DRAFT
GEOTECHNICAL ENGINEERING STUDY
PROPOSED NORTH CREEK
RESIDENTIAL DEVELOPMENT
196TH STREET SOUTHEAST
SNOHOMISH COUNTY, WASHINGTON

E-11341

January 26, 2005

PREPARED FOR
RIVERBEND NORTH, LLC

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Geotechnical Engineers, Geologists & Environmental Scientists

January 26, 2005 E-11341

Riverbend North, LLC
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Attention: Mr. Kevin O'Brien

Dear Mr. O'Brien:

Earth Consultants, Inc. (ECI) is pleased to submit our report titled "Draft Geotechnical Engineering Study, Proposed North Creek Residential Development, 196th Street Southeast, Snohomish County, Washington". This report presents the results of our field exploration, selective laboratory tests, and engineering analyses. The purpose and scope of our study were outlined in our proposal PR-11341, dated August 3, 2004.

Based on the results of our study, it is our opinion development of the site with a residential development and related infrastructure is feasible from a geotechnical standpoint.

In general, our study indicates the western and southern portions of the site are underlain by alternating beds of loose to medium dense silty sand with varying amounts of gravel (Unified Soil Classification SM) to silt with varying amounts of sand (ML). Within the silty sand and silt beds, we encountered localized areas of poorly graded gravel with sand (GP), poorly graded gravel with sand and silt (GP-GM), poorly graded sand (SP), and poorly graded sand with silt (SP-SM).

The northeastern portion of the site is underlain by up to fourteen (14) feet of fill on the west side and underlain by loose to medium dense layer of silty sand with gravel (SM) underlain by glacial till consisting of silty sand with gravel (SM) on the east side. The glacial till was medium dense to dense, becoming increasingly dense with depth. The glacial till continued to the maximum depth explored at each location.

Based on the subsurface conditions encountered, the proposed residences may be supported on conventional spread and continuous footing foundation systems. The foundations should bear on the competent native soils encountered on the southeastern portion of the site, on at least two (2) feet of structural fill on the western portion of the site, and on competent native soils or structural fill on the northeast portion of the site. The existing unsuitable fill material encountered in the areas of Lots 16 and 17 should be removed.

We appreciate this opportunity to be of continued service to you. If you have any questions, or if we can be of further assistance, please call.

Respectfully submitted,

EARTH CONSULTANTS, INC.

Kristina M. Weller, P.E.
Project Manager

SSR/KMW/ddw

TABLE OF CONTENTS

E-11341

TABLE OF CONTENTS, Continued

E-11341

ILLUSTRATIONS

APPENDICES

DRAFT
GEOTECHNICAL ENGINEERING STUDY
PROPOSED NORTH CREEK
RESIDENTIAL DEVELOPMENT
196TH STREET SOUTHEAST
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E-11341

INTRODUCTION

General

This report presents the results of the draft geotechnical engineering study completed by Earth Consultants, Inc. (ECI) for the proposed North Creek residential development, 196th Street Southeast in Snohomish County, Washington. The general location of the site is shown on the Vicinity Map, Plate 1.

Project Description

We understand it is planned to develop the site with about 30 single-family residences, a stormwater control facility, and associated roadway and infrastructure. At the time our study was performed, the site, lot locations, and our exploratory locations were approximately as shown on the Test Pit Location Plan, Plate 2.

We anticipate the proposed residences will be two to three stories in height and will be of relatively lightly loaded, wood-frame construction with either slab-on-grade or wood joist floors. Based on our experience with similar projects, we anticipate wall loads will be in the range of two (2) to three (3) kips per lineal foot, column loads in the range of fifteen (15) to twenty (20) kips, and slab-on-grade floor loads of one hundred fifty (150) pounds per square foot (psf).

The conclusions and recommendations in this study are based on our understanding of the proposed development, which is in turn based on the project information provided us. If the above project description is incorrect or the project information changes, we should be consulted to review the recommendations contained in this draft study and make modifications, if needed.

Scope of Services

The purpose of this draft study was to explore the subsurface conditions at the site and, based on the conditions encountered, develop geotechnical engineering recommendations for the proposed site development.

Our scope of services included excavation of test pits across the site and preparation of this report, which specifically addresses:

- Surface and subsurface soil and water conditions;
- Site preparation, grading and earthwork procedures, including stripping depth recommendations, details of structural fill placement and compaction;
- Suitability of existing on-site materials for use as structural fill, or recommendations for imported fill materials;
- Short-term and long-term groundwater management and erosion control measures;
- Foundation design recommendations, including bearing capacity and lateral pressures for walls and structures;
- Estimates of potential total and differential settlement magnitudes;

- Geotechnical seismic design parameters, including evaluation of potential liquefaction hazard;

- Utility trench excavation and backfill recommendations;

- Suggested pavement sections; and

- Temporary and permanent slope recommendations.

SITE CONDITIONS

Surface

The subject site consists of an approximately 11.69-acre irregularly shaped property located at 1515 – 196th Street Southeast in Snohomish County, Washington (see Plate 1, Vicinity Map).

The site is bordered to the south by 196th Street Southeast and undeveloped forest along North Creek, to the west by a wetland area bordering North Creek, undeveloped forest, and by a single-family residence, to the north by 194th Street Southeast and a paved driveway extension, and to the east by a single-family residence and a commercial storage development.

North Creek and a surrounding wetland area occupy the southwest corner of the site. A second wetland area extends from the north-central perimeter of the site southeast through the central portion of the east half of the property, exiting the site on the east site perimeter. A single-family residence and several outbuildings occupy the southwestern portion of the site, just north of North Creek. A northwest-southeast trending gravel driveway extends approximately 300 feet to the residence from 196th Street Southwest. The south-central portion of the site is occupied by a large steel-frame structure and several outbuildings, accessed by an approximately 100 foot north-south driveway from 196th Street Southeast.

A single-family residence and an outbuilding are located near the southeast corner of the site along 196th Street Southeast. To the east of the residence, a north-south trending gravel road enters the site from 196th Street Southeast. The road extends approximately 150 feet to a clearing occupied by numerous old cars. A single-family residence and several outbuildings occupy the northeast portion of the site, accessed by a short driveway from 194th Street Southeast.

The western half of the site is relatively level, sloping gently from north to south at gradients less than five (5) percent to a topographic low in the southwest corner occupied by North Creek. The southeastern portion of the site slopes gently west to east at gradients less than five (5) percent, with a five (5) to ten (10) percent gradient slope descending south to 196th Street Southeast on the south site perimeter. The northeast portion of the site consists of an upland area along 194th street Southeast, descending southwest at gradients of approximately 20 to 30 percent.

The western half of the site is vegetated primarily with grass, with several medium to large diameter trees near the residence and along the driveway. The southwestern corner of the site south of North Creek is heavily forested.

The upland area in the northeast site corner is vegetated primarily with medium diameter deciduous trees, mixed brush and blackberry brambles, with grass and several pine trees surrounding the residence. The southeastern portion of the site is vegetated with mixed brush and patches of blackberry brambles, with areas of grass surrounding the buildings. Several medium to large diameter trees surround the residence near the southeast site corner.

Subsurface

Subsurface conditions at the site were evaluated by excavating fourteen (14) test pits at the approximate locations shown on Plate 2. The test pits were excavated with a tracked excavator to a maximum depth of fourteen and one-half (14.5) feet below existing grade. Our test pit logs are included as Plates A2 through A15. Please refer to the test pit logs for a detailed description of the conditions encountered at each exploration location. A description of the field exploration methods is included in Appendix A. The following is a generalized description of the subsurface conditions encountered.

At our test pit locations, we generally encountered a two (2) to twelve (12) inch thick layer of topsoil, with areas as thick as twenty-four (24) inches. The topsoil is characterized by its dark brown to black color, loose consistency, and the presence of roots and organic debris. The soil and vegetative layer is not suitable for support of foundations, slab-on-grade floors, or pavements. In addition, it is not suitable for use as structural fill, nor should it be mixed with material to be used as structural fill.

At six of our test pit locations, underlying the topsoil, we encountered a zone of silty sand with gravel fill (SM). At Test Pits TP-8 and TP-9, the fill was in a medium dense condition, ranging in thickness from one (1) to one and one-half (1.5) feet. At Test Pits TP-11 through TP-14, the fill was in a loose condition, ranging in thickness from six (6) inches to fourteen (14) feet. The fill at Test Pits TP-12 through TP-14 contained large quantities of wood, plastic, and other garbage debris. The approximate area of wood and garbage-laden fill is shown on the Test Pit Location Plan, Plate 2.

Underlying the fill at Test Pits TP-11, TP-13, and TP-14, we generally encountered a loose to medium dense layer of silty sand with gravel (SM) underlain by glacial till consisting of silty sand with gravel (SM). The glacial till was medium dense to dense, becoming increasingly dense with depth. The glacial till continued to the maximum depth explored at each location.

Underlying the topsoil at eight of our test pit locations and underlying the fill at Test Pits TP-8, TP-9, and TP-12, we generally encountered alternating beds of loose to medium dense silty sand with varying amounts of gravel (SM) to silt with varying amounts of sand (ML). Within the silty sand and silt beds, we encountered localized areas of poorly graded gravel with sand (GP), poorly graded gravel with sand and silt (GP-GM), poorly graded sand (SP), and poorly graded sand with silt (SP-SM). The localized sand and gravel beds increased in thickness and occurrence in the southeastern portion of the site (Test Pits TP-8 through TP-10). At Test Pits TP-1, TP-3, and TP-7, we encountered organic-rich soils consisting of very stiff organic silt (OL) and Peat (PT). The silt and peat was encountered at seven (7) to ten (10) feet below existing grade and ranged in thickness from one and one-half (1.5) to two (2) feet.

Groundwater

Groundwater seepage was encountered at twelve (12) of our test pit locations, at depths ranging from two (2) to eleven (11) feet below existing grade. The seepage generally observed within the upper two (2) to four (4) feet at our test pit locations appears to be seasonal perched groundwater collecting impermeable soil layers. The seepage encountered at depths greater than four (4) feet generally appear to be groundwater traveling through permeable soil lenses.

Based on conditions observed at our test pit locations, in our opinion, light to moderate groundwater seepage should be anticipated. The contractor should be made aware that groundwater seepage levels are not static. There will likely be fluctuations in the level depending on the season, amount of rainfall, surface water runoff, and other factors. Generally, the water level is higher and seepage rates are greater in the wetter winter months (typically October through May). The contractor should be prepared to control groundwater if seepage is encountered in site excavations.

Laboratory Testing

Laboratory tests were conducted on representative soil samples to verify or modify the field soil classification and to evaluate the general physical properties and engineering characteristics of the soil encountered. Visual field classifications were supplemented by grain size analyses on representative soil samples. Moisture content tests were performed on all samples. The results of laboratory tests performed on specific samples are provided either at the appropriate sample depth on the individual test pit logs or on a separate data sheet contained in Appendix B. It is important to note that these test results may not accurately represent the overall in-situ soil conditions. Our geotechnical recommendations are based on our interpretation of these test results and their use in guiding our engineering judgment. ECI cannot be responsible for the interpretation of these data by others.

In accordance with our Standard Fee Schedule and General Conditions, the soil samples for this project will be discarded after a period of 15 days following completion of this report unless we are otherwise directed in writing.

DISCUSSION AND RECOMMENDATIONS

General

Based on the results of our study, in our opinion the development of the site with a residential development and associated infrastructure is feasible from a geotechnical standpoint. The primary geotechnical concerns for the proposed site development include providing an adequate roadway subgrade and support for the residences.

The proposed residences may be supported on conventional spread and continuous footing foundation systems. The foundations should bear on the competent native soils encountered on the southeastern portion of the site, on at least two (2) feet of structural fill on the western portion of the site, and on competent native soils or structural fill on the northeast portion of the site. The existing unsuitable fill material encountered in the areas of Lots 16 and 17 should be removed.

This draft report has been prepared for specific application to this project only and in a manner consistent with that level of care and skill ordinarily exercised by other members of the profession currently practicing under similar conditions in this area for the exclusive use of Riverbend North, LLC and their representatives. No warranty, expressed or implied, is made. This report, in its entirety, should be included in the project contract documents for the information of the contractor.

Site Preparation and General Earthwork

Based on our understanding of the proposed project, site earthwork will likely consist of installing erosion control measures, stripping the site, cutting and filling the site to provide street and building pad grades, removing the exiting unsuitable fill, installing underground utilities, preparing curb, gutter, sidewalk and roadway subgrades, excavating the detention pond, and the future construction of single family residence on the lots.

Erosion Control and Stripping

Prior to clearing on site, the clearing limits should be flagged. Silt fence should be installed down slope of proposed grading areas and construction fence should be installed at the top of proposed cut slopes. We recommend ECI be contacted once the site clearing limits are flagged to walk the site with the contractor to provide additional geotechnical and erosion control recommendations.

The proposed grading areas of the site should be stripped and cleared of surface vegetation, organic matter and other deleterious material. Existing utility pipes to be abandoned should be plugged or removed so that they do not provide a conduit for water and cause soil saturation and stability problems.

The topsoil encountered in our test pits varied widely and is generally up to twelve (12) inches thick with isolated areas up to twenty-four (24) inches thick. The forest duff and topsoil should be stripped and removed from the site or may be stockpiled on-site to be used in landscaping areas. The stripped materials should not be mixed with materials to be used as structural fill.

During construction, the site must be graded such that surface water is collected and tightlined to an appropriate drainage facility. Water must not be allowed to stand in fill areas or where buildings, slabs, or pavements are to be constructed. Loose surfaces should be sealed by compacting the surface to reduce the potential for moisture infiltration into the soils.

Existing Fill Area

Fill up to fourteen (14) feet thick was encountered on Lots 16 and 17. The fill was generally loose to medium dense and contains large quantities of wood, plastic, and other garbage debris. The approximate area of wood and garbage-laden fill is shown on the Test Pit Location Plan, Plate 2.

The fill should be removed from the proposed building footprints and replaced with structural fill. The extent of the fill area and depth of removal should be determined during construction when the fill area can be further explored.

Temporary Slopes

The following information is provided solely as a service to our client. Under no circumstances should this information be interpreted to mean that ECI is assuming responsibility for construction site safety or the contractor's activities; such responsibility is not being implied and should not be inferred.

In no case should excavation slopes be greater than the limits specified in local, state (WISHA), and Federal (OSHA) safety regulations. Based on the information obtained from our field exploration and laboratory testing, the soils encountered on the majority of the site would be classified as Type C by OSHA/WISHA. Temporary cuts greater than four (4) feet in height in Type C soils should be sloped at an inclination of 1.5H:1V (Horizontal:Vertical). If slopes of this inclination, or flatter, cannot be constructed, temporary shoring may be necessary. The dense till soils encountered on the northeastern corner of the site would be classified as Type B by OSHA/WISHA. Temporary cuts greater than four (4) feet in height in Type B soils should be sloped at an inclination of 1H:1V.

If slopes of this inclination, or flatter, cannot be constructed, temporary shoring may be necessary. If temporary shoring is required, we will be available to provide shoring design criteria.

Structural Fill

Structural fill is defined as compacted fill placed under buildings, roadways, floor slabs, pavements, on slopes, or other load-bearing areas. Structural fill should be placed in horizontal lifts not exceeding twelve (12) inches in loose thickness and compacted to a minimum of ninety-five (95) percent of its laboratory maximum dry density determined in accordance with ASTM Test Designation D-1557-00 (Modified Proctor). The fill materials should be placed at or near their optimum moisture content.

During dry weather, any non-organic compactible soil with a maximum grain size of four (4) inches may be used. Fill for use during wet weather or in wet subgrade conditions should consist of a fairly well graded granular material having a maximum grain size of four (4) inches and no more than five (5) percent fines passing the No. 200 sieve. A contingency in the earthwork budget should be included for the possibility of importing material meeting these specifications.

Based on the results of our laboratory tests, the on-site soils, at the time of our exploration, are over the optimum moisture content and will require moisture conditioning prior to their use as structural fill. Based on the gradation of the native soils, significant drying time may be necessary especially on the western portion of the site. The majority of the native soils will degrade if exposed to moisture.

In our opinion, to maximize the success of using the existing site soils for structural fill, thereby avoiding the costs associated with export and import, provisions should be made for stockpiling and protecting suitable on-site soils. Excavation and placement of the native soils should only be performed during dry weather conditions. ECI should periodically meet with the contractor during construction to assess the suitability of the on-site soils for use as structural fill.

Fill Slope Placement

Placement of fill may be necessary on the slopes on the northeastern portion of the site. In our opinion, the placement of fill on a sloping grade is acceptable, however, where slope gradients exceed twenty (20) percent, the fill must be keyed and benched into the slope.

This process consists of excavating a keyway at the toe of the planned fill. The keyway should have a width of approximately six to eight feet and a depth of at least two (2) feet into medium dense native soil. This slope above the keyway should then be cut into a series of horizontal to slightly inward sloping benches. Typically, the benches are excavated with a small bulldozer as the fill is brought up. The width of the benches will vary with the gradient of the slope, usually the gentler the slope, the wider the benches.

A schematic diagram of the keyway and benches is included in Plate 4, Slope Fill Placement.

Permanent Slopes

Permanent cut and fill slopes should be inclined no steeper than 2H:1V. Cut slopes should be observed by ECI during excavation to verify that conditions are as anticipated. Fill slope construction should also be observed under the full time observation of an ECI representative to test structural fill soils. Supplementary recommendations can be developed, if needed, to improve stability, including flattening of slopes, placing erosion control fabrics, or installation of surface or subsurface drains.

Permanently exposed slopes should be hydroseeded with an appropriate species of vegetation to reduce erosion and improve stability for the surficial layer of soil immediately after construction. In the summer months, it may be necessary to water the slopes to maintain the hydroseed germination.

Rockeries and Modular Block Walls

In our opinion, the use of rockeries or modular block walls at the site is feasible from a geotechnical standpoint. If walls or rockeries that exceed four (4) feet in exposed height are utilized, an engineered design will need to be completed. ECI can provide an engineered design for rockeries or modular block walls, if requested. At a minimum, due to the variability of the site soils, ECI should review the layout of the proposed walls and the proximity of foundations to the walls. Supplemental geotechnical recommendations can then be prepared, if necessary, to address wall design and surcharge loading.

Utility Support and Backfill

We anticipate storm, sewer, water, and franchise utilities will be installed on-site within the proposed roadway right-of-way. If remedial measures are necessary to provide adequate support for utilities, the unsuitable soils should be overexcavated and replaced with crushed rock or quarry spalls and a pipe bedding material such as pea gravel. The presence of groundwater seepage should be expected in utility trench excavations.

In our opinion, the native soils may be considered for use as backfill for the utility trenches, provided the soil moisture content is at or near its optimum level at the time of placement. However, at the time of our explorations in January of 2005, the moisture content of the native soil was over the optimum moisture content and moisture conditioning (drying out) of the soils will be necessary prior to use as backfill. Due to moisture sensitivity of the native soils, placement and compaction of the soil will need to be performed during dry weather conditions and may require significant drying time to reduce the moisture content. ECI will be available to work with the contractor in assessing the suitability of the soils as structural backfill in utility trenches.

Utility trench backfill is a primary concern in reducing the potential for settlement along utility alignments, particularly in pavement areas. It is important that each section of utility line be adequately supported in the bedding material. The material should be hand tamped to ensure support is provided around the pipe haunches. Fill should be carefully placed and hand tamped to about 12 inches above the crown of the pipe before heavy compaction equipment is brought into use. The remainder of the trench backfill should be placed in lifts having a loose thickness of less than twelve (12) inches and compacted to ninety-five (95) percent of the maximum dry density

A representative of ECI should be on-site during excavation and backfill of the utility trenches to provide recommendations for the suitability of the soils for use as backfill and perform representative testing on backfill soils.

Pavement Areas

The adequacy of site pavements is related in part to the condition of the underlying subgrade. To provide a properly prepared subgrade for pavements, the subgrade should be treated and prepared as described in the *Site Preparation* section of this report. This means the subgrade should be compacted to ninety-five (95) percent of the maximum dry density (per ASTM D-1557).

Based on the soils encountered in the proposed roadway, overexcavation and moisture conditioning and compaction of the native soils should be expected. The extent and necessity of overexcavations verses moisture conditioning and recompaction of the native soils should be determined during construction by ECI's representative.

The subgrade should be proof-rolled with a loaded dump truck under the observation of an ECI representative prior to the placement of the crushed rock base. Soft, wet or unstable subgrade should be removed and replaced with granular structural fill or crushed rock.

The following pavement section for lightly loaded areas is suggested for site roadways:

- Two (2) inches of asphalt concrete (AC) over four (4) inches of crushed rock base (CRB) material; or

- Two (2) inches of AC over three (3) inches of asphalt treated base (ATB) material.

We will be pleased to assist in developing appropriate pavement sections for heavy traffic zones, if needed. The pavement section provided above may be superceded by Snohomish County requirements for minimum pavement sections. Pavement materials should conform to WSDOT and Snohomish County specifications.

Foundations

Based on the results of our study and provided our recommendations are followed, in our opinion, the proposed residences may be supported on a conventional spread and continuous footing foundation system. The foundations should bear on the competent native soils encountered on the southeastern portion of the site (Lots 21 through 30), on at least two (2) feet of structural fill on the western portion of the site (Lots 1 through 15), and on competent native soils (Lots 18 through 20) or structural fill (Lots 16 and 17) on the northeast portion of the site.

Exterior foundation elements should be placed at a minimum depth of eighteen (18) inches below final exterior grade. Interior spread foundations should be placed at a minimum depth of twelve (12) inches below the top of slab, except in unheated areas, where interior foundation elements should be founded at a minimum depth of eighteen (18) inches.

With foundation support obtained as described, for design, an allowable soil bearing capacity of two thousand (2,000) psf should be used for the competent native soil or structural fill. Continuous and individual spread footings should have minimum widths in accordance with local building codes. Loading of this magnitude would be provided with a theoretical factor-of-safety in excess of 3.0 against shear failure. For short-term dynamic loading conditions, a one-third increase in the above allowable bearing capacity may be used.

With structural loading as expected and provided the above design criteria is followed, total settlement in the range of one (1) inch is anticipated with differential settlement of about one-half inch. Most of the anticipated settlements should occur during construction as dead loads are applied.

Horizontal loads can be resisted by friction between the base of the foundation and the supporting soil and by passive soil pressure acting on the face of the buried portion of the foundation. For the latter, the foundation must be poured "neat" against the competent native soils or backfilled with structural fill. For frictional capacity, a coefficient of 0.30 should be used. For passive earth pressure, the available resistance should be computed using an equivalent fluid pressure of three hundred (300) pounds per cubic foot (pcf). These lateral resistance values are allowable values and a factor-of-safety of 1.5 has been included. As movement of the foundation element is required to mobilize full passive resistance, the passive resistance should be neglected if such movement is not acceptable or the grade slopes away from the foundation at a gradient steeper than 4H:1V.

Footing excavations should be observed by a representative of ECI, prior to placing forms or rebar, to verify that conditions are as anticipated in this report.

Slab-on-Grade Floors

Slab-on-grade floors should be supported on competent native soil or on structural fill used to modify site grades. Disturbed subgrade soil must either be recompacted or replaced with structural fill.

Slabs placed on structural fill or the silty sand native soils should be provided with capillary break consisting of a minimum of four (4) inches of free-draining sand or gravel. In areas where slab moisture is undesirable, a vapor barrier such as a 6-mil plastic membrane should be placed beneath the slab.

Permanent Retaining and Foundation Walls

Retaining walls, and foundation walls that act as retaining walls, should be designed to resist lateral earth pressures from the retained soils, and any surcharge loading. For walls designed to yield a minimum of 0.002 times the height of the wall, lateral earth pressures should be calculated using an equivalent fluid with a unit weight of thirty-five (35) pcf.

For non-yielding walls, the equivalent fluid pressure should be increased to fifty (50) pcf. The above lateral earth pressure values assume free-draining, horizontal backfill conditions. The above lateral earth pressures assume no surcharges due to traffic, adjacent foundation, construction loads, or other loading. If surcharges are to apply, they should be added to the above design lateral pressures. A two (2) foot soil surcharge should be used to account for traffic surcharges, where applicable.

To reduce the potential for hydrostatic forces building up behind the walls, the below grade portion of the walls should be provided with a perforated drainpipe and backfilled with a free-draining material extending at least eighteen (18) inches behind the wall. The remainder of the backfill should consist of structural fill. A typical retaining wall backfill detail is provided in Plate 4.

Seismic Design Considerations

The Puget Lowland is classified as a Seismic Zone 3 in the 1997 Uniform Building Code (UBC). Earthquakes occur in the Puget Lowland with regularity, however, the majority of these events are of such low magnitude they are not felt without instruments.

Large earthquakes do occur, as indicated by the 1949, 7.2 magnitude earthquake in the Olympia area and the 1965, 6.5 magnitude earthquake in the Midway area and the 2001, 6.8 magnitude earthquake in the Nisqually area.

There are three potential geologic hazards associated with a strong motion seismic event at this site: ground rupture, liquefaction, and ground motion response.

Ground Rupture

The strongest earthquakes in the Puget Lowland are widespread, subcrustal events, ranging in depth from thirty (30) to fifty-five (55) miles. Surface faulting from these deep events has not been documented to date. Therefore, it is our opinion, that the risk of ground rupture at this site during a strong motion seismic event is negligible.

Liquefaction

Liquefaction is a phenomenon in which soils lose all shear strength for short periods of time during an earthquake. Groundshaking of sufficient duration results in the loss of grain-to-grain contact and rapid increase in pore water pressure, causing the soil to behave as a fluid.

To have a potential for liquefaction, a soil must be cohesionless with a grain size distribution of a specified range (generally sand and silt); it must be loose; it must be below the groundwater table; and it must be subject to sufficient magnitude and duration of groundshaking. The effects of liquefaction may be large total and/or differential settlement for structures founded in the liquefying soils.

In our opinion, based on the soil gradation and density below the groundwater table, the potential for widespread liquefaction-induced settlement at this site is low on the western portion of the site and low to negligible on the eastern portion of the site. The settlements from liquefaction-induced settlement may be up to two (2) inches and may not occur uniformly across the site. In our opinion these settlements will be mitigated provided the recommendations in this study are incorporated into the site development.

Ground Motion Response

The 2003 International Building Code (IBC) Earthquake regulations contain a static force procedure and a dynamic force procedure for design-base shear calculations. Based on the encountered soil conditions, it is our opinion Site Class D from Table 1615.1.1, should be used to characterize the site soils.

Site Drainage

Groundwater seepage was encountered at twelve (12) of our test pit locations, at depths ranging from two to eleven feet below existing grade in January of 2005. The seepage generally observed within the upper two (2) to four (4) feet at our test pit locations appears to be seasonal perched groundwater collecting impermeable soil layers. The seepage encountered at depths greater than four (4) feet generally appear to be groundwater traveling through permeable soil lenses.

Based on conditions observed at our test pit locations, in our opinion, light to moderate groundwater seepage should be anticipated. If seepage is encountered, the bottom of the excavation should be sloped to one or more shallow sump pits. The collected water can then be pumped from these pits to a positive and permanent discharge, such as a nearby storm drain. Depending on the magnitude of such seepage, it may also be necessary to connect the sump pits by a system of connector trenches.

Final site grades must allow for drainage away from the residence foundations. The ground should be sloped at a gradient of three (3) percent for a distance of at least ten (10) feet away from the residences.

Footing drains should be installed around the perimeter of the residences, at or just below the invert of the footing, with a gradient sufficient to initiate flow. A typical detail is provided on Plate 5. Under no circumstances should roof downspout drain lines be connected to the footing drain system. Roof downspouts must be separately tightlined to discharge. Cleanouts should be installed at strategic locations to allow for periodic maintenance of the footing drain and downspout tightline systems.

LIMITATIONS

Our recommendations and conclusions are based on the site materials observed, selective laboratory testing and engineering analyses, the design information provided us, and our experience and engineering judgment. The conclusions and recommendations are professional opinions derived in a manner consistent with that level of care and skill ordinarily exercised by other members of the profession currently practicing under similar conditions in this area. No warranty is expressed or implied.

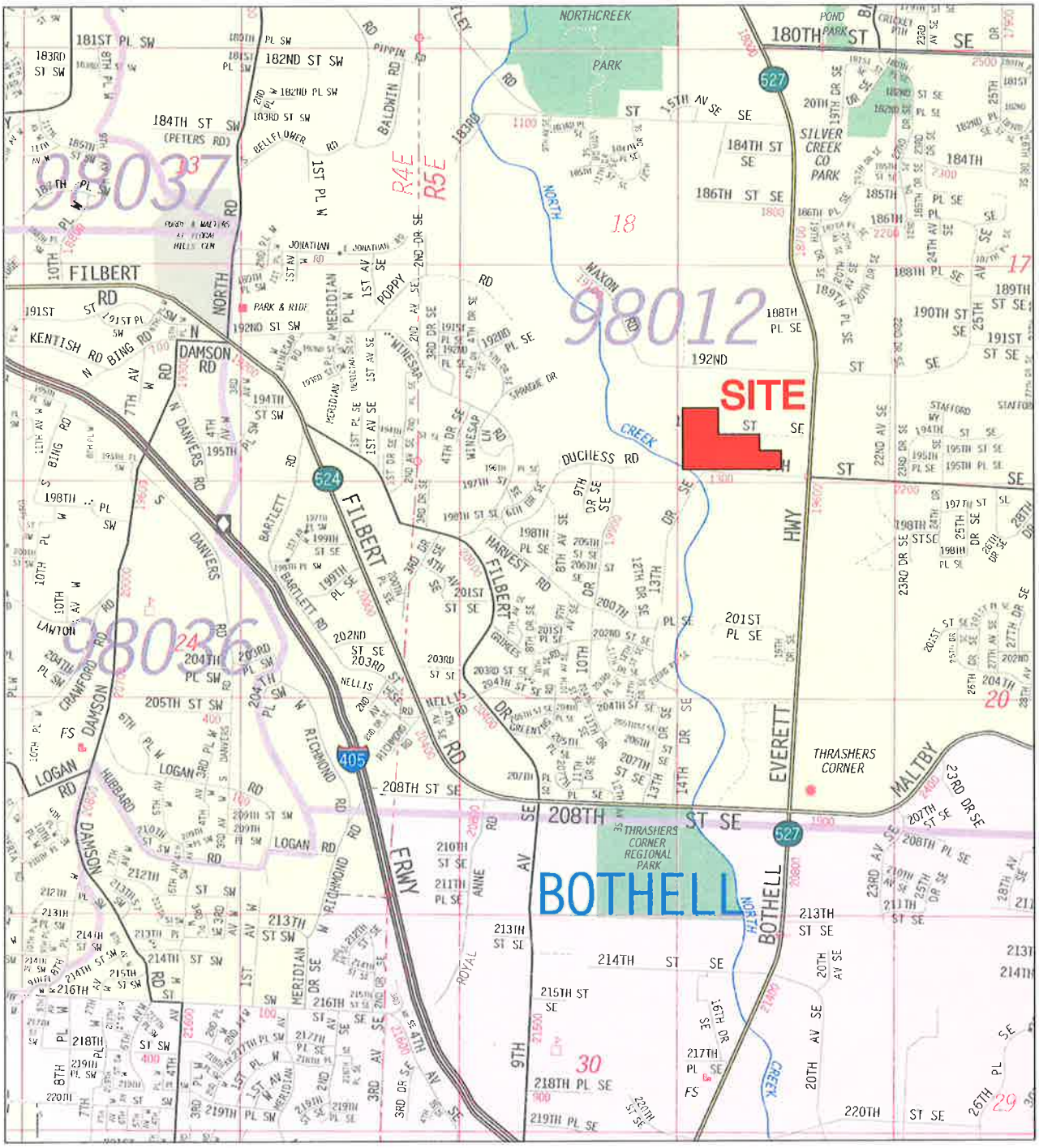
The recommendations submitted in this report are based upon the data obtained from the test pits. Soil and groundwater conditions between test pits may vary from those encountered.

The nature and extent of variations between our exploratory locations may not become evident until construction. If variations do appear, ECI should be requested to reevaluate the recommendations of this report and to modify or verify them in writing prior to proceeding with the construction.

Additional Services

As the geotechnical engineer of record, ECI should be retained to perform a general review of the final design and specifications to verify that the earthwork and foundation recommendations have been properly interpreted and implemented in the design and in the construction specifications.

ECI should also be retained to provide geotechnical services during construction. This is to observe compliance with the design concepts, specifications or recommendations and to allow design changes in the event subsurface conditions differ from those anticipated prior to the start of construction.



Reference:
Snohomish County
Map 456
By Thomas Brothers Maps
Dated 2005

NOTE: This plate may contain areas of color. ECI cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

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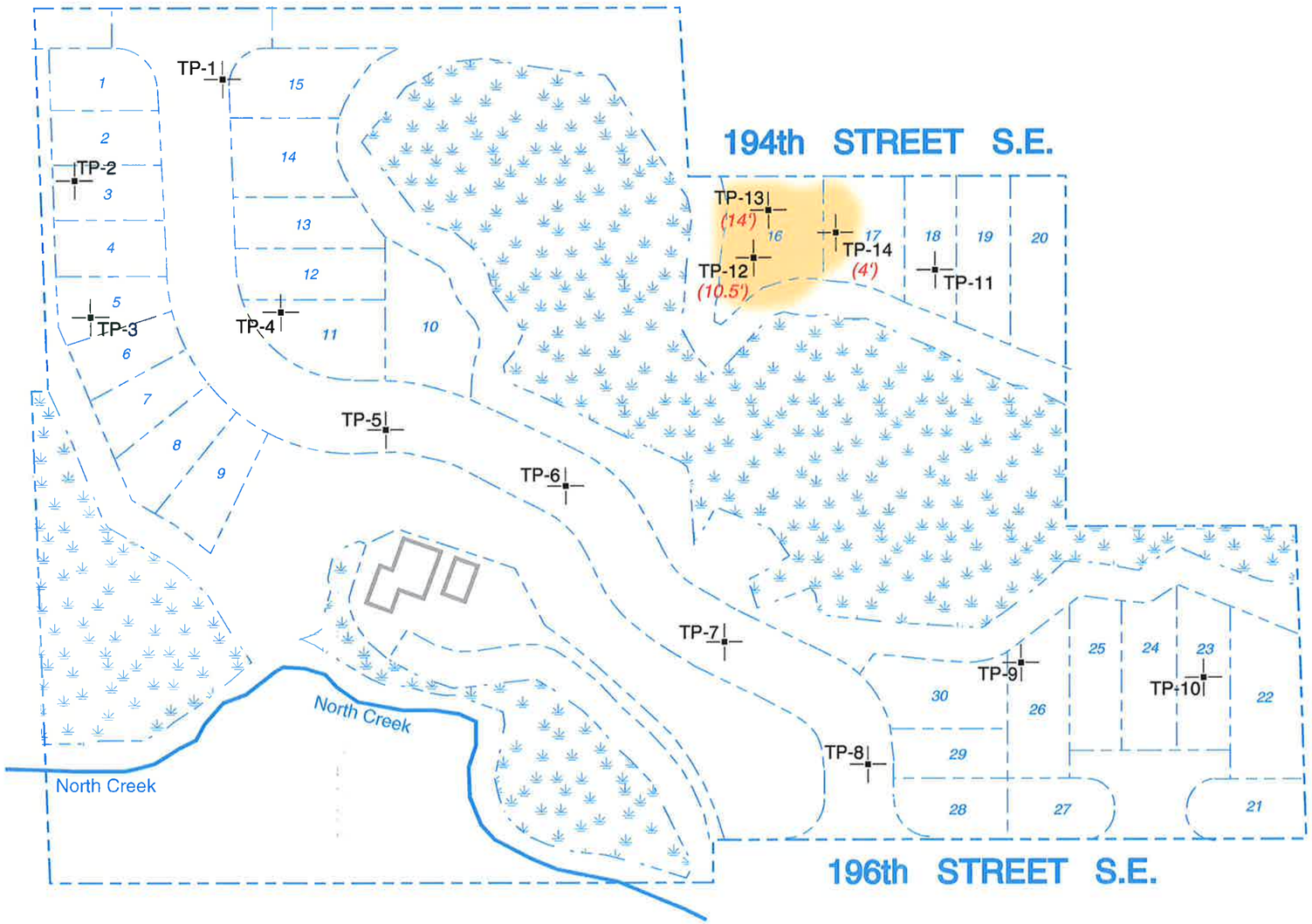
Vicinity Map
North Creek Residential Development
Snohomish County, Washington

Drwn. GLS	Date Jan. 2005	Proj. No. 11341
Checked ELW	Date 1/20/05	Plate 1



NORTH

Approximate Scale

0 50 100 200ft.

LEGEND

TP-1 — Approximate Location of ECI Test Pit, Proj. No. E-11341, Jan. 2005

(14') Approximate Depth of Fill (Feet)

Subject Site

Existing Building

Wetland Area (Delineated by Others)

Approximate Area of Fill

23 Proposed Lot Number

NOTE: The graphics shown on this plate are not intended for design purposes or precise scale measurements, but only to illustrate the approximate test locations relative to the approximate locations of existing and/or proposed site features. The information illustrated is largely based on data provided by the client at the time of our study. ECI cannot be responsible for subsequent design changes or interpretation of the data by others.

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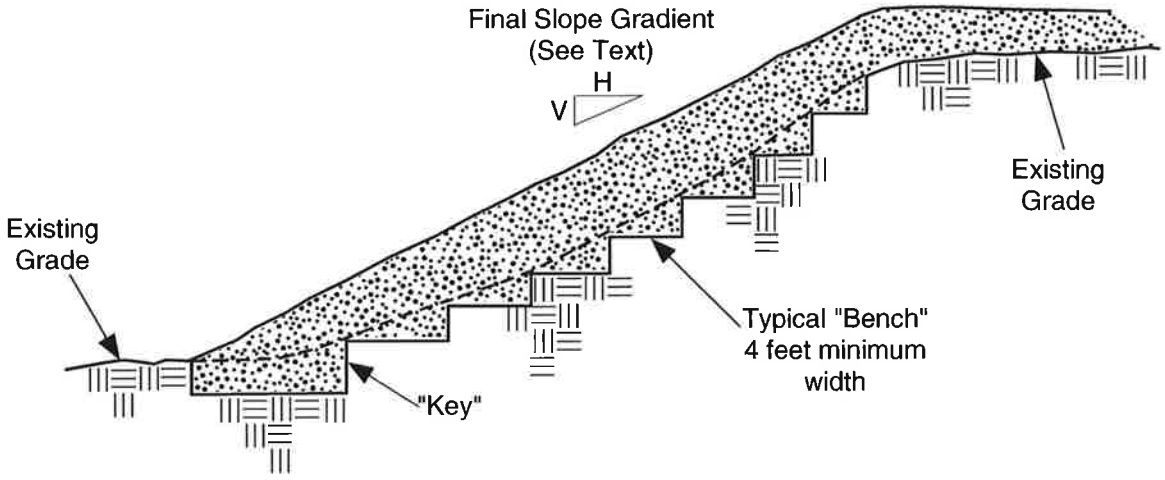
Test Pit Location Plan
North Creek Residential Development
Snohomish County, Washington

Drwn. GLS	Date Jan. 2005	Proj. No. 11341
Checked ELW	Date 1/20/05	Plate 2



STANDARD NOTES

- Slope should be stripped of topsoil and unsuitable materials prior to excavating key way or benches.
- Benches will typically be equal to a dozer blade width, approximately 8 feet, but a minimum of 4 feet.
- Final Slope gradient should be __ : __ (Horizontal : Vertical).
- Final Slope face should be densified by over-building with compacted fill and trimming back to shape or by compaction with dozer or roller.
- Planting or Hydroseeding slope face with a rapid growth deep rooted vegetative mat will reduce erosion potential of slope area.
- Use of pegged-in-place jute matting or geotechnical fabric will help maintain the seed and mulch in place until the root system has an opportunity to germinate.
- Structural Fill should be placed in thin loose lifts not exceeding 10 inches in thickness. Each lift should be compacted to no less than the degree specified in the site preparation and Earth Work Section of this report. No additional lift should be placed until compaction is achieved.

LEGEND

Free draining, organic free, granular material with a maximum size of 3 inches, containing no more than 5 percent fines (silt and clay size particles passing the No. 200 mesh sieve) or other material approved by Geotechnical Engineer.

Key Way Fill is same as Structural Fill described above. Key Way should be minimum 2 feet deep and 6 feet wide, extending the full length of the slope face.

Approximate original grade.

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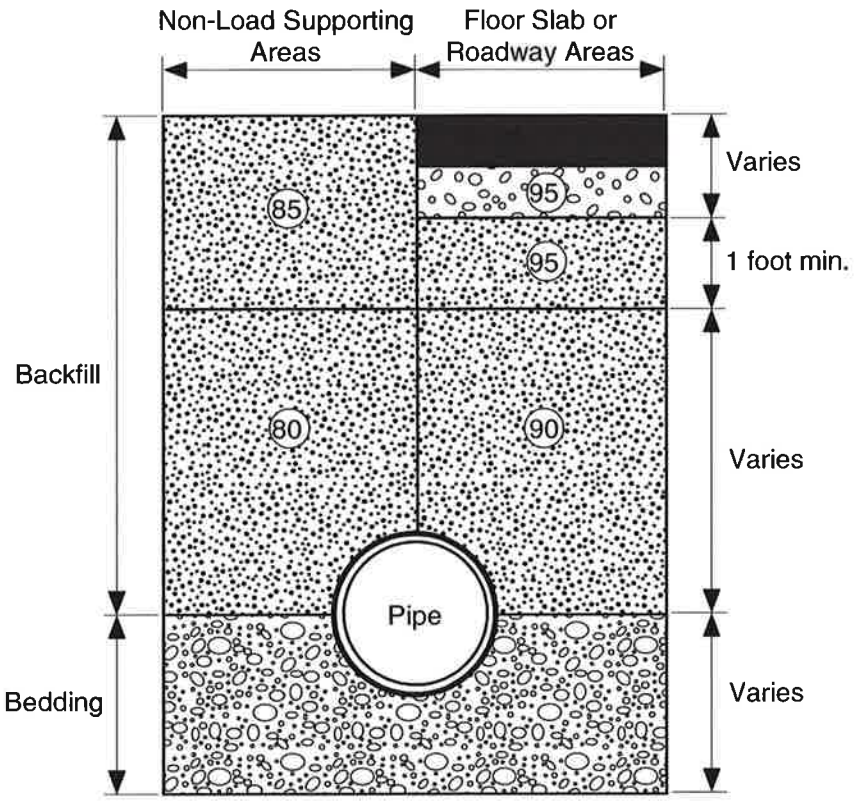
SLOPE FILL PLACEMENT
North Creek Residential Development
Snohomish County, Washington

Drwn.	GLS	**Date**	Jan. 2005	**Proj. No.**	11341
Checked	ELW	**Date**	1/27/05	**Plate**	3



LEGEND

Asphalt or Concrete Pavement or Concrete Floor Slab

Base Rock or Capillary Break, as Appropriate

Backfill; Compacted On-Site Soil or Suitable Imported Fill Material

(90) Minimum Percentage of Maximum Laboratory Dry Density as determined by ASTM Test Method D 1557-91 (Modified Proctor), unless otherwise specified in the attached report text.

Bedding Material; material type depends on type of pipe and laying conditions. Bedding should conform to the manufacturers recommendations for the type of pipe selected.

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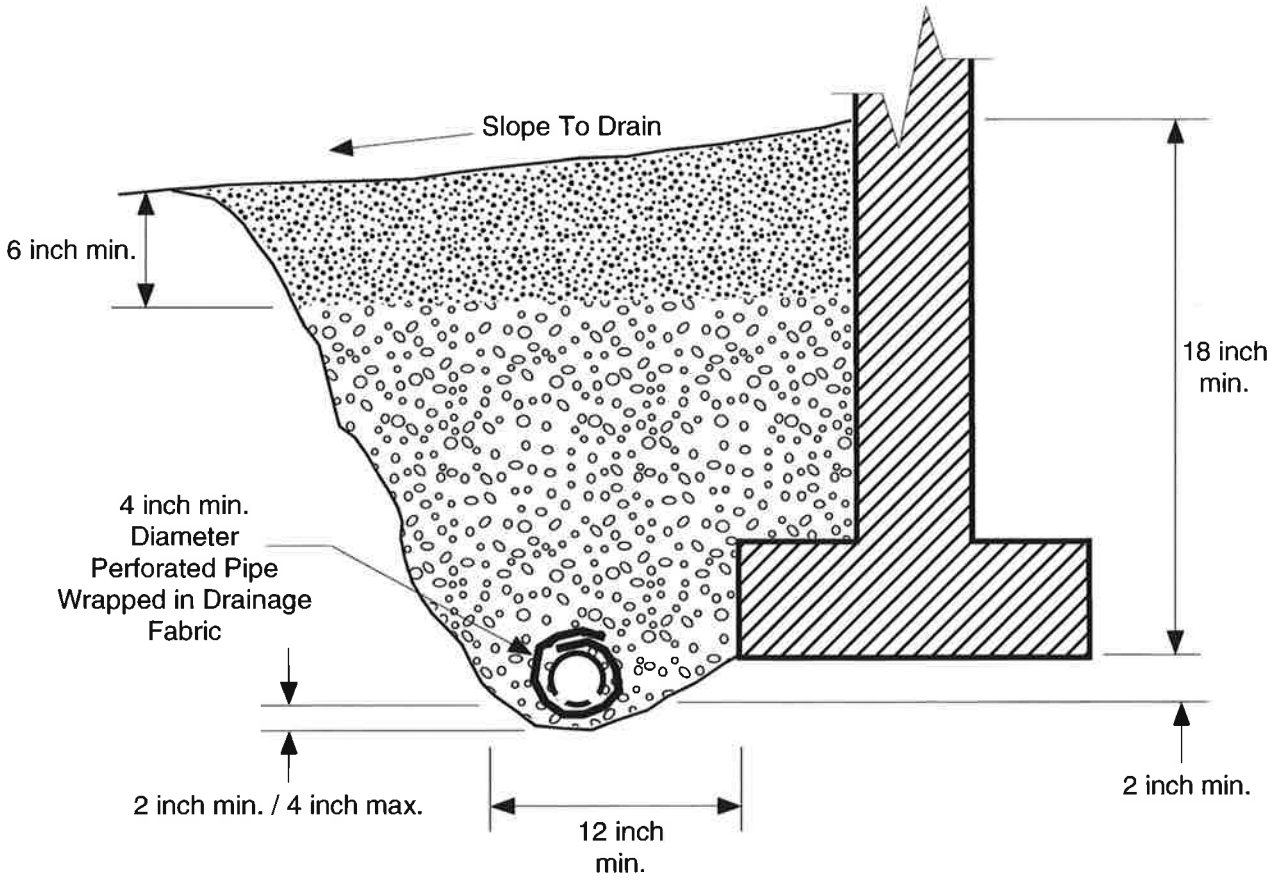
TYPICAL UTILITY TRENCH FILL
North Creek Residential Development
Snohomish County, Washington

Drwn.	GLS	**Date**	Jan. 2005	**Proj. No.**	11341
Checked	ELW	**Date**	1/27/05	**Plate**	4



LEGEND

Surface seal; native soil or other low permeability material.

1" Drain Rock

Drain pipe; perforated or slotted rigid PVC pipe laid with perforations or slots facing down; tight jointed; with a positive gradient. Do not use flexible corrugated plastic pipe. Do not tie building downspout drains into footing lines. Wrap with Mirafi 140 Filter Fabric or equivalent.

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TYPICAL FOOTING SUBDRAIN DETAIL
North Creek Residential Development
Snohomish County, Washington

Drwn.	GLS	**Date**	Jan. 2005	**Proj. No.**	11341
Checked	ELW	**Date**	1/27/05	**Plate**	5

APPENDIX A

FIELD EXPLORATION

E-11341

Our field exploration was performed on January 13, 2005. Subsurface conditions at the site were explored by excavating fourteen (14) test pits to a maximum depth of fourteen and one-half (14.5) feet below grade. The test pits were excavated by Northwest Excavating, Inc. using a track-hoe.

Approximate test pit locations were determined by pacing from the existing roads surrounding the site and referencing plans provided by the client. The locations of the test pits should be considered accurate only to the degree implied by the method used. These approximate locations are shown on the Test Pit Location Plan, Plate 2.

The field exploration was continuously monitored by a geologist from our firm who classified the soils encountered, maintained a log of each test pit, obtained representative samples, measured groundwater levels, and observed pertinent site features. The samples were visually classified in accordance with the Unified Soil Classification System, which is presented on Plate A1, Legend. Representative soil samples were placed in closed containers and returned to our laboratory for further examination and testing.

Logs of the test pits are presented on Plates A2 through A16. The final logs represent our interpretations of the field logs and the results of our laboratory examination and testing. The stratification lines on the logs represent the approximate boundaries between soil types. In actuality, the transitions may be more gradual.

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTION
Coarse Grained Soils	Gravel And Gravelly Soils	Clean Gravels (little or no fines)		GW gw	Well-Graded Gravels, Gravel-Sand Mixtures, Little Or No Fines
				GP gp	Poorly-Graded Gravels, Gravel-Sand Mixtures, Little Or No Fines
	More Than 50% Coarse Fraction Retained On No. 4 Sieve	Gravels With Fines (appreciable amount of fines)		GM gm	Silty Gravels, Gravel-Sand-Silt Mixtures
				GC gc	Clayey Gravels, Gravel-Sand-Clay Mixtures
More Than 50% Material Larger Than No. 200 Sieve Size	Sand And Sandy Soils	Clean Sand (little or no fines)		SW sw	Well-Graded Sands, Gravelly Sands, Little Or No Fines
				SP sp	Poorly-Graded Sands, Gravelly Sands, Little Or No Fines
	More Than 50% Coarse Fraction Passing No. 4 Sieve	Sands With Fines (appreciable amount of fines)		SM sm	Silty Sands, Sand-Silt Mixtures
				SC sc	Clayey Sands, Sand-Clay Mixtures
Fine Grained Soils	Silts And Clays	Liquid Limit Less Than 50		ML ml	Inorganic Silts & Very Fine Sands, Rock Flour, Silty-Clayey Fine Sands; Clayey Silts w/ Slight Plasticity
				CL cl	Inorganic Clays Of Low To Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean
				OL ol	Organic Silts And Organic Silty Clays Of Low Plasticity
More Than 50% Material Smaller Than No. 200 Sieve Size	Silts And Clays	Liquid Limit Greater Than 50		MH mh	Inorganic Silts, Micaceous Or Diatomaceous Fine Sand Or Silty Soils
				CH ch	Inorganic Clays Of High Plasticity, Fat Clays.
				OH oh	Organic Clays Of Medium To High Plasticity, Organic Silts
Highly Organic Soils				PT pt	Peat, Humus, Swamp Soils With High Organic Contents

Topsoil		Humus And Duff Layer
Fill		Highly Variable Constituents

The discussion in the text of this report is necessary for a proper understanding of the nature of the material presented in the attached logs.

DUAL SYMBOLS are used to indicate borderline soil classification.

C	TORVANE READING, tsf
qu	PENETROMETER READING, tsf
W	MOISTURE, % dry weight
P	SAMPLER PUSHED
*	SAMPLE NOT RECOVERED
pcf	DRY DENSITY, lbs. per cubic ft.
LL	LIQUID LIMIT, %
PI	PLASTIC INDEX

- 2" O.D. SPLIT SPOON SAMPLER
- 24" I.D. RING OR SHELBY TUBE SAMPLER
- WATER OBSERVATION WELL
- ▽ DEPTH OF ENCOUNTERED GROUNDWATER DURING EXCAVATION
- ▼ SUBSEQUENT GROUNDWATER LEVEL W/ DATE

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LEGEND

Proj. No.	Date	Plate
11341	Jan. 2005	A1

Test Pit Log

Project Name: North Creek Residential Development			Sheet 1 of 1
Job No. 11341	Logged by: ELW	Date: 1/13/05	Test Pit No.: TP-1
Excavation Contactor: NW Excavating			Ground Surface Elevation: 105'
Notes:			

General Notes	W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions: Depth of Topsoil & Sod 18": grass
			1		TPSL	Black TOPSOIL
	53.7		2		SM	Gray silty fine to medium SAND with gravel, loose, saturated, light to moderate water seepage at 2.5'
	38.1		3		ML	Tan SILT, medium dense, wet -iron oxide staining -96.0% fines -becomes moist to wet
	35.1		5		ML	Blue green sandy SILT, medium dense, moist to wet -trace iron oxide staining -moderate caving
	31.5		7		SM	Grades to blue green silty fine SAND, medium dense, moist to wet -contains sand and silt interbeds -becomes dense
	26.7		9		ML	Gray sandy SILT, dense, moist -contains thin sand beds
	65.2		10		PT	Brown PEAT, very stiff, moist
			11			Test pit terminated at 11.0 feet below existing grade due to caving. Groundwater seepage encountered at 2.5 feet during excavation. NOTES: Test pits excavated by NW Excavating with a trackhoe. Elevations estimated from an assumed elevation of 100' at 196th Street S.E. in the southeast site corner.

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Test Pit Log
North Creek Residential Development
Snohomish County, Washington

Proj. No. 11341	Dwn. GLS	Date Jan. 2005	Checked ELW	Date 1/27/05	Plate A2

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

TEST PIT LOG 11341.GPJ ECI.GDT 1/31/05

Test Pit Log

Project Name: North Creek Residential Development			Sheet 1 of 1
Job No. 11341	Logged by: ELW	Date: 1/13/05	Test Pit No.: TP-2
Excavation Contactor: NW Excavating			Ground Surface Elevation: 105'
Notes:			

General Notes	W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions: Depth of Topsoil & Sod 8": grass
			1		SM	Reddish brown silty fine SAND with gravel, loose, wet
	27.0		2			
	10.3		3		GP-GM	Gray poorly graded GRAVEL with silt and sand, loose, saturated, light water seepage at 3'
	36.8				ML	Tan SILT with sand, medium dense, wet, iron oxide staining
	36.8		4		ML	Blue green SILT, medium dense, moist to wet
			5			-contains occasional sand and silt beds
			6		SM	Gray silty fine SAND, dense, moist to wet
	26.7		7			
			8			-contains sand and silt interbeds
			9			
			10			
						Test pit terminated at 10.5 feet below existing grade. Groundwater seepage encountered at 3.0 feet during excavation.

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Test Pit Log
North Creek Residential Development
Snohomish County, Washington

Proj. No. 11341	Dwn. GLS	Date Jan. 2005	Checked ELW	Date 1/27/05	Plate A3

TEST PIT LOG 11341.GPJ ECI.GDT 1/27/05

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

Test Pit Log

Project Name: North Creek Residential Development			Sheet 1 of 1
Job No. 11341	Logged by: ELW	Date: 1/13/05	Test Pit No.: TP-3
Excavation Contactor: NW Excavating			Ground Surface Elevation: 104'
Notes:			

Surface Conditions: Depth of Topsoil & Sod 6": grass

General Notes	W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	
			1		SM	Reddish brown silty fine SAND, loose, moist
			2			-contains gravel
	30.9		3			-becomes saturated -light water seepage at 3.5'
			4		ML	Tan sandy SILT, medium dense, wet
	38.3		5			-iron oxide staining -contains 4" gravel bed at 5'
			6			-becomes blue green in color
	28.6		7			
			8		OL	Dark brown organic SILT, very stiff, moist
	55.3		9			
			10		ML	Blue gray SILT, dense, moist
	25.1					Test pit terminated at 10.5 feet below existing grade. Groundwater seepage encountered at 3.5 feet during excavation.

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Test Pit Log
North Creek Residential Development
Snohomish County, Washington

Proj. No. 11341	Dwn. GLS	Date Jan. 2005	Checked ELW	Date 1/27/05	Plate A4

TEST PIT LOG 11341.GPJ ECI.GDT 1/27/05

Test Pit Log

Project Name: North Creek Residential Development			Sheet 1 of 1
Job No. 11341	Logged by: ELW	Date: 1/13/05	Test Pit No.: TP-4
Excavation Contactor: NW Excavating			Ground Surface Elevation: 105'
Notes:			

General Notes	W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions: Depth of Topsoil & Sod 12": grass
					TPSL	Black TOPSOIL
	13.6		1		SM	Brown silty fine to medium SAND with gravel, loose, wet
	9.3		2 3 4		GP-GM	Brown poorly graded GRAVEL with silt and sand, medium dense, wet -iron oxide staining -light to moderate water seepage at 3'- 4.5', becomes saturated -moderate caving
	31.8		5 6 7		ML	Gray SILT with sand, medium dense, moist to wet
	26.7		8 9 10		SM	Gray silty fine SAND, medium dense, moist to wet -contains silt and sand interbeds
						Test pit terminated at 10.0 feet below existing grade. Groundwater seepage encountered at 3.0 to 4.5 feet during excavation.

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Test Pit Log
North Creek Residential Development
Snohomish County, Washington

Proj. No. 11341	Dwn. GLS	Date Jan. 2005	Checked ELW	Date 1/27/05	Plate A5

TEST PIT LOG 11341.GPJ ECI.GDT 1/27/05

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

Test Pit Log

Project Name: North Creek Residential Development				Sheet 1 of 1
Job No. 11341	Logged by: ELW	Date: 1/13/05	Test Pit No.: TP-5	
Excavation Contactor: NW Excavating			Ground Surface Elevation: 105'	
Notes:				

Surface Conditions: Depth of Topsoil & Sod 24": grass

General Notes	W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	
			1		TPSL	Black TOPSOIL
	17.9		2		SP	Tan poorly graded SAND with gravel, loose, wet -iron oxide staining, 4.3% fines -light to moderate water seepage at 3.5', increase in fines
	25.1		4		SP-SM	Gray poorly graded SAND with silt, medium dense, wet, light water seepage at 5'
	30.8		5		ML	Gray SILT, dense, moist, trace organics
			6		SM	Gray silty fine SAND, dense, moist to wet -contains sand and silt interbeds
	25.0		9			Test pit terminated at 9.5 feet below existing grade. Groundwater seepage encountered at 3.5 and 5.0 feet during excavation.

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Test Pit Log
North Creek Residential Development
Snohomish County, Washington

Proj. No. 11341	Dwn. GLS	Date Jan. 2005	Checked ELW	Date 1/27/05	Plate A6

TEST PIT LOG 11341.GPJ ECI.GDT 1/27/05

Test Pit Log

Project Name: North Creek Residential Development			Sheet 1 of 1
Job No. 11341	Logged by: ELW	Date: 1/13/05	Test Pit No.: TP-6
Excavation Contactor: NW Excavating			Ground Surface Elevation: 105'
Notes:			

General Notes	W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions: Depth of Topsoil & Sod 12": grass
					TPSL	Black TOPSOIL
			1		SM	Tan silty medium SAND with gravel, loose to medium dense, wet
	10.9		2			-light water seepage at 2', iron oxide staining
			3		GP-GM	Blue green poorly graded GRAVEL with silt and sand, medium dense, saturated
	13.1		4			-increase in sand
			5		SM	Gray silty fine to medium SAND, medium dense, wet
	18.2		6			-contains gravel -light to moderate caving
			7		SP	Gray poorly graded SAND, medium dense, wet
	16.9		8			
						Test pit terminated at 8.5 feet below existing grade. Groundwater seepage encountered at 2.0 feet during excavation.

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Test Pit Log
North Creek Residential Development
Snohomish County, Washington

Proj. No. 11341	Dwn. GLS	Date Jan. 2005	Checked ELW	Date 1/27/05	Plate A7

TEST PIT LOG 11341.GPJ ECI.GDT 1/27/05

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

Test Pit Log

Project Name: North Creek Residential Development			Sheet 1 of 1
Job No. 11341	Logged by: ELW	Date: 1/13/05	Test Pit No.: TP-7
Excavation Contactor: NW Excavating			Ground Surface Elevation: 105'
Notes:			

Surface Conditions: Depth of Topsoil & Sod 10": grass

General Notes	W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	
			1		SM	Brown silty medium SAND with gravel, loose to medium dense, wet
			2			-iron oxide staining
	14.4		3			-light water seepage at 3'
					SM	Blue green silty fine SAND, medium dense, wet
	27.4		4			-contains silt and sand interbeds
			5			-becomes dense, contains gravel
	15.8		6			-contains gravel lens with moderate water seepage at 6.5'
	87.0		7		PT	Dark brown PEAT, very stiff, moist
	44.0				OL	Tan organic SILT, very stiff, moist
	22.5		8		SM	Gray silty medium SAND, dense, moist
			9			-contains silt and sand interbeds
			10			Test pit terminated at 10.5 feet below existing grade. Groundwater seepage encountered at 3.0 and 6.5 feet during excavation.

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Test Pit Log
North Creek Residential Development
Snohomish County, Washington

Proj. No. 11341	Dwn. GLS	Date Jan. 2005	Checked ELW	Date 1/27/05	Plate A8

TEST PIT LOG 11341.GPJ ECI.GDT 1/27/05

Test Pit Log

Project Name: North Creek Residential Development			Sheet 1 of 1
Job No. 11341	Logged by: ELW	Date: 1/13/05	Test Pit No.: TP-8
Excavation Contactor: NW Excavating			Ground Surface Elevation: 105'
Notes:			

Surface Conditions: Depth of Topsoil & Sod 8": grass

General Notes	W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	
	14.5		1		SM	Brown silty SAND with gravel, medium dense, moist (Fill)
			2		GP	Brown poorly graded GRAVEL with sand, dense, moist
			3			-increase in fines, becomes very dense, moist to wet
	5.4		4			-iron oxide staining -1.7% fines
	17.5		5		SM	Tan silty fine SAND, medium dense, wet
			6			-contains gravel, thin sand and silt interbeds -iron oxide staining, becomes gray
	9.0		7		GP-GM	Gray poorly graded GRAVEL with silt and sand, medium dense, saturated
			8			-moderate caving
			9			-moderate water seepage at 9.5'
	14.5		10		SM	Gray silty fine SAND with gravel, dense, moist to wet, contains sand and silt interbeds
						Test pit terminated at 10.0 feet below existing grade. Groundwater seepage encountered at 9.5 feet during excavation.

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Test Pit Log
North Creek Residential Development
Snohomish County, Washington

Proj. No. 11341	Dwn. GLS	Date Jan. 2005	Checked ELW	Date 1/27/05	Plate A9

TEST PIT LOG 11341.GPJ ECI.GDT 1/27/05

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

Test Pit Log

Project Name: North Creek Residential Development			Sheet 1 of 1
Job No. 11341	Logged by: ELW	Date: 1/13/05	Test Pit No.: TP-9
Excavation Contactor: NW Excavating			Ground Surface Elevation: 104'
Notes:			

General Notes	W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions: Depth of Topsoil & Sod 4": grass
	22.6		1		SM	Dark brown silty SAND with gravel, medium dense, moist to wet (Fill)
			2		GP-GM	Brown poorly graded GRAVEL with silt and sand, medium dense, wet -iron oxide staining, becomes saturated -light water seepage at 3.5'
	13.3		3			
	10.8		4		SM	Gray silty fine SAND with gravel, medium dense, wet
	8.9		5			-contains sand and silt interbeds -becomes dense, moist
			6		GP-GM	Gray poorly graded GRAVEL with silt and sand, medium dense, saturated -moderate water seepage at 6' to 11' -moderate to heavy caving
			7			
			8			
			9			
	8.6		10			
			11			Test pit terminated at 11.0 feet below existing grade. Groundwater seepage encountered at 3.5 and 6.0 to 11.0 feet during excavation.

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Test Pit Log
North Creek Residential Development
Snohomish County, Washington

Proj. No. 11341	Dwn. GLS	Date Jan. 2005	Checked ELW	Date 1/27/05	Plate A10

TEST PIT LOG 11341.GPJ ECI.GDT 1/27/05

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

Test Pit Log

Project Name: North Creek Residential Development			Sheet 1 of 1
Job No. 11341	Logged by: ELW	Date: 1/13/05	Test Pit No.: TP-10
Excavation Contactor: NW Excavating			Ground Surface Elevation: 104'
Notes:			

Surface Conditions: Depth of Topsoil & Sod 10": grass

General Notes	W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	
	9.3		1		GP-GM	Brown poorly graded GRAVEL with silt and sand, medium dense, wet -becomes saturated -light water seepage encountered at 2.5'
	19.4		3		SP	Gray poorly graded SAND, medium dense, wet -4.9% fines
	17.5		6		SM	Tan silty fine SAND, medium dense, moist, contains sand and silt interbeds, iron oxide staining
	6.3		7		GP-GM	Gray poorly graded GRAVEL with silt and sand, medium dense, wet, light water seepage at 7.5'
	24.5		8		SP-SM	Gray poorly graded SAND with silt, medium dense, wet
	19.8		9		SM	Gray silty fine SAND, medium dense, wet -contains sand and silt interbeds, becomes dense
			10			Test pit terminated at 10.5 feet below existing grade. Groundwater seepage encountered at 2.5 and 7.5 feet during excavation.

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Test Pit Log
North Creek Residential Development
Snohomish County, Washington

Proj. No. 11341	Dwn. GLS	Date Jan. 2005	Checked ELW	Date 1/27/05	Plate A11

TEST PIT LOG 11341.GPJ ECI.GDT 1/27/05

Test Pit Log

Project Name: North Creek Residential Development			Sheet 1 of 1
Job No. 11341	Logged by: ELW	Date: 1/13/05	Test Pit No.: TP-11
Excavation Contactor: NW Excavating			Ground Surface Elevation: 115'
Notes:			

General Notes	W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions: Depth of Topsoil & Sod 2": grass
					SM	Gray silty fine SAND with gravel, loose, wet (Fill)
			1		SM	Reddish brown silty fine SAND with gravel, loose moist to wet
			2			
	14.0		3			-becomes wet -light water seepage at 3.5'
	7.7		4		SM	Tan silty fine SAND with gravel, medium dense, moist (Glacial Till)
			5			-iron oxide staining -becomes gray, very dense
			6			
	9.5		7			Test pit terminated at 7.0 feet below existing grade. Groundwater seepage encountered at 3.5 feet during excavation.

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Test Pit Log
North Creek Residential Development
Snohomish County, Washington

Proj. No. 11341	Dwn. GLS	Date Jan. 2005	Checked ELW	Date 1/27/05	Plate A12

TEST PIT LOG 11341.GPJ ECI.GDT 1/27/05

Test Pit Log

Project Name: North Creek Residential Development			Sheet 1 of 1
Job No. 11341	Logged by: ELW	Date: 1/13/05	Test Pit No.: TP-12
Excavation Contactor: NW Excavating			Ground Surface Elevation: 112'
Notes:			

General Notes	W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions: Depth of Topsoil & Sod 6": blackberry brambles
	16.2		1		SM	Brown silty fine SAND with gravel, loose, moist to wet (Fill)
			2			-contains asphalt debris
			3			
	13.7		4			-contains wood debris and logs to 10'
			5			
			6			
			7			
			8			
			9			
			10		TPSL	Black TOPSOIL, heavy water seepage at 10.5'
	58.3		11		ML	Gray SILT, medium dense, wet
			12			-trace gravel
	12.7		13		SP-SM	Blue green poorly graded SAND with silt and gravel, medium dense, wet
						Test pit terminated at 13.5 feet below existing grade. Groundwater seepage encountered at 10.5 feet during excavation.

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Test Pit Log
North Creek Residential Development
Snohomish County, Washington

Proj. No. 11341	Dwn. GLS	Date Jan. 2005	Checked ELW	Date 1/27/05	Plate A13

TEST PIT LOG 11341.GPJ ECI.GDT 1/27/05

Test Pit Log

Project Name: North Creek Residential Development			Sheet 1 of 1
Job No. 11341	Logged by: ELW	Date: 1/13/05	Test Pit No.: TP-13
Excavation Contactor: NW Excavating			Ground Surface Elevation: 115'
Notes:			

Surface Conditions: Depth of Topsoil & Sod 12": blackberry brambles

General Notes	W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	
					TPSL	Black TOPSOIL
			1		SM	Brown silty fine SAND with gravel, loose, wet (Fill)
			2			
			3			
	10.7		4			
			5			
			6			
			7			
			8			-contains log debris
			9			
			10			
			11			
			12			-plastic debris
			13			-garbage debris
			14			
	14.3				SM	Reddish brown silty fine SAND with gravel, loose to medium dense, moist
						Test pit terminated at 14.5 feet below existing grade. No groundwater encountered during excavation.

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Test Pit Log
North Creek Residential Development
Snohomish County, Washington

Proj. No. 11341	Dwn. GLS	Date Jan. 2005	Checked ELW	Date 1/27/05	Plate A14

TEST PIT LOG 11341.GPJ ECI.GDT 1/27/05

Test Pit Log

Project Name: North Creek Residential Development			Sheet 1 of 1
Job No. 11341	Logged by: ELW	Date: 1/13/05	Test Pit No.: TP-14
Excavation Contactor: NW Excavating			Ground Surface Elevation: 110'
Notes:			

General Notes	W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions: Depth of Topsoil & Sod 4": blackberry brambles
			1		SM	Brown silty fine SAND with gravel, loose, moist (Fill)
			2			-contains wood, organics, garbage debris
	23.0		3			
	4.9		4		SM	Gray silty fine SAND with gravel, dense, moist (Glacial Till)
						Test pit terminated at 4.5 feet below existing grade. No groundwater encountered during excavation.

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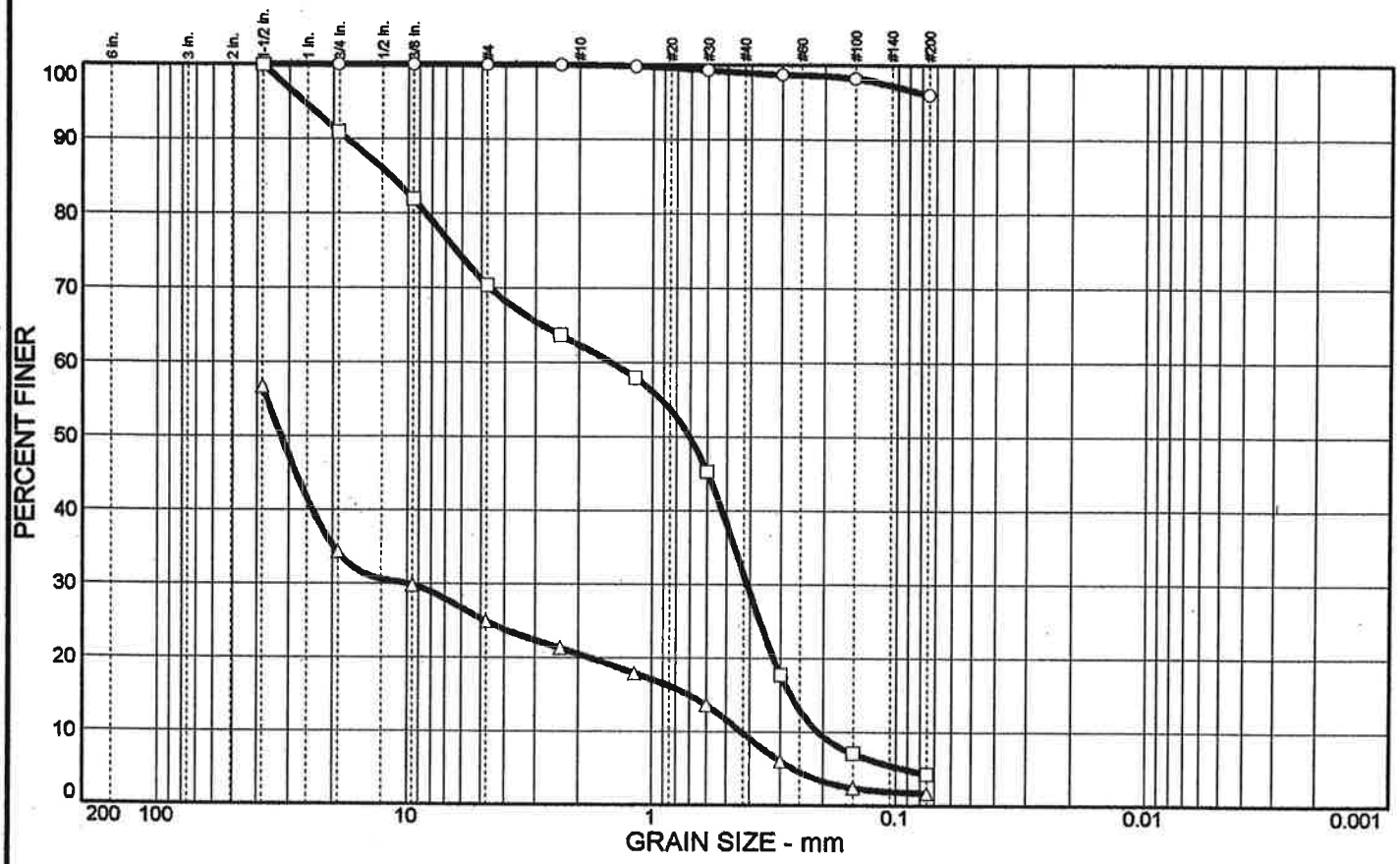
Test Pit Log
North Creek Residential Development
Snohomish County, Washington

Proj. No. 11341	Dwn. GLS	Date Jan. 2005	Checked ELW	Date 1/27/05	Plate A15

TEST PIT LOG 11341.GPJ ECI.GDT 1/27/05

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

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○			4.0	96.0		ML			
□		29.6	66.1	4.3		SP			
△			23.2	1.7		GP			

SIEVE Inches size	PERCENT FINER ○	□	△
1.5	100.0	100.0	56.7
3/4	100.0	90.9	34.3
3/8	100.0	81.9	29.8
GRAIN SIZE			
D_{60}		1.48	
D_{30}		0.411	10.1
D_{10}		0.209	0.432
COEFFICIENTS			
C_c		0.54	
C_u		7.09	

SIEVE number size	PERCENT FINER ○	□	△
#4	100.0	70.4	24.9
#8	100.0	63.6	21.3
#16	99.8	57.9	17.9
#30	99.3	45.3	13.6
#50	98.7	17.7	6.0
#100	98.2	7.1	2.4
#200	96.0	4.3	1.7

SOIL DESCRIPTION

○ TP-1: 3.5' - ML
Tan Silt; 38.1% moisture

□ TP-5: 3.0' - SP
Tan poorly graded Sand with gravel; 17.9% moisture

△ TP-8: 3.5' - GP
Brown poorly graded Gravel with sand; 5.4% moisture

REMARKS:

○ Tech: SEP

□ Tech: SEP

△ Tech: SEP

○ Source: Sample No.: TP-1 Elev./Depth: 3.5'

□ Source: Sample No.: TP-5 Elev./Depth: 3.0'

△ Source: Sample No.: TP-8 Elev./Depth: 3.5'

EARTH CONSULTANTS, INC.

Client:

Project: 1515 - 196th Ave SE

Project No.: E-11341

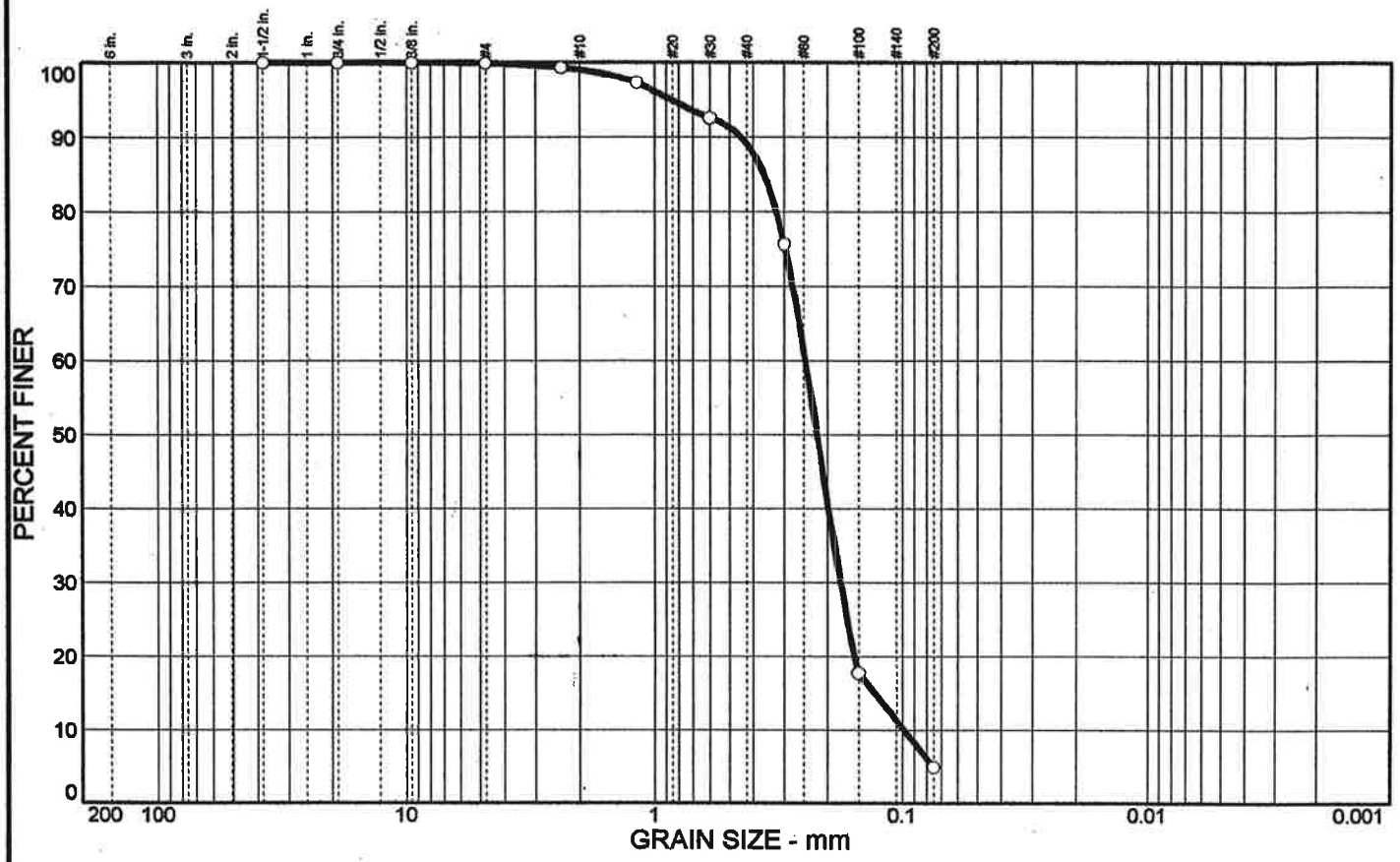
Plate B1

APPENDIX B

LABORATORY TEST RESULTS

E-11341

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		0.1	95.0	4.9		SP			

SIEVE inches size	PERCENT FINER ○		
1.5	100.0		
3/4	100.0		
3/8	100.0		
	GRAIN SIZE		
D_{60}	0.246		
D_{30}	0.177		
D_{10}	0.0989		
	COEFFICIENTS		
C_c	1.29		
C_u	2.49		

SIEVE number size	PERCENT FINER ○		
#4	99.9		
#8	99.3		
#16	97.2		
#30	92.5		
#50	75.6		
#100	17.7		
#200	4.9		

SOIL DESCRIPTION

○ TP-10: 4.0' - SP
Gray poorly graded Sand; 19.4% moisture

REMARKS:

○ Tech: SEP

○ Source: Sample No.: TP-10 Elev./Depth: 4.0'

EARTH CONSULTANTS, INC.

Client:

Project: 1515 - 196th Ave SE

Project No.: E-11341 Plate B2

DISTRIBUTION

E-11341

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