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May 23, 2018

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Subject: **Geotechnical Investigation**
Rollins Ranch – Lot 605
Mountain Green, Utah
GeoStrata Project No.: 864-005

Mr. Workman:

INTRODUCTION

This letter provides a summary of the geotechnical investigation completed on the subject property and provides recommendations for general site grading and the design and construction of foundations, slabs-on-grade, and exterior concrete flatwork as well as results of our slope stability analysis completed for the subject lot.

Based on our discussions, we understand that it is planned to construct a single-family residence on residential building Lot 605 of the Rollins Ranch development located at the northern end of Horseshow Hollow Lane in Mountain Green, Utah (Plate A-1, Site Vicinity Map). The building is anticipated to be a one- to two-story structure with a basement founded on conventional spread footings. Lot 605 has a total area of approximately 6.9 acres and is bordered by undeveloped residential lots and Horseshoe Hollow to the south. Our investigation included a site reconnaissance, subsurface exploration, soil sampling, laboratory testing, engineering analysis, and preparation of this report.

FIELD INVESTIGATION

As a part of this investigation, subsurface soil conditions at the site were explored by excavating two test pits to depths of 17½ to 18 feet below the existing site grade. The approximate locations of the explorations are shown on the Exploration Location Map, Plate A-2. Subsurface conditions, as encountered in the explorations, were recorded at the time of excavation by a qualified representative of the geotechnical engineer and are presented on Plate B-1 to Plate B-2. A Key to USCS Soil Symbols and Terminology is included on Plate B-3.

Based on our observations, subgrade soils encountered within the test pits consisted of 0 to 1 feet of undocumented fill soils comprised of sand and clay (this fill material was only observed in TP-2). Underlying the fill in TP-2 and in the upper sidewall of TP-1, we observed 1 foot of topsoil

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comprised of sand and clay with fine roots. Underlying the topsoil, we encountered sediments mapped by King and others (2008) as consisting of Pleistocene-aged lacustrine fine-grained sediments (Qlf) deposited near and just off-shore of Lake Bonneville (see Plate A-3, Site Vicinity Geologic Map). Where observed, these soils consisted largely of fine-grained sediments as well as occasional seams of coarse-grained sediments. The fine-grained sediments consisted of a stiff to very stiff, moist, red-brown to brown Lean CLAY (CL) and Silty CLAY (CL-ML), and generally had low to no plasticity, and frequently contained seams of Silty SAND (SM) throughout. Both sediments contained significant amounts of iron-staining throughout.

Groundwater was not encountered in either of the explorations completed as part of our investigation, nor was any signs observed of near-surface perched water tables such as weeps or springs. Seasonal fluctuations in precipitation, surface runoff from adjacent properties, or other on or offsite sources may increase moisture conditions. Groundwater conditions can be expected to rise several feet seasonally depending on the time of year; however, it is not anticipated that groundwater will impact the proposed residence.

The stratification lines shown on the enclosed test pit logs represent the approximate boundary between soil types (Plates B-1 and B-2). The actual in-situ transition may be gradual. Due to the nature and depositional characteristics of the native soils, care should be taken in interpolating subsurface conditions between and beyond the exploration points.

LABORATORY TESTING

Samples of the various soils encountered in the test pits were collected, packaged, and transported to our geotechnical laboratory in Bluffdale, Utah for testing. Geotechnical laboratory tests were conducted on selected bulk soil samples obtained during our field investigation. The laboratory program was designed to evaluate the engineering characteristics of onsite soils. Soil tests completed on the samples include:

- Grain Size Distribution Analysis (ASTM D422)
- Atterberg Limits Test (ASTM 4318)
- Collapse/Swell Test (ASTM 4546)
- 1-D Consolidation Test (ASTM D2435)
- Direct Shear Test (ASTM D3080)
- In-situ Moisture and Unit Weight Tests

The results of laboratory tests are presented on the Test Pit Logs (Plate B-1 to Plate B-2), the Laboratory Summary Table (Plate C-1), and the test result plates (Plate C-2 to Plate C-5).

ENGINEERING ANALYSIS

Engineering analyses were performed using soil data obtained from the laboratory test results and empirical correlations from material density, depositional characteristics and classification. Appropriate factors of safety were applied to the results consistent with industry standards and the accepted standard of care.

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CONCLUSIONS AND RECOMMENDATIONS

Based on our understanding of the proposed construction and our engineering analysis, the subject property is suitable for the proposed construction provided that the recommendations contained below are complied with.

MOISTURE SENSITIVE SOILS

Collapse (often referred to as "hydro-collapse") is a phenomena whereby undisturbed soils exhibit volumetric strain and consolidation upon wetting under increased loading conditions. Swell is a phenomenon whereby undisturbed soils exhibit a volumetric strain and expansion upon wetting. Collapsible and expansive soils, or moisture sensitive soils, can cause differential settling of structures and roadways. Moisture sensitive soils do not necessarily preclude development and can be mitigated by over-excavating porous, potentially moisture sensitive soils and replacing with engineered fill and by controlling surface drainage and runoff. For some structures that are particularly sensitive to differential settlement, or in areas where moisture sensitive soils are identified at great depth, a deep foundation system may need to be considered. Soils that have a potential to collapse under increased loading and moisture conditions are typically characterized by a pinhole structure and relatively low unit weights. In general, potentially moisture sensitive soils are observed in fine-grained soils that include clay and silt, although this may include sandy soils. Results of our laboratory testing indicated that the subsurface soils have a low swell potential upon wetting of 0.58% and 0.04% (Plate C-2 and Plate C-3). As a result, it is not anticipated that remediation measures will be required to address moisture sensitive soils.

STRENGTH OF EARTH MATERIALS

A direct shear test was performed on a relatively "undisturbed" sample of near-surface sediments that classify as a Lean CLAY (CL) with sand. The test indicated that the sample tested had cohesion of 320 psf and an internal angle of friction (phi) of 17 (peak strength ≈ ultimate strength). A summary of the test results is presented on Plate C-5.

SEISMIC DESIGN

Seismic hazard maps depicting probabilistic ground motions and spectral response have been developed for the United States by the U.S. Geological Survey as part of NEHRP/NSHMP (Frankel et al, 1996). These maps have been incorporated into both *NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures* (FEMA, 1997) and the *International Building Code* (IBC) (International Code Council, 2015). Spectral responses for the Maximum Considered Earthquake (MCE) are shown in the table below. These values generally correspond to a two percent probability of exceedance in 50 years (2PE50) for a "firm rock" site. To account for site effects, site coefficients which vary with the magnitude of spectral acceleration are used. Based on our field exploration, it is our opinion that this location is best described as a Site Class C. The spectral accelerations are shown in the table below. The spectral accelerations are calculated based on the site's approximate latitude and longitude of 41.1515° and -111.7840° respectively and the United States Geological Survey Seismic Design Maps web-based application. Based on the IBC, the site coefficients are F_a=1.06 and F_v=1.52. From this procedure the peak ground acceleration (PGA) is estimated to be 0.36 g.

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Stability of Natural Slopes

An approximate 5H:1V descending slope forms the eastern boundary of the site. The stability of this slope was modeled using SLIDE, a computer application incorporating (among others) Bishop's Simplified Method of analysis. Calculations for stability were developed by searching for the minimum factor of safety for a circular-type failure. Homogeneous earth materials (Tertiary volcanic rock) and arcuate failure surfaces were assumed. Stability analyses were conducted for a representative cross-section drawn through the subject lot, designated as Section A-A' (see Plate A-2 in Appendix A).

Pseudo-static (seismic screening) analysis of the natural slope was performed in general conformance with the simplified procedures as outlined in the SCEC (2002) document. Per the industry standard, seismic screening was completed using one-half of the deterministic median (50^{th} percentile) peak ground acceleration (PGA) for the area resulting from a *characteristic* earthquake of 7.0Mw on the Weber segment of the Wasatch fault, which is estimated to be 0.36g (see "Seismic Design section of this report).

Strength parameters used in our analyses were developed based on the results of laboratory testing, experience and engineering judgment. Based on the results of a direct shear test performed on a relatively undisturbed sample of the lacustrine sediments, we selected shear strength parameters consisting of a cohesion value of 300 psf and an angle of internal friction (ϕ) of 17 degrees for the near-surface sediments.

Groundwater was not encountered during our investigation, nor was any evidence of near-surface perched groundwater tables observed during our investigation. As such, groundwater was not included in our slope stability modeling.

Based on our preliminary analysis, the natural slope associated with the subject lot meets the minimum design factor-of-safety of 1.5 and 1.1 for static and seismic conditions, respectively. The results of the stability analyses are presented in Appendix D.

Earthwork

Within construction areas for footings or concrete flatwork, any existing vegetation, topsoil, debris, undocumented fill (if encountered), or otherwise unsuitable soils should be removed. Any loose or soft soils should also be removed and replaced with properly placed and compacted structural fill. Following the removal of vegetation, unsuitable soils, and loose or disturbed soils, as described above, site grading may be conducted to bring the site to design elevations.

Structural Fill

All fill placed for the support of any proposed improvements should consist of structural fill. Structural fill may consist of reworked, native, fine-grained or granular soils (with particles larger than 4 inches in diameter removed). The contractor should be aware that it may be difficult to properly moisture condition and compact fine-grained soils, however. Alternatively, structural fill may consist of an imported granular soil with a maximum particle size of 4 inches, a maximum of 50 percent passing the No. 4 mesh sieve and a minimum fines content (minus No. 200 mesh sieve) of 25 percent. Structural fill should be placed in maximum 8-inch loose lifts and compacted to at least 95

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percent of the maximum dry density, as determined by the ASTM D-1557. The moisture content should be slightly above optimum at the time of compaction. Utility trenches in non-structural areas should be backfilled and compacted to approximately 90 percent of the maximum density. All structural fill should be placed in maximum 6-inch loose lifts if compacted by small hand operated equipment, maximum 8-inch loose lifts if compacted by light duty rollers, and maximum 10-inch maximum lifts if compacted by heavy duty compaction equipment that is capable of efficiently compacting the entire thickness of the lift. We recommend that all structural fill be compacted on a horizontal plane unless otherwise approved by the geotechnical engineer. Prior to the placement of any fill, the excavations should be observed by the geotechnical engineer to observe that any unsuitable materials or loose soils have been removed.

FOUNDATIONS

Bearing capacity values were calculated using Meyerhof and others' modification to Terzaghi's original bearing capacity formula. Strength parameters for the bearing strata were assigned based on laboratory shear strength parameters and field observations. A factor of safety of 3 is generally used in developing allowable bearing values; however, additional reduction of allowable bearing is typically warranted to account for static settlement and potentially poor construction practices.

Foundations for the proposed structures may consist of conventional strip and/or spread footings founded entirely on competent native soils. Foundation walls will likely need to be reinforced in order to aid in retaining the upslope, near-surface soils. Exterior shallow footings should be embedded at least 40-inches below final grade for frost protection and confinement. Interior footings not subject to frost should be embedded at least 18 inches below final grade to provide confinement. To provide adequate support and confinement, we recommend that footings be place at least 15 feet, measured horizontally, from the face of existing or fill slopes at the site.

Conventional strip footings founded entirely on competent native soils may be proportioned for a maximum net allowable bearing capacity of **1,600 psf**. The net allowable bearing capacity may be increased (typically by one-third) for temporary loading conditions such as transient wind and seismic loads. All footing excavations should be observed by the Geotechnical Engineer prior to footing placement.

FOUNDATION DRAINAGE

Due to the possibility of moisture reaching the foundation elements during spring runoff, it is recommended that a foundation drain be constructed. The foundation drain should consist of a 4-inch perforated pipe placed at or below the footing elevation. The pipe should be covered with at least 12 inches of free draining gravel (containing less than 5 percent passing the No 4 sieve) and be graded to a free gravity out fall or to a pumped sump. A separator fabric, such as Mirafi 140N, should separate the free draining gravel and native soil (i.e. the separator fabric should be placed between the gravel and the native soils at the bottom of the gravel, the side of the gravel where the gravel does not lie against the concrete footing or foundation and at the top of the gravel). We recommend that the gravel extend up the foundation wall to within 3 feet of the final ground surface. As an alternative, the gravel extending up the foundation wall may be replaced with a prefabricated drain panel, such as Ecodrain-E.

CONCRETE SLAB-ON-GRADE

Concrete slabs-on-grade should be constructed over at least 4 inches of compacted gravel overlying native soils or a zone of structural fill that is at least 12 inches thick. Disturbed native soils should be compacted to at least 95% of the maximum dry density as determined by ASTM D-1557 (modified proctor) prior to placement of gravel. The gravel should consist of road base or clean drain rock with a ¾-inch maximum particle size and no more than 12 percent fines passing the No. 200 mesh sieve. The gravel layer should be compacted to at least 95 percent of the maximum dry density of the modified proctor or until tight and relatively unyielding if the material is non-proctorable. All concrete slabs should be designed to minimize cracking as a result of shrinkage. Consideration should be given to reinforcing the slab with welded wire, re-bar, or fiber mesh.

LATERAL EARTH PRESSURES

Lateral forces imposed upon conventional foundations due to wind or seismic forces may be resisted by the development of passive earth pressures and friction between the base of the footing and the supporting subgrade. In determining the frictional resistance, a coefficient of friction of 0.32 for native soils against concrete should be used. Ultimate lateral earth pressures from native backfill acting against retaining walls and buried structures may be computed from the lateral earth pressure coefficients or equivalent fluid densities presented in the following table:

Condition	Lateral Pressure Coefficient	Equivalent Fluid Density (pounds per cubic foot)
Active*	0.49	54
At-rest**	0.71	78
Passive*	2.40	264
Seismic Active***	0.20	22
Seismic Passive***	-0.47	-52

* Based on Coulomb's Equation
** Based on Jaky
*** Based on Mononobe-Okabe Equation

These coefficients and densities assume level, granular backfill with no buildup of hydrostatic pressures. The force of the water should be added to the presented values if hydrostatic pressures are anticipated.

Walls and structures allowed to rotate slightly should use the active condition. If the element is constrained against rotation, the at-rest condition should be used. These values should be used with an appropriate factor of safety against overturning and sliding. A value of 1.5 is typically used. Additionally, if passive resistance is calculated in conjunction with frictional resistance, the passive resistance should be reduced by ½.

For seismic analyses, the *active* and *passive* earth pressure coefficient provided in the table is based on the Mononobe-Okabe pseudo-static approach and only accounts for the dynamic horizontal thrust produced by ground motion. Hence, the resulting dynamic thrust pressure *should be added* to the static pressure to determine the total pressure on the wall. The pressure distribution of the dynamic horizontal thrust may be closely approximated as an inverted triangle with stress decreasing with depth and the resultant acting at a distance approximately 0.6 times the loaded height of the structure, measured upward from the bottom of the structure.

The coefficients shown assume a vertical wall face. Hydrostatic and surcharge loadings, if any, should be added. Over-compaction behind walls should be avoided. Resisting passive earth pressure from soils subject to frost or heave, or otherwise above prescribed minimum depths of embedment, should usually be neglected in design.

Permanent Cut and Fill Slopes

Due to elevated potential for slope instability, it is recommended that cut/fill sections at the subject site be limited to 5 feet or less. Larger cut/fill sections may be feasible at the subject site; however, it is recommended that a location specific stability investigation be completed within the area of any proposed cut/fill sections that exceed 5 feet. The cut/fill slopes should be created no steeper than 3:1 horizontal to vertical.

Moisture Protection and Surface Drainage

Precautions should be taken during and after construction to minimize the potential for saturation of foundation soils. Over wetting the soils prior to or during construction may result in increased softening and pumping, causing equipment mobility problems and difficulty in achieving compaction.

Infiltration of moisture in the vicinity of structures should be minimized. We recommend that roof runoff devices be installed to direct all runoff a minimum of 10 feet away from structures. The grade within 10 feet of the structures should be sloped a minimum of 5% away from the structure in accordance with the IBC, 2015. During spring months, melt water from the slope to the west, east, and north of the property may impact the proposed residence if strategic site grading is not completed. Catchment basins and diversionary berms should be installed upgradient from the property and should direct all moisture toward the storm drains on the eastern portion of the residence.

LIMITATIONS

The recommendations contained in this report are based on limited field exploration, laboratory testing, and our understanding of the proposed construction. The subsurface data used in the preparation of this report was obtained from the explorations made for this investigation. It is possible that variations in subsurface conditions could exist beyond the point explored. The nature and extent of variations may not be evident until construction occurs. If any conditions are encountered at this site that are different from those described in this report, we should be immediately notified so that we may make any necessary revisions to the recommendations contained in this report. In addition, if the scope of the proposed construction changes from that described in this report, we should be notified.

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This report was prepared in accordance with the generally accepted standard of practice at the time the report was written. No other warranty, expressed or implied, is made. It is the Client's responsibility to see that all parties to the project including the Designer, Contractor, Subcontractors, etc. are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the Contractor's option and risk.

We appreciate the opportunity to provide these services. Please contact us if you have questions regarding the information provided in this letter.

Respectfully,
GeoStrata

J. Scott Seal, P.E.
Associate

Reviewed by

Daniel J. Brown, P.E.
Senior Geotechnical Engineer

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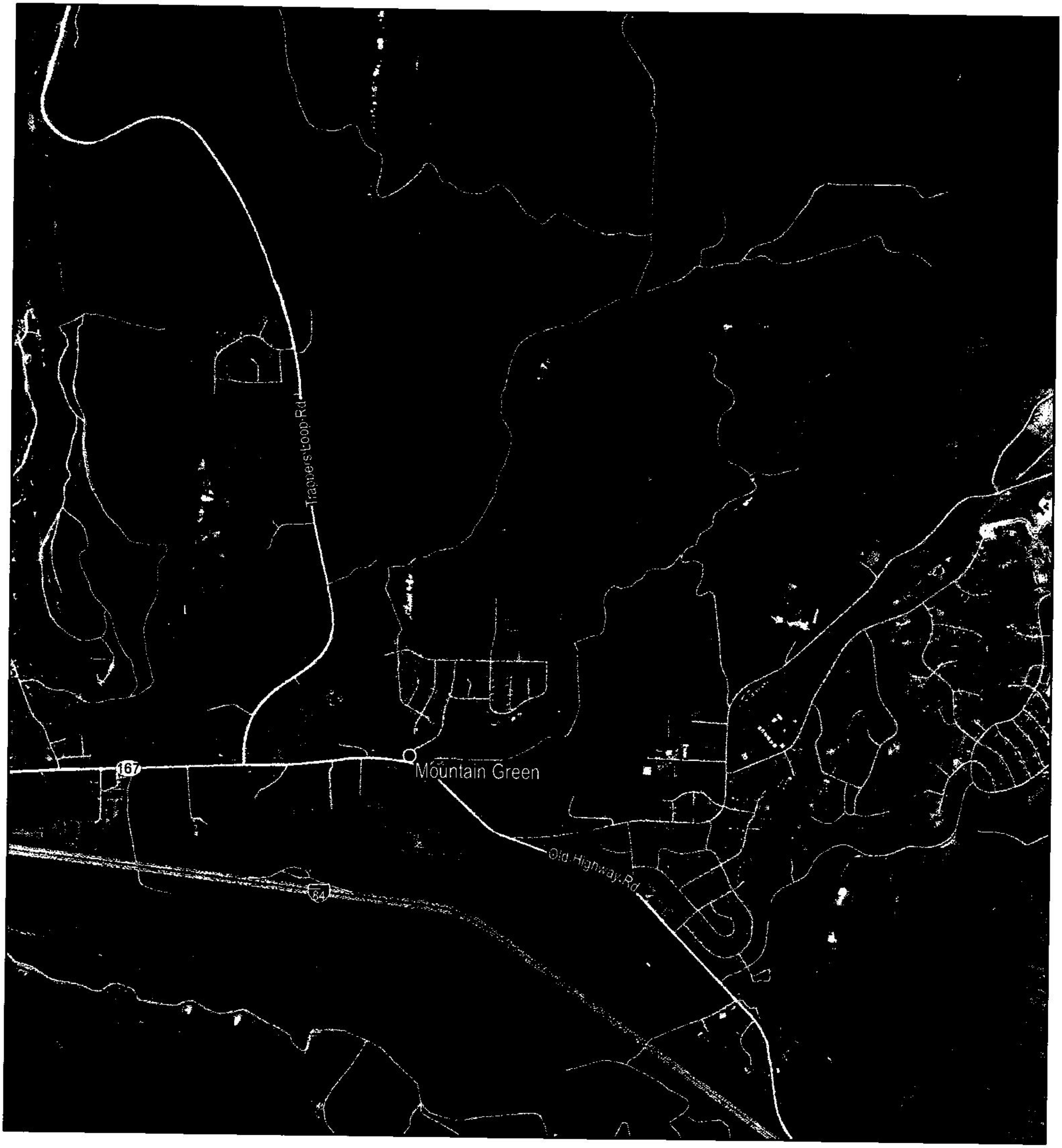

Legend

Approximate Site Boundary

0 625 1,250 2,500 3,750 5,000 Feet

1 inch = 2,000 feet

Basemap:
2016 1 m NAIP aerial imagery and hillshades derived from 2 meter DEMs provided by the State of Utah AGRC.

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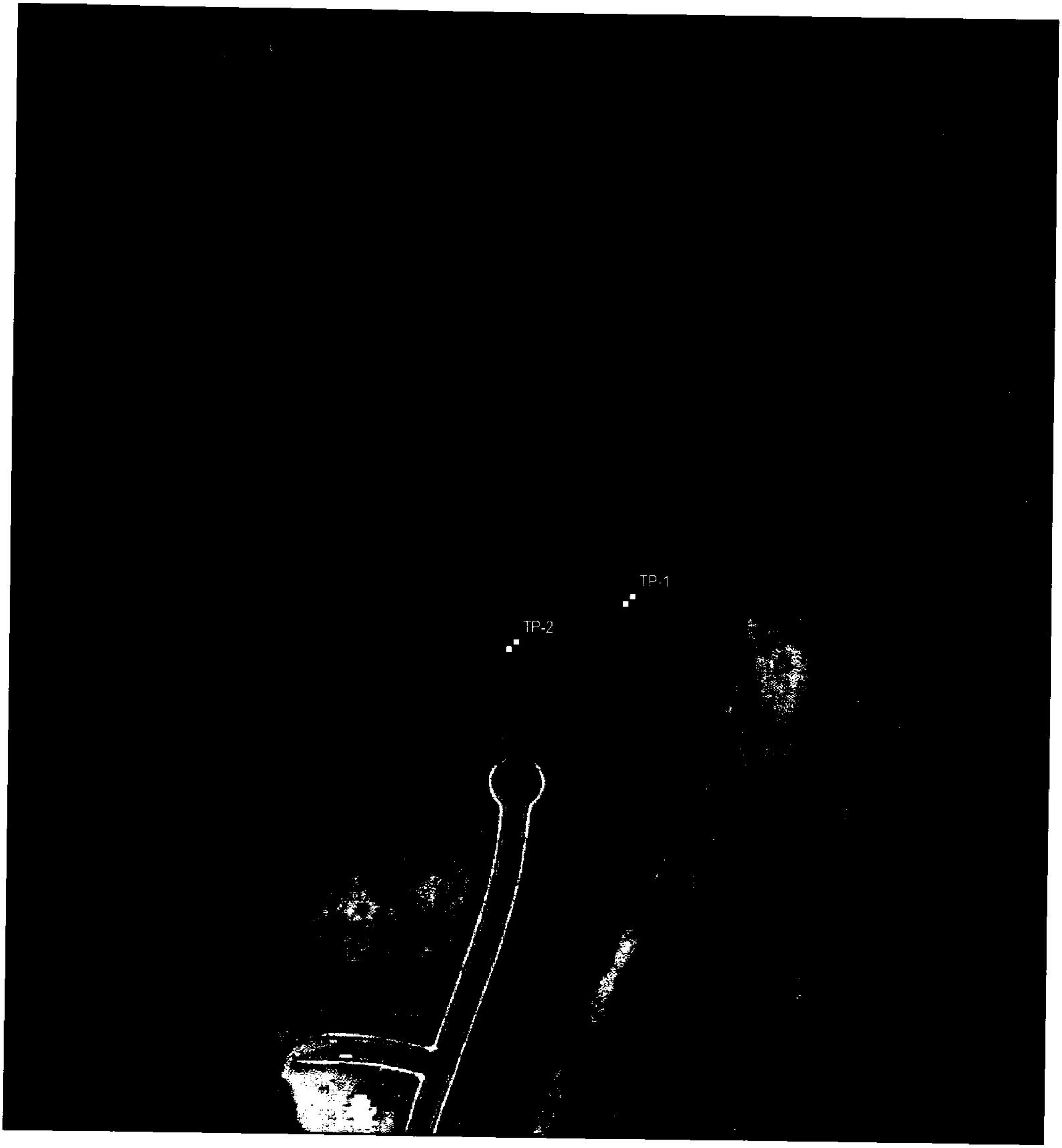
Geotechnical Investigation
Pineview Builders
Rollins Ranch Lot 605
Mountain Green, Utah
Project Number: 864-005

Site Vicinity Map

Plate A-1



Legend

Approximate Site Boundary

Approximate Test Pit Location

0 75 150 300 450 600 Feet

1 inch = 250 feet

Basemap:
2016 1 m NAIP aerial imagery provided by the State of Utah AGRC.

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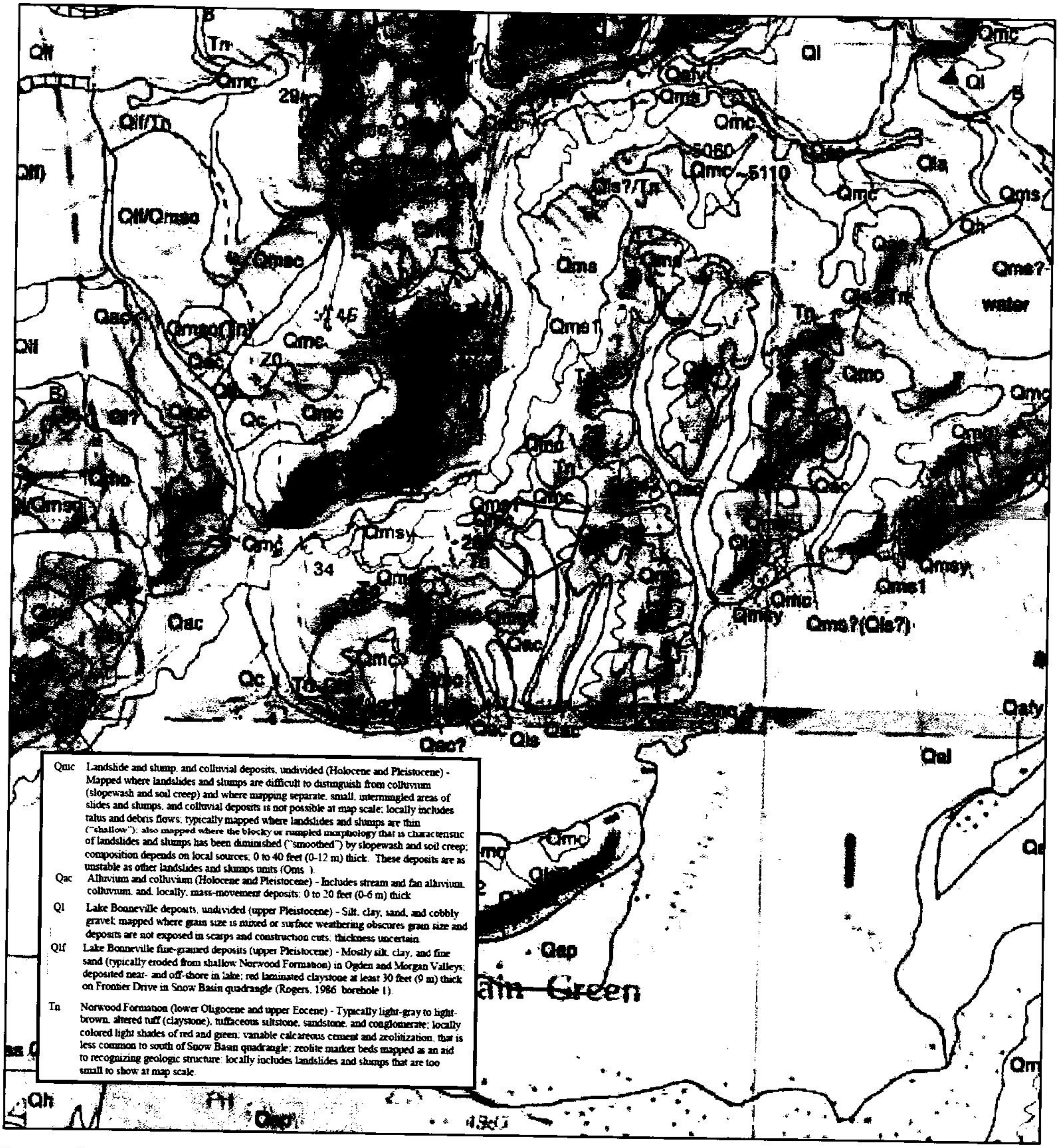
Pineview Builders
Rollins Ranch Lot 605
Mountain Green, Utah
Project Number: 864-005

Exploration Location Map

Plate A-2



Qmc Landslide and slump, and colluvial deposits, undivided (Holocene and Pleistocene) - Mapped where landslides and slumps are difficult to distinguish from colluvium (slopewash and soil creep) and where mapping separate, small, intermingled areas of slides and slumps, and colluvial deposits is not possible at map scale; locally includes talus and debris flows; typically mapped where landslides and slumps are thin ("shallow"); also mapped where the blocky or rumpled morphology that is characteristic of landslides and slumps has been diminished ("smoothed") by slopewash and soil creep; composition depends on local sources; 0 to 40 feet (0-12 m) thick. These deposits are as unstable as other landslides and slumps units (Qms).

Qac Alluvium and colluvium (Holocene and Pleistocene) - Includes stream and fan alluvium, colluvium, and, locally, mass-movement deposits; 0 to 20 feet (0-6 m) thick

Ql Lake Bonneville deposits, undivided (upper Pleistocene) - Silt, clay, sand, and cobbly gravel; mapped where grain size is mixed or surface weathering obscures grain size and deposits are not exposed in scarps and construction cuts; thickness uncertain.

Qlf Lake Bonneville fine-grained deposits (upper Pleistocene) - Mostly silt, clay, and fine sand (typically eroded from shallow Norwood Formation) in Ogden and Morgan Valleys; deposited near- and off-shore in lake; red laminated claystone at least 30 feet (9 m) thick on Frontier Drive in Snow Basin quadrangle (Rogers, 1986 borehole 1).

Tn Norwood Formation (lower Oligocene and upper Eocene) - Typically light-gray to light-brown, altered tuff (claystone), tuffaceous siltstone, sandstone, and conglomerate; locally colored light shades of red and green; variable calcareous cement and zeolitization, that is less common to south of Snow Basin quadrangle; zeolite marker beds mapped as an aid to recognizing geologic structure; locally includes landslides and slumps that are too small to show at map scale.

Legend

Approximate Site Boundary

Feet
0 315 630 1,260 1,890 2,520

1 inch = 1,000 feet

Basemap:
Interim Geolgic Map of the Snow Basin Quadrangle and Part of the Huntsville Quadrangle, Davis, Morgan, and Weber Counties, Utah, King and others, 2008. Hillshades derived from 2 meter DEMs provided by the State of Utah AGRC.

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Pineview Builders
Rollins Ranch Lot 605
Mountain Green, Utah
Project Number: 864-005

Site Vicinity Geologic Map

Plate A-3

DATE	
STARTED:	5/3/18
COMPLETED:	5/3/18
BACKFILLED:	5/3/18

Pineview Builders
Rollins Ranch Lot 605
Mountain Green, UT
Project Number 864-005

GeoStrata Rep: S. Agopian
Rig Type: Trackhoe

TEST PIT NO:
TP-1
Sheet 1 of 1

LOCATION

NORTHING | EASTING | ELEVATION

DEPTH (METERS)	DEPTH (FEET)	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0					TOPSOIL; Clayey SAND - moist, dark brown, pinholes and fine roots throughout					
					CL	Lean CLAY with sand - very stiff, moist, red-brown, sand largely isolated to frequent 1/4 inch thick seams with iron staining throughout					
2		Grab						25.4	99.8	36	15
3	10	Grab					99.6	27.1	99.6	46	26
5	15										
		Grab						27.9	99.6	40	17
						Bottom of Test Pit @ 17.5 Feet					

Moisture Content and Atterberg Limits

Plastic Limit — Moisture Content — Liquid Limit

10 20 30 40 50 60 70 80 90

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

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Plate B-1

DATE	
STARTED:	5/3/18
COMPLETED:	5/3/18
BACKFILLED:	5/3/18

Pineview Builders
Rollins Ranch Lot 605
Mountain Green, UT
Project Number 864-005

GeoStrata Rep: S. Agopian
Rig Type: Trackhoe

TEST PIT NO:
TP-2
Sheet 1 of 1

LOCATION
NORTHING EASTING ELEVATION

DEPTH (FEET)	SAMPLES	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0			FILL; Clayey SAND - moist, light brown					
			TOPSOIL; Clayey SAND - moist, dark brown, fine roots throughout					
		CL	Lean CLAY with sand - very stiff, moist, red-brown, sand largely isolated to frequent 1/4 inch thick seams with iron staining throughout					
	Grab				15.6	98.9	39	17
	Grab	CL-ML	Silty CLAY - very stiff, moist, red-brown	99.0	17.6	91.0	24	6
	Grab							
18			Bottom of Test Pit @ 18 Feet					

Moisture Content and Atterberg Limits
Plastic Limit — Moisture Content — Liquid Limit
10 20 30 40 50 60 70 80 90

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SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate
B-2

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			USCS SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	GRAVELS (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
			SC	CLAYEY SANDS SAND-GRAVEL-CLAY MIXTURES
FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid limit less than 50)		ML	INORGANIC SILTS & VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid limit greater than 50)		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

LOG KEY SYMBOLS

BORING SAMPLE LOCATION

TEST-PIT SAMPLE LOCATION

WATER LEVEL (level after completion)

WATER LEVEL (level where first encountered)

CEMENTATION

DESCRIPTION	DESCRIPTION
WEAKELY	CRUMBLES OR BREAKS WITH HANDLING OR SLIGHT FINGER PRESSURE
MODERATELY	CRUMBLES OR BREAKS WITH CONSIDERABLE FINGER PRESSURE
STRONGLY	WILL NOT CRUMBLE OR BREAK WITH FINGER PRESSURE

OTHER TESTS KEY

C	CONSOLIDATION	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	DS	DIRECT SHEAR
UC	UNCONFINED COMPRESSION	T	TRIAXIAL
S	SOLUBILITY	R	RESISTIVITY
O	ORGANIC CONTENT	RV	R-VALUE
CBR	CALIFORNIA BEARING RATIO	SU	SOLUBLE SULFATES
COMP	MOISTURE/DENSITY RELATIONSHIP	PM	PERMEABILITY
CI	CALIFORNIA IMPACT	-200	% FINER THAN #200
COL	COLLAPSE POTENTIAL	Gs	SPECIFIC GRAVITY
SS	SHRINK SWELL	SL	SWELL LOAD

MODIFIERS

DESCRIPTION	%
TRACE	<5
SOME	5 - 12
WITH	>12

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
DRY	ABSENCE OF MOISTURE, DUSTY, DRY TO THE TOUCH
MOIST	DAMP BUT NO VISIBLE WATER
WET	VISIBLE FREE WATER, USUALLY SOIL BELOW WATER TABLE

STRATIFICATION

DESCRIPTION	THICKNESS	DESCRIPTION	THICKNESS
SEAM	1/16 - 1/2"	OCCASIONAL	ONE OR LESS PER FOOT OF THICKNESS
LAYER	1/2 - 12"	FREQUENT	MORE THAN ONE PER FOOT OF THICKNESS

GENERAL NOTES

1. Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual.
2. No warranty is provided as to the continuity of soil conditions between individual sample locations.
3. Logs represent general soil conditions observed at the point of exploration on the date indicated.
4. In general, Unified Soil Classification designations presented on the logs were evaluated by visual methods only. Therefore, actual designations (based on laboratory tests) may vary.

APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

APPARENT DENSITY	SPT (blows/ft)	MODIFIED CA. SAMPLER (blows/ft)	CALIFORNIA SAMPLER (blows/ft)	RELATIVE DENSITY (%)	FIELD TEST
VERY LOOSE	<4	<4	<5	0 - 15	EASILY PENETRATED WITH 1/2-INCH REINFORCING ROD PUSHED BY HAND
LOOSE	4 - 10	5 - 12	5 - 15	15 - 35	DIFFICULT TO PENETRATE WITH 1/2-INCH REINFORCING ROD PUSHED BY HAND
MEDIUM DENSE	10 - 30	12 - 35	15 - 40	35 - 65	EASILY PENETRATED A FOOT WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER
DENSE	30 - 50	35 - 60	40 - 70	65 - 85	DIFFICULT TO PENETRATED A FOOT WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER
VERY DENSE	>50	>60	>70	85 - 100	PENETRATED ONLY A FEW INCHES WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER

CONSISTENCY - FINE-GRAINED SOIL

CONSISTENCY	SPT (blows/ft)	TORVANE UNTRAINED SHEAR STRENGTH (tsf)	POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH (tsf)	FIELD TEST
VERY SOFT	<2	<0.125	<0.25	EASILY PENETRATED SEVERAL INCHES BY THUMB. EXUDES BETWEEN THUMB AND FINGERS WHEN SQUEEZED BY HAND.
SOFT	2 - 4	0.125 - 0.25	0.25 - 0.5	EASILY PENETRATED ONE INCH BY THUMB. MOLDED BY LIGHT FINGER PRESSURE.
MEDIUM STIFF	4 - 8	0.25 - 0.5	0.5 - 1.0	PENETRATED OVER 1/2 INCH BY THUMB WITH MODERATE EFFORT. MOLDED BY STRONG FINGER PRESSURE.
STIFF	8 - 15	0.5 - 1.0	1.0 - 2.0	INDENTED ABOUT 1/2 INCH BY THUMB BUT PENETRATED ONLY WITH GREAT EFFORT.
VERY STIFF	15 - 30	1.0 - 2.0	2.0 - 4.0	READILY INDENTED BY THUMBNAIL.
HARD	>30	>2.0	>4.0	INDENTED WITH DIFFICULTY BY THUMBNAIL.

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Soil Symbols Description Key

Geotechnical Investigation
Rollins Ranch – Lot 605
Mountain Green, Utah
GeoStrata Project No. 864-005

Plate
B-3

Test Pit No.	Sample Depth (feet)	USCS Soil Classification	Natural Moisture Content (%)	Natural Dry Density (pcf)	Gradation		Atterberg		Swell (%)	Direct Shear	
					Sand (%)	Fines (%)	LL	PI		Friction Angle (°)	Cohseion (psf)
TP-1	6	CL	25.4		0.2	99.8	36	15			
TP-1	11	CL	27.0	100	0.4	99.6	46	26	.58	17	320
TP-1	17.5	CL	27.9		0.4	99.6	40	17			
TP-2	4	CL	15.6		1.1	98.9	39	17			
TP-2	5.5	CL-ML	17.6	99.0	9.0	91.0	24	6	.04		

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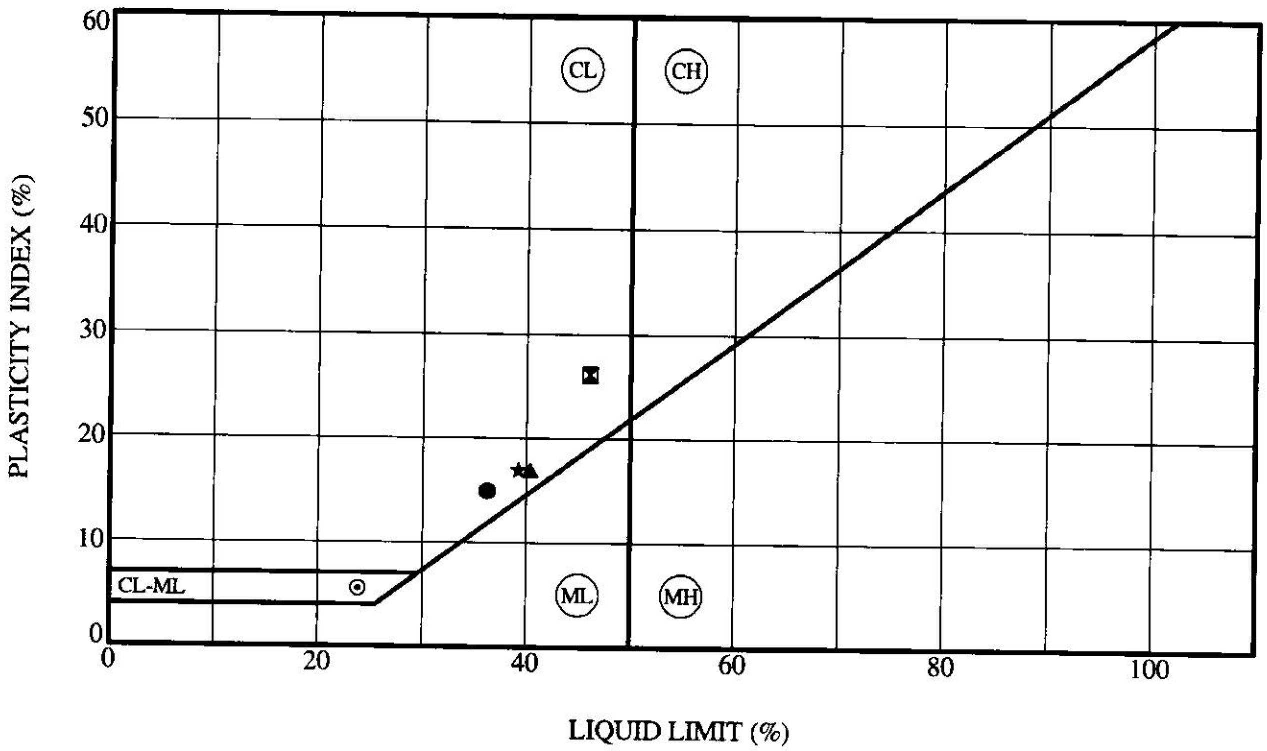
Lab Summary Report

Pineview Builders
Rollins Ranch Lot 605
Mountain Green, Utah
Project Number: 864-005

Plate C - 1



	Sample Location	Depth (ft)	LL (%)	PL (%)	PI (%)	Fines (%)	Classification
●	**TP-1**	**6.0**	**36**	**21**	**15**	**99.8**	**Lean CLAY**
⊠	**TP-1**	**11.0**	**46**	**20**	**26**	**99.6**	**Lean CLAY**
▲	**TP-1**	**17.5**	**40**	**23**	**17**	**99.6**	**Lean CLAY**
★	**TP-2**	**4.0**	**39**	**22**	**17**	**98.9**	**Lean CLAY**
⊙	**TP-2**	**5.5**	**24**	**18**	**6**	**91.0**	**Silty CLAY**

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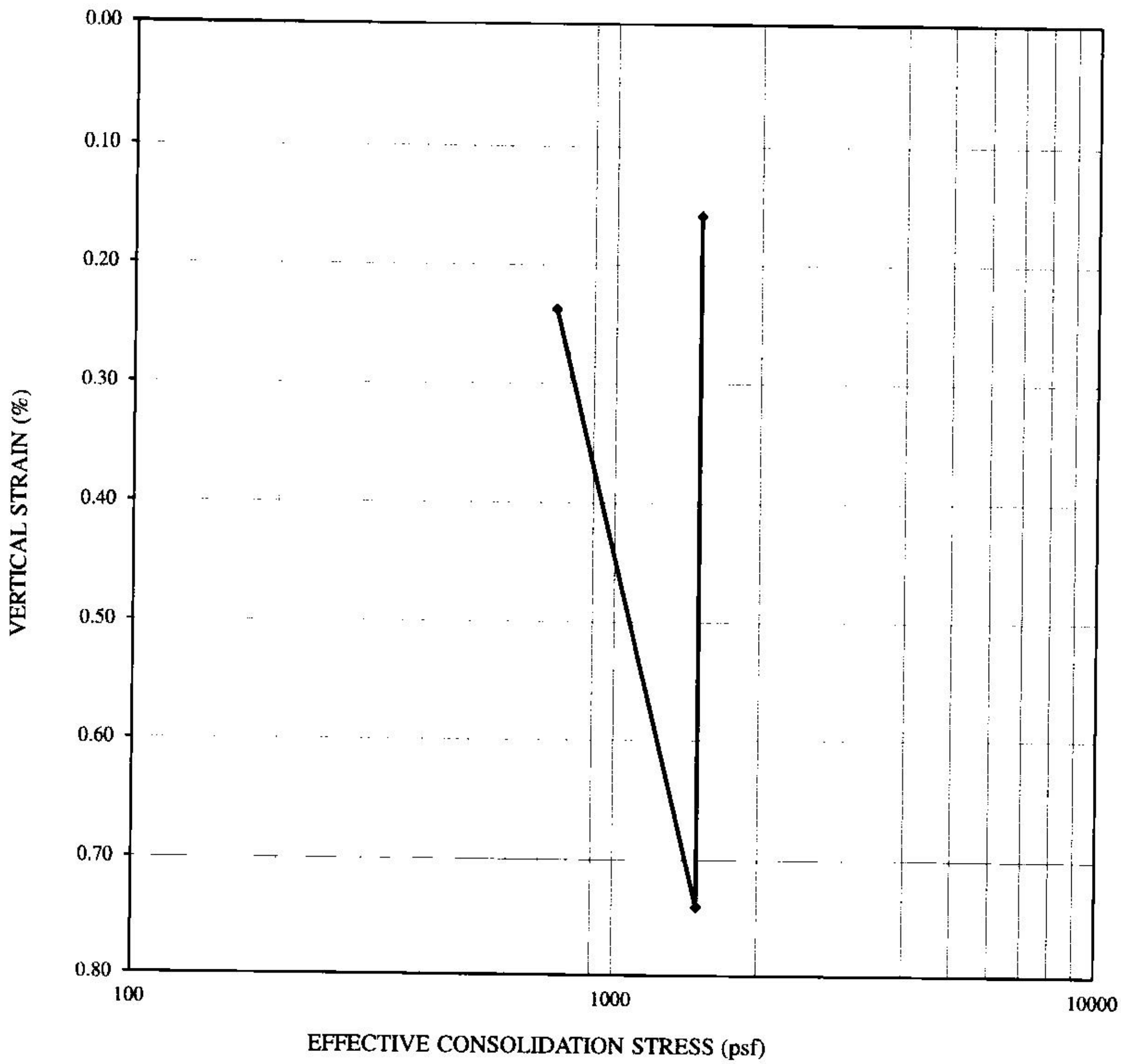
ATTERBERG LIMITS' RESULTS - ASTM D 4318

Pineview Builders
Rollins Ranch Lot 605
Mountain Green, UT
Project Number: 864-005

Plate
C - 2



Sample Location	Depth (ft)	Classification	γ_d (pcf)	MC (%)	Inundation Load (psf)	Swell (%)	Collapse (%)
TP-1	**11.0**	**Lean CLAY**	**99.6**	**27.0**	**1500**	**0.58**	**---**

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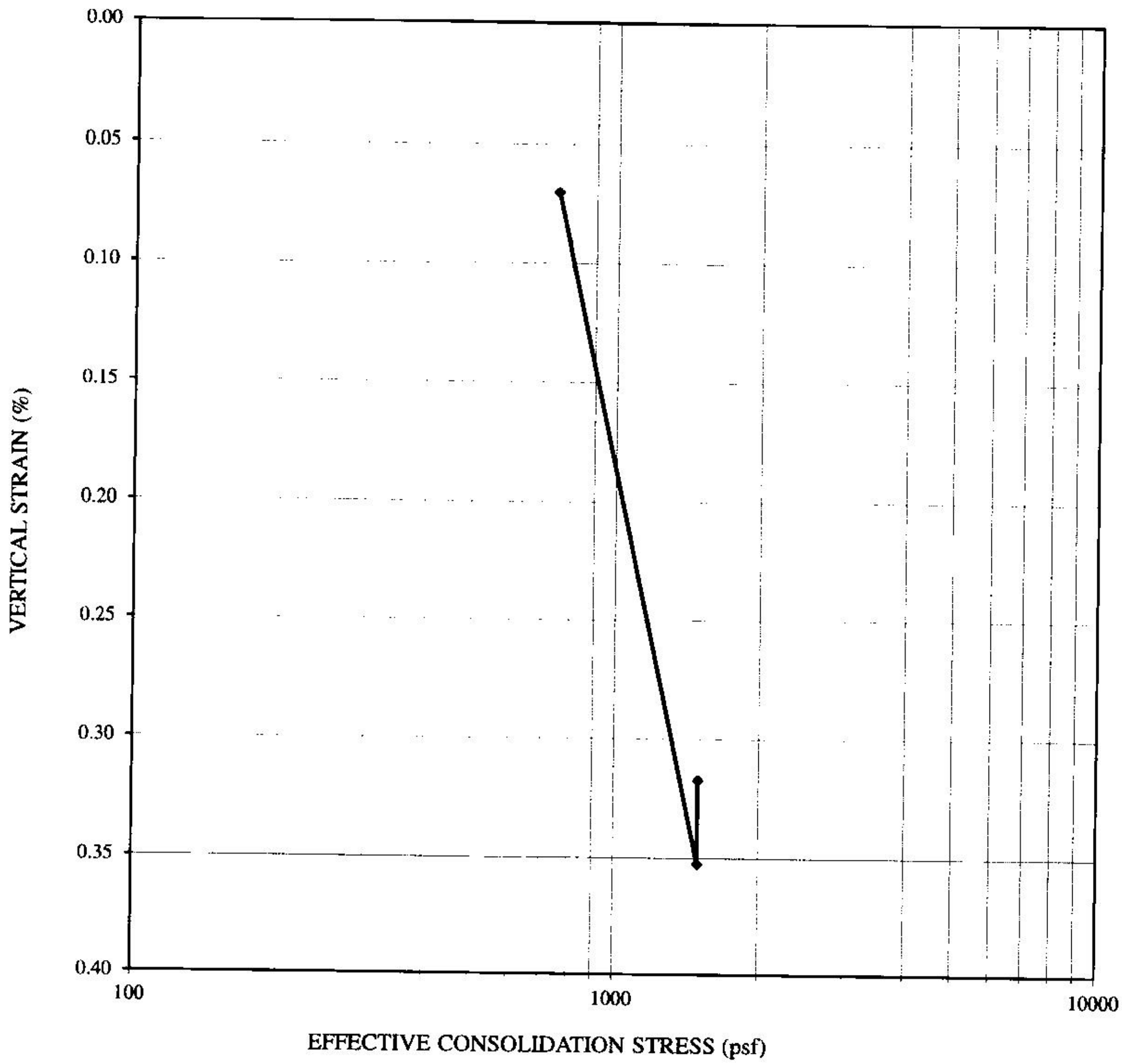
1-D SWELL/COLLAPSE TEST

Pineview Builders
Rollins Ranch Lot 605
Mountain Green, Utah
Project Number: 864-006

Plate C-3



Sample Location	Depth (ft)	Classification	γ_d (pcf)	MC (%)	Inundation Load (psf)	Swell (%)	Collapse (%)
TP-2	**5.5**	**Silty CLAY**	**99.0**	**17.6**	**1500**	**0.04**	**---**

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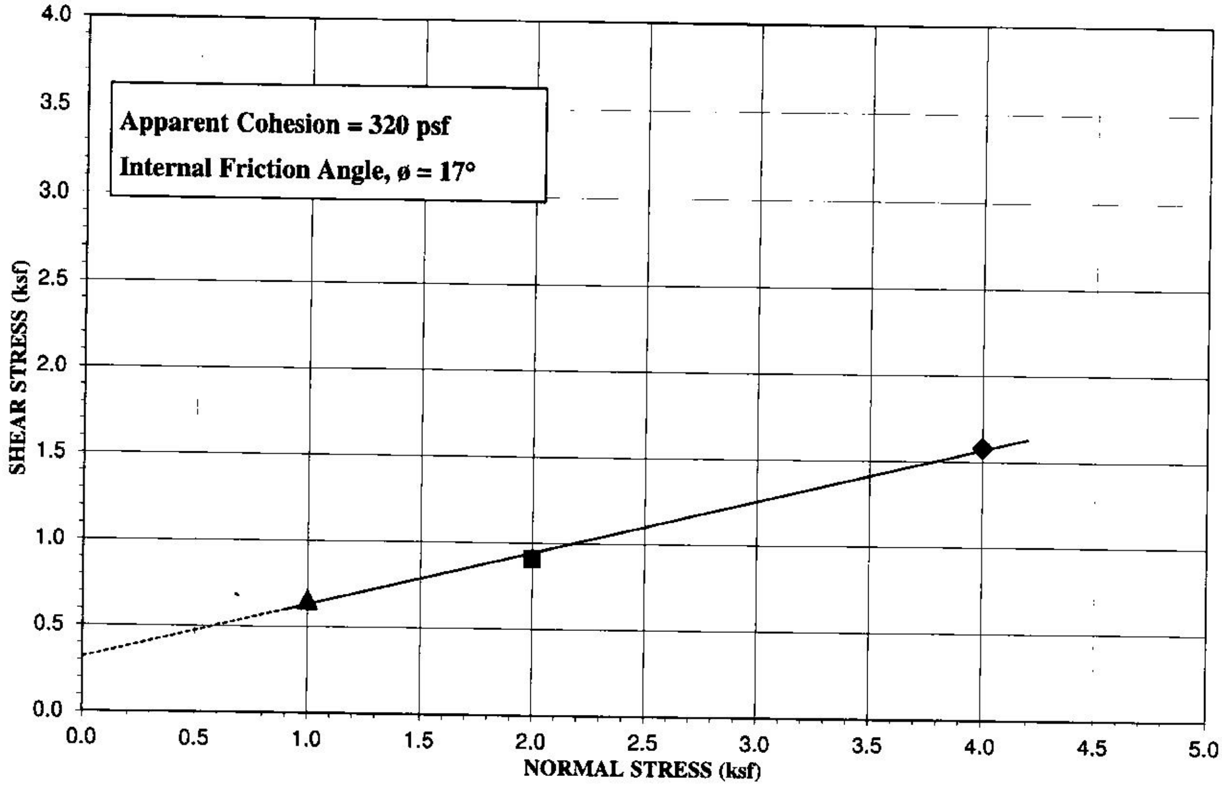
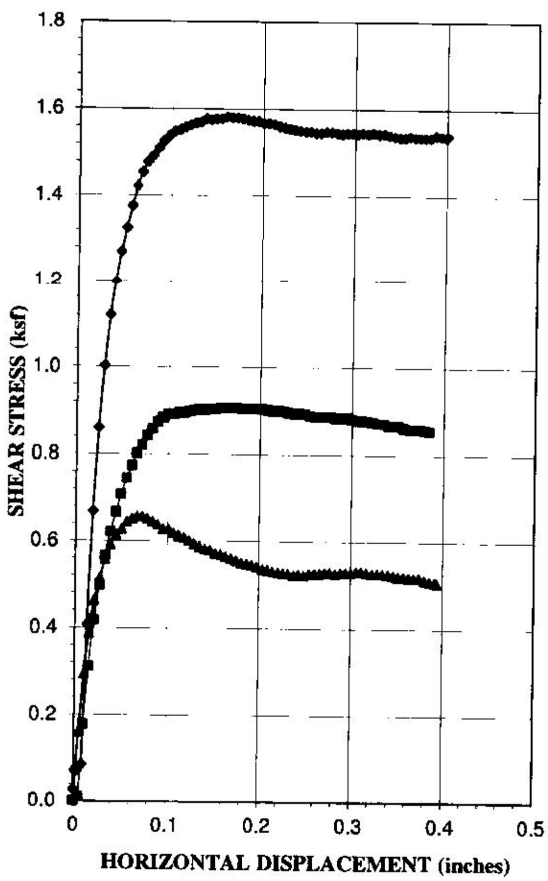
1-D SWELL/COLLAPSE TEST

Pineview Builders
Rollins Ranch Lot 605
Mountain Green, Utah
Project Number: 864-005

Plate C-4

DIRECT SHEAR TEST





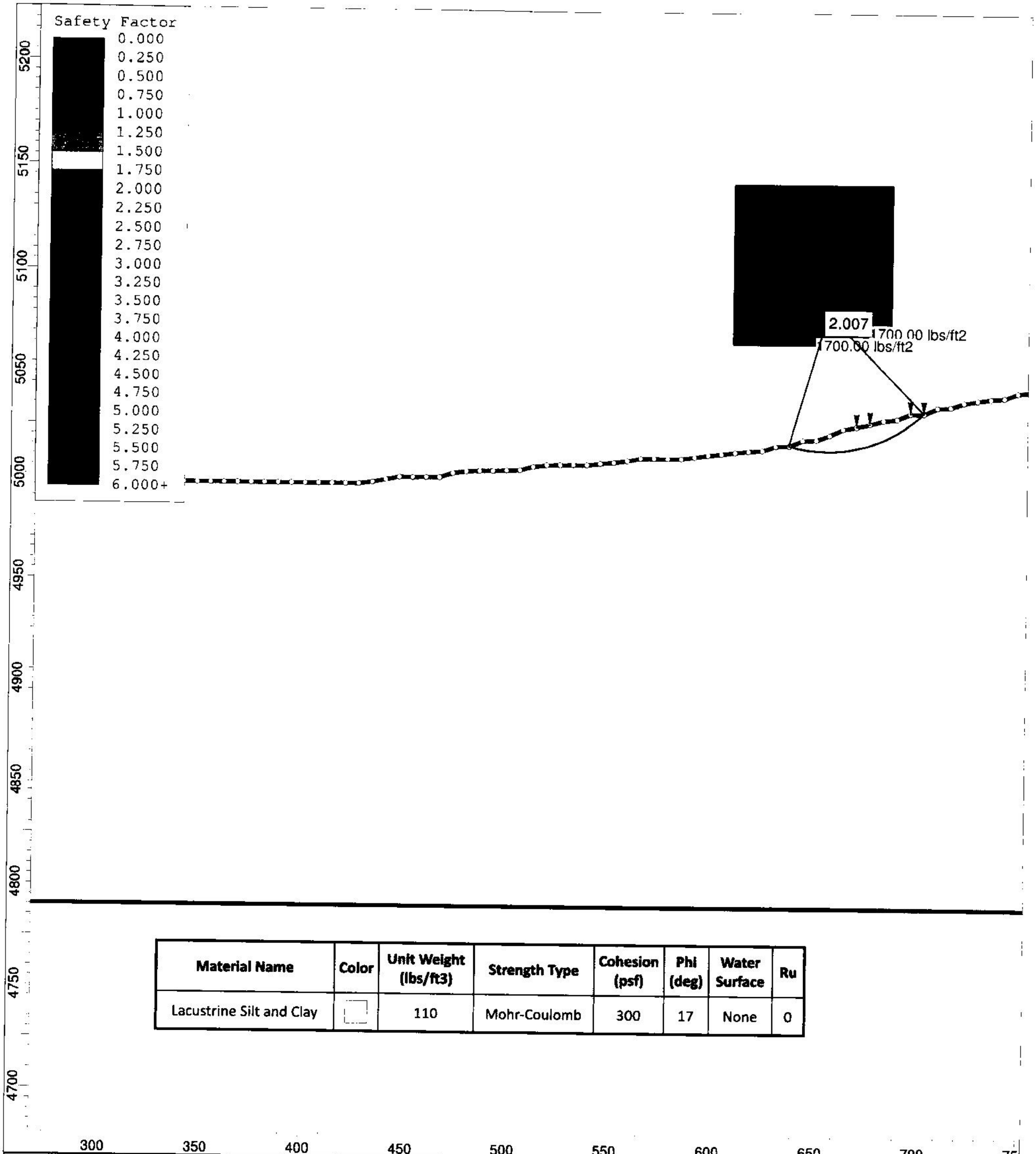
Sample Location:	TP-1 @ 11
Type of Test:	Consolidated Drained/Saturated

Test No. (Symbol)	**1 (◆)**	**2 (■)**	**3 (▲)**
Sample Type	Remolded		
Initial Height, in.	0.988	0.992	0.994
Diameter, in.	2.5	2.5	2.5
Dry Density Before, pcf	99.5	93.1	98.5
Dry Density After, pcf	101.3	94.9	100.3
Moisture % Before	24.9	29.2	24.5
Moisture % After	27.6	29.8	28.1
Saturation, % Before	99.6	99.8	95.8
Saturation, % After	115.8	106.4	114.6
Normal Load, ksf	4.0	2.0	1.0
Shear Stress, ksf	1.58	0.91	0.66
Strain Rate	0.0114 IN/MIN		

Sample Properties	
Cohesion, psf	320
Friction Angle, ϕ	17
Liquid Limit, %	46
Plasticity Index, %	26
Percent Gravel	0.0
Percent Sand	0.4
Percent Passing No. 200 sieve	99.6
Classification	Lean CLAY (CL)

PROJECT: Lot 605 Rollins Ranch

PROJECT NO.: 864-005	GeoStrata Copyright GeoStrata, 2018	**Plate C-5**



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Lacustrine Silt and Clay		110	Mohr-Coulomb	300	17	None	0

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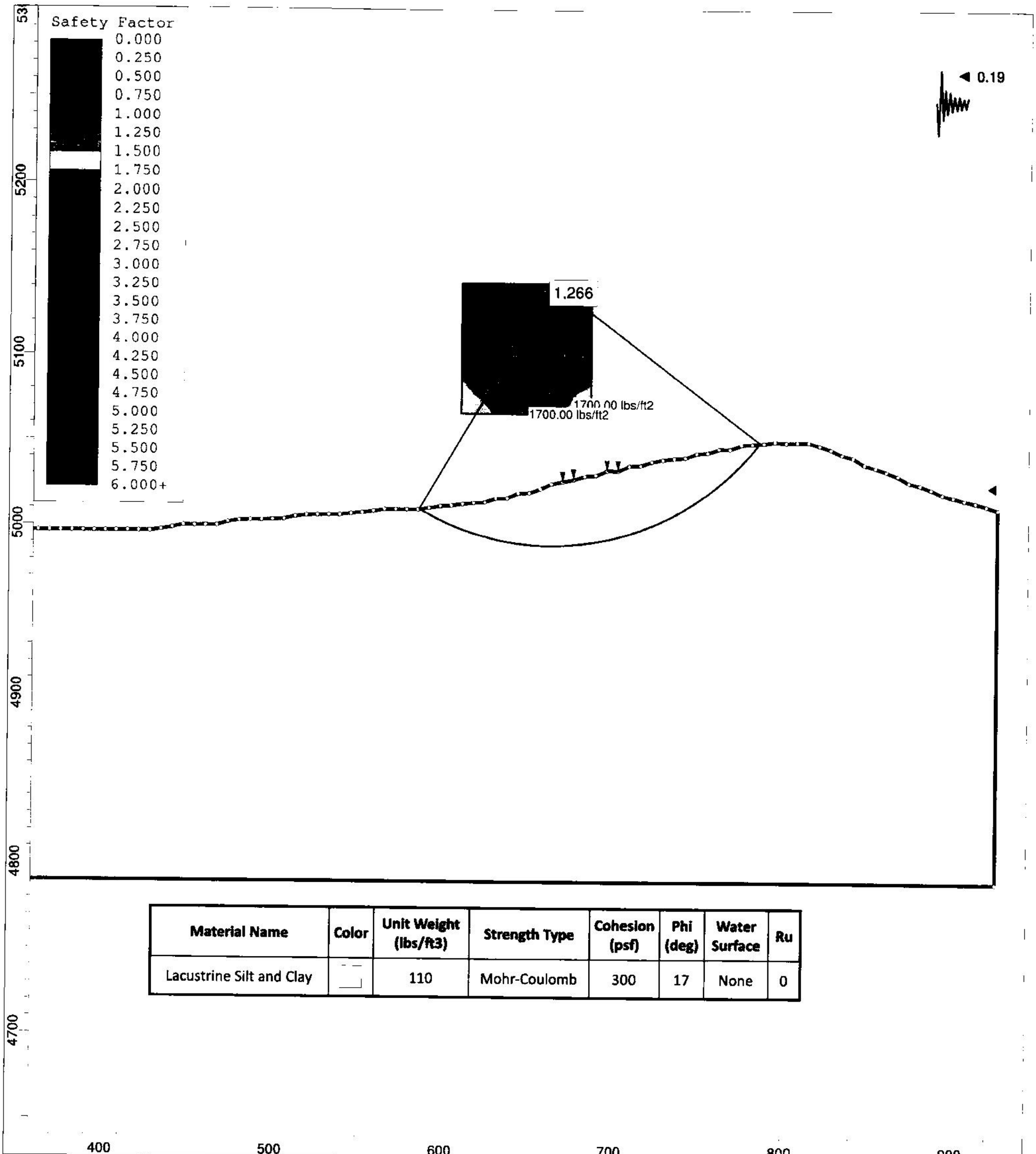
Lot 605 - Profile A Static

Pineview Builders
Rollins Ranch - Lot 605
Mountain Green, Utah
GeoStrata Project No. 864-005

Plate D-1



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Lacustrine Silt and Clay		110	Mohr-Coulomb	300	17	None	0

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Plate D-2