

MODOT Property

6/11/07

Design Analysis

General: This system will serve an existing State Maintenance 1-bathroom facility located at 28923 Highway 133, Richland, Missouri, in Section 28, Township 13N, Range 13W, Pulaski County, Missouri, in care of Phil Hamilton -MODOT.

Treatment: The Soil Morphology report by Richard Dickman, #531 indicates 8 inches of group III clay loam soil in the Ap horizon, over 22 inches of group IVb clay soil in the Bt1 horizon, over 10 inches of group IVb clay soil in the Btx2 horizon, over 8 inches of group IVb clay soil in the Bt3 horizon. The overall Site Suitability determination indicates that the site is "unsuitable for a conventional system" based on representative soil characteristics, soil drainage, and restrictive horizon. A shallow placed low-pressure drip absorption system will more uniformly distribute the effluent over the total absorption area. The following alternative system is proposed: Primary treatment shall consist of a new 1250 gallon two compartment septic tank, (1000 gallon septic zone/ 250 gallon pump vault zone), and a new 1000 gallon dose tank. Secondary treatment will be provided with the FAST Activated Sludge Treatment process. The soil absorption field shall be dosed by means of a low-pressure drip system, which will uniformly distribute effluent over the area. Certain setback variances are necessary for this property platted prior to 1996.

FAST SYSTEM: Supplemental treatment will be provided by the FAST Activated Sludge Treatment process to treat and denitrify wastewater. The FAST process is a two-zone design, which consists of a primary anaerobic settling zone and anaerobic biological treatment zone. Solids are trapped in the primary settling zone. The aerobic biological zone consists of a submerged media bed, which is colonized by nitrifying bacteria naturally present in sewage. Wastewater is recirculated between these two zones allowing both nitrification and denitrification to occur. DEP, in its Provisional Approval for the FAST unit, recognizes that the unit is capable of producing finished effluent with total nitrogen content of 19 mg/L. The FAST unit is also capable of 90-95% removal of BOD and total suspended solids (TSS). BOD and TSS in finished effluent are both consistently less than 30 mg/L. The effluent concentrations exceed secondary treatment standards for BOD and TSS which require that a minimum of 85% of influent BOD and TSS be removed and that 1-log reduction of fecal coliform. Operation and maintenance of the unit appear to be fairly simple. The only moving part of the unit is the air blower. This makes mechanical failure unlikely and simple to remedy should it occur. The air blower is also equipped with an alarm system, which is activated if the blower fails.

Pump: A pump shall be used which will deliver 5 g.p.m. at 50 feet of total head. For flushing system, the required pump is 40 g.p.m. at 30 ft. of head. Use Webtrol Model 351W54T-SP or 352W54T-SP. (For model 352 must use 230v control panel). Use this same pump model for the pump vault requiring 30 g.p.m at 30 feet of head.

Absorption Field: The Soil Morphology report indicates a loading rate of 0.40 gal./day/sq. ft. for the limiting Ap horizon, based on a conventional system. From 19 CRS 20-3.060 (7)(M) 2 and

Table 14 the corresponding loading rate, for a shallow placed alternative system in this group III soil, would be 0.20 gal./day/sq. ft. . For the one bath-room maintenance garage the minimum required absorption field area is:

$$240 \text{ g.p.d.}/0.20 = 1200 \text{ sq. ft.}$$

A total of 600 linear feet of NetaFim Pressure Compensating drip irrigation lines has been fit into the available area, as shown on the plan spaced 2 ft. on center. Emitters are spaced at 2 ft. on center for a total of 300 emitters in the field. Each emitter doses 4 square feet for an effective area of 1200 square feet. At the design pressure of 20 psi each emitter will dose at the rate of .60 g.p.h.. Provisions shall be made for drip irrigation lines, supply line and return line to drain back to the dose tank between doses. To prevent possible problems with frost, anti vacuum devices shall be installed at the high points in the field.

Absorption field dosing pump and controls: With a dose rate of 3 g.p.m., it will take 80.0 minutes to discharge the design flow of 240 g.p.d.. It will take approximately 0.4 minutes to fill the 1-1/4-inch supply and 3/4-inch return lines and the drip lines each cycle. A timer shall initially be set for 7.1 minutes ON and 112.9 minutes OFF, which will allow disposal of 240 gallons/day in 12 doses. Floats for a high water alarm and low water off shall be provided. The lift to the absorption field is 3 ft. The operating pressure is 20 psi or 46 ft. of water pressure. A pump shall be used which will deliver 5 g.p.m. at 50 feet total head pressure. (40 g.p.m./30ft. of hd. required for flushing system drip lines)

Variances:

- A Fast Biofilter system was selected for the high quality effluent produced with ease of installation and maintenance.
- The dose tank shall be equipped with a high water alarm.

With these design considerations all setback requirements are met in accordance with 19 CRS 20-3-060 (1) (D) and Table1.

Construction Notes:

- All products, materials, and construction methods shall comply with Missouri and Pulaski County Laws for onsite sewage disposal systems and applicable building codes.
- Pump out old septic tank by a certified septic pumper/ then remove or crush the old tank in place. Primary treatment shall be a new 1250 gallon (two-compartment-1000 gallon septic/250 gallon pump vault) septic tank followed by a new 1000-gallon dose tank. A Micro-Fast 0.25(250 g.p.d.) water treatment system shall be installed in the septic tank according to the manufacture's instructions. The effluent will then be pressure fed upslope to the dose tank through 2" SCH 40 PVC pipe.

- A 1000-gallon dose tank with pump timer controls and pump shall be installed according to manufacture's recommendations. Tank shall be watertight. A high water alarm shall be provided in the dose tank.
- NetaFim Pressure Compensating ½ inch drip irrigation lines shall be spaced 2 ft. on center.
- Drip irrigation lines shall be placed 6 inches deep.
- A Geo-Flo vacuum break device shall be placed at the high points in the field and in the return line. A ball valve shall be installed on the end of the return line inside the tank, to be opened only slightly if necessary, to insure the water head will not prevent the lines from draining.
- No point on any drip irrigation line shall be above the vacuum break device.
- A Spin-Clean filter rated for greater than 22 g.p.m. shall precede the supply line.
- A manual valve to bypass the pressure regulator shall be installed for flushing the lines.
- The 1-1/4 inch supply and 3/4-inch return lines shall be sloped to drain back into the dose tank between doses.
- A timer shall be provided, for pump control, to initially dose 7.1 minutes ON and 112.9 minutes OFF.
- The layout of lines should be done so as to avoid removing any trees in the absorption area. If it is necessary to remove any trees, do so only with the owner's permission. If a large tree is removed at the time of installation, the preferred method to reduce soil disturbance is to cut the tree at the ground surface leaving the roots and soil intact. A portion of any root which interferes with installation may be cut out. Any over-excavation shall be backfilled with a sandy textured soil prior to continuing with installation. If a tree is removed after the system is installed, it must be cut at the surface and the roots left to decay in place, to avoid damage to the underground system, which might be caused by removing the roots.
- Drip Lines will be installed after importing and grading 12 inches of sandy textured soil with less than 20% clay content over the entire field, extending 5 feet beyond the Drip lines to level out the proposed field and maintain the 12 inches of depth requirement from the bottom of the drip lines to the impeding Bt1 layer. Prior to work, verify to the administrative authority that the imported soil meets requirements for use in the absorption field. The fill material should not be hauled or worked wet. The area to be filled must be protected from traffic and small brush and trees removed prior to placement of the fill. The soil surface must be loosened with a cultivator or garden plow when the soil is dry. Move the fill onto the site without driving on the loosened soil. The

fill material is then tilled into the natural soil to create a gradual boundary between the two. The remaining fill is then added in layers until the desired height is obtained with each layer being tilled into the preceding layer. The site is then shaped to shed water and fill all low spots before the absorption system is installed. A locally hardy grass shall be seeded as soon as possible after construction is completed, to stabilize the area and to aid in preventing erosion. Straw mulching or some other method shall be used to temporarily reduce erosion of the newly placed soil material until a stand of grass is established.

- Divert surface/sub-surface water away from the field by installing a curtain drain to prevent overloading the absorption area.
- The absorption area shall be protected from damage or compaction before and after installation of the drip irrigation lines.

Please call (573) 280-5221 if you have any questions.

Drip Irrigation Calculations

Name: 6/11/07 MODOT

Address:

SOIL: Group:
 Texture:
 Depth:
 App. rate conv. gpd per sq. ft.
 App. rate LPP: gpd per sq. ft.

OCCUPANCY: 1-Rest Room 240 gpd (minimum)

TANK: Septic Tank gpd (minimum)
 Pump tank: gal. (minimum)

ABSORPTION FIELD: Absorption field: 1200 sq. ft. minimum
 Linear feet of drip irrigation line 600 ft. minimum
 Number of drip lines: 40 ft. per line (average)
 Use average line length: ft.
 Emitter spacing: 600 linear feet total
 2 ft.
 Each emitter doses : 300 emitters in the field
 square feet
 Design pressure: 1200 square feet effective area
 psi
 Dose per emitter: gph
 3.0 gpm dose to field
 80.0 minutes to dose design flow
 Approx. length of supply lines: feet
 Diameter of supply lines: inches
 Approx. length of return lines: feet
 Diameter of return lines: inches
 Class/Schedule :
 Total volume of lines: 11.4 gallon
 Nominal pump rate: gpm
 0.4 minutes to fill lines (approx.)

TIMER CONTROLS: Doses per day:
 7.1 minutes on
 112.9 minutes off

PUMP: Elev difference in field:
 number of zones:
 Elev difference in zone: feet maximum
 Length of (longest) supply line to regulator: feet
 Lift to pressure regulator: 3.00 feet
 Friction head loss in supply line: 0.01 feet
 46.20 feet operating pressure
 49.21 Total head

Select pump for: gpm
 ft. head
 For Flushing System Need 40gpm/30Ft.Hd.

ON-SITE SOIL EVALUATION

Dickman Professional Engineering Services/Soil Evaluations
P.O. BOX 617-Osage Beach, MO 65065
Phone 573-280-5221

Date: 6/11/07

Landowner/Client: MODOT (Phil Hamilton)

Mailing Address: 3956 East Main, Willow Springs, Missouri 65793

Site Location (legal): Sec 28, TWP 13N, RG 37W Pulaski County

Structure Type: Maintenance Building- 1 Bathroom

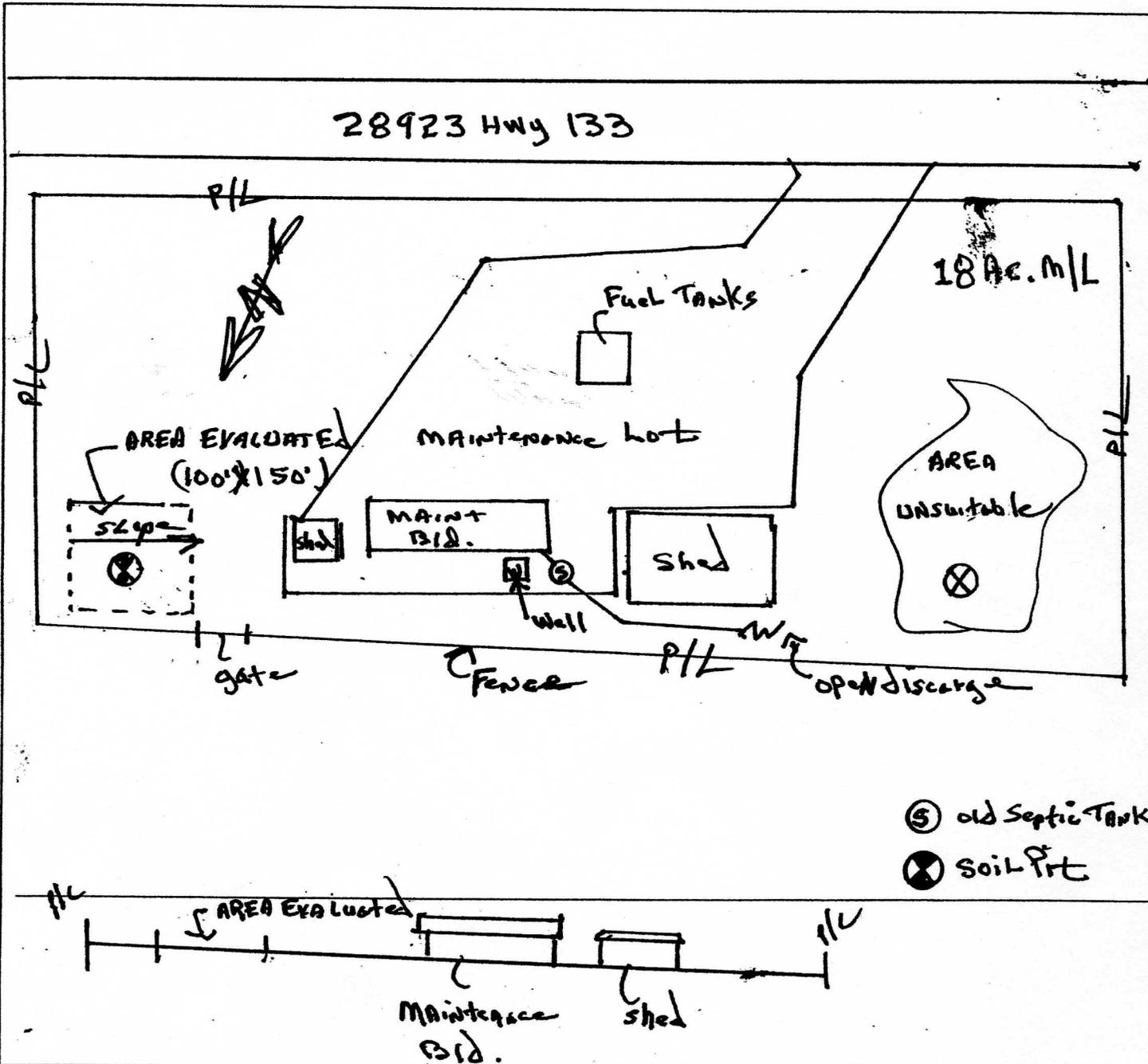
Job #: 531

Plat Available: Yes

Physical Site Location:

28923 Hwy 133, Richland, MO.

I. Site Diagram: (Not to scale)



Important General Information

- Application rates are for conventional systems. Use Table 13 or 14 of Missouri Laws Governing On-Site Sewage Systems for appropriate sewage disposal system design application rates.
- Area evaluated must be used for the absorption field.
- Overall Site Suitability rating: S=Suitable, conditions favorable for a conventional system; PS=Provisionally Suitable, some site modification/alternatives are needed; U=Unsuitable, extensive site modifications/alternative sewer system is required.

II. Topography/Landscape

| Landscape Position | % Slope | Slope and Type | Vegetation | Suitability |
|--------------------|---------|----------------|------------|-------------|
| Summit | 5 | Linear/Convex | Grass | S |

III. Representative Soil Characteristics

| Soil Horiz | Depth Inches | Texture | Structure | Consistency | Color Munsell Notation | % Clay | Low Chroma | Boundary | Roots | Pores | % Coarse Fragments | | Soil Group | Load Rate | Suitability |
|------------|--------------|---------|-----------|-------------|------------------------|--------|------------|----------|-------|-------|--------------------|-------|------------|-----------|-------------|
| | | | | | | | | | | | <3" | >3" | | | |
| Ap | 0-8 | CL | 2MSBK | SS-SP | 10YR3/2 | 30 | ----- | CS | M-1 | ----- | ---- | ---- | III | 0.40 | S |
| Bt1 | 8-30 | C | 3MPL | VS-VP | 10YR4/3 | 45 | 2.5YR5/1 | CS | ---- | ---- | ---- | ----- | IVb | ---- | U#1 |
| Btx2 | 30-40 | C | 3MPL | VS-VP | 10YR5/2 | 50 | 2.5YR5/1 | CS | ---- | ---- | 25 | 10 | IVb | ---- | U#1 |
| Bt3 | 40-48 | C | 3MPL | VS-VP | 5YR4/6 | 55 | ----- | ---- | ---- | ---- | ---- | ----- | IVb | ---- | U#1 |

Soil Drainage

| Seasonal Water Table | Type | Upper Depth | Lower Depth | Suitability |
|----------------------|----------|-------------|-------------|-------------|
| Yes | Apparent | 8" | 40" | U#1 |

IV. Restrictive Horizons

| Yes/No | Depth | Thickness | Suitability |
|--------|-------|-----------|-------------|
| Yes | 30 | 10" | U#1 |

V. Soil Thickness

| Soil Depth | Suitability |
|------------|-------------|
| >48" | S |

VI. Available Space and Pertinent Environmental Factors

| Dependent on approved system design & setback requirements | Suitability |
|---|-------------|
| Area evaluated 100X150 feet. All set backs can be met. Slope is 5%. | S |

Overall Site Suitability (based on Conventional System):**Unsuitable #1**

**See notation page for recommendations, footnotes, additional comments.

Site Factor Recommendations:

| | | |
|---|----|---|
| x | 1 | Special design, layout, and/or installation modifications are needed, with approval from the Administrative authority. |
| | 2 | Soil should be Suitable or Provisionally Suitable for texture and structure. |
| x | 3 | Surface drainage is needed over the absorption area. |
| x | 4 | Contour lateral placement is required. |
| x | 5 | One foot of soil is needed between the trench bottom and water table or modification to maintain one-foot separation. |
| x | 6 | Soil should only be dug when dry enough to prevent smearing or compaction of the soil structures. |
| | 7 | Usually need soil >36" thick and larger area than normal to construct absorption field. |
| x | 8 | Lateral subsurface flow zone should be intercepted and diverted to prevent it from saturating the absorption area. |
| | 9 | Should use sand liner and have four-foot separation between trench bottom and bedrock or water table. |
| | 10 | Should have four foot separation between trench bottom and bedrock or water table |
| x | 11 | Divert surface water away from the absorption field. |
| | 12 | Provisionally Suitable if the site is terraced or graded with trenches in natural soil classified as Suitable or Provisionally Suitable to one foot below trench bottom and ten feet horizontal distance from top edge of fill embankment. Surface water should be diverted away from the absorption area and, if needed, lateral subsurface flow zone should be intercepted and diverted to prevent it from saturating the absorption area. Sufficient area is needed to construct absorption field. |
| | 13 | Provisionally Suitable if special design and installation modifications can be made to provide two feet of natural soil below the absorption trench. |
| | 14 | Possible ground water contamination |

Footnotes:

- (1) **Texture:** SIL-silt loam; SICL-silty clay loam; L-loam; CL-clay loam; S-sand; LS-loamy sand; SL-sandy loam; SCL-sandy clay loam, SIC-silty clay; C-clay
- (2) **Consistency:** SS-slightly sticky; S-sticky; VS-very sticky; SP-slightly plastic; P-plastic; VP-very plastic
- (3) **Structure:** 1-weak; 2-moderate; 3-strong; F-fine; M-medium; C-coarse; ABK-angular blocky; SBK-subangular blocky; GR-granular; MA-massive; PL-platy
- (4) **Roots/Pores:** F-few ; C-common; M-many; 1-fine and/or very fine; 2-medium; 3-coarse (pores considered are non-matrix macropores)
- (5) Color descriptions made with moist, broken samples
- (6) Soil Group is based on morphology of horizons
- (7) "Low Chroma" refers to colors indicative of redoximorphic conditions unless otherwise noted
- (8) Record distinctness and topography: A-abrupt; C-clear; G-gradual; S-smooth; W-wavy; I-intermittent

Minimum Set-Back Distances
Based on 19 CSR 20-3.060 (1)(D) Table 1
[See also (6)(D) for lagoons]

| Minimum Distance from | Sewage Tank (feet) | Disposal Area (feet) | Lagoons (feet) |
|---|-----------------------|-------------------------|-------------------|
| Private water supply well | 50 | 100 | 100 |
| Public water supply well | 300 | 300 | 300 |
| Cistern | 25 | 25 | 25 |
| Spring | 50 | 100 | 100 |
| Classified stream or lake | 50 | 50 | 50 |
| Stream or open ditch | 25 | 25 | 25 |
| Property lines | 10 | 10** | 75 |
| Building foundation | 5 | 15 | [100] |
| Basement | 15 | 25 | [100] |
| Swimming pool | 15 | 15 | |
| Pressure water line | 10 | 10 | 10 |
| Suction water line | 50 | 100 | 100 |
| Upslope interceptor drain | - | 10 | |
| Downslope interceptor drain | - | 25 | |
| Embankment or cuts | - | 20 | |
| Edge of sink holes | 50 | 100 | 500 |
| Other absorption systems | | 20 | 20 |
| ** Recommend 25 feet from downslope property line. | | | |

**Important Recommendations for
Installers and Homeowners:**

Protect the absorption area before and after construction. Do not drive over or store evacuated materials on field area, etc.

Shallow placed absorption systems utilize more permeable and better-aerated soil horizons.

Do not install soil absorption system when soil is wet.

Redirect surface water, house guttering, and foundation drains away from the absorption field.

Establish & maintain adequate vegetative cover over the field.

Regularly inspect, maintain, and pump your sewage system.

Install water saving devices, practice water conservation, & repair any water leaks as soon as discovered.

Restrict garbage disposal use.

Do not put fats or grease into the sewage system.

Keep chemicals and hazardous wastes out of your system.

Use disinfectants and high strength cleaners sparingly.

Do not plan any building improvements, patios, etc. near the sewage system or repair area.

*** Soil Evaluation and Notation Page**

Please review this report in its entirety. Its intent is to provide identification and limitations related to soil specific criteria. It is not a septic system design, nor a permit to construct or repair a septic system. Soil descriptions made in accordance with Missouri Laws accompanied by Department of Health Rules Governing On-site Sewage Systems.

Comments, Recommendations:

Recommend installation of a Drip Absorption System in the Ap horizon, using an application rate of 0.20 gpd./sq.ft..

Soil should be dug when dry enough to prevent smearing or compaction of the soil structures.

Protect field before and after installation.

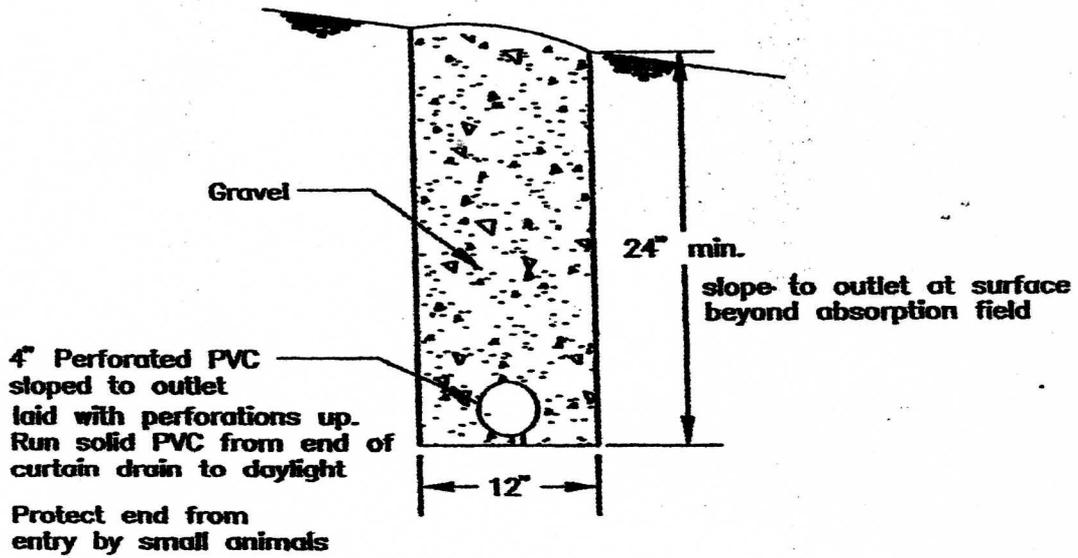
Divert surface water away from the field by installing a curtain drain.

Import 12" of sandy textured soil with less the 20% clay content over the entire field to maintain the 12" separation of the trench bottom from the impeding layer.

Richard Dickman, PE/Soil Evaluator ID# 10078 Date: 6/11/07

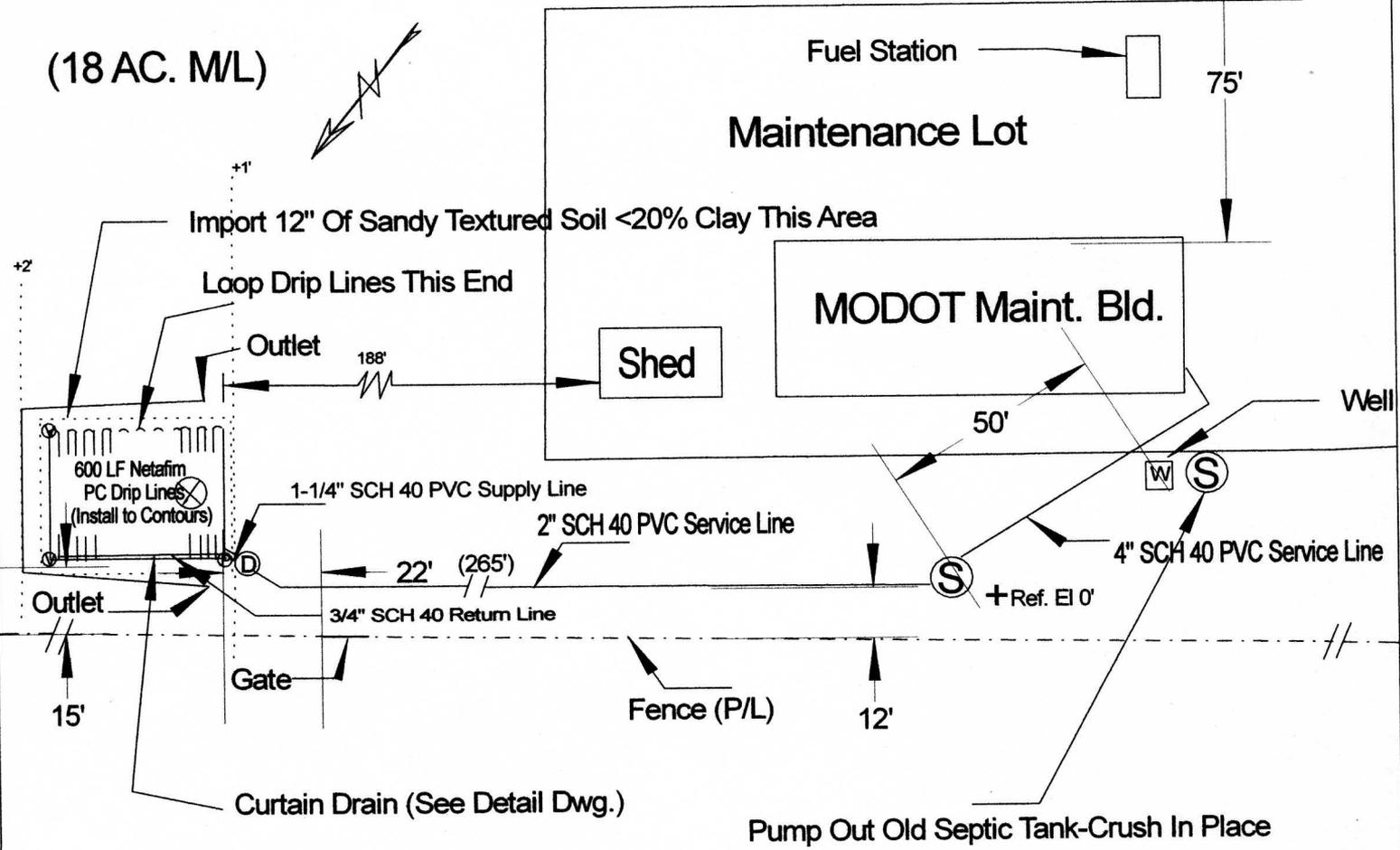
Signature: Richard Dickman

Requirements and recommendations provided DO NOT guarantee that the absorption field system will function properly. They are provided solely to assist in meeting the specifications of the applicable standards as modified or approved by the administrative authority.



Curtain Drain Detail
 Section
 No Scale

(18 AC. M/L)



SCALE 1"=40'

- S New 1250 gallon septic tank (two compartment 1000-gallon septic/250 gallon pump vault) a Retro-Fast 0.25 (250 gpd) Water Treatment System installed in tank accordance to manufacture instructions.
- D New 1000 gallon dose tank with screened pump basket, float timer controls and highwater alarm. Refer to Design Analysis for pump requirements.
- PV Pressure Reguator
- VR Vacuum Release

Legend



Soil Pit
Edge of Property

Notes: 1. Contractor shall be responsible for locating all utilities, whether shown or not prior to construction.
2. Owner is responsible for protection of field before and after construction of home.