

Design and Installation Manual for Advanced Enviro-Septic® (AES) Wastewater Systems



For more detailed design and installation information on AES, please contact Infiltrator Water Technologies at (800) 221-4436 or Presby Environmental, Inc. at (800) 473-5298.

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Missouri



INFILTRATOR®
water technologies

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The information in this Manual is subject to change without notice. We recommend that you check your state's page on our website on a regular basis for updated information. Your suggestions and comments are welcome. Please contact us at:

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IMPORTANT NOTICE: This Manual is intended ONLY for use in designing and installing Presby Environmental's Advanced Enviro-Septic® Wastewater Treatment Systems. The processes and design criteria contained herein are based solely on our experience with and testing of Advanced Enviro-Septic®. Substitution of any product is prohibited.

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1.0 INTRODUCTION

NEW FOR 2020

IMPORTANT CHANGES TO THE USE OF ADVANCED ENVIRO-SEPTIC IN MISSOURI

The Missouri Department of Health and Senior Services (DHSS) has approved a number of critical changes to the way in which the Advanced Enviro-Septic System (AES) is to be designed, permitted and installed in Missouri. The changes are effective September 1, 2020 and will remain in effect until further notice.

ALL OF THESE CHANGES ARE INCORPORATED INTO THIS MANUAL.

PLEASE READ, UNDERSTAND AND INCORPORATE/PRACTICE THESE CHANGES BEFORE DESIGNING AND/OR INSTALLING AN AES SYSTEM

1.1 Missouri State-Specific Information

System Type

The AES is approved for use as an *experimental* system. In every instance the property owner(s) must:

- be made aware of this fact before purchasing an AES system;
- sign a form acknowledging that they understand this fact; and
- allow DHSS and Presby Environmental (PEI) or Infiltrator Water Technologies (Infiltrator) personnel onto their property to investigate system function.

The AES is a combined treatment and dispersal system (CTDS), a system type which is not specifically addressed in 19 CSR 20-3.060 (the Rules). It shall be designed, permitted, and installed in accordance with the requirements and exceptions listed below. If there are questions about design specifications, please contact your local health department or Presby Environmental (PEI) for assistance at (800) 473-5298.

System Design

Design of the AES shall comply with the following:

- the soil type and soil loading rate (SLR) must be established by a soil morphology evaluation;
 - the AES system shall not be permitted for installation and use in IVb soils.
- the minimum total absorption area is determined by utilizing the soil loading rates in Table A in Section 2.1 below, which are based on Tables 13 and 14 in the Rules;
- a minimum vertical separation distance of 1 foot (ft) is required:
 - there must be a minimum of 12 inches (in) of naturally occurring suitable or provisionally suitable soil below grade at the location of the system on the site for the AES to be permitted; and
- AES pipe rows in a given bed shall be designed and installed at the same elevation (level to one another);
- serial distribution is not allowed;
- a Missouri-licensed engineer is required for design if either:
 - the SLR is less than or equal to (\leq) 0.29 gallons per day per square foot (gpd/ft²); or
 - any aspect of the AES (18 in tall – 6 in of system sand plus the 12 in diameter pipe) is at grade or above grade.

1.0 INTRODUCTION

System Installation

Installation shall be undertaken and completed only by an advanced registered onsite wastewater treatment system installer.

Variances

No variances shall be issued with use of the AES system while approved as an experimental system.

1.2 Background

The Advanced Enviro-Septic® (AES) Wastewater Treatment System utilizes a unique combination of components that work together to treat effluent and prevent suspended solids from sealing the underlying soil. Comprised of a patented corrugated, perforated plastic pipe with interior skimmer tabs and cooling ridges, the large-diameter pipe retains solids while the Bio-Accelerator® fabric, coarse fibers, and geo-textile fabric provide multiple bacterial surfaces to treat effluent prior to its contact with the receiving soils. The continual cycling of effluent (the rising and falling of liquid inside the pipe) enhances bacterial growth. The AES system is completely passive, and yet provides increased aeration and a greater bacterial treatment area than traditional systems. The result is a system that is more efficient, lasts longer, and has a virtually no negative environmental impact.

The AES system has been successfully tested and certified to NSF/ANSI 40, Class I (a certification typically given to mechanical aeration devices) and BNQ Class I, II, III standards.

Additional system benefits include:

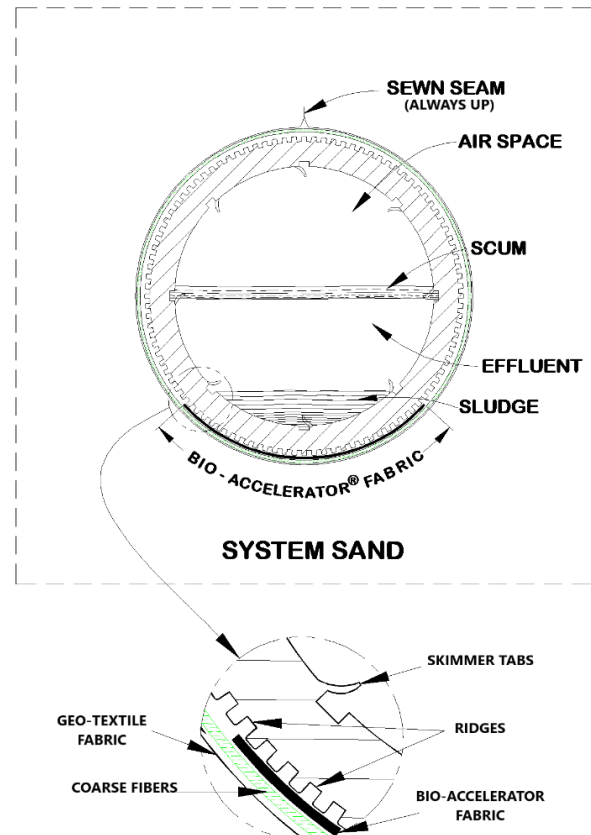
- requires a smaller area
- installs easily and quickly
- eliminates the need for environmentally impactful washed stone
- adapts easily to residential, commercial and difficult sites
- prevents formation of organic material at the receiving soil interface
- safely recharges groundwater

Environmental Standards and Technical Support

All AES systems shall be designed and installed in compliance with the procedures and specifications detailed in this Manual and in the product's state approval. In the event of contradictions between this Manual and DHSS regulations (the Rules), PEI should be contacted for technical assistance at (800) 473-5298.

Certification Requirements

Designers and installers who have not previously attended a PEI certification course are required to obtain certification. Certification is obtained by attending a certification course presented by PEI or its sanctioned representative or by viewing tutorial videos on our website and then successfully passing a short assessment test. PEI recommends professionals involved in the inspection or review of AES systems also become PEI certified.



1.0 INTRODUCTION

1.3 System Components

AES Pipe:

- nominal exterior diameter of 12 in
- holding capacity of 5.8 gallons per foot
- 10 ft length of AES pipe is flexible enough to bend up to 90° and can be cut to any length
- made with a significant amount recycled material



Offset Adapter - A 12 in plastic fitting with a single inlet hole oriented in the 12 o'clock position and designed to accept a 4 in sewer line, raised connection or vent pipe.

Double Offset Adapter - A 12 in plastic fitting with two 4 in holes designed to accept a 4 in inlet pipe, raised connection, vent or vent manifold, and/or bottom drain, depending upon the requirements of the design configuration.

Coupling - A plastic fitting used to create a connection between two pieces of AES pipe.

System Sand - The system sand that surrounds the AES pipes is an essential component of the system. It is critical that the correct type and amount of system sand is used during construction. System sand shall be coarse to very coarse, clean, granular sand, free of organic matter. System sand is placed a minimum of 3 in above and 6 in below, between, and around the outer perimeter of the AES pipes. It shall adhere to all of the following percentage and quality restrictions:

System Sand Specification

Sieve Size	Percent Retained on Sieve (by weight)
3/4 in (19 mm)	0
#10 (2 mm)	0 - 35
#35 (0.50 mm)	40 - 90
Note: not more than 3% allowed to pass the #200 sieve (verified by washing sample per requirements of ASTM C-117)	

System Sand Bed Height Dimension

The height of an AES system measures 21 in minimum (not including cover material):

- minimum of 6 in of system sand below the AES pipe;
- 12 in diameter of the pipe;
- minimum of 3 in of system sand above the AES pipe; and
- when a system sand extension is required it shall be a minimum of 6 in thick.

Note: the 3 in of system sand is not considered as "part of the AES" when determining if the system is at grade or above grade.

System Sand Acceptable Alternative - ASTM C-33 (concrete sand), natural or manufactured sand, with not more than 3% passing the #200 sieve (verified by washing the sample per the requirements of ASTM C-117 as noted in the ASTM C-33 specification) may be used as an acceptable alternate material for use as system sand.

Fill Material - Fill material or system sand may be used in side slope tapers. Fill material shall meet the requirements of the Rules.

2.0 SYSTEM DESIGN

2.1 System Sizing

All residential AES systems require the use of 70 linear feet (lf) of AES pipe per bedroom (br). In non-residential or commercial applications, divide the DDF by 2.14 gal to calculate the minimum amount of AES pipe required.

In accordance with the Rules, daily design flow (DDF) is calculated as follows: the minimum flow rate shall be one hundred twenty gallons (120 gals.) per day per bedroom. When the occupancy of a single family dwelling exceeds two (2) persons per bedroom, the volume of sewage shall be determined by the maximum occupancy at a rate of sixty gallons (60 gals.) per person per day.

The minimum absorption area (known as the system sand bed area or SSBA) for the AES system is determined using the formulas provided in Table A below and is based on the soil loading rate (SLR) as established by a soil morphology evaluation.

Table A: AES Minimum Pipe Requirements and System Sizing Formulas for Residential Systems

Actual Soil Loading Rate at Site (gpd/ft ²)	Minimum AES Pipe per Bedroom (ft)	System Sand Bed Area (SSBA) Formula	Soil Loading Rate Rule Reference
1.20 – 0.30	70	$SSBA = DDF/SLR * 0.90$	Table 13
0.29 – 0.10	70	$SSBA = DDF/SLR$	Table 14

2.2 Design Procedure

Step #1: Determine System Sand Bed Area (SSBA) Required

Based upon the SLR on the site as established by a soil morphology evaluation, use the formulas from Table A above to calculate the minimum SSBA required.

Step #2: Calculate the Minimum Amount of AES Pipe Needed

Residential systems: multiply the number of bedrooms in the design by 70 ft.

Non-residential or commercial applications: divide the DDF by 2.14.

This results in the minimum amount of AES pipe that must be used in the system.

Step #3: Determine Row Length and Quantity Needed

Select a row length suitable for the site and calculate the number of rows needed (round up to whole number).

Step #4: Determine Pipe Layout Width (PLW)

Calculate the PLW using a 1.5 ft minimum center-to-center row spacing (larger spacing allowed).

Formula for PLW = [(# of rows – 1) * spacing (1.5)] + 1.

Step #5: Determine Minimum System Sand Bed Width (SSBW)

Calculate the minimum SSBW by dividing the SSBA from Step #1 by the selected row length from Step #3 + 1 ft (1 ft allows for 6 inches of sand on each end of the AES rows).

Step #6: Verify Final Bed Width Requirements

- Beds sloping 5% or less: If the minimum SSBW is less than the PLW + 1 ft, use (PLW + 1 ft) as the new minimum SSBW.
- Beds sloping > 5%: If the minimum SSBW is less than the PLW + 3.5 ft, use PLW + 3.5 ft as the new minimum SSBW. Adding 3.5 ft to the pipe layout width accounts for the minimum required 2.5 ft

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system sand extension on the down slope side of the AES system. [Please see sections titled “System Sand Extensions (SSE)” on page 9 and “Elevated Bed Systems” on page 10].

Step #7: Calculate System Sand Extension (SSE):

- Beds sloping 5% or less: SSE is divided in half and placed evenly on each side of AES pipes. Formula for SSE on level sites $[SSBW - (PLW + 1)] \div 2$. There will be no SSEs if the $SSBW \leq PLW + 1$ ft.
- Beds sloping > 5%: SSE placed entirely on the down slope side of the bed. Formula for $SSE = SSBW - (PLW + 1)$ and must be at least 2.5 ft (3 ft from the edge of the AES Pipe).

2.3 Design Examples

Design Example #1:

Single family residence, 4 bedrooms (480 gpd), SLR = 1.00 gpd/ft², level site, vertical separation greater than 2 feet.

Step #1: Determine System Sand Bed Area (SSBA) Required

$$SSBA: 480 \text{ gpd} \div 1.00 \text{ gpd/ft}^2 = 480 \text{ ft}^2. \quad 480 \text{ ft}^2 * 0.90 = 432 \text{ ft}^2.$$

Step #2: Calculate the Minimum Amount of AES Pipe Needed

$$\text{AES pipe required: } 70 \text{ ft/br} * 4 \text{ br} = 280 \text{ ft minimum.}$$

Step #3: Determine Row Length and Quantity Needed

$$\text{Using a row length of 70 ft requires 4 rows } (280 \text{ ft} \div 70 \text{ ft} = 4 \text{ rows}).$$

Step #4: Determine Pipe Layout Width (PLW)

$$PLW = [(4 - 1) * (1.5)] + 1 = 5.5 \text{ ft.}$$

Step #5: Determine Minimum System Sand Bed Width (SSBW)

$$\text{Minimum SSBW} = 432 \text{ ft}^2 \div (70 \text{ ft} + 1 \text{ ft}) = 6.08 \text{ ft (round up to 6.5 ft for ease of construction).}$$

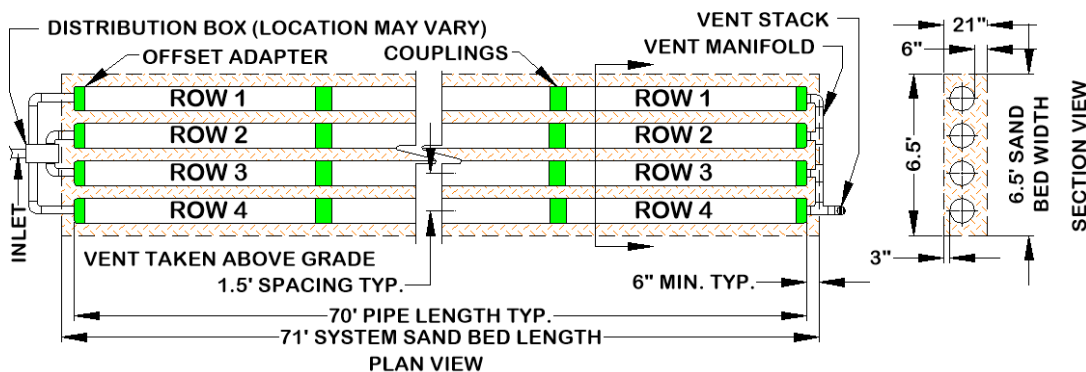
Step #6: Verify Final Bed Width Requirements

- Beds sloping 5% or less: Minimum SSBW of 6.5 ft is equal to $PLW + 1$ (5.5 ft + 1 ft.). Use Minimum SSBW for design.
- Not Applicable.

Step #7: Calculate System Sand Extension (SSE):

- Beds sloping 5% or less: SSE is divided in half and placed evenly on each side of AES pipes. $SSE = [6.5 \text{ ft} - (5.5 + 1)] \div 2 = 0.0 \text{ ft}$. No system sand extensions are needed for this design.
- Not Applicable

Illustration of Example #1:



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Design Example #2:

Single family residence, 3 bedrooms (360 gpd), SLR = 0.25 gpd/ft², 12% site slope, limiting layer at 14 in. The SLR of 0.25 gpd/ft and the fact that the system will be above grade both require that the system be designed by a licensed professional engineer.

Step #1: Determine System Sand Bed Area (SSBA) Required

$$SSBA = (360 \text{ gpd} \div 0.25 \text{ gpd/ft}^2) = 1440 \text{ ft}^2 \text{ minimum.}$$

Step #2: Calculate the Minimum Amount of AES Pipe Needed

$$\text{AES pipe required: } 70 \text{ ft/br} \times 3 \text{ br} = 210 \text{ ft minimum.}$$

Step #3: Determine Row Length and Quantity Needed

$$\text{Using a row length of 70 ft requires 3 rows } (210 \text{ ft} \div 70 \text{ ft} = 3 \text{ rows}).$$

Step #4: Determine Pipe Layout Width (PLW)

$$PLW = [(3 - 1) \times (1.5)] + 1 = 4.0 \text{ ft.}$$

Step #5: Determine Minimum System Sand Bed Width (SSBW)

$$\text{Minimum SSBW} = 1,440 \text{ ft}^2 \div (70 \text{ ft} + 1 \text{ ft}) = 20.28 \text{ ft (round up to 20.5 ft).}$$

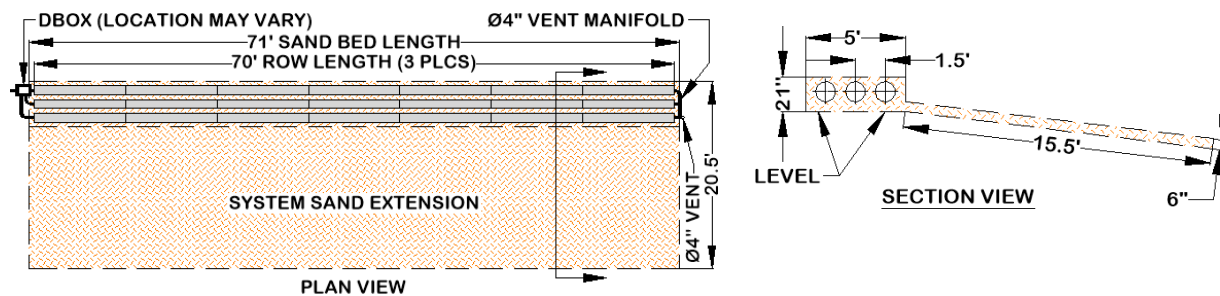
Step #6: Verify Final Bed Width Requirements

- a) Beds sloping 5% or less: not applicable.
- b) Beds sloping > 5%: Minimum SSBW 20.5 ft is greater than the (4.0 + 3.5 ft), use 20.5 as the SSBW.

Step #7: Calculate System Sand Extension (SSE):

- a) Beds sloping 5% or less: not applicable.
- b) Beds sloping > 5%: SSE placed entirely on the down slope side of the bed. $SSE = 20.5 - (4.0 + 1) = 15.5$ which meets the 2.5 ft minimum extension for this slope.

Illustration of Example #2:



2.4 Design Specifications

The AES system shall be designed in accordance with this Manual and the Rules and can be installed using either bed or trench design utilizing any of the design configurations outlined in this Manual.

Daily Design Flow (DDF)

In accordance with the Rules, daily design flow (DDF) is calculated as follows: the minimum flow rate shall be one hundred twenty gallons (120 gals.) per day per bedroom. The minimum volume of sewage from each single family dwelling shall be two hundred forty gallons (240 gals.) per day. When the occupancy of a single family dwelling exceeds two (2) persons per bedroom, the volume of sewage shall be determined by the maximum occupancy at a rate of sixty gallons (60 gals.) per person per day.

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Septic Tank

The AES system is designed to treat effluent that has received “primary treatment” in a standard septic tank. Septic tanks shall be sized according to the Rules.

Pressure Distribution

The use of pressure distribution lines in AES systems is prohibited. Pumps may be utilized when necessary only to gain elevation and to feed a distribution box which then distributes effluent by gravity to the AES field. Siphon dosing is permitted; adequate venting is required in a siphon-dosed system or pumped system, which may require an additional high vent (referred to as “differential venting”).

Effluent (Wastewater) Strength

The AES pipe requirement for bed or trench systems is based on residential strength effluent, which has received primary treatment in a septic tank. Use of the AES in non-residential or commercial applications requires that a treatment train be included in the design which reduces effluent to residential strength prior to release into the AES. Industrial (processed) waste shall not be discharged into the AES system. Our Technical Advisors may be consulted for recommendations at (800) 473-5298.

Effluent Filters

- Effluent filters are not recommended for use with AES systems.
- If used, effluent filters shall be maintained on at least an annual basis. Follow manufacturer’s instructions regarding required inspections, cleaning and maintenance of the effluent filter.
- Effluent filters must allow the free passage of air to ensure the proper functioning of the system.
- Charcoal filters in vent stacks (for odor control) are not recommended by PEI. They can block air flow and potentially shorten system life.

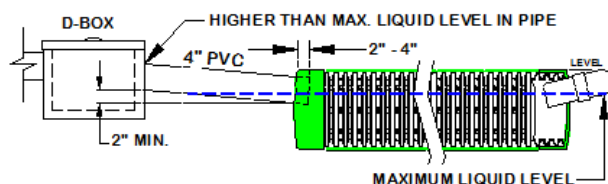
Flow Equalizers Required

All distribution boxes (D-box) used to divide effluent flow require flow equalizers in their outlets. A flow equalizer is an adjustable plastic insert installed in the outlet holes of a D-box to equalize effluent distribution to each outlet whenever flow is divided. Each row is limited to a maximum of 15 gallons per minute (gpm), due to the flow constraints of the equalizers. Example: pumping to a D-box with 4 outlets. The maximum delivery rate is $(4 \times 15) = 60$ gpm. Always provide a means of velocity reduction when needed.



Two Inch Rule

The outlet of a septic tank or D-box shall be set at least 2 in above the highest inlet of the AES row, with the connecting pipe slope not less than 1% (approximately $\frac{1}{8}$ in per foot). Illustration of 2 in rule:



AES Pipe Requirement

AES systems use the bed sizing tables, pipe and installation requirements noted in this Manual.

- Residential systems: 70 ft/br.
- Non-residential or commercial systems comprised of residential strength effluent: 2.14 gpd/ft².

Water Purification Systems

- Water purification systems and water softeners should not discharge into any AES system.

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- If there is no alternative means of disposing of this backwash other than in the system, the system will need to be “oversized.” Calculate the total amount of backwash in gpd, multiply by 2, and add this amount to the daily design flow when determining the field and septic tank sizing.
- Water purification systems and water softeners require regular routine maintenance; consult and follow the manufacturer’s maintenance recommendations.

Sloping Sites and Sloping Mound Systems

- On sloping sites (>5%) the AES pipe rows and surrounding system sand shall be level.
- Any system sand extension may follow the slope of the site.
- Maximum site slope is 25%.

Row Requirements

- All beds shall have at least 2 rows.
- Maximum row length for any system is 100 ft of pipe.
- Recommended minimum row length is 30 ft of pipe.
- A minimum of two D-box outlets must be used and the field must be vented. Minimum center-to-center spacing is 1.5 ft for all systems. Spacing may be increased at the discretion of the system designer or as needed to meet the required SSBA.
- Sewn seam must be oriented in the 12 o'clock position. This correctly orients the Bio-Accelerator® fabric in the 6 o'clock position.
- For level beds the AES rows shall be centered in the middle of the system sand bed area (SSBA) and any system sand extensions (SSE) divided evenly on both sides.
- For sloping beds (>5%): the elevation for the AES rows must be provided on the drawing. All rows shall be grouped 6 in from the up-slope edge of the SSBA with any system sand extensions placed entirely on the downslope side. Systems sloping greater than 5% require a 2.5 ft SSE on the downslope side of the bed (3 ft when measured from the pipe).
- Each row must be laid level to within $\pm \frac{1}{2}$ in (total of 1 in) of the specified elevation and shall be parallel to the contour of the site.
- It is most convenient if row lengths are designed in exact 10 ft increments to accommodate the length of the AES pipe as manufactured. However, AES pipe lengths can be cut to any length.

System Sand Extensions (SSE)

System sand extensions (SSE) are placed on the down slope side of sloping systems and equally divided on each side of level systems. The SSE is measured from the tall portion of the system sand bed. In systems sloping more than 5%, a 2.5 ft minimum SSE is required. The SSE area is a minimum of 6 in deep.

Separation Distances (Horizontal and Vertical)

Horizontal separation distances are measured from the outermost edge of the system sand bed area. Vertical separation distances are measured from the bottom of the 6 in-deep basal system sand layer to the naturally occurring suitable or provisionally suitable receiving soil interface.

Design of the AES requires a minimum vertical separation of 12 in. There must be a minimum of 12 in of naturally occurring suitable or provisionally suitable soil below grade at the location of the system on the site for the AES to be permitted.

No variances will be issued until the AES system is no longer considered by DHSS to be experimental.

Barrier Materials over System Sand

No barrier materials (hay, straw, tarps, etc.) are to be placed between the system sand and cover material. The only exception is the placement of the specified fabric to achieve H-20 loading requirements.

2.0 SYSTEM DESIGN

2.5 System Configurations

Elevated Bed Systems

Elevated beds are designed for sites with soil, depth to groundwater or restrictive feature constraints that do not allow for in-ground bed systems. An elevated bed system is a soil absorption field with any part of the AES system (6 in basal system sand layer and 12 in tall AES pipe rows) is located above original grade. Side-slope tapering is used to blend the raised portion of the system with the existing grade. Elevated bed systems require 6 in fill extensions on each side (measured from the pipe), after which side-slope tapering is to be a maximum of 3 horizontal feet for each 1 ft of vertical drop until it meets existing grade. In systems sloping greater than 5%, there must be a minimum of 2.5 ft of system sand extension (3 ft measured from the pipe) beyond the last down-slope row of pipe. There must be a minimum of 12 in of cover material over the ends of all system sand extensions (if present).

Illustration of an elevated level bed:

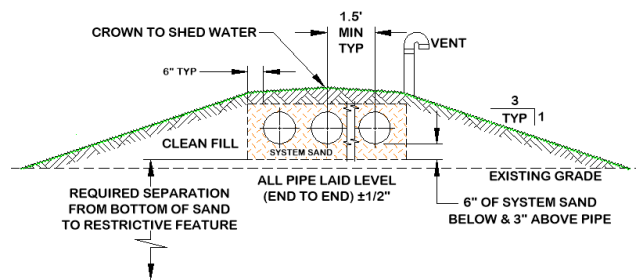
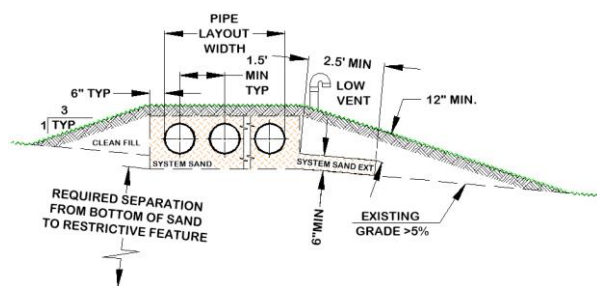
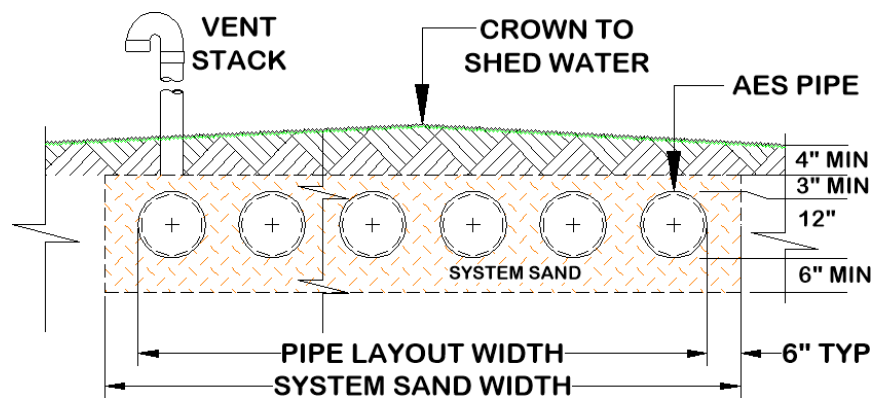


Illustration of an elevated sloping bed:



In-Ground Bed Systems

Systems are installed at or below existing grade for sites with no soil restrictive features within 30 in of grade. In-ground systems that slope over 5% require a 2.5 ft system sand extension on the downhill side of the field. In-ground on level site:



Trench Systems

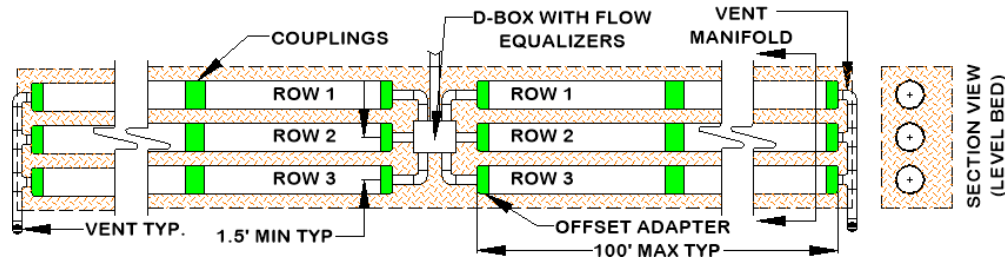
AES pipe may be installed in trench configurations on level or sloping terrain. Trench systems incorporate one or more rows of AES pipe per trench. A minimum of 3 in of system sand is required above and 6 in below, between, and around the perimeter of the AES pipe. Consult the Rules for acceptable trench width and/or required trench separation.

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Butterfly Configuration

- A “butterfly configuration,” is considered a single bed system with two or more sections extending in opposite directions from the D-box along the contour.
- Butterfly configurations are generally used to accommodate bed lengths longer than the maximum row length of 100 ft.
- Rows shall meet requirements outlined in the design criteria above.

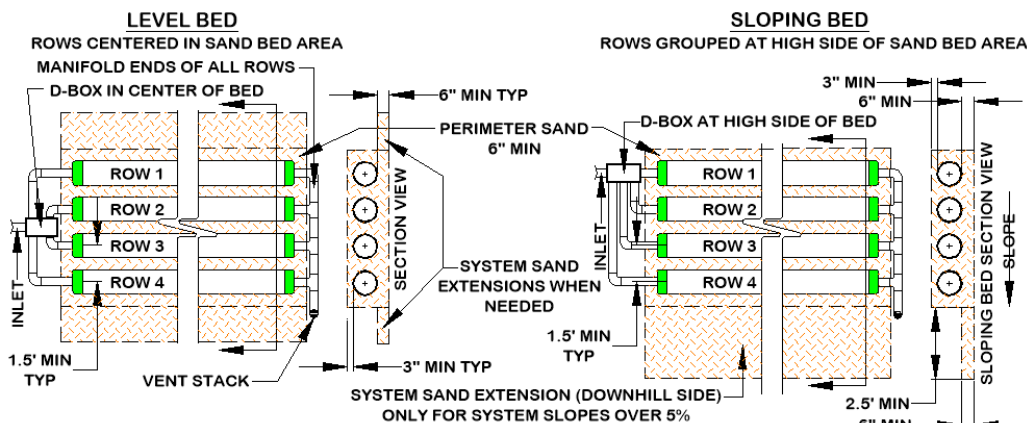
Illustration of a butterfly configuration bed design:



D-box (Parallel) Distribution

- All pipe rows shall be the same length.
- Flow equalizers must be used in the D-box.
- Use a manifold to connect the ends of all rows. Manifold shall be sloped toward AES pipes.
- D-box placement shall be installed on level, firmly compacted soil.
- All rows shall be laid level end-to-end.
- A 2 in min. drop is required between the D-box outlets and the AES pipe inlets.
- Rows shall meet requirements outlined in the design criteria above.

Illustrations for D-box (parallel) distribution bed design:



Multiple Bed Distribution

Incorporates two or more beds, each bed receiving an equal amount of effluent from a D-box. Multiple beds may be oriented along the contour of the site or along the slope of the site.

- Each bed shall have the same minimum linear feet of pipe. The minimum linear feet of pipe per bed is determined by dividing the total linear feet required in the system by the number of beds.
- All pipe rows to be the same length.
- End-to-end configurations are preferred to side-to-side configurations.
- Bed separation distance is measured from the edge of the SSBA. Multiple beds located at the same elevation shall be separated by a minimum of 10 ft. Multiple beds located upslope and downslope of one another shall be separated by a minimum of 25 ft.

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Illustration of multiple beds at same elevation:

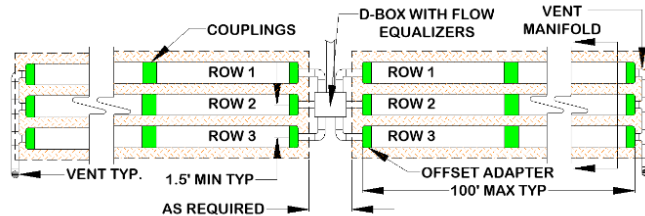
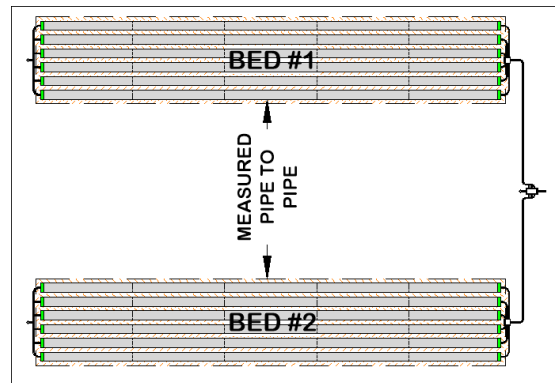


Illustration of multiple beds at different elevations:

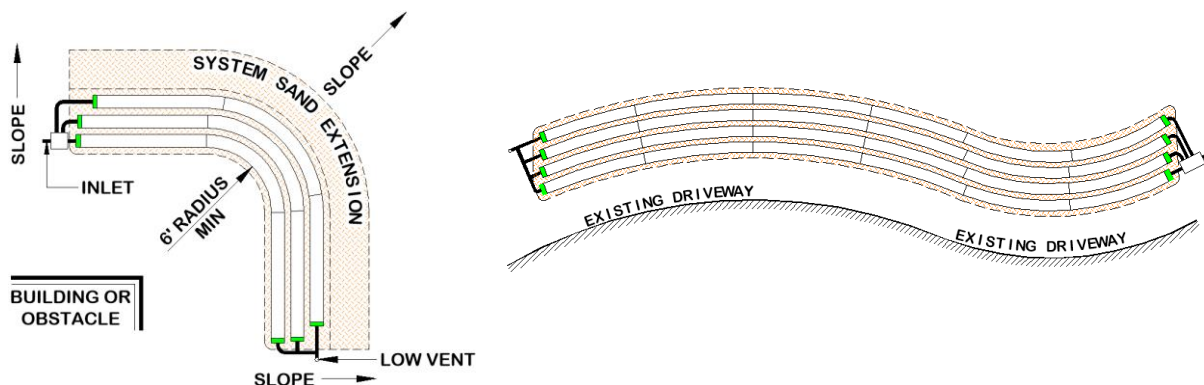


Angled and Curving Beds

Angled and curving beds are used to avoid obstacles and work well around structures, setbacks, and slopes. Multiple curves can be used within a system to accommodate various contours of the site.

- Rows are angled by bending pipes up to 90 degrees or through the use of offset adapters
- Rows shall meet requirements outlined in the design criteria above.

Illustrations of angled and curving beds:



2.6 Pump Systems

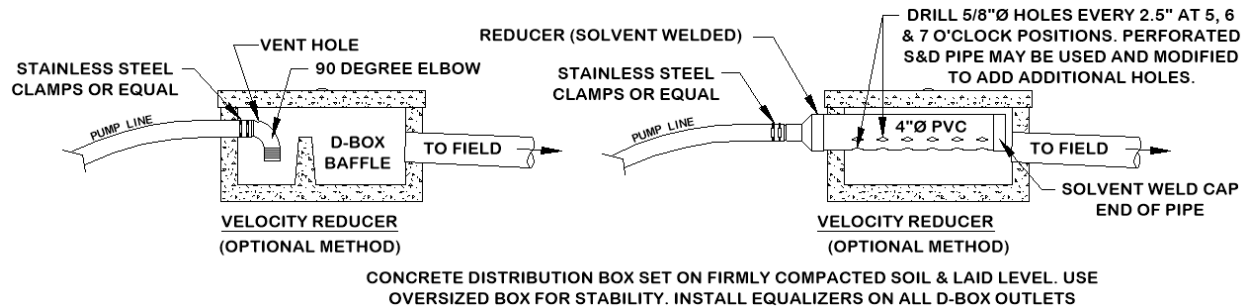
Pumped systems supply effluent to the system using a pump and D-box when site conditions do not allow for a gravity system. Dosing siphons are also an acceptable means of delivering effluent to the system.

- Pump volume per dose shall be no greater than 1-gallon times the total linear feet of AES pipe.
- Pump dosing should be designed for a minimum of 6 cycles per day; 6-8 cycles per day are recommended.
- If possible, the dosing cycle should provide one hour of drying time between doses.
- Pump systems must have a high-water alarm float or sensor installed inside the pump chamber. Follow state, local and national code requirements.
- All pump systems require differential venting.
- All pumped systems require a D-box with baffles, a velocity reducing tee or other means to be used for velocity reduction.

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- All systems with multiple bed distribution shall use flow equalizers in each D-box outlet with each bed or section limited to a maximum of 15 gpm, due to the flow constraints of the equalizers.
 - *Example: pumping to a system using 3 D-box outlets, the maximum delivery rate is $(3 \times 15) = 45$ gpm. Higher flow rates can be accommodated by connecting multiple D-box outlets to each line.*
- The rate at which effluent enters the AES pipe shall be controlled. Excessive effluent velocity can disrupt solids that settle in the pipes.
 - Effluent shall never be pumped directly into AES pipes.
 - A D-box or tank shall be installed between the pumping chamber and the AES pipe to reduce effluent velocity.
 - Force mains shall discharge into a D-box (or equivalent) with velocity reducer such as a baffle, 90° bend, tee or equivalent.
- Velocity reducers are also needed for gravity systems when there is excessive slope between the septic tank and the AES system.

Two methods of velocity reduction:



2.7 Venting

An adequate air supply is essential to the proper functioning of AES systems. Venting is always required. All systems shall utilize differential venting.

General Rules

- Differential venting is the use of high and low vents in a system.
- In a gravity system, the roof stack acts as the high vent.
- High and low vent openings shall be separated by a minimum of 10 vertical ft.
- If possible, the high and low vents should be of the same capacity.
- Roof vent diameter must be a minimum of 3 in, 4 in diameter is recommended. If the roof vent is less than 3 in, an additional high vent is recommended.
- Vent openings shall be located to ensure the unobstructed flow of air through the entire system.
- The low vent inlet shall be a minimum of 1 ft above final grade or anticipated snow level. Vents extending more than 3 ft above grade must be anchored.
- Sch. 40 or SDR 35 PVC (or equivalent) should be used for all vent stacks.
- One 4 in vent is required for every 1,000 ft of AES pipe.
- A single 6 in vent may be installed in place of up to three 4 in vents.
- If a vent manifold is used, it shall be at least the same diameter as the vent(s).
- Vent piping should slope downward toward the system to prevent moisture from collecting in the pipe and blocking the passage of air.
- Remote venting may be utilized to minimize the visibility of vent stacks.
- When venting multiple beds, it is preferred that each bed be vented separately rather than connecting bed vents together. Multiple vents can be remotely located to the same location if desired.

2.0 SYSTEM DESIGN

Vent Manifolds

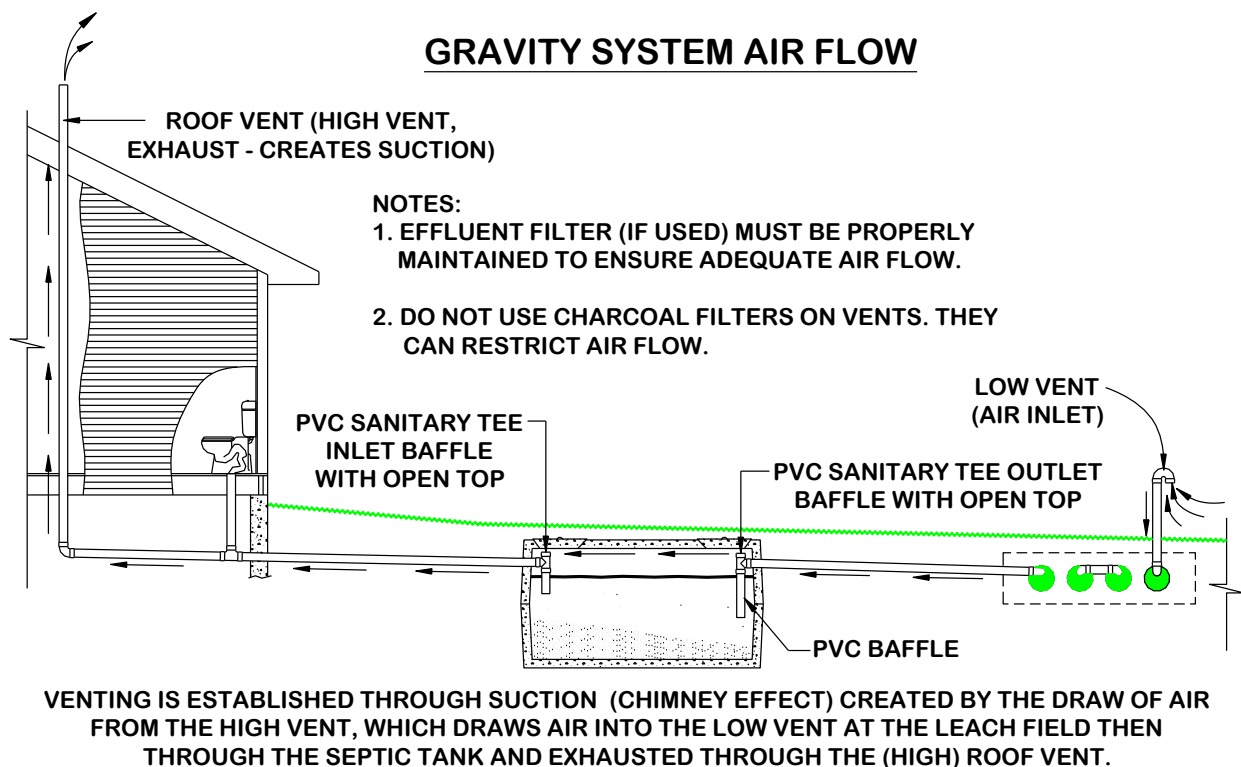
A vent manifold may be incorporated to connect the ends of a number of sections or rows of AES pipe to a single vent opening. Slope the lines connecting the manifold to the AES pipes to drain condensation.



Gravity Systems Vent Location

- A vent manifold shall be used to connect the distal ends of the rows within a bed (or each section in a multiple bed system).
- The vent manifold shall include use of offset adapters.
- A low vent shall be installed into any aspect of the vent manifold of the bed (or each section in a multiple bed system).
- The house (roof) vent functions as the high vent as long as there are no restrictions or other vents between the low vent and the house (roof) vent.
- When the house (roof) vent functions as the high vent, there shall be a minimum of a 10 ft vertical differential between the low and high (roof) vent openings.

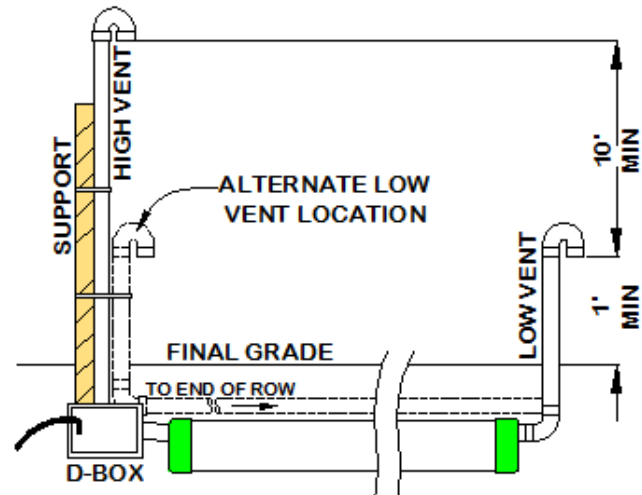
Illustration of gravity system air flow:



2.0 SYSTEM DESIGN

Pump System Vent Locations

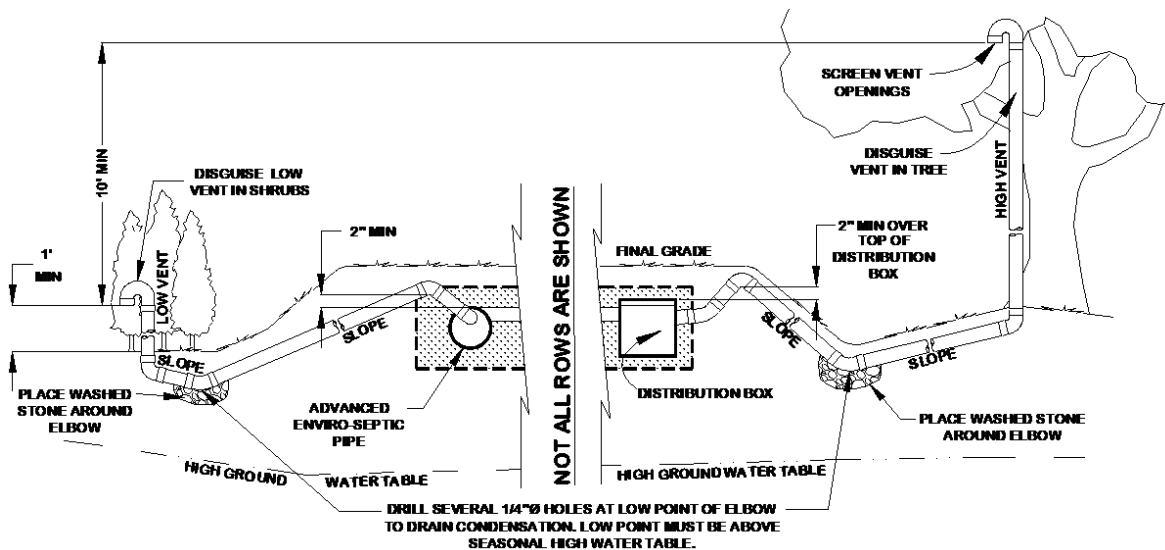
- A low vent shall be installed into any aspect of the vent manifold on the distal end of the bed (or each section in a multiple bed system).
- The vent manifold shall include use of offset adapters.
- A high vent is attached to an unused D-box outlet.
- The low and high vents may be swapped, provided the D-box is insulated against freezing in cold climates.
- For options to relocate the high vent, see Remote Venting.
- For options to eliminate the high vent, see Bypass Venting.



Remote Venting

If site conditions do not allow the vent pipe to slope toward the system, or the owner chooses to utilize remote venting for aesthetic reasons (causing the vent pipe not to slope toward the system), the low point of the vent line must be drilled creating several $\frac{1}{4}$ in holes to allow drainage of condensation. This procedure may only be used if the vent pipe connecting to the system has:

- A high point that is above the highest point of all AES pipes or the D-box (2 in minimum for each); and,
- A low point opened for drainage which is above the SHWT (see diagram below).

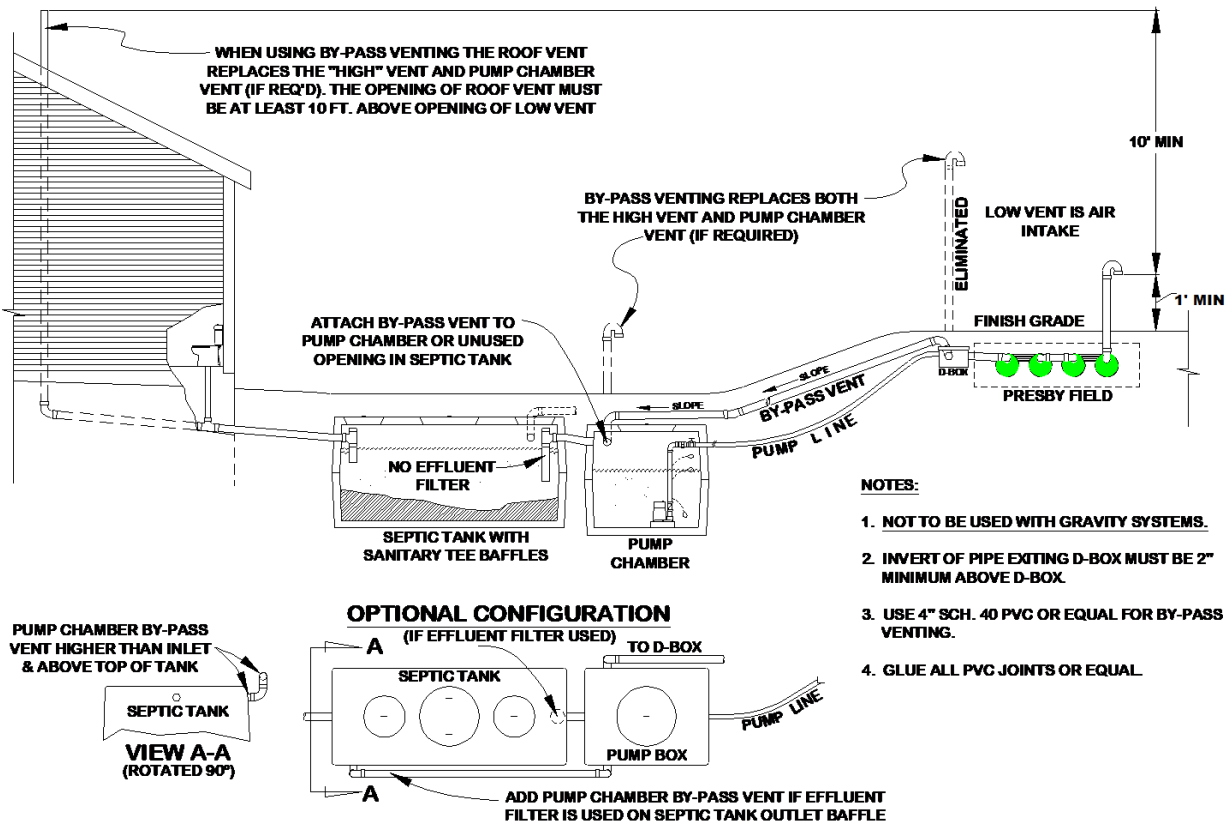


By-Pass Venting

When a field is fed using pumping or dosing, it is necessary to provide air flow through the system by using either an independent high vent at the field or "by-pass venting". For by-pass venting, the system is plumbed by attaching Sch. 40 or SDR 35 PVC from the D-box back to the septic tank or pump chamber if no effluent filter is present. This process "by-passes" the pump line and allows air to flow from the low vent to the roof vent which functions as the high vent. The bypass vent line invert must rise 2 in above the D-box before dropping to pump chamber or septic tank.

2.0 SYSTEM DESIGN

Illustration of by-pass venting:



2.8 Site Selection

Determining Site Suitability

Refer to DHSS regulations and local rules regarding site suitability requirements.

Topographic Position Requirement

AES systems shall not be located where surface or ground waters will converge, causing surface water flow to become concentrated or restricted within the soil absorption field. The system shall be located in an area that does not concentrate water, both surface and subsurface. If allowed by state and local authorities, altering the terrain upslope of a system may alleviate this requirement if the waters are sufficiently altered to redirect flows away from the field.

- Locate systems on convex, hill, slope or level locations. Avoid swales, low areas, or toe-of-slope areas that may not provide sufficient drainage away from the system.
- No onsite system may be located on concave slopes that concentrate surface or ground water flows unless up-slope terrain is sufficiently altered or interceptor drains are used to redirect water away from the system.
- Systems should not be located where lawn irrigation, roof drains, or natural flows increase water loading to the soils around the system. Divert surface water away from the system.
- Interceptor drains, if used, must be upslope of the AES system and a minimum of 10 ft away from all AES pipe.
- Systems should not be located where structures such as curbs, walls or foundations might adversely restrict the soil's ability to transport water away from the system.

2.0 SYSTEM DESIGN

- Systems should be located to allow access for septic tank maintenance and to at least one end of all AES rows.
- Avoid locating systems in rocky or wooded areas that require additional site work, since this may alter the soil's ability to accept water.
- No trees or shrubs should be located within 10 ft of the system to prevent root infiltration.

AES as a Replacement System

If an AES system is being installed in the same location where another onsite system has previously been installed:

- Remove the existing components and contaminated sand and soil.
- If the soils under and around the system have not been compromised, it is permissible to install the AES system in the same excavated location using new system sand.

Note: Permits are required for system replacement.

3.0 INSTALLATION

3.1 *Installation Requirements*

Component Handling

- Keep mud, grease, oil, etc. away from all components. Avoid dragging pipe through wet or muddy areas. Store pipe on high and dry areas to prevent surface water and soil from entering the pipes or contaminating the fabric prior to installation.
- The outer fabric of the AES pipe is ultra-violet stabilized; however, this protection breaks down after a period of time in direct sunlight. To prevent damage to the fabric, cover the pipe with an opaque tarp if stored outdoors.

Site Preparation Prior to Excavation

1. Locate and stake out the system sand bed, extension areas and soil material cover extensions on the site according to the approved plan.
2. Install sediment/erosion control barriers prior to beginning excavation to protect the system from surface water flows during construction.
3. Do not stockpile materials or equipment within the portion of the site receiving system sand.

Critical Reminder to Prevent Soil Compaction

It is critical to keep excavators, backhoes, and other equipment off the excavated or tilled surface of a bed. Before installing the system sand, excavation equipment should be operated around the bed perimeter; not on the bed itself. It is especially important to avoid using construction equipment down slope of the system to prevent soil compaction.

When to Excavate

- Do not work wet or frozen soils. If a fragment of soil from about 9 in below the surface can easily be rolled into a wire, the soil moisture content is too high for construction.
- Do not excavate the system area immediately after, during or before precipitation.

Tree Stumps

Before tilling, remove all grass, leaves, sticks, brush and other organic matter or debris from the excavated system site. Removal of all tree stumps and the central root system below grade is recommended (see note below). Use a backhoe or excavator with a mechanical “thumb” or similar extrication equipment to lift or leverage the stump in a manner that minimizes soil disturbance. It is not necessary for the soil of the system site to be smooth when the site is prepared.

- Avoid soil disturbance, relocation, or compaction.
- Avoid mechanical leveling or tamping of dislodged soil.

Fill all voids created by stump or root removal with system sand.

NOTE: If removal of a tree stump will result in disturbance of the suitable or provisionally suitable soils which comprise part of the minimum vertical separation distance, then the stump should not be removed. Disturbance of the materials which comprise the minimum vertical separation will render the site unacceptable.

Raking and Tilling Procedures

All areas receiving system sand, sand fill, side-slope tapering and fill extensions shall be raked or tilled to remove the organic layer (grass, leaves, forest litter, etc.). If a backhoe/excavator is used to till the site, fit it with chisel teeth and till the site. The backhoe/excavator shall remain outside of the proposed system sand area and all areas that will be impacted by side-slope tapering. While tilling, remove all stones larger than 6 in, stumps roots, grass, brush and other organic matter or debris from the excavated system site.

- For in-ground bed systems, excavate the system bed as necessary below original grade. Using an excavator or backhoe, tilt the bucket teeth perpendicular to the bed and use the teeth to rake furrows 2 in – 6 in deep into the bottom of the entire area receiving system sand or sand fill.
- For elevated bed systems, remove all organics and topsoil (O & A soil horizons) in the footprint of the dispersal area prior to installing system sand; for percolation rates of 61 – 120 MPI, remove the organics,

3.0 INSTALLATION

the topsoil may be left in-place and tilled. Next, use an excavator or backhoe to rake furrows 2 in – 6 in deep into the receiving area.

Note: It is not necessary for the soil of the system site to be smooth when the site is prepared.

Install System Sand and/or Sand Fill Immediately After Excavation

- To protect the tilled area from damage by precipitation, system sand should be installed immediately after tilling.
- Work off either end or the uphill side of the system to avoid compacting soil.
- Keep at least 6 in of sand between the vehicle tracks and the tilled soil of the site if equipment must work on receiving soil.
- Track construction equipment should not travel over the installed system area until at least 12 in of cover material is placed over the AES pipes.
- Heavy equipment with tires shall never enter the receiving area due to likely wheel compaction of underlying soil structures.

Distribution Box Installation

It is essential that the D-box remain level after installation in order to ensure even distribution to all rows within the system. To prevent movement, D-box shall be set on a layer of level compacted soil, sand, pea gravel base or a concrete footing. Take care when backfilling that the D-box remains level.

Row Installation Sequence

1. Install a minimum of 6 in of system sand to the elevation where the bottom of AES pipes will be and install the sand for side-slope tapering to allow machinery movement around the perimeter of the system. Rake the system sand where the AES pipes will be installed so it is as level as possible before placing pipes on the system sand. This will make it easier to level the pipe rows.
2. Locate AES rows horizontally.
3. Locate AES rows vertically using a laser level or transit. Lift or lower the pipes at couplings using a hand shovel and adding or removing system sand as necessary.
4. Drop system sand along each row of couplings being careful to avoid moving the rows.
5. Add or remove system sand along rows to level. The rows may be raised by pushing additional system sand below the pipes. A hand shovel may be scraped along the system sand below the pipes to remove a small amount if needed.
6. Re-check horizontal and vertical locations. Re-check that pipes are level to within 1 in end-to-end.
7. Add system sand between and around the AES pipes, leaving the uppermost surface of the pipe exposed to allow for system inspection (if required by local approving authority).

Level Row Tolerances

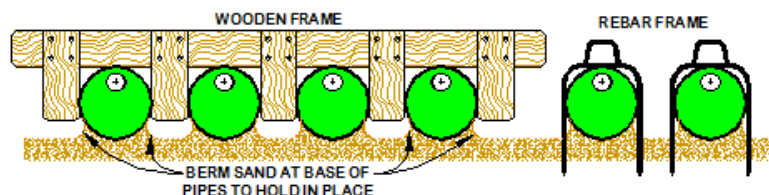
Use a laser level or transit to install rows level. Variations beyond 1 in ($\pm\frac{1}{2}$ in) may affect system performance and are not acceptable.

Correct Alignment of AES Bio-Accelerator® Fabric

The Bio-Accelerator (white geo-textile fabric) is to be positioned centered along the bottom of the pipe rows (sewn seam up).

Row Spacers

System sand may be used to keep pipe in place while covering, but simple tools may also be constructed for this purpose. Two examples are shown. One is made from rebar, the other from wood. Caution: Remove all tools used as row spacers before final covering.



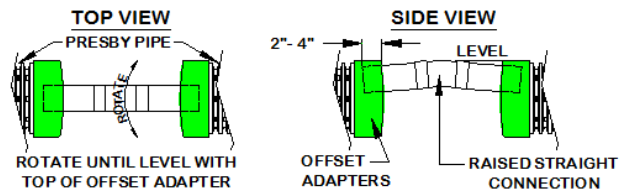
3.0 INSTALLATION

Connect Rows Using Raised Connections

Raised connections consist of offset adapters, 4 in PVC sewer and drainpipe, and 90° elbows. They enable greater liquid storage capacity and increase the bacterial surfaces being developed. Raised connections extend 2 in to 4 in into pipe and are installed on an angle (as shown in the drawing to the right). If the ends are not at least 2 in into the pipe, they may become dislodged during backfilling. If the ends extend more than 4 in into the pipe, this may cut off the flow of oxygen to the system. The top of the raised connections should be level with the top of the AES pipe. All PVC joints should be glued or mechanically fastened.

Raised Straight Connection

A raised straight connection is a PVC sewer & drain pipe configuration which is used to connect AES rows that are placed end to end along the same contour. Raised straight connections extend 2 in to 4 in into pipe and are installed on an angle (as shown in the drawings to the right). All PVC joints should be glued or mechanically fastened.



Backfilling Rows

1. Spread system sand between the rows.
2. Confirm pipe rows are positioned with Bio-Accelerator along the bottom (sewn seam up).
3. Straddle each row of pipe and walk heel-to-toe its entire length, ensuring that system sand fills all void spaces beneath the AES pipe.
4. Finish spreading system sand to the top of the rows and leave them exposed for inspection purposes.
5. Confirm that all rows of pipe are level to within 1 in end-to-end.
6. After inspection (if required) proceed to backfilling and final grading.

Backfilling and Final Grading

1. Spread system sand to a minimum of 3 in over the pipe and a minimum of 6 in on all four sides of the bed beyond the AES pipes.
2. Spread a minimum of 4 in of suitable earth cover (topsoil or loam) free of organics, stones over 4 in and building debris, having a texture similar to the soil at the site, without causing compaction.
3. To prevent erosion, soil cover above the system shall be planted with native, shallow-rooted vegetation such as grass, wildflowers and certain perennials or ground covers. No trees or shrubs should be located within 10 ft of the system perimeter to prevent roots from growing into and damaging the system.

Fill Extensions Requirements

All systems with any portion of the system sand bed above original grade require 6 in fill extensions on each side beyond the outside edge of all AES pipes and then tapering to meet existing grade at a maximum slope of 3:1. There must be a minimum of 12 in of cover material over the ends of all system sand extensions (if present).

4.0 REJUVENATION AND EXPANSION

4.1 *Bacteria Rejuvenation and Expansion*

Why Would System Bacteria Rejuvenation Be Needed?

Bacteria rejuvenation is the return of bacteria to an aerobic state. Flooding, improper venting, alteration or improper depth of soil material cover, use of incorrect sand, sudden use changes, introduction of chemicals or medicines, and a variety of other conditions can contribute to converting bacteria in any system from an aerobic to an anaerobic state. This conversion severely limits the bacteria's ability to effectively treat effluent, as well as limits liquids from passing through. A unique feature of the AES system is its ability to be rejuvenated in place.

How to Rejuvenate System Bacteria

System bacteria are "rejuvenated" when they return to an aerobic state. By using the following procedure, this can be accomplished in most AES systems without costly removal and replacement.

1. Contact PEI before attempting rejuvenation for technical assistance.
2. Determine and rectify the problem(s) causing the bacteria conversion.
3. Have system and septic tank pumped by a registered septage pumper. This may require a permit.
4. If foreign matter has entered the system, flush the pipes.
5. Safeguard the open excavation.
6. Guarantee a passage of air through the system.
7. Allow all rows to dry for 72 hours minimum. The system sand should return to its natural color.
8. Re-assemble the system to its original design configuration. As long as there is no physical damage to the AES components, the original components may be reused.

Note: *Permits are required for system rejuvenation.*

System Expansion

AES systems are easily expanded by adding equal lengths of pipe to each row of the original design or by adding additional equal sections. All system expansions shall comply with state and local regulations.

Note: *Permits are required for system expansion.*

Reusable Components

AES pipe and components are not biodegradable and may be reused. In cases of improper installation, it may be possible to excavate, clean, and reinstall all system components.

System Replacement

If an AES system requires replacement...

- Remove the existing components and contaminated sand
- If the soils under and around the system have not been compromised, replace in the same excavated location with new system sand.
- If components are not damaged, they may be cleaned and reused.

Note: *Permits are required for system replacement.*

5.0 OPERATION AND MAINTENANCE

5.1 Operation and Maintenance

Proper Use

AES systems do not require a maintenance and monitoring agreement, however they do require minimal maintenance as is common for traditional pipe and stone onsite systems, provided the system is not subjected to abuse. An awareness of proper use and routine maintenance will guarantee system longevity. We encourage all system owners and service providers to obtain and review a copy of our Owner's Manual, available from our website www.presbyeco.com or via mail upon request to (800) 473-5298 or info@presbyeco.com.

System Abuse Conditions

The following conditions constitute system abuse:

- Liquid in high volume (excessive number of occupants and use of water in a short period of time, leaking fixtures, whirlpool tubs, hot tubs, water softening equipment or additional water discharging fixtures if not specified in system design).
- Solids in high volume (excessive number of occupants, paper products, personal hygiene products, garbage disposals or water softening equipment if not specified in system design).
- Antibiotics and medicines in high concentrations.
- Cleaning products in high concentrations.
- Fertilizers or other caustic chemicals in any amount.
- Petroleum products in any amount.
- Latex and oil paints.
- System suffocation (compacted soils, barrier materials, etc.) without proper venting.

Note: PEI does not recommend the use of septic system additives.

System Maintenance/Pumping of the Septic Tank

- Inspect the septic tank at least once every two years under normal usage.
- Pump the tank when surface scum and bottom sludge occupy one-fourth or more of the liquid depth of the tank.
- If a garbage disposal is used, the septic tank will likely require more frequent pumping.
- After pumping, inspect the septic tank for integrity to ensure that no groundwater is entering it. Also check the integrity of the tank inlet and outlet baffles and repair if needed.
- Inspect the system to ensure that vents are in place and free of obstructions.
- Effluent filters require ongoing maintenance due to their tendency to clog and cut off oxygen to the system. Follow filter manufacturer's maintenance instructions and inspect filters frequently.

Site Maintenance

It is important that the system site remain free of shrubs, trees, and other woody vegetation, including the entire SSBA, and areas impacted by side slope tapering and perimeter drains (if used). Roots can infiltrate and cause damage or clogging of system components. If a perimeter drain is used, it must be located a minimum of 10 ft above the edge of the uppermost aspect of the system sand basal area. It is important to make sure that the outfall pipes are screened to prevent animal activity. Also check outfall pipes regularly to ensure that they are not obstructed in any way.

6.0 WARRANTY

6.1 PRESBY ENVIRONMENTAL, INC. STANDARD LIMITED WARRANTY

(a) The structural integrity of each unit, endcap and other accessory manufactured by Presby Environmental, Inc. (collectively referred to as “Units”), when installed and operated in an onsite wastewater system in accordance with Presby Environmental’s installation instructions, is warranted to the original purchaser (“Holder”) against defective materials and workmanship for one year from the date upon which a septic permit is issued for the septic system containing the Units; provided, however, that if a septic permit is not required for the septic system by applicable law, the one (1) year warranty period will begin upon the date that installation of the septic system commences. In order to exercise its warranty rights, Holder must notify Presby Environmental in writing at its corporate headquarters in Whitefield, New Hampshire within fifteen (15) days of the alleged defect. Presby Environmental will supply replacement Units for those Units determined by Presby Environmental to be defective and covered by this Limited Warranty. Presby Environmental’s liability specifically excludes the cost of removal and/or installation of the Units.

(b) THE LIMITED WARRANTY AND REMEDIES IN SUBPARAGRAPH (a) ARE EXCLUSIVE. THERE ARE NO OTHER WARRANTIES WITH RESPECT TO THE UNITS, INCLUDING NO IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

(c) This Limited Warranty shall be void if any part of the Presby Environmental system (unit, endcap or other accessory) is manufactured by anyone other than Presby Environmental. The Limited Warranty does not extend to incidental, consequential, special or indirect damages. Presby Environmental shall not be liable for penalties or liquidated damages, including loss of production and profits, labor and materials, overhead costs, or other losses or expenses incurred by the Holder or any third party. Specifically excluded from Limited Warranty coverage are damage to the Units due to ordinary wear and tear, alteration, accident, misuse, abuse or neglect of the Units; the Units being subjected to vehicle traffic or other conditions which are not permitted by the installation instructions; failure to maintain the minimum ground covers set forth in the installation instructions; the placement of improper materials into the system containing the Units; failure of the Units or the septic system due to improper siting or improper sizing, excessive water usage, improper grease disposal, or improper operation; or any other event not caused by Presby Environmental. This Limited Warranty shall be void if the Holder fails to comply with all of the terms set forth in this Limited Warranty.

Further, in no event shall Presby Environmental be responsible for any loss or damage to the Holder, the Units, or any third party resulting from installation or shipment, or from any product liability claims of Holder or any third party. For this Limited Warranty to apply, the Units must be installed in accordance with all site conditions required by state and local codes; all other applicable laws; and Presby Environmental’s installation instructions.

(d) No representative of Presby Environmental has the authority to change this Limited Warranty in any manner whatsoever, or to extend this Limited Warranty. No warranty applies to any party other than the original Holder.

The above represents the standard Limited Warranty offered by Presby Environmental. A limited number of states and counties have different warranty requirements. Any purchaser of Units should contact Presby Environmental’s corporate headquarters in Whitefield, New Hampshire, prior to such purchase, to obtain a copy of the applicable warranty, and should carefully read that warranty prior to the purchase of Units.