

# Mantis

*Wastewater Leaching Systems*



## Massachusetts Design & Installation 2016

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# Glossary of Terms

## Mantis M<sup>5</sup> Series Units

The Eljen Mantis M<sup>5</sup> Series is a wastewater dispersal and disposal technology that applies clarified effluent to the native soil through a proprietary filtering process. Mantis M<sup>5</sup> Series units come preassembled and are 5 feet in length (as measured from the Support Distribution Pipe) and 8" or 12" high depending on the model. 12" and 24" wide models are available. For product specific details, please refer to Figures 2 - 4 in this manual.

## Support Distribution Pipe

The Mantis M<sup>5</sup> Series Support Distribution Pipe is 5 feet in length and constructed from crush resistant PVC Pipe. The pipes provide 3 pre-drilled one inch holes within each Filter Support Module at the 12, 5 and 7 o'clock position.

## Filter Support Module

There are 5 Filter Support Modules for each M<sup>5</sup> unit. All Filter Support Modules are 4" thick. The Mantis 5.1 & 5.1 *LowPro* models are 12" wide and the Mantis 5.2 & 5.2 *LowPro* models are 24" wide.

## Specified Sand

The Specified Sand envelope around the Mantis M<sup>5</sup> Series (6" minimum underneath, 6" minimum on the sides, 1" minimum on the top, and 8" in-between the Support Modules) shall meet the requirements as indicated in the Specified Sand Requirements chart listed below. This sand is an **ASTM C33 WASHED CONCRETE SAND WITH LESS THAN 10% PASSING #100 SIEVE AND LESS THAN 5% PASSING A #200 SIEVE.**

Ask your material supplier for a sieve analysis to verify that your material meets the required specifications.

**Table 1: SPECIFIED SAND SIEVE REQUIREMENTS**

Eljen Mantis M <sup>5</sup> Series ASTM C33 Specified Sand Requirements		
Sieve Size	Sieve Square Opening Size	Specification Percent Passing (Wet Sieve)
0.375"	9.5 mm	100.0
#4	4.75 mm	95.0 – 100.0
#8	2.36 mm	80.0 – 100.0
#16	1.18 mm	50.0 – 85.0
#30	600 µm	25.0 – 60.0
#50	300 µm	5.0 – 30.0
#100	150 µm	< 10.0
#200	75 µm	< 5.0
Request a sieve analysis from your material supplier to ensure that the system sand meets the specification requirements listed above.		

## Design Flow

The estimated design flow used to size a system is 110 gallons per day per Bedroom with a minimum allowable 330 gpd for system design. See regulations for special circumstances and additional design guidance.

# Mantis M<sup>5</sup> General Description

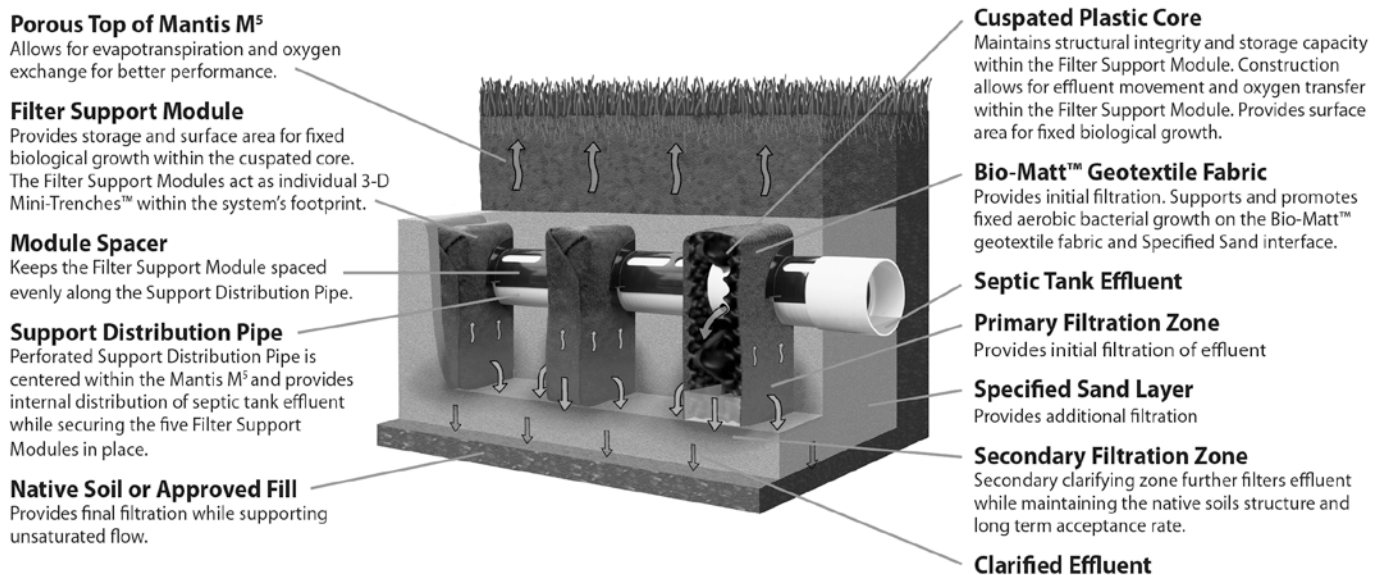
Note: Design layouts and installation instructions for sequential, equal or dosed distribution systems are included. Details on unique design and construction procedures are also provided. To receive design standards for specially engineered dosing systems or commercial systems, contact Eljen's Technical Resource Department at 1-800-444-1359. Mantis M<sup>5</sup> Series systems must be designed and constructed according to this Design & Installation Manual and the Massachusetts Title 5 Regulations (hereinafter the Regulations).

## How the Mantis M<sup>5</sup> Series System Works

The Eljen Mantis M<sup>5</sup> Series is a wastewater dispersal and disposal technology that applies clarified effluent to the native soil through a proprietary filtering process. The Mantis M<sup>5</sup> protects the native soils long term acceptance rate by keeping the biological growth off the native soils and within the Mantis M<sup>5</sup> units. The Mantis M<sup>5</sup> utilizes 3-D Mini-Trenches™ to improve effluent quality resulting in greater performance, reliability, and ease of operation.

- The perforated Support Distribution Pipe is centered within the Mantis M<sup>5</sup> and provides internal distribution of septic tank effluent while securing the five Filter Support Modules.
- The Filter Support Modules filter septic tank effluent and act as individual 3-D Mini-Trenches™ within the systems footprint. Each module consists of a cusped core surrounded by Bio-Matt™ geotextile fabric. The Mantis M<sup>5</sup>'s unique design increases the available surface area within each module. This is known as *Infiltrative Surface Optimization (ISO)* and provides a system surface area that greatly exceeds that of the Filter Support Module, a traditional gravel trench or that of gravel replacement technology.
- Open air channels within the Filter Support Modules support and promote fixed aerobic bacterial growth on the Bio-Matt™ geotextile fabric interface.
- Septic tank effluent migrates through the Filter Support Modules and into the Specified Sand layer which surrounds each Mantis M<sup>5</sup> unit. The Filter Support Module clarifies septic tank effluent and assists in its delivery to the Specified Sand. This process promotes unsaturated flow in the Specified Sand and native soils while maintaining the native soils structure, long term acceptance rate, and its ability to effectively absorb the clarified effluent.
- The Specified Sand layer also protects the native soil from compaction, helps maintain existing pore spaces within the native soil column, and preserves the native soil's natural infiltration capacity which is critical for long-term performance.

FIGURE 1: MANTIS M<sup>5</sup> COMPONENTS



## 1.0 General System Information

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**1.1 TREATMENT FIELD SIZE AND NUMBER OF UNITS:** System size will vary depending on design flow and soil analysis. Tables 2 – 7 indicate the number of Mantis units required for various soil percolation rates and design flows. *Note: For new construction, no system shall be designed and constructed with an effective leaching area less than 400 square feet. Minimum repair or upgrade sizing will vary depending on site constraints.*

**1.2 NON-RESIDENTIAL BUILDINGS & RESIDENTIAL INSTITUTIONS:** Commercial systems require different sizing and design criteria as compared to residential systems. Please contact Eljen's Technical Resource Department at 1-800-444-1359 for more information on commercial systems.

**1.3 DEPTH TO GROUND WATER OR RESTRICTIVE LAYER:** As required by state regulations; a minimum of four feet of separation between the bottom of the soil absorption system (Specified Sand) and the high groundwater elevation shall be provided, using fill if necessary. The local Approving Authority may allow a three feet separation only in full compliance with 310 CMR 15.405(1)(h).

**1.4 SPECIFIED SAND SPECIFICATION FOR TRENCH AND BED SYSTEMS:** The first 6 inches of Specified Sand immediately under, between Filter Support Modules, between unit rows and around the perimeter of the Mantis M<sup>5</sup> Series system must be an **ASTM C33 WASHED CONCRETE SAND WITH LESS THAN 10% PASSING A #100 SIEVE AND LESS THAN 5% PASSING A #200 SIEVE.**

**1.5 VEHICULAR TRAFFIC AND PAVED AREAS OVER SYSTEM:** All vehicular traffic is prohibited over the Mantis system. This is due to the compaction of material required to support traffic loading. Compaction greatly diminishes absorption below the system and reduces the void space that naturally exists in soils for oxygen transfer and water migration. For shallow installations, light-weight track-mounted machines are best for setting the final grade. It is also permissible to back-blade the soil to set final minimum cover.

**1.6 SYSTEM VENTING:** Eljen mandates venting when the system has greater than 18" of cover material as measured from the top of the unit to finished grade. This will ensure proper aeration of the units.

**1.7 BACKFILL & FINISH GRADING:** Completely backfill over the Mantis M<sup>5</sup> units followed by topsoil to minimum depth of 9" as measured from the top of the units. 1" of the fill is Specified Sand, immediately on top of the unit. Systems with total cover that exceeds 18" as measured from the top of the units to finished grade shall be vented at the distal (far) end of the system. Backfill material shall be well graded sandy fill; clean, porous, and devoid of large rocks. Divert surface runoff with diversion ditches or berms. Finish grade to prevent surface ponding. Seed or sod excavated areas to protect against erosion.

**1.8 EFFLUENT FILTERS:** Effluent filters are required as a means of preventing solids from leaving the tank.

**1.9 DISTRIBUTION PIPE LAYOUT:** No additional distribution pipe is needed to connect units to one another. The support distribution pipe runs through the center of the units and provides distribution for all configurations. For bed systems, the distal ends of rows may be connected with non-perforated pipe.

**1.10 GARBAGE DISPOSALS:** The use of a garbage disposal is not recommended as they can cause septic system problems by generating an increased amount of suspended solids, grease and nutrients. Design drawings shall include a note "Garbage disposals shall not be used with this system".

When a domestic garbage grinder is proposed or installed, the minimum liquid capacity of the septic tank shall be 200% of the design flow with a minimum tank size of 1,500 gallons and a two compartment tank or two tanks in series shall be required which meet the design criteria specified in 310 CMR 15.223(1)(b). Domestic garbage grinders are prohibited in facilities which include an elevated septic tank constructed in accordance with 310 CMR 15.213 (construction in V-zones).

NOTE: Eljen recommends the use of septic tank outlet effluent filters on all systems, especially on those systems that a garbage disposal is installed, even if the tanks design capacity has been increased. Filters with higher filtration are recommended for systems with garbage disposals.

**1.11 ADDITIONAL FACTORS EFFECTING RESIDENTIAL SYSTEM SIZE:** Homes with expected higher than normal water usage should consider increasing the septic tank volume as well as increasing the size and number of units in the disposal area. For example: Homes with tubs holding more than 100 gallons or utilizing other high use fixtures and homes with higher than normal occupancy should consider septic tank and drain field modifications.

## 1.0 General System Information

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**1.12 WATER SOFTENERS OR CONDITIONERS:** Discharge of water softener or conditioner backwash to Eljen Products is not allowed. Discharge from these devices shall be into a separate disposal system meeting the requirements of State and Local Regulations.

**1.13 PLANS AND SPECIFICATIONS:** Typical treatment system drawings and specifications are shown at the end of this manual. When used in conjunction with a permit sketch, site specific specifications, and manufacturer installation criteria, these documents will normally be sufficient to assure a system can be properly installed. In some instances where a complex system is encountered, formal plans and specifications may be required. This determination is left to the discretion of the District Health Department.

## 2.0 Design for Level Sites

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**2.1 BED SYSTEMS ROW SPACING:** Design level in-ground or raised systems with a minimum of 12-inches of spacing between unit rows. The Mantis M<sup>5</sup> units and Specified Sand must be installed level at their design elevations.

**2.2 TRENCH ROW SPACING:** The minimum separation distance between any two trenches shall be two times the effective width or depth of each trench, whichever is greater, or where the area between trenches is designated as reserve area, three times the effective width or depth of each trench, whichever is greater. The Mantis M<sup>5</sup> units and Specified Sand must be installed level at their design elevations.

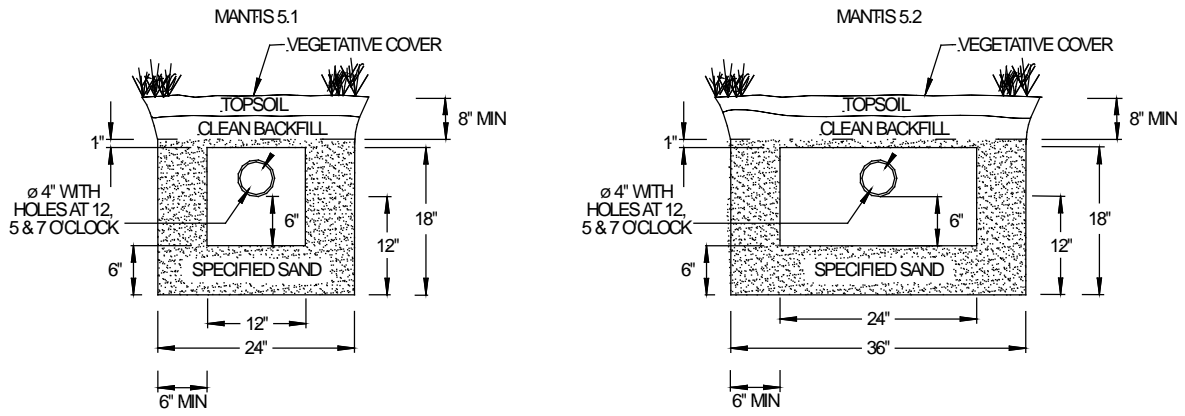
## 3.0 Design for Sloped Sites

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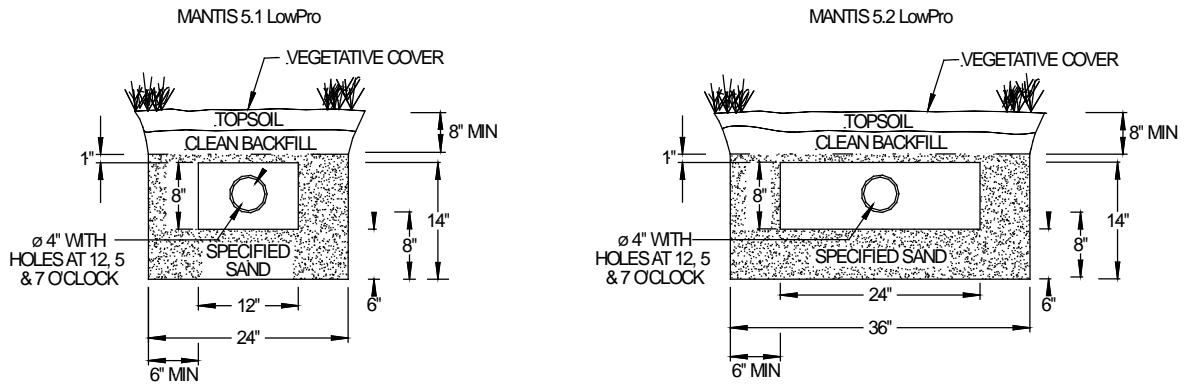
**3.1 BED SYSTEM ROW SPACING:** Design level in-ground or raised systems with a minimum of 12-inches of spacing between units. The Mantis M<sup>5</sup> units and Specified Sand must be installed level at their design elevations.

**3.2 TRENCH ROW SPACING:** The minimum separation distance between any two trenches shall be two times the effective width or depth of each trench, whichever is greater, or where the area between trenches is designated as reserve area, three times the effective width or depth of each trench, whichever is greater. The Mantis M<sup>5</sup> units and Specified Sand must be installed level at their design elevations.

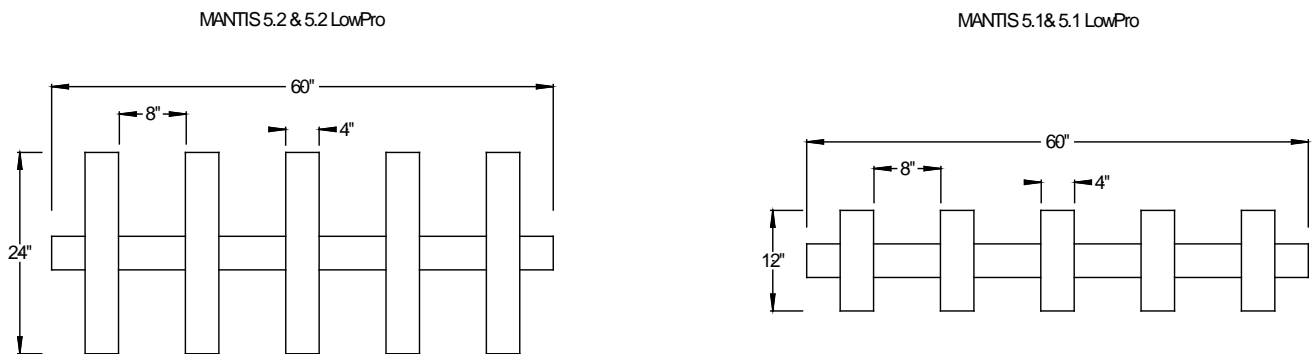
**FIGURE 2: MANTIS M<sup>5</sup> CROSS SECTION**



**FIGURE 3: MANTIS M<sup>5</sup> LowPro CROSS SECTION**



**FIGURE 4: MANTIS M<sup>5</sup> & MANTIS M<sup>5</sup> LowPro PLAN VIEW**



## 4.0 Mantis M<sup>5</sup> Trench Installation and Design Guidance

**TABLE 2: Mantis 5.1 Trench Sizing Table – \*See Notes Below**

Mantis 5.1 Trench Application			3 Bedroom or Less 330 GPD		4 Bedroom 440 GPD		5 Bedroom 550 GPD	
Soil Type	Percolation Rate (Min/In)	Application Rate (GPD/SF)	Mantis 5.1 Units Required (2 ft Wide Trench)	System Length (lf)	Mantis 5.1 Units Required (2 ft Wide Trench)	System Length (lf)	Mantis 5.1 Units Required (2 ft Wide Trench)	System Length (lf)
Class I	1 - 5	0.74	14	70	18	90	23	115
Class II	1 - 5	0.60	17	85	22	110	28	140
Class I	6	0.70	15	75	19	95	24	120
Class II	6	0.60	17	85	22	110	28	140
Class I	7	0.68	15	75	20	100	25	125
Class II	7	0.60	17	85	22	110	28	140
Class I	8	0.66	15	75	20	100	25	125
Class II	8	0.60	17	85	22	110	28	140
Class II	10	0.60	17	85	22	110	28	140
Class II	15	0.56	18	90	24	120	30	150
Class III	15	0.37	27	135	36	180	45	225
Class II	20	0.53	19	95	25	125	32	160
Class III	20	0.34	30	150	39	195	49	245
Class II	25	0.40	25	125	33	165	42	210
Class III	25	0.33	30	150	40	200	50	250
Class II	30	0.33	30	150	40	200	50	250
Class III	30	0.29	35	175	46	230	57	285
Class III	40	0.25	40	200	53	265	66	330
Class III & IV	50	0.20	50	250	66	330	83	415
Class III & IV	60	0.15	66	330	88	440	110	550
Remedial Use 60 - 90 MPI Systems								
Class III & IV	60	0.15	66	330	88	440	110	550
Pressure Dosed Systems								
Class III	40	0.29	35	175	46	230	57	285
Class III & IV	50	0.25	40	200	53	265	66	330
Class III & IV	60	0.20	50	250	66	330	83	415

1. Numbers of Mantis M<sup>5</sup> Series units are determined on the current application rates defined in Title 5 Regulations 310 CMR 15.242.
2. Mantis 5.1 unit = 6.68 ft<sup>2</sup>/lf or 33.40 ft<sup>2</sup> per unit.
3. The minimum number of bedrooms for residential designs shall be 3 bedrooms unless otherwise dictated by the regulations.
4. For new construction, no system shall be designed and constructed with an effective leaching area of less than 400 square feet.  
Note: A Minimum of 12 Mantis 5.1 units are required to meet 400 square foot effective leaching area minimum for new construction. For repair or upgrades, the minimum number of M<sup>5</sup> Series units will vary based on site constraints.
5. When recorded percolation rates are between those listed in 310 CMR 15.242, the next slower rate shall be used for design purposes.



## 4.0 Mantis M<sup>5</sup> Trench Installation and Design Guidance

**TABLE 3: Mantis 5.1 LowPro Trench Sizing Table – \*See Notes Below**

Mantis 5.1 LowPro Trench Application			3 Bedroom or Less 330 GPD		4 Bedroom 440 GPD		5 Bedroom 550 GPD	
Soil Type	Percolation Rate (Min/In)	Application Rate (GPD/SF)	Mantis 5.1 LowPro Units Required (2 ft Wide Trench)	System Length (lf)	Mantis 5.1 LowPro Units Required (2 ft Wide Trench)	System Length (lf)	Mantis 5.1 LowPro Units Required (2 ft Wide Trench)	System Length (lf)
Class I	1 - 5	0.74	16	80	22	110	27	135
Class II	1 - 5	0.60	20	100	27	135	33	165
Class I	6	0.70	17	85	23	115	29	145
Class II	6	0.60	20	100	27	135	33	165
Class I	7	0.68	18	90	24	120	29	145
Class II	7	0.60	20	100	27	135	33	165
Class I	8	0.66	18	90	24	120	30	150
Class II	8	0.60	20	100	27	135	33	165
Class II	10	0.60	20	100	27	135	33	165
Class II	15	0.56	22	110	29	145	36	180
Class III	15	0.37	32	160	43	215	54	270
Class II	20	0.53	23	115	30	150	38	190
Class III	20	0.34	35	175	47	235	58	290
Class II	25	0.40	30	150	40	200	50	250
Class III	25	0.33	36	180	48	240	60	300
Class II	30	0.33	36	180	48	240	60	300
Class III	30	0.29	41	205	55	275	68	340
Class III	40	0.25	48	240	64	320	79	395
Class III & IV	50	0.20	60	300	79	395	99	495
Class III & IV	60	0.15	79	395	106	530	132	660
Remedial Use 60 - 90 MPI Systems								
Class III & IV	60	0.15	79	395	106	530	132	660
Pressure Dosed Systems								
Class III	40	0.29	41	205	55	275	68	340
Class III & IV	50	0.25	48	240	64	320	79	395
Class III & IV	60	0.20	60	300	79	395	99	495

1. Numbers of Mantis M<sup>5</sup> Series units are determined on the current application rates defined in Title 5 Regulations 310 CMR 15.242.
2. Mantis 5.1 LowPro unit = 5.58 ft<sup>2</sup>/lf or 27.90 ft<sup>2</sup> per unit.
3. The minimum number of bedrooms for residential designs shall be 3 bedrooms unless otherwise dictated by the regulations.
4. For new construction, no system shall be designed and constructed with an effective leaching area of less than 400 square feet.  
Note: A Minimum of 15 Mantis 5.1 LowPro units are required to meet 400 square foot effective leaching area minimum for new construction. For repair or upgrades, the minimum number of M<sup>5</sup> Series units will vary based on site constraints.
5. When recorded percolation rates are between those listed in 310 CMR 15.242, the next slower rate shall be used for design purposes.

## 4.0 Mantis M<sup>5</sup> Trench Installation and Design Guidance

**TABLE 4: Mantis 5.2 Trench Sizing Table – \*See Notes Below**

Mantis 5.2 Trench Application			3 Bedroom or Less 330 GPD		4 Bedroom 440 GPD		5 Bedroom 550 GPD	
Soil Type	Percolation Rate (Min/In)	Application Rate (GPD/SF)	Mantis 5.2 Units Required (3 ft Wide Trench)	System Length (lf)	Mantis 5.2 Units Required (3 ft Wide Trench)	System Length (lf)	Mantis 5.2 Units Required (3 ft Wide Trench)	System Length (lf)
Class I	1 - 5	0.74	11	55	15	75	18	90
Class II	1 - 5	0.60	14	70	18	90	22	110
Class I	6	0.70	12	60	16	80	19	95
Class II	6	0.60	14	70	18	90	22	110
Class I	7	0.68	12	60	16	80	20	100
Class II	7	0.60	14	70	18	90	22	110
Class I	8	0.66	12	60	16	80	20	100
Class II	8	0.60	14	70	18	90	22	110
Class II	10	0.60	14	70	18	90	22	110
Class II	15	0.56	15	75	19	95	24	120
Class III	15	0.37	22	110	29	145	36	180
Class II	20	0.53	15	75	20	100	25	125
Class III	20	0.34	24	120	31	155	39	195
Class II	25	0.40	20	100	27	135	33	165
Class III	25	0.33	24	120	32	160	40	200
Class II	30	0.33	24	120	32	160	40	200
Class III	30	0.29	28	140	37	185	46	230
Class III	40	0.25	32	160	43	215	53	265
Class III & IV	50	0.20	40	200	53	265	66	330
Class III & IV	60	0.15	53	265	71	355	88	440
Remedial Use 60 - 90 MPI Systems								
Class III & IV	60	0.15	53	265	71	355	88	440
Pressure Dosed Systems								
Class III	40	0.29	28	140	37	185	46	230
Class III & IV	50	0.25	32	160	43	215	53	265
Class III & IV	60	0.20	40	200	53	265	66	330

1. Numbers of Mantis M5 Series units are determined on the current application rates defined in Title 5 Regulations 310 CMR 15.242.
2. Mantis 5.2 unit = 8.35 ft<sup>2</sup>/lf or 41.75 ft<sup>2</sup> per unit.
3. The minimum number of bedrooms for residential designs shall be 3 bedrooms unless otherwise dictated by the regulations.
4. For new construction, no system shall be designed and constructed with an effective leaching area of less than 400 square feet.  
Note: A Minimum of 10 Mantis 5.2 units are required to meet 400 square foot effective leaching area minimum for new construction. For repair or upgrades, the minimum number of M<sup>5</sup> Series units will vary based on site constraints.
5. When recorded percolation rates are between those listed in 310 CMR 15.242, the next slower rate shall be used for design purposes.

## 4.0 Mantis M<sup>5</sup> Trench Installation and Design Guidance

**TABLE 5: Mantis 5.2 LowPro Trench Sizing Table – \*See Notes Below**

Mantis 5.2 LowPro Trench Application			3 Bedroom or Less 330 GPD		4 Bedroom 440 GPD		5 Bedroom 550 GPD	
Soil Type	Percolation Rate (Min/In)	Application Rate (GPD/SF)	Mantis 5.2 LowPro Units Required (3 ft Wide Trench)	System Length (lf)	Mantis 5.2 LowPro Units Required (3 ft Wide Trench)	System Length (lf)	Mantis 5.2 LowPro Units Required (3 ft Wide Trench)	System Length (lf)
Class I	1 - 5	0.74	12	60	16	80	20	100
Class II	1 - 5	0.60	15	75	19	95	24	120
Class I	6	0.70	13	65	17	85	21	105
Class II	6	0.60	15	75	19	95	24	120
Class I	7	0.68	13	65	17	85	21	105
Class II	7	0.60	15	75	19	95	24	120
Class I	8	0.66	13	65	18	90	22	110
Class II	8	0.60	15	75	19	95	24	120
Class II	10	0.60	15	75	19	95	24	120
Class II	15	0.56	16	80	21	105	26	130
Class III	15	0.37	23	115	31	155	39	195
Class II	20	0.53	16	80	22	110	27	135
Class III	20	0.34	25	125	34	170	42	210
Class II	25	0.40	22	110	29	145	36	180
Class III	25	0.33	26	130	35	175	43	215
Class II	30	0.33	26	130	35	175	43	215
Class III	30	0.29	30	150	39	195	49	245
Class III	40	0.25	34	170	46	230	57	285
Class III & IV	50	0.20	43	215	57	285	71	355
Class III & IV	60	0.15	57	285	76	380	94	470
Remedial Use 60 - 90 MPI Systems								
Class III & IV	60	0.15	57	285	76	380	94	470
Pressure Dosed Systems								
Class III	40	0.29	30	150	39	195	49	245
Class III & IV	50	0.25	34	170	46	230	57	285
Class III & IV	60	0.20	43	215	57	285	71	355

1. Numbers of Mantis M5 Series units are determined on the current application rates defined in Title 5 Regulations 310 CMR 15.242.
2. Mantis 5.2 LowPro unit = 7.82 ft<sup>2</sup>/lf or 39.1 ft<sup>2</sup> per unit.
3. The minimum number of bedrooms for residential designs shall be 3 bedrooms unless otherwise dictated by the regulations.
4. For new construction, no system shall be designed and constructed with an effective leaching area of less than 400 square feet.  
Note: A Minimum of 11 Mantis M5.2 LowPro units are required to meet 400 square foot effective leaching area minimum for new construction. For repair or upgrades, the minimum number of M<sup>5</sup> Series units will vary based on site constraints.
5. When recorded percolation rates are between those listed in 310 CMR 15.242, the next slower rate shall be used for design purposes.

## 4.0 Mantis M<sup>5</sup> Trench Installation and Design Guidance

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1. Carefully lay out all boundaries defining the location and elevation for all system components.
2. Prepare the site according to state and local regulations. Do not install a system on frozen or saturated soils. Take precautions not to compact or smear the area with heavy machinery.
3. Plan all drainage requirements above (up-slope) the system and set soil grades to insure storm water drainage and surface water is diverted away from the absorption area once the system is complete.
4. Excavate a minimum thirty-six inch (36") wide level trench for the Mantis 5.2 unit or a minimum twenty-four inch (24") wide level trench for the Mantis 5.1 unit. Remove all organic soil, roots, and rocks within the absorption trench area.
5. Scarify receiving layers including sidewalls to eliminate soil smearing. Once scarifying is completed, avoid walking over prepared absorption area until the Specified Sand has been placed on the bottom of the trench.
6. Place, stabilize, and rake a minimum 6" level layer of Specified Sand along the trench bottom. Specified Sand must meet the minimum requirements listed on Table 1 of this manual. Ask your material supplier for a sieve analysis report to verify that the sand you are going to install meets this specification. A hand tamper or a vibratory plate compactor is sufficient for stabilization of the Specified Sand layer.
7. Cut shipping cardboard and center each Mantis unit in the trench with the fabric side up.

*Note: To make backfilling between the units easier, you can completely remove the shipping cardboard from the Support Distribution Pipe.*

8. Connect the Support Distribution Pipes of each unit together. Direction changes are accomplished by using a variety of standard fittings.
9. Install a termination cap or vent piping if required at the distal (far) end of the distribution pipe.
10. Begin placing Specified Sand between the Filter Support Modules and to the sides of the units. Specified Sand must be placed lightly and may be accomplished with a backhoe or other suitable equipment. **DO NOT** dump full loads of Specified Sand directly on the units.
11. Steps for placement of Specified Sand.
  - a. Starting at the top center of the units, use a minimal amount of Specified Sand necessary to set in place the bottom section of the Filter Support Modules at their correct spacing.
  - b. Stabilize the sand that is between the Filter Support Modules with a cut 2 x 4 or tamp. Ensure that the void area under the Support Distribution Pipe is filled and stabilized with Specified Sand.
  - c. Additional Specified Sand is lightly added between the Filter Support Modules and along the sides of the Mantis units to bring the sand fill 1-inch above the Filter Support Modules to account for sand settling.
  - d. Continue to moderately tamp and stabilize the sand that is between the Filter Support Modules. Spread additional Specified Sand as necessary.
12. Set distribution box to the proper elevation to achieve a 1/8" drop per foot to the first unit. Make the connection to the beginning of the first unit from the distribution box with SDR-35 pipe or equivalent.
13. Completely backfill over the Mantis M<sup>5</sup> units followed by topsoil to a minimum depth of 9" as measured from the top of the units. 1" of the fill is Specified Sand, immediately on top of the unit. Systems with total cover that exceeds 18" as measured from the top of the units to finished grade shall be vented at the distal (far) end of the system. Backfill material shall be well graded sandy fill; clean, porous, and devoid of large rocks. Divert surface runoff with diversion ditches or berms. Finish grade to prevent surface ponding. Seed or sod excavated areas to protect against erosion. Do not drive or pave over the absorption area.

## 4.0 Mantis M<sup>5</sup> Trench Installation and Design Guidance

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### Trench Design Example for Mantis 5.2:

House size:	4 Bedrooms
Soil Permeability min/in:	20 min/in Class II Soil
Design Flow – 110 gpd x 4 bedrooms =	440 gpd
Trench Area Required =	830.2 ft <sup>2</sup>
Mantis M <sup>5</sup> Trench Area Required=	498.4 ft <sup>2</sup>
Total Number of Mantis 5.2 Units Required (Table 4):	20 Mantis 5.2 Units

### Calculate Minimum Trench Length

20 Mantis 5.2 Units x 5 ft/Unit = 100 linear feet

### Minimum Trench Width

2 ft Unit Width + 6 inches of Specified Sand on each side = 3 feet

### Final Dimension Layout

Trench is 100 feet in length by 3 feet in width with 500 square feet of system area provided (Bottom Area + 2 Sidewalls).  
(Note: System layout and number of rows will vary based on site constraints)

- Minimum Trench Length = 100 ft
- Minimum Trench Width = 3 ft
- Minimum Number of Rows = System layout will vary based on site constraints.
- Minimum Number of Mantis 5.2 units = 20
- System Area Provided = 500 ft<sup>2</sup>
- Equivalent System Area Provided = 835 ft<sup>2</sup>

*Note: If designing with multiple rows or split rows, number of M<sup>5</sup> units may increase in order to have an even number of Units per row.*

*Note: Edge to edge trench spacing is as follows:*

*4' minimum edge to edge trench spacing for Mantis 5.1*

*6' minimum edge to edge trench spacing for Mantis 5.2*

# 4.0 Mantis M<sup>5</sup> Trench Installation and Design Guidance

FIGURE 5: MANTIS M<sup>5</sup> MULTIPLE TRENCH CROSS SECTION

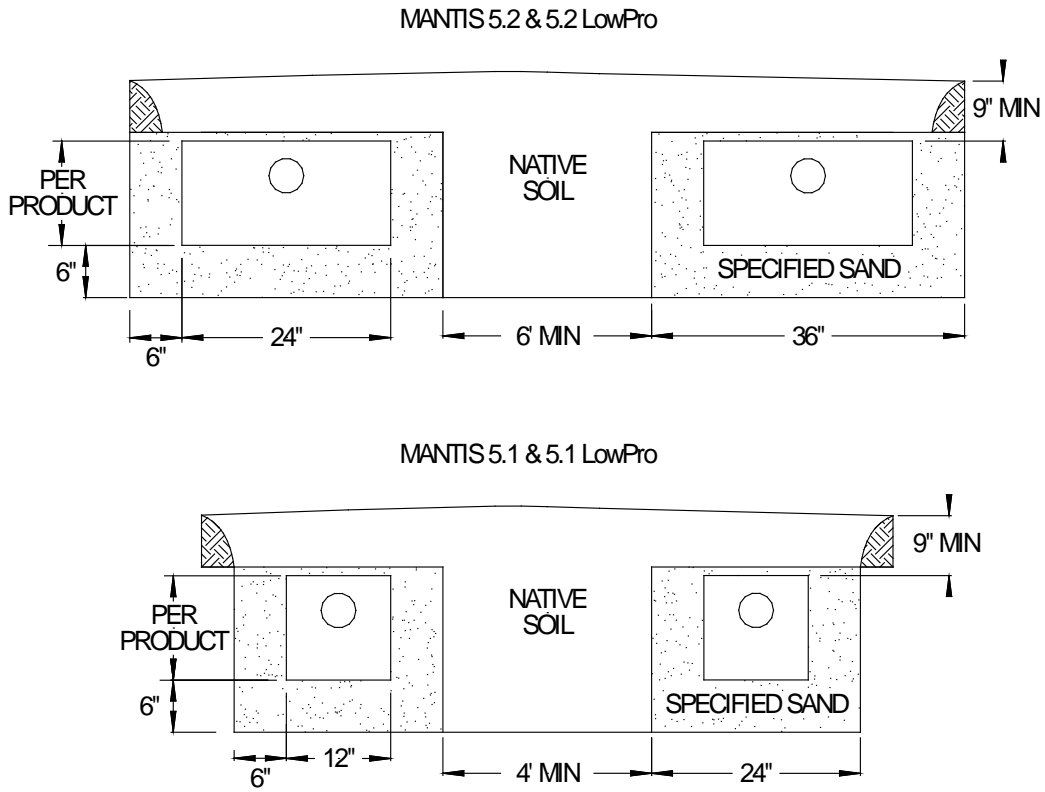
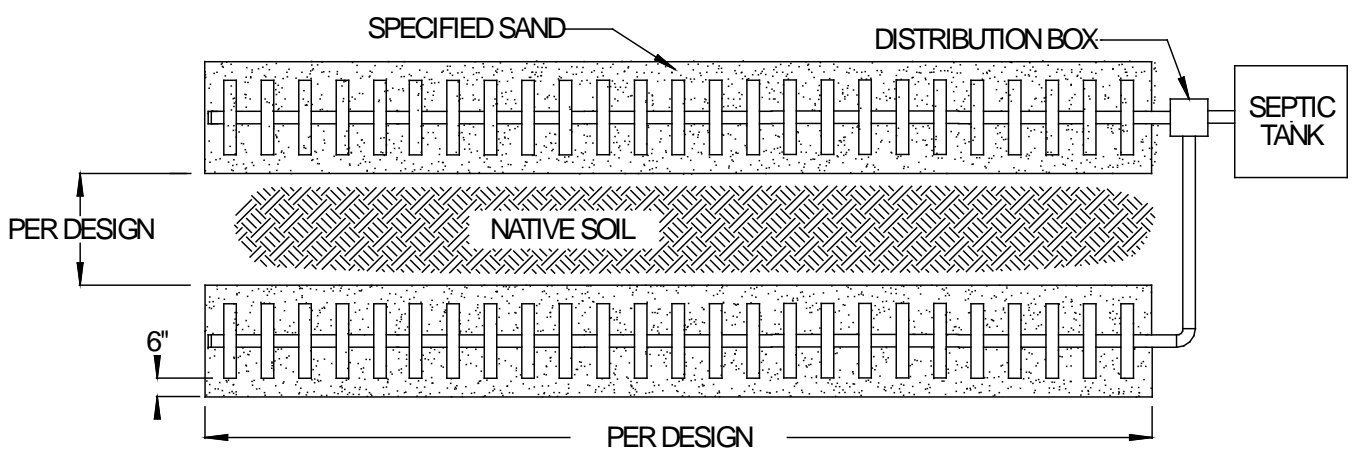


FIGURE 6: MANTIS M<sup>5</sup> MULTIPLE TRENCH PLAN VIEW



## 5.0 Mantis M<sup>5</sup> Bed Installation and Design Guidance

**TABLE 6: Mantis 5.1 & 5.1 LowPro Bed Sizing Table - \*See Notes Below**

Mantis 5.1 & 5.1 LowPro Bed Application			3 Bedroom or Less 330 GPD		4 Bedroom 440 GPD		5 Bedroom 550 GPD	
Soil Type	Percolation Rate (Min/In)	Application Rate (GPD/SF)	Mantis 5.1 & 5.1 LowPro Units Required (2 ft Product Width)	System Length (lf)	Mantis 5.1 & 5.1 LowPro Units Required (2 ft Product Width)	System Length (lf)	Mantis 5.1 & 5.1 LowPro Units Required (2 ft Product Width)	System Length (lf)
Class I	1 - 5	0.74	27	135	36	180	45	225
Class II	1 - 5	0.60	33	165	44	220	55	275
Class I	6	0.70	29	145	38	190	48	240
Class II	6	0.60	33	165	44	220	55	275
Class I	7	0.68	30	150	39	195	49	245
Class II	7	0.60	33	165	44	220	55	275
Class I	8	0.66	30	150	40	200	50	250
Class II	8	0.60	33	165	44	220	55	275
Class II	10	0.60	33	165	44	220	55	275
Class II	15	0.56	36	180	48	240	59	295
Class III	15	0.37	54	270	72	360	90	450
Class II	20	0.53	38	190	50	250	63	315
Class III	20	0.34	59	295	78	390	97	485
Class II	25	0.40	50	250	66	330	83	415
Class III	25	0.33	60	300	80	400	100	500
Class II	30	0.33	60	300	80	400	100	500
Class III	30	0.29	69	345	91	455	114	570
Class III	40	0.25	80	400	106	530	132	660
Class III & IV	50	0.20	99	495	132	660	165	825
Class III & IV	60	0.15	132	660	176	880	220	1100
Remedial Use 60 - 90 MPI Systems								
Class III & IV	60	0.15	132	660	176	880	220	1100
Pressure Dosed Systems								
Class III	40	0.29	69	345	91	455	114	570
Class III & IV	50	0.25	80	400	106	530	132	660
Class III & IV	60	0.20	99	495	132	660	165	825

1. Numbers of Mantis M<sup>5</sup> Series units are determined on the current application rates defined in Title 5 Regulations 310 CMR 15.242.
2. Mantis 5.1 & 5.1 LowPro unit = 3.34 ft<sup>2</sup>/lf or 16.70 ft<sup>2</sup> per unit.
3. The minimum number of bedrooms for residential designs shall be 3 bedrooms unless otherwise dictated by the regulations.
4. For new construction, no system shall be designed and constructed with an effective leaching area of less than 400 square feet.  
Note: A Minimum of 24 Mantis 5.1 & 5.1 LowPro units are required to meet 400 square foot effective leaching area minimum for new construction. For repair or upgrades, the minimum number of M<sup>5</sup> Series units will vary based on site constraints.
5. When recorded percolation rates are between those listed in 310 CMR 15.242, the next slower rate shall be used for design purposes.

## 5.0 Mantis M<sup>5</sup> Bed Installation and Design Guidance

**TABLE 7: Mantis 5.2 & 5.2 LowPro Bed Sizing Table - \*See Notes Below**

Mantis 5.2 & 5.2 LowPro Bed Application			3 Bedroom or Less 330 GPD		4 Bedroom 440 GPD		5 Bedroom 550 GPD	
Soil Type	Percolation Rate (Min/In)	Application Rate (GPD/SF)	Mantis 5.2 & 5.2 LowPro Units Required (3 ft Product Width)	System Length (lf)	Mantis 5.2 & 5.2 LowPro Units Required (3 ft Product Width)	System Length (lf)	Mantis 5.2 & 5.2 LowPro Units Required (3 ft Product Width)	System Length (lf)
Class I	1 - 5	0.74	18	90	24	120	30	150
Class II	1 - 5	0.60	22	110	30	150	37	185
Class I	6	0.70	19	95	26	130	32	160
Class II	6	0.60	22	110	30	150	37	185
Class I	7	0.68	20	100	26	130	33	165
Class II	7	0.60	22	110	30	150	37	185
Class I	8	0.66	20	100	27	135	34	170
Class II	8	0.60	22	110	30	150	37	185
Class II	10	0.60	22	110	30	150	37	185
Class II	15	0.56	24	120	32	160	40	200
Class III	15	0.37	36	180	48	240	60	300
Class II	20	0.53	25	125	34	170	42	210
Class III	20	0.34	39	195	52	260	65	325
Class II	25	0.40	33	165	44	220	55	275
Class III	25	0.33	40	200	54	270	67	335
Class II	30	0.33	40	200	54	270	67	335
Class III	30	0.29	46	230	61	305	76	380
Class III	40	0.25	53	265	71	355	88	440
Class III & IV	50	0.20	66	330	88	440	110	550
Class III & IV	60	0.15	88	440	117	585	147	735
Remedial Use 60 - 90 MPI Systems								
Class III & IV	60	0.15	88	440	117	585	147	735
Pressure Dosed Systems								
Class III	40	0.29	46	230	61	305	76	380
Class III & IV	50	0.25	53	265	71	355	88	440
Class III & IV	60	0.20	66	330	88	440	110	550

1. Numbers of Mantis M<sup>5</sup> Series units are determined on the current application rates defined in Title 5 Regulations 310 CMR 15.242.
2. Mantis 5.2 & 5.2 LowPro unit = 5.01 ft<sup>2</sup>/lf or 25.10 ft<sup>2</sup> per unit.
3. The minimum number of bedrooms for residential designs shall be 3 bedrooms unless otherwise dictated by the regulations.
4. For new construction, no system shall be designed and constructed with an effective leaching area of less than 400 square feet.  
Note: A Minimum of 18 Mantis 5.2 & 5.2 LowPro units are required to meet 400 square foot effective leaching area minimum for new construction. For repair or upgrades, the minimum number of M<sup>5</sup> Series units will vary based on site constraints.
5. When recorded percolation rates are between those listed in 310 CMR 15.242, the next slower rate shall be used for design purposes.



## 5.0 Mantis M<sup>5</sup> Bed Installation and Design Guidance

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1. Carefully lay out all boundaries defining the location and elevation for all system components.
2. Prepare the site according to state and local regulations. Do not install a system on frozen or saturated soils. Take precautions not to compact or smear the area with heavy machinery.
3. Plan all drainage requirements above (up-slope) the system and set soil grades to insure storm water drainage and surface water is diverted away from the absorption area once the system is complete.
4. Excavate the bed area. Remove all organic soil, roots, and rocks within the absorption area.
5. Scarify receiving layers including sidewalls to eliminate soil smearing. Once scarifying is completed, avoid walking over prepared absorption area until the Specified Sand has been placed on the bottom of the absorption area.
6. Place, stabilize, and rake a minimum 6" level layer of Specified Sand along the trench bottom. Specified Sand must meet the minimum requirements listed on Table 1 of this manual. Ask your material supplier for a sieve analysis report to verify that the sand you are going to install meets this specification. A hand tamper or a vibratory plate compactor is sufficient for stabilization of the Specified Sand layer.
7. Cut shipping cardboard and place the Mantis units in their rows with the fabric side up, adjust the Filter Support Modules to ensure they are spaced evenly and have not shifted during placement.

*Note: To make backfilling between the units easier, you can completely remove the shipping cardboard from the Support Distribution Pipe.*

8. Connect the Support Distribution Pipes of each unit together. Direction changes are accomplished using a variety of standard fittings.
9. Install a termination cap or vent piping if required at the distal (far) end of the distribution pipe.
10. Begin placing Specified Sand between the Filter Support Modules and to the sides of the units. Specified Sand must be placed lightly and may be accomplished with a backhoe or other suitable equipment. **DO NOT** dump full loads of Specified Sand directly on the units.
11. Steps for placement of Specified Sand.
  - a. Starting at the top center of the units, use a minimal amount of Specified Sand necessary to set in place the bottom section of the Filter Support Modules at their correct spacing.
  - b. Stabilize the sand that is in-between the Filter Support Modules. Ensure that the void area under the Support Distribution Pipe is filled and stabilized with Specified Sand.
  - c. Additional Specified Sand is lightly added between the Filter Support Modules and along the sides of the Mantis units to bring the sand fill 1-inch above the Filter Support Modules to account for sand settling.
  - d. Continue to moderately tamp and stabilize the sand that is between the Filter Support Modules. Spread additional Specified Sand as necessary.
12. Set distribution box to the proper elevation to achieve a 1/8" drop per foot to the first unit. Make the connection to the beginning of the first unit row from the distribution box with SDR-35 pipe or equivalent.
13. Completely backfill over the units followed by topsoil to a minimum depth of 9" as measured from the top of the units. 1" of the fill is Specified Sand, immediately on top of the unit. Systems with total cover that exceeds 18" as measured from the top of the units to finished grade shall be vented at the distal (far) end of the system. Backfill material shall be well graded sandy fill; clean, porous, and devoid of large rocks. Divert surface runoff with diversion ditches or berms. Finish grade to prevent surface ponding. Seed or sod excavated areas to protect against erosion. Do not drive or pave over the absorption area.

## 5.0 Mantis M<sup>5</sup> Bed Installation and Design Guidance

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### Bed Design Example for Mantis 5.2:

House size:	4 Bedrooms
Soil Permeability min/in:	10 min/in Class II Soil
Design Flow: 110 gpd x 4 bedrooms =	440 gpd
Bed Area in Required =	733 ft <sup>2</sup>
Mantis M <sup>5</sup> Bed Area Required =	439.8 ft <sup>2</sup>
Total Number of Mantis 5.2 Units Required (Table 6):	30 Mantis 5.2 Units

### Calculate Minimum Bed Length

*(Note: For this example we will use 2 rows)*

Divide the number of rows by the number of units required.

$$30 \text{ M5.2 units} \div 2 \text{ rows} = 15 \text{ Mantis 5.2 units per row}$$

Multiply numbers of units per row by 5 feet per Mantis 5.2 unit.

$$15 \text{ Mantis 5.2 units} \times 5 \text{ ft/module} = 75 \text{ feet per row}$$

### Minimum Bed Width

$(\text{Unit Width} + \text{Specified Sand}) \times \text{Number of Rows}$ :

$$2 \text{ ft Unit width} + 6 \text{ inches of Specified Sand on each side} = 3 \text{ ft}$$

$$3 \text{ ft width} \times 2 \text{ rows} = 6 \text{ feet}$$

### Final Dimension Layout

Bed is 75 feet in length by 6 feet in width with 450 square feet of system area provided (Bottom Area Only).

*(Note: System layout and number of rows will vary based on site constraints)*

- Minimum Bed Length = 75 ft
- Minimum Bed Width = 6 ft
- Minimum Number of Rows = 2
- Minimum Number of Mantis 5.2 units = 30
- System Area Provided = 450 ft<sup>2</sup>
- Equivalent System Area Provided = 753.0 ft<sup>2</sup>

*Note: If designing with multiple rows or split rows, number of M<sup>5</sup> units may increase in order to even up number of Units per row.*

*Note: This design example can be used for shallow placement or mound systems.*

# 5.0 Mantis M<sup>5</sup> Bed Installation and Design Guidance

FIGURE 7: MANTIS M<sup>5</sup> IN-GROUND BED SYSTEM CROSS SECTION

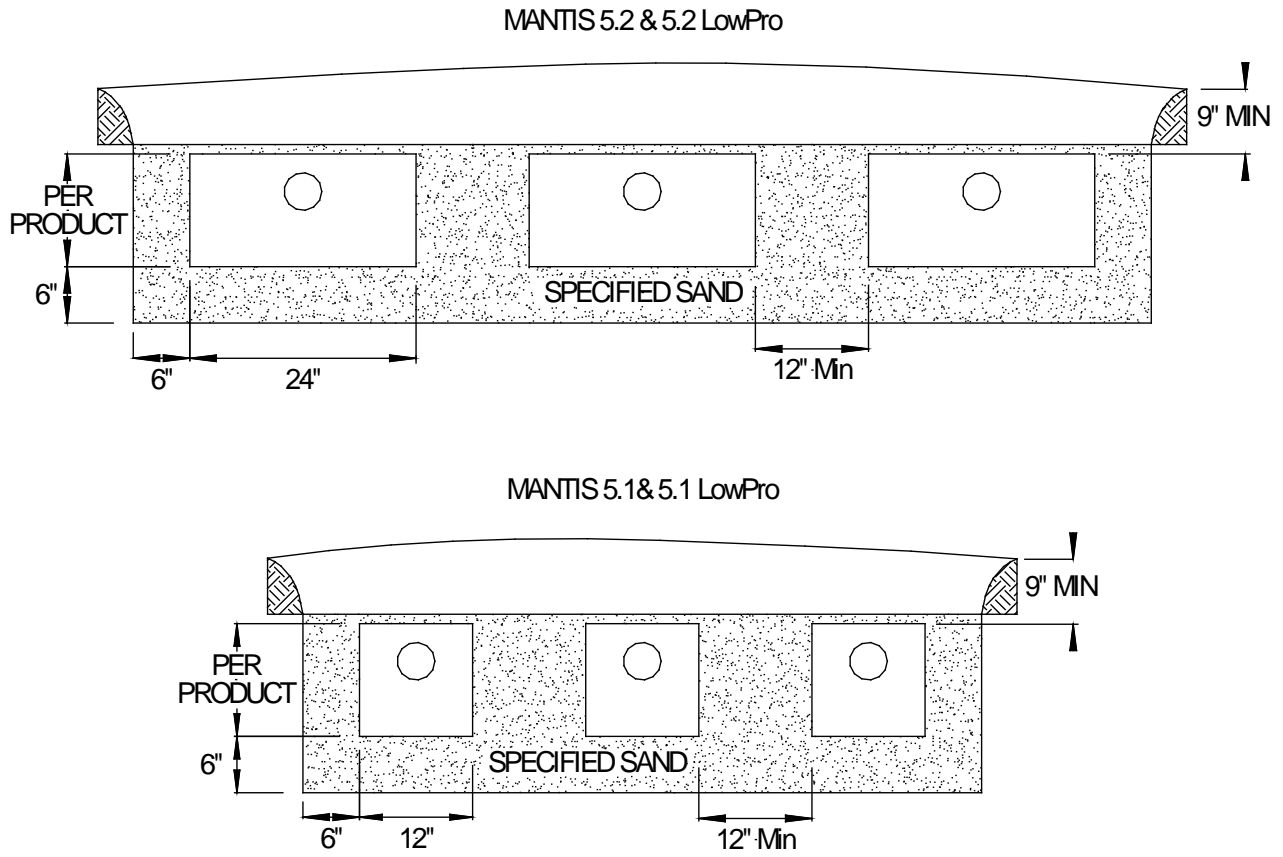
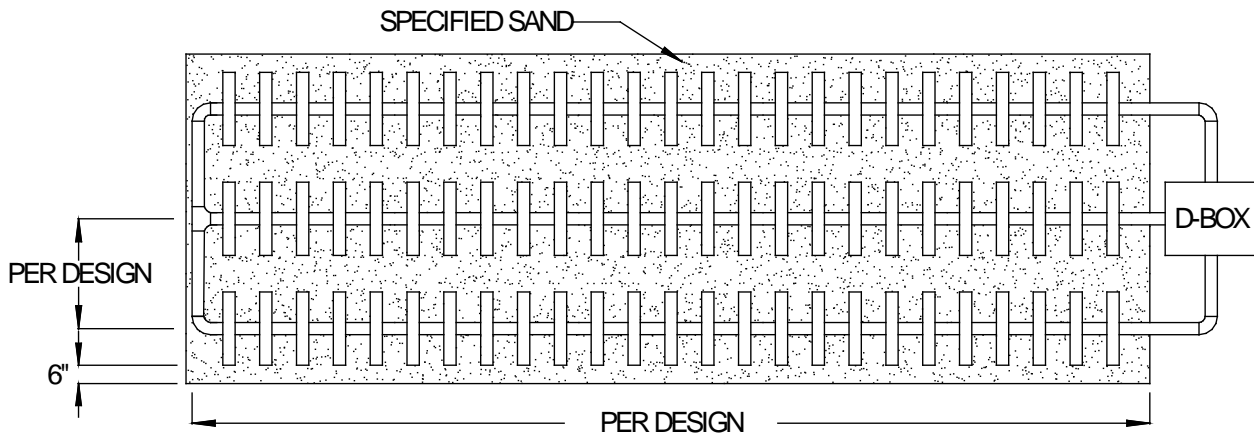


FIGURE 8: MANTIS M<sup>5</sup> BED SYSTEM PLAN VIEW



# 5.0 Mantis M<sup>5</sup> Bed Installation and Design Guidance

FIGURE 9: MANTIS M<sup>5</sup> SHALLOW PLACEMENT OR MOUND SYSTEM CROSS SECTION

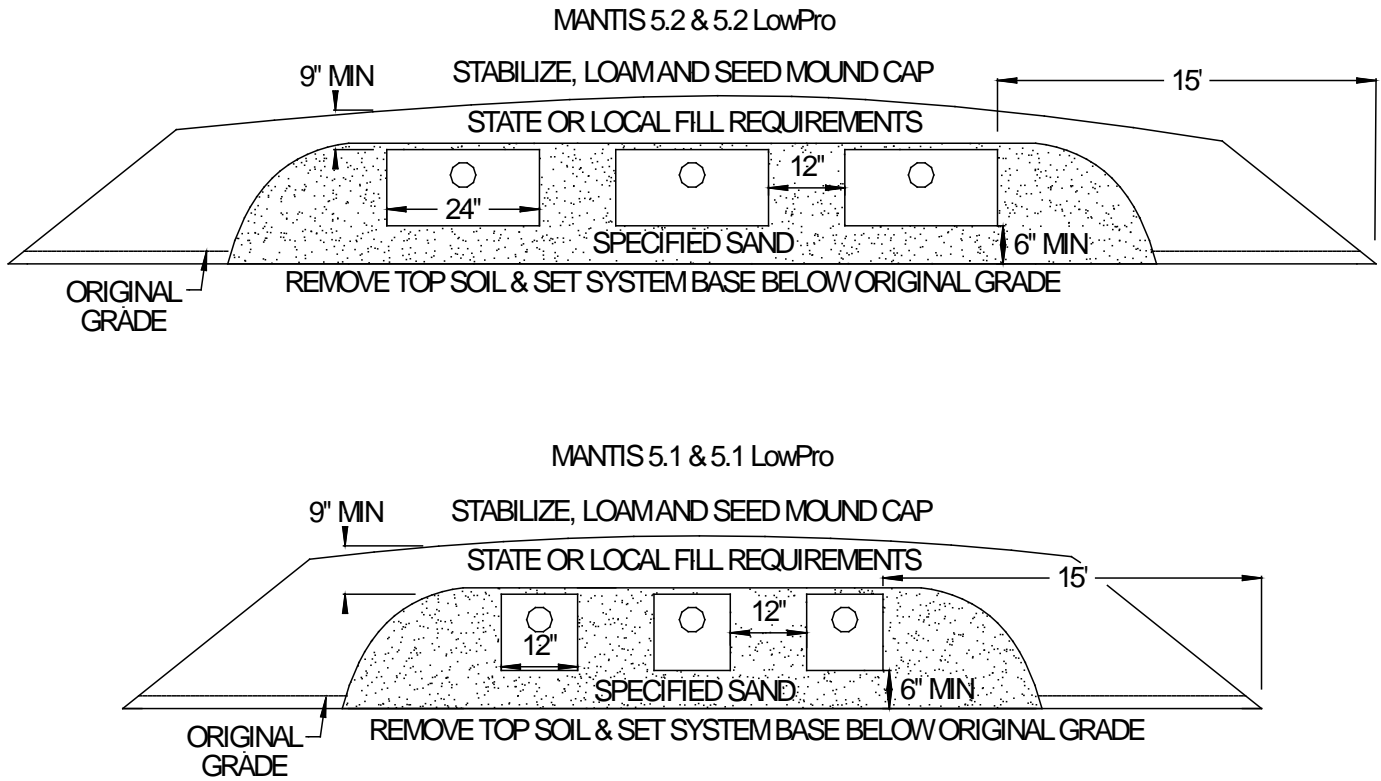
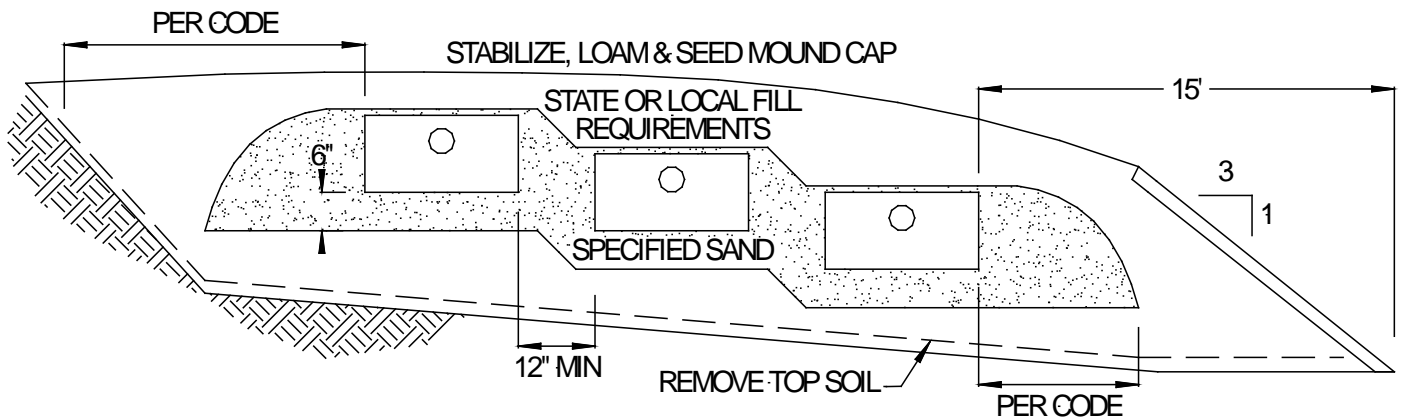


FIGURE 10: MANTIS M<sup>5</sup> SLOPED BED SYSTEM CROSS SECTION



## 6.0 Pumped & Pressure System Guidance

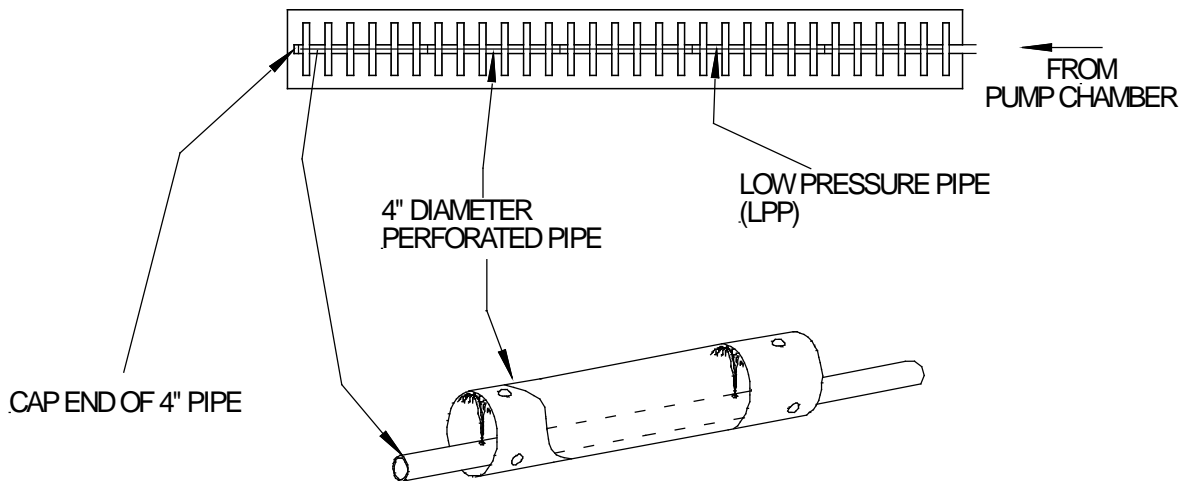
**6.1 PUMP DOSED DISTRIBUTION BOX:** Specify an oversized distribution box for pumped systems. Provide velocity reduction in the D-box with a tee or baffle.

**6.2 PRESSURE OR PUMPED DOSED DESIGN CRITERIA:** Dosing volume must be set to deliver a maximum of 6 gallons per Mantis 5.2 & 5.2 *LowPro* per dose cycle or 3 gallons per Mantis 5.1 & 5.1 *LowPro* per dose cycle.

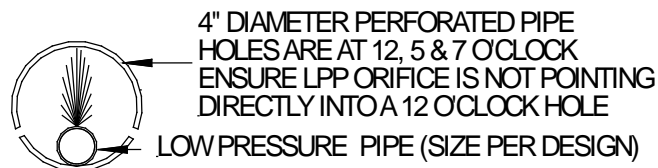
**6.3 LOW PRESSURE DISTRIBUTION:** Pressure lines should have a minimum 1 1/4 inch inside diameter. Orifices should be designed at 3/16 inch to 1/4 inch in diameter and at pre-determined intervals per design and code. Design requirements will vary depending on length of system and dose volume. At least one drain hole per line at the 6 o'clock position must be added to each line.

Flushing ports are required at the distal end of all pressure distribution networks. Flushing valves and vents can be consolidated in larger systems by using valves on the outlet manifold.

**FIGURE 11: MANTIS M<sup>5</sup> PRESSURE DISTRIBUTION – ORIFICE LAYOUT**



### PRESSURE PIPE CROSS SECTION FOR ALL APPLICATIONS



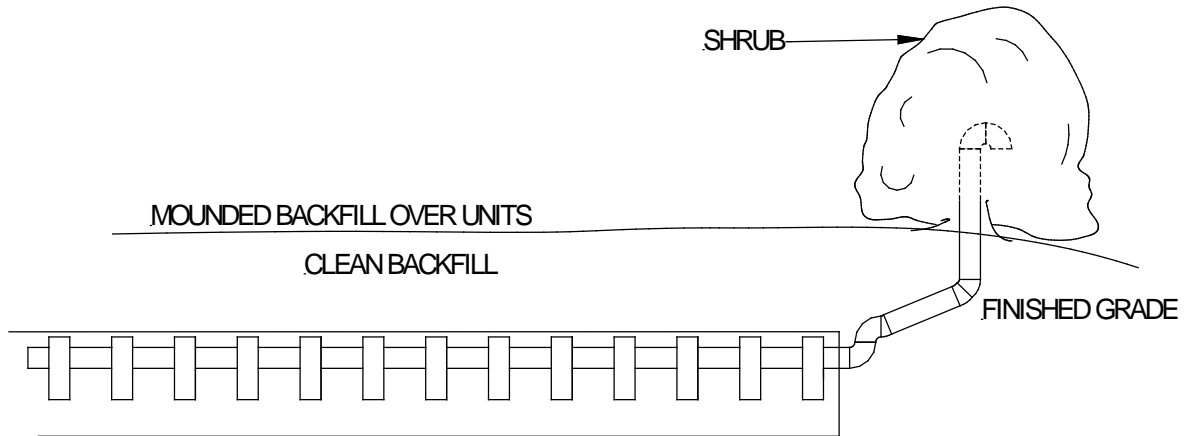
## 7.0 System Ventilation Guidance

**7.1 SYSTEM VENTILATION:** Air vents are required at the distal end of unit rows on all absorption systems with more than 18 inches of soil cover as measured from the top of the Mantis units or located under impervious surfaces. This will ensure proper aeration of the Mantis system. The extension of the distribution pipe at the distal end of each row to the vent provides adequate delivery of air into the the Mantis system, as shown in Figure 12.

The vent is usually a 4-inch diameter pipe extended to a convenient location behind shrubs. Corrugated pipe can be used to vent the system. Make sure the pipe has a pitch towards the surface so it does not accumulate water or condensation that will close off the airflow to the system.

If a pump dosed system is specified with greater than 18 inches of cover, an additional 2-inch minimum airline must be extended from the D-box back to a knockout or riser on the septic tank or pump chamber. This maintains the continuity of airflow from the field.

**FIGURE 12: MANTIS M<sup>5</sup> VENTING DIAGRAM**



## 7.0 System Ventilation Example Drawing

FIGURE 13: MANTIS M<sup>5</sup> 2" BY-PASS LINE

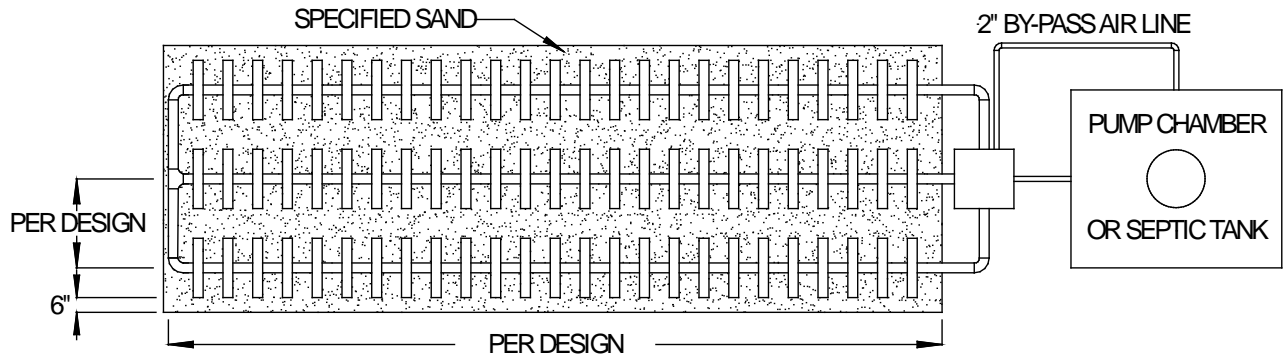
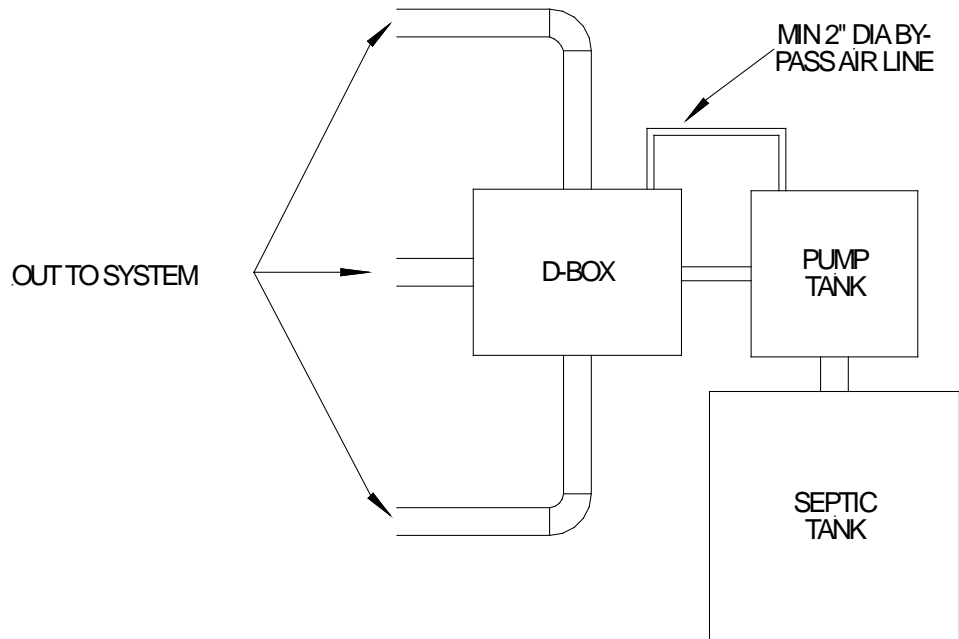


FIGURE 14: MANTIS M<sup>5</sup> 2" BY-PASS LINE – CLOSE UP



## 8.0 Recommended Notes on Design Plans

- This system is not designed for backwash from a water softener.
- This system (is/is not) designed for the use of a garbage disposal.
- The Mantis system is not for use under vehicular traffic or for under paving applications.
- Organic topsoil layer must be removed from trench and slope extension areas prior to placement of approved fill or Specified Sand. Scarify subsoil prior to select fill or Specified Sand placement.
- All Mantis M<sup>5</sup> Series installations utilize a Specified Sand envelope around the units. 6" minimum underneath, 6" minimum on the sides, 1" minimum on top, and 8" between the Filter Support Modules. The Specified Sand specification is listed below: The Specified Sand shall be washed concrete sand meeting the requirements of ASTM C33 with less than 10% passing a #100 sieve and less than 5% passing a #200 sieve.

### SPECIFIED SAND SIEVE REQUIREMENTS

Eljen Mantis M <sup>5</sup> Specified Sand Requirements		
Sieve Size	Sieve Square Opening Size	Specification Percent Passing (Wet Sieve)
0.375"	9.5 mm	100.0
#4	4.75 mm	95.0 – 100.0
#8	2.36 mm	80.0 – 100.0
#16	1.18 mm	50.0 – 85.0
#30	600 µm	25.0 – 60.0
#50	300 µm	5.0 – 30.0
#100	150 µm	< 10.0
#200	75 µm	< 5.0

Request a sieve analysis from your material supplier to ensure that the system sand meets the specification requirements listed above.

- Eljen Corporation requires the use of an appropriate sized septic tank effluent filter for all Mantis systems.
- Pumped systems shall have an oversized distribution box utilizing a velocity reduction tee or baffle.
- Eljen mandates venting when the system will have more than 18" of cover material as measured from the top of the unit to finished grade.
- After backfill, there should be a minimum of 9" of material as measured from the top of the Filter Support Modules to the finished grade. The first inch of that fill is specified sand.
- Backfill and Finish Grading: Carefully place backfill over the units, followed by a total minimum depth of 6 - 18 inches of well graded sandy fill; clean, porous, and devoid of rocks, as measured from the top of the Filter Support Modules. Finish grade must divert surface runoff from the soil treatment area and prevent surface ponding. Protect the system area from erosion by loaming and seeding or by using other approved methods of erosion control.
- Fill material shall meet the Eljen Mantis M<sup>5</sup> Series Design & Installation Manual requirements. All fill material shall be clean sand, free of topsoil, directly beneath the system area.
- For pumped systems, set pump floats or pump control panels to deliver a maximum of 6 gallons per Mantis 5.2 & Mantis 5.2 *LowPro* per dose cycle or 3 gallons per Mantis 5.1 & Mantis 5.1 *LowPro* per dose cycle.
- This design complies with and must be installed in accordance with the most current Eljen Massachusetts Mantis M<sup>5</sup> Design and Installation Manual.