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DISTRIBUTION OF EFFLUENT

Distribution

Distribution is defined as the process of conveying wastewater or effluent to one or more components or devices (CIDWT Glossary, 2009). All decentralized wastewater treatment systems (whether simple or complex) include components that distribute effluent to and among various components. The goal of distribution is to spread wastewater and effluent over space and time to allow physical, biological, and chemical treatment processes to effectively remove contaminants.

The distribution of effluent includes all the piping and distribution media through which effluent passes after it leaves the septic tank. The supply line transports sewage from the tank to the soil treatment area; the distribution system, operating under gravity or pressure, distributes the effluent into the soil. Piping is an important part of all onsite SSTSs. Both the type of system and method of application determines the necessary pipe characteristics and installation. Distribution applications can be divided into several categories, two of which are shown in Figure 11.1.

![Figure 11.1 Distribution of Effluent](image)
1. The supply pipe from the septic tank via gravity distribution to either a:
   a. Pump tank/dosing chamber
   b. Pretreatment device for secondary treatment
   c. Soil treatment system
2. The supply pipe from a pump tank to either a:
   a. Collection line to a cluster system
   b. Pretreatment system or gravity soil treatment system
   c. Pressure distribution system to another
   d. Pre-treatment device, pump tank or the distribution system for final dispersal.
3. The piping in a gravity distribution network in a trench or bed system
4. The piping in a pressure distribution network

Each application needs a specific type, size, and strength of pipe.

**Supply Pipes**

*According to MN Rules Chapter 7080.2050, Subp. 2(B), supply pipes must:*

- Be made from materials resistant to breakdown from sewage and soil
- Be watertight, including all joints
- Be durable throughout the design life
- Not deflect, buckle, crush, or longitudinally bend
- Be resistant to pressures, fatigue, and strain for the application
- Be designed, installed, and operated to minimize the danger of freezing in the pipe
- Not be closer than six inches from final grade. Pipes susceptible to freezing shall be insulated
- Be set back from water supply wells and water service pipes according to Chapter 4715

**Materials**

In the past, materials such as cast iron, clay tile, or other materials were used, but plastic is now required due to its durability, ease of handling, and economics. Now, the rules specify that the supply pipe extending from the septic tank to the undisturbed soil beyond the tank excavation must meet the strength requirements of ASTM, Schedule (Sch) 40 Pipe, contained in Standard Specification for PolyVinyl Chloride (PVC) Plastic Pipe, Sch 40, 80, and 120, ASTM D1785 (2006) (7080.2050 Subp. 2. (A)).

Ease of handling includes the ability to make watertight connections between pipe sections to reduce root intrusion or leaking.
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**Schedule 40 and ASTM 3034**

The two most common pipe grades used are Schedule 40 and ASTM 3034. These pipes have different wall thicknesses, which give them different lateral strengths. Schedule 40 has a thicker wall and is stronger than 3034. It was designed to be the plastic equivalent of cast iron pipe. This strength also makes it the required pipe to use at the inlet and outlet of the septic tank or any other span across excavated soil. ASTM 3034 pipe should only be used if it is well supported and the effluent will flow by gravity.

You may ask: If Schedule 40 plastic pipe was designed as the equivalent of cast iron pipe, why not use cast iron? Cast iron is not used because it is more difficult to connect and, more importantly, it tends to develop plugging related to a number of common detergents. Schedule 40 pipe, as shown in Figure 11.2, is required to be used in areas of non-native soil where a stronger pipe can help reduce sagging in pipes along with proper backfilling techniques.

**Existing Piping**

If existing pipe is to be used, be sure to examine the piping materials. As mentioned above, cast iron can be a problem because of reactivity with some detergents. Problems with clay and orangeburg pipes are also common, as both these materials are likely to crack, and cracking leads to troubles with roots. If there is excessive root infiltration or cracks in the piping, it is not watertight and therefore sewage is leaking out of the pipe or groundwater is leaking in. Either situation creates problems.

**Size**

In pressure applications where grinder pumps are feeding into a collection line for a cluster system, pipe one to three inches in diameter is used as the solids are ground or ejected by a pump (see Section 8 for more information on pumps), while a four inch diameter is common with gravity distribution where the solids are intact. In pressure applications, when smaller diameter pipes are used, there will be more energy lost to friction in the pipe, which requires more total dynamic head from the pump to overcome the friction loss. As shown in Figure 11.3, the length of the supply line as well as the elevation difference from the pump to the point of discharge will affect the size of pump needed.
Slope

The minimum slope for gravity supply pipes is one percent (1/8 inch per lineal foot). There is no maximum slope (7080.2050 Subp. 2 (C)). No maximum slope is required because there will not be any large solids to transport, while the minimum slope is there to assure that effluent travels through the pipe at an appropriate velocity and does not freeze. For pressure systems, a minimum slope of one percent is required for drainback and other frost protection measures must be employed. Pipe restraints must be used for slopes greater than 20 percent or where fluid velocities in the pipe exceed 15 feet per second. Thrust forces in pressurized pipelines should be restrained or anchored to prevent excessive movement and joint separation under all projected conditions. Common methods include thrust blocking and various types of restrained joints as shown in Figure 11.4.

In a theoretical continuous straight run of pipe, the forces at one joint are balanced by the equal and opposite forces at the adjacent joints. No restraint is necessary. When a bend, tee, reducer, valve, or other flow-altering fitting is introduced, the forces no longer balance each other. The hydrostatic forces created at the joints on both ends of the fitting combine to form a single reaction. This reaction is the resultant thrust force, which is the force attempting to move the fitting away from the bend and its attached piping. This is the force to be restrained.

The typical acceptable method of restraint for PVC would be Uni-flange or Mega-lug type restraints. All restraint devices must have a water working pressure rating equivalent to the full rated pressure of the pipe on which they are installed, with a minimum 2:1 safety factor in any nominal pipe size. Restraining devices should provide full (360 degree) support around the circumference of the pipe. See the 2007 ASTM Standard F1674, “Standard Test Method for Joint Restraint Products for Use with PVC Pipe,” for more information.

Installation

By following three simple rules, excavation problems with supply pipes can be avoided:

Rule 1: Avoid over-excavating the trenches when possible. If effluent is to flow properly, the pipe must be supported. Unsupported pipe can lead to clogging and freezing problems. Minimizing unexcavated soil under the pipe reduces the potential for low spots developing where water can collect.

In general, natural soil provides a solid base (unless you work in organic or peat soils). If the trench is over-excavated, the soil will need to be compacted before the pipe is put
into place. When placing pipe in organic soils, remove the original organic material and replace it with a solid material or aggregate. Organic soils—peat and muck—do not provide a solid base, and settling and heaving are likely to take place. This movement puts pressure and stress on the pipe and will cause leaks at the joints. More importantly, the pipe will not maintain the proper pipe slope. See Section 7 for installation of septic tanks in these situations.

Rule 2: Support the pipe over deep excavations. If you removed material, like organic soil, or if you installed a septic tank and the piping going in and out of the structure, the pipe will be at least partially on fill, and this material can settle. To minimize problems, use a granular fill material and compact it as the material is installed. Sand or pea rock is most typically used as fill. If rock is used, silting into the rock is a form of settling that can cause an aesthetic problem. Rock can also create a drain system that channels groundwater into septic tanks. Soil which is in large clumps does not make for a stable base which will support the pipe.

Another aspect of support in these situations is the pipe material choice. Using a heavier pipe such as Sch 40 helps minimize sagging but does not remove the requirement of proper backfilling. In pressure supply pipes where two-inch pipe is used, the two-inch pipe can be placed inside a four-inch pipe, adding strength and decreasing the potential for bows as shown in Figure 11.5. Be sure that the four-inch pipe is sealed to avoid having the pipe fill with soil or groundwater.

Rule 3: Backfill with good material. The backfill material has two functions: protecting the pipe system and maintaining the slope. Protection means the pipe is surrounded by and covered with the backfill material, providing some protection from freezing.
For this to be true, the backfill must surround the pipe. The strength of the pipe is related to its round shape. If the shape is deformed, the strength is reduced, which can lead to failure. The minimum total burial depth is six inches. To minimize the weight of the cover and the potential for collapse, apply granular backfill at least to the midway point of the pipe. Plastic pipe needs to be covered to protect it from UV rays and other surface activities that can cause failure. Lawn mowing and traffic over excavations can break and crack the pipe. The potential for these problems can be minimized by a backfill system that properly supports the pipe. Avoid using large stones, as these also can damage the pipe during backfilling. Large rocks should not be returned to the trench in contact with the piping. In heavier clay soils, dry soil clods can act like rocks, so do not use them to backfill the excavation. A granular material in contact with the pipe will minimize the impact of soil clods.

During septic system installations it is important to assure the sewer line and supply do not leak if they are within 20-50 feet of the well or water line as shown in Figure 11.6. This requires a pressure test, which must be done after the pipe is installed but before the piping has been backfilled. This simplifies any required repairs, but also means an installer needs to be careful backfilling the trench to avoid any breaks. A pressure test is conducted by plugging the pipe at both ends and adding compressed air for a period of time. It is important to have a method of adding air and measuring the pressure in the pipe. Air pressure is raised to a set level, typically three to five pounds. The pipe then should hold this pressure for an extended period, typically five to ten minutes. In MN Rule 4715.2820, Subp. 2 on the pressure testing requirements are 5 pounds for 15 minutes. If the pipe and joints can hold this pressure, it is considered watertight. When the Installer is performing the pressure test they must fill out the required air test paperwork. This form can be found at septic.umn.edu/ssts-professionals/forms-worksheets.

**Freeze Protection**

Supply pipes must be designed, installed, and protected so that they are not closer than six inches from final grade and so that effluent will not freeze in the pipe. According to 7080.2050 Subp. 2(B) 8, pipes susceptible to freezing shall be insulated. In cold-weather areas, pipes installed with minimal cover (fewer than one to two feet), or in areas with compacted soil or lack of snow cover such as driveways, must be protected from freezing. In city sewer systems, this protection is often achieved by ensuring that the pipe is installed deep (six to eight feet) underground, but in onsite systems this depth is not typically achievable.

If the bury depth is shallow (fewer than one to two feet), the pipe is minimally sloped for drainage, or if the pipe is under a driveway or sidewalk, it should be insulated. There
are two methods of insulation: 1. pipe with insulation already attached (Figure 11.7) or 2. install foam sheets over the pipe (Figure 11.8). Make sure you choose insulation rated for use underground. Fiberglass battings are not designed for such applications. Another critical issue for freeze protection is that the supply pipe must drain after the pump shuts off. This is typically done through a weep hole in the pump tank.

**Cleaning, Priming, and Gluing Joints**

Upon installation, the pipe must be clean and clear of debris and PVC cuttings. During construction, protect the ends of the pipe to keep dirt and rodents out. All pipes and fittings must be properly joined together with primer and glue, which is discussed in more detail in Section 6.

**Cleanout Requirements and Maintenance**

7080.2050 Subp. 2 (D) requires access to each supply pipe must be provided for cleanout. The cleanout point must be accessible from the final grade. Installing a cleanout at the wall outside the home or business is a good idea should the system ever need to be jetted or cleaned. This cleanout allows all work to be done outside, so any mess stays outside. Inside the home, there is potential for the cleanout to be hidden and the possibility of a major spill.

Maintenance of the sewer should be a design and installation consideration. As the pipe is installed close to structures or decks, it becomes more difficult to maintain the proper slopes and to make good connections. The need to clean and replace pipe is the reason for specifying setback requirements from structures. Typically, ten to twelve feet will allow for the excavator to work on the piping around the structure. Decks present bigger problems because they are often built after the pipe is installed. The pipe can
be crushed or broken during installation of the deck footings. Installers must work with homeowners so that they understand the importance of avoiding the pipes and planning for access in case future repairs are needed.

Gravity Distribution
Flow to gravity distribution systems is directly related to use at the source: effluent from the septic tank flows to the soil treatment area (STA) whenever sewage enters the septic tank. In pressure-dosed gravity distribution, wastewater flows out of the septic tank into a dosing tank and is stored before being intermittently applied to the STA in demand- or timed-doses of equal volume. Pressure-dosed gravity distribution adds a “dose and rest” regime that spreads the effluent out over time relative to conventional gravity distribution but not necessarily over space; effluent is still applied to the beginning of the trench or bed and subsequently flows by gravity within it. Regardless of the trench media, the effluent moves rapidly to the soil infiltrative surface in a localized area at the beginning of the trench.

Gravity distribution of septic tank effluent has been the most common design over the history of onsite treatment in Minnesota. Less expensive to install and maintain than systems in which effluent is pumped, gravity distribution systems take advantage of natural elevation differences. Effluent flows down from its sources to the septic tank, then on to the soil treatment system in either serial or parallel distribution (discussed below).

Today, gravity distribution systems for conveying septic tank effluent are used in two types of systems: either trench and seepage bed systems. Trenches are narrow (less than or equal to three feet wide), long (typically greater than 25 feet), level ditches dug in soil of suitable texture, filled with distribution media, covered with a fairly shallow (maximum allowable depth of four feet to the bottom of the media) layer of topsoil, and planted/seeded with a dense vegetative cover. Seepage beds are basically wide (greater than three to 25 feet) trenches. The rate at which sewage is generated and the rate at which soil will absorb effluent will vary throughout the year. A change in the number of people using a system will affect the daily sewage flow. High soil moisture conditions will decrease the rate at which the soil will absorb effluent, while hot, dry weather will increase the ability of the soil to accept effluent. Less trench bottom area may be required during warmer, drier months than during winter when evapotranspiration is negligible. Thus, the trench bottom area not being used will automatically rest and dry out. This resting and drying will increase the soil’s ability to absorb effluent over time.

Rule Requirements, Definition and Description
There are several types of gravity distribution devices that receive and transfer effluent from the supply pipes to distribution pipes or down slope components (Chapter 7080.1100, Subp, 21): drop boxes, distribution boxes, valve boxes, and manifolds. The primary purpose of flow distribution devices is to control the flow of the effluent into the drainfield.

Some site conditions require a pump to deliver the effluent to the distribution device as shown in Figure 11.9. In these instances, the pump discharge must be directed into the distribution device against a wall, the side of the box on which there is no outlet, or against a deflection wall, baffle, or other energy dissipater. The pump must discharge at a rate at least ten times greater than the water supply flow rate but no
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faster than the rate at which effluent will flow out of the distribution device. The distribution device must be placed on firm and settled soil and covered by a minimum of six inches of soil. If the top of the device is deeper than six inches, access must be provided within six inches. The type of distribution device used depends on whether effluent is distributed by serial or parallel distribution.

Serial Distribution
In MN Rules Chapter 7080.1100, Subp. 71, serial distribution is defined as the distribution of septic tank effluent by gravity flow that progressively loads one section of a soil treatment and dispersal system to a predetermined level before overflowing to the succeeding section and does not place a dynamic head on the lower section of the soil treatment and dispersal system. The distribution media may function as a conveyance medium to the next section (see “Continual Distribution Systems,” below).

According to 7080.2050, Subp. 3(A) serial distribution must be used to distribute effluent to individual trenches in a soil treatment and dispersal system. If the necessary elevation differences between trenches for serial distribution cannot be achieved by natural topography or by varying the excavation depths, parallel distribution may be used. Serial distribution must not create a pressure head on trenches at lower elevations.

Application
Serial distribution are highly recommended to be used in gravity flow trenches whenever possible as it encourages biomat formation and unsaturated flow.

Drop Boxes
Drop boxes are used to achieve serial distribution. A drop box is a distribution device used for the serial gravity application of sewage tank effluent to a soil dispersal system (Chapter 7080.1100, Subp. 24).

With drop box distribution, septic tank effluent flows into the first trench until effluent has ponded and the trench reaches capacity. Then, the effluent flows into the second trench until it, too, reaches capacity, then into the third. The first trench should be at capacity before effluent is delivered to the second trench. Figure 11.10 shows the layout of a SSTS using drop box distribution. Effluent flows through a watertight pipe from the septic tank to the first drop box. An outlet, near the bottom of the drop box, connects to the distribution pipe of the trench. Another outlet near the top of the drop box connects to a watertight pipe leading to the drop box of the lower trench.

Aside from the order in which effluent reaches them, the trenches function independently, each receiving effluent at the rate it is accepted in that trench. If one is draining more slowly than the others, perhaps because it is located in less permeable soil, it will accept less effluent. If one tends to drain quickly, perhaps because it receives more sunlight on the surface and more water is lost through evaporation in the

FIGURE 11.9  Pressurized Delivery to a Drop Box

From septic tank
Inspection pipe
Outlet to trenches
To next drop box
warmer months, it will receive more effluent. Since the trenches are not directly connected, there is no hydraulic head from trench to trench - effluent does not move more quickly into or through the second or third trenches because they are downhill from the first one.

Drop boxes are most suitable for sloping sites as shown in Figures 11.10 and 11.11, but can be used on level sites by positioning the downstream boxes two inches lower than the up slope unit, as shown in Figure 11.13. The first inch is for the elevation difference between the inlet pipe and the supply pipe to the next drop box, and the second inch is for the slope of the supply pipe to the next drop box. Effluent flows through a watertight pipe from the septic tank to the first drop box, where all the effluent enters the first trench. Outlets near the bottom of the drop box connect to the distribution pipe of the trenches as shown in Figure 11.12. Another outlet near the top of the drop box connects to a watertight pipe leading to the drop box of the next trench. When a trench will no longer accept the effluent, the liquid level increases in the drop box and flows to the second drop box where the effluent enters the second trench. When the first and second trenches cannot handle the flow, the effluent enters the third drop box/trench.
The drop box distribution system allows for flexibility. If additional soil treatment system capacity becomes necessary, or if one of the trenches clog, additional trenches can be added, assuming there are suitable soils and space on the lot. This system can also be constructed on steeper slopes than can other distribution methods. Although use of very steep slopes may be impractical because construction machinery cannot safely be operated on steep hills, the serial distribution system itself has no maximum slope limits. This site flexibility may allow these systems to be constructed on the most suitable soils on a lot, or at an ideal distance from other improvements, such as wells, driveways, or surface water bodies. As shown in Figure 11.13, a watertight pipe is connected to the last drop box of the existing system, and additional drop boxes and trenches can be added without disturbing the existing SSTS. Each trench can be any length to accommodate structures and trees as long as the total trench length is adequate for the wastewater source and site conditions, as shown in Figure 11.14.

Features of drop box distribution:

- No slope maximum
- No need for even lengths of trenches (See Figure 11.14)
- Flexibility to construct and connect new trenches as needed
- Quick inspection at the box and ends of the trenches
- No standing effluent in solid pipe between septic tank and drop boxes

See Figures 11.13 and 11.14 on the next page.
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FIGURE 11.13 Drop Boxes and Piping

- Finished grade
- Soil
- Building Sewer
  - 4” diameter - Watertight
  - Min. grade 1” in 8’
  - Max grade 1” in 4’
- Outlet Sewer
  - 4” diameter - Watertight
  - Sch. 40 across the excavation
  - Min. grade 1” in 8’

FIGURE 11.14 Trench Lengths May Vary

Additional trenches can be easily added.
According to Chapter 7080.2050 Subp. 3 (B), when drop boxes are used for serial distribution, the drop box must meet the requirement in Table 11.1.

**TABLE 11.1 Drop Box Specs**

<table>
<thead>
<tr>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The drop box must be watertight and constructed of durable materials not subject to corrosion or decay.</td>
</tr>
<tr>
<td>2. Drop boxes must have an invert of the inlet supply pipe at least one inch higher than the invert of the outlet supply pipe to the next drop box.</td>
</tr>
<tr>
<td>3. Drop boxes must have an invert of the outlet supply pipe to the next drop box no greater than two inches higher than the crown of the distribution pipe serving the trench in which the box is located.</td>
</tr>
<tr>
<td>4. When sewage tank effluent is delivered to the drop box by a pump, the pump discharge must be directed against a wall or side of the box on which there is no outlet or directed against a deflection wall, baffle, or other energy dissipater. The discharge rate into the drop box must not result in surfacing of sewage from the drop box. The supply pipe must drain after the pump shuts off.</td>
</tr>
<tr>
<td>5. The drop box must be covered by a minimum of six inches of soil. If the top of the box is deeper than six inches, access must be provided above, at, or within six inches of finished grade.</td>
</tr>
<tr>
<td>6. The drop box must be placed on firm and settled soil.</td>
</tr>
</tbody>
</table>

A detailed view of the drop box is shown in Figure 11.11 on page 10. A drop box should be installed in each trench. In addition to providing for loading of the soil treatment area, drop boxes also allow inspection of the system. Drop boxes may be constructed of concrete, fiberglass, or polyethylene. For installations where the drop box will have minimal soil cover (less than 1 foot), the installer should consider insulating the box. Drop box strength is a factor to consider when backfilling the SSTS.

The liquid level in a trench is established by the elevation of the supply line pipe leading to the next drop box. If the elevation of the bottom of the supply pipe is approximately equal with the top of the rock in the trench, this will achieve a liquid level that will maximize the trench sidewall, develop the maximum hydraulic head on the bottom of the trench, and maximize the potential for evapotranspiration during warmer months. When the first trench is accepting effluent at its long-term acceptance rate, any additional effluent will flow to the drop box of the second trench. Only the portion of the soil treatment unit required to treat the effluent is used.

**Management of systems with drop boxes**

Drop boxes can be managed by the homeowner or an onsite professional. To rest the system, after a year or more of use, plug or cap the outlet pipe from the first box, or place an elbow on the outlet pipe. The effluent will then flow into the second drop box, by passing the first trench. The first trench will rest; the infiltrative surface may assist with the recovery of a trench segment if a clogging biomass has formed. The following year, after the first trench has been rested, the second trench can be rested. The first one may be reinstated or allowed to rest depending on the number of unused trenches. In a 2004 study by Owens et al., ten year old trenches were rested during the summer months. Following these rest periods, the effluent absorption rates increased 70-280%. These results indicate that resting improves the hydraulic function of soil treatment systems.

The drop box provides a convenient point at which to inspect the soil treatment unit. The drop box inspection pipe can be installed at the ground surface or covered with a few inches of soil to prevent it being hit by a lawn mower. Opening and inspecting the drop boxes will show if a trench is being used. By evaluating the inspection port at the end of the trench, it can be determined how much of the drainfield trench system is being used.
**SECTION 11: Distribution of Effluent**

**No drop box**
Serial distribution can be achieved without the use of drop boxes, but it is more challenging because management and expansion is more difficult. In serial distribution systems without drop boxes, the pipe from trench to trench is often dropped, with a 90° elbow or a T, into the top of the media, such as a chamber, with an outlet pipe at a higher elevation in the media.

**Continual Distribution**
In continual distribution (also known as “in-line distribution”), trenches are connected so that all effluent passes through the first trench on its way to the second, which it passes through on its way to the third as shown in Figure 11.15. This means that the first trench in the series will see all of the effluent unless another distribution/management option exists.

Effluent entering the second or third trench may have had some solids removed by passing through the length of the previous trench. High levels of organic matter or suspended solids tend not to reach the last trench. The biomat at this end of the system is expected to be a thinner layer, since there is little in the effluent for the bacteria to consume, and the effluent will drain more quickly. The soil pores at the end of the last trench will take a long time to develop a biomat. The first trench, however, is fairly likely to have problems, including:

- Soil pores becoming clogged
- The buildup of an impermeable biomat layer
- Hydraulic overload

The first trench of a continual distribution system must handle more than its share of suspended solids and organic matter.

When any part of the system gets clogged or otherwise fails, the rest of the system goes without having been used to its full potential. The primary features of continual distribution are:

- No slope maximum
- No limits on trench length
- Easy expansion

**Valve Boxes**
Valve boxes are another distribution option, similar to drop boxes. **MN Rules Chapter 7080.1100, Subp. 90 defines a valve box as a watertight structure designed for alternate distribution of septic tank effluent to segments of a soil treatment system.** Valve boxes have valves that open and close the outlets. **All the requirements of drop boxes apply to valve boxes (Chapter 7080.2050, Subp 3 (C)).** Valve boxes are often used with dual field systems.
Parallel Distribution
Parallel distribution is the distribution of septic tank effluent by gravity flow, loading all sections of the soil treatment and dispersal system equally at the same time. The parallel distribution system directs effluent flow into all trenches in the soil treatment unit simultaneously. Trenches are constructed to be of equal length and depth and to be suited for the same type of soil, so treatment occurs at the same rate in each trench. In theory, this allows for equal use of all parts of the system. However, in practice this rarely, if ever, happens. In practice, the trenches are never identical to each other, so the result is unequal flow.

Differences between the trenches are unavoidable: one trench may be dug in slightly more permeable soil or be slightly deeper or longer. Effluent will enter all the trenches at the same time and at the same rate; however, since it won’t all be treated and leave the trenches at the same rate, the result can be backflow, as effluent leaves a full trench and moves to one that is emptying faster.

The parallel distribution system can freeze in winter since the solid pipes between the trenches and the distribution box sometimes contain standing effluent. Even when there is no backflow problem, there may be significant hydraulic head between the top of the system (the distribution box) and the trenches, with effluent in lower trenches being forced up to the soil surface—a surface failure. These systems must, therefore, be sited where the slope is not very steep (typically less than 5%), often not steep enough to take advantage of gravity.

To evenly distribute effluent to the soil, a pump is required to deliver the effluent to the trenches. Depending on elevation differences, parallel distribution systems can fail when a single trench fails if the trenches are not fed completely levelly and equally. Unlike the continual distribution system, in which a failure at one part of the system can also mean failure of most or all of the system, the parallel system offers no benefit in terms of improved effluent quality. Features of parallel distribution include:

- Common application
- Best for level sites

Application
Parallel distribution is only used when serial distribution is not an option due to site limitations. Parallel distribution spreads the effluent equally between all the trenches, which can limit the development of a biomat.

Distribution Boxes
A distribution box is defined in Minnesota Rules Chapter 7080.1100, Subp. 22, as a device designed to distribute septic tank effluent concurrently and equally by gravity to multiple segments of a soil treatment and dispersal system and must meet the requirement in Table 11.2. Distribution boxes are made of concrete or plastic and typically have one inlet and multiple outlets, with the outlets available in a variety of configurations. They work best on level or nearly level sites. In operation, septic tank effluent enters the box and flows out one or more of the outlets. The outlet pipes leaving the distribution box should have equal slopes for at least five feet beyond the box. Distribution boxes will rarely provide equal distribution to each outlet pipe.
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<table>
<thead>
<tr>
<th>TABLE 11.2 Distribution Box Specs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. They must be water tight and constructed of durable materials not subject to corrosion or decay.</td>
</tr>
<tr>
<td>2. The distribution box shall be covered by a minimum of six inches of soil. If the top of the box is deeper than six inches, access must be provided above, at, or within six inches of the finished grade.</td>
</tr>
<tr>
<td>3. Inverts of all outlets must be set and maintained at the same elevation.</td>
</tr>
<tr>
<td>4. The inlet invert must be either at least one inch above the outlet inverts or sloped such that an equivalent elevation above the outlet invert is obtained within the last eight feet of inlet pipe.</td>
</tr>
<tr>
<td>5. Each trench line must be connected separately to the distribution box and must not be subdivided. Distribution boxes must not be connected to one another if each box has distribution pipes.</td>
</tr>
<tr>
<td>6. When sewage tank effluent is delivered to the drop box by a pump, the pump discharge must be directed against the wall or side of the box on which there is no outlet, or directed against a deflection wall, baffle, or other energy dissipater.</td>
</tr>
</tbody>
</table>

The condition necessary for the use of a distribution box is that the ground surface at the lowest trench be at least 12 inches higher than the outlets of the distribution box, this will prevent any effluent from surfacing until all of the trenches have been loaded with effluent. All trenches must be exactly the same length, and each must be able to treat the same amount of effluent as the others throughout its operational life. All of the outlets of the distribution box must be at exactly the same elevation when installed and after the system has been backfilled.

A study by the Federal Housing Authority showed that distribution boxes were rarely installed properly and recommended that their use be discontinued (Coulter and Bendixen, 1958). The theory of distribution box operation is difficult to realize in the field because all the trenches are often not the same length, at the same elevation, are not able to treat a like amount of effluent, and may settle over time, with the freeze thaw cycle. This situation is rarely true in practice.

**Distribution Box Modifications**

Many devices have been developed to overcome the problems associated with distribution boxes. Some manufactures have developed distribution boxes that can be leveled after they are installed. A leveling device can be inserted in the end of the four-inch outlet pipes, which makes the outlet inverts somewhat level. These levelers need to be adjusted periodically. The distribution box outlet adjuster is a device that can be placed inside the distribution box into each pipe leaving the distribution box. These adjusters can be turned or dialed so that the inverts of the small openings are at exactly the same elevations or at different elevations to provide trench resting. The advantage of this approach is that it allows readjustments to be made when one side of the distribution box settles or when freeze-thaw activity or shrink-swell in the soil causes the distribution box to become slightly out of level.

Instead of trying to get equal flow to all trenches, it may be more appropriate to direct the flow to a given trench. This can be done by adjusting the levelers to different invert elevations or by placing an elbow on the outlet end of the pipe with the invert set at one-inch increments, with the lowest elbow invert set at the outlet pipe invert. In this case, all the effluent enters the trench with the lowest elbow or adjuster invert, causing the clogging mat to develop, and resulting in ponding at some time depending on loading rate, soil conditions, and other factors. If this trench cannot handle the flow, the effluent goes out through the next highest elbow (or leveler) to the second trench. If neither trench one nor two can handle the flow, the effluent goes out through the next highest elbow to the third trench, and so on. Once a year or so, the trench receiving the effluent for the longest time can be shut off and allowed to rest. The resting may reduce the biomat.
There are other proprietary devices available that can distribute the effluent somewhat equally to each trench, such as a tipping D-box.

**Management**

There is limited management of systems with distribution boxes. Some boxes may have access to shut off and rest individual runs of the trench. The inspection ports at the end of each trench can tell you how much ponding is in the system and if the system may be reaching the end of its useful life. The distribution or drop boxes should be evaluated to assure that clean water is not entering or sewage leaking out as shown in Figure 11.16.

**Manifolds and other distribution methods**

Manifold pipe distribution is totally buried and connects several distribution pipes in parallel trenches or in beds. In trench systems, the septic tank effluent will flow into one trench as the header pipe is incapable of dividing the flow equally to all trenches. When that trench can no longer handle the flow, the effluent will back up and flow into another trench. Manifold distribution is easy and inexpensive to install. Header systems cannot be managed as individual trenches because the trenches cannot be taken out of service. Lines can potentially be added on if site and soil conditions are appropriate.

**Installation of Gravity Distribution Components**

Installation activities can greatly impact how closely gravity systems come to achieving even application. Distribution boxes and drop boxes must be properly bedded to remain stable over time. The proper bedding is a thin layer of washed rock placed on a level foundation of native soil. Alternately, they can be placed directly on a smooth, level foundation of native soil. Pipes exiting the device must be securely installed and stabilized or...
they will settle over time and may negatively affect distribution or allow infiltration.
The elevation and orientation of any distribution device (distribution box, drop box)
is critical because it determines the depth of the succeeding trench bottom. If trenches
are installed too deeply, there may be inadequate separation to a limiting condition,
resulting in inadequate treatment of effluent before it rejoins the hydrologic cycle.

Distribution boxes and drop boxes must be rendered watertight to prohibit infiltration
by water and roots. Boxes that include pipe penetrations that remain watertight after
installation are the best choice. Using concrete to seal pipes to boxes is ineffective and
results in significant problems over time.

It is absolutely critical that distribution boxes be installed level because they are used
on flat sites. If all trenches are installed at equal elevations, the pipes exiting the d-box
should theoretically be on the same grade. If the pipes exit the box with different grade,
unequal distribution will result. Pipes exiting a distribution box should be installed on
identical grade. Otherwise they will not provide even distribution.

While leveling drop boxes is not as critical as leveling distribution boxes, they must still
be installed so that they remain stable. The proper bedding is a thin layer (3 - 6 inches)
of rock or pea gravel placed on a level foundation of native soil. Alternatively, they can
be placed directly on a smooth level foundation of native soil.

**Pressure Distribution**

This section examines the distribution system that conveys the septic tank effluent to
the soil treatment system for treatment and dispersal under pressure through a series
of perforated pipes.

With pressure distribution, effluent is delivered either to taps in a pressure manifold
(pressure-dosed gravity systems) or to multiple points across an infiltrative surface (low
pressure or drip distribution). By definition, pressure distribution systems incorporate
a pump or siphon to provide the energy needed to overcome the forces of gravity.
Pressure distribution systems using pumps can be dosed either on demand or at
specific times. Those with siphons are inherently demand-dosed. Use of a siphon is
limited to sites where the soil treatment area (STA) is downhill from the siphon tank,
but systems can still be pressurized because of the energy they provide. Effluent can
thus be distributed along the entire length of an infiltrative surface without using
electricity.

*Chapter 7080.1100, Subp. 61 defines pressure distribution as a network of
distribution pipes in which effluent is forced through orifices under pressure.*

Pressure distribution has been used for more than 40 years to apply septic tank
effluent to soil treatment systems. In 1974, Converse et al. published a paper
documenting the application and performance of pressure distribution systems
particularly in sandy soils. Today, media filters and many other advanced treatment
units rely on pressure distribution. Because this trend is sure to grow, professionals
need to understand how pressure distribution works.

Pressure distribution substitutes for the biomat in gravity systems to distribute effluent
across the infiltrative surface. It provides increased treatment efficiency on sites with
soil and size limitations. A pump typically controls the application, which proceeds
at a rate determined by the long-term acceptance rate of the soil or media. Pressure
distribution at the proper rate maintains an aerobic (oxygen rich) environment that
allows for effective treatment.
Any pressure distribution system has four interdependent components, as shown in Figure 11.17:

- Pump tank and pump that pressurizes the system
- Pump controls
- Pipes that deliver the effluent
- Orifices that discharge effluent into the treatment area

Each has important design and installation requirements.

Pressure distribution applies effluent uniformly over the entire infiltrative surface such that each square foot of bottom area receives approximately the same amount per dose at a rate less than the saturated hydraulic conductivity of the soil. This application promotes soil treatment performance by maintaining vertical unsaturated flow and also may reduce the degree of clogging in finer-textured soils. Pressure distribution closely approaches uniform distribution. In a field study, the more uniform distribution of effluent offered by pressure distribution resulted in better aeration and nitrification during system start-up. Fecal coliform removal was significantly lower in pressure-dosed systems over the course of the study (Bomblat et al., 1994). Uneven distribution of effluent can result in localized overloading and the system failure.
One often overlooked benefit of pressure distribution is that it ensures resting periods between applications, allowing time for the soil or media to recover. Designs should allow for a number of resting periods. A typical pressure distribution system is designed with four dosing and resting periods per day. Equally spaced applications allows resting between doses and more uniform application, resulting in more consistent oxygen transfer and better treatment potential. A timer can further assist in spreading out the application of effluent. Typical demand dosing, by comparison, which turns the pump on whenever sufficient effluent is available. Pressure distribution is usually used in locations where it is either desirable or required to:

- achieve uniform application of effluent throughout the soil treatment area;
- disperse effluent higher in the soil profile;
- avoid potential contamination of groundwater beneath excessively permeable soils;
- improve the treatment performance and extend the life expectancy of a drainfield or other component;
- reduce the potential for breakout or seepage on slopes;
- distribute effluent to all above ground-systems;
- avoid potential contamination on sites in aquifer-sensitive areas;
- avoid potential contamination on sites with limited soil depth;
- disperse effluent evenly for larger drainfield systems; and
- disperse effluent evenly in conditions where pumping is needed due to elevation problems.

One disadvantage of pressure distribution is that it needs a pump tank, pump, controls, and an alarm. This means the owner has to pay for these components along with electrical service and usage.

Another issue with pressure distribution is that the orifices must be kept clear for the system to work properly. Septic tank effluent inevitably contains some solids, which can plug the system. Effluent screens which are increasingly popular, further limit the size of suspended solids leaving the pump tank. Maintenance of the septic tank and distribution system is critical for long-term performance.

**Purpose and Application**

*Under Chapter 7080.2050, Subp 4 (A), pressure distribution is required in several situations:*

1. Mound systems
2. At-grade systems
3. All seepage beds with a width greater than 12 feet
4. Systems receiving pretreated effluent (levels A, A2, B, or B2)
5. All systems where the distribution network is installed above the original grade
6. All MSTS systems (7081.0250)
MN Rules Chapter 7080.2210 Subp. 4 (F) (1) identifies pressure distribution as one of three treatment options for trenches or seepage beds in which the distribution media is in contact with any sand textured soils with a percolation rate of 0.1 to 5 minutes per inch.

Pressure distribution systems are designed so that the volume of septic tank effluent flowing out of each orifice of the distribution pipe is nearly identical. The pipe diameters and orifice diameters must be appropriately sized to achieve uniform distribution. A pump placed in a pump tank is used to deliver the septic tank effluent. A pump tank is defined as a tank or a separate compartment following the septic tank that serves as a reservoir for a pump (MN Rules Chapter 7080.1100, Subp. 64). For more information on pump tanks and pumps, see Section 8.

**Pipe Specifications**

The distribution piping system includes supply pipe, which carries effluent from the septic tank to the pressure distribution system, and laterals, which actually distribute the effluent. The volume necessary to fill the pipe—the amount of effluent needed to charge the system before even distribution occurs—is an important variable. The dose volume must be four times the amount to pressurize the system (7080.2100, Subp. 4 (D)). In cold climates, another issue is the volume that drains back to the pump tank when the pump turns off. Drain-back is necessary to prevent freeze-ups. However, if this volume is too great, the system becomes less efficient because the pump must move a significant amount of effluent more than once. The size and kind of supply piping determine friction loss, which affects the pressure requirement. Larger diameter pipe has less friction loss, and thus requires less total dynamic head and may allow for a smaller pump. On the other hand, more materials costs are incurred when larger pipes are employed.

**Supply Pipe and Manifold Requirements**

The supply pipe delivers the effluent from the dosing chamber to the manifold. The supply pipe diameter is dependent on the system flow rate. From the head loss values given in Table 11.3, select a pipe diameter that will have a low head loss at the given flow rate. The head loss in this pipe affects the sizing of the pump; see Section 9: Pumping Systems for more information. Note that the head losses listed are for a 100-foot length of pipe. After the main diameter is selected, compare it with the chosen manifold diameter. If the manifold is smaller than the supply pipe, increase the manifold diameter to match the supply pipe.

The supply line for pump systems must be properly bedded and the connection between the discharge assembly and the supply line should be secure and stable. The supply line must be appropriately sized and pump capacity must be considered if changes are made. If the elevation of the supply line changes between the pump tank and the next component, air may become trapped in the line during rest periods and affect performance. In this situation, an air release valve should be specified for installation at the highest elevation of the line or pipe. The valve should be housed in a vault that comes to final grade to allow for inspection and maintenance. If the installer determines that any such device should be added to a system, the affect on pump performance must be assessed.
TABLE 11.3  Head Loss per 100 Feet, Based on Flow Rates: C = 130

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<tr>
<th>FLOW RATE (GPM)</th>
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<th>2&quot;</th>
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</table>

According to MN Rules Chapter 7080.2050, Subp. 4 (H), pressure distribution laterals must be connected to a header or manifold pipe that is of a diameter such that the friction loss in the header or manifold will be no greater than five percent of the average head at the orifices. The manifold connects the laterals and distributes the septic tank effluent to each lateral. Manifolds and supply pipes are usually PVC pipe with appropriate ‘L’ or ‘T’ fittings. The manifold pipe should be connected to the supply pipe from the pump, and sloped toward the supply pipe. The manifold should be the same diameter as the supply pipe. The size and position of the manifold and main will vary for each pressure distribution system.

Depending on the site conditions and the design of the pressure distribution system, the manifold may be run along one end or down the center of the distribution system. See Figure 11.18 for an end manifold and Figure 11.19 for a center manifold connection. The benefit of a center manifold is that it allows more orifices per lateral while maintaining the required minimum friction loss.
The manifold must be installed level. If it is not level, effluent will flow by gravity to laterals at the lowest elevations during filling (pressurizing) and draining (depressurizing) stages of the dosing cycle. Use proper bedding materials and techniques to ensure a stable installation.

The size of the taps in the manifold affects the system flow. For a long manifold on a level site, the taps should be spaced to correspond to the trench spacing to eliminate the need for additional elbows that will increase friction losses (and costs). Use a string line to mark the manifold to ensure the taps are drilled in a straight line. This provides the proper orientation for connections.
With a Schedule 40 PVC manifold, the taps will consist of reducing tees which should be joined to the pipe using appropriate adhesives. Do not attempt to drill and tap a Schedule 40 manifold. A Schedule 80 PVC manifold has a wall thickness sufficient to allow the installer to drill and tap the fittings without compromising pipe strength. The correct diameter drill and associated tap is critical for these activities to avoid changing system flow. All burrs should be removed from the drilled and/or tapped orifices, and the assembled network should be flushed through open cleanouts using clean water to remove all debris. This prevents clogging of taps in the manifold or orifices in the field after startup.

Designing the Pressure Distribution System

This section presents steps to design and construct components of the pressure distribution system. These steps can be used to design pressure distribution systems where each lateral is at the same elevation. A reference can be found online at septicumn.edu. To develop a pressure distribution system for a series of laterals at different elevations, consult the “Non-Level Distribution” section and worksheet.

In a pressure distribution system, small-diameter pipes are used to distribute the effluent. The four-inch perforated pipe used in conventional soil absorption systems is not suitable because it is too large, and the orifices are not appropriately sized and spaced to provide even effluent distribution.

Sch 40 PVC pipe and fittings are used in pressure distribution systems. The pipe and connections must be able to withstand a pressure of at least 40 pounds per square inch. Pressurized distribution laterals must be installed level, and the orifice must be free of burrs. Orifices may be spaced no more than three feet apart, and a method to introduce air into the pipe after dosing must be provided. The pipes must completely drain after the pump turns off.

The pipe diameter, orifice diameter, and orifice spacing must be determined for each pressure distribution system. As the lateral diameter increases, the maximum allowable length increases, but as lateral diameter decreases, the velocity in the pipe increases. Increased velocity is a benefit, as it helps keep solids suspended. The length of the laterals is related to the number and size of the orifices.

For uniform distribution, the discharge from each orifice must be effectively the same or within ten percent of the others. Table 11.5 (page 11-27), from MN Rules Chapter 7080.2050, Subp. 5 (E), meets this requirement, so as long as the spacing, pipe diameter, and orifice size you have chosen produce a sufficient number of orifices, you can proceed.

Table 11.5 is calculated by using the friction loss over the laterals. By using the friction loss or F factor for pipes with multiple outlets (shown in Table 11.4), the friction loss is calculated as if the entire flow were moving through the entire pipe. To assure the discharge is within ten percent, the friction loss in the pipe should not be greater than two percent of the average operating pressure head. The pressure head should be between one and five feet at the end of each lateral. For a system with a design pressure head of one foot, the maximum allowable friction loss would be 0.20 foot. By using the F factor and...
the friction loss for plastic pipe, a designer can determine if any pressure distribution design will meet the requirement. Pressure systems have many components, but none are more important than the orifices in the distribution pipe. Taking the role of orifices lightly can lead to disastrous consequences. Proper design and installation of orifices is critical to creating a system that uniformly distributes effluent. Key design parameters include the size of the orifices, location, and spacing in the pressure distribution lateral. Friction losses relate to the diameter of the pipe and the flow. The larger the orifices and length of pipe, the more flow is necessary to properly charge the pipe. This translates into a maximum length for the laterals based upon the size of orifices and the size or diameter of the pipes. All pressurized laterals should be the same size. The number of orifices may be adjusted slightly to match the available pump capacity and head. The orifices should be staggered between adjacent laterals, if possible. The last orifice should be drilled at the end of the lateral, at least one foot from the media edge, and in the elbow or sweep of one of the cleanout accesses (see Figure 11.20 for specifications). It is important that this orifice be below the media to assure that effluent does not freeze in the access box. This final orifice facilitates venting as the pipe fills and drains. If rock is used as the distribution media, at least six inches must be placed under the pipe and two inches over the pipe. The designer needs to balance the diameter of the pipe with the size of the orifices to provide the necessary lateral length to maintain equal distribution across the area. The larger the orifice size, the greater the capacity the pump must be able to deliver. Large orifices allow fewer orifices per lateral to achieve even distribution, resulting in shorter maximum lateral lengths. The smaller diameter orifices have smaller flow requirements, smaller pumps, and greater maximum allowable lengths. Smaller orifices create additional management requirements because they are more subject to plugging. This issue can be addressed in one of three ways:

1. Include a screen or filter upstream from the pressure distribution system. Removal of solids from the effluent reduces the risk of plugging. Effluent screens are only required when the dwelling includes a garbage disposal or pump in the basement, but is advantageous for all systems.  

2. Increase the pressure at each of the orifices. The higher the pressure at the orifice, the less likely it is that solids will hang up and plug the orifice. Typical designs using quarter-inch orifices operate at a pressure of one to two feet of head. For smaller orifices (1/8 or 3/16 inch) a greater operating pressure is beneficial.  

3. Provide access for maintenance. Even if all solids are removed from the effluent by filtration, the growth of solids in the distribution system remains a threat (Chapter 7080.2050, Subp. 4 (J)).
Steps to designing the pressure distribution system

1. First, establish the dimensions of the system from estimated daily flow rate and soil conditions.

2. Next, determine the length of the laterals and the distance between laterals. At this time the designer also chooses an orifice diameter, although it may be adjusted later in the design if modifications are needed. The laterals do not all need to be the same length. **One foot should be subtracted from each edge of the distribution media because perforated laterals must not be installed closer than 12 inches from the edges of the absorption bed, and perforations must not be installed closer than 12 inches from the ends of the absorption bed, as shown in Figure 11.20. Pressure distribution laterals must be spaced no further than 36 inches apart in seepage beds and mound absorption beds, and no further than 24 inches from the outside edge of the bed.** The lateral length is measured from the distribution manifold to the end of the lateral.

3. Select a perforation spacing from two to three feet. Previous to the 2008 rule change, spacing was allowed up to five feet, but with smaller perforations spacing and higher density, the effluent is more uniformly distributed. The perforations can not be more than three feet apart.

4. Select a perforation size from 1/8 to ¼ inch in diameter. For systems serving single-family homes, ¼ inch perforations are typically used. Perforations larger than ¼ inch in diameter require larger pipe diameters and greater pump capacity and are not allowed.

5. Determine total number of perforations per lateral. This is equal to the number of spaces plus one additional perforation in the cleanout access. The number of orifices is calculated by taking the length of each lateral and dividing it by the spacing, then rounding down and adding one. Table 11.5 shows the maximum number of 1/8 – ¼ inch perforations per lateral to guarantee less than ten percent discharge variation for various pipe diameters (from MN Rules Chapter 7080.2050, Subp. 4 (D)). If the number of perforation designed is greater then the amount allowed in Table 11.5 the orifice diameter can be decreased, the pipe diameter increased, the spacing increase, or the system may be fed with a center manifold. The total number of perforations allowed across the length of a system is double the amount in Table 11.5, if the system is fed with a center manifold.

6. Next, determine the total number of perforations in the system. This is done by taking the number per lateral and multiplying by the number of laterals if they are all the same length. If they are not, you must determine the number in each lateral and add them together. At this time you can determine the square feet per perforation, which should be less than 10 ft² / perforation.

7. The next step is to determine the required discharge of the pump in gallons per minute (GPM). Select the **pressure head** to be maintained at the end of each lateral. The head should be between one foot and five feet. The pump discharge capacity must be based on the perforation discharges for a minimum average head of 1.0 foot for 3/16-inch to 1/4-inch perforations and 2.0 feet for 1/8-inch perforations for dwellings. The minimum average head must be 2.0 feet for other establishments with 3/16- to 1/4-inch perforations and 5.0 feet of head for 1/8-inch perforations (Chapter 7080.2100, Subp. 4 (B)). For MSTS the minimum average...
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Head is two feet for 1/4 inch and 3/16 inch perforations and five feet for 1/8 inch perforations (Chapter 7081.0260 (C)). Using the selected head and the perforation diameter, the flow rate per perforation can be determined from Table 11.6. The figures in this table are calculated from the equation found in Chapter 7080, Subp. 4 (B). Calculate the lateral flow rate by multiplying the flow rate per perforation by the number of perforations in the lateral.

**TABLE 11.5 Maximum Number of Perforations per Lateral**

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<th>Perforation Diameter in (inches)</th>
<th>Perforation Spacing (feet)</th>
<th>Pipe Diameter (inches)</th>
</tr>
</thead>
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<tr>
<td></td>
<td>3.0</td>
<td>20</td>
</tr>
</tbody>
</table>

**TABLE 11.6 Perforation Discharges in GPM**

<table>
<thead>
<tr>
<th>Head (feet)</th>
<th>Perforation Diameter (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1/8</td>
</tr>
<tr>
<td>1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.18</td>
</tr>
<tr>
<td>1.5</td>
<td>0.22</td>
</tr>
<tr>
<td>2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.26</td>
</tr>
<tr>
<td>2.5</td>
<td>0.29</td>
</tr>
<tr>
<td>3</td>
<td>0.31</td>
</tr>
<tr>
<td>4</td>
<td>0.36</td>
</tr>
<tr>
<td>5</td>
<td>0.41</td>
</tr>
</tbody>
</table>

<sup>a</sup> Use 1.0 foot for 1/4 inch and 3/16 inch perforations

<sup>b</sup> Use 2 feet of head for 1/8 inch perforations for dwellings and for all other establishments

8. Select a maximum pipe diameter based on either a center or end manifold. Effluent is distributed by one to three inch diameter perforated pipe under pressure. Based on the lateral flow rate, manifold length, and lateral spacing, determine the minimum pipe diameter. If the desired pipe length or spacing is not listed, use the next greater length listed.

9. Based on the pipe diameter chosen, calculate the volume of effluent required to charge or fill the pipes. This is the amount of effluent that is required to be delivered by the pump before even pressure distribution is achieved. From Table 9.3, select the gallons per foot of pipe based on the distribution, manifold, and supply pipe diameters in inches. Then take the total length of each diameter of pipe and multiply by the length of each section. When added together, this volume in gallons is the amount to fill all the pipes. The dose volume can then be calculated by taking four times the amount of effluent to fill the distribution pipes only (Chapter 7080.2100, Subp. 4 (D)).
10. Pressure distribution pipe cleanouts must be provided to check the system for proper operation and cleaning of plugged perforation. According to MN Rule Chapter 7080.2050, Subp 4 (J), cleanouts must be accessible from the final grade. These clean-outs should:

- Have threaded removable caps or plugs on the ends of the laterals to allow for cleaning the laterals and for monitoring the lateral pressure
- Be large enough to allow access to caps or plugs with hands, tools, etc.
- Be accessible from the ground surface

Cleanouts are placed at the distal end of pressurized laterals to allow flushing of the system prior to startup, measurement of operating pressure and regular flushing of solids. The pipe configuration of the cleanout varies, but the most basic and convenient cleanout consists of a 90 degree turn up. Two 45 degree elbows or one sweep 90 degree elbow may be used. Using these allows the service provider to use a pressure washer or bottle brush for cleaning purposes because the gentle turn allows easy insertion of the pressure line. If a cap assembly is used, a female screw cap is easier to remove during O&M activities. Alternately, ball valves may be installed at the distal end of the lateral in a vertical position. These can be opened to flush laterals using pump pressure. Figure 11.21 is an example of a cleanout with a ball valve.

There does need to be a perforation part way up the elbow to make sure that air is able to re-enter the pipe after the pump shuts off. The clean-out is then brought to grade and covered with a landscaping box. It is recommended that rock be placed in the box to cover the perforation so effluent isn’t spraying freely in the box. UMN OSTP recommends the larger sized boxes as with the small ones it is difficult to get your hand inside to remove the threaded cap. Insulation is also recommended on the lid of this box. Some installers also place removable insulation around the cleanout.

Make sure that the access is completely stabilized to prevent shifting during backfill activities. Its location and orientation should be verified during installation to ensure the cleanouts are ultimately located in the center of the access upon completion of the installation.

Inspection ports to the infiltrative surface are also required in pressure distribution systems. They should be

- Accessible from the surface
- Open and slotted at the bottom
- Void of gravel to the infiltrative surface to allow visual monitoring of standing effluent in the trench or bed
Design for pipes at different elevations

Local program requirements or site conditions may dictate the use of pressure distribution in trenches. Trenches cannot be installed level and meet vertical separation requirements in many sites. Figure 11.22 shows non-level trenches down a hillslope. To design a pressure distribution system with laterals at different elevations, there are four methods from which to choose:

1. Have a separate pump for each lateral/zone at a different elevation. This option may be more applicable with larger flow systems split into several zones. Switching valves can also be used to dose several zones within a system with one pump.

2. Use valves to regulate the pressure head in each lateral/zone so it is equal. This option requires squirt height testing at system start up and adjustment over the life of the system as shown in Figure 11.23.

3. Some types of drip distribution are pressure compensating and can account for pipes at differing elevation (see Drip Distribution Section).

4. Vary the perforation size, spacing, and pipe length to assure even distribution from one lateral/zone to the next.

The nonlevel pressure distribution worksheet found at septic.umn.edu can be used to complete this design using the following steps:

a. Determine the elevation and length of each lateral.

b. Calculate the difference in elevation from the lateral at the highest versus the lowest elevation.

c. Add in the required head at the perforation (one to two feet.)

d. Calculate the pressure head at each elevation.

e. Estimate a perforation size and determine the flow rate per orifice for each lateral.

f. Calculate gallons per minute per foot for lateral at highest elevation with an estimated spacing.
g. Balance gallons per minute per lateral for each of the other elevations by varying the length of pipe, perforation size, and spacing so equivalent gallons per minute per foot are being delivered.
h. Add gallons per minute for each lateral to determine the total gallons per minute required.

Installation

Manifold construction
The connections elevations between the manifold and the laterals and between the manifold and the supply pipe determine how the system drains. If the manifold and laterals are connected at the same elevation with staggered tees, the manifold volume will drain through the perforation. If the manifold and laterals are connected at different elevations, with the manifold higher, and using tee-to-tee connections, the manifold volume will be part of the delivery pipe system, because effluent will drain back to the pump tank. The supply pipe should be sloped back to the pump tank so that effluent drains back to the tank between doses. This helps minimize the potential for freezing in cold climates.

Distribution piping construction
According to MN Rules Chapter 7080.2050, Subp. 4, (C), pressure distribution pipes and associated fittings must be properly joined together. The pipe and connections must be able to withstand a pressure of at least 40 pounds per square inch. Care during the connection of the pressure distribution system will ensure proper system operation. All connections in the pressure distribution system must be properly primed, glued and tight in order to prevent leakage and to withstand pressure. Proper connection of the pipes is a critical element of system construction. Pressure-rated PVC pipes and connections are installed using glue, and proper gluing requires the use of a cleaner. In fact, many codes recommend that the cleaner be purple so that inspectors can verify that the cleaner was used. The cleaner prepares for the glue that welds the pipes together. Once the pipe is clean, the next step is to apply the glue. A ¼ turn of the pipe, once glued, helps solidify the connection. Pressure fitting means that twice as much area is exposed to the glue, creating a better connection. Cleaner and glue are applied using an applicator supplied with the materials. The applicator should be kept clean. Users should avoid excessive glue, because when the glue hardens, it can actually break into particles that can contribute to plugging of the perforation. When cutting the piping, be sure that the filings do not go into the pipe as they can cause a perforation restriction.

Temperature is also critical when constructing the system. Cold pipe can be brittle and crack during transport. Installers must use the proper glue for the temperature at the time of installation. Temperature also affects the speed at which the glue sets. The colder the weather, the longer it takes for the glue to set up. Holding the sections longer allows for a better connection. Also, be very careful that rock, soil, and other debris do not get in the pipe as these can plug the perforations.

Perforations
Perforations are drilled perpendicular to the pipe in a straight line, typically along the underside of the pipe. An orifice drilled at an angle creates an oval-shaped opening that has more area than a round one, increasing the flow through the perforation. This change in flow in turn affects the uniformity of distribution. Again, the smaller the
SECTION 11: Distribution of Effluent

The perforation, the more critical this becomes. Being a “little off” and expanding a ¼ inch perforation will have a smaller impact than if a 1/8 inch perforation is expanded. In fact, for drilling smaller perforations, using a drill press is a good idea. The perforations should be drilled as uniformly as possible. A good, sharp drill bit should be used, and the plastic material removed should be cleaned from inside the pipe. Great care should be used to keep plastic shavings from entering the system, as these can easily become permanent plugs once effluent begins flowing through the laterals. Any burrs or rough edges must be removed from the orifices so they do not collect debris and become clogged. Sliding a rod or small-diameter pipe along the inside of the lateral pipe works to remove burrs. During construction, protect the ends of pipe to keep dirt and rodents out of pipes.

Perforated laterals must be installed level with either all of the orifices pointing downward or with a small percentage (10-20%) facing upward to drain the pipe of all the effluent. In systems utilizing rock as the distribution media and ¼ inch perforations, all the perforations are typically pointed downward, but in the case of installations with smaller perforations or with other distribution media, having a majority of orifices pointing upwards has advantages. The advantages include a more even distribution of effluent and reduced likelihood of perforation being blocked by the media. A method to introduce air into the pipe after dosing must be provided. This is typically achieved by a perforation in the elbow or sweep of one of the cleanout accesses to assure a vacuum is not created. **The pipes must completely drain after the pump turns off (Chapter 7080.2100, Subp. 4 (F)).**

A requirement under an increasing number of state codes is the installation of perforation/orifice shields—removable coverings that protect each orifice from media. This protection is important because if the perforation is covered or partially covered by the distribution media or rock, the actual flow from that perforation will be less than designed. This can contribute to plugging with solids, resulting in non-uniform distribution on the treatment surface. Shields become more critical as perforation size decreases. The smaller the perforation, the more easily the media can affect the flow and the greater the potential for varying distribution. A number of orifice shields are commercially available.

**Management**

Experience with pressure distribution has indicated that laterals have the potential for plugging. Even with large perforation and high pressure, it is possible for solids to plug up the perforations. Providing maintenance access is probably the single most important component for long-term operation of a pressure distribution system. If proper access, which has been required since 2008, is provided at installation, regular maintenance can be an easy job. When lateral ends are buried, the only time maintenance takes place is after the system fails. To ensure long-term system performance, the laterals must be periodically flushed or cleaned. Typically, access for maintenance is provided by putting a valve box at the end of the pressure distribution lateral and bringing it near the surface. A threaded cap allows easy removal and access. This access is located in a valve box at the end of each lateral.

The best way to provide access is to bring a pipe off the end of the lateral using sweep 90-degree fittings or two 45-degree-angle elbows. A threaded cap in which an orifice is drilled is used at the end. The orifice should be drilled to the side to avoid spraying directly up to the top of the valve box. However, in cold weather, spray into the valve
box can cause freezing, so this method should be used cautiously, and if used, insulation should be provided around the box. A preferred method would be to install a ball valve at the end of each lateral. During normal operation, these valves are turned off, but they can be accessed one at a time when flushing the distribution laterals. The distal pressure at the end of each lateral can be checked by threading in a cap with an orifice pointing upwards on each lateral. The height to which the effluent squirts up should be the same in each lateral. If it is higher in one lateral versus another, this indicates that the lateral with a greater squirt height has plugging in some of the orifices and that flushing and cleaning is needed.

Partial plugging of the distribution piping may also be detected by long dosing times, such as 25% extra run time per dose, or a decreased drawdown following the dose event (decrease from original settings). The ends of the distribution laterals should be exposed and the pump activated to flush out any solid material. If necessary, the pipe can be cleaned. Any visible solids or effluent which discharge from the pipe should be removed from the site and properly disposed of.

Under normal operation the inspection ports in pressure distribution system should be dry unless the pump has just delivered a dose to the system. If prolonged ponding exists, further investigation of the system is required to determine if it is being hydraulically or organically overloaded.

Drip Dispersal

Drip dispersal is a method of distributing effluent into the soil with pressure distribution. As of the publication of this manual, no drip dispersal products have been registered for use in Minnesota, meaning that any application would be considered a Type V system and must be designed by a PE and Advanced Designer. Typically drip dispersal systems use pretreated effluent as a source of nutrients and moisture for plant growth. The pretreated effluent is piped under pressure to the soil treatment site, where it “drips” out of tubing at regular intervals. In this way, a small amount of effluent irrigates a large vegetative area, maximizing both uptake of water by plants and evaporation. Topsoil with vegetation is an excellent environment for treatment. Treatment of septic tank effluent is maximized, and the risk of untreated effluent flowing quickly through the soil is minimized. Suitable soils, separation, and area are required.

Drip irrigation has been used for many years in agricultural settings but has only been employed successfully in the United State to distribute wastewater effluent since the late 1980s. Most of the initial experience with drip technology has been in the southeastern United States. In the past years, the technology has been of national interest, and there are now a number of states, including Minnesota, which are conducting research, developing standards, and/or actively permitting these systems. See Bohrer and Converse, 2001 for more information on cold weather design and installation.

A subsurface drip system is an efficient pressurized effluent distribution system that can deliver small, precise doses of effluent to shallow subsurface dispersal/reuse fields. Drip distribution piping is small diameter, flexible polyethylene tubing (drip line) with small in-line emitters (orifices that can discharge effluent at slow, controlled rates, usually specified in gallons per hour). Drip line can be trenched (by hand or with a trenching machine) into narrow, shallow trenches or plowed (with a vibratory plow or other insertion tool) directly into the soil and backfilled without gravel or geotextile.
Freezing is an issue in cold climates, since most product development has occurred in warm climates. Initial operation of a drip system installed near Duluth, MN showed that while parts of the system (most notably the filters) worked well in the winter, other portions froze (McCarthy et al., 2001). To assure that the system would not freeze, the following steps were taken:

1. The drip field was located in a wooded area, and it was covered with 12 inches of hay immediately following installation in October 1997 while the ground was still fairly warm.

2. The entire drip network was constructed to drain back to the dose tank.

3. The manifolds and air release valve were also insulated with 12 inches of hay.

With these measures, the system did not freeze after two winters with limited snow cover.

The filter portion must be both well-insulated and heated. Depth of placement is an important consideration. Systems installed in colder climates, and only used during the summer, often place the tubing six inches deep, while in climates where freezing is not a concern, six inch burial depths are common in all applications. A minimum depth of twelve inches is recommended for all other systems in Minnesota to minimize freezing problems. A research site near Hastings had freezing problems attributed to compaction of snow cover by foot traffic over the area (Gustafson, 1999). Repeated walking or driving over the system reduces the insulating ability of the snow. A thick vegetative cover will also assist with freeze protection of the system. If the system is located over a manicured lawn, it should not be mowed later in the summer to ensure additional protection.

Outlined below are some additional measures to reduce the risk of a drip system freezing:

- Manifolds, supply lines, and return lines should be sloped back to their respective dosing or treatment tanks to drain between doses.
- Insulating the return and supply manifolds is recommended for systems which will be used year round in MN.
- Be sure the drain valve on the flush line remains open for long enough for the entire field to drain.
- Remove the check valve at the pump.
- Insulate all equipment boxes, including headworks box or filter and field flush valve boxes as well as zone dosing valves, and air vacuum relief valves. Use closed-cell insulation such as perlite in a plastic bag.
- The top of air vacuum relief valves must be no higher than the soil surface.
- If using an index valve to split field zones, be sure it is capable of self-draining.
- Drip line will self-drain through the emitters into the soil. If the cover crop over the drip field is not yet adequately established, add hay or straw over the field for insulation.
- Mark valve boxes with a metal pin so you can find it in the winter when covered in snow.
Definition and Description

A drip dispersal system as a small diameter pressurized effluent distribution system that can deliver small, precise doses of effluent to the soil surrounding the drip distribution piping. Drip dispersal works on the same basic principles as any other soil based treatment system: filtering and bacterial decomposition of the effluent. However, the method of application of the effluent to the soil is different. The goal in a drip distribution system is to distribute the effluent evenly over a large area, so no single location receives excess effluent. A drip distribution system has four parts: a pretreatment device, a pump tank, a filtering/flushing device, and the distribution system as shown in Figure 11.24.

All drip systems will have plugging problems without a good filtering system. The filtering system depends on the drip tubing and the manufacturer’s recommendations. Some drip systems require advanced pretreatment, but others have been put in with only a septic tank. The type of pretreatment will in part determine the type of filter necessary. Pretreatment devices include aerobic treatment systems, sand, peat, textile, single pass recirculating filters, and constructed wetlands. Most of these pretreatment devices use a septic tank for primary treatment. In a research study by Rowan et al., (2004) sand filter effluent caused significantly less reduction of flow rates (2%) than did septic tank effluent (11%).

The pump tank as shown in Figure 11.24 stores the effluent until the drip field is ready for a dose of effluent. A high head pump is required for even application of the effluent to the soil. Pump selection and installation follows typical onsite treatment system design practices.

The filters in drip systems remove all particles larger than 100 microns. Some filters have automatic cleaning systems. Flushing capacity and the total dynamic head are two important design parameters to assure that effluent passes through the emitters in the tubing. Even with excellent filtration, algal growth in the tubing can cause plugging. Flushing the system removes the growth and minimizes plugging.

Two types of filters are commonly used: spin and disc. A disc filter diagram is shown in Figure 11.25. Both filters will function adequately with the proper pretreatment, so the designer and owner must weigh the advantages and disadvantages of each type.

- Disc filters use serrated discs as the filtering medium. The manufactured medium allows flexibility in application waste strength. The initial investment in materials is greater, but O&M will be less intensive and can be completely automated with pressure gauges and control panels.
Spin filters have a stainless steel screen that filters the effluent, and most are self-cleaning. The effluent is forced through a directional nozzle plate onto the inside of the screen. This creates a centrifugal action that rotates debris down the screen wall to a large debris-holding basin.

The distribution system includes the components that carry effluent from the pump to the soil treatment area. This is the drip part of the system, which is complex and has seen the most design changes over the last twenty years. At one end, the tubing is connected to the pump. Along its length, tiny orifices, or emitters, allow the effluent to drip out into the soil. The tubing is generally 1/2 inch in diameter with an emitter in the tubing wall. See Figure 11.26 and 11.27. The pressure inside operates at 15 - 20 pounds per square inch. The collection manifold for the drip system is connected back to the tank for flushing solids in the drip tubing. Typical drip line installations are six to twelve inches deep, have emitters spaced two feet apart and are installed on two-foot centers (with increased separations on sloped sites). Distribution networks are often laid out with the lines running parallel to one another, but due to its flexibility, drip line can be installed to accommodate irregularly shaped sites and to run parallel to contours on sloped sites. The two-foot spacing is convenient for installation, and has been used in many areas as a basis of drip distribution system sizing.

Soil application rates have been established empirically and generally assume each emitter will wet an area of four square feet. This assumption is not valid in all soil types. Research conducted for agricultural applications has shown that wetting patterns around emitters are impacted by soil/site characteristics, emitter discharge...
rate, and dosing regime. Site characteristics and installation methods also affect distribution patterns, particularly in fine, textured soils. Care must be taken to apply effluent at a rate that the soil can accept it. A complete soil investigation, including soil texture, structure, and redoximorphic features, must be performed to determine the appropriate size and necessary pretreatment. Emitter discharge rates should be matched with soil conditions (slower discharge rates are required in finer textured soils) to avoid effluent surfacing during dosing.

Tubing is where most problems can occur, including plugging of the tubes or the emitters by dissolved or suspended solids or roots, resulting in uneven distribution of effluent. Each brand of tubing is unique and tubing suppliers approach problems differently; system designers or operators should research tubing choices thoroughly before making a selection. Tubing with pressure compensation automatically increases flow if an emitter starts to plug. It is also designed for systems installed on non-level sites, so even distribution is provided with no additional design requirements.

**Rule Requirements**

Currently in Minnesota, drip distribution can be used as a Type I system if it is on the registered product list, designed with three feet of separation, and sized with 7080 loading rates ([7080.2200](#)). If three feet of separation to the limiting layer are not present below the tubing, the system is classified either a Type IV system with a registered pretreatment system in front of it ([7080.2350](#)) or as a Type V ([7080.2400](#)) with a non-registered pretreatment unit. Chapter 7080.4070 (E) has requirements for subsurface drip dispersal products:

1. be warranted by the manufacturer for use with sewage and for resistance to root intrusion;
2. have a means to inhibit the accumulation of slime and bacterial growth within the drip line and plugging of the emitters. Emitter discharge rate must be controlled by the use of either pressure compensating emitters or a pressure regulator.

**Purpose and Application**

Drip distribution is commonly used in areas where other soil treatment distribution systems may be difficult to install, such as on steep slopes and forested areas. They are also used for resorts and golf courses that only operate during the warmer months of the year. Drip distribution systems are often used after a pretreatment system, such as an aerobic treatment system or sand filter. Drip distribution systems have also been used to place the rock and pipe in mound systems (Gustafson, 1999).

Advantages of subsurface drip systems include:

- Installation of drip line is less site-intrusive when plowed in.
- Flexible drip line can be installed in grid or irregular patterns as needed to accommodate contours on sloped sites, irregularly shaped areas, difficult site conditions, or landscape irrigation applications.
- Small diameter drip line can be pressurized quickly, resulting in even distribution.
- Low flow rates allow for long lateral runs to take advantage of site contours typically longer than can typically be obtained with conventional piping.
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- Shallow placement of drip line can enhance treatment by maximizing soil depth and vertical separation and delivering effluent to a point in the soil profile where there is more oxygen and organic material.
- A vegetative cover over the drip field (usually turf) provides additional treatment and reuse through plant evapotranspiration.
- Slow, controlled emitter discharge combined with multiple daily dosing enhances aerobic conditions in the soil and results in frequent soil treatment system resting periods.

Design Basis and Operational Theory

Like all soil treatment systems, drip distribution systems require primary wastewater treatment prior to receiving effluent at the pump tank. Depending on the application and manufacture, after primary treatment the effluent stream enters a pretreatment unit or the pump tank. Pump and dosing controls are required to operate the dosing cycles and alarm system. The effluent stream is discharged from the pump tank to filters that are located prior to the supply line discharging to the distribution field. The effluent stream should be treated so as to remove solids greater than 1/8 inch in size prior to entering the drip line filter. The filters that receive the discharged effluent stream from the pump tank must be designed to prevent solids greater than 100 microns in size from entering into the drip line effluent dispersal component. The filters should be flushed no less than the minimum frequency required by the drip line manufacturer.

Two connections are made to the filter discharge: the supply line, which feeds the manifold, and a return discharge line. The supply line discharges the effluent stream to the supply manifold. The supply manifold should be installed at the highest elevation in the distribution field or within each zone. The return discharge line should be connected to the filters to carry the flushed filter effluent back to the primary treatment tank. The return discharge line should be sloped at a minimum of 1/8 inch per foot. The discharge line may be connected to the return manifold line from the distribution field or directly connected to the building sewer at a distance of greater than four feet from the primary treatment tank.

After receiving the effluent flow from the supply line, the supply manifold discharges the effluent stream to the drip line laterals through pressure-rated pipe and fittings, which are connected to the supply manifold and to the drip line laterals. The pressure-rated pipe and fittings must be able to withstand the pressures to which the piping will be subjected. The pressurized pipe and fittings should be able to withstand deformation when covered by backfill materials. The pressure-rated piping typically extends from the supply manifold into the distribution field greater than one foot prior to connecting to the drip line lateral.

The drip line laterals consist of tubing typically installed in parallel lines within one or more zones. Emitters can be either:

1. pressure compensating to give an even flow through a range of pressures or
2. non-pressure compensating with pressures controlled by pump selection, pressure compensating valves, or by some other means within the system design.
At the distal end of the drip line, laterals connecting to a return manifold are again made with pressure-rated pipe and fittings able to withstand the pressures to which the piping will be subjected. The pressurized pipe and fittings should be able to withstand deformation when covered by backfill materials. The pressure-rated piping should extend from the return manifold into the distribution field greater than one foot prior to connecting to the drip line lateral. The drip line laterals should not be connected directly to the return manifold. The return manifold should be installed at a lower elevation than the supply manifold. The drip line’s distal end is connected to the return manifold to allow periodic line flushing. The drip line laterals should be flushed no less than the minimum frequency required by the drip line manufacturer. The effluent stream flushed from the laterals is collected in the return manifold. From the return manifold a return manifold discharge pipe is connected to the building sewer. The return manifold discharge pipe should be sloped at a minimum of 1/8 inch per foot. The return manifold line should be connected to the building sewer at a distance of greater than four feet from the primary treatment tank.

**Sizing**

The sizing of the system is based on the effluent flow and the soil acceptance rate. See septic.umn.edu/ssts-professionals/forms WORKSHEETS: Forms for a step-by-step guide to designing a drip system. A manufacturer of drip systems gives a range of system sizes based on soil acceptance rates; these values are similar to existing long-term acceptance rates. The area is somewhat larger than a conventional soil treatment system, since the goal is to maximize the area loaded by a given volume of effluent.

Location of the system depends on soil conditions, including depth of soil to bedrock or zone of saturation, texture, and winter climate. The tubing type dictates siting requirements. These may include equal length runs, a level distribution field, equal distance from the pump, and equal manifold heights. Pressure compensating tubing has the fewest siting restrictions; in particular, a level field is not required and the system-dosing controller allows for different lengths of tubing runs. In warmer climates and for systems used seasonally in MN, it is recommended that systems be located in open areas where exposure to sun and wind increases evaporation and transpiration. In cold climates where the system will be used year round, it is recommended that the system be placed where a good vegetative cover or thick layer of leaf litter can be relied upon to help protect the systems from freezing. It is recommended that a drip line design should not be installed in areas where all the laterals would have elevation differences exceeding six feet.

**Installation**

Procedures used in the construction of a drip system are just as critical as the design of the components. A good design with poor construction can result in component failure. Installations are to be made only when the soil is below the plastic limit and therefore, dry enough to prevent compaction and smearing of the infiltrative surface. Proper equipment includes tractors or other equipment that will not compact the infiltrative surface.

At all times, no equipment should cross the field areas during rainfall events, when the site is above field capacity, or when water is standing over the site. Minimize traffic on infiltrate surface and avoid equipment traffic on or over infiltrate surface.
Construction procedures

1. Check the moisture content and condition of the soil. If the soil at the infiltrative surface can be rolled into a 1/4-inch wire, the site is too wet and construction cannot proceed until it dries out. If the soil at or below the infiltrative surface is frozen the construction should not occur. If the soil moisture content and the condition of the soil allows, the distribution field area should be prepared in a manner that minimizes site disturbance. The distribution field site should be cleared of all obstructions prior to bringing materials on site. The lateral lines can be directed around trees or bushes. The site should be prepared as needed to enable a grass cover to be established and maintained prior to drip line lateral installation.

2. Set up a construction level, engineer’s, or laser level and tape to assure conformation with natural contours and design requirements for sizing, location, and separations to determine all relative elevations in relationship to the system benchmark.

3. It is suggested that the four corners of the distribution field or of each zone within the distribution field be marked. The top two corners should be at the same elevation and the bottom two corners should be at a lower elevation. Because of freezing conditions, the bottom drip line must be higher than the supply line connection at the dosing chamber and the return flushing line connection to the building sewer. Lay out the distribution area(s) on the site so that the distribution field runs parallel with the land surface contours and is within the designated area.

4. Consult with the manufacturer of the drip line tubing regarding appropriate trenching techniques.

O&M and Troubleshooting

Primary treatment tanks and pump tanks are to be inspected routinely and maintained when necessary. Recommended maintenance tasks of the drip system depend on the manufacturer and specific components of the system. The manufacturer should be consulted and maintenance performed in accordance with the manufacturer’s recommendations. Inspections of the drip system components should be performed at least twice every year by a licensed professional. Maintenance of a drip distribution system is similar to maintaining other systems. The tubing and emitters themselves are designed to self-clean, but will still need periodic cleaning, even though they have the automatic self-flushing feature.

Inspections will include:

- If the filters are plugging and pretreatment is working correctly, you need bigger filters
- Checking the system to ensure flush and alarm systems are functioning properly
- Checking flush valves and vacuum release valves and cleaning if necessary
- Checking pressure-reducing valves to see if cleaning is needed
- Ensuring that dose volumes registered on the water meter are acceptable in accordance with the system design dose
- Checking pump discharge capacity
- Ensuring that wet or damp spots do not appear on the surface of the distribution field
Rodents are active in some areas and can damage drip system components. Gophers have been reported to eat through drip lines and burrow into valve boxes and other enclosures, where they can damage components or simply fill the valve box up with soil. One drip line manufacturer reports that rodents will not burrow towards a drip line when the ground is kept continuously moist (one reason for high-frequency dosing). This still could pose a problem during system dormancy—when a drip system is charged and tested and then left out of service for a period of time, such as with seasonal usage, or where a system has been in continuous use, but is temporarily shut down during a family vacation. Ideally, a drip system should be tested shortly before it is placed into continuous service. Another means of discouraging rodents is to add enough butyric acid to the pump chamber to achieve a two-ppm solution. Butyric acid is the substance that gives spoiled butter its rancid smell. This substance is relatively harmless but creates an unpleasant odor. Possible ways to prevent rodents from burrowing into valve boxes are to line the bottom of the valve box with bricks, drain rock, or other hard material to create a barrier to digging, or to sprinkle butyric acid or powdered boric acid at the bottom of the enclosure, creating an unpleasant odor. Avoid sprinkling anything corrosive on wires or other drip components.
References


McCarthy, B., Monson Geets, S., Axler, R. and J. Henneck. Performance of an Aerobic Treatment Unit and Drip Dispersal System for the Treatment of Domestic Wastewater at the Northeast Regional Corrections Center. NRRI/TR-01/33. NRRI, Duluth, MN.
