Eljen GSF Combined Treatment and Dispersal System

Ontario Design and Installation Manual Model-A42

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Manufactured By:

Eljen Corporation
Windsor, CT 06095
info@eljen.com
Tel: 800-444-1359 ▪ Fax: 860-610-04270
www.eljen.com

Represented By:

Enviro-STEP Technologies Inc.
Quebec City (Qc)
dmercier@enviro-step.ca
Tel: 877-925-7496 ▪ Fax: 418-626-4090
www.enviro-step.ca

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Eljen GSF Technology

The Eljen GSF technology is based on scientific principles which show that improving the effluent quality before infiltration in the native soil increases soil long term acceptance rates and reduces risks of clogging. Extensive use of the product for over 40 years, backed-up with rigorous and official third-party independent testing conducted in accordance with the NSF/ANSI Standard 40 Protocol, CAN/BNQ 3680-600 and actual Ontario Eljen GSF System field testing / sampling ensure onsite system designers can confidently specify The Eljen GSF Combined Treatment and Dispersal System.

The NSF Standard 40 Protocol testing and the CAN/BNQ 3680-600 testing covered winter conditions with 'uncontrolled' effluent temperature to verify the stability of the performances and the capacity to handle colder weather conditions. Eljen is safe and performing in Canadian climate.

It is relevant to mention that the Eljen GSF A42 product has been used extensively throughout North America for decades and is also approved in eight Canadian provinces (Ontario, BC, Manitoba, Nova Scotia, Newfoundland, Saskatchewan, New Brunswick and Quebec).

The intrinsic characteristics of the Eljen GSF System, combining simplicity, robustness and optimized natural biological processes make it one of the best options for onsite wastewater treatment.

For more information on our product testing, design standards, installation procedures or how the Eljen GSF System meets high effluent quality, please contact Enviro-STEP Technologies at 1-877-925-7496 or the Eljen Technical Support Department at 1-800-444-1359.

This Design and Installation Manual is a complement to the BMEC Authorization and Ontario Building Code and should be followed thoroughly

ELJEN GSF A42 modules can only be acquired from an Ontario distributor authorized by Enviro-STEP Technologies

ELJEN GSF installation can only be performed by an installer authorized by Enviro-STEP Technologies or its Ontario distributors

Maintenance of ELJEN GSF System can only be performed by service provider authorized by Enviro-STEP Technologies or its Ontario distributors

Glossary of Terms

Eljen A42 GSF Module	Dimensions – (L x W x H) – 1220 mm x 610 mm x 180 mm (48” x 24” x 7”) The individual module of an Eljen GSF System. The module is comprised of a cuspated plastic core and geotextile fabric.
Authorized/Certified Installer	Identifies an installer with a valid BCIN that successfully fulfilled the mandatory requirement of attending at least one ELJEN training session per period of 12 months and was supervised by an authorized ELJEN representative on their first installation. Any non-authorized installer with a valid BCIN can be authorized to install an ELJEN GSF System with the condition that they are supervised by an authorized ELJEN representative and attends training with the 12 months following the installation.
Anti-Siltation Fabric	The geotextile Anti-Siltation fabric (provided by manufacturer) that is placed over the GSF modules.
Daily Design Flow (Q)	The Daily Design Sewage Flow (Q) used for sizing a wastewater system taking into account mass loading and peak flows. The flow rate per A42 GSF module that is used to size an Eljen GSF System using residential strength waste is 95 liters per day per module.
Distribution Box	(Or D-Box) A plastic or concrete box that receives effluent from a septic tank or pump tank and splits the flow to pipes placed above the GSF modules. This may include optimized surge distribution boxes. All D-boxes must be accessible from grade at all times for inspection and maintenance
Effective Length of Distribution	Refers to the total length of perforated pipe between the beginning of the first Eljen GSF module and the end of the last Eljen GSF module in a row. This represents the total length over which primary effluent will be applied.
GSF	Geotextile Sand Filter - Includes the Eljen Geotextile Filter modules and the 150 mm sand layer along the base and sides of the modules and the Anti-Siltation fabric.
Flow Equalizer	Special insert placed in the extremity of a distribution pipes inside the distribution box to allow the adjustment of the pipe invert. Also known as speed-levelers.
OBC-B8	Ontario Building Code Division B, Part 8.
Primary Treatment Zone	Refers to the Eljen GSF modules where aerobic biofiltration process takes place.
Secondary Treatment Zone	Refers to layer of Eljen Specified Sand located directly under and on each side of the Eljen GSF modules or rows of modules providing additional filtration prior to dispersal into the native soils. This Specified Sand layer has a thickness of 150 mm.
Absorption Bed	Refers to the total area provided for the dispersal of the treated effluent. Its minimum size corresponds to the area covered by the Secondary Treatment Zone and increases as the soil is less permeable.
Imported Sand Fill	Granular material with a percolation time of at least 6 and not more than 10 min/cm, with not more than 5% fines passing the “200 sieve” that can be used to make-up the vertical separation and/or parts of the Absorption Bed outside of the secondary treatment zone.

Specified Sand

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

To ensure proper system operation, the system must be installed using ASTM C33 sand with a maximum of 5% of particles with a diameter of 75 µm or less, a maximum of 10% of particles with a diameter of 150 µm or less and a maximum of 20% of particles with a diameter of 2,36 mm or greater.

TABLE 1: SPECIFIED SAND SIEVE REQUIREMENTS

ASTM C33 SAND SPECIFICATION		
Sieve Size	Sieve Square Opening Size	Specification Percent Passing (Wet Sieve)
3/8 inch	9.52 mm	100
No. 4	4.76 mm	95 - 100
No. 8	2.38 mm	80 - 100
No. 16	1.19 mm	50 - 85
No. 30	590 µm	25 - 60
No. 50	297 µm	5 - 30
No. 100	149 µm	< 10
No. 200	75 µm	< 5
Note: Request a sieve analysis from your material supplier to ensure that the specified sand meets the specification requirements listed above.		

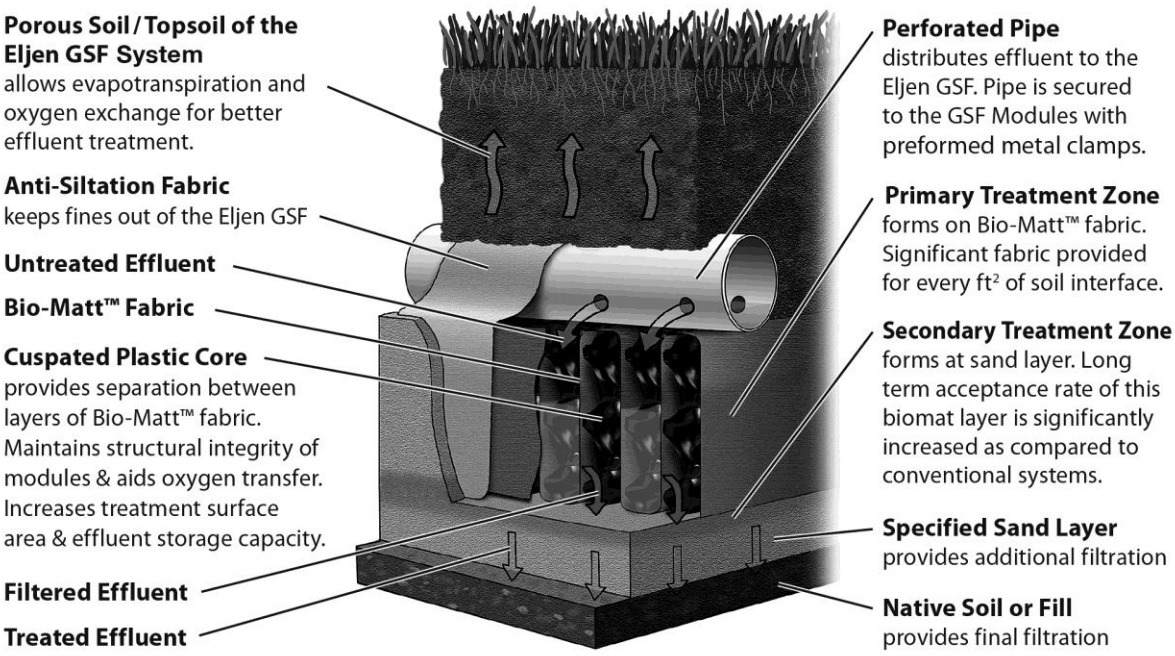
Primary Treatment Zone

- 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 module geotextile "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 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 absorption and allows groundwater recharge.

FIGURE 1: ELJEN GSF SYSTEM OPERATION



1.0 Eljen GSF System Preconditions

1.1 REQUIREMENTS FOR USE: Eljen GSF Systems must meet the requirements of the Building Materials Evaluation Commission (BMEC) Authorization, the Ontario Building Code (OBC), and must be designed / installed in accordance with the latest version of the Ontario ELJEN GSF model A42 Design and Installation Manual.

Please contact Enviro-STEP Technologies at 1-877-925-7496 for design information on commercial systems.

1.2 DOMESTIC WATER TREATMENT DEVICES: Backwash from domestic water treatment devices may adversely affect septic tank treatment and Eljen GSF System. Please contact Enviro-STEP Technologies at 1-877-925-7496 before discharging backwash water from a Water Treatment Device towards an Eljen GSF System.

As a general design consideration, discharge from residential water treatment device **shall be diverted into a separate alternative disposal system**.

1.3 GARBAGE DISPOSALS: Garbage Disposal units (garburators) increase the organic loading to the system by 50%. If the owner wishes to use a garburator, then the Daily Design Flow must be increased by 50% which subsequently increases the size of all components of the system including the number of Eljen GSF modules and the overall field size. Design Drawings and Owner's O&M manual must include a note that clearly indicates "Garbage Disposals **ARE** (or **ARE NOT**) allowed to be used with this system."

1.4 ADDITIONAL FACTORS AFFECTING RESIDENTIAL SYSTEM SIZE: Homes with expected higher than normal water usage may consider increasing the septic tank volume. Consideration is to be given for upsizing the Eljen GSF absorption bed for any expected higher than normal water use.

For example:

- Luxury homes, homes with Jacuzzi style tubs, and other high use fixtures.
- Homes with known higher than normal occupancy.
- Vacation rentals such as Airbnb
- Home with a combined commercial use

1.5 SYSTEM PROHIBITED AREAS: All vehicular traffic is prohibited over the Eljen GSF System. Eljen 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.

1.6 IMPORTED SAND FILL FOR RAISED SYSTEMS: If the absorption bed requires to be raised such that more than 150 mm of Specified Sand is required to extend any limiting factor (such as vertical separation), the fill material below the minimum Specified Sand shall be ASTM C-33 sand or imported sand fill (with a percolation time of at least 6 and not more than 10 min/cm, with not more than 5% fines passing the "200 sieve").

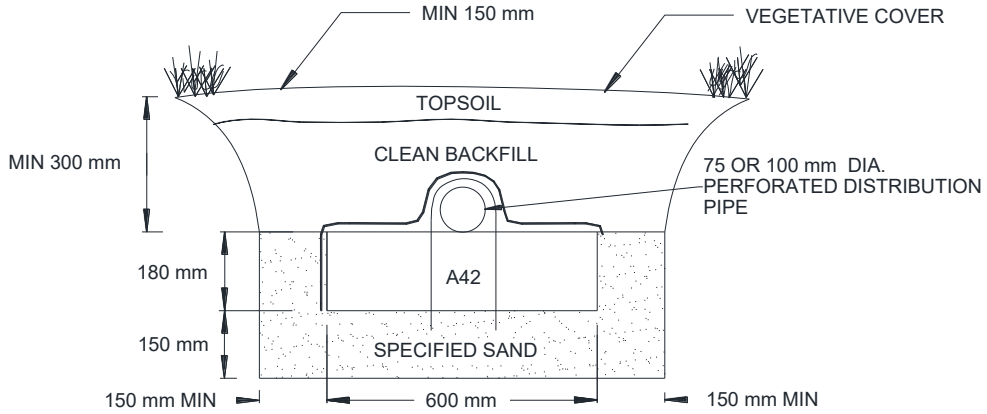
2.1 ABSORPTION BED: The total absorption area required is site specific and determined by the Daily Design Sewage Flow (Q) and percolation time (T) from the native soils analysis as specified in the OBC and determined by an approved Designer.

The Eljen GSF System is a Combined Treatment and Dispersal System that allows for a reduced field area in comparison to conventional beds.

Absorption Bed does not require a mantle extension and can be formed of one or several sections of regular or irregular shape totalizing the minimum area required.

The native soil to consider in the calculation of the area is any layer composed of non-organic material in which the treated effluent is applied. The designer must perform an adequate site assessment to properly identify any limiting layers that could reduce the infiltration rate and choose the proper horizon of soil for infiltration.

FIGURE 2: TYPICAL ELJEN GSF A42 CROSS SECTION



All Eljen GSF Systems are required to have a minimum of:

- 150 mm of Specified Sand at the edges of module (results in minimum row spacing of 300mm calculated from side to side of each row).
- 150 mm of Specified Sand at the beginning and end of each Eljen GSF Row.
- 150 mm of Specified Sand directly below the Eljen GSF module.
- 300 mm of minimum cover over the Eljen GSF module.

The geometry of the absorption bed is determined considering the site characteristics and constraints.

2.1.1 Sloped site

On a sloped site (slope of natural soil greater than 2% and not greater than 25%), the bed shall have its long dimension parallel to the contour lines and short dimension in the direction of slope. In sloped sites, design must also comply to maximum linear loading rates as described in Section 4.0.

2.2 SEPTIC TANKS: Two compartment tanks are required for all Systems. Effluent filters are also required. Use a septic tank in compliance with the OBC.

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. More frequent cleaning of the effluent filter may be required.

Access risers are required with septic tanks.

2.3 EFFLUENT FILTERS: An OBC Approved effluent filter is required on the outlet end of the septic tank. Filter manufacturers 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.

2.4 VERTICAL SEPARATION TO LIMITING LAYER:

Like in any soil-based system design, providing and adequate distance between the effluent dispersal zone (secondary treatment layer in an ELJEN GSF System) and any limiting layer is one of the most important aspects of the design to assure longevity.

A limiting layer is defined as any soil feature that significantly reduce the absorption rate of effluent. The quality and precision of the site assessment is critical in identifying limiting layers. It is generally one or several of the following underground features:

- Seasonal high ground water table
- Perched water table
- Bedrock
- Soil with a percolation time (T) greater than 50 min/cm (Caution: this does not only pertain to clay soil but may include some permeable soils that are naturally heavily densified):

The percolation time (T) of the native soil shall determine the minimum vertical distance from the bottom of the Eljen Specified Sand to any limiting layers.

Vertical separation required is the following:

1. if T is less than or equal to 6 min/cm, or greater than 50 min/cm, then the vertical separation distance shall be at least 600 mm, or
2. if T is greater than 6 min/cm, or less than or equal to 50 min/cm, then the vertical separation shall be at least 450 mm.

Where the native soil cannot provide for the entire required vertical separation, imported sand with a 6 ≤ T ≤ 10, less than 5% fines passing the “200 sieve”, is to be provided to meet the required vertical separation distances.

FIGURE 3: VERTICAL SEPARATION DISTANCE

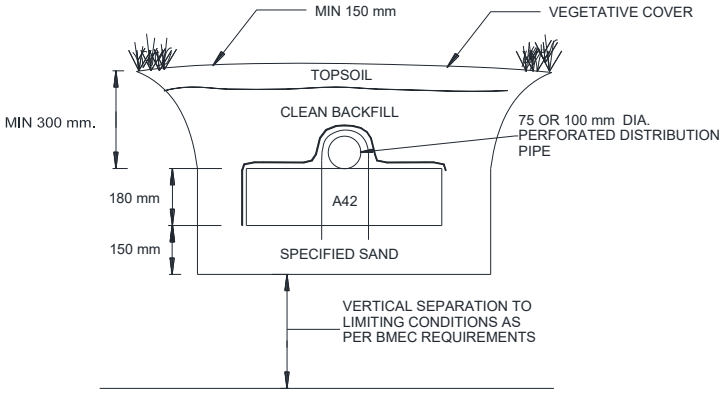
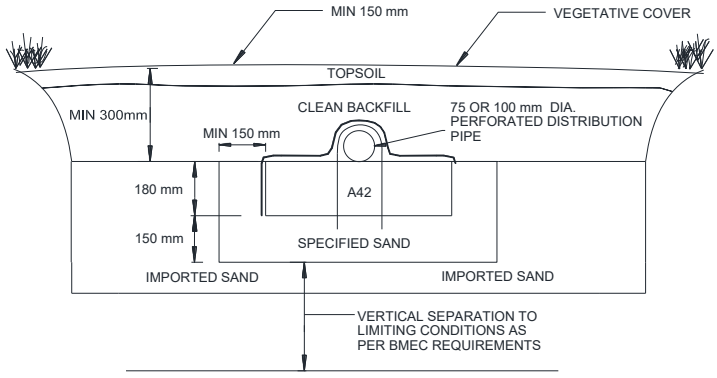


FIGURE 4: VERTICAL SEPARATION DISTANCE WITH IMPORTED SAND



2.5 SPECIFIED SAND AND IMPORTED SAND SPECIFICATIONS: The Specified Sand immediately under, between rows and around the perimeter of the GSF system forming the secondary treatment zone shall be **ASTM C33 SAND** with a minimum thickness of 150 mm**.** Please place a prominent note to this effect on each design drawing. See Table 3, page 5 of this manual for details on the ASTM C33 sand specification.

Sand outside of the Secondary Treatment Zone (areas beyond 150mm from the modules) shall be ASTM C33 Sand **OR** an imported sand fill meeting BMEC requirements, as detailed in section 1.6.

2.6 PLACING ELJEN GSF MODULES IN THE ABSORPTION BED:

2.6.1: Modules placed on its right side "white paint stripe" demarcation line

Each module has a "painted stripe" on one side. This corresponds to the side with the most surface of Eljen black geotextile fabric which will receive untreated effluent. This side must be facing up. The other side must be facing down towards the specified sand layer. This bottom side has the most open spacing and is intended to release treated effluent to the secondary treatment zone (ASTM sand).

2.6.2: Modules Level

All rows of GSF modules are set level or with a maximum slope of 1% over the Specified Sand layer. If a slope is provided, the designer must create that slope by varying the thickness of the Specified sand or imported sand fill as the basecut in the native soil under the rows of modules must be level. Vertical separation and minimum ASTM sand thickness under modules must be met at all locations.

2.6.3: Modules Configuration over the Contact Area

Eljen GSF modules are placed to form rows. Modules in a row can be placed end-to-end or spaced one another individually or in groups. See Figures 9 to 13 for details. Rows can be made of straight lines, angled or curved. Modules may be placed inside the absorption bed geometry in a manner which best serves the installation site, its constraints and drainage properties.

Placement of modules over the absorption bed is an important design consideration to promote effluent dispersion and avoid effluent mounding. With the ELJEN GSF biofiltration modules, there are often multiple possibilities of configurations on a site. Here are some of the governing principles for optimal module placement. Optimal placement is considering effluent distribution efficiency as well as ease of installation:

- The ELJEN GSF treatment component of the combined treatment and dispersal system consists of modules with a minimum of 150mm of Specified sand on each side and under the modules. This configuration will create a compact treatment area meeting the minimum requirements of Eljen GSF primary and secondary treatment zones, see Figure 9.

- The designer must assure that treated effluent will be dispersed properly over the entire absorption areas. To achieve this, if any part of the absorption bed that is located more than 3m away from an Eljen row, the basecut must have a 2% slope starting at a maximum of 3m from that row and sloping away from the row and provided with an equivalent additional thickness of Specified sand or imported sand to promote good lateral drainage and avoid mounding. See Figure 14 for an example.

- On a sloped site (slope of native soil greater than 2% but not greater than 25%), modules can be spread apart in equal groups of modules to extend the length of the distribution over the long dimension of the absorption bed. **Design on sloped site must also comply with linear loading rate limitation on sloped sites. Refer to section 4.0.**

2.7 DISTRIBUTION:

Gravity, pump to gravity or pressure distribution are acceptable when using the Eljen GSF System. Piping shall meet the Ontario Building Code or good Engineering design practices, for solid and perforated drainage pipes.

Gravity Distribution refers to the absence of pump or siphon to feed the effluent to the ELJEN modules. When using strictly gravity distribution, a distribution box equipped with a flush valve or surge device is mandatory. The use of elbows and tees (traditional pipe header) as the primary mean of splitting effluent is not permitted.

Pump to Gravity refers to the use of a pump or siphon to feed the effluent to the Eljen system. The pressure device must allow for adjusting discharge rate and dose volume per event. Regular D-box or a surge device can be used in pump to gravity systems.

Low Pressure Distribution refers to the use of pump or siphon creating pressurizing the entire distribution network with a squirt height between 0.6 and 2m at each orifice and a difference in squirt height not more than 10% between orifices

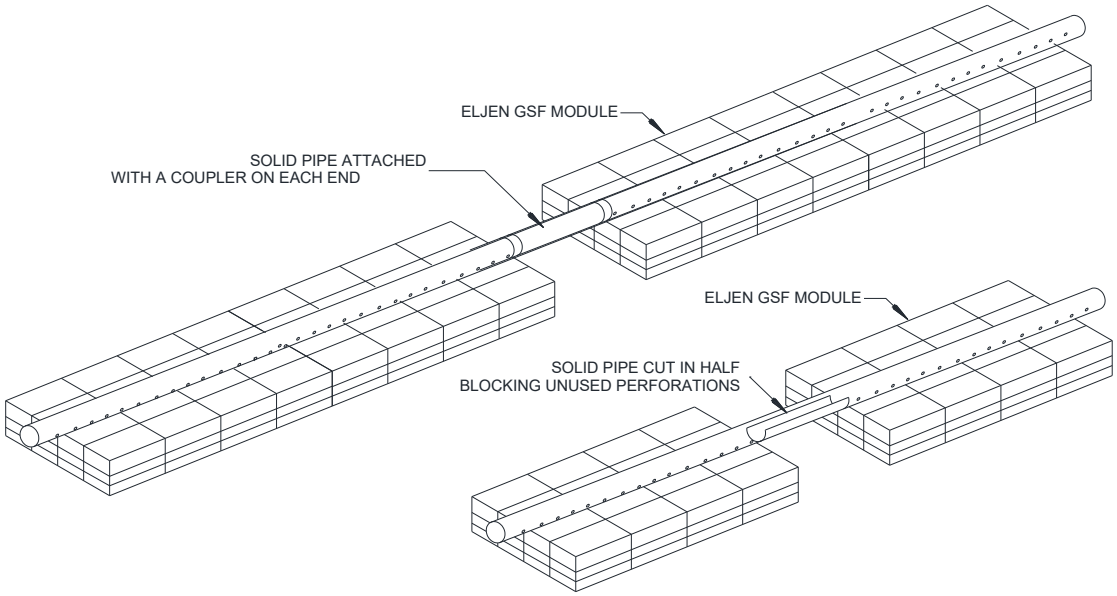
Place the approved perforated pipe (75 or 100 mm ∅) centered on top of the Eljen GSF modules with holes at 4 and 8 o'clock. The distribution pipe may be level or have up to 1% slope in the direction of flow. When a slope is provided to the distribution pipe and GSF modules, the thickness of the Specified sand must be adapted to provide a minimum thickness of 150 mm at the lowest extremity of the distribution pipe.

When the modules are placed forming an angle to follow contour lines or to go around obstacles, the perforated distribution pipe shall in no case be closer than 150 mm from the side of the module as measured from the center of the distribution pipe. Use elbows when require creating bends.

Complete system piping (everything not located over the Eljen GSF modules) with solid pipe and fittings. Refer to Sections 3 and 4 for level and sloped site piping information respectively.

All Eljen GSF Systems require the perforated pipe to be centered on top of the GSF modules unless the system is curving. The distribution pipe continues along the entire length of the modules. Holes are set at the 4 and 8 o'clock position and secured by the Eljen provided wire clamps. In all applications, any pipe distribution holes not discharging onto the GSF module must be sealed or solid pipe used. See the figure below for suggested method of sealing perforated holes.

FIGURE 5: END-TO-END SEPARATION FOR ALL APPLICATIONS



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

2.9 GRAVITY DISTRIBUTION DEVICE PERMITTED:

Only Distribution boxes EQUIPPED with a surge device or flush valve such as the SeptiSurge or equivalent, can be used in strictly gravity configuration.

Distribution Box NOT EQUIPPED with a surge device, or flush valve CANNOT be used in a Gravity Distribution System but can be used in a Pumped to Gravity configuration.

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Pipe headers (elbows and tees to split effluent) are prohibited on strictly gravity distribution systems as the principal effluent distribution mean. On large systems with pressure distribution or pump to gravity distribution, headers can only be used as the secondary mean of distribution (second level of splitting).

Distribution boxes must be installed level and on a compacted layer of sand or a base of gravel to prevent movement over time.

Using any type of D-box, ALL OUTLETS INVERT MUST BE LEVEL. Slope can be provided only once the distribution pipe as cleared at least 300mm (12 inch) from the D-box. This allows all outlets to be level and assure optimal distribution. D-box must be cleaned at least once a year.

The fill below the D-Box and distribution piping must be adequately compacted to avoid settling and render the outlet invert unlevel inside the D-box. Flow Equalizers (speed levelers) can be used for gravity systems.

In a design where gravity header is used as secondary effluent distribution mean (prohibited as the primary effluent distribution mean), the fittings (elbow or tee) must be properly seated on the edge of the Eljen GSF module to assure stability and reduce risk of movement.

2.10 PARALLEL DISTRIBUTION: Parallel distribution is the preferred method of dosing to a gravity or pump to gravity system. It encourages equal flows to each of the module rows in the system.

2.11 ANTI-SILTATION FABRIC: Anti-Siltation fabric is provided by Eljen Corporation for all Eljen GSF Systems. It is placed over the top and sides of the module rows to prevent long term siltation and failure. **Anti-Siltation fabric substitution is not allowed.** Anti-Siltation 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 the Anti-Siltation fabric and pipe.

The remaining area of the absorption bed should be free of geotextile fabric. Fabric must only cover ELJEN modules.

Note: If modules are spaced end-to-end, the Anti-Siltation fabric must be cut and allowed to drape over and protect the ends of each spaced module. A continuous run of Anti-Siltation fabric is not allowed for these applications.

Example of how to wrap the Anti-Siltation fabric over a pipe: Cut a T in the anti-siltation fabric across and along the pipe. Wrap the anti-siltation fabric around pipe. Hold in place with sand.

2.12 SYSTEM VENTING: All systems require sufficient oxygen supply to the effluent dispersal area to maintain proper long-term effluent treatment. Venting is generally provided by the natural movement of air entering the soil and drafted out to the building roof vent. However, the following situations require additional measures for venting:

- Any system with more than 450 mm of total cover as measured from the top of the module.
- Areas where soil density and natural compaction is significant.
- Any system fed with a pressurized pipe therefore preventing the adequate operation of the building vent (pump to gravity, pressure or any forced main in between the house plumbing and the Eljen system).

FIGURE 6: AIR BY-PASS LINE FOR VENTING PUMPED SYSTEMS

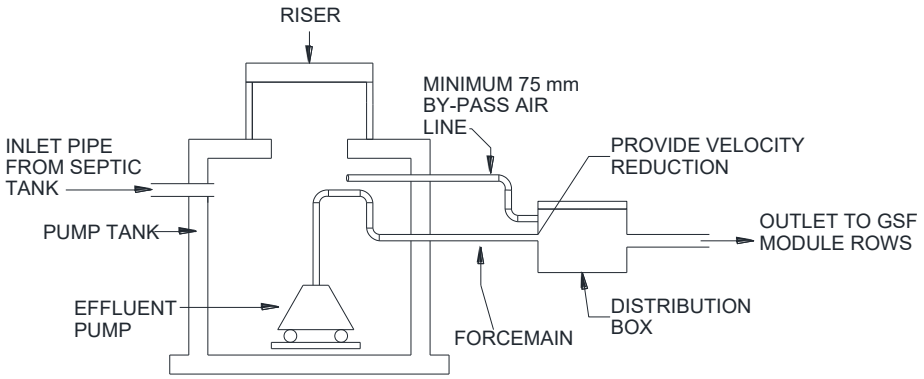


Figure 6 gives the general principle of pumped system venting using an air bypass line. See Section 10.0 for more detailed explanations of venting ELJEN GSF Systems.

2.13 BACKFILL & FINISH GRADING: Carefully place uncompacted breathable and clean backfill over the modules, followed by a minimum of 150 mm of topsoil to complete a total minimum depth of 300 mm as measured from the top of the module. Systems with total cover that exceed 450 mm as measured from the top of the module shall be vented at the far end of the system.

Backfill material should be a well-graded sandy loam fill; clean, porous, breathable and devoid of silt, clay and rocks larger than 50 mm (ie: Fill material with a percolation time not exceeding 18 minutes).

Design grading to divert surface runoff from the absorption bed area. Finish grade to prevent ponding.

Seed / sod to protect Absorption Bed from erosion.

2.14 NUMBER OF ELJEN GSF MODULES REQUIRED: Each Eljen GSF A42 module is designed to a standard loading for residential strength effluent of 95 liters per day per module or a maximum of 19 grams of BOD (considering septic tank effluent). For all systems receiving typical domestic strength wastewater (raw sewage BOD not exceeding 300 mg/l), the number of A42 GSF modules is calculated by dividing the Daily Design Flow (Q in L/day), as detailed in the BMEC authorization, by 95 L/day/module.

Number of Eljen GSF modules = Q / 95

2.15 SAMPLING DEVICE: The sampling device refers to the assembly required on every Eljen GSF System and allows for taking a sample of the treated effluent. The sampling device is installed below the Specified Sand and placed lengthwise under the first and last Eljen GSF modules of one row. This sampling pipe is extended using solid 100 mm pipe to the surface where a cap allows access for sampling. Refer to Section 13 for complete details of the sampling device.

3.1 MINIMUM SYSTEM CONFIGURATION:

Design of in-ground, partially raised or fully raised systems with:

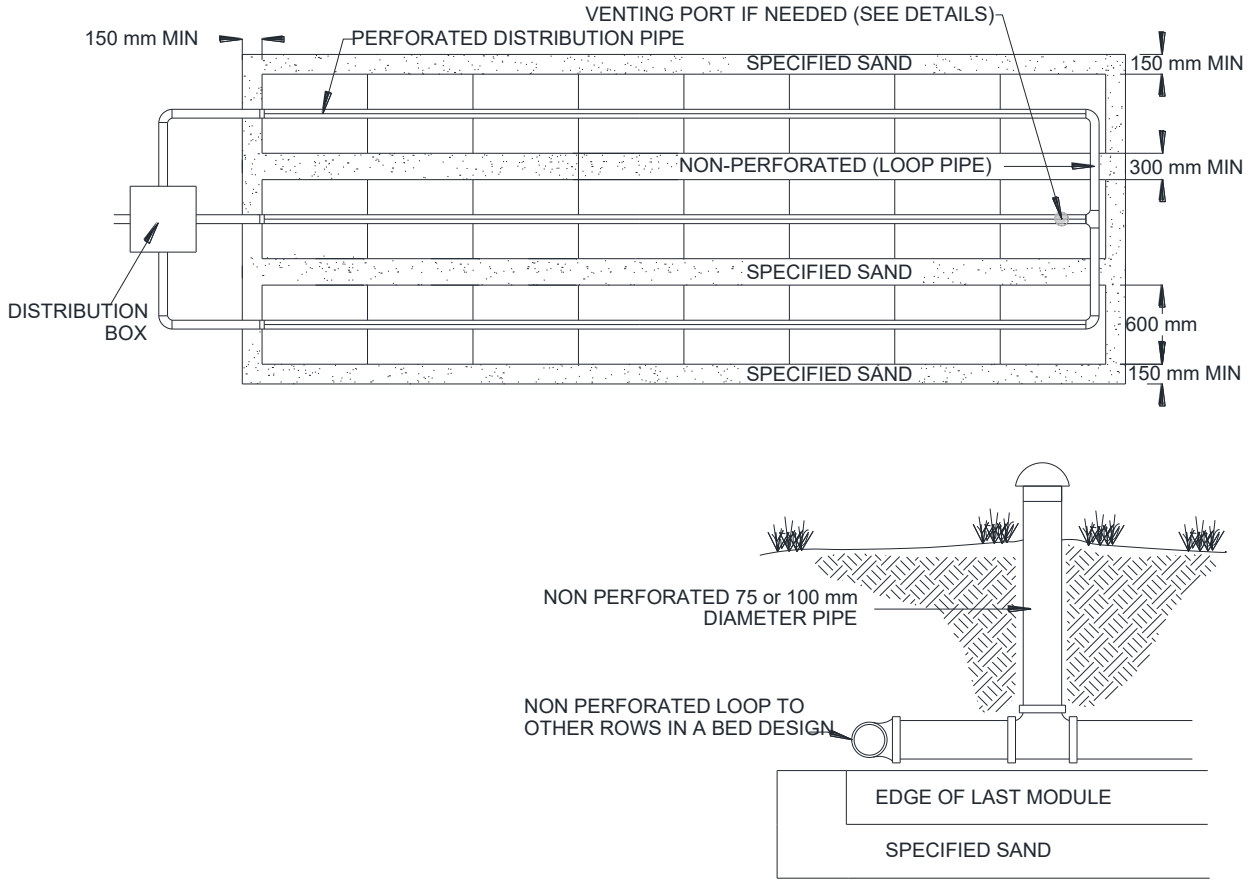
- 150 mm minimum spacing between Specified Sand outside perimeter and modules;
- 150 mm minimum spacing between the receiving soil and bottom of the modules;
- 300 mm minimum spacing between rows of modules;
- The modules forming a row can be laid end-to-end or spaced from one another;
- The Specified Sand, Eljen GSF modules and distribution pipes are installed level or up to 1% slope in the direction of flow.

3.2 DISTRIBUTION PIPE LAYOUT: Approved perforated pipe (75 or 100 mm ∅) runs along the center of the modules. Ends of rows are connected together with approved (75 or 100 mm ∅) solid pipe. Solid pipe is used to connect perforated lines to the distribution box.

Where the Eljen GSF System is fed by gravity or pump to gravity, each distribution pipe shall not exceed a maximum length of 18 m between the first and last point of effluent release,

Where the Eljen GSF System is fed by low pressure distribution system (see Section 9.0 for details on low-pressure distribution systems), each distribution pipe shall not exceed a maximum length of 30 m between the first and last point of effluent release,

FIGURE 7: ELJEN GSF SYSTEM MINIMUM SPACINGS



4.0 Sloped Site Systems

4.1 SYSTEM CONFIGURATIONS: Sloped site is a contact area with an average slope greater than 2% but not greater than 25%. Rows of Eljen GSF modules are laid at different elevations, following the slope of the site in a “stepped” pattern. Each step can contain one or more rows of ELJEN modules. Row within a step must be level.

4.2 GOVERNING DIRECTION OF FLOW: Effluent will flow both horizontal and vertical in sloped site. The governing direction of flow in sloped site will be vertical in more permeable soil with greater unsaturated vertical separation. Horizontal flow will be prevalent in denser and/or less permeable soil. Horizontal flow will also govern in shallower available vertical separation. Governing horizontal movement may lead to higher risks of effluent ponding within the Absorption Bed or downstream. Designers must take great care in assuring adequate movement of effluent laterally while always keeping the vertical separation as well as the specified sand unsaturated at all times and in all seasonal conditions (thaw, heavy rain, etc.). To control that risk, the design must take into account the Hydraulic Linear Loading Rate of the receiving soil.

Darcy’s Law governs lateral movement of effluent in unsaturated soils. Proper length will assure limited and controlled mounding keeping the Specified sand and vertical separation distance unsaturated at all times, especially seasonally during thaw or heavy rain events. Long dimension of the bed must be parallel to contour lines.

In sloped site, additional thickness of specified sand or imported sand fill may be required. As the effluent moves downslope, effluent from upper rows adds up to the total effluent volume the soil must carry away down. This compounding effect can rapidly create mounding if there is insufficient unsaturated soil thickness. We encourage designers to increase specified sand or imported sand thickness going downslope if required.

4.3 ROW SPACING: Row spacing in sloped site must comply to the minimum of 300mm between module rows. As the slope increases increasing the spacing between rows must be considered to avoid having the effluent from upper rows to travel across the ELJEN GSF secondary treatment zone (150mm of Specified sand) of lower elevation rows.

4.4 EFFLUENT DISTRIBUTION: On gravity or pump to gravity systems, install the distribution box at an elevation higher than the highest distribution pipe. The first 300mm of distribution pipe exiting the distribution box must be level over a compacted layer of good soils to avoid uneven elevation of outlet inverts within the D-box. Use elbows or flexible coupling to create slope once cleared from the D-box.

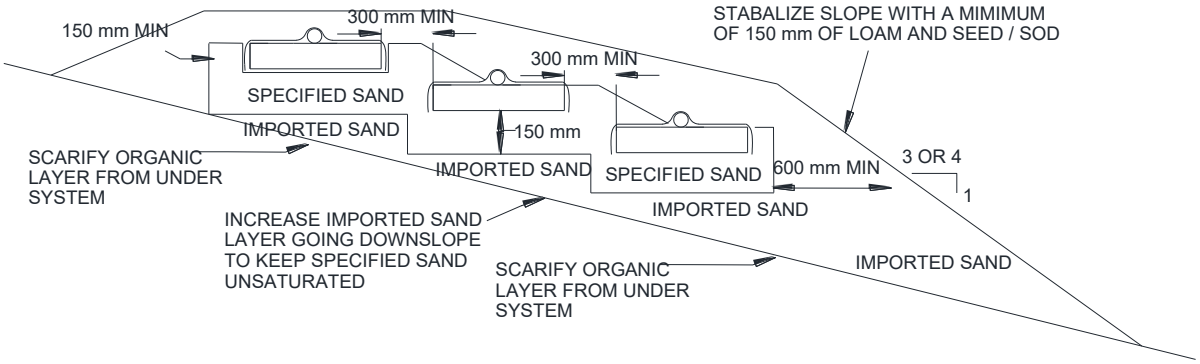
Important Note: Do not loop distribution pipe ends on sloped site to avoid moving effluent downward.

4.5 BASECUT PREPARATION: Basecut of the absorption bed must be level. On a sloped site this often requires breaking down the absorption bed in multiple “steps” or “levels” at different elevations to avoid excessive depth or maintaining adequate vertical separation upslope. Each step, across the width of the absorption bed, needs to be level.

4.6 HYDRAULIC LINEAR LOADING RATE (HLLR): Sloped system must comply to the maximum allowable linear loading rate. This provides a system length assuring lateral movement of effluent reducing risks of mounding.

T Time	Soil class	Maximum HLLR (L/m/d)		
(min/cm)		Slope 2 to <10%	Slope 10 to < 15%	Slope 15 to ≤ 25%
1 ≤ T < 15	Sand to loamy sand (CSL, SL)	150	200	250
15 ≤ T < 50	Fine sand, Silt, Loam (FSL, VFSL, L, SIL)	60	80	100
T ≥ 50	Clayed soils (SC, C, SIC, SCL, CL, SICL)	40	50	60

FIGURE 8: RAISED BED ON SLOPE



5.0 System Sizing and Guidelines

5.1 DESIGN PARAMETERS SUMMARY

5.1.1 Vertical Separation:

The percolation time (T) of the natural soil shall determine the minimum vertical distance from the bottom of the Eljen GSF System 150 mm depth Specified Sand to the high seasonal ground water table, bedrock or soil with a percolation time (T) greater than 50 min/cm:

- if T is less than or equal to 6 min/cm, or greater than 50 min/cm, then the vertical separation distance shall be at least 600 mm, or
- if T is greater than 6 min/cm, or less than or equal to 50 min/cm, then the vertical separation shall be at least 450 mm.

Imported sand fill with a $6 \leq T \leq 10$ can be used to comply to vertical separation requirements (refer to Item 1.6).

5.1.2 Number of Eljen GSF A-42 modules Required:

Each Eljen GSF A-42 module has the capacity to treat 95 L of domestic wastewater per day. Thus, the number of Eljen GSF modules required:

- The formula to determine the number of Eljen GSF modules required is Q / 95, where Q is the daily design sewage flow as determined in accordance with the Ontario Building Code.
- The number of Eljen GSF modules obtained must be rounded up at all times.

5.1.3 Module Spacing Requirements:

The Eljen GSF modules shall be spaced using the following criteria:

- Each modules of a given row are placed end-to-end or in groups.
- Each row is spaced at a minimum of 300 mm calculated side to side of modules.
- Each row starts and stops at a minimum of 150 mm inside the perimeter of the absorption bed.
- Modules can be placed in angle to follow site topographic contours or avoid obstacles.
- Modules may be placed inside the system absorption bed in a manner which best serves the site and its constraints and required clearances (as detailed in OBC Table 8.2.1.6.B and Article 8.2.1.4)
- Modules configuration smallest footprint corresponds to 150 mm of Specified Sand shoulders on each side of the modules. This configuration will create a treatment area meeting the minimum requirements of Eljen GSF primary and secondary treatment zones. The remainder of the absorption bed area function as the dispersal area for infiltration of treated effluent into the native soils.

5.1.4 Absorption Bed Area (A) – In-ground, Partially Raised, or Fully Raised System

The area (m^2) to be covered by the Specified Sand (and imported sand fill when installed) in the Eljen GSF System shall be equal or larger than the area (A) determined by the formula A = Q T / 400, in which the T is the percolation time (T) in min/cm of the native soil - to a maximum of 50 min/cm - and Q is the total daily design sewage flow in (L).

- In all Eljen GSF System designs the minimum spacing requirement shall be met.
- Where the area determined using QT/400 is larger than that required by the minimum area required for spacing of modules as detailed in above Item 5.1.3, the Eljen GSF modules may be placed inside the absorption bed in a manner which best serves effluent distribution, the site and its constraints.
- The dispersal surface long dimension must be perpendicular to the direction of groundwater flow.
- When the native soil has a T of 50 min/cm or greater, the Eljen GSF System must be fully raised (exception for sloped site where the system can be partially raised on the upslope side).
- The Absorption Bed Area can be divided in multiple absorption beds each receiving effluent volume proportional to its area.
- Basecut need to be sloped 2% away from modules if there is more than 3m between a row and edge of the absorption bed (see picture 14).
- In sloped site, geometry must comply to linear loading rates as described in Section 4.6 of this manual.

5.1.5 Other

The Eljen GSF System shall be designed, installed, operated, and maintained using these criteria:

- No Eljen GSF System shall be installed in an area in which the original ground has a slope in excess of 4 horizontal to 1 vertical (i.e. 25% slope).
- All pumped systems shall provide venting. This can be achieved using a buried pipe connecting the Eljen gravity distribution to the incoming gravity influent pipe from the house or using a stand-alone vent connected to the Eljen GSF distribution footer pipe.
- Except when used with a “Low Pressure Distribution System” (See section 9.0 for details on low-pressure distribution systems), all Eljen GSF Systems that have a pump must use a velocity reducer located in the distribution box or transitioning to a 75 or 100 mm gravity pipe at least 2 m from the distribution box. Flow entering a distribution box must assure it does not overflow
- All fully gravity fed system must use a distribution box equipped with a flush valve or surge device creating a dose with velocity in the distribution pipe. Traditional pipe header are prohibited as the principal mean of distribution of gravity Eljen GSF Systems.
- The Eljen GSF System shall have a sampling device, for the purpose of sampling the treated effluent below the specified sand and it shall be installed as described in Section 13 of this manual. The sampling port parts are supplied by Enviro-Step Technologies Inc. or its representatives.
- The site shall be protected from erosion by proper grading, seeding, sod and runoff control.
- The Eljen GSF peripheral modules in the bed, measured from the centre of the perforated distribution pipe, shall meet the setback requirements outlined in Article 8.2.1.4. and Table 8.2.1.6 B of Division B, of the Ontario Building Code.
- No reduction in size of the Eljen GSF System is permitted with the use of treatment device beyond that of a septic tank.
- The distribution pipe in the ELJEN GSF System are to be provided with a mean of detection as detailed in Article 8.7.2.2 of Division B of The Building Code.

5.2 SIZING TOOLS

5.2.1 Excel Spreadsheet: Available from Enviro-STEP.

ELJEN GSF DESIGN SPREADSHEET
(BMEC Approval 15-02-376)

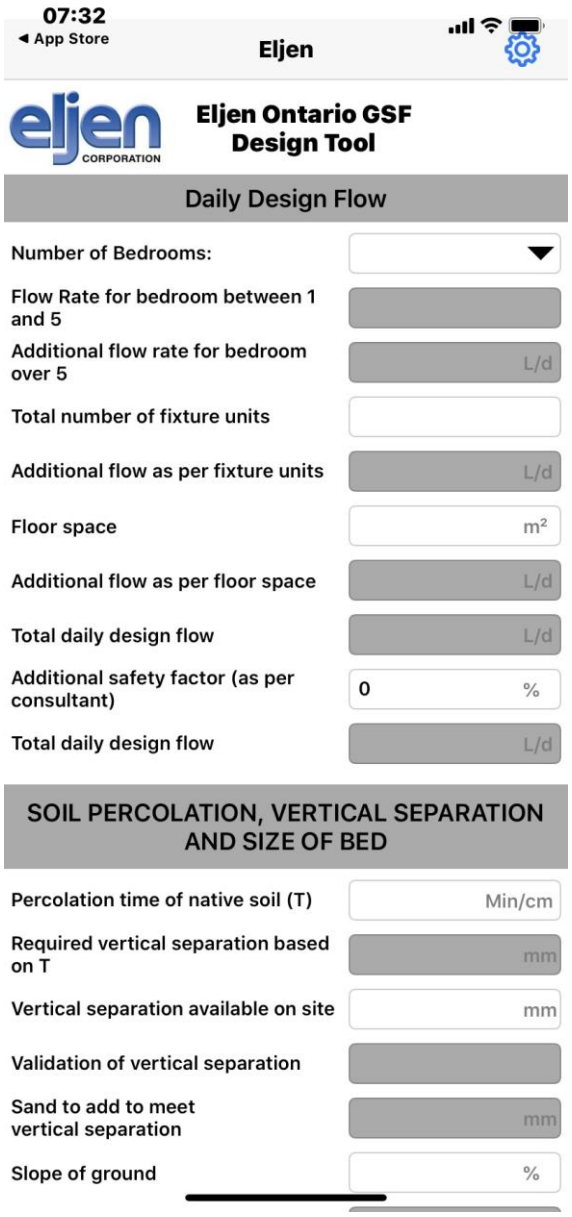
VALUE ENTERED BY USER
CALCULATED VALUE OR MESSAGE
KEY DESIGN INFORMATION

Project :	
Location:	

ESTABLISHING DAILY DESIGN FLOW			
Number of Bedrooms:	3	bedrooms	
Flow Rate for bedroom between 1 and 5	1600		*352.4 gpd*
Additional flow rate for bedroom over 5	0	L/d	*0.0 gpd*
Total number of fixture units	33.5	Total fixture units	
Additional flow as per fixture units	675	L/d	*148.7 gpd*
Floor space	195	m²	
Additional flow as per floor space	0	L/d	*0.0 gpd*
Total daily design flow	**2275**	**L/d**	*501.1 gpd*
Additional safety factor (as per consultant)	0	%	
Total daily design flow	**2275**	**L/d**	*501.1 gpd*

SOIL PERCOLATION, VERTICAL SEPARATION AND SIZE OF BED			
Percolation time of native soil (T)	50	min/cm	
Required vertical separation based on T	450	mm	*18 inch*
Vertical separation available on site	0	mm	*0 inch*
Validation of vertical separation	ADD SAND		
Sand to add to meet vertical separation	450	mm	*18 inch*
Slope of ground	0	%	
Validation of slope (must be <25%)	OK		
Minimal Infiltration surface required (QT/400)	284.4	m²	*3060 ft²*

5.2.2 Downloadable APP: Available in the Apple Store or Google Play under Eljen Ontario Design App.



6.0 Level Absorption Bed Installation and Guidelines

The following section presents detailed layout, instructions and examples for the construction of Eljen GSF absorption beds with level basecut.

FIGURE 9: EXAMPLE – ABSORPTION BED SHOWING SMALLEST CONFIGURATION

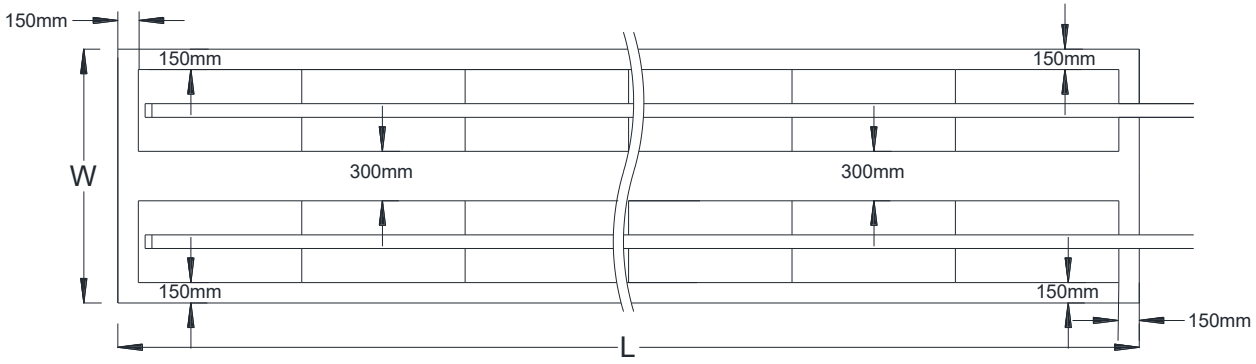


FIGURE 10: EXAMPLE – ABSORPTION BED WITH END-TO-END MODULES

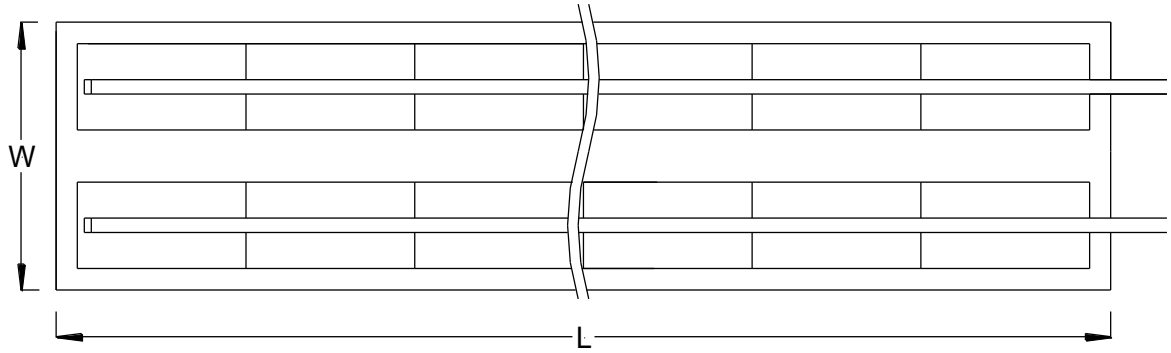


FIGURE 11: EXAMPLE – ABSORPTION BED WITH GROUPED MODULES

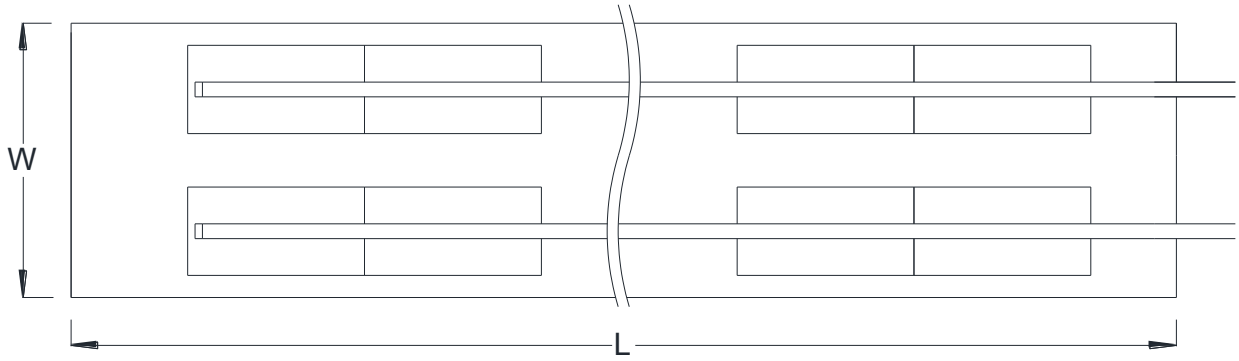


FIGURE 12: EXAMPLE – ABSORPTION BED WITH SPACED MODULES

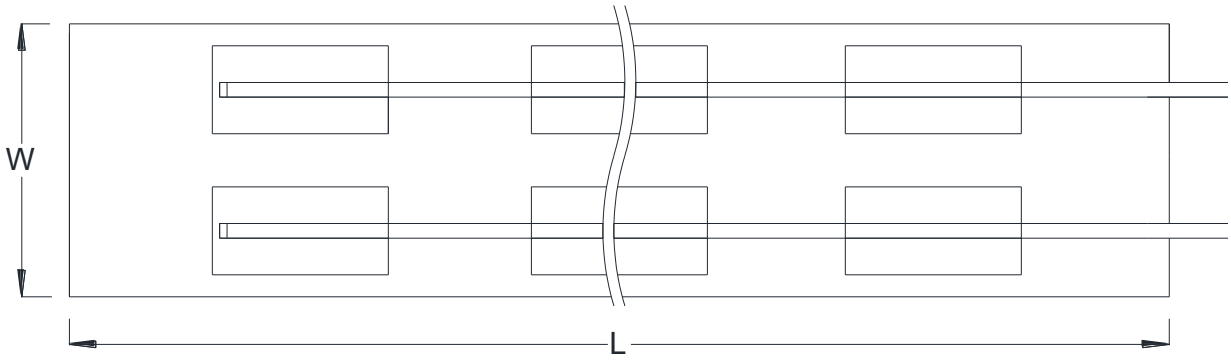


FIGURE 13: EXAMPLE – ABSORPTION BED WITH SETBACK RESTRICTIONS

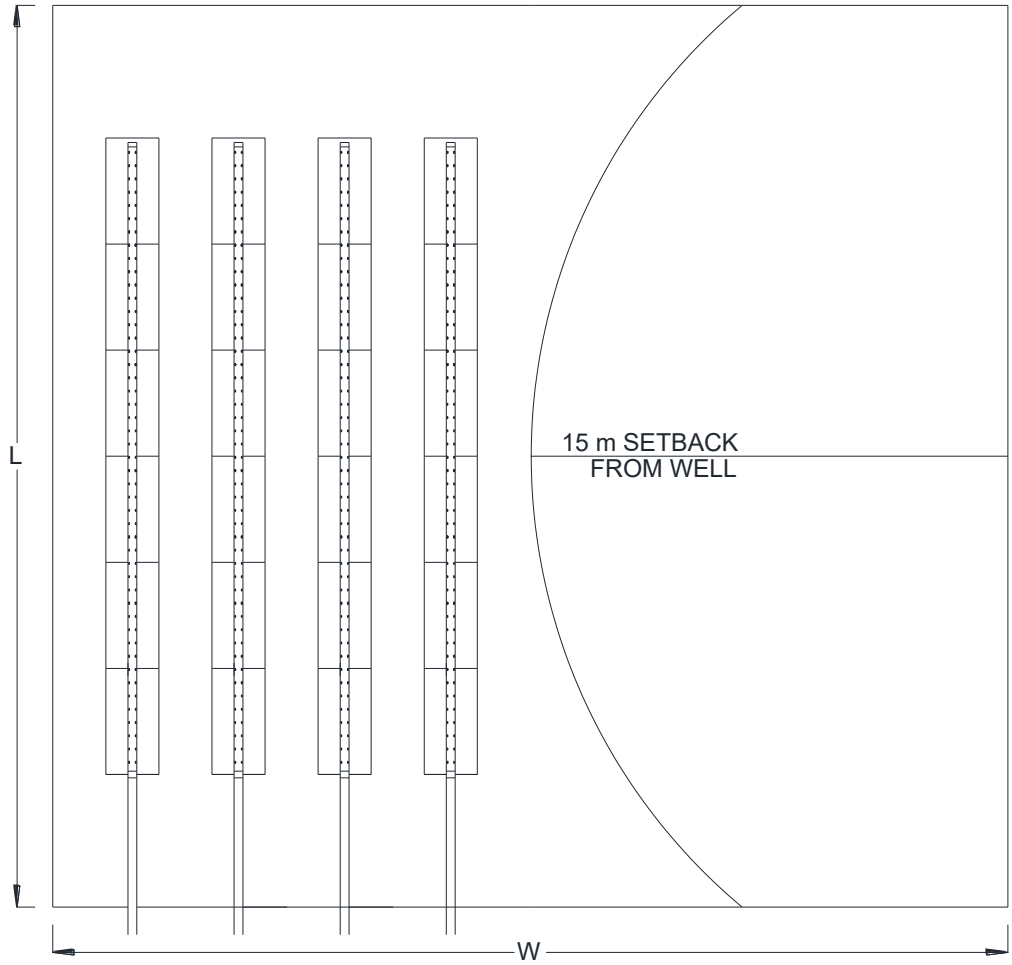


FIGURE 14: EXAMPLE – ABSORPTION BED WITH SETBACK RESTRICTIONS

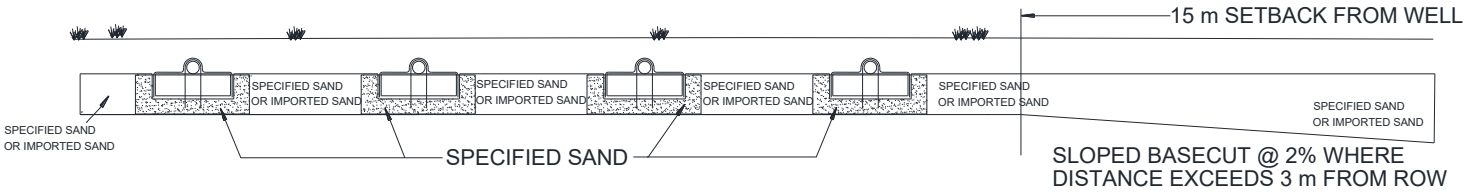


FIGURE 15: EXAMPLE – ABSORPTION BED SYSTEM WITH IMPORTED SAND

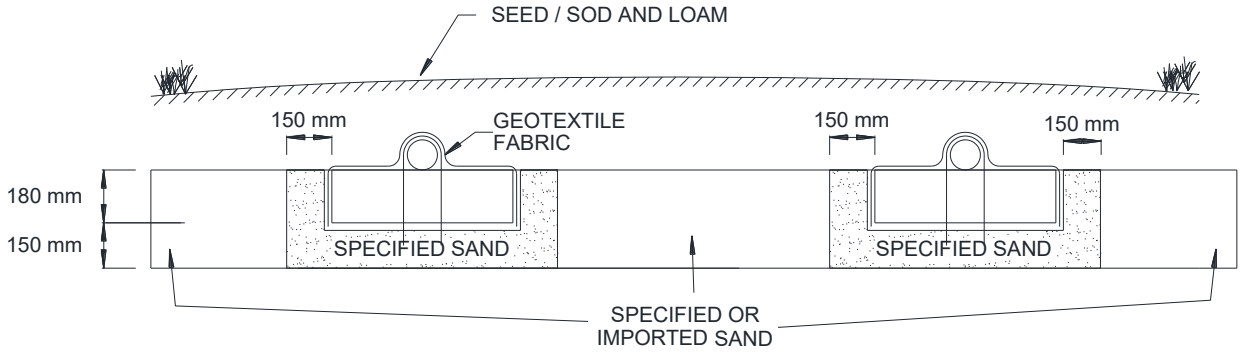


FIGURE 16: EXAMPLE – IN-GROUND ABSORPTION BED SYSTEM

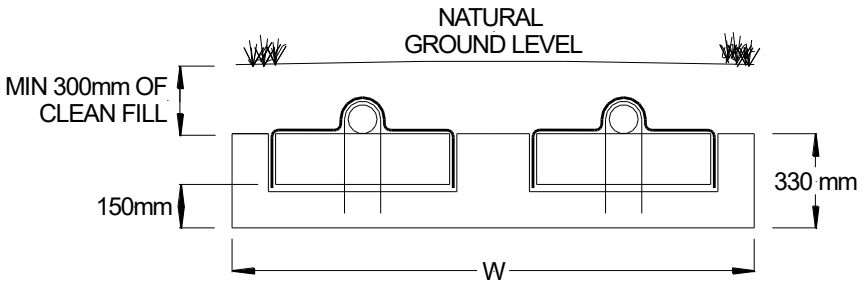
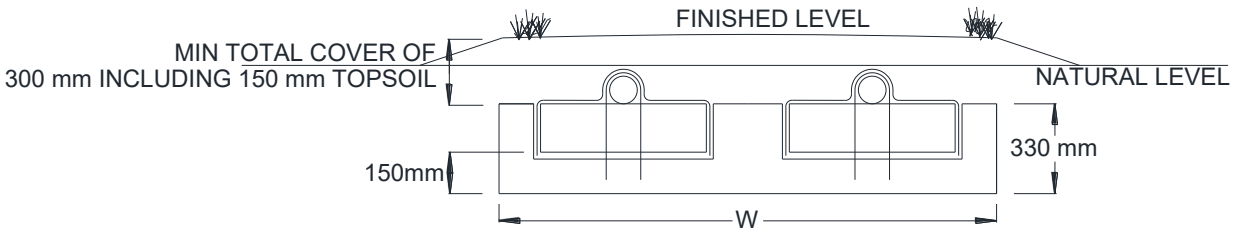


FIGURE 17: EXAMPLE – PARTIALLY RAISED ABSORPTION BED SYSTEM



6.0 Absorption Bed Installation and Guidelines

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

2. The design drawings should present the system layout and details. The Installers must reproduce the system layout with respect to surface covered, spacing, number of modules, type of material, elevations, wastewater distribution, primary treatment, etc.

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

4. Plan all drainage requirements above (up-slope) of the system as to not adversely affect systems area. Set soil grades to ensure that storm water drainage and ground water is diverted away from the absorption bed area once the system is complete.

5. Excavate the absorption bed area, including organic / topsoil and native soils to specified design elevations; Scarify the receiving layer to approximately 150 mm in depth to maximize the interface between the native soil and Specified Sand.

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

7. Place a minimum of 150 mm layer of Specified Sand above the native soil grade. Gently hand compact, level and rake the Specified Sand on grade. A hand tamper is sufficient to stabilize the Specified Sand below the Eljen GSF modules. The finished height below the Eljen GSF module must be 150 mm minimum. Check the zero grades with a laser level before placing the Eljen GSF modules.

8. Place Eljen GSF modules with PAINTED STRIPE FACING UP, on top of the Specified Sand following the design drawings in regard to number of rows, spacing between rows, spacing around the Specified Sand perimeter, end-to-end modules spacing and number of Eljen GSF modules per row.

9. If using a D-box(s), installation must follow the manufacturer's guidance. The D-box receiving soil must be compacted to avoid differential movement. For gravity system use D-box with a flush or surge device.

10. Use approved 75 or 100 mm ∅ non-perforated pipe from the distribution box to the Eljen GSF modules. Orifices are set at the 4 & 8 o'clock position.

11. In applications where modules are spaced end-to-end to increase effective length of distribution, all perforated holes not discharging at least 150 mm onto an Eljen GSF module must be sealed. See Figure 5 for details.

12. All 75 or 100 mm pipes are secured with manufacturer's supplied wire clamps, one per module. Push clamp ends straight down into up-facing core, through the module geotextile fabric and into the underlying sand.

13. (Pressurized Distribution Systems) Insert a pressure pipe (size per design and code) into the standard 75 or 100 mm perforated pipe. The pressure pipe orifices are set at the 12 o'clock position as shown in Figure 20. Each pressure lateral will have a drain hole at the 6 o'clock position. Each pressure lateral shall include sweeping cleanouts at the terminal ends and be accessible from grade.

14. ***Anti-Siltation Fabric substitution is not allowed.*** The installer should lay the Eljen provided Anti-Siltation fabric lengthwise down the row, with the Anti-Siltation fabric fitted to the perforated pipe on top of the Eljen GSF modules. The Anti-Siltation fabric should be neither too loose, nor too tight. The correct tension is set by:
    a. Spreading the anti-siltation fabric over the top of the module and down both sides of the module with the anti-siltation fabric tented over the top of the perforated distribution pipe.
    b. Place shovelfuls of Specified Sand directly over the pipe area allowing the anti-siltation fabric to form a mostly vertical orientation along the sides of the pipe. Repeat this step moving down the pipe.
    c. No fabric shall cover soil outside of the module perimeter

15. Place Specified Sand along both sides of the modules edge. A minimum of 150 mm of Specified Sand is placed at the beginning and end of each module row. Absorption beds on level sites require a minimum spacing of 300 mm of Specified Sand between parallel module rows. No mechanical connection is required between modules.

16. Use Specify sand or imported sand with a T time between 6 and 10 min/cm to cover the remainder of the absorption area beyond 150mm of the modules

17. Complete backfill over the Specified sand or imported sand with permeable soil (ex: Sandy Loam) to a minimum of 150 mm over the GSF modules. Place a minimum of 150 mm of topsoil on top of the fill. Total backfill exceeding 450 mm requires venting at the far end of the trench. Fill should be clean, porous and devoid of debris, large rocks and organic matter. 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.

18. Divert surface runoff from the absorption bed. Finish grade to prevent surface ponding. Topsoil and sod/seed absorption bed area and adjacent drainage swales to protect from erosion.

7.1 RAISED ABSORPTION BED: The following guidelines provide an overview for partially raised or fully raised design and construction. Raised distribution can either be gravity, pump to gravity or pressurized.

FIGURE 18: EXAMPLE – RAISED SYSTEM

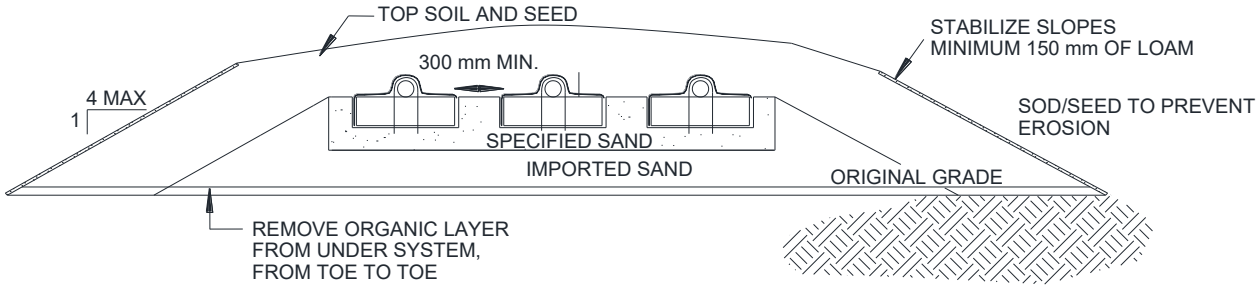
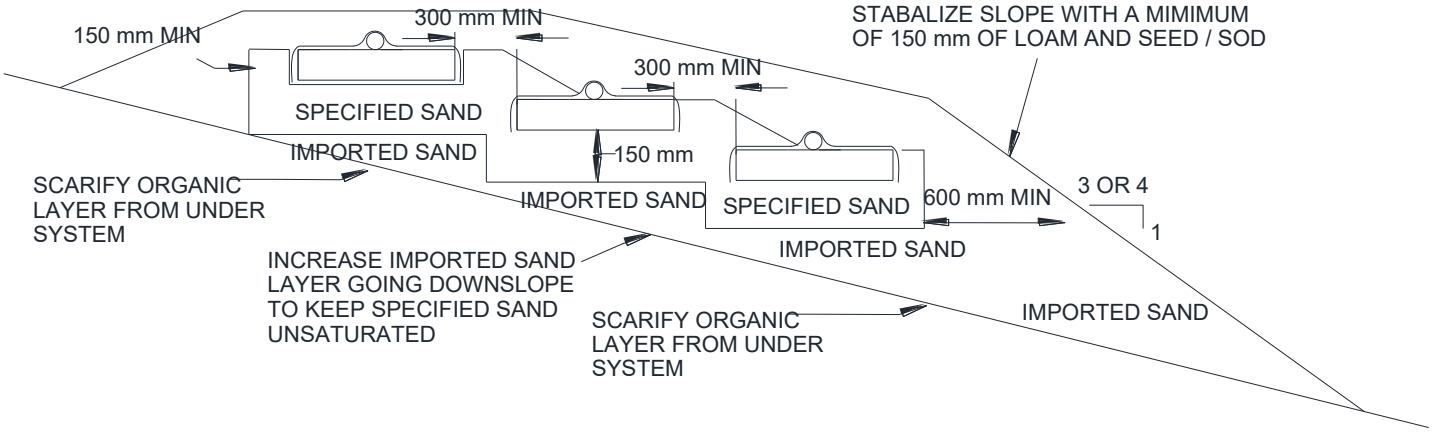


FIGURE 19: EXAMPLE – SLOPED RAISED SYSTEM



7.0 Raised Absorption Bed Installation Guidelines

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

2. The design drawings should present the system layout and details. The Installers must reproduce the system layout with respect to surface covered, spacing, number of modules, type of material, elevations, wastewater distribution, primary treatment, etc.

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

4. Plan all drainage requirements above (up-slope) of the system as to not adversely affect systems area. Set soil grades to ensure that storm water drainage and ground water is diverted away from the absorption area once the system is complete.

5. Excavate the organic / topsoil Layer and native soils to specified elevations. Scarify the receiving layer to around 150 mm depth to maximize the interface between the native soil and Specified Sand.

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

7. Place imported sand material meeting BMEC requirements onto the soil interface as you move down the excavated area. If this is done in two steps, bring in any imported sand material from the up-slope side of the excavation. Place 150 mm layer of Specified Sand above the imported sand grade. Gently hand compact, level and rake the sand on grade.

8. A hand tamper is sufficient to stabilize the Specified Sand below the Eljen GSF modules. Check the zero grade of the top of the Specified Sand using a 2 x 4 and carpenter's level or a laser before placing the modules

9. Place GSF modules with **PAINTED STRIPE FACING UP**, on top of the Specified Sand following the design plans in regard to number of rows, spacing between rows, spacing around the Specified Sand perimeter, end-to-end modules spacing and number of GSF modules per row.

10. Center approved perforated distribution pipe lengthwise over modules with orifices at 4:00 and 8:00.

11. All 75/100 mm pipes are secured with manufacturer's supplied wire clamps, one per module. Push clamp ends straight down into up-facing core, through the module fabric and into the underlying sand.

12. (Pressurized Distribution Systems) Insert a pressure pipe (size per design and code) into the standard 75 / 100 mm perforated pipe. The pressure pipe orifices are set at the 12 o'clock position as shown in Figure 20. Each pressure lateral will have a drain hole at the 6 o'clock position. Each pressure lateral shall include sweeping cleanouts at the terminal ends and be accessible from grade.

13. ***Anti-Siltation Fabric substitution is not allowed.*** The installer should lay the Eljen provided Anti-Siltation fabric lengthwise down the row, with the Anti-Siltation fabric fitted to the perforated pipe on top of the Eljen GSF modules. The Anti-Siltation fabric should be neither too loose, nor too tight. The correct tension is set by:
    a. Spreading the anti-siltation fabric over the top of the module and down both sides of the module with the anti-siltation fabric tented over the top of the perforated distribution pipe.
    b. Place shovelfuls of Specified Sand directly over the pipe area allowing the anti-siltation fabric to form a mostly vertical orientation along the sides of the pipe. Repeat this step moving down the pipe.
    c. No fabric shall cover soil outside of the module perimeter

14. Place Specified Sand along both sides of the modules edge. A minimum of 150 mm of Specified Sand is placed at the beginning and end of each module row. Absorption beds on level sites require a minimum spacing of 300 mm of Specified Sand between parallel module rows. No mechanical connection is required between modules

15. Use Specify sand or imported sand with a T time between 6 and 10 min/cm to cover the remainder of the absorption area beyond 150mm of the modules

16. Complete backfill with permeable soil (ex: Sandy Loam) to a minimum of 150 mm over the GSF modules. Place a minimum of 150 mm of topsoil on top of the sandy loam fill. Total backfill exceeding 450 mm requires venting at the far end of the trench. Fill should be clean, porous and devoid of debris, large rocks and organic matter. 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 from the absorption bed. Finish grade to prevent surface ponding. Topsoil and sod/seed absorption bed area and adjacent drainage swales to protect from erosion.

18. In raised bed configurations, the clearance distances indicated in Column 2 of Table 8.2.1.6.B of Division B of the Building Code shall be increased by twice the height that the system is raised above original grade.

8.0 Dosing Distribution Guidance

Gravity distribution refers to the absence of pump or siphon to feed the effluent to the ELJEN modules. When using gravity distribution, a distribution box equipped with a flush valve or surge device is mandatory. The use of elbows and tees (traditional pipe header) as the primary means of splitting effluent is prohibited in gravity only systems.

Pump to gravity distribution refers to the use of a pump or siphon to feed the effluent to the Eljen system. The discharged volume per dose (pump event) must be adjusted to comply to a maximum of 10 L per Eljen module per dose and to achieve even distribution over the entire system

Pressure distribution refers to the use of pump or siphon pressurizing the entire distribution network with a squirt height between 0.6 and 2m at each orifice and a difference in squirt height not more than 10% between the closest and furthest orifices

8.1 PUMP TO DISTRIBUTION BOX: Specify an oversized distribution box for pumped to gravity systems. Provide velocity reduction in the D-box with a tee or baffle. The first 300mm of distribution pipe exiting the distribution box must be level over a compacted layer of good soils to avoid uneven elevation of outlet inverts within the box. When using a SeptiSurge D-box with flush valve, adjust the pump discharge rate to a maximum of 40 USgpm (150 L/min).

Do not use flow equalizers or other restricting devices in the outlet lines of the D-box receiving pumped effluent. The pump chamber shall be vented.

8.2 DOSING DESIGN AND FLOW RATE: For all pump or pump to gravity systems; use a maximum of 10 liters per dose per Eljen GSF A42 module in the system. Adjust pump flow and run time to achieve the above maximum dose or less. Longevity of currently available effluent pumps is not affected by shorter run times. Choose force main diameter to minimize percentage of dose drain back.

Maximum flow entering the distribution box must avoid overflowing the D-box and cannot exceed 150 l/min (40 usgpm).

In all cases design for a minimum of 9 doses per day. For Commercial Eljen Systems refer to Section 11.0.

Effluent velocity in force main should not exceed 3 m/sec.

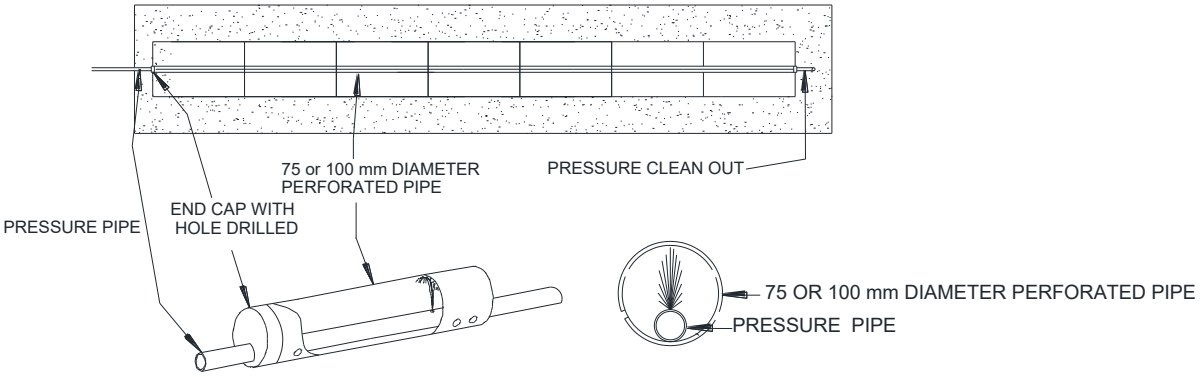
9.0 Low-Pressure Distribution Guidance

9.1 LOW-PRESSURE DISTRIBUTION: The use of low-pressure distribution is the prerogative of the Designer and mostly used for large Eljen GSF System handling flow rate above 10 000 L/d. The designer can also use low pressure to increase the effective length of distribution to 30m compared to the maximum of 18m using gravity distribution (see section 3.2).

Dosing with small diameter low-pressure laterals with calibrated orifices is acceptable for Eljen GSF Systems. Pressure distribution piping is configured as shown in Figures 20, 21 and 22. A smaller pressure pipe is inserted inside the larger perforated pipe. Distribution is assured through small diameter pressurized orifices. Drainage of the line after each pump cycle is assure through drainage orifices. One distribution orifice is drilled at 12 o'clock for each Eljen GSF A42 module. One draining orifice is drilled at 5 o'clock at the beginning of the first module of each row and at the end of the last module of each row. Orifices size is determined using low pressure distribution calculations assuring that the flow is equally divided to every orifice and the residual pressure result in a minimum of 600 mm squirt height.

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 n pressure distribution systems.

FIGURE 20: PRESSURIZED PIPE PLACEMENT



PRESSURIZED PIPE CROSS SECTION FOR ALL APPLICATIONS

FIGURE 21: PRESSURE CLEAN OUT

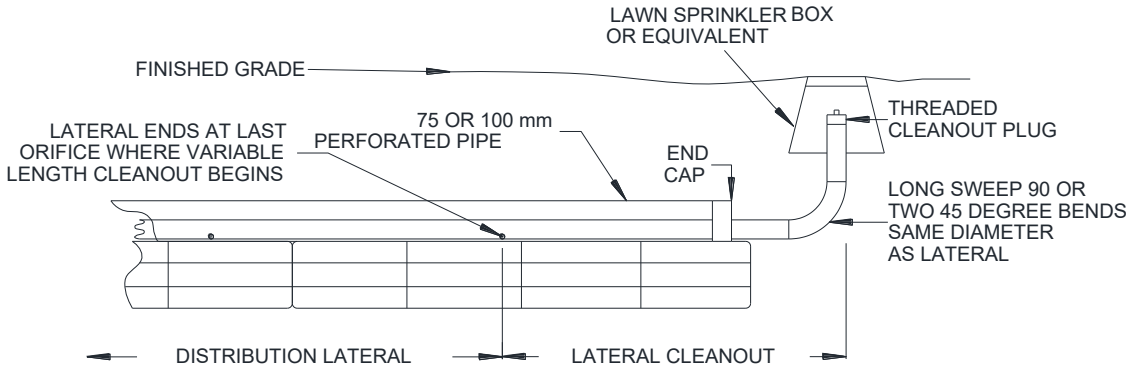
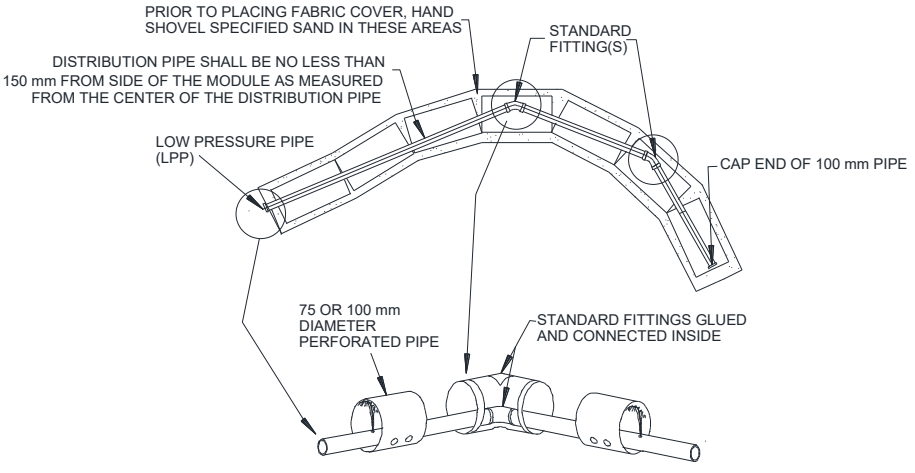


FIGURE 22: CONTOURED TRENCH PRESSURIZED DISTRIBUTION



PRESSURE PIPE CROSS SECTION FOR ALL APPLICATIONS

10.0 System Ventilation

10.1 SYSTEM VENTILATION: On systems with 450mm or less of cover over the modules, venting is usually provided by a functioning plumbing vent on the building and additional vents are facultative. Air vent (s) placed on the effluent distribution network is only required on absorption bed systems with more than 450 mm of cover material as measured from the top of the GSF module to finished grade or in a pumped to gravity system with no underground bypass venting pipe or in low pressure distribution systems. Vents ensure proper aeration of the GSF modules and Specified Sand. The GSF has aeration channels between the rows of GSF modules connecting to cuspations within the GSF modules. Under normal operating conditions, only a small portion of the GSF module 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 Eljen GSF System. Vent can be located anywhere over the gravity distribution grid or further away for esthetical reasons. See Figures 23 and 24 for examples.

10.2 VENT PIPE AND VENT PLACEMENT: Vent is typically a 100 mm (4 in.) diameter non-perforated pipe extended over natural ground level. Vent is located close to the extremity of the distribution system or end of a row of modules. The vent can also be placed further away for esthetical reasons. See Figures 23 and 24 for examples. 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 placed away from the system, the pipe must not drain effluent and must have an invert higher than the system. Elevated systems requiring venting must elevate the first meter of vent line above the top of the GSF modules with fittings to prevent effluent from migrating down the vent. The vent can then be pitched away from the system to a discrete area. A drain hole must be installed at the lowest point to drain any condensation.

FIGURE 23: VENT LAYOUTS EXAMPLES FOR GRAVITY AND LOW-PRESSURE SYSTEMS

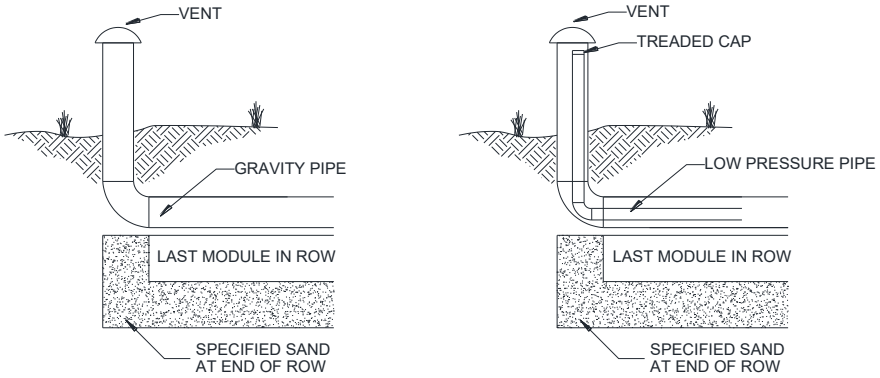
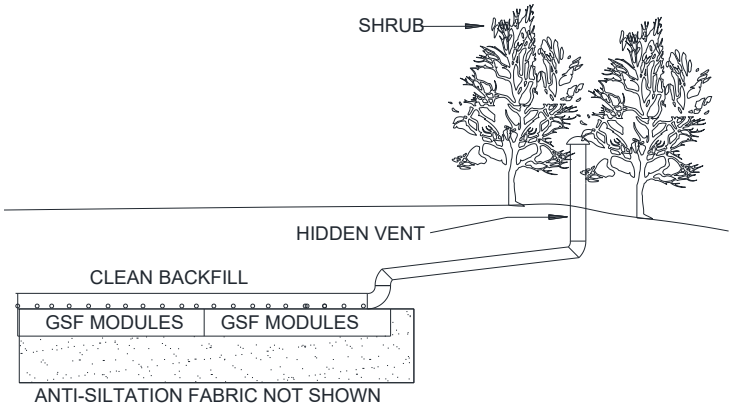
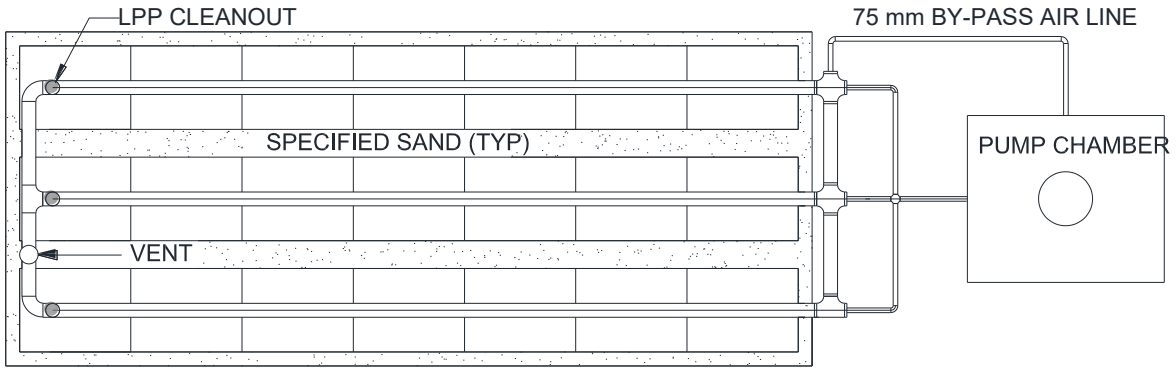


FIGURE 24: ELJEN GSF SYSTEM WITH VENT EXTENDED TO CONVENIENT LOCATION



10.4 VENTING ON PUMPED TO GRAVITY SYSTEMS USING AN AIR BY-PASS: On pumped to gravity systems, a conventional vertical vent on the distribution grid can be used as describes in section 10.2 or it is possible to use a buried by-pass line connecting the gravity portion of the incoming sewer to the gravity grid of the Eljen System. This will allow the house plumbing vent to create the adequate air movement. See the figure 25 for example of the by-pass connection.

FIGURE 25: PRESSURE DISTRIBUTION VENTING BY-PASS LINE



11.0 Commercial Eljen Systems

CONTACT ENVIRO-STEP TECHNOLOGIES OR ELJEN CORPORATION FOR COMMERCIAL DESIGN

11.1 DESIGN CONSIDERATIONS: Commercial Eljen 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 dispersal/absorption bed systems and their integrity, groundwater hydrology, drainage above and below the Eljen GSF System and design accordingly.

Designers should carefully review and document with their client, the effluent BOD_5 and TSS concentrations and water use flows. 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 start up and document technical capabilities for personnel required for Operation and Maintenance of the system.

Owners can expect operational issues when occupants are not educated/knowledgeable in the operation of the system, the discharge of excessive wastewater flows due to leaks, use of excessive water, installation of illegal items such as garbage grinders, and not performing routine maintenance on grease traps and septic tanks. Since the system owners and users may not know the costs associated with these types of problems they will not be motivated to limit effluent problems and should be educated in these types of systems. Designers must provide oversight of system installation and associated system equipment.

We strongly recommend to the designer to validate each commercial design with Enviro-STEP Technologies Engineering staff.

11.2 MAXIMUM UNIT LOADING: For commercial applications the design must be verified to assure that not only the hydraulic loading rate per GSF module is respected but also the organic loading rate (i.e. non-residential strength sewage), taking the more stringent of the two criteria.

11.3 DESIGN FLOW: To determine design flow (Q) for commercial systems, please refer to OBC Tables 8.2.1.3.A and 8.2.1.3.B. When using water meter readings, Eljen recommends an adequate safety factor to account for expansion, unusual events and reflects full occupancy of the facility. We strongly recommend to the designer to validate each commercial design with Enviro-STEP Technologies Engineering staff.

11.4 EFFLUENT DISTRIBUTION: It is critical to assure good effluent distribution in commercial application as the dispersal area may be considerably larger than for residential applications. Pressure to gravity or low-pressure distribution should be the preferred mean of distribution unless there are considerations making it technically not feasible. Gravity only system should be avoided as they distribute poorly the effluent over large surface. Time dosing over 24 hours should is strongly recommended.

11.5 EFFLUENT APPLICATION: Dispersion of effluent across an absorption bed system or down a row of Eljen GSF modules 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 must also consider that longer systems are naturally preferred as this geometry reduces the linear loading rate. Water table mounding must be considered to assure that an adequate layer of unsaturated soils is maintained at all times.

Extremely large Eljen GSF systems should be designed as several smaller systems allowing for independent management of the wastewater treatment system. Designs typically include indexing valves to rotate zones into service.

11.6 SITE DRAINAGE AND STORMWATER: Very large onsite absorption beds can be impacted by site drainage from up-slope to the absorption bed area. Larger effluent flows can also increase the groundwater mound down slope. Large recharge systems must be designed and located so that they can accept precipitation and the specified wastewater volume. Control and diversion of up-slope storm water is normally included in the design. Understanding the storm water 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 Eljen GSF 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.

11.7 MULTI-FAMILY DWELLINGS: Condominiums, apartments, vacation resorts, trailer parks, RV campgrounds and other systems with domestic type wastewater may use the design formula in Section 11.10 with the maximum loading specified in Section 8.2. Ensure that garbage disposals are not being installed or specified. Appropriate sized septic tank and effluent filters are required for all commercial systems. If the design formula in Section 11.10 is not used, a 1.5 safety factor should be added to the Daily Design Flow (Q).

11.8 RESTAURANTS: Restaurant or food preparation systems shall use the design formula in Section 11.10. Designs shall in all cases include an appropriately sized grease interceptor. Wastewater from the kitchen shall be piped separately from the rest of the sewage and discharged to the grease interceptor. The reminder of the sewage is discharged to the septic tank where the effluent from the grease interceptor will also be connected on the kitchen plumbing.

Designers may strongly consider the use of a high strength wastewater treatment unit to reduce the organic loading to conventional domestic sewage strength. These designs must consider the additional sludge produced and assure an adequate settling and storage capacity between pump-outs.

11.9 LAUNDROMATS: Laundromat systems shall use the design formula in Section 11.10. Designs shall use an effluent filter in the septic tank with filtration openings no larger than 0.8 mm.

11.10 OTHER COMMERCIAL SYSTEMS: Other non-residential systems, e.g. schools, butcher shops, milk or ice cream facilities etc. will require more detailed design. The designer is advised to contact Enviro-STEP Technologies Inc. for recommendations on sizing prior to design and submission of plans for permitting.

11.11 FORMULA FOR DESIGN FLOW ADJUSTMENT: Any application where the raw sewage is stronger than conventional domestic wastewater (ex: raw sewage with CBOD > 250 mg/L, TSS > 350 mg/L) must **be designed taking into consideration both hydraulic and organic loading rates of the Eljen GSF A42 modules. The most stringent number of modules as to be considered.**

Since the Eljen GSF system receives primary effluent, the primary effluent BOD concentration is to be considered in the calculation. Approximately 30% of the raw sewage BOD is considered being removed by the septic tank.

Eljen GSF daily average hydraulic loading rate:	**95 litres/module/day (daily average)**
Eljen GSF maximum hourly peak loading rate:	**300 litres/module/day (hourly peak)**
Eljen GSF maximum organic loading rate:	**19g $CBOD_5$/module/day**

11.12 SYSTEM VENTING: It is recommended that all commercial systems be designed with vents. Systems with high waste strength and systems with more than 450 mm of cover material as measured from the top of the GSF modules to finished grade require venting. 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 airflow 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.

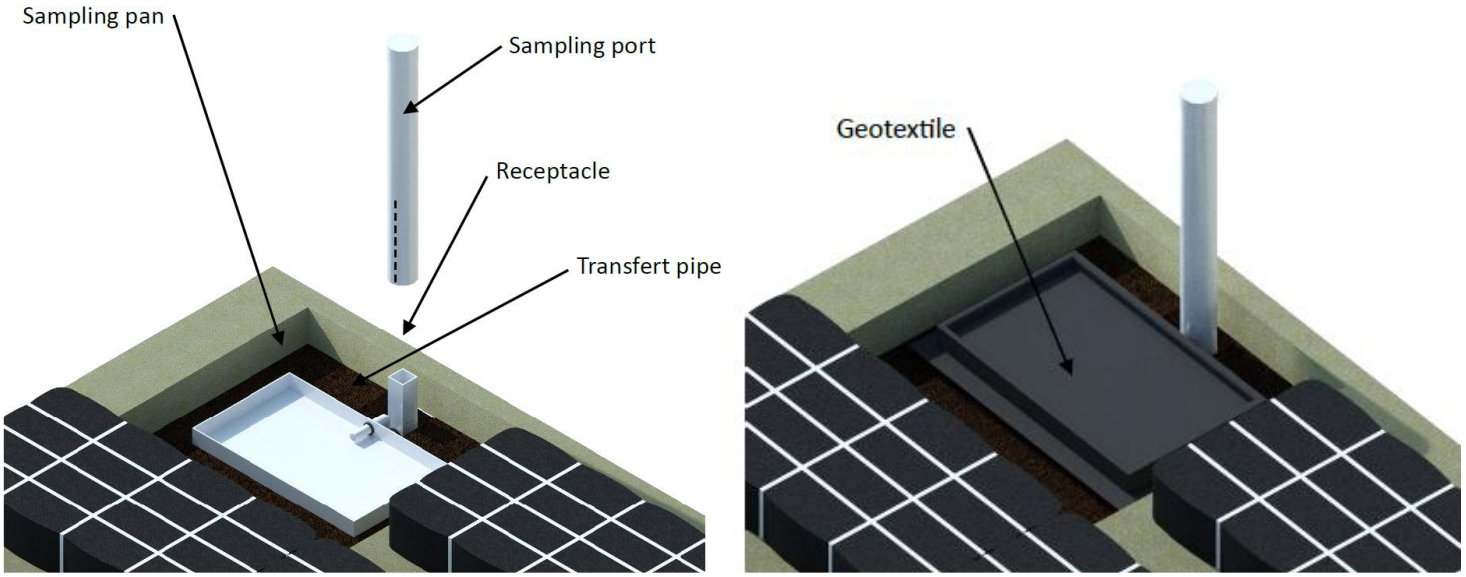
11.13 COMMERCIAL SYSTEM DESIGN DRAWINGS REVIEW: Enviro-STEP Technologies Engineering staff, will review at no cost all commercial Eljen GSF System plans prior to submission for approval from the local approving authority. Overall responsibility for system design remains with the licensed designer and / or professional.

- Do not drive backhoe wheels over GSF modules or any portion of the Specified Sand area. Light-weight track rigs may cross system area sparingly with a minimum of 300 mm of cover over the distribution pipe. System area should only be crossed perpendicularly.
- Do not drive over raised systems.
- 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 maximum 4:1 grade can be used to help eliminate soil erosion and support maintenance of the stabilizing grass cover adjacent to the GSF modules.
- For pumped systems, provide a well-anchored D-box with a velocity reduction tee or baffle. Vent system at far end of the trench or bed when more than 450 mm of cover material as measured from the top of the GSF modules to finished grade is used.
- Eljen GSF product shall be supplied by an Ontario authorized Eljen GSF Distributor.
- Installation shall be performed by an authorized Eljen Installer detaining a valid BCIN.
- Installer and/or designer shall notify the end user of the requirements pertaining to servicing and maintaining the Eljen and refer the end user to the authorized Eljen distributor or Ontario Home owner's manual for details.

13.1 SAMPLING DEVICE INSTALLATION

FIGURE 26: PARTS AND DEVICES

Field Sampling Device to be installed with system:



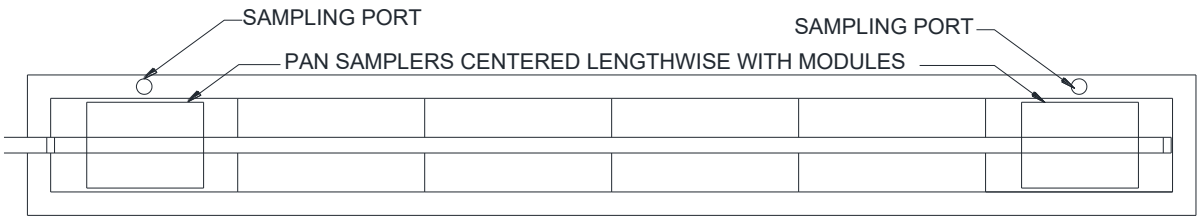
13.2 SAMPLING DEVICE PLACEMENT

1. Determine the collection pipe and sampling pan placement in the system. We recommend one sampler in a low-pressure distribution system and a minimum of two samplers used in gravity or pump to gravity distribution system. For gravity systems, a minimum of one sampler is placed 150mm below the Specified Sand layer of the first and last module of the same row.

2. Once the Specified sand layer and modules are laid out, removed the module (s) under which the sampling device will be located, and hand shovel the entire specified sand layer down to the native soil surface or imported sand.

3. Install the sampling pan over the native soil or imported sand directly under where the module will be located. Install the sample receptacle on the side of the pan. Cover the entire sampling pan with the provided geotextile to prevent sand from entering the pan.

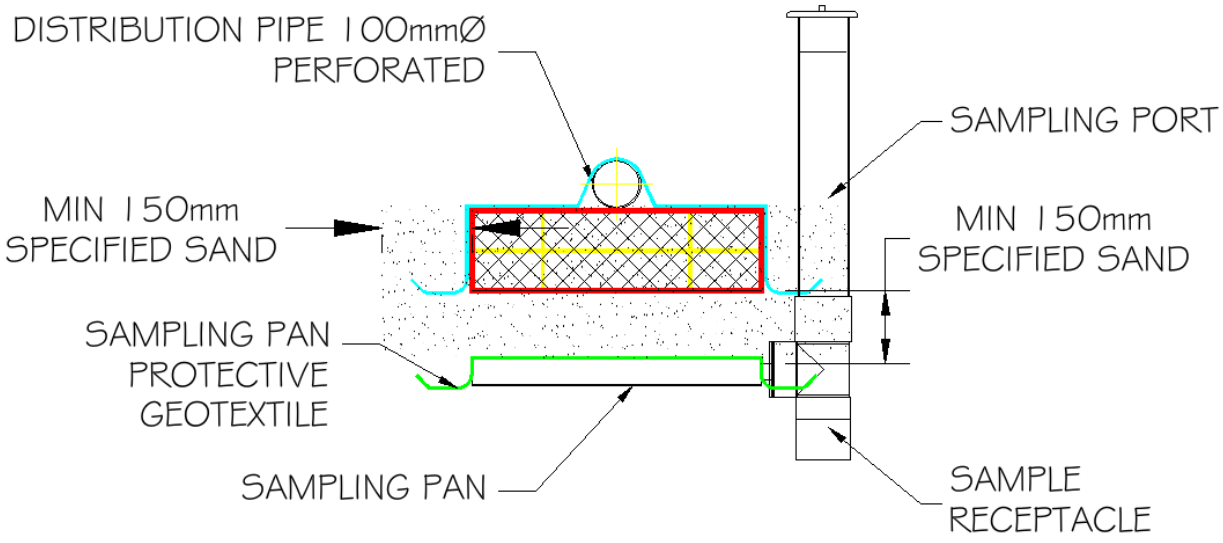
FIGURE 27: SAMPLING DEVICE LOCATION



4. Install a section of solid pipe over the sample receptacle (referred to as the sampling port) to provide access for sampling from grade. Put a cap on top of the pipe. DO NOT GLUE THE CAP.

5. Shovel back the Specified sand layer over the sampling device to the level corresponding to the module elevation and put the modules back in place.

FIGURE 28: SAMPLING DEVICE INSTALLATION CROSS SECTION VIEW



13.3 SAMPLING DEVICE SAMPLING

1. Open the sampling port.

2. Lower the sampling tube mid-way into the effluent collecting receptacle at the bottom of the sampling port, not touching the sides of the sampling port and keep clear from the receptacle bottom.

3. Retrieve sample using a clean suction device (vacuum pump or drill pump).

4. Store sample at proper temperature.

5. After collecting the sample, empty the sampling port receptacle, clean and rinse with tap water and empty again.

6. Close the sampling port.

7. Expedite sample to the lab respecting proper delays, temperature and transport procedures.

8. Submit the results to the customer and Building Official.