Livingston County Department of Public Health

Environmental Health Division

Minimum Requirements for Pressure Mound Systems on Marginal Sites

Prepared November, 2003

Pressure Mound Systems

Minimum Requirements for Site Suitability, Design, Construction, Operation and Maintenance

Preface

This minimum requirement document was developed by Livingston County Department of Public Health (LCDPH) and is based upon the Michigan Department of Environmental Quality (MDEQ) Technical Guidance Document for Pressure Mound Systems, dated June 2003. LCDPH has made slight modifications to the MDEQ Mound Guidance Document to reflect LCDPH's commitment to protection of public health and the environment. *Note: For marginal sites, a two acre minimum parcel size is typically required.*

The minimum requirements contained in this document have been developed for countywide application of the described alternative method of sewage treatment for sites with clay loam characteristics only. This is a working document and modifications may be made as deemed necessary by the Livingston County Department of Public Health.

This document was reviewed and adopted by the Livingston County Sanitary Code Board of Appeals on October 15, 2003.

TABLE OF CONTENTS

APPENDICES

I. PRESSURE MOUND SYSTEMS

When properly sited, designed, constructed, operated and maintained, pressure mounds provide a proven effective alternative method of on-site treatment. A pressure mound system relying on subsurface distribution to in-situ soils can be an effective solution where site conditions are not suitable for conventional treatment and disposal systems.

In Livingston County, pressure mound systems using these design standards are only intended for use on sites with clay loam soil characteristics. Typical situations where mound systems might be applied include:

- **Slowly permeable soils with a high groundwater elevation.**

  Where slowly permeable soils with a high groundwater elevation prevent the installation of a conventional treatment system, a mound may be an acceptable alternative to provide for final treatment and disposal. Utilizing a mound with pressure distribution of effluent to promote unsaturated flow, along with elevating the infiltrative surface to provide vertical separation, maximizes final treatment efficiency.

- **Slowly permeable soils without high groundwater.**

  Slowly permeable soils are most effective for final treatment and disposal where the natural soil profile is maintained in an undisturbed condition. Utilizing a mound system with pressure distribution for these sites offers a number of advantages as opposed to attempts to construct a conventional below grade final treatment and disposal system, including:

  - Damage to the natural soils during construction including compaction and smearing is minimized.
  - Treated effluent is discharged and dispersed into the uppermost soil horizons which are typically more permeable.
  - The mound sand fill media provides additional treatment which minimizes clogging of the slowly permeable soils while maintaining their hydraulic conductivity.
  - Utilizing pressure distribution promotes unsaturated flow resulting in more efficient treatment, extended life of the system and improves overall hydraulic performance by minimizing groundwater mounding.

A. GENERAL INFORMATION

1. Site suitability for pressure mound systems must be first approved by Livingston County Department of Public Health. This guidance document is only intended for use on sites with clay loam soil characteristics.

2. Plans prepared by a Michigan registered engineer or registered sanitarian are required for pressure mound systems. In addition to the following details, the plan shall include a legal description of the property and general site plan including building and their uses.

3. Pressure mound systems are intended for residential use. Pressure mound systems may be used for commercial use if flows are limited (less than or equal to typical residential use).

4. Alternative systems are generally recommended for sites that do not meet the minimum criteria set forth for conventional systems by the Livingston County Sanitary Code. However, alternative systems are NOT viable options for every site. Some sites are unfortunately unsuitable for the construction of a home utilizing an on-site sewage treatment system.

B. DEFINITIONS

Alternative System: A treatment and disposal system which is not a conventional system and provides for an equivalent or better degree of protection for public health and the environment than a conventional system.

Approved: A written statement of acceptability issued by the local health officer or the department.

Basal Area: The effective in situ soil surface area available to transmit the treated effluent from the sand fill media into the original receiving soils.

Conventional System: An on-site sewage treatment system consisting of a watertight septic tank and a subsurface soil absorption system with non-uniform distribution of the effluent to subsurface soil trenches or an absorption bed.

Cover Material: The material used to cover a mound system, usually selected on its availability, cost, and ability to support vegetation, transfer oxygen, and shed water.

Distribution Cell Area: The area within the mound where the effluent is distributed into the fill material.

Effluent: Liquid discharged from a septic tank or other on-site sewage system component.

Excessively Permeable Soils: Soil that contains a high percentage of coarse to very coarse sands (2.0 mm and larger) and often including fine gravels and/or cobbles. Water passes through the soil very rapidly (i.e., soil permeability < 3 min/in) and internal free water is very rare.

Green Belt Area: The area measured horizontally down slope from the edge of the mound fill which is maintained undisturbed prior to, during, and after construction so as not to impede lateral movement of effluent.

High Groundwater Elevation: The uppermost part of the soil or underlying material wholly saturated with water. The term includes perched and apparent conditions that are seasonally saturated for a time period in excess of two weeks, or permanently saturated.

Hydraulic Linear Loading Rate: The hydraulic linear loading rate is the volume of effluent applied per day per linear foot of system along the natural ground contour.

Hydrostatic Test (i.e., Static Water Test): A performance test conducted onsite to determine that the septic tank and pump chamber are water tight.

Influent: Wastewater flowing into an on-site sewage system component.

In Situ Soil : Soil present in the undisturbed natural or original position.

Limiting Layer: High groundwater elevation, soils with an expected permeability above 60 minutes/inch, or bedrock.

Original Grade: The natural land elevation immediately which exists prior to the construction of the mound system.

Permeable Soil: Soils with a textural classification, according to the U.S. Department of Agriculture Soil Conservation Service classification system, of silt loams and some silty clay loams that are well structured with expected permeability less than or equal to 60 minutes/inch.

Permeability: The ability of soil to transmit liquids through pore spaces in a specified direction, e.g., horizontally or vertically.

Pressure Distribution: A system of small diameter pipes uniformly distributing effluent throughout a trench, bed or chamber.

Pressure Mound System: An alternative method of on-site sewage treatment and disposal in which a specified sand fill media is laid on top of a properly prepared original soil surface. The pressure distribution system and wastewater distribution cells are then placed entirely within the filter media at such a level that the desired vertical separation to provide the necessary treatment exists. The fill material provides a measurable degree of wastewater treatment and allowing effluent dispersal for final treatment into the natural soil environment.

Pump Chamber: A watertight tank or compartment following the septic tank or other pretreatment process which contains a pump, floats and volume for storage of effluent.

Reserve Area: An area of land with site conditions deemed suitable for the installation of a replacement system upon failure of the initial system.

Sand Fill: Sand meeting specific criteria regarding particle size and installation technique to ensure adequate wastewater treatment.

Sanitary Sewage: Water and contaminants discharged from sanitary conveniences, including bathroom, kitchen, and household laundry fixtures of dwellings, office buildings, industrial plants, commercial buildings, and institutions. Commercial laundry wastes and industrial and commercial processes are not considered sanitary sewage.

Septic Tank: A water tight pretreatment receptacle receiving the discharge of sanitary sewage from a building sewer or sewers, designed and constructed to permit separation of settleable and floating solids from the liquid, detention and anaerobic/facultative digestion of the organic matter, prior to discharge of the liquid.

Soil Mottling (also known as redoximorphic features): Spots or blotches of contrasting colors, such as, but not limited to, gray or brown or gray and brown colors in close proximity, that are formed in the soil matrix by the processes of reduction, translocation, and oxidation of iron and manganese compounds in soils that have been periodically saturated.

Slowly Permeable Soil: Soils with a textural classification, according to the U.S. Department of Agriculture Soil Conservation Service classification system, of silt loams, and some silty clay loams that are well structured with expected permeability above 60 minutes/inch.

Soil Compaction: An increase the soil bulk density, and decreased in soil porosity, by the application of mechanical forces to the soil which results in a soil that retains less water and resists root penetration. Soils with high clay content are more easily compacted than sandy soils.

Soil Loading Rate: The allowable application rate to the basal area required for absorption of effluent based upon soil texture for a given soil structure.

Timer-Controlled System: A pressure distribution system where the pump on and off times are preset, discrete time periods.

Uniform Distribution: A method of distribution which results in equal distribution of the effluent throughout the distribution network. This will help assure a vertical unsaturated flow regime.

Vacuum Test: A performance test conducted onsite to determine that the septic tank and pump chamber are water tight.

Vertical Separation: The total depth of unsaturated soil that exists between the infiltrative surface of a distribution cell and a limiting layer.

II. Site Suitability

Those sites meeting the following criteria for the initial, replacement and green belt areas may be considered for pressure mounds:

- Soils – undisturbed natural soils only. Historical agricultural activities are not generally considered as disturbance.
- Soil texture and structure – the most limiting horizon encountered in the upper 18 inches must be a suitable clay loam soil structure (i.e., weak, moderate or strong blocky or granular structure), as shown in Table 1. Platy or massive clay loam structures are considered unsuitable.
- Permeability of uppermost soil horizon – soils with an estimated permeability of 60 minutes/inch based on soil texture and structure.
- Depth to high groundwater elevation – 18 inches minimum from the undisturbed natural ground surface. The depth to high groundwater elevation shall be confirmed by a soil profile with **12 inches or more** of soil without mottling (a.k.a. redoximorphic features) below the "A" horizon (topsoil) or groundwater monitoring in accord with R560.423.
- Slope – natural ground slope should be $\leq$ 25 % in the mound area to promote safety of workers during construction.
- Two Acre Minimum - Lot size requirements may be slightly reduced depending upon useable property characteristics.

III. Site Evaluation & Planning

A critical step in the successful application of mound technology is the site evaluation and planning process. This step provides the site specific information necessary to evaluate overall site suitability and is used as the foundation for actual design.

Prior to completing the site evaluation, available site specific information related to soils, slopes, etc. should be reviewed in detail. USDA soil surveys are a valuable resource in this regard. This information will provide general guidance as to the potential for application of mound technology. After a thorough review of this information, preliminary site plans can be developed and a site evaluation conducted.

For each lot where a mound is intended, a minimum of three soil profile evaluations are considered sufficient to delineate the area under investigation for initial, replacement systems and greenbelt and to establish consistency. Soil evaluations should be completed during those time periods where soils are sufficiently dry to avoid damage to the absorption area. In areas of complex soils, additional evaluations may be necessary. *Soil evaluations must be completed by utilizing a hand auger and must be completed by a Livingston County Department of Public Health Sanitarian and the engineer.*

All of the following shall be accurately reported by a competent soil consultant for each soil horizon or layer:

- Thickness.
- USDA soil textural class.
- Presence of soil mottles or redoximorphic features
- Soil structure - grade and shape
- Occurrence of saturated soil, groundwater, or disturbed soils

Site planning for development sites, subdivision lots, or site condominium units must also consider the following features:

- Property lines and lot lines
- Slope
- Required setback distances
- Existing or proposed structures
- Existing or proposed wells
- Surface waters

For projects involving multiple lots or units, overall planning should also consider and mitigate any negative impacts from other off lot development activities, including grading, road construction, and surface water drainage.

IV. Design Requirements

Sufficient design detail must be provided for a site development to assure that adequate suitable area is available for construction of initial and reserve mound systems and required greenbelt. These areas must be at locations that are readily accessible for construction and for future maintenance and repair. A proper design must allow for the home and any proposed improvements while maintaining required setbacks. The following design criteria are recommended for pressure mound systems:

Design Flows – For design purposes an allowance of **150 gpd/bedroom** is required. This figure provides an adequate factor of safety necessary to promote satisfactory long term function of the distribution cell and mound.

Distribution Cell Sizing – The absorptive bottom area in the distribution cell should be designed with **a maximum loading rate of 0.5 gallon per day per square foot**. Horizontal separation between distribution cells shall be based on allowable soil loading rate with a minimum of three feet.

Reserve Area – A reserve area with suitable site conditions must be set aside and protected for future use. The reserve area shall include a basal area, sized in accordance with Table 1, which is totally separate from the basal area of the initial mound.

Mound Orientation – The absorptive area should be long and narrow with the long dimension running parallel to the contour for a sloping site.

Soil Loading Rate – The minimum mound basal area required for absorption of effluent is based upon soil texture for a given soil structure. Table 1 suggests recommended maximum soil loading rates. The basal area for sloping sites (i.e. those with slopes $\geq$ 2%) includes the area under the distribution cell and area down slope only. On flat sites (i.e. those with slopes $\leq$ 2%), the minimum required basal area includes that under the distribution cell and either side of it. Generally, the minimum required basal area will be found to be less than the actual area filled after accounting for required depth of fill and side slopes.

Hydraulic Linear Loading Rate – The hydraulic linear loading rate is the volume of effluent applied per day per linear foot of system along the natural ground contour. From a hydraulic standpoint, a long and narrow mound design is most efficient and better promotes aerobic conditions under the distribution cell. Table 1 suggests recommended maximum hydraulic linear loading rates based on soil texture and structure encountered in the upper 18 inches of the soil profile.

Setbacks – Table 2 summarizes minimum horizontal isolation distances which should be maintained from the toe of the mound fill.

Depth of Fill – The depth of fill must be such that the bottom of the distribution cell is isolated **$\geq$ 4 feet above established high ground water elevation or limiting layer**. Limiting layer includes soils with an expected permeability above 60 minutes per inch based on soil texture and structure. The minimum depth of fill at the outer edge of the distribution cell area shall be 12 inches. The approved plan shall indicate the location of a suitable benchmark to be used by the contractor during construction to judge that the required depth of fill has been provided.

Final Cover – The settled depth of final cover at the outer edge of the distribution cell should be a minimum of 12 inches and the top of the mound graded to promote positive drainage. Final cover over the mound should support the growth of a suitable vegetative cover while shedding rainfall and promoting aeration of the mound. Final cover should have a texture no heavier than sandy loam. If system is constructed after September 15th, a vegetative cover must be provided. Cover may consist of sod, mulch, straw or other suitable material to prevent with freezing.

Side Slopes – The final side slope of the mound surface should be 4:1 or flatter.

Green Belt Area – On sloping sites (i.e. those with slopes $\geq$ 2%) it can be expected that flow will move laterally down gradient. So as to not to adversely impede this lateral movement, a suitable down slope green belt area shall be provided. The greenbelt area is to be measured from the toe of the mound and located within property boundaries. The minimum required green belt area is based on soil texture as indicated in Table 1.

Pressure Distribution System – Pressure distribution of effluent is required in the distribution cell to promote maximum achievable treatment and is critical from a hydraulic standpoint, especially where slowly permeable soils are encountered. Pressure distribution system design should generally comply with currently accepted design practice including the following features:

- Septic tank effluent filters or screen pump vaults are necessary.
- Small frequent doses to the mound by means of time dosing to promote unsaturated flow and enhanced treatment and hydraulics are required. Design shall provide uniform doses with no more than 0.5 gallons per orifice per dose.
- Distribution cell area per orifice shall not exceed 12 ft^2.
- To reduce orifice plugging, high head pumps are recommended.
- Orifice shields should be provided.
- Provisions for flushing must be incorporated at the ends of all laterals.
- Geotextile fabric which prevents the downward migration of fine materials but allows for free passage of air and water should be placed over the stone in the distribution cell prior to placement of final cover.

Septic Tank & Pump Chamber – The septic tank and pump chamber shall be certified water tight in writing by the design engineer. *A vacuum or static water test shall be used to verify watertightness*. The test must be conducted onsite on septic tanks that are hooked up with risers in place. Refer to Table 3 in Appendix A for recommended test methods. Engineer plans must reflect that the septic tank and pump chamber have a watertightness test conducted and indicate what test method will be used.

Sand Fill Requirements – It is important that the specification of the sand fill material be closely controlled from both a performance and longevity standpoint. From a treatment standpoint, the mound functions in a similar fashion to a sand filter. Sand fill should be clean and meet the Michigan Department of Transportation (MDOT) 2NS gradation without excessive fines. A qualitative field check to assess the cleanliness of sand delivered to the construction site should be conducted (See Appendix A).

Observation Ports – At least one observation port to gauge ponding depth in the distribution cell is necessary. Where the distribution cell is divided into multiple zones, at least one per zone is required.

V. Site Preparation And Construction

Ultimate success or failure of a mound also relies on a clear communication and understanding of basic site preparation and construction principles. Prior to issuance of a permit, site plans must be submitted and approved, site suitability must be determined by LCDPH, and field verification that active and reserve areas have been protected must occur. These issues, as well as other critical issues regarding site preparation and construction, are further discussed as follows:

- Proper procedures must be followed to protect the mound area, including required greenbelt during and after construction. After establishing a suitable location for the mound and replacement area, including greenbelt, it must be suitably fenced or protected with barriers in order to prevent further disturbance until actual construction can occur. **Before issuance of a permit, it must be demonstrated that the mound and replacement area has been protected from disturbance (i.e., fencing or barrier protection, as discussed previously).** Site planning resulting in a location for the mound which is isolated from other anticipated home construction activities is encouraged.

- All openings in both the septic tank and pump chamber must be fitted with water-tight, securable lids or risers that extend to grade.

- Soil smearing and compaction which can reduce infiltration capacity will occur if soils are worked on when wet. **Construction activities must be scheduled only when soils are sufficiently dry.** Proper soil moisture content of the soils in the upper foot must be evaluated by LCDPH and the engineer by rolling a sample of soil between the hands (i.e., “ribbon test”). LCDPH and the engineer shall determine when soils are suitable by the ribbon test. If the soil can be rolled into a ¼ inch or smaller "ribbon" it is considered too wet and should be allowed to dry before preparing.

- Excess vegetation must be removed from the mound basal area. Trees should be cut flush to the ground and other vegetation over six inches in length should be mowed and cut vegetation removed. Where an excessive number of stumps and large boulders are encountered, the absorption area must be enlarged or an alternative site must be selected.

- The entire basal area of the mound shall be suitably prepared by roughening in a ridge and furrow fashion with ridges following the contours. Methods which can be considered for roughening include chisel teeth fastened to the backhoe bucket, plowing with a multiple bottom agricultural chisel plow, or moldboard plow. Rototilling is not acceptable. Sand fill material should be applied immediately after roughening and prior to any subsequent precipitation.

- Cleanliness of sand fill should be field checked prior to installation. Placement of fill material is then to be accomplished from the end and upslope sides utilizing a tracked vehicle or equipment with adequate reach to minimize soil compaction. A minimum of six inches of fill material should be maintained below the tracks to minimize compaction. Wheeled vehicles should be prevented from travel over the mound basal area and down slope green belt area. Total depth of fill shall be established based on a benchmark provided by the design consultant on the approved plan.

- Final grading of the mound area should divert surface water drainage away from the mound. Sod the entire mound area or seed and mulch.

VI. Operation and Maintenance

The system owner is responsible for assuring the continuous operation and maintenance of the system. ***Deed restrictions must be recorded to communicate to the system owner and subsequent future owners the importance of routine and regular maintenance activities.***

As a minimum requirement, an owner's manual must be submitted with the construction plans and must be submitted to LCDPH for final approval. A copy of the manual must be provided to the property owner after completion of the mound system. The manual needs to contain the following as a minimum:

1. As-built drawings of all system components and their location are to be provided. The location of the reserve area also needs to be clearly defined and its importance communicated to the owner.

2. Specifications for all electrical and mechanical components.

3. Names and phone numbers of local health authority, component manufacturer or management entity to be contacted in the event of an alarm, or other problems or failure.

4. Information on the periodic maintenance of the mound system, including electrical/mechanical components.

5. Information on what activities can or cannot occur on and around the mound, reserve area, and greenbelt area.

6. A standard homeowner "Do's and Don'ts" list for proper system operation.
7. Information regarding suitable landscaping and vegetation for the mound and surrounding areas.

The Livingston County Department of Public Health recommends that a maintenance inspection be conducted on an annual basis by a trained maintenance provider. In such cases, it is recommended that the operator be responsible for the continuous operation and maintenance of the system and submit appropriate records routinely to LCDPH.

Routine and preventative maintenance aspects are:

- Scum and sludge levels in the septic tank, as well as the pump chamber, need to be inspected routinely on an annual basis and tanks pumped as necessary. Depending on tank size and usage, pumping will typically be required at intervals exceeding every 3 to 5 years.

- Periodic inspections of system performance are recommended. Liquid levels in the observation ports should be checked and examinations made for any seepage around the toe of the mound. The pressure distribution system should be assessed and laterals flushed as necessary. It is recommended that mounds be visited at least once per year. A suggested maintenance visit checklist is attached (See Appendix C).

- A good water conservation plan within the house or establishment will help assure that the mound system will not be hydraulically overloaded.

- Avoid traffic in the initial and replacement mound areas and down slope greenbelt area. No vehicular traffic or livestock should be permitted. With lawn care equipment, such as a riding lawn mowers or tractor, it is important not to travel on the mound, or the down slope area, when the soil is saturated. Winter traffic on the mound should be avoided to minimize frost penetration in colder climate areas and to minimize compaction in other areas.

<u>Appendix A</u>

Figures & Tables

Figure 1
Typical Mound System Components

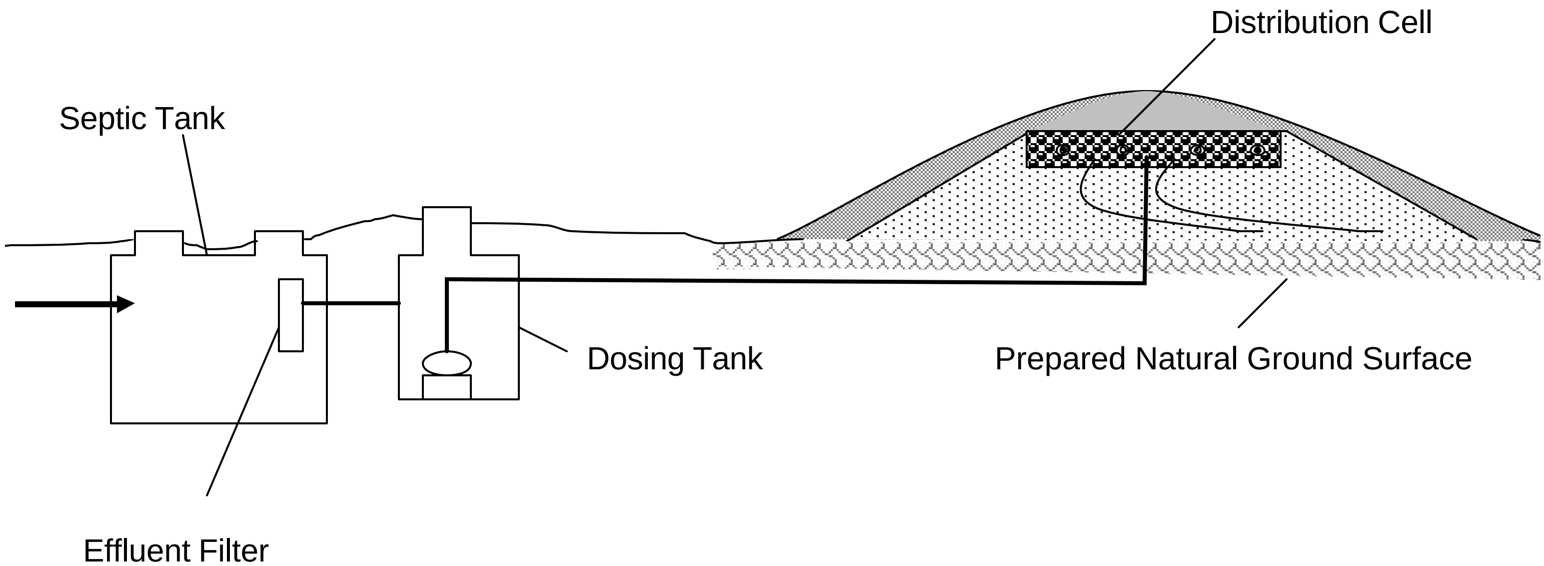
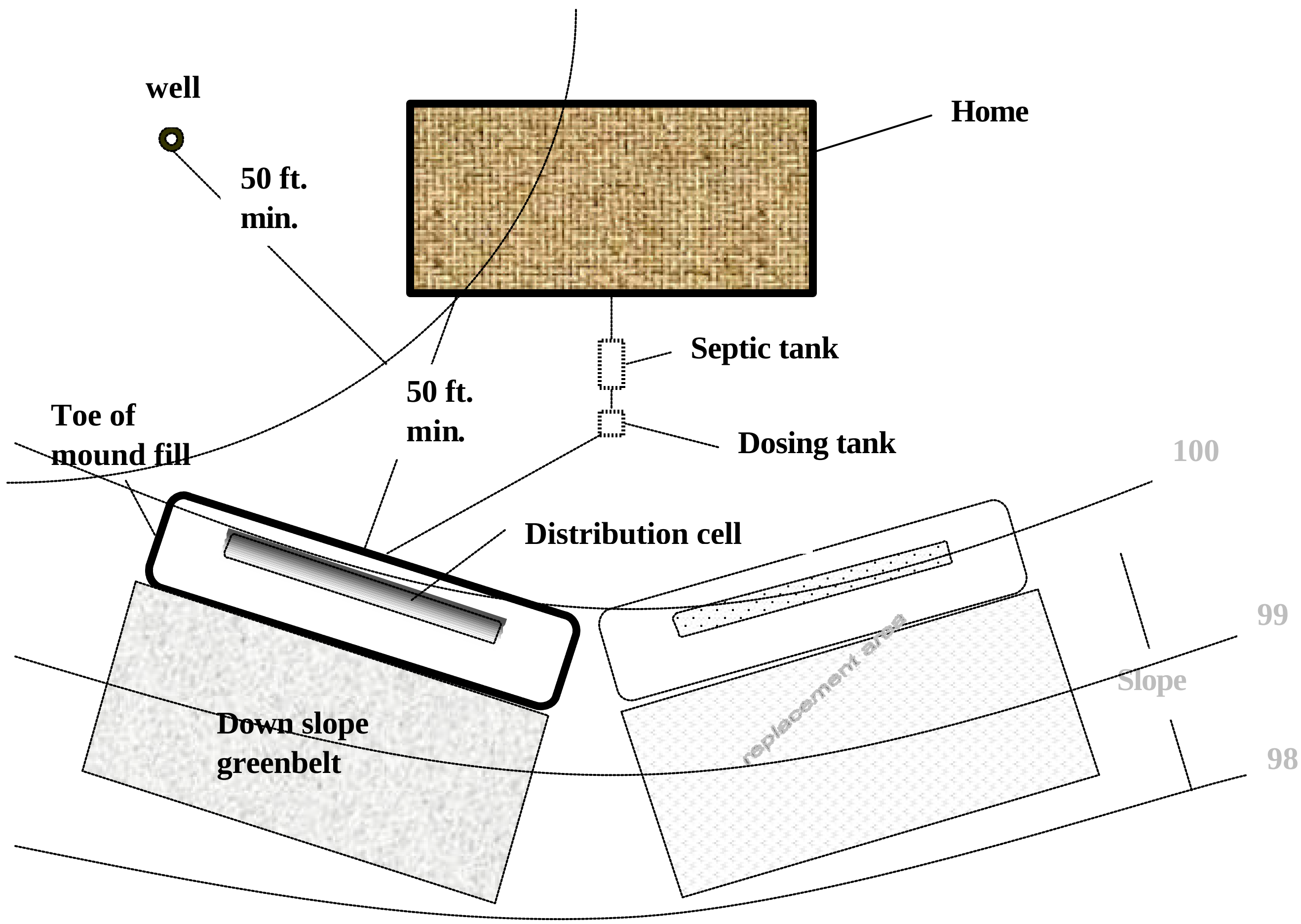


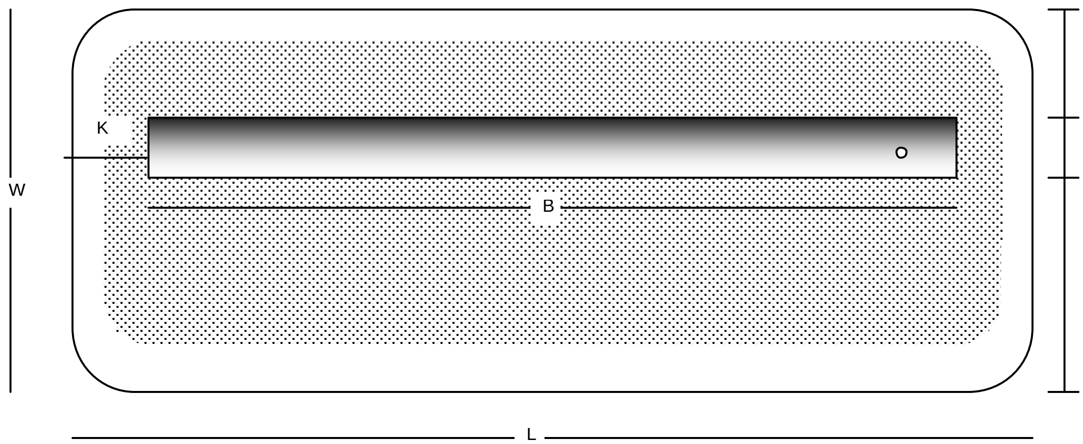
Figure 2
Typical Site Plan

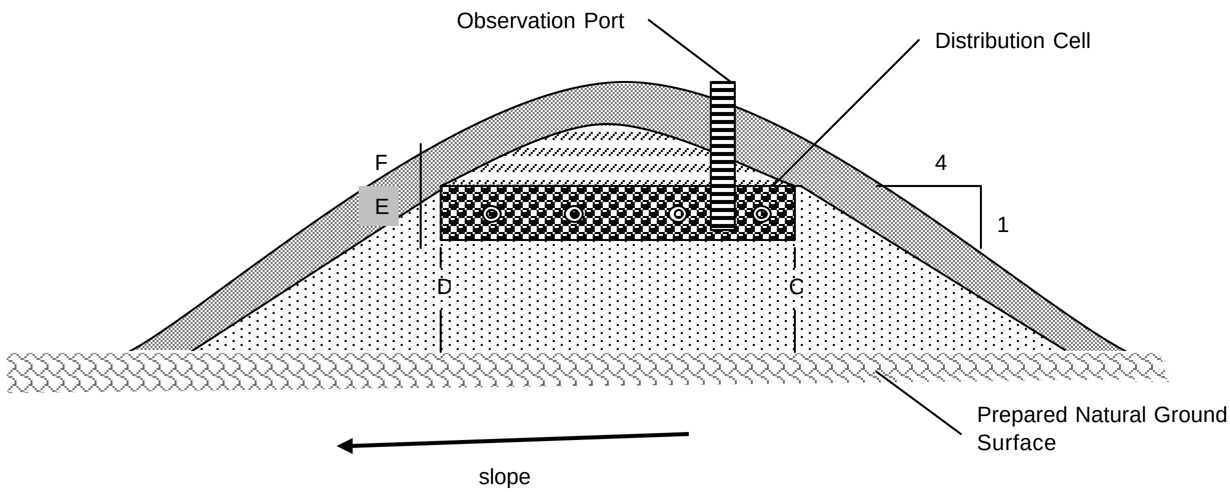


<u>Note:</u>

Mound active and reserve areas may be designed end to end or back to back. However, the reserve area shall include a basal area, sized in accordance with Table 1, which is totally separate from the basal area of the initial mound.

Figure 3
Mound Plan View & Cross Section





<u>Legend</u>

A – Distribution cell width
B – Distribution cell length
C –Up slope fill depth under distribution cell
D – Down slope fill depth under distribution cell
E – Distribution cell depth
F – Depth of final cover
I – Distance from edge of distribution cell to down slope edge of fill
J – Distance from edge of distribution cell to up slope edge of fill
K – Distance from end of distribution cell to edge of fill
L – Overall mound fill length
W - Overall mound fill width

Figure 4
MDOT 2NS Sand Specification

Sieve Size	Grain Size (mm)	Percent Passing %	Percent Passing %
3/8	9.52	100	100
4	4.76	95	100
8	2.38	65	95
16	1.19	35	75
30	0.59	20	55
50	0.297	10	30
100	0.149	0	10
200	0.074	0	3

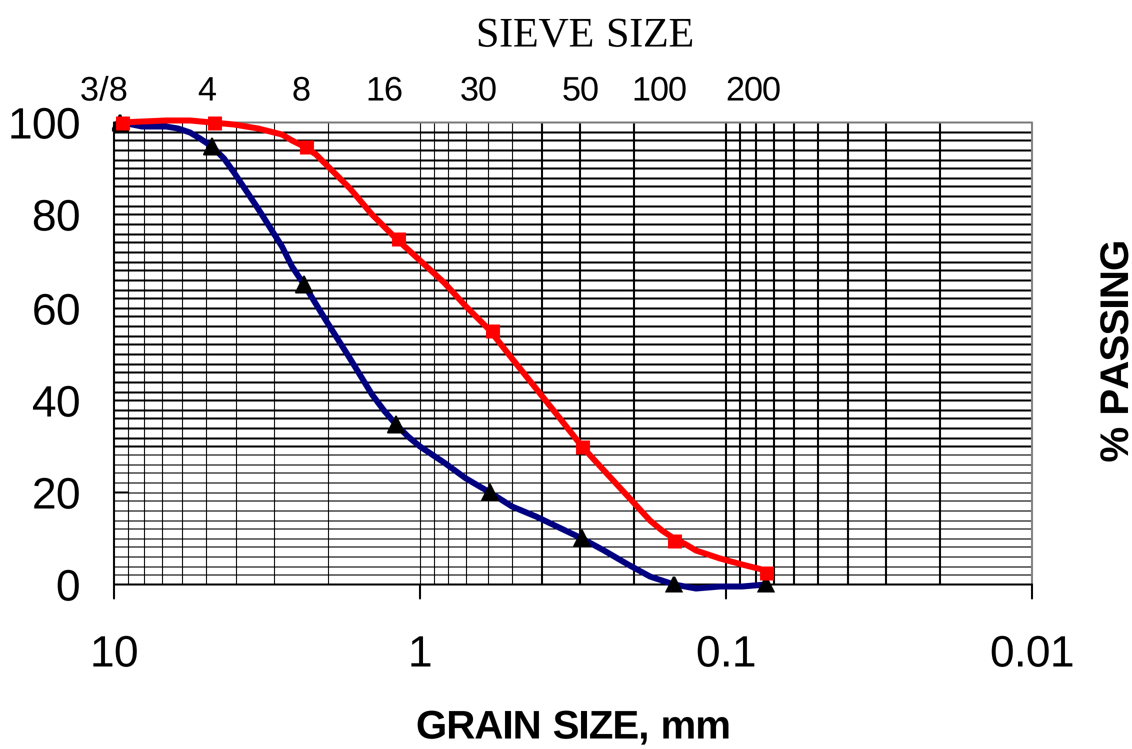


Figure 5
Procedure for Qualitative Field Test of Sand Cleanliness

Sand fill materials for mound construction shall be obtained from a supplier that has documented through sieve analysis that the 2NS specification is met. As results of sieve analyses will typically vary over time, it is recommended that a qualitative field assessment of the cleanliness of the sand delivered to the construction site also be conducted. The following procedure is suggested:

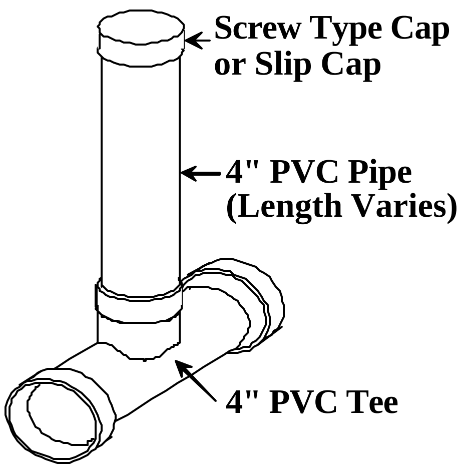
1. Fill a quart jar one half full of the sand fill material to be tested.

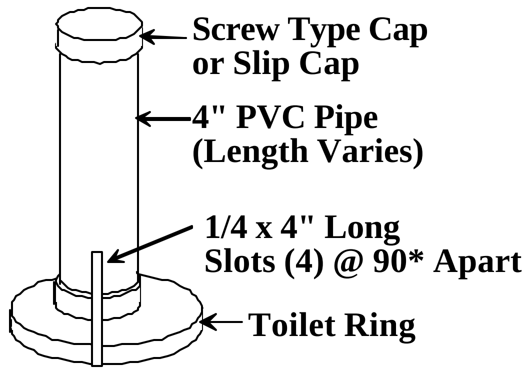
2. Add water to fill the jar.

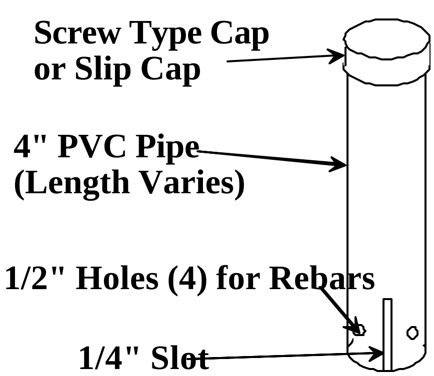
3. Shake the jar contents vigorously after which it should be allowed to settle for 30 minutes.

4. If after settling a perceptible layer of fines greater than 1/8 inch in thickness has accumulated on the surface, the fill material shall not be considered clean enough and an alternate source shall be explored.

Figure 6
Observation Port Example Details







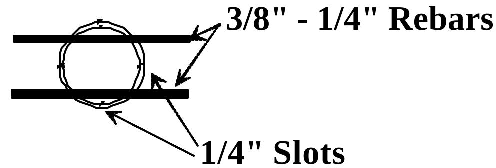


Table 1
Allowable Soil Loading Rates

SOIL STRUCTURE / *SOIL TEXTURE*	*MAXIMUM SOIL LOADING RATE GAL/DAY/FT²*					*MAX. HYDRAULIC LINEAR LOADING RATE, GPD/LF*					*REQUIRED DOWNSLOPE GREENBELT** (SLOPE > 2%, DISTANCE IN FEET)*
	BK/GR			*PL*	*M*	*BK/GR*			*PL*	*M*	
	1	*2*	*3*			*1*	*2*	*3*			
CLAY LOAM / SILTY CLAY LOAM	*0.15*	*0.2*	*0.25*	*U*	*U*	*1.8*	*2.5*	*3.0*	*U*	*U*	*40*
SILTY CLAY/ SANDY CLAY /CLAY	*UNSUITABLE*										

** MOST LIMITING LAYER IN UPPER 18 INCHES*
*** MEASURED FROM TOE OF MOUND FILL*

TABLE LEGEND

BK = BLOCKY	*1 = WEAK*
GR = GRANULAR	*2 = MODERATE*
PL = PLATY	*3 = STRONG*
M= MASSIVE	*U = UNSUITABLE*

Note: The maximum sand fill loading rate shall not exceed 0.5 gpd/sf (gallons per day per square foot).

Table 2
Minimum Horizontal Isolation Distances

From Toe of Mound Fill To:	Minimum Horizontal Isolation Distance (feet)
Private individual well	50
Surface waters	100
Basement foundation walls	50*
Top of drop-off	20
Property lines	10
Footing drains installed in water table without direct connection to surface water	25
Footing drains installed in water table with direct connection to surface water	50
Drains designed to lower the water table	100

***** The downslope edge of the greenbelt area may be located within 25 feet of the foundation walls.

Table 3
Watertightness Testing of Installed Precast Concrete Tanks

Because of the serious problems that may result from infiltration or leakage, no single field test for tanks is more important that the watertightness test. The objective of this test is to assess the entire tank for watertightness, including the concrete structure itself, tank section seams, pipe penetrations and riser connection seams, after it has been installed and all connections have been made.

Either of two tests may be used: 1). Static Water Test; or, 2). Vacuum Test. Under most circumstances, either test should adequately assess the watertightness of a tank. Vacuum testing is generally preferred because it requires a shorter test time, applied forces are equally distributed throughout the inside of the tank (during the static water test, the force on the inside of the tank increases with depth), and it affords an easier, more precise measurement of test results. The major disadvantage of vacuum testing is the somewhat specialized equipment required and the difficulty in sealing off tank access openings.

Regardless of the test employed, a thorough inspection of tank construction and installation are crucial and can often identify potential watertightness problems prior to watertightness testing.

Recommended Procedure for the Static Water Test:

1. Temporarily seal inlet and outlet pipes.
2. Fill tank with clean water to a point at least one foot above the pipe connections or the highest seam within the tank or riser, whichever is highest.
3. Allow the tank to sit undisturbed overnight.
4. Refill tank, if necessary, and record *starting water level*.
5. Cover access openings and allow tank to sit undisturbed for at least 24 hours.
6. Remeasure and record *ending water level*.
7. Tank passes watertightness test if the difference between the *starting water level* and the *ending water level* is equal to or less than one-half inch (½ inch) or one-percent (1%) of the liquid capacity of the tank.

Recommended Procedure for the Vacuum Test (Refer to the table below):

1. Temporarily seal inlet and outlet pipes and access openings.
2. Using proper equipment, draw a vacuum to the *starting negative pressure*.
3. Hold vacuum for the specified time and remeasure and record the *ending negative pressure* inside of the tank.
4. Tank passes watertightness test if the difference between the *starting negative pressure* and the *ending negative pressure* is ten percent (10%) or less.

Recommended Vacuum Testing Conditions and Criteria

Starting Vacuum	**Test Holding Time**	**Allowable Pressure Change**
8 cm (3 in.) of mercury	1 hour	0.8 cm (0.3 in.) of mercury
13 cm (5 in.) of mercury	10 minutes	1.3 cm (0.5 in.) of mercury
25 cm (10 in.) of mercury	1 minute	2.5 cm (1.0 in.) of mercury

Appendix B

Design Example

EXAMPLE

Site Criteria

1. Soil Profile

A	0 - 12 in.	Top soil
B	12 - 30 in.	Clay loam with strong blocky structure.
C	30 - 48 in.	Silty clay loam with strong blocky structure and mottling starting at 42 inches.

2. Slope 4%

3. This is a site for a proposed 3 bedroom home.

Step 1. Evaluate the quantity and quality of wastewater generated

For this example, it is intended to serve a three bedroom home and the designer has proposed to discharge domestic septic tank effluent to the mound. Design flows are established based on an estimate of 150 gallons per day (gpd) per bedroom which equates to a design flow rate of 450 gpd. Using a design flow of 150 gpd/bedroom provides for a factor of safety resulting necessary to promote greater system performance and longevity.

Step 2. Evaluate the soil profile and site description for maximum soil loading rate and hydraulic linear loading rate.

From the soil profile description, the soils encountered in the upper 18 inches consist of clay loam with strong blocky structure. Using Table 1, the soil loading rate (SLR) and linear loading rate (LLR) are selected.

- Soil Loading Rate (SLR) = 0.25 gpd/ft^2
- Linear Loading Rate (LLR) = 3.0 gpd/lineal foot

Step 3. Select the sand fill loading rate and calculate the distribution cell width (A).

The **maximum** sand fill loading rate for septic tank effluent is **0.5 gpd/ft^2** (refer to Page 6, Design Requirements). Use of this rate is based on the assumption that the sand fill under the distribution cell will meet the requirements of Figure 4 and that a factor of safety has been provided in design flows as discussed in Step 1. The width of the distribution cell (A) can then be calculated as follows:

A = Linear Loading Rate ÷ Sand Fill Loading Rate
= 3.0 gpd/ft ÷ 0.5 gpd/ ft^2
= 6.0 ft.

Step 4. Determine the distribution cell length (B).

B = Design Flow ÷ Linear Loading Rate
= 450 gpd ÷ 3.0 gpd/ft
= 150 ft

Step 5. Determine the soil infiltration area width (IW).

The soil infiltration width represents the width required to absorb the effluent into the natural soil. To provide a factor of safety, it is based on the most limiting horizon in the upper 18 inches. For this example, the most limiting horizon is clay loam which has a maximum soil loading rate of 0.25 gal/day/ft^2.

IW = Design flow ÷ (soil loading rate x B)
= 450 ÷ (0.25 x 150)
= 12 ft

For situations where the most limiting horizon is less permeable, it will be found that the infiltration width will exceed width of the distribution cell. The infiltration width is important when evaluating the adequacy of the overall mound fill area and horizontal spacing when using multiple distribution cells.

Step 6. Determine mound fill depth (C) at the upslope edge of the distribution cell.

In this case, the limiting layer starts at 12 inches. As such, the depth of fill (C) at the upslope edge of the distribution cell will be the fill required to elevate the stone four (4) feet above high groundwater elevation or limiting layer, which is 3.0 ft.

Step 7. Determine the mound fill depth (D) at the down slope edge of the distribution cell.

For a 4% slope, the following can be used:

D = C + 0.04 (A)
= 3.0 + 0.04 (6)
= 3.24 ft

Step 8. Determine mound depths (E) and (F).

E = 1.0 ft (total depth of stone)

F = 1.0 ft (amount of final cover)

Step 9. Determine the down slope width (I).

Using a recommended side slope of 4:1 the calculations is as follows:

Down slope correction factor = 100 ÷ [100 - (side slope x % ground slope)]
= 100 ÷ [100 - (4 x % slope)]
= 100 ÷ [100 - (4 x 4)]
= 1.19

I = 4 (D+ E+ F) x down slope correction factor
= 4 (3.24 + 1.0 + 1.0) (1.19)
= 25.0 ft

Step 10. Determine the upslope width (J).

Using a recommended side slope of 4:1 the calculations is as follows:

Upslope correction factor = 100 ÷ [100 + (side slope x % slope)]
= 100 ÷ [100 + (4 x % slope)]
= 100 ÷ [100 + (4 x 4)]
= 0.86

J = 4 (C+ E+ F) x upslope correction factor
= 4 (3.0 + 1.0 + 1.0) (0.86)
= 17.2 ft

Step 11. Determine the end slope length (K).

Using a recommended side slope of 4:1 the calculations is as follows:

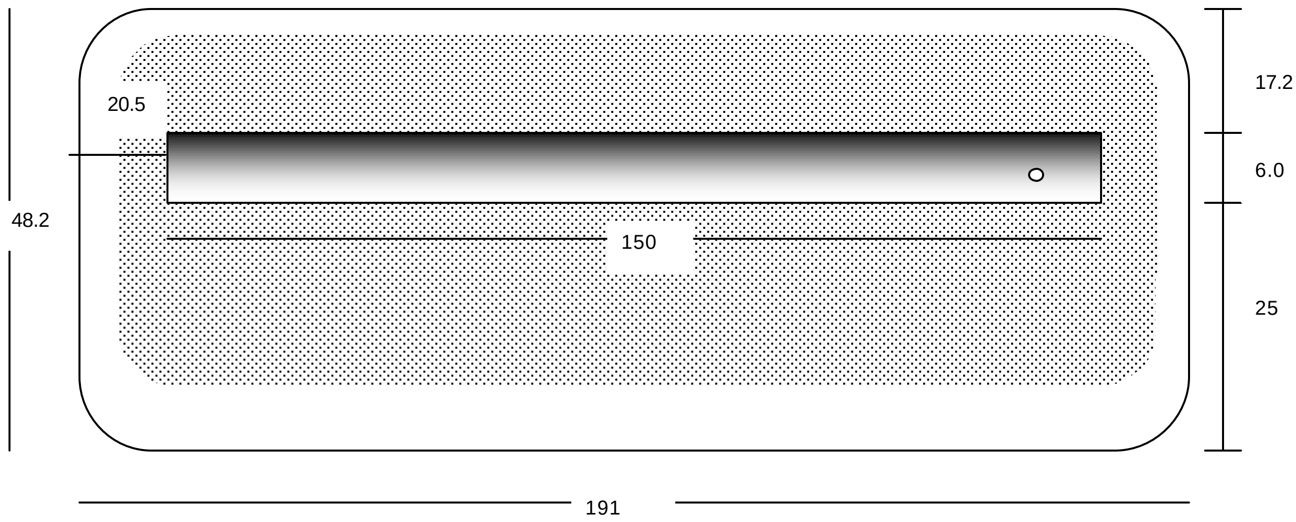
K= 4 [(C + D) / 2 + E + F]
= 4 [(3.0 + 3.24) / 2 + 1.0 +3.0]
= 20.5 ft

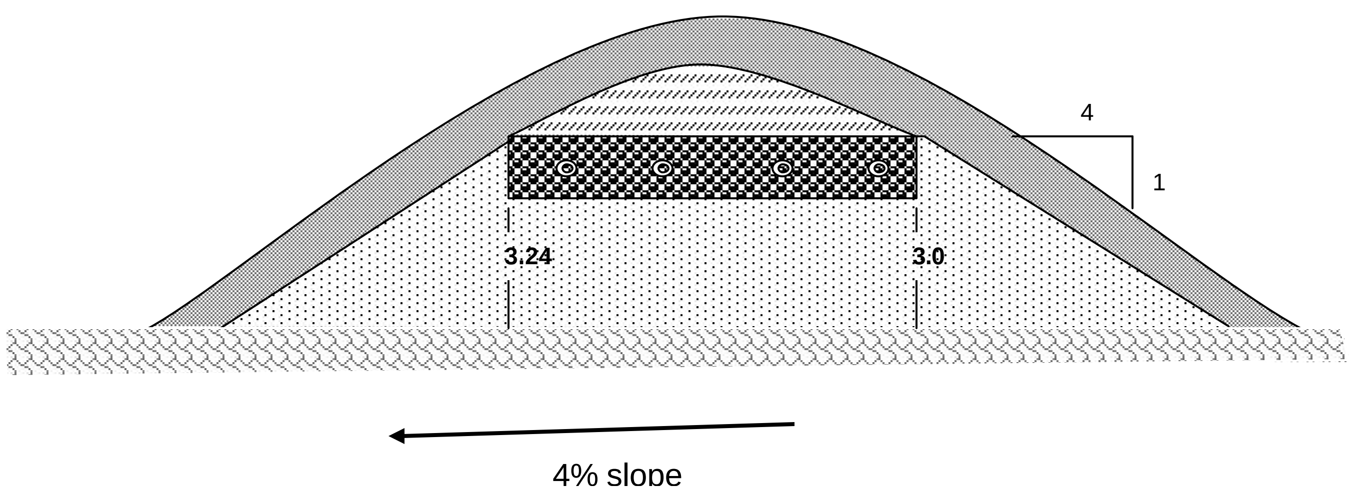
Step 11. Determine the overall width (W) and length (L) of the mound fill.

W= A + I + J
= 6 + 13 + 8.6
= 48.2 ft

L = B + 2K
= 150 + 2 (10.5)
= 191 ft

The calculated dimensions are summarized on the following plan view and cross section:





Appendix C

Mound Maintenance Visit Checklist

Mound Maintenance Visit Checklist

General Observations

Mound Appearance (check items that may apply)

- ☐ Erosion has occurred
  Explain____
- ☐ Greener vegetation visible in spots
  Explain____

Toe of Slope Wetness

- ☐ Soil at downslope toe is soggy
- ☐ Water at surface of downslope toe
- ☐ Sewage odor around wet spots

General Condition

- ☐ Attractive, well groomed, completely sodded
- ☐ Mostly vegetated, evidence of mowing
- ☐ Overgrown with weeds
- ☐ Overgrown with brush

Observation Tube in Stone Bed

- ☐ Observation tube is present
- ☐ Depth of ponding in tube_____________

Other observation tubes?

Describe and note distance to water below soil surface:

____

____

Pump Chamber

Appearance: (Note any apparent problems or concerns)

____

____

- ☐ Water level normal

Pump operation is:

- ☐ Demand (float) controlled
- ☐ Timer controlled

Number of floats: _______

Check float operation and desirable function of each (first visit only) :

____

____

If timer is present, note settings

_____ On time

_____ Off time

Flush Laterals

- ☐ Access is provided to ends of lines
- ☐ Have to dig up ends of lines (recommend addition of sumps for access)

Perform flush of each line by opening the end of one lateral at a time. Have helper turn pump on while you observe end of line. Note what flushes out of each line. Provide sketch to identify laterals.

Lateral #1 ____

Lateral #2 ____

Lateral #3 ____

Lateral #4 ____

Lateral #5 ____

Lateral #6 ____

After flushing all lines, make head measurement at the end of the line farthest from the pump. Note head and compare with previous records (if available) of how residual head in the system is supposed to be set. If head is more than 20 % above previous value, bottle brush the lines – or otherwise clean – and measure head again.

Note final head: __________ ft.

Appendix D

Mound Design Worksheet

MOUND DESIGN WORKSHEET

Site Criteria

1. Soil Profile

2. Slope %

3. This is a site for a proposed bedroom home.

Step 1. Evaluate the quantity and quality of wastewater generated

Daily Flow = # of bedrooms X 150 gpd/bedroom
= (X 150) gpd

= gpd

Step 2. Evaluate the soil profile and site description for maximum soil loading rate and hydraulic linear loading rate.

Seasonal High Groundwater Elevation = inches

Depth to Limiting Layer = inches

Limiting Layer texture, structure, grade- , ,

Using Table 1, determine the soil loading rate (SLR) and linear loading rate (LLR).

- Soil Loading Rate (SLR) = gpd/ft^2
- Linear Loading Rate (LLR) = gpd/lineal foot

Step 3. Select the sand fill loading rate and calculate the distribution cell width (A).

The **maximum** sand fill loading rate for septic tank effluent is **0.5 gpd/ft^2**. For this design, the following rate will be used gpd/ft^2. The width of the distribution cell (A) can then be calculated as follows:

A = Linear Loading Rate ÷ Sand Fill Loading Rate

= gpd/ft ÷ gpd/ ft^2

= feet

Step 4. Determine the distribution cell length (B).

B = Design Flow ÷ Linear Loading Rate
= ____ gpd ÷ ____ gpd/ft

= ____ ft.

Step 5. Determine the soil infiltration area width (IW).

The soil infiltration width represents the width required to absorb the effluent into the natural soil. To provide a factor of safety, it is based on the most limiting horizon in the upper 18 inches. For this design, the most limiting horizon is ____ with a ____ which has a maximum soil loading rate of ____ gal/day/ft^2.

IW = Design flow ÷ (soil loading rate x B)
= ____ ÷ ____

= ____ feet

For situations where the most limiting horizon is slowly permeable, it will be found that the infiltration width will exceed width of the distribution cell. The infiltration width is important when evaluating the adequacy of the overall mound fill area and horizontal spacing when using multiple distribution cells.

Step 6. Determine mound fill depth (C) at the upslope edge of the distribution cell.

In this case, the depth of fill (C) at the upslope edge of the distribution cell will be the fill required to elevate the stone **four (4) feet** above high groundwater elevation or limiting layer which is ____ feet.

Step 7. Determine the mound fill depth (D) at the down slope edge of the distribution cell.

For a given slope, the following can be used:

D = C + (slope x A) Note: express slope as decimal, i.e. 4% = 0.04

= ____ +(____ x ____)

= ____ ft.

Step 8. Determine mound depths (E) and (F).

E= ____ ft (total depth of stone)

F= ____ ft (amount of final cover)

Step 9. Determine the down slope width (I).

Using a recommended side slope of 4:1 the calculations is as follows:

Down slope correction factor = 100 ÷[100-(side slope x % ground slope)]
= 100 ÷ [100-(4 x % ground slope)]
= 100 ÷ [100-(4 x ____)]
= ____

I = 4 (D+ E+ F) x down slope correction factor
= 4 (____+____+____) (____)

= ____ feet

Step 10. Determine the upslope width (J).

Using a recommended side slope of 4:1 the calculations is as follows:

Upslope correction factor = 100 ÷ [100+(side slope x % slope)]
= 100 ÷ [100+(4 x % slope)]
= 100 ÷ [100+(4 x ____)]
= ____

J = 4 (C+ E+ F) x upslope correction factor
= 4 (____+____+____) (____)

= ____ feet.

Step 11. Determine the end slope length (K).

Using a recommended side slope of 4:1 the calculations is as follows:

K= 4 [(C+D)/2 +E +F]
= 4 [(____+____)/2 + ____+____]

= ____ feet

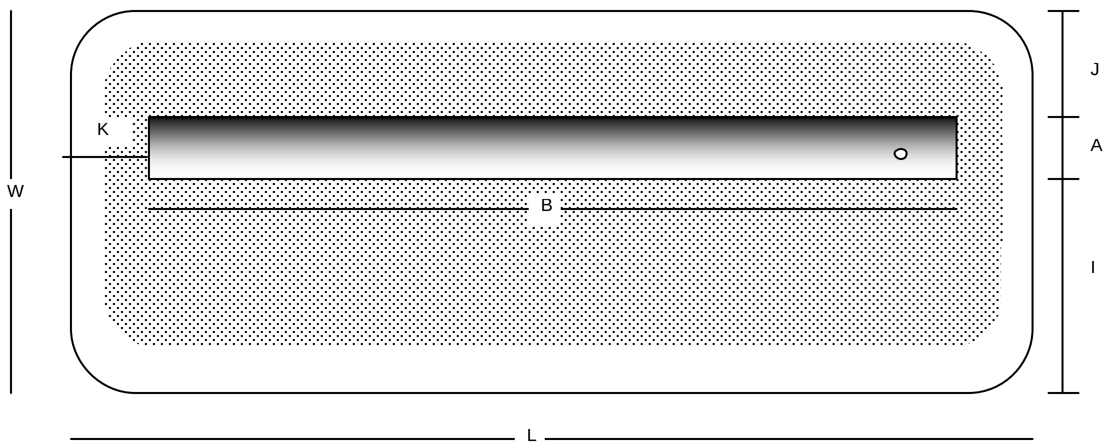
Step 11. Determine the overall width (W) and length (L) of the mound fill.

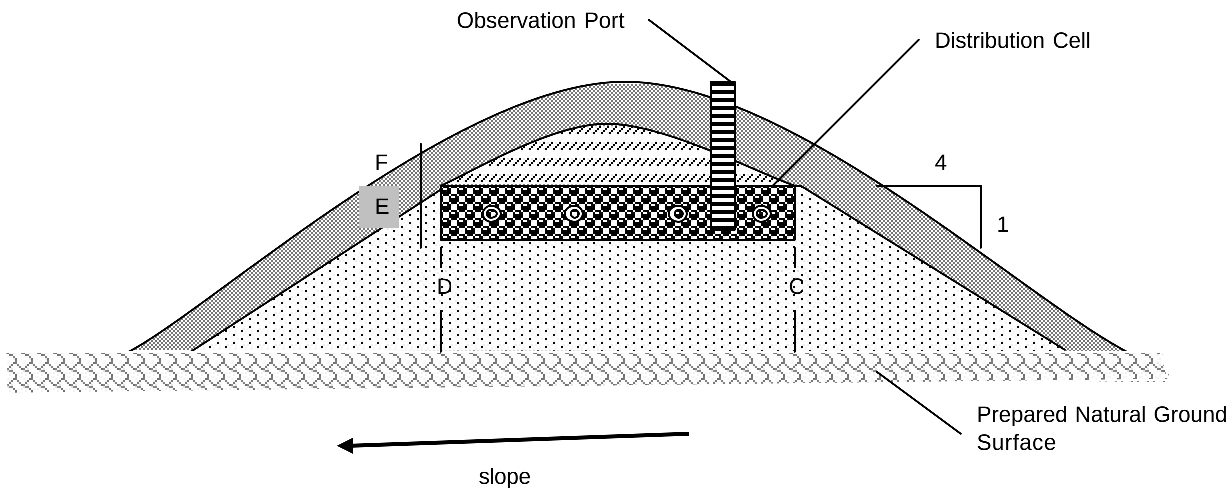
W= A + I + J
= ____ + ____ + ____

= ____ feet.

L = B + 2K
= ____ + 2(____)

= ____ feet





<u>Mound Component Dimensions</u>

A	Distribution cell width	
B	Distribution cell length	
C	Up slope fill depth under distribution cell	
D	Down slope fill depth under distribution cell	
E	Distribution cell depth	
F	Depth of final cover	
I	Distance from edge of distribution cell to down slope edge of fill	
J	Distance from edge of distribution cell to up slope edge of fill	
K	Distance from end of distribution cell to edge of fill	
L	Overall mound fill length	
W	Overall mound fill width	

Appendix E

Plan Submittal Checklist

PLAN SUBMITTAL CHECKLIST

In order to install a system correctly, it is important to develop overall plans that will clearly communicate how to install the system correctly. The following checklist may be used when preparing plans for review. The checklist is suggested as a general guide. Not all needed information may be included in this list. Additional information may be needed or requested to address unusual or unique characteristics of a particular project.

Forms and Fees

☐ **?** Application form for submittal, provided by reviewing agency along with proper fees.

Soils Information

☐? Complete soil description for each soil boring described by a competent professional.
☐ The location of all borings and backhoe excavations must be identified on the plot plan.

Documentation

☐? Plans signed, sealed, and dated by licensed professional.
☐ Copy of mound design work sheet confirming basis of design & design calculations.
☐ Copy of the Operation & Maintenance (Owner's) Manual.

Plot Plan

☐? Dimensioned plans or plans drawn to scale (scale indicated on plans) with property boundaries clearly marked.
☐? Slope directions and percent in initial and replacement system area.
☐? Bench mark and north arrow.
☐? Setbacks indicated as per appropriate code.
☐? Two-foot contours or other appropriate contour interval within the system area.
☐? Location information; legal description of parcel must be noted.
☐? Location of any nearby existing system or well.

Plan View

☐ Dimensions for distribution cell(s).
☐? Location of observation pipes.
☐? Overall dimensions of mound.
☐? Pipe lateral layout, which must include the number of laterals, pipe material, diameter, length and number, location and size of orifices and orifice shields.
☐? Manifold and force main locations, with materials, length and diameter of each.

Cross Section of System

- [ ] **?** Include tilling requirement, distribution cell details, percent slope, side slope, and cover material.
- [ ] ? Lateral elevation, position of observation pipes, dimensions of distribution cell, and type of cover material and geotextile fabric.
- [ ] Sand fill specifications.

Tank And Pump Information

- [ ] ? All construction details including cross section of tanks.
- [ ] ? Size and manufacturer information for prefabricated tanks.
- [ ] ? Notation of pump model, pump performance curve, and summary of calculation for total dynamic head.
- [ ] ? Notation of high water alarm manufacturer and model number.
- [ ] ? Cross section of dose tank / chamber to include storage volumes; connections for piping, vents, and power, pump "off" setting , pump control timer settings and volume, high water alarm setting, location of vent and riser details.
- [ ] Tank leak testing requirements.

Detailed specifications

- [ ] Detailed specifications for all materials and equipment.
- [ ] Detailed specifications describing all phases of site preparation and construction including provisions for protection of mound areas prior to construction and testing.

Inspections

- [ ] Inspection shall be made in accordance with requirements of the local health department. The inspection of the system installation and/or plans is to verify that the system at least conforms to specifications listed. Minimum inspections that may be included, but are not limited to:

  - Preconstruction Meeting (to verify proper site preparation)
  - Preparation Active Field
  - Verify Acceptable Sand Fill
  - Final/Pressure Test
  - Final Grade
  - Engineer Certification

- [ ] Affidavit signed by designer attesting to compliance with approved plans and specifications.

Appendix F

Affidavit for Deed Restriction

DEED RESTRICTION

___________________________________, (husband and wife; married man/married woman; single man/single woman) (herein after referred to as "Property Owners") and currently residing at ____, own property commonly known as ____, _______________ Township, Livingston County, Michigan, (hereinafter referred to as the "Property") and legally described as:

____
____
____
____
________Tax ID#:_____________
_________________, Township, Livingston County, Michigan.

The above mentioned property will utilize pressure mound technology for marginal sites. This system is considered unconventional due to the marginal nature of the soils present on site.

Purpose: The purpose of this Deed Restriction is to ensure that the on-site sewage treatment system on the Property is properly operated and maintained by the current and future Property Owners so as to not create a public health concern or nuisance due to failure of the treatment system; to meet the minimum sewage system requirements suitable for an on-site sewage system; and to provide notice to future owners that such restrictions run with the land in order to prevent a public health concern or nuisance on the Property.

Description of Restrictions:

1. **The Property Owners shall record this Deed Restriction with the Livingston County Register of Deeds and provide proof of recordation to the LCDPH.**

2. **The Property Owners shall have installed an on-site sewage treatment system in conformance with the LCDPH's Sanitary Code and the Minimum Requirements for Pressure Mound Systems on Marginal Sites.**

3. **The Property Owners acknowledge that the on-site treatment system is an unconventional system. Due to the mechanical nature of the system, failure to properly operate and maintain the system greatly increases the likelihood of failure, therefore potentially creating a public health nuisance. The Property Owners assume the risk associated with the operation of the on-site treatment system.**

4. **Once the system is approved, the engineer that designed the system shall provide LCDPH and the Property Owners with an operation and maintenance manual. It is recommended that a maintenance inspection for the on-site treatment system be conducted annually by a trained maintenance provider that is knowledgeable in the industry. LCDPH also reserves the right to conduct an on-site inspection of the system to verify that is functioning as intended.**

5. **The Property Owners shall be required to connect to a public sanitary sewer system when it is available, as defined by Public Act 368 of 1978, as amended.**

6. **Term: This Deed Restriction is permanent and shall run with the land, and is fully applicable and enforceable upon all future owners of the Property unless the Property is connected to a public sanitary sewer.**

IN WITNESS WHEREOF this instrument shall take effect upon full execution by the authorized representatives of the parties.

PROPERTY OWNERS:

_______ By:____________________________
Date , a married/single man

_______ By:____________________________
Date , a married/single woman

SUBSCRIBED AND SWORN before me, a Notary Public, this ____ day of ________________, 20___
by:____

_____________________, Notary Public
State of Michigan, County of
____

Acting in the County of

____

My Commission Expires:

LIVINGSTON COUNTY DEPARTMENT OF PUBLIC HEALTH

_______ By:___________________________
Date Dianne McCormick
Environmental Health Director

SUBSCRIBED AND SWORN to before me, a Notary Public, this ____ day of ________________, 20___
by:____

______________________, Notary Public

State of Michigan, County of

____

Acting in the County of

____

My Commission Expires

After recording, please return to:
Livingston County Department of Public Health
Environmental Health Division
2300 E. Grand River, Suite 102
Howell, MI 48843