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Introduction

Context

The purpose of this manual is to provide information specific to the Province of Ontario for use in the design and installation of the System O)).

The Building Materials Evaluation Committee (BMEC) authorization report specifies design criteria that must be followed in order to design and install a System O)). The BMEC authorization takes precedence over any design criteria detailed in this manual.

The Ontario Building Code (OBC) must also be followed and takes precedence over any design criteria in this manual.

Project of more than 10,000 Liters

This design manual is applicable to systems that have a daily design sewage flow of 10,000 litres or less. Systems that have a daily design sewage flow of greater than 10,000 litres per day are governed by the Ministry of Environment, Conservation and Parks (MECP). Consult a Professional Engineer for projects exceeding 10,000 litres per day.

Provincial Standards

This manual is applicable to the Province of Ontario. This design and installation manual is to be used in conjunction with Part 8 of the OBC, and the BMEC authorization.

Certification Required

The Province of Ontario requires that all designers and installers of septic systems must be licensed and registered with the Province. Designers and Installers of the System O)) must also be certified by the manufacturer or manufacturer’s representative. Certification is obtained by attending the “System O)) Designer and Installer Certification Course” presented by Make-Way Environmental Technologies Inc.

Technical Support

Make-Way Environmental Technologies Inc., the Ontario distributor of the System O)) products provides technical support to all individuals using the System O)). For questions about the System O)) product or the information contained in this manual, please contact us at 1-866-625-3929.

Section A. Terms and Definitions

Introduction	As you read through the information in this manual, you will encounter common terms, terms that are common to our industry, and terms that are unique to System O)). While alternative definitions may exist, this section defines these terms as they are used in this manual.
Advanced Enviro-Septic Pipe	An Advanced <u>Enviro-Septic pipe</u> (AES) is a single unit of pipe, 3.05 m in length, with an outside diameter of 300 mm and a volume capacity of approximately 220 liters. The set of membranes surrounding the pipe includes the Bio-Accelerator.
Centre to Centre Spacing	<u>Centre to centre spacing</u> is the horizontal distance from the centre of one System O)) row to the centre of the adjacent row. The abbreviation for this term is E_{cc} .
Coupling	A <u>coupling</u> is a fitting that joins two pieces of Advanced Enviro-Septic pipe together.
Daily Design Sewage Flow	<u>Daily design sewage flow</u> is the determined liters/day flow for sewage systems as detailed by the Ontario Building Code (Table 8.2.1.3.A and Table 8.3.1.3.B)
D-Box	<u>D-Box</u> is an abbreviation for distribution box.
Differential Venting	<u>Differential venting</u> is a method of venting a System O)) utilizing high and low vents.
Distribution Box	A <u>distribution box</u> is a device used to divide and/or control the septic tank effluent flow into the Advanced Enviro-Septic rows of pipe.
Distribution Box Manifold	A <u>distribution box manifold</u> is a method of joining any number of distribution box outlets to a single pipe.
Distribution Device	A <u>distribution device</u> is a device used to divide and/or control the septic tank effluent flow. The distribution device can be a distribution box, or another flow splitting device.
End Cap	An <u>end cap</u> is a solid cap used to seal the end of an Advanced Enviro-Septic pipe.
End Extension Distance	The <u>end extension distance</u> is the distance filled with additional sand material extending from the end of a row to the side of the System O)) contact area. The abbreviation for this term is E_e .
Equalizer™	An <u>equalizer</u> is a plastic insert installed in the outlet lines of a distribution box to provide more equal effluent distribution to each outlet and allow future adjustments.
High and Low Vents	<u>High and low vents</u> are pipes used in differential venting.
Imported Sand	<u>Imported sand</u> is imported leaching bed fill having a 'T' time of 6 to 10 min/cm with less than 5% fine passing #200 sieve that is imported to the site to raise the system to achieve the required vertical separation. This does not include the system sand which is part of the treatment system.
Infiltrative Surface	The <u>infiltrative surface</u> means the area of interface where effluent migrates downward from the System O)) and passes into the native soil or leaching bed fill.
Inject O))	An end cap used for low-pressure distribution that acts as a multipurpose adapter for the piping of the distribution network and the aeration network for the supply side of an Advanced Enviro-Septic row.

L/day	Abbreviation for liters per day.
Lateral Extension Distance	The <u>lateral extension distance</u> is the distance filled with system sand extending from the centre of the last lateral row to the side of the treatment system. The abbreviation for this term is E_L .
Low-Pressure Distribution System	A low-pressure distribution system (LPDS) is a way to homogeneously supply a Standard System O)) when a pump chamber is required. A LPDS replaces completely a D-Box as a distribution device. The Inject O)) is a type of LPDS.
Nested pipe configuration	A System O)) design based on total length that uses a network of pipes with openings calibrated for supplying the rows of Advanced Enviro-Septic pipes with water along the entire length of the row. The nested pipes are specifically adapted for Advanced Enviro-Septic pipes to allow the proper distribution of water and aeration between the rows.
Offset Adapter	An <u>offset adapter</u> is an end cap fitted with a 100 mm offset opening at the 12 o'clock position.
Piezovent	An end cap that acts as a multipurposed adapter for the piping of the aeration network and the piezometer at the far end of an Advanced Enviro-Septic row.
Raised or Partially Raised System O))	<u>Raised or partially raised System O))</u> means a System O)) in which any part of the system (excluding piezometers and vents) is above the natural ground elevation.
Row Length	The <u>row length</u> is the length of the Advanced Enviro-Septic pipes that are connected together with the couplings. The abbreviation for row length is L _r .
Row width	A row width is applicable when a System O)) is designed as a non-continuous bed or as a trench. The width includes the AES pipe and the lateral extension of system sand (E _L)
Shunt pipe	Also known as an air by-pass pipe, a shunt pipe is a pipe installed between the treatment system and the pumping station in order to re-establish the air circuit from the treatment system to the house vent.
Sloping System	A <u>sloping system</u> is a system in which rows of Advanced Enviro-Septic pipes are at different elevations.
Standard configuration	A standard configuration is a System O)) design based on a dispersal area. It can be supplied by gravity or using a pump chamber.
System O)) Contact Area	The System O)) contact area is equal to the dispersal area, directly below the treatment system, required to absorb the treated effluent into the underlying native soil.
System Sand	<u>System sand</u> is sand that has specific criteria and is used to surround the Advanced Enviro-Septic pipe. See Section G. for sand criteria.
Uniform Distribution	The <u>uniform distribution</u> means the even dispersal of septic tank effluent to the rows of pipe.
Vertical Separation	The <u>vertical separation</u> means the depth of unsaturated soil including any imported sand below the System O)) as measured from the bottom of the system (system sand layer) to a limiting surface such as high ground water table, rock or soil with a percolation time greater than 50 min/cm.

Section B. Presentation of System O))

Section B.1. Background

Sewage effluent leaving a septic tank (primary treatment effluent) contains suspended solids that can cause traditional systems to fail prematurely. Solids can overload bacteria, cut off airflow required for aerobic bacterial activity, and/or clog the underlying soil, interfering with its ability to absorb liquid.

Why our System excels?

By utilizing simple yet effective natural processes, the System O)) wastewater treatment system treats a standard septic tank effluent in a manner that prevents suspended solids from clogging the underlying soil, increases system aeration, and provides a greater bacterial area (“biomat”) than traditional leaching systems. No other passive wastewater treatment system design offers this functionality. System O)) excel because they are more efficient, last longer, and have a minimal environmental impact.

Advantages

Here’s a brief list of the advantages of the System O)).

- Eliminates “septic mounds” through sloping system installations
- Adapts to difficult sites
- Installs more easily and quickly than traditional systems
- Eliminates the need for expensive washed stone
- Adapts easily to both residential and commercial sites
- No mechanical equipment for treatment performance
- Allows for gravity discharge with often no requirement for pumps
- Lower cost than comparable level IV (tertiary) treatment systems

Section B.2. System Components



Figure 1. Typical System O)) components

Section B.3. Overview of the Advanced Enviro-Septic pipes and their Functions

Advanced Enviro-Septic pipes consists of:

- A 300 mm diameter, high-density plastic pipe which is corrugated and perforated. Skimmer tabs extend into the pipe at the point of each perforation.
- A dense mat of coarse, randomly oriented plastic fibres surrounds the outside of the pipe.
- The Bio-Accelerator™ geo-textile fabric layer partially covers the fibres on the lower half of the pipes. It is located between the pipe and the plastic fibres.
- The outer layer non-woven geo-textile fabric holds the other components in place and provides a protected surface on which a biomat develops.

The Advanced Enviro-Septic pipes are surrounded by a bed of system sand, which facilitates the process by wicking the liquid out of the pipes and ensuring that the system receives sufficient oxygen to support a healthy population of bacteria.

Pipe Cross Section

The following schematic presents the four components of the Advanced Enviro-Septic pipe.

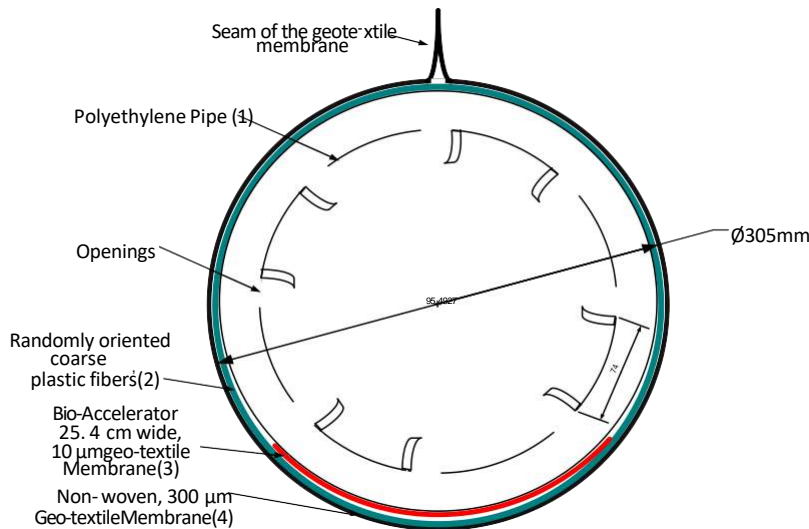


Figure 2. Pipe Cross-Section

Operating Principles

When effluent leaves the septic tank (primary treatment tank), it still contains some suspended material, fats and grease and other pollutants. The presence of these elements eventually causes clogging in traditional leaching fields. The Enviro-Septic pipe facilitates the treatment of sewage effluent by using natural bacterial processes in a more efficient way. The cooling of the effluent in the pipes and the aerobic bacterial activity around the geo-textile allows for the separation of suspended solids, which are retained inside the pipes. The combination of air flow and continually fluctuating liquid levels in the pipes increases the effectiveness of bacterial activity in the membranes. These processes create a system with an interior equilibrium, prolonging the system's lifespan and allowing the system to treat the wastewater effectively before it is dispersed into the environment.

What it Looks Like

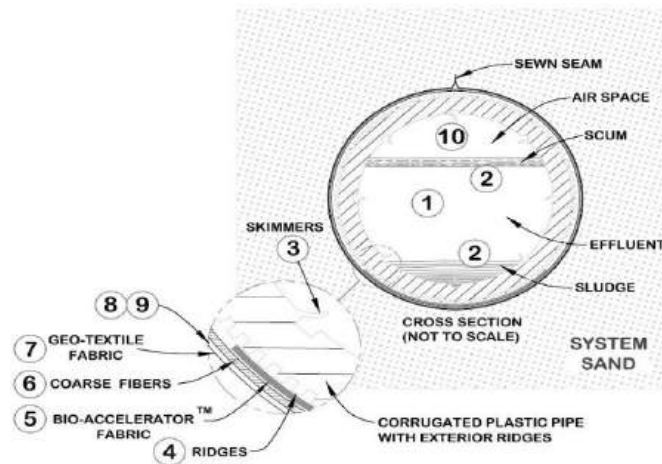


Figure 3. System O)) Treatment Steps

How it Works

These are the basic stages that take effect in the System O)).

1. Warm effluent enters the pipe and is cooled to ground temperature.
2. Suspended solids and grease separate from the cooled liquid effluent.
3. Skimmers further capture grease and suspended solids from the effluent as it exits through the perforations in the pipe.
4. Pipe ridges allow the effluent to flow uninterrupted around the circumference of the pipe and aid in cooling.
5. Bio-Accelerator fabric filters additional solids from the effluent and develops a biomat which provided treatment and ensures effluent distribution along the entire length of the pipes.
6. A mat of course random fibers separates more suspended solids from the effluent.
7. Effluent passes into the geo-textile fabric and grows a protected bacterial surface.
8. Liquid exiting the geo-textile fabric is wicked away from the piping by the surrounding system sand. This enables air to transfer to the bacterial surface.
9. Bacteria grows on the fibrous mat and geo-textile surfaces to create and break down sewage solids.
10. Bacterial efficiency is increased by the large air supply and fluctuating liquid levels which provide for optimum bacterial activity.

Section B.4. System O)) Treatment Chain

There are six (6) main components in the System O)) chain of treatment. They are:

1. Standard septic tank in accordance with section 8.2.2.3 of the Ontario Building Code
2. Effluent filter
3. Pump chamber (optional)
4. Distribution device
5. Advanced Enviro-Septic pipe
6. System sand.

The effluent is then infiltrated into the native soil. Various System O)) configurations are possible such as a standard configuration or a nested pipe configuration. The optimal configuration depends on multiple criteria such as the soil conditions or the available space and are subject to different design criteria.

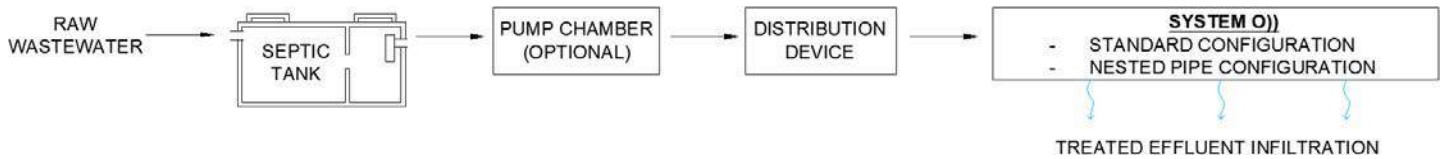


Figure 4. Treatment Chain

Section B.5. Treatment Components of the System O))

Table 1. Components of a Treatment System

Standard Septic Tank	Used as primary treatment
Effluent Filter	Used to prevent solids from passing out of the septic tank.
Pump Station (optional)	Used between the septic tank and the distribution device when the effluent cannot be sent to the System O)) pipe rows by gravity or when using a nested pipe configuration.
Velocity Reducer	Always required when a pump station is used to lift water to a distribution box. Can be done with a minimum 3 m length 100 mm watertight pipe placed horizontally or in an upwards slope towards the distribution box. Used to reduce the velocity of the septic tank effluent before arriving at the distribution device.
Distribution Device	Used to distribute the septic effluent between the rows of Advanced Enviro-Septic pipe. For example, a distribution box with flow equalizers, an Inject O)) or a nested pipe.
System O)) Contact Area	The area of dispersal surface directly below the System O)) that is required to absorb the treated effluent into the underlying native soil.
System O)) Rows	Used to treat and distribute the septic tank effluent over the System O)) contact area. The System O)) rows are comprised of the 3.05 m lengths of Advanced Enviro-Septic pipes, adaptors and couplings.
System Sand	Used to increase the development of microorganisms that treat wastewater before it infiltrates into the soil. Also helps in providing air to the system.
Sampling Device	The sampling device is used to retrieve samples of the treated effluent from the System O)). The sampling device is placed at the base of the System O)), below the system sand.
Vents	The vents are to allow the circulation of air throughout the system. Venting occurs through a combination of a high and low vent to create a vacuum. The low (entry) vent is usually located at the end of the rows of Advanced Enviro-Septic pipe and the high vent (exit) is usually located on the roof of the building. Other configurations may be used when the roof vent is not viable.
Piezometers	The piezometers are located at the end of each row or a combination of rows. They are used to monitor the system.

Section B.6. Presentation of a Standard Configuration

A System O)) with a standard configuration is a treatment bed on which one or multiple rows of Advanced Enviro-Septic pipes are laid over a required contact area. A standard configuration is always fed by one end of each row, either by gravity through a distribution box, or through a low-pressure distribution system (LPDS) such as the Inject O)).

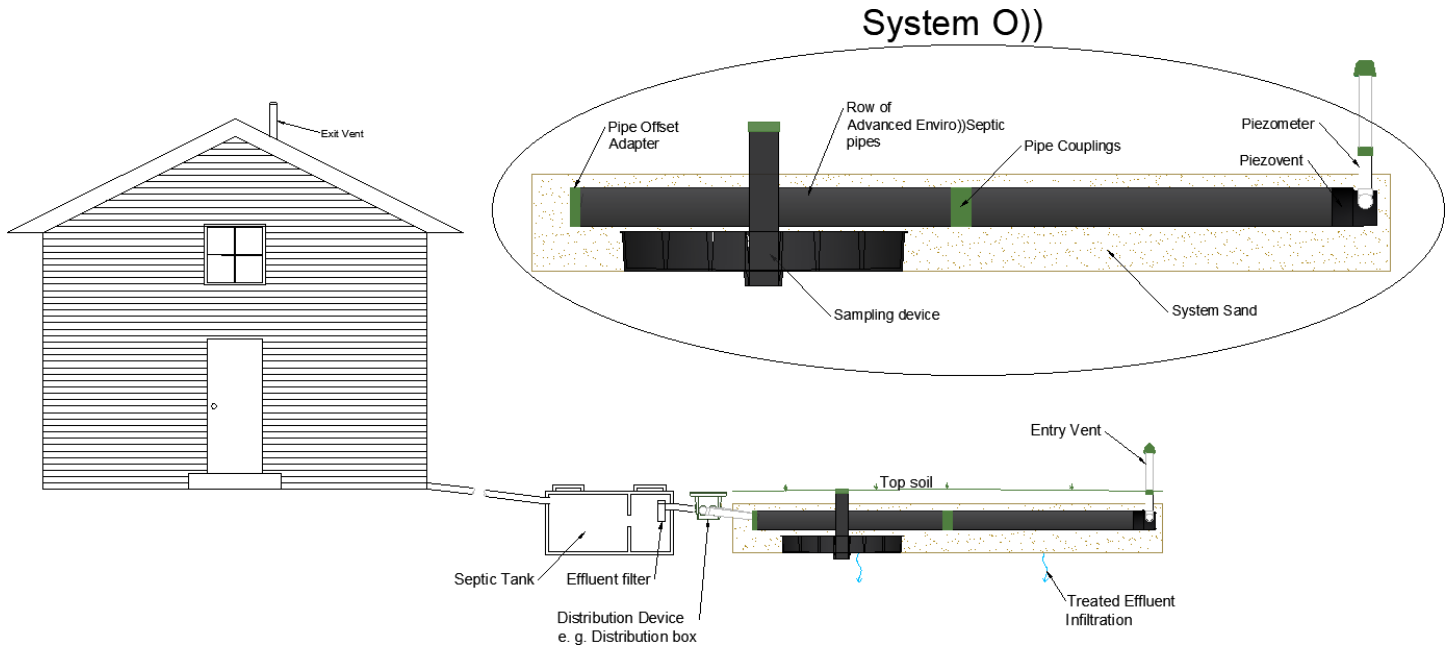


Figure 5. Treatment Chain - Standard Configuration

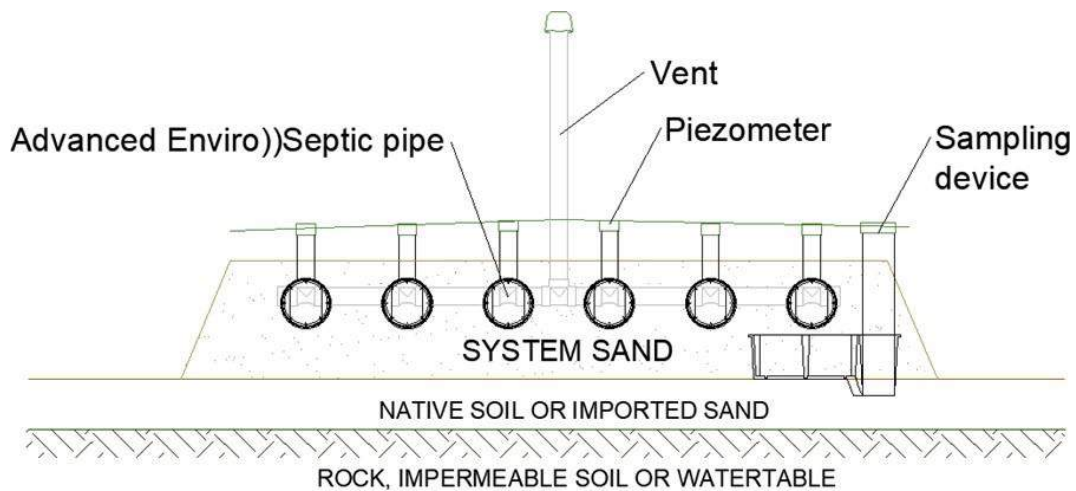


Figure 6. Front View – Standard Configuration

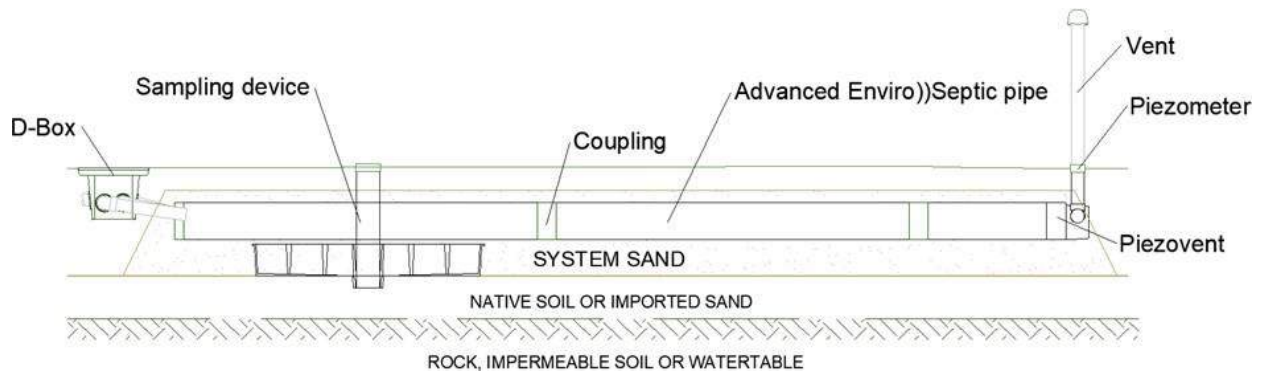


Figure 7. Side view – Standard Configuration

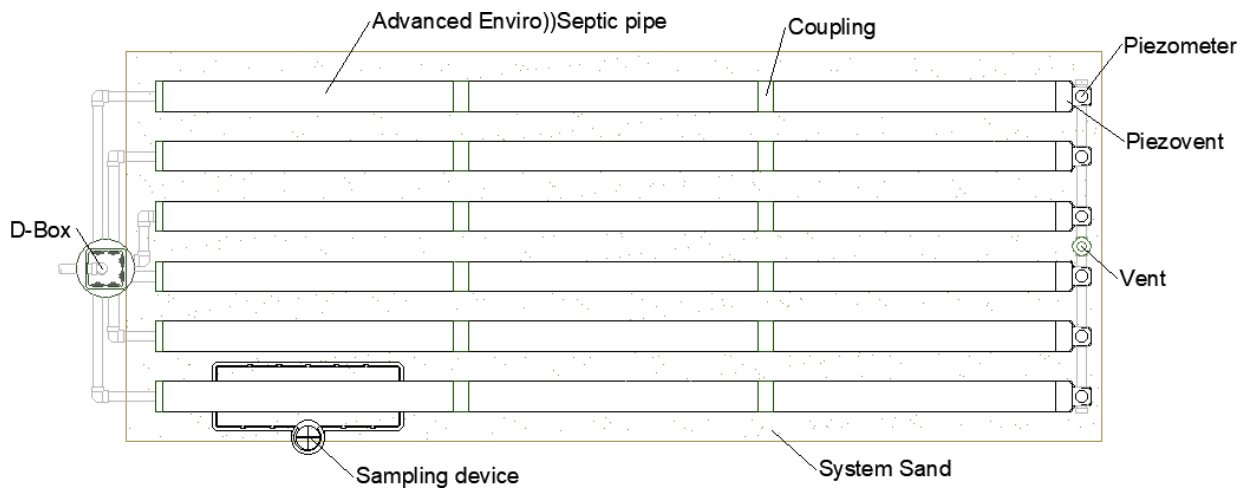


Figure 8. Top View - Standard Configuration

Section B.7. Presentation of a Nested Pipe Configuration

A System O)) with a nested pipe configuration is a treatment system based on a linear length. A nested pipe configuration is always fed through a pressurized distribution pipe (Green PVC, 38 mm diameter) nested inside the entire length of Advanced Enviro-Septic pipe. The nested pipes allow for an optimal utilisation of the entire length of pipes which in turn assists in maintaining consistent periods of oxygenation.

It can be built as one or multiple trenches or as a bed if desired.

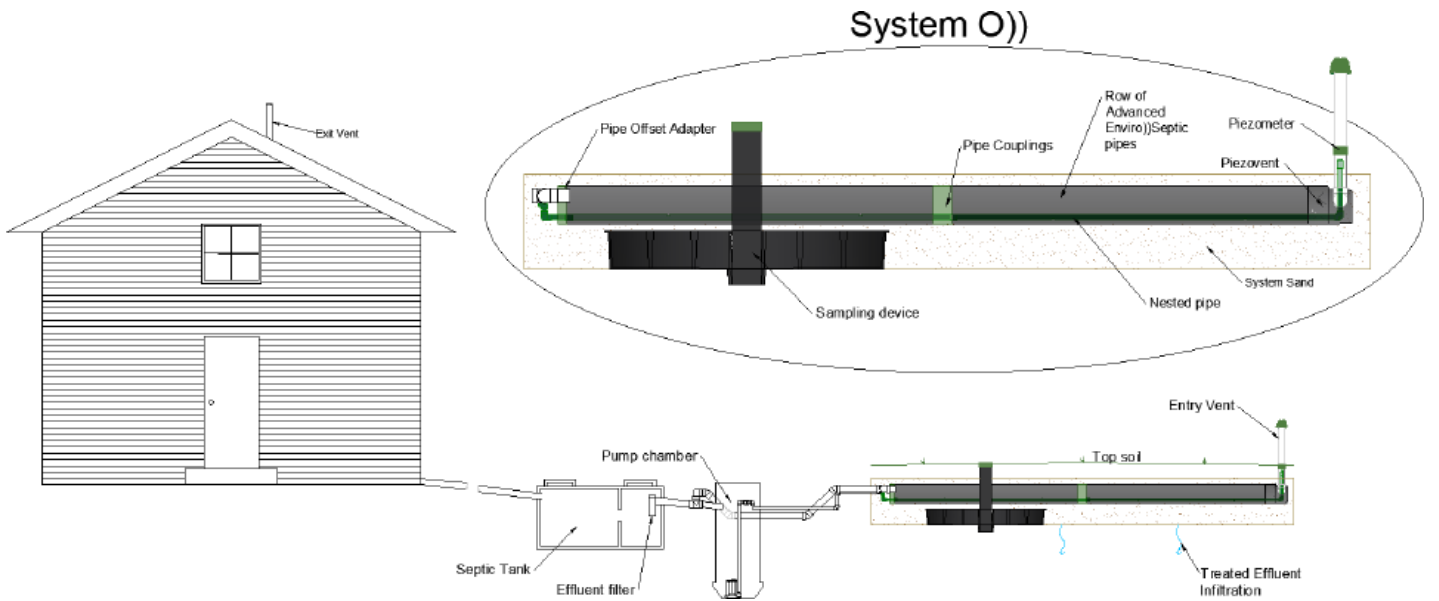


Figure 9. Treatment Chain – Nested Pipe Configuration

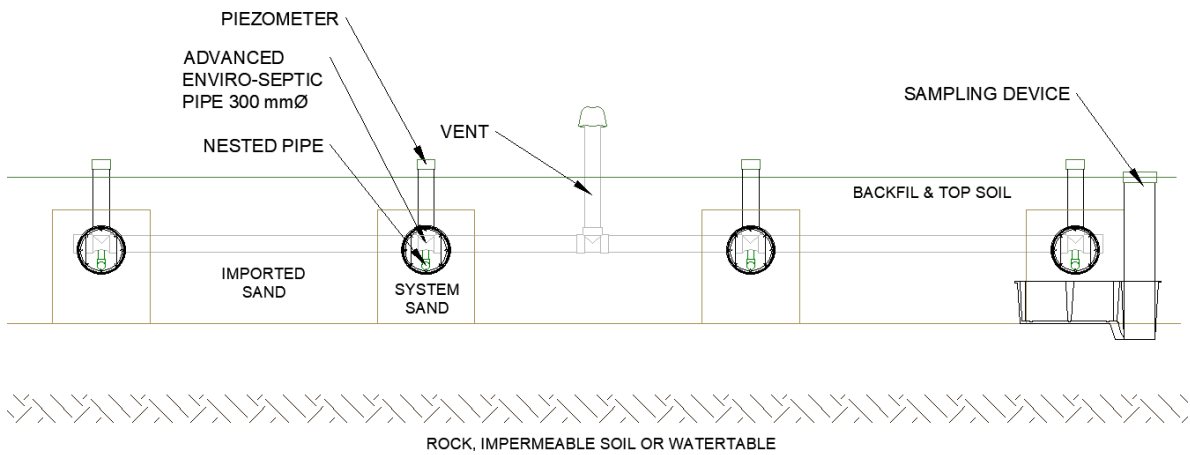


Figure 10. Front View – Nested Pipe Configuration

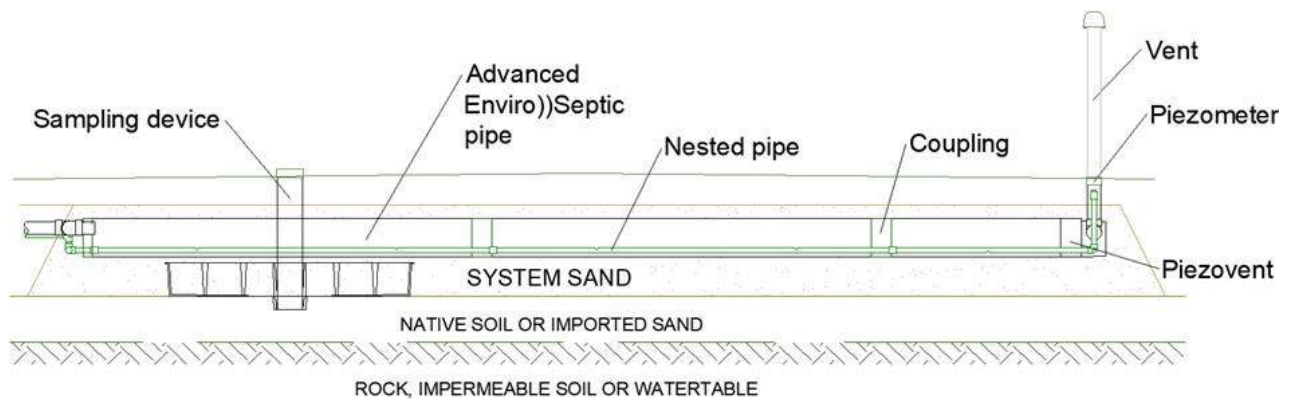


Figure 11. Side View – Nested Pipe Configuration

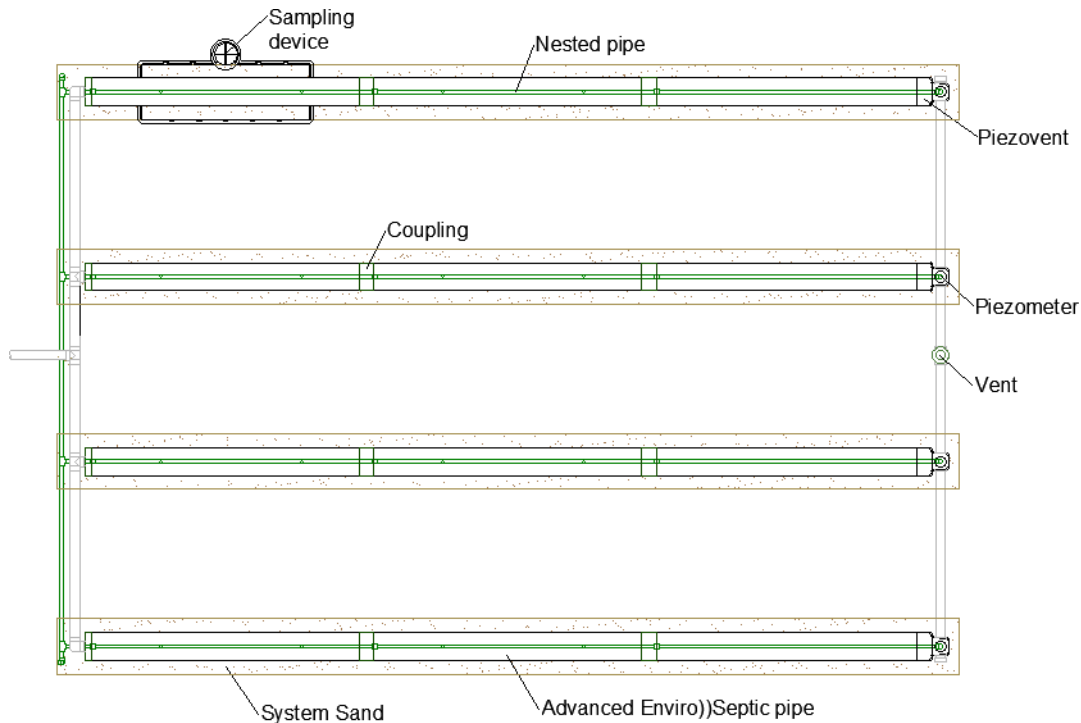


Figure 12. Top View – Nested Pipe Configuration

Section C. Designing Steps for the System O))

In this section we will present the necessary steps prior to designing a System O)). All these steps are required in order to choose the most adequate configuration.

Determine the Daily Design Sewage Flow

Reference: Ontario Building Code: code and guide for sewage systems - Ontario Regulation 332/12 Article 8.2.1.3

Note: the maximum daily sewage flow is 10,000 litres per day.

Determine to Clearance Distances

The clearances for the System O)) are governed by the Ontario Building Code. The System O)), as measured from the centre of the pipes, must meet the clearance distances detailed in Table 8.2.1.3.B, of the Building Code.

Evaluating the Native Soil Permeability

The soil's ability to infiltrate treated effluent is critical to a successful onsite septic system installation. The ability to infiltrate treated effluent will determine the size of the contact area which will distribute the treated effluent to the natural soils. The soils capacity to infiltrate treated effluent is determined by the percolation time (T) in min/cm of the native soil.

Vertical separation

The percolation time of the native soil will determine the minimum clearances from the bottom of the System O)) (dispersal area) to the high groundwater table, bedrock or impermeable soil with a percolation time $T > 50$ min/cm.

Section D. System O)) General Design Criteria

In this section, we will go over some general design criteria required to design a System O)). These criteria are required independently of the configuration but may vary depending on the System O)) configuration.

There are three main steps in sizing this system:

- Determine the standard septic tank size.
- Determine the number of Advanced Enviro-Septic pipes required.
- Determine the dimensions of the System O)) and the total footprint of this installation required to properly infiltrate the treated effluent.

Septic Tank

The System O)) is designed to receive septic tank effluent for treatment and dispersal. As such, the septic tank requires no specific upfront treatment for incoming sewage which is of domestic nature. All raw sewage will enter into a septic tank sized in accordance with Clause 8.2.2.3 of the Ontario Building Code.

The pipe between the building and the septic tank should have a 2% minimum slope.

Number of Advanced Enviro-Septic Pipes

This step applies to all options for the System O)). Each section of Advanced Enviro-Septic pipe (AES) has the capacity to treat 126 L of wastewater per day. Therefore, the formula to determine the minimum number of Advanced Enviro-Septic pipe (N_{AES}) required is $Q/126$.

$$N_{AES} = Q/126$$

The number of Advanced Enviro-Septic pipe obtained must be rounded up at all time.

As each section of pipe is 3.05 m in length thus the total linear length of pipe is the number of pipes multiplied by the length.

For example, a 3 bedroom house: $Q = 1600 \text{ L/day}$, $N_{AES} = 1600 / 126 = 12.7 \text{ AES}$.

Rounded up, it gives a minimum of 13 AES required. The minimum length of pipe is: $13 \times 3.05 = 39.65 \text{ m}$ of pipe.

It is easier for the installer if systems are designed in 3.05 m increments since Advanced Enviro-Septic pipes are 3.05 m in length. However, the pipe is easily cut to any length necessary with a sharp knife.

Minimum / Maximum Length of Row

To maintain efficient effluent cycling, the minimum length of a row of Advanced Enviro-Septic pipes is 3.05 m and the maximum length is 30.5 m.

Basic Profile of System O))

As discussed in Section C. , the environment in which the System O)) is installed will influence the system's design. Figure 13 shows a front view of a System O)) row.

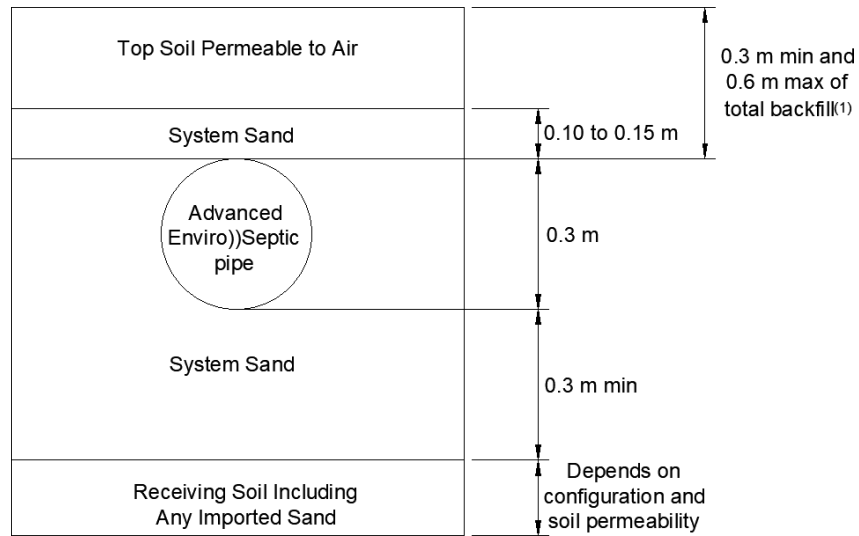


Figure 13. Basic profile of System O))

Note: (1) The layer of the system sand above the Advanced Enviro-Septic Pipes added to the backfill on top of it needs to be 300 mm thick (i.e. If the sand layer above the pipes is 100 mm, the backfill needs to be 200 mm thick → 100 mm + 200 mm = 300 mm). More backfill is allowed if needed for a Standard System O)).

Vertical Separation

The percolation time of the native soil will determine the minimum clearances from the bottom of the System O)) (dispersal area) to a limiting layer such as the high groundwater table, bedrock or impermeable soil with a percolation time $T > 50$ min/cm. The vertical separation criteria vary based on the System O)) configuration and the T-time.

For partially raised and fully raised systems, it is possible to achieve vertical separation by adding a layer of imported sand. Proper evaluation needs to be done to verify that the native soil layer will have the capacity to evacuate the treated water. The imported sand must have a percolation rate of 6 to 10 min/cm, with less than 5% fines passing the 200 sieve.

Row orientation

Rows of Advanced Enviro-Septic pipes must be laid level and should run parallel to contours (perpendicular to sloping terrain), where possible.

If known, the Advanced Enviro-Septic pipes should be placed perpendicular to the hydraulic gradient of the ground water.

Horizontal Clearance distances

The clearances for the System O)) are governed by the Ontario Building Code. The Advanced Enviro-Septic pipes, as measured from the centre of the pipes, must meet the clearance distances detailed in Table 8.2.1.3.B, of the Building Code.

Section E. Standard Configuration

Section E.1. Design Criteria

In this section, we will go over the design criteria required to design a Standard System O)). While some criteria could apply for Nested Pipe Configurations, they may have subtle differences. Please refer to Section F. for Nested Pipe Configuration Design Criteria.

Contact Area Sizing

The System O)) contact area is the interface of the base of the System O)) including any imported sand with the native soil.

The System O)) contact area is obtained from the larger of two possibilities:

- Minimum dispersal surface (S_D): the minimum surface required to disperse the water from the System O)).
- Minimum surface for spacing requirements (S_{SR}): the minimum surface calculated using the minimum spacing required between and around the length of a row of Advanced Enviro-Septic pipes to properly install the System sand.

Minimum evacuation surface (S_E)

When the percolation time of the native soil is more than 15 min/cm, the surface requirement is as follows:

The minimum surface required to disperse the treated effluent from the system is calculated:

$$S_D = QT/400$$

When the percolation time of the native soil is less than or equal to 15 min/cm, the surface requirement is as follows:

The minimum surface required to disperse the treated effluent from the system is calculated:

When Q is less than or equal to 3000 L

$$S_D = QT/850$$

When Q is more than 3000 L

$$S_D = Q/50$$

Where:

- S_D , is the contact area in m^2 between the base of the sand layer and the underlying native soil
- Q is the total daily design sewage flow in litres, and
- T is the percolation time of the underlying native soil in min/cm to a maximum of 50 min/cm.

Minimum surface for spacing requirements (S_{SR})

In some cases, the minimum excavation surface/contact area is not sufficient due to the spacing requirements for the Advanced Enviro-Septic pipe. In these cases, the area must be increased to accommodate the spacing requirements.

The area required is based on the number of rows within the system and the extension of System sand material around the limits of the pipes. The minimum pipe spacing are the following:

Acronym	Description	Minimum horizontal spacing (m)
E_{cc}	Centre to centre spacing from one row of pipes to the next.	0.45
E_L	Lateral extension distance from the centre of the last lateral row of pipes to the limit of the System O)).	0.45
E_E	End extension distance from the end of a row of pipes to the limit of System O)).	0.30

The System O)) is based on a standard rectangle. However, other special configurations can be permitted providing that the flow is properly distributed between pipes and over the dispersal area. Wherever possible, the design should be based on Length > Width and the pipes should be evenly distributed over the area of the dispersal surface. The dispersal surface/contact area must have the long dimension perpendicular to the direction in which effluent entering the soil will move horizontally.

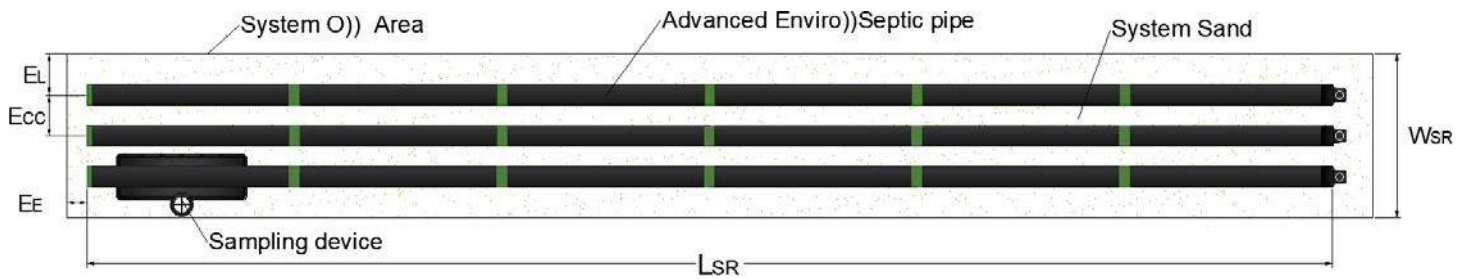


Figure 14. System O)) spacings

Therefore, the minimum surface for spacing requirement is:

$$L_{SR} = L_r + (2 \times E_E)$$

$$W_{SR} = (E_{cc} \times (N_r - 1)) + (2 \times E_L)$$

$$S_{SR} = W_{SR} \times L_{SR}$$

Where:

- S_{SR} is the minimum surface/contact area for spacing requirement
- L_{SR} is the length of the minimum surface/contact area for spacing requirement
- W_{SR} is the width of the minimum surface/contact area for spacing requirement
- N_r is the number of rows of Enviro-Septic pipe

The System O)) minimum contact area is the larger of S_D or S_{SR} .

Note: When the spacing between the System O)) rows (E_{cc}) exceeds the minimum required horizontal spacing, imported sand can be added between the Enviro-Septic pipes instead of using System sand (Figure 15).

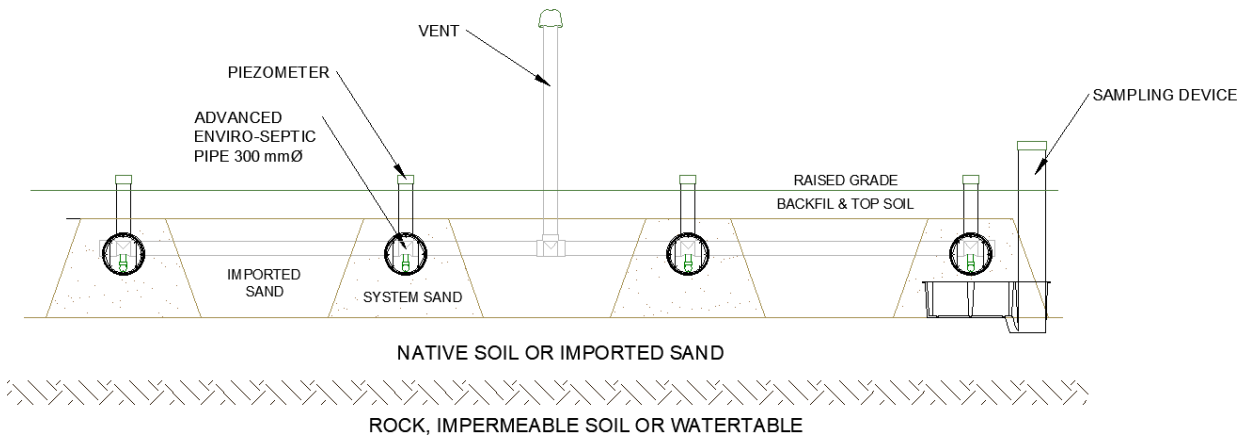


Figure 15. Imported Sand can be used when the Ecc spacings exceed the minimum required spacings

Vertical Separation

The table below shows the minimal vertical separation required for a standard configuration. The vertical separation is calculated from the bottom of the System O)) to the high groundwater table, bedrock or impermeable soil.

Table 2. Minimal Vertical Separation for Standard Configurations

Percolation Time (T) of natural soil	$T \leq 6 \text{ min/cm}$	$6 < T \leq 50 \text{ min/cm}$	$T > 50 \text{ min/cm}$
Minimum Vertical Separation as measured from the bottom of the System sand	600 mm	450 mm	600 mm

Horizontal clearance distances

When possible, the rows of Advanced Enviro-Septic pipes should be evenly spread over the surface. If it is not possible, the rows can be placed with the minimum spacing over the required area.

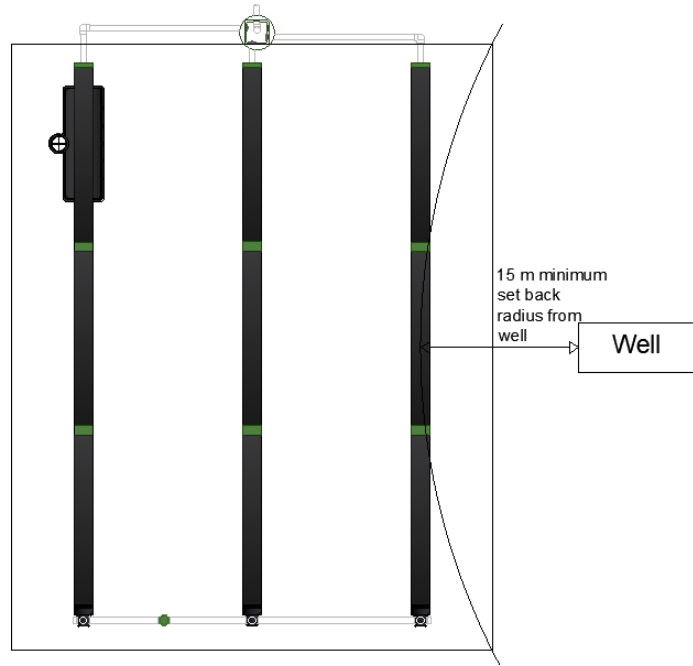


Figure 16. Disposition of the AES pipes over the entire area

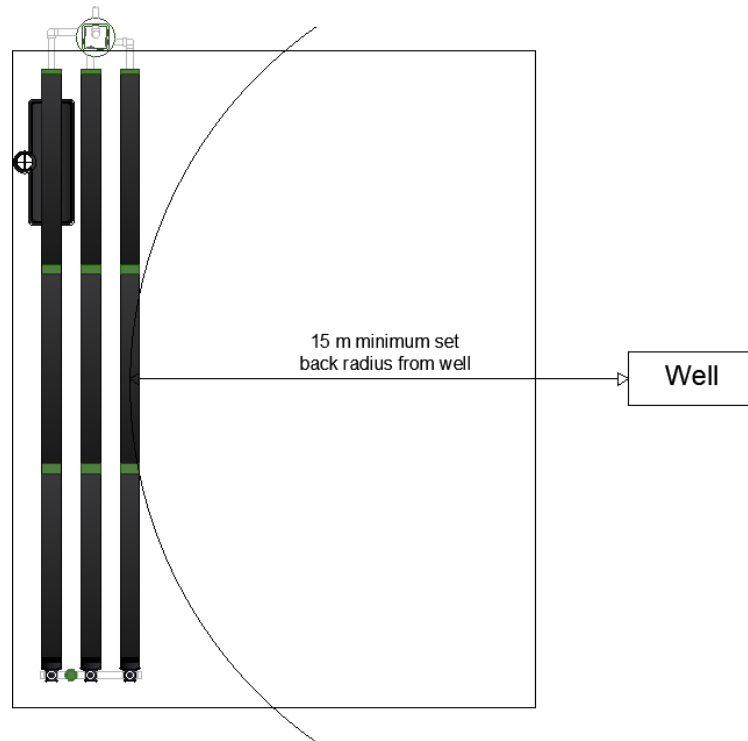


Figure 17. Disposition of the AES pipes with minimum spacing

In ground or Above Ground System

Taking into consideration the properties of the soil, the depth of soil before getting to the position of the high-water table, bedrock or soils with T time greater than 50 min/cm, the system can be in-ground, partially raised or raised system in order to respect the vertical separation.

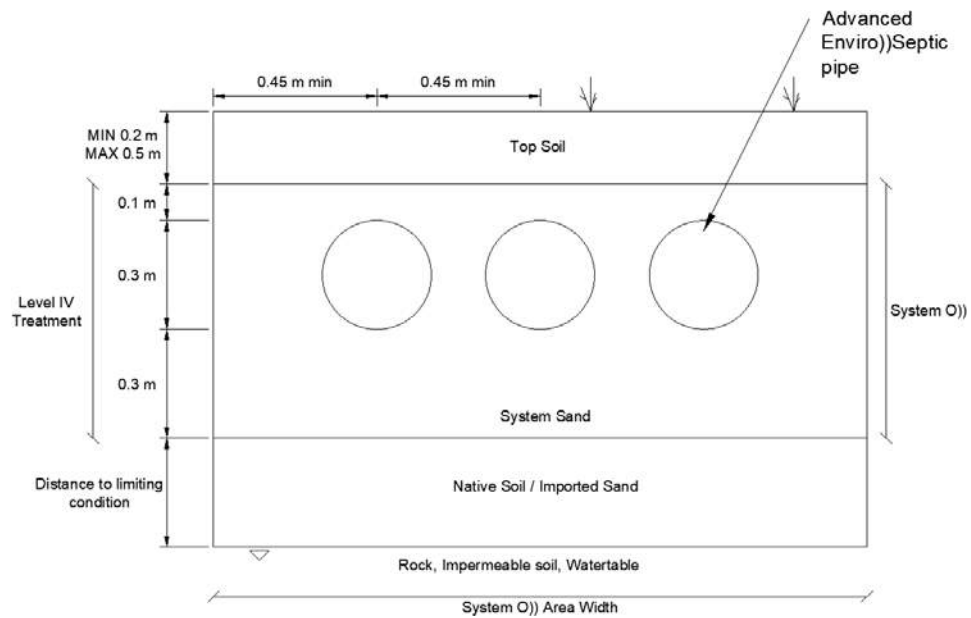


Figure 18. In-Ground Standard System Cross Section

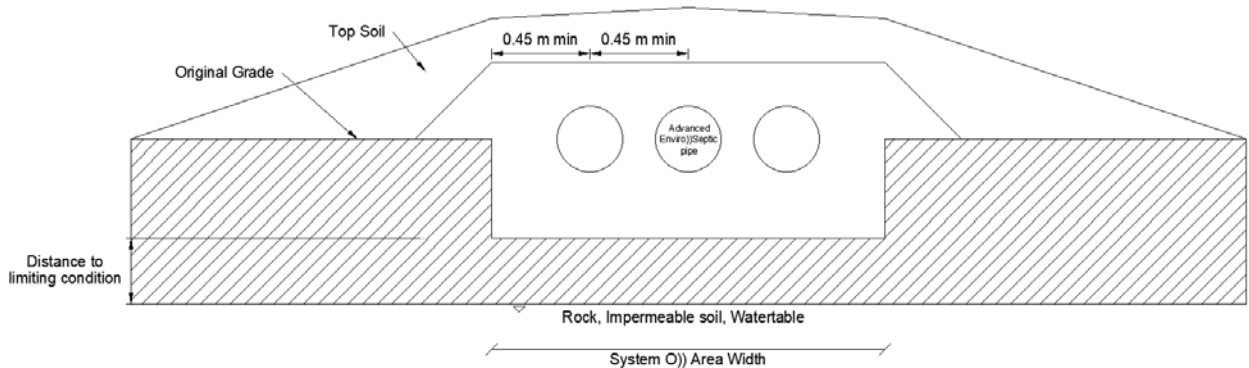


Figure 19. Partially Raised Standard System Cross Section

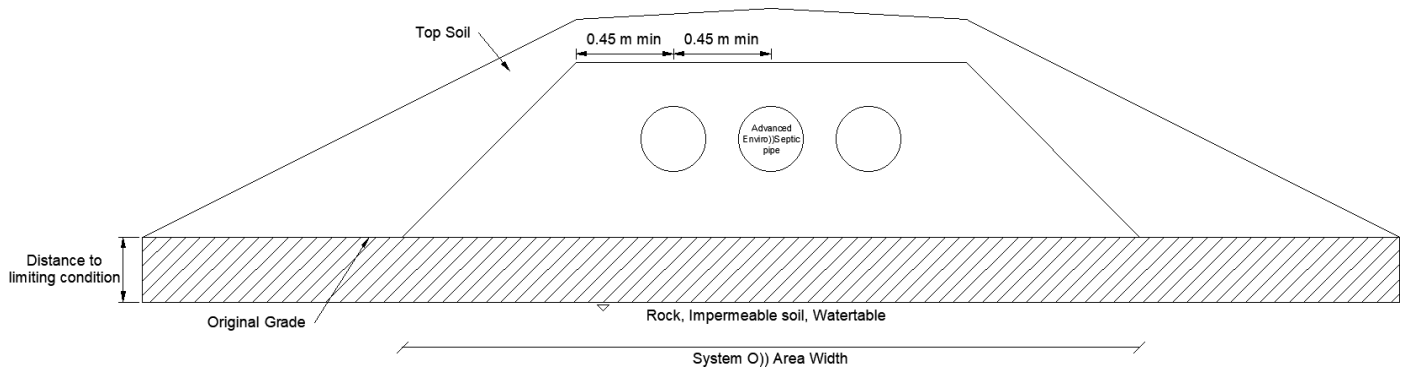


Figure 20. Fully Raised Standard System Cross Section

Design Criteria Summary

The Standard System O)) Configuration can be installed directly in-ground or partially raised when the site conditions permit it, or completely above ground as a fully raised system.

The vertical separations set out in the BMEC approval must be met, as detailed in Table 2.

Table 3 is a summary of the design criteria for a Standard configuration.

Table 3. Design criteria for a standard configuration

Design criteria	Percolation Time (T) of native soil		
	T ≤ 6 min/cm	6 < T ≤ 50 min/cm	T > 50 min/cm
Type of installation	In ground, partially raised or fully raised systems		Fully raised systems
Minimum System O)) Contact Area (m ²)	<ul style="list-style-type: none"> • T > 15 min/cm : QT/400 or Min. AES Spacing • T ≤ 15 min/cm: <ul style="list-style-type: none"> • Q ≤ 3000 L: QT/850 or Min. AES Spacing • Q > 3000 L: Q/50 or Min. AES Spacing 		QT/400 or Min. AES Spacing
System sand layer under Advanced Enviro-Septic pipe	300 mm		
System sand layer above Advanced Enviro-Septic pipe	100 mm minimum		
Top soil permeable to air on top of the system sand	200 mm minimum		
Minimum Vertical Separation as measured from the bottom of the System O)) system sand	600 mm	450 mm	600 mm

Section E.2. Flow Distribution Devices

A System O)) often uses multiple rows of Advanced Enviro-Septic pipe. For the system to function properly the effluent must be distributed equally to each row of Advanced Enviro-Septic pipe. Most of the time, this can be done by using a distribution box with equalizers, but other techniques are used and are discussed within this section.

Note: Where the total length of pipe required is 150 m or more, the sewage system must have at least 1 pump contained in a dosing tank.

Gravity – Distribution Box

Distribution Box

A distribution box (D-Box) with equalizers can be used to distribute the septic tank effluent to each row. The distribution box should be accessible from grade.

For this type of installation, the designer must consider the following:

- The dimensions of the distribution box to be used. The inlet should be 50 mm above the outlets of the box.
- The use of equalizers for each outlet is required to ensure proper distribution.
- Wherever possible, the use of a vertical tee is required on the inlet pipe. The tee is positioned in the middle of the box allowing effluent to drain down at the bottom and the air to circulate at the top.
- Place the distribution box in an area where the effluent will be able to flow by gravity.
- Minimize the length of the feed piping from the distribution box to each row.
- A minimum 1% downward slope is required for all piping. The pipe slope is toward the Advanced Enviro-Septic pipe (minimum 50 mm).



Figure 21. 7-hole D-Box with T in vertical position (left) and with internal insulation (right).

Below is a top view of a basic system with a distribution box. This system has three rows of pipes.

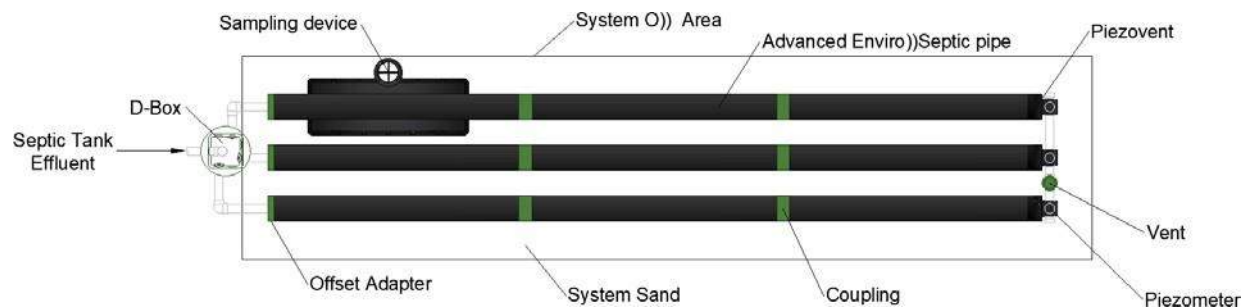


Figure 22. Basic system – Top view

This side view shows the minimum drop from a D-Box to a row of pipes. The minimum drop between the D-Box and the Enviro-Septic pipe needs to be 1% and at least 50 mm.

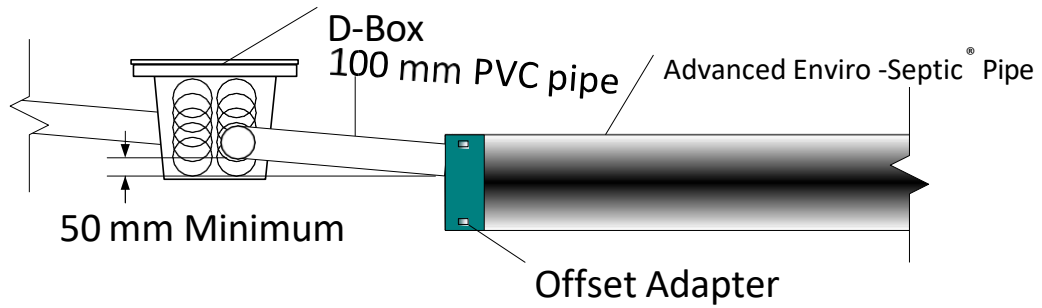


Figure 23. Side view – Basic system

If piping from the septic tank to the Advanced Enviro-Septic pipe is excessively steep, a velocity reducer at the system inlet is necessary. A distribution box with a baffle or an inlet tee may be an adequate velocity reducer.

Note: An Equalizer is limited to a maximum of 38 liters / minute in gravity systems

Pumping to a Distribution Box

If the Advanced Enviro-Septic pipes are above the septic tank outlet a pumping station will be required to distribute the septic tank effluent to the rows of Advanced Enviro-Septic pipe.

Note: For each Equalizer, calculate a maximum of 75 liters / minute when water is pumped inside a Distribution box.

A Velocity Reduction Device must be used to reduce the velocity of the effluent entering the distribution box. Using a pump chamber also requires a particular attention to the air flow circuit with a requirement for a 100 mm shunt pipe or the use of a differential vent. Section H. and Section I. describe the pump station and ventilation requirements in more detail.

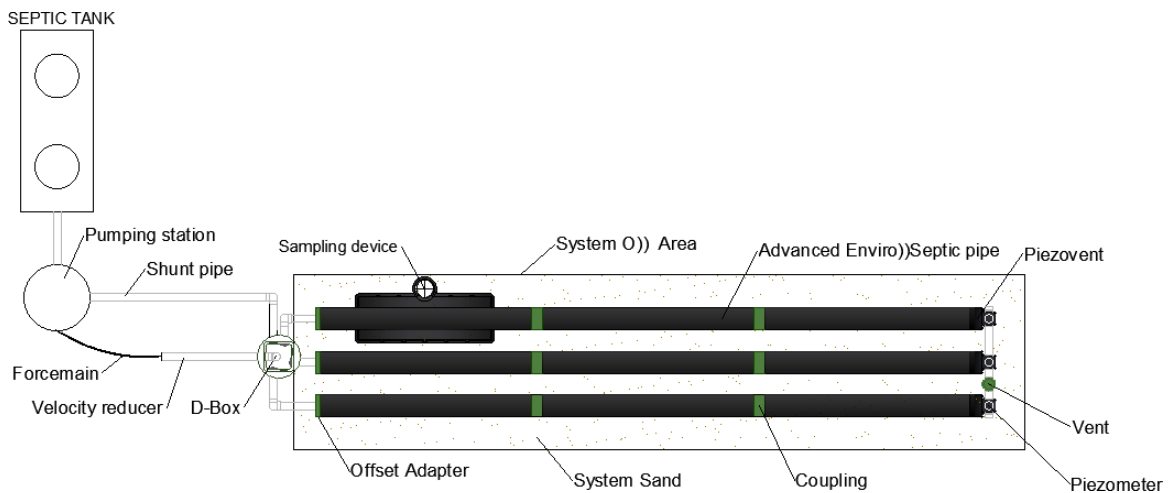


Figure 24. System O) using a pump chamber

Multiple Cells System

If multiple System O) cells are required, multiple D-boxes can be used. A principal D-Box can be used to feed secondary D-Boxes, or a pump chamber can be used to feed the D-Boxes (as seen in Figure 25).

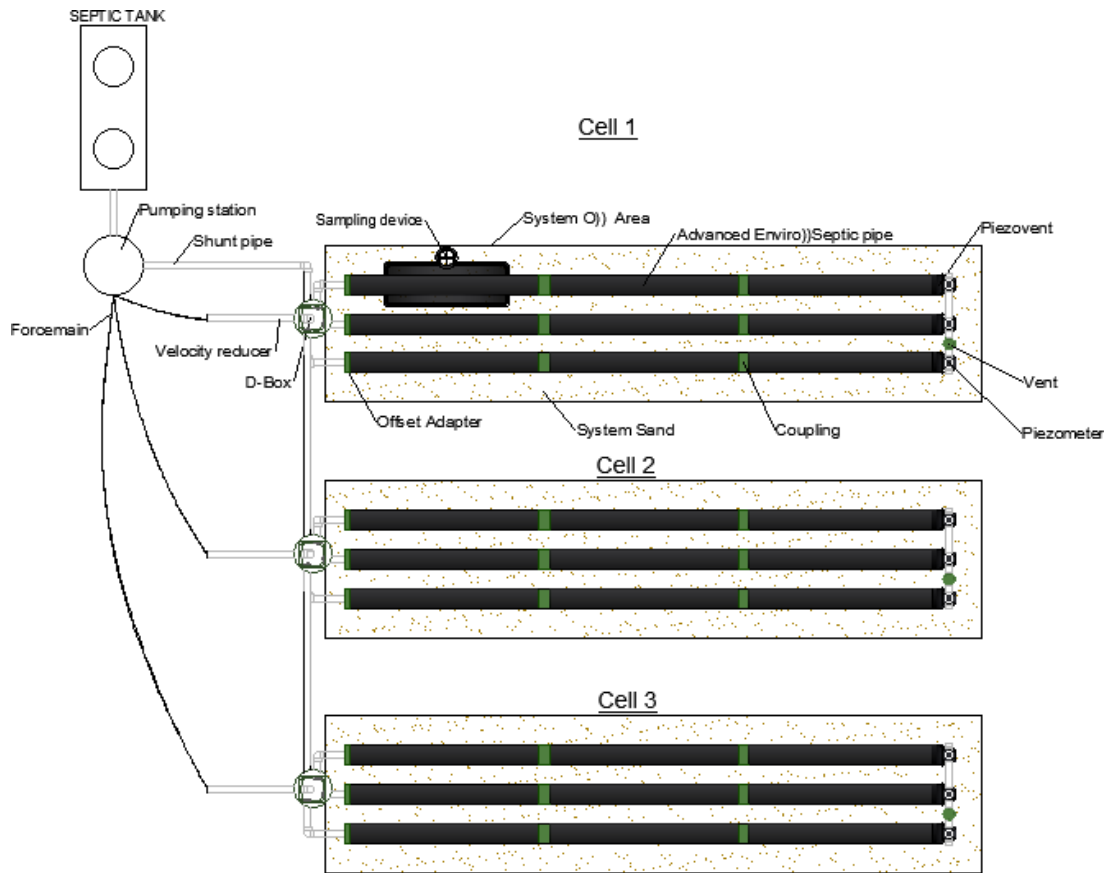


Figure 25. Multiple cells system configuration using a pump chamber

Low-Pressure Distribution System

When pumping the effluent from the septic tank to the System O) is required, a low-pressure distribution system (LPDS) can be used to directly dose the effluent uniformly between the System O) rows. The LPDS completely replaces the D-Box.

The Inject O) is a low-pressure distribution device developed by DBO Expert. It consists of a piezovent containing a perforated vertical pipe that creates a flow restriction, allowing for a pressure build up. The Inject O) replaces the Offset Adapter and each row is connected to one another by the distribution pipe (PVC, 50 mm), plus a venting pipe (PVC, 100 mm). During a pumping cycle, once pressure has built up throughout each Inject O), the water shoots from the Inject O) opening, hits the access cap and then flows into the Advanced Enviro-Septic pipes.

Figure 26 shows the Inject O) and Figure 27 shows a top view of how the Inject O) is used in with Standard Configuration.

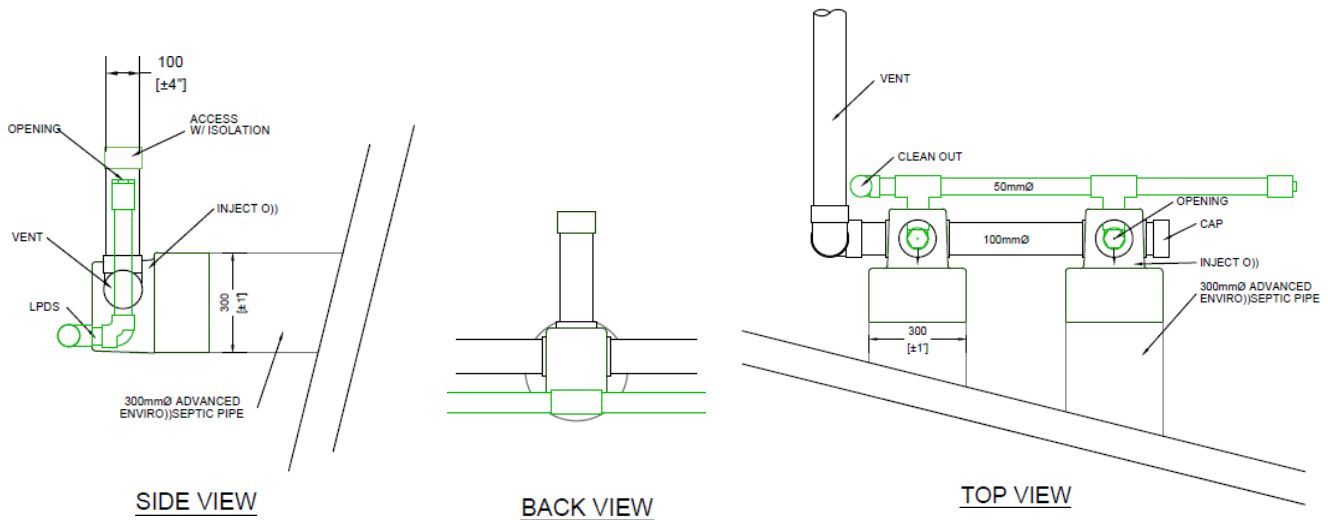


Figure 26. Inject O))

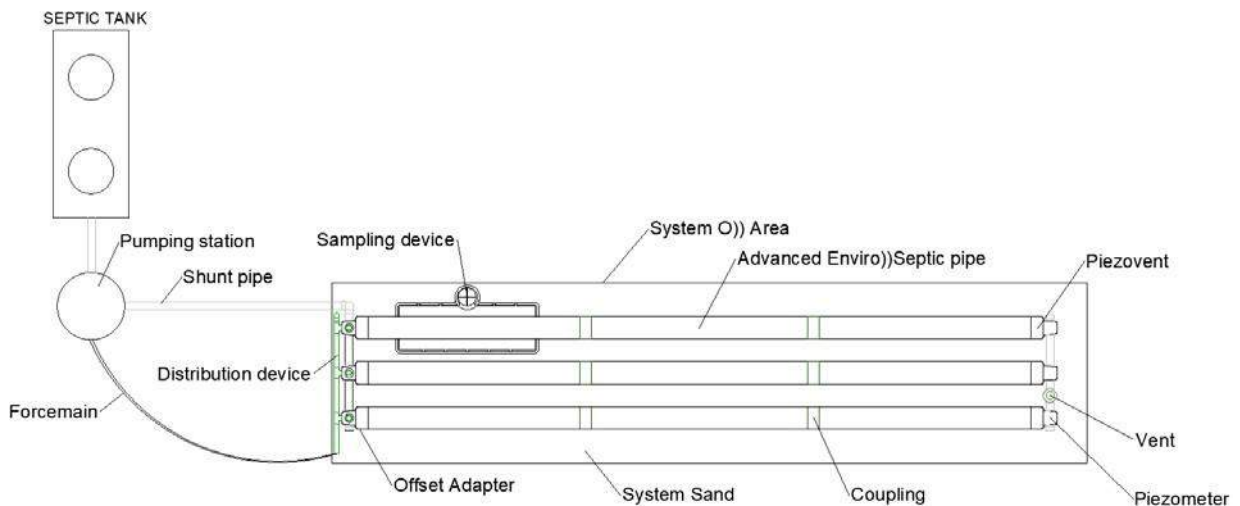


Figure 27. LPDS with a Standard Configuration

Distribution valve

When using a LPDS on large systems containing multiple cells or groups of rows, a pump stronger than usual could be required due to the flow restriction created by the Inject O)). Instead of simultaneously supplying all the rows, a variation can be used consisting of a distribution valve (also called an indexing valve or rotating valve) to distribute the water to 2 to 6 cells of Advanced Enviro-Septic pipes. These mechanical rotating distribution valves are available with 2 to 6 exit positions. With each cycle of the pump, the rotating valve turns one position allowing the water to reach the next cell or group of rows.

Section E.3. Sloping Systems

The percentage of slope refers to the slope of the System O)), not the existing terrain. The slope of the system and the existing terrain are not required to be equal. A sloping system can be designed in multiple sections, with more than one distinct slope and/or centre-to-centre pipe spacing in the same system. Maximum slopes are 1 unit vertical to 4 units horizontal (OBC 8.7.2.1).

No System must be installed in an area in which the original ground has a slope in excess of 25% (1 vertical:4 horizontal).

Perimeter sand

Systems sloping greater than 10% require the System sand area to extend a minimum of 1.2 m beyond the Advanced Enviro-Septic pipe on the down-slope side.

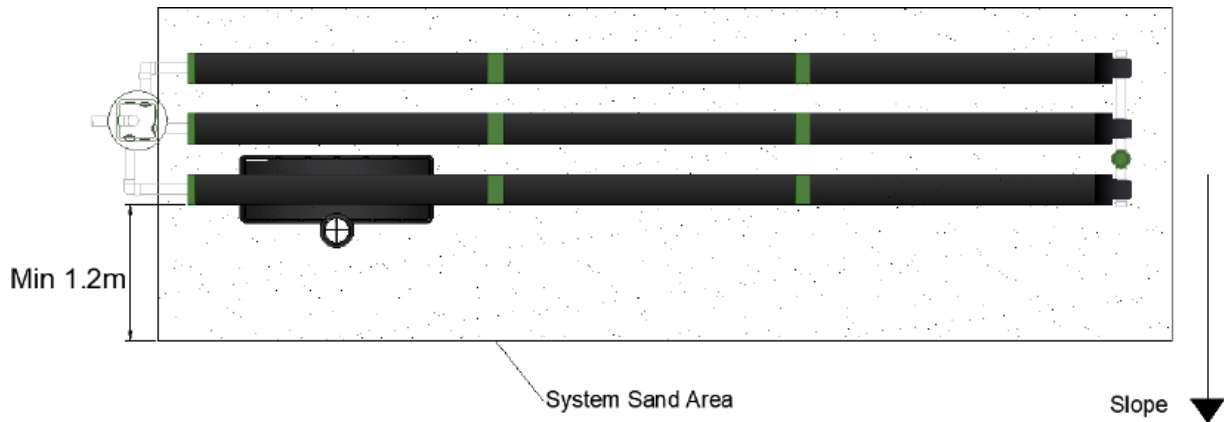


Figure 28. Perimeter sand with a slope greater than 10%

In-Ground Sloping Standard System

In-ground sloping Standard System, cross-section and side views.

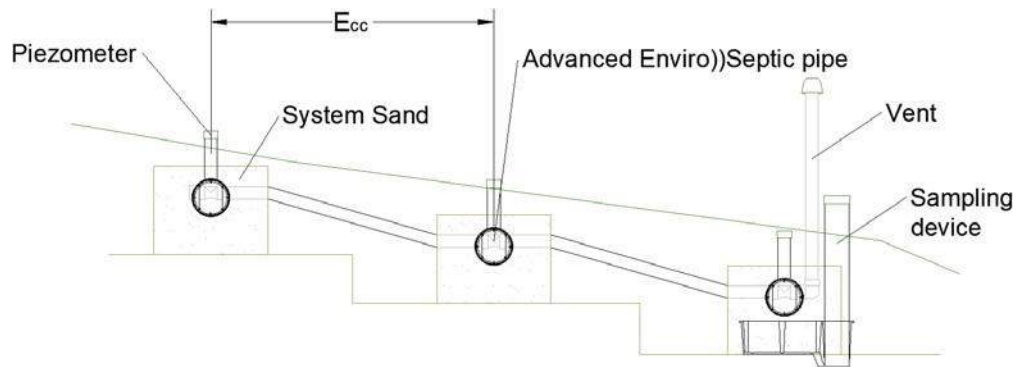


Figure 29. Front view – In-ground sloping standard system

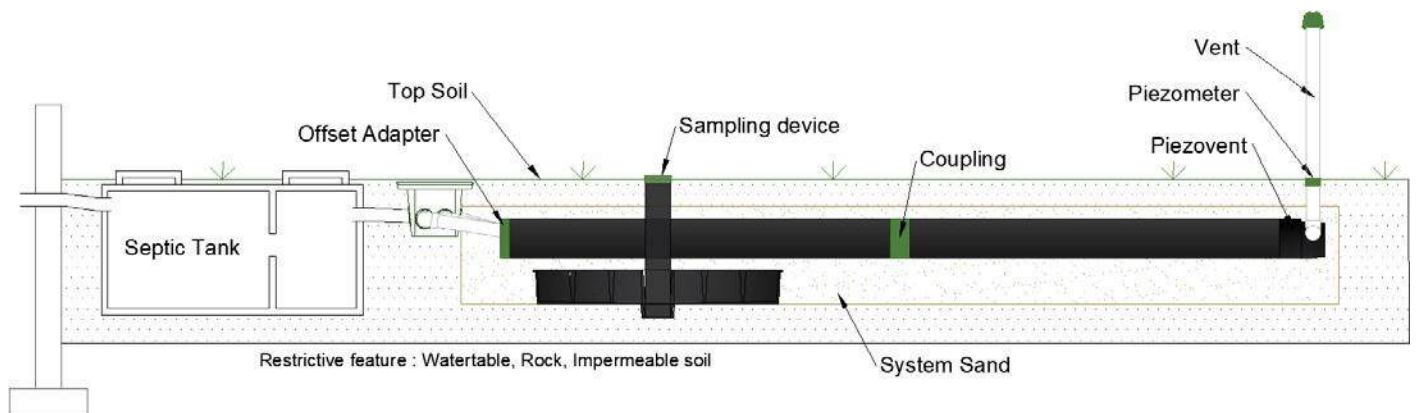


Figure 30. Side view – In-ground sloping standard system

Raised Sloping

Cross-section view of a Raised Standard system.

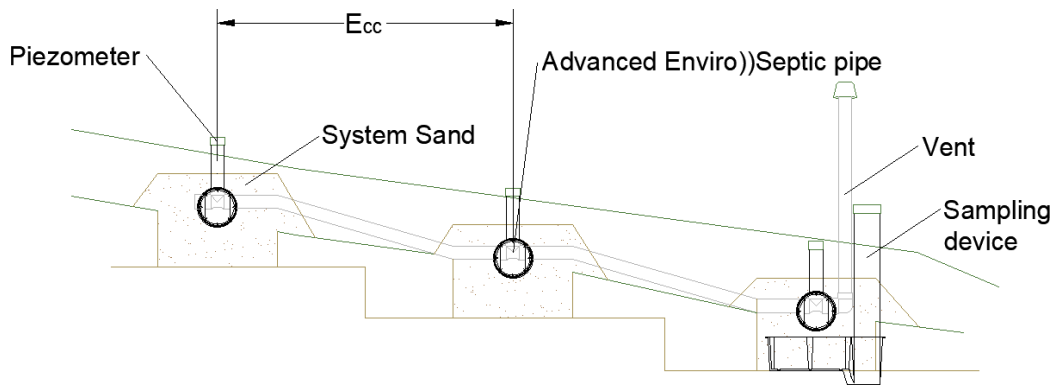


Figure 31. Side view – Raised sloping standard system

Section E.4. Special Shapes

Introduction

Non-conventional system shapes may be used for difficult site conditions. They may take irregular shapes to accommodate site constraints.

Curved Bed

Curved shapes work well around objects, setbacks, and slopes.

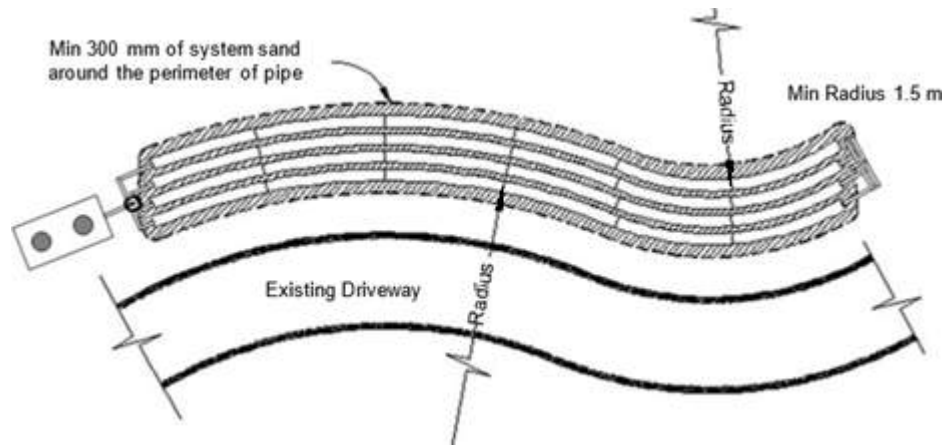


Figure 32. Curved shape System O))

Angled Shapes

Angular shapes can include one or more angles. Rows are angled by bending pipes. The shortest acceptable curve radius for System O)) is obtained by bending a 3 m pipe length at a right angle.

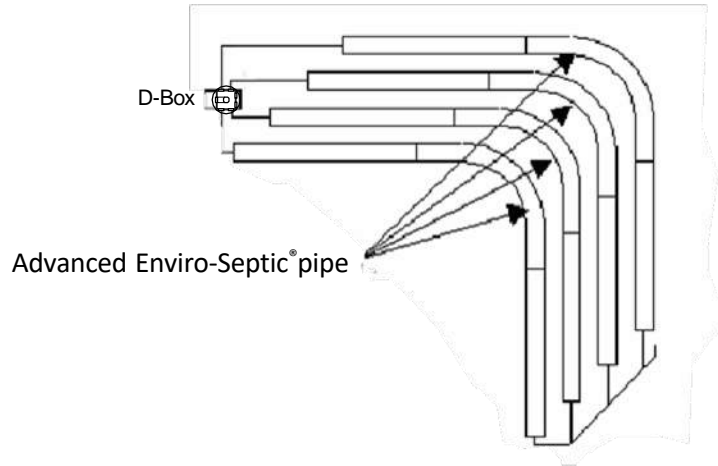


Figure 33. Angled shape System O))

Trapezoid Shape

The following system uses a trapezoid Shape to get around an obstacle or to adapt to a slope.

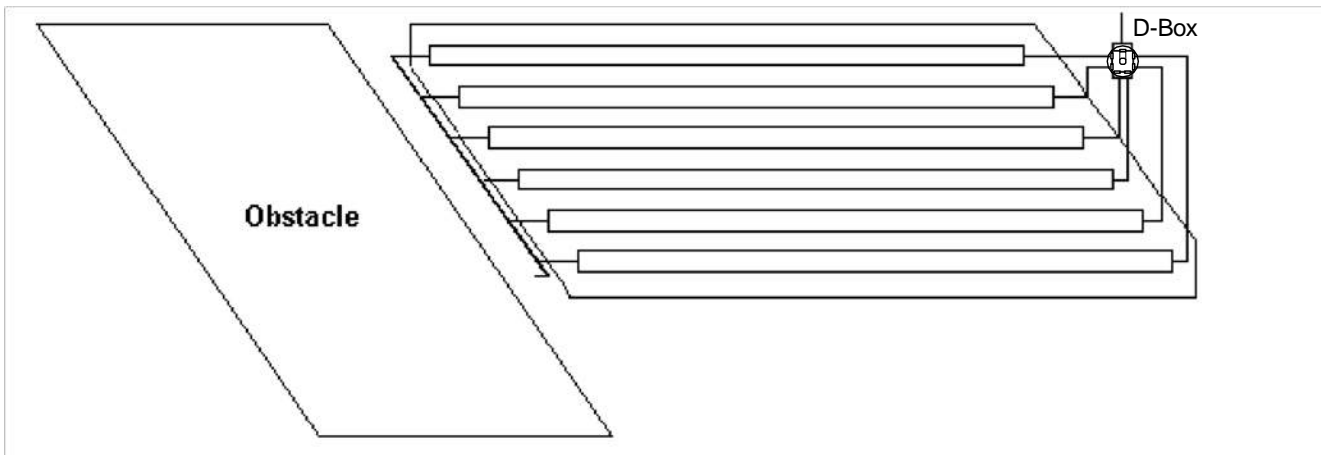


Figure 34. Trapezoid shape System O))

Section F. Nested Pipe Configuration

Section F.1. Design Criteria

Material depths

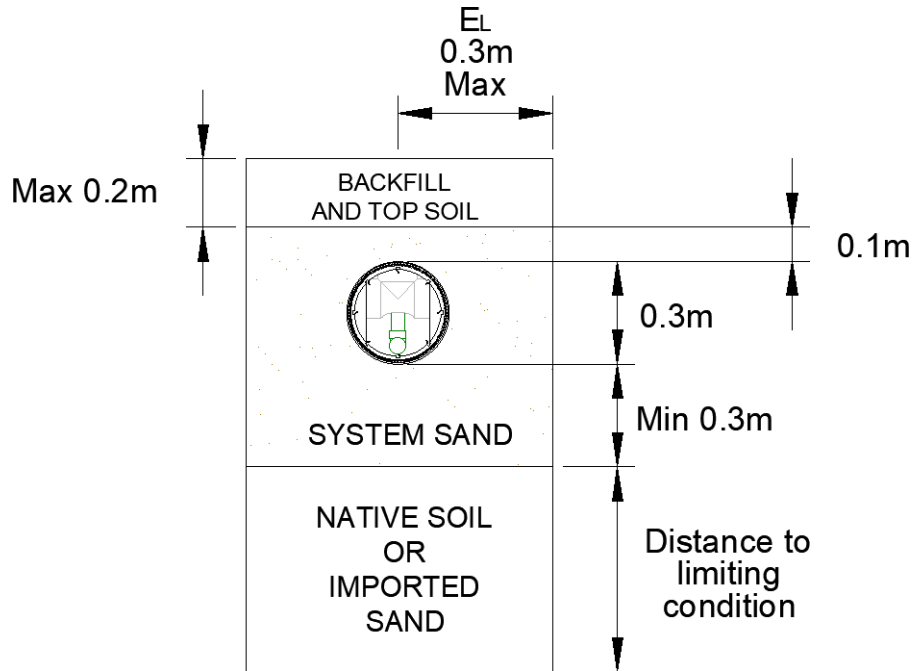


Figure 35. Material depths – Nested pipe

Total Length Sizing

The total length of the system depends on the daily flow (Q). As any System O)) Configuration, a minimal amount of pipe is required, each pipe having a treatment capacity of 126 L/day. However, apart from the length of the Advanced Enviro-Septic pipes, other length requirements can result in a longer system. The largest of either LAES or TRL, presented below, is the minimal total length of the system:

$$NAES = Q/126$$

$$LAES = (NAES \times AES \text{ pipes length}) = (NAES \times 3,05 \text{ m})$$

This value must be at least 30 m

or

Percolation Time of Natural Soil (min/cm)	Total Required Length (TRL) (m)
$1 < T \leq 20$	$Q/75$
$20 < T \leq 50$	$Q/50$
$50 < T \leq 125$	$Q/30$

If LAES is bigger than the TRL, the total length should be as long as the space taken up by LAES. If LAES is smaller than the TRL, additional Advanced Enviro-Septic pipes are required to reach the TRL.

If $LAES > TRL$, Total length = LAES

If $LAES < TRL$, Total length = TRL

Spacings

A Nested pipe configuration must follow the spacing requirements below.

- E_{CC} : Centre to centre spacing is the horizontal distance from the centre of one System O)) row to the centre of the adjacent row. The minimum centre to centre spacing is 2.0 m
- E_L : Lateral Extension Distance is the distance filled with additional sand material extending from the centre of the last lateral row to the side of the System O)). The minimum lateral extension is 300 mm
 - When made into trenches separated by Native Soil or Imported Sand, the width of the trenches should be 600 mm as seen in Figure 38.
- E_E : End Extension Distance is the distance filled with additional sand material extended from the end of a row to the side of the System O)), the minimum end extension distance is 300 mm.

When the T-time of the underlying soil is less than or equal to 20, the system can be built in the form of trenches separated by Native Soil.

When the T-time of the underlying soil is greater than 20, the entire area should be excavated. The system must be built as a continuous layer of system sand with a thickness of at least 300 mm under the Advanced Enviro-Septic Pipes. Imported sand may be used as backfill on top of and between the rows of Advanced Enviro-Septic pipes, provided that a minimum of 100 mm of System Sand shall be placed on top the Advanced Enviro-Septic Pipes, and a minimum of 150 mm of System Sand shall be placed beside each of the Advanced Enviro-Septic Pipes (see Figure 38 B.).

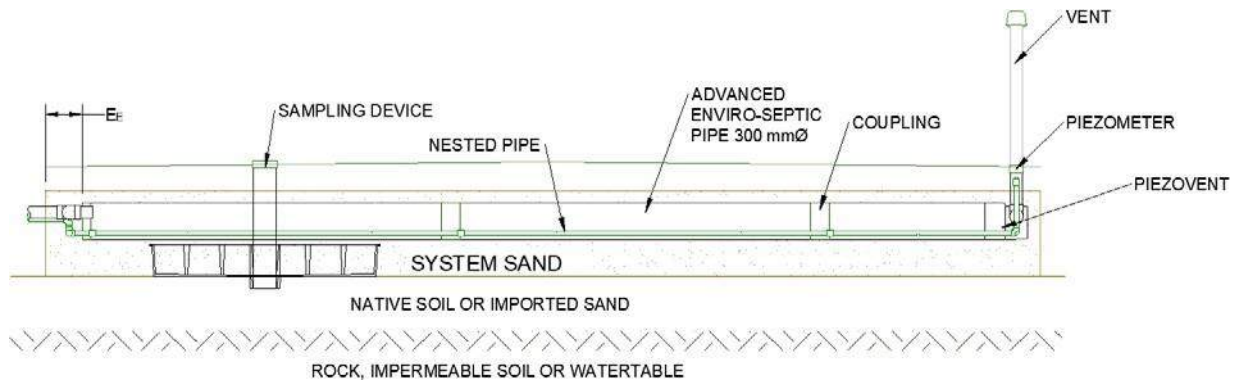


Figure 36. Side view – Nested pipes

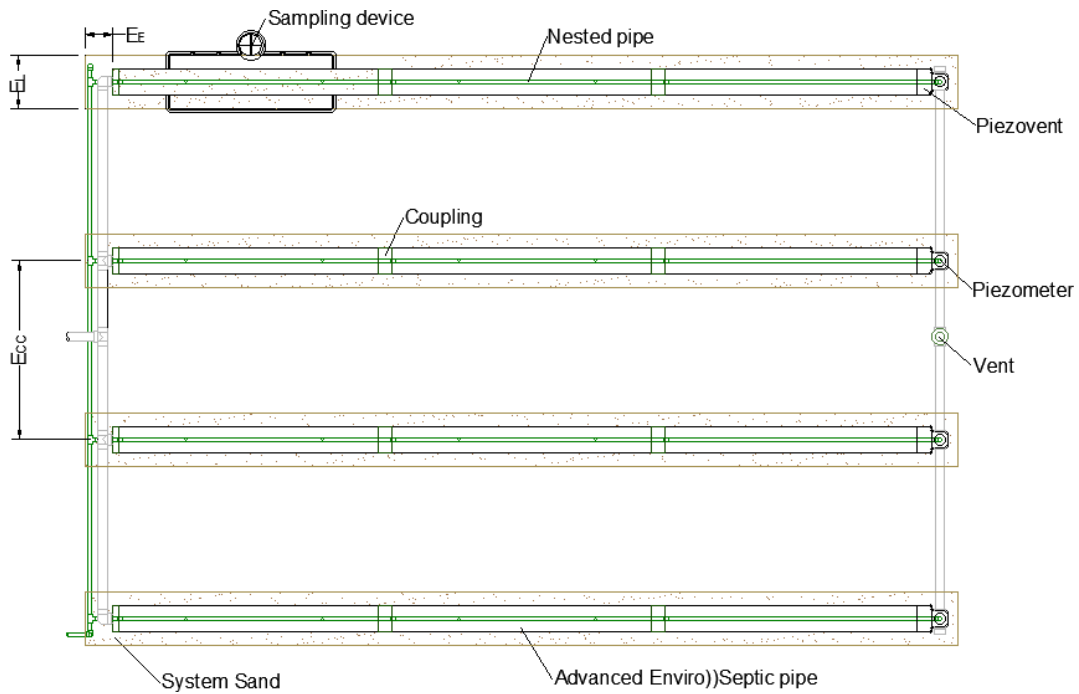


Figure 37. Top view – Nested pipe

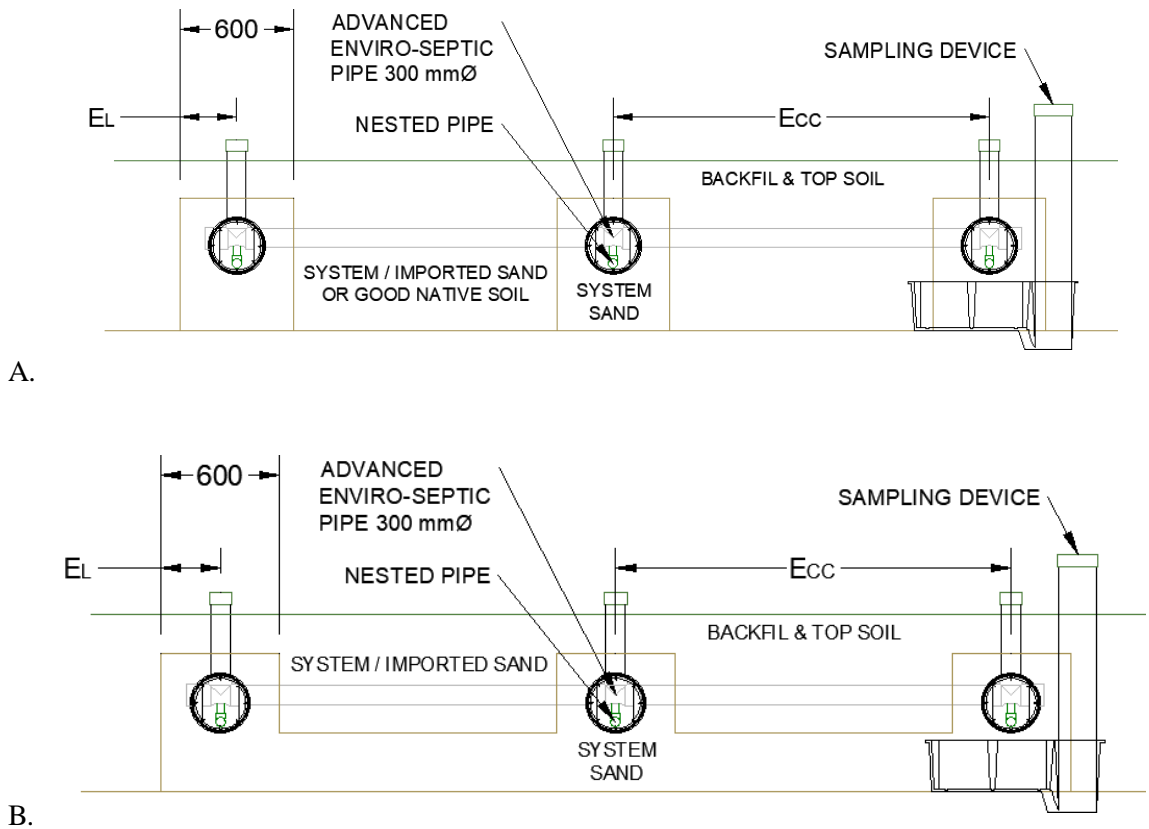


Figure 38. A. Front view - Nested pipe configuration. B. Front view- Nested pipe configuration (T > 20)

Vertical Separation

The table below shows the minimal vertical separation required for a Nested Pipe Configuration. The vertical separation is calculated from the bottom of the System O)) to the high groundwater table, soil with a T-time higher than 125 min/cm or bedrock.

Table 4. Minimal Vertical Separation for Nested Pipe Configuration

Percolation Time (T) of natural soil	$T \leq 6$ min/cm	$6 < T \leq 50$ min/cm	$T > 50$ min/cm
Minimum Vertical Separation as measured from the bottom of the System sand	600 mm		

Pump Chamber

A Nested Pipe Configuration must include at least one pump in a pump chamber that is capable of pumping for the timed dosing and distribution of septic tank effluent to the System O)).

- The pump chamber must be sized to provide sufficient storage volume so that the effluent is evenly dosed on an hourly basis over a 24-hour period.
- Where more than one pump is employed within a pump chamber, the pumps must alternate dosing, and dosing must continue if one pump fails.
- The pump must be equipped with an audible and visual alarm signal to indicate a high-water level in the pump chamber.
- The pump must be sized to provide a minimum pressure head of not less than 600 mm when measured to the most distant point of the Enviro-Septic piping from the pump.
 - Taking into consideration that the distribution pipe is placed at the bottom of the 300 mm diameter Advanced Enviro-Septic pipe, and that a minimum of 300 mm of sand and topsoil is needed over the Advanced Enviro-Septic pipe, the squirt should be at least barely observable from the surface.

Table 5. Design criteria for a Nested Pipe Configuration

Design criteria	Percolation Time (T) of native soil		
	$T \leq 20$ min/cm	$20 < T \leq 50$ min/cm	$T > 50$ min/cm
Type of installation	In ground, partially raised or fully raised systems		
Minimum system length (m)	Q/75 or LAES	Q/50 or LAES	Q/30 or LAES
System sand layer under Advanced Enviro-Septic pipe	300 mm		
System sand layer above Advanced Enviro-Septic pipe	100 mm		
Top soil permeable to air on top of the system sand	200 mm		
Minimum Vertical Separation as measured from the bottom of the System O)) system sand	600 mm		

Section F.2. Flow Distribution Devices

The mandatory pump chamber is combined with pressurized nested pipes, one inside each AES pipe. Each unit of nested pipes is the same length as an AES pipe (3,05 m) and contains two calibrated openings with a diameter of 4,77 mm (3/16"). The first opening is positioned 0,76 m from the start of the nested pipe and the second one is 2,285 m from the start, meaning that the openings are 1,525 m apart. When joining two nested pipes one after the other, the distance between the last opening of the first pipe and the first opening of the second pipe is also 1,525 m.

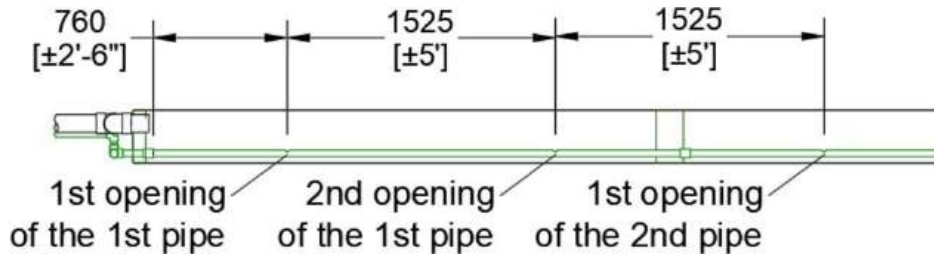


Figure 39. Distance between openings of the nested pipes

Since the passage of water is restricted by the small diameter of the orifices, pressure establishes in the supply pipe network. This pressure quickly equalizes causing the orifices, which are all the same diameter, to supply a uniform volume of water.

The supply side extremity of each row is equipped with a 2-hole adapter, also called the low-pressure adapter: the upper hole of 100 mm is used for the ventilation pipe. The lower hole is used for the 38 mm pressurized supply pipe.



Figure 40. 2-hole adapter

The far end of each row is equipped with a piezovent that combines the piezometer, the ventilation pipe and the purge for the 38 mm supply pipe. The purge can be used if the supply pipe becomes obstructed for some reason.

Special considerations need to be taken to ensure that the air flows efficiently through the system since the pump chamber interrupts the air flow between the System O)) and the septic tank. Two available options are discussed in Section I.2. such as an air deviation pipe seen below.

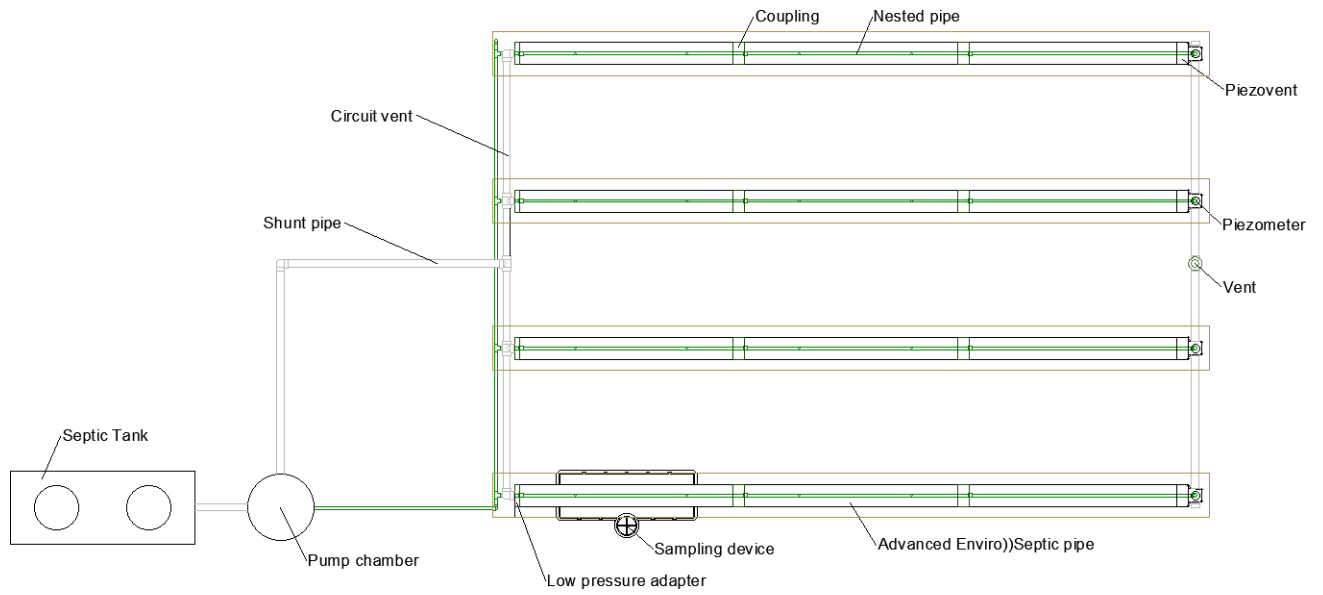


Figure 41. Top view - Flow distribution in a nested pipe configuration

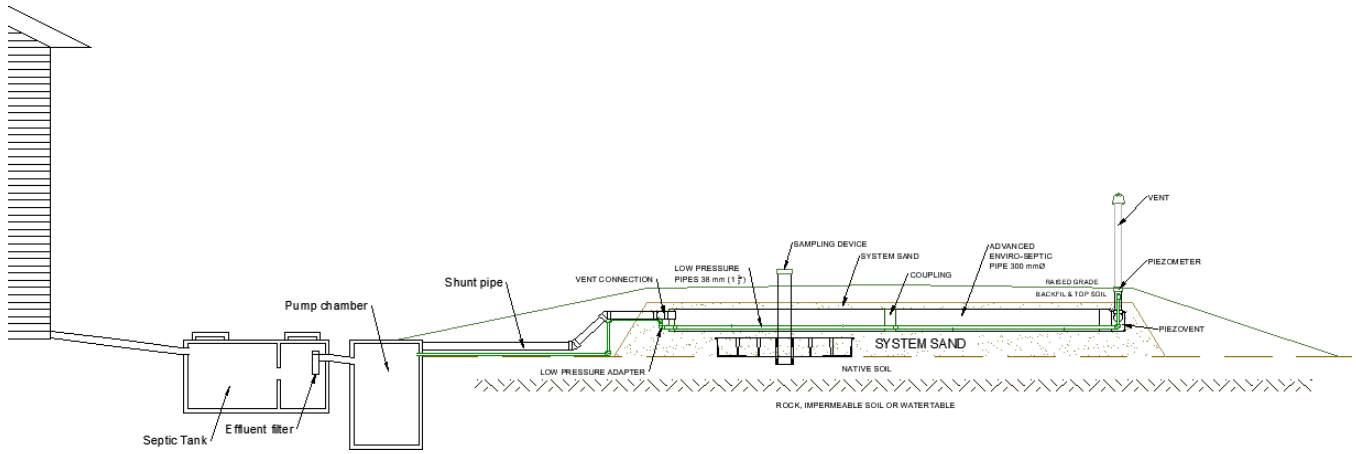


Figure 42. Side view – Flow distribution in a nested pipe configuration

Section G. Sand and Fill Requirements

System Sand

All System O)) configurations require system sand to surround the Advanced Enviro-Septic pipes by at least:

- 300 mm below the pipes
- 100 mm above the pipes.

For the side of the pipes:

- 75 mm for Standard Configuration
- 150 mm for Nested Pipe Configuration

The system sand can be natural sand, or filter sand that has been modified, and it must meet the requirements stated below:

- Effective diameter (D_{10}) between 0.2 and 0.5 mm;
- Coefficient of Uniformity (C_u) ≤ 4.5 ;
- Less than 3% of material smaller than 80 μm ; and
- Less than 20% of material larger than 2.5 mm.

The system sand required for the System O)) treatment and distribution system falls into the sand spectrum of the Ontario Building Code filter sand, but not the whole range. By comparison, Ontario Building Code filter sand material has an effective diameter of between 0.25 and 2.5 mm with a Coefficient of Uniformity not greater than 4.5. There is no discussion of fines and large particle content. Therefore, filter sand may meet the specifications of the system sand but it may need to be modified to meet the specifications as stated above.

Contact your System O)) distributor for a list of system sand suppliers.

Section H. Pump and Dosing Requirements

Section H.1. Standard Configuration

Pump systems typically supply wastewater effluent to System O)) pipe using a force main, a distribution box and a velocity reducer when site conditions do not permit a gravity system.

Differential Venting

When using a pump chamber, the natural air circuit going from the System O)) to the septic tank to the house vent is disrupted. To ensure a functioning air circuit, all pumped System O)) must use differential venting or have an additional vent as an exit vent. Reference: See Section I.1.

Velocity Control

When pumping inside a D-Box, the high velocity of the water can allow preferential path inside the D-Box. Always install a velocity reducer prior to the D-Box when pumping. Below is an example.

Force mains must discharge into a 100 mm pipe that is 3 m long. The change in diameter reduces the pressure in the pipe. If the distribution box is not equipped with a baffle, then the 100 mm pipe must be terminated with a vertical tee fitting inside the D-Box.

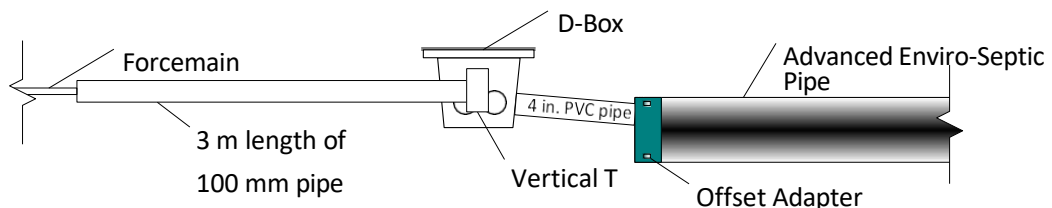


Figure 43. Velocity control

Standard Loading Rate per Pump Cycle

Taking into consideration the daily design sewage flow, the volume of wastewater per cycle should be specified to be 6 to 8 cycles per day.

Maximum Loading rate per Pump Cycle

The maximum volume of effluent pumped per cycle per length of Advanced Enviro-Septic Pipe (3.05 m) is 55 litres.

Maximum Flow in Litre per Minute

Each equalizer in a system using a pump and a distribution box cannot receive a flow higher than 75 liters per minute. Therefore, the maximum flow rate in Litre per Minute should be:

$$75 \text{ L/min} \times \text{Number of equalizer}$$

If the expected flow is higher than the above calculation, adding more equalizer to the D-Box is a simple option.

Section H.2. Nested Pipe Configuration

The Effluent from the septic tank must always be pumped to the System O)) when using a Nested Pipe Configuration.

Differential Venting

When using a pump chamber, the natural air circuit going from the System O)) to the septic tank to the house vent is disrupted. To ensure a functioning air circuit, all pumped System O)) must use differential venting or have an additional vent as an exit vent. Reference: See Section I.2.

Minimal Pressure Head

The pump must be sized to provide a minimum pressure head of not less than 600 mm when measured to the most distant point of the Enviro-Septic piping from the pump. Taking into consideration that the distribution pipe is placed at the bottom of the 300 mm diameter Advanced Enviro-Septic pipe, and that 300 mm of sand and topsoil is needed over the Advanced Enviro-Septic pipe, the squirt should be at least barely observable from the surface.

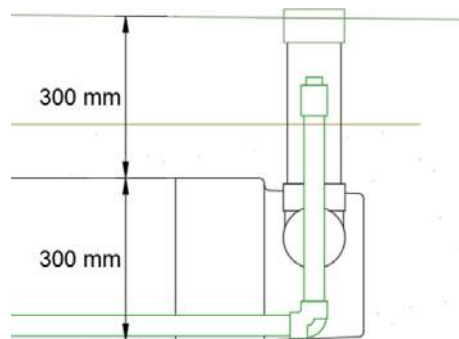


Figure 44. Minimal pressure head

Section I. Venting Requirements

General Rule

All System O)) require the use of a vent pipe as well as appropriate aeration pipes. Locate vent openings to ensure air is drawn completely through each row or section of Advanced Enviro-Septic pipe.

The aeration circuit must be continuous between the entry and exit vent. The vent installed at the end of the rows of pipes (piezovent side) acts as the entry point. The Piezovents allow to easily connect each row with an aeration pipe (vent manifold), as shown in the following figure.

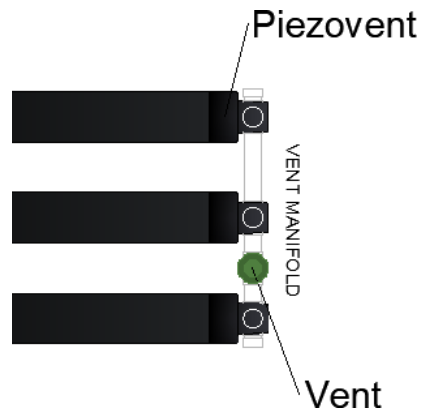


Figure 45. Venting connection

Design Standards

The entry vent (located at the end / piezometer side of the System O))) must meet the following standards:

- Must be a minimum of 100 mm but high enough to rise above snow during winter (around 1.2 m);
- Can be hidden among trees, located at fence post, Etc.;

The entry vent must be at least 3 m lower than the exit vent.

All vents must conform to the Ontario Plumbing Code (OBC part 7).

Vent Locations

System O)) can be vented at the following areas:

Entry vent (Low) located downstream from the system, through the piezovent installed at the end of each row.

- The vent pipe is to be connected to the air manifold between two pipe rows or at the side of the last row.
- If the vent is located away from the System O)), use an open T-shaped fitting at the base of the aeration pipe to prevent condensation build up.

Exit vent (High) located upstream from the treatment system.

First choice is to use the building plumbing stack:

- Vent pipe connected on the sewer pipe between the house and the septic tank. This vent stack borders the exterior wall of the house and rises above the roof. It is not recommended to put a vent on the septic tank because of potential odour problems.

And if the use of the building plumbing stack is impossible:

- Install an additional differential vent (see below and Figure 46 is an example of a differential vent with a gravity-fed standard configuration)

Note: The designer must make sure that there is a well-vented line between both high and low vent pipes.

Differential Venting

Differential venting is the use of a high vent and in addition to the regular low vents in a system. High vents are connected close-to or to the distribution box (for gravity-fed systems) or in-between rows or at the extremity (for LPDS and Nested pipe systems). This arrangement enhances the circulation of air throughout the entire system. The high vent should be brought next to a gate, a building, or a tree as a good esthetical practice.



Figure 46. Differential venting – Standard configuration



Figure 47. Differential venting – Low-pressure Distribution for Standard Configuration



Figure 48. Differential venting - Nested Pipe Configuration

Section I.1. Standard Configuration Air Flow Circuit

The most common setup is when the air flows through the Advanced Enviro-Septic pipes, the D-Box and the septic tank and exits through the vent stack of the residence.

On systems that use a pump chamber (pumping in D-Box or LPDS), special considerations need to be taken to ensure that the air flows efficiently through the system since the pump chamber interrupts the air flow between the System O)) and the septic tank. This leaves the designer with 2 options:

- Install a shunt pipe (also known as an air by-pass pipe) between the treatment system and the pumping station in order to re-establish the air circuit, as seen in Figure 49;
- Install an additional differential vent pipe.

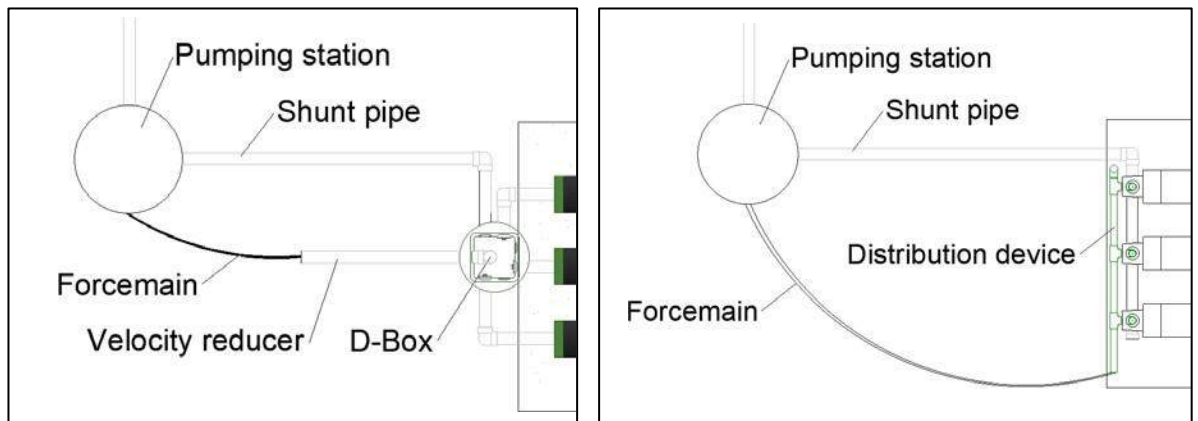


Figure 49. A. Pumping in D-Box / B. LPDS

Section I.2. Nested Pipe Configuration Air Flow Circuit

Requiring a pump chamber, a Nested Pipe Configuration always requires a particular attention to the air flow circuit. This leaves the designer with 2 options:

- Install a shunt pipe (also known as an air by-pass pipe) between the treatment system and the pumping station in order to re-establish the air circuit, as seen in Figure 50;
- Install an additional differential vent pipe.

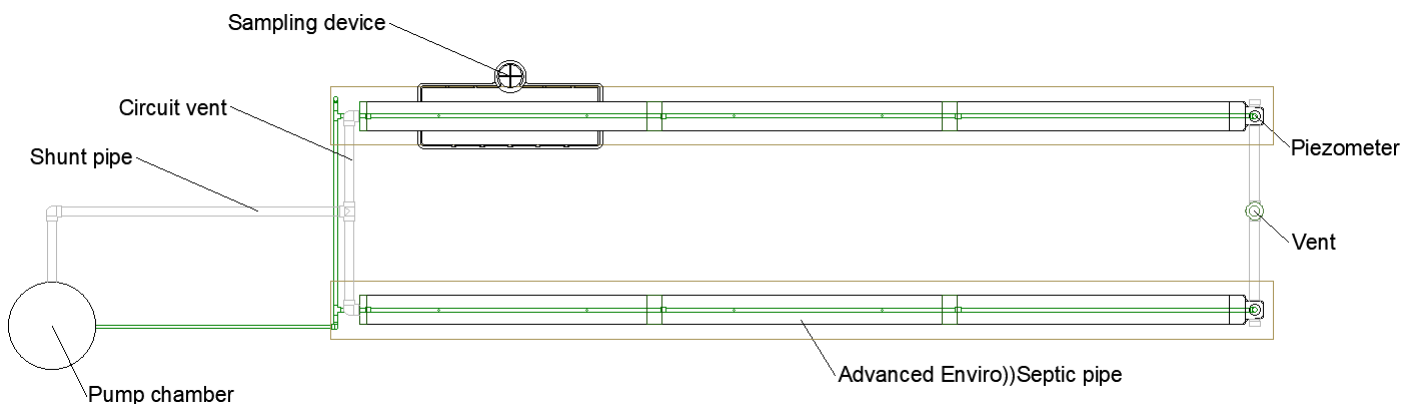


Figure 50. Nested pipe configuration – Air flow circuit

Section J. Piezometers

Background

The piezometer allows the measuring of the water level in the pipes.

A piezometer is required at the end of each row.

Piezometer Design

Figure 51 shows a piezometer installed at the end of a row of Advanced Enviro-Septic pipe.

The piezometer is to be capped at finish grade level.

The watertight cap at the end of the piezometer needs to be on at all times, except during follow-up or maintenance of the system.

Piezometer Model

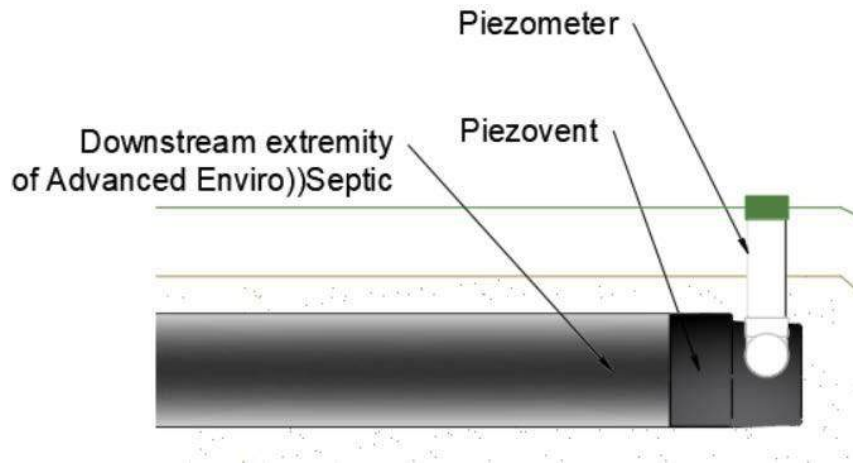


Figure 51. Piezometer design

Section K. Sampling device

Context

The System O)) requires the installation of an effluent sampling device. The following paragraphs describe the sampling device to be used.

Sampling Device Description

The sampling device includes two major components:

- Collector
- Sample port

The collector consists of a thermoformed trough in which a collector pipe is installed. The pipe is then covered with a layer of system sand.

The collector is installed at the bottom of the system sand directly below a length of Advanced Enviro-Septic pipe. The collected treated effluent is routed towards the sample port. The sample port is used to take the treated effluent samples for analysis. See Figure 52 for a drawing of the sampling device.



Figure 52. Sampling device

Collector

The collector is installed at the bottom of the system sand directly below the first length of Advanced Enviro-Septic pipe.

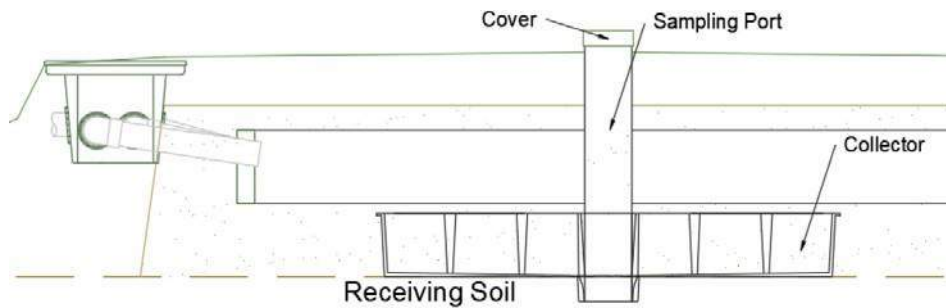


Figure 53. Position of the collector

The sample port should be located under an outside row as a standard practice. It should be centered below the first pipe of the row, meaning that the perimeter of the collector should be approximately 570 mm from the Offset Adapter.

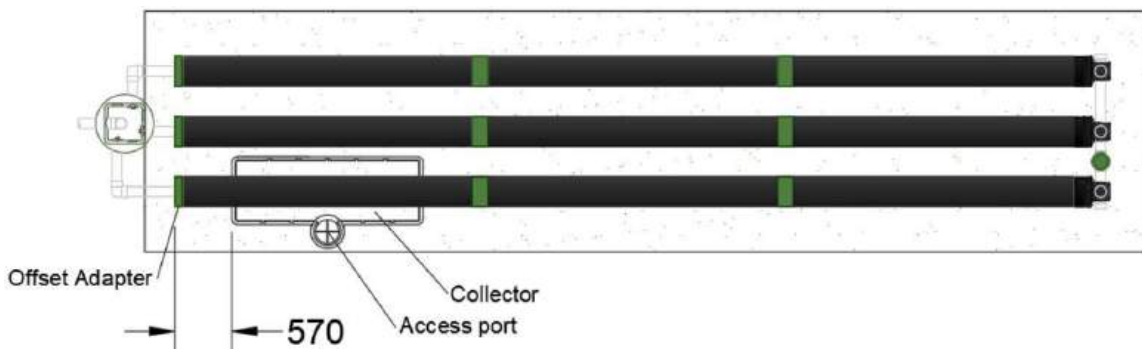


Figure 54. Localisation of the sample port

Installation Guide

Section L. Overview and Preparation

Section L.1. General Information

The following paragraphs provide the necessary steps for the installation of a System O)). The installation sequence of the components may vary according to the constraints of the installation site. For example, the septic tank / pump station may be installed after the System O)).

Authorized Installer Required

All System O)) installations must be done by an installer authorized by Make-Way Environmental Technologies Inc. (Make-Way is authorized by DBO Expert Inc to train and accredit installers). Authorization is obtained by attending a training session or by doing the first installation under supervision of Make-Way Environmental Technologies Inc.

Steps to Follow

The installer must follow a series of steps in the construction of a System O)):

- Excavate the contact area and scarify the surface of the receiving soil.
- If required, install the imported sand on the System O)) Contact Area.
- Install the sampling device.
- Install the system sand on the System O)) Contact Area.
- Install the Advanced Enviro-Septic pipe rows.
- Place system sand between rows
- Pack system sand between rows by walking on top of the system sand between the rows.
- Install the Distribution device (D-Box, LPDS/Inject O)) or Nested pipes)
- Cover the Advanced Enviro-Septic pipes with system Sand exposing the ends.
- Install the feed, and ventilation piping.
- Cover the system sand with clean top soil (no silt or impermeable soil) permeable to air.

The installation of the septic tank should be done following the manufacturer's recommendations and OBC requirements. Depending on site conditions, the septic tank may be installed before or after the System O)) is installed.

Installation of a pump station should be done according to the supplier's manual.

List of Typical Materials

System O))

- Advanced Enviro-Septic pipes
- Couplings
- Offset adapters
- Piezovents (Double adapters)
- Distribution system (i.e.; Distribution box with equalizers, LPDS, Nested pipes)
- Piezometer End Caps
- Sampling device
- PVC pipes, 100 mm
- PVC 90° elbows, 100 mm
- PVC Tees, 100mm
- System sand that meets specifications
- Air permeable top soil with no silt for final fill
- Pump station, manifold, and other accessories (optional)

Planning the Installation

Find the optimal order of steps for the installation:

- According to site constraints.
- Considering the movement of machinery.

The system sand must meet the following specifications:

- Effective diameter (D_{10}): $0.20 < D_{10} < 0.5$ mm.
- Coefficient of uniformity (D_{60}/D_{10}): $C_u \leq 4.5$
- Less than 3% silt; diameter $< 80 \mu\text{m}$ (0.080 mm)
- Less than 20% particles with diameter > 2.5 mm.

Calculating the different elevations:

- 1% slope between:
 - the exit from the septic tank and the distribution box (gravity feed) or pump chamber
 - the distribution box and the entry to the furthest pipe
- Minimum separation between the interface of the system sand / receiving soil and the high point of groundwater, rock or limiting soil.
- 1% incline in the ventilation pipes leading to the vent (sloping toward the Advanced Enviro-Septic pipes)

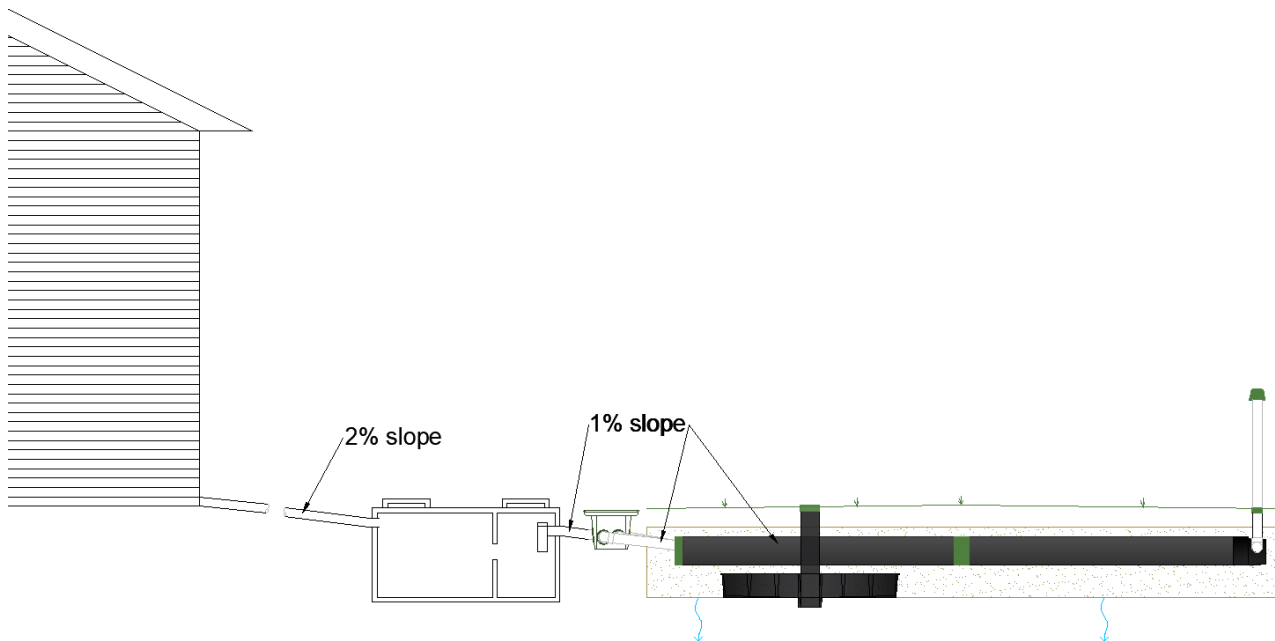


Figure 55. Elevations required between elements

Septic Tank

Install the septic tank in accordance with manufacturer's recommendations and OBC requirements.

Preparation of the Installation Site

- Outline the contact area / surface to be excavated.
- Excavate the layer of soil required according to whether the installation will be raised partially raised or in-ground.
- Scarify the surface of the receiving soil where the system sand (or imported sand if required) will be spread out including the side walls. At the interface between sand and soil, the soil surface must not be smoothed or compacted. It must be scarified to allow for optimal percolation of the treater effluent from the sand in to the receiving soil.

- To the extent possible, conserve the existing conditions of the soil underneath. Avoid compaction of the soil as this will affect its permeability.

Note:

- Install the imported sand (when required) and the system sand the same day as the excavation.
- Avoid the accumulation of rain water or surface runoff in or on the system during the construction period.
- Do not do an installation in ground that is saturated with water or in the presence of frost.

Soil Compaction

Minimize machine movement to avoid soil compaction and destruction of the soil structure under and around the system. Be especially careful not to compact soil on the down slope side of the system. Only tracked equipment should be utilised, i.e. no rubber tired vehicle.

Section M. Detailed installation procedure

The installation of a gravity-fed Standard, a low-pressure Standard and a Nested Pipe configuration has many identical steps. For each section with a particularity associated with the configuration or distribution device, subsections are added.

Section M.1. Sampling Device Installation

Introduction

The sampling device is to be installed on the surface of the scarified receiving soil. Its installation is done in four steps:

- Install the collector tray
- Install the sample port
- Add system sand as required
- Cut the sample port to grade (after the final backfilling of the system)

The following paragraphs detail the steps for the installation of the sampling device.

Step 1 – Installing the tray

Once the surface of the receiving soil has been scarified, the installer must install the sampling device. Here are the steps:

- Place the tray of the sampling device:
 - ✓ Under the first pipe of one of the rows of Advanced Enviro-Septic pipes (on the supply side),
 - ✓ Preferably under a side row.
 - ✓ In the case of sloping land, under the side row down the slope.

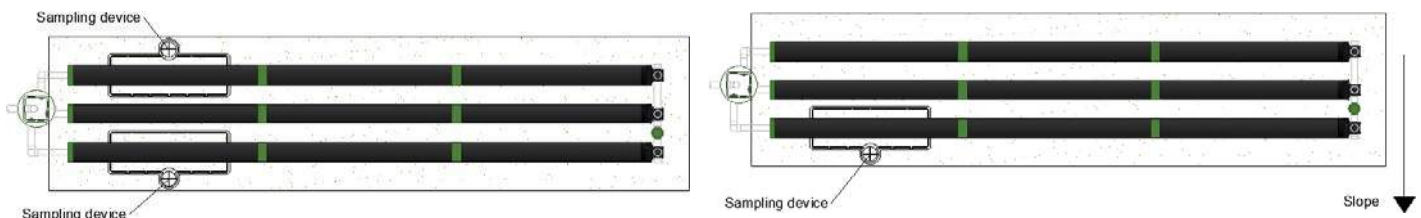


Figure 56. Sampling device localisation



Figure 57. tray installation

Step 2 – Installing the Well

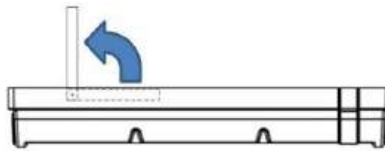
- Once the tray is in place, place the sampling well in the base defined for this purpose.



Figure 58. Sampling well installation

Step 3 – Filling the tray

- While holding the elements in place, cover the well and the tray with system sand according to the selection criteria provided.
- Add sand inside and outside the tray so that it retains its original shape.
- Raise the positioning blades that will allow you to properly align the row of pipes above the sampling device



- Complete the installation of the sampling device as shown below.



Figure 59. Final installation of the sampling device

Section M.2. Sand Layer and Rows of Pipe

Preparing the Layer of System Sand Under the Pipes

After having scarified the receiving soil and after having installed the sampling device (see previous paragraph):

- Add a layer of imported sand over the System O)) Contact Area if required.
- Add a layer of 0.3 m of system sand. When the spacing between the System O)) rows (E_{cc}) exceeds the minimum required horizontal spacing, imported sand can be added between the Advanced Enviro-Septic pipes instead of using system sand.
- Level lengthwise the surface of sand which will receive the Advanced Enviro-Septic pipes.

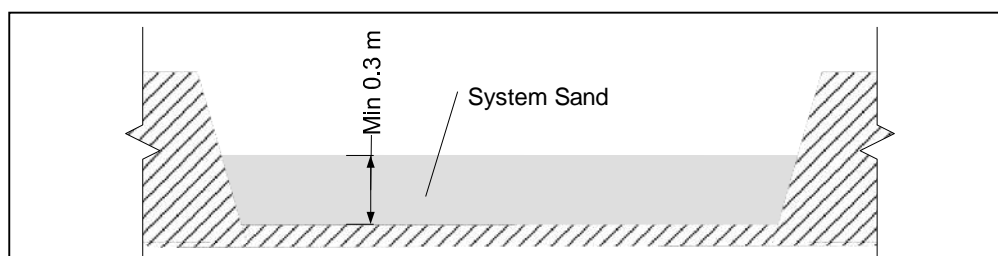


Figure 60. Layer of system sand under the AES pipes

Installing the Advanced Enviro-Septic Pipes

- Be sure that the surface of system sand over the System O)) Contact Area corresponds with the dimensions prescribed in the plan and that it is level the full length in the direction of the pipes.
- Arrange the pipes on the surface keeping in mind the number of rows needed, the number of pipes per row and the centre to centre spacing (E_{cc}), lateral extension distance (E_L) and end extension distance (E_E).
- The seam side of the geotextile fabric that covers the pipes must be upwards. The 250 mm wide white membrane (bio-Accelerator) must be situated at the bottom of the pipe.
- Assemble the Advanced Enviro-Septic pipes using the couplings provided.
- Level the rows of Advanced Enviro-Septic pipe from one end to the other.

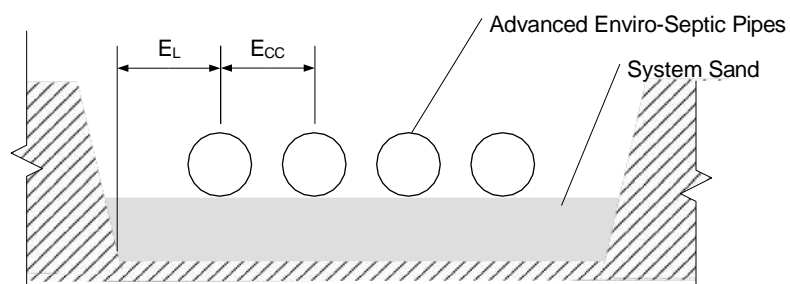


Figure 61. Installation of the AES pipes

Installing the Couplings

Couplings are used to join the Advanced Enviro-Septic pipes and create rows. To put them in place the installer must:



Figure 62. Installation of the couplings

- Pull back the geotextile membrane at the ends of the two pipes to be connected.
- Place the two ends one or two centimetres apart making sure that the seam is on top of the pipes and that the two white membranes are at the bottom.
- Install the coupling on the two Advanced Enviro-Septic pipes to be joined, being careful to insert the ridges of the couplings in the channels of the pipes.
- Close the upper part of the coupling by inserting the locking tab into the corresponding opening.
- Replace the geotextile membranes over the coupling.
- Keep seams upward.



Figure 63. Replacing the geotextile over the couplings

Covering the Advanced Enviro-Septic pipes

Once the pipes are connected and the adapters properly in place, the installer must spread system sand on the pipes to keep them from moving.



Figure 64. Covering the AES pipes

- First, add system sand over the couplings to stabilize the rows.
- Next, progressively add system sand along the length of the pipes up to their mid height.
- Push down the system sand by walking on both sides of the Advanced Enviro-Septic pipes to fill gaps which may have been created under the pipes.



Figure 65. Filling the void around the Advanced Enviro-Septic pipes

- Completely cover the pipes with system sand and add an extra layer of a minimum of 100 mm on top of the pipes.

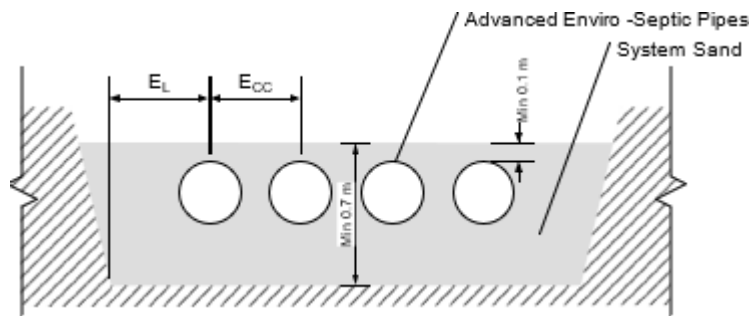


Figure 66. Layer of system sand on top of the AES pipes

Section M.3. Adapters

To put adapters in place, the installer must pull back both geotextiles (the black membrane and the bio-accelerator) at the end of the pipe, insert the adapters, and place back both geotextiles over the adapters.

A Piezovent is installed at the end of each row. The bell end will easily slide over the Advanced Enviro-Septic pipe. The Piezovent includes three 100 mm holes allowing for the insertion of a piezometer (top hole) and the connection to the other rows (side holes).



Figure 67. Piezovent

For the adapter at the beginning of each row, refer to the appropriate subsection below.

Gravity-fed Standard Configuration

This subsection applies for every system using a D-box as a distribution device.

Offset Adapters are used to connect the PVC pipe coming from the D-box to the Advanced Enviro-Septic pipes for both air and wastewater. An Offset Adapter must be installed at the beginning of each row.

- Make sure to push the adapter in place so that the locking tabs located on the inside of the adapter locks into the corrugations of the Enviro-Septic pipe.
- The opening must be placed at the top position to facilitate the passage of air at all times.



Figure 68. Installation of the Single Offset Adapter

Low-pressure Standard Configuration

This subsection applies for systems using a LPDS (such as the Inject O)).

The Inject O)) is a low-pressure distribution system build inside a Piezovent. It is installed the same way as a Piezovent.

Nested pipe Configuration

This subsection applies for Nested pipe configurations.

A Nested pipe configuration requires adapters similar to a gravity-fed Standard configuration but containing an additional smaller opening at its lower point. It is installed the same way as a one-hole adapter (see subsection above).

The distribution device (Section N.3.) must be installed simultaneously to the adapters for Nested pipe configurations.

Section M.4. Plumbing components

Piezometers

The piezometer is made of PVC pipe 100 mm in diameter. It needs to be as long as needed in order to be above the final fill or embankment (usually around 35 cm / 14 inches).

It is inserted directly in the upper opening of the Piezovent.

Add a green cap part of the System O)) kit on the extremity of each piezometer.

Vent

Each Piezovent need to be connected one to another by their side-holes with 100 mm PVC pipes.

There are two options to install the entry vent:

- Option 1: between two rows
- Option 2: at either extremity of an extremity row

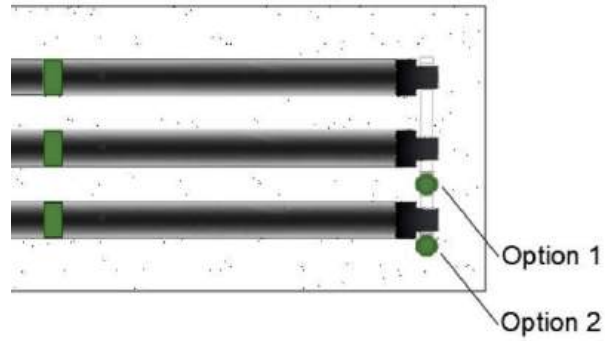


Figure 69. Options to install the entry vent

Figure 70 shows an example with 4 piezovents connected together, each with a piezometer, and a part of the vent at the left side extremity (Option 2).



Figure 70. Entry vent on an extremity row

Make sure that there is a continuous air circulation between the entry vent located downstream of the System O)) and the exit vent of the residence's plumbing located on the roof. If not possible, a differential vent should be installed at the other end of the System O)).

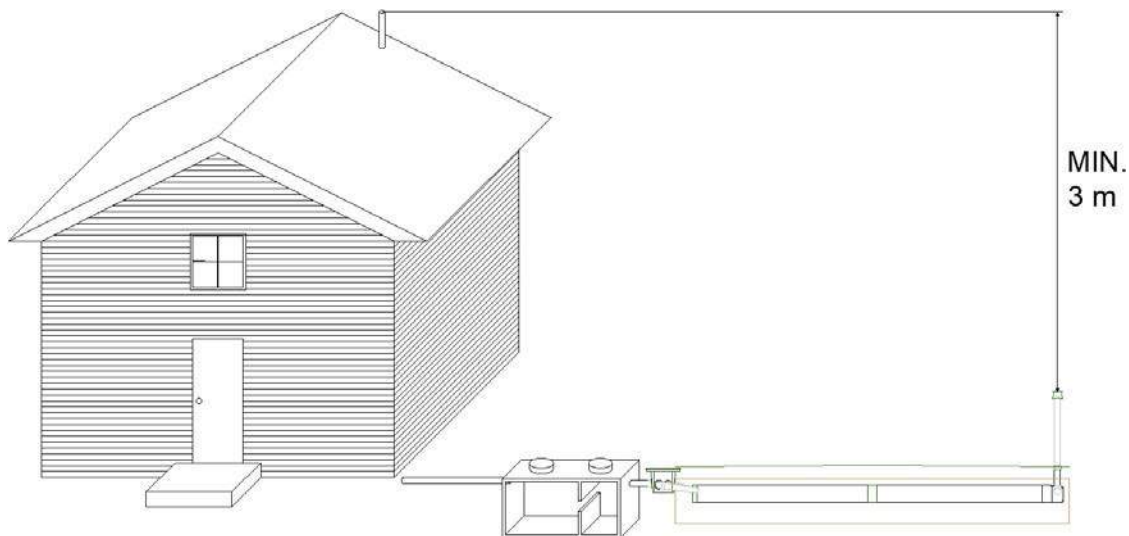


Figure 71. Minimum height difference between the two vents

There must always be a height difference of 3 m between the two vents.

Pump chamber Systems:

When using a pump chamber, the natural air circuit going from the System O)) to the septic tank to the house vent is disrupted. To ensure a functioning air circuit, all pumped System O)) must use a derivation air pipe or have a differential vent as an exit vent.

- Derivation air pipe: install a bypass pipe connecting the pump station to the System O)) header manifold using a 100 mm PVC pipe. Make sure to construct the bypass pipe with a high point in such a manner that only air but not water can travel back to the pump station.
- Differential vent: install a second vent located on the distribution box or on supply-side vent circuit. The 3 m difference between the entry and exit vents is still required.

Section M.5. Distribution Device

Refer to Section N. depending on the configuration (Standard by gravity, Standard pumped or Nested pipe)

Section M.6. Final Backfill and Grading

Cover the Advanced Enviro-Septic pipes with a minimum of 300 mm (maximum 600 mm) of backfill permeable to air with no silt or impermeable soil.

Of this 300 mm, the first 100 mm on top of the pipes must be system sand.

The top soil is to be permeable top soil according to the OBC requirements.

When part of the system is above ground, put the lateral embankment at the required slope as indicated in the plan.

Leave a slight slope on top of the bed. The final grade must permit rainwater to flow toward the exterior perimeter of the system.

Erosion Control

Protect the top of the bed by creating a slight slope to permit water runoff. Plant grassy vegetation to prevent erosion.

Section N. Distribution Device Installation

Section N.1. D-Box Installation

The majority of Standard System O)) use a D-Box as a method of distributing the wastewater between the rows of pipes. The steps to install the distribution box are as follow:

- Create a stable horizontal base of compacted sand.
- Place the distribution box level on the sand surface.
- Correctly place the distribution box keeping in mind that the entry hole is higher than the exit holes. Whenever possible, make sure that the cover will be accessible from the surface for inspection purposes. Use a riser if needed.
- Keep a 1% slope between the exit hole of the septic tank and the entry hole of the distribution box.
- Cut out the plastic of the openings of the distribution box to be used according to the number of distribution pipes to be installed:
 - Cut part of the diameter of the opening with a knife.
 - Gently pull out the remaining part of the circle.
 - Do not try to push in the rubber circle as it may damage the gasket.
 - Repeat these steps for each opening to be used.
- Insert the 100 mm PVC pipes into the distribution box :
 - Insert the pipe approximately 25 mm into the distribution box
 - Twist the pipe to insert it easily
 - Insert the inlet pipe a little further and add a vertical tee in the centre position.



Figure 72. Distribution box

Installation and Balancing of Distribution Box Equalizers™

Equalizers™ are inserted into each of the 100 mm PVC pipes exiting the D-Box. They are used to improve the D-Box performance by equalizing the flow to each of the Enviro-Septic Pipes.

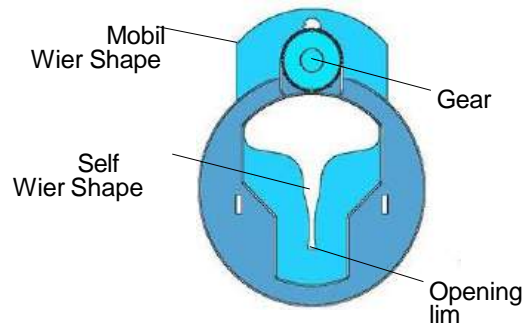


Figure 73. Equalizer

The Equalizers must be installed and adjusted as follows:

1. Insert one Equalizer unit into each D-Box outlet pipe with the adjustment knob positioned on top.
2. Rotate all adjustment knobs clockwise to the full UP position.
3. Add water into the D-Box until reaching the weir openings of the Equalizers. Using the water as a level, observe which outlet sits lowest in the D-Box and do not adjust the Equalizer fitted to that outlet. Rotate all remaining Equalizer knobs counter-clockwise, moving the weir plate DOWN to match the level of the lowest Equalizer and the water line. Fine tune by slowly adding water to make sure all weir opening outlets are at the same level.

CAUTION: If a D-Box is out of level more than 9.5 mm (3/8”), re-level the D-Box and start again.

Feed, Distribution and Aeration Pipes

Use 100 mm PVC water tight pipes. Place the bell opening of the pipes in the direction of the slope.

Insert the 100 mm PVC pipes into the Advanced Enviro-Septic pipes. Use a minimum of 200 mm of pipe between the extremity of the Advanced Enviro-Septic pipe and the elbow or T of the header manifold.



Figure 74. Inlet Pipe sloped toward Advanced Enviro-Septic

- Keep a minimum of 1% slope between the distribution box and the opening of the single offset adapter.
- If the slope is steep, make sure the water will be slowed down before entering the pipe to avoid too much movement at the beginning of the row.

- Where frost is a concern, add insulation around the D-Box and over the feeding pipes as shown on the following figure.



Figure 75. Insulation around a distribution box

Pumping Station (optional)

If a pump station is required, it must be installed according to the manufacturer’s recommendations. The installer must be careful to follow the designer’s specifications when programming the pump cycles. The parameters to consider are:

- Minimum and Maximum volume per cycle.
- Maximum flow of the pump

Velocity Reducer

If a pump station is required to send the wastewater up to the D-Box, a velocity reducer must be used to slow down the flow and encourage an even distribution of wastewater through the equalizers. Install this device according to the plans, upstream from the D-Box.

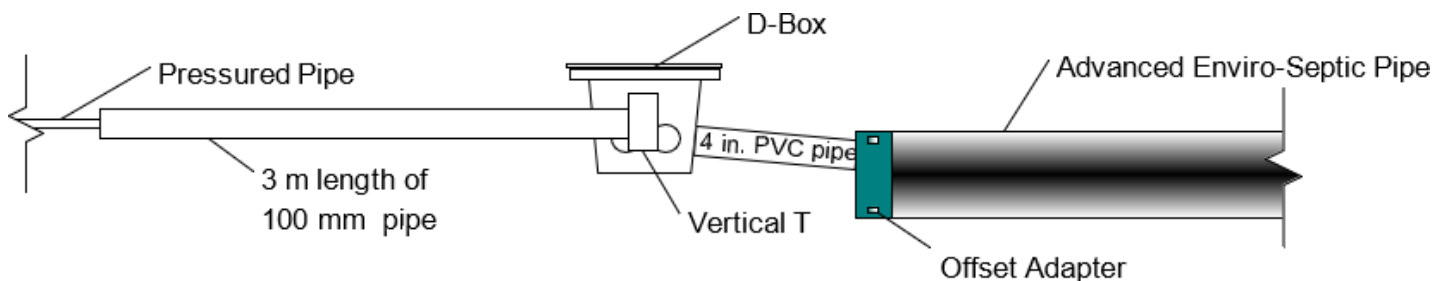


Figure 76. Velocity reducer

Section N.2. Low-Pressure Distribution System / Inject O)) Installation

An Inject O)) consists of a piezvent containing a perforated vertical pipe that creates a flow restriction, allowing a homogenous distribution between each row. Each Inject O)) comes with a 100 mm chimney and an insulated cap.

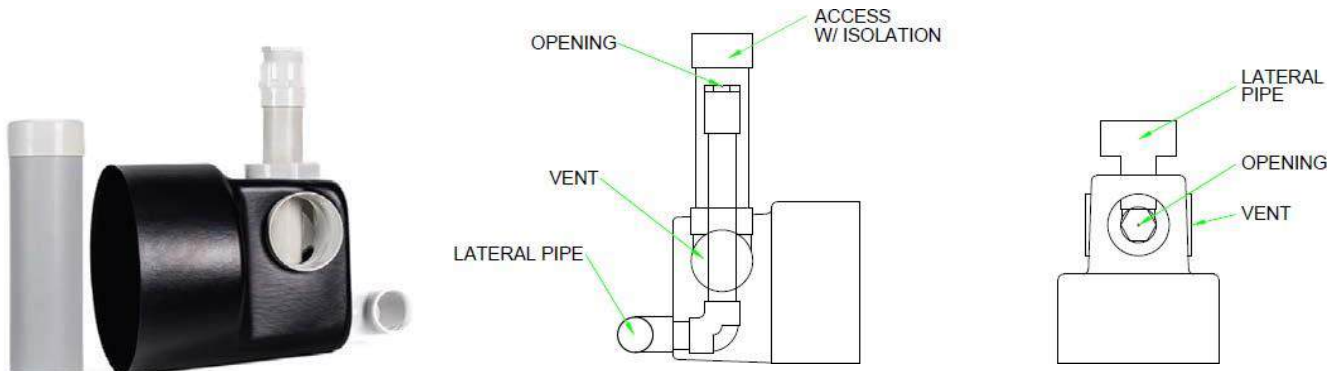


Figure 77. Inject O))

The Inject O)) is installed the same way as a Piezovent. A 100 mm PVC pipe must connect all rows to ensure a homogenous venting between each row. This circuit must continue as an air derivation pipe or be connected to a differential vent.

Each Inject O)) are also connected by a 50 mm (2'') PVC pipe, creating the low-pressure distribution (or lateral) circuit. This circuit ends on one side with a coupling used to connect the force main coming from the pump chamber, and on the other side with a capped purge. This purge acts as a clean out and should be accessible above ground.

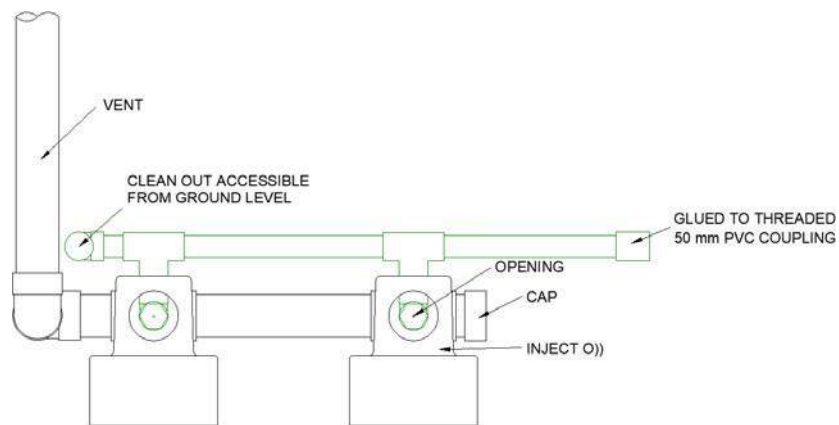


Figure 78. Inject O))

Section N.3. Nested Pipe Installation

A Nested pipe configuration kit comes with multiple pressurized pipe components (Green PVC, 38 mm).

	Component	Quantity
A	Perforated Nested Pipes	One per AES pipe
B	Supply-side purge	One per system
C	Force main connecting kit	One per system
D	Row entry	One per row
E	Row purge	One per row
F	Centre-to-centre	Number of row minus 1

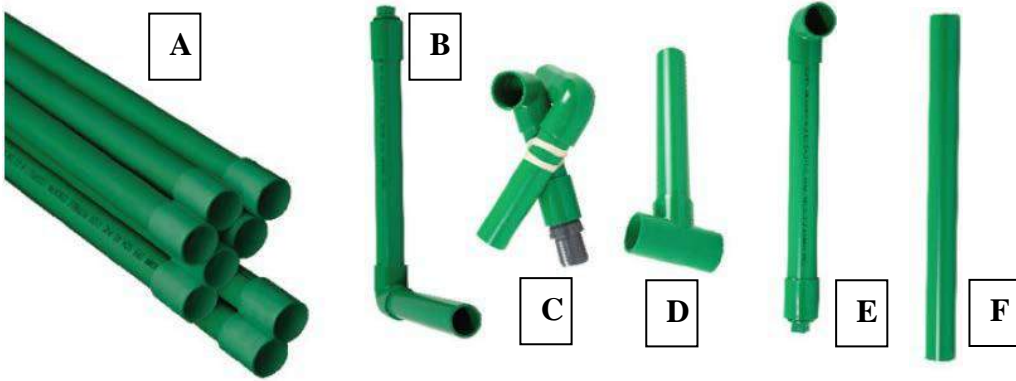


Figure 79. Distribution Device - Nested Pipe Configuration

The Nested pipe components are installed simultaneously with the adapters.

Installation sequence

It is extremely important to glue every component together with PVC glue.

1. For each row, glue together the appropriate amount of perforated nested pipes (one nested pipe per AES pipe)

Note: The last perforated pipe of each row must have their openings facing down. The other openings must face up.



2. Slide the joined nested pipes inside the row of AES pipes



3. From the supply side, pass the Row entry (D) through the small hole of the 2-hole adapter

4. Glue the Row entry (D) to the perforated pipe, while making sure the openings are facing down.
5. Insert the 2-hole adapter on the AES pipe.



6. From the end side, insert the piezovent while simultaneously gluing the Row purge (E) to the end of the perforated pipe. The Row purge should pass through the top hole of the piezovent.



7. From each side, connect each row together:
 - a. Supply side: Use the Centre-to-centre components (F) for the low-pressure circuit and 100 mm PVC pipes for the air circuit
 - b. End side: Use 100 mm PVC pipes for the air circuit



8. Add the piezometers over each Piezovent

9. From the supply side, connect the Supply-side purge (B) and the Force main connecting kit (C) to the low-pressure circuit.



To complete the installation, do not forget to:

1. Connect the Force main connecting kit (C) to the force main
2. Complete the air circuit
 - a. Short entry vent at the end side
 - b. Air deviation circuit or differential vent at the supply side

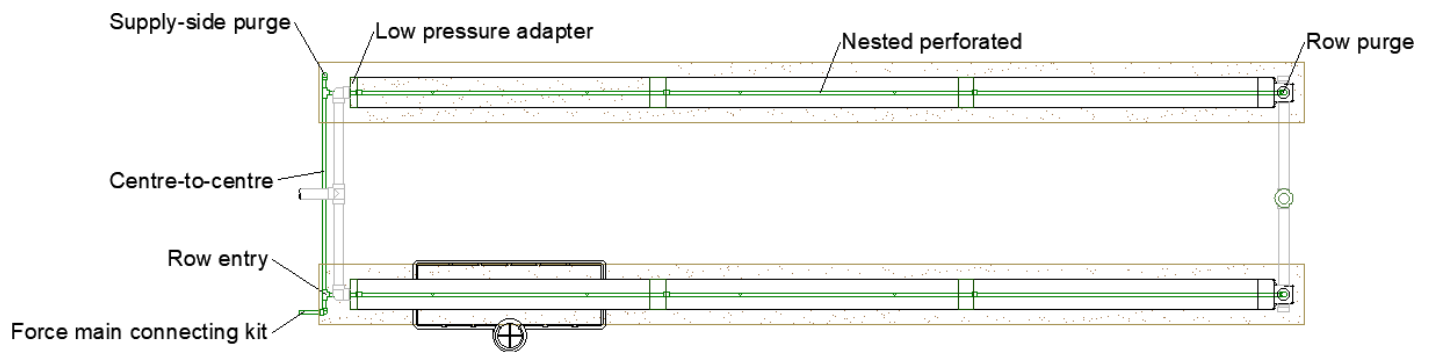


Figure 80. Components – Top view Nested pipe configuration

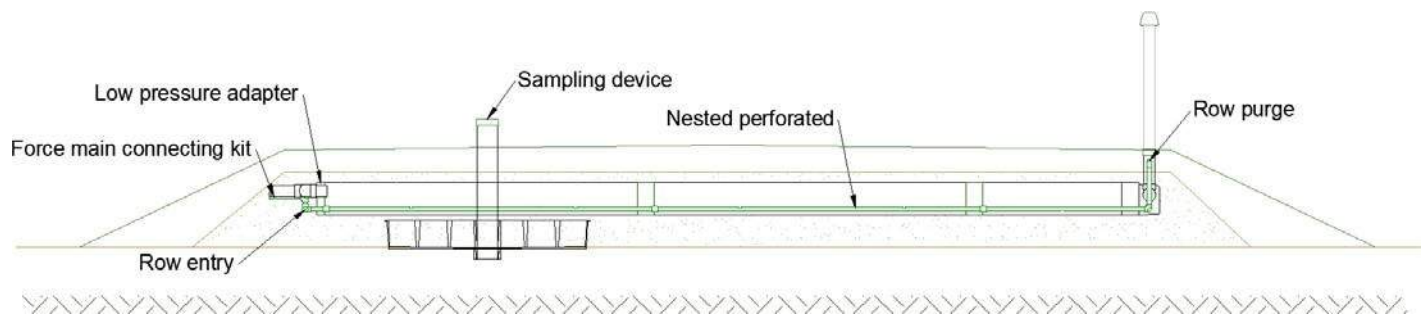


Figure 81. Components – Side view Nested pipe configuration

Section O. Completing the Installation

Starting the System

Be sure that all the installation steps have been followed to the satisfaction of the designer or engineer in accordance with the BMEC authorization, the OBC regulation and this installation manual.

Visualize the aeration circuit to be sure that it is continuous between the entry vent located at the end of the Advanced Enviro-Septic pipes and the exit vent (min 3 m higher) generally located on the roof of the residence or building.

Where required, connect the electricity to the pump station in accordance with the requirements of the Electrical Safety Authority (ESA) and make sure it is running properly according to manufacturer's directions. For the Nested Pipe configuration, ensure the pump dosing timers have been programmed to dose the daily flow, over a 24 hour period.

The system is now ready to be used!

Leaving the Site

If the finished grade or landscaping is to be done by others, upon leaving the site, place a stake or several stakes as needed, that mark the finished grade. Also leave a note to explain that vehicular traffic is not allowed on the system.

Inspection Agreement

The homeowner must be aware that according to section 8.9.2.3. of the OBC there must be a service inspection agreement between the homeowner and a service provider. The inspection agreement must be signed in triplicate by both the homeowner and Make-Way Environmental Technologies. A signed copy of the agreement must be filed with Regulator, Make-Way Environmental technologies and the homeowner must also keep a copy of file.