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Subject: Revisions to CT Leaching System Rating Formula, Leaching System Void Capacity and Competing Bio-mat Interfaces

Dear Bob:

As per our discussion of December 2, 2009, I am writing at this time to express my comments and concerns about the current process used to credit leaching systems in CT and other important subject matters. As you know, this process originated under my watch so much of the criticism on the current rating system should be directed at myself but I am retired now so I don't feel too bad. Seriously, I believe it is time to review the leaching system product credit formula and I was pleased to see that the framework for such a review was incorporated into the 2009 Technical Standards under Section G.

For the benefit of some of the new folks you now rely upon serving on your Code Advisory Committee (CAC), I would like to document for the record the origins of the leaching system crediting process. Back in the 80's, there were new leaching products being brought to the market such as Infiltrator chamber, the original Eljen (separate fingers in the sand) In Drain, the bundled In-Drain and some products from down south like the Easy Lay Styrofoam/mesh covered pipe system. All of these product manufacturers drove us crazy trying to determine their effectiveness per linear foot of system. So, with the help of our CAC, you, Arthur and I came up with a mathematical formula we could apply to any new product thereby figuring out the system credit in an unbiased manner. It was a process not based totally upon solid data or testing but it did attempt to consider the various processes effluent must experience before it escapes into the surrounding fill or natural soils. Back then, DEP was using a much simpler rating system treating all types system interfaces the same and they still do today. The wetted perimeter, where effluent enters the surrounding soil at the bio-mat, is used.

The rating system worked well for many years but we did not always apply it equally for all products. We required side by side plastic chambers to be equal to galleries even though they should have been credited higher. We allowed some systems to be utilized to the top by flooding but not all systems including stone trenches. We discredited filter fabric to some extent even though we did not have data to show that was valid. I truly believed you, Arthur and I tried to be uniform and fair but even our formula process had flaws and it is fitting, now, to bring this matter up for discussion and review and to fix many of the problems our "old' formula created. In the remainder of this rather lengthy letter, I will attempt to explain and clarify why the process should be revised and point out some inequalities in the system. It is a bit awkward for me now, as a former regulator and more recently a patent holder of a proprietary leaching system, to offer up my thoughts without some questioning my motives but I can assure you that my

comments are made for the good of all CT residents as buyers and users of septic system that should be expected to last for at least 30-50 years.

General Comments:

1. If you elect to keep a numerical rating system, it should be applied to all leaching systems and products out there with no exceptions. For example, if you allow many proprietary products to use a pipe on top of the leaching system without stone bedding or stone cover on top, then all systems, including leaching trenches, should be afforded the same privilege and be credited accordingly if flooded. If you want all systems to never use the top 3" of the system, then do that for ***every*** system. The requirement for gas/air transfer and non-flooded D boxes could remain if you allow flooding of every system. As a side note, I would recommend that *all* ASTM D2729 perforated distribution pipe be bedded in stone (that includes proprietary systems) and if not bedded and covered with stone, then require ASTM D3034 SDR 35 perforated pipe. My company, Waste Engineering Inc., has been using the perforated 3034 and bedding/covering the pipe in stone for the past two years. Placement of the pipe at top should apply to leaching galleries provided the pipe was set in the stone on the side of and at the top of the gallery. It is assumed that for all of these systems, the septic tank and/or D box would have to be set at an elevation higher than the system and the high level overflow elevation if used.
2. If you elect to use different credits for various types of interfaces, then all products should be accurately rated based upon the actual interfaces provided. As previously noted, the side by side plastic units or the Cultec Field Drain units should be rated for their valid open bottom area and the wetted sidewalls below the perforated pipe, not as an equal to a conventional concrete gallery. Open bottom area as a higher application rate benefit may not totally be justified but granting slightly higher rates was pushed back in the 80's by Randy May and Jim Nichols of Infiltrator, Inc. I emailed you a recent web copy of a contradictory study showing little difference between stone and open chamber flows and hope you will share it with the Committee members. What I do believe is that the technical measurement of flow from every anaerobic leaching system out there is directly related to the LTAR and a system that uses rates in or close to the LTAR with built in safety factors should work fine. I also believe that there should not be such a wide discrepancy between the methods of application to the soil *unless* the prescribed flow path was more restrictive than the LTAR.

   In the past when developing the rating system, the goal was to keep the standard trench rated about 3.0 SF/LF and the other conventional units such as galleries close to what we had done in the past. I think that is still an honorable goal and uses the stone trench as a "standard". Using that concept and considering the normal 5 SF/LF contact area (wetted perimeter) where sewage meets the soil, an application rate of 0.6 GPD/SF would be acceptable and keep things equal to today's rating of 3.0 SF/LF. Relating back to actual system performance and the LTAR, a 3-bedroom house, 450 GPD with a 10 M/I perc would require 495 SF or 165 LF of trench. That in turn would provide (165x5) 825 SF of soil contact area. Using 450 GPD applied to 825 SF, we get a soil application rate of 0.54 GPD/SF which is within the acceptable LTARs for good soils in that perc range.

   If we used that same application rate for every system, you would see that the open bottom products would be down rated and, given their past long term

suitable performance, that is not my recommendation. I would suggest the formula be kept simple and an application rate of 0.9 or 1.0 be used for crediting open bottom areas. I will use the 1.0 application factor for the remainder of this document. For a 12" gallery flooded to the top, 3.5' open bottom, 12" stone bottom and 12" stone vertical wall, rating would be (3.5x1.0)+(4x0.6)= 5.9 SF/LF, the exact same as today's rating. A similar 30" gallery flooded would be rated 7.7 SF/LF, slightly higher than today's 7.4 SF/LF. The 4x4 gallery would get 9.5 SF/LF rating. Flooding to the top of the structure would be required in all three of these system designs.

3. The factor applied to filter fabric products should be, in my opinion, equal to that of stone (0.6) because it is most like a stone trench in that some type of media; stone, horse hair plastic fiber, plastic mesh or dimpled plastic sheets, covered by fabric are pressed against the soil or sand fill. The fabric itself, for all products, should not be considered restrictive and likely has a permittivity in excess of 75 or 100 GPD/SF. You have the filter specifications for all proprietary products on file for all products in your office and those flow rates would be easy to confirm. With real life flows through the bio-mat of 0.4 to 0.8 GPD/SF, the fabric presents no obstruction to flow from the system into the adjacent soil or sand. CT has experienced the flow through fabric systems over the past 25 years and once we got the sizing and effluent distribution down right, those larger fabric systems continue to perform admirably. For all fabric covered products, the added benefit of providing another initial filter (when brand new) and a base for the mat to become established and remain should be realized. There is no technical basis to additionally down rate products that utilize flow through filter fabric.

   With that said, the combined ELU reducing effect of stone and fabric factors currently in use has no basis in fact. As you know, this combination has been applied only to the Living Filter (LF) and more recently, the GreenLeach Filter (GLF). I acknowledge that it was I who originally did this with the formula but the concept of relying upon such a large percentage of vertical leaching area for effluent flow from a leaching system was a totally new proposal 18 years ago and I agreed with Arthur that we should be cautious in granting credits to the LF. For that reason, the double reduction factor was applied. The original 0.6 stone factor (which is different from the 0.6 application factor I am proposing in this letter) was less than the 1.0 for open bottom due to the silt, dirt and fine sand commonly observed on stone. Our thought back then was that these foreign particles would clog the bottom area and restrict flow. As it turns out, the bottom area of both the LF and GLF represent a very small percentage of sand (soil) contact area. For the GLF, bottom area is only 17% of contact area on our 12" product and 6% for the 36" high product.

   Most recently, DPH rated the GST system which uses a metal form to create a product almost exactly the same as the GLF without fabric between the sand and stone and that rating was about 20% higher than the GLF. I am of the opinion that the fabric provides a permanent sand barrier to prevent sand infiltration into the stone (particularly when the sand is not properly compacted) and does not restrict flow whatsoever. Use of an application rate 0.6 GPD/SF of wetted perimeter for all sand/stone interface and sand/fabric & stone would eliminate that inequality in product rating. It would bring the GLF and LF on an equal par with the GST and all other systems.

4. In my contact with engineers and installers in the field, I am frequently questioned as to how the narrow finger leaching products obtained such a high product rating. Once again, I do admit to them that you are using a formula that was adopted under my watch so I do assume some historic responsibility for a methodology that should now be changed. I share their concern and am aware of the expanding use of these new systems that are relatively small in size. I believe the high ratings will result in a shortening of leaching system life as the system matures and the bio-mat, with the slowly developing LTAR, governs flow of effluent out of the system. For example, if we had a 4-BR home, a perc rate of 10.1 - 20 M/I requiring 900 SF effective leaching area, standard stone trenches would provide (300x5) 1500 SF of wetted perimeter area below the pipe invert. Using a 12" Mantis in the example above, only 81.8 LF of product would be required. There are 10 fingers/5' section or 2 fingers/LF. The surface contact area with sand for 1 finger is, sides (1.0x2.5) x2 + ends (.25x1.0) x2 + bottom (2.5x.25)-(0.17 SF for 2-4"dia. holes) = 5.95 SF x 2 per foot = 11.9 SF/LF. If you take the 81.8 trench x 11.9 SF, that would provide a total of 973 SF of contact area, about 65% of that compared to a trench. This is the reason all fabric covered systems using a core of stone, horse hair plastic fiber, plastic mesh or dimpled plastic sheets should be rated at an application rate of 0.6 SF x wetted interface provided. If you used the rating system I am proposing, the 12" top pipe Mantis would be rated at (11.9 x 0.6) 7.1 SF/LF and (900/7.1) 127 LF would now be required thereby increasing the contact area with sand to (127x11.9) 1,511 SF, equal to that of a trench. Using this same process to rate the 12" GLF, the GLF 12.62 would be 10.5 SF/LF and require (900/10.5) 86 LF. The 86' GLF, at 17.6 SF/LF of contact area with sand would provide a total of (17.6x86) 1,514 SF. All other fabric systems would be put on the same contact area as that of stone trenches. Either this or some other method of interface equalization must be considered.
5. There has also been significant discussion on the importance of providing internal liquid storage within all leaching systems. In Section 11 of the Design manual written by Ted Willerford and me, we discuss briefly the importance of having void capacity within the stone or structure. Most of the approved systems do provide this storage capacity but a few of the smaller, narrow finger systems do not. For example, the 900 SF trench system cited above would have about (300'x3'x1.')x0.50x7.48gal/CF) more than 3,000 gallons of storage when new and still have1500 gallons available for storage if half of the trench was flooded. A shallow 4'x1' stone trench would provide about (300x.5x4x7.48) 2,240 gallons of storage. The 900 SF Mantis system used in the example above would provide somewhere around 8.5 Gal/LF or 695 gallons when new and about 387 gallons if half full. The 900 SF GLF 12.62 system described above would provide about 963 gallons when new and 480 gallons if flooded half full. As stated 25 years ago in the Design Manual, "The system must contain sufficient hollow spaces within the stone or leaching structure to allow sewage to be stored during periods of heavy use, or when rainfall or subsurface flooding reduces the ability of the system to disperse liquid". In-system storage is important for pump systems too. It is not beneficial for pumps to start and stop frequently and a longer, larger dose extends pump life. My recommendation is that all systems provide liquid storage equal to at least 100% of the design flow when the system is new.
6. Another important subject of discussion should be consideration of conflicting leaching interfaces when product segments are placed too close to each other.

This is primarily a concern with the new proprietary leaching systems. There is significant benefit to promoting aerated effluent treatment between the leaching segments and putting them too close together could result in conflicting bio-mats and possibly cause hydraulic overloading if there is considerable vertical application area. The shallower systems should not be candidates for the combined conflicting interface/hydraulic overload situation and a smaller reduction for competing interface could be considered. Based upon the long term experience with the LF, I would support a minimum interface separation of 4" between leaching segments more than 8" high and discounting of interface in systems lower than 8" if components are less than 3" apart. Uniformity and fairness in formula application is critical and must be justifiable. You should realize that some movement of product segments can occur during installation with several proprietary products and the larger distance apart provides a factor of safety in maintaining whatever distance you really would like to achieve.

7. The final comments made are in support of a maximum credit number (29.9 is as good as any), specifying a maximum trench width (six feet), specifying a maximum *product* width (60" or max 72"), specifying a maximum product height (4' for all products rated less than15 SF/LF, 3' for all rated more than 15 SF/LF). As you can see from what we (at DPH) did years ago with the first formula, creative entrepreneurs will take whatever you give them and use that to maximize any crediting system. Being fair to product manufacturers is important but it is much more important to be protective of CT residents and the valuable properties they develop.

In summary, I recommend that you move quickly in resolving the rating discrepancies and other matters described above. You should notify all interested parties of the upcoming discussions and pending changes. If you elect to downgrade some existing systems, I would include wording to make clear that all prior approved systems were Code Complying under the previous Technical Standards. We had to do that when we down rated the first bundled Eljen In-Drain back in the 80's. It was difficult but necessary back then. If you elect not to make changes that result in equalization of leaching system rating (which would cause a lowering of the small finger type systems), you can be assured that more small finger systems will be presented to you for review and approval. Galleries and trenches will be replaced with higher rated systems. My partners at Waste Engineering, Inc. have considered bringing out a fabric/finger system to stay competitive and we have a concept product ready to go but my explanations of why we should not follow an unproven product path have prevailed thus far. I can't hold them off forever.

Please contact me if you have questions on any of the comments made above. I would be willing to assist you and the CAC in any way possible to resolve these critical matters.

Sincerely,

Frank A. Schaub

G. Leaching System Product Approvals, ELA Ratings, Center to Center Spacing

All approved leaching system products are assigned an effective leaching area (ELA) rating in square feet per linear foot (SF/LF) of product except leaching pits (See Section VIII C). Approved leaching systems with assigned ELA ratings are listed in the various subsections of Section VIII, or in a leaching system product approval issued by the Commissioner of Public Health. Proprietary leaching system companies shall submit new product approval requests to the Commissioner of Public Health along with product specifications, drawings, cross-sections, dated installation instructions, and a completed product application/measurement worksheet provided by the Commissioner of Public Health. Proprietary leaching system companies that have products listed in the January 1, 2009 revision of the Technical Standards shall submit to the Commissioner of Public Health, by July 1, 2009, the following information and documentation on all currently approved products: Product specifications, drawings, cross-sections, product marking information, dated installation instructions, internal storage capacities and a completed product application/measurement worksheet provided by the Commissioner of Public Health.

All approved leaching systems are assigned an ELA rating that is calculated in accordance with crediting criterion that takes into account several factors including the type of leaching system interface on which the biologically active layer (bio-mat) forms upon the routine application of septic tank effluent. For the purpose of the ELA ratings, the factors noted for stone are used also for two (2) inch nominal tire chip aggregate, an approved aggregate/stone substitute. Interface Factors for different leaching system interfaces are as follows:

Open:	2.0	
Filter Fabric (No Stone):	1.5	Note: Factor reduced by % obstructed.
Stone:	1.0	
Filter Fabric & Stone:	0.75	

The filter fabric interface factors also apply to cardboard and cardboard/filter fabric interfaces. Three types of leaching system interfaces are credited: sidewall interfaces, bottom interfaces, and internal interfaces. Sidewall interfaces discharge wastewater that does not pass through the product footprint area. Bottom interfaces discharge wastewater from the bottom of the product. Internal interfaces are non-bottom leaching surfaces that discharge wastewater from within and through the product footprint area. No credit is given for bottom interfaces that include cardboard. Horizontal measurements are used for bottom interfaces, except for corrugated pipes. Vertical measurements are utilized for sidewall and internal leaching interfaces, except for corrugated pipes. Corrugated pipes have measurements taken along the perimeter of the pipe. Sidewall and internal interfaces are credited up to the leaching unit's pipe invert unless otherwise established by the Commissioner of Public Health.

The Commissioner of Public Heath shall establish crediting limitations that are applicable to competing bio-mats (overlapping bio-mats of specified thickness), and internal interfaces based on the cross-sectional area of the product footprint, which is the horizontal area within a rectangular boundary around the outermost perimeter of the leaching system interface. The Commissioner of Public Heath shall also establish minimum internal storage requirements for leaching system products.

Leaching system center to center minimum spacing, except for leaching pits (See Section VIII C), is determined based on the following:

- Products with ELA ratings of 5.0 SF/LF or less: Seven (7) feet minimum, however at least four (4) feet side edge to side edge must be provided.
- Products with ELA ratings of 5.1 to 10.0 SF/LF: Nine (9) feet minimum, however at least six (6) feet side edge to side edge must be provided.
- Products with ELA ratings exceeding 10.0 SF/LF: Twelve (12) feet minimum, however at least eight (8) feet side edge to side edge must be provided.

Further center to center reductions will be considered at the time leaching system minimum storage requirements and leaching system crediting criterion for internal interfaces and competing bio-mats are established. Reduced spacing will only be considered if it is satisfactorily demonstrated that the particular leaching product can be reasonably installed by the licensed installer without compromising the installation.