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Page 1 of 17
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Brenda Lex
3305 NE 62nd ave
Portland OR 97213

***DOCUMENT TITLE(S)***

Geo tech report

***REFERENCE NUMBER(S)*** *of Documents assigned or released:*

2008169127

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Brenda F Lex

[ ] Additional names on page _____ of document.

***LEGAL DESCRIPTION*** *(Abbreviated: i.e. Lot, Block, Plat or Section, Township, Range, Quarter):*

342 Agate Lane - Crestview lot 4 - Washougal Wa.

[ ] Complete legal on page _____ of document.

***TAX PARCEL NUMBER(S):***

[ ] Additional parcel numbers on page _____ of document.

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March 6, 2008

Mrs. Brenda Lex
3305 NE 62nd Avenue
Portland, Oregon 97213

**Report of Limited Forensic Geotechnical Evaluation**
**Lex Residence**
**Crestview Lot 4 – Eagle Peak Subdivision**
**Skamania County, Washington**

CGT Project Number G0803213

## 1 INTRODUCTION

Carlson Geotechnical (CGT) is pleased to submit the results of our Report of Forensic Geotechnical Evaluation for the Lex Residence located at Crestview Lot 4 – Eagle Peak Subdivision in Skamania County, Washington. The location of the site is shown on the attached Site Location, Figure 1. CGT completed a Report of Geotechnical Engineering and Geologic Assessment for the subdivision on February 5, 2005. CGT performed our work in general accordance with CGT Proposal PO4707, dated January 22, 2008. We received your written authorization for our services on January 30, 2008.

## 2 PROJECT INFORMATION

We understand that the existing foundations for the residence were constructed sometime prior to June 8, 2007, at which point CGT observed some soil conditions adjacent to the footings, within the southeast side of the residence. CGT observed some relatively softer soils adjacent to the foundations at that time, however, due to the previously completed construction, we were not able to access the entire area and determine the depth or extent of the soft material. We understand that in November 2007, after the interior garage slab had been poured, the southeastern portion of the residence began to experience differential settlement, evidenced by cracking of the garage slab, hairline cracks in the southern stem wall, and framing beginning to go out of plumb.

## 3 SCOPE OF WORK

The purpose of our limited forensic geotechnical evaluation was to explore subsurface conditions adjacent to the area of the noted distress in order to provide a geotechnical opinion regarding the nature of the distress observed and provide remediation alternatives to limit potential future distress. Our scope of work consisted of the following:

- Explore subsurface conditions in the area of the distress by advancing two (2) mud-rotary borings (B-1 and B-2) to depths of about 26½-feet below ground surface (bgs) using equipment provided and operated by Western States Soil Conservation from Aurora, Oregon. Borings were backfilled with granular bentonite prior to leaving the site.
- Performed Standard Penetration Tests (SPT) within the borings at 2½-foot intervals to a depth of 15-feet bgs, and then at 5-foot intervals to the termination depths of the borings. The SPT's were performed in general accordance with American Society for Testing and Materials (ASTM) D1586.
- Classify the materials encountered within the explorations in general accordance with ASTM D2488 (Visual-Manual Procedure). A qualified member of CGT's staff observed and maintained a detailed log of each exploration.
- Collected representative disturbed samples of the soils encountered within the explorations for laboratory testing and to confirm our field classifications.
- Completed laboratory testing that included:
    - Twelve (12) moisture content determinations,
    - Two (2) Plasticity Limits tests,
    - Two (2) percent passing the U.S. Standard No. 200 Sieve tests.
- Provide geotechnical engineering opinion regarding the nature of the observed distress and possible remediation alternatives for limiting additional settlement.
- Provide a written report summarizing the results of our limited forensic geotechnical evaluation.

## 4 LIMITED FORENSIC GEOTECHNICAL EVALUATION

### 4.1 Site Surface Conditions

At the time of our field investigation, we observed a diagonal crack in the garage slab (approximately 2 inches wide) and hairline cracks in the exposed southern stem wall. We also observed loose fill that had been placed on the south side of the residence that appeared to have moved/settled due to past precipitation as evidenced by erosion features and tension cracking. Framing on the house had been completed and dry-walling was started. Photos detailing our observations are presented in the attached Site Photographs – Figure 3.

## 4.2 Site Exploration

### 4.2.1 Field Investigation

CGT observed the advancement of two (2) mud-rotary soil borings (B-1 and B-2) to depths of about 26½-feet bgs on February 21, 2008. The soil borings were advanced utilizing a track mounted, CME-55 drill rig equipped with an automatic hammer supplied and operated by Western States Soil Conservation from Aurora, Oregon. The soil borings were backfilled with granular bentonite after completion of the boring. During the explorations, SPT tests were conducted at 2½-foot intervals to a depth of about 15-feet bgs, and then continued at 5-foot intervals to the completion depths of the borings. The SPT is performed by driving a 2-inch, outside-diameter, split-spoon sampler into the relatively undisturbed material located at the bottom of the advanced boring with repeated blows of a 140-pound, pin-guided, automatic hammer falling a vertical distance of 30 inches. The number of blows, N-Value, required to drive the sampler one foot, the last 12 inches of an 18-inch sample interval, is used to measure the soil consistency (cohesive soil), or relative density (non-cohesive soils). In addition, two modified California samples (Dames and Moore) were obtained during one of the explorations at specific depths by utilizing the SPT test method.

It should be noted that automatic hammers generally produce lower SPT values than those obtained using a traditional (wire line, donut, or cat-head) hammers. Studies have generally indicated that penetration resistances may vary by a factor of 1½ to 2 between the methods. We have considered this in our description of soil consistency, and in our evaluation of soil strength and compressibility. In addition, due to the size of the modified California sampler, the SPT value for this test is generally about 1½ times greater than an actual SPT test performed on the same material.

Our explorations were located in the field by measuring distances relative to existing site features, and are shown on the attached Site Plan, Figure 2. Elevations shown on the logs were based on an assumed 100-foot elevation established at the top of existing first floor slab for the residence, shown on the attached Site Plan, Figure 2. A member of CGT's staff logged the soils observed within the explorations in general accordance with the Unified Soil Classification System (USCS) and collected representative samples of the materials encountered. CGT has provided an explanation of the USCS Classification on the attached Figure 4. Our staff visually examined all samples returned to our laboratory in order to refine the field classifications. Samples were then selected and tested in our laboratory in order to better define our classifications. Results of the laboratory testing are presented on the logs of our explorations and are attached as Figures 5 and 6.

### 4.2.2 Subsurface Materials

The following subsurface materials were encountered at the site:

Undocumented Fill (MH-Fill): We encountered undocumented fill, generally consisting of elastic sandy silt fill (MH-Fill), in the exploratory boring B-2, located near the southwest side of the residence. The elastic sandy silt fill (MH-Fill) was encountered at the surface and extended about 12-feet bgs. The elastic sandy silt fill (CL-Fill) was generally soft to medium stiff in relative consistency, had medium plasticity, had fine grained sand, contained varying amounts of small gravel, was moist to wet, and was brown in color.

Silty Sand with Gravel (SM): We encountered native, silty sand with gravel (SM) in both of our explorations (B-1 and B-2). The silty sand with gravel (SM) was encountered at the surface in boring B-1 and extended to a depth of about 9½-feet bgs. In boring B-2, the silty sand with gravel (SM) was encountered underlying the elastic sandy silt fill (MH-Fill) at 12 feet bgs and extended to a depth of about 14½-feet bgs. The silty sand with gravel (SM) was generally medium dense to very dense in relative density, had low plasticity, contained varying amount of sub angular to subrounded gravel generally less than 1½-inches in diameter, was moist, and was brown in color.

Elastic Sandy Silt (MH): We encountered native, elastic sandy silt (MH) in both of the soil borings (B-1 and B-2) underlying the native, silty sand with gravel (SM) and continuing to the extent of the explorations. The elastic sandy silt (MH) was generally medium stiff to hard in relative consistency, had high plasticity, had fine grained sand, was moist, and was brown to grey in color.

The subsurface materials are described in more detail on the attached Boring Logs, Figures 5 and 6.

# 5 GEOTECHNICAL OPINION

Based on the visual observations and results of the field investigation, it is our opinion that the distress noted in the garage slab and stem walls is most likely due to the compression of the underlying soft soils and/or fill settling due to loading from the adjacent soil slope and water infiltration. We recommend that the southern portion of the residence be underpinned utilizing a helical anchor system. In addition, we recommend that the existing fill material be removed and replaced with properly placed and compacted material. The foundation drains should be inspected to assure that they have been installed correctly and are functioning properly. If fill located adjacent to the southern side of the residence is to replace to existing site grades, we recommend that the material be retained by a properly designed retaining wall system.

# 6 RECOMMENDATIONS

The recommendations presented in this report are based on the information provided to us, results of the field investigation, laboratory data, and professional judgment. CGT has observed only a small portion of the pertinent soil and groundwater conditions. The recommendations are based on the assumptions that the soil conditions do not deviate appreciably from those found during the field investigation. If the design or location of the proposed development changes, or if variations or undesirable geotechnical conditions are encountered during site development, CGT should be consulted for further recommendations.

## 6.1 Stripping / Over-Excavation

Undocumented fill (MH-Fill) and any soft or loose native soils (MH or SM) encountered should be removed in their entirety from the southern side of the residence. Based on the results of our field explorations, the anticipated depth undocumented fill (MH-Fill) at the site will be on the order of approximately 12-feet. A geotechnical representative from CGT should provide recommendations for actual stripping depths based on observations made during site stripping. Stripped undocumented fill (ML-Fill) should be transported off-site for disposal, or stockpiled for later use in landscaped areas. Strippings should not be placed on slopes of greater than 5H:1V.

## 6.2 Imported Granular Structural Fill

Imported granular structural fill should consist of angular pit or quarry run rock, crushed rock, or crushed gravel that is fairly well graded between coarse and fine particle sizes. The granular fill should contain no organic matter, debris, or particles larger than four (4) inches, and have less than five (5) percent material passing the U.S. Standard No. 200 Sieve. For fine grading purposes, the maximum particle size should be limited to 1½ inches. The percentage of fines can be increased to twelve (12) percent of the material passing the U.S. Standard No. 200 Sieve if placed during dry weather, and provided the fill material is moisture-conditioned, as necessary, for proper compaction. Granular fill material should be placed in lifts with a maximum thickness of about twelve (12) inches, and compacted to not less than 95 percent of the material's maximum dry density, as determined in general accordance with ASTM D1557 (Modified Proctor). Density tests of the exposed fill material will remain valid for a period of 48 hours after the test is taken, provided there are no drastic changes in weather conditions or construction traffic. Proper moisture conditioning and the use of vibratory equipment will facilitate compaction of these materials.

### 6.3 Underpinning of Foundation

In order to mitigate the potentially adverse effects due to settlement, we recommend that the foundation located along the south and west walls of the residence be underpinned using helical anchors, such as Chance® Helical Pier® Anchors or approved equivalent, equipped with a foundation repair bracket. The helical anchors should penetrate through the fill and any soft or loose native soils and bear in the underlying, native, stiff to hard, elastic sandy silt (MH) located at depths estimated to be on the order of about 15- to 20-feet below ground surface (bgs). Allowable helical anchor capacity and specifications are provided below in Table 1.

**Table 1.** Allowable Helical Anchor Capacity & Specifications.

| | |
|---|---|
| **Shaft Size** | 1½ Inches by 1½ Inches |
| **Lead Section Helix Size** | Stacked 8-Inch & 10-Inch |
| **Allowable Axial Capacity (Compression)** | 20,000 Pounds |
| **Required Torque For Allowable Capacity** | 4,000 Foot-Pounds |
| **Minimum Installation Depth** | 12 feet below bottom of footing (see note below) |
| **Foundation Repair Bracket** | Specification per Structural Engineer |

If the allowable capacity or required torque cannot be obtained using the stacked 8- and 10-inch-diameter, lead section helix, then it will be necessary to either increase the diameter of the helix or use a different stacked helix lead section. The project structural engineer should determine the required spacing of helical anchors using the calculated building loads and allowable helical anchor capacity.

6.3.1 Depth Consideration

The minimum installation depth mentioned in Table 1 is our best estimation of the depth necessary to reach the to penetrate into native, stiff to hard, elastic sandy silt (MH) strata. The required installation depth may vary in the field, depending on actual site conditions. Generally speaking, the helical anchors should be installed to a sufficient depth to achieve the required torque of 4,000 feet-pounds. The geotechnical engineer should be available to perform observations of helical anchor installations.

6.3.2 Load Testing

In order to verify the design allowable axial capacity of 20,000 pounds (P) at an installed torque of 4,000 feet-pounds, we recommend that at least 2 load tests be performed on installed anchors under the observation of the geotechnical engineer. The test anchors should be tested at a seating load of 5 kips. Incremental loadings of 0.25P, 0.50P, 0.75P, 1.0P, 1.25P, 1.5P, and 2.0P shall be applied to the test anchors. Anchor movements should be recorded to the nearest 0.001 inches via at least 3 dial indicators mounted on an independent beam. Incremental loads should be held for 5 minutes after no visible change in the dial indicator is noted. The test anchors should be unloaded using the same increments noted above. Total allowable anchor movements shall be limited to ¾-inch.

## 6.4 Retaining Wall System

If the owner elects to replace the undocumented fill on located on the southern side of the residence with properly placed and compacted structural fill, CGT recommends that the fill be retained with a retaining wall system. The retaining wall system should be properly designed by a structural engineer. We have provided the following design parameters to be utilized for design of a retaining wall system:

6.4.1 Foundations

We recommend that retaining wall foundations bear on either native, medium dense to dense, silty sand with gravel (SM), stiff to hard elastic silt (MH), or on properly placed and compacted structural fill that extends to these materials. We generally encountered the medium dense to dense, silty sand with gravel (SM) at depths of about 12-feet bgs within our explorations, and the stiff to hard, elastic silt (MH) at depths of between 15- to 25-feet bgs within our explorations.

If loose/soft or otherwise unsuitable soils are encountered within the footing excavations, they should be over-excavated as recommended by the geotechnical engineer or their representative. The resulting over-excavation should be brought back to grade with structural fill. All footing over-excavations should be constructed a minimum of 8 inches wider on each side of the footing for every vertical foot of over-excavation.

We recommend that all individual footings have a minimum width of 24 inches, and the base of the footings be founded at least 24 inches below the lowest adjacent grade. Excavations near footings should not extend within a 1H:1V plane projected out and down from the outside, bottom edge of the footings.

All foundations located adjacent to slope faces should be sited to provide a minimum distance from the slope face based on Section 1805.3.2 of the 2006 International Building Code (IBC). The IBC requires that foundations have a set-back that is a minimum of ⅓ the height of the slope with a minimum of five feet and a maximum of 40 feet measured horizontally from the base of the foundation to the slope face. This may require that some foundations be deepened to meet the geometric setback requirements.

Shallow spread footings founded as recommended should be proportioned for a maximum allowable soil bearing pressure of 2,500 pounds per square foot (psf). The bearing pressure provided is a net bearing pressure, and applies to the total of dead and long-term live loads, and may be increased by 1/3 when considering seismic or wind loads.

For the recommended design bearing pressure, total settlement of footings is anticipated to be less than 1 inch. Differential settlements between adjacent load bearing walls and adjacent columns should not exceed ½-inch.

#### 6.4.2 Backfill

Retaining walls should be backfilled with imported granular structural fill compacted to a minimum of 90 percent of material's maximum dry density, as determined in general accordance with ASTM D1557 (Modified Proctor). When placing fill behind walls, care must be taken to minimize undue lateral loads on the walls by keeping heavy compaction equipment at least 5 feet from the back of the walls or a distance equal to the height of the wall, whichever is greater. Light mechanical or hand tamping equipment should be used for compaction of backfill materials within 3 feet of the back of the walls.

#### 6.4.3 Drainage

We recommend placing drains behind the walls at their base. Wall drains should consist of a minimum 4-inch-diameter, perforated, flexible, PVC drainpipe wrapped with a geotextile filter fabric. The drains should be backfilled with a minimum of 2-cubic-feet per lineal foot (of drainpipe) of open graded drain rock, which should be encased within a geotextile fabric in order to provide separation from the surrounding fine-grained soils. The wall drains should be connected to the nearest storm drain or other suitable discharge point. CGT should be contacted to observe the drain prior to backfilling.

### 6.4.4 Design Parameters & Limitations

For retaining walls founded, backfilled, and drained, as recommended above, the following design parameters are recommended for design of the retaining walls at the site:

**Table 2.** Retaining Wall Design Parameters

| Wall Condition | Backfill Condition | Equivalent Fluid Pressure / Static Soil Lateral Load | Seismic / Dynamic Lateral Load♦ |
|---|---|---|---|
| **Not Restrained from Rotation** | Level♣ | 30 pcf | (17 pcf)*H*H |
| **Restrained from Rotation** | Level♣ | 48 pcf | (21 pcf)*H*H |

♦Acting at a point 0.6H above the base of the wall, where H is equal to the exposed wall height in feet.

♣Assumes a maximum of 0 degrees of back-slope from the top of the wall.

Note: Seismic / dynamic lateral loads were computed using the Mononobe-Okabe Equation as presented in the 1997 Federal Highway Administration (FHWA) design manual.

The above design recommendations are based on the assumptions that: (1) the wall consists of either a conventional cast-in-place concrete cantilevered retaining wall, gravity wall, or MSE wall system, (2) the wall, is equal to or less than 12 feet in height, (3) the backfill is drained and consists of imported granular structural fill, (4) no surcharges are imposed behind the wall, and (5) the grade in front of the walls is level or a slope angle of no more than 2 degrees for a distance of at least the face height of the wall or that the foundations are embedded as detailed in the previous section. Re-evaluation of our recommendations will be required if the basement and retaining wall design criteria for the project vary from these assumptions.

## 7 Limitations and Closure

Please note that an evaluation of seismic or other geologic hazards at the site was not included in the scope of this limited report. As such, our report does not address these issues. If an evaluation of seismic or other geologic hazards or other geotechnical issues at the site is required, we would be pleased to provide them for an additional fee.

This report has been prepared for use by the owner/developer and other members of the design and construction team for the proposed development. The opinions and recommendations contained within this report are not intended to be, nor should they be construed as a warranty of subsurface conditions, but are forwarded to assist in the planning and design process.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with the generally accepted practices in this area at the time this report was prepared. No warranty or other conditions express or implied, should be understood. Information contained herein is not to be reproduced, except in full, without prior authorization from this office.

Should you have any questions regarding the recommendations or opinions presented in this report, please contact us at (503) 601-8250.

Respectfully submitted,
**Carlson Geotechnical**

GABRIEL A. BURGESS
STATE OF WASHINGTON
42977
REGISTERED PROFESSIONAL ENGINEER
EXPIRES 3/3/2009

State of Washington
Engineering Geologist
180
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Ryan T. Houser

Gabriel A. Burgess, P.E.
Project Geotechnical Engineer

Ryan T. Houser, LEG
Senior Engineering Geologist

Attachments: Site Location, Figure 1
Site Plan, Figure 2
Site Photographs, Figure 3
Soil Classification Criteria and Terminology, Figure 4
Boring Logs, Figures 5 and 6

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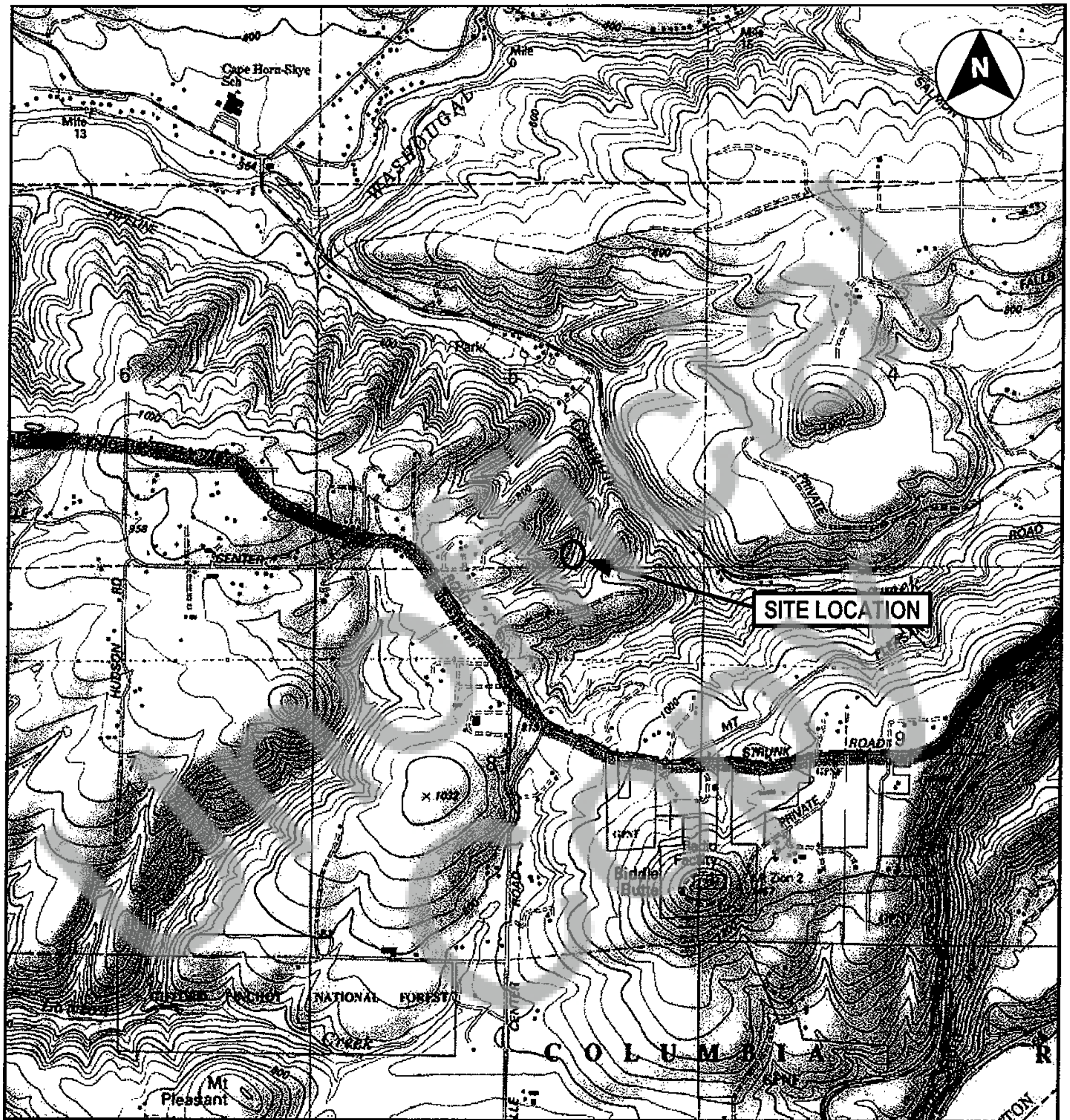
## *LEX RESIDENCE - CRESTVIEW LOT 4, SKAMANIA COUNTY, WASHINGTON*
## SITE LOCATION






Map created with TOPO!™, © 2006 National Geographic Holdings
USGS 7.5 Minute Topographic Map Series, Bridal Veil, OR/WA Quadrangle.

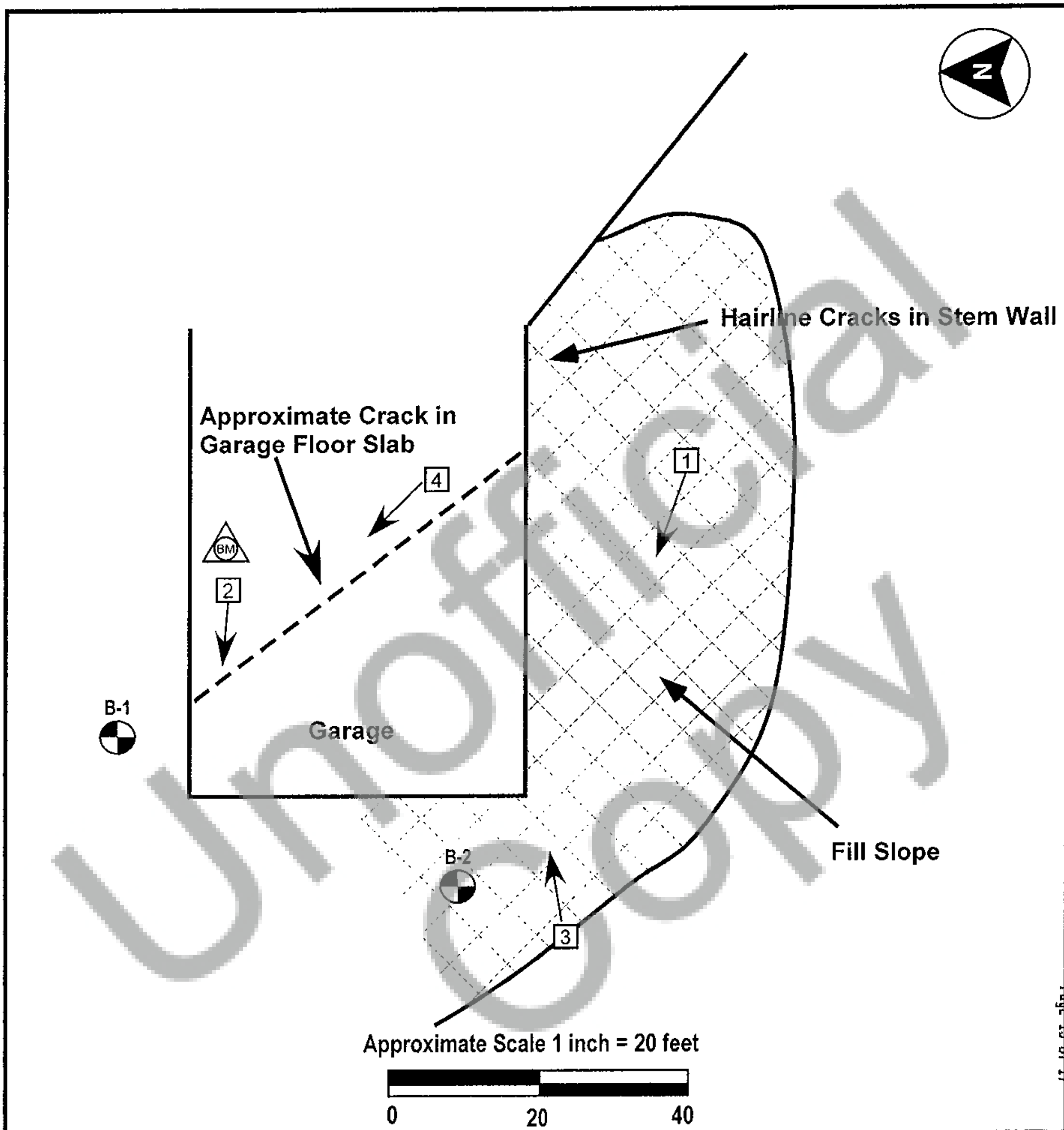
Scale 1 Inch = 2,000 feet

0 2000 4000

Township 1 North, Range 4 East, Section 5 Willamette Meridian

| | | |
|---|---|---|
| CARLSON CGT GEOTECHNICAL 503-601-8250 *Carlson Geotechnical P.O. Box 23814 Tigard, Oregon 97281* | CGT Job No. G0803213 | FIGURE 1 |

## *LEX RESIDENCE - CRESTVIEW LOT 4, SKAMANIA COUNTY, WASHINGTON*
## SITE PLAN



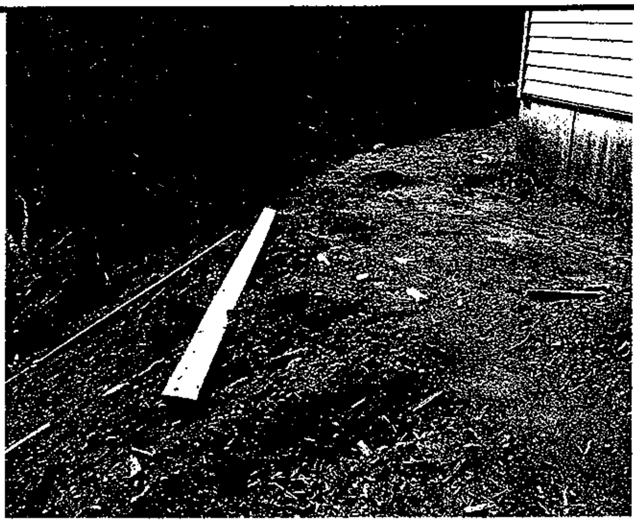





| NOTES: | LEGEND | |
|---|---|---|
| Drawing based on observations made while on site. | B-1 Approximate location of mud-rotary soil boring. | CGT Job No. G0803213 |
| | 1 Number, location, and direction of site photographs shown on Figure 3 | |
| CARLSON CGT GEOTECHNICAL 503-601-8250 *Carlson Geotechnical P.O. Box 23814 Tigard, Oregon 97281* | BM Referenced elevation benchmark - assumed 100' mark at finished first floor elevation. | FIGURE 2 |

# *LEX RESIDENCE - CRESTVIEW LOT 4, SKAMANIA COUNTY, WASHINGTON*

## SITE PHOTOGRAPHS



Photograph 1: Looking west at existing fill slope located on southwest side of residence.

Photograph 2: Interior garage slab crack near west entrance to garage.

Photograph 3: Looking southeast at fill slope.

Photograph 4: Interior garage slab crack near south wall.

*See Figure 2 for approximate photograph locations and directions.*





| | | |
|---|---|---|
| CARLSON CGT GEOTECHNICAL 503-601-8250 *Carlson Geotechnical P.O. Box 23814 Tigard, Oregon 97281* | CGT Job No. G0803213 | FIGURE 3 |

# LEX RESIDENCE - CRESTVIEW LOT 4, SKAMANIA COUNTY, WASHINGTON
# SOIL CLASSIFICATION CRITERIA AND TERMINOLOGY

## Classification of Terms and Content

NAME : MINOR Constituents (12-50%); MAJOR Constituents (>50%); Slightly (5-12%)
Relative Density or Consistency
Color
Moisture Content
Plasticity
Trace Constituents (0-5%)
Other: Grain Shape, Approximate gradation, Organics, Cement, Structure, Odor....
Geologic Name or Formation: (Fill, Willamette Silt, Till, Alluvium,...)

## USCS Grain Size

| | | |
|---|---|---|
| Fines | | <#200 (.075 mm) |
| Sand | Fine | #200 - #40 (.425 mm) |
| | Medium | #40 - #10 (2 mm) |
| | Coarse | #10 - #4 (4.75) |
| Gravel | Fine | #4 - 0.75 inch |
| | Coarse | 0.75 inch - 3 inches |
| Cobbles | | 3 to 12 inches; scattered <15% est., numerous >15% est. |
| Boulders | | > 12 inches |

## Relative Density or Consistency

| Granular Material | | Fine-Grained (cohesive) Materials | | | | |
|---|---|---|---|---|---|---|
| SPT N-Value | Density | SPT N-Value | Torvane tsf Shear Strength | Pocket Pen tsf Unconfined | Consistency | Manual Penetration Test |
| | | <2 | <0.13 | >0.25 | Very Soft | Thumb penetrates more than 1 inch |
| 0 - 4 | Very Loose | 2 - 4 | 0.13 - 0.25 | 0.25 - 0.50 | Soft | Thumb penetrates about 1 inch |
| 4 - 10 | Loose | 4 - 8 | 0.25 - 0.50 | 0.50 - 1.00 | Medium Stiff | Thumb penetrates about 1/4 inch |
| 10 - 30 | Medium Dense | 8 - 15 | 0.50 - 1.00 | 1.00 - 2.00 | Stiff | Thumb penetrates less than 1/4 inch |
| 30 - 50 | Dense | 15 - 30 | 1.00 - 2.00 | 2.00 - 4.00 | Very Stiff | Readily indented by thumbnail |
| >50 | Very Dense | >30 | >2.00 | >4.00 | Hard | Difficult to indent by thumbnail |

## Moisture Content

Dry: Absence of moisture, dusty, dry to the touch
Damp: Some moisture but leaves no moisture on hand
Moist: Leaves moisture on hand
Wet: Visible free water, likely from below water table

| | Plasticity | Dry Strength | Dilatancy | Toughness |
|---|---|---|---|---|
| ML | Non to Low | Non to Low | Slow to Rapid | Low, can't roll |
| CL | Low to Med. | Medium to High | None to Slow | Medium |
| MH | Med to High | Low to Medium | None to Slow | Low to Medium |
| CH | Med to High | High to V. High | None | High |

## Structure

Stratified: Alternating layers of material or color >6 mm thick
Laminated: Alternating layers < 6 mm thick
Fissured: Breaks along definate fracture planes
Slickensided: Striated, polished, or glossy fracture planes
Blocky: Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lenses: Has small pockets of different soils, note thickness
Homogeneous: Same color and appearance throughout

## Unified Soil Classification Chart (Visual-Manual Procedure) (Similar to ASTM Designation D-2488)

| Major Divisions | | | Group Symbols | Typical Names |
|---|---|---|---|---|
| Coarse Grained Soils: More than 50% retained on No. 200 sieve | Gravels: 50% or more *retained* on the No. 4 sieve | Clean Gravels | GW | Well graded gravels and gravel-sand mixtures, little or no fines |
| | | | GP | Poorly-graded gravels and gravel-sand mixtures, little or no fines |
| | | Gravels with Fines | GM | Silty gravels, gravel-sand-silt mixtures |
| | | | GC | Clayey gravels, gravel-sand-clay mixtures |
| | Sands: more than 50% *passing* the No. 4 Sieve | Clean Sands | SW | Well-graded sands and gravelly sands, little or no fines |
| | | | SP | Poorly-graded sands and gravelly sands, little or no fines |
| | | Sands with Fines | SM | Silty sands, sand-silt mixtures |
| | | | SC | Clayey sands, sand-clay mixtures |
| Fine-Grained Soils: 50% or more Passes No. 200 Sieve | Silt and Clays Low Plasticity Fines | | ML | Inorganic silts, rock flour, clayey silts |
| | | | CL | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays |
| | | | OL | Organic silt and organic silty clays of low plasticity |
| | Silt and Clays High Plasticity Fines | | MH | Inorganic silts, clayey silts |
| | | | CH | Inorganic clays of high plasticity, fat clays |
| | | | OH | Organic clays of medium to high plasticity |
| Highly Organic Soils | | | PT | Peat, muck, and other highly organic soils |





CARLSON CGT GEOTECHNICAL 503-601-8250
*Carlson Geotechnical*
*P.O. Box 23814*
*Tigard, Oregon 97281*

CGT Job No. G0803213

FIGURE 4

Carlson Geotechnical
7185 SW Sandburg Street, Suite 110
Tigard, OR 97223
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Fax: (503) 601-8254

# FIGURE 5

## BORING B-1



**CLIENT** Brenda Lex
**PROJECT NAME** Brenda Lex Residence
**PROJECT NUMBER** G0803213
**PROJECT LOCATION** Crestview Lot 4, Skamania County, WA
**DATE STARTED** 2/21/08
**ELEVATION DATUM** 100-Ft Benchmark at Finished Floor
**DRILLING CONTRACTOR** Western States Soil Conservation
**GROUND ELEVATION** 99.5 ft
**DRILLING METHOD** Mud Rotary
**GROUND WATER LEVELS:**
**LOGGED BY** Jeff Jones **CHECKED BY** Gabriel Burgess
**AT TIME OF DRILLING** ---
**NOTES** CME-55 Track mounted drill rig equipped with auto-hammer
**AFTER DRILLING** ---

| DEPTH (ft) | U.S.C.S. | MATERIAL DESCRIPTION | ELEVATION (ft) |
|---|---|---|---|
| 0–10 | SM | Brown, medium dense to very dense, **SILTY SAND with GRAVEL**: subangular to subround gravel, generally less than 1 1/2 inches in diameter, low plasticity, moist to wet. | 99.5–90 |
| 10–25 | MH | Light grey to brown, stiff to very stiff, **ELASTIC SANDY SILT**: high plasticity, fine grained sand, moist. | 90–75 |
| | | Terminated boring at 25-feet bgs.<br>Terminated sampling at 26 1/2-feet bgs.<br>No groundwater encountered.<br>Boring backfilled with bentonite chips on 02/21/08. | |

| SAMPLE TYPE NUMBER | RECOVERY % | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS: LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | FINES CONTENT (%) |
|---|---|---|---|---|---|---|---|---|---|
| SPT S-1 | 0 | 2-6-7 (13) | | | | | | | |
| SPT S-2 | 56 | 3-11-14 (25) | | | 22 | | | | 17 |
| SPT S-3 | 67 | 16-36-69 (105) | | | 16 | | | | |
| SPT S-4 | 78 | 7-11-14 (25) | | | 32 | | | | |
| SPT S-5 | 89 | 5-6-5 (11) | | | 42 | 64 | 29 | 35 | |
| SPT S-6 | 100 | 3-7-10 (17) | | | 38 | | | | |
| SPT S-7 | 100 | 4-9-9 (18) | | | 42 | | | | |
| SPT S-8 | 33 | 4-7-17 (24) | | | 56 | | | | |

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# FIGURE 6
## BORING B-2



CLIENT Brenda Lex
PROJECT NUMBER G0803213
PROJECT NAME Brenda Lex Residence
PROJECT LOCATION Crestview Lot 4, Skamania County, WA

DATE STARTED 2/21/08
DRILLING CONTRACTOR Western States Soil Conservation
DRILLING METHOD Mud Rotary
LOGGED BY Jeff Jones CHECKED BY Gabriel Burgess
NOTES CME-55 Track mounted drill rig equipped with auto-hammer
ELEVATION DATUM 100-Ft Benchmark at Finished Floor
GROUND ELEVATION 97.5 ft
GROUND WATER LEVELS:
AT TIME OF DRILLING ---
AFTER DRILLING ---

| DEPTH (ft) | U.S.C.S. | MATERIAL DESCRIPTION | ELEVATION (ft) | SAMPLE TYPE NUMBER | RECOVERY % | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS: LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | FINES CONTENT (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0–12 | MH-FILL | Brown, soft to medium stiff, **ELASTIC SANDY SILT-FILL**: medium plasticity, fine grained sand, moist. | 95 | SPT S-1 | 17 | 0-2-1 (3) | | | | | | | |
| 5 | | | | MC S-2 | 67 | 1-3-3 (6) | | | 36 | | | | |
| | | | 90 | SPT S-3 | 28 | 1-2-3 (5) | | | 40 | | | | |
| 10 | | | | MC S-4 | 0 | 3-4-4 (8) | | | | | | | |
| 12–14.5 | SM | Brown, medium dense to very dense, **SILTY SAND with GRAVEL**: subangular to subrounded gravel, generally less than 1 1/2 inches in diameter, low plasticity, moist to wet. | 85 | SPT S-5 | 11 | 3-5-6 (11) | | | | | | | |
| 15 | MH | Grey, medium stiff to hard, **ELASTIC SANDY SILT**: medium plasticity, fine grained sand, moist. | | SPT S-6 | 11 | 7-4-3 (7) | | | 39 | | | | |
| 20 | | | 80 | SPT S-7 | 67 | 2-2-3 (5) | | | 46 | | | | |
| 25 | | | 75 | SPT S-8 | 100 | 6-13-19 (32) | | | 33 | 71 | 36 | 35 | 51 |

Terminated boring at 25-feet bgs.
Terminated sampling at 26 1/2-feet bgs.
No groundwater encountered.
Boring backfilled with bentonite chips on 02/21/08.