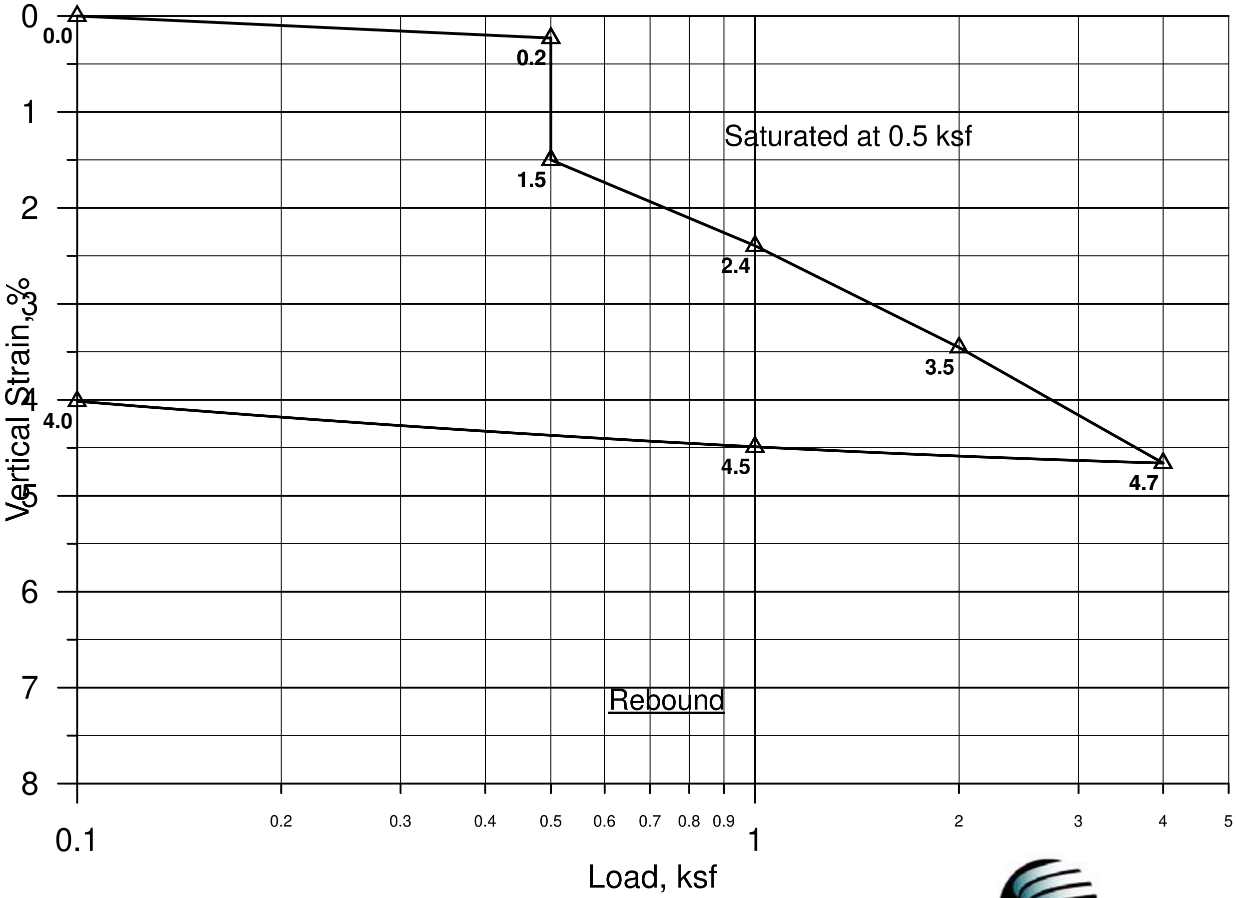
Project: Sandhill Crane Apartments
Client: Affordable Housing Solutions

Project Number: BO16176A
Date: 10/4/2016

Test Pit	Depth (feet)	Lab Number	Soil Classification (remarks)	Dry Unit Weight, pcf	In Situ Moisture, %	Passing No. 200,%	Atterberg Limits		Fines Class.
							LL	PI	
TP-1	1-1.5'	BO1600872	Silty Sand	91.9	3.6	46.4			SM
	7-7.5'	BO1600873	Poorly-Graded Gravel		2.0	1.0			GP
TP-2	1-1.5'	BO1600874	Sandy Silty Clay	86.4	8.8	58.3	25	6	CL/ML
	3-4'	BO1600875	Poorly-Graded Gravel			2.5			GP
TP-3	2.5-3'	BO1600885	Poorly-Graded Gravel			2.6			GP
TP-4	5-6'	BO1600886	Poorly-Graded Gravel		0.6	2.4			GP

CONSOLIDATION TEST RESULTS
ASTM D 2435 (Method A)

Project: Sandhill Crane Apartments
Client: Affordable Housing Solutions
Project Number: BO16176A
Lab Number: BO1600872
Sample Identification: TP-1 1-1.5'
Sample Classification: Silty Sand (Loess)
Sample: In-Situ Tube (Condition: Good)
Date Tested: 09/23/2016 By: KW
Sample Dry Unit Weight: 91.9 pcf
Moisture Content: 3.6%
Percent Passing #200: 46%



Reviewed By: ______________________

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R-VALUE
Idaho T 8

Project: Sandhill Crane Apts.
Client: Affordable Housing Solutions
Sample Identification:TP-2 1-1.5'
Sample Classification: Sandy Silty Clay
Liquid Limit: 25 Plastic Index: 6
Fines Class: ML/CL
Percent Minus #200: 58.3%

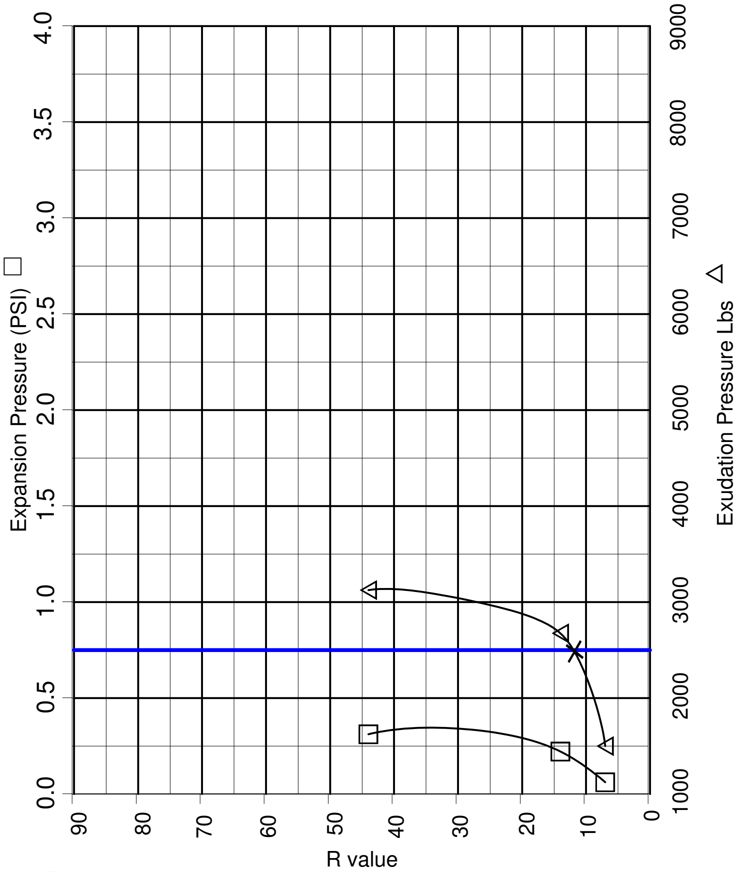
Project #: BO16176A
Lab Number: BO1600874
Date Received: 9/8/2016
Date Tested: 9/20/2016
By: K. Wildman

R VALUE DATA

Percolation: None	Point 1	Point 2	Point 3
Exudation, PSI	119	213	249
Dry Density, PCF	95.8	100.2	97.7
Moisture Content, %	23.3	22.1	19.7
Exp. Pressure, PSI	0.06	0.22	0.31

SOIL CONSTANTS

R VALUE: 12



GRADATION: AASHTO T-11, T27

SCREEN SIZE	AS RECEIVED % PASSING	AS TESTED % PASSING
4"		
3"		
2"		
1"		
3/4"		
1/2"		
3/8"		
No. 4	100	100
No. 8		
No. 16		
No. 30		
No. 50		
No. 100		
No. 200		

Note: This report covers only material as represented by this sample and does not necessarily cover all soil from this layer or source.

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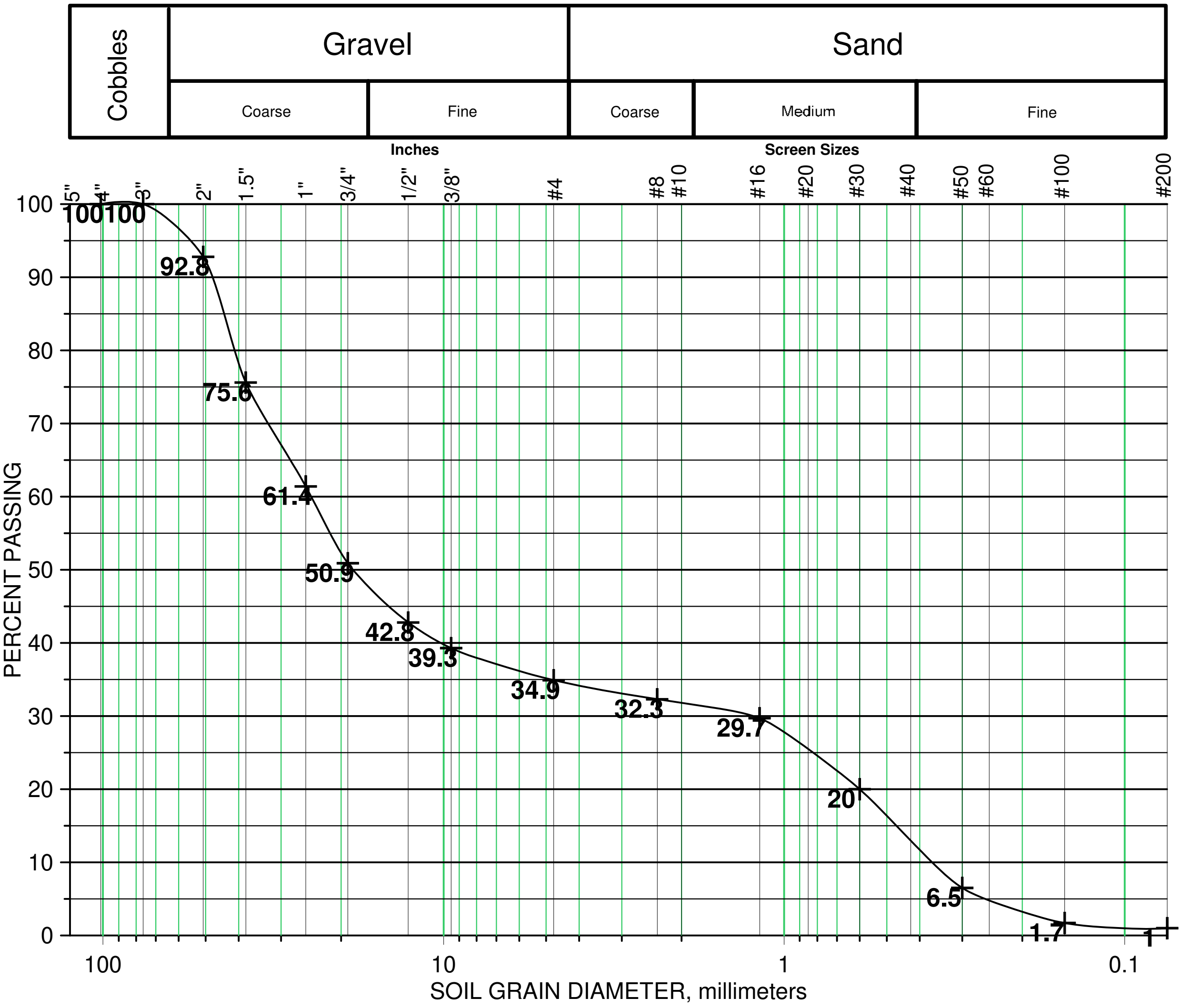
GRADATION ANALYSIS
ASTM D 6913

Project: Sandhill Crane Apartments
Client: Affordable Housing Solutions
Project Number: BO16176A
Lab Number: BO1600873
Sample Identification: TP-1   7-7.5'
Sample Classification: Poorly Graded Gravel With Sand
Date tested: 9/23/2016   By: K. Wildman
Moisture Content: 2%



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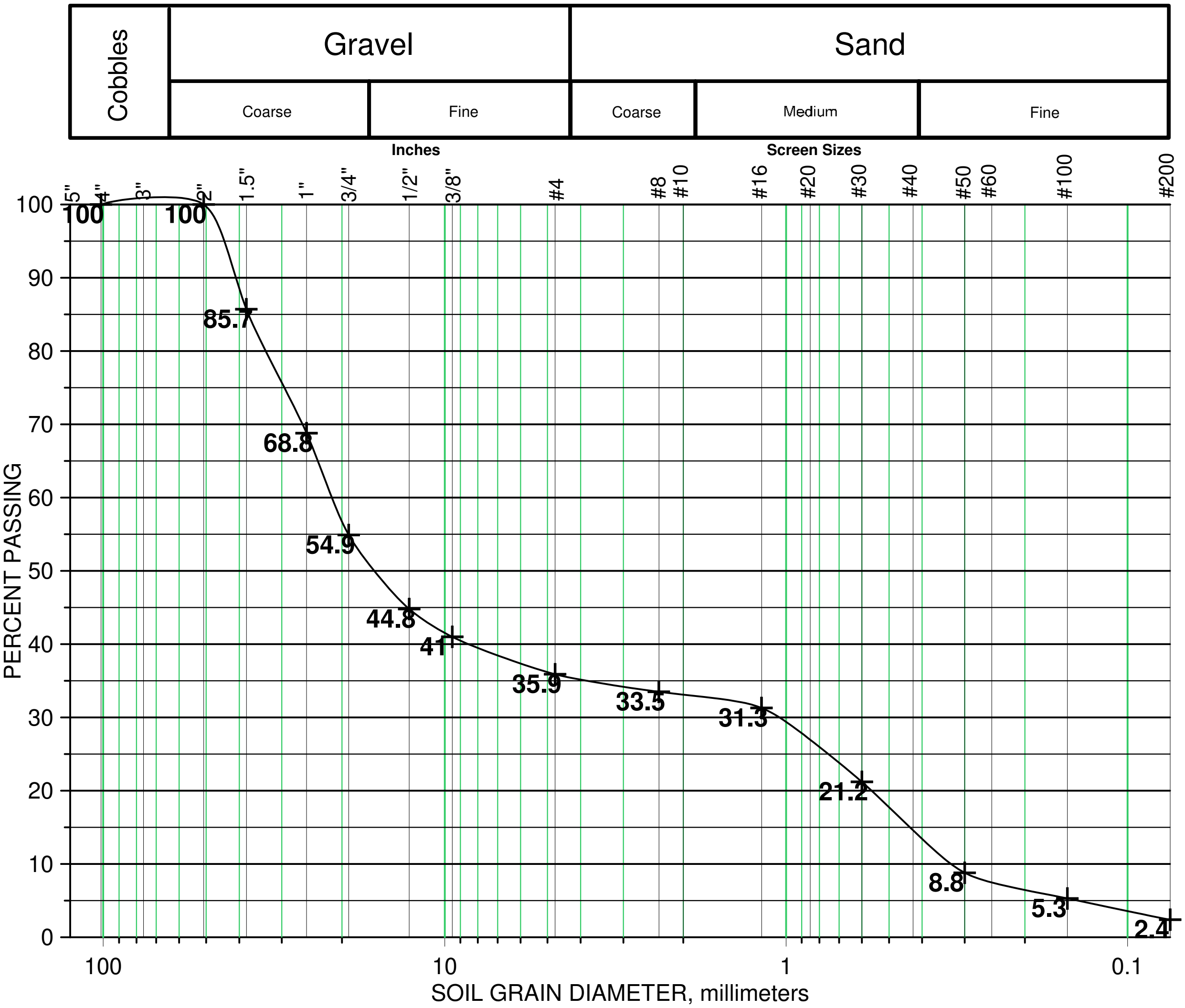
GRADATION ANALYSIS
ASTM D 6913

Project: Sandhill Crane Apartments
Client: Affordable Housing Solutions
Project Number: BO16176A
Lab Number: BO1600886
Sample Identification: TP-4 5-6'
Sample Classification: Poorly Graded Gravel With Sand
Date tested: 9/23/2016 By: K. Wildman
Moisture Content: 0.6%



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