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Understanding Problems and Identifying Solutions for Texas OSSFs using Drip Irrigation

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APPENDIX B - Field visits to drip systems conducted on May 3-4, 2023, in Hood County, Texas, near Lake Granbury. Features, issues, and recommendations identified with the Health Department staff and local designers and installers.

EXECUTIVE SUMMARY

Drip irrigation systems provide precise application and allow for improved use of the application area. Almost four percent (more than 40,000) of the total permits (Authorization To Construct, ATC) issued during the last 30 years in Texas are for drip irrigation. In 2022, more than 9% of the permits were issued for drip systems. Industry professionals have frequently observed problems with drip irrigation and there is potential for improving its performance, especially in terms of effluent distribution uniformity and maintenance.

To answer the questions posed in the RFGP, the project gathered and summarized information from surveys, existing literature, and field experiments with focus on aspects specific to Texas conditions (i.e., dosing technique, application rate, effect of soil type, installation configuration, flushing method, filtering type and method, and tubing cleaning). This resulted in a unique compilation of recommendations and a guidance document that will support license holders, regulators, and landowners to implement successful drip irrigation configurations and design practices. The research also identified gaps in current regulations to aid TCEQ when considering potential rule or policy changes.

The project was carefully planned by preparing a Quality Assurance Project Plan (QAPP), approved by TCEQ, and collecting suggestions and recommendations from license holders, regulators, and homeowners. Such useful recommendations were collected by organizing two TOGP committee's meetings during the project. QAPP approval time, limited resources, and design and testing times shortened effective field activity. The no cost extension allowed by TCEQ was helpful to allow for additional field activity.

AgriLife designed a survey form titled "*Survey to get your feedback for improving DRIP design in terms of effluent distribution uniformity, and ability to maintain the system*". The survey was distributed both at in person events and online. Once approved by TCEQ the survey was launched at the TOWA 2023 annual meeting (March 8, 2023), and later also presented at the NOWRA conference. A total of 38 surveys were completed and contact information was included by 50% of the participants. Overall, 6,226 systems are represented in this summary, where each answer is multiplied by the number of systems owned, designed, installed, maintained, and inspected. Results consistently suggested to put special focus on the following issues: 1) Dosing (on and off times) and application rates, 2) Drip installed in imported soil or fill material, 3) Drip installed in slopes, and depressions, 4) Filter clogging, 5) Excessive water usage / undersized dispersal area, and 6) Drip system maintenance. The most represented roles have been Installer, Maintenance Provider, and Owner.

Existing literature was consulted and included rules from North Carolina and Virginia, private sector (e.g., American Manufacturing, JNM Technologies, Inc.), NOWRA guidance, Consortium of Institutes for Decentralized Wastewater Treatment (CIDWT), Electric Power Research Institute (EPRI) & Tennessee Valley Authority (TVA). Consulted documentation suggested that more could be detailed in the Texas rules, such as minimum soil absorption area, minimum dose volume per zone, percolation rates, specific local conditions.

Field visits included a two-days tour of the Hood County drip systems on May 3-4, 2023, near Lake Granbury, as well as a follow up 1-day tour on May 2, 2024. The Health Department staff and local designers and installers guided the visit to observe and understand real word problems. The main problems were related to 1) Wrong timer settings/models, 2) Surfacing on first year, 3) External runoff on drain field, 4) Intermittent use (e.g., B&B).

The field experiment was conducted at the Texas A&M University (TAMU) OSSF Center, at Texas A&M RELLIS Campus, Bryan Texas, and addressed questions regarding flushing methods, filters (screen and disc), and cleaning procedures. Systems performances were determined by comparing measurements of Total Suspended Solids (TSS), flow rates, pressure, filters status, and drip tubing status after artificially induced clogging. In spring 2023 the experiment set up was finalized and pressure set at 36 psi for inflow and 31 psi for return flow, dosing set at 4 minutes ON and 56 minutes OFF, and flow rate at 100 gal/day. Pressure compensating drip tubing was placed in two wetland cells available at the Center (two 150-ft long runs in each) and laid out about two inches below the gravel. The two wetlands were fed by two ATUs where filters were compared, and one trash tank and one aeration tank fed both ATUs. Samples were collected from the bottom of the pump tank and artificial clogging induced by adding sludge about once a week in the pump tank, and toilet paper about 3 times a week in the clean outs between the trash tank and the aeration tanks. To accelerate clogging and to perform cleaning, back flow from filters was capped and lines flushed, and at the end one filter was completely removed.

Main results from the field experiment included:

- Flow to ATUs was relatively constant for the entire study period.
- After adding chicken feed, sludge, and toilet paper, pump filters became clogged. It was decided to stop using chicken feed and to add toilet paper before the aeration tank.
- Artificial clogging was successful, with high water alarm occurring on five occasions: August 28, September 18, October 10, November 8, and November 30, 2023.
- It appeared that adding sludge only or capping back flow only did not have an evident effect unless combined. Effects included decrease of flow and increase of TSS and pressure. Conditions went back to normal once artificial clogging was interrupted.
- Flashing the lines determined an evident increase in flow.
- Compared filters did not show evident differences in terms of flow, pressure, or TSS.
- The drip line was sectioned toward the end of the experiment. Deposits outside the tubing near the emitters, inside the tubing, and inside the emitters were found.
- TSS in the return flow water (first water discharged) was much higher than in the water sampled from the bottom of the trash tank (about 20 times).

Based on the results obtained from the activity reported, the **project questions** can be answered as follow:

1) What are the operational problems faced by the users and operators with the current drip irrigation design in Texas? **ANSWER:**
    a. Based on the survey that was conducted, and weighting the answers based on the number of systems owned, designed, installed, maintained, and inspected, the main issues are related to: 1) Dosing (on and off times) and application rates, 2) Drip installed in imported soil or fill material, 3) Drip installed in

slopes, and depressions, 4) Filter clogging, 5) Excessive water usage / undersized dispersal area, and 6) Drip system maintenance.

b. Based on the survey that was conducted but removing the answers from a designer that alone represented 3-4,000 systems, the main issues are related to: 1) Drip system maintenance, 2) Excessive water usage/undersized dispersal area, 3) Mechanism to flush the drip tubing, and 4) Dosing (on and off times) and application rates.
c. Based on the field visit conducted in Hood County, the main issues are related to 1) Wrong timer settings/models, 2) Surfacing on first year, 3) External runoff on drain field, 4) Intermittent use (e.g., B&B).

2) <u>Can the current design, installation, and maintenance be improved to achieve better distribution of effluent and to allow for better performance of drip irrigation systems</u>? **<u>ANSWER</u>**: Based on the project conducted (survey, literature, field visits, and field research), it appears that there is a margin for improving water distribution and obtaining better performances. Our study was limited in time and resources, but several recommendations were drafted. These include all steps of designing, installing, and maintaining the systems, and suggest that Texas rules could be improved. The main areas for improvement appear to relate to insufficient distribution surface area, filtering set up, and maintenance requirements in the regulation.
3) <u>Do screened filters perform better than disc filters, and how does auto-backflushing affect the performance of both types of filters</u>? **<u>ANSWER</u>**: Based on all information collected, but mostly field visits and research, it appears that different filters may perform differently, but that all other factors of design, management, installation, and inspection could have more influence over the type of filter; at least in the short/medium period. Backflushing of filters, on the other hand, appeared to be a key factor in determining drip systems' performances.
4) <u>Are changes required in the current design specifications of a drip irrigation system in 30 TAC Chapter 285, and if so, what changes are recommended</u>? **<u>ANSWER</u>**: The research indicated that an effort is needed to identify the priorities for changes in the current design specifications. The current research was too limited to recommend specific ones, but certainly more flexibility is needed to adapt design to the specific local site conditions to ensure better performance of drip irrigation systems in Texas.

INTRODUCTION

In Texas, in the late 80s and early 90s, legislators debated and passed a law requiring the state's environmental regulatory agency to award competitive grants supporting applied research and demonstration projects regarding on-site wastewater treatment technologies. Funds were provided by a $10 fee collected from each OSSF permit. In year 2011, the Onsite Wastewater Treatment Research Council was sunset, and the oversight of the research grant program (Health and Safety Code Chapter 367) was moved to TCEQ; 82(R) HB 2694 took effect in September 2011. Thanks to political lobbying efforts by the Texas Onsite Wastewater Association in 2017 the 85th Texas Legislative Session passed HB 2771 that required TCEQ to renews the research funding and to include wastewater reuse as a one of the possible research topics. HB 2771 went into effect in September 2017.. As a result, the Texas Commission on Environmental Quality (TCEQ) in 2019 announced a Request for Grant Application (RFGA Number 582-19-93772), as part of the Texas OSSF Grant Program (TOGP). The RFGA called for research addressing four topics: 1) black water non-potable reuse, 2) implementation of low-pressure dose systems with various configurations, 3) dosing verses non-dosing in aerobic treatment units (ATU), and 4) adequacy of ATUs designs with higher strength wastewater. Texas A&M AgriLife was awarded three contracts to address all four research topics. In 2021 TCEQ announced a second TOGP RFGA (Number 582-21-10767). The RFGA called for research addressing four topics: 1) Wastewater Treatment Challenges at RV Parks, 2) Aerobic Treatment Units in the Real World (Sampling and New Data), 3) Proper Dosing Techniques and Application Rates for Drip Irrigation, and 4) Reduction of Wastewater Effluent from On-Site Sewage Facilities. Texas A&M AgriLife was awarded three contracts to address all four research topics. This report regards the contract addressing topic 3, which was titled "Understanding Problems and Identifying Solutions for Texas OSSFs using Drip Irrigation."

Drip irrigation systems provide precise application and allow for improved use of the application area. Almost four percent (more than 40,000) of the total permits (Authorization To Construct, ATC) issued during the last 30 years in Texas are for drip irrigation. In 2022, more than 9% of the permits were issued for drip systems (Figs. 1 and 2)[1]. The utilization of drip irrigation will increase in OSSF systems installed in Texas in response to issues such as limited space and challenging site conditions. Industry professionals have frequently observed problems with drip irrigation and there is potential for improving its performance, especially in terms of effluent distribution uniformity and maintenance. These improvements would substantially impact central Texas where Drip Irrigation systems are quite common. Demonstrated success in this region would encourage application of drip irrigation solutions in other parts of Texas.

This applied research and demonstration project was designed to answer the following four main questions: 1) What are the operational problems faced by the users and operators with the current drip irrigation design in Texas? 2) Can the current design, installation, and maintenance be improved to achieve better distribution of effluent and to allow for better performance of drip irrigation systems? 3) Do screened filters perform better than disc filters, and how does auto-backflushing affect performance of both types of filters? 4) Are changes required in the current

[1] TCEQ On-Site Activity Reporting System website, https://www.tceq.texas.gov/permitting/ossf/on-site-activity-reporting-system (last visit June 17, 2023).

design specifications of a drip irrigation system in 30 TAC Chapter 285, and if so, what changes are recommended?

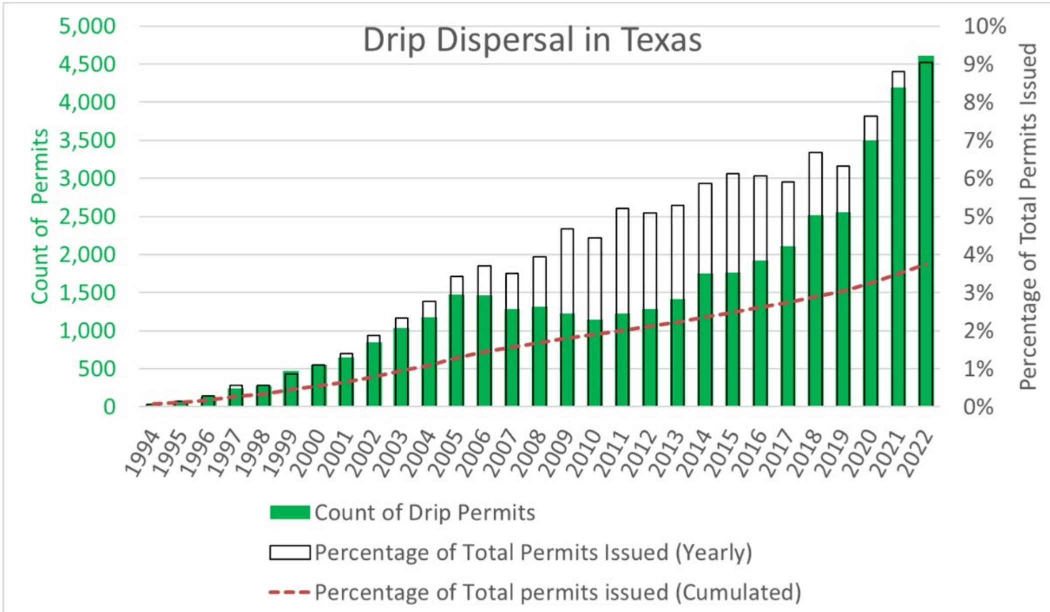
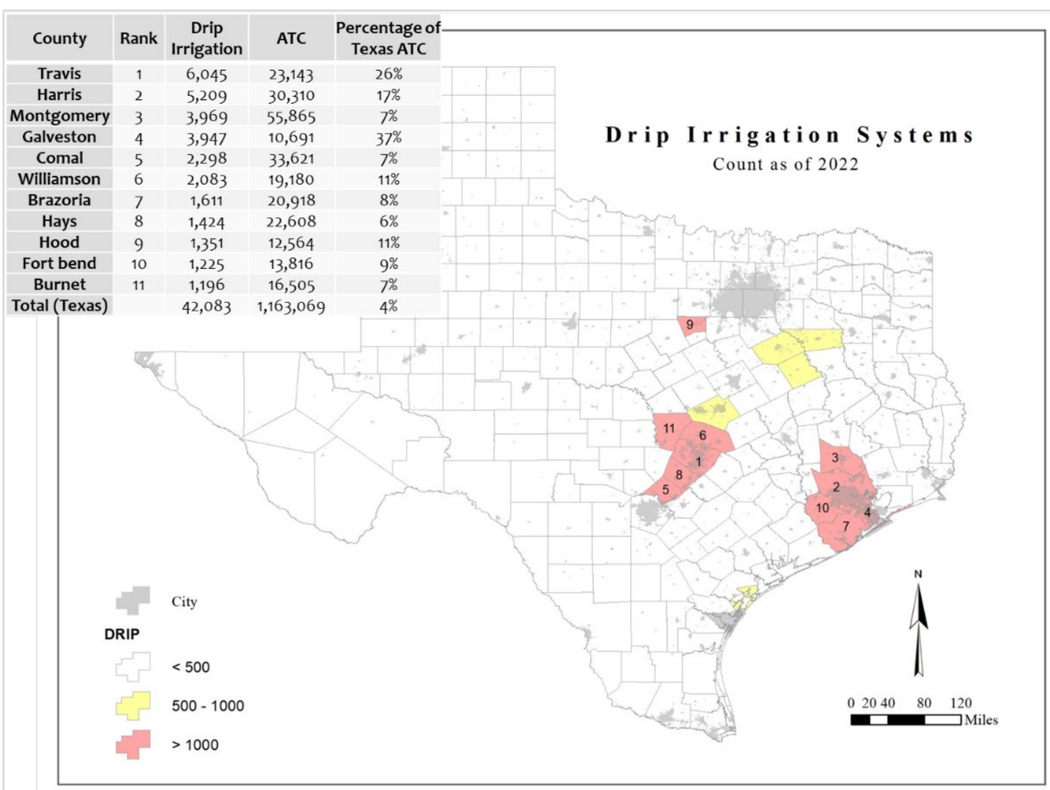


Figure 1. Drip irrigation permits (Aerobic Treatment Unit followed by Drip) issued as of 2022 in Texas (Authorization To Construct, ATC). Data is compiled from TCEQ's annual permit dataset *(OARS)* by *the Texas A&M University (*TAMU*)* OSSF Team



County	Rank	Drip Irrigation	ATC	Percentage of Texas ATC
Travis	1	6,045	23,143	26%
Harris	2	5,209	30,310	17%
Montgomery	3	3,969	55,865	7%
Galveston	4	3,947	10,691	37%
Comal	5	2,298	33,621	7%
Williamson	6	2,083	19,180	11%
Brazoria	7	1,611	20,918	8%
Hays	8	1,424	22,608	6%
Hood	9	1,351	12,564	11%
Fort bend	10	1,225	13,816	9%
Burnet	11	1,196	16,505	7%
Total (Texas)		42,083	1,163,069	4%

Figure 2. Drip irrigation permits (Authorization To Construct, ATC) issued as of 2022. *Drip* systems are implemented in Texas mostly in the Central and Southeast regions, especially in proximity of largest cities *such as Austin, San Antonio, and Houston.*

To answer these questions, the project gathered and summarized information from surveys, existing literature, and field experiments with focus on aspects specific to Texas conditions (i.e., dosing technique, application rate, effect of soil type, installation configuration, flushing method, filtering type and method, and tubing cleaning). This resulted in a unique compilation of recommendations and a guidance document that will support license holders, regulators, and landowners to successfully implement drip irrigation configurations and design practices. The research also identified gaps in current regulations to aid TCEQ when considering potential rule or policy change.

Challenges related to the proposed research included the ability to obtain sufficient responses from administered surveys and the amount of field experimentation that could be accomplished within the specified budget. As addressing each of the separate research topics related to drip irrigation strictly through field experimentation was not feasible, part of the topics was investigated only with the survey and a comprehensive literature review. Such documentation provided a substantial and useful starting point in terms of standardized documentation for Texas license providers and regulators.

MATERIALS AND METHODS, RESULTS, AND DISCUSSION

Specific objectives of this project included the following: 1) Create a survey instrument to query and interview regulators and license holders regarding the most common design, installation, operation, maintenance and troubleshooting procedures associated with drip irrigation systems in Texas; 2) Conduct an extensive literature review of scientific articles and existing local, state, and federal publications regarding drip irrigation practices. 3) Conduct field experiments at the TAMU OSSF center evaluating drip irrigation flushing and filtration performance and irrigation line cleaning solutions; 4) Summarize designs, installation practices, maintenance schemes, and troubleshooting procedures based on surveys, interviews, literature reviews and field experiments, and prepare a guidance document describing best practices for installing, operating, maintaining, and troubleshooting drip irrigation systems in Texas.

Control in the planning phases was ensured by the compilation of a Quality Assurance Project Plan (QAPP), which was part of the contract and followed TCEQ and USEPA standards (EPA, 2001; TCEQ, 2014). The QAPP was compiled in collaboration with TCEQ to define all details of the project and was approved on October 4, 2022. Additional feedback on the survey and field design and preliminary results was obtained at two Texas OSSF Research Grant Program (TOGP) Committee Meetings, which were organized and held at the Texas A&M RELLIS Campus (October 12, 2022, and September 26, 2023). Attendees represented academic institutions, onsite wastewater industry, and regulatory agencies (Figure 3). Preliminary results, including the official launch of the survey, were also presented at the annual Texas On-Site Wastewater Association (TOWA) and National On-Site Wastewater Recycling Association (NOWRA) conferences.

Figure 3. Texas OSSF Research Grant Program (TOGP) Committee Meetings held at the Texas A&M RELLIS Campus on September 26, 2022. Attendees represented academic institutions, onsite wastewater industry, and regulatory agencies, and provided feedback on project design.

This chapter includes details related to the work plan, design, and monitoring results. The survey was distributed in all Texas at the beginning of the study period, both at in person events and online. The field experiment was conducted at the Texas A&M University (TAMU) OSSF Center, at Texas A&M RELLIS Campus, Bryan Texas. Safety at the TAMU OSSF Center has been addressed with assistance from the Texas A&M School of Public Health (TAMSPH) and the Texas A&M Office of Biosafety (TAMOB). TAMSPH developed a Hazard Analysis and Critical Control Point (HACCP) plan to ensure the safety of visitors, students and staff working at the facility. Permit #IBC2018-101 has been issued by the Institutional Biosafety Committee through TAMOB and allows the facility to use wastewater for training and research purposes. All students and staff working at the facility are required to be familiar with the HACCP plan and utilize all required and recommended safety equipment/gear when working with wastewater and wastewater treatment systems at the facility.

Survey

AgriLife developed the "*Survey to get your feedback for improving DRIP design in terms of effluent distribution uniformity, and ability to maintain the system*" form for OSSF license holders, regulators, and homeowners to determine the type and magnitude of problems faced in Texas with DRIP systems. The form was submitted to TCEQ for approval on October 13, 2022, and was approved on December 15. The 2-page survey form asks for information about the individual and the number of systems designed, installed, maintained, and inspected, and the observed problems and their frequency. A large space is provided to include comments and suggestions, and a final section provides contacts and background about the project. The draft version of the survey was presented at the NOWRA annual mega conference on November 1, 2022. Upon approval of the survey by TCEQ, it was launched at the TOWA 2023 annual meeting on March 8, 2023. A copy of the approved survey form is reported in Appendix A, together with all surveys results (including slides presented to the NOWRA conference on October 23, 2023, summarizing surveys descriptive comments).

A total of 38 surveys were completed. Contact information was included by 50% of the participants. Summary results from all surveys received are reported in Figure 4. Overall, 6,226 systems are represented in this summary, where each answer is multiplied by the number of systems owned/designed/installed/maintained/inspected, and a system is counted for each problem indicated (some individuals indicated more than one problem).

Although one of the participants represented 3-4,000 systems, results consistently suggested to put special focus on the following issues:

1. Dosing (on and off times) and application rates,
2. Drip installed in imported soil or fill material,
3. Drip installed in slopes, and depressions,
4. Filter clogging,
5. Excessive water usage / undersized dispersal area, and
6. Drip system maintenance.

If the individual that represented 3-4,000 systems was not considered, the most represented role would have been Designer, followed by Installer and Regulator (as the individual was Owner, Installer, and Maintenance Provider), and top issues would have been:

1. Drip system maintenance,
2. Excessive water usage/undersized dispersal area,
3. Mechanism to flush the drip tubing, and
4. Dosing (on and off times) and application rates.

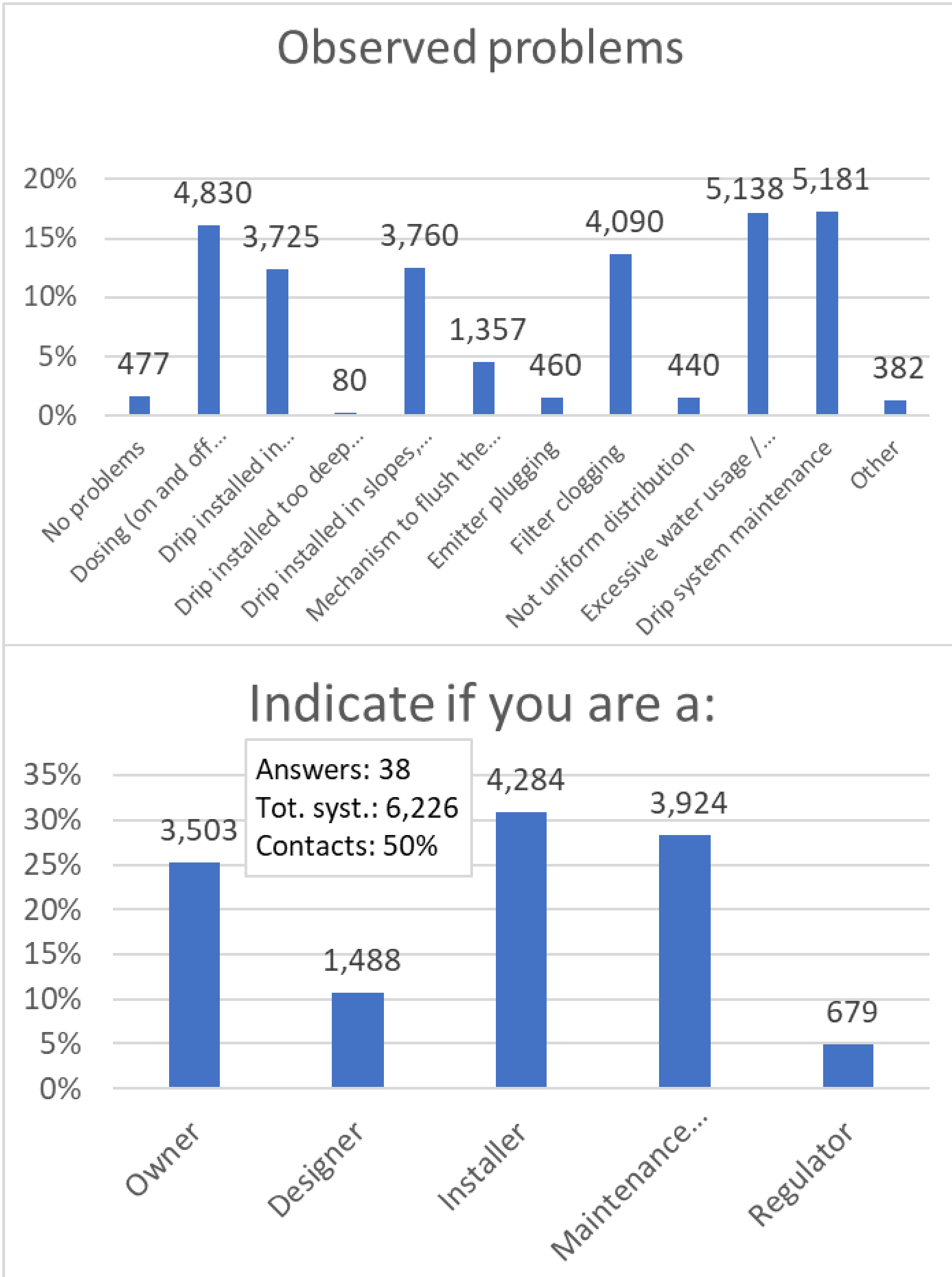


Figure 4. Summary results from the *DRIP* survey response. Results were weighted based on the number of OSSF designed/installed/maintained/inspected/owned (count is reported on top of each bar)*: Observed problems (top); Role (bottom).*

Literature review and Texas field visits

Existing literature was consulted and included rules from North Carolina and Virginia, private sector (e.g., American Manufacturing, JNM Technologies, Inc.), NOWRA guidance, Consortium of Institutes for Decentralized Wastewater Treatment (CIDWT), Electric Power Research Institute (EPRI) & Tennessee Valley Authority (TVA). Rules and recommendations were compared to the current ones for Texas, particularly chapter §285.33 (Criteria for Effluent Disposal Systems). Consulted documentation suggested that more could be detailed in the Texas rules, such as minimum soil absorption area, minimum dose volume per zone, percolation rates, specific local conditions. Sources that have most in common with Texas rules are Sections 15A NCAC 18E 0908 from the North Carolina rules, and sections 12VAC5-610-955 and 12VAC5-613-80 from the Virginia rules.

Additional literature was consulted to identify real-world issues. An example is the one reported below, which refers to the field research conducted in Virginia in the mid-1990s. Figure 5 shows the case of a septic drip system not working because of organic overloading. The drip dispersal of primary effluent in the figure is less than 4.5 years old but is already failing. Figure 6 shows the case of a drip system following an ATU unit working correctly. As in the first case, the drip dispersal system is less than 4.5 years old. Although the drip tubing in these two projects were not from the same manufacturer, it was determined that the causes for the different behavior were related to loading design.

Figure 5. Drip dispersal of primary effluent not working because of organic overloading (about 4.5 years in use).

Figure 6. Drip dispersal following ATU unit working correctly (about 4.5 years in use).

Field visits conducted in Texas during the research project included a two-day tour of the Hood County drip systems on May 3-4, 2023, near Lake Granbury. The Health Department staff, local designers, and installers guided the visit to observe and understand real world problems (Fig. 7). The following information was summarized at the end of the visit:

- Frequent issues:
  - Wrong timer settings/models.
  - Surfacing on first year.
  - External runoff on drain field.
  - Intermittent use (e.g., B&B).
- Recommendations:
  - Homeowner education.
  - Adding gravel bedding material and/or valves to isolate areas.
  - Monitoring.
  - Timer settings.
  - Maintenance.
  - “Feed” system in vacant periods.
  - Managing runoff.

In Appendix B are reported all notes related to the field visits, including features, issues, and recommendations identified with the Health Department staff, local designers, and installers.

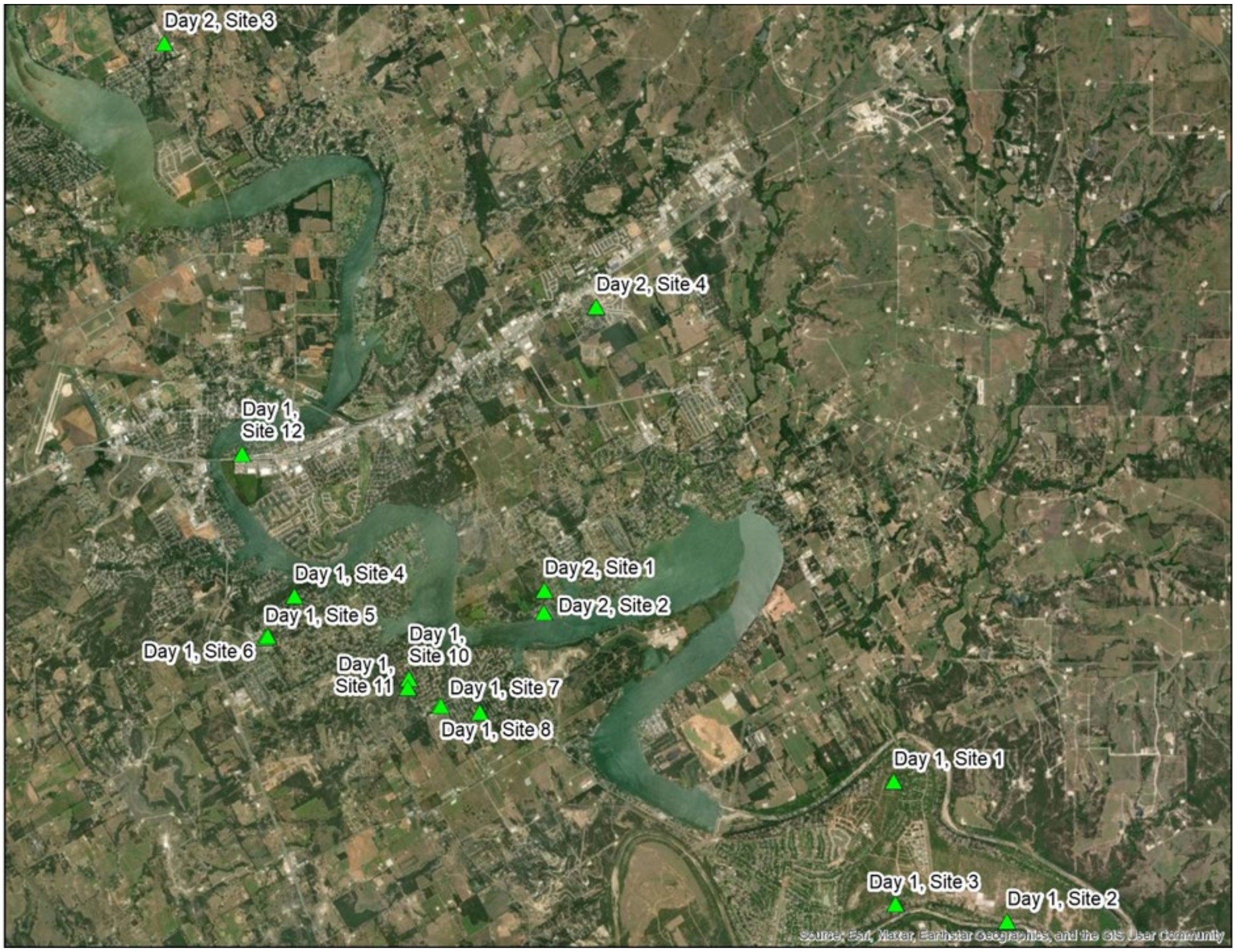


Figure 7. Sites visited with the Hood County health department staff near Lake Granbury to see operating conditions of existing drip systems and new installations (May 3 and 4, 2023).

One of the cases regarded a property located in the Pecan Plantation neighborhood, where the drip system was installed on October 10, 2022 (Fig. 8). At the time of the visit, it was noticed that effluent was surfacing in several areas (Fig. 9). Design Information included a drip field 1,500 square feet large, 4-bedroom home, soil texture group IV. If calculated according to the Texas Rules, the required area would be at least 3,600 square feet (360 gpd with water saving devices ÷ loading rate 0.1 gpd/sq.ft. for a Class IV Soil). The owner purchased the house in the year 2013, knowing that the previously failing system was fixed, but the repaired system started failing in 2021 (which means in less than 10 years).

Based on a follow up interview with the Health Department, conducted at the end of the summer 2023, a new contractor was then hired (after the visit by AgriLife here reported) and started repairing the system in July 2023. During the repair, the contractor found old leaching chambers under the drip full of water. The contractor dug up the chambers and filled the entire area with the gravel material that he uses for his drip installation and installed a new drip system (Fig. 10). Upon revisiting the site in May 2024, the repaired drip field appeared to have fixed the effluent surfacing problems and the homeowner indicated that the system was finally working fine for them (Fig. 11).

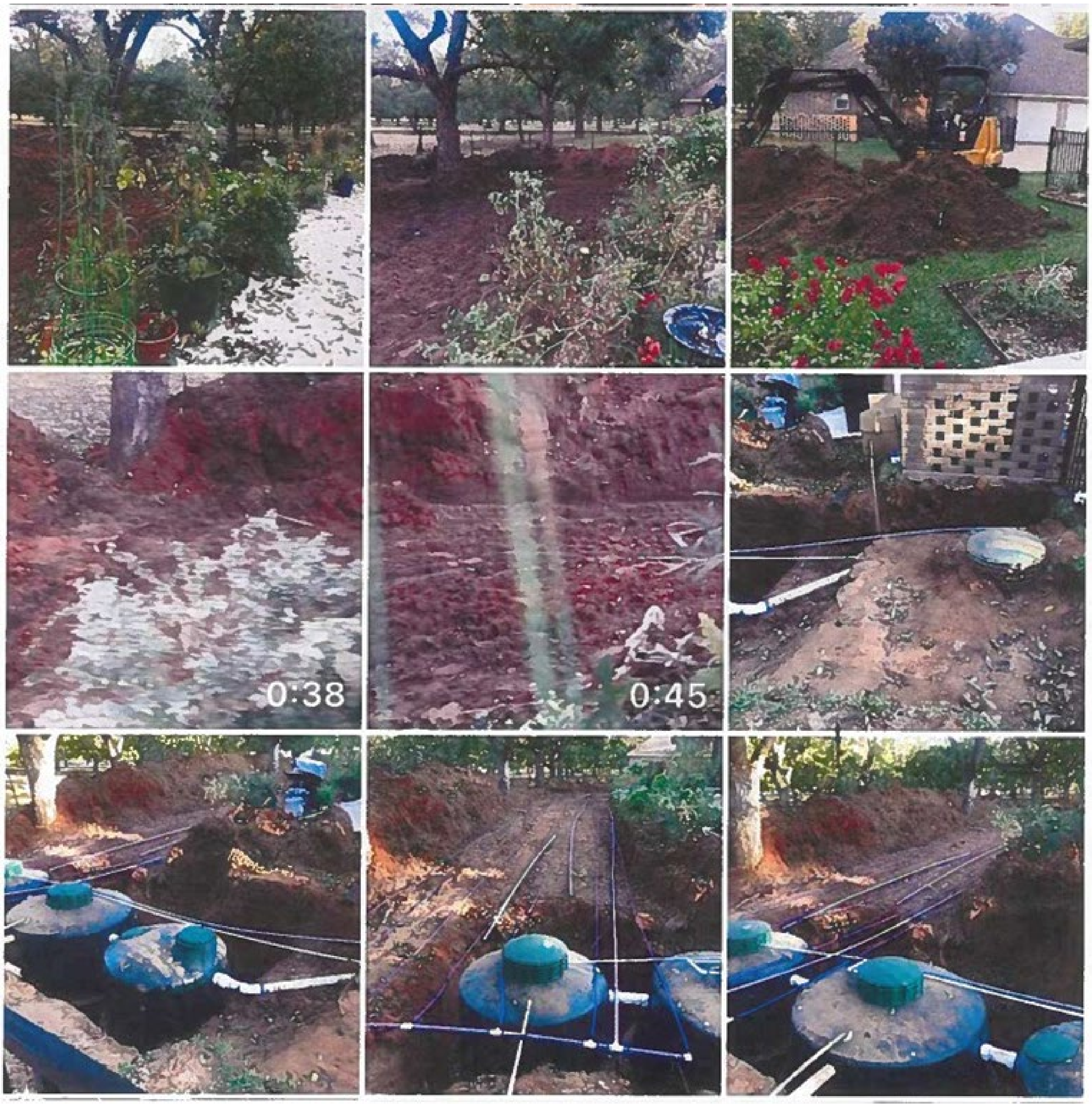


Figure 8. Pecan Plantation site, Hood County, Texas (Site # 1-1). Images taken at installation, October 10, 2022 (Photos taken by homeowner).

Figure 9. Pecan Plantation site (Site # 1-1), Hood County, visited on May 3, 2023 (Photo Anish Jantrania).

Figure 10. Pecan Plantation site (Site # 1-1). Image taken at installation in July 2023 (Photos taken by homeowner)

Figure 11. Pecan Plantation site (Site # 1-1), visited on May 2, 2024 (Photo Anish Jantrania).

Figure 12 shows another property where the same contractor was installing a repair system using his approach for drip systems. Based on a follow up interview with the Health Department, the repaired system started operating on July 14, 2023, and no problems had been noticed, although very little rain had fallen since the repair. Figure 13 shows the photos taken during the follow-up visit in May 2024, where the system was observed to be operating in good condition. These observations suggest that it may be beneficial in certain site conditions to use gravel bedding for installation of drip systems.

Figure 14 shows another case visited, where a new installation was not in use yet. The issues observed at the site included improper fill and the retaining wall installed without a liner or drains. A year later, the same site was visited in May 2024, and the house was still not occupied; however, the drip field was repaired, and the retaining wall repair was ongoing (Fig. 15).

Figure 12. New way of doing it – Using gravel as bedding materials. (Site # 1-2). (Photo Anish Jantrania).

Figure 13. Site # 1-2, visited on May 2, 2024 (Photo Anish Jantrania).

Figure 14. New Installation not in use yet (Site # 1-6).

Figure 15. Site # 1-6, visited on May 2, 2024 (Photo Anish Jantrania)

Field experiment

The field experiment addressed questions regarding flushing methods, filters, and cleaning procedures. In particular, to study and compare two types of flushing methods (continuous vs. periodic), two types of filters (screened v. disc), and to study effectiveness of cleaning and unclogging drip tubing. Artificially clogging was induced by adding sludge to the pump tank. System performance was determined by comparing measurements of Total Suspended Solids (TSS), flow rates, pressure, filters status, and drip tubing status after artificially induced clogging. The main challenge was the limited set up time for each experiment. Drip tubing, filters, back flushing devices, and various fittings were purchased. The experiment was conducted at the OSSF Center located on the Texas A&M RELLIS Campus in Bryan (TAMU OSSF Center) (Fig. 16). The Center has access to RELLIS drinking water and wastewater flows allowing OSSF research using actual and amended wastewater, and features monitoring amenities, including adjustable hydrology configurations.

Installation

Drip tubing was placed on the two wetland cells (open and covered by a greenhouse) on October 24, 2022 (Fig. 17). The wetlands' beds size are 12 x 25 feet (open) and 11 x 24 feet (greenhouse), and in each one 300 ft of tubing (two 150-ft long runs) were installed to ensure adequate flushing. Tubing was laid out uniformly about two inches below the gravel allowing operators to easily locate tubing to visually inspect emitters. Specifications of the tubing are as follows: Netafim Bioline 560 045, pressure compensating dripline, ISO 9261, Internal Diameter 0.560 in, Wall Thickness 0.045 in, Flow Rate: 0.61 GPH @ 14.5 PSI, maximum allowable system pressure to maintain 0.61 GPH: 58.0 PSI. Two Omron timers were installed in existing control panels on November 3, 2022. The timers manage and monitor the flow in each pump tank and allow more precise control of the drip dosing (Fig. 18). A manual valve can be operated to direct the flow to the wetland through the original connections or the newly installed drip tubing (Figs. 19 and 20). Dosing and monitoring of the flow to the wetlands using original connections started on October 14, 2022, at a rate of 100 gal/day, to verify uniformity in time and between the two wetlands.

In spring 2023 the experiment set up was finalized (filters, filters' back flush lines, flow meters out of the pump tank, pressure sensors, pressurization of drip lines) (Figs. 21 and 22). Between April 21 and 24 the Clearstream screen filters were installed in both pump tanks (simple filter dosing to open wetland, and Aztec Dual Spin Filter dosing to greenhouse wetland), with 150 mesh (100-micron filter) cartridges, connection of the filters' back flush lines, and manometers monitoring pressure going to and returning from the drip fields. Drip tubing was pressurized on both wetlands, including adding about 150 gallons of tap water directly to the ATU pump tanks to have enough water, checking and fixing leaks, and setting the field flush valves. Dosing trough drip tubing was then started with timer set at 5 minutes ON and 1 hour OFF. On May 8-9, flow meters from the pump tanks to the drip lines were installed and tested, including adding tap water directly to the ATU pump tanks to have enough water (return flow meters were replaced on July 18, as the initial ones demonstrated to be not reliable). Final pressure was also set at 36 psi for inflow and 31 psi for return flow, and dosing changed to 4 minutes ON and 56 minutes OFF. On September 9 the Aztec Dual Spin Filter dosing to greenhouse wetland was replaced with a Netafim Arkal 100-micron 140-mesh disc filter (Figure 23). Table 1 summarizes the main features of the experimental construction and set up.

Table 1. Main features of the experimental set up

Effluent	RELLIS Campus
Units	Two Clearstream 500N ATU units
Drain field area	Two wetland beds, one "Open" (12' x 25') and one covered by a greenhouse (11' x 24')
Dripline specifications	Netafim Bioline 560 045 pressure compensating dripline; ISO 9261; Internal Diameter (I.D.): 0.560 in; Wall Thickness (W.T.): 0.045 in; Flow Rate: 0.61 GPH @ 14.5 PSI; maximum allowable system pressure to maintain 0.61 GPH: 58.0 PSI
Dripline installation	Total of 300 ft (two 150-ft runs) of drip tubing in each wetland, less than two inches below the gravel
Filters	Clearstream screen filter (Open), Clearstream screen Aztec Dual Spin filter and Netafim Arkal 100-micron 140-mesh disc filter (GH); 150-mesh (100-micron filter) screens cartridges; back flush to aeration tank
Timers	Omron
Monitoring instrumentation	Flow meters to ATUs, and flow and pressure meters to and from drip fields; sludge judge

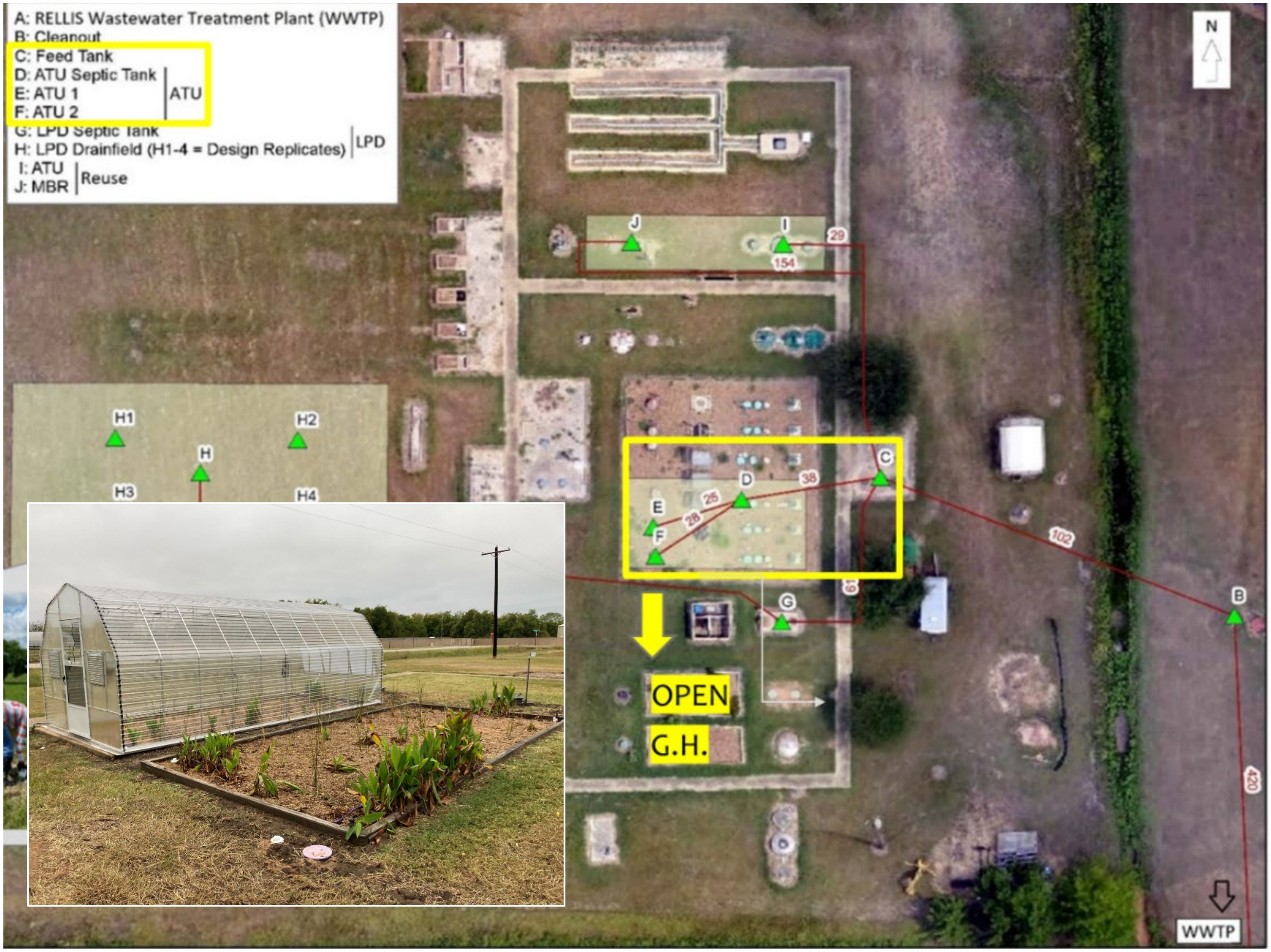


Figure 16. Aerial view of the TAMU OSSF Center. Features C, D, E, and F were used for the experiment. Drip lines were laid out in two wetlands ("OPEN", open wetland, and "G.H.", greenhouse). A lateral view of the two wetlands is also shown.

Figure 17. Installation of drip tubing on both the wetland cells (open and covered by greenhouse) on October 24, 2022.

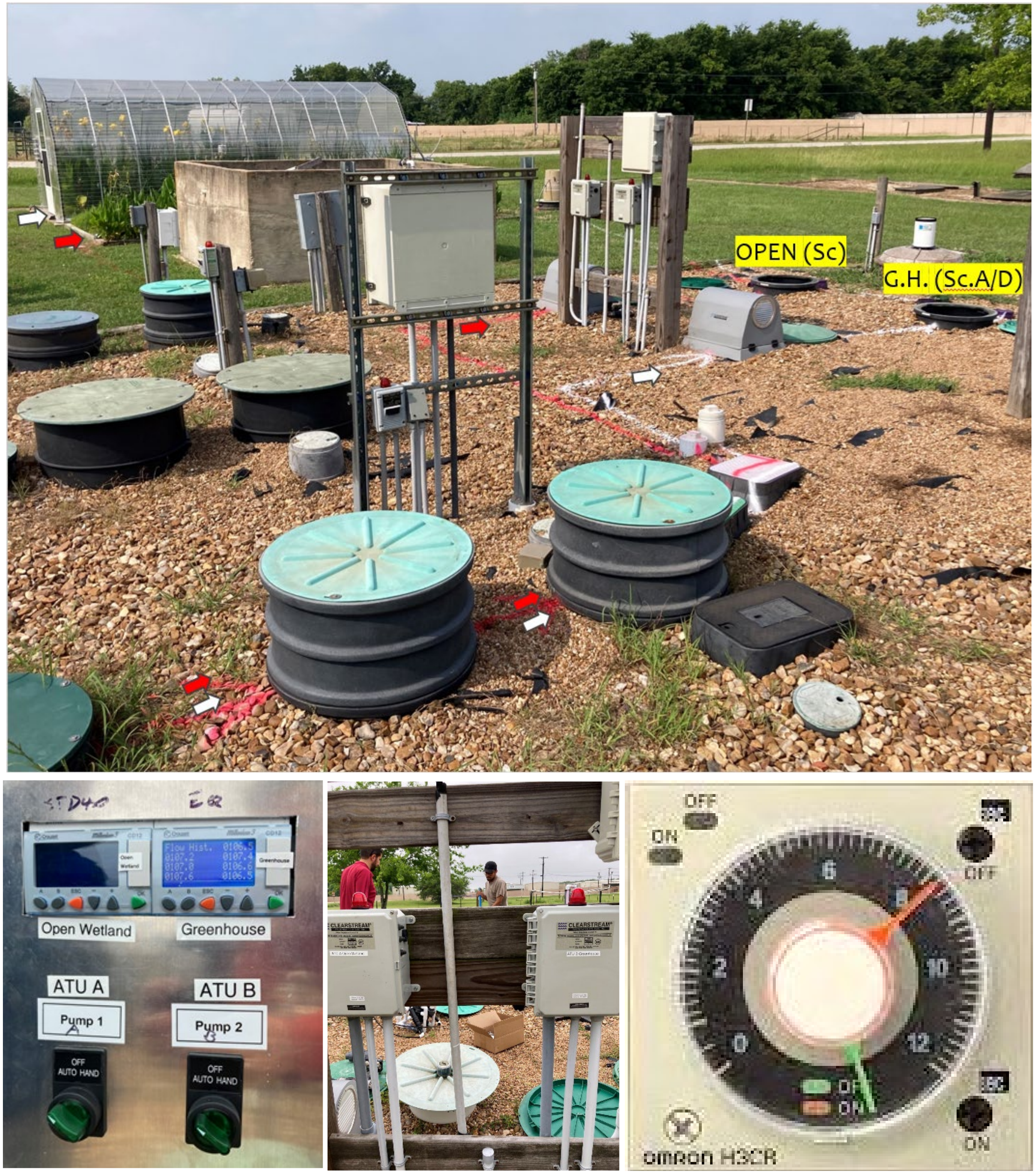


Figure 18. Direction of flow from the trash tank to the two ATUs and two drip lines being compared (top), meters monitoring the flow to the ATUs (bottom left), and control panels and Omron timer controlling the flow from the aeration tanks to the pump tanks (bottom right).

Figure 19. Connections of drip tubing in the open wetland. A manual valve can be operated to direct the flow through the original connection or the newly installed drip tubing (top left).

Figure 20. Connections to drip tubing in the wetland covered by greenhouse.

Figure 21. Installation of filters and pressure sensors on April 21-24, 2023: simple Clearstream filter, dosing to open wetland (TOP); and Clearstream Aztec Dual Spin Filter, dosing to greenhouse wetland (BOTTOM)

Figure 22. Installation of filter back flush lines (TOP, April 21-24, 2023) and flow meters out of the pump tank (BOTTOM, May 8-9, 2023)

Figure 23. Disc filter compared to simple screen filter, at installation (September 22, 2023)

Monitoring, sampling, and artificial clogging and cleaning.

As mentioned in the setting paragraph, dosing and monitoring of the flow to the wetlands using original connections started on October 14, 2022, at a rate of 100 gal/day, to verify uniformity in time and between the two wetlands. Drip tubing was pressurized for testing on both wetlands on April 21, 2023, with a timer set at 5 minutes ON and 1 hour OFF. On May 8-9, settings were finalized with pressure set at 36 psi for inflow and 31 psi for return flow, and dosing changed to 4 minutes ON and 56 minutes OFF. Daily flow to the ATUs was maintained at a rate of 100 gal/day.

Table 2 summarizes the starting conditions, and includes phases of monitoring, sampling, and artificial clogging and cleaning. Monitoring of cumulated flow to the ATUs was conducted automatically on a daily basis, while flow and pressure to and from the drip fields were monitored about 3 times a week by manually reading the meters. Filters status was monitored about once a week, and once a day right after inducing artificial clogging. Pump filter status was checked when needed. Grab samples were collected from the bottom of the pump tank about three times a week and a total of two times from the return flow. Samples were sent for analyis of Total Suspended Solids (TSS) to the Aquatec laboratory, which is a local laboratory compliant with project data quality objectives as defined by the contract and in the QAPP. A sludge judge test was also conducted occasionally after inducing artificial clogging to monitor the conditions inside the pump tank.

The experiment included comparing two filters with different flushing set ups (simple screen vs Dual Aztec screen), two different types of filters (simple screen vs disc), and conditions without filter (no filter vs disc). Simple screen and no screen layouts were installed in the line flowing to the open wetland (line "Sc"), while a Dual Aztec screen and disc filter were installed in the line flowing to the greenhouse (line "Sc.A/D"). Artificial clogging was initially induced by adding in each pump tank 15 gallons of sludge retrieved from a MBR system currently tested at the TAMU OSSF Center, together with 2400 mL of chicken feed and 2 rolls of toilet paper. After the first two times, it was decided to add toilet paper in the clean outs between the trash tank and the aeration tank and to stop adding chicken feed, which had caused issues with the pump filters. Sludge was added about once a week, and toilet paper about 3 times a week. Starting September 15, sludge was added from the aeration tanks, and starting November 2 from the trash tank. To accelerate clogging and to perform cleaning, back flow from filters was capped and lines flushed at least once in each of the comparisons.

Table 3 and Figure 24 show details and summary results for all parameters during the monitoring phases.

Table 2. Starting conditions, monitoring, sampling, and artificial clogging.

Phases		Start date	Monitoring plan
Starting conditions	Flow to drip field	Oct. 14, 2022	100 gal/day
	Pressurized drip tubing	Apr. 21, 2023 (testing)	Timer set at 5 minutes ON and 1 hour OFF
		May 8-9, 2023 (final)	Timer set at 4 minutes ON and 56 minutes OFF; pressure set at 35 psi inflow and 30 psi return flow
Monitoring and sampling	Inflow to ATUs	Oct. 14, 2022	once/day (automatic recording)
	Drip inflow	May 8, 2023	3 times/week (manual reading)
	Drip return flow	Jul. 18, 2023	3 times/week (manual reading)
	Pressure	May 8, 2023	3 times/week (manual reading)
	Filter status	Apr 24, 2023	Once/week, and once a day right after inducing artificial clogging (visual)
	Pump filter status	Jul. 13, 2023	When needed (visual)
	Sludge TSS	Jul. 19, 2023	3 times/week from pump tank (lab); two times from return flow (Jul. 28, 2023, visual, Sep. 7, 2023, lab)
	Sludge Judge test	Jul. 19, 2023	Occasionally after inducing artifical clogging
Artificial clogging	Sludge	Jul. 12, 2023	15 gal in each pump tank (once/week); from MBR Jul 12-Sep. 7, from aeration tank Sep. 13-Oct. 31, from trash tank Nov. 2-8.
	Chicken feed	Jul. 12, 2023	2,400 mL in pump tank (only Jul. 12 and 13, 2023)
	Toilet paper	Jul 13, 2023	2 times/week in each clean out before aeration tank (in pump tank Jul. 12-13)
Filters comparison	Simple screen vs Dual Aztec filter screen	Jul 12, 2023	Capped 2 times, flushed once
	Simple screen vs disc	Sep. 22, 2023	Capped 2 times, flushed once
	No filter vs disc	Nov. 7, 2023	Capped 1 time, flushed once

Table 3. Details of monitoring and artificial clogging, and related issues

Date	FILTER TYPE Sc	FILTER TYPE ScA/D	return flow set at about	ADD (sludge/chicken feed/toilet paper)	CLEAN pump filter	CLEAN drip filter	CAP back flow	FLUSH lines	ON/OFF pump trash	ON/OFF pump drip	!!! power outage	!!! high water	!!! drip filter plugged	Other
12-Jul	Sc	ScA	20%	sl./ch.f.			no		on	on				Sludge from MBR system
13-Jul				sl./ch.f./t.p.	both									
14-Jul					both									
15-Jul											X			
16-Jul									off ScA/D	off ScA/D				Reprogrammed
17-Jul					both				on ScA/D	on ScA/D				Added aeration pipe ScA/D
18-Jul									off ScA/D					
19-Jul					Sc				on ScA/D					
20-Jul					ScA/D									
28-Jul				sl./t.p.										Sampled from return lines; started t.p. in clean outs
31-Jul				sl./t.p.										
4-Aug				t.p.										
9-Aug											X			
14-Aug				t.p.			yes Sc				X			
18-Aug				sl./t.p.										
22-Aug				t.p.										
28-Aug						Sc	no Sc					Sc	Sc	
29-Aug				t.p.										
31-Aug														
5-Sep				t.p.										
7-Sep				sl.				both						
8-Sep				t.p.										
11-Sep							yes Sc							
12-Sep				t.p.										
13-Sep											X			
15-Sep				sl./t.p.										Started sludge from aeration tanks
18-Sep						Sc	no Sc		off Sc			Sc	Sc	
19-Sep									on Sc					
20-Sep				t.p.										
22-Sep		D			both									Reset pressures (ScA/D, return Sc)
27-Sep				sl./t.p.										
29-Sep				t.p.										
2-Oct				t.p.										
5-Oct				t.p.										
6-Oct				t.p.										
9-Oct				sl.			yes both							
10-Oct				t.p.		both	no both					both	both	Filters plugging: <100% screen
12-Oct				t.p.			yes both							
15-Oct				t.p.										
17-Oct			0%				no both							
18-Oct				t.p.										
20-Oct				sl. (Sc)										
23-Oct				sl. (Sc)/t.p.										
24-Oct				sl. (Sc)										
26-Oct				t.p.										
27-Oct				t.p.										
31-Oct				sl. (Sc)/t.p.										
2-Nov				sl. (Sc)/t.p.										Started sludge from trash tank
3-Nov				sl. (Sc)/t.p.										
7-Nov	No					Sc	Sc	Sc						
8-Nov				sl. (Sc)/t.p.	Sc			Sc				Sc	Sc	lower pressure during dose
9-Nov					Sc									lower pressure during dose
11-Nov														Sc: residuals on drip line (pics)
13-Nov														lower pressure during dose
14-Nov														lower pressure during dose
30-Nov									off Sc					
1-Dec									on Sc					Sc: end; moved flow to front wetland

Figure 24. Details of monitoring and artificial clogging and issues. Colors are used here to highlight similar issues and consequences.

Analysis of Figure 24 suggests the following considerations:

- Flow to ATUs was relatively constant for the entire period, except for a few power outages due to campus routine maintenance.
- The period when artificial clogging was induced was quite short (July-November 2023), and drip lines clogging was achieved only at the very end of the period.
- After adding chicken feed, sludge obtained from the MBR system, and toilet paper in the pump tanks, pump filters became clogged. It was decided to stop using chicken feed and add toilet paper in the clean outs between the trash and the aeration tanks. Later, sludge was collected from the aeration tanks, which was similar and more abundant than the one from the MBR (Figs. 25-28).
- Artificial clogging was successful, with high water alarm occurring on five occasions: August 28, September 18, October 10, November 8, and November 30, 2023. The typical scenario included (example from August 28, after capping back flow for the simple screen): pump found running at 42 psi; water not going out to the drip field; filter 100% plugged; pump running in override mode with water temperature at 46 degrees C (normally was 35 C); filter removed and cleaned; back flush line re installed; everything back to normal (Figs. 29-31).
- It appeared that adding sludge only or capping back flow only did not have an evident effect unless combined. When these two actions were combined the following effects occurred consistently: a decrease of flow to the drip field, an increase of TSS in the pump tank, and an increase of about 5 psi in both inflow and return flow. Once the back flow lines were reconnected, conditions rapidly went back to normal.
- Return flow tended to slowly decrease with time; however, it is difficult to have confidence in this effect, considering the very short intervals with steady conditions tested, except for the initial period from April to July.
- Flashing the lines determined an evident increase inflow (including return flow).
- Compared filters did not show evident differences in terms of flow, pressure, or TSS.
- On November 2-8, 2023, sludge was collected from the trash tank, and added only to the pump tank with the simple screen filter. Right after applications, both flow and the pressure declined during the dosing, likely due to a clogging that was observed in the pump filter (Fig. 32).
- On November 7, 2023, the simple screen filter back flow was capped, and the filter removed. As a result, flow declined, pressure increased, TSS reached the highest level (almost 230 mg/L), run times were longer (visual observation only), and water level reached the alarm point after three weeks. This happened even though sludge and toilet paper were not added anymore, and the trash tank pump was turned off on November 30. On December 1, 2023, flow to the open wetland (simple screen filter line) was diverted to the original inlet point and drip line disconnected.
- On November 8 and 11, 2023, the drip line was sectioned and observed. It is evident the presence of deposit outside the tubing near the emitters, inside the tubing, and inside the emitters (Figs. 33-35). On December 11, 2023, the drip line was sectioned again. The inside of the line looked clean, likely because no sludge had been added for weeks in the last phases and the line was flushed on November 7 and 8. On the other hand, emitters showed signs of clogging, which was likely the reason for the flow's constant decline (Fig. 36).

Return flow water was sampled and sent to the lab for analysis of TSS on September 7, 2023. Other samples were collected and observed only visually on July 28, 2023. In both cases, filters being compared were simple screen vs Dual Aztec filter screen. September 7 samples had similar concentration (respectively, 6,520 and 4,840 mg/L) and were much higher than the ones found for the samples from the bottom of the trash tank (about 20 times). Visual observations suggested a similar pattern and revealed that after a few seconds of flow, the color of the return water was again comparable to the color of the water from the bottom of the tank (Figs. 37-40).

Figure 25. Chicken feed applied in the pump tanks (July 12, 2023).

Figure 26. Sludge obtained from the MBR system and applied in the pump tanks (July 12, 2023).

Figure 27. Pump filters clogged probably due to the combination of chicken feed and toilet paper. Chicken feed was not used anymore after the first applications: Pump filter clogged on July 14 and 17, 2023 (TOP); sludge judge test from Sc pump tank (BOTTOM LEFT) and from Sc.A/D pump tank (BOTTOM RIGHT), on July 19, 2023.

Figure 28. After initial pump filters' clogging, toilet paper started to be added in the clean outs between the trash and the aeration tanks (LEFT, July 28, 2023). Later, sludge was collected from the aeration tank instead of the MBR system (RIGHT, September 15, 2023).

Figure 29. Filters status on August 25, 2023, after several days of sludge application: Simple screen (TOP), Aztec Dual Spin Filter #1 (MIDDLE), Aztec Dual Spin Filter #1 (BOTTOM).

Figure 30. Pump tank high water and clogged filters a few days after capping the back filter flow: pump tank and simple screen on August 28, 2023 (TOP); simple screen and disc on October 10, 2023 (BOTTOM).

Figure 31. Once the back flush lines were reinstalled, filters looked clean again (October 17, 2023).

Figure 32. On November 2, 2023, sludge started to be collected from the trash tank (TOP). The flow and pressure declined during the dosing, likely due to the pump filter clogging (November 8, 2023, BOTTOM).

Figure 33. Drip line was cut open and observed toward the end of the experiment, right before the final clogging phases (November 8, 2023). Very little deposit was found in the end portions of the line, including in the emitters.

Figure 34. More deposit compared to the front or end of the line was found in middle sections (November 8, 2023). It is evident the deposit of some material inside the tubing, including inside the emitter.

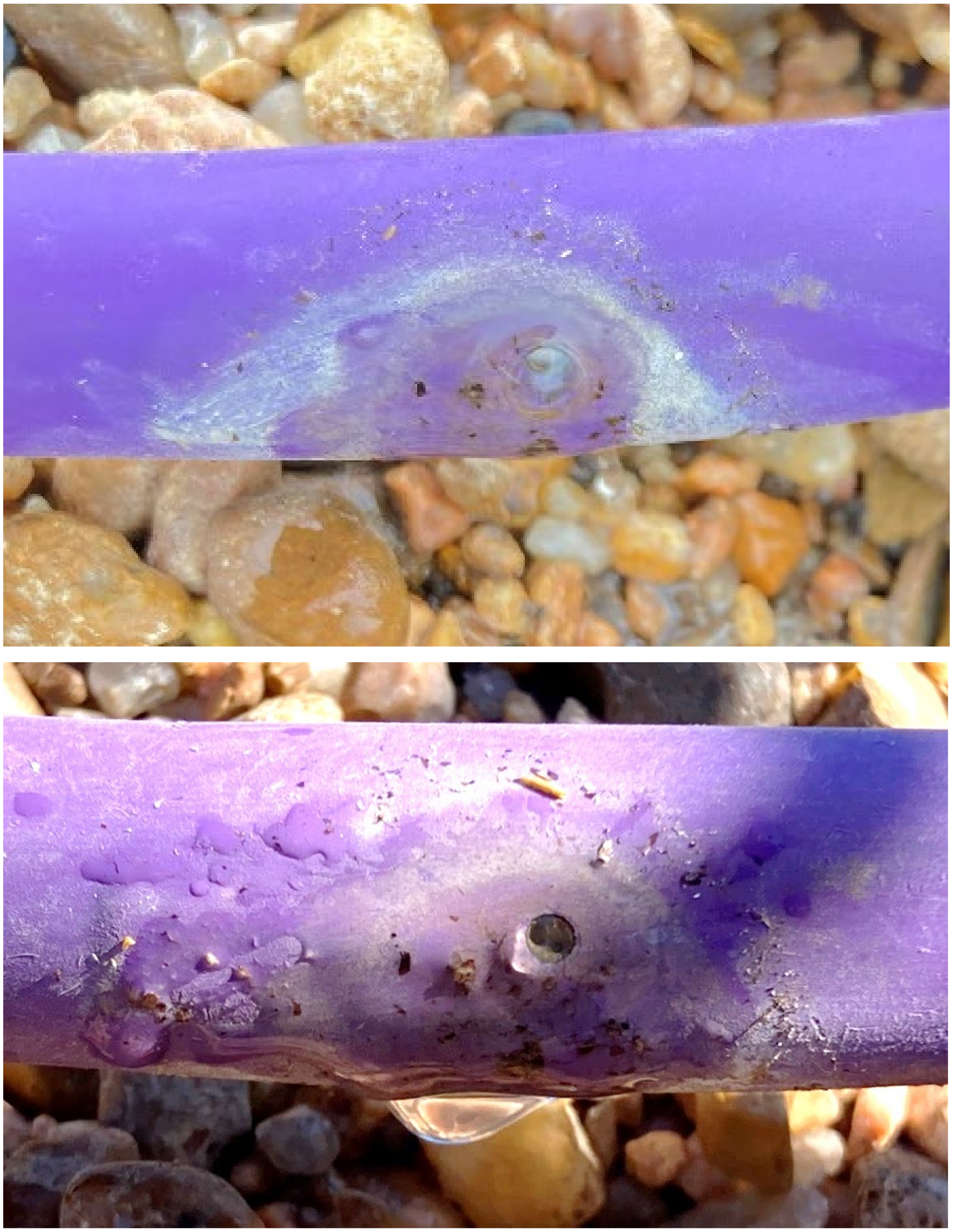


Figure 35. Some deposit was found outside the line, including larger material likely due to the type of sludge added in the last days (from the trash tank). Pictures were taken on the same portion of the line on November 11 (top) and on November 15 (bottom).

Figure 36. Simple screen filter line section on December 11, 2023. Line looked clean, likely because no sludge had been added for weeks in the last phases, and the line was flushed on November 7 and 8; emitters, on the other hand, showed signs of clogging, which was likely the reason for the flow constant decline.

Figure 37. Visual comparison of samples collected from the pump tank bottom and from the return flow on July 28, 2023. From left to right: Sc pump, Sc return, Sc.A/D tank, Sc.A/D return.

Figure 38. Visual comparison of samples collected from return flow on September 7, 2023. Initial samples (Sc sample, TOP LEFT, Sc.A/D, TOP RIGHT), collection moments (BOTTOM).

Figure 39. Visual comparison of samples collected from the return flow on September 7, 2023. Changing color progression and final sample from the Sc line (from top left to bottom right).

Figure 40. Visual comparison of samples collected from the return flow on September 7, 2023. Changing color progression and final sample from the Sc.A/D line (from top left to bottom right).

CONCLUSIONS AND RECOMMENDATIONS

The project was carefully planned by preparing a Quality Assurance Project Plan (QAPP), approved by TCEQ, and collecting suggestions and recommendations from license holders, regulators, and homeowners. Such useful recommendations were collected by organizing two TOGP committee's meetings during the project. QAPP approval time, limited resources, and design and testing times particularly impacted the field activity. The 3-month no cost extension allowed by TCEQ was helpful to allow for additional field activity. (September-November 2023).

The "*Survey to get your feedback for improving DRIP design in terms of effluent distribution uniformity, and ability to maintain the system"* was successfully distributed and provided a wide range of answers, including identification of common issues and related causes, recommendations for improvement, and contacts. The approach of multiplying each problem indicated (some individuals indicated more than one problem) by the number of systems owned, designed, installed, maintained, and inspected (some individuals represented more than one role) allowed to identify 6,226 answers from the 38 surveys completed.

Literature review demonstrated that a large documentation exists in the country regarding drip systems, and that several concepts are worth further analysis for possible adoption in the current design specifications of a drip irrigation system in 30 TAC Chapter 285. Field visits to local real-world problems conducted in Hood County with Health Department staff and local designers and installers was also very beneficial to understand some of the current issues related to adoption of drip systems in Texas. Experience, confidence, and simple design improvements are only some of the factors that appeared to have great potential for impacting future application of drip systems in Texas in terms of better performance.

Despite the limited time available, the field experiment clearly distinguished phases where scenarios were tested and related effects documented (screen and disc filters, filter backflushing, drip line flushing, artificial clogging). Filters' back flushing was identified as one of the key factors impacting maintenance and distribution.

Based on the results obtained from the activity reported, the **<u>project questions</u>** can be answered as follows:

1) <u>What are the operational problems faced by the users and operators with the current drip irrigation design in Texas</u>? **<u>ANSWER:</u>**
    a. Based on the survey that was conducted, and weighting the answers based on the number of systems owned, designed, installed, maintained, and inspected, the main issues are related to 1) Dosing (on and off times) and application rates, 2) Drip installed in imported soil or fill material, 3) Drip installed in slopes, and depressions, 4) Filter clogging, 5) Excessive water usage / undersized dispersal area, and 6) Drip system maintenance.
    b. Based on the survey that was conducted but removing the answers from a designer that alone represented 3-4,000 systems, the main issues are related to 1) Drip system maintenance, 2) Excessive water usage/undersized dispersal

area, 3) Mechanism to flush the drip tubing, and 4) Dosing (on and off times) and application rates.

c. Based on the field visit conducted in Hood County, the main issues are related to 1) Wrong timer settings/models, 2) Surfacing on first year, 3) External runoff on drain field, 4) Intermittent use (e.g., B&B).

2) Can the current design, installation, and maintenance be improved to achieve better distribution of effluent and to allow for better performance of drip irrigation systems? **ANSWER**: Based on the project conducted (survey, literature, field visits, and field research), it appears that there is a margin for improving water distribution and obtaining better performances. Our study was limited in time and resources, but several recommendations were drafted. These include all steps of designing, installing, and maintaining the systems, and suggest that Texas rules could be improved. The main areas for improvement appear to relate to insufficient distribution surface area, filtering set up, and maintenance requirements in the regulation.
3) Do screened filters perform better than disc filters, and how does auto-backflushing affect the performance of both types of filters? **ANSWER**: Based on all information collected, but mostly field visits and research, it appears that different filters may perform differently, but that all other factors of design, management, installation, and inspection could have more influence over the type of filter; at least in the short/medium period. Backflushing of filters, on the other hand, appeared to be a key factor in determining drip systems' performances.
4) Are changes required in the current design specifications of a drip irrigation system in 30 TAC Chapter 285, and if so, what changes are recommended? **ANSWER**: The research indicated that an effort is needed to identify the priorities for changes in the current design specifications. The current research was too limited to recommend specific ones, but certainly more flexibility is needed to adapt design to the specific local site conditions to ensure better performance of drip irrigation systems in Texas.

APPENDIXES

APPENDIX A - Survey form "*Survey to get your feedback for improving DRIP design in terms of effluent distribution uniformity, and ability to maintain the system*", all received surveys information, and summary of surveys descriptive comments.

SURVEY FORM

Survey to get your feedback for improving DRIP design ın terms of effluent distribution uniformity, and ability to maintain the system

Please complete the following questions to the best of your ability.

About you

Indicate if you are a:

☐ Owner ☐ Designer ☐ Installer ☐ Maintenance Provider ☐ Regulator

Estimate number of DRIP systems designed/installed/maintained/inspected

(INCLUDING IN WHICH STATE): ________________________________

Observed problems

- ☐ No problems
- ☐ Dosing (on and off times) and application rates
- ☐ Drip installed in imported soil or fill material
- ☐ Drip installed too deep (specify the depth)
- ☐ Drip installed in slopes, and depressions
- ☐ Mechanism to flush the drip tubing
- ☐ Emitter plugging
- ☐ Filter clogging
- ☐ Not uniform distribution
- ☐ Excessive water usage / undersized dispersal area
- ☐ Drip system maintenance
- ☐ Other ____

Please describe the type and frequency of problem/s you are observing in your area:

____

____

____

____

Survey form (page 1)

Suggestions

Indicate your suggestions for improving DRIP design, installation, operation, maintenance:

____

____

____

____

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Additional comments

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FAQs

How will this information be used? Texas A&M AgriLife Extension is a public entity, therefore data collected is classified as public information. Data collected from surveys may be published in a report intended for research and educational purposes.

Why should I answer these questions? TCEQ have provided Texas A&M AgriLife Extension grant money[1] to conduct research to investigate whether the design of DRIP systems can be improved in terms of effluent distribution over time, and ability to maintain the distribution system.

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[1] Texas On-Site Sewage Facility Research Grant Program (TOGP), Request for Grant Applications (RFGA), 2nd cycle, 2021

Survey form (page 2)

ALL RECEIVED SURVEYS INFORMATION

ID	Date (2020)	Indicate if you are a:	Estimate number of DRIP systems Owned, Designed, Installed, Maintained, Inspected	Observed problems: (1)	Other (describe)
1	11/1/2022	Regulator	Inspected, Missouri, 40	11	Ponding in the drip field
2	11/1/2022	Installer	100+ Missouri	10	
3	11/1/2022	Installer	6	9, 10	
4	11/1/2022	Designer, Installer, Maintenance Provider	10	9, 10, 11	
5	3/8/2023	Regulator	15/year	0, 2, 10	
6	3/8/2023	Owner	Texas, 100.	6	
7	3/8/2023	Owner, Designer, Installer	100. Texas	0	
8	3/8/2023	Regulator	4 Texas	0	
9	3/8/2023	Designer, Installer	100 in Texas	0	
10	3/8/2023	Installer	3	7, 9, 11	Lift station used with drip systems
11	3/8/2023	Installer, Maintenance Provider	50 Texas	1, 2, 5, 6, 7, 9	
12	3/8/2023	Regulator	2 in Webb County	9	
13	3/8/2023	Designer	20 in Texas	6, 7, 10	
14	3/8/2023	Designer, Installer, Maintenance Provider	50 / 20 / 20	7, 8, 9, 10	
15	3/8/2023	Installer	120, Texas	7	
16	3/8/2023	Installer	0	11	Have not installed any
17	3/8/2023	Designer, Regulator	8 Texas	0, 11	No problems that I can tell, I have not gone back. Have issues with DR and Designers not familiar enough with drip design and approval. Need training for DR's in rural counties that have no Engineer on staff.
18	3/8/2023	Regulator	40-80 Jefferson County TX	11	Poor engineering, poor soil, installed in Flood zone AE
19	3/8/2023	Regulator	Victoria Calhoun County >100	9, 10, 11	GLO homes using drip systems and homeowners know nothing about the systems
20	3/8/2023	Installer, Maintenance Provider	100. In Texas	5, 7, 10	
21	3/8/2023	Designer, Installer, Maintenance Provider	15 i, 8 d, 4 m all Texas	5, 7, 9	
22	3/8/2023	Installer, Maintenance Provider	20 Texas	5, 7, 10, 11	The maintenance technician doesn't clean the disc filter. Homeowners drive on the drip field, compacting the soil and causing chimneys of water. Bell County Public Health District

ID	Date (2020)	Indicate if you are a:	Estimate number of DRIP systems Owned, Designed, Installed, Maintained, Inspected	Observed problems: (1)	Other (describe)
					interprets 285 wrong and classifies a drip field as a mound. This is why you see very few drip systems in Bell County. 285 needs to be amended to clarify the definition so Bell will ease up on this and let us have the drip disposal back into our toolbox. The customers in Bell Co are suffering because of this situation.
23	3/8/2023	Designer, Regulator	100+	1, 6, 8, 9, 10	
24	3/8/2023	Designer	40 designed in Texas	2, 4	
25	3/8/2023	Designer	1000	1, 5, 9, 10	
26	11/1/2022	Maintenance Provider	10 units serviced in Texas	2, 6, 7, 8, 9, 11	Heavy lawn mowers on top of the drip field during wet months on a shallow field.
27	11/1/2022	Installer, Maintenance Provider	20 North Texas	1, 2, 6, 7, 8, 9	
28	11/1/2022	Installer, Maintenance Provider	80 Texas	1, 2, 5, 6, 7, 8, 9, 10	
29	11/1/2022	Regulator	120 Harris County	0	
30	3/8/2023	Designer, Installer	10	2, 4, 7	
31	3/8/2023	Designer, Regulator	Designed and inspected 50+	0	
32	3/8/2023	Regulator	50 - TX	10, 11	Landscaping/surface (or home) improvements over drain field.
33	3/8/2023	Regulator	30 Texas	4, 10	
34	3/8/2023	Regulator	0	11	Under sized
35	3/8/2023	Regulator	100 Texas	4, 8, 9	
36	3/8/2023	Owner	1-Texas	11	
37	3/8/2023	Owner, Installer, Maintenance Provider	3-4000 Texas	1, 2, 4, 7, 9, 10	
38	3/8/2023	Maintenance Provider	80 Bedford Virginia	1, 3, 4, 5, 6, 7, 8, 9, 10, 11	All above

(1) Observed problems:

1. Dosing (on and off times) and application rates,
2. Drip installed in imported soil or fill material,
3. Drip installed too deep (specify the depth),
4. Drip installed in slopes, and depressions,
5. Mechanism to flush the drip tubing,
6. Emitter plugging,
7. Filter clogging,
8. Not uniform distribution,
9. Excessive water usage / undersized dispersal area,

10. Drip system maintenance,
11. Other.

ID	Please describe the type and frequency of problem/s
1	Ponding in a new installation drip field
2	Original owner will move, new homeowner will cancel service contract because they think it's an unnecessary expense. System fails, lack of education.
3	Maintenance is the biggest problem for owners. Convincing them that paying to maintain twice a year is important
4	Latest: people watering their drip field even though it is poor soil. Fittings coming apart and leaking.
6	Commercial
10	Filters clogging
11	Main problem is hydraulic overload. Typical in our area where STR's are increasing in number and individuals occupying the location exceeds capacity of design
12	Usage surpassed after installation
13	Poor maintenance
14	Excess water usage. Cellulose clogging drip filter due to surge flow propagating debris into the pump tank.
15	Some of our customers have filters clogging very frequently. This issue isn't fixed by pumping out tanks and they are not a high water use demographic.
18	N/A
19	Education for homeowners
20	Mostly just keeping filters clean. Also, other contractors damage the systems. Also, builders or homeowners will install yard sprinkler systems on top of the system.
21	Over usage from stuck toilets running too much.
22	See previous comments
23	I think that drip installed directly into class 4 should have a lower application rate. Probably about .08. If it's installed in scarified class 2 or 3 on top of clay, I don't think the application rate needs to be as low. I do think continuous flush is better and either that or automated flush should be required.
24	None now
25	I think the most common issue is improper distribution because the timer isn't properly set. Too common that technicians reduce dose time when they see wetness not understanding that shortening dose is the cause of the problem.
26	Spring time coming out of winter, is the hard season change. Heavier uses during holidays then into low sun light till March. Just a maintenance provider so I only see what's been installed 2 years plus. But a lot of systems lose areas of the field or whole field stops dripping due to filters or lines plugging. Both disk and screen filter plug even during normal or moderate usage on a 2-person house. Maintenance providers will say it is installer, I installers will say it's not maintained correctly. Both are probably correct. Between installer, the county inspector and homeowner use, maintenance providers start behind on most systems. We need to get where the county inspectors know the systems as well as the installer. In the counties I operate in the county inspector is usually getting trained but the installers. Kinda backward in my opinion. County or permitting authority should be able to test and function any system they could approve or deny proper function. I may have gotten off topic a bit there. The drips are being installed with the installer walking away or not informing owner of what their duties are and pushing all onto the maintenance providers. By the time a second or third provider gets the contract the drips end be in a state that takes months to get back functioning correctly. Had one in a subdivision Pecan Plantation, system had been in years, at least 3 before I ever stepped foot on the tank. Took me a year to get the drip line working properly. Tanks were pumped twice in 3 years. The owners start to wonder if the providers are just trying to make money. If the industry wants to push more drips, then all involved need to know how these systems function. Not just better design but the knowledge to correctly understand the systems.
27	50% of the installations suffer from one problem or another.
33	Rare
35	Installing in slopes, not enough disposal area designed Not often. Maybe 3-4 times

ID	Please describe the type and frequency of problem/s
36	Water from drip lines rises instead of absorbing into the ground. System was installed in October 2022.
37	Systems installed improperly by installers that aren’t qualified or just don’t care.
38	General not working or lost over time

ID	Indicate your suggestions for improving LPD design	Additional comments
1	Remove tree canopy to provide more sunlight to the drip field. Add additional cover soil in ponded areas. Establish a good grass/sod cover to improve evapotranspiration.	
2	Education. Drips are new, Workmanship plays a huge role in the longevity of drips.	
3	The simpler controls the better. Less items to maintain and less to go wrong	
4	Uniform design manual!	Regulators aren't educated enough to inspect.
6	Flushing tool.	
7	DR's need more knowledge of how to check pump flows to keep flushing velocities adequate.	
13	Better maintenance	None
14	Equalization to prevent surge flow.	
15	Drip tubes could have larger openings to allow for a looser filter which will let larger particles through.	
16	Haven't installed any	None
17	Better training for DR's and Designer.	
18	Simplify regulation, provide updated definitions and clarification in drip irrigation vs. Pressure dosing systems.	N/A
19	Homeowners required to participate in class to stress importance of maintenance	
21	Good installation techniques are very important.	
22	See previous comments	See previous comments
23	I did that in the previous question.	
24	Continue offering classes	None
25	Better understanding of design and implementation to insure proper distribution.	Maintenance by contractor is often not well communicated and demonstrated. The result is discontinuing contract because they don't perceive anything is being done. Then no maintenance until failure.
27	1. Always use high resolution timers such as OMHRON. 2. Never import soil of any type to the drainfield site. 3. If mounding soil, always use proper and thorough vegetation coring techniques prior to mounding. 3. Install enough valves to be able to isolate individual lines for proper scrubbing. 4. Limit single feed line length to 600ft max.	I have more comments than you have provided space. 214-733-8883 Chris Gracy
36	Dig trenches deeper and add more lines toward fence line to give the existing wet soil a chance to dry out.	
37	Dig 2ft deep and replace material with 1ft of class B soil. Lay lines and cover with 1ft of class2 Soil.	Jenny said you had a new system you wanted me to install, just let us know and we would love to help out anyway we can, just let me know, Thanks, Auddie
38	Longevity. Make it last long time and self-maintaining	

SUMMARY OF SURVEYS DESCRIPTIVE COMMENTS

Problems (please describe)

- X 11: Hydraulic overload (e.g., main problem, suck toilet, occupancy going up, season, holiday use, poor soil flows goes up, sprinklers x3)
- X 7: Maintenance (e.g., biggest issue, maintenance provider blaming installer and vice versa, convince owner is needed, new owner cancels contract "not needed", fittings)
- X 6: Filter clogging (e.g., cellulose, try to fix by pumping)
- X 5: Education (e.g., installer, installer not educating owner, all involved), class 4, timer x2 (e.g., dose time reduced)
- X 1: 50% fail, damages, no testing by regulator

TEXAS A&M AGRILIFE EXTENSION

Other comments

- X 12: Maintenance: (e.g., not proper use … nobody flush! ... 90%! … 3 times/yr … filters service and flushing ... Clean disc filters (home or 10 min soak) or replace … … provider work not well defined (check alarms and go) … pump maintenance ... providers …demo maintenance to owner … discontinuing contract “not good” … no maintenance until failure)
- X 5: Design: (e.g., design, same loading rates for all in rules, design, Tennessee rules, Arkansas not clear directions)
- X 4: Texas: (e.g., converting, continuous flush; usual issues, just new!)
- X 2: Education (e.g., ... customer education ... ... people do not know what continuous flush means)
- X 1: ... grass … improve soil …

TEXAS A&M AGRILIFE EXTENSION

Suggestions

- X 9: Design (e.g., larger tube openings and filters, deeper trenches, standard manual, simpler control → less to maintain and to go wrong, valves to isolate zones <=600 ft, continuous flush/automated backflush, flushing tool, equalization, high resolution timers)
- X 7: Education (e.g., drip is new, DR to test flow and to inspect, DR/designer, design/implementation, owner)
- X 3: Vegetation (e.g., proper vegetation on mounds, Remove tree canopy, good grass/sod cover for ET)
- X 2: Soil (e.g., no import, cover soil)
- X 1: Maintenance, Simpler regulation/definitions, Installation

Texas A&M AgriLife Extension

APPENDIX B - Field visits to drip systems conducted on May 3-4, 2023, in Hood County, Texas, near Lake Granbury. Features, issues, and recommendations identified with the Health Department staff and local designers and installers.

ID	Summary	Issue1	Issue2	Issue3	Issue4	Issue5	Recommendation
1-1	Return to pump tank, 100 micron, conv failed and replaced with drip 1 year ago, 2 feet deep, 3/hour reset few weeks ago (it was 80/min run!); 1,500 sqft	fittings	80/min run!	lines on top of the tank will break when refilling!			Add lines, 3/hour reset
1-2	conv, good, in contract to clean filter, timer as #1, chlorination in all septic DR required, "hybrid system", changed pump, 16-18 psi Netafim, adjusted pressure looking at lines one by one, GeoFlow tubing	timer as #1	changed pump				Chlorine might have positive side effects…kills biomat? liquid chlorine might be better, will come back in 10-15 years
1-3	conv, good, 4-in trenches, 1-2 years old, 8 inches deep (all sand!), came to the top first year	vacation, too many days without drainage, which kills all bugs	surfacing first year				Maintenance prov should teach the owner this is the way it works: be patient and wait! 1-2 caps of dog /cat food time to time during vacation
1-4	did not file before the platting, complain, water main?	water main issue?	missing French drain anyways				
1-5	2009, ATU, good, restaurant and commercial, surfaced initially	surfaced initially than expanded	one weak spot at end and lowest, maintenance would not walk and notice this				Follow up sampling
1-6	the installer was not supposed to fill	the installer was not supposed to fill	no liner nor drains in containing wall				
1-7	ATU, do not know, fixed drain but not sure what else happened	surfacing					
1-8	ATU, added grass and diverted gutters, about 1 year old	surfacing					

ID	Summary	Issue1	Issue2	Issue3	Issue4	Issue5	Recommendation
1-9	ATU, almost 2 years old, surfacing in the back only, 1 on its way!, issues with pump (cleaned), found a leak, neighbor maybe drainage (french drain added), have sprinklers (not used anymnore), gutters, water line running nearby, always wet even before, installed March 2021 issues started in the fall, getting better, installed irrigation after inspection, GeoFlow,	pump (toilet paper)	leak	neighbor drainage, sprinklers (permit says no irrigation), 4 gutters, water line running nearby, area wet before, too many new homes, aqua water sewer provider closer	owner do not know how to maintain	builder not cooperating	Divert gutters, spilt and give a break only in the back, patience, teach owner, maybe avoid holes facing up
1-10	impeller broke, surfacing no rain, 1-year-old	impeller broke	lines 1 foot off the porch	pump dead			
1-11	good, redone everything 1 year ago, was over rock too little soil, added 2 ft, tubing depth 1 foot, was few months old, was running 26 minutes (brought back to 4 min/hour)	over rock too little soil					Rock maybe can be a recommendation
1-12	conv, was very old (70s), drip installed in trenches 1 foot below, worked for two years, one person passed away now,						
2-1	loop, bb too many people, doubled the area, 3600 sqf, will check next year, 600 gal in the week end should be taken care of	AREA: 3070 bb in the county (up to 25 people)	AREA: once a month in many systems here	AREA: soil replacement (2 feet of sand in middle of clay will surface!)			Dog food, homeowner must sign they know what they have, monitoring…protect gw…ho take a class…then we can put straight to the lake…, will check next year
2-2	something broken rushing work, wrong timer (spray timer that can go only 15 min periods), worked fine for a month with trenches open	damaging the lines filling	wrong timer				Suggested to go every 3 hours

ID	Summary	Issue1	Issue2	Issue3	Issue4	Issue5	Recommendation
2-3	1500 gal/day, grass trap, dosing tank (overflowing the dosing to the tanks, redone to cut flow), 4500 feet tubing, one compressor not working (to the dosing pre treatment), surfacing, was conventional with high E. coli draining down, pumping not done at the time	grass trap	dosing tank overflowing	compressor not working	surfacing	pumping not done	Pump as needed (every 6 months)
2-4	conv., very old no permit, complaint, rental, 2 ft of sand on top of clay everywhere, used to be crop land	old no permit	rental	2 ft of sand on top of clay everywhere			Need new system