

Final Report

Field Performance Assessment of the Advanced Enviro-Septic Wastewater Treatment and Dispersal System in Missouri, 2022

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Introduction

A field performance assessment study of 30 installed, mature Infiltrator Water Technologies (Infiltrator) Advanced Enviro-Septic (AES) systems installed in three geographic areas of Missouri was performed in June 2022. Installation sites included a diversity of soil properties (soil loading rates) and site conditions (lot size and slope conditions), along with daily wastewater flow volume (number of bedrooms). This field performance assessment was initiated to elucidate the effectiveness of mature AES system installations in Missouri settings. All but one of the systems were residential, with the non-residential system being a Dollar General retail store. With one exception, the AES systems had been installed for a minimum of three years and were installed under the State of Missouri “Experimental” category for new onsite wastewater treatment and dispersal system technologies. The purpose of this study was to assess the hydraulic functionality and performance of the installed systems relative to the soil and site characteristics, in concert with additional permitted information to determine whether the AES system meets the requirements for moving from the “Experimental” approval category to the state’s general use approval category.

Background

The AES system was approved at experimental level by the Missouri Department of Health and Senior Services (DHSS) twice, with differing sizing criteria for the AES pipe and surrounding system sand sizing for each approval, as follows:

- 2012 approval – Under the initial 2012 approval, the system was approved for use at a variable 50 to 70 feet proprietary product length per bedroom, with the size of the system sand footprint based upon variable soil loading rates, and 6 inches of system sand below the system piping.
- 2015 approval – The initial 2012 approval was revised in 2015, where the system was sized at a fixed length of 50 feet per bedroom and the system sand footprint was calculated based on 90% of the area required for the applicable soil loading rate assigned to the site, with 6 inches of system sand below the system piping.

As a result of the DHSS product approval history, surveyed field installations could range from a minimum of 50 feet of pipe per bedroom up to 70 feet of pipe per bedroom. Of note is that the present-day manufacturer's installation recommendations for the AES systems require the more conservative values from the two approvals, with 70 feet of AES pipe required per bedroom and the required system area being 90% of what would be required for the conventional soil loading rate assigned to the site. The use of 70 feet of AES pipe as the minimum length per bedroom was established after the ownership of Presby Environment, Inc. transitioned to Infiltrator Water Technologies in 2019. Because current-day system sizing employs the maximum surveyed AES pipe length and lower-bound of the surveyed soil loading rates, the field performance assessment did not differentiate between sites based on either AES pipe length or soil loading rate. Systems installed under the 2012 DHSS approval may have less AES pipe than 70 feet per bedroom or employ a smaller system sand footprint than would be specified under current-day design requirements. In either case, this aspect of the investigation represents an element of conservatism relative to AES system sizing under a potential future general use approval that would result from the field performance assessment end-point requirements being met.

Product Description

AES is a combined treatment and dispersal (CTD) system, a system type which is not specifically addressed in 19 CSR 20-3.060 (the Missouri rules). AES is (and CTDs are) a reliable, sustainable, non-electric low-impact means of treating domestic wastewater to secondary standards and dispersing the treated water to the native soil within the CTD system footprint. AES is comprised of a proprietary, manufactured wastewater distribution device known as a "pipe" surrounded by system sand conforming with ASTM C33 particle gradation specifications.

Methods

This study was conducted in accordance with the DHSS-approved "Experimental System Field Evaluation Protocol Infiltrator Water Technologies/Presby Environmental, Inc. Advanced Enviro-Septic System", which set forth the scope and requirements of the field performance assessment and end-point requirements for general-use approval eligibility. In accordance with the "Experimental System Field Evaluation Protocol Infiltrator Water Technologies/Presby Environmental, Inc. Advanced Enviro-Septic System", study systems were divided into two "Study Groups". Study Group 1 included systems designed with >0.25 gpd/sqft soil loading rates of which a minimum of 20 sites would be evaluated. Study Group 2 included systems designed with ≤ 0.25 gpd/sqft soil loading rates of which a minimum of seven sites would be evaluated. With respect to Study Group 1, if $\leq 10\%$ of systems evaluated were determined to be in a

condition of failure, the AES system would be deemed to have passed the DHSS field performance assessment endpoint requirements. With respect to Study Group 2, if $\leq 15\%$ of systems evaluated were determined to be in a condition of failure, the AES system would be deemed to have passed the DHSS field performance assessment endpoint requirements.

The study was led in the field by soil scientist Dr. Randall J. Miles with support from Curtis Cluckey and Dick Bachelder of Infiltrator, who provided assistance locating sites and understanding relevant system historical information. Eric Folks from DHSS participated in the visual inspection and site observation process at each installation location. Part-time participants were Rick Kirkpatrick of Infiltrator, Tammy Trantham, soil evaluator and Executive Director of the Missouri Smallflows Organization, Michael Bowers, President of the Missouri Smallflows Organization and John Souttee, Program Manager of the Taney County Regional Sewer District OWTS Permitting Authority.

Under the “Experimental System Field Evaluation Protocol Infiltrator Water Technologies/ Presby Environmental, Inc. Advanced Enviro-Septic System”, the number of site inspections required is as follows:

- One evaluation will be conducted for sites ≥ 3 years old.
- Two evaluations will be conducted for sites < 3 years old, with the second evaluation occurring at least 30 days following the first evaluation.
- Where DHSS or the local health department has visited a site previously and deemed it to be functioning properly, the prior site evaluation(s) shall be included in meeting the minimum number of required visits.

The number of systems requiring site inspection is as follows:

- For systems with > 0.25 gpd/sqft soil loading rates, at least 20 sites are to be evaluated.
- For systems with ≤ 0.25 gpd/sqft soil loading rates, at least 7 sites are to be evaluated.

All 30 installation sites in the study were visited a single time during four consecutive days in June 2022. The evaluation was conducted to ascertain the hydraulic function of each installation. The field evaluation was comprised of a non-intrusive, walkover visual assessment of the entire site, with a focus on the area where the system was installed and its environs. The evaluation included an assessment for the presence of surfacing effluent, as well as the presence of shallow saturated soil in and around the system installation location, malfunction indicators such as odors associated with effluent, staining and stressed vegetation associated with past effluent breakout and ponding events. The assessment included a topographical evaluation for potential overland

flow toward the system installation site that could potentially interfere with proper operation. Where the occupant of the structure was present and available, the occupant was interviewed in regard to the functionality of the system, and whether it had exhibited signs of malfunction, including surfacing effluent or effluent backing into the home. The AES systems were not installed with effluent sample collection equipment or flow meters, so effluent quality and hydraulic loading capacity were not assessed.

Determination of system performance was based on the number of documented system failures reported to DHSS. In the context of the field performance assessment, the term “failure” was defined to mean the following: any failure of the system to function properly, so as to cause the discharge of untreated or partially treated wastewater onto the ground surface, or back up of effluent into the residence, solely and proximately as a result of design defect. The overall rate of failure for the evaluation was determined as the number of documented failures attributed to failure of the system divided by the number of installed systems surveyed and expressed as a percentage. Under the terms of the DHSS-approved field performance assessment protocol, in the event that certain qualifying conditions were found to be present, a system could be excluded from the evaluation if any of the following were found to apply: improper or non-code-compliant installation; excessive or improper use, including hydraulic overload; inaccurate site evaluation and system sizing; or installation of the system by an unauthorized installer.

The system evaluator recorded observations for each site using the “Advanced Enviro-Septic Field Evaluation Form”, which was provided by Infiltrator personnel. This objective-based form contained two main sections of assessment items: the AES System Evaluation component; and the Owner/Occupant Interview. The AES System Evaluation component contained objective questions addressing the appearance of each AES system, which was subject to at least two walk-over inspections during the site visit, in different directions to fully capture any of the objective points in and around the site. In addition to addressing the questions on the form, comments were added to supply supplemental information such as effluent odor, vegetative appearance, possible hydrological intrusion by surface water, etc. The individual forms are reported in Appendix A, with summarization in Table 1 of this report. The owner/occupant responses are also reported in the Appendix A.

Little upfront information was shared with the evaluator about each system and site before and during the site inspection, except for soil loading rate and number of bedrooms. The labeling of each site for Table 1 and the appendices is a letter which represented the day of the week (M=Monday, T=Tuesday, W=Wednesday, R=Thursday) followed by the numerical order of assessment (1=first...30=last system assessed) during the field assessment period.

Results and Discussion

The 30 individual AES systems and their site number, homeowner and locations, AES system design specifications, and the “Advanced Enviro-Septic Field Evaluation Form” observations are presented in Table 1. The inputs for this table came from the AES system design specification section provided by Infiltrator personnel Curtis Cluckey and Dick Bachelder. This information was originally compiled from the county-issued permit for each site. The completed original “Advanced Enviro-Septic Field Evaluation Forms” that contained field observations for each site are provided in Appendix A for sites M1 through R30, referenced herein as Table M1 through Table R30. Photographs of the systems taken during the site inspection and observed site conditions are presented in Appendix B. The distribution of surveyed system locations across Missouri is depicted in Figure 1.

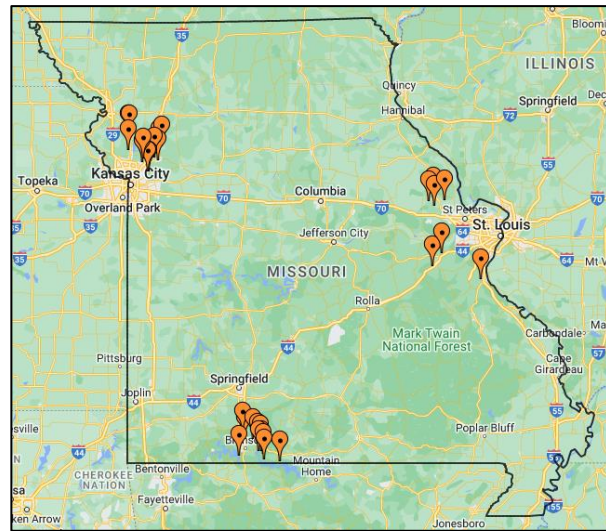


Figure 1 – Site locations

Individual Site Observations and Discussion

Site M1 located at 17708 N. Highway 69, Lawson, MO had a design soil loading rate of 0.20 gallons per day per square foot (gpd/sqft) and 210 linear feet (ft) of AES (3 lines of 70 ft of product) (Table 1). Photos of this site and system are provided in photos M1-1 and M1-2 (Appendix B). This system was installed in August 2014. The summary of the field evaluation observed no current surfacing effluent over any part of the system, nor evidence of past surfacing. There was no surfacing of sewage with pressure of footwear. No straight pipe discharges were found and no visible signs of malfunction were observed (Table 1 and Appendix A, Table M1). Additionally, site observations included consistent, even green vegetation, and no effluent odor within 10 feet of the system. The northwest surface outlet for the gutter could not be located, so it was not possible to determine if flow from this source intruded onto the AES system. The homeowners expressed that there were no problems with the onsite technology and were pleased with the system function (Appendix A, Table M1).

Site M2 located at 23810 Highway, MM, Kearney, MO had a design soil loading rate of 0.30 gpd/sqft and 150 linear feet of AES (2 lines of 75 ft of product) (Table 1). Photos of this site and system are provided in photos M2-1 and M2-2 (Appendix B). This system was installed in November 2016. The summary of the field evaluation observed no current surfacing effluent over any part of the system nor evidence of past surfacing. There was no surfacing of sewage

with pressure of footwear. No straight pipe discharges were found and no visible signs of malfunction were observed (Table 1 and Appendix A, Table M2). Additionally, thistle and milkweed were observed on the summit of the system and grass on the side slope with some clover on the foot slope. There was no effluent odor within 10 feet of the system and no seepage of effluent observed. The occupants of this home were not available for an interview.

Site M3 located at 100 Shepherd Lane, Lawson, MO had a design soil loading rate of 0.20 gpd/sqft and 280 linear feet of AES (4 lines of 70 ft of product) (Table 1). Photos of this site and system are provided in photos M3-1 and M3-2 (Appendix B). This system was installed in August 2017. The summary of the field evaluation observed no current surfacing effluent over any part of the system nor evidence of past surfacing. There was no septic odor, and no green striping. Instead, a consistent green color was observed over the technology. Infiltrator was informed of a breakout in the northern end of the system in 2019, and in response made a site visit. It was determined that a lawn mower had created ruts from its tires on the downslope taper. Infiltrator placed cover material on the damaged areas. No evidence either of this damage or of a breakout was observed during the site inspection. No straight pipe discharges were found and no visible signs of malfunction were observed (Table 1 and Appendix A, Table M3). Additionally, the homeowner expressed that there were no problems with the onsite technology (Appendix A, Table M3).

Site M4 located at East Highway 10, Excelsior Springs, MO (Dollar General store) had a design soil loading rate of 0.40 gpd/sqft and 150 linear feet of AES (2 lines of 75 ft of product) (Table 1). Photos of this site and system are provided in photos M4-1 and M4-2 (Appendix B). This system was installed in August 2016. The summary of the field evaluation observed no current surfacing effluent over any part of the system nor evidence of past surfacing. There was no surfacing of sewage with pressure of footwear. No straight pipe discharges were found and no visible signs of malfunction were observed (Table 1 and Appendix A, Table M4). There was no effluent odor within 10 feet of the system and no seepage outbreaks observed. Some small brush existed, but did not appear to inhibit the system. The managers of the Dollar General store were not available for an interview (Appendix A, Table M4).

Site M5 located at 24205 NE 136th Terrace, Excelsior Springs, MO had a design soil loading rate of 0.40 gpd/sqft and 150 linear feet of AES (2 lines of 75 ft of product) (Table 1). Photos of this site and system are provided in photos M5-1 and M5-2 (Appendix B). This system was installed in May 2016. The summary of the field evaluation observed no current surfacing effluent over any part of the system, nor evidence of past surfacing. There was no surfacing of sewage with pressure of footwear. No straight pipe discharges were found and no visible signs of malfunction were observed (Table 1 and Appendix A, Table M5). Additionally, uniform, even green vegetation was prevalent, with no green striping and no effluent odor noted within 10 feet of the system. The homeowners were available to interview. They were very positive about the system performance (Appendix A, Table M5).

Site M6 located at 6851 Nebo Hills Road, Liberty, MO had a design soil loading rate of 0.30 gpd/sqft and 225 linear feet of AES (3 lines of 75 ft of product) (Table 1). Photos of this site and system are provided in photos M6-1 through M6-3 (Appendix B). This system was installed in October 2018. The summary of the field evaluation observed no current surfacing effluent over any part of the system, nor evidence of past surfacing. There was no surfacing of sewage with pressure of footwear. No straight pipe discharges were found and no visible signs of malfunction were observed (Table 1 and Appendix A, Table M6). Additionally, field observations indicated that runoff water could be intruding on the system, as there was some rill and sheet erosion (Photo M6-2). The need for consistent vegetative cover upslope to divert water off of the system was strongly suggested. The homeowners were available to interview. They expressed no problems with the system (Appendix A, Table M6).

Site M7 located at 6901 Nebo Hills Road, Liberty, MO had a design soil loading rate of 0.30 gpd/sqft and 225 linear feet of AES (3 lines of 75 ft of product) (Table 1). Photos of this site and system are provided in photos M7-1 and M7-2 (Appendix B). This system was installed in April 2019. The summary of the field evaluation observed no current surfacing effluent over any part of the system, nor evidence of past surfacing. There was no surfacing of sewage with pressure of footwear. No straight pipe discharges were found and no visible signs of malfunction were observed (Table 1 and Appendix A, Table M7). There was no striping of vegetation, no effluent odor within 10 feet of the system or breakouts. A surface diversion could be added to prevent intrusion of water on the system from upslope, possibly consisting of through flow of surface water on the site during heavy rainfall events. The homeowners were available to interview. They expressed satisfaction with the system performance (Appendix A, Table M7).

Site M8 located at 12402 NE 112th, Liberty, MO had a design soil loading rate of 0.30 gpd/sqft and 220 linear feet of AES (4 lines of 55 ft of product) (Table 1). Photos of this site and system are provided in photos M8-1 and M8-2 (Appendix B). This system was installed in April 2015. The summary of the field evaluation observed no current surfacing effluent over any part of the system, nor evidence of past surfacing. There was no surfacing of sewage with pressure of footwear. No straight pipe discharges were found and no visible signs of malfunction were observed (Table 1 and Appendix A, Table M8). The homeowners were available to interview. They expressed no problems with the system (Appendix A, Table M8).

Site M9 located at 13416 Plattsburg Road, Kearney, MO had a design soil loading rate of 0.50 gpd/sqft and 210 linear feet of AES (3 lines of 70 ft of product) (Table 1). Photos of this site and system are provided in photos M9-1 and M9-2 (Appendix B). This system was installed in May 2017. The summary of the field evaluation observed no current surfacing effluent over any part of the system, nor evidence of past surfacing. There was no surfacing of sewage with pressure of footwear. No straight pipe discharges were found and no visible signs of malfunction were observed (Table 1 and Appendix A, Table M9). Additionally, no breakouts or effluent odor was observed with 10 feet of the system. A functional upslope surface water diversion was in place,

as well as vegetation cover that could be more dense, but was deemed adequate. The homeowners were available to interview. They expressed no problems with the system (Appendix A, Table M9).

Site M10 located at 9578 SW 247th, Gower, MO had a design soil loading rate of 0.30 gpd/sqft and 150 linear feet of AES (2 lines of 75 ft of product (Table 1). Photos of this site and system are provided in photos M10-1 through M10-3) (Appendix B). This system was installed in October 2016. The summary of the field evaluation observed no current surfacing effluent over any part of the system, nor evidence of past surfacing. There was no surfacing of sewage with pressure of footwear. No straight pipe discharges were found and no visible signs of malfunction were observed (Table 1 and Appendix A, Table M10). Additionally, no stripes in the vegetation or effluent odor within 10 feet of the system was noted. An agricultural terrace above the system and a tilled strip in the surface diversion were observed, neither of which were impeding the performance of the system. The homeowners were available to interview. They expressed no problems with the system (Appendix A, Table M10).

Site M11 located at 9740 SW 247th, Gower, MO had a design soil loading rate of 0.30 gpd/sqft and 200 linear feet of AES (Table 1). The configuration of the AES rows was not shown on the permit. Photos of this site and system are provided in photos M11-1 through M11-3) (Appendix B). This system was installed in June 2017. The summary of the field evaluation observed no current surfacing effluent over any part of the system, nor evidence of past surfacing. There was no surfacing of sewage with pressure of footwear. No straight pipe discharges were found and no visible signs of malfunction were observed (Table 1 and Appendix A, Table M11). Additionally, consistent vegetative cover was observed, with no stripes. No effluent odor was detected within 10 feet of the system. Adequate diversion of surface water above the system was in place (Photo M11-1). The homeowners were available to interview. They expressed no problems with the system (Appendix A, Table M11).

Site M12 located at 17270 N. US Highway 169, Smithville, MO had a design soil loading rate of 0.40 gpd/sqft and 210 linear feet of AES (3 lines of 70 ft of product) (Table 1). Photos of this site and system are provided in photos M12-1 through M12-2 (Appendix B). This system was installed in October 2016. The summary of the field evaluation observed no current surfacing effluent over any part of the system, nor evidence of past surfacing. There was no surfacing of sewage with pressure of footwear. No straight pipe discharges were found and no visible signs of malfunction were observed (Table 1 and Appendix A, Table M12). There was no effluent odor within 10 feet of the system, and consistent vegetative cover with no green stripes was noted. A surface diversion could be placed above the site to divert surface runoff away from the site. The occupants of this home were not available for an interview (Appendix A, Table M12).

Site T13 located at 150 Autumn, Branson, MO had a design soil loading rate of 0.40 gpd/sqft and 100 linear feet of AES (2 lines of 50 ft of product) (Table 1). Photos of this site and system are provided in photos T13-1 through T13-3 (Appendix B). This system was installed in January

2018. The summary of the field evaluation observed no current surfacing effluent over any part of the system, nor evidence of past surfacing. There was no surfacing of sewage with pressure of footwear. No straight pipe discharges were found and no visible signs of malfunction were observed (Table 1 and Appendix A, Table T13). There was no effluent odor within 10 feet of the system, no vegetative striping, and adequate vegetative cover. A surface diversion should be placed above the site to divert surface and roof runoff away from the system. The homeowner expressed no problems with the system (Appendix A, Table T13).

Site T14 located at 298 Bear Creek Estates, Walnut Shade, MO had a design soil loading rate of 0.30 gpd/sqft and 195 linear feet of AES (3 lines of 65 ft of product) (Table 1). Photos of this site and system are provided in photos T14-1 through T14-3 (Appendix B). This system was installed in June 2018. The summary of the field evaluation observed no current surfacing effluent over any part of the system, nor evidence of past surfacing. There was no surfacing of sewage with pressure of footwear. No straight pipe discharges were found and no visible signs of malfunction were observed (Table 1 and Appendix A, Table T14). There was no effluent odor within 10 feet of the system and no vegetative striping. Vegetation on the system was green, compared to that above or below the system, as the system had adequate vegetative cover. A surface diversion should be placed above the site to divert surface runoff away from the site. The occupants of this home were not available for an interview (Appendix A, Table T14).

Site T15 located at 1200 Clevenger, Hollister, MO had a design soil loading rate of 0.40 gpd/sqft and 140 linear feet of AES (4 lines of 35 ft of product) (Table 1). Photos of this site and system are provided in photos T15-1 through T15-3 (Appendix B). This system was installed in December 2015. The summary of the field evaluation observed no current surfacing effluent over any part of the system, nor evidence of past surfacing. There was no surfacing of sewage with pressure of footwear. No straight pipe discharges were found and no visible signs of malfunction were observed (Table 1 and Appendix A, Table T15). There was no effluent odor within 10 feet of the system and no vegetative striping. Vegetation on the system was consistent, as the system had sufficient vegetative cover. A surface diversion was horseshoed above the AES technology, thus providing what appeared to be a model for effective surface water management appropriate for the setting and the longevity of the system (Photo T15-1). The occupants of this home were not available for an interview (Appendix A, Table T15).

Site T16 located at 193 Star, Forsythe, MO had a design soil loading rate of 0.40 gpd/sqft and 120 linear feet of AES (3 lines of 40 ft of product) (Table 1). Photos of this site and system are provided in photos T16-1 through T16-3 (Appendix B). This system was installed in May 2019. The summary of the field evaluation observed no current surfacing effluent over any part of the system or evidence of past surfacing. There was no surfacing of sewage with pressure of footwear. No straight pipe discharges were found and no visible signs of malfunction were observed (Table 1 and Appendix A, Table T16). There was no effluent odor within 10 feet of the system and no vegetative striping. Vegetation on the system was consistent as the system had

sufficient vegetative cover. The occupants of this home were not available for an interview (Appendix A, Table T16).

Site W17 located at 1196 Lakeway Road, Kissee Mill, MO had a design soil loading rate of 0.20 gpd/sqft and 150 linear feet of AES (3 lines of 50 ft of product) (Table 1). Photos of this site and system are provided in photos W17-1 through M17-5) (Appendix B). This system was installed in March 2015. The summary of the field evaluation observed no current surfacing effluent over any part of the system, nor evidence of past surfacing. There was no surfacing of sewage with pressure of footwear. No straight pipe discharges were found and no visible signs of malfunction were observed (Table 1 and Appendix A, Table W17). There was no effluent odor within 10 feet of the system and no vegetative striping. Vegetation on the system was consistent as the system had sufficient vegetative cover. No surface diversion was observed. Vegetation was brown over the septic tank. The occupants of this home were not available for an interview (Appendix A, Table W17).

Site W18 located at 960 Sanders Road, Kissee Mill, MO had a design soil loading rate of 0.40 gpd/sqft and 150 linear feet of AES (3 lines of 50 ft of product) (Table 1). Photos of this site and system are provided in photos W18-1 through W18-3 (Appendix B). This system was installed in December 2017. The summary of the field evaluation observed no current surfacing effluent over any part of the system, nor evidence of past surfacing. There was no surfacing of sewage with pressure of footwear. No straight pipe discharges were found and no visible signs of malfunction were observed (Table 1 and Appendix A, Table W18). There was no effluent odor within 10 feet of the system, and no vegetative striping. There was a fresh tree stump near the distal end of the system. There was some slight physical movement of soil in the northwest corner of the system from erosion that appeared to be caused by tire tracks and scalping during mowing. The occupants of this home were not available for an interview (Appendix A, Table W18).

Site W19 located at 2213 Highway KK, Cedar Creek, MO had a design soil loading rate of 0.20 gpd/sqft and 100 linear feet of AES (2 lines of 50 ft of product) (Table 1). Photos of this site and system are provided in photos W19-1 through W19-4 (Appendix B). This system was installed in October 2018. The summary of the field evaluation observed no current surfacing effluent over any part of the system, nor evidence of past surfacing. There was no surfacing of sewage with pressure of footwear. No straight pipe discharges were found and no visible signs of malfunction were observed (Table 1 and Appendix A, Table W19). The system was sufficiently vegetated and there was no effluent odor within 10 feet of the system and no outbreaks of sewage. The septic tank lid was at the soil surface and there was no cap on the outlet to the tank. The homeowner was available to be interviewed and expressed no problems with the system (Appendix A, Table W19).

Site W20 located at 852 Camelot, Cedar Creek, MO had a design soil loading rate of 0.40 gpd/sqft and 210 linear feet of AES (3 lines of 70 ft of product) (Table 1). Photos of this site and system are provided in photos W20-1 through W20-4 (Appendix B). This system was installed in

July 2019. The summary of the field evaluation observed no current surfacing effluent over any part of the system, nor evidence of past surfacing. There was no surfacing of sewage with pressure of footwear. No straight pipe discharges were found and no visible signs of malfunction were observed (Table 1 and Appendix A, Table W20). There was no effluent odor within 10 feet of the system, which had good vegetative cover with no striping. The water level was below the outlets in the distribution box (Photo W20-4) and there was a need to have a surface diversion to redirect run-on water away from the AES system. The occupants of this home were not available for an interview (Appendix A, Table W20).

Site W21 located at 132 Route OO, Cedar Creek, MO had a design soil loading rate of 0.25 gpd/sqft and 100 linear feet of AES (2 lines of 50 ft of product) (Table 1). Photos of this site and system are provided in photos W20-1 through W20-3 (Appendix B). This system was installed in June 2019. The summary of the field evaluation observed no current surfacing effluent over any part of the system, nor evidence of past surfacing. There was no surfacing of sewage with pressure of footwear. No straight pipe discharges were found and no visible signs of malfunction were observed (Table 1 and Appendix A, Table W21). There was no effluent odor within 10 feet of the system and no vegetation striping. There is some Johnsongrass and Bermuda grass over the system. A surface diversion could be placed above the system to divert surface run-on away from the AES technology. The homeowner was available to be interviewed and expressed no problems with the system (Appendix A, Table W21).

Site W22 located at 1189 A. B. Fine, Cedar Creek, MO had a design soil loading rate of 0.30 gpd/sqft and 140 linear feet of AES (2 lines of 70 ft of product) (Table 1). Photos of this site and system are provided in photos W20-1 through W20-5 (Appendix B). This system was installed in December 2015. The summary of the field evaluation observed no current surfacing effluent over any part of the system, nor evidence of past surfacing. There was no surfacing of sewage with pressure of footwear. No straight pipe discharges were found and no visible signs of malfunction were observed (Table 1 and Appendix A, Table W22). There was no effluent odor within 10 feet of the system and no vegetation striping. Greater vegetative cover could be used on the downhill side of the AES technology. Upslope trees shade the system, thus likely decreasing evapotranspiration of water from the dispersal field. There was no high vent on this system. A surface diversion could be placed above the system to divert surface run-on away from the AES technology (Photo W22-2). The homeowner was available to be interviewed and expressed no problems with the system. (Appendix A, Table W22).

Site W23 located at 475 Shady Lane, Protem, MO had a design soil loading rate of 0.25 gpd/sqft and 140 linear feet of AES (2 lines of 70 ft of product) (Table 1). Photos of this site and system are provided in photos W23-1 through W23-5 (Appendix B). This system was installed in April 2018. The summary of the field evaluation observed no current surfacing effluent over any part of the system nor evidence of past surfacing. There was no surfacing of sewage with pressure of footwear. No straight pipe discharges were found and no visible signs of malfunction were

observed (Table 1 and Appendix A, Table W23). There was no effluent odor within 10 feet of the system and no vegetation striping, although there was dormant vegetation over the crown of the AES technology. A surface diversion could be placed above the system to divert surface run-on away from the AES technology. There is some shelf rock below the system but no observed associated operational issues. The homeowner was available to be interviewed and expressed no problems with the system (Appendix A, Table W23).

Site R24 located at 642 W. Springfield Road, St. Claire, MO had a design soil loading rate of 0.65 gpd/sqft and 240 linear feet of AES (6 lines of 40 ft of product) (Table 1). Photos of this site and system are provided in photos R24-1 through R24-7 (Appendix B). This system was installed before May 2015. The summary of the field evaluation observed current surfacing effluent over part of the system and evidence of past surfacing. There was surfacing of sewage with pressure of footwear. No straight pipe discharges were found, however, visible signs of malfunction were observed (Table 1 and Appendix A, Table R24). There was no effluent odor within 10 feet of the system and no striping. Dark-colored vegetation covered most of the soil treatment area. There were mower tracks up and down the backslope of the breakout area. Additionally, there was compaction on the uphill side due to the parking of vehicles (Photo R24-3). This area of compaction would likely direct increased surface runoff onto the AES technology. The backslope had a very steep configuration of greater than 3 to 1 and possessed the greatest component of the breakout from the system, especially in the north to northeast facing areas (Photo 24-6). The homeowner was available to be interviewed, and expressed no problems, from their perspective, with the system (Appendix A, Table R24).

Site R25 located at 4934 Highway B, Villa Ridge, MO had a design soil loading rate of 0.30 gpd/sqft and 200 linear feet of AES (4 lines of 50 ft of product) (Table 1). Photos of this site and system are provided in photos R25-1 through R25-3 (Appendix B). This system was installed in November 2016. The summary of the field evaluation observed no current surfacing effluent over any part of the system nor evidence of past surfacing. There was no surfacing of sewage with pressure of footwear. No straight pipe discharges were found and no visible signs of malfunction were observed (Table 1 and Appendix A, Table R25). There were remote vents for the system. There was no effluent odor within 10 feet of the system and no effluent breakout. There was dormant vegetation over the crown of the AES technology. A surface diversion could be placed above the system to divert surface run-on away from the AES technology. Additionally there was no water in the observation ports. The occupants of this home were not available for an interview (Appendix A, Table R25).

Site R26 located at 43 Persimmon Court, Troy, MO had a design soil loading rate of 0.20 gpd/sqft and 210 linear feet of AES (3 lines of 70 ft of product) (Table 1). Photos of this site and system are provided in photos R26-1 through R26-3 (Appendix B). This system was installed in September 2016. The summary of the field evaluation observed no current surfacing effluent over any part of the system nor evidence of past surfacing. There was no surfacing of sewage

with pressure of footwear. No straight pipe discharges were found and no visible signs of malfunction were observed (Table 1 and Appendix A, Table R26). There was no effluent odor within 10 feet of the system and no effluent breakout. Good vegetative cover was observed, with no striping. There were dryness cracks over the septic tank. A surface diversion could be placed above the system to divert surface run-on away from the AES technology. The occupants of this home were not available for an interview (Appendix A, Table R26).

Site R27 located at 41 Persimmon Court, Troy, MO had a design soil loading rate of 0.25 gpd/sqft and 200 linear feet of AES (4 lines of 50 ft of product) (Table 1). Photos of this site and system are provided in photos R27-1 through R27-6) (Appendix B). This system was installed in November 2015. Repairs to this system were performed in October 2019 by Infiltrator utilizing AES installation protocols and specified soil material to cover exposed system sand on the downslope portion of the AES technology. Repairs were undertaken to complete the installation, which had been left unfinished relative to the AES manufacturer's installation instructions. The summary of the current field evaluation observed no surfacing effluent over any part of the system nor evidence of past surfacing. There was no surfacing of sewage with pressure of footwear. No straight pipe discharges were found and no visible signs of malfunction were observed (Table 1 and Appendix A, Table R27). This system pumps to a distribution box (Photo R27-6). There was no effluent odor within 10 feet of the system, and adequate vegetative cover. There was no evidence of past breakout and the system did not have any failure indicators at the time of assessment (Photo R27-4). There were many mole holes and ruts near the distribution box end of the system. This system has a sharp drop off on the absorption/treatment side that appears to be greater than 3 to 1, as required by the manufacturer. This area was very green, but was not excessively wet, just moist. The occupants of this home were not available for an interview (Appendix A, Table R27).

Site R28 located at 160 E. Pine Lake Drive, Troy, MO had a design soil loading rate of 0.20 gpd/sqft and 150 linear feet of AES (3 lines of 50 ft of product) (Table 1). Photos of this site and system are provided in photos R28-1 through R28-3 (Appendix B). This system was installed in January 2017. Repairs to this system were performed in October 2019 by Infiltrator utilizing AES installation protocols and specified soil material to cover exposed system sand on the downslope side of the AES technology. Repairs were undertaken to complete the installation, which had been left unfinished relative to the AES manufacturer's installation instructions, to place soil backfill over exposed system sand. The summary of the current field evaluation observed no surfacing effluent over any part of the system nor evidence of past surfacing. There was no surfacing of sewage with pressure of footwear. No straight pipe discharges were found and no visible signs of malfunction were observed (Table 1 and Appendix A, Table R28). There was no effluent odor within 10 feet of the system. Good vegetative cover was observed, with the vegetation on the crown of structure being dormant. This site could use a surface diversion to stop the intrusion of run-on water from higher elevations. The homeowner was available to be interviewed. He was dissatisfied with the original system installer, who did not answer calls

relative to the past breakout and trouble with the pump. These issues occurred prior to the 2019 repair work that completed the installation requirements (Appendix A, Table R28).

Site R29 located at 1565 Rahmier Road, Moscow Mills, MO had a design soil loading rate of 0.30 gpd/sqft and 162 linear feet of AES (2 lines of 81 ft of product) (Table 1). Photos of this site and system are provided in photos R29-1 through R29-3 (Appendix B). This system was installed in September 2016. The summary of the field evaluation observed no current surfacing effluent over any part of the system, nor evidence of past surfacing. There was no surfacing of sewage with pressure of footwear. No straight pipe discharges were found and no visible signs of malfunction were observed (Table 1 and Appendix A, Table R29). There was no indication of effluent breakout and no striping of vegetation. Some effluent odor that had a slight fats, oil, and grease (FOG)-like smell was evident in the observation port. A surface diversion could be placed above the system to divert surface run-on away from the AES technology, as well as moving the playground equipment off of the crown to prevent compaction (Photo 29-1). The homeowner was available to be interviewed and expressed no problems with the system (Appendix A, Table R29).

Site R30 located at 10960 Bailey School Road, Festus, MO had a loading rate of 0.20 gpd/sqft and 210 linear feet of AES (3 lines of 70 ft of product) (Table 1). Photos of this site and system are provided in photos R30-1 through R30-3 (Appendix B). This system was installed in August 2019. The summary of the field evaluation observed no current surfacing effluent over any part of the system, nor evidence of past surfacing. There was no surfacing of sewage with pressure of footwear. No straight pipe discharges were found and no visible signs of malfunction were observed (Table 1 and Appendix A, Table R30). There was no smell of effluent within 10 feet of the system. Sufficient vegetative cover was present. A surface diversion could be placed above the system to divert surface run-on away from the AES technology (Photo 30-3). The homeowner was available to be interviewed and expressed past problems with an effluent odor from the septic tank (Appendix A, Table R30). However, he indicated no problem with the soil based portion of the AES technology.

Evaluation Summary

Overall Assessment

The overall results of 30 individual AES system inspections found 29 AES systems operating properly. Only one system was failing according to terms of the “Experimental System Field Evaluation Protocol Infiltrator Water Technologies/Presby Environmental, Inc. Advanced Enviro-Septic System”. This system was site R24 at 642 W. Springfield Road, St Claire, Missouri. The site had a daily soil loading rate of 0.65 gal/sqft. Based upon over 30 years of experience evaluating soils for onsite wastewater systems in Missouri, the lead investigator

deemed the soil loading rate used to design the AES system sand footprint to be much greater than is characteristic of this area of Missouri based on the geology and soils of the area. Additionally, parking of vehicles on the uphill side had likely promoted compaction and greater run-on of surface water from upslope unto the AES dispersal/treatment area. A third consideration was that this installation had a downslope topography greater than the 3 to 1 slope required per the manufacturer's installation instructions. In summary, multiple factors caused by possible undersizing, poor installation, and lack of maintenance likely had a negative influence on the performance of this system.

It should also be noted that sites R27 and R28 were reported by the Infiltrator personnel to have had installation/installer follow-up problems relative to conforming with the manufacturer's AES installation protocol and procedures that would be expected regardless of technology installed at the site. This incomplete installation and lack of installer follow-up after installation likely contributed to the startup problems and less than expected performance of the AES technology immediately after installation. However, no problems were observed in this assessment as, following the change in ownership of Presby Environmental, Inc., Infiltrator-led repairs took place several years earlier, including covering the downslope exposed system sand on the downslope with soil material as required under the manufacturer's installation instructions. Completing the installation with these repair activities brought the systems to a state of proper function, which appeared to be occurring during the site evaluations.

Geographical Assessment within Missouri

This study utilized sites from three major geographical areas of Missouri: the Kansas City area, southwest Missouri with major emphasis in the Branson, Table Rock Lake area, and the St. Louis area primarily north and south of the metro area.

Twelve systems were assessed in the Kansas City area (Figure 2). This area is represented by assessments M1 to M12. This area had a wide array of sites that possessed soil loading rates ranging from 0.20 to 0.50 gpd/sqft. One system was a business (M4, Dollar General Store) with the others being residential single-family homes. All systems were functioning as designed, with no negative objective site assessment components noted in any of the assessed systems (Table 1). When home occupants were interviewed, their responses were positive about the performance and satisfaction with the system. Suggested long-term sustainability enhancements would be surface water control measures to divert surface run-off

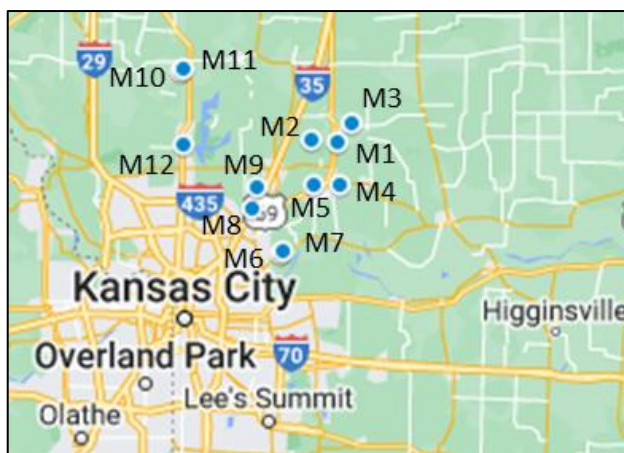


Figure 2 – Kansas City-area site locations

from higher elevations away from the AES system to limit water intrusion, especially during wet periods, and to limit the probability of erosion. The control of excessive vegetative growth could be limited by mowing vegetation to promote evapotranspiration. Based on information stated by Infiltrator personnel, it appears selection of trained and certified installers who follow AES protocol and manufacturer's installation procedures, assisted with the positive performance of the systems. Overall, all of the AES systems in the Kansas City area performed satisfactorily.

The southwest Missouri/Branson area assessment component consisted of 11 systems (sites T13 through W23, Figure 3). This area had a wide array of sites that possessed soil loading rates ranging from 0.20 to 0.40 gpd/sqft. This area possessed many systems that were constructed on smaller lots and greater sloping sites as a result of the lake environment.

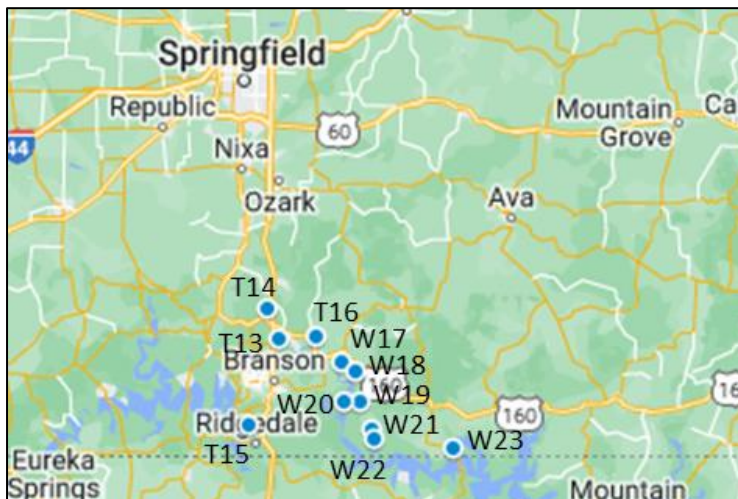


Figure 3 – Southwest Missouri-area site locations

This required greater care in meeting setback distances. All of the systems were functioning as designed, with no negative site evaluation components noted in any of the assessed systems (Table 1). When home occupants were interviewed, their responses were positive about the performance and satisfaction with the system. Suggested long-term sustainability enhancements would be surface water control measures to divert surface run-off from higher elevations away from the AES system to limit water intrusion, especially during wet periods, and to limit the probability of erosion. Avoiding scalping the soil surface and vegetation while mowing could, along with maintaining a full vegetative grass cover over the system, provide physical stability of the surface. A greater likelihood of long-term performance of the AES technology would result. Based on information stated by Infiltrator personnel, it appears selection of prudent installers who follow AES protocol and manufacturer's installation procedures assisted with the positive performance of the systems. Overall, all of the AES systems in the southwest Missouri/Branson area performed satisfactorily.

The St. Louis area assessment component consisted of 7 systems (sites R24 through R30, Figure 4). This area had a wide array of sites that possessed soil loading rates ranging from 0.20 to 0.65 gpd/sqft. All the systems were functioning as designed with no negative objective site assessment components noted in any of the assessed systems (Table 1) except for site R24. When home occupants were interviewed, their responses were mostly positive about the performance and satisfaction with the system. Those that expressed dissatisfaction centered on the installers that did not return calls immediately after reporting pump problems or indicators of breakout. As

reported by Infiltrator personnel, many of these follow-up activities were later addressed by Infiltrator personnel following the change in ownership of Presby Environmental, Inc. in 2019. One system that had a lesser than expected performance is site R24, which used a 0.65 gpd/sqft soil loading rate. This soil loading rate is much greater than expected for the soils of this area based on the distribution and prevalence of soil textures in Missouri. The parking of vehicles on the upslope side of this system as noted earlier could have contributed to the poor performance of the system. A third consideration was that this installation had a downslope topography greater than the 3 to 1 slope required per the manufacturer's installation instructions. Two of the other systems in the area that have reported less than expected performance (sites R27 and R28) three years prior to this field performance



Figure 4 – St. Louis-area site locations

assessment appear to be performing better than immediately after start-up and the reported problems with lack of follow-up by the installer. In both cases, the systems were modified with placement of soil backfill over exposed system sand, effectively completing the installation process, which had not been achieved at the time of initial AES system installation. Infiltrator undertook the installation completion work following the change of ownership of Presby Environmental, Inc. in 2019. Once the repairs were completed and the systems were brought into compliance with the manufacture's installation procedures, they began functioning properly, as verified through the inspection conducted during this study.

Suggestions for long-term sustainability of the St. Louis-area systems would be surface water control to divert surface run-off from higher elevations away from the AES system to limit water intrusion, especially during wet periods, and to limit the probability of erosion. It was noted with at least two systems that performance could potentially be impaired from compaction by the parking of vehicles immediately on the upslope side, which likely increased compaction and water intrusion onto the system (site R24) or placement of playground equipment on the crown of the AES technology (site R29) could decrease the long-term performance of the system. All of the systems in the St. Louis area except site R24 were performing satisfactorily at the time of this assessment. The AES systems in the St. Louis area that performed satisfactorily from initial start-up appear to be installed by prudent installers who follow AES protocol and manufacturer's installation instructions and assisted in consultation with a prudent designer in the area that is very particular with design and construction details of AES systems.

Soil Loading Rate Assessment

Soil loading was a strong consideration in setting the design parameters of this study to assist in assessing the long-term sustainability of AES technology. Per the “Experimental System Field Evaluation Protocol Infiltrator Water Technologies/Presby Environmental, Inc. Advanced Enviro-Septic System”, the two major soil loading rate categories were equal to or less than 0.25 gpd/sqft and greater than 0.25 gpd/sqft, with a minimum of 7 and 20 AES system inspections required for installations in each category, respectively. The study met the requirements associated with each soil loading rate category, with 7 sites investigated with soil loading rates less than 0.25 gpd/sqft and 23 sites investigated with soil loading rates exceeding 0.25 gpd/sqft. Figure 5 provides the distribution of soil loading rates for all sites included in the study, divided into three broad categories. For systems installed in soils having a soil loading rate greater than 0.25 gpd/sqft, 21 of the sites were in soils having a soil loading rate between 0.25 and 0.40 gpd/sqft. Only 2 sites were installed in soils having a soil loading rate greater than 0.40 gpd/sqft.

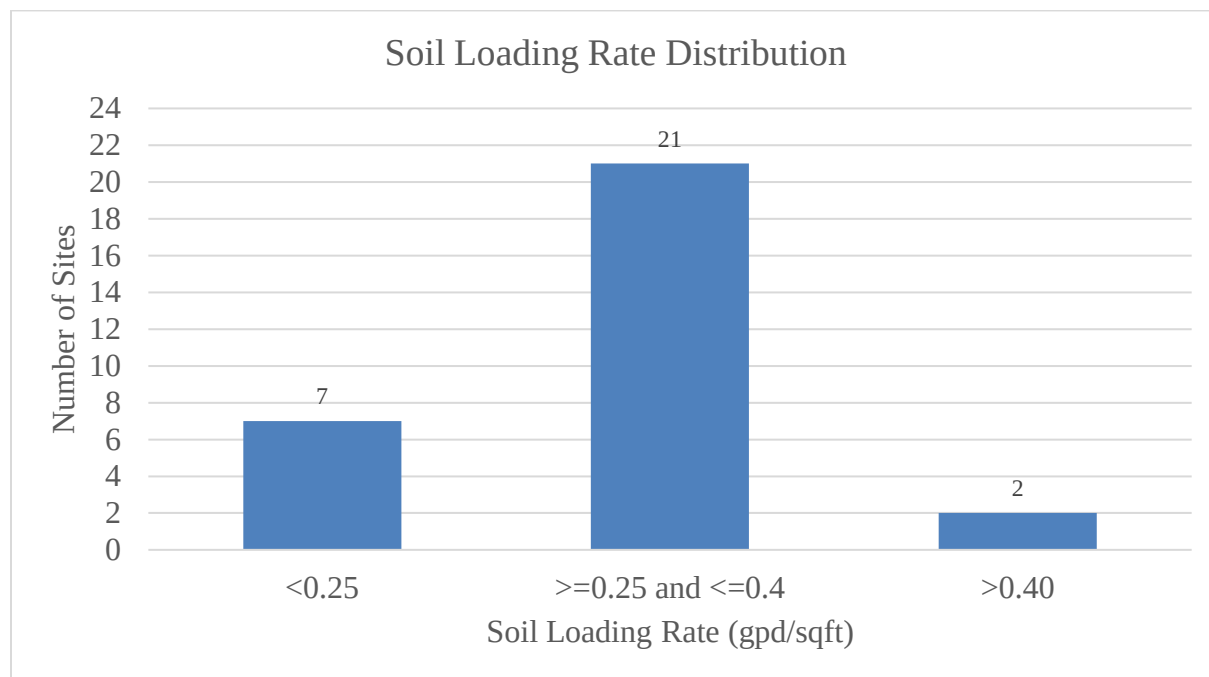


Figure 5: Soil loading rate distribution for all study sites

There were 7 systems that had soil loading rates of less than 0.25 gpd/sqft; 2 sites in the Kansas City area; 2 in the southwest Missouri/Branson area with 3 in the St. Louis area. The systems for this lesser loading category in both the Kansas City and southwest Missouri/Branson areas were observed to perform satisfactorily. Two in the St. Louis area, sites R28 and R30, had start-up concerns because the initial installation was not completed in conformance with the manufacturer’s installation procedures. Site R28 (Table 1) had no observed problems during this field performance assessment but had reported startup problems that were linked to installer issues that Infiltrator addressed in October 2019, with the placement of specified soil on top of

exposed system sand of the AES technology. Additionally, site R30 had homeowner concerns with an effluent odor from the septic tank, but no present or past problems with AES technology soil based components.

There were 23 systems that had soil loading rates of equal to or greater than 0.25 gpd/sqft; 11 sites in the Kansas City area; 8 in the southwest Missouri/Branson area; and 4 in the St. Louis area. The systems in this higher loading rate category in the Kansas City and southwest Missouri/Branson areas all were assessed to be performing as designed (Table 1). Field observations of surface water diversions, as well as proper mowing protocols, in concert with vegetative cover for enhancement of long-term sustainability, will assist with system longevity. The three greater than 0.25 gpd/sqft soil loading rate sites in the St. Louis area initially were not installed in accordance with the manufacturer's installation procedures and requirements and experienced signs of malfunction. Ultimately, these systems had favorable performance when appropriate design, maintenance, and management were utilized. As discussed previously, site R24 had the greatest loading rate in this study and exhibited signs of failure. The likelihood of an exceedingly large loading rate for the soil and poor maintenance of the site by the homeowner have been linked to this rating. Site R25 received a satisfactory rating (Table 1). Additionally, site R29 had a satisfactory rating (Table 1). Repairs were made following Infiltrator's purchase of Presby Environmental, Inc., and each system received a satisfactory rating in the current evaluation (Table 1). Overall, the larger loading rate category had a high success rating with the exception of site R24, which had a number of design-, maintenance- and management-related anomalies.

Based on the summary of the two soil loading rate categories established for this field performance assessment, AES installations in both categories can be expected have a large degree of success in the future AES. This large degree of success is highlighted by the fact that the evaluated AES systems are mature, ranging from 3 up to 8 years old after installation. The prudent input of the soil evaluator, designer, and installer, along with consistent education of the homeowner in management and maintenance of the system is key to long-term sustainability and performance of the AES technology.

Age Assessment

Per the "Experimental System Field Evaluation Protocol Infiltrator Water Technologies/Presby Environmental, Inc. Advanced Enviro-Septic System", a minimum of 27 site inspections were required for a one-time site visit when the AES installation was 3 or more years old. This requirement was satisfied with 29 one-time site inspections of systems having been installed for 3 or more years. One site was installed for 2.9 years at the time of inspection, narrowly missing the 3-year age requirement. The oldest system was installed for 8.2 years. Figure 6 provides the distribution of AES system installation ages within the 30-system sample population, with individual site system ages presented in Table 1. The average system age within the 30-system sample size is 5.2 years. The largest of the three age groups was equal to or greater than 4 years,

up to 6 years old, with 15 systems evaluated. The 2-to-4 and 6-to-9 year age groups contained 7 and 8 systems, respectively. Site R24, which was the only system to demonstrate evidence of failure during the field performance assessment, was in the oldest age group, at 7.2 years old.

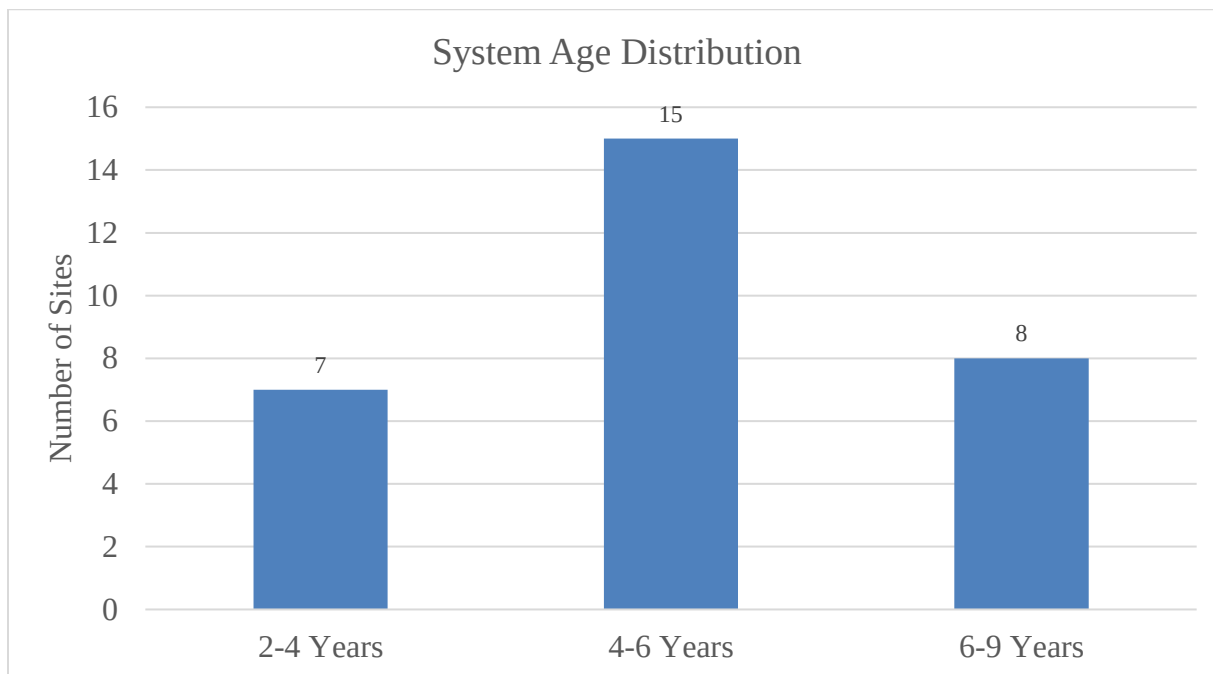


Figure 6: Age-of-installation distribution for all study sites

Conclusions and Future Considerations

Based on the study of AES systems installed for at least three years in three geographical areas of Missouri with a wide array of soil loading rates and site conditions such as lot size, slope, and wastewater volume, many conclusions can be stated for long-term adaption to Missouri. With proper assessment of soil and site conditions, along with prudent design of the AES technology for those conditions and installers properly applying the AES installation protocols and procedures, the AES technology has a high probability of functioning as intended both after initially installed and for a long-term portion of the home site life cycle. With appropriate education of the homeowner, the long-term sustainability of the AES system can further be assured.

This study illustrated that AES technology can properly function with a large degree of success in three geographical areas of Missouri. Sites with a wide variety of soil loading rates, ranging from 0.20 to 0.65 gpd/sqft, and various slopes, from moderate in the Kansas City and St. Louis areas, to steeper in the southwest Missouri/Branson area were included in the evaluation. Additionally, many of the residences had a variety of wastewater loads of one to five bedrooms.

One of the major factors for proper function of the AES technology and homeowner satisfaction appears to be proper designer input along with installers diligently following AES installation protocol and procedures for handling of specified media and proper slope of the downslope component of the technology. The handling of specified media with proper placement by installers has been a common problem since the implementation of the Missouri statewide onsite wastewater code in 1996. This installer weakness has been prevalent in basic conventional trench systems with greater problems, where diligent, design placement of specified media materials is very critical to the long term functioning of the onsite system. The high degree of functional success found in this study of mature AES systems with a minimum of 3 years of use, is a strong testament to the suitability of this technology in a variety of Missouri soil site landscapes.

According to Infiltrator personnel, AES installers are required to go through certification training to install this technology. This requirement is critical. Training for all installers of this technology is recommended. Continued education for the installers, in concert with continuing education for designers, is also recommended.

Since the AES technology may be new to other areas of Missouri, specific AES technology-oriented training for regulators, installers, designers, and soil evaluators is recommended. With the traditional high turnover of onsite regulator personnel, continual basic education of AES technology for use in their area of jurisdiction is important. For many areas of Missouri, the AES technology has a high probability of adaptation. Therefore, the regulators should have firsthand information, such as details of this study, as well as field visits to these sites or similar sites in the state. Historical experience with onsite wastewater systems in Missouri, and involvement with associated training has shown that soil evaluators are not always up to date with technology based systems beyond the basic trench systems. Training for the soil evaluators to inform landowners, designers, and regulators of the AES technology and performance provides valuable information for “another tool in the toolbox” for a successful, long-term technology adaptation for many sites.

Development of homeowner education for owners of AES systems is strongly suggested. The need for diversion of surface water to eliminate the intrusion of water onto the AES technology, and not driving directly or compacting over the AES system, or placing playground equipment or yard chairs, picnic tables on or near the AES system was noted during the field survey work. An education system for regulators and installers to educate the homeowner, along with the development of a homeowner educational booklet could be valuable in maintaining the long term proper functioning of the AES technology.

The long-term sustainability of the AES technology includes insuring that surface water controls are present, to divert stormwater run-off originating from upslope areas away from the AES system, in order to limit water intrusion and the possibility of erosion. Controlling excessive growth by mowing promotes efficient effluent dispersal through evapotranspiration. Avoiding vehicular traffic on and around the AES installation site protects against soil compaction that can

reduce soil permeability within, around, and beneath the site that reduces the soil receiving permeability. The use of trained and certified installers who follow the manufacturer's installation procedures and protocols increases the likelihood of successful long-term operation. Two systems were initially installed without all of the system sand being covered with sufficient soil backfill, resulting in surfacing effluent over two years prior to this field assessment. Once the installations were completed with the addition of the backfill per the manufacture's installation procedures, the systems functioned properly.

In summary, 29 of the 30 AES technology based systems evaluated in this assessment study were functioning properly at this time of field evaluation. The lone failing system was designed using a soil loading rate that was significantly greater than expected for soils of this area. The end result of this type of soil loading rate incongruity is an undersized system sand footprint having less effluent dispersal area than would otherwise be required. Under terms of the "Experimental System Field Evaluation Protocol Infiltrator Water Technologies/Presby Environmental, Inc. Advanced Enviro-Septic System", this site could be eliminated from consideration in determining the rate of failure for this study, but it was not due to the uncertainty associated with the soil characterization. From the observations experienced through examining 30 sites the performance of these mature soil based treatment systems was found to be exceptional. This large positive rate of successful function for an intact onsite wastewater system of over three years in age is much greater than observed with other soil based technologies studied.

Field Evaluation Protocol Recommendation

In summary, utilizing the "Experimental System Field Evaluation Protocol Infiltrator Water Technologies/Presby Environmental, Inc. Advanced Enviro-Septic System", systems were divided into two "Study Groups". Study Group 1 included systems designed with >0.25 gpd/sqft soil loading rates of which a minimum of 20 sites would be evaluated. Study Group 2 included systems designed with ≤ 0.25 gpd/sqft soil loading rates of which a minimum of seven sites would be evaluated. In Study Group 1, if $\leq 10\%$ of systems evaluated were determined to be in a condition of failure, AES would be deemed to have passed the DHSS field performance assessment endpoint requirements. With Study Group 2, if $\leq 15\%$ of systems evaluated were determined to be in a condition of failure, the AES system would be deemed to have passed the DHSS field performance assessment endpoint requirements.

In Study Group 1 one system failure was identified, resulting in a 4.3% failure rate (1 site failure of 23 total sites = 4.3%). The minimum number of site inspections based upon soil loading rate was met, the failure rate was below that allowed, and system age was satisfied for Study Group 1. Accordingly, the AES system passed the field evaluation for use on sites with >0.25 gpd/sqft soil loading rates. In Study Group 2 no system failures were identified, resulting in a 0.0% failure rate (0 site failure of 7 total sites = 0.0%). The minimum number of site inspections based upon soil loading rate was met, the failure rate was below that allowed, and system age was

satisfied for Study Group 2. Accordingly, the AES system passed the field evaluation for use on sites with ≤ 0.25 gpd/sqft soil loading rates. Based upon this information, the AES technology qualifies to transition from experimental to general use approval under the terms of the “Experimental System Field Evaluation Protocol Infiltrator Water Technologies/Presby Environmental, Inc. Advanced Enviro-Septic System”.