Eljen In-Drain™ GSF *Geotextile Sand Filter*

Design and Installation Manual

For New Systems and Repairs

RHODE ISLAND

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Eljen In-Drains ™

Introduction

Eljen In-Drain technology is based upon 25 years of published research work and field experience.

The Eljen In-Drain system is a cost effective, treatment based upgrade from conventional stone and other absorption systems. The Eljen In-Drain design is based on proven enhancements. Evapo-transpiration, oxygen transfer, bio-degradation, soil treatment and long term operation are accomplished by using bio-textile pre-filtration and controlled soil loading. The installation is protected from long term siltation failure with a geotextile fabric cover.

Eljen In-Drains, Type "B" finished dimensions are 36" x 48" x 7". In-Drains are designed to create multiple vertical infiltrating surfaces, which provide approximately 8 times the biofabric area per square foot of In-Drain bottom area. Type B In-Drains are constructed of multiple fins securely banded together into rigid modules.

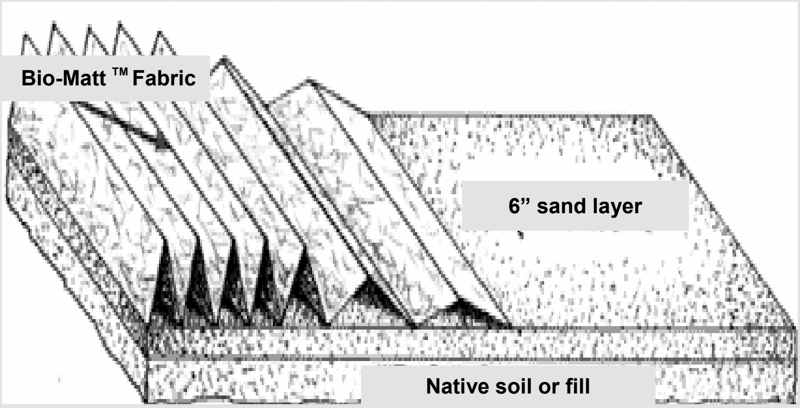
The primary biomat clogging layer forms within the In-Drain on the biofabric. The In-Drain absorption system is sized for the long term acceptance rate (LTAR) of the site. In-Drain systems are designed to operate indefinitely, not for a useful life of 15-30 years. The soil directly below the In-Drain modules never develop a significant biomat layer, thus allowing In-Drain absorption fields to be approximately 1/3 the size of a conventional stone and pipe system. A combination of lower final grade and smaller leach area reduces land requirements by about 50% and cuts clearing costs on wooded sites. In-Drain trenches can be stepped down slopes, thus further reducing fill requirements. Smaller and shallower leach bed areas also minimize site impact. Reduced system size allows more flexibility for the designer in dealing with site constraints.

Refer to Addendum (page 12) for discussion of basic design concepts and calculation of effective infiltration areas for In-Drain leach fields. A list of published references follow the addendum.

In-Drain System Advantages

1 In-Drain absorption systems are designed to last indefinitely. They are based on the long term acceptance rate (LTAR) of the site, not the 15-30 year half life of conventional systems.
2 In-Drain absorption systems areas are only about 1/3 the size of conventional stone and pipe systems.
3 In-Drains provide less costly and less time consuming replacement of failed absorption systems.
4 Lower costs are encountered where difficult terrain is present in leach field area. In-Drain rows can be stepped down slopes to reduce site impact and fill requirements.
5 In-Drain biofabric has approximately 8 times the amount of surface area for the biomat layers to form, compared to a conventional absorption systems.
6 System failure is minimized because the biomat layer forms inside the fabric; little biomat forms on the underlying sand.
7 Effluent infiltrates into the situ soil beneath the In-Drain modules, 3 to 10 times faster, due to double filtration of wastewater by biofabric and sand.
8 A very effective biomat layer forms within the In-Drains because the aerobic action that occurs results in a more rapid biodegradation of pollutants.
9 In-Drains provide better protection of groundwater because biomat inside the fabric results in a pre-treated effluent.
10 Steady infiltration from In-Drains reduces occurrence of overload and temporary ponding on the soil. This results in aerobic-anaerobic stability, removing pollutants from the effluent by biochemical action. Temporary ponding in other leach fields results in aerobic-anaerobic destabilization so that untreated pollutants move into the soil.
11 Long term siltation, that can bring about failure in other leach fields, is prevented by the geotextile fabric cover of the In-Drain system.
12 In-Drains provide greater evapotranspiration than with the conventional stone leach or chamber leach fields.

Terms and Definitions



- **In-Drain (Type B)**: A module measuring 36" x 48" x 7" made of interleaved recycled plastic cuspated core and 100 square feet of Bio-Mat fabric.
- **Bio-Matt fabric**: Special filter fabric within In-Drain modules upon which primary biomat layer forms.
- **Geotextile fabric**: Anti-Siltation fabric placed over In-Drain assembly to prevent fill and fines from washing into modules.
- **Sand**: Medium to coarse textured, washed, silica sand, effective size 0.25 to 2.0mm passing #200 <5%, uniformity coefficient <5, coefficient of permeability > 5 ft./day. Material must meet ASTM C-33.
- **Fill:** Material used for raised systems should be *bank run gravel (*as described in DEM regulations); *clean soil* (free of topsoil, humus, dredging, or stones more than 3/4” in any dimensions) .
- **Cuspated core**: Rigid plastic material used to bolster and separate biofabric, thereby creating many infiltrating channels.
- **Wire clamps**: Hardware used to secure pipe to In-Drains.
- **MGWTE:** Maximum ground water table elevation.
- **LTAR**: Long Term Acceptance Rate
- **STE**: Septic Tank Effluent
- **SHWT**: Seasonal High Water Table
- **Design flow**: 150 Gallons per day/bedroom.
- **Code**: Rhode Island DEM, ISDS, rules and regulations.

Basic System Design

1 Design and installation of In-Drain systems must comply with all State and local regulations, and the requirements of this manual.

2 The sizing equation applies for all residential and commercial systems. Normal design for Rhode Island requires 5' from the bottom of any leach system to MGWTE. This distance is measured from the bottom of the In-Drain unit.

3 In-Drains are placed on a level base of 6" washed sand, with the white line showing on top of the units. Refer to page 4 for sand specifications.

4 Top of In-Drain units should be at least 2" lower than distribution box outlet invert (pipe bottom) elevation.

5 A 12” space is required between trenches. This distance is measured from the sand/soil interface of In-Drain trenches.

6 The In-Drain fins are perpendicular to perforated pipe runs. Perforated pipe PVC schedule 35 (4" diameter) is placed on top of In-Drains and is secured to In-Drains modules with wire clamps (supplied). Piping is connected at ends and at mid points in systems over 30' in lengths, to ensure more equal distribution of effluent.

7 Geotextile fabric, provided with each system, is placed over the In-Drains and their sides to prevent long term siltation and failure. Fabric must drape slightly outward at distribution pipe to prevent blocking holes.

8 Clean backfill and seeded top soil completes the In-Drain installation.

Sizing Credit: 7.0 sqft. per linear foot.

Sizing example:

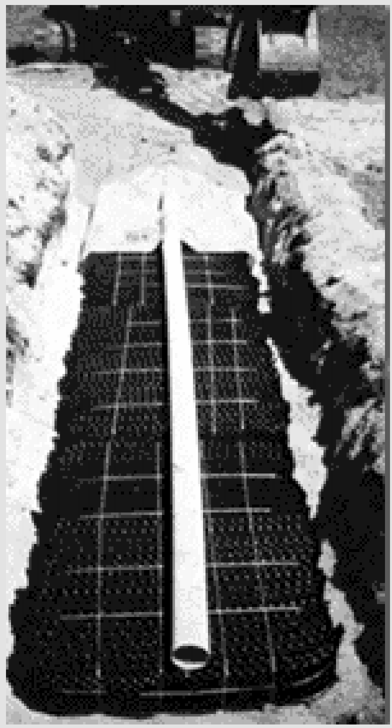
- Percolation Rate 10 min./in.
- Three bedroom dwelling
- 150 gal./day
- 495 sq ft.
- 495 divided by sizing credit of 7.0
- 70 linear feet
- 70 divided by In-Drain length (4')
- 70/4 = 17.5 rounded up = 18 In-Drain units
- 6 In-Drains per bedroom
- Minimum sizing requirement shall be based on a 10 min/in percolation rate, and 165 sqft. per bedroom.

Installation

Trench Installation

1 Prepare the site according to state and local regulations. Do not install system on frozen or saturated ground.
2 Scarify receiving layer to eliminate smearing.
3 Add 6” layer of sand (see page 4 for specifications).
4 Avoiding footprints, place In-Drains with painted stripe facing up, end-to-end on sand.
5 Center 4” perforated distribution pipe lengthwise over In-Drains. Use solid pipe over compacted sand from distribution box to In-Drains.
6 Secure pipe to In-Drain unit, using one Eljen wire clamp per In-Drain unit. Push clamp ends straight down though core, forcing through fabric into sand.
7 Spread geotextile fabric lengthwise over pipe and drape over sides of In-Drains. Secure in place with hand-shoveled sand. Avoid blocking holes in perforated pipe.
8 Place sand 6” (minimum) at the sides in trench.
9 Complete backfill, and loam to 12” (minimum) over pipe. Fill should be clean, porous, and devoid of large rocks.
10 Divert surface runoff. Finish grade to prevent surface ponding. Seed loam, and protect from erosion.

In-Drains in trench



May be placed in straight line, or curved to follow contours.

Bed configuration: Place 12” (minimum) of sand between In-Drains in bed.

Pumped system: Provide a well-anchored D-box with a velocity reduction tee or baffle.

Optimum Layout

System configuration: Long and narrow designs increase system hydraulic capacity and decrease ground water mounding, and are therefore preferred over more square designs. This can be particularly important for large systems in slow percolation sites, and in level areas with high ground water table.

Normal design for Rhode Island requires 3’ from the bottom of any leach system to the MGWTE. Measure this from the bottom of the In-Drain unit.

An 11’ space is required between trenches. This distance is measured from the point of sand/soil interface of In-Drain trenches.

Level Systems: Level system layout may employ any leach field configuration. The bottom of the In-Drain system and distribution pipes are installed level at their design elevations. In-Drains may be used to connect the ends of trenches with perforated pipe placed on top (Figures 2 and 3).

Fill material in *raised systems* must conform to fill specifications as described on page four.

Pumped (D-Box) **Systems**: When topography dictates, the simplest and most cost effective pumped system includes a force main to the D-Box and gravity distribution to the leach field.

Provide velocity reduction in the D-Box. Top of In-Drains should be at least 2” lower than DB outlet invert (pipe bottom) elevation.

Commercial Systems: System sizing for In-Drains applies to commercial and non-commercial systems generating domestic type wastewater (black or gray). Commercial systems such as food service establishments, which handle large quantities of grease, must have a grease trap installed before the septic tank. As with residential systems, use of an effluent filter in the outlet sanitary tee is required in all commercial systems.

With problem effluent situations such as restaurants, service stations or slaughter-houses, designers are strongly encouraged to contact their Eljen distributor or design engineer for assistance.

Figure one: Trench Cross Section

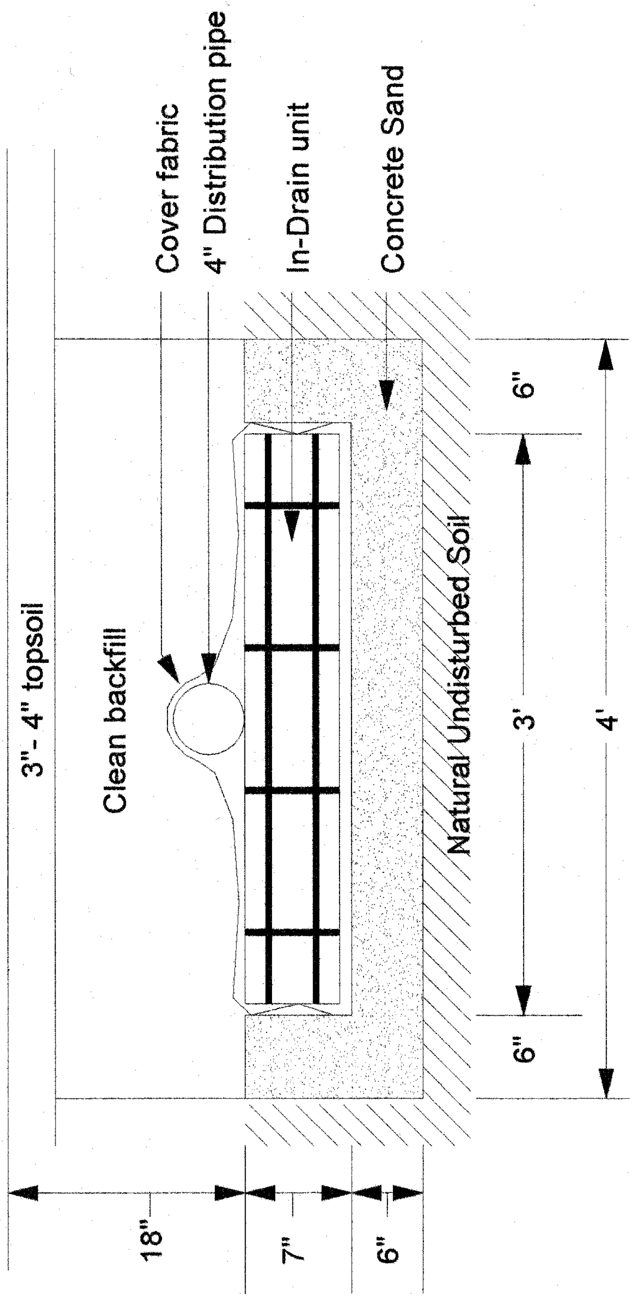


Figure two: Leach Field Layout

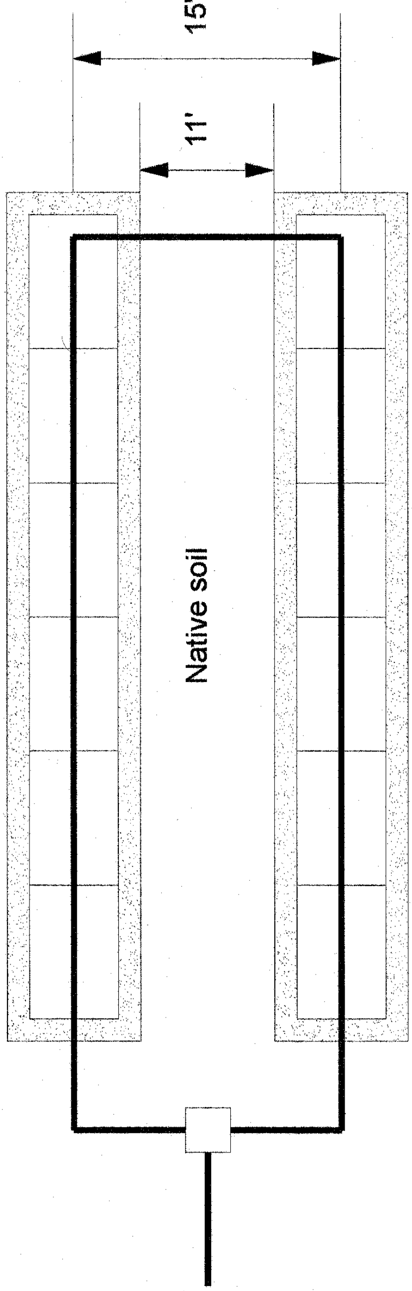
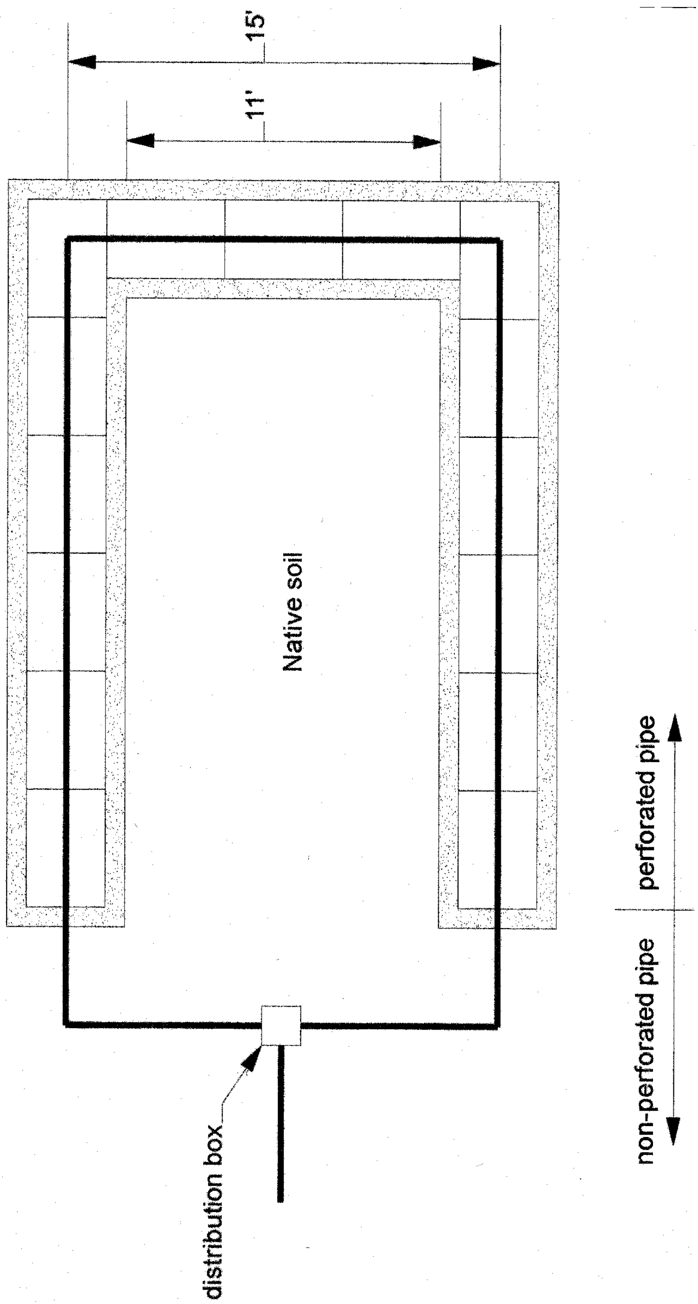


Figure three: Cross-over Layout



Addendum

Long term acceptance rate is the small but finite infiltration rate of septic tank effluent through a biomat layer when biological equilibrium is reached. In-Drain leach field sizing is based on measured soil percolation rates, prescribed design flows and prescribed wastewater application rates. Refer to Figure 1 for Cross Section View of In-Drain module.

In-Drain biofabric was tested using septic tank effluent over 20 years ago. Long term acceptance rate of biofabric not touching soil was measured with septic tank effluent to be greater that 1 gal/sq. ft./day. Also, biofabric was found not to produce any masking when used in contact with the soil. Biofabric filtered effluent was observed to have low soil clogging capacity. Biofabric pre-filtration significantly reduces the infiltration limiting biomat layer on the soil directly below a standard In-Drain module.

Actual measurements reveal an improved soil LTAR of 3 to 10 times the non-prefiltered case with a typical system average of 4 to 6. The LTAR enhancement for a given absorption system will vary within this range depending on location and time. In other words at any particular time different areas of the absorption bed soil will have LTAR enhancement within the stated range. Likewise, the LTAR enhancement of a particular section of absorption bed will vary over a period of time. In-Drain leach fields are conservatively designed using an infiltration enhancement factor equal to 2.0 This is the principal basis for the small size of In-Drain absorption systems.

References

- **Kropf, F., R. Laak and K.A. Healy. 1977. Equilibrium Operation of Subsurface Absorption systems. Water Pollution Control Fed. 49 (9) : 2007. Laak, R. 1984. In-Drain Tests. Civil Eng. Dept., University of Connecticut.**
- **Laak, R. 1966 The Effects of Aerobic and Anaerobic Household Sewage Pretreatment on Seepage Beds. doctoral Dissertation, University of Toronto.**
- **Laak, R. 1970 Influence of Domestic Wastewater Pretreatment on clogging. J. Water Possution Contr. Fed., 42 (8) Part 1, 1495 -1500**
- **Civil Eng. Dept., 1973. Wastewater Disposal Systems in Unsewered Areas. Final Report to State of Connecticut. Grant RSA 70 - 22 Univ. of Connecticut.**
- **Healy, K.A. and R. Laak. 1974 Evaluation and Design of Seepage Fields. Env. Eng. Div., Amer. Soc Civil Eng. 100 (EES): 1133 - 1146**
- **Kropf, F., K.A. Healy and R. Laak. 1075. Soil Clogging in Subsurface Absorption Systems for Liquid Domestic Wastes. Progress in Water Technology. Pergamon Press. 767 - 774**
- **Laak, R. 1976. Pollutant Loads from Plumbing Fixtures and Pretreatment to Control Soil clogging, J. of Environmental Health. 39 (1) July - Aug.**
- **Tyler, E. J., R. Laak, et al. 1977 The Soil as a Treatment System. Proc. ASAE, 2nd National Conference, Chicago, Dec.**
- **Laak, R. 1987 On-Site Wastewater Drain Fields Using Lightweight In-Drains. Proc. International Conf. Cold Regions Env. Eng., Edmonton, Canada**
- **Laak, R. 1988 Using In-Drains at Soil Clogging Infiltration Surface. ASAE Rapid City, South Dakota**
- **Laak R. 1988 Using In-Drains Geosynthetics in Soil Infiltration Systems. ASAE, International Meeting, Quebec, Canada. Paper no. 892176, June**
- **Amerson, R.S., E.J. Tyler and S.C. Converse 1991. Infiltration as Affected by Compaction, Fines and Contact Area of Gravel. ASAE Publ. 10 - 9**

Improving the Environment Since 1976

ELJEN CORPORATION was founded in 1976 to address the growing concerns with many of the environmental problems caused by traditional systems.

Eljen pioneered the design and development of the very first completely prefabricated, non-aggregate drainage system.

The Eljen In-Drain™ GSF was developed to solve the increasing problems caused by the growing need for higher capacity septic systems in limited space, and the rising costs of traditional methods.

Our systems have proven their effectiveness by withstanding the test of time. Many of our earliest installations continue to provide the same benefits to this day.

If you have a drainage problem of any type, call Eljen first.

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Environmental Products Since 1976

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