GeoMat™ Leaching System

Mound Component Manual

March 18, 2022

Patents: www.geomatrixsystems.com –

TABLE OF CONTENTS

Published by:
Geomatrix Systems, LLC
114 Mill Rock Road East
Old Saybrook, CT 06475

Geomatrix Systems, LLC reserves the right to revise this component manual according to changes in regulations or Geomatrix products installation instructions.

Version 1

I. INTRODUCTION AND SPECIFICATIONS

This component manual provides design, construction, inspection, operation, and maintenance specifications for GeoMat Mound Component.

These items must accompany a properly prepared and reviewed plan acceptable to the governing unit to help provide a system that can be installed and function properly.

When designed, installed and maintained in accordance with this manual, the GeoMat Mound provides treatment and dispersal of domestic wastewater in conformance with NSF/ANSI Standard 40 Class I Certification.

"To achieve NSF 40 Class I Certification, treatment systems must produce an acceptable quality of effluent during a six month (26-week) test. Class I systems must achieve a 30-day average effluent quality of 25 mg/L CBOD5 and 30 mg/L TSS or less, and pH 6.0 – 9.0 spanning six months of testing. System service and maintenance are prohibited during the test period."

- Plans are submitted for review and approved by the governing unit having authority over the plan for the installation.
- A Sanitary Permit must be obtained from the department or governing unit having jurisdiction. See Section XI for more details.

TABLE 1: INFLUENT FLOWS AND LOADS

Design Wastewater flow (DWF)	≤ 5000 gal/day
Monthly average of Fats, Oils, and Grease (FOG)	≤ 30 mg/L
Monthly average value of Biochemical Oxygen Demand (BOD5)	≤ 220 mg/L
Monthly average value of Total Suspended Solids (TSS)	≤ 150 mg/L
Design loading rate of Geomat	≤ 2.0 gpd/sq.ft./day
Design loading rate of the basal area	Equals soil absorption rate of effluent with maximum average monthly values of $BOD_5$and TSS of ≤30mg/L as per SPS table 383.44-2 (Column 2)
Value of single dose to dispersal component	≥ 5 times void volume of the distribution lateral(s) and < 20% of the wastewater flow
Design wastewater flow (DWF) from one and two-family dwellings Design wastewater flows (DWF) from public facilities	Based on SPS 383.43 (3)(4) or (5) Wis. Admin. Code ≥ 150% of estimated daily wastewater flow in accordance with Table 4 of this manual
Linear loading rate for systems with in situ soils having a soil application rate of ≤ 0.3 gpd/sq.ft./day within 12" of the surface of in-situ soil	≤ 4.5 gal/ft/day
Linear loading rate for systems with in situ soils having a soil application rate of > 0.3 gpd/sq.ft./day within 12" of the thesurface of in-situ soil	≤ 10 gal/ft/day
Filter Required: One filter required on all pressure mound systems. Gravity filter not required on pressure systems.	≤ 1/8 inch
Distribution cell area per orifice	≤ 12 SQ. ft. per orifice

TABLE 2: SIZE AND ORIENTATION

Distribution component cell width (A)	Maximum of three (3) 39" wide GeoMat sections placed side-by-side for a total of 117"; followed by 36" open area. Every 39" GeoMat section must have a individual distribution pipe
Total distribution cell area (A x B) a	≥ Design wastewater flow rate ÷ design loading rate of the fill material
Geo Mat Distribution component cell depth (F)	1 inch + nominal size of distribution pipe+ 12" ASTM C-33 for fine sand aggregate
Geo Mat Depth of Fill Material (D)	The depth of additional sand fill under the GeoMat distribution cell is based on the minimum depth of unsaturated soil required from treatment listed in Table 383.44-3 (column 2), WI Adm. Code, and table 2 of this manual. Under the 12" of sand required for the GeoMat Component, any additional sand fill that is required is on an inch-by-inch basis. So that if 24" of suitable in-situ soil is available, then D = 0". If 20" of in-situ soil is available, then D = 4".
Depth of cover material at the top center of the distribution Pipe (H)a	≥ 12 inches
Depth of cover material at the outer edge of the distribution cell (G)a	≥ 6 inches
Basal area	≥ Design wastewater flow rate ÷ Design loading rate of in-situ soil as specified in Table 1 Row 6
Vertcal Separation to limiting factor	≥ 2' as measured from bottom of Geo Mat Component. (see Figure 8)
Deflection of Distribution cell on concave slopes	≤10%

Note a: Letter corresponds to letters referenced in figures, formulas and on worksheets.

TABLE 3: OTHER SPECIFICATIONS

Bottom of the distribution cell	Level
Slope of original grade	≤ 25% in area of the mound
Depth of in situ soil to high groundwater elevation and bedrock under basal area.	≥ 6 inches
Horizontal separation between distribution cells	GeoMat component is 39" wide. Three (3) GeoMat sections can be placed side-by-side; totaling 117" followed by ≥ 3' separation.
Fill material	Sand meeting ASTM C-33 specification for fine aggregate
Size for basal area (for level sites) (B x W)a	Cell length x (total mound width)
Size for basal area (for sloping sites) (B x (A + I)a	Cell length x [(# of cells x cell width) + ({# of cells – I} x cell spacing) + down slope width]
Effluent application (Orifice Shields required)	By use of pressure distribution only. Conforming to sizing methods established by either Small Scale Waste Management Project publication 9.6, entitled "Design of Pressure Distribution Networks for Septic Tank - Soil Absorption Systems. " Pressuer distribution component manual for onsite wastewater treatment systems Version 2.0 January 30 2001.
Piping material	Meets the requirements of s. SPS 384.30(2) Wis. Adm. Code for its intended use.
Number of observation pipes per distribution cell	2
Location of observation pipes for components	Two Observation pipes will be installed in each distribution cell. The observation pipes shall be placed 2' from the end of the GeoMat cell. (See observation pipe diagram on Page 26)
Maximum final slope of mound surface	≤ 3:1
Cover material	Soil that will provide frost protection, prevent erosion and excess precipitation or runoff infiltration and allow air to enter the distribution cell.
Grading of surrounding area	Graded to divert surface water around mound system.
Limited activities	Vehicular traffic, excavation, and soil compaction are prohibited in the basal area and 15 feet down slope of basal area, if there is a restrictive horizon that negatively affects treatment or dispersal.

Note a: Letter corresponds to letters referenced in figures, formulas and on worksheets.

Table 4
Public Facility Wastewater Flows

Source	Unit	Estimated Wastewater Flow (gpd)
Apartment or Condominium	Bedroom	100
Assembly hall (no kitchen)	Person (10 sq. ft./person)	1.3
Bar or cocktail lounge (no meals served)	Patron (10 sq. ft./patron)	4
Bar or cocktail lounge* (w/meals – all paper service)	Patron (10 sq. ft./patron)	8
Beauty salon	Station	90
Bowling alley	Bowling lane	80
Bowling alley (with bar)	Bowling lane	150
Camp, day and night	Person	25
Camp, day use only (no meals served)	Person	10
Campground or Camping Resort	Space, with sewer connection and/or service building	30
Campground sanitary dump station	Camping unit or RV served	25
Catch basin	Basin	65
Church (no kitchen)	Person	2
Church* (with kitchen)	Person	5
Dance hall	Person (10 sq. ft./person)	2
Day care facility (no meals prepared)	Child	12
Day care facility* (with meal preparation)	Child	16
Dining hall* (kitchen waste only without dishwasher and/or food waste grinder)	Meal served	2
Dining hall* (toilet and kitchen waste without dishwasher and/or food waste grinder)	Meal served	5
Dining hall* (toilet and kitchen waste with dishwasher and/or food waste grinder)	Meal served	7
Drive-in restaurant* (all paper service with inside seating)	Patron seating space	10
Drive-in restaurant* (all paper service without inside seating)	Vehicle space	10
Drive-in theater	Vehicle space	3
Employees (total all shifts)	Employee	13
Floor drain (not discharging to catch basin)	Drain	25
Gas station / convenience store	Patron (minimum 500 patrons)	3
Gas station (with service bay) Patron Service bay	 Patron Service bay	 3 50
Hospital*	Bed space	135
Hotel, motel or tourist rooming house	Room	65
Medical office building Doctors, nurses, medical staff Office personnel Patients	 Person Person Person	 50 13 6.5
Migrant labor camp (central bathhouse)	Employee	20
Mobile Home (Manufactured home) (served by its own POWTS)	Bedroom	100
Mobile home park	Mobile home site	200

Table 4

Public Facility Wastewater Flows

(continued)

Source	**Unit**	**Estimated Wastewater Flow (gpd)**
Nursing, Rest Home, Community Based Residential Facility	Bed space	65
Outdoor sport facilities (toilet waste only)	Patron	3.5
Parks (toilets waste only)	Patron (75 patrons/acre)	3.5
Parks (toilets and showers)	Patron (75 patrons/acre)	6.5
Public shower facility	Shower taken	10
Restaurant*, 24-hr. (dishwasher and/or food waste grinder only)	Patron seating space	4
Restaurant*, 24-hr. (kitchen waste only without dishwasher and/or food waste grinder)	Patron seating space	12
Restaurant, 24-hr. (toilet waste)	Patron seating space	28
Restaurant*, 24-hr. (toilet and kitchen waste without dishwasher and/or food waste grinder)	Patron seating space	40
Restaurant*, 24-hr. (toilet and kitchen waste with dishwasher and/or food waste grinder)	Patron seating space	44
Restaurant* (dishwasher and/or food waste grinder only)	Patron seating space	2
Restaurant* (kitchen waste only without dishwasher and/or food waste grinder)	Patron seating space	6
Restaurant (toilet waste)	Patron seating space	14
Restaurant* (toilet and kitchen waste without dishwasher and/or food waste grinder)	Patron seating space	20
Restaurant* (toilet and kitchen waste with dishwasher and/or food waste grinder)	Patron seating space	22
Retail store	Patron (70% of total retail area ÷ 30 sq. ft. per patron)	1
School* (with meals and showers)	Classroom (25 students/classroom)	500
School* (with meals or showers)	Classroom (25 students/classroom)	400
School (without meals or showers)	Classroom (25 students/classroom)	300
Self-service laundry (toilet waste only)	Clothes washer	33
Self-service laundry (with only residential clothes washers)	Clothes washer	200
Swimming pool bathhouse	Patron	6.5

* = May be high strength waste

II. DESCRIPTION AND PRINCIPLES OF OPERATION

Construction of BEST GeoMat Mound must consist of the following components

1. **GeoMat 3900 Flat Leaching System From Geomatrix:** GeoMat is a patented soil-based treatment system that has earned NSF 40 Certification. It utilizes a hydroscopic membrane with a transmissive core. Physical properties consist of fused entangled plastic filaments with a geotextile fabric on the top and bottom.

   GeoMat has a thin profile (1") that maximizes contact with the soil and enhances oxygen transfer. Together, the geotextile fabric and the entangled filament pull the water across the entire surface of the mat, maximizing oxygen transfer.

   A pressure distribution line is installed on top of the core and covered with a layer of geotextile fabric. The combination of pressure dosing and flow equalization serves to reduce the peak hydraulic loading. Additionally, GeoMat can be configured with a time dose pump station for greater flow equalization.

   A cleanout/distal monitoring port is installed on the terminal end of each of the lateral lines. The lateral lines can readily be cleaned, flushed, and jetted.

   GeoMat increases removal of BOD, TSS, pathogens, and nutrients such as nitrogen and phosphorus. When used with 12" ASTM C33 sand placed directly under the mat, GeoMat provides maximum treatment of effluent and infiltration of wastewater into soil.

   GeoMat is 39" wide. It is 1" high. It is shipped in 100-foot rolls that weigh 59 pounds.

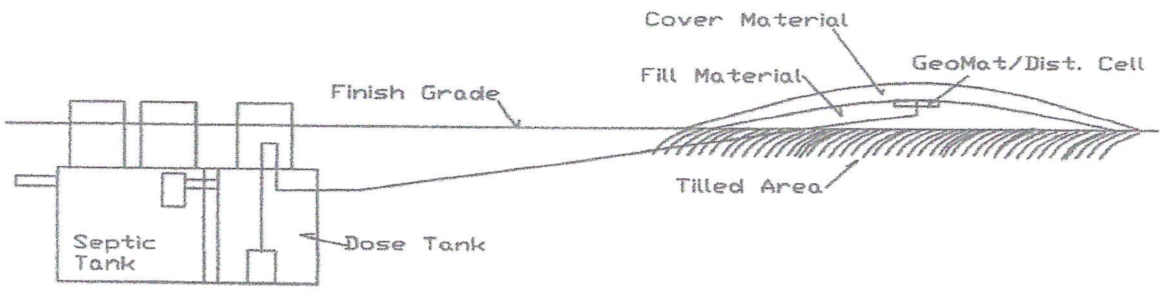


Figure 1: Cross section of a GeoMat mound system

2. Filters: 1 Required. The septic tank effluent filter is optional. The PSI filter provides protection for all distribution systems from suspended solids and is required.

3. **Orifice Shields.** This orifice shield is designed for holes that point down. All orifices point down. Orifice shields are designed to protect the discharge holes in pressurized systems from the outside. The GeoMat POWTS Treatment System is designed with specific flow rates and pressure heads to obtain even distribution to the leach field. Placing the shield over the pipe is easy and no part of the shield can block the distribution hole.

III. DEFINITIONS

A. "Basal Area" means the effective in situ soil surface area available for infiltration of partially treated effluent from the fill material.

B. "Deflection of distribution cell" means the ratio between the maximum distance between the down slope edge of the concave distribution cell to the length of the perpendicular line that interests the furthest points of the contour line along the down slope edge of the distribution cell.

C. "Distribution cell area" means the area within the mound where the effluent is distributed into the fill material.

D. "Fill material" means sand that meets the specifications of ASTM C33 for fine aggregate and is used along the sides of and under the distribution cell to provide treatment of effluent.

E. "Limiting factor," means high groundwater elevation or bedrock.

F. "Mound" means an onsite wastewater treatment and dispersal component. The structure contains a distribution cell area surrounded by, and elevated above, the original land surface by suitable fill material. The fill material provides a measurable degree of wastewater treatment and allows effluent dispersal into the natural environment under various degrees of soil permeability.

G. "Original Grade" means that the land elevation immediately prior to construction of the mound system.

H. "Parallel to the surface grade contours on sloping sites" means the mound is on a contour except that a 1% cross slope is allowed along the length of the mound. See Ch. SPS 383 Appendix A-383.44 ORIENTATION (6).

I. "Permeable Soil" means soil with textured classifications according to the U.S. Department of Agriculture, Natural Resource Conservation Service, classification system of silt loams to gravelly medium sand.

J. "Slowly permeable soil" means soil with textured classifications according the U.S. Department of Agriculture, Natural Resource Conservation Service, classification system of clay loams and silty clay loams that exhibit a moderate grade of structure; and loams, silt loams, and silts with weak grades of structure; or soils with weak to moderate grades of platy structure.

K. "Unsaturated flow" means liquid flow through a soil media under a negative pressure potential. Liquids containing pathogens and pollutants come in direct contact with soil/fill material microsites, which enhance wastewater treatment by physical, biological, and chemical means.

L. "Vertical separation" means the total depth of unsaturated soil that exists between the infiltrative surface of a distribution cell and limiting factor (as by redoximorphic features, groundwater or bedrock)

M. "Vertical Flow" means the effluent flow path downward through soil or fill material, which involve travel along soil surfaces, or through soil pores.

IV. SOIL AND SITE REQUIREMENTS

Every mound design is ultimately matched to the given soil and site characteristics.

The design approach is based on criteria that all applied wastewater is successfully transported away from the component, in a manner that will not affect later wastewater additions, and the effluent is ultimately treated.

QUALIFICATIONS

1. Soil Evaluation. A person who holds a certified soil tester credential number under s. SPS 305.33 Wis. Adm. Code.

2. Site Evaluation. A site evaluation shall be performed by a registered architect, professional engineer, designer of plumbing systems, designer of private sewage systems or land surveyor, a certified soil tester or POWTS inspector, or a licensed master plumber or master plumber-restricted service.

3. Soil Saturation Determinations. Soil saturation determinations may only be conducted and reported by an individual who is a certified soil tester.

V. FILL AND COVER MATERIAL

(a) Fill Material – The fill material and its placement is one of the most important components of the mound system. Quality control of the fill material is critical to system performance; each truckload of material must meet specifications of the fill.

Determining whether a proposed fill material is suitable or not requires that a textured analysis be performed. The standard method used for performing this analysis conforms to ASTM C-136. "Method for Sieve Analysis of Fine and Course Aggregates, and ASTM E-11." "Specifications for Wire-Cloth Sieves for Testing Purposes, Annual Book of ASTM Standards, Volume 04.02." Information for obtaining these methods can be obtained from Methods of Soil Analysis Part 1, C. A. Back, ed., ASA Monograph #9, American Society of Agronomy, Inc., 1975.

(b) Cover Material – The cover material is a soil that will allow air exchange while promoting plant growth. The gas exchange will increase the treatment performance of the system by providing oxygen to the wastewater to help ensure aerobic conditions in the mound system. The plant growth will provide frost protection in the winter season. Clays may not be used for cover material, as they will restrict oxygen transfer. Often, excavated soil from the site can be used. Seeding or other means must be done to prevent erosion of the mound.

VI. DESIGN

(1) Design Requirements – Design of GeoMat Component Systems must be completed utilizing the GeoMat component manual

(2) Location, Size, and Shape – Placement, sizing and shaping of the GeoMat mound and the distribution cell within the mound must be in accordance with this manual. The means of pressurizing the distribution network must provide equal distribution of the wastewater. A pressurized distribution network using a method of sizing as described in either Small Scale Waste Management Project publication 9.6, entitled "Design of Pressure Distribution Networks for Septic Tank – Soil Absorption System" or Department of Safety and Professional Services "Pressure Distribution Component Manual for Private Onsite Wastewater Treatment Systems" is acceptable.

(3) Component Design – Design of the GeoMat mound system is based upon the design wastewater flows and soil characteristics. It must be sized such that is can accept the design wastewater flow without causing surface seepage or groundwater pollution. Consequently, the basal area, which is the in situ soil area beneath the fill, must be sufficiently large enough to absorb the effluent into the underlying soil. The system also must be designed to avoid encroachment of the water table into the required minimum unsaturated zone.

Design of the mound includes the following three steps: (A) calculating wastewater flow per SPS 383.43(3) (b), (B) design of the distribution cell within the fill, (C) design of the entire mound. This includes calculating the total width, total length, system height, and distribution lateral location and observation pipes.

Step A: Design Wastewater Flow Calculations
One and two-family dwellings
150 gal/day/bedroom

Public Facilities
Distribution cell size for public facilities application is determined by calculating the DWF using Table 4 in this manual.

Sizing –GeoMat Systems for Public Facilities is done on an individual site basis

Step B. Design of the Distribution Cell – This section determines the required infiltrative surface area of the distribution cell/fill interface, as well as the dimensions of the dimensions of the distribution network within the fill.

Sizing the Distribution Cell – The design-loading rate of the infiltrative surface of the distribution cell is: ≤2.0 gal/day/sq.ft.

Design of the Distribution Cell – The minimum bottom area of the distribution cell is determined by dividing the design wastewater flow per day by the design-loading rate of the fill material. As specified in Table 1, the design-loading rate of the infiltration surface of the distribution cell is: ≤2.0gal/day/sq. ft.

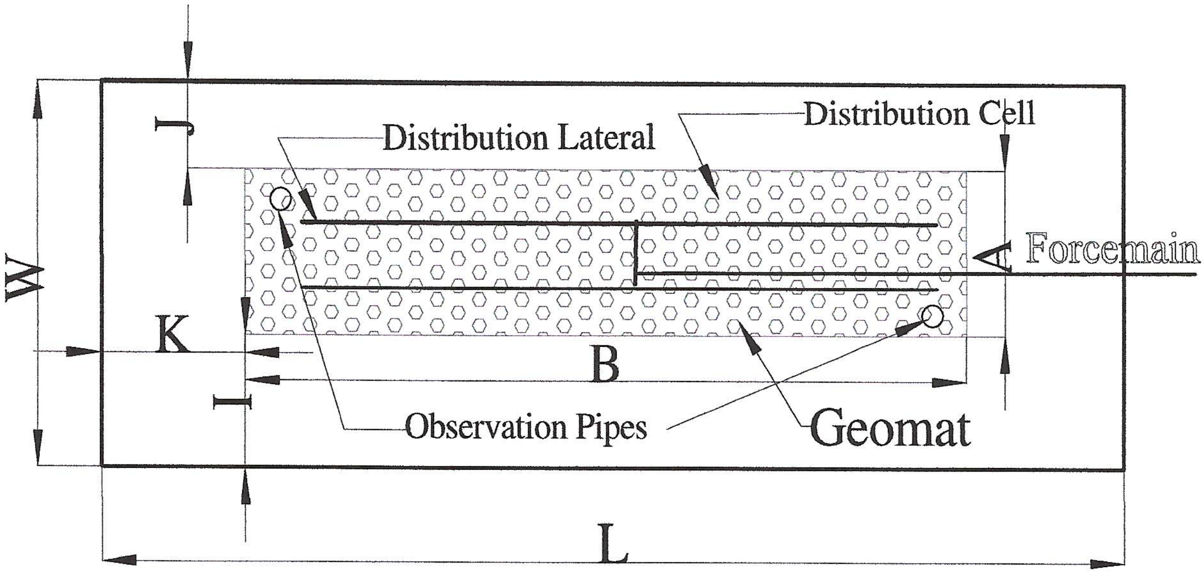
Using the information above, the infiltrative surface area of the distribution cell is determined by using formulas 5 and 6.

Formula 5

Area = DWF ÷ by design loading rate of the fill material.

For concave systems the actual distribution cell length must be checked to determine if the cell area is sufficient. See Step B2 for further information.

Figure 2
Design Plan View of a Mound



Detailed Cross Section of a Mound

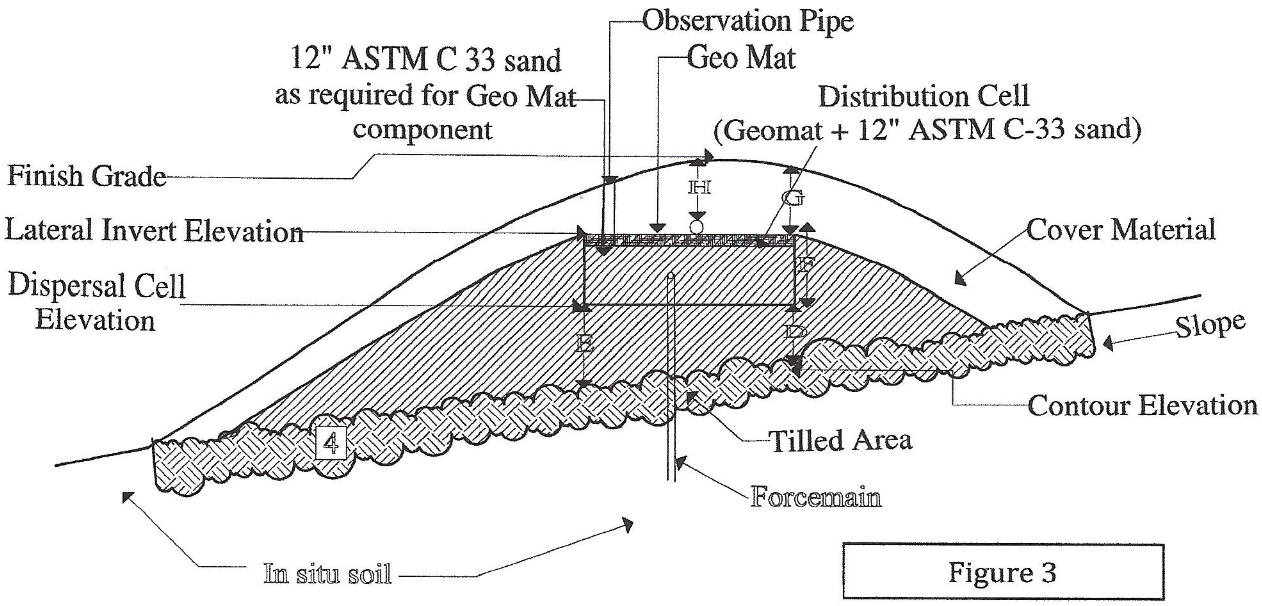


Figure 3

1. System Configuration – The distribution cell must be longer than it is wide. GeoMat maximum width is 117" (three 39" wide mats placed side-by-side). The maximum length of a distribution cell is dependent upon setback requirements and soil evaluation.

   The distribution cell is aligned with its longest dimension parallel to surface grade contours on sloping sites as required by the specifications of this package so as not to concentrate the effluent into a small area as it moves laterally down the slope.

   The dimensions of the distribution cell are calculated using Formulas 6 or 7. Formula 6 is used when the in situ soil has a soil application rate of greater than 0.3-gal/sq. ft./day. Maximum linear loading rate is 10 gal/sq.ft. /day.

   Formula 7 must be used to check for linear loading rate for the system when the in situ soil within 12" of the fill material has a soil application rate of ≤0.3 gal/sq.ft. /day the linear loading rate may not exceed 4.5 gal/sq.ft. /day.

Formula 6

Area of distribution cell = A x B

Where: A = Distribution cell width:(Individual GeoMat cell width is 39" - Max. Allowed is 117")

B = Distribution cell length

*Use formula 7 to confirm linear loading rate is ≤10 gal/sq.ft. /day.

Formula 7

Linear Loading Rate = DWF ÷ B

Where DWF = Design wastewater flow

B = Distribution cell length

2. Concave Mound Configuration – the maximum deflection of a concave distribution cell of a mound system is 10%. The percent of deflection of a distribution cell is determined by dividing the amount of deflection by the effective distribution cell length of the concave distribution cell. The deflection is the maximum distance between the down slope edges of a concave distribution cell to the length of a perpendicular line along the down slope edge of the distribution cell. The effective distribution cell length of the concave distribution cell is the distance between the furthest points along the contour line of the down slope edge of the concave distribution cell. See Figures 4 and 5.

   The deflection of the distribution cell on concave slopes is calculated using Formula 8.

Formula 8

Percent of Deflection = (Deflection ÷ Effective distribution cell length) x 100

Where: Deflection = Maximum distance between the down slope edge of a concave distribution cell to the length of a perpendicular line that intersects furthest points of the contour line along the down slope of the distribution cell.

Effective cell distribution length = Distance between the furthest points along the contour line of the down slope edge of the concave distribution cell.

100 = Conversion factor
The actual distribution cell length must be checked to determine if the cell area is sufficient. The actual distribution cell length is calculated using Formula 9.

Formula 9

Actual distribution cell length = [{% of deflection x 0.00265} + 1] x effective distribution cell length.

Where: % of deflection = determined by Formula 8

0.00265 = Conversion factor from percent to feet
1 = Constant

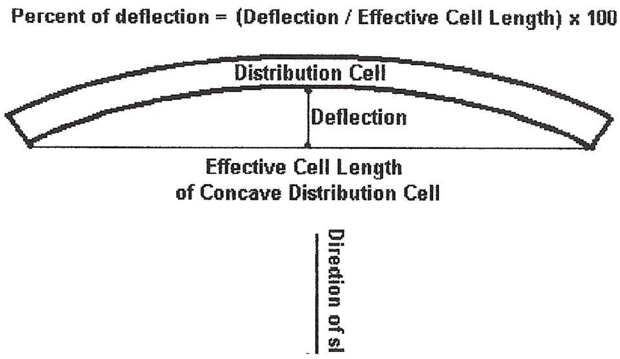


Figure 4– Simple Concave Distribution Cell

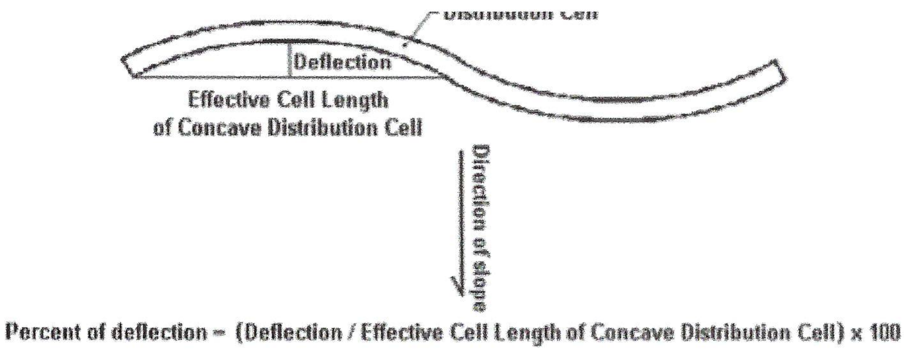


Figure 4A-Complex concave distribution cell

Step C. Sizing the Mound

1. Mound Height – The mound height on sloping sites is calculated using Formula 10.

Formula 10

Mound Height = [(D + E) divided by 2] + F + H

Where D = Sand fill depth
E = Down slope fill depth
F = Geo Mat Component depth 1" + 12" of ASTM C-33sand + Nominal pipe size
H = Cover material depth

2. Sand Fill Depth – The depth of additional sand fill under the Geomat distribution cell is based on the minimum depth of unsaturated soil required from treatment listed in Table 383.44-3, WI Adm. Code, and table 2 of this manual. Under the 12" of sand fill required for the Geomat Component, any additional sand fill that is required is on an inch by inch basis. So that if 24" of suitable in-situ soil is available, then D = 0". If 20" of in-situ soil is available, then D = 4".

3. For sloping sites the fill depth below the down slope edge of the distribution cell (E) > D + {% slope of original grade as decimal x width of distribution cell (A)}

4. Geo Mat component Cell Depth – GeoMat 1" + Nominal Pipe size + 12" ASTM C33 sand

5. Cover Material – The cover material (G + H) provides frost protection and a suitable growth medium for vegetation. The design uses 12" above the distribution pipe (H) and 6" above the outer edge of the distribution cell (G).

6. Fill Length and Width – The length and width of the fill are dependent upon the length and width of the distribution cell, fill depth and side slopes of the fill. Side slopes may not be steeper than 3:1 over the basal area, (i.e. 3' of run to every 1' of rise). Soil having textures other than those specified or the fill media may be used to make the slopes greater than the required 3:1 slopes, once the 3:1 slope exists with the fill material. The distribution cell length is generally perpendicular to the direction of the slope so the effluent is spread out along the contour.

   The fill length consists of end slopes (K) and the distribution cell length (B). The fill width consists of the up slope width (J), the distribution cell width (A), and the down slope width (I) is greater than on a level site to the 3:1 side slope (see Figure 2). To calculate the up slope and down slope widths when a 3:1 side slope is maintained, multiply the calculated width by the correction factor found by using the following equations or the correction factor listed in Table 5.

Up slope correction factor = 100 ÷ [100 + (3 x % of slope)]
Down slope correction factor = 100 ÷ [100 – (3 x % of slope}]
The most critical dimensions of the fill are: fill depths (D) & (E), distribution cell length (B), distribution cell width (A), and the down slope width (I).

End slope width (K) – Total fill at center of distribution cell {[(D + E) ÷ 2] + F +H} x horizontal gradient of selected side slope width (I).

Fill width (L) = Distribution cell length (B) + 2 x end slope width (K)

Up slope width (J) – Fill depth at up slope of distribution cell (D + F + G) x horizontal gradient of side slope (3 if 3:1) x slope correction factor {100 ÷ [100 – (3 x % of slope)] if 3:1}

Down slope width (I) – Fill depth at up slope of distribution cell (E + F + G) x horizontal gradient of side slope (3 if 3:1) x slope correction factor {100 ÷ [100 – (3 x % of slope)] if 3:1}

Fill width W = Up slope width (J) + down slope width (I) + width of distribution cell (A)

These calculations result in the fill material extending at least 6" horizontally from the top edges of the distribution cell as noted in Figure 3.

Cross Section of a Mound System

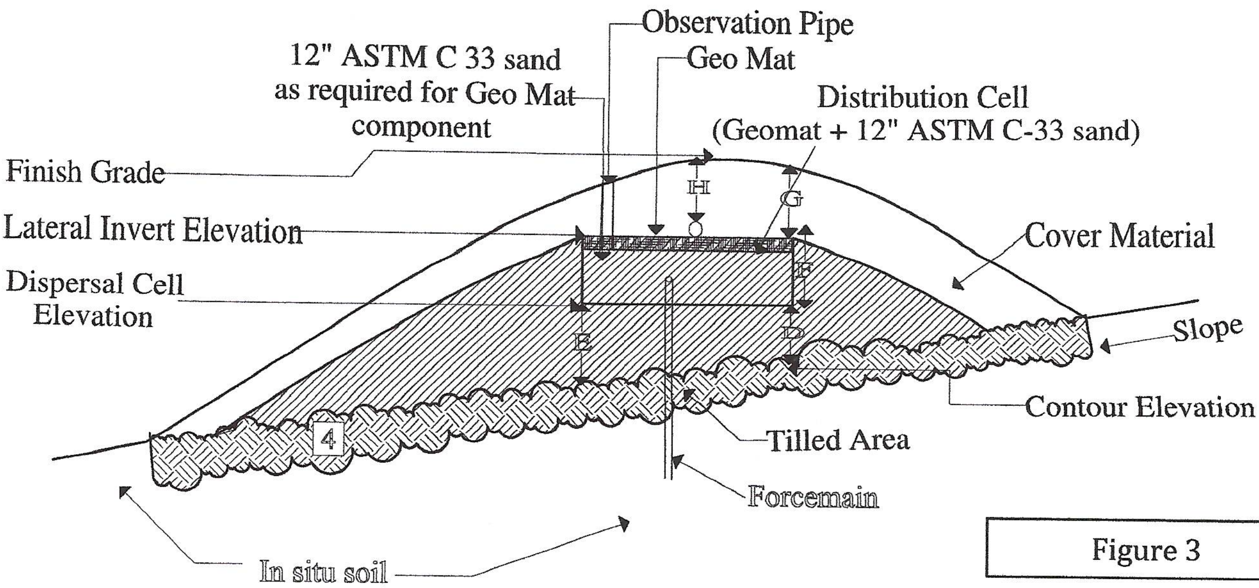


Figure 3

7. Basal Area – The basal area is the in situ soil/fill interface between the soil and the fill material. Its function is to accept the effluent from the fill, assist the fill in treating the effluent, and transfer the effluent to the subsoil beneath the fill or laterally to the subsoil outside of the fill.

   The soil infiltration rate of the in situ soil determines how much basal area is required. When the wastewater applied to the mound has values for bod_5 and TSS of < 30 mg/L or if there is at least 12" of fill material (as part of Geomat Component) beneath the distribution cell the soil application rate for the basal area is specified in table SPS 383.44-1 Column 2.

   For level sites, the total basal area, excluding end shape area [length of distribution cell (B) x width of fill and cover (W) beneath the fill and soil cover is available for effluent absorption into the soil (see Figure 5a).

   For sloping sites, the available basal area is the fill and soil cover or (A + I) times the length of the distribution cell (B) (see Figure 5b.). The up slope width and end slopes are not included as part of the total basil area.

   It is important to compare the required basal area to the available basal area. The available basal area must be equal to or exceed the required basal area.

8. Outside of the fill.

   The soil infiltration rate of the in situ soil determines how much basal area is required. When the wastewater applied to a Geo Mat component mound has values for BOD5 and TSS of ≤ 30 mg/L or when there is at least 12" of ASTM 33 sand material beneath the Geo Mat distribution material (Also called the Geo Mat component) the soil application rate for the basal area is determined using Table SPS 383.44-2. Column 2.

   For level sites, the total basal area, excluding end shape area [length of distribution cell (B) x width of fill and cover (W) beneath the fill and soil cover is available for effluent absorption into the soil (see Figure 5a). For sloping sites, the available basal area is the fill and soil cover or (A + I) times the length of the distribution cell (B) (see Figure 5b.). The up slope width and end slopes are not included as part of the total basal area.

It is important to compare the required basal area to the available basal area. The available basal area must be equal to or exceed the required basal area.

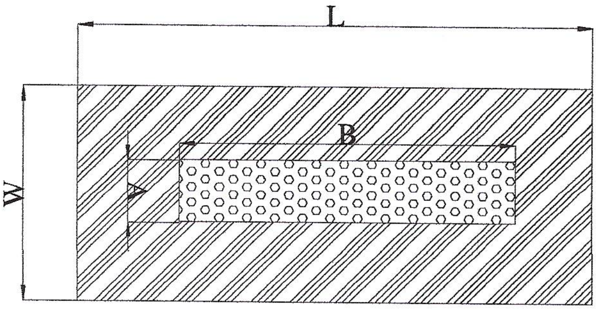


Figure 5A Level Site

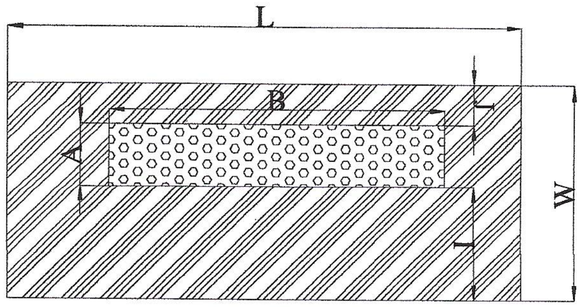


Figure 5B One direction slope

Basal area required = DWF + Infiltration rate of in situ soil

Basal area available = B x W on a level site or = B x (A + I) on a sloping site.

If sufficient area is not available for the given design and site conditions, corrective action is required to increase (J) and (I) on level sites or (I) on sloping sites.

9. Location of the observation pipes.

- See Table 3 Page 7 of this manual
- Observation pipes must be located at each end of the distribution cell. Special care must be taken to make sure GeoMat is continuous and not separated to install Observation Pipe. Use zip ties to but material together. Have extra filter fabric to cover joints. Use a heavy blade or utility knife to create holes for observation pipe. See Figure 7.

Step D. Distribution Network and Dosing System – A pressurized distribution network based on a **method of sizing** as described either Small Scale Waste Management Project publication 9.6 entitled "Design of Pressure Distribution Networks for Septic Tank – Soil Absorption Systems" or the Department of Safety and Professional Services "pressure Distribution Component Manual for Private Onsite Wastewater Treatment Systems" is acceptable.

Table 5 Down slope and up slope width correction factors		
Slope %	Down slope correction factor	Up Slope correction factor
0	1.00	1.00
1	1.03	0.97
2	1.06	0.94
3	1.10	0.915
4	1.14	0.89
5	1.18	0.875
6	1.22	0.85
7	1.27	0.83
8	1.32	0.81
9	1.37	0.79
10	1.43	0.77
11	1.49	0.75
12	1.56	0.735
13	1.64	0.72
14	1.72	0.705
15	1.82	0.69
16	1.92	0.675
17	2.04	0.66
18	2.17	0.65
19	2.33	0.64
20	2.50	0.625
21	2.70	0.61
22	2.94	0.60
23	3.23	0.59
24	3.57	0.58
25	4.00	0.57

MOUND PLACEMENT CONSIDERATIONS

(1) Design Flows – Listed in Table 1: Influent Flows and Loads.

(2) Minimum Soil Requirements – Listed in Table 2: Size and Orientation

(3) Other Site Considerations –

- Slopes – The slope on which a GeoMat mound is to be installed may not indicate the direction of the groundwater movement. If there is a determination that the direction of the groundwater movement is different from the slope of the land, the direction of groundwater movement must be considered during mound design.

  On a crested site the fill can be situated such that the effluent can move laterally down the slopes. A level site allows lateral flow in all directions, but may present problems as the water table could rise higher beneath the fill in slowly permeable soils. The sloping site allows the water to move in one direction away from the fill. Figure 3 shows a cross-section of a mound and the effluent movement in a slowly permeable soil on a sloping site. Systems that installed on a concave slope may have a deflection that does not exceed that allowed in Table 2.

  Mound components rely on lateral effluent movement through the upper soil horizons. Lateral movement becomes more important as soil permeability decreases.

- Mound location – In open areas, exposure to sun and wind increases the assistance of evaporation and transpiration in the dispersal of the wastewater.

- Sites with trees and large boulders – Generally, sites with large trees, numerous smaller tress or large boulders are less desirable for installing a mound system because of difficulty in preparing the surface and reduced infiltration beneath the mound. Areas that are occupied with rock fragments; tree roots, stumps and boulders reduce the amount of soil available for proper treatment. If no other site is available, trees in the basal area of the mound must be cut off at ground level. A larger fill area is necessary when any of the above conditions are encountered, to provide sufficient infiltrative area.

- Setback distances – Per Table SPS 383.43-1 are measured from the basal area except for wells, which are measured from the outer edges of the cover material as per chs, NR 811 and 812.

VII. SITE PREPERATION AND CONSTRUCTION OF A GEOMAT MOUND

Construction Plan

1. Soil Conditions – Soil shall only be tilled when it is not frozen and the moisture content is low to avoid compaction and smearing. Remove any loose organic matter, which can interfere with infiltration.

2. Equipment – Proper equipment is critical. Track type equipment that will not compact the mound or the down slope are required.

3. Sanitary Permit – Prior to the construction of the system, a sanitary permit, obtained for the installation must be posted in a clearly visible location on the site. Arrangements for inspection(s) must also be made within the department or government unit issuing the sanitary permit.

Construction Procedures

1. Check the moisture content of the soil to a depth of 8". Smearing and compacting of wet soil will result in reducing the infiltrative capacity of the soil. Proper soil moisture can be determined by rolling a soil sample between the hands. If the soil rolls into a ¼" wire, the site is to wet to prepare. If it crumbles, site preparation can proceed. If the site is to wet to prepare, do not proceed until it dries.

2. Lay out the fill area on the site so the distribution cell runs perpendicular to the direction of the slope.

3. Establish the original grade elevation (surface contour) along the top edge of the distribution cell. The elevation is used throughout the mound construction as a reference to determine the bottom of the distribution cell. Lateral elevations, etc., and is referenced to the permanent benchmark for the project. A maximum of 4" of fill may be tilled into the surface.

4. Determine where the force main from the dosing chamber will connect to the distribution system in the distribution cell. Place the pipe either before tilling or after placement of the fill. If the force main is to install in the down slope area, the trench for the force main may not be wider than 12".

5. Cut trees flush to the ground and leave stumps, remove surface boulders that can be easily rolled off, remove vegetation over 6" long by mowing and removing cut vegetation. Prepare the site by breaking up, perpendicular to the slope, the top 8" so as to eliminate any surface that could impede the vertical flow of liquid into the in situ soil. When using a moldboard plow, it should have as many bottoms as possible to reduce the number of passes over the area to be tilled and minimize compaction of the subsoil. Tilling with a moldboard plow is done along the contours. Chisel type plowing is highly recommended, especially in fine textured soils. Rototilling or other means that pulverize the soil is not acceptable. The important point is that a rough, unsmeared surface be left. The sand fill will intermingle between the clods of soil, which improves the infiltration rate into the natural soil.

   Immediate application of at least 6" of fill material is required after tilling. All vehicular traffic is prohibited on the tilled area. For sites where the effluent may move laterally, vehicle traffic is also prohibited for 15' down slope and 10' on both sides of level sites. If it rains after tilling is completed, wait until the soil dries out before continuing construction, and contact the local inspector for a determination on the damage done by rainfall.

6. Place the approved sand fill material around the edge of the tilled area being careful to leave adequate perimeter area, not covered by the sand fill, on which to place the soil cover. There should be approximately 2' of basal area adjacent to the mound perimeter that is not covered by the sand fill. The area serves to tie the soil cover into the natural surface material that has been tilled and helps seal the toe from leakage. Work from the end and up slope sides. This will avoid compacting the soils on the down slope side, which, if compacted, affects lateral movement away from the fill and could cause surface seepage at the toe of the fill on slowly permeable soils.

7. Move the fill material into place using a small track type tractor with a blade or a large backhoe that has sufficient reach to prevent compaction of the tilled area. Do not use a tractor/backhoe having tires. Always keep a minimum of 6" of fill material beneath tracks to prevent compaction of the in situ soil.

8. Place the fill material to the required depth.

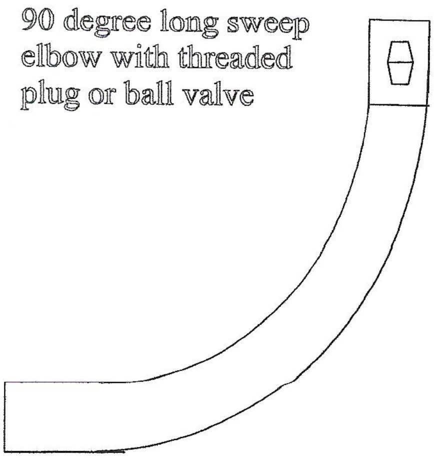
9. Form the distribution cell. Take care to hand level the bottom of the distribution cell.

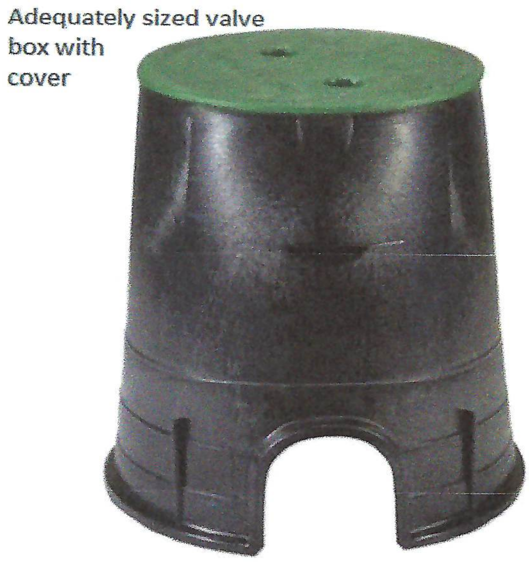
10. Shape the sides with additional fill to the desired slopes.

11. Install the GeoMat and pressure piping per instructions, pressure distribution design and application in the GeoMat Mound Design App. Small slits may need to be made in geotextile fabric to install a center manifold. Keep cuts to a minimum. Extra fabric may be used to preserve integrity of fabric.

12. At the end of the lateral, place a 90-degree long sweep with a capped piece of pipe pointing up through the soil surface. Cover the capped pipe with a valve box and lid of an adequate size. The cover of the valve box shall be located above the final grade of the mound (Figure 6).

Figure 6





13. Install an observation pipe at each end of GeoMat Cell
    The slots need to extend from the bottom of the GeoMat (placed flat on top of the sand) to the top of the fabric (approximately 1") See figure 7.

Observation Pipe Diagram

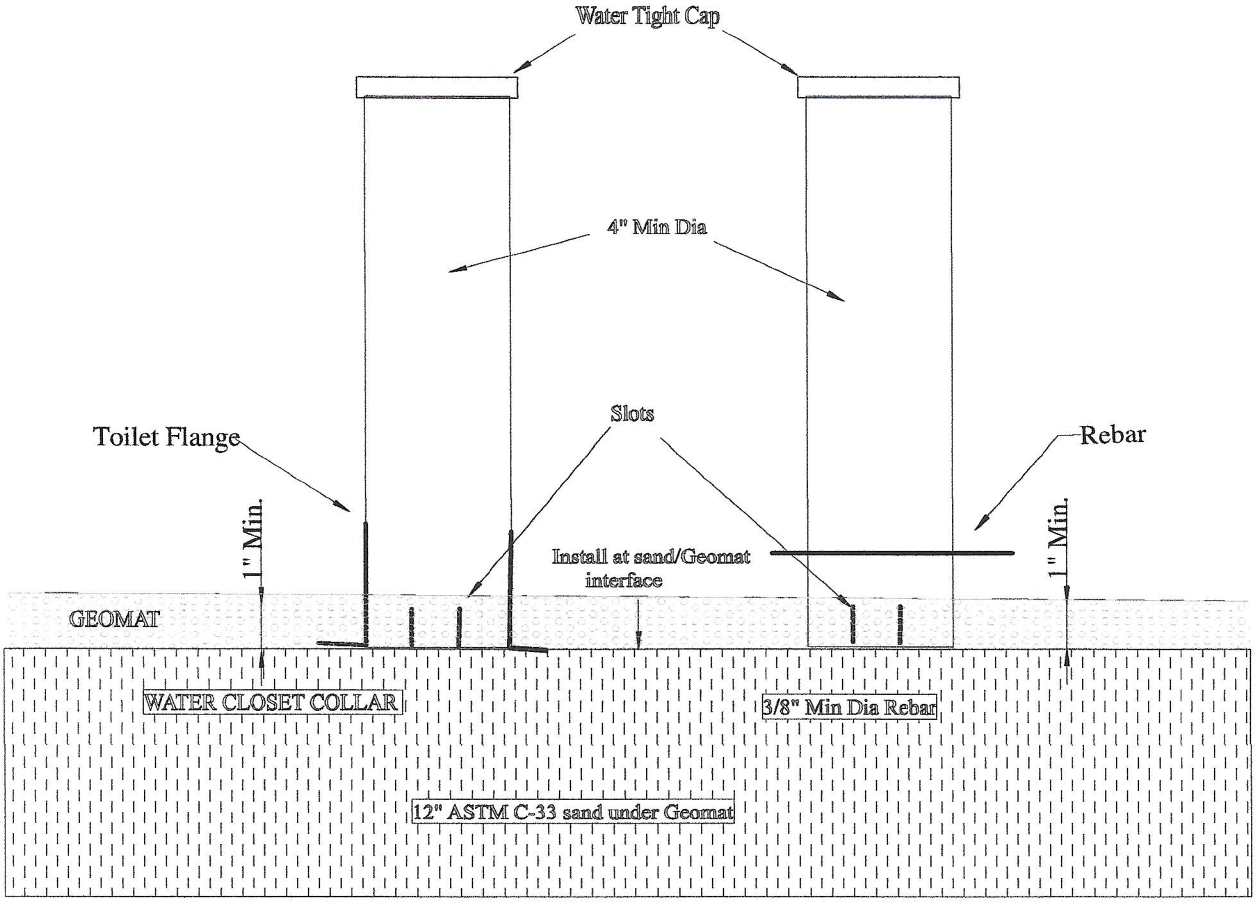


Figure 7

14. Complete the final grading to divert surface water drainage away from the mound. Sod or seed the entire mound component.

GeoMat Cross Section

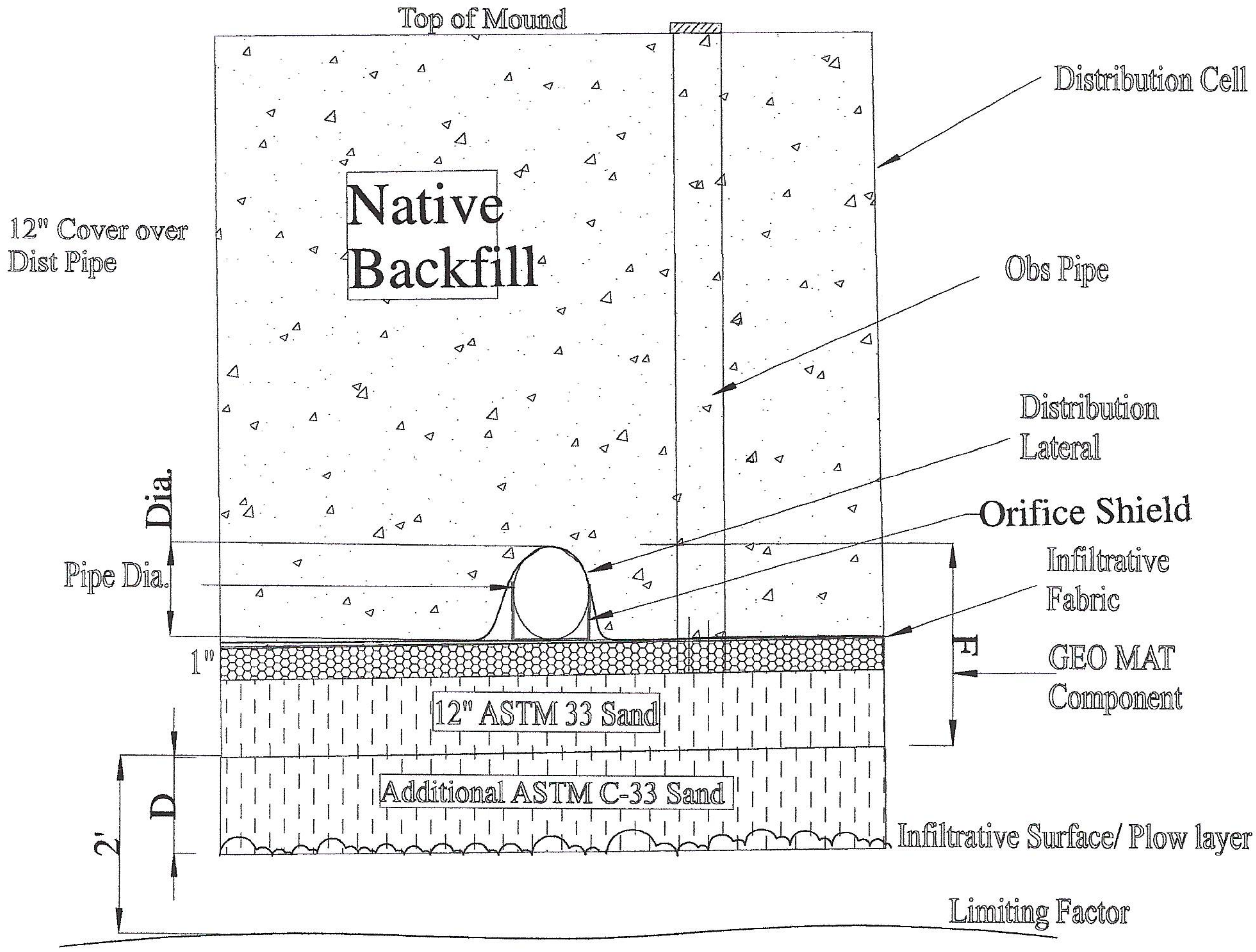


Figure 8

VIII. GEOMAT MOUND WORKSHEET

A. SITE CONDITIONS

Evaluate the site and soils for the following:

- Surface water movement.
- Measure elevations and distances on the site so that slope, contours, and available areas can be determined.
- Determine the limiting conditions such as bedrock, high groundwater level, soil application rates, and setbacks.

Slope - ____%

Occupancy – One or two-family dwelling___ (number of bedrooms)

Public facility gallons per day _______ (Estimated water flow)

Depth to limiting factor ______inches

Minimum depth of unsaturated soil required by table 383.44-3, (Column 2)
Wis. Adm. Code_______ inches

In Situ Soil application rate of in situ soil used _______ gal/sq.ft. /day (2nd column)

FOG value of effluent applied to component ≤ _______mg/L

BOD5 value of effluent applied to component ≤ ______mg/L

TSS value of effluent tied to component ≤___________mg/L

Fecal coliform monthly geometric mean value of effluent tied to component ≥ 10^4 CFU /100mg

______Yes ______No

Type of Dist. Cell---GeoMat

B. DESIGN WASTEWATER FLOW

One and two-family dwelling

Combined wastewater flow:

DWF = 150 gal/day/ bedroom x number of bedrooms

= 150 gal/day/bedroom x # of bedrooms

= 150 gal/day/bedroom x _____bedrooms

= 450 gal/day

Clearwater and greywater only:

DWF = 90 gal/day/bedroom x # of bedrooms
= 90 gal/day/bedroom x _______ # of bedrooms

= gal/day

Blackwater only:

DWF = 60 gal/day/bedroom x # of bedrooms

= 60 gal/day/bedroom x ________ # of bedrooms

= gal/day

Public Facilities

DWF = Estimated wastewater flow x 1.5

= ________ gal/day x 1.5

= ________ gal/day

C. DESIGN OF THE DISTRIBUTION CELL

1. Total size of the Distribution cell(s) area

a. Loading rate of fill material = ______ ≤ 1.0 gal/sq.ft./day if BOD5 or TSS ≥ 30 mg/L

or = __X__ ≤ 2.0 gal/sq.ft./day if BOD5 or TSS ≤30 mg/L

b. Bottom area of distribution cell = Design wastewater flow ÷loading rate of fill material as determined in C.1 a.

Distribution cell area = ____ gal/day÷ 2.0 gal/ft^2./day

Distribution cell area =____ ft^2

2. Distribution Cell Configuration
OPTIONS—3.25', 6.5', 9.75'

a. Distribution cell width(s) (A) = _____feet, and the number of distribution

cells = _____cells.

b. Distribution cell length (B) = Bottom area of distribution cell ÷ width of distribution cell.

B = ________ ft^2. ÷ (Distribution cell area required) ÷ ______ft. (A)

B = _______ or ______ft

c. Check distribution cell length (B)

For linear loading rate

Linear loading rate ≤ Design wastewater flow ÷ Cell length (B) or effective cell length for a concave mound.

Linear loading rate ≤ _____gal/day ÷ _____feet

Linear loading rate ≤ _____gal/ft/day

Linear loading rate for systems with in situ soils having a soil application rate of ≤ 0.3 gal/ ft^2/day within 12 inches of original grade must be less than or equal to 4.5 gal/ft/day.

Linear loading rate for systems with in situ soils having a soil application rate of > 0.3 gal/ ft^2/day within 12 inches of original grade must be less than or equal to 10 gal/ft/day.

Is the linear loading rate ≤ what is allowed? ______Yes ____ No -----If no, then the length and width of the distribution cell must be changed so it does.

Distribution cell length B = Design Wastewater Flow ÷ Maximum Linear Loading Rate

Distribution cell length B = ________ gal/day ÷ gal/ft/day

Distribution cell length B = ________ ft.

Distribution cell total width (A) = ________ sq. ft. (Distribution cell area) ÷ ________ ft. (B)

Distribution cell total width (A) = ________ ft.

d. Check percent of deflection and actual length of concave distribution cell length

Percent of deflection = Deflection ÷ effective distribution cell length x 100

Percent of deflection = ________ ft. ÷ ________ ft. x 100

Percent of deflection = ________ % (≤ 10%)

Actual distribution cell length = [{_______ % of deflection x 0.00265 ÷ 1] x effective distribution cell length

Actual distribution cell length = [{_______ % x 0.00265 ÷ 1] x ________ ft.

Actual distribution cell length = ________ ft.

D. DESIGN OF THE ENTIRE MOUND AREA

1. Fill Depth

a. The depth of additional sand fill under the Geomat distribution cell is based on the minimum depth of unsaturated soil required from treatment listed in Table 383.44-3, WI Adm. Code, and table 2 of this manual. Under the 12" of sand fill required for the Geomat Component, any additional sand fill that is required is on an inch by inch basis. So that if 24" of suitable in-situ soil is available, then D = 0". If 20" of in-situ soil is available, then D = 4".

2) Depth at up slope edge of distribution cell (D) = distance required by Table 383.44-3 (column 2), WI Adm. Code minus distance in inches to limiting factor.

D = _____ inches -______ inches

D =_____ inches

3) Depth at down slope of distribution cell (E)

E = Depth at up slope of distribution cell (D) + (% natural slope expressed as a decimal x distribution cell width (A)

E = D + (% natural slope expressed as decimal x A)

E =_____ inches ÷ (_____x _____ feet x 12 inches/ft)

E =_____inches or _____inches

4) Distribution cell depth for Geo Mat Component Distribution Cell.

Distribution cell component depth (F) for GEO MAT distribution cell = Depth of GeoMat Material (1")+ normal outside diameter of the largest lateral + 12" of ASTM 33 sand

F =_____(1) inch +_____ inches + 12" ASTM sand

F =_____inches

5) Cover material

a) Depth at distribution cell center (H) ≥ __12__ inches

b) Depth at distribution cell edges (G) ≥ __6__ inches

6) Mound Length

a. End slope with (K) = Total fill at center of distribution cell x horizontal gradient of side slope.

K = {([(D + E) ÷ 2] + F + H) x horizontal gradient of side slope) ÷ 12 inches/foot

K = {([(_____ + _____ inches ÷ 2] +_____ inches +_____inches) x _____) ÷ 12 Inches/foot

K = _____ or _____ft.

b. Mound length (L) = Distribution cell length + (2 x end slope width)

L = B + 2K

L =_____ft. + (2 x _____ft.)

L = _____feet

7) Mound width

a. Up slope width (J) = Fill depth at up slope edge of distribution cell (D + F + G) x Horizontal gradient of side slope x Slope correction factor (100 ÷ [100 + (gradient side slope x % of slope or value from Table 5)]}

J = (D + F + G) x horizontal gradient of side slope x Slope correction factor 100 + [100 + (gradient of side slope x % of slope or value from Table 5)]}

J = (_____in. + ______in. + ______in) ÷ 12 in/ft x ______x 100 ÷ [100 + (3 x 6)] or [Table 5 value]

J = ______or ______ feet

b. Down slope width (I) = Fill depth at down slope edge of distribution cell (E + F + G) x Horizontal gradient of side slope x Down slope correction factor {100 + [100 – (gradient of side slope or value from Table 5)]}

I = (E + F + G) x Horizontal gradient of side slope x Down slope correction factor {100 + [100 – (gradient of side slope x % of slope or value from table 5)}]

I = (_____ in. + ______in. + ______in.) ÷ 12 in/ft x 3 x 100 ÷ [100 - 3 x 6)]

I = _____ in ÷ 12 in/ft x 3 x 100 ÷ ______

I = _____ ft or _____ ft

c. Mound width (W) = (Up slope width (J) + Distribution cell width (A) + Down slope width (I)

W = J + A + I

W = _______ ft. + _______ft. + _______feet

W = _______feet

8) Check the basal area

a. Basal area required = Daily wastewater flow + soil application rate of in situ soil (the soil application rate may be that which is listed for BOD5 and TSS ≥ or ≤ 30 mg/L depending on wastewater characteristics or fill depth below distribution cell. See Table 1.)

= _______ gal/day ÷ _______gal/sq.ft. /day

= _______sq. ft.

b. Basal area available

1) Sloping site = Cell length (B) x [(# of cells x cell width) + ({# of cells – 1} x cell spacing) + down slope width (A + I)

= _____ ft x [(____x ____ft) + ({1 – 1] x 0 ft) + _____ ft)

= _____ ft x (_____ft. + 0 ft. + _____ft.)

= _____ ft x _____ ft

= ______ft^2

2) Level site = Cell length (B) x total mound width (W)

= _______ft x _______ ft

= _______ ft^2

c. Is available basil area sufficient? _____ Yes ___X___ No

If yes, FINAL MOUND DIMENSIONS

L = ___' W = ___'

Basal area required - Basal Area Available

______sq. ft -_____ ft^2

=_______

The available down slope must be increased by ______ ft^2 This can be

accomplished by increasing the down slope width (I) by _____ft. making it

_______ ft.
See d. for recalculation of basal area.

d. Basal area available

1) Sloping site = Cell length (B) x [{# of cells x cell width) + ({[# of cells – 1} x cell spacing) + down slope width (A + I)

= ______ft x [(1 x______ft) + ({1 – 1] x 0 ft) +______ft)

= ______ ft x (______ft. + 0 ft. + ______ft.)

= ______ ft x ______ ft

= ______ ft^2

2? Level site = Cell length (B) x total mound width (W)

= ______ ft. x _____ ft.

= ______ ft^2

IX. GEOMAT MOUND WORKSHEET EXAMPLE

A. SITE CONDITIONS

Evaluate the site and soils for the following:

- Surface water movement.
- Measure elevations and distances on the site so that slope, contours, and available areas can be determined.
- Determine the limiting conditions such as bedrock, high groundwater level, soil application rates, and setbacks.

Slope - __6__%

Occupancy – One or two-family dwelling _3_ (number of bedrooms)

Public facility gallons per day ___0___ (Estimated water flow)

Depth to limiting factor ___25___ inches

Minimum depth of unsaturated soil required by table 383.44-3, (Column 2)
Wis. Adm. Code__24__ inches

In Situ Soil application rate of in situ soil used ___0.6_____ gal/sq.ft. /day (2nd Column)

FOG value of effluent applied to component ≤ _30_ mg/L

BOD5 value of effluent applied to component ≤ _180_mg/L

TSS value of effluent tied to component ≤__50_ mg/L

Fecal coliform monthly geometric mean value of effluent tied to component ≥ 10^4 CFU /100mg

__X___Yes ________ No

Type of Dist. Cell---GeoMat

B. DESIGN WASTEWATER FLOW

One and two-family dwelling

Combined wastewater flow:

DWF = 150 gal/day/ bedroom x number of bedrooms

= 150 gal/day/bedroom x # of bedrooms

= 150 gal/day/bedroom x ___3___bedrooms
= 450 gal/day

Clearwater and greywater only:

DWF = 90 gal/day/bedroom x # of bedrooms
= 90 gal/day/bedroom x ________ # of bedrooms

= gal/day

Blackwater only:

DWF = 60 gal/day/bedroom x # of bedrooms

= 60 gal/day/bedroom x ________ # of bedrooms

= gal/day

Public Facilities

DWF = Estimated wastewater flow x 1.5

= ________ gal/day x 1.5

= ________ gal/day

C. DESIGN OF THE DISTRIBUTION CELL

3. Total size of the Distribution cell(s) area

a. Loading rate of fill material = ______≤ 1.0 gal/sq.ft./day if BOD5 or TSS ≥ 30 mg/L

or = __X__ ≤ 2.0 gal/sq.ft./day if BOD5 or TSS ≤30 mg/L

b. Bottom area of distribution cell = Design wastewater flow ÷loading rate of fill material as determined in C.1 a.

Distribution cell area = 450 gal/day÷ 2.0 gal/ft^2./day

Distribution cell area = 225 ft^2

4. Distribution Cell Configuration
OPTIONS—3.25', 6.5', 9.75'

a. Distribution cell width(s) (A) = 6.50 feet and the number of distribution

cells = 1 cells.

b. Distribution cell length (B) = Bottom area of distribution cell ÷ width of distribution cell.

B = 225 ft^2. ÷ (Distribution cell area required) ÷ 6.50 ft. (A)

B = 34.62or 34.7 ft

c. Check distribution cell length (B)

For linear loading rate

Linear loading rate ≤ Design wastewater flow ÷ Cell length (B) or effective cell length for a concave mound.

Linear loading rate ≤ 450 gal/day ÷ 34.7 feet

Linear loading rate ≤ 13.0 gal/ft/day

Linear loading rate for systems with in situ soils having a soil application rate of ≤ 0.3 gal/ ft^2/day within 12 inches of original grade must be less than or equal to 4.5 gal/ft/day.

Linear loading rate for systems with in situ soils having a soil application rate of > 0.3 gal/ ft^2/day within 12 inches of original grade must be less than or equal to 10 gal/ft/day.

Is the linear loading rate ≤ what is allowed? ____ Yes _X_ No -----If no, then the length and width of the distribution cell must be changed so it does.

Distribution cell length B = Design Wastewater Flow ÷ Maximum Linear Loading Rate

Distribution cell length B = 450 gal/day ÷ 10.0 gal/ft/day

Distribution cell length B = 45 ft.

d. Check percent of deflection and actual length of concave distribution cell length

Percent of deflection = Deflection ÷ effective distribution cell length x 100

Percent of deflection = ________ ft. ÷ ________ ft. x 100

Percent of deflection = ________ % (≤ 10%)

Actual distribution cell length = [{________ % of deflection x 0.00265 ÷ 1] x effective distribution cell length

Actual distribution cell length = [{________ % x 0.00265 ÷ 1] x ________ ft.

Actual distribution cell length = ________ ft.

D. DESIGN OF THE ENTIRE MOUND AREA

1. Fill Depth

a. The depth of additional sand fill under the Geomat distribution cell is based on the minimum depth of unsaturated soil required from treatment listed in Table 383.44-3, WI Adm. Code, and table 2 of this manual. Under the 12" of sand fill required for the Geomat Component, any additional sand fill that is required is on an inch by inch basis. So that if 24" of suitable in-situ soil is available, then D = 0". If 20" of in-situ soil is available, then D = 4".

2) Depth at up slope edge of distribution cell (D) = distance required by Table 383.44-3 (Column 2), WI Adm. Code minus distance in inches to limiting factor.

D = 24 inches - 25 inches

D = 0 inches