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Mr. Britton Dotson, P.G., Fellow
Tennessee Department of Environment and Conservation
William R. Snodgrass Tennessee Tower
312 Rosa L. Parks Avenue, 11th Floor
Nashville, TN 37243

Dear Mr. Dotson;

My role at the University of Tennessee is to provide education and conduct research in the area of onsite and decentralized wastewater management systems. Part of my responsibility is to stay up-to-date with the science and engineering that supports the utilization of land-based wastewater treatment. With this background in mind, I want to take this opportunity to express my concern about specific portions of the proposed New Rule Chapter 0400-40-06 - State Operating Permits. My goal is to focus on the science and engineering aspects of the proposed rule. I will try not to address policy issues; however, when policy overrides the professional judgement of soil scientists and engineers, then I believe that it is appropriate for me to call out that policy.

0400-40-06-.03 (9)
No land application system shall be approved or certified by the Commissioner which proposes to use land having a water table at an elevation which would preclude adequate treatment of the wastewater and which may result in surfacing of ground water pollution.

There seems to be two broad rules in this one sentence: 1) there must be adequate soil depth above a zone of saturation such that waste constituents will be removed before reaching groundwater, and 2) wastewater will not be added that may result in the surfacing of ground water pollution. I understand the intent of not polluting the groundwater, but I do not understand what is intended by the prohibition of "surfacing of ground water pollution."

There are several science questions here – what depth of soil is required to remove waste constituents, will this depth change depending on the soil texture, and which waste constituents will be enforced? Can this rule override the 20-inch rule [400-40-06-.06(2)(c)]? There are waste constituents that cannot be removed by soil treatment (such as artificial sweeteners) and thus, this rule cannot be enforced for all waste constituents.

What is meant by 'surfacing of ground water pollution?' Does this rule mean an outcrop of soil water within the land application area, or does it include a seep that is down gradient of the land application area? Is it the intent of this rule to address potential groundwater mounding under a land treatment area? Paragraph 0400-40-06-.03 (9) needs to be re-written to express the intent of the rule.

0400-40-06-.05 (2)
Permits shall impose monitoring, recording, reporting, and inspection requirements as determined necessary by the Commissioner. All monitoring conducted pursuant to permits issued under this chapter shall be representative of the wastewater being sampled. The Commissioner may make monitoring, recording, reporting, and inspection forms available electronically and, if submitted electronically, then that electronic submission shall comply with the requirements of Chapter 044-01-40.

What factors will be used to determine when monitoring is required (or necessary)? Monitoring serves an important purpose - monitoring can indicate the performance of the treatment process. If a permit limit has been established, then it is reasonable to expect the permittee to monitor the process to ensure that performance is being achieved. However, if there is not a specific purpose for monitoring, then it is an arbitrary and capricious policy.

0400-40-06-.05 (3)
Permits may require best management practices to carry out the purposes and intent of the Act.

What are best management practices - are they guidelines, are they accepted engineering practices, and who makes the determination between a "best" management practice and a "marginal" management practice? One of the philosophical factors that separate "prescriptive" rules from "performance-based" rules is the selection of best management practices. Prescriptive rules eliminate the need for best management practices because there is no freedom in the design. The determination to employ best management practices is made when "performance" must be achieved.

0400-40-06-.05 (4) (c)
There shall be no discharge of wastewater to groundwater, except as separately authorized by an underground injection control permit.

If the intent of this rule is to say that all land-based system must have UIC coverage, then simply say that all system must have UIC coverage when applicable and leave out the "no discharge of wastewater to groundwater."

Everyday, independent of rules and regulations, waste constituents <u>are</u> being <u>transferred</u> to the groundwater. I purposely did not use the word "discharge," in this rebuttal. I am not sure that "discharge" is the correct word to use from a regulatory perspective when discussing a waste product that has been placed in the soil and is then allowed to move by natural forces into a saturated zone. The word "discharge" suggests a direct conduit between the waste source and the protected waterbody. The intent of land-based wastewater treatment and dispersal is to have a dispersed conveyance to the saturated zone.

Scientists, engineers, and regulators know that the soil does not remove all of the waste constituents out of domestic wastewater. Treatment technologies exist that can remove all waste constituents from wastewater, but society cannot afford that cost. Instead, we use technologies that remove <u>regulated</u> constituents.

0400-40-06-.05 (4) (h)
The permittee shall own the sewerage system, treatment works, and land application area, including any parts thereof and extensions thereto, as applicable.

This rule is very important for the success of Tennessee's decentralized wastewater industry – this management model must be followed. This rule does become more difficult when components of the system are located on private property – such as STEP tanks, pump and controls. It would be more helpful if this rule contained language that instructed the permittees to obtain legal easements to the on-lot portions of the sewerage system.

A particular concern is the phrase "including any parts thereof and extensions thereto, as applicable." You must define "parts" and "extensions." Parts could include the pumper truck needed to withdrawal septage from STEP tanks – does the permittee need to show ownership of pumper trucks?

0400-40-06-.06 (b) Ponding
1. Land application systems shall be operated and maintained to ensure complete hydraulic infiltration within the soil profile such that there are no instances of dry weather persistent ponding.

2. Instances of dry weather persistent ponding as a result of system operation are prohibited. Instances of dry weather persistent ponding shall be promptly investigated and noted on the Monthly Operations Report. The report shall include details regarding location(s), determined cause(s), action(s) taken to eliminate the issue, and the date the corrective actions were made. Any instances of dry weather persistent ponding not corrected within three days of discovery shall be reported to the local Environmental Field Office at that time for investigation.

The intent of this rule is simple, effluent is placed below the soil surface and it should stay below the soil surface. The implementation of this rule is much more difficult. As defined in the Definitions Section of these proposed rules, ponding means standing water on the surface of the ground. Water standing on the soil surface does not imply that it is effluent. All land application areas have small locations where stormwater will pond. While this issue is seemly accounted for by allowing ponding to occur for 24 hours after a storm event of 1/2-inch or greater, the reality is not that simple. During the winter, or when the soil is completely saturated from several days of low-intensity precipitation (or snowfall), surface ponding (due to hydrology) may not infiltrate within 24 hours.

I am concerned that this proposed rule does not adequately separate surface water (from a storm event) from surfacing effluent. Effluent will only surface when the hydraulic gradient (feet of head) forcing the water into the soil is greater than the surface elevation of the soil. In other words, for effluent to come up to the soil surface and form a layer of free water on the soil surface, there must be hydraulic pressure pushing the effluent upward. When this occurs, it should be evident that the distribution system has a problem, such as effluent moving to the lowest emitter after the pump shuts off, or the dose cycle is too long.

Because the proposed rule defines ponding as standing water, I assume that a saturated soil that does not have standing water is not considered to be in violation of the rule. Paragraph 0400-40-06-.06 (2)(b) states that the loading rate shall be determined that will maintain aerobic conditions in the soil, but this does not account for hydraulic loading due to the precipitation event.

Because of the real potential to mistake surface water for surfacing effluent, I believe that TDEC needs to remove all references to "ponding" and instead provide guidance to its field staff on how to determine when a system has an issue with surfacing effluent. These determinations can be as simple as the over-growth of vegetation or a soil that will not support foot traffic.

0400-40-06-.06 (2) Land Application Area
This paragraph (2) shall apply to new land application facilities approved after June 1, 2019. The primary land application area shall contain suitable soils area(s) of sufficient size to accommodate at least 150% of the daily design flow. Soil suitability shall be demonstrated through an extra high-intensity soils map as defined in Rule 0400-48-01-.02 (copied below) and supported by soil pedon descriptions prepared in accordance with the Soils Handbook of Tennessee or equivalent soil pedon description development practice as approved by the Commissioner.

I view the 150% land application area requirement to be a policy issue rather than one based in science and engineering. The history of having suitable land in excess of the design requirement is based on the use of subsurface sewage disposal systems. Conventional subsurface sewage systems tend to fail due to the loss of water movement through the infiltrative surface in the bottom of the trench. This failure mode is largely due to the strength of the septic tank effluent and due to the marginal installation practices such as serial loading of the trench system. Decentralized land application systems will not have this same failure mode; the effluent is pretreated to a higher standard and the effluent is uniformly distributed across the application area. Safety factors are best management practices. However, there may be other safety factors that can be implemented that do not include the purchase of additional land.

Questions: does the distribution system have to be installed in the extra land and be actively used as part of the overall land application area; or, is the intent for this land to sit idle unless needed for future utilization?

Lastly, I do not understand how a rule can be imposed while it is still open for public comment. If a permittee pays for the land and for the components needed for the distribution system, and then the rule is withdrawn – will TDEC reimburse the permittee for the extra expense? I foresee lawsuits that TDEC cannot win.

0400-40-06-.06(2)(a) The soil profile shall be described to a minimum depth of 36 inches or to rock or fragipan. There shall be a minimum of two pedon descriptions per acre with at least one description in any soil unit intended for use, unless a different frequency is specified by the Commissioner.

I do not have a science or engineering concern about the soil being described down to 36 inches. I certainly have a policy question. The rules indicate what soil features are acceptable down to 20 inches. So, what are we looking for between 20 and 36 inches. Are there soil features in the soil profile between 20 and 36 inches that would prohibit the use of that soil for land application?

0400-40-06-.06(2)(b) Application rates or soil areas loading rates shall be such that long-term acceptance of treated wastewater is achieved and aerobic status of the soil column is maintained.
1. The maximum design loading rate cannot exceed the lower of the maximum hydraulic loading rate from the table below, or the maximum pollutant loading rate. For municipal wastewater, the maximum nutrient loading rate is based on calculations for nitrogen loading to ensure groundwater concentrations of nitrate do not exceed 10 mg/L. For industrial wastewater, additional constituents may need to be addressed as applicable.

2. The following table should be used to determine the maximum hydraulic loading rate.

Maximum Hydraulic Loading Rates

TEXTURE	STRUCTURE: SHAPE	STRUCTURE: GRADE	HYDRAULIC LOADING RATE (GPD/ft²)
Coarse Sand, Loamy Coarse Sand	NA	NA	NA*
Sand	NA	NA	NA*
Loamy Sand, Fine Sand, Loamy Fine Sand, Very Fine Sand, Loamy Very Fine Sand	Single Grain	Moderate, Strong	0.50
		Massive, Weak	0.40
Coarse Sandy Loam, Sandy Loam	Massive	Structureless	0.30
	Platy	Weak	0.20
		Moderate, Strong	Not Used
	Blocky, Granular	Weak	0.40
		Moderate, Strong	0.50
Loam	Massive	Structureless	0.20
	Platy	Weak, Moderate, Strong	Not Used
	Blocky, Granular	Weak	0.30
		Moderate, Strong	0.40
Silt Loam	Massive	Structureless	0.20
	Platy	Weak, Moderate, Strong	Not Used
	Blocky, Granular	Weak	0.20
		Moderate, Strong	0.30

Sandy Clay Loam, Clay Loam, Silty Clay Loam	Massive	Structureless	NA*
	Platy	Weak, Moderate, Strong	Not Used
	Blocky, Granular	Weak	0.20
		Moderate, Strong	0.20
Sandy Clay, Clay, Silty Clay	Massive	Structureless	Not Used
	Platy	Weak, Moderate, Strong	Not Used
	Blocky, Granular	Weak	0.075
		Moderate, Strong	0.10

* Requires a special site investigation

The Maximum Hydraulic Loading Rates Table
This table was created by Dr. Jerry Tyler, retired Professor of Soil Science from the University of Wisconsin. I, and nearly everyone else who conducts research in land-based wastewater treatment, have full respect for Dr. Tyler's work. This table was intended to be used as guidance. This table has never appeared in a peer-reviewed science or engineering journal. It was published in an U.S. EPA document (Onsite Wastewater Treatment Systems Manual, EPA/625/R-00/008, 2002) as guidance for designers. Dr. Tyler's professional experience was in individual septic systems. In personal conversations with Jerry, he has made it clear that he regrets the day he first constructed this table – this information has been misused by manufacturers of drip tubing, by engineers, and by the regulatory community. The knowledge provided in Jerry's table is good information and is based on his understanding on how water moves through the soil. However, the numbers that he provided with the various soil textures and structures are approximates and not absolutes. The use of Dr. Tyler's table as rule, instead of guidance, is a violation of his original intent.

As published in this proposed rule, weak blocky structured Sandy Clay, Clay, and Silty Clay soils are now considered acceptable and can be loaded at 0.075 gallons per day per square foot. This represents a significant departure from the TDEC Design Criteria for Sewage Works, Chapter 17 Drip Guidelines for Wastewater Dispersal Using Drip Irrigation. This soil structure is allowed for individual wastewater systems that use drip dispersal after advanced treatment. I support the inclusion of this soil structure in the proposed rules.

0400-40-06-.06 (2)(e) Non-forested land application areas with slopes greater than 30% are prohibited.

What is the science behind this rule? Does Tennessee have a history of land slides associated with subsurface drip dispersal? Prohibiting slopes greater than 30% seems arbitrary and capricious, unless there is a geological or morphologic basis for such a prohibition. It is reasonable to impose a geologic investigation of sites with slopes greater than 30% to determine the risks. Whether the site is forested or non-forested really does not bear much significance as to the risk – the real issue is water management. I do not believe that TDEC can defend this rule.

0400-40-06-.06(3) Construction.
For new land application facilities approved after June 1, 2019, the following construction standards shall apply:

> *(a) Drip disposal lines shall be installed at a depth of six to ten inches below the natural soil surface.*
>
> *(b) Drip lines shall be installed at an elevation conforming generally to the natural ground surface contour of the site.*
>
> *(c) All components of the system shall be designed and manufactured for the purpose of managing wastewater.*

Part (a). I do not have any problems with the six to ten inch installation depth. I do have a problem with the complete prohibition of laying drip tubing on the soil surface. The risk to public and environmental health would be the same as spray irrigation. The maintenance is a different issue – having drip tubing on the soil surface will require more maintenance due to varmints chewing on the tubing. Once the tubing is covered with the natural detritus (duff), it is effectively covered. As long as the permittee is willing to perform the higher level of maintenance and is willing to accept an NOV when leaks occur, I do not believe that TDEC can defend the carte blanche prohibition of the practice.

Part (b). I agree that drip tubing shall generally conform to the natural ground contour. I have a very STRONG concern about the word "generally." Does generally mean plus/minus 2 inches, 4 inches or 12 inches? There will be a different interpretation of "generally" in every environmental field office.

Part (c). I agree with the intent of this rule. However, designers, engineers, and installers are completely dependent on the manufacturer to list their product as being "designed and manufactured for the purpose of managing wastewater."

Components, such as pumps, valves, control panels, connectors, and others need to be compatible with the pH, solids content, and aggressiveness that is found in wastewater. Part of the problem is that most turbine-style pumps used in STEP tanks (high-head, low flow) look just like a pump you would place in a drinking water well. In reality, the only difference is the pump's label.

This is especially true for the drip tubing. Netafim tubing for crop irrigation comes off the same injection system and uses the same emitters as the Netafim tubing used for wastewater dispersal. The only difference is the color and the inclusion of an herbicide that has been impregnated into the plastic to slow the growth of roots into the emitters. Very little research supports the benefit of the herbicide, except from the manufacturer.

The two major manufacturers of drip tubing that is designed and manufactured for wastewater management are Netafim and Geoflow. RainBird, Hunter and other traditional irrigation suppliers have their own brand of drip tubing, but do not advertise their product for wastewater management. As an engineer, I would recommend Netafim or Geoflow because they have the history, but I do not know that TDEC can say to RainBird that your product cannot be used just because they do not advertise their product for that use. The bottom line is that the filtration system is equally (if not more so) important than whether the drip tubing was advertised as being designed and manufactured for wastewater management. If the permittee allows high levels of TSS into the tubing, it will plug the emitters – independent of who manufactured the tubing.

0400-40-06-.06(4) Design Basis
(a) Design flows for residential developments shall be based on the higher of 300 gpd per single family dwelling unit or 65 gpd per person. For vacation rental units the design flow shall be based on 65 gpd per person for the maximum number of occupants.

The use of 300 gallons per day per single-family dwelling includes a significant safety factor. In 2009 we used water-use data from Consolidated Utilities of Rutherford County to model the appropriate design flow for cluster systems (Dobbs, Cox, Tyner, & Buchanan, 2010, Preliminary Risk Analysis of Decentralized Wastewater Design Flows for Cluster Systems, Water Environment Research, Vol 82(12):2357-2362). Using risk analysis, it was determined that a design flow of 250 gpd/dwelling only had a one percent chance of having a flow exceedance (to the treatment system) for systems containing 15 or more dwellings. Similarly, we found that a design flow of 225 gpd/dwelling had a one percent chance of having a flow exceedance if 30 or more dwellings was connected to the system. As a final point, the design flow for sewer systems (with 100's of connections) tends to be about 200 gpd/dwelling.

Assuming that 250 gpd/dwelling is a more realistic design flow, for a 100 home system – the land application area will be oversized by 5,000 gpd. If the loading rate is 0.20 gpd/ft2, then 25,000 additional square footage will be required to meet the 300 gpd/dwelling flow. This is a difference of having 2.87 acres (for 250 gpd/dwelling) as compared to 3.44 acres for 300 gpd/dwelling. This is a 20% increase in land application area. In combination with the 150% land requirement (0400-40-06-.06 (2)), these two rules force a 70% factor of safety in sizing the land application area. As an engineer, I believe in safety factors, but choose one or the other – we do not need both.

Vacation rental units certainly present a design flow an issue. However, we should have sufficient history with the vacation units that were constructed near Gatlinburg and Pigeon Forge to formulate a loading rate based on real data. So my question is has anyone in TDEC asked for a copy of water use records of these rental properties to determine an appropriate flow per square-foot of living area per day? Second question: How will the maximum number of occupants be determined - by the fire marshal?

0400-40-06-.06(4) Design Basis
(b) Land application shall be designed and installed such that the area of influence of the drip emitters or spray pattern covers the minimum square footage calculated of the application area. For drip dispersal system design, one emitter represents four square feet of application area, provided the emitters are not spaced more closely than two feet along the drip tubing or perpendicular to the drip tubing unless otherwise approved by the Commissioner.

In the Chapter 17 Design Guidelines for Wastewater Dispersal Using Drip Irrigation, line spacing is addressed as follows.

> "In an attempt to achieve even distribution of the wastewater and maximum utilization of the soil, it is recommended that the emitter line spacing and emitter spacing be at 2-foot spacing. Depending upon site conditions (soil type, slope and reserve area) the Department of Environment and Conservation may allow spacing to increase to ensure that each emitter supplies a minimum wetted area of not more than ten (10) square feet (i.e., 5-foot line spacing with 2-foot emitter spacing or 10-foot line spacing with 1-foot emitter spacing)."

The five-foot lateral spacing is an artifact of Low Pressure Pipe (LPP) design. However, a drip system and a LPP system are not comparable. The dose volume and the in-trench storage (which provides a large interface for infiltration) of the LPP creates a very different hydraulic gradient in the soil, and thus there is the potential for water move a greater horizontal distance via soil-moisture tension. A drip system has a lower dose volume and a much-reduced soil interface for infiltration. The moisture does not move as far in the horizontal direction. For these reasons, I have never supported the 5-foot lateral spacing, and certainly not the 10-foot spacing – independent of the number of emitters along the lateral. Effluent will naturally flow along the lateral due to the soil disturbance that took place during the installation process.

Having said that, there is no justification for the 2-foot lateral spacing with a drip system. The soil-moisture tension will deliver the effluent to the area between the laterals with 3-foot spacing and, depending on the soil texture, a 4-foot spacing. The only literature that is available that suggests that a 2-foot spacing should be prescribed comes from the manufacturers of drip tubing.

This is a classic swing of the pendulum, 5-feet was (is) too wide and there was (is) soil between the laterals that was (is) not be utilized for wastewater treatment. With this proposed rule, the pendulum has moved to the other extreme – placing tubing on 2-foot centers does not improve the distribution uniformity. Using HYDRUS, a soil physics model, Dr. David Radcliffe, a Professor of Soil Science at the University of Georgia, showed that placing the tubing on a 2-foot spacing allowed the plumes (from each lateral) to overlap in the area between the laterals – resulting in a zone of higher soil moisture and a greater concentration of waste constituents (Abstract, WEFTEC 2016, Using the HYDRUS Model to Determine Optimum Emitter Spacing for Community Wastewater Drip Dispersal Systems, D. Radcliffe and J. Buchanan). This modeling effort is far from being truly representative of real-world effects, but in non-sandy soils, it is expected that water will move horizontally at least 18 inches from the emitters. Based on this research and on field observations, an appropriate drip lateral and emitter spacing would be 3-foot by 3-foot, respectively. Drip tubing with 36-inch emitter spacing is available from the manufacturers; however, the 24-inch spacing is more readily available. Placing laterals on a 3-foot spacing and using drip tubing with emitters spaced every 24 inches would provide one emitter for every 6 square feet.

I agree that there needs to be more emitters distributed across the land application area than can be provided with the 5-foot spacing. However, mandating a 2-foot spacing is overkill, the additional expense cannot be justified by the minimum benefit (if any) to public and environmental health. TDEC may be under the impression that the developers will pay the price to keep building houses, and to some extent, that is true. My concern is for existing small communities that are installing their first sewer system and want to use drip dispersal. By adding so much unnecessary expense to the drip system, these communities will likely opt to install a wastewater pressure main to the next community. This is the USDA Rural Development Model and it has long-term negative consequences for the small community whose growth is now limited by the wastewater treatment plant in the adjacent community.

Concluding thoughts. I am very active in the decentralized wastewater community in Tennessee; I know many of the soil scientists, engineers, installers, regulators, and service providers on a personal level. On May 9, 2019, Mr. Brad Harris sent me an email to inform me about these proposed rules and to get the mailing list for TOWA members so they could be so informed. This was my first and only notification that a rule change of this magnitude was in the works. Since May 9th, I have yet to find anyone outside of TDEC who knew these rules were being crafted. I am very concerned about TDEC's lack of stakeholder involvement with this process. As of this writing, I believe that TDEC needs to withdrawal Chapter 0400-40-06 from the rulemaking process. The intent of most of the proposed rules are fine, but the implementation of these rules will have negative consequences. TDEC should form a stakeholder group, and craft rules that are based on good science, engineering, and economics. As a secondary benefit, that stakeholder group can help defend TDEC during the legislative inquires that are sure to come. If I can provide clarification on any of the points I have mentioned in this letter, please let me know.

Sincerely,

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