EXHIBIT G

GeoPacific Engineering, Inc.
Real-World Geotechnical Solutions
• Investigation
• Design
• Construction Support

August 16, 2005

Project No. 05-9266

Cascade Communities, Inc.
13535 SE 145th Avenue
Clackamas, OR 97015

Attention: Don Oakley (Fax 503-658-4544)

RE: **GEOTECHNICAL AND SLOPE STABILITY INVESTIGATION**
VISTA LOOP NORTH AND VISTA LOOP SOUTH SUBDIVISIONS
SANDY, OREGON

This report presents the results of our geotechnical and slope stability investigation of the proposed Vista Loop Planned Development in the City of Sandy, Clackamas County, Oregon. The purpose of our investigation was to evaluate subsurface conditions and slope stability at the site, and provide geotechnical recommendations for site development and construction. Our work was performed in accordance with GeoPacific Engineering, Inc.'s (GeoPacific) proposal letter No. P2463, dated May 4, 2005. The scope of our work included extensive investigation of Vista Loop North with particular attention to slopes on northern portion of the site. On Vista Loop South, the scope of our work was limited to a localized several acre area where slopes exceed 15% grade.

1.0 PROJECT INFORMATION

Location:	The subject property is approximately 25.14 acres located in the City of Sandy, Clackamas County, Oregon (Figure 1).
Owner/ Developer:	Cascade Communities, Inc. 13535 SE 145th Avenue, Clackamas, OR 97015
Civil Engineer:	Don Oakley, P.E. 13535 SE 145th Avenue, Clackamas, OR 97015
Jurisdictional Agency:	City of Sandy, Oregon

2.0 SITE DESCRIPTION AND PROPOSED DEVELOPMENT

The subject property includes approximately 25.14 acres that is divided by Highway 26 and is located in the City of Sandy, Clackamas County, Oregon (Figure 1). Vista Loop North, which is bordered on the south by the street right of way for Highway 26, consists of approximately 9.14 acres. Vista Loop South, which is bordered by Highway 26 on the north, consists of approximately 15.57 acres. These proposed residential developments are situated on the margin of an upland plateau with Vista Loop North at the top of an approximately 300 foot high slope that forms the southern portion of the Cedar Creek drainage. Slopes on the upland plateau portion of the site generally incline to the west at about 5% to 15% grade. Slopes on the northern portion of Vista Loop North are moderately steep inclining at 40% to 70% grade. An old logging road is present at the top of this slope. Vegetation consists of low grasses, brush, and young to mature trees.

The proposed subdivision layout and grading plan for Vista Loop North and Vista Loop South are shown in Figure 2 and Figure 4, respectively. On Figure 2, the plan also shows conservation easement limits which set the northerly extend of building foundations on Lots 6 through 16. We presume that underground utilities will generally be constructed at depths of less than 10 feet.

3.0 SITE GEOLOGY

The subject property lies on the far eastern margin of the Willamette Valley/Puget Sound physiographic province, a broad structural depression situated between the Coast Range on the west and the Cascade Range on the east. Underlying the site vicinity is the Plio-Pleistocene age (about 2 million years ago) Springwater Formation, a broad fluvial/alluvial fan deposit of outwash sediment derived from the Cascade Range (Schlicker and Finlayson, 1979). Regionally, the Springwater Formation consists of fluvial conglomerate, volcaniclastic sandstone, siltstone and debris flows. The conglomerate typically consists of deeply weathered to decomposed, well-rounded pebbles to cobbles of basalt, andesite and dacite with a sand matrix composed of feldspathic and volcanic lithics. Siltstone units typically consist of quartzofeldspathic silt, volcanic ash and clay. The estimated thickness of the Springwater Formation in the site vicinity based on mapped thicknesses exposed in the Sandy River drainage is 150 to 200 hundred feet.

Underlying the Springwater Formation is the Pliocene age (3 to 5 million years ago) Troutdale Formation, which is informally divided into an upper and lower member (Schlicker and Finlayson, 1979). The upper member consists primarily of indurated sandstone and conglomerate with localized clay seams. In the site vicinity, the estimated thickness of the upper member is 100 to 150 feet. The lower member, also known as the Sandy River Mudstone, consists of moderately-well indurated siltstone, claystone, very-fine-grained sandstone and some volcanic lapilli tuff layers with a total estimated thickness of about 725 feet. In the site vicinity, these strata are generally horizontally bedded with maximum dip angles on the order of 2 degrees (Schlicker and Finlayson, 1979).

4.0 SUBSURFACE CONDITIONS

In order to characterize subsurface conditions on the subject property, GeoPacific conducted a two phase program of subsurface exploration. The first phase consisted of 12 test pits excavated to depths of 8 to 12 feet with an 8-ton trackhoe. The second phase consisted of drilling 3 exploratory borings with a track-mounted drill rig to depths of 51.5 and 61.5 feet below the ground surface, using mud-rotary drilling techniques. Exploration locations shown in Figure 2 were located in the field by pacing distances from apparent property corners and other site features, and as such should be considered approximate.

The following section presents generalized discussions of soil, rock and groundwater conditions anticipated on site based on subsurface explorations performed for the project. Each of the geologic deposits encountered is discussed separately below. For additional details regarding conditions at specific exploration locations, refer to the attached test pit and boring logs.

4.1 Soil

Fill: A localized fill wedge is present on the outboard edge of the existing logging road which skirts the top of the moderately steep slope on the northern portion of the site (see Figure 3). This fill consists of organic silt and clayey silt soil that is poorly compacted. In test pits (TP-4, TP-5, & TP-7), the fill ranges between 2 and 5 feet thick.

Topsoil: Over most of the site, the ground surface is directly underlain by topsoil consisting of dark brown, organic SILT (OL) with common fine roots in grassland areas and many roots in forested areas. The observed thickness of topsoil generally varies from about 12 to 18 inches.

Native Soil Horizon/Colluvium: On the gently sloping portions of the site, the topsoil is underlain by a native soil horizon, while on the more steeply sloping portions the topsoil is underlain by colluvial soil. The native soil horizon generally consists of brown to red-brown, clayey SILT (ML) derived from in-place weathering and mineral decomposition. In general, this soil horizon has a stiff to very-stiff consistency. Pocket penetrometer measurements indicate an approximate unconfined compressive strength of 1.5 to greater than 3.0 tons/ft^2. The thickness of this layer ranges between 2 and 3 feet. Colluvial soil underlying the topsoil in sloping areas is derived from weathering, mineral decomposition, erosion and soil creep. The colluvial soil consists of brown to red-brown, clayey SILT (ML) to sandy SILT (ML) with fragments of weathered volcanic rocks and cobbles. In general, the consistency of the colluvial soil ranges from stiff with loose pockets to very-stiff. Pocket penetrometer measurements indicate approximate unconfined compressive strengths of 0.5 to 3.5 tons/ft^2. In test pits, the thickness of colluvial soil ranges between 2.5 and 4 feet.

Residual Soil: Underlying the native and colluvial soil is residual soil derived from in-place decomposition of the Springwater Formation. The residual soil consists of red-brown, clayey SILT (ML), sandy SILT (ML), and silty CLAY (CL) with some sand and weathered rock fragments. In general, this soil horizon has a stiff to very-stiff consistency. Pocket penetrometer measurements indicate an approximate unconfined compressive strength of 1.5 to 3.0 tons/ft^2. In test pits, the thickness of this layer ranges from about 3 feet to greater than 7 feet thick, while in some sloping areas, the residual soil is absent.

Springwater Formation: Underlying the above soil units is the Springwater Formation. In test pits, the Springwater Formation consists of multi-colored, sandy SILT (ML) with clay and abundant weathered volcanic lithics and decomposed rounded cobbles. The consistency is generally medium-stiff to very-stiff but is variable depending on the original sediment mineralogy and degree of weathering and decomposition. In borings, Standard Penetration Test (SPT) N-values generally range between N=5 and N=greater than 50 consistent with a medium-stiff to hard consistency. Springwater Formation extends below the maximum depth explored of 60 feet below the ground surface.

4.2 Soil Moisture and Groundwater

In May of 2005, near surface soil moisture conditions observed in test pits generally ranged from damp to moist. Minor groundwater seepage was observed in test pits TP-1 and TP-3 at a depth of 7 feet below the ground surface.

Seasonal springs are common in the Springwater Formation and tend to occur in localized areas in a variety of topographic settings. No springs or geomorphic evidence of seasonal springs was observed during our reconnaissance of the site. However, we anticipate that minor seasonal perching of infiltrating surface water and localized groundwater seepage may be encountered in cuts and in shallow excavations during the wet weather season. Because mud-rotary drilling techniques do not permit measurement of groundwater, the exploratory borings provided no information regarding groundwater conditions.

5.0 SLOPE STABILITY

For the purpose of evaluating slope stability, we: (1) performed a review of published geologic literature, (2) performed a series of field reconnaissance traverses of the subject property and adjacent areas, (3) conducted a program of subsurface exploration, (4) constructed geologic cross sections and slope stability models, and (5) performed a quantitative analyses of slope stability.

5.1 Regional Landslide Hazard Mapping

Regional slope instability mapping identifies the slopes on the northern margin of the site as a moderate to high relative slope hazard zone based primarily on slope gradient (Hofmeister et al., 2003). Regional geologic hazard mapping of the westward projection of these slopes identifies numerous "landslide topography" features (Schlicker and Finlayson, 1979). Common slope instability in this area is attributed to weak horizons in the Troutdale Formation underlying the lower portion of the slope and erosional oversteeping of slopes by stream undercutting. The mapped "landslide topography" closest to the subject site lies approximately 2,000 feet to the west. Based on our review of 1:24,000 scale topographic mapping, there appears to be a possible landslide feature expressed as benched topography located approximately 500 feet east of the site (see Figure 1).

These mapped hazard zone designations are general in nature based largely on prevailing slopes, and are intended to indicate the need for site-specific geotechnical investigation such as this report.

5.2 Slope Geomorphology and Subsurface Soil Structure

We performed a series of slope reconnaissance traverses of the moderately steep slope on the northern margin the subject site and adjacent property. This north-facing slope is approximately 300 feet high and extends to the bottom of the Cedar Creek drainage, a small tributary to the Sandy River (See Figure 1). Based on review of the site topographic survey (see Figure 2) and clinometer measurements collected during our reconnaissance traverses, the upper portion of this slope inclines at 40% to 70% grade and includes both concave and slightly convex slope geometries. In contrast the lower portion of the slope, inclines at grades of less than 40% with a concave geometry becoming more gentle towards the toe of the slope at Cedar Creek. Figure 3 presents a slope profile constructed using hand-held clinometer and cloth tape techniques.

Based on observations made during our reconnaissance traverses, slope geomorphology on and directly below the site is generally smooth and uniform consistent with relatively stable slope conditions. No geomorphic evidence of significant slope movement, such as benches, closed depressions, scarps, ground cracks, etc., was observed during our reconnaissance.

Subsurface soil conditions were evaluated in three exploratory borings drilled along the top of slope on the northern margin of the site. Soil samples were collected and standard penetration tests (SPTs) of soil strength were performed on 5 foot intervals. Logs of the borings are presented in Appendix A. The borings indicate that the Springwater Formation underlying the upper portion of the slope generally consists of highly tuffaceous, clayey silt with varying amounts of highly weathered volcanic lithics and decomposed cobbles. Due to the high degree of weathering and decomposition, the consistency of the Springwater Formation is variable, ranging between medium-stiff and hard. Standard penetration tests of soil strength indicate that Springwater Formation within 35 feet of the ground surface is generally medium-stiff to stiff with SPT N-values of between N=5 and N=12. These N-values are considered to be consistent with low to moderate strength and low to moderate resistance to slope instability. In contrast, standard penetration tests indicate that the Springwater Formation at depths of 35 to 60 feet is generally stiff to hard with SPT N-values of N=13 to N= greater than 50 for 1 inch of penetration. These N-values are considered to be consistent with moderate strength and moderate resistance to slope instability.

5.3 Slope Stability – Lower Slope

We performed a qualitative geologic evaluation of the potential for deep seated slope instability in the Troutdale Formation underlying the lower portion of the slope that extends beyond the northern limits of the subject site. Regionally, the lower section of the Troutdale Formation has a relatively high susceptibility to slope instability due to the presence of weak bedding plane layers and a low internal strength. Because reported bedding planes in the Troutdale Formation generally incline gently to the west at approximate dips of 2 to 3 degrees (Schlicker and Finlayson, 1979), weak bedding planes are unlikely to provide potential failure planes slope movement. Regional distribution patterns indicate that slope failures in the lower section of the Troutdale Formation are triggered more by oversteepening of slopes due to undercutting by stream erosion.

In our assessment, the presence of Troutdale Formation underlying the lower portion of the slope beyond the northern boundary of the subject property does not appear to present a significant instability hazard on the subject site, because: (1) the lower slope inclines at relatively gentle grades (about 10% to 40% grade), (2) the slope is not significantly undercut by Cedar Creek, (3) the Troutdale Formation is somewhat buttressed by deposition of colluvial and alluvial sediments at the toe the slope, and (4) we observed no geomorphic evidence of prior, deep-seated slope instability on the lower slope directly below the subject site.

5.4 Slope Stability Modeling and Quantitative Stability Analysis – Upper Slope

Our slope profile and relevant subsurface data was compiled and used to construct a representative geologic cross section of the slope geometry on and adjacent to the northern portion of the site (Figure 3). A quantitative slope model was then constructed and stability analyses performed to evaluate local slope stability under future conditions with the proposed development cuts at the top of slope. Our analysis presumes that a substantial cut is made at the top of the slope as shown in the project grading plan (Figure 2).

The slope was modeled as a multi-layered system with each layer being an isotropic medium. For the stability evaluation, the most critical circular failure surface was found by analyzing 100 potential failure surfaces. Shear strength parameters used in the model were selected based on correlations with field SPT N-value measurements and our local experience with similar soil and geologic conditions. The parameters assumed in the slope stability calculations are summarized in Table 1.

Table 1 - Summary of Assumed Soil Strength Parameters

Geologic Unit	Moist Unit Weight (pcf)	Friction Angle	Cohesion (psf)
Weathered Springwater Fm.	125	33°	300
Springwater Fm.	130	36°	500
Troutdale Formation	125	32°	250

Slope stability analyses were performed using the SLOPE/W computer program developed by Geo-Slope International of Calgary, Canada. This numerical analysis program utilizes a two-dimensional limiting equilibrium method to calculate the factor of safety of a potential slip surface and incorporates search routines to identify the most critical potential failure surfaces for the cases analyzed. Factors of safety were calculated using Spencer's method of slices. Potential seismic forces were also incorporated into the analysis using a pseudostatic approach. The pseudostatic analysis used a horizontal ground acceleration of 0.1 g, which is approximately 50 percent of our maximum estimated acceleration for a design seismic event (10 percent probability of exceedence in 50 years). Due to the inherent conservatism of the pseudostatic methodology, it is standard engineering practice to utilize one-half to two-thirds of the expected horizontal accelerations in pseudostatic slope stability calculations.

Results of the slope stability factor of safety calculations are presented in Table 2. Graphic plots of the slope model and analysis output are presented in Appendix B.

Table 2 - Summary of Slope Stability Analysis Results

Cross Section	Slope Conditions	Factor of Safety (Static Conditions)	Factor of Safety (Pseudostatic Conditions)
A-A'	Preliminary Plan Finish Grade	1.46	-
A-A'	Preliminary Plan Finish Grade	-	1.19

Our slope stability analysis indicates that a factor of safety of 1.46 is achieved under post development, static conditions with a finish grade setback from the top of the slope of 40 feet (see Appendix B). Pseudostatic stability calculations indicate that the factor of safety under seismic loading during the maximum probable event is 1.1. Potential failure surfaces closer than 40 feet to the top of slope (finish grade) will have reduced factors-of-safety.

In our opinion, the factors of safety presented in Table 2 against slope instability for both static and pseudostatic conditions are adequate for conventional foundation construction that maintains a minimum 40 foot horizontal setback from the top of the moderately-steep slope on the northern margin of Vista Loop North (Lots 6 through 16). Structures located closer than 40 feet horizontal from the top of slope will need to be evaluated individually and will likely require deepened foundations and/or soil anchors. For the purpose of determining setbacks from the top of slope, "top of slope" refers to the top of slope resulting after the project grading cuts shown on Figure 2 are made.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Our geotechnical investigation indicates that the proposed residential development is geotechnically feasible provided that the site is developed and constructed in accordance with our recommendations. The potential for damaging deep-seated slope instability is considered to be low for conventional house foundations that maintain a minimum setback of 40 feet from the top of the moderately-steep slope on the northern portion of Vista Loop North. Houses on Vista Loop North Lots 6 through 16 that are situated closer than 40 feet from the top of the slope will likely require deep foundations such as drilled piers or driven piles and soil anchors.

Appendix C contains an itemized checklist of soil testing and inspection procedures that are recommended to help guide the project to completion.

6.1 Slope Stability

The northern margin of Vista Loop North is situated at the top of a moderately-steep, 300-foot-high, north-facing slope. In our opinion, the primary slope instability hazard is the potential for localized slope failure on the steeper upper portion of the slope where grades incline up to 70%. Quantitative slope stability modeling and analysis indicates that at distances of less than 40 feet from the top of the slope, the upper slope has a factor of safety against movement of less than 1.46. We recommend that houses supported on conventional shallow foundations maintain a minimum setback of 40 feet from the top of the moderately-steep slope on the northern portion of the property. Houses on Vista Loop North Lots 6 through 16 situated closer than 40 feet from the top of the slope will likely require deep foundations such as drilled piers or driven piles and soil anchors. These foundations will need to be evaluated and designed individually. For maintaining slope stability, stormwater runoff from the development should not be allowed to flow onto the moderately-steep slopes on the northern margin of the development.

Slope gradients on Vista Loop South are generally gentle except for a localized approximately 20 foot high slope inclining at about 35% to 50% grade on the east-central portion of the site (Figure 4). Exploratory test pits indicate that this slope is underlain by relatively competent soils that have a moderate to high resistance to instability on moderate slopes. The preliminary grading plan specifies that 8 feet of structural fill will be placed at the toe of this slope. In our opinion, the potential for damaging slope instability on this slope is low and no special mitigating measures are necessary for slope stability.

6.2 Site Preparation

All areas to be graded should first be cleared of debris, trees, stumps, vegetation, etc., and all debris from clearing should be removed from the site. Organic-rich topsoil should then be stripped. We anticipate that an average stripping depth of 8 to 10 inches will be necessary to remove organic-rich topsoil. Localized deeper stripping, or tilling and root-picking, to depths of 12 to 24 inches may be necessary to remove thick topsoil and abundant roots around trees. The final depth of stripping removal will be determined on the basis of a site inspection after the initial stripping has been performed. Stripped topsoil should be stockpiled only in designated areas and stripping operations should be observed and documented by GeoPacific.

Once stripping is approved, the area should be aerated, and/or ripped or tilled to a depth of 8 inches, moisture conditioned, and compacted in-place prior to the placement of engineered fill or crushed aggregate base for pavement (dry weather only). Exposed subgrade soils should be evaluated by the geotechnical engineer. For large areas, this evaluation is normally performed by proof-rolling the exposed subgrade with a fully loaded scraper or dump truck. For smaller areas where access is restricted, the subgrade should be evaluated by probing the soil with a steel probe.

Old fill, subsurface structures, etc, in future structural areas should be demolished, removed from the site, and the excavations backfilled with fill compacted to engineered fill specifications. We anticipate that some old fill may be present on Vista Loop North in the vicinity of Lots 49 through 58.

6.4 Rough Grading

Grading for the proposed development should be performed as engineered grading in accordance with Appendix Chapter 33 of the 1997 Uniform Building Code (UBC) with the exceptions and additions noted herein. Proper test frequency and earthwork documentation usually requires daily observation and testing during stripping, rough grading, and placement of engineered fill. Imported fill material must be approved by the geotechnical engineer prior to its arrival on site.

Engineered fill should be compacted in horizontal lifts not exceeding 8 inches using standard compaction equipment. We recommend that engineered fill be compacted to at least 95% of the maximum dry density determined by Standard Proctor AASHTO T-99 or equivalent. Field density testing should conform to ASTM D2922 and D3017, or D1556. Engineered fill should be observed and tested by GeoPacific. Typically, one density test is performed for at least every 2 vertical feet of fill placed or every 500 yd^3, whichever requires more testing. Because the standard of practice is to perform testing on an on-call basis, we recommend that the earthwork contractor be held contractually responsible for test scheduling and frequency.

Earthwork is usually performed in the summer months, generally mid-June to mid-October, when warm dry weather is available for proper moisture conditioning of soils. Earthwork performed during the wet-weather season will probably require expensive measures such as cement treatment or imported granular material to compact fill to the recommended engineering specifications.

The preliminary grading plan for Vista Loop South specifies an approximately 10 foot thick fill in the bottom of a broad drainage swale extending through the site (Figure 4). We anticipate that soft soils and shallow groundwater may be present in the drainage bottom such that subgrade stabilization measures may be necessary to construct structural fills for lots and streets. We recommend that this area be evaluated in construction prior to fill placement. Recommended subgrade stabilization measures may include imported rock stabilization layers, subdrains, drying out ("baking") of exposed subgrade during hot weather conditions, etc.

6.5 Landscaping Fill

Landscaping fill not supporting structures may consist of organic soils (such as topsoil strippings) that are free of large woody debris and/or other deleterious material. To limit settlement and shifting, landscaping fill should be compacted to a firm, unyielding state as determined by GeoPacific (typically 90% of standard proctor AASHTO T-99 or equivalent).

6.6 Erosion Control Considerations

Due to the presence of gentle to moderate slope gradients, we consider the potential for adverse erosion during construction to be moderate. Erosion at the site during construction can be minimized by implementing the project erosion control plan specified by the civil engineer, which typically includes the use of straw bales, bio-bags, and silt fences. Where used, these erosion control devices should be in place and remain in place throughout site preparation and construction.

Areas of exposed soil requiring immediate and/or temporary protection against exposure should be covered with either mulch or erosion control netting/blankets. Areas of exposed soil requiring permanent stabilization should be seeded with an approved grass seed mixture, or hydroseeded with an approved seed-mulch-fertilizer mixture. Cut and fill slopes should be seeded or planted as soon as possible after construction, so that vegetation has time to become established before the onset of the next wet-weather season.

6.7 Excavating Conditions and Temporary Excavations

Based on subsurface test pit exploration, we anticipate that the planned excavation depths will generally be achievable with conventional heavy equipment. Some boulders may be encountered, particularly in deeper excavations. All temporary cuts in excess of 4 feet in height should be sloped in accordance with U.S. Occupational Safety and Heath Administration (OSHA) regulations (29 CFR Part 1926), or be shored. At the time of our exploration, native soils at the site were generally classified as Type A and Type B Soil. Temporary excavation side slope inclinations as steep as ¾:1 (Type A) and 1H:1V (Type B) may be assumed for planning purposes. This cut slope inclination is applicable to excavations above the water table only. Maintenance of safe working conditions, including temporary excavation stability, is the responsibility of the contractor. Actual slope inclinations at the time of construction should be determined based on safety requirements and actual soil and groundwater conditions.

Vibrations created by traffic and construction equipment may cause some caving and raveling of excavation walls. In such an event, lateral support for the excavation walls should be provided by the contractor to prevent loss of ground support and possible distress to existing or previously constructed structural improvements.

6.8 Utilities

PVC pipe should be installed in accordance with the procedures specified in ASTM D2321. We recommend that structural trench backfill be compacted to at least 95% of the maximum dry density determined by Standard Proctor AASHTO T-99 or equivalent. Initial backfill lift thickness for a ¾"-0 crushed aggregate base may need to be as great as 4 feet to reduce the risk of flattening underlying flexible pipe. Subsequent lift thickness should not exceed 1 foot. If imported granular fill material is used, then the lifts for large vibrating plate-compaction equipment (e.g. hoe compactor attachments) may be up to 2 feet, provided that proper compaction is being achieved and each lift is tested. Use of large vibrating compaction equipment should be carefully monitored near existing structures and improvements due to the potential for vibration-induced damage.

Adequate density testing should be performed during construction to verify that the recommended relative compaction is achieved. Typically, one density test is taken for every 4 vertical feet of backfill on each 200-lineal-foot section of trench. Franchise utility trenches are generally not compacted unless they are located near a structural area. Trench spoils spread over lots should be kept to a minimum.

6.9 Pavement Construction

It is our understanding that the project will incorporate the standard City pavement section for dry weather construction consisting of 2.5 inches of asphaltic concrete over 8 inches of crushed aggregate (1 ½"-0 or ¾"-0) compacted to at least 95% of AASHTO T-180 or equivalent. For the purpose of evaluating native soil strength for support of pavement, we performed Portable Dynamic Cone Penetrometer (PDCP) field tests which approximate the California Bearing Ratio (CBR) of in-situ soils (see Appendix A). Using a CBR of 10 for in-situ, native soil at damp to dry moisture conditions, and empirical correlations between CBR and resilient modulus (M_r), in-situ native soil strength is considered adequate for support of the standard pavement section assuming a light duty traffic index of 4.0 and a design life of 20 years.

Areas of yielding, native soil subgrade should be tilled to a minimum depth of 12 to 24 inches, aerated, and recompacted in-place to at least 95% of the maximum dry density obtained by AASHTO T-99 or equivalent. GeoPacific recommends that subgrade strength be verified visually by proof-rolling directly on soil subgrade with a loaded dump truck during dry weather and on top of base course in wet weather. Soft areas which rut, pump, or weave by more than ¼ inch on soil and 1/8 inch on base course should be stabilized prior to paving. Generally, one subgrade, one base course, and one asphalt compaction test is performed for every 100 to 200 linear feet of paving.

If pavement areas are to be constructed during wet weather, GeoPacific should review the subgrade and proposed construction methods immediately prior to the placement of base course so that specific recommendations can be provided. Wet-weather pavement construction is likely to require soil amendment, or woven geotextile fabric and a minimum additional 6 inches of crushed aggregate base.

6.10 Anticipated House Foundations

The majority of the subject site to within 40 feet of the top of slope on Vista Ridge North is suitable for shallow foundations bearing on stiff, native soil and/or engineered fill. Foundation design, construction, and setback requirements should conform to the applicable code at the time of permitting. For protection against frost heave, spread footings should be embedded at a minimum depth of 18 inches below exterior grade. The recommended minimum widths for continuous footings supporting wood-framed walls without masonry are presented in Table 3. Minimum reinforcement consisting of three horizontal No. 4 bars, two in the footing and one in the stem wall, is recommended. Actual footing widths, sizing, and reinforcement should be determined by the house designer, architect- or engineer-of-record.

Table 3 - Recommended Minimum Width of Continuous Spread Footings

Number of Stories	Minimum Width of Continuous Spread Footings
1-Story	12 inches
2-Story	15 inches
3-Story	18 inches

The recommended allowable soil bearing pressure is 1,500 lbs/ft^2 for footings on stiff, native soil and engineered fill. A maximum chimney and column load of 35 kips is recommended for the site. For heavier loads, GeoPacific should be consulted. The coefficient of friction between on-site soil and poured-in-place concrete may be taken as 0.40 (no factor of safety included). The maximum anticipated total and differential footing movements (generally from soil expansion and/or settlement) are 1 inch and ¾ inch over a span of 20 feet, respectively. Excavations near structural footings should not extend within a 1H:1V plane projected downward from the bottom edge of footings.

Footing excavations should penetrate through topsoil and any loose soil to stiff subgrade that is suitable for bearing support. All footing excavations should be trimmed neat, and all loose or softened soil should be removed from the excavation bottom prior to placing reinforcing steel bars. Due to the moisture sensitivity of on-site native soils, foundations constructed during the wet weather season may require overexcavation of footings and backfill with compacted, crushed aggregate.

6.11 House Foundations Incorporating Retaining Walls

Lateral soil pressures recommended by GeoPacific for design of permanent retaining structures with adequate drainage can be calculated using the equivalent fluid unit weights provided in Table 4. The effect of surcharges or live loads on lateral pressures has not been included. The recommended values assume that adequate drainage measures are incorporated, and that no hydrostatic pressures develop behind the walls. The unit weights in Table 4 are for backfill consisting of free-draining granular material such as crushed aggregate; on-site soils are not recommended for use as retaining wall backfill. Wall backfill should be compacted to at least 95% of the maximum dry density determined by ASTM D698 or equivalent.

The average allowable bearing pressure for retaining walls may be taken as 2,000 lbs/ft^2 with a maximum allowable toe pressure of 2,500 lbs/ft^2. The coefficient of friction between native soil or engineered granular fill and poured-in-place concrete may be taken as 0.45 (no factor of safety added).

Subdrains should be installed behind all retaining walls to prevent the build-up of adverse hydrostatic pressure. We recommend that subdrains consist of ADS Highway Grade (or equivalent), perforated, plastic pipe enveloped in a minimum of 3 ft^3 per lineal foot of 2" - ½", open-graded gravel (drain rock) wrapped with geofabric filter (Amoco 4545, Trevia 1120, or equivalent). A minimum 0.5 percent fall should be maintained throughout the drain and non-perforated pipe outlet.

Table 4 - Recommended Equivalent Fluid Lateral Earth Pressures

	Unrestrained Wall		Restrained Wall	
Type	Level Profile	2H:1V Upslope	Level Profile	2H:1V Upslope
Active Pressure ($lbs/ft^2/ft$)	32	46	-	-
At-Rest Pressure ($lbs/ft^2/ft$)	-	-	50	65
Passive Pressure * ($lbs/ft^2/ft$)	280	280	250	250

* Passive pressure values are allowable and include a factor of safety of 1.5. For passive pressure calculations, the upper 6 inches of embedment should be ignored.

For concrete retaining walls in living spaces, waterproofing and a geocomposite wall drain such as Tuff-N-Dry and Warm-N-Dry or CONTECH C-DRAIN 11K, or equivalent are recommended to minimize the potential for interior moisture problems.

6.12 Footing Subdrains, Roof Drains, and Drainage

Footing subdrains constructed as standard practice should consist of a minimum 3-inch diameter ADS Highway Grade (or equivalent), perforated, plastic pipe enveloped in a minimum of 1 ft^3 per lineal foot of 2"- ½", open, graded gravel (drain rock) wrapped with geofabric filter (Amoco 4545, Trevia 1120, or equivalent). Subdrains should be connected to the storm drain system or daylight to a suitable outfall location. A minimum 0.5% fall should be maintained throughout all subdrains and non-perforated pipe outlets. Footing subdrains are normally installed for mitigating detrimental effects of water on foundations only, and are not intended for elimination of all potential sources of water beneath the house or within crawl spaces.

Additional subdrains such as cut-off trenches or blanket drains may be necessary to facilitate drainage of springs encountered during construction. If springs are encountered during construction, GeoPacific Engineering should be contacted to make site-specific recommendations.

Surface water drainage should be directed away from structures. In no case should roof drains be connected to footing drains.

6.13 Seismic Design

The subject site is located in a region of moderate seismic risk, and moderate levels of earthquake shaking should be anticipated during the design life of the proposed structures and improvements. Probabilistic assessments of the seismic shaking hazard in Oregon predict that in the next 50 years bedrock underlying the subject site has a 10% probability of experiencing a peak ground acceleration (PGA) of 0.18 g, a 5% probability of experiencing a PGA of 0.22 g, and a 2% probability of experiencing a PGA of 0.34 g (Geomatrix, 1995).

Seismic design requirements for single-family homes are included in the Oregon One- and Two-Family Dwelling Specialty Code, which specifies the site location as being in Seismic Design Category D_1. Structures not governed by the One- and Two- Family Dwelling Specialty Code should be designed to resist earthquake loading in accordance with the methodology described in section 1615 of the State of Oregon 2004 Structural Specialty Code (OSSC) Amendments to the 2003 International Building Code (IBC). The maximum considered earthquake ground motion for short period and 1.0 second period spectral response may be determined from map Figures 1615(1) and 1615(2) of the State of Oregon 2004 Structural Specialty Code (OSSC) or the 2003 National Earthquake Hazard Reduction Program (NEHRP) "Recommended Provisions for Seismic Regulations for New Buildings and Other Structures" published by the Building Seismic Safety Council. We recommend Site Class D be used for design per the OSSC, Table 1615.1.1. Using this information, the structural engineer can select the appropriate site coefficient values (F_a and F_v) from Tables 1615.1.2(1) and 1615.1.2(2) of the 2003 IBC to determine the maximum considered earthquake spectral response acceleration for design of the project.

In our opinion, the potential for liquefaction or liquefaction-related ground failure at the subject site is very low, and no special mitigating measures are recommended against liquefaction.

7.0 UNCERTAINTY AND LIMITATIONS

We have prepared this report for the developer and designers, for use on this project only. The report should be provided in its entirety to prospective contractors for bidding and estimating purposes; however, the conclusions and interpretations presented in this report should not be construed as a warranty of the subsurface conditions. Inconsistent conditions can occur between explorations that may not be detected by a geotechnical study. If, during future site operations, subsurface conditions are encountered which vary appreciably from those described herein, GeoPacific should be notified for review of the recommendations of this report, and revision of such if necessary.

We recommend that GeoPacific perform sufficient geotechnical monitoring, testing and consultation during construction to confirm that the conditions encountered are consistent with those indicated by explorations, and to verify that the geotechnical aspects of construction comply with the contract plans and specifications. Recommendations for design changes will be provided should conditions revealed during construction differ from those anticipated. The checklist attached to this report (Appendix C) outlines the minimum recommended geotechnical observations and testing for the project.

Within the limitations of scope, schedule and budget, GeoPacific attempted to execute these services in accordance with generally accepted professional principles and practices in the fields of geotechnical engineering and engineering geology at the time the report was prepared. No warranty, express or implied, is made. The scope of our work did not include environmental assessments or evaluations regarding the presence or absence of wetlands or hazardous or toxic substances in the soil, surface water, or groundwater at this site.

We appreciate this opportunity to be of service.

Sincerely,

GEOPACIFIC ENGINEERING, INC.

CERTIFIED OREGON PAUL A. CRENNA E1766 ENGINEERING GEOLOGIST

REGISTERED PROFESSIONAL ENGINEER 14743 OREGON JAN. 23, 1990 JAMES D. IMBRIE

Exp 6-30-07

Paul A. Crenna, C.E.G.
Engineering Geologist

James D. Imbrie, P.E., C.E.G
Geotechnical Engineer

8.0 REFERENCES CITED

Geomatrix Consultants, 1995, Seismic Design Mapping, State of Oregon: unpublished report prepared for Oregon Department of Transportation, Personal Services Contract 11688, January 1995.

Hofmeister, R.J., Hasenberg, C.S., Madin, I.P, and Wang, Y., 2003, Relative earthquake and landslide hazards in Clackamas County: Oregon Department of Geology and Mineral Industries Open File Report O-03-09, map scale 1:100,000.

Schlicker, H.G. and Finlayson, C.T., 1979, Geology and Geologic Hazards of northwestern Clackamas County, Oregon: Oregon Department of Geology and Mineral Industries, Bulletin No. 99, 79 p., scale 1:24,000.

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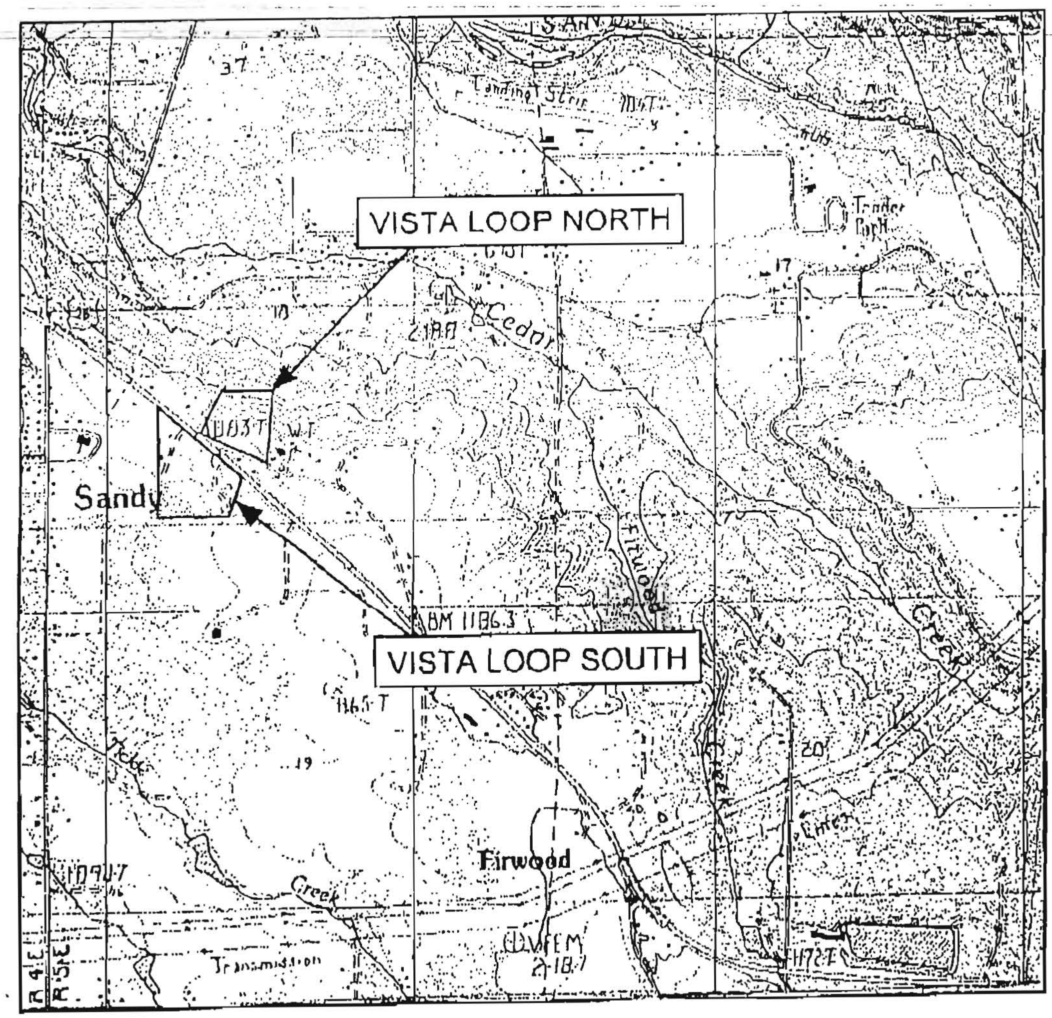
VICINITY MAP

NORTH



Legend

Approximate Scale 1 in = 2,000 ft

Date: 8/16/05
Drawn by: PAC

Base map: U.S. Geological Survey 7.5 minute Topographic Map Series, Bull Run Quadrangle, 1985

Project: Vista Loop Sandy, Oregon	Project No. 05-9266	FIGURE 1

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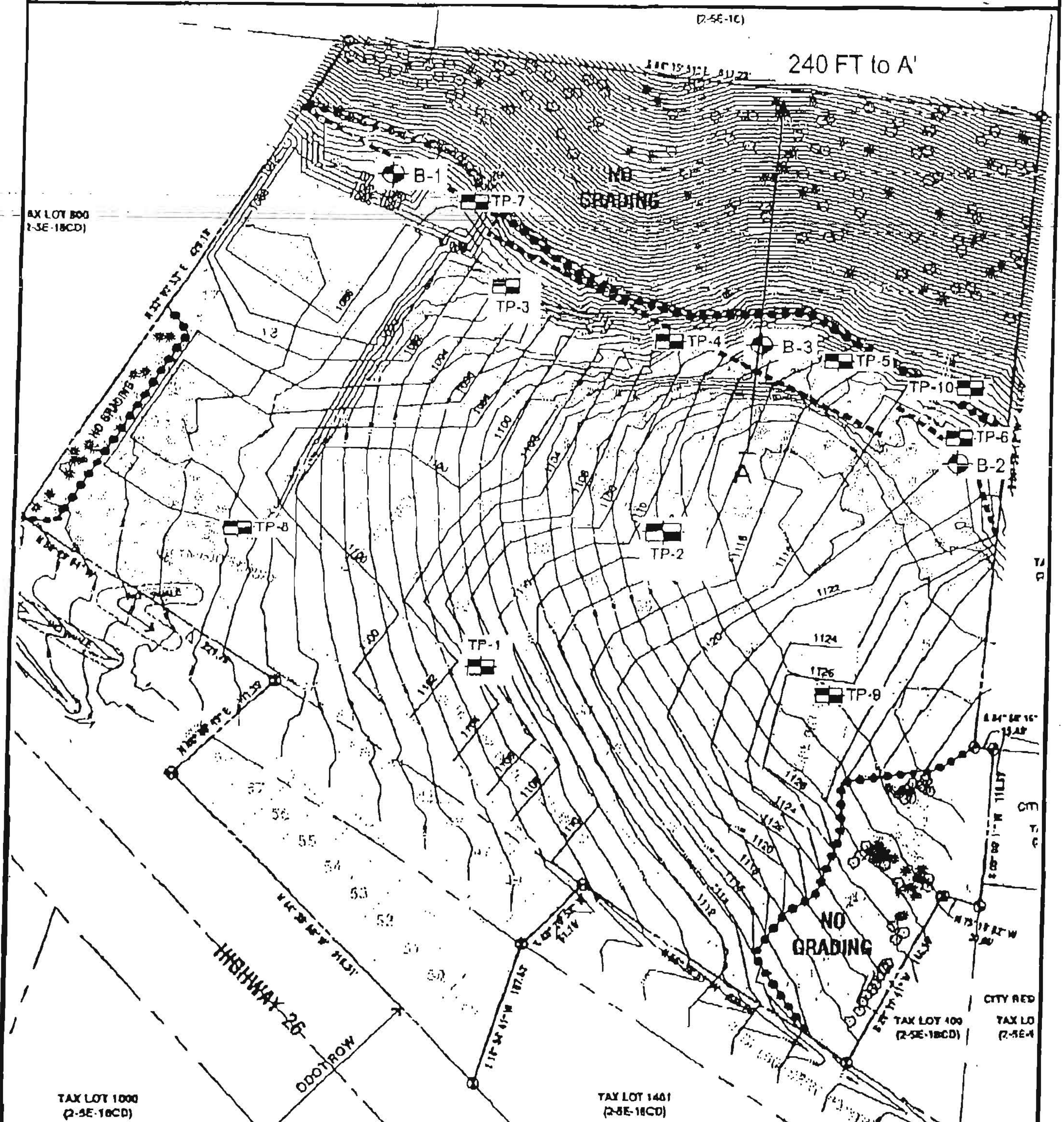
VISTA LOOP NORTH GRADING PLAN WITH EXPLORATIONS



Legend

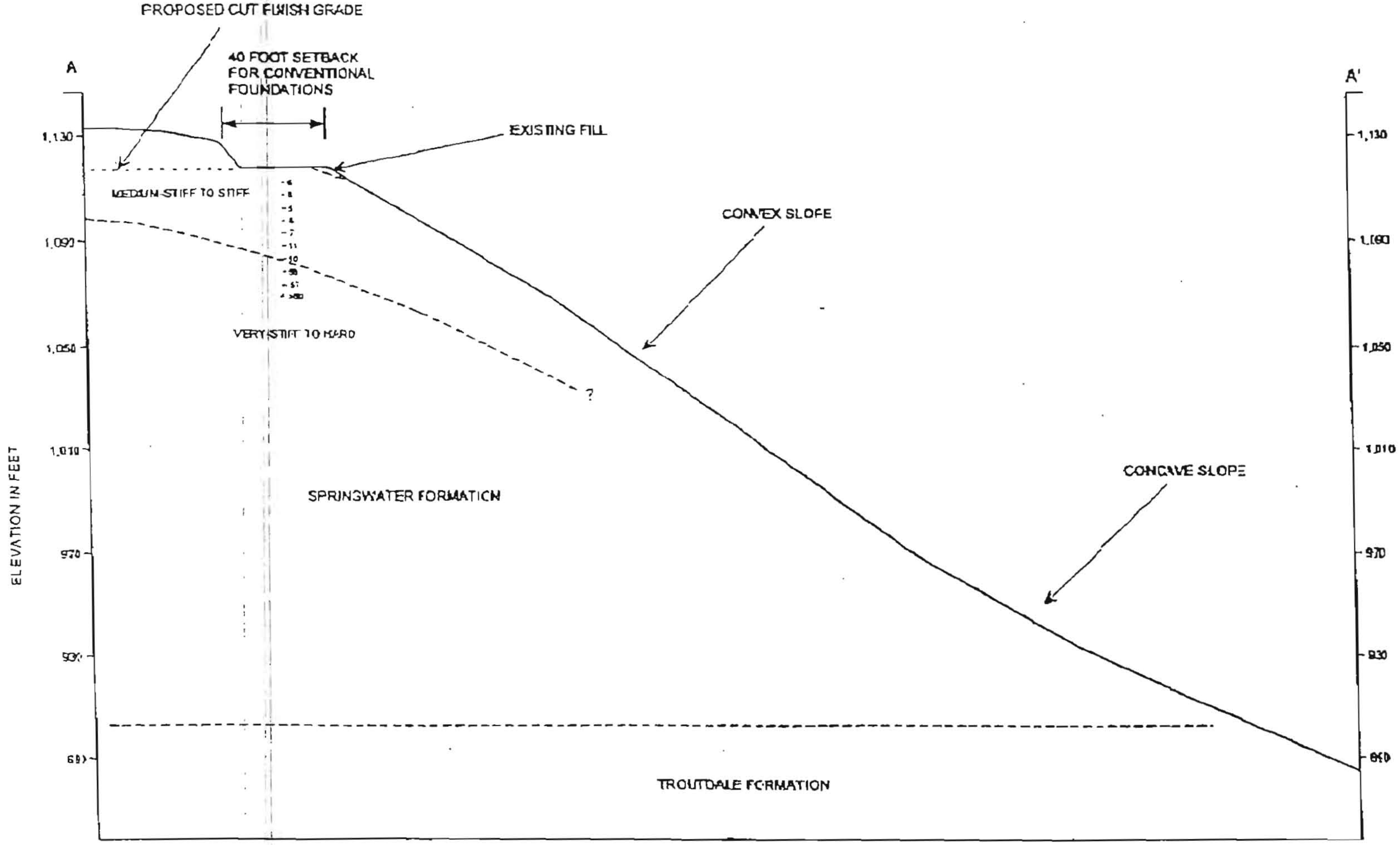
TP-2 EXPLORATORY TEST PIT

B-2 EXPLORATORY BORING

APPROXIMATE SCALE 1 IN = 100 FT

Date: 8/16/05
Drawn by: PAC

Project: Vista Loop Sandy, Oregon	Project No. 05-9266	FIGURE 2



NOTES: (1) SLOPE PROFILE WAS CONSTRUCTED USING HAND-HELD CLINOMETER MEASUREMENTS SOLELY FOR USE IN THIS REPORT AND SHOULD NOT BE CONSIDERED ACCURATE FOR OTHER USES.

(2) LOCATION OF ALL GEOTECHNICAL INFORMATION IS APPROXIMATE

APPROXIMATE SCALE

0 40 80 FEET

1 IN = 40 FT

GeoPacific — 7312 SW Durham Road, Portland, Oregon 97224, Tel: (503) 598-8445 Fax: (503) 598-8705		GEOLOGIC CROSS SECTION	
Project: Vista Loop North Sandy Oregon	Project No. 05-5266	Drawn By: PAC	FIGURE 3

GeoPacific Engineering, Inc.
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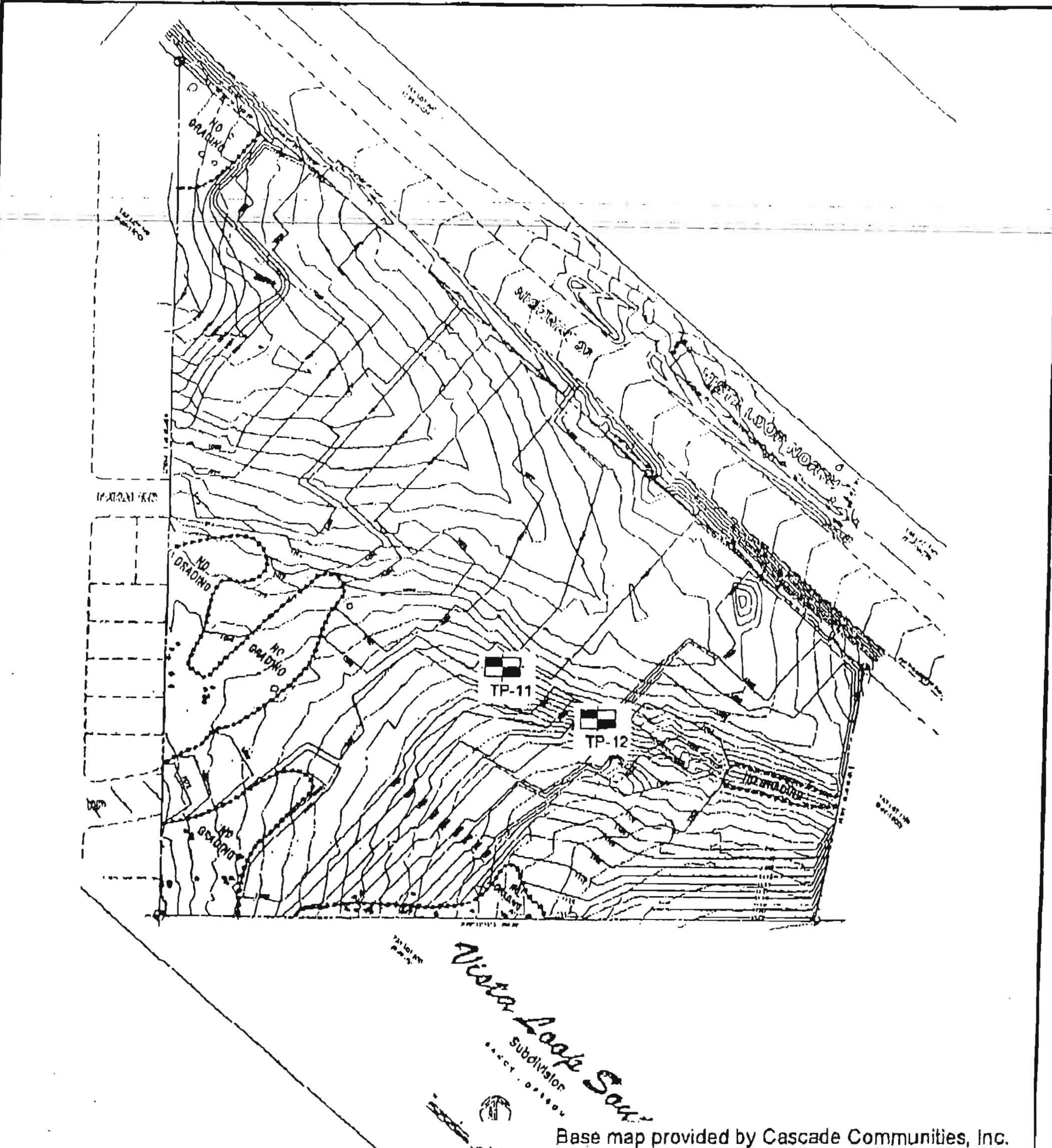
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 598-8705

VISTA LOOP SOUTH GRADING PLAN WITH EXPLORATIONS



Base map provided by Cascade Communities, Inc.

Legend

TP-2 EXPLORATORY TEST PIT

APPROXIMATE SCALE 1 IN = 200 FT

Date: 8/15/05
Drawn by: PAC

Project: Vista Loop Sandy, Oregon	Project No. 05-9266	FIGURE 4

APPENDIX A

FIELD EXPLORATIONS, SAMPLING, LABORATORY AND FIELD TESTING

On May 18, 2005, twelve exploratory test pits were excavated on the subject property to depths of 8 to 12 feet. On May 31 and June 1 of 2005, three exploratory borings were advanced to depths of 51.5 to 61.5 feet. The approximate exploration locations are shown on Figure 2. A GeoPacific Engineering Geologist evaluated and logged the explorations with regard to soil type, moisture content, relative strength, groundwater content, etc. and collected representative samples. Logs of the explorations are presented in this Appendix. The borings were drilled with track-mounted drill-rigs operated by Geotechnical Explorations, Inc. of Tualatin, Oregon. Standard penetration tests were performed on 5-foot intervals using a standard 2-inch O.D., split-spoon sampler driven with a 140 pound auto-hammer. The test pits were excavated with a 16,000 lbs. trackhoe operated by Dan Fisher Excavating of Banks, Oregon using a 30-inch-wide bucket. All excavations were backfilled immediately after completion of logging and sampling. At the completion of the test pit logging, the test pits were backfilled with the excavated spoils and tamped with the backhoe bucket. This backfill should not be expected to behave as compacted structural fill and some minor settling of the ground surface may occur.

Classification, Moisture Content, and Unit Weights

Soil samples were evaluated, described, and classified in accordance with the Unified Soil Classification System. Rock hardness was characterized using a modified version of the Oregon Department of Transportation (ODOT) Soil and Rock Classification Manual (Table A2). All natural moisture samples were collected in plastic bags, and tested in accordance with the methods outlined in ASTM D2216. Moisture content is expressed as a percentage of the mass of water lost during oven drying to the dry weight of soil.

Moisture-Density Relationship

A Standard Proctor compaction test was performed on one bulk sample from the site to determine the moisture-density relationship of native soils. The test was conducted in accordance with AASHTO T-99. The results obtained may be compared with field densities for the purpose of evaluating relative compaction of fill and native soils. The test results are summarized in Table B1.

Table B1 - Proctor Test Results (AASHTO T-99)

Material Description	Maximum Dry Density (lbs/ft^3)	Optimum Moisture Content
Clayey SILT (ML)	88.0	30.8%

Portable Dynamic Cone Penetrometer Tests

Field tests were conducted with a Portable Dynamic Cone Penetrometer (PDPC) to determine the strength parameters of the native soil for support of pavement.

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TEST PIT LOG

Project: Vista Loop North Sandy, Oregon	Project No. 05-9266	Test Pit No. **TP-1**

Depth (ft)	Pocket Penetrometer (tons/ft²)	Sample Type	In-Situ Dry Density (lb/ft³)	Moisture Content (%)	Water Bearing Zone	Material Description
						Dark brown, organic SILT (OL), many roots and organics (Topsoil)
1	1.5					
						Stiff to very stiff, clayey SILT (ML), brown to red-brown, few roots, moist (Native Soil Horizon)
2	2.5					
3	3.0					
4	3.0					
5						Very-stiff, clayey SILT (ML), red-brown, includes sand below 8 feet, damp to moist (Residual Soil)
6						
7						Minor groundwater seepage at 7 feet
8						
9						
10						Test Pit Terminated at 10 feet
11						
12						Note: Minor groundwater seepage encountered at 7 feet
13						
14						
15						
16						
17						

LEGEND

Bag Sample (100 to 1,000 g) — Bucket Sample (5 Gal. Bucket) — Shelby Tube Sample — Seepage — Water Bearing Zone — Water Level at Abandonment

Date Excavated: 5/18/05
Logged By: P. Crenna
Surface Elevation:

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Portland, Oregon 97224
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TEST PIT LOG

Project: Vista Loop North, Sandy, Oregon	Project No. 05-9266	Test Pit No. TP-2

Depth (ft)	Pocket Penetrometer (tons/ft²)	Sample Type	In-Situ Dry Density (lb/ft³)	Moisture Content (%)	Water Bearing Zone	Material Description
0						Dark brown, organic SILT (OL), many roots (Topsoil)
1	0.5					
2	1.5					Stiff, clayey SILT (ML), red-brown, moist (Native Soil)
3	3.0					
4	3.5					
5						Very-stiff, clayey SILT (ML) to silty CLAY (CL), red-brown with localized gray and orange mottling, damp to moist (Residual Soil)
6						
7						
8						
9						
10						Test Pit Terminated at 10 feet
11						
12						Note: No seepage or groundwater encountered.
13						
14						
15						
16						
17						

LEGEND

100 to 1,000 g — Bag Sample; 5 Gal. Bucket — Bucket Sample; Shelby Tube Sample; Seepage; Water Bearing Zone; Water Level at Abandonment

Date Excavated: 5/18/05
Logged By: P. Crenna
Surface Elevation:

GeoPacific Engineering, Inc.
7312 SW Durham Road
Portland, Oregon 97224
Tel: (503) 598-0445 Fax: (503) 598-8705

TEST PIT LOG

Project: Vista Loop North, Sandy, Oregon	Project No. 05-0266	Test Pit No. TP-3

Depth (ft)	Pocket Penetrometer (tons/ft²)	Sample Type	In-Situ Dry Density (lb/ft³)	Moisture Content (%)	Water Bearing Zone	Material Description
						Dark brown, organic SILT (OL), many roots (Topsoil)
1	0.5					
2	1.5					Stiff to very stiff with localized loose pockets, clayey SILT (ML), brown to red-brown, moist (Colluvial soil)
3	3.0					
4	2.5					
5						Very-stiff, clayey SILT (ML) to lean CLAY (CL), red-brown with localized orange and gray mottling, damp to moist (Residual Soil)
6						
7						
0						Minor groundwater seepage at 7 feet
9						
10						Test Pit Terminated at 10 feet
11						
12						
13						Note: Minor groundwater seepage encountered at 7 feet.
14						
15						
16						
17						

LEGEND

Bag Sample (100 to 1,000 g) · Bucket Sample (5 Gal. Bucket) · Shelby Tube Sample · Seepage · Water Bearing Zone · Water Level at Abandonment

Date Excavated: 5/18/05
Logged By: P. Crenna
Surface Elevation:

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TEST PIT LOG

Project: Vista Loop North, Sandy, Oregon	Project No. 05-9266	Test Pit No. TP-4

Depth (ft)	Pocket Penetrometer (tons/ft²)	Sample Type	In-Situ Dry Density (lb/ft³)	Moisture Content (%)	Water Bearing Zone	Material Description
1						Variable consistency with loose pockets, mixed organic SILT (OL) and clayey SILT (ML), dark brown to red-brown (Poorly Compacted Fill)
2						
3						
4						
5	1.5					Stiff to very-stiff, clayey SILT (ML) to silty CLAY (CL), red-brown, moist (Residual Soil)
6						
7						
8						
9						Stiff to very-stiff, sandy SILT (ML), multi-colored light yellow-brown, red, brown, orange, gray and black, highly tuffaceous with relict volcanic lithics, moist (Springwater Formation)
10						
11						
12						Test Pit Terminated at 12 feet
13						
14						
15						Note: No seepage or groundwater encountered.
16						
17						

LEGEND: Bag Sample (100 to 1,000 g); Bucket Sample (5 Gal. Bucket); Shelby Tube Sample; Seepage; Water Bearing Zone; Water Level at Abandonment

Date Excavated: 5/18/05
Logged By: P. Crenna
Surface Elevation:

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7312 SW Durham Road
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 598-8705

TEST PIT LOG

Project: Vista Loop North, Sandy, Oregon	Project No. 05-9266	Test Pit No. TP-5

Depth (ft)	Pocket Penetrometer (tons/ft²)	Sample Type	In-Situ Dry Density (lb/ft³)	Moisture Content (%)	Water Bearing Zone	Material Description
0–2						Variable consistency with loose pockets, mixed organic SILT (OL) and clayey SILT (ML), dark brown to red-brown (Poorly Compacted Fill)
2–4.5						Stiff, clayey SILT (ML), red-brown, contains abundant fragments of decomposed volcanic lithics, moist (Colluival Soil)
4.5–10	1.5 (at 5)					Stiff to very-stiff, sandy SILT (ML) with clay, multi-colored light yellow-brown, red, brown, orange, gray and black, highly tuffaceous, includes abundant relict volcanic lithics, moist (Springwater Formation)
10						Test Pit Terminated at 10 feet
						Note: No seepage or groundwater encountered.

LEGEND: Bag Sample (100 lb 1,000 g); Bucket Sample (5 Gal. Bucket); Shelby Tube Sample; Seepage; Water Bearing Zone; Water Level at Abandonment

Date Excavated: 5/18/05
Logged By: P. Crenna
Surface Elevation:

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7312 SW Durham Road
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 598-8705

TEST PIT LOG

Project: Vista Loop North, Sandy, Oregon	Project No. 05-0266	Test Pit No. **TP-6**

Depth (ft)	Pocket Penetrometer (tons/ft²)	Sample Type	In-Situ Dry Density (lb/ft³)	Moisture Content (%)	Water Bearing Zone	Material Description
0–1						Dark brown, organic SILT (OL), many roots (Topsoil)
1–5	1.0 (2 ft); 0.5 (3 ft); 1.0 (4 ft); 3.0 (5 ft)					Stiff with loose pockets, clayey SILT (ML) with fragments of decomposed volcanic lithics, red-brown, brown and yellow-brown, moist (Colluvial Soil)
5–10						Stiff to very-stiff, sandy SILT (ML) with clay and weathered volcanic lithics including cobbles, light gray-brown, yellow-brown, orange, gray and black, highly tuffaceous, moist (Springwater Formation)
10						Test Pit Terminated at 10 feet
10–17						Note: No seepage or groundwater encountered.

LEGEND: Bag Sample (100 to 1,000 g); Bucket Sample (5 Gal. Bucket); Shelby Tube Sample; Seepage; Water Bearing Zone; Water Level at Abandonment

Date Excavated: 5/18/05
Logged By: P. Crenna
Surface Elevation:

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7312 SW Durham Road
Portland, Oregon 97224
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TEST PIT LOG

Project: Vista Loop North, Sandy, Oregon	Project No. 05-9266	Test Pit No. TP-7

Depth (ft)	Pocket Penetrometer (tons/ft²)	Sample Type	In-Situ Dry Density (lb/ft³)	Moisture Content (%)	Water Bearing Zone	Material Description
1–5						Medium-stiff with loose pockets, mixed organic SILT (OL) and clayey SILT (ML), dark brown and red-brown, damp to moist (Fill)
5–8						Stiff, clayey SILT (ML), red-brown, moist (Residual Soil)
8–10						Stiff to very-stiff, sandy SILT (ML) with abundant weathered volcanic lithics, light yellow-brown, brown, red-brown, and gray, moist (Springwater Formation)
10–17						Test Pit Terminated at 10 feet Note: No seepage or groundwater encountered.

LEGEND: Bag Sample (100 to 1,000 g); Bucket Sample (5 Gal. Bucket); Shelby Tube Sample; Seepage; Water Bearing Zone; Water Level at Abandonment

Date Excavated: 5/18/05
Logged By: P. Crenna
Surface Elevation:

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TEST PIT LOG

Project: Vista Loop North, Sandy, Oregon	Project No. 05-9266	Test Pit No. TP-8

Depth (ft)	Pocket Penetrometer (tons/ft²)	Sample Type	In-Situ Dry Density (lb/ft³)	Moisture Content (%)	Water Bearing Zone	Material Description
1	1.5					
2	3.0					Stiff to very-stiff, sandy SILT (ML) with clay, red-brown, moist (Residual Soil)
3	3.5					
4	3.5					
5						
6						
7						
8						Test Pit Terminated at 8 feet
9						
10						Note: No seepage or groundwater encountered.
11						
12						
13						
14						
15						
16						
17						

LEGEND

Bag Sample (100 to 1,000 g) · Bucket Sample (5 Gal. Bucket) · Shelby Tube Sample · Seepage · Water Bearing Zone · Water Level at Abandonment

Date Excavated: 5/18/05
Logged By: D. Cronna
Surface Elevation:

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TEST PIT LOG

Project: Vista Loop North
Sandy, Oregon

Project No. 05-9266

Test Pit No. TP-9

Depth (ft)	Pocket Penetrometer (tons/ft²)	Sample Type	In-Situ Dry Density (lb/ft³)	Moisture Content (%)	Water Bearing Zone	Material Description
0						Dark brown, organic SILT (OL), many roots (Topsoil)
1						
2	3.0					Very-stiff, clayey SILT (ML), red-brown, moist (Native Soil)
3	3.0					
4	3.5					
5						Very-stiff, clayey SILT (ML) to silty CLAY (CL), red-brown, damp to moist (Residual Soil)
6						
7						
8						
9						
10						Test Pit Terminated at 10 feet
11						
12						Note: No seepage or groundwater encountered.
13						
14						
15						
16						
17						

LEGEND

100 to 1,000 g Bag Sample | 5 Gal. Bucket Bucket Sample | Shelby Tube Sample | Seepage | Water Bearing Zone | Water Level at Abandonment

Date Excavated: 5/18/05
Logged By: P. Crenna
Surface Elevation:

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TEST PIT LOG

Project: Vista Loop North, Sandy, Oregon | Project No. 05-9266 | Test Pit No. TP-10

Depth (ft)	Pocket Penetrometer (tons/ft²)	Sample Type	In-Situ Dry Density (lb/ft³)	Moisture Content (%)	Water Bearing Zone	Material Description
0–1						Dark brown, organic SILT (OL), many roots (Topsoil)
2	2.0					Stiff to very-stiff, clayey SILT (ML), red-brown, includes few weathered volcanic lithics and roots, moist (Colluvial Soil)
3	2.5					
4	3.0					
5–10						Very-stiff, sandy SILT (ML) with clay and abundant weathered volcanic lithics, includes few cobbles, red-brown, gray, light brown, and yellow-brown, highly tuffaceous, damp to moist (Residual Soil)
10						Test Pit Terminated at 10 feet

Note: No seepage or groundwater encountered.

LEGEND: 100 to 1,000 g Bag Sample; 5 Gal. Bucket Bucket Sample; Shelby Tube Sample; Seepage; Water Bearing Zone; Water Level at Abandonment

Date Excavated: 5/18/05
Logged By: P. Crenna
Surface Elevation:

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TEST PIT LOG

Project: Vista Loop North, Sandy, Oregon	Project No. 05-9266	Test Pit No. TP-11

Depth (ft)	Pocket Penetrometer (tons/ft²)	Sample Type	In-Situ Dry Density (lb/ft³)	Moisture Content (%)	Water Bearing Zone	Material Description
0						Dark brown, organic SILT (OL), many roots (Topsoil)
1	1.5					
2	3.0					Stiff to very-stiff, clayey SILT (ML), brown to red-brown, damp to moist (Native Soil)
3	3.0					
4	3.0					
5						Very-stiff, clayey SILT (ML), red-brown, damp to moist (Residual Soil)
6						
7						
8						Test Pit Terminated at 8 feet
9						
10						Note: No seepage or groundwater encountered.
11						
12						
13						
14						
15						
16						
17						

LEGEND

Bag Sample (100 to 1,000 g) — Bucket Sample (5 Gal. Bucket) — Shelby Tube Sample — Seepage — Water Bearing Zone — Water Level at Abandonment

Date Excavated: 5/18/05
Logged By: P. Crenna
Surface Elevation:

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TEST PIT LOG

Project: Vista Loop North, Sandy, Oregon	Project No. 05-8266	Test Pit No. TP-12

Depth (ft)	Pocket Penetrometer (tons/ft²)	Sample Type	In-Situ Dry Density (lb/ft³)	Moisture Content (%)	Water Bearing Zone	Material Description
0–1						Dark brown, organic SILT (OL), many roots (Topsoil)
2	3.0					Very-stiff, clayey SILT (ML), brown to red-brown, damp to moist (Colluvial Soil)
3	3.5					
4	3.5					
5–9						Very-stiff, clayey SILT (ML), red-brown with gray mottling below 8 feet, damp (Residual Soil)
10						Test Pit Terminated at 10 feet
11–17						Note: No seepage or groundwater encountered.

LEGEND: Bag Sample (100 to 1,000 g); Bucket Sample (5 Gal. Bucket); Shelby Tube Sample; Seepage; Water Bearing Zone; Water Level at Abandonment

Date Excavated: 5/18/05
Logged By: P. Cronna
Surface Elevation:

GeoPacific Engineering Inc.
7312 SW Durham Road
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 598-8705

BORING LOG

Project: Vista Loop North
Sandy, Oregon

Job No. 05-9266

Boring No. B-1

Depth (ft)	Sample Type	N-Value	Well Construction	Moisture Content (%)	Water Bearing Zone	Material Description
						Medium-stiff, clayey SILT (ML) and organic SILT (OL), red-brown and dark brown (Fill and Topsoil)
5	Split-Spoon	5				
10	Split-Spoon	21				Medium-stiff to very-stiff, sandy SILT (ML) with clay and abundant fragments of weathered volcanic lithics, highly tuffaceous, red-brown, brown, gray and black, moist (Springwater Formation)
15	Split-Spoon	6				
20	Split-Spoon	2/ 50 for 5"				
25	Split-Spoon	6				Medium-stiff to very-stiff, sandy SILT (ML) with clay and abundant fragments of weathered volcanic lithics, highly tuffaceous, red-brown, brown, gray and black, moist (Springwater Formation)
30	Split-Spoon	8				
35						

LEGEND

100 to 1,000 g Bag Sample · Split-Spoon · Shelby Tube Sample · Static Water Table at Drilling · Static Water Table · Water Bearing Zone

Date Drilled: 5/31/05
Logged By: P. Crenna
Surface Elevation:

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7312 SW Durham Road
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 598-8705

BORING LOG

Project: Vista Loop North, Sandy, Oregon | Job No. 05-9266 | Boring No. B-1

Depth (ft)	Sample Type	N-Value	Well Construction	Moisture Content (%)	Water Bearing Zone	Material Description
	Split-Spoon	7				
40	Split-Spoon	13				Stiff to hard, sandy SILT (ML), brown to gray, includes volcanic lithics, damp (Springwater Formation)
45	Split-Spoon	23				
50	Split-Spoon	50 for 3"				
55	Split-Spoon	75				Hard, gravelly SILT (ML) with sand and volcanic lithics, indurated, highly tuffaceous, damp (Springwater Formation)
60	Split-Spoon	50 for 1"				
						Boring Terminated at 61.5 feet
65						Note: No groundwater observations possible due to use of mud-rotary drilling technique.
70						

LEGEND

Bag Sample (100 lb / 1,000 g) | Split-Spoon | Shelby Tube Sample | Static Water Table at Drilling | Static Water Table | Water Bearing Zone

Date Drilled: 5/31/05
Logged By: P. Crenna
Surface Elevation:

GeoPacific Engineering, Inc.
7312 SW Durham Road
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 598-8705

BORING LOG

Project: Vista Loop North, Sandy, Oregon	Job No. 05-0266	Boring No. B-2

Depth (ft)	Sample Type	N-Value	Well Construction	Moisture Content (%)	Water Bearing Zone	Material Description
5	Split-Spoon	0				Soft, clayey SILT (ML), some sand, red-brown, highly tuffaceous, moist (Residual Soil)
10	Split-Spoon	5				Medium-stiff to stiff, sandy SILT (ML) with clay and abundant fragments of weathered volcanic lithics, red-brown, brown to yellow-brown and gray, highly tuffaceous, moist (Springwater Formation)
15	Split-Spoon	6				
20	Split-Spoon	12				
25	Split-Spoon	9				
30	Split-Spoon	8				Medium-stiff to stiff, sandy SILT (ML) with clay and abundant fragments of weathered volcanic lithics, red-brown, brown to yellow-brown and gray, highly tuffaceous, moist (Springwater Formation)
35						

LEGEND

Bag Sample (100 to 1,000 g) | Split-Spoon | Shelby Tube Sample | Static Water Table at Drilling | Static Water Table | Water Bearing Zone

Date Drilled: 5/31/05

Logged By: P. Crenna

Surface Elevation:

GeoPacific Engineering, Inc.
7312 SW Durham Road
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 598-8705

BORING LOG

Project: Vista Loop North, Sandy, Oregon	Job No. 05-9266	Boring No. B-2

Depth (ft)	Sample Type	N-Value	Well Construction	Moisture Content (%)	Water Bearing Zone	Material Description
	Split-Spoon	9				Stiff to hard, sandy SILT (ML) with clay and abundant fragments of weathered volcanic lithics, red-brown, brown to yellow-brown and gray, highly tuffaceous, moist (Springwater Formation)
40	Split-Spoon	49				
45	Split-Spoon	16				
50	Split-Spoon	19				
						Boring Terminated at 51.5 feet
55						Note: No groundwater observations possible due to use of mud-rotary drilling technique.
60						
65						
70						

LEGEND

Bag Sample (100 to 1,000 g) — Split-Spoon — Shelby Tube Sample — Static Water Table at Drilling — Static Water Table — Water Bearing Zone

Date Drilled: 5/31/05
Logged By: P. Crenna
Surface Elevation:

GeoPacific Engineering Inc.
7312 SW Durham Road
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 598-8705

BORING LOG

Project: Vista Loop North, Sandy, Oregon	Job No. 05-9266	Boring No. B-3

Depth (ft)	Sample Type	N-Value	Well Construction	Moisture Content (%)	Water Bearing Zone	Material Description
5	Split-Spoon	6				Medium-stiff, sandy SILT (ML) with clay and abundant fragments of weathered volcanic lithics, red-brown, brown, gray and black, highly tuffaceous, moist (Springwater Formation)
10	Split-Spoon	5				
15	Split-Spoon	5				
20	Split-Spoon	8				Medium-stiff to stiff, sandy SILT (ML) with clay and abundant fragments of weathered volcanic lithics, gray, red-brown and brown, highly tuffaceous, moist (Springwater Formation)
25	Split-Spoon	7				
30	Split-Spoon	11				
35						

LEGEND

100 lb / 1,000 g Bag Sample; Split-Spoon; Shelby Tube Sample; Static Water Table at Drilling; Static Water Table; Water Bearing Zone

Date Drilled: 6/1/05
Logged By: P. Crenna
Surface Elevation:

GeoPacific Engineering, Inc.
7312 SW Durham Road
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 598-8705

BORING LOG

Project: Vista Loop North, Sandy, Oregon	Job No. 05-9266	Boring No. B-3

Depth (ft)	Sample Type	N-Value	Well Construction	Moisture Content (%)	Water Bearing Zone	Material Description
	Split-Spoon	10				
40	Split-Spoon	35				Stiff to hard, sandy SILT (ML) with clay pods and abundant fragments of weathered volcanic lithics, gray, brown, buff and light green-brown, highly tuffaceous, moist (Springwater Formation)
45	Split-Spoon	57				
50	Split-Spoon	16/ 50 for 5"				
						Boring Terminated at 51.5 feet
55						Note: No groundwater observations possible due to use of mud-rotary drilling technique.
60						
65						
70						

LEGEND

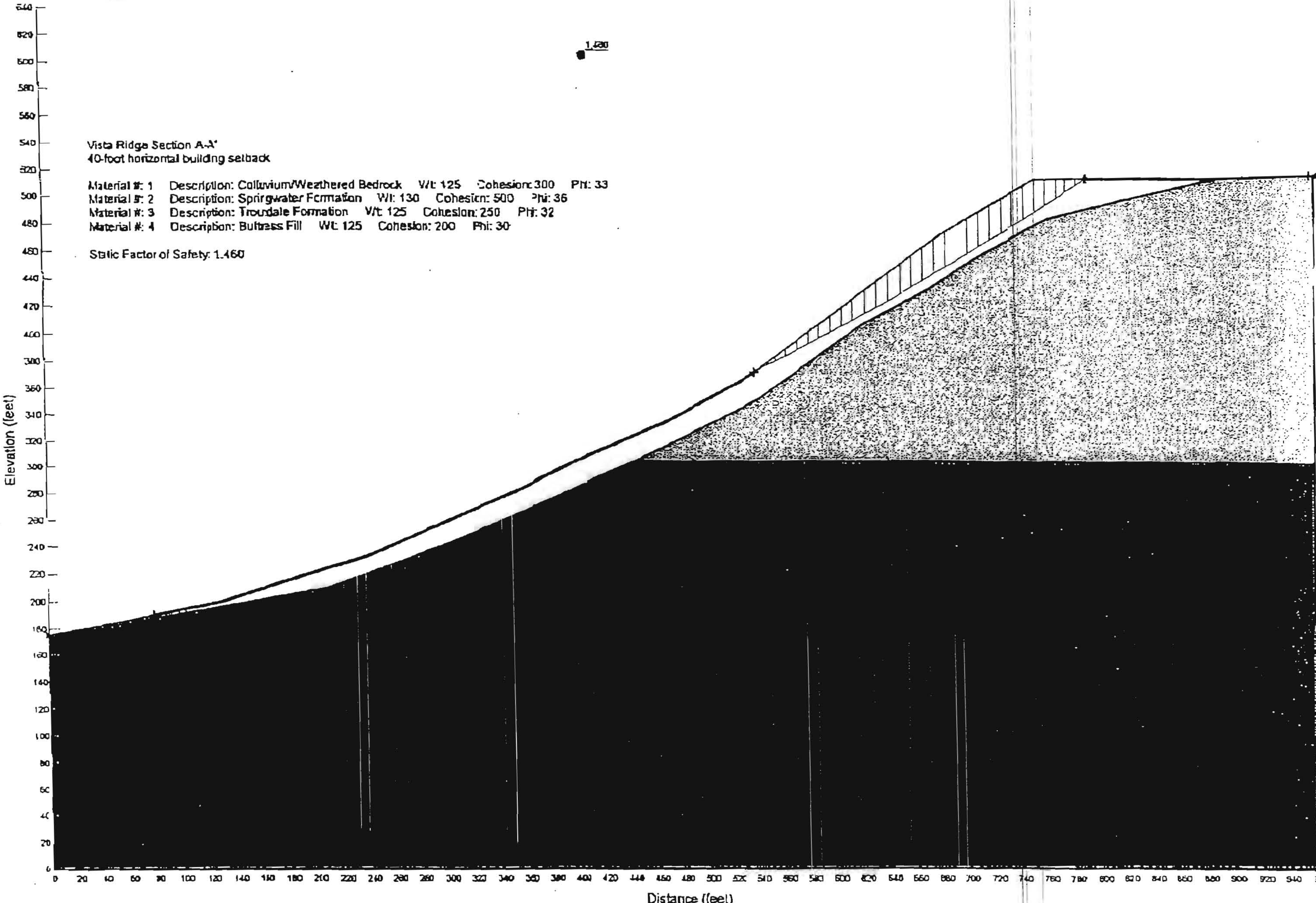
Bag Sample (100 to 1,000 g) · Split-Spoon · Shelby Tube Sample · Static Water Table at Drilling · Static Water Table · Water Bearing Zone

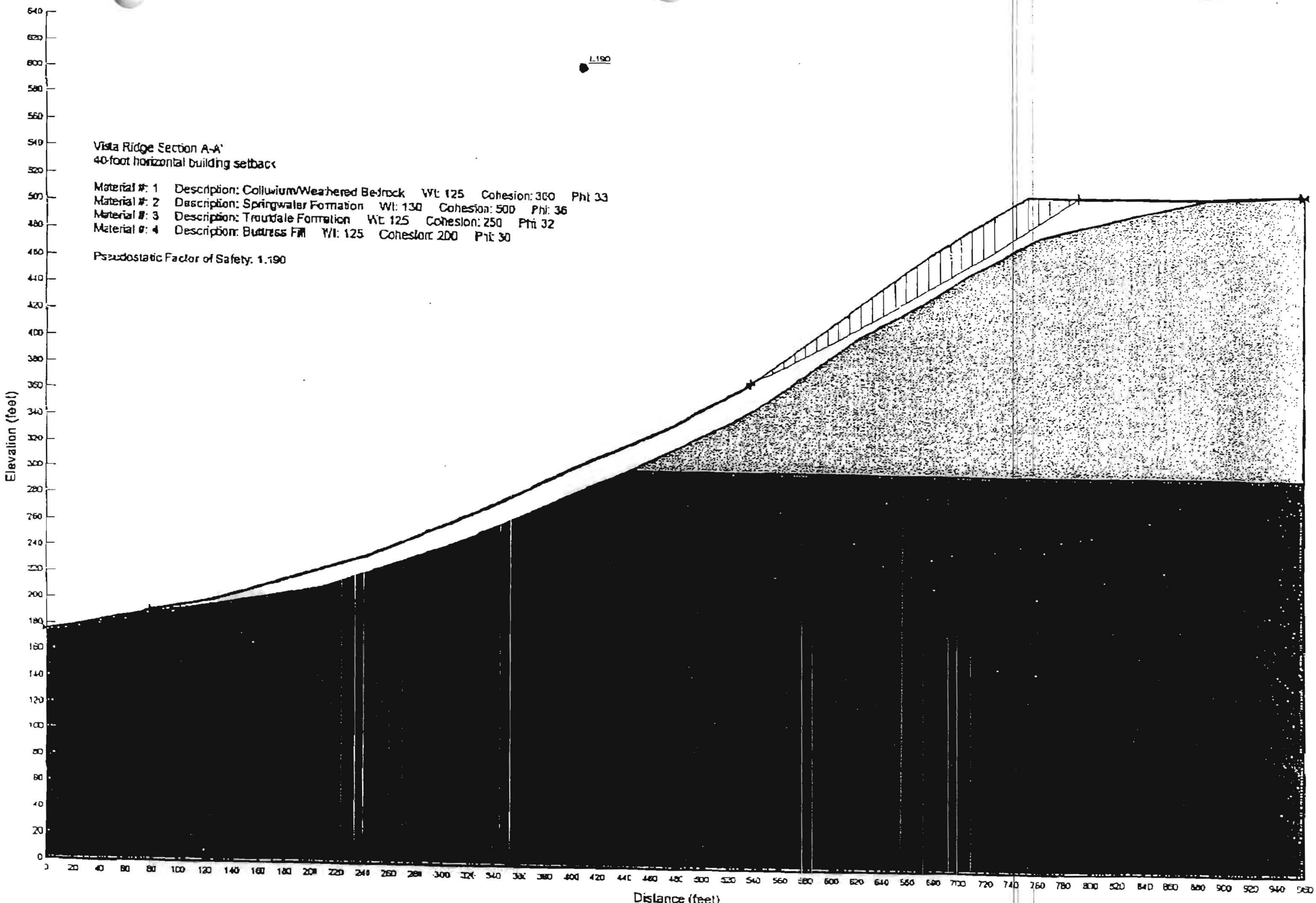
Date Drilled: 6/1/05
Logged By: P. Crenna
Surface Elevation:

APPENDIX B

SLOPE STABILITY QUANTITATIVE MODELING ANALYSIS

GRAPHIC PLOTS AND OUTPUT RESULTS


Vista Ridge Section A-A'
40-foot horizontal building setback
Material #: 1 Description: Colluvium/Weathered Bedrock Wt: 125 Cohesion: 300 Phi: 33
Material #: 2 Description: Springwater Formation Wt: 130 Cohesion: 500 Phi: 36
Material #: 3 Description: Troutdale Formation Wt: 125 Cohesion: 250 Phi: 32
Material #: 4 Description: Buttress Fill Wt: 125 Cohesion: 200 Phi: 30
Static Factor of Safety: 1.460
1.460
Elevation (feet)
Distance (feet)


1.190
Vista Ridge Section A-A'
40-foot horizontal building setback
Material #: 1 Description: Colluvium/Weathered Bedrock Wt: 125 Cohesion: 300 Phi: 33
Material #: 2 Description: Springwater Formation Wt: 130 Cohesion: 500 Phi: 36
Material #: 3 Description: Troutdale Formation Wt: 125 Cohesion: 250 Phi: 32
Material #: 4 Description: Buttress Fill Wt: 125 Cohesion: 200 Phi: 30
Pseudostatic Factor of Safety: 1.190
Elevation (feet)
Distance (feet)

APPENDIX C

CHECKLIST OF RECOMMENDED SOIL TESTIING & INSPECTIONS

Item No.	Procedure	Timing	By Whom	Done
1	Pre-construction meeting	Prior to beginning site work	Contractor, Developer, Civil and Geotechnical Engineers	
2	Stripping, aeration, and root-picking operations	During stripping	Soil Technician	
3	Compaction testing of engineered fill (96% of Standard Proctor)	During filling, tested every 2 vertical feet per lot	Soil Technician	
4	Compaction testing of trench backfill (95% of Standard Proctor)	During backfilling, tested every 4 vertical feet for every 200 lineal feet	Soil Technician	
5	Street subgrade compaction (95% of Standard Proctor)	Prior to base course every 200 lineal feet	Soil Technician	
6	Base course compaction (95% of Modified Proctor)	Prior to paving, tested every 200 lineal feet	Soil Technician	
7	AC Compaction (91% (bottom lift) / 92% (top lift) of Rice)	During paving, tested every 200 lineal feet	Soil Technician	
8	Final Geotechnical Engineer's certification	Completion of project	Geotechnical Engineer	

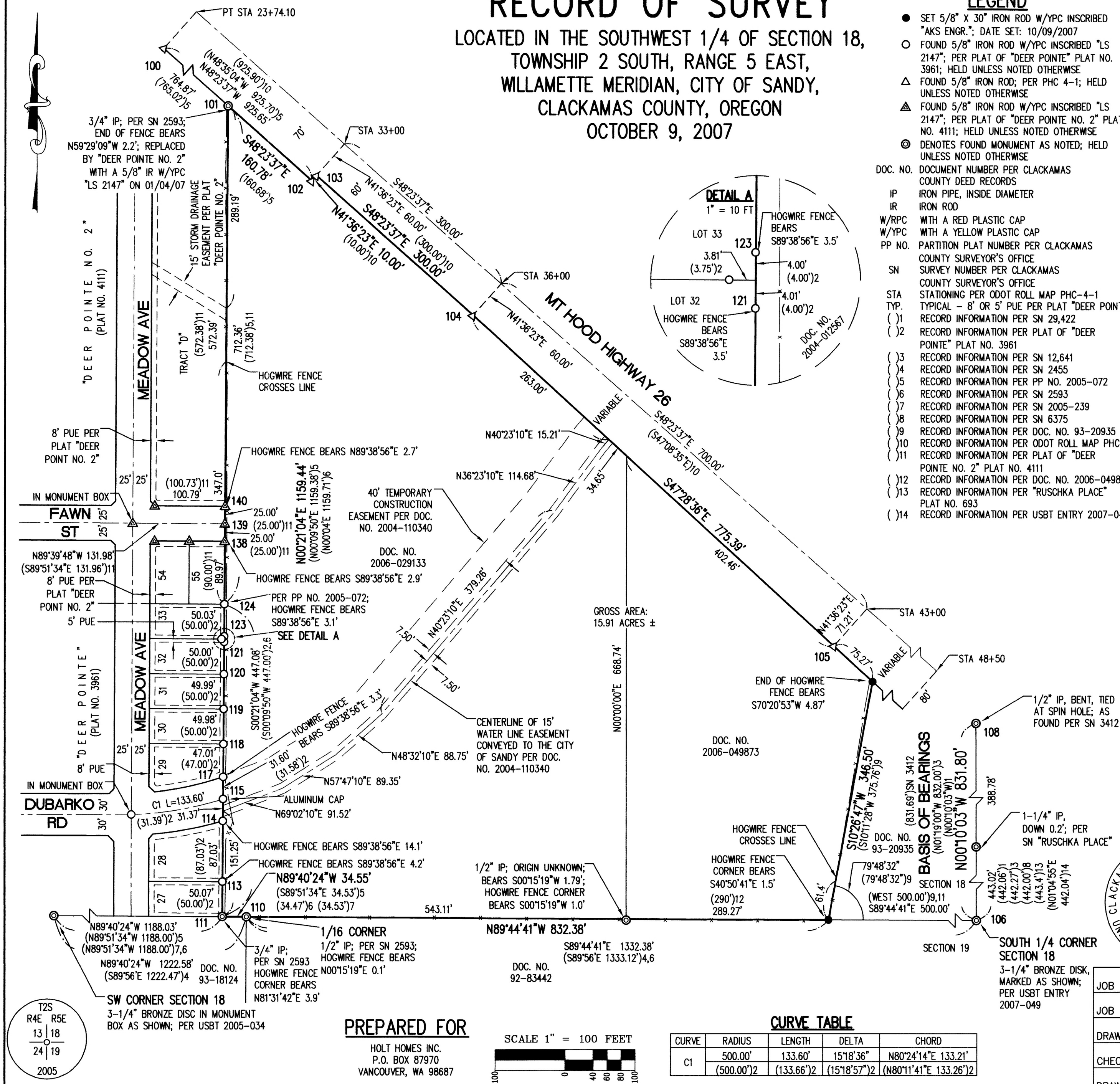
SN2007-384

CLACKAMAS COUNTY SURVEYOR
RECEIVED 08/16/2007
ACCEPTED FOR FILING 11/14/2007
SURVEY NUMBER SN2007-384

RECORD OF SURVEY

LOCATED IN THE SOUTHWEST 1/4 OF SECTION 18, TOWNSHIP 2 SOUTH, RANGE 5 EAST, WILLAMETTE MERIDIAN, CITY OF SANDY, CLACKAMAS COUNTY, OREGON

OCTOBER 9, 2007



LEGEND

- ● SET 5/8" X 30" IRON ROD W/YPC INSCRIBED "AKS ENGR."; DATE SET: 10/09/2007
- ○ FOUND 5/8" IRON ROD W/YPC INSCRIBED "LS 2147"; PER PLAT OF "DEER POINTE" PLAT NO. 3961; HELD UNLESS NOTED OTHERWISE
- △ FOUND 5/8" IRON ROD; PER PHC 4-1; HELD UNLESS NOTED OTHERWISE
- ▲ FOUND 5/8" IRON ROD W/YPC INSCRIBED "LS 2147"; PER PLAT OF "DEER POINTE NO. 2" PLAT NO. 4111; HELD UNLESS NOTED OTHERWISE
- ◎ DENOTES FOUND MONUMENT AS NOTED; HELD UNLESS NOTED OTHERWISE

DOC. NO.	DOCUMENT NUMBER PER CLACKAMAS COUNTY DEED RECORDS
IP	IRON PIPE, INSIDE DIAMETER
IR	IRON ROD
W/RPC	WITH A RED PLASTIC CAP
W/YPC	WITH A YELLOW PLASTIC CAP
PP NO.	PARTITION PLAT NUMBER PER CLACKAMAS COUNTY SURVEYOR'S OFFICE
SN	SURVEY NUMBER PER CLACKAMAS COUNTY SURVEYOR'S OFFICE
STA	STATIONING PER ODOT ROLL MAP PHC-4-1
TYP.	TYPICAL - 8' OR 5' PUE PER PLAT "DEER POINTE"
( )1	RECORD INFORMATION PER SN 29,422
( )2	RECORD INFORMATION PER PLAT OF "DEER POINTE" PLAT NO. 3961
( )3	RECORD INFORMATION PER SN 12,641
( )4	RECORD INFORMATION PER SN 2455
( )5	RECORD INFORMATION PER PP NO. 2005-072
( )6	RECORD INFORMATION PER SN 2593
( )7	RECORD INFORMATION PER SN 2005-239
( )8	RECORD INFORMATION PER SN 6375
( )9	RECORD INFORMATION PER DOC. NO. 93-20935
( )10	RECORD INFORMATION PER ODOT ROLL MAP PHC-4-1
( )11	RECORD INFORMATION PER PLAT OF "DEER POINTE NO. 2" PLAT NO. 4111
( )12	RECORD INFORMATION PER DOC. NO. 2006-049873
( )13	RECORD INFORMATION PER "RUSCHKA PLACE" PLAT NO. 693
( )14	RECORD INFORMATION PER USBT ENTRY 2007-049

NARRATIVE

THE PURPOSE THIS SURVEY WAS TO ESTABLISH THE OUTER BOUNDARY OF THE PROPERTY DESCRIBED IN DOCUMENT NUMBER 2006-029133 AND DOCUMENT NUMBER 2006-049873 CLACKAMAS COUNTY DEED RECORDS, FOR THE FUTURE SUBDIVISION OF "VISTA LOOP SOUTH". THE BASIS OF BEARINGS FOR THIS SURVEY IS BETWEEN FOUND MONUMENTS 108, AND 106 PER SURVEY NUMBER 29,422.

THE EASTERLY SOUTH LINE OF SAID PROPERTY, BEING THE SOUTH LINE OF SECTION 18, WAS ESTABLISHED BY HOLDING FOUND MONUMENT 106 PER ODOT ROLL MAP PHC-4-1 (RESTORED PER USBT ENTRY 2007-049) AND FOUND MONUMENT 110 PER SURVEY NUMBER 2593. SURVEY NUMBER 2593 AND SURVEY NUMBER 2455 APPEAR TO HAVE USED PROPER PROCEDURE TO ESTABLISH THE SAID SOUTH LINE OF SECTION 18. THIS RESOLUTION AGREES WITH DOCUMENT NUMBER 93-20935, DOCUMENT NUMBER 92-83442, SURVEY NUMBER 2593, AND SURVEY NUMBER 2455 WITHIN REASONABLE TOLERANCES. THE EXISTING HOGWIRE FENCE FALLS BETWEEN 1 FOOT AND 1.5 FEET SOUTH OF LINE.

THE WESTERLY SOUTH LINE OF SAID PROPERTY, BEING THE SOUTH LINE OF SECTION 18, WAS ESTABLISHED BY HOLDING FOUND MONUMENT 110 AND 111 PER SURVEY NUMBER 2593. SURVEY NUMBER 2593 APPEARS TO HAVE USED PROPERTY PROCEDURE TO ESTABLISH THE SOUTH LINE OF SECTION 18. THIS RESOLUTION AGREES WITH PARTITION PLAT NUMBER 2005-072, SURVEY NUMBER 2593, AND SURVEY NUMBER 2005-239 WITHIN REASONABLE TOLERANCES. THE EXISTING HOGWIRE FENCE FALLS BETWEEN 0 FEET AND 1 FOOT SOUTH OF LINE.

THE WESTERLY LINE OF SAID PROPERTY, BEING THE EAST LINE OF "DEER POINTE" AND THE EAST LINE OF "DEER POINTE NO. 2", WAS ESTABLISHED BY HOLDING FOUND MONUMENT 111 PER SURVEY NUMBER 2593, FOUND MONUMENTS 113, 114, 115, 117, 118, 119, 120, 121, AND 123 PER "DEER POINTE", FOUND MONUMENTS 138, 139, AND 140 PER "DEER POINTE NO. 2", FOUND MONUMENT 124 PER PARTITION PLAT NUMBER 2005-27, AND FOUND MONUMENT 101 PER SURVEY NUMBER 2593. THIS RESOLUTION AGREES WITH THE PLAT "DEER POINTE", THE PLAT "DEER POINTE NO. 2", PARTITION PLAT 2005-72, AND SURVEY NUMBER 2593 WITHIN REASONABLE TOLERANCES. THE EXISTING HOGWIRE FENCE FALLS BETWEEN 14 FEET EAST OF LINE AND 2 FEET WEST OF LINE.

ODOT ROLL MAP PHC-4-1 APPEARS TO BE THE BASIS FOR THE DEDICATION OF MT HOOD HIGHWAY 26. BOOK 520 PAGE 403 AND CIRCUIT COURT CONDEMNATION SUIT NUMBER 50 269 (WHICH AFFECTS DOCUMENT NUMBER 2006-049873) APPEAR TO FOLLOW SAID ROLL MAP. THE SOUTHWESTERLY RIGHT-OF-WAY LINE (BEING THE NORTHERLY LINE OF SAID PROPERTY) OF MT HOOD HIGHWAY 26 WAS ESTABLISHED BY HOLDING FOUND MONUMENTS 100 AND 102 FOR 70 FOOT OFFSETS FROM THE CENTERLINE PER ODOT ROLL MAP PHC-4-1; BY HOLDING FOUND MONUMENT 101 FOR A 70 FOOT OFFSET FROM THE CENTERLINE PER SURVEY NUMBER 2539; BY HOLDING FOUND MONUMENTS 103 AND 104 (FOUND MONUMENT 104 ALSO BEING AN ANGLE POINT) FOR 60 FOOT OFFSETS FROM THE CENTERLINE; BY HOLDING FOUND MONUMENT 105 FOR A POINT ALONG THE TRANSITION OF THE TAPER TO AN 80 FOOT RIGHT-OF-WAY PER ODOT ROLL MAP PHC-4-1; AND BY PROJECTING THE LINE BETWEEN FOUND MONUMENT 104 AND 105 SOUTHEASTERLY TO THE EASTERLY LINE OF DOCUMENT NUMBER 2006-049873. FOUND MONUMENTS 102 AND 103 PER ODOT ROLL MAP PHC-4-1 WERE HELD AS 60 FOOT AND 70 FOOT OFFSETS TO THE CENTERLINE OF MT HOOD HIGHWAY.

THE EASTERLY LINE OF SAID PROPERTY WAS ESTABLISHED BY HOLDING A POINT AT RECORD DEED DISTANCE OF 500 FEET FROM THE SOUTH ONE-QUARTER OF SECTION 18 AND PROJECTING A LINE NORTHEASTERLY TO THE SOUTHERLY RIGHT-OF-WAY LINE OF MT HOOD HIGHWAY 26, HOLDING A RECORD ANGLE OF 79°48'32" PER DOCUMENT NUMBER 93-209358. DOCUMENT NUMBER 86-29161 (PRIOR DEED TO DOCUMENT NUMBER 93-20935) IS THE SENIOR DEED THAT DEFINES THE LOCATION OF SAID EASTERLY LINE BY "NORTH 10°11'28" EAST 375.76 FEET, MORE OR LESS TO THE SOUTH LINE OF RELOCATED MT HOOD HIGHWAY" AND THE JUNIOR DEED DOCUMENT 86-29162 (PRIOR DEED TO DOCUMENT NUMBER 2006-049873) AGREES WITH THE LOCATION BY CALLING "SOUTHWESTERLY 375.76 FEET". SAID DOCUMENTS 86-29161 AND 86-29162 APPEAR TO BE THE FIRST DEEDS OF RECORD TO RELOCATE THE SAID EASTERLY LINE (PREVIOUSLY A NORTH-SOUTH LINE).

CLACKAMAS COUNTY SURVEYOR — UNLAWFUL TO DISTURB — T2S R5E S 18 1/4 S 19 2007

I CERTIFY THAT THIS SURVEY WAS PREPARED USING HP PRODUCT #51645A CARTRIDGE ON OCE #868342.

10-31-07

REGISTERED PROFESSIONAL LAND SURVEYOR
OREGON
JULY 15, 2003
MONTGOMERY B. HURLEY
58542LS
RENEWAL DATE: 6/30/09

PREPARED FOR

HOLT HOMES INC.
P.O. BOX 87970
VANCOUVER, WA 98687

SCALE 1" = 100 FEET

CURVE TABLE

CURVE	RADIUS	LENGTH	DELTA	CHORD
C1	500.00'	133.60'	15°18'36"	N80°24'14"E 133.21'
	(500.00')2	(133.66')2	(15°18'57")2	(N80°11'41"E 133.26')2

JOB NAME:	VISTA LOOP S.
JOB NUMBER:	1487
DRAWN BY:	TMK / MSK
CHECKED BY:	NSW
DRAWING NO.:	1487ROS

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LICENSED IN OR & WA
AKS ENGINEERING & FORESTRY
13910 SW GALBREATH DRIVE, SUITE 100
SHERWOOD, OR 97140
PHONE: (503) 925-8799
FAX: (503) 925-8969