Geotextile Sand Filter

# Hawaii

## Design and Installation Manual

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**90 Meadow Road**
**Windsor, CT 06095**
**Tel: 800-444-1359**
**Fax: 860-610-0427**
**www.eljen.com**

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DRAWINGS



TABLES

**A42 Module** 48” x 24” x 7” (L x W x H)

**Cover Fabric** The geotextile cover fabric (provided by manufacturer) that is placed over the GSF modules.

**Design Flow** The estimated design flow used to size a system is 200 gallons per day per bedroom in accordance with 11-62-34 (2) (A) up to 1,000 gallons per day.

**Distribution Box** A plastic or concrete box that receives effluent from a septic tank and splits the flow to pipes placed above the GSF modules. For equal distribution, the outlet pipe orifices are required to be set at the same elevation to equalize the flow to each line.

**GSF** The Eljen Geotextile Sand Filter Modules and the 6-inch sand layer at the base and 6-inches along the sides of the modules.

**GSF Module** The individual module of a GSF system. The module is comprised of a cuspated plastic core and geotextile fabric.

**Nitrification Zone** The nitrification zone is an aerobic rich area allowing the nitrification of the effluent. The output from this process is nitrified effluent.

**Sand / Lignocellulose Layer** Wood chips or saw dust from hard wood trees that have not been further processed by chemicals shall be the carbon source for the system. The 12” sand and lignocellulose layer shall be a 50/50 equal mixture of ASTM C33 Sand and wood chips from hard wood trees. The mixture can go 60/40 in favor of more wood to sand.

**Serial Distribution** For designs commonly used on sloping sites where GSF module rows are laid on contour at varying elevations and where each successive module row receives septic tank effluent only after the preceding module row have become full to the bottom of the invert. This design supports unequal length of module rows.

**Specified Sand** To ensure proper system operation, the system MUST be installed using ASTM C33 Sand.

ASTM C33 sand will have less than 10% passing the #100 Sieve and less than 5% passing the # 200 sieve. Ask your material supplier for a sieve analysis to verify that your material meets the required specifications.

**TABLE 1: SPECIFIED SAND SIEVE REQUIREMENTS**

| ASTM C33 SAND SPECIFICATION | | |
|---|---|---|
| Sieve Size | Sieve Square Opening Size | Specification Percent Passing (Wet Sieve) |
| 3/8 inch | 9.52 mm | 100 |
| No. 4 | 4.76 mm | 95 - 100 |
| No. 8 | 2.38 mm | 80 - 100 |
| No. 16 | 1.19 mm | 50 - 85 |
| No. 30 | 590 µm | 25 - 60 |
| No. 50 | 297 µm | 10 - 30 |
| No. 100 | 149 µm | < 10 |
| No. 200 | 75 µm | < 5 |

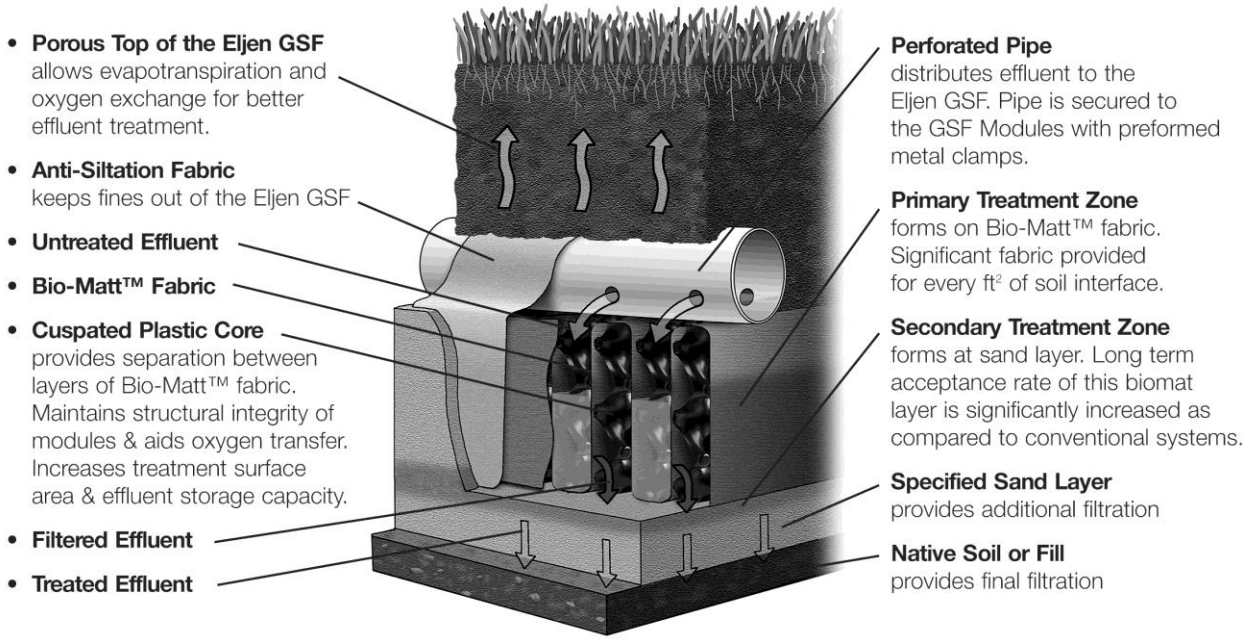
**Primary Treatment Zone**

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

**Secondary Treatment Zone**

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

FIGURE 1: GSF SYSTEM OPERATION



# 1.0 System Preconditions

**1.1 REQUIREMENTS:** GSF systems must meet the local rules and regulations except as outlined in this manual. Chapter 62 of Title 11, Hawaii Administrative Rules, Wastewater Systems and the local regulations will be referred to as the *guidelines* in this manual.

Please contact Eljen's Technical Resource Department at 1-800-444-1359 for design information on commercial systems.

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

**1.3 GARBAGE DISPOSALS:** Eljen does not recommend the use of garbage disposals.

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

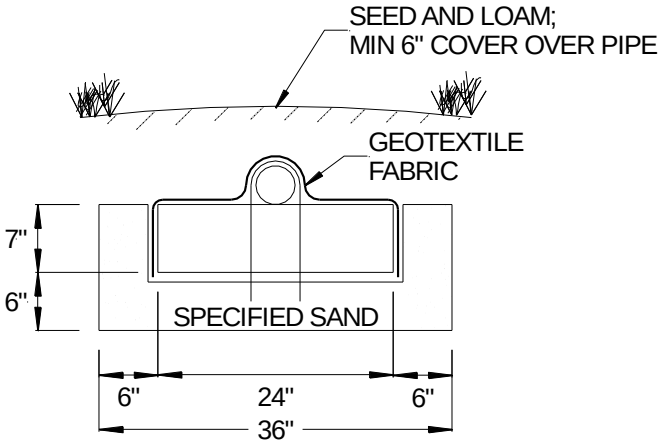
For example:

- Luxury homes, homes with a Jacuzzi style tubs, and other high use fixtures.
- Homes with known higher than normal occupancy.
- Multi home rental properties.

In accordance with HAR, Chapter 11-62, Section 11-62-31.1 (a)(1)(D), an IWS shall not serve more than five (5) bedrooms, whether they are in one (1) dwelling unit or two (2). An IWS cannot serve a dwelling unit that exceeds five (5) bedrooms. Also, a dwelling (or house) with more than (5) bedrooms may not use more than (1) IWS to accommodate the wastewater from the building.

**1.5 SYSTEM PROHIBITED AREAS:** All vehicular traffic is prohibited over the GSF system. GSF systems shall not be installed under paved or concreted areas. If the system is to be installed in livestock areas, the system must be fenced off around the perimeter to prevent compaction of the cover material and damage to the system.

FIGURE 2: TYPICAL A42 CROSS SECTION




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

**All systems are required to have a minimum of:**

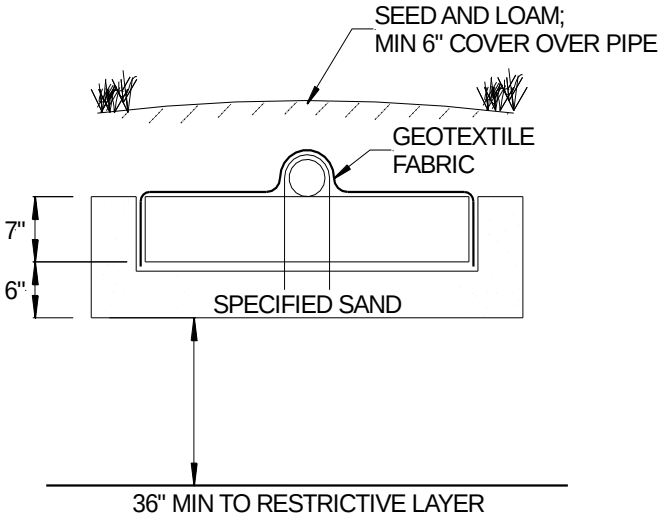
- 6 inches of Specified Sand is at the edges of the GSF module.
- 6 inches of Specified Sand is at the beginning and end of each GSF Row.
- 6 inches of Specified Sand is directly below the GSF module.
- Minimum 6 inches of cover over the distribution pipe.

**2.1 SEPTIC TANKS:** Dual compartment tanks are required for all systems. Eljen supports this practice as it helps to promote long system life by reducing TSS and BOD to the effluent dispersal area. Effluent filters are also required.

**2.2 SEPTIC TANK FILTERS:** Septic tank effluent filters are ***REQUIRED*** on the outlet end of the septic tank. Filter manufactures require that filters be cleaned from time to time. Ask your installer or designer for specific cleaning requirements based on the type or make of the filter installed. Eljen requires the septic tank to be pumped every three years or as needed which would be a good time to check and conduct filter maintenance.

**2.3 VERTICAL SEPARATION TO LIMITING LAYER:** Hawaii rules allow for the Vertical Separation from bottom of the 6 inches of sand under the GSF units to the seasonal high groundwater level, bedrock, or other limiting layer shall not be less than 3 feet.

FIGURE 3: VERTICAL SEPARATION DISTANCE



**2.4 SPECIFIED SAND SPECIFICATION FOR GSF SYSTEMS:** The sand immediately under, between rows and around the perimeter of the GSF system must meet ***ASTM C33 SPECIFICATIONS, WITH LESS THAN 10% PASSING A #100 SIEVE AND LESS THAN 5% PASSING A #200 SIEVE.*** Please place a prominent note to this effect on each design drawing. See Table 1 for more information on the sand and sieve specifications. Washed concrete sand easily meets the above specification and is a reliable choice. Suitability of bank run sand must be verified.

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

**2.6 DISTRIBUTION:** Gravity, pump to gravity or pressure distribution are acceptable when using the GSF System. Piping shall meet the requirements guidelines; however, Eljen strongly recommends the use of ASTM 2729 or SDR 35 pipe and fittings as to prevent crushing during backfill.

All systems require a perforated 4" diameter pipe centered on top of the GSF modules unless the system is curving. The distribution pipe continues along the entire length of all modules in a trench or row. Holes are set at the 4 and 8 o'clock position and secured by the Eljen provided wire clamps.

No holes in the distribution pipe shall be located over the sand. All holes in the distribution pipe must be over the GSF units. This is for all systems to include systems designed on the contour or winding distribution systems.

When using pressure distribution, a pressure manifold is placed inside the 4-inch distribution pipe. Section 7.0 of this manual goes into details of how to construct the distribution network. All piping must meet state and local regulations.

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

**2.8 DISTRIBUTION BOX CONNECTION:** Plastic or concrete distribution boxes are acceptable. Distribution boxes must be installed level and on a compacted layer of sand or a base of gravel to prevent movement over time. Set gravity system distribution box outlet pipes 1/2" to 1/8" drop per foot above the perforated pipe above the modules. A 2" minimum drop to the perforated pipe is required for pumped systems. Non-perforated pipes from the distribution box to the GSF modules must be placed on a compacted surface and secured with fill material that will prevent movement and settling. Dial-a-Flow fittings on outlet pipes are required for demand dosed systems.

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

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

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

**2.12 BACKFILL & FINISH GRADING:** Complete backfill with a minimum of 6 inches of clean porous fill measured from the top of the distribution pipe. Backfill exceeding 18 inches requires venting at the far end of the trench or bed. Use well graded native soil fill that is clean, porous and devoid of large rocks. Do not use wheeled equipment over the system. A light track machine may be used with caution, avoiding crushing or shifting of pipe assembly. Divert surface runoff from the Effluent Disposal Area. Finish grade to prevent surface ponding. Place topsoil and seed system area to protect from erosion.

**2.13 SYSTEM GEOMETRY:** Design systems as long and narrow as practical along site contours to minimize ground water mounding especially in poorly drained low permeability soils. If possible, design level systems with equal number of modules per row.

Trenches shall be horizontally separated by at least 4 feet of naturally occurring soil.

**2.14 NUMBER OF GSF MODULES REQUIRED:** Table 2 indicates the minimum number of GSF modules required for various percolation rates and number of bedrooms. At a minimum, every system shall be sized at 6 A42 modules per bedroom. Units may be scaled up for slower soils to improve distribution in the absorption area.

**2.15 GSF SIZING TABLE:**

**TABLE 2: GSF SIZING CHART***

| Percolation Rate (min/inch) less than or equal to | Application Rate | 2 Bedroom 400 GPD | 3 Bedroom 600 GPD | 4 Bedroom 800 GPD | 5 Bedroom 1,000 GPD | Commercial Rate 100 GPD | Min Units Per Bedroom (BEDS) |
|---|---|---|---|---|---|---|---|
| 1 - 5 | 2.02 | 198 | 297 | 396 | 495 | 72 | 6 |
| 6 - 10 | 2.02 | 198 | 297 | 396 | 495 | 72 | 6 |
| 11 - 15 | 1.75 | 229 | 343 | 457 | 571 | 72 | 6 |
| 16 - 20 | 1.59 | 252 | 377 | 503 | 629 | 72 | 7 |
| 21 - 25 | 1.45 | 276 | 414 | 552 | 690 | 72 | 7 |
| 26 - 30 | 1.33 | 301 | 451 | 602 | 752 | 75 | 8 |
| 31 - 35 | 1.25 | 320 | 480 | 640 | 800 | 80 | 8 |
| 36 - 40 | 1.17 | 342 | 513 | 684 | 855 | 85 | 8 |
| 41 - 45 | 1.11 | 360 | 541 | 721 | 901 | 90 | 8 |
| 46 - 50 | 1.08 | 370 | 556 | 741 | 926 | 93 | 9 |
| 51 - 55 | 1.04 | 385 | 577 | 769 | 962 | 96 | 9 |
| 56 - 60 | 1.01 | 396 | 594 | 792 | 990 | 99 | 9 |
| 61 - 65 | 0.94 | 426 | 638 | 851 | 1064 | 106 | 10 |
| 66 - 70 | 0.86 | 465 | 698 | 930 | 1163 | 116 | 10 |
| 71 - 75 | 0.81 | 494 | 741 | 988 | 1235 | 123 | 10 |
| 76 - 80 | 0.76 | 526 | 789 | 1053 | 1316 | 132 | 11 |
| 81 - 85 | 0.71 | 563 | 845 | 1127 | 1408 | 141 | 11 |
| 86 - 90 | 0.68 | 588 | 882 | 1176 | 1471 | 147 | 11 |
| 91 - 95 | 0.62 | 645 | 968 | 1290 | 1613 | 161 | 11 |
| 96 - 100 | 0.56 | 714 | 1071 | 1429 | 1786 | 179 | 12 |
| 101 - 105 | 0.52 | 769 | 1154 | 1538 | 1923 | 192 | 12 |
| 106 - 110 | 0.48 | 833 | 1250 | 1667 | 2083 | 208 | 12 |
| 111 - 115 | 0.44 | 909 | 1364 | 1818 | 2273 | 227 | 13 |
| 116 - 120 | 0.4 | 1000 | 1500 | 2000 | 2500 | 250 | 13 |

*Individual Wastewater Systems (IWS) shall not exceed 1,000 gallons per day. Design considerations are for dwellings of no more than five (5) bedrooms and/or building other than dwelling of no more than 1,000 gpd.

**Trench Example:**

House size: 3 Bedrooms
Absorption field type: Trench
Percolation Rate: 18 min/in

| Percolation Rate (min/inch) less than or equal to | Application Rate | 2 Bedroom 400 GPD | 3 Bedroom 600 GPD | 4 Bedroom 800 GPD | Add'l Bedrooms 200 GPD | Commercial Rate 100 GPD | Min Units Per Bedroom (BEDS) |
|---|---|---|---|---|---|---|---|
| 1 - 5 | 2.02 | 198 | 297 | 396 | 99 | 72 | 6 |
| 6 - 10 | 2.02 | 198 | 297 | 396 | 99 | 72 | 6 |
| 11 - 15 | 1.75 | 229 | 343 | 457 | 114 | 72 | 6 |
| 16 - 20 | 1.59 | 252 | 377 | 503 | 126 | 72 | 7 |

**Calculate the Minimum Modules Required**

Minimum Bottom Area Required ÷ 12 $ft^2$ per module

A42: 377 $ft^2$ ÷ 12 $ft^2$/module = 31.4 A42s
A42: Round up if required 32 A42's

**Calculate Minimum Required Total Trench Length**

Modules Required x 4 + 1 ft

A42: 32 Units x 4 + 1 ft 129 linear feet

**Trench Width**

A42: 32 units ÷ #rows
32 A42s ÷ 2 = 16 A42s per row 3 ft wide

**Final Dimension Layout**

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

**A42**

| | |
|---|---|
| Min. Required Total Trench Length* | 129 ft |
| Trench Width | 3 ft |
| Minimum Number of Units | 32 A42 modules |
| Two rows | 16 A42s per Row |
| Designed Absorption Area | 387 $ft^2$ |

*The total trench length will be broken up among all of the trenches. The total of all the trench lengths must be equal to or greater than the minimum required total trench length.

FIGURE 4: PLAN VIEW –TRENCH SYSTEM EXAMPLE

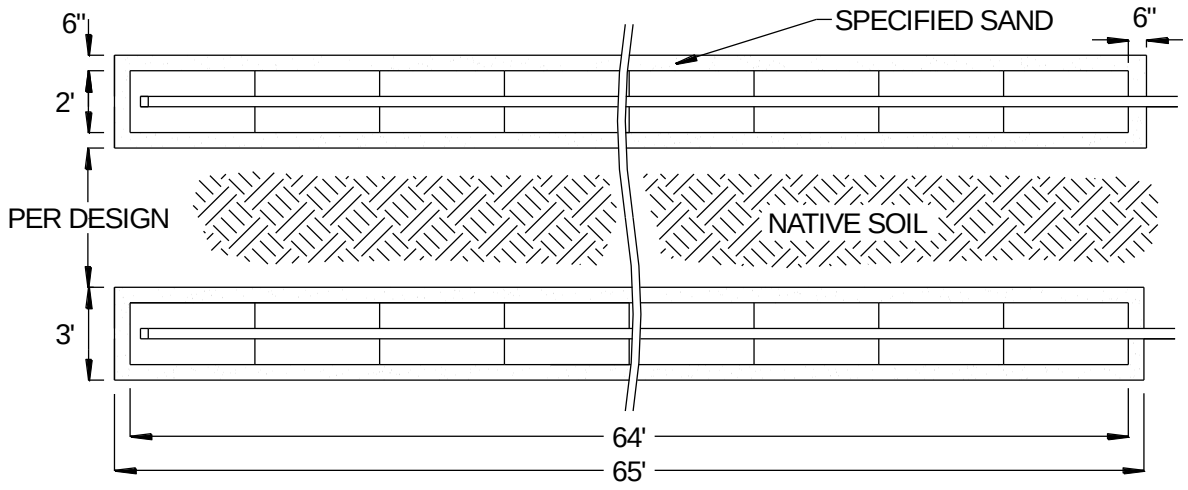



FIGURE 5: SECTION VIEW – TRENCH SYSTEM EXAMPLE – LEVEL SITE

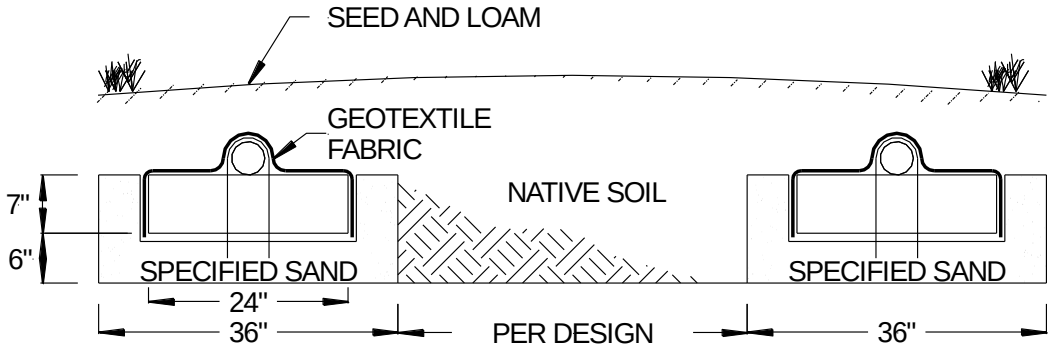
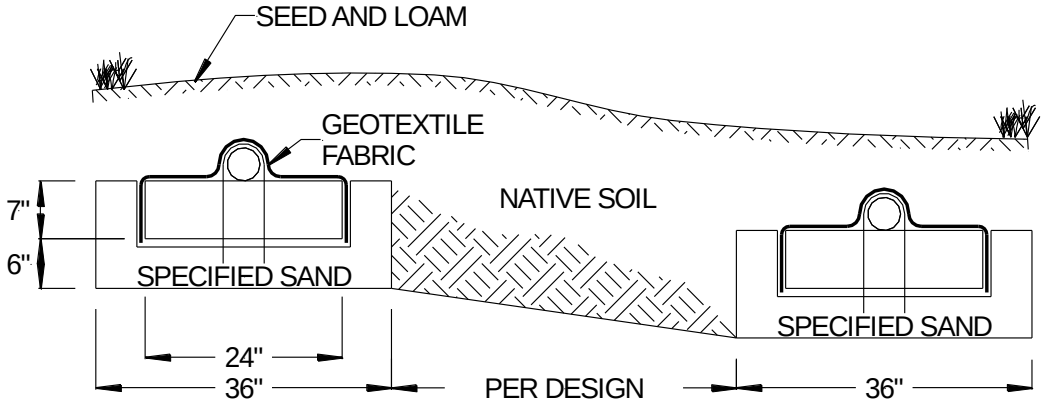



FIGURE 6: SECTION VIEW – TRENCH SYSTEM – SLOPING SITE EXAMPLE



# 3.0 Trench Installation Sizing and Guidelines

1. Ensure all components leading to the GSF system are installed properly. Septic tank effluent filters are required with the GSF system.

2. Determine the number of GSF Modules required using the trench sizing example.

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.

4. Plan all drainage requirements above (up-slope) of the system. Set soil grades to ensure that storm water drainage and ground water is diverted away from the absorption area once the system is complete.

5. Excavate the trench; prepare 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 specified sand in a 6" lift and stabilize by foot, a hand held tamping tool or a portable vibrating compactor. The minimum stabilized height below the GSF module must be level at 6".

8. Place GSF modules with **PAINTED STRIPE FACING UP**, end to end on top of the specified sand along their 4-foot length.

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 & 8 o'clock position.

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

11. (Pressure Distribution Systems) Insert a pressure pipe (size per design and code) into the standard 4-inch perforated pipe. The pressure pipe orifices are set at the 12 o'clock position as shown in Figure 11. Each pressure lateral will have a drain hole at the 6 o'clock position. Each pressure lateral shall include sweeping cleanouts at the terminal ends and be accessible from grade.

12. ***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. Place shovelfuls of Specified Sand directly over the pipe area allowing the cover fabric to form a mostly vertical orientation along the sides of the pipe. Repeat this step moving down the pipe.

13. Place the sand extensions 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.

14. Complete backfill with a minimum of 6 inches of clean porous fill measured from the top of the distribution pipe. Backfill exceeding 18 inches requires venting at the far end of the trench. Use well graded native soil fill that is clean, porous and devoid of large rocks. Do not use wheeled equipment over the system. A light track machine may be used with caution, avoiding crushing or shifting of pipe assembly.

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

**Bed Example:**

House size: 4 Bedrooms
Absorption field type: Bed
Percolation Rate: 15 min/in

**Determine Bed Requirements from Table 2:**

**Square Footage Required: 457 sf**

| Percolation Rate (min/inch) less than or equal to | Application Rate | 2 Bedroom 400 GPD | 3 Bedroom 600 GPD | 4 Bedroom 800 GPD | Add'l Bedrooms 200 GPD | Commercial Rate 100 GPD | Min Units Per Bedroom (BEDS) |
|---|---|---|---|---|---|---|---|
| 1 - 5 | 2.02 | 198 | 297 | 396 | 99 | 72 | 6 |
| 6 - 10 | 2.02 | 198 | 297 | 396 | 99 | 72 | 6 |
| 11 - 15 | 1.75 | 229 | 343 | 457 | 114 | 72 | 6 |

**Number of Units Required per Bedroom: 6 A42s per Bedroom, 4 Bedrooms x 6 = 24 Total Units**

Total units ÷ # of Rows = Units per Row

2 Row System:
24 A42s ÷ 2 rows = 12 A42s per Row

3 Row System:
24 A42s ÷ 3 rows = 8 A42s per Row

**Determine Bed Length**

Units per Row x 4 ft per unit + 1 ft = Bed Length

2 Row System:
12 A42s x 4 + 1 ft = 49 ft

3 Row System:
8 A42s x 4 + 1 ft = 33 ft

**Determine Bed Width**

Square Footage Required ÷ Bed Length = Bed Width

2 Row System:
457 sf ÷ 49 ft = 9.3 ft, round up to 10 ft

3 Row System:
457 sf ÷ 33 ft = 13.8 ft, round up to 14 ft

**Determine Lateral Spacing**

Lateral to Lateral Spacing = Bed Width ÷ Number of Rows

2 Row System:
10 ft ÷ 2 rows = 5 ft

3 Row System:
14 ft ÷ 3 rows = 4.6 ft

Lateral to Edge Spacing = Lateral to Lateral Spacing ÷ 2

2 Row System:
5 ft ÷ 2 = 2.5 ft

3 Row System:
4.6 ft ÷ 2 = 2.3 ft

**Final Dimension Layout**

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

**A42 – 2 Rows**

| | |
|---|---|
| Bed Length | 49 ft |
| Bed Width | 10 ft |
| Minimum Number of Units | 24 A42 modules |
| Modules per row | 12 A42s |
| Lateral to Lateral Spacing | 5 ft. |
| Lateral to Edge Spacing | 2.5 ft. |
| System Area | 490 $ft^2$ |

**A42 – 3 Rows**

| | |
|---|---|
| Bed Length | 33 ft |
| Bed Width | 14 ft |
| Minimum Number of Units | 24 A42 modules |
| Modules per row | 8 A42s |
| Lateral to Lateral Spacing | 4.6 ft. |
| Lateral to Edge Spacing | 2.3 ft. |
| System Area | 462 $ft^2$ |

FIGURE 7: PLAN VIEW – BED SYSTEM EXAMPLE – LEVEL SITE

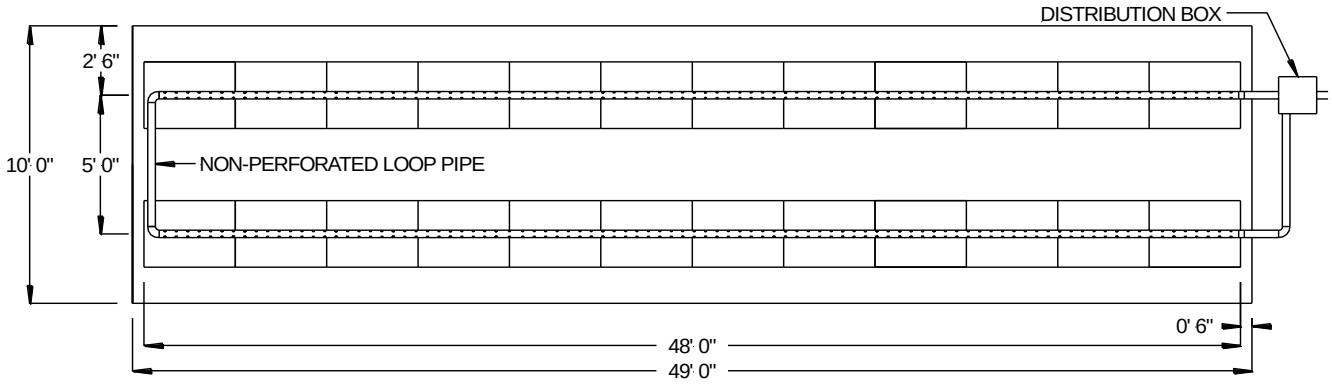
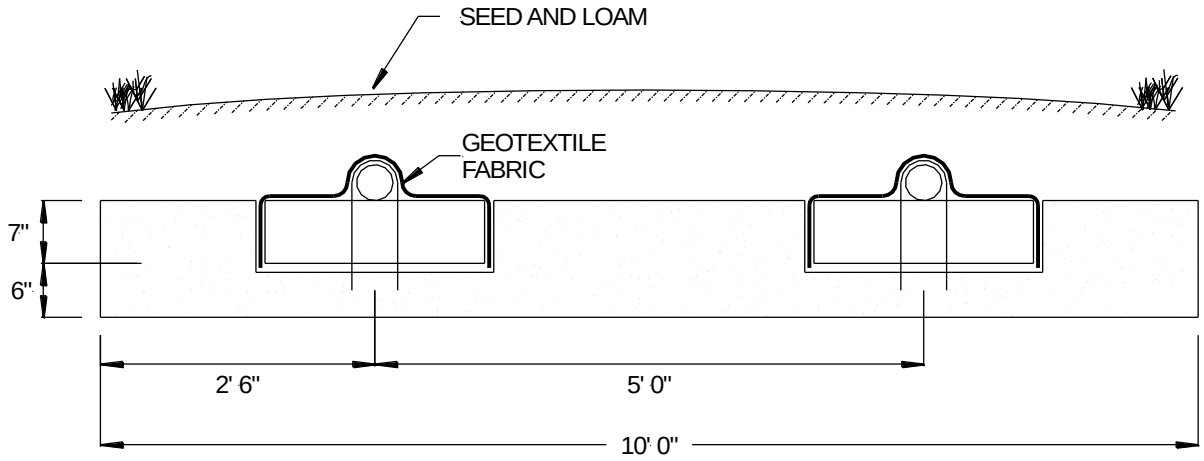



FIGURE 8: SECTION VIEW – BED SYSTEM EXAMPLE



# 4.0 Bed Installation Sizing and Guidelines

1. Ensure all components leading to the GSF system are installed properly. Septic tank effluent filters are required with the GSF system.

2. Determine the number of GSF Modules required using the bed sizing example.

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.

4. Plan all drainage requirements above (up-slope) of the system. Set soil grades to ensure that storm water drainage and ground water is diverted away from the absorption area once the system is complete.

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

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

7. Place specified sand in 6" lifts, stabilize by foot, a hand held tamping tool or a portable vibrating compactor. The minimum stabilized height below the GSF module must be level at 6".

8. Place GSF modules with **PAINTED STRIPE FACING UP**, end to end on top of the specified sand along their 4-foot length.

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 & 8 o'clock position.

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

11. (Pressure Distribution Systems) Insert a pressure pipe (size per design and code) into the standard 4-inch perforated pipe. The pressure pipe orifices are set at the 12 o'clock position as shown in Figure 11. Each pressure lateral will have a drain hole at the 6 o'clock position. Each pressure lateral shall include sweeping cleanouts at the terminal ends and be accessible from grade.

12. ***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. Place shovelfuls of Specified Sand directly over the pipe area allowing the cover fabric to form a mostly vertical orientation along the sides of the pipe. Repeat this step moving down the pipe.

13. 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. Beds on level sites require a minimum spacing of 12" of Specified Sand between parallel module rows with 24" of separation required on sites with greater than 15% slope. No mechanical connection is required between modules.

14. Complete backfill with a minimum of 6 inches of clean porous fill measured from the top of the pipe. Backfill exceeding 18 inches requires venting at the far end of the bed. Use well graded native soil fill that is clean, porous and devoid of large rocks. Do not use wheeled equipment over the system. A light track machine may be used with caution, avoiding crushing or shifting of pipe assembly.

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

**5.1 MOUND REFERENCE:** The following guidelines provide an overview for mound design and construction. Mound distribution can either be gravity, pump to gravity or pressurized.

FIGURE 9: CROSS SECTION – MOUND SYSTEM

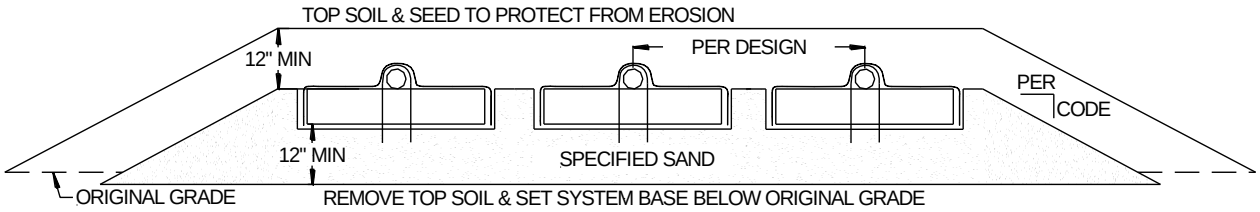
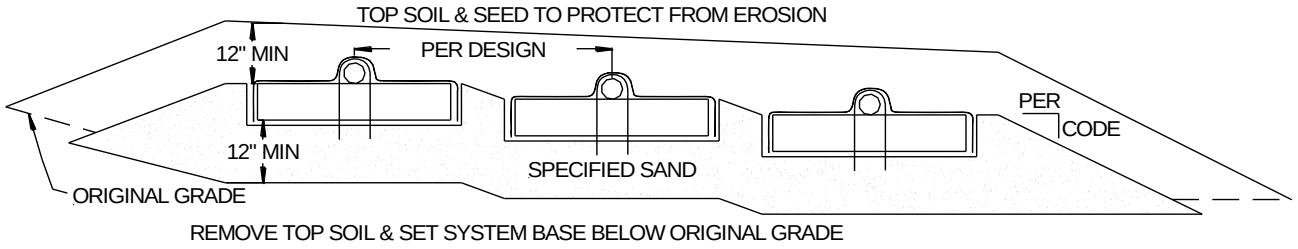



FIGURE 10: CROSS SECTION – SLOPED MOUND SYSTEM



# 5.0 Mound Installation Guidelines

1. Ensure all components leading to the GSF system are installed properly. Septic tank effluent filters are required with the GSF system.

2. Determine the number of GSF Modules required using the sizing formula.

3. Prepare the site. Do not install a system on saturated ground or wet soils that are smeared during preparation. Keep machinery off infiltrative areas.

4. Plan all drainage requirements above (up-slope) of the system. Set soil grades to ensure that storm water drainage and ground water is diverted away from the absorption area once the system is complete.

5. Remove the organic soil layer. Prepare the receiving layer to maximize the interface between the native soil and Specified Sand. Minimize walking in the absorption area prior to placement of the Specified Sand to avoid soil compaction.

6. Place fill material meeting local requirements (or Specified Sand requirements) onto the soil interface as you move down the excavated area. Place specified sand in 6" lifts and stabilize by foot, a hand held tamping tool or a portable vibrating compactor. The stabilized height below the GSF module shall meet the mound design requirements.

7. Place GSF modules with **PAINTED STRIPE FACING UP**, end to end on top of the specified sand along their 4-foot length.

8. A standard perforated 4-inch distribution pipe is centered along the modules 4-inch length. Orifices are set at the 4 & 8 o'clock position.

9. All distribution pipes are secured with manufacturers supplied wire clamps, one per module.

10. (Pressure Distribution Systems) Insert a PVC Sch. 40 pressure pipe (size per design and code) into the standard perforated distribution pipe. The pressure pipe orifices are set at the 12 o'clock position as shown in Figure 11. Each pressure lateral will have a drain hole at the 6 o'clock position. Each pressure lateral shall include sweeping cleanouts at the terminal ends and be accessible from grade.

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. Place shovelfuls of Specified Sand directly over the pipe area allowing the cover fabric to form a mostly vertical orientation along the sides of the pipe. Repeat this step moving down the pipe.

12. Ensure there is 6 inches of specified sand surrounding the GSF modules in the mound. Slope the sand away from the mound as described on the plan.

13. Complete backfill with a minimum of 6 inches of cover material measured from the top of the distribution pipe. Use well graded native soil fill that is clean, porous and devoid of large rocks. Do not use wheeled equipment over the system. A light track machine may be used with caution, avoiding crushing or shifting of pipe assembly.

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

# 6.0 Dosing Distribution Guidance

**6.1 PUMP TO DISTRIBUTION BOX:** Specify an oversized distribution box for pumped dosed systems. Provide velocity reduction in the d-box with a tee or baffle. Set d-box outlets at the same elevation to equalize flow to each line or use drop boxes at the head of each line for serial distribution. If the absorption area is installed deeper than 18 inches, the system must be vented. See section 8.0 of this manual for detailed information on venting of systems.

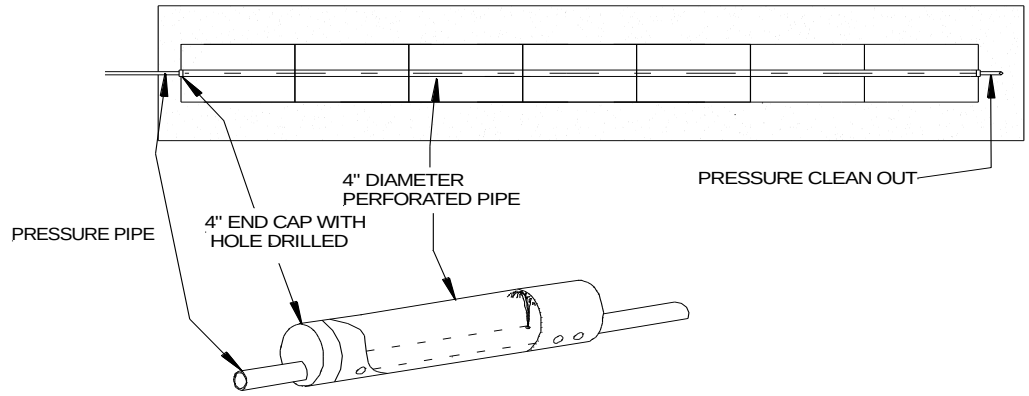
**6.2 DOSING DESIGN AND FLOW RATE:** Dosing volume must be set to deliver a maximum of 3 gallons per A42 Module per dosing cycle. Higher flow rates and short dose cycle push the effluent down the line and thus disperse the effluent over a larger area. A valve on the force main is recommended to set the flow rate so that the outlet pipes are submerged but prevents the d-box from over flowing.

# 7.0 Pressure Distribution Guidance

**7.1 PRESSURE DISTRIBUTION:** Dosing with small diameter pressurized laterals or the use of orifice shields are acceptable for GSF systems. The pipe networks must be engineered and follow principles established for pressure distribution. Flushing ports are required to maintain the free flow of effluent from orifices at the distal ends of each lateral. Contact Eljen's Technical Resource Department at 1-800-444-1359 for more information on pressure distribution systems

Standard procedures for design of pressure distribution networks apply to the GSF filter. A minimum orifice size according to the regulations shall be maintained. A drain hole is required at the 6 o'clock position of each pressure lateral for drainage purposes. The lateral pipe network, constructed of PVC Sch. 40 pipe *(size per design and code),* is placed within a standard 4-inch perforated pipe. The perforation in the 4-inch outer pipe are set at the 4 and 8 o'clock position, the drilled orifices on the pressure pipe are set to spray at the 12 o'clock position directly to the top of the 4-inch perforated pipe as shown below. Pressure clean outs are required at the end of each lateral.

FIGURE 11: PRESSURE PIPE PLACEMENT




PRESSURE PIPE CROSS SECTION FOR ALL APPLICATIONS

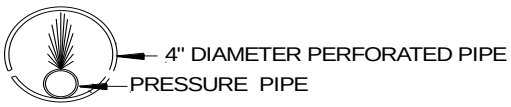


FIGURE 12: PRESSURE CLEAN OUT

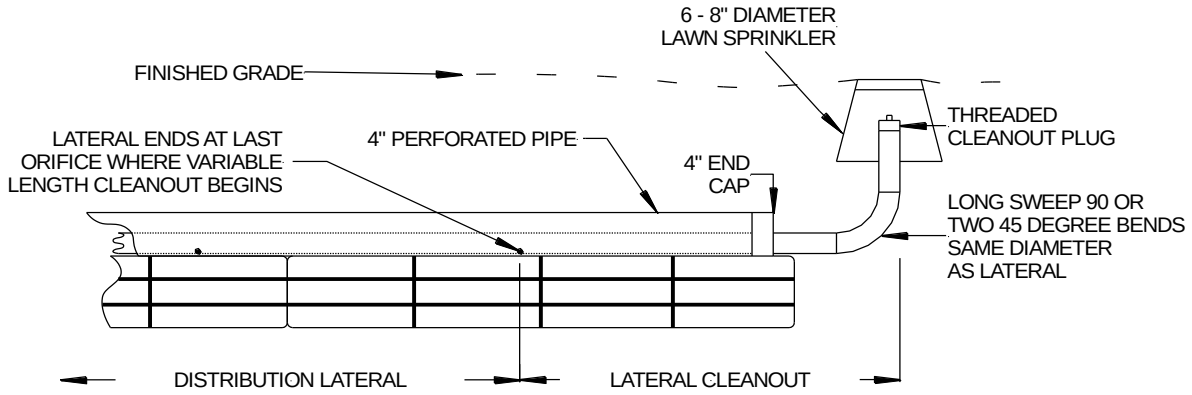
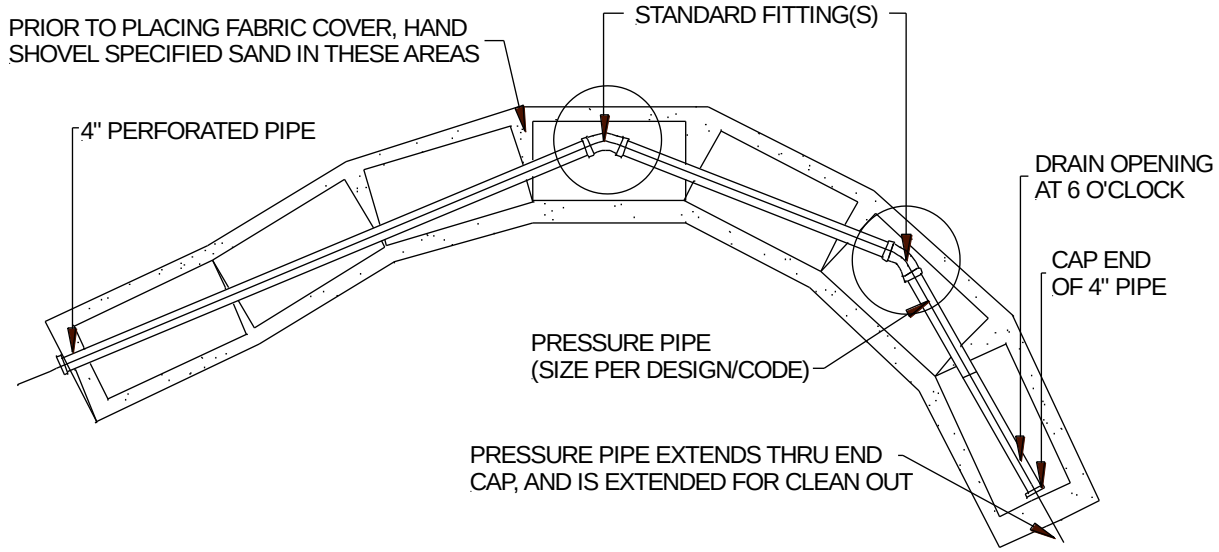



FIGURE 13: CONTOURED TRENCH PRESSURE DISTRIBUTION




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

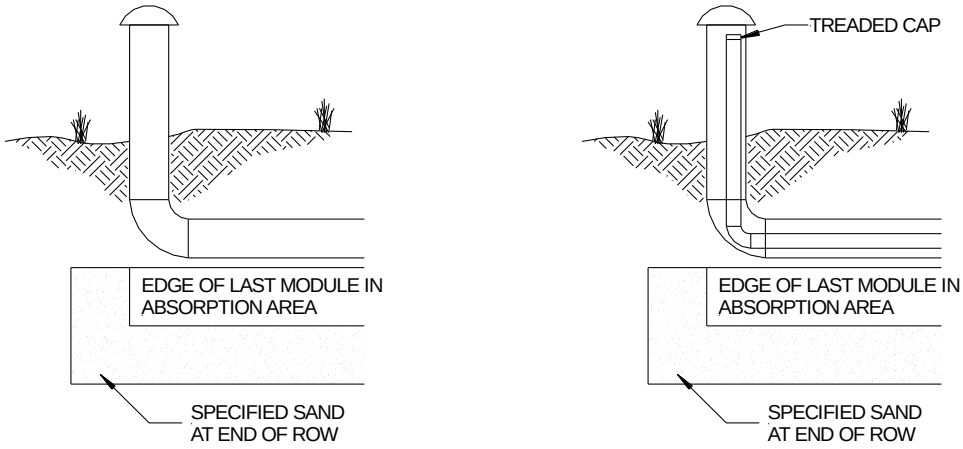
**7.2 PRESSURE DISTRIBUTION REFERENCES:** Please consult the following documents for specifications and guidelines for the construction of pressure distribution networks.

1. Converse, J. Pressure Distribution Network Design. Jan 2020.
2. State of Washington, Department of Health. Pressure Distribution Systems Guidance, DOH Publication #337-009. July 2012.

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

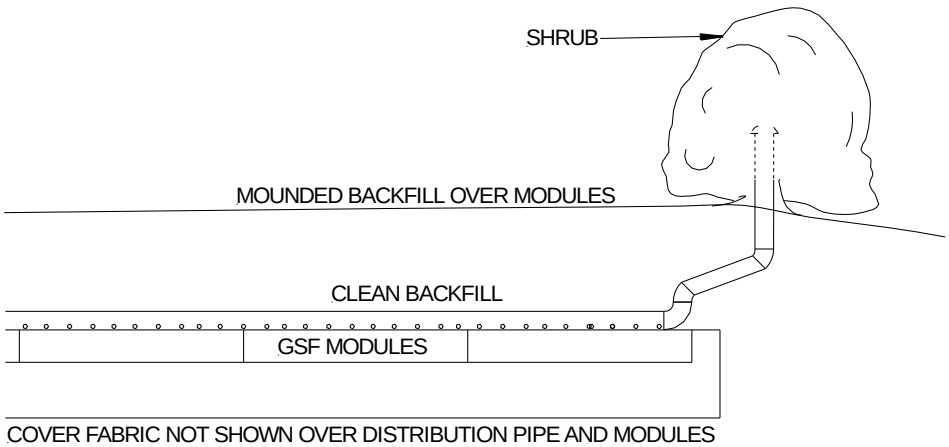
**8.2 VENT PIPE FOR GRAVITY AND LOW-PRESSURE SYSTEMS:** Systems with over 18" of cover over the top of the distribution pipes require a vent. If the system is a low-pressure distribution system, ensure that the LPP clean outs are located in the vent for easy access.

FIGURE 14: VENT LAYOUTS FOR GRAVITY AND LOW-PRESSURE SYSTEMS




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

FIGURE 15: GSF WITH 4" VENT EXTENDED TO CONVENIENT LOCATION



**Primary Treatment Zone**

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

**Secondary Treatment Zone**

- Effluent drips into the Specified Sand layer and supports unsaturated flow to the carbon source.
- The Specified Sand supports nitrification of the effluent, which reduces oxygen demand in the soil, thus minimizing clogging from anaerobic bacteria.

**Nitrification Zone**

- Nitrification continues from the secondary treatment zone. Additional sand exists in this area to promote 100% nitrification of the effluent.

**Denitrification Zone**

- Effluent infiltrates into the carbon source which has a slower percolation rate than the secondary treatment zone. This creates an anaerobic zone in the carbon rich environment.
- The effluent from the secondary zone is denitrified and passed over limestone rock to balance the pH prior to discharge.

FIGURE 16: GSF SYSTEM OPERATION

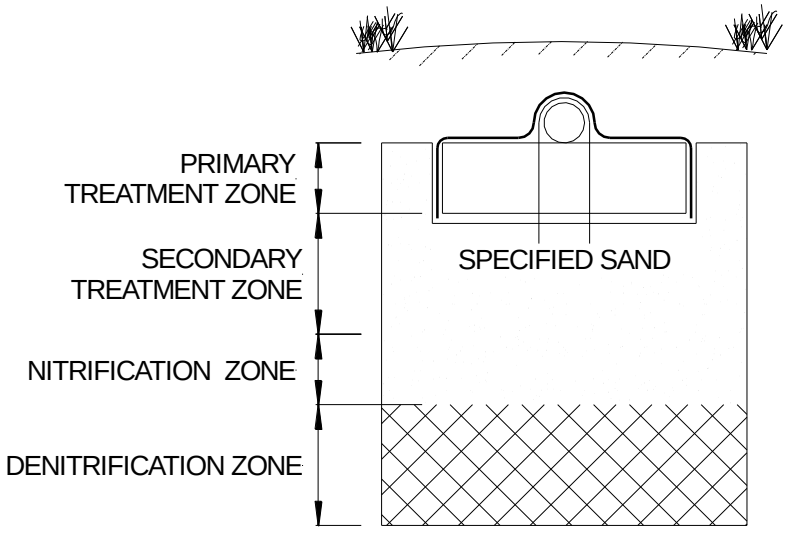
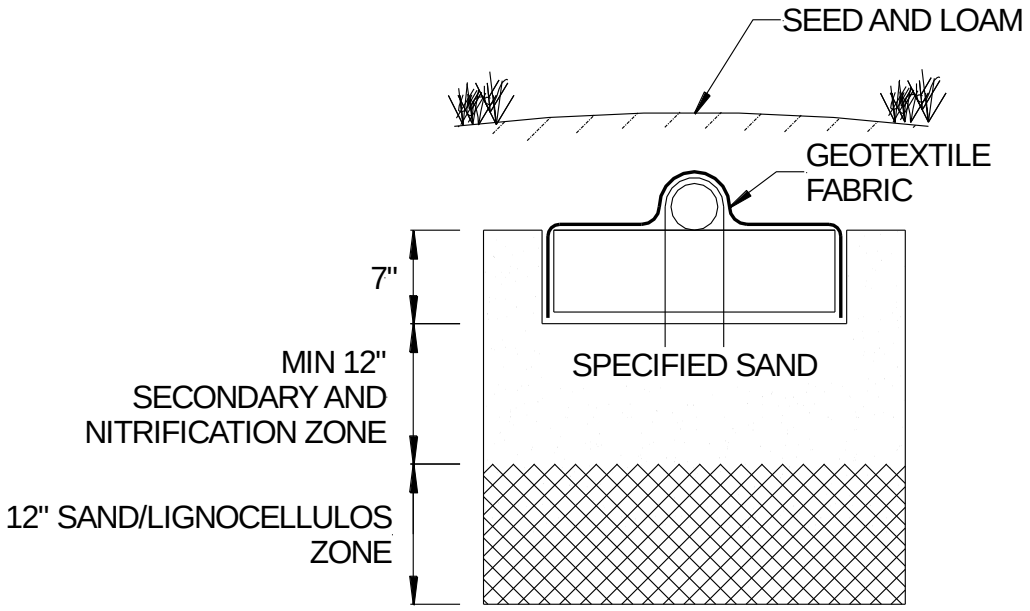


FIGURE 17: TYPICAL DENITRIFICATION TRENCH CROSS SECTION




**All systems are required to have a minimum of:**

- 6 inches of Specified Sand is at the edges of the GSF module.
- 6 inches of Specified Sand is at the beginning and end of each GSF Row or Trench.
- 12 inches of Specified Sand is directly below the GSF module.
- 12 inches of Sand/Lignocellulos Layer.

**9.1 DESIGN:** The denitrification system is designed the same way as the treatment and dispersal systems. Refer to Sections 3.0 and 4.0 for sizing the system.

**9.2 SAND/LIGNOCELLULOS ZONE:** Wood chips or saw dust from hard wood trees that have not been further processed by chemicals shall be the carbon source for the system. The 12" sand and lignocellulose layer shall be a 50/50 equal mixture of ASTM C33 Sand and wood chips from hard wood trees. The mixture can go 60/40 in favor of more wood to sand.

**9.3 SAND/LIGNOCELLULOS ZONE INSTALLATION:** Prior to step 7 on pages 11 and 14, the sand/wood mixture is mixed prior to installation. It is then placed in the excavation in 6" lifts and stabilize by foot, a hand held tamping tool or a portable vibrating compactor. The stabilized height of the sand and wood shall be greater or equal to 12 inches and level.