Pressure Distribution (August 2002)

Standards and Guidance for Performance, Application, Design, and Operation and Maintenance

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1.0 Introduction

Pressure distribution applies effluent uniformly over the entire drainfield area such that each square foot of bottom area receives approximately the same amount per dose at a rate less than the saturated hydraulic conductivity of the soil. This process promotes soil treatment performance by maintaining vertical unsaturated flow at all times and also reduces the degree of clogging in finer textured soils. Pressure distribution closely approaches uniform distribution.

A pressure distribution system consists of a pretreatment component (septic tank) to separate the major solid materials from the liquid, a screening device to protect the pump and drainfield orifices from solids, and a means to deliver specified doses of effluent, under pressure, to the distribution system. The distribution system (drainfield) consists of small 1 to 2 inch diameter laterals with small discharge orifices. A pressure head is created within the laterals, usually by means of a pump or siphon.

Pressure distribution is applicable to any system, which uses soil as a treatment medium and may improve long term performance of those systems. Pressure distribution is required by Sutter County Chapter 700 for certain site and soil conditions, and is also a required component for mounds and sand filters.

Research evidence indicates that wastewater traveling vertically through 2-4 feet of suitable, unsaturated soil provides adequate treatment of wastewater. Research also indicates that the method of distribution of septic tank effluent within the drainfield can affect the system's treatment performance.

The most frequently used and simplest method for distributing effluent is gravity flow. Gravity flow allows wastewater to flow by gravity through large diameter pipes into the drainfield. Distribution is usually localized in a few areas within the drainfield, which results in overloading of the infiltrative surface in those areas. This overloading can lead to groundwater contamination in coarse granular soils due to insufficient treatment, or more rapid clogging in finer textured soils.

A second method of distribution, dosing, can overcome some of these problems. Because effluent is distributed over a larger portion of the drainfield area and the period between doses is maximized, the degree of soil clogging is reduced. However, localized overloading may still occur.

The third method is pressure distribution, which comes closest in achieving uniform distribution. Pressure distribution is usually used in locations where it is either desirable or required to:

1) *achieve uniform application of wastewater throughout the drainfield area;*
2) *treat and dispose of effluent higher in the soil profile;*
3) *avoid potential contamination of ground water beneath excessively permeable soils;*
4) *improve the treatment performance and extend the life expectancy of a drainfield or other component;*
5) *reduce the potential for breakout or seepage on slopes; and*
6) *distribute effluent to all packed bed filters and mounds.*

Pressure distribution is appropriate for sites in aquifer sensitive areas, for sites with limited soil depth, and for larger drainfield systems

1.1 System Components / Process Summary

Pressure distribution systems require the following basic components: septic tank (or other pretreatment to the same quality as residential septic tank effluent), pump tank or siphon chamber, and distribution system (transport line, manifold, and laterals). (See Figure 1)

2.0 Performance Standards

2.1 Intent

The intent of pressure distribution is uniform distribution of effluent throughout the drainfield.

2.2 Measure of Performance

2.2.1 The variation in orifice discharge rates within any one lateral must not be more than 10%.

2.2.2 The variation in orifice discharge rates over the entire distribution system must not be more than 15%.

Maximum Difference Allowed (Inches)		
Nominal Residual Squirt Height	*10% Difference*	*15% Difference*
2 Feet	*5 Inches*	*7.5 Inches*
5 Feet	*12.5 Inches*	*19 Inches*

2.2.3 A minimum residual pressure of 0.87 psi (2 feet of head) is required for systems with 3/16 inch diameter orifices and larger, and 2.18 psi (5 feet of head) is required for systems with orifices smaller than 3/16 inch.

The steps for conducting a pressure test are described below. Generally, the testing should verify that distribution is uniform with the required minimum residual pressure, that the system is dosed at the proper volume and frequency, and that the alarms are functioning properly. If problems are encountered during testing, the installer should notify the designer. Wiring problems should be referred to the electrician.

- ❑ *Measure squirt height.*

Minimum squirt height for orifice size:
3/16" orifice size = 2' or 24" squirt height
1/8" orifice size = 5' or 60" squirt height
5/32" orifice size = 5' or 60" squirt height

- ❑ *Check uniformity of squirt height.*

The true residual head is measured from the top of the lateral pipe to the top of the water column. An alternate method to check the squirt height is to attach a clear PVC standpipe to the end of the lateral.

- ❑ *Check float placement.*

High water alarm, "on" level, "off" level, and "redundant off" alarm must activate or deactivate at the elevation called out on the design. It is recommended that, for simplicity and accuracy, these adjustments be made with the float tree out of the water.

- ❑ *Ensure that the pump delivers the correct dose to the drainfield.*

- ❑ *In preparation for the final inspection, fill the pump tank.*

Demand dose systems:
*Verify that "dry" float settings (completed above) send the correct dose to the drainfield when floats are in water. This may require minor adjustments of float placement. **

Timed dose systems:
(1) Determine the time required to pump a full dose to the drainfield. This can be done by running the system in manual. Be sure there is plenty of water in the pump tank. Timer run times provided by designers must be field tested.
*(2) Using the time obtained above, verify that when the system runs automatically it runs the time required to send the proper dose to the drainfield. Two steps to speed this process are to start testing with the pump tank mostly full and to set the "off" time temporarily to minutes or seconds. **
(3) Verify that the timer "off" time is the same as that specified in the design and will dose the system the correct number of times a day. Check this number in minutes and note the "off" time. For instance, if the drainfield is to receive 24 doses per day, the "off" time should be approximately 1 hour.

** Determination of the float activation level in water may take several tries. For both system types, note the pump run time that delivers the proper dose. Record the results.*

3.0 Application Standards

3.1 Listing -- Pressure distribution is a public domain technology and therefore is not listed in the Department's *List of Approved Systems and Products*, but may be permitted by the Health Officer as technical standards have been adopted by the Department.

3.2 Permitting

3.2.1 Installation permits, and if required, operational permits must be obtained from the Health Officer prior to installation and use.

3.3 Pretreatment

3.3.1 A pressure distribution system must be preceded by a properly sized two-compartment septic tank.

3.3.2 Septic Tank (See Figure 2) **--** The septic tank must be designed in compliance with Sutter County Chapter 700-160-F and must also:

(a) Be watertight;
(b) Be equipped with a minimum 20-inch diameter, watertight, secured (bolts or equivalent) access riser that extends to the ground surface for each compartment of the septic tank; and
(c) Include screening of the effluent, unless a screened pump vault is utilized.

3.3.3 Effluent Filter -- An effluent filter must meet the following performance criteria and perform these functions without a loss of performance between routine service events:

(a) Protect the pressure distribution drainfield discharge orifices from plugging by particles larger than the orifices. The screen shall have a mesh size of 1/16 inch smaller than the drainfield orifices;
(b) Protect the effluent pump from damage due to particles which exceed the pump's capacity to pass (may be an issue with some types of pumps);
(c) Provide an open area flow capacity sufficient to ensure a minimum service interval of one (1) year;
(d) Be constructed of durable, non-corroding materials;

(f) Draw liquid from the "clear zone" of the septic tank, the zone between 40% down from the top of the liquid and 40% up from the bottom of the tank; and

(g) Be designed, constructed, and installed for easy and thorough cleaning.

3.4 Pump Tank (See Figure 2)

3.4.1 Pump Tank Requirements -- All pump tanks must be structurally sound, conform to Sutter County Chapter 700-160-G and:

(a) Be watertight. Watertight testing shall be required;

(b) Be equipped with a twenty-four (24) inch minimum diameter, watertight riser with a secured lid that extends to the ground surface. Lids must be equipped with an airtight gasket to eliminate nuisance odors; and

(c) Include a screened pump vault if an effluent filter is not provided at the outlet of the septic tank. A basket screen around the pump without the septic tank effluent filter is not allowed.

> *Screening at the septic tank outlet may result in a higher quality effluent than screening around the pump, as the flow rate through a septic tank effluent filter is much lower. However, pump tanks can continue to accumulate screenable solids, as it is still a biologically active fluid. Therefore, a screened pump vault may be a wise choice either by itself or in conjunction with a septic tank effluent filter.*

3.4.2 Pump Tank Sizing

(a) The internal volume of the pump tank shall be at least two (2) times the daily design flow with a minimum capacity of 500 gallons to provide sufficient operating volume, emergency storage, and depth below the pump inlet for sludge accumulation; and

(b) Emergency storage volume of at least 50% of the daily design flow shall be maintained above the high water alarm and may include volume to flood capacity in the pump tank only.

> *For most applications, an 18-inch minimum space for sludge accumulation in the pump tank is prudent. Pump tanks receiving septic tank effluent will accumulate sludge and scum, and in some new systems it will form quite rapidly. The emergency storage is required for periods of power outages or equipment malfunctions.*

3.5 Pumps, Fittings, and Controls

Pumps must be selected to pump effluent and be capable of meeting the minimum hydraulic flow and head requirements of the proposed on-site system.

3.5.1 Pumps

(a) All pumps must be installed so that they can be easily removed and/or replaced from the ground surface. *(Under no circumstances shall pump replacement and/or repairs require service personnel to enter the pump tank).*

(b) All pumps must be fitted with unions, valves, and electrical connections necessary for easy pump removal and repair. All pumps must be protected by an approved effluent filter in the chamber preceding the pump tank or by a screened pump vault meeting the requirements of Section 3.3.3.

(c) Pumps and electrical hook-ups must conform to the National Electric Code and Sutter County Electrical Code.

Pumps and controls must have gas-tight junction boxes or splices and have electrical disconnects appropriate for the installation (as per the National Electric Code). The boxes should be placed so that they do not interfere with the servicing of other components.

(d) If any portion of the pump fittings or transport line is at a higher elevation than the drainfield, the system must be equipped with an air vacuum release valve or other suitable device to avoid siphoning.

(e) Duplex pumps shall be required on non-residential facilities with design flows over 500 gallons/day.

3.5.2 Pump Controls

(a) For sand filters, mounds, and pressure distribution systems in soil type 2, controls must be capable of:

- Meeting the functional requirements for pressure distribution;
- Delivering prescribed dose sizes uniformly to the orifices in the distribution network;
- Delivering the effluent to the distribution network in evenly spaced doses over a 24 hour period;
- Providing prescribed resting periods between doses;
- Assuring no more than the design volume for each 24 hour period is delivered to the receiving component; and
- Be listed by Underwriter's Laboratory or equivalent.

Pump controls that perform the functions in section 3.5.2 (timed dosing) is strongly recommended on all pressure distribution systems to enhance performance, reliability, and protection from abuse. These requirements and recommendations are based on the need to control the size of doses to the coarser and single grained soils and treatment media, and to prevent hydraulic overload of the receiving component. Usual sources of hydraulic overload are excessive water use in the facility or groundwater infiltration into the septic tank or pump tank.

Timed dosing means that both the length of each dose and the interval between doses is controlled by a timing device. The number of pump cycles should be adjustable and in sufficient number to meet the design needs of the system.

As the number of dose cycles increases, the amount of effluent delivered per dose must decrease (in order to prevent more than daily design dose from being delivered to the drainfield). Delivering more than 6 or 8 doses per 24 hours will require one or more of the following features to be designed into the system:

- *orifices at 12 o'clock to keep the piping network full or mostly full of effluent between doses (to reduce the volume per dose)*
- *reduce transport, manifold, and lateral pipe diameters (to reduce the volume per dose)*
- *reduce orifice size (to help reduce the volume per dose)*
- *increase the fluid velocity in pipes (to help scour the pipe)*
- *increase the residual hydraulic head at the orifices (to help clear the smaller orifices)*
- *place check valves in the system to prevent flowback (to reduce the volume per dose)*

(b) Pressure distribution out of an intermittent sand filter does not need the controls listed in 3.5.2(a). In this case, only an elapsed time meter is required to monitor the integrity of the containment liner.

(c) At a minimum, all pressure distribution systems must include an electrical control system that:

- Will meet the functional and reliability requirements for pressure distribution;
- Has controls and components that are listed by UL or equivalent;
- Is located outside in an accessible location; and
- Is secure from tampering and resistant to weather (minimum of NEMA Type 4).

(d) All control panels must contain dose counters and elapsed time meters for all pumps.

(e) All control panels must be equipped with both audible and visual high liquid level alarms and the alarms must be placed in a conspicuous location.

(f) Float switches must be mounted independent of the pump and transport line so that they can be easily replaced and/or adjusted without removing the pump.

(g) Electrical control and other electrical components must be approved by Underwriters Laboratories (UL) or equivalent.

(h) All designers and installers must comply with the National Electrical Code and Sutter County Electrical Code for pump and control systems.

3.5.3 Minimum Dose Frequency

The minimum dosing frequency must be according to the following:

Soil Type 1	12 times per day
Soil Types 2-3	6 times per day
Soil Type 4-5	4 times per day
Soil Type 6	1 to 2 times per day

Dose Frequency - Although this standard lists the minimum frequency for various soil types, more frequent doses may be desirable in some designs. Dosing of drainfields provides intermittent aeration to the infiltrative surface. With intermittent dosing, periods of loading are followed by periods of resting, with cycle intervals ranging from hours to a day or more. The resting phase should be sufficiently long to allow the drainfield to drain and expose the infiltrative surface to air, encouraging the degradation of clogging materials by aerobic bacteria.

In sands, rapid infiltration rates can lead to inadequate treatment, especially when first put into use. Therefore, systems constructed in these soils should be dosed with small volumes of wastewater more frequently to prevent saturated conditions from occurring. In finer textured soils, saturated flow is much less likely, so frequent doses do not add to the performance. Large, less frequent doses are more suitable in these soils to provide longer aeration times between doses.

3.5.4 Floats (or other types of liquid level sensors)

(a) For pump tanks serving single family residences, a float to actuate and turn off the pump control system, and a high water alarm float is required. Redundant off controls are highly recommended and may be required by the Health Officer.

(b) Non-residential and public use applications with a design flow greater than 500 gallons/day must include redundant off controls.

A redundant off float and control circuit serve several very desirable functions not related to an explosive environment and are therefore highly recommended. Properly wired and tied to an alarm, the redundant off float and control circuit will turn off the pump at low liquid level even when the pump is operating with the manual switch. In addition, an alarm will be activated. In this way, the redundant off will protect the pump from homeowner tampering, a leaking pump tank, siphoning through the pump discharge pipe, or any other situation where there is insufficient liquid volume in the pump tank.

3.5.5 Siphons (See Figure 3)
Siphons may be used for charging a pressure distribution system. However, they are flow-dependent and cannot provide evenly spaced doses, nor limit the daily volume. Therefore siphons cannot be used for timed dosing required in Section 3.5.2(a). Where siphons are used the following requirements apply:

(a) The area to be dosed must be downhill from the siphon chamber and according to manufacturer's instructions for minimum elevation differential;
(b) The effluent must be screened before entering the siphon chamber;
(c) The siphon must be installed to allow access for maintenance and cleaning;
(d) A dose counter must be incorporated into the design and installation; and
(e) Siphons may only be used where they will be monitored and managed to the satisfaction of the Health Officer.

Other important considerations:

- *Proper siphon size must be selected, as they are available in many sizes.*
- *Air leaks in the siphon or fittings will prevent the siphon from functioning.*
- *If the siphon chamber fills too rapidly, the bell and siphon will not receive a full dose of air and will enter a trickling mode.*
- *Adjustment to the "trip" level of the liquid in the siphon chamber is limited; dose volume is better handled by careful sizing of the siphon chamber.*
- *Blockage of the snifter tube, even momentarily, at the end of the discharge cycle, will cause the siphon to enter a trickling mode.*
- *The transport pipe must be vented just outside the siphon chamber and other venting must be placed in the system as needed.*
- *It is advisable not to bury the transport pipe until the system is tested and proper operation is verified; additional venting may be needed for unanticipated air locks.*

3.6 Piping Materials

At a minimum, all pipe in the distribution system must be a pressure rated PVC material and meet the following specifications:

3.6.1 ASTM D2241 for Class 160 or Class 200; and
3.6.2 ASTM D1785 for schedule 40 and schedule 80 PVC.

3.7 Manifold

3.7.1 The manifold shall be designed to deliver equal flow to all lateral orifices.

Manifold / Lateral Connections:
The laterals can be connected to the manifold in several ways. The manifold to lateral connection must be appropriate for the site conditions and the specific use. Several types are described below:

- *A header manifold is positioned at an elevation below the laterals (See Figure 4) with check valves, flow control valves, and feeder lines to each lateral. This configuration will maintain the manifold, feeder lines, and laterals full between doses; will not allow drain back; and can be adjusted at one location to equalize residual head in all laterals. This arrangement can deliver small volumes per dose, allowing many doses per day. Caution should be taken to minimize the potential for effluent freezing in the laterals and manifold.*
- *Tee-to-Tee with manifold below (See Figure 5) - When freezing and sloping site conditions are not a concern, this method of construction can be used to allow a very rapid pressurization of the system, especially if the transport line remains full between doses. When check valves are used in the manifold just downstream of each lateral, the manifold (and laterals too, when orifices are in the 12 o'clock position) stays full of effluent between doses. With this type of connection, there is no drainback from the upper laterals and manifold into the lower lateral, the system is completely charged within just a second or two after the pump is turned on, and the system can be dosed with very small volumes per dose.*
- *Cross construction (See Figure 6) - If the lateral orifices are drilled in the 6 o'clock position, this design will allow the laterals and a portion of the manifold to drain between doses, assuming the transport line remains full between doses.*

Sloping Sites:
Manifold designs for sloping sites are particularly critical. Laterals at different elevations will have different residual pressures, with the lowest lateral having the highest residual. In addition, if the manifold is not designed correctly the lowest lateral will receive pressure before the top lateral and system backflow will continue to the lower laterals after the pumping cycle has ended

3.7.2 Check Valves

(a) Check valves shall be installed in such a manner to be easily located, and removed for servicing or replacement; and

(b) The location of check valves shall be well documented.

Check valves occasionally require maintenance, and therefore should be installed so that they can be removed for servicing or replacement. Unions or some other fittings need to be included in the installation to allow service to the check valves while avoiding destruction or severe excavation of the manifold. Their location should be well documented and marked, or should be located in a structure that is accessible from the surface. Some brass check valves can be disassembled without removing them from the line.

3.8 Laterals

3.8.1 Laterals in a pressure distribution system shall be designed to deliver equal flows through orifices to each square foot of the drainfield bottom area.

Orifice Design:
The actual flow rate from each orifice is best represented by the equation:

$Q_o = 11.79\, d^2\, h^{0.5}$

Where:

- Q_o *is the orifice flow in gallons per minute*
- d *is the orifice diameter in inches*
- h *is the discharge head in feet (also called residual head)*
  (see Appendix C-2 for a derivation of this equation)

There are other factors complicating accurate calculation of the orifice flow rate such as accurate drilling of holes, class of pipe, size of pipe, and slight variations in the friction coefficients used for fittings. Proper technique and practice in drilling holes includes use of proper drill size and a sharp bit. Accurate holes also may require jigs or other drill stabilizing tools to prevent wobble and to keep the holes perpendicular to the pipe. Proper layout and control will ensure that the designed number of orifices are actually placed in each lateral.

The above formula for calculating orifice discharge rates is recommended. However, the choice of coefficient to use in a design can vary from 11.79 to 16, depending on the experience of the designer in being able to predict accurately and control for the friction losses and other variables of construction and manufacture. For many designers, experience has shown that use of a slightly higher coefficient in the equation more accurately predicts the actual flow. For whichever coefficient is selected, it is critically important that the same coefficient be used throughout the design. Other ways to handle the inaccuracies are to add 10% to the total flow after the calculations, or to design to more than minimum residual head.

3.8.2 Residual Pressure Requirements

For systems with orifice diameters of 3/16 inch or larger, the minimum residual head at the orifice must be 2 feet (0.87 psi). For systems with orifices less than 3/16 inch diameter, the minimum residual head must be 5 feet (2.18 psi).

3.8.3 Orifice Size and Orientation

(a) Orifices must be no smaller than 1/8 inch in diameter.
(b) When using gravelless chambers with pressure distribution, the orifices must be oriented in the 12 o'clock position.

A discussion on the advantages and disadvantages of orifice orientation is contained in Appendix A.

3.8.4 Orifice Spacing

(a) Sand filters (including sand-lined trenches) and mounds must have a minimum of one orifice per 6 ft^2 of infiltrative surface area, evenly distributed;
(b) Pressure distribution systems in soil type 2 must have a minimum of one orifice per 9 ft^2 of infiltrative surface area, evenly distributed; and
(c) In other soil types, there shall be a minimum of one orifice every six feet along the lateral.

While these are minimum requirements, orifices spaced at closer intervals may be prudent. Closer orifice spacing should be considered when small doses are specified and where the infiltrative surface is in highly structured soils or soils that have large macropores.

3.8.5 Orifice Shields

(a) When orifices are oriented in the 12 o'clock position, orifice shields or gravelless chambers must be utilized; and

(b) The shields must be strong enough to withstand the weight of the backfill and large enough to protect the orifice from being plugged by pieces of gravel.

3.8.6 Cleanouts and Monitoring Ports

(a) All pressure distribution laterals must be equipped with cleanouts and monitoring ports at the distal ends (See Figure 7). These cleanouts and monitoring ports must:

- Have threaded removable caps or plugs on the ends of the laterals to allow for cleaning the laterals and for monitoring the lateral pressure;
- Be large enough to allow access to caps or plugs with hands and/or tools;
- Be accessible from the ground surface;
- Be open and slotted at the bottom; and
- Be void of gravel to the infiltrative surface to allow visual monitoring of standing water in the trench.

(b) All designs must show them in detail and explain how they accomplish the respective tasks.

3.8.7 Trenches

(a) In a pressure drainfield, as in any drainfield, the bottom of the trench must be level with a maximum grade of two (2) inches per one hundred (100) feet;

(b) The bottom and sides of the trench must not be smeared;

(c) An acceptable barrier material must be used on top of the gravel before backfilling; and

(d) The trenches and laterals must run parallel to the natural ground contours on sloping sites.

3.9 Minimum Design Submittal

A completed design must include the following as a minimum:

- All requirements of Sutter County Chapter 700-100;
- Daily design flow;
- Septic tank size and location;
- Size of pump tank or siphon chamber;
- Transport line length, location, and diameter;
- All valves or other such components in the system;
- Manifold diameter, location, length, and orientation;
- Lateral diameter, specific site location, length, and orientation;
- Orifice diameter, spacing, and orientation;
- Dose volume, pumping rate (gpm), dose frequency, and design residual head;
- Location and detail of access ports on the laterals;
- Detail of pump controls, floats, and the position of the floats;
- An electrical wiring diagram specific to the project;
- Relative elevations necessary for calculating the dynamic head loss in the system;
- General slope and topography in the drainfield area;
- System parameters and calculations used by the designer to arrive at the component sizing and flow distribution shown in the design; and
- Required inspections.

3.10 As-Built Information

A completed as-built submission must contain, at a minimum, the following items:

- All required items under Sutter County Chapter 700-210-F;
- All the items contained in the design submittal listed above, as installed, identifying any changes from the approved plan;
- The measured drawdown per dose cycle;
- Timer functions;
- Residual pressure and/or squirt height at the end of each lateral, as inspected; and
- Pump run time and pump time off.

3.11 User's Manual

A user's manual must be developed by the designer and provided to the homeowner and the Department. This document may be developed in conjunction with the installer and submitted with the as-built information, but will be the responsibility of the designer. The user's manual must contain, at a minimum, the following:

- Diagrams of the system components;
- Explanation of general system function, operational expectations, and owner responsibility;
- Specifications of all electrical and mechanical components installed (occasionally components other than those specified on the design are used);
- Names and telephone numbers of the system designer, Department, component manufacturers, supplier/installer, and/or the management entity to be contacted in the event of a failure;
- Information on the periodic maintenance requirements of the various components of the sewage system; and
- Information on "trouble-shooting" common operational problems that might occur. This information should be as detailed and complete as needed to assist the system owner to make accurate decisions about when and how to attempt corrections of operational problems, and when to call for professional assistance.

4.0 Operation and Maintenance

The systems must be monitored and maintained at a frequency commensurate with the site, soil, system complexity and use patterns. At a minimum, it is strongly recommended that the items in 4.1-4.5 be inspected at six months after the system is put into use and yearly thereafter. Refer to the system as-built for initial readings and settings.

4.1 Evaluate drainfield area for:

- Indications of surfacing effluent;
- Inappropriate vegetation, landscaping impacts and/or grading;
- Presence of heavy traffic;
- Inappropriate building and development;
- Impervious materials or surfaces; and
- Abnormal settling or erosion.

4.2 Evaluate laterals for:

- Residual pressure and/or squirt height at the distal end of each lateral;
- Equal flows in each lateral; and
- Need for cleaning. Clean laterals and orifices as necessary.

4.3 Measure pump run time per cycle and drawdown.

Compare with time recorded on as-built. If not the same, evaluate the system for improperly set timer control, float switches, clogged laterals, and/or plugged orifices.

4.4 Test alarms for proper functioning (high and low liquid level).

4.5 Evaluate septic tank and pump tank for:

- Sludge and scum accumulations. Pump when the sludge and scum thickness totals 1/3 of the depth of the tank.

> *Septic tanks should be pumped if there is 12 inches or less from the top of the sludge to the bottom of the outlet baffle, and 3 inches or less from the bottom of the scum mat to the bottom of the outlet baffle.*

- Clogging, damage, and proper placement of the effluent filter. Clean each time it is inspected or as needed to avoid clogging.
- Signs of leaking in tanks and risers. Repair or replace if necessary.
- Accessibility of the risers and lids and that lids are secure.
- Proper functioning of floats. Movement of floats should not be restricted, floats should be positioned correctly, and they should provide for designed functions. Adjust and repair floats as necessary.

4.6 All findings and repairs must be recorded and reports sent to the Department.

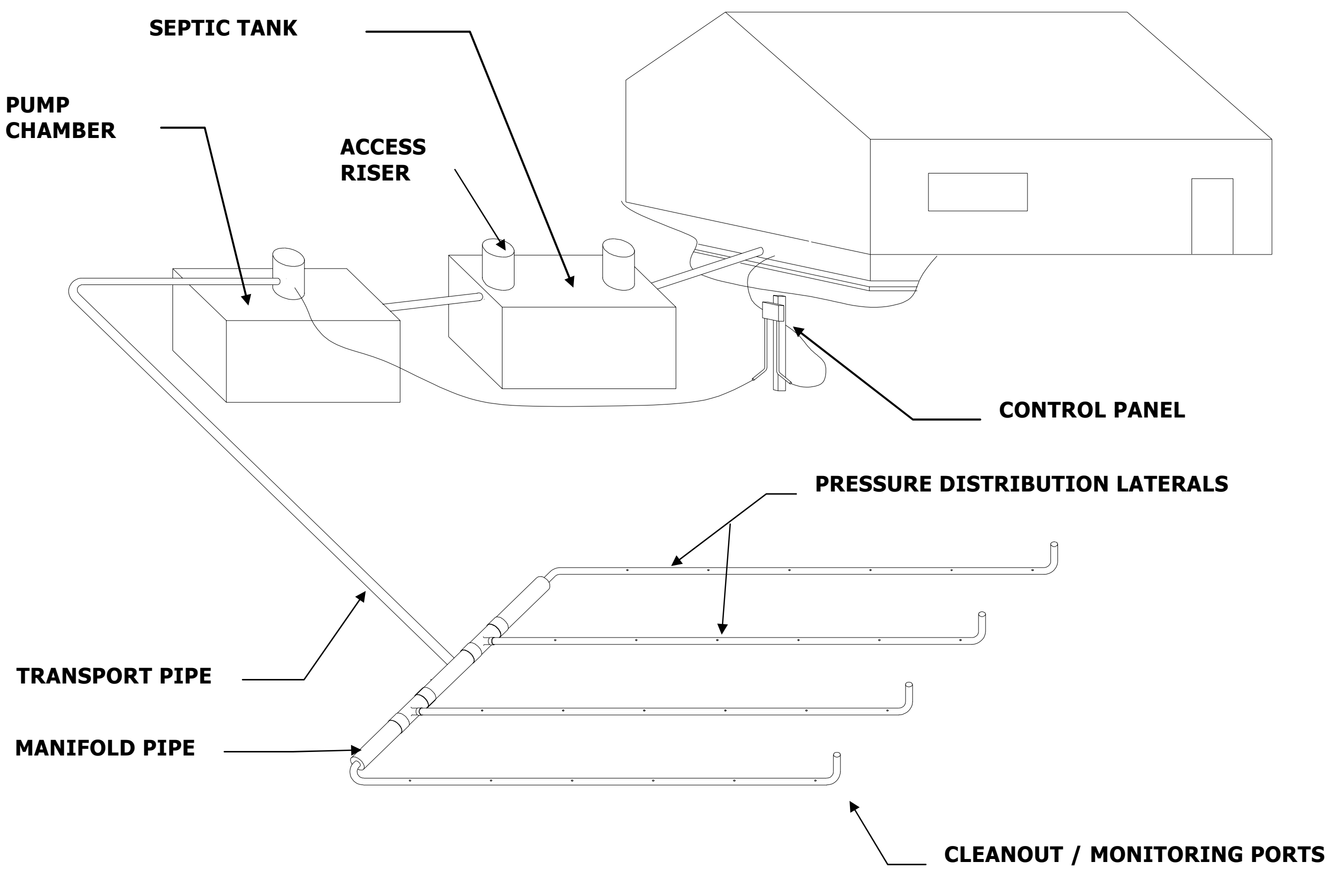
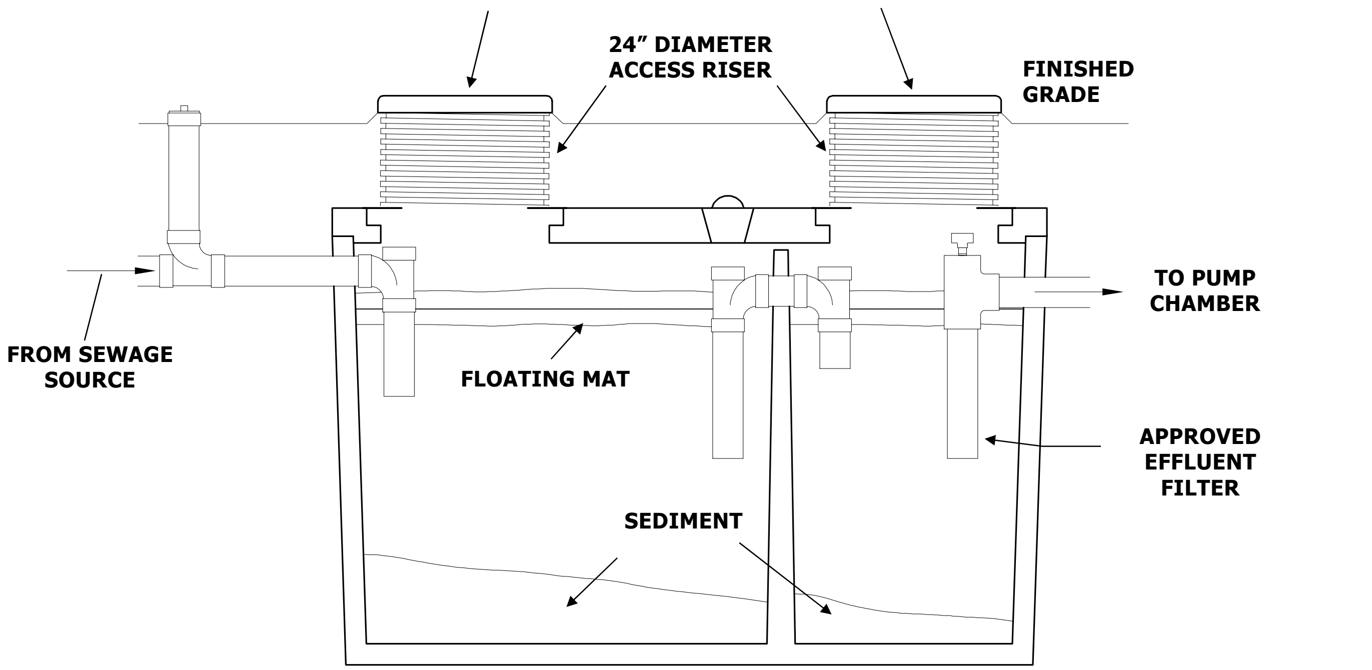
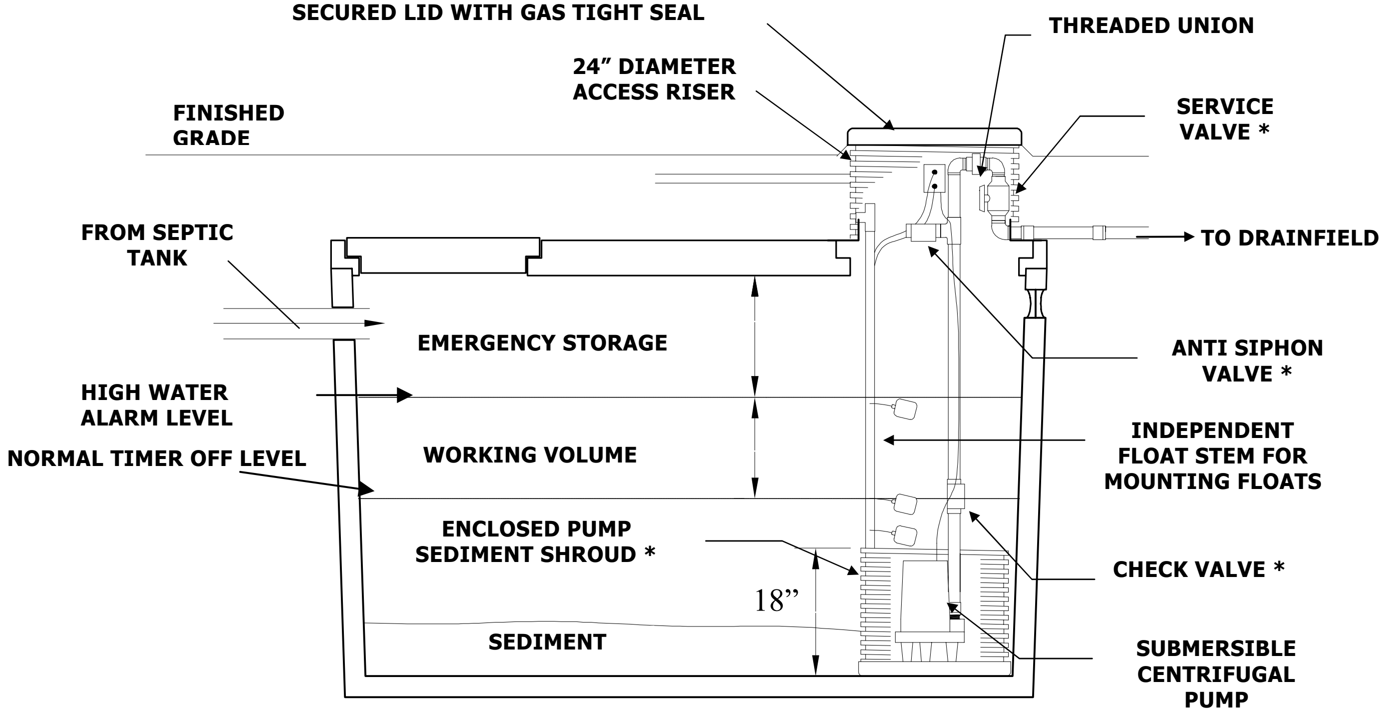

SEPTIC TANK
PUMP CHAMBER
ACCESS RISER
CONTROL PANEL
PRESSURE DISTRIBUTION LATERALS
TRANSPORT PIPE
MANIFOLD PIPE
CLEANOUT / MONITORING PORTS

FIGURE 1



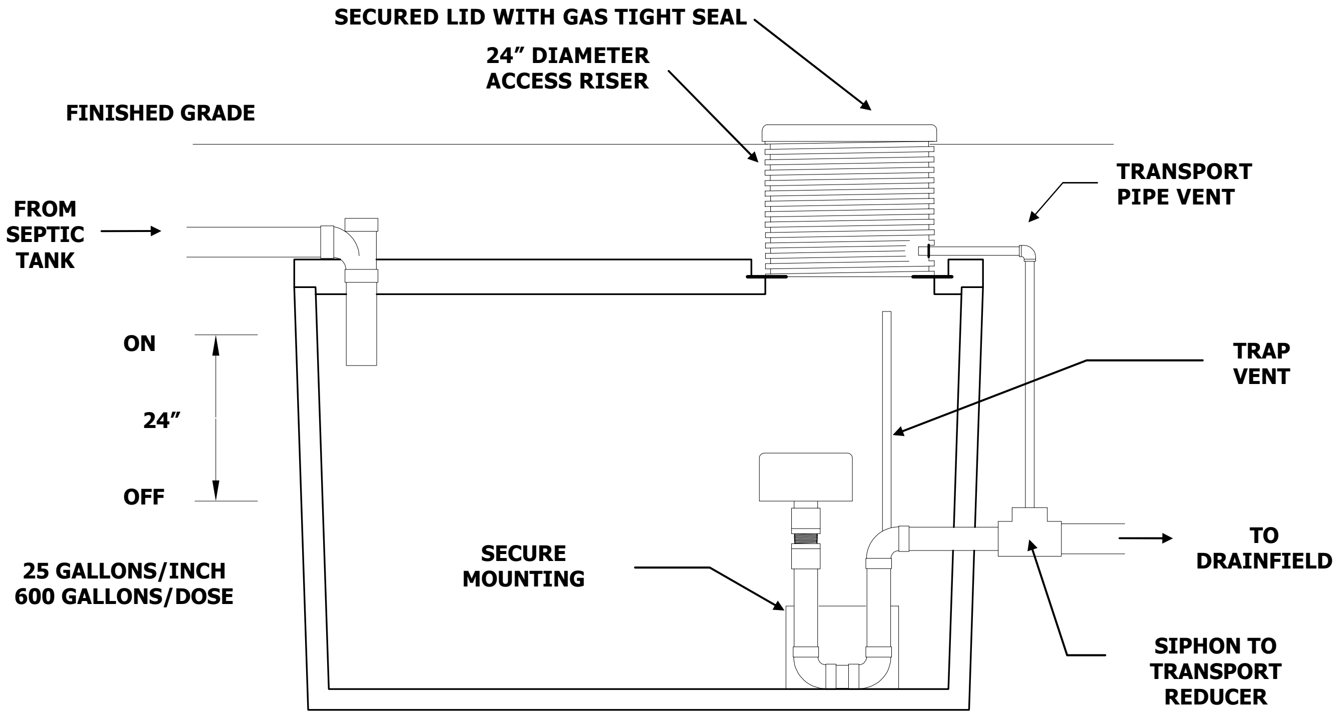
SEPTIC TANK (TYPICAL)



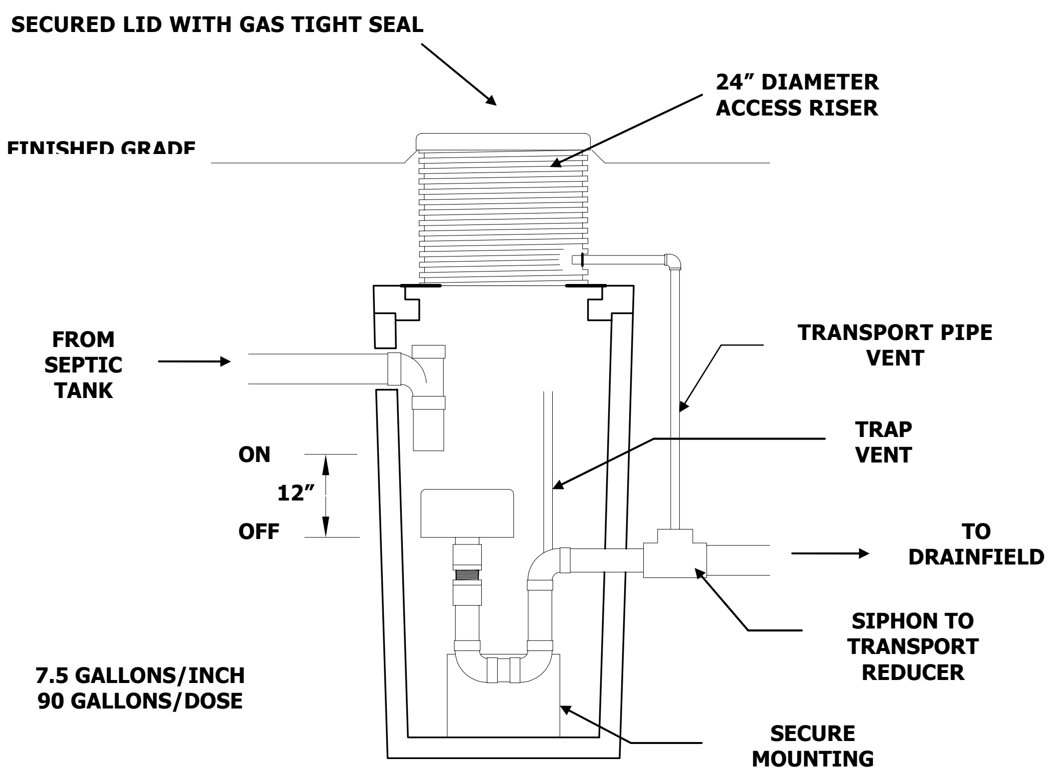
PUMP TANK (TYPICAL)

* AS NEEDED

FIGURE 2

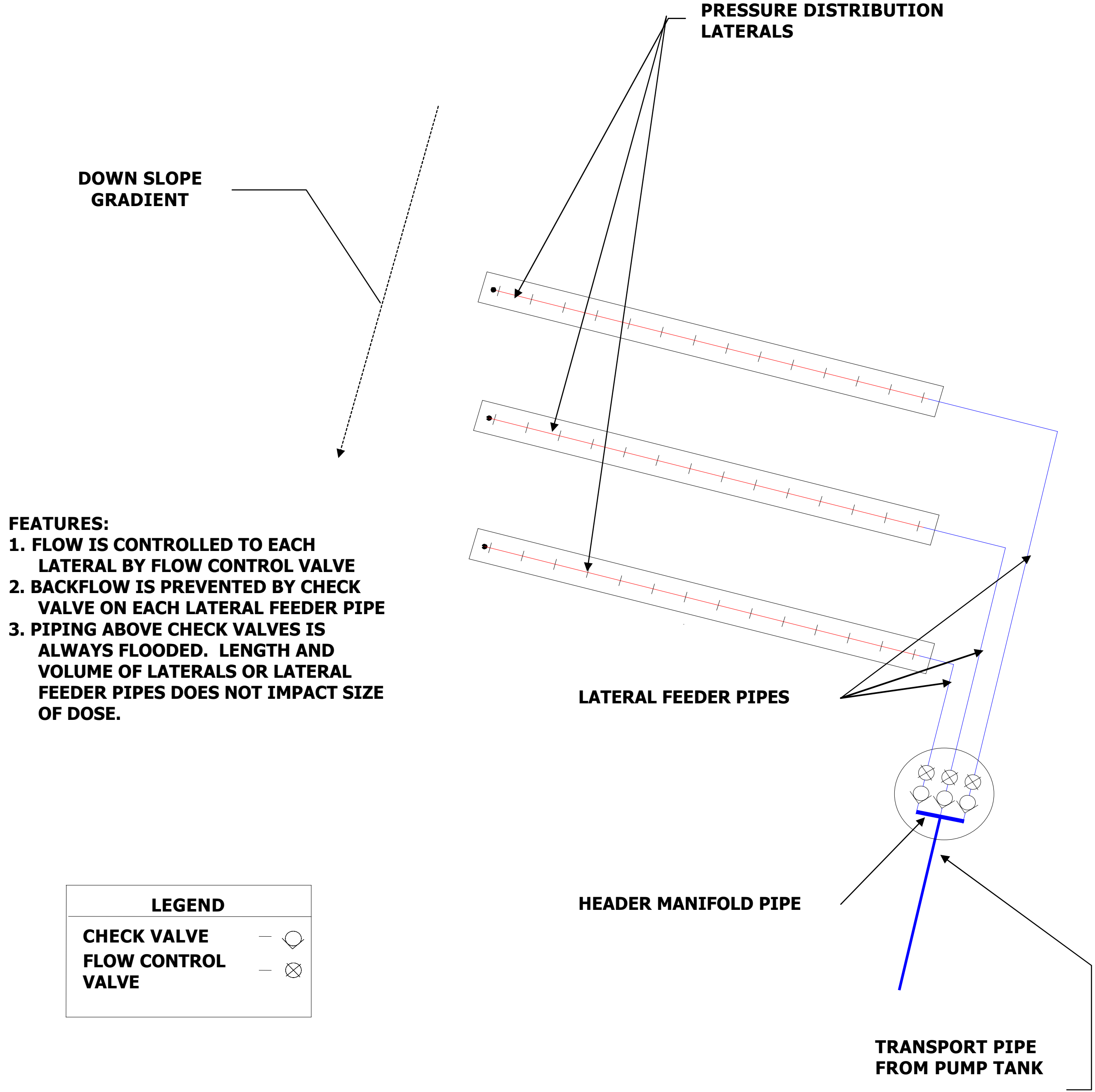


SIPHON TANK
HIGH DOSE VOLUME EXAMPLE



SIPHON TANK
LOW DOSE VOLUME EXAMPLE

FIGURE 3



PRESSURE DISTRIBUTION DRAINFIELD
(SLOPING GROUND)

FIGURE 4

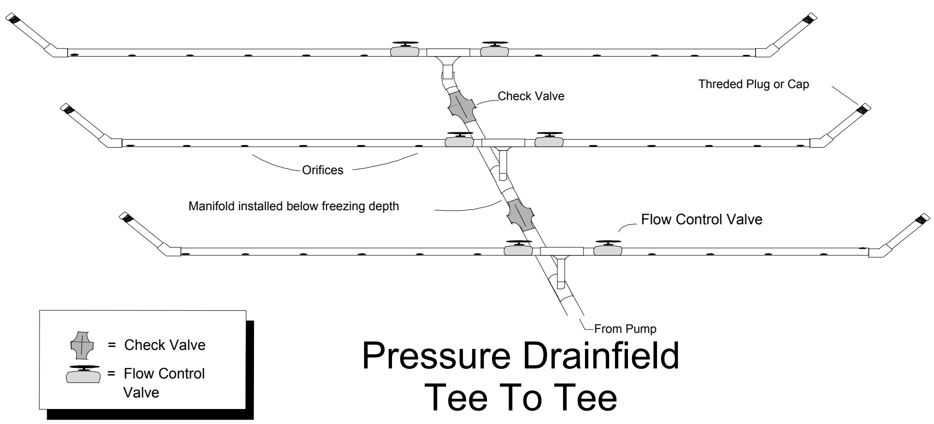


FIGURE 5

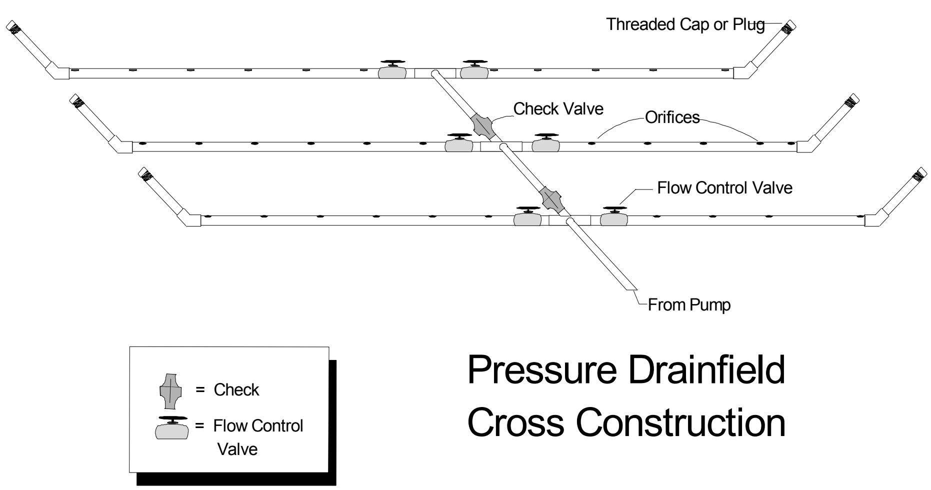
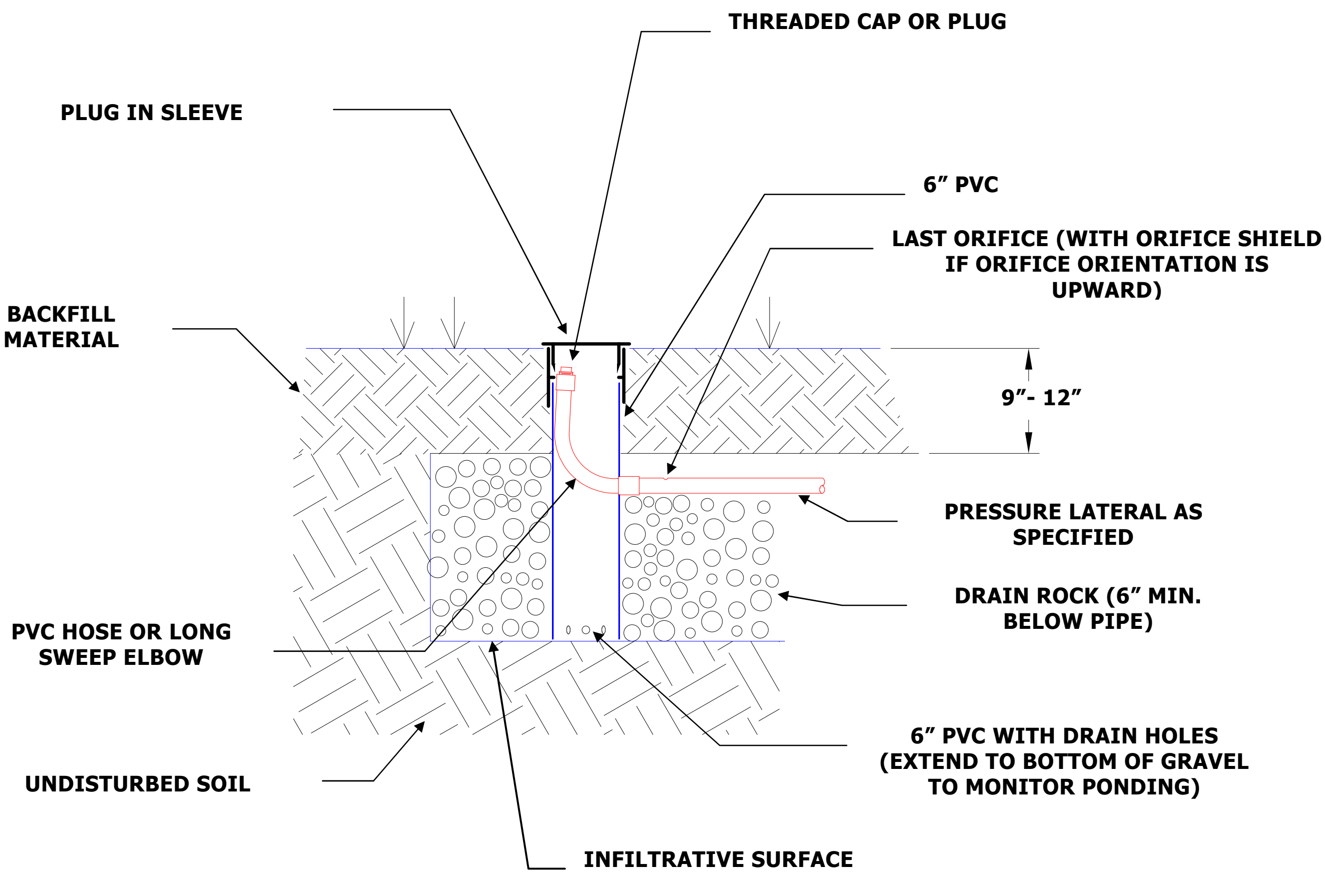


FIGURE 6



MONITORING/CLEANOUT PORT (EXAMPLE)

FIGURE 7

APPENDIX A

Advantages/Disadvantages of: Demand Dosing, Timed Dosing, Reduced Dose Volumes, Orifices in 12 o'clock Position, Orifices in 6 o'clock Position, and Network Remaining Full or Partially Full between doses.

1. Demand Dosing

   a. Least complex of control systems and therefore the least costly to install and easiest to understand.
   b. Not sensitive to heavy use days and therefore will not activate the alarm circuit with weekend guests, large laundry days, or parties.
   c. Does not protect the drainfield, mound, or sand filter from hydraulic surges and overload.
   d. Does not meter the effluent to the receiving component throughout a 24-hour period; but instead delivers the dose whenever a dose volume accumulates in the pump tank. Peak water use from a residence usually occurs in the morning, evening, and in weekend surges.

2. Timed Dosing

   a. Meters the effluent to the receiving component in discrete, evenly spaced doses.
   b. Allows more frequent, smaller doses to be pumped to the receiving component; thereby promoting unsaturated flow through the soil or filter media.
   c. Protects the receiving component from hydraulic overload.
   d. Sensitive to heavy use days and therefore may activate the alarm circuit when the volume of wastewater exceeds the design flow. Some causes may include weekend guests, large laundry days, parties, and leaking fixtures.
   e. More costly and complicated installation and maintenance.
   f. Can be used to help detect groundwater leaking into the septic tank or pump tank.

3. Reduced Dose Volumes

   a. More frequent, smaller doses with intervening resting and aeration periods are pumped to the receiving component, thereby assuring unsaturated flow through the soil or filter media.
   b. May require smaller orifices, smaller transport and lateral pipes, check valves, and/or orifices in the 12 o'clock position in order to reduce the flow rate and to maintain the system full of effluent between doses. The smaller orifices will increase the frequency of maintenance due to clogging. Likewise, maintaining the pipes full of effluent between doses will promote more rapid biological growth on the inside of the pipes and increase the rate of orifice clogging.

4. Orifices in the 12 o'clock Position

   a. As mentioned above, orifices in this position will maintain the laterals full or partially full and therefore reduce the amount of effluent needed to pressurize the system. This feature is important when designing a system with reduced dose volumes.
   b. Orifices in the "up" position require the use of orifice shields or chambers, to prevent blocking of some orifices with gravel pieces. Shields also deflect the squirt over a wider surface area and spread the effluent over more of the infiltrative surface. Shields have the greatest importance in systems with medium to coarse sand soils or with imported media providing the treatment.
   c. Maintaining effluent in the lines will promote biological growth, which will accelerate clogging of the orifices and buildup of sludge and slime in the lines. It also makes the laterals subject to freezing in areas where this is a concern.

d. Laterals may be drained by putting a few orifices in the 6 o'clock position, or by draining laterals and transport line back to the pump tank. However, these practices will increase the dose volume required.

5. Orifices in the 6 o'clock Position

a. When some or all of the orifices are in the "down" position, the laterals will drain between dose cycles retarding the biological growth in them and reducing freeze up potential. To maintain equal distribution in systems that drain, the dose volume should be designed to be at least 5 times the volume of the liquid that drains after a dose.
b. When the orifice at the distal end (farthest from the manifold) is in the down position, sludge in the lines tends to be driven to the distal end of the lateral and out the last orifice. As that orifice clogs, the next in line will clog, and so on.
c. Although systems with some or all of the orifices in the down position may be less prone to clogging, they also will require a larger dose volume to pressurize the system, due to laterals draining between pump cycles.
d. Orifices in the down position cannot be directed to gravelless chambers, and therefore will not have as wide a distribution pattern. However there are special orifice shields available for orifices oriented in this position.

6. Network remaining full or partially full between doses (laterals can rarely be maintained at a level grade; therefore some orifices will be lower than others causing some of the effluent to drain out the lowest orifice oriented in the 12 o'clock position).

a. Allows smaller, more frequent doses with intervening resting and aeration periods, to be pumped to the receiving component, thereby promoting unsaturated flow through the soil or filter media.
b. Maintaining effluent in the lines will promote biological growth, which will accelerate clogging of the orifices and buildup of sludge in the lines. It also makes the laterals subject to freezing in areas where this is a concern.

APPENDIX B

USEFUL TABLES FOR PRESSURE DISTRIBUTION

The design tables in the four sections of this appendix have been developed in order to allow the designer to evaluate alternative lateral configurations.

Appendix B-1, LATERAL DESIGN TABLE, has a table of maximum lateral lengths for various lateral diameters, orifice diameters, and orifice spacing. Appendix B-1 also includes the design criteria used to calculate maximum lateral lengths.

Appendix B-2, ORIFICE DISCHARGE RATE DESIGN AID, contains a derivation of an equation used to calculate orifice discharge rates and a table of discharge rates for various residual heads and orifice diameters.

Appendix B-3, FRICTION LOSS DESIGN AID, includes a derivation of an equation that can be used to calculate friction losses and a table of constants to simplify the calculation. Also included is a friction loss table for PVC pipe fittings.

Appendix B-4, MAXIMUM MANIFOLD LENGTHS, lists the assumptions used to calculate the enclosed tables for maximum manifold length. Table B-4-1 is for 1/8 inch and 5/32 inch orifices (where the minimum residual head at the distal orifice must be 5 feet) and Table B-4-2 is for orifices of 3/16 inch and up (where the minimum residual head at the distal orifice must be 2 feet).

Throughout Appendix B, it is assumed that laterals and manifolds will be constructed using only PVC pipe materials conforming to ASTM standards D-2241 or D-1785.

APPENDIX B-1

LATERAL DESIGN TABLES

The maximum allowable length for any lateral is determined by allowable differences in discharge rates between the proximal and distal orifices. These tables assume that $Q_p/Q_d \leq 1.1$;

Where Q_p = the proximal orifice discharge rate
Q_d = the distal orifice discharge rate

The maximum allowable difference in discharge rates is 10%. The maximum allowable lateral length is a function of lateral diameter and orifice diameter and is independent of the residual pressure.

Orifice discharge rates are a function of orifice diameter and residual pressure (see APPENDIX B-2 for a discussion). Table B-1 gives the maximum lateral length for each orifice diameter, lateral diameter, and orifice spacing.

TABLE B-1. **Lateral Design Table**

			Maximum Lateral Length (ft)		
Orifice	**Lateral**	**Orifice Spacing**	Pipe Material		
(inches)	(inches)	(feet)	**Schedule 40**	**Class 200**	**Class 160**
1/8	1	1.5	42	51	
1/8	1	2	50	62	
1/8	1	2.5	57.5	72.5	
1/8	1	3	66	81	
1/8	1	4	80	96	
1/8	1	5	90	110	
1/8	1	6	102	126	
1/8	1.25	1.5	66	76.5	79.5
1/8	1.25	2	80	92	96
1/8	1.25	2.5	92.5	107.5	110
1/8	1.25	3	105	120	123
1/8	1.25	4	124	144	148
1/8	1.25	5	145	165	175
1/8	1.25	6	162	186	192
1/8	1.5	1.5	85.5	96	100.5
1/8	1.5	2	104	116	120
1/8	1.5	2.5	120	135	140
1/8	1.5	3	135	150	156
1/8	1.5	4	164	184	188
1/8	1.5	5	190	210	220
1/8	1.5	6	210	240	246
1/8	2	1.5	132	141	145.5
1/8	2	2	160	170	176
1/8	2	2.5	185	197.5	202.5
1/8	2	3	207	222	228
1/8	2	4	248	268	276
1/8	2	5	290	310	320
1/8	2	6	324	348	360
5/32	1	1.5	31.5	39	39
5/32	1	2	36	46	46
5/32	1	2.5	42.5	52.5	52.5
5/32	1	3	48	60	60
5/32	1	4	56	72	72
5/32	1	5	65	80	85
5/32	1	6	72	90	96

			Maximum Lateral Length (ft)		
Orifice	**Lateral**	**Orifice Spacing**	Pipe Material		
(inches)	(inches)	(feet)	**Schedule 40**	**Class 200**	**Class 160**
5/32	1 1/4	1.5	48	55.5	58.5
5/32	1 1/4	2	58	68	70
5/32	1 1/4	2.5	67.5	77.5	80
5/32	1 1/4	3	75	87	90
5/32	1 1/4	4	92	104	108
5/32	1 1/4	5	105	120	125
5/32	1 1/4	6	120	138	144
5/32	1 1/2	1.5	63	70.5	73.5
5/32	1 1/2	2	76	84	88
5/32	1 1/2	2.5	87.5	97.5	102.5
5/32	1 1/2	3	99	111	114
5/32	1 1/2	4	120	132	136
5/32	1 1/2	5	140	155	160
5/32	1 1/2	6	156	174	180
5/32	2	1.5	96	103.5	106.5
5/32	2	2	116	124	128
5/32	2	2.5	135	142.5	147.5
5/32	2	3	150	162	168
5/32	2	4	184	196	200
5/32	2	5	210	225	235
5/32	2	6	240	252	264
3/16	1	1.5	24	30	
3/16	1	2	28	36	
3/16	1	2.5	32.5	42.5	
3/16	1	3	39	45	
3/16	1	4	44	56	
3/16	1	5	50	65	
3/16	1	6	60	72	
3/16	1.25	1.5	37.5	43.5	45
3/16	1.25	2	46	54	56
3/16	1.25	2.5	52.5	62.5	62.5
3/16	1.25	3	60	69	72
3/16	1.25	4	72	84	88
3/16	1.25	5	85	95	100
3/16	1.25	6	96	108	114

			Maximum Lateral Length (ft)		
Orifice	**Lateral**	**Orifice Spacing**	Pipe Material		
(inches)	(inches)	(feet)	**Schedule 40**	**Class 200**	**Class 160**
3/16	1.5	1.5	49.5	55.5	57
3/16	1.5	2	60	68	70
3/16	1.5	2.5	70	77.5	80
3/16	1.5	3	78	87	90
3/16	1.5	4	92	104	108
3/16	1.5	5	110	120	125
3/16	1.5	6	120	138	144
3/16	2	1.5	76.5	81	84
3/16	2	2	92	98	102
3/16	2	2.5	105	112.5	117.5
3/16	2	3	120	129	132
3/16	2	4	144	152	160
3/16	2	5	165	180	185
3/16	2	6	186	198	210
7/32	1	1.5	19.5	24	
7/32	1	2	24	30	
7/32	1	2.5	27.5	35	
7/32	1	3	30	39	
7/32	1	4	36	44	
7/32	1	5	45	55	
7/32	1	6	48	60	
7/32	1.25	1.5	31.5	36	37.5
7/32	1.25	2	38	44	46
7/32	1.25	2.5	42.5	50	52.5
7/32	1.25	3	48	57	60
7/32	1.25	4	60	68	72
7/32	1.25	5	70	80	80
7/32	1.25	6	78	90	90
7/32	1.5	1.5	40.5	45	46.5
7/32	1.5	2	50	54	56
7/32	1.5	2.5	57.5	62.5	65
7/32	1.5	3	63	72	75
7/32	1.5	4	76	88	88
7/32	1.5	5	90	100	105
7/32	1.5	6	102	114	114

			Maximum Lateral Length (ft)		
Orifice	**Lateral**	**Orifice Spacing**	Pipe Material		
(inches)	(inches)	(feet)	**Schedule 40**	**Class 200**	**Class 160**
7/32	2	1.5	63	66	69
7/32	2	2	76	80	84
7/32	2	2.5	87.5	92.5	95
7/32	2	3	99	105	108
7/32	2	4	116	124	132
7/32	2	5	135	145	150
7/32	2	6	156	162	168
1/4	1	1.5	16.5	21	
1/4	1	2	20	24	
1/4	1	2.5	22.5	27.5	
1/4	1	3	27	33	
1/4	1	4	32	40	
1/4	1	5	35	45	
1/4	1	6	42	48	
1/4	1.25	1.5	27	30	31.5
1/4	1.25	2	32	36	38
1/4	1.25	2.5	37.5	42.5	45
1/4	1.25	3	42	48	48
1/4	1.25	4	48	56	60
1/4	1.25	5	55	65	70
1/4	1.25	6	66	72	78
1/4	1.5	1.5	34.5	39	39
1/4	1.5	2	42	46	48
1/4	1.5	2.5	47.5	52.5	55
1/4	1.5	3	54	60	63
1/4	1.5	4	64	72	76
1/4	1.5	5	75	85	85
1/4	1.5	6	84	96	96
1/4	2	1.5	52.5	55.5	58.5
1/4	2	2	64	68	70
1/4	2	2.5	72.5	77.5	80
1/4	2	3	81	87	90
1/4	2	4	100	104	108
1/4	2	5	115	120	125
1/4	2	6	126	138	144

APPENDIX B-2

ORIFICE DISCHARGE RATE DESIGN AID

Orifice discharge rates can be calculated using Toricelli's equation:

$$Q = C_d\, A_o \sqrt{2gh}$$

Where: Q = the discharge rate in ft^3/sec
C_d = the discharge coefficient (unitless)
A_o= the cross sectional area of the orifice in ft^2
g = the acceleration due to gravity (32.2 ft/sec^2)
h = the residual pressure head at the orifice in ft

The formula shown above can be simplified for design purposes by incorporating the discharge coefficient and using conversion factors so that the discharge is given in gallons per minute and the orifice diameter is given in inches. The discharge coefficient depends on the characteristics of the orifice and is usually determined empirically. This value can range from 0.6 to 0.8 but a value of 0.6 was assumed for the purpose of this design aid. The formula therefore simplifies to:

$$Q = 11.79\, d^2 \sqrt{h}$$

Where: Q= the orifice discharge rate in gpm
d = the orifice diameter in inches
h = the residual pressure head at the orifice in feet

On the next page Table B-2 gives orifice discharge rates (in gpm) generated using the above formula for various residual pressures (head) and orifice diameters.

TABLE B-2

Orifice Discharge Rates (gpm)					
Head (ft)	Orifice Diameter (in)				
	1/8	5/32	3/16	7/32	1/4
2			0.59	0.80	1.04
3			0.72	0.98	1.28
4			0.83	1.13	1.47
5	0.41	0.64	0.93	1.26	1.65
6	0.45	0.71	1.02	1.38	1.80
7	0.49	0.76	1.10	1.49	1.95
8	0.52	0.81	1.17	1.60	2.08
9	0.55	0.86	1.24	1.69	2.21
10	0.58	0.91	1.31	1.78	2.33

For residuals greater than 10 feet or for orifice diameters greater than 1/4 inch, the equation must be used. This is also true if the residual pressure is not a whole number. For large systems use the equation and verify with Table B-2.

Note: Table B-2 was generated assuming that the minimum residual head at the distal orifice is 5 feet when orifices are 1/8 and 5/32 inch in diameter, and 2 feet for larger orifice diameters.

APPENDIX B-3

FRICTION LOSS DESIGN AID

Friction losses in pipes can be calculated using the Hazen-Williams formula:

Original form: $V = 1.318 * C * R^{0.63} * S^{0.54}$

Where: V = velocity (ft/sec)
C = Hazen-Williams flow coefficient (unitless)
R = hydraulic radius (ft^2/ft)[1]
S = slope of energy grade line (ft/1000 ft)

This equation can be modified through algebraic substitutions and using unit conversions to yield a formula that directly calculates friction loss[2]:

$$f = \frac{10.46L\ Q^{1.85}}{C^{1.85}\ D^{4.87}}$$

Where: f = friction loss (ft)
D = actual inside pipe diameter (in)
L = length of pipe (ft)
Q = flow (gpm)
C = Hazen-Williams flow coefficient (unitless)

The Hazen-Williams flow coefficient (C) depends on the roughness of the piping material. Flow coefficients for PVC pipe have been established by various researchers in a range of values from 155 to 165 for both new and used PVC pipe. A coefficient of C = 150 generally is considered to yield conservative results in the design of PVC piping systems.[3]

The equation shown above can be further simplified by assuming that only PVC pipe conforming to ASTM standard D-2241 (or D-1785 for Schedule 40 and Schedule 80 pipe) is used. With this assumption, the inside diameters ("D") for the various nominal pipe sizes can be determined and combined with all other constants to yield the following equation:

$$f = L\,(Q/K)^{1.85}$$

Where: f = friction loss through pipe (ft)
L = length of pipe (ft)
Q = flow (gpm)
K = Constant from Table B-3-1 (K can be determined for any PVC pipe conforming to the above ASTM standards using the equation $K=42.17*D^{2.63}$)

TABLE B-3-1

[1] Hydraulic radius = cross sectional area of the conduit divided by the inner perimeter of the conduit.
[2] Analysis of Pipe Flow Networks, Jeppson, Ann Arbor Science Publications, 1983 (p. 41).
[3] Handbook of PVC Pipe Design and Construction, 2nd Edition, Uni-Bell Plastic Pipe Association, 1982.

Table for Constant "K"			
Nominal Pipe Diameter	Schedule 40	Class 200	Class 160
1	47.8	66.5	
1.25	98.3	122.9	129.4
1.5	147.5	175.5	184.8
2	284.5	315.2	332.5
2.5	454.1	520.7	551.1
3	803.9	873.3	920.5
4	1642.9	1692.7	1783.9
6	4826.6	4677.4	4932

TABLE B-3-2. **Friction Loss for PVC Fittings**[1]

Equivalent Length of Pipe (feet) PVC Pipe Fittings				
Pipe Size (in)	90^o Elbow	45^o Elbow	Through Tee Run	Through Tee Branch
.5	1.5	0.8	1.0	4.0
.75	2.0	1.0	1.4	5.0
1	2.25	1.4	1.7	6.0
1.25	4.0	1.8	2.3	7.0
1.5	4.0	2.0	2.7	8.0
2	6.0	2.5	4.3	12.0
2 1/2	8.0	3.0	5.1	15.0
3	8.0	4.0	6.3	16.0
4	12.0	5.0	8.3	22.0
6	18.0	8.0	12.5	32.0
8	22.0	10.0	16.5	38.0

[1]From SPEC-DATA, Sheet 15, Plastic Pipe and Fitting Association, November 1994

APPENDIX B-4

MAXIMUM MANIFOLD LENGTHS

Tables B-4-1 and B-4-2 can be used to determine maximum manifold lengths for various manifold diameters, lateral discharge rates and lateral spacings. The method used to determine the table values is described below.

Pressurized distribution systems are designed to assure even distribution of effluent throughout the drainfield area. Even distribution maximizes the treatment capabilities and useful life of the drainfield. Completely uniform distribution is difficult or impossible to obtain because of friction losses that occur in all piping networks so we settle for a standard or acceptable variance in orifice discharges throughout the network. The maximum lateral lengths in Table B-1 were developed to assure there will be no more than a 10% variance (drop) in the discharge rates between the proximal and distal orifices in any given lateral. The maximum manifold lengths in the tables below were developed to assure there will be no more than a 15% variance in discharge rates between any two orifices in a given distribution system.

Two assumptions used to develop these tables are: (1) the maximum variance in orifice discharge rates within a network occurs between the proximal orifice in the first lateral connected to a manifold and the distal orifice on the last lateral connected to the manifold and (2) the friction loss that occurs between the proximal orifice of a lateral and the point where the lateral connects to the manifold is negligible.

Using the assumptions mentioned above a computer program was developed to calculate maximum manifold lengths for various manifold diameters, lateral discharge rates, and lateral spacings. The program assumes that the discharge rate at the distal orifice of the last lateral in a distribution system is as listed in Table B-2 for a given orifice size at the required minimum residual head. That value is multiplied by 1.1 and 1.15 to determine the maximum allowable discharge rates at the proximal orifices of the last and first laterals in the network, respectively. The residual head (h) that corresponds to those discharges was calculated by manipulating the orifice discharge equation in Appendix B-2 and solving for "h".

Using the simplified equation in Appendix B-3, the friction loss that occurs across the manifold was calculated for various materials and pipe diameters ("K"), lateral discharge rates ("Q") and lateral spacings ("L"). The program adds the friction loss calculated for successive pipe segments to the residual pressure, which corresponds to the proximal orifice discharge at the last lateral. The combined value is compared to the residual pressure at the proximal orifice of the first lateral until it is equal to or greater than this value.

Maximum manifold lengths were calculated as described above for various pipe materials and orifice diameters. Slightly greater manifold lengths were obtained when 1/8 and 5/32 inch orifices were assumed using 5 feet residual pressure at the distal orifice (see Table B-4-2). These tables were generated using Schedule 40 as the pipe material, which yields the most conservative results (shorter manifold lengths).

TABLE B-4-1
(For orifice diameters of 3/16 in. and up with minimum 2 feet of residual head)

Maximum Manifold Length (ft)

Lateral Discharge Rate (gpm/lateral)		Manifold Diameter (inches): 1 1/4						1 1/2						2						3						4						6					
Central Manifold	End Manifold	Lateral Spacing (ft): 2	3	4	6	8	10	2	3	4	6	8	10	2	3	4	6	8	10	2	3	4	6	8	10	2	3	4	6	8	10	2	3	4	6	8	10
5	10	4	6	4	6	8	10	6	6	8	12	8	10	10	12	16	18	24	20	22	27	32	42	48	60	34	45	52	72	80	90	72	93	112	144	176	200
10	20	2	3	4				2	3	4	6	8		6	6	8	12	8	10	12	15	20	24	32	30	22	27	32	42	48	60	46	57	72	90	112	120
15	30	2						2	3	4				4	6	4	6	8	10	10	12	12	18	24	20	16	21	24	30	40	40	34	45	52	66	80	90
20	40							2						2	3	4	6	8		8	9	12	12	16	20	12	18	20	24	32	30	28	36	44	54	64	80
25	50													2	3	4				6	9	8	12	16	10	10	15	16	18	24	30	24	30	36	48	56	60
30	60													2	3	4				6	6	8	6	8	10	10	12	16	18	24	20	22	27	32	42	48	60
35	70													2	3					4	6	8	6	8	10	8	12	12	18	16	20	18	24	28	36	40	50
40	80													2						4	6	4	6	8	10	8	9	12	12	16	20	18	21	28	36	40	40
45	90																			4	3	4	6	8	10	6	9	8	12	16	20	16	21	24	30	32	40
50	100																			4	3	4	6	8	10	6	9	8	12	16	10	14	18	24	30	32	40
55	110																			2	3	4	6	8		6	6	8	12	8	10	14	18	20	24	32	30
60	120																			2	3	4	6			6	6	8	12	8	10	12	15	20	24	32	30
65	130																			2	3	4	6			6	6	8	6	8	10	12	15	20	24	24	30
70	140																			2	3	4				4	6	8	6	8	10	12	15	16	24	24	30
75	150																			2	3	4				4	6	8	6	8	10	10	15	16	18	24	30
80	160																			2	3	4				4	6	4	6	8	10	10	12	16	18	24	30
85	170																			2	3					4	6	4	6	8	10	10	12	16	18	24	20
90	180																			2	3					4	3	4	6	8	10	10	12	12	18	24	20
95	190																			2	3					4	3	4	6	8	10	8	12	12	18	16	20
100	200																			2						4	3	4	6	8	10	8	12	12	18	16	20

Instructions: This Table can be used to determine maximum length of a given diameter manifold *or* to determine required minimum diameter for a given manifold length. Known values must include:

1) Manifold - lateral configuration (end or central)
2) Lateral discharge rate “Q” in gallons per minute
3) Lateral spacing in feet

Example A: Central manifold configuration, lateral discharge “Q” = 40 gpm, lateral spacing = 6 ft., manifold diameter = 4 inch; Maximum length = 12 ft.
Example B: End manifold configuration, lateral discharge “Q” = 30 gpm, lateral spacing = 6 ft., manifold length = 18 ft.; Minimum diameter = 3 inch

TABLE B-4-2
(for orifice diameters of 1/8 in. and 5/32 in. with minimum 5 feet of residual head)

Maximum Manifold Length (ft)																																					
Lateral Discharge Rate (gpm/lateral)		Manifold Diameter (inches)																																			
		1 1/4						1 1/2						2						3						4						6					
Central	End	Lateral Spacing (ft)																																			
Manifold	Manifold	2	3	4	6	8	10	2	3	4	6	8	10	2	3	4	6	8	10	2	3	4	6	8	10	2	3	4	6	8	10	2	3	4	6	8	10
5	10	6	9	8	12	16	10	8	12	12	18	16	20	14	18	20	30	32	40	30	39	48	60	72	80	48	63	76	96	120	130	100	129	156	204	240	280
10	20	4	3	4	6	8	10	4	6	8	6	8	10	8	12	12	18	16	20	18	24	28	36	40	50	30	39	48	60	72	80	64	81	100	126	152	180
15	30	2	3	4				4	3	4	6	8	10	6	6	8	12	8	10	14	18	20	24	32	30	22	30	36	42	56	60	48	63	76	96	112	130
20	40	2						2	3	4	6			4	6	8	6	8	10	12	15	16	18	24	30	18	24	28	36	40	50	40	51	60	78	96	110
25	50							2	3	4				4	6	4	6	8	10	10	12	12	18	16	20	16	21	24	30	40	40	34	45	52	66	80	90
30	60							2						4	3	4	6	8	10	8	9	12	12	16	20	14	18	20	24	32	40	30	39	48	60	72	80
35	70							2						2	3	4	6			8	9	12	12	16	20	12	15	20	24	24	30	26	36	40	54	64	70
40	80													2	3	4				6	9	8	12	16	10	12	15	16	18	24	30	24	30	36	48	56	70
45	90													2	3	4				6	6	8	12	8	10	10	12	16	18	24	20	22	30	36	42	56	60
50	100													2	3					6	6	8	6	8	10	10	12	12	18	24	20	20	27	32	42	48	60
55	110													2	3					4	6	8	6	8	10	8	12	12	18	16	20	20	24	28	36	48	50
60	120													2						4	6	8	6	8	10	8	9	12	12	16	20	18	24	28	36	40	50
65	130													2						4	6	4	6	8	10	8	9	12	12	16	20	18	21	28	36	40	50
70	140													2						4	6	4	6	8	10	8	9	12	12	16	20	16	21	24	30	40	40
75	150																			4	3	4	6	8	10	6	9	8	12	16	20	16	21	24	30	32	40
80	160																			4	3	4	6	8	10	6	9	8	12	16	10	14	18	24	30	32	40
85	170																			4	3	4	6	8		6	9	8	12	16	10	14	18	20	30	32	40
90	180																			2	3	4	6	8		6	6	8	12	8	10	14	18	20	24	32	30
95	190																			2	3	4	6	8		6	6	8	12	8	10	14	18	20	24	32	30
100	200																			2	3	4	6			6	6	8	12	8	10	12	15	20	24	32	30

Instructions: This Table can be used to determine maximum length of a given diameter manifold *or* to determine required minimum diameter for a given manifold length. Known values must include:

1) Manifold - lateral configuration (end or central)
2) Lateral discharge rate "Q" in gallons per minute
3) Lateral spacing in feet

Example A: Central manifold configuration, lateral discharge "Q" = 40 gpm, lateral spacing = 6 ft., manifold diameter = 4 inch; Maximum length = 18 ft.
Example B: End manifold configuration, lateral discharge "Q" = 30 gpm, lateral spacing = 6 ft., manifold length = 24 ft.; Minimum diameter = 3 inch

APPENDIX C

VOLUME OF PIPE (GALLONS PER FOOT)

	Type of Pipe		
Nominal Diameter (in)	PR 160	PR 200	Schedule 40
0.75		0.035	0.028
1	0.058	0.058	0.045
1.25	0.098	0.092	0.078
1.5	0.126	0.121	0.106
2	0.196	0.188	0.174
2.5	0.288	0.276	0.249
3	0.428	0.409	0.384
4	0.704	0.677	0.661
5	1.076	1.034	1.039
6	1.526	1.465	1.501
8	2.586	2.485	
10	4.018	3.861	
12	5.652	5.432	

APPENDIX D

DEFINITIONS

Alternative System means an on-site sewage system other than a conventional gravity system or a pressure distribution system. Properly operated and maintained, alternative systems provide equivalent or enhanced treatment performance compared to conventional gravity systems.

Approved list means "List of Approved Systems and Products" developed and maintained by the Department and Technical Advisory Committee. This document contains:
a. A list of proprietary devices approved by the RWQCB and/or Department;
b. List of specific systems meeting Treatment Standards 1 and 2;
c. List of experimental systems approved by the Department in consultation with the RWQCB; and
d. List of septic tanks, pump tanks, and holding tanks approved by the Department.

BOD_5 means biochemical oxygen demand, one of the commonly used indicators of waste strength.

Demand system means any system where the dosing frequency (or flow to a treatment or disposal component) is controlled by the volume of effluent flowing to the component. For a demand system utilizing pressure distribution, the pump turns on when sufficient volume (demand) flows into the tank causing the pump-on float to activate and a predetermined dose to be discharged to the treatment and/or disposal component which follows.

Drainfield means the treatment and disposal component of an OSS receiving effluent from a septic tank or other pretreatment device and transmitting it into native soil.

Drain rock means durable, clean, washed, non-deteriorating gravel free of organic materials and fines, and varying in size from 1/2 inch to 2 inches.

Effluent means liquid which is stored in and conveyed from an on-site sewage system component, such as a septic tank (septic tank effluent) or sand filter (sand filter effluent).

Fecal Coliform (bacteria) means coliform bacteria specifically originating from the intestines of warm-blooded animals, used as a potential indicator of groundwater and/or surface water pollution.

Infiltrative surface means (in drainfields) the drain rock-original soil interface at the bottom of the trench.

Influent means wastewater flowing into an on-site sewage system component such as a septic tank (septic tank influent) or sand filter (sand filter influent).

Laterals mean the small diameter pipes with orifices that distribute effluent within the drainfield trenches.

Manifold means the piping network connecting the transport line to the various laterals.

Proprietary device or method means a device or method classified as an alternative system, or a component thereof, held under a patent, trademark or copyright.

Pressure distribution system means an on-site sewage system consisting of a septic tank and a drainfield with pressure distribution of the effluent.

Pump tank means a tank or compartment for temporary storage of effluent following the septic tank or other pretreatment process and containing a pump and float switches.

Residential sewage means sewage having the constituency and strength typical of wastewater from domestic households.

Restrictive layer means a layer that impedes the movement of water, air, and growth of plant roots; including, but not limited to, groundwater, hardpan, clay pan, fragipan, compacted soils, bedrock, unstructured clay soils or unsuitable soils.

Septic tank means a water tight pretreatment receptacle receiving the discharge of sewage from a building sewer or sewers; and is designed and constructed to permit separation of settleable and floating solids from the liquid, and detention and digestion of the organic matter, prior to discharge of the liquid portion.

Sewage means urine, feces, and the water carrying human wastes; including kitchen, bath, and laundry wastes from residences, buildings, industrial establishments or other facilities.

Timer-controlled system means a pressure distribution system where the pump on and off times are regulated over time.

Transport line means the pipeline that connects the pump to the drainfield manifold.

TSS - Total suspended solids means a measurement of the solids that either float on the surface of, or are in suspension in water or wastewater, and often used in conjunction with BOD_5 to describe wastewater strength.

Vertical separation means the depth of unsaturated, native soil of Soil Types 1-6 between the bottom of a drainfield and the highest seasonal water table, a restrictive layer, or unsuitable soils.

Wastewater design flow means the volume of wastewater that a single-family residence or non-residential facility is expected to produce during peak operating flows and from which the drainfield is sized. For single-family residences, flows of 150 GPD (gallons per day) per bedroom shall be used for design purposes.