GEOPACIFIC ENGINEERING, INC.

Real-World Geotechnical Solutions
Investigation • Design • Construction Support

February 5, 2001
Project No. 01-7178

GT_005635

Mr. Craig Harris
McAllister Custom Homes
P.O. Box 1759
Beaverton, Oregon 97075

Via Facsimile: 503-579-4444

Subject: Rockery Wall Design
Forest Heights Lot 337
NW Devoto Lane
Portland, Oregon

7-Mid

1N1W23D3200

At your request, GeoPacific Engineering, Inc. (GeoPacific) performed geotechnical review regarding rockery wall design for the subject lot. Specifically, we evaluated whether the rockery wall design used on the recently completed Lot 18 Rigert Woods project is applicable for use on this project. As shown on the attached site plan you provided, the proposed wall will be two-tiered, with the two walls up to 5 feet high each and separated by at least 10 feet horizontally. The proposed wall configuration and anticipated subsurface conditions are similar to those on the Lot 18 Rigert Woods project. In fact, conditions for the subject wall are somewhat more favorable since the planned slope between the tiered walls will be on the order of 3H:1V or 4H:1V rather than the 2H:1V used on the Rigert Woods project.

WALL DESIGN AND CONSTRUCTION RECOMMENDATIONS

In our opinion, the wall design detail and calculations presented in our October 21, 2000 letter report for the Rigert Woods Lot 18 project can be used on the current project. The rockery wall should be constructed as indicated on Figures 2 and 3, and the attached design calculations.

For the purpose of the design recommendations presented below, it was assumed that rockery foundation soils will have an allowable bearing pressure of 2,500 psf. Rockery walls should be founded on relatively undisturbed native soils or engineered fill compacted in accordance with project specifications. If soft compressible soils are encountered in the rockery foundation soils, it will be necessary to remove and replace the soft soils to the depth determined by the geotechnical engineer in the field.

A drainage system should be provided behind the base of the rockery wall to prevent buildup of hydrostatic pressures, as indicated on Figure 3. A minimum 1-foot wide, free draining crushed

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aggregate layer should be placed directly behind the rockery. For the planned maximum wall height, we recommend a minimum rock base width of 3 feet and a minimum top width of 2 feet. The width is designated as the dimension of a single rock measured perpendicular to the face of the slope. To accommodate the recommended base rock size and drainage system, a minimum keyway width of 3.5 feet is recommended (Figures 2 and 3).

The wall face should be inclined no steeper than 1H:4V. The base of the rockery should be keyed in at least 0.5 feet below the lowest adjacent grade. Any slopes above the rockery wall should be no steeper than 3H:1V. Structural foundations above the top of the wall (if any) should be set back from the rockery wall a horizontal distance of at least 1.5H, where H is the height of the wall plus any retained slope behind the wall.

The individual boulders forming the wall should be stacked in a careful manner, to minimize the void space. Where voids greater than 6 inches are present between individual boulders, they should be filled or "chinked" with smaller, angular rock. GeoPacific should monitor rockery wall construction and fill placement, including keyway adequacy, rock size and placement, drainage systems, backfill soils and compaction.

Rock quality is critical to rockery wall performance. In our experience, rockery wall failures sometimes occur because of degradation of poor-grade rocks under freeze-thaw and weathering conditions. It is difficult to determine rock quality visually. The contractor and/or rock supplier should verify the rocks used are hard, sound, durable and relatively free from seams and cracks or other defects tending to reduce the resistance to weathering. Rocks should be placed so that the contact seam between two adjacent rocks is not above or below the vertical contact seam for the upper and lower courses (i.e. each rock should overlap at least two different rocks in the course below). The long axis of each rock should be placed perpendicular to the slope. The rock surfaces between individual courses should be relatively flat, and should in no case slope downward away from the wall. All rocks used in the uppermost course should be heavy enough to minimize the potential for vandalism or accidental dislodging.

UNCERTAINTIES AND LIMITATIONS

We have prepared this report for the owner and their consultants for use in design of this project only. 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 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

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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.

2-5-01

EXPIRES: 06-30-2001

Scott L. Hardman, P.E.
Principal Geotechnical Engineer

Attachments: Figure 1 – Site Plan
Figure 2 – Slope/Wall Section
Figure 3 – Rockery Wall Design Detail
Rockery Wall Design Calculations

Post-it® Fax Note 7671	Date	# of pages ▶
To Scott Hardiman	From Craig Harris	
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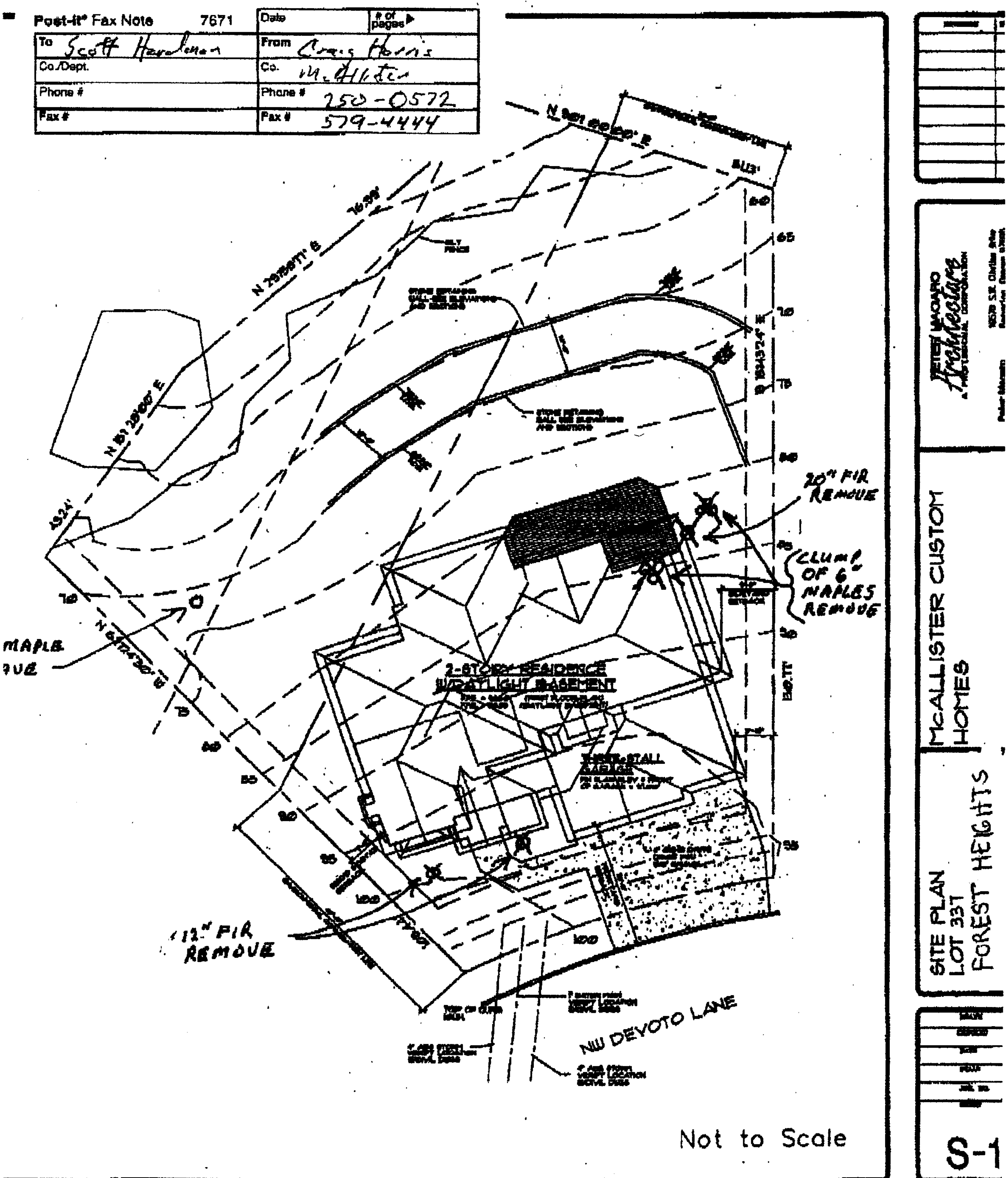

FIGURE 1

All Values per foot of wall.

Toe Bearing =	897.7	psf	<	2500	psf	OK
Heel Bearing =	254.3	psf	>	0	psf	OK
Area =	4.0	ft^2				
Section Modulus =	2.7	ft^3				
e =	0.372	ft				< B / 6
F.S. Overturning =	4.27		>	1.5		OK
F.S. Sliding =	1.61		>	1.5		OK

All Calculations are per foot of wall

Overturning Moment = 55pcf * (4.5ft. + 0.5ft.)^2 / 2
Sliding Force = 55pcf * (4.5ft. + 0.5ft. + 0.8ft. + 0.5ft.)^2 / 2

W1 = (4.5ft. + 0.5ft.)^2 * 144pcf / (2 * 4) = 450.0 pounds
W2 = ((4.5ft. + 0.5ft. - 0.8ft.) * (3ft. - ((4.5ft. + 0.5ft.) / 4))) * 144pcf = 1058.4 pounds
W3 = (4.5ft. + 0.5ft.)^2 * 144pcf / (2 * 4) = 450.0 pounds
W4 = 0.5 * 0.8ft. * 3ft. * 144 ft. = 172.8 pounds
W5 = 0.5 * 0.8ft. * 3ft. * 144 ft. = 172.8 pounds
Total Vertical Weight = 450.0 + 1058.4 + 450.0 + 172.8 + 172.8 = 2304 pounds

Distance @ W1 = 2 * (4.5ft. + 0.5ft.) / (3 * 4) = 0.833 ft.
Distance @ W4 = ((3ft. - ((4.5ft. + 0.5ft.) / 4)) / 2 + ((4.5ft. + 0.5ft.) / 4) = 2.125 ft.
Distance @ W3 = 3ft. + ((4.5ft. + 0.5ft.) / (3 * 4)) = 3.417 ft.
Distance @ W4 = ((4.5ft. + 0.5) / 4ft.) + (3ft. / 3) = 2.250ft.
Distance @ W5 = 3ft. * 2 / 3 = 2.000 ft.

Resisting Moment @ W1 = 450.0# * 0.833ft. = 375.0#-ft.
Resisting Moment @ W2 = 1058.4# * 2.125ft. = 2249.1#-ft.
Resisting Moment @ W2 = 450.0# * 3.417ft. = 1537.5#-ft.
Resisting Moment @ W2 = 172.8# * 2.250ft. = 388.8#-ft.
Resisting Moment @ W2 = 172.8# * 2.000ft. = 345.6#-ft.
Total Resisting Moment = 375.0#-ft. + 2249.1#-ft. + 1537.5#-ft. + 388.8#-ft. + 345.6#-ft. = 4896.0 #-ft.

Resisting Sliding = 0.5 * 2304.0# = 1152.0 pounds
Passive Resistance = 375pcf * (0.5ft. + 0.8ft. + 0.5ft.)^2 / 2 = 607.5 pounds
Total Sliding Resistance = 607.5# + 1152.0# = 1759.5 pounds

e = (0.5 ft. + 3 ft. + 0.5 ft.) / 2 - (4896.0 #-ft. - 1146.8 #-ft.) / 2304 # = 0.372 ft.
Section Modulus = (0.5ft. + 3 ft. + 0.5 ft.)^2 / 6 = 2.7 ft^3
Area = 0.5 ft. + 3 ft. + 0.5 ft. = 4.0 ft^2

Toe Pressure = 2304.0# / 4.0ft^2 * (1 + (6 * 0.372 ft. / (0.5 ft. + 3 ft. + 0.5 ft.))) = 897.7 psf
Heel Pressure = 2304.0# / 4.0ft^2 * (1 - (6 * 0.372 ft. / (0.5 ft. + 3 ft. + 0.5 ft.))) = 254.3 psf

F.S. Overturning = 4896.0 #-ft. / 1146.8 #-ft. = 4.27
F.S. Sliding = 1759.5 # / 1091.5 # = 1.61

d2 = (4.5ft. + 0.5ft.)/ 4 = 1 ft.
H3 = 3ft. / 4 = 0.8 ft.
H4 = (0.8ft. / 4) + (0.5ft. * 4 / (((((1)^2 + (4)^2]^0.5) * 4))) + 0.5ft. /([(1)^2 + (4)^2)^0.5] * 4)) = 0.5ft.
Batter Angle = arctan (1 / 4) * 180 / PI = 14.04 degrees

REGISTERED PROFESSIONAL ENGINEER
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OREGON
JAN. 23, 1990
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