Geotextile Sand Filter

Michigan

Design and Installation Manual

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125 McKee Street
East Hartford, CT 06108
Tel: 800-444-1359 ▪ Fax: 860-610-0427
www.eljen.com

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Glossary of Terms

A42 Module	48” x 24” x 7” (L x W x H)
A22 Module	24” x 24” x 7” (L x W x H) *Note: A22 Half Modules are half the length of the standard A42 Module and are utilized to round up trench rows to equal length.*
B43 Module	48” x 36” x 7” (L x W x H)
B23 Module	24” x 36” x 7” (L x W x H) *Note: B23 Half Modules are half the length of the standard B43 Module and are utilized to round up trench rows to equal length.*
Bio-Matt™ fabric	Proprietary filter fabric within the Geotextile Sand Filter Modules upon which the primary biomat layer forms.
Cover Fabric	The geotextile cover fabric (provided by manufacturer) that is placed over the GSF modules.
Cuspated Core	The rigid plastic core of the GSF module. It separates the geotextile fabric and creates downward infiltration channels and upward aeration channels to provide primary filtration and biological treatment of the septic effluent. The curvilinear shape of the cuspations offers increased treatment surface area and greater effluent storage.
Design Flow	The estimated peak flow that is used to size a GSF system is 150 gallons per day per Bedroom.
Distribution Box	A plastic or concrete box that receives effluent from a septic tank and splits the flow to pipes placed above the GSF modules. For equal distribution, the outlet pipe orifices are typically set at the same elevation to equalize the flow to each line.
EHGWT	The Estimated High Ground Water Table (EHGWT) is the elevation of saturated condition as measured or as estimated from evaluation of soil color.
Flow Dial/Equalizer	Special insert placed in the end of distribution pipes within the distribution box to compensate for possible unlevel installation and promote favorable flow to the distribution pipes.
GSF	The Eljen Geotextile Sand Filter Modules and the 12-inch sand layer at the base and 6 inches along the sides of the modules.
GSF Module	The individual module of a GSF system. The module is comprised of a cuspated plastic core and corrugated geotextile fabric.
LTAR	Long Term Acceptance Rate (LTAR) is the average equilibrium absorption rate for effluent in a system, usually expressed in gallons per day per square foot. It should not be confused with the soil loading rate that is used by regulatory officials in their regulations.
SHGWT	Seasonal High Ground Water Table (SHGWT) is the elevation to which the ground or surface water can be expected to rise due to a normal wet season.

Specified Sand

To ensure proper system operation, the system MUST be installed using either MDOT 2NS sand or ASTM C33 Sand.

MDOT 2NS sand will have less than 10% passing the #100 Sieve and less than 3% passing the # 200 sieve. Ask your material supplier for a sieve analysis to verify that your material meets the required specifications.

TABLE 1: SPECIFIED SAND SIEVE REQUIREMENTS

MDOT 2NS SAND SPECIFICATION		
Sieve Size	Sieve Square Opening Size	Specification Percent Passing (Wet Sieve)
3/8 inch	9.52 mm	100
No. 4	4.76 mm	95 - 100
No. 8	2.38 mm	80 - 100
No. 16	1.19 mm	50 - 85
No. 30	590 µm	25 - 60
No. 50	297 µm	5 - 30
No. 100	149 µm	0 - 10
No. 200	75 µm	0 - 3

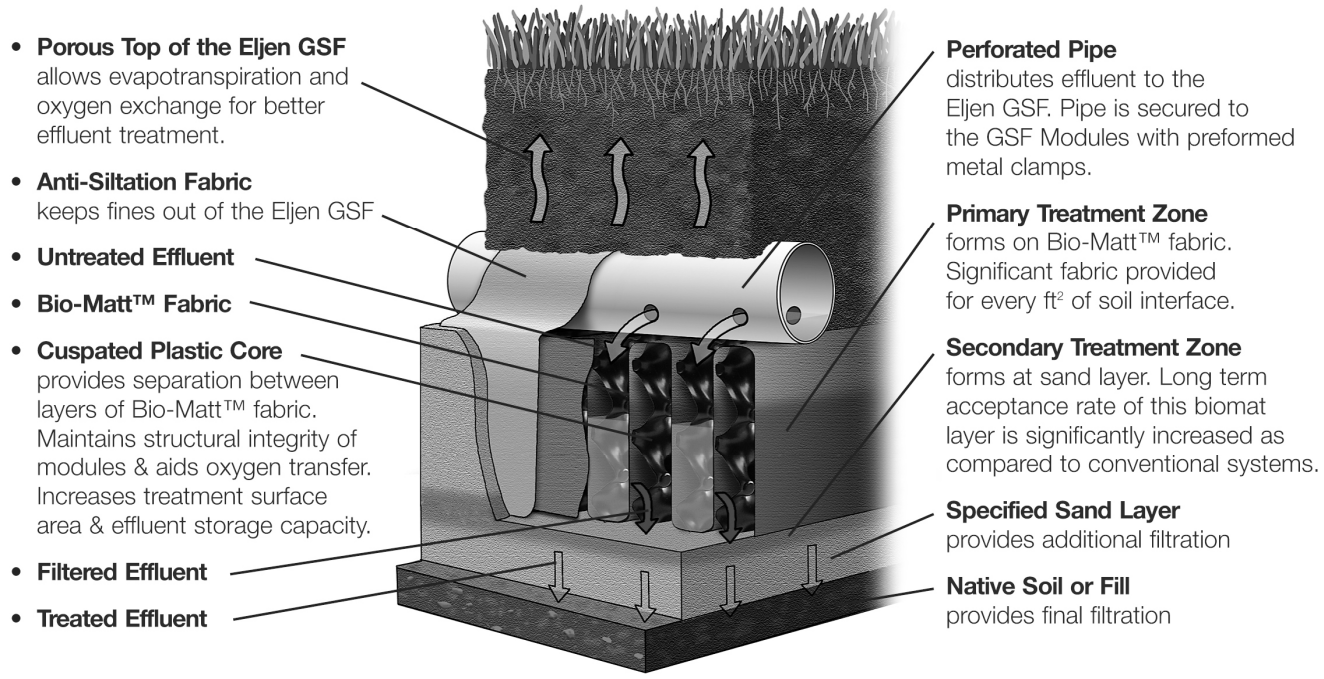
Primary Treatment Zone

- Perforated pipe is centered above the GSF module to distribute septic effluent over and into corrugations created by the cuspated core of the geotextile module.
- Septic effluent is filtered through the Bio-Matt fabric. The module's unique design provides increased surface area for biological treatment that greatly exceeds the module's footprint.
- Open air channels within the module support aerobic bacterial growth on the modules geotextile fabric interface, surpassing the surface area required for traditional absorption systems.
- An anti-siltation geotextile fabric covers the top and sides of the GSF module and protects the Specified Sand and soil from clogging, while maintaining effluent storage within the module.

Secondary Treatment Zone

- Effluent drips into the Specified Sand layer and supports unsaturated flow into the native soil. This Specified Sand/soil interface maintains soil structure, thereby maximizing the available absorption interface in the native soil. The Specified Sand supports nitrification of the effluent, which reduces oxygen demand in the soil, thus minimizing soil clogging from anaerobic bacteria.
- The Specified Sand layer also protects the soil from compaction and helps maintain cracks and crevices in the soil. This preserves the soil's natural infiltration capacity, which is especially important in finer textured soils, where these large channels are critical for long-term performance.
- Native soil provides final filtration and allows for groundwater recharge.

FIGURE 1: GSF System Operation



Testing and Performance

GSF Modules were subjected to independent third-party testing in accordance with NSF/ANSI Standard 40 Protocol. Three different methods of distribution were tested:

- Pressure Distribution
- Lift Pump/Gravity Demand Dosed Distribution
- Gravity Distribution

The data and detailed reports for each system tested were reviewed by NSF in accordance with NSF/ANSI Standard 40 Protocol and the Pennsylvania Department of Environmental Protection Technical Verification Program. This independent review validates the performance data listed below for Demand Dosed, Pressure Dosed, and Gravity systems.

Testing Arrangement & Common Factors:

Common Factors for all tested systems listed in Table 2:

- A42 modules: (L x W x H) 48" x 24" x 7" plus Specified Sand.
- Six modules per bedroom at 150 gal/day, 18 modules total for three bedrooms per house equals 450 gal/day.
- Standard distribution pipe with orifices at the 5 & 7 o'clock position,
- 12 inches of Specified Sand base extending 6 inches at either edge of the modules.

Lift Pump/Gravity Demand Dosed System:

- 1000 gal septic tank – 500 gallon pump chamber to distribution box.
- Dial-a-flow fittings set level to deliver effluent into each of the three rows of laterals via a 4-inch perforated distribution pipe with orifices at the 5 & 7 o'clock position.
- A non-perforated pipe connects the distal end to the end of other rows.

Time Pressure Dosed System:

- 1000 gal septic tank – 500 gal pump chamber – 1.25" low-pressure pipe (LPP) or other diameter as required.
- LPP placed inside a 4-inch perforated distribution pipe with orifices at 12 o' clock, at least one drain hole per line at 6 o'clock.
- The 4-inch perforated pipe orifices are placed at the 5 & 7 o'clock positions with the end of pipe capped

Gravity System Trench Design:

- 1000 gal septic tank–gravity to distribution box.
- Dial-a-flow fittings set level to deliver influent into three individual trenches.
- Perforated distribution pipe with orifices at the 5 & 7 o'clock positions with the end of pipe capped.

TABLE 2: TESTING RESULTS

GSF Modules Treatment Performance
NSF Standard 40 Protocol
Wastewater Influent Median Characteristics:
CBOD 180 mg/L & TSS 180 mg/L

Demand Dosed

	CBOD (mg/L)	TSS (mg/L)
Mean	2.0	2.7
Median	1.0	2.5
Min Value	1.0	2.5
Max Value	7.2	7.0

GSF Modules Treatment Performance
NSF Standard 40 Protocol
Wastewater Influent Median Characteristics:
CBOD 180 mg/L & TSS 190 mg/L

Timed Pressure Dosed

	CBOD (mg/L)	TSS (mg/L)
Mean	2.6	2.7
Median	2.2	2.5
Min Value	1.0	2.5
Max Value	14.0	9.0

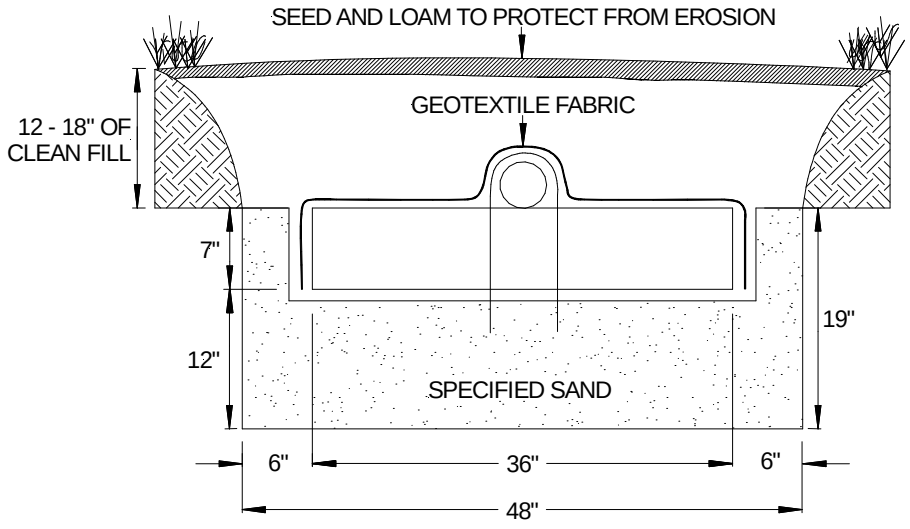
GSF Modules Treatment Performance
NSF Standard 40 Protocol
Wastewater Influent Median Characteristics:
CBOD 180 mg/L & TSS 180 mg/L

Gravity

	CBOD (mg/L)	TSS (mg/L)
Mean	8.0	7.4
Median	7.6	5.0
Min Value	1.0	2.5
Max Value	18	55

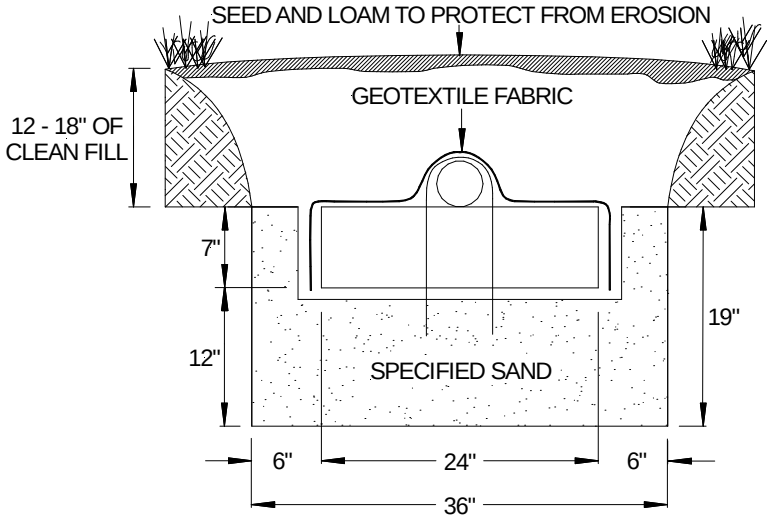
TSS 2.5mg/L = sample was below detection limits
CBOD 1.0mg/L = sample was below detection limits

FIGURE 2: Typical B43 GSF Cross Section



B43 MODULE (L x W x H) 48" x 36" x 7"

FIGURE 3: Typical A42 GSF Cross Section



A42 MODULE (L x W x H) 48" x 24" x 7"

All Systems are Required to Have a Minimum of:

- 6 inches of Specified Sand is at the edges of the GSF module.
- 6 inches of Specified Sand is at the beginning and end of each GSF Trench.
- 12 inches of Specified Sand is directly below the GSF module.
- Minimum 12 inches of native soil fill above the module.

1.0 Design and Installation

1.1 REQUIREMENTS: GSF systems must meet the local rules and regulations except as outlined in this manual. The Michigan Criteria for Subsurface Sewage Disposal and the local regulations will be referred to as the *guidelines* in this manual.

The sizing charts apply to residential systems only. Sizing charts are found in section 1.15. Please contact Eljen's Technical Resource Department at 1-800-444-1359 for design information on commercial systems.

1.2 SPECIFIED SAND SPECIFICATION FOR TRENCH SYSTEMS: The first 12 inches of sand immediately under, between rows and around the perimeter of the GSF system must be ***MICHIGAN DEPARTMENT OF TRANSPORTATION (MDOT) 2NS SAND, WITH LESS THAN 10% PASSING A #100 SIEVE AND LESS THAN 3% PASSING A #200 SIEVE.*** Please place a prominent note to this effect on each design drawing. See Table 1 for more information on the sand and sieve specifications.

1.3 CONNECTIONS AND FITTINGS: Connections of lines to tanks and distribution boxes must be made using watertight mechanical seals. Use of any grouting material is not permitted.

1.4 PLACING GSF MODULES: The "White Stripe" on the GSF modules indicates the top of the module and is not intended to indicate the location of the distribution pipe. With the white stripe facing up, all rows of GSF modules are set level, end to end on the Specified Sand layer. No mechanical connection is required between modules.

1.5 DISTRIBUTION PIPE: SDR-35 or equivalent is required. Place perforated pipe on top of GSF modules with holes at 5 and 7 o'clock. Secure pipe to GSF modules with provided wire clamps, one clamp per Eljen module. All distribution piping must meet a minimum 2,500 pound crush test specification or meet the requirements of the most recent revision of ASTM D 2665 for polyvinyl chloride (PVC) drain and waste pipe. Furthermore, all piping must meet state and local regulations.

1.6 DISTRIBUTION BOX: Set the gravity system D-box outlet invert a minimum of ⅛ inch drop in elevation per linear foot to the top first module in the trench. Set a 2-inch minimum drop for dosed systems from the D-box to the modules. Ensure that the distribution box and pipes feeding the system are placed on settled soil. Flow Dials may be used in either Gravity or Dosed installations.

1.7 COVER FABRIC: Geotextile cover fabric is provided by Eljen Corporation for all GSF systems. It is placed over the top and sides of the module rows to prevent long term siltation and failure. **Cover fabric substitution is not allowed.** Fabric should drape vertically over the pipe and must *not* block holes in the distribution pipe or be stretched from the top of the pipe to the outside edge of the modules. "Tenting" will cause undue stress on fabric and pipe.

1.8 BACKFILL & FINISH GRADING: Complete backfill with 12-18 inches of clean porous fill measured from the top of modules. Backfill exceeding 18 inches requires venting at the far end of the trench or bed. Use well graded native soil fill that is clean, porous and devoid of large rocks. Do not use wheeled equipment over the system. A light track machine may be used with caution, avoiding crushing or shifting of pipe assembly. Divert surface runoff from the Effluent Disposal Area, (EDA). Finish grade to prevent surface ponding. Topsoil and seed system area to protect from erosion.

1.9 ADDITIONAL FACTORS EFFECTING RESIDENTIAL SYSTEM SIZE: Homes with expected higher than normal water usage may consider increasing the septic tank volume as well as incorporating a multiple compartment septic tank. Consideration for disposal area may be up-sized for expected higher than normal water use.

For example:

- Luxury homes, homes with a Jacuzzi style tubs, and other high use fixtures.
- Homes with known higher than normal occupancy.
- Homes on high-pressure city water: recommend that the homeowner install a water pressure regulator to reduce pressure.

1.10 GARBAGE DISPOSALS: Eljen discourages the use of garbage disposals with septic systems. If a GSF system is to be designed and installed with garbage disposals the following measures must be taken to prevent solids from leaving the tank and entering the GSF system:

- Increase the septic tank capacity by a minimum of 30% or
- Installation of a second septic tank installed in series or
- Installation of an appropriate sized septic tank outlet effluent filter.

Eljen strongly recommends the use of septic tank outlet effluent filters on all systems especially on those systems that have single compartment tanks, even if up-sized, and when the dwelling has a garbage disposal installed.

1.11 WATER SOFTENER BACKWASH: At no time should water softener backwash be disposed of in the septic system. Water softener backwash should be discharged to a separate soil absorption field.

1.12 SEPTIC TANKS: Many designers are now specifying dual compartment tanks for all their systems. Eljen supports this practice as it helps to promote long system life by reducing TSS and BOD to the effluent disposal area. Gas baffles and/or effluent filters are also recommended.

1.13 SEPTIC TANK FILTERS: Wastewater filters are strongly recommended as a means of preventing solids from leaving the tank and entering your system. Filter manufactures require that filters be cleaned from time to time. Ask your installer or designer for specific cleaning requirements based on the type or make of the filter installed. Eljen requires the septic tank to be pumped every three years or as needed which would be a good time to check and conduct filter maintenance.

1.14 SYSTEM VENTING: It is strongly recommended to vent all systems that are over 18" below finished grade and systems beneath any surface condition that would not allow for surface air exchange with the system such as patios. See Section 8.0 for a more detailed explanation of venting GSF products.

1.15 NUMBER OF GSF MODULES REQUIRED: Residential systems use a minimum of six (6) A42 modules per bedroom or five (5) B43 modules per bedroom. See Section 1.16 for more information on systems sizing.

1.16 SIZING GSF SYSTEM FOR TRENCHES, BEDS & SAND MOUNDS: To remain consistent with advanced treatment sizing practices within Michigan, Eljen recommends a 50% reduction to current state, county and/or local wastewater soil application rates for trenches, beds and mounds.

Based on third-party performance testing data, NSF verification letters and over 20 years of success using similar sizing across the country, Eljen Corporation feels this is a reasonable and rational approach to system sizing based on the improved effluent quality achieved by septic tank effluent going through the Eljen Module and 12 inches of Specified Sand.

Table 3 below shows adjusted soil application rate numbers for Michigan Pressure Sand Mounds based on sizing requirements found in the Michigan Department of Environmental Quality *Pressure Mound Systems: Technical Guidance for Site Suitability, Design, Construction, and Operation and Maintenance, June 2003.*

TABLE 3: GSF B43 & A42 PRESSURE SAND MOUND SOIL APPLICATION RATES

Soil Structure	Maximum Soil Loading Rate GPD/FT^2					Maximum Hydraulic Linear Loading Rate GPD/LF					Required Downslope Greenbelt** (Slope > 2 %, Feet)
	BK/GR			PL	M	BK/GR			PL	M	
Soil Texture*	1	2	3			1	2	3			
Coarse Sand / Medium Sand	2.0	2.0	2.0	1.0	1.0	5.0	5.0	5.0	2.5	2.5	NR
Fine Sand / Sandy Loam	0.8	1.0	1.2	0.8	0.8	3.5	4.0	4.5	2.0	2.0	10
Very Fine Sand / Sandy Loam	0.6	0.8	1.0	U	0.4	3	3.5	4	U	1.0	20
Loam / Sandy Clay Loam	0.4	0.5	0.6	U	0.4	2.5	3.0	3.5	U	U	30
Clay Loam / Silty Clay Loam	0.3	0.4	0.5	U	U	1.8	2.5	3.0	U	U	40
Silty Clay / Sandy Clay / Clay	***UNSUITABLE***										NA

* Most Limiting Layer in Upper 18 inches

** Measured From Toe of Mound Fill

Trench Example:

House size –	4 Bedrooms
Soil Permeability min/in –	15 min/in
Design Flow – 150 gpd x 4 bedrooms =	600 gpd

Existing Soil Application Rate (for this example) – 0.75 gpd/ft^2

(Note: Please refer to your State, County, and/or Local regulations for specific application rate information)

How to calculate reduced application rate:

0.75 gpd/ft^2 ÷ 0.5 (50% reduction) = 1.5 gpd/ft^2

How to calculate the modules necessary:

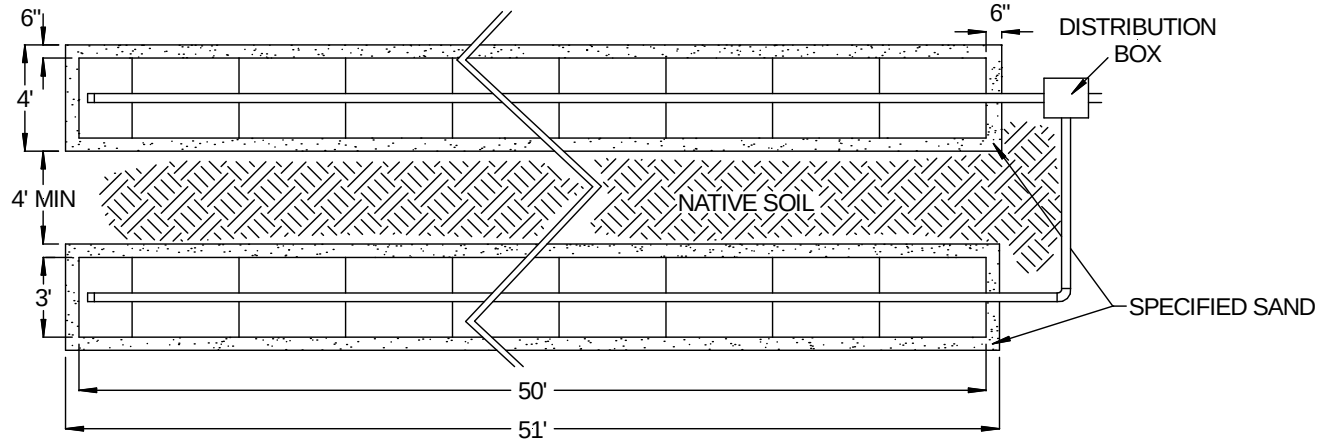
Field Size with Reduction = 600gpd ÷ 1.5 gdp/ft^2 =	400 ft^2
Number of units required = 400 ft^2 ÷ 16 ft^2 / module =	25 modules

For this example, assume the number of trenches equals two:

Trench Width – Module width (3ft) + Sand Sidewalls (6" + 6") =	4 ft
Trench Length – 25 modules ÷ 2 trenches = 12.5, use	12 B43 & 1 B23 modules per row
Modules (12.5) x 4 lf/module + 1 ft (6" sand at each end of trench) =	51 ft
Trench area (width x length x trenches) – 4 ft x 51 ft x 2 trenches =	408 ft^2

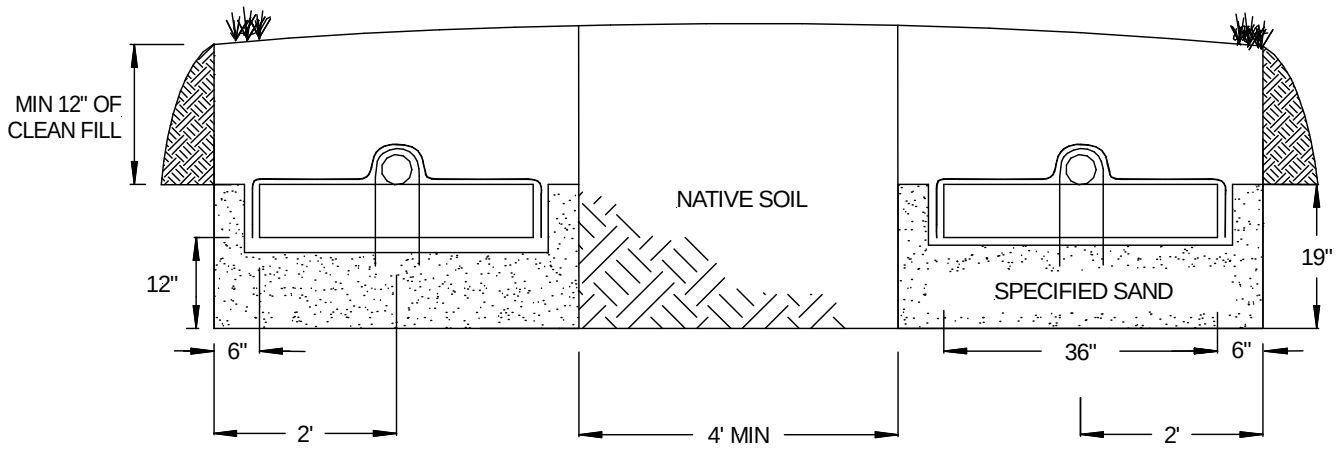
Trench Dimensions:	
Length =	51 ft/trench
Width =	4 ft
Trenches =	2
Modules =	24 B43 & 2 B23
Total Area =	408 ft^2

FIGURE 4A: PLAN VIEW – 600 GPD – TRENCH SYSTEM – LEVEL SITE



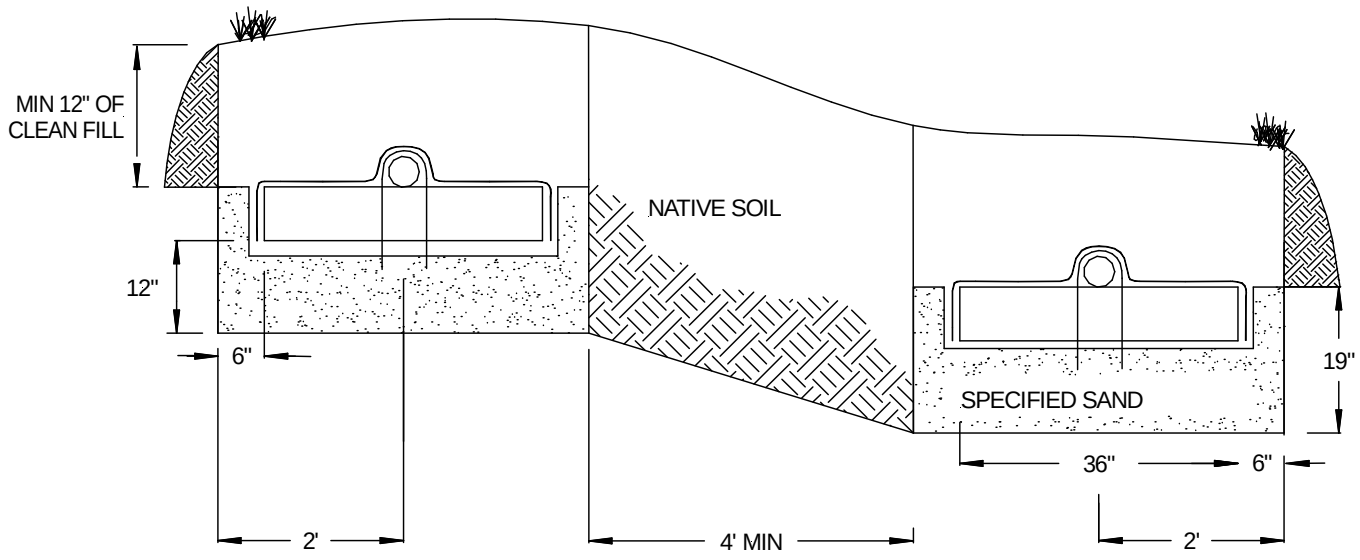
Design Flow 150 gpd x 4 Bedrooms = 600 gallons per day.
(12 B43 & 1 B23 Modules per Trench)

FIGURE 4B: SECTION VIEW – 600 GPD – TRENCH SYSTEM – LEVEL SITE



Design Flow 150 gpd x 4 Bedrooms = 600 gallons per day.
(12 B43 & 1 B23 Modules per Trench)

FIGURE 4C: SECTION VIEW – 600 GPD – TRENCH SYSTEM – SLOPING SITE



Design Flow 150 gpd x 4 Bedrooms = 600 gallons per day.
(12 B43 & 1 B23 Modules per Trench)

2.1 Trench Installation Sizing and Guidelines

Trench Installation Guidelines Additional guidance in State and Local regulations	
Determine the Number Modules	Determine the number of GSF Modules required using the trench sizing example.
Plan all Drainage Requirements	Plan all drainage requirements above (up-slope) of the system. Set soil grades to ensure that storm water drainage and ground water is diverted away from the absorption area once the system is complete.
Excavating the Trench Area	Scarify the receiving layer to maximize interface between the native soil and Specified Sand. Minimize walking in the trench prior to placement of the Specified Sand to avoid soil compaction.
Placing Specified Sand Base	Place Specified Sand in two 6 inch lifts, compact each lift at a time. The compacted height below the GSF module must be level at 12 inches. A hand tamping tool or vibrating compactor is both acceptable.
Place GSF Modules	Place the GSF Modules, ***PAINTED STRIPE FACING UP***, end to end on top of the Specified Sand along their 4-foot length.
Distribution Pipes Gravity & Lift Pump/Gravity Systems	A standard 4-inch perforated pipe, SDR 35 or equivalent, is centered along the modules 4-foot length. Orifices are set at the 5 & 7 o'clock position. All 4-inch pipes are secured with manufacturers supplied wire clamps, one per module.
Distribution Pipes: Pressure Systems	A standard 4-inch perforated pipe, SDR 35 or equivalent, is centered along the modules 4-foot length. Orifices are set at the 5 & 7 o'clock position. Insert a pressure pipe *(size per design and code)* into the standard 4-inch perforated pipe. The pressure pipe orifices are set at the 12 o'clock position as shown in Figure 7. Each pressure lateral will have a drain hole at the 6 o'clock position. All 4-inch pipes are secured with manufacturers supplied wire clamps, one per module.
Place Geotextile Cover Fabric	***Cover fabric substitution is not allowed.*** The installer should lay the Eljen provided geotextile cover fabric lengthwise down the trench, with the fabric fitted to the perforated pipe on top of the GSF modules. Fabric should be neither too loose, nor too tight. The correct tension of the cover fabric is set by: • Spreading the cover fabric over the top of the module and down both sides of the module with the cover fabric tented over the top of the perforated distribution pipe. • Place shovel full's of Specified Sand directly over the pipe area allowing the cover fabric to form a mostly vertical orientation along the sides of the pipe. Repeat this step moving down the pipe.
Placing Specified Sand after Cover Fabric is in place	Place 6 inches of Specified Sand along both sides of the modules edge. A minimum of 6 inches of Specified Sand is placed at the beginning and end of each trench.
Backfilling the System	Complete backfill with native soil to 12 - 18 inches over the GSF modules. Backfill exceeding 18 inches requires venting at the distal end of the trench. Fill must be clean, porous and devoid of rocks. Do not use wheeled equipment over the system during backfill operation. A light track machine may be used with extreme caution, avoiding crushing or shifting of pipe assembly. Divert surface runoff. Finish grade to prevent surface ponding. Topsoil and seed to protect from erosion.

Bed Example:

House size –	3 bedrooms
Soil Permeability min/in –	18 min/in
Design Flow – 150 gpd x 3 bedrooms =	450 gpd
Existing Soil Application Rate (for this example)	0.5 gpd/ft^2

(Note: Please refer to your State, County, and/or Local regulations for specific application rate information)

How to calculate reduced application rate:

0.5 gpd/ft^2 ÷ 0.5 (50% reduction) =	1.0 gpd/ft^2

How to calculate the modules necessary:

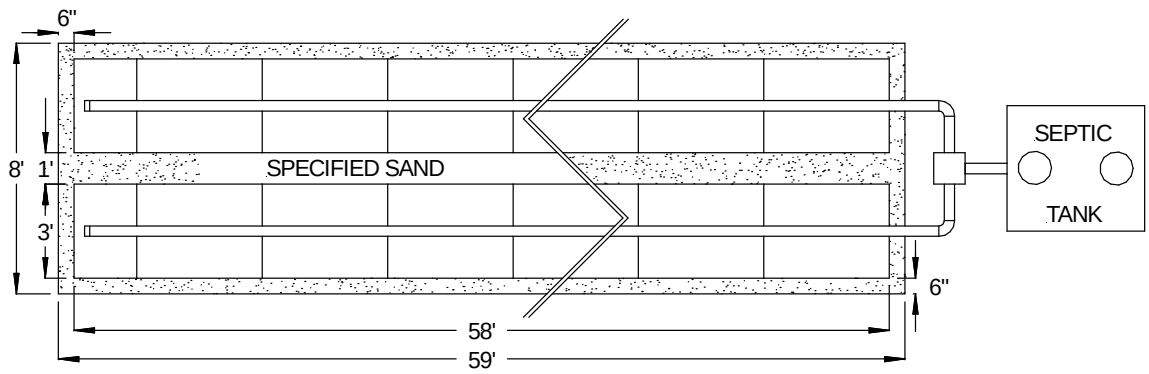
Field Size with Reduction = 450gpd ÷ 1.0 gdp/ft^2 =	450 ft^2
Number of units required = 450 ft^2 ÷ 16 ft^2 / module =	28.125 modules, round up to 29 modules

For this example, assume the number of rows equals two:

Bed Width – Module width (3ft) + Sand Sidewalls (6" + 6") x Rows (2) =	8 ft
Bed Length – 29 modules ÷ 2 rows = 14.5, use	14 B43 & 1 B23 modules per row
Modules (14.5) x 4 lf/module + 1 ft (6" sand at each end of bed) =	59 ft
Bed area (width x length x rows) – 4 ft x 59 ft x 2 rows =	472 ft^2

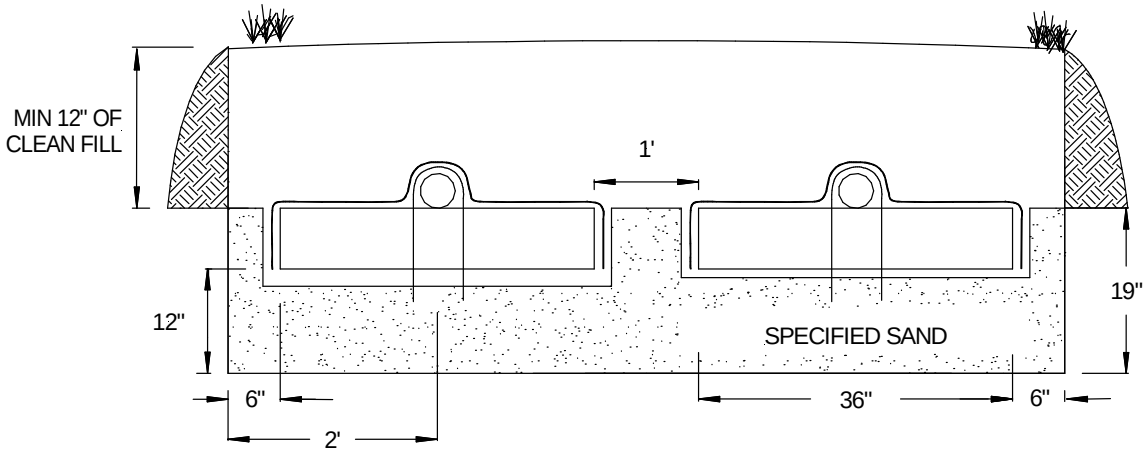
Bed Dimensions:	
Length =	59 ft
Width =	8 ft
Rows =	2
Modules =	28 B43 & 2 B23
Total Area =	472 ft^2

FIGURE 5A: PLAN VIEW – 450 GPD – BED SYSTEM – SLOPING SITE



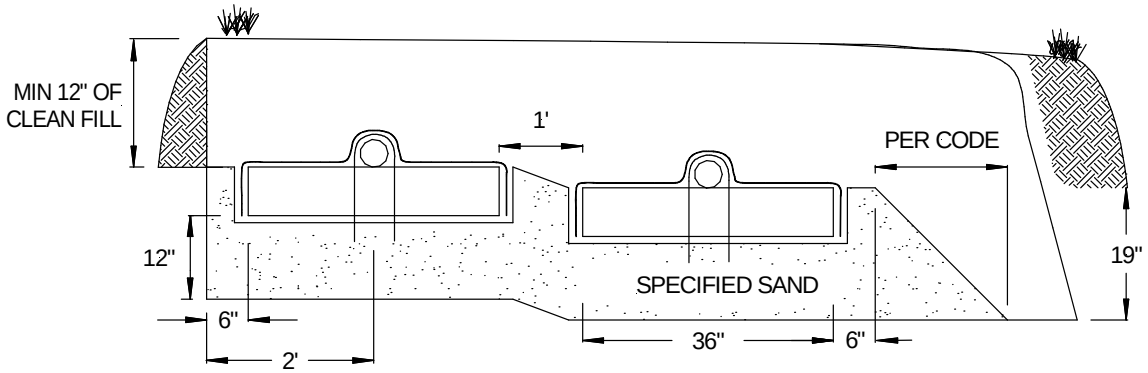
Design Flow 150 gpd x 3 Bedrooms = 450 gallons per day.
(14 B43 & 1 B23 Modules per Row)

FIGURE 5B: SECTION VIEW – 450 GPD – BED SYSTEM – LEVEL SITE



Design Flow 150 gpd x 3 Bedrooms = 450 gallons per day.
(14 B43 & 1 B23 Modules per Row)

FIGURE 5C: SECTION VIEW – 450 GPD – BED SYSTEM – SLOPING SITE



Design Flow 150 gpd x 3 Bedrooms = 450 gallons per day.
(14 B43 & 1 B23 Modules per Trench)

3.1 Bed Installation Sizing and Guidelines

Bed Installation Guidelines Additional guidance in State and Local regulations	
Determine the Number Modules	Determine the number of GSF Modules required using the bed sizing example.
Plan all Drainage Requirements	Plan all drainage requirements above (up-slope) of the system. Set soil grades to ensure that storm water drainage and ground water is diverted away from the absorption area once the system is complete.
Excavating the Bed Area	Scarify the receiving layer to maximize the interface between the native soil and Specified Sand. Minimize walking in the bed prior to placement of the Specified Sand to avoid soil compaction.
Placing Specified Sand Base	Place Specified Sand in two 6 inch lifts, compact each lift at a time. The compacted height below the GSF module must be level at 12 inches. A hand tamping tool or vibrating compactor is both acceptable.
Place GSF Modules	Place the GSF Modules, ***PAINTED STRIPE FACING UP***, end to end on top of the Specified Sand along their 4-foot length.
Distribution Pipes Gravity & Lift Pump/Gravity Systems	A standard 4-inch perforated pipe, SDR 35 or equivalent, is centered along the modules 4-foot length. Orifices are set at the 5 & 7 o'clock position. All 4-inch pipes are secured with manufacturers supplied wire clamps, one per module.
Distribution Pipes Pressure Systems	A standard 4-inch perforated pipe, SDR 35 or equivalent, is centered along the modules 4-foot length. Orifices are set at the 5 & 7 o'clock position. Insert a pressure pipe *(size per design and code)* into a standard 4-inch perforated pipe. The pressure pipe orifices are set at the 12 o'clock position as shown in Figure 7. Each pressure lateral will have a drain hole at the 6 o'clock position. All 4-inch pipes are secured with manufacturers supplied wire clamps, one per module.
Place Geotextile Cover Fabric	***Cover fabric substitution is not allowed.*** The installer should lay the Eljen provided geotextile cover fabric lengthwise down the row, with the fabric fitted to the perforated pipe on top of the GSF modules. Fabric should be neither too loose, nor too tight. The correct tension of the cover fabric is set by: • Spreading the cover fabric over the top of the module and down both sides of the module with the cover fabric tented over the top of the perforated distribution pipe. • Place shovel full's of Specified Sand directly over the pipe area allowing the cover fabric to form a mostly vertical orientation along the sides of the pipe. Repeat this step moving down the pipe.
Placing Specified Sand after Cover Fabric is in place	Place 6 inches minimum of Specified Sand along both sides of the modules and a minimum of 6 inches of Specified Sand is placed at the beginning and end of each row.
Backfilling the System	Complete backfill with native soil to 12 - 18 inches over the GSF modules. Backfill exceeding 18 inches requires venting at the distal end of the bed. Fill must be clean, porous and devoid of rocks. Do not use wheeled equipment over the system during backfill operation. A light track machine may be used with extreme caution, avoiding crushing or shifting of pipe assembly. Divert surface runoff. Finish grade to prevent surface ponding. Topsoil and seed to protect from erosion.

4.0 Pressure Mound Installation Sizing and Guidelines

4.1 PRESSURE MOUND REFERENCE: The following sizing and guidelines provide the dimensions of the distribution cell for your pressure mound. Consult the *Pressure Mound Systems, Technical Guidance for Site Suitability, Design, Construction and Operation and Maintenance, Michigan Department of Environmental Quality, June 2003* for more information on the construction of the pressure mound.

4.2 PRESSURE MOUND EXAMPLE:

House size –	4 bedrooms
Slope of site	4%
Soil Structure –	Loam/Sandy Clay Loam Moderately Blocky and Granular (2)
Design Flow – 150 gpd x 4 bedrooms =	600 gpd
Refer to Table 3, and find the soil loading rate.	0.5 gpd/ft^2
Refer to Table 3, and find the maximum hydraulic linear loading rate.	3.0 gpd/lf

FIGURE 6A: CROSS SECTION – PRESSURE MOUND SYSTEM

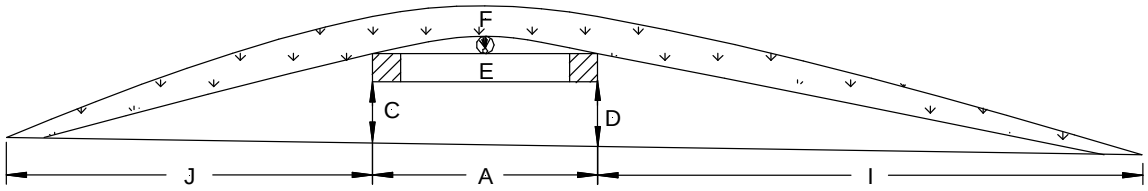
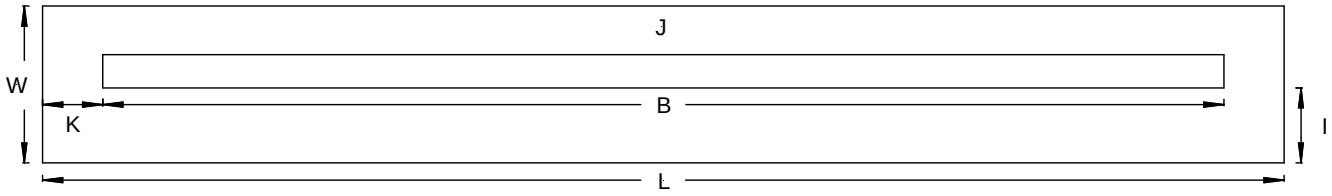


FIGURE 6B: PLAN VIEW – PRESSURE MOUND SYSTEM



A – Distribution cell width (accounts for sand) – **Minimum 4 ft for B43, Minimum 3 ft for A42**
B – Distribution cell length
C – Up slope fill depth under distribution cell – **Minimum 1 ft**
D – Downslope fill depth under distribution cell – **Minimum 1 ft**
E – Distribution cell depth – **Constant 7 in**
F – Depth of final cover – **Minimum 1 ft**
I – Distance from edge of distribution cell to downslope 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

4.3 CALCULATE VARIABLES: The following equations are from the guidelines.

A – Distribution cell width = Linear Loading Rate ÷ Sand Fill Loading Rate
(State Rule w/ 50% Reduction = 2.0 gpd/ft^2)

Linear Loading Rate from Table 3 = 3.0 gpd/lf ÷ 2.0 gpd/ft^2 = **1.5 ft**
(***NOTE:*** For this example, the minimum width of distribution cell is **3 ft** when using A42 Modules.)

B – Distribution cell length = Design Flow ÷ Linear Loading Rate

600 ÷ 3.0 gpd/lf = **200 ft**

C – Up slope fill depth under distribution cell = **Minimum 1 ft**
(***NOTE:*** For this example, assume the depth of fill at the up slope edge of the distribution cell is **1.5 ft**.)

D – Downslope fill depth under distribution cell = **Minimum 1 ft**

C + Slope of site (Distribution cell width)

1.5 ft + (0.04 x 3 ft) = **1.62 ft**

E – Distribution cell depth – Constant 7 in., convert to feet – **0.583 ft**

F – Depth of final cover = **Minimum 1 ft**

(***NOTE:*** For the slope of the mound, we are using a **recommended 4:1 slope)**

I – Distance from edge of distribution cell to downslope edge of fill:

Downslope correction factor = 100 ÷ [100 – (side slope x % ground slope)]

100÷ [100 – (4 x 4)] = **1.19**

4 x (D + E + F) x Downslope correction factor

4 x (1.62 + 0.583 + 1) x 1.19 = **15.25 ft**

J – Distance from edge of distribution cell to up slope edge of fill

Up slope correction factor – 100 ÷ [100 + (side slope x % ground slope)]

100 ÷ [100 + (4 x 4)] = **0.86**

4 x (C + E + F) x Up slope correction factor
4 x (1.62 + 0.583 + 1) x 0.86 = **11.02 ft**

K – Distance from end of distribution cell to edge of fill
4 x [{(C + D)/2} + E +F]

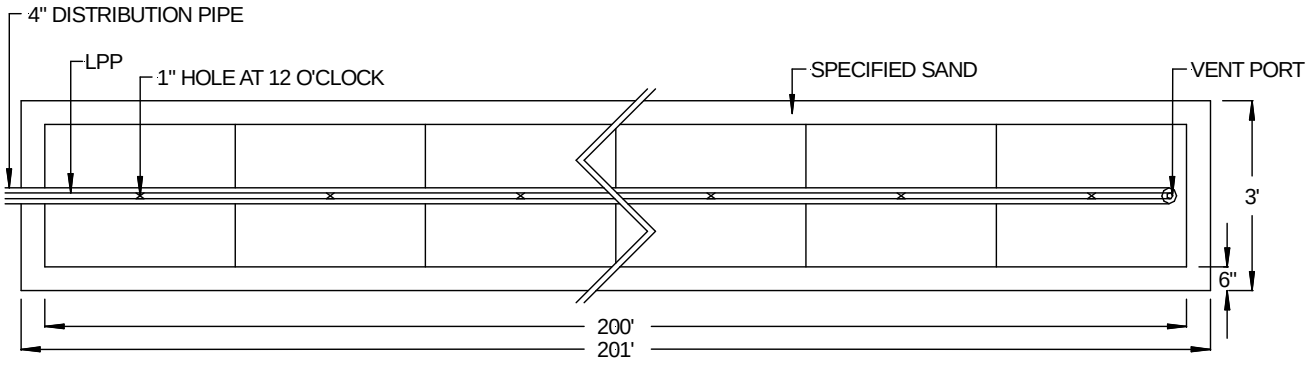
4 x [(1.5 + 1.62)/2 + 0.583 + 1] = **12.57 ft**

L – Overall mound fill length
B + 2(K)
200 + 2(12.57) = **225.14 ft**

W – Overall mound fill width
A + I + J
3 + 15.25 + 11.02 = **29.27 ft**

Distribution Cell Construction –
Width – 3 ft
Length – 200 ft
Modules in cell – 200 ft ÷ 4 lf per Modules = 50 A42 Modules

FIGURE 6C: PLAN VIEW – 450 GPD – DISTRIBUTION CELL MOUND SYSTEM



Mound Construction –
Width – 29.27 ft
Length – 225.14 ft

FIGURE 6D: SECTION VIEW – 450 GPD – MOUND SYSTEM

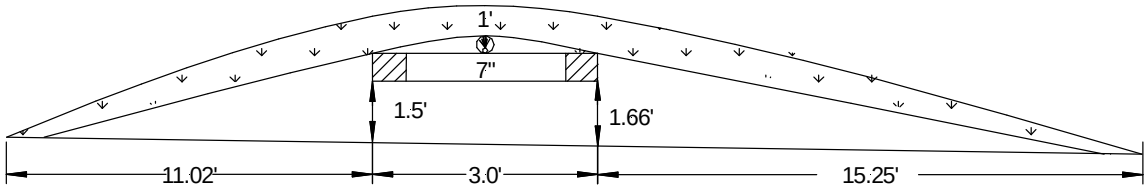
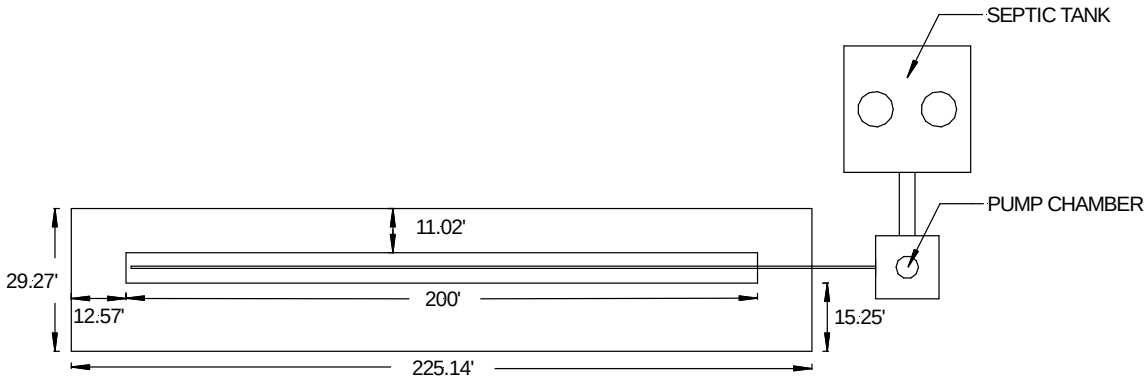


FIGURE 6E: SECTION VIEW – 450 GPD – MOUND SYSTEM



4.4 Pressure Mound Installation Sizing and Guidelines

Pressure Mound Installation Guidelines Additional guidance in State and Local regulations	
Determine the Number Modules	Determine the number of GSF Modules required using the mound sizing example.
Excavating the Bed Area	Scarify the receiving layer to maximize the interface between the native soil and Specified Sand. Minimize walking in the absorption area prior to placement of the Specified Sand to avoid soil compaction.
Placing Specified Sand Base	Place Specified Sand in two 6 inch lifts, compact each lift at a time. The compacted height below the GSF module must be level at 12 inches. A hand tamping tool or vibrating compactor is both acceptable.
Place GSF Modules	Place the GSF Modules, ***PAINTED STRIPE FACING UP***, end to end on top of the Specified Sand along their 4-foot length.
Distribution Pipes: • Lift Pump/Gravity • Siphons • Pressure	A standard 4-inch perforated pipe, SDR 35 or equivalent, is centered along the modules 4-foot length. Orifices are set at the 5 & 7 o'clock position. Insert a pressure pipe *(size per design and code)* into the standard 4-inch perforated pipe. The pressure pipe orifices are set at the 12 o'clock position as shown in Figure 7. Each pressure lateral will have a drain hole at the 6 o'clock position. All 4-inch pipes are secured with manufacturers supplied wire clamps, one per module.
Pump Chamber to the GSF System	Refer to local regulations for guidance · Lift Pump/Gravity Guidance · Pressure Distribution Guidance · Pump Controls
Place Geotextile Cover Fabric	***Cover fabric substitution is not allowed.*** The installer should lay the Eljen provided geotextile cover fabric lengthwise down the trench, with the fabric fitted to the perforated pipe on top of the GSF modules. Fabric should be neither too loose, nor too tight. The correct tension of the cover fabric is set by: • Spreading the cover fabric over the top of the module and down both sides of the module with the cover fabric tented over the top of the perforated distribution pipe. • Place shovel full's of Specified Sand directly over the pipe area allowing the cover fabric to form a mostly vertical orientation along the sides of the pipe. Repeat this step moving down the pipe.
Backfilling the System	Complete backfill with native soil to 12 - 18 inches over the GSF modules. Backfill exceeding 18 inches requires venting at the distal end of the bed. Fill must be clean, porous and devoid of rocks. Do not use wheeled equipment over the system during backfill operation. A light track machine may be used with extreme caution, avoiding crushing or shifting of pipe assembly. Divert surface runoff. Finish grade to prevent surface ponding. Topsoil and seed to protect from erosion.

5.0 Dosing Distribution Guidance

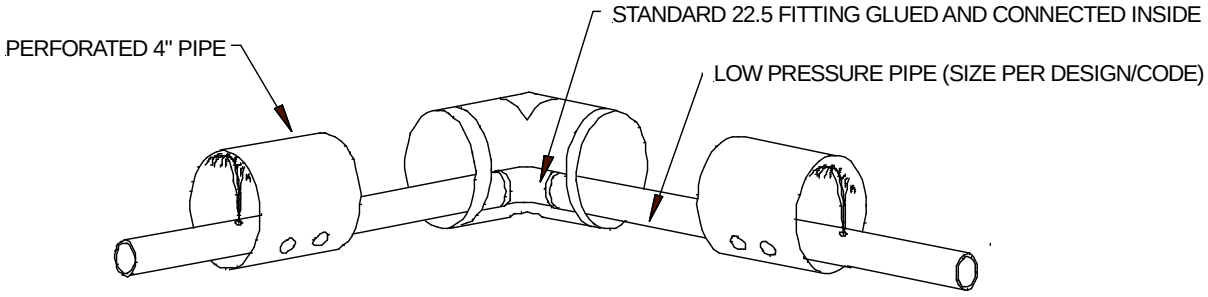
5.1 PUMP DISTRIBUTION BOX: Specify an oversized distribution box for pumped systems. Provide velocity reduction in the D-box with a tee or baffle. Set D-box invert 2 inches higher than invert of perforated pipe over GSF modules. If the absorption area is installed deeper than 18 inches, the system must be vented. See section 8.0 of this manual for detailed information on venting of systems.

5.2 DOSING DESIGN CRITERIA: Dosing volume must be set to deliver a maximum of 4 gallons per B43 Module and 3 gallons per A42 Module per dosing cycle with low head high volume pumps preferred. Higher flow rates and short dose cycle push the effluent down the line and thus disperse the effluent over a larger area. A valve on the force main is recommended to set the flow rate so that the orifices on the outlet pipes are submerged and the d-box does not overflow. Adjustment of the flow rate is likely needed if a row of modules are rested thus changing the number or outlets. Fewer outlets in the d-box force more effluent down each line and improve linear loading. Head loss and drain back volume must be considered in choosing the pump size and force main diameter.

6.0 Pressure Distribution Guidance

Standard procedures for design of pressure distribution networks apply to the GSF filter. Orifices shall be a minimum of 4-foot on center spacing so the orifices fall in the center of each module. A minimum orifice size of ¼ inch shall be maintained. A ¼ inch diameter drain hole is required at the 6 o'clock position of each pressure lateral for drainage purposes. The lateral pipe network *(size per design and code)* is placed within a standard 4-inch perforated pipe. The perforation in the 4-inch outer pipe are set at the 4 and 8 o'clock position, the drilled orifices on the pressure pipe are set to spray at the 12 o'clock position directly to the top of the 4-inch perforated pipe as shown below.

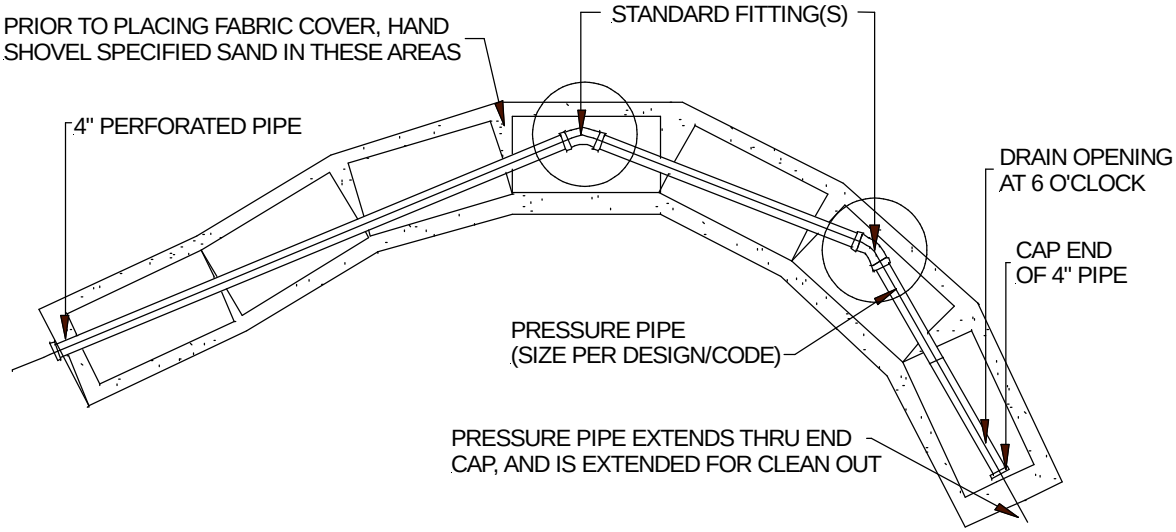
FIGURE 7: PRESSURE PIPE PLACEMENT



Pressure pipe placement when following contours or changes in trench direction.

6.0 Pressure Distribution Guidance

FIGURE 8: CONTOURED TRENCH PRESSURE DISTRIBUTION



GSF Pressure Distribution trench placed on a contour or winding trenches to maintain horizontal separation distances may also be used in Dosed or Gravity system by removing the pressure pipe and using the 4-inch diameter perforated distribution pipe.

7.0 Pump Controls

Demand and Pressure Dosed controlled systems will include an electrical control system that has the alarm circuit independent of the pump circuit, controls and components that are listed by UL or equivalent, is located outside, within line of sight of the pump chamber and is secure from tampering and resistant to weather (minimum of NEMA 4). The control panel shall be equipped with cycle counters and elapsed time meters. Where a water supply water meter is available it may be possible to eliminate the counters or timers.

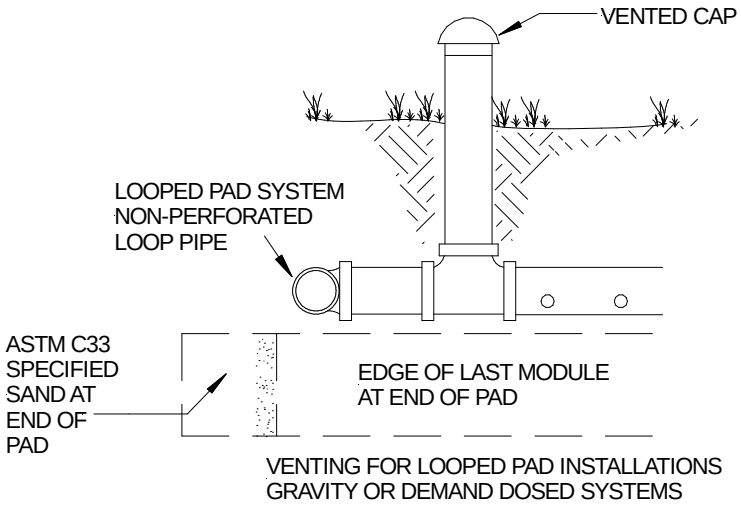
The control panel shall be equipped with both audible and visual high liquid level alarms installed in a conspicuous location. Float switches shall be mounted independent of the pump and force main so that they can be easily replaced and/or adjusted without removing the pump.

8.0 System Ventilation

8.1 SYSTEM VENTILATION: Air vents are required on all absorption systems located under impervious surfaces or systems **with *more than 18 inches of cover material*** as measured from the top of the GSF module to finished grade. This will ensure proper aeration of the modules and sand filter. The GSF PAD has aeration channels between the rows of GSF modules connecting to cuspations within the GSF modules. Under normal operating conditions, only a fraction of the filter is in use. The unused channels remain open for intermittent peak flows and the transfer of air. The extension of the distribution pipe to the vent provides adequate delivery of air into the GSF system, as shown in Figure 13.

Home plumbing operates under negative pressure due to hot water heating the pipes and reducing the density of air in the house vent. As hot air rises and exits the home, it must be replaced by air from the GSF. To maintain this airflow and fully aerate the GSF system, it is important that air vents are located only on the distal end of the GSF pipe network.

FIGURE 9: VENT FOR GRAVITY AND PRESSURE DOSED BED SYSTEMS



8.2 VENTILATION FOR PRESSURE AND DEMAND DOSED SYSTEMS: If a pressure or demand dosed system is specified with greater than 18 inches of cover, an additional 2-inch minimum air line must be extended from the GSF D-box back to a knockout or riser on the septic tank or pump chamber. This maintains the continuity of airflow from the field into the house plumbing.

FIGURE 10: AIR BY-PASS LINE PLAN VIEW FOR VENTING OF PUMPED SYSTEMS

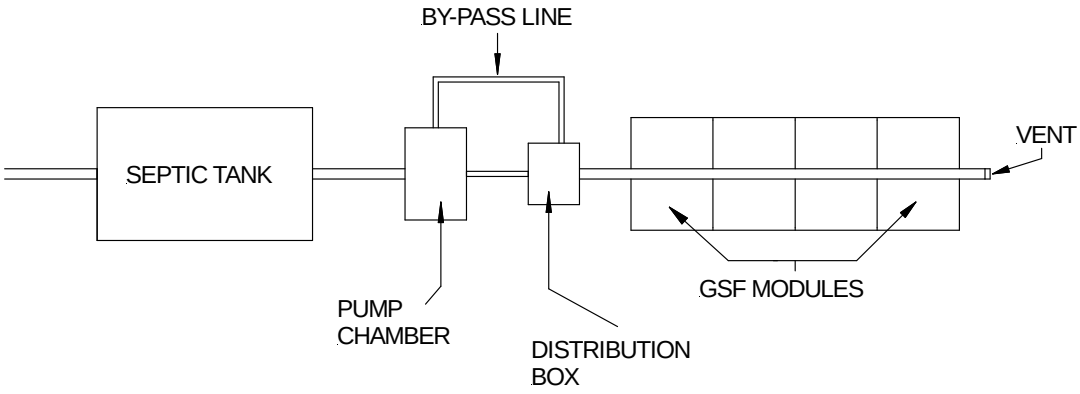
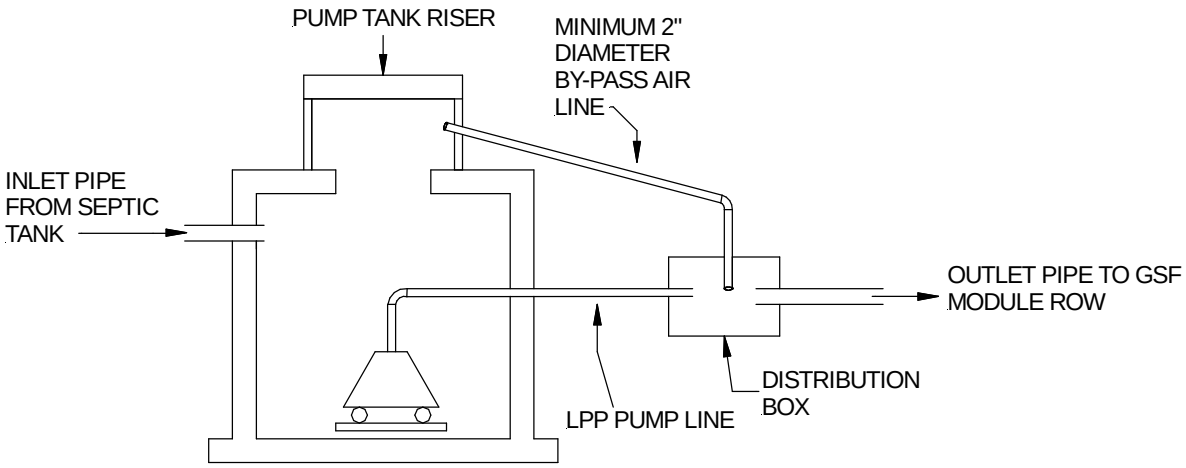
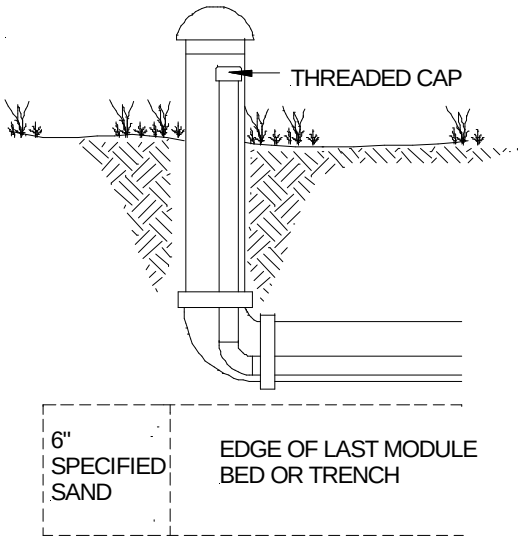


FIGURE 11: AIR BY-PASS LINE CROSS SECTION FOR VENTING OF PUMPED SYSTEM



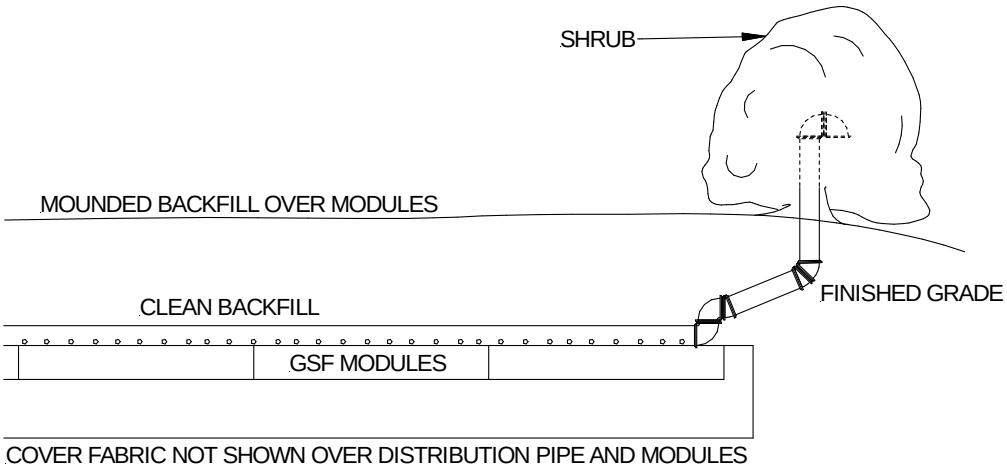
8.3 VENT PIPE FOR LOW PRESSURE DISTRIBUTION SYSTEMS: If the system is a low pressure distribution system with greater than 18 inches of cover, ensure that the LPP clean outs are located in the vent for easy access.

FIGURE 12: PRESSURE CLEAN OUT PRESSURE DOSED SYSTEMS



8.4 VENTILATION PLACEMENT: In a GSF system, the vent is usually a 4-inch diameter pipe extended to a convenient location behind shrubs, as shown in Figure 13. Corrugated pipe may be used. If using corrugated pipe, ensure that the pipe does not have any bends that will allow condensation to pond in the pipe. This may close off the vent line. The pipe must have an invert higher than the system so that it does not drain effluent.

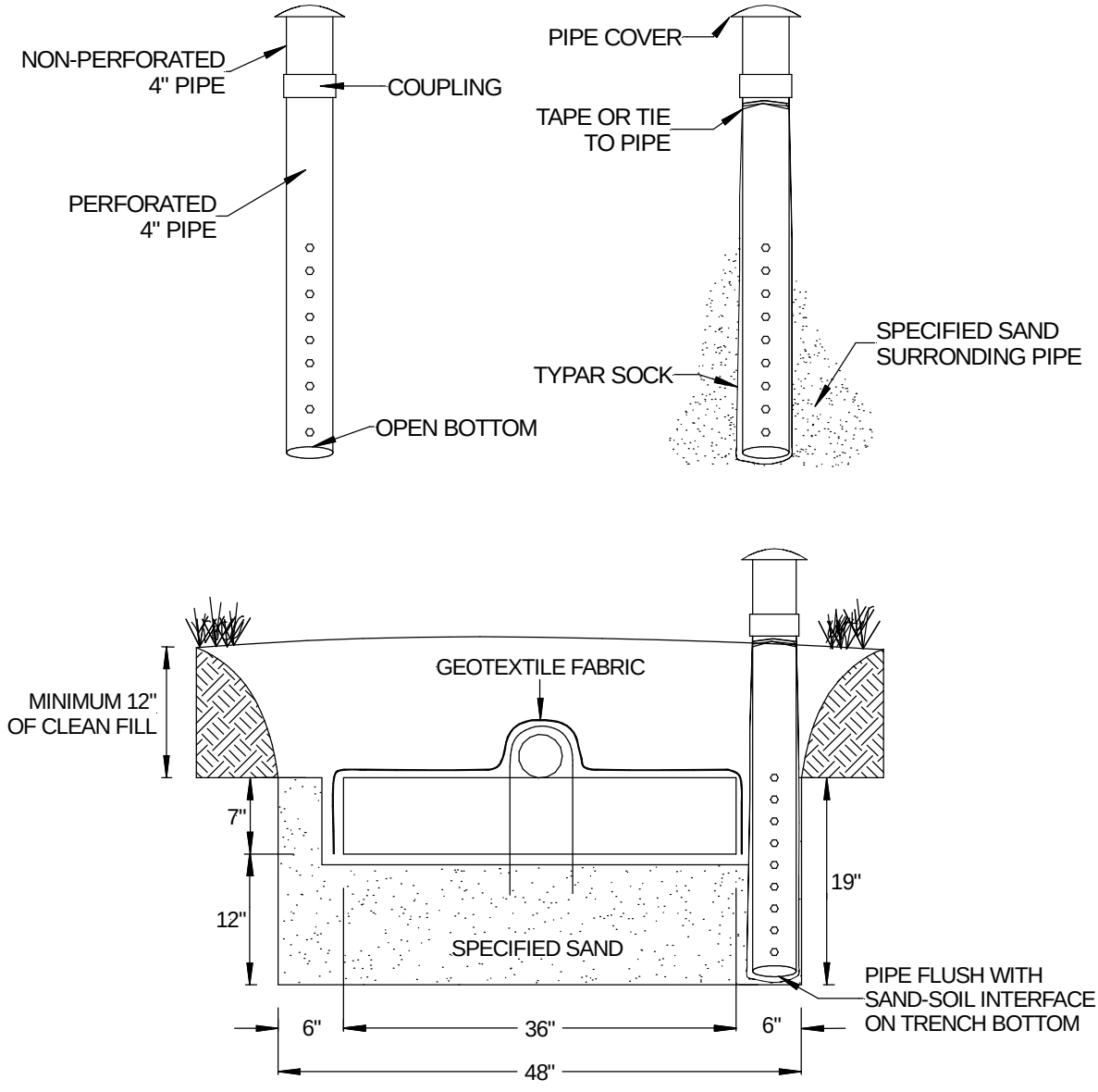
FIGURE 13: GSF WITH 4" VENT EXTENDED TO CONVENIENT LOCATION



9.0 Inspection/Monitoring Port

The system shall include an Inspection/Monitoring Port designed and installed with access from the ground surface. It shall be open and slotted at the bottom, and be void of sand or gravel to the infiltrative surface to allow visual monitoring of standing liquid in the trench. The figures below depict construction and placement of the Inspection/Monitoring Port. Positioning of the port in reference to the length of the trench is in accordance to your local regulations and specifications.

FIGURE 14: MONITORING WELL FOR SAND-SOIL INTERFACE



10.0 GSF Inspection Check List

Geotextile Sand Filter, (GSF) Checklist					
Facility Owner:					
Facility Address:					
Installation Date: (MDY)					
Previous Inspection Date: (MDY)					
Date of Inspection : (MDY)					
Residential Number of Bedrooms:					
Is this a Commercial Design? If yes what type:	Yes	No			
What is the estimated BOD5 and TSS strength?	BOD5	TSS	Comments		
Observation Port Location(s):	1		2	3	
Inspection Data, (complete all fields)					
Is daily flow within the system design flow? If no, explain:	Yes	No			
Does the owner verify the system use as described above? If no, explain:	Yes	No			
Septic tank last inspection date:	Date				
Inspected by:					
Septic tank last pumped date:					
Is pumping recommended?	Yes	No			
Condition of the soil absorption system: Wet, Dry, Firm, Soft, Vegetative, or Other. If Other, explain:	W	D	S	F	V
Is there evidence of storm water flows or erosion over the septic system? If yes, explain:	Yes	No			

10.0 GSF Inspection Check List

Is there evidence of soil slump or compaction by traffic or other means in the vicinity of the soil absorption system? If yes, describe:	Yes	No	Comments
Is effluent visible through the observation port? If yes, describe the condition and the fluid level:	Yes	No	Comments
Is there a garbage disposal in the home?	Yes	No	Comments
Is a water softer connected to the system?	Yes	No	Comments
Are solids visible through the observation port? If yes, describe the condition and depth of solids:	Yes	No	Comments
Is there evidence of surcharging or effluent ponding in the D-Box? If yes, describe and measure:	Yes	No	Comments
Are the system vents in place?	Yes	No	Comments
Are they operational? If no, describe conditions and location:	Yes	No	
Describe any other pertinent issues:			

Inspected by:	
License Number:	
Date:	
Time:	
Print Name & Signature of Inspector:	
I certify I have inspected the system at the above address, completed this report, and the information reported is true, accurate, and complete.	