DESIGN SPECIFICATION

4.1 EnviroSoxx® Pollutant Filter

filtrexx® SUSTAINABLE TECHNOLOGIES

PURPOSE & DESCRIPTION

Filtrexx **EnviroSoxx® Pollutant Filter** are a temporary or permanent water or storm water biofiltration system **used to remove sediment and/or soluble pollutants from water or storm water**. This land based, passive biofiltration system uses Compost FilterMedia™ and natural sorbents to remove pollutants from water and storm water. Filtrexx EnviroSoxx are customizable, easily installed and maintained, and can be used to target specific pollutants in contaminated water and storm water flows, including but limited to fine sediments (TSS and turbidity), nitrogen, phosphorus, metals, hydrocarbons, and harmful bacteria.

APPLICATION

EnviroSoxx can be applied on bare soil, vegetation, or impervious surfaces in the flow path of sheet flow or concentrated flow storm water to target storm water pollutants. Typical applications include:

- In swales, bioswales, ditches, or channels,
- Around site perimeters,
- Across landscapes or impervious surfaces,
- Around curb or drain inlets,
- As flow or filtration baffles,
- Pretreatment for bioretention, rain garden, storm water ponds, or similar storm water treatment systems,
- Flow velocity reduction,
- Infiltration enhancement,
- Compliance with industrial or municipal storm water permits,
- Part of TMDL, Green Infrastructure, or Low Impact Development ordinances,
- Treatment on or around animal feeding operations, agricultural cropping systems, and mining operations,
- As an integral component of a wholistic, treatment train approach to site storm water management.

ADVANTAGES AND DISADVANTAGES

Advantages

- EnviroSoxx can be used for permanent or temporary pollutant filtration applications.
- EnviroSoxx are easily installed and can establish vegetation in difficult areas.
- EnviroSoxx can be easily designed and incorporated as one treatment in a treatment train approach to storm water management.
- EnviroSoxx can slow down runoff velocity, thereby increasing sediment deposition, reducing the erosive energy of runoff and the potential for soil erosion, and pollutant transport.
- EnviroSoxx can be used to filter pollutants and infiltrate storm water entering or leaving areas where storm water may pass, collect, drain, or be stored.
- EnviroSoxx have the ability to bind and sorb soluble nutrients, metals, and hydrocarbons that may be in storm water runoff, thereby reducing loading to nearby receiving waters.
- EnviroSoxx can remove fine sediments, pathogens, and pesticides from storm runoff preventing pollution of receiving water bodies.
- EnviroSoxx can be customized to handle a variety of water pollutant concentrations, pollutant loads, and water volumes and flow rates.
- EnviroSoxx are available in 8in (200mm) and 12 in (300mm) diameters.
- EnviroSoxx are easily maintained and/or replaced for long-term pollutant filtration applications.
- No trenching is required; therefore soil and plant roots are not disturbed upon installation.
- EnviroSoxx can be installed year around in difficult soil conditions such as frozen or wet ground, and dense and compacted soils, as long as stakes can be driven.
- EnviroSoxx can be installed on pavement, blacktop, concrete or other hard surfaces as temporary treatment systems.
- EnviroSoxx can be easily installed on top of impervious mats or membranes.
- Microorganisms in FilterMedia and have the ability to degrade organic pollutants and cycle captured nutrients from contaminated water.
- FilterMedia is organic and can be left on site, used in landscape design, and/or seeded and planted with permanent vegetation.
- FilterMedia improves existing soil structure if spread out and used as a soil amendment.
- Humus colloids and organic matter in FilterMedia provide increased water holding capacity and reduced water evaporation to aid in seed germination and the potential for reduced irrigation.
- FilterMedia is organic, all natural, biodegradable, and locally manufactured.
- EnviroSoxx can be used as an integrated management practice for Low Impact Development (LID) design and for possible point accrual in LEED Green Building Certification programs.
- EnviroSoxx may assist in qualification for LEED® Green Building Rating and Certification credits under LEED Building Design & Construction (BD+C), New Construction v4. Awarded credits may be possible from the categories of Sustainable Sites, Water Efficiency, Materials & Resources, and Innovation. *Note: LEED is an independent program offered through the U.S. Green Building Council. LEED credits are determined on a per project basis by an independent auditing committee. Filtrexx neither guarantees nor assures LEED credits from the use of its products. LEED is a trademark of the U.S. Green Building Council.*

Disadvantages

- If EnviroSoxx do not use Filtrexx® FilterMedia™ and natural sorbents, and adhere to their specifications, performance may be diminished.
- If not installed correctly, maintained or used for a purpose or intention that does not meet specifications, performance may be diminished.
- EnviroSoxx performance may be diminished or require frequent maintenance if water/storm water flows exceed the design capabilities of the system.
- EnviroSoxx performance may be diminished or require frequent maintenance if pollutant concentrations or loads are high or exceed the design capabilities of the system.
- EnviroSoxx should not be installed in streams, rivers, lakes, or areas where the system will submerged under water.

MATERIAL CHARACTERISTICS

EnviroSoxx use only photodegradable or biodegradable Soxx netting materials available from Filtrexx International and are the only mesh materials accepted in creating EnviroSoxx for any application. For Soxx tubular mesh material specifications see Table 1.1.

FILTERMEDIA™ CHARACTERISTICS

EnviroSoxx use a combination of Filtrexx FilterMedia and natural

sorbents. FilterMedia is a composted material that is specifically designed for removal of solids and soluble pollutants from storm water runoff by physical trapping, deposition, and chemical sorption mechanisms.

For information on the physical and chemical characteristics of Certified FilterMedia refer to Specification 5.1 Filtrexx® FilterMedia™.

PERFORMANCE

QA/QC material testing of Filtrexx FilterMedia to ensure specifications are met is conducted by the Soil Control Lab, Inc. Scientific research on the performance of EnviroSoxx is extensive and can be located in the Filtrexx Library at http://www.filtrexx.com/en/resources/research-library.
Note: the Contractor is responsible for establishing a working effluent filtration, hydrologic, and/or storm water management system and may, with approval of the Engineer, work outside the minimum requirements as needed. Where EnviroSoxx are damaged or ineffective, it shall be repaired or replaced.

DESIGN CRITERIA

Function

The primary function of EnviroSoxx are to remove sediment and soluble pollutants, such as nutrients, heavy metals, petroleum hydrocarbons, and harmful bacteria from storm runoff or contaminated effluent waters. By using a combination of high quality compost media and natural sorbent materials EnviroSoxx are able to chemically sorb soluble pollutants rendering them less toxic and less available to animals and humans, and remove sediment and particulate bound pollutants through deposition and physical filtration mechanisms. EnviroSoxx are specifically designed to target specific pollutants in water and storm water, thereby reducing their concentration and load exiting the system.

Planning Considerations

EnviroSoxx should be used as one treatment in a treatment train approach to storm water management or pollution prevention. Meetings should be conducted to educate site personnel about the devices/practices used and acceptable traffic patterns that avoid running over the filtration system with vehicles and heavy equipment. Vehicular traffic is not permitted on the filtration system because heavy equipment may reduce the effectiveness. Infiltration and runoff velocity reduction practices may be installed upslope from EnviroSoxx to reduce runoff peak flows and pollutant loading entering the filtration system.

Point Source & Non-point Source Influent

If influent is from a point-source discharge the area of entry or contact should be stabilized. Options include an impervious ground layer, turf reinforcement mats, Filtrexx® Channel Protection (see Filtrexx Design Manual Section 2.4), or rip rap. For non-point source influent see the following section.

Sheet and Equalized Flow

To maintain sheet flow or create equalized flow conditions, reduce runoff velocity, and to act as a pretreatment system for sediment removal a shallow gravel trench (level spreader) may be constructed directly upslope from the EnviroSoxx (USEPA, 2006). The gravel trench should be a minimum of 12 in (300mm) wide and 12 in (300mm) deep and filled with pea gravel. Alternatively, a flow equalization cell may be designed at the influent edge of the filtration system. The equalization cell should function as a flow restricting weir, installed perpendicular to flow, to temporarily restrict flow into the EnviroSoxx system.

Sizing and Spacing

There are several options for sizing and spacing EnviroSoxx, ultimately it depends on the goal of the application. The area, slope degree, and slope length of the contributing drainage area, as well as water volume, water influent flow rate, pollutant concentration, pollutant load, and type of pollutants can all affect the size of a any filtration system. As each of these parameters increase the pressure on the filtration system increases, therefore the functional size of the system should be increased. Additionally, vegetation density and height will reduce flow velocities and increase pollutant removal efficiencies entering the filtration system.

Design for Bare Soils and Hill Slopes

If EnviroSoxx will be placed on bare soils and/or hillslops, refer to Maximum Slope Lengths for Filtrexx Perimeter Control, Section 1.1 Filtrexx Sediment Control.

Design for Impervious Surfaces

If EnviroSoxx will be placed on impervious surfaces design based on the hydraulic flow through rate per unit length of the EnviroSoxx. Refer to Table 4.3. Filtrexx EnviroSoxx® Performance and Design Specifications Summary for each EnviroSoxx diameter. Design and construction of EnviroSoxx in a pyramid configuration is acceptable, extrapolation of the design criteria in this section may be used for this custom design option. Larger diameter EnviroSoxx should never be placed on top of smaller diameters when using the pyramid design configuration.

If the flow rate (Q) entering the EnviroSoxx system is unknown, the Rational Formula (below) can be used as the governing equation to determine Q. Be sure units of measurement for Q are consistent with the units of measurement for hydraulic flow through rates of EnviroSoxx.

$Q = C*I*A$

Where:

Q = peak flow rate
C = runoff coefficient
I = rainfall intensity
A = drainage area

Design for Swales and Channels

If EnviroSoxx will be placed in a swale or channel, refer to Table 4.2 Spacing and Height for Filtrexx EnviroSoxx Placed in Channels or Swales. Design and construction of EnviroSoxx in a pyramid configuration is acceptable, extrapolation of the design criteria in this section may be used for this custom design option. Larger diameter EnviroSoxx should never be placed on top of smaller diameters when using the pyramid design configuration.

Design for Increased Pollutant Removal

Research shows multiple EnviroSoxx can significantly increase pollutant removal. If footprint allows, space EnviroSoxx 1 ft apart to allow for reservoir ponding and particulate deposition. If mosquito vector control regulation is a concern, EnviroSoxx may be placed adjacent with no spacing. Recent research also shows pollutant removal maintains performance over multiple events with very little, to no decrease in performance (TechLink 3343, TechLink 3344).

INSTALLATION

1. EnviroSoxx shall meet Filtrexx Soxx Mesh Material and Filtrexx Certified FilterMedia Specifications.
2. Call Filtrexx at 877-542-7699 or visit www.filtrexx.com for a current list of installers and distributors of Filtrexx products.
3. EnviroSoxx shall be placed at locations indicated on plans as directed by the Engineer.
4. EnviroSoxx shall be placed perpendicular to water flow in a manner that allows water or storm water to passively flow through the system.
5. EnviroSoxx shall not be placed in rivers, lakes, streams, or in submerged in water environments.
6. EnviroSoxx must be installed and stabilized before water flow is allowed to enter the filtration system.
7. Land surface shall be cleared of debris, including rocks, roots, large clods, and sticks prior to installation.
8. Land surface may be lightly compacted and graded prior to installation.
9. EnviroSoxx ends should never be abutted, they should be overlapped by a minimum of 2 ft (600mm) to prevent flow bypass. A stake shall be placed in the overlap section, securing the two sections.
10. Once in place, EnviroSoxx shall be lightly compacted to prevent water undercutting.
11. Stakes shall be installed through the middle of the EnviroSoxx on a minimum of 10 ft (3m) centers, using 2 in (50mm) by 2 in (50mm) by 3 ft (1m) wooden stakes. In concentrated flow applications staking may be increased.
12. Stakes shall also be placed at the ends of EnviroSoxx to hold them in place.
13. Minimum staking depth for sand and silt loam soils shall be 12 in (300mm), and 8 in (200mm) for clay soils.

INSPECTION

Routine inspection should be conducted within 24 hours of a runoff or flow event, or as designated by the regulating authority. If product dislodgement occurs, it should be repaired or replaced immediately. If sediment accumulation is 50% of the height of the EnviroSoxx, sediment removal is recommended. Storm debris and trash should be removed immediately.

MAINTENANCE

1. The Contractor shall maintain EnviroSoxx in a functional condition at all times and it shall be routinely inspected.
2. If the EnviroSoxx has been damaged, it shall be repaired, or replaced if beyond repair.
3. The Contractor shall remove sediment at the base of the upslope side of the device when accumulation has reached 1/2 of the effective height, or as directed by the Engineer.
4. If a EnviroSoxx becomes clogged with debris or solids, they shall be maintained so as to assure proper hydraulic flow through. Overflow or undercutting of contaminated water is not acceptable.
5. If minor undercutting occurs, leveling or minor grading of ground surface may be required to increase surface contact with replacement EnviroSoxx.
6. Replace EnviroSoxx when no longer meeting performance requirements. As an option, if using multiple EnviroSoxx, replace EnviroSoxx in areas of initial runoff contact first, as these receive the highest pollution exposure.

METHOD OF MEASUREMENT

Bid items shall show measurement as Filtrexx EnviroSoxx® per linear ft or linear meter, per diameter, 8 in [200mm], or 12 in [300mm], as specified by the Engineer.

FIELD APPLICATION PHOTO REFERENCES

EnviroSoxx used around a drain/inlet.

EnviroSoxx used as check dam.

ADDITIONAL INFORMATION

For other references on this topic, including additional research reports and trade magazine and press coverage, visit the Filtrexx website at filtrexx.com

Filtrexx International, Technical Support
877-542-7699 | www.filtrexx.com | info@filtrexx.com
Call for complete list of international installers and distributors.

REFERENCES CITED & ADDITIONAL RESOURCES

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Table 1.1. Filtrexx EnviroSoxx® Mesh Material Specifications.

Material Type	EXTREME (Multi-Filament Polypropylene MFPP)
Material Characteristic	Photodegradable
Design Diameters	8 in (200mm), 12 in (300mm)
Mesh Opening	1/16 in (1.5mm)
Tensile Strength (ATSM D4595)[1]	MD: 1062 lbs TD: 797 lbs
% Original Strength from Ultraviolet Exposure (ASTM G-155)	100% at 1000 hr
Functional Longevity/ Project Duration[2]	up to 5 yr

[1] Tensile Strength is based on 12" diameter using ATSM D4595. See Filtrexx TechLink #3342 for full tensile strength testing.
[2]Functional longevity ranges are estimates only. Site specific environmental conditions may result in significantly shorter or longer time periods.

Table 1.2. Spacing and Height for Filtrexx EnviroSoxx® Placed in Channels or Swales.

Slope Percent	Maximum Slope Length Above EnviroSoxx® in Feet (meters)	
	8 in (200 mm)	12 in (300 mm)
.5	130 (40)	200 (61)
1	66 (20)	100 (30)
1.5	44 (13)	66 (20)
2	36 (11)	54 (16)
2.5	26 (8)	38 (12)
3	22 (7)	34 (10)
3.5	20 (6)	30 (9)
4	18 (5)	28 (9)
4.5	18 (5)	26 (8)
5	18 (5)	24 (7)
5.5	14 (4)	20 (6)
6	10 (3)	16 (5)
6.5	10 (3)	14 (4)
7	8 (2)	12 (4)
7.5	8 (2)	12 (4)
8	6 (2)	10 (3)
8.5	6 (2)	8 (2)
9	6 (2)	8 (2)
9.5	4 (1)	6 (2)
10	4 (1)	6 (2)

Table 1.3. Filtrexx EnviroSoxx® Performance and Design Specifications Summary.

Design Diameter / Design & Performance	8 in (200mm)	12 in (300mm)	Testing Lab/ Reference	Publication(s)
Effective Height	6.5 in (160mm)	9.5 in (240mm)	The Ohio State University, Ohio Agricultural Research and Development Center	Transactions of the American Society of Agricultural & Biological Engineers, 2006
Effective Circumference	25 in (630mm)	38 in (960mm)		
Density (when filled)	13 lbs/ft (20 kg/m)	32 lbs/ft (50 kg/m)	Soil Control Lab, Inc	
Air Space	20%	20%	Soil Control Lab, Inc	
Maximum continuous length	unlimited	unlimited		
Maintenance Requirement (sediment accumulation removal at X height)	3.25 in (80mm)	4.75 in (120mm)		
Initial Maintenance Requirement based on Rainfall-Runoff *	22 in (55 cm); 1109 L/linear m	32 in (80 cm); 1388 L/linear m	The University of Georgia & Auburn University	
Maximum Slope Length (<2%)	600 ft (183m)	750 ft (229m)	The Ohio State University, Ohio Agricultural Research and Development Center	Filtrexx Design Tool, Filtrexx Library #301, Filtrexx Tech Link #3304 & #3311
Hydraulic Flow Through Rate	7.5 gpm/ft (94 L/min/m)	11.3 gpm/ft (141 L/min/m)	The Ohio State University, Ohio Agricultural Research and Development Center; University of Guelph, School of Engineering/ Watershed Research Group	Filtrexx Tech Link #3311 & #3313, #3308; American Society of Agricultural & Biological Engineers Meeting Proceedings, 2006, Second Interagency Conference on Research in Watersheds, 2006
P Factor (RUSLE)	0.1-0.32	0.1-0.32	USDA ARS Environmental Quality Lab/ University of Georgia	American Society of Agricultural & Biological Engineers Meeting Proceedings, 2006
Sediment Storage Capacity**	174 cu. in (2850cc)	396 cu. in (6490cc)		Filtrexx Tech Link #3314
Total Solids Removal	97%	97%		Filtrexx Tech Link #3333
Total Suspended Solids Removal	80%	80%		Filtrexx Tech Link #3317
Turbidity Reduction	63%	63%	USDA ARS Environmental Quality Lab	Filtrexx Tech Link #3308; American Society of Agricultural & Biological Engineers Meeting Proceedings , 2006
Clay (<0.002mm) Removal	65%	65%	USDA ARS Environmental Quality Lab	Filtrexx Tech Link
Silt (0.002-0.05mm) Removal	64%	64%	USDA ARS Environmental Quality Lab	Filtrexx Tech Link
Recommended Uses	Perimeter Control, Inlet Protection, Check Dam, Slope Interruption	Perimeter Control, Inlet Protection, Check Dam, Slope Interruption, Filtration System		

* Based on rainfall intensity of 12.5 cm (5 in)/hr applied to a bare clay loam soil at a 10% slope; runoff flow rate of 108 ml/sec/linear m (0.52 gpm/linear ft); and mean runoff volume of 230 L/m2 (6.3 g/ft2).
** Sediment Storage Capacity = sediment accumulation behind (directly upslope) + within the device.

Table 1.4. Filtrexx® EnviroSoxx Pollutant Removal Performance Summary.

EnviroSoxx Blend	Design Diameter / Design & Performance	8 in (200mm)	12 in (300mm)	Testing Lab/ Reference	Publication(s)
Industrial	Aluminum (Al) Removal	44%	44%		Filtrexx TechLink #3343
Industrial	Arsenic (Ar) Removal	11%	11%		Filtrexx TechLink #3343
Industrial	Cadmium (Cd) Removal	73%	73%	USDA ARS Environmental Quality Lab	3; Filtrexx TechLink #3325
Industrial	Chromium (Cr) Removal	47%	47%	USDA ARS Environmental Quality Lab	3; Filtrexx TechLink #3325
Industrial	Copper (Cu) Removal	70%	70%	USDA ARS Environmental Quality Lab	3; Filtrexx TechLink #3325
Industrial	Iron (Fe) Removal	44%	44%		Filtrexx TechLink #3343
Industrial	Lead (Pb) Removal	73%	73%	USDA ARS Environmental Quality Lab	3; Filtrexx TechLink #3325
Industrial	Nickel (Ni) Removal	69%	69%	USDA ARS Environmental Quality Lab	3; Filtrexx TechLink #3325
Industrial	Selenium (Se)	18%	18%		Filtrexx TechLink #3343
Industrial	Zinc (Zn) Removal	53%	53%	USDA ARS Environmental Quality Lab	3; Filtrexx TechLink #3325
Industrial	Diesel Fuel Removal	99%	99%	USDA ARS Environmental Quality Lab	3; Filtrexx TechLink #3325
Industrial	Gasoline Removal	54%	54%	USDA ARS Environmental Quality Lab	3; Filtrexx TechLink #3325
Industrial	Motor Oil Removal	99%	99%	USDA ARS Environmental Quality Lab	3; Filtrexx TechLink #3325
Industrial	Ammonium Nitrogen (NH4-N) Removal	54%	54%	USDA ARS Environmental Quality Lab	2; Filtrexx TechLink #3328
Industrial	Total Nitrogen (TN) Removal	24%	24%		Filtrexx TechLink #3343
Advanced	E. coli Removal	99%	99%	USDA ARS Environmental Quality Lab	3; Filtrexx TechLink #3325
Advanced	Total coliforms Removal	99%	99%	USDA ARS Environmental Quality Lab	3; Filtrexx TechLink #3325
Advanced	Cadmium (Cd) Removal	73%	73%	USDA ARS Environmental Quality Lab	3; Filtrexx TechLink #3325
Advanced	Diesel Fuel Removal	99%	99%	USDA ARS Environmental Quality Lab	3; Filtrexx TechLink #3325
Advanced	Gasoline Removal	54%	54%	USDA ARS Environmental Quality Lab	3; Filtrexx TechLink #3325
Advanced	Motor Oil Removal	99%	99%	USDA ARS Environmental Quality Lab	3; Filtrexx TechLink #3325
Advanced	Ammonium Nitrogen (NH4-N) Removal	54%	54%	USDA ARS Environmental Quality Lab	2; Filtrexx TechLink #3328
Advanced	Soluble Phosphorus Removal	92%	92%	USDA ARS Environmental Quality Lab	1; TechLink #3322

Reference Key:
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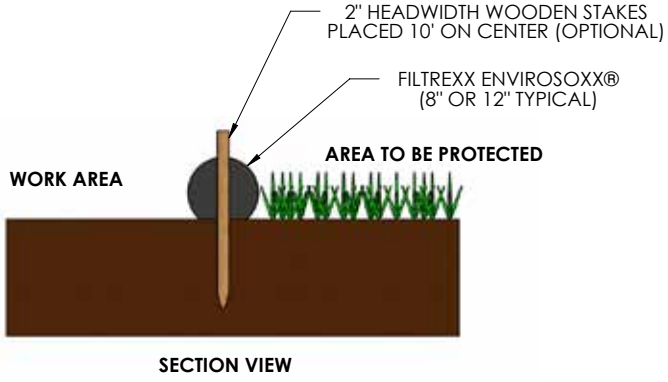
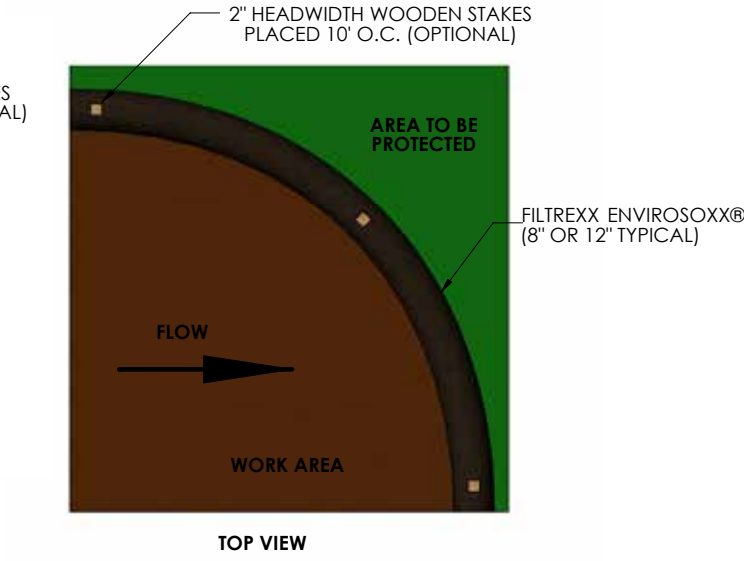
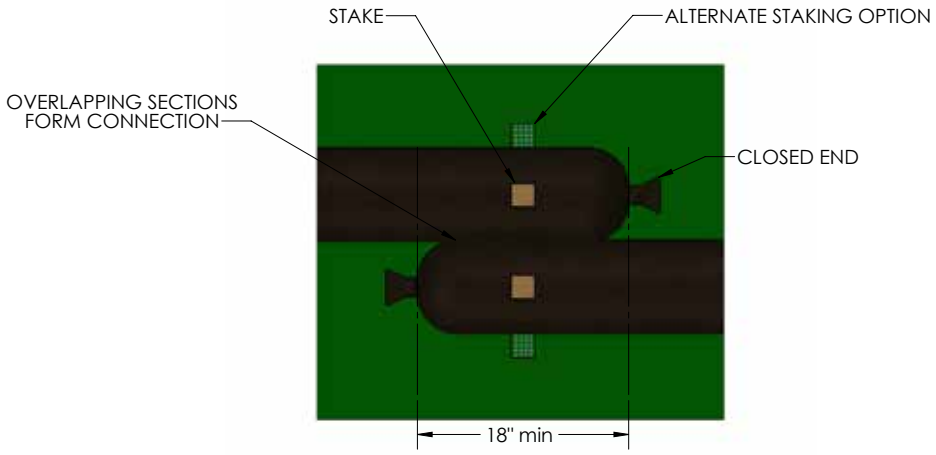
Figure 4.1. Engineering Design Drawing for Filtrexx EnviroSoxx®

FILTREXX ENVIROSOXX®





ENVIROSOXX® CONNECTION/ATTACHMENT DETAIL



ENVIROSOXX® PYRAMID STAKING DETAIL