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Gravity Systems 101

By Jim Anderson, NAWT, *reprinted with permission*

Question:

How is effluent moved between trenches by gravity?

Answer:

This question comes from an installer who said, "I am used to using a distribution box to deliver septic effluent by gravity to a series of trenches. I have been told this method is superior to others, what do you think?"

In my travels to different parts of the country conducting workshops, I've realized gravity distribution is not just the simplest and least expensive way of distributing sewage effluent to the soil for treatment, but it remains the most common. This is the case despite the proliferation over the last decade of low-pressure pipe distribution and drip irrigation systems. This is a topic that has been discussed in the Answer Man column a number of times; but the question continues to be asked, so I'll offer my take on the subject.

Gravity distribution is used where soils are generally viewed as good for treatment of septic tank effluent after development of the biomat at the trench infiltrative surface. These sites have deep, well-drained soils with adequate separation between the bottom of the trench and any limiting condition, such as bedrock, dense soil horizons or presence of saturated soil conditions.

The purpose of gravity distribution is to accept, store and distribute effluent to be dispersed and treated. The main method for this distribution today is a series of trenches as opposed to beds. Jurisdictional codes treat the definition of trenches and beds somewhat differently, but generally trenches are 1 to 3 feet wide and beds wider usually with a width limitation placed in code: often 10 to 20 feet and a required increase in bottom area to account for the lack of sidewall area. These requirements recognize that use of gravity distribution in trenches is hydraulically superior to that in beds.

For soil treatment areas with multiple trenches, there are three recognized configurations: serial, parallel and sequential.

Serial distribution

In serial distribution, effluent flows into the first trench in series and then follows a continuous flow path through the series of trenches. Serial systems often use drop boxes at the head and end of the trenches in series to move effluent down-slope and through the series. In some locations, piping configurations using elbows and tees move the effluent between trenches.

There are several disadvantages to this configuration, leading many permitting agencies to ban the use of serial distribution. Using the continuous serpentine pattern means every drop of effluent has to pass through the first trenches in series. This sets up the potential to overload those areas of the system, develop more resistant biomats and reduce the long-term acceptance rate of the soil in those trenches.

This configuration also does not allow for resting parts of the system. There is no practical way to isolate a single trench or two if they become plugged due to excess solids or excessive biomat development. In areas where relief devices other than drop boxes are used or if extreme care is not taken by the installer on sloping sites, the location of the relief devices become wet areas in the yard as effluent comes to the surface.

Parallel distribution

Design of parallel distribution systems assumes effluent is delivered simultaneously and equally to the series of trenches through

a distribution box or a header pipe. This means all of the trenches must be able to accept equal volumes. The distribution box has the inlet pipe at the highest elevation and the outlet pipes at an identical lower elevation.

Since in practice it is impossible for equal amounts of effluent to flow evenly from the outlets – not to mention soil variability almost always means the trenches will not accept equal volumes of effluent – installers use devices that will deliver effluent to the trenches in sequence.

This means levelers or pipe caps with holes are used to direct the effluent into the first trench – where the biomat develops until ponding occurs – and the effluent backs up into the supply pipe to the distribution box and then out to the next lowest trench in sequence. This is why distribution boxes should only be used on level sites where effluent can back up into the box. In cold climates, freezing can occur so we discourage the use of distribution boxes.

Sequential distribution

Our preferred method for distribution is sequential, which uses a series of drop boxes at the head of trenches to move effluent between trenches. Effluent flows to the first trench until the biomat develops. Ponding occurs to the level in the drop box that allows the effluent to move to the next trench. Once the first trench is ponded, it will only accept the amount of effluent that the long-term acceptance rate through the biomat will allow.

The rest of the effluent is delivered to the lower trenches. This is one of the significant differences between sequential and serial distribution. The trench only sees the effluent it can properly treat. If there is a need to rest this part of the system, this is easily accomplished by capping the outlet pipe to the trench in the drop box. So this configuration lends itself to effective management.

Sequential distribution is designed ideally for sloping sites. The trenches can be of different lengths. Because they are designed to operate in sequence, they can be as long or as short as necessary to fit the limitations of the site. They will only accept the effluent they can treat. This configuration allows easy addition of trenches as long as soil conditions allow.

So the short answer to the question is: For gravity distribution on sloping sites, sequential distribution is the superior system.

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