Geotextile Sand Filter

Maine

Design and Installation Manual

Revised
October 22, 2010

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Glossary of Terms

GSF B43 Module	(L x W x H), 48” x 36” x 7”
GSF HB Module	(L x W x H), 24” x 36” x 7”
GSF Transverse Module	(L x W x H), 36 x 48” x 7”
Beds	GSF modules placed on a 6” base of specified sand. A minimum of 12” of specified sand is placed between rows of modules; 9” of Specified Sand is placed around the outside perimeter of the installation.
Biofabric	Special filter fabric within the Geotextile Sand Filter Modules upon which the primary biomat layer forms.
Cover Fabric	The geotextile cover fabric (provided by manufacturer/ distributor only) that is placed over the GSF modules protects the GSF modules from infiltration of backfill and fines. Geotextile cover fabric must cover of the top and side of the modules prior to placement of specified sand and backfill material.
Cuspated Core	The rigid plastic core of the GSF module. It separates the geotextile fabric and creates downward infiltration channels and upward aeration channels to provide primary filtration and biological treatment of the septic effluent. The curvilinear shape of the cuspations offers increased treatment surface area and greater effluent storage.
Dial-a-Flow Fitting	A plastic fitting placed on the end of a distribution pipe inside a distribution box or drop box allowing an Installer to rotate the fitting thereby directing effluent to any one trench at a time.
Design Flow	The estimated peak flow that is used to size a GSF system is 90 gallons per day per bedroom. Specific situations may require system designers to establish higher design flows than stated above.
Distribution Pipe	Perforated pipe that applies effluent to the top of the GSF modules. SDR 35 non-perforated or perforated pipe is required. Schedule 40 pipe is recommended if the contractor uses wheeled equipment to cover the system.
Distribution Box	(Or D-Box) is a plastic or concrete box that receives effluent from a septic tank and splits the flow to pipes placed above the GSF modules. For equal distribution, the outlet pipe orifices are typically set at the same elevation to equalize the flow to each line. The distribution box method is only used when the receiving GSF modules are at the same elevation.
Drop Box	A plastic or concrete box that is used on sloped systems where the elevation of the incoming distribution line is higher than that of the outgoing distribution line. This allows the loading of upper most trenches/rows in the system prior to loading lower trenches/rows.
EDA	Effluent Disposal Area.
GSF	Geotextile Sand Filter.
GSF Module	The individual module of a GSF system. The module is comprised of a cuspated plastic core and corrugated geotextile fabric.

LTAR Long Term Acceptance Rate (LTAR) is the average equilibrium absorption rate for effluent in a system, usually expressed in gallons per day per square foot. It should not be confused with the design loading rate that is used by regulatory officials in their regulations.

Maine Rules Subsurface Wastewater Disposal Rules, 10-144 CMR 241 or most current addition or latest revisions.

MLF Most Limiting Factor to Seasonal Ground Water Table (high water table), and/or bedrock, and /or restrictive horizon, Maine rules require 12", 18" or 24" from disposal bed bottom to MLF depending on Design Class and depth to ledge. Eljen's conservative leach field design specifies a receiving sand bed layer (level to within ½ inch) directly beneath the GSF modules as shown in Figure 4. The bottom of the disposal area is the bottom of the GSF module. The Vertical separation from bottom of the GSF module to the MLF shall not be less than 18".

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.

Sequential Distribution A method of effluent distribution for sloping sites using drop boxes where the effluent discharges first to the lowest outlet in the upper most box and then backs up to a slightly higher overflow outlet to the next down slope row of modules. Sequential loading maximizes utilization of a row of modules and allows downstream rows to rest for use only during peak flows or stress conditions. It can also be applied to a distribution box for a level bed system by fitting the outlet pipes with dial-a-flows. This method of distribution also supports inspection and management of the system to define the percent of the system in use, maximum use, and to monitor and adjust system stress.

Specified Sand To ensure proper system operation, the system must be installed using a medium to coarse sand with an effective size of 0.25 to 2.0 mm, no greater than 10% passing a #100 sieve and 5% passing a #200 sieve, and no particles larger than .375", or materials meeting the ASTM C33 specification with less than 10% passing a #100 sieve and less than 5% passing a #200 sieve. Washed concrete sand easily meets the above specification and is a reliable choice. Suitability of bank run sand must be verified. Listed below is chart outlining the sieve requirements for the ASTM C33 sand specification.

Sieve	Sieve Square Opening Size	Specification Percent Passing (Dry Sieve)
0.375"	9.5 mm	100.0 –100.0
#4	4.75 mm	95.0 – 100.0
#8	2.36 mm	80.0 – 100.0
#16	1.18 mm	50.0 – 85.0
#30	600 µm	25.0 – 60.0
#50	300 µm	10.0 – 30.0
#100	150 µm	< 10.0
#200	75 µm	< 5.0

STE	Septic Tank Effluent (STE) is anaerobically digested effluent that is discharged to a Geotextile Sand Filter module for further treatment.
Trenches	GSF Modules are placed on a base of 6” of Specified Sand with minimum 9” of Specified Sand is placed at each side of the row of modules. Trench rows are separated by 3’ minimum of native soil.
Wire Clamps	Are used to secure the distribution pipe to the GSF modules. Wire clamps are inserted prior to covering the system with Geotextile Cover Fabric.

Introduction

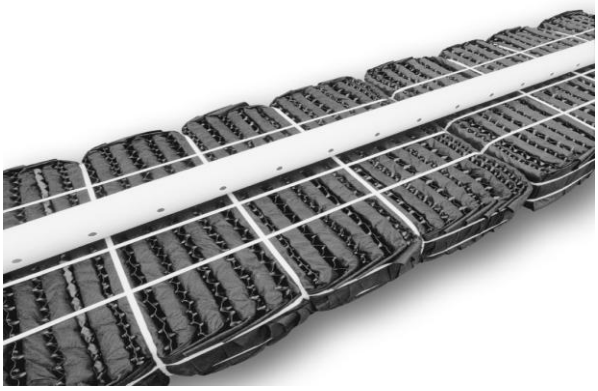
This manual provides design and installation information for the Eljen GSF Geotextile Sand Filter system using the B43 and HB GSF modules. Design layouts and installation instructions for sequential, equal or dosed distribution systems are included. Details on unique design and construction procedures stated in Maine's Subsurface Wastewater Disposal Rules, 10-144 CMR 241 or most current addition or latest revisions.

The Eljen GSF system technology is based on research conducted by nationally recognized engineering scientists from the University of Connecticut. Eljen Corporation has over 30 years of success in the onsite wastewater industry, with tens of thousands of systems currently in use. The GSF is recognized by regulatory officials and experts in the industry as one of the most reliable pretreatment technologies in the marketplace today. The system specifications in this manual are founded on this research and history.

The GSF technology is based on scientific principles which state that improved effluent quality provides increased soil absorption rates. GSF's proprietary two-stage Bio-Matt™ pre-filtration process improves effluent quality while increasing reliability and ease of operation.

Third-party independent testing data based on NSF/ANSI Standard 40 Protocol has shown that the Eljen GSF provides advanced treatment of septic tank effluent to better than secondary levels.

The Eljen GSF Geotextile Sand Filter



GSF System Description

The Eljen GSF Geotextile Sand Filter system is a cost-effective upgrade from other septic technologies. Comprised of a proprietary two-stage Bio-Matt™ pre-treatment process, the geotextile modules apply a better-than-secondary aerobic effluent to the soil, increasing the soil's ability to accept the effluent. The result is superior treatment in a smaller soil absorption area.

How the GSF System Works

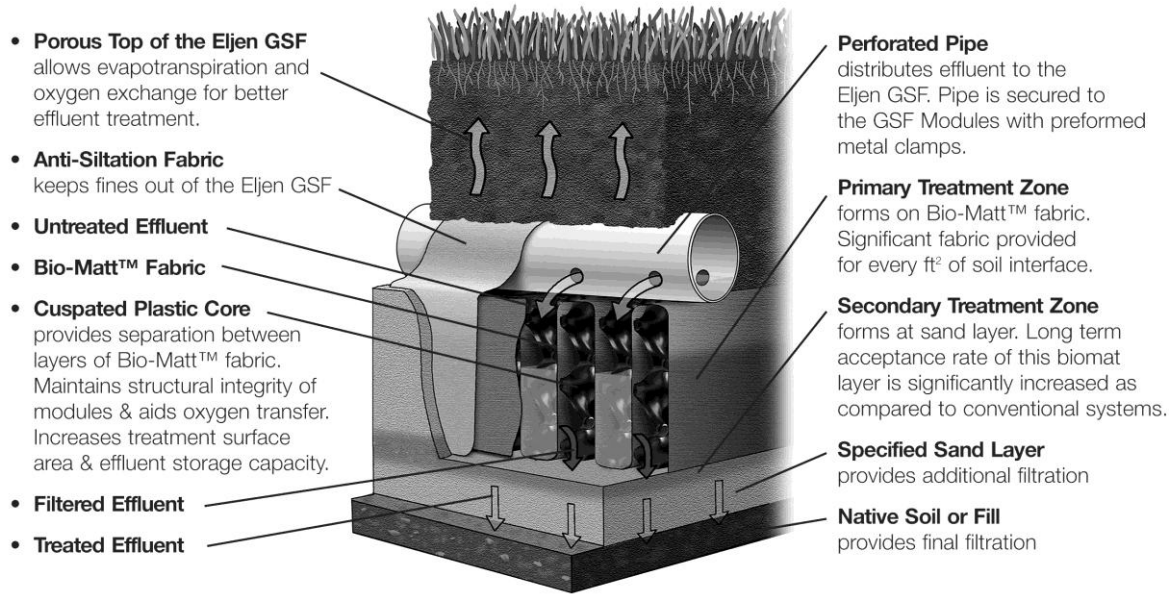
Primary Treatment Zone

- Perforated pipe is centered above the GSF module to distribute septic effluent over and into corrugations created by the cuspated core of the geotextile module.
- Septic effluent is filtered through the Bio-Matt fabric. The module's unique design provides increased surface area for biological treatment that greatly exceeds the module's 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 Basic System Design

1.1 DESIGN AND INSTALLATION: Design and Installation of GSF systems shall comply with all State and any Local regulations and the requirements of this manual.

1.2 SYSTEM SIZING: GSF systems must be sized on the basis of Table 600.1 of the Maine Rules (a simplified version can be found in Table 3 on page 32 of this manual). Effective Area of a B43 module is approved at 4.0 sqft per sqft of module basal area or 48 sqft per GSF B43 module. Use the GSF sizing chart on Table 2 of this manual to determine the number of B43 modules for a given design flow and disposal field size group or divide the required infiltrative area by 48 and round up to the nearest 1/2 module. The 400% module rating for the GSF modules applies to residential systems for both Trench and Bed configurations. For example, two rows of 10 modules in a bed 40 feet in length is rated as providing 960 square feet. Refer to Page 30 for additional information on commercial systems.

1.3 TRENCH CONFIGURATIONS: Trench configurations shall provide a minimum spacing of 7.5' center to center (3 feet of native soil between excavated sidewalls) with 6" of Specified Sand (See Glossary of Terms) below GSF modules and 9" of Specified Sand around the outer edge of the modules. Trench configurations utilize the same number of GSF modules as Bed configurations. Most designs utilize Bed configurations unless the site designer feels that the site has some unusual hydraulic capacity characteristics.

1.4 BED CONFIGURATIONS: GSF modules may be installed in a Bed configuration with a minimum of 12" of Specified Sand (See Glossary of Terms) between rows, 9" of Specified Sand around the outer edge of the GSF modules and 6" of Specified Sand below the GSF modules. Modules rows in a bed configuration on sloping sites are spaced 12" on slopes <15%, and 24" between module rows on slopes of 15% to 20%. On level Bed systems, install non-perforated interconnecting pipes between GSF module rows at midpoints in systems over 40' long and at the distal end of the system to form pipe loops to ensure long term system efficiency.

1.5 EXPERIMENTAL SYSTEMS: Use of GSF modules at a higher loading rate than approved and or less than 12" of spacing between the rows of GSF modules are considered experimental systems under Chapter 18 of the Maine Rules. Installations on some sites may result in reduced capacity due to ground water mounding and/or the hydraulic capacity of the site. Special care must be given on sites with AI, AII, D or E design class conditions.

1.6 LINED DISPOSAL FIELDS: Disposal fields for very permeable shoreline sites must comply with Chapter 16 of the Maine Rules. Place backfill below the GSF meeting Section 804.2.2 of the Maine Rules at the required depth followed by a 6" layer of Specified Sand.

1.7 VERTICAL SEPARATION: Maine rules require 12", 18" or 24" from disposal bed bottom to Most Limiting Factor (MLF) depending on Design Class and depth to ledge. Eljen's conservative design specifies a receiving sand bed layer (level to within ½ inch) directly beneath the GSF assembly as shown in Figure 4. The bottom of the disposal area is the bottom of the GSF unit. The Vertical Separation from bottom of the GSF units to the MLF shall not be less than 18". GSF's low profiles results in a system finished grade comparable to or lower than conventional disposal fields.

1.8 SPECIFIED SAND SPECIFICATION FOR TRENCH AND BED SYSTEMS: To ensure proper system operation, the system must be installed using a medium to coarse sand with an effective size of 0.25 to 2.0 mm, no greater than 5% a #200 sieve, and no particles larger than .375"; or materials meeting the ASTM C33 specification with less than 10% passing a #100 sieve and less than 5% passing a #200 sieve. Washed concrete sand easily meets the above specification and is a reliable choice. Suitability of bank run sand must be verified. Page 4 has a chart outlining the sieve requirements for the ASTM C33 sand specification.

1.9 BACKFILL MATERIAL FOR RAISED SYSTEMS: Backfill material (placed underneath the disposal area) for raised systems shall meet the requirement of Section 804.2.2 of the Maine Rules. Fill must be consolidated (stabilized) in lifts to prevent differential settling. A hand tamper is an appropriate choice.

1.10 PLACEMENT OF GSF MODULES: The "White Stripe" on the GSF modules indicates the top of the module and is not intended to indicate the location of the distribution pipe. With the white stripe facing up, all rows of GSF modules are set level, end to end (meaning along their 4' length) on top of a 6" base of compacted Specified Sand. 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 15% to 20% slope. Trenches required 9” of Specified Sand at both end and along the sides of the modules. No mechanical connection is required between modules. In a Bed system, non-perforated pipe may be connected at the end of each perforated distribution lateral thereby creating a looped distribution system as shown in Figure 7.

1.11 DISTRIBUTION PIPE LAYOUT: Ensure all modules have the “white stripe” showing. A perforated 4” diameter pipe is centered on top of the GSF modules and continues along the entire length of all modules in a trench or row. Holes are set at the 5 and 7 o’clock position and secured by the Eljen provided wire clamps. Piping shall meet the requirements of Section 1402.0 of the Maine Rules, however, Eljen strongly recommends the use of SDR 35 pipe and fittings as to assure against crushing during backfill. Systems with excessive wheel loading require Schedule 40.

1.12 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 to 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.

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

1.14 FILL MATERIAL & FINISH GRADING: Place a minimum of 12” of fill material meeting Maine Rules Section 804.2.5 over the GSF system. The 12” height is measured from the top of the GSF modules to finished grade. Fill material must be free of large rocks that would damage distribution pipes, cover fabric or GSF modules. All other required fill shall meet the requirements of Section 804.2 of the Maine Rules. Topsoil placed on top of the fill shall meet Section 804.2.6 and must be seeded and protected from erosion as described in Section 806.0 of the Maine Rules. Grading of the system area during construction and upon completion must divert surface run off from buildings, parking areas and nearby sloped terrain away from the GSF. Grade or slightly mound the finished system to compensate for soil settling. A minimum of a 3% grade over the system will prevent water from ponding on top of the system. Systems with over 18” of cover material as measured from the top of the GSF modules require venting.

1.15 NUMBER OF GSF MODULES REQUIRED: Table 2, on page 22, indicates the minimum number of B43 GSF modules required for various Soil Sizing Groups for Residential and Commercial Systems taking into account BOD_5 and TSS levels. Tables 3 and 4 on page 32 should be used to determine the number of modules required on systems that have wastewater strengths that are different than typical residential wastewater.

1.16 ADDITIONAL FACTORS EFFECTING RESIDENTIAL SYSTEM SIZE: Homes with expected higher than normal water usage should have an increased septic tank capacity and/or multiple compartment tanks and larger than minimum effluent disposal areas. Factors for additional sizing considerations include, but are not limited to:

- Homes with oversized or Jacuzzi style tubs shall increase disposal field sizing by one bedroom in the appropriate field sizing group for every 90 to 125 gallons increment of capacity. For example, an oversized tub with a 200 gallon capacity shall be sized as 2 additional bedrooms of disposal field area in the appropriate field sizing group.
- Homes with known higher than normal occupancy shall increase disposal field sizing by ½ bedroom in the appropriate filed sizing group for each additional person. For example, a two bedroom home with six occupants should be sized as a three bedroom home in the appropriate filed sizing group.
- Homes on high-pressure town water. It is recommended that the homeowner install a water pressure regulator to reduce pressure to 45-50 psi or increase the size of the disposal field by 30%.

Designers should use discretion when there are multiple additional factors involved. Increase size in proportion to excess flow.

1.17 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.

1.18 GARBAGE DISPOSALS: In accordance with Maine Rules Section 913.1, Eljen discourages the use of garbage disposals with septic systems. If a GSF system is to be designed and installed with garbage disposals the following measures must be taken to prevent solids from leaving the tank and entering the GSF system:

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

Eljen strongly recommends the use of septic tank outlet effluent filters on all systems especially on those systems that have single compartment tanks, even if up-sized, and when the dwelling has a garbage disposal installed. Refer to Section 1.23 for more information on septic tank outlet filter.

1.19 WATER CONDITIONERS: Water conditioners can adversely affect septic tank treatment and add to the hydraulic load of the EDA. **Discharge residential conditioner backwash from these devices shall be into a separate alternative disposal system.**

1.20 SYSTEM VENTING: It is strongly recommended to vent all systems that are over 18" below finished grade and systems beneath any surface condition that would not allow for surface air exchange with the system such as patios. See Section 6.0 for a more detailed explanation of venting GSF products.

1.21 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. If systems must be installed in trafficked areas, please contact Eljen's Maine distributor for installation guidelines.

1.22 SEPTIC TANKS: Many designers are now specifying dual compartment tanks for all their systems. Eljen supports this practice as it helps to promote long system life by reducing TSS and BOD to the effluent disposal area. Gas baffles and/or effluent filters are also recommended. Single upright cylindrical tanks allowed under Section 903.5 of the Maine Rules are prohibited with the GSF system.

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

2.0 Raised and Backfill Systems

Backfill material used below and adjacent to the Specified Sand in raised systems must conform to Section 804.2.2 Backfill Standards of the Maine Rules. In-ground systems that require additional backfill shall be covered with the backfill material meeting the requirements of Section 804.2.5 and graded smoothly into the topography on all sides as specified in Section 804.3 of the Maine Rules.

Partially raised system with extended backfill shall meet the requirements of Section 804.4 of the Maine Rules. On sloping sites with over 15% slope shall have minimum spacing of 24" between module rows and shall be serially or sequentially loaded to ensure equal loading across the entire contour. Longer thinner fill systems are best on sloping site using fewer lines of modules.

3.0 Systems for Level Sites

3.1 SYSTEM CONFIGURATIONS: Design level in-ground or raised systems with 12" minimum spacing between module rows. The sand bed, GSF modules and distribution pipes are installed level at their design elevations. To ensure continuity of flow to all lines the distal end of all beds are connected with non-perforated pipe. Perforated pipe is only used directly above the modules.

3.2 Sequential Loading: Centrally located distribution boxes fitted with speed levelers or dial-a-flows allow sequencing the loading of STE onto the rows of GSF modules. Setting the outlet dial at 6:00 loads one row first while setting the dial at 12:00 reserves the modules for peak flows. If a three line system is installed, set the left side at 6:00, the center at 12:00 and the right at 9:00. This setup forces a clockwise loading of the bed. Years later when the distribution box is inspected, the number of lines in use can be determined and the outside lines reversed thus allowing the more heavily loaded line to rest. Note the looped distal end of the distribution lines allows overflow to the back end of other lines when the first line is fully utilized.

4.0 Systems for Sloped Sites

4.1 DESIGN FLOW: Gravity or dosed GSF systems on sloped sites shall be serially loaded. A distribution box can be used in conjunction with serially loaded lines if the distribution box is dosed with larger flows such as for homes over 5 bedrooms. Larger access to the distribution box is essential to managing the operation of the system.

4.2 ROW SPACING: Minimum spacing between adjacent module rows is 12" for sites with 0 to 15% slope. Sites with 15% to 20% slope require 24" minimum spacing between adjacent module rows. No system shall be installed on sites with slopes greater than 20% as described in Section 400.8 of the Maine Rules.

4.3 DISTRIBUTION PIPING: There are two commonly used designs on sloping sites where GSF module rows are laid on a contour receive effluent.

Option One uses a series of "Overflow Pipes" where a perforated distribution pipe that is fed from a distribution box is laid lengthwise and centered over the GSF modules on the upper most trench/row and cap the end of this pipe. A second perforated pipe "overflow pipe" is placed alongside the previously laid distribution pipe. This pipe must have a minimum length of 10' or 50% the length of the trench/row. The perforated overflow pipe is capped at the end closest to the distribution box and runs to the distal end of the trench/row. Place a 90 degree fitting onto the end of the over-flow pipe. On the next lower trench/row, another distribution pipe is installed lengthwise and centered over the GSF modules with a 90 degree fitting placed at the end of the pipe. The opposite end of the pipe is capped. The distribution pipe is then plumed to the 90 degree fitting on the over-flow pipe on the upper trench using a section of non-perforated pipe. This (back and forth) process continues along the slope. The last trench/row does not require an over-flow pipe. However, the distribution pipe must be capped at the distal (far) end. Refer to Figure 13 for example system diagrams.

Option Two uses drop boxes at the head of each line as shown in Figure 12. Standard drop boxes are available with preset pipe elevations to overflow to successive drop boxes and rows of modules. Dial-a-Flows may be used to adjust overflow elevations to the next line if standard boxes are not available or for custom engineered designs. Both designs fully utilize and linear loading of the upslope rows of modules prior to overflow to the next lowest row of modules.

4.4 COVER REQUIREMENTS: On sloped systems, a minimum of 8" of clean fill meeting the requirements of Section 804.2.5 and top soil in Section 804.2.6 of the Maine Rules. Final grading and soil stabilization of the system shall be in accordance with Section 806.0 of the Maine Rules.

5.0 Pumped Systems

5.1 PUMP DISTRIBUTION BOX: Please specify an oversized distribution box for pumped systems. Provide velocity reduction in the distribution box with an elbow on the inlet pipe that directs effluent to the base of the box or a distribution box with a baffle is sufficient. A valve on the force main, normally located in the dosing tank is recommended to adjust the flow rate into the distribution box. Set distribution box invert 2" higher than invert of perforated pipe over GSF modules. Dial-a-Flow fittings may be used with a pumped system should the Designer decided to direct effluent to one or more trenches first. For example, in a Sloped pump system, the effluent must load the upper trench first and will require Dial-a-Flow fittings. A three row level gravity system would not require Dial-a-Flow fittings unless directed in the Designers plans. While not required by Maine Rules, Eljen requires venting on all pumped systems with greater than 18 inches of cover as measured from the top of the module to aid in oxygen transfer within the system. A separate 2" minimum pipe is required from the distribution box back to the riser in the septic or pump tank. This insures that fresh air can flow from the back end of the GSF into the home vent stack, overcoming the barrier created by the dosing pump. If any of the distribution lines are taken out of service to rest a portion of the system, they should be fitted with an elbow directed to the top of the distribution box to allow air exchange without receiving effluent.

5.2 DOSING DESIGN and Flow Rate: Set the floats or pump time controls to deliver 4 gallons per B43 module for each dosing cycle. Additional volume for the effluent draining back to the dose tank must be added to this volume.

Dose Volume = number of modules x 4 gallons per module + force main volume

For example, if the system uses 24 modules, set the dose volume at 96 gallons plus the volume of effluent in the force main. Pipe volume per foot is provided in Table 1407.8 of the Maine Rules. A 2" pipe stores 0.163 gallons per foot. Using 10 feet of 2" pipe, the pipe storage volume is 1.63 gallons. This is added to the 96 gallons module dose volume for a sum total of 97.63 gallons per dosing cycle.

To set the flow rate into the distribution box, close the valve on the force main, turn on the pump and slowly open the valve until the effluent level in the distribution box is at the crown of the discharge pipes. The flow rate will need to be adjusted whenever the number of outlets is changed. If changes in effluent distribution are anticipated, easy access to distribution box is essential.

5.3 PRESSURE DISTRIBUTION: Dosing with small diameter pressurized laterals is acceptable for GSF systems. The pipe networks must be engineered and follow principles established for pressure distribution. Using pipe-in-pipe networks as shown in Figure 17, the orifice size and spacing of 3/16 inch and 4 feet is respectively recommended. On sloping sites the orifices should be offset by 2 feet on each line. For example, the orifice on line one may be at 1 ft, 5 ft, 9 ft etc. with the next line at 3 ft, 7 ft, 11 ft etc. 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.

6.0 System Venting

6.1 System Venting: Air vents are required on all absorption systems located under impervious surfaces or systems with more than 18” 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 bed has aeration channels between the rows of filter modules connecting to larger downward open cuspations within the GSF modules. Under normal operating conditions, only a fraction of the filter is in use. The unused channels remain open for intermittent peak flows and the transfer of air. The extension of the distribution pipe to the vent provides adequate delivery of air into the GSF system, as shown in Figures 14 and 15.

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 air flow and fully aerate the GSF system, it is important that air vents are located only on the distal (far) end of the GSF pipe network. If a pressure dosed system is specified, an additional 2” air line must be extended from the distribution box back to the septic tank or the riser on the pump tank is required as shown in Figure 16. This maintains the continuity of air flow from the field into the house plumbing.

In the gravity fed GSF system, the vent is usually a 4” diameter pipe extended to a convenient location behind shrubs. Corrugated pipe can be used with the placement and grade such that any condensation that may accumulate in the pipe does not fill and thus close off this line. If the vent is extended, the pipe must not drain effluent and must have an invert higher than the system.

7.0 Required Notes on Design Plans

1. This system (is / is not) designed for the use of a garbage disposal.
2. This system is not designed for backwash from a water softener.
3. On raised systems, the organic loam layer must be removed from trench or bed and slope extension areas prior to fill placement. A bucket with teeth is best used for this construction step as buckets without teeth can compact and smear the underlying soil.
4. Scarify subsoil prior to fill placement.
5. Backfill material shall meet Section 804.2 of the Maine Rules. All backfill material shall be clean bank run sand, free of topsoil or humus and dredging directly beneath the EDA.
6. The 6” underneath and 9” surrounding the GSF modules shall be installed using a medium to coarse washed sand with an effective size of 0.25 to 2.0 mm, no greater than 10% passing a #100 sieve and no greater than 5% passing a #200 sieve, and no particles larger than .375”, or materials meeting the ASTM C33 specification with less than 10% passing a #100 sieve and less than 5% passing a #200 sieve. Washed concrete sand easily meets the above specification and is a reliable choice. Suitability of bank run sand must be verified.
7. Fill (cover material) and Backfill material (fill added below and around the GSF Specified Sand envelope) shall be bank run sand with less than 4 to 8% passing a #200 sieve and clay less than 2% and no stones larger than 3” in any dimension to a minimum depth of 12” over the GSF modules with the last 4” to 6” of cover being clean loam.
8. Any system which is more than 18” below finish grade as measured from the top of the modules shall be vented.
9. This design complies with and must be installed in accordance with the Eljen Design and Installation Manual.

8.0 Inspection of GSF Systems

Potential problem areas to check if a system is not working properly.

8.1 SEPTIC TANK

- Clogged outlet filter.
- No outlet baffle or tee.
- Infiltration of ground water or surface water.
- Solids exceed 1/3 of the tank volume and the tank needs to be pumped.
- Line to distribution box is blocked or broken and needs replacement.
- Cracked or leaking septic tank.
- Line to septic tank is clogged or is not at the required grade and may need to be replaced.

8.2 PUMP SYSTEMS

- Incorrect float settings or pump selection.
- Wiring or electrical problems.
- Infiltration of ground water or surface water into pump chamber.
- No vent installed on disposal area.
- Force main to distribution box is blocked or leaking.

8.3 EFFLUENT DISPOSAL AREA

- Excessive backfill over system (More than 18” requires venting).
- Crushed distribution pipe(s).
- Distribution pipes are not level.
- Use of material that does not meet the Specified Sand requirement as specified in this manual.
- Use of fill material over the system that does not meet Section 804.2.5 of the Maine Rules.
- Use of fill material underneath the system that does not meet Section 804.2.2 of the Maine Rules.
- Organic loam layer in raised systems was not removed during construction.
- System size is too small for actual use (Excessive water usage or bedrooms).
- Inaccurate site evaluation.
- Stormwater draining from upslope into the system or affecting groundwater mounding.
- Surface drainage not pitched away from the system.

Trench and In-Ground Bed System Installation Instructions

1. Carefully lay out the system components and define setbacks from wells, property boundaries and land forms such as streams and drainage ways as specified in Table 700.2 for first time systems (new construction), Table 700.3 for replacement or repair systems, and Table 700.4 for systems located in the shoreland zone as specified in the Maine Rules. Define the location and elevation of the trench and work upstream to define the elevation of the distribution box and septic tank outlet required to maintain flow to each component.

2. Prepare the site according to the Maine Rules. Do not install a system on saturated ground or wet soils that are smeared during excavation. Keep heavy machinery off clayey soils used for the GSF system as well as down-slope from the system where soil structure is critical for absorption and drainage of the treated effluent.

3. Plan the diversion of upslope stormwater. Set soil grades at 3% minimum to ensure that stormwater drainage is diverted away from the EDA once the system is complete.

4. Excavate the trench or bed. Scarify the receiving layer to maximize the interface between the native soil and Specified Sand (See Glossary of Terms).

5. Minimize walking in the trench or bed prior to placement of the Specified Sand to avoid soil compaction.

6. Place Specified Sand directly below the area for the GSF modules to a compacted height of 6” minimum.

7. A hand tamper is sufficient to stabilize the sand below the GSF modules. Set the elevation of the top of the Specified Sand and check to make sure it is level using a 2 x 4 and carpenter’s level or a laser level before placing the GSF modules.

8. Place GSF modules with PAINTED STRIPE FACING UP, end to end on top of the Specified Sand.

9. Provide distribution box(s) or drop-boxes depending if the site is level or sloped.

10. Use 4” non-perforated pipe (Refer to Section 1.11 in this manual for piping requirements) from the distribution box to the perforated pipe that is installed above the GSF modules. Note: perforated pipe is only used above the modules.

11. Center 4” perforated distribution pipe (Refer to Section 1.11 in this manual for piping requirements) lengthwise over modules with orifices at 5:00 and 7:00. Connect mid points on level bed systems with non-perforated pipe on module rows over 40’ long as shown in Figure 9.

12. Secure pipe to GSF modules using one Eljen wire clamp per module. Push clamp ends straight down into up-facing core, through the fabric and into the underlying sand.

13. Spread Eljen cover fabric lengthwise over the pipe and drape over the sides of the GSF module rows. Secure the fabric by placing several shovels of Specified Sand on top of the modules, between and along the sides of the modules. Avoid blocking holes in perforated pipe by placing the cover fabric over the pipe prior to placing fill over the modules.

14. Place 9” minimum of Specified Sand along the outside perimeter of the modules and at the ends of each module row. Minimum separation of module rows in a bed configuration shall be 12”.

15. Cover the rows of geotextile modules with fill meeting 804.2.5 and 804.2.6 of the Maine Rules to a minimum of 12” over the GSF modules. Backfill exceeding 18” requires venting at the distal (far) end of the trench. Do not use wheeled equipment over the system. A light track machine may be used with caution, avoiding crushing or shifting of pipe assembly. Backfill in direction of perforated pipe.

16. Final grading of the site shall be in accordance with Section 806.0 of the Main Rules. Set grade of system and upslope area to divert stormwater runoff. Finish grade over the GSF system shall be at a 3% minimum to prevent surface ponding. Fill material surface shall be stabilized by seeding or sodding to establish a good vegetative cover to prevent erosion.

Raised or Fill System Installation Instructions

1. Carefully lay out the system components and define setbacks from wells, property boundaries and land forms such as streams and drainage ways as specified in Table 700.2 for first time systems (new construction), Table 700.3 for replacement or repair systems, and Table 700.4 for systems located in the shoreland zone as specified in the Maine Rules. Define the location and elevation of the trench and work upstream to define the elevation of the distribution box and septic tank outlet required to maintain flow to each component.

2. Plan all diversion of Stormwater above and upslope up-slope from the system. Set soil grades to ensure that stormwater is diverted away from the absorption area once the system is complete.

3. Excavate the area by remove the organic loam layer from trench or bed and slope extension areas to the proper design elevations prior to fill placement. A bucket with teeth is best used for this construction step as buckets without teeth can compact and smear the underlying soil. Do not install a system on saturated ground or wet soils that are smeared during excavation. Keep heavy machinery off clayey soils below and down slope from the GSF system where soil structure and permeability is critical for absorption and drainage of the treated effluent.

4. Scarify the receiving layer to maximize the interface between the native soil and Specified Sand (See Glossary of Terms).

5. Minimize walking in the scarified or plowed area prior to placement of the specified fill material to avoid soil compaction.

6. Place backfill material meeting Section 804.2.2 of the Maine Rules. Level and set the elevation of this backfill extending the toes (sides and ends) as required meeting final grade requirements. On sloping sites the toe is extended to ensure transfer of effluent into the native soil.

7. Place Specified Sand directly below the area for the GSF modules to a compacted height of 6” minimum.

8. A hand tamper is sufficient to stabilize the sand below the GSF modules. Set the elevation of the top of the Specified Sand and check to make sure it is level using a 2 x 4 and carpenter’s level or a laser level before placing the GSF modules.

9. Place GSF modules with PAINTED STRIPE FACING UP, end-to-end on top of the Specified Sand.

10. Provide distribution box(s) if the site is designed level. Drop boxes can be used on sloped designs for sequential loading.

11. Use 4” non-perforated pipe (Refer to Section 1.11 in this manual for piping requirements) from the distribution box to the perforated pipe that is installed above the GSF modules. Note: perforated pipe is only used above the modules.

12. Center 4” perforated distribution pipe (Refer to Section 1.11 in this manual for piping requirements) or equivalent lengthwise over modules with orifices at 5:00 and 7:00. Connect mid points on level bed systems with non-perforated pipe on module rows over 40’ long as shown in Figure 9.

13. Secure pipe to GSF modules using one Eljen wire clamp per module. Push clamp ends straight down into up-facing core, through the fabric and into the underlying sand.

14. Spread Eljen cover fabric lengthwise over the pipe and drape over the sides of the GSF module rows. Secure the fabric by placing several shovels of Specified Sand on top of the modules, between and along the sides of the modules. Avoid blocking holes in perforated pipe by placing the cover fabric over the pipe prior to placing fill over the modules.

15. Place 9” minimum of Specified Sand along the outside perimeter of the modules and at the ends of each module row. Minimum separation of module rows in a Bed configuration shall be 12”.

16. Cover the rows of geotextile modules with fill meeting 804.2.5 and 804.2.6 of the Maine Rules to a minimum of 12” over the GSF modules. Backfill exceeding 18” requires venting at the distal (far) end of the trench. Do not use wheeled equipment over the system. A light track machine may be used with caution, avoiding crushing or shifting of pipe assembly. Backfill in direction of perforated pipe.

17. Final grading of the site shall be in accordance with Section 806.0 of the Main Rules. Set grade of system and upslope area to divert stormwater runoff. Finish grade over the GSF system shall be at a 3% minimum to prevent surface ponding. Fill material surface shall be stabilized by seeding or sodding to establish a good vegetative cover to prevent erosion.

Residential Serial Distribution Sloped System Installation Instructions

Note: There are two options for effluent dispersal on sloping sites. Listed below are the installation instructions utilizing the “Overflow” dispersal method which is commonly used for Residential type design flows. The “Drop-Box” method of effluent dispersal or sequential distribution systems is commonly used for Commercial type design flows. A combination of both methods can be used in beds on sloping sites where linear loading concerns requires more flexibility and adjustment of flow onto the rows of GSF modules. See Page 30 for information on Commercial Systems.

1. Carefully lay out the system components and define setbacks from wells, property boundaries and land forms such as streams and drainage ways as specified in Table 700.2 for first time systems (new construction), Table 700.3 for replacement or repair systems, and Table 700.4 for systems located in the shoreland zone as specified in the Maine Rules. Define the location and elevation of the trench and work upstream to define the elevation of the distribution box and septic tank outlet required to maintain flow to each component.

2. Prepare the site according to the Maine Rules. Do not install a system on saturated ground or wet soils that are smeared during excavation. Keep heavy machinery off clayey soils used for the GSF system as well as down-slope from the system where soil structure is critical for absorption and drainage of the treated effluent.

3. Plan the diversion of upslope stormwater. Set soil grades at 3% minimum to ensure that stormwater drainage is diverted away from the EDA once the system is complete.

4. Excavate the area by remove the organic loam layer from trench or bed and slope extension areas to the proper design elevations prior to fill placement. A bucket with teeth is best used for this construction step as buckets without teeth can compact and smear the underlying soil. Do not install a system on saturated ground or wet soils that are smeared during excavation. Keep heavy machinery off clayey soils below and down slope from the GSF system where soil structure and permeability is critical for absorption and drainage of the treated effluent.

5. Minimize walking in the excavated area prior to placement of the Specified Sand to avoid soil compaction and smearing.

6. Place Specified Sand directly below the area for the GSF modules to a compacted height of 6” minimum.

7. A hand tamper is sufficient to stabilize the sand below the GSF modules. Set the elevation of the top of the Specified Sand and check to make sure it is level using a 2 x 4 and carpenter’s level or a laser level before placing the GSF modules.

8. (Bed System), Minimum spacing between rows of GSF modules is 12” for sites when installed on slopes less than 15%. Slopes of 15% to 20% will have a minimum spacing of 24” of Specified Sand between GSF module rows.

9. (Trench System), The center to center spacing shall be a minimum of 7.5’ as measured from the center of the GSF B43 module rows (3’ feet of native soil between excavated trenches). 9” of Specified Sand is placed around the perimeter of all GSF module rows with native soil separating trenches.

10. Place GSF modules with PAINTED STRIPE FACING UP, end to end on top of the Specified Sand.

11. Distribution Pipe and Over-Flow Pipe Setup:

a. Upper Trench/Row , (refer to Figure 13)

Install a 4” perforated distribution pipe (Refer to Section 1.11 in this manual for piping requirements) lengthwise and centered over the GSF modules on the upper most trench/row with orifices at 5:00 and 7:00 and cap the end of this pipe. A second perforated “overflow pipe” with orifices also at 5:00 and 7:00 is placed alongside the previously laid distribution pipe at the distal end of the module row. This pipe must have a minimum length of 10’ or 50% of the length of the trench/row. The perforated overflow pipe is capped at the end closest to the distribution box and runs to the distal end of the trench/row.

b. Next Lower Trench/Row , (refer to Figure 13)

Install the 4” perforated distribution pipe lengthwise and centered over the GSF modules with orifices at 5:00 and 7:00 place a 90 degree fitting at the end of the pipe. The opposite end of the pipe is capped.

c. The distribution pipe is then plumed to the 90 degree fitting on the over-flow pipe on the upper trench using a section of non-perforated pipe. This (back and forth) process continues along the slope.

d. The last trench/row does not require an over-flow pipe. However, the distribution pipe must be capped at the distal (far) end.

12. Secure pipe to GSF modules using one Eljen wire clamp per module. Push clamp ends straight down into up-facing core, through the fabric and into the underlying sand.

13. Spread Eljen cover fabric lengthwise over the pipe and drape over the sides of the GSF module rows. Secure the fabric by placing several shovels of Specified Sand on top of the modules, between and along the sides of the modules. Avoid blocking holes in perforated pipe by placing the cover fabric over the pipe prior to placing fill over the modules.

14. Place 9” minimum of Specified Sand along the sides of the modules and at the ends of each module row.

15. Cover the rows of geotextile modules with fill meeting 804.2.5 and 804.2.6 of the Maine Rules to a minimum of 12” over the GSF modules. Backfill exceeding 18” requires venting at the distal (far) end of the trench. Do not use wheeled equipment over the system. A light track machine may be used with caution, avoiding crushing or shifting of pipe assembly. Backfill in direction of perforated pipe.

16. Final grading of the site shall be in accordance with Section 806.0 of the Main Rules. Set grade of system and upslope area to divert stormwater runoff. Finish grade over the GSF system shall be at a 3% minimum to prevent surface ponding. Fill material surface shall be stabilized by seeding or sodding to establish a good vegetative cover to prevent erosion.

Module Specification and Rating Table

Eljen Geotextile Sand Filter Module Specification and Rating Table			
	L x W x H	Configurations	
		Bed (B)	Trench (A)
B43 Module	48” x 36” x 7”	48 sqft/ module	48 sqft/ module
HB Module	24” x 36” x 7”	24 sqft/ module	24 sqft/ module
Transverse Module*	36” x 48” x 7”	48 sqft/module	48 sqft/ module

(A) 7.5’ center to center spacing for B43 Modules

(B) A minimum of 12” of spacing between rows of modules for system that have all the rows at the same elevation. Bed installations that have rows that step down slopes of 15% or less shall have a minimum spacing of 12” of Specified Sand between module rows. Step down bed installations from 16% to 20% shall have a minimum spacing of 24” of Specified Sand between module rows.

* Transverse modules are only used on sites with extreme constraints and are available by special order only.

TABLE 1

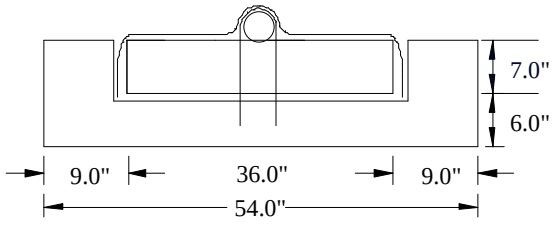


FIGURE 2

B43 MODULE
CROSS SECTION

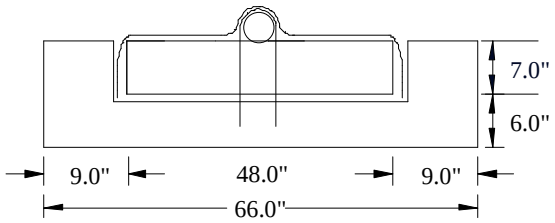


FIGURE 3

TRANSVERSE MODULE
CROSS SECTION

Sizing Table

Eljen Geotextile Sand Filter Sizing Table						
Field Sizing Group	2 Bedrooms Modules Per System	3 Bedrooms Modules Per System	4 Bedrooms Modules Per System	Additional Bedroom Modules Per Bedroom	Commercial BOD_5+TSS **Less** than 240 mg/L Modules Per 100 Gallons Design Flow	Commercial BOD_5+TSS **Greater** than 240 mg/L See Page 30
Medium	10	15	20	5	5.5	
Medium-Large	13	19	25	6.5	6.9	
Large	16	24	32	8	8.6	
Extra Large	19	29	38	9.5	10.5	

TABLE 2

- Round up fractional modules to the next whole number or utilize HB modules.
- Level bed designs should use equal number of modules per row unless site constraints require unequal rows.

Example 1- Residential System:

3 Bedrooms, Medium-Large Field Size Group
Requires 19 type B43 modules; Two rows, 19 / 2 = 9.5 modules per row, rounded up to 20 modules or use 9 (B43 modules) and 1 (HB module) for each row to create two equal rows of 9.5 modules each.

Example 2 - Residential System:

5 Bedrooms, Large Size Group
Requires 40 type B43 modules; choose 4 rows, 40 / 4 = 10 modules per row.

Example 3 - Commercial Systems when (BOD_5 + TSS) is less than 240 mg/l

2,500 GPD Design Flow, Commercial System, Small Field Size Group
Determine Total number of modules,
(Field Size Group Modules Per 100 Gallons Design Flow) x (Design Flow GPD) ÷ 100 = Number of Modules
(5.5 modules x 2500 GPD) ÷ 100 = 137.5 round up to 138 Modules

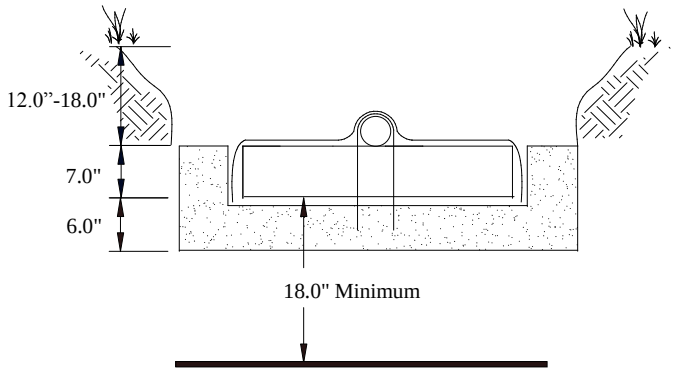


FIGURE 4

VERTICAL SEPARATION DISTANCE

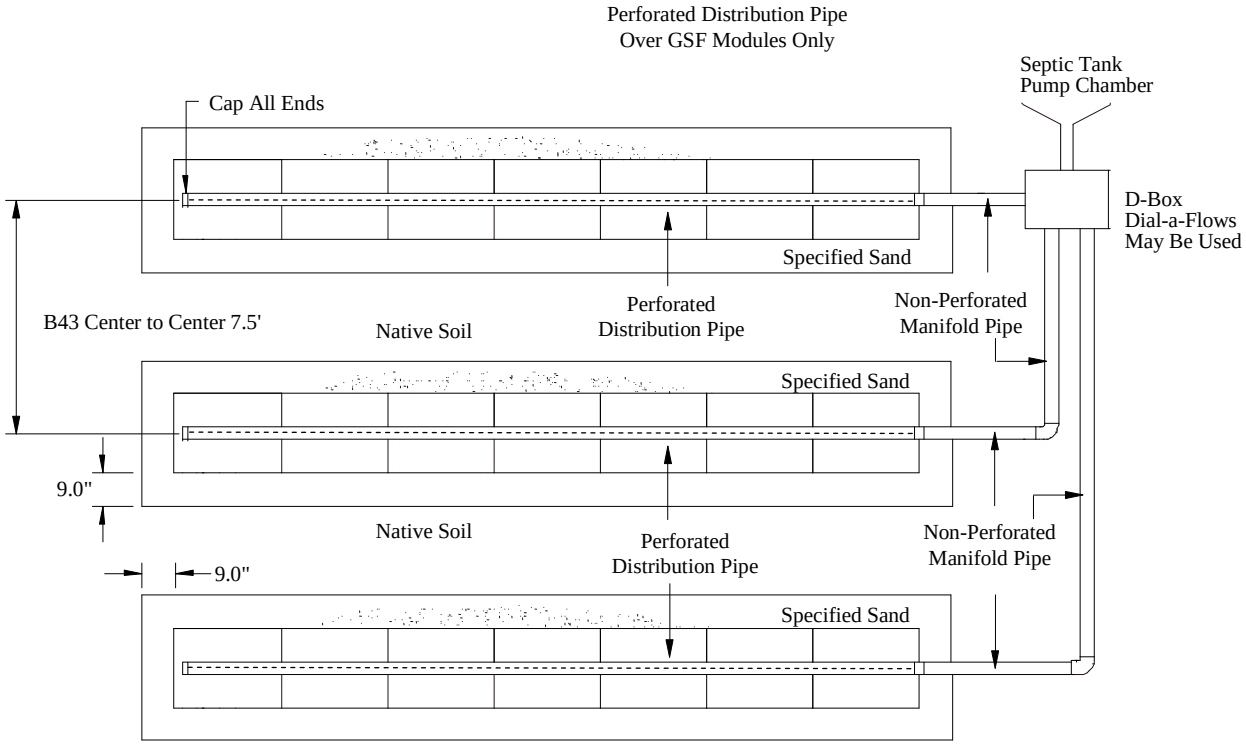


FIGURE 5

TRENCH CONFIGURATION LEVEL SITE – PLAN VIEW

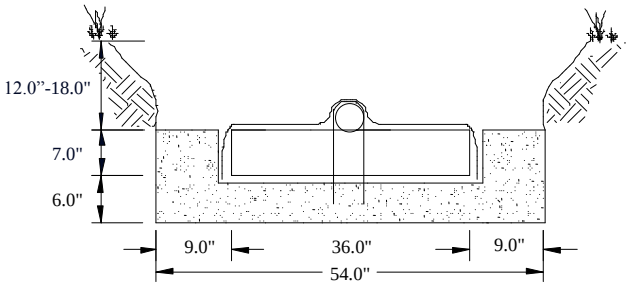


FIGURE 6

TRENCH CONFIGURATION LEVEL SITE – CROSS SECTION

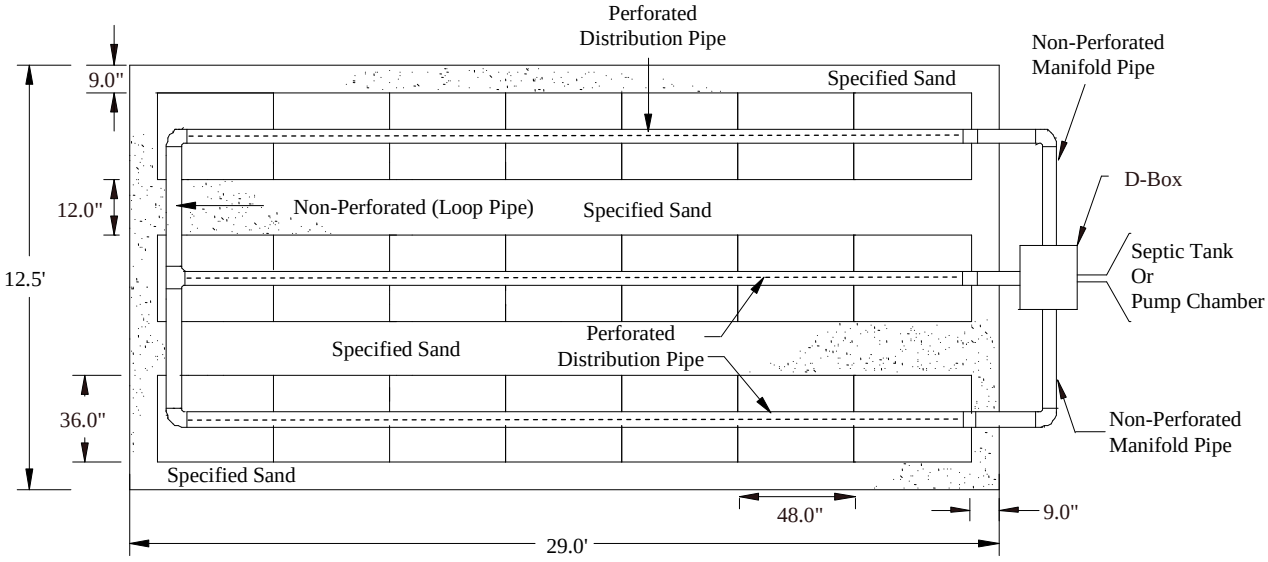


FIGURE 7

BED CONFIGURATION ON A LEVEL SITE – PLAN VIEW

GSF Bed configurations with non-perforated pipe connecting all rows, looped ends are not used in serial loaded bed systems.

System Drawings

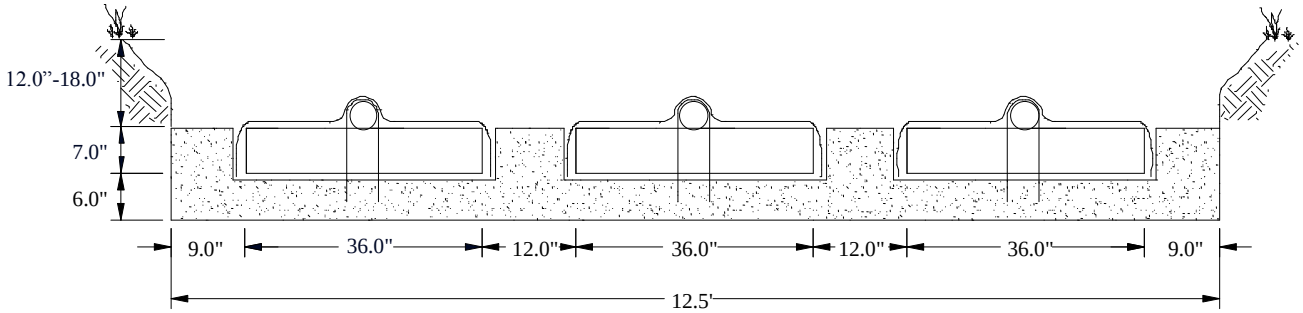


FIGURE 8

BED CONFIGURATION ON A LEVEL SITE – CROSS SECTION

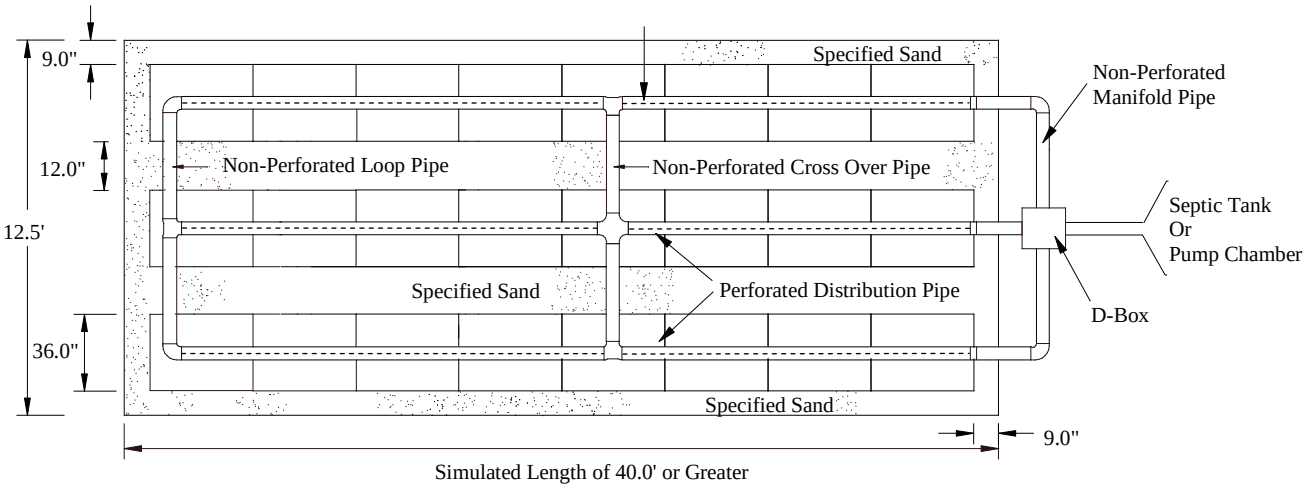


FIGURE 9

BED CONFIGURATION ON A LEVEL SITE – CROSS OVER PIPE AND LOOPED END PIPE

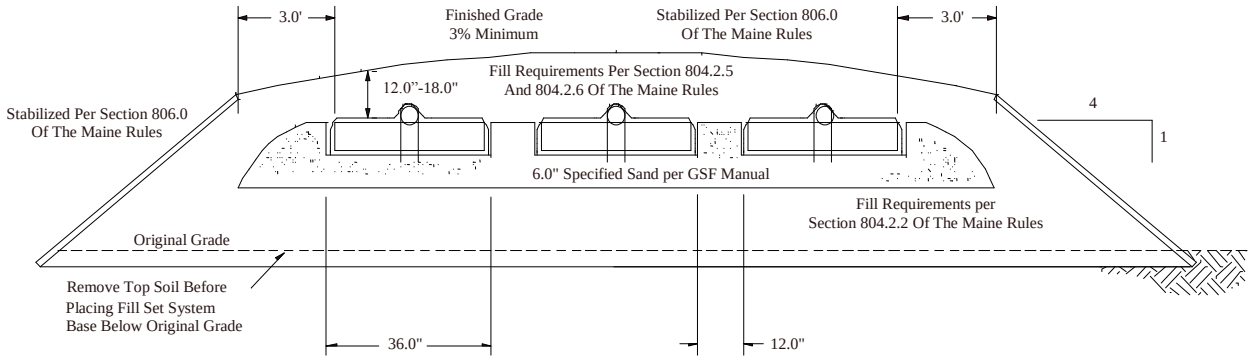


FIGURE 10

RAISED BED CONFIGURATION

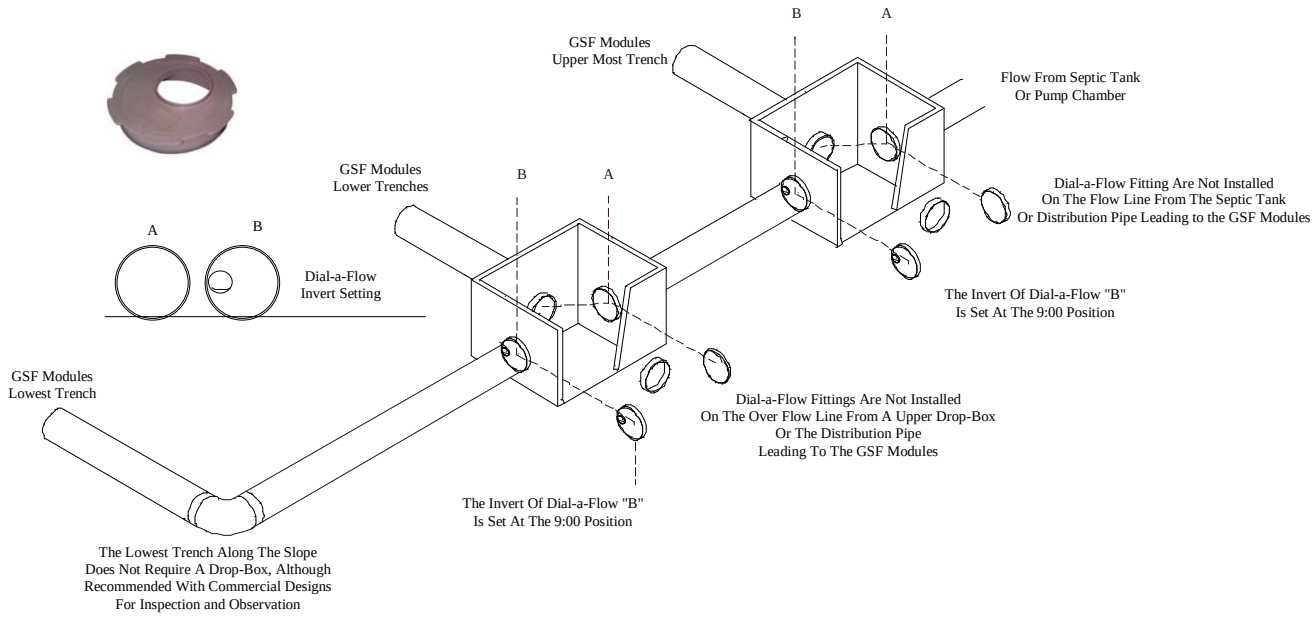
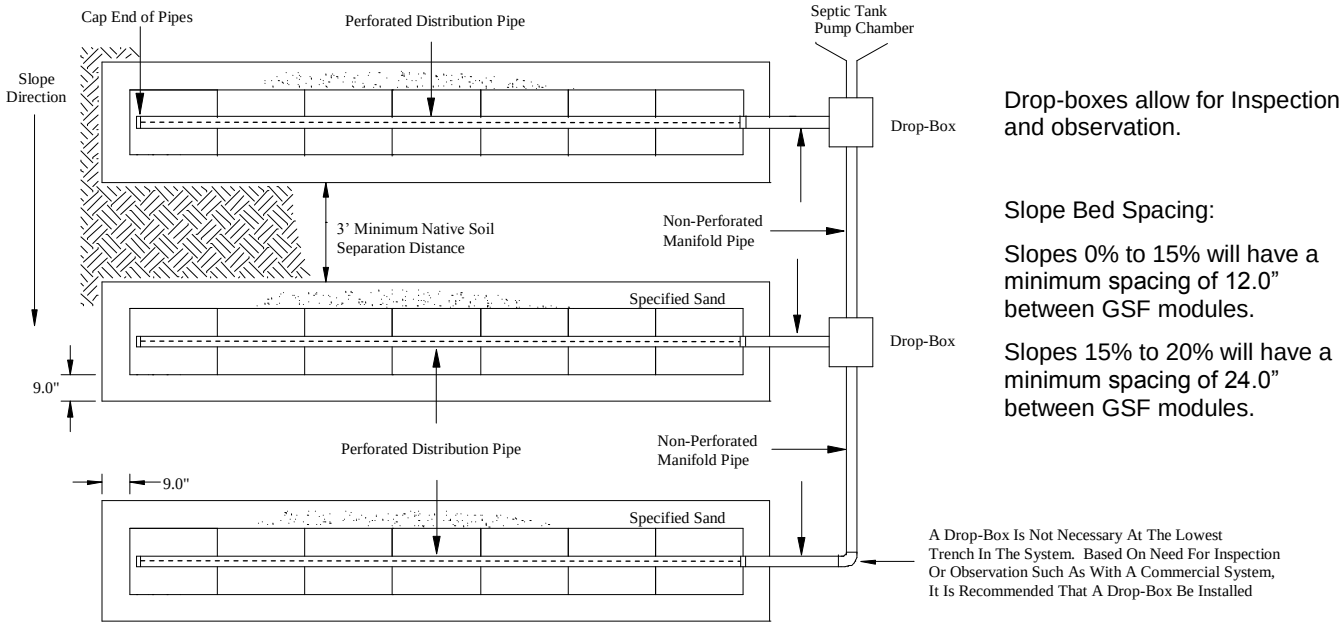


FIGURE 11

SERIAL DISTRIBUTION ON SLOPED SITES – DROP-BOX DETAIL
GENERAL APPLICATION WHEN TRENCHES ARE SEPARATED BY NATIVE SOILS



Drop-boxes allow for Inspection and observation.

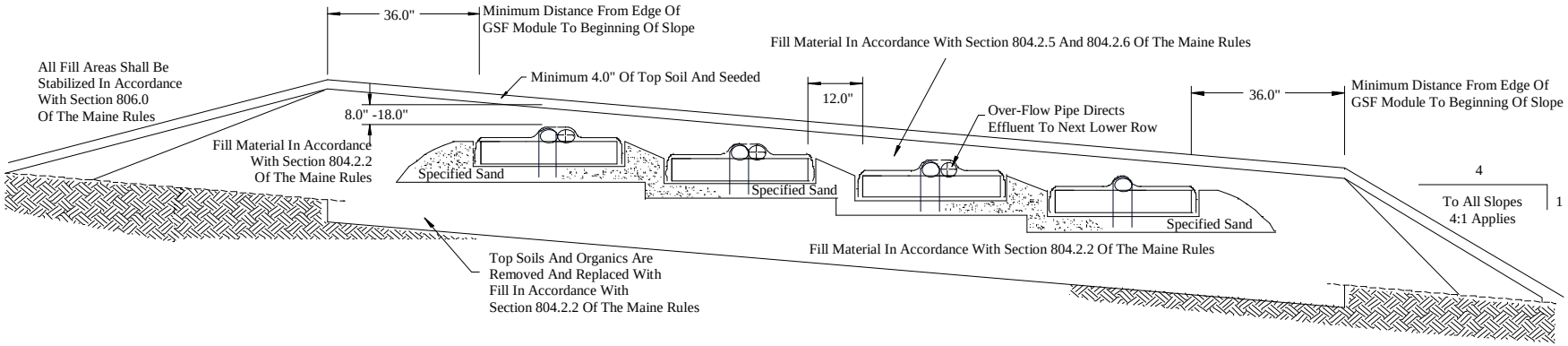
Slope Bed Spacing:

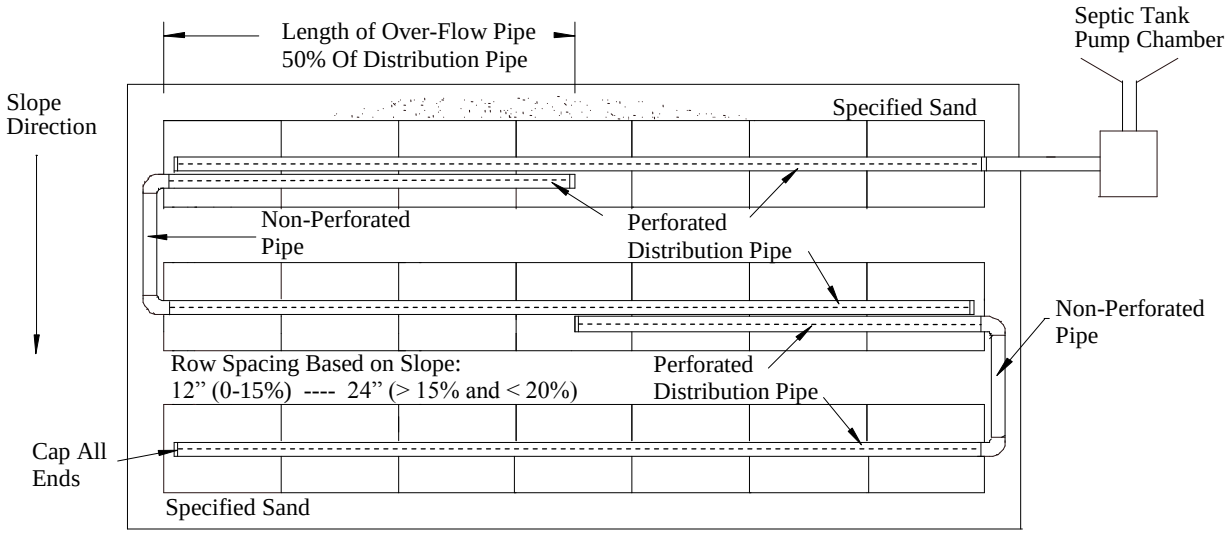
Slopes 0% to 15% will have a minimum spacing of 12.0" between GSF modules.

Slopes 15% to 20% will have a minimum spacing of 24.0" between GSF modules.

FIGURE 12
SERIAL DISTRIBUTION ON SLOPED SITE WITH DROP-BOX – PLAN VIEW

System Drawings

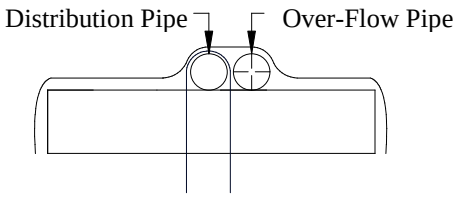




Slope Bed Spacing:

Slopes 0% to 15% will have a minimum spacing of 12.0" between GSF modules.

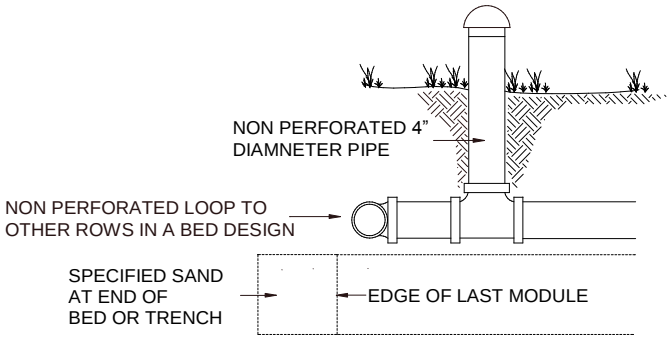
Slopes 15% to 20% will have a minimum spacing of 24.0" between GSF modules.



Orifices locations for Over-Flow Pipes and Distribution Pipes are positioned at 5:00 and 7:00 Perforated sections of the Over-Flow pipes and Distribution pipes are covered with Geotextile cover fabric.

FIGURE 13

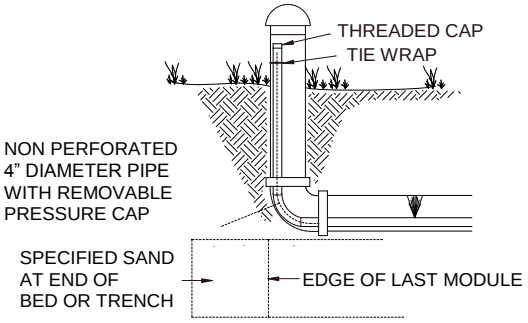
RESIDENTIAL SERIAL DISTRIBUTION SYSTEM WITH OVERFLOW PIPE



Gravity / Demand Dosed

FIGURE 14

VENTING FOR
LOOPED BED INSTALLATIONS
GRAVITY OR DEMAND DOSED
SYSTEMS



Pressure Dosed

FIGURE 15

VENTING FOR
BED OR TRENCH INSTALLATIONS
PRESSURE DOSED
SYSTEMS

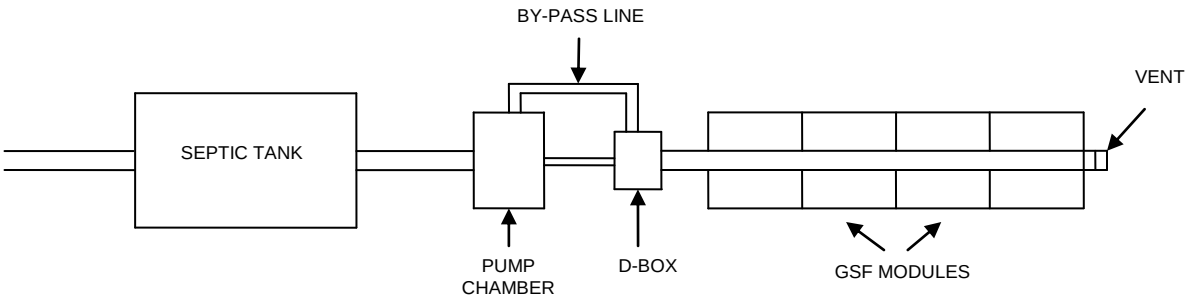


FIGURE 16
AIR BY-PASS LINE DETAIL FOR VENTING OF PUMPED SYSTEMS
NOTE: NEEDED FOR SYSTEMS WITH GREATER THAN 18 INCHES OF COVER.

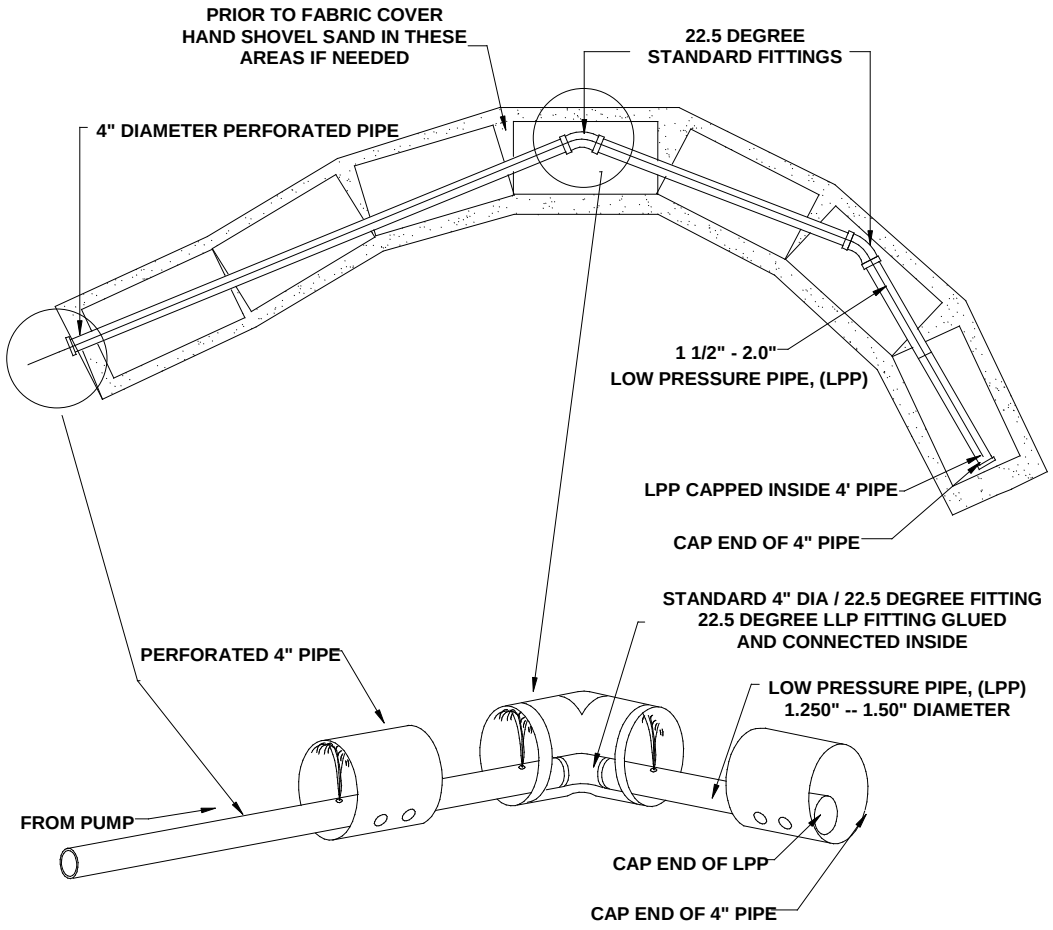


FIGURE 17

EXAMPLE PRESSURE DESIGN LAYOUT

Commercial Recommendations and Guidance

Commercial systems differ from residential systems relative to wastewater characteristics, effluent distribution strategies, peak flows, system size and geometry. As these systems are normally larger, the designer must also consider the collection systems and their integrity, groundwater hydrology, drainage above and below the GSF system and design accordingly.

Designers should carefully review and document with their client effluent BOD_5 and TSS concentrations and water use numbers. The designer should document that the system installation meets the technology supplier's specifications to ensure long term performance. In addition, designers must be attentive to special details of the system, conduct follow-through startup and document technical capabilities for personnel required for Operation and Maintenance of the system.

To determine design flow for commercial systems, with the exception that the highest measured single day flow in a 12 month period shall not result in a design flow less than the measured average flow with a peaking factor of 2 to 3 depending on the type of usage.

Dispersion of effluent across a bed system or down a row of modules in a serially loaded system must be specifically addressed in the design plans. A variety of wastewater delivery options exists and includes pressure distribution, pressure dosing, and gravity dispersed type systems. Wastewater volume and strength, systems size, and site conditions often dictate which type of system is designed. Designers should confer with the local permitting authority as many jurisdictions mandate pressure distribution or pressure dosing when daily wastewater flow exceeds certain levels.

Designers must also consider how the distribution of the effluent onto the GSF modules may affect the linear loading rates and allow for the means to adjust the linear loading should the soils fail to move the effluent as predicted. Longer systems are naturally preferred as this geometry reduces the linear loading and the risk of hydraulic overload with surfacing of treated effluent down slope in serial type systems.

Extremely large systems should be designed as several smaller systems allowing for independent management of the wastewater treatment system. Designs typically include valves to rotate zones into service with access to flow diversion boxes. Management plans are frequently implemented for monitoring the fluid levels and adjusting the effluent application onto the geotextile filter modules.

Larger flow groundwater recharge systems can be impacted by site drainage from above the GSF. The additional effluent can also increase the groundwater mound down slope. Recharge systems such as the GSF must be designed and located so that they can accept precipitation and the specified wastewater volume. Control and diversion of up-slope stormwater is normally included in the design. Understanding the stormwater flows onto and out of the system is essential to successful management of these systems.

Landscape position and slope impact the drainage because the gradient frequently changes with the slope of the land, especially if placed above a restrictive layer. The depth and permeability of each soil layer above the restrictive horizon impacts the groundwater mound. For example, upper horizons may be fairly permeable and accept precipitation easily. If these layers are above a more restrictive horizon, a perched water table will develop whenever it rains. Movement of this perched groundwater can influence the disposal system and if not recognized will result in surfacing effluent. Interception and diversion of the groundwater is therefore necessary with larger systems especially over restrictive soils to insure acceptance of the treated effluent under wet conditions.

Down slope hydraulic capacity is also an important consideration with larger systems. For example, a system may be located on a free draining slope but down slope conditions show a perched water table due to a reduced hydraulic gradient. Design limits and linear loading must be considered and these limits should be based on the limitations of these down slope soils and gradient. Ideally systems are located with diverging topography that reduces the linear loading and results in the effluent moving down slope.

It is recommended that all commercial systems, systems with high waste strength, and systems with more than 18” of cover material as measured from the top of the GSF modules to finished grade are vented. Designers that include vents in their designs often specify the use of Granular Activated Carbon or Charcoal (GAC) filters to ensure that septic odors do not become a nuisance. Designers should verify with the GAC filter manufacturer or supplier to ensure that the filter will allow air flow from both directions of the filter. Otherwise the filter will block airflow and the vent will not be effective in supplying enough oxygen that the system demands for long term performance.

System owners should educate occupants in the operation and maintenance of the system to help ensure long term system performance. The state or local permitting authority should provide for site specific items and require inspection and evaluation of an overall operating plan as commercial systems can produce flows in the thousands of gallons per day range. Designers should also provide oversight of system installation and associated system equipment.

Contact Eljen’s Technical Resource Department at 1-800-444-1359 for questions regarding Commercial Systems. Overall responsibility for system design remains with the licensed designer and/or professional engineer.

Adjustment Factor for Wastewater Strengths Different from Typical Domestic Wastewater

Disposal Field Sizing Factor (From Maine Rules Table 600.1)		
Multiply the hydraulic loading rate (square feet per gallon per day) times the design flow (gallons per day) this gives the minimum square feet of bottom and side wall area below the invert needed.		
Parent Material	Soil Profiles	Loading Rates
Basal Glacial Till	1	4.1 sqft/gpd Large
Ablation Till	2	3.3 sqft/gpd Medium-Large
Basal Glacial Till	3	3.3 sqft/gpd Medium-Large
Ablation Till	4	2.6 sqft/gpd Medium
Stratified Glacial Drift	5	2.6 sqft/gpd Medium
Stratified Glacial Drift	6	2.6 sqft/gpd Medium
Mixed Geological Origins	7	3.3 sqft/gpd Medium-Large
Lacustrine Deposits	8	4.1 sqft/gpd Large
Marine Deposits	9	5.0 sqft/gpd Extra Large

TABLE 3

Subsurface Wastewater Disposal System Commercial High-Strength Wastewater (From Maine Rules Table 603.1)	
Strength of Wastewater Entering the Disposal Field (BOD_5 plus TSS)	Adjustment Factor (AF) The Adjustment Factor for Wastewater Strength Entering the Disposal Field
30 or less milligrams/liter	0.5
52	0.6
82	0.7
122	0.8
175	0.9
240	1.0
320	1.1
420	1.2
530	1.3
660	1.4
810	1.5
985	1.6
1180	1.7
1400	1.8
1645	1.9
2000*	2.0

TABLE 4

* Subsurface wastewater disposal areas designed to handle wastes with a combined BOD_5 and TSS greater than 2,000 mg/l are beyond the scope of the Maine Rules and may require licensing by the Department of Environmental Protection as specified in Section 203.2 of the Maine Rules.

Commercial Sizing Procedure

Refer to Tables 3 and 4 for information to determine systems sizing based on Disposal Field Sizing and High-Strength Wastewater Adjustment Factors.

Commercial System Equation Table	
AF	Is the adjustment factor for wastewater strength entering the disposal field, taken from Maine Rules Table 603.1, if applicable.
HLR	Is the hydraulic loading rate, in square feet per gallon per day, for the applicable soil profile from Maine Rules Table 600.1.
AHLR = AF x HLR	Is the adjusted hydraulic loading rate.

TABLE 5

Procedure

- Identify the Hydraulic Loading Rate (HLR) from the Disposal Field Sizing Factor from Table 3.
- Identify the High-Strength Wastewater Adjustment Factor (AF) based on the sum of BOD_5 and TSS from Table 4.
- Multiply the Hydraulic Loading Rate (HLR) x High-Strength Wastewater Adjustment Factor (AF) to determine the value for the Adjusted Hydraulic Loading Rate (AHLR).
- The GSF B43 module is rated at 48 square feet per module.
- Obtain the value for the system Design Flow.
- Determine the amount of square feet of absorption area required for the system by multiplying the Design Flow (DF) x Adjusted Hydraulic Loading Rate (AHLR).
- Determine the number of GSF modules required for the system by dividing the absorption area required by the GSF module rating of 48 SF/Module. See the sizing examples listed below.

Examples: High-Strength Wastewater Designed Systems when BOD_5 + TSS Exceeds 240 mg/l

Example 1
B43 Module Rating = 48 SF/Module
Design Flow (DF) = 2500 GPD
Field Sizing Group = Medium
Hydraulic Loading Rate = 3.3 SF/GPD
Wastewater Adjustment Factor (AF) = 1.8
Adjusted Hydraulic Loading Rate (AHLR) = 3.3 x 1.8 = 5.94 SF/GPD
Determine Size of the System (DF x AHLR) = 2,500 x 5.94 = 14,850 SF
Determine Number of GSF Modules: 14,850 ÷ 48 = 310 GSF B43 Modules

Example 2
B43 Module Rating = 48 SF/Module
Design Flow (DF) = 2500 GPD
Field Sizing Group = Extra-Large
Hydraulic Loading Rate = 5.0 SF/GPD
Wastewater Adjustment Factor (AF) = 1.4
Adjusted Hydraulic Loading Rate (AHLR) = 5.0 x 1.4 = 7.0 SF/GPD
Determine Size of the System: (DF x AHLR) 2,500 x 7.0 = 17,500 SF
Determine Number of GSF Modules: 17,500 ÷ 48 = 364 GSF B43 Modules

Commercial Serial Distribution Sloped System Installation Instructions

1. Carefully lay out the system components and define setbacks from wells, property boundaries and land forms such as streams and drainage ways as specified in Table 700.2 for first time systems (new construction), Table 700.3 for replacement or repair systems, and Table 700.4 for systems located in the shoreland zone as specified in the Maine Rules. Define the location and elevation of the trench and work upstream to define the elevation of the distribution box and septic tank outlet required to maintain flow to each component.

2. Prepare the site according to the Maine Rules. Do not install a system on saturated ground or wet soils that are smeared during excavation. Keep heavy machinery off clayey soils used for the GSF system as well as down-slope from the system where soil structure is critical for absorption and drainage of the treated effluent.

3. Plan the diversion of upslope stormwater. Set soil grades at 3% minimum to ensure that stormwater drainage is diverted away from the EDA once the system is complete.

4. Excavate the trench or bed. Groove receiving layer by raking or contour plowing at a right angle to slope before placing the specified fill material or Specified Sand. Scarify the receiving layer to maximize the interface between the native soil and Specified Sand.

5. Minimize walking in the excavated area prior to placement of the specified fill material to avoid soil compaction and smearing.

6. Place fill material, if required, meeting Section 804.0 of the Maine Rules to the required design elevation compacting in lifts of 6” to prevent differential settling.

7. Place Specified Sand directly below the GSF modules to a compacted depth of 6” minimum.

8. A hand tamper is sufficient to stabilize the sand below the GSF modules. Set the elevation of the top of the Specified Sand and check to make sure it is level using a 2 x 4 and carpenter’s level or a laser level before placing the GSF modules.

9. Place GSF modules with PAINTED STRIPE FACING UP, end to end on top of the Specified Sand.

10. Septic tank effluent flows to a drop-box placed at the beginning of the upper most trenches. One pipe from this drop-box is plumed along the length of the upper row of GSF modules. The second pipe is an overflow pipe and is connected to the next lowest drop-box. Dial-a-Flow adapters are placed on this over flow pipe inside the drop-boxes. The invert of the Dial-a-Flow opening must be rotated so that it is above the invert height of the pipe loading the GSF modules. This procedure will ensure the upper trenches are utilized prior to flowing to the next down slope trench. This process is duplicated until reaching the lowest trench in the sloped system which does not require Dial-a-Flow adapters or an over flow pipe, but is strongly recommended and can be used as an observation port. Refer to Figure 18 for drop-box layout drawing.

11. Use 4” non-perforated pipe (Refer to Section 1.11 in this manual for piping requirements) or equivalent from the distribution boxes to the upper most drop-box.

12. Install a line of 4” perforated distribution pipe (Refer to Section 1.11 in this manual for piping requirements) lengthwise on the first row over the GSF modules with orifices at the 5:00 and 7:00 positions. Cap the pipe at the distal (far) end.

13. Secure the distribution pipe to the GSF modules using one Eljen wire clamp per module. Push clamp ends straight down into up-facing core, through the fabric and into the underlying sand.

14. Spread Eljen cover fabric lengthwise over the pipe and drape over the sides of the GSF module rows. Secure the fabric by placing several shovels of Specified Sand on top of the modules, between and along the sides of the modules. Avoid blocking holes in perforated pipe by placing the cover fabric over the pipe prior to placing fill over the modules.

15. Place 9” minimum of Specified Sand along the outside perimeter of the modules and at the ends of each module row. Minimum separation of GSF module rows in a bed configuration shall be 12” for sites when installed on slopes less than 15%. Slopes of 15% to 20% will have a minimum spacing of 24” of Specified Sand between GSF module rows.

16. Cover the rows of geotextile modules with fill meeting 804.2.5 and 804.2.6 of the Maine Rules to a minimum of 12” over the GSF modules. Backfill exceeding 18” requires venting at the distal (far) end of the trench. Do not use wheeled equipment over the system. A light track machine may be used with caution, avoiding crushing or shifting of pipe assembly. Backfill in direction of perforated pipe.

17. Final grading of the site shall be in accordance with Section 806.0 of the Main Rules. Set grade of system and upslope area to divert stormwater runoff. Finish grade over the GSF system shall be at a 3% minimum to prevent surface ponding. Fill material surface shall be stabilized by seeding or sodding to establish a good vegetative cover to prevent erosion.

System Drawings

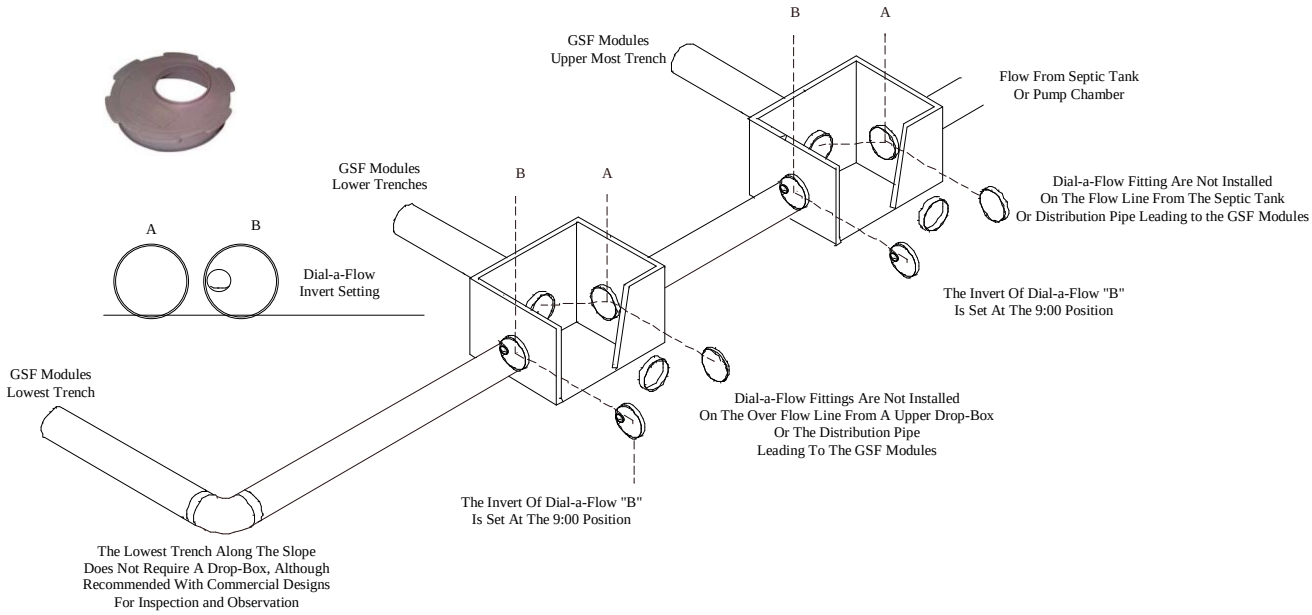


FIGURE 18

SERIAL DISTRIBUTION ON SLOPED SITES – DROP-BOX DETAIL