Drip Irrigation Course

Table of Contents

main page

Overview of Drip Irrigation

Chapter 1

OVERVIEW OF DRIP IRRIGATION

* What You Will Learn in This Chapter
* Components of a Drip Irrigation System
* Drip Irrigation Absorption Area Terminology
* Advantages and Disadvantages of Drip Irrigation
* Elements of Success in Drip Irrigation

NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Overview of Drip Irrigation

Chapter 1 What You Will Learn in This Chapter

- The components of a drip irrigation system.
- The secondary treatment options for the system.
- Drip irrigation absorption area terminology.
- The advantages and disadvantages of drip irrigation.
- Elements for success of a drip irrigation system.

BACK HOME NEXT

Back to the Table of Contents

Overview of Drip Irrigation

Chapter 1 Components of a Drip Irrigation System page 3 out of 14 pages

1) Building sewer

- No regulation changes; same as conventional systems

2) Primary treatment

Septic tank or aerobic tank; same as conventional systems

3) Secondary treatment

- Intermittent sand filtration
  - Free access
  - Buried
- Check the DEP Alternate Guidance for alternate secondary treatment options
- Aerobic tank (Some units can be used as primary and secondary treatment)

4) Pump tank to hydraulic unit

5) Hydraulic unit

6) Drip zones

BACK HOME NEXT

Back to the Table of Contents

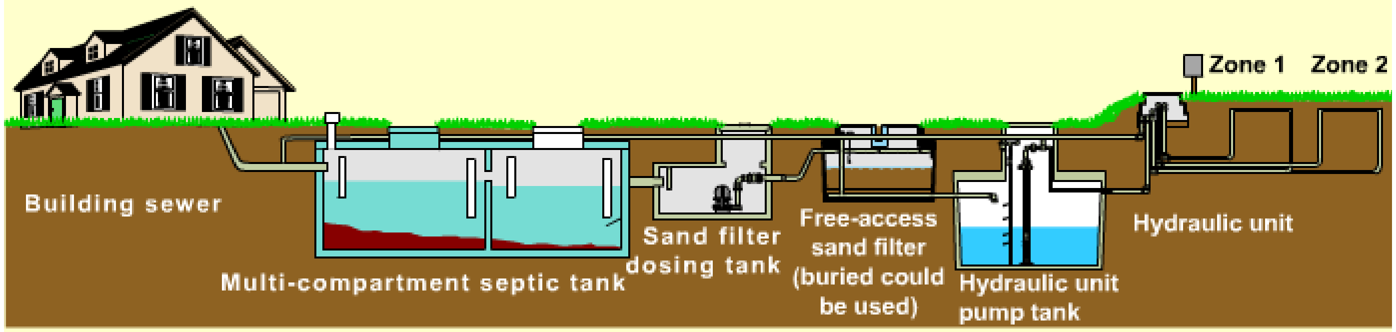
Drip Irrigation Training Course

Overview of Drip Irrigation

Chapter 1

Components of a Drip Irrigation System

Drip System with a Septic Tank and Intermittent Sand Filter



- Secondary treatment can be obtained with an intermittent sand filter (free access or buried).

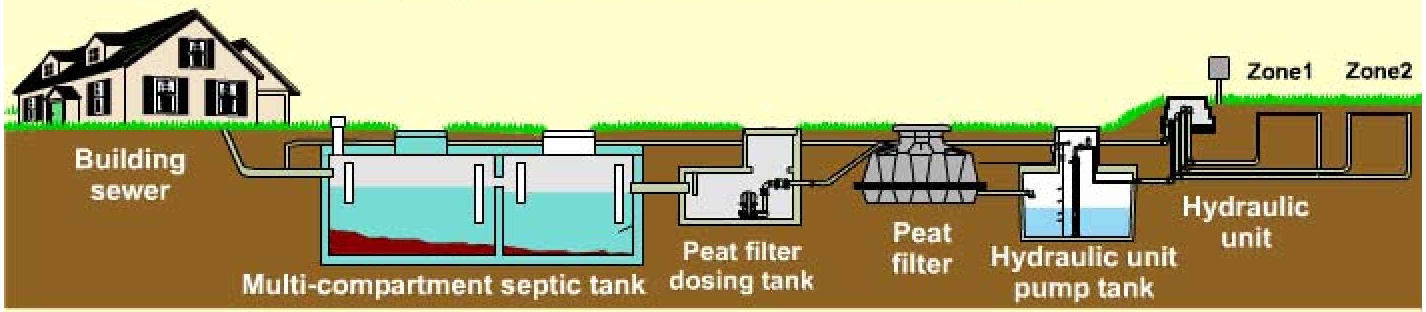
BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Overview of Drip Irrigation

Components of a Drip Irrigation System



- Secondary treatment can be obtained with a secondary treatment filter option.

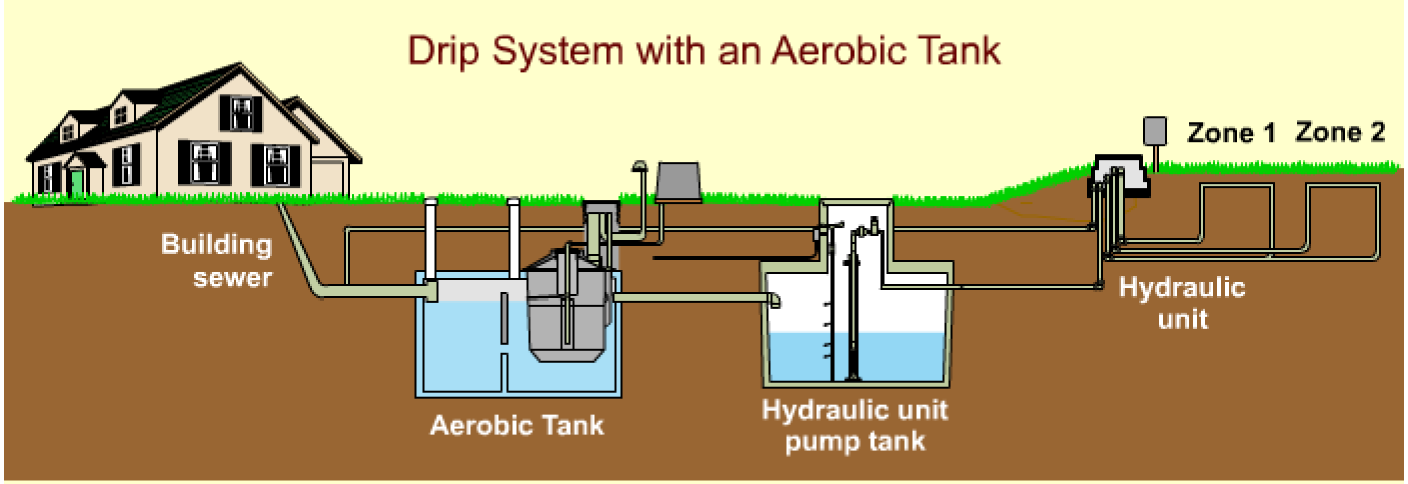
BACK HOME NEXT

Back to the Table of Contents

Overview of Drip Irrigation

Chapter 1

Components of a Drip Irrigation System

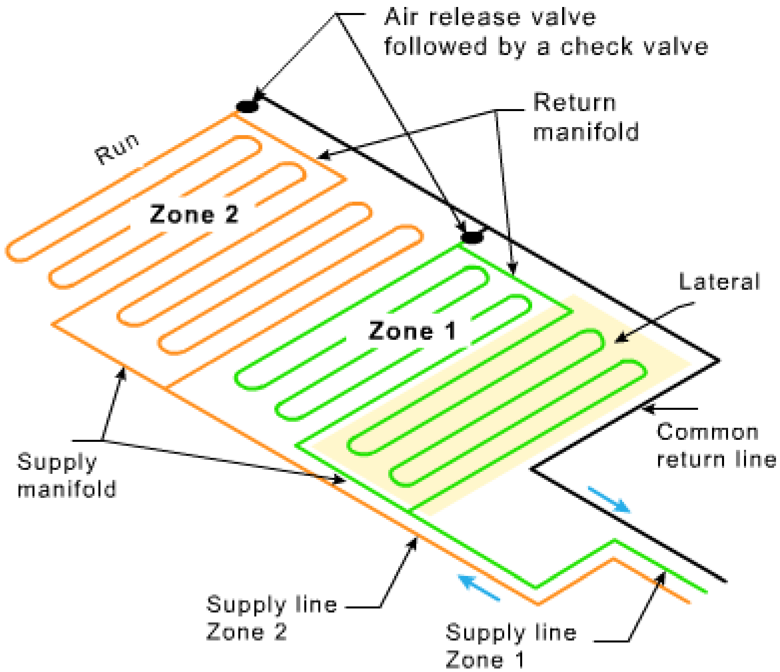


- When an approved aerobic tank is used as primary treatment, a filter is not required. The approved aerobic tank also provides the secondary treatment.

Overview of Drip Irrigation

Chapter 1

Drip Irrigation Absorption Area Terminology



Instructions: *Read the definition, then locate and click the corresponding term in the diagram on the left.*

One continuous length of drip tubing runs along the contour and is connected to a supply manifold or a return manifold or looped to another run.

BACK HOME NEXT

Back to the Table of Contents

Overview of Drip Irrigation

Chapter 1 Advantages and Disadvantages of Drip Irrigation

Advantage

Cleaner effluent is discharged to the ground because of secondary treatment.

BACK HOME NEXT

Back to the Table of Contents

Overview of Drip Irrigation

Advantage

Drip irrigation can be used on slopes up to 25%.

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Overview of Drip Irrigation

Chapter 1 Advantages and Disadvantages of Drip Irrigation

Advantage

Drip irrigation reduces the chance of clogging the soil pores.

BACK HOME NEXT

Back to the Table of Contents

Overview of Drip Irrigation

Chapter 1 Advantages and Disadvantages of Drip Irrigation page 11 out of 14 pages

Advantage

Drip irrigation provides for the desirable unsaturated flow of water through the soil.

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Overview of Drip Irrigation

Chapter 1 Advantages and Disadvantages of Drip Irrigation page 12 out of 14 pages

Advantage

Drip irrigation uses frequent small doses.

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Overview of Drip Irrigation

Chapter 1 Advantages and Disadvantages of Drip Irrigation page 13 out of 14 pages

Disadvantage

Drip irrigation may cost more than an elevated system.

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Overview of Drip Irrigation

Chapter 1 Elements for Success in Drip Irrigation

- Hydraulic capacity of soil must not be overloaded.
- Initial soil and siting conditions must be appropriate.
- System must be sized correctly.
- Area covered by drip irrigation tubing must be sufficient enough to allow wastewater to enter soil, be treated, and move through the soil at a sufficient rate so it will not rise to the surface.

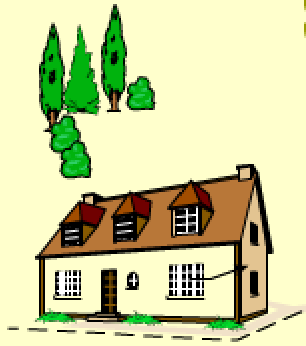
BACK HOME

Back to the Table of Contents

Site Evaluation

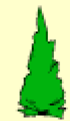
Chapter 2

page 1 out of 17



SITE EVALUATION

- What You Will Learn in This Chapter
- System Criteria
- Permit Issuance
- Isolation Distances
- Slope
- Soils
- Role of the SEO in Issuing a Permit



NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Site Evaluation

Chapter 2

What You Will Learn in This Chapter

- The site testing needed to issue a drip irrigation permit.
- What must be included in a soil scientist report.
- The role of the SEO in issuing a drip irrigation permit.

BACK HOME NEXT

Back to the Table of Contents

Site Evaluation

System Criteria

- Isolation distances must be measured from a perimeter extending 2 feet beyond the outermost drip tubing in a drip irrigation zone.
- Slope — up to 25%
- Limiting zone — ≥ 20 inches - for a seasonal high water table limiting zone

  ≥ 20 inches - for a rock limiting zone

> Note: A minimum vertical isolation distance of 20 inches must be maintained between the depth of drip irrigation tubing and the shallowest indication of rock that is defined as a limiting zone.

BACK HOME NEXT

Back to the Table of Contents

Site Evaluation

Chapter 2

Permit Issuance

For an SEO to issue a drip irrigation permit, the following is needed:

Instructions: *In the order of the following statements, find and click the correct word in the list at the bottom. When the correct word is clicked, it will appear in the sentence in place of the blank .*

SEO verification that ____?____ are met.

SEO verification that ___?___ requirement is met.

A ______?______ done by a soil scientist. The SEO must verify the soil probe(s).

SEO reviewed the __?__

slope | soil morphological evaluation | isolation distances | design

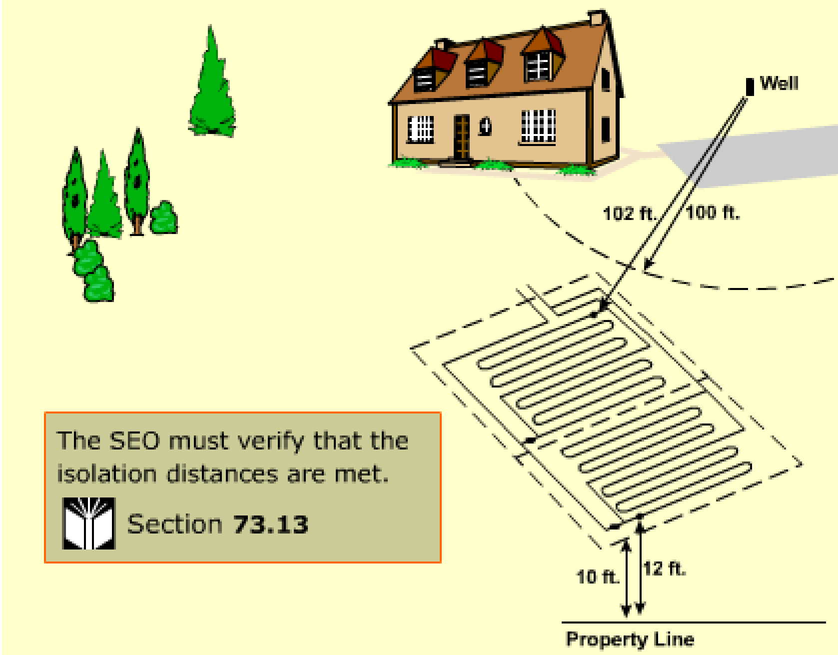
BACK HOME NEXT

Back to the Table of Contents

Site Evaluation

Chapter 2

Isolation Distances



The SEO must verify that the isolation distances are met.

Section **73.13**

Isolation distances must be measured from a perimeter extending _?_ feet beyond the outermost drip tubing in a drip irrigation zone.

BACK HOME NEXT

Back to the Table of Contents

Site Evaluation

Slope

The SEO must verify that the slope requirements are met.

Section 12.A.2

Maximum slope for a drip irrigation system = 25%

An advantage of the drip irrigation system is that it can be used on steeper slopes than some conventional onlot systems.

BACK HOME NEXT

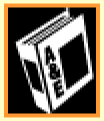
Back to the Table of Contents

Site Evaluation

Soils

LIMITING ZONES

Minimum Depth of Suitable Soil to a Limiting Zone and Drip Tube Placement



Section 12.A.3

Depth to a seasonal high water table limiting zone ≥ **20** inches

Drip tube depth:

20-inch limiting zone to a seasonal high water table - drip tube installed at a minimum of **6** inches deep to a maximum of **12** inches.

6 inches is the optimum installation depth.

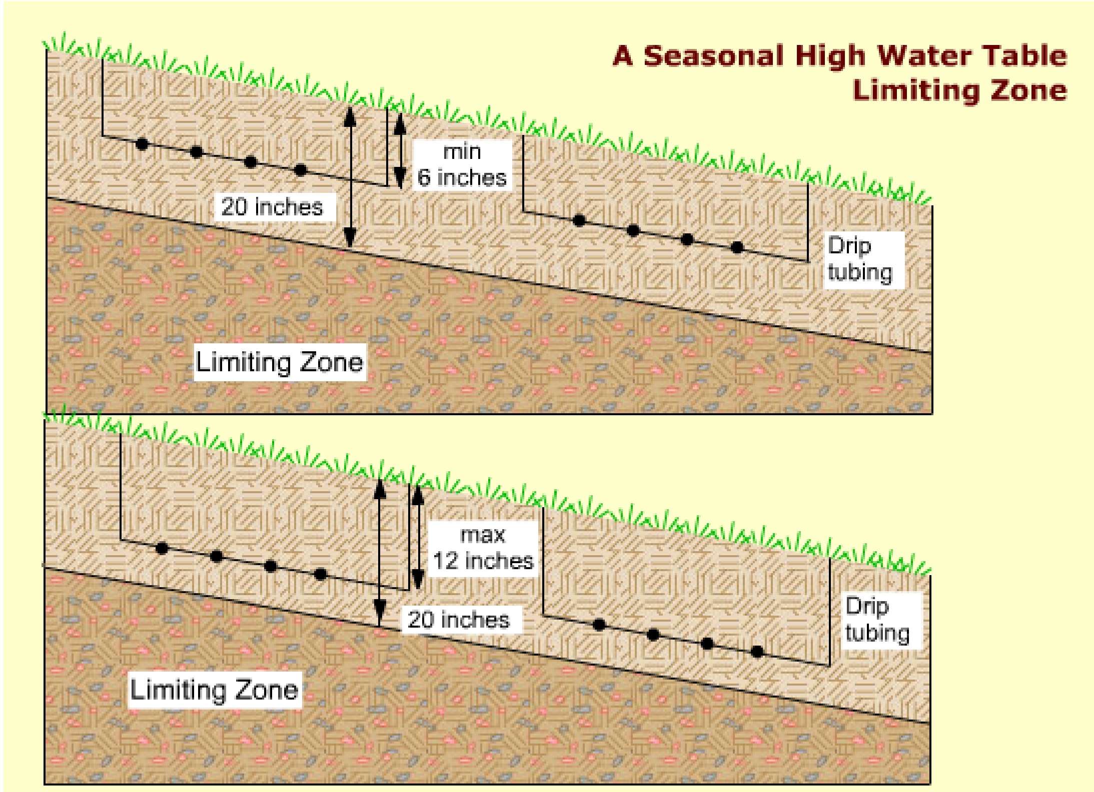
BACK HOME NEXT

Back to the Table of Contents

Site Evaluation

Chapter 2

Soils



BACK HOME NEXT

Back to the Table of Contents

Site Evaluation

Soils

Depth to a rock limiting zone ≥ 20 inches

Drip tube depth:

A minimum vertical isolation distance of 20 inches must be maintained between the depth of installation of drip irrigation tubing and the most shallow indication of rock that is defined as a limiting zone.

Maximum drip tube installation depth **12** inches.

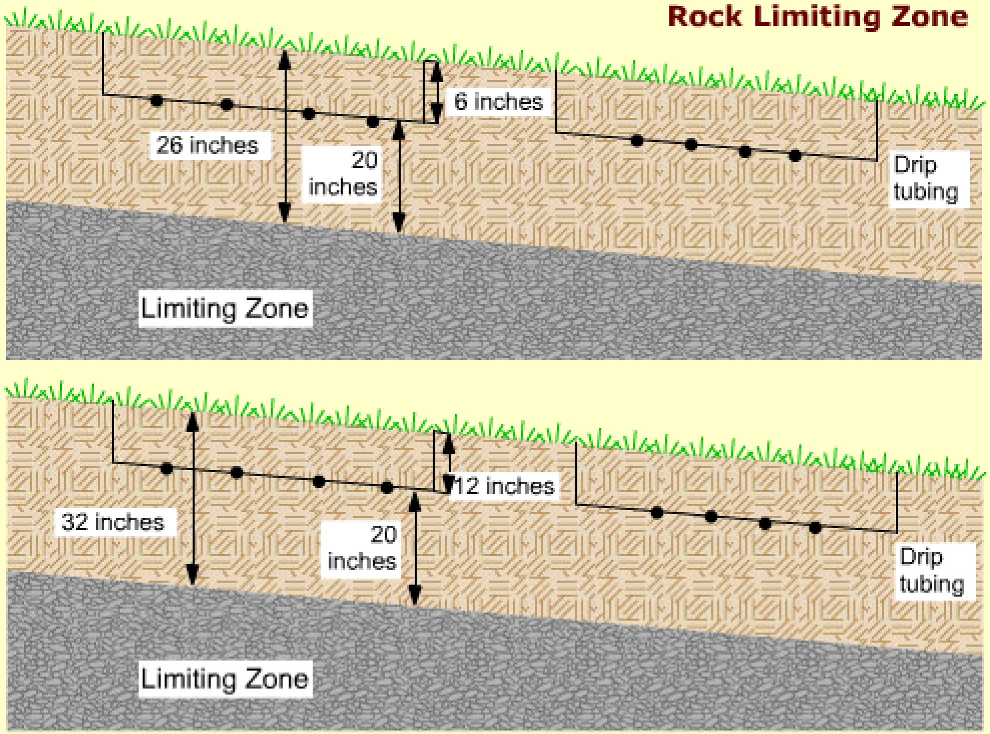
Note: If the drip tubing is installed at less than 6 inches, additional cover must be provided to a depth of 6 to 12 inches. Section 12.C.2

BACK HOME NEXT

Back to the Table of Contents

Site Evaluation

Soils



BACK HOME NEXT

Back to the Table of Contents

Site Evaluation

Chapter 2

Soils

A soil scientist must classify the soil morphology and determine the soil linear load for a drip irrigation system.

Section 12.A.1

An acceptable soil scientist is:

Section 73.1

- A professional member of Pennsylvania Association of Professional Soil Scientists (PAPSS);

or

- A "qualified soil scientist" as defined in Chapter **73.1** of the regulations.

BACK HOME NEXT

Back to the Table of Contents

Site Evaluation

Soils

The report from the soil scientist must classify the soil as either:

Well drained,
or Moderately well drained

This report must include:

- Soil linear load (minimum linear feet of drip tubing required).
- Horizontal linear load (minimum length of the system site).
- The signature of the soil scientist.
- Number and placement of soil profiles.

BACK HOME NEXT

Back to the Table of Contents

Site Evaluation

Soils

The soil profiles should be supplemented by digging with a hand auger to the depth of the limiting zone to confirm soil conditions between profiles.

For a drip irrigation system, a qualified soil scientist must determine the number and placement of soil profiles.

Note: Requirements for a minimum number of soil profiles as specified in DEP's regulations, alternate and experimental guidance, or policy regarding other onlot systems are not applicable to drip irrigation systems.

BACK HOME NEXT

Back to the Table of Contents

Site Evaluation

Soils

Soil Scientist Report Checklist

Site Conditions

- Project name
- Project location
- Date of investigation
- Soil series
- Slope

The SEO must verify the soil probe as he or she would do for any other conventional, alternate, or experimental system.

Section 72.41(l)

- **Complete profile description(s)**
  - color (Munsell notation)
  - textural classes
  - rock fragment modifiers
  - abundance, size, contrast, and color of mottles
  - grade, class, and type of structure
  - consistence
  - boundary

BACK HOME NEXT

Back to the Table of Contents

Site Evaluation

Soils

Soil Scientist Report Checklist

Drip Irrigation Criteria

- Depth to seasonal high water table limiting zone
- Depth to a rock limiting zone
- Soil drainage classification
- Soil linear load (min. linear feet of drip tubing required)
- Horizontal linear load (min. length of the system site)
- Tubing installation depth (recommended)

BACK HOME NEXT

Back to the Table of Contents

Site Evaluation

Soils

Soil Scientist Report Checklist

Soil Scientist Qualifications / Requirements

- **Soil scientist who is a:**

  Professional member of the Pennsylvania Association of Professional Soil Scientists (PAPSS)

  or

  "Qualified soil scientist" as defined in Chapter 73, Section 73.1

- **Signature of the soil scientist on the soil morphological report**

BACK HOME NEXT

Back to the Table of Contents

Site Evaluation

Role of the SEO in Issuing a Permit

Q: What have you learned so far is the SEO's role in issuing a drip irrigation permit?

A: The SEO must verify the isolation distances, slope, and soil probe. The SEO must also check the soil morphology report for completeness using the soil scientist report checklist.

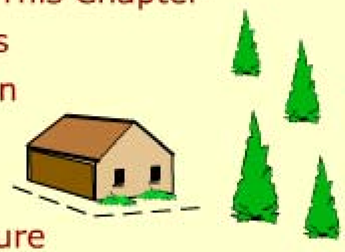
BACK HOME

Back to the Table of Contents

Drip Irrigation-Sewage Renovation

Chapter 3 page 1 out of 32

DRIP IRRIGATION-SEWAGE RENOVATION



NEXT

Back to the Table of Contents

Drip Irrigation Training Course

What You Will Learn in This Chapter

- Drip irrigation applies wastewater in small, frequent doses, which maintains an aerobic environment in the soil.
- Two important soil characteristics direct water movement through a soil profile and influence the soil's ability to hold water against gravitational forces.
- The renovative capacity of soil is significantly enhanced when wastewater is applied at a rate that provides unsaturated flow.
- Soil morphological features are used to properly size a drip irrigation system, to promote an aerobic soil environment, and to improve wastewater renovation.

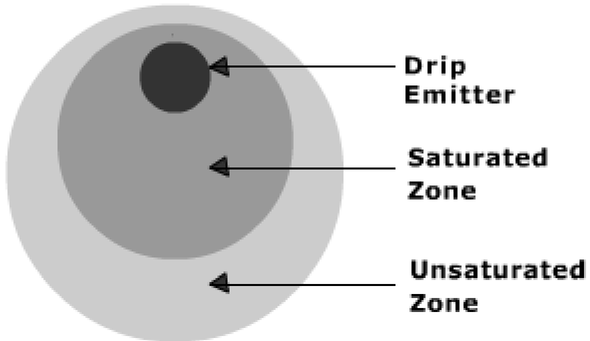
BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation-Sewage Renovation

Drip Irrigation Concepts

Emitter in a Drip Irrigation System



- Frequent low-pressure applications of effluent to the soil result in conditions that promote wastewater renovation. A drip irrigation system provides this type of application.

- These frequent, small doses allow the soil to remain in an aerobic condition. Unsaturated flow occurs in this condition.

- During unsaturated flow, exchange sites in soil pores facilitate the chemical, physical, and biological processes that filter and renovate wastewater effluent.

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation-Sewage Renovation

Aeration and Renovation

Unsaturated flow typically occurs in an aerobic environment.

Why is aeration important?

Wastewater has a BOD (biological oxygen demand).
This is the quantity of oxygen used in the biochemical oxidation of organic and inorganic matter in a specified time, at a specified temperature, and in specified conditions. It is an indirect measure of the concentration of biologically degradable material present in organic wastes.

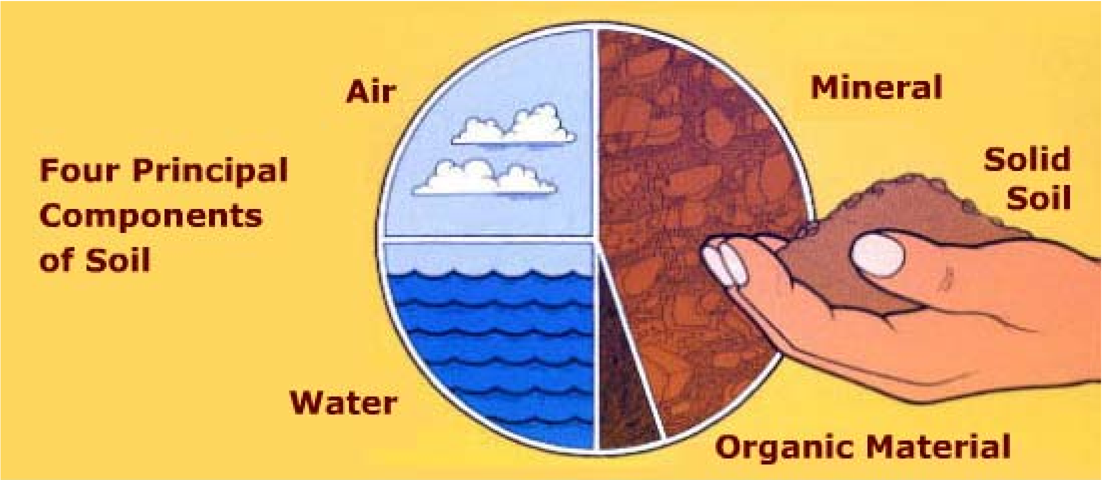
BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation-Sewage Renovation

Chapter 3

Components of Soil



In a typical soil, about **25%** of the volume is water and **25%** of the volume is air. The rest of the soil is made up of solid material, consisting of mostly mineral and a small amount of organic material.

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation-Sewage Renovation

Soil Porosity

- Porosity is the component of a soil body that is not occupied by solid material (mineral or organic). It is the available pore space that is filled with air or water (about 50% in a typical soil).

- Porosity is influenced by **texture** and **structure**. These two soil characteristics have a direct influence on aeration, infiltration of water, and movement of water through the soil profile.

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation-Sewage Renovation

Soil Porosity

Relative Pore Size

Macropores

These larger pore spaces are often **air** filled and they usually transmit water flow under saturated conditions.

Micropores

These smaller pore spaces fill first with water under unsaturated flow. Most renovation is associated with these micropores. Unsaturated flow provides improved wastewater renovation, which usually occurs in these pores.

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation-Sewage Renovation

Chapter 3

Soil Texture and Structure

Listed below are two important soil characteristics that influence the aerobic conditions in soil:

Instructions: Click on the correct answer.

? **Soil Texture**
? **Soil Structure**
is the relative percentages of sand, silt, and clay particles.

? **Soil Texture**
? **Soil Structure**
is the combination or arrangement of soil particles into units or peds of recognizable shapes.

BACK HOME NEXT

Back to the Table of Contents

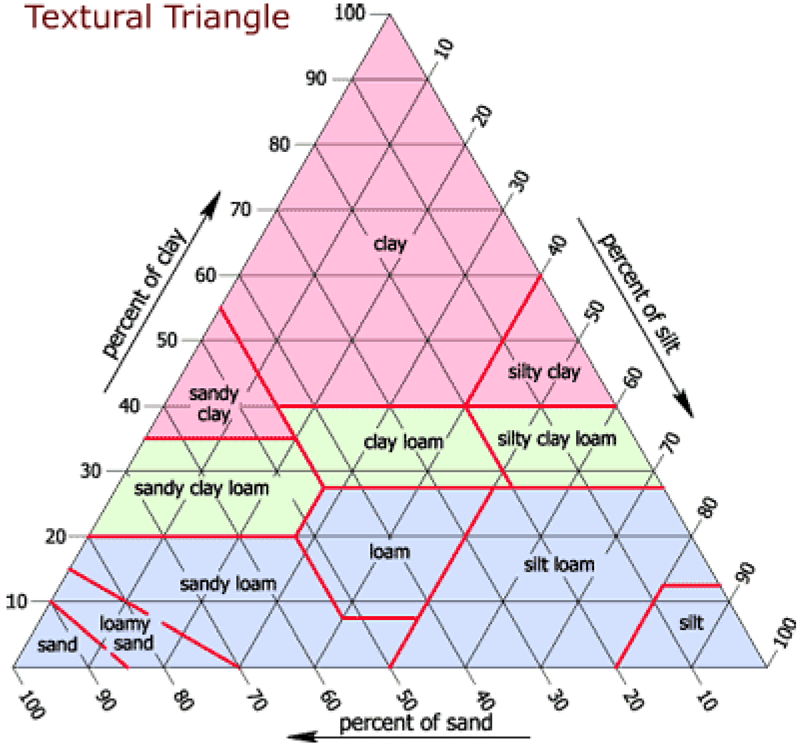
Drip Irrigation Training Course

Drip Irrigation-Sewage Renovation

Chapter 3

Soil Texture and Structure

Textural Triangle



Texture

- Soil texture is the percent of sand, silt, and clay in a soil.
- Soil texture modifies water movement through the soil profile due to its influence on pore size.

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Texture and Pore Size

Instructions: Click on the correct answer.

? Macropores
? Micropores
are associated with sandy textures.

Sandy soils are generally well-aerated soils, because the larger pores are typically filled with oxygen from the atmosphere. This texture is low in total porosity, yet individual pore sizes are large.

? Macropores
? Micropores
are associated with silt and clay textures.

Silty and **clayey** soils are generally less-aerated, because the smaller pores may be filled with water. These textures are high in total porosity, yet individual pore sizes are small.

Texture and Pore Size

The rate of water movement is directly related to **pore size**.

Texture also affects the amount of air and water present in the soil.

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation-Sewage Renovation

Soil Texture and Structure

Structure

- Structure is the combination or arrangement of primary soil particles (sand, silt, and clay) into secondary units or peds.
- These secondary units provide an additional network of macropores and micropores. Structural units further influence the content and movement of air and water in the soil.
- The individual structural units can be categorized by general types or shapes, which may determine the rate of water flow through the soil.

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation-Sewage Renovation

Soil Texture and Structure

Granular Structure

- Granular structure typically occurs close to the surface of the soil.
- The spherical granules generally do not pack tightly, primarily leaving macropores between individual structural units.
- Water flow is usually good, aeration is good, and wastewater renovates well in this structure.

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation-Sewage Renovation

Soil Texture and Structure

Angular and Subangular Blocky Structure

- These structures are block-like in shape with either angular or rounded edges.
- As the units pack together, they have more micropores and fewer macropores than granular structure.
- Angular and subangular blocky structures are good for water movement and aeration and provide good hosts for wastewater renovation.

Subangular Blocky Structure

Subangular Blocky Structure

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation-Sewage Renovation

Soil Texture and Structure

Prismatic and Platy Structures

- These structures have reduced water movement and poor aeration.
- Platy structure has a long horizontal axis, and prismatic structure has a long vertical axis.
- These structures are not desirable for soil horizons receiving wastewater.

Platy structure

Prismatic structure

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation-Sewage Renovation

Structure Review

Do the structures listed below have good aeration and water movement and are therefore good hosts for receiving wastewater?

Instructions: Click on the correct answer.

- Granular - YES
- Angular Blocky - YES
- Subangular Blocky - YES
- Platy - NO
- Prismatic - NO

Drip Irrigation-Sewage Renovation

The Soil-Wastewater Relationship

- The soil characteristics of texture and structure influence the way water moves through soil.
- The properties associated with these soil characteristics affect water flow. Natural forces also direct water movement through soils.
- The interrelationship of these characteristics, properties, and forces determines the rate and direction of water movement through the soil.

BACK HOME NEXT

Back to the Table of Contents

Properties of Water

- **Cohesion** causes water molecules to attract to **other water molecules.**
- **Adhesion** causes water molecules to attract to **solid surfaces.**

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation-Sewage Renovation

The Soil-Wastewater Relationship

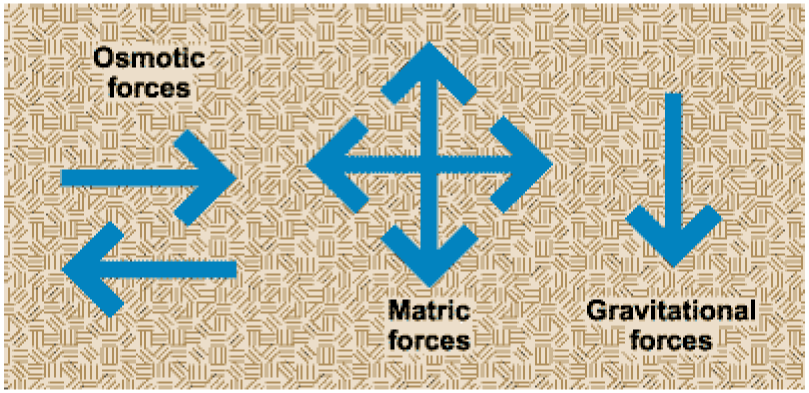
Natural Forces That Affect Water Flow Through Soils

- **Gravitational** forces result in the downward movement of water in saturated flow.
- **Matric** forces are the cohesive and adhesive forces that result in capillary action during unsaturated flow. Capillary action is the ability of water to move against the force of gravity.
- **Osmotic** forces involve the chemical interaction between ions occurring in soil and water.
- Gravitational forces pull the water **downward**, matric forces may pull the water in **any** direction, and the osmotic forces are associated with any corresponding **chemical** reactions. All of these forces affect the flow of wastewater through soil.

BACK HOME NEXT

Back to the Table of Contents

Natural Forces of Water



Water Movement Through Soil

The two flows that affect wastewater renovation:

- **Saturated** flow - Water movement without adequate renovation.
- **Unsaturated** flow - Water movement with adequate renovation.

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation-Sewage Renovation

The Soil-Wastewater Relationship

Saturated Flow

- Saturated flow refers to the movement of water through soil that typically occurs in the macropores.
- Saturated flow results when micropores and macropores are filled with water and gravitational forces overcome the capillary forces associated with adhesion and cohesion.

  The water flows downward through the soil driven by gravitational force in an anaerobic condition. Wastewater under saturated flow creates an anaerobic environment.

- Is this environment conducive to good wastewater renovation?
  Exchange sites are occupied by water molecules in the micropores when soils are saturated. Consequently, the renovation of effluent is significantly **reduced** during saturated flow.

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation-Sewage Renovation

The Soil-Wastewater Relationship

Unsaturated Flow

- Unsaturated flow results when the soil moisture content is below field capacity. Field capacity occurs when the matric and gravitational forces are equal. When the two forces are equal, the soil is able to hold onto or adsorb the water.
- **Adsorption** – The process by which atoms, molecules, or ions are taken up from the soil solution or soil atmosphere and retained on the surface of solids by chemical or physical binding.
- When water is held in the soil, it remains in contact with the exchange sites. Typically, chemical and biological reactions occur at these sites.
- Water movement through these micropores during unsaturated flow results in improved renovation.
- Unsaturated flow almost always occurs under aerated soil conditions. When soil conditions are aerobic, the renovative capacity of the soil is **improved**. Air is also available to assist with the breakdown of organic materials found in wastewater.

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation-Sewage Renovation

The Soil-Wastewater Relationship

Summary of Water Movement Through Soil

Unsaturated Flow

This flow occurs through the micropores, and it allows a longer retention time in the soil for bacteria and virus to die off. Consequently, there will be little or no migration of these organisms.

Saturated Flow

This flow occurs when the micropores are filled and the wastewater moves through the macropores of the soil. Bacteria and viruses travel along with the wastewater through these macropores. This flow may not allow the retention time necessary for the decay of anaerobic organisms and the corresponding organic decomposition that occurs in an aerobic environment.

BACK HOME NEXT

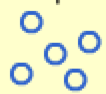
Back to the Table of Contents

Drip Irrigation-Sewage Renovation

The Soil-Wastewater Relationship

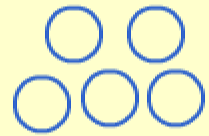
Summary of Water Movement Through Soil

Micropores



Instructions: Choose the correct flow that is represented in each of the drawings below.

Macropores

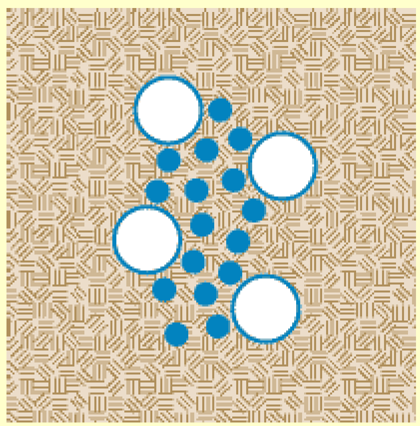


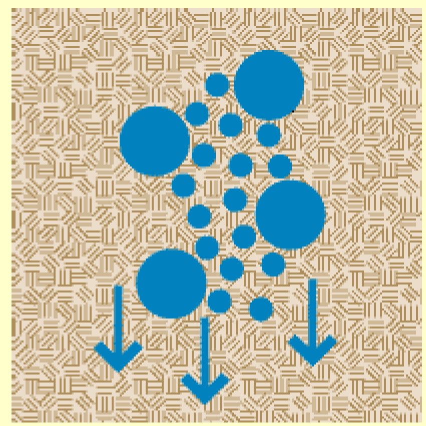
CORRECT!

? Unsaturated Flow

CORRECT!

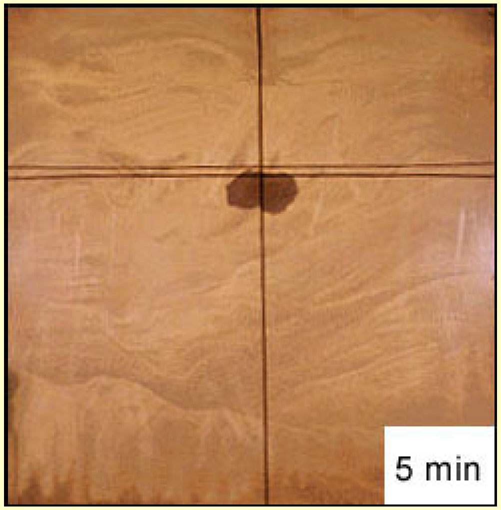
? Saturated Flow





Drip Irrigation-Sewage Renovation

Water Flow Through the Soil Using a Drip Emitter

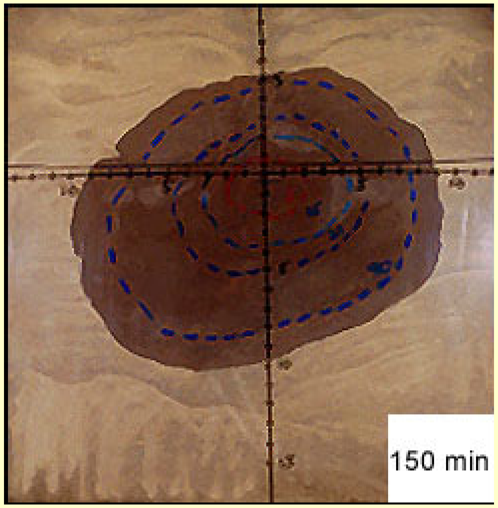


A single emitter was placed in dry soil. The emitter is located at the intersection of the vertical and horizontal lines in the photo at left. As more water is added in the photos that follow, note how the shape of the wetting front changes.

BACK HOME NEXT

Back to the Table of Contents

Water Flow Through the Soil Using a Drip Emitter



After 150 minutes of constant flow, the wetting front has extended 10 inches to each side (matric forces) and below the emitter (gravitational forces). It has extended 6 inches above the emitter (matric forces). Unsaturated flow is at the outer edge of the wetting front, and saturated flow is closer to the emitter.

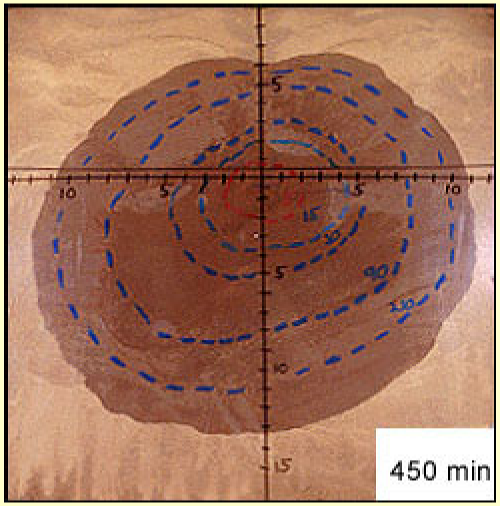
BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation-Sewage Renovation

Chapter 3 Summary of Water Movement Through Soil page 28 out of 32

Water Flow Through the Soil Using a Drip Emitter



After 450 minutes of constant flow, the wetting front has extended 13 inches below the emitter, 6 inches above the emitter, and 11 inches to each side of the emitter. Saturated flow is beginning to move the wetting front in the downward direction more rapidly.

This picture shows how the wetting front has continued moving in all directions exhibiting unsaturated flow. Capillary actions are still pulling the wetting front laterally and upward but at a relatively reduced rate.

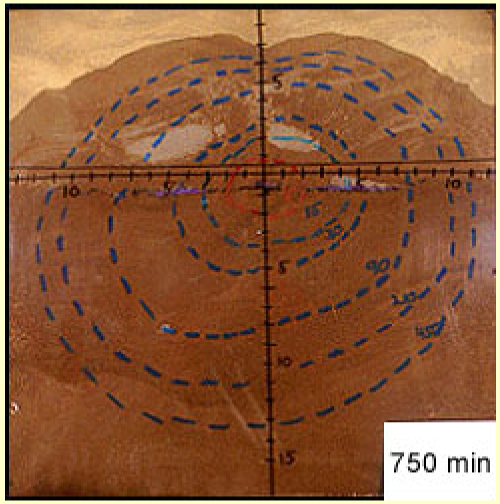
BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation-Sewage Renovation

Chapter 3 Summary of Water Movement Through Soil page 29 out of 32

Water Flow Through the Soil Using a Drip Emitter



After 750 minutes of constant flow, most of the soil pores are filled, resulting in increased saturated flow. Capillary action is no longer pulling the wetting front up as gravity overcomes the soil's adhesive and cohesive forces and pulls the wetting front down.

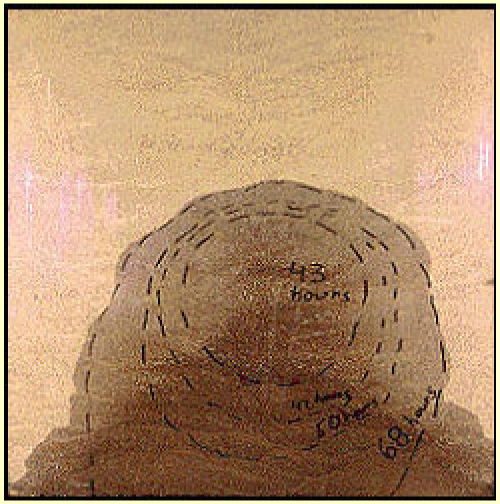
BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation-Sewage Renovation

Summary of Water Movement Through Soil

Water Flow Through the Soil Using a Drip Emitter



This picture shows the wetting front for a drip irrigation system. The drip emitter has not been run constantly in this model but has been dosed and allowed to rest between doses. Note the difference in the wetting front for a drip irrigation system compared to the previous photos.

Unsaturated flow is pulling the wetting front laterally and upward. Below the emitter, there is a reduced area of saturated flow. The dosing allows for a greater percentage of the wetting front to be in an unsaturated condition.

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation-Sewage Renovation

Review

Instructions: Choose the correct answers in the following statments.

Wastewater should be applied to the soil at a rate that provides **unsaturated** flow conditions.

CORRECT!

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation-Sewage Renovation

Summary of Water Movement Through Soil

Review

- Drip irrigation distributes frequent, small doses of wastewater evenly throughout a large area. Consequently, this sustains an CORRECT! / aerobic environment in the soil where wastewater is more effectively treated.
  The corresponding unsaturated flow of wastewater through soil yields improved renovation.
- Drip irrigation takes maximum advantage of the soil's natural porosity / CORRECT! and maintains an aerobic environment, which improves permeability and encourages BOD reduction. This system also promotes optimal unsaturated flow conditions and provides the retention time needed for bacteria and virus to die off.

BACK HOME

Back to the Table of Contents

System Components — Treatment

Chapter 4 A

NEXT

Back to the Table of Contents

System Components — Treatment

What You Will Learn in This Chapter

- ☑ The components of the drip irrigation system.
- ☑ The options for primary and secondary treatment.

BACK HOME NEXT

Back to the Table of Contents

System Components — Treatment

Chapter 4 A

Smith Design Example

Throughout the next three chapters, you will find it helpful to use the information in the appendix. If you have not printed the pages from the appendix, click on the View Appendix button below and print them now. The following chapters were designed to use information from the appendix.

VIEW APPENDIX

In this chapter, you will learn more about the components of the Smith drip irrigation system and review the Smith design.

SMITH DESIGN CRITERIA

- Number of bedrooms – 3-bedroom single-family home
- Slope – 11%
- Limiting zone – 42 inches to a seasonal high water table
- Soil loading rate – .33 gal. per day/linear foot
- Horizontal linear load rate – 4.6 gal. per day/linear foot

BACK HOME NEXT

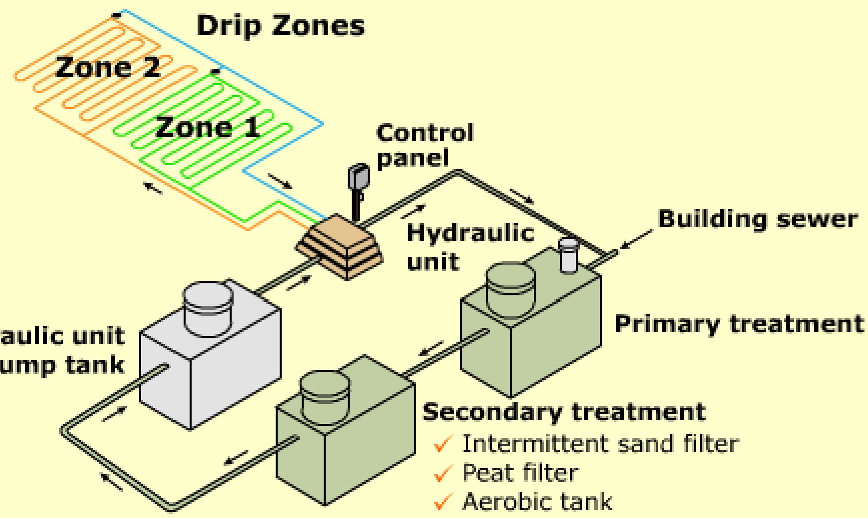
Back to the Table of Contents

System Components — Treatment

Chapter 4 A

System Components

page 4 out of 13



Drip Irrigation System Components

Building Sewer ⇨ Primary treatment ⇨ Secondary treatment ⇨ Pump ⇨ Hydraulic unit ⇨ Zones

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

System Components — Treatment

Building Sewer

Section 73.21

- The building sewer for a drip system must meet all the requirements of the Department of Environmental Protection regulations regarding onlot sewage systems.

Drip Irrigation System Components
BUILDING SEWER ⇨ Primary treatment ⇨ Secondary treatment ⇨ Pump ⇨ Hydraulic unit ⇨ Zones

BACK HOME NEXT

Back to the Table of Contents

System Components — Treatment

Primary Treatment

Sections 73.31 and 73.32

Two Options:

1) Septic tank(s)

- The septic tank or tanks for a drip system must meet all the requirements of the Department of Environmental Protection regulations regarding onlot sewage systems.

2) Aerobic tank

- An aerobic tank must be approved by the National Sanitation Foundation (NSF) as specified in the Department of Environmental Protection regulations regarding onlot sewage systems, or it must be a department-approved tank.

Note: The designer may choose either primary treatment option to use in a drip irrigation system design.

Drip Irrigation System Components
Building Sewer ⇨ PRIMARY TREATMENT ⇨ Secondary treatment ⇨ Pump ⇨ Hydraulic unit ⇨ Zones

BACK HOME NEXT

Back to the Table of Contents

System Components — Treatment

Primary Treatment

SMITH DESIGN

What primary treatment option did the designer choose for the Smith design?
(Refer to note #1 on the design plan from the appendix, and click on the correct answer.)

a) Two septic tanks

b) Multiple-compartment septic tank

c) Aerobic tank

System Components — Treatment

Primary Treatment

Three Secondary Treatment Options:

1) Intermittent sand filtration

2) An alternate guidance secondary treatment option

3) Aerobic tank *(An aerobic tank that is approved for secondary treatment for this system can provide both primary and secondary treatment.)*

Note: The designer may choose any of the secondary treatment options above in a drip irrigation system design.

Drip Irrigation System Components
Building Sewer ⇨ Primary Treatment ⇨ SECONDARY TREATMENT ⇨ Pump ⇨ Hydraulic unit ⇨ Zones

BACK HOME NEXT

Back to the Table of Contents

System Components — Treatment

Chapter 4 A

Secondary Treatment

page 9 out of 13

Pump from the Primary Treatment to the Intermittent Sand Filter or Alternate Treatment Filter Option

Sections 73.44 — 73.46

- The pump for the sand filter or peat filter must meet the requirements of the Department of Environmental Protection regulations regarding onlot sewage systems and the DEP alternate and experimental guidance.
- The pump is necessary for use with an intermittent sand filter.
- Some alternate secondary treatment filter options may use a lift pump or be gravity fed.

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

System Components — Treatment

Secondary Treatment

Option #1) Intermittent Sand Filtration

Section 73.162 Section 12.B.2.a

- The intermittent sand filter is a filtering system that uses sand to provide additional treatment to the effluent before it is applied to a disposal area.
- The two options of filters are:

  a) Free-access filters – These filters are easily accessible for maintenance and cleaning.

  b) Buried – These filters are buried and are not accessible.

System Components — Treatment

Secondary Treatment

Option #2) Alternate Guidance Secondary Treatment Option

- All systems must meet the DEP alternate guidance requirements.

BACK HOME NEXT

Back to the Table of Contents

System Components — Treatment

Secondary Treatment

Option #3) Aerobic Tank

- An approved aerobic treatment unit may be used in place of a primary treatment tank and a sand or peat filter.
- This option will provide both primary and secondary treatment.

DEP-Approved Aerobic Tanks for This Purpose:

Section 12.B.2.c

1) FAST system manufactured by Bio-Microbics

2) Units manufactured by Cromaglass Corporation

BACK HOME NEXT

Back to the Table of Contents

System Components — Treatment

Secondary Treatment

SMITH DESIGN

What secondary treatment option was used in the Smith design?

(Refer to note #2 on the design plan from the appendix, and click on the correct answer.)

1) Intermittent sand filtration, free access

2) Intermittent sand filtration, buried

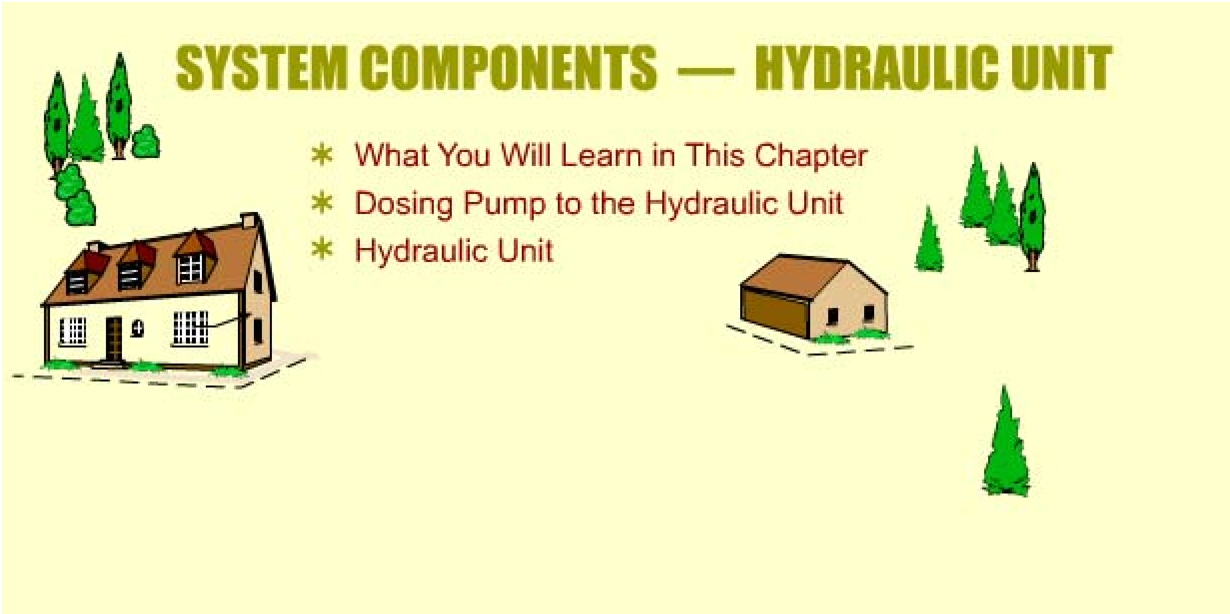
3) Peat filter

4) Aerobic tank

System Components — Hydraulic Unit

Chapter 4 B

page 1 out of 10



NEXT

Back to the Table of Contents

Drip Irrigation Training Course

System Components — Hydraulic Unit

Chapter 4 B

What You Will Learn in This Chapter

- The functions of the floats on the pump to the hydraulic unit.
- The maximum specifications for the hydraulic unit.
- The flow rates needed for the three hydraulic conditions.

BACK HOME NEXT

Back to the Table of Contents

System Components — Hydraulic Unit

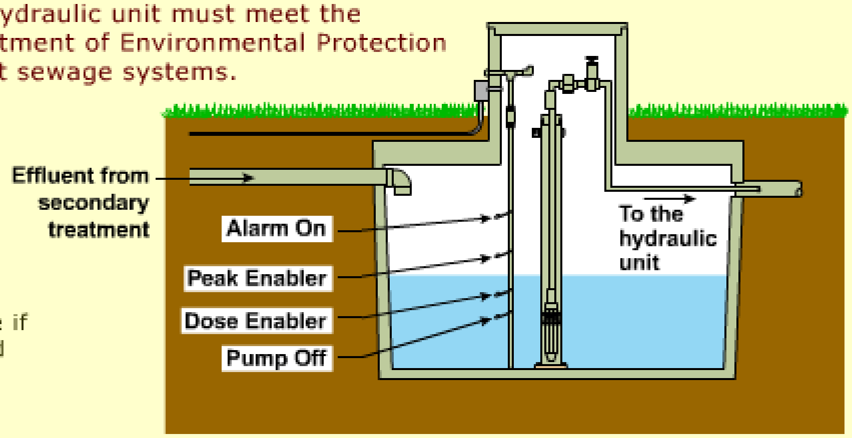
Chapter 4 B

Dosing Pump to the Hydraulic Unit

page 3 out of 10

- The dosing pump produces flow through the hydraulic unit to dose a drip zone.
- The dosing pump for the hydraulic unit must meet the requirements of the Department of Environmental Protection regulations regarding onlot sewage systems.
- The pump must be properly sized to dose the drip zones.

You will learn how to determine if a dosing pump is properly sized in Chapter 5 of this course.



Drip Irrigation System Components
Building Sewer ⇨ Primary treatment ⇨ Secondary treatment ⇨ PUMP ⇨ Hydraulic unit ⇨ Zones

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

System Components — Hydraulic Unit

Dosing Pump to the Hydraulic Unit

Size the Pump Tank

The hydraulic unit pump tank should have enough capacity to provide flow equalization and one day's capacity for emergency storage; therefore, twice the volume of the daily flow would be sufficient.

SMITH DESIGN

What size pump tank will the Smith design need?

400 gpd
×2
= 800 gallons minimum

Place the 800 gallons min. in the screened box under dosing tank to the hydraulic unit, liquid capacity on page 1 of the design review worksheet from the appendix.

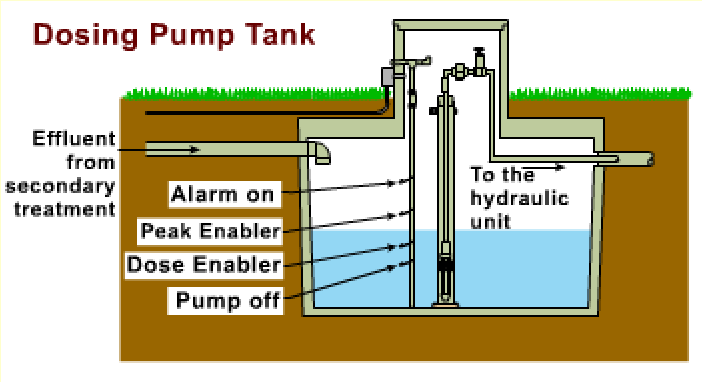
BACK HOME NEXT

Back to the Table of Contents

System Components — Hydraulic Unit

Chapter 4 B

Dosing Pump to the Hydraulic Unit



After the drip zones are laid out, the size of the dosing pump to the hydraulic unit will be selected. This will be explained later in Chapter 5.

Alarms

1) Alarm on — Notifies the homeowner that there is a problem and the pump tank is not working.
2) Peak enabler — Signals the control panel that there is an adequate volume of effluent to begin the timed dose disposal at the peak flow frequency.
3) Dose enabler — Signals the control panel that there is an adequate volume of effluent to begin the timed dose disposal at the average flow frequency.
4) Pump off — Signals the control panel that the effluent level is not high enough to permit the pump to run.

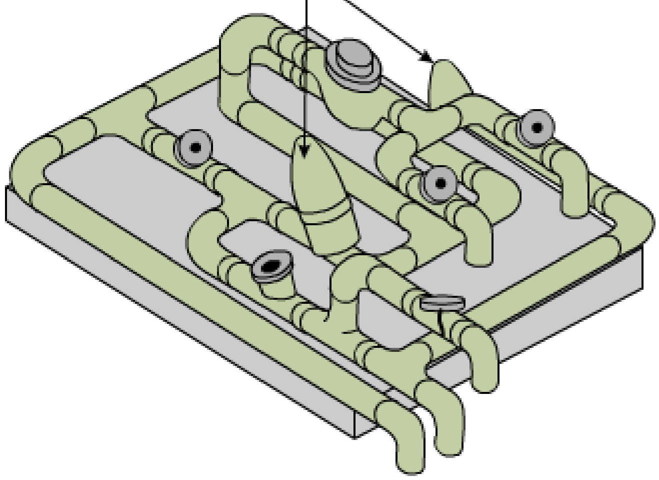
BACK HOME NEXT

Back to the Table of Contents

System Components — Hydraulic Unit

Chapter 4 B

Hydraulic Unit



The hydraulic unit controls the hydraulic conditions by controlling and directing the flow to the correct zones. It also filters the effluent to prevent solids from entering the drip tubing.

Drip Irrigation System Components

Building Sewer ⇨ Primary treatment ⇨ Secondary treatment ⇨ Pump ⇨ HYDRAULIC UNIT ⇨ Zones

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

System Components — Hydraulic Unit

Chapter 4 B

Hydraulic Unit

page 7 out of 10

Maximum Specifications:

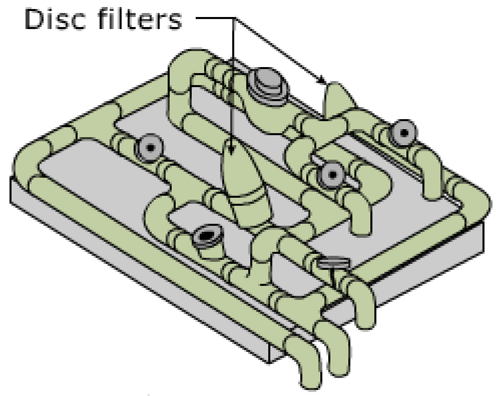
After the drip zones are designed, then the hydraulic unit (either a two-disc filter or a three-disc filter) that meets the design requirements may be chosen. The maximum specifications for each unit are listed below.

Two-disc filter unit:

- ✓ Max. 1,200 feet of tubing per zone
- ✓ Max. 15 gpm = tubing forward field flush flow rate
- ✓ Max. 5 lateral connections
- ✓ Max. 4 zones
- ✓ Max. 4,800 feet of tubing

Three-disc filter unit:

- ✓ Max. 2,400 feet of tubing per zone
- ✓ Max. 25 gpm = tubing forward field flush flow rate
- ✓ Max. 8 lateral connections
- ✓ Max. 16 zones
- ✓ Max. 38,400 feet of tubing



Two-disc filter hydarulic unit

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

System Components — Hydraulic Unit

Hydraulic Unit

Hydraulic Conditions:

- A hydraulic condition is a name given to a certain flow and its direction. There are three hydraulic conditions, and each one has a purpose, whether it is to dose the drip zone, clean the drip tubing, or back wash the disc filters.
- All three hydraulic conditions will be used at different times during the process of operating the hydraulic unit.

BACK HOME NEXT

Back to the Table of Contents

System Components — Hydraulic Unit

Hydraulic Unit

Three Hydraulic Conditions:

Different flows in particular paths are required to perform different hydraulic conditions.

1) **Back-Washing Disc Filters**

- Each filter in the hydraulic unit is back washed individually at the beginning of each dose cycle. The back washing cleans the filters. This takes 30 seconds to occur.
- This should be the most limiting condition, thus creating the greatest demand on the pump.

2) **Routine Zone Dosing**

- A drip zone is dosed during this hydraulic condition. Typically, each zone will be dosed four times a day.
- This should be the least limiting condition, thus creating the least amount of demand on the pump.

3) **Drip Tubing Forward Field Flush**

- This hydraulic condition cleans the drip tubing in the drip zones.
- The drip zone will typically be forward field flushed every 50 doses.
- The normal dose plus extra flow is pushed through the system during this hydraulic condition. At this time, the return line is also open, which allows debris to flow through the drip tubing. Then the effluent goes through piping in the hydraulic unit and back into the building sewer. This process will remove the debris from the drip tubing, and the debris will go through the primary and secondary treatment again.

BACK HOME NEXT

Back to the Table of Contents

System Components — Hydraulic Unit

Hydraulic Unit

Flow Rates:

These are the flow rates needed for certain hydraulic conditions. After the drip zones are laid out, the flows can be calculated. We will return to these flow rates later in the course.

A) Dosing Flow Rate

- This is the least limiting flow needed during routine zone dosing.
- The dosing flow rate for a particular zone is determined by the number of emitters in that zone.

B) Field Flush Flow Rate

- The flow required at distal ends of the laterals to achieve the proper scouring velocity (>2 ft./sec.).
- This flow rate is part of the flow needed for the drip tubing forward field flush hydraulic condition.
- This flow rate provides the velocity that will move solids.

1.6 gpm (Flow needed to achieve >2 ft./sec. velocity.)
× number of laterals
= field flush flow rate

C) Total Drip Tubing Forward Field Flush Flow Rate

- The flow used during the drip tubing forward field flush hydraulic condition.

dosing flow rate (A)
+ field flush flow rate (B)
= total drip turbing forward field flush flow rate (C)

BACK HOME

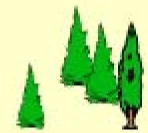
Back to the Table of Contents

System Components — Drip Zones

Chapter 4-C

SYSTEM COMPONENTS — DRIP ZONES

* What You Will Learn in This Chapter
* Number of Zones
* Total Linear Feet of Drip Tubing
* Length of the Drip Irrigation Laterals
* Minimum Site Length of the Drip Irrigation Zones
* Review



NEXT

Back to the Table of Contents

System Components — Drip Zones

Chapter 4-C

What You Will Learn in This Chapter

page 2 out of 17

- How to calculate the total linear feet of drip tubing.
- How to calculate the minimum drip site length for a drip irrigation zone.

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

System Components — Drip Zones

Chapter 4-C

Number of Zones

Section 12.B.Drip Irrigation Zone.1

- To determine the number of zones that can be used in a drip irrigation system, the total linear feet of drip tubing must be calculated.
- The DEP alternate and experimental guidance requires a minimum of two zones per drip irrigation system.
- The two-disc filter hydraulic unit limits the design to 4 zones, and the three-disc filter hydraulic unit limits the design to 16 zones

Drip Irrigation System Components

Building Sewer ⇨ Primary treatment ⇨ Secondary treatment ⇨ Pump ⇨ Hydraulic Unit ⇨ ZONES

BACK HOME NEXT

Back to the Table of Contents

System Components — Drip Zones

Chapter 4-C

Total Linear Feet of Drip Tubing

Section 12.B.Drip Irrigation Zone.3

gal. per day
÷ soil linear load

= total drip tubing required in linear feet

Drip Irrigation System Components

Building Sewer ⇨ Primary treatment ⇨ Secondary treatment ⇨ Pump ⇨ Hydraulic Unit ⇨ ZONES

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

System Components — Drip Zones

Chapter 4-C

Total Linear Feet of Drip Tubing

page 5 out of 17

Calculating Total Linear Feet of Drip Tubing:

Gallons Per Day

Sections 73.16 — 73.17

- Sewage flows must be calculated according to the requirements of the Department of Environmental Protection regulations regarding onlot sewage systems.

SMITH DESIGN

The gallons per day for the Smith home = 400 / 500 / 600 (click on the correct answer) gallons

Total Linear Feet of Drip Tubing — Smith Design

__?__ gal. per day
÷ soil linear load
= total drip tubing required in linear feet

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

System Components — Drip Zones

Chapter 4-C

Total Linear Feet of Drip Tubing

Calculating Total Linear Feet of Drip Tubing:

Total Linear Feet of Drip Tubing–Smith Design

400 gal. per day
÷ soil linear load
= total drip tubing required in linear feet

Soil Linear Load

Section 12.B. Drip Irrigation Zone 3

The soil linear load is found on the soil scientist's soil morphology report. (This report is in the appendix .)

Maximum soil linear load = .34 gpd/linear feet of tubing

What does the .34 gal. per day/linear foot mean?

It means .34 gallons of effluent per foot of tubing can be discharged each day. This is the maximum amount of effluent the soil can absorb in a day to properly renovate the effluent.

BACK HOME NEXT

Back to the Table of Contents

System Components — Drip Zones

Total Linear Feet of Drip Tubing

SMITH DESIGN

What is the soil linear load for the Smith design?
(Use the soil scientist morphological report in the appendix to find the answer.)

.33 linear feet

What is the total linear feet of drip tubing needed for the Smith design?

400 gal. per day
÷ .33 gpd /linear foot

= 1,212 total linear feet of drip tubing required

BACK HOME NEXT

Back to the Table of Contents

System Components — Drip Zones

Total Linear Feet of Drip Tubing

Calculating Total Linear Feet of Drip Tubing:

Number of Zones

Section 12B.Drip Irrigation Zone.1

- A minimum of two drip zones is required per drip irrigation system.
- The number of zones is selected by the designer and must be checked against the hydraulic unit specifications. The number of zones selected must not exceed the hydraulic unit maximum specifications for a two-disc or three-disc unit.

Maximum number of zones for two-disc hydraulic unit: 4 / 8 / 16 (Click on the correct answer.)

Maximum number of zones for three-disc hydraulic unit: 4 / 8 / 16 (Click on the correct answer.)

BACK HOME NEXT

Back to the Table of Contents

System Components — Drip Zones

Chapter 4-C

Length of the Drip Irrigation Laterals

page 9 out of 17

- A drip irrigation lateral is a length of drip tubing with a supply and return manifold connection.
- The lengths of the drip irrigation laterals in the zone should be about the same length as the site will allow.
- A drip irrigation lateral may be made of several runs with connecting loops. A _?_ is one continuous length of drip tubing run along the contour and connected to a supply manifold, return manifold, or looped to another run.

Note: American Manufacturing recommends that the lateral length not exceed 300 feet.

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

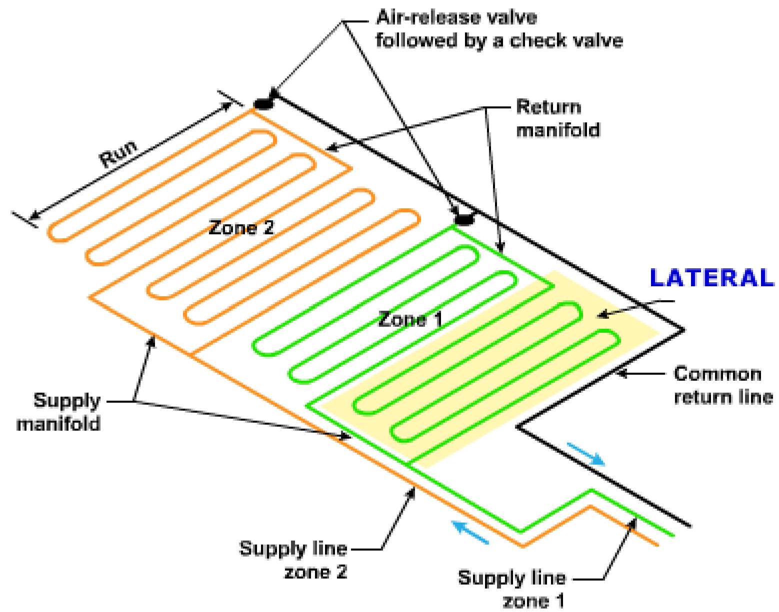
System Components — Drip Zones

Chapter 4-C

Length of the Drip Irrigation Laterals

The shaded area in the illustration represents one lateral.

There are 5 runs in this lateral.



BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

System Components — Drip Zones

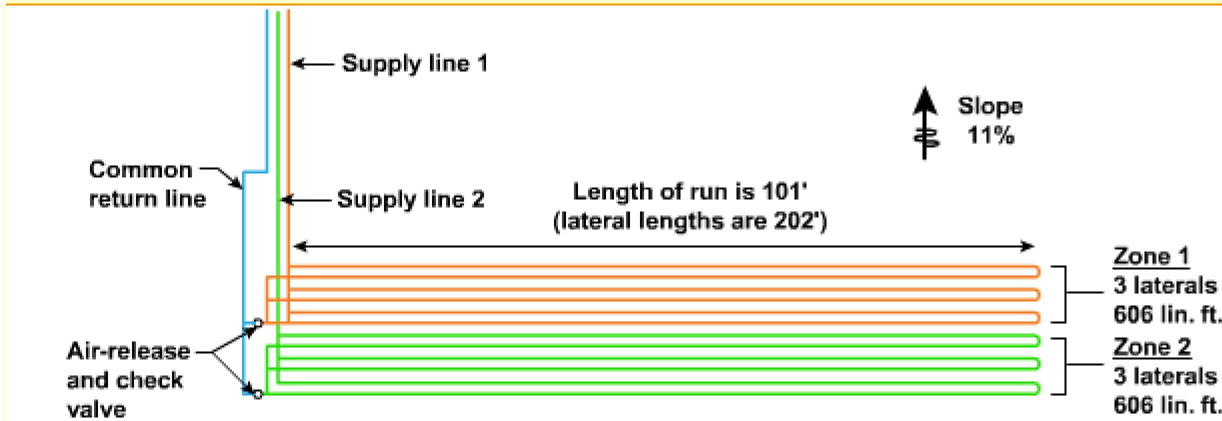
Length of the Drip Irrigation Laterals

SMITH DESIGN

What is the length of the laterals in the Smith design zones?

Zone 1 – 606 linear feet ÷ 3 laterals = 202 feet

Zone 2 – 606 linear feet ÷ 3 laterals = 202 feet



BACK HOME NEXT

Back to the Table of Contents

System Components — Drip Zones

Chapter 4-C Minimum Site Length of the Drip Irrigation Zones

The horizontal linear load determines the minimum site length of the drip irrigation zones. This load is the maximum gallons per foot along the topographical contour that the drip tubing can receive in a day.

Section 12.B.Drip Irrigation Zone.5

Note: All drip tubing runs are to be installed along contours.

Maximum horizontal linear load = **4.6** gpd/linear foot

Note: The horizontal linear load is assigned by the soil scientist.

Minimum Site Length of the Zones

average gpd
÷ horizontal linear load (gpd/linear ft.)
= minimum site length

BACK HOME NEXT

Back to the Table of Contents

System Components — Drip Zones

Chapter 4-C **Minimum Site Length of the Drip Irrigation Zones** page 13 out of 17

Average Gallons Per Day

Average gallons per day = Half (50 percent) of the peak gallons per day. Peak flow gpd is found in the Department of Environmental Protection regulations regarding onlot sewage systems.

SMITH DESIGN *(Use the soil scientist morphological report in **the appendix** to find the horizontal linear load.)*

What is the minimum site length for the zones in the Smith drip system?

Average Gallons Per Day:

400 peak gpd
× .5 (50 percent)
= 200 average gpd

Minimum Site Length:

200 average gpd
÷ 4.6 gpd/linear foot horizontal linear load
= 43.5 linear feet (minimum site length)

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

System Components — Drip Zones

Chapter 4-C Minimum Site Length of the Drip Irrigation Zones page 14 out of 17

What does 43.5 feet in the Smith design mean?

There must be a minimum of 43.5 feet of site length for the drip irrigation zones.

Why is the 43.5 feet important? Why can't the site length be less than 43.5 feet?

The DEP alternate and experimental guidance states that the site length cannot be less than 43.5 feet for a system with a peak daily flow of 400 gpd. This is to keep the system long and narrow and placed along contours.

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

System Components — Drip Zones

Review

SMITH DESIGN

*(Use the design plan in **the appendix** to find the answers.)*

How many zones were chosen by the designer of the Smith system?

2 - CORRECT!
2 / 4 / 8 zones *(Click on the correct answer.)*

What hydraulic unit was chosen by the designer of the Smith system?

2 - CORRECT!
2 / 3 — disc filter hydraulic unit. *(Click on the correct answer.)*

BACK HOME NEXT

Back to the Table of Contents

System Components — Drip Zones

Review

SMITH DESIGN

Was the correct hydraulic unit chosen for the number of zones and the linear feet of drip tubing required in the Smith drip irrigation design?

Yes, the two-disc filter can handle two zones and the 1,212 linear feet of total drip tubing (or 606 linear feet of tubing per zone).

Maximum Specifications

Two-disc filter unit:

- ✓ Max. 1,200 feet of tubing per zone
- ✓ Max. 15 gpm = tubing forward field flush flow rate
- ✓ Max. 5 lateral connections
- ✓ Max. 4 zones
- ✓ Max. 4,800 feet of tubing

Three-disc filter unit:

- ✓ Max. 2,400 feet of tubing per zone
- ✓ Max. 25 gpm = tubing forward field flush flow rate
- ✓ Max. 8 lateral connections
- ✓ Max. 16 zones
- ✓ Max. 38,400 feet of tubing

BACK HOME NEXT

Back to the Table of Contents

System Components — Drip Zones

Review

SMITH DESIGN REVIEW

What do we know about the Smith design so far?
*(Use **the appendix** materials to answer the questions below.)*

Peak daily flow – 400 gpd
Soil linear load – .33 gpd/linear foot
Total feet of drip tubing required for the system – 1,212 feet
Number of zones – 2
Hydraulic unit chosen for the system? – Two-disc
Total feet of drip tubing per zone – 606 feet
Number of laterals per zone – 3
Drip irrigation lateral length – 202 feet
Horizontal linear load – 4.6 gpd/linear foot
Minimum site length – 43.5 feet

BACK HOME

Back to the Table of Contents

System Components — Drip Zone Components

Chapter 4 D

page 1 out of 12

SYSTEM COMPONENTS — DRIP ZONE COMPONENTS

- What You Will Learn in This Chapter
- Drip tubing
- Drip emitters
- Drip loop connections
- Supply and return lines
- Supply and return manifold connections
- Air-release and check valves
- Review

NEXT

Back to the Table of Contents

Drip Irrigation Training Course

What You Will Learn in This Chapter

- How to determine the drip tube spacing.
- How the pressure-compensating emitter is able to deliver even distribution on slopes and uneven run lengths.
- The components of a drip loop connection.
- The components of the supply and return manifold connections.
- The role of the air-release and check valves in the drip irrigation system.

System Components — Drip Zone Components

Component 1: Drip Tubing

- Drip tubing delivers the effluent to the disposal area. Effluent is discharged during the dose through the drip emitters in the drip tubing.
- The drip tubing used in a zone may be a minimum of 1 to a maximum of 3 feet apart based on the slope of the site unless justification for different spaces is provided (i.e., trees, irregular topography, etc.).

Section 12.B.Drip Irrigation Zone

Table 1 from the DEP alternate and experimental guidance is used to determine the spacing between the drip tubing.

Table 1 — Slope vs. Drip Line Spacing

Slope (percent)	Tubing Separation (feet)	Comments
0-8	1-1.5	Texture group IV (clays) and all clay loams (SiCL, SdCL, CL) with weak structure indicate 1.5-2 foot separation between drip tubing.
8-12	1.5-2	
12-25	2+	

BACK HOME NEXT

Back to the Table of Contents

System Components — Drip Zone Components

Component 1: Drip Tubing

SMITH DESIGN

How far apart are the runs in the zones in the Smith design?
*(Use the design plan in **the appendix** to find the answers.)*

Zone 1 — **1.5** feet.

Zone 2 — **1.5** feet.

BACK HOME NEXT

Back to the Table of Contents

System Components — Drip Zone Components

Chapter 4 D

Component 2: Drip Emitters

Section 12.B.Drip Irrigation Zone.4

- Pressure-compensating emitters are required in Pennsylvania. They provide even distribution of effluent on slopes and over sites with uneven run lengths.
- The pressure-compensating emitter will maintain a constant flow rate of .65 gph over a pressure range of 7 to 60 psi.
- During the manufacturing process, the drip emitters are placed 2 feet apart in the drip tubing.
- Drip irrigation is a timed-dose system. Since the discharge emitters deliver the same volume per minute, the zones can be different sizes. The timer can be set to deliver the correct volume dose of effluent to different zones.

Note: The American Septic Drip System has the only drip emitter that meets DEP's alternate and experimental guidance requirements at this time.

BACK HOME NEXT

Back to the Table of Contents

Component 3: Drip Loop Connections

The drip loop connections connect the runs in the lateral.

SMITH DESIGN

- In the Smith design, two runs will be connected with a drip loop connection to make one drip lateral.

BACK HOME NEXT

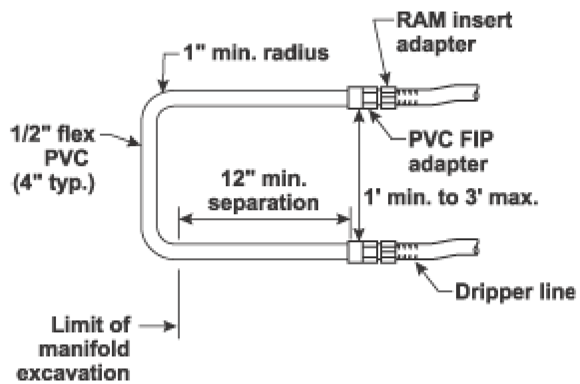
Back to the Table of Contents

System Components — Drip Zone Components

Chapter 4 D

Component 3: Drip Loop Connections

A Closer Look at a Drip Loop Connection:



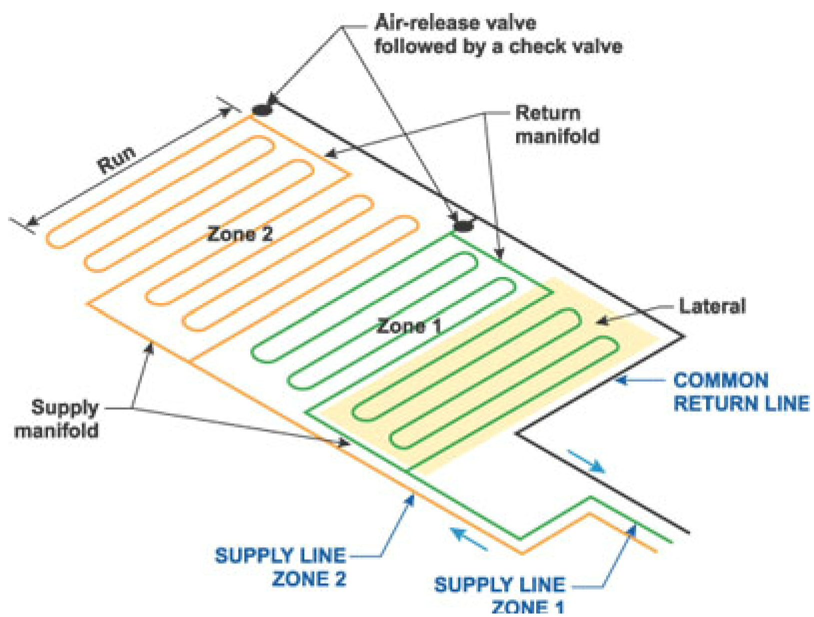
BACK HOME NEXT

Back to the Table of Contents

System Components — Drip Zone Components

Component 4: Supply and Return Lines

- The supply line takes the effluent from the hydraulic unit to the supply manifold, which then takes the effluent to the lateral.
- The return line takes the effluent coming out from the lateral through the return manifold into the common return line. The common return line takes the effluent back to the building sewer.
- The supply and return lines can be placed on the same side of the zone or on opposite sides.



BACK HOME NEXT

Back to the Table of Contents

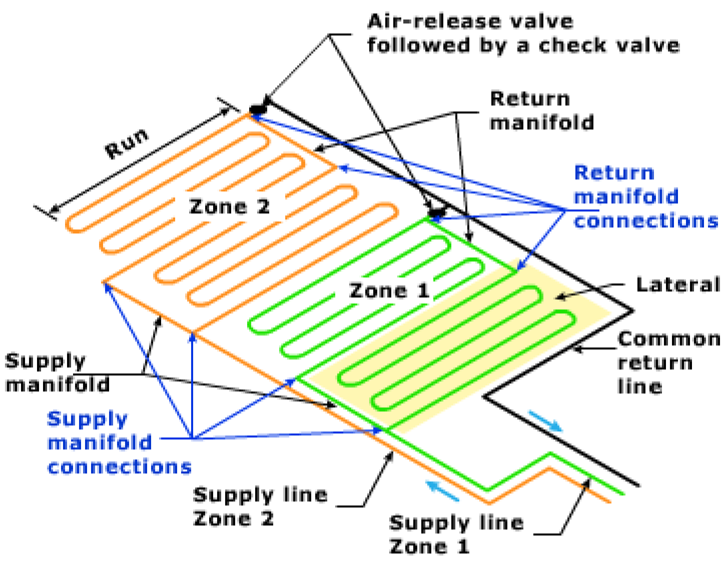
System Components — Drip Zone Components

Chapter 4 D

Component 5: Supply and Return Manifold Connections

page 9 out of 12

The manifold connections are at the beginning and the end of each lateral. They take the effluent in and out of the lateral.



Manifold Connections

The black tubes are connectors that connect the drip tubing to the manifold connection. The long white pipe is the manifold pipe, and the short white pipes and fittings are the manifold connections.

BACK HOME NEXT

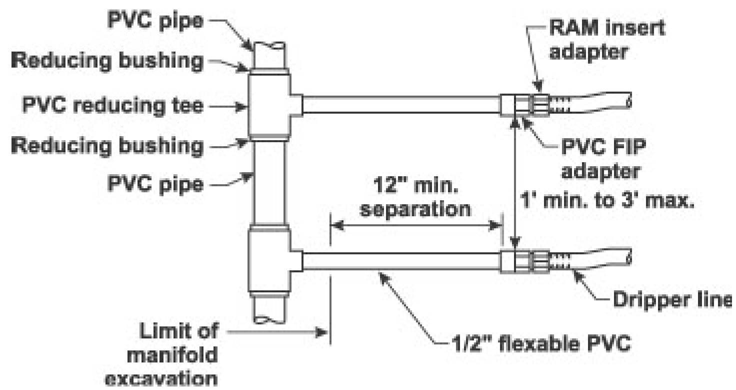
Back to the Table of Contents

Drip Irrigation Training Course

System Components — Drip Zone Components

Component 5: Supply and Return Manifold Connections

A Closer Look at a Supply or Return Manifold Connection:



BACK HOME NEXT

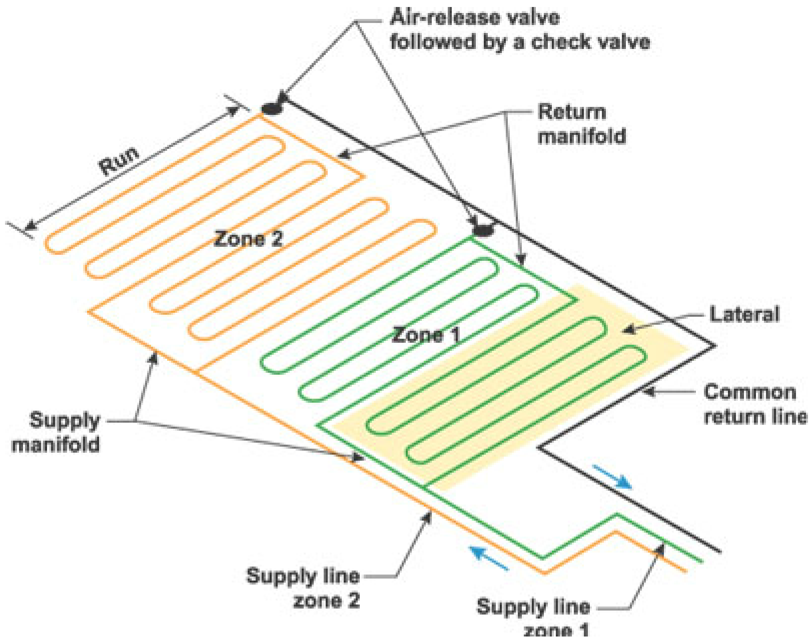
Back to the Table of Contents

System Components — Drip Zone Components

Chapter 4 D

Component 6: Air-Release and Check Valves

- The air-release valves allow for quick system pressurization and venting for quick drainage at pump shut off.
- The check valve prevents back dosing of one zone while the other zone is being dosed.
- An air-release valve must be followed by a check valve.
- Each zone must have both valves.
- The valves are placed at the highest elevation of each zone.



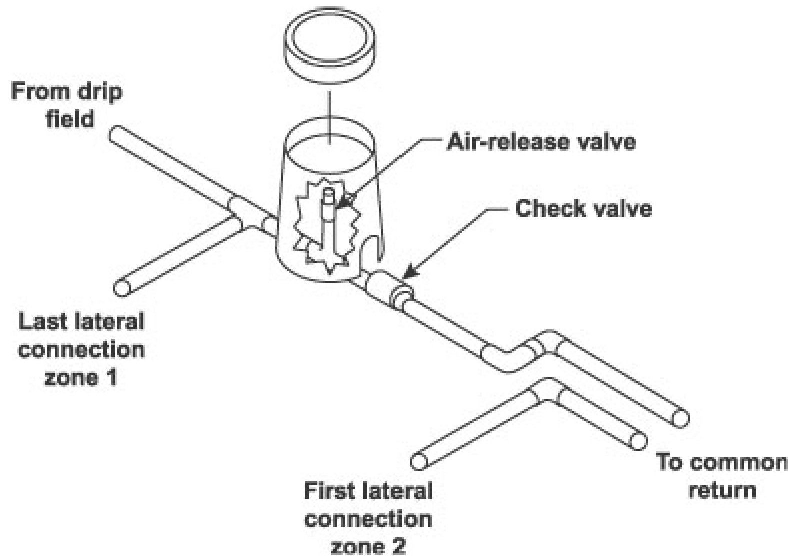
BACK HOME NEXT

Back to the Table of Contents

System Components — Drip Zone Components

Component 6: Air-Release and Check Valves

A Closer Look at Air-Release and Check Valves:



BACK HOME

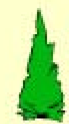
Back to the Table of Contents

System Components — Calculating Flows

Chapter 4 E

SYSTEM COMPONENTS — CALCULATING FLOWS

- What You Will Learn in This Chapter
- Review of the Hydraulic Conditions
- Review of Flows
- Dosing Flow Rate Per Zone
- Field Flush Flow Rate Per Zone
- Total Flow Required for Each Drip Zone During the Forward Field Flush Hydraulic Condition
- Review



NEXT

Back to the Table of Contents

Drip Irrigation Training Course

System Components — Calculating Flows

What You Will Learn in This Chapter

- ☑ How to calculate the dosing flow rate per zone.
- ☑ How to calculate the field flush flow rate per zone.
- ☑ How to calculate the total flow required for each drip zone during the forward field flush hydraulic condition.

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

System Components — Calculating Flows

Review of the Hydraulic Conditions

You will learn how to determine if a dosing pump is sized properly in Chapter 5.

The dosing pump to the hydraulic unit must be sized for the hydraulic condition that creates the greatest demand on the pump.

Review of the Hydraulic Conditions

1) Back-washing disc filters

2) Routine zone dosing

3) Drip tubing forward field flush

To determine which hydraulic condition creates the greatest demand on the pump, you will need to calculate the total flow required for each drip zone during the drip tubing forward field flush hydraulic condition.

BACK HOME NEXT

Back to the Table of Contents

Review of Flows

Total Flow Required for Each Drip Zone During the Forward Field Flush Hydraulic Condition

dosing flow rate per zone (A)
\+ field flush flow rate per zone (B)
= total drip tubing forward field flush rate per zone (C)

A) Dosing Flow Rate

- The flow needed during routine zone dosing.

B) Field Flush Flow Rate

- The flow required at distal ends of laterals to achieve proper scouring velocity (>2 ft./sec.).
- The velocity that will move solids through the drip tubing to prevent clogging of the drip emitters.

C) Total Drip Tubing Forward Field Flush Flow Rate

- Total flow required for each drip zone during the forward field flush hydraulic condition.

System Components — Calculating Flows

A) Dosing Flow Rate Per Zone

This is the flow rate needed to dose the zones.

(linear feet of drip tubing for a zone
÷ distance between emitters)
× (.65 gph ÷ 60 minutes/hour)
= dosing rate for a zone in gallons per minute

.65 gph = emitter specifications

Total Flow Required for Each Drip Zone During the Forward Field Flush Hydraulic Condition

dosing flow rate per zone (A)
+ field flush flow rate per zone (B)
= total drip tubing forward field flush rate per zone (C)

System Components — Calculating Flows

Dosing Flow Rate Per Zone

SMITH DESIGN

What is the dosing flow rate for the zones in the Smith design?

Zone 1:

(606 ft. of drip tubing for a zone
÷ 2 ft. between emitters)
× (.65 gph ÷ 60 minutes/hour)
= 3.3 gpm dosing rate for zone 1

Zone 2:

(606 ft. of drip tubing for a zone
÷ 2 ft. between emitters)
× (.65 gph ÷ 60 minutes/hour)
= 3.3 gpm dosing rate for zone 2

BACK HOME NEXT

Back to the Table of Contents

System Components — Calculating Flows

B) Field Flow Rate Per Zone

When the drip tubes are flushed at 1.6 gpm, enough velocity will be created at the distal ends of a lateral to move the solids through the tubing and back to the building sewer to prevent clogging of the drip emitters.

1.6 gpm *(flow needed to move solids)*
× number of drip laterals for a zone
= field flush rate per zone

Total Flow Required for Each Drip Zone During the Forward Field Flush Hydraulic Condition–Smith Design

_?_ gpm dosing flow rate per zone (A)
+ field flush flow rate per zone (B)
= total drip tubing forward field flush rate per zone (C)

BACK HOME NEXT

Back to the Table of Contents

System Components — Calculating Flows

Field Flush Flow Rate Per Zone

SMITH DESIGN

What is the field flush flow rate for the zones in the Smith design?

Zone 1:

1.6 gpm
× 3 drip irrigation laterals for zone 1
= 4.8 gpm

Zone 2:

1.6 gpm
× 3 drip irrigation laterals for zone 2
= 4.8 gpm

BACK HOME NEXT

Back to the Table of Contents

System Components — Calculating Flows

Chapter 4 E

C) Total Flow Required for Each Drip Zone During the Forward Field Flush Hydraulic Condition

Total Flow Required for Each Drip Zone During the Forward Field Flush Hydraulic Condition–Smith Design

3.3 gpm dosing flow rate per zone (A)
\+ 4.8 gpm field flush flow rate per zone (B)
= total drip tubing forward field flush rate per zone (C)

System Components — Calculating Flows

Chapter 4 E

Total Flow Required for Each Drip Zone During the Forward Field Flush Hydraulic Condition

SMITH DESIGN

What is the total flow required for each drip zone in the Smith design during the forward field flush hydraulic condition?

Zone 1:

3.3 gpm - dosing rate
+ 4.8 gpm - field flush flow rate
= 8.1 gpm - forward field flush flow rate

Zone 2:

3.3 gpm - dosing rate
+ 4.8 gpm - field flush flow rate
= 8.1 gpm - forward field flush flow rate

BACK HOME NEXT

Back to the Table of Contents

System Components — Calculating Flows

Review

All the flows that were just calculated will be used in Chapter 5 to size the pump to the hydraulic unit for the Smith design. To help you remember these flows, print out this page to use during Chapter 5.

A) Dosing flow rate – 3.3 gpm

B) Field flush flow rate – 4.8 gpm

C) Drip tubing forward field flush flow rate – 8.1 gpm
This is the flow required for the drip tubing forward field flush hydraulic condition.

BACK HOME

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

Chapter 5 A

Total Head Loss to Size the Dosing Pump – Smith Design

- What You Will Learn in This Chapter
- Calculating Total Head Loss
- Head Loss to the Hydraulic Unit
- Friction Loss Through the Hydraulic Unit
- Review

NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Total Head Loss to Size the Dosing Pump — Smith Design

What You Will Learn in This Chapter

- What numbers must be calculated to determine the total head loss to size the dosing pump.
- How to calculate the head loss to the hydraulic unit.
- How to calculate the head loss through the hydraulic unit.

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

Calculating Total Head Loss

To calculate the total head loss to size the dosing pump, you will need to total the following head loss numbers.

1) Head Loss to the Hydraulic Unit
2) Friction Loss Through the Hydraulic Unit
3) Friction Loss Through the Zone Supply Lines
4) Flushing Requirements Through the Drip Tubes
5) Friction Loss Through the Common Return Line
6) Zone Static Head Loss

These numbers will all be calculated in this chapter using the Smith design as an example.

Make sure you have the design review worksheet printed out from the appendix.
You will be using pages 3 and 4 from the design review worksheet to help calculate the total head loss for the Smith design and then size the dosing pump.

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

1) Head Loss to the Hydraulic Unit

Head Loss

Head loss is the amount of force behind the fluid that is lost due to elevation change and friction inside of the pipe. The head loss must be calculated to determine how much head the pump must begin with to withstand the head loss and end up with the correct amount of head at the end of the piping system.

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

1) Head Loss to the Hydraulic Unit

Calculating Head Loss to the Hydraulic Unit:

hydraulic unit supply line head loss due to friction (A)
+ static head loss from dose-enabler float to hydraulic unit (B)
= total head loss from the hydraulic unit pump to the hydraulic unit (C)

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

1) Head Loss to the Hydraulic Unit

A) Hydraulic Unit Supply Line Head Loss Due to Friction

To calculate the hydraulic unit supply line head loss due to friction, you need to know:

i) Total feet of pipe and equivalent fitting length for the hydraulic pump supply line
ii) Head loss due to friction per 100 feet of pipe

Head Loss to the Hydraulic Unit

hydraulic unit supply line head loss due to friction (A)
\+ static head loss from the dose-enabler float to the hydraulic unit (B)
= total head loss from the hydraulic unit pump to the hydraulic unit (C)

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

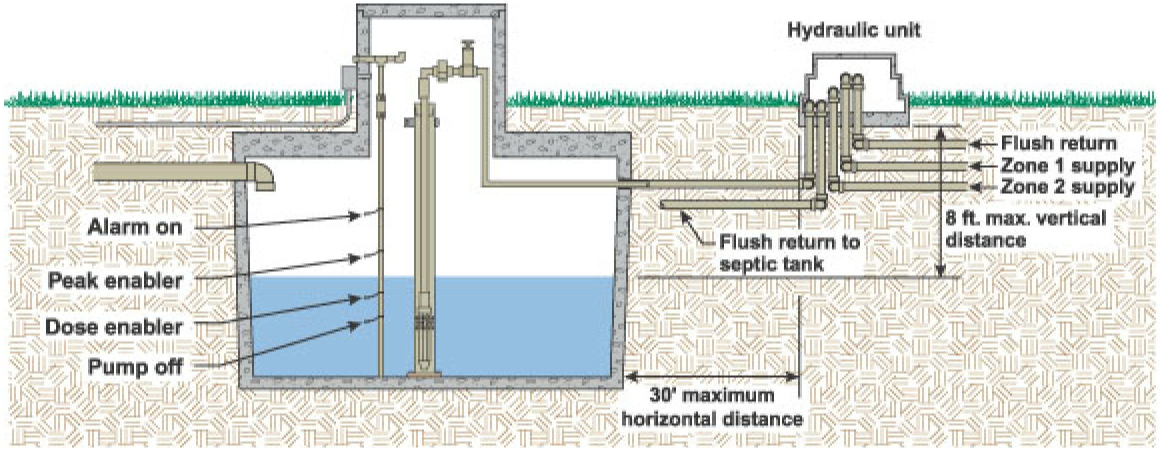
1) Head Loss to the Hydraulic Unit

A) Hydraulic Unit Supply Line Head Loss Due to Friction

i) Total Feet of Pipe and Equivalent Fitting Length

pump supply line equivalent fitting length in feet
+ length of the supply line in feet
= total feet of pipe for the hydraulic unit pump supply line

- The maximum distance between the pump supply line and the hydraulic unit should be no more than 30 feet.
- The pump supply line equivalent fitting length = 50 feet
  (This value is given by American Manufacturing and can be used in the calculations.)



BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

1) Head Loss to the Hydraulic Unit

i) Total Feet of Pipe and Equivalent Fittings–Example

SMITH DESIGN

50 feet – pump supply line equivalent fitting length in feet
+ 30 feet – length of the supply line in feet
= 80 feet – total feet of pipe and equivalent fitting length for the hydraulic unit pump supply line

Note: These numbers should be the same for most drip irrigation systems.

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

1) Head Loss to the Hydraulic Unit

A) Hydraulic Unit Supply Line Head Loss Due to Friction

ii) Head Loss Due to Friction

To calculate head loss due to friction, you will need to use the head loss chart you printed from the appendix.

To use the head loss chart, you need to know:

- Nominal pipe diameter
- Gallons-per-minute (gpm) flow

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Total Head Loss to Size the Dosing Pump — Smith Design

1) Head Loss to the Hydraulic Unit

A) Hydraulic Unit Supply Line Head Loss Due to Friction

ii) Head Loss Due to Friction – Diameter of Pipe

SMITH DESIGN

What is the diameter of the hydraulic unit pump supply line in the Smith design? *(Use the plot design from the appendix to find the answer.)*

1.5 inches in diameter

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

1) Head Loss to the Hydraulic Unit

A) Hydraulic Unit Supply Line Head Loss Due to Friction

ii) Head Loss Due to Friction – GPM Flow

SMITH DESIGN

The head loss due to friction in the supply line at **15 GPM** with a **1.5-INCH DIAMETER PIPE** can be determined using the head loss due to friction chart. This chart is in the appendix.

Note: The 15 gpm comes from the minimum required flow during the disc filter back washing and the maximum achievable flow during the drip tubing forward field flush.

Diameter of pipe = 1.5 inches
GPM flow = 15
Head loss due to friction = 1.45 per 100 feet of pipe *(from the head loss chart)*

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

1) Head Loss to the Hydraulic Unit

A) Hydraulic Unit Supply Line Head Loss Due to Friction

SMITH DESIGN

What is the head loss due to friction from the pump to the hydraulic unit in the Smith design?

[80 feet of pipe (i)

× 1.45 feet (ii) (*from head loss chart*)]

÷ 100 feet of pipe

= 1.16 feet of supply line head loss due to friction (*round to 1.2 ft.*)

Head Loss to the Hydraulic Unit–Smith Design

1.2 feet – hydraulic unit supply line head loss due to friction (A)

\+ static head loss from dose-enabler float to hydraulic unit (B)

= total head loss from the hydraulic unit pump to the hydraulic unit (C)

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

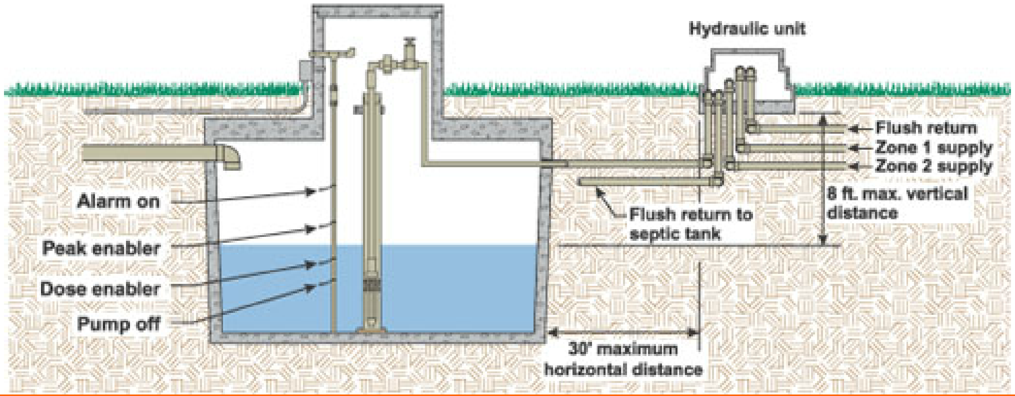
1) Head Loss to the Hydraulic Unit

B) Static Head Loss From the Dose-Enabler Float to the Hydraulic Unit

SMITH DESIGN

What is the static head loss from dose-enabler float to the hydraulic unit?

_?_ feet



American Manufacturer recommends the vertical distance between the hydraulic unit and the dose-enabler float be no more than 8 feet. Therefore, the maximum static head loss from the dose-enabler float to the hydraulic unit is 8 feet.

Head Loss to the Hydraulic Unit–Smith Design

1.2 feet – hydraulic unit supply line head loss due to friction (A)
\+ **8 feet** – static head loss from dose-enabler float to hydraulic unit (B)
= total head loss from the hydraulic unit pump to the hydraulic unit (C)

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

1) Head Loss to the Hydraulic Unit

C) Total Head Loss from the Hydraulic Unit Pump to the Hydraulic Unit

SMITH DESIGN

What is the total head loss from the hydraulic unit pump to the hydraulic unit in the Smith design?

1.2 feet – supply line head loss due to friction (A)
+ 8 feet – static head loss from dose-enabler float to hydraulic unit (B)
= 9.2 feet – total head loss from the hydraulic unit pump to the hydraulic unit (C)

Design Review Worksheet

Place the 9.2 feet in the screened box under **head loss, pump tank to the hydraulic unit** *on page 3 of the design review worksheet from the appendix*.

Total Head Loss to Size the Dosing Pump — Smith Design

2) Friction Loss Through the Hydraulic Unit

To calculate the friction loss through the hydraulic unit, use Table 2A from the appendix. You need the total flow required during the drip tubing forward field flush hydraulic condition to determine the friction loss through the hydraulic unit.

SMITH DESIGN
(The flows were calculated in Chapter 4.)

A) Dosing flow rate of 3.3 gpm
B) Field flush flow rate of 4.8 gpm
C) Total flow of **8.1** gpm required for the drip tubing forward field flush hydraulic condition

What is the head loss in feet for the hydraulic unit for the Smith design?

*(Using Table 2A from the appendix, round 8.1 to 8 and find **8** gpm on the chart. Look across the table to the two-disc filter with a maximum flow of 15 gpm used in the Smith design.)*

6 feet

Design Review Worksheet

Place 6 feet in the screened box under **head loss, through the hydraulic unit** *on page 3 of the design review worksheet from the appendix.*

Total Head Loss to Size the Dosing Pump — Smith Design

Review

To calculate the total head loss to size the dosing pump, you will need to total the following head loss numbers.

1) Head Loss to the Hydraulic Unit = 9.2 feet
2) Friction Loss Through the Hydraulic Unit = 6 feet
3) Friction Loss Through the Zone Supply Lines
4) Flushing Requirements Through the Drip Tubes
5) Friction Loss Through the Common Return Line
6) Zone Static Head Loss

BACK HOME

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

Chapter 5 B

Total Head Loss to Size the Dosing Pump – Smith Design

NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

What You Will Learn In This Chapter

- How to calculate the friction loss through the zone supply lines.

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Total Head Loss to Size the Dosing Pump — Smith Design

Calculating Total Head Loss

In Section A, you learned how to calculate the head loss to the hydraulic unit and the head loss through the hydraulic unit. In Section B, you will learn how to calculate the friction loss through the zone supply lines.

1) Head Loss to the Hydraulic Unit = 9.2 feet

2) Friction Loss Through the Hydraulic Unit = 6 feet

3) FRICTION LOSS THROUGH THE ZONE SUPPLY LINES

ZONE 1 =

ZONE 2 =

4) Flushing Requirements Through the Drip Tubes

5) Friction Loss Through the Common Return Line

6) Zone Static Head Loss

These numbers will all be calculated in this chapter using the Smith design as an example.

Make sure you have the design review worksheet printed out from the appendix. You will be using pages 3 and 4 from the design review worksheet to help calculate the total head loss for the Smith design and then size the dosing pump.

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

3) Friction Loss Through the Zone Supply Lines

You will need the following information to calculate friction loss through the zone supply lines:

- Length of the zone supply line
- Total minimum flow requirement for the drip zone tubing forward field flush hydraulic condition
- Diameter of the zone supply pipe

Friction Loss Through the Supply Line

[length of zone supply line (A)
× head loss due to friction (B) (*use head loss chart*)]
÷ 100 feet of pipe
= feet of head loss for a zone supply line (C)

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

A) Length of Zone 1 Supply Line

SMITH DESIGN

What is the length of the zone 1 supply line in the Smith design?
(Use the design plan in the appendix to find the answer.)

150 feet

Friction Loss Through the Smith Zone 1 Supply Line–Smith Design

[150 ft. length of zone supply line (A)

× head loss due to friction (B) (use head loss chart)]

÷ 100 feet of pipe

= feet of head loss for a zone 1 supply line (C)

Total Head Loss to Size the Dosing Pump — Smith Design

B) Head Loss Due to Friction in Zone 1 and 2 Supply Lines

You need to find the following information to use the head loss chart from the appendix:

i) Total minimum flow required for the drip zone tubing forward field flush hydraulic condition.

ii) Diameter of zone supply pipe.

Total Head Loss to Size the Dosing Pump — Smith Design

B) Head Loss Due to Friction in Zone 1 Supply Line

SMITH DESIGN

i) Flow

What is the total flow required for zone 1 during the drip tubing forward field flush hydraulic condition in the Smith design? *(This number was calculated in Chapter 4.)*

8.1 gpm (round to 8)

ii) Diameter of Zone Supply Line

What is the diameter of the zone 1 supply line in the Smith design? *(Use the design plan in the appendix to find the answer.)*

1 inch

Note: A 1-inch supply line offers a velocity of greater than 2 feet per second during the drip tubing forward field flush hydraulic condition.

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

Chapter 5 B B) Head Loss Due to Friction in Zone 1 Supply Line page 8 out of 14

SMITH DESIGN

Using the head loss chart from the appendix, what is the head loss through a 1-inch pipe at 8 gpm per 100 feet of pipe?

3.64 ft. per 100 feet of pipe

Friction Loss Through the Supply Line–Smith Design

[150 ft. length of zone 1 supply line (A)
× 3.64 ft. head loss due to friction (B) (from head loss chart)]
÷ 100 feet of pipe
= feet of head loss for zone 1 supply line (round to 5.5 ft.) (C)

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

C) Feet of Head Loss for Zone 1 Supply Line

SMITH DESIGN

What is the feet of head loss for the zone 1 supply line in the Smith design?

[150 ft. length of zone 1 supply line pipe (A)
× 3.64 ft. head loss due to friction (B) (from head loss chart)]
÷ 100 feet of pipe
= 5.46 feet of head loss for zone 1 supply line (round to 5.5 ft.) (C)

Design Review Worksheet

Place the 5.5 feet in the screened box under **head loss, through the supply lines, zone 1** *on page 3 of the design review worksheet from the appendix.*

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

A) Length of Zone 2 Supply Line

SMITH DESIGN

What is the length of the zone 2 supply line in the Smith design?
(Use the design plan in the appendix to find the answer.)

160 feet

Friction Loss Through the Zone 2 Supply Line–Smith Design

[160 ft. length of zone 2 supply line (A)
× head loss due to friction (B) (use head loss chart)]
÷ 100 feet of pipe
= feet of head loss for a zone 2 supply line (C)

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Total Head Loss to Size the Dosing Pump — Smith Design

B) Head Loss Due to Friction in Zone 2 Supply Line

SMITH DESIGN

i) Flow

What is the total flow required for zone 2 during the drip tubing forward field flush hydraulic condition in the Smith design? *(This number was calculated in Chapter 4.)*

8.1 gpm? *(round to 8)*

ii) Diameter of Zone Supply Line

What is the diameter of the zone 2 supply line in the Smith design? *(Use the design plan in the appendix to find the answer.)*

1 inch

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

Chapter 5 B **B) Head Loss Due to Friction in Zone 2 Supply Line**

SMITH DESIGN

Using the head loss chart from the appendix, what is the head loss through a 1-inch pipe at 8 gpm per 100 feet of pipe?

3.64 ft. per 100 feet of pipe

Friction Loss Through the Zone 2 Supply Line–Smith Design

[160 ft. length of zone 2 supply line (A)

× 3.64 ft. head loss due to friction (B) (use head loss chart)]

÷ 100 feet of pipe

= feet of head loss for a zone 2 supply line (C)

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Total Head Loss to Size the Dosing Pump — Smith Design

C) Feet of Head Loss for Zone 2 Supply Line

SMITH DESIGN

What is the feet of head loss for the zone 2 supply line in the Smith design?

[160 feet of zone 2 supply line pipe (A)
× 3.64 feet (B) (*from head loss chart*)]
÷ 100 feet of pipe
= 5.82 feet of head loss for zone 2 (C) (*round to 5.8*)

Design Review Worksheet

Place the 5.8 feet in the screened box under **head loss through the supply lines, zone 2** *on page 3 of the design review worksheet from the appendix.*

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

Review

To calculate the total head loss to size the dosing pump, you will need to total the following head loss numbers.

1) Head Loss to the Hydraulic Unit = 9.2 feet

2) Friction Loss Through the Hydraulic Unit = 6 feet

3) Friction Loss Through the Zone Supply Lines

Zone 1 = 5.5 feet

Zone 2 = 5.8 feet

4) Flushing Requirements Through the Drip Tubes

5) Friction Loss Through the Common Return Line

6) Zone Static Head Loss

BACK HOME

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

Chapter 5 C

TOTAL HEAD LOSS TO SIZE THE DOSING PUMP – SMITH DESIGN

- What You Will Learn in This Chapter
- Calculating Total Head Loss
- Flushing Requirements Through the Drip Tubes
- Friction Loss Through the Common Return Line
- Zone Static Head

NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

What You Will Learn in This Chapter

- How to calculate the flushing requirements through the drip tubing.
- How to calculate the friction loss through the common return line.
- How to calculate the static head.

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

Calculating Total Head Loss

In Sections A and B, you learned how to calculate the head loss to the hydraulic unit, the head loss through the hydraulic unit, and the friction loss through the zone supply lines. In Section C you will learn how to calculate the flushing requirements, the friction loss through the common return line, and the zone static head loss.

1) Head Loss to the Hydraulic Unit = 9.2 feet

2) Friction Loss Through the Hydraulic Unit = 6 feet

3) Friction Loss Through the Zone Supply Lines

Zone 1 = 5.5 feet

Zone 2 = 5.8 feet

4) FLUSHING REQUIREMENTS THROUGH THE DRIP TUBES

5) FRICTION LOSS THROUGH THE COMMON RETURN LINE

6) ZONE STATIC HEAD LOSS

ZONE 1 =

ZONE 2 =

These numbers will all be calculated in this chapter using the Smith design as an example.

Make sure you have the design review worksheet printed out from the appendix. You will be using pages 3 and 4 from the design review worksheet to help calculate the total head loss for the Smith design and then size the dosing pump.

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

Chapter 5 C 4) Flushing Requirements Through the Drip Tubes

- During flushing through the drip tubes, a certain head is required to achieve the scouring velocity (2 ft./sec.) at the distal end of the longest drip irrigation lateral of each zone.
- The flushing value in feet comes from Table 3A. This table will provide the head loss in feet through the drip tubes. This table is found in the appendix.
- To use Table 3A, take the maximum drip irrigation lateral length for a zone and read the number to the right in the head loss in feet column.

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

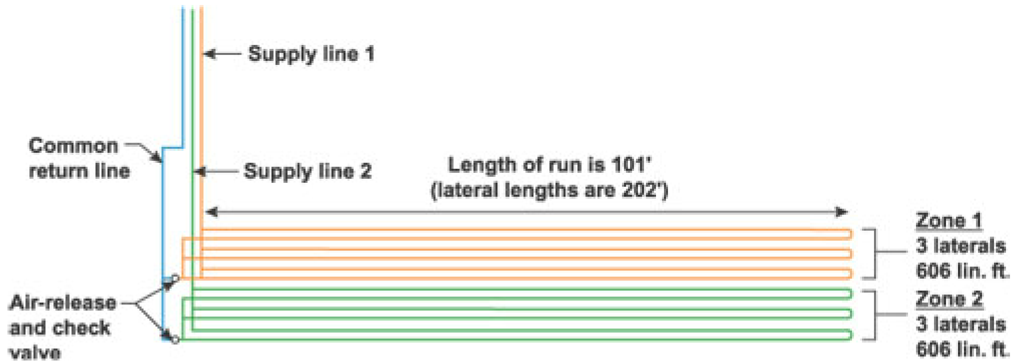
 4) Flushing Requirements Through the Drip Tubes

Maximum Lateral Length

SMITH DESIGN

What is the maximum drip irrigation lateral length for zone 1 and zone 2 in the Smith design?

Zone 1 – 202 feet   Zone 2 – 202 feet



BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

Chapter 5 C **4) Flushing Requirements Through the Drip Tubes** page 6 out of 19

Feet of Head Needed for Flushing

SMITH DESIGN

Using Table 3A, what is the head loss in feet for the maximum lateral length of drip tubing in the Smith design? *(Use Table 3A and round the 202 feet down to 200 feet.)*

18 feet

Design Review Worksheet

Place the 18 feet in the screened boxes under **head loss, flushing through the drip tubing, zone 1 and zone 2** *on page 3 of the design review worksheet from the appendix.*

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

Chapter 5 C 5) Friction Loss Through the Common Return Line page 7 out of 19

You will need the following information to calculate friction loss through the common return line:

- Length of the zone common return line
- Total minimum field flush flow requirement for the drip zone tubing forward field flush hydraulic condition
- Diameter of the common return pipe

Friction Loss Through the Common Return Line

[length of common return line (A)

× head loss due to friction (B) *(use head loss chart)*]

÷ 100 feet of pipe

= feet of head loss for the common return line (C)

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Total Head Loss to Size the Dosing Pump — Smith Design

5) Friction Loss Through the Common Return Line

A) Length of Zone 1 Common Return Line

SMITH DESIGN

What is the length of the zone 1 common return line in the Smith design?
(Use the design plan in the appendix to find the answer.)

160 feet

Friction Loss Through the Zone 1 Common Return Line–Smith Design

[160 ft. length of the common return line (A)
× head loss due to friction (B) *(use head loss chart)*]
÷ 100 feet of pipe
= feet of head loss for a zone 1 common return line (C)

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

5) Friction Loss Through the Common Return Line

B) Head Loss Due to Friction

You need to find the following information to use the head loss chart from the appendix:

i) The field flush flow required for the drip zone tubing forward field flush hydraulic condition.

ii) Diameter of zone common return pipe.

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

Chapter 5 C 5) Friction Loss Through the Common Return Line

B) Head Loss Due to Friction in Zone 1 Common Return Line

SMITH DESIGN

i) Flow

What is the minimum total flow required in the common return line during the drip tubing forward field flush hydraulic condition in the Smith design? *(This is the field flush flow required for the zone 1 common return line during the drip tubing forward field flush hydraulic condition. This field flush flow of 4.8 gpm was calculated in Chapter 4.)*

Flows – Smith Design

A) Dosing flow rate – 3.3 gpm

B) Field flush flow rate – 4.8 gpm

C) Total flow required for the drip tubing forward field flush hydraulic condition – 8.1 gpm

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

5) Friction Loss Through the Common Return Line

B) Head Loss Due to Friction in Zone 1 Common Return Line

SMITH DESIGN

ii) Diameter of Zone 1 Common Return Line

What is the diameter of the zone 1 common return line in the Smith design? *(Use the design plan in the appendix to find the answer.)*

1 inch

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Total Head Loss to Size the Dosing Pump — Smith Design

Chapter 5 C 5) Friction Loss Through the Common Return Line page 12 out of 19

B) Head Loss Due to Friction in Zone 1 Common Return Line

SMITH DESIGN

Using the head loss chart from the appendix**, what is the head loss through a 1-inch pipe at 5 gpm** (4.8 gpm field flush flow rounded to the nearest chart flow value) **per 100 feet of pipe?**

1.52 ft. per 100 feet of pipe

Friction Loss Through the Common Return Line–Smith Design

[160 ft. length of zone 1 common return line (A)
× 1.52 ft. head loss due to friction (B) (use head loss chart)]
÷ 100 feet of pipe
= feet of head loss for a zone 1 common return line (C)

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Total Head Loss to Size the Dosing Pump — Smith Design

Chapter 5 C **5) Friction Loss Through the Common Return Line** page 13 out of 19

C) Feet of Head Loss for Zone 1 Common Return Line

SMITH DESIGN

What is the feet of head loss for the zone 1 common return line in the Smith design?

[160 feet of zone 1 common return line pipe (A)
× 1.52 feet (B) *(from head loss chart)*]
÷ 100 feet of pipe
= 2.43 feet of head loss for zone 1 common return line (C) *(round to 2.4 ft.)*

Design Review Worksheet

Place the 2.4 feet in the screened box under **head loss, through the common return line, zone 1** *on page 3 the design review worksheet from the appendix.*

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Total Head Loss to Size the Dosing Pump — Smith Design

5) Friction Loss Through the Common Return Line

A) Length of Zone 2 Common Return Line

SMITH DESIGN

What is the length of the zone 2 common return line in the Smith design?
(Use the design plan in the appendix to find the answer.)

170 feet

Friction Loss Through the Zone 2 Common Return Line–Smith Design

[170 ft. length of zone 2 common return line (A)
× head loss due to friction (B) *(use head loss chart)*]
÷ 100 feet of pipe
= feet of head loss for a zone 2 common return line (C)

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

Chapter 5 C 5) Friction Loss Through the Common Return Line page 15 out of 19

B) Head Loss Due to Friction in Zone 2 Common Return Line

SMITH DESIGN

i) Flow

What is the minimum total flow required in the common return line during the drip tubing forward field flush hydraulic condition in the Smith design?
(This is the field flush flow required for zone 2 in the common return line during the drip tubing forward field flush hydraulic condition. This flow was calculated in Chapter 4.)

4.8 gpm *(round to 5)*

ii) Diameter of Zone Supply Line

What is the diameter of the zone 2 common return line?
(Use the design plan in the appendix to find the answer.)

1 inch

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

 5) Friction Loss Through the Common Return Line

B) Head Loss Due to Friction in Zone 2 Common Return Line

SMITH DESIGN

Using the head loss chart from the appendix, what is the head loss through a 1-inch pipe at 5 gpm per 100 feet of pipe?

1.52 ft. per 100 feet of pipe

Friction Loss Through the Common Return Line–Smith Design

[170 ft. length of zone 2 common return line (A)
× 1.52 ft. head loss due to friction (B) *(use head loss chart)*]
÷ 100 feet of pipe
= feet of head loss for a zone 2 common return line (C)

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

 5) Friction Loss Through the Common Return Line

C) Feet of Head Loss for Zone 2 Common Return Line

SMITH DESIGN

What is the feet of head loss for the zone 2 common return line in the Smith design?

[170 feet of zone 2 common return line pipe (A)

× 1.52 feet (B) (from head loss chart)]

÷ 100 feet of pipe

= 2.58 feet of head loss for zone 2 (C) *(round to 2.6)*

Design Review Worksheet

Place the 2.6 feet in the screened box under **head loss, through the common return line, zone 2** *on page 3 of the design review worksheet from the appendix.*

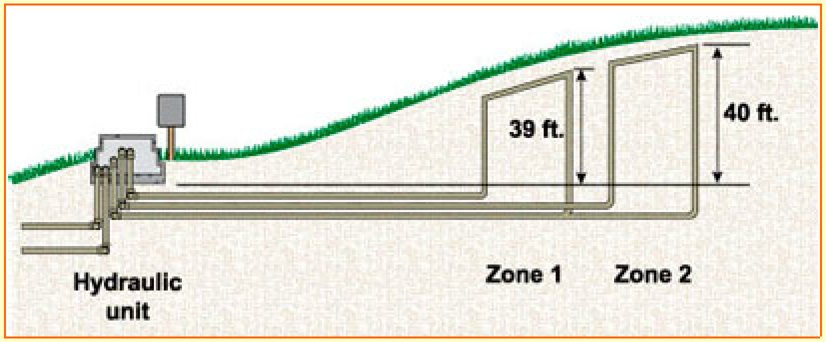
BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

6) Zone Static Head Loss

The static head loss here is the change in elevation between the hydraulic unit and the highest drip emitter in a zone.



SMITH DESIGN

What is the zone 1 total static head loss in the Smith design? 39 feet

What is the zone 2 total static head loss in the Smith design? 40 feet

Design Review Worksheet

Place the 39 feet in the screened box under **head loss, zone static head loss, zone 1** *on page 3 of the design review worksheet from the appendix.*

Place the 40 feet in the screened box under **head loss, zone static head loss, zone 2** *on page 3 of the design review worksheet from the appendix.*

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

The next section in Chapter 5 will use all the numbers calculated in Sections A, B, and C to calculate the total head loss to size the dosing pump.

BACK HOME

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

Chapter 5 D

TOTAL HEAD LOSS TO SIZE THE DOSING PUMP – SMITH DESIGN

* What You Will Learn in This Chapter
* Total Head Loss
* Total Head Loss During the Drip Tubing Forward Field Flush Hydraulic Condition for Zone 1
* Total Head Loss During the Drip Tubing Forward Field Flush Hydraulic Condition for Zone 2
* Dosing Pump Size
* Pump Selection

NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Total Head Loss to Size the Dosing Pump — Smith Design

What You Will Learn in This Chapter

- How to calculate the head loss to size the dosing pump.
- How to size the dosing pump and select a pump.

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

Total Head Loss

Total Head Loss for a Zone During the Drip Tubing Forward Field Flush Hydraulic Condition

You now have calculated all the head loss numbers you need to determine the total head loss to help size the pump.

Head Loss From the Items Below Equals the Total Head Loss During the Forward Field Flush Hydraulic Condition

1) Hydraulic unit pump to hydraulic unit
2) Hydraulic unit
3) Zone supply line
4) Flushing through drip zone tubes
5) Zone return line
6) Zone static head head loss *(hydraulic unit to highest drip emitter)*

Note: All these head loss numbers have been calculated and you should have placed them on the design review worksheet you printed out from the appendix.

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

Chapter 5 D

Total Head Loss During the Drip Tubing Forward Field Flush Hydraulic Condition for Zone 1

SMITH DESIGN

Total the following parts for zone 1:

1) Hydraulic unit pump to hydraulic unit.................................... 9.2 feet
2) Hydraulic unit .... 6 feet
3) Zone 1 supply line... 5.5 feet
4) Flushing through drip zone tubes.. 18 feet
5) Zone 1 return line... 2.4 feet
6) Zone static head (hydraulic unit to highest zone 1 drip emitter)... 39 feet

TOTAL HEAD LOSS = 80.1 feet

Design Review Worksheet

Place the numbers from above in the screened boxes under **head loss, calculating total head loss for zone 1** *on page 4 of the design review worksheet from the appendix.*

Place the 80.1 feet in the box under **head loss, total head loss for zone 1** *on page 4 of the design review worksheet from the appendix.*

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Total Head Loss to Size the Dosing Pump — Smith Design

Total Head Loss During the Drip Tubing Forward Field Flush Hydraulic Condition for Zone 2

SMITH DESIGN

Total the following parts for zone 2:

1) Hydraulic unit pump to hydraulic unit.................................... 9.2 feet
2) Hydraulic unit .... 6 feet
3) Zone 2 supply line... 5.8 feet
4) Flushing through drip zone tubes.. 18 feet
5) Zone 2 return line.. 2.6 feet
6) Zone static head (hydraulic unit to highest zone 2 drip emitter)... 40 feet

TOTAL HEAD LOSS = 81.6 feet

Design Review Worksheet

Place the numbers from above in the screened boxes under **head loss, calculating total head loss for zone 2** *on page 4 of the design review worksheet from the appendix.*

Place the __?__ feet in the box under **head loss, total head loss for zone 2** *on page 4 of the design review worksheet from the appendix.*

Total Head Loss to Size the Dosing Pump — Smith Design

Pump Size

To determine the size of the dosing pump, use the greater value of the two options below:

A) Maximum head loss from a zone during the drip tubing forward field flush hydraulic condition *(Use the largest calculated head loss of the zones.)*

OR

B) The disc filter back flush requirement of 115 feet
+ head loss from the hydraulic unit pump to the hydraulic unit at 15 gpm

Note: The 115 feet of head is needed to properly back flush the disc filters.

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

Pump Size

SMITH DESIGN

A) Maximum head loss from a zone during the drip tubing forward flush hydraulic condition =

(Use the largest calculated head loss of the zones. In the Smith design, it's zone 2.)

81.6 feet *(You just calculated this number.)*

B) Total head loss from back flush

115 feet–Disc filter back flush requirements
+ 9.2 feet–Head loss from hydraulic unit pump
= 124.2 feet

Head Loss from the Hydraulic Unit Pump to the Hydraulic Unit–Smith Design
(This was calculated earlier in the chapter.)

1.2 feet supply line head loss due to friction
+ 8 feet static head
= 9.2 feet total head loss from the hydraulic unit pump to the hydraulic unit

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

Pump Size

Which number is used to size the dosing pump for the Smith design?

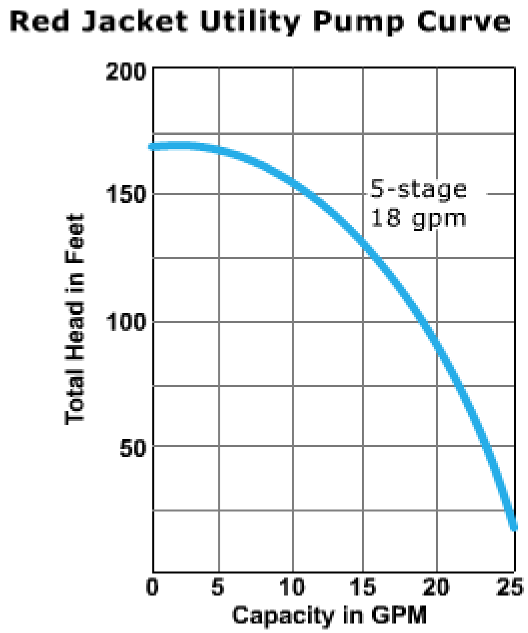
124.2 feet - head required during the back flush hydraulic condition–since this is the greatest value

Design Review Worksheet

Place the 124.2 feet in the screened box under **pump size, use greater of the two head losses** *on page 4 of the design review worksheet from the appendix.*

Total Head Loss to Size the Dosing Pump — Smith Design

Pump Size



Pump Selection

SMITH DESIGN

Size the pump using 15 gpm @ 124 feet of head on the pump curve.

The 5-stage, Red Jacket utility pump was selected.

Note: The designers should spec the pump as a Red Jacket or equivalent per American Manufactures package system.

Design Review Worksheet

Place the 5-stage, Red Jacket utility pump in the screened box under ***pump size, pump selected*** *on page 4 of the design review worksheet from the appendix.*

BACK HOME NEXT

Back to the Table of Contents

Total Head Loss to Size the Dosing Pump — Smith Design

Congratulations! You have reviewed the calculations to size the dosing pump to the hydraulic unit.

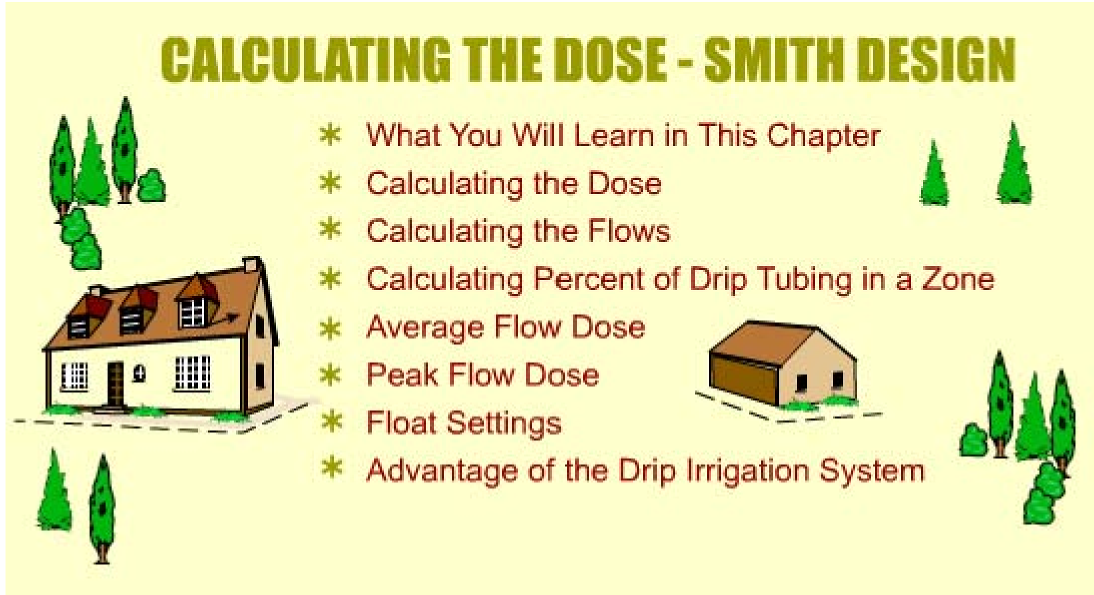
The next chapter will explain how to review the calculations for the timed doses in the zones.

BACK HOME

Back to the Table of Contents

Calculating the Dose — Smith Design

Chapter 6



NEXT

Back to the Table of Contents

Calculating the Dose — Smith Design

What You Will Learn in This Chapter

- How to calculate the number of minutes each zone is dosed at both average and peak flows.
- The functions of the different floats in the dosing tank.

BACK HOME NEXT

Back to the Table of Contents

Calculating the Dose — Smith Design

Calculating the Dose

To calculate the timed dose of effluent that is sent to each zone in a drip system, the following information must be calculated:

1) Gallons-per-day flow for peak and average flows

2) Percent of drip tubing in a zone

Average Flow Dose:

A) Gallons per day for total doses in a zone
B) Gallons per dose
C) Minutes per dose

Peak Flow Dose:

A) Gallons per day for total doses in a zone
B) Gallons per dose
C) Minutes per dose

BACK HOME NEXT

Back to the Table of Contents

Calculating the Dose — Smith Design

1) Calculating the Gallons-Per-Day Flows

Peak Gallons-Per-Day Flow

Sections 73.16 and 73.17

- The peak gallons-per-day flow is calculated from the criteria provided in the Department of Environmental Protection regulations regarding onlot sewage systems. It is the same criteria used for a conventional system: i.e., 400 gpd for a three-bedroom single-family dwelling.

Average Gallons-Per-Day Flow (when calculating the dose)

- The average gallons-per-day flow = _?_ % of the peak daily flow

BACK HOME NEXT

Back to the Table of Contents

Calculating the Dose — Smith Design

Calculating the Flows

1) Calculating the Peak and Average Flows–Example

SMITH DESIGN

What are the peak and average gallons-per-day flows for the Smith design (3-bedroom single-family home)?

- Peak gallons-per-day flow = 400 gpd
- Average gallons-per-day flow = 400 × .6 = 240 gpd

Note: These gallons-per-day flows will be used to help calculate the minutes a zone is dosed.

BACK HOME NEXT

Back to the Table of Contents

Calculating the Dose — Smith Design

Calculating Percent of Drip Tubing in a Zone

2) Calculating Percent of Drip Tubing in a Zone

linear feet of drip tubing for a zone
÷ linear feet of drip tubing in the total system
percentage of drip tubing in a zone

BACK HOME NEXT

Back to the Table of Contents

Calculating the Dose — Smith Design

Calculating Percent of Drip Tubing in a Zone

SMITH DESIGN

What is the percentage of the total drip tubing for zone 1 and zone 2 in the Smith design?

(The total linear feet for the zones and the linear feet per zone were calculated in Chapter 4.)

Zone 1:

606 linear feet of drip tubing
÷ 1,212 total linear feet of drip tubing
50 % (.5) drip tubing in zone 1

Zone 2:

606 linear feet of drip tubing
÷ 1,212 total linear feet of drip tubing
50 % (.5) drip tubing in zone 2

BACK HOME NEXT

Back to the Table of Contents

Calculating the Dose — Smith Design

Average Flow Dose

Calculating Average Flow Dose

A) Gallons Per Day for Total Doses in a Zone

average gallons per day
× percentage of drip tubing in a zone
---
gallons per day at average flow for the total doses in a zone

Calculating Average Flow Dose:

✓ **GPD FOR TOTAL DOSES IN A ZONE (A)** • Gallons per dose (B) • Minutes per dose (C)

BACK HOME NEXT

Back to the Table of Contents

Calculating the Dose — Smith Design

Average Flow Dose

Calculating Average Flow Dose

A) Gallons Per Day for Total Doses in a Zone–Example

SMITH DESIGN

What are the total gallons per day at average flow doses for zone 1 and zone 2 in the Smith design?

Zone 1:

240 average gallons per day
× 50 % (.5) of total drip tubing is in zone 1
120 gpd for the total doses in zone 1

Zone 2:

240 average gallons per day
× 50 % (.5) of total drip tubing is in zone 2
120 gpd for the total doses in zone 2

BACK HOME NEXT

Back to the Table of Contents

Calculating the Dose — Smith Design

Average Flow Dose

Calculating Average Flow Dose

B) Gallons Per Dose

total gallons per day at average flow for the total doses for a zone
÷ number of doses per zone in a day at the average flow
gallons per dose at the average flow for a zone

Doses Per Day During Average Flow Conditions:

When the structure is using an average flow of effluent, the dose-enabler float will tell the timer to dose a zone ? times a day. The 4 times a day is recommended by the system manufacturer for average flow dosing.

Calculating Average Flow Dose:

✓ GPD for total doses in a zone (A) ✓**GALLONS PER DOSE (B)** • Minutes per dose (C)

Calculating the Dose — Smith Design

Average Flow Dose

Calculating Average Flow Dose

B) Gallons Per Dose–Example

SMITH DESIGN

What would be the gallons per dose at the average flow for zone 1 and zone 2 in the Smith design?

Zone 1:

120 total gpd at average flow
÷ 4 doses a day
30 gallons per dose

Zone 2:

120 total gpd at average flow
÷ 4 doses a day
30 gallons per dose

BACK HOME NEXT

Back to the Table of Contents

Calculating the Dose — Smith Design

Average Flow Dose

Calculating Average Flow Dose

C) Minutes Per Dose

gallons per day per zone at the average flow
÷ zone dosing flow rate *(This flow was calculated in Chapter 4.)*
minutes of total dose time per day at the average flow for a zone

minutes of total dose time per day at the average flow for a zone
÷ number of doses per zone in a day at average flow
minutes per dose at the average flow for a zone

Calculating Average Flow Dose:

✓ GPD for total doses in a zone (A) ✓ GALLONS PER DOSE (B) ✓ **MINUTES PER DOSE (C)**

BACK HOME NEXT

Back to the Table of Contents

Calculating the Dose — Smith Design

Average Flow Dose

Calculating Average Flow Dose

C) Minutes Per Dose–Example

SMITH DESIGN

How many minutes will zone 1 and zone 2 in the Smith design receive a dose during the average flow?
(The 3.3 gpm field dosing flow rate was calculated in Chapter 4.)

Total Minutes Per Day–Zone 1:

120 gpd at average flow for zone 1
÷ 3.3 zone dosing flow rate
? total minutes a day

Total Minutes Per Day–Zone 2:

120 gpd at average flow for zone 2
÷ 3.3 zone dosing flow rate
36.4 total minutes a day

Total Minutes Per Dose–Zone 1:

36.4 total minutes a day
÷ 4 doses a day
9.1 minutes per dose

Total Minutes Per Dose–Zone 2:

36.4 total minutes a day
÷ 4 doses a day
9.1 minutes per dose

Calculating the Dose — Smith Design

Average Flow Dose

Calculating Average Flow Dose

C) Minutes Per Dose-Example

Design Review Worksheet

Place the *9.1 minutes* in the screened boxes under **dosing tank to the hydraulic unit, minutes set for timers, zone 1 and zone 2 average flow dose** *on page 1 of the design review worksheet from the appendix.*

Summary

In the Smith design example, zones 1 and 2 at average flow would each dose 30 gallons for 9.1 minutes four times a day.

BACK HOME NEXT

Back to the Table of Contents

Calculating the Dose — Smith Design

Peak Flow Dose

1) Peak Gallons-Per-Day Flow Review

SMITH DESIGN

3-bedroom single-family house = 400 gpd peak flow

2) Percent of Drip Tubing in a Zone Review

SMITH DESIGN

What is the percentage of the total drip tubing for zone 1 and zone 2 in the Smith design? *(The total linear feet for the zones and the linear feet per zone were calculated in Chapter 4.)*

Zone 1:

606 linear feet of drip tubing for zone 1
÷ 1,212 linear feet of drip tubing in the system
50 % (.5) drip tubing in zone 1

Zone 2:

606 linear feet of drip tubing for zone 2
÷ 1,212 linear feet of drip tubing in the system
50 % (.5) drip tubing in zone 2

BACK HOME NEXT

Back to the Table of Contents

Calculating the Dose — Smith Design

Peak Flow Dose

Calculating Peak Flow Dose

A) Gallons Per Day for Total Doses in a Zone–Example

SMITH DESIGN

What are the total gallons per day at peak flow doses for zone 1 and zone 2 in the Smith design?

Zone 1:

400 peak gallons per day
× 50 % (.5) of total drip tubing is in zone 1
200 gpd for the total doses in zone 1

Zone 2:

400 peak gallons per day
× 50 % (.5) of total drip tubing is in zone 2
200 gpd for the total doses in zone 2

Calculating Peak Flow Dose:

✓ **GPD FOR TOTAL DOSES IN A ZONE (A)** • Gallons per dose (B) • Minutes per dose (C)

BACK HOME NEXT

Back to the Table of Contents

Calculating the Dose — Smith Design

Peak Flow Dose

Calculating Peak Flow Dose

B) Gallons Per Dose

total gallons per day at peak flow for the total doses for a zone
÷ number of doses per zone in a day at the peak flow
gallons per dose at the peak flow for a zone

Doses Per Day During Peak Flow Conditions:

When the structure is using a peak flow of effluent, the peak-enabler float will tell the pump to dose a zone 6.7 times a day. The 6.7 times a day is recommended by the system manufacturer for peak flow dosing.

Calculating Peak Flow Dose:

✓ GPD for total doses in a zone (A) ✓**GALLONS PER DOSE (B)** • Minutes per dose (C)

BACK HOME NEXT

Back to the Table of Contents

Calculating the Dose — Smith Design

Peak Flow Dose

Calculating Peak Flow Dose

B) Gallons Per Dose–Example

SMITH DESIGN

What would be the gallons per dose at the peak flow for zone 1 and 2 in the Smith design?

Zone 1:

200 total gpd at peak flow
÷ 6.7 doses a day
30 gallons per dose

Zone 2:

200 total gpd at peak flow
÷ 6.7 doses a day
30 gallons per dose

BACK HOME NEXT

Back to the Table of Contents

Calculating the Dose — Smith Design

Peak Flow Dose

Calculating Peak Flow Dose

C) Minutes Per Dose

gallons per day per zone at the peak flow
÷ zone dosing flow rate *(This rate was calculated in Chapter 4.)*
minutes of total dose time per day at the peak flow for a zone

minutes of total dose time per day at the peak flow for a zone
÷ number of doses per zone in a day at the peak flow
minutes per dose at the peak flow for a zone

Calculating Peak Flow Dose:

✓ GPD for total doses in a zone (A) ✓ Gallons per dose (B) ✓ **MINUTES PER DOSE (C)**

BACK HOME NEXT

Back to the Table of Contents

Calculating the Dose — Smith Design

Peak Flow Dose

Calculating Peak Flow Dose

C) Minutes Per Dose–Example

SMITH DESIGN

How many minutes will zone 1 and zone 2 in the Smith design receive a dose during the peak flow?

Total Minutes Per Day–Zone 1:

200 gpd at peak flow for zone 1
÷ 3.3 zone dosing flow rate
60.6 total minutes a day

Total Minutes Per Day–Zone 2:

200 gpd at peak flow for zone 2
÷ 3.3 zone dosing flow rate
60.6 total minutes a day

Total Minutes Per Dose–Zone 1:

60.6 total minutes a day
÷ 6.7 doses a day
9.1 minutes per dose

Total Minutes Per Dose–Zone 2:

60.6 total minutes a day
÷ 6.7 doses a day
9.1 minutes per dose

BACK HOME NEXT

Back to the Table of Contents

Calculating the Dose — Smith Design

Peak Flow Dose

Calculating Peak Flow Dose

C) Minutes Per Dose-Example

Design Review Worksheet

Place the *9.1 minutes* in the screened boxes under **dosing tank to the hydraulic unit, minutes set for timers, zone 1 and zone 2 peak flow dose** *on page 1 of the design review worksheet from the appendix.*

BACK HOME NEXT

Back to the Table of Contents

Calculating the Dose — Smith Design

Peak Flow Dose

Calculating Peak Flow Dose

Summary

In the Smith design example, zones 1 and 2 at peak flow would each dose 30 gallons for 9.1 minutes 6.7 times a day.

The minutes the system doses the zones at the peak or average flow are always the same. The frequency of the dose is just more with the peak flow. The manufacturer recommends calculating each flow to make sure the minutes of run time is the same for both flows. If the minutes differ, the calcualations should be reviewed again.

Note: The system will dose the average flow unless a peak flow occurs. The control panel will only activate the peak flow dose frequency if the peak-enabler float is activated. If the household is discharging its peak flow, the peak-enabler float tells the control panel that there is enough effluent in the tank to dose at the peak flow dose calculation.

BACK HOME NEXT

Back to the Table of Contents

Calculating the Dose — Smith Design

Float Settings

The Timer Controls the Dose

The floats in the dosing tank tell the control panel that enough effluent is in the tank to dose the system. When the control panel hits the correct time to dose and the floats have signaled to the control panel that enough effluent is present, the pump will turn on for the prescribed minutes and dose effluent to the zone.

BACK HOME NEXT

Back to the Table of Contents

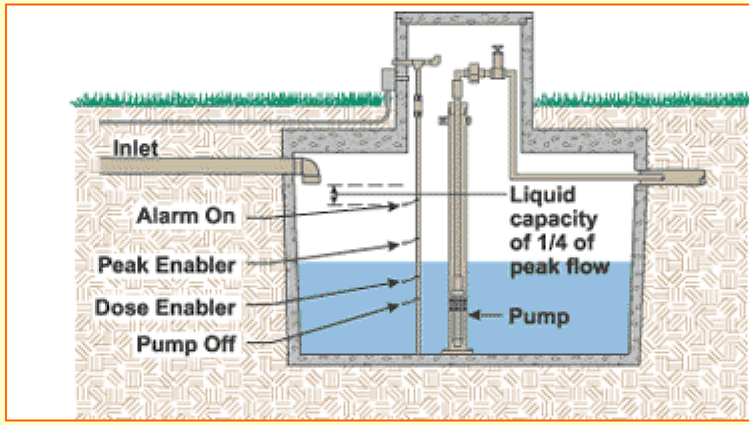
Calculating the Dose — Smith Design

Placement of Floats

- **Pump-off** float is placed above top of pump.
- **Dose-enabler** float is placed between pump-off float and peak-enabler float.

Note: American Manufacturing will set the two above floats.

- **Peak-enabler** float is placed halfway between the alarm-on and the dose-enabler float.
- **Alarm-on** float is between the bottom of the inlet and the peak-enabler float. The distance between the alarm-on float and the bottom of the tank inlet must provide enough liquid capacity to hold a minimum of one quarter of the peak flow. [In the Smith design, this would be at least 100 gallons (400 gallons ÷ 4 = 100).]



Note: The volume of water between the dose enabler- and alarm-on float must be a minimum of 1/2 to a full days design flow.

BACK HOME NEXT

Back to the Table of Contents

Calculating the Dose — Smith Design

Advantage of the Drip Irrigation System

- One of the unique features of the drip irrigation system is that equal distribution is achieved with pressure-compensating emitters. This allows for different sized zones to be used in the same system.
- The pressure-compensating emitters discharge rate per minute is the same between 7 and 70 psi. This causes the drip emitters to discharge the same amount of effluent per linear foot. This is how equal distribution is achieved. Therefore, if all zones have the same run time and the same number of doses each day, then they will receive the same amount of effluent per linear foot. This is why the uniformity of soil loading is provided regardless of pump pressure, distance to the field, slope, or topography.

BACK HOME

Back to the Table of Contents

Installation and Construction

Chapter 7

page 1 out of 24

NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Installation and Construction

Chapter 7

What You Will Learn in This Chapter

- ☑ The basics of how to install a drip irrigation system.
- ☑ The basics of constructing a drip irrigation system.
- ☑ The SEO's role in installation and construction.

BACK HOME NEXT

Back to the Table of Contents

Installation and Construction

Chapter 7 Alternate and Experimental Guidance Requirements

Section 12.C.3

The manufacturer's representative must be present to oversee the installation of a drip irrigation system. As an alternative, contractors may attend a training course approved by DEP before installing drip tubing independent of oversight by the manufacturer.

Section 12.C.4

Installation of a drip irrigation system must meet the specifications provided by the manufacturer.

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Installation and Construction

Building Sewer

Section 73.21

The building sewer must be installed according to the Department of Environmental Protection regulations for onlot sewage systems.

Treatment Tank(s)

Section 73.31 and 73.32

The treatment tank(s) must be installed according to the Department of Environmental Protection regulations for onlot sewage systems.

BACK HOME NEXT

Back to the Table of Contents

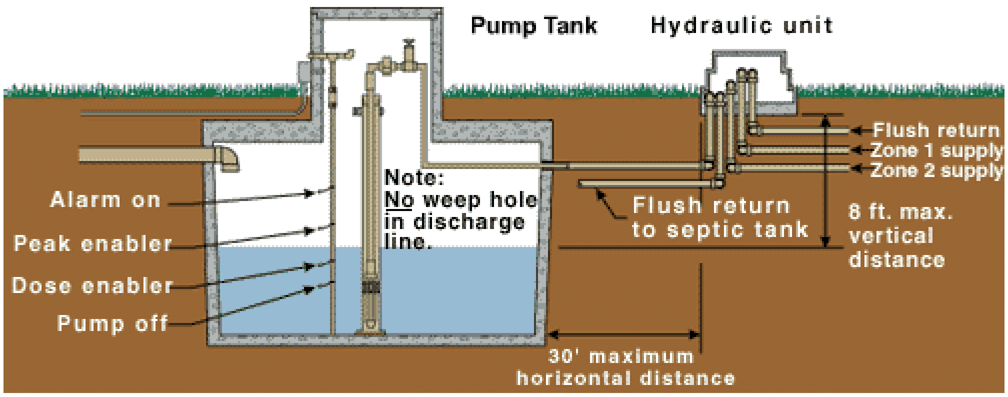
Installation and Construction

Hydraulic Unit Pump

Install Pump and Floats

The hydraulic unit must be placed within 30 feet horizontally and 8 feet vertically of the dose-enabler float for sufficient head to back flush the filters. The extra effluent from the drip tube forward flush and disc filter back flush should be sent by gravity flow through the common return line to the building sewer leading to the treatment tank.

- Pump and floats should be installed as shown below.
- Because of high pressure, the pump must **not** be installed with a weep hole.



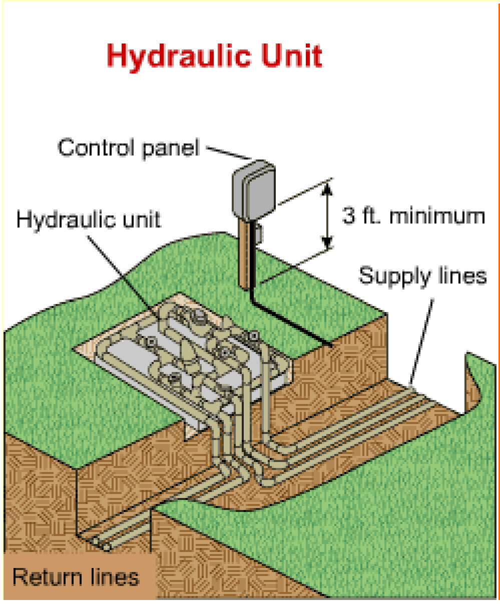
BACK HOME NEXT

Back to the Table of Contents

Installation and Construction

Chapter 7

Installation



- Dig a trench in front of the hydraulic unit for the supply lines to attach to the hydraulic unit.
- Make sure the area around the unit is free from groundwater or rainwater infiltration.
- Place unit on gravel bed with pipes slightly over edge.
- Connect supply and return lines.
- Install control panel. The bottom of the panel should be a minimum of three feet from the ground.

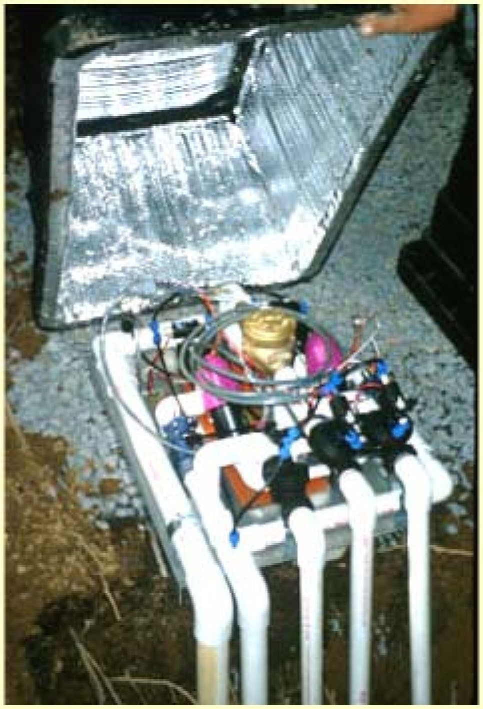
BACK HOME NEXT

Back to the Table of Contents

Installation and Construction

Hydraulic Unit

Two-disk hydraulic unit
with the supply lines attached



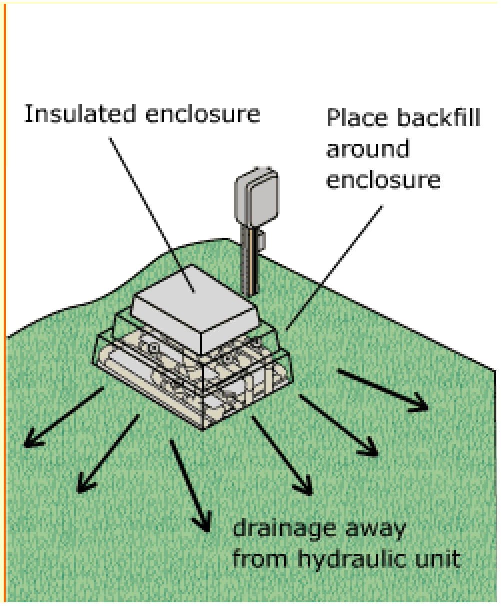
Back to the Table of Contents

Drip Irrigation Training Course

Installation and Construction

Protect Hydraulic Unit

- Install insulated enclosure and backfill around the unit.
- Provide drainage away from unit.
- Place backfill around enclosure to help heater maintain temperature above freezing.



BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Installation and Construction

Control Unit

- Power the control unit.
- Make sure electrician provides three sources of power to control unit:
  - ✓ Alarm
  - ✓ Control panel
  - ✓ Pump
- Make sure wire runs through conduit.
- Connect heater, floats, and the pump to the control unit.
- Connect the hydraulic unit wiring harness.

BACK HOME NEXT

Back to the Table of Contents

Installation and Construction

Drip Tubing and Manifolds

1) Prepare field location for installation.
   - Allow only minimum activity on drip zones.
   - Maintain soil porosity.
2) Set treatment and pump tanks.
3) Install header ditch for field manifold.

Header ditch for manifold

Installation and Construction

Installation

Section 12.C.2

4) Install dripper tubing.

Dripper tubing must be installed with a:

a) Vibratory plow,

b) Standard trencher (ditch witch), or

c) By hand

Dripper tubing being installed

Dripper tube installation:

- Optimum dripper tubing installation depth is 6 inches from the soil surface.
- No lines can be installed at a depth greater than 12 inches.

BACK HOME NEXT

Back to the Table of Contents

Installation and Construction

Chapter 7 **Installation** page 12 out of 24

Drip Tubing

A vibratory plow allows tubing to be fed into the plow rather than pulled through the soil.

Drip tubing being installed in an open field using a vibratory plow

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Installation and Construction

Chapter 7

Installation

Drip Tubing

Drip tubing being installed with a vibratory plow in a wooded area

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Installation and Construction

Installation

5) Install loops (flex tubing) that connect runs of dripper tubing.

Note: The connecting loops should be above the elevation of the drip tube.

Loop connector

BACK HOME NEXT

Back to the Table of Contents

Installation and Construction

Chapter 7 **Installation** page 15 out of 24

6) Dig ditches for conveyance lines.
   - Inlet to hydraulic unit
   - Supply lines
   - Return line
   - Hydraulic unit to primary treatment tank line
7) Place hydraulic unit and mount control panel.

Hydraulic unit with conveyance lines

Control panel

BACK HOME NEXT

Back to the Table of Contents

Installation and Construction

Installation

8) Connect pressure lines and field manifolds when the lines are dry.

Manifold connections

BACK HOME NEXT

Back to the Table of Contents

Installation and Construction

Installation

9) Set floats in pump tank.

10) Glue all fittings.

11) Install electrical line (and phone line for remote monitoring, if applicable).

12) Check power supply and power up unit.

13) Provide one day's volume of clean water for start up.

14) Pressure check all fitting and lines.

15) Inspect field and loops.

Installation and Construction

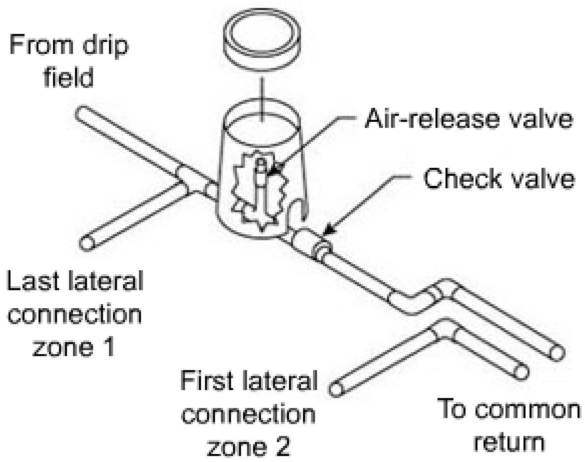
Chapter 7

Installation

16) Flush all fields through air-release valves.

Air release valve close-up

Air-release and check valve



BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Installation and Construction

Chapter 7

Installation

17) Set run time for central unit.

18) Check setup values against calculated values.

19) Find leaks and repair.

20) Backfill once lines and fields are determined to have no leaks. Backfilling is to be controlled to prevent the damage of pipes or fittings.

21) Grade and seed site.

BACK HOME NEXT

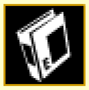
Back to the Table of Contents

Installation and Construction

Chapter 7

Construction

SEOs should know the particulars of how and when a drip irrigation system should be constructed and installed.



Section 12.C.1

1) No wet weather installation. Soil moisture content must be at or below field capacity for drip line installation.

Soil moisture field test:

A) Squeeze a handful of soil in one hand.

B) Open your hand.

C) Bounce the sample once lightly in your hand or tap the soil lightly with your finger.

If the sample of soil crumbles or breaks up immediately when bounced or tapped, the soil moisture should be acceptable, and construction can occur. If the sample sticks together, the soil moisture is unacceptable, and construction should be postponed.

BACK HOME NEXT

Back to the Table of Contents

Installation and Construction

Construction

Retun trench with drip lines taped to prevent debris from getting into the tubing. These tubes will be connected to the return manifold or a drip loop connector.

2) No activity must occur on the drip zones. No parking of equipment or storage of materials is permitted over the drip zones.

3) The system should be installed as permit requires.

4) All PVC pipe and fittings must be PVC Schedule-40 type-1 rated for pressure applications. All glued joints must be cleaned and primed with purple (dyed) PVC primer prior to being glued.

5) All pipe, flexible PVC, and/or dripper tubing should be cut with pipe cutters. If sawing is done, all shavings from the sawing must be cleaned out of the pipe.

6) All PVC pipe, flexible PVC, and/or dripper tubing in the work area must have the ends covered with duct tape to prevent construction debris from entering the pipe. Prior to gluing, all glue joints must be inspected for and cleared of construction debris.

BACK HOME NEXT

Back to the Table of Contents

Installation and Construction

Construction

7) Prior to starting up the drip system, the air-release valves must be removed, and each zone in the system must be flushed as follows:

   a) Attach an appropriate length of flexible PVC pipe with a male fitting to the air-release connection to direct the flushing away from the construction area.

   b) Flush the zone with a volume of clean water equal to 1.5 times the volume of the pipes from the hydraulic unit to the air-release valve.

   c) Repeat this procedure for each zone.

8) If existing treatment tank(s) to be used, they must be pumped out by a commercial septic tank pumper. After the tank(s) are emptied, they must be rinsed, pumped, and refilled with clean water. Debris in treatment tank(s) must be kept to a minimum since it could clog the disc filters during start up.

BACK HOME NEXT

Back to the Table of Contents

Installation and Construction

Winter Operation

Section 12.C.5

Drip tubing is susceptible to freezing when sufficient turf cover is not established in non-wooded areas prior to winter operation.

What should occur if turf cover will not be established prior to winter operation?

Such measures as a temporary cover of mulch or straw should be used to insulate the tubing.

BACK HOME NEXT

Back to the Table of Contents

Installation and Construction

SEO's Role in Installation

What is the SEO's role in installation and construction of a drip system?

The SEO should verify that the installation is being done according to the permit requirements, and the alternate and experimental guidance requirements.

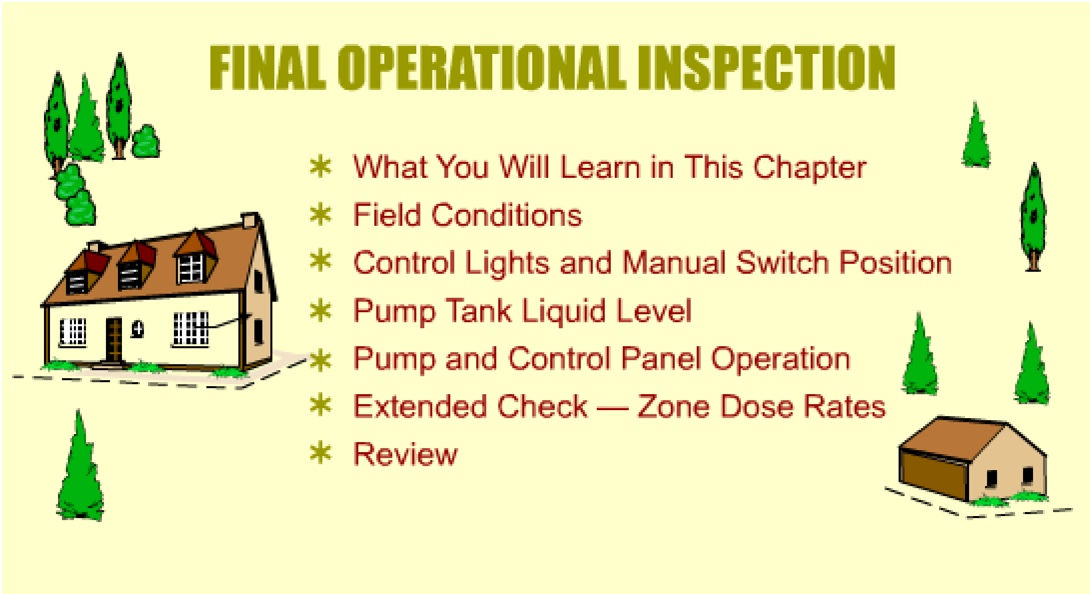
BACK HOME

Back to the Table of Contents

Final Operational Inspection

Chapter 8

page 1 out of 9



NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Final Operational Inspection

Chapter 8

What You Will Learn in This Chapter

page 2 out of 9

- [x] How to do a final operational inspection for a drip irrigation system.

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Final Operational Inspection

Field Conditions

1) Check the Field Conditions:

- Walk the field to determine if wet spots are visible.

A representative from American Manufacturing will complete the final operational inspection. The SEO should be present during the inspection.

BACK HOME NEXT

Back to the Table of Contents

Final Operational Inspection

Chapter 8 Control Lights and Manual Switch Position

page 4 out of 9

2) Check Control Lights and Manual Switch Position

1) Open the control panel.

2) Open the lid to the hydraulic unit.

3) Make sure manual switches are in the automatic position.

4) Make sure the microprocessor on.

5) Verify microprocessor input lights.

6) Verify microprocessor output lights.

BACK HOME NEXT

Back to the Table of Contents

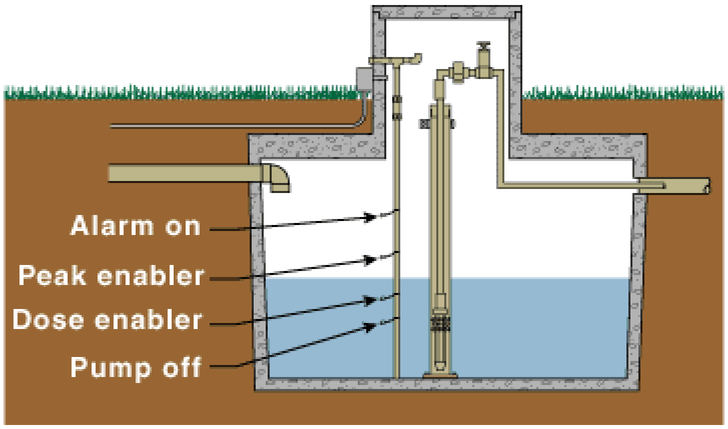
Drip Irrigation Training Course

Final Operational Inspection

Pump Tank Liquid Level

3) Verify Pump Tank Liquid Level

- Check liquid level in pump tank to confirm switch operation. If a float is up, the light on the microprocessor should be on.



BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Final Operational Inspection

Pump and Control Panel Operation

4) Check the Pump and Control Panel

- Place pump "Hand-Off-Auto" switch in the "Hand" position to dead head pump against valves. The flow meter should not turn, and there should be no leaks.
- With the pump in the "Hand" position, open the filter back-wash valve for filter one (1) for 10 seconds and then close. Repeat for filter two (2) for 10 seconds. There should be no flow registering in the flow meter, and you should hear the valves open and close. The valve diaphragm will rise, then lower during back flush.
- With the pump running, place each zone valve in the "Hand" (open) position one at a time to check operation. With each zone valve open, flow should register on the flow meter. When the zone valve closes (off position), the flow should stop.
- Return all switches to the automatic position.

BACK HOME NEXT

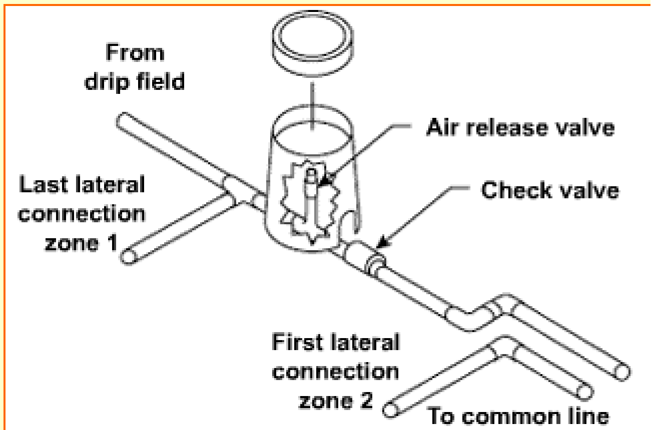
Back to the Table of Contents

Final Operational Inspection

Extended Check — Zone Dose Rates

5) Do an Extended Check of the Zone Dose Rates

- Open air-release valves and inspect. Make sure they close during the dosing. They should not leak water after air is evacuated.
- Check to see if only one air-release valve is pressurized at a time.
- With the pump in the "Hand" position, select the first zone by placing the zone valve switch in the "Hand" position on the control panel. After pressurization time, check flow rate by reading the flow meter for a timed minute. Repeat for all zones. If flow varies by more than _?_ percent from the calculated flow rate, contact a qualified operator.



BACK HOME NEXT

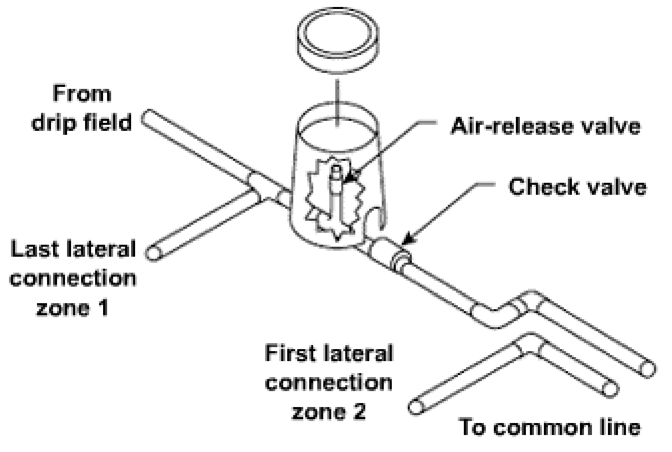
Back to the Table of Contents

Final Operational Inspection

Extended Check — Zone Dose Rates

5) Do an Extended Check of the Zone Dose Rates (continued)

- Verify that only the correct air-release valve is pressurized.
- After the final zone is checked, place the "Zone Return" valve in the "Hand" position while the zone valve is still in the "Hand" (open) position. Verify that the flow rate increased to provide the flow for drip tubing forward field flush.
- Return all switches to the automatic position.



- Press the reset button for 5 seconds and verify zone dosing time is set according to the start up by manually timing the dose.

BACK HOME NEXT

Back to the Table of Contents

Final Operational Inspection

Chapter 8

Review

page 9 out of 9

Instructions: Choosing from the blue area, click on each of the final operational inspections in the correct sequence from one to five.

1 ?	Check the pump and control panel.
2 ?	Do an extended check of the zone dose rates.
3 ?	Check the field conditions.
4 ?	Check the control lights and manual switch position.
5 ?	Verify pump tank liquid.

BACK HOME

Back to the Table of Contents

Drip Irrigation Training Course

Operation and Maintenance

Chapter 9

page 1 out of 6

OPERATION AND MAINTENANCE

* What You Will Learn in This Chapter
* Home Owner and Factory Representative Meeting
* Warranty
* SEO Training Requirements

NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Operation and Maintenance

Chapter 9

What You Will Learn In This Chapter

- The alternate and experimental guidance requirements for operation and maintenance of a drip irrigation system.
- The requirement for a meeting between the homeowner and the system's factory rep.
- The warranty provided by the manufacturer of the system.
- The name and address of the only drip system manufacturer that has met DEP's requirements.

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Operation and Maintenance

Chapter 9 Home Owner and Factory Representative Meeting page 3 out of 6

The following two operation and maintenance conditions must be attached to the permit issued by the local agency:

Section 12.D.1

1) The manufacturer's representative must meet with the property owner within one month of occupancy of the dwelling and with the local agency's SEO upon request. At this meeting, the manufacturer's representative must explain the operation and maintenance of the system and provide written instructions to the property owner that include:

   a) Instruction on the operation and maintenance of the system.

   b) The location of all parts of the system.

   c) A caution notice regarding disturbances of the drip zones that may cause system damages (i.e., excavation of trees, fencing, etc.)

   d) An explanation of the automatic alarm system.

   e) A statement requiring that the manufacturer's representative be contacted if the alarm system is activated.

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Operation and Maintenance

Chapter 9

Warranty

page 4 out of 6

Section 12.D.2

2) The manufacture of the drip irrigation system must provide minimum two-year warranty on all defects due to materials or workmanship.

BACK HOME NEXT

Back to the Table of Contents

Operation and Maintenance

Warranty

Section 12.D

The only drip irrigation system that has met the requirements for the alternate system listing to date is

Perc-Rite® System, manufactured by the American Manufacturing Company, Incorporated (5517 Wellington Road, Gainesville, VA 20155 americanonsite.com - 800-345-3132.)

All proposals for the application of drip irrigation systems that fall outside the standards established by the alternate system listing must be proposed and reviewed as experimental systems under the provisions of Chapter 73.71.

BACK HOME NEXT

Back to the Table of Contents

Operation and Maintenance

SEO Traning Requirements

What would happen if a resident wanted to install a drip system and an SEO has not taken DEP-approved training on drip irrigation siting, design, and construction?

Until such time as the local agency's SEO receives training on drip irrigation siting, design, and construction, all proposals for drip irrigation must be forwarded to the appropriate regional office of DEP for review and comment prior to permit issuance.

BACK HOME

Back to the Table of Contents

Drip Irrigation Review

Chapter 10

NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Drip Irrigation Review

Chapter 10

What You Will Learn in This Chapter

page 2 out of 17

- What the drip irrigation components look like after they are installed.
- What a complete installation looks like in a forested and grassy area.

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Drip Irrigation Review

Chapter 10

Review of Drip Irrigation Components

page 3 out of 17

BACK HOME NEXT

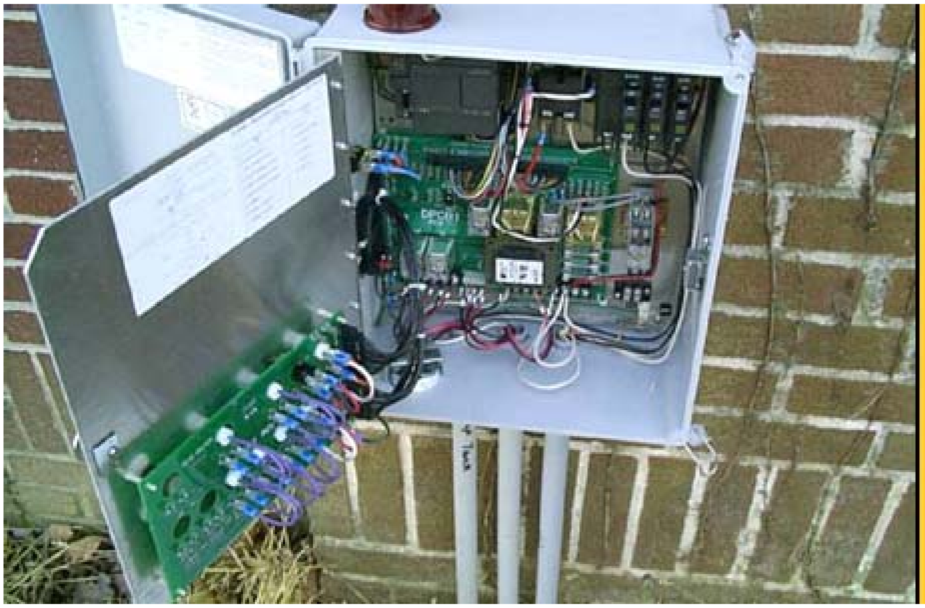
Back to the Table of Contents

Drip Irrigation Training Course

Drip Irrigation Review

Chapter 10

Review of Drip Irrigation Components



Inside of Control Panel

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Drip Irrigation Review

Chapter 10

Review of Drip Irrigation Components

Top View:
Hydraulic Unit Inside of Insulated Box

BACK HOME NEXT

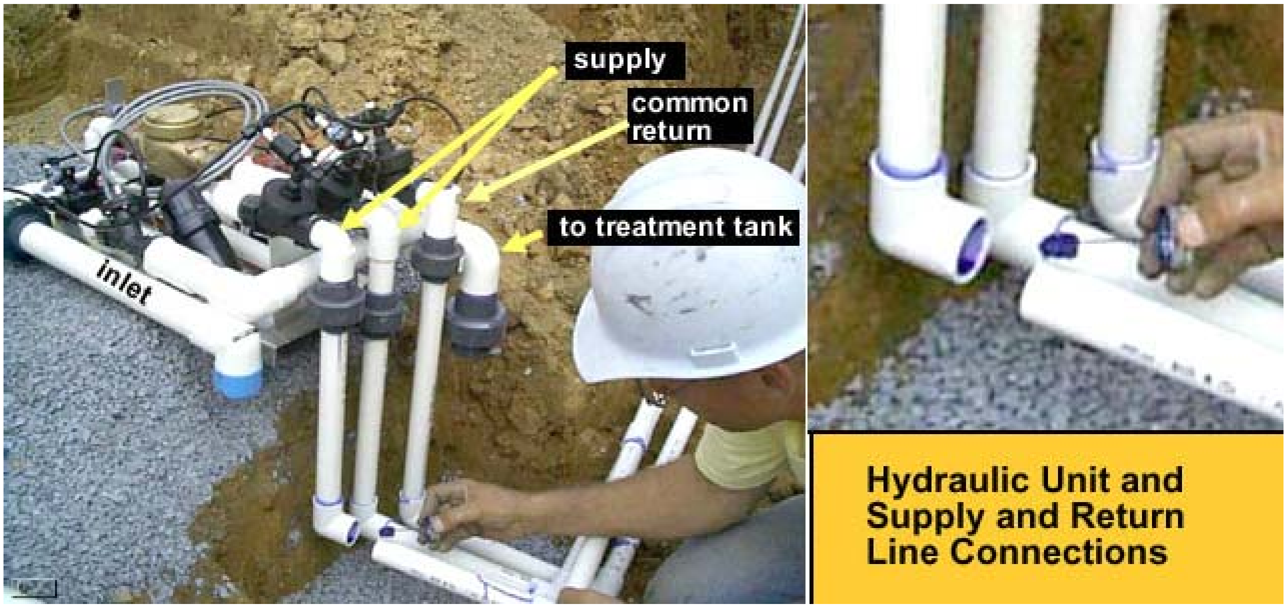
Back to the Table of Contents

Drip Irrigation Training Course

Drip Irrigation Review

Chapter 10

Review of Drip Irrigation Components



BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Review

Chapter 10

Review of Drip Irrigation Components

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Drip Irrigation Review

Chapter 10

Review of Drip Irrigation Components

page 8 out of 17

BACK HOME NEXT

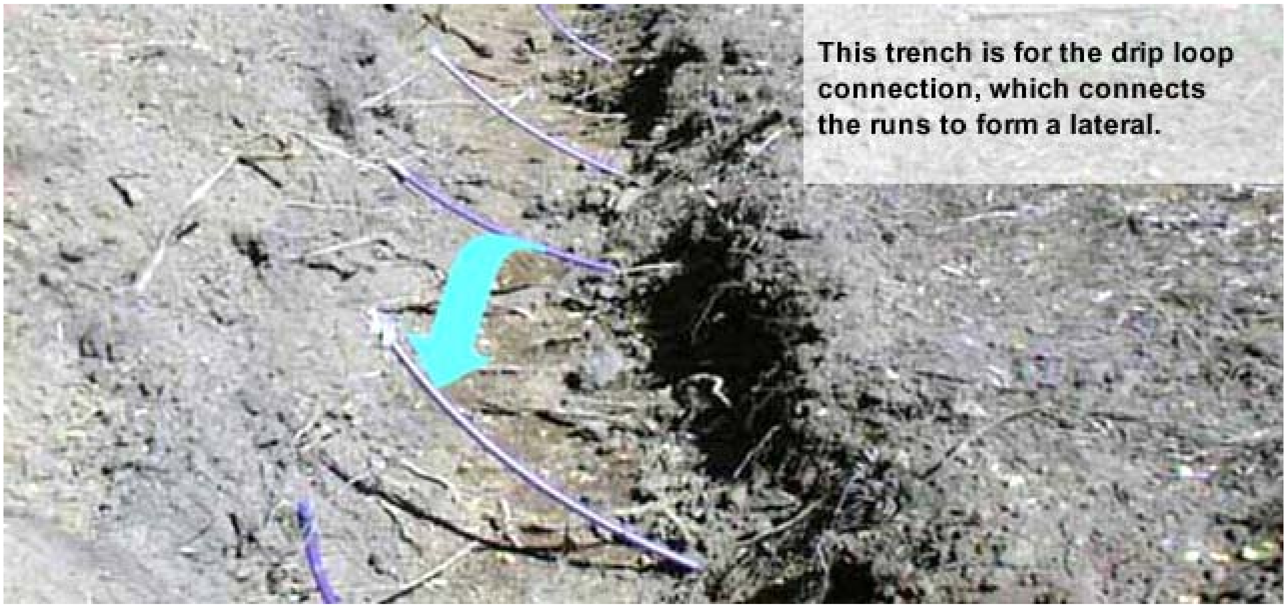
Back to the Table of Contents

Drip Irrigation Training Course

Drip Irrigation Review

Chapter 10

Review of Drip Irrigation Components



BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Drip Irrigation Review

Chapter 10

Review of Drip Irrigation Components

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Drip Irrigation Review

Chapter 10

Review of Drip Irrigation Components

page 11 out of 17

BACK HOME NEXT

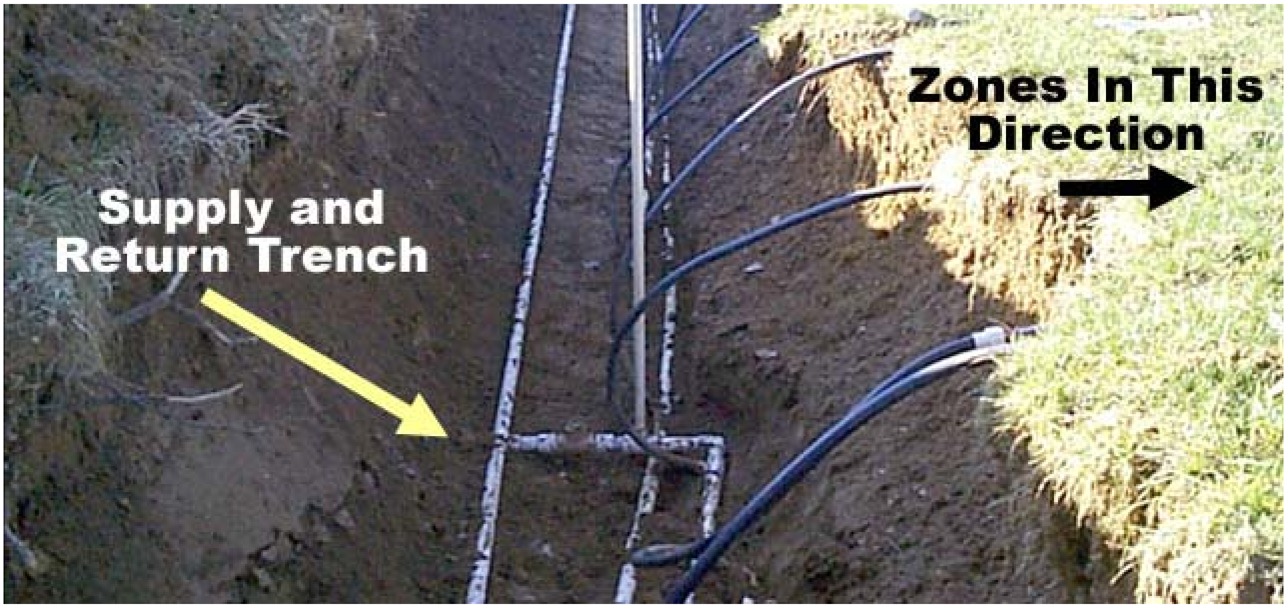
Back to the Table of Contents

Drip Irrigation Training Course

Drip Irrigation Review

Chapter 10

Review of Drip Irrigation Components



BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Drip Irrigation Review

Chapter 10

Review of Drip Irrigation Components

page 13 out of 17

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Drip Irrigation Review

Chapter 10

Review of Drip Irrigation Components

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Drip Irrigation Review

Chapter 10

Completed Installation

BACK HOME NEXT

Back to the Table of Contents

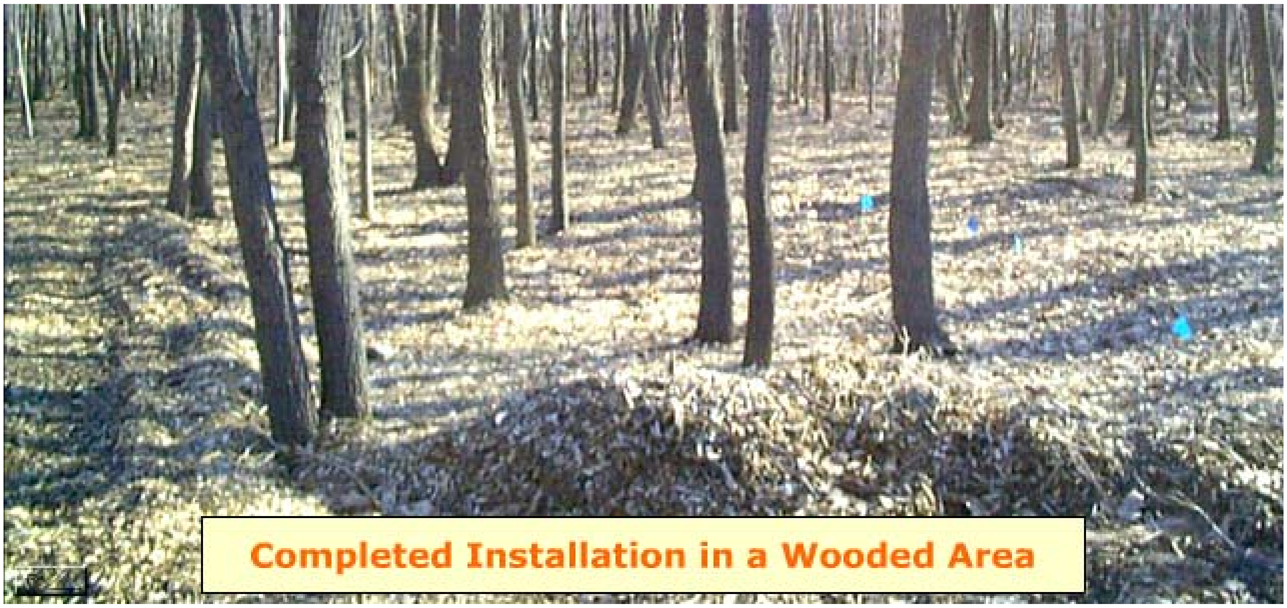
Drip Irrigation Training Course

Drip Irrigation Review

Chapter 10

Completed Installation

page 16 out of 17



BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Drip Irrigation Review

Review of Drip Irrigation Components

- Drip irrigation is an alternate technology approved by the Department of Envirnomental Protection.
- Drip irrigation achieves equal distribution through the pressure-compensating drip emitters.
- Drip irrigation can use the available space on a lot, because the zones can be different sizes.
- A drip irrigation system is buried in the ground. It could be in the front yard, but no one would know it was there.

BACK HOME

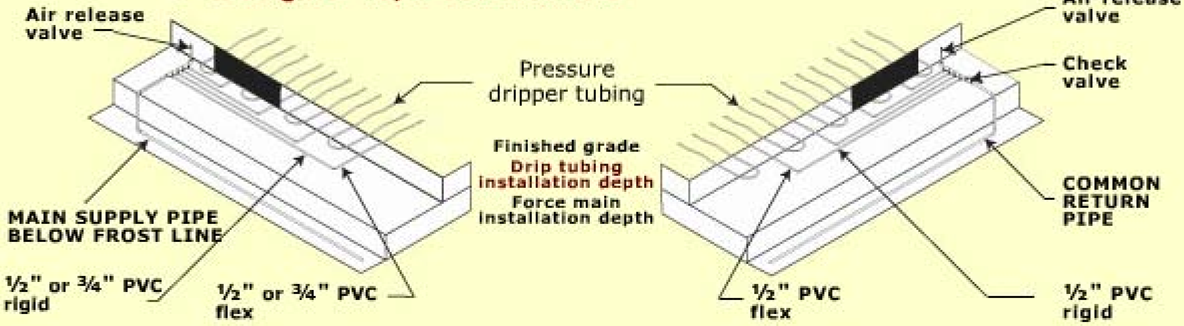
Back to the Table of Contents

Top Feed Manifold

Chapter 11 page 1 out of 10

Top Feed Manifold

* What You Will Learn in This Chapter
* Why Should a Top Feed Manifold Be Used
* Design of Top Feed Manifold



NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Top Feed Manifold

Chapter 11

What You Will Learn in This Chapter

- When to use a top feed manifold system.
- The design components of a top feed manifold system.

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

Top Feed Manifold

Chapter 11 Why Should a Top Feed Manifold Be Used page 3 out of 10

American Manufacturing is recommending that sites with a slope of greater than five percent to use top feed manifolds.

If the site has a slope of more than five percent, the drip irrigation system should be designed with a top feed supply manifold and a top feed return manifold. If the site has a slope of five percent or less, the **supply** manifold connection and **return** manifold connection as described in the course should be used.

BACK HOME NEXT

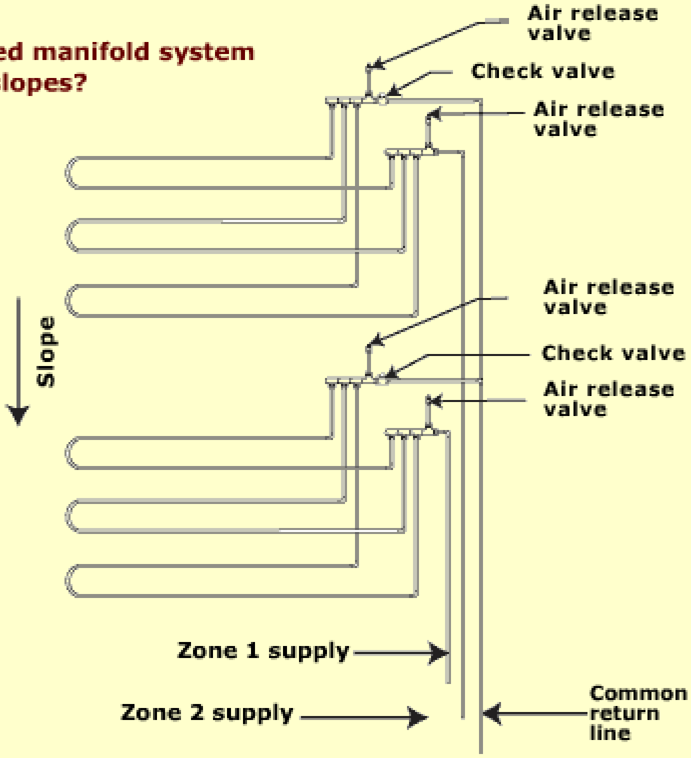
Back to the Table of Contents

Top Feed Manifold

Chapter 11 Why Should a Top Feed Manifold Be Used page 4 out of 10

Why should a top feed manifold system be used on steeper slopes?

The top feed manifold system helps prevent drain down of upper laterals in the zone to lower laterals in the zone. This may help prevent overloading of the lower laterals within a zone after the pump shuts off. By using these "top feed" manifolds the only thing that changes in the entire system is the way in which the drip lines are fed from the main supply line, and back into the common return line.



BACK HOME NEXT

Back to the Table of Contents

Top Feed Manifold

Design of Top Feed Manifold

This section of the chapter will cover the design aspects of the top feed manifold system listed below:

1) Placement of top feed manifold system.
2) Valves that should go with the manifold system.
3) How to calculate for the head loss of the manifold system.

BACK HOME NEXT

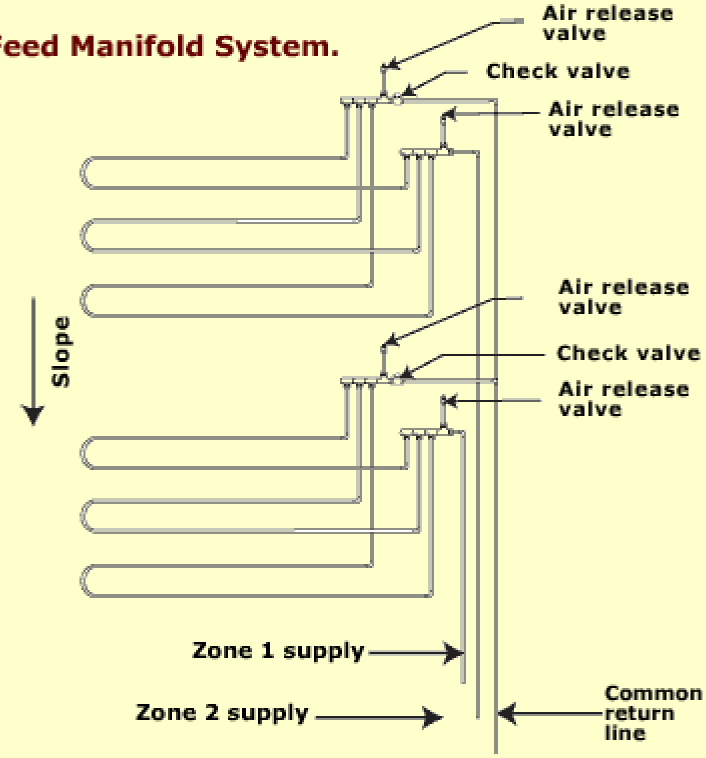
Back to the Table of Contents

Top Feed Manifold

Design of Top Feed Manifold

1) Placement of Top Feed Manifold System.

The top feed supply and return manifolds must be at the highest point in the drip zone. Each zone must have a **supply** and **return** top feed manifold system.



BACK HOME NEXT

Back to the Table of Contents

Top Feed Manifold

Chapter 11

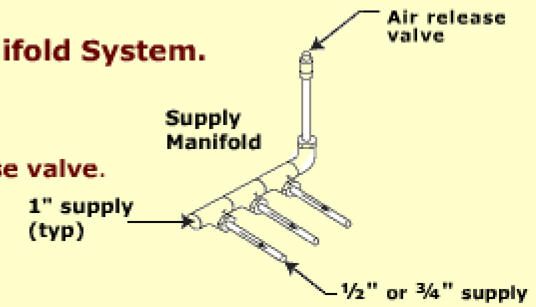
Design of Top Feed Manifold

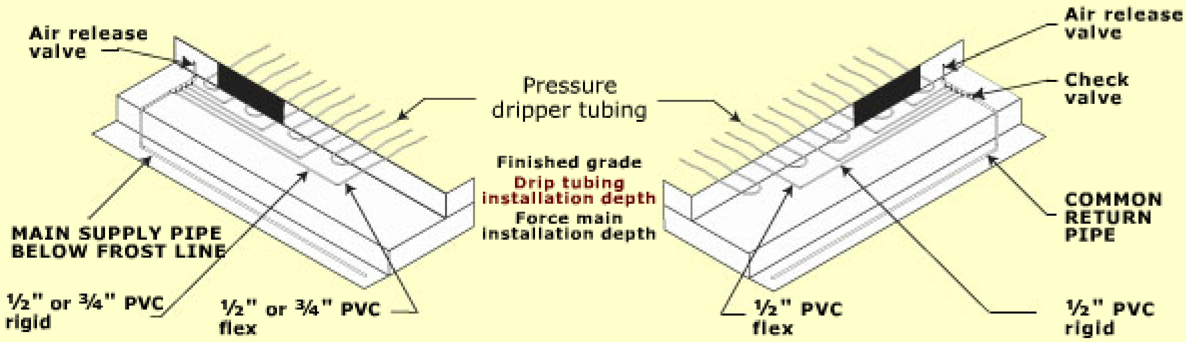
page 7 out of 10

2) Valves That Should Go With the Manifold System.

Supply Top Feed Manifold

Each top feed supply manifold needs an **air release valve**.





The **air release valve** provides ready venting of the distribution system, enhancing drainage of tubing and the top feed manifold. It also provides freeze protection.

BACK HOME NEXT

Back to the Table of Contents

Drip Irrigation Training Course

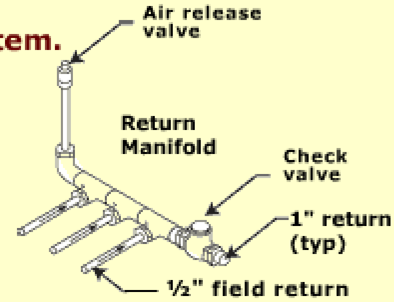
Top Feed Manifold

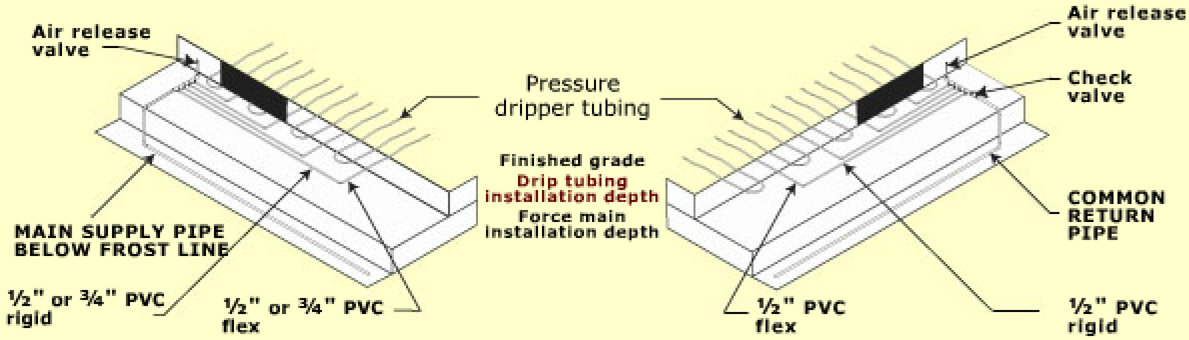
Design of Top Feed Manifold

2) Valves That Should Go With the Manifold System.

Return Top Feed Manifold

Each top feed return manifold needs an air release valve and a **check valve**.





The **air release valve** provides ready venting of the distribution system, enhancing drainage of tubing and the top feed manifold. It also provides freeze protection.

The **check valve** prevents effluent from entering the zone when another zone is being dosed.

BACK HOME NEXT

Back to the Table of Contents

Top Feed Manifold

Design of Top Feed Manifold

3) How to Calculate for the Head Loss of the Manifold System.

When determining the head loss for the top feed manifold add 50 feet of pipe equivalent length for the supply and 50 feet of pipe equivalent length for the return manifold. The 50 feet on both the supply and return manifolds is more than enough to cover the head loss through the top feed manifold.

When reviewing the head loss calculations make sure the designer added the 50 feet of pipe equivalent length for both the supply and return manifold, if the top feed manifold was used.

BACK HOME NEXT

Back to the Table of Contents

Top Feed Manifold

Chapter 11

Design of Top Feed Manifold

American Manufacturing is recommending the top feed manifold system on sites with a slope of greater than five percent to prevent drain down of upper laterals in the zone to lower laterals in the zone. This may help prevent the overloading of the lower laterals within a zone after the pump shuts off.

If you have any questions about the top feed manifold system, please contact:

American Manufacturing
5517 Wellington Road
Gainesville, VA 20155
americanonsite.com
800-345-3132

BACK HOME

Back to the Table of Contents

Appendix

All materials are in Adobe Acrobat format. If you don't have Acrobat Reader installed on your computer, you can download it from here. It's free.

Please note that the files are optimized for printing. We recommend that you print all the materials of the Appendix rather than vewing them on screen.

Soil Morphological Report

Drip Irrigation Design Review Worksheet

Tables

Checklist Drip Irrigation Soil Scientist Report

Head Loss Chart

Design Plan

Close Appendix

Soil Morphological Report

August 1, 2001

Tom and Sue Smith
1234 Lake Drive
Harrisburg, PA 17011

Dear Mr. And Mrs Smith:

On July 20, 2001, the soil conditions at your residential property were evaluated with regard to morphological characteristics and the corresponding suitability for a drip irrigation installation. The investigation was conducted in the presence of the township Sewage Enforcement Officer (SEO), who is responsible for the design review and permit approval of this alternate system, in accordance with the Department of Environmental Protection, January 2000 ***Alternate and Experimental Systems Guidance*** document.

Several backhoe excavations were examined in order to establish depth to seasonal water table, rock limiting condition depth, drainage classification, and the morphological indicators used to design the drip irrigation system. In addition, soil borings were hand augered throughout the proposed absorption area to confirm the soil conditions described in the individual soil test probes. The following summarizes the actual soil conditions present and provides specific criteria, which will be used in the preparation of an individual design for this alternative technology.

The soil conditions at your proposed residential absorption area were characterized by a professional member of the PA Association of Professional Soil Scientists (PAPSS), who is also recognized as a Qualified Soil Scientist as defined in Chapter 73, Section 73.1. The soils were characteristic of the Laidig soil series, which confirms the mapping provided by the NRCS Dauphin County Soil Survey. The soils within the proposed absorption area are (e.g., deep and well drained), with a maximum slope of 11 percent. Depth to a seasonal water table was noted at 42 inches, and the most shallow indication of a rock limiting condition was 62+ inches. Based upon these general observations, a drip irrigation system may be further considered.

The accompanying soil profile description(s) provides additional morphological detail, which may be used to prepare a design for a drip irrigation system for your residential lot. Based upon the morphology of the soil, a maximum soil linear load rate of .33 gallons per linear foot per day may be used. The horizontal linear load must not exceed 4.6 gallons per day as calculated on the average daily flow of your proposed system. Drip line tubing shall be installed to a depth of 6 inches, with a horizontal separation of 1.5 feet. Based upon this design criteria, a site plan for the individual drip irrigation zones may be developed.

The accompanying design plan displays the individual soil test probe locations and the proposed absorption area necessary for this alternative sewage treatment and disposal technology. This approved area must remain undisturbed prior to actual design stake-out, permit issuance, and installation. A copy of this report has been submitted to the SEO for his review and approval and should be included in the subsequent design drawings to be submitted with your septic permit application.

If I can provide you with any additional information at this time with regard to the existing soil conditions encountered or the corresponding drip irrigation design criteria, please feel free to contact me. Thank you for the opportunity to provide these services on your behalf.

Respectfully submitted,

Rick Smith

Rick Smith
Qualified soil scientist

cc: Towwnship SEO

DRIP IRRIGATION DESIGN REVIEW WORKSHEET		
		BUILDING SEWERS
		PRIMARY TREATMENT TANKS
		1) septic tank(s)
		a) multiple-compartmented tank
		b) tanks in a series
		2) aerobic
		SECONDARY TREATMENT OPTIONS
		1) intermittent sand filter
		a) free access
		b) buried
		2) aerobic tank
		3) peat filter
		DOSING TANK TO THE HYDRAULIC UNIT
	gal.	liquid capacity
	pump	pump
		Minutes set for timer:
	minutes	zone 1 – average flow dose (doses 4 per zone)
	minutes	zone 1 – peak flow dose (doses 6.7 per zone)
	minutes	zone 2 – average flow dose (doses 4 per zone)
	minutes	zone 2 – peak flow dose (doses 6.7 per zone)

		DRIP ZONES
	gpd	gallons per day – number of bedrooms?
	lin. ft.	soil linear load – max. .34 gpd. ÷ linear ft. (from soil scientist report)
	linear ft. min.	total drip tubing = gpd ÷ soil loading rate
	zones	number of zones on the design
	ft. min.	horizontal linear load = average gpd ÷ 4.6 gal./foot
		HYDRAULIC UNIT
		two-disc filter
		three-disc filter
		Zone 1
	ft.	linear feet of drip tubing
	ft.	length of longest run
	ft.	length of longest drip irrigation lateral
	laterals	number of drip irrigation laterals or number of field flush connections (must meet hydraulic unit specifications)
	ft.	distance between drip tubing
	ft.	distance between drip emitters
	gpm	field flush flow rate (1.6 gpm × lateral connections)
	gpm	dosing rate = linear feet of drip tubing ÷ distance between emitters × .65 gph ÷ 60 min./hr.
	gpm	total drip tube forward flush flow required
		Zone 2
	ft.	linear feet of drip tubing
	ft.	length of longest run
	ft.	length of longest drip irrigation lateral
	laterals	number of drip irrigation laterals or number of field flush connections (must meet hydraulic unit specifications)
	ft.	distance between drip tubing
	ft.	distance between emitters
	gpm	field flush flow rate (1.6 gpm × lateral connections)
	gpm	dosing rate = linear feet of drip tubing ÷ distance between emitters × .65 gph ÷ 60 min./hr.
	gpm	total drip tube forward flush flow required

		HEAD LOSS
		Pump Tank to the Hydraulic Unit
	in.	size of supply line
	ft.	supply line equivalent fitting length = 50 feet of pipe
	ft. max.	length of supply line (should be ≤ 30 feet)
	ft.	total feet of pipe = supply line fitting equivalent in feet + supply line in feet
	ft.	supply line friction loss @ 15 gpm = total feet of supply line pipe × head loss due to friction (using head loss due to friction chart) ÷ 100 feet of pipe
	ft. max.	static head loss from the dose enabler (second float) to the hydraulic unit
	ft.	total feet of head loss from the pump tank to the hydraulic unit = supply line friction loss + static head loss
		Through the Hydraulic Unit
	gpm	max. design drip tubing forward field flush flow = the largest design flow from a zone
	ft.	feet of head loss from hydraulic unit (from table 2A @ maximum design drip tubing forward flushing flow)
		Through the Supply Lines
		Zone 1
	gpm	zone 1 total flow requirement during drip tubing forward field flush
	in.	size of supply line
	ft.	length of supply line
	ft.	supply line friction loss = [total feet of supply line pipe × head loss due to friction (using the head loss due to friction chart, round the gpm to the closest whole number on the chart)] ÷ 100 feet of pipe
		Zone 2
	gpm	zone 2 total flow requirement during drip tubing forward field flush
	in.	size of supply line
	ft.	length of supply line
	ft.	supply line friction loss = [total feet of supply line pipe × head loss due to friction (using the head loss due to friction chart, round the gpm to the closest whole number on the chart)] ÷ 100 feet of pipe
		Flushing Through the Drip Tubing
	ft.	Zone 1
	ft.	Zone 2
		Through the Return Lines
		Zone 1
	gpm	zone 1 total flow requirement during drip tubing forward flush
	in.	size of return line
	ft.	length of return line
	ft.	return line friction loss = [total feet of common return line pipe × head loss due to friction (using the head loss due to friction chart, round the gpm to the closest whole number on the chart)] ÷ 100 feet of pipe
		Zone 2
	gpm	zone 2 total flow requirement during drip tubing forward flush
	in.	size of return line
	ft.	length of return line
	ft.	return line friction loss = [total feet of common return line pipe × head loss due to friction (using the head loss due to friction chart, round the gpm to the closest whole number on the chart)] ÷ 100 feet of pipe
		Zone Static Head Loss
	ft	Zone 1 total static head loss = elevation change between hydraulic unit and the highest drip emitter in zone 1
	ft.	Zone 2 total static head loss = elevation change between hydraulic unit and the highest drip emitter in zone 2

		<u>Calculating Total Head Loss for Zone 1</u>
	ft.	hydraulic unit pump to hydraulic unit
	ft.	hydraulic unit
	ft.	zone 1 supply line pipe
	ft.	flushing through the drip tubing in zone 1
	ft.	zone 1 return line pipe
	ft.	static head (hydraulic unit to highest zone 1 drip emitter)
	ft.	**Total head loss for zone 1**
		<u>Calculating Total Head Loss for Zone 2</u>
	ft.	hydraulic unit pump to hydraulic unit
	ft.	hydraulic unit
	ft.	zone 2 supply line pipe
	ft.	flushing through the drip tubing in zone 2
	ft.	zone 2 return line pipe
	ft.	static head (hydraulic unit to highest zone 2 drip emitter)
	ft.	**Total head loss for zone 2**
		Pump Size
	ft	maximum head loss from a zone during the forward field flush hydraulic condition
	ft.	disc filter back flush (hydraulic unit supply line dynamic head loss +115 @ 15 gpm)
	ft.	use greater of the two head losses to determine pump size at 15 gpm
	pump	pump selected

Table 2A

CENTRAL HYDRAULIC UNIT Table 2A FLOW vs HEAD LOSS IN FEET		
FLOW IN GPM	TOTAL LOSS IN TDH 25 gpm Three-disc	TOTAL LOSS IN TDH 15 gpm Two-disc
5	2	4
6	2	4
7	3	5
8	4	6
9	5	7
10	6	8
11	7	9
12	7	11
13	8	12
14	9	13
15	10	16
16	12	19
17	14	22
18	16	24
19	18	27
20	20	28
21	21	
22	22	
23	23	
24	24	
25	25	

Table 3A

DRIPPER LINE PRESSURE Table 3A FIELD FLUSHING		
MAXIMUM LATERAL LENGTH	HEAD LOSS PSI	HEAD LOSS FT.
50	7	16
60	7	16
70	7	16
80	7	16
90	7	16
100	7	16
110	7	16
120	7	16
130	7	16
140	7	16
150	7	16
160	7	16
170	7	16
180	7	16
190	7.4	17
200	8	18
210	8.6	20
220	9.2	21
230	9.9	23
240	10.5	24
250	11.2	26
260	12	28
270	12.7	29
280	13.5	31
290	14.3	33
300	15.2	35
310	16	37
320	16.9	39
330	17.9	41
340	18.9	44
350	19.9	46
360	20.9	48
370	22	51
380	23.1	53
390	24.2	56
400	25.4	59

CHECKLIST
DRIP IRRIGATION
SOIL SCIENTIST REPORT

Site Conditions

Project name	_____
Project location	_____
Date of investigation	_____
Soil series	_____
Slope	_____
Complete profile description(s)	_____
color (Munsell notation)	_____
textural classes and CF modifiers	_____
abundance, size, contrast, and color of mottles	_____
grade, class, and type of structure	_____
consistence	_____
coarse fragment content	_____
boundary	_____

Drip Irrigation Criteria

Depth to seasonal water table	_____
Depth to rock with insufficient soil	_____
Soil drainage classification	_____
Soil linear load	_____
Horizontal linear load	_____
Tubing installation depth	_____

Soil Scientist Qualifications

Soil scientist who is a professional member of the Pennsylvania Association of Professional Soil Scientists (PAPSS) (copy of membership card or consultants list), or	_____
"Qualified soil scientist" as defined in Chapter 73, Section 73.1 (ARCPACS seal and/or certification number along with SEO number)	_____
Signature of the soil scientist	_____

Head Loss Chart

HEAD LOSS DUE TO FRICTION IN SMOOTHWALL PLASTIC PIPE (feet)

Note: The shaded areas below represent a velocity of less than 2 feet per second. The minimum velocity required to carry solids is 2 feet per second.

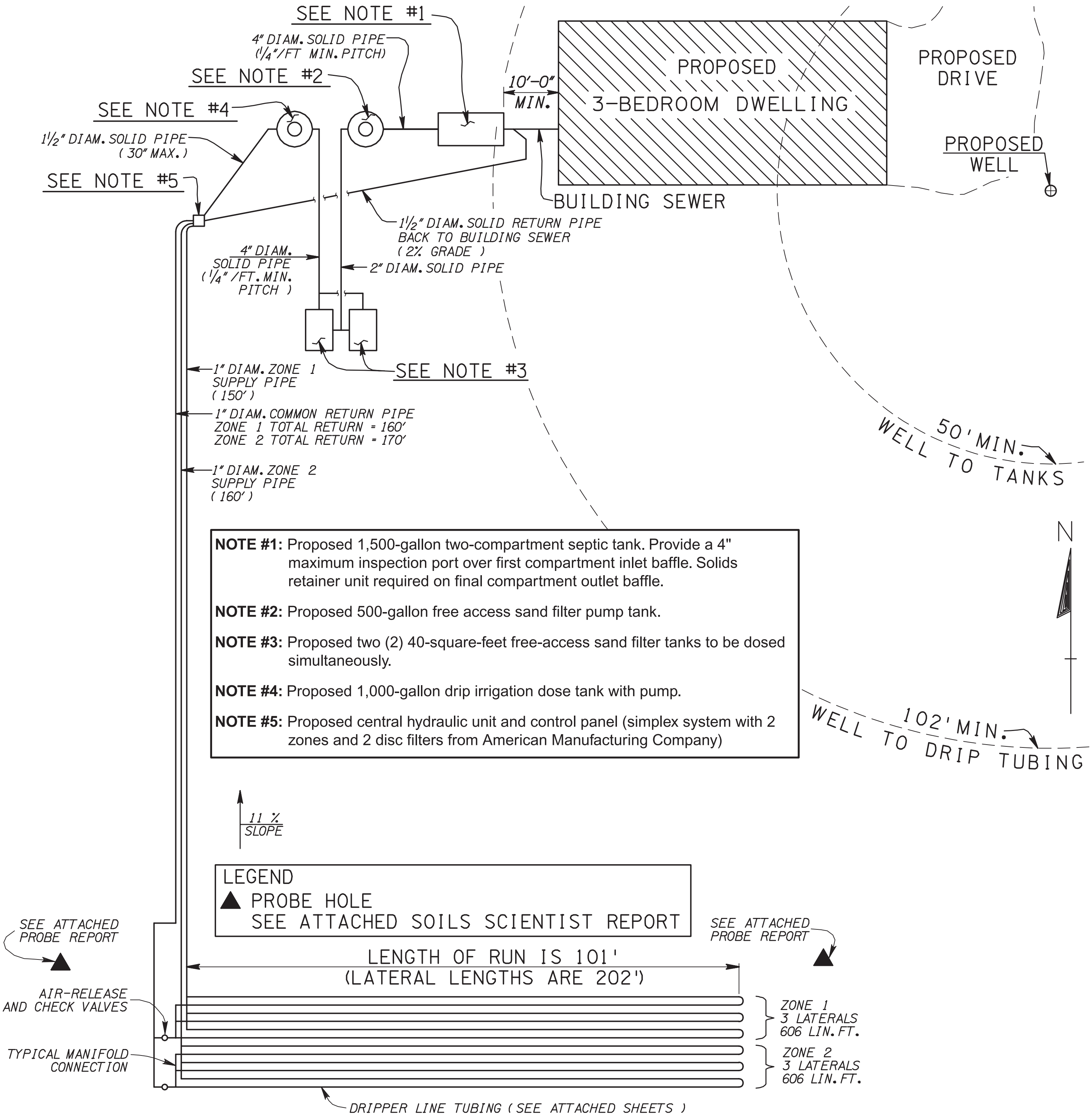
GPM FLOW	NOMINAL PIPE DIAMETER (inches)					
	1	1.5	2	3	4	6
1						
2	0.28					
3	0.59	0.07				
4	1.01	0.13				
5	1.52	0.19				
6	2.13	0.27	0.08			
7	2.84	0.35	0.11			
8	3.64	0.45	0.13			
9	4.52	0.56	0.17			
10	5.51	0.68	0.21	0.03		
11	6.56	0.81	0.24	0.04		
12	7.71	0.96	0.28	0.04		
13	8.93	1.11	0.33	0.05		
14	10.25	1.27	0.38	0.06		
15	11.65	1.45	0.43	0.06		
16	13.13	1.63	0.48	0.07		
17	14.69	1.82	0.54	0.08		
18	16.33	2.03	0.61	0.09		
19	18.05	2.24	0.66	0.11		
20	19.85	2.46	0.73	0.11	0.03	
25		3.73	1.11	0.16	0.04	
30		5.22	1.55	0.23	0.06	
35		6.95	2.06	0.31	0.08	
40		8.91	2.63	0.38	0.11	
45		11.06	3.28	0.48	0.13	
50		13.45	3.98	0.58	0.15	0.02
60			5.58	0.82	0.22	0.03
70			7.43	1.09	0.29	0.04
80			9.51	1.39	0.37	0.05
90			11.83	1.73	0.46	0.06
100			14.38	2.11	0.56	0.08
125				3.18	0.85	0.11
150				4.45	1.19	0.16
175				5.92	1.58	0.22
200				7.58	2.02	0.28
250				11.47	3.05	0.42

Notes:

1. Values are for 100 feet of Schedule-40 pressure-rated pipe.
2. Actual I.D. of pipe: 1.049, 1.61, 2.067, 3.068, 4.026, 6.065
3. Formula for friction loss is: Hf= $\frac{10.46\ (Q / C)\ \hat{}1.852}{D\ \hat{}4.87}$ x100

Q = flow (gpm)
C = coefficient of roughness (150)
D = actual I.D. of pipe (inches)

Chart from the "On-site Waste Water Treatment" publication from the National Symposium on Individual and Small Community Sewage Systems.



NOTE #1: Proposed 1,500-gallon two-compartment septic tank. Provide a 4" maximum inspection port over first compartment inlet baffle. Solids retainer unit required on final compartment outlet baffle.

NOTE #2: Proposed 500-gallon free access sand filter pump tank.

NOTE #3: Proposed two (2) 40-square-feet free-access sand filter tanks to be dosed simultaneously.

NOTE #4: Proposed 1,000-gallon drip irrigation dose tank with pump.

NOTE #5: Proposed central hydraulic unit and control panel (simplex system with 2 zones and 2 disc filters from American Manufacturing Company)

LEGEND
▲ PROBE HOLE
SEE ATTACHED SOILS SCIENTIST REPORT

DESIGN PLAN

Scope:

Household sewage will flow by gravity through a treatment unit, typically a septic tank, to the sand filter feed tank. From the sand filter feed tank, the effluent is pumped to the sand filter where, after treatment, it flows by gravity to the drip dose tank for disposal. The central unit will dispose of the effluent by alternately dosing multiple zones in the soil absorption area. The central unit comprises both the hydraulic and control units.

General Notes - Drip Disposal

1. All installation and construction techniques shall conform to county codes and State Board of Health "Sewage Handling and Disposal Regulations" pertaining to on-site sewage systems and the permit for this site.
2. The installation of this system shall be in accordance with specifications and procedures as supplied by the manufacturer of the equipment.
3. All PVC pipe and fittings shall be PVC Sch-40 Type 1 rated for pressure applications. All glued joints shall be cleaned and primed with purple (dyed) PVC primer prior to being glued.
4. All cutting of PVC pipe, flexible PVC and dripper tubing shall be accomplished with pipe cutters approved by manufacturer. No sawing of PVC, flexible PVC, or dripper tubing allowed.
5. All PVC pipe, flexible PVC, and dripper tubing in the work area shall have the ends covered with duct tape to prevent construction debris from entering the pipe. Prior to gluing, all joints shall be inspected for and cleaned of any construction debris.
6. No wet weather installation is permitted.
7. No activity on drainfield area other than minimum required to install system. Do not park equipment, drive large equipment over, or store materials on drainfield site.
8. Horizontal spacing between dripper lines and the installation depth shall be as specified.
9. Prior to start-up of the drip disposal system, the air-release valves shall be removed and each zone in the system shall be flushed as follows: a) Using an appropriate length of flexible PVC pipe with a male fitting attached to the air-release connection to direct the flushing water away from the construction area; b) Flush the zone with a volume of water (clean water to be provided by contractor) equal to 1.5 times the volume of the pipes from the central unit to the air-release valve; c) Repeat this procedure for each zone (the flushing of the system is accomplished by manual override of the control panel by the manufacturer or engineer).
10. If existing septic tanks are to be used, they shall be pumped out by a commercial septic tank cleaner. After the tank is emptied, it shall be rinsed, pumped, and refilled with clean water. Debris in septic tank must be kept to a minimum as it could clog the disc filters during start-up. If used septic tanks must be watertight.
11. If trees are to be removed from site, cut stumps flush with ground. Remove by hand.
12. Gravel base under central control unit is to be drained via 2" PVC pipe, screened at inlet and outlet, discharge to be at grade downslope (to ensure drainage of surface water from unit).
13. The contractor shall be certified to install this type of system by the manufacturer and shall hold a preconstruction meeting with the individuals responsible for soil evaluation, permitting, and inspections prior to site work beginning to ensure protection of the site conditions and to ensure the system is installed according to design.
14. If site conditions are determined to require the installation of the system to deviate from these plans, all site work shall stop immediately and the designer shall be notified. Any ongoing work shall be at the sole responsibility of the contractor.
15. Operation and maintenance manual to be provided at job completion.

* Drip lines are 6 inches below grade, with emitters every 2 feet.
* Drip lines are 1.5 feet on center.
* Drip lines follow contours.
* PVC manifold perpendicular to contours.
* See attached hydraulic profile sheet for all elevations.
* Static head; hydraulic unit pump dose enabler float to hydraulic unit base; 8 feet max.
* Static head; hydraulic unit base to highest drip emitter; 40 feet.