SUBSURFACE EXPLORATION AND PRELIMINARY GEOTECHNICAL ENGINEERING REPORT

PROPOSED ZAHRADNIK SUBDIVSION

SNOHOMISH COUNTY, WASHINGTON

PREPARED FOR

Mr. John C. Raby

PROJECT NO. KE98305G

SEPA 278
MJ 98-0026LP

OCTOBER 1998

CORPORATE OFFICE
911 Fifth Avenue, Suite 100
Kirkland, Washington 98033
(425) 827-7701
FAX (425) 827-5424

ASSOCIATED EARTH SCIENCES, INC

BAINBRIDGE ISLAND OFFICE
179 Madrone Lane North
Bainbridge Island, WA 98110
(206) 780-9370
FAX (206) 780-9438

SUBSURFACE EXPLORATION AND
PRELIMINARY GEOTECHNICAL ENGINEERING REPORT
PROPOSED ZAHRADNIK SUBDIVISION
HIGHWAY 9 AND 172ND STREET NE
SNOHOMISH COUNTY, WASHINGTON

October 30, 1998
Project No. KE98305G

I. PROJECT AND SITE CONDITIONS

1.0 INTRODUCTION

This report presents the results of our subsurface exploration and preliminary geotechnical engineering study for the proposed Zahradnik Subdivision site, located near the northwest corner of the intersection of Highway 9 and 172nd Street NE in Snohomish County, Washington. Our report is considered preliminary, as grading and construction plans have not been finalized at this time. The site layout and approximate locations of the explorations accomplished for this study are presented on the Site and Exploration Plan, Figure 1. In the event that any changes in the nature, design, or layout of the project are planned, the conclusions and recommendations contained in this report should be reviewed and modified, or verified, as necessary.

1.1 Purpose and Scope

The purpose of this study was to provide subsurface data to be used in the design and development of the above-noted project. Our study included a review of published geologic information, completion of 11 exploration pits using a tracked excavator, geotechnical engineering analyses, and preparation of this report.

1.2 Authorization

Our work was completed in general accordance with our proposal for this project dated July 27, 1998, and we were subsequently authorized to proceed by means of a signed copy of our proposal dated August 7, 1998. This report has been prepared for the exclusive use of Mr. John C. Raby and his agents, for specific application to this project. Within the limitations of scope, schedule, and budget, our services have been performed in accordance with generally accepted geotechnical engineering and engineering geology practices in effect in this area at the time our report was prepared. No other warranty, expressed or implied, is made.

2.0 PROJECT AND SITE DESCRIPTION

The project site is located north of 172nd Street NE and west of Highway 9 in Snohomish County near Arlington, Washington. An area immediately at the northwest corner of that intersection is omitted from the site, and an existing home along 172nd Street NE is omitted from the southwest corner of the site. An access easement proceeds southward from the main portion of the site to 172nd Street NE. The site is irregularly shaped, and includes approximately 36 acres. The site is bound to the north by a residential development that is partially constructed; to the south by a residence, a vacant property, and 172nd Street NE; to the east by Highway 9, and to the west by existing residences.

Site topography was generally flat to gently sloping. Overall vertical relief was relatively low, estimated on the order of 20 feet or less. Site vegetation consists of second growth forest of mixed composition, with moderate to heavy understory vegetation. Wetlands had been identified by others on some portions of the site. Although no surface water was observed during our site visit, we anticipate that it may be present seasonally in wetland areas.

The proposed project would include construction of a new subdivision. The Preliminary Lot Layout by NOVA dyne Engineering dated 10/98 includes 140 single-family home sites, along with a network of access roads which are unnamed on the preliminary plan. Although no grading plan was available for our review, we anticipate that relatively minor grading will be required to construct the project as envisioned, with excavation cuts and structural fills generally less than about 3 to 5 feet in thickness. The preliminary plan shows new home sites in the locations of some areas currently identified as wetlands, and therefore we anticipate that some grading in wetland areas will be required to complete the project as currently envisioned.

3.0 SUBSURFACE EXPLORATION

Our subsurface investigation for the project included excavating 11 exploration pits on the site using a tracked excavator, and conducting a visual reconnaissance to gain information about the site. The various types of sediments, as well as the depths where characteristics of the sediments changed, are indicated on the exploration logs presented in the Appendix. The depths indicated on the logs where conditions changed may represent gradational variations between sediment types. Our explorations were approximately located in the field by measuring from marked property corners using a hand-held compass and a hip chain.

The conclusions and recommendations in this report are based, in part, on the exploration pits completed for this study. Because of the nature of exploratory work below ground, extrapolation of subsurface conditions between field explorations is necessary. It should be noted that differing subsurface conditions may sometimes be present due to the random nature of deposition and the alteration of topography by past grading and/or filling. Additionally, we were asked not to enter wetland areas during our site investigation, although the preliminary development plan indicates that development is proposed in the wetland areas. Variations in subsurface conditions are commonly encountered in wetland areas, as compared to adjacent portions of the site that do not contain wetlands. The nature and extent of any variations between the field explorations and in unexplored areas may not become fully evident until construction. If variations are observed at that time, it may be necessary to reevaluate specific recommendations in this report and make appropriate changes.

3.1 Exploration Pits

The exploration pits advanced for this study were excavated with a track-mounted excavator. The pits permitted direct, visual observation of subsurface conditions. Materials encountered in the exploration pits were studied and classified in the field by an engineering geologist from our firm. All exploration pits were backfilled immediately after examination and logging. Selected samples were then transported to our laboratory for further visual classification and testing, as necessary.

4.0 SUBSURFACE CONDITIONS

Subsurface conditions at the project site were inferred from the referenced field explorations accomplished within the study area, visual reconnaissance of the site, and review of applicable geologic literature.

As shown on the field logs, the exploration pits generally encountered topsoil underlain by loose to medium dense silty sands, which graded to dense and very dense at increasing depth. The following section presents more detailed subsurface information organized from the shallowest (youngest) to the deepest (oldest) sediment types.

4.1 Stratigraphy

Subsurface conditions on the parcel were inferred from the field explorations accomplished as part of this study of the site, visual reconnaissance, and review of the U.S. Geological Survey (USGS) Geologic Map of the area titled, *Distribution and Description of the Geologic Units in the Arlington East Quadrangle, Washington*, by James P. Minard (1980). Our subsurface explorations encountered glacial deposits of lodgement till at each exploration location. Although no exploration pits were completed in the wetland areas located on the site, it has been our experience on other project sites that these drainage swales and closed drainage basins may contain shallow deposits of organic silt and peat that have formed above the lodgement till.

The referenced geological map indicates that area soils consist of deposits of Vashon lodgement till, which confirms our interpretation. The lodgement till was deposited by the Vashon stage glacial ice sheet, which advanced into the area approximately 15,000 years ago during the Fraser glacial period. The dense condition of the till is due to its compaction by approximately 3,000 feet of glacial ice which once overlaid these sediments. The upper 2 to 3 feet of the till soils are generally loose to medium dense. The reduced density of the soil is due to weathering of the dense parent material (weathered till). Alternatively, these soils may represent sediments deposited as the glaciers receded from the area (recessional sands and gravels), and were therefore never glacially consolidated.

Lodgement Till

The lodgement till soil sequence encountered within our site explorations typically consisted of a thin topsoil/forest duff zone (6 inches to 1.2 feet) underlain by loose to medium dense, reddish-brown, silty fine sand with gravel soil (weathered lodgement till), extending to depths of approximately 2 to 3 feet below the existing ground surface. A zone of heavy roots and rootlets extended to approximately 24 inches below the ground surface. Underlying these soils, dense to very dense, partially cemented, moist to wet, tan-gray to brown and gray, gravelly sand to silty sand with variable amounts of silt, gravel, and cobbles (lodgement till) were encountered. Below a depth of approximately 4 to 5 feet, soils generally became grayer in coloration and very dense. Occasionally, 12- to 48-inch diameter, isolated boulders were found within the till.

Properly moisture-conditioned weathered till that is free from organic debris, or the underlying competent unweathered till soil can be utilized to support the proposed homes and roads, and contingent on suitable moisture content can be used as structural fill, in our opinion.

4.2 Hydrology

No ground water seepage was encountered in any of the test pits advanced for this study, and no surface water was observed. It should be noted that the exploration program for this study was completed in early fall, when ground water levels are typically at seasonal low levels. In areas characterized by lodgement till soils, perched ground water is frequently present during winter, spring, and early summer months. Perched ground water occurs where surface water infiltrates down through the relatively permeable weathered till soil until it becomes trapped or "perched" upon a less permeable material, such as the unweathered lodgement till. The perched water located above the lodgement till is typically referred to as interflow. This water generally flows atop the less permeable material, roughly following the surface topography.

It should be noted that fluctuations in the level of the ground water or seepage zones may occur locally, due to the time of the year, changes in off-site land usage, and variations in rainfall. Higher levels and volumes of interflow typically occur during the wetter winter season.

II. DESIGN RECOMMENDATIONS

5.0 INTRODUCTION

Our study indicates that, from a geotechnical standpoint, the site is suitable for development of the proposed subdivision, provided the geotechnical recommendations contained in this report are properly implemented.

In general, loose to medium dense, weathered lodgement till soils mantle the site to depths of approximately 2 to 3 feet. These soils will not provide suitable bearing support for the proposed building foundations and pavements in their present state. In order to improve the bearing capacity of these soils, densification subsequent to stripping of the topsoil and root zone will be required. The underlying dense lodgement till will provide suitable bearing support for these facilities if exposed within the cut areas of the site.

Specific recommendations concerning site earthwork, as well as foundation bearing soil preparation and footing design parameters for the new subdivision, are presented in the following sections of this report.

6.0 SITE PREPARATION

Site preparation should include the removal of all vegetation from beneath areas where new homes, roads, or other structures are planned. Additionally, any organic topsoil should be stripped from these areas and the remaining roots grubbed. We anticipate general stripping depths of 6 to 14 inches will likely be required to remove topsoil, and grubbing or root raking to depths of 18 to 24 inches to remove root zones. If modifications are planned in or adjacent to existing wetland areas, deeper stripping depths estimated at 24 to 36 inches or deeper may be required to remove saturated, organic soils and loose/soft till soils. Once the construction sites and road areas have been cleared and stripped, excavation to expose building foundation and pavement subgrade soils can be completed. Where little excavation or placement of fill soils is required to achieve the proposed subgrade elevations, we recommend that the stripped surface be compacted in place until a firm and unyielding condition results. If the subgrade soils are unstable and yielding after compaction, they should be overexcavated until firm natural soils are exposed, or should be replaced with structural fill to a depth that will provide a stable subgrade. We recommend that this compaction be completed using a minimum 20-ton vibratory roller. Since the density of the on-site soil is variable, random soft pockets may exist, and the depth and extent of the required excavations can best be determined in the field by the geotechnical engineer or engineering geologist at the time of construction.

Inorganic site soils generated from excavation cuts may be used as structural fill, provided they can be separated from the overlying topsoil and root zone, and that they are at a suitable moisture content to allow compaction to a firm and unyielding condition at the recommended compaction levels. The upper reddish-brown, weathered lodgement till may be mixed with the gray unweathered till soils at depth. All of the site soils observed in our exploration pits contained a high percentage of fine-grained material which makes them moisture-sensitive and subject to disturbance when wet. The contractor must use care during site preparation and excavation operations so that the underlying soils are not softened. If disturbance occurs, the softened soils should be removed and the area brought to grade with compacted granular fill. Consideration should be given to protecting the construction and staging areas with an appropriate thickness of crushed rock placed above an engineering stabilization fabric, or asphalt treated base (ATB).

7.0 STRUCTURAL FILL

Although specific grading plans were not available to Associated Earth Sciences, Inc. (AESI) at the time of this study, it is expected that relatively limited structural fill placement will be required to achieve desired grades in some areas. Due to the loose nature of the upper 2 to 3 feet of natural soils, overexcavation of the loose soils and replacement with structural fill may also be necessary in foundation excavations. All references to structural fill in this report refer to subgrade preparation, fill type, placement, and compaction of materials as discussed in this section. If a percentage of compaction is specified under another section of this report, the value given in that section should be used.

After overexcavation/stripping has been performed to the satisfaction of the geotechnical engineer/engineering geologist, the upper 12 inches of exposed ground should be recompacted to at least 90 percent of the modified Proctor maximum density using ASTM:D 1557 as the standard. After the recompacted, exposed ground is tested and approved, structural fill may be placed to attain desired grades.

Structural fill is defined as non-organic soil acceptable to the geotechnical engineer placed in maximum 8-inch loose lifts, with each lift being compacted to at least 95 percent of the modified Proctor maximum density using ASTM:D 1557 as the standard. In the case of roadway and utility trench filling, the backfill should be placed and compacted in accordance with current local or county codes and standards. Where sloping fill inclined at gradients steeper than 5H:1V (Horizontal:Vertical) are planned, the top of the compacted fill should extend horizontally outward a minimum distance of 3 feet beyond the location of the perimeter footings or roadway edges before sloping down at an angle no steeper than 2H:1V.

The contractor should note that any proposed fill soils must be evaluated by AESI prior to their use in fills. This would require that we have a sample of the material 48 hours in advance of filling activities to perform a Proctor test and determine its field compaction standard. Soils in which the amount of fine-grained material (smaller than No. 200 sieve) is greater than approximately 5 percent (measured on the minus No. 4 sieve fraction) should be considered moisture-sensitive. Use of moisture-sensitive soils in structural fills should be limited to favorable, dry weather conditions. The on-site soils are suitable for use as structural fill, but generally contained significant amounts of silt, and are considered to be moisture-sensitive. In addition, construction equipment traversing the site when the soils are wet can cause considerable disturbance. If fill is placed during wet weather, or if proper compaction cannot be obtained, a select import material consisting of a clean, free-draining gravel and/or sand should be used. Free-draining fill consists of non-organic soil with the amount of fine-grained material limited to 5 percent by weight when measured on the minus No. 4 sieve fraction.

A representative from our firm should inspect the stripped subgrade and be present during placement of structural fill to observe the work and perform a representative number of in-place density tests. In this way, the adequacy of the earthwork may be evaluated as filling progresses and any problem areas may be corrected at that time. It is important to understand that taking random compaction tests on a part-time basis will not assure uniformity or acceptable performance of a fill. As such, we are available to aid the owner in developing a suitable monitoring and testing frequency.

8.0 TEMPORARY AND PERMANENT SLOPES

Temporary slope stability is a function of many factors, including the following:

- The presence and abundance of ground water
- The type and density of the various soil strata
- The depth of cut
- Surcharge loadings adjacent to the excavation
- The length of time the excavation remains open

It is exceedingly difficult under the variable circumstances present on the site to pre-establish a safe and "maintenance free" temporary cut slope angle. Therefore, it should be the responsibility of the contractor to maintain safe temporary slope configurations since the contractor is continuously at the job site, able to observe the nature and condition of the cut slopes, and able to monitor the subsurface materials and ground water conditions encountered. It may be necessary to drape temporary slopes throughout the site with plastic sheeting or other means to protect the slopes from the elements and minimize sloughing and erosion. Unsupported vertical slopes or cuts deeper than 4 feet are not recommended if worker access is necessary. The cuts should be adequately sloped, shored, or supported to prevent injury to personnel from local sloughing and spalling. The excavation should conform to applicable federal (OSHA), WISHA, and local regulations.

We recommend that all permanent slopes be designed at a 2H:1V inclination or flatter. With slopes steeper than about 2H:1V, topsoil erodes readily and it is more difficult and time consuming to establish vegetation for slope protection. Temporary slopes in medium dense to dense, weathered lodgement till soils should be excavated at an inclination no steeper than 1H:1V. Where perched ground water conditions have saturated the surficial soils, slope angles of up to 2H:1V to 3H:1V or flatter may be required for both temporary and permanent slope construction.

Permanent fill placed on existing slopes steeper than 5H:1V should be keyed and benched into soils of the underlying slope. We recommend that the base downslope key be cut into undisturbed native soil. The key slot should be at least 8 feet wide and 3 feet deep. The hillside benches cut into the native soil should be at least 4 feet in width. The face of the embankment should be compacted to the same minimum 95 percent relative compaction as the body of the fill. This may be accomplished by overbuilding the embankment and cutting back to the compacted core. Alternatively, the surface of the slope may be compacted as it is built, or upon completion of the embankment fill placement.

9.0 FOUNDATIONS

Spread footings may be used for building support when founded on recompacted, weathered lodgement till soils, or on structural fill placed over similarly prepared soils, as described under the *Site Preparation* and *Structural Fill* sections of this report. Foundations may also be founded directly on dense, unweathered lodgement till soil where exposed after site grading. For footings founded over the recompacted, weathered lodgement till or properly compacted structural fill, we recommend that an allowable bearing pressure of 2,500 pounds per square foot (psf) be utilized for design purposes, including both dead and live loads. Higher allowable foundation bearing pressures are possible on unweathered lodgement till at depth, however higher foundation bearing pressures are not expected to be needed for residential construction. The recommended foundation bearing pressure may be increased by one-third to accommodate transient seismic or wind loads.

Footings for the proposed homes should be buried a minimum of 18 inches into the surrounding soil for frost protection. All footings must penetrate to the prescribed stratum and no footing should be founded in or above loose or organic soils. All footings should have a minimum width of 16 inches for one-story structures, or 18 inches for two-story structures.

It should be noted that the area bound by lines extending downward at 1H:1V from any footing must not intersect another footing or intersect a filled area which has not been compacted to at least 95 percent of ASTM:D 1557. In addition, a 2H:1V line extending downward and away from any footing must not daylight because sloughing or raveling may eventually undermine the footing. Thus, footings should not be placed near the edge of steps or cuts in the bearing soils.

Anticipated settlement of footings founded on the recompacted natural sediments as described above, or approved structural fill should be on the order of 1 inch or less, and differential settlement is expected to be one-half or less of the maximum total settlement. However, disturbed soil not removed from footing excavations prior to footing placement could result in increased settlements. All footing areas should be inspected by AESI prior to placing concrete to verify that the design bearing capacity of the soils has been attained, and that construction conforms with the recommendations contained in this report. Such inspections may be required by the governing municipality. Perimeter footing drains should be provided as discussed under the section on *Drainage Considerations*.

10.0 LATERAL WALL PRESSURES

Retaining walls may be required if basements are planned for the new homes, or if landscaping walls are required. We should be allowed to offer situation-specific retaining wall recommendations for any walls that exceed 10 feet in height, or walls that have sloping backfill. Retaining walls less than 10 feet tall should be designed to resist the lateral earth pressures imposed by the retained soils. Horizontally backfilled walls that are free to yield laterally at least 0.1 percent of their height may be designed using an equivalent fluid equal to 35 pounds per cubic foot (pcf). Fully restrained, horizontally backfilled rigid walls which cannot yield should be designed for an equivalent fluid of 50 pcf. If parking areas are adjacent to walls, a surcharge equivalent to 2 feet of soil should be added to the wall height in determining lateral design forces.

The lateral pressures presented above are based on the conditions of uniform backfill consisting of on-site silty sand soils compacted to 90 percent of ASTM:D 1557. A higher degree of compaction is not recommended as this will increase the pressure acting on the wall. Surcharges from adjacent footings, heavy construction equipment, or sloping ground must be added to the above values.

It is imperative that proper drainage be provided so that hydrostatic pressures do not develop against retaining walls. Thus, all retaining walls should be provided with a gravel blanket drain and perimeter footing drain as discussed under the *Drainage Considerations* section of this report. These drainage improvements are intended to mitigate hydrostatic pressure acting on retaining walls, but do not constitute waterproofing. Where the interior of retaining walls will serve as habitable space, or if interior moisture-sensitive finishes are planned, waterproofing should be completed in addition to the drainage improvements.

10.1 Passive Resistance and Friction Factors

Lateral loads can be resisted by friction between the foundation and the supporting structural fill soils, and by passive earth pressure acting on the buried portions of the foundations. The foundations must be backfilled with compacted, structural fill to achieve the passive resistance provided below. We recommend the following design parameters which are allowable values and contain a factor of safety of at least 1.5:

- Passive resistance, expressed as equivalent fluid weight (allowable): 250 pcf
- Coefficient of friction (allowable): 0.35

11.0 FLOOR SUPPORT

Slab-on-grade floors may be constructed on natural, loose to medium dense, weathered lodgement till soil, which has been recompacted to a minimum of 90 percent of ASTM:D 1557 (modified Proctor), or on structural fill placed over similarly prepared soils. Areas of the slab subgrade that are disturbed (loosened) during construction, should be compacted to a non-yielding condition prior to placing the pea gravel as described below.

In order to limit moisture intrusion through floor slabs, the slabs should be constructed atop a capillary break material and a vapor barrier. The capillary break should consist of a minimum thickness of 4 inches of washed pea gravel, with a 6-mil plastic moisture barrier on top of the capillary break. In addition, it is recommended that a minimum of 2 inches of clean sand cover the moisture barrier to protect the integrity of the moisture barrier during concrete placement, and to aid in the curing of the concrete. If seepage is encountered within the slab excavation, a sub-slab drainage system may be required, and should be determined by AESI in the field.

12.0 DRAINAGE CONSIDERATIONS

The soils encountered at the site are moisture-sensitive. These soils, when wet and disturbed, will become soft and propose an erosion hazard. Therefore, prior to and during site work, the contractor should be prepared to provide drainage and subgrade protection as necessary.

All retaining and perimeter footing walls should be provided with a drain at the base of the footing elevation. Drains should consist of rigid, perforated, PVC pipe surrounded by washed pea gravel. The level of the perforations in the pipe should be set approximately 2 inches below the bottom of the footing, and the drains should be constructed with sufficient gradient to allow gravity discharge away from the building. In addition, all retaining walls should be lined with a minimum 12-inch thick washed gravel blanket, or backfilled with free-draining fill to within 2 feet of the surface. The wall drain fill material should be continuous with, and freely communicate with the footing drain system. Roof and surface runoff should not discharge into the footing drain system, but should be handled by a separate, rigid, tightline drain. In planning, exterior grades adjacent to walls should be sloped downward away from the structures to achieve surface drainage.

13.0 PROJECT DESIGN AND CONSTRUCTION MONITORING

AESI would be available to provide additional geotechnical consultation as the project design develops and to address variations from the expected site conditions upon which this report is based. If significant changes in grading are made, we recommend that AESI perform a geotechnical review of the plans prior to final design completion. In this way, our earthwork and foundation recommendations may be properly interpreted and implemented in the design.

We have enjoyed working with you on this study and are confident that these recommendations will aid in the successful completion of your project. Should you have any questions, or require further assistance, please do not hesitate to call.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

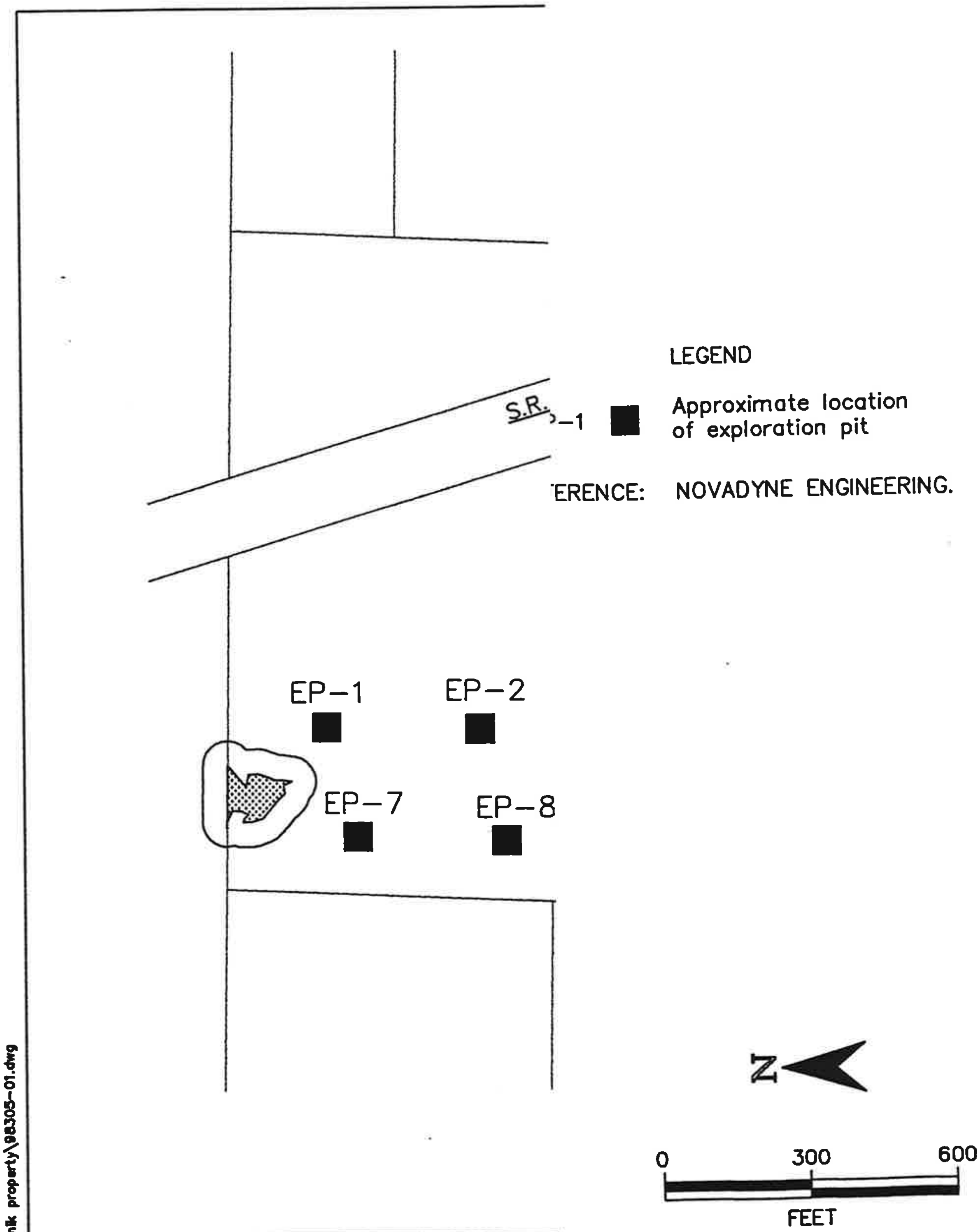
Bruce W. Guenzler
Project Geologist

Jon N. Sondergaard, P.G.
Associate Geologist

Kurt D. Merriman, P.E.
Senior Geotechnical Engineer

Attachments: Figure 1, Site and Exploration Plan
Exploration Pit Logs

BWG/ld
KE98305G1
10/1/98 ld - WP8



LEGEND

-1 ■ Approximate location of exploration pit

ERENCE: NOVADYNE ENGINEERING.

derra\projects\98305 zahradnik property\98305-01.dwg

ASSOCIATED EARTH SCIENCES, INC

FIGURE

2

EXPLORATION PIT LOG

Number EP-1

Depth (ft)	Description
0	Topsoil and roots.
	Medium dense, damp, reddish-brown, silty fine SAND, some fine to coarse gravel. (Weathered Till)
	Dense, damp, mottled brown, silty fine SAND, some fine gravel, trace cobbles. (Weathered Till)
5	grades to very dense, gray (Till)
10	BOH @ 10' Note: No seepage, no caving
15	

Number EP-2

Depth (ft)	Description
0	Topsoil and forest duff.
	Loose to medium dense, damp, reddish-brown, silty fine SAND, trace to little fine gravel. (Weathered Till)
	Dense, damp, mottled brown, silty fine SAND, some fine to coarse gravel, trace cobbles. (Weathered Till)
5	becomes very dense, gray (Till)
10	BOH @ 10' Note: No seepage, no caving
15	

Reviewed By

Associated Earth Sciences, Inc.
911 Fifth Avenue, Suite 100
Kirkland, Washington 98033
Phone: 425-827-7701
Fax: 425-827-5424

Zahradnik Subdivision
Snohomish County, Washington
KE98305G
October 1998

EXPLORATION PIT LOG

Number EP-3

Depth (ft)	Description
0	Topsoil and roots.
	Medium dense, damp, reddish-brown, silty fine SAND, some fine gravel. (Weathered Till)
	Dense, damp, mottled brown, silty fine to coarse SAND, some fine to coarse gravel, trace cobbles. (Weathered Till)
5	grades to very dense, gray (Till)
10	BOH @ 10' Note: No seepage, no caving
15	

Number EP-4

Depth (ft)	Description
0	Topsoil.
	Medium dense, damp, reddish-brown, silty fine SAND, some fine to coarse gravel, ,trace cobbles, trace boulders. (Weathered Till)
	Dense, damp, mottled brown, silty fine to medium SAND, some fine to coarse gravel. (Weathered Till)
5	grades to very dense, gray (Till)
10	BOH @ 10' Note: No seepage, no caving
15	

Subsurface conditions depicted represent our observation at the time and location of this exploratory hole, modified by geologic interpretation, engineering analysis, and judgment. They are not necessarily representative of other times and locations. We will not accept responsibility for the use or interpretation by others of information presented on this log.

Reviewed By

Associated Earth Sciences, Inc.
911 Fifth Avenue, Suite 100
Kirkland, Washington 98033
Phone: 425-827-7701
Fax: 425-827-5424

Zahradnik Subdivision
Snohomish County, Washington
KE98305G
October 1998

EXPLORATION PIT LOG

Number EP-5

0	Topsoil.
	Medium dense, damp, reddish-brown, silty fine SAND, trace to little fine gravel. (Weathered Till)
	Dense, damp, mottled brown, silty fine SAND, little fine gravel. (Weathered Till)
5	grades to very dense, gray (Till)
10	BOH @ 8' Note: No seepage, no caving
15	

Number EP-6

0	Topsoil.
	Medium dense, damp, reddish-brown, silty fine SAND, trace fine gravel. (Weathered Till)
	Dense, moist, mottled brown, silty fine to medium SAND, some fine to coarse gravel. (Weathered Till)
5	grades to very dense, gray (Till)
10	BOH @ 8' Note: No seepage, no caving
15	

Subsurface conditions depicted represent our observation at the time and location of this exploratory hole, modified by geologic interpretation, engineering analysis, and judgment. They are not necessarily representative of other times and locations. We will not accept responsibility for the use or interpretation by others of information presented on this log.

Reviewed By

Associated Earth Sciences, Inc.
911 Fifth Avenue, Suite 100
Kirkland, Washington 98033
Phone: 425-827-7701
Fax: 425-827-5424

Zahradnik Subdivision
Snohomish County, Washington
KE98305G
October 1998

EXPLORATION PIT LOG

Number EP-7

Depth (ft)	Description
	Topsoil.
	Medium dense, damp to moist, reddish-brown, silty fine to medium SAND, some fine to coarse gravel. (Weathered Till)
	Dense, moist, mottled brown, silty fine to coarse SAND, some fine gravel, trace cobbles. (Weathered Till)
	grades to very dense, gray (Till)
	BOH @ 8' Note: No seepage, no caving

Number EP-8

Depth (ft)	Description
	Topsoil.
	Medium dense, moist, reddish-brown, silty fine SAND, some fine to coarse gravel. (Weathered Till)
	Dense, moist, mottled tan, silty fine to coarse SAND, some fine gravel. (Weathered Till)
	grades to very dense, gray (Till)
	BOH @ 8' Note: No seepage, no caving

Reviewed By

Associated Earth Sciences, Inc.
911 Fifth Avenue, Suite 100
Kirkland, Washington 98033
Phone: 425-827-7701
Fax: 425-827-5424

Zahradnik Subdivision
Snohomish County, Washington
KE98305G
October 1998

EXPLORATION PIT LOG

Number EP-9

0	Topsoil.
	Medium dense, damp, reddish-brown, silty fine SAND, some fine to coarse gravel. (Weathered Till)
	Dense, moist, mottled brown, silty fine SAND, some fine to coarse gravel, trace cobbles and boulders. (Weathered Till)
5	grades to very dense, gray (Till)
10	BOH @ 9' Note: No seepage, no caving
15	

Number EP-10

0	Topsoil.
	Medium dense,damp, reddish-brown, silty fine SAND, little fine to coarse gravel. (Weathered Till)
	Dense, moist, mottled brown, silty fine SAND, some fine to coarse gravel, trace cobbles. (Weathered Till)
5	grades to very dense, gray (Till)
10	BOH @ 9' Note: No seepage, no caving
15	

Subsurface conditions depicted represent our observation at the time and location of this exploratory hole, modified by geologic interpretation, engineering analysis, and judgment. They are not necessarily representative of other times and locations. We will not accept responsibility for the use or interpretation by others of information presented on this log.

Reviewed By

Associated Earth Sciences, Inc.
911 Fifth Avenue, Suite 100
Kirkland, Washington 98033
Phone: 425-827-7701
Fax: 425-827-5424

Zahradnik Subdivision
Snohomish County, Washington
KE98305G
October 1998

EXPLORATION PIT LOG

Number EP-11

Depth (ft)	Description
0	Topsoil.
	Medium dense, moist, reddish-brown, silty fine SAND, some fine to coarse gravel, trace cobbles. (Weathered Till)
	Dense, damp, mottled brown, silty fine to coarse SAND, some fine to coarse gravel. (Weathered Till)
5	grades to very dense, gray (Till)
10	BOH @ 9' Note: No seepage, no caving
15	

Number

Depth (ft)	Description
0	
5	
10	
15	

Subsurface conditions depicted represent our observation at the time and location of this exploratory hole, modified by geologic interpretation, engineering analysis, and judgment. They are not necessarily representative of other times and locations. We will not accept responsibility for the use or interpretation by others of information presented on this log.

Reviewed By

Associated Earth Sciences, Inc.
911 Fifth Avenue, Suite 100
Kirkland, Washington 98033
Phone: 425-827-7701
Fax: 425-827-5424

Zahradnik Subdivision
Snohomish County, Washington
KE98305G
October 1998