National Onsite Wastewater Recycling Association

Recommended Guidance for the Design of Wastewater Drip Dispersal Systems

1. SCOPE

1.1 Drip dispersal is a method used to distribute wastewater that 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 1980s.

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 ensure 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.

2. REFERENCE DOCUMENTS

2.1 USEPA. *Onsite Wastewater Treatment Systems Design Manual*, EPA/625/R-00/008. Office of Water, Office of Research and Development. Washington, D.C. February 2002.

2.2 NOWRA. *Subsurface Drip Dispersal Systems Workshop Manual.* National Onsite Wastewater Recycling Association, Edgewater, Maryland. 2001.

2.3 CIDWT. *Residential Onsite Wastewater Treatment Systems: An Operation and Maintenance Service Provider Program.* Consortium of Institutes for Decentralized Wastewater Treatment, www.onsiteconsortium.org, 2005.

2.4 American Society for Testing and Materials (ASTM), West Conshohocken, Pennsylvania.

2.3.1 ASTM D5925-96. *Standard Practice for Preliminary Sizing and Delineation of Soil Adsorption Field for On-Site Septic Systems*. 1996

2.3.2 ASTM D5879-95. *Standard Practice for Surface Characterization for On-Site Systems*. 1996

2.3.3 ASTM D5921-96. *Standard Practice for Subsurface Site Characterization of Test Pits for On-Site Septic Systems.* 1996

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2.4 Texas Cooperative Extension, The Texas A&M University System. *Drip Dispersal Systems for Land Application of Effluents*.

2.5 EPRI & TVA, *Wastewater Subsurface Drip Distribution, Peer Reviewed Guidelines for Design, Operation, and Maintenance.* Report #1007406. Revised Report, September 2004, Electric Power Research Institute and Tennessee Valley Authority, co-sponsors. EPRI, Concord, California.

3. DEFINITIONS

3.1 **Air/Vacuum Release Valve:** A device installed in a piping system to allow air to escape from the piping system during pressurization and air to enter during depressurization.

3.2 **Area Loading Rate:** The volume of wastewater effluent or mass of contaminants dispersed within the perimeter of the infiltration area over a 24-hour period. The area loading rate is generally described in engineering units such as gallons per day of wastewater per square foot (area hydraulic loading rate) or pounds per day of contaminant (biochemical oxygen demand, fats, oils, and greases, suspended solids, total nitrogen, etc.) per 1000 square feet (area contaminant loading rate).

3.3 **Organic Loading Rate:** The amount of BOD_5 *(Biochemical Oxygen Demand)* delivered to a treatment component expressed as pounds per day per design unit (for example, pounds per day per square foot)**.**

3.4 **Contour Loading Rate:** The sum of the daily volume of wastewater discharged by the dispersal system along a downslope projection parallel to the slope that intersects all dispersal zones on the slope that will or could receive wastewater on the same day. The contour loading rate is expressed in gallons per day per linear foot of contour.

3.5 **Design Flow:** The estimate of the projected maximum daily wastewater volume (gallons per day) the facility will receive during its design service life that is used to size the components of the facility.

3.6 **Dispersal Zone:** The smallest unit of a drip dispersal system, consisting of a supply manifold, return manifold, drip laterals, and associated appurtenances, which can be loaded independently of all other parts of the dispersal system.

3.7 **Dosing:** The act of intermittently discharging a measured volume or dose of wastewater to a dispersal system either on demand or on timed cycles.

3.8 **Drain-down:** The non-uniform gravity-induced redistribution of water within the piping network dripperline pre- and post-pressurization of the dripperline, which allows some emitters in the dispersal zone to discharge more wastewater than others do. This phenomenon can result in locally overloading areas of the dispersal zone.

3.9 **Dripperline (or drip tubing):** Polyethylene tubing that has uniformly spaced drip emitters along its length, which are attached to the inside wall of the tubing.

3.10 **Drip Emitter:** An engineered flow control device that is typically attached to the inside wall of the dripperline over each orifice. The emitter discharges water at a predictable rate under a given pressure, typically stated in gallons per hour.

3.11 **Emitter, pressure-compensating (PC):** A drip emitter that discharges water out an orifice of the dripperline at a constant rate over a range of operating pressures.

3.12 **Emitter, turbulent-flow:** a non-pressure-compensating (non-PC) emitter that discharges water out an orifice of the dripperline at a rate that varies directly with the operating pressure.

3.13 **Flow, pressurizing:** The portion of a dosing event during which the dispersal system is being filled to its operating pressure.

3.14 **Flow equalization:** The process of reducing the variability of the influent flow to a system component by storing peak flows and metering their release at a predetermined rate close to the average daily flow.

3.15 **Flushing:** The process by which dripperlines are hydraulically cleansed to prevent emitter clogging by increasing the velocity of water flow through the dripperlines to scour and transport solid materials that may have accumulated in or on the interior surfaces of the dripperlines.

3.16 **Infiltrative surface:** The soil surface that is in direct contact with free water from the dripperline through which the applied water first enters the soil and where its state changes from free water to water under tension.

3.17 **Instantaneous loading:** The volume of water discharged to a dispersal zone during a dosing event. This may be expressed as gallons per dose, gallons per dose per linear foot of dripperline, or gallons per dose per emitter.

3.18 **Lateral:** A dripperline consisting of a run or series of runs extending from the supply manifold to the return manifold of a single dispersal zone.

3.19 **Minimum dose volume:** The volume of water discharged during a dosing event that is necessary to pressurize the entire dispersal system and sustain that pressure over a sufficient period to achieve the desired uniformity of discharges between all orifices. It is commonly specified as a multiple of the total volume of the laterals in the system (for example, four times the volume of the piping network).

3.20 **Particle separator:** A device such as a filter or screen that is able to remove particulate matter from the wastewater that is larger than a predetermined size.

3.21 **Preconditioned wastewater:** Wastewater that, at a minimum, has received pretreatment in a septic tank and screening or filtration prior to discharge into the dripperline.

3.22 **Pressure regulator:** A device typically used to reduce the pressure in a dispersal system, employing turbulent flow emitters to control emitter discharges at a predetermined rate.

3.23 **Pressurization period:** The time between pump startup during a dosing event and the time when the dispersal zone is full and pressurized.

3.24 **Return flush main:** The pipe connected to the return manifold that conveys the flush water from the dispersal zone back to the preconditioning system during a flushing event.

3.25 **Return manifold:** The pipe to which the distal ends of each lateral in a dispersal zone are connected. Its purposes are to help equalize the pressure between laterals of a zone, provide an alternative pathway to a lateral that may be obstructed, and collect the wastewater from the laterals during field flushing for discharge to the return flush main.

3.26 **Run:** The portion of a looped or folded lateral that is between two loops on contour.

3.27 **Separation distance:** The vertical or horizontal distance that must be maintained between a designated design barrier, such as groundwater, bedrock, property lines, wells, or other site features, and components of the wastewater systems, which may be defined by local rules.

3.28 **Scouring:** The process to clear a conduit of particulates by hydraulic flushing at a sufficient velocity to lift and carry particulates downstream.

3.29 **Supply main:** The force main from the dose pump to the supply manifold of a dispersal zone.

3.30 **Supply manifold:** The pipe to which the proximal ends of the laterals of a dispersal zone are connected to supply water to the dripperline during dosing events.

3.31 **Timed dosing:** The dosing of an infiltration system on preset timed cycles at equal intervals that discharge equal volumes typically four or more times in a 24-hour period.

3.32 **Valve, check:** A valve that allows water to flow in only one direction.

3.33 **Valve, flush:** A valve that allows field flushing of the drip laterals.

3.34 **Valve, sequencing:** A valve used in a multiple zone dispersal system to direct flow from the supply main to the supply manifolds of the zones sequentially, one zone at a time, for each dosing event.

3.35 **Valve, zone:** A valve used to direct a dose to the supply manifold of a selected dispersal zone.

3.36 **Vacuum release valve:** A valve installed in a dispersal zone that opens to the atmosphere when a negative pressure develops within the piping to prevent water and particulate matter outside the dripperline from being aspirated into the emitters.

4. SUMMARY OF PRACTICE

4.1 Wastewater drip dispersal networks provide uniform distribution of preconditioned wastewater over infiltrative surfaces of land application systems, subsurface infiltration systems, media filters, or any other surfaces where water is to be infiltrated. The systems are designed to be sustainable, year-round, land application systems. Although they are not primarily irrigation systems, plant irrigation and other reuse practices may be incorporated into the design.

4.2 The unique feature of drip dispersal networks is the use of uniformly spaced drip emitters that are inserted within flexible tubing to control the rate of wastewater discharges out the tubing through small orifices. Typically, the dripperline is installed directly into the soil without aggregate or other media to expose more infiltration surface, although a drip dispersal system may be applied in other applications to achieve uniform distribution of wastewater where gravel aggregate or other media may be used to bed the distribution network. Pumps are used to fill and pressurize the dripperline sufficiently to achieve uniformity of distribution.

4.3 The drip emitter is designed to create a high headloss between the in-line pressure of the dripperline and the outlet orifice in dripperline wall. The pressure loss that is created controls the pressure at the outlet orifice so that the discharge is limited within a desired range. Each emitter in a dripperline acts as a point discharge, which releases water at a rate nearly equal to the discharge rate from other emitters in the same dripperline. Roots may intrude into the emitters. The severity of root intrusion is dependent upon the climate, soil, type of vegetation, dosing regimes, and the hydraulic loading rates. There are proprietary methods to guard against root intrusion. Follow the manufacturer's instructions.

4.4 Two types of emitters are commonly used, "turbulent-flow" and "pressure-compensating." The turbulent-flow emitter discharges water at rates that vary directly with the in-line pressure of the dripperline. The pressure-compensating emitter discharges water at a nearly constant rate over a wide range of pressures above a minimum pressure. Below the minimum pressure, the pressure-compensating emitter operates similarly to a turbulent-flow emitter. Both types of emitters are used successfully in drip dispersal systems.

4.5 The preconditioned wastewater is intermittently dosed to each drip dispersal zone. Intermittent dosing provides several significant benefits. It allows time for the soil at the infiltrative surface to reaerate so the soil can maintain an aerobic environment for biochemical treatment of the wastewater to occur. It makes better use of the hydraulic capacity of the system to accept the wastewater by avoiding few, large doses. It prevents excessively high instantaneous hydraulic loadings that can cause surface breakouts of wastewater above the infiltration system, because the dripline typically is installed directly in the soil, and therefore little void space is provided for storage of any wastewater that is not immediately infiltrated. Also, timed dosing protects the infiltration system from receiving wastewater in excess of the daily design flow storing excessive flows in the dose tank for later dispersal.

4.6 Monitoring system function and performance is essential to proper operation. In addition, metering the volume of water dispersed is a critical monitoring item for evaluating performance.

4.7 The dispersal system is usually operated by an integrated controller, which is programmed to activate the pumps to dose the dripperline at appropriate intervals and duration, to flush the dripperline, and backflush the liquid/solid separator device. It also may be used to store operating data for later use in documenting system performance and diagnosing system malfunctions.

5. SIGNIFICANCE OF USE

5.1 Subsurface drip dispersal is an efficient method for dispersal of wastewater into the soil. It is the most precise method currently available for applying wastewater effluent over an infiltration surface in small-volume doses throughout the day. The uniformity of the dosing and equal distribution can be designed and operated to provide for unsaturated flow over the entire infiltration area.

5.2 Wastewater drip dispersal systems may be used anywhere preconditioned wastewater needs to be distributed uniformly over an infiltration surface such as is used in land application, subsurface infiltration, and media filters. They are ideally suited for facilities treating large volumes of wastewater, but are also available for single-home use.

5.3 With appropriate design and operation, drip dispersal systems are sustainable year-round. In cold climates, design and operating measures should be considered to protect the dispersal system against freezing.

6. PROCESS DESCRIPTION

6.1 The drip dispersal system typically includes the following components arranged as illustrated in Figure 1.

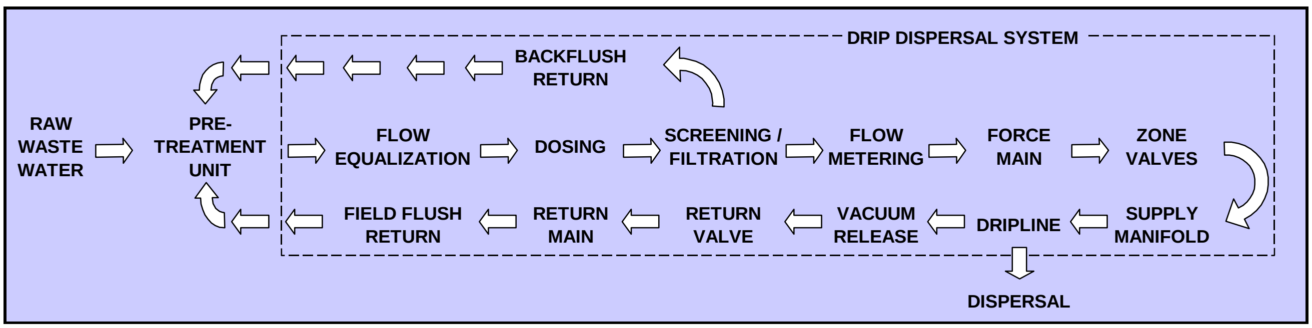

Figure 1: Drip Dispersal System Component Train

6.2 The wastewater must be preconditioned before it is discharged to the drip dispersal system. The preconditioning criteria depend on the component equipment used, system design, and characteristics of the receiving environment. Primary settling or septic tank treatment is a minimum level of preconditioning necessary. Additional preconditioning to remove specific pollutants, which may adversely impact the soil or receiving environment, may be necessary.

6.3 The preconditioned wastewater is discharged to the dispersal system through a dosing tank that has sufficient volume to provide flow equalization. Flow equalization is frequently used to maximize the hydraulic and treatment capacity of the infiltration system by dosing each zone at pre-set timed intervals. This process is called “timed dosing.” The dose tank is sized with sufficient volume to be able to hold influent flows of wastewater that exceed the dosing rate. The wastewater that is held during peak periods is dosed to the infiltration system during periods of lower-than-average flow conditions. If the storage volume that is used for equalization in the dose tank is exceeded, a high-water alarm is activated.

6.4 Before a dose is discharged to the dripperline, it typically undergoes particle separation by screening or filtering. The purpose of this step is to remove any particles larger than the smallest opening in the emitters to reduce the potential for emitter clogging. This is a necessary step regardless of the level of preconditioning the wastewater receives. The separation devices are usually either self-cleansing or routinely cleansed by backwashing with filtered water, which is returned to the headworks of the preconditioning system.

6.5 The manufacturers of dripperline should be consulted for recommendations regarding specifications for maximum particulate size that can pass the liquid/solid separation device to adequately protect the emitters. The screens or filters must be cleaned periodically and the residuals returned to the preconditioning device. Both manual and automatic cleaning methods are used. Access to the particle separator is important for the periodic servicing required to sustain its performance.

6.6 The drip dispersal systems are designed to provide nearly equal distribution between all emitters in a zone when applying the preconditioned wastewater. The dispersal system layout must consider the system hydraulics during the pressurization, dosing, and drain down periods that occur with each dose.

6.6.1 The density of emitters determines uniformity of wastewater application over the infiltration area. This is a function of both emitter spacing and dripperline spacing. The number of emitters and rate required is determined from the daily hydraulic design application rate over the infiltration surface. This determines the total length of dripperline needed.

6.6.2 During pressurization and drain-down of a drip zone, the in-line pressure at each emitter in a network will vary, resulting in unequal discharge rates between the emitters and localized hydraulic overloading within the zone. Minimum dose volumes must be established for each drip dispersal system to limit any hydraulic overloading. While small doses can enhance soil treatment, this advantage is lost if a significant portion of each dose is discharged by the system during pressurization and drain-down periods of the network. Small, frequent doses should be avoided. Dose volumes should be several times the total supply and return manifolds and dripperline volumes within the zone.

6.6.3 Air/vacuum release should be provided at the highest elevation in each zone to let air out during pressurization and to let air in to prevent negative pressure within the dripline, which can result in aspiration of soil fines into the emitters and dripperline during system drain-down.

6.6.4 The drip system should also be designed to periodically flush the supply and return manifolds as well as the dripperlines. Flushing velocities must be created to achieve sufficient velocities to scour the dripperline to remove any accumulations of organic and inorganic particulates.

6.7 Flushing of the dripperlines is typically included as a routine operating practice to remove biological solids that grow within the dripperline and any other solids that may enter the lines during construction or operation. The flushing is typically a forward flush that is done during a normal dose. A return main directs the flush water to the headworks of the pretreatment system, which must be sized to accommodate the returned flush volume and characteristics to avoid impacts detrimental to the pretreatment. To activate the field flushing, the return valve on the return main is opened, which increases the flow rate. Experience indicates that necessary flushing flow velocities can vary with the characteristics of the preconditioned wastewater and the type of dripperline used. Designers should meet or exceed the recommendation of the dripperline manufacturer for necessary flushing velocity.

6.8 Automatic controls are necessary for effective operation and monitoring of drip dispersal systems. The system controller should activate a dose only when there is a sufficient volume of preconditioned wastewater for a full design dose to ensure that each dose achieves uniform distribution. It should also be programmed to provide a sufficient rest time between doses for the effluent to move into the soil away from the dripperline. It must confirm that there is a sufficient volume of effluent to proceed with a dose event. Partial doses will result in non-uniform application of wastewater and reduced performance of the dispersal system. The control provides the operator interfaces for the operational adjustments and diagnostic monitoring of the system. A means to meter and record flow volumes is essential to provide total flow processed over time, monitor flow rates during both dosing and flushing events, and troubleshoot system malfunctions.

7. DESIGN

7.1 A demand analysis of water use at the building(s) to be served should be conducted to estimate the average daily flow, expected daily peak flows and diurnal and weekly variations. Local codes usually will dictate unit values to estimate the design flows for wastewater systems. The design flow estimates obtained from using these unit values typically will represent maximum peak flows. While dispersal systems must be designed to distribute the maximum expected peak flows, drip dispersal systems are usually designed to distribute the average daily flow with peak flows controlled by flow equalization.

7.2 The dose or pump tank should provide sufficient storage for equalization of peak flows. The storage volume is calculated to hold any peak flows that are expected to routinely occur over a given period, typically a day or week depending on the expected flow variations. The pump tank should provided at least one quarter of a day’s storage above the alarm level, and more storage is better. Equalization storage from one-half to one day between the pump-enable water level and the alarm water level is necessary for small flow systems. Local regulations may require a specific storage capacity. The design may increase or decrease this storage based on available redundancy of facilities.

7.3 Drip distribution may be used with a wide range of preconditioning processes and water quality. Preconditioning, water quality and quantity should be evaluated when selecting soil loading rates and mechanical equipment.

7.4 The layout of the dispersal system piping network must provide reasonably uniform distribution over the proposed soil treatment area. The hydraulic design should achieve discharge rates and volumes that vary no more than ±10% between all the emitters within a zone during a complete dosing event. Consideration should be given to the unequal distribution during flow pressurizing and flow depressurizing periods. The designer must be able to mathematically support the design for equal distribution and demonstrate it upon installation. The design of the soil treatment area (sizing, depth, geometry, and orientation), are not included in this document.

7.4.1 Manufacturers must rate all valves, pressure regulators, fittings, and piping for wastewater application. The system designer must evaluate the compatibility of these appurtenances for the specific application.

7.4.2 Drip field piping layout must provide a sufficient number and density of emitters to achieve reasonably uniform distribution and application of the preconditioned wastewater over the entire soil treatment area. The number of emitters must be sufficient to maintain an instantaneous loading rate (gallons per dose) that will maximize use of the hydraulic and treatment capacities of the soil and prevent breakout of wastewater on the treatment area surface during dosing.

7.4.3 Emitter and dripperline spacing should be based on the permeability of the soil. Horizontal movement of water in coarse-textured soils with high permeability is much less than it is in fine-textured soils, which can draw water several feet, so the horizontal spacing of the dripperline should be adjusted accordingly to avoid exceeding the instantaneous hydraulic capacity of the infiltrative surface. Standard two-foot emitter and dripperline spacing should be adequate for most applications.

7.4.4 Minimum and maximum installation depths of the dripperline may be established by local rules based on soil characteristics and separation distances. Installation depths typically range from 6 to 12 inches. Recommendations of the manufacturer should be considered. Shallow drip dispersal systems must be protected from possible physical damage.

7.4.5 Drain-down, which occurs after each dose as the dripperline depressurizes, must be managed to prevent localized overloading through the lower laterals of the network. Dripperline should be placed on contour and laid out to drain itself through the emitters as evenly as possible so as not to cause localized overloading.

7.4.6 Dispersal systems are often divided into zones that can be loaded independently. This is done to better adapt the dispersal of wastewater to the capacity of the receiving environment and to meet the hydraulic requirements for equal distribution, field flushing of the dripperline, reduce localized overloading from the drain down prior to and after pressurization of dripperline. Multiple zones also can provide standby capacity for equipment servicing and system repairs.

7.4.7 Lateral lengths within a zone should be close to equal to achieve efficient flushing of each of the laterals. To determine the suitable flushing flow and pressure requirements at the proximal end necessary to achieve the flushing velocity at the distal end, the designer should obtain dripperline headloss information relating dripperline diameter, emitter spacing, and emitter and flushing flow rates to lateral lengths. Computer programs are available to aid in evaluating the hydraulic design of the dispersal system.

7.4.8 Drip dispersal systems should be designed to operate in the manufacturer's specific pressure range for emitter operation. The dripperline should be placed within appropriate elevation tolerance limits in each zone to maintain equal distribution within the preferred range. It may be necessary to control the inlet pressure with a pressure-regulating valve in order to control emitter flow rate. Hydraulic analyses should be performed to ensure appropriate pressure and flow is achieved for both dosing and flushing conditions.

7.4.9 Air/vacuum release valves must be installed at the high points in each zone to provide a vacuum break as the dripperline drains after a dose event. This is critical to prevent aspiration of soil particulates back into the dripperline through the emitter.

7.5 The piping layout is typically flushed. Flushing velocities should meet or exceed the recommendations of the manufacturer of the dripperline used. Flush materials should be returned to the headworks of the wastewater treatment system.

7.6 The pump must be designed to handle preconditioned wastewater and to manage all hydraulic operations required for the system. The dosing capacity must be sufficient to apply a full dose at the design rate for the largest zone in the system and meet the flushing rate requirements. If automatic particle separators are used the pump must also be capable of achieving the backflushing or washing rate and pressure requirements of the manufacturer of the separator.

7.7 Particle separation is required to reduce the size of suspended particles in the wastewater effluent to prevent emitter plugging. Separators should follow the manufacturer’s recommendations and be suitable for wastewater applications. They should be accessible for maintenance and designed to match the maintenance frequency of the system.

7.8 Monitoring Devices: A method for measuring the volume of wastewater dispersed against elapsed time should be provided. Also, means to measure flow rates and operating pressures are beneficial to diagnose hydraulic problems. Continuous data recording should be considered.

7.9 Controls: An integrated controller is necessary to manage the multifunction processes of drip dispersal systems. The control panel shall be located in an accessible location where an operator can monitor and perform diagnostics on the system. Manual override switches for all automated mechanical functions should be provided. H-O-A (Hand-Off-Auto) switches for manual operation of pump and valves should be provided for an operational interface. Visual indications of specific operations are recommended.

7.9.1 The controller must manage the dosing and resting cycles to the drip field as designed. The run times and the rest times should be adjustable to manage the instantaneous loading rates to regulate the demand with the field capacity.

7.9.2 Each major component should be located to perform properly and to be accessible for operation and maintenance.

7.10 All components of the drip arrangement must work together for the successful, long-term, reliable operation of a drip dispersal system. Each function of the system design, regarding flow rates and pressures, should be appropriately integrated and designed to meet requirements. All components in a drip dispersal system should be rated to withstand contact with wastewater and recommended for this application by the manufacturer or supplier. Additional components may be used as deemed appropriate by the manufacturer or designer to treat and evenly disperse the wastewater to prevent emitter clogging, prevent physical damage, monitor operation, or otherwise enhance system performance.

8. INSTALLATION

8.1 Only trained and otherwise qualified contractors shall install drip dispersal systems.

8.2 The installer must pay particular attention to site protection and protection of the dripperline. Installation practices should provide site protection for shallow soil installations.

8.3 The installation of the dispersal system should reasonably follow the designer’s plans.

8.4 During installation, the dripperline should be protected against entry of construction debris and soil materials by taping or otherwise tightly covering the ends until their connections to the manifolds are made.

8.5 All aspects of the design objectives should be tested, proven, and recorded at startup to confirm that site-specific design objectives are met.

9. OPERATION, MONITORING, AND MAINTENANCE

9.1 Drip dispersal systems should be designed such that system operation can be monitored for proper usage and performance. The monitoring frequency should be based on the most limiting process in the system.

9.2 Monitoring of flow rates and pressures is necessary to diagnose possible overuse and ensuing system damage.

9.3 All aspects of the design objectives should be monitored, proven, and recorded at regular intervals to confirm that site-specific design objectives are met.

9.4 Operational monitoring should determine if wastewater has been or is surfacing as a result of the operation of the drip system and that the system is in good repair.

9.5 Only trained and otherwise qualified operators or installers should operate and services drip dispersal systems.

9.6 For more complete guidance, see reference documents 2.3 and 2.5.