Geotextile Sand Filter

Clark County

Southern Nevada Health District

Design and Installation Manual

Revised August 2010

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Approval Letter

Southern Nevada Health District

September 4, 2008

Mr. Jack Bale
Seven Sigma Management, Ltd
4535 W. Sahara Ave, Suite 200
Las Vegas, NV 89102

Re: Product Review Approval for ELJEN A42 and B43 Geotextile Sand Filter

Dear Mr. Bale:

Please note that the ELJEN A42 and B43 Geotextile Sand Filter are hereby **approved** with the following conditions:

1. A 50% reduction in the soil absorption area of the conventional pipe and gravel leach field is approved for the subject products.
2. A maintenance provider is required for systems utilizing pumps, which includes but is not limited to: pump distribution box, pump dosing, and pressure distribution.
3. The design plans for permitting must be signed and sealed by a Nevada Registered Professional Engineer.
4. The septic tank sizing must be based on fixture units (FU) per Southern Nevada Health District Regulations in the Sizing Table.

The Southern Nevada Health District's approval for the conditional use of this product in Clark County is not to be construed as an endorsement of the product or any claims made on its behalf. Furthermore, the statements made in this letter may not be used for any commercial purpose.

If you have any questions, please contact Dan LaRubio at (702) 759-0660.

Sincerely,

ENVIRONMENTAL HEALTH DIVISION

A. Brown

Adrian E. Brown, E.I.
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Daniel LaRubio, Jr.

Daniel LaRubio, Jr. P.E., R.E.H.S
Environmental Health Engineer/Supervisor
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AEB/DPL:hh

cc: James Donlin, ELJEN Corp. Vice President of Manufacturing
Joe Pollock, Bureau of Health Protection Services

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Glossary of Terms

B43 Module (L x W x H) 36” x 48” x 7”

A42 Module (L x W x H) 24” x 48” x 7”

Biofabric Special filter fabric within the Geotextile Sand Filter Modules upon which the primary biomat layer forms.

Combination System Multiple serial distribution layouts generally fed with equally divided effluent flow from a special distribution box or other accurate dosing device.

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

Cuspated Core The rigid plastic core of the GSF module. It separates the geotextile fabric and creates downward infiltration channels and upward aeration channels to provide primary filtration and biological treatment of the septic effluent. The curvilinear shape of the cuspations offers increased treatment surface area and greater effluent storage.

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

Distribution Box (Or D-Box) A plastic or concrete box that receives effluent from a septic tank and splits the flow to pipes placed above the GSF modules. For equal distribution, the outlet pipe orifices are typically set at the same elevation to equalize the flow to each line. The distribution box method is only used when the receiving GSF modules are at the same elevation.

EDA Effluent Disposal Area.

EHGWT The Estimated High Ground Water Table is the elevation of saturated condition as measured or as estimated from evaluation of soil color.

Flow Dial Special insert placed in the end of distribution pipes at the distribution box to compensate for possible of level installation and direct effluent to each line in the system.

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

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

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

Serial or Sequential Distribution Designs common to sloping sites where GSF lines are laid on the contour, receiving effluent from a series of Drop-Boxes starting at upper trench/line and overflows effluent when required to down-slope trenches/lines.

SHWT Seasonal High Ground Water Table.

Specified Sand To ensure proper system operation, the system must be installed using ASTM C33 sand with less than 10% passing a #100 sieve and less than 5% passing a #200 sieve. Listed below is chart outlining the sieve requirements for the specified sand.

TABLE 2: SPECIFIED SAND SIEVE REQUIREMENTS

Sieve Size	Specification Percent Passing (Dry Sieve)
0.375"	100.0 -100.0
#4	95.0 - 100.0
#8	80.0 - 100.0
#16	50.0 - 85.0
#30	25.0 - 60.0
#50	10.0 - 30.0
#100	< 10.0
#200	< 5.0

STE Septic Tank Effluent (STE) is anaerobically digested effluent that is discharged to a Geotextile Sand Filter module for further treatment.

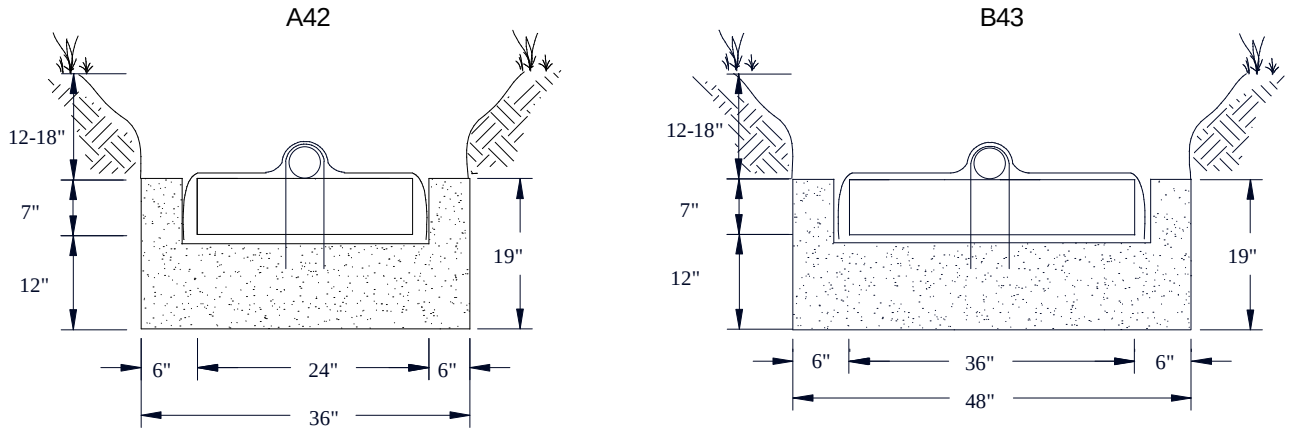
Width & Length The system width is the sand dimension perpendicular to the GSF module rows. The system length is measured parallel to the rows of GSF modules.

Wire Clamp Wire clamps used to secure perforated pipe above the GSF modules.

Introduction

This manual provides design and installation information for the Eljen GSF Geotextile Sand Filter system utilizing either the GSF - B43 or A42 modules.

FIGURE 1: GSF CROSS SECTIONS



Design layouts and installation instructions for sequential, equal or dosed distribution systems are included. Details on unique design and construction procedures are also provided. For design standards for specially engineered dosing systems or commercial systems, contact Eljen's Technical Resource Department at 1-800-444-1359. GSF systems must be designed and constructed according to this Design & Installation Manual and SNHD regulations.

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.

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

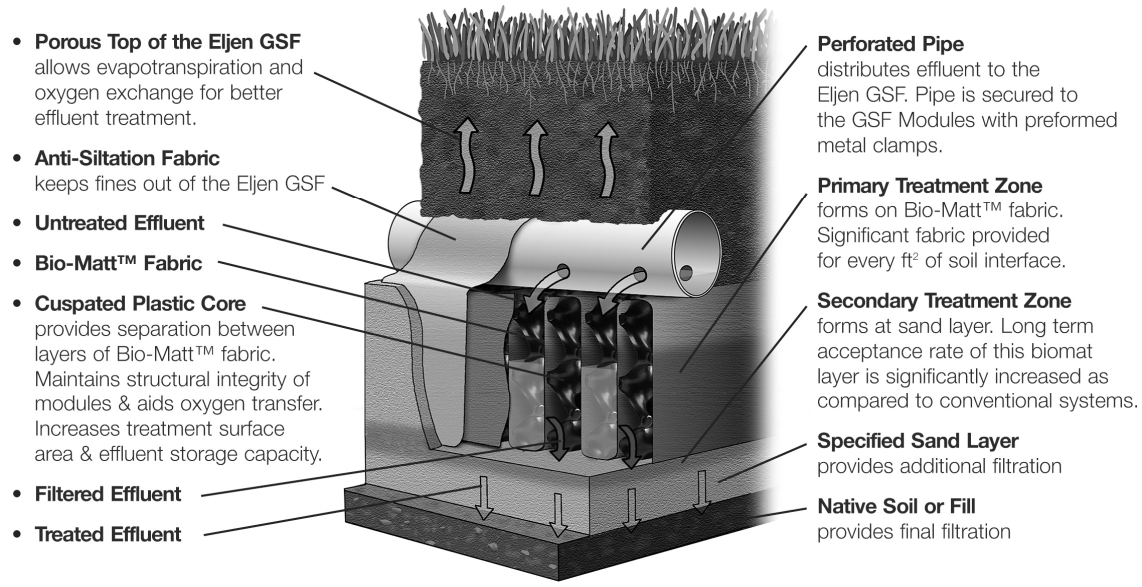
Primary Treatment Zone

- 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 2: GSF SYSTEM OPERATION



1.0 Basic System Design

1.1 TREATMENT FIELD SIZE: The sizing table (Table 1) applies for residential systems only. The number of GSF modules required is the same for trench or bed systems. A minimum of 12" separation is required between parallel rows of a GSF bed system to utilize sidewall infiltration area. Please contact Eljen's Technical Resource Department at 1-800-444-1359 for design information on commercial systems.

1.2 DEPTH TO GROUND WATER OR RESTRICTIVE LAYER: As required by SNHD rules; the bottom of the GSF system may be designed with a separation distance from the maximum seasonal elevation of the groundwater table of 2' on lots or parcels with a net area greater than 5 acres. On lots or parcels with a net area less than 5 acres, the separation distance between the bottom of the GSF system and the maximum seasonal elevation of the groundwater table of shall be 5'.

1.3 SPECIFIED SAND SPECIFICATION FOR TRENCH AND BED SYSTEMS: The first 12" of sand immediately under, between rows and around the perimeter of the GSF system must be an ASTM C33 WASHED CONCRETE SAND 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 page 5, (Table 2) of this manual for more information on the ASTM C33 sand and sieve specifications.

1.4 FILL FOR RAISED SYSTEMS: Fill material below the 12" sand specified in Section 1.3 for raised bed systems must be clean fill material in accordance with State of Nevada or SNHD requirements. Fill must be compacted in 6" lifts to prevent differential settling within the system.

1.5 PLACING GSF MODULES: Each row of modules are laid level, end to end on the above specified sand bed with a minimum spacing of 12" between parallel rows. No mechanical connection is required between modules.

1.6 DISTRIBUTION PIPE: SDR-35 or equivalent is required. Place SDR-35 perforated pipe on top of GSF modules with holes a 5 and 7 o'clock. Refer to section 2.0, for level and serial piping details respectively. Secure pipe to GSF modules with provided wire clamps, one wire clamp per Eljen module.

1.7 DISTRIBUTION BOX: Set gravity system D-box outlet invert a minimum of 1/8" or 1/2 " drop in elevation per linear foot to the top first module in the trench or bed. Set a 2.0" minimum drop for dosed systems from the D-box to the modules. The fill below the distribution box and pipes feeding the system must be compacted to prevent settling. Flow Dials may be used in either Gravity or Dosed installations.

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

1.9 BACKFILL & FINISH GRADING: Carefully place backfill over the modules, followed by loam to complete a total minimum depth of 12" as measured from the top of the module. Systems with total cover that exceeds 18" as measured from the top of the module shall be vented at the far end of the system. Backfill material shall be a well graded sandy fill; clean, porous, and devoid of rocks larger than 2", with a maximum of 10% passing a #200 sieve. Divert surface runoff from the Effluent Disposal Area, (EDA). Finish grade to prevent surface ponding. Seed loam to protect from erosion.

1.10 NUMBER OF GSF MODULES REQUIRED: Table 1, page 18, indicates the minimum number of A42 or B43 GSF modules required for various soil percolation rates for all systems. Residential systems use a minimum of 4 Type B units per bedroom, or 5 type A units per bedroom. Example trench and bed configuration drawings are located on pages 19-23 of this manual.

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

For example:

- Luxury homes, homes with a Jacuzzi style tubs, and other high use fixtures.
- Homes with known higher than normal occupancy.
- Homes with water conditioner backwash (Diversion from septic tank required).
- Homes on high-pressure city water: recommend that the homeowner install a water pressure regulator to reduce pressure to 45-50 psi.

1.12 GARBAGE DISPOSALS: Design drawings shall include a note "GARBAGE DISPOSALS SHALL NOT BE USED WITH THIS SYSTEM." If the property owner insists on installing a disposal, use a 2-compartment septic tank, increase tank volume by 25% which will provide a longer settling period for the increase of suspended solids that the garbage disposal will introduce into the system. Use an appropriate sized septic tank effluent filter.

1.13 WATER SOFTNERS/ CONDITIONERS: Water conditioners can adversely affect septic tank treatment and add to hydraulic load of the system. Discharge residential conditioner backwash from these devices shall be into a separate alternative disposal system of in accordance with State / County regulations.

1.14 SYSTEM VENTING: All systems require sufficient oxygen supply to the EDA to maintain proper long term effluent treatment. Therefore, the following situations require venting at the far end of the EDA:

- Any system with more than 18" of total cover as measured from the top of the module.
- Areas subject to compaction.

1.16 VEHICULAR TRAFFIC: All vehicular traffic is prohibited over the GSF system. This is due to the compaction of material required to support traffic loading which greatly diminishes absorption below the EDA; and the void space that naturally exists in soils for oxygen transfer on top of the EDA is reduced by compaction from vehicular traffic.

1.17 SEPTIC TANKS: Many designers are now specifying 2-compartment septic tanks, Eljen supports this practice. Effluent filters are required as a means of preventing solids from leaving the tank.

1.18 RISERS: It is strongly recommended that riser(s) be installed which will extend the septic tank lids to within 6" of the finished grade. This will provide easy access to the septic tank for periodic maintenance, such as pumping, inspection and filter maintenance.

2.0 Systems for Level Sites

2.1 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.

2.2 DISTRIBUTION PIPE LAYOUT: Perforated SDR-35 pipe or equivalent runs along the center of the modules. Ends are connected with non-perforated, (Figure: 6) pipe at the far end of the system. A non-perforated “cross-over” connection, (Figure: 7) for (Bed Configurations) if the length of the rows are over 40’ in length.

3.0 Systems for Sloped Sites

3.1 DESIGN FLOW: Serially dosed GSF systems may be used on sloped sites.

3.2 ROW SPACING: Systems with up to 6” elevation drop between adjacent rows use 12” minimum spacing. If over 6” drop, use 2 times the elevation drop as minimum spacing between module rows.

3.3 DISTRIBUTION BOX: Provide a D-box at the beginning of the first row of modules for effluent velocity reduction and a system inspection port. Lower rows will also require D-boxes with Flow Dials to insure effluent is loaded to the upslope trench before continuing to lower trenches within the system.

4.0 Pumped Systems

4.1 PUMP DISTRIBUTION BOX: Specify an oversized distribution box for pumped systems. Provide velocity reduction in the D-box with a tee or baffle. Set D-box invert 2” higher than invert of perforated pipe over GSF modules. The EDA must be vented if installed with greater than 18 inches of cover measured from the top of the module. See section 5.0 of this manual for detailed information on venting of GSF systems.

4.2 DOSING DESIGN CRITERIA: Use a maximum of 4 gallons per dose per B43 module in the system. When A42 modules are designed, use a maximum of 3 gallons per dose per A42 module. Adjust pump gallons per minute and run time to achieve the above maximum dose. Use a minimum pump run time of one minute. Longevity of currently available effluent pumps is not affected by shorter run times. Choose force main diameter to minimize percentage of dose drain back. Effluent velocity in force main should fall between approximately 3 and 5 ft/sec. Pump flow rate shall be less than 30 G.P.M. in residential systems.

4.3 LOW PRESSURE DISTRIBUTION: Dosing with small diameter pressurized pipes with holes drilled at pre-determined intervals depending on the size, length of system, and volume. A pressure distribution system should be designed by a professional engineer or other qualified person.

5.0 Ventilated System

5.1 Ventilated System: 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 cuspations within the GSF modules. Under normal operating conditions, only a fraction of the filter is in use. The unused channels remain open for intermittent peak flows and the transfer of air. The extension of the distribution pipe to the vent provides adequate delivery of air into the GSF system, as shown in Figure 11.

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

If a pressure or demand dosed system is specified with greater than 18 inches of cover measured from the top of the module to finished grade, an additional 2” airline must be extended from the GSF D-box back to the septic tank or the riser on the pump tank is required. This maintains the continuity of airflow 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, as shown in Figure 11. 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. Down-slope vents must first go 4” above the trench and also have a drain hole at the lowest point to drain any condensation.

6.0 Commercial Systems

Commercial systems require different sizing and design criteria as compared to residential systems. Please contact Eljen’s Technical Resource Department at 1-800-444-1359 for more information on commercial systems.

7.0 Inspection of GSF Systems

If the GSF system is not operating properly, a system inspection should be performed BY A QUALIFIED PERSON to identify the cause of the problem so that the system can be restored to normal operation. Possible problem areas to check if a system is not operating properly are:

SEPTIC TANK

- Clogged filter
- No outlet baffle or tee
- Infiltration of ground water or surface water
- Tank needs to be pumped
- Line to D-Box needs repair
- Cracked or leaking Septic Tank
- Line to septic tank is clogged

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
- Line to D-Box needs repair
- Pump chamber not vented when installed with greater than 18 inches of cover

EFFLUENT DISPOSAL AREA

- Excessive backfill over system – (More than 18” requires venting)
- Crushed Distribution Pipe(s)
- Distribution Pipes are not Level
- Poor quality backfill over system – (No oxygen flow to system)
- Poor quality sand or fill used below the system
- Loam was not removed prior to construction
- System size is too small for actual use – (Excessive use or bedrooms)
- Surface drainage not pitched away from field

8.0 Designs for Failed Systems

Before designing a Geotextile Sand Filter system to replace a failed system, identify all possible reasons why the system failed. Proper identification of the failure is critical to ensure the GSF system will operate properly. Listed below are the most common reasons for septic system failures.

IDENTIFY THE CAUSE(s) of FAILURE prior to REPLACEMENT
• Leaky plumbing fixtures
• Inaccurate percolation test
• Pump settings incorrect or not working properly.
• More occupants or bedrooms than system were designed for
• Unusually high water usage
• Garbage disposal
• Water softener backwash
• Excessive grease in system
• Detrimental chemicals being used
• Failed or missing septic tank outlet baffle
• Infiltration of ground water into septic tank or pump chamber
• System is faulty in design or installation
• Specified sand that does not meet the requirements as outlined in this manual
• Improper materials
• System too close to water table
• Mounding due to poor drainage or soil permeability
• Part or system not used because of blockage or excessive settling
• System is undersized

9.0 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. Organic Loam Layer must be removed from bed and slope extension areas prior to fill placement. Scarify subsoil prior to fill placement.

4. Fill material shall meet or exceed of Design & Installation Manual requirements. All fill material shall be clean sand, free of topsoil directly beneath the EDA. The 6” surrounding and the 12” below the GSF modules shall be washed concrete sand meeting the requirements of ASTM C33 with less than 10% passing a #100 sieve and less than 5% passing a #200 sieve.

5. BACKFILL & FINISH GRADING: Carefully place backfill over the modules, followed by loam to complete a total minimum depth of 12” as measured from the top of the module. Systems with total cover that exceeds 18” as measured from the top of the module shall be vented at the far end of the system. Backfill material shall be a well graded sandy fill; clean, porous, and devoid of sand rocks larger than 2”, with a maximum of 10% passing a #200 sieve. Divert surface runoff from the Effluent Disposal Area, (EDA). Finish grade to prevent surface ponding. Seed loam to protect from erosion.

6. Any system which is more than 18” below finish grade, as measured from the top of the module, shall be vented.

7. This design complies with and must be installed in accordance with the Eljen 2008 Design and Installation Manual”.

System Installation Guidelines

Important Guidelines

- All GSF systems are installed onto a 12” layer of specified ASTM C33 sand. Specified sand is compacted in two 6” lifts.
- Place the 7” tall Geotextile Filter Modules on top of a 12” minimum level surface of ASTM C33 specified sand with less than 10% passing a #100 sieve and less than 5% passing a #200 sieve. You must use the specified sand as listed on page 5, Table 2 of this manual to ensure proper system operation.
- The GSF modules are placed with the PAINTED STRIPE FACING UP, end to end on top of the specified sand.
- Use the provided wire clamps to secure the approved perforated 4” diameter distribution pipe SDR- 35 or equivalent to the top of each GSF module.
- Cover the tops and sides of the modules along the entire length of each row with Eljen geotextile cover fabric.
- Specified sand placed between module rows and around the perimeter of trench or bed configurations ensures aeration of the GSF modules. Additional sand placed above the modules is recommended.
- Where the percolation rate exceeds 30 minutes-per-inch or the soil texture is finer, the system should be built from one end to the other to avoid any compaction of the soil by the excavator.
- When backfilling the installation with native soil, stones 2” or larger must be removed.
- Finish by grading the area to divert storm water runoff away from the system.
- Do not drive backhoe wheels over GSF modules with less than 12” of cover over the distribution pipe. **Driving or paving over the Geotextile Sand Filter area is prohibited.** For shallow installations, light-weight track-mounted machines are best for setting the final grade. It is also permissible to back-blade the soil to set final minimum cover. Perimeter landscape timbers are also recommended to locate the shallow beds, thereby keeping vehicles off the system.
- Seeding and stabilizing the soil cover is required to protect the system from soil erosion.
- Where the elevation of the surface exceeds the natural grade, a block or landscape timber frame or sloping soil toe at a 3:1 grade can be used to help eliminate soil erosion and support maintenance of the stabilizing grass cover adjacent to the GSF.
- For pumped systems, provide a well-anchored D-box with a velocity reduction tee or baffle. Do not use flow dials or other restricting devices in the outlet lines of the D-box in pump systems. Vent system at far end of the trench or bed.

Trench and In-Ground Bed System Installation Instructions

1. Carefully lay out the system components and boundaries. Define the location and elevation of the trench or bed and distribution box based on the septic tank outlet elevation and pipe grades required to maintain flow to each component.

2. Prepare the site. Do not install a system on saturated ground or wet soils that are smeared during excavation. Keep heavy machinery off clay 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 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.

4. Excavate the trench or bed. Scarify the receiving layer to maximize the interface between the native soil and specified sand.

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

6. Place specified sand (see page 5, Table 2) in two 6" lifts, compact each lift at a time. The compacted height below the GSF module must be 12" minimum.

7. A hand tamper is sufficient to stabilize the sand below the GSF modules. Check the zero grade of the top of the sand using a flat piece of lumber and a carpenter's level and/or a laser before placing the modules.

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

9. Provide D-box(s) installed in accordance with the current SNHD regulations. Install flow dials in the D-box in gravity dispersed systems. Do not use flow dials or other restricting devices in the outlet lines of the D-box in pump systems.

10. Use 4" SDR-35 or equivalent non-perforated pipe from the distribution box to the GFS modules. Recommended drop for gravity systems from D-Box to modules is 1/8" per linear foot.

11. Center 4" SDR-35 or equivalent perforated distribution pipe lengthwise over modules with orifices at 5:00 and 7:00. Connect mid points (see Figure 7) on level bed systems on rows over 40' long.

12. Secure pipe to GSF modules using one Eljen hoop per module. Push hoop 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 GFS module rows. Secure in place with specified sand between and along the sides up to the top of the modules at a minimum. Avoid blocking holes in perforated pipe by placing the cover fabric over the pipe prior to placing fill over the modules.

14. Trench: Place 6" minimum of specified sand along both sides of the module(s) and 6" at the beginning and end of each row. Sidewall separation between trenches shall be 5'.

15. Bed: Place 12" on specified sand between the sides of each module along the entire length and 6" of specified sand around the perimeter of the entire bed extending out from the outer modules sidewall.

16. Complete backfill with loam to 8" minimum of the GSF modules. Backfill exceeding 18" requires venting at the far end of the trench. Fill should be clean, porous and devoid of large rocks. Use well graded sandy fill with a maximum 10% passing a #200 sieve. 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. Divert surface runoff. Finish grade to prevent surface ponding. Seed loam, and protect from erosion.

Raised or Fill System Installation Instructions

1. Carefully lay out the system components and boundaries. Define the location and elevation of the raised bed or fill system and distribution box based on the septic tank outlet elevation and pipe grades required to maintain flow to each component.

2. Prepare the site. Do not install a system on saturated ground or wet soils that are smeared during excavation. Keep heavy machinery off clay 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 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.

4. Excavate the bed. 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.

6. Place fill material meeting Design & Installation requirements onto the soil interface as you move down the excavated area. If this is done in two steps, compacting in 6" lifts to the required height. Compact specified sand (see page 5, Table 2) on top of the compacted fill material in two 6" lifts with a light tracked machine or a compacting machine, to a total height of 12" minimum.

7. A hand tamper is also sufficient to stabilize the sand below the GSF modules. Check the zero grade of the top of the sand using a flat piece of lumber and a carpenter's level and/or a laser before placing the modules.

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

9. Provide D-box(s) installed in accordance with the current SNHD regulations. Install flow dials in the D-box in gravity dispersed systems. Do not use flow dials or other restricting devices in the outlet lines of the D-box in pump systems.

10. Use 4" SDR-35 non-perforated pipe or equivalent non-perforated pipe from the distribution box to the GFS modules. Recommended drop for gravity systems from D-Box to modules is 1/8" per linear foot to the GFS modules.

11. Center 4" SDR-35 perforated distribution pipe or equivalent lengthwise over modules with orifices at 5:00 and 7:00. Connect mid points on level bed systems on rows over 40' long (see Figure 7).

12. Secure pipe to GSF modules using one Eljen supplied hoop per module. Push hoop 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 GFS module rows. Secure in place with specified sand between and along the sides up to the top of the modules at a minimum. Avoid blocking holes in perforated pipe by placing the cover fabric over the pipe prior to placing fill over the modules.

14. Place 6" minimum of specified sand along the sides of the modules and at the ends of each module row.

15. Complete backfill with loam to 8" minimum of the GSF modules. Backfill exceeding 18" requires venting at the far end of the trench. Fill should be clean, porous and devoid of large rocks. Use well graded sandy fill with a maximum 10% passing a #200 sieve. 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. Divert surface runoff. Finish grade to prevent surface ponding. Seed loam, and protect from erosion.

Serial Distribution on Slopes System Installation Instructions

1. Carefully lay out the system components and boundaries. Define the location and elevation of the serial distribution system and distribution box based on the septic tank outlet elevation and pipe grades required to maintain flow to each component.
2. Prepare the site. Do not install a system on saturated ground or wet soils that are smeared during excavation. Keep heavy machinery off clay 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 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.
4. Excavate the 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.
6. Place fill material meeting state / county requirements onto the native soil interface as you move down the excavated area. If this is done in two steps, bring in the fill material from the up-slope side of the excavation. Compact specified sand (see page 5, Table 2) below the GSF module in two 6” lifts with a light tracked machine or compactor to a total height of 12” minimum below the modules.
7. A hand tamper is sufficient to stabilize the sand below the GSF modules. Check the zero grade of the top of the sand using a flat piece of lumber and a carpenter’s level and/or a laser before placing the modules.
8. Place GSF modules with PAINTED STRIPE FACING UP, end to end on top of the specified sand.
9. Drop Boxes are placed at the beginning of each row along the slope. Install flow dials so that the septic tank effluent is directed into the first upper trench in the system. A second non perforated pipe is plumed to the next lower trench by adjusting a flow dial to deliver over flow effluent to the next lower trench and so on.
10. Use 4” SDR-35 or equivalent non-perforated pipe from the distribution boxes to each row of the GFS modules.
11. Install a line of 4” SDR-35 perforated distribution pipe lengthwise on the upper first row over the GSF modules with orifices at 5:00 and 7:00 and cap at end.
12. Secure pipe to GSF modules using one Eljen hoop per module. Push hoop 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 GFS module rows. Secure in place with specified sand between and along the sides up to the top of the modules at a minimum. Avoid blocking holes in perforated pipe by placing the cover fabric over the pipe prior to placing fill over the modules.
14. Place 6” minimum of specified sand along the sides of the modules and at the ends of each module row.
15. Complete backfill with loam to 8” minimum of the GSF modules. Backfill exceeding 18” requires venting at the far end of the trench. Fill should be clean, porous and devoid of large rocks. Use well graded sandy fill with a maximum 10% passing a #200 sieve. 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. Divert surface runoff. Finish grade to prevent surface ponding. Seed loam, and protect from erosion.

Sizing Table

TABLE 1: STANDARD GSF SIZING TABLE FOR A42 AND B43 MODULES

Percolation Rate Min / In	Application Rate Gal / Sqft	Square Feet Required **1000**	Square Feet Required **1200**	Square Feet Required **1500**
0 - 11	1.6	625	750	938
11 - 15	1.3	769	923	1154
16 - 20	1.1	909	1091	1364
21 - 25	1	1000	1200	1500
26 - 30	0.9	1111	1333	1667
31 - 40	0.8	1250	1500	1875
41 - 50	0.7	1429	1714	2143
51 - 60	0.6	1667	2000	2500

A42
Geotextile Module

10.00 sf/lf

Effective size of the GSF = 2 times the capasity of the soil interface = 3 sf basal area per lf + 2 sf sidewall
5sf/lf times 2 = 10 sf/lf

Percolation Rate Min / In	Application Rate Gal / Sqft	Linear Feet of Trench 3 Bdrms **1000**	Linear Feet of Trench 4 Bdrms **1200**	Linear Feet of Trench 5-6 Bdrms **1500**		Total Number of Modules 3 Bdrms **1000**	Total Number of Modules 4 Bdrms **1200**	Total Number of Modules 5-6 Bdrms **1500**
0 - 11	1.6	72	96	120		18	24	30
11 - 15	1.3	77	96	120		19	24	30
16 - 20	1.1	91	109	136		23	27	34
21 - 25	1.0	100	120	150		25	30	38
26 - 30	0.9	111	133	167		28	33	42
31 - 40	0.8	125	150	188		31	38	47
41 - 50	0.7	143	171	214		36	43	54
51 - 60	0.6	167	200	250		42	50	63

Minimum A42 Modules = 6 PER BEDROOM

Percolation Rate Min / In	Application Rate Gal / Sqft	Square Feet Required **1000**	Square Feet Required **1200**	Square Feet Required **1500**
0 - 11	1.6	625	750	938
11 - 15	1.3	769	923	1154
16 - 20	1.1	909	1091	1364
21 - 25	1	1000	1200	1500
26 - 30	0.9	1111	1333	1667
31 - 40	0.8	1250	1500	1875
41 - 50	0.7	1429	1714	2143
51 - 60	0.6	1667	2000	2500

B43
Geotextile Module

12.00 sf/lf

Effective size of the GSF = 2 times the capasity of the soil interface = 4 sf basal area per lf + 2 sf sidewall
6sf/lf times 2 = 12 sf/lf

Percolation Rate Min / In	Application Rate Gal / Sqft	Linear Feet of Trench 3 Bdrms **1000**	Linear Feet of Trench 4 Bdrms **1200**	Linear Feet of Trench 5-6 Bdrms **1500**		Total Number of Modules 3 Bdrms **1000**	Total Number of Modules 4 Bdrms **1200**	Total Number of Modules 5-6 Bdrms **1500**
0 - 11	1.6	60	80	86		15	20	25
11 - 15	1.3	64	80	100		16	20	25
16 - 20	1.1	76	91	114		19	23	28
21 - 25	1.0	83	100	125		21	25	31
26 - 30	0.9	93	111	139		23	28	35
31 - 40	0.8	104	125	156		26	31	39
41 - 50	0.7	119	143	179		30	36	45
51 - 60	0.6	139	167	208		35	42	52

Minimum B43 Modules = 5 PER BEDROOM

- For commercial systems, contact Eljen's Technical Resource Department at 1-800-444-1359 for sizing and design requirements.
- Half-Length B43or A42 modules are available, e.g. 15 B43 modules can be 2 rows of 7.5 modules per row.

Vertical Separation A42 and B43 Module

FIGURE 3: VERTICAL SEPARATION FOR A42 and B43 MODULES

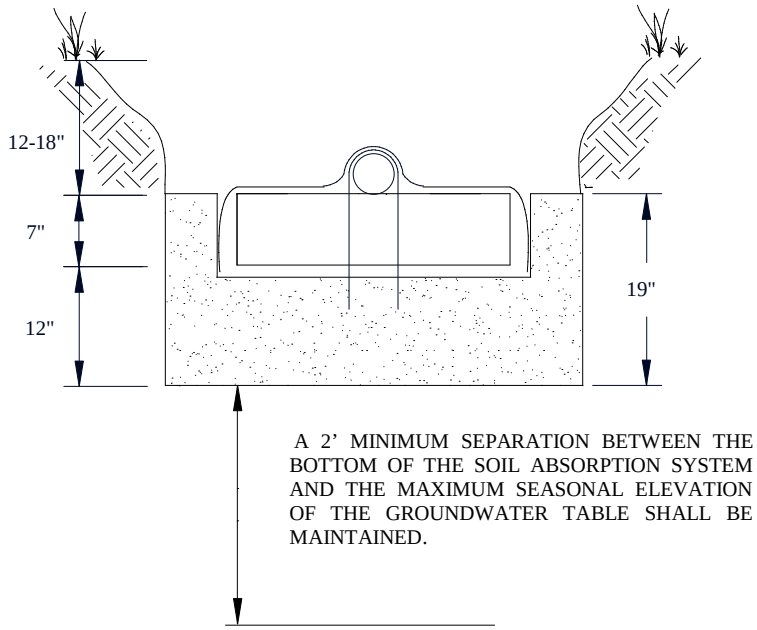


FIGURE 4: A42 MODULE BED CONFIGURATION CROSS SECTION

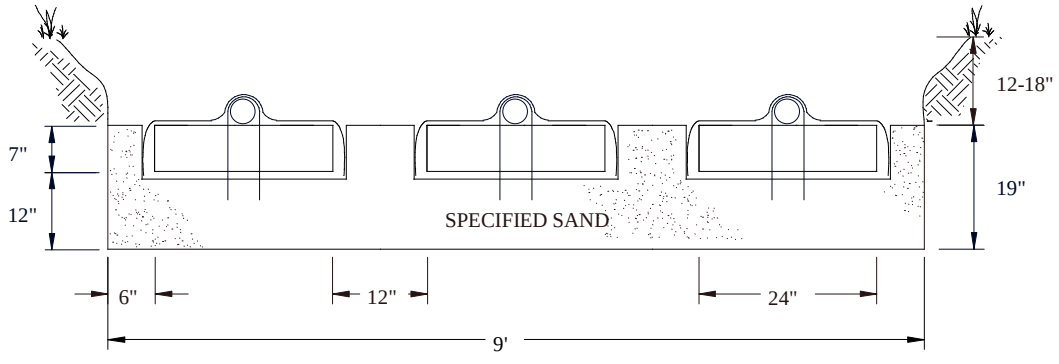


FIGURE 5: B43 MODULE BED CONFIGURATION CROSS SECTION

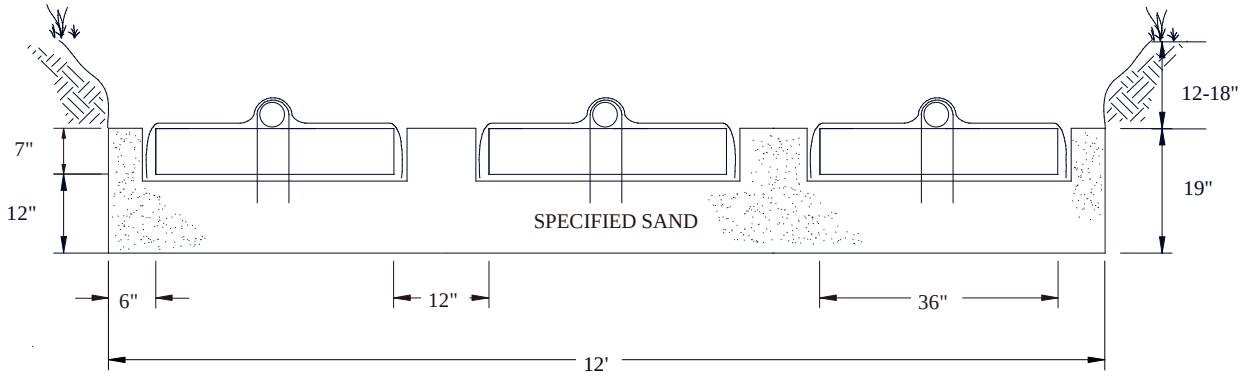


FIGURE 6: TYPICAL BED CONFIGURATION A42 AND B43 MODULES

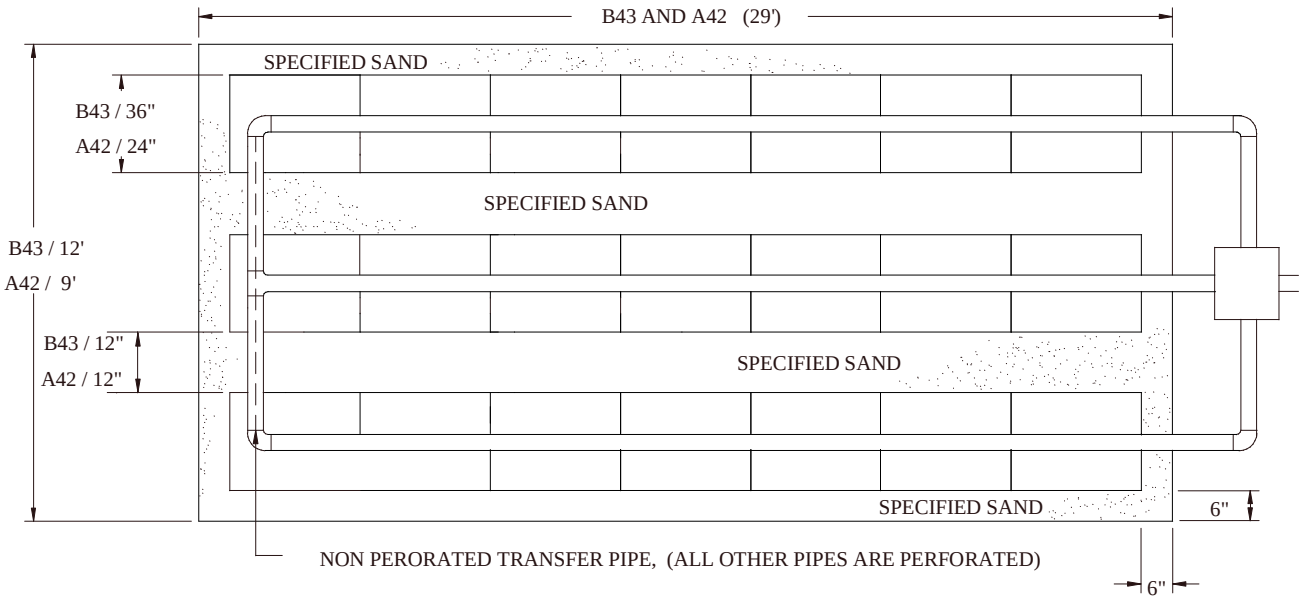


FIGURE 7: CROSS OVER CONNECTION FOR SYSTEMS OVER 40' IN LENGTH

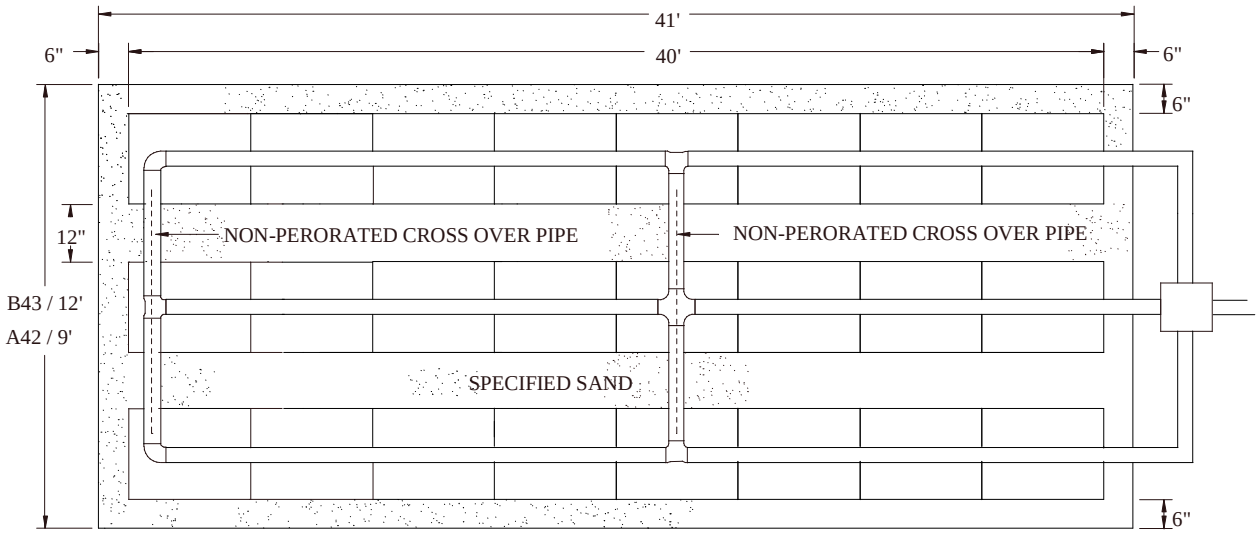
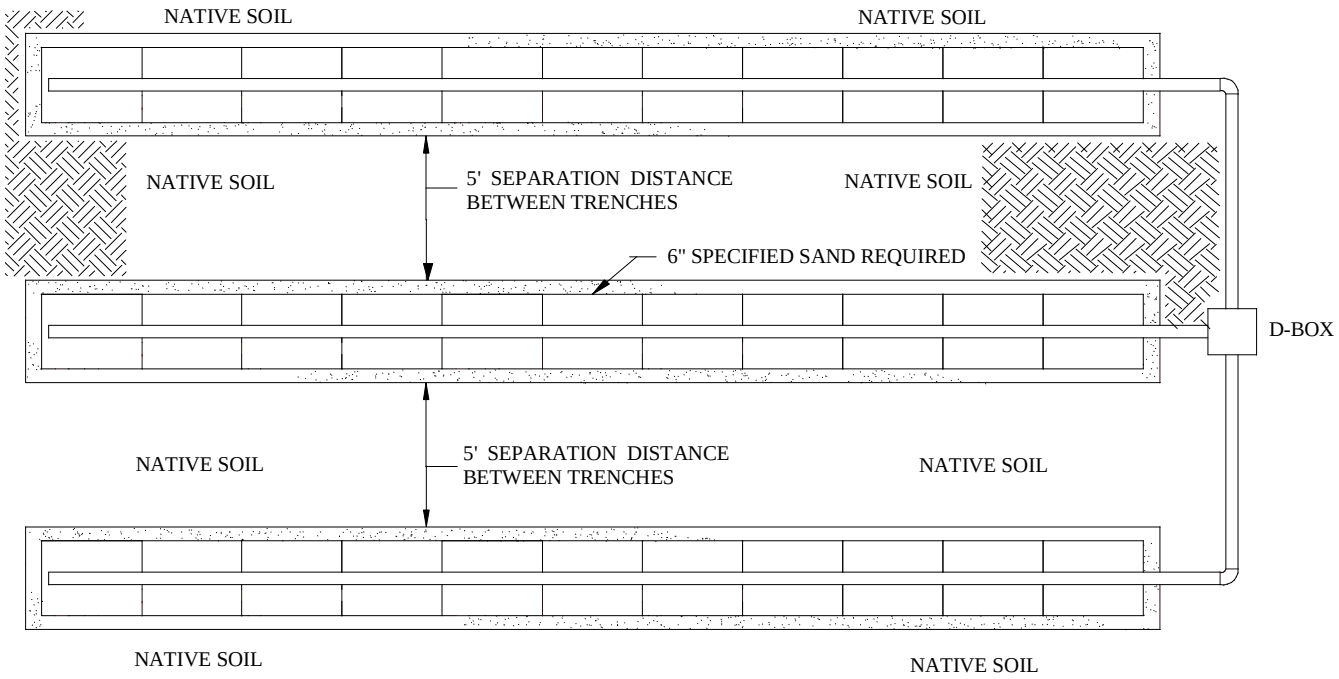


FIGURE 8: TYPICAL TRENCH CONFIGURATION FOR A42 AND B42 MODULES



IN ACCORDANCE WITH CLARK COUNTY REGULATIONS, FIGURE 8

IF, DEPTH "D" BELOW PIPE IS BETWEEN = 18" - 23" THE MINIMUM DISTANCE BETWEEN SIDEWALLS SHALL BE 5'

THE 7" HEIGHT OF THE GSF MODULE and 12"
HEIGHT OF THE SPECIFIED SAND BELOW THE MODULE

THE TOATAL DEPTH "D" BELOW THE DISTRIBUTION PIPE TO THE BOTTOM OF THE SYSTEMS IS 19"

THE MINIMUM DISTANCE BETWEEN SIDEWALLS FOR THE GSF IS = 5'

FIGURE 9: MOUNDED BED CONFIGURATION

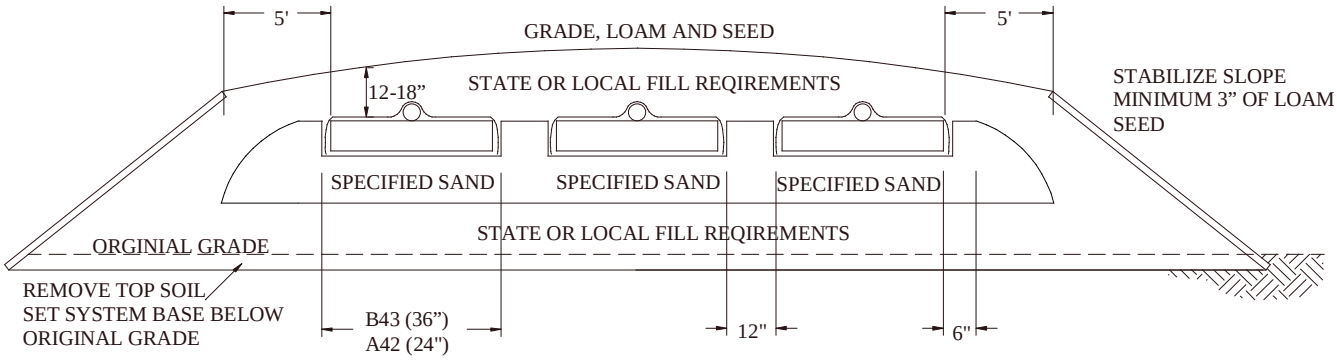


FIGURE 10: MOUNDED BED CONFIGURATION SLOPE

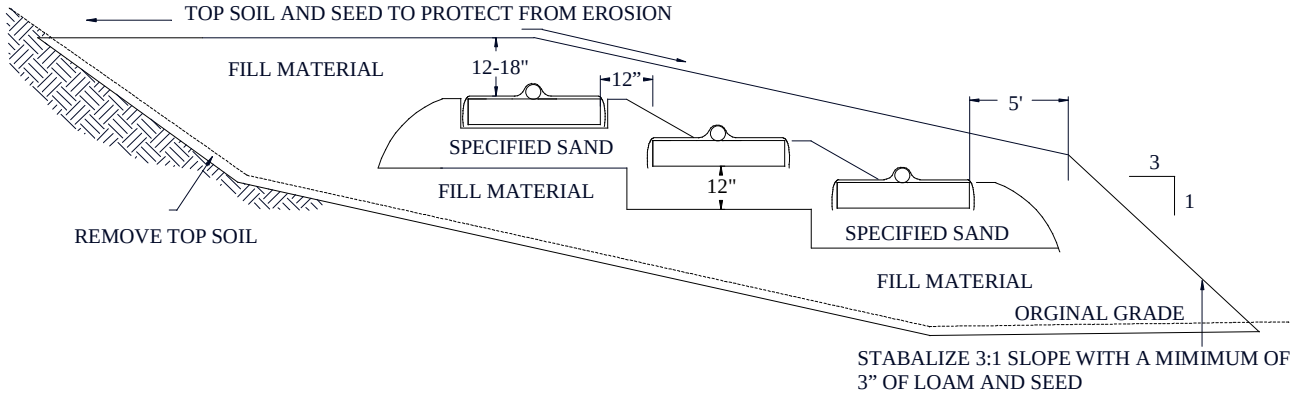
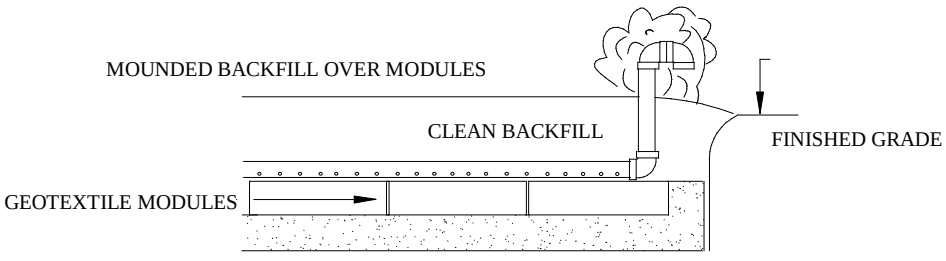


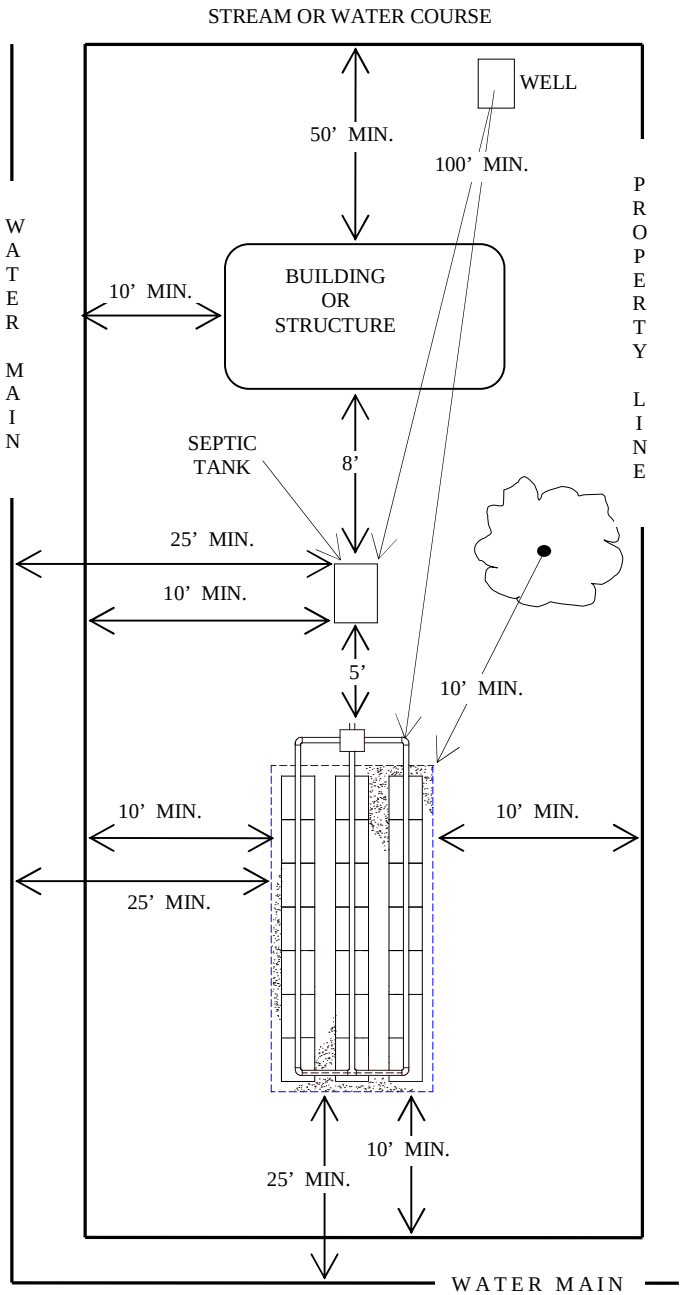
FIGURE 11: 4” PIPE VENT PLACED AT FAR END OF TRENCH OR BED



* COVER FABRIC NOT SHOWN OVER DISTRIBUTION PIPE AND MODULES

FIGURE 12: SETBACK DISTANCES

Minimum Horizontal Separation Distance Feet	Building Sewer Drain Feet	Septic Tank Feet	Shallow Soil Absorption System Feet	Deep Soil Absorption System Feet
Building or Structure	2	8	8	20
Property Line	10	10	10	10
Water Supply – Wells	50	100	100	150
Streams or Watercourses	50	100	100	150
Soil Disposal Systems		5		
Community Water Main Lines	10	10	25	25
Individual Water Service Lines	6	10	25	25



Detailed Setback Requirements