STRATA
Integrity from the Ground Up

October 9, 2017
File: PO17066A

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RE: **Geotechnical Engineering Evaluation**
Tigert Middle School Additions
250 East 2nd South
Soda Springs, Idaho

Dear Mr. Balls:

Strata, Inc. (STRATA), is pleased to present our authorized Geotechnical Engineering Evaluation for the proposed Tigert Middle School Additions located at the Tigert Middle School in Soda Springs, Idaho. Our Geotechnical Engineering 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 proposed development area is underlain by undocumented fill of variable thickness extending up to 9.5 feet below existing site grades. The fill is underlain by compressible lean clay overlying basalt bedrock which varies in depth. The following report provides specific geotechnical recommendations for preparing the site, including earthwork activities, foundation design, and construction recommendations. It is our opinion that geotechnical continuity with the project team throughout design and construction will assist in addressing project constraints and confirming our design assumptions and recommendations.

The project design team, 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, employing 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 during construction to verify our report recommendations are being followed.

We appreciate the opportunity to develop our professional relationship with the Soda Springs Jt. School District No.150 (District 150) and the project owner and design team. 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
Tigert Middle School Additions
250 East 2nd South
Soda Springs, Idaho

PREPARED FOR:
Soda Springs Jt. School District No. 150
Mr. Jonathan Balls
250 East 2nd South
Soda Springs, Idaho

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October 9, 2017

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Tigert Middle School Additions
Soda Springs, Idaho

INTRODUCTION

Strata Inc. (STRATA) is pleased to provide our geotechnical engineering evaluation for the proposed Tigert Middle School Additions located at the Tigert Middle School in Soda Springs, Idaho. We understand the project will include construction of a new gymnasium and classroom addition at the existing Tigert Middle School. We accomplished this evaluation referencing our proposal dated August 9, 2017. To accomplish our evaluation, STRATA performed the following services:

1. Reviewed the project information received from Mr. Jonathan Balls, with respect to existing site conditions, proposed construction, and required engineering parameters.
2. Reviewed geologic maps, aerial photographs, and well logs in the area to gain an understanding of anticipated subsurface conditions.
3. Pre-marked exploration locations selected by District 150, and contacted the regional utility mark-out service, Dig-line, to reduce the potential for damage to existing public utilities.
4. Subcontracted to advance 8 exploratory borings within the proposed development area and in general accordance with the predetermined boring location plan provided to us. The exploratory borings were performed on August 31, 2017. Boring locations are provided on Plate 1: *Exploration Location Plan*. Exploratory borings extended between 8 feet and 26.5 feet below the existing site grades. We visually described, classified, and logged the soil encountered referencing the *Unified Soil Classification System* (USCS).
5. Performed laboratory tests with reference to *ASTM International* (ASTM) procedures. We utilized the laboratory results to help verify soil classification and to correlate soil engineering characteristics used in our design. The soil index properties are included on the boring logs and the laboratory testing summary is presented in Appendix B of this report.
6. Performed engineering analyses in order to provide geotechnical design and construction recommendations. Our engineering analyses provided geotechnical earthwork recommendations and geotechnical foundation design recommendations for the proposed construction.
7. Prepared and provided an electronic copy of our finalized geotechnical findings and opinions including exploration logs and laboratory test results.

PROJECT UNDERSTANDING

Site Description

The proposed development area consists of both developed and undeveloped areas. The developed areas include the existing middle school, gymnasium and administration buildings as well as asphalt, gravel, and landscaped surfaces. We understand some site structures have been previously demolished in the development area. Additionally, we understand that previous fill placement has been performed throughout the site establish existing grades and that no documentation of the fill placement exists.

Proposed Construction

We understand Soda Springs School District No. 150 (District 150) plans to construct a new gymnasium and classroom addition attached to the existing Tigert Middle School. The new gymnasium will be located east of the main building, and the classroom addition will be located north of the main building (northwest corner). We understand the additions will consist of single-story CMU structures, with approximate footprint areas of 19,250 square feet (ft^2) and 4,900 ft^2 for the gymnasium and classroom additions, respectively. Furthermore, the existing gymnasium, located just south of the proposed gymnasium, is planned to be removed to make room for a new asphalt paved parking lot. We also understand that the finished floor elevations will generally correspond with the existing school elevations, and that overall site grading will require up to approximately 2 to 3 feet of cuts and/or fills.

At the time of preparation of this report, estimated structural loads had not yet been specified and as such assumed loading conditions were utilized for accomplishing settlement estimates. We do not anticipate significant below grade features (basements, pits …etc.) or any significant dynamic loads. Additionally, traffic loading and frequencies are anticipated to be comprised primarily of passenger vehicles and school buses.

FIELD EXPLORATION

Subsurface Exploration

STRATA drilled and observed 8 soil borings on August 31, 2017. Borings were advanced to depths between approximately 8 feet and 26.5 feet below existing site grades. We provide exploration locations on Plate 1 and the *Exploration logs* in Appendix A.

Exploration was performed using a CME 85 drill rig equipped with an 8" outside diameter hollow stem auger. A geotechnical engineer logged and visually classified soil encountered in each boring referencing the Unified Soil Classification System (USCS). A brief explanation of the USCS is included in Appendix A and should be used to interpret terms presented on the boring logs in this report. STRATA obtained disturbed and relatively undisturbed soil samples of the respective soil profiles at select depths via 2-inch outside diameter, split-spoon samples driven with a 140 pound automatic hammer falling 30 inches, as well as a 3-inch outside diameter shelby tube sampler, driven with direct push. The standard penetration test (SPT) N-values (in blows per foot) were recorded on the boring logs for soil samples recovered with split spoons samplers. No modifications or corrections have been performed to the reported N Values. We also obtained bulk samples of the soils encountered within the upper 5 feet of the soil profile. Sampling was accomplished referencing ASTM D1586, for 2-inch outside diameter split spoon, and ASTM D1587, for Shelby tube, samplers. Samples recovered were packaged, labeled, and transported back to our laboratory for testing.

At the conclusion of our subsurface investigation, borings were backfilled with bentonite chips as required by the Idaho Department of Water Resources (IDWR) and marked with a painted lath for location during future site survey, if desired.

SUBSURFACE CONDITIONS

Subsurface conditions varied significantly between the classroom addition and gymnasium development areas. Generally, surficial conditions included topsoil with grass and significant organics within the upper 4-6 inches. The topsoil is generally underlain by undocumented fill, underlain by native lean clay, underlain by basalt bedrock. We provide additional detail of each soil unit's stratigraphic location and properties below:

- **Topsoil** - We encountered brown topsoil consisting of clay with variable amounts of sand and gravel in the upper 4 to 11 inches at all boring locations. The topsoil generally contained significant organics in the upper 4 to 6 inches of the soil profile.
- **Undocumented Fill** - We encountered undocumented fill of variable soil type at each boring location across the site with the exception of B04-STR-17. The undocumented fill varied in depth by location and was observed to extend between approximately 2 to 9.5 feet below grade. The fill ranged in classification from silty sand, clayey sand and poorly graded sand with silt and/or gravel to silty gravel and poorly graded gravel with sand. In the classroom addition area, the fill was generally observed to be orange to tan silty sand. In the gymnasium addition area, fill soil types were variable.
- **Lean Clay** - We encountered native brown, moist, and stiff to very stiff lean clay with variable sand content in all borings. Based on the soil structure the clay appeared to be a windblown (loess) deposit and was generally encountered below topsoil and undocumented fill, and extended to a depth between approximately 7 to 18 feet below grade. Additionally, basalt cobbles and/or boulders were observed within this layer, typically above/near the basalt bedrock contact.

- **Basalt Bedrock** - We encountered grey to black basalt bedrock below the clay in all borings except B05-STR-17 and B06-STR-17. The basalt was encountered at variable depths between 7 and 18 feet at boring locations. Additionally, the basalt was observed to be highly weathered to slightly weathered, with weathering generally decreasing with depth. Where encountered, the basalt extended to the termination depth of each boring. The transition between lean clay and bedrock may be gradual.

We encountered groundwater during our exploration between depths of 16.8 and 20.4 feet below grade. The groundwater may be perched above the basalt bedrock. Based on Idaho Department of Water Resources (IDWR) well drilling reports, groundwater in the area is variable and can be encountered between 5 and 20 feet below ground surface. Groundwater elevations should be expected to fluctuate throughout the year and will primarily be influenced by the stage and flow of the Bear River and Alexander Reservoir. The degree of fluctuation at this site is unknown.

LABORATORY TESTING

We returned soil samples collected in the field to our laboratory for further classification and testing. We accomplished laboratory testing referencing ASTM procedures. We developed our geotechnical laboratory testing program for this project primarily to verify soil classification through index testing, as well as to evaluate strength and deformation characteristics of the soil encountered. Specifically, we accomplished the following laboratory testing:

- USCS Classification (ASTM D2487)
- Moisture content (ASTM D2216)
- No. 200 wash (ASTM D1140)
- Unit weight (ASTM D2937)
- Atterberg Limits (ASTM D4318)
- pH (ASTM G51)
- Resistivity (ASTM G187)
- Soluble Sulfate content (ASTM C1580)
- California Bearing Raito (ASTM D1883)
- 1-D Consolidation Collapse (ASTM D5333)

Laboratory testing results are presented in *Appendix B*. Index testing results are also included on the boring logs in *Appendix A.*

GEOTECHNICAL OPINIONS AND RECOMMENDATIONS

Geotechnical Constraints and Considerations

Based on the results of our field exploration and laboratory testing program we anticipate the following considerations will be the primary project constraints from a geotechnical standpoint:

- **Undocumented Fill:** Undocumented fill was observed to depths of 2 to 9.5 feet throughout the site and it will be encountered during construction. Any existing non-native soil at the project site, or native soil that has been reworked, is considered undocumented fill. Although, the fill in the classroom addition area generally indicated medium dense to very dense conditions, and appeared to be of similar soil type between locations, no documentation of its placement (controlled or otherwise) exists and as such is considered undocumented fill. Undocumented fill is likely associated with a variety of previous site activities, including grading, building construction/demolition, utility installation, and other activities that may not be apparent at this time. During excavation, earthwork contractors may encounter debris, abandoned utilities, and other non-uniform conditions within the undocumented fill, the extent of which may not be apparent prior to construction. The properties of undocumented fill can vary significantly between locations and create the potential for non-uniform bearing conditions beneath potential site improvements. Typically, in order to maintain uniform support conditions, undocumented fill is removed from below structure foundations or foundation support is extended through the undocumented fill. Removal of undocumented fill below other site improvements should also be considered, dependent on the project owners preferred risk tolerance and desired level of investment. We provide additional discussion on undocumented fill removal within the site preparation section of this report.

- **Native (Loess) Lean Clay:** The site is underlain by native lean clay that is likely windblown (loess) in origin. The depth and thickness of this soil varies, but was observed to be up to 18 feet thick (not including undocumented fill). The lower portion of this soil contains basalt rock fragments. Based on laboratory testing the collapse potential of this soil type was low, however, the soil is compressible and will undergo consolidation settlement when loaded.

- **Considerations:** Considering the geotechnical constraints at this site, project economy and risk tolerance should be carefully evaluated prior to finalizing design. Based on observed fill thicknesses and compressibility of the underlying clay soil improvements (over excavation and backfill) will be required to provide shallow foundation support. Alternately, deep foundation support via helical piers or micropiles bearing in the underlying basalt rock may be considered. However, based on our scope of services, our recommendations are limited to shallow foundations. Furthermore, presence of undocumented fill will impact final design of floor slabs and pavements.

Earthwork

Excavation Characteristics

We anticipate near-surface undocumented fill and lean clay may be excavated using conventional excavation techniques. However, special provisions may be necessary to remove/excavate the basalt bedrock, if encountered. We recommend the earthwork contractors closely review subsurface conditions presented in this report and select appropriate excavation methods.

Site excavations must be sloped in accordance with the *Occupational Safety and Health Administration* (OSHA) regulations and local codes. The site soils encountered in the upper 26.5 feet vary in classification, and we anticipate lean clay soils will be classified as “B,” type soil and undocumented fill will be classified as “C” type soil according to OSHA requirements. Unless otherwise classified by a competent individual, we recommend provisions be made to allow temporary excavations of type “B” soil to be sloped to at least 1H: 1V and type “C” soil to be sloped to at least 1.5H: 1V in accordance with OSHA recommendations. Surcharges must not be allowed within a horizontal distance equal to one-half the excavation depth. Construction vibrations can cause excavations to slough or cave. Ultimately, the contractor is solely responsible for site safety and excavation configurations.

Temporary Shoring and Underpinning

Based on the potential deep undocumented fill removal (to a depth up 9.5 ft) and the proximity of existing site structures to proposed structures, the contractor must carefully plan excavations adjacent to existing structures to avoid undermining foundations, slabs and utilities. Where proper setbacks cannot be accommodated and/or undermining is possible shoring options should be evaluated and included in project planning. Furthermore, underpinning of existing foundations may be required depending on structure location, existing foundation depths, and the limits of soil improvement over excavation. We recommend temporary shoring and underpinning be designed and sealed by a licensed professional engineer.

Subgrade and Site Preparation

Soil containing significant organics must be stripped and removed from the site or stockpiled for re-use in landscaping applications. We anticipate stripping of approximately 6 inches will be required, depending on location. However, topsoil thicknesses can vary and additional stripping may be necessary in select locations such as tree and shrub removal areas.
Aligned with geotechnical standard-of-care, and to reduce the risk of foundation settlement, we recommend **all undocumented fill be removed beneath planned foundations or use of deep foundations, extending through the undocumented fill, be evaluated.** If District 150 elects to leave the undocumented fill beneath any site improvements (foundations, slabs-on-grade, asphalt pavements, exterior hardscapes…etc.), STRATA accepts no risk associated with site improvement performance and maintenance as **constructing over undocumented fill is not without risk of settlement, ponding, increased weathering, and long-term distress.**

We provide the following relative risk summary for potential settlement within slab on grade, asphalt paved, and hardscape areas for consideration:

- Low Risk – Complete removal and replacement of undocumented fill and topsoil with compacted *Structural Fill*.
- Moderate Risk – Removal of topsoil and partial removal of undocumented fill beneath slabs on grade, asphalt pavement and/or hardscape areas. Removal of upper 12 inches of undocumented fill, compact the subgrade as required in the *Subgrade Preparation* section, followed by placing compacted *Structural Fill* to pavement subgrade elevations.
- High Risk – Removal of topsoil but no removal of undocumented fill beneath slabs on grade, asphalt pavement and/or hardscape areas. Topsoil must be removed. Compact the subgrade as required in the *Subgrade Preparation* section, followed by placing compacted *Structural Fill* to design elevations.

In foundation areas, preparation of subgrades for fill placement or foundation placement can commence once topsoil and undocumented fill is removed. Removal of undocumented fill to depths up to 9.5 feet below existing grade could cause undermining of existing foundations, floor slabs and utilities and may require underpinning of existing structures. Considering the above discussion, we provide the following recommendations for site preparation following topsoil and undocumented fill removal:

- Excavate the exposed subgrade to the project design elevations and tolerances including necessary over excavations discussed within the foundation section of this report. Scarify, moisture condition and compact the exposed native subgrade. Moisture conditioning may include aeration or adding moisture. Compaction must be performed referencing structural fill criteria presented in Table 1 to improve support characteristics.
- Where clay subgrade is encountered in deep soil improvement excavations, use a smooth blade bucket to excavate the clay to mitigate disturbance. In lieu of compacting the clay subgrade, use a woven geotextile on the bottom and side walls of the trench if the clay has a pocket penetrometer reading of less than 1.5 tons per square foot (tsf). No geotextile required for clay with greater than penetrometer reading of 1.5 tsf.
- Place and compact structural fill as required to achieve proposed grades and/or minimum foundation support requirements.

Structural Fill

All fill placed under foundations, slabs-on-grade, pavements, and hardscapes for the development must be placed as structural fill. Generally, our recommended material requirements for structural fill follow Idaho Standard for Public Works (ISPWC) requirements. Project structural fill materials and compaction requirements are described in Table 1 below.

Table 1. Structural Fill Specifications and Allowable Use

Soil Material • Allowable Use	**Material Specifications**	**Sieve Size**	**% Passing**	**Minimum % Compaction (ASTM D 1557)**
Unsuitable Soil • NONE	• Soil classified as CL, CH, MH, OH, OL or PT may not be used at the project site for structural fill. • Soil not maintaining moisture contents within recommended range. • Any soil containing more than 3 percent organics by weight or other deleterious substances (wood, metal, plastic, waste, etc.) is unsatisfactory soil.	N/A	N/A	N/A
Subgrade Soil	• Base of any depression created by topsoil or fill removal, or over excavations • Base of foundation soil improvement sections • Base of any utility trench • Base of hardscape or slab section(s) • Any in-situ soil surface to receive fill	N/A	N/A	90 (+/-3% Moisture)
General Structural Fill • General site grading • Over excavation backfill placement	• Soil classified as GP, GM, GW, SP, SW, SM, according to the USCS. • Soil must exhibit plasticity Index of less than 20 • Soil must consist of inert earth materials with less than 3 percent organics or other deleterious substances (Wood, Metal, Plastic, Waste…etc.)	6 inch	100	95 (+/-2% Moisture)
Granular Structural Fill • Over-excavations • Foundation support General structural fill	• Soil meeting requirements stated in the latest edition of the *Idaho Standard for Public Works Construction (ISPWC), Section 801 – Uncrushed Aggregates.* • Soil may not contain particles larger than 6 inch in median diameter and must meet the required gradation.	6 Inch No. 4 No. 200	100 15-60 0-12	95
Aggregate Base Course • pavement base course • slab support • Granular and general structural fill	• Soil meeting requirements stated in the latest edition of the *Idaho Standard for Public Works Construction (ISPWC), Section 802 – Aggregate Base.* • Soil may not contain particles larger than 1 inch in median diameter and must meet the required gradation.	1 Inch ¾ Inch No. 4 No. 8 No. 200	100 90-100 40-65 30-50 3-9	95

The existing undocumented fill could be reused as structural fill beneath foundations and floor slabs provided it is moisture conditioned to near optimum moisture content for compaction. The on-site silty sand and silty gravel fill is moisture sensitive and can be difficult to reuse as structural fill during inclement weather. An allowance for importing granular structural fill should be considered if construction proceeds during inclement weather.

Structural fill materials and existing subgrades must be moisture conditioned to near optimum moisture content, placed in maximum 10-inch-thick, loose lifts and compacted to the requirements stated in Table 1. The above assumes large, appropriate compaction equipment with a drum weight of 5 tons or greater are used to attempt compaction. If smaller or lighter compaction equipment is provided, reduce the lift thickness to meet the compaction requirements presented herein.

Material with greater than 30 percent retained above the ¾-inch sieve is too coarse for proctor density testing, but may be used as general structural fill. However, compaction testing must be accomplished for coarse fill. Coarse fill must be compacted using a "method specification" developed during construction and based on density testing, considering the material characteristics and the contractor's means and methods. It is common that "method specifications" are developed during construction, specific to the materials and conditions encountered. At a minimum, STRATA recommends coarse, granular fill be placed in maximum 10-inch lifts and compacted with 6 complete passes of a 10-ton, vibratory or grid roller. Vibratory rollers must have a dynamic force of at least 30,000 pounds per impact per vibration and at least 1,000 vibrations per minute. Coarse fill must be compacted to a dense, interlocking and unyielding surface, and the maximum density obtained must be verified using nuclear density testing methodology. We recommend STRATA, or other competent entity, review the soil and aggregate material planned for fill use and monitor compaction effort during construction.

Wet and Cold Weather/Soil Construction

No fill shall be placed on frozen soil. Frozen soil may not be used as fill or backfill. All frozen soil, snow, or ice shall be removed from the subgrade or fill soils prior to continuing with construction. Winter excavations should be limited to areas small enough to be refilled to finished grade or higher on the same day.

During construction, intersect and divert surface runoff from rainfall or snowmelt to avoid water ponding on the project site. Subgrades must always slope and be exposed to daylight to help direct water away from subgrades after the end of each construction day or before precipitation events.

We strongly recommend earthwork construction take place during dry weather conditions. Near-surface clay soil may be susceptible to pumping or rutting from heavy loads such as rubber-tired equipment or vehicles when the soil is above optimum moisture content. During and after achieving subgrade elevation, the contractor(s) must take precautions to protect the subgrade from becoming disturbed or saturated. We recommend the contractor limit construction traffic to any prepared subgrade and reduce exposure to precipitation and water. In general, earthwork contractors should:

- Grade subgrades to aggressively direct surface water away from construction areas that could be adversely affected by infiltration.
- Remove exposed subgrade soil that becomes soft or begins to pump to firm soil and replace it with structural fill as described above for over-excavations.
- Not attempt structural fill placement where structural fill or subgrade soil is above the optimum moisture content to a degree that creates unstable soil conditions such as pumping or rutting.
- Never allow subgrades to freeze or become saturated prior to fill placement. Subgrades that do freeze or become saturated must be removed and underlying subgrades must be prepared as recommended in the *Subgrade and Site Preparation* section of this report.

The final subgrade conditions and careful construction procedures are critical to the long-term project performance. We recommend earthwork specifications specifically identify the contractor's responsibility to protect and maintain prepared subgrades. We recommend STRATA be retained to observe the subgrade preparation activities to identify techniques or construction activities that may be attributing to unstable subgrades and contributing to the need for over-excavations.

<u>Geosynthetics</u>

If earthwork contractors are unable to achieve subgrade compaction requirements outlined in this report's *Site Preparation* section, geosynthetic fabrics may be considered for use to improve subgrade support when constructing on soft or wet soil.

If utilized, we recommend a geotextile meeting property requirements in The Idaho Standards for Public Works Construction Section 2050.2.3. Apply geosynthetics directly on approved subgrade, taut, free of wrinkles, and overlapped at least 12 inches. STRATA must be consulted to develop appropriate recommendations prior to using geosynthetics for subgrade stabilization.

Seismic Design Criteria

STRATA utilized site soils, geologic data, the project location, the International Building Code (IBC), and ASCE-7 to establish a Seismic Site Classification of "D" at the project site. We recommend seismic design reference the seismic parameters provided in Table 2 based on the soil conditions and project location. Furthermore, based on the depth to bedrock, and the anticipated depth of groundwater, the likelihood of liquefaction during a seismic event should be considered low.

Table 2. Seismic Response Criteria (2012 IBC/ ASCE 7) [1]

Period (seconds)	Mapped Acceleration Coefficients (g)	Site Factor for Site Class D	Modified Acceleration Coefficient for Site Class D (g)
0.0 (Peak)	PGA = 0.340	F_{PGA} = 1.160	PGA_M = 0.394
0.2 (Short)	S_S = 0.889	F_a = 1.144	S_{DS} = 0.678
1.0	S_1 = 0.262	F_v = 1.876	S_{D1} = 0.328

Values for location Latitude 42.65248°N and Longitude 111.59637°W

Shallow Foundation Design

Based on the presence of significant undocumented fill and compressibility of the native clay, soil improvement over excavation and backfill soil improvements will be required to provide shallow foundation support. Alternatively, deep foundation support via helical piers or micropiles extended through the fill and compressible clay into the underlying basalt rock may be considered. However, based on our scope of services, our recommendations are limited to shallow foundations at this time.

<u>General</u>

Foundations exposed to freezing conditions must extend a minimum of 36 inches below the final exterior ground surface to help protect against frost action. Interior foundations that will not be exposed to freezing conditions, must extend at least 18 inches below final slab-bearing elevations and maintain at least 4 inches of gravel between slabs and the top of the footing to reduce the reflective cracking potential. Foundations must be structurally designed to conform to the latest edition of the IBC and have a minimum width of 24 inches for isolated column footings, and 18 inches for strip footings. Structural fill placed beneath foundations should extend a minimum of 1 foot horizontally for each 2 feet of thickness placed below foundations. The horizontal dimension is measured from the bottom edge of the foundation.

We recommend STRATA be retained to observe the foundation installation including reviewing subgrade preparations and structural fill placement and compaction prior to placing concrete forms or concrete. The foundation subgrade should be observed by the geotechnical engineer or his representative to verify subgrade density and moisture content. Any loose or frozen zones will require additional compaction or excavation and replacement with structural fill. 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.

Estimated structural loads were not available at the time this report was prepared. As such we assumed maximum column loads could be between 200 and 300 kips and maximum wall loads could be between

10 and 12 kips per lineal foot of wall for the gymnasium, with wall loading of 3 to 6 kips per lineal foot for the new classroom addition.

Bearing Soil and Structural Fill Foundation Support

We recommend all shallow foundations, bear on structural fill as defined in Table 1 extending to native lean clay. The native lean clay must be prepared as discussed in the *Subgrade and Site Preparation* section of this report. Soil improvement over excavations of up to 9.5 feet below existing grade will be required to remove the existing undocumented fill. Based on the assumed structural loads provided above, shallow foundations should be supported by a minimum of 4 feet of structural fill for the gymnasium and classroom addition. These recommendations should be verified once structural loading is evaluated for the structures.

Design Criteria

If the above recommendations are accomplished, shallow foundations should be designed using an allowable bearing pressure of up to 3,000 pounds per square foot (psf). A one-third increase in allowable bearing may be utilized for short-term loading from seismic or wind induced loads. In our opinion, long-term live loads such as equipment, fixtures, furniture, files, etc. should be considered in the total dead structural loads for the project.

Mass concrete placed on soil improvements (structural fill per Table 1) over compacted subgrades can utilize a friction coefficient (fs) of 0.40 to resist lateral loads. This coefficient must be reduced by ⅔ if concrete is not cast directly on soil such as for pre-cast panels.

Using good construction practices and constructing during good weather, we estimate post construction total settlement will be up to 1-inch and differential settlement of building foundations will be up to ¾ -inch over a 30-foot span. Our analysis utilizes a factor of safety against bearing capacity failure of 3.0 or greater. Settlement estimates and other design criteria are un-factored.

Concrete Slab-on-Grade

Concrete slab-on-grade floors should be supported by compacted crushed aggregate base course placed on a prepared subgrade, as described in this report's *Site Preparation* section. We recommend concrete slab-on-grade floors exposed to pedestrian and light storage loading be underlain by at least 6-inches of crushed aggregate base course to provide a leveling course and capillary break for the slab. Below equipment, service and storage areas, we recommend the slab be underlain by a minimum of 12-inches of crushed aggregate base course. Subgrade areas that become soft, wet or disturbed or that cannot be re-compacted to structural fill requirements must be over-excavated to firm soil and replaced with granular structural fill, prior to placing aggregate base, in general accordance with the recommendations detailed in the Site Preparation section of this report.

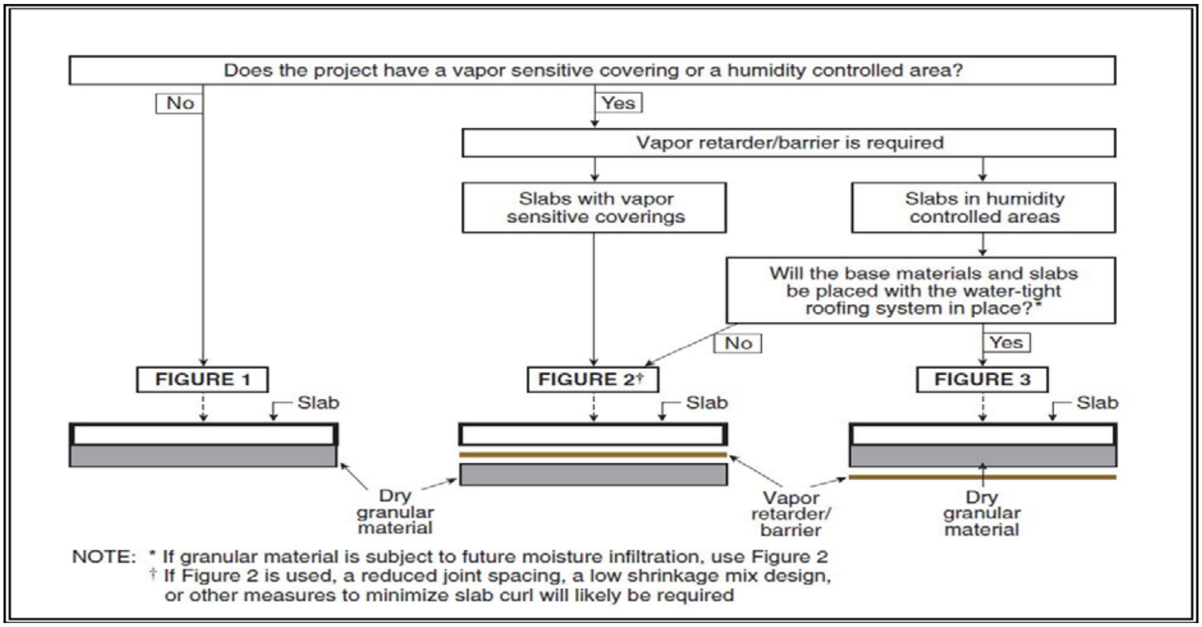
Floor slabs must be designed for the anticipated use and equipment or storage loading conditions. Based on correlations to our field and laboratory test results, we recommend concrete slab design utilize a modulus of subgrade reaction (k_{s1}) of 200 pounds per cubic inch (pci) for aggregate base course overlying compacted clay subgrades. To realize the reported modulus of subgrade reaction, drained conditions and the recommended slab support section and subgrades, including accomplishing removal of undocumented fill are required.

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.

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.

District 150 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 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 negative impacts associated with the above options for vapor retarder locations.

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, bays or other critical areas adjacent to the building that will be exposed to weather. One approach to provide partial frost protection would be to place and compact a minimum of 18 inches of aggregate base course beneath the slab. Alternatively, if partial frost protection is unacceptable, over-excavation and aggregate base course replacement must be accomplished to the anticipated frost depth of 36 inches.

Surface Drainage

Consistent with the IBC, we recommend both the final graded surface, as well as the underlying subgrade, be sloped at a minimum of 5 percent away from proposed structures. The ground surface beyond 10 feet of structures should be sloped a minimum of 2 percent away. If grades of less than 5% are required, placement of asphalt pavement should be performed to limit stormwater infiltration into site subgrades near foundations. However, compliance with the Americans with Disabilities Act (ADA) may oppose this practice, and should be evaluated to ensure adequate drainage is achieved.

Improper management of surface or near-surface water, by not providing an effective grading and drainage design, can result in moisture entering subgrade soils which can result in a decrease in subgrade support characteristics, especially with the clay soils observed throughout the site. Possible sources of surface and near-surface water include, but are not limited to, pressurized irrigation water, rainwater, snowmelt, roof drains, or leaking water lines. Solid conveyance piping from roof drains and/or downspouts terminating at stormwater collection/disposal locations should also be considered. Stormwater must be directed to an acceptable stormwater collection area and conveyed to disposal facilities. Further, infiltration of surface water near foundations can result in observed settlement greater than our design estimates.

Flexible Pavement Subgrade Preparation and Section Design

General

The following flexible asphalt pavement section design was developed referencing the *American Association of State Highway and Transportation Officials* (AASHTO) Guide for Design of Pavement Structures (1993). STRATA estimated the pavement design parameters based on our understanding of the proposed construction, the results of our laboratory testing program, and our understanding of the subsurface conditions.

Traffic and Subgrade

The following tables present the assumed traffic loading data, geotechnical design parameters and references, and the resulting flexible pavement section design recommendations. Standard duty pavement sections have been assumed to be primarily subject to passenger vehicle traffic with occasional truck and bus traffic, such as in parking areas. Heavy duty pavement sections, on the other hand, have been assumed to be subject to passenger vehicle traffic as well as frequent bus traffic. Based on these assumptions and the daily traffic counts, we have provided pavement design sections using 18-kip Equivalent Single Axle Loads (ESALs) ranging from 26,000 for flexible light duty pavement to 100,000 for heavy duty flexible pavement. We recommend District 150 closely review these assumptions and verify the applicability for the planned construction.

Table 3. Flexible Pavement Design Parameters

Design Parameter	Value Used	References
Reliability (R)	90%	AASHTO 1997
Standard Deviation (S)	0.45	AASHTO 1993
Initial Serviceability (PSI_i)	4.2	Typical regional values
Terminal Serviceability (PSI_z)	2.5	Typical regional values
Traffic Loading – Flexible Pavement	26,000 ESALS[1] (Light-Duty) 100,000 ESALS[1] (Heavy-Duty)	Assumed
Design Life – Flexible Pavement	20 years	Assumed
Growth Rate	3.0%	Assumed
Resilient Modulus (M_r)	16,500 psi[2]	Based on CBR and M_r correlations (see paragraph below)
Asphalt Layer Coefficient (a_1)	0.42	Figure 2.5 AASHTO 1993
Top Course Layer Coefficient (a_2)	0.12	Figure 2.6 AASHTO 1993
Top Course Drainage Coefficient (m_2)	1.0	Table 2.4 AASHTO 1993 for "fair" drainage, 1 to 8 percent saturation

[1]Equivalent Single Axle Loads (ESALs).
[2]Pounds per square inch (psi).

Based on the clay subgrade soil, we utilized a resilient modulus (M_r) of 16,500 pounds per square inch (psi). To help improve subgrade characteristics, the pavement subgrade should be prepared as recommended in this report's *Subgrade and Site Preparation* 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 structural fill shall conform to the Structural Fill requirements presented in this report, and shall be placed directly over a properly prepared subgrade. A non-woven geotextile may be used for constructability during wet and inclement weather, which may also increase performance at the subgrade. The non-woven geotextile should have material properties and be placed as outlined in this report's *Geosynthetics* section. We recommend STRATA be retained to observe final subgrade preparations, geotextile placement, and all aggregate placements.

Asphalt concrete must be compacted to between 92 percent and 96 percent of the maximum density for a Superpave mix design. The final traveling surface of asphalt concrete shall meet ISPWC (Idaho Standards for Public Works Construction) ¾-inch asphalt mix design requirements and utilize PG 58-28 Binder. Asphalt mix designs and all appropriate aggregate source certificates should be accepted by the engineer at least 5 days prior to initiating asphalt paving. Asphalt construction and final surface smoothness, joints and density should meet ISPWC specifications. If subgrade conditions appear significantly different during construction, traffic loading conditions change, or traffic volumes increase, STRATA should be notified to amend the design accordingly.

Flexible Pavement Section Thickness

STRATA evaluated the pavement sections utilizing the AASHTO pavement design methodology, soil-engineering parameters from field and laboratory testing, and the estimated traffic-loading conditions provided to us. Assuming subgrades will be prepared as recommended in the *Site Preparation Section* of this report and based on the traffic criteria shown in Table 3, we provide the pavement design section recommendations in Table 4 below. We anticipate the standard duty section would be used for the parking areas that are not subject to bus or truck traffic and the heavy duty section would be utilized for bus lanes, high traffic, and truck routes.

Table 4. Pavement Design Sections

Asphalt Pavement Application	Asphalt (inches)	Base Aggregate (inches)	Subbase Aggregate* (inches)
Standard Duty Section	2.5	4	8
Heavy Duty Section	3.0	4	12

*If the clay subgrade is wet at the time of construction consider a woven geotextile over the clay subgrade to mitigate infiltration of clay fines into the granular subbase.

Pavement Maintenance

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 performance of the pavement section; therefore, we recommend the subgrade, base and asphalt surfaces slope at no less than 2 percent to an appropriate stormwater disposal system or other appropriate location that does not negatively impact adjacent buildings or properties. The pavement's life is dependent on achieving adequate drainage throughout the section, especially at the subgrade elevation. Ponding water at the pavement subgrade surface can induce heaving during the freeze-thaw process.

Rigid Pavement Subgrade Preparation and Section Design

General

The following rigid pavement section design was developed referencing the *American Concrete Institute* (ACI) Guide for Design and Construction of Concrete Parking Lots (2008). STRATA estimated design parameters based on anticipated traffic information provided to us, as well as on our proposed construction understanding, results from laboratory testing, and the subsurface conditions encountered.

Design Parameters

The following Table 5 presents our assumed geotechnical design parameters and references, and the resulting rigid pavement section design recommendations. We recommend District 150 and the design team closely review these assumptions and verify the applicability to the planned construction.

Table 5. Rigid Pavement Design Parameters

Design Parameter	Value Used	References - ACI330R-08
Design Life	20 Years	Assumed
Modulus of Subgrade Reaction (k)	200	Table 3.1 and 3.2
Modulus of Rupture (MOR)	600	Equation 3-2 (f'_c = 4,000 psi)
Traffic Category	C	Table 3.3
Average Daily Truck Traffic (ADTT)	100	Table 3.4 (value based on traffic category)

Placement, Aggregate Base Course, and Subgrade Material

Formwork, concrete placement, and consolidation shall conform to applicable ACI requirements. A concrete mix design and all appropriate aggregate source certificates should be accepted by the engineer at least 5 days prior to initiating concrete placement. The Portland cement concrete should have a minimum of 4,000 psi compressive strength (f'_c) and be placed at a maximum 4-inch slump with an air content between 4% and 6%. Use of a curing compound is recommended.

The Concrete should be supported by crushed aggregate base course conforming to the *Structural Fill* requirements and be placed directly over a properly prepared subgrade. We recommend STRATA observe final subgrade preparations, and all aggregate placements.

The pavement subgrade should be prepared as recommended in this report's *Site Preparation* section. Subgrades must be shaped (crowned) and graded to facilitate positive drainage and inverted crowns must be avoided. If subgrade conditions appear significantly different during construction or traffic volumes increase, STRATA should be notified to amend our design accordingly.

Pavement Section Thickness

Table 6 provides the recommended rigid pavement design section. If traffic volumes or subgrade conditions change as design is finalized or during construction, STRATA must review our pavement analyses and resulting sections.

Table 6. Rigid Pavement Design Section

Pavement (Application)	Concrete (inches)	Base Aggregate (inches)	Subbase Aggregate (inches)
Rigid Section*	6	8	0

*Pavement section design assumes stable subgrade conditions consisting of moisture conditioned and compacted clay subgrade. If the subgrade is wet at the time of construction consider a woven geotextile over the clay subgrade to mitigate infiltration of clay fines into the base course.

ADDITIONAL RECOMMENDED SERVICES

Review of Plans and Specifications

We recommend that STRATA review the final plans and specifications for the proposed project prior to issuing the construction documents for bidding. It has been our experience that having geotechnical consultants from the design team review the construction documents prior to bidding helps reduce the potential for errors, and costly changes to the contract during construction.

Construction Observation and Monitoring

It is our opinion the success of the proposed construction will be dependent on following the report recommendations, good construction practices, and providing the necessary construction monitoring, testing and consultation to verify the work is completed as recommended. We recommend STRATA provide construction monitoring, testing and consultation services to verify the report recommendations are being followed. We also recommend that the construction monitoring program include observation for removal of undocumented fill and testing for subgrade improvement of the native lean clay prior to placing structural fill. If we are not retained to provide the recommended construction monitoring services, we cannot be responsible for soil engineering related construction errors or omissions.

EVALUATION LIMITATIONS

This report has been prepared to assist project planning, design and construction of the proposed Tigert Middle School Additions located at the Tigert Middle School in Soda Springs, Idaho. Our geotechnical findings and opinions have been developed based on the authorized subsurface exploration and laboratory testing, as well as our understanding of the project at this time. Our geotechnical design recommendations are specific to the anticipated construction and should not be extrapolated to other future projects without allowing adequate geotechnical consultation by STRATA.

Boring exploration only allows observation of a small portion of the site subsurface conditions and unknown conditions may exist. Furthermore, subsurface variations are possible between exploration locations and the extent of these variations may not be apparent until construction. Where such variations exist, they may influence the opinions and recommendations presented within this report, as well as construction timing and costs. 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.

Our services consist of professional opinions and findings made in accordance with generally accepted geotechnical engineering principles and practices in Southeast Idaho at the time of this report. The geotechnical recommendations provided herein are based on the premise that appropriate geotechnical consultation during subsequent design phases is implemented and an adequate program of tests and observations will be conducted by STRATA during construction to verify compliance with our recommendations and to confirm conditions between exploration locations. This acknowledgment is in lieu of all warranties either expressed or implied.

The following plates accompany and complete this report:

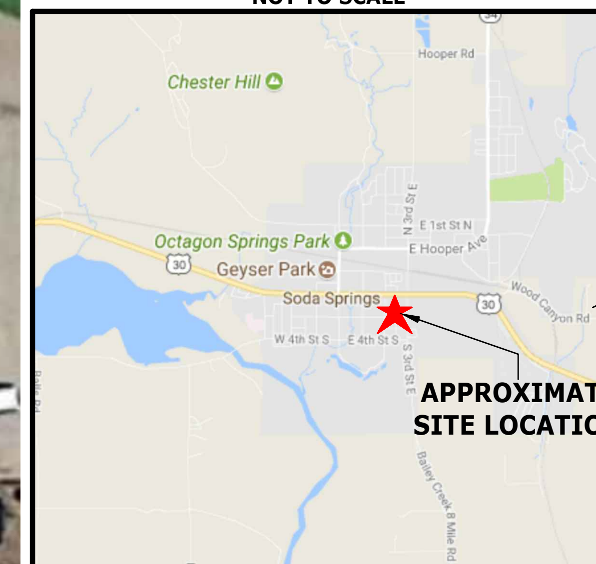
Plate 1:	Exploration Location Plan
Appendix A:	Unified Soil Classification System (USCS)
	Exploration Logs
Appendix B:	Laboratory Test Results

LEGEND

B01-STR-17	Approximate boring location observed by STRATA on August 31, 2017. (Advanced via CME 75 Drill Rig)
(5.0')	Approximate depth, in feet, of undocumented fill observed during exploration.
(15.0')	Approximate depth, in feet, to basalt bedrock observed during exploration.

VICINITY MAP

NOT TO SCALE



EXPLORATION LOCATION PLAN
Tigert Middle School Additions
Soda Springs, Idaho

0 25 50 100

SCALE: 1 inch = 50 feet

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Project Name	Tigert Middle School	Drawing By	R. Benedetti
Project No.	PO17066A	Checked By	M. Quick
Client	School Dist. No. 150	Date	09/27/2017

REFERENCE: Aerial Image Provided by Google Earth dated 06/18/2016.

PLATE 1

APPENDIX A

Unified Soil Classification System (USCS)

&

Exploration Logs

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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

- Standard 2–Inch OD Split–Spoon Sample
- California Modified 3–Inch OD Split–Spoon Sample
- Rock Core
- Shelby Tube 3–Inch OD Undisturbed Sample

GROUNDWATER SYMBOLS

- Groundwater After 24 Hours
- (7–3–07) Indicates Date of Reading
- Groundwater at Time of Drilling

TEST PIT LOG SYMBOLS

- BG Baggie Sample
- BK Bulk Sample
- RG Ring Sample

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

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USCS Description	Depth (ft)	Elevation	Symbol	Sample Type	SPT Blows Per 6 Inches	SPT N	Dry Density (pcf)	TEST RESULTS: Pocket Penetrometer, TSF ▲ (0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5); SPT, N-Value ●; % Passing No. 200 Sieve ★; PL MC LL (20 40 60 80)	Remarks Note: BGS = Below Ground Surface
	0	5798.5							
SILT, (ML) brown, loose, moist , topsoil - Fill		5798.2	ML						Surface condition: Grass Depth of significant organics: 4"
POORLY GRADED GRAVEL WITH SAND, (GP) red, medium dense, moist, weak HCL reaction , cinders - Fill		5797.5	GP		5 5 7	12		● ▲	
SILTY GRAVEL, (GM) reddish brown to black, medium dense, moist, weak to strong HCL reaction , cinders - Fill		5795.0	GM		4 4 8	12		●	
SANDY LEAN CLAY, (CL) tan to brown, stiff to very stiff, moist - Native	5	5791.5	CL				72.7	20 ★ ▲	
(RX) BASALT, slightly to highly weathered, black			RX		50/4.0"	50+		50+ ●	Low recovery
	10	5788.3			50/2.0"	50+		50+ ●	Low recovery
Borehole Terminated at 10.2 Feet.									Note: Surface elevations estimated from topographic information provided by RMES

Client: Soda Springs School Jt. Dist. # 150	**Boring Number:** B01-STR-17
Project: PO17066A - Tigert Middle School	**Date Drilled:** 08-31-2017
Drill Rig: CME 75	**Borehole Diameter:** 8" OD HSA
Depth to Groundwater: N.E.	**Logged By:** R. Benedetti

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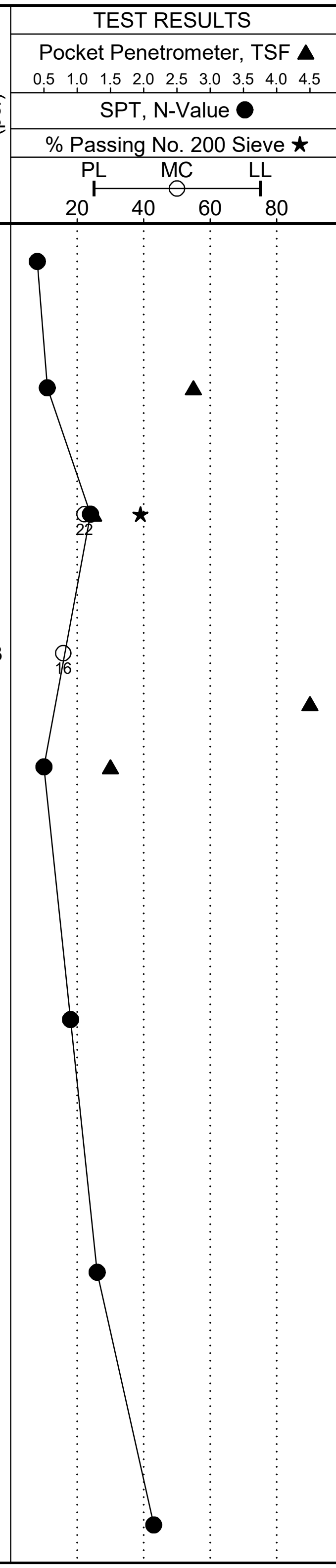
EXPLORATORY BORING LOG

EXPLORATORY BORING LOG

Note: BGS = Below Ground Surface

USCS Description	Depth (ft)	Elevation	Symbol	Remarks
	0	5797.0		
SILT WITH GRAVEL, (ML) brown, loose, moist , topsoil - Fill		5796.6	ML	Surface condition: Grass Depth of significant organics: 5"
POORLY GRADED GRAVEL WITH SAND, reddish brown to red, loose, moist , cinders - Fill		5795.0		Bulk sample obtained from 1'-4' BGS.
CLAYEY SAND, (SC) tan to brown, medium dense, moist, weak to strong HCL reaction - Native	5	5790.0	SC	
SANDY LEAN CLAY, (CL) tan to brown, stiff, moist, weak to strong HCL reaction	10	5784.0	CL	Pinholes
LEAN CLAY WITH COBBLES, (CL) brown to black, stiff to very stiff, moist, strong HCL reaction	15, 20	5774.0	CL	Basalt cobbles from 13' to 23' Low recovery
(RX) BASALT, moderately to highly weathered, black	25	5770.5	RX	

Sample Depth (approx. ft)	SPT Blows Per 6 Inches	SPT N	Dry Density (pcf)	Test Results
0.5–2	4, 4, 4	8		
2.5–4	3, 6, 5	11		
5–6.5	5, 10, 14	24		MC 22
7.5–9.5			98.3	MC 16
10–11.5	5, 4, 6	10		
15–16.5	7, 12, 6	18		
20–21.5	8, 14, 12	26		
25–26.5	41, 21, 22	43		



Borehole Terminated at 26.5 Feet.

Note: Surface elevations estimated from topographic information provided by RMES

Client: Soda Springs School Jt. Dist. # 150	**Boring Number:** B02-STR-17
Project: PO17066A - Tigert Middle School	**Date Drilled:** 08-31-2017
Drill Rig: CME 75	**Borehole Diameter:** 8" OD HSA
Depth to Groundwater: 20.3'	**Logged By:** R. Benedetti

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EXPLORATORY BORING LOG

Sheet 1 Of 1

USCS Description	Depth (ft)	Elevation	Symbol	SPT Blows Per 6 Inches	SPT N	Dry Density (pcf)	Test Results (MC)	Remarks
	0	5796.0						
SILT, (ML) brown, loose, moist , topsoil - Fill		5795.5	ML	6 13 21	34			Surface condition: Grass Depth of significant organics: 6"
POORLY GRADED SAND WITH SILT, (SP-SM) orange to tan, very dense to medium dense, moist, weak HCL reaction - Fill			SP-SM	18 28 38	66		5	Appears to be silica sand from Monsanto Bulk sample obtained from 2'-5' BGS.
	5	5790.0		18 12 6	18			
LEAN CLAY, (CL) tan to brown, stiff, moist, strong HCL reaction - Native			CL					Pinholes
						94.1	16	
	10			3 8 11	19			
	15	5779.5		6 13 30	43			
(RX) BASALT, highly weathered, black			RX					Grinding on Basalt
	20			1 8 10	18			Low recovery
Slightly to moderately weathered		5772.8		50/2.0"	50+		50+	No recovery
Borehole Terminated at 23.2 Feet.								Note: Surface elevations estimated from topographic information provided by RMES

Test Results: Pocket Penetrometer, TSF ▲; SPT, N-Value ●; % Passing No. 200 Sieve ★; PL, MC, LL

Remarks: Note: BGS = Below Ground Surface

Client: Soda Springs School Jt. Dist. # 150	**Boring Number:** B03-STR-17
Project: PO17066A - Tigert Middle School	**Date Drilled:** 08-31-2017
Drill Rig: CME 75	**Borehole Diameter:** 8" OD HSA
Depth to Groundwater: 16.8'	**Logged By:** R. Benedetti

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EXPLORATORY BORING LOG

Sheet 1 Of 1

STRATA BOREHOLE - STRATA.GDT - 10/6/17 16:16 - P:\CLIENTS\S\SODA SPRINGS SCHOOL JT. DISTRICT #150\PO17066A - TIGERT MIDDLE SCHOOL ADDITION\GEO\ELECTRONIC LOGS\PO17066A - BORING LOGS.GPJ

USCS Description	Depth (ft)	Elevation	Symbol	SPT Blows Per 6 Inches	SPT N	Dry Density (pcf)	TEST RESULTS: Pocket Penetrometer, TSF ▲ (0.5–4.5); SPT, N-Value ●; % Passing No. 200 Sieve ★; PL / MC / LL (20, 40, 60, 80)	Remarks (Note: BGS = Below Ground Surface)
LEAN CLAY, (CL) brown, stiff to hard, moist, weak to strong HCL reaction - Native	0	5795.0	CL	3 4 6	10			Surface condition: Grass Depth of significant organics: 6"
				3 5 6	11			
	5					86.5	PL 16, MC 18, LL 35	
				5 7 11	18			Grinding on basalt cobbles from 9' to 18'
	10			8 8 14	22			
	15			10 13 12	25			
(RX) BASALT, highly weathered, black		5777.0	RX					
	20			31 13 37	50			
Slightly to moderately weathered								
	25	5769.7		50/4.0"	50+		50+	Low recovery
Borehole Terminated at 25.3 Feet.								Note: Surface elevations estimated from topographic information provided by RMES

Client: Soda Springs School Jt. Dist. # 150	**Boring Number:** B04-STR-17
Project: PO17066A - Tigert Middle School	**Date Drilled:** 08-31-2017
Drill Rig: CME 75	**Borehole Diameter:** 8" OD HSA
Depth to Groundwater: 18.4'	**Logged By:** R. Benedetti

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EXPLORATORY BORING LOG

Sheet 1 Of 1

USCS Description	Depth (ft)	Elevation	Symbol	Sample Type	SPT Blows Per 6 Inches	SPT N	Dry Density (pcf)	TEST RESULTS: Pocket Penetrometer, TSF ▲ (0.5–4.5); SPT, N-Value ●; % Passing No. 200 Sieve ★; PL / MC / LL (20, 40, 60, 80)	Remarks (Note: BGS = Below Ground Surface)
	0	5796.0							
SILT, (ML) brown to dark brown, loose, moist , topsoil - Fill		5795.3	ML	SPT	1 2 3	5			Surface condition: Grass Depth of significant organics: 6"
SILTY SAND, (SM) orange to tan, medium dense to loose, moist, weak HCL reaction - Fill			SM	SPT	3 7 4	11		MC: 9	Appears to be silica sand from Monsanto
	5			SPT	2 3 3	6			Potential unmarked utility at approx. 8' BGS. Moved approx. 10' to the NE to B05A-STR-17.
		5788.0							
Borehole Terminated at 8.0 Feet.									Note: Surface elevations estimated from topographic information provided by RMES

Client: Soda Springs School Jt. Dist. # 150	**Boring Number:** B05-STR-17
Project: PO17066A - Tigert Middle School	**Date Drilled:** 08-31-2017
Drill Rig: CME 75	**Borehole Diameter:** 8" OD HSA
Depth to Groundwater: N.E.	**Logged By:** R. Benedetti

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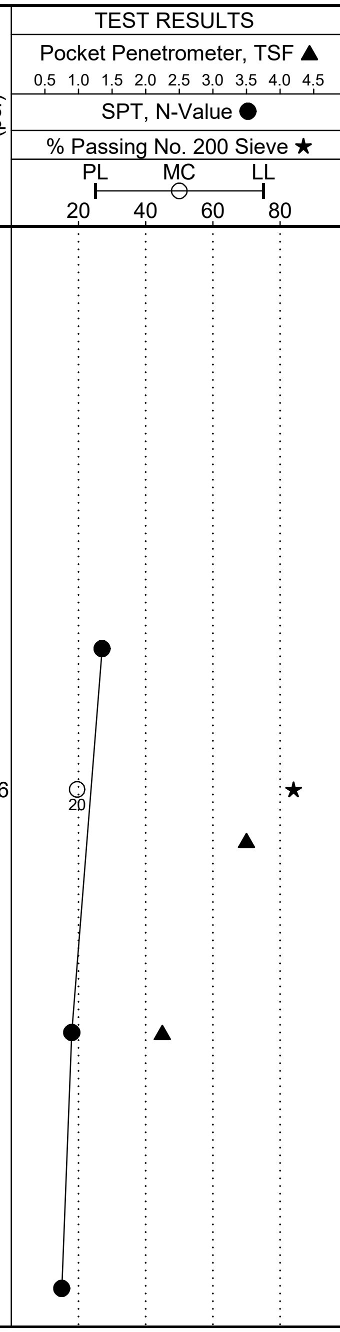
EXPLORATORY BORING LOG

Sheet 1 Of 1

STRATA BOREHOLE - STRATA.GDT - 10/6/17 16:16 - P:\CLIENTS\S\SODA SPRINGS SCHOOL JT. DISTRICT #150\PO17066A - TIGERT MIDDLE SCHOOL ADDITION\GEO\ELECTRONIC LOGS\PO17066A - BORING LOGS.GPJ

USCS Description	Depth (ft)	Elevation	Symbol	Sample Type	SPT Blows Per 6 Inches	SPT N	Dry Density (pcf)	Remarks (Note: BGS = Below Ground Surface)
SILT, (ML) brown, loose, moist , topsoil - Fill	0	5796.0	ML					Surface condition: Grass Depth of significant organics: 6"
POORLY GRADED SAND WITH GRAVEL, (SP) orange to tan, loose to medium dense, moist, weak HCL reaction - Fill		5795.3	SP					Appears to be silica sand from Monsanto
				SPT	14 16 11	27		
LEAN CLAY WITH SAND, (CL) tan to brown, stiff to very stiff, moist, strong HCL reaction - Native		5786.5	CL					
				Ring			102.6	
	15			SPT	4 8 10	18		
(RX) BASALT, highly to moderately weathered, black		5779.0	RX					Grinding
	20			SPT	4 7 8	15		
Borehole Terminated at 21.5 Feet.		5774.5						Note: Surface elevations estimated from topographic information provided by RMES



Client: Soda Springs School Jt. Dist. # 150	**Boring Number:** B05A-STR-17
Project: PO17066A - Tigert Middle School	**Date Drilled:** 08-31-2017
Drill Rig: CME 75	**Borehole Diameter:** 8" OD HSA
Depth to Groundwater: N.E.	**Logged By:** R. Benedetti

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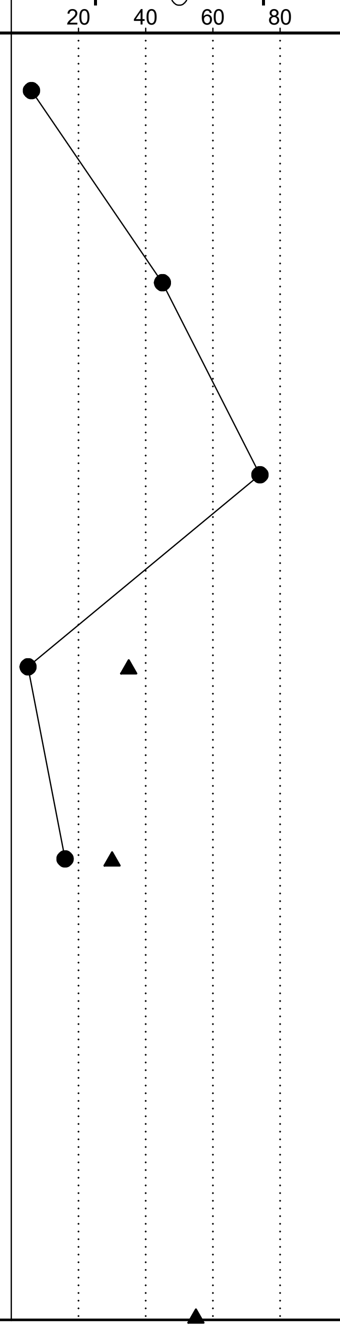
EXPLORATORY BORING LOG

Sheet 1 Of 1

EXPLORATORY BORING LOG

USCS Description	Depth (ft)	Elevation	Symbol	Sample Type	SPT Blows Per 6 Inches	SPT N	Dry Density (pcf)	Remarks
SILT, (ML) brown, loose, moist , topsoil - Fill	0	5795.5	ML	SPT	1, 1, 5	6		Surface condition: Grass Depth of significant organics: 6"
SILTY SAND, (SM) orange to tan, dense to very dense, moist, weak HCL reaction - Fill		5794.6	SM	SPT	11, 20, 25	45		Appears to be silica sand from Monsanto Bulk sample obtained from 2'-5' BGS.
	5			SPT	12, 32, 42	74		
SANDY LEAN CLAY, (CL) tan to brown, stiff to very stiff, moist, strong HCL reaction - Native		5788.0	CL	SPT	6, 3, 2	5		
	10			SPT	2, 7, 9	16		
	15	5778.8						
Borehole Terminated at 16.8 Feet.								Note: Surface elevations estimated from topographic information provided by RMES

TEST RESULTS
Pocket Penetrometer, TSF ▲ (0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5)
SPT, N-Value ●
% Passing No. 200 Sieve ★
PL MC LL (20 40 60 80)



Remarks: Note: BGS = Below Ground Surface

Client: Soda Springs School Jt. Dist. # 150	**Boring Number:** B06-STR-17
Project: PO17066A - Tigert Middle School	**Date Drilled:** 08-31-2017
Drill Rig: CME 75	**Borehole Diameter:** 8" OD HSA
Depth to Groundwater: N.E.	**Logged By:** R. Benedetti

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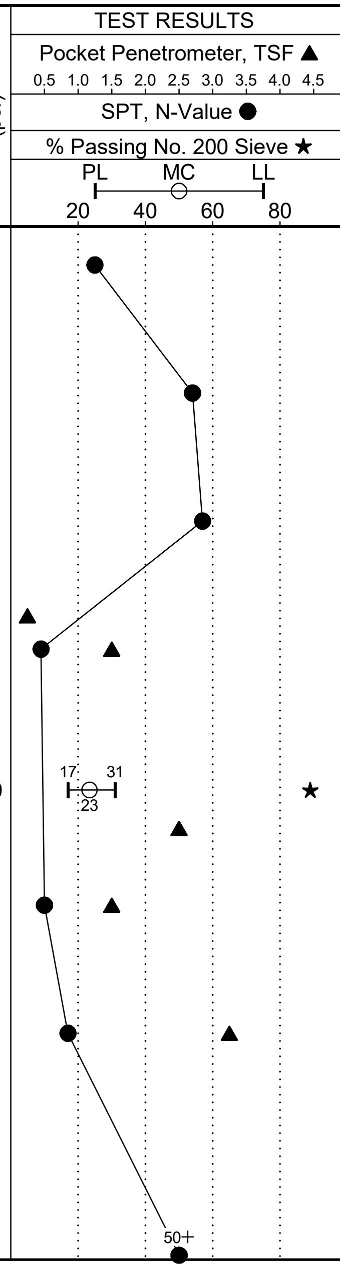
Integrity from the Ground Up

EXPLORATORY BORING LOG

USCS Description	Depth (ft)	Elevation	Symbol	Sample Type	SPT Blows Per 6 Inches	SPT N	Dry Density (pcf)	Remarks (Note: BGS = Below Ground Surface)
	0	5794.5						
SILT, (ML) brown, loose, moist, topsoil - Fill		5794.0	ML		1 9 16	25		Surface condition: Grass Depth of significant organics: 6"
SILTY SAND, (SM) orange to tan, very dense, moist, weak HCL reaction - Fill			SM		12 26 28	54		Bulk sample obtained from 1'-4' BGS. Appears to be silica sand from Monsanto
	5				12 25 32	57		
LEAN CLAY, (CL) tan to brown, stiff to very stiff, moist, weak to strong HCL reaction - Native		5787.0	CL		2 3 6	9		
	10						86.9	
					2 4 6	10		
	15				4 8 9	17		
		5776.5						Groundwater likely perched above basalt bedrock.
(RX) BASALT, highly to moderately weathered, black			RX					
	20	5774.3			50/2.0"	50+		No recovery
Borehole Terminated at 20.2 Feet.								Note: Surface elevations estimated from topographic information provided by RMES

TEST RESULTS



Client: Soda Springs School Jt. Dist. # 150	**Boring Number:** B07-STR-17
Project: PO17066A - Tigert Middle School	**Date Drilled:** 08-31-2017
Drill Rig: CME 75	**Borehole Diameter:** 8" OD HSA
Depth to Groundwater: 18'	**Logged By:** R. Benedetti

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USCS Description	Depth (ft)	Elevation	Symbol	Sample Type	SPT Blows Per 6 Inches	SPT N	Dry Density (pcf)	TEST RESULTS: Pocket Penetrometer, TSF ▲ (0.5–4.5); SPT, N-Value ●; % Passing No. 200 Sieve ★; PL / MC / LL (20, 40, 60, 80)	Remarks (Note: BGS = Below Ground Surface)
	0	5797.5							
SILT, (ML) brown, loose, moist , topsoil - Fill		5797.2	ML	SPT	3 7 7	14		●	Surface condition: Grass Depth of significant organics: 4"
POORLY GRADED GRAVEL WITH SAND, (GP) red, medium dense, moist, weak HCL reaction , cinders - Fill		5796.5	GP						
SILTY GRAVEL, (GM) reddish brown to black, medium dense, moist, weak to strong HCL reaction , cinders - Fill		5795.0	GM						
SANDY LEAN CLAY, (CL) tan to brown, stiff to very stiff, moist - Native			CL	SPT	3 7 7	14		● ▲	
	5			SPT	5 10 18	28		● ▲	
		5788.5		SPT	7 12 11	23		● ▲	
(RX) BASALT, highly weathered, black	10		RX	SPT	8 5 8	13		●	
Moderately weathered to slightly weathered		5783.3		SPT	50/3.0"	50+		● 50+	Low recovery
Borehole Terminated at 14.3 Feet.									Note: Surface elevations estimated from topographic information provided by RMES

Client: Soda Springs School Jt. Dist. # 150	**Boring Number:** B08-STR-17
Project: PO17066A - Tigert Middle School	**Date Drilled:** 08-31-2017
Drill Rig: CME 75	**Borehole Diameter:** 8" OD HSA
Depth to Groundwater: N.E.	**Logged By:** R. Benedetti

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EXPLORATORY BORING LOG

APPENDIX B
Laboratory Test Results

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Summary of Test Results

Project: Tigert Middle School Additions
Client: Soda Springs School Jt. District # 150

Project Number: PO17066A
Date: 9/28/2017

Location	Depth, feet	Lab Number	Soil Classification (USCS)	In-situ moisture, %	Passing No. 200, %	Atterberg LL	Atterberg PL	Atterberg PI	Fines class	CBR, %	pH	Min. Resistivity, ohm-cm	Sulfate, SO4, mg/kg	In-situ dry unit weight, pcf
BO1-STR-17	5-7	PO1700762	Sandy Lean Clay (CL)	19.7%	57%									72.7
BO2-STR-17	5-6.5	PO1700763	Clayey Sand (SC)	22.2%	39%									
BO2-STR-17	7.5-9.5	PO1700764	Sandy Lean Clay (CL)	15.8%										98.3
BO3-STR-17	2.5-4	PO1700766	Poorly Graded Sand with Silt (SP-SM)	5.3%	11%									
BO3-STR-17	7.5-9.5	PO1700767	Lean Clay (CL)	16.1%	90%									94.1
BO4-STR-17	5-7	PO1700768	Lean Clay (CL)	17.8%	96%	35	16	19	CL					86.5
BO5-STR-17	2.5-4	PO1700770	Silty Sand (SM)	8.5%	13%									
BO5A-STR-17	10-12	PO1700771	Lean Clay with Sand (CL)	19.6%	84%									102.6
BO7-STR-17	10-12	PO1700772	Lean Clay (CL)	23.4%	89%	31	17	14	CL					86.9
Composite	5-9.5	762,764,767	Sandy Lean Clay (CL)							11.0	8.71	3,107	13.0	

NV = No Value NP = Non-Plastic

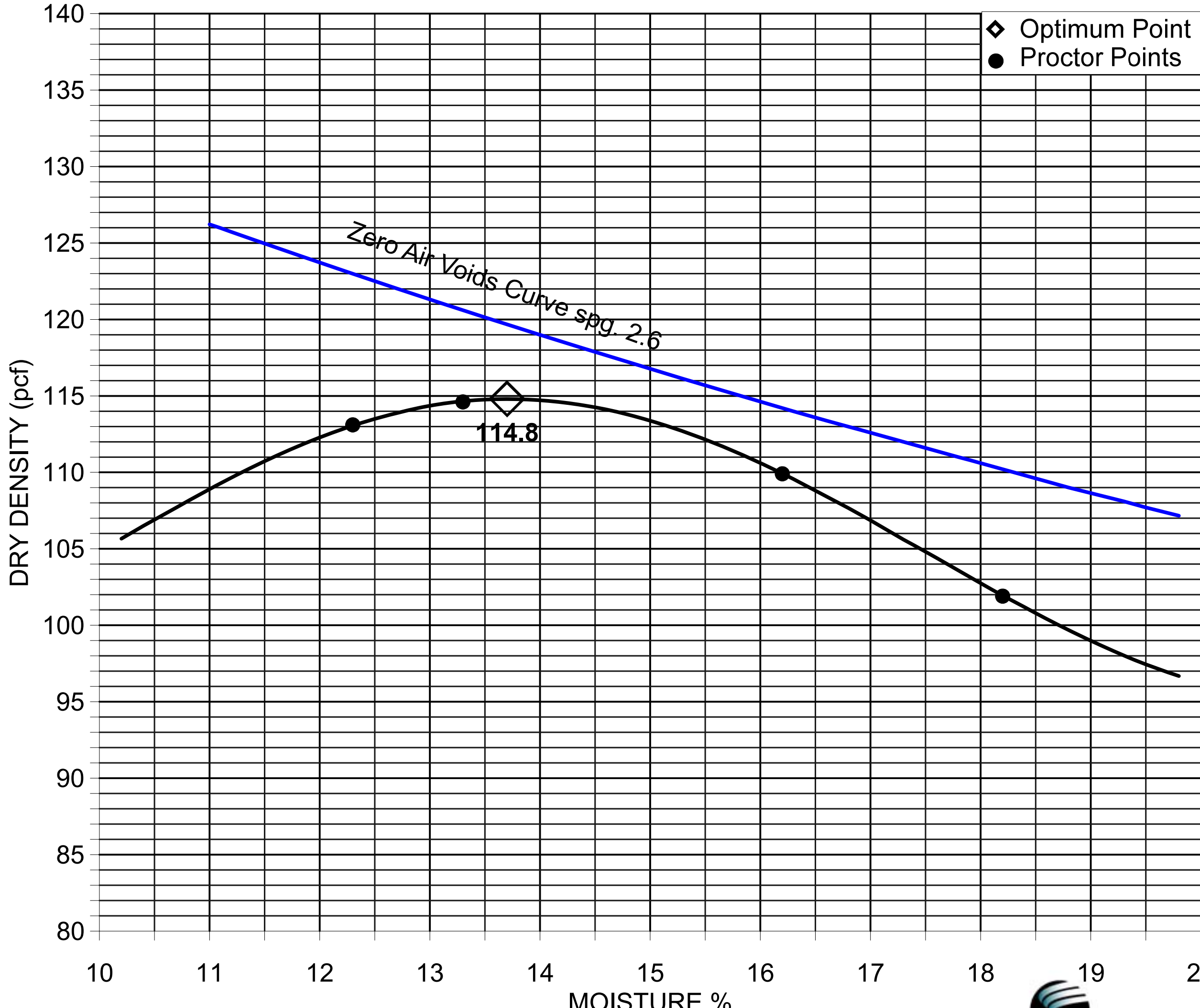
MOISTURE-DENSITY RELATIONSHIP CURVE
AASHTO T180
Method A

Project: Tigert Middle School Additions
Client Name: Soda Springs School Jt. District # 150
Project ID.: PO17066A
Sample No.: PO1700762, 764, 767
Sample Source: Composite Sample (B01-STR-17 (5'-7'), B02-STR-17 (7.5'-9.5'), and B03-STR-17 (7.5'-9.5'))
Sample Classification: Sandy Lean Clay (CL)
Date Sampled: 8/8/2017, Sampled By: R. Benedetti - STRATA
Date Tested: 9/13/2017, Tested By: S. Myers - STRATA
Soil Tempered: Yes
Rammer Type: Mechanical

GRADING ANALYSIS

SCREEN SIZE	% PASSING	AS TESTED
6 inch		
3 inch		
2 inch		
3/4 inch		
3/8 inch		
#4 screen	100	100

Maximum Dry Density, pcf : 114.8
Optimum Moisture Content, %: 13.7



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CALIFORNIA BEARING RATIO
ASTM D 1883

Project: Tigert Middle School Addition
Client: Soda Springs School Jt. District # 150
Sample Identification: Composite Sample
(B01-STR-17 (5'-7'),B02-STR-17 (7.5'-9.5'), and B03-STR-17 (7.5'-9.5'))
Sample Classification: Sandy Lean Clay (CL)

Project Number: PO17066A
Lab Number: PO1700762, 764, 767
Date Tested: 9/18/2017
Tested By: S. Myers

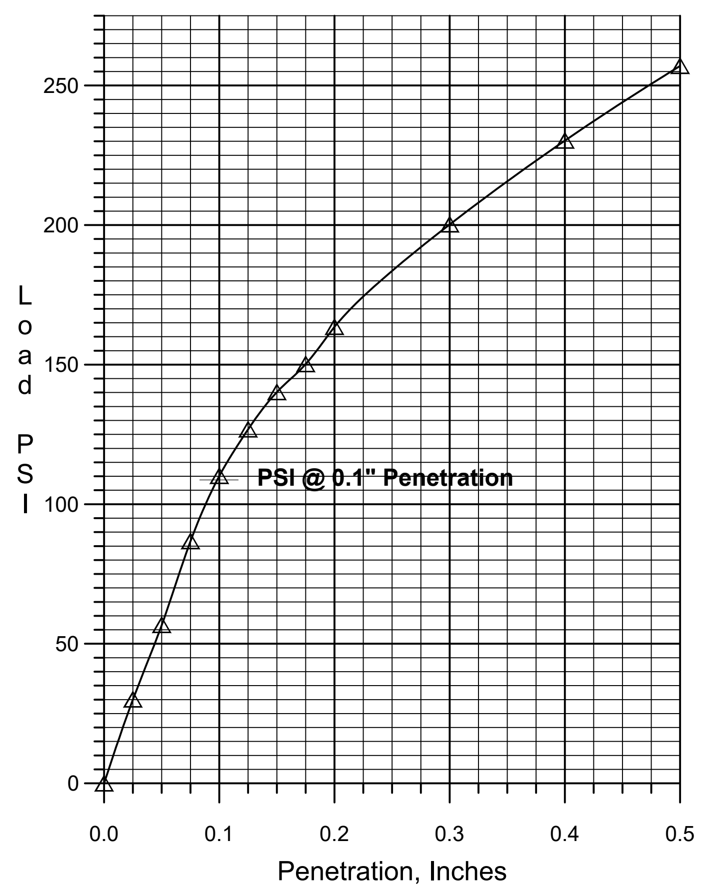
SOIL CONSTANTS

CBR = 11.0
Fines Classification: Sandy Lean Clay (CL)
Test Dry Density = 104.1 pcf
Test Specimen Remolded @ 13.4% Moisture
Remold Percentage of Proctor = 90.7%
Test Performed @ 24.9% Moisture (Top 1")
Percent Swell = 1.1%
Soak Time = 95 hrs
Surcharge = 50 psf

GRADING ANALYSIS

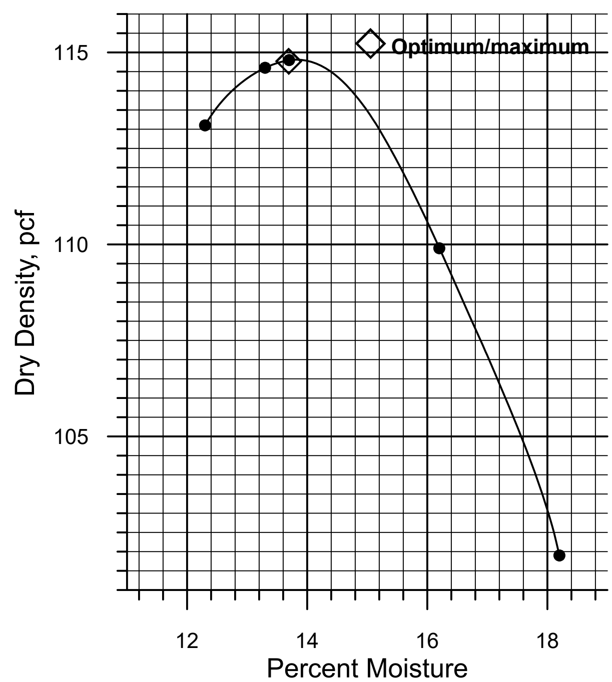
SCREEN SIZE	% PASSING
3"..................	
2"..................	
1"..................	
3/4"...............	
1/2"...............	
3/8"...............	
No. 4.............	100
No. 10...........	
No. 20...........	
No. 40...........	
No. 50...........	
No. 100..........	
No. 200..........	

CBR CURVE



MOISTURE-DENSITY CURVE
AASHTO-T180 Method A

Maximum Dry Density, pcf: 114.8
Optimum Moisture Content, %: 13.7



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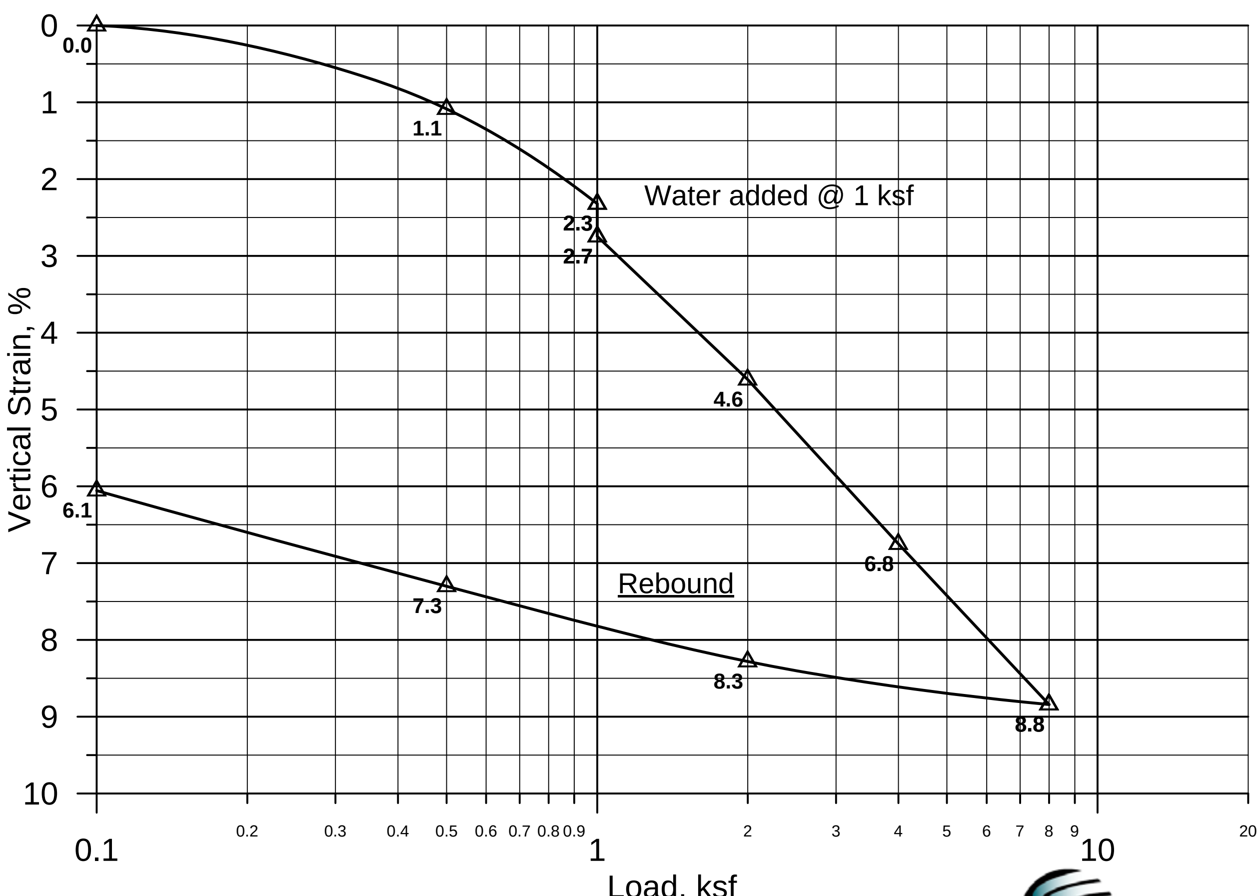
CONSOLIDATION TEST RESULTS
ASTM D 4546 (Method C)

Project: Tigert Middle School Additions
Client: Soda Springs School Jt. District # 150
Project Number: PO17066A
Sample Number: BL1702506
Sample Location: 17-STR-B04 @ 5'-7'
Sample Classification: Lean Clay
Atterberg Limits: LL=35, PI=19 (CL)
Percent Passing #200 Screen: 96.2%
Sample: In-Situ Tube (Condition: Good)
Date Tested: 9/25/17 By: K. Wildman
Sample Dry Unit Weight: 86.5 pcf
Moisture Content: 17.8%



Reviewed By: ______________________

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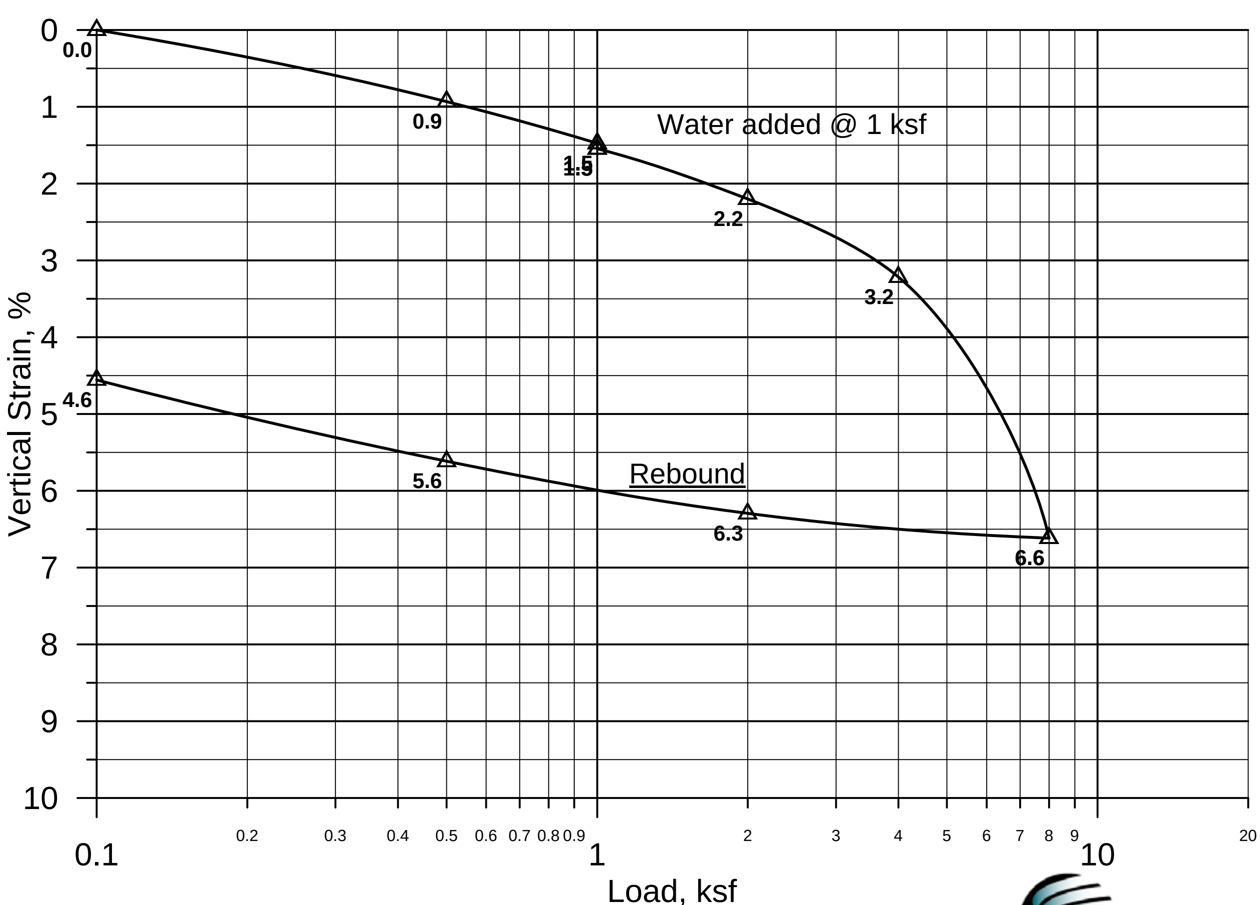
CONSOLIDATION TEST RESULTS
ASTM D 2435 (Method A)

Project: Tigert Middle School Additions
Client: Soda Springs School Jt. District # 150
Project Number: PO17066A
Sample Number: BL1702507
Sample Location: 17-STR-B07 @ 10'-11.5'
Sample Classification: Lean Clay
Atterberg Limits: LL=31, PI=14 (CL)
Percent Passing #200 Screen: 89.3%
Sample: In-Situ Tube (Condition: Good)
Date Tested: 9/25/17 By: K. Wildman
Sample Dry Unit Weight: 86.9 pcf
Moisture Content: 23.4%



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