Verti-Grid ™

Onsite Wastewater Dispersal Units

DESIGN, INSTALLATION, and MAINTENANCE

by

Better Dispersal Systems LLC

Overview

Product Name: ***Verti-Grid ™***
Description: Onsite Wastewater Dispersal Units
Patent Status: Patent Pending

Description

Verti-Grid ™ is a modular dispersal component of an onsite wastewater system. Septic effluent is dispersed horizontally, laterally, and vertically into the native soil sidewalls of 4” to 6” narrow trenches excavated with a trenching machine.

Advantages

- **Capillary Action**: Effluent is dispersed and absorbed into vertical sidewalls of narrow trenches by capillary action.
- **Aerobic Conditions**: Trenches remain unsaturated and aerobic due to increased volume of airspace.
- **Reduced Clogging**: The bottom of the trench has less biomass buildup and clogging with sidewall absorption.
- **No Stone Installation**: No need for wide trenches or large beds of gravel for distribution or percolation.
- **Trencher Installation**: 4”-6” wide trenches, minimum separation of 24” on center, and typically less than 30” deep
- **Installation Efficiency**: Save TIME and MONEY with simplified installation and reduced materials needed.
- **Less Disruption**: Minimal site disturbance and unwanted soil compaction compared to heavy equipment installs.
- **Even Distribution**: Effluent is evenly distributed and dispersed from a low-pressure dosing (LPD) system.
- **Space Efficiency**: Ideal replacement option for drain fields that are failing and have limited additional space.
- **Low maintenance**: Easy periodic maintenance and modular replacement of damaged septic field section.
- **Preferable Alternative**: For sites with high water table, differing trench lengths, or variable elevation contours.

Installation

- **Trenching**: Use a 4” or 6” wide trenching machine to excavate trenches.
- **Connecting**: Join modules with cemented PVC couplings or add flexible PVC spa hose as needed for any variations.
- **Lateral Flush Assembly**: Installed at the end of each lateral for periodic flushing and cleaning of each lateral.
- **Backfilling**: Use native soil or clean sand for backfill, hand compacted to minimize settling.
- **Manifold and Pump**: Size according to Design Table 2
- **Force-main / Transport Pipe**: Size according to Design Table 3
- **Pump Required**: Necessary for pressure distribution to ensure uniform septic effluent dispersal.
- **Design Parameters**: Ensure less than 10% variation in effluent distribution.

Specifications

Description: Dispersal Panel of injection molded PVC with intersecting H & V grids and cells. Includes attached section of Sch 40 Rigid PVC plain end pipe to distribute effluent under low pressure, available in 1/8” or 3/16” orifice sizes. The entire assembly is covered in a porous geotextile fabric with only the ends of the pipe exposed to facilitate the assembly of the grid modules in series installed in the excavated narrow trench.

Panel Size: 36” L x 12” H x 2.5” W
Pipe Size: ~43” L x 1” ID x 1.315” OD with pipe wall thickness of .133”
Module Weight: 10.2 pounds

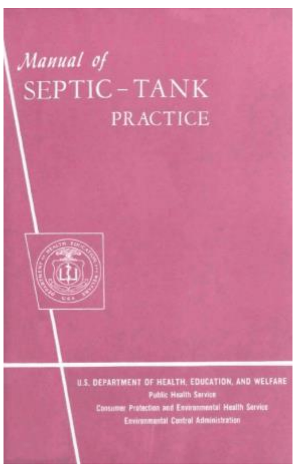
Patent Status: Patent Pending

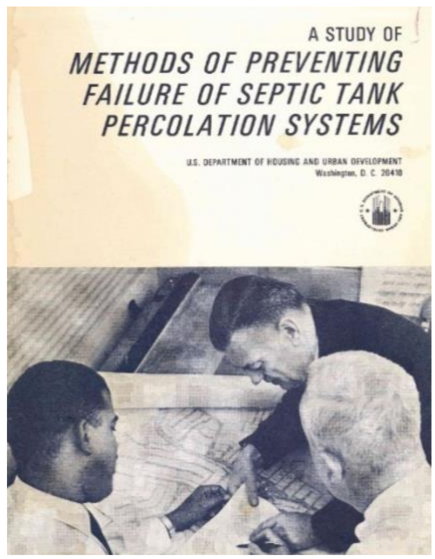
Research Basis for *Verti-Grid* ™

Extensive research was conducted at the Sanitary Engineering Research Laboratory at the University of California, Berkley and other places in the 1960's. Two of the researchers on this subject were P.H. McGauhey and John H. Winneberger, and their work provided a significant part of the basis for the guidance document known as the **"Manual of Septic Tank Practice"** published then by the U.S. Public Health Service. This manual became the first national basis of practice for the design and installation of septic systems, now known as "onsite wastewater treatment systems".

The work of McGauhey and Winneberger in the 1960's was also cited in a document published in 1967 by the U.S. Department of Housing and Urban Development called:

"A Study of METHODS OF PREVENTING FAILURE OF SEPTIC TANK PERCOLATION SYSTEMS"

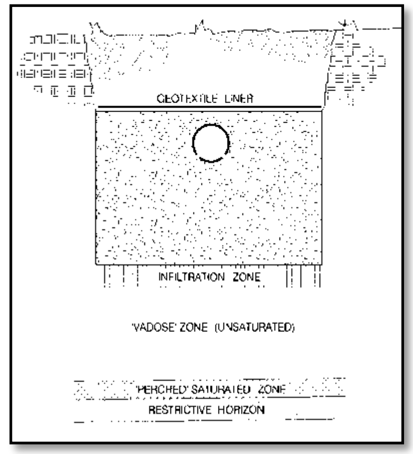




To summarize, the research of McGauhey and Winneberger made a strong case for the benefit of using trench sidewall infiltration as the primary method of soil dispersal of effluent following the septic tank and other primary treatment means. **They recommended that the soil "percolation system" should use narrow trenches to maximize the sidewall area and minimize the bottom area of the soil dispersal system.**

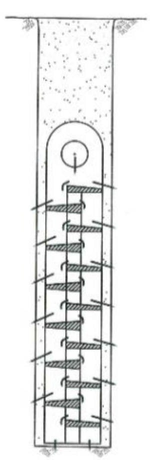
But due to the physical difficulty of placing stone (the most typical distribution system media) into narrow trenches, most codes and installation practices in the 60 years since that research use bottom area as the design criteria, even if the recommendation is to minimize the bottom area of the soil dispersal system.

While there are some new products on the market today, most onsite system designs incorporate some form of STONE-AND-PIPE in trenches or beds excavated using heavy equipment. The bottom of the excavation needs to be level unless specific design measures are taken to overcome sloping conditions of the site. The system is sized based upon the amount of bottom area required by code to accommodate the size of the flow and the site soil conditions. Commonly 0.5” - 1.5” clean aggregate is then placed in the trench to a typical depth of 12”. The distribution pipe is then installed level or with limited slope, covered with stone, and a distribution box may or may not be used to improve even distribution of the effluent. A lightweight geotextile fabric is then placed over the stone, and 12” to 24” of backfill is placed over the fabric, finish graded, and seeded.



There are several disadvantages with this method:

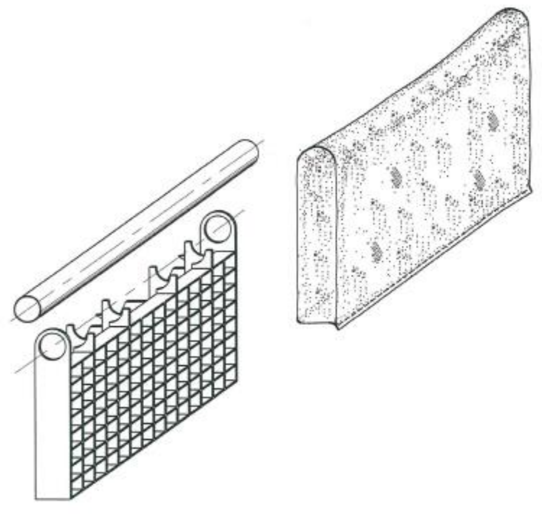
- Construction practices can smear the bottom and sidewalls of the excavation, compromising the infiltrative capacity.
- The design of most systems does not promote the movement of air to the infiltrative surfaces.
- Biomass build up and silt tend to accumulate on the bottom areas and clog the soil pores.
- Precipitation events and construction itself contaminate the absorption area with silt from spoil piles.
- Uneven distribution by gravity limits the use of much of the installed system early in its life.
- Stone is often expensive and difficult to handle without large equipment which increases the traffic in the absorption area causing soil compaction and system damage from the beginning.
- Large equipment required to install most systems means a larger area is required to maneuver

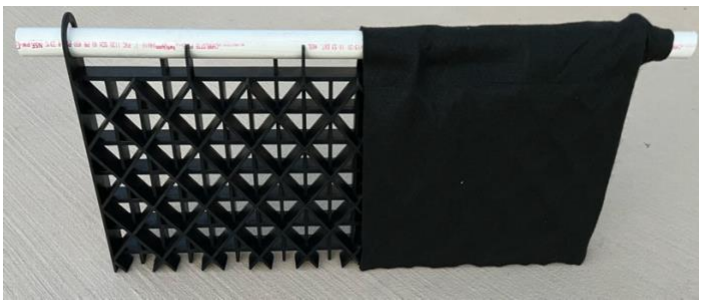


***Verti-Grid* ™** dispersal units now overcome these obstacles by providing a pre-manufactured product that can easily be placed in narrow trenches and maximize use of the recommended sidewall area. The module is designed to eliminate the need for stone and internally distributes the applied wastewater horizontally, laterally, and vertically to the sidewalls of the trench. The native soil of the vertical trench sidewall absorbs effluent by capillary action and the trench remains unsaturated and aerobic due to increased volume of airspace created by the cellular design of the ***Verti-Grid* ™** modules. With no more need for wide trenches or large beds of sand or stone for distribution, there is less biomass buildup and clogging in the bottom of the trench or drain bed, less unwanted disturbance and compaction to the absorption site with the use of smaller machinery, and less premature system failure. Narrow trench systems occupy a smaller footprint of the yard and offer added options in replacement situations with less available space.

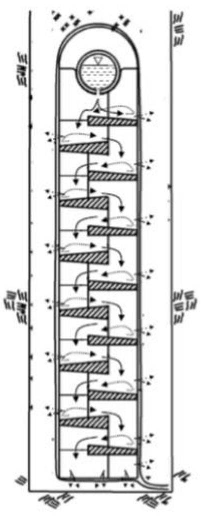
Verti-Grid™ UNIT DESIGN

Modules are manufactured with an injection mold process. Then a section of 1” Sch 40 PVC pipe is installed on top of the dual-layered grid with either one 1/8” or 3/16” orifice in the bottom near the center, or two 1/8” orifices at approximately the 1/3 points (designer’s choice). These orifices are purposely pointed downward when installed, opposite the pipe labeling. When cementing modules together, confirm that the labeling is up so that the orifice will be pointed downward when the installation is complete. After the pipe is installed, the entire assembly is covered in a carefully chosen, porous geotextile fabric with only the ends of the pipe exposed to facilitate the assembly of the grid modules in series to install in the excavated narrow trench.

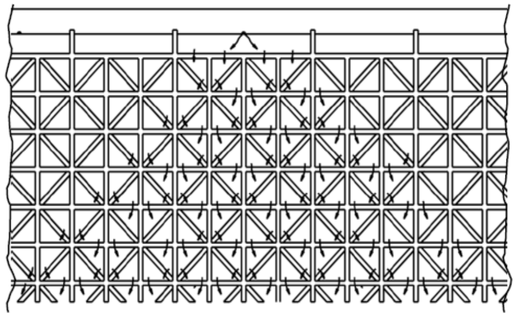




Verti-Grid ™ DESIGN FUNCTION



When the septic effluent is delivered to the ***Verti-Grid*** **™** dispersal module by the pump, the pipe is pressurized so that, by design, an equal amount of the effluent is delivered to each of the modules (within the 10% tolerance). This effluent then enters each module through a small orifice (or orifices) from the pipe above. As the effluent then flows downward by gravity, it is forced by the dual-layered grid to flow back and forth from side to side and spread out longitudinally as shown in these two illustrations. As it does, it will wet the geotextile fabric and the soil sidewalls of the trench. This moisture will then be drawn away by the capillary attraction of the soil. Capillary forces are stronger than gravity, so the moisture will be dispersed in the shallow soil profile both horizontally and vertically.

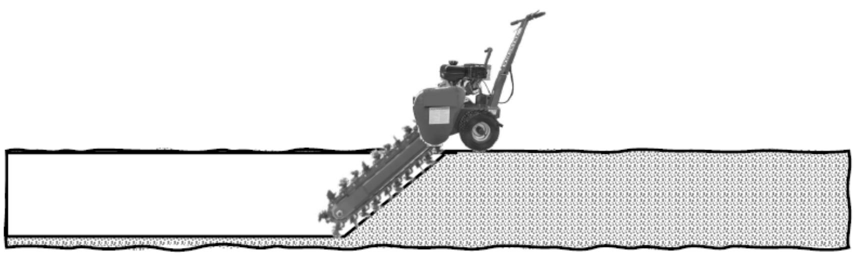


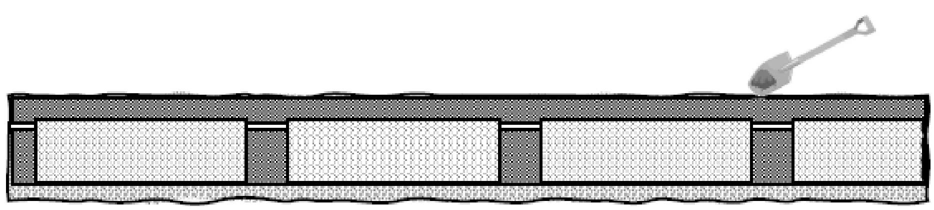
Verti-Grid ™ INSTALLATION

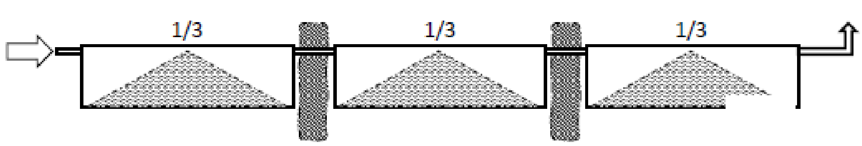
The onsite wastewater dispersal modules can be installed anywhere any other absorption system can be used and often sites not conducive to other system designs become feasible. Whether crowded conditions limit access of larger equipment, limited additional move-over space in replacement situations, or high-water table conditions, just to name a few.

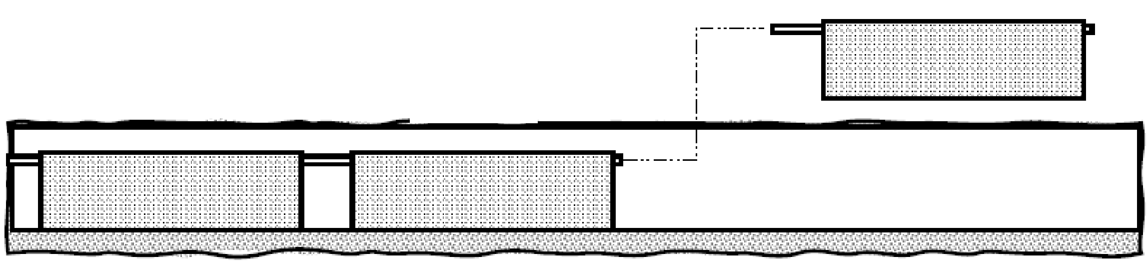
The dispersal system design always includes a pump to pressure the distribution of wastewater effluent evenly to the entire installation throughout the life of the system. Design parameters listed below will result in each installation having less than 10% difference in the amount of wastewater applied anywhere in the system. This uniform effluent distribution will provide the greatest longevity for the onsite system.

Verti-Grid **™** dispersal units are installed in 4” or 6” wide narrow trenches about 24” deep. Deeper trenches may be used for the pump feed lines to facilitate burial below the frost line to help prevent freezing in cold climates, but the laterals with the modules should not be deeper than 24” to 30” deep. The most permeable soil is normally found in the top 24” of the soil profile.









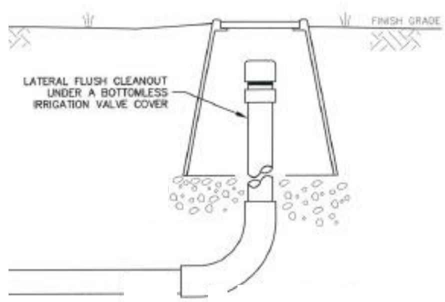
Before starting, lay out the location of the laterals and mark to be sure that the system will fit the area available. Laterals may be as close as 24” on center, with the maximum length of each lateral listed in **Table #1** below.

After excavation of the trench, the ***Verti-Grid*** **™** modules should be joined together end to end with PVC cement and the chosen fittings. A simple PVC pressure-pipe coupler may be used to join modules. If the contractor finds that a little more flexibility is necessary, a short 4” section of pressure spa hose (flexible PVC) with two couplers is ideal for more flexibility between modules. If it becomes necessary to work around immovable objects such as large boulders, trees, or tree roots, a longer section of flex hose can be used between modules.

After placement in the trench and connection of the modules, the trench should be carefully backfilled. In many cases the backfill can be the native soil. If the native soil is fine textured soil with a high clay content, it is recommended that a clean Class 2 or Class 3 sand be used for the backfill. Backfill should be hand compacted to minimize settling.

Note that when put in use, each module will be separated from the next by a short section of backfill. This backfill serves a useful purpose by blocking the flow of effluent down the excavated trench. In effect, this feature forces each module to perform like a small autonomous dispersal field of its own as depicted in the above illustration. Because of this feature, it is not necessary to keep each trench level. Within reason, the elevation of each module can vary a little with existing grade. It is recommended that the elevation of modules may vary within each lateral by up to a maximum of 6” from end to end.

A lateral flush assembly **must be** installed at the end of each lateral to accommodate periodic flushing and cleaning of the laterals. The recommended cleaning frequency of the laterals is dependent upon the quality of the wastewater being dispersed.   For septic tank effluent without further treatment, laterals should be flushed at least every 2 years. For wastewater that has been further treated with advanced treatment means, the frequency of flushing can be less frequent. However, the professional that maintains such a system should establish a necessary frequency based upon their observation of the system over time. A detail of the lateral flushing assembly is shown below.



Lateral Flushing Detail

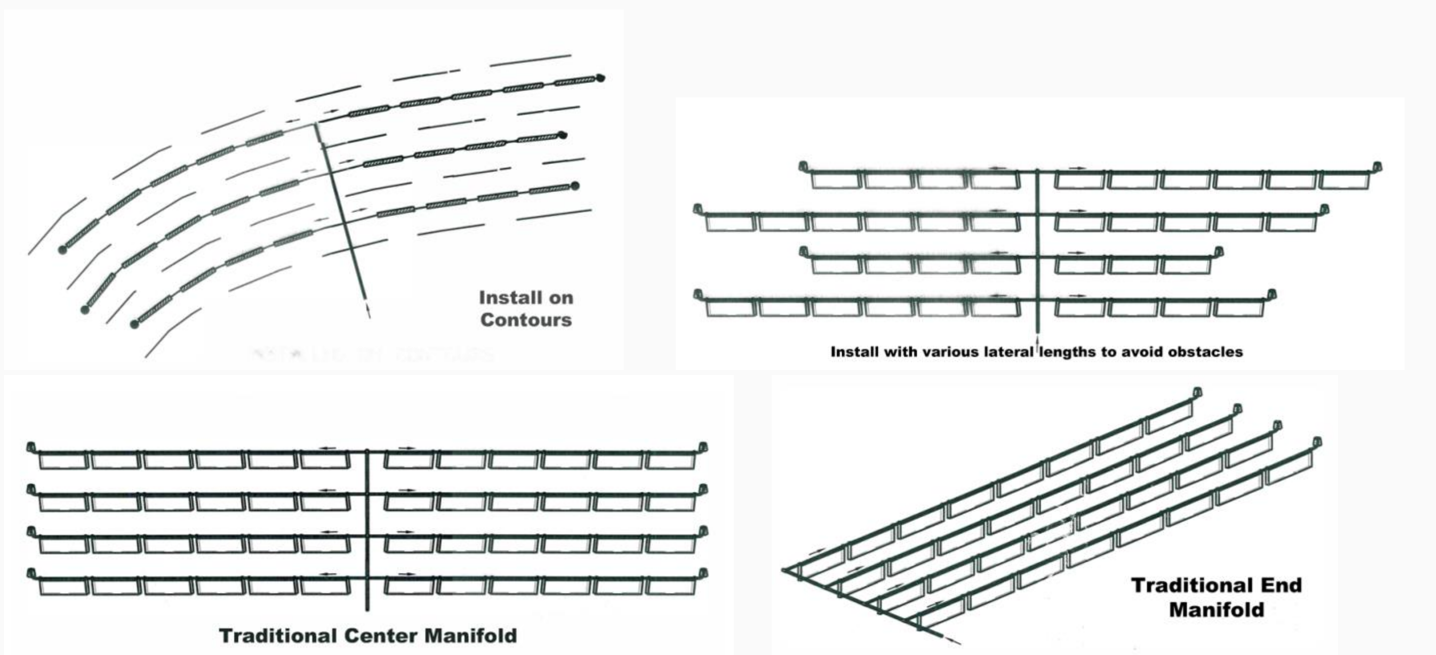
Verti-Grid ™ SYSTEM LAYOUT

The dispersal system can be laid out in almost an unlimited number of configurations to fit the need of a particular site. Below are shown four illustrations of the basic configurations, but each system can be custom configured for any particular space that is available.

As previously mentioned, each lateral has a limited length depending upon the size and number of orifices. This is necessary to conform to the design parameter of less than 10% difference in the flow from any part of the system from any other part of the system. **Table #1** lists the maximum number of modules **per lateral** for the specified orifice sizes.

A manifold of a larger pipe diameter can be used to feed as many laterals as necessary for the equal distribution of effluent to multiple laterals. **Table #2** provides some guidance as to how large the manifold line should be for a given number of laterals.

Flexible layout options to fit site needs.



The original research that recommended narrow trenches over wider trenches or beds suggested that these narrow trenches could be placed as close as "twice the depth" apart. This suggests that a ***Verti-Grid* ™** module that is 12" tall could be placed as close as 24" on center. Such an installation suggests that a series of ***Verti-Grid* ™** laterals could be installed in the **same "footprint"** as a typical **drainbed** with the equivalent infiltrative surface of that bed. The difference is that with the ***Verti-Grid* ™** the infiltrative surface will be 100% sidewall rather than 100% bottom area with a bed installation. Based upon experience and research, this most certainly will provide a soil dispersal system with much greater longevity.

Verti-Grid ™ SYSTEM DESIGN

While laying out the dispersal system on any site, note the limitations of the number of modules to be installed in any lateral. When appropriate, a center manifold can be used to feed laterals in two directions, making it possible to double the length of the dispersal field. Each lateral should not exceed the maximum length specified in **Table #1.** This limitation is specified to protect the design parameter of limiting the difference in the amount of effluent being discharged in any part of the system to a maximum of 10%.
Once the location and configuration of the components of the dispersal system have been determined for a site, only a few short steps remain to determine the size of the manifold, forcemain, and pump. These are as follows:

1. Choose a manifold size based upon the number of modules and laterals to be installed.

2. Choose the location of the pump basin or tank and determine the length of the transport pipe (force-main) to be used to connect the pump with the manifold.

3. Choose a size of the transport pipe based upon the length, anticipated flow, velocity of flow, and headloss for use in the pump selection. **Table 3** provides some critical information upon which to base this decision. It is generally desirable to keep the velocity of flow in the force-main between 2.0 and 5.0 feet/sec., but justifiable deviations are acceptable for valid reasons. Flow velocities and estimated head losses shown in all tables are for Sch 40 PVC pressure pipe. If other pipe materials are used, adjustments in the numbers shown may be needed due to different interior pipe diameters.

4. The **GPM** of the pump required is determined by the number of modules in the system and orifice size used. If the system does not fit the characteristics of the systems listed in the **Tables 1-3**, professional design help may be needed. Required flows shown in these tables is based upon maintaining a residual head (“squirt height”) in the system of 5’ (five feet) when the system is being dosed.

5. Next, the **TDH** (“Total Design Head”) for the pump selection needs to be calculated. This will be a combination of following factors:
    a. The **elevation difference** between the low water level in the pump basin and the elevation of the pipes in the dispersal field in feet.
    b. The **desired residual head** used in the design (typically 5’ in for systems described here).
    c. The **headloss in the transport pipe** in feet of head. This will be determined by the length and size of the pipe, and the flow.
    d. The **headloss in the pipes and fittings in the pump discharge assembly**. This can be calculated by a professional for larger systems, but this headloss can be estimated by adding 3.0 to 6.0 feet of headloss to the other estimated head losses of other components for most smaller systems.

6. So, the following formula is used to calculate the TDH required for the pump:

    TDH =

    Elev. Diff. =_____ +

    Residual Head Desired =_____ +

    (Length of Transport Pipe in feet **/** 100) X Headloss per 100 ft from table = ______+

    Estimated headloss in pump discharge assembly = ______

    Total = ________ is the TDH for the pump specification **along with the GPM**

Note: A spreadsheet is available to make this calculation easy. Contact the author listed at the end of these instructions.

Table 1 -MAXIMUM NUMBER OF MODULES PER LATERAL

Orifice Size	Max. No. of Modules With 1 Orifice Per Module
1/8"	18
3/16"	11

Table 2 -RECOMMENDED MANIFOLD AND PUMP SIZE FOR VARIOUS SIZE DISPERSAL SYSTEMS

			Recommended Manifold Size		
Orifice Size	No. of Modules in System	Soil Absorption Area S.F.*	End Manifold	Center Manifold	Pump Size GPM
1/8"	50	300	1.5"	1.5"	24
	67	400	1.5"	1.5"	30
	83	500	2"	1.5"	36
	100	600	2"	2"	45
3/16"	50	300	2"	2"	49
	67	400	2"	2"	65
	83	500	3"	3"	81
	100	600	3"	3"	97

*** Soil absorption area is based upon 6 square feet of soil interface for each *Verti-Grid™* module: all sidewall area.**

Table 3 -RECOMMENDED FORCEMAIN (TRANSPORT PIPE) SIZE FOR VARIOUS FLOWS

Orifice Size	No. of Modules in System	Pump Size GPM	Recommended Force-main Size	Flow Velocity (ft/sec)	Headloss per 100 ft. of pipe (feet)
1/8"	50	24	1.5"	3.9	3.7
	67	30	1.5"	4.7	5.2
	83	36	1.5"	5.7	7.3
	100	45	2"	4.3	3.3
3/16"	50	49	2"	4.9	5.3
	67	65	2"	6.2	6.4
	83	81	3"	3.5	1.4
	100	97	3"	4.2	5.3

Verti-Grid ™ SYSTEM MAINTENANCE

Since the ***Verti-Grid*** **™** dispersal system is fed by a pump that feeds the network of small diameter piping with small orifices for equal distribution, routine maintenance is required as with any other pressure distribution system. The suggested maintenance frequency by a trained professional is once a year … certainly no less than every other year. Below are listed the tasks that should be included with each maintenance visit.

1. Check the pump and controls to be sure they are working properly. This is done by manipulating the floats to be sure that they function as designed, and that all alarms are functioning.
2. Check and record the Elapsed Time Meter and the Pump Cycle Counter recordings and note any irregularities in these numbers by comparing them with the previous readings.
3. Manually operated the pump to be sure it is functioning as expected.
4. Check the scum and sludge depths in the septic tank(s) and record. Arrange for the tank(s) to be pumped by a licensed septic tank pumping company if the scum and sludge occupy more than 1/3 of the tank capacity.
5. Check and clean the septic tank effluent filter as needed.
6. Perform any required maintenance checks on any advanced treatment components according to manufacturer's instructions.
7. Remove the caps on the lateral flush assemblies in the dispersal system and run the pump until the discharge is more or less clear. This may require flushing one lateral at a time to generate more flow as needed. Sometimes this task may also require bottle-brushing the lines to clear them of debris.
8. **BE SURE THAT ALL TANK COVERS ARE SECURELY FASTENED IN PLACE BEFORE LEAVING THE SITE.**

ADDITIONAL INFORMATION

For more information on *Verti-Grid* ™ or for help with the design of a system, contact us at:

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Haslett, MI

Larry Stephens, PE
Phone: 517-749-1658
Email: info@betterdispersalsystems.com

ABOUT the INVENTOR

The inventor of ***Verti-Grid* ™** is Larry Stephens, PE with a degree in Civil Engineering from Michigan State University and a Master of Engineering Degree in Environmental Engineering from the University of Florida and has been a Licensed Professional Engineer in Michigan since 1971.
The founder of Stephens Consulting Services PC located in Michigan, Larry provides design services for infrastructure projects for clients throughout the state, often small to mid-size wastewater treatment facilities. Prior to 1980 he was an engineer in a regulator role at the Michigan Department of Public Health for 12 years.
Larry now has one of the most comprehensive backgrounds in the country in onsite wastewater treatment with over 50 years of design experience and continuous practical insight from his 20 plus years of owning an Operation and Maintenance company for hundreds of systems with his son. They found that the primary job of an O&M service provider is continuous troubleshooting and problem solving, particularly regarding what works and what does not work in the field.
Though he was aware of the concepts and findings of McGauhey and Winneberger since the 1970's during his time working for the MDPH, he began developing the concepts for the ***Verti-Grid* ™** design in the 1990's. Following the sale of their O&M services company the designs were refined, pre-production details of ***Verti-Grid* ™** modules accelerated, and now the buyer of the O&M business is also a partner in Better Dispersal Systems LLC.