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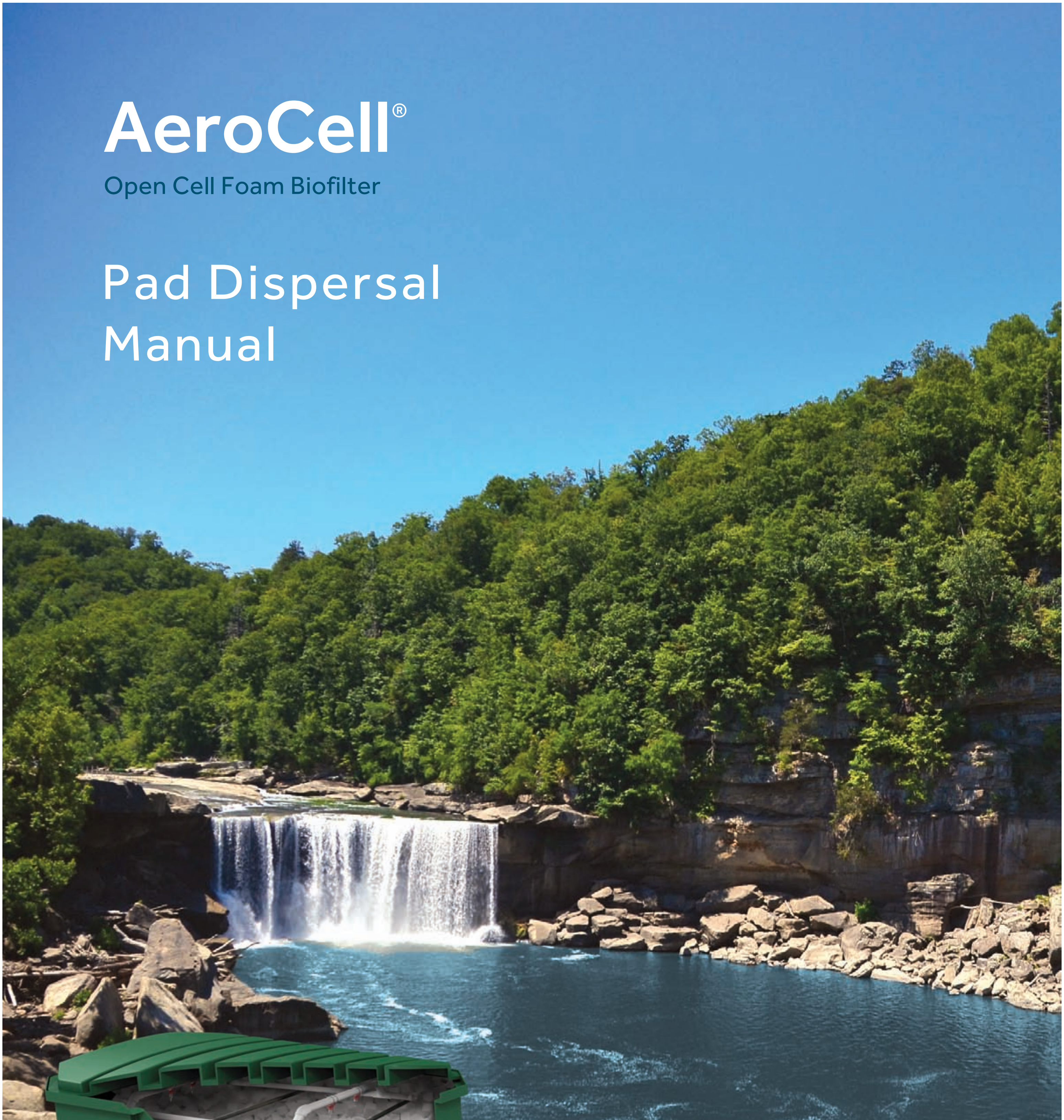
Pad Dispersal Manual



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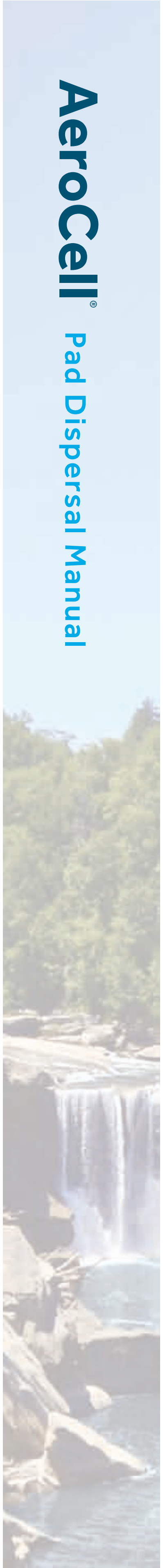

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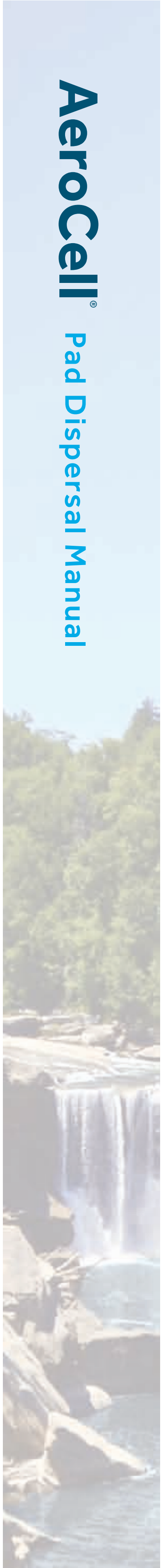


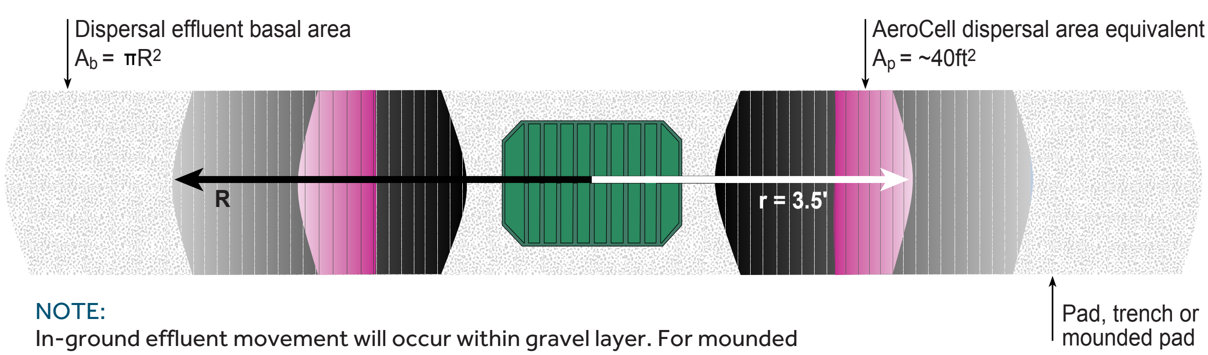
1.0 General Criteria

Note: See Appendix 1 for detailed information on length and width sizing using water mounding models to determine hydraulic linear loading rate (HLLR).

- Refer to the *Residential Design Guide* and to the *Installation Manual* for treatment system details.
- All components must comply with all applicable State or Local rules and codes.
- The septic tank shall be sized according to State or Local code.
- A commercial effluent filter/screen with 1/32" filtration shall be placed on the outlet of the septic tank that meets the requirements as stated in the *Residential Design Guide* and the *Installation Manual*.
- The dosing tank shall be a minimum of one times daily flow and meet the requirements of State or Local code.
- Distribution laterals must use 4-inch rigid perforated pipe that meets AASHTO M252, ASTM F2306, ASTM F810, ASTM F891, ASTM D2661, ASTM D2665, ASTM D2751, ASTM D3034, and/or ASTM 1785. Corrugated pipe must be dual wall with smooth interior and rigid. Gravity distribution laterals shall have two rows of holes separated by 120 degrees (4 o'clock and 8 o'clock) with 1/2-inch or 5/8-inch hole diameter with spacing at 5-inches or less.
- Microsoft Excel Design Sheet may be used to calculate any water mounding and determine appropriate hydraulic linear loading rate used to derive pad geometry (L x W).
- The length and width are sized using the Kaplan (1991), Allen (1980), or Poeter (2005) water mounding equations or linear loading rates in the Tyler (2001) Table ≤30 mg/l BOD_5.
- Additional design considerations:

  For slowly permeable soils, designers must use professional judgment to ensure effluent absorption into the soil and that other potential issues are mitigated, such as water mounding. For most soils, absorption and water mounding are not issues, even with as little as 1 foot of minimum vertical separation. Also, Converse and Tyler (2000) note, "The design loading rates are based on 150 gpd/bedroom resulting in 450 gpd for a 3 bedroom home. If the mound, as well as other soil based units, is loaded at 450 gpd on a regular basis, it will likely fail. The daily average flow is expected to be no more than about 60% of design or 270 gpd."

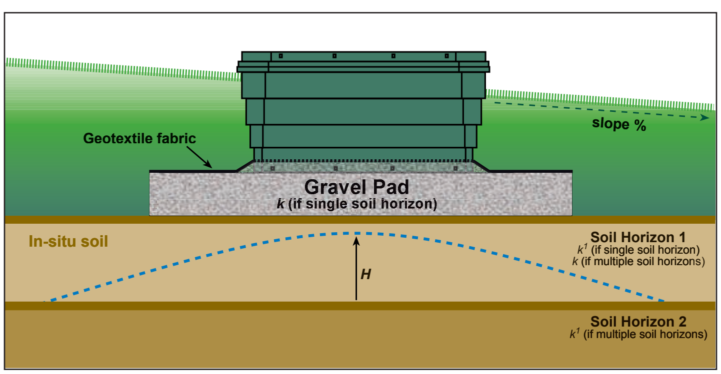
The effluent spread, as depicted in the diagram below, and water mounding height can be calculated using the Kaplan (1991) equations below:



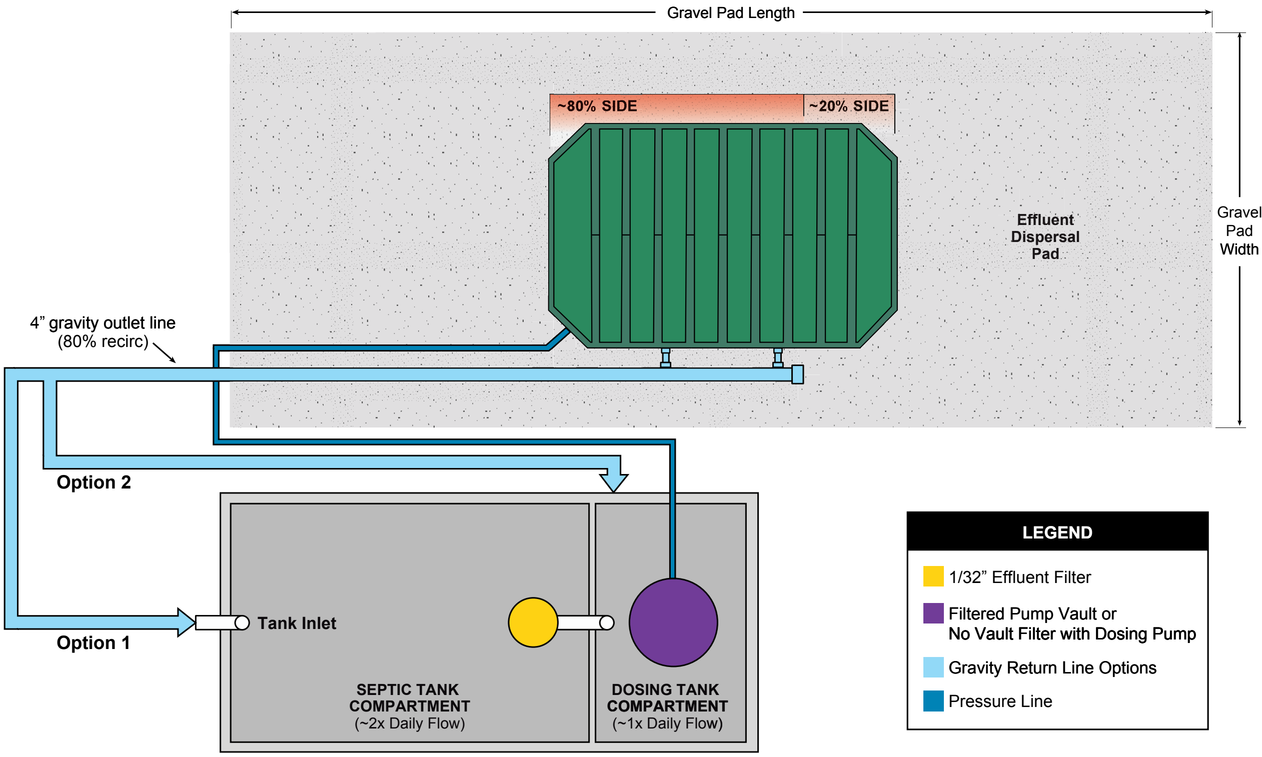
NOTE:
In-ground effluent movement will occur within gravel layer. For mounded applications, movement will occur through gravel and sand along contour.

2.0 Type A: In-Ground Pad Dispersal

- The in-ground pad dispersal area may be sized per the soil texture hydraulic loading (BOD=30) in Table 4-3 of the USEPA 2002 Onsite Wastewater Treatment Systems Manual or Anua criteria.
- The bottom of the stone dispersal area shall maintain a minimum vertical separation distance from limiting conditions per State or Local requirements or 1 foot (6 inches to seasonal high water table). Seasonal high water table vertical separation distance may be reduced to greater than 0 inches and less than 6 inches if approved by the local board of health or administrative authority. In situ soil must be a minimum of 6 inches or per hydraulic modeling.
- The dispersal aggregate shall be clean stone (3/4 to 1 inch). The stone shall be washed with not more than 5% passing the No. 200 (75 µm) sieve as determined by ASTM C117, "Test Method for Material Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing" and shall be durable with a hardness of 3 or greater on the Moh's Scale of Hardness. Alternatively, gravelless technologies may be utilized instead of stone.
- The dispersal material shall be leveled to a minimum depth of 6 inches.
- The pod(s), flow dividers, and perforated distribution piping shall be placed on the stone so that they are uniformly spaced. The flow dividers will portion the hydraulic flow to multiple cells with the dispersal pad. The perforated distribution piping will provide uniform distribution within each cell.
- The pod(s) shall be level from side-to-side and end-to-end.
- Connect the force main to the pod inlet coupling.
- Distribution media shall be placed at a level to completely cover the distribution holes of the perforated distribution pipe.
- A sample chamber shall be placed on the outlet of the pod(s) for sampling of effluent.
- Once the pod(s) are installed and all connections have been made, the distribution media shall be covered with a geotextile fabric.
- The system shall be backfilled with sandy to loamy soil material as needed to cover the pod(s) and meet the State of Local code for drainfield minimum soil cover.

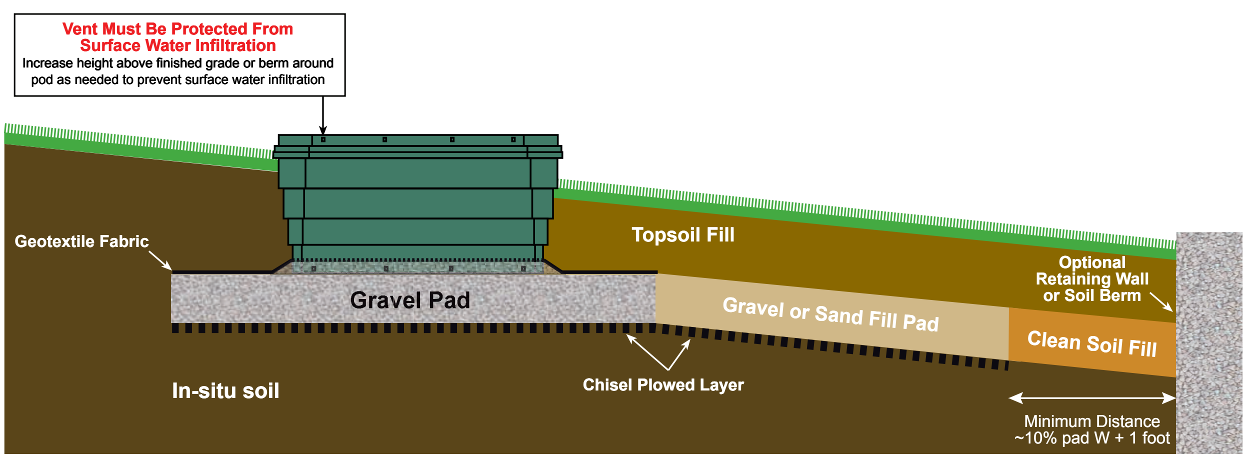


In-ground Pad Typical Layout



Note: Compartments can be as single tank or as multiple tanks.

In-ground Pad Sloped Site Options



3.0 Type A: Mounded Pad Dispersal

Note: Portions of this section are applicable to in-ground pad dispersal systems using sand fill to facilitate soil acceptance of effluent or to address landscape position issues.

Site Limitations and Modifications

- Mounded pads shall be oriented parallel to natural surface contours and shall be sited to avoid natural drainage features and depressions that may hold surface water. A design plan shall address surface water diversion as needed.

- An interceptor drain may be used upslope of a mounded pad soil absorption component to intercept the horizontal flow of subsurface water to reduce its impact on the down gradient mounded pad component.

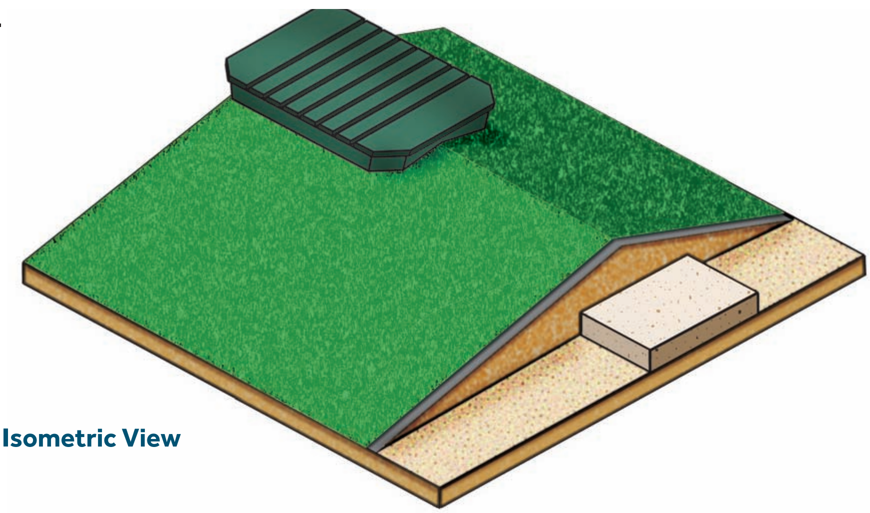
- A mounded pad soil absorption component shall not be sited on a slope greater than 25 percent unless the design plan includes special installation criteria.

- Sites with boulders or numerous trees are less desirable for a mounded pad soil absorption component. Such conditions shall be avoided or the design plan shall increase the basal area to compensate for losses due to boulders or flush cut trees and shall include special instructions for the basal area preparation under such conditions.

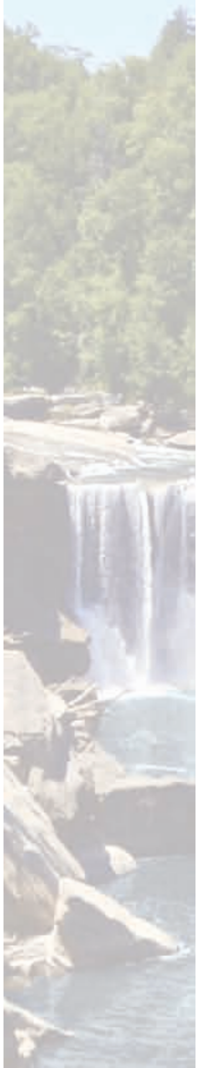
Site and Soil Information

- Site information shall include a description of landscape position, slope, vegetation, drainage features, rock outcrops, erosion and other natural features; and documentation of any relevant surface hydrology, geologic and hydrogeologic risk factors for the specific site or in the surrounding area that may indicate vulnerability for surface water and ground water contamination.

- Soil Information shall include identification of depth to limiting conditions including but not limited to water table and rock strata, and a description of soil texture, consistence, and structure, including shape and grade.



Isometric View



Sand Fill

- The mounded pad sand fill depth shall be determined based on the depth to the limiting conditions. The sand fill depth shall not exceed two feet and shall not be less than four inches. The loading rate for the sand fill material shall not exceed 2.0 gpd/ft^2.
- Natural sand is defined as naturally deposited silica based sand not manufactured by mechanical processing such as the crushing of rock or coarse aggregates. Manufactured sand that meets Anua specifications and State or Local rules and codes may be used.
- Sand fill for the mounded pad must be concrete sand meeting the gradation requirements of ASTM C33 provided not more than 5% passes the No. 200 sieve as determined by ASTM C117, "Test Method for Material Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing".
- A comparison of sand application rates from various regulatory authorities is in the table below.

Table 6 Sand Application Rates Comparison

Regulatory Authority	Gradation	Additional Gradation Requirements	Effective Size	Uniformity Coefficient	Sand Application Rate Gpd/ft^2 (≤30mg/l BOD$_5$)
Iowa	ASTM C33 or IDOT No.1	Sand fill must not have more than 20% (by weight) material that is greater than 2mm in diameter (coarse fragments), which includes stone, cobbles and gravel. Also, there must not be more than 3% silt and clay (< 0.53 mm, 270 mesh sieve) in the fill.	0.15 – 0.3mm	4 – 6	2.0
Minnesota	ASTM C33	No spec for No. 100 sieve. No. 200 sieve 0-5% passing. Clean sand must also contain less than three percent deleterious substances and be free of organic impurities.	None Specified	None Specified	1.6
Washington	ASTM C33	No. 100 sieve prefer <4% passing. No. 200 sieve 0-3% passing.	None Specified	None Specified	2.0
Wisconsin	ASTM C33	None Specified	None Specified	None Specified	2.0
British Columbia	ASTM C33	No. 100 sieve 0-4% passing. No. 200 sieve 0-1% passing.	None Specified	None Specified	1.6 – 3.15
Manitoba	CSA A23.1 (ASTM C33)	No. 200 sieve 0-5% passing.	None Specified	None Specified	1.6 – 3.75

Distribution of Area Over Sand Fill

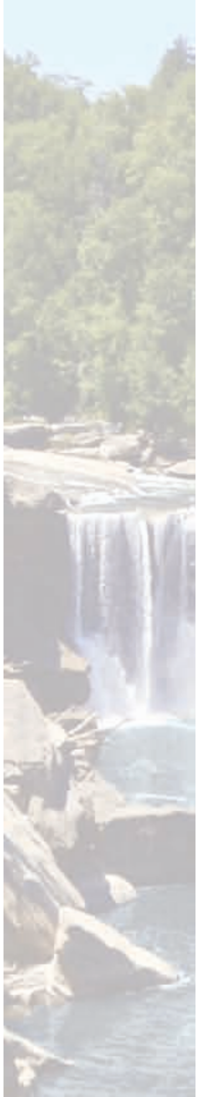
- The dispersal aggregate shall be clean stone (3/4 to 1 inch). The stone shall be washed with not more than 5% passing the No. 200 (75 µm) sieve as determined by ASTM C117, "Test Method for Material Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing" and shall be durable with a hardness of 3 or greater on the Moh's Scale of Hardness. Alternatively, gravelless technologies may be utilized instead of stone.
- The dispersal material shall be leveled to a minimum depth of 6 inches.
- The pod(s), flow dividers, and perforated distribution piping shall be placed on the stone so that they are uniformly spaced. The flow dividers will portion the hydraulic flow to multiple cells with the dispersal pad. The perforated distribution piping will provide uniform distribution within each cell.
- Connect the force main to the pod inlet coupling (incorporating a flexible pipe). Note sizing requirements in Section 5.3 of this guide. The manifold connection shall be configured like the illustration in Appendix 2 and 4 of this guide and shall pass the last pod by a minimum of six inches and be capped. It is recommended that a clean-out be brought to finished grade.

Monitoring Components

- At least three inspection ports shall be spaced at intervals adequate for observation of the absorption area and any ponding at the sand fill surface. The ports shall be anchored and be accessible with at least a four inch opening and a removable watertight cap.

Mound Cover

- Once the system is installed and all connections have been made, the distribution media shall be covered with a geotextile fabric used to prevent introduction of soil fines and allow for free movement of air and water.
- The soil cover shall be applied to allow for an approximate depth of six inches after settling, and the mounded pad shall be crowned to promote runoff.
- Soil cover shall be of a quality to allow for oxygen transfer and growth of vegetation.



Installation

- **Pre-Installation:** The full soil absorption area shall be free of any site disturbances. If any disturbance or damage has occurred, installation shall not proceed and the registered installer shall contact the owner and the board of health. Prior to installation the registered installer shall check all elevations in the design plan relative to the established benchmark including the surface contour and the flow line elevation of other components to assure proper flow through the system and freeze protection as applicable. Soil moisture conditions shall be evaluated and basal area preparation shall not proceed when there is risk of smearing or compaction.

- **Site Preparation and Installation:** The mound shall be installed according to the design manual and any referenced resource and shall comply with the following:

  (1) All vegetation shall be cut close to the ground and removed from the site. Stumps, roots, sod, topsoil, and boulders shall not be removed.

  (2) The force main should be installed from the upslope side. All vehicle traffic on the basal area and downslope area of the mounded pad should be avoided with installation work being conducted from the upslope side or end of the mounded pad basal area.

  (3) The basal area of the mounded pad shall be prepared to provide a sand/soil interface and to improve infiltration if needed. The basal area preparation shall not reduce the infiltrative capacity of the soil surface. The degree of basal area preparation shall be determined on a site by site basis depending on soil conditions. Any basal scarification or other basal area preparation shall be conducted working along the contour. Sand may be incorporated into the basal area during the preparation process. Following basal preparation, a layer of sand fill shall be placed on the entire basal area to prevent damage from precipitation and foot traffic.

  (4) The specified depth and sufficient amount of sand fill shall be placed to cover the basal area, form the absorption area, and shall not be steeper than 3 to 1 side slopes. The distribution area shall be formed to the specified dimensions and the sand surface of the distribution area shall be level.

  (5) Construct and install all components, including the distribution laterals and observation ports.

  (6) Once the pod(s) are installed and all connections have been made, the distribution media shall be covered with a geotextile fabric.

  (7) Field test the sand to verify quality with one of the methods outlined below.

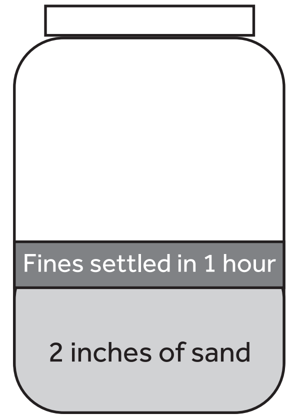
Minnesota Method

(from 1995 University of Minnesota "Onsite Sewage Treatment Manual")

Jar Test for Clean Sand for Mounds

Use a 1 quart Mason jar

If the fines that settle out in 1 hour is greater than **1/8 inch**, then the percentage of fines is too great and the sand **SHOULD NOT** be used for mound construction.



Manitoba Method

(from OWMS Jar Test revised April, 2010)

OWMS – Field Reference Guide Jar Test

Under some circumstances, it may be beneficial to perform a jar test for fines (silt or clay) on the sand when it is received or before it is purchased to determine if the sand supplied meets the specification of the sand ordered.

An 8 hour jar test must be conducted for best results.

The jar test is a "quick" method to determine if the sand contains too many fines. The jar test is not to be used as a replacement for sieve analysis; however the test can be used as a field method to determine that the sand meets CSA A23.1-04 (ASTM C33) specifications.

After settling for several hours, if the layer of fines that settle on top of the sand is thicker than 3.2mm (1/8 inch), the sand contains too many fines and is not suitable for use in a treatment mound. When in doubt the aggregate supplier should provide an aggregate analysis report to confirm that the product meets the sieve specification.

When a "check" in the sand is required, it is recommended that a sample of the sand be obtained prior to construction and the 8 hour jar test be conducted.

Jar test procedure is as follows:

- Place approximately 2 inches of sand in a glass quart jar.
- Fill the jar with water.
- Shake the jar vigorously to mix the sand and water.
- Set the jar on a level platform and allow to settle for 4–8 hours.
- Upon settling, after 4–8 hours, the layer of fines that settle on top of the sand layer should not be thicker than 3.2mm (1/8 inch).

Tips:

- Take a sample from the middle of the pile.
- It may be necessary to jar test a composite sample.
- It may be necessary to conduct two jar tests.
- When in doubt, obtain the sieve analysis report from the aggregate supplier or send a sample to the laboratory. Be sure to ask the laboratory to include the No. 200 sieve size.

Completion

(1) The area around the mounded pad shall be protected from erosion through upslope surface water diversion and provision of suitable vegetative cover, mulching, or other specified means of protection.
(2) Installer documentation shall include the drawdown test, as specified in Appendix 7, as baseline measure for future service and monitoring. Documentation shall be provided to the local health authority to be included in the permit record.
(3) The system shall be backfilled with sandy to loamy soil material and topsoil to the bottom lip of the pods.

Mounded Pad Operation and Maintenance

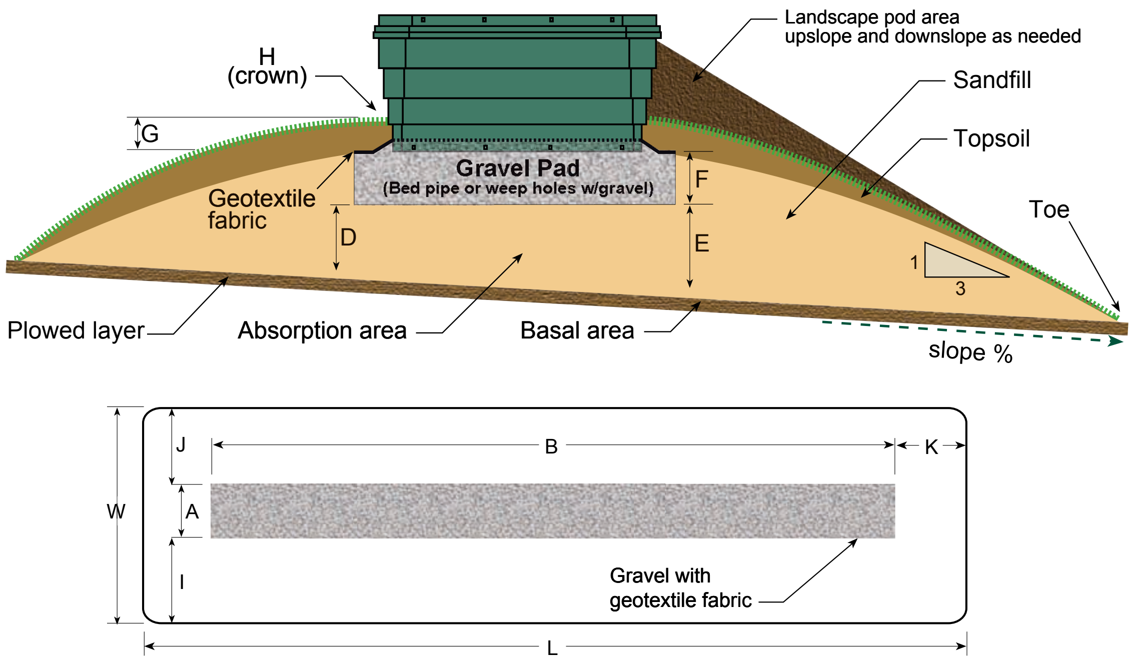
- The mounded pad system shall be operated, maintained, and monitored as outlined in the "Maintenance Manual" and per applicable State or Local rules and codes.

- The system service shall include but is not limited to:

  (1) Checking the mounded pad vegetative cover for erosion or settling and any evidence of seepage on the sides or toes of the mounded pad.
  (2) Checking flow dividers.
  (3) Checking for ponding in the distribution area.
  (4) Monitoring the dose volume to the treatment pod(s) and performing the drawdown test as needed.
  (5) Checking for any surface water infiltration or clear water flows from the dwelling or structures into the system components or around the mounded pad soil absorption area.

Mounded Pad System Schematic (typical)

NOTE:
A mounded pad soil absorption component shall not be sited on a slope greater than 25 percent unless the design plan includes special installation criteria.



Appendix 1 Using Water Mounding Models to Derive Hydraulic Linear Loading Rate

One challenge regulations may present for some sites is conformance with Tyler Hydraulic Linear Loading Rate (HLLR) values. HLLR is the daily volume of effluent applied to the soil over a certain distance (on contour). If we dump a five gallon bucket of water in a trench that is one foot long, our HLLR is 5 gpd/ft. Another way to think about it is if we dump that same 5 gallon bucket in a trench that is 6 inches long, our HLLR is 10 gpd/ft.

The challenge is water has to go somewhere. Depending on what is going on beneath the ground surface, water can move in all directions. We want to keep effluent from surfacing and from contaminating groundwater. If the application of effluent over time is greater than can be assimilated, water mounding can occur. In simple terms, surfacing effluent or breakout on a slope is evidence of water mounding. So another way to think about HLLR is a number that will guide us to an appropriate drainfield length and width. Keep in mind that HLLR rate does not take into account the instantaneous dose volume or dose rate.

Soil texture and structure, and site slope are the factors used to determine the HLLR. So what if the property is 100 feet wide but the HLLR calculates a drainfield length requirement of 110 feet? Fortunately, some regulations allow for "alternative methods" for determining HLLR. So what are some of the alternative methods and how do they work?

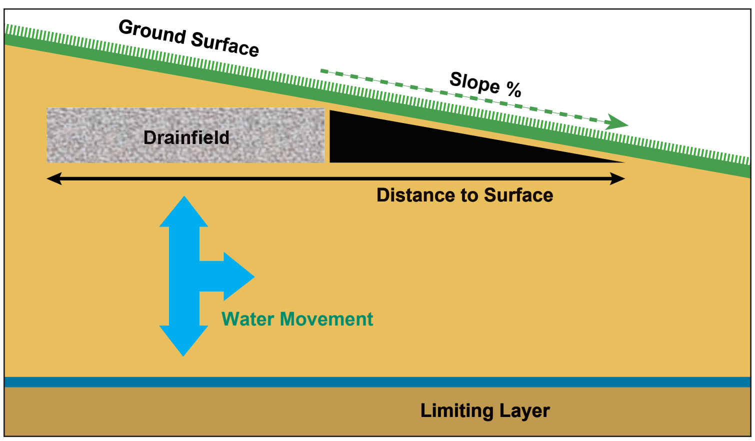


Figure 1 Water May Move in All Directions

The alternative methods described in this appendix will calculate if water mounding occurs at a certain length of drainfield with a certain volume of effluent application. **Once the drainfield length is calculated where little to no water mounding will occur, then we know we have calculated an acceptable HLLR.** The good news is that oftentimes the calculated HLLR, using models, allows for a shorter drainfield than using the Tyler table.

The first alternative method is the situation where a slower permeable soil is beneath a more permeable soil. The formula for water mounding is found in chapter 13 of *Septic Systems Handbook* by O. Benjamin Kaplan. The information we need to run the model is the following:

- Daily design flow, Q
- Higher permeable soil saturated hydraulic conductivity, Ksat1
- Slower permeable soil saturated hydraulic conductivity, Ksat2

If saturated hydraulic conductivity field tests are not performed, then estimates can be used. Tables of Ksat estimates can be found in various textbooks or research papers. The Virginia Department of Health has a Ksat table in their Alternative Onsite Sewage System regulations. The formula described by Kaplan is the following:

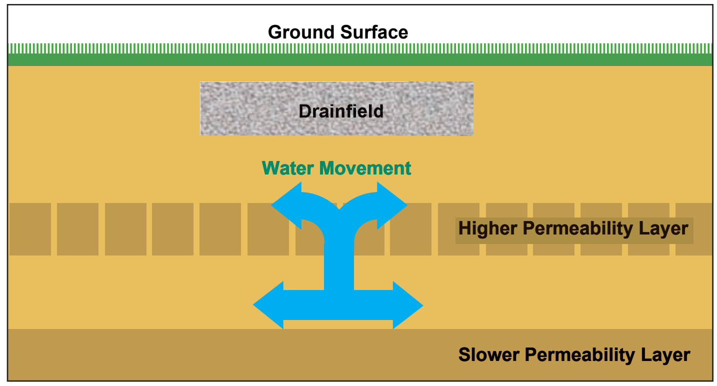


Figure 2 Less Permeable Soil beneath a More Permeable Soil *(Kaplan Model)*

$$\text{Height of water mounding} = \sqrt{Q^2} \div (2 \times Ksat1 \times Ksat2)$$

The second alternative method is the situation where a water table is beneath the drainfield soil. The formula for water mounding is found in the 1980 paper *Hydraulic Mounding of Groundwater Under Axisymmetric Recharge* by Dan H. Allen. The information we need to run the model is the following:

- Daily design flow, Q
- Drainfield length, l
- Drainfield width, W
- Soil saturated hydraulic conductivity, K
- Water table depth of saturation, D

Height of water mounding formula:

$$H^2 = D^2 + \frac{Q}{\pi K}\left(1n\frac{L}{R} + 1/2\right)$$

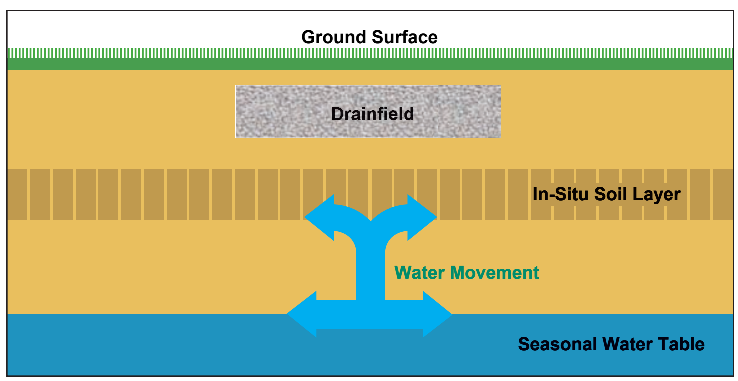


Figure 3 Water Table beneath Drainfield *(Allen Model)*

The third alternative method is the situation where the drainfield is on a sloped site and the horizontal water movement can be greater than the vertical water movement. The formula for water mounding is found in the 2005 paper *Designing Cluster and High Density Wastewater Soil Absorption Systems to Control Groundwater Mounding* by Eileen Poeter, P.E., Ph.D., et al.

The information we need to run the model is the following:

- Daily design flow, Q
- Drainfield length, L
- Drainfield width, W
- Horizontal saturated hydraulic conductivity, upper layer K1
- Vertical saturated hydraulic conductivity, lower layer K2

Height of water mounding formula:

$$H_{max} = W\left[\frac{Q}{K_1}\left(\frac{Q}{K_2} - 1\right)\right]^{1/2}$$

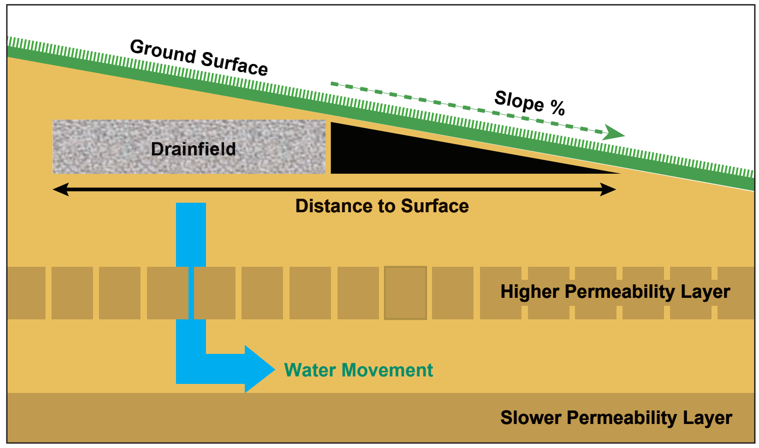


Figure 4 Horizontal Water Movement on Slope *(Poeter Model)*

Spreadsheets of the models presented in this appendix are available from Anua. With the spreadsheets, a suitable HLLR can easily be determined by the designer and checked by the health department. The models demonstrate that subsurface effluent dispersal can be accomplished on-site while meeting regulatory requirements.

Soil Hydraulic Conductivity Table

Ksat Values	Rawls et al, 1998		VA AOSS Regulations, 2011	
	mm/h	gpd/ft²	cm/d	gpd/ft²
Sand	181.9	107.11		
Fine Sand	141.3	83.20	>17	>4.17
Loamy Sand	123.0	72.43		
Sandy Loam	55.8	32.86		
Loam	6.2	3.65	10 to 17	2.45 to 4.17
Silt Loam	14.4	8.48		
Sandy Clay Loam	7.7	4.53		
Clay Loam	4.2	2.47	4 to <10	0.98 to <2.45
Silty Clay Loam	4.9	2.89		
Sandy Clay	0.9	0.53		
Silty Clay	1.8	1.06	<4	<0.98
Clay	2.0	1.18		

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ANUA

P.O. Box 77457
Greensboro, NC 27417

T 336.547.9338
F 336.547.8559
anuainternational.com