

DRIP-LINE EFFLUENT DISPERSAL COMPONENT MANUAL
FOR
MULTI-FLO ONSITE WASTEWATER TREATMENT UNITS

Produced By
Consolidated Treatment Systems, Inc.
and
Multi Flo Wisconsin

TABLE OF CONTENTS

	Page
I. Introduction and Specifications	3
II. Definitions	8
III. Description and Principle of Operation	9
IV. Soil and Site Requirements	10
V. Cover Material	11
VI. Design	12
VII. Site Preparation and Construction	21
VIII. Installation, Operation, Maintenance and Performance Monitoring	22
IX. References	27
X. Drip Line Worksheet	29
XI. Example Work Sheet Drip Line Effluent Component	30
XII. Plan Submittal and Installation Inspection	32

**Published on February 7, 2001,
by
Consolidated Treatment Systems, Inc. and Multi-Flo Wisconsin**

I. INTRODUCTION AND SPECIFICATIONS

This Private Onsite Wastewater Treatment System (POWTS) component manual provides design, construction, inspection, operation, and maintenance specifications for a drip line effluent disposal component receiving effluent from a Multi-Flo onsite wastewater treatment unit. The process units covered in this manual consist of a pretreatment tank, Multi-Flo FTB-Series wastewater treatment unit, dripline pump chamber, dripline tubing, and all associated piping, controls, and appurtenances. The pretreatment tank receives holds flow for timed dosing into the Multi-Flo unit. The Multi-Flo unit provides wastewater treatment, producing an very highly treated effluent, as defined in this manual. The Multi-Flo effluent drains into the dripline pump chamber from where it is timed-dosed through the dripline into the soil. These units produce an effluent that comply with s. Comm 83.43 (8) and 83.44 (2), Wis. Adm. Code,. To ensure equal distribution is achieved, specifications in Tables 1, 2, and 3 shall be met.

Detailed plans and specifications must be reviewed and approved by the governing unit having authority over the plan for the installation. Also, a Sanitary Permit must be obtained from the department or governmental unit having jurisdiction. (See Section XII for more details.)

Table 1 INFLUENT FLOWS AND LOADS TO MULTI-FLO UNIT	
Design Wastewater flow (DWF)	≤ 5000 gal/day
Monthly average value of Fats, Oil and Grease (FOG)	≤ 30 mg/L
Monthly average value of five day Biochemical Oxygen demand (BOD ₅)	≤ 220 mg/L
Monthly average value of Total Suspended Solids (TSS)	≤ 150 mg/L
Monthly average value of fecal coliform (/100mL)	≤ 10 ⁸ /100mL
Velocity of flush dose	≥ 2 ft./sec. at distal end of longest lateral
Volume of a single dose	Minimum dose volume per zone shall be six times the liquid capacity of the drip laterals plus the liquid capacity of the supply and return manifold lines (which drain between doses) accounting for instantaneous loading and drain back
Volume of Each Dose to Treatment Tank	DWF/48 per dose
Dosing Frequency of Each Dose to Treatment Tank	Every 30 minutes
Volume of a flush dose	≥ Twice the void volume of all pressurized piping
Flush dose frequency	Continuous trickle while loaded. Annual complete flush.
DWF from one- or two-family dwellings	≥ 150 gal/day/bedroom
DWF from public facilities	≥ DWF per Table 4 or s. Comm 83.43 (6), Wis. Adm. Code
Wastewater particle size to drip line filter	≤ 100 micron
Wastewater particle size to drip line distribution piping network	≤ 100 micron
Distribution field area per emitter for drip line distribution network	4 ft ²

Table 2. SIZE AND ORIENTATION OF DRIPLINE FIELD	
Area of distribution field	≥ DWF ÷ SLR for the most restrictive soil horizon within 12" below the infiltrate surface.
Linear loading rate for components with <i>in situ</i> soils having a SLR of ≤ 0.3 gal/ft ² /day within 12 inches infiltrative surface	≤ 4.5 gal/ft
Lateral Spacing	2 feet on center
Depth of cover over system laterals	≥ 6 inches to final grade

Table 3. OTHER SPECIFICATIONS	
Slope of original grade	≤ 25 % in area of distribution field
Vertical separation between distribution field and limiting factor	Equal to depth required by s. Comm 83 Table 83.44-3, Wis. Adm. Code
Clean Outs	Clean outs shall be provided at the end of each supply and return manifold
Piping material	In conformance to Ch. Comm.84, Wis. Adm. Code.
Horizontal separation between dripline zones	≥2 feet.
Bottom of distribution field for drip lines	≥ 6" of final grade
Pretreatment Tank	Tank meeting requirements of chs. Comm 83 and 84 with a minimum capacity ≥ DWF
Treatment Tank	Multi-Flo FTB-Series wastewater treatment unit, as approved by Chs. Comm 83 and 84, and sized in accordance with this manual
Capacity of Dose Chamber	≥ 2/3 DWF above pump on level and 1/3 DWF above high level alarm
Dripline Distribution System Spin Filter	≤ 100 microns
Cover material	Soil that will promote plant growth
Stabilization	Cover material shall be stabilized.
Frost Protection	All mechanical parts of the POWTS shall be protected from frost by insulation or bury of sufficient depth as to prevent freezing.
Controls	Mechanical and electronic system to ensure operation as intended by this manual. Controls start and stop pumps, activate alarms, and other wise control and monitor the operation of the installation. Controls shall be installed in accordance with the designer's and/or manufacturer's instructions.
Installation inspection	In accordance with ch. Comm 83, Wis. Adm. Code and this manual
Drip line and emitters	Through plumbing product approval per ch. Comm. 84, Wis. Adm. Code. Drip lines must have a means in which to inhibit the

Table 3. OTHER SPECIFICATIONS	
	accumulation of slime and bacterial growth. Emitters must have means of preventing root intrusion.
Pump	Rated by pump manufacture as an effluent or sewage pump
Dose tank	Meets requirements of chs. Comm 83 and 84, Wis. Adm. Code
Pump controls	Controls and float levels shall be synchronized to assure the minimum dose is available before initiating a dosing cycle to a zone and meet requirements of chs. Comm 83 and 84, Wis. Adm., Code
Timed Dosing	Multi-Flo units will be time-dosed from a pretreatment tank unless the installation is for a "low use" occupancy" such as a seasonal cabin. For low-use occupancies, no pretreatment tank will be installed, and the dripline will be time dosed from the pump chamber received the fully treated Multi-Flo effluent. "Low-use occupancies will be decided on a case-by-case basis.
Electrical equipment and wiring	Meet requirements of ch. Comm 16 and 83, Wis. Adm. Code
Access to pump	Means of removing pump by not entering dose tank must be provided
Alarm or warning system	Meets requirements of ch. Comm 83, Wis. Adm. Code
Sewage treatment tank	Meet requirements of chs. Comm 83 and 84, Wis. Adm., Code
Sewage tank apparatus	Meet requirements of chs. Comm 83 and 84, Wis. Adm., Code
Management	In accordance with ch. Comm 83, Wis. Adm. Code and this manual
Installation inspection	In accordance with ch. Comm 83, Wis. Adm. Code and this manual

Table 4 PUBLIC FACILITY WASTEWATER FLOWS		
Source	Unit	Design Flow (gpd)
Apartment or Condominium	Bedroom	100
Assembly hall (no kitchen)	Person (10 sq. ft./person)	1.3
Bar or cocktail lounge (no meals served)	Patron (10 sq. ft./patron)	4
Bar or cocktail lounge* (w/meals - all paper service)	Patron (10 sq. ft./patron)	8
Beauty salon	Station	90
Bowling alley	Bowling lane	80
Bowling alley (with bar)	Bowling lane	150
Camp, day and night	Person	25
Camp, day use only (no meals served)	Person	10
Campground or Camping Resort	Space, with sewer connection and/or service building	30

**Table 4
PUBLIC FACILITY WASTEWATER FLOWS**

Source	Unit	Design Flow (gpd)
Campground sanitary dump station	Camping unit or RV served	25
Catch basin	Basin	65
Church (no kitchen)	Person	2
Church* (with kitchen)	Person	5
Dance hall	Person (10 sq. ft./person)	2
Day care facility (no meals prepared)	Child	12
Day care facility* (with meal preparation)	Child	16
Dining hall* (kitchen waste only without dishwasher and/or food waste grinder)	Meal served	2
Dining hall* (toilet and kitchen waste without dishwasher and/or food waste grinder)	Meal served	5
Dining hall* (toilet and kitchen waste with dishwasher and/or food waste grinder)	Meal served	7
Drive-in restaurant* (all paper service with inside seating)	Patron seating space	10
Drive-in restaurant* (all paper service without inside seating)	Vehicle space	10
Drive-in theater	Vehicle space	3
Employees (total all shifts)	Employee	13
Floor drain (not discharging to catch basin)	Drain	25
Gas station / convenience store	Patron (minimum 500 patrons)	3
Gas station (with service bay)		
Patron	Patron	3
Service bay	Service bay	50
Hospital*	Bed space	135
Hotel, motel or tourist rooming house	Room	65
Medical office building		
Doctors, nurses, medical staff	Person	50
Office personnel	Person	13
Patients	Person	6.5
Migrant labor camp (central bathhouse)	Employee	20
Mobile Home (Manufactured home) (served by its own POWTS)	Bedroom	100
Mobile home park	Mobile home site	200
Nursing, Rest Home, Community Based Residential Facility	Bed space	65
Outdoor sport facilities (toilet waste only)	Patron	3.5
Parks (toilets waste only)	Patron (75 patrons/acre)	3.5
Parks (toilets and showers)	Patron (75 patrons/acre)	6.5
Public shower facility	Shower taken	10
Restaurant*, 24-hr. (dishwasher and/or food waste grinder only)	Patron seating space	4
Restaurant*, 24-hr. (kitchen waste only without dishwasher and/or food waste grinder)	Patron seating space	12
Restaurant, 24-hr. (toilet waste)	Patron seating space	28
Restaurant*, 24-hr. (toilet and kitchen waste without dishwasher and/or food waste grinder)	Patron seating space	40
Restaurant*, 24-hr. (toilet and kitchen waste with dishwasher and/or food waste grinder)	Patron seating space	44
Restaurant* (dishwasher and/or food waste grinder only)	Patron seating space	2
Restaurant* (kitchen waste only without dishwasher and/or food waste grinder)	Patron seating space	6
Restaurant (toilet waste)	Patron seating space	14
Restaurant* (toilet and kitchen waste without dishwasher and/or food waste grinder)	Patron seating space	20
Restaurant* (toilet and kitchen waste with dishwasher and/or	Patron seating space	22

Table 4 PUBLIC FACILITY WASTEWATER FLOWS		
Source	Unit	Design Flow (gpd)
food waste grinder)		
Retail store	Patron (70% of total retail area ÷ 30 sq. ft. per patron)	1
School* (with meals and showers)	Classroom (25 students/classroom)	500
School* (with meals or showers)	Classroom (25 students/classroom)	400
School (without meals or showers)	Classroom (25 students/classroom)	300
Self-service laundry (toilet waste only)	Clothes washer	33
Self-service laundry (with only residential clothes washers)	Clothes washer	200
Swimming pool bathhouse	Patron	6.5

* = May be high strength waste

Table 5 Maximum Soil Application Rates Based Upon Morphological Soil Evaluations and Use of Very Highly-Treated, Filtered Effluent^{12 13,14 15}		
Soil Texture	Soil Structure	Soil Application Rate (gpd/ ft²)
Course sand or coarser	N/A	1.6
Loamy coarse sand	N/A	1.4
Sand	N/A	1.2
Loamy sand	Weak to strong	1.2
Loamy sand	Massive	0.7
Fine sand	Moderate to strong	0.9
Fine sand	Massive or weak	0.6
Loamy fine sand	Moderate to strong	0.9
Loamy fine sand	Massive or weak	0.6
Very fine sand	N/A	0.6
Loamy very fine sand	N/A	0.6
Sandy loam	Moderate to strong	0.9
Sandy loam	Weak, weak platy	0.6
Sandy loam	Massive	0.5
Loam	Moderate to strong	0.8
Loam	Weak, weak platy	0.6
Loam	Massive	0.5
Silt loam	Moderate to strong	0.8
Silt loam	Weak, weak platy	0.3
Silt loam	Massive	0.2
Sandy clay loam	Moderate to strong	0.6
Sandy clay loam	Weak, weak platy	0.3
Sandy clay loam	Massive	0.0
Clay loam	Moderate to strong	0.6
Clay loam	Weak, weak platy	0.3
Clay loam	Massive	0.0

Table 5 Maximum Soil Application Rates Based Upon Morphological Soil Evaluations and Use of Very Highly-Treated, Filtered Effluent ^{12 13,14 15}		
Soil Texture	Soil Structure	Soil Application Rate (gpd/ ft²)
Silty clay loam	Moderate to strong	0.6
Silty clay loam	Weak, weak platy	0.3
Silty clay loam	Massive	0.0
Sandy clay	Moderate to strong	0.3
Sandy clay	Massive to weak	0.0
Clay	Moderate to strong	0.3
Clay	Massive to weak	0.0
Silty clay	Moderate to strong	0.3
Silty clay	Massive to weak	0.0

Note: ">" means greater than
"<=" means equal to or less than
"N/A" means not applicable

II. DEFINITIONS.

Definitions not found in this section are located in ch. Comm 81, Wis. Adm. Code, or standard dictionary.

- A. "Distribution Field" - The area occupied by the drip line laterals that distributes effluent onto an in situ soil distribution area or fill material placed on a well tilled in situ soil area.
- B. "Flush line" means a pipe connected to drip line laterals used to carry effluent back to pretreatment tank (building sewer pipe or directly into tank if by means that will not upset contents of tank).
- C. "Non-pressure compensating emitter" means a device located at each orifice within the drip line pipe, which does not regulate the rate of flow so that the effluent is discharged at a flow rate which is controlled by the hydraulic pressures in the drip line.
- D. "Pressure compensating emitter" means a device located at each orifice within the drip line pipe, which regulates the rate of flow so that the effluent is discharged at the same rate of flow through variable hydraulic pressures in the drip line.
- E. "Pretreatment tank" means a surge/storage/dosing tank that receives wastewater from the dwelling or structure served by the POWTS and holds the wastewater until it is pumped to the treatment tank.
- F. "Sewage Tank Apparatus" means any device used in conjunction with a sewage treatment tank or dosing chamber that is not an integral part of the tank or chamber.

- G. "Site plan" means a scaled or completely dimensioned drawing, drafted by hand or computer aided technology, presented in a permanent form that shows the relative locations of setback encumbrances to a regulated object. The site plan also includes a reference to north, the size of the parcel, on which the regulated object is placed, and permanent vertical and horizontal reference point or benchmark.
- H. "Surge capacity" means a volume in a tank above the normal working level, which stores above average discharge of wastewater from the facility.
- I. "Treatment tank" means a Multi-Flo onsite wastewater treatment unit.
- J. "Vacuum relief valve" means a valve that allows air to enter distribution field when negative pressure exists.
- K. "Very highly-treated, filtered Effluent" means products of wastewater treatment from a Multi-Flo wastewater treatment unit. This effluent will have BOD₅ and TSS less than or equal to 10 mg/L, fecal coliform less than or equal to 1,000 colonies per 100/mL, and filtration through filter media having an effective size of 100 microns.

III. DESCRIPTION AND PRINCIPLES OF OPERATION.

POWTS drip line effluent dispersal components designed under this document require treatment by a Multi-Flo onsite wastewater treatment device as a prerequisite. The POWTS has four basic components: pretreatment tank, treatment tank, dosing chamber, and drip-line system. Wastewater is discharged to the pretreatment tank for dosing into the treatment tank. From the treatment tank, treated wastewater enters the dosing chamber. The wastewater stream is discharged or suctioned from the dosing chamber to filters that are located before the force main discharging to the distribution field. Effluent remaining in the drip lines after the pump cycle will drain back to the pretreatment tank. All treatment methods, dosing chambers and sewage treatment apparatus used are subject to approval under ch. Comm 83 and 84, Wis. Adm. Code, and local jurisdictions.

Wastewater is discharged from the dwelling or structure served to a pretreatment tank, which has a minimum volume equal to the rated daily capacity of the treatment tank. The pretreatment tank contains a pump and controls set to deliver 48 equal doses in a 24-hour period. Dosing to the treatment tank occurs every 30 minutes. A high-water alarm will notify the owner of malfunctions.

The treatment tank is designed to treat and filter effluent in accordance with this document. The treatment tank will have a rated treatment capacity equal to or greater than the DWF for the building being served. The rating of the treatment unit is based on documented engineering principles, testing, and/or the manufacturer's documented certification. Treated wastewater is discharged to the dosing chamber for dispersal by the drip-line system.

The dosing chamber holds fully treated effluent for dispersal. Pump controls are set to deliver doses of equal volume at the interval set by the designer. The filters that receive the

discharged wastewater stream from the dosing chamber must be designed to prevent solids ≥ 100 microns in size from entering into the drip line effluent dispersal component. The filters shall be flushed no less than the minimum frequency required by the drip line manufacturer. A return discharge line shall be connected to the filters to carry the flushed filter effluent back to the pretreatment tank. The return discharge line shall be pitched at a minimum of 1/8 inch per foot. The discharge line may be connected to the return manifold line from the distribution field or directly connected to the building sewer at a distance of ≥ 4 ft from the pretreatment tank.

A second pipe connection is made to the filter discharge. This pipe is the force main that discharges the wastewater stream to the supply manifold. Where practical, the supply manifold shall be installed at the highest elevation in the distribution field or within each zone. When gravity flow from the flush to the pretreatment tank is not possible, the elevations of the supply manifold and flush shall be reversed. The discharge pipe, force main, return manifold pipe, supply and return manifolds shall be constructed of approved materials in accordance with ch. Comm 84, Wis. Adm. Code.

After receiving the wastewater flow from the force main, the supply manifold discharges the wastewater stream to the drip line laterals through pressure rated pipe and fittings, which are connected to the supply manifold and to the drip line laterals. The pressure-rated pipe and fittings must be able to withstand the pressures to which the piping will be subjected. The pressurized pipe and fittings shall be able to withstand deformation when covered by backfill materials. The pressure rated piping shall extend from the supply manifold into the distribution field ≥ 1 ft. before connecting to the drip line lateral. The drip line laterals shall not to be connected directly to the supply manifold.

The drip line laterals consist of tubing installed in parallel lines within one or more zones. The tubing incorporates evenly spaced emitters inside each tube. Emitter spacing is set at two feet. Emitters can be pressure compensating, to give an even flow through a range of pressures, or non-pressure compensating, having pressure controlled by pump selection, pressure compensating valves or by some other means within the system design.

At the distal end of the drip line, laterals connecting to a return manifold are made of pressure rated pipe and fittings able to withstand the pressures to which the piping will be subjected. The pressurized pipe and fittings shall be able to withstand deformation when covered by backfill materials. The pressure-rated piping shall extend from the return manifold into the distribution field ≥ 1 ft. before connecting to the drip line lateral. The drip line laterals shall not to be connected directly to the return manifold. The distal end is connected to return manifold to allow periodic line flushing. The drip line laterals shall be flushed no less than the minimum frequency required by the drip line manufacturer.

The wastewater flushed from the laterals is collected in the return manifold. From the return manifold a return manifold discharge pipe is connected to the building sewer or pretreatment tank. The return manifold discharge pipe shall be pitched at a minimum of 1/8

inch per foot. The return manifold line shall be connected to the building sewer at a distance of ≥ 4 ft from the pretreatment tank.

By using Table 5 to determine soil loading rates, the soil will not reach saturated conditions. Physical entrapment, increased retention time, and conversion of pollutants in the wastewater are important treatment objectives accomplished under unsaturated soil conditions. The design criteria should be to load the system by applying water for a total of 2 hours per day. By applying doses in intervals several times per day, within 6" to 10" of the soil surface, effluent will also be taken up by evapotranspiration. Drip line systems are designed to distribute effluent frequently, and the greater the number of dosing cycles used, the less chance the soil distribution system will become saturated.

IV. SOIL AND SITE REQUIREMENTS

Every drip line design is ultimately matched to the given soil and site.

The design approach presented in this manual is based on criteria that all applied wastewater is successfully transported away from the system, that it will not affect subsequent wastewater additions, and that the effluent is treated.

- A. Minimum Soil Depth Requirements - The minimum soil factors required for successful drip line system performance is listed in the introduction and specification section of this document.

Soil evaluations must be in accordance with ch. Comm 85 of the Wis. Adm. Code. In addition, soil loading rates must be in accordance Table 5 of this manual.

- B. Other Site Considerations -

1. Slopes - The slope on which a drip line design can be installed may not be greater than 25 percent. All drip line laterals shall be installed on the contour. Non-pressure compensating emitters in drip lines are not to be installed in areas where the laterals would be installed having elevation differences in the distribution field exceeding six feet.
2. Drip line systems - In open areas, exposure to sun and wind increases the assistance of evaporation and transpiration in the dispersal of the wastewater.
3. Sites with trees and large boulders - Generally, sites with large trees, numerous smaller trees or large boulders are less desirable for installing a POWTS because of difficulty in preparing the surface. Rock fragments, tree roots, stumps and boulders occupying the distribution area reduce the amount of soil available for proper treatment. A drip line system may still be installed even when the best site for the system contains these limitations. Laterals can be installed with a limited amount of construction and around the obstructions such as large trees or boulders. It is also possible to overcome the restrictions presented by increased rock fragments by increasing dose cycles and increasing the area of the distribution field.

4. Setback distances - The setbacks specified in ch. Comm 83, Wis. Adm. Code, for soil subsurface treatment/dispersal components apply to drip line systems. The edge of the distribution field is two feet from the centerline of the drip line lateral.
5. Drainage requirements - Depressions, gullies, and drainage and erosion areas must be avoided to prevent overloading by surface runoff. Surface water must be intercepted and diverted away from all components of the drip line system. Site modification may be necessary to accomplish this.

V. COVER MATERIAL

- A. Cover material - The cover material, when needed is of such quality and is placed so that it will encourage the growth of plants. Sands are not recommended, as they drain rapidly and allow more infiltration of precipitation into the distribution field. In addition, clays are not recommended as they restrict oxygen transfer. Often, excavated soil from the site can be used. Seeding or other means must be performed to prevent erosion of the distribution field area.

VI. DESIGN

Influent Quantity

The area needed for the distribution field is determined by the soil loading rates in Table 5, the DWF, and the volume of effluent provided to the drip line effluent component. The first step needed in determining the design of the drip line distribution field is to determine the volume of wastewater that will be generated.

Step A: Determine DWF

1. Design Wastewater Flow (DWF) Calculations

For One and two-family dwellings calculate DWF for one and two family dwellings use:

$$DWF = 150 \text{ gallons/day/bedroom}$$

For Public Facilities calculate DWF for public facilities use:

$$DWF = \text{Sum of each wastewater flow per source per day (from Table 4)} \times 1.5$$

Step: B: Determine Volume of Pretreatment Tank

The volume of the pretreatment tank is equal to or greater than the DWF, as identified in Table 3.

Step C: Determine Size of the Treatment Tank

The size of the treatment tank is equal to or greater than the rated treatment capacity of the tank, as identified in Table 3 and described in Part III, Description and Principles of Operation. The rated treatment capacity of the treatment tank must be equal to or greater than the DWF.

Step D: Dosing Chamber

1. Design Wastewater Flow (DWF) Calculations

Use DWF from Step A.

2. Determining volume of Dosing Chamber

Choose the type of dosing chamber you are going to use. There are two types of dosing chambers. The first type is a pump chamber that has a submerged pump in the chamber. The second type is a pump chamber that has a pump located outside the dose chamber that suctions effluent. All dosing chambers must receive plumbing product approval in accordance with Ch. Comm. 84, Wis. Adm. Code.

Determine the size of the dose chamber that will be needed. The dosing chamber must have a surge capacity equal to 2/3 Daily Waste Flow (DWF) above the pump "ON" switch and a reserve capacity of 1/3 the DWF above the high water alarm. This is added to the volume below the pump "on" switch. The volume below the "on" switch will be determined by the number of inches from the bottom of the tank to the pump on switch and the volume of the tank in inches per gallon.

$$\text{Volume} = 2/3 \text{ DWF} + 1/3 \text{ DWF} + (\text{inches below pump on switch} \times \text{chamber vol. (gal/in)})$$

Pump selection and filter size depends on total dynamic head and flow rates in gallon per minute. Because we have not calculated these yet, the pump sizing is covered in Step D.

Step E: Design of the Distribution field(s)

1. Determine the soil loading rate (SLR) for the site.

The soil loading rate equals the most restrictive soil application rate of the soil horizon within 12" below the infiltrate surface of the distribution field. Use Table 5 to determine the soil loading rate.

2. Determine the effective area of the distribution field(s).

The effective area of the distribution field is calculated by dividing design wastewater flow (DWF) by the soil loading rate (SLR).

$$\text{*Area of the distribution field(s)} = \text{DWF} \div \text{SLR}$$

3. Determine the length of drip line laterals needed.

Drip line laterals shall be spaced no closer than two feet on center. With this required spacing for laterals, the length of the drip line laterals can be determined by dividing the distribution area needed by the lateral spacing.

$$\text{*Area of Distribution field(s) (ft}^2\text{) , Lateral spacing (2 ft) = Drip line lateral (ft.)}$$

Lateral line length may not exceed the manufacture's maximum lengths allowed for design pressure being used.

4. Determine number of emitters needed.

For this manual, emitter spacing is set at two feet for determining the number of emitters needed. To determine the number of emitters needed divide the drip line lateral length needed by a two-foot spacing.

$$\text{Drip line lateral length (ft.) , emitter spacing (ft) = Number of emitters}$$

5. Pressure compensating or non-pressure compensating drip lines.

Before the total flow for the system design can be determined, the type of emitter used in the drip line laterals must be determined. Pressure compensating emitters will give a constant flow rate over a range of pressures. Non-pressure compensating emitter flow will vary dependent upon the pressure supplied.

Pressure compensating emitters are used where elevation differences within the area of the dispersal cell(s) are greater than six feet. Pressure compensating emitters have the same amount of friction loss as do non-pressure compensating emitters, but the flow rates for non-compensating emitters are affected more by the variations in the pressure supplied than are the pressure compensating emitters.

Step F Determine Total Flow For System.

The minimum dose volume per zone shall be six times the liquid capacity of the drip laterals plus the liquid capacity of the supply and return manifold lines.

1. Determine the dose volume to system **using non-compensating emitters**

Determine the number of times the system is to be dosed. Divide the DWF by the number of doses to determine the number of gallons needed per dose.

$$\text{DWF , Number of Doses = Volume per Dose}$$

Next, divide the volume needed per dose by the number of emitters from Step B, 4. This will give the amount each emitter must discharge per dose.

$$\text{Volume per Dose (gal.)} \div \text{\# of emitters} = \text{Needed Emitter Flow Per Dose (gal)}$$

The flow rates in Table 6 are for emitters at different pressures given in gallons per hour. Different flows may be used if the manufacturer's recommended flows are submitted with the plan.

Non-compensating emitter drip lines need between 10 and 45 psi. Typically, flow rates per emitter will be determined based on the pressure. Table 6 shows the flow rates that each emitter will have at varying pressures. Flow rates from the emitters are allowed a variance of ± 10 percent.

Table 6	
Non-Pressure Compensating for 1/2" diameter drip lines	
*Flow Rate vs. Pressure Loss	
Pressure Psi	Flow Rate Gal./Hr. (GPH)
10.0	0.93
12.5	1.00
15.0	1.13
17.5	1.18
20.0	1.30
22.5	1.41
25.0	1.47
27.5	1.51
30.0	1.63
32.5	1.70
35.0	1.76
37.5	1.79
40.0	1.82
42.5	1.86
45.0	1.89

* Flow rates vary $\pm 5\%$

Select an emitter with a GPH that meets the design. To determine the flow per minute, divide flow in GPH by sixty minutes per hour.

$$\text{GPM per emitter} = \text{Flow in GPH} \div 60 \text{ min/hour}$$

The volume of the dose per cycle will determine how long the dosing cycles are for each cell based on the amount of flow per emitter. The minimum system pressure needed will be the minimum pressure needed to supply the longest lateral within the system with a minimum velocity of 2 feet per second at the distal end of the longest drip line lateral for each zone or in the drainage field.

2. Determine the Dose Volume to System Using Compensating Emitters

Determine the number of times the system is to be dosed. Divide the DWF by the number of doses to determine the number of gallons needed per dose.

$$DWF \div \text{Number of Doses} = \text{Volume per Dose.}$$

Next, divide the volume needed per dose by the number of emitters from Step B, 4. This will give the amount each emitter must discharge per dose.

$$\text{Volume per Dose (gal.)} \div \text{\# of emitters} = \text{Needed Emitter Flow Per Dose (gal)}$$

Compensating emitter drip lines have minimum and maximum operating pressures. The emitters will generate consistent flow rates through the range of pressures specified by the manufacturer. The flow rates and pressure ranges must be within the manufacturer's recommendations. The flow rates and pressure ranges must within manufacture recommendations when designing the system. Flow rates from the emitters are allowed a variance of $\pm 10\%$. Select an emitter with a GPH that meets the needs of the design. To determine the flow per minute divide flow in GPH by sixty minute per hour.

$$\text{Flow in GPH} \div 60 \text{ min/hour} = \text{GPM per emitter.}$$

The volume of the dose per cycle will determine how long the dosing cycles are for each cell based on the amount of flow per emitter. The minimum system pressure needed will be the minimum pressure needed to supply the longest lateral within the system with a minimum velocity of 2 feet per second at distal end of the longest drip lateral of each zone or the drainage field.

3. Supply Manifold sizing

Determine the number of drip line laterals needed for the distribution fields. Determine the length of each zone in the distribution field. Calculate the length of drip line needed, not exceeding the maximum distance allowed by manufacturer for each lateral, in each zone. If the length of lateral line is exceeded, the length must be shortened and lateral(s) added. For sites with soils having a SLR of $\leq 0.3 \text{ gal. / ft}^2 / \text{day}$ within 12 inches of the infiltrative surface be sure not to exceed a linear loading rate of 4.5 gal/ft.

The supply manifold must supply the distal end of the longest lateral for the distribution field or zone with a minimum velocity of 2 feet per second at the distal end of the longest lateral within each zone or in the distribution field.

Table 7
Friction loss (foot per 100 feet) in plastic pipe
Pipe Diameter

Flow (gpm)	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	3"	4"	6"
1									
2	10.99								
3	23.27	3.24							
4	39.63	5.51							
5	59.88	8.33	2.05						
6	83.90	11.67	2.88						
7		15.52	3.83						
8		19.87	4.90	1.65					
9		24.70	6.09	2.06					
10		30.02	7.41	2.50					
11		35.81	8.83	2.98					
12		42.06	10.38	3.50	1.44				
13		48.78	12.03	4.06	1.67				
14		55.94	13.80	4.66	1.92				
15			15.68	5.29	2.18				
16			17.67	5.97	2.46				
17			19.76	6.67	2.75				
18			21.97	7.42	3.06				
19			24.28	8.20	3.38				
20			26.70	9.01	3.71	0.92			
25			40.34	13.62	5.61	1.38			
30				19.08	7.86	1.94			
35				25.38	10.45	2.58			
40				32.50	13.38	3.30			
45					16.64	4.11	0.57		
50					20.22	4.99	0.69		
60						6.99	0.97		
70						9.30	1.29		
80						11.90	1.66	0.41	
90						14.80	2.06	0.51	
100						17.98	2.50	0.62	
125							3.78	0.93	
150							5.30	1.31	
175							7.04	1.74	
200							9.02	2.22	0.31
250								3.36	0.47
300								4.71	0.65
350								6.26	0.87

Flows in this area are below 2 feet per second velocity

Flows in this area exceed 10 feet per second velocity

Flows in the shaded area exceed 5 feet per second velocity

Note a: Table is based on Hazen-Williams formula: $h = 0.002082L \times (100/C)^{1.85} \times (GPM)^{1.85} \div d^{4.8655}$
 Where: h = feet of head
 L = Length in feet GPM = gallons per minute
 C = Friction factor from Hazen-Williams (145 for plastic pipe)
 d = Nominal pipe size
 Note b: Velocities in gray areas exceed 5 feet per second and should be selected with caution.

Using the number of gallons needed per dose from Step C 1, determine the gallons per minute needed for each dose. This may be different for each zone. Select a manifold pipe size from table 7 that will supply the gallons needed at a minimum velocity of 2 feet per

second to the distal end of the longest lateral in the distribution field or in each zone given the number of gallons per minute.

4. Manifold Volume

After determining the size of the manifold to use, calculate the void volume for the supply manifold. The void volume of the supply manifold must be added to the dose volume to give the Total System Flow. Select the size manifolds used from table 8 and multiply by the total length of manifold used.

$$\text{Supply Manifold Length} \times \text{Gallons/Foot} = \text{Total gallons for supply manifold}$$

Nominal Pipe Size	Gallons per Foot
½	0.010
¾	0.023
1	0.041
1-1/4	0.064
1-1/2	0.092
2	0.163
3	0.367
4	0.65
6	1.469

Note: a: Table is based on - $\pi r^2 \times 12''/\text{ft} \div 231 \text{ cu.in./cu.ft.}$
Where: r = nominal pipe size in inches

5. Force Main Volume

Select from Table 7 a force main pipe size that will be able to deliver a velocity of 2 feet per second at the distal end of the longest lateral in each zone or drainage field. The force main will need to first supply the supply manifold feeding the laterals. Once the size of the force main is selected, determine the volume of the force main by taking the void volume from table 8 and multiply the amount per gallon per foot by the length of the force main.

$$\text{Force Main Length (ft)} \times \text{Volume in (gal/foot)} = \text{Volume of Force Main in Gallons}$$

6. Total Flow Requirement of System Per Dose

The total system flow will be the number of gallons needed to supply an individual zone when the distribution field is separated into more than one zone and each zone is dosed independently. The total system flow will be the number of gallons needed to supply each zone in a distribution field when all zones are of the same size and dosed at one time. Add to the dose volume for the zone or zones the volume of the supply manifold, force main, and suction line (if used.). The total system flow per dose will be then be:

(a) For Dosing chambers using a pump **inside** the chamber
 $Manifold (gal) + Force Main (gal) + Dose (gal) = Total Flow per Dose (gal)$

(b) For Dosing chambers using a pump **outside** the chamber
 $Manifold (gal) + Force Main (gal) + Dose (gal) = Total Flow per Dose (gal)$

7. Return Manifold

The return manifold would be sized at the same size as the supply manifolds. The return manifolds are to be buried to drain by gravity to the return flush line and to be protected from freezing.

8. Return Flush Main

The return flush line is to be pitched a minimum of 1/8 inch per foot back to building sewer line. This connection to the building sewer must be ≥ 4 feet from the pretreatment tank to minimize disturbance in the primary wastewater treatment tank.

Step G Pump Sizing

To determine the pump size, system friction and head losses must be determined:

1. Suction Line (if pump outside of the dosing chamber is used)
2. Suction Lift (if pump outside of the dosing chamber is used)
3. Force Main
4. Supply Manifold
5. Pump, Filter, System Appurtenances and Pipe Fittings
6. Elevation Changes
7. Drip line lateral

1. Suction Line Friction Loss

Use the friction loss values found in Table 7 for the size pipe and GPM needed per dose. Divide the length of pipe used by 100 and multiply this times the friction loss value at the given GPM. Knowing GPM and Size pipe for Suction Line

$$(Suction\ Pipe\ Length\ (ft) \div 100) \times Friction\ Loss\ Factor\ (Table\ 7) = Suction\ Line\ Friction\ Loss\ (ft)$$

2. Force Main Friction Loss

Use the friction loss values found in Table 7 for the size pipe and GPM needed per dose. Divide the length of pipe used by 100 and multiply this times the friction loss value at the given GPM. Knowing GPM and size pipe for Force Main:

$$\text{Force Main Friction Loss (ft)} = (\text{Force Main Length (ft)} \div 100) \times \text{Friction Loss (Table 7)}$$

3. Supply Manifold

The supply manifold used to supply the lateral flushing dose to the lateral lines need to be large enough to supply the longest lateral in each zone or in the distribution field area with a minimum of velocity of 2 feet per second at the distal end. Use the friction loss values found in Table 7 for the size pipe and GPM needed per dose. Divide the length of pipe used by 100 and multiply this times the friction loss value at the given GPM.

$$(\text{Manifold Length (ft)} \div 100) \times \text{Friction Loss Factor (Table 7)} = \text{Supply Manifold Friction Loss (ft)}$$

$$((\text{Manifold Length (ft)} \times 2) \div 100) \times \text{Friction Loss Factor (Table 7)} = \text{Manifold Friction Loss (ft)}$$

4. Filter, System Appurtenances Loss and Pipe Fittings

The friction losses through filters, system appurtenances, and pipe fittings will be per manufacturers' specifications. These specifications must be taken into account when determining the total head loss for the system. System appurtenances include, but are not limited to, flow control valves, vacuum relief valves, water meters and pressure regulators.

5. Elevation Head Loss

Changes in elevation contribute to the total losses that need to be considered. To determine the amount of head loss, subtract the pump elevation from the elevation of the highest point in the distribution field.

$$\text{Distribution field Highest Elevation (ft)} - \text{Pump Elevation} = \text{Head Loss (ft)}$$

6. Drip Line Lateral Friction Loss

Friction losses for the drip line laterals are to be supplied by the manufacturer of the drip line. Take the longest drip lateral line in each zone or in the distribution field. Calculate the manifold supply pressure needed to supply a velocity of 2 feet per second at the distal end of the longest drip lateral of each zone or the drainage field.

This pressure is the minimum pressure needed to maintain drip line lateral operation as it is for the longest drip line lateral.

7. Total Friction Loss for System

To calculate the total friction loss for the system, per dose, sum up all of the combined friction losses. For friction loss 1 psi = 2.31 ft.

Suction Line (where used)	_____ Ft.
Force Main	_____ Ft.
Supply Manifold	_____ Ft.
Filter, System Appurtenances and Pipe Fittings	_____ Ft.
Elevation Changes	_____ Ft.
Drip line lateral	_____ Ft.
Required Distal End Head	<u>0.1</u> Ft
Total Head Loss = _____ Ft	

The size of pump needed for the system will be determined by the pressure and flow rate required to operate the system or by the pressure and flow rate required to flush the filter, **whichever is greater.**

VII. SITE PREPARATION AND CONSTRUCTION

Proper construction of a drip line effluent component is as critical as its design. A good design with poor construction results in component failure. The soil only is worked when the moisture content is low enough to prevent compaction and smearing of the infiltrative surface. The construction plan to be followed includes:

- A. Equipment - Proper equipment includes tractors or other equipment that will not compact the infiltrative surface. No equipment shall cross the field areas during rainfall events, or when the site is above field capacity or water is standing over the site. Minimize traffic on infiltrate surface and avoid equipment traffic on or over infiltrate surface.
- B. Sanitary Permit - Before the construction of the component, a sanitary permit, obtained for the installation must be posted in a clearly visible location on the site. Arrangements for inspection(s) must also be made with the department or governmental unit issuing the sanitary permit.
- C. Construction Procedures
 - 1. Check the moisture content and condition of the soil. If the soil at the infiltrate surface can be rolled into a 1/4-inch wire, the site is too wet, smearing and compaction will result, thus reducing the infiltrate capacity of the soil. If the site is too wet, do not proceed until it dries out. If the soil at or below the infiltrate surface is frozen, do not proceed.

If soil moisture content and condition of soil allow, distribution field area shall be prepared in a manner, which minimizes site disturbance. The distribution field site should be cleared of all obstructions before bringing materials on site. The lateral lines can be directed around trees or bushes, which are desirable. The site shall be prepared as

needed to enable a grass cover to be established and maintained before drip line lateral installation.

2. Set up a construction level, engineers or laser level and tape to assure conformation with natural contours and design requirements for sizing, location and separations to determine all relative elevations in relationship to the system benchmark.
3. Mark the corners of the distribution field or each zone. The top two corners should be at the one specified elevation and the bottom two corners should be at other specified elevation. Because of freezing conditions, the drip lines must drain to the pretreatment tank or building sewer. Reference stakes offset from the corner stakes are recommended in case corner stakes are disturbed during construction. Lay out the distribution area(s) on the site so that the distribution field runs parallel with the land surface contours and is within the designated area.
4. Stake drip line laterals with an accurate level to assure conformance with the contours, design requirements for sizing, location and separations.

VIII. INSTALLATION, OPERATION, MAINTENANCE AND PERFORMANCE MONITORING

- A. Installation - The pretreatment tank(s) and dosing chamber shall be installed such that the force main, filter and system flush return pipes can drain by gravity. This is important in that the return pipes must connect to the building sewer ≥ 4 feet upstream of the pretreatment tank. The dosing chamber shall be filled and water made available to determine systems function properly after installation.
 1. Electrical Connections - Make sure all system electrical components are connected, to the system control panel, dose chamber pump, and alarms. Controls and float levels shall be set to assure the minimum dose is available prior to initiating a dosing cycle to the distribution fields or zone.
 2. Pump and Filter - The pump whether contained within the dosing chamber or located outside of the dosing chamber must be installed in accordance with manufacturer's recommendations. If located outside of the dosing chamber, insulation to protect the pump from freezing shall be installed.

Provisions shall be made to remove solids $\geq 1/8$ " from the wastewater stream before reaching the drip line filter. A filter capable of removing solids ≥ 100 microns in size must be installed in accordance with manufacturer's recommendations. All supply lines and flush lines for the filter must be installed at a minimum $1/8$ " per foot from the filter to drain by gravity. The filter must be flushed at least as often as required by the drip line manufacturer.

3. **Note: Never leave the drip lines or PVC lines with open ends. Close all exposed ends until permanent connections are made. Care must be taken to keep all construction debris from entering force mains, manifolds and drip line.**
4. Force Main and Supply Manifold - Install the force main and supply manifold as per design specifications and elevations.
5. Drip line laterals - Drip line laterals shall be installed in accordance with manufacturer's recommendations or design for each site. The drip lines are not to be connected directly to the supply or return manifolds. Each drip line lateral shall be connected to pressure-rated pipe and fittings that cannot be deformed by backfilling and connect to the supply or return manifold. The first emitter shall a minimum of one foot from the manifold. A vibratory plow, static plow, or trencher is most typically used and soil moisture must be dry enough so that soil compaction will not occur. Hand-placement of drip line laterals may be needed to go around trees or other obstructions left in the distribution field.

Lay drip line laterals in trenches without kinks, or rocks or debris in direct contact. For laterals that contain loops prior to connection to the return flush manifold, make the loop connection at the end of the drip line using a flexible pressure rated pipe assembly or rigid pipe assembly with two 90°elbows. Individual drip lines shall be designed and installed level, following the ground contours ≥ 6 " below final grade.

Care must be taken during system installation to assure no extraneous debris enters the tank, supply lines, and drip line network. All open pipe connections in shall be closed so that debris does not enter these pipes during construction.

6. Install Return Manifold and Flush Line - Install return manifold so that it can be connected to pressure-rated pipe and fittings at the end of the drip line laterals. Be sure that the return manifold is installed at elevation appropriate for the design. Connect the manifold to the return flush line. The return flush line shall connect to the building sewer ≥ 4 feet of the pretreatment tank so as not disturb the contents of the primary wastewater treatment tank. The flush line shall drain be pitched at $\geq 1/8$ " per foot so that it will drain by gravity.

System Flush - Flush force main, supply manifold, drip line laterals, return manifold and return flush line to remove any soil, pipe shavings or other debris. Complete system flushing will be completed annually. The manual flush valve will be set so that after every use, the drip lines and return manifold will drain into the pump chamber within five minutes. Returned effluent will be pumped back to the primary treatment tank. Check for leaks at all exposed pipe joint. If leaks are found, repair the leaks and re-flush checking repairs.

7. System Appurtenance Installation - Field appurtenances must be installed in accordance with approved system design and manufacturers' recommendations. When a manufacturer's recommendations are in conflict with approved plans, the approved plans will take precedence. At least one air release valve shall be installed at the high point of

each distribution field or zone within a distribution field. Check valves, solenoid valves, pressure regulators, water meters and pressure monitoring fittings shall be installed per approved plans and drip line manufacturer's recommendations. Protect all appurtenances from freezing. A method of access shall be provided so appurtenances can be repaired. After installation, all mechanical components, pumps, pump cycling, filters, flushing sensors, high water alarms, water meters, event counters, telemetry systems (where installed) and other appurtenances are demonstrated to be fully operable in accordance with their design.

The drip line manufacturer's recommendations shall be followed for system startup. The design dosing pressures shall be checked to assure that the system is providing the design pressure to the distribution field or to each zone. The longest drip line lateral within each zone shall be checked to assure that a velocity of 2 ft. per second is provided at the distal end of the lateral. After the system has been inspected to assure all design criteria has been met, backfill of the system and its components may begin.

Fields shall be finish graded to shed surface water. Provisions shall be made to establish and maintain a vegetative cover.

B. Operation, Maintenance and Performance Monitoring

1. The system owner is responsible for the operation and maintenance of the drip line effluent component. The county, department or POWTS service contractor may make periodic inspections of the all parts of system.

The owner or owner's agent is required to submit necessary maintenance reports to the appropriate jurisdiction and/or the department.

2. Design approval and site inspections before, during and after construction are to be done by the county or other appropriate jurisdictions in accordance with this manual and ch. Comm 83, Wis. Adm. Code.
3. Routine and preventative maintenance aspects:
 - a. Pretreatment tanks and dosing chambers shall be inspected routinely and maintained when necessary or as specified in accordance with their approvals.
 - b. Inspections of the drip line effluent component are required at least twice every year. Inspections will include checking:
 - the system to ensure flush and alarm systems are functioning properly;
 - dose volumes registered on the water meter are acceptable in accordance with the system design dose; and
 - wet or damp spots do not appear on the surface of the distribution field.

- c. Vehicle traffic, except for lawn maintenance equipment, is not permitted on the drip line effluent component.
4. User's Manual: A user's manual is to accompany the component. The manual is to contain the following as a minimum:
 - a. Diagrams of all components and their location. This should include the location of the reserve area, if one is provided.
 - Names and phone numbers of local health authority and component manufacturer or POWTS service contractor to be contacted in the event of component failure or malfunction.
 - Information on the periodic maintenance of the component, including electrical/mechanical components.
 - What activities can or cannot occur on the reserve area, if one is provided.
 - Note: Dose chamber may fill due to flow continuing during pump malfunction or power outages. One large dose when the power comes on or when the pump is repaired may cause the drip line effluent component to have problems. In this situation, the pump chamber should be pumped by a licensed pumper before pump cycling begins or other measures shall be used to dose the conventional soil distribution component with only the proper amount of influent. This may include manual operation of the pump controls until such time the pump chamber has reached its normal level.
5. Performance monitoring must be performed on components installed under this manual.
 - a. The frequency of monitoring must be:
 - At least twice every year following installation, and
 - At time of a problem, complaint, or failure.
 - b. The minimum criteria addressed in performance monitoring of all system components are:
 - Type of use,
 - Age of component,
 - Type of component,
 - Nuisance factors, such as odors or user complaints,

- Mechanical malfunction within the component including problems with valves or other mechanical or plumbing components,
- Material fatigue or failure, including durability or corrosion as related to construction or structural design,
- Neglect or improper use, such as overloading the design rate, poor maintenance of vegetative cover, inappropriate cover over the component, or inappropriate activity over the component,
- Pretreatment component maintenance, including dosing frequency, structural integrity, groundwater intrusion or improper sizing,
- Pump chamber maintenance, including improper maintenance, infiltration, structural problems, or improper sizing,
- Ponding in distribution field, before the pump cycle, is evidence of development of a clogging mat or reduced infiltration rates.
- Pump malfunction including dosing volume problems, breakdown, burnout, or cycling problems, and
- Overflow/seepage problems, as shown by evident or confirmed sewage effluent, including backup.

6. Reports are to be submitted in accordance to ch. Comm 83, Wis. Adm. Code.

IX References

1. Innovative Wastewater system Approval No: IWWA-93-1R, "Perc Rite" Subsurface Wastewater Drip System, issued to Wastwater Systems, Inc., 4386 Lilburn Industril Way, Lilburn, GA, 30247 February 9, 1996, North Carolina Department of Environment, Health, and Natural Resources, Division of Environmental Health, Onsite Wastewater Section.
2. Converse, J.C., 1999. Drip Distribution of Domestic Wastewater. Small Scale Waste Management Project, University of Wisconsin-Madison, 1525 Observatory Drive, Madison, WI 53706
3. Lilburn Industrial Way. Lilburn, GA 30247 Perc-Rite, August 1994. Design Guidelines and Manual. Wastewater Systems, Inc. 4386
4. Geoflow Inc. 1996. Design and Installation Manual for On-Site Effluent Disposal of Wastewater -Systems larger than 1,000 Gallons. 307 - O W. Tremont Avenue, Charlotte, NC 28203
5. Geoflow Inc. 1996. Design and Installation Manual Subsurface Drip Systems Applied to Secondary Treated On-Site Effluent Disposal of Flows Less Than 1000 GPD. 307 - O W. Tremont Avenue, Charlotte, NC 28203
6. Gustafson, D. and Anderson, J.L.. Individual Sewage Treatment Systems Fact Sheet Series, Drip Irrigation. Department of Biosystems and Agricultural Engineering, University of Minnesota. 213 BioAgEng Building, 1390 Eckles Avenue, St. Paul, MN 55108-6005
7. Wisconsin Administrative Code, 1999. In-Ground Soil Distribution Component Manual For Private Onsite Wastewater Treatment Systems. Pub. No. SBD-10567-P (R.2/99). Wisconsin Department of Commerce, Safety and Buildings Division, 201 West Washington Avenue, Madison, WI 53707
8. Wisconsin Administrative Code, 1998. Single Pass Sand Filter Component Manual For Private Onsite Wastewater Treatment Systems. Pub. No. SBD-10595-P (N.5/98). Wisconsin Department of Commerce, Safety and Buildings Division, 201 West Washington Avenue, Madison, WI 53707
9. Development of Alternative On-Site Treatment Systems for Wastewater Treatment: A Demonstration Project for Northern Minnesota. Pub. No. NRRI/TR-97/10 501 Natural Resources Research Institute, University of Minnesota, Duluth, 5013 Miller Trunk Highway, Duluth, MN 55811
10. Baker, J. Personal Communication
11. Ruskin, R. Memorandum regarding drip lines receiving treated effluents.

12. Tyler, E.J. and Converse, J. "Soil Acceptance of Onsite Wastewater as Affected by Soil Morphology and Wastewater Quality. Madison: University of Wisconsin, Small Scale Waste Management Project, Publication 4.38, October 1994.
13. Converse, J. and Tyler E.J. "Soil Dispersal of Highly Pretreated Effluent— Considerations for Incorporation into Code. Madison: University of Wisconsin, Small Scale Waste Management Project, Publication 10.22, January 1999.
14. Converse, J. and Tyler E.J. "Soil Dispersal Units with Emphasis on Aerobically Treated Domestic Effluent. Madison: University of Wisconsin, Small Scale Waste Management Project, Publication 16.4, Revised January 1999.
15. Bohrer, R. and Converse, J. "Soil Treatment Performance and Cold Weather Operation of Drip Distribution Systems." Madison: University of Wisconsin, Small Scale Waste Management Project, Draft Publication, December 2000.

X. WORKSHEET

A. EVALUATE SOIL AND SITE CONDITIONS

1. Evaluate the site and soils report for the following:

- Surface water movement.
- Measure elevations and distances on the site so that slope, contours and available areas can be determined.
- Description of several soil profiles where the component will be located.
- Determine the limiting conditions such as bedrock, high groundwater level, soil application rates, and setbacks.

Slope - ____%

Depth to limiting factor - _____inches

Minimum depth of unsaturated soil required by Table 83.44-3, Wis. Adm. Code - ____in

Soil application rate of in situ soil used - _____ gal/ft²/day

FOG value of effluent applied to in situ soil component - _____ mg/L

BOD₅ value of effluent applied to in situ soil component - _____ mg/L

TSS value of effluent applied to in situ soil component - _____ mg/L

Fecal Coliform monthly geometric mean value of effluent applied to in situ soil component > 10⁴ cfu/100ml __Yes __ No

Type of distribution cell - __ Pressure compensating or __ Non-pressure compensating

B. DETERMINE DESIGN WASTEWATER FLOW (DWF) AND LOADS

Occupancy – One or Two-Family Dwelling - _____ (# of bedrooms)-_____gal/day

Public Facility - _____ gal/day (Estimated wastewater flow)

FOG value of influent to treatment tank component - _____ mg/L

BOD₅ value of influent to treatment tank component - _____ mg/L

TSS value of influent to treatment tank component - _____ mg/L

Fecal Coliform monthly geometric mean value of influent to treatment tank component assumed to be $\geq 10^8$ cfu/100ml

C. DETERMINE VOLUME OF PRETREATMENT TANK

Volume = DWF from Part B

D. DETERMINE SIZE OF MULTI-FLO FTB-SERIES TREATMENT UNIT

Size = Rated Capacity \geq DWF from Part B

Daily Flow Ratings for Multi-Flo FTB-Series Wastewater Units	
FTB 0.5	500 gpd
FTB 0.6	600 gpd
FTB 0.75	750 gpd
FTB 1.0	1,000 gpd
FTB 1.5	1,500 gpd

E. DETERMINE VOLUME OF DOSING CHAMBER

Obtain the DWF from Part B

Calculate/Determine the volume per inch of depth for the tank considered, gal/in.

Set the pump on and pump off elevations.

Determine the number of inches above the pump on switch the tank will be.

$$\text{Volume} \leq 2/3 \text{ DWF} + 1/3 \text{ DWF} + (\text{inches below pump on switch} * \text{volume (gal/in)})$$

F. DETERMINE SIZE OF DISTRIBUTION FIELD

1. Determine the Soil loading rate (SLR) for the site.

From Table 5 in this manual, select the effluent application rate for the most restrictive soil horizon within 12" below the infiltrate surface of the distribution field. Depending on the level of treatment of the effluent, the effluent application rate selected from Table 5 will be the soil loading rate (SLR) for the site.

$$\text{SLR} = \text{_____ gpd/ft}^2$$

2. Determine the distribution field area.

Calculate the distribution field area by dividing the daily design wastewater flow (DWF) by the soil loading rate (SLR).

$$\text{Distribution field area} = \text{DWF} \div \text{SLR}$$

$$\text{Distribution field area} = \text{_____ gpd} \div \text{_____ gpd/ft}^2$$

$$\text{Distribution field area} = \text{_____ ft}^2$$

2. Determine the total length of drip line lateral needed.

The width for spacing between drip line laterals is 2 feet apart on center. Knowing this as the width between laterals, determine the length of laterals that will be needed.

Calculate the total length of drip line needed for the system by dividing the distribution field area by 2 feet.

$$\text{Total Length of Drip Line Lateral Needed} = \text{Distribution Field Area} \div 2 \text{ feet}$$

The maximum length of a drip line lateral that can be installed in a distribution field drainage field or zone shall not be greater than the drip line manufacturer maximum length requirement. Knowing the area available and the maximum lengths allowed will determine the number of drip laterals needed.

The linear loading rate for components with in situ-soil having a soil application rate of ≤ 0.3 gal/ft²/day within 12 inches below the infiltrative surface area of the distribution field or zone can not exceed ≤ 4.5 gal/ft.

$$\text{Total Length of Drip Line lateral} = \text{ ______ } \text{ ft}$$

4. Determine the number of emitters needed.

Emitter spacing is set at two feet apart. Knowing this, calculate the number of emitters needed by dividing the total length of drip line lateral needed by 2.

$$\text{Number of emitters needed} = \text{Total length of drip line laterals needed} \div 2$$

5. Determine dose volume needed per emitter

Dose volume per emitter is determined by the quotient of the DWF divided by number of doses per day and dividing this by the number of emitters needed.

$$\text{Dose volume per emitter} = (\text{DWF} \div \text{ ______ } \text{ doses per day}) \div \text{number of emitters}$$

Emitter flow is given in gallons per hour from most manufacturers. Divide the Emitter flow by 1 hour/60 minutes to get the emitter flow per minute.

$$\text{Emitter Flow Per Minute} = \text{Emitter Flow Per Dose} \div 1 \text{ hour} / 60 \text{ minutes}$$

The emitter flow volumes vary dependant upon the drip line lateral manufacturer and whether non-pressure compensating or pressure compensating emitters are used. Non-compensating emitters have flow rates that depend upon the pressure available in the lateral line. Pressure compensating emitters will have a predetermined flow through a range of pressures.

XI. EXAMPLE WORKSHEET DRIP LINE EFFLUENT COMPONENT

A. EVALUATE SOIL AND SITE CONDITIONS

1. Evaluate the site and soils report for the following:

- Surface water movement.
- Measure elevations and distances on the site so that slope, contours and available areas can be determined.
- Description of several soil profiles where the component will be located.
- Determine the limiting conditions such as bedrock, high groundwater level, soil application rates, and setbacks.

Slope - 2 %

Depth to limiting factor - 60 inches

Minimum depth of unsaturated soil required by Table 83.44-3, Wis. Adm. Code - 12 in

Soil application rate of in situ soil used - 0.8 gal/ft²/day

FOG value of effluent applied to in situ soil component - < 5 mg/L

BOD₅ value of effluent applied to in situ soil component - 10 mg/L

TSS value of effluent applied to in situ soil component - 10 mg/L

Fecal Coliform monthly geometric mean value of effluent applied to in situ soil component > 10⁴ cfu/100ml Yes XX No Fecal Coliform ≤ 1,000 cfu/100 ml

Type of distribution cell - Pressure compensating or XX Non-pressure compensating

B. DETERMINE DESIGN WASTEWATER FLOW (DWF) AND LOADS

Occupancy – One or Two-Family Dwelling - 3 (# of bedrooms)-450 gal/day

Public Facility - _____ gal/day (Estimated wastewater flow)

FOG value of influent to treatment tank component - 30 mg/L

BOD₅ value of influent to treatment tank component - 220 mg/L

TSS value of influent to treatment tank component - 150 mg/L

Fecal Coliform monthly geometric mean value of influent to treatment tank component assumed to be ≥ 10⁸ cfu/100 ml

C. DETERMINE VOLUME OF PRETREATMENT TANK

Volume = DWF from Part B

Pretreatment Tank Volume = 450 gal

D. DETERMINE SIZE OF MULTI-FLO FTB-SERIES TREATMENT UNIT

Size = Rated Capacity \geq DWF from Part B

From Part B, DWF = 450 gpd

From Table below, select Multi-Flo with Rating \geq DWF

Select Multi-Flo FTB 0.5

Daily Flow Ratings for Multi-Flo FTB-Series Wastewater Units	
FTB 0.5	500 gpd
FTB 0.6	600 gpd
FTB 0.75	750 gpd
FTB 1.0	1,000 gpd
FTB 1.5	1,500 gpd

E. DETERMINE VOLUME OF DOSING CHAMBER

Obtain the DWF from Part B

DWF = 450 gpd

Calculate/Determine the volume per inch of depth for the tank considered, gal/in.

Volume = 20 gal/in

Set the pump on and pump off elevations.

Pump off at 12 inches above tank bottom

Pump on at 12 inches below tank roof

Determine the number of inches above the pump on switch the tank will be.

Volume \leq $\frac{2}{3}$ DWF + $\frac{1}{3}$ DWF + (inches below pump on switch * volume (gal/in))

Volume = $(\frac{2}{3} * 450) + (\frac{1}{3} * 450) + (12 * 20) + (12 * 20) = 490$ gal

F. DISTRIBUTION FIELD AREA

1. Determine the soil loading rate (SLR) for the site.

From Table 5 of this manual, select the effluent application rate for the most restrictive soil horizon within 12" below the infiltrate surface. The effluent application rate selected from Table 5 of this manual is the soil loading rate (SLR) for the site.

SLR = 0.8 gpd/ft²

2. Determine the distribution field area.

Calculate area by dividing the DWF by the soil loading rate (SLR).

$$\text{Distribution field area} = \text{DWF} \div \text{SLR}$$

$$\text{Distribution field area} = \underline{450} \text{ GPI} \div \underline{0.8} \text{ GPI/ft}^2$$

$$\text{Distribution field area} = \underline{563} \text{ ft}^2$$

3. Determine total length of drip line lateral needed.

$$\text{Total Length of Lateral} = \underline{563} \text{ ft}^2 \text{ Distribution field area ft}^2 \div 2 \text{ ft Lateral Spacing}$$

$$\text{Total Length of Lateral} = \underline{282} \text{ ft.}$$

1. Determine number of emitters needed

$$\text{Number of Emitters Needed} = \underline{282} \text{ ft Total Length of Lateral} \div \underline{2} \text{ ft Emitter Spacing}$$

$$\text{Number of Emitters Needed} = \underline{141} \text{ Emitters (always round up)}$$

2. Distribution field area in size. Selecting a dosing frequency of 12 time per day:

$$\text{Dose Volume} = \underline{450} \text{ gpd DWF} \div 18 \text{ Doses/day (12/ doses/day is minimum)}$$

$$\text{Dose Volume} = \underline{25} \text{ gallons per dose}$$

$$\text{Dose Volume Flow Rate per Emitter} = \underline{25} \text{ gallons per dose} \div \underline{141} \text{ Number of Emitters}$$

$$\text{Dose Volume Flow Rate per Emitter} = \underline{0.17} \text{ gallons per dose per emitter}$$

Emitter flow rates are given in gallons per hour. To determine the flow rates needed per emitter divide the emitter flow rate from the manufacturer of the drip line by 1hour/60 min.

The manufacturer will state the flow that an emitter discharges. Given an emitter flow rate of 1.13 gallons per hour divide the flow rate by 1 hour/60 minutes.

$$\text{Emitter Flow rate in GPM} = \underline{1.13} \text{ gallons per hour} \div 1 \text{ hour/ } 60 \text{ minutes}$$

$$\text{Emitter Flow rate in GPM} = \underline{0.019} \text{ gallons per minute}$$

Multiply the number of emitter by the gallons per minute per emitter. This will give the volume per dose per minute of time of each dose.

$$\text{Total Volume of dose per minute} = \underline{0.019} \text{ gallons per minute/emitter} \times \underline{141} \text{ Emitters}$$

Total Volume of dose per minute = 8.9 gallons per minute

Using a single dose volume of 25 gallons per dose, dose time would be:

Dose time = 25 gallons per dose ÷ 8.9 gallon per minute

Dose time = 2.8 minutes per dose

XII PLAN SUBMITTAL AND INSTALLATION INSPECTION

A. Plan Submittal

In order to install a system correctly, it is important to develop plans that will be used to install the system correctly the first time. The following checklist may be used when preparing plans for review. The checklist is intended to be a general guide. Conformance to the list is not a guarantee of plan approval. Additional information may be needed or requested to address unusual or unique characteristics of a particular project. Contact the reviewing agent for specific plan submittal requirements, which the agency may require that are different than the list included in this manual.

General Submittal Information

- Photocopies of soil reports forms, plans, and other documents are acceptable. However, an original signature is required on certain documents.
- Submittal of additional information requested during plan review and questions concerning a specific plan must be referenced to the plan identification indicator assigned to that plan by the reviewing agency.
- Plans or documents must be permanent copies or originals.

Forms and Fees

- Application form for submittal, provided by reviewing agency along with proper fees set by reviewing agent.
- Onsite verification report signed by the county or appropriated state official.

Soils information

- Complete Soils and Site Evaluation Report (form # SBD-8330) for each backhoe pit described; signed and dated by a certified soil tester, with current customre I.D. nubmer.
- Separate sheet showing the location of all borings. The location of all borings and backhoe pits must be able to be identified on the plot plan.

Documentation

- Architects, engineers or designers must sign, seal and date each page of the submittal or provide an index page, which is signed, sealed and dated.

- Master Plumbers must sign, date and include their license number on each page of the submittal or provide an index page, which is signed, sealed and dated.
- Three completed sets of plans and specifications (clear, permanent and legible); submittals must be on paper measuring at least 8-1/2 by 11 inches.

Plot Plan

- Dimensioned plans or plans drawn to scale (scale indicated on plans) with parcel size or all property boundaries clearly marked.
- Slope directions and percent in system area.
- Benchmark and north arrow.
- Setbacks indicated as per appropriate code.
- Two-foot contours to 25 ft. either side of system area or include elevations at all four- corners of proposed system.
- Location information; legal description of parcel must be noted.
- Location of any nearby existing system or well.

Plan View

- Dimensions for distribution field(s).
- Pipe lateral layout, number of laterals and location of and number of clean outs.
- Manifold and force main locations
- Flush return lines from filter and system and distance from pretreatment tank to building sewer flush line connection
- length and diameter of all pipes except laterals.

Cross Section of System

- Lateral, manifold, and flush line elevation
- Type of cover material and depth
- Minimum and maximum depths of piping below original and final grades.

System Sizing

- For one- and two-family dwellings the number of bedrooms must be included.
- For public buildings, the sizing calculations must be included.
- Volume of all pressurized pipes

Tank and Pump

- All construction details for site-constructed tanks.
- Size and manufacturer information for prefabricated tanks.

- Notation of pump model, pump performance curve, friction loss for force main and calculation for total dynamic head.
- Cross-section of dosing chamber including storage volumes; connections for piping, and electricity; pump “off” setting; dosing cycle and volume; and location of vent and manhole.
- Cross-section of pretreatment tank(s).

MATERIAL SPECIFICATIONS

- Provide from manufacturer of drip line:
 1. drip line manufacturer name, model and size of pipe material;
 2. flow rate per emitter;
 3. type of drip line used (compensating or non-compensating);
 4. filter and field flush cycles required;
 5. maximum allowed length for a single lateral; and
 6. number and spacing of emitters.
- Provide from manufacturer of pressurized pipe connecting supply and return manifolds to drip line pipe;
 1. manufacturer name, model and size of pipe and fitting material;
 2. pressure rating for pipe;
 3. description of the joint connection to a manifold and drip line lateral; and
 4. list of standards to which the pipe conforms
- Provide from manufacturer system filters
 1. manufacturer name, model and size of particles the filter will remove;
 2. pressure rating for filter; and
 3. means in which the filter will be protected from freezing.

B. Inspections

Inspection shall be made in accordance with ch. 145.20, Wis. Stats. and s. Comm 83.26, Wis. Adm. Code. The inspection form on the following two pages may be used. The inspection of the system installation and/or plans is to verify that the system at least conforms to specifications listed in Tables 1 - 3 of this manual.

ATTACHMENT #2

A. SITE CONDITIONS

Evaluate the site and soils report for the following:

- Surface water movement.
- Measure elevations and distances on the site so that slope, contours and available areas can be determined.
- Description of several soil profiles where the component will be located.
- Determine the limiting conditions such as bedrock, high groundwater level, soil application rates, and setbacks.

Slope - ____%

Occupancy – One or Two-Family Dwelling - _____ (# of bedrooms)

Public Facility - _____ gal/day (Estimated wastewater flow)

Depth to limiting factor - _____ inches

Minimum depth of unsaturated soil required by Table 83.44-3, Wis. Adm. Code - ____ inches

Soil application rate of in situ soil used - _____ gal/ft²/day

FOG value of effluent applied to component - ____ mg/L

BOD₅ value of effluent applied to component - _____ mg/L

TSS value of effluent applied to component - ____ mg/L

Fecal Coliform monthly geometric mean value of effluent applied to component > 10⁴ cfu/100ml __Yes __ No

Type of distribution cell - __ Pressure compensating or __ Non-pressure compensating

ATTACHMENT #3

POWTS INSPECTION REPORT

(ATTACH TO PERMIT)

GENERAL INFORMATION

Permit Holder's Name		<input type="checkbox"/> City <input type="checkbox"/> Village <input type="checkbox"/> Town of		County		Sanitary Permit No.	
State Plan ID No.		Tax Parcel No.		Property Address if Available			
TANK INFORMATION				SETBACKS			
TYPE	MANUFACTURER	CAPACITY	P/L	WELL	BLDG.	VENT TO AIR INTAKE	ROAD
SEPTIC							
DOSING							
AERATION							

PUMP INFORMATION

Manufacturer:		Model No.		Demand in GPM		Vert. Lift	
FORCE MAIN INFORMATION				FRICTION LOSS			
Length	Diameter	Dist. To Well	Component Head	TDH - As Built	TDH - Design		

SOIL DISTRIBUTION COMPONENT

TYPE OF COMPONENT				COVER MATERIAL			
Cell Width	Cell Length	Cell Diameter	Cell Depth	Horizontal Separation	Liquid Depth	No. of Cells	
SETBACK INFO.	Property Line	Bldg.	Well	Lake/Stream	Flush Connection to Building Sewer		Distance to tank

DISTRIBUTION COMPONENT / Elevation data on back of form

Supply Manifold		Return Manifold		Distribution Pipe(s)		Emitter Spacing	
Length	Dia.	Length	Dia.	Length	Dia.	Spacing	

SOIL COVER

Depth over center of cell:	Depth over edge of cell:	Depth of Cover material	Seeded / Sodded	Mulched
----------------------------	--------------------------	-------------------------	-----------------	---------

DEVIATIONS FROM APPROVED PLAN

DATE OF INST. DIRECTIVE:	DATE OF ENFORCEMENT ORDER:
DATE OF REFERRAL TO LEGAL COUNSEL:	

COMMENTS (Persons present, discrepancies, etc.)

COMPONENTS NOT INSPECTED

Plan Revision Required <input type="checkbox"/> Yes <input type="checkbox"/> No	Date:	Signature of Inspector:	Cert. Number
--	-------	-------------------------	--------------

Sketch on other side

ELEVATION DATA

Point	Back sight	Height of instrument	Foresight	Elevation	Comments
Bench mark					
Bldg. sewer					
Tank inlet					
Tank outlet					
Tank inlet					
Tank outlet					
Dose chamber inlet					
Bottom of dose chamber					
Dist. Longest lateral zone 1					
System elev. 1					
Dist. Longest lateral zone 2					
System elev. 2					
Dist. Longest lateral zone 3					
System elev. 3					
Grade elev. 1					
Grade elev. 2					
Grade elev. 3					

SKETCH OF COMPONENT & ADDITIONAL COMMENTS