



**Septic System Potential & Soils Evaluation
For Forest Grove**

February 6, 2004

Compiled by:

John Brobeck
J.B. Engineering
6429 Shady Lane SE
Lacey, WA 98503-2922

Tel (253) 847-3912
Fax (360) 412-0219

Mark Stevens
Pacific Ridge Consulting
1111 Oak Drive
Chehalis, WA 98532

Tel (360) 748-1090
Fax (360) 748-1090

**Septic System Potential for
Forest Grove, Highland Meadows & Willow Lake**

February 6, 2004

Background/Scope

This report discusses our findings for evaluation of soil test holes for 108 lots located in the Willow Lake, Forest Grove and Highland Meadows communities.

Test hole locations are shown on the attached map. They are marked in the field with pink flagging, except orange flagging was used on lot 104. Pink directional flags (bearing & distance) are hung alongside the roads for each test hole area. An average of about 3 holes per lot was evaluated. The soil logs are attached.

This is a preliminary report, designed to provide limited information about the suitability of on-site septic systems for each lot, based on very limited subsurface exploration. There is no guarantee implied as to decisions that Tacoma-Pierce County Board of Health may make on any lot. All lots will need further exploration to reach preliminary and final system designs.

Published Soil Maps

The *Soil Survey of Pierce County Area, Washington* USDA Feb. 1979, identifies the project as being located in the Kapowsin association. These are "Undulating to rolling, moderately well drained soils that formed in glacial till; on uplands." Three main soil types are identified on the project by USDA:

1. Alderwood gravelly sandy loam
2. Everett stony sandy loam
3. Kapowsin gravelly loam

Alderwood-Everett soils are moderately well drained. The substratum is weakly cemented and very slowly permeable, beginning at a depth of about three feet. Slopes are dominantly 0 to 15 percent but range to 30 percent, and are convex. Kapowsin soils are moderately well drained. These soils have a faintly mottled subsoil and a weakly cemented, very slowly permeable substratum at a depth of about two feet. Slopes are mainly 0 to 15 percent but range to 70 percent.

System Costs

The costs presented in Table 1 are our opinion of probable construction costs, but no guarantee is implied. They can be used for general budgeting comparisons.

Table 1: Septic System Construction Costs

Septic System	Const. Cost	Abbreviations: PD = Pressure Distribution SDS = Subsurface Drip System
Gravity	\$2,500 - \$3,500	
Pressure Distribution	\$3,500 - \$4,500	
PD w/ Pre-treatment	\$8,500 - \$9,500	
Sand-lined Trench	\$8,500 - \$10,500	
Mound	\$12,000 - \$14,000	
Mound w/ Pre-treatment	\$13,000 - \$15,000	
SDS w/ Pre-treatment	\$16,000 - \$18,000	
Glendon	\$12,500 - \$14,500	

Types of Septic Systems

Following is a discussion of types of on-site septic systems that could be feasible. As test holes are completed, the probable system type(s) for each lot are summarized in Table 2.

Scenario 1: Pressure Distribution (PD)

It is unlikely that any lots on the project will qualify for this type of system, due to the shallow useable soils. It is useful to start with it's description because PD is typically a component of the other system types.

This scenario can occur when there is a minimum usable soil depth of 30 or 33 inches, depending on whether gravel or gravel-less technology is used. In all cases discussed in this report, the lower number applies to gravel-less. These depths apply to level ground. They must be increased, typically by 0.36 inches per each % of slope. For example, on a 10% slope, you would increase the depth by 3.6 inches.

PD systems consist of a septic tank, followed by a pump chamber, or surge chamber. Pressure is usually obtained from a pump in a pump chamber. In some rare cases, a siphon in a surge chamber is used to achieve pressure. The effluent is discharged under pressure to a series of gravel-filled trenches or a gravel bed. A variation is to use gravel-less trenches. In this case, plastic chambers are often used in-lieu of gravel.

Scenario 2: Pressure Distribution with Pre-treatment (FAST)

This scenario can occur when the minimum useable soil depths for gravel and gravel-less technology are 18 and 21 inches, respectively. The increases for slope as discussed in 1) apply.

The system often consists of a septic tank, followed by a pump chamber, followed by an intermittent sand filter. A sand filter is a public domain item, built below grade. It can be thought of as a "mound in a box" (see scenario 4 below). A pump is used to evenly dose effluent, via a timer, over the top of the sand. Effluent is treated as it trickles down through the sand. In most cases, the sand filter discharges to the drainfield with a PD network.

A common variation is to use an aerobic treatment unit (ATU) in lieu of a sand filter. The layout of ATU systems varies, depending upon which proprietary brand is used. A PD network is typically incorporated in the design to discharge effluent to the drainfield under pressure.

Another variation is to pre-treat with a proprietary packed bed filter (PBF). Like ATU's, there are various proprietary types, and their function is to provide pre-treatment similar to levels provided by a sand filter.

Scenario 3: Sand-Lined Trench

Sand-lined trenches consist of a standard drainfield trench with a minimum of 24" of imported sand media placed in the bottom, below the discharge pipe. They are used to slow the infiltration rate, through excessively permeable soils (known as type 1A soils), thereby providing effluent pre-treatment like a sand filter.

There must be a useable soil depth of at least 18 inches before encountering type 1A soils when considering a PD or subsurface drip system, or at least 12 inches when considering a mound or Glendon. If these depths cannot be met, one potential option is the sand-lined trench. There must be a minimum of 42 inches depth (measured from the ground surface) before encountering groundwater or a restrictive layer. This 42 inches allows for 6 inches burial of an infiltration chamber, plus 24 inches of sand, plus 12" of vertical separation between the trench bottom and a restrictive layer or groundwater.

Sand-lined trenches are also used to reach suitable soils if there are overlying unsuitable soils.

Scenario 4: Mound

This scenario is often used when the useable soil depth is shallower than needed for PD systems, or PD with pre-treatment. They become viable when there is less than 30 inches of useable soil. For aesthetics, they are often not desired until all other types of systems are eliminated. This occurs when the usable soil depth is less than 18 inches. Mounds designed on sites where the usable soil depth is less than 18 inches must have pre-treatment (see next scenario).

The system consists of a septic tank followed by a pump chamber, followed by the mound. Mounds are characterized by sand media placed upon the ground surface, with effluent being treated within the sand before discharge from the sand media into the underlying soil. A PD system is always built into a mound. Mounds share the same attributes as intermittent sand filters except the media is not contained within a structure.

Scenario 5: Mound with Pre-treatment

This scenario is one of the two types of systems that can be permitted with a useable soil depth that starts as shallow as 12 inches. This system consists of a mound system (see scenario 4) preceded by any of the pretreatment components described in scenario 2.

Scenario 6: Glendon® BioFilter

These proprietary systems are used in similar situations as with scenario 5. The Glendon is the other system that can be used with useable soil depth as low as 12 inches. Although they typically look like small mounds, they are different. The system consists of a septic tank followed by a pump chamber, followed by the Glendon. The biofilter consists of a below-grade, watertight vessel filled with sand and gravel layers. The vessel's rim is covered with a lift of sand, which gives it the mound appearance. They can be configured as multiple or single pods (vessels).

Scenario 7: Subsurface Drip (SDS)

With a minimum of 18 inches of useable soil, SDS systems can be used. They were approved for use Washington in 2002. The system components typically include a septic tank, a pump chamber, and a distribution network comprised of ½-inch diameter flexible polyethylene tubing (dripline) with small in-line emitters. SDS systems can be used wherever PD systems are allowed. A pre-treatment method as described in Scenario 2 is required when the useable soil depth is less than 30 inches. If installation is done by a trenchless method, e.g. vibrating plow or dripline installation tool, no adjustment for slope to the minimum useable soil depth is required.

Soils Recommendations for Forest Grove							
Lot No.	Pressure Distribution	PD w/Pre-treatment (FAST)	Sand-Lined Trench	Mound	Mound w/ Pre-Treatment	Sub Surface Drip System	Glendon
13		X					
14	Conventional gravity possible.						
15		X					
16		X					
17		X					
18		X					
19	X						
20	X						
21	X						
22	X						
23	X						
24		X					
25		X					
26		X					
27			X				
28	X						
29		X					
30		X					
31			X				
32		X	X				
33		X	X				
34			X				
35							
36		X	X				
37		X					

Lot	Test Hole	Depth	Soil Description
Lot 13	TH 1	0"-2"	Dark brown silt loam
		2"-6"	Medium brown loam
		6"-24"	Grey mottled densely compacted till
	TH 2	0"-8"	Grey loam
		8"-36"	Grey densely compacted till
Lot 14	TH 3	0"-9"	Grey loam
		9"-16"	Grey mottled loam
		16"-	Grey densely compacted till
	TH-4	0"-24"	Silt Loam
		24"-45"	Clay Loam
Lot 14	TH-5	0"-24"	Silt Loam
		24"-39"	Clay Loam
	TH 1	0"-2"	Dark brown sandy loam
		2"-8"	Grey mottled sandy loam
		8"-28"	Grey compacted till
Lot 14	TH 2	0"-8"	Grey loam
		8"-34"	Grey densely compacted till
	TH 3	0"-3"	Grey loam
		3"-32"	Grey compacted/cemented till
	TH-4	0"-41"	Sandy Loam
Lot 14	TH 5	0"-34"	Sandy Loam
		34"+	Till

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Lot 15

- TH 1 0"-3" Dark brown sandy loam
3"-25" Light brown sandy loam
25"-56" Grey extremely gravelly very cobbly fine sand
- TH 2 0"-3" Dark brown sandy loam
3"-21" Light brown sandy loam
21"-31" Light brown mottled sandy loam
31"-60" Grey/brown extremely gravelly cobbly cemented sand
- TH 3 0"-8" Dark brown sandy loam
8"-14" Light brown gravelly compacted/cemented sandy loam
14"-30" Grey extremely gravelly very cobbly weakly cemented sand
30"-48" Grey extremely gravelly very cobbly sand

Lot 16

- TH 1 0"-3" Dark brown sandy loam
3"-19" Light brown very gravelly very cobbly stony sandy loam
19"-50" Grey extremely gravelly very cobbly weakly cemented sand
- TH 2 0"-3" Dark brown sandy loam
3"-22" Light brown very gravelly cobbly stony sandy loam
22"-52" Grey extremely gravelly very cobbly stony sand
- TH 3 0"-3" Dark brown sandy loam
3"-20" Light brown very gravelly very cobbly stony sandy loam
20"-48" Grey extremely gravelly very cobbly stony sand

Lot 17A

- TH 1 0"-1" Dark brown silt loam
1"-8" Grey mottled till
8"-26" Grey mottled compacted till
- TH 2 0"-1" Dark brown silt loam
1"-6" Grey mottled till
6"-20" Grey mottled compacted till

Lot 17B

- TH 1 0"-8" Dark brown gravelly loam
8"-24" Light brown very gravelly very cobbly stony loamy sand
24"-54" Grey extremely gravelly very cobbly stony coarse sand

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Lot	TH	Depth (ft)	Soil Description
Lot 18A		0"-2"	Dark brown sandy loam
		2"-8"	Grey/brown sandy loam
		8"-28"	Grey compacted till; cemented at 28"
Lot 18B	TH 1	0"-1"	Dark brown loam
		1"-10"	Medium brown loam
		10"-25"	Light brown/grey mottled very compacted till
	TH 2	0"-1"	Dark brown loam
		1"-10"	Medium brown loam
		10"-24"	Olive mottled cemented till
TH 3	0"-1"	Dark brown loam	
	1"-13"	Medium brown/grey clay loam	
	13"-29"	Grey very compacted till	
	29"-36"	Olive cemented till	
TH 4	0"-24"	Sandy loam	
	24"+	Silt loam	
TH 5	0"-42"	Sandy loam	
	0"-2"	Dark brown sandy loam	
	2"-21"	Grey/brown sandy loam	
	21"-28"	Grey mottled sandy loam	
	28"-50"	Undulating grey compacted/cemented till - at 3" in places	
Lot 19A	TH 1	0"-2"	Dark brown sandy loam
		2"-21"	Grey/brown sandy loam
		21"-28"	Grey mottled sandy loam
TH 2	0"-3"	Dark brown sandy loam	
	3"-16"	Grey sandy loam	
	16"-44"	Grey compacted till	
	0"-32"	Silt loam	
TH 3	0"-32"	Silt loam	
	32"+	Till	
TH 4	0"-32"	Silt loam	
	32"+	Till	

Sample ID	Depth (ft)	Soil Description
Lot 19B TH 1	0"-3"	Dark brown sandy loam
	3"-8"	Grey/brown gravelly sandy loam
	8"-15"	Grey gravelly mottled sandy loam
	15"-32"	Grey gravelly compacted till
TH 2	0"-1"	Dark brown sandy loam
	1"-15"	Grey/brown very gravelly mottled sandy loam
	15"-36"	Grey very gravelly compacted till
TH-3	0-32"	Silt Loam
	32"+	Till
TH-4	0-32"	Silt Loam
	32"+	Till
Lot 20A TH 1	0"-2"	Dark brown sandy loam
	2"-9"	Medium brown sandy loam
	9"-23"	Grey gravelly weakly cemented mottled fine sand
	23"-41"	Grey very gravelly cemented till
Lot 20B TH 1	0"-1"	Dark brown sandy loam
	1-10"	Brown/grey mottled sandy loam
	10"-28"	Undulating grey densely compacted till - at surface in places
TH 2	0"-1"	Dark brown sandy loam
	1"-10"	Brown/grey mottled sandy loam
	10"-44"	Grey densely compacted till
TH-3	0"-39"	Silt Loam
	39"+	Till
TH-4	0"-40"	Silt Loam
	40"+	Till

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Test Hole	Soil Description	Depth (ft)
Lot 21 TH 1	Dark brown sandy loam	0"-4"
	Light brown sandy loam	4"-10"
	Light brown mottled sandy loam	10"-19"
TH 2	Dark brown sandy loam	0"-2"
	Light brown sandy loam	2"-7"
	Grey gravelly mottled compacted till	7"-14"
	Grey gravelly very compacted till – cemented below 36"	14"-47"
TH 3	Dark brown loam	0"-3"
	Grey/brown gravelly mottled sandy clay loam	3"-14"
	Grey gravelly densely compacted till	14"-45"
TH-4	Silt Loam	0"-40"
	Till	40"+
TH-5	Silt Loam	0"-40"
	Till	40"+
Lot 22B TH 1	Dark brown sandy loam	0"-2"
	Light brown/grey gravelly mottled sandy loam	2"-18"
	Grey compacted till	18"-40"
TH 2	Dark brown sandy loam	0"-2"
	Light brown/grey gravelly mottled sandy loam	2"-18"
TH 3	Dark brown sandy loam	0"-2"
	Light brown/grey gravelly mottled compacted till	2"-15"
	Grey gravelly mottled compacted till	15"-25"
TH 3	Dark brown sandy loam	0"-2"
	Grey very gravelly very compacted till	25"-42"

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Lot 23B

TH 1 0"-2" Dark brown sandy loam
2"-13" Light brown loamy sand
13"-19" Grey mottled loamy sand
19"-38" Grey compacted till

TH 2 0"-2" Dark brown sandy loam
2"-8" Medium brown loamy sand
8"-18" Light brown mottled loamy sand
18"-22" Grey mottled sandy loam
22"- Grey compacted till

Lot 24

TH 1 0"-2" Dark brown sandy loam
2"-19" Light brown sandy loam
19"-42" Grey compacted till

TH 2 0"-3" Dark brown sandy loam
3"-7" Medium brown sandy loam
7"-22" Light brown/grey mottled sandy loam
22"-36" Grey very fine sandy till

TH 3 0"-2" Dark brown sandy loam
2"-8" Medium brown sandy loam
8"-17" Grey mottled sandy loam
17"- Grey compacted till

Lot 25

TH 1 0"-3" Dark brown sandy loam
3"-14" Light brown sandy loam
14"-27" Grey sandy loam
27"-40" Grey compacted till

TH 2 0"-2" Dark brown sandy loam
2"-16" Light brown sandy loam
16"-45" Grey compacted till

Lot	TH	Soil Description	Depth
Lot 26	TH 1	Dark brown sandy loam	0"-2"
		Medium brown sandy loam	2"-14"
		Light brown gravelly mottled sandy loam	14"-19"
Lot 26	TH 1	Grey compacted till	19"-44"
		Dark brown sandy loam	0"-1"
		Medium brown sandy loam	1"-6"
Lot 26	TH 2	Dark brown sandy loam	6"-24"
		Grey mottled sandy loam	24"-36"
		Grey compacted till	24"-36"
Lot 26	TH 3	Dark brown sandy loam	0"-2"
		Light brown sandy loam	2"-8"
		Light brown/grey gravelly mottled sandy loam	8"-12"
Lot 26	TH 3	Grey compacted till	12"-39"
		Dark brown sandy loam	0"-2"
		Light brown sandy loam	2"-7"
Lot 27A	TH 1	Light brown gravelly mottled sandy loam	7"-18"
		Light brown sandy loam	18"-42"
		Grey very gravelly cobbly compacted till	18"-42"
Lot 27B	TH 1	Dark brown sandy loam	0"-1"
		Light brown very gravelly loamy sand	1"-17"
		Grey extremely gravelly cobbly sand	17"-48"
Lot 27B	TH 2	Medium brown sandy loam	0"-3"
		Light brown very gravelly loamy sand	3"-15"
		Grey extremely gravelly cobbly sand	15"-54"

Lot 28

TH 1
 0"-3"
 Dark brown sandy loam
 3"-16"
 Light brown gravelly sandy loam
 16"
 Grey gravelly compacted till

TH 2
 0"-8"
 Dark brown sandy loam
 8"-12"
 Medium brown/grey gravelly sandy loam
 12"-54"
 Light brown/grey compacted till

TH 3
 0"-3"
 Dark brown sandy loam
 3"-18"
 Light brown/grey sandy loam
 18"-29"
 Grey gravelly mottled till
 29"
 Grey gravelly compacted till

TH 4
 0"-3"
 Dark brown sandy loam
 3"-12"
 Light brown/grey sandy loam
 12"-16"
 Light brown/grey mottled sandy loam
 16"-50"
 Grey gravelly mottled compacted till
 50"-63"
 Grey cemented sand

Lot 29

TH 1
 0"-2"
 Dark brown sandy loam
 2"-8"
 Medium brown sandy loam
 8"-20"
 Light brown sandy loam
 20"-44"
 Grey gravelly compacted till

TH 2
 0"-2"
 Dark brown sandy loam
 2"-49"
 Grey very fine sandy mottled semi-compacted gravelly till
 49"-63"
 Grey extremely gravelly sand

TH 3
 0"-2"
 Dark brown sandy loam
 2"-44"
 Grey compacted till
 44"-55"
 Grey extremely gravelly sand

Lot	Test Hole	Depth (ft)	Soil Description
Lot 30A	TH 1	0'-2"	Dark brown sandy loam
		2'-12"	Light brown/grey very gravelly sandy loam
	12'-48"	Grey gravelly very compact till	
	TH 2	0'-3"	Dark brown sandy loam
		3'-12"	Light brown gravelly sandy loam
		12'-30"	Grey very gravelly mottled sandy loam
	TH 3	30'-	Grey gravelly compacted till
		0'-2"	Dark brown sandy loam
		2'-14"	Light brown/grey mottled sandy loam
	Lot 31A	TH 3	14'-19"
19'-32"			Grey mottled till
32'-42"			Grey compacted till
0'-2"			Dark brown sandy loam
Lot 31A	TH 1	0'-2"	Dark brown sandy loam
		2'-16"	Light brown mottled sandy loam
	16'-43"	Grey compacted till	
	TH 2	0'-1"	Dark brown sandy loam
1'-14"		Light brown mottled sandy loam	
14'-27"		Grey mottled sandy loam	
27'-43"		Grey gravelly mottled compacted till	
Lot 31B	TH 3	0'-2"	Dark brown sandy loam
		2'-17"	Grey mottled sandy loam
		17'-44"	Grey compacted till
Lot 31B	TH 1	0'-1"	Dark brown sandy loam
		1'-16"	Light brown sandy loam
		16'-24"	Light brown gravelly mottled sandy loam
	24'-32"	Grey very gravelly compacted till	
	32'-48"	Grey gravelly extremely cobbly till	

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Lot 32A

TH 1 0"-3" Dark brown sandy loam
3"-18" Light brown very gravelly very cobbly stony sandy loam
18"-48" Light brown very gravelly extremely cobbly stony sand

TH 2 0"-3" Dark brown sandy loam
3"-20" Light brown very gravelly cobbly sandy loam
20"-48" Grey extremely gravelly very cobbly stony coarse sand

Lot 33A

TH 1 0"-2" Dark brown sandy loam
2"-20" Light brown very gravelly cobbly stony loamy sand
20"-44" Grey extremely gravelly very cobbly stony sand

TH 2 0"-2" Dark brown sandy loam
2"-21" Light brown very gravelly cobbly stony loamy sand
21"-33" Grey extremely gravelly very cobbly stony sand
33"-43" Dark grey extremely cobbly cemented till

TH 3 0"-3" Dark brown sandy loam
3"-20" Light brown gravelly cobbly stony loamy sand
20"-36" Grey extremely gravelly very cobbly stony fine sand
36"-52" Grey extremely gravelly cobbly weakly cemented till

Lot 34

TH 1 0"-3" Dark brown sandy loam
3"-18" Light brown very gravelly sand
18"-44" Grey extremely gravelly cobbly sand

TH 2 0"-2" Dark brown sandy loam
2"-20" Light brown very gravelly cobbly stony fine sand
20"-45" Grey extremely gravelly very cobbly stony fine sand

TH 3 0"-3" Dark brown sandy loam
3"-12" Light brown very gravelly very cobbly stony fine sand
12"-42" Grey extremely gravelly very cobbly stony fine sand

Lot	TH	Depth (ft)	Description	
Lot 35	TH 1	0"-2"	Dark brown sandy loam	
		2"-28"	Light brown sandy loam	
		28"-37"	Light brown mottled sandy loam	
			37"-52"	Grey mottled compacted till
	TH 2	0"-2"	Dark brown sandy loam	
		2"-12"	Light brown sandy loam	
		12"-18"	Light brown mottled sandy loam	
		18"-25"	Grey mottled compacted till	
	TH 3	0"-3"	Dark brown sandy loam	
		3"-18"	Light brown mottled sandy loam - fire baked	
18"-35"		Light brown/grey mottled compacted till		
		35"-46"	Grey cemented till	
Lot 36	TH 1	0"-3"	Dark brown sandy loam	
		3"-18"	Light brown very gravelly very cobbly stony fine sand	
		18"-44"	Grey extremely gravelly very cobbly fine sand	
	TH 2	0"-2"	Dark brown sandy loam	
		2"-16"	Light brown very gravelly very cobbly fine sand	
		16"-50"	Grey extremely gravelly very cobbly stony fine sand	
TH 3	0"-3"	Dark brown sandy loam		
	3"-22"	Light brown very gravelly very cobbly fine sand		
	22"-	Grey extremely gravelly very cobbly sand		
Lot 37	TH 1	0"-3"	Dark brown loam	
		3"-31"	Light brown very gravelly very cobbly stony loamy sand	
		31"-49"	Grey extremely gravelly cobbly stony coarse sand	
	TH 2	0"-4"	Dark brown loam	
		4"-30"	Light brown very gravelly very cobbly stony fine sand	
		30"-46"	Grey extremely gravelly very cobbly stony sandy loam	
	TH 3	0"-3"	Dark brown loam	
		3"-23"	Light brown very gravelly very cobbly stony sandy loam	
		23"-53"	Grey extremely gravelly very cobbly stony fine sand	

Forest Grove Test Hole Locations

