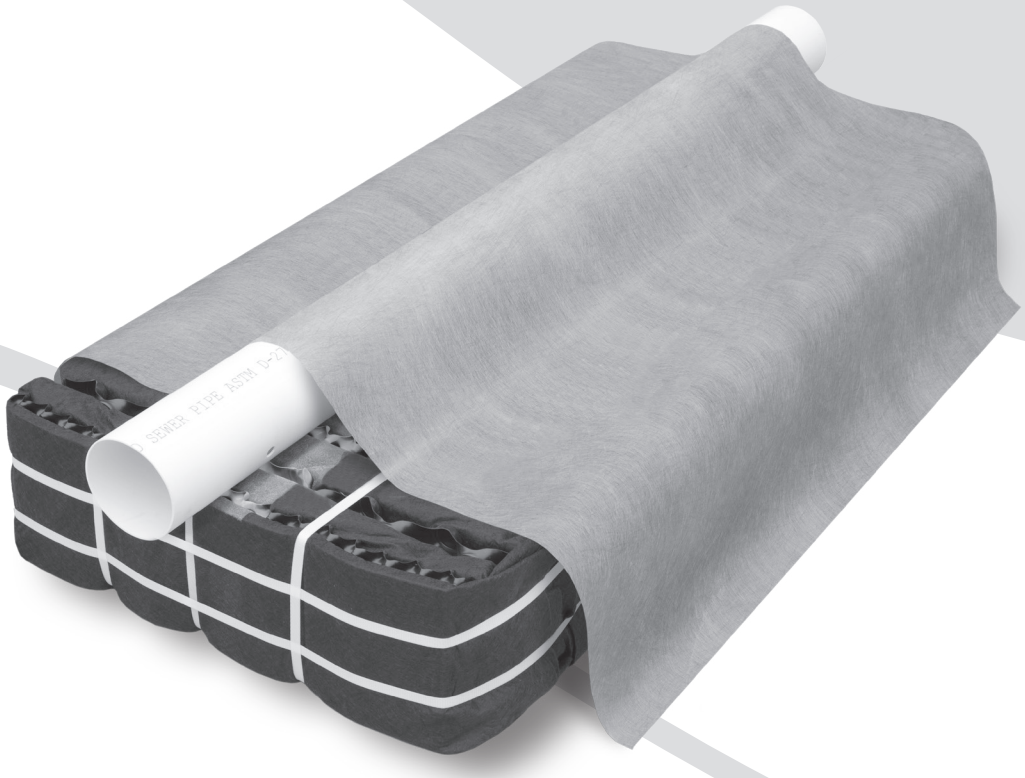
GSF®

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)

Cover Fabric The geotextile cover fabric (provided by manufacturer) is placed over the GSF modules. Barrier material cannot be substituted.

DDF "Design daily flow" or "DDF" means the calculated peak daily sewage flow from a residence used to design a residential onsite sewage system.

Design Flow The estimated peak flow that is used to size a GSF system is 150 gallons per day per bedroom.

GPD Gallons Per Day.

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 composed of a cuspated plastic core and geotextile fabric.

Specified Sand To ensure proper system operation, the system MUST be installed using Indiana Department of Transportation Specification 23 (INDOT SPEC 23) sand AND must be used in accordance with IDOH Rule 410 IAC6-8.3-80(j) or IDOH Rule 410 IAC6-8.3-88(j). Ask your material supplier for a sieve analysis to verify that your material meets the required specifications. Please place a prominent note to this effect on each design drawing.

TABLE 1: SPECIFIED SAND SIEVE REQUIREMENTS

INDIANA DEPARTMENT OF TRANSPORTATION SPECIFICATION 23 SAND		
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

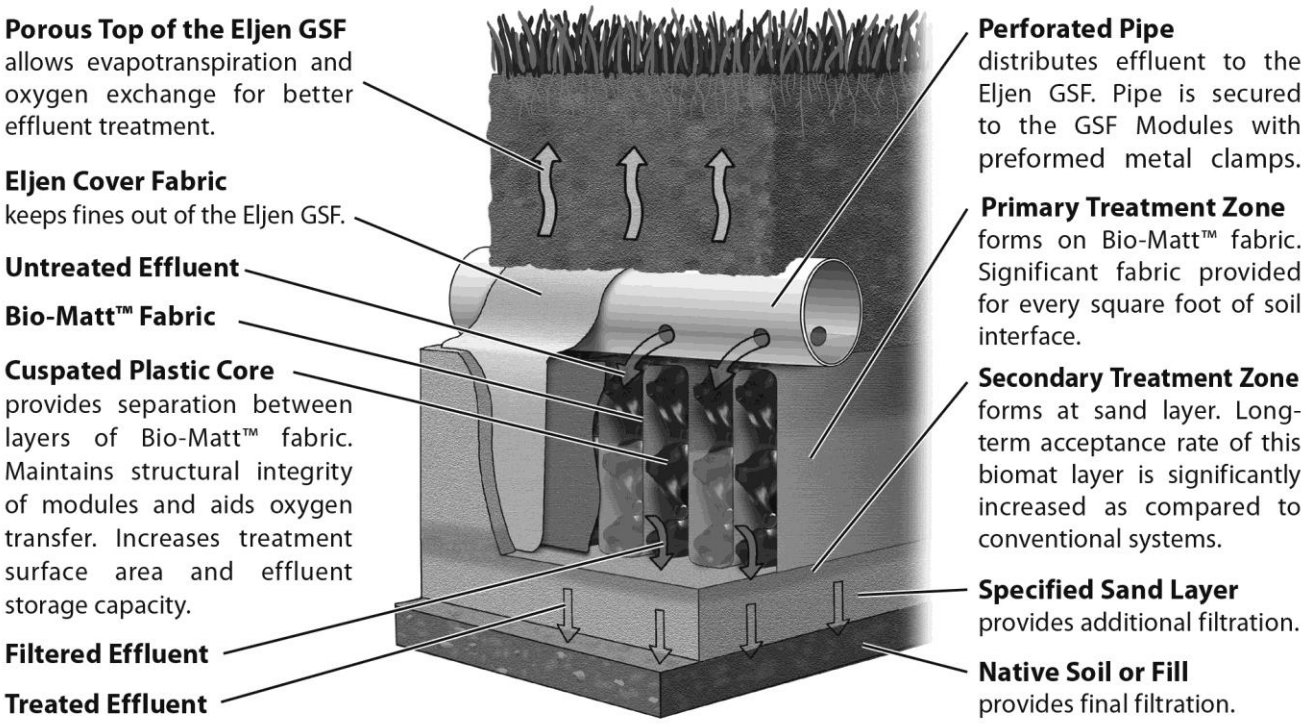
Primary Treatment Zone

- 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™ (geotextile) 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 module's geotextile fabric interface, surpassing the surface area required for traditional absorption systems.
- A cover 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



1.0 Conditions for Use

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

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

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

1.0.4 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 is not used.

1.0.5 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 Jacuzzi- style tubs, and other high-use fixtures.
- Homes with known higher than normal occupancy.

1.1 System Design

1.1.1 REQUIREMENTS: GSF systems must meet IDOH Rule 410 IAC6-8.3 except as outlined in this manual.

- The sizing tables in this manual apply to residential systems of any size and
- Commercial systems with daily design flows less than or equal to 750 Gallons per day (GPD).

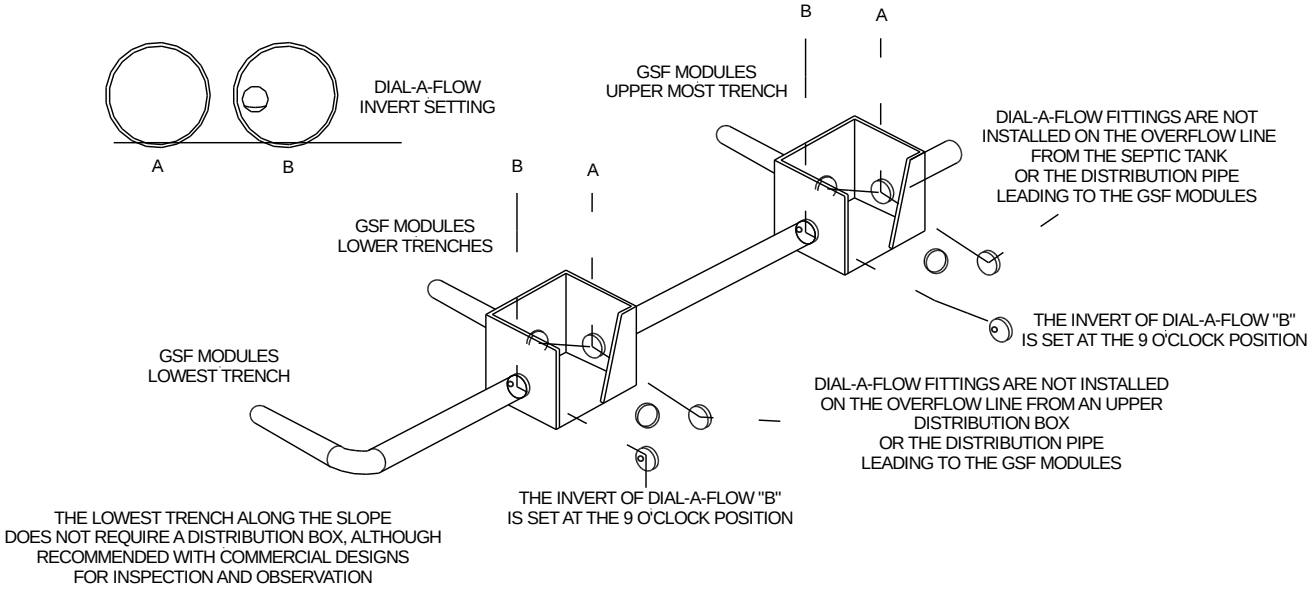
Sizing examples are included in this manual. Please contact Eljen's Technical Resource Department at 1-800-444-1359 for design information on commercial systems and adhere to IDOH Rule 410 IAC6-10.1

1.1.2 NUMBER OF GSF MODULES REQUIRED: The tables in 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 6 B43 modules.

1.1.3 SUITABLE SITE AND SOIL CONDITIONS: The Eljen Modules may be designed for all sites that meet the criteria described in the Indiana State Department of Health, Residential Onsite Sewage Systems, Rule 410 IAC6-8.3-970-73 or IDOH Rule 410 IAC6-10.1-(78-80).

1.1.4 SEQUENTIAL LOADING: Sequential distribution may be utilized only for sloping sites. Sequential Distribution uses a distribution box equipped with speed levelers. The uppermost line of the system and the inlet to the distribution box will be left open. Down slope lines from the distribution box will have the speed leveler at 9 o'clock. Figure 2 demonstrates this practice, which 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. These systems are approved in writing on a case-by-case basis by the Eljen Technical Department.

FIGURE 2: SEQUENTIAL LOADING DIAGRAM



1.1.5 SYSTEM GUIDANCE The chart below directs you to the appropriate section of this manual for the design and installation of the system.

TABLE 2: SYSTEM GUIDANCE CHART

Minimum Depth of Installation from Existing Grade	Number of Laterals per Excavation	Slope	Section	Page
4 Inches or Greater	Single	0 – 15%	Subsurface Trench and Single Lateral Bed	8
	Multiple	0.0 – 0.5%	Subsurface Bed	15
		0.5 – 15%	Sloped Subsurface Bed	21
Existing Grade	Single	0 – 6%	Elevated Sand Mound	29
	Multiple	0.0 – 0.5%	Above Grade Bed	37
		0.5 – 6%	Sloped Above Grade Bed	42

Use the section above to go to the correct portion of this manual.

2.0 Subsurface Trench and Single Lateral Bed Design and Installation

2.0.1 ACCEPTABLE METHODS OF DISTRIBUTION: Gravity, dosed, and pressure distribution are acceptable.

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

2.0.3 GENERAL CROSS SECTIONS

FIGURE 3: SUBSURFACE A42 TRENCH CROSS SECTION

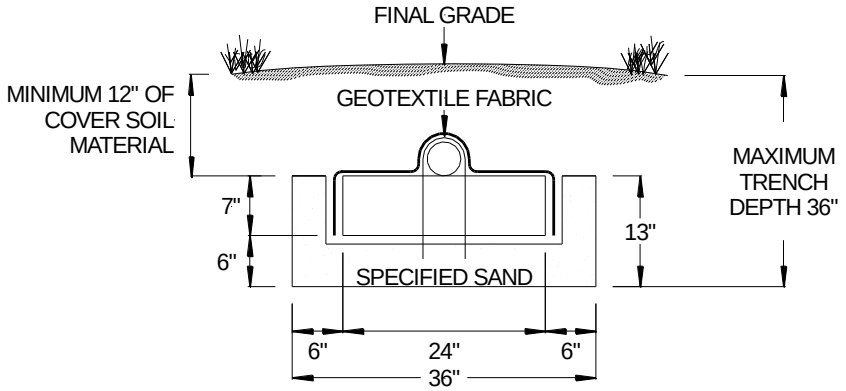
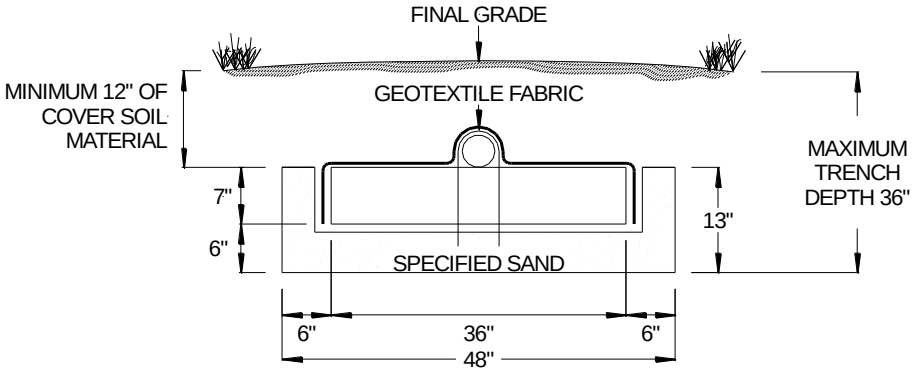


FIGURE 4: SUBSURFACE B43 SINGLE LATERAL BED CROSS SECTION



<u>All subsurface trenches and single lateral beds are required to have:</u>

- 6 inches of Specified Sand at the edges of the GSF module.
- 6 inches of Specified Sand at the beginning and end of each GSF Row.
- Minimum 6 inches of Specified Sand directly below the GSF module.
- Minimum 12 inches of cover soil material above the module.
- And a maximum trench or single lateral bed depth from final grade of 36 inches.

2.0.4 VERTICAL SEPARATION TO SEASONAL HIGH-WATER TABLE OR LIMITING LAYER: Refer to section Rule 410 IAC6-8.3-70(b) for subsurface absorption systems or IDOH Rule 410 IAC6-10.1-61.

Vertical Separation Distance (VSD)			
System Type	Daily Design Flow	Limiting Layer	Seasonal High-Water Table
Subsurface Trench and Single Lateral Bed System	≥450	30"	24"
	<450	24"	
Pressure Distribution	Any	24"	24"
VSD measured from the bottom of the excavated trench or bed for the subsurface system.			

2.0.5 DISTRIBUTION BOX: Parallel distribution is preferred. Sequential distribution may be utilized for sloping sites and must conform to 1.1.4. Distribution boxes are required to be 5 feet from the proximal end of each soil absorption field trench.

2.0.6 PARALLEL DISTRIBUTION: Parallel distribution is the preferred method of application 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 systems.

2.0.7 TRENCH LENGTH: Trenches will have a maximum of 100 feet in length unless pressure distribution is used per Rule 410 IAC6-8.3-74(r) or IDOH Rule 410 IAC6-10.1-82(r).

2.0.8 EQUAL LENGTH: Trenches must be of equal length to provide equal distribution.

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

2.0.10 DISPERSAL AREA: Dispersal area requirements are in IDOH Rule 410 IAC6-8.3-58 or IDOH Rule 410 IAC6-10.1-62.

2.0.11 MINIMUM SLOPE REQUIREMENTS: Maintain a 3:1 slope or gentler for all slopes off the application area.

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

2.0.13 SIZING GSF SYSTEMS

TABLE 3: GSF TRENCH AND SINGLE LATERAL BED SIZING CHART

Soil Loading Rate (GPD/Square Foot)	Minimum Absorption Area Required (Square Feet)				A42 Modules per House				B43 Modules per House			
	Bedrooms per House				Bedrooms per House				Bedrooms per House			
	2	3	4	5	2	3	4	5	2	3	4	5
1.2	168	252	335	419	14	21	28	35	11	18	24	30
0.75	268	402	536	670	23	34	45	56	17	26	34	42
0.6	335	503	670	838	28	42	56	70	21	32	42	53
0.5	402	603	804	1005	34	51	67	84	26	38	51	63
0.3	670	1005	1340	1675	56	84	112	140	42	63	84	105
0.25	804	1206	1608	2010	67	101	134	168	51	76	101	126

Notes:

- Sizing charts are based on third-party testing data. In some cases, round up the number of units to maintain even laterals and to meet hydraulic loading requirements.
- The Minimum Absorption Area has been adjusted to reflect a 33% reduction in absorption field area.
- Any jetted bathtub with a capacity greater than 125 gallons will be treated as an extra bedroom for the system sizing requirements per Rule 410 IAC6-8.3.

2.1 Subsurface Trench and Single Lateral Bed Design Example

Example 1: Subsurface Trench (A42 Module) and Single Lateral Bed System (B43 Module)

House Size:	3 Bedrooms
Design Flow:	450 GPD
Soil Loading Rate:	0.3 GPD/square foot
Absorption Field Type:	Trench

Calculate Minimum Basal Area and Units Required

Refer to Table 3 for the minimum number of units and minimum sized basal area required for installation.

Soil Loading Rate	Minimum Absorption Area Required (Square Feet)				A42 Modules per House				B43 Modules per House			
(GPD/square foot)	Bedrooms per House				Bedrooms per House				Bedrooms per House			
	2	3	4	5	2	3	4	5	2	3	4	5
0.3	670	1005	1340	1675	56	84	112	140	42	63	84	105

Calculate Minimum Trench Length

A42: 84 units x 4 feet/unit = 336 linear feet

B43: 63 units x 4 feet/unit = 252 linear feet

Trench Width

A42: 3 feet

B43: 4 feet

Final Dimension Layout

(Note: System layout and number of rows will vary based on site constraints)

A42 – Trench

Min. Product Length	336 feet
(Note: 6 inches sand required at each end of trench, which makes the minimum trench length 337 feet)	
Trench Width	3 feet
Minimum Number of Units	84 A42 Modules
Designed Absorption Area	1,011 square feet

B43 – Single Lateral Bed

Min. Product Length	252 feet
(Note: 6 inches sand required at each end of trench, which makes the minimum trench length 253 feet)	
Trench Width	4 feet
Minimum Number of Units	63 B43 Modules
Designed Absorption Area	1,012 square feet

FIGURE 5: PLAN VIEW – 450 GPD – B43 –SINGLE LATERAL BED SYSTEM

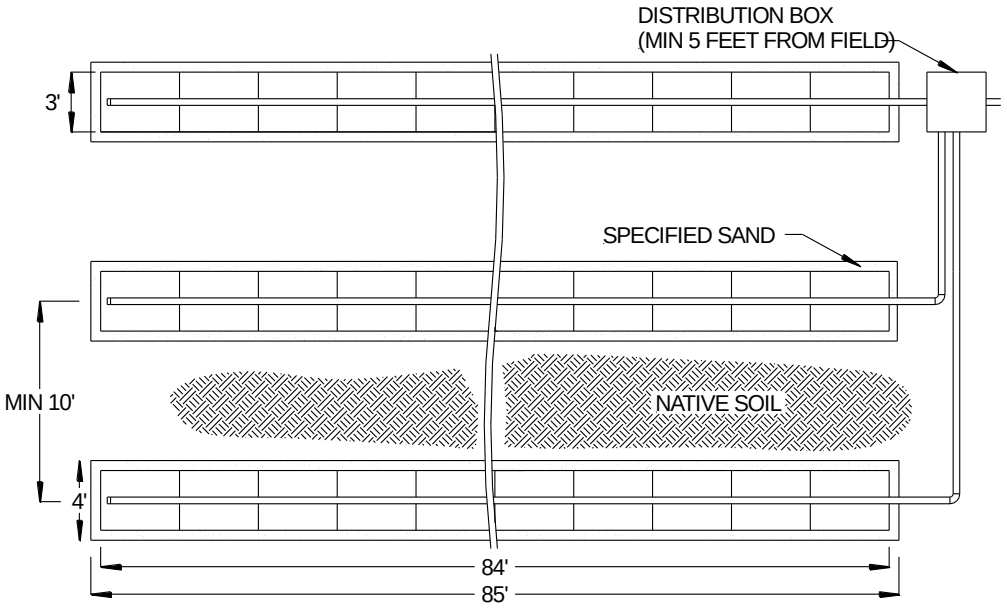
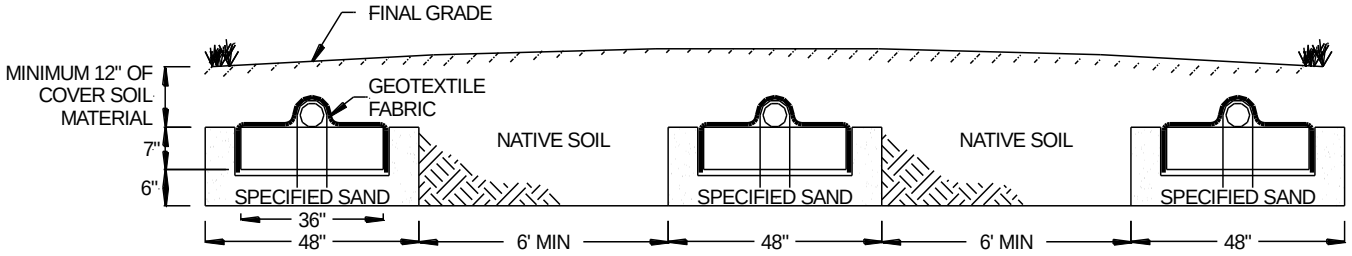


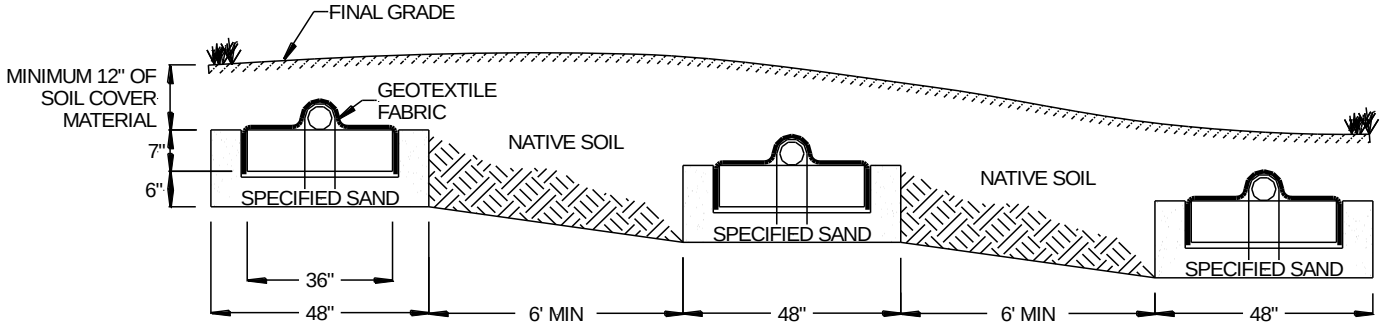
FIGURE 6: SECTION VIEW – B43 – SINGLE LATERAL BED SYSTEM – ≤ 0.5% SLOPE



Loading Rate 0.3 GPD/Square Feet, Design Flow 150 GPD x 3 Bedrooms = 450 Gallons per Day.

(21 Modules per Row)

FIGURE 7: SECTION VIEW – B43 – SINGLE LATERAL BED SYSTEM – 0.5 – 15% SLOPE



Loading Rate 0.3 GPD/Square Feet, Design Flow 150 GPD x 3 Bedrooms = 450 Gallons per Day.
(21 Modules per Row)

2.2 Subsurface Trench and Single Lateral Bed Design Installation Steps

1. Ensure all components leading to the GSF system are installed properly. Outlet filters are required with the GSF system. Connections of lines to tanks and distribution boxes must follow requirements of IDOH Rule 410 IAC6-8.3 or IDOH Rule 410 IAC6-10.1.

2. Determine the number of GSF Modules required using Table 3.

3. Prepare the site. Do not install a system in saturated ground or wet soils that are smeared during excavation. Keep machinery off infiltrative areas. Refer to IDOH Rule 410 IAC6-8.3or IDOH Rule 410 IAC6-10.1for all site preparation requirements prior to site construction.

4. Plan all drainage requirements above (up slope) of the system. Set soil grades to ensure that stormwater drainage and groundwater is diverted away from the absorption area once the system is complete. All drainage requirements shall be in accordance with IDOH Rule 410 IAC6-8.3-59or IDOH Rule 410 IAC6-10.1-63.

5. Excavate the trench absorption area; scarify the receiving layer to maximize the interface between the native soil and specified sand.

6. Minimize walking in the trench prior to placement of the specified sand to avoid soil compaction.

7. Place a minimum of 6 inches of Specified Sand in the absorption area, stabilize and level. The first 6 inches of sand immediately under and around the perimeter of the GSF system must be ***INDIANA DEPARTMENT OF TRANSPORTATION (INDOT) SPECIFICATION 23 SAND.*** See Table 1 for more information on the sand and sieve specifications.

8. Place GSF modules with **PAINTED STRIPE FACING UP.** Each row of modules is laid level in its length and width, end-to-end, along their four-foot length on the Specified Sand layer. No mechanical connection is required between modules.

9. A standard 4-inch perforated pipe, SDR 35 or equivalent, is centered along the modules 4-foot length. Orifices are set at the 4 and 8 o'clock positions. All distribution piping must meet the requirements of IDOH Rule 410 IAC6-8.3-67 or IDOH Rule 410 IAC6-10.1-75.

10. All 4-inch pipes are secured with manufacturer supplied wire clamps, one per module.

11. (Pressure Distribution Systems) Insert a Sch. 40 pressure pipe that meets IDOH Rule 410 IAC6-8.3-67 or IDOH Rule 410 IAC6-10.1-75into the standard 4-inch perforated pipe. The pressure pipe orifices are set at the 12 o'clock position, as shown in Figure 26. Each pressure lateral will have a drain hole at the distal end of the lateral at the 6 o'clock position. Each pressure lateral shall have a cleanout at the end of the trench.

12. The 4-inch distribution pipe shall be capped or vented.

13. ***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:
    a. 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.
    b. Placing 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.

14. 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.

2.2 Subsurface Trench and Single Lateral Bed Design Installation Steps, Continued

15. Complete backfill with cover soil material to a minimum of 12 inches measured from the top of the module. The 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.

16. Divert surface runoff from the system. Finish grade to prevent surface ponding. Topsoil and seed system area to protect from erosion.

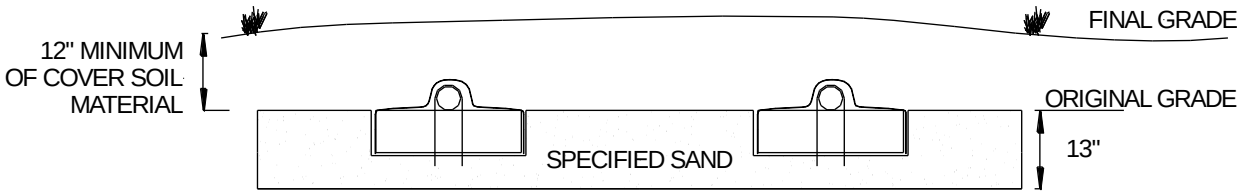
3.0 Subsurface Bed Design and Installation

3.0.1 ACCEPTABLE METHODS OF DISTRIBUTION: Gravity, dosed, and pressure distribution are acceptable.

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

3.0.3 GENERAL CROSS SECTION

FIGURE 8: SUBSURFACE BED CROSS SECTION



All subsurface bed systems are required to have a minimum of:

- 6 inches of Specified Sand at the edges of the GSF module.
- 6 inches of Specified Sand at the beginning and end of each GSF Row.
- 6 inches of Specified Sand directly below the GSF module.
- 12 inches of cover soil material above the module.

And a maximum excavation depth from final grade of 36 inches.

3.0.4 VERTICAL SEPARATION TO SEASONAL HIGH-WATER TABLE OR LIMITING LAYER: Refer to IDOH Rule 410 IAC6-8.3-70(b) for subsurface absorption systems or IDOH Rule 410 IAC6-10.1-61.

Vertical Separation Distance (VSD)			
System Type	Daily Design Flow	Limiting Layer	Seasonal High-Water Table
Subsurface Bed	≥450	30"	24"
	<450	24"	
Pressure Distribution	Any	24"	24"
VSD measured from the bottom of the excavated bed for the subsurface system.			

3.0.5 DISTRIBUTION BOX: Parallel distribution is preferred. Sequential distribution may be utilized for sloping sites and must conform to the above content in the systems design section 1.1.4. Distribution boxes are recommended to be 5 feet from the proximal end of each soil absorption field row, as per IDOH Rule 410 IAC6-8.3-75(i) or IDOH Rule 410 IAC6-10.1-75. This may be amended to a shorter distance per the designer.

3.0.6 PARALLEL DISTRIBUTION: Parallel distribution is the preferred method of application 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 bed systems.

3.0.7 ROWS REQUIRED: All bed systems shall have a minimum of two rows of modules.

3.0.8 ROW LENGTH: Rows will have a maximum of 100 feet in length unless pressure-dosed per IDOH Rule 410 IAC6-8.3-74(r) or IDOH Rule 410 IAC6-10.1-82(r).

3.0.9 EQUAL LENGTH: Rows must be of equal length to provide equal distribution.

3.0.10 DISPERSAL AREA: Dispersal area requirements are in IDOH Rule 410 IAC6-8.3-58 or IDOH Rule 410 IAC6-10.1-62.

3.0.11 MINIMUM SLOPE REQUIREMENTS: Maintain a 3:1 slope or gentler for all slopes off the application area.

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

3.0.13 SIZING GSF SYSTEMS:

TABLE 4: GSF SUBSURFACE BED SIZING CHART

Soil Loading Rate (GPD/Square Foot)	Minimum Basal Area Required (Square Feet) Bedrooms per House				A42 Modules per Room	B43 Modules per Room
	2	3	4	5		
1.2	168	252	335	419	6	6
0.75	268	402	536	670	8	7
0.6	335	503	670	838	9	8
0.5	402	603	804	1005	11	9
0.3	670	1005	1340	1675	12	10
0.25	804	1206	1608	2010	13	11

Notes:

- Sizing charts are based on third-party testing data. In some cases, round up the number of units to maintain even laterals and to meet hydraulic loading requirements.
- The Minimum Basal Areas have been adjusted to reflect a 33% reduction in absorption field area.
- Any jetted bathtub with a capacity greater than 125 gallons will be treated as an extra bedroom for the system sizing requirements per Rule 410 IAC6-8.3.

3.0.14 SYSTEM LENGTH AND WIDTH: Best engineering practices should be used when constructing the bed systems. IDOH Rule 410 IAC6-8.3-79(2) and IDOH Rule 410 IAC6-10.1-87(b) state the dimensions of the bed shall be as long and as narrow as the site allows.

3.0.15 BED DESIGN: For beds with less than a 0.5% slope, evenly distribute the bed laterals in the basal area. The minimum separation distance between laterals for A42s is 3′ and a minimum separation distance between laterals of 4′ for B43s.

3.1 Subsurface Bed Design Example

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

House Size:	4 Bedrooms
Design Flow:	600 GPD
Soil Loading Rate:	0.3 GPD/Square Foot
Absorption Field Type:	Bed
Site Slope:	Less than 0.5%

Calculate Minimum Basal Area and Units Required

Refer to Table 4 for the minimum number of units and minimum basal area required for installation.

Soil Loading Rate (GPD/Square Foot)	Minimum Basal Area Required (Square Feet) Bedrooms per House				A42 Modules per Room	B43 Modules per Room
	2	3	4	5		
0.3	670	1005	1340	1675	12	10

Units required per bedroom x bedrooms = Total units required. For example:

A42: 12 units/bedroom x 4 bedrooms = 48 A42s

B43: 10 units/bedroom x 4 bedrooms = 40 B43s

Calculate Minimum Bed Basal Area Length

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

Modules per Row: Modules Needed ÷ Rows

A42: 48 units ÷ 2 rows = 24 modules per row

A42: 24 units x 4 feet/unit +1 foot = 97 linear feet

B43: 40 units ÷ 2 rows = 20 modules per row

B43: 20 units x 4 feet/unit +1 foot = 81 linear feet

Calculate Bed Basal Area Width

a) Minimum A42 Basal Area Width

a) A42: Rows x 3 Feet = 2 x 3 Feet = 6 Feet

or

b) Proposed Basal Area Width

b) Minimum Basal Area ÷ Length of System

b) A42: 1340 Square Feet ÷ 97 Feet = 13.8 Feet, Round to 14 Feet

A42: Use greater width of a or b: 14 feet

a) Minimum B43 Basal Area Width

a) B43: Rows x 4 Feet = 2 x 4 Feet = 8 Feet

or

b) Proposed Basal Area Width

b) Minimum Basal Area ÷ Length of System

b) B43: 1340 Square Feet ÷ 81 Feet = 16.5 Feet, Round to 17 Feet

B43: Use greater width of a or b:17 feet

Determine Lateral Spacing

Slope	Upper Edge to Lateral Spacing		Lateral to Lateral Spacing	
	A42	B43	A42	B43
Less than or Equal to 0.5%	Lateral to Lateral Spacing ÷ 2		Basal Area Width Divided by Number of Rows	

Lateral to Lateral Spacing = Bed Width ÷ Rows

A42: 14 feet ÷ 2 rows = 7 feet

B43:17 feet ÷ 2 rows = 8.5 feet

Upper Edge to Lateral Spacing = Lateral to Lateral Spacing ÷ 2
A42: 7 feet ÷ 2 = 3.5 feet
B43: 8.5 feet ÷ 2 = 4.25 feet

Final Dimension Layout
(Note: System layout and number of rows will vary based on site constraints.)

A42

Basal Area Length:	97 feet
Basal Area Width:	14 feet
Minimum Number of Units:	48 A42 Modules
Center to Center Spacing:	7 feet
Edge to Center Spacing:	3.5 feet
Designed Basal Area:	1,358 square feet

B43

Bed Length:	81 feet
Bed Width:	17 feet
Minimum Number of Units:	40 B43 Modules
Center to Center Spacing:	8.5 feet
Edge to Center Spacing:	4.25 feet
Designed Basal Area:	1,377 square feet

FIGURE 9: PLAN VIEW – 600GPD – A42 – BED SYSTEM – ≤ 0.5% SLOPE

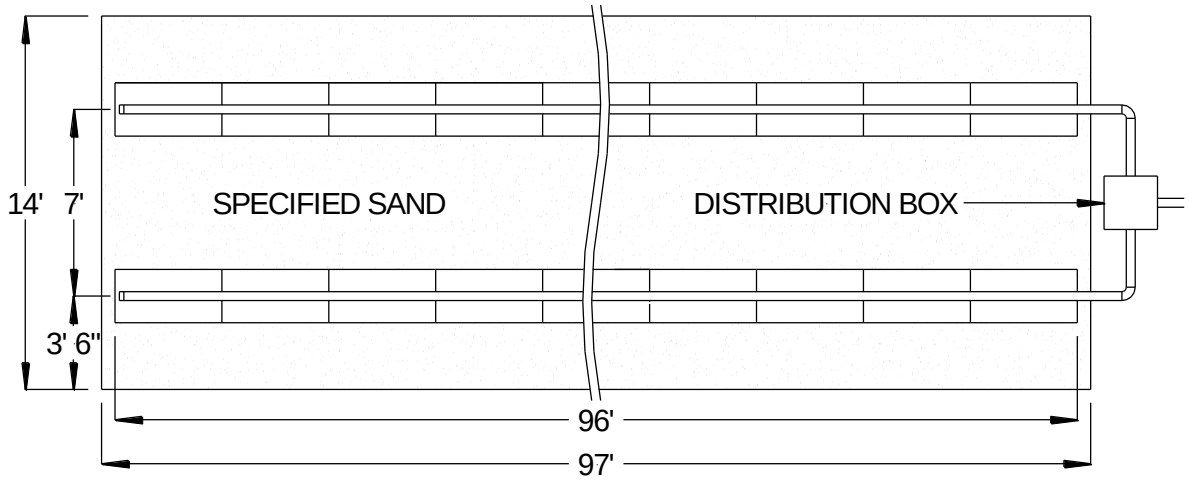
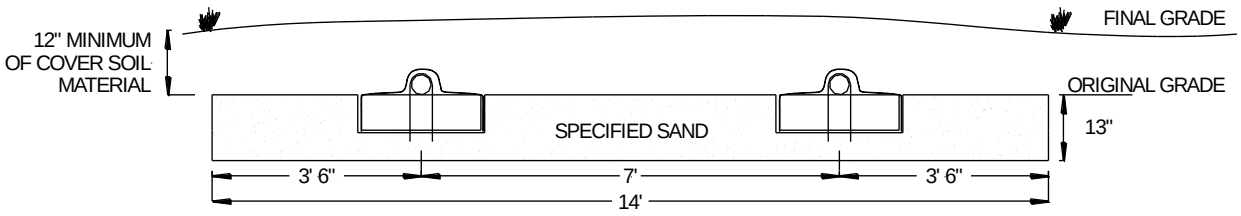


FIGURE 10: CROSS SECTION VIEW – 600 GPD – A42 – BED SYSTEM – ≤ 0.5% SLOPE



3.2 Subsurface Bed Design Installation Steps

1. Ensure all components leading to the GSF system are installed properly. Outlet filters are required with the GSF system. Connections of lines to tanks and distribution boxes must follow requirements of IDOH Rule 410 IAC6-8.3 or IDOH Rule 410 IAC6-10.1.

2. Determine the number of GSF Modules required using Table 4.

3. Prepare the site. Do not install a system in saturated ground or wet soils that are smeared during excavation. Keep machinery off infiltrative areas. Refer to IDOH Rule 410 IAC6-8.3 or IDOH Rule 410 IAC6-10.1 for all site preparation requirements prior to site construction.

4. Plan all drainage requirements above (up slope) of the system. Set soil grades to ensure that stormwater drainage and groundwater are diverted away from the system once it is complete. All drainage requirements shall be in accordance with IDOH Rule 410 IAC6-8.3-59.

5. Excavate the bed basal area; scarify the receiving layer to maximize the interface between the native soil and specified sand.

6. Minimize walking in the excavated area prior to placement of the specified sand to avoid soil compaction.

7. Place a minimum of 6 inches of Specified Sand in the basal area, then stabilize and level. The first 6 inches of sand immediately under and around the perimeter of the GSF system must be ***INDIANA DEPARTMENT OF TRANSPORTATION (INDOT) SPECIFICATION 23 SAND.*** See Table 1 for more information on the sand and sieve specifications.

8. Place GSF modules with **PAINTED STRIPE FACING UP**. Each row of modules is laid level in its length and width, end to end, along their four-foot length on the Specified Sand layer. No mechanical connection is required between modules.

9. A standard 4-inch perforated pipe, SDR 35 or equivalent, is centered along the modules' 4-foot length. Orifices are set at the 4 and 8 o'clock positions. All distribution piping must meet the requirements of IDOH Rule 410 IAC6-8.3-67 or IDOH Rule 410 IAC6-10.1-75.

10. All 4-inch pipes are secured with manufacturer supplied wire clamps, one per module.

11. (Pressure Distribution Systems) Insert a Sch. 40 pressure pipe that meets IDOH Rule 410 IAC6-8.3-67 or IDOH Rule 410 IAC6-10.1-75into the standard 4-inch perforated pipe. The pressure pipe orifices are set at the 12 o'clock position, as shown in Figure 26. Each pressure lateral will have a drain hole at the distal end of the lateral at the 6 o'clock position. Each pressure lateral shall have a cleanout at the end of the row.

12. The distribution pipe shall be capped or vented.

13. ***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:
    a. 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.
    b. Placing 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.

3.2 Subsurface Bed Design Installation Steps, Continued

14. 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 row. A minimum of 12 inches of Specified Sand is placed in between module rows.

15. Complete backfill with cover soil material to a minimum of 12 inches measured from the top of the module. 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.

16. Divert surface runoff from the system. Finish grade to prevent surface ponding. Topsoil and seed system area to protect from erosion.

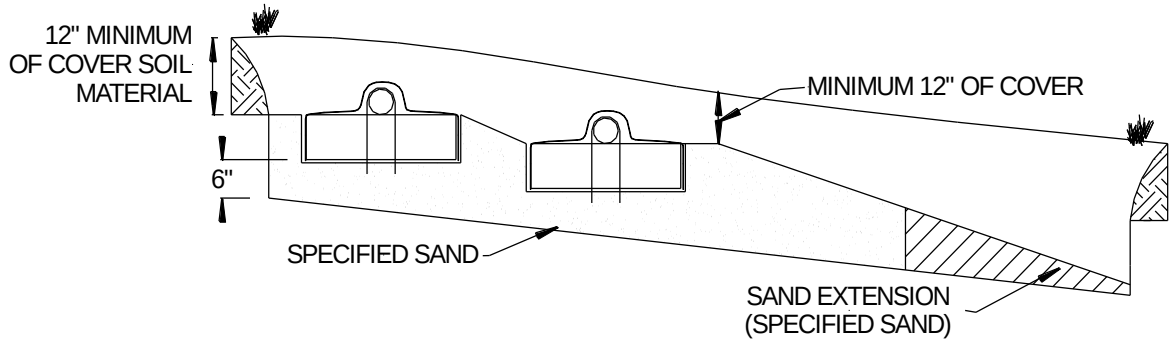
4.0 Sloped Subsurface Bed Design and Installation

4.0.1 ACCEPTABLE METHODS OF DISTRIBUTION: Gravity, dosed, and pressure distribution are acceptable.

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

4.0.3 GENERAL CROSS SECTION

FIGURE 11: SUBSURFACE SLOPED BED CROSS SECTION



All subsurface bed systems are required to have a minimum of:

- 6 inches of Specified Sand at the edges of the GSF module.
- 6 inches of Specified Sand at the beginning and end of each GSF Row.
- 6 inches of Specified Sand directly below the GSF module.
- 12 inches of cover soil material above the module.

And a maximum excavation depth from final grade is 36 inches.

4.0.4 VERTICAL SEPARATION TO SEASONAL HIGH-WATER TABLE OR LIMITING LAYER: Refer to IDOH Rule 410 IAC6-8.3-70(b) for subsurface absorption systems or IDOH Rule 410 IAC6-10.1-61.

Vertical Separation Distance (VSD)			
System Type	Daily Design Flow	Limiting Layer	Seasonal High-Water Table
Subsurface Bed	≥450	30"	24"
	<450	24"	
Pressure Distribution	Any	24"	24"
VSD measured from the bottom of the excavated bed for the subsurface system.			

4.0.5 DISTRIBUTION BOX: Parallel distribution is preferred. Sequential distribution may be utilized for sloping sites and must conform to the above content in the systems design section 1.1.4. Distribution boxes are recommended to be 5 feet from the proximal end of each soil absorption field row as per IDOH Rule 410 IAC6-8.3-75(i) or IDOH Rule 410 IAC6-10.1-74. This may be amended to a shorter distance per the designer.

4.0.6 PARALLEL DISTRIBUTION: Parallel distribution is the preferred method of application 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 bed systems.

4.0.7 ROWS REQUIRED: All bed systems shall have a minimum of two rows of modules.

4.0.8 ROW LENGTH: Rows will have a maximum of 100 feet in length unless pressure-dosed per IDOH Rule 410 IAC6-8.3-74(r) or IDOH Rule 410 IAC6-10.1-82(r).

4.0.9 EQUAL LENGTH: Rows must be of equal length to provide equal distribution.

4.0.10 DISPERSAL AREA: Dispersal area requirements are in IDOH Rule 410 IAC6-8.3-58 or IDOH Rule 410 IAC6-10.1-62.

4.0.11 MINIMUM SLOPE REQUIREMENTS: Maintain a 3:1 slope or gentler for all slopes off the application area.

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

4.0.13 SIZING GSF SYSTEMS:

TABLE 5: GSF SLOPED SUBSURFACE BED SIZING CHART

Soil Loading Rate (GPD/Square Foot)	Minimum Basal Area Required (Square Feet) Bedrooms per House				A42 Modules per Room	B43 Modules per Room
	2	3	4	5		
1.2	168	252	335	419	6	6
0.75	268	402	536	670	8	7
0.6	335	503	670	838	9	8
0.5	402	603	804	1005	11	9
0.3	670	1005	1340	1675	12	10
0.25	804	1206	1608	2010	13	11

Notes:

- Sizing charts are based on third-party testing data. In some cases, round up the number of units to maintain even laterals and to meet hydraulic loading requirements.
- The Minimum Basal Areas have been adjusted to reflect a 33% reduction in absorption field area.
- Any jetted bathtub with a capacity greater than 125 gallons will be treated as an extra bedroom for the system sizing requirements per Rule 410 IAC6-8.3.

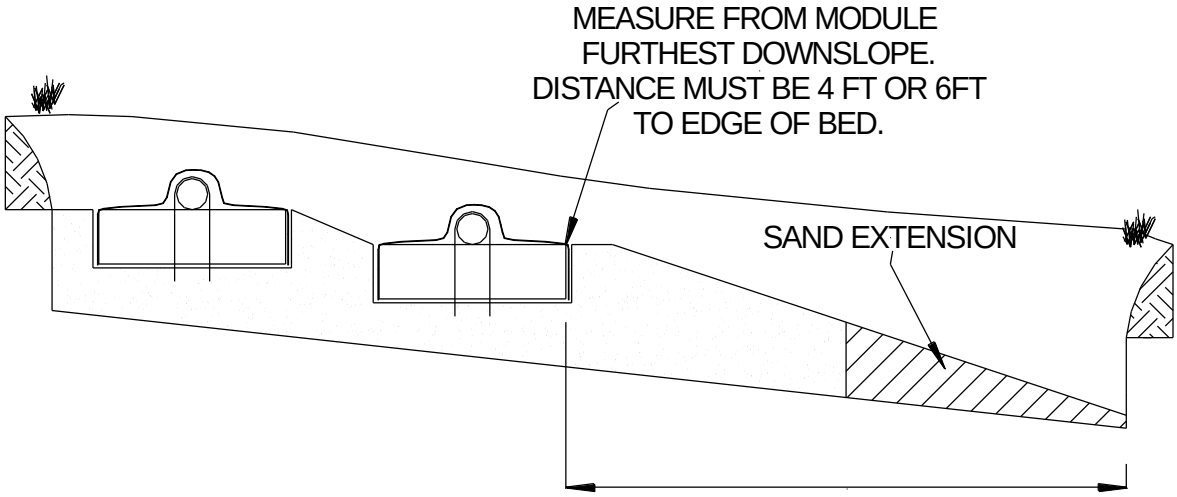
4.0.14 SYSTEM LENGTH AND WIDTH: Best engineering practices should be used during construction of the bed systems. IDOH Rule 410 IAC6-8.3-79(2) and IDOH Rule 410 IAC6-10.1-87(2) state the dimensions of the bed shall be as long and narrow as the site allows.

4.0.15 BED DESIGN: For all slopes greater than 0.5%, Eljen recommends moving the uppermost lateral 1.5 feet to 2 feet (for A42 and B43, respectively) from the upper edge of the basal area while maintaining a minimum of 6 inches between the module and the upper edge of the basal area. For sloping sites greater than 0.5%, maintain a distance between laterals of 3′ for A42 and 4′ for B43s.

4.0.16 SAND EXTENSION: For subsurface bed systems on slopes between 0.5% and 10%, a minimum of 4 feet of INDOT SPEC 23 sand extending from the edge of the furthest down slope GSF module is required. For slopes between 10% and 15%, a minimum of 6 feet of INDOT SPEC 23 sand extending from the edge of the furthest down slope GSF module is required. If the design calls for less sand than prescribed above, add a down slope

sand extension to meet the minimum 4- or 6-foot sand requirements from the edge of the furthest down slope GSF module.

FIGURE 12: SAND EXTENSIONS



SLOPE %	EXTENSION
0.5-10	4ft
10-15	6ft

4.1 Sloped Subsurface Bed Design Example

Example 3: Bed System – A42 Modules – Greater than 0.5% slope – Greater than 0.3 GPD/Square Foot Loading Rate

House Size:	3 Bedrooms
Design Flow:	450 GPD
Soil Loading Rate:	0.75 GPD/Square Foot
Absorption Field Type:	Bed
Site Slope:	11%

Calculate Minimum Basal Area and Units Required

Refer to Table 5 for the minimum number of units and minimum basal area required for installation.

Soil Loading Rate (GPD/Square Foot)	Minimum Basal Area Required (Square Feet) Bedrooms per House				A42 Modules per Room	B43 Modules per Room
	2	3	4	5		
0.75	268	402	536	670	8	7

Units required per bedroom x bedrooms = Total units required

A42: 8 units/bedroom x 3 bedrooms = 24 A42s

B43: 7 units/bedroom x 3 bedrooms = 21 B43s

Calculate Minimum Bed Basal Area Length

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

Modules per Row: Modules Needed ÷ Rows

A42: 24 units ÷ 2 rows =12 modules per row

B43: 21 units ÷ 2 rows = 10.5, round 11 modules per row

A42: 12 units x 4 feet/unit +1 foot = 49 linear feet

B43: 11 units x 4 feet/unit +1 = 45 linear feet

Determine Lateral Spacing

Slope	Upper Edge to Lateral Spacing		Lateral to Lateral Spacing	
	A42	B43	A42	B43
Greater than 0.5%	Minimum 1.5 feet	Minimum 2 feet	Minimum 3 feet	Minimum 4 feet

Lateral to Lateral Spacing from Table above:

A42: 3 feet

B43: 4 feet

Upper Edge to Lateral Spacing from Table above:

A42: 1.5 feet

B43: 2 feet

Calculate Bed Basal Area Width

a) Minimum A42 Basal Area Width

a) A42: Rows x 3 feet = 2 x 3 feet = 6 feet

or

b) Proposed Basal Area Width

b) Minimum Basal Area ÷ Length of System

b) A42: 402 square feet ÷ 49 feet = 8.2 feet, round to 8.5 feet

A42: Use greater width of a or b: 8.5 feet

a) Minimum B43 Basal Area Width

a) B43: Rows x 4 feet = 2 x 4 feet = 8 feet

or

b) Proposed Basal Area Width

b) Minimum Basal Area ÷ Length of System

b) B43: 402 square feet ÷ 45 feet = 8.9 feet, round to 9 feet

B43: Use greater width of a or b: 9 feet

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

Calculate Lateral to Lower Edge Spacing

Proposed Basal Area Width – Upper edge to Lateral Spacing – Lateral to Lateral Spacing =

A42: 8.5 feet – 1.5 feet – 3 feet = 4 feet

B43: 9 feet – 2 feet – 4 feet = 3 feet

Calculate Sand Extension

A42: Lateral to Lower Edge – 1 foot

A42: 4 feet – 1 foot = 3 feet

B43: Lateral to Lower Edge – 1.5 feet

B43: 3 feet – 1.5 feet = 1.5 feet

Since the slope is 11%, which requires a 6-foot sand extension from the edge of the last module.

A42: 3 feet is less than 6 feet

A42: Sand extension = 6 feet

B43: 1.5 feet is less than 6 feet

B43: Sand extension = 6 feet

Adjusted Lateral to Lower Edge

A42: Sand Extension + 1 foot

A42: 6 feet + 1 foot = 7 feet

B43: Sand Extension + 1.5 feet

B43: 6 feet + 1.5 feet = 7.5 feet

Adjusted Cell Width

Adjusted Lateral to Lower Edge – Lateral to Lower Edge + Proposed Basal Area Width

A42: 7 feet – 4 feet + 8.5 feet = 11.5 feet

B43: 7.5 feet – 3 feet + 9 feet = 13.5 feet

Final Dimension Layout

(Note: System layout and number of rows will vary based on site constraints.)

A42

Basal Area Length:	49 feet
Basal Area Width:	11.5 feet
Minimum Number of Units:	24 A42 Modules
Center to Center Spacing:	3 feet
Edge to Center Spacing:	1.5 feet
Designed Basal Area:	563.5 square feet

B43

Basal Area Length:	45 feet
Basal Area Width:	13.5 feet
Minimum Number of Units:	22 B43 Modules
Center to Center Spacing:	4 feet
Edge to Center Spacing:	2 feet
Designed Basal Area:	607.5 square feet

FIGURE 13: PLAN VIEW – 450 GPD – A42 – BED SYSTEM – 0.5 – 15% SLOPE

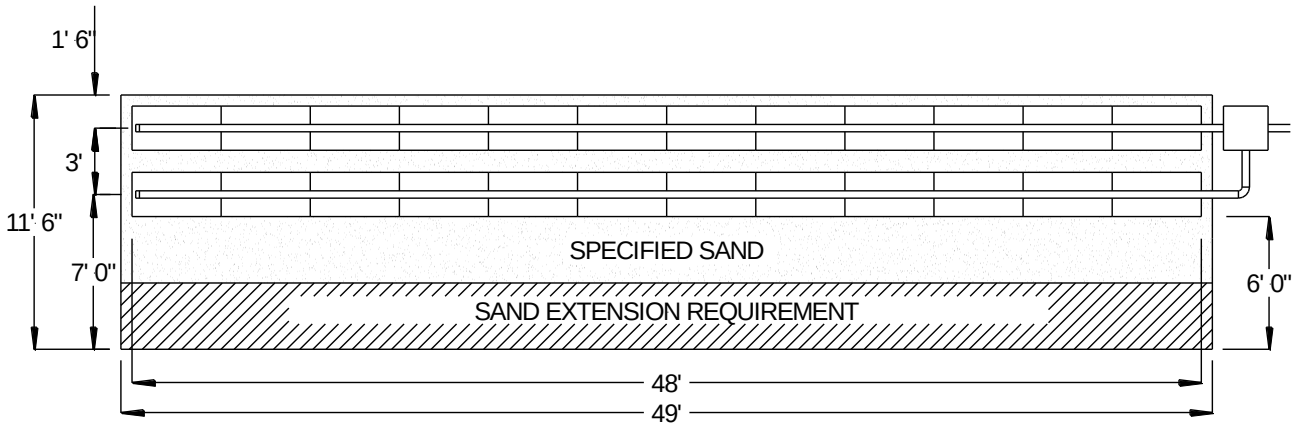
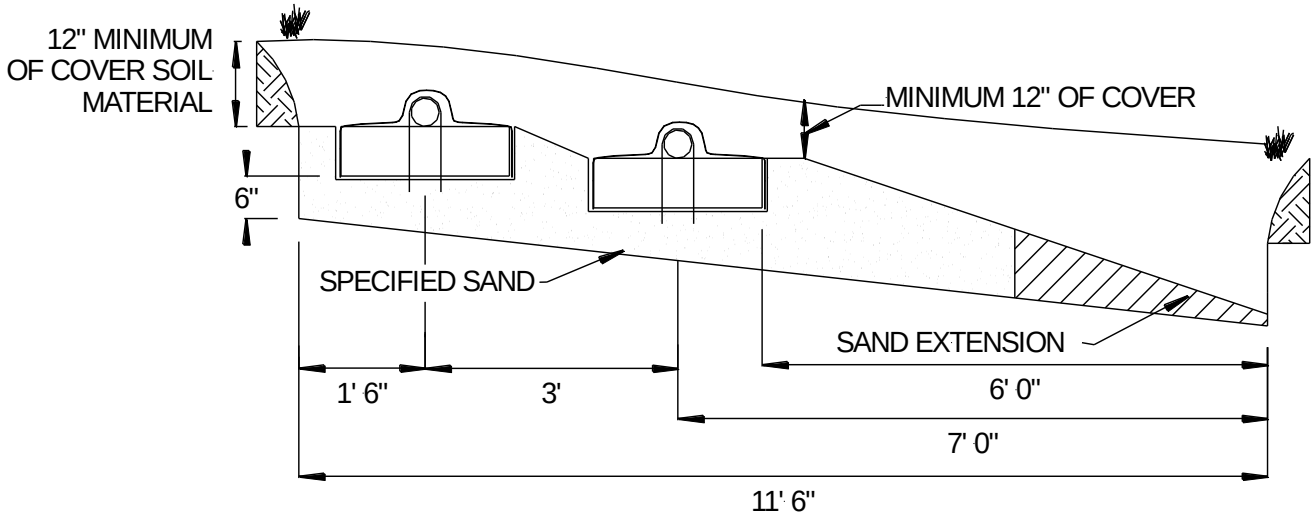


FIGURE 14: CROSS SECTION VIEW – 450 GPD – A42 – BED SYSTEM – 0.5 – 15% SLOPE



4.2 Sloped Subsurface Bed Design Installation Steps

1. Ensure all components leading to the GSF system are installed properly. Outlet filters are required with the GSF system. Connections of lines to tanks and distribution boxes must follow requirements of IDOH Rule 410 IAC6-8.3 or IDOH Rule 410 IAC6-10.1.

2. Determine the number of GSF Modules required using Table 5.

3. Prepare the site. Do not install a system in saturated ground or wet soils that are smeared during excavation. Keep machinery off infiltrative areas. Refer to IDOH Rule 410 IAC6-8.3 or IDOH Rule 410 IAC6-10.1 for all site preparation requirements prior to site construction.

4. Plan all drainage requirements above (up slope) of the system. Set soil grades to ensure that stormwater drainage and groundwater are diverted away from the system once it is complete. All drainage requirements shall be in accordance with IDOH Rule 410 IAC6-8.3-59.

5. Excavate the bed basal area; scarify the receiving layer to maximize the interface between the native soil and specified sand.

6. Minimize walking in the basal area prior to placement of the specified sand to avoid soil compaction.

7. Place a minimum of 6 inches of Specified Sand in the basal area, then stabilize and level. The first 6 inches of sand immediately under and around the perimeter of the GSF system must be ***INDIANA DEPARTMENT OF TRANSPORTATION (INDOT) SPECIFICATION 23 SAND.*** See Table 1 for more information on the sand and sieve specifications.

8. Place GSF modules with **PAINTED STRIPE FACING UP.** Each row of modules is laid level in its length and width, end to end, along their four-foot length on the Specified Sand layer. No mechanical connection is required between modules.

9. A standard 4-inch perforated pipe, SDR 35 or equivalent, is centered along the modules' 4-foot length. Orifices are set at the 4 and 8 o'clock positions. All distribution piping must meet the requirements of IDOH Rule 410 IAC6-8.3-67or IDOH Rule 410 IAC6-10.1-75.

10. All 4-inch pipes are secured with manufacturer supplied wire clamps, one per module.

11. (Pressure Distribution Systems) Insert a Sch. 40 pressure pipe that meets IDOH Rule 410 IAC6-8.3-67 or IDOH Rule 410 IAC6-10.1-75 into the standard 4-inch perforated pipe. The pressure pipe orifices are set at the 12 o'clock position, as shown in Figure 26. Each pressure lateral will have a drain hole at the distal end of the lateral at the 6 o'clock position. Each pressure lateral shall have a cleanout at the end of the row.

12. The distribution pipe shall be capped or vented.

13. ***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:
    a. 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.
    b. Placing 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.

4.2 Sloped Subsurface Bed Design Installation Steps, Continued

14. 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 row. A minimum of 12 inches of Specified Sand is placed in between module rows.

15. Complete backfill with cover soil material to a minimum of 12 inches measured from the top of module. 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.

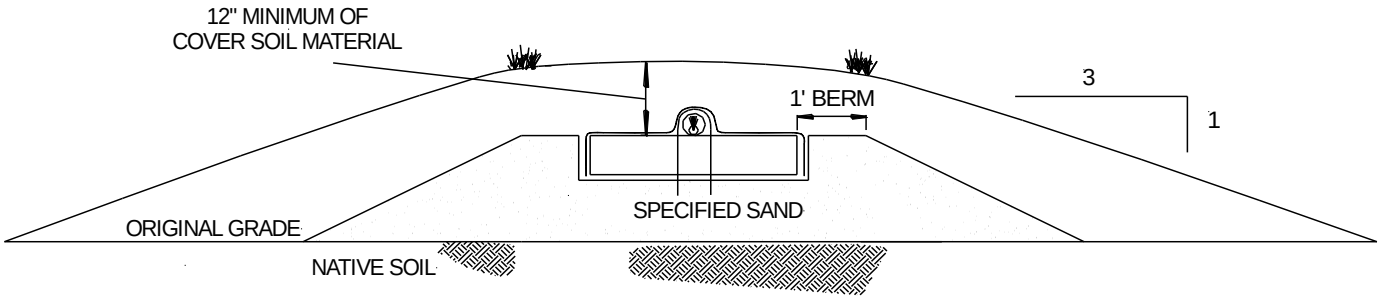
16. Divert surface runoff from the system. Finish grade to prevent surface ponding. Topsoil and seed system area to protect from erosion.

5.0 Elevated Sand Mound Design and Installation

5.0.1 ACCEPTABLE METHODS OF DISTRIBUTION: Elevated Sand Mounds require pressure distribution.

5.0.2 GENERAL CROSS SECTION

FIGURE 15: ELEVATED SAND MOUND CROSS SECTION



All elevated sand mound systems are required to have a minimum of:

- 12 inches of Specified Sand at the edges of the GSF module.
- 12 inches of Specified Sand at the beginning and end of each GSF Row.
- 12 inches of Specified Sand directly below the GSF module.
- 12 inches of cover soil material above the module.

5.0.3 VERTICAL SEPARATION TO SEASONAL HIGH-WATER TABLE OR LIMITING LAYER: Refer to IDOH Rule 410 IAC6-8.3-72(b) for elevated systems or IDOH Rule 410 IAC6-10.1-61.

Vertical Separation Distance (VSD)			
System Type	Daily Design Flow	Limiting Layer	Seasonal High-Water Table
Elevated Sand Mound (12" of sand under GSF modules and a pressure distribution network)	Any	20"	20"
VSD measured from the existing grade for the elevated sand mound system.			

5.0.4 ELEVATED SAND MOUND SYSTEM: Follow the requirements in IDOH Rule 410 IAC6-8.3-79 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.

5.0.5 APPLICATION AREA REQUIREMENTS: The application area is the GSF Module and the up slope and down slope sand from the module. Modules may not have more than one foot of sand up slope or down slope 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.

5.0.6 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.

5.0.7 DISPERSAL AREA: Dispersal area requirements are in IDOH Rule 410 IAC6-8.3-58 or IDOH Rule 410 IAC6-10.1-62.

5.0.8 SAND EXTENSION: For Elevated Sand Mound systems between 0.5% and 6% slope, a minimum of 4 feet of INDOT SPEC 23 sand extending from the edge of the furthest down slope GSF module is required. If the design calls for less sand than prescribed above, add a down slope sand extension to meet the minimum 4-foot sand requirements from the edge of the furthest down slope GSF module.

5.0.9 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%.

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

FIGURE 16: CROSS SECTION – MOUND SYSTEM

EXISTING GRADE GREATER THAN 0.5%

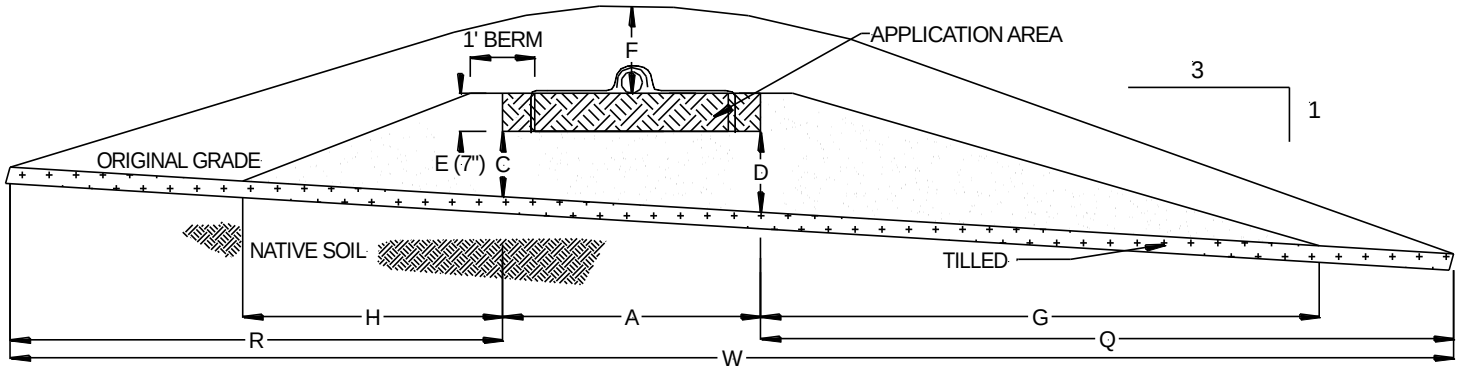
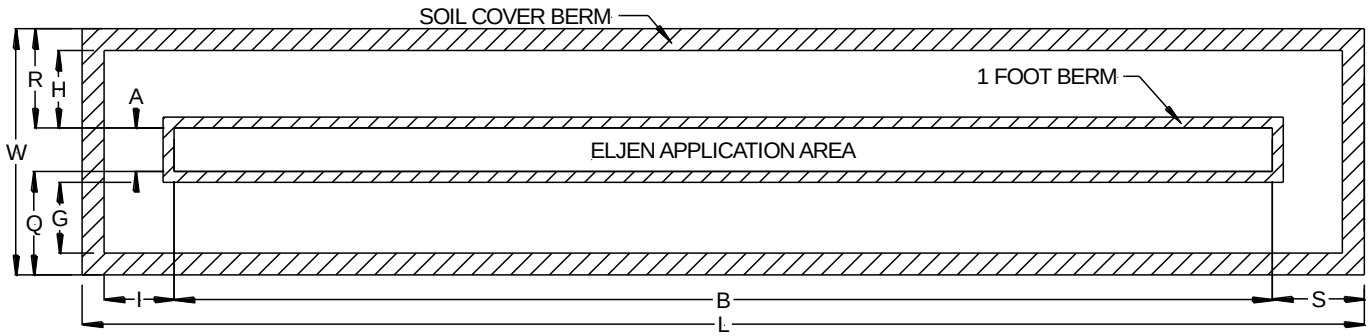


FIGURE 17: PLAN VIEW – MOUND SYSTEM



5.1 Elevated Sand Mound Design Example

Example 4 – Elevated Sand Mound – B43 Modules – Greater than 0.5% - 6% slope.

House Size:	3 bedrooms
Daily Design Flow: 3 Bedrooms x 150 gallons per day	450 GPD
Slope of Site:	6%
Soil Loading Rate:	0.25 GPD/square foot

A42: Minimum number of modules per bedroom: 6 per Bedroom x 3 Bedrooms = 18 A42 Modules
B43: Minimum number of modules per bedroom: 6 per Bedroom x 3 Bedrooms = 18 B43 Modules

CALCULATE VARIABLES:

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

(**NOTE:** The minimum width of distribution cell is **4 feet.**)
Cell width must conform to 6-8.3 (79) (3) (A)
Consult the state code, 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:

$$\text{Maximum Distribution Cell Width (feet)} = 0.83 \text{ square feet/GPD} \sqrt{\frac{\text{DDF (GPD)} \times \text{SLR (GPD/ SQUARE FEET)}}{n}}$$

TABLE 6: 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 feet

B – Distribution Cell Length = Daily Design Flow ÷ 1.2 GPD/square feet (constant) ÷ Distribution Cell Width
450 GPD ÷ 1.2 GPD/square feet = 375 square feet
375 square feet ÷ 4 feet = 93.75 feet, round to **97 feet** to accommodate 24 modules + 1 foot of INDOT Spec 23 sand (6 inches at the proximal and distal end of the cell).

Modules Required – Determined by (Distributions Cell Length – 1) ÷ 4 (Module Length)
Modules Required – (97– 1) ÷ 4 = **24 Modules**.
For this system, we decided to use B43s. For this system, use **24** 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 foot** to maintain separation distance from the infiltrative layer. *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 foot + (0.06 x 4 feet) = **1.2 feet**

E – Distribution cell depth – Constant 7 inches, convert to feet = **0.6 feet**

5.1 Elevated Sand Mound Design Example, Continued

F – Depth of final cover = **12 inches or 1 foot; this includes cover 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 sand:
Down slope correction factor = 100 ÷ [100 – (side slope x % ground slope)]
100 ÷ [100 – (3 x 6)] = **1.2**
3 x (D + E) x Down slope correction factor + .5 feet for berm
3 x (1.2 + 0.6) x 1.2 +.5 = **7.0 feet**

H – Distance from edge of distribution cell to up slope edge of sand:
Up slope correction factor – 100 ÷ [100 + (side slope x % ground slope)]
100 ÷ [100 + (3 x 6)] = **0.9**
3 x (C + E) x Up slope correction factor + .5 feet for berm
3 x (1 + 0.6) x 0.9 + .5= **4.8 feet**

I – Distance from end of distribution cell to edge of sand:
3 x [{(C + D)/2} + E] + .5 feet for berm
3 x [(1 + 1.2)/2 + 0.6] +.5 = **5.6 feet**

Q – 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**
3 x (D + E + F) x Down slope correction factor + .5 feet for berm
3 x (1.2 + 0.6 + 1) x 1.2 +.5 = **10.6 feet**

R – 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**
3 x (C + E + F) x Up slope correction factor + .5 feet for berm
3 x (1 + 0.6 + 1) x 0.9 + .5= **7.6 feet**

S – Distance from end of distribution cell to edge of system
3 x [{(C + D)/2} + E + F] + .5 feet for berm
3 x [(1 + 1.2)/2 + 0.6 + 1] +.5 = **8.6 feet**

L – Overall mound system length:
B + 2(S)
97 feet + 2 (8.6 feet) = **114.2 feet**

W – Overall mound system width:
A + Q + R
4 + 10.6 + 7.6 = **22.2 feet**

VERIFY MINIMUM REQUIREMENT MET:

TABLE 7: MINIMUM ELEVATED SAND MOUND BASAL AREA REQUIRED

Soil Loading Rate (GPD/Square Foot)	Minimum Basal Area Required (Square Feet) Bedrooms per House				A42 Modules per Room	B43 Modules per Room
	2	3	4	5		
1.2	168	252	335	419	6	6
0.6	335	503	670	838	6	6
0.5	402	603	804	1005	6	6
0.25	804	1206	1608	2010	6	6

Notes:

- Sizing charts are based on third-party testing data. In some cases, round up the number of units to maintain even laterals and to meet hydraulic loading requirements.
- The Minimum Basal Areas have been adjusted to reflect a 33% reduction in absorption field area.
- Any jetted bathtub with a capacity greater than 125 gallons will be treated as an extra bedroom for the system sizing requirements per Rule 410 IAC6-8.3.

Using the figures in Table 7, determine required basal area:

Minimum required basal area 1206 square feet
Determine the Minimum Distribution Cell Size: Daily Design Flow ÷ 1.2 GPD/square foot
450 GPD ÷ 1.2 GPD/square foot 375 square feet

Determine minimum down slope area needed:
Minimum required basal area – minimum distribution cell size:
1206 square feet - 375 square feet = 831 square feet

Determine if design meets required down slope:
B (Distribution Cell Length) x G
97 feet x 7.0 feet = 679 square feet
Since 679 square feet is less than 831 square feet, the design does not meet the minimum basal area requirements, Add length to dimension G to meet the 831 square feet requirement.

Minimum down slope area needed ÷ Distribution Cell Length = G
831 square feet ÷ 97 feet = 8.6 feet
Extend G 1.6 feet (8.6 feet – 7.0 feet).
Q must be 3 feet greater than new G value.
New values:
G = 8.6 feet
Q = 11.7 feet

5.1 Elevated Sand Mound Design Example, Continued

Make sure to consult IDOH Rule 410 IAC6-8.3-80 or IDOH Rule 410 IAC6-10.1-87, 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: IDOH Rule 410 IAC6-8.3-80 and IDOH Rule 410 IAC6-10.1-87 states use the greater result: (for this section, the Distribution Cell Width is equivalent to the Aggregate Bed Width referred to in section 80).

a) Minimum basal area sand width = minimum basal area (from Table 8) ÷ length of bed (B)
   1206 square feet ÷ 97 feet = 12.43 feet
b) For slopes, less than or equal to 0.5%:
   Eljen application area width + 14 feet
c) For slopes, greater than 0.5%:
   Eljen application area width + 9 feet
   4 feet + 9 feet = 13 feet

Actual basal area width for this example is (A + G). 4 feet + 8.6 feet = 12.6 feet.

This sum for the calculation of the actual basal area (A+G) does not provide for a basal area width beyond the 13 feet, which is set as a minimum for the 6% slope site. Increase G to 9 feet to meet requirement and confirm the Q is 3 feet greater than G.
G = 9 feet
Q = 12 feet

FIGURE 18: CROSS SECTION – MOUND SYSTEM EXISTING GRADE GREATER THAN 0.5%

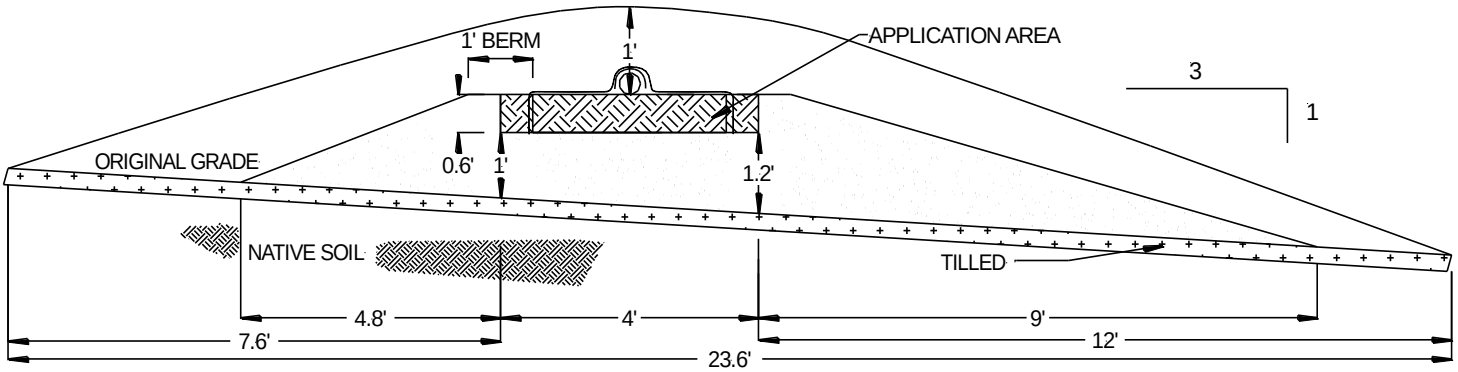


FIGURE 19: PLAN VIEW – MOUND SYSTEM

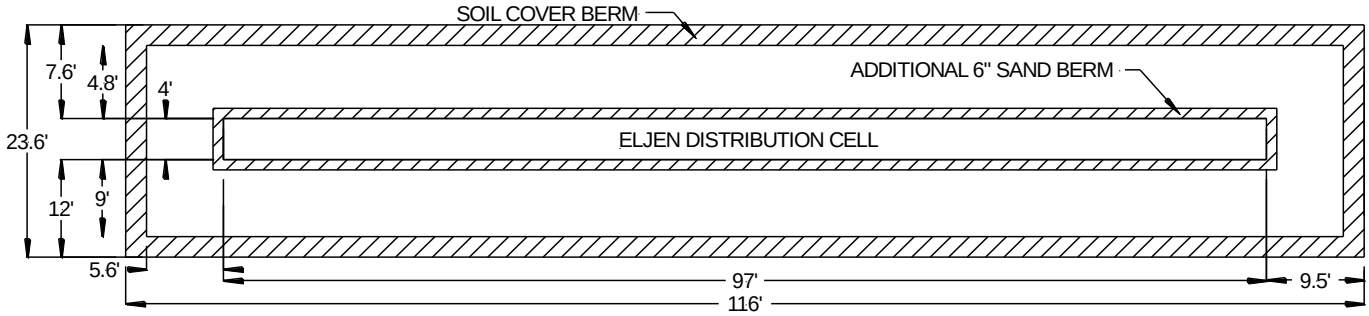
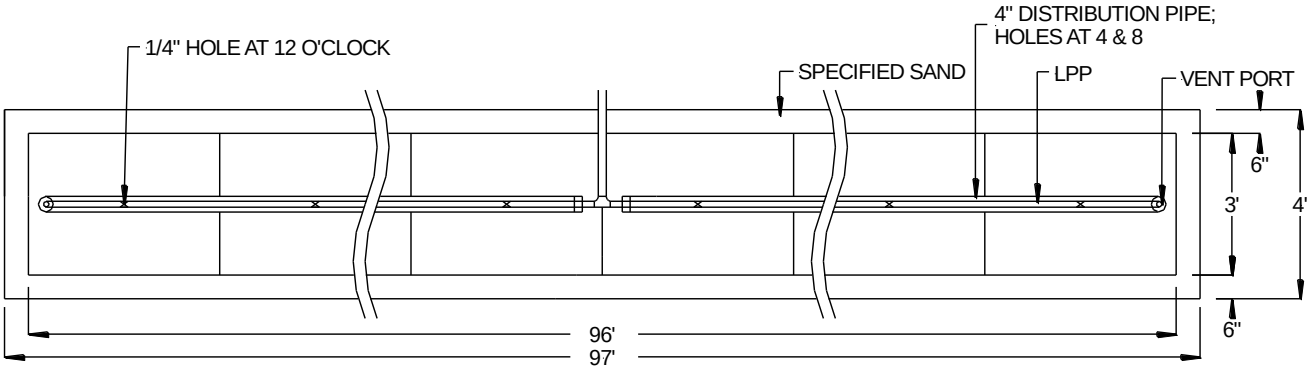


FIGURE 20: PLAN VIEW – 450 GPD – APPLICATION AREA MOUND SYSTEM



5.2 Elevated Sand Mound Installation Steps

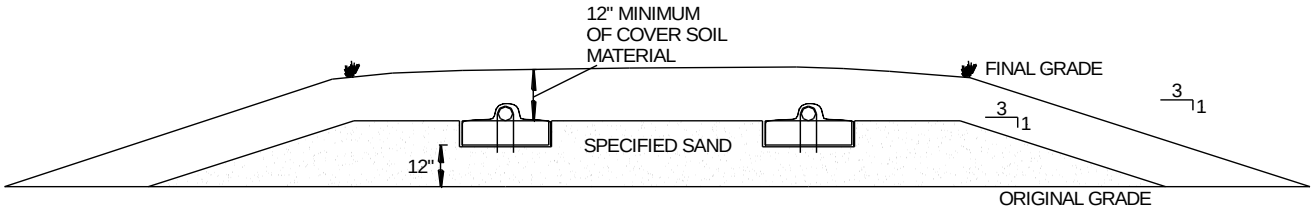
1. Ensure all components leading to the GSF system are installed properly. Outlet filters are required with the GSF system. Connections of lines to tanks and distribution boxes must follow requirements of IDOH Rule 410 IAC6-8.3 or IDOH Rule 410 IAC6-10.1.
2. Determine the mound dimensions using Table 7.
3. Prepare the site. Do not install a system on saturated ground or wet soils that are smeared during excavation. Keep machinery off infiltrative areas. Refer to IDOH Rule 410 IAC6-8.3-86or IDOH Rule 410 IAC6-10.1-94.
4. Plan all drainage requirements above (up slope) of the system. Set soil grades to ensure that stormwater drainage and groundwater are diverted away from the system once it is complete. All drainage requirements shall be in accordance with IDOH Rule 410 IAC6-8.3-59 or IDOH Rule 410 IAC6-10.1-63.
5. Scarify the basal layer to maximize the interface between the native soil and Specified Sand. Minimize walking on the receiving layer prior to placement of the Specified Sand.
6. Place Specified Sand in two 6-inch lifts, then stabilize after each lift. The stabilized height below the GSF module must be level at 12 inches. All the sand used in the construction of the system sand components must be ***INDIANA DEPARTMENT OF TRANSPORTATION (INDOT) SPECIFICATION 23 SAND.*** See Table 1 for more information on the sand and sieve specifications. Refer to IDOH Rule 410 IAC6-8.3-87or IDOH Rule 410 IAC6-10.1-95.
7. Place GSF modules with **PAINTED STRIPE FACING UP**, level in its length and width, end to end, along their four-foot length on the Specified Sand layer.
8. A standard 4-inch perforated pipe, SDR 35 or equivalent, is centered along the modules' 4-foot length. Orifices are set at the 4 and 8 o'clock position.
9. All 4-inch pipes are secured with manufacturer supplied wire clamps, one per module.
10. Insert a Sch. 40 pressure pipe that meets IDOH Rule 410 IAC6-8.3-67 or IDOH Rule 410 IAC6-10.1-75 into the standard 4-inch perforated pipe. The pressure pipe orifices are set at the 12 o'clock position, as shown in Figure 26. Each pressure lateral will have a drain hole at the distal end of the lateral at the 6 o'clock position. Each pressure lateral shall have a cleanout at the end of the trench.
11. ***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:
    a. 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.
    b. Placing 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.
12. Place a minimum of 12 inches of Specified Sand along both sides of the modules edge. A minimum of 12 inches of Specified Sand is placed at the beginning and end of each module row. A minimum of 12 inches of Specified Sand is placed in between module rows.
13. Complete backfill with cover soil material to a minimum of 12 inches measured from the top of the module. 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. Placement of the soil material and final grade shall be in accordance with IDOH Rule 410 IAC6-8.3-89(a).
14. Divert surface runoff from the system. Finish grade to prevent surface ponding. Topsoil and seed system area to protect from erosion. All drainage requirements shall be in accordance with IDOH Rule 410 IAC6-8.3-59

6.0 Above Grade Bed Design and Installation

6.0.1 ACCEPTABLE METHODS OF DISTRIBUTION: Gravity, dosed, and pressure distribution are acceptable.

6.0.2 GENERAL CROSS SECTION

FIGURE 21: ABOVE GRADE BED CROSS SECTION



All above grade bed systems are required to have a minimum of:

- 6 inches of Specified Sand at the edges of the GSF module.
- 6 inches of Specified Sand at the beginning and end of each GSF Row.
- 12 inches of Specified Sand directly below the GSF module.
- 12 inches of cover soil material above the module.

6.0.4 VERTICAL SEPARATION TO SEASONAL HIGH-WATER TABLE OR LIMITING LAYER: Refer to IDOH Rule 410 IAC6-8.3-72(b)for above grade beds or IDOH Rule 410 IAC6-10.1-61.

Vertical Separation Distance (VSD)			
System Type	Daily Design Flow	Limiting Layer	Seasonal High-Water Table
Above Grade Bed (12" of sand under GSF module)	Any	20"	20"
VSD measured from the existing grade for the above grade bed system.			

6.0.5 DISTRIBUTION BOX: Parallel distribution is preferred. Sequential distribution may be utilized for sloping sites and must conform to the above content in the systems design section 1.1.4. Distribution boxes are recommended to be 5 feet from the proximal end of each soil absorption field row as per IDOH Rule 410 IAC6-8.3-75(i) or IDOH Rule 410 IAC6-10.1-74. This may be amended to a shorter distance per the designer.

6.0.6 PARALLEL DISTRIBUTION: Parallel distribution is the preferred method of application 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 bed systems.

6.0.7 ROWS REQUIRED: All bed systems shall have a minimum of two rows of modules.

6.0.8 ROW LENGTH: Rows will have a maximum of 100 feet in length unless pressure distribution is used per IDOH Rule 410 IAC6-8.3-74(r) or IDOH Rule 410 IAC6-10.1-82(r).

6.0.9 EQUAL LENGTH: Rows must be of equal length to provide equal distribution.

6.0.10 DISPERSAL AREA: Dispersal area requirements are in IDOH Rule 410 IAC6-8.3-58 or IDOH Rule 410 IAC6-10.1-62.

6.0.11 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%.

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

6.0.13 SIZING GSF SYSTEMS:

TABLE 8: GSF ABOVE GRADE BED SIZING CHART

Soil Loading Rate (GPD/Square Foot)	Minimum Basal Area Required (Square Feet) Bedrooms per House				A42 Modules per Room	B43 Modules per Room
	2	3	4	5		
1.2	168	252	335	419	6	6
0.6	335	503	670	838	9	8
0.5	402	603	804	1005	11	9
0.25	804	1206	1608	2010	13	11

Notes:

- Sizing charts are based on third-party testing data. In some cases, round up the number of units to maintain even laterals and to meet hydraulic loading requirements.
- The Minimum Basal Areas have been adjusted to reflect a 33% reduction in absorption field area.
- Any jetted bathtub with a capacity greater than 125 gallons will be treated as an extra bedroom for the system sizing requirements per Rule 410 IAC6-8.3.

6.0.14 SYSTEM LENGTH AND WIDTH: Best engineering practices should be used when constructing the bed systems. IDOH Rule 410 IAC6-8.3-79(2) and IDOH Rule 410 IAC6-10.1-87(b) state the dimensions of the bed shall be as long and narrow as the site allows.

6.0.15 BED DESIGN: For beds with less than a 0.5% slope, evenly distribute the bed laterals in the basal area. A minimum separation distance between laterals for A42s is 3′ and a minimum separation distance between laterals of 4′ for B43s.

6.1 Above Grade Bed Design Example

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

House Size:	4 Bedrooms
Design Flow:	600 GPD
Soil Loading Rate:	0.25 GPD/square foot
Absorption Field Type:	Bed
Site Slope:	Less than 0.5%

Calculate Minimum Basal Area and Units Required

Refer to Table 8 for the minimum number of units and minimum basal area required for installation.

Soil Loading Rate (GPD/Square Foot)	Minimum Basal Area Required (Square Feet) Bedrooms per House				A42 Modules per Room	B43 Modules per Room
	2	3	4	5		
0.25	804	1206	1608	2010	13	11

Units required per bedroom x bedrooms = Total units required

A42: 13 units/bedroom x 4 bedrooms = 52 A42s

B43: 11 units/bedroom x 4 bedrooms = 44 B43s

Calculate Minimum Bed Basal Area Length:

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

Modules per row: Modules Needed ÷ Rows

A42: 52 units ÷ 2 rows = 26 modules per row

A42: 26 units x 4 feet/unit +1 feet = 105 linear feet

B43: 44 units ÷ 2 rows = 22 modules per row

B43: 22 units x 4 feet/unit +1 = 89 linear feet

Calculate Bed Basal Area Width

a) Minimum A42 Basal Area Width

a) A42: Rows x 3 feet = 2 x 3 feet = 6 feet

or

b) Proposed Basal Area Width

b) Minimum Basal Area ÷ Length of System

b) A42: 1608 square feet ÷ 105 feet = 15.3 feet, round to 16 feet

A42: Use greater width of a or b: 16 feet

a) Minimum B43 Basal Area Width

a) B43: Rows x 4 feet = 2 x 4 feet = 8 feet

or

b) Proposed Basal Area Width

b) Minimum Basal Area ÷ Length of System

b) B43: 1608 square feet ÷ 89 feet = 18.1 feet, round to 19 feet

B43: Use greater width of a or b: 19 feet

Determine Lateral Spacing

Slope	Upper Edge to Lateral Spacing		Lateral to Lateral Spacing	
	A42	B43	A42	B43
Less than or Equal to 0.5%	Lateral to Lateral Spacing ÷ 2		Basal Area Width Divided by Number of Rows	

Center to Center of Lateral Spacing = Bed Width ÷ Rows

A42: 16 feet ÷ 2 rows = 8 feet

B43: 19 feet ÷ 2 rows = 9.5 feet

Edge to Center of Lateral Spacing = Center to Center of Lateral Spacing ÷ 2

A42: 8 feet ÷ 2 = 4 feet

B43: 9.5 feet ÷ 2 = 4.75 feet

Final Dimension Layout
(Note: System layout and number of rows will vary based on site constraints.)

A42

Basal Area Length:	105 feet
Basal Area Width:	16 feet
Minimum Number of Units:	52 A42 Modules
Center to Center Spacing:	8 feet
Edge to Center Spacing:	4 feet
Designed Basal Area:	1,680 square feet

B43

Basal Area Length:	89 feet
Basal Area Width:	19 feet
Minimum Number of Units:	44 B43 Modules
Center to Center Spacing:	9.5 feet
Edge to Center Spacing:	4.75 feet
Designed Basal Area:	1,691 square feet

FIGURE 22: PLAN VIEW – 600GPD – A42 – BED SYSTEM – ≤ 0.5% SLOPE

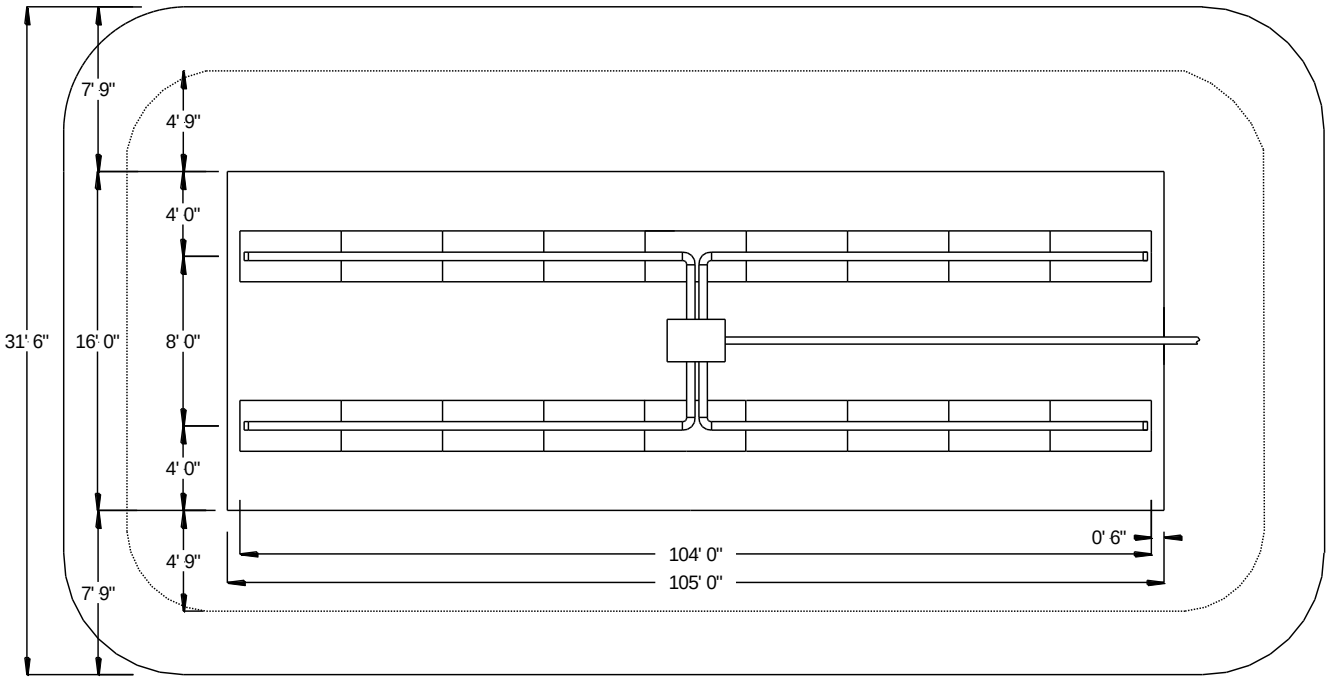
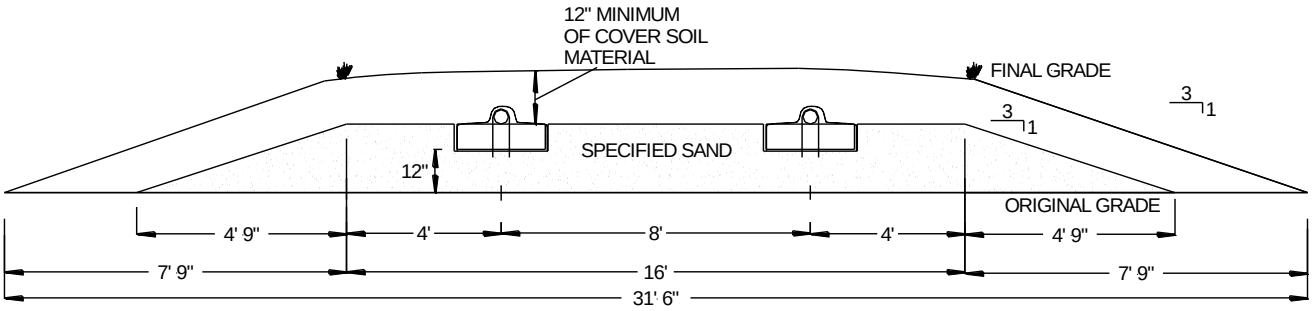


FIGURE 23: CROSS SECTION VIEW – 600 GPD – A42 – BED SYSTEM – ≤ 0.5% SLOPE



6.2 Above Grade Bed Design Installation Steps

1. Ensure all components leading to the GSF system are installed properly. Outlet filters are required with the GSF system. Connections of lines to tanks and distribution boxes must follow requirements of IDOH Rule 410 IAC6-8.3 or IDOH Rule 410 IAC6-10.1.

2. Determine the number of GSF Modules required using Table 8.

3. Prepare the site. Do not install a system in saturated ground or wet soils that are smeared during excavation. Keep machinery off infiltrative areas. Refer to IDOH Rule 410 IAC6-8.3 or IDOH Rule 410 IAC6-10.1 for all site preparation requirements prior to site construction.

4. Plan all drainage requirements above (up slope) of the system. Set soil grades to ensure that stormwater drainage and groundwater is diverted away from the system once it is complete. All drainage requirements should be in accordance with IDOH Rule 410 IAC6-8.3-59 or IDOH Rule 410 IAC6-10.1-63.

5. Scarify the receiving layer to maximize interface between the native soil and Specified Sand.

6. Minimize walking in the system area prior to placement of the specified sand to avoid soil compaction.

7. Place Specified Sand in two 6-inch lifts and stabilize after each lift. The stabilized height below the GSF module must be level at 12 inches. All the sand used in the construction of the system sand components must be ***INDIANA DEPARTMENT OF TRANSPORTATION (INDOT) SPECIFICATION 23 SAND.*** See Table 1 for more information on the sand and sieve specifications.

8. Place GSF modules with **PAINTED STRIPE FACING UP**. Each row of modules is laid level in its length and width, end to end, along their four-foot length on the Specified Sand layer. No mechanical connection is required between modules.

9. A standard 4-inch perforated pipe, SDR 35 or equivalent, is centered along the modules' 4-foot length. Orifices are set at the 4 and 8 o'clock positions. All distribution piping must meet the requirements of IDOH Rule 410 IAC6-8.3-67or IDOH Rule 410 IAC6-10.1-75.

10. All 4-inch pipes are secured with manufacturer supplied wire clamps, one per module.

11. (Pressure Distribution Systems) Insert a Sch. 40 pressure pipe which meets IDOH Rule 410 IAC6-8.3-67 or IDOH Rule 410 IAC6-10.1-75 into the standard 4-inch perforated pipe. The pressure pipe orifices are set at the 12 o'clock position, as shown in Figure 26. Each pressure lateral will have a drain hole at the distal end of the lateral at the 6 o'clock position. Each pressure lateral shall have a cleanout at the end of the row.

12. The distribution pipe shall be capped or vented.

13. ***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:
    a. 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.
    b. Placing 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.

6.2 Above Grade Bed Design Installation Steps, Continued

14. 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 row in gravity distribution. A minimum of 12 inches of Specified Sand is placed in between module rows.

15. Complete backfill with cover soil material to a minimum of 12 inches measured from the top of the module. 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. Placement of the soil material and final grade shall be in accordance with 410 IAC6-8.3-89 (a)-(c).

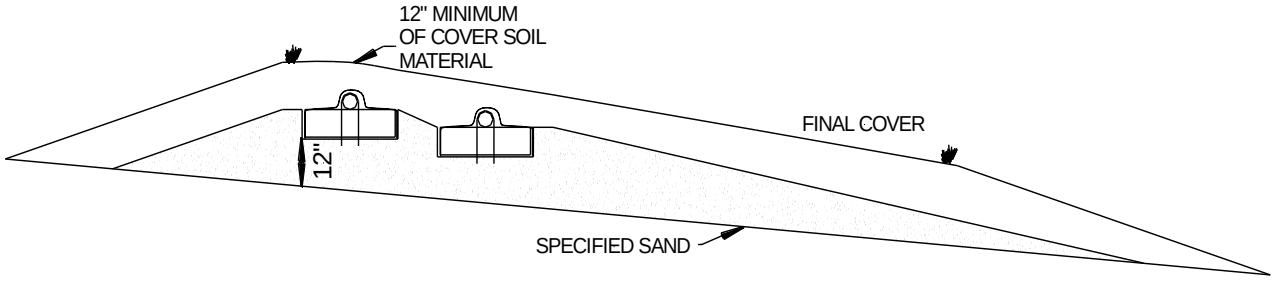
16. Divert surface runoff from the system. Finish grade to prevent surface ponding. Topsoil and seed system area to protect from erosion.

7.0 Sloped Above Grade Bed Design and Installation

7.0.1 ACCEPTABLE METHODS OF DISTRIBUTION: Gravity, dosed, and pressure distribution are acceptable.

7.0.2 GENERAL CROSS SECTION

FIGURE 24: SLOPED ABOVE GRADE BED CROSS SECTION



All sloped above grade bed systems are required to have a minimum of:

- 6 inches of Specified Sand at the edges of the GSF module.
- 6 inches of Specified Sand at the beginning and end of each GSF Row.
- 12 inches of Specified Sand directly below the GSF module.
- 12 inches of cover soil material above the module.

7.0.3 VERTICAL SEPARATION TO SEASONAL HIGH-WATER TABLE OR LIMITING LAYER: Refer to IDOH Rule 410 IAC6-8.3-72(b)above grade beds or IDOH Rule 410 IAC6-10.1-61.

Vertical Separation Distance (VSD)			
System Type	Daily Design Flow	Limiting Layer	Seasonal High-Water Table
Above Grade Bed (12" of sand under GSF module)	Any	20"	20"
VSD measured from the original grade for the sloped, above-grade bed system.			

7.0.4 DISTRIBUTION BOX: Parallel distribution is preferred. Sequential distribution may be utilized for sloping sites and must conform to the above content in the systems design section 1.1.4. Distribution boxes are recommended to be 5 feet from the proximal end of each soil absorption field row as per IDOH Rule 410 IAC6-8.3-75(i) or IDOH Rule 410 IAC6-10.1-74. This may be amended to a shorter distance per the designer.

7.0.5 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 bed systems.

7.0.6 ROW LENGTH: Rows will have a maximum of 100 feet in length unless pressure distribution is used per IDOH Rule 410 IAC6-8.3-74(r) or IDOH Rule 410 IAC6-10.1-82(r).

7.0.7 ROWS REQUIRED: All bed systems shall have a minimum of two rows of modules.

7.0.8 EQUAL LENGTH: Rows must be of equal length to provide equal distribution.

7.0.9 DISPERSAL AREA: Dispersal area requirements are in IDOH Rule 410 IAC6-8.3-58 or IDOH Rule 410 IAC6-10.1-62.

7.0.10 SAND EXTENSION: For above-grade bed sloping systems between 0.5% and 6% slope, a minimum of 4 feet of INDOT SPEC 23 sand extending from the edge of the furthest down slope GSF module is required. If the design calls for less sand than prescribed above, add a down slope sand extension to meet the minimum 4-foot sand requirements from the edge of the furthest down slope GSF module.

7.0.11 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%.

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

7.0.13 SIZING GSF SYSTEMS:

TABLE 9: GSF SLOPED ABOVE-GRADE BED SIZING CHART

Soil Loading Rate (GPD/Square Foot)	Minimum Basal Area Required (Square Feet) Bedrooms per House				A42 Modules per Room	B43 Modules per Room
	2	3	4	5		
1.2	168	252	335	419	6	6
0.6	335	503	670	838	9	8
0.5	402	603	804	1005	11	9
0.25	804	1206	1608	2010	13	11

Notes:

- Sizing charts are based on third-party testing data. In some cases, round up the number of units to maintain even laterals and to meet hydraulic loading requirements.
- The Minimum Basal Areas have been adjusted to reflect a 33% reduction in absorption field area.
- Any jetted bathtub with a capacity greater than 125 gallons will be treated as an extra bedroom for the system sizing requirements per Rule 410 IAC6-8.3.

7.0 Sloped Above Grade Bed Design and Installation, Continued

7.0.14 SYSTEM LENGTH AND WIDTH: Best engineering practices should be used when constructing the bed systems. IDOH Rule 410 IAC6-8.3-79(2) and IDOH Rule 410 IAC6-10.1-87(b) state the dimensions of the bed shall be as long and narrow as the site allows.

7.0.15 BED DESIGN: For beds with less than a 0.5% slope, evenly distribute the bed laterals in the basal area. The minimum separation distance between laterals for A42s is 3′ and the minimum separation distance between laterals of 4′ for B43s.

7.1 Sloped Above Grade Bed Design Example

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

House Size:	3 Bedrooms
Design Flow:	450 GPD
Soil Loading Rate:	0.25 GPD/square feet
Absorption Field Type:	Bed
Site Slope:	5%

Calculate Minimum Basal Area and Units Required

Refer to Table 9 for the minimum number of units and minimum basal area required for installation.

Soil Loading Rate (GPD/Square Foot)	Minimum Basal Area Required (Square Feet) Bedrooms per House				A42 Modules per Room	B43 Modules per Room
	2	3	4	5		
0.25	804	1206	1608	2010	13	11

Units required per bedroom x bedrooms = Total units required
A42: 13 units/bedroom x 3 bedrooms = 39 A42s B43: 11 units/bedroom x 3 bedrooms = 33 B43s

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

Modules per Row: Modules Needed ÷ Rows

A42: 39 units ÷ 2 rows = 19.5 modules per row
A42: 20 units x 4 feet/unit +1 foot = 81 linear feet

B43: 33 units ÷ 2 rows = 16.5 modules per row
B43: 17 units x 4 feet/unit +1 = 69 linear feet

Determine Lateral Spacing

Slope	Upper Edge to Lateral Spacing		Lateral to Lateral Spacing	
	A42	B43	A42	B43
Greater than 0.5%	Minimum 1.5 feet	Minimum 2 feet	Minimum 3 feet	Minimum 4 feet

Lateral to Lateral Spacing from above table.
A42: 3 feet
B43: 4 feet

Upper Edge to Lateral Spacing from above table.
A42: 1.5 feet
B43: 2 feet

Calculate Bed Basal Area Width

a) Minimum A42 Basal Area Width
a) A42: Rows x 3 feet = 2 x 3 feet = 6 feet
or
b) Proposed Basal Area Width
b) Minimum Basal Area ÷ Length of System
b) A42: 1206 square feet ÷ 81 feet = 14.8 feet, round to 15 feet
A42: Use greater width of a or b: 15 feet

a) Minimum B43 Basal Area Width
a) B43: Rows x 4 feet = 2 x 4 feet = 8 feet
or
b) Proposed Basal Area Width
b) Minimum Basal Area ÷ Length of System
b) B43: 1206 square feet ÷ 69 feet = 17.5 feet, round to 17.5 feet
B43: Use greater width of a or b: 17.5 feet

DESIGN REQUIREMENT: IDOH Rule 410 IAC6-8.3-80 states use the greater result (for this section, the Minimum Bed Width is equivalent to the Aggregate Bed Width referred to in section 80).

a) Minimum basal area width = minimum basal area (from Table 9) ÷ bed basal area length

A42: 1206 square feet ÷ 81 feet = 14.9 feet

B43: 1206 square feet ÷ 69 feet = 17.5 feet
Minimum Basal Area Width + 9 feet

b) For slopes, greater than 0.5%:
A42: 6 feet + 9 feet = 15 feet

B43: 8 feet + 9 feet = 17 feet

Minimum basal area width is the greater of a. or b.
A42: a) 14.9 feet
A42: b) 15 feet
Use 15 feet for Basal Area Width

B43: a) 17.5 feet
B43: b) 17 feet
Use 17.5 feet for Basal Area Width

Final Dimension Layout
(Note: System layout and number of rows will vary based on site constraints.)

A42

Basal Area Length:	81 feet
Basal Area Width:	15 feet
Minimum Number of Units:	40 A42 Modules
Center to Center Spacing:	3 feet
Edge to Center Spacing:	1.5 feet
Designed Basal Area:	1,215 square feet

B43

Basal Area Length:	69 feet
Basal Area Width:	17.5 feet
Minimum Number of Units:	34 B43 Modules
Center to Center Spacing:	4 feet
Edge to Center Spacing:	2 feet
Designed Basal Area:	1,207.5 square feet

FIGURE 25: PLAN VIEW – 450 GPD – A42 – BED SYSTEM – 0.5% - 6% SLOPE

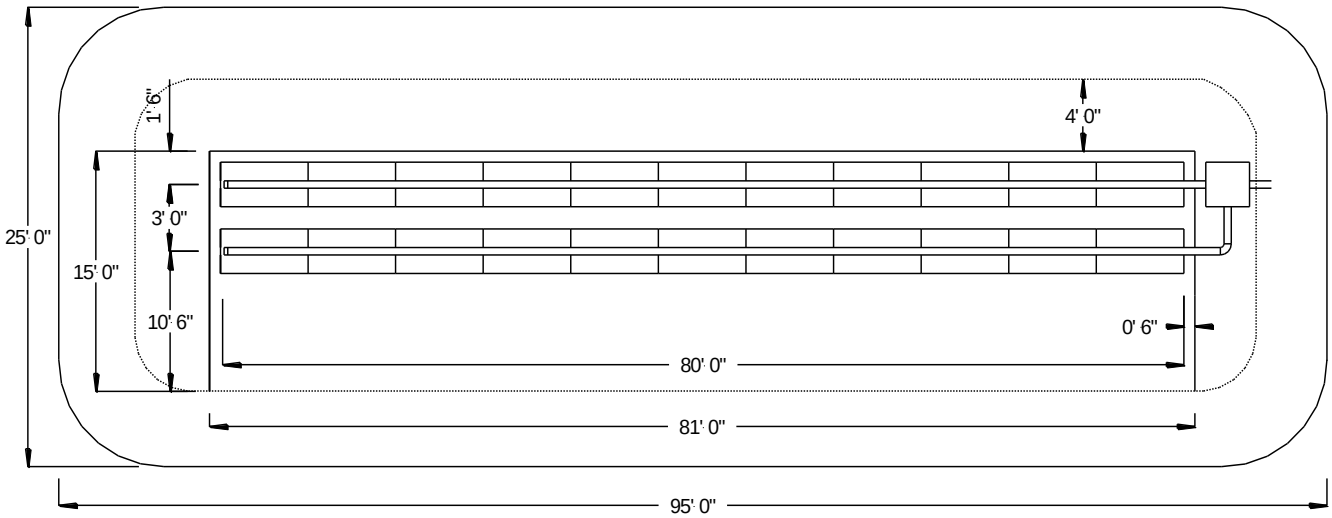
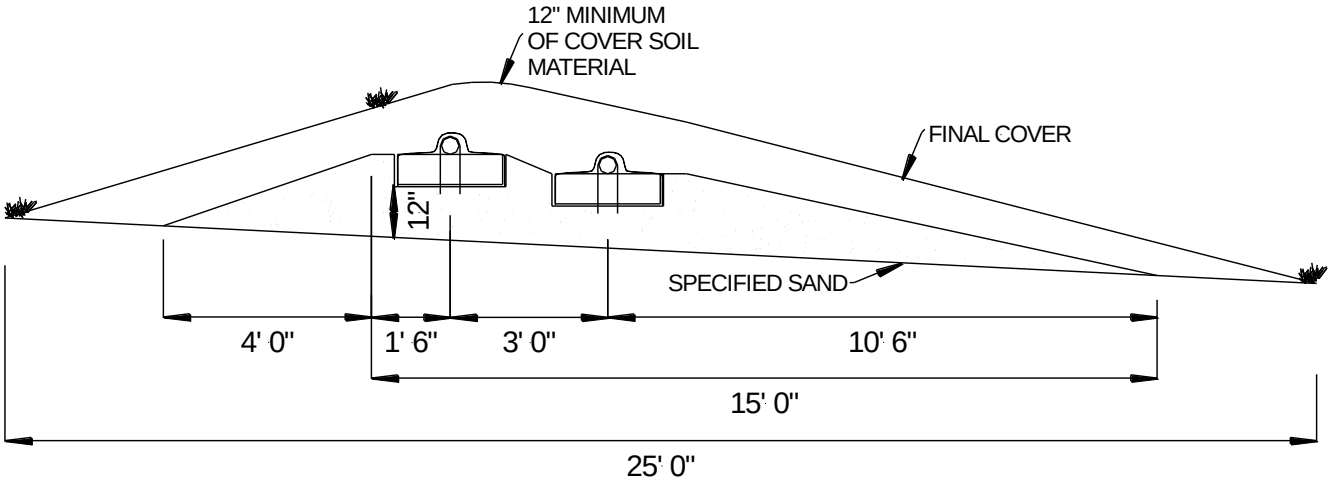


FIGURE 26: CROSS SECTION VIEW – 450 GPD – A42 – BED SYSTEM – 0.5% - 6% SLOPE



7.2 Sloped Above Grade Design Installation Steps

1. Ensure all components leading to the GSF system are installed properly. Outlet filters are required with the GSF system. Connections of lines to tanks and distribution boxes must follow requirements of IDOH Rule 410 IAC6-8.3 or IDOH Rule 410 IAC6-10.1.

2. Determine the number of GSF Modules required using Table 9.

3. Prepare the site. Do not install a system in saturated ground or wet soils that are smeared during excavation. Keep machinery off infiltrative areas. Refer to IDOH Rule 410 IAC6-8.3 or IDOH Rule 410 IAC6-10.1 for all site preparation requirements prior to site construction.

4. Plan all drainage requirements above (up slope) of the system. Set soil grades to ensure that stormwater drainage and groundwater is diverted away from the system once it is complete. All drainage requirements should be in accordance with IDOH Rule 410 IAC6-8.3-59 or IDOH Rule 410 IAC6-10.1-63.

5. Scarify the receiving layer to maximize interface between the native soil and Specified Sand.

6. Minimize walking in the system area prior to placement of the specified sand to avoid soil compaction.

7. Place Specified Sand in two 6-inch lifts and stabilize after each lift. The stabilized height below the GSF module must be level at 12 inches. All the sand used in the construction of the system-sand components must be ***INDIANA DEPARTMENT OF TRANSPORTATION (INDOT) SPECIFICATION 23 SAND.*** See Table 1 for more information on the sand and sieve specifications. Refer to Section 87 of the Rule.

8. Place GSF modules with **PAINTED STRIPE FACING UP**. Each row of modules is laid level in its length and width, end to end, along their four-foot length on the Specified Sand layer. No mechanical connection is required between modules.

9. A standard 4-inch perforated pipe, SDR 35 or equivalent, is centered along the modules' 4-foot length. Orifices are set at the 4 and 8 o'clock positions. All distribution piping must meet the requirements of IDOH Rule 410 IAC6-8.3-67 or IDOH Rule 410 IAC6-10.1-75.

10. All 4-inch pipes are secured with manufacturer supplied wire clamps, one per module.

11. (Pressure Distribution Systems) Insert a Sch. 40 pressure pipe that meets IDOH Rule 410 IAC6-8.3-67 or IDOH Rule 410 IAC6-10.1-75 into the standard 4-inch perforated pipe. The pressure pipe orifices are set at the 12 o'clock position as shown in Figure 26. Each pressure lateral will have a drain hole at the distal end of the lateral at the 6 o'clock position. Each pressure lateral shall have a cleanout at the end of the row.

12. The distribution pipe shall be capped or vented.

13. ***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:
    a. 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.
    b. Placing 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.

7.2 Sloped Above Grade Design Installation Steps, Continued

14. 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 row. A minimum of 12 inches of Specified Sand is placed in between module rows.

15. Complete backfill with cover soil material to a minimum of 12 inches measured from the top of the module. The 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. Placement of the soil material and final grade shall be in accordance with IDOH Rule 410 IAC6-8.3-89(a)-(c).

16. Divert surface runoff from the system. Finish grade to prevent surface ponding. Topsoil and seed system area to protect from erosion.

8.0 Dosing Distribution Requirements

8.0.1 ADDITIONAL REQUIREMENTS: Dosing tanks, effluent pumps, and effluent force mains must comply with IDOH Rule 410 IAC6-8.3-62,65,75, and 76 or IDOH Rule 410 IAC6-10.1-70,73,83 and 84 for dosing tanks, effluent pumps, and force mains.

IDOH Rule 410 IAC6-8.3-78 or IDOH Rule 410 IAC6-10.1-86 Subsurface Pressure Distribution is enforced except when noted.

A design head of 3 feet is required for pressure distribution systems.

8.0.2 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, use a minimum of 1.5 gallons per dose per module or 2 gallons per dose per B43 module. The drain back volume resulting from the effluent force main volume must be added to the dose volume, when appropriate.

Eljen does not have a recommendation on minimum and maximum gallons per minute as long as ***a maximum of 3 gallons per dose per A42 module or 4 gallons per dose per B43 module*** is followed and dosing tanks, effluent pumps, and effluent force mains must comply with IDOH Rule 410 IAC6-8.3-62,65,75,and 76 or IDOH Rule 410 IAC6-10.1-70,73,83 and 84 for dosing tanks, effluent pumps, and force mains.

Dosing volumes are set to encourage more short-term loading and resting times.

Example:

A system design calls for 18 A42 modules on a 3-bedroom home.

18 modules X 3 gallons per module/per dose = 54. Set floats to deliver 54 gallons per dose. In this instance, the system is dosing the field < 1/8 of the DDF (Daily Design Flow).

9.0 Pressure Distribution Requirements

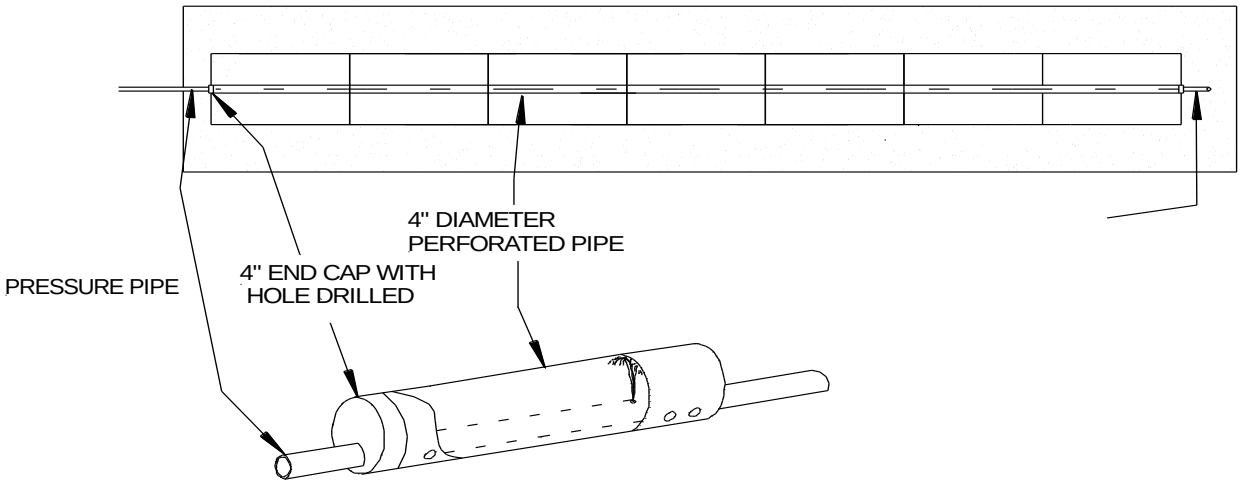
9.0.1 ADDITIONAL REQUIREMENTS: Dosing tanks, effluent pumps, pipe specifications, and the pressure distribution network must comply with IDOH Rule 410 IAC6-8.3-62,65,67,78 and 82or IDOH Rule 410 IAC6-10.1-70,73,75,86 and 90 for dosing tanks, effluent pumps, pipe specifications, and pressure distribution network.

Standard procedures for design of pressure distribution networks apply to the GSF system. Eljen recommends using a 1.5-inch Sch. 40 pressure pipe with ¼ inch orifices placed 4-foot on center, so the orifices fall in the center of each module. Each lateral will have one drain hole placed at the end of lateral at 6 o'clock. Engineers can design their own pressure distribution network if it falls within the IDOH guidelines.

All pressure distribution systems must be made of Sch. 40 pipe from 1 to 1.5 inch, have equivalent and equally spaced orifices, a drain hole, and a pressure cleanout or other means of flushing the pressure lateral.

The Sch. 40 pressure line is placed within a standard 4-inch perforated pipe. The perforations in the 4-inch outer pipe are set at the 4 and 8 o'clock positions, 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 in Figure 26.

FIGURE 27: PRESSURE PIPE PLACEMENT



PRESSURE PIPE CROSS SECTION FOR ALL APPLICATIONS

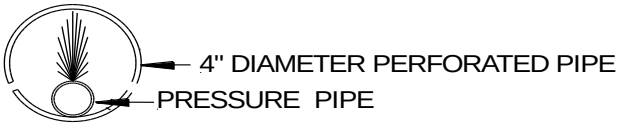


FIGURE 28: PRESSURE CLEANOUT (PIPE IN PIPE)

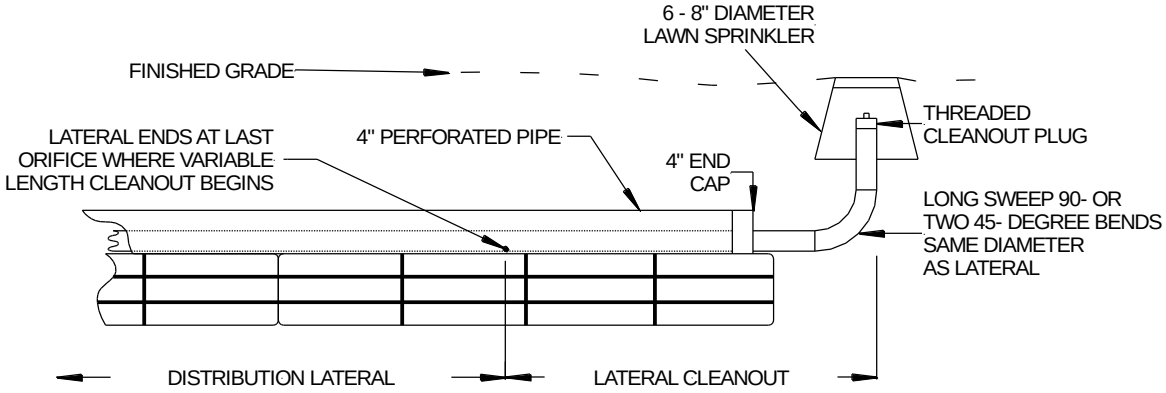


FIGURE 29: CONTOURED TRENCH INSTALLATION

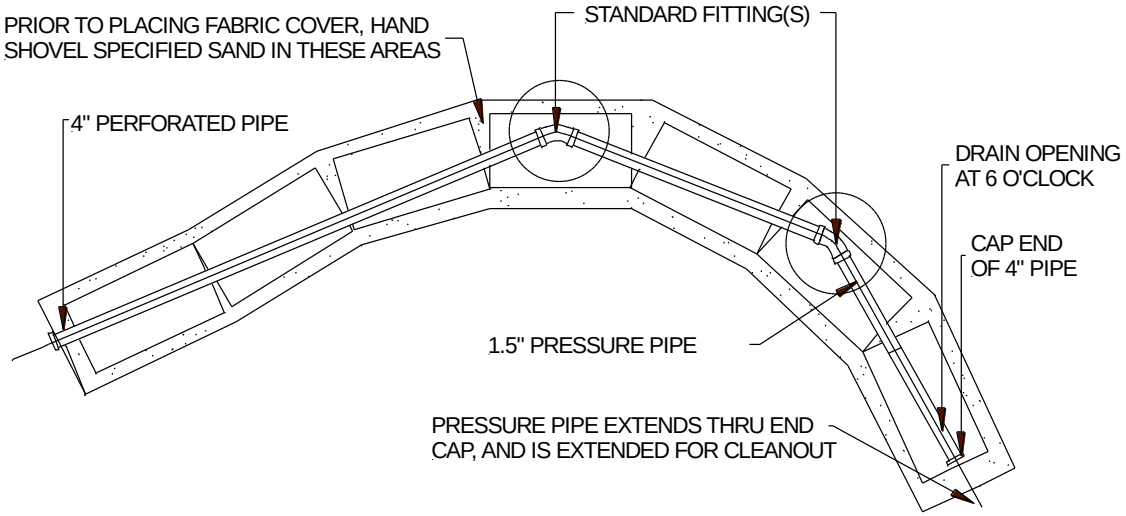


Figure 29 depicts a GSF Pressure Distribution trench placed on a contour or winding trenches to maintain horizontal separation distances. The above graphic could also be used in a dosed or gravity-fed system if the pressure line were removed from the 4-inch diameter perforated distribution pipe.

10.0 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, that is located outside, within line of sight of the dosing tank, and that is secure from tampering and resistant to weather (minimum of NEMA4X). 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.

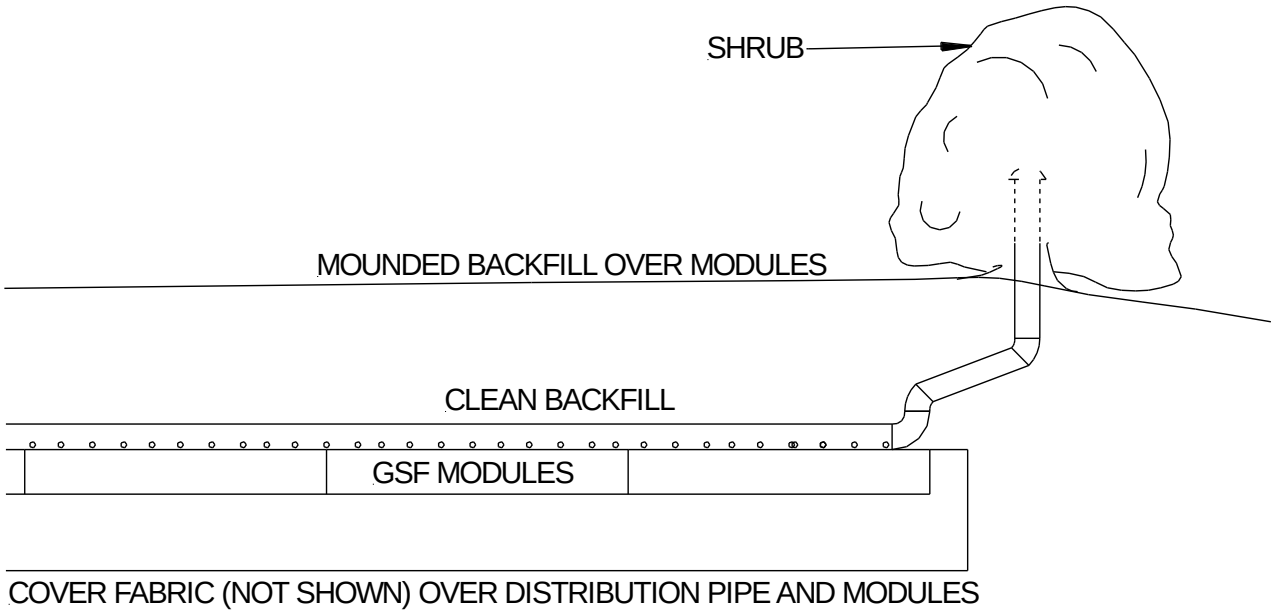
11.0 System Ventilation

11.0.1 SYSTEM VENTILATION: Air vents are required on all absorption systems located 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.

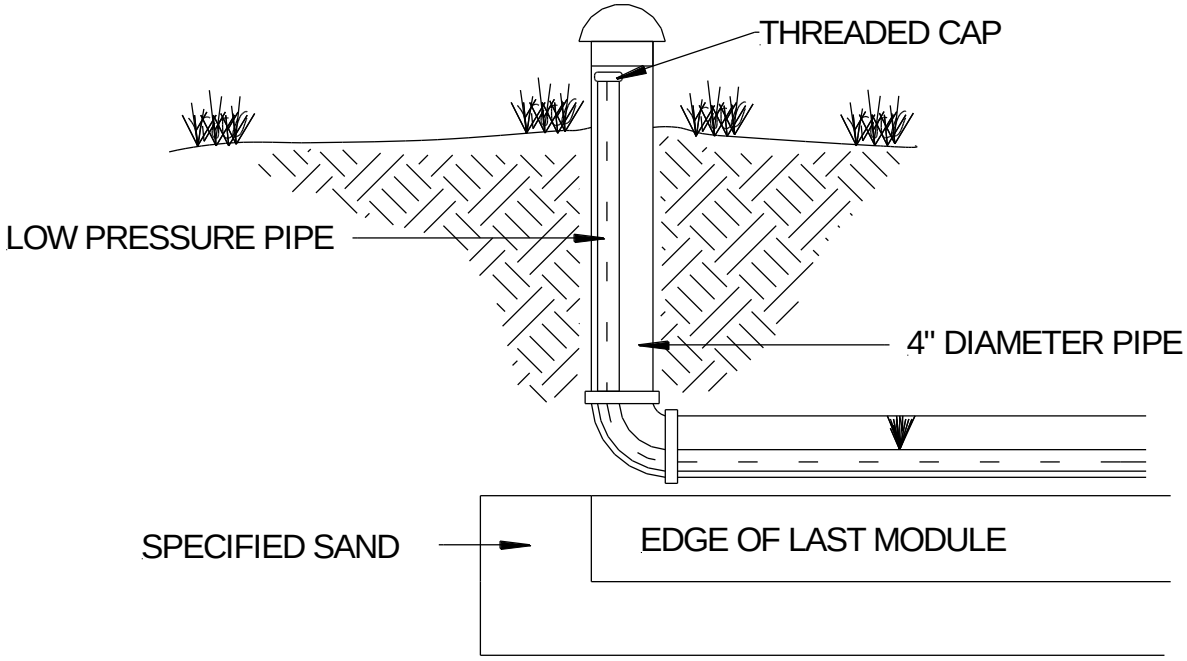
11.0.2 VENTILATION PLACEMENT: In a GSF system, the vent is usually a 4-inch diameter pipe extended to a convenient location behind shrubs, as shown below. The pipe must have an invert higher than the system so that it does not drain effluent.

FIGURE 30: GSF WITH 4" VENT EXTENDED TO CONVENIENT LOCATION



11.0 System Ventilation, Continued

FIGURE 31: GSF VENT WITH PRESSURE DISTRIBUTION



12.0 Inspection/Monitoring Ports

All beds require at least one 4 in. diameter perforated Observation Port designed and installed with access from the ground surface, wrapped with geo-textile fabric and installed at the bottom of the infiltrative surface (bed bottom). 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. For level beds, the port is to be located at the outermost edge of the tall portion of the System Sand or System Sand extension (if present). For sloping beds, locate the port at the lowest elevation of the System Sand extension. The port must extend to final grade for easy access and have a threaded cap. The figures below depict construction and placement of the Inspection/Monitoring Port. At least one inspection port should be placed 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.

FIGURE 32: MONITORING WELL FOR SAND-SOIL INTERFACE

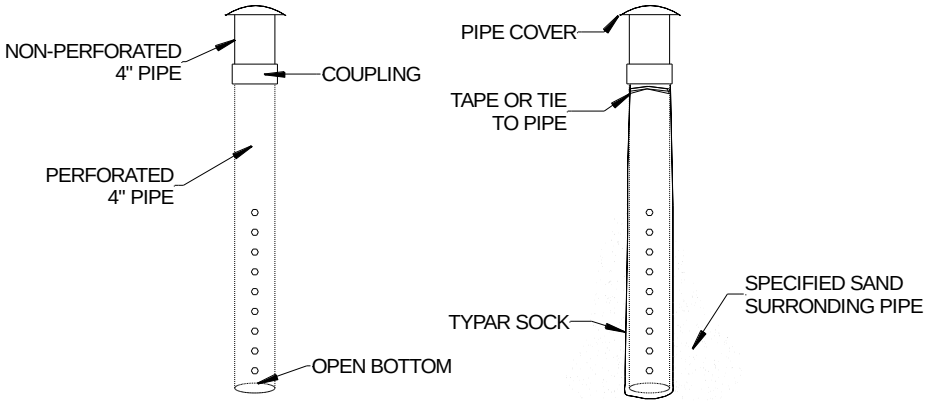


FIGURE 33: OBSERVATION PORT INSTALLED NEXT TO MODULE

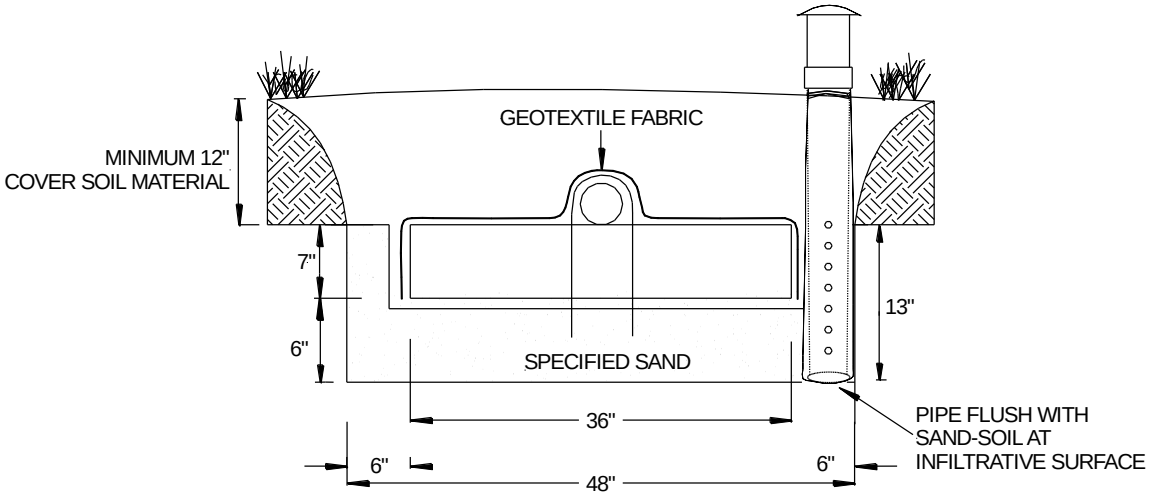


FIGURE 34: OBSERVATION PORTS INSTALLED

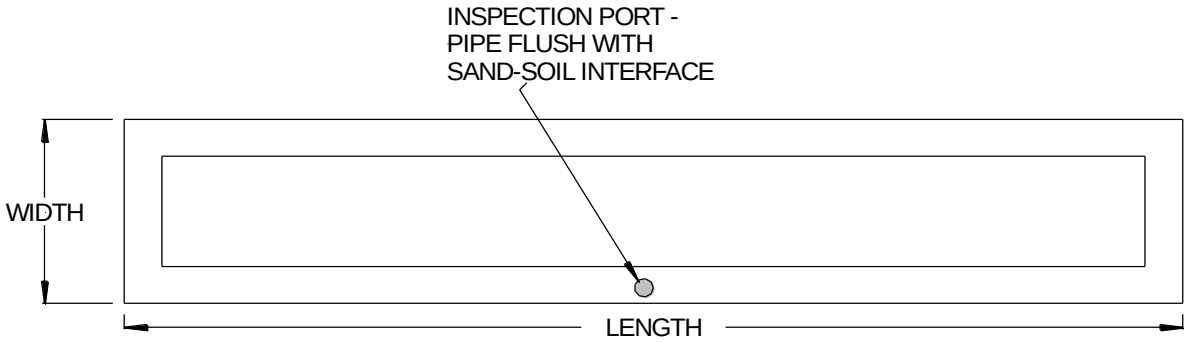
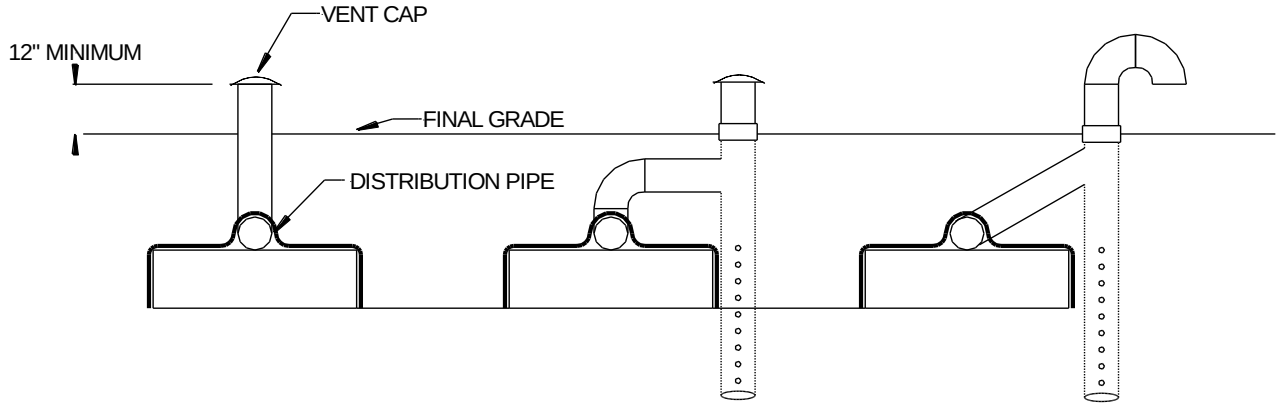


FIGURE 35: COMBINATION VENT/MONITORING WELL FOR SAND-SOIL INTERFACE



13.0 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:

U.S. Mail:

Eljen Corporation
90 Meadow Road
Windsor, CT 06095

Website Online Submission: http://eljen.com/indiana-gsf-system-registration-form

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

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

Phone: 800-444-1359 – For technical assistance.

13.0 Indiana GSF Registration Form, Continued

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 (48 inch x 36 inch x 7 inch) A42 (48 inch x 24 inch x 7 inch)
(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 inches of sand beneath module

TYPE OF SYSTEM: Gravity Pressure Dosed
(Circle One)

13.0 Indiana GSF Registration Form, Continued

AREA REDUCTION: Refer to section labeled notes below Tables 3, 4, 5, 7, 8, and 9 on page(s) 9, 15, 21, 31, 37, and 43.

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 IAC6-8.3 (59) or 4106-10.1 (63) for depth requirements of subsurface drainage.

VENTING
(Circle One) Yes No

*Venting is required if system cover exceeds 18 inches.

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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

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