28-7E-31

Associated Earth Sciences, Inc.

August 13, 2002
Project No. KE02446A

B20 - B30

Woods Creek Highlands, LLC
600 108th Avenue NE, No. 343
Bellevue, Washington 98004

The Farm

Attention: Mr. Jim Howton

Subject: Soldier Pile Wall Geotechnical Evaluation and Design Criteria
The Farm @ Woods Creek
Monroe, Washington

Dear Mr. Howton:

This letter presents soldier pile wall design criteria for the above-referenced project. Our services were performed at the request of Woods Creek Highlands, LLC in accordance with generally accepted geotechnical engineering practices in effect in this area at the time this letter was prepared. No other warranty, express or implied, is made. The following documents were reviewed during the course of our geotechnical evaluation:

- *"Draft Geotechnical Evaluation, Entry Road, The Farm at Woods Creek..."* by Nelson Geotechnical Associates, Inc., dated December 28, 2000, provided to us by Triad Associates (Triad) on July 11, 2002.

- *"Geotechnical Engineering Evaluation, The Farm @ Woods Creek, Woods Creek Road Widening, Soldier Pile Wall,"* Prepared for JMR Pacific by Nelson Geotechnical Associates, Inc. (Nelson), dated May 10, 2002, provided to us by Nelson on August 6, 2002.

**Project Summary**

We understand that improvements are planned to accommodate site distance requirements at the intersection of Woods Creek Road and Country Crescent Boulevard. Planned improvements consist of widening the north shoulder of Woods Creek Road from roughly Station 28+00 to Station 38+84. The subject intersection is shown on Figure 1, Sheets 1 and 2, Site and Exploration Plan. Associated Earth Sciences Inc. (AESI) reviewed initial site plan drawings prepared by Triad and approved by the City of Monroe on July 20, 2001. This initial plan proposed 2H:1V (Horizontal:Vertical) cut slopes from roughly Station 27+50 to 39+00.

During the week of July 8th, AESI completed seven backhoe exploration pits at accessible locations within the proposed improvement area, as shown on Figure 1. Exploration pit logs are attached to this letter.

**Initial Stability Assessment**

Using subsurface soil profiles developed through review of our exploration pit logs and soil boring logs (attached) shown in Nelson's December 28, 2000 report, we performed slope stability analyses at roughly the locations shown on Figure 1 as Cross Section XX' and YY'. The following strength characteristics used in our analysis were based on review of Nelson's December 28th report.

**Table 1**
**Assumed Soil Characteristics**

| Soil Description | Internal Friction Angle ($\phi$ in degrees) | Cohesion (psf)* (mobilized, saturated case) | Moist Unit Weight (pcf)** |
|---|---|---|---|
| Silt and Sand Colluvium | 28 | 0 | 110 |
| Transitional Sediments | 25 | 250 | 120 |

* = pounds per square foot
** = pounds per cubic foot

Our slope stability analysis considered winter high perched ground water conditions with the proposed 2H:1V cut slope geometry. A seismic coefficient equal to 0.2g was used to simulate dynamic loading conditions.

An acceptable factor of safety against slope failure would depend on the level of risk deemed acceptable by the owner and City. A static factor of safety of 1.5 is generally considered suitable with respect to generally accepted geotechnical engineering practice for new construction. During short-term seismic loading, a dynamic factor of safety of 1.1 is generally considered acceptable. Our analysis yielded factors of safety less than 1.5 under static conditions for failures within the colluvium. Deep-seated slope failure (factor of safety less than 1) occurred under dynamic conditions with failure planes extending through the transitional sediments. We discussed these findings with you during a meeting on July 16, 2002. We understand that similar cut slopes in comparable soil types were attempted during construction of Country Crescent Boulevard. The cut slopes failed and required repair with large rock buttresses and retaining walls. Based on these low factors of safety and limited available space conditions, we recommended that a soldier pile retaining wall be used to support the toe of the slope along the north shoulder of Woods Creek Road in order to complete the proposed widening.

## Additional Exploration/Laboratory Soils Analysis

We were advised that deep explorations had not been completed within the proposed improvement area. Therefore, we completed four geotechnical borings at locations shown on Figure 1, Sheet 2 in order to provide accurate design pressures for a soldier pile wall. Borings EB-1 and EB-4 were completed to confirm the accuracy of assumptions applied to our slope stability analysis. Piezometers were installed in all four borings to obtain accurate ground water elevations within the deeper transitional sediment aquifer. Perched ground water elevations within the colluvium were recorded at the time of drilling. Laboratory analysis on samples secured from boring EB-3 provided the following soil strength and density data:

**Table 2**
**Soil Characteristics based on Laboratory Testing**

| Soil Description | Boring Number and Depth (ft) | Internal Friction Angle ($\phi$ in degrees) ASTM:D 3080-90 | Apparent Cohesion (psf) (unmobilzed, summer condition) ASTM:D 3080-90 | Moist Unit Weight (pcf) ASTM:D 4531-86 |
|---|---|---|---|---|
| Silt Colluvium | EB-3 at 13.5 | 25 | 775 | 111 |
| Transitional Sediments | EB-3 at 21 | 20 | 700 | 103 |

The internal friction angles assumed for our slope stability analyses were slightly higher than the average friction angles for the soil column derived through laboratory testing. In our opinion, the in situ cohesive strengths shown in Table 2 are not representative of winter, saturated, mobilized conditions. Under mobilized conditions, cohesive strength becomes negligible. Therefore, we did not re-run the slope stability analysis as our assumptions before testing appeared to be conservative. Re-testing with the laboratory friction angles would likely result in less stable cut slope conditions.

During scheduling of drill rigs for exploration of the east wall area, we spoke with CN Drilling who informed us that they had completed several borings along the proposed wall alignment. We obtained copies of these boring logs from Nelson to supplement data obtained during our subsurface exploration. The borings completed by Nelson are shown on Figure 1 and were used to develop equivalent fluid pressures for the east wall assuming similar soil strength characteristics described in Table 2. Equivalent Earth Pressure Diagrams are shown on Figure 4.

## Recommended Wall/Slope Geometry

We recommend that the toe slope in front of the proposed soldier pile wall be graded to a maximum inclination of 3H:1V given the low friction angles identified by the laboratory tests. The toe slope should be vegetated as soon as practical after wall construction. Based on our review of the finalized Site Plan by Triad (Figure 1) cross sections shown on the attached

Figures 2 and 3, we understand that cuts of up to 8 feet deep are planned for the proposed wall located west of Country Crescent Boulevard (west wall). Cuts of up to 12 feet are anticipated for the east wall as shown on Figure 1, Sheet 2.

**Soldier Piles**

Soldier piles consist of wide-flanged beams placed in pre-drilled holes that extend below the bottom of the excavation. The portion of each soldier pile extending below the bottom of the excavation is grouted in place with sufficient strength concrete to transmit the load from the soldier beams into the soil below the excavation level. The upper portion of the soldier pile is then backfilled with a relatively weak grout so that it may be removed as necessary for placement of lagging.

For excavations of approximately 15 feet or less, the soldier beams typically may be cantilevered without the use of bracing. Passive pressure exerted by the upper 4 feet of material (weak soil) at the toe of the walls should be neglected. In addition, the walls should be designed with a catchment area above existing top-of-wall grade. We recommend a catchment stickup of 2 feet for the west wall with the active pressure triangle starting 1 foot below the top of finished wall to account for material not removed on a routine basis and construction traffic behind the wall. We recommend a catchment stickup of 4 feet for the east wall with the active pressure triangle starting 2 feet below the top of finished wall. These criteria will result in retained heights of approximately 13 feet for the west wall and approximately 18 feet for the east wall. Thus, it is anticipated that cantilever piling can be used for the west wall and that tieback anchors will be required to brace the east wall.

**West Wall**

For the west wall, an equivalent fluid equal to 75 pcf should be used for unrestrained (active) conditions above the effective cut height, with a maximum 3H:1V re-graded backslope extending to the approximate elevation of 130 feet. Above this elevation, the existing slope can be left undisturbed. Below the effective cut height (neglecting the upper 4 feet of toe slope soil), an equivalent fluid of 35 pcf can be used within the dense sand.

**East Wall**

For the east wall, an equivalent fluid pressure of 80 pcf should be used for unrestrained (active) conditions for the full height of the wall with a single level of tieback anchors. The construction area behind the wall should be re-graded to its existing condition. Above the effective base of the excavation, the active pressures act over the tributary area of the soldier piles. Below the base of the excavation (neglecting the upper 4 feet of toe soil), they act over one concreted pile diameter. The planned east wall configuration will require some form of anchorage or bracing for the soldier pile walls as the excavation progresses. We recommend a tieback system constructed by drilling behind the soldier pile wall at an angle below the horizontal and installing high strength rods or cables with a grout anchor. Horizontal waler beams at the soldier pile wall may be used to transmit the wall loads to the grouted anchor. The tieback method has the advantage of creating a minimum of obstructions in the

construction area. Care must be taken to avoid underground utilities if they exist. The anchor holes should be drilled in a manner to minimize loss of ground and not endanger adjacent anchors and surrounding subgrades due to subsidence. For this site, it will likely be necessary to install anchors from the top of the completed soldier pile wall to avoid power line and roadway conflict. We can provide the name of a tieback drilling contractor that has equipment suited for this application, if necessary.

**Catchment Area – East and West Walls**

It should be noted that surficial sloughing of colluvial soils above the walls may still occur where undisturbed slopes are inclined at greater than 3H:1V. The recommended additional wall stickup will provide a catchment area for some of this material, but may not contain large debris flows and vegetation. If a failure should occur, the catchment area should be cleaned out as soon as practical. The re-graded areas above the wall should be armored with 2- x 4-inch crushed rock spalls or covered with erosion control matting and vegetated as soon as possible.

**Passive Soil Resistance – East and West Walls**

Below the retained soil zone, the lateral earth pressures will be resisted by "passive" soil pressures acting against the base of the pile shaft. An allowable equivalent fluid passive earth pressure of 250 pcf may be assumed to act over a width equal to twice the pile diameter for the west wall. This value is appropriate for passive resistance against undisturbed, native, dense transitional sand sediments. An allowable equivalent fluid passive earth pressure of 180 pcf may be assumed to act over a width equal to twice the pile diameter for the east wall. This value is appropriate for passive resistance against undisturbed, native, medium stiff transitional silt sediments. The upper 4 feet of soil at the toe of the wall should be neglected for both (east and west) wall sections as shown on Figure 4.

**Tieback Anchors – East Wall**

Tieback anchors will be necessary for lateral support of the top of the east soldier pile wall. Theoretical adhesion values for undisturbed sediments of the type found on the site are in the range of 500 to 1,000 psf. We recommend that a maximum allowable shaft stress of 250 psf be utilized for low pressure grouting and 500 psf for high pressure grouting. These values include a factor of safety of 2. In our opinion, these values provide a high probability of obtaining successful results of load verification tests. For the recommended allowable shaft stress to apply, anchor lengths must be located entirely behind the no-load zone as defined in Figure 4. Permanent anchors should be provided with double corrosion protection. Anchor tests must be performed to verify that the design resistance is available on the installed anchors. A common anchor testing program would consist of at least one 200 percent verification test of the design or allowable load along each shoring wall where tiebacks are to be used. In addition, we recommend proof-loading every production anchor to 130 percent of the design load. These tests should conform to the recommendations of the Post-Tensioning Institute for verification testing and proof-loading of production anchors. Anchor tests and

their results should be observed and recorded by a representative of AESI. Our earth pressure diagrams can be modified to incorporate multiple level tiebacks, if necessary.

**Pile Lengths – East and West Walls**

A minimum pile length is shown on Figure 4 for estimating purposes only. The actual required pile lengths, steel reinforcement, and other design details must be determined by a structural engineer by moment equilibrium analysis. All values presented above assume that ground water will be drained or drawn down to below base excavation levels during construction and that the completed walls will be provided with drainage so that hydrostatic forces do not build up behind the wall. Therefore, we have not included hydrostatic forces in our design pressures.

**Pile Spacing and Lagging – East and West Walls**

We recommend that the soldier piling be spaced at a maximum distance of 8 feet on-center. The entire space between the piles should be retained using treated wood lagging. Soils should be excavated from between the piles to facilitate placement of the wood lagging over the entire retained soil height. Voids behind the lagging must be backfilled with washed pea gravel or select imported, clean, free-draining sand and gravel material. Seepage from the wall should be controlled and conveyed in an adequately sized roadside ditch to a suitable disposal area. Permanent soldier pile walls should be corrosion protected.

**Ground Water Conditions/Mitigations – West Wall**

Ground water elevations within explorations completed along the west wall alignment are shown on Figures 2 and 3. Below an approximate elevation of 92 feet, heaving sand should be expected during installation of soldier piles for the west wall. Therefore, the borings will likely require drilling fluid, "water heading", and/or casing below this elevation. Soil-cement mixing is not an acceptable alternative for tremmie placement or casing installation for borings that contain more than 2 feet of standing water, or in moderate to severe heaving/caving conditions.

**Ground Water Conditions/Mitigations – East Wall**

Ground water was not encountered within explorations completed along the east wall alignment in April 2002. Therefore, we anticipate that these borings will generally stay open during and immediately after drilling above the ground water table if the borings do not extend deeper than the exploration depth of approximately 25 feet (roughly Elevation 100), but may require casing or other stabilization techniques below the ground water table, if one exists below the explored depths. We recommend that the shoring contractor be prepared to case the borings if caving conditions are encountered to prevent loss of ground and to facilitate proper grout placement. If persistent perched ground water is encountered within the colluvium, some method to convey the water away from the site (i.e., pumping from sumps/ditches) will also be necessary to stabilize the subgrade soils during construction of the cut and installation of the lagging and tiebacks.

**Construction Monitoring – East and West Walls**

Since completion of the piling takes place below ground, the judgment and experience of the geotechnical engineer must be used for determining the acceptability of each pile and determining if the required anchor capacity has been met. Consequently, the use of the presented design information requires that all pile and tieback installations be observed by a qualified geotechnical engineer or engineering geologist from our firm who can interpret and collect the installation data and observe the contractor's operations. AESI, acting as the owner's field representative, would keep records of pertinent installation and wall construction data. A final summary report would then be distributed following completion of pile and tieback installation.

**Closure**

We trust this information meets your current needs. Please do not hesitate to contact us if you require additional information or have any questions regarding the presented information.

Sincerely,
**ASSOCIATED EARTH SCIENCES, INC.**
**Kirkland, Washington**

BRUCE BLYTON
STATE OF WASHINGTON
26890
REGISTERED
PROFESSIONAL ENGINEER
8/13/02
EXPIRES 5/3/04

Susan G. Beckham, P.E., P.G., P.Hg.
Project Engineer

Bruce L. Blyton, P.E.
Principal Engineer

Attachments: Figure 1, Sheets 1 and 2: Site and Exploration Plan
Figure 2: Section X-X'
Figure 3: Section Y-Y'
Figure 4: Soldier Pile Wall Design Earth Pressure Diagrams
Boring and Exploration Pit Logs (EP-1 through EP-7 and EB-1 through EB-4 by AESI, July 2002; and B-1 through B6 by Nelson, April 2002)

cc: Mr. John Burn, P.E., Ground Support, PLLC
8082 160th Avenue NE
Redmond, Washington 98052

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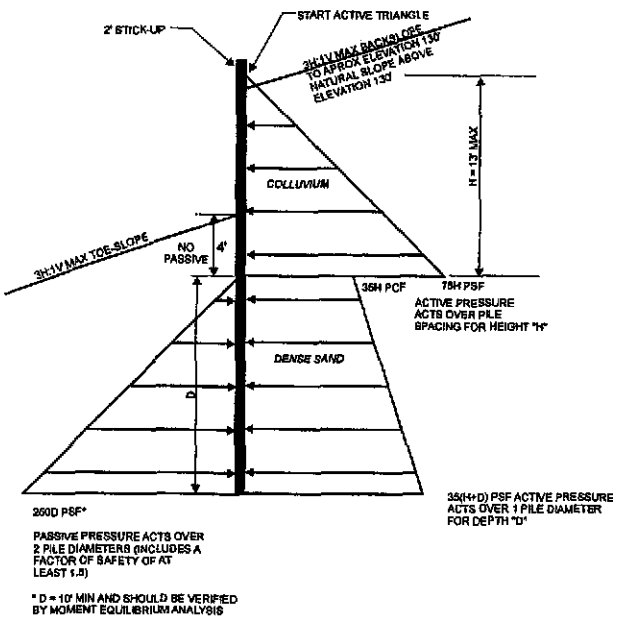
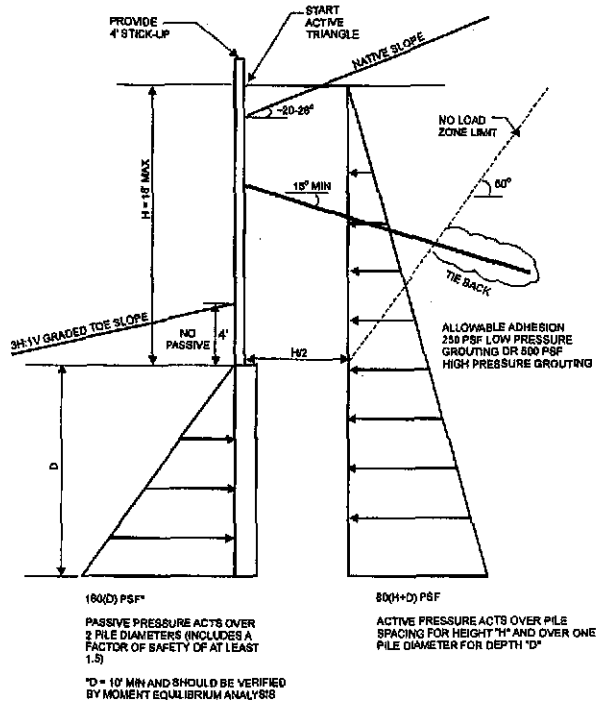



WEST WALL




EAST WALL

Notes:

1. Soldier pile embedment depth "D" should consider necessary vertical capacity, kickout, and overturning resistance and must be verified by the project structural engineer by moment equilibrium analysis.

2. All tiebacks should be prestressed to 130 percent of design load and locked off at 100 percent of design load. Tieback anchor zone is to be located behind the no-load zone.

3. Allowable tieback - soil adhesion - 250 psf (for low pressure grouting), or 500 (for high pressure grouting) behind no-load zone; includes a factor of safety of 2. To be verified by one 200 percent verification test per Post-tensioning Institute Guidelines.

4. Passive pressures are allowable and include a factor of safety of at least 1.5.

5. Diagram is approximate for one tieback level only.

6. Diagram assumes ground water conditions observed at time of drilling and maximum effective cuts of 13 feet for cantilever walls and 18 feet for tieback walls. Diagram does not include hydrostatic pressures and assumes walls are suitably drained to prevent buildup of hydrostatic pressure. Please refer to Figures 2 and 3 and logs for approximate ground water elevations.

7. Diagram is illustrative and not referenced to a particular location.

8. Shoring design criteria is based in part on proposed site geometries presented on site plan by Triad Associates.

NOT TO SCALE

Associated Earth Sciences, Inc.

**SOLDIER PILE WALL DESIGN EARTH PRESSURE DIAGRAMS**
**THE FARM @ WOODS CREEK**
**MONROE, WASHINGTON**

FIGURE 4
DATE 8/02
PROJ. NO. KE02446A

# LOG OF EXPLORATION PIT NO. EP-1

| Depth (ft) | This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. |
|---|---|
| | **DESCRIPTION** |
| | **Colluvium** |
| 1 | Soft to medium stiff, very moist, mottled gray-brown SILT with fine sand and gravel. |
| 2 | |
| 3 | Grades to medium stiff at 2.5'. |
| 4 | |
| 5 | At 5', changes to medium stiff, moist, red grading to gray SILT with very fine sand, massive unstratified. |
| 6 | Grades to medium stiff to stiff below 6'. |
| 7 | |
| 8 | Roots and charcoal below 8'. |
| 9 | |
| 10 | Bottom of exploration pit at depth 9.5 feet due to limits of backhoe. No ground water seepage. No caving. Former seepage zone from 4'-5'. |
| 11 | |
| 12 | |
| 13 | |
| 14 | |
| 15 | |
| 16 | |
| 17 | |
| 18 | |
| 19 | |
| 20 | |

**The Farm @ Woods Creek**
**Monroe, WA**

Associated Earth Sciences, Inc.

Logged by: SGB

Approved by:

**Project No. KE02446A**

**July 2002**

KCTP3 02446A-1.GPJ August 2, 2002

# LOG OF EXPLORATION PIT NO. EP-2

| Depth (ft) | This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.<br><br>**DESCRIPTION** |
|---|---|
| | **Colluvium** |
| 1 | Loose, moist, SILTY SAND with gravel and abundant roots. |
| 2 | EP60 |
| 3 | |
| 4 | **Colluvium/Shear Zone** |
| 5 | Soft to medium stiff, moist, mottled gray, SILTY very fine SAND to SANDY SILT with lenses of fine sand, trace fine roots and charcoal. ? |
| 6 | Medium stiff at 5'. |
| 7 | Stiff and no longer mottled at 7'. |
| 8 | Fractured texture and weakly stratified, color grades to blue-gray below 7'. |
| 9 | |
| 10 | |
| 11 | Bottom of exploration pit at depth 10 feet<br>No ground water seepage. No caving. |
| 12 | |
| 13 | |
| 14 | |
| 15 | |
| 16 | |
| 17 | |
| 18 | |
| 19 | |
| 20 | |

**The Farm @ Woods Creek**
**Monroe, WA**

Associated Earth Sciences, Inc.

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**July 2002**

KCTP3 02446A-1.GPJ August 2, 2002

# LOG OF EXPLORATION PIT NO. EP-3

EP61

| Depth (ft) | This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.<br><br>**DESCRIPTION** |
|---|---|
| | **Colluvium** |
| 1 | Loose/soft, moist, dark brown and gray, SILTY fine SAND mixed with SANDY SILT with gravel, cobbles, and roots. |
| 2 | |
| 3 | |
| 4 | At 3.5', changes to medium stiff, very moist, mottled brown-gray, SILTY fine SAND grading to SANDY SILT intermixed with SILT with gravel and cobbles (medium stiff and dark brown). |
| 5 | |
| 6 | |
| 7 | |
| 8 | **Pre-Vashon Lacustrine or Colluvial Shear Zone** |
| 9 | Stiff to very stiff, very moist, gray-brown, stratified, SANDY SILT with thin lenses of fine, wet sand, charcoal, wood and roots, small dropstones. |
| 10 | |
| 11 | |
| 12 | |
| 13 | Bottom of exploration pit at depth 12 feet<br>No ground water seepage. No caving. |
| 14 | |
| 15 | |
| 16 | |
| 17 | |
| 18 | |
| 19 | |
| 20 | |

**The Farm @ Woods Creek**
**Monroe, WA**

Associated Earth Sciences, Inc.

Logged by: SGB

Approved by:

**Project No. KE02446A**

**July 2002**

KCTP3 02446A-1.GPJ August 5, 2002

# LOG OF EXPLORATION PIT NO. EP-4

EP62

| Depth (ft) | This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.<br><br>**DESCRIPTION** |
|---|---|
| | Topsoil and Roots |
| 1 | |
| | **Colluvium** |
| 2 | Loose, moist, brown, medium to coarse SAND with gravel, trace silt with cobbles. |
| 3 | Changes to loose, moist to very moist, brown, SILTY SAND with gravel and cobbles mixed with SANDY SILT at 3'. |
| 4 | |
| 5 | |
| 6 | |
| 7 | At 7', changes to soft, wet, mottled brown and gray SILT with sand, some gravel, abundant charred wood. |
| 8 | |
| 9 | |
| 10 | |
| 11 | **Pre-Vashon Lacustrine or Colluvial Shear Zone** |
| 12 | Medium stiff, moist, gray mottled, massive SILT with fine sand. ? |
| 13 | Grades to stiff and gray at 13'. |
| 14 | |
| 15 | |
| 16 | Bottom of exploration pit at depth 15 feet<br>Slight ground water seepage at c/lc boundary. Severe caving upper 7'-8'. |
| 17 | |
| 18 | |
| 19 | |
| 20 | |

**The Farm @ Woods Creek**
**Monroe, WA**

Associated Earth Sciences, Inc.

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Approved by:

**Project No. KE02446A**

**July 2002**

KCTP3 02446A-1.GPJ August 2, 2002

# LOG OF EXPLORATION PIT NO. EP-5

EP63

| Depth (ft) | This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.<br><br>**DESCRIPTION** |
|---|---|
| | **Colluvium** |
| 1 | Mixture of loose, wet, brown SAND with gravel, trace silt and soft to medium stiff, wet, brown SILT with sand, gravel and cobbles, wood. |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | **Pre-Vashon Lacustrine or Colluvial Shear Zone** |
| 9 | Medium stiff, very moist, gray (mottled to 9') SILT with fine sand.<br>Grades to stiff below 9' and weakly stratified. |
| 10 | |
| 11 | |
| 12 | |
| 13 | |
| 14 | |
| 15 | |
| 16 | Bottom of exploration pit at depth 15 feet<br>Slight ground water seepage within sandy layers of colluvium. Slight caving above 8'. |
| 17 | |
| 18 | |
| 19 | |
| 20 | |

**The Farm @ Woods Creek**
**Monroe, WA**

Associated Earth Sciences, Inc.

Logged by: SGB

Approved by:

**Project No. KE02446A**

**July 2002**

KCTP3 02446A-1.GPJ August 5, 2002

# LOG OF EXPLORATION PIT NO. EP-6

| Depth (ft) | This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. **DESCRIPTION** |
|---|---|
| | **Colluvium** |
| 1 | Loose, very moist, dark brown, SILTY SAND mixed with SANDY SILT with roots, organics. |
| 2 | |
| 3 | |
| 4 | At 4', changes to soft to medium stiff, very moist, mottled gray and brown SILT with fine sand, trace organics and charred wood. |
| 5 | |
| 6 | |
| 7 | No longer mottled and grades to medium stiff to stiff below 7'. |
| 8 | |
| 9 | |
| 10 | Bottom of exploration pit at depth 9 feet<br>Very, very slight ground water seepage at 6'. No caving. |
| 11 | |
| 12 | |
| 13 | |
| 14 | |
| 15 | |
| 16 | |
| 17 | |
| 18 | |
| 19 | |
| 20 | |

**The Farm @ Woods Creek**
**Monroe, WA**

Associated Earth Sciences, Inc.

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**July 2002**

KCTP3 02446A-1.GPJ August 2, 2002

# LOG OF EXPLORATION PIT NO. EP-7

EP64

| Depth (ft) | This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. **DESCRIPTION** |
|---|---|
| | **Colluvium** |
| 1 | Soft grading to medium stiff, moist, brown SILT with gravel, sand, organics, charcoal. |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | At 8', changes to medium stiff grading to stiff, moist, gray-brown (mottled to 10') SILT. |
| 9 | |
| 10 | Contains little gravel and coarse sand, stiff at 10'. Weak stratification or fracturing? below 10'. |
| 11 | Bottom of exploration pit at depth 10 feet<br>No ground water seepage. No caving. |
| 12 | |
| 13 | |
| 14 | |
| 15 | |
| 16 | |
| 17 | |
| 18 | |
| 19 | |
| 20 | |

Qcpf

**The Farm @ Woods Creek**
**Monroe, WA**

Associated Earth Sciences, Inc.

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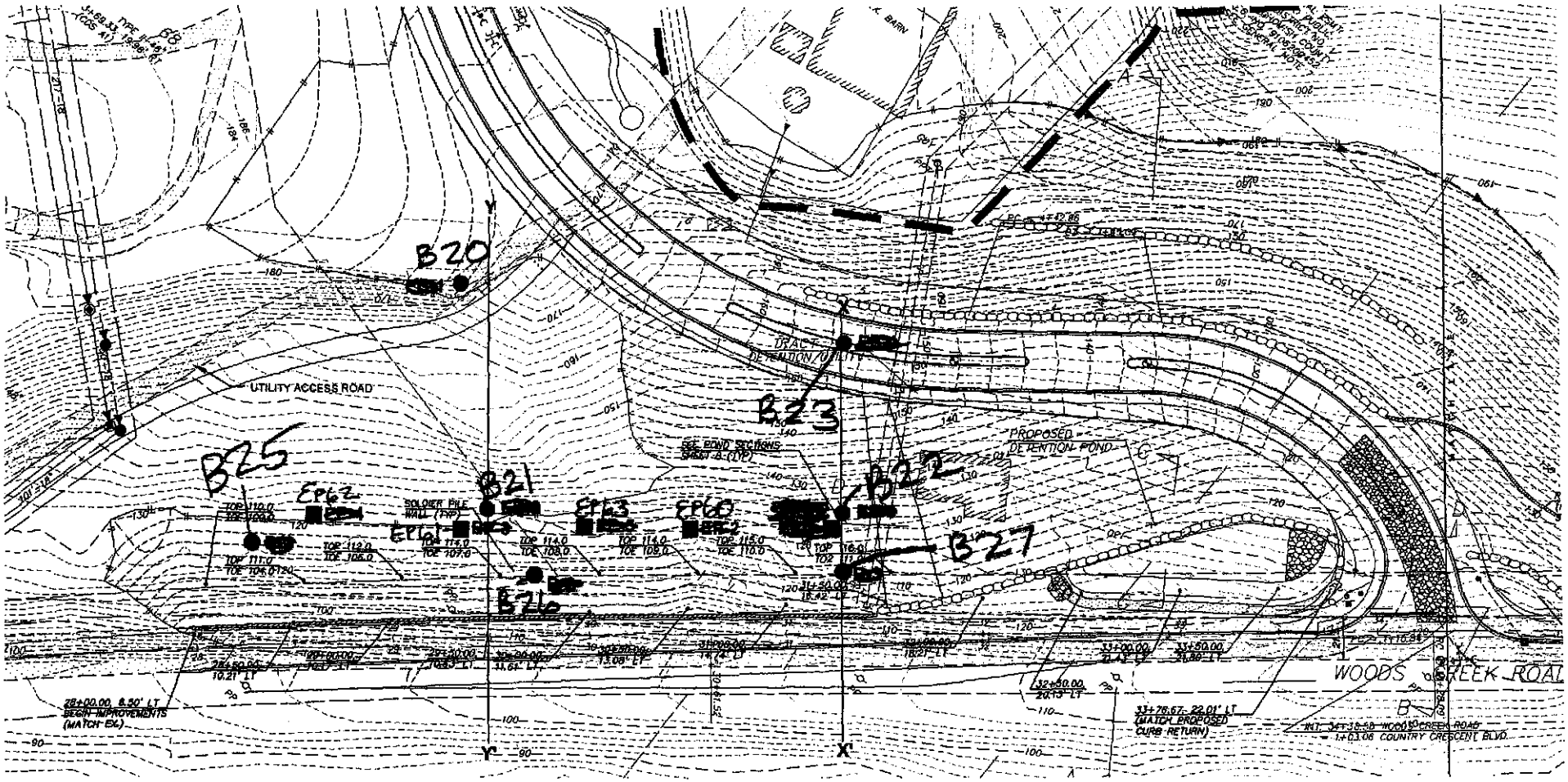
Approved by:

**Project No. KE02446A**

**July 2002**

KCTP3 02446A-1.GPJ August 2, 2002




**LEGEND**

EP-1 ■ Approximate location of exploration pit
EB-1 ● Approximate location of exploration boring
B-1 ● Approximate location of boring by Nelson Geotechnical Associates, Inc. April 2002

X——— X' Cross-section

2 ft contours

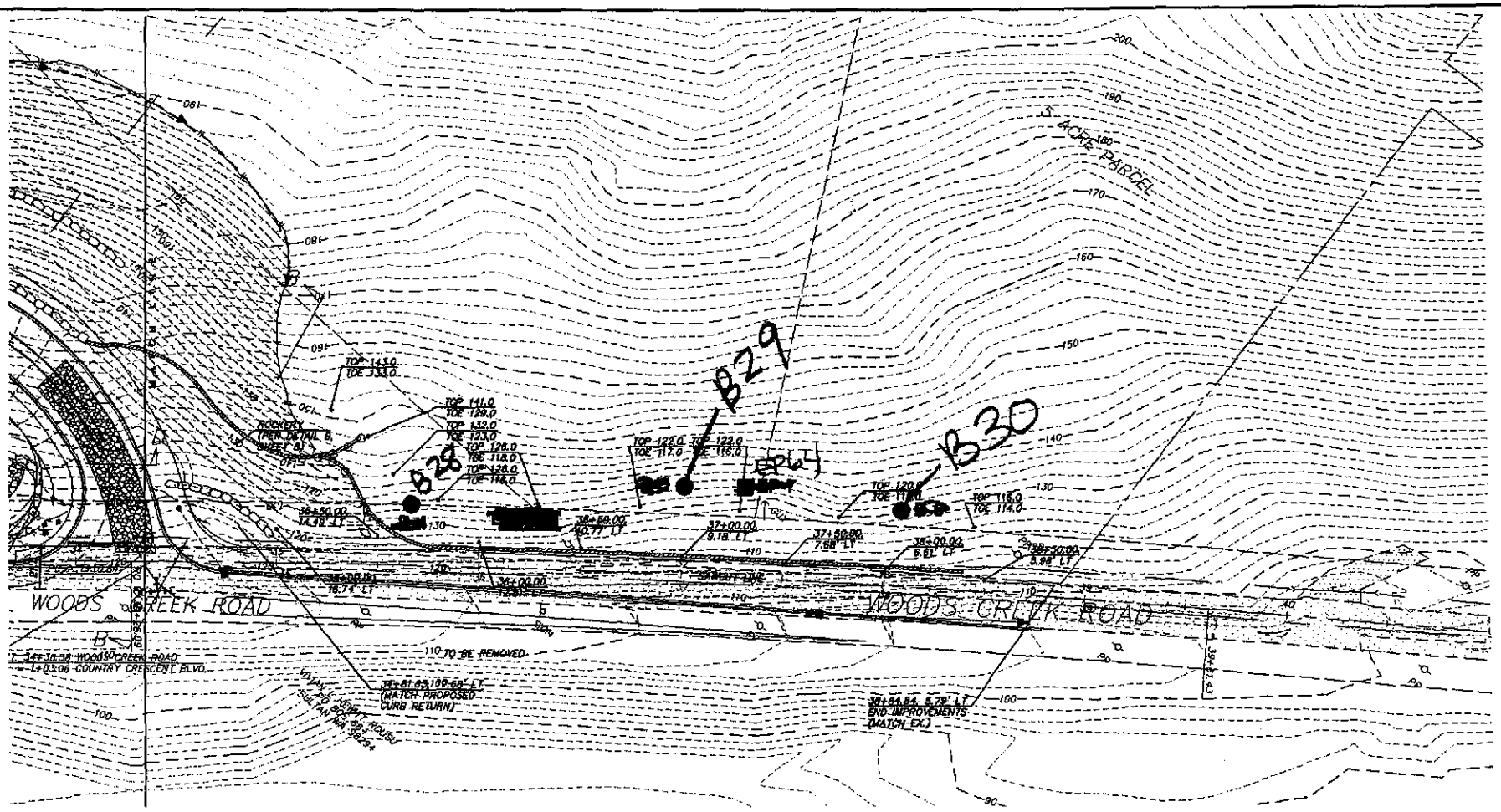
0 25 50 FEET

REFERENCE: TRIAD ASSOCIATES, 8/7/02.

Associated Earth Sciences, Inc.

SITE AND EXPLORATION PLAN
THE FARM @ WOODS CREEK
MONROE, WASHINGTON

FIGURE 1 - SHEET 1
DATE 06/02
PROJECT NO. KE02446A




**LEGEND**

- EP-1 ■ Approximate location of exploration pit
- EB-1 ● Approximate location of exploration boring
- B-1 ● Approximate location of boring by Nelson Geotechnical Associates, Inc. April 2002
- X——— X' Cross-section

REFERENCE: TRIAD ASSOCIATES, 8/7/02.

Associated Earth Sciences, Inc.

SITE AND EXPLORATION PLAN
THE FARM @ WOODS CREEK
MONROE, WASHINGTON

FIGURE 1 - SHEET 2
DATE 08/02
PROJECT NO. KE02446A

B-20

Associated Earth Sciences, Inc.

# Exploration Log

| Project Number | Exploration Number | Sheet |
|---|---|---|
| KE02446A | EB-1 | 1 of 1 |

Project Name: The Farm @ Woods Creek
Location: Monroe, WA
Driller/Equipment: Davies Drilling / B61
Hammer Weight/Drop: 140# / 30"
Ground Surface Elevation (ft): 164
Datum: N/A
Date Start/Finish: 07/23/02,07/24/02
Hole Diameter (in):

| Depth (ft) | ST | Samples | Graphic Symbol | DESCRIPTION | Well Completion | Water Level | Blows/6" | Blows/Foot (10 20 30 40) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|
| | | | | **Fill** | | | | | |
| | | | | Loose, moist, brown, SILTY SAND with gravel (cuttings). | | | | | |
| | | | | **Colluvium** | | | | | |
| | | S-1 | | Moist, red-brown, SILTY SAND with gravel and organics and clumps of silty clay. | | | 3 3 4 | ▲7 | |
| 5 | | S-2 | | | | | 1 2 3 | ▲5 | |
| | | S-3 | | | | | 2 4 3 | ▲7 | |
| 10 | | S-4 | | Grades to very moist, red-brown, medium to coarse SAND with gravel, trace silt and organics. | | | 6 6 5 | ▲11 | |
| | | S-5 | | *Bentonite 0-30'* | | | 5 5 4 | ▲9 | |
| 15 | | S-6 | | Grades to wet, yellow-brown mottled, SILTY fine to coarse SAND with gravel. Perched ground water | | ▼ | 9 10 6 | ▲16 | |
| | | S-7 | | | | | 4 5 8 | ▲13 | |
| | | | | **Transitional Sediments** | | | | | |
| 20 | | S-8 | | Moist, gray, CLAYEY SILT with fine sand. | | | 8 13 16 | ▲29 | |
| | | S-9 | | pp > 5 tsf (silt) Highly fractured (horizontal at ± 1" intervals), very thin fine SAND seams interbedded with SILTY very fine SAND. pp = 2.5 tsf in sandy areas. | | | 9 16 19 | ▲35 | |
| 25 | | S-10 | | 7/13 no BR | | | 5 16 18 | ▲34 | |
| 30 | | S-11 | | Occassional fractures. Sand layers become wet with trace silt. Most layers 6"-8" thick. *Sand 30'-35'* | | | 12 14 23 | ▲37 | |
| 35 | | S-12 | | Grades to gray, massive SILT (no sand lenses). *Screen 35'-45'* | | ▼ | 8 13 20 | ▲33 | |
| 40 | | S-13 | | Wet, brown, fine to medium SAND, trace silt seams from 40'-40.5'. | | | 14 15 23 | ▲38 | |
| 45 | | S-14 | | Wet, gray, CLAYEY SILT. *Bentonite plug 45'-50'* | | | 10 15 25 | ▲40 | |
| 50 | | S-15 | | Contains wet sand lenses (± 2" thick) at 50' and 51.5'. | | | 9 15 27 | ▲42 | |

Bottom of exploration boring at 51.5 feet
pp = pocket penetrometer reading (approximate unconfined compressive strength in tons per square foot).

164

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- Water Level (07/24/02)
- Water Level at time of drilling (ATD)

Logged by: SGB
Approved by:

AESIBOR 02446A-1.GPJ August 2, 2002

B21

Associated Earth Sciences, Inc.

# Exploration Log

| Project Number | Exploration Number | Sheet |
|---|---|---|
| KE02446A | EB-2 | 1 of 1 |

Project Name: The Farm @ Woods Creek
Location: Monroe, WA
Driller/Equipment: Davies Drilling / B61
Hammer Weight/Drop: 140# / 30"

Ground Surface Elevation (ft): 124
Datum: N/A
Date Start/Finish: 07/23/02,07/24/02
Hole Diameter (in):

| Depth (ft) | ST | Samples | Graphic Symbol | DESCRIPTION | Blows/6" | Blows/Foot (10 20 30 40) | Other Tests |
|---|---|---|---|---|---|---|---|
| | | | | **Fill** Loose, moist, brown, SILTY SAND (cuttings). | | | |
| | | | | **Colluvium** | | | |
| | | S-1 | | Very moist, brown-black-red-brown mottled, SILTY SAND intermixed with SANDY SILT with organics and gravel. | 2 2 4 | ▲6 | |
| 5 | | S-2 | | Becomes wet. *Bentonite 0-25'* | 2 2 4 | ▲6 | |
| | | S-3 | | pp = 2.5 tsf Very moist, gray and brown mottled, fractured, CLAYEY SILT with little organics and gravel. | 3 4 3 | ▲7 | |
| 10 | | S-4 | | pp = 0.75 tsf Contains saturated 6" fine SAND seams. Perched ground water | 2 3 5 | ▲8 | |
| | | S-5 | | pp = 2.25 - 3 tsf. Saturated. | 2 4 5 | ▲9 | |
| | | | | **Transitional Sediments** | | | |
| 15 | | S-6 | | pp = 2.5 - 4.5 tsf Very moist, gray SILT with very fine sand and trace very fine sand seams. | 4 7 9 | ▲16 | |
| | | S-7 | | | 5 7 9 | ▲16 | |
| 20 | | S-8 | | Wet, brown, fine SAND with trace silt grading to little silt. | 5 10 12 | ▲22 | |
| 25 | | S-9 | | Moist, brown, SILTY fine to medium SAND with trace silt clumps (layered) and organics. *Sand 25'-30'* | 9 12 11 | ▲23 | |
| 30 | | S-10 | | Moist, brown, fine SAND, little silt. *Screen 30'-40'* | 10 19 23 | ▲42 | |
| 35 | | S-11 | | Wet, brown, medium SAND with trace silt grading to fine SAND, some silt at 36'. *Natural sand pack 37'-40' due to heave* | 4 11 20 | ▲31 | |
| 40 | | S-12 | | | 26 50 | ▲50/6" | |

Bottom of exploration boring at 41 feet
pp = pocket penetrometer reading (approximate unconfined compressive strength in tons per square foot). 3' of heave in saturated sands at 40'.

Well Completion / Water Level

124
41
83

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- Water Level (07/26/02)
- Water Level at time of drilling (ATD)

Logged by: SGB
Approved by:

AESIBOR 02446A-1.GPJ August 2, 2002

B22

Associated Earth Sciences, Inc.

# Exploration Log

| Project Number | Exploration Number | Sheet |
|---|---|---|
| KE02446A | EB-3 | 1 of 1 |

Project Name: The Farm @ Woods Creek
Location: Monroe, WA
Driller/Equipment: Davies Drilling / B61
Hammer Weight/Drop: 140# / 30"
Ground Surface Elevation (ft): 126
Datum: N/A
Date Start/Finish: 07/23/02,07/24/02
Hole Diameter (in):

| Depth (ft) | ST | Samples | Graphic Symbol | DESCRIPTION | Blows/6" | Blows/Foot (10 20 30 40) | Other Tests |
|---|---|---|---|---|---|---|---|
| | | | | **Colluvium** | | | |
| | | S-1 | | Moist, red-brown, SILTY fine to medium SAND with gravel, cobbles, and organics. | 2 3 2 | 5 | |
| 5 | | S-2 | | Grades to very moist, gray-brown mottled SILT with sand, gravel and organics. | 2 2 6 | 8 | |
| | | S-3 | | Very moist, mottled gray and brown, CLAYEY SILT with fine SAND, trace organics (massive). | 3 5 6 | 11 | |
| 10 | | S-4 | | *Bentonite 0-23'* | 2 2 3 | 5 | |
| | | S-5 | | Little organics and gravel, wet and highly fractured. Perched ground water | 1 2 2 | 4 | DS BD |
| 15 | | S-6 | | Grades to wet, gray SILT with fine sand, trace organics, occasionally fractures, trace clay. | 2 2 2 | 4 | |
| | | | | **Holocene Alluvium?** | | | |
| | | S-7 | | Color changes to dark gray/black at 19'. Little organics. Organic silt from 19'-20'. | 4 6 8 | 14 | |
| 20 | | S-8 | | **Transitional Sediments** Moist, gray SILT with fine sand. | 5 10 10 | 20 | DS BD |
| | | S-9 | | Very moist, brown, fine SAND, trace silt. | 10 18 25 | 43 | |
| 25 | | S-10 | | Grades to moist, brown SILT with very fine sand-filled fractures (horizontal sand seams at 1" ± increments). *Sand 23'-30'* | 7 15 21 | 36 | |
| | | S-11 | | Moist, very fine SAND, trace silt. | 8 25 34 | 59 | |
| 30 | | S-12 | | | 10 18 27 | 45 | |
| | | S-13 | | Very slight mottling. | 12 26 32 | 58 | |
| 35 | | S-14 | | Grades to wet, brown, fine to medium SAND, little silt. *Screen 30'-40'* | 11 19 26 | 45 | |
| 40 | | S-15 | | | 11 20 32 | 52 | |

Bottom of exploration boring at 41.5 feet
No heave within saturated sands.
Lab Tests
DS = Direct Shear BD = Bulk Density

785 NO BR

126 41 85

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- Water Level (07/26/02)
- Water Level at time of drilling (ATD)

Logged by: SGB
Approved by:

AESIBOR 02446A-1.GPJ August 5, 2002

B23

Associated Earth Sciences, Inc.

# Exploration Log

| Project Number | Exploration Number | Sheet |
|---|---|---|
| KE02446A | EB-4 | 1 of 1 |

Project Name: The Farm @ Woods Creek
Location: Monroe, WA
Driller/Equipment: Davies Drilling / B61
Hammer Weight/Drop: 140# / 30"

Ground Surface Elevation (ft): 154
Datum: N/A
Date Start/Finish: 07/23/02,07/24/02
Hole Diameter (in):

| Depth (ft) | ST | Samples | Graphic Symbol | DESCRIPTION | Blows/6" | Blows/Foot (10 20 30 40) | Other Tests |
|---|---|---|---|---|---|---|---|
| | | | | 1-1/4" minus crushed rock | | | |
| | | | | **Roadway Fill** | | | |
| | | S-1 | | Rock in sampler - blow counts overstated. Very moist, brown, SILTY fine to medium SAND with gravel- to cobble-sized rock ballast 4"x8". | 50/2" | ▲50/2" | |
| 5 | | S-2 | | Rock in sampler - blow counts overstated. Grades to very moist, brown, medium to coarse SAND with gravel, cobbles, little silt. | 5 12 41 | ▲53 | |
| | | | | **Colluvium** | | | |
| | | S-3 | | Wet, brown, medium to coarse SAND with gravel. | 6 6 7 | ▲13 | |
| 10 | | S-4 | | *Bentonite 0-20'* | 7 5 2 | ▲7 | |
| | | | | Becoming saturated. Perched ground water | | | |
| | | S-5 | | Wet, gray SILT. | 3 3 2 | ▲5 | |
| | | | | **Transitional Sediments** | | | |
| 15 | | S-6 | | pp = 4.75 - 4.5 tsf Moist, gray, CLAYEY SILT. | 5 10 19 | ▲29 | |
| | | S-7 | | pp = 3.5 - 2.5 tsf Contains fine SAND seams. | 6 12 15 | ▲27 | |
| 20 | | S-8 | | pp = 1 - 0.75 tsf Grades to wet, gray, SILTY very fine SAND. | 7 12 15 | ▲27 | |
| | | S-9 | | *Sand 20'-32'* | 8 11 14 | ▲25 | |
| 25 | | S-10 | | pp = 3.25 tsf Grades to very moist, gray, SILTY fine to medium SAND interbedded with SILTY very fine SAND. | 10 15 16 | ▲31 | |
| | | S-11 | | Silt from 27.5'-28.5'. Wet, brown, fine to medium SAND with silt to SILTY SAND from 28.5'-29' with 45-degree lenses of stratified SILT to 1" thick interbedded very fine SAND with silt and SILT with very fine sand. | 7 14 19 | ▲33 | |
| 30 | | S-12 | | *Screen 25'-35'* | 10 17 19 | ▲36 | |
| | | S-13 | | Traces of wood fragments. | 8 14 22 | ▲36 | |
| 35 | | S-14 | | pp = 4 tsf Moist, gray SILT with very fine sand (massive). | 6 14 19 | ▲33 | |
| | | S-15 | | *Bentonite 35'-40'* pp > 5 tsf | 9 14 19 | ▲33 | |
| 40 | | S-16 | | pp > 5 tsf Grades to moist, gray, massive, CLAYEY SILT with trace very fine sand. | 7 12 19 | ▲31 | |

Bottom of exploration boring at 41.5 feet
pp = pocket penetrometer reading (approximate unconfined compressive strength in tons per square foot).

7113 NO BR

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- Water Level (07/24/02)
- Water Level at time of drilling (ATD)

Logged by: SGB
Approved by:

AESIBOR 02446A-1.GPJ August 2, 2002

# Boring B-1

STATION 2B+30 20 FT W OF ROW

B25

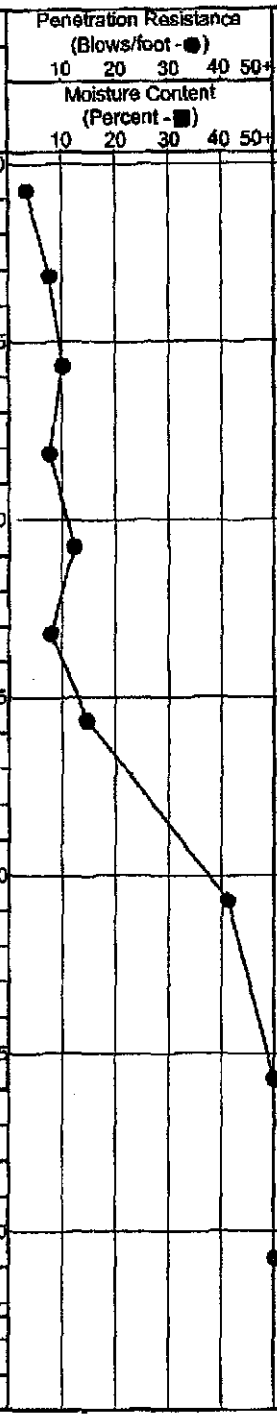
Approximate Ground Surface Elevation: 124 ft (DPD)

Logged by: MDR on 04/08/02

| Depth in Feet | Soil Profile: Description | Graphic Log | Sample Data: Group Symbol | Blow Count | Sample Location |
|---|---|---|---|---|---|
| 0 | Dark brown to brown iron oxid stained silty Sand with Gravel and abundant organics (loose, moist to wet) **(Topsoil)** | | SM | 3 | |
| | Brown to gray iron oxide stained fine to coarse SAND with gravel (loose, moist to wet) | | SM | 8 | |
| 5 | Brown to gray iron oxide stained silty fine to coarse sand with gravel and fine sand seam (loose, moist to wet) | | SM | 10 | |
| | Silt with fine sand seam (stiff, moist to wet) | | ML | | |
| | Brown to gray SILT with fine sand and fine sand seams (medium stiff, moist) | | ML | 8 | |
| 10 | Gray SILT with fine sand (stiff, moist) | | ML | 12 | |
| | | | ML | 8 | |
| 15 | | | ML | 14 | |
| 20 | Brown fine to medium SAND with trace silt (dense, moist) | | SP | 41 | |
| | Brown sandy SILT (hard, moist) | | ML | | |
| | Heaving sand | | | | |
| 25 | Brown fine to medium SAND with trace silt (very dense, wet) | | SP | 72 | |
| | Heaving sand | | | | |
| 30 | Brown/gray fine to coarse SAND with trace silt (very dense, wet) | | SP | 50/6" | |
| | Boring completed at 31.0 feet on 04/08/02. Groundwater was encountered at 21.0 feet during drilling. | | | | |

93 NO BR

124 − 31 = 93




## LEGEND

- Depth 2" O.D. split spoon sample driven
- * Liquid Limit
- + Plastic Limit
- Impervious seal
- Water level
- Piezometer tip
- P Sample pushed
- TV Torvane reading, tons/ft²
- PP Pocket penetrometer reading, tons/ft²

NOTE: The stratification lines represent the approximate boundaries between soil types and the transition may be gradual.

PROJECT NUMBER 3227B02

Figure 4

Page 1 of 1

**WoodsCreek Road Widening Boring Log**

NELSON GEOTECHNICAL ASSOCIATES, INC.
GEOTECHNICAL ENGINEERS & GEOLOGISTS
17311-135th Ave. NE, A-500 Woodinville, WA 98072 (425) 488-1968 / Fax 481-2010
Snohomish County (425) 337-1689 Wenatchee/Chelan (509) 784-2735 www.nelsongeotech.com

| NO. | DATE | REVISION | BY | CK |
|---|---|---|---|---|
| 1 | 04/16/02 | | JAW | |

mgsdrafts\2002\postcad\3227 Form at Woods Creek\3227B1 WoodsCreekLog.dwg

Logged by: MDR on 04/08/02

# Boring B-2

STATION 29+70

B26

Approximate Ground Surface Elevation: 122 (topo)

| Depth in Feet | Description | Group Symbol | Blow Count |
|---|---|---|---|
| 0 | Dark brown silty fine to coarse Sand with Gravel and abundant organics (loose, moist to wet)(Topsoil) | SM | 8 |
| | Brown silty fine to coarse SAND with gravel (medium dense, wet) | SM | 26 |
| 5 | Brown to gray silty fine to coarse sand with gravel (medium dense, moist to wet) | SM | 26 |
| | Brown iron oxide stained silty fine to coarse SAND (loose, moist to wet) | SM | 12 |
| | Brown to gray iron oxide stained SILT with fine sand seams (medium stiff, moist to wet) | ML | |
| 10 | Brown to gray SILT with fine to medium sand (stiff, moist to wet) | ML | 14 |
| | Brown to gray iron oxide stained SILT with with trace organics (very stiff, moist to wet) | ML | 29 |
| 15 | Brown Silty fine to medium SAND (stiff, moist to dry) | SM | 44 |
| 20 | Brown to gray fine to medium SAND with trace silt (dense, moist) | SP | 49 |
| | Heaving sand | | |
| 25 | (very dense, moist) | SP | 64 |
| | Boring completed at 26.5 feet on 04/08/02. Groundwater was encountered at 22.0 feet during drilling. | | |
| 30 | | | |

Penetration Resistance (Blows/foot - ●): 10 20 30 40 50+

Moisture Content (Percent - ■): 10 20 30 40 50+

Laboratory Testing

Piezometer Installation - Ground Water Data

122 - 26 = 96

-96 NO BR

## LEGEND

- Depth 2" O.D. split spoon sample driven
- * Liquid Limit
- + Plastic Limit
- Impervious seal
- Water level
- Piezometer tip
- P Sample pushed
- TV Torvane reading, tons/ft²
- PP Pocket penetrometer reading, tons/ft²

NOTE: The stratification lines represent the approximate boundaries between soil types and the transition may be gradual.

| PROJECT NUMBER | | | |
|---|---|---|---|
| 3227B02 | WoodsCreek Road Widening Boring Log | NELSON GEOTECHNICAL ASSOCIATES, INC. GEOTECHNICAL ENGINEERS & GEOLOGISTS | 1 04/15/02 JAW |
| Figure 5 | | | |
| Page 1 of 1 | | | |

17311-135th Ave. NE, #-500 Woodinville, WA 98072 (425) 486-1669 / Fax 481-2510
Snohomish County (425) 337-1888 Wenatchee/Chelan (509) 784-1755 www.nelsongeotech.com

| NO. | DATE | REVISION | BY | CK |
|---|---|---|---|---|

ngpdrafting2002\projects\3227 Farm at Woods Creek\3227B1 WoodsCreekLog.dwg

# Boring B-3

STATION 31+30

B27

Approximate Ground Surface Elevation: 115 (Topo)

Logged by: MDR on 04/09/02

| Depth in Feet | Soil Profile: Description | Graphic Log | Sample Data: Group Symbol | Blow Count | Sample Location |
|---|---|---|---|---|---|
| 0 | Brown silty fine to coarse Sand with Gravel and abundant organics (loose, wet)(Topsoil) | | SM | 7 | |
| | Brown to gray iron oxide stained silty fine to coarse SAND with gravel (loose, wet) | | SM | 5 | |
| 5 | ( dense,wet) | | SM | 50/2" | |
| | | | SM | 38 | |
| 10 | Brown iron-oxide-stained fine SAND and brown silt with sand lenses (medium dense, wet) | | SP-SM | 16 | |
| 15 | Brown SILT with sand | | ML | | |
| | Brown silty fine to coarse SAND with silt | | SM | 30 | |
| | Brown fine SAND with silt (very stiff/medium dense to dense, moist) | | SP-SM | | |
| | Heaving sand | | | | |
| 20 | Brown to gray fine to medium SAND with trace silt (very dense, moist to wet) | | SP | 69 | |
| | Boring completed at 21.5 feet on 04/09/02. Groundwater was encountered at 18.0 feet during drilling. | | | | |
| 25 | | | | | |
| 30 | | | | | |

Penetration Resistance (Blows/foot - ●): 10 20 30 40 50+

Moisture Content (Percent - ■): 10 20 30 40 50+

Laboratory Testing

Piezometer Installation - Ground Water Data

115 - 21 = 94

794 no BR

LEGEND

- Depth 2" O.D. split spoon sample driven
- * Liquid Limit
- + Plastic Limit
- Impervious seal
- Water level
- Piezometer tip
- P Sample pushed
- TV Torvane reading, tons/ft²
- PP Pocket penetrometer reading, tons/ft²

NOTE: The stratification lines represent the approximate boundaries between soil types and the transition may be gradual.

PROJECT NUMBER 3227B02

Figure 6

Page 1 of 1

WoodsCreek Road Widening Boring Log

NELSON GEOTECHNICAL ASSOCIATES, INC.
GEOTECHNICAL ENGINEERS & GEOLOGISTS

17311-135th Ave. NE, A-500 Woodinville, WA 98072 (425) 485-1669 / Fax 481-2510

Snohomish County (425) 337-1669 Monroe/Sultan (360) 794-3739 www.nelsongeotech.com

| No. | DATE | REVISION | BY | CK |
|---|---|---|---|---|
| 1 | 04/18/02 | | JAW | |

mpodrh/drgs2002/revised/3227 Farm at Woods Creek/3227B01 WoodsCreek.dwg

# Boring B-4

STATION 35+65

B28

Approximate Ground Surface Elevation: 135 (topo)

| Depth in Feet | Soil Profile: Description | Graphic Log | Sample Data: Group Symbol | Blow Count | Sample Location |
|---|---|---|---|---|---|
| 0 | Dark brown silty SAND with Gravel and straw (very loose, moist to wet)(Topsoil) | | SM | 4 | |
| | Brown to gray Iron oxided stained SILT with sand (stiff, moist) | | ML | 10 | |
| 5 | with a lense of fine wet sand (stiff, moist to wet) | | ML | 14 | |
| | with fine sand lenses and hard silt chunks (stiff, moist) | | ML | 13 | |
| 10 | (very stiff, moist) | | ML | 17 | |
| | with 1" seam of silty sand with gravel | | ML | 22 | |
| 15 | with trace gravel (stiff, moist) | | ML | 12 | |
| 20 | Gray to brown SILT with sand (very stiff, moist) | | ML | 21 | |
| | Brown SILT with sand and gravel (hard, moist to wet) | | ML | 50/4" | |
| 25 | Boring completed at 23.0 feet on 04/09/02. Groundwater was not encountered during drilling. | | | | |
| 30 | | | | | |

Penetration Resistance (Blows/foot - ●) 10 20 30 40 50+

Moisture Content (Percent - ■) 10 20 30 40 50+

Laboratory Testing

Piezometer Installation - Ground Water Data

135
123
112

7 112
no BR

**LEGEND**

- Depth 2" O.D. split spoon sample driven
- * Liquid Limit
- + Plastic Limit
- Impervious seal
- Water level
- Piezometer tip
- P Sample pushed
- TV Torvane reading, tons/ft²
- PP Pocket penetrometer reading, tons/ft²

NOTE: The stratification lines represent the approximate boundaries between soil types and the transition may be gradual.

| PROJECT NUMBER | | NELSON GEOTECHNICAL ASSOCIATES, INC. | | |
|---|---|---|---|---|
| 322701 | WoodsCreek Road Widening Boring Log | NGA GEOTECHNICAL ENGINEERS & GEOLOGISTS | 1 | 04/16/02 |
| Figure 7 | | 17311-135th Ave. NE, A-300 Woodinville, WA 98072 (425) 486-1669 / Fax 485-2310 | Snohomish County (425) 337-1669 Westchester/Tacoma (509) 784-2758 www.nelsongeotech.com | |
| Page 1 of 1 | | | | |

# Boring B-5

STATION 37+00 9.5 FT N

B29

Approximate Ground Surface Elevation: 136 (top)

Logged by: JAW on 4/10/02

| Depth in Feet | Soil Profile: Description | Graphic Log | Sample Data: Group Symbol | Blow Count | Sample Location |
|---|---|---|---|---|---|
| 0 | Tan silty fine SAND with straw and organics (loose, moist)(Topsoil) | | SM | 5 | |
| | Tan silty fine SAND (loose, moist) | | SM | 9 | |
| | Brown to gray iron oxided stained SILT (stiff, moist) | | ML | | |
| 5 | with a lense of fine moist sand (stiff, moist) | | ML | 12 | |
| | with fine sand seams and trace gravel and inclusions of hard silt chunks (medium stiff, moist) | | ML | 6 | |
| 10 | with occasional fine sand seams with hard silt chunks (stiff, moist) | | ML | 9 | |
| | with 2" seam of brown fine to medium wet sand with inclusions of hard silt chunks (very stiff, moist) | | ML | 16 | |
| 15 | Interbedded brown silty fine to medium SAND with iron oxide stained silt (medium dense, moist) | | SP-SM/ML | 31 | |
| 20 | with gravel | | SP-SM | 17 | |
| | Brown to gray and iron oxide stained SILT (very stiff, moist) | | ML | | |
| 25 | Brown and iron oxide stained SILT (hard, moist) | | ML | 45 | |
| | Boring completed at 26.0 feet on 04/10/02. Groundwater was not encountered during drilling. | | | | |
| 30 | | | | | |

136
26
110

>110 NO BR

Penetration Resistance (Blows/foot - ●): 10 20 30 40 50+
Moisture Content (Percent - ■): 10 20 30 40 50+

Laboratory Testing

Piezometer Installation - Ground Water Data

LEGEND

- Depth 2" O.D. split spoon sample driven
- * Liquid Limit
- + Plastic Limit
- Impervious seal
- Water level
- Piezometer tip
- P Sample pushed
- TV Torvane reading, tons/ft²
- PP Pocket penetrometer reading, tons/ft²

NOTE: The stratification lines represent the approximate boundaries between soil types and the transition may be gradual.

PROJECT NUMBER 3227B02

Figure 8

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WoodsCreek Road Widening Boring Log

NELSON GEOTECHNICAL ASSOCIATES, INC.
GEOTECHNICAL ENGINEERS & GEOLOGISTS

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| NO. | DATE | REVISION | BY | CK |
|---|---|---|---|---|
| 1 | 04/10/02 | | JAW | |

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# Boring B-6

STATION 38+05 6.0 FT N

B30

Approximate Ground Surface Elevation: 130 (topo)

Logged by JAW on 4/10/02

| Depth in Feet | Soil Profile – Description | Graphic Log | Sample Data – Group Symbol | Blow Count | Sample Location |
|---|---|---|---|---|---|
| 0 | Light to dark brown SILT with organics (medium stiff, moist)(**Topsoil**) | | ML | 5 | |
| | Brown to gray iron oxided stained SILT with sand seams and organics (stiff, moist) | | ML | 9 | |
| 5 | (medium stiff, moist) | | ML | 7 | |
| | Brown-tan iron oxided stained SILT with sand seams and occasional fine to coarse gravel (stiff, moist) | | ML | 10 | |
| 10 | Brown silty fine SAND with trace gravel (loose, wet) | | SM | 7 | |
| | Brown to gray iron oxide stained SILT with sand seams and occasional coarse sand and fine gravel (very stiff, moist) | | ML | 11 | |
| 15 | with brown fine sand seams | | ML | 13 | |
| 20 | Brown to gray and iron oxide stained SILT (stiff, moist) | | ML | 15 | |
| | | | ML | 14 | |
| 25 | with sand seams (very stiff, moist) | | ML | 26 | |
| | with wet sand lense | | ML | 24 | |
| 30 | Boring completed at 27.5 feet on 04/10/02. Groundwater was not encountered during drilling. | | | | |

Penetration Resistance (Blows/foot - ●): 10 20 30 40 50+

Moisture Content (Percent - ■): 10 20 30 40 50+

Laboratory Testing

Piezometer Installation - Ground Water Data

130
-27
103

~103 no BR

**LEGEND**

- Depth 2" O.D. split spoon sample driven
- ✱ Liquid Limit
- + Plastic Limit
- Impervious seal
- Water level
- Piezometer tip
- P Sample pushed
- TV Torvane reading, tons/ft²
- PP Pocket penetrometer reading, tons/ft²

NOTE: The stratification lines represent the approximate boundaries between soil types and the transition may be gradual.

| PROJECT NUMBER | | |
|---|---|---|
| 3227B02 | WoodsCreek Road Widening Boring Log | NELSON GEOTECHNICAL ASSOCIATES, INC. GEOTECHNICAL ENGINEERS & GEOLOGISTS |
| Figure 9 | | 17711-135th Ave. NE, A-500 Woodinville, WA 98072 (425) 486-1669 / Fax 421-2510 |
| Page 1 of 1 | | Snohomish County (425) 337-1669 Monroe/Sultan (360) 794-7758 www.nelsongeotech.com |

| No. | Date | Revision | By | Ck |
|---|---|---|---|---|
| 1 | 04/15/02 | | JAW | |

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