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AMERICAN "PERC-RITE®" DRIP DISPERSAL SYSTEMS

ENGINEERING DESIGN GUIDELINES

FOR

COMMUNITY AND COMMERCIAL SIZED DISPERSAL SYSTEMS

AMERICAN "PERC-RITE®" DRIP DISPERSAL

ENGINEERING & DESIGN GUIDELINES

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SECTION I

INTRODUCTION:

The *AMERICAN "PERC-RITE®" DRIP DISPERSAL SYSTEM* is a unique fluid handling system for dispersal of wastewater effluent into the soil. The system incorporates filtration, time, and level controlled application with ultra low rate drip distribution. Decentralized subsurface effluent dispersal system via Drip Distribution utilizing the patented American "Perc-Rite®" Drip Technology is ideal for communities, schools, churches, state parks and other commercial and large flow applications.

NOWRA DRIP STANDARD

NOWRA, the National Onsite Wastewater Recycling Association has developed a guidance that has the following scope. The entire document may be found in the Technical Information section of the American Engineering Catalog.

Recommended Guidance for Design of Wastewater Drip Dispersal Systems

1. SCOPE

1.1 Drip dispersal is a method used to distribute wastewater, which has received at least primary treatment, over an area of land for final polishing, reuse or recharge of groundwater. This method of dispersal is capable of uniformly distributing the wastewater effluent over large areas. It has been used in the U.S. for dispersal of preconditioned wastewater onto soil infiltrative surfaces since the late 1980's. Drip dispersal is frequently, but inappropriately, referred to as drip irrigation. Drip dispersal is seldom designed to meet the agronomic water requirements of a crop. Instead, it is usually designed to maximize infiltration of water into the soil throughout the year. Some of the dispersed water will evaporate or be transpired by vegetation during the growing season, but most will percolate into the soil and recharge the underlying groundwater. However, plant irrigation or other water reuse applications can be incorporated into the design.

1.2 This guidance describes the appropriate design, installation, operation, monitoring and maintenance practices that are necessary to assure the long-term performance of drip dispersal.

1.3 Site-specific engineered designs must be used. The owner may choose to specify a "pre-engineered" package that is appropriate for the site requirements; however using a pre-engineered package does not preclude the need for proper site-specific design.

SECTION II

PROCESS DESCRIPTION:

Following a minimum of the settling process in the treatment tanks, the wastewater is to collect in a final disposal pump chamber sized to hold a minimum storage for emergency and flow equalization, typically one half to three full days of working volume. The effluent will be time dosed via a four-float operating system. Two multi-stage submersible high head pumps or skid mounted centrifugal pumps are controlled by a "state of the art" "Siemens" PLC or "OPTO 22" controller. The effluent will undergo 115 micron disc filtration prior to final dispersal through pressure compensating emitters located every two feet on-center inside the ½ inch tubing, Netafim Bioline polyethylene pressure compensating dripper tubing.

The *“PERC-RITE®” Drip System* will accommodate almost any type of pretreatment process provided. Only primary treatment (the removal of large settleable solids) of sewage is necessary for the operation of this equipment. Additional treatment may be necessary to protect the receiving environment. The installation of the system will have minimal site impact and after installation there should be virtually no visible indications that the installation site is being used for disposal purposes.

SEQUENCE OF OPERATION:

The *AMERICAN “PERC-RITE®” DRIP DISPERSAL SYSTEM* is operated via a "state of the art" controller. Level sensing devices (standard mechanical differential float switches) located in a dosing tank downstream from the pretreatment process sense the rising level of effluent in the dosing tank, the controller will enable the timed disposal cycle and pump the effluent through 115 micron disc filters and then to final drip dispersal.

The pump control panel is equipped with four float switches to control the timed doses to be discharged. The four float switches, "Redundant Off", "Standard Dose Enable", “Peak/Level Indicator” and "High Level" function as follows:

- Redundant Off - The water level must be high enough to overcome the "Redundant Off" (first & bottom) float in order for the pump to be permitted to run.
- Standard Dose Enable - When the water level rises high enough to overcome the "Standard Dose Enable" (second) float and the time clock has timed out the preset time delay (rest time between dosing cycles), the pump will activate and the lead zone(s) is dosed. The pump will continue to run for the length of time required to disperse of the specified dose volume and then shut off. The pump will remain off until the internal time clock again times out the preset time delay which the pump will activate (as long as the "Standard Dose Enable" float is still up) and will run again until the specified volume is pumped. This process will repeat until the water level drops below the "Standard Dose Enable" float and the pump run timer has timed out.
- Peak / Level Indicator - Used to indicate level of effluent in final pump tank. This float may be used to increase the pumping frequency to design flow.
- High Level - If the water level rises enough to overcome the "High Level" (fourth) float, the audiovisual alarm will activate (if applicable). The audio portion of the alarm may be silenced by pressing the Test-Normal-Silence switch (located on the outside of the control panel) to the silence position. The alarm circuit will latch until manually reset after the "High Level" float returns to its normal (down) position. The alarm circuit is manually reset by switching the High Level Reset/Off-Normal switch (located inside the control panel on the inner door) to the Reset position and then back to Normal position.

DISC FILTRATION:

The pumps deliver unfiltered effluent to each of the 115-micron Arkal Disc filters during the normal forward filtration process. Per program, each system goes through a backflush cycle to clean the filters. The filter backflushing schedule is automatically triggered after a specified volume passes forward through the flow meter, or after a specified differential pressure reading is detected between the upstream and downstream gauges, or based on time. One filter valve closes, thus blocking the flow of unfiltered effluent to that filter. The filtered effluent from the operating filter(s) is directed to the outlet manifold to clean the backwashing filter. Filtered water from the outlet manifold flows in reverse direction through the spine of the filter and into the backflush nozzles, spinning the loosened discs and flushing the captured debris out the drain manifold. The accumulated impurities discharge back into the pretreatment unit. The backflush procedure lasts approximately fifteen to thirty seconds then the back flushing valve closes. Only after the first filter has completed its backflushing cycle, will the next filter begin its cycle of backflushing in the same manner as the first. The sequence repeats until all the filters have been backflushed. Effluent will then again be pumped through clean disc filters, then through the flow meter and finally through the outlet manifold to the drip field supply line.

DRIP TUBING:

The American “Perc-Rite®” Drip system utilizes Netafim Bioline pressure compensating dripperline for wastewater. The tubing is nominal 0.61 gallons per hour (+/- 5% flow rate from 7 to 70 psi). The tubing functions as a turbulent flow emitter between 0 and 7 psi, ensuring that the nominal design flow is not exceeded at system startup. Tubing end connections and splice connections are manufactured specifically for the tubing and for connection to standard schedule 40 NPT adapters. Emitters are typically spaced every 2.0 ft on center inside the drip tubing.

ZONE DOSING & FORWARD FLUSHING:

Each system will be divided into isolated drip zones and automatically alternate zone doses after the preset rest times are timed out (provided enough effluent is in the pump chamber). Each drip zone will automatically undergo a periodic “Forward Field Flush” every 25 cycles or 15 days (adjustable), whichever occurs first, to scour the inside of the dripper tubing. Forward field flushing is accomplished by automatically opening a 24v automatic zone return valve to allow effluent to return to the head of the system after passing through the drip field. Zones are flushed individually. American Manufacturing follows generally accepted standard engineering requirements for scouring velocity of 2.0 ft/sec. 1.6 gpm per distal lateral connection is provided to achieve minimum scouring velocity of two (2.0) feet per second at the distal end of each lateral. Flushing volume is to be a minimum of three and one half times the volume of the drip tubing plus the volume of any shallow manifolds that may be designed to drain after each. Please note that emitters continue dripping during “forward field flush” events therefore pump and filtration unit sizing will must take into consideration both the zone dose flow and zone flushing flow.

Zones are dosed either individually or two at a time (dual zone dosing). Dual zone dosing systems are typically designed with an even number of zones. Dual zone dosing cuts pump run time in half reducing energy requirements, increasing pump life and it allows the pumps to operate more efficiently as the pumps are sized at nearly the same operating point for individual zone forward field flushing and dual zone dosing. Dose volumes may be as low as three and one half times the volume of dripper tubing volume of the zone being dosed. This is to insure adequate dose time under complete pressurization. Dose volumes too large (greater than 10x volume of drip tubing) may defeat the concept of “low volume, timed dosing” and increase the instantaneous loading. Smaller frequent doses promote unsaturated conditions but if too short (or low of volume) may result in unequal distribution and excess overloading of portions of the dispersal fields. Pump selection must take into consideration the system curve requirements for disc filter backflushing, zone dosing, and forward field flushing of the emitters making sure no hardware pressure ratings are exceeded. If the dosing residual pressure is greater than 40-50 psi, a pressure regulator will be required after the filtration unit but prior to the drip fields.

GENERAL DRIP DESIGN CRITERIA & SYSTEM STANDARDS

CRITERIA		STANDARD
I.	PRETREATMENT OF EFFLUENT	
	1. Domestic	septic effluent or better
	2. BOD	no clogging of downstream (components or soil)
	3. Grease	no clogging of downstream (components or soil)
	4. Solids	no clogging of downstream (components or soil)
	5. Flow Rate	do not exceed capacity of downstream (components or soil)
II.	MECHANICAL FILTRATION (downstream filters)	
	1. Solid size allowed	4 :1 emitter orifice size to filtrate particle size
	2. Automatic self flushing	return backflush to treatment tank with provision made to minimize disturbance of solids pretreatment process ,operate filters to manufacturers specification.
III.	FIELD FLUSHING	
	1. Supply pipe velocity	maintain 2 feet per second scouring velocity in supply line.
	2. Periodically forward flushing drip line	operation at 2 feet per second at distal to scour tubing handled in public safe manner.
	3. Frequency	per manufacturer, biweekly to semi annual with regard to water quality.
IV.	DRIPPER TUBING LOADING RATES	
	1. Grease	no clogging of soil
	2. Solids	no clogging of emitters
	3. Flow Rate	no clogging of soil
	4. BOD	no clogging of soil
	5. emitter flow variation	max 10% variation in flow between any two emitters in any separately dosed zone.
	6. Draindown limits	loading rate not to exceed soil recommended rates including total daily dosing.
V.	STAND OFF	
	1. Ground Surface septic	covered
	2. Ground surface treated	uncovered
	3. Water table septic	12"
	4. Water table treated	none
	5. Restrictive layer	12" or special design
	6. Separation	tubing installed is typically 24" O.C. minimum (no maximum)
* Note all standoffs to meet applicable state code criteria for conventional drainfields.		
VI.	INSTALLATION AND TESTING	
	1. Tubing	Trenched, plowed, or excavated or special procedure for ultra shallow.
	2. Clean tubing	flushed clean of construction debris, w/ clean water
	3. Leaks	no non-emitter leaks tubing, fittings or supply piping
	4. Flow rate	Normal dosing and flushing flow rates and flushing pressure at the ends of each zone supply and return manifold shall be measured and determined to be in accordance with design criteria.
	5. Equipment	All mechanical components, pumps, pump cycling, filters, filter flushing, high water alarm, and other systems, must be demonstrated to be fully operable in accordance with their design.
	6. Air Release	Air release shall be provided for each drip zone for drainage of normally open emitters after each dose.
VII.	OPERATION	
	1. Automatic dosing	automatic if no operator on site
	2. Flow equalization required	timer enable float and time dosed
	3. Alarms	high water and other as needed for specific site
	4. Monitoring	a) periodic if active process failure causes system damage or high risk to health or environment. b) for repair only if passive and low risk to health & environment.
	5. Optional remote monitoring	a) remote if nonresidential and no operator on site. b) remote if restrictive site & high risk of surfacing
	6. Storage	½ day to 1 day storage between enable & alarm

SECTION III

SITE EVALUATION

SOIL AND SITING CONSIDERATIONS

The size of the required dispersal area will be determined by the design peak daily flow and the soils application rate provided by a qualified soils scientist and / or hydrogeologist. Typically systems greater than 10,000 gpd may be required to undergo in-depth groundwater mounding analysis and / or mass nutrient loading calculations as well as additional infiltration testing. States may have extensive, limited, or no guidance in the siting and design of large flow land based systems.

Loading rates should not be assigned based on textural classes alone. The characterization of a soil based receiver site involves a systematic evaluation by trained individuals. Factors to consider consist of a variety of topographic and soil conditions such as regional hydrology and landscape position, slope, soil depth, soil texture / structure, depth to water table, depth to restriction, soil consistence, clay mineralogy, compaction, density, and site uniformity. At minimum, characterization of the soils should consider features 2-4' + below the point of infiltration.

Infiltration rate estimates based on texture essentially are an indicator of the general status of the total amount of macro pores that would allow water to freely pass through the soil. The macro pores also provide conduits for gas exchange with the surface. The amount, depth, and distribution of macro pores within a soil matrix is very important for performance of any on site system for the soil to efficiently treat and dispose of effluent.

Secondary factors in texture status such as void reduction (increase in density) by compaction, or enhancement by natural soil ped structure development need consideration.

Caution should be exercised when depending upon soil structure to increase loading rates beyond those that may be estimated by texture. The influence of the secondary voids may not extend deep enough to provide the reaeration necessary for efficient biological treatment of the residual organic constituent of the wastewater.

Compaction by even minimum construction activity will always impact or could severely destroy soil structure. These considerations are very important in the case of the find sands and clayey textures and the characteristics shallow installations.

The loading rate and system configuration should consider a site / soil assessment and be based on an estimate of vertical and horizontal subsurface water movement over / through a limitation.

Typical prescriptive loading rates are maximum values addressing infiltrative capacity**. Landscape linear load** determination and application mitigates the hydraulics of dispersal over shallow limitations in small flows. Large flow systems present similar hydrologic conditions that need to be considered. Application of typical landscape linear loading guidelines is difficult (if not impossible) to achieve in large flows.

An effort should be made to avoid concentration of the adsorption fields in one area. Stretching the system along contour as much as possible (avoid zone stacking) to reduce landscape linear loading as well as placement of "pods" of zones in differing landforms will enhance the hydraulic dispersal of the effluent on the landscape. Typically, begin the loading rate determination process by sizing the foot print of a conventional in ground system and adjust accordingly with justification. **For sizing, the footprint is the trench bottom loading rate (gal. / ft^2 / day) divided by three (if 3 trenches are used).**

Generally, deep soils with sandy and loamy textures should not be loaded at any greater than 2" per week or .18 gal/ft^2/day. The clay loams or shallow to limitation sites should not be loaded at any greater than 1" per week or .09 gal/ft^2/day. Loading rates of 1/2" per week or .05 gal/ft$_2$/day are indicated in the most severe sites.

Very deep, coarse, freely draining soils, have been loaded at rates greater than 11" per week or 1 gal/ft$_2$/day after extensive evaluation, testing, and groundwater modeling.

Depth of soil, slope, site landscape linear load, hydraulic conductivity testing of restrictions below the point of infiltration, bedrock permeability, water mounding, and further subsurface geohydrologic investigation may allow for the increase (or reduction) of these loading rates.

When properly sited, drip disposal provides aerobic unsaturated flow conditions at the contact with the soil interface. Saturation of the soil voids should be for brief periods during or directly after dosing. In a typical situation, dose volumes per emitter per dose events are approximately .1 - .25 gallon per dose depending upon the instantaneous dose capacity of the soil and the zone dose volume necessary to provide equal distribution.

At these small volumes, water movement may be primarily influenced by matric (capillary or suction) forces within the soil in addition to, or preceding, downward (or lateral) gravity flow. The result is the retainment of the effluent from the point of distribution, outward and upward such that a drip disposal system can be considered a method of surface disposal within the upper soil horizons. Coupled with time dosing at regular intervals, aerobic conditions are maintained and a nearly static environment is created for the microbial population. The soil treatment system essentially functions as a trickling filter with a film flow condition over the surface of the soil aggregate as the effluent moves within the soil column.

SECTION IV

DISPERSAL AREA SIZING:

The size of the required dispersal area will be determined by the daily design flow and the soils application rate provided by a qualified soils scientist and / or hydrogeologist. Typically systems greater than 10,000 gpd may be required to undergo in-depth groundwater mounding analysis and / or mass nutrient loading calculations as well as additional infiltration testing.

An effort should be made to avoid concentration of the absorption fields in one area. Stretching the system along contour as much as possible (avoid zone stacking) to reduce landscape linear loading as well as placement of "pods" of zones in differing landforms will enhance the hydraulic dispersal of the effluent on the landscape.

Please note that the American "Perc-Rite®" system claims no effluent treatment and suggests that any effluent quality requirements be addressed prior to final dispersal or in the soil after dispersal. The micron disc filtration on our hydraulic unit is for the sole purpose of protecting the drip tubing emitters and network.

Typical designs call for drip tubing to be spaced 1.5 feet to 3.0 feet on center (2.0' o.c. is most common) although site conditions and applications may dictate closer or farther apart spacing. It is very important to keep the drip tubing along contour so spacing may change as contours change from manifolds to distal ends. When designing on sloping sites and treed sites 2.0 - 3.0 feet on center is more realistic so the system installer has adequate room to make field adjustments (i.e. maneuvering around rocks, trees, etc.). Flatter sites may lend itself to closer spacing but the area requirement should not be compromised.

The typical design methodology for an single family home or other small flow system provides that the minimum amount of tubing required as being determined by the square footage of the absorption area divided by two, indicating a two foot spacing.

This criterion is a good starting point. However, in the case of larger flows, as a fluid handling system applied as a subsurface or slow rate land application system, the amount of tubing maybe further determined by a variety of factors. These considerations include the actual flows, the loading rate, pump run times, instantaneous dose to the soil, the zone dosing regime, and other variables.

An example would be a large flow system installed in a soil with a very low loading rate. Tubing separations of 3' or more maybe indicated based on project analysis and considerations of the above outline factors. Conversely, a system in a deep, coarse soil material may indicate an increased amount of tubing.

COMPONENT SIZING:

Standard American "Perc-Rite®" skid mounted filtration units range from 25 gpm (ASD25) to 250 gpm (ASD250) with 25, 40, 60, 90, 120, 150, 200 and 250 gpm units readily available. This does not mean that for example the 250 gpm unit actually runs at 250 gpm continually, rather a total daily pump run time of 20-50% is targeted <u>when utilizing "dual zone" dosing</u>. This enables rest times for the soil, and maintenance time for pumps controls, etc. plus will allow the system to catch up in the event more than the normal flow has been stored for dispersal.

Example: 50,000 gpd daily peak flow. Check run time for 40 gpm unit (ASD40):
50,000 gpd / 40 gpm / 1440 min/day = 86% RUN TIME AT PEAK CAPACITY

This leaves little time for routine disc filter backwashing or general maintenance events. This flow rate relates to dosing from 2% to 13% of the total dispersal area at a time.

Check run time for 90 gpm unit (ASD90):
50,000 gpd / 90 gpm / 1440 min/day = 39% RUN TIME AT CAPACITY

This falls within the desired range of 20-50% run time and allows ample time for zone resting, routine disc filter backwashing and/or general maintenance events. This flow rate relates to dosing from 5% to 17% of the total dispersal area at a time. *Please note that the ASD120 (29% run time) and the ASD150 (23% run time) also fall within the desired range and are options to be considered. This does require siting larger zones.*

Most designs will have more than one appropriate ASD model filtration unit. Choosing between multiple options involves examining site layout, costs of each option and future expansion requirements (if applicable). American Manufacturing Company can assist in evaluating these many options.

The model number indicators for the ASD units also represent the filtering volume capacity of each filter battery. From this flow volume the amount of tubing and the number of laterals is calculated that can be properly flushed at a minimum of 2 ft/sec at the distal end of each lateral. Typical zone details for each ASD model along with typical component quantities are provided in a later section. A quick summary reference is as follows:

TYPICAL ZONE DYNAMICS
(assuming 300' laterals)

ASD Model No.	Linear Feet of Drip Tubing	Dose Flow (gpm)	No. of Lateral Connections	Flushing Flow (gpm)	Total Flow Required (gpm)
ASD25 - 25 gpm	2400	12.2	8	12.8	25.0
ASD40 - 40 gpm	3600	18.3	12	19.2	37.5
ASD60 - 60 gpm	5400	27.5	18	28.8	56.3
ASD90 - 90 gpm	8400	42.7	28	44.8	87.5
ASD120 - 120 gpm	11100	56.4	37	59.2	115.6
ASD150 - 150 gpm	13800	70.2	46	73.6	143.8
ASD200 - 200 gpm	18600	94.6	62	99.2	193.8
ASD250 - 250 gpm	23100	117.4	77	123.2	240.6

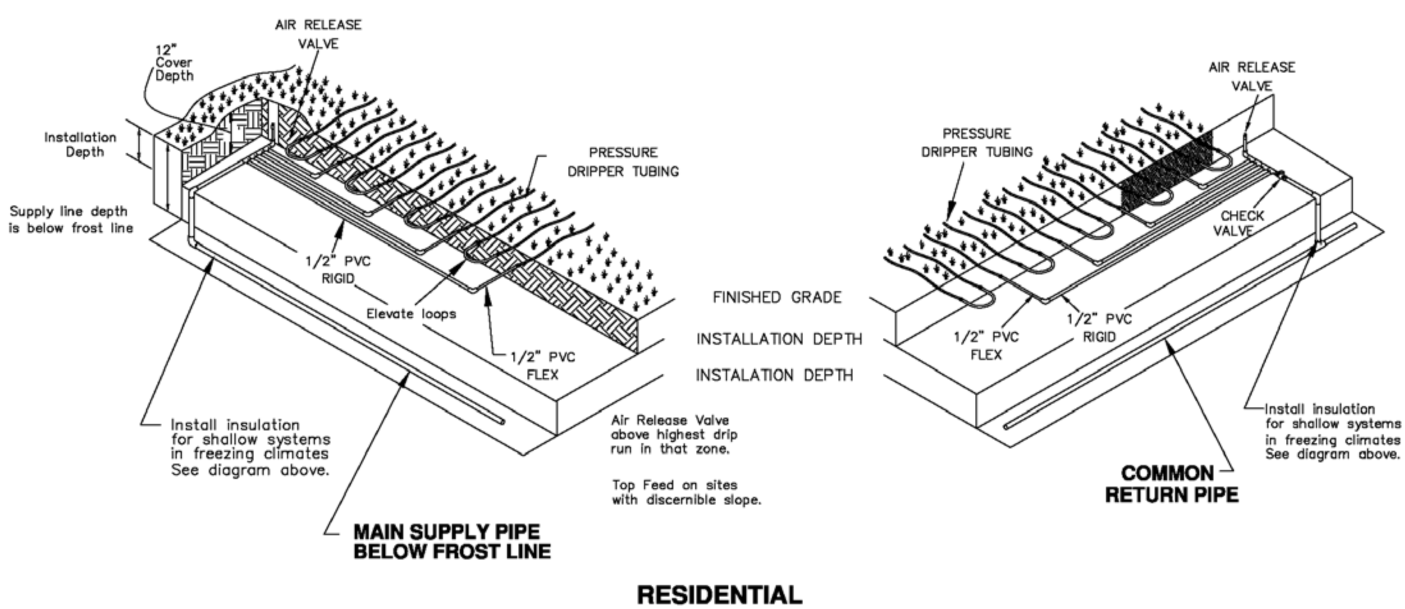
Larger models are available upon request. Please note that zones of all shapes and sizes are common and can be incorporated into each model provided it can be flushed properly with the specified ASD unit.

A length of drip tubing across the contour is identified as a **"run"**. A series of connected runs that start at the supply manifold and terminate into the return manifold is identified as a **"lateral"**. Lateral lengths of 300' are common. Longer laterals can be accommodated but should be discussed with American Manufacturing as head loss through the laterals during flushing increase exponentially. A group of laterals dosed at the same time are a **"Zone"**. It is encouraged that lateral lengths within a zone remain as close to each other in size as possible to ensure equal flushing. Zones within a system may be of different sizes but zones too large or with too many lateral connections may not be able to be flushed properly. Over pressurizing a zone too small must also be considered.

Top Feed Manifolds and Run Length:

Top feed manifolds are used whenever any discernable slope is encountered in any zone. The alternative is side feed manifolds which on sloping sites enable **"draindown"** which will overload the lower most laterals in a zone after the pump shuts off. Draindown in the draining of manifolds and upper zone laterals into the lower laterals after each dose.

TOP FEED MANIFOLD



RESIDENTIAL
Patent No. 5,984,574

The maximum number of laterals within a sub-zone may also be affected by the tubing spacing in that sub-zone. There are top-feed manifolds placed at the high point of each sub-zone that are connected to 3/4" lateral feeds or 1/2" lateral returns. The 3/4" dia. and 1/2" dia. SCH40 PVC lateral feeds and returns are positioned to drain into the drip tubing upon the completion of each dose (pump shut off) and to prevent the drain down of upper to lower laterals. It is recommended that the 3/4" and 1/2" lateral feeds and returns **not exceed 50 feet** length down the slope. Longer lengths may begin to defeat their original purpose.

Sub-Zones: Zones may be split into sub-zones. However, they are still part of the same zone and controlled by a single 24v zone Control Valve. Sub-zones within a zone are designed to minimize construction cost and have the ability to be manually isolated from the remainder of the zone for repair or maintenance without taking the entire zone out of service. Sub-zones within a zone may consist of various amounts of drip tubing, number of laterals, and number of runs. However, they still must maintain nearly the same run lengths and lateral constraints listed above.

SUPPLY & RETURN MANIFOLD LENGTHS (ft)
For tubing spacing 2' O.C.

MODELS	Maximum Zone (ft.)	150' Full Zone Manifold	Contour 1/2 Zone Manifold	100' Full Zone Manifold	Contour 1/2 Zone Manifold	75' Full Zone Manifold	Contour 1/2 Zone Manifold
ASD-25	*2,400*	*32*	*16*	*48*	*24*	*64*	*32*
ASD-40	*3,600*	*48*	*24*	*72*	*36*	*96*	*48*
ASD-60	*5,400*	*72*	*36*	*108*	*54*	*144*	*72*
ASD-90	*8,400*	*112*	*56*	*168*	*84*	*224*	*112*
ASD-120	*11,100*	*148*	*74*	*222*	*111*	*296*	*148*
ASD-150	*13,800*	*184*	*92*	*276*	*138*	*368*	*184*
ASD-200	*18,600*	*248*	*124*	*372*	*186*	*496*	*248*
ASD-250	*23,100*	*308*	*154*	*462*	*231*	*616*	*308*

DOSING & FORWARD FLUSH FLOW RATES:

Zone sizing and layout are critical design factors since pump sizing is based on dosing, flushing, and filter cleaning. The following example shows how to calculate zone flushing. The example illustrate how in large systems most designs provide for dosing two zones at a time and flushing one zone at a time.

Example: ASD60 - 60 gpm. Typical Zone has approximately 5400 l.f. and 18 - 300' laterals.

Dose Flow: (5400 l.f. / 2.0' o.c. emitter spacing) x (0.61 gph / 60 min/hr) = 27.5 gpm

Flush Flow: 18 lateral connections x 1.6 gpm/connection = 28.8 gpm

Total Flow Required: 27.5 gpm + 28.8 gpm = 56.3 gpm

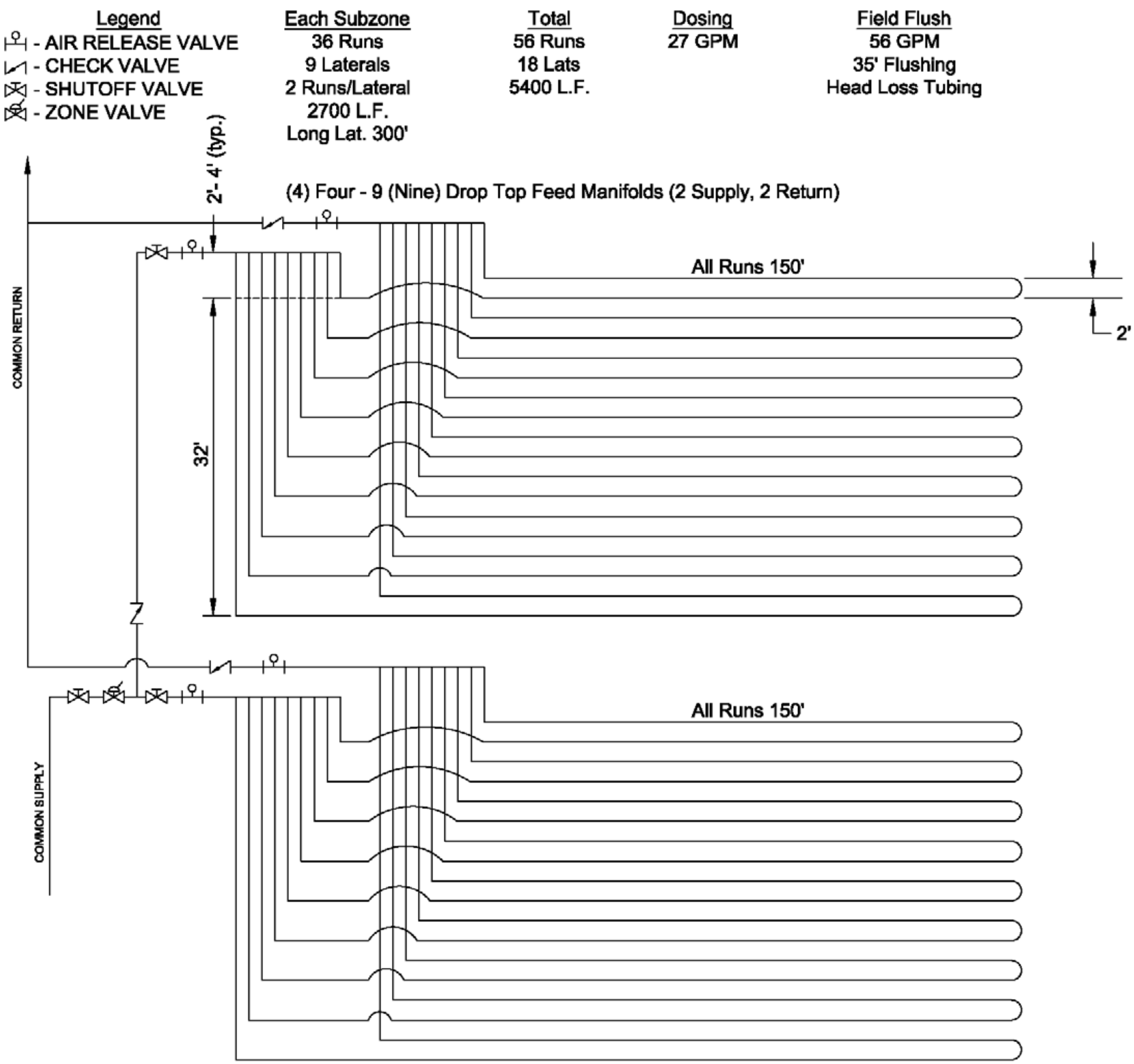
** 1.6 gpm equals 2.0 ft/sec inside ½ drip tubing (0.57 actual inside dia.)*

ZONE LAYOUT TECHNIQUES:

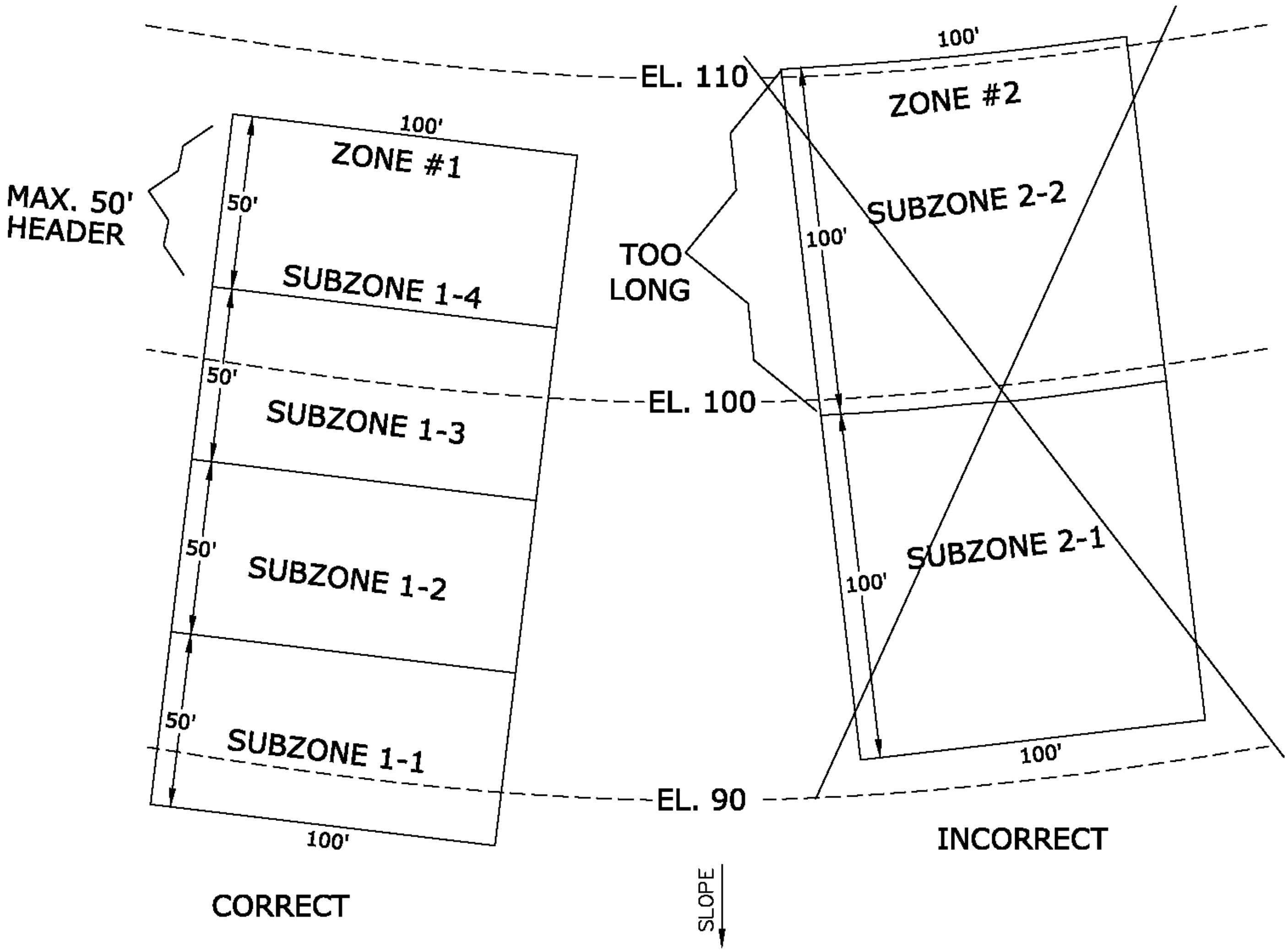
The results of the site and soil evaluation should be information to delineate suitable soil areas on contour for the project. Experienced site evaluators will layout areas on contour showing the width across contour, typically from 75' up to 300'. Long runs of 300 feet are not common but are possible in some landscapes. The available distance down slope will also be provided.

Based on the preliminary evaluation of the Perc-Rite system sizing, zone details need to be developed to fit into the landscape. For example, if it has been determined to use a 60 gallon per minute system, then zones must be developed for the landscape that do not exceed 5,400 linear feet. Reference the "Supply & Return manifold lengths" Table. This table shows the manifold lengths for 2 foot run spacing for the various typical contours and the available systems sizes. For a 60 gpm unit and 150 feet across contour, with two sub zones the manifold lengths are 36 Feet.

ASD 60 - 5400 Linear Feet



SUBZONES



“Top Feed Manifolds” should be utilized on all sites with discernable slope. When using “Top Feed Manifolds”, zones should be broken into subzones with no subzone header being longer than 50’. The above schematics show zone #1 correctly being broken into multiple zubzones with headers no longer than 50’. The schematic also shows zone #2 incorrectly being broken into subzones with 100’ header.

SCALE: 1’ = 50’ ±

SECTION V

DESIGN CALCULATIONS

OPERATING POINTS & SYSTEM HEADLOSS:

There are three operating points to consider:

I. Single zone forward field flush (typically every 15-25 cycles or every 15 days)
II. Single or dual zone dose flow (typically 3-5 doses/day/zone)
III. Disc Filter Backflush (at preset volumes, times, or pressure differential)

When calculating headloss American suggests taking the worst case scenarios to ensure proper flushing. For example 50’ of equivalent length is added to most pipe lengths to more than compensate for minor losses. Velocity head is typically so small it is negligible.

I. Items to consider when calculating Forward Field Flushing requirements are as follows:

1. TDH from pump to Hydraulic Unit (or suction lift to pumps on H.U.).
2. Loss through the Hydraulic Unit.
3. Loss in supply force main to drip zones.
4. Loss through 24v zone valve assembly.
5. Loss through zone supply manifolds.
6. Loss through longest drip lateral in zone (from mfg. chart).
7. Static lift.
7. Loss through return manifolds.
8. Loss through common zone return line.

II. Items to consider when calculating Single or Dual Zone Dosing requirements are as follows:

1. TDH from pump to Hydraulic Unit (or suction lift to pumps on H.U.).
2. Loss through the Hydraulic Unit.
3. Loss in supply force main to drip zones.
4. Loss through 24v zone valve assembly.
5. Loss through zone supply manifolds.
6. Loss through longest drip lateral in zone (from mfg. chart).
7. Static lift.

Residual pressure at emitters must be calculated to verify it is within proper operating range (7-70 psi).

III. Items to consider when calculating Disc Filter Backflushing requirements are as follows:

1. TDH from pump to Hydraulic Unit (or suction lift to pumps on H.U.).
2. Backflush pressure at filter unit (typically 50 psi).
3. Loss in return line.

* Note: Loss in return is typically negligible since it is suggested to have a gravity return line from H.U. Back to head of system. If not gravity then TDH in return line must be considered.

An example headloss and system calculation sheet is included as an attachment. Please contact American Manufacturing for assistance in headloss calculations and proper pump sizing and specification.

Design Calculations

The designer must run design calculations in order to lay out the system in the field and after the system is laid out to determine if the hardware components of the system will function properly. These calculations are for the most part the same as typically performed during the design of wastewater treatment or pumping facilities.

Size of Absorption Area

The total amount of absorption area required generally depends on two factors, the daily wastewater load of the facility being serviced by the system and the absorption capacity and treatment ability of the soil.

Demand analysis: Calculate the design flow.

Example: Flow = 360 gpd per home x 60 Homes = 21,600 Gallons per Day Design Flow

Soil Loading Rate: Determine the soil loading rate.

A field evaluation of the soils at the site must be completed by a qualified person, such as a soil scientist as described in section II. The site evaluator should determine the soil loading rate and the depth of installation. The calculations are performed with the soil loading rate.

Example: Area = 21,000 gpd / 0.1 gpd per sq. ft. area = 216,000 square feet of required area.

Linear feet of tubing: Compute total tubing necessary for the absorption field.

Tubing necessary = Area / 2 = (Daily Flow / AREA Loading Rate) / 2 = Linear Feet
Tubing necessary = (21,000 GPD / 0.1 gal./day/ft^2) / 2 = 108,000 Linear Feet

Determine Layout: Determine layout of the dripper line absorption field.

It must be determined through the designer's system evaluation if larger or smaller zones are the best suited for the site. Zone control is typically incremented in groups of four (4). For example:

108,000 linear feet / 4 = 27,000 linear feet per zone (250 (+) gpm filtration unit)
108,000 linear feet / 16 = 6,750 linear feet per zone (90 (-) gpm filtration unit)

Keep each individual dripper line lateral length the same length in each zone. Attempt to provide 300 linear feet per lateral from its connection to the supply manifold to its connection to the return flush manifold. Always configure the system supply line to *feed using top feed manifolds* and supply and return *from the highest* elevations. When running a continuous dripper line, it may turn and make a loop or series of loops back to the return flush line before making a connection. Feed each lateral from the lower elevation from the top feed manifold. Call American for assistance in zone layout.

Determine Zone Operating Conditions: Calculate Dosing and Flushing flows

108,000 linear feet / 16 = 6,750 linear feet per zone
6750 linear feet per zone / 300 linear feet per lateral = 22.5 laterals,
(Use 24 laterals, 8 laterals per sub zone.)
24 laterals X 300 linear feet per lateral = 7200 linear feet per zone.
7200 feet / 2 = 3600 emitter
3600 X .61 gallons per hour per emitter / 60 minutes per hour = 36.6 Gallons per minute Dosing
24 laterals X 1.6 gpm per lateral flushing rate = 38.4 gpm for Flushing
Dosing + Flushing = 36.6 + 38.4 = 75 gpm total flow required.
Reference "Zone Dynamics Table" and select an ASD90, 90 gpm filtration unit.

<u>Determine Pump Operating Conditions:</u> Calculate Systems Head Curves

The pump must be able to properly operate under three conditions. First calculate the head loss during field flushing. Second determine pump requirements for backwashing the disc filters. Third, determine if pump will dose one or two zones at a time and in all cases it will not over pressurize the piping network and operate each process according to design. American Manufacturing can assist in this determination.

<u>Size of Pump/Dosing Tanks</u>

The pumping tank should provide flow equalization and emergency storage. The designer should determine the backup requirements for mechanical equipment and therefore how much storage is appropriate for a specific site. Typical demand pumping stations require an operating volume determined by pump run times and storage determined by the operators response time in case of mechanical failure. A drip dispersal system is a pump system with filtration. Typical storage requirements range from one half (1/2) to a full day storage for flow equalization. Emergency storage due to a catastrophic mechanical event varies and could be evaluated in the same manner as pump systems servicing similar facilities in the region.

Example: For a 21,600 GPD waste flow.
Volume of Pumping Tank = 21,600 Gallons x 1/2 = 10,800 Gallons operating volume.
Volume for emergency storage = ½ day X 21,600 = 10,800 Gallons Storage volume
Total Tank Volume = Operating Volume + Emergency Storage Volume = 21,600 Gallons

Equalization operating volume may be further enhanced in consideration of conveyance system storage and pretreatment process equalization.

<u>SECTION VI</u>

Drip Dispersal Installation & Construction Techniques

<u>General Layout Requirements Drip System</u>

The tanks, treatment units and distribution fields are subject to set back regulations to keep required distances from wells, property lines building foundations and bodies of water according to local regulations. Prevent damage to distribution areas by traffic and follow plans, which should be provided for all larger systems.

<u>Site Preparation</u>

On sites where a majority of the vegetation needs to be removed, care must be taken to minimize the impact on the soils natural permeability. Clearing and removal should be by hand, with minimal machine assistance, under optimum soil moisture conditions. Track machines are preferred to those with rubber tires. Soil moisture conditions need to be confirmed prior to beginning clearing and system installation by the soil scientist of record.

NOTE: ***The preservation of the original structure of the soil in the absorption area is essential to maintaining the percolative capacity of the soil. No activity other than the construction of the system is permitted within the absorption area.***

The absorption system is not to be constructed during periods of wet weather when the soil is sufficiently wet at the depth of installation to exceed its plastic limit. The plastic limit is exceeded when the soil can be rolled between the palms of the hands to produce threads 1/8 inch in diameter without breaking and crumbling.

All trees and brush, as necessary, should be cut flush with the ground surface. Depending upon the density of the root zone, there maybe a need to grub out the smaller stumps. The grub tooth depth should not exceed 12”.

Grubbing pulls and tears out the stumps, with digging and pushing being more detrimental to the soils infiltrative characteristics. Selective grubbing of the site coupled with chisel plowing, and raking is required prior to the establishment of turf. Once cleared, seed the area liberally with native grasses. The standard VDOT specification is acceptable consisting of perennial rye and fescue.

Larger stumps may remain or if there are many, ground out as necessary.

There is to be no cutting, filling, or storage of material on or within 20’ of the adsorption areas

Topography

The dripper tubing should be placed on contour. Dripper tubing along any given lateral should not be off grade by more than 6" in 100 feet. Tubing installed on sloping sites should have Top Feed manifolds for supply and return and with sub zones per design to minimize draindown which may overload the down slope laterals. Since pressure compensating dripper emission rates are consistent at varying pressures, no special design requirements are needed to ensure proper soil loading rates.

The filtration unit must be positioned to allow the backflush and field flush water to be discharged back to the treatment tank with minimum backpressure. The waste line from the filter unit is recommended to be gravity. If this line needs to go up hill or is over 30' long a special design may be necessary. Call American for special design considerations.

Each zone should be fed from the lowest elevation top feed manifold of the zone and the air release should be placed at the highest elevation. Accumulate the return manifold piping to a common return line to save pipe costs.

General Installation Information Requirements Summary

The site layout will determine those items of information needed. The installation contractor should be familiar with the following information in order to prove proper installation and operation of the system after installation:

1. NUMBER OF ZONES
2. LATERAL CONNECTIONS IN EACH ZONE
3. GPM PER ZONE BOTH DOSING AND FLUSHING
4. FILTER BACKWASHING REQUIREMENTS

The above information is needed to perform the simple pump test to determine if the pump which is necessary to backflush the disc filters is also adequate for dosing and field flushing. Standard head loss tables are used to compare to the pump curve.

Filtration Unit

The self-contained units have a 25 gpm capacity. The capacity includes dosing and field flush flow rates. Skid mounted units need to be enclosed in a heated and floor drained building. They start at 40 gpm and increase in increments of twenty gpm or more. Each filtration series has unique operating conditions so the individual manual must be referenced for each installation.

REMEMBER: Always configure the layout to avoid draindown of the zones. On sloped sites zones are feed from the top and return to the top using the Top Feed supply and return manifolds.

Flow Rate during Absorption Field Dosing

The flow rate during absorption field dosing depends on the amount of dripper line required for any particular installation. The units of measure used are GPH = Gallons per Hour and GPM = Gallons per Minute. The flow rates are easily calculated as follows:

Note: Dripper Line Length in Absorption Field / 2 Foot Emitter Spacing = Number of Emitters
Number of Emitters x .61 GPH = Absorption Field Dosing Rate in GPH
GPH / 60 minutes = Absorption Field Dosing Rate in GPM

Field Flushing Flow Rates

Since automatic flushing of the dripper lines in the absorption field is an integral function of the total system, it should be considered as part of the overall flow rate generated by the system. It has been established that proper scouring and flushing of any pipe system will require at least **1.6 gallons per minute** flow at the outflow end (distal end) of any pipe. Therefore, we should design for a flow of at least 1.6 gallons per minute out of each dripper line connection that has been made to the return flush manifold pipe. Multiply each return manifold connection by 1.6 GPM to get the field flushing flow requirement.

Total Flow Requirement of System

The total flow used in calculating the operating flow requirement of the absorption field would be the combination of both the field dosing flow and the field flushing flow.

Field dosing flow **+** field flushing flow = total hydraulic design flow

SECTION VII

Cold Weather Installation

1. “Top feed” manifolds should be used on all sites with a discernible slope to allow for proper drainage of the manifolds and the 3/4” and 1/2” lateral connectors into the drip tubing.
2. The main supply and return lines shall be installed below the frost line and shall feed the shallow “top feed” manifolds with a single vertical section of insulated sch 40 PVC pipe. Insulation shall be minimum 1/2” thick foam insulation (or equivalent).
3. On flat sites where “top feed” manifolds will not drain therefore requiring the use of side feed manifolds, 12” cover is recommended between highest point of 1/2” black flexible PVC pipe (non loop connections) and final grade. On drip tubing installations less than 12” this would require additional cover over the header ditch area to create the 12” separation. Any additional cover is to be graded and tapered into landscape without compacting soil in tubing area. Please see note on loop connections below.
4. Dense vegetation turf cover to be established over supply trench, return trench and tubing prior to 1st exposure to cold weather. If vegetation cannot be established, then trenches and tubing to be covered with a thick layer (minimum 6”) of mulch, straw/hay, etc. until such turf cover is established. Cover must be stabilized and maintained until dense vegetative turf is established. Amount of cover may need to be adjusted to account for settling.
5. All valve boxes that house “remote zone valves” shall be insulated by contractor. Insulation to consist of either blue board, bagged Styrofoam peanuts or equivalent. If fiberglass insulation is used it must be sealed to prevent it from becoming saturated. The “remote valves” shall be placed on a bed of gravel or screenings (4”-6”). Positive grade away from valve boxes is encouraged to reduce the volume of groundwater that may collect in valve box. Certain sites may require positive drains to daylight.
6. All loops connecting drip runs with 1/2” flexible PVC shall be slightly elevated (minimum 1”-2”) so that they drain into the drip tubing after the pump shuts off. It is contractors responsibility to ensure these loops stay elevated during and after the loops are backfilled.
7. All main supply and return trenches to be installed below the local frost line. If this is not possible due to site restrictions then adequate soil must be added over the top of the trenches so that the effective depth remains below the frost line after settling occurs. The added soils must be prepared for turf cover and stabilized. If vegetation cannot be established then trenches are to be covered with an additional layer (minimum 6”) of mulch, straw/hay, etc. until such turf cover is established.
8. Sufficient ground cover around the hydraulic unit is required to insulate the unit. All pipes entering and leaving the hydraulic unit shall elbow vertically down 90 degrees to a depth below the frost line prior to extending away from the unit horizontally. Additional insulation inside the hydraulic unit is encouraged. Insulation to consist of either blue board, bagged Styrofoam peanuts, or equivalent. If fiberglass insulation is used it must be sealed to prevent it from becoming saturated.
9. All conduit entering into the control panel shall be sealed to prevent condensation inside the panel.
10. Established vegetation height shall be minimum 4”-6” throughout winter months.
11. Air release valves shall be placed below the ground surface inside a valve box but at an elevation above the highest drip line in that particular zone.

SECTION VIII

DRIP DISPERSAL INSTALLATION & CONSTRUCTION NOTES

1. All installation and construction techniques shall conform to state and county codes pertaining to on site sewage systems and the permit for this site.
2. The installation of this system shall be in accordance with specifications and procedures as supplied by the Manufacturer of the equipment.
3. The drip tubing shall be installed using a vibratory plow or trencher. Install all tubing along contour.
4. All PVC pipe and fittings shall be PVC SCH 40 Type 1 rated for pressure applications. All glued joints shall be cleaned and primed with purple (dyed) PVC primer prior to being glued.
5. All cutting of PVC pipe, flexible PVC and dripper tubing of size 1 1/2" or smaller shall be accomplished with pipe cutters approved by American Manufacturing Company, Inc. No sawing of PVC, flexible PVC or dripper tubing of size 1 1/2" or smaller allowed.
6. All PVC pipe, flexible PVC and dripper tubing in the work area shall have the ends covered with duct tape to prevent construction debris from entering the pipe. Prior to gluing, all joints shall be inspected for and cleared of any construction debris.
7. All automatic valves (zone valves & field flush return valves) shall be installed with isolation valves, bypass valves, and disconnects (i.e. unions, flanges) for manual field operation during field maintenance events. All valves must be provided with at-grade access.
8. Drainfield supply and return lines and manifolds to be installed at adequate depth to prevent freezing. Horizontal spacing between the dripper lines and the installation depth are to be as specified.
9. No activity on drainfield area other than minimum is required to install system. Do not park equipment, drive large equipment over or store materials on drainfield area.
10. No wet weather installation is permitted.
11. The contractor shall be certified by American Manufacturing Company, Inc. to install this type of system and shall hold a pre construction meeting with the individuals responsible for soil evaluation, permitting and inspections prior to site work beginning to insure protection of the site conditions and to ensure the system is installed according to design.
12. If site conditions are determined to require the installation of the system to deviate from these plans, all work shall stop immediately and the designer shall be notified. Any ongoing work shall be at the sole responsibility of the contractor.
13. All force mains shall be tested for leaks prior to drip tubing installation and prior to system startup. Uncovered force mains shall be visibly inspected for leaks. If a leak is suspected in covered force mains then the force main shall be re-tested at a minimum pressure of at least 50 percent above the design operating pressure, for at least 30 minutes. There shall be no discernible leakage.

SYSTEM STARTUP

1. A representative from the manufacturer should be on hand for system startup.
2. ½ day of training should be provided by the factory-trained representative supplying the drip irrigation system equipment.