GeoPacific
Engineering, Inc.

Real-World Geotechnical Solutions
• Investigation
• Design
• Construction Support

12-166931-RES

April 18, 2012

Project No. 12-2529

Baiju V. Patel
10552 NW La Cassel Crest Lane
Portland, OR 97229
baiju.v.patel@intel.com

Cc: Jo Landefeld (jo@JoLandefeldArchitect.com)

RE: GEOTECHNICAL INVESTIGATION
NW 81ST PLACE HOMESITE
PANAVISTA PARK BLOCK 2 LOT 3
PORTLAND, OREGON

This report presents the results of a geotechnical investigation conducted by GeoPacific Engineering, Inc. (GeoPacific) for construction of a proposed single-family home at the above referenced location in the City of Portland, Multnomah County, Oregon. The scope of our investigation included field reconnaissance, exploratory drilling, analysis, and preparation of this report. Our work was performed in accordance with GeoPacific proposal letter No. P-4018c dated February 21, 2012.

PROJECT INFORMATION

Location:	The subject site is located adjacent to 2737 NW 81st Place in the City of Portland, Multnomah County, Oregon (Figure 1).
Owner/ Developer:	Baiju Patel
Architect/ Designer:	Jo Landefeld Architect. 3145 NE 21st Street, Portland, OR 97212
Jurisdictional Agency:	City of Portland, Oregon

SITE DESCRIPTION AND PROPOSED DEVELOPMENT

The subject property is a 0.23 acre parcel situated on a south-facing slope at an approximate elevation of 980 to 1,030 feet above mean sea level that borders NW 81st Place on the north (Figure 2). The property is situated at the head of a drainage gully that receives drainage from catch basins on NW 81st Place. A storm pipe outfall and drainage channel lies partially on the property. Slopes on the homesite incline at about 30% to 65% grade with a gently sloping bench at the top of the slope.

The proposed construction is a two- or three-level, wood-frame, single-family home with daylight basement. Preliminary architectural plans indicate that the lower floor incorporates a retaining wall with an approximate maximum height of 10 feet. The home also includes an attached three car garage. A suspended deck is planned at the rear of the home.

REGIONAL GEOLOGY

The subject site is underlain by Quaternary age (last 1.6 million years) loess, a windblown silt deposit that mantles older deposits including sedimentary strata and basalt bedrock in the Portland Hills (Beeson et al., 1989; Madin, 1990). The loess generally consists of massive silt deposited following repeated catastrophic flooding events in the Willamette Valley, the last of which occurred about 10,000 years ago. In localized areas, the loess includes buried paleosols that developed between depositional events. Regionally, the total thickness of loess ranges from 5 feet to greater than 100 feet.

Underlying the Quaternary loess is Miocene age (about 14.5 to 16.5 million years ago) Columbia River Basalt (Madin, 1990; Beeson et al., 1989). The Columbia River Basalt is a thick sequence of lava flows that form a dense, finely crystalline rock commonly fractured along blocky and columnar vertical joints. Individual basalt flow units typically range from 25 to 125 feet thick and interflow zones are typically vesicular, scoriaceous, and brecciated, and sometimes include sedimentary rock. Typically, the upper surface of the basalt is deeply weathered to a residual soil about 5 to 30 feet thick.

SUBSURFACE CONDITIONS

On March 5, 2012, GeoPacific explored subsurface conditions in the vicinity of the proposed homesite by advancing two exploratory borings at the approximate locations shown on Figure 2. Field exploration methodology is discussed in Appendix A, which also contains the boring logs. The observed subsurface conditions and soil properties are summarized below.

Fill: The ground surface directly underlying the proposed homesite is fill that is characterized by variable strength properties. Fill encountered in boring B-1 consists of well-compacted, very-stiff, clayey SILT (ML). Standard penetration tests (SPT) indicate N-values of N=14 to N=25 which correlate with a very-stiff consistency. In contrast, fill encountered in boring B-2 consists of poorly-compacted, soft to medium-stiff, clayey SILT (ML) to silty CLAY (CL). Standard penetration tests (SPT) in B-2 indicate N-values of N=1 to N=4 which correlates with a soft to medium-stiff consistency. In borings, the thickness of fill ranges from about 14 to 18 feet. The distinctly dissimilar strength of the fill suggests at least two episodes of fill placement have occurred on the property.

Quaternary Loess: Underlying fill is a clayey SILT (ML) loess (windblown silt) deposit that blankets older rocks throughout the Portland Hills. The loess is generally characterized by a uniform texture and a medium-stiff to stiff consistency. Standard penetration tests indicate N-values of N=7 to N=11 which correlates to a medium-stiff to stiff consistency. The thickness of loess encountered in borings B-1 and B-2 ranges from 24 feet to 11 feet, respectively.

Residual Soil/Weathered Basalt: Underlying the loess is residual soil and weathered basalt derived from in place decomposition of basalt bedrock. The residual soil consists of clayey SILT (ML) with abundant fragments of decomposed to weathered basalt. The residual soil is generally characterized by a very-stiff consistency increasing to hard at depth. Standard penetration tests (SPT) indicate N-values of N=25 to N=>50 consistent with a very-stiff to hard consistency. The residual soil and weathered basalt extends below the maximum depth of exploration of 41.5 feet.

Soil Moisture and Groundwater

On March 5, 2012, groundwater was encountered in both exploratory borings. In boring B-1, groundwater was first encountered at a depth of 30 feet with a static water level at abandonment of 27 feet below the ground surface. In boring B-2, a perched groundwater zone was encountered at a depth of 7.5 to 15 feet below the ground surface, and a deeper groundwater zone was encountered at a depth of 24 feet below the ground surface.

It should be noted that the groundwater conditions reported herein are those existing at the time of exploration, and that conditions will vary depending on the season, local subsurface conditions, changes in site utilization, and other factors.

SLOPE STABILITY

For the purpose of evaluating slope stability, we reviewed published geologic and landslide mapping, reviewed regional topography and lidar imagery, performed a field reconnaissance of slope geomorphology, and evaluated subsurface soil conditions in exploratory test pits. Regional earthquake hazard mapping identifies the site vicinity as a low relative slope instability hazard zone (Zone 1 with Zone 3 being the highest relative hazard) (Mabey et al., 1996). Published geologic maps and lidar landslide inventory mapping show no landslides in the immediate vicinity of the subject site (Madin, 1990; Burns et al., 2011).

The proposed homesite is situated at the top of a south-facing slope that inclines at about 40% to 65% grade on the upper portion and about 25% to 35% grade on the lower portion (Figure 2). The total height of the slope on the property is 52 feet. The slope descends into a broad drainage swale that includes a 2 to 3 foot deep channel conveying stormwater from catch basins on NW 81st Place and the adjacent home.

Slope geomorphology at the site is characterized by an arcuate, bowl-shaped configuration that suggests the slope has experienced minor shallow-seated instability that is typical of drainage side slopes, and may have formed as an evacuation scarp. Hand probe measurements indicate the lower slope is characterized by a medium-stiff consistency in the upper 4 feet, and trees on the lower portion of the property are tilted consistent with minor slope movement and/or slope creep. No geomorphic evidence of prior, deep-seated slope instability was observed.

Review of USGS topographic mapping indicates that the drainage swale originally continued upslope above the property and that fill was placed in the drainage, presumably for construction of the NW 81st Place roadbed (Figure 1). This fill was likely constructed concurrently with development of the Panavista Park Subdivision circa the late 1970s; however, based on review of aerial photographs from 2001 through 2010 (on PortlandMaps.com), it appears that additional fill may have been placed on the eastern portion of the homesite circa 2001.

Exploratory boring data indicates that the slope is underlain by a layered sequence of geologic units including fill, loess, and residual soil that transitions to weathered basalt. Two geologic cross sections were constructed to characterize the subsurface geometry of these units with reference to slope stability (Figures 3 and 4). The uppermost layer is fill that consists of well-compacted clayey silt on the west and poorly-compacted clayey silt on the east. SPT values indicate that the slope on the east is underlain by very weak fill that is about 18 feet thick and saturated by perched groundwater. This material is considered to be susceptible to slope movement.

Underlying the fill is a loess deposit consisting of medium-stiff to stiff, clayey silt. This material is considered to have a moderate to high shear strength and resistance to slope instability on gentle to moderate slopes; however, its strength is somewhat diminished when saturated by groundwater. Groundwater was encountered in both B-1 and B-2 in the lower portion of the loess deposit at depths of 24 to 27 feet below the ground surface. Underlying the loess is residual soil that transitions to weathered basalt at a depth 36 to 41 feet below the ground surface. SPT values indicate a stiff to hard consistency. This material is considered to have a high shear strength and resistance to slope instability on moderate to moderately-steep slopes.

Our analysis indicates that soils underlying the slope are potentially susceptible to slope instability due to the presence of poorly compacted fill and high groundwater conditions. In contrast, soils underlying the site at depths greater than about 20 feet are relatively competent and are considered relatively resistant to instability.

CONCLUSIONS AND RECOMMENDATIONS

Our investigation indicates that the subject site is suitable for support of the proposed single-family home provided that the following recommendations are incorporated into the design and construction phases of the project. In our opinion, the potential for damage due to slope instability and/or settlement is low provided that the home is supported on a pile foundation. GeoPacific Engineering should review the preliminary foundation plan before it is finalized and should observe piling driving operations to verify that the foundation is designed and constructed in accordance with our recommendations.

Slope Stability

In our opinion, the potential for damage to the proposed single-family home due to slope instability and/or settlement is low provided that the home is supported on a pile foundation. Deep foundation elements such as piles are considered necessary to mitigate the presence of thick, poorly compacted fill and adverse high groundwater conditions. GeoPacific Engineering should review the preliminary foundation plan before it is finalized and observe piling driving operations during construction to verify that the foundation is designed and constructed in accordance with our recommendations.

Pile Foundations

We recommend that the building and deck be supported on a deep foundation system with structural grade beams and raised wood floors to mitigate the potential for slope movement and ground settlement damage. Piles should consist of HP8x36 steel H-piles with a minimum length of 30 feet. Anticipated total lengths are 30 to 40 feet; however, actual pile lengths would be determined based on refusal termination criteria during pile driving operations; hence, greater pile lengths may be necessary depending on soil actual conditions encountered. Typical pile spacing is on the order of 6 to 8 feet center to center. Actual pile spacing should be determined by the project structural engineer based on design considerations.

In our opinion, a driven pile system is most appropriate for the site conditions given the high groundwater conditions; however, grouted piles may be feasible if temporary casing and/or tremie methods are employed for grout placement. Grouted piles are preferable to driven piles if the piles are to be utilized for soldier pile retaining walls since grouted piles can be set plumb along a wall line.

Driven steel HP8x36 H-piles, embedded as recommended herein, may be designed using an allowable compressive capacity of 30 kips per pile. An allowable uplift capacity of 6 kips may be used. The recommended pile capacities in compression and uplift incorporate factors of safety of 3 and 2, respectively. Maximum anticipated vertical pile settlement due to allowable loads is ½ inch. Slip-type couplers are not recommended to connect lengths of pile and top plates. Welds for pile extensions, couplings and/or top plates should be designed and/or approved by the project structural engineer.

Piles may be driven with a hydraulic hammer trackhoe attachment with an approximate hammer weight of 1,000 to 2,000 pounds. We anticipate that refusal criteria for termination of pile driving effort will be 10 to 16 seconds per inch depending on soil conditions and actual methods employed. Piles encountering obstructions such as large rocks may need to be repositioned or the obstruction drilled through and the pile re-driven until refusal is achieved. We anticipate that some piles may need to be pre-drilled through obstructions. GeoPacific should observe pile driving to verify installation in accordance with our recommendations.

Given that the proposed building lies adjacent to existing improvements, care should be taken during pile driving operations to not cause excessive ground vibration. The risk of vibration damage to the existing foundations and improvements is considered to be low, provided that the piling contractor employs appropriate mitigating measures such as low impact energy hammers, shallow pre-drilling, initial push installation methods, etc. The piling contractor should monitor the site during construction for excessive vibration.

Lateral resistance of driven piles may be evaluated using the passive pressure approach. This approach is conservative by neglecting the redistribution of vertical stresses and shear forces that develop near the bottom of the pile and contribute to resisting lateral loads. If the passive pressure approach is used, we recommend an allowable passive earth pressure of 300 pcf, assumed to act over an area measuring 2 pile diameters in width and up to 8 pile diameters in depth, and neglecting the uppermost 6 feet of embedment below the ground surface. The allowable passive pressure recommended above incorporates a safety factor of at least 1.5. If other methods of analyzing lateral pile capacity are used, such as the modulus of subgrade reaction method, GeoPacific should be contacted for additional recommendations.

Structural members of the home should be supported on continuous grade beams that are structurally connected to and bearing on the piles. The grade beams, connections, and above ground elements should be designed by the project structural engineer in accordance with applicable building codes. The garage may be supported on conventional spread footing foundations, although overexcavation and replacement with compacted granular fill may be necessary if surficial soft fill is encountered.

Pile Driving Refusal Criteria and Load Testing

We recommend that GeoPacific monitor pile driving operations to verify that construction is performed in accordance with our recommendations and confirm suitability for foundation support. We anticipate that refusal criteria for termination of pile driving effort will be 10 to 16 seconds per inch depending on actual soil conditions and driving methods employed. We recommend that at least two piles be compression tested to 150 percent of the allowable design load. Load testing should be performed in accordance with ASTM method D1143 (quick method). The load testing settlement acceptance criteria shall be no greater than 0.3 inches.

Passive Resistance of Structural Grade Beams

Lateral loads from wind and seismic forces may be resisted utilizing passive resistance on the below grade portion of structural grade beams using the passive pressure values specified in this section. For passive resistance against wind and/or seismic loading, we recommend a passive earth pressure of 280 pcf be used for design up to a maximum of 4 feet in height. Passive pressure values are allowable and include a factor of safety of 1.5. For passive pressure calculations, the upper 1 foot of embedment should be ignored.

Conventional Shallow Foundations

The garage may be supported on conventional spread footing foundations, although overexcavation and replacement with compacted granular fill may be necessary if surficial soft fill is encountered. Foundation design, construction, and setback requirements should conform to applicable building codes at the time of permitting (2011 Oregon Residential Specialty Code). For protection against frost heave, spread footings should be embedded at a minimum depth of 18 inches below exterior grade. The recommended minimum width for continuous footings supporting wood-framed walls without masonry is 12 inches for a one-story, 15 inches for a two-story and 18 inches for a three-story building. Minimum reinforcement consisting of four horizontal No. 4 bars, two in the footing and two in the stem wall, is recommended. Actual footing widths, sizing, and reinforcement should be determined by the house designer, architect- or engineer-of-record.

The recommended allowable soil bearing pressure is 1,500 lbs/ft^2 for footings on stiff, native soil and compacted fill. A maximum column load of 35 kips is recommended for the site. For heavier loads, GeoPacific should be specifically consulted. The coefficient of friction between on-site soil and poured-in-place concrete may be taken as 0.4 (value does not include a factor of safety adjustment). 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.

The above recommendations for lateral earth pressures assume that the backfill behind subsurface walls will consist of properly compacted structural fill, and no adjacent surcharge loading. If the walls will be subjected to the influence of surcharge loading within a horizontal distance equal to or less than the height of the wall, the walls should be designed for the additional horizontal pressure. For uniform surcharge pressures, a uniformly distributed lateral pressure of 0.3 times the surcharge pressure should be added. Traffic surcharges may be estimated using an additional vertical load of 250 psf (2 feet of additional fill), in accordance with local practice.

The recommended equivalent fluid densities assume granular backfill and a free-draining condition behind the walls so that hydrostatic pressures do not build-up. This can be accomplished by placing a minimum 12- to 18-inch-wide backfill zone of gravel containing less than 5 percent fines behind the walls, and a subdrain connected to a suitable discharge point to remove water in this zone. Subdrains should consist of a minimum 3-inch diameter 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. Given the typically low flow rate through subdrains, the subdrain may discharge to the ground surface.

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 typically installed to minimize the potential for interior moisture problems.

Foundation Drainage

Surface water drainage should be directed away from structures typically by sloping the ground surface away from buildings and improvements. Roof-drain water should be carried to a suitable discharge point.

A perimeter footing drain is recommended around the building foundation to intercept shallow perched groundwater, except where it would be redundant to retaining wall subdrains. Perimeter drains should consist of a minimum 3-inch diameter Schedule 40 or ADS Highway Grade, 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). A minimum 0.5 percent fall should be maintained throughout the drain and non-perforated pipe outlet. Low point drains are recommended to drain potential groundwater seepage from crawlspaces and/or under slab floors in basements. Footing subdrain and low point drains may drain to daylight and should not be connected to stormwater systems due to the potential for backflow under slabs or into the crawl space.

Our recommendations regarding foundation drainage are recommended 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. Limited groundwater seepage in crawlspaces and/or beneath slab floors is common in the Pacific Northwest and should be expected.

Excavating Conditions and Temporary Excavations

Based on subsurface test pit exploration, we anticipate that the planned excavation depths will be generally achievable with conventional heavy equipment. All temporary cuts in excess of 4 feet in

GeoPacific Engineering, Inc.

14835 SW 72nd Avenue
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 941-9281

BORING LOG

Project: NW 81st Place Homesite, Portland, Oregon	Job No. 12-2529	Boring No. **B-1**

Depth (ft)	Sample Type	N-Value	Well Construction	Moisture Content (%)	Water Bearing Zone	Material Description
	Split-Spoon	15				Very-stiff, clayey SILT (ML), mixed light brown, brown, gray and orange, minor amounts of fine organic material, damp (Compacted Fill)
5	Split-Spoon	14				
	Split-Spoon	25				Slow augering
10	Split-Spoon	18				
15	Split-Spoon	7				Medium-stiff to stiff, clayey SILT (ML), light brown, uniform texture, moist (Quaternary Loess Deposit)
20	Split-Spoon	7				
25	Split-Spoon	9			Static Water Table at Drilling (approx. 27.5 ft); Water Bearing Zone below	
30	Split-Spoon	10			Water Bearing Zone	Cuttings wet below 32 feet
35					Water Bearing Zone	

LEGEND

100 to 1,000 g

Bag Sample | Split-Spoon | Shelby Tube Sample | Static Water Table at Drilling | 10-20-99 Static Water Table | Water Bearing Zone

Date Drilled: 3/5/12
Logged By: P. Crenna
Surface Elevation:

GeoPacific Engineering Inc.
14835 SW 72nd Avenue
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 941-9281

BORING LOG

Project: NW 81st Place Homesite, Portland, Oregon	Job No. 12-2529	Boring No. **B-1**

Depth (ft)	Sample Type	N-Value	Well Con-struction	Moisture Content (%)	Water Bearing Zone	Material Description
	Split-Spoon	13			Water Bearing Zone	
40	Split-Spoon	58			Water Bearing Zone	Hard, clayey SILT(ML) with abundant fragments of weathered vesicular basalt, relict fractures, black manganese accumulations, moist (Decomposed to Highly Weathered Columbia River Basalt)
						Boring Terminated at 41.5 feet
45						
50						
55						
60						
65						
70						

Note: Groundwater first encountered at 30 feet. Static water level at abandonment was approximately 27 feet.

LEGEND

100 to 1,000 g

Bag Sample | Split-Spoon | Shelby Tube Sample | Static Water Table at Drilling | 10-20-99 Static Water Table | Water Bearing Zone

Date Drilled: 3/5/12
Logged By: P. Crenna
Surface Elevation:

GeoPacific Engineering, Inc.

14835 SW 72nd Avenue
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 941-9281

BORING LOG

Project: NW 81st Place Homesite, Portland, Oregon	Job No. 12-2529	Boring No. **B-2**

Depth (ft)	Sample Type	N-Value	Well Construction	Moisture Content (%)	Water Bearing Zone	Material Description
		9				Soft, clayey SILT (ML), mixed brown, gray and orange, minor amounts of fine organic material, moist to wet (Poorly Compacted Fill)
5		3				
		1				Cuttings wet at 7.5 feet to 15 feet
10		2				
15		4				Soft to medium-stiff, silty CLAY (CL), gray, plastic, few roots, moist to wet (Poorly Compacted Fill)
20		11				Stiff, clayey SILT (ML), light brown, uniform texture, trace sand, damp to moist (Quaternary Loess Deposit)
25		10				Cuttings wet below 27 feet
30		25				Very-stiff to hard, clayey SILT (ML) with abundant fragments of weathered, vesicular basalt, brown to gray, relict fractures, black manganese accumulations, moist to wet (Decomposed to Weathered Columbia River Basalt)
35						

LEGEND

100 to 1,000 g — Bag Sample; Split-Spoon; Shelby Tube Sample; Static Water Table at Drilling; 10-20-99 Static Water Table; Water Bearing Zone

Date Drilled: 3/5/12
Logged By: P. Crenna
Surface Elevation:

GeoPacific Engineering Inc
14835 SW 72nd Avenue
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 941-9281

BORING LOG

Project: NW 81st Place Homesite, Portland, Oregon	Job No. 12-2529	Boring No. **B-2**

Depth (ft)	Sample Type	N-Value	Well Construction	Moisture Content (%)	Water Bearing Zone	Material Description
	Split-Spoon	50 for 3"				
						Boring Terminated at 36.5 feet
40						
45						Note: Perched groundwater encountered at about 7.5 to 15 feet and at about 24 to 31 feet. Water level in borehole at abandonment was 17 feet below the ground surface.
50						
55						
60						
65						
70						

LEGEND

100 to 1,000 g
Bag Sample | Split-Spoon | Shelby Tube Sample | Static Water Table at Drilling | 10-20-99 Static Water Table | Water Bearing Zone

Date Drilled: 3/5/12
Logged By: P. Crenna
Surface Elevation:

GeoPacific Engineering, Inc.

Real-World Geotechnical Solutions
Investigation • Design • Construction Support

MAINTENANCE OF HILLSIDE HOMESITES

All homes require a certain level of maintenance for general upkeep and to preserve the overall integrity of structures and land. Hillside homesites require some additional maintenance because they are subject to natural slope processes, such as runoff, erosion, shallow soil sloughing, soil creep, perched groundwater, etc. If not properly controlled, these processes could adversely affect your or neighboring properties. Although surface processes are usually only capable of causing minor damage, if left unattended, they could possibly lead to more serious instability problems.

The primary source of problems on hillsides is uncontrolled surface water runoff and blocked groundwater seepage which can erode, saturate and weaken soil. Therefore, it is important that drainage and erosion control features be implemented on the property, and that these features be maintained in operative condition (unless changed on the basis of qualified professional advice). By employing simple precautions, you can help properly maintain your hillside site and avoid most potential problems. The following is an abbreviated list of common Do's and Don'ts recommended for maintaining hillside homesites.

Do List

1. Make sure that roof rain drains are connected to the street, local storm drain system, or transported via enclosed conduits or lined ditches to suitable discharge points away from structures and improvements. In no case, should rain drain water be discharged onto slopes or in an uncontrolled manner. Energy dissipation devices should be employed at discharge points to help prevent erosion.
2. Check your roof drains, gutters and spouts to make sure that they are clear. Roofs are capable of producing a substantial flow of water. Blocked gutters, etc., can cause water to pond or run off in such a way that erosion or adverse oversaturation of soil can occur.
3. Make sure that drainage ditches and/or berms are kept clear throughout the rainy season. If you notice that a neighbor's ditches are blocked such that water is directed onto your property or in an uncontrolled manner, politely inform them of this condition.
4. Locate and check all drain inlets, outlets and weep holes from foundation footings, retaining walls, driveways, etc. on a regular basis. Clean out any of these that have become clogged with debris.
5. Watch for wet spots on the property. These may be caused by natural seepage or indicate a broken or leaking water or sewer line. In either event, professional advice regarding the problem should be obtained followed by corrective action, if necessary.
6. Do maintain the ground surface adjacent to lined ditches so that surface water is collected in the ditch. Water should not be allowed to collect behind or flow under the lining.

Don't List

1. Do not change the grading or drainage ditches on the property without professional advice. You could adversely alter the drainage pattern across the site and cause erosion or soil movement.
2. Do not allow water to pond on the property. Such water will seep into the ground causing unwanted saturation of soil.
3. Do not allow water to flow onto slopes in an uncontrolled manner. Once erosion or oversaturation occurs, damage can result quickly or without warning.
4. Do not let water pond against foundations, retaining walls or basements. Such walls are typically designed for fully-drained conditions.
5. Do not connect roof drainage to subsurface disposal systems unless approved by a geotechnical engineer.
6. Do not irrigate in an unreasonable or excessive manner. Regularly check irrigation systems for leaks. Drip systems are preferred on hillsides.

14835 SW 72nd Avenue
Portland, Oregon 97224

Tel (503) 598-8445
Fax (503) 941-9281