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

October 19, 2010

Project No. 10-1938

Larry Luethe
13225 NW McNamee Road
Portland, OR 97231
E-mail: labells1@gmail.com

**RE: ADDENDUM TO GEOTECHNICAL INVESTIGATION AND LANDSLIDE HAZARD STUDY
LUETHE PARTITION LOT 2
SECTION 32 2N 1W TAX LOT 800
MULTNOMAH COUNTY, OREGON**

This letter is an addendum to GeoPacific's Geotechnical Investigation and Landslide Hazard Study report, dated March 17, 2010, and should be considered in conjunction with the report. The attached revision of Figure 2 completely replaces the original Figure 2. The purpose of this addendum is to present GeoPacific's assessment of potential impacts on slope stability posed by the construction and use of on-site septic system serving the proposed single-family home.

It is our understanding that a septic leach field is proposed on the slope south of the proposed homesite at the approximate location shown in Figure 2 (attached). We further understand that geotechnical review of possible adverse effects that the system might pose to slope stability have been requested because the slope at the leach field location exceeds 20% grade.

On October 15, 2010, GeoPacific engineering geologist, Paul A. Crenna, visited the project site and reviewed slope conditions in the vicinity of the proposed leach field and stormwater facilities. Field measurements with a hand-held clinometer indicate that the slope at this location inclines at about 22% grade. Slope geomorphology is smooth and uniform consistent with relatively stable slope conditions, and no evidence of prior slope instability was observed on slopes immediately below the proposed leach field.

In our opinion, the proposed septic leach field has a low potential for adverse effects on slope stability; however, due to space conflicts with the planned on-site stormwater infiltration system, we recommend that the stormwater management plan for the homesite be modified. We recommend that roof runoff be discharged to a stormwater flow-through planter constructed in accordance with the standard City of Portland detail (attached) with the overflow outlet discharging to the natural drainage along the eastern property line as shown in Figure 2. We anticipate that the pipeline can be installed in a shallow hand dug trench in accordance with the International Plumbing Code.

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. This report was prepared for Larry Luethe only and should not be relied upon by third parties without consulting GeoPacific.

Project No. 10-1938
Luethe Partition Lot 2

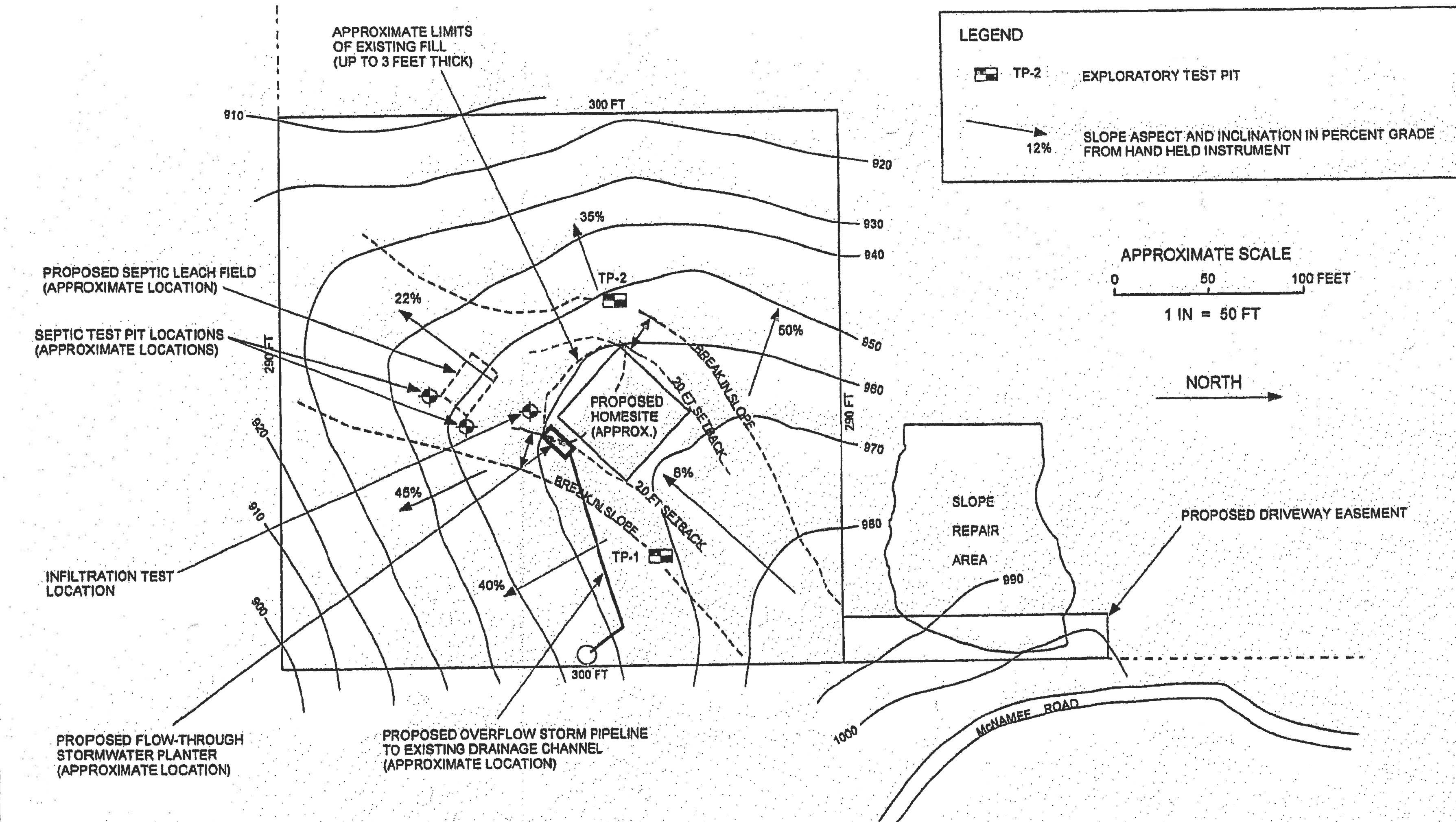
Sincerely,

GeoPacific Engineering, Inc.

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

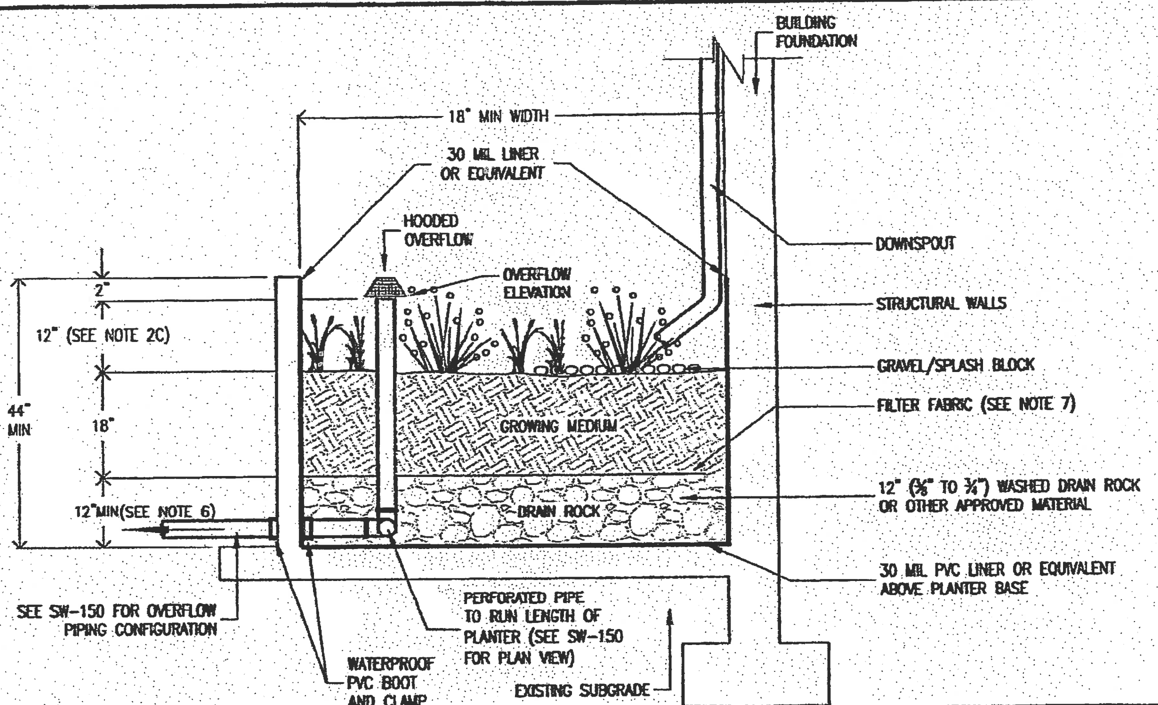
James D. Imbrie, P.E., C.E.G.
Geotechnical Engineer

Attachments: Revised Figure 2
2008 City of Portland Stormwater Manual Planter Detail SW-130



SITE TOPOGRAPHY TAKEN FROM U.S. GEOLOGICAL SURVEY, LINNTON QUADRANGLE. CONTOURS ARE IN FEET ABOVE MEAN SEA LEVEL. PROPERTY LINE REGISTRATION AND SLOPE BREAK BASED ON LIDAR IMAGERY. ALL LOCATIONS AND ELEVATIONS ARE APPROXIMATE.

GeoPacific Engineering, Inc. 13910 SW Galbreath Drive, Suite 102, Sherwood, Oregon 97140, Tel: (503) 625-4455 Fax: (503) 625-4405			SITE PLAN WITH EXPLORATIONS
Project: Luethe Partition Lot 2, Multnomah County, Oregon	Project No. 01-1938	Drawn By: PAC	FIGURE 2



1. Provide protection from all vehicle traffic, equipment staging, and foot traffic in proposed infiltration areas prior to, during, and after construction.

2. Dimensions:
   a. Width of flow-through planter: 18" minimum.
   b. Width of infiltration planter: 30" minimum.
   c. Depth of planter (from top of growing medium to overflow elevation). Simplified: 12"; Presumptive: 6"- 18".
   d. Slope of planter: 0.5% or less.

3. Setbacks (from centerline of facility):
   a. Infiltration planters must be 10' from foundations and 5' from property lines.
   b. Flow-through planters must be less than 30" in height above surrounding area if within 5 feet of property line.

4. Overflow:
   a. Overflow required for Simplified Approach.
   b. Inlet elevation must allow for 2" of freeboard, minimum.
   c. Protect from debris and sediment with strainer or grate.

5. Piping: shall be ABS Sch.40, cast iron, or PVS Sch.40. 3" pipe required for up to 1,500 sq ft of impervious area, otherwise 4" min. Piping must have 1% grade and follow the Uniform Plumbing Code.

6. Drain rock:
   a. Size for infiltration planter: 1½" - ¾" washed
   b. Size for flow-through planter: ¾" washed
   c. Depth for Simplified: 12"
   d. Depth for Presumptive: 0-48", see calcs.

7. Separation between drain rock and growing medium: Use filter fabric (see SWMM Exhibit 2-4 Geotextile table) or a gravel lens (¾ - ¼ inch washed, crushed rock 2 to 3 inches deep).

8. Growing medium:
   a. 18" minimum
   b. See Appendix F.3 for specification or use sand/loam/compost 3-way mix.

9. Vegetation: Follow landscape plans otherwise refer to plant list in SWMM Appendix F. Minimum container size is 1 gallon. # of plantings per 100sf of facility area:
   a. Zone A (wet) 115 herbaceous plants, OR
   b. Zone A (wet) 100 herbaceous plants and 4 small shrubs.

10. Planter walls:
    a. Material shall be stone, brick, concrete, wood, or other durable material (no chemically treated wood).
    b. Concrete, brick, or stone walls shall be included on foundation plans.

11. Waterproof liner: Shall be 30 mil PVC or equivalent, for flow-through facilities.

12. Install washed pea gravel or river rock to transition from inlet or splash pad to growing medium.

13. Inspections: Call BDS IVR Inspection Line, (503) 823-7000, for appropriate inspections.

- DRAWING NOT TO SCALE -

STORMWATER MANAGEMENT MANUAL TYPICAL DETAILS

- Simplified / Presumptive Design Approach -

Planter

Bureau of Environmental Services

NUMBER

SW-130

REVISION
LOT 2 NEW PARCEL 3

GeoPacific Engineering, Inc.

Real-World Geotechnical Solutio
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March 17, 2010

Project No. 10-1938

Larry Luethe
13225 NW McNamee Road
Portland, OR 97231
E-mail: labells1@gmail.com

**RE: GEOTECHNICAL INVESTIGATION AND LANDSLIDE HAZARD STUDY
LUETHE PARTITION LOT 2
SECTION 32 2N 1W TAX LOT 800
MULTNOMAH COUNTY, OREGON**

This report presents the results of a geotechnical investigation conducted by GeoPacific Engineering, Inc. (GeoPacific) for a proposed lot partition that would create two, new single-family homesites. The primary purpose of this study was to evaluate geological hazards, soil conditions and land suitability criteria specified by Multnomah County Code MCC 33.7890 with respect to residential homesite construction on Lot 2 of the proposed partition. The scope of our investigation included field reconnaissance, exploratory test pits, infiltration testing, analysis, and preparation of this report. This work was performed in accordance with GeoPacific proposal letter No. P-3721 dated January 29, 2010.

Project Information

Location:	The subject site is located adjacent to 13225 NW McNamee Road in Multnomah County, Oregon (Figure 1). Thomas Guide coordinates of the site are 534-H6.
Owner/ Developer:	Larry and Laura Luethe 13225 NW McNamee Road, Multnomah County, Oregon
Jurisdictional Agency:	Multnomah County, Oregon

SITE DESCRIPTION AND PROPOSED DEVELOPMENT

The proposed Lot 2 partition is an approximate 2 acre parcel located at the southeastern corner of Tax Lot 800 (Figure 1). Tax Lot 800 is a 15.92 acre parcel situated on the south side of NW McNamee Road in Multnomah County, Oregon. The proposed homesite on Lot 2 is situated on a gently-sloping ridgeline with moderately-steep side slopes. The general site topography based on U.S. Geological Survey mapping is shown in Figure 2. Vegetation consists of low grasses and sparse brush and mature trees.

The proposed homesite development includes construction of a single-family home and associated improvements including an engineered fill slope, gravel driveway, stormwater management facilities and an on-site septic system. We anticipate that building construction will incorporate a conventional spread footing foundation and possibly short retaining walls for a daylight basement. We anticipate that grading for the project will be limited to an engineered fill slope, a foundation excavation for the home, minor landscaping fill around the home, and placement of baserock for a gravel driveway. Grading for an engineered fill slope along the driveway is currently in progress.

REGIONAL GEOLOGY

The subject site is underlain by Quaternary age (last 1.6 million years) loess, a windblown silt deposit that mantles older deposits and basalt bedrock in the Tualatin Hills region (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 loess is Miocene age (about 14.5 to 16.5 million years ago) Columbia River Basalt, a thick sequence of lava flows which form the crystalline basement of the Tualatin Hills (Madin, 1990). These basalts are a dense, finely crystalline rock that is 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 rocks. Where highly weathered, the upper portion of the basalt is typically altered to a distinctive red-brown clayey silt known as laterite or residual soil.

SUBSURFACE CONDITIONS

On February 10, 2010, GeoPacific explored subsurface conditions in the vicinity of the proposed homesite by excavating two exploratory test pits at the approximate locations shown on Figure 2. Field exploration methodology is discussed in Appendix A, which also contains the test pit logs. The observed subsurface conditions and soil properties are summarized below.

Topsoil: Directly underlying the ground surface is a topsoil horizon consisting of organic SILT (OL) with a 3-inch- to 4-inch thick root mat for low grasses. The topsoil is dark brown in color and has a mixed structure, presumably due to land clearing activities. The total thickness of the topsoil horizon is approximately 12 to 14 inches.

Native Soil Horizon: Underlying the topsoil is a native soil weathering horizon consisting of clayey SILT (ML). The soil color is mottled light brown, orange and gray. Field pocket penetrometer measurements indicate approximate unconfined compressive strengths of 0.5 tons/ft^2 under damp to moist conditions. These measurements are consistent with a medium-stiff consistency. In test pits TP-1 and TP-2, the native soil horizon is about 1.5 feet thick.

Quaternary Loess Deposit: Underlying the native soil horizon is a deposit of Quaternary windblown loess that consists of clayey SILT (ML) to silty CLAY (CL). The soil color is mottled light brown, orange and gray. The loess is generally uniform in texture, has a low to moderate plasticity, and a very-stiff consistency. Field pocket penetrometer measurements indicate an approximate unconfined compressive strength of 3.5 to 4.0 tons/ft^2. In test pits, the loess deposit is greater than 5.5 feet thick and extends below the maximum depth explored (8 feet below the ground surface).

Soil Moisture and Groundwater

On February 10, 2010, soil moisture conditions observed in test pits were generally damp to moist. No seepage or groundwater was observed to a maximum exploration depth of 8 feet below the ground surface.

SLOPE STABILITY OF HOMESITE

For the purpose of evaluating slope stability, we reviewed published geologic and hazard mapping, reviewed regional site topography, performed a field reconnaissance, 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), where Zone 3 is the highest relative hazard (Mabey et al., 1996). Published regional geologic mapping shows no landslides in the immediate vicinity of the subject site (Madin, 1990).

The proposed homesite is situated on a gently sloping ridgeline inclining at about 8% to 22% grade (Figure 2). The side slopes on the southeast incline at 40% to 45% grade descending to an incised drainage channel beyond the boundaries of the property. Reconnaissance observations indicate that slope geomorphology is generally smooth and uniform, consistent with relatively stable slope conditions. No geomorphic evidence of prior deep-seated slope instability (such as hummocky topography, benches or old scarps) was observed. The side slopes on the northwest incline at 35% to 50% grade descending to an incised drainage on the central portion of the Tax Lot 800 property. . Reconnaissance observations indicate that slope geomorphology on the Lot 2 property is generally smooth and uniform, consistent with relatively stable slope conditions. No geomorphic evidence of prior deep-seated slope instability (such as hummocky topography, benches or old scarps) was observed.

Exploratory test pits indicate that slopes in the immediately vicinity of the homesite are underlain by very-stiff, clayey silt to silty clay. This soil is characterized by a moderate to high shear strength and moderate to high resistance to instability on gentle to moderately-steep slopes.

SLOPE STABILITY OF DRIVEWAY

The proposed Lot 2 property is to include a driveway easement that extends from the northeast corner of the property to the McNamee Road right-of-way (Figure 2). This easement lies at the head of a drainage gully which, in January of 2009, experienced a slope failure that encroached into the easement towards McNamee Road (see Figure 2).

In the Summer of 2009, GeoPacific conducted a geotechnical study of the slope failure and formulated an engineered slope repair plan (GeoPacific Engineering, 2009). This study concluded that the slope failure was a relatively shallow-seated feature that involved primarily undocumented, poorly-compacted fill and shallow native soils. A wedge of undocumented, non-engineered fill had apparently been placed in the gulley head prior to 2005 as indicated by review of 2005 Lidar imagery. Failure of the fill and underlying shallow native soils was triggered by a heavy rainfall and rapid snowmelt event on or about January 1, 2009.

Test pit exploration for the study indicated that only a thin mantle to slide debris was remaining on slopes at the head of the gully, and that undeformed, native residual soils derived from in place decomposition and weathering of basalt was present at depths of 2 to 4 feet below the upper surface of the slide debris. No groundwater was observed in the test pits.

An engineered slope repair was formulated to construct a stable fill slope in the head of the gully. The slope repair consists of removal of remnant slide debris followed by construction of a compacted engineered fill constructed on a keyway and benches excavated into competent native soils. The repair also includes a series of subdrains to prevent potential adverse build up of groundwater behind the fill mass. A detailed evaluation of slope stability including a quantitative, numerical analysis, slope repair plans and cross sections are presented in a separate geotechnical report, dated August 4, 2009 (GeoPacific Engineering, 2009).

Grading earthwork for the slope repair was begun in August of 2009 and continued through October 2009 until the onset of the wet weather season. During this phase of earthwork, GeoPacific performed on-call geotechnical construction observation and testing services as the geotechnical engineer of record. We observed excavation of the fill keyway, installation of the keyway subdrain, and tested compaction of engineered fill placed in the keyway to an approximate thickness of 6 feet. A summary of GeoPacific's field inspection reports and compaction test reports complied to date are presented in Appendix B.

INFILTRATION TESTING

On February 10, 2010, three open-hole, falling-head infiltration tests were performed at the home site in general accordance with City of Portland Stormwater Management Manual guidelines. The tests were conducted in 8-inch diameter holes excavated into native soils at an approximate depth of 4 feet below the ground surface. On March 3, 2010, an additional infiltration test was conducted in an 8-inch-diameter hole excavated into native soils at a depth of 2 feet. All of the test holes were pre-saturated for 4 hours prior to performing the final test measurements. During the tests, water levels were measured over 15 minute intervals with approximate head pressures ranging between 8 and 10 inches until three successive measurements showing a consistent infiltration rate were achieved. Soils encountered in the pits consisted of clayey silt with a field determined Unified Soil Classification System designation of ML. The approximate test location is shown in Figure 2.

The results of our infiltration testing indicate that the average infiltration rate at a depth of 4 feet is 0.04 inches per hour, and the infiltration rate at a depth of 2 feet is 1.8 inches per hour. These results indicate that infiltration rates at the site are very low, such that water tends to flow laterally in the upper few feet of soil rather than vertically.

System Design Assumptions and Parameters

Stormwater management for the development is required by Multnomah County to control the 24 hour runoff volume resulting from the 10 year storm recurrence event "such that the rate of stormwater runoff attributed to the development will be no greater than that which existed prior to development as measured from the property line or from the point of discharge into a watercourse". For design of stormwater planters, we used an effective infiltration rate of 0.9 inches per hour, such that the system has a factor of safety of 2 against clogging from the measured effective rate. Infiltration rates tend to decrease over time due to clogging by silt, clay and organic particles, and thus incorporation of a factor of safety extends the service life of the system. A maximum effective head pressure within the system of 1 foot was assumed.

The peak rainfall intensity resulting from a 10-year storm (occurring once every 10 years) is 0.65 inches per hour producing a total rainfall over a 24 hour period of 3.4 inches (ODOT Hydraulics Manual and City of Portland Stormwater Management Manual). Based on the above design assumptions, we calculate that 90 square feet of infiltration stormwater planter constructed in accordance with the standard City of Portland detail is needed for every 1,000 square feet of impermeable roof area.

CONCLUSIONS AND RECOMMENDATIONS

Results of this geotechnical investigation indicate that the subject site is suitable for support of conventional shallow foundations provided that the following recommendations are incorporated into the design and construction phases of the project. The proposed homesite conforms to the land suitability criteria for a land division specified by Multnomah County Code MCC 33.7890, and in our opinion, the potential for damage to the single-family home due to slope instability is low provided that the project is designed and constructed in accordance with our recommendations. GeoPacific Engineering, Inc. should observe the foundation excavation during construction to verify subgrade bearing strength prior to setting forms and pouring concrete.

Slope Stability of Homesite

In our opinion, the potential for damage to the proposed single-family home due to deep-seated slope instability is low provided that the project is designed and constructed in accordance with our recommendations. Exploratory test pits indicate that the homesite is underlain by competent, very-stiff, clayey silt to silty clay characterized by a moderate to high shear strength and moderate to high resistance to slope instability. For preliminary planning purposes, we recommend a minimum setback distance from the ridgeline side slopes of 20 feet horizontal for structures intended for human occupancy as shown in Figure 2. Proposed construction within this setback zone would require further geotechnical review.

Slope Stability of Driveway Easement

An engineered slope repair consisting of earthwork grading is in progress to construct a stable fill slope at the head of a gully which experienced landsliding in January of 2009. The slope repair area includes the proposed driveway easement which will access the Lot 2 homesite. The slope repair consists of removal of remnant slide debris followed by construction of a compacted engineered fill constructed on a keyway and benches excavated into competent native soils. The repair also includes a series of subdrains to prevent the potential for adverse build up of groundwater behind the fill mass. A detailed evaluation of slope stability including a quantitative, numerical analysis, slope repair plans and cross sections are presented in a separate geotechnical report, dated August 4, 2009 (GeoPacific Engineering, 2009).

GeoPacific is under contract to perform on-call geotechnical observation and testing services for completion of the engineered slope repair as it progresses. Once the recommended slope repair is complete, it is our opinion that the gully head and driveway easement will be in compliance with the requirements of Multnomah County Code MMC 37.0560 and 33.7890. Upon completion of the grading project, GeoPacific will issue a final summary report verifying completion of the slope repair in accordance with our design recommendations and the requirements of Multnomah County Code MCC 37.0560 and 33.7890.

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 height should be sloped in accordance with U.S. Occupational Safety and Heath Administration (OSHA) regulations (29 CFR Part 1926), or be shored. 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.

Shallow Foundations

The subject site is suitable for shallow foundations bearing on competent, native soil and/or engineered fill. Foundation design, construction, and setback requirements should conform to applicable building codes at the time of permitting (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 engineered fill. A maximum chimney and 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.

Footing excavations should penetrate through surficial fill, topsoil and any loose soil to competent 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. Foundations constructed during the wet weather season may require localized overexcavation of footings and backfill with compacted, crushed aggregate to retard softening of subgrade soils by surface water.

GeoPacific should observe the foundation excavation during construction to verify subgrade bearing strength prior to setting forms and pouring concrete. We anticipate that minimum excavation depths of 1 to 4 feet will necessary to penetrate shallow fill and loose surficial soil and reach subgrade suitable for bearing support of footings.

Concrete Slabs-On-Grade

For slab-on-grade floors in living spaces, we recommend that underslab base rock consist of ¾- ¼ " crushed aggregate containing no more than 1% fine-grained material passing the No. 200 (0.75 mm) sieve. The minimum recommended base rock thickness for capillary break is 8 inches for dry weather construction and 12 inches for wet weather. Soil subgrade should be sloped away from the center of the slab at an approximate gradient of 1% in order to promote underslab drainage. Underslab aggregate should be compacted to at least 90% of its maximum dry density as determined by ASTM D1557 or equivalent.

Moisture barrier products should be installed in accordance with the architect's and manufacturer's recommendations. For wet-weather construction, it is important that moisture sensitive flooring (such as vinyl tiles) be installed after the building is complete and the HVAC system operating for a period of time long enough to allow the vapor gradient within and below the building to stabilize and obtain acceptable slab moistures.

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 (an infiltration stormwater planter).

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.

Stormwater Management

In our opinion, the subject site is suitable for only limited subsurface disposal of stormwater into the near surface soils. Infiltration test results indicate that infiltration rates at the site are very low, such that water tends to flow laterally in the upper few feet of soil rather than vertically. The measured infiltration rate at a depth of 2 feet is 1.8 inches per hour.

Based on infiltration test results and observed site conditions, we recommend a stormwater infiltration planter system for management of runoff from impermeable roof areas. This type of system combines stormwater detention and limited infiltration into the near surface soils such that post development runoff from the property does not increase over the current rate of runoff. Based on our design assumptions, we calculate that 90 square feet of infiltration stormwater planter constructed in accordance with the standard City of Portland detail is needed for every 1,000 square feet of impermeable roof area. Hence, for 2,500 square feet of impermeable building area, a minimum of 225 square feet of stormwater infiltration planter (constructed in accordance with the standard City of Portland detail) is needed. No special stormwater management is considered necessary for gravel driveway surfaces other than those specified in our geotechnical report dated August 4, 2009 (GeoPacific Engineering, 2009).

Planters should be constructed as an open-bottom, "infiltration planter" on native soils, elevated above the ground surface in accordance with standard City of Portland Detail SW-130 (see attachment). Planters should be constructed downhill of the home at a minimum horizontal distance of 10 feet from foundations and should include overflow outlets to suitable discharge locations. Rainfall in excess of the design storm will result in overflow of the system. We recommend that overflow be distributed to two or three outlet locations such that water is spread evenly across the gentle ridgeline slope below the homesite.

As with all hillside homesites, we recommend that the owner maintain this property in a manner appropriate to hillside development as outlined in "Maintenance of Hillside Homesites" (Appendix C).

Concrete Retaining Walls

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 fill and poured-in-place concrete may be taken as 0.40 (value does not include a factor of safety adjustment).

Recommended lateral soil pressures for design of permanent retaining structures up to 8 feet in retained height with adequate drainage can be calculated using the equivalent fluid unit weights provided in Table 1. 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 1 are for backfill consisting of free-draining granular material (crushed aggregate); on-site soils are not recommended for use as retaining wall backfill. Wall backfill should be compacted to at least 90% of the maximum dry density determined by ASTM D1557 or equivalent.

Table 1 - Recommended Equivalent Fluid Unit Weights for Calculating Lateral Earth Pressures

Type	Unrestrained Wall		Restrained Wall	
	Level Profile	2H:1V Upslope	Level Profile	2H:1V Upslope
Active Pressure ($lbs/ft^2/ft$)	32	45	-	-
At-Rest Pressure ($lbs/ft^2/ft$)	-	-	50	65
Passive Pressure * ($lbs/ft^2/ft$)	280	280	120	120

* 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.

Subdrains should be installed behind all retaining walls to prevent the build-up of adverse hydrostatic pressure. 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.

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.

Seismic Design

Structures should be designed to resist earthquake loading in accordance with the methodology described in the 2006 International Residential Code (IRC) for One- and Two-Family Dwellings, with applicable Oregon Residential Specialty Code revisions. We recommend Site Class D be used for design. Design values determined for the site using the USGS (United States Geological Survey) *Earthquake Ground Motion Parameters* utility are summarized in Table 2.

Table 2 - Recommended Earthquake Ground Motion Parameters (2006 IRC)

Parameter	Value
Location (Lat, Long), degrees	45.616, -122.841
Mapped Spectral Acceleration Values (MCE):	
Short Period, S_s	0.99 g
1.0 Sec Period, S_1	0.36 g
Soil Factors for Site Class D:	
F_a	1.11
F_v	1.68
Residential Site Value = 2/3 x F_a x S_s	0.73 g
Residential Seismic Design Category	D_1

Soil liquefaction is a phenomenon wherein saturated soil deposits temporarily lose strength and behave as a liquid in response to earthquake shaking. Soil liquefaction is generally limited to loose, granular soils located below the water table. Following development, on-site soils will consist predominantly of engineered fill or stiff native soils, which are not considered susceptible to liquefaction. Therefore, it is our opinion that special design or construction measures are not required to mitigate the effects of liquefaction.

UNCERTAINTY AND LIMITATIONS

We have prepared this report for the client, 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. Experience has shown that soil and groundwater conditions can vary significantly over small distances. 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.

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.

Sincerely,

GeoPacific Engineering, Inc.

EXPIRES: 06/30/20 0

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

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

Attachments: Figure 1 - Vicinity Map
Figure 2 - Site Plan with Topography and Explorations
City of Portland Typical Stormwater Infiltration Planter Detail SW-130
Multnomah County Stormwater Certificate
Appendix A - Field Explorations, Sampling and Laboratory Testing
Appendix B - Field Soil Observation Summary (1 page)
Summary of Field Soil Density Tests (1 page)
Appendix C - Maintenance of Hillside Homesites

REFERENCES CITED

GeoPacific Engineering, Inc., 2009, Geotechnical evaluation of slope instability and recommended slope repair, 13225 NW McNamee Road, Multnomah County, Oregon: unpublished consulting report, dated August 4, 2009, 10 pages, 4 figures.

Mabey, M.A., Madin, I.P., and Black, G.L., 1996, Relative earthquake map of the Linnton Quadrangle, Multnomah and Washington Counties, Oregon: Oregon Department of Geology and Mineral Industries, GMS-104, 6 pages, scale 1:24,000.

Madin, I.P., 1990, Earthquake hazard geology maps of the Portland metropolitan area, Oregon: Oregon Department of Geology and Mineral Industries Open-File Report 0-90-2, scale 1:24,000, 22 p.

GeoPacific Engineering, Inc.
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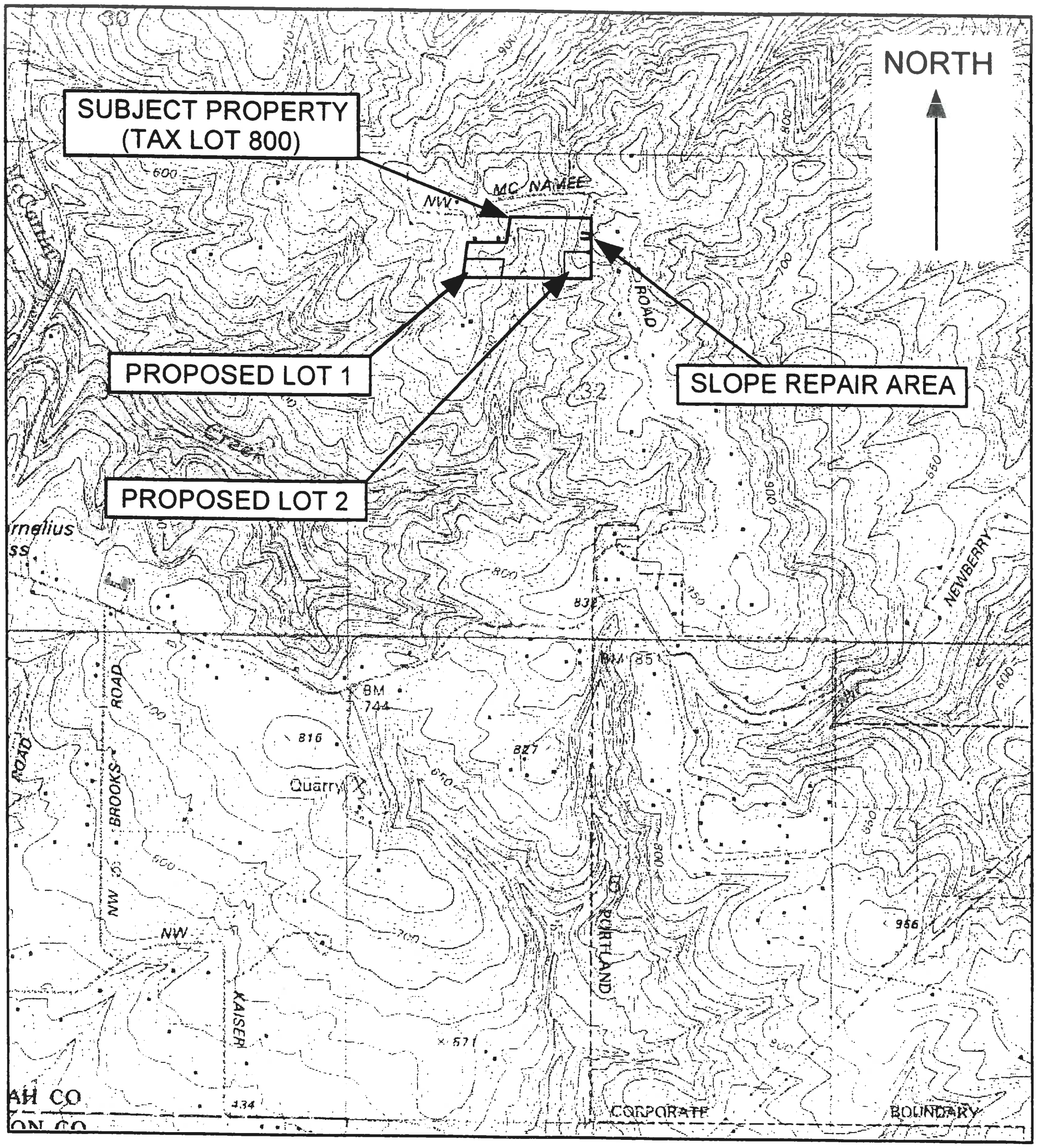
VICINITY MAP



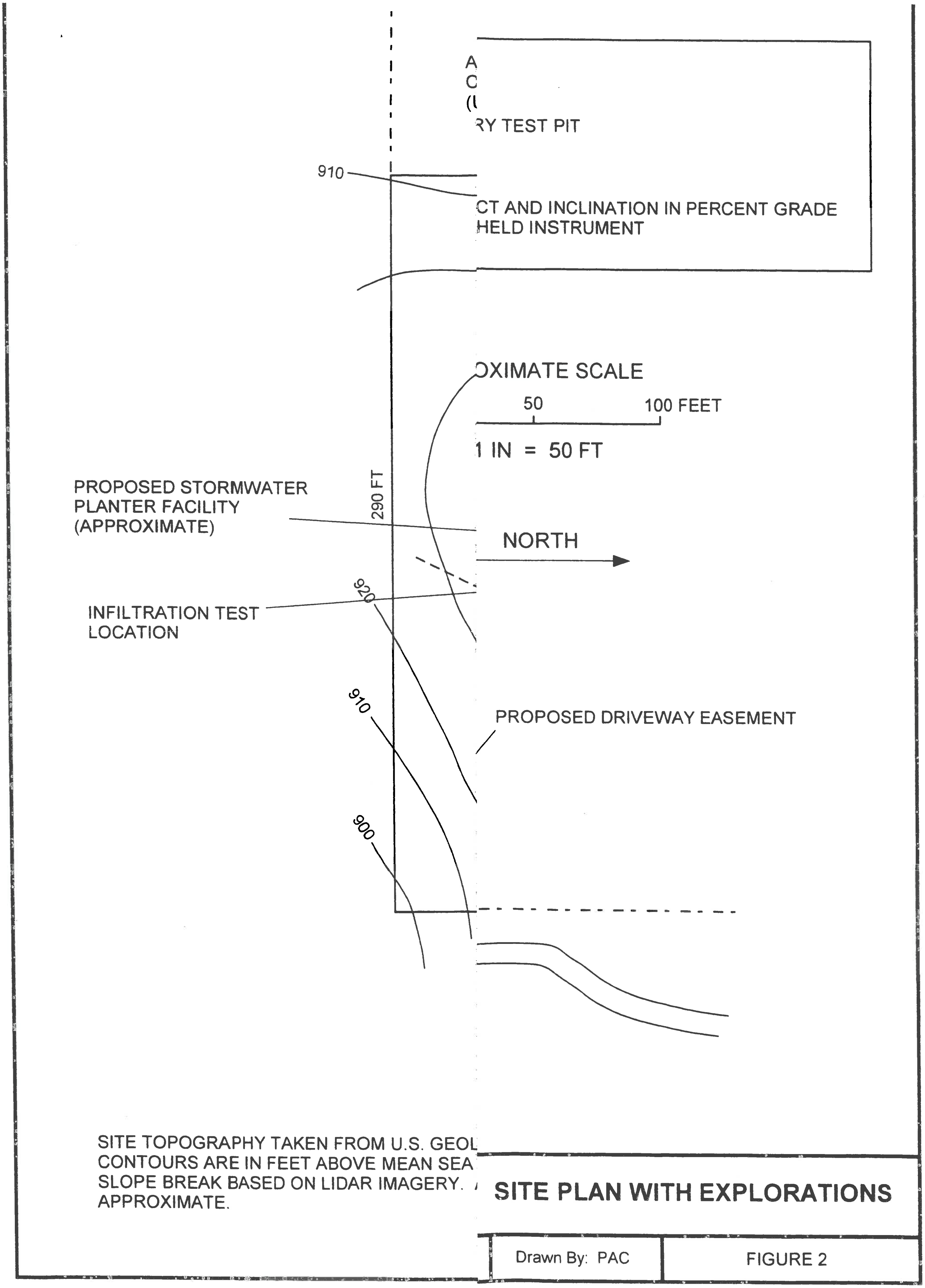
Legend

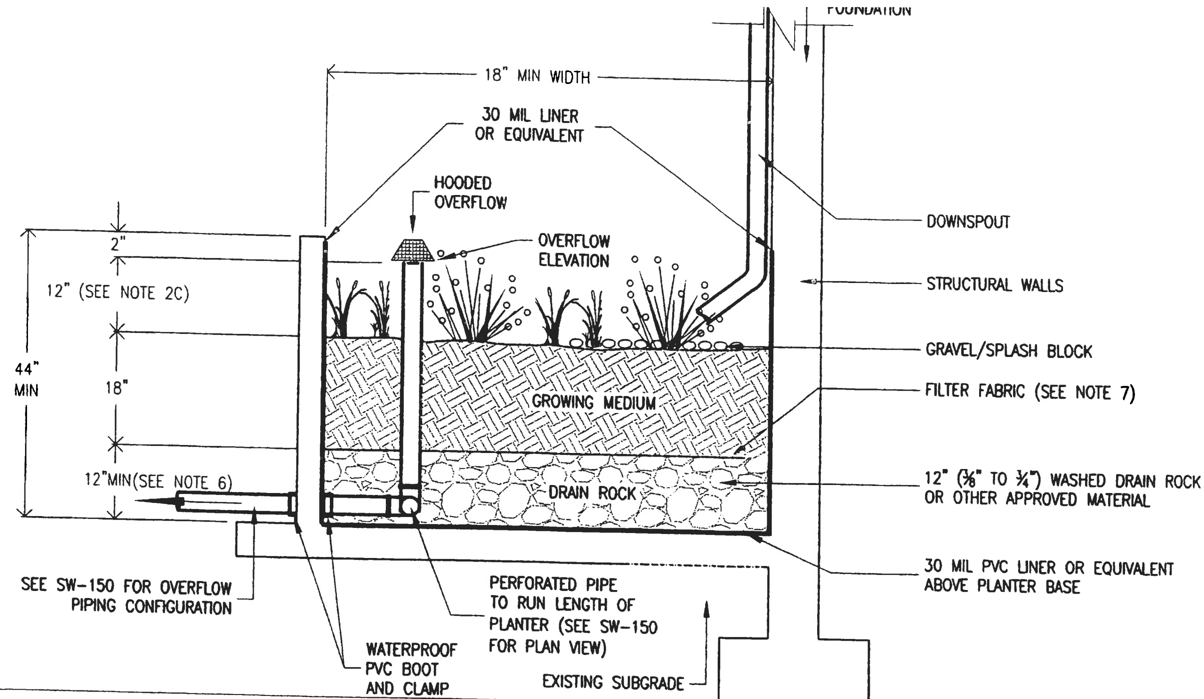
Approximate Scale 1 in = 2,000 ft

Date: 2/1/10
Drawn by: PAC

Base map: U.S. Geological Survey 7.5 minute Topographic Map Series, Linnton Quadrangle

Project: Luethe Partition Multnomah Co., Oregon	Project No. 09-1938	FIGURE 1


A
C
(l
RY TEST PIT
CT AND INCLINATION IN PERCENT GRADE
HELD INSTRUMENT
910
OXIMATE SCALE
50
100 FEET
1 IN = 50 FT
290 FT
PROPOSED STORMWATER
PLANTER FACILITY
(APPROXIMATE)
NORTH
920
INFILTRATION TEST
LOCATION
910
PROPOSED DRIVEWAY EASEMENT
900
SITE TOPOGRAPHY TAKEN FROM U.S. GEOL
CONTOURS ARE IN FEET ABOVE MEAN SEA
SLOPE BREAK BASED ON LIDAR IMAGERY.
APPROXIMATE.
SITE PLAN WITH EXPLORATIONS
Drawn By: PAC
FIGURE 2



1. Provide protection from all vehicle traffic, equipment staging, and foot traffic in proposed infiltration areas prior to, during, and after construction.

2. Dimensions:
   a. Width of flow-through planter: 18" minimum.
   b. Width of infiltration planter: 30" minimum.
   c. Depth of planter (from top of growing medium to overflow elevation). Simplified: 12"; Presumptive: 6"- 18".
   d. Slope of planter: 0.5% or less.

3. Setbacks (from centerline of facility):
   a. Infiltration planters must be 10' from foundations and 5' from property lines.
   b. Flow-through planters must be less than 30" in height above surrounding area if within 5 feet of property line.

4. Overflow:
   a. Overflow required for Simplified Approach.
   b. Inlet elevation must allow for 2" of freeboard, minimum.
   c. Protect from debris and sediment with strainer or grate.

5. Piping: shall be ABS Sch.40, cast iron, or PVS Sch.40. 3" pipe required for up to 1,500 sq ft of impervious area, otherwise 4" min. Piping must have 1% grade and follow the Uniform Plumbing Code.

6. Drain rock:
   a. Size for infiltration planter: 1½" - ¾" washed
   b. Size for flow-through planter: ¾" washed
   c. Depth for Simplified: 12"
   d. Depth for Presumptive: 0-48", see calcs.

7. Separation between drain rock and growing medium: Use filter fabric (see SWMM Exhibit 2-4 Geotextile table) or a gravel lens (¾ - ¼ inch washed, crushed rock 2 to 3 inches deep).

8. Growing medium:
   a. 18" minimum
   b. See Appendix F.3 for specification or use sand/loam/compost 3-way mix.

9. Vegetation: Follow landscape plans otherwise refer to plant list in SWMM Appendix F. Minimum container size is 1 gallon. # of plantings per 100sf of facility area:
   a. Zone A (wet) 115 herbaceous plants, OR
   b. Zone A (wet) 100 herbaceous plants and 4 small shrubs.

10. Planter walls:
   a. Material shall be stone, brick, concrete, wood, or other durable material (no chemically treated wood).
   b. Concrete, brick, or stone walls shall be included on foundation plans.

11. Waterproof liner: Shall be 30 mil PVC or equivalent, for flow-through facilities.

12. Install washed pea gravel or river rock to transition from inlet or splash pad to growing medium.

13. Inspections: Call BDS IVR Inspection Line, (503) 823-7000, for appropriate inspections.

- DRAWING NOT TO SCALE -

STORMWATER MANAGEMENT MANUAL TYPICAL DETAILS

- Simplified / Presumptive Design Approach -

Planter

NUMBER

SW-130

Bureau of Environmental Services

MULTNOMAH COUNTY

MULTNOMAH COUNTY OREGON
LAND USE AND TRANSPORTATION PROGRAM
1600 SE 190TH Avenue Portland, OR 97233
PH: 503-988-3043 FAX: 503-988-3389
http://www.co.multnomah.or.us/dbcs/LUT/land_use

STORM WATER CERTIFICATE

(Required when >500 Square Feet of Impervious Surface Created)

Please have an Oregon Licensed Professional Engineer check one below:

☐ Construction of an on-site storm water drainage control system **is not required**. The rate of storm water runoff attributed to the development (during the 10-year/24-hour storm) will be no greater than that which existed prior to development as measured from the property line or from the point of discharge into a watercourse (MCC 29.333(C), or MCC 29.353(C)).

☑ Construction of an on-site storm water drainage control system **is required**. After installation of the drainage control system, the rate of storm water runoff attributed to the development (during the 10-year/24-hour storm) will be no greater than that which existed prior to development as measured from the property line or from the point of discharge into a watercourse (MCC 29.333(C), or MCC 29.353(C)). **I certify the attached site plan and on-site storm water control design dated** 3/17/10 **will meet the requirements listed above. Please attach associated plans, designs and calculations.**

Signature [signature]

Print Name James D. Imbrie

Address 13910 SW Galbreath Dr. Ste102 Sherwood 97140

Phone (503) 625-4455 Fax (503) 625-4405

Date 3/19/10

Provide Stamp Below:

REGISTERED PROFESSIONAL ENGINEER
14743PE
OREGON
JAN. 23, 1989
JAMES D. IMBRIE
EXPIRES: 06/30/20__

APPENDIX A

FIELD EXPLORATIONS, SAMPLING, AND LABORATORY TESTING

On February 10, 2010, two exploratory test pits were excavated on the subject property to depths of 8 feet to 8.5 feet at the approximate locations shown in 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 test pits were excavated with a small to medium-sized trackhoe provided by the client using an approximate 30-inch-wide, bucket. All excavations were backfilled immediately after completion of logging and sampling. Minimal compactive effort was applied to backfill.

Soil samples were visually evaluated, described, and classified in general accordance with the Unified Soil Classification System visual-manual procedure, and the Oregon Department of Transportation Soil and Rock Classification Manual.

Sherwood, Oregon 97140
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TEST PIT LOG

Project: Luethe Partition Lot 2, Multnomah County, Oregon	Project No. 10-1938	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
1						Organic SILT (OL), dark brown, many roots, moist (Topsoil)
2	0.5					Soft to medium-stiff, clayey SILT (ML), mottled light brown, orange and gray, common fine roots, moist (Disturbed Native Soil)
3	4.0					Very-stiff, clayey SILT (ML) to silty CLAY (CL), mottled light brown, orange and gray, low to moderate plasticity, damp to moist (Quaternary Loess Deposit)
4	4.0					
5	4.0					
6						
7						
8						Test Pit Terminated at 7.5 feet
9						
10						Note: No seepage or groundwater encountered.
11						
12						
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: 2/10/10
Logged By: P. Crenna
Surface Elevation:

Engineering, Inc.
Sherwood, Oregon 97140
Tel: (503) 625-4455 Fax: (503) 625-4405

TEST PIT LOG

Project: Luethe Partition Lot 2, Multnomah County, Oregon	Project No. 10-1938	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
						Organic SILT (OL), dark brown, many roots, moist (Topsoil)
1						
2	0.5					Medium-stiff, clayey SILT (ML), mottled light brown, orange and gray, common fine roots, damp to moist (Native Soil Horizon)
3	3.5					
4	4.0					Very-stiff, clayey SILT (ML) to silty CLAY (CL), mottled light brown, orange and gray, low to moderate plasticity, damp to moist (Quaternary Loess Deposit)
5	3.5					
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: 2/10/10
Logged By: P. Crenna
Surface Elevation:

APPENDIX B

GEOTECHNICAL CONSTRUCTION OBSERVATION AND TESTING FIELD REPORTS

Field Soil Observation Summary

Project: McNamee Road Slope Repair
Job number: OR 09-1796
Project address: 13225 NW McNamee Rd Multnomah County, OR

Daily Reports

8/25/09: GeoPacific engineering geologist, Paul A. Crenna, visited the project site to observe keyway excavation. Contractor has excavated 25-foot-wide keyway to approximate length of 28 feet. Excavation bottom consists of weathered basalt bedrock. Recommended that keyway at south end be extended and that both ends be benched.

8/31/09: GeoPacific engineering geologist, Paul A. Crenna, visited the project site to observe installed subdrain. The 25-foot-wide keyway has been enlarged to 36 feet long at the bottom with a benched south end. A T-configuration subdrain has been installed in the keyway in general accordnace with GeoPacific's recommendations. The subdrain consists of a 4-inch-diameter, perforated plastic pipe with filter sock enveloped in drainrock and covered with filter fabric. Subdrain outlet extends through trench downslope through central portion of drainage bottom below keyway.

10/16/09: GeoPacific technician, Jason Burgess, was on site to observe benching in and for the slide repair engineered fill. At about the 6 foot level in the fill two benches have been cut about 6 feet back into the slope they are about 2 and 3 foot tall. Soils exposed are a brown clayey silt with grey striations and a red brown silty clay. No groundwater water is present.

Go back to the task select page for McNamee Road Slope Repair

Go back to the project select page

Summary of Field Soil Density Tests

Project: McNamee Road Slope Repair
Job number: OR 09-1796
Client: V and K Construction

Summary Coding and Explanation

Date of test	Test number	Test location	Elev (ft)	C.P. (%)	Max density (pcf)	Field moist (%)	Dry density (pcf)	Comp spec (%)	Comp result (%)	Test status
9/28/09	SF1	Keyway-Northeast	+2		113.7	12.1	103.0	90	91	Passed
9/28/09	SF2	Keyway-Northwest	+2		113.7	15.4	103.7	90	91	Passed
9/28/09	SF3	Keyway-Southwest	+2		113.7	12.8	105.8	90	93	Passed
9/28/09	SF4	Keyway-Southeast	+2		113.7	15.2	105.4	90	93	Passed
10/2/09	SF5	Keyway-Southeast	+4		113.7	12.9	104.0	90	92	Passed
10/2/09	SF6	Keyway-Southwest	+4		113.7	13.4	103.5	90	91	Passed
10/2/09	SF7	Keyway-Northwest	+4		113.7	12.9	105.4	90	93	Passed
10/2/09	SF8	Keyway-Northeast	+4		113.7	13.8	103.0	90	91	Passed
10/16/09	SF9	Slide repair northwest	+6		113.7	16.4	103.7	90	91	Passed
10/16/09	SF10	Slide repair southwest	+6		113.7	17.0	106.4	90	94	Passed
10/16/09	SF11	Slide repair southeast	+6		113.7	17.3	104.5	90	92	Passed
10/16/09	SF12	Slide repair northeast	+6		113.7	16.1	102.8	90	90	Passed

Go back to the task select page for McNamee Road Slope Repair

Go back to the project select page

APPENDIX C

MAINTENANCE OF HILLSIDE HOMESITES

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.

3. APPROPRIATE ZONING JURISDICTION (Applicant must take this form to the appropriate zoning office. If property is outside Portland City Limits, please contact Multnomah County at 503-988-3043.

Zoning Overlay(s) Sec-h, HD, SEC-S

The Division of Planning and Zoning has reviewed the referenced property and finds that based on current land use regulations the property is:

☒ Approved for Land Feasibility/Test Pits Only

☐ Other ______________________

Comments/Conditions Applicant will be submitting for Land use permits in the future partition.

Joanna Valencia | Multnomah County | 7/6/10
Planner Signature | Jurisdiction | Date

4. SOILS INFORMATION – *Applicant to complete the Soils Information*

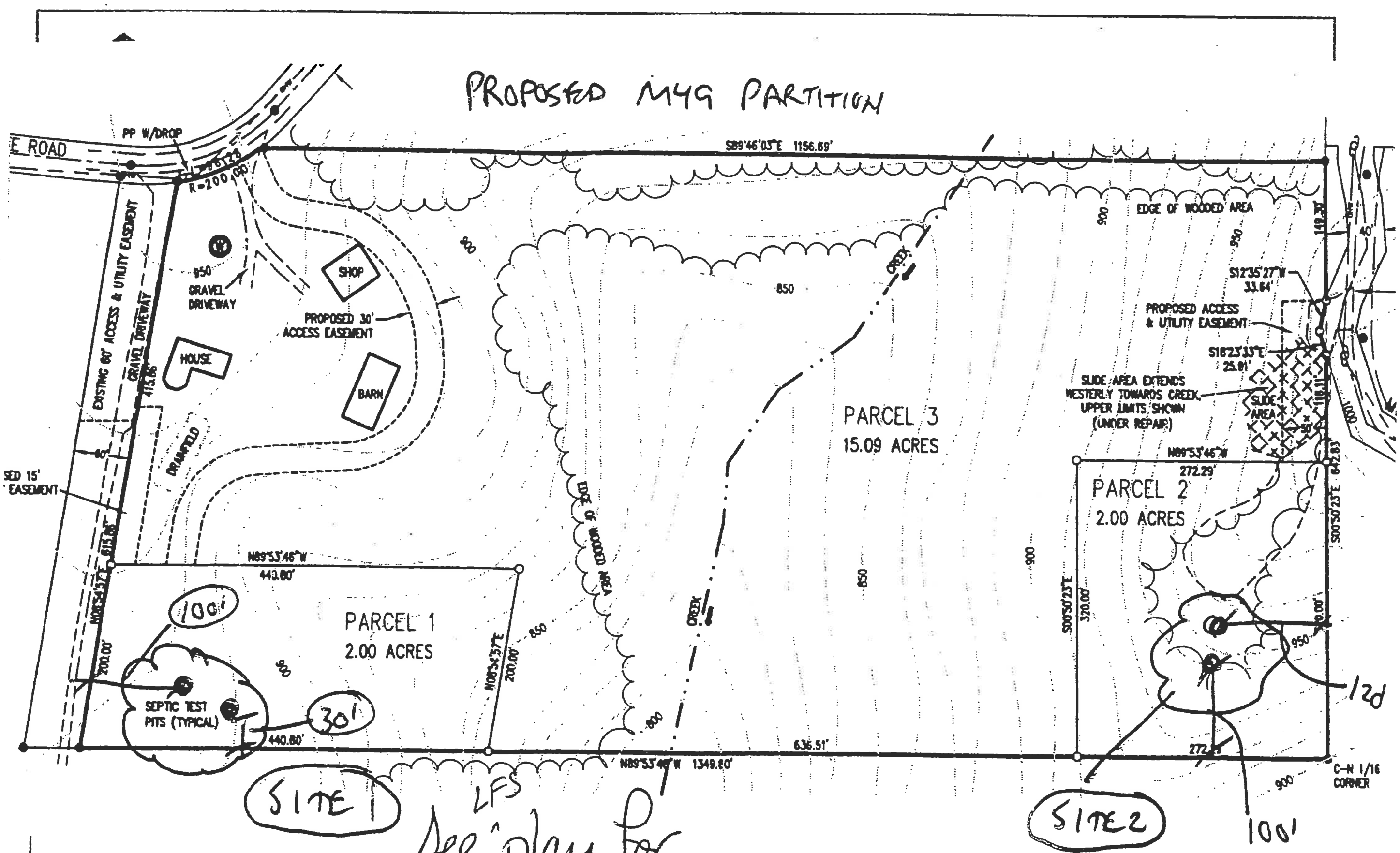
Please have the two (2) test pits dug and ready for inspection by the Environmental Soils Inspector. See paragraph 2 of the procedure sheet for more details.

☒ Test Pits are dug in accordance with diagram below

☐ Test pits **ARE NOT** dug; I will call you for inspection.

It is required that property access and test pits be marked and flagged for field inspection location.

Please sketch a location map below showing test pits, and the distances from adjacent property lines, site specific landmarks, such as wells, creeks, roads etc. and any other information helpful to inspector in locating the test holes.



See plan for distance to Test Pit Changes for both Parcels E Mick 8/13/10.