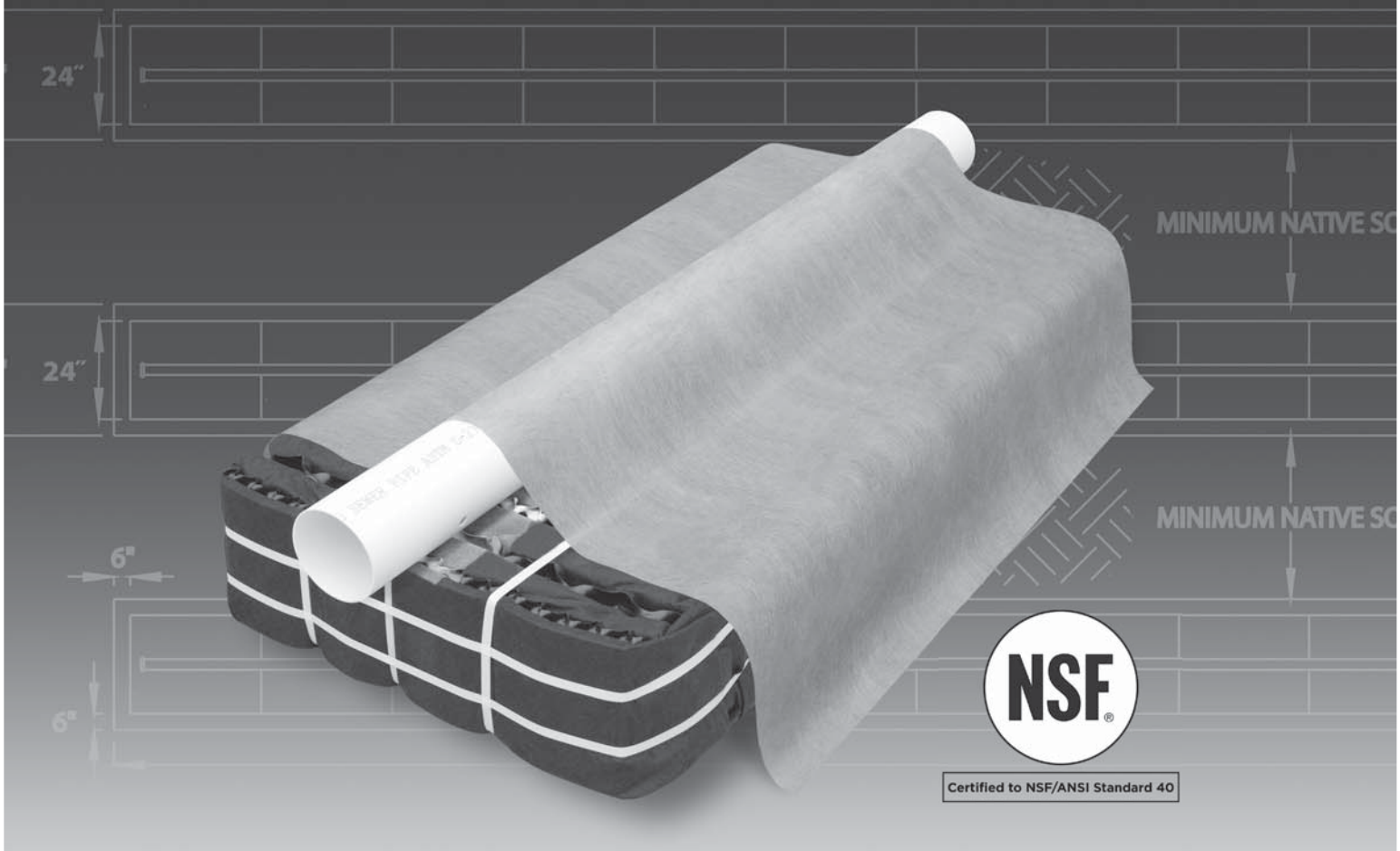
GSF®

Geotextile Sand Filter

Indiana
Design & Installation Manual



eljen CORPORATION

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Glossary of Terms

A42 Module	48” x 24” x 7” (L x W x H)
B43 Module	48” x 36” x 7” (L x W x H)
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, is placed over the GSF modules. This material cannot be substituted.
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.
Flow Dial/Equalizer	Special insert placed in the outlet of the distribution pipes within the distribution box to compensate for possible un-level installation and promote favorable flow to the distribution pipes.
GSF Unit	The Eljen Geotextile Sand Filter Modules and the minimum 6-inch (for subsurface trench or bed) or minimum 12-inch (for above grade or elevated sand mound) 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 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.
Sequential Distribution	Designs common to sloping sites where GSF lines that are laid on contour and receive effluent from a series of drop boxes at different elevations. Effluent floods up-slope lines and then spills excess effluent to down-slope lines. Non-perforated pipe placed on undisturbed soil connects successive down-slope trenches.
SHWT	Seasonal High Water Table (SHWT) is the upper limit of soil saturated with water for periods long enough for anaerobic conditions to affect soil color.

Glossary of Terms

Specified Sand

To ensure proper system operation, the system MUST be installed using Indiana State Highway Specification 23 sand AND must be used in accordance with ISDH Rule 410 IAC 6-8.3 (80) (j) or ISDH Rule 410 6-10.1 (88) (j). Ask your material supplier for a sieve analysis to verify that your material meets the required specifications.

TABLE 1: SPECIFIED SAND SIEVE REQUIREMENTS

INDIANA STATE HIGHWAY SPECIFICATION 23 SAND		
Sieve Size	Sieve Square Opening Size	Specification Percent Passing (Wet Sieve)
3/8 inch	9.5 mm	100
No. 4	4.75 mm	95 - 100
No. 8	2.36 mm	80 - 100
No. 16	1.18 mm	50 - 85
No. 30	600 µm	25 - 60
No. 50	300 µm	5 - 30
No. 100	150 µm	0 - 10
No. 200	75 µm	0 - 3

*Note: The fine aggregate shall not have more than forty-five percent (45%) retained between any two (2) consecutive sieves. Aggregate which meets Indiana State Highway Specification 23 meets these criteria.

STE

Septic Tank Effluent (STE)

Width & Length

The system width is the sand dimension perpendicular to the GSF module rows. The system length is measured parallel to the rows of GSF modules.

Wire Clamp

Wire Clamps are used to secure perforated pipe above the GSF modules.

GSF System Description

The Eljen GSF Geotextile Sand Filter system is a cost-effective upgrade from other septic treatment technologies. Comprised of a proprietary two-stage Bio-Matt™ pre-treatment process, the geotextile modules apply filtered septic tank effluent to the soil, increasing the soil's ability to accept the effluent and increase the long-term acceptance rate (LTAR). The result is a superior performance in a smaller soil absorption area.

How the GSF System Works

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 absorption area.
- 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 slowly 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

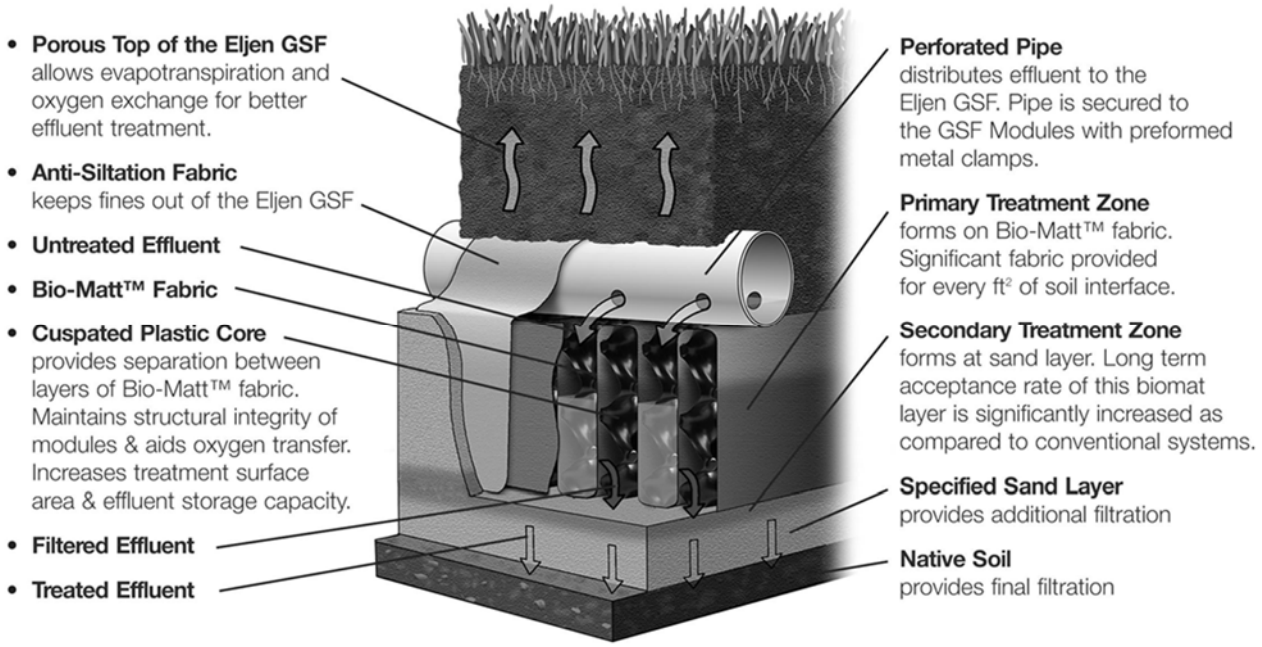


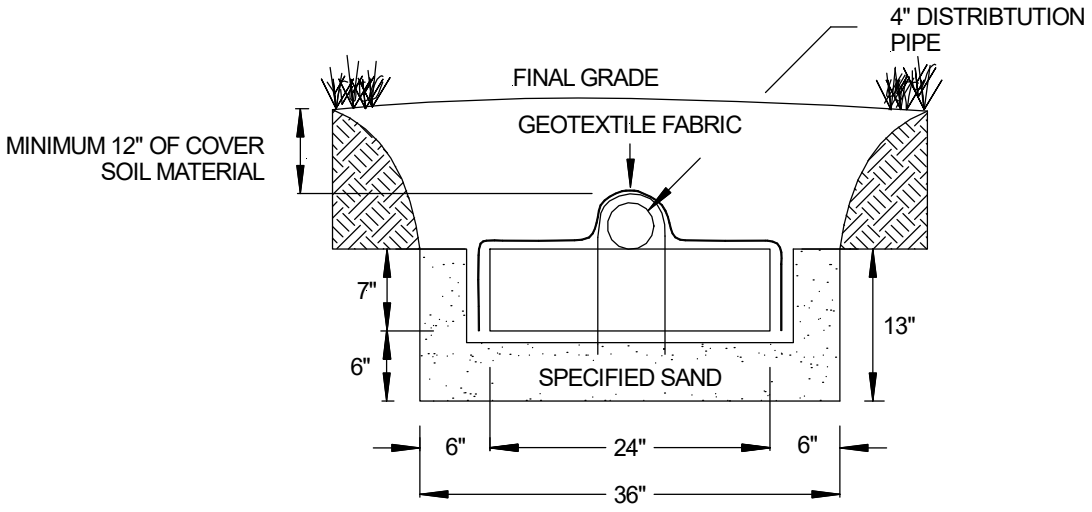
TABLE 2: SUBSURFACE SOIL LOADING RATES

Table IV - Soil Loading Rates for Subsurface Trench and Bed Onsite Sewage Systems (in gpd/ft^2)								
	SOIL STRUCTURE CLASSES							
SOIL TEXTURE CLASSES	Single Grain	Granular	Strong: Angular, Sub-Angular Blocky, Prismatic	Moderate: Angular, Sub-Angular Blocky, Prismatic	Weak: Angular, Sub-Angular Blocky, Prismatic; Platy[1]	Fragic Characteristics: Very Coarse Prismatic	Structureless, Massive, Friable, V. Friable	Structureless, Massive, Compact, Firm, V. Firm; Platy[2]
Gravel, Coarse Sand	>1.20	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Loamy Coarse Sand, Medium Sand	1.20	1.20	N/A	N/A	1.20	N/A	N/A	N/A
Fine Sand, Loamy Sand, Loamy Fine Sand	0.75	0.60	N/A	0.75	0.75	N/A	0.75	N/A
Very Fine Sand, Loamy V. Fine Sand	0.50	0.50	N/A	0.75	0.60	N/A	0.60	N/A
Sandy Loam, Coarse Sandy Loam	N/A	0.75	N/A	0.60	0.60	0.00	0.60	0.00
Fine Sandy Loam, V. Fine Sandy Loam	N/A	0.75	N/A	0.60	0.60	0.00	0.60	0.00
Loam	N/A	0.75	0.75	0.50	0.50	0.00	0.50	0.00
Silt Loam, Silt	N/A	0.75	0.75	0.50	0.30	0.00	0.30	0.00
Sandy Clay Loam	N/A	0.60	0.60	0.50	0.30	0.00	0.30	0.00
Silty Clay Loam, Clay Loam, Sandy Clay	N/A	0.60	0.60	0.30	0.25	0.00	0.25	0.00
Silty Clay, Clay	N/A	0.60	0.50	0.30	0.25	N/A	0.25	0.00
Organic Soil Materials	N/A	N/A	N/A	N/A	N/A	N/A	0.00	N/A
Limnic Soil Materials	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
Bedrock	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
N/A NOT APPLICABLE								
[1]Naturally occurring platy structure.								
[2]Platy structure caused by mechanical compaction has a soil loading rate of 0.00 gpd/ft^2 unless broken up by methods approved by the department.								

TABLE 3: ABOVE GROUND SOIL LOADING RATES

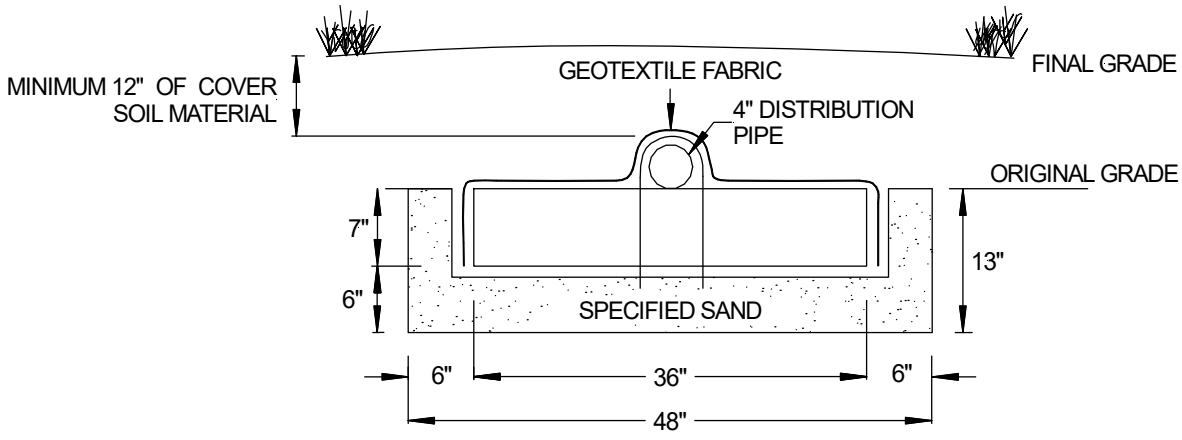
Table V – Soil Loading Rates for Elevated Sand Mound Onsite Sewage Systems (in gpd/ft^2)								
SOIL STRUCTURE CLASSES								
SOIL TEXTURE CLASSES	Single Grain	Granular	Strong: Angular, Sub-Angular Blocky, Prismatic	Moderate: Angular, Sub-Angular Blocky, Prismatic	Weak: Angular, Sub-Angular Blocky, Prismatic; Platy[1]	Fragic Characteristics: Very Coarse Prismatic	Structureless, Massive, Friable, V. Friable	Structureless, Massive, Compact, Firm, V. Firm; Platy[2]
Gravel, Coarse Sand	>1.20	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Loamy Coarse Sand, Medium Sand	1.20	1.20	N/A	N/A	1.20	N/A	N/A	N/A
Fine Sand, Loamy Sand, Loamy Fine Sand	0.60	0.60	N/A	0.60	0.60	N/A	0.60	N/A
Very Fine Sand, Loamy V. Fine Sand	0.50	0.50	N/A	0.50	0.50	N/A	0.50	N/A
Sandy Loam, Coarse Sandy Loam	N/A	0.60	N/A	0.60	0.60	0.00	0.60	0.00
Fine Sandy Loam, V. Fine Sandy Loam	N/A	0.60	N/A	0.60	0.60	0.00	0.60	0.00
Loam	N/A	0.50	0.50	0.50	0.50	0.00	0.50	0.00
Silt Loam, Silt	N/A	0.50	0.50	0.50	0.50	0.00	0.50	0.00
Sandy Clay Loam	N/A	0.50	0.50	0.50	0.50	0.00	0.50	0.00
Silty Clay Loam, Clay Loam, Sandy Clay	N/A	0.25	0.25	0.25	0.25	0.00	0.25	0.00
Silty Clay, Clay	N/A	0.25	0.25	0.25	0.25	N/A	0.25	0.00
Organic Soil Materials	N/A	N/A	N/A	N/A	N/A	N/A	0.00	N/A
Limnic Soil Materials	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
Bedrock	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
N/A NOT APPLICABLE								
[1] Naturally occurring platy structure.								
[2] Platy structure caused by compaction has a soil loading rate of 0.00 gpd/ft^2 unless broken up by methods approved by the department.								

FIGURE 2: SUBSURFACE A42 TRENCH CROSS SECTION



6 inches of Specified Sand is required at the sides of the GSF module
6 inches of Specified Sand is required at the beginning and end of each GSF Trench.
6 inches of Specified Sand is required directly below the GSF module.
Minimum 12 inches of cover soil material above the 4-inch distribution pipe.
Maximum trench depth from Final Grade is 36 inches.

FIGURE 3: SUBSURFACE B43 SINGLE LATERAL BED CROSS SECTION



6 inches of Specified Sand is required at the sides of the GSF module
6 inches of Specified Sand is required at the beginning and end of each GSF row.
6 inches of Specified Sand is required directly below the GSF module.
Minimum 12 inches of cover soil material above the 4-inch distribution pipe.
Maximum trench depth from Final Grade is 36 inches.

General Design and Installation

1. REQUIREMENTS: GSF systems must meet ISDH Rule 410 IAC 6-8.3 except as outlined in this manual. The Eljen GSF Indiana Design and Installation Manual and the local regulations will be referred to as the *Code or Regulations* in this manual.

- The sizing tables in this manual (Table 5 and 6) applies to residential systems of any size and
- Commercial systems with daily design flows less than or equal to 750 GPD

Sizing examples are found in this manual. Please contact Eljen's Technical Resource Department at 1-800-444-1359 for design information on commercial systems and adhere to ISDH Rule 410 6-10.1.

2. SUITABLE SITE AND SOIL CONDITIONS: The Eljen Modules maybe designed for all sites that meet the criteria described in the Indiana State Department of Health, Residential Onsite Sewage Systems, Rule 410 IAC 6-8.3 (70-73) or ISDH Rule 410 6-10.1 (78-80).

3. VERTICAL SEPARATION TO SEASONAL HIGH WATER TABLE OR LIMITING LAYER: Refer to sections Rule 410 IAC 6-8.3 70.b.5 for subsurface absorption systems and Rule 410 IAC 6-8.3 72.b.4 for elevated systems and above grade beds or ISDH Rule 410 6-10.1 (61).

Vertical Separation Distance (VSD) for Eljen GSF System Types

System Type	Daily Design Flow	Limiting Layer	Seasonal High Water Table
Subsurface Trench	≥450	30"	24"
	<450	24"	
Single Lateral Bed	≥450	30"	24"
	<450	24"	
Subsurface Bed	≥450	30"	24"
	<450	24"	
Any type subsurface system utilizing Pressure Distribution	Any	24"	24"
VSD measured from the bottom of the excavated trench or bed for the subsurface systems.			
Above Grade Bed (12" of sand under GSF module)	Any	20"	20"
Elevated Sand Mound (12" of sand under GSF modules and a pressure distribution network)	Any	20"	20"
VSD measured from the original grade for the above grade bed and ESM systems.			

4. MINIMUM DEPTH FROM ORIGINAL GRADE FOR SUBSURFACE SYSTEMS: The minimum depth from existing grade for subsurface systems is 10 inches from original grade. That is the start of the sand/soil interface for the system.

5. SPECIFIED SAND REQUIREMENTS FOR SYSTEMS: The first 6 inches of sand for a subsurface and 12 inches of sand for a elevated sand mound and above grade bed immediately under, between rows and around the perimeter of the GSF system must be ***INDIANA DEPARTMENT OF TRANSPORTATION (INDOT) SPECIFICATION 23 SAND.*** Please place a prominent note to this effect on each design drawing. See Table 1 for more information on the sand and sieve specifications.

6. CONNECTIONS AND FITTINGS: Connections of lines to tanks and distribution boxes must follow requirements of 410 IAC 6-8.3 or ISDH Rule 410 6-10.1.

7. PLACING GSF MODULES: Each row of modules is laid level along their length and width, end to end along the four-foot length on the Specified Sand layer. No mechanical connection is required between modules. For effective effluent distribution, long and narrow systems are recommended.

8. DISTRIBUTION PIPE: Place perforated pipe on top of GSF modules with holes at 4 and 8 o'clock. Secure pipe to GSF modules with provided wire clamps, one clamp per Eljen module. All distribution piping must meet the requirements of ISDH Rule 410 6-8.3 Section 67 or ISDH Rule 410 6-10.1 Section 75.

9. DISTRIBUTION BOX (D-BOX): Parallel distribution is preferred. Sequential distribution may be utilized for sloping sites. Distribution boxes are recommended to be 5 feet from the proximal end of each soil absorption field trench as per Rule 410 IAC 6-8.3 Section 75.i or ISDH Rule 410 6-10.1 Section 74. In bed and above grade systems, this may be amended to shorter distance per the designer.

10. PARALLEL DISTRIBUTION: Parallel distribution is the preferred method of dosing to a gravity or pump to gravity system. It encourages equal flows to each of the lines in the system. It is recommended for most trench and bed systems.

11. SEQUENTIAL DISTRIBUTION: Sequential Distribution using a distribution box will fully utilize the uppermost section of the system prior to spilling effluent into a lower row of modules. This is for use on any site with greater than 0.5% slope and parallel distribution cannot be used. Contact the Eljen Technical Resource Department with sequential distribution design information and inquiries.

12. COVER FABRIC: Geotextile cover fabric is provided by Eljen Corporation for all GSF systems. **Cover fabric substitution is not allowed.** Place the cover fabric over the system after setting the distribution pipes in place and secured with wire clamps. Fabric shall drape vertically over the pipe and extend to the bottom of the modules on either side. The fabric must neither block holes nor be stretched from the top of the module. "Tenting" i.e. pulling the fabric tight will cause undue stress on fabric and pipe. Geotextile Cover Fabric prevents fines and backfill material from entering the GSF system.

13. BACKFILL & FINISH GRADING: Complete backfill with a minimum of 12 inches of cover soil material measured from the top of the distribution pipe. Ensure backfill does not exceed 19 inches from the top of the module. The maximum depth from the final grade to the bottom of the system sand is 36 inches. If system cover exceeds 18 inches; vent the far end of the system. Use well graded cover soil material 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 system area. Finish grade to prevent surface ponding. Topsoil and seed system area to protect from erosion.

14. NUMBER OF GSF MODULES REQUIRED: Tables 5 and 6 of this manual indicate the minimum number of A42 or B43 modules allowed. Systems can always be designed beyond the minimum required number of modules. The minimum design requirements per 150 gpd are 6 A42 modules or 5 B43 modules. Refer to 28. Sizing GSF Systems for more details.

15. TRENCH/ROW LENGTH: Trenches and Rows will have a maximum of 100 ft in length unless pressure dosed per 410 IAC 6-8.3 (74) (r) or ISDH Rule 410 6-10.1 (82) (r).

16. ADDITIONAL FACTORS AFFECTING 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.

17. 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 if a multi-compartment tank isn't used

18. SEPTIC TANK OUTLET FILTERS: Eljen requires the use of septic tank outlet effluent filters on all tanks including single compartment tanks, up-sized tanks or when the dwelling has a garbage disposal installed.

19. ALTERATION OF MODULES: GSF modules shall not be altered by cutting or any other type of physical modification.

20. EQUAL LENGTH: Trenches must be of equal length in order to provide equal distribution.

21. WATER SOFTENER BACKWASH: Water softener backwash shall be discharged to a separate soil absorption field meeting all required codes and regulations.

22. SPACING GUIDANCE BETWEEN TRENCHES AND SINGLE LATERAL ROWS: Ensure trenches are of equal length throughout the system. If using the B43 in a single lateral bed system, ensure there is center to center distance of 10 feet and 7.5 feet center to center distance for the A42 in a trench.

23. SYSTEM LENGTH AND WIDTH: Best engineering practices should be used when construction the bed systems. Rule IAC 6-8.3 (79) (2) and ISDH Rule 410 6-10.1 (88) (a) states the dimensions of the bed shall be as long and narrow as the site allows.

24. DISPERSAL AREA: Dispersal area requirements are located in IAC 6-8.3 (58) or ISDH Rule 410 6-10.1 (87).

25. SITE PREPARATION: Refer to IAC 6-8.3 or ISDH Rule 410 6-10.1 (75), for all site preparation requirements prior to site construction.

26. SAND EXTENSION: For subsurface bed systems other than single lateral beds on slopes between 0.5% and 10%, a minimum downslope extension of 4 feet of INDOT SPEC 23 sand extending from the edge of the furthest downslope GSF module is required. For slopes between 10% to 15%, a minimum downslope extension of 6 feet of INDOT SPEC 23 sand extending from the edge of the furthest downslope GSF module is required.

27. BED DESIGN: For beds with less than a 0.5% slope, evenly distribute the bed laterals in the absorption area. For all slopes greater than 0.5%, Eljen recommends moving the upper most lateral a distance of 1.5' to 2' (for A42 and B43 respectively) from the upper edge of the absorption area while maintaining a minimum of 6 inches between the module and the upper edge of the absorption area. A minimum separation distance between laterals for A42's is 3' and a minimum separation distance between laterals of 4' for B43's. For sloping sites greater than 0.5%, you should have a distance between laterals of 3' for A42 and 4' for B43's.

The overall goal is keep the distribution laterals upslope, while maintaining a minimum of one foot in between the modules. Designers may extend the lateral separation depending on their design as long as the requirements for the sand extension in section 26 are met.

TABLE 4: BED DESIGN DECISION TABLE

<table>
<tr><th rowspan="2">Depth of Excavation</th><th rowspan="2">Slope</th><th colspan="2">Upper Edge to Lateral Spacing</th><th colspan="2">Lateral to Lateral Spacing</th><th rowspan="2">Example</th></tr>
<tr><th>A42</th><th>B43</th><th>A42</th><th>B43</th></tr>
<tr><td rowspan="3">10 - 36 Inches</td><td>Less than or Equal to 0.5%</td><td colspan="2">Lateral to Lateral Spacing ÷ 2</td><td colspan="2">Absorption Bed width divided by number of rows</td><td>2</td></tr>
<tr><td rowspan="2">Greater 0.5%</td><td>Min 1.5 ft</td><td>Min 2 ft</td><td>Min 3 ft</td><td>Min 4 ft</td><td>3</td></tr>
<tr><td></td><td></td><td></td><td></td><td>4</td></tr>
<tr><td rowspan="2">Above Grade</td><td>Less than or Equal to 0.5%</td><td colspan="2">Lateral to Lateral Spacing ÷ 2</td><td colspan="2">Absorption Bed width divided by number of rows</td><td>5</td></tr>
<tr><td>Greater 0.5%</td><td>Min 1.5 ft</td><td>Min 2 ft</td><td>Min 3 ft</td><td>Min 4 ft</td><td>6</td></tr>
</table>

28. ABOVE GRADE BED DESIGN: For all elevated beds, a required 12 inches of sand shall be below the modules, with 3:1 slopes. Sand shall go to the top edge of the module. A minimum of 12 inches of cover soil material is required over the pipe. Sloping sites shall meet the guidance in 26. Sand Extension and shall not be place on slopes greater than 6%.

29. SIZING GSF SYSTEMS:

TABLE 5: GSF TRENCH OF SINGLE LATERAL BED SIZING CHART

Soil Loading Rate (gpd/sf)	Required Area of Absorption Field (Square Feet)			A42 Modules per House			B43 Modules per House		
	Bedrooms per House			Bedrooms per House			Bedrooms per House		
	3	4	5	3	4	5	3	4	5
1.2	252	335	419	21	28	35	16	21	27
0.75	402	536	670	34	45	56	26	34	42
0.6	503	670	838	42	56	70	32	42	53
0.5	603	804	1005	51	67	84	38	51	63
0.3	1005	1340	1675	84	112	140	63	84	105
0.25	1206	1608	2010	101	134	168	76	101	126

Notes:
1. Number of GSF Modules have been adjusted to reflect the following:
   - 33% reduction in absorption field area.
2. Any jetted bath tub with a capacity greater than 125 gallons will be treated as an extra bedroom for the system sizing requirements per Rule 410 IAC 6-8.3.
3. A42 Modules have an effective area of 12 ft^2/mod. B43 Modules have an effective area of 16 ft^2/mod.

TABLE 6: GSF BED SIZING CHART

Soil Loading Rate (gpd/sf)	Required Area of Absorption Field (Square Feet)			A42 Modules per Room	B43 Modules per Room
	Bedrooms per House				
	3	4	5		
1.2	252	335	419	6	5
0.75	402	536	670	8	7
0.6	503	670	838	9	8
0.5	603	804	1005	11	9
0.3	1005	1340	1675	12	10
0.25	1206	1608	2010	13	11

Notes:
1. Number of GSF Modules have been adjusted to reflect the following:
   - 33% reduction in bed area.
2. Any jetted bath tub with a capacity greater than 125 gallons will be treated as an extra bedroom for the system sizing requirements per Rule 410 IAC 6-8.3.

Subsurface Trench and Single Lateral Bed Installation Requirements

Methods of Distribution	Gravity, dosed and pressure dosed are acceptable for distribution in trenches.
Determine the Number Modules	Determine the number of GSF Modules required from Table 5 of this manual.
Plan all Drainage Requirements	Plan all drainage requirements above (up-slope) of the system or on all sides of system if it has a 2% slope or less. Set soil grades to ensure that storm water drainage and surface water is diverted away from the absorption area once the system is complete. All drainage requirements shall be in accordance with 410 IAC 6-8.3 (59).
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 a minimum of 6 inches of Specified Sand in the basal area and stabilize level.
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 for Gravity & Dosed Systems	A standard 4-inch perforated pipe, SDR 35 or equivalent which meets 410 IAC 6-8.3 (67) or ISDH Rule 410 6-10.1 (75), is centered along the modules 4-foot length. Orifices are set at the 4 & 8 o'clock position. All 4-inch pipes are secured with manufacturers supplied wire clamps, one per module. Page 9, 8. Distribution Pipe of this manual has more information on pipe selection. The pipe shall be capped or vented.
Distribution Pipes for 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 4 & 8 o'clock position. Insert a 1.5-inch pressure pipe which meets 410 IAC 6-8.3 (67) or ISDH Rule 410 6-10.1 (75), into the standard 4-inch perforated pipe. The pressure pipe orifices are set at the 12 o'clock position as shown in Figure 22. Each pressure lateral will have a drain hole at the distal end of the pipe at the 6 o'clock position. The pressure line shall include a cleanout. All 4-inch pipes are secured with manufacturers supplied wire clamps, one per module. The pipe shall be capped or vented. Page 9, 8. Distribution Pipe of this manual has more information on pipe selection.
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 4- inch perforated distribution pipe. • Place multiple shovel-full 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 cover soil material to a minimum of 12 – 19 inches measured from the top of the 4-inch distribution pipe. Fill must be clean, porous and able to sustain vegetation. 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.

Single Lateral Bed System Design Example

Example 1: Single Lateral Bed System – B43 Modules

House size:	3 bedrooms
Soil Loading Rate:	0.3 gpd/ft^2
Design Flow: 150 gpd x 3 bedrooms =	450 gpd

Refer to Table 2 for the soil loading rate, and then refer to Table 5 for the minimum number of modules and minimum sized absorption area required for installation.

Modules Needed:	63 B43 Modules
Minimum Absorption area:	1005 ft^2

For This Example, Assume the Number of Rows Equals Three:

Row Width: Module width (3 ft) + Sand Sidewalls (6" + 6") =	4 ft
Row Length: 63 modules ÷ 3 rows =	21 modules per row
Modules (21) x 4 lf/module + 1 ft (6" sand at each end of row) =	85 ft
System area (width x length): 4 ft x 85 ft x 3 rows =	1020 ft^2

Bed Dimensions:

Length =	85 ft/row
Width =	4 ft
Rows =	3
Modules =	63 B43
Total Area =	1020 ft^2

FIGURE 4: PLAN VIEW – 450 GPD – B43 –SINGLE LATERAL BED SYSTEM – SLOPING SITE

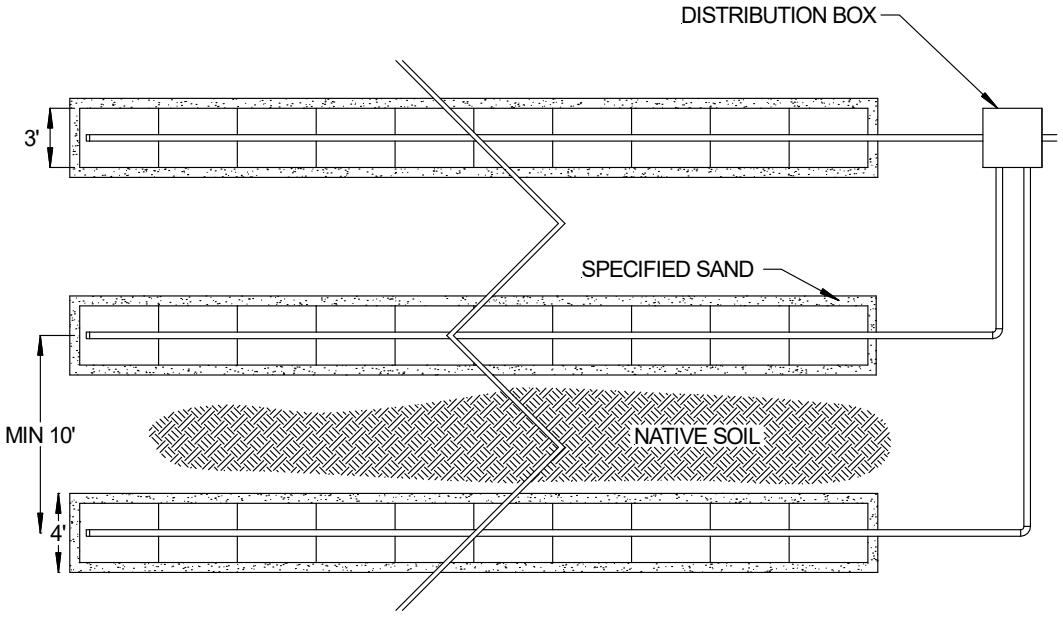
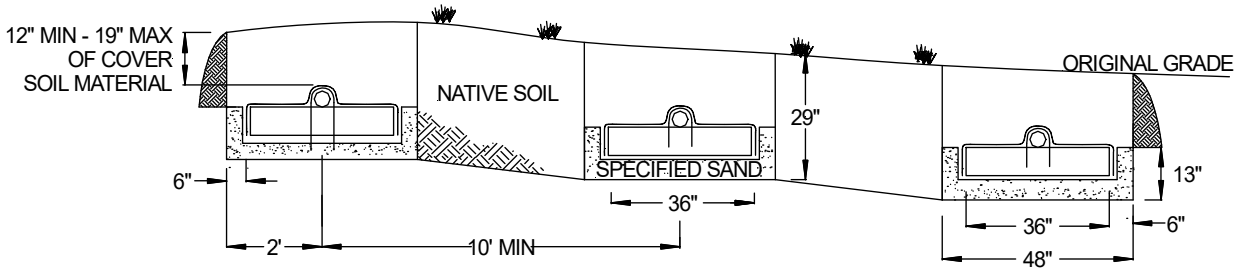
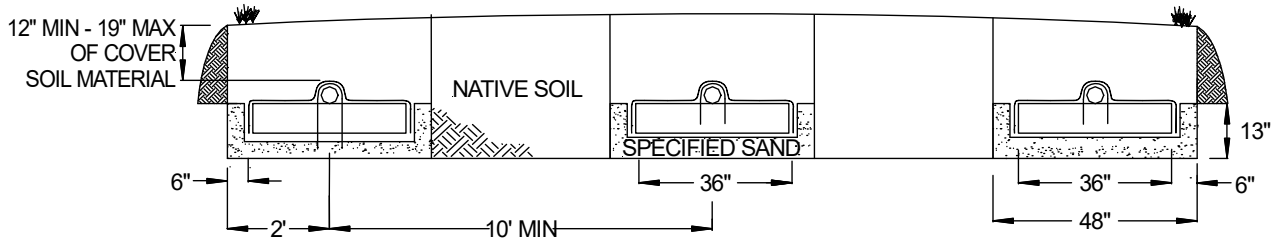


FIGURE 5: SECTION VIEW – B43 – SINGLE LATERAL BED SYSTEM – SLOPING SITE



Loading Rate 0.3 gpd/ft^2, Design Flow 150 gpd x 3 Bedrooms = 450 gallons per day.
(21 Modules per Row)

FIGURE 6: SECTION VIEW – B43 – SINGLE LATERAL BED SYSTEM – LEVEL SITE



Loading Rate 0.3 gpd/ft^2, Design Flow 150 gpd x 3 Bedrooms = 450 gallons per day.
(21 Modules per Row)

Subsurface Bed Installation Requirements

Method of Distribution	Gravity, dosed and pressure distribution are acceptable for distribution in beds.
Determine the Number Modules	Determine the number of GSF Modules required from Table 6 of this manual.
Plan all Drainage Requirements	Set soil grades to ensure that storm water drainage and surface water is diverted away from the absorption area once the system is complete. All drainage requirements should be in accordance with 410 IAC 6-8.3 (59) or ISDH Rule 410 6-10.1 (46).
Excavating the Subsurface Bed Area	Scarify the receiving layer to maximize 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 6 inches of Specified Sand in the area of excavation. The minimum depth of sand below the GSF module must be level at 6 inches for the length and width of the absorption area.
Place GSF Modules	***PAINTED STRIPE FACING UP***, end to end on top of the Specified Sand along their 4-foot length.
Distribution Pipes for Gravity & Dosed Systems	A standard 4-inch perforated pipe, SDR 35 or equivalent which meets 410 IAC 6-8.3 (67) or ISDH Rule 410 6-10.1 (75), is centered along the modules 4-foot length. Orifices are set at the 4 & 8 o'clock position. All 4-inch pipes are secured with manufacturers supplied wire clamps, one per module. Page 9, 8. Distribution Pipe of this manual has more information on pipe selection. The pipe shall be capped or vented.
Distribution Pipes for 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 4 & 8 o'clock position. Insert a 1.5-inch pressure pipe which meets 410 IAC 6-8.3 (67) or ISDH Rule 410 6-10.1 (75), into the standard 4-inch perforated pipe. The pressure pipe orifices are set at the 12 o'clock position as shown in Figure 22. Each pressure lateral will have a drain hole at the distal end of the pipe at the 6 o'clock position. The pressure line shall include a cleanout. All 4-inch pipes are secured with manufacturers supplied wire clamps, one per module. The pipe shall be capped or vented. Page 9, 8. Distribution Pipe of this manual has more information on pipe selection.
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 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 module.
Backfilling the System	Complete backfill with cover soil material to a minimum of 12 - 19 inches measured from the top of the 4-inch distribution pipe. Soil cover material must be clean, porous and able to sustain vegetation. 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.

Subsurface Bed Design Examples

Example 2: Subsurface Bed System – A42 Modules – 0.0 – 0.5% Slope

House size:	4 bedrooms
Soil Loading Rate:	0.3 gpd/ft^2
Design Flow – 150 gpd x 4 bedrooms =	600 gpd

Refer to Table 2 for the soil loading rate, and then refer to Table 6 for the minimum number of modules and minimum sized absorption area required for installation.

Minimum Number of Modules per Bedroom Required:	12 A42 Modules
Minimum Number of Modules: Bedrooms x Min Number: 4 x 12 A42	48 A42 Modules
Minimum Absorption Area:	1340 ft^2

For This Example, Assume the Number of Bed Rows Equals Two (this encourages the longest and narrowest subsurface bed design):

Eljen Absorption Area Length:

Modules per Row: Modules Needed ÷ Rows = 48 Modules ÷ 2 Rows	24 Modules per Row
Distribution Cell Length: Number of Modules x 4 ft +1 ft (6 inches of sand on the ends)	
24 Modules x 4 ft + 1 ft =	97 ft
Distribution Cell Length = Absorption Area Length =	97 ft

Eljen Absorption Cell Width:

Minimum Distribution Cell Width: 2 Rows x 3 ft (use 3 ft for A42s, 4 ft for B43s)	6 ft
Calculated Absorption Area Width: Minimum Absorption Area ÷ Eljen Absorption Cell Length:	
1340 ft^2 ÷ 97 ft	13.8 ft, round to 14 ft
The Calculated Absorption Area Width was greater than the Minimum Distribution Cell Width,	
use the greater of these two numbers	14 ft
Eljen Absorption Cell Width	14 ft

Determine Module Spacing:

Eljen Absorption Area Width ÷ Rows = 14 ft ÷ 2 = Center to Center Row Spacing	7 ft
Center to Center Row Spacing ÷ 2 = 7 ÷ 2 = Edge to Lateral Spacing	3.5 ft

Determine Total Absorption Area:

Eljen Absorption Area Length x Eljen Absorption Area Width = 97 ft x 14 ft	1358 ft^2

Subsurface Bed Dimensions:

Eljen Absorption Area Length =	97 ft
Eljen Absorption Area Width =	14 ft
Center to Center Spacing =	7 ft
Edge to Lateral Spacing =	3.5 ft
Total Absorption Area =	1358 ft^2

FIGURE 7: PLAN VIEW – 600GPD – A42 – BED SYSTEM – LEVEL SITE

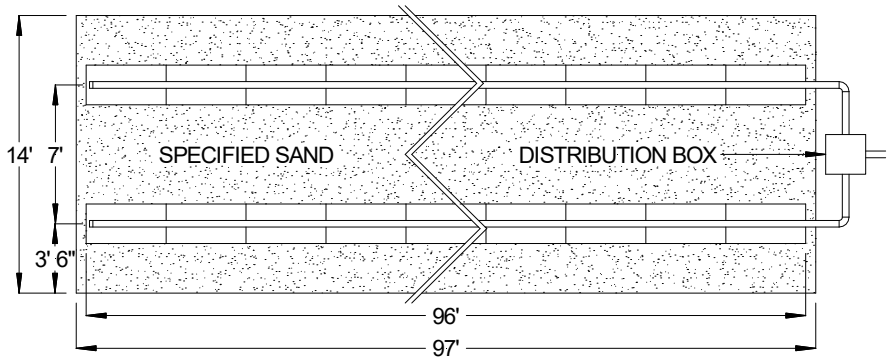
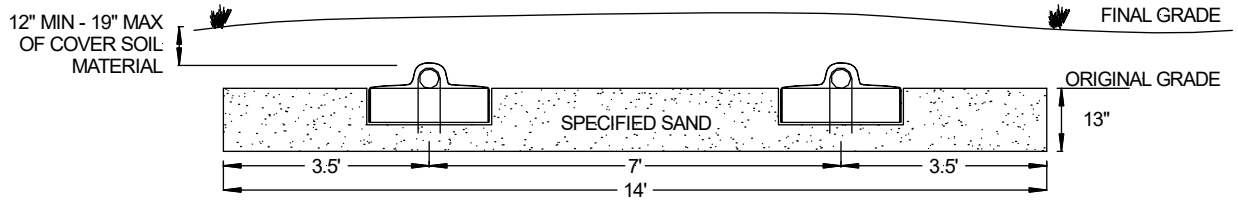


FIGURE 8: CROSS SECTION VIEW – 600 GPD – A42 – BED SYSTEM – LEVEL SITE



Subsurface Bed Design Examples

Example 3: Bed System – A42 Modules – Greater than 0.5% slope – Greater than 0.3 gpd/sf loading rate

House size –	3 bedrooms
Soil Loading Rate –	0.75 gpd/ft^2
Design Flow – 150 gpd x 3 bedrooms =	450 gpd
Slope -	11%

Refer to Table 2 for the soil loading rate, and then refer to Table 6 for the minimum number of modules and minimum sized absorption area required for installation.

Minimum Number of Modules per Bedroom Required –	8 A42 Modules
Minimum Number of Modules: Bedrooms x Min Number: 3 x 8 A42	24 A42 Modules
Minimum Absorption Area –	402 ft^2

For This Example, Assume the Number of Bed Rows Equals Two (this encourages the longest and narrowest subsurface bed design):
Eljen Absorption Cell Length :

Modules per Row = Modules Needed ÷ Rows = 24 Modules ÷ 2 Rows	12 Modules
Distribution Cell Length = Number of Modules x 4 ft +1 ft (6 inches of sand on the ends)	
12 Modules x 4 ft + 1 ft =	49 ft
Distribution Cell Length = Absorption Area Length	49 ft

Eljen Absorption Cell Width:

Minimum Distribution Cell Width: 2 Rows x 3 ft (use 3 ft for A42s, 4 ft for B43s)	6 ft
Calculated Absorption Area Width: Minimum Absorption Area ÷ Eljen Absorption Cell Length:	
402 ft^2 ÷ 49 ft	8.2 ft, round to 8.5 ft
In this case, use the Calculated Absorption Area Width to achieve a full sized basal area	8.5 ft
Eljen Absorption Cell Width	8.5 ft

Determine Module Spacing:

Refer to page 11, 27. Bed Guidance for lateral spacing on sloping sites	
Upper edge to Lateral spacing A42	1.5 ft
Lateral to Lateral spacing A42	3 ft
Lateral to Lower Edge = Eljen Absorption Area Width – Upper edge to Lateral Spacing – Lateral to Lateral Spacing	
8.5 ft – 1.5 ft – 3 ft =	4 ft

DESIGN REQUIREMENT: For bed systems on slopes between the grades of 0.5% and 10%, a minimum downslope extension of 4 feet of INDOT SPEC 23 sand extending from the edge of the furthest downslope GSF module is required. For slopes between the grades of 10% to 15%, a minimum downslope extension of 6 feet of INDOT SPEC 23 sand extending from the edge of the furthest downslope GSF module is required.

Determine Downslope Sand Extension:

Determine Module to Lower Edge = Lateral to Lower Edge – 1 ft (A42) = 4 ft – 1 ft =	3 ft
Since the slope is 11% which requires a 6 ft sand extension from the edge of the last module row which is greater than 3 ft: Proper sand extension from Lower Edge	6 ft
Adjusted Lateral to Lower Edge = Sand Extension + 1 ft (A42) = 6 ft + 1 ft	7 ft

As a result, the Eljen Absorption Cell Width is increased.
Adjusted Lateral to Lower Edge – Lateral to Lower Edge + Eljen Absorption Area Width = Adjusted Eljen Distribution Cell Width
7 ft – 4 ft + 8.5 ft = 11.5 ft

Determine Total Absorption Area:
Eljen Absorption Area Length x Adjusted Eljen Absorption Area Width = 49 ft x 11.5 ft 563.5 ft^2

Subsurface Bed Dimensions:	
Eljen Absorption Area Length =	49 ft
Eljen Absorption Area Width =	11.5 ft
Upper edge to Lateral Spacing =	1.5 ft
Lateral to Lateral Spacing =	3 ft
Lateral to Lower Edge Spacing =	7 ft
Total Area =	563.5 ft^2

FIGURE 9: PLAN VIEW – 450 GPD – A42 – BED SYSTEM – SLOPING SITE

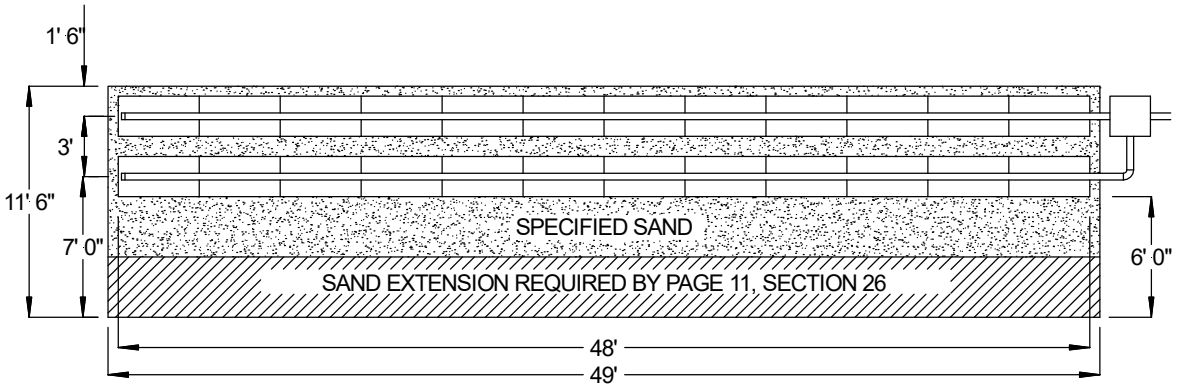
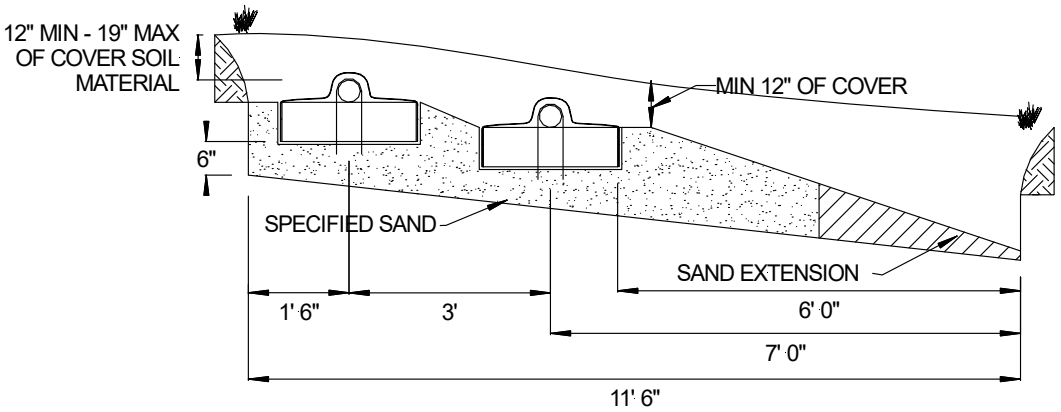


FIGURE 10: CROSS SECTION VIEW – 450 GPD – A42 – BED SYSTEM – SLOPING SITE



Subsurface Bed Design Examples

Example 4: Bed System – B43 Modules – Greater than 0.5% slope – Less than or equal to 0.3 gpd/sf loading rate

House size –	3 bedrooms
Soil Loading Rate –	0.3 gpd/ft^2
Design Flow – 150 gpd x 3 bedrooms =	450 gpd
Slope –	7%

Refer to Table 2 for the soil loading rate, and then refer to Table 6 for the minimum number of modules and minimum sized absorption area required for installation.

Minimum Number of Modules per Bedroom Required –	10 B43 Modules
Minimum Number of Modules: Bedrooms x Min Number: 3 x 10 B43	30 B43 Modules
Minimum Absorption Area –	1005 ft^2

For This Example Assume the Number of Bed Rows Equals Two (this encourages the longest and narrowest subsurface bed design):

Eljen Absorption Area Length:

Modules per Row = Modules Needed ÷ Rows = 30 Modules ÷ 2 Rows	15 Modules
Distribution Cell Length = Number of Modules x 4 ft +1 ft (6 inches of sand on the ends)	
15 Modules x 4 ft + 1 ft =	61 ft
Distribution Cell Length = Absorption Area Length	61 ft

Eljen Absorption Area Width:

Minimum Distribution Cell Width: 2 Rows x 4 ft (use 3 ft for A42s, 4 ft for B43s)	8 ft
Calculated Absorption Area Width: Minimum Absorption area ÷ Eljen Absorption Cell Length:	
1005 ft^2 ÷ 61 ft	16.5 ft
In this case, use the Calculated Absorption Area Width to achieve a full sized basal area	16.5 ft
Eljen Absorption Area Width	16.5 ft

Determine Module Spacing:

Refer to page 11, 27. Bed Guidance for lateral spacing on sloping sites	
Upper edge to Lateral spacing B43	2 ft
Lateral to Lateral spacing B43	4 ft
Lateral to Lower Edge = Eljen Absorption Area Width – Upper edge to Lateral Spacing – Lateral to Lateral Spacing	
16.5 ft – 2 ft – 4 ft =	10.5 ft

DESIGN REQUIREMENT: For bed systems on slopes between the grades of 0.5% and 10%, a minimum downslope extension of 4 feet of INDOT SPEC 23 sand extending from the edge of the furthest downslope GSF module is required. For slopes between the grades of 10% to 15%, a minimum downslope extension of 6 feet of INDOT SPEC 23 sand extending from the edge of the furthest downslope GSF module is required.

Determine Downslope Sand Extension:

Determine Module to Lower Edge = Lateral to Lower Edge – 1.5 ft (B43) = 10.5 ft – 1.5 ft = 9 ft

Since the slope is 7% which requires a 4 ft sand extension from the edge of the last module row which is less than 9 ft: No adjustment needed.

As a result, no change to the absorption area width.

Determine Total Absorption Area:

Eljen Absorption Area Length x Eljen Absorption Area Width = 61 ft x 16.5 ft 1006.5 ft^2

Subsurface Bed Dimensions:	
Eljen Absorption Cell Length =	61 ft
Eljen Absorption Cell Width =	16.5 ft
Upper edge to Lateral Spacing =	2 ft
Lateral to Lateral Spacing =	4 ft
Lateral to Lower Edge Spacing =	10.5 ft
Total Absorption Area =	1006.5 ft^2

FIGURE 11: PLAN VIEW – 450 GPD – B43 – BED SYSTEM – SLOPING SITE

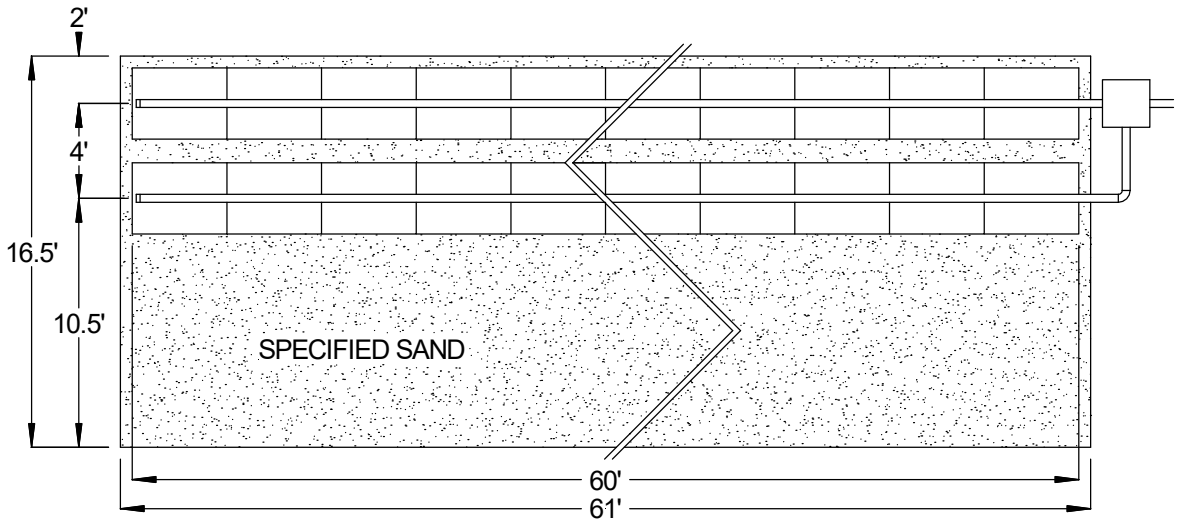
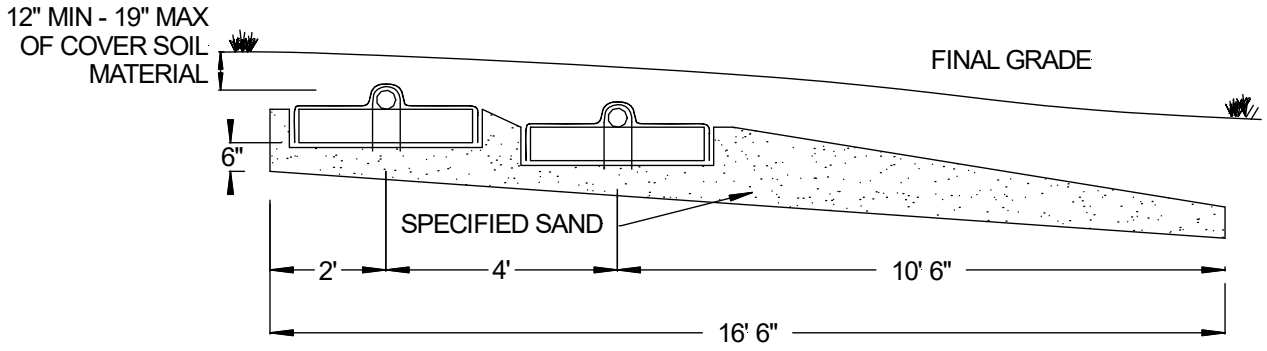


FIGURE 12: CROSS SECTION VIEW – 450 GPD – B43 – BED SYSTEM – SLOPING SITE



Above Grade Bed Installation Requirements

Method of Distribution	Gravity, dosed and pressure distribution are acceptable for distribution in above grade beds.
Determine the Number Modules	Determine the number of GSF Modules required from Table 6 of this manual.
Plan all Drainage Requirements	Set soil grades to ensure that storm water drainage and surface water is diverted away from the absorption area once the system is complete. All drainage requirements should be in accordance with 410 IAC 6-8.3 (59) or ISDH Rule 410 6-10.1 (46).
Excavating the Subsurface Bed Area	Scarify the receiving layer to maximize 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 6 inches of Specified Sand in the area of excavation in two lifts for a total of 12 inches. The minimum depth of sand below the GSF module must be level at 12 inches for the length and width of the absorption area.
Place GSF Modules	***PAINTED STRIPE FACING UP***, end to end on top of the Specified Sand along their 4-foot length.
Distribution Pipes for Gravity & Dosed Systems	A standard 4-inch perforated pipe, SDR 35 or equivalent which meets 410 IAC 6-8.3 (67) or ISDH Rule 410 6-10.1 (75), is centered along the modules 4-foot length. Orifices are set at the 4 & 8 o'clock position. All 4-inch pipes are secured with manufacturers supplied wire clamps, one per module. Page 9, 8. Distribution Pipe of this manual has more information on pipe selection. The pipe shall be capped or vented.
Distribution Pipes for 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 4 & 8 o'clock position. Insert a 1.5-inch pressure pipe which meets 410 IAC 6-8.3 (67) or ISDH Rule 410 6-10.1 (75), into the standard 4-inch perforated pipe. The pressure pipe orifices are set at the 12 o'clock position as shown in Figure 22. Each pressure lateral will have a drain hole at the distal end of the pipe at the 6 o'clock position. The pressure line shall include a cleanout. All 4-inch pipes are secured with manufacturers supplied wire clamps, one per module. The pipe shall be capped or vented. Page 9, 8. Distribution Pipe of this manual has more information on pipe selection.
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 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 module.
Backfilling the System	Complete backfill with cover soil material to a minimum of 12 - 19 inches measured from the top of the 4-inch distribution pipe. Fill must be clean, porous and able to sustain vegetation. 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.

Above Grade Bed Design Requirements

Example 5: Subsurface Bed System – A42 Modules – 0.0 – 0.5% Slope

House size:	4 bedrooms
Soil Loading Rate:	0.25 gpd/ft^2
Design Flow – 150 gpd x 4 bedrooms =	600 gpd
Slope –	0.0%

Refer to Table 3 for the soil loading rate, and then refer to Table 6 for the minimum number of modules and minimum sized absorption area required for installation.

Minimum Number of Modules per Bedroom Required:	13 A42 Modules
Minimum Number of Modules: Bedrooms x Min Number: 4 x 13 A42	52 A42 Modules
Minimum Absorption Area:	1608 ft^2

For This Example, Assume the Number of Bed Rows Equals Two (this encourages the longest and narrowest subsurface bed design):

Eljen Absorption Area Length:

Modules per Row: Modules Needed ÷ Rows = 52 Modules ÷ 2 Rows	26 Modules per Row
Distribution Cell Length: Number of Modules x 4 ft +1 ft (6 inches of sand on the ends)	
26 Modules x 4 ft + 1 ft =	105 ft*
Distribution Cell Length = Absorption Area Length =	105 ft*

*Page 10, Section 15 dictates that the maximum gravity or dosed design may be 100 ft in length. Pressure distribution or placing a distribution box feeding the center of the system is acceptable for this design.

Eljen Absorption Cell Width:

Minimum Distribution Cell Width: 2 Rows x 3 ft (use 3 ft for A42s, 4 ft for B43s)	6 ft
Calculated Absorption Area Width: Minimum Absorption Area ÷ Eljen Absorption Cell Length:	
1608 ft^2 ÷ 105 ft	15.3 ft, round to 16 ft
The Calculated Absorption Area Width was greater than the Minimum Distribution Cell Width,	
use the greater of these two numbers	16 ft
Eljen Absorption Cell Width	16 ft

Determine Module Spacing:

Eljen Absorption Area Width ÷ Rows = 16 ft ÷ 2 = Center to Center Row Spacing	8 ft
Center to Center Row Spacing ÷ 2 = 8 ÷ 2 = Edge to Center Row Spacing	4 ft

Determine Total Absorption Area:

Eljen Absorption Area Length x Eljen Absorption Area Width = 105 ft x 1 ft	1680 ft^2

Above Grade Bed Dimensions:

Eljen Absorption Area Length =	105 ft
Eljen Absorption Area Width =	16 ft
Center to Center Spacing =	8 ft
Edge to Center Spacing =	4 ft
Total Absorption Area =	1680 ft^2

FIGURE 13: PLAN VIEW – 600GPD – A42 – BED SYSTEM – LEVEL SITE

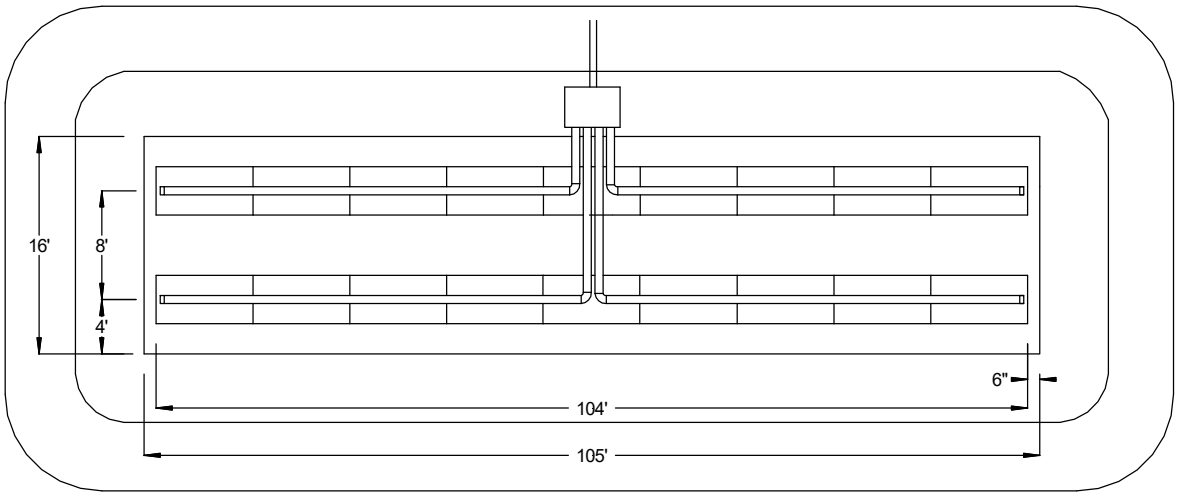
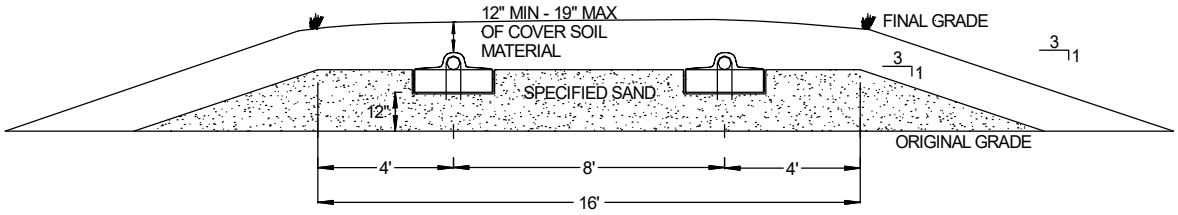


FIGURE 14: CROSS SECTION VIEW – 600 GPD – A42 – BED SYSTEM – LEVEL SITE



Above Grade Bed Design Examples

Example 6: Bed System – A42 Modules – Greater than 0.5% slope

House size –	3 bedrooms
Soil Loading Rate –	0.25 gpd/ft^2
Design Flow – 150 gpd x 3 bedrooms =	450 gpd
Slope -	5%

Refer to Table 3 for the soil loading rate, and then refer to Table 6 for the minimum number of modules and minimum sized absorption area required for installation.

Minimum Number of Modules per Bedroom Required –	13 A42 Modules
Minimum Number of Modules: Bedrooms x Min Number: 3 x 13 A42	39 A42 Modules
Minimum Absorption Area –	1206 ft^2

For This Example, Assume the Number of Bed Rows Equals Two (this encourages the longest and narrowest subsurface bed design):
Eljen Absorption Cell Length:

Modules per Row = Modules Needed ÷ Rows = 39 Modules ÷ 2 Rows	19.5, round to 20 Modules
Distribution Cell Length = Number of Modules x 4 ft +1 ft (6 inches of sand on the ends)	
20 Modules x 4 ft + 1 ft =	81 ft
Distribution Cell Length = Absorption Area Length	81 ft

Determine Module Spacing:

Refer to page 11, 27. Bed Guidance for lateral spacing on sloping sites	
Upper edge to Lateral spacing A42	1.5 ft
Lateral to Lateral spacing A42	3 ft

Determine Eljen Application Area Width:

Eljen Application Area Width: 2 Rows x 3 ft (use 3 ft for A42s, 4 ft for B43s)	6 ft

DESIGN REQUIREMENT: 410 IAC 6-8.3-80 states use the greater result: (for this section, the Eljen Application Area Width is equivalent to the Aggregate Bed Width referred to in section 80)

a) Minimum basal area width = minimum basal area (from Table 6) ÷ length of bed (B)
   1206 ft^2 ÷ 81 ft = 14.9 ft

b) For slopes less than or equal to 0.5%:
   Eljen application area width + 14 ft
c) For slopes greater than 0.5%:
   Eljen application area width + 9 ft
   6 ft + 9 ft = 15 ft

Minimum basal area width is = 15 ft

From section 6-8.3-80 it was determined the system required a minimum of 15 ft of Eljen application area width and downslope basal width. The design is smaller (Actual basal area = 14.9 ft) and does not meet the requirements.
Use the result from c. Eljen Application Area Width = 15 ft

Determine Total Absorption Area:

Eljen Absorption Area Length x Adjusted Eljen Absorption Area Width = 81 ft x 15 ft	1,215 ft^2

Above Grade Bed Design Examples

Above Grade Bed Dimensions:	
Eljen Absorption Area Length =	81 ft
Eljen Absorption Area Width =	15 ft
Upper edge to Lateral Spacing =	1.5 ft
Lateral to Lateral Spacing =	3 ft
Total Area =	1215 ft^2

FIGURE 15: PLAN VIEW – 450 GPD – A42 – BED SYSTEM – SLOPING SITE

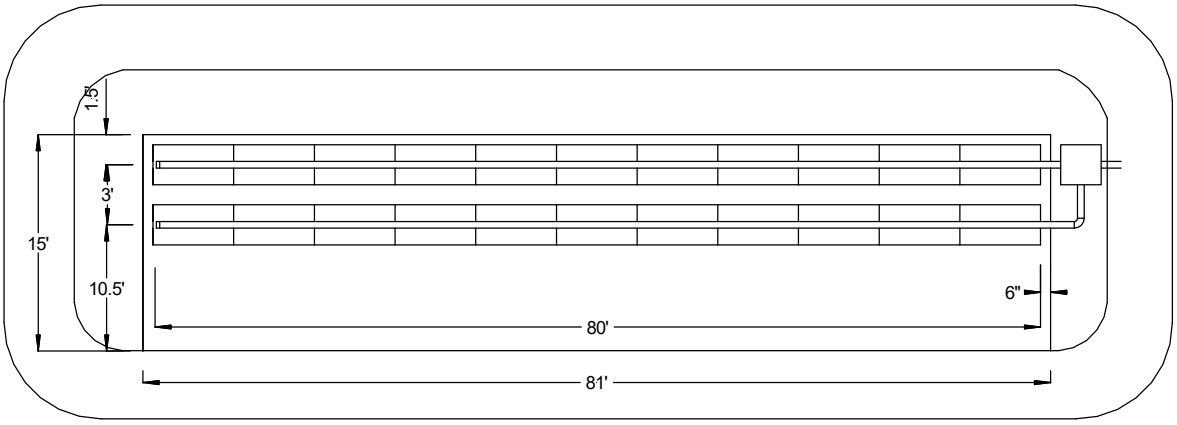
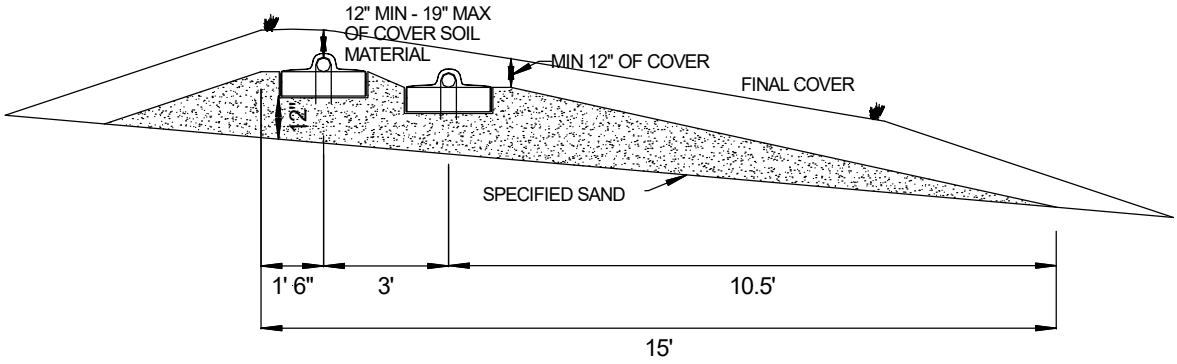


FIGURE 16: CROSS SECTION VIEW – 450 GPD – A42 – BED SYSTEM – SLOPING SITE



Elevated Sand Mound Installation Requirements

Method of Distribution	Pressure distribution is required for elevated sand mounds.
Determine the Number Modules	Determine the number of GSF Modules required from Table 6 of this manual.
Preparing the site	Refer to Section 86 of the rule.
Placing Specified Sand Base	Refer to Section 87 of the rule. **For Elevated Sand Mound sloping systems between 0.5% and 6% a minimum four-foot sand extension is required beyond the furthest downslope module edge.**
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 for 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 4 & 8 o'clock position. Insert a 1.5-inch pressure pipe which meets 410 IAC 6-8.3 (67) or ISDH Rule 410 6-10.1 (75), into the standard 4-inch perforated pipe. The pressure pipe orifices are set at the 12 o'clock position as shown in Figure 22. Each pressure lateral will have a drain hole at the distal end of the pipe at the 6 o'clock position. The pressure line shall include a cleanout. All 4-inch pipes are secured with manufacturers supplied wire clamps, one per module. The pipe shall be capped or vented. Page 9, 8. Distribution Pipe of this manual has more information on pipe selection.
Dosing tank to the GSF System	Refer to local regulations for requirements • Pressure Distribution Requirements • 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 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 shovelfuls 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 cover soil material to a minimum of 12 - 19 inches measured from the top of the 4-inch distribution pipe. Fill must be clean, porous and able to sustain vegetation. 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.
Drainage	All drainage requirements shall be in accordance with 410 IAC 6-8.3 (59)

FIGURE 17: CROSS SECTION – PRESSURE ELEVATED SAND MOUND SYSTEM

EXISTING GRADE 0% - 0.5%

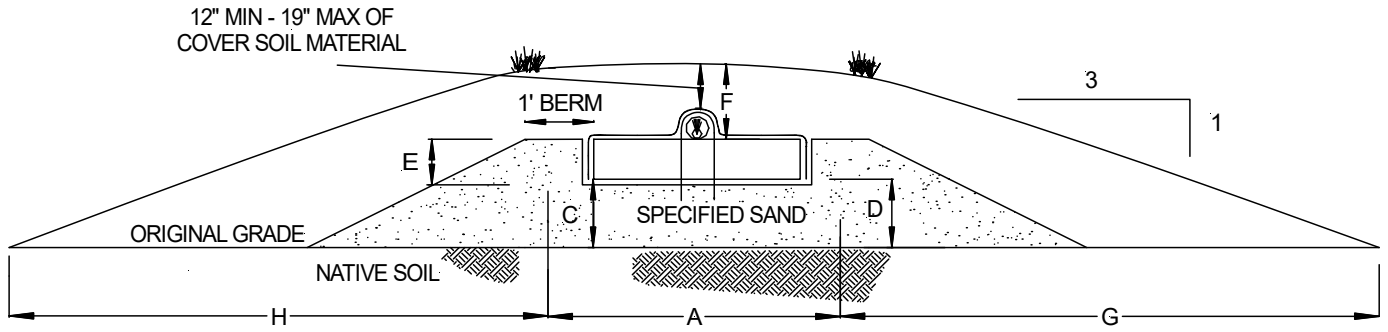
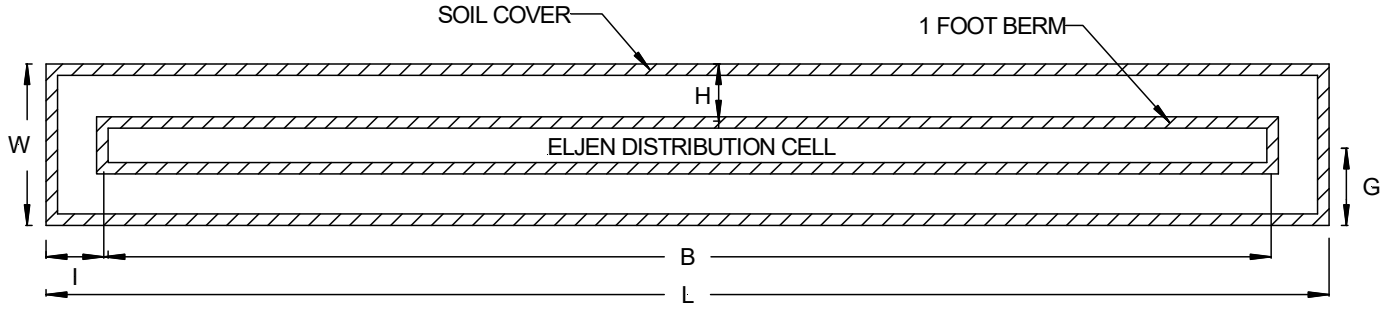


FIGURE 18: PLAN VIEW – PRESSURE ELEVATED SAND MOUND SYSTEM



A – Distribution cell width (includes 6" sand surrounding module) – **Minimum 4 ft**
B – Distribution cell length
C – Up slope fill depth under distribution cell – **Minimum 1 ft**
D – Down slope fill depth under distribution cell – **Minimum 1 ft**
E – Distribution cell depth – **Constant 7 in**
F – Depth of final cover – **Min 16 inches** (Includes 4" pipe and a minimum 12 inches of cover soil material)
G – Distance from edge of distribution cell to down slope edge of cover soil material
H – Distance from edge of distribution cell to up slope edge of cover soil material
I – Distance from end of distribution cell to edge of cover soil material
L – Overall Elevated Sand Mound Length
W – Overall Elevated Sand Mound Width

Elevated Sand Mound Design Example

1. APPLICATION AREA REQUIREMENTS: The application area is the GSF Module and the upslope and downslope sand from the module. Modules may not have more than one foot of sand up or downslope of any module. The maximum distance of the distribution cell edge measured to the module is one foot, and the minimum distance to the distribution cell edge is six inches. See Figure 19 for an example.

2. MINIMUM SLOPE REQUIREMENTS: Maintain a 3:1 slope or gentler for all slopes off the application area. Elevated systems using GSF modules will not be permitted on slopes greater than 6%.

3. PLACEMENT OF THE ELJEN APPLICATION AREA: Place the Eljen application area in the middle of the basal area for sites with slopes less than 0.5%. For sites with greater than 0.5% slope, place the Eljen application area along the upper edge of the basal area.

4. ELEVATED SAND MOUND SYSTEM: Follow the requirements in 410 IAC 6-8.3 (79) to complete the mound. When placing the Eljen application area on the basal area, there must be 12 inches of INDOT SPEC 23 Sand under the A42 or B43 Modules.

5. PRESSURE ELEVATED SAND MOUND SYSTEM: Elevated Sand Mounds require pressure distribution.

6. SUBSURFACE DRAINS: If subsurface drains are utilized they must remain 10 feet from the edge of the system sand perimeter.

7. MINIMUM NUMBER OF MODULES PER BEDROOM: If using A42 modules, maintain 6 modules per bedroom as a minimum. If using B43 modules, maintain 5 modules per bedroom as a minimum.

Example 5 - Pressure Mound – A42 Modules – Greater than 0.5% - 6% slope.

House Size:	4 bedrooms
Daily Design Flow: 4 Bedrooms x 150 gallons per day	600 gpd
Slope of site:	6%
Soil Loading Rate:	0.25 gpd/ft^2

A42: Minimum number of modules per bedroom: 6 per Bedroom x 4 Bedrooms 24 A42 Modules
B43: Minimum number of modules per bedroom: 5 per Bedroom x 4 Bedrooms 20 B43 Modules

8. CALCULATE VARIABLES:

A – Distribution cell width = **4 ft**

(***NOTE:*** The minimum width of distribution cell is **4 ft.**)
Cell width must conform to 6-8.3 (79) (3) (A)
Consult the regulations 6-8.3 (79) (a) (3). Minimum distribution cell width is 4 feet for all systems. If the site permits, promote long and narrow systems. For this example, the maximum distribution cell width is:

$$\text{Maximum Distribution Bed Width} = 0.83 \text{ ft}^2/\text{gpd} \sqrt{\frac{\text{DDF (gpd)} \times \text{SLR (gpd/ft}^2)}{\text{n}}}$$

TABLE 7: N VALUE FOR MOUNDS

DDF (gpd)	n
≤ 1500	3
1501 - 3000	4
3001 - 4000	5

For this example, the maximum distribution cell width is: 5.8 ft

Elevated Sand Mound Design Example

B – Distribution cell length = Daily Design Flow ÷ 1.2 gpd/ft^2 (constant) ÷ Distribution Cell Width
600 gpd ÷ 1.2 gpd/ft^2 ÷ 4 ft = **125 ft**

Modules required – Modules required are determined by (Distributions Cell Length – 1) ÷ 4
Modules required – (125 – 1) ÷ 4 = **31 modules**
For this system we decided to use B43s. For this system, use 31 B43 Modules.

C – Up slope sand depth under distribution cell = **Minimum 12 inches**
(***NOTE:*** For this example, assume the depth of sand at the up-slope edge of the distribution cell is **1 ft** to maintain separation distance from a infiltrative layer. *Note: Infiltrative layer is measured to sand/soil interface*.)

D – Down slope sand depth under distribution cell = **Minimum 12 inches**
C + (Slope of site x A)
1 ft + (0.06 x 4 ft) = **1.2 ft**

E – Distribution cell depth – Constant 7 in., convert to feet – **0.6 ft**

F – Depth of final cover = **16 inches or 1.3 ft, this includes cover and pipe over the module.**
(***NOTE:*** For the side slope of the mound, we are using a **required 3:1 slope)**

G – Distance from edge of distribution cell to down slope edge of system:
Down slope correction factor = 100 ÷ [100 – (side slope x % ground slope)]
100 ÷ [100 – (3 x 6)] = **1.2**
4 x (D + E + F) x Down slope correction factor
4 x (1.2 + 0.6 + 1.3) x 1.2 = **12.4 ft**

H – Distance from edge of distribution cell to up slope edge of system
Up slope correction factor – 100 ÷ [100 + (side slope x % ground slope)]
100 ÷ [100 + (3 x 6)] = **0.9**
4 x (C + E + F) x Up slope correction factor
4 x (1 + 0.6 + 1.3) x 0.9 = **10.4 ft**

I – Distance from end of distribution cell to edge of system
4 x [{(C + D)/2} + E + F]
4 x [(1 + 1.2)/2 + 0.6 + 1.3] = **12 ft**

L – Overall mound system length
B + 2(I)
125 ft + 2 (12 ft) = **149 ft**

W – Overall mound system width
A + G + H
4 + 12.4 + 10.4 = **26.8 ft**

9. VERIFY MINIMUM REQUIREMENT MET:

TABLE 8: MINIMUM ELEVATED SAND MOUND ABSORPTION AREA REQUIRED UTILIZING ELJEN GSF

Soil Loading Rate (gpd/sf)	Required Area of Absorption Field (Square Feet)		
	Bedrooms per House		
	3	4	5
1.2	252	335	419
0.75	402	536	670
0.6	503	670	838
0.5	603	804	1005
0.3	1005	1340	1675
0.25	1206	1608	2010

Using the Table 8, determine required absorption area

Minimum required absorption area 1608 ft^2
Determine the Minimum Distribution Cell Size: Daily Design Flow ÷ 1.2 gpd/ft^2
600 gpd ÷ 1.2 gpd/ft^2 500 ft^2

Determine minimum downslope area needed: Minimum required absorption area – minimum distribution cell size
1608 ft^2 - 500 ft^2 1108 ft^2
Determine if Design meets required downslope.
B (Distribution Cell Length) x (G – 3) (Distance from edge of distribution cell to down slope edge of sand)
125 ft x (12.4 – 3) ft 1175 ft^2
Since 1175 ft^2 is greater than 1108 ft^2, the design meets the minimum area requirements.

Make sure to consult Rule 410 IAC 6-8.3-80, Design of Basal Area. In this example, the sand extension from the distribution cell meets the minimum requirements. Final Dimensions of the system are on the following page.

DESIGN REQUIREMENT: 410 IAC 6-8.3-80 states use the greater result: (for this section, the Eljen Application Area Width is equivalent to the Aggregate Bed Width referred to in section 80)

d) Minimum basal area sand width = minimum basal area (from Table 8) ÷ length of bed (B)
1608 ft^2 ÷ 125 ft = 12.86 ft

e) For slopes less than or equal to 0.5%:
Eljen application area width + 14 ft
f) For slopes greater than 0.5%:
Eljen application area width + 9 ft
4 ft + 9 ft = 13 ft

Actual basal area width is A + (G – 3). 4 ft + 9.4 ft = 13.4 ft

From section 6-8.3-80 it was determined the system required a minimum of 13 ft of Eljen application area width and downslope basal width. The design is greater (Actual basal area = 13.4 ft) and meets the requirements.

Elevated Sand Mound Design Example

FIGURE 19: CROSS SECTION – 600 GPD – MOUND SYSTEM

EXISTING GRADE GREATER THAN 0.5%

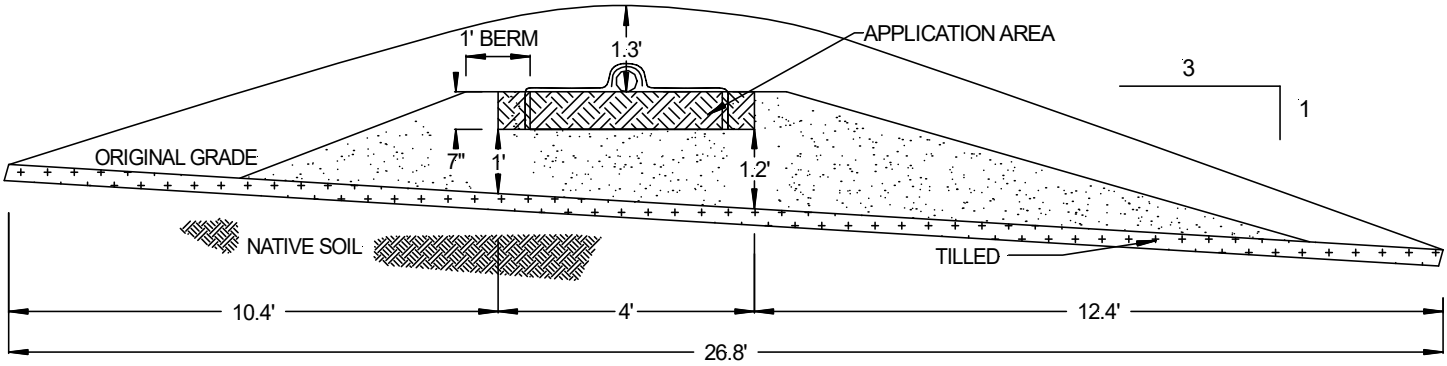


FIGURE 20: PLAN VIEW – 600 GPD – MOUND SYSTEM

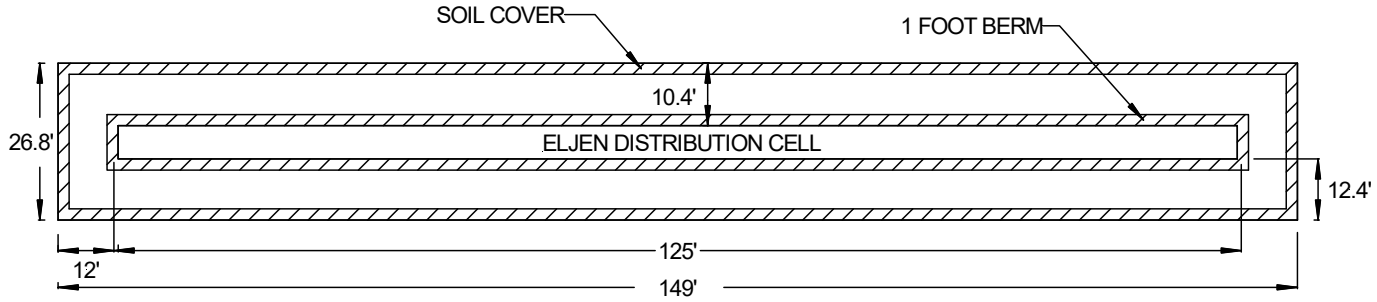
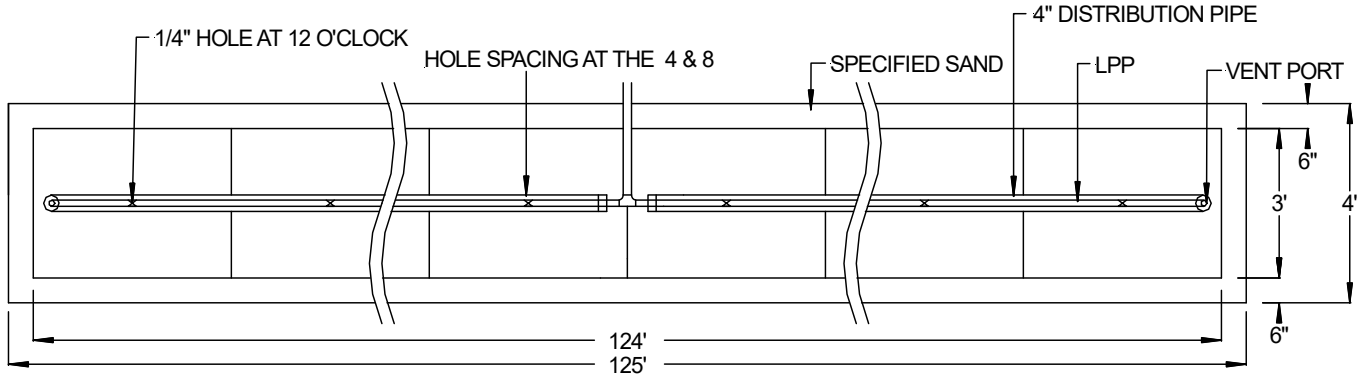


FIGURE 21: PLAN VIEW – 600 GPD – APPLICATION AREA MOUND SYSTEM



Dosing Distribution Requirements

1. ADDITIONAL REQUIREMENTS
Dosing tanks and effluent pumps must comply with ISDH Rule 410 6-8.3 Section 62 and 65 for dosing tanks and effluent pumps.

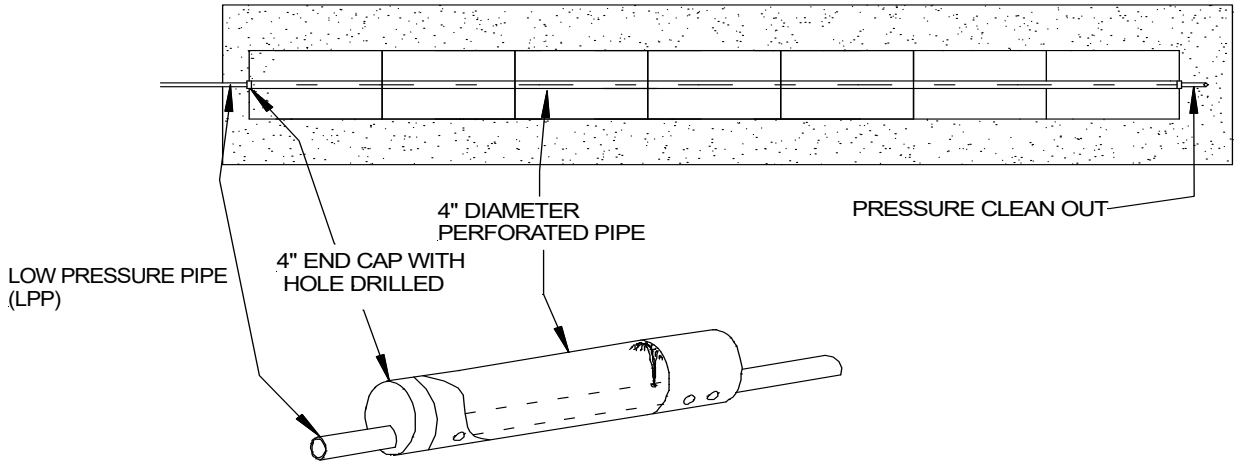
Section 410 IAC 6-8.3 (78) Subsurface Pressure Distribution is enforced except when noted.

2. DOSE VOLUME: Dose volume is calculated as follows. ***Use a maximum of 3 gallons per dose per A42 module or 4 gallons per dose per B43 module*** in the system. For the A42, a minimum of 1.5 gallons per dose per module or 2 gallons per dose per B43 module.

Pressure Distribution Requirements

Standard procedures for design of pressure distribution networks apply to the GSF system. Orifices shall be 4-foot on center spacing so the orifices fall in the center of each module. An orifice size of ¼ inch shall be maintained. A ¼ inch diameter drain hole is required at the 6 o'clock distal end of each pressure lateral for required drainage. The 1.5 inch is specified throughout the lateral pipe network and 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 22: PRESSURE PIPE PLACEMENT



PRESSURE PIPE CROSS SECTION FOR ALL APPLICATIONS

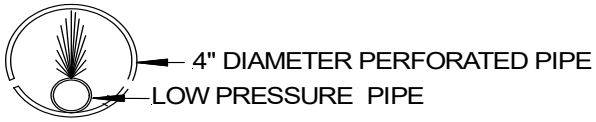


FIGURE 23: PRESSURE CLEAN OUT

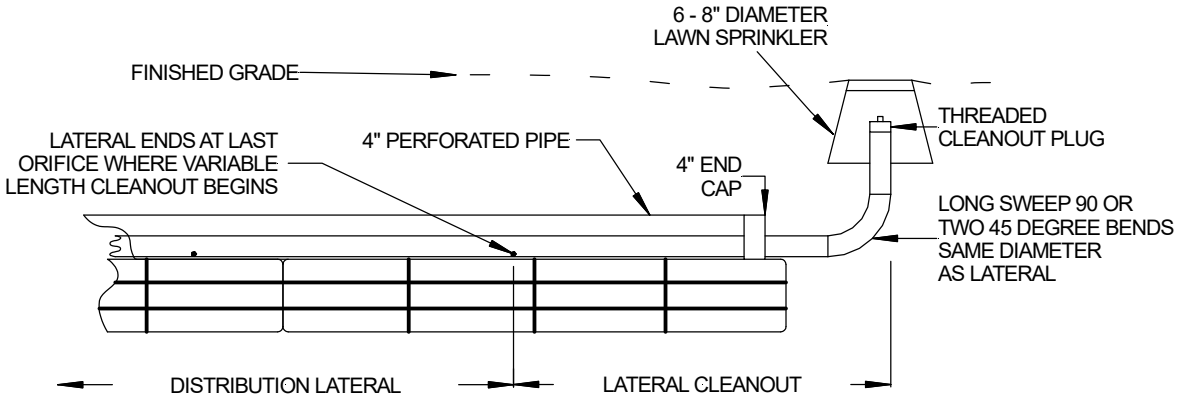


FIGURE 24: CONTOURED TRENCH INSTALLATION

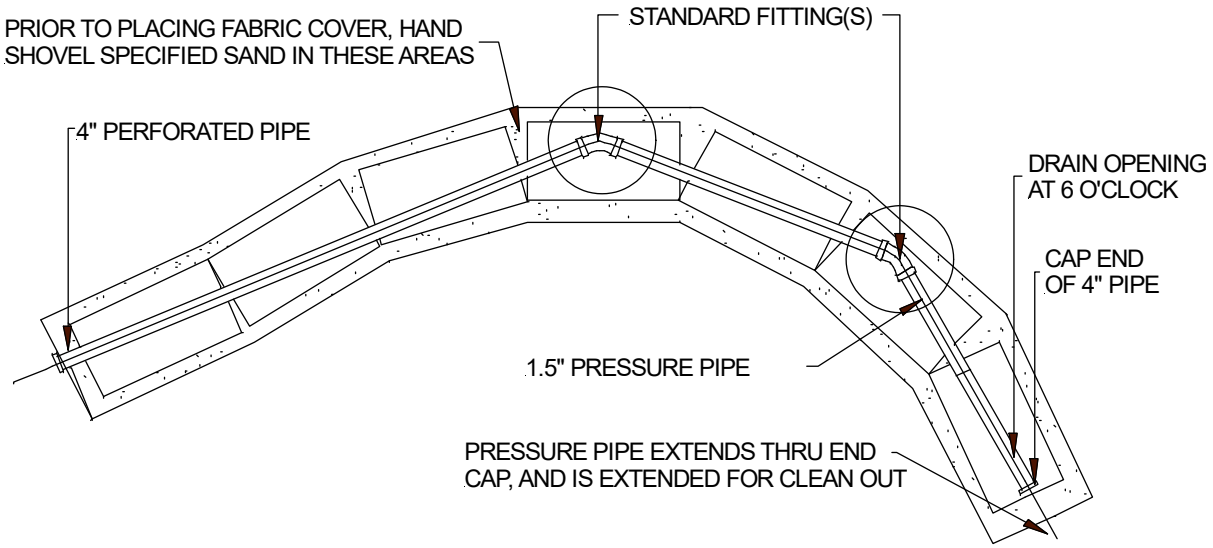


Figure 24 depicts a GSF Pressure Distribution trench placed on a contour or winding trenches to maintain horizontal separation distances. The above graphic could also be used in a dosed or gravity fed system if the low pressure line were removed from the 4-inch diameter perforated distribution pipe.

Pump Controls

Pump 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 dosing tank and is secure from tampering and resistant to weather (minimum of NEMA4X). 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.

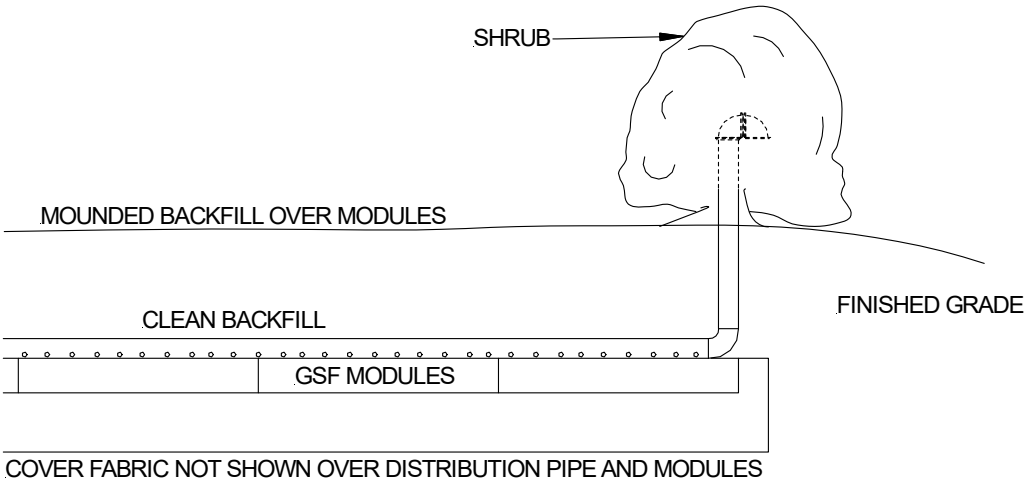
System Ventilation

1. SYSTEM VENTILATION: Air vents are required on all absorption systems located 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 Module has aeration channels inside the physical unit and in between the rows of 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.

Typically, 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.

2. VENTILATION PLACEMENT: In a GSF system, the vent is usually a 4-inch diameter pipe extended to a convenient location behind shrubs, as shown below. Non-perforated 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 25: GSF WITH 4" VENT EXTENDED TO CONVENIENT LOCATION



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 absorption field. The figures below depict construction and placement of the Inspection/Monitoring Port. For beds and elevated systems, place one port per lateral. At least one inspection port should be place at the midpoint of a row. At the distal ends, use 90 degree elbows and extend to the surface as an additional inspection port, capped and sealed to be watertight. One inspection port should be located downslope in the toe as well.

FIGURE 26: MONITORING WELL FOR SAND-SOIL INTERFACE

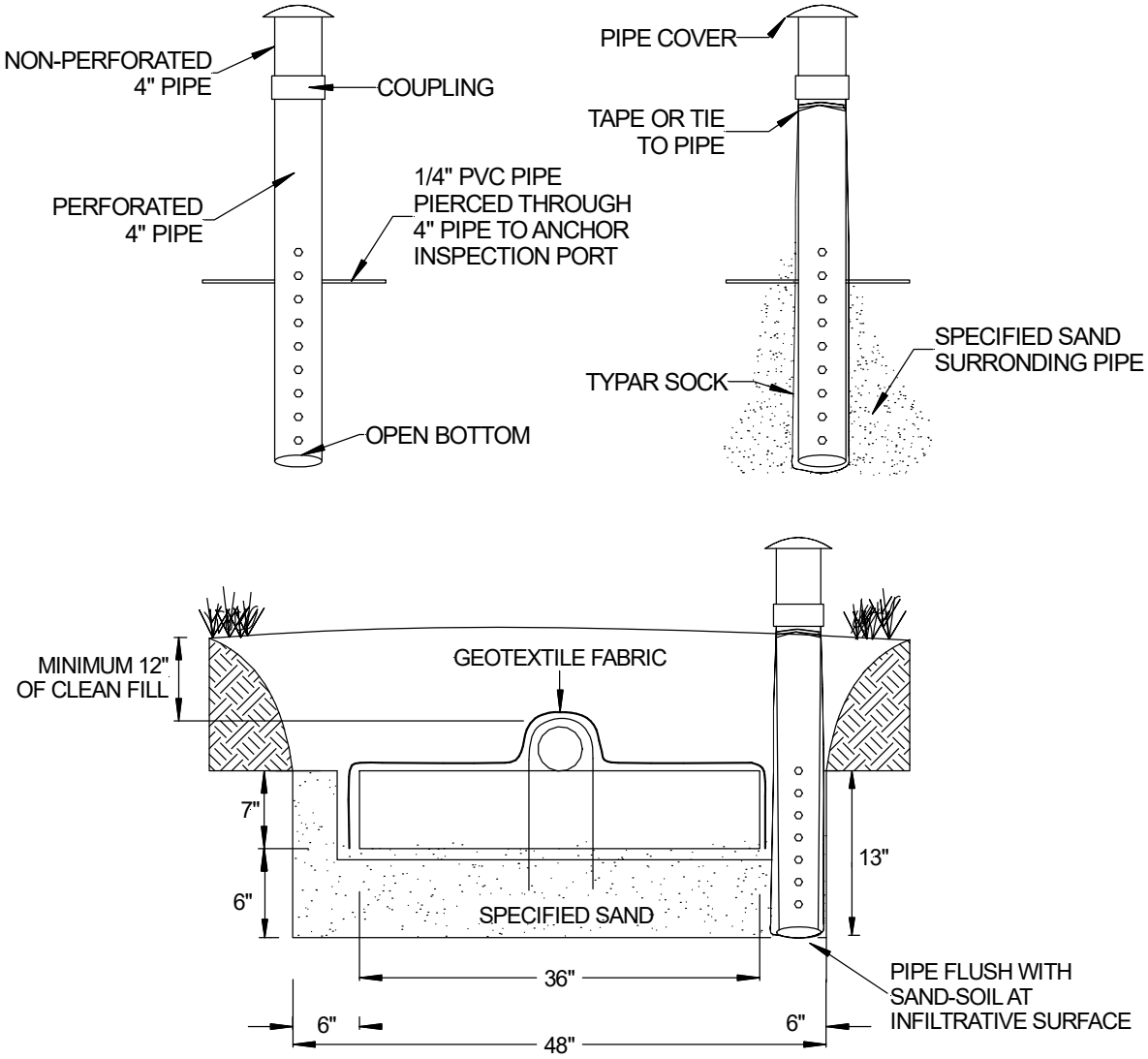


TABLE 9: GSF INSPECTION CHECK LIST

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		

TABLE 9: GSF Inspection Check List (continued)

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:	
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.

Indiana GSF Registration Form

In accordance with manufacturers requirements for each installation, Indiana installers of Eljen systems must complete and fax, email or mail a copy of this form to one of the following addresses:

US Mail:

Eljen Corporation
125 McKee Street
East Hartford, CT
06108

Website Online Submission: www.eljen.com – http://www.eljen.com/Pages/GSF/GSFinstallationForm_IN.html

Email: indianagsfsystem@eljen.com – Subject: IN GSF System Installation Form

Fax: 860-610-0427 – Subject: Indiana GSF System Installation Form

Indiana GSF Registration Form

INSTALLED BY:

NAME _____
COMPANY _____
ADDRESS _____
TELEPHONE _____

DESIGNED BY:

NAME _____
COMPANY _____
ADDRESS _____
TELEPHONE _____

INSPECTED BY:

NAME _____
COMPANY _____
ADDRESS _____
TELEPHONE _____

SITE LOCATION:

NAME _____
COMPANY _____
ADDRESS _____
TELEPHONE _____

MODULES USED B43 (48in x 36in x 7 in) A42 (48in x 24in x 7 in)
(Circle One)

NUMBER OF BEDROOMS 1 2 3 4 5 (Number Greater than 5) ____
(Circle One)

DAILY DESIGN FLOW: Number of Bedrooms **x** 150 gpd= _____

SYSTEM CONFIGURATION: Subsurface Bed Above Grade Bed Trench Elevated sand mound
(Circle One)
Subsurface requires 6 inches of sand beneath module
Elevated sand mounds and above grade beds requires 12 in of sand beneath module

TYPE OF SYSTEM: Gravity Pressure Dosed
(Circle One)

Indiana GSF Registration Form

AREA REDUCTION: Refer to section labeled notes below tables 5 and 6 on page 12

SITE SLOPE: Elevated Systems: (6% max slope) Subsurface System (15% max slope)
(Circle One)

TRENCH/LATERAL LENGTH:
Gravity and Dosed systems have a maximum length of 100 feet.

SUBSURFACE DRAINAGE Yes No
(Circle One)

*Reference 410 IAC 6-8.3 (59) for depth requirements of subsurface drainage.

VENTING
(Circle One) Yes No

*Venting is required if system cover exceeds 18 inches.

COMPANY HISTORY

Established in 1970, Eljen Corporation created the world's first prefabricated drainage system for foundation drainage and erosion control applications. In the mid-1980s, we introduced our Geotextile Sand Filter products for the passive advanced treatment of onsite wastewater in both residential and commercial applications. Today, Eljen is a global leader in providing innovative products and solutions for protecting our environment and public health.

COMPANY PHILOSOPHY

Eljen Corporation is committed to advancing the onsite industry through continuous development of innovative new products, delivering high quality products and services to our customers at the best price, and building lasting partnerships with our employees, suppliers, and customers.

eljen CORPORATION

Innovative Environmental Products & Solutions Since 1970

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