Geotechnical & Geoenvironmental Engineering

Investigation/Assessment through Construction/Remediation

SUBSURFACE INVESTIGATION AND FOUNDATION STUDY

PROPOSED OFFICE BUILDINGS
COTTONWOOD HEIGHTS RETIREMENT COMMUNITY
6900 SOUTH WHITEMORE WAY
COTTONWOOD HEIGHTS, UTAH

GEO Project No. K042401.1

Prepared for:

RIMROCK CONSTRUCTION
P.O. Box 618
Lehi, Utah 84043

May 22, 2001

GEO COMPANY

4767 South Ichabod Place • Salt Lake City, Utah 84117 • (801) 272-2064

GEO COMPANY
Geotechnical & Materials Engineering
Geoenvironmental Engineering

May 22, 2001

Mr. Richard White
RIMROCK CONSTRUCTION
P.O. Box 618
Lehi, Utah 84043

Subject: Subsurface Investigation and Foundation Study
Proposed Office Buildings - Cottonwood Heights Retirement Community
6900 South Whitemore Way
West Jordan, UT

GEO Project No. K042401.1

Dear Mr. White:

Enclosed is our report of a geotechnical investigation at the subject site. The study was carried out in accordance with our discussion and your authorization on April 24, 2001 and our standard procedures.

The retirement community structures may be founded on conventional spread footings on the natural GRAVELS AND SANDS at shallow depths or COMPACTED FILL if the developer chooses to limit the possibility of settlement caused by the intermediate depth soft to medium firm SILTY CLAY strata at 12 to 15 feet below grade. This strata is relatively level in actual height; the change in surface elevation accounts for variability of strata encounter. This strata is 2.5 to 6 feet thick, moist to wet and soft to medium firm. The higher moisture content is likely the result of this layer acting as a barrier to the movement of surface waters to the underlying groundwater table at about 30 feet below grade.

The footings may be founded within the upper gravels resulting in minor loading upon this silty clay if the established allow for minimum five feet from footing bottom to anticipated silty clay encounter. This distancing will minimize the loads to the silty clay and limit any settlement to acceptable limits. Elimination of the possibility of excessive settlement will require site excavation to remove this strata and replace this strata with compacted fill; the replaced gravel above the replaced silty clay will necessarily need controlled compaction.

Both exterior and interior footings should bear in this strata founded at 36 and 18 inches below grade, respectively. These penetrations will provide frost protection for exterior footings and bearing and lateral resistance for interior footings. The footings may bear at design bearing pressures of 2,500 psf for continuous wall footing and increased to 3,000 for isolated column footings founded in the in-place gravels. If the excavation and replacement option is selected, the footings may bear in compacted STRUCTURAL FILL at the same recommended bearing pressures.

4767 South Ichabod Place • Salt Lake City, Utah 84117 • Phone (801) 272-2064 • Fax (801) 278-2612 • E-mail: jconly@webguy-prod.com

Detailed recommendations and additional design and construction criteria are contained in the attached report.

The opportunity to be of service to you on this phase of the project is truly appreciated.

Sincerely,
GEO COMPANY

Jeffrey C. Olson, P.E.
Consulting Engineer

Distribution: 5 - Addressee

JCO/nf

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1.0 INTRODUCTION

The GEO Company (GEO) was been retained by Mr. Richard White to conduct a Subsurface Investigation and Foundation Study for the proposed Site on approximately 0.97 acre at 1575 West 7000 South in West Jordan, Utah.

The scope of this investigation includes:

- Field Exploration, including test borings
- Laboratory Analysis
- Engineering Analysis

2.0 ABSTRACT

The retirement community structures may be founded on conventional spread footings on the natural GRAVELS AND SANDS at shallow depths or COMPACTED FILL if the developer chooses to limit the possibility of settlement caused by the intermediate depth soft to medium firm SILTY CLAY strata at 12 to 15 feet below grade. This strata is relatively level in actual height; the change in surface elevation accounts for variability of strata encounter. This strata is 2.5 to 6 feet thick, moist to wet and soft to medium firm. The higher moisture content is likely the result of this layer acting as a barrier to the movement of surface waters to the underlying groundwater table at about 30 feet below grade.

The footings may be founded within the upper gravels resulting in minor loading upon this silty clay if the established allow for minimum five feet from footing bottom to anticipated silty clay encounter. This distancing will minimize the loads to the silty clay and limit any settlement to acceptable limits. Elimination of the possibility of excessive settlement will require site excavation to remove this strata and replace this strata with compacted fill; the replaced gravel above the replaced silty clay will necessarily need controlled compaction.

Both exterior and interior footings should bear in this strata founded at 36 and 18 inches below grade, respectively. These penetrations will provide frost protection for exterior footings and bearing and lateral resistance for interior footings. The footings may bear at design bearing pressures of 2,500 psf for continuous wall footing and increased to 3,000 for isolated column footings founded in the in-place gravels. If the excavation and replacement option is selected, the footing may bear in compacted STRUCTURAL FILL at the same recommended bearing pressures.

Slab-on-grade construction is the recommended method of construction of floor slabs.

Detailed recommendations and construction considerations are contained in the body of this report.

3.0 PURPOSE AND SCOPE OF STUDY

This report presents the results of a subsoil investigation and foundation study for a proposed development at a site located in Cottonwood Heights, Utah as shown on Figure 1, Site Vicinity Map.

WESTERN VIEW FROM 2600 EAST

The investigation was intended to determine the vertical sequence and pertinent physical and structural properties of the subsurface profile and establish groundwater conditions for formulation of recommendations relative to:

1. selection and design of a foundation system for the planned buildings,
2. groundwater control and drainage requirements,
3. earthwork operations and specifications,
4. subgrade preparations for floor slab-on-grade and pavement support, and
5. pavement design.

Our investigation has included field sampling and observations. The recovered samples have been visually inspected and submitted to various laboratory tests for evaluation of their structural and physical properties. These results and evaluations were then used in the formulation of the recommendations contained in this report.

4.0 SITE HISTORY AND PLANNED DEVELOPMENT

The site is currently unoccupied, but surrounded by a variety of construction types from residential to commercial structures. Adjacent development includes residential home and apartments to the west, retail facilities to the south and a post office to the immediate north as well as open field across 2600 East. Some native gravels and topsoil have been excavated and removed in a shallow mining operation resulting in irregular topography; limited construction dumping is also evident on the site. The site extends from 2600 East eastward to Whitemore Way, with planned future access from both Whitemore Way and 26000 East.

Two-story buildings without subgrade levels are planned for construction. We expect low to moderate foundation loads from these structures.

Current site grades will require significant earthwork to establish final site grades, increased dependent on the bearing option selected.

5.0 SITE CONDITIONS

The proposed site borders 260 East and Whitemore Way on the east and west, respectively, and slopes slightly down generally toward from the east. The Boring Location Plan includes the site topographic survey.

WESTERN VIEW SITE INTERIOR

5.1 Topography

Topography is irregular both from adaptation to adjacent development and due to the noted construction excavation. The Boring Location Plan includes the site topographic survey.

6.0 INVESTIGATION PROGRAMS

6.1 Field Exploration

Four test borings were drilled on April 30, 2001 with hollow stem augers and a conventional rotary drive mounted drill rig (see Appendix for details). The number of borings was based on relatively uniform subgrade conditions and the planned construction. The building test drilling was extended from 20.5 to 35.5 feet below current site grades based on planned construction as well as to verify depth to groundwater.

All soil samples obtained during the course of drilling operations were visually classified in the field and subsequently checked in the laboratory to identify various formations. The results of classification operations are presented on the accompanying test boring logs and the following paragraphs. Both drive and bulk samples were obtained. Details of the field drilling and sampling operations are outlined in the appendix.

6.2 Laboratory Testing

All samples which were recovered during the exploration operation were physically inspected and classified in the laboratory by the Project Engineer. The testing program consisted of the following tests: In-situ Moisture Content, Percent Fines (passing -#200 sieve), Atterberg Limits, Unconfined Compression (hand penetrometer), Moisture-Density Relationship (Proctor) and California Bearing Ratio testing .

In-situ or natural moisture content and dry density were performed to evaluate the structural state and the likelihood of the soil to swell upon change in moisture content. (See Table 1)

Grain size analyses, full gradation and percent passing No. 200 sieve, were performed to evaluate drainage characteristics and soil structure.

Atterberg limits were performed on samples to define the various stages of soil consistency. The water contents are used to define the limits where soil behaves as a viscous liquid (Liquid Limit [LL]) or where the soil breaks apart and crumbles and is no longer plastic (Plastic Limit [PL]). The difference between LL and PL is known as the Plasticity Index (PI) and is used in conjunction with the percent fines (No. 200 sieve) and percent binder (No. 40 sieve) for classification purposes. Results are presented in the attached table.

Moisture-Density Relationship (Proctor) and California Bearing Ratio tests were performed to determine roadway support characteristics and for use in pavement thickness design.

7.0 SUBSURFACE CONDITIONS

The subsurface conditions encountered at this site appear quite consistent based on exposed slopes and cuts in the area. The detailed subsurface conditions encountered in our test borings are described in the attached logs of boring and the following paragraph. The General Notes which are needed to interpret these descriptions are attached.

About 4 inches of TOPSOIL were observed at some of the test boring and excavation locations which were covered with grasses. Gravels and sands began at the surface in other locations. SANDY GRAVEL and GRAVELLY SAND was encountered near or at the surface in all locations and extended to about 8 to 15 feet below grade where either medium fir to soft SILTY CLAY was encountered which then extended 2.5 to 6.5 feet before either SANDY GRAVEL or SAND were evident to the full depth of the borings.

Groundwater was encountered at 24.5 to 30 feet below grade, again relatively level with varying depth due to surface elevation irregularities.

8.0 RECOMMENDATIONS

8.1 Structure Foundations

Based on the field and laboratory test results, the nature of the subsoil and bedrock formations and the type of planned structure, it is our opinion that the most economical and structurally-feasible foundation system for the proposed residential buildings will be a matrix of conventional spread and continuous footings founded on in-situ medium dense silty sands or compacted fill depending on building plans and layout.

The retirement community structures may be founded on conventional spread footings on the natural GRAVELS AND SANDS at shallow depths or COMPACTED FILL if the developer chooses to limit the possibility of settlement caused by the intermediate depth soft to medium firm SILTY CLAY strata at 12 to 15 feet below grade. This strata is relatively level in actual height; the change in surface elevation accounts for variability of strata encounter. This strata is 2.5 to 6 feet thick, moist to wet and soft to medium firm. The higher moisture content is likely the result of this layer acting as a barrier to the movement of surface waters to the underlying groundwater table at about 30 feet below grade.

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8.1.1 Spread Footings

Based on the available data and in compliance with the applicable data and in compliance with the applicable building codes, the recommended design parameters for footings bearing within the silty sand and gravelly fill beginning at the surface are as follows:

Maximum Allowable Bearing Pressure

1) Continuous (Wall) Footings	2,500 psf
2) Isolated Spread (Column) Footings	3,000 psf
Minimum Dead-Load Pressure	500 psf
Minimum Continuous Footing Width	12 in.
Minimum Isolated Footing Dimension	18 in.
Exterior Footing Frost Depth	30 in.
Interior Footing Embedment Depth	18 in.

Continuous (wall) footings should be designed to span 15 feet to account for local "soft" spots. Any "soft" or saturated areas observed during overlot grading or prior to footing construction should be removed or scarified, aerated and recompacted.

Recommendations for structural fill are contained in Section 8.2 of this report. All footing excavations should be observed and tested by a representative of this firm prior to placement of concrete.

8.2 Structural Fill

Any general fill or backfill should meet the requirements of our Specification for Compacted Fill Placement which is available at our office. Key points within this specification include:

1. Prior to the initiation of any earthwork operations, general clearing of building footprints should be carried out. Select topsoil, organically-rich, and other objectionable materials should be removed from the proposed area of construction.

   Careful visual control of clearing and stripping operations should be maintained to assure that all deleterious materials are removed.

   The demolished structures should be removed in their entirety; any resulting depressions or excavations may be filled with compacted site soils.

2. Subsequent to site area clearing and stripping, all structural subgrade sectors should be subjected to critical proof-rolling operations and careful visual observation of subgrade reaction.

   Any sectors which exhibit instability or excessive deflection are to be undercut to such depths as may be necessary to assure satisfactory supporting properties. These undercut areas shall then be backfilled with approved fill materials, placed and compacted under carefully-controlled procedures.

3. All those areas which are to receive structural fill are to be filled on a controlled lift-by-lift basis, employing select, clean, organically-free materials. Individual lifts are to be of maximum 8-inch loose-measure thickness. Each individual lift is to be adjusted in moisture content and systematically compacted to minimum in-place densities as tabulated in Table 3 of the recommended specification. Throughout the course of fill construction, care is to be exercised to maintain positive drainage and to prevent inundation of either the existing subgrade or new fill materials.

   Specifications should require that the resulting subgrade and fill material densities be verified by test measurements conducted by a qualified testing and inspection agency under the overview or subcontract through GEO Company.

4. Site materials are acceptable but some Import materials are anticipated on this Site. to complete final grades. Non-swell potential material should be utilized. Fill material should meet the following general soil index properties:

1) Liquid Limit:	15 to 40
2) Plasticity Index:	7 to 20
3) Percent Passing # 200 Sieve:	12 to 30
4) Swell index under 200 psf surcharge load	<1%

5. Fill material intended for use on this project should be tested and approved by the GEO prior to delivery to the site.

   Low to medium swell potential soils are suitable as fill material in areas not subject to structural loads. High to very high swell potential materials should not be used as fill material. These materials should only be used away from structures in landscape or backlot areas.

6. On-site materials are suitable for use as fill.

8.3 Floor Slabs

Design should anticipate small relative movements between the floor slab-on-grade and walls and columns. Any settlements should be uniform based on the depth of the soft SILT CLAY but not of a magnitude to impact slag-on-grade construction. Slab on-grade construction is feasible and recommended on these soils. However, we recommend a 4-inch thickness of free-draining gravel be placed below the slab to preclude build-up of miscellaneous moisture below the slabs. Maximum slab settlement should be limited to 1 inch with maximum differential settlement of 1/2 inch. Excessive settlement or slab heaves are not anticipated if standard construction procedures are followed.

The following precautions are recommended in the use of slab-on-grade construction:

1. The on-site granular material will provide acceptable slab support, providing they are compacted in accordance with project specifications and they are not contaminated with fine-grained soils.

2. The slabs should be separated from exterior walls and interior bearing members. **Vertical movement** of the slabs should **not** be **restricted**.

3. If feasible, exterior slabs should be separated from the building; these slabs should be reinforced to function as independent units. Movement of these slabs should not be transmitted to the foundation of the structure.

   If practical considerations require that some connection be made, control joints should be used to locate the cracking which may occur.

4. Frequent control joints should be provided to reduce the problems associated with shrinkage. These control joints will also act to "absorb" or centralize small slab movements. Joints should be provided around columns and at a maximum of every 20 feet on centers in each direction.

5. Subgrade surfaces should be compacted in accordance with Table 1 of Appendix III. A footed compactor followed by a smooth drum roller for final grading is recommended to compact this on-site material.

8.4 Drainage

8.4.1 Surface Drainage

Performance of foundations and slabs is influenced by the moisture conditions existing within the foundation and subgrade soils. Surface drainage should be designed to provide for rapid runoff of surface water away from the building foundation. We recommend the following precautions be observed during construction and be maintained at all times after construction is completed.

1. Excessive wetting or drying of the open foundation excavations should be avoided as much as possible during construction.

2. The ground surface surrounding the exterior of the building should be sloped to drain away from the building in all directions. We recommend a minimum slope of at least 12 inches in the first 10 feet.

3. Backfill around foundations should be moistened and compacted.

4. Roof downspouts and drains should discharge well beyond the limits of all backfill.

5. Any landscaping which requires considerable watering and lawn sprinkler heads should be located at least 10 feet from foundation walls of the building.

   Trickler or bubbler type irrigation systems are not recommended.

8.4.2 Subsurface Drainage

No subsurface drainage requirements are anticipated within the proposed construction.

9.0 DESIGN AND CONSTRUCTION CONSIDERATIONS

9.1 Cement Type

We expect a negligible relative degree of sulfate attack on concrete in contact with these soils. Use of concrete which uses a Type I cement is adequate.

9.2 Lateral Earth Pressures

No subgrade construction is currently planned within present plans. The GEO Company should be contacted for appropriate recommendations if subgrade construction (basement) is added.

9.3 Floor Slabs

As noted above, a layer of free-draining material is recommended.

9.4 Pavement Areas

Areas where pavement is likely should be prepared in much the same way as the floor slabs. The native coarse-grained soils should be compacted as noted above a near optimum moisture content. These soils exhibited high strength; CBR testing indicated a CBR value of 23.5 at .1" penetration. A pavement section of 2.5 inches of hot bituminous asphalt over 6 inches of base course should provide support for all anticipated traffic within residential development. This section should be increased to 3 inches of asphalt over 6 inches of base course in any high truck traffic areas.

9.5 Geoseismic Considerations

The Site in question lies within the Uniform Building Code (UBC) zone 3. In review of geologic maps of the region, no known faults exist within the immediate Site area. Estimated horizontal accelerations for a 100 year time period are listed below for the Site area.

Exceedance Probability	50%	10%	5%
Maximum Ground Acceleration (g)	0.06%	0.17%	0.22%

9.6 Foundation Excavations

All foundation excavations should be protected against detrimental change in conditions such as disturbance, rain and freezing. Surface runoff should be directed away from the excavation and not be allowed to pond. If possible, all footing concrete should be poured the same day as the excavation is made. If this is not practical, the footing excavation should be adequately protected from freezing temperatures and any anticipated heavy rainfall. All footing excavations should be inspected by the GEO Company prior to construction to verify bearing strata and condition.

9.7 Temporary Excavation Slopes

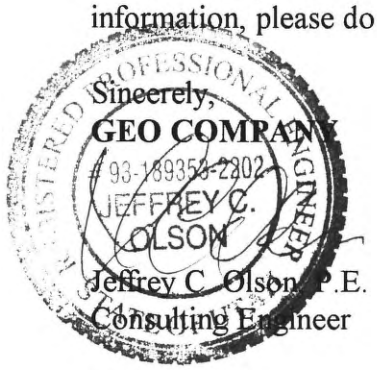
Temporary construction excavations or stockpiles greater than 4 feet in height should be shored or sloped. Furthermore, no heavy surcharge loads (stockpiles, construction equipment, etc.) should be placed within 10 feet of the top of any excavation slopes. If any signs of instability are noted, immediate remedial action must be initiated.

10.0 CLOSURE

The recommendations provided herein were developed from the information obtained from the soil test borings that reflect the subsurface conditions only at the specific locations and at the particular time designated. Soil and groundwater conditions may differ from conditions occurring at the test boring locations. The nature and extent of any variation from the test borings may not become evident until during the course of construction. If variations do appear, it may become necessary to reevaluate the recommendations of this report after we have observed the variation.

These professional services have been performed, findings obtained and recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices in this area at the time of execution. This warranty is in lieu of all other warranties either expressed or implied. Anyone using this report for bidding or construction purposes should perform such independent investigation as they deem necessary to satisfy themselves as to the surface conditions to be encountered and the procedures to be used in the performance of this project.

It has been a pleasure to serve you on this project. If you have any questions, or require additional information, please do not hesitate to contact me.



Sincerely,
GEO COMPANY

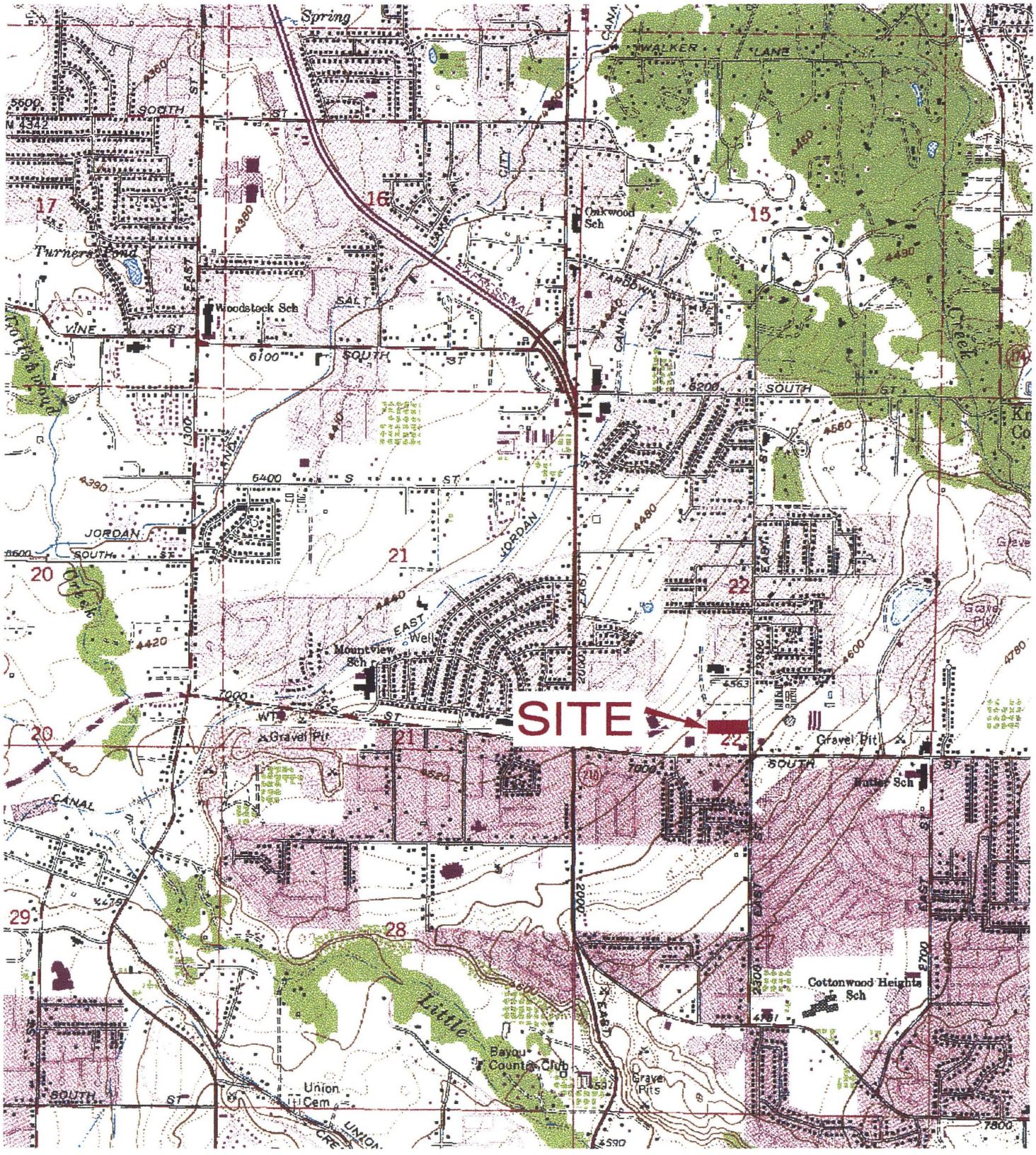
Jeffrey C. Olson, P.E.
Consulting Engineer

JCO/nf

APPENDIX I

Field Exploration Program

- Site Vicinity Map & Topographic Survey
- Test Boring Location Plan
- Drilling and Sampling Procedures
- Test Boring Logs
- General Notes



NOTES:
1: BASE MAP SOURCE: U.S.G.S SUGAR HOUSE AND DRAPER, 7.5 MINUTE QUADRANGLE DRGS

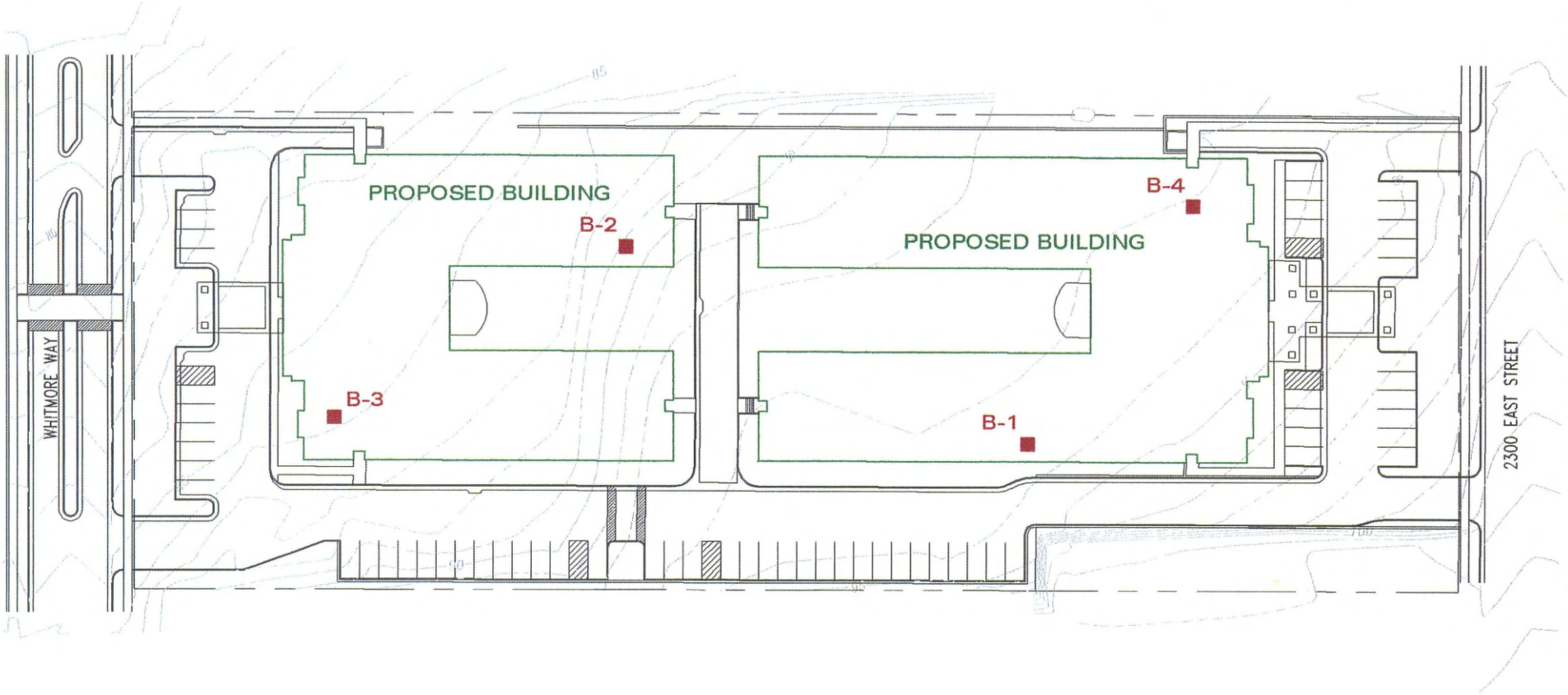
N

2000 FEET
1 INCH = 2000 FEET
APPROXIMATE SCALE

GEO COMPANY
4767 SOUTH ICHABOD PLACE
SALT LAKE CITY, UTAH 84117

FIGURE 1
SITE LOCATION PLAN
COTTONWOOD HEIGHTS RETIREMENT COMMUNITY
6900 SOUTH WHITMORE WAY
SALT LAKE CITY, UTAH

PROJECT: K042401.1	MAY 01	GEO-110



LEGEND

B-1 BORING LOCATION

N

75 FEET
1 INCH = 75 FEET
APPROXIMATE SCALE

BASE MAP SOURCE: McNEIL ENGINEERING AND LAND SURVEYING, L.C.

GEO COMPANY
4767 SOUTH ICHABOD PLACE
SALT LAKE CITY, UTAH 84117

FIGURE 2
BORING LOCATION PLAN
COTTONWOOD HEIGHTS RETIREMENT COMMUNITY
6900 SOUTH WHITMORE WAY
SALT LAKE CITY, UTAH

PROJECT: K042401.1	MAY 01	GEO-110

Drilling and Sampling Procedures

The test holes were drilled by conventional rotary-drive drilling procedures, employing solid-stem continuous flight augers.

Variations of soil and groundwater conditions encountered during the boring operations were noted and representative samples of the existing subsoils were taken at intervals by means of a 2-inch i.d. California-spoon sampling device driven by a 140-pound hammer, free-falling through a distance of 30 inches. The number of hammer blows required to achieve 12 inches of sample spoon penetration, after an initial seating penetration, was noted and is recorded in 6-inch increments under "Resist" on the accompanying Boring Logs.

The sum of the blow counts associated with the second and third 6-inch penetration intervals is similar to the Standard Penetration Test, which is described in ASTM Designation D-1586-87 (Reapproved 1974). The resistance of the last foot is known as the "Standard Penetration Resistance" and as the "N" value. The Penetration Test, when properly evaluated, is an index to the soil strength and density. The Penetration Test results are indicated on the Boring Logs.

The samples of the materials obtained as a result of drive sampling and hand auger operations were removed from the sampler, visually classified and placed in properly-identified, sealed brass liners, plastic bags or glass sample jars. The subsoil material samples were then removed to our Salt Lake City soil mechanics laboratory for evaluation.

PROJECT NAME: COTTONWOOD HEIGHTS RETIREMENT COMMUNITY DATE: April 30, 2001

PROJECT LOCATION: 6900 South Whitemore Way, Cottonwood Heights, UT PROJECT NUMBER: K042401.1

SURFACE ELEVATION: _____ ELEVATION DATUM: _____ RIG TYPE: Mobile B-60

GEOLOGIST: Jeff Olson, P.E. DRILLING METHOD: Hollow Stem Auger HOLE DIAMETER: 8"

DRILLER: Interstate

SOIL DESCRIPTION	USCS	GRAPHICAL LOG	DEPTH (FEET)	SAMPLE (TYPE & NO)	RECOVERY (in.) DRIVEN (in.)	RESISTANCE	OVM (ppm)	WATER LEVEL	REMARKS
SAND, medium to coarse-grained, and GRAVEL, medium-grained, medium dense to dense, brown and gray, dry									
SAND, medium-grained, and GRAVEL, gray and brown, moist	GP			SPT 1		11-25 40			
SAND, medium to coarse-grained with some gravel, brown, moist	SP		10	SPT 2		12-23 28			
SAND, medium-grained, some silt, dense, brown, moist trace silt	SM			SPT 3		12-15 17			
SAND, fine-grained, with SILTY CLAY interlayered, brown and gray, wet	SC		20	SPT 4		5-25 28			
SAND, medium-grained, dense, gray, moist to wet	SP								
SAND, coarse-grained, dense, brown, wet	SP								Groundwater enters
BORING TERMINATED AT 25.5' GROUNDWATER ENTERS AT 24.5'			30 40						

SUMMARY OF SUBSURFACE CONDITIONS: This log is part of the report prepared by GEO COMPANY for this project and should be read as part of the report. Subsurface conditions described in this log may change at this location with the passage of time. The data presented are a simplification of conditions encountered.

GROUNDWATER

	DEPTH	HOUR	DATE
▽			
▼			
▽			

SAMPLER TYPE

AC - Auger Cuttings: 1.5' - 4.5'

CA - California Sampler: _____

SS - Split-Spoon Sampler: 1.4" ID, 2.4" OD

ST - Shelby Tube Sampler: _____

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GEOTECHNICAL & ENVIRONMENTAL ENGINEERING

SHEET 1 of 1

BORING #	FIG. #
B-1	

PROJECT NAME: COTTONWOOD HEIGHTS RETIREMENT COMMUNITY DATE: April 30, 2001

PROJECT LOCATION: 6900 South Whitemore Way, Cottonwood Heights, UT PROJECT NUMBER: K042401.1

SURFACE ELEVATION: _____ ELEVATION DATUM: _____ RIG TYPE: Mobile B-60

GEOLOGIST: Jeff Olson, P.E. DRILLING METHOD: Hollow Stem Auger HOLE DIAMETER: 8"

DRILLER: Interstate

SOIL DESCRIPTION	USCS	GRAPHICAL LOG	DEPTH (FEET)	SAMPLE (TYPE & NO)	RECOVERY (in.) DRIVEN (in.)	RESISTANCE	OVM (ppm)	WATER LEVEL	REMARKS
TOPSOIL, brown, weedy	TS								
GRAVEL, fine-grained, some SAND, medium to coarse-grained, loose, brown, dry	GP			SPT 1		2-3 4			
SAND and GRAVEL, dense to very dense, gray, dry QUARTZITE seam @ 4'				SPT 2		12-19 20			
	GP		10	SPT 3		39-50/5"			
SILTY CLAY, soft to very soft, gray brown, very moist	CL			CA 4		12-2 1			
SAND, medium-grained, dense to very dense, gray brown, moist	SM		20	SPT 5		11-20 37			
GRAVEL, gray, some sand, dense, moist	GP			SPT 6		11-19 22			
SAND, medium-grained, gray, dense, moist	SM		30	SPT 7		10-16 21			Groundwater enters
				SPT 8		24-31 26			
BORING TERMINATED AT 35.5' GROUNDWATER ENTERS AT 30'			40						

SUMMARY OF SUBSURFACE CONDITIONS: This log is part of the report prepared by GEO COMPANY for this project and should be read as part of the report. Subsurface conditions described in this log may change at this location with the passage of time. The data presented are a simplification of conditions encountered.

GROUNDWATER

	DEPTH	HOUR	DATE
▽			
▼			
▽			

SAMPLER TYPE

AC - Auger Cuttings: 2' - 5'

CA - California Sampler: 2" ID, 3.4" OD

SS - Split-Spoon Sampler: 1.4" ID, 2.4" OD

ST - Shelby Tube Sampler: _____

GEO COMPANY

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING

SHEET 1 of 1

BORING #	FIG. #
B-2	1

PROJECT NAME: COTTONWOOD HEIGHTS RETIREMENT COMMUNITY DATE: April 30, 2001

PROJECT LOCATION: 6900 South Whitemore Way, Cottonwood Heights, UT PROJECT NUMBER: K042401.1

SURFACE ELEVATION: _____ ELEVATION DATUM: _____ RIG TYPE: Mobile B-60

GEOLOGIST: Jeff Olson, P.E. DRILLING METHOD: Hollow Stem Auger HOLE DIAMETER: 8"

DRILLER: Interstate

SOIL DESCRIPTION	USCS	GRAPHICAL LOG	DEPTH (FEET)	SAMPLE (TYPE & NO)	RECOVERY (in.) DRIVEN (in.)	RESISTANCE	OVM (ppm)	WATER LEVEL	REMARKS
TOPSOIL - Clayey Sand, grass/weeds soft to medium, moist	TS								
SAND, medium to coarse-grained and GRAVEL, gray-brown, moist	GP								
GRAVEL, sandy, gray, very dense, dry	GW		10	SPT 1		20-32 50/3"			
SILTY CLAY, medium firm, gray-brown, moist becoming soft to very soft	CL			CA 2		1-1 1			
SAND, medium dense, gray, moist	SP		20	SPT 3		8-8 9			
BORING TERMINATED AT 20.5' GROUNDWATER NOT ENCOUNTERED			30						
			40						

SUMMARY OF SUBSURFACE CONDITIONS: This log is part of the report prepared by GEO COMPANY for this project and should be read as part of the report. Subsurface conditions described in this log may change at this location with the passage of time. The data presented are a simplification of conditions encountered.

GROUNDWATER

	DEPTH	HOUR	DATE
▽			
▼			
▽			

SAMPLER TYPE

AC - Auger Cuttings: _____

CA - California Sampler: 2" ID, 3.4" OD

SS - Split-Spoon Sampler: 1.4" ID, 2.4" OD

ST - Shelby Tube Sampler: _____

GEO COMPANY

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING

SHEET 1 of 1

BORING #	FIG. #
B-3	1

PROJECT NAME: COTTONWOOD HEIGHTS RETIREMENT COMMUNITY DATE: April 30, 2001

PROJECT LOCATION: 6900 South Whitemore Way, Cottonwood Heights, UT PROJECT NUMBER: K042401.1

SURFACE ELEVATION: _____ ELEVATION DATUM: _____ RIG TYPE: Mobile B-60

GEOLOGIST: Jeff Olson, P.E. DRILLING METHOD: Hollow Stem Auger HOLE DIAMETER: 8"

DRILLER: Interstate

SOIL DESCRIPTION	USCS	GRAPHICAL LOG	DEPTH (FEET)	SAMPLE (TYPE & NO)	RECOVERY (in.) DRIVEN (in.)	RESISTANCE	OVM (ppm)	WATER LEVEL	REMARKS
TOPSOIL, silty sand, weeds	TS								
SAND, medium to coarse-grained, and GRAVEL, trace to some silt, brown, moist	SP			SPT 1		9-12 15			
GRAVEL, extremely dense, brown, dry	GP								
			10	SPT 2		23-50/5"			
SAND, coarse to medium-grained, and GRAVEL, very dense, gray-brown, moist	SP								
				SPT 3		24-14 4			
SILTY CLAY, medium firm to soft, brown, moist to wet	CL								
SAND, some silt, dense, moist	SM								
			20	SPT 4		12-20 26			
BORING TERMINATED AT 20.5' GROUNDWTER NOT ENCOUNTERED									
			30						
			40						

SUMMARY OF SUBSURFACE CONDITIONS: This log is part of the report prepared by GEO COMPANY for this project and should be read as part of the report. Subsurface conditions described in this log may change at this location with the passage of time. The data presented are a simplification of conditions encountered.

GROUNDWATER

	DEPTH	HOUR	DATE
▽			
▼			
▽			

SAMPLER TYPE

AC - Auger Cuttings: _____

CA - California Sampler: 2" ID, 3.4" OD

SS - Split-Spoon Sampler: 1.4" ID, 2.4" OD

ST - Shelby Tube Sampler: _____

GEO COMPANY

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING

SHEET 1 of 1

BORING #	FIG. #
B-4	1

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS

CA	California Sampler	VS	Vane Shear
SS	Split Spoon – 1⅜" I D 2 O D unless otherwise noted	OS	Osterberg Sampler – 3" Shelby Tube
		HS	Hollow Stem Auger
ST	Shelby Tube – 2" O D unless otherwise noted	WS	Wash Sample
PA	Power Auger	FT	Fish Tail
DB	Diamond Bit – NX,BX AX	RB	Rock Bit
AS	Auger Sample	BS	Bulk Sample
JS	Jar Sample	PM	Pressuremeter test-in situ

Standard "N" Penetration Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch O D split spoon, except where noted

WATER LEVEL MEASUREMENT SYMBOLS

WL	Water Level
WCI	Wet Cave In
DCI	Dry Cave In
WS	While Sampling
WD	While Drilling
BCR	Before Casing Removal
ACR	After Casing Removal
AB	After Boring

MOISTURE CONTENT VISUAL DESCRIPTION

Dry	Below Plastic Limit
Slightly Damp	Difficult to Mold
Damp	Below Optimum Moisture Content
Moist	At Optimum Moisture Content
Wet	Above Optimum Moisture Content
Saturated	Fluid

Water levels indicated on the boring logs are the levels measured in the boring at the times indicated In pervious soils, the indicated elevations are considered reliable ground water levels In impervious soils the accurate determination of ground water elevations is not possible in even several days observation, and additional evidence of ground water elevations must be sought

GRADATION DESCRIPTION & TERMINOLOGY

Coarse Grained or Granular soils have more than 50% of their dry weight retained on a #200 sieve they are described as boulders, cobbles gravel or sand Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve, they are described as clays or clayey silts if they are cohesive, and silts if they are non-cohesive In addition to gradation, granular soils are defined on the basis of their relative in-place density and fine grained soils on the basis of their strength or consistency, and their plasticity

Major Component Of Sample	Size Range	Descriptive Terms Of Components Also Present in Sample	Percent of Dry Weight Coarse	Fine
Boulders	Over 8 in (200mm)	Trace	1 - 9	0 - 5
Cobbles	8 in to 3 in (200mm to 75mm)	Little	10 - 19	
Gravel	3 in to #4 sieve (75mm to 2mm)	Some	20 - 29	6 - 12
Sand	#4 to #200 sieve (2mm to 0 074mm)	(*component*)-y	30 - 44	13 - 44
Silt	Passing #200 sieve (0 074mm to 0 005mm)	And	45 - 50	45 - 50
Clay	Smaller than 0 005mm			

CONSISTENCY OF COHESIVE SOILS

Unconfined Comp. Strength, Qu, tsf	Consistency
<0.25	Very Soft
0 25 – 0 49	Soft
0 50 – 0 99	Medium (Firm)
1 00 – 1 99	Stiff
2 00 – 3.99	Very Stiff
4.00 – 8 00	Hard
>8 00	Very Hard

RELATIVE DENSITY OF GRANULAR SOILS

N – Blows/ft	Relative Density
0 - 3	Very Loose
4 - 9	Loose
10 - 29	Medium Dense
30 - 49	Dense
50 - 80	Very Dense
80 +	Extremely Dense

Qp = Unconfined compressive strength in tons per square foot (TSF) obtained with calibrated penetrometer

APPENDIX II

Laboratory Test Results

COARSE / FINE SIEVE ANALYSIS

ASTM D422, C136
AASHTO T27

Project Name	: Cottonwood Rec. Center	Client :	Geo Company	Date	05-08-2001
Project No.	: 2600/#650	Segment No. :		Contractor :	
Sample Location	: Cottonwood Rec	Sample Source :	Existing	W.O. No.	: 001-5105
Sample Description	:				
Ref. Specification	:			Class :	
Station No.:	, Starting , Ending		Ref. Line :	Category No.:	
Offset Limit:	, Starting , Ending		Elevation :	Activity No. :	

Dry Sample Wt., (g)	a	43500	Weight Before Washing, (g)	c	1137.5
Wet Sample Wt. (g)	b		Weight after Washing, (g)	d	872.1
% Moisture	100*(b-a)/a	-100.0	Loss from washing(-#200), (g)	c - d	265.4

Coarse

Sieve Size	Weight Ret., (g)	Percent Ret., (g)	Total, % Passing	Specification
4 (100mm)	0		100.0	
3 (75mm)	0		100.0	
2 1/2 (62.5mm)	0		100.0	
2 (50mm)	0		100.0	
1 1/2 (37.5mm)	900	2.1	97.9	
1 (25mm)	2000	4.6	93.3	
3/4 (19mm)	2050	4.7	88.6	
1/2 (12.5mm)	4200	9.7	78.9	
3/8 (9.5mm)	2850	6.6	72.3	
#4 (4.75mm)	6150	14.2	58.1	
Pan	25300	58.2		
Total	43450.0			

Fine

Sieve Size	Weight Ret., (g)	Percent Ret., (g)	Total,% Pass#4 (4.75mm)	Total, % Passing	Specification
#10 (2mm)	338.8	29.8	17.5	40.8	
#40 (0.425mm)	342.6	30.1	17.5	23.3	
#200 (0.075mm)	183.8	16.2	9.4	13.9	
Pan dry	6.4	0.6	0.3		
Pan wash	265.4	23.3	13.5		
Total	1137.0				

Remarks _____

Technician's Signature

Supervisor's Signature

ASTM D 4718 Worksheet

AASHTO T 224 - Correction for Coarse Particles (19.0 mm, 3/4" screen) in Soil Compaction Test

Project Name: Cottonwood Rec Center | **Client** Geo Company
Project Number: 2600/8650 | **W.O.** 001-5105
Sample Source: Existing
Sample Date: 5/8/01
I and Rock to 3" P-154 Material, Dark Brown Silty Sand With Gravel and Rock to 3"

Adjusted Maximum Dry Density, D (english)

Empirical

$$D = (1.00 - P_c)D_f + 0.9P_cD_c$$

More Exact

$$D = \frac{62.4}{\frac{P_c}{G_m} + \frac{62.4\,(P_f)}{r\,(D_f)}}$$

Where:

D =	adjusted maximum dry density	
P_c =	% Rock Retained on 3/4" screen, decimal (ASTM D 422 & C 136, AASHTO T 27)	0.114
P_f =	% Rock Passing 3/4" screen, decimal (ASTM D 422 & C 136, AASHTO T 27)	0.886
D_f =	Maximum Dry Density pcf (ASTM D 698 & D 1557 AASHTO T 99 & T 180)	139.3
G_m =	Bulk specific gravity (oven dry basis) (ASTM C 127 & C 128, AASHTO T 84 & T 85)	2.606
D_c =	Bulk specific gravity (oven dry basis) x 62.4	162.6
r =	Coefficient dependent on P_c, See following Table	1.00

r	P_c
1	0.20 or less
0.99	0.21 - 0.25
0.98	0.26 - 0.30
0.97	0.31 - 0.35
0.96	0.36 - 0.40
0.95	0.41 - 0.45
0.94	0.46 - 0.50
0.92	0.51 - 0.55
0.89	0.56 - 0.60
0.86	0.61 - 0.65
0.83	0.66 - 0.70

	Empirical	More Exact
Rock Adjusted Density (based on material passing 19.0-mm, 3/4"), D =	**140.1**	**141.6**

Enter DATA into BLUE cells only

ASTM D 4718 - Correction of Unit Weight and Water Content for Soil Containing Oversize Particles

Project Name	**Cottonwood Rec Center**	**Client**	**Geo Company**
Project Number	**2600/8650**	**W.O.**	**001-5105**
Sample Source	**Existing**		
Sample Date	**5/8/01**		

Sample Desc.: P-154 Material, Dark Brown Silty Sand With Gravel and Rock to 3"

Corrected unit dry weight of total material, $C\delta_D$

$$C\delta_D = \frac{100 D_f G_m 62.4}{(D_f P_c + G_m P_f 62.4)}$$

Corrected water content, C_w

$$C_w = (w_f P_f + w_c P_c)$$

Where:

$C\delta_D$ =	corrected unit dry weight, pcf	
P_c =	% Rock Retained on 3/4" screen, % (ASTM D 422 & C 136; AASHTO T 27)	11.4
P_f =	% Rock Passing 3/4" screen, % (ASTM D 422 & C 136; AASHTO T 27)	88.6
D_f =	Maximum Dry Density, pcf (ASTM D 698 & D 1557; AASHTO T 99 & T 180)	139.3
G_m =	Bulk specific gravity (oven dry basis) (ASTM C 127 & C 128; AASHTO T 84 & T 85)	2.606
D_c =	Bulk specific gravity (oven dry basis) x 62.4	162.61
δ_w =	Unit weight of water, pcf	62.40
C_w =	corrected water content, %	
w_f =	Water content of finer fraction, decimal	0.05
w_c =	Water content of oversize fraction, decimal	0.01

Rock Corrected Density (based on material passing 19.0-mm, 3/4"), $C\delta_D$ = 141.6

Rock Corrected Water Content (based on material passing 19.0-mm, 3/4"), C_w = 4.6

Aggregate Specific Gravity and Water Absorption
ASTM C127, C128
AASHTO T84-T85

Project Name	: Cottonwood Rec Center	Client :	Geo Company	Date	: 05-08-2001
Project No.	: 2600/8650	Segment No. :		Contractor :	
Sample Location	: Cottonwood Rec	Sample Source :	Existing	W.O. No.	: 001-5105
Sample Description					
Ref. Specification					
Station No.:	, Starting , Ending		Ref. Line :		Category No.:
Offset Limit:	, Starting , Ending		Elevation :		Activity No. :

		Coarse Aggregate
Weight of Oven Dry Sample in Air, g	A	4922.1
Weight of SSD Sample in Air ,g	B	4957.9
Weight of Sample in Water, g	C	3069.0
Bulk Specific Gravity, Gb (dry)	A / (B-C)	2.606
Bulk Specific Gravity , Gb (SSD)	B / (B-C)	2.625
Apparent Specific Gravity, Gb (Apparent)	A / (A - C)	2.656
Water Absorption, Wba %	100*(B - A) / A	0.728

		Fine Aggregate
Weight of Oven Dry Sample in Air, g	A	
Weight of SSD Sample in Air, g	S	
Weight of Calibrated Pyc. Filled with Water, g	B	
Weight of Pyc. with Sample and Water , g	C	
Bulk Specific Gravity, Gb (Dry)	A / (B + S - C)	
Bulk Specific Gravity , Gb (SSD)	S / (B + S - C)	
Apparent Specific Gravity, Gb (Apparent)	A / (A + B - C)	
Water Absorption, Wba %	100*(S - A) / A	

		Moisture	
Aggregate		Coarse	Fine
Weight of Original Sample, (g)	X		
Weight of Dried Sample, (g)	Y		
Aggregate Moisture, %	(X-Y)*100/Y-Wba		

Remarks :

Technician's Signature

Supervisor's Signature

COMPACTION TEST

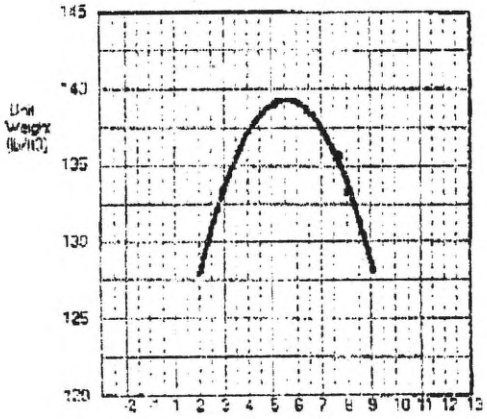
Project Name	: Cottonwood Rec Center	Client :	GEO Company	Date	: 05-08-2002
Project No.	: 2600/8650	Segment No. :		Contractor :	
Sample Location	: Cottonwood Rec	Sample Source :	Existing	W.O. No.	: 001-5105
Sample Description	:				
Ref. Specification	:	Proctor Type :	Mechanic	☐ AASHTO T99	
		Method :	D	☐ AASHTO T180	
Sample Mold Size, d, (in)	: 6	Soil Classification :		☐ ASTM D698	
Sample Mold Volume, V, (ft3)	: 0.075	Soil Specific Graviy :		☒ ASTM D1557	
Station No.:	, Starting Ending	Ref. Line :		Category No.:	
Offset Limit:	, Starting Ending	Elevation :		Activity No. :	

Wet Unit Weight

		1	2	3	4	5	6
Sample ID							
Estimated Water Content, %	W	2	4	6	8		
Weight Of Mold+Soil, (g)	W_2	10240.9	10535.1	10539.3	10473.9		
Weight Of Mold, (g)	W_1	5591.5	5591.5	5591.5	5591.5		
Weight Of Wet Soil, (g)	$W_t=W_2-W_1$	4649.4	4943.6	4947.8	4882.4		
Wet Unit Weight, (lb/ft3)	$W_{uw}=W_t/V$	136.7	145.3	145.4	143.5		

Dry Unit Weight

		1	2	3	4	5	6
Container No.		B1	A	J1	4		
Weight Wet Soil+Tare, (g)	W_W	984.8	1244.3	1690.6	1428.6		
Weight Dry Soil+Tare, (g)	WD	966.7	1200.6	1593.6	1345.4		
Weight Of Tare, (g)	W_T	242.1	244.1	242.5	254.6		
Weight Of Dry Soil, (g)	$W_S=W_D-W_T$	724.6	956.5	1351.1	1090.8		
Weight Of Water, (g)	$W_w=W_W-W_D$	18.1	43.7	97.0	83.2		
Water Content, (%)	$W_c=100*W_w/W_S$	2.5	4.6	7.2	7.6		
Dry Unit Weight, (lb/ft3)	$W_{dw}=W_t/(1+W_c)$	133.4	139.0	135.7	133.2		



Curve No :

	Actual	Specification
Liquid Limit		
Plastic Limit		
Plasticity Index		

Optimum Moisture Content, (%) : 5.1

Maximum Dry Density, (lb/ft3) : 139.3

Remarks

45-D-T99
7/20/9" Revision : 1

Tested by

Supervisor's Signature

12/31/97

ATSER
Advanced Technology Science Engineering Research

439 West Paro Drive
Salt Lake City, Utah 84123

(801) 263-9666
Fax (801) 263-9639

May 22, 2001

Job No.: 04-01-21034

Jeffrey C. Olsen, P.E.
GEO COMPANY
4767 South Ichabod Place
Salt Lake City, Utah 84117

Subject: California Bearing Ratio

Dear Mr. Olsen,

We are pleased to submit the results of the material you submitted for CBR testing.

TEST RESULTS:

Project Name: 2600/8650 Cottonwood Rec Center

Proctor Value (ASTM D 1557) Maximum Dry Density 139.3 pcf @ 5.1%

Sample Preparation: Material was placed in mold at approximately 95% of Maximum Dry Density and optimum moisture. Sample was then soaked for 96 hours and then tested

Bearing Ratio @ 0.1": 23.5%

Thank you for allowing ATSER to serve you. If we can be of further assistance, please contact us at your convenience.

Respectfully,

Randy Jackovich
Laboratory Manager

Eric A. Boone, P.E.
Geotechnical Engineer

RJ/EAB: E:\Admin\Rjackovich\Forms\cbrreport.doc

APPENDIX III

Compaction Criteria

Table I
COMPACTION CRITERIA

Non-Expansive Materials

Area	Compaction*	Moisture Content*
1) Below spread footings, floor labs and other structural support areas	minimum 95%	± 3 percent of Optimum Moisture content (OMC)
2) Driveways and Parking Lots	minimum 95%	± 3 percent of OMC
3) Landscape areas around the structures	minimum 90%	± 3 percent of OMC
4) Landscape areas	minimum 85%	± 3 percent of OMC

* Modified Proctor Test (ASTM D-1557)

Low to Medium Expansive Materials

Area	Compaction**	Moisture Content**
1) Below spread footings, floor slabs and other structural support areas	Not recommended	Not recommended
2) Driveways and parking lots (to a depth of 3 feet below proposed grade)	minimum 95%	1 percent point below to 3 percent above OMC
3) Landscape areas around the structures	minimum 90%	1 percent below to 3 percent above OMC
4) Landscape areas	minimum 85%	3 percent below to 3 percent above OMC

** Standard Proctor Test (ASTM D-698)
Alternatively, Modified Proctor Test with recommended compaction decreased by 5%