PRELIMINARY GEOTECHNICAL INVESTIGATION

RIVER CLUB DEVELOPMENT

6515 West State Street

Garden City, ID

PREPARED FOR:

Mr. Trever Nicoll
Lincoln Property Group
1211 Southwest 5th Avenue, Suite 700
Portland, OR 97204

PREPARED BY:

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December 6, 2022
B220582g

ATLAS

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Mr. Trever Nicoll
Lincoln Property Group
1211 Southwest 5th Avenue, Suite 700
Portland, OR 97204

Subject: Preliminary Geotechnical Investigation
River Club Development
6515 West State Street
Garden City, ID

Dear Mr. Nicoll:

In compliance with your instructions, Atlas has conducted a soils exploration and foundation evaluation for the above referenced development. Fieldwork for this investigation was conducted on April 13 and 14, 2022. Data have been analyzed to evaluate pertinent geotechnical conditions. Results of this investigation, together with our recommendations, are to be found in the following report. We have provided a PDF copy for your review and distribution.

Often, questions arise concerning soil conditions because of design and construction details that occur on a project. Atlas would be pleased to continue our role as geotechnical engineers during project implementation.

If you have any questions, please call us at (208) 376-4748.

Respectfully submitted,

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1. INTRODUCTION

This report presents results of a geotechnical investigation and analysis in support of data utilized in design of structures as defined in the 2018 International Building Code (IBC). Information in support of groundwater and stormwater issues pertinent to the practice of Civil Engineering is included. Observations and recommendations relevant to the earthwork phase of the project are also presented. Revisions in plans or drawings for the proposed development from those enumerated in this report should be brought to the attention of the soils engineer to determine whether changes in the provided recommendations are required. Deviations from noted subsurface conditions, if encountered during construction, should also be brought to the attention of the soils engineer.

1.1 Project Description

The proposed development is in the northern portion of the City of Garden City, Ada County, ID, and occupies a portion of the NW¼ of Section 30, Township 4 North, Range 2 East, Boise Meridian. This project will consist of a mixed-use development comprised of 1 to 4-story podium style structures and 3-story townhomes. The site to be developed is approximately 22.21 acres. Size, layout, and loading of the structures are not know at this time; therefore, all recommendations provided in this report should be considered preliminary. Atlas must be contacted once the project scope has been developed to provide a final geotechnical engineering report. Total settlements are limited to 1 inch. Loads of up to 6,000 pounds per lineal foot for wall footings, and column loads of up to 300,000 pounds were assumed for settlement calculations. Additionally, assumptions have been made for traffic loading of pavements. Retaining walls are anticipated in the form of elevator pits in the mixed-use structures. Atlas was informed by Trever Nicoll with Lincoln Property Company that portions of the site reside in the floos plain and will need to be elevated 2.3 feet or greater.

1.2 Authorization

Authorization to perform this exploration and analysis was given in the form of a written authorization to proceed from Mr. Patrick Gilligan of Lincoln Property Group to Max Kasberger of Atlas Technical Consultants (Atlas), on April 12, 2022. Said authorization is subject to terms, conditions, and limitations described in the Professional Services Contract entered into between Lincoln Property Group and Atlas. Our scope of services for the proposed development has been provided in our proposal dated April 5, 2022 and repeated below.

1.3 Scope of Investigation

The scope of this investigation included review of geologic literature and existing available geotechnical studies of the area, visual site reconnaissance of the immediate site, subsurface exploration of the site, field and laboratory testing of materials collected, and engineering analysis and evaluation of foundation materials. The scope of work did not include design recommendations specific to individual structures.

2. SITE DESCRIPTION

2.1 Site Access

Access to the site may be gained via Interstate 184 to the Curtis Road exit. Proceed north and northeast on Curtis Road approximately 1.0 mile to where it becomes Veterans Memorial Parkway. Continue northeast on Veterans Memorial Parkway roughly 1.0 mile to its intersection with State Street. Head northwest on State Street approximately 2.4 miles to its intersection with Plantation Drive. The site is located to the southeast of this intersection. The location is depicted on site maps included in the **Appendix**.

2.2 Regional Geology

The project site is located within the western Snake River Plain of southwestern Idaho and eastern Oregon. The plain is a northwest trending rift basin, about 45 miles wide and 200 miles long, that developed about 14 million years ago (Ma) and has since been occupied sporadically by large inland lakes. Geologic materials found within and along the plain's margins reflect volcanic and fluvial/lacustrine sedimentary processes that have led to an accumulation of approximately 1 to 2 km of interbedded volcanic and sedimentary deposits within the plain. Along the margins of the plain, streams that drained the highlands to the north and south provided coarse to fine-grained sediments eroded from granitic and volcanic rocks, respectively. About 2 million years ago the last of the lakes was drained and since that time fluvial erosion and deposition has dominated the evolution of the landscape.

The southwestern portion of the project site is underlain by "Alluvium of Boise River" as mapped by Othberg and Stanford (1993). These Holocene (10,000 years ago to present) age deposits accumulated as the result of stream processes on low-lying river beds, flood plains and alluvial fans. Deposits are composed of sandy cobble gravel upstream grading to sandy pebble gravel downstream and typically contain no pedogenic clay. Gravel deposits underlie the flood plain of the Boise River to depths of 23-35 feet and overlie a surface cut by the river into earlier Tertiary basin-fill sediments.

The northeastern portion of the project site is underlain by "Gravel of the Boise Terrace" as mapped by Othberg and Stanford (1993). The Boise terrace is the first terrace above the modern Boise River. It consists of a low surface about 10 feet above the river level that is virtually undissected and mostly mantled with loess. These deposits are typically 10 to 35 feet thick and contain little or no pedogenic clay and no duripan.

2.3 General Site Characteristics

The site to be developed is approximately 22.21 acres in size. The site currently exists as a portion of the River Club Golf Course. Vegetation on the site consists primarily of landscape trees, shrubs, and grasses. The site is relatively flat and level. However, localized slopes are present around the greens. An open irrigation channel runs on the southwestern portion of the work site. Residential development surrounds the golf course.

Regional drainage is south and west toward the Boise River, which is approximately ¼ mile to the southwest of the project site. Stormwater drainage for the site is achieved by percolation through surficial soils. From the south, intermittent off-site stormwater may drain onto the project site. Stormwater drainage collection and retention systems are not in place on the project site but were noted in adjacent roadways in the form of curb, gutter and drop inlets.

2.4 Regional Site Climatology and Geochemistry

According to the Western Regional Climate Center, the average precipitation for the Treasure Valley is on the order of 10 to 12 inches per year, with an annual snowfall of approximately 20 inches and a range from 3 to 49 inches. The monthly mean daily temperatures range from 21°F to 95°F, with daily extremes ranging from roughly -25°F to 111°F. Winds are generally from the northwest or southeast with an annual average wind speed of approximately 9 miles per hour (mph) and a maximum of 62 mph. Soils and sediments in the area are primarily derived from siliceous materials and exhibit low electro-chemical potential for corrosion of metals or concretes. Local aggregates are generally appropriate for Portland cement and lime cement mixtures. Surface water, groundwater, and soils in the region typically have pH levels ranging from 7.2 to 8.2.

3. SEISMIC SITE EVALUATION

3.1 Geoseismic Setting

Soils on site are classed as Site Class C in accordance with Chapter 20 of the American Society of Civil Engineers (ASCE) publication ASCE/SEI 7-16. Shear wave velocity testing was conducted in the location shown on the REMI Report included in the **Appendix**. Considering the percentage of error or bias for the test is 1.7 percent, shear wave velocity results showed an average value of 1,454 ft/s. Therefore, structures constructed on this site should be designed per IBC requirements for a Site Class C. Our investigation did not reveal hazards resulting from potential earthquake motions including: slope instability, liquefaction, and surface rupture caused by faulting or lateral spreading. Incidence and anticipated acceleration of seismic activity in the area is low.

3.2 Seismic Design Parameter Values

The United States Geological Survey National Seismic Hazard Maps (2008), includes a peak ground acceleration map. The map for 2% probability of exceedance in 50 years in the Western United States in standard gravity (g) indicates that a peak ground acceleration of 0.173 is appropriate for the project site based on a Site Class C.

The following section provides an assessment of the earthquake-induced earthquake loads for the site based on the Risk-Targeted Maximum Considered Earthquake (MCE_R). The MCE_R spectral response acceleration for short periods, S_{MS}, and at 1-second period, S_{M1}, are adjusted for site class effects as required by the 2018 IBC. Design spectral response acceleration parameters as presented in the 2018 IBC are defined as a 5% damped design spectral response acceleration at short periods, S_{DS}, and at 1-second period, S_{D1}.

The USGS National Seismic Hazards Mapping Project includes a program that provides values for ground motion at a selected site based on the same data that were used to prepare the USGS ground motion maps. The maps were developed using attenuation relationships for soft rock sites; the source model, assumptions, and empirical relationships used in preparation of the maps are described in Petersen and others (1996).

Table 1 – Seismic Design Values

Seismic Design Parameter	Design Value
Site Class	C "Very Dense Soil and Soft Rock"
S_s	0.309 (g)
S_1	0.111 (g)
F_a	1.300
F_v	1.500
S_{MS}	0.401
S_{M1}	0.166
S_{DS}	0.268
S_{D1}	0.111

4. SOILS EXPLORATION

4.1 Exploration and Sampling Procedures

Field exploration conducted to determine engineering characteristics of subsurface materials included a reconnaissance of the project site and investigation by soil boring and test pit. Borings and test pits were located in the field by means of a Global Positioning System (GPS) device and are reportedly accurate to within ten feet. Borings were advanced by means of a truck-mounted drilling rig equipped with continuous flight hollow-stem augers. At specified depths, samples were obtained using a standard split-spoon sampler, and Standard Penetration Test (SPT) blow counts were recorded. Uncorrected SPT blow counts are provided on logs, which can be found in the **Appendix**. Delayed water level observations were made in open borings to evaluate groundwater levels. At completion of exploration, borings were backfilled with loose excavated materials. Test pits were backfilled with loose excavated materials. Re-excavation and compaction of these test pit areas are required prior to construction of overlying structures.

Samples have been visually classified in the field by professional staff, identified according to test pit/boring number and depth, placed in sealed containers, and transported to our laboratory for additional testing. Subsurface materials have been described in detail on logs provided in the **Appendix**. Results of field and laboratory tests are also presented in the **Appendix**. Atlas recommends that these logs **not** be used to estimate fill material quantities.

4.2 Laboratory Testing Program

Along with our field investigation, a supplemental laboratory testing program was conducted to determine additional pertinent engineering characteristics of subsurface materials necessary in an analysis of anticipated behavior of the proposed structures. Laboratory tests were conducted in accordance with current applicable American Society for Testing and Materials (ASTM) specifications, and results of these tests are to be found in the Appendix. The laboratory testing program for this report included: Atterberg Limits Testing – ASTM D4318 and Grain Size Analysis – ASTM C117/C136.

4.3 Soil and Sediment Profile

The profile below represents a generalized interpretation for the project site. Note that on site soils strata, encountered between test pit and boring locations, may vary from the individual soil profiles presented in the logs, which can be found in the **Appendix**.

Various silt-sand-gravel fill mixtures were noted at ground surface. These materials varied from dark brown to light brown or gray and generally exhibited moisture contents of slightly moist to wet. Fills were noted to be soft to stiff/loose to very dense. Fine to coarse-grained sand, fine to coarse gravel, and 6-inch minus cobbles were present throughout. Organic materials were measured to depths of up to roughly 2.4 feet.

Lean clay with sand soils were observed beneath fill materials in boring 6 and test pits 7 and 8. These soils were dark brown to blue-gray, slightly moist to saturated, and very soft to soft, with fine-grained sand. Poorly graded sand sediments were found below surficial fill materials in borings 2 and 3, test pits 1, 3, 4, and 9, and underlying lean clays with sand in test pit 8. Poorly graded sand with silt sediments were encountered beneath fill materials in test pit 12. These sediments were light brown, slightly moist to saturated, and loose to medium dense, with fine to coarse-grained sand.

At depth, poorly graded gravel with sand sediments and poorly graded sand with gravel sediments were exposed. These sediments were light brown to gray, slightly moist to saturated, and medium dense to very dense. Fine to coarse-grained sand, fine to coarse gravel, and 8-inch minus cobbles were noted throughout.

Competency of test pit/boring sidewalls varied little across the site. In general, fine-grained soils remained stable while more granular sediments readily sloughed. However, moisture contents will also affect wall competency with saturated soils having a tendency to readily slough when under load and unsupported.

4.4 Volatile Organic Scan

No environmental concerns were identified prior to commencement of the investigation. Therefore, soils obtained during on-site activities were not assessed for volatile organic compounds by portable photoionization detector. Samples obtained during our exploration activities exhibited no odors or discoloration typically associated with this type of contamination. Groundwater encountered did not exhibit obvious signs of contamination.

5. SITE HYDROLOGY

Existing surface drainage conditions are defined in the **General Site Characteristics** section. Information provided in this section is limited to observations made at the time of the investigation. Either regional or local ordinances may require information beyond the scope of this report.

5.1 Groundwater

During this field investigation, groundwater was encountered in test pits and borings at depths ranging from 2.7 to 8.8 feet bgs. Relatively shallow groundwater was generally encountered near the open irrigation channel. Soil moistures in the test pits and borings were generally slightly moist to moist within surficial fill materials and native soils. Within the deeper horizons, soil moistures graded from slightly moist to saturated as the water table was approached and penetrated. In the vicinity of the project site, groundwater levels are controlled in large part by the stage and flow of the Boise River and by irrigation of the golf course. Maximum groundwater elevations likely occur during late spring to early summer runoff season and continue through the later portion of the irrigation season.

Atlas has previously performed 6 geotechnical investigations within 0.2 mile of the project site. Information from these investigations has been provided in the table below.

Table 2 – Groundwater Data

Date	Approximate Distance from Site (mile)	Direction from Site	Groundwater Depth (feet bgs)
February 2022	Onsite	N/A	6.1
December 2004	0.05	North	6.4 to 7.0
July 2008	0.07	North	6.9 to 8.5
July 2004	0.13	Northeast	4.4 to 6.1
May 2016	0.14	East	7.7 to 8.0
January 2022	0.18	Northwest	7.2

Furthermore, according to United States Geological Survey (USGS) monitoring well data and Idaho Department of Water Resources (IDWR) well logs within approximately ¼-mile of the project site, groundwater was measured at depths ranging between 4 and 10 feet bgs.

Based on evidence of this investigation and background knowledge of the area, Atlas estimates groundwater depths to remain greater than approximately 2 feet bgs throughout the year. If the influence of the open irrigation channel is negated, groundwater depths are estimated to remain greater than approximately 4 feet bgs. However, as the site is heavily influenced by the Boise River, flooding or near flooding conditions will result in temporarily higher groundwater elevations. This depth can be confirmed through long-term groundwater monitoring. Since this is an estimated depth and seasonal groundwater levels fluctuate, actual levels should be confirmed by periodic groundwater data collected from piezometers installed in test pits 2, 5 and 15. If desired, Atlas is available to perform this monitoring.

5.2 Soil Infiltration Rates

Soil permeability, which is a measure of the ability of a soil to transmit a fluid, was not tested in the field. Given the absence of direct measurements, for this report an estimation of infiltration is presented using generally recognized values for each soil type and gradation. Of soils comprising the generalized soil profile for this study, lean clay with sand soils generally offer little permeability, with typical hydraulic infiltration rates of less than 2 inches per hour. Poorly graded sand with silt sediments usually display rates of 6 to 10 inches per hour. Poorly graded sand and gravel sediments typically exhibit infiltration values in excess of 12 inches per hour; though groundwater may reduce these rates to near zero. Infiltration rates through fill materials can be highly variable based on level of compaction and type of soil matrix. Therefore, infiltration into fill materials on the site is prohibited.

It is recommended that infiltration facilities constructed on the site be extended into native poorly graded gravel with sand and poorly graded sand sediments. Excavation depths ranging from 1 to 7 feet bgs should be anticipated to expose these poorly graded gravel with sand and poorly graded sand sediments. Because of the high soil permeability, ASTM C33 filter sand, or equivalent, should be incorporated into design of infiltration facilities. The high groundwater depth is expected to be higher than these soils through portions of the year and in the vicinity of the irrigation channel. When this occurs, vertical drainage of stormwater will be limited. An infiltration rate of 2 inches per hour should be used in design to account for this condition. Actual infiltration rates should be confirmed at the time of construction.

6. PRELIMINARY FOUNDATION AND SLAB DISCUSSION AND RECOMMENDATIONS

Various foundation types have been considered for support of the proposed development. Two requirements must be met in the design of foundations. First, the applied bearing stress must be less than the ultimate bearing capacity of foundation soils to maintain stability. Second, total and differential settlement must not exceed an amount that will produce an adverse behavior of the superstructure. Allowable settlement is usually exceeded before bearing capacity considerations become important; thus, allowable bearing pressure is normally controlled by settlement considerations.

Considering subsurface conditions and the proposed construction, it is recommended that the structure be founded upon conventional spread footings and continuous wall footings. Total settlements should not exceed 1 inch if the following design and construction recommendations are observed. <u>The size, layout, and loading for the structures are unknown at this time. The following recommendations should be considered preliminary. Once the building layout and loading information are known, Atlas must be contacted to provide final recommendations.</u>

6.1 Option 1: Preliminary Spread Footing Recommendations

Based on data obtained from the site and test results from various laboratory tests performed, Atlas recommends the following guidelines for the net allowable soil bearing capacity:

Table 3 – Soil Bearing Capacity

Footing Depth	ASTM D1557 Subgrade Compaction	Net Allowable Soil Bearing Capacity
Footings must bear on competent, undisturbed, native poorly graded sand sediments, poorly graded sand with silt sediments, poorly graded sand with gravel sediments, poorly graded gravel with sand sediments, or compacted structural fill. Existing fill materials, organics, and lean clay with sand soils must be completely removed from below foundation elements.[1] Excavation depths ranging from roughly 0.3 to 5.5 feet bgs should be anticipated to expose proper bearing soils.[2] Depending on time of year of construction, dewatering may be required.	Not Required for Native Soil 95% for Structural Fill	3,500 lbs/ft^2

[1] It will be required for Atlas personnel to verify the bearing soil suitability for each structure at the time of construction.
[2] Depending on the time of year construction takes place, the subgrade soils may be unstable because of high moisture contents. If unstable conditions are encountered, over-excavation and replacement with granular structural fill and/or use of geotextiles may be required.

6.2 Option 2: Rammed Earth Aggregate Pier Recommendations

This approach would involve the use of 2.5 foot diameter piers for support of shallow spread footings. Rammed earth aggregate piers are typically drilled to a specified depth. Aggregate fill materials are then placed and compacted in lifts. The typical allowable design bearing capacity would be 4,000 psf to 5,000 psf, depending on final design parameters and requirements. Pier spacing should be at least 3 times the diameter. The specialty contractor would provide the final design, with support and assistance from Atlas.

6.3 General Foundation Information

The following sliding frictional coefficient values should be used: 1) 0.40 for footings bearing on native poorly graded sand sediments, poorly graded sand with silt sediments, and poorly graded sand with gravel sediments, and 2) 0.45 for footings bearing on native poorly graded gravel with sand sediments and granular structural fill. A passive lateral earth pressure of 405 pounds per square foot per foot (psf/ft) should be used for native poorly graded sand sediments and poorly graded sand with silt sediments, and a passive lateral earth pressure of 430 psf/ft should be used for poorly graded sand with gravel sediments. For compacted sandy gravel fill and native poorly graded gravel with sand sediments, a passive lateral earth pressure of 496 psf/ft should be used.

Footings should be proportioned to meet either the stated soil bearing capacity or the 2018 IBC minimum requirements. Total settlement should be limited to approximately 1 inch, and differential settlement should be limited to approximately ½ inch. Objectionable soil types encountered at the bottom of footing excavations should be removed and replaced with structural fill. Excessively loose or soft areas that are encountered in the footings subgrade will require over-excavation and backfilling with structural fill.

To minimize the effects of slight differential movement that may occur because of variations in the character of supporting soils and seasonal moisture content, Atlas recommends continuous footings be suitably reinforced to make them as rigid as possible. For frost protection, the bottom of external footings should be 30 inches below finished grade. Exterior foundations must be backfilled in accordance with the **Exterior Foundation Backfill Recommendations** section. Based on the soil types encountered onsite and the character of the proposed construction, foundation drains are not needed.

6.4 Exterior Foundation Backfill Recommendations

Atlas recommends that exterior foundations be backfilled in a controlled manner as outlined below.

- **Landscaping Adjacent to Structure:** Exterior foundations are to be backfilled with onsite fine-grained soils. Backfill must be placed in 6-inch thick loose lifts and be compacted to at least 90 percent of the maximum dry density as determined by ASTM D698. The top 12 inches must consist of a low permeability (clay or silt) soil to limit surface water infiltration. The surface must be graded away from the structure at least 5 percent for a distance of 10 feet. In addition, Atlas recommends that roof drains carry stormwater at least 10 feet away from the structure.
- **Hardscaping Adjacent to Structure:** Exterior foundations are to be backfilled with onsite soils or imported structural fill. Backfill must be placed in 6-inch thick loose lifts and each lift must be compacted to at least 95 percent of the maximum dry density as determined by ASTM D698. The top 12 inches must consist of granular structural fill and be compacted to at least 95 percent of the maximum dry density as determined by ASTM D1557. The hardscape surface must be sloped away from the structure for a sufficient distance to avoid water ponding along the foundation walls from precipitation, snowmelt, and other water events.

6.5 Preliminary Floor Slab-on-Grade

Atlas was informed that approximately 3 feet of fill material will be placed to elevate the site. If the grading plan changes and 3 feet of fill material will not be placed, Atlas must be contacted to revise these recommendations.

Uncontrolled fill was encountered across the site. Atlas recommends that these fill materials be completely removed or excavated to a depth of at least 1 foot below existing site grade. If fill materials remain after excavation, the exposed subgrade must be compacted to at least 95 percent of the maximum dry density as determined by ASTM D1557. The excavated fill materials can be replaced in accordance with the **Structural Fill** section provided that all organic material and debris is completely removed.

It is noted that uncontrolled fill may remain below the improved zone (specified above) in portions of the site. If water or increased moisture conditions occur within these fill materials, settlement or vertical movement may occur. This risk must be recognized and accepted by the project owner. Otherwise, complete removal of the fill zone will be required.

Organic, loose, or obviously compressive materials must be removed prior to placement of concrete floors or floor-supporting fill. In addition, the remaining subgrade should be treated in accordance with guidelines presented in the **Earthwork** section. Areas of excessive yielding should be excavated and backfilled with structural fill. Fill used to increase the elevation of the floor slab should meet requirements detailed in the **Structural Fill** section. Fill materials must be compacted to a minimum 95 percent of the maximum dry density as determined by ASTM D1557.

A free-draining granular mat should be provided below slabs-on-grade to provide drainage and a uniform and stable bearing surface. This should be a minimum of 4 inches in thickness and properly compacted. The mat should consist of a sand and gravel mixture, complying with Idaho Standards for Public Works Construction (ISPWC) specifications for ¾-inch (Type 1) crushed aggregate. The granular mat should be compacted to no less than 95 percent of the maximum dry density as determined by ASTM D1557. A moisture-retarder should be placed beneath floor slabs to minimize potential ground moisture effects on moisture-sensitive floor coverings. The moisture-retarder should be at least 15-mil in thickness and have a permeance of less than 0.01 US perms as determined by ASTM E96. Placement of the moisture-retarder will require special consideration with regard to effects on the slab-on-grade and should adhere to recommendations outlined in the ACI 302.1R and ASTM E1745 publications. Upon request, Atlas can provide further consultation regarding installation.

7. PAVEMENT DISCUSSION AND RECOMMENDATIONS

Atlas has made assumptions for traffic loading variables based on the character of the proposed construction. The Client shall review and understand these assumptions to make sure they reflect intended use and loading of pavements both now and in the future. Based on experience with soils in the region, a subgrade California Bearing Ratio (CBR) value of 4 has been assumed for near-surface fill materials and native soils on site. The following are minimum thickness requirements for assured pavement function. Depending on site conditions, additional work, e.g. soil preparation, may be required to support construction equipment. These have been listed within the **Soft Subgrade Soils** section.

7.1 Flexible Pavement Sections

The American Association of State Highway and Transportation Officials (AASHTO) design method has been used to calculate the following pavement sections. Calculation sheets provided in the **Appendix** indicate the soils constant, traffic loading, traffic projections, and material constants used to calculate the pavement sections. Atlas recommends that materials used in the construction of asphaltic concrete pavements meet requirements of the ISPWC Standard Specification for Highway Construction. Construction of the pavement section should be in accordance with these specifications and should adhere to guidelines recommended in the section on **Construction Considerations**.

Table 4 – AASHTO Flexible Pavement Specifications

Pavement Section Component	Driveways and Parking Light Duty	Driveways and Parking Heavy Duty
Asphaltic Concrete	2.5 Inches	3.0 Inches
Crushed Aggregate Base	4.0 Inches	4.0 Inches
Structural Subbase	10.0 Inches	14.0 Inches
Compacted Subgrade	See **Pavement Subgrade Preparation** Section	See **Pavement Subgrade Preparation** Section

[1] It will be required for Atlas personnel to verify subgrade competency at the time of construction.

- Asphaltic Concrete: Asphalt mix design shall meet the requirements of ISPWC, Section 810. Materials shall be placed in accordance with ISPWC Standard Specifications for Highway Construction.
- Aggregate Base: Material complying with ISPWC Standards for Crushed Aggregate Materials.
- Structural Subbase: Granular structural fill material complying with the requirements detailed in the **Structural Fill** section of this report except that the maximum material diameter is no more than $^2/_3$ the component thickness. Gradation and suitability requirements shall be per ISPWC Section 801, Table 1.

7.2 Preliminary Pavement Subgrade Preparation

Atlas was informed that approximately 3 feet of fill material will be placed to elevate the site. If the grading plan changes and 3 feet of fill material will not be placed, Atlas must be contacted to revise these recommendations.

Uncontrolled fill was encountered across the site. Atlas recommends that these fill materials be completely removed or excavated to a depth of at least 1 foot below existing site grade. <u>If fill materials remain after excavation, the exposed subgrade must be compacted to at least 95 percent of the maximum dry density as determined by ASTM D698.</u> The excavated fill materials can be replaced in accordance with the **Structural Fill** section provided that all organic material and debris is completely removed.

<u>It is noted that uncontrolled fill may remain below the improved zone (specified above) in portions of the site. If water or increased moisture conditions occur within these fill materials, settlement or vertical movement may occur. This risk must be recognized and accepted by the project owner. Otherwise, complete removal of the fill zone will be required.</u>

7.3 Common Pavement Section Construction Issues

The subgrade upon which above pavement sections are to be constructed must be properly stripped, compacted, inspected, and proof-rolled. Proof rolling of subgrade soils should be accomplished using a heavy rubber-tired, fully loaded, tandem-axle dump truck or equivalent. Verification of subgrade competence by Atlas personnel at the time of construction is required. Fill materials on the site must demonstrate the indicated compaction prior to placing material in support of the pavement section. Atlas anticipated that pavement areas will be subjected to moderate traffic. <u>Subgrade clayey and silty soils near and above optimum moisture contents may pump during compaction.</u> Pumping or soft areas must be removed and replaced with structural fill.

Fill material and aggregates in support of the pavement section must be compacted to no less than 95 percent of the maximum dry density as determined by ASTM D698 for flexible pavements and by ASTM D1557 for rigid pavements. If a material placed as a pavement section component cannot be tested by usual compaction testing methods, then compaction of that material must be approved by observed proof rolling. Minor deflections from proof rolling for flexible pavements are allowable. Deflections from proof rolling of rigid pavement support courses should not be visually detectable.

Atlas recommends that rigid concrete pavement be provided for heavy garbage receptacles. This will eliminate damage caused by the considerable loading transferred through the small steel wheels onto asphaltic concrete. Rigid concrete pavement should consist of Portland Cement Concrete Pavement (PCCP) generally adhering to ITD specifications for Urban Concrete. PCCP should be 6 inches thick on a 4-inch drainage fill course (see **Floor Slab-on-Grade** section), and should be reinforced with welded wire fabric. Control joints must be on 12-foot centers or less.

8. CONSTRUCTION CONSIDERATIONS

Recommendations in this report are based upon structural elements of the project being founded on competent, poorly graded sand sediments, poorly graded sand with silt sediments, poorly graded sand with gravel sediments, poorly graded gravel with sand sediments or compacted structural fill. Structural areas should be stripped to an elevation that exposes these soil types.

8.1 Earthwork

Excessively organic soils, deleterious materials, or disturbed soils generally undergo high volume changes when subjected to loads, which is detrimental to subgrade behavior in the area of pavements, floor slabs, structural fills, and foundations. Mature trees, and thick grasses with associated root systems were noted at the time of our investigation. It is recommended that organic or disturbed soils, if encountered, be removed to depths of 1 foot (minimum), and wasted or stockpiled for later use. However, in areas where trees are/were present, deeper excavation depths should be anticipated. Stripping depths should be adjusted in the field to assure that the entire root zone, disturbed zone or topsoil are removed prior to placement and compaction of structural fill materials. Exact removal depths should be determined during grading operations by Atlas personnel, and be based upon subgrade soil type, composition, and firmness or soil stability.

If underground storage tanks, underground utilities, wells, or septic systems are discovered during construction activities, they must be decommissioned then removed or abandoned in accordance with governing Federal, State, and local agencies. Excavations developed as the result of such removal must be backfilled with structural fill materials as defined in the **Structural Fill** section.

Atlas should oversee subgrade conditions (i.e., moisture content) as well as placement and compaction of new fill (if required) after native soils are excavated to design grade. Recommendations for structural fill presented in this report can be used to minimize volume changes and differential settlements that are detrimental to the behavior of footings, pavements, and floor slabs. Sufficient density tests should be performed to properly monitor compaction. For structural fill beneath building structures, one in-place density test per lift for every 5,000 square feet is recommended. In parking and driveway areas, this can be decreased to one test per lift for every 10,000 square feet.

8.2 Dry Weather

If construction is to be conducted during dry seasonal conditions, many problems associated with soft soils may be avoided. However, some rutting of subgrade soils may be induced by shallow groundwater conditions related to springtime runoff or irrigation activities during late summer through early fall. Solutions to problems associated with soft subgrade soils are outlined in the **Soft Subgrade Soils** section. Problems may also arise because of lack of moisture in native and fill soils at time of placement. This will require the addition of water to achieve near-optimum moisture levels. Low-cohesion soils exposed in excavations may become friable, increasing chances of sloughing or caving. Measures to control excessive dust should be considered as part of the overall health and safety management plan.

8.3 Wet Weather

If construction is to be conducted during wet seasonal conditions (commonly from mid-November through May), problems associated with soft soils must be considered as part of the construction plan. During this time of year, fine-grained soils such as silts and clays will become unstable with increased moisture content, and eventually deform or rut. Additionally, constant low temperatures reduce the possibility of drying soils to near optimum conditions.

8.4 Soft Subgrade Soils

Shallow fine-grained subgrade soils that are high in moisture content should be expected to pump and rut under construction traffic. During periods of wet weather, construction may become very difficult if not impossible. The following recommendations and options have been included for dealing with soft subgrade conditions:

- Track-mounted vehicles should be used to strip the subgrade of root matter and other deleterious debris. Heavy rubber-tired equipment should be prohibited from operating directly on the native subgrade and areas in which structural fill materials have been placed. Construction traffic should be restricted to designated roadways that do not cross, or cross on a limited basis, proposed roadway or parking areas.
- Soft areas can be over-excavated and replaced with granular structural fill.
- Construction roadways on soft subgrade soils should consist of a minimum 2-foot thickness of large cobbles of 4 to 6 inches in diameter with sufficient sand and fines to fill voids. Construction entrances should consist of a 6-inch thickness of clean, 2-inch minimum, angular drain-rock and must be a minimum of 10 feet wide and 30 to 50 feet long. During the construction process, top dressing of the entrance may be required for maintenance.
- Scarification and aeration of subgrade soils can be employed to reduce the moisture content of wet subgrade soils. After stripping is complete, the exposed subgrade should be ripped or disked to a depth of 1½ feet and allowed to air dry for 2 to 4 weeks. Further disking should be performed on a weekly basis to aid the aeration process.
- Alternative soil stabilization methods include use of geotextiles, lime, and cement stabilization. Atlas is available to provide recommendations and guidelines at your request.

8.5 Frozen Subgrade Soils

Prior to placement of structural fill materials or foundation elements, frozen subgrade soils must either be allowed to thaw or be stripped to depths that expose non-frozen soils and wasted or stockpiled for later use. Stockpiled materials must be allowed to thaw and return to near-optimal conditions prior to use as structural fill.

The onsite, shallow clayey and silty soils are susceptible to frost heave during freezing temperatures. For exterior flatwork and other structural elements, adequate drainage away from subgrades is critical. Compaction and use of structural fill will also help to mitigate the potential for frost heave. Complete removal of frost susceptible soils for the full frost depth, followed by replacement with a non-frost susceptible structural fill, can also be used to mitigate the potential for frost heave. Atlas is available to provide further guidance/assistance upon request.

8.6 Structural Fill

Soils recommended for use as structural fill are those classified as GW, GP, SW, and SP in accordance with the Unified Soil Classification System (USCS) (ASTM D2487). Use of silty soils (USCS designation of GM, SM, and ML) as structural fill may be acceptable. However, use of silty soils (GM, SM, and ML) as structural fill below footings is prohibited. These materials require very high moisture contents for compaction and require a long time to dry out if natural moisture contents are too high and may also be susceptible to frost heave under certain conditions. Therefore, these materials can be quite difficult to work with as moisture content, lift thickness, and compactive effort becomes difficult to control. If silty soil is used for structural fill, lift thicknesses should not exceed 6 inches (loose), and fill material moisture must be closely monitored at both the working elevation and the elevations of materials already placed. Following placement, silty soils must be protected from degradation resulting from construction traffic or subsequent construction.

Recommended granular structural fill materials, those classified as GW, GP, SW, and SP, should consist of a 6-inch minus select, clean, granular soil with no more than 50 percent oversize (greater than ¾-inch) material and no more than 12 percent fines (passing No. 200 sieve). These fill materials should be placed in layers not to exceed 12 inches in loose thickness. Prior to placement of structural fill materials, surfaces must be prepared as outlined in the **Construction Considerations** section. Structural fill material should be moisture-conditioned to achieve optimum moisture content prior to compaction. For structural fill below footings, areas of compacted backfill must extend outside the perimeter of the footings for a distance equal to the thickness of fill between the bottom of foundation and underlying soils, or 5 feet, whichever is less. All fill materials must be monitored during placement and tested to confirm compaction requirements, outlined below, have been achieved.

Each layer of structural fill must be compacted, as outlined below:

- Below Structures and Rigid Pavements: A minimum of 95 percent of the maximum dry density as determined by ASTM D1557.
- Below Flexible Pavements: A minimum of 92 percent of the maximum dry density as determined by ASTM D1557 or 95 percent of the maximum dry density as determined by ASTM D698.

The ASTM D1557 test method must be used for samples containing up to 40 percent oversize (greater than ¾-inch) particles. If material contains more than 40 percent but less than 50 percent oversize particles, compaction of fill must be confirmed by proof rolling each lift with a 10-ton vibratory roller (or equivalent) until the maximum density has been achieved. Density testing must be performed after each proof rolling pass until the in-place density test results indicate a drop (or no increase) in the dry density, defined as maximum density or “break over” point. The number of required passes should be used as the requirements on the remainder of fill placement. Material should contain sufficient fines to fill void spaces, and must not contain more than 50 percent oversize particles.

8.7 Backfill of Walls

Backfill materials must conform to the requirements of structural fill, as defined in this report. For wall heights greater than 2.5 feet, the maximum material size should not exceed 4 inches in diameter. Placing oversized material against rigid surfaces interferes with proper compaction, and can induce excessive point loads on walls. Backfill shall not commence until the wall has gained sufficient strength to resist placement and compaction forces. Further, retaining walls above 2.5 feet in height shall be backfilled in a manner that will limit the potential for damage from compaction methods and/or equipment. It is recommended that only small hand-operated compaction equipment be used for compaction of backfill within a horizontal distance equal to the height of the wall, measured from the back face of the wall.

Backfill should be compacted in accordance with the specifications for structural fill, except in those areas where it is determined that future settlement is not a concern, such as planter areas. In nonstructural areas, backfill must be compacted to a firm and unyielding condition.

8.8 Excavations

Shallow excavations that do not exceed 4 feet in depth may be constructed with side slopes approaching vertical. Below this depth, it is recommended that slopes be constructed in accordance with Occupational Safety and Health Administration (OSHA) regulations, Section 1926, Subpart P. Based on these regulations, on-site soils are classified as type “C” soil, and as such, excavations within these soils should be constructed at a maximum slope of 1½ feet horizontal to 1 foot vertical (1½:1) for excavations up to 20 feet in height. Excavations in excess of 20 feet will require additional analysis. <u>Note that these slope angles are considered stable for short-term conditions only, and will not be stable for long-term conditions.</u>

During the subsurface exploration, test pit and boring sidewalls generally exhibited little indication of collapse; however, sloughing of fill materials and native granular sediments from test pit sidewalls was observed, particularly after penetration of the water table. For deep excavations, native granular sediments cannot be expected to remain in position. These materials are prone to failure and may collapse, thereby undermining upper soil layers. This is especially true when excavations approach depths near the water table. Care must be taken to ensure that excavations are properly backfilled in accordance with procedures outlined in this report.

8.9 Groundwater Control

Groundwater was encountered during the investigation and may be problematic during consturction. Excavations below the water table will require a dewatering program. Dewatering will be required prior to placement of fill materials. Placement of concrete can be accomplished through water by the use of a tremie. It may be possible to discharge dewatering effluent to remote portions of the site, to a sump, or to a pit. This will essentially recycle effluent, thus eliminating the need to enter into agreements with local drainage authorities. Should the scope of the proposed project change, Atlas should be contacted to provide more detailed groundwater control measures.

Special precautions may be required for control of surface runoff and subsurface seepage. It is recommended that runoff be directed away from open excavations. Silty and clayey soils may become soft and pump if subjected to excessive traffic during time of surface runoff. Ponded water in construction areas should be drained through methods such as trenching, sloping, crowning grades, nightly smooth drum rolling, or installing a French drain system. Additionally, temporary or permanent driveway sections should be constructed if extended wet weather is forecasted.

9. GENERAL COMMENTS

Based on the subsurface conditions encountered during this investigation and available information regarding the proposed development, the site is adequate for the planned construction. When plans and specifications are complete, and if significant changes are made in the character or location of the proposed development, consultation with Atlas must be arranged as supplementary recommendations may be required. Suitability of subgrade soils and compaction of structural fill materials must be verified by Atlas personnel prior to placement of structural elements. Additionally, monitoring and testing should be performed to verify that suitable materials are used for structural fill and that proper placement and compaction techniques are utilized.

10. REFERENCES

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Appendix I WARRANTY AND LIMITING CONDITIONS

Atlas warrants that findings and conclusions contained herein have been formulated in accordance with generally accepted professional engineering practice in the fields of foundation engineering, soil mechanics, and engineering geology only for the site and project described in this report. These engineering methods have been developed to provide the client with information regarding apparent or potential engineering conditions relating to the site within the scope cited above and are necessarily limited to conditions observed at the time of the site visit and research. Field observations and research reported herein are considered sufficient in detail and scope to form a reasonable basis for the purposes cited above.

Exclusive Use

This report was prepared for exclusive use of the property owner(s), at the time of the report, and their retained design consultants (“Client”). Conclusions and recommendations presented in this report are based on the agreed-upon scope of work outlined in this report together with the Contract for Professional Services between the Client and Atlas Technical Consultants (“Consultant”). Use or misuse of this report, or reliance upon findings hereof, by parties other than the Client is at their own risk. Neither Client nor Consultant make representation of warranty to such other parties as to accuracy or completeness of this report or suitability of its use by such other parties for purposes whatsoever, known or unknown, to Client or Consultant. Neither Client nor Consultant shall have liability to indemnify or hold harmless third parties for losses incurred by actual or purported use or misuse of this report. No other warranties are implied or expressed.

Report Recommendations are Limited and Subject to Misinterpretation

There is a distinct possibility that conditions may exist that could not be identified within the scope of the investigation or that were not apparent during our site investigation. Findings of this report are limited to data collected from noted explorations advanced and do not account for unidentified fill zones, unsuitable soil types or conditions, and variability in soil moisture and groundwater conditions. To avoid possible misinterpretations of findings, conclusions, and implications of this report, Atlas should be retained to explain the report contents to other design professionals as well as construction professionals.

Since actual subsurface conditions on the site can only be verified by earthwork, note that construction recommendations are based on general assumptions from selective observations and selective field exploratory sampling. Upon commencement of construction, such conditions may be identified that require corrective actions, and these required corrective actions may impact the project budget. Therefore, construction recommendations in this report should be considered preliminary, and Atlas should be retained to observe actual subsurface conditions during earthwork construction activities to provide additional construction recommendations as needed.

Since geotechnical reports are subject to misinterpretation, **do** **not** separate the soil logs from the report. Rather, provide a copy of, or authorize for their use, the complete report to other design professionals or contractors. Locations of exploratory sites referenced within this report should be considered approximate locations only. For more accurate locations, services of a professional land surveyor are recommended.

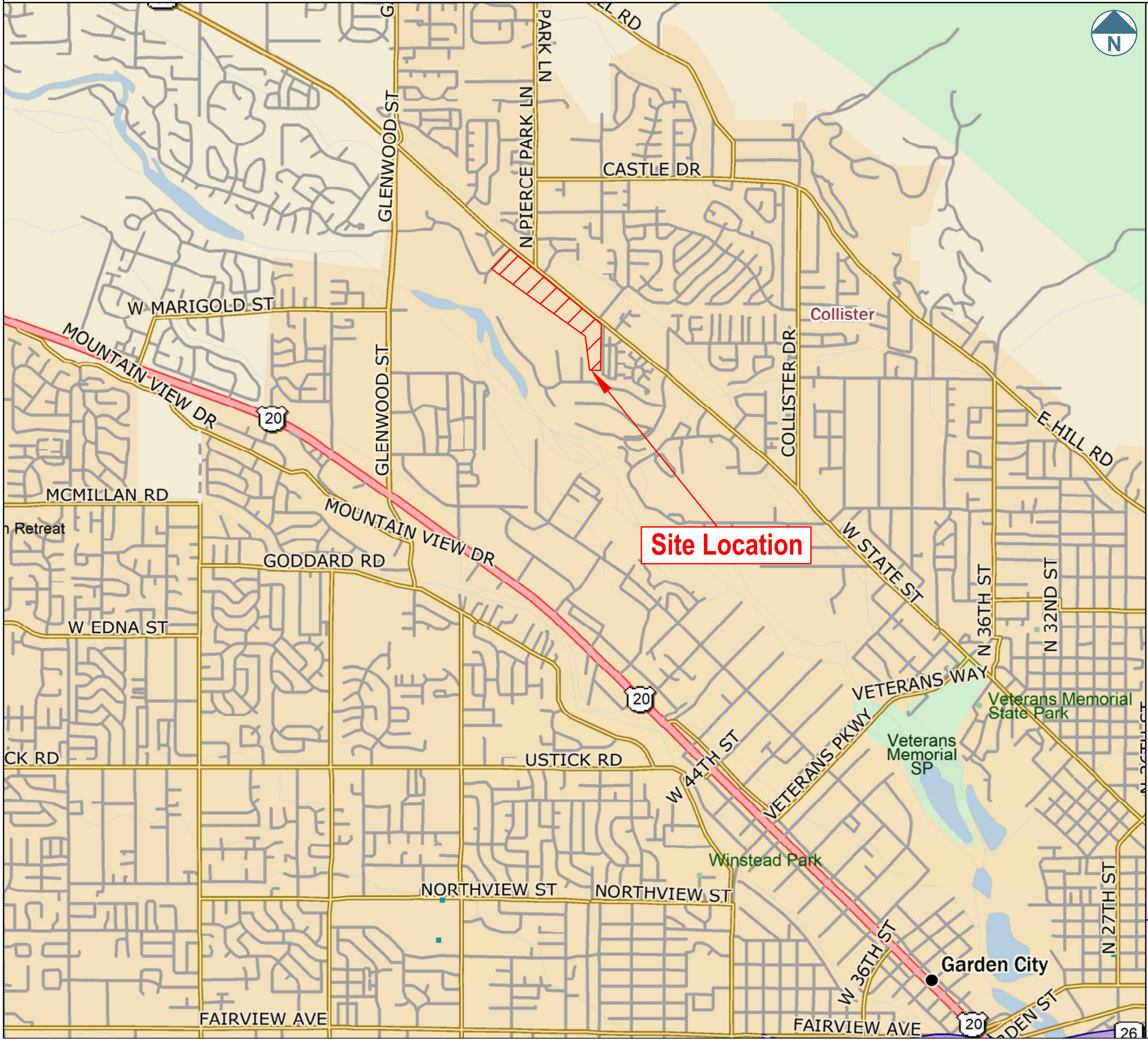
This report is also limited to information available at the time it was prepared. In the event additional information is provided to Atlas following publication of our report, it will be forwarded to the client for evaluation in the form received.

Environmental Concerns

Comments in this report concerning either onsite conditions or observations, including soil appearances and odors, are provided as general information. These comments are not intended to describe, quantify, or evaluate environmental concerns or situations. Since personnel, skills, procedures, standards, and equipment differ, a geotechnical investigation report is not intended to substitute for a geoenvironmental investigation or a Phase II/III Environmental Site Assessment. If environmental services are needed, Atlas can provide, via a separate contract, those personnel who are trained to investigate and delineate soil and water contamination.

Vicinity Map

Figure 1



MAP NOTES:

- Delorme Street Atlas
- Not to Scale

LEGEND

Approximate Area of Work	▨

River Club Development

6515 West State Street
Garden City, ID

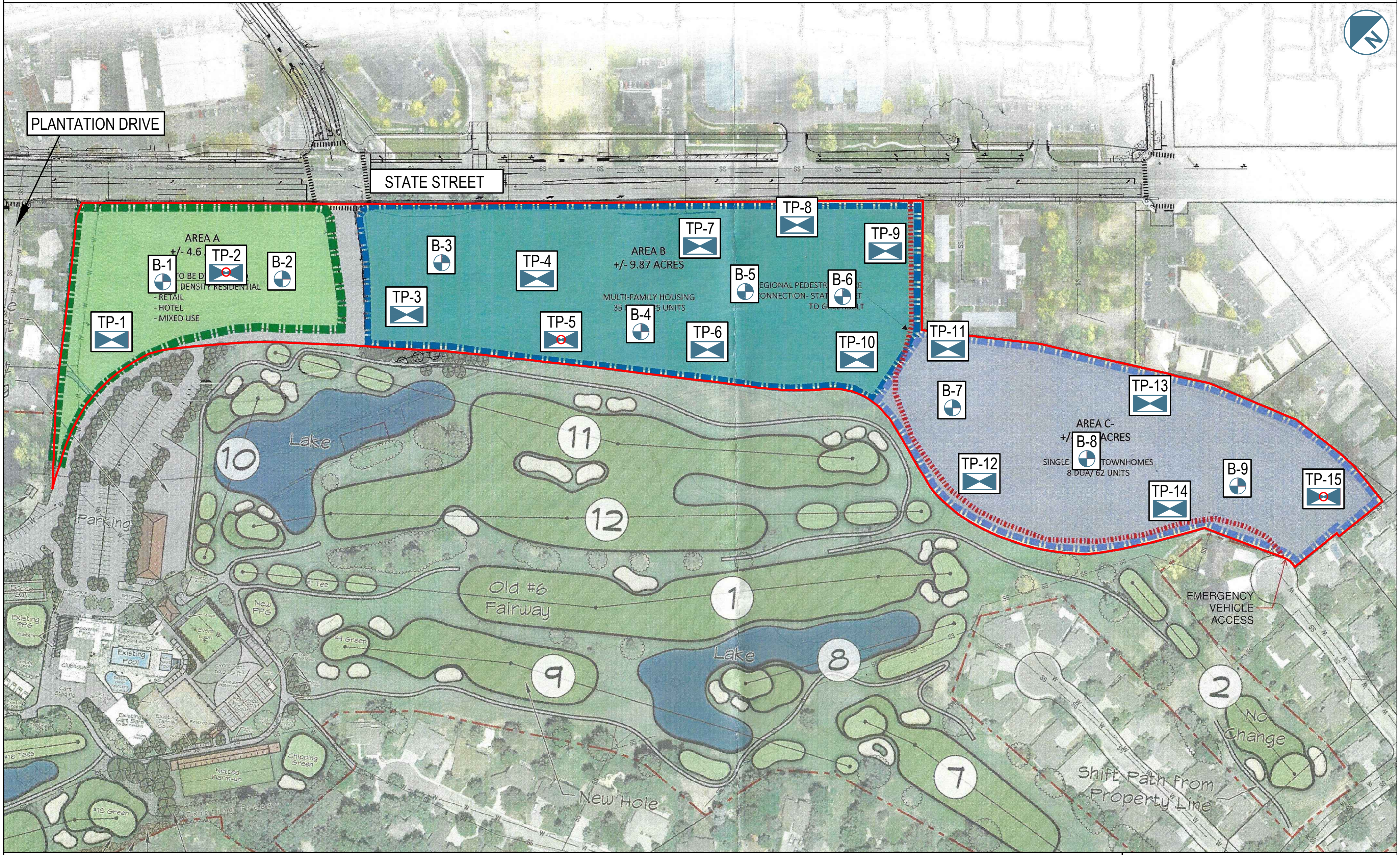
Modified from DeLorme by: MPK
April 22, 2022
Drawing: B220582g

2791 S. Victory View Way
Boise, ID 83709

Phone: (208) 376-4748
Fax: (208) 322-6515
Web: oneatlas.com

Site Map

Figure 2



NOTES:

- Not to Scale

LEGEND

Approximate Site Boundary 🟥

Approximate Atlas Boring Location ⊕

Approximate Atlas Test Pit Location ⊠

Approximate Atlas Test Pit Location with Piezometer ⊠

River Club Development
6515 West State Street
Garden City, ID

Modified by: MPK
April 4, 2022
Drawing: B220582g

ATLAS

2791 S. Victory View Way
Boise, ID 83709

Phone: (208) 376-4748
Fax: (208) 322-6515
Web: oneatlas.com

Appendix IV GEOTECHNICAL INVESTIGATION TEST PIT LOG

Test Pit Log #: TP-1
Date Advanced: April 14, 2022
Excavated by: Turn of the Century Homes
Logged by: Max Kasberger

Latitude: 43.661880
Longitude: -116.271005
Depth to Water Table: 8.8 feet bgs.
Total Depth: 9.2 feet bgs

Depth (feet bgs)	Field Description and USCS Soil and Sediment Classification	Sample Type	Sample Depth (feet bgs)	Qp	Lab Test ID
0.0-3.4	Sandy Silt Fill (ML-FILL): Dark brown, slightly moist, soft to medium stiff, with fine-grained sand. --Organic material encountered to 0.4 foot bgs.			0.5-0.75	
3.4-6.8	Poorly Graded Sand (SP): Light brown, slightly moist, medium dense, with fine to medium-grained sand.				
6.8-9.2	Poorly Graded Gravel with Sand (GP): Light brown, slightly moist to saturated, medium dense to dense, with fine to coarse-grained sand, fine to coarse gravel, and 6-inch minus cobbles.				

Notes: See Site Map for test pit location.

GEOTECHNICAL INVESTIGATION TEST PIT LOG

Test Pit Log #: TP-2
Date Advanced: April 14, 2022
Excavated by: Turn of the Century Homes
Logged by: Max Kasberger

Latitude: 43.661840
Longitude: -116.269963
Depth to Water Table: 8.5 feet bgs.
Total Depth: 8.7 feet bgs

Depth (feet bgs)	Field Description and USCS Soil and Sediment Classification	Sample Type	Sample Depth (feet bgs)	Qp	Lab Test ID
0.0-2.6	Silty Sand Fill (SM-FILL): Light brown, slightly moist, loose, with fine to medium-grained sand. --Organic material encountered to 0.2 foot bgs. --Tree roots encountered to 2.4 feet bgs.				
2.7-8.7	Poorly Graded Gravel with Sand (GP): Light brown, slightly moist to saturated, medium dense to very dense, with fine to coarse-grained sand, fine to coarse gravel, and 6-inch minus cobbles				

Notes: See Site Map for test pit location.
Piezometer installed to a depth of 8.7 feet bgs.

GEOTECHNICAL INVESTIGATION TEST PIT LOG

Test Pit Log #: TP-3
Date Advanced: April 14, 2022
Excavated by: Turn of the Century Homes
Logged by: Max Kasberger

Latitude: 43.660965
Longitude: -116.269015
Depth to Water Table: 7.2 feet bgs.
Total Depth: 8.3 feet bgs

Depth (feet bgs)	Field Description and USCS Soil and Sediment Classification	Sample Type	Sample Depth (feet bgs)	Qp	Lab Test ID
0.0-1.2	Sandy Silt Fill (ML-FILL): Brown, slightly moist, soft to medium stiff, with fine to medium-grained sand. --Organic material encountered to 0.5 foot bgs. --Tree roots encountered to 0.8 foot bgs.			0.5-0.75	
1.2-2.6	Poorly Graded Sand (SP): Light brown, slightly moist, medium dense, with fine to coarse-grained sand.				
2.6-8.3	Poorly Graded Gravel with Sand (GP): Light brown, slightly moist to saturated, medium dense to very dense, with fine to coarse-grained sand, fine to coarse gravel, and 8-inch minus cobbles.				

Notes: See Site Map for test pit location.

GEOTECHNICAL INVESTIGATION TEST PIT LOG

Test Pit Log #: TP-4
Date Advanced: April 14, 2022
Excavated by: Turn of the Century Homes
Logged by: Max Kasberger

Latitude: 43.660664
Longitude: -116.267990
Depth to Water Table: 6.8 feet bgs.
Total Depth: 7.0 feet bgs

Depth (feet bgs)	Field Description and USCS Soil and Sediment Classification	Sample Type	Sample Depth (feet bgs)	Qp	Lab Test ID
0.0-2.3	Sandy Silt Fill (ML-FILL): Brown, slightly moist, soft to medium stiff, with fine to medium-grained sand. --Organic material encountered to 0.5 foot bgs. --Tree roots encountered to 0.8 foot bgs.			0.25-0.5	
2.3-3.1	Poorly Graded Sand (SP): Light brown, slightly moist, medium dense, with fine to coarse-grained sand.				
3.1-7.0	Poorly Graded Gravel with Sand (GP): Light brown, slightly moist to saturated, medium dense to very dense, with fine to coarse-grained sand, fine to coarse gravel, and 8-inch minus cobbles.				

Notes: See Site Map for test pit location.

GEOTECHNICAL INVESTIGATION TEST PIT LOG

Test Pit Log #: TP-5	**Latitude:** 43.660278
Date Advanced: April 14, 2022	**Longitude:** -116.268182
Excavated by: Turn of the Century Homes	**Depth to Water Table:** 2.8 feet bgs.
Logged by: Max Kasberger	**Total Depth:** 3.2 feet bgs

Depth (feet bgs)	Field Description and USCS Soil and Sediment Classification	Sample Type	Sample Depth (feet bgs)	Qp	Lab Test ID
0.0-1.4	Silty Sand Fill (SM-FILL): Light brown, slightly moist, loose, with fine to medium-grained sand. --Organic material encountered to 0.3 foot bgs.				
1.4-3.2	Poorly Graded Gravel with Sand (GP): Light brown, slightly moist to saturated, medium dense to very dense, with fine to coarse-grained sand, fine to coarse gravel, and 5-inch minus cobbles.				

Notes: See Site Map for test pit location.
Piezometer installed to a depth of 3.2 feet bgs.

GEOTECHNICAL INVESTIGATION TEST PIT LOG

Test Pit Log #: TP-6	**Latitude:** 43.659706
Date Advanced: April 14, 2022	**Longitude:** -116.267285
Excavated by: Turn of the Century Homes	**Depth to Water Table:** 5.8 feet bgs.
Logged by: Max Kasberger	**Total Depth:** 6.0 feet bgs

Depth (feet bgs)	Field Description and USCS Soil and Sediment Classification	Sample Type	Sample Depth (feet bgs)	Qp	Lab Test ID
0.0-2.4	Silty Sand Fill (SM-FILL): Light brown to gray, slightly moist, loose to medium dense, with fine to medium-grained sand. --Organic material encountered to 0.2 foot bgs.				
2.4-6.0	Poorly Graded Gravel with Sand (GP): Light brown, slightly moist to saturated, medium dense to very dense, with fine to coarse-grained sand, fine to coarse gravel, and 5-inch minus cobbles.				

Notes: See Site Map for test pit location.

GEOTECHNICAL INVESTIGATION TEST PIT LOG

Test Pit Log #: TP-7	**Latitude:** 43.660664
Date Advanced: April 14, 2022	**Longitude:** -116.267990
Excavated by: Turn of the Century Homes	**Depth to Water Table:** 5.8 feet bgs.
Logged by: Max Kasberger	**Total Depth:** 6.2 feet bgs

Depth (feet bgs)	Field Description and USCS Soil and Sediment Classification	Sample Type	Sample Depth (feet bgs)	Qp	Lab Test ID
0.0-3.4	Sandy Silt Fill (ML-FILL): Dark brown to brown, slightly moist, soft to medium stiff, with fine to medium-grained sand. --Organic material encountered to 0.5 foot bgs. --Tree roots encountered to 1.2 foot bgs.			0.5-0.75	
3.4-4.6	Lean Clay with Sand (CL): Blue-gray to dark brown, slightly moist to moist, soft, with fine-grained sand.				
4.9-6.2	Poorly Graded Gravel with Sand (GP): Light brown, slightly moist to saturated, medium dense to very dense, with fine to coarse-grained sand, fine to coarse gravel, and 7-inch minus cobbles.				

Notes: See Site Map for test pit location.

GEOTECHNICAL INVESTIGATION TEST PIT LOG

Test Pit Log #: TP-8
Date Advanced: April 14, 2022
Excavated by: Turn of the Century Homes
Logged by: Max Kasberger

Latitude: 43.659900
Longitude: -116.266221
Depth to Water Table: 5.7 feet bgs.
Total Depth: 6.3 feet bgs

Depth (feet bgs)	Field Description and USCS Soil and Sediment Classification	Sample Type	Sample Depth (feet bgs)	Qp	Lab Test ID
0.0-2.1	Silty Sand Fill (SM-FILL): Dark brown to brown, slightly moist, loose, with fine to medium-grained sand. --Organic material encountered to 0.2 foot bgs. --Tree roots encountered to 0.8 foot bgs.				
2.1-3.6	Lean Clay with Sand (CL): Blue-gray to dark brown, slightly moist to moist, soft, with fine-grained sand.				
3.6-5.1	Poorly Graded Sand (SP): Light brown, slightly moist, medium dense, with fine to medium-grained sand.				
5.1-6.3	Poorly Graded Gravel with Sand (GP): Light brown, slightly moist to saturated, medium dense to very dense, with fine to coarse-grained sand, fine to coarse gravel, and 7-inch minus cobbles.				

Notes: See Site Map for test pit location.

GEOTECHNICAL INVESTIGATION TEST PIT LOG

Test Pit Log #: TP-9
Date Advanced: April 14, 2022
Excavated by: Turn of the Century Homes
Logged by: Max Kasberger

Latitude: 43.659390
Longitude: -116.265708
Depth to Water Table: 8.4 feet bgs.
Total Depth: 9.0 feet bgs

Depth (feet bgs)	Field Description and USCS Soil and Sediment Classification	Sample Type	Sample Depth (feet bgs)	Qp	Lab Test ID
0.0-2.2	Silty Sand Fill (SM-FILL): Light brown, slightly moist, loose to medium dense, with fine to medium-grained sand. --Organic material encountered to 0.4 foot bgs.				
2.2-4.1	Poorly Graded Sand (SP): Light brown, slightly moist, medium dense, with fine to medium-grained sand.				
4.1-9.0	Poorly Graded Gravel with Sand (GP): Light brown, slightly moist to saturated, medium dense to very dense, with fine to coarse-grained sand, fine to coarse gravel, and 5-inch minus cobbles.				

Notes: See Site Map for test pit location.

GEOTECHNICAL INVESTIGATION TEST PIT LOG

Test Pit Log #: TP-10
Date Advanced: April 14, 2022
Excavated by: Turn of the Century Homes
Logged by: Max Kasberger

Latitude: 43.659134
Longitude: -116.266388
Depth to Water Table: 3.5 feet bgs.
Total Depth: 3.7 feet bgs

Depth (feet bgs)	Field Description and USCS Soil and Sediment Classification	Sample Type	Sample Depth (feet bgs)	Qp	Lab Test ID
0.0-1.8	Sandy Silt Fill (ML-FILL): Light brown to gray, slightly moist, soft to medium stiff, with fine to medium-grained sand. --Organic material encountered to 0.4 foot bgs.			0.25-0.75	
1.8-3.7	Poorly Graded Gravel with Sand (GP): Light brown, slightly moist to saturated, medium dense to very dense, with fine to coarse-grained sand, fine to coarse gravel, and 5-inch minus cobbles.				

Notes: See Site Map for test pit location.

GEOTECHNICAL INVESTIGATION TEST PIT LOG

Test Pit Log #: TP-11
Date Advanced: April 14, 2022
Excavated by: Turn of the Century Homes
Logged by: Max Kasberger

Latitude: 43.658884
Longitude: -116265775
Depth to Water Table: 5.8 feet bgs.
Total Depth: 6.0 feet bgs

Depth (feet bgs)	Field Description and USCS Soil and Sediment Classification	Sample Type	Sample Depth (feet bgs)	Qp	Lab Test ID
0.0-3.6	Poorly Graded Sand Fill (SP-FILL): Light brown, slightly moist, loose, with fine to medium-grained sand. --Organic material encountered to 2.3 feet bgs.				
3.6-6.0	Poorly Graded Gravel with Sand (GP): Light brown, slightly moist to saturated, medium dense to very dense, with fine to coarse-grained sand, fine to coarse gravel, and 7-inch minus cobbles.				

Notes: See Site Map for test pit location.

GEOTECHNICAL INVESTIGATION TEST PIT LOG

Test Pit Log #: TP-12	**Latitude:** 43.658151
Date Advanced: April 14, 2022	**Longitude:** -116.266234
Excavated by: Turn of the Century Homes	**Depth to Water Table:** 6.5 feet bgs.
Logged by: Max Kasberger	**Total Depth:** 6.8 feet bgs

Depth (feet bgs)	Field Description and USCS Soil and Sediment Classification	Sample Type	Sample Depth (feet bgs)	Qp	Lab Test ID
0.0-2.2	Silty Sand Fill (SM-FILL): Light brown, slightly moist, loose, with fine to medium-grained sand. --Organic materials noted to 0.4 foot bgs.				
2.2-4.1	Poorly Graded Sand with Silt (SP-SM): Light brown, slightly moist, medium dense, with fine-grained sand.				
4.1-6.8	Poorly Graded Gravel with Sand (GP): Light brown, slightly moist to saturated, medium dense to very dense, with fine to coarse-grained sand, fine to coarse gravel, and 5-inch minus cobbles.				

Notes: See Site Map for test pit location.

GEOTECHNICAL INVESTIGATION TEST PIT LOG

Test Pit Log #: TP-13
Date Advanced: April 14, 2022
Excavated by: Turn of the Century Homes
Logged by: Max Kasberger

Latitude: 43.657897
Longitude: -116.264742
Depth to Water Table: 5.3 feet bgs.
Total Depth: 6.0 feet bgs

Depth (feet bgs)	Field Description and USCS Soil and Sediment Classification	Sample Type	Sample Depth (feet bgs)	Qp	Lab Test ID
0.0-5.2	Poorly Graded Sand with Gravel Fill (SP-FILL): Light brown, slightly moist, dense to very dense, with fine to medium-grained sand and fine to coarse gravel. --Organic material encountered to 0.2 foot bgs.				
5.2-6.0	Poorly Graded Gravel with Sand (GP): Light brown, moist to saturated, medium dense to very dense, with fine to coarse-grained sand, fine to coarse gravel, and 7-inch minus cobbles.				

Notes: See Site Map for test pit location.

GEOTECHNICAL INVESTIGATION TEST PIT LOG

Test Pit Log #: TP-14
Date Advanced: April 14, 2022
Excavated by: Turn of the Century Homes
Logged by: Max Kasberger

Latitude: 43.657317
Longitude: -116.265200
Depth to Water Table: Not Encountered
Total Depth: 1.2 feet bgs

Depth (feet bgs)	Field Description and USCS Soil and Sediment Classification	Sample Type	Sample Depth (feet bgs)	Qp	Lab Test ID
0.0-1.2	Silty Sand Fill (SM-FILL): Dark brown to light brown, slightly moist, medium dense, with fine to medium-grained sand. --Organic materials encountered to 0.2 foot bgs. --Irrigation control wires and 2.5-inch irrigation line encountered at 1.2 feet bgs.				

Notes: See Site Map for test pit location.

GEOTECHNICAL INVESTIGATION TEST PIT LOG

Test Pit Log #: TP-15	**Latitude:** 43.656825
Date Advanced: April 14, 2022	**Longitude:** -116.264134
Excavated by: Turn of the Century Homes	**Depth to Water Table:** 6.5 feet bgs.
Logged by: Max Kasberger	**Total Depth:** 6.8 feet bgs

Depth (feet bgs)	Field Description and USCS Soil and Sediment Classification	Sample Type	Sample Depth (feet bgs)	Qp	Lab Test ID
0.0-4.8	Poorly Graded Gravel with Sand Fill (GP-FILL): Light brown to dark brown, slightly moist, dense to very dense, with fine-grained sand, fine to coarse gravel, and 6-inch minus cobbles. --Organic material noted to 0.2 foot bgs.				
4.8-6.8	Poorly Graded Sand with Gravel (SP): Light brown, slightly moist to saturated, medium dense, with fine to medium-grained sand, fine to coarse gravel, and 5-inch minus cobbles.				

Notes: See Site Map for test pit location.
Piezometer installed to a depth of 6.8 feet bgs.

FIELD BORING LOG

BORING NO.: B-1
TOTAL DEPTH: 30.3'
GROUNDWATER DEPTH: 7.7'

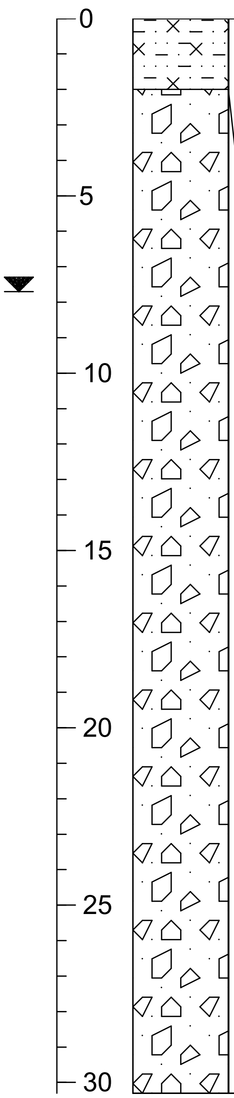
PROJECT INFORMATION

PROJECT: River Club Development
LOCATION: 6515 West State Street
Garden City, ID
JOB NO.: B220582g
LOGGED BY: Colby Meyer, GIT

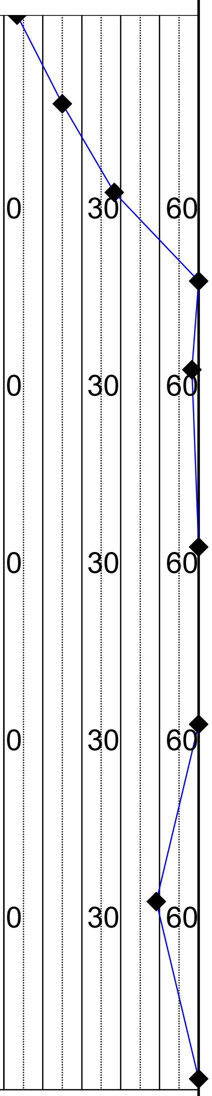
DRILLING INFORMATION

DRILLING CO.: Haztech Drilling, Inc.
METHOD OF DRILLING: 6" Hollow Stem Auger
SAMPLING METHODS: Split Spoon
DATES DRILLED: April 13, 2022
LATITUDE/LONGITUDE: 43.662024, -116.270475

▼ Water level during drilling ◣ Standard Split Spoon ☒ Auger Sample ▨ California Sampler



DESCRIPTION	MOISTURE (%)	LL/PI	% < #4	% < #200	SAMPLE	BLOWS
SILTY SAND FILL (SM-FILL): Dark brown, slightly moist, loose, with fine to medium-grained sand. --Organic material encountered to 0.3 foot bgs.	16.4	NP	100	42.7	◣	2,2,2
					◣	8,9,9
POORLY GRADED GRAVEL WITH SAND (GP): Light brown, slightly moist to saturated, medium dense to very dense, with fine to coarse-grained sand and fine to coarse gravel.					◣	11,16,18
					◣	20,40,34
					◣	30,37,21
					◣	26,38,27
					◣	26,30,48
					◣	18,24,23
					◣	50 for 4"



ATLAS

FIELD BORING LOG

BORING NO.: B-2
TOTAL DEPTH: 16.5'
GROUNDWATER DEPTH: 6.9'

PROJECT INFORMATION

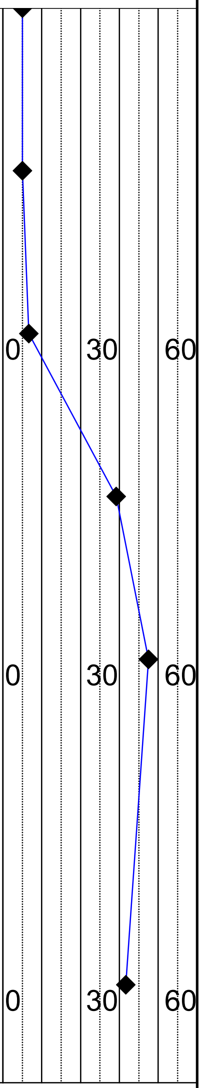
PROJECT: River Club Development
LOCATION: 6515 West State Street
Garden City, ID
JOB NO.: B220582g
LOGGED BY: Colby Meyer, GIT

DRILLING INFORMATION

DRILLING CO.: Haztech Drilling, Inc.
METHOD OF DRILLING: 6" Hollow Stem Auger
SAMPLING METHODS: Split Spoon
DATES DRILLED: April 13, 2022
LATITUDE/LONGITUDE: 43.661597, -116.269639

▼ Water level during drilling
◪ Standard Split Spoon
☒ Auger Sample
▥ California Sampler

DEPTH	SOIL TYPE	DESCRIPTION	MOISTURE (%)	LL/PI	% < #4	% < #200	SAMPLE	BLOWS	BLOWS PER FOOT (N)
0	ML-FILL	SANDY SILT FILL (ML-FILL): Brown, slightly moist, medium stiff, with fine-grained sand. --Organic material encountered to 0.4 foot bgs.					◪	2,3,3	
							◪	4,3,3	
			16.7	NP	100	50.3			
5	SP	POORLY GRADED SAND (SP): Light brown, slightly moist to saturated, loose, with fine to medium-grained sand.					◪	3,4,4	
▼									
	GP	POORLY GRADED GRAVEL WITH SAND (GP): Light brown, saturated, dense, with fine to coarse-grained sand and fine to coarse gravel.					◪	13,15,20	
10							◪	19,20,25	
15							◪	15,11,27	



ATLAS

FIELD BORING LOG

BORING NO.: B-3
TOTAL DEPTH: 30.5'
GROUNDWATER DEPTH: 7.5'

PROJECT INFORMATION

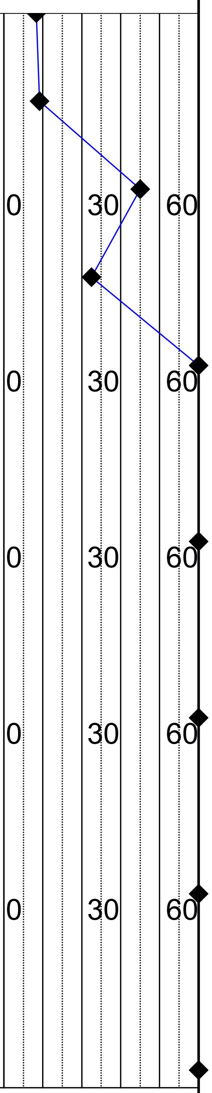
PROJECT:	River Club Development
LOCATION:	6515 West State Street Garden City, ID
JOB NO.:	B220582g
LOGGED BY:	Colby Meyer, GIT

DRILLING INFORMATION

DRILLING CO.:	Haztech Drilling, Inc.
METHOD OF DRILLING:	6" Hollow Stem Auger
SAMPLING METHODS:	Split Spoon
DATES DRILLED:	April 13, 2022
LATITUDE/LONGITUDE:	43.661082, -116.268550

▼ Water level during drilling ◪ Standard Split Spoon ☒ Auger Sample ▨ California Sampler

DEPTH	SOIL TYPE	DESCRIPTION	MOISTURE (%)	LL/PI	% < #4	% < #200	SAMPLE	BLOWS	BLOWS PER FOOT (N)
0		SANDY SILT FILL (ML-FILL): Brown, slightly moist, stiff, with fine-grained sand. --Organic material encountered to 0.4 foot bgs.					◪	3,5,5	
							◪	5,5,6	
5		POORLY GRADED SAND (SP): Light brown, slightly moist, medium dense, with fine to medium-grained sand.					◪	10,15,27	
▼		POORLY GRADED GRAVEL WITH SAND (GP): Light brown, slightly moist to saturated, medium dense to very dense, with fine to coarse-grained sand and fine to coarse gravel.					◪	12,13,14	
10							◪	14,50 for 6"	
15							◪	20, 50 for 4"	
20							◪	20,26,43	
25							◪	50 for 5"	
30							◪	50 for 6"	



ATLAS

FIELD BORING LOG

BORING NO.: B-4
TOTAL DEPTH: 16.5'
GROUNDWATER DEPTH: 2.7'

PROJECT INFORMATION

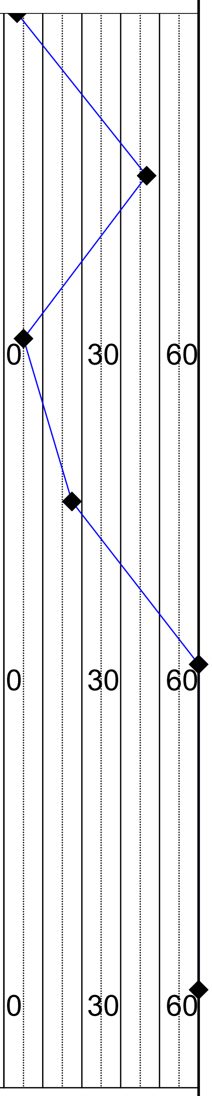
PROJECT:	River Club Development
LOCATION:	6515 West State Street Garden City, ID
JOB NO.:	B220582g
LOGGED BY:	Colby Meyer, GIT

DRILLING INFORMATION

DRILLING CO.:	Haztech Drilling, Inc.
METHOD OF DRILLING:	6" Hollow Stem Auger
SAMPLING METHODS:	Split Spoon
DATES DRILLED:	April 13, 2022
LATITUDE/LONGITUDE:	43.660094, -116.267558

▼ Water level during drilling ◩ Standard Split Spoon ☒ Auger Sample ▨ California Sampler

DEPTH	SOIL TYPE	DESCRIPTION	MOISTURE (%)	LL/PI	% < #4	% < #200	SAMPLE	BLOWS	BLOWS PER FOOT (N)
0		SANDY SILT FILL (ML-FILL): Brown, slightly moist, soft to medium stiff, with fine-grained sand. --Organic material encountered to 0.4 foot bgs.					◩	2,2,2	
▼		POORLY GRADED GRAVEL WITH SAND (GP): Light brown to gray, slightly moist to saturated, loose to very dense, with fine to coarse-grained sand and fine to coarse gravel.					◩	10,27,17	
5		Poorly graded sand lense encountered from 5 to 6 feet bgs.					◩	3,3,3	
							◩	9,9,12	
10							◩	7,14,50 for 5"	
15							◩	12,30,46	



FIELD BORING LOG

BORING NO.: B-5
TOTAL DEPTH: 30.5'
GROUNDWATER DEPTH: 4.4'

PROJECT INFORMATION

PROJECT: River Club Development
LOCATION: 6515 West State Street
Garden City, ID
JOB NO.: B220582g
LOGGED BY: Colby Meyer, GIT

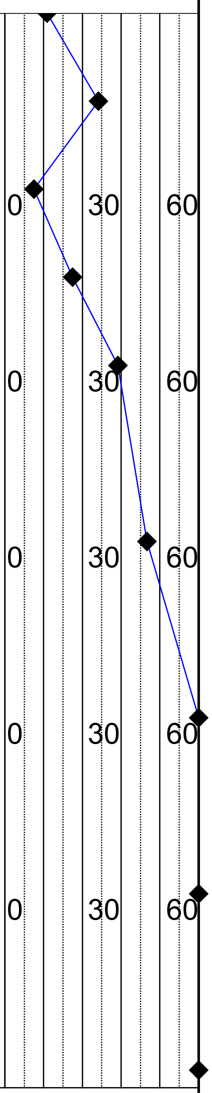
DRILLING INFORMATION

DRILLING CO.: Haztech Drilling, Inc.
METHOD OF DRILLING: 6" Hollow Stem Auger
SAMPLING METHODS: Split Spoon
DATES DRILLED: April 14, 2022
LATITUDE/LONGITUDE: 43.659857, -116.266712

▼ Water level during drilling
◣ Standard Split Spoon
☒ Auger Sample
▥ California Sampler

DEPTH	SOIL TYPE	DESCRIPTION	MOISTURE (%)	LL/PI	% < #4	% < #200	SAMPLE	BLOWS
0		SILTY SAND FILL (SM-FILL): Brown, slightly moist, medium dense, with fine-grained sand. --Organic material encountered to 0.3 foot bgs.	11.1	NP	97	46.7	◣	3,6,7
							◣	12,15,14
▼								
5		POORLY GRADED GRAVEL WITH SAND (GP): Light brown, slightly moist to saturated, loose to very dense, with fine to coarse-grained sand and fine to coarse gravel. --Increased sand content noted from 2.0 to 4.0 feet bgs.					◣	3,2,7
							◣	10,9,12
10							◣	8,12,23
15							◣	18,27,27
20							◣	29,45,50 for 5"
25							◣	32,50 for 5"
30							◣	50 for 6"

BLOWS PER FOOT (N)



FIELD BORING LOG

BORING NO.: B-6
TOTAL DEPTH: 15.4'
GROUNDWATER DEPTH: 5.0'

PROJECT INFORMATION

PROJECT: River Club Development
LOCATION: 6515 West State Street
Garden City, ID
JOB NO.: B220582g
LOGGED BY: Colby Meyer, GIT

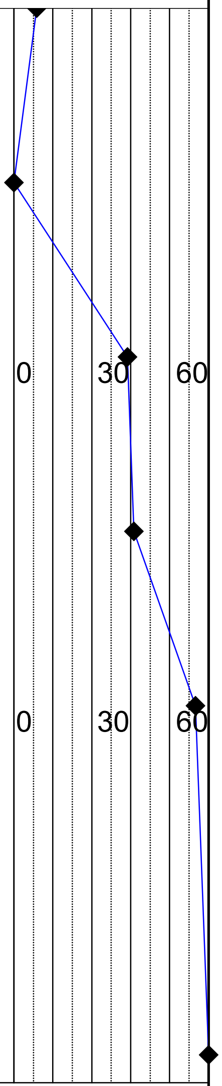
DRILLING INFORMATION

DRILLING CO.: Haztech Drilling, Inc.
METHOD OF DRILLING: 6" Hollow Stem Auger
SAMPLING METHODS: Split Spoon
DATES DRILLED: April 14, 2022
LATITUDE/LONGITUDE: 43.659480, -116.266157

▼ Water level during drilling ◩ Standard Split Spoon ☒ Auger Sample ▨ California Sampler

DEPTH	SOIL TYPE	DESCRIPTION	MOISTURE (%)	LL/PI	% < #4	% < #200	SAMPLE	BLOWS
0		SILTY SAND FILL (SM-FILL): Brown, slightly moist, loose, with fine-grained sand. --Organic material encountered to 0.3 foot bgs.					◩	4,4,3
		LEAN CLAY WITH SAND (CL): Dark brown, moist to saturated, very soft, with fine-grained sand.					◩	1,0,0
			31.2	33/17	100	73.4		
▼ 5		POORLY GRADED GRAVEL WITH SAND (GP): Light brown, saturated, dense to very dense, with fine to coarse-grained sand and fine to coarse gravel.					◩	7,14,21
							◩	16,16,21
10							◩	22,32,24
15							◩	50 for 5"

BLOWS PER FOOT (N)



FIELD BORING LOG

BORING NO.: B-7
TOTAL DEPTH: 16.5'
GROUNDWATER DEPTH: 4.4'

PROJECT INFORMATION

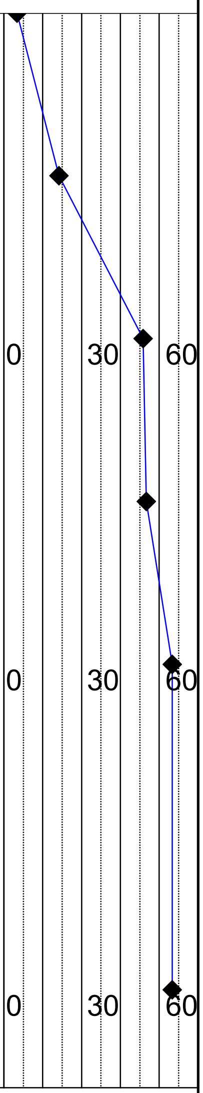
PROJECT: River Club Development
LOCATION: 6515 West State Street
Garden City, ID
JOB NO.: B220582g
LOGGED BY: Colby Meyer, GIT

DRILLING INFORMATION

DRILLING CO.: Haztech Drilling, Inc.
METHOD OF DRILLING: 6" Hollow Stem Auger
SAMPLING METHODS: Split Spoon
DATES DRILLED: April 14, 2022
LATITUDE/LONGITUDE: 43.658566, -116.266056

▼ Water level during drilling ◩ Standard Split Spoon ☒ Auger Sample ▨ California Sampler

DEPTH	SOIL TYPE	DESCRIPTION	MOISTURE (%)	LL/PI	% < #4	% < #200	SAMPLE	BLOWS	BLOWS PER FOOT (N)
0		SILTY SAND FILL (SM-FILL): Brown, slightly moist, loose, with fine-grained sand. --Organic material encountered to 0.3 foot bgs.					◩	2,2,2	
		POORLY GRADED GRAVEL WITH SAND (GP): Light brown, slightly moist to saturated, medium dense to very dense, with fine to coarse-grained sand and fine to coarse gravel. --Increased sand content noted from 0.8 to 2.8 feet bgs.					◩	3,6,11	
▼ 5							◩	18,25,18	
							◩	20,20,24	
10							◩	19,24,28	
15							◩	31,30,22	



ATLAS

FIELD BORING LOG

BORING NO.: B-8
TOTAL DEPTH: 31.4'
GROUNDWATER DEPTH: 3.9'

PROJECT INFORMATION

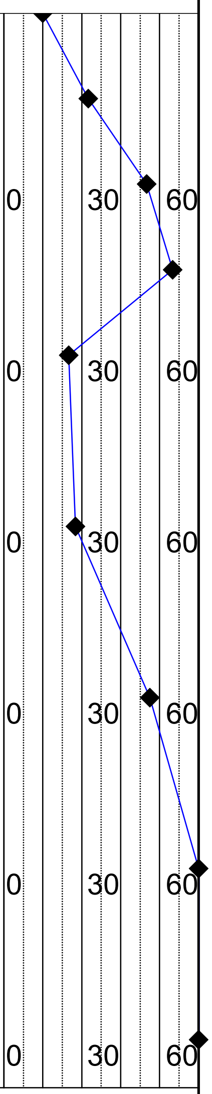
PROJECT: River Club Development
LOCATION: 6515 West State Street
Garden City, ID
JOB NO.: B220582g
LOGGED BY: Colby Meyer, GIT

DRILLING INFORMATION

DRILLING CO.: Haztech Drilling, Inc.
METHOD OF DRILLING: 6" Hollow Stem Auger
SAMPLING METHODS: Split Spoon
DATES DRILLED: April 14, 2022
LATITUDE/LONGITUDE: 43.657848, -116.265445

▼ Water level during drilling ◩ Standard Split Spoon ☒ Auger Sample ▯ California Sampler

DEPTH	SOIL TYPE	DESCRIPTION	MOISTURE (%)	LL/PI	% < #4	% < #200	SAMPLE	BLOWS	BLOWS PER FOOT (N)
0		SILT FILL (ML-FILL): Brown, slightly moist, stiff, with fine-grained sand. --Organic material encountered to 0.5 foot bgs.					◩	4,5,7	
▼							◩	9,12,14	
5		POORLY GRADED GRAVEL WITH SAND (GP): Light brown, slightly moist to saturated, medium dense to very dense, with fine to coarse-grained sand and fine to coarse gravel.					◩	17,19,25	
							◩	22,25,27	
10							◩	19,12,8	
15							◩	4,10,12	
20							◩	20,20,25	
25							◩	37,35,41	
30							◩	40,35,50 for 4"	



FIELD BORING LOG

BORING NO.: B-9
TOTAL DEPTH: 16.5'
GROUNDWATER DEPTH: 5.7'

PROJECT INFORMATION

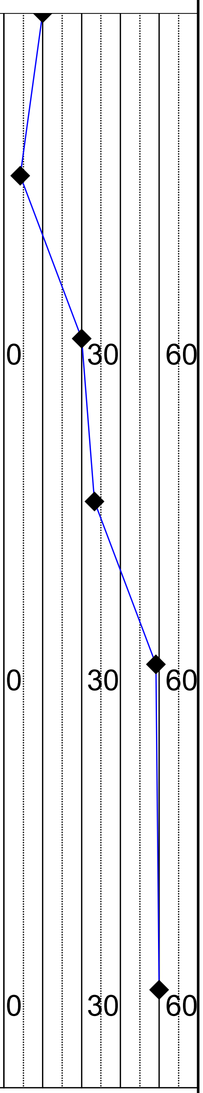
PROJECT:	River Club Development
LOCATION:	6515 West State Street Garden City, ID
JOB NO.:	B220582g
LOGGED BY:	Colby Meyer, GIT

DRILLING INFORMATION

DRILLING CO.:	Haztech Drilling, Inc.
METHOD OF DRILLING:	6" Hollow Stem Auger
SAMPLING METHODS:	Split Spoon
DATES DRILLED:	April 14, 2022
LATITUDE/LONGITUDE:	43.657273, -116.264443

▼ Water level during drilling ◩ Standard Split Spoon ☒ Auger Sample ▥ California Sampler

DEPTH	SOIL TYPE	DESCRIPTION	MOISTURE (%)	LL/PI	% < #4	% < #200	SAMPLE	BLOWS	BLOWS PER FOOT (N)
0		SILTY SAND FILL (SM-FILL): Brown, slightly moist, medium dense, with fine-grained sand. --Organic material encountered to 0.3 foot bgs.					◩	3,5,7	
							◩	3,2,3	
		POORLY GRADED GRAVEL WITH SAND FILL (GP-FILL): Light brown, slightly moist to wet, loose, with fine to coarse-grained sand and fine to coarse gravel.							
5 ▼		SILTY SAND FILL (SM-FILL): Gray, wet, loose, with fine to medium-grained sand.	40.0	NP	99	32.3	◩	2,6,18	
		POORLY GRADED GRAVEL WITH SAND (GP): Light brown, wet to saturated, medium dense to dense, with fine to coarse-grained sand and fine to coarse gravel.					◩	12,12,16	
10							◩	18,22,25	
15							◩	14,22,24	



Appendix VI GEOTECHNICAL GENERAL NOTES

Unified Soil Classification System			
Major Divisions		**Symbol**	**Soil Descriptions**
Coarse-Grained Soils < 50% passes No.200 sieve	Gravel & Gravelly Soils < 50% coarse	GW	Well-graded gravels; gravel/sand mixtures with little or no fines
		GP	Poorly-graded gravels; gravel/sand mixtures with little or no fines
		GM	Silty gravels; poorly-graded gravel/sand/silt mixtures
		GC	Clayey gravels; poorly-graded gravel/sand/clay mixtures
	Sand & Sandy Soils > 50% coarse fraction	SW	Well-graded sands; gravelly sands with little or no fines
		SP	Poorly-graded sands; gravelly sands with little or no fines
		SM	Silty sands; poorly-graded sand/gravel/silt mixtures
		SC	Clayey sands; poorly-graded sand/gravel/clay mixtures
Fine-Grained Soils > 50% passes No.200 sieve	Silts & Clays LL < 50	ML	Inorganic silts; sandy, gravelly or clayey silts
		CL	Lean clays; inorganic, gravelly, sandy, or silty, low to medium-plasticity clays
		OL	Organic, low-plasticity clays and silts
	Silts & Clays LL > 50	MH	Inorganic, elastic silts; sandy, gravelly or clayey elastic silts
		CH	Fat clays; high-plasticity, inorganic clays
		OH	Organic, medium to high-plasticity clays and silts
Highly Organic Soils		PT	Peat, humus, hydric soils with high organic content

Relative Density and Consistency Classification	
Coarse-Grained Soils	**SPT Blow Counts (N)**
Very Loose:	< 4
Loose:	4-10
Medium Dense:	10-30
Dense:	30-50
Very Dense:	> 50
Fine-Grained Soils	**SPT Blow Counts (N)**
Very Soft:	< 2
Soft:	2-4
Medium Stiff:	4-8
Stiff:	8-15
Very Stiff:	15-30
Hard:	> 30

Moisture Content and Cementation Classification	
Description	**Field Test**
Dry	Absence of moisture, dry to touch
Slightly Moist	Damp, but no visible moisture
Moist	Visible moisture
Wet	Visible free water
Saturated	Soil is usually below water table
Description	**Field Test**
Weak	Crumbles or breaks with handling or slight finger pressure
Moderate	Crumbles or breaks with considerable finger pressure
Strong	Will not crumble or break with finger pressure

Particle Size	
Boulders:	> 12 in.
Cobbles:	12 to 3 in.
Gravel:	3 in. to 5 mm
Coarse-Grained Sand:	5 to 0.6 mm
Medium-Grained Sand:	0.6 to 0.2 mm
Fine-Grained Sand:	0.2 to 0.075 mm
Silts:	0.075 to 0.005 mm
Clays:	< 0.005 mm

Acronym List	
GS	grab sample
LL	Liquid Limit
M	moisture content
NP	non-plastic
PI	Plasticity Index
Q_p	penetrometer value, unconfined compressive strength, tsf
V	vane value, ultimate shearing strength, tsf

Appendix VII PRELIMINARY AASHTO PAVEMENT DESIGN

Pavement Section Design Location: River Club Development, Light Duty

Average Daily Traffic Count: 500 All Lanes & Both Directions
Design Life: 20 Years
Percent of Traffic in Design Lane: 50%
Terminal Seviceability Index (Pt): 2.5
Level of Reliability: 95
Subgrade CBR Value: 4 **Subgrade Mr:** 6,000

Calculation of Design-18 kip ESALs

	Daily Traffic	Growth Rate	Load Factors	Design ESALs
Passenger Cars:	174	2.0%	0.0008	1,235
Buses:	0	2.0%	0.6806	0
Panel & Pickup Trucks:	60	2.0%	0.0122	6,492
2-Axle, 6-Tire Trucks:	15	2.0%	0.1890	25,142
Emergency Vehicles:	0.5	2.0%	4.4800	19,866
Dump Trucks:	0	2.0%	3.6300	0
Tractor Semi Trailer Trucks:	0	2.0%	2.3719	0
Double Trailer Trucks	0	2.0%	2.3187	0
Heavy Tractor Trailer Combo Trucks:	0	2.0%	2.9760	0
Average Daily Traffic in Design Lane:	250			

Total Design Life 18-kip ESALs: 52,734

Actual Log (ESALs): 4.722

Trial SN: 2.52

Trial Log (ESALs): 4.770

Pavement Section Design SN: 2.61

	Design Depth Inches	**Structural Coefficient**	**Drainage Coefficient**
Asphaltic Concrete:	2.50	0.42	n/a
Asphalt-Treated Base:	0.00	0.25	n/a
Cement-Treated Base:	0.00	0.17	n/a
Crushed Aggregate Base:	4.00	0.14	1.0
Subbase:	10.00	0.10	1.0
Special Aggregate Subgrade:	0.00	0.09	0.9

PRELIMINARY AASHTO PAVEMENT DESIGN

Pavement Section Design Location: River Club Development, Heavy Duty

Average Daily Traffic Count:	500	All Lanes & Both Directions		
Design Life:	20	Years		
Percent of Traffic in Design Lane:	50%			
Terminal Seviceability Index (Pt):	2.5			
Level of Reliability:	95			
Subgrade CBR Value:	4		**Subgrade Mr:**	6,000

Calculation of Design-18 kip ESALs

	Daily Traffic	Growth Rate	Load Factors	Design ESALs
Passenger Cars:	125	2.0%	0.0008	887
Buses:	2	2.0%	0.6806	12,072
Panel & Pickup Trucks:	103	2.0%	0.0122	11,144
2-Axle, 6-Tire Trucks:	15	2.0%	0.1890	25,142
Emergency Vehicles:	2.0	2.0%	4.4800	79,462
Dump/Garbage Trucks:	1	2.0%	3.6300	32,193
Tractor Semi Trailer Trucks:	2	2.0%	2.3719	42,071
Double Trailer Trucks	0	2.0%	2.3187	0
Heavy Tractor Trailer Combo Trucks:	0	2.0%	2.9760	0
Average Daily Traffic in Design Lane:	250			

Total Design Life 18-kip ESALs: 202,971

Actual Log (ESALs): 5.307

Trial SN: 3.10

Trial Log (ESALs): 5.312

Pavement Section Design SN: 3.22

	Design Depth Inches	**Structural Coefficient**	**Drainage Coefficient**
Asphaltic Concrete:	3.00	0.42	n/a
Asphalt-Treated Base:	0.00	0.25	n/a
Cement-Treated Base:	0.00	0.17	n/a
Crushed Aggregate Base:	4.00	0.14	1.0
Subbase:	14.00	0.10	1.0
Special Aggregate Subgrade:	0.00	0.09	0.9

Refraction Microtremor Survey of the River Club Golf Course Property

Boise, Idaho

April 19, 2022

Prepared for:

ATLAS
2791 S Victory View Way
Boise, ID 83709

Prepared by:

ECA Geophysics
372 South Eagle Road, Suite 146
Eagle, ID 83616

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1.0 Qualifications, Certification and Use Reliance

ECA Geophysics (ECA), a subsidiary of Environmental Compliance Associates, LLC, has a core competency in conducting geophysical surveys. Mr. Brett D. Smith, PE performed a refraction microtremor (ReMi™) survey on the property for the River Club Colf Course located at 6515 West State Street in Boise, Idaho and as shown in the Survey Area Map in Appendix A.

Mr. Smith is a registered environmental engineer (PE registrations in ID, NV, OR and WA) and a licensed geologist (LG registration in WA), who holds a Bachelor of Science degree in Biology from the University of Utah and a Master of Science degree in Geophysics from the Colorado School of Mines. Mr. Smith has performed numerous geophysical surveys and environmental site assessments during his 37-year career as an earth scientist and environmental professional.

At the request of **ATLAS** of Boise, Idaho (Client), ECA performed this ReMi™ survey, utilizing methods and procedures consistent with good commercial or customary practices that conform to acceptable industry standards. The findings and conclusions presented in this report are based strictly upon information and data available to ECA during the course of this assignment. ECA did not perform subsurface exploratory drilling, sampling or chemical analyses under the work scope of this project. This report represents ECA's professional opinion only, such that no warranty, expressed or implied, can be made.

This report is exclusively for the use and benefit of the Client and may not be relied upon by any other person or entity without the advance written consent of ECA.

Brett Smith

Designed, surveyed and written by: Brett D. Smith PE, LG

2.0 Introduction

ECA was hired by the Client, to acquire shear-wave velocities of the upper 100 feet (Vs_{100}) of the soils underlying the above referenced location.

On April 14, 2022, **ECA** performed a single SW-NE oriented **ReMi™** survey, as shown in the Survey Area Map. This survey recorded sound energy (microtremors) originating from nearby vehicle traffic, ambient surface noise and impulsive energy from sledgehammer impacts at the northwest end of the linear recording array (line), providing excellent frequency bandwidth for the 21 **ReMi™** recordings collected at this location. This was confirmed during subsequent data processing, as discussed in Section 5.0 below.

The National Earthquake Hazards Reduction Program (NEHRP) / International Building Code (IBC) site class, in accordance with Chapter 20 of ASCE/SEI 7-10, is often utilized regarding new construction design. The site class is important for comparing measured ground motions with building code seismic design levels and is formally described in Table 20.3-1 of ASCE/SEI 7-10 and is shown below:

Site Class A	Vs > 5,000 ft/s	Includes unweathered intrusive igneous rock. Site Class A does not contribute greatly to shaking amplification.
Site Class B	5,000 ft/s > Vs > 2,500 ft/s	Includes volcanic bedrock, typically Miocene-aged Columbia River Basalts. Soil type B does not contribute greatly to shaking amplification.
Site Class C	2,500 ft/s > Vs > 1,200 ft/s	Includes some Quaternary sands, sandstones and mudstones.
Site Class D	1,200 ft/s > Vs > 600 ft/s	Includes Quaternary sands, gravels, silts and mud. Significant amplification of shaking by these soils is generally expected.
Site Class E	600 ft/s > Vs	Includes water-saturated mud and artificial fill. The strongest amplification of shaking is expected for this site class.

NOTES
Quaternary – less than 2 million years old
Miocene – 5 to 23 million years before the present-day

3.0 Project Description

The objective of the project was to determine the shear-wave velocity structure to 100 feet depth at the above referenced location. The shear-wave analysis utilized the **ReMi™** method which maps layers of varying acoustic properties within the upper 100 feet and computes Vs_{100}, as per Chapter 20 of ASCE/SEI 7-10 (1).

4.0 Data Acquisition

The **ReMi™** method enables rapid recording of surface-wave velocity dispersion, by utilizing a single receiving sensor (geophone) at each channel along a linear spread of 12 equally-spaced geophones. The **ReMi™** method exploits such ambient "noise" as foot / vehicle traffic, vegetation responses to wind and intentional impulsive energy such as sledgehammer strikes against the ground surface. The equipment used for the survey included a 12-channel seismograph (DAQLinkII) system manufactured by Seismic Source of Ponca City, OK, that stored 30-second seismic records from twelve 10 Hz geophones.

This geophysical investigation comprised one 275-ft long ReMi™ array (line) having 12 geophones equally-spaced 25 feet apart.

There was no need to incorporate lat-lon-elevation measurements for the receiver (geophone) locations, since the 1) *maximum* 3-foot linear-sloped deviation from level was *considerably* less than the allowed 5 percent (14-ft) elevation tolerance and the 2) *maximum* 1-foot lateral bend was *considerably* less than the allowed 5 percent (14-ft) lateral deviation tolerance. As previously stated, 21 unfiltered 30-second records were recorded for the line, providing an abundance of high-quality data for the derivation of Vs_{100}.

5.0 Data Processing

The data were processed utilizing the proprietary SeisOpt ReMi™ software provided by Optim Earth, Inc. of Reno, Nevada, that analyzes ReMi™ data having frequencies as low as 2 Hz and utilizes a simple two-dimensional slowness-frequency (p-f) operator that separates Rayleigh waves from other seismic arrivals, enabling the recognition of true phase velocity amongst apparent velocities (2).

Processing of raw ReMi™ data involves Velocity Spectral Analysis, Rayleigh Phase-Velocity Dispersion Picking and Shear-Wave Velocity Modeling. These processing steps were implemented in the derivation of Vs and are discussed below:

STEP 1 - Velocity (Dispersion Curve) Analysis: A velocity spectrum (p-f image) was created from the noise data and a distinctive slope of dispersive waves was plotted. Because all other arrivals (ie, body waves and airwaves) found in microtremor records have no such slope, the dispersive wave slope (derived from picks) was diagnostically unique to the p-f analysis. The p-f spectral power image indicates where such waves have significant energy. Even when most of the energy in a seismic record comprises phase, rather than Rayleigh waves, the p-f analysis isolates that energy away from the dispersion curves. By recording many channels, retaining complete vertical seismograms, and employing the p-f transform, this method successfully analyzes Rayleigh dispersion where surface wave spectral analysis techniques cannot.

STEP 2 - Rayleigh Phase Velocity Dispersion Picking: Rayleigh-wave dispersion picks were made along a "lowest-velocity envelope" that bounded the energy appearing in the p-f image. This ensured that the picks were representative of true velocities rather than apparent velocities, since noise is assumed to come from all directions. Picking a surface-wave dispersion curve along an envelope of the lowest phase velocities having high spectral ratio at each frequency has a further desirable effect. Since higher-mode Rayleigh waves have phase velocities above those of the fundamental mode, the ReMi™ method preferentially yields the fundamental-mode velocities. Higher modes may appear as separate dispersion trends on the p-f images, if they are as energetic as the fundamental. Spatial aliasing of the slowness-frequency spectral-ratio images will create artifacts that have p-f image slopes that trend in the opposite direction to the normal-mode dispersion slope, as shown in Figure 1 in Appendix B. Because the seismic waves are not continuously harmonic but rather arrive in groups, the p-tau transform is performed in the space-time domain, so that even aliased frequencies preserve the information.

STEP 3 - Shear-Wave Velocity Modeling: Utilizing software created by Yuehua Zeng and adapted from Saito, the ReMi™ method interactively performs forward modeling upon the normal-mode dispersion data obtained from the p-f images. This code produces results identical to those of the forward-modeling codes used by Iwata et al and by Xia et al within their inverse modeling procedure (3-6). The modeling iterates upon the phase velocity at each frequency, reports when a solution has not been found within the iteration parameters and continues to model velocity reversals with increasing depth until convergence to a valid solution is achieved in the form of a Vs_{100} model. Eight inversion trials were run that ranged from a "wide open" (no layers specified) model to specified 3 to 6-layer models, with and without allowances for velocity reversals. The selected 4-layer Vs model has one velocity reversal, no thin layers, a low RMS convergence error (RMS error) and correlates with the subsurface data from recently drilled onsite geotechnical borings (see B-1 and B-3 on the Survey Area Map).

6.0 Analysis and Results

As previously discussed, the ReMi™ line was 275 feet long. Due to the broad frequency content (bandwidth), excellent Vs data were acquired along the ReMi™ line to an imaging depth of 209 feet.

Chapter 20 of ASCE/SEI 7-10 for seismic design site classification pertains to the upper 100 feet of the soil profile. The following equation is utilized to determine Vs, the applicable parameter from which the appropriate site class is derived. The RMS error en route to a reliable Vs solution ranged from 1.0 to 6.2 percent over eight qualifying inversions, with an average value of 1.8 percent. The final Vs_{100} (Depth-Velocity) model revealed an RMS error of 1.7 percent (see Figure 2), where 5.0 percent error is acceptable.

$$Vs_{100} = \frac{\sum_{i=1}^{n} d_i}{\sum_{i=1}^{n} d_i / v_{si}}$$

where $\sum_{i=1}^{n} d_i$ = 100 feet,

v_{si} = interval shear wave velocity (ft/s)

d_i = layer thickness (ft)

Applying the equation to the Vs changes in the Depth-Velocity model, the calculated Vs_{100} is 1,454 ft/s. The eight inversion trials yielded Vs that ranged from 1,204 to 1,454 ft/s, with an ***average value* of 1,363 ft/s.**

Vs_{100} = 1,454 ft/s, which places the Site subsurface soils within **Site Class C**.

ECA selects **Site Class C** with very high confidence, due to the excellent data quality that was confirmed in the processing steps discussed in Section 5.0.

7.0 References

1. American Society of Civil Engineering / Structural Engineering Institute (ASCE / SEI) Standard 7-10: *Minimum Design Loads for Buildings and Other Structures*, 2010.
2. Louie, J.N.: *Faster, Better: Shear-wave Velocity to 100 meters Depth from Refraction Microtremor Arrays*: Bulletin of the Seismological Society of America, v. 91, p. 347-364, 2001.
3. Zeng, Yuehua: *Personal communication with J.N. Louie of the Nevada Seismological Lab*, 1992.
4. Saito, M.: *Compound Matrix Method for the Calculation of Spheroidal Oscillation of the Earth*: Seismology Research Letters, v. 59, p. 29, 1988.
   Saito, M.: *Computations of Reflectivity and Surface Wave Dispersion Curves for Layered Media; I, Sound wave and SH wave*: Butsuri-Tanko, v. 32, no. 5, pp. 15-26, 1979.
5. Iwata, T., Kawase, H., Satoh, T., Kakehi, Y., Irikura, K., Louie, J. N., Abbott, R. E., and Anderson, J. G.: *Array Microtremor Measurements at Reno, Nevada, USA (abstract)*: EOS, Transactions of the American Geophysical Union, v. 79, supplemental to no. 45, p. F578, 1998.
6. Xia, J., Miller, R. D., and Park, C. B.: *Estimation of Near-surface Shear-wave Velocity by Inversion of Rayleigh Waves*: Geophysics, v. 64, p. 691-700, 1999.

APPENDIX A

SURVEY AREA MAP

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SURVEY AREA
1 inch = 57 feet

N

ECA Project No. 22ECA348

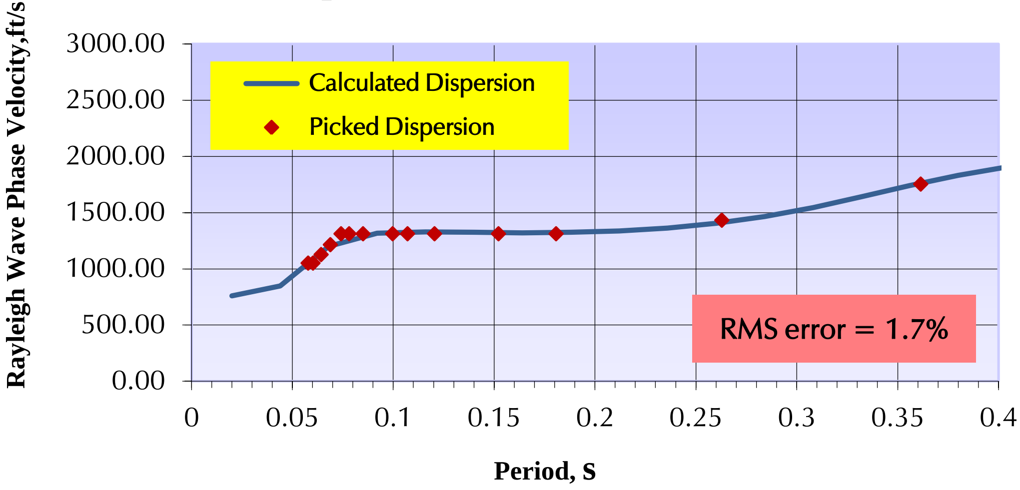
The River Club

APPENDIX B

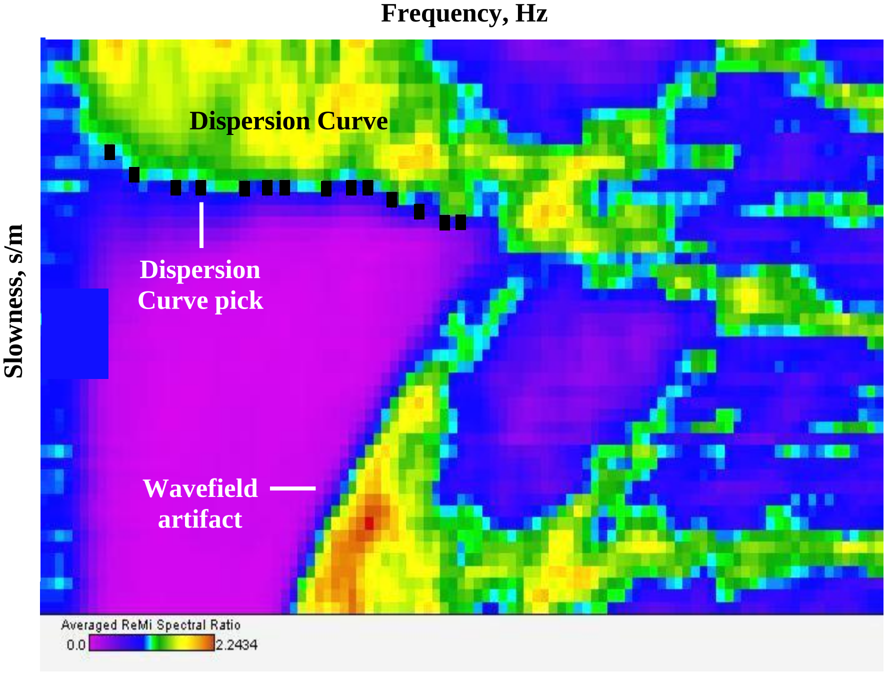
VELOCITY SPECTRAL ANALYSIS AND DISPERSION PICKS

Figure 1

Dispersion Curve with Picks and Fit



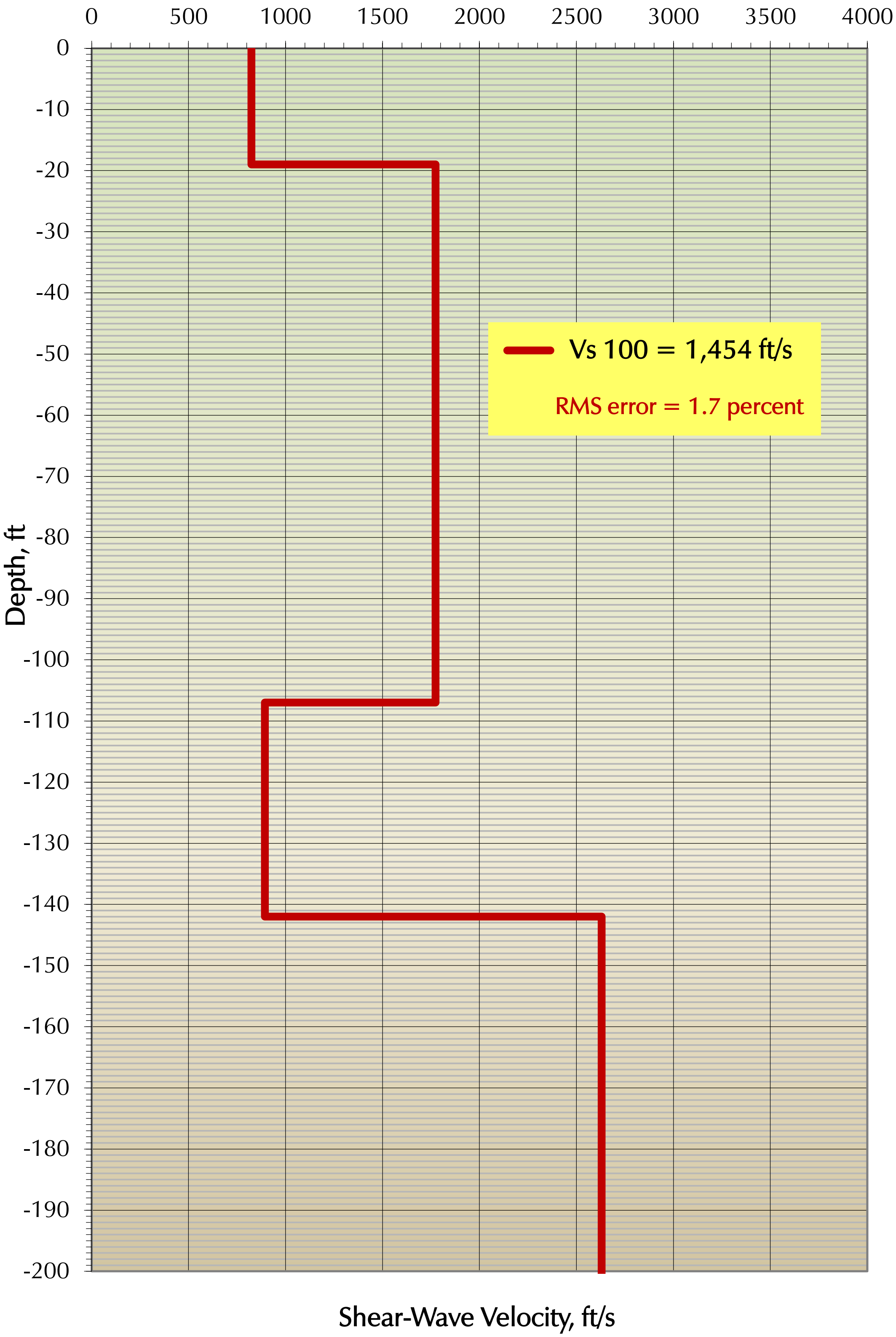
p-f Image with Dispersion Modeling Picks



APPENDIX C

SHEAR WAVE VELOCITY (**VS**) MODEL

Figure 2 - Vs Model



Important Information about This

Geotechnical-Engineering Report

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

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

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

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

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

Most of the "Findings" Related in This Report Are Professional Opinions

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

This Report's Recommendations Are Confirmation-Dependent

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

This Report Could Be Misinterpreted

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

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

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

Give Constructors a Complete Report and Guidance

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

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are <u>Not</u> Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will <u>not</u> of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are <u>not</u> building-envelope or mold specialists.***

GEOPROFESSIONAL
BUSINESS
ASSOCIATION

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