

**SUBMITTAL APPLICATION FOR
TREATMENT PRODUCT LISTING
ARIZONA ADMINISTRATIVE CODE R18-9-A309(E)**

Submitted to:

**Arizona Department of Environmental Quality
1110 West Washington
Phoenix, AZ 85007**

Submitted by:

**NextGen Septic, LLC
1776 Mentor Avenue; STE 420
Cincinnati, OH 45212
Attention: Dr. Rakesh Govind**

May 5, 2022

NextGen Septic, LLC requests the Arizona Department of Environmental Quality to list its treatment system, NextGen Septic, LLC Zero Liquid Discharge (ZLD). This treatment system is designed to treat wastewater from a single family house with a maximum average daily flowrate of 1,000 gallons per day.

The NextGen Septic Zero Liquid Discharge (ZLD) system consists of the NextGen Septic treatment system coupled to a Zero Liquid Discharge (ZLD) system, that evaporates the treated disinfected water into ambient air, thereby having no liquid discharge. The NextGen Septic system is a patent-pending, advanced system which combines anoxic decomposition of solids, followed by aerobic treatment. The wastewater is biologically treated using aeration and moving biomedial, consisting of plastic mesh spheres with open cell foam inside, which grows active biofilms to convert the organic load to carbon dioxide and water. It also converts ammonium to nitrogen gas through simultaneously nitrification and denitrification. Treated water is filtered through two self-cleaning membranes – 5 micron and 0.2 micron pore size and disinfected using ozone, generated from ambient air. The treated, disinfected water is then injected into a flow of ambient air with water droplets with an average size of 30 microns, thereby allowing the high surface area of the drops to rapidly evaporate the water into the air. Even at 95% relative humidity, the water drops evaporate before they reach the ground or freeze in the winter time.

The NextGen Septic ZLD system can be used when there is insufficient land to dispose the water or the percolation rate of the soil is very low.

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PRODUCT LISTING APPLICATION



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I. PROCESSES FOR PRODUCT LISTING AND TREATMENT PERFORMANCE CATEGORIES

	Existing Products (Already in Use in Arizona)	New Products (Not Yet in Use in Arizona)
	Treatment technologies approved, either as a product statewide or individually for a single site, under Engineering Bulletin 12 in the old program, or under an APP Type 4 General Permit rule beginning on January 1, 2001	Treatment technologies encompassed by an APP Type 4 General Permit that has not been used or listed for use in Arizona pursuant to A.A.C. R18-9-A309(E)
Product Listing for Performance Meets Default Standards in 18 A.A.C. 9, Article 3, Part E	See <i>List of Proprietary Treatment Products For On-Site Wastewater Systems in Arizona</i> , issued by ADEQ on June 10, 2003	ADEQ product listing process described below
Product Listing for "Treatment Performance Superior to the Default Performance Values"	ADEQ product listing process described below. The current list is at http://static.azdeq.gov/forms/ppla_app.pdf	ADEQ product listing process described below

II. ADEQ PRODUCT LISTING PROCESS

1. **Manufacturer submits Product Listing Application (PLA), and supporting documents to ADEQ.**
 Submit this application and appropriate supplemental information and forms, which are identified in rule and/or in this form. Only one copy of the application and associated documents is needed. **Due to recent events, both an electronic and paper copy of the application and related documents must be submitted.** Submit the application by email to GWP_ERU@azdeq.gov and submit a paper copy by mail or in-person to:
 Arizona Department of Environmental Quality
 Groundwater Protection Value Stream
 Engineering Review Desk, 5th Floor
 1110, West Washington Street
 Phoenix, Arizona 85007
 - a. A description of the product and specifications for design, installation, operation (including the O&M manual), and warranty limitations to achieve performance for a 20-year operational life [A.A.C. R18-9-101(28)].
 - b. The Type 4 General Permit number or numbers for which the applicant is seeking product approval.
 - c. Treatment performance data documenting that the product either meets the default performance values specified in rule or exceeds them depending on which product listing the manufacturer is seeking. [In selecting treatment performance data to submit, the manufacturer should be aware that ADEQ will evaluate claims for "treatment performance superior to default performance values" based on the maximum wastewater strength in A.A.C. R18-9-101(42) and give the most weight to data developed by independent third parties on actual installations in realistic use scenarios and the least weight to data developed by the manufacturer under test bench conditions].
 - d. A check in the box on the PLA indicating whether the manufacturer wishes to make a presentation on their submittal.
2. ADEQ will review the submittal and, if the information is sufficient, will prepare a package that contains:

UPDATED JULY 2020

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY, 1110 WEST WASHINGTON, PHOENIX, AZ 85007



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- a. Performance values to be listed.
- b. Description of the product and specifications for design, installation, operation (including the O&M manual), and warrantee limitations to achieve performance for a 20-year operational life.
- c. Any conclusions on the applicability or limitations of the product.
- d. **The review costs of \$122.00 per hour will be billed monthly during the review period. Before an approval certificate can be issued, all review costs must have been paid.**



Product Name and Model Identification:

☒ Description continued, pages attached.



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3 General Permit Treatment Technology

Check below the treatment technology that is most applicable to the product described. Please note that the Arizona Department of Environmental Quality lists only those treatment products defined in Arizona Administrative Code, Title 18, Chapter 9, Article 3.

- ☐ GP 4.03 Composting Toilet [A.A.C. R18-9-E303(A)(1)]
- ☒ GP 4.09 Engineered Pad System [A.A.C. R18-9-E309(A)(1)]
- ☐ GP 4.10 Intermittent Sand Filter [A.A.C. R18-9-E310(A)(1)]
- ☐ GP 4.11 Peat Filter [A.A.C. R18-9-E311(A)(1)]
- ☐ GP 4.12 Textile Filter [A.A.C. R18-9-E312(A)(1)]
- ☐ GP 4.13 Denitrifying System Using Separated Wastewater Streams [A.A.C. R18-9-E313(A)(1)]
- ☒ GP 4.15 Aerobic System [A.A.C. R18-9-E315(A)(1)]
- ☐ GP 4.16 Nitrate-Reactive Media Filter [A.A.C. R18-9-E316(A)(1)]
- ☐ GP 4.19 Sand-Lined Trench [A.A.C. R18-9-E319(A)(1)]
- ☒ GP 4.20 Disinfection Device [A.A.C. R18-9-E320(A)(1)]

4 Manufacturer Specifications for Product

Describe the Manufacturer Specifications for pretreatment, appurtenances, controls, design, installation and operation of the product and enclose two (2) indexed copies:

Refer to attached pages

☐ Description continued, __ pages attached. ☐ Manufacturer Specifications enclosed

5 Manufacturer Warranty and Service Recommendations for Product

Describe the product maintenance recommendations to achieve a 20-year operational life for the product, appurtenances and controls, and include 2 indexed copies:

Refer to attached pages

☒ Description continued, __ pages attached. ☒ Warranty and Recommendations enclosed

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6 Exceptions to A.A.C. Title 9, Chapter 9, Article 3, Part E for the Technology Checked in Item 2

Note: All listed treatment products shall comply with the rule applicable to the treatment technology, unless the listing specifies an alternative requirement approved by the Department. All exceptions shall be justified by independent third party data which is accepted by the Department. List each exception below, specifying the rule number and describe the alternative provision:

RULE	DESCRIBE EXCEPTION

7 Data For The Department Review (enclose 2 complete indexed copies)

Note: When a complete pursuant to A.A.C. R18-9-A309(E) and the appropriate fee is received, the Department shall review the materials submitted, including independent third party test data relevant to the treatment product under consideration. If a proposed exception in Item 5 is for treatment performance which is superior to the default values for the technology, the test data shall be for: (a) typical (raw) sewage at the maximum values in A.A.C. R18-9-101(42) and (b) documented equivalent design and operating conditions. The test data for the "documented equivalent" demonstration shall be consistent with other rule requirements and the proposal for listing. These include, but are not limited to: product design, media material and installation, loading rates and the method (such as a pump or other equipment) by which raw or pretreated wastewater is delivered to the product or removed from the product. The materials and methods used for data collection, quality assurance and reporting shall be provided to assure data are accurate and consistent.

Comments:

☐ Comments continued, __ pages attached. ☒ Data for Review is enclosed

8 MANUFACTURER OFFICER CERTIFICATION

I have reviewed the materials presented with this Application for Treatment Product Listing pursuant to A.A.C. R18-9-A309(E), including ____ pages of indexed attachments pertaining to the product described. I believe that these materials are an accurate representation of facts.

Officer Signature and Date Signed: _____

5/5/2022

Officer Title: **President**

Pursuant to A.R.S. § 41-1030:

- (1) ADEQ shall not base a licensing decision, in whole or in part, on a requirement or condition not specifically authorized by statute or rule. General authority in a statute does not authorize a requirement or condition unless a rule is made pursuant to it that specifically authorizes the requirement or condition.
- (2) Prohibited licensing decisions may be challenged in a private civil action. Relief may be awarded to the prevailing party against ADEQ, including reasonable attorney fees, damages, and all fees associated with the license application.
- (3) ADEQ employees may not intentionally or knowingly violate the requirement for specific licensing authority. Violation is cause for disciplinary action or dismissal, pursuant to ADEQ's adopted personnel policy. ADEQ employees are still afforded the immunity in A.R.S. §§ 12-821.01 and 12-820.

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PROODUCT INFORMATION

Product Description

The NextGen Septic ZLD process is designed to treat the wastewater from a single family house (maximum flowrate of 1,000 gallons per day) using a three step treatment system. The first step consists of a 1,730 gallon, standard, plastic septic tank, installed below ground, which has a single baffle. This tank serves as the Equalization and Filtration Tank. Wastewater with solids from the house flows by gravity into this tank, wherein the solids are allowed to settle down and the clear liquid, overflowing the baffle, flows into the second compartment, wherein there is self-cleaning filter (50 microns), which is equipped with a submersible pump. This pump flows some of the filtered water to the rotating nozzles, located inside the screen, which continuously cleans the screen, while the remaining filtered water flows into a second, identical, 1,730 gallon septic tank, also installed below ground. This second Bioreactor tank represents the second treatment step, in which the water is aerated using a blower and porous tubes, installed at the bottom of the tank. There is moving biomedica, consisting of a spherical plastic mesh (2 inches in diameter) in which a 2 inch cubic piece of open cell foam is enclosed inside the mesh. These balls of Biomesh Biomedica move around the tank, while it is being aerated. The plastic mesh protects the open cell foam from being clogged by the suspended particles, while the open cell foam inside the mesh provides a very high surface area for the active biofilms. A drawing of the moving Biomedica and the first and second septic tanks are attached in the following sheets.

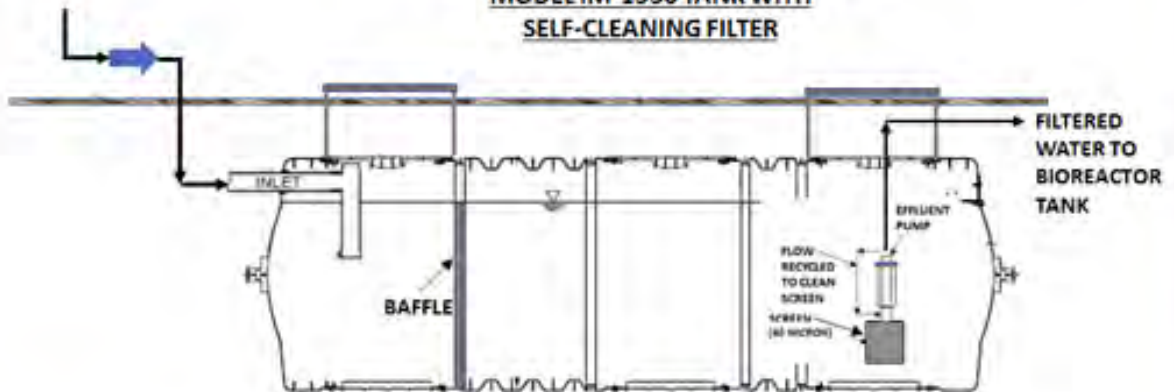
EQUALIZATION AND FILTRATION TANK


RECYCLE FLOW FROM
STAINLESS STEEL MEMBRANE
(STREAM NUMBERED 3 IN NXTGEN-NC-3)

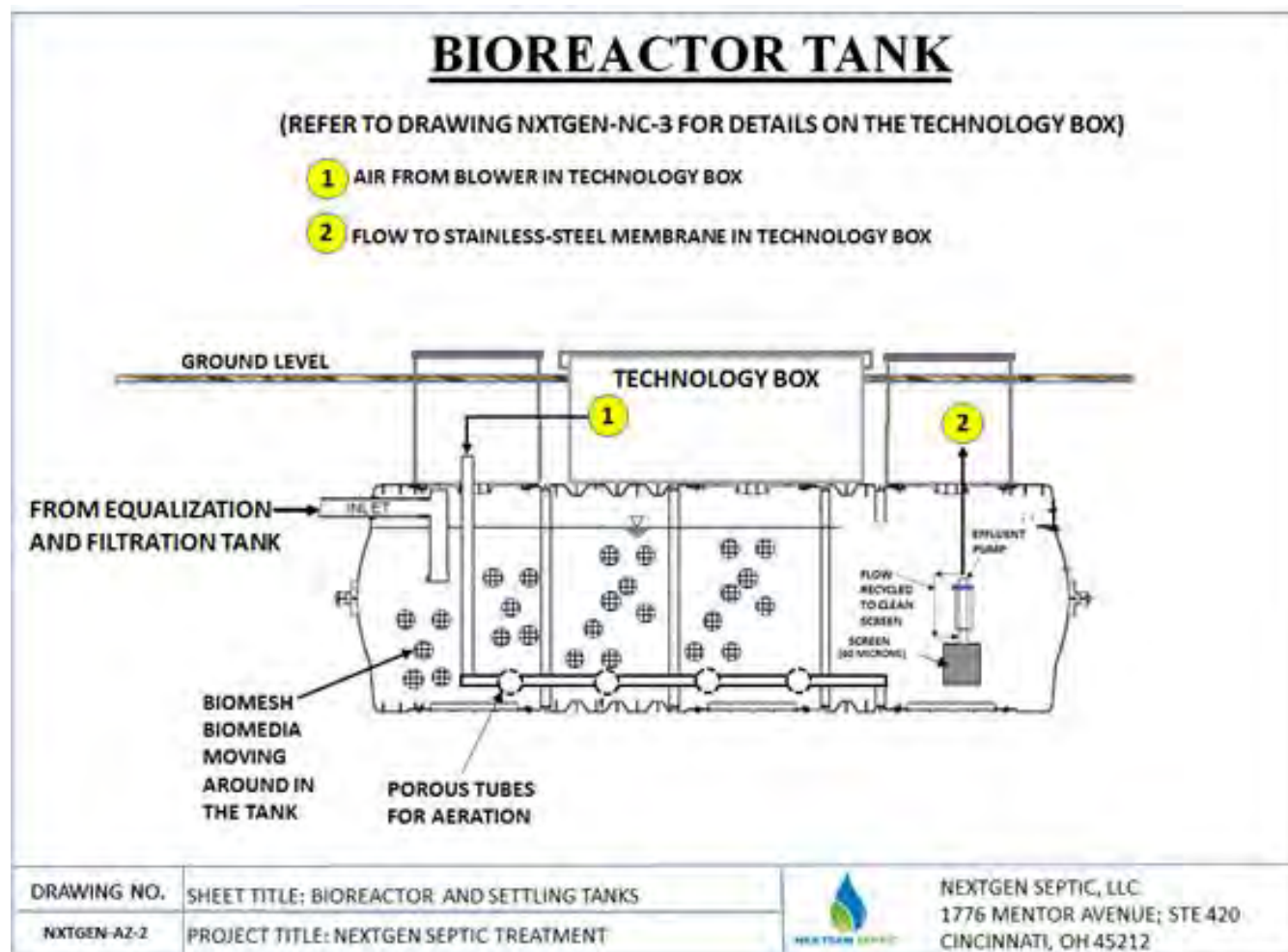
3

+
INFLUENT FLOW
FROM HOUSE

FILTRATION TANK
INFILTRATOR WATER TECHNOLOGIES
MODEL IM-1530 TANK WITH
SELF-CLEANING FILTER



DRAWING NO.	SHEET TITLE: PRIMARY FILTER WITH FILTRATION TANK	 <p>NEXTGEN SEPTIC, LLC 1776 MENTOR AVENUE; STE 420 CINCINNATI, OH 45212</p>
NXTGEN-AZ-1	PROJECT TITLE: NEXTGEN SEPTIC TREATMENT	



Moving Biomedia characteristics are given below.

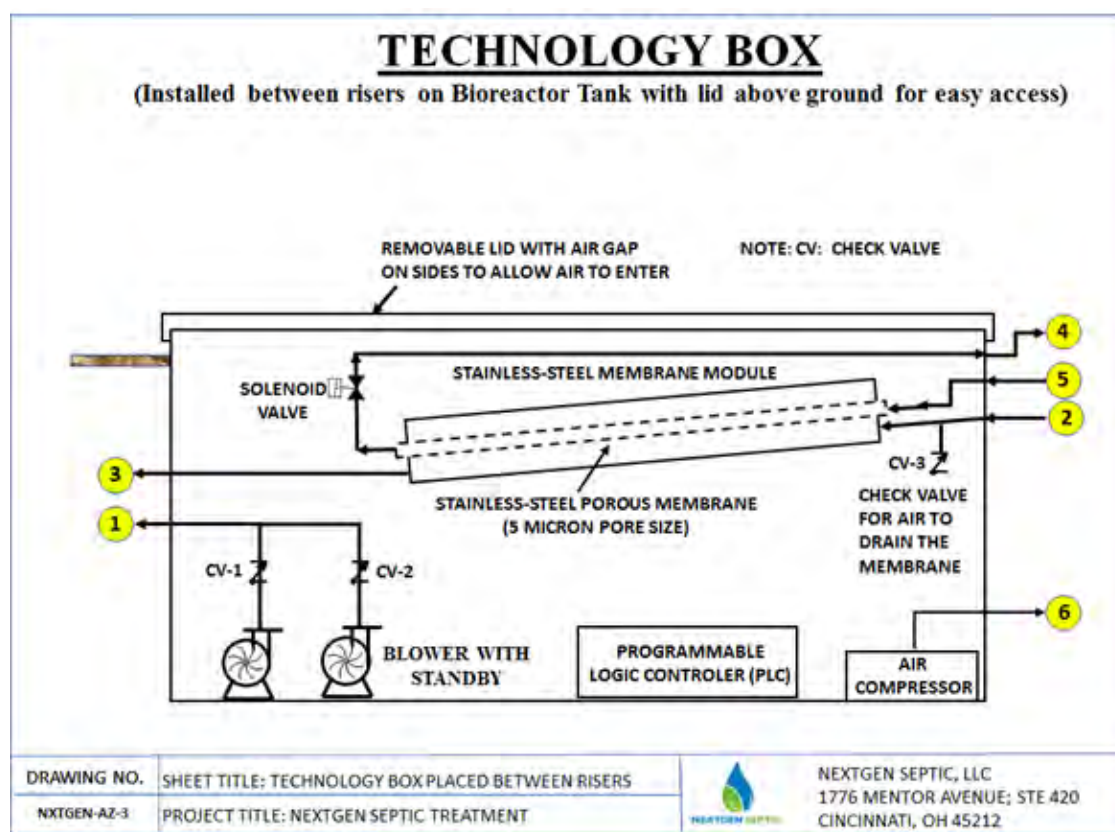
Biomesh Biomedia Characteristics	Value
Biomesh Biomedia dimensions	2 inch diameter, spherical with foam inside
Number of Biomesh Biomedia/ft ³	412
Weight per ft ³	2.4 lbs
Material	Virgin polyethylene
Specific Gravity	0.95
Volume % in Bioreactor	20 vol%
Effective surface area	3,000 m ² /m ³ (914 ft ² /ft ³)
COD Treatment Rate	12.5 lbs COD/ft ³ .day
NH4-N Treatment Rate	0.25 – 0.28 lbs NH ₃ -N/ft ³ .day



Biomesh Biomedia balls consist of a spherical, plastic mesh enclosing a 2-inch cube of open cell foam. The outside surface of the open cell foam immobilizes aerobic biofilms, while the inside surface area of the foam, which has limited penetration of dissolved oxygen, supports anoxic biofilms. These anoxic biofilms convert the nitrate/nitrites to nitrogen gas.

The contaminants (BOD, ammonium, etc.) are treated in this Bioreactor Tank, which has a single baffle, separating the tank into two compartments. Water from the Bioreactor compartment flows into the smaller second compartment, which has a self-cleaning filter (50 microns screen size) and a submersible pump. This self-cleaning and pump is identical to the self-cleaning filter in the first septic tank.

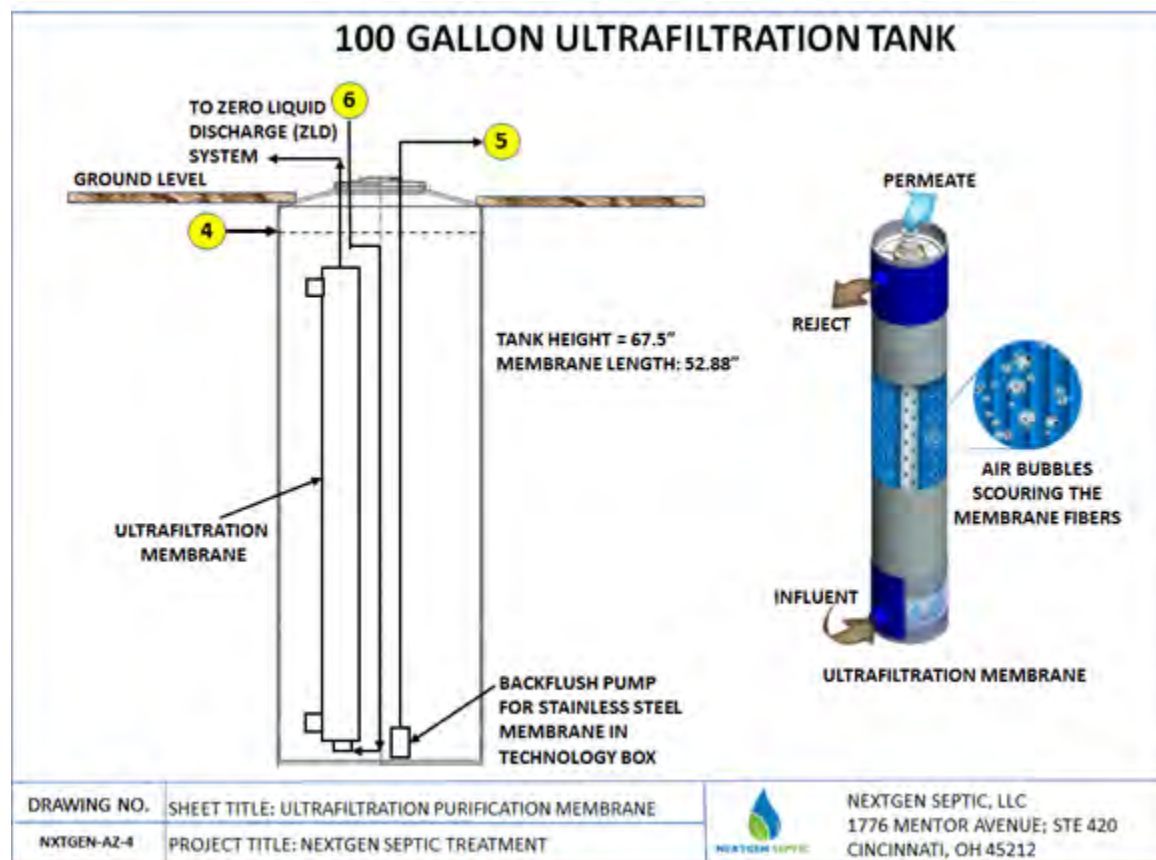
Filtered water from the self-cleaning filter in the second septic tank is pumped to a 5 micron screen size, stainless steel membrane, which is located inside a Technology Box, shown below.



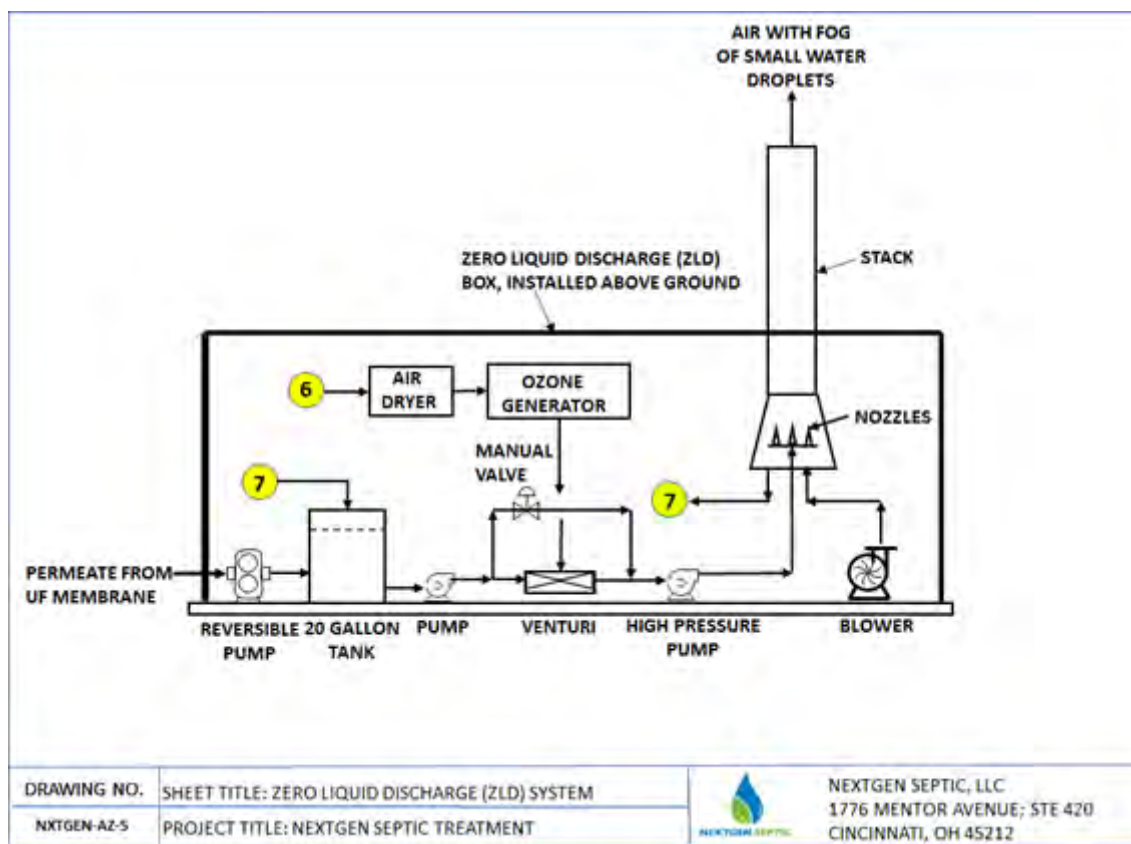
This Technology Box is usually installed on top of the second Bioreactor Tank, between the two risers, such that the cover of this box and the riser covers of the second Bioreactor Tank are above ground. This allows easy access to the components inside the Technology Box, for maintenance purposes.

Water which passes through the 5-micron membrane flows into a separate 100 gallon tank, while the unfiltered water, which does not cross the stainless steel membrane is recycled back to the first septic tank. The technology box also houses an air blower and a stand-by blower. In addition, the Programmable Logic Controller (PLC) and an air compressor are also installed inside this box.

Filtered water from the stainless-steel membrane flows into a 100 gallon tank, shown below, which houses a submerged Ultrafiltration Membrane, with an average membrane pore size of 0.03 microns. There is a submerged pump in this 100 gallon tank, which pumps the water back into the stainless-steel membrane to periodically back flush the solids off the stainless-steel membrane into the first septic tank.



Filtered water from the Ultrafiltration Membrane flows into the Zero Liquid Discharge (ZLD) system, which is installed above ground on a concrete platform, as shown below.



A reversible pump pulls water from the Ultrafiltration Membrane in the 100-gallon tank and stores it in a 20 gallon tank. Periodically, this pump reverses to push water from this 20-gallon tank to back flush the Ultrafiltration membrane.

Water from the 20-gallon tank is pumped through a venturi in which ozone, created from dried, ambient air, is mixed to disinfect the water. Ozone is made from ambient air, from the air compressor, which is dried in a regenerable air dryer and then through a solid-state ozone generator, which generates 3-4 volume% ozone from the oxygen in the dried ambient air flow. Ozone is a very strong disinfectant.

Treated, disinfected water is then pumped by a high-pressure pump through multiple nozzles, which create small water droplets in an air flow, 4,200 cubic feet per minute, from a blower.

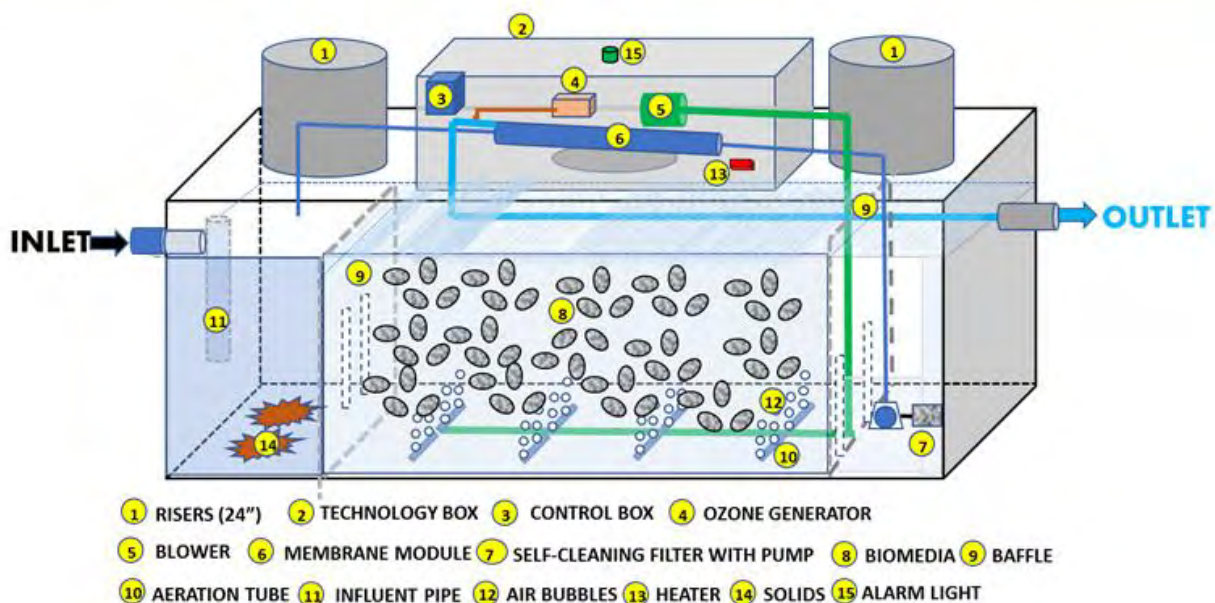
The Zero Liquid Discharge (ZLD) process relies on the small water droplet size (typically less than 50 microns), created by the atomizer, and the high interfacial area of these small water droplets with the ambient air. The surface area of the water droplets for various water droplet sizes, are shown in the table below.

Droplet Size (micron)	Time to fall 10 ft (seconds)	Distance moved in 4,583 ft/min air flow** (feet)	Number of Water Droplets in 1 gallon	Surface Area of 1 gallon of water* (ft ²)
10	1,020	68,000	7.23 trillion	24,450
40	64	4,200	113 billion	6,113
100	11	720	7.23 billion	2,445

For water droplets in the range of 30-40 microns diameter, the time it takes to reach the ground from a distance of 10 ft is about 39 seconds, and this is considering free fall due to gravity. In actual practice due to the air velocity through the stack, 18 inches in diameter, and air flowrate of 4,200 acfm, the air velocity is 2,373 ft/min (40 ft/sec). This allows the water droplets to travel about 1,000 ft above the stack before they would begin to free fall to the ground. The number of water droplets formed from 1 gallon of water will be 57.8 billion. The surface area of the water droplets is about 4,887 ft².

Detailed analysis and experimental data shows that these water droplets, even at 95% humidity and 25 deg C, will evaporate before they can reach the ground. Even at sub-zero ambient temperatures, which will also have low ambient humidity, these droplets will evaporate faster than they will cool down enough to form ice/snow.

The Most Advanced Septic System in the World



According to the EPA, it is estimated that nationwide, between 10 and 20 percent of over 26 million septic systems are malfunctioning as a result of inadequate management.

Traditional septic systems are identified by State water quality agencies as the second greatest threat to groundwater quality.

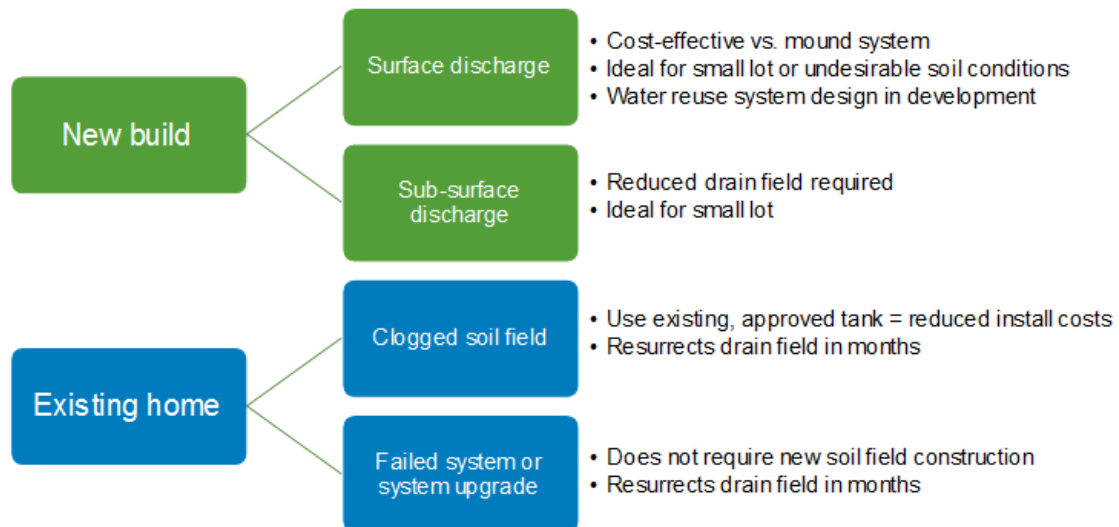
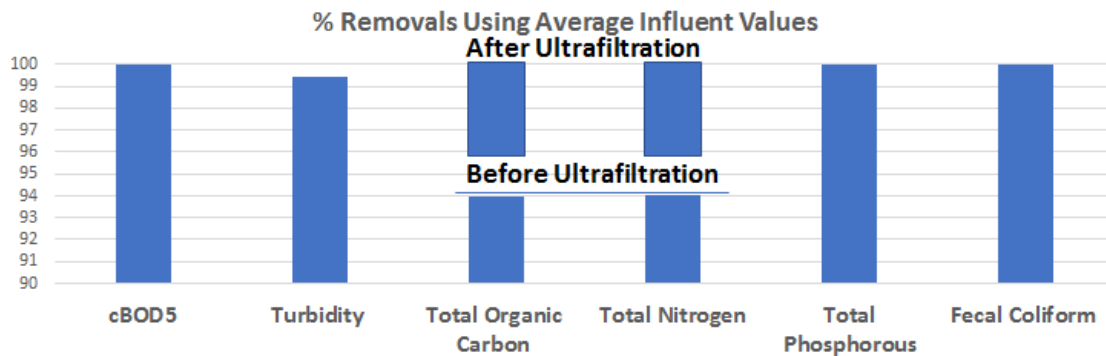
Problems with Traditional Septic Systems

- *Minimal treatment using anaerobic organisms, with most of the treatment being conducted by soil bacteria in the drain field;*
- *Does not remove microplastics, which eventually accumulate and clog the soil drain field;*
- *Allows raw, untreated sewage to surface when the soil drain field is clogged or saturated with water (high seasonable water table, heavy rain, etc.);*
- *Requires a large soil drain field, and an alternate field, when the first drain field clogs;*
- *Does not treat nutrients (nitrates, nitrites and phosphate) allowing nearby water bodies to grow algal blooms, which put toxins in the water; and*
- *Upgrading old septic tanks with an aerobic tank after the septic tank allows suspended biomass to form a “biomat” on top of the drain field soil, thereby preventing water from percolating into the soil.*

Why NextGen Septic?

- *Patent pending technology, developed after 30 years of research on wastewater treatment;*
- *Treats the water completely and treated water can be surface discharged, when permitted;*
- *Uses aerobic bacteria, immobilized on the most effective biomedia (Biomesh Biomedia), to effectively treat the organics and nutrients;*
- *Use of immobilized biofilms instead of suspended cultures makes the treatment system robust against occasional exposure to biocides, such as cleaning chemicals containing chlorine and ammonia;*
- *Uses self-cleaning filter to filter the water down to a few microns, preventing soil drain fields from clogging;*
- *Uses ozone, made from ambient air, to disinfect the water instead of chlorine, which forms toxic by-products; and*
- *Uses wireless alarms to inform the homeowner and NextGen Septic about any failures in the treatment system;*
- *Treats the contaminants in the raw wastewater effectively and with minimal energy consumption; and*
- *Major moving parts are located in a separate box with its lid above ground to simplify maintenance of the system.*

NextGen Septic Performance



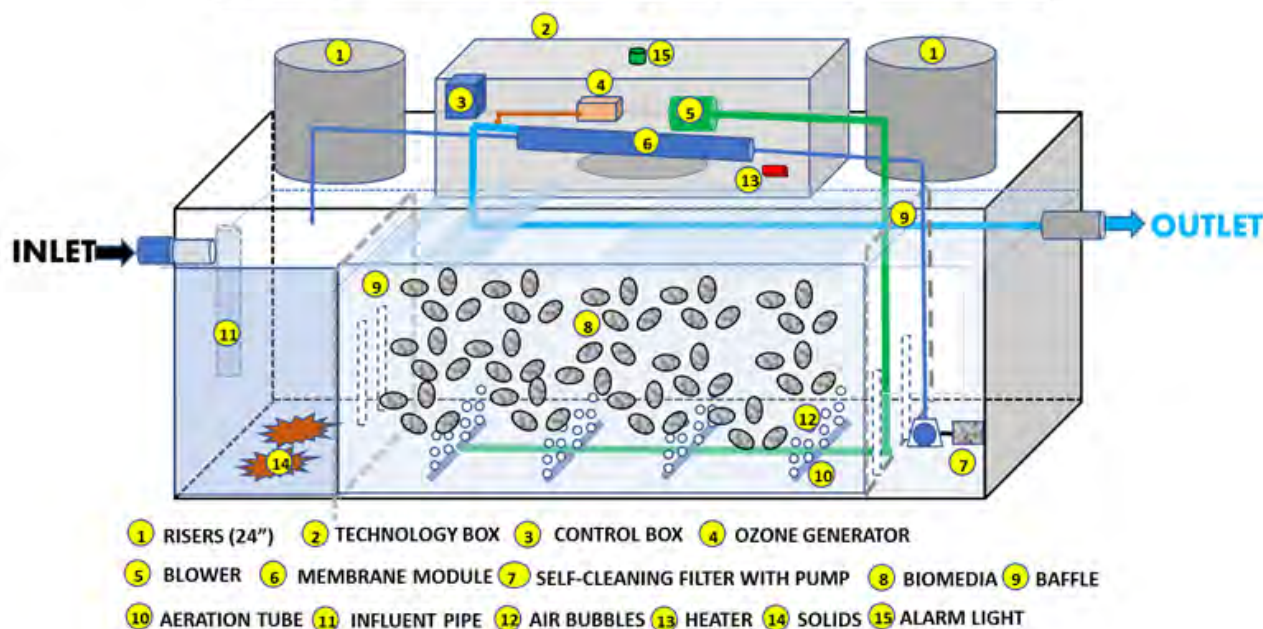
Community System

NextGen Septic system can be scaled up to treat wastewater from multiple homes connected by a local sewer line. Allows builders to develop land in a phased approach using modular NextGen Septic Community Treatment systems

Zero Liquid Discharge

NextGen Septic, LLC has also developed a Zero Liquid Discharge (ZLD) system which evaporates the water using ambient air, resulting in no liquid discharge. This system is used in conjunction with NextGen Septic system.

NextGen Septic System



Influent wastewater from a house enters the first compartment of a standard septic tank. The baffle (numbered 9) has slots in the middle to allow the water to flow into the second compartment, while the solids settle down and slowly decay under anaerobic conditions.

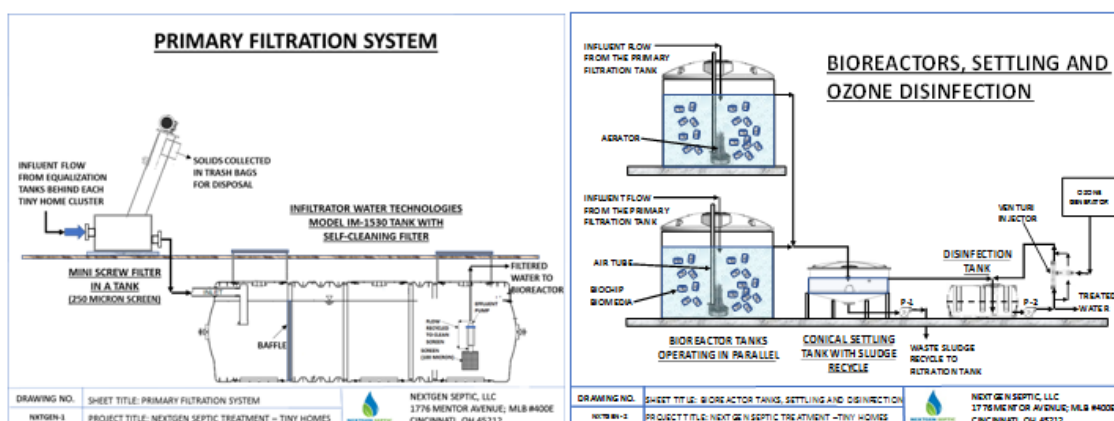
The second compartment is an aerated region, which has moving Biomedia. The Biomedia consists of plastic spheres with open cell foam (numbered 8), 2-inches diameter. The Biomesh Biomedia allows active biofilms to grow on their surface and within the open cell foam, and these active biofilms treat the wastewater as these spheres move around in the water. Aeration is accomplished by a blower (numbered 5) which bubbles air through porous tubes (numbered 10), installed at the bottom of the compartment.

After the water gets treated in the second compartment, it is pumped to a stainless-steel porous membrane (numbered 6) with an average pore size of a few microns. This flow is pre-filtered using a self-cleaning filter (numbered 7). The filtered water is disinfected using ozone, generated from ambient air by the ozone generator (numbered 4). The NextGen Septic system is controlled by a Programmable Logic Controller (PLC) (numbered 3) which also generates alarms, if any failures occur, and these failures are indicated by an alarm light (numbered 15). Most of the major parts are located inside a Technology Box (numbered 2), installed between the two risers, so that the components are easily accessible. The treatment system is installed below ground, with the riser lids and lid of the Technology Box are above ground.

The NextGen Septic system treats all the contaminants in the influent wastewater (organic and nutrients) and disinfects the water using ozone, which generates no toxic by-products.

NextGen Community System

The NextGen Septic Community system is designed to handle higher flowrates of influent wastewater from multiple houses, as in the case of an apartment building or a sub-division. Community systems employ the same NextGen Septic technology which involves an Equalization Tank, following by a Bioreactor Tank. Flow from the Equalization Tank is filtered using a self-cleaning filter to prevent large solids from entering the bioreactor. In some cases, a spiral screen is used to lift the solids out of the tank and then allow them to drain as they are lifted by the spiral shaft, and then allow them to be separated, before the wastewater is treated in the Bioreactor.



The Bioreactor tanks are aerated using mixer and aeration system, and use moving Biochip Biomedica, which has a very high surface area to immobilize the active biofilms. The Bioreactor Tanks are followed by settling and then disinfection with ozone. Stainless-steel membranes are used after the settling tank and are not shown in the drawings to maintain clarity.

The entire treatment system is installed above ground in a 40 ft x 40 ft metal building, installed on a concrete platform. The system is modular and has a Programmable Logic Controller (PLC) controlling the process and transmitting alarms wirelessly. This allows the treatment system to be maintained and being modular, multiple identical plants can be installed, as the sub-divisions expand over time.

Ozone disinfection is very effective in killing a variety of bacteria and viruses. Ozone dissolves in the water, unlike UV light, which can only disinfect water which is directly in line with the light source, since light can only travel in straight lines. Hence, bacteria and viruses attached to any suspended particles will escape unharmed due to the "shadow effect". In addition, UV light sources have limited life and the glass containers have to be wiped clean periodically to maintain the intensity of the UV light source.

Ozone does not suffer from these limitations and decomposes to oxygen in the water, which increases the dissolved oxygen in the treated water, exiting the treatment process. With the capability to transmit alarms and process status wirelessly, the NextGen Septic Community System can treat the wastewater efficiently and cost-effectively for many years.

NextGen Zero Liquid Discharge (ZLD) System

The Zero Liquid Discharge (ZLD) treatment system can be used when there is no land available for a soil drain field or no water body close enough to discharge treated water or direct discharge to a water body is not permitted by the State. The Zero Liquid Discharge (ZLD) system treats the water from the NextGen Septic system to a greater extent using an additional Ultrafiltration Membrane, disinfects the water and then disperses the treated water into the air in the form of very fine water droplets, less than 50 microns in diameter. This allows the treated, disinfected water to evaporate into the ambient air. As the water droplet size decreases, the surface area of these water droplets increases substantially, which increases evaporation rates. In the wintertime, due to low ambient humidity, the evaporation rates of the water droplets is much faster than its cooling, and hence it does not form any snow/ice.

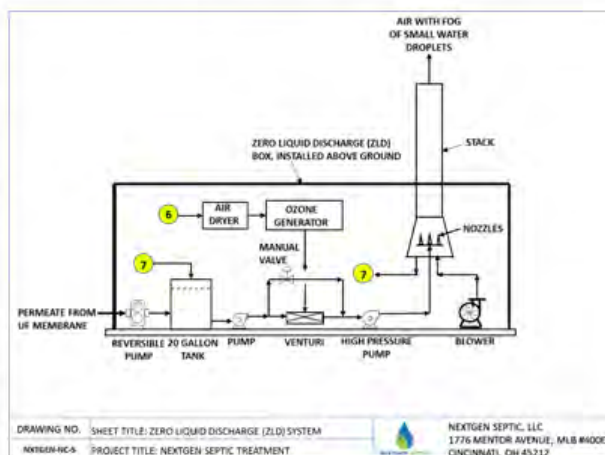
Droplet Size (micron)	Time to fall 10 ft (seconds)	Distance moved in 4,583 ft/min air flow** (feet)	Number of Water Droplets in 1 gallon	Surface Area of 1 gallon of water* (ft ²)
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40	64	4,200	113 billion	6,113
100	11	720	7.23 billion	2,445

* Surface Area of 1 gallon of water in a pond is 0.26 ft²
** This is the air velocity in the stack of the ZLD system



Photograph of the stack showing the water vapor coming out from a pilot-scale ZLD system, when the ambient temperature is well below freezing.

The water vapor does not freeze since the rate of evaporation is faster than the rate at which the water droplet cools.



Two models of the Zero Liquid Discharge (ZLD) systems are available: 600 gallons per day and 1200 gallons per day. These systems are enclosed in a housing which is installed above ground on a concrete platform. It is connected to the NextGen Septic system which is upgraded with an additional ultrafiltration membrane (not shown in the above drawing) and an ozone disinfection system. Typically, this system would operate at night when the ambient humidity is lower than in the daytime. The ZLD system operates only when the ambient humidity is less than 80%.

Advantages of Zero Liquid Discharge (ZLD) Systems

1. Can be used in locations where water discharge is not possible;
2. Eliminates the need for periodic pumping the waste treatment system and transporting it for treatment;
3. Cost-effective since evaporation is accomplished due to lower ambient humidity rather than heat;
4. Energy efficient and cost-effective; and
5. Compact footprint [600 GPD ZLD system is 8 ft x 5 ft x 4 ft (height)]; and
6. Uses standard house voltage and current to operate.

Contact Information:

NextGen Septic, LLC
1776 Mentor Avenue; STE 420
Cincinnati, OH 45212
Tel: (513) 673 3583
Attn: Dr. Rakesh Govind
Website: www.nextgenseptic.com

Local Distributor:

PRODUCT WARRANTY

*NextGen Septic, LLC warrants, to the purchaser and subsequent owner during the warranty period, every new NextGen Septic ZLD treatment system to be free from defects in material and workmanship under normal use and service, when properly used and maintained, for a period of **one year** from date of purchase by the end user. No allowance will be made for shipping charges, damages, labor or other charges that may occur due to product failure, repair or replacement. This warranty does not apply to and there shall be no warranty for any material or product that has been disassembled without prior approval of supplier (NextGen Septic, LLC), subjected to misuse, misapplication, neglect, alteration, accident or act of nature; that has not been installed, operated or maintained in accordance with Supplier's installation instructions; operated without pump out of the accumulated solids in the Equalization and Filtration Tank when the solids occupy more than 50% of the first compartment volume; influent wastewater characteristics exceed the typical values specified in this document; influent flowrate exceeds the average daily flowrate of 1,000 gallons per day; spare parts not supplied by NextGen Septic, LLC are used in the treatment process and general maintenance and sampling procedures are not followed by the operator.*

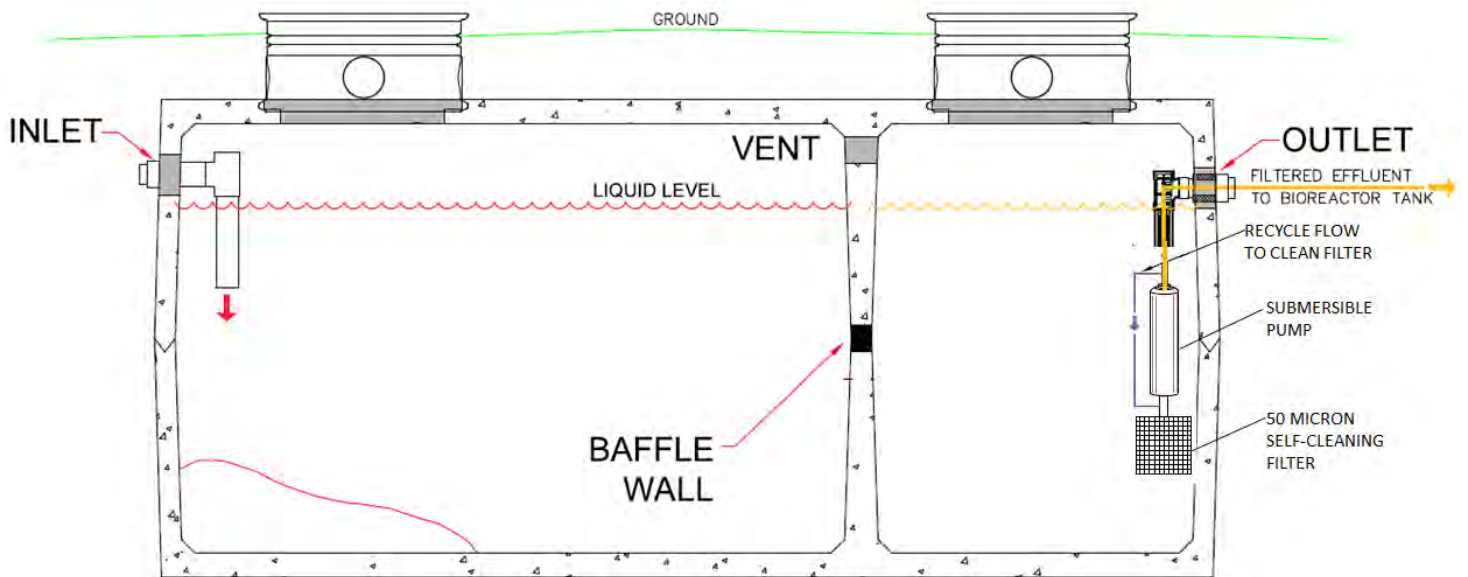
The warranty set out in the paragraph above is in lieu of all other warranties expressed or implied; and we do not authorize any representative or other person to assume for us any other liability in connection with our products.

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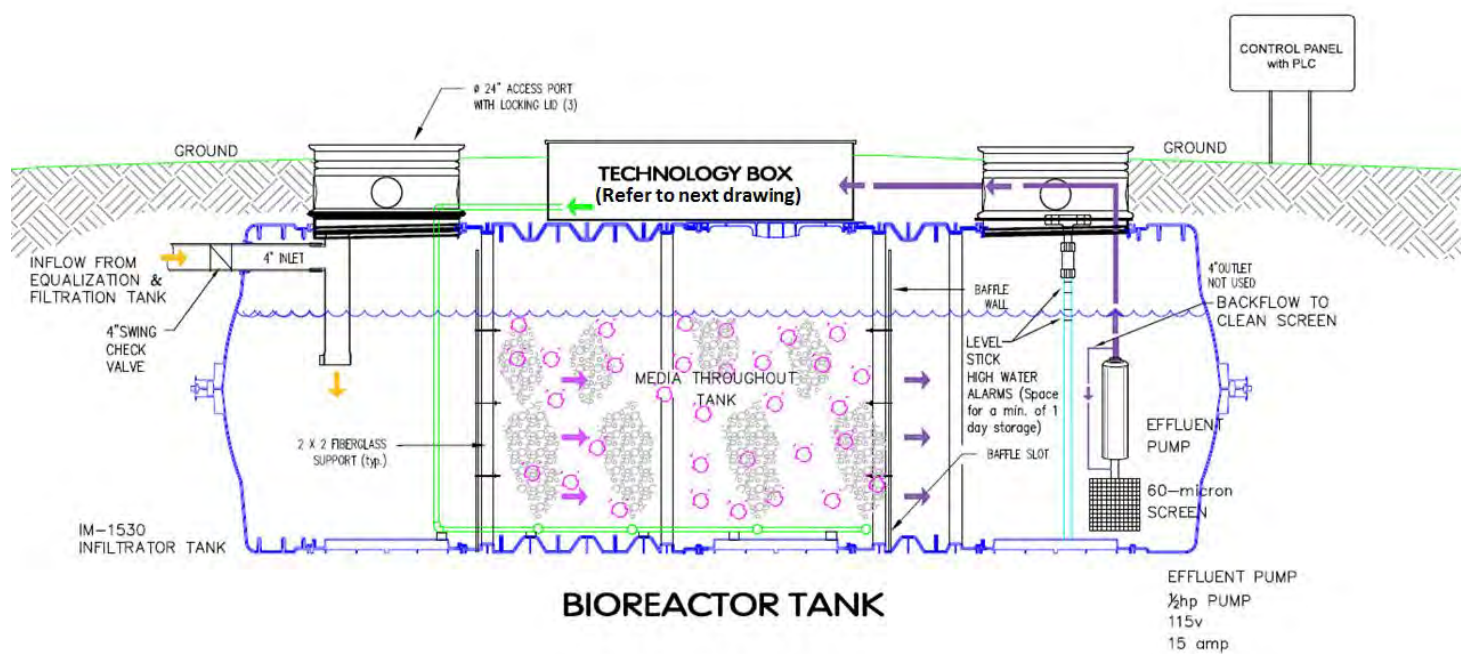
This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

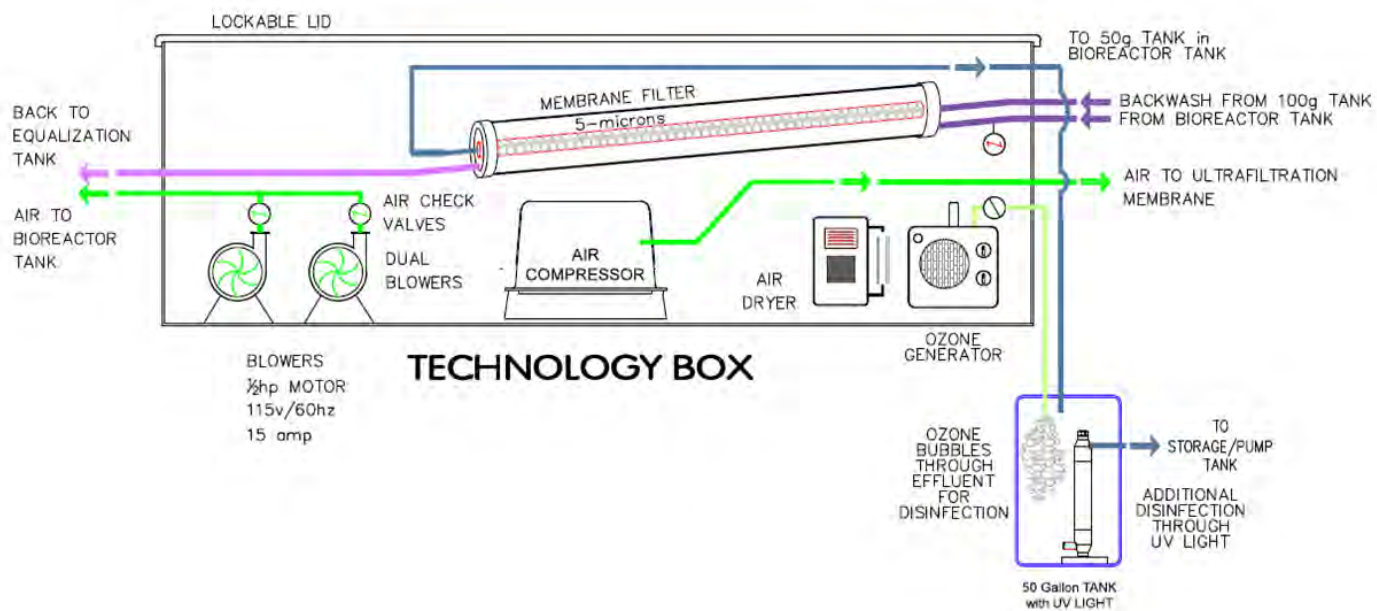
TECHNICAL DRAWINGS

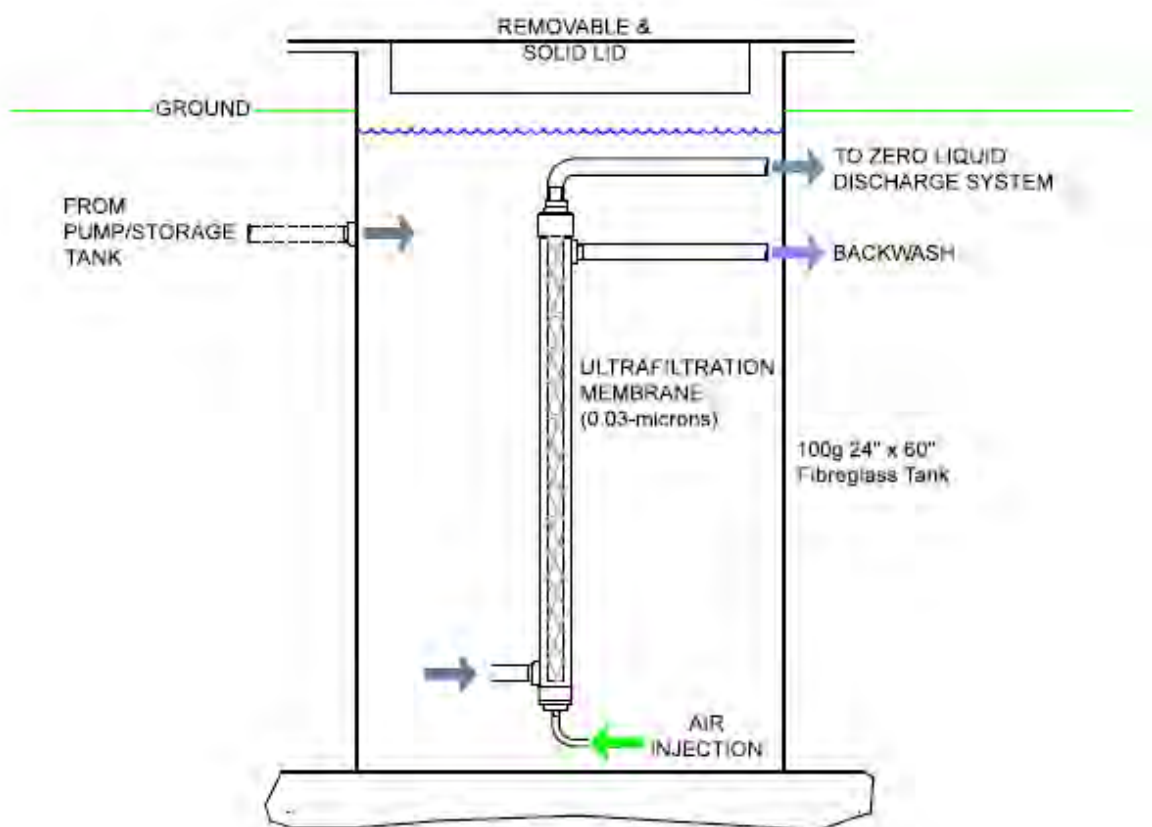


EQUALIZATION & FILTRATION TANK (Septic Tank)

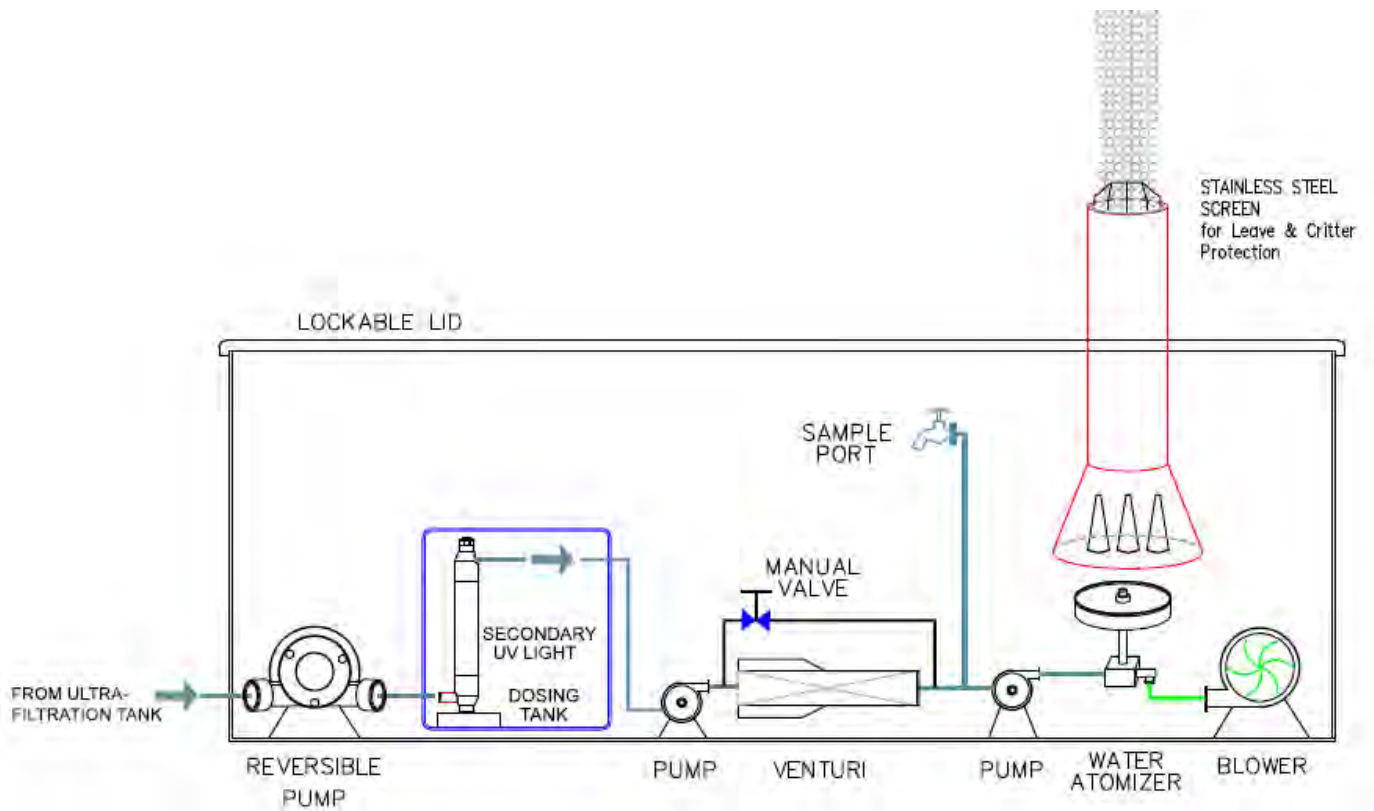
SEPTIC TANK SIZED ACCORDING
TO STATE REGULATIONS WITH
BAFFLE WALL & EFFLUENT FILTER







ULTRAFILTRATION TANK



ZERO LIQUID DISCHARGE BOX

PRETREATMENT REQUIREMENTS AND SPECIFICATIONS

The raw wastewater from the house will have the following maximum parameter values:

Average Daily Flowrate (ADF):	1,000 gpd
Maximum Influent BOD:	900 mg/L
Maximum Influent Ammonia-N:	60 mg/L
Maximum Influent TSS:	300 mg/L

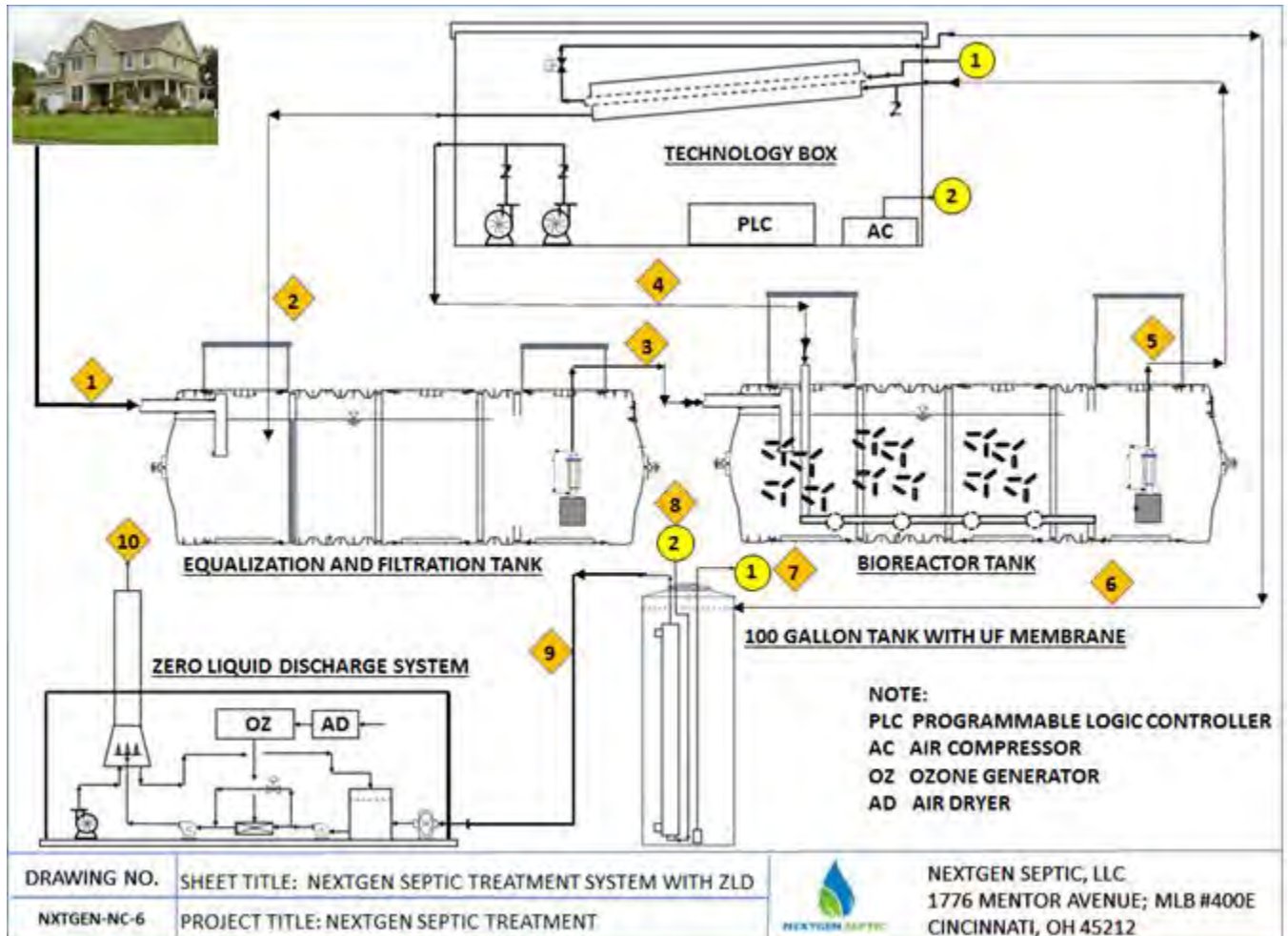
The treated water pumped into the Zero Liquid Discharge (ZLD) system, after treatment will have the following water parameters:

BOD (BDL)	Below Detection Limit
TSS (BDL)	Below Detection Limit
Total Nitrogen (BDL)	Below Detection Limit
E Coli (BDL)	Below Detection Limit
Maximum ambient humidity:	>95%
Minimum Ambient temperature:	-30 deg C

The PVC line from the house to the NextGen Septic treatment system will be at least 4 inches in diameter, with no valves or pipe size reductions. Raw wastewater will flow from the house to the NextGen Septic treatment system by gravity.

The NextGen Septic ZLD system will operate using 110V single phase electrical supply which will be generated from the DC supply from the solar cells using an inverter, located near the solar cell's power generation system, which will minimize the wire size from the solar power system to the NextGen Septic treatment system.

A schematic of the NextGen Septic ZLD system is shown below:



The design and operating conditions are summarized below:

Design and Operating Conditions	Value (units)
Equalization Tank and Filtration Tank	
Volume of Equalization Tank (Infiltrator Water Technologies, IM-1530)	1,787 gallons
Liquid volume in Equalization Tank	1,537 gallons
Maximum Depth of water in tank	44 inches
Number of Baffle in Tank	1
Average Daily Influent Flowrate (Stream numbered 1 in flow diagram)	1,000 GPD (0.70 GPM)
Maximum Daily Settleable solids in Influent Flow (numbered 1 in figure)	2.5 lbs/day (dry)
Influent Daily BOD	7.5 lbs BOD/day
Influent Daily NH3-N	0.5 lbs NH3-N/day
Number of pumps in self-cleaning filter	1
Power consumption by each sump pump	0.5 HP; 9.5 amps max; 110V
Maximum flowrate from sump pump	10 GPM
Maximum exit pressure from sump pump	120 ft head
Discharge line size	1-1/2" NPT
Solids Handling capacity for sump pump	1/2" solids
Recycle flow into Self-Cleaning Filter	4 GPM
Maximum Flow into Bioreactor Tank	8 GPM
Bioreactor Tank	
Max. Influent flowrate into Bioreactor Tank (numbered 3)	8 GPM
Total volume of Bioreactor Tank	1,787 gallons
Depth of water in tank	44 inches
Aerator Inlet pipe size for air flow	2"
Air flow into Bioreactor Tank (stream 4)	25 acfm
Power consumption of Blower	0.5 HP
Number of Air Blowers	2 (one standby)
Volume of biomedica in bioreactor tank	0.25 m ³
Number of Bimesh Biomedica in bioreactor tank	3,640
Diameter of Biomesb Biomedica piece	2 inches
Specific Gravity of Biochip Biomedica	0.95
Material of Biomesb Biomedica	Polyethylene
Surface Area of Biomesb Biomedica	3,000 m ² /m ³
Max. Flow out of Self Cleaning Filter to Stainless Steel membrane (stream 5)	8 GPM
Recycle flow to Self-Cleaning Filter	4 GPM
Recycle flow to Equalization and Filtration Tank (stream 2)	7.58 GPM
Filtered flow to 100 gallon tank (stream 6)	2 GPM
Power consumption by pump in self cleaning filter	0.5 HP; 9.5 amps max; 110V
100 Gallon Tank with UF membrane	
Size of 100 gallon tank	23-1/8" diam; 65.5" height

Depth of water in tank	60 inches
Flowrate of water into tank from Bioreactor Tank	2 GPM
Recycle flowrate to backflush stainless steel membrane (stream 7)	1.58 GPM
Maximum Flowrate into reversible pump in ZLD Box	070 GPM
Ozone generation rate	4 gms/hr
Blower in ZLD Box	38 watts
Blower in ZLD Box air flowrate	420 acfm
Power for water atomizer	2.5 HP
Total Power consumption by NextGen Septic and ZLD Processes	5.0 HP
Annual Electrical Operating Cost at \$0.07/kWh	\$2,300/year

ENGINEERING DESIGN CALCULATIONS

The following are the design calculations as required in the **15A NCAC 18A .197, Engineered Option Permit** rule.

Raw Wastewater Influent from Each House

Average Daily Flowrate (ADF):	1,000 gpd
Surge Factor	4.2
Maximum Instantaneous Flowrate:	3.0 gpm (180 maximum instantaneous hourly flowrate)
Maximum Influent BOD:	900 mg/L
Maximum Influent Ammonia-N:	60 mg/L
Maximum Influent TSS:	300 mg/L

Equalization Tank Volume

As given in the following table, equalization tank volume is typically 50% of the Average Daily Flow.

Table 5.1: Flow Equalization Basin Design Criteria	
Flows (gpd)	Minimum Tank Basin Volume (% ADF)
0 - 40,000	50
40,001 - 100,000	33

Calculated volume of Equalization Tank = 50% of Average Daily Flow (ADF) = $0.50 \times 1,000$ gpd = 500 gallons

The actual tank selected has a total volume of 1,735 gallons with a liquid volume of about 1,500 gallons. Since the raw wastewater will be typical domestic sewage, the following influent raw wastewater parameters have been assumed for the design calculations:

Wastewater Parameter (mg/L)	Raw Wastewater from House
BOD	900
TKN	60
TSS	300
Total Nitrogen	60
Chloride	200
Phosphorus	30

Effluent Standards

The following effluent standards need to be met by the proposed wastewater treatment system to meet the NC TS1 levels:

BOD	<10 mg/L
TSS	<5 mg/L
% Reduction of Total Nitrogen	> 90%

Bioreactor Design

The Bioreactor is a well-mixed tank with moving biomedica. Hence, the design of the bioreactor has to follow the design procedure for a Moving Bed Bioreactor or MBBR system.

1. BOD loading rate = $Q \cdot S_o \cdot 8.34 \cdot 453.59$

where: **Q** is the wastewater flow rate into the MBBR reactor in MGD

S_o is the BOD concentration in that influent flow in mg/L

8.34 is the conversion factor from mg/L to lb/MG

453.59 is the conversion factor from lb to g

The calculated **BOD loading rate** will be in g/day.

$$\text{BOD Loading Rate} = 0.001 \times 900 \times 8.34 \times 453.59 = 3,405 \text{ g/day}$$

2. required carrier surf. area = BOD Loading Rate/SALR

where: **BOD Loading Rate** is in g/day

SALR is the design surface area loading rate in g/m²/day

The calculated **required carrier surface area** will be in m².

$$\text{Required Biomedica Carrier Surface Area} = 3,405 \text{ g/day/SALR}$$

The SALR value which is the Surface Area Loading Rate for the moving Biomedica is determined from the following table (Reference #1):

Typical Design Values for MBBR reactors at 15°C		
Purpose	Treatment Target % Removal	Design SALR g/m ² -d
BOD Removal		
High Rate	75 - 80 (BOD ₇)	25 (BOD ₇)
Normal Rate	85 - 90 (BOD ₇)	15 (BOD ₇)
Low Rate	90 - 95 (BOD ₇)	7.5 (BOD ₇)

$$\begin{aligned} \text{The Treatment Target Rate} &= ((\text{Influent BOD} - \text{Effluent BOD})/\text{Influent BOD}) \times 100 = \\ &= (900-5/900) \times 100 = 99.4\% \end{aligned}$$

We will select a design SALR value of $5.0 \text{ g/m}^2 \cdot \text{d}$ to achieve 99.4% removal of influent BOD.

Required Biomedia Carrier Surface Area = $3,405/5 = 681 \text{ m}^2$

The surface area of the Biochip Biomedia is $3,000 \text{ m}^2/\text{m}^3$ as given earlier in this document

3. required carrier volume = required carrier surf. area/carrier specific surf. area

where: **required carrier surface Area** is in m^2

carrier specific surface Area is in m^2/m^3

The calculated **required carrier volume** will be in m^3 .

Required Biomesh Biomedia volume = $681 \text{ m}^2/5000 \text{ m}^2/\text{m}^3 = 0.14 \text{ m}^3$

We will use 0.25 m^3 of Biomesh Biomedia in the Bioreactor Tank with a total volume of 1,500 gallons.

4. required tank volume = required carrier volume/carrier fill %

where: **required tank volume** will be in the same units as **required carrier volume**.

The Maximum Biomesh Biomedia fill % = 25%

Required Bioreactor Volume for the Bioreactor Tank = $0.25 \text{ m}^3/0.25 = 1 \text{ m}^3 = 264 \text{ gallons}$

Actual Bioreactor volume = 1,500 gallons of water (5.7 m^3) in the 1,730 gallon tank, as shown in the drawing.

5. liquid volume in tank

= required tank volume – [required carrier volume(1 – carrier % void space)]

where: all three volumes will be in the same units.

The actual % volume occupied by the Biomesh Biomedia = $[0.25/(5.7-0.25)] \times 100 = 4.6 \%$

Although hydraulic retention time (HRT) is not typically used as a primary design parameter for MBBR reactors, it can be calculated at the design wastewater flow rate, if the liquid volume in the tank is known. Also, if a design peak hour factor is specified, then the HRT at peak hourly flow can be calculated as well. The equations for calculating HRT are as follows:

$$1. \text{ Ave. HRT}_{\text{des ave}} = \text{liquid vol. in tank} * 7.48 / [Q * 10^6 / (24 * 60)]$$

where: **liquid vol. in tank** is in ft^3

Q is in MGD

7.48 is the conversion factor for ft^3 to gal

10^6 is the conversion factor for MG to gal

$24 * 60$ is the conversion factor for days to min

Ave. HRT_{des ave} will be in min

$$2. \text{ Ave. HRT}_{\text{peak hr}} = \text{Ave. HRT}_{\text{des ave}} / \text{Peak Hour Factor}$$

where: **Ave. HRT_{peak hr}** will also be in min

$$\text{Average HRT}_{\text{des ave}} = (1,500) / (1000 / (24 * 60)) = 2,160 \text{ minutes} = 36 \text{ hours}$$

$$\text{Average HRT}_{\text{peak hr}} = 36 \text{ hours} / 4.2 = 9.0 \text{ hours where the Peak hour factor given at the beginning of the design calculation section was 4.2}$$

The Surface Area Removal Rate (SARR) is determined based on the following table and a straight line fit between SARR/SALR vs SALR, as shown below:

Data points for SARR/SALR vs SALR		
SALR (g/m ² /d):	7.5	15.0
SARR/SALR:	0.925	0.875
(default values above are based on the table of typical values of % BOD removal vs SALR at the right)		
Slope, SARR/SALR vs SALR:	-0.007	
Intercept, SARR/SALR vs SALR:	0.975	
Est. of SARR/SALR Ratio =	0.925	
(Surf. Area Removal Rate/Surf. Area Loading Rate) (for SALR value specified at left)		

Remember the SALR value we used = $5 \text{ g}/\text{m}^2.\text{d}$ to achieve 98.3% BOD treatment

$$\text{SARR/SALR} = (\text{Slope}) * (\text{SALR}) + \text{Intercept} = -0.007 * 5 + 0.983 = 0.948$$

$$\text{SARR} = 5 * 0.948 = 4.74 \text{ g}/\text{m}^2.\text{d}$$

Est BOD removal rate = (est SARR)(carrier surface area)

Estimated BOD Removal Rate = $4.74 \text{ g/m}^2\cdot\text{d} * 5,000 \text{ m}^2 = 23,700 \text{ g/d}$

The estimated effluent BOD concentration can then be calculated from the equation:

Est effluent BOD conc. = [(BOD loading rate - est BOD removal rate)/ Q_o]/8.34

Estimated Effluent BOD concentration = $(3,405 \text{ g/d} - 23,700 \text{ g/d})/(0.0006)/8.34$ which is a negative value

Hence, by using a total of 0.25 m^3 of Biochip Biomedia, in the two bioreactor tanks, all the influent BOD should be treated biologically.

Now we also have to calculate the ammonia-N treatment level, and for this calculation, we have to use the SARR value for ammonia-N oxidation, which is given in the following table.

The maximum **SARR** for each of the D.O. levels shown in the figure above are shown in **Table 2** below, along with the ammonia nitrogen concentration above which the **SARR** will be at that maximum value.

Table 2. Values of $SARR_{max}$ and NH_3-N_e @ $SARR_{max}$

D.O.	$SARR_{max}$	min NH_3-N_e @ $SARR_{max}$
mg/L	$g/m^2/d$	mg/L
2	0.61	0.5
3	0.88	0.8
4	1.03	1
5	1.23	1.3
6	1.41	1.65

If we maintain a dissolved oxygen level in the Bioreactor water at 3 mg/L, the $SARR_{max}$ is $0.88 \text{ g/m}^2\cdot\text{d}$ and the minimum NH_3-N at this $SARR_{max}$ value is 0.8 mg/L .

The **SARR** for the design D.O. and ammonia nitrogen removal at 15°C will then be equal to $SARR_{max}$ if the target effluent ammonia nitrogen concentration is greater than the 0.80 mg/L value determined above. If the target effluent ammonia nitrogen concentration is less than 0.80 mg/L , then the SARR needs to be calculated using Metcalf & Eddy's equation 9-48. In this case, the target effluent NH_3-N of 20 mg/L is greater than 0.8 mg/L , so the SARR at 15°C is $0.88 \text{ g/m}^2\cdot\text{d}$.

The design value for the SARR at the design minimum wastewater temperature can then be calculated as: $SARR_T = SARR_{15}(\theta^{T-15})$, where the WW temperature must be in °C. Since this case has D.O. limited conditions, $\theta = 1.058$. Carrying out this calculation gives: **design value of SALR = 0.88 g/m²/d.**

The minimum temperature assumed is 60 deg F or 15 deg C, which is used in the above equation.

Ammonia Loading Rate = 1000 gallons/day x 3.785 Liters/Gallon x 60 mg/L = 227 g/d

Surface Area of Biochip Biomedia needed for nitrification of ammonia = 227/0.88 = 258 m²

Volume of Biochip Biomedia needed = 258/3000 = 0.1 m³.

Hence, using 0.25 m³ of Biochip Biomedia in each of the two Bioreactor Tanks will result in ammonia-N treatment, and meet the required effluent ammonia-N concentration of 4 mg/L in the summer time and 10 mg/L in the winter time.

Aeration Rate

Oxygen is consumed to treat influent BOD and ammonia-N. The total oxygen consumption can be calculated as follows:

Total Oxygen Required = 1000 x 3.785 (900 mg/L + 4.57*60)/(1000*453.6) = 9.8 lbs oxygen/day

Volume of air needed for aeration =

= 9.8 lbs of oxygen/day / 0.0173 lbs oxygen/ft³ air / Oxygen absorption Efficiency of 5% = 11,330 ft³ of air/day at the average daily flow of water, which is equal to 8 acfm.

Volume of air needed at the maximum instantaneous flow of wastewater = 4.2 x 11,300 ft³/day = 47,460 ft³/day = 33 acfm for the maximum instantaneous wastewater flowrate.

This aerator will provide an air flow rate of 40 acfm and this air will be bubbled through porous tubes installed at the bottom of the bioreactor tank.

The Zero Liquid Discharge (ZLD) process relies on the small water droplet size (typically less than 50 microns), created by the atomizer, and the high interfacial area of these small water droplets with the ambient air. The surface area of the water droplets for various water droplet sizes, are shown in the table below.

Droplet Size (micron)	Time to fall 10 ft (seconds)	Distance moved in 4,583 ft/min air flow** (feet)	Number of Water Droplets in 1 gallon	Surface Area of 1 gallon of water* (ft ²)
10	1,020	68,000	7.23 trillion	24,450
40	64	4,200	113 billion	6,113
100	11	720	7.23 billion	2,445

For water droplets in the range of 30-40 microns diameter, the time it takes to reach the ground from a distance of 10 ft is about 39 seconds, and this is considering free fall due to gravity. In actual practice due to the air velocity through the stack, 4 inches in diameter, and air flowrate of 400 acfm, the air velocity is 4,583 ft/min (76.4 ft/sec). This allows the water droplets to travel about 3,000 ft above the stack before they would begin to free fall to the ground. The number of water droplets formed from 1 gallon of water will be 57.8 billion. The surface area of the water droplets is about 4,887 ft².

The evaporation rate of these water droplets is controlled mainly by the humidity of ambient air and water temperature. The change of the water droplet radius with time is given by the following equation [Kukkonen J., Vesala T. and Kulmala M., *The Interdependence of Evaporation and Settling for Airborne Freely Falling Droplets*, J. Aerosol Sci., Vol. 20, No. 7, pp. 749 763, 1989]:

$$\frac{dr}{dt} = \frac{D_{corr}(101325(P_v - P_d))}{(1 \times 10^6 \rho) r \left(\frac{D_{corr} H_v (101325 P_d) \left(\frac{H_v}{RT} - 1 \right)}{M_v k_{corr} T} + \frac{RT}{M_v} \right)}$$

where dr/dt is the time rate of change of the droplet radius [m/s], D_{corr} is the corrected diffusion coefficient of water vapor in air [m²/s], P_v is the ambient water vapor pressure of the atmosphere

[atm], P_d is the vapor pressure of water at the surface of the droplet [atm] (the factor of 101,325 converts both vapor pressures into Pascals), ρ is the density of liquid water [g/mL] (the factor of 1×10^6 converts the density to g/m³), H_v is the heat of vaporization of water (J/mol), R is the universal gas constant [8.314151 J/(mol.K)], T is the local atmospheric temperature [°K], M_v is the molecular weight of water agent vapor [g/mol] and k_{corr} is the corrected thermal conductivity of air [W/(mK)].

To obtain D_{corr} , the molecular diffusion coefficient D [m²/s] is first computed based on Hall and Pruppacher (1976) and Pruppacher and Klett (1978):

$$D = 2.11 \times 10^{-5} \left(\frac{T}{T_0} \right)^{1.94} \left(\frac{P_0}{P} \right)$$

where T_0 is the reference air temperature [273.15 K], P_0 is the reference pressure [1 atm], T is the local air temperature [°K], and P is the local pressure [atm]. The diffusion coefficient is then corrected for non-continuum effects through ventilation and collision geometry terms:

$$D_{corr} = D \frac{C_{vent}}{C_{coll}}$$

The ventilation coefficient C_{vent} is a function of the Reynolds number ($Re = Ud/\nu$) and the Schmidt number ($Sc = \nu/D$), where U is the droplet speed [m/s], d is the droplet diameter [m], and ν is the kinematic viscosity of air [m²/s]:

$$C_{vent} = 1 + 0.108 Re Sc^{2/3} \quad \text{for } Re^{1/2} Sc^{1/3} \leq 1.4$$

$$C_{vent} = 0.78 + 0.308 Re^{1/2} Sc^{1/3} \quad \text{for } Re^{1/2} Sc^{1/3} > 1.4$$

The collision coefficient C_{coll} is a function of a geometry coefficient and a sticking coefficient:

$$C_{coll} = 1 + (C_{geom} + C_{stick}) \frac{MFP}{r}$$

where

$$C_{geom} = 1.33 + \frac{0.70r / MFP}{1 + r / MFP}$$

and

$$C_{stick} = \frac{4 \cdot (1 - E_{stick})}{3 E_{stick}}$$

Here, r is the radius of the droplet [m], MFP is the mean free path of water in the vapor phase [m], and C_{stick} is the sticking efficiency [0-1]. For water vapor, the sticking efficiency is set to one.

The vapor pressure P_v of the ambient atmosphere is determined from the relative humidity profile and the saturation vapor pressure of water:

$$P_v(z) = rh(z) \cdot P_{sat}.$$

The saturation vapor pressure P_{sat} [atm] is computed using:

$$P_{sat} = P_{sat0} \exp \left(\frac{M_v}{R} \left(A \left(\frac{T - T_0}{T T_0} \right) + B \ln \left(\frac{T}{T_0} \right) \right) \right)$$

where P_{sat0} is the reference vapor pressure of water [6.03 X 10⁻³ atm], M_v is the molecular weight of water vapor [g/mol], R is the universal gas constant [8.314151 J/(mol.K)], T is the atmospheric temperature [°K], T_0 is the reference temperature [273.15 K], A has a value of 3.14839 x 10³ J/g, and B has a value of 2.370 J/(g.°K).

The vapor pressure of water at the surface of the droplet P_d [atm] is

$$P_d = P_{sat} \exp \left[\frac{2\sigma M_{liq}}{rRT(1 \times 10^6 \rho_{liq})} \right]$$

where σ is the surface tension of the water droplet [N/m], M_{liq} is the molecular weight of water [g/mol], r is the radius of the droplet [m], and ρ_{liq} is density of water [g/mL] (the factor of 1 x 10⁶ converts the density to g/m³). The water droplet surface tension is calculated using:

$$\sigma = 0.001 \cdot (76.1 - 1.55(T - T_0)) \quad \text{if } T \geq T_0$$

$$\sigma = \sum_{i=1}^7 \alpha_i (T - T_0)^i \quad \text{if } T < T_0$$

where $\alpha_1 = 7.593 \times 10^{-2}$, $\alpha_2 = 1.15 \times 10^{-4}$, $\alpha_3 = 6.818 \times 10^{-5}$, $\alpha_4 = 6.511 \times 10^{-6}$, $\alpha_5 = 2.933 \times 10^{-7}$, $\alpha_6 = 6.283 \times 10^{-9}$, and $\alpha_7 = 5.285 \times 10^{-11}$.

The heat of vaporization H_v [J/mol] is determined from

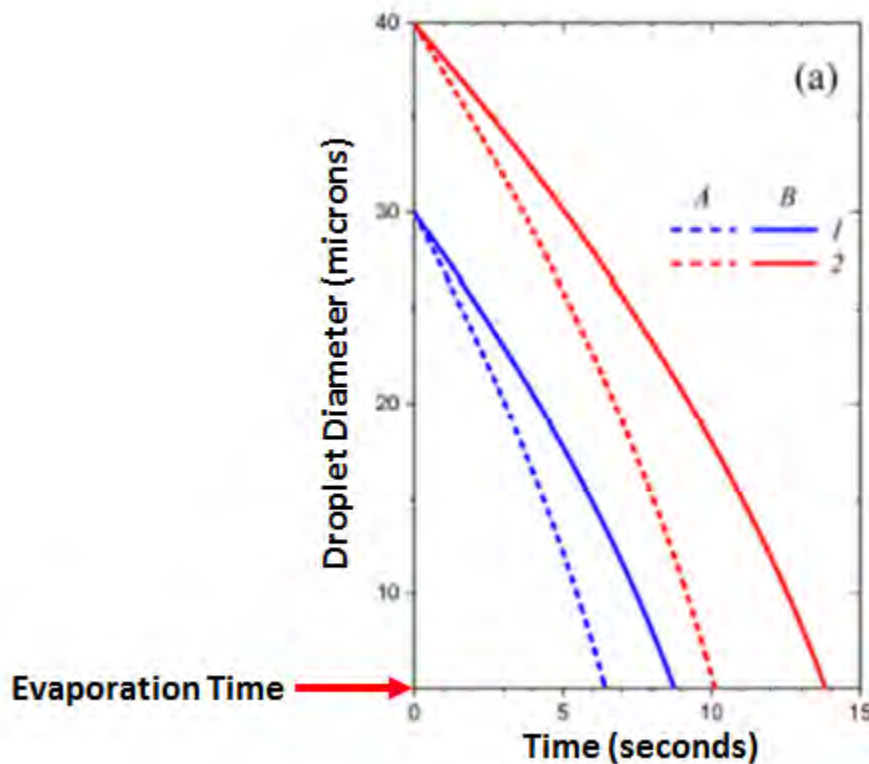
$$H_v = (2501 - 2.37 \cdot (T - T_0)) \cdot M_{liq}$$

while the corrected thermal conductivity of air k_{corr} [W/(m.°K)] is specified using where C_{vent} and C_{coll} are as defined above with the exception of the Schmidt number the mean free path of water vapor, and the sticking efficiency being replaced with the Prandtl number $Pr=$

$$k_{corr} = k \frac{C_{vent}}{C_{coll}}$$

$\rho v C_p / k$, where C_p is the heat capacity of air [J/(kg.°K)], v the mean free path of air, and k the thermal conductivity of air, respectively.

Experimental and model calculated results for 40 micron and 30 micron size water droplets are shown below:



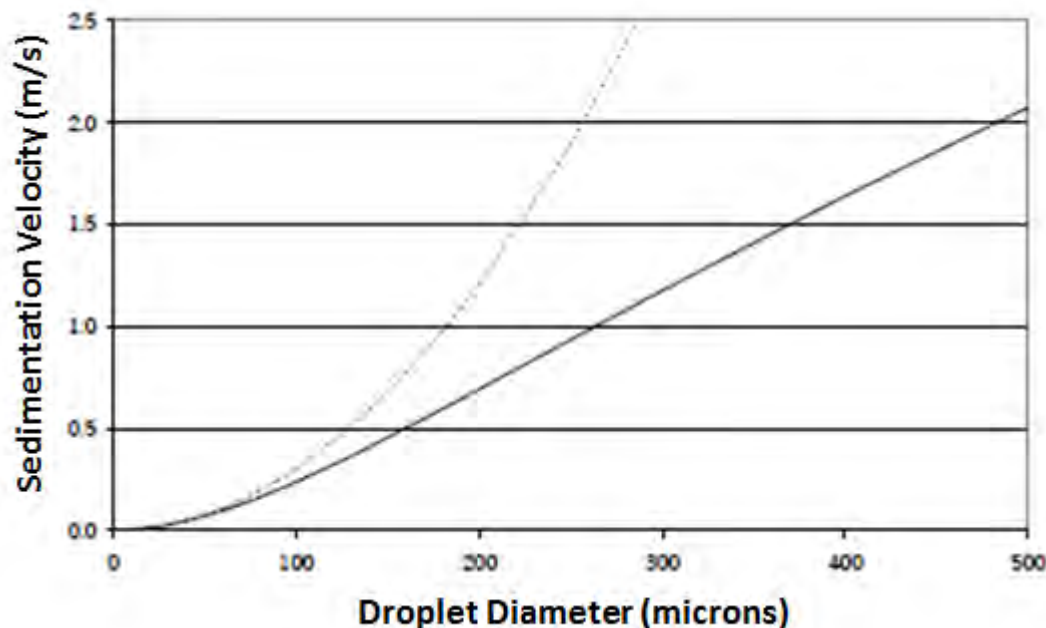
Comparison of experimental results (A: dotted) with calculations (B: curve) are shown above. The ambient temperature was 25 deg C and 60% with an initial droplet size of 30 microns (blue color) and 95% Relative Humidity and 40 micron drop diameter (red color). The water droplets evaporate in about 10 seconds (dotted) when the ambient temperature is 25 deg C and the Relative Humidity is 95%.

The droplet settling time depends on its free fall velocity, which is achieved when the drag force of the air is balanced by its weight. The sedimentation velocity is given by the following equation:

$$v_s = \sqrt{\frac{4\rho_s g D}{3\rho_a C_{d,s}}} \quad [\text{m/s}]$$

Note that $C_{d,s}$ is the drag coefficient at sedimentation; it depends on Reynolds Number and therefore on sedimentation velocity itself. This implies that sedimentation velocity can only be calculated iteratively, using the expression above. Convergence rate depends on drop size, but it can be shown that the sedimentation velocity is accurate within 1% after 6 iterations at most, and within 0.1% after 8 iterations at most. Substituting $C_d = 24/\text{Re}$ will return the above equation to the sedimentation velocity in the Stokes regime, as required.

The figure below shows sedimentation velocity as a function of drop diameter for water drops in air, as calculated from the above equation. The dashed line shows the velocity as computed from Stokes' law. Clearly for drop diameters larger than about 50 μm Stokes' law is not applicable, and may overestimate the actual velocity considerably.



Using the 50 microns water droplet diameter, the sedimentation velocity, as given by the above equation, is 0.2 m/s or 0.65 ft/s. For this droplet to free fall 10 ft height it will take about 15 seconds to deposit on the ground, which is more than the evaporation time. Hence, clearly, even

when the ambient humidity is 95%, the 50 micron or smaller water droplet will not deposit on the ground and will evaporate before it can reach the ground surface.

The second question is regarding the cooling of the water droplet if the ambient temperature is below freezing. The heat transfer model used is given by the following equation:

$$\rho_w c_w \frac{dT}{dt} = \frac{1.5Nu k_{air}}{a^2} (T_{air} - T) - 3 \frac{\dot{m} L_{ev}}{a}$$

$$T(0) = T_0$$

where $Nu = 2rh/k_{air}$ is the Nusselt number for convective heat transfer from ambient air, h is the convective heat transfer coefficient, a is the radius of a droplet, m is the mass rate of evaporation per unit of droplet's surface, ρ_w and c_w are the density and specific heat capacity of water, L_{ev} is

$$\rho_w c_w \frac{dT}{dt} = \frac{3 k_{air}}{a^2} (T_{air} - T) - 3 \frac{\dot{m} L_{ev}}{a}$$

$$T(0) = T_0$$

the latent heat of water evaporation, T_{air} is the air temperature at a distance from the droplet (outside the thermal boundary layer), k_{air} is the thermal conductivity of air. the first term in the right-hand side of the equation given above and characterizes the incoming heat flux, while the second term is the heat loss due to the evaporation of water. In the Stokes flow regime the problem is simplified. In addition, we do not take into account the effect of vapor blowing on the convective heat transfer. In this case, $Nu = 2$, and the equation becomes:

Note that the mass rate of evaporation is related to the derivative of the droplet radius. This gives us an additional differential equation for the droplet radius:

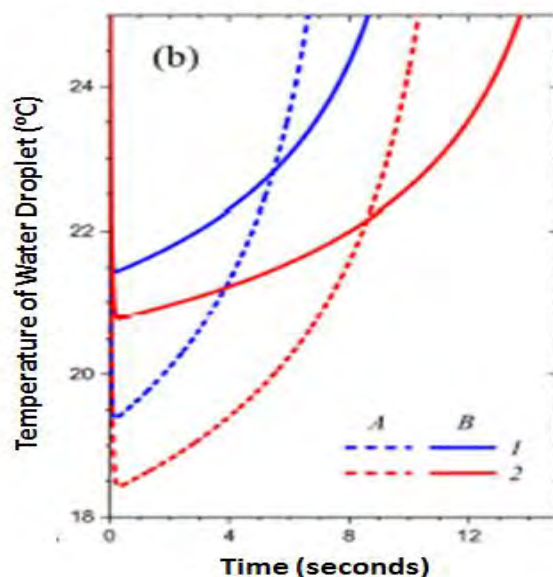
In the case of constant temperature of a droplet, the above equations gives the following expression for the evaporation flow rate:

This enables one to solve the above equation and obtain the known d-squared law ($d = 2a$ is the droplet diameter):

$$\rho_w \frac{da}{dt} = -\dot{m}$$

$$a^2 = a_0^2 - k_{air} t / \rho_w$$

It was shown in [Levashov, V.Y.; Kryukov, A.P.; Shishkova, I.N. Influence of the non-condensable component on the characteristics of temperature change and the intensity of water droplet evaporation. *Int. J. Heat Mass Transf.* 2018, 127, 115–122], that more realistic parabolic approximation of a quasi-steady temperature profile in the droplet (instead of the assumption of isothermal droplet) gives the so-called elliptic law instead of the d-squared law for the time dependence of droplet size. Results of the simulation and comparison with experimental data



gave the following results.

Comparison of experimental results (A: dotted) with calculations (B: curve) are shown above. The ambient temperature was 25 deg C and Relative Humidity 60% (blue color) and 95% Relative Humidity (red color). The 50 micron water droplet evaporates in about 10 seconds (dotted) when the ambient temperature is 25 deg C and the Relative Humidity is 95%.

Experimentally, the time taken for the droplet to decrease the temperature from an initial temperature of 25°C to its final temperature of 18.5°C, as shown by the dotted red line (95% Relative Humidity) is about 10 seconds while for 60% Relative Humidity it is about 6 seconds (blue dotted curve).

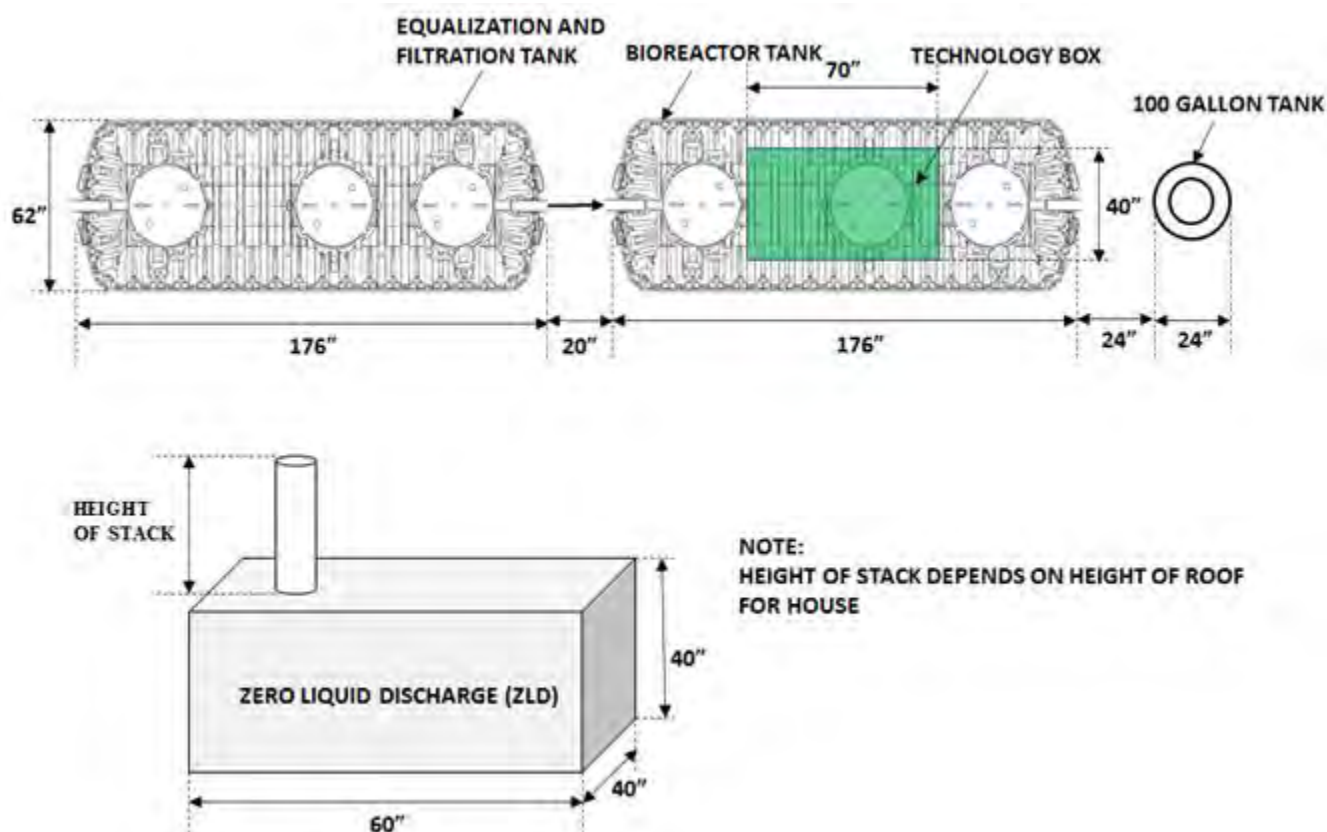
I could not run the simulation at below freezing temperature and high humidity since these two conditions are mutually incompatible. However, from the previous analysis we know that water droplets in the 30-40 micron diameter range take about 5- 10 seconds to evaporate completely. However, from an analysis of water droplet temperature it shows that temperature decline is a much slower process with temperature decreasing about 6.5°C in the time period of 6-10 seconds. This decrease in temperature is not sufficiently high to cause any phase change.

Simulations were run at -10°C , when the Relative Humidity was very low, the 30-40 micron droplets evaporated in 1-3 seconds, which was not high enough to either cause the water droplets to reach the ground from a distance of 10 ft and also did not freeze since the temperature decrease was only about 10°C in the few seconds it took for the water droplet to evaporate completely.

INSTALLATION MANUAL

Proposed Installation Layout

The proposed installation of the NextGen Septic ZLD system is shown below:



As mentioned earlier, the Bioreactor Tank with the Technology Box (underground with the riser covers and Technolgy Box cover above ground) and the Zero Liquid Discharge (ZLD) system can be installed in a building, 10 ft z 12 ft area to keep them out of direct sunlight.

Installation of the NextGen Septic System

Installation of the two septic tanks (Equalization and Filtration Tank and Bioreactor Tank) is accomplished as for a standard Infiltrator, Model IM-1530 tank. The Zero Liquid Discharge (ZLD) system is installed above ground on a concrete platform, 3 inches high, and 5 ft x 6 ft size.

Installation procedure for the two tanks is detailed in the following pages.

NEXTGEN SEPTIC INSTALLATION PROCEDURE

The NextGen Septic system consists of the standard Infiltrator septic tank (Model IM_1530) with biomedica and pumps installed inside this tank and a NextGen Treatment Box, pre-installed on top of the tank. It should be noted that the wastewater from the house flows into the NextGen Septic Tank by gravity, and hence the maximum height of water in the septic tank, when the tank is overflowing, should be below the lowest source of wastewater in the house. Also, the treated water effluent pipe from the NextGen Septic tank to the discharge point should be sloping downwards, so that the treated water can flow by gravity to the discharge point.

Electrical requirements for the NextGen Septic system are 220V, single phase, 20 amps at the NextGen Septic system.

ITEMS NEEDED FOR INSTALLATION

STANDARD SEPTIC
INFILTRATOR TANK
WITH BIOMEDIA AND
PUMPS



Tank Volume 1,765 gallons

+



Box (70 inches length, 30 inches wide, 32 inches height)

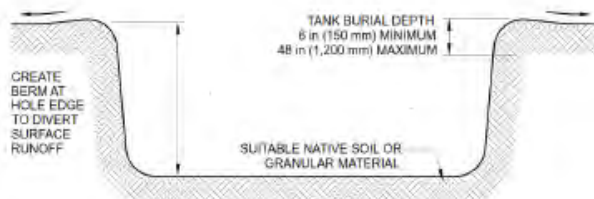
INSTALLATION OF THE SEPTIC TANK

GENERAL REQUIREMENTS

- Failure to comply with these installation instructions will void warranty.
- Prior to ground disturbance, check for sub-surface obstructions and utilities in conformance with applicable requirements.
- Operating water temperature shall be less than 140°F (60°C).
- Tanks are not fire resistant. Store the tank away from ignition sources.
- Removal of structural bulkheads is prohibited.
- NextGen Septic tanks can only be installed underground. Contact NextGen Septic, LLC for special requirements applicable to above-ground us.

SITE SELECTION

1. Do not install the tank in vehicular traffic areas. The tank is designed for non-traffic applications.
2. The allowable soil cover depth is 6 to 48* inches (150 to 1,200 mm).
*18-inch (450 mm) maximum in Florida; 36-inch (900 mm) maximum in Massachusetts, New Hampshire, North Carolina, and Oregon.
3. The maximum vehicle load is a 4,500 lbs (20 kN) axle load at a soil cover depth of 6-48* inches (150 – 1,200 mm)
*18-inch (450 mm) maximum in Florida; 36-inch (900 mm) maximum in Massachusetts, New Hampshire, North Carolina, and Oregon.
4. The tank shall not be installed where the subsurface water level outside the tank exceeds the height of the outlet pipe saddle. Follow the following guidelines:



Maximum Allowable vertical distance from top of tank to water elevation outside the tank: 13 inches (330 mm)

Maximum Allowable vertical distance from tank base to water elevation outside the tank: 43 inches (1,075 mm)

EXCAVATING AND PREPARING THE SITE

1. Unless buoyancy control measures are required, the excavation width and length should be 18 to 36 inches (450 to 900 mm) larger than the tank on each side or sized as necessary to ensure proper backfill compaction, as outlined in Steps 5-10 of “Backfilling the Tank” in this document. For specific excavation requirements when installing buoyancy control measures, refer to section on Buoyancy Control.
2. Excavation depth shall account for the height of tank (55 inches or 1,375 mm). Also account for 4 inches (100 mm) of bedding (if required) and cover depth (permissible cover depth is 0.5 to 4 feet (150 to 1,200 mm) of soil).

Note: If the water level outside the tank exceeds the height of the outlet pipe saddle, tank structural integrity may be compromised. Follow the guidelines given above.

3. Inspect bottom of excavation to verify suitability of native soil for tank installation. Soils with large, protruding, or sharp stones or other similar objects that may damage the tank are not suitable.
4. The tank may be installed either in suitable native soil (see Backfilling the Tank section) or a minimum 4-inch (100 mm) layer of well-graded granular soil having particles less than 3 inches (75 mm) in diameter, or maximum 0.5-inch (13 mm) diameter crushed stone.
5. Create a uniform, compacted, level surface to ensure that the bottom of the tank is evenly supported. Verify that the installation surface is flat.

INSTALLING THE INFLUENT PIPE AND TANK

1. Inspect the tank for damage before installation.
2. Mark the placement of the influent pipe from the house or existing septic tank in the ground using a spray can, as shown below.



3. Dig a trench for placement of the influent pipe, along the line marked by the spray can



4. After installation of the influent 4 in nominal ID, PVC Schedule 80 pipe, fill the trench with pea gravel.



5. Dig an area for the septic tank and measure the size to ensure that the septic tank will fit in the dug space.



6. Lower the septic tank in the dugout space, slowly, ensuring that the tank does not tilt too much in any direction. **NOTE: These pictures were taken when the NextGen Septic box was provided separate from the septic tank. Now NextGen Septic supplies the NextGen Septic box pre-installed on top of the septic tank.**



7. Place the septic tank softly into the dugout space and mark the height of the inlet influent pipe height position, so that the inlet 4 inch hole can be drilled on the inlet end of the tank.



8. Use a hand-held grinder to reduce the diameter at the edge of the 4 inch nominal ID PVC pipe so it can be inserted into the influent hole of the septic tank.
9. Apply PVC glue in the influent hole of the septic tank and insert the gasket before inserting the sharpened side of the 4 inch influent PVC pipe

The inlet and outlet may be drilled on either the sides or ends of the tank, as required based on applicable codes and site conditions.*

* Indiana, Kentucky, Oregon, West Virginia, and certain Florida and Texas tanks are factory-drilled.

The drill height markings are provided to set the inlet and outlet invert heights based on state and/or local regulations. The table below provides the proper inlet and outlet drill points. Note that state, provincial and local regulatory requirements take precedence over the information provided in the table below.

State or Province	Inlet Drill Location	Outlet Drill Location	Invert Drop (in) [mm]	Inlet Invert Height ² (in) [mm]	Outlet Invert Height ² and Liquid Level (in) [mm]
DE, FL, IA, MA, ON	A	D	2 [51]	42 [1,067]	40 [1,016]
AR, CA, CO, CT, ID, IN ¹ , KS, KY ¹ , MO, MT, ND, PA, SD, VT, WV ¹	B	C	3 [76]	42.75 [1,086]	39.75 [1,010]
TX	B	D	2.75 [70]	42.75 [1,086]	40 [1,016]
All Others	A	C	2.25 [57]	42 [1,067]	39.75 [1,010]

Notes:

1. Florida, Indiana, Kentucky, Oregon, West Virginia, and certain Texas tanks are factory drilled.

2. Invert heights are measured from the interior surface at the bottom of the tank.

3. Invert heights based on 4-inch-diameter (100 mm) inlet/outlet pipes.

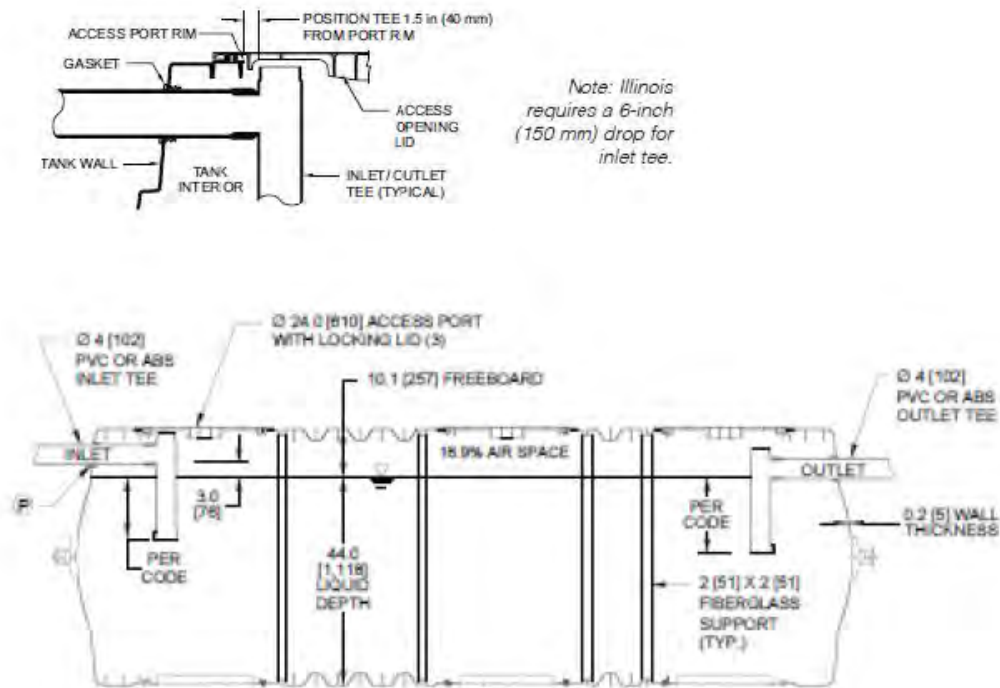
10. Install the rubber gaskets at the inlet and outlet.

The gaskets supplied with the tank are compatible with Schedule 40 and SDR 35 pipe using a 5-inch-diameter (125 mm) hole saw.

11. Insert the influent pipe into the hole on the side of the septic tank and place a piece of wood at the other end of the pipe before tapping it with a hammer to insert it to the proper length inside the septic tank



12. Horizontally position the tee 1-1/2 inches (40 mm) from the access port rim, allowing the tee to fit into the recess in the access port lid (see detail).



13. Install the riser at the inlet manway of the septic tank and fix with the screws provided.



INSTALLING THE NEXTGEN SEPTIC BOX

The septic tank is now provided with the NextGen Septic box pre-installed on top of the tank, so no separate installation procedure is needed for the NextGen Septic box.

MAKING THE ELECTRICAL CONNECTION FROM THE HOUSE TO THE NEXTGEN SEPTIC TANK.

The maximum current draw by the NextGen Septic treatment system is 20 amps at the NextGen Septic system. Hence, the wiring from the electrical supply point inside the house to the house breaker, behind the house, where the NextGen Septic system connection will be made, and then from the breaker behind the house to the NextGen Septic system, has to be selected such that when the NextGen treatment system has a maximum current draw of 20 amps, the wiring can withstand this required current flow of a maximum of 20 amps by the NextGen Septic Treatment system.

The electrical connection to be made at the NextGen Septic system is shown in the picture below.



The two black wires are Line 1 and Line 2. White wire is Neutral and Green wire is Ground. The NextGen Septic requires 220V, single phase, 20 amps at the NextGen Septic system.



BACKFILLING THE TANK

Note: NextGen Septic tanks do not require filling with water prior to backfill placement. Water filling and backfilling to the tank mid-height is required if the tank is left in either an open or backfilled excavation that may fill with water from rain or other sources.

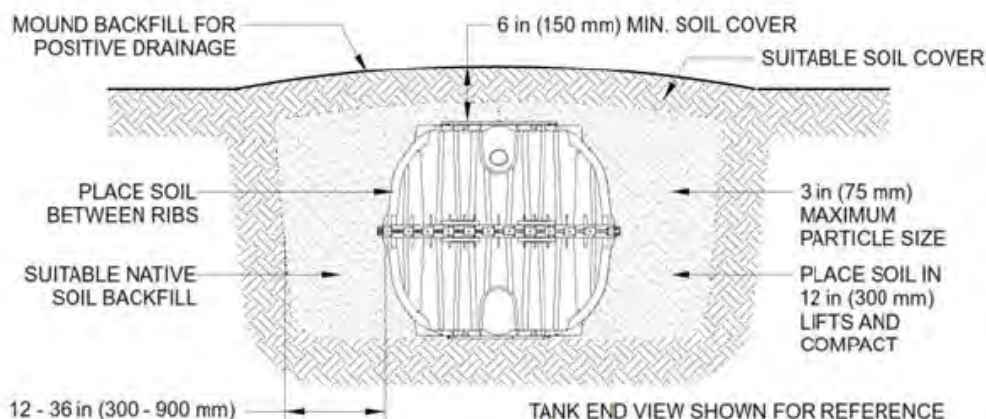
1. Backfill with suitable native soil (max. 3-inch (75-mm) stone diameter) or pea gravel, if native soil is unsuitable
2. Suitable soil shall include soil textural classes defined in the United States Department of Agriculture soil triangle. Suitable soil textural classes are based on the tank installation depth, as measured from finished grade to the top of tank.
3. For a tank soil cover depth of 0.5 to 2.0 feet (150 to 600 mm), suitable soil textures include:
 - i. Sand
 - ii. Loamy sand
 - iii. Sandy loam
 - iv. Loam
 - v. Sandy clay loam
 - vi. Sandy clay
 - vii. The following, assuming that the sand particle fraction by weight (i.e. % that would be retained on No. 200 sieve, as per ASTM D2487) is greater than 30%: silt loam, clay loam, and clay
 - viii. The following, assuming that the sand particle fraction by weight (i.e. % that would be retained on No. 200 sieve, as per ASTM D2487) is less than 30% and the soil is shown to be dilatant (refer to Step 5 below for simple dilatancy test to be conducted in the field): silt loam, silt, clay loam, silt clay loam, silty clay, and clay
4. For a tank installation depth that is greater than 2 ft and less than 4 ft (600 – 1,200 mm), suitable soil textures includes:
 - i. Sand
 - ii. Loamy sand
 - iii. Sandy loam
 - iv. Loam
 - v. Sandy clay loam
 - vi. Sandy clay
 - vii. Silt loam, clay loam, and clay having at least a 30% sand particle fraction by weight (i.e. % that would be retained on No. 200 sieve, as per ASTM D2487).
5. Backfill should not have stones greater than 3 inches (75 mm) in diameter or excessive clods that do not break apart during placement and compaction. Backfill must be capable of occupying the spaces between the tank ribs and beneath the haunches.

Note: Rounded screened aggregate (e.g., pea gravel) is not a suitable backfill.
6. Standard field soil classification methods shall be used to determine the soil textural class.



Under most circumstances, the determination of soil dilatancy will not be required. Dilatancy shall be determined in the field using a test that does not require specialized equipment, per ASTM D2488, Section 14.3, and as described below:

- a) Mold a 1/2-inch-diameter (13 mm) soil test specimen in the palm of the hand. The test specimen shall be representative of the prospective tank backfill soil.
 - b) Mold the test specimen, adding water if necessary, until it has a soft, but not sticky consistency.
 - c) Smooth the soil ball in the palm of one hand with a spatula or similar instrument.
 - d) Shake the soil sample by striking the hand vigorously against the other hand approximately 5 times. Do not strike hand in a manner that results in an injury.
 - e) Immediately following shaking, gently squeeze the soil in the palm of the hand.
 - f) Repeat shaking test if necessary to evaluate soil.
 - g) Note whether water appears on the surface of the soil specimen during shaking and squeezing.
 - i. If water appears on and disappears from the surface of the soil specimen, the soil is dilatant, and is suitable.
 - ii. If no visible change or only a slight visible change in the soil specimen occurs due to shaking or squeezing, the soil is not dilatant, and is unsuitable.
7. Do not backfill top of the tank until the sidewalls are completely backfilled.
 8. Place backfill around the four sidewalls in an alternating manner, so that the backfill height along the four sidewalls is maintained within a 12-inch (300-mm) tolerance.
 9. Continue to place backfill along the sidewalls in 12-inch (300-mm) lifts. Place backfill between the ribs on the sidewalls such that the space between the ribs is completely filled with soil.
 10. Compact backfill material either by walking-in, hand tamping or mechanical compaction (includes backhoe bucket). If mechanical compaction is used, such as a walk-behind tamper or backhoe bucket, a single pass is recommended. Compact each lift prior to placement of next lift. Compact backfill from tank walls to excavation sidewalls.
 11. Complete backfilling and grade the area.
 12. A minimum 6-inch (150-mm) depth of suitable soil must be placed over the top of the tank. The balance of backfill placed to finish grade above the tank may be either suitable or unsuitable soil.



Note: Grade to prevent the backfilled excavation from filling with surface runoff. If the water level in the backfilled excavation exceeds the height of the outlet pipe saddle, tank structural integrity may be compromised.

SHORT AND LONG-TERM GROUNDWATER CONTROL

It may be necessary to implement groundwater control measures during tank installation. Maintain dry conditions by expanding the excavation to create a short-term groundwater collection sump for temporary placement of a dewatering pump if needed. Long-term groundwater control measures such as underdrains and interceptor trenches may be sensible if the site is amenable to construction of a control system and such systems are not prohibited by regulation or law, and the tank location is not subject to flooding. Properly installed underdrains and groundwater interceptor trenches may prevent the need for tank buoyancy control measures.

INSTALLING UNDER SHALLOW GROUNDWATER CONDITIONS

Buoyancy control measures may be required if the NextGen Septic tank is to be installed with less than 24 inches (600 mm) of soil backfill cover, and where the seasonal high groundwater table has the potential to rise 24 inches (600 mm) or more above the elevation of the tank bottom. Otherwise, no control measures are required. The need for buoyancy control measures must be determined based on backfill cover depth and height of groundwater above the tank bottom according to the following table.

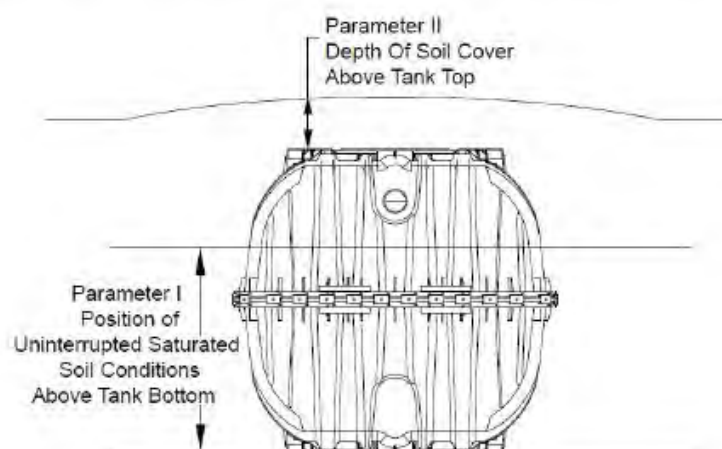
INSTALLATION CONDITIONS REQUIRING BUOYANCY CONTROL MEASURES

NOTE: Minimum 6" inches soil cover backfill required above all NextGen Septic tanks.

NextGen Septic tank should not be installed where the water level outside the Tank exceeds the height of the outlet pipe saddle.



The buoyancy control parameters are shown in the figure below:



The weights required to prevent the septic tank from lifting due to buoyancy, as recommended by the tank supplier, are given below in the table.

Parameter I: Position of uninterrupted saturated soil conditions above tank bottom	Parameter II: Soil cover depth above tank top	Minimum supplemental downward force required* (total, both tank sides)	Buoyancy Control Methods				
			Concrete-filled half pipe (min. length/ side)	Concrete parking bumpers (min. length/ side)	Concrete traffic barriers (min. length/ side)	Helical anchors (min. no./side)	Concrete collar (min. width x min. height)
30 in (750 mm) to outlet pipe saddle ^a	6 in (150 mm) to 12 in (300 mm)	4,300 lbs (1,955 kg)	6.3 ft (2.0 m)	6.5 ft (2.0 m)	6.3 ft (2.0 m)	2	12 in (300 mm) x 9 in (225 mm)

SEASONAL HIGH GROUNDWATER ELEVATION

Groundwater elevation, or water table, fluctuates seasonally based on various factors including: soil type and porosity, rainfall amounts, frost/thaw cycles, proximity to sources such as springs and gutter downspouts, and uptake from plants (evapotranspiration). The seasonal high groundwater elevation represents the highest point the water table has the potential to reach at any time of the year and is not necessarily the level at which groundwater may be observed seeping from the soil at the time of tank installation. In general, a qualified soil evaluator can estimate the seasonal high groundwater elevation from careful examination of the soil profile. This information is critical to the design of a successful on-site wastewater treatment system, including installation of the septic tank.

INSTALLING RISERS

Compatible risers include 24 inch (600 mm) diameter products.

Oregon water tightness testing shall include filling with water at least 2 inches above riser connection, with no more than 1gallon leakage per 24 hours, per OAR 340-073-0025 (3).

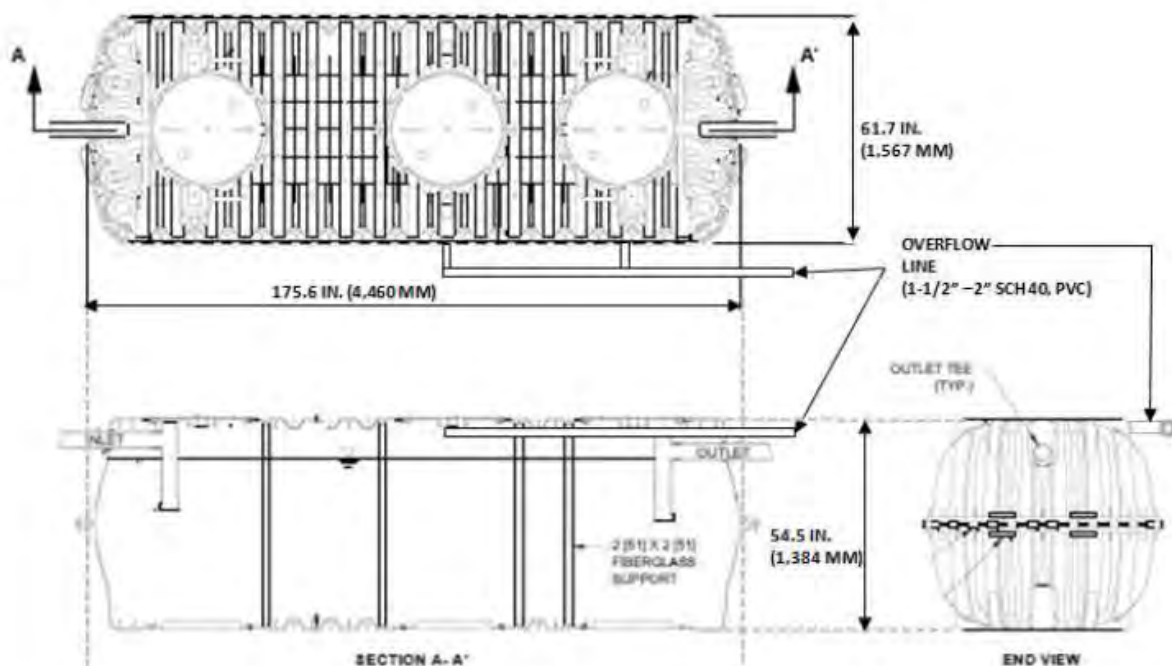
INSTALLING NEXTGEN SEPTIC OVERFLOW LINE

If there is loss of electrical power to the NextGen Septic tank, it will function as a conventional septic tank. In this case, the wastewater, exiting the tank, will overflow into the overflow line, and then it is either pumped or gravity-flows into the conventional soil leach field or sub-surface drip soil treatment areas. (Refer to NextGen Septic's Sub-Surface Drip Soil Treatment System Document).

There are two sets of overflow lines (generally 1-1/2" or 2" PVC pipes) that are installed on the side of the tank, as shown the figure below. In the Infiltrator tank, there are defined locations on the side of the tank, wherein an exit pipe connection can be installed. These locations are used in the NextGen Septic tank design as the overflow lines (see figure below).

The overflow lines are used to direct the wastewater from the NextGen Septic tank to either a conventional soil leach field or to a dosing tank of a sub-surface drip soil treatment system. It is required that the overflow lines slope towards the leach field or the dosing tank of the sub-surface drip soil treatment system, so that the wastewater can gravity flow from the NextGen Septic tank to the soil leach field/sub-surface drip soil treatment system.

In the event that the soil leach field or the dosing tank of the sub-surface soil treatment system is located at a higher level than the NextGen Septic tank and/or the flow has to travel through a pipe exceeding 100 ft in length, it is necessary for the overflow line to be connected to a pump station, equipped with a float level switch and submersible pump, that works on a rechargeable battery power source. For more information on the pump station, refer to the NextGen Septic Pump Station Document.



NOTES:

1. ALL DRAWING DIMENSIONS IN INCHES [MILLIMETERS] OR AS NOTED.
2. EXTERIOR OF ACCESS OPENING LID INCLUDED THE FOLLOWING WARNING IN ENGLISH, FRENCH & SPANISH: "DANGER DO NOT ENTER: POISON GASES."
3. TANK MARKINGS WILL INCLUDE: MANUFACTURER NAME, MODEL NUMBER, LIQUID CAPACITY, DATE OF MANUFACTURE, MAXIMUM BURIAL DEPTH, INLET, AND OUTLET.
4. MAXIMUM BURIAL DEPTH IS 48 in [1,219 mm].
5. MINIMUM BURIAL DEPTH IS 6 in [152 mm].
6. TANK IS FOR NON-TRAFFIC APPLICATIONS.
7. AIRSPACE IS 16.9%.
8. LENGTH TO WIDTH RATIO IS 2.8:1 (175.6-INCH LENGTH / 61.7-INCH WIDTH = 2.8).
9. FREE VENT AREA BETWEEN TOP OF BAFFLE WALL AND BOTTOM OF TOP BAFFLE SLOT IS 135.5 in².
10. BAFFLE WALL THICKNESS IS 2.31 in [58 mm].

TANK EXTERIOR	
LENGTH	175.6 [4,460]
WIDTH	61.7 [1,567]
HEIGHT	54.5 [1,384]

LIQUID DEPTH	44.0 [1,118]
INVERT DROP	3.0 [76]
FREEBOARD	10.1 [257]

OPERATION AND MAINTENANCE MANUAL



Zero Liquid Discharge System



Wastewater: Making Possible today what was not known yesterday.

Our purpose is to create and develop new technologies to address the global freshwater crisis, starting in our back yards.

OPERATOR & MAINTENANCE MANUAL

NextGen Septic, LLC
1776 Mentor Avenue, Suite 420
Cincinnati, Ohio. 45212
513-673-3583
rgovind837@aol.com

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August 6, 2021

INTRODUCTION

NEXTGENSEPTIC was founded in 2008 by Dr. Rakesh Govind. He has been a pioneer in the wastewater industry for the past 30 years. At **NextGen Septic**, our main goal is to create and develop new technologies to address the global freshwater crisis, starting in our backyards. We continue to dedicate ourselves to improving our products and creating new technologies that can be used for improving our environment while making our lives simpler and enriched. Concerning wastewater, we strive to make possible today what was not known yesterday.

The **NextGen Septic - Zero Liquid Discharge (ZLD)** system is composed of two separate technologies, and each had to be tested separately and independently. The treatment process of the **NextGen Septic** has been tested extensively and exceeds the requirements for particle size and treatment levels at the Class I plant characteristic requirements. The misting process of the ZLD does not have a federal or state standard and as such has been tested at the **NextGen Septic** labs and in-field studies. The Zero Liquid Discharge (ZLD) units in conjunction with NextGen Septic can be used if there is no possible discharge location for treated water (soil field or water body). The Zero Liquid Discharge operates by using ambient air to evaporate the treated effluent from the NextGen Septic system.

The influent raw residential wastewater parameters used for the design of the wastewater treatment system are as follows:

Average Daily Flowrate (ADF): is determined by the project. Each state has guidelines for determining the rate used for most projects. Typical for residential is 120 gpd per bedroom i.e., 360 gpd for a three-bedroom or 480 gpd for a 4-bedroom house.

Current ranges for the ZLD are between 100 – 1200 gpd. Systems needing a greater capacity can be accommodated but require an individual customized design. Maximum Influent BOD: 900 mg/L (typical Residential BOD is 250 mg/l)

Maximum Influent Ammonia-N: 69 mg/L (typical Residential is 60 Total N)
Maximum Influent TSS: 300 mg/L (typical Residential TSS is 250 mg/l)

PROCESS DESCRIPTION

NextGen Septic Treatment System:

The NextGen Septic Treatment System consists of three treatment steps:

1. Equalization and Filtration Tank (refer to Figure 1)

Influent wastewater from a house enters the first compartment (approximately 1,000 gallon liquid volume) of a standard septic tank (1730 gallons total volume, 1,500 gallon liquid volume), where the solids settle to the floor and slowly decay under anaerobic conditions. These solids consist of both readily biodegradable solids and non-biodegradable solids or solids which are very slow to biodegrade. The readily biodegradable solids breakdown into soluble organics, while the non-biodegradable and slow to biodegrade solids accumulate in this compartment.

We recommend that the home owner should get only the accumulated solids in this compartment to be pumped out yearly, which would prevent these solids from entering the second compartment of this tank.

Wastewater flows over the baffle into the second compartment, which is about 500 gallons in liquid volume, and the water exits through a self-cleaning filter.

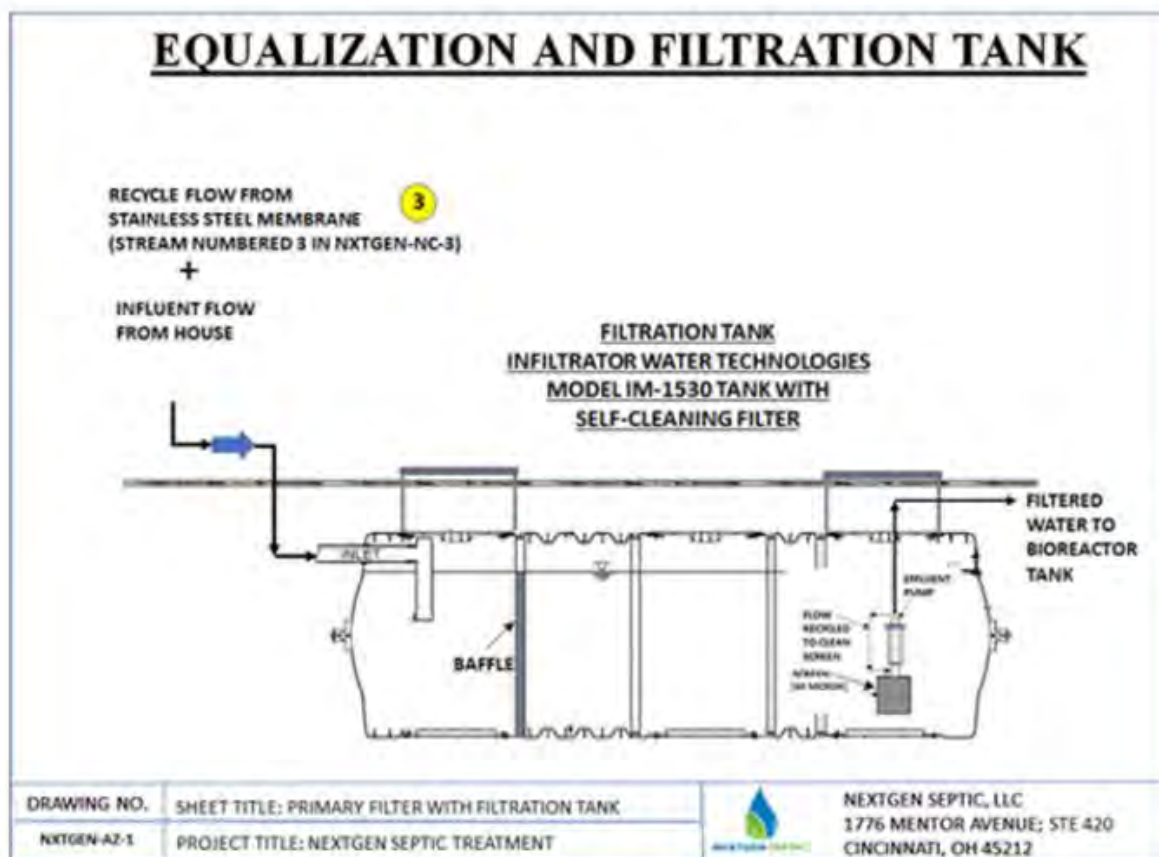


Figure 1. Schematic of the Equalization and Filtration Tank, installed below ground, with the riser lids above ground. The effluent filter is accessed from the second manway.

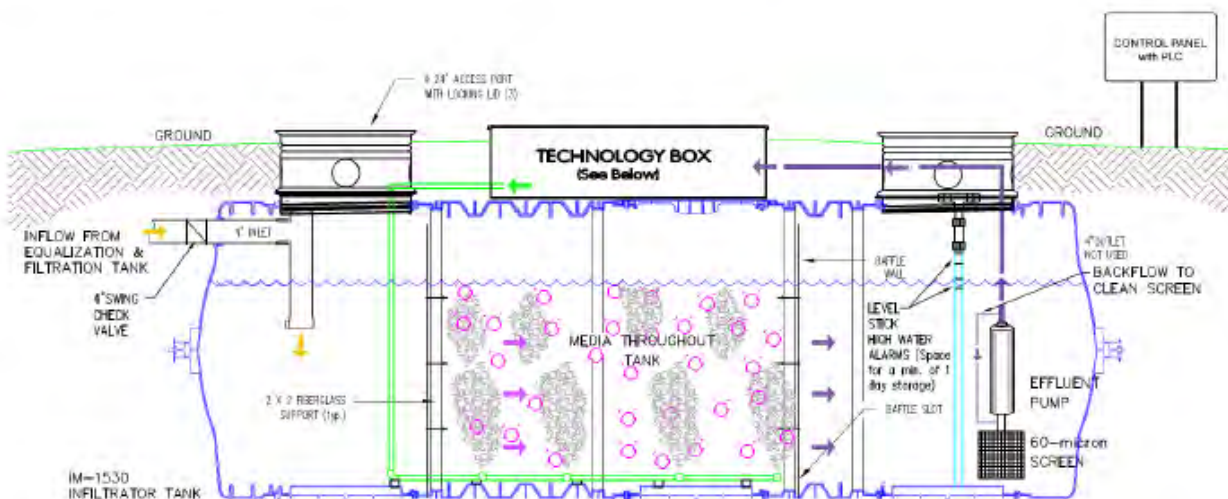
2. Bioreactor Tank

Wastewater from the Equalization and Filtration Tank flows into the second tank, which is an identical standard septic tank, 1730 gallons in total volume and 1,500 gallons in liquid volume. It has two baffles which divides this tank into three compartments. The first compartment allows the liquid to flow into this tank. The baffle has holes in the middle, which allows the wastewater to move into the second compartment.

The second compartment is an aerated region, which has contained moving Biomedia. The Biomedia consists of 1" size, open cell cubes, which have been coated with a special coating. This coating allows active bacteria to form biofilms within and on the surface of these cubes. The coated foam cubes freely move around within the second compartment and treat the water by converting the

soluble organics into carbon dioxide and water.

Aeration to provide dissolved oxygen in the water is accomplished by using a blower, which bubbles the air through several porous tubes, installed at the bottom of the second compartment.



The water is treated for both soluble organics and ammonium, which is converted to nitrates and nitrites. Biofilms near the outside surface of each biomedica cube immobilizes bacteria oxidize the soluble organics to carbon dioxide and ammonium to nitrates and nitrites. However, biofilms inside the biomedica cube, have an anoxic environment, wherein the nitrates and nitrites are simultaneously converted to nitrogen gas.

Treated water flows into the third compartment, where the water is pumped through a self-cleaning filter by a submersible pump. The self cleaning filter has a 50 micron stainless steel screen, which is continuously cleaned. The filtered water is then pumped by the submersible pump through a stainless steel membranes with 5 micron openings. This filters the water further and filtered water flows into a separate tank, 100 gallon, where it is further purified by an Ultrafiltration Membrane.

3. Disinfection of Treated Water

The filtered effluent is disinfected using ozone, generated from ambient air by the ozone generator. This is accomplished in the Zero Liquid Discharge (ZLD) box, which is installed above ground.

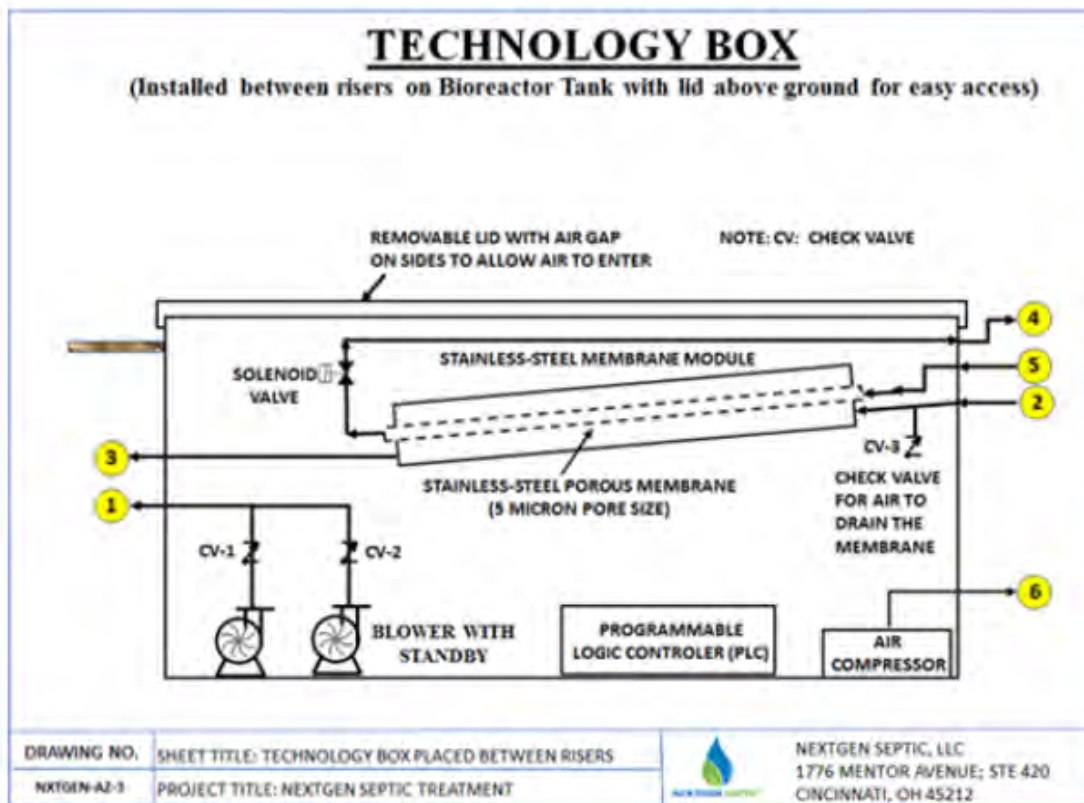
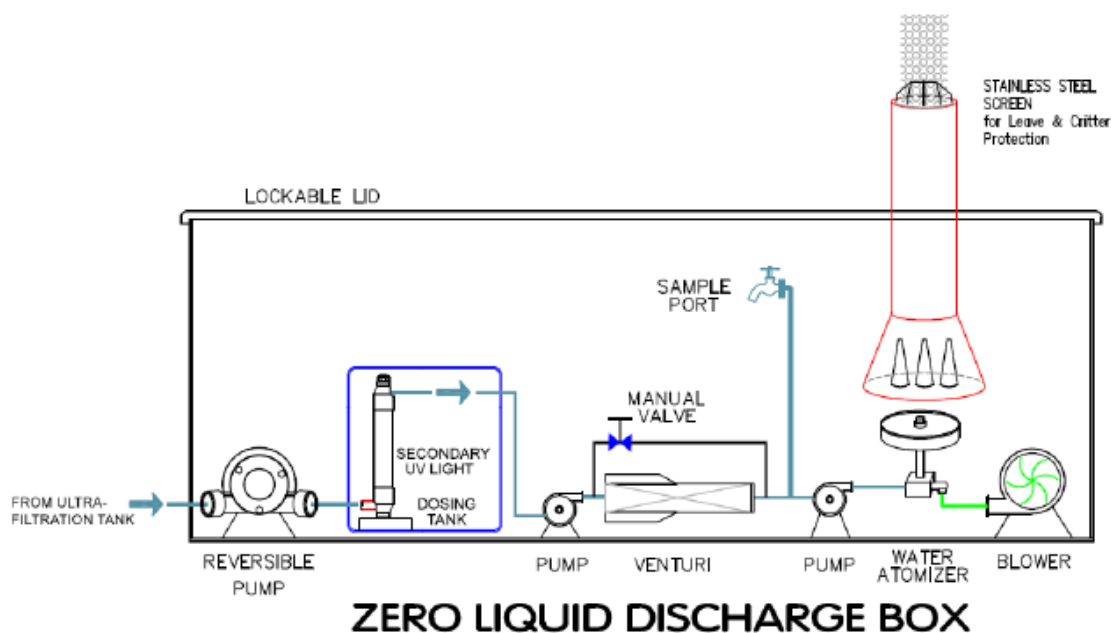


Figure 2. Schematic of the Technology Box, which houses the stainless steel membrane, air blowers.

4. Dispersal of the Disinfected Water into Ambient Air

Treated, disinfected water is then dispersed into ambient air using an air blower and a water atomizer as shown in the drawing below. Treated, disinfected water is pumped from the water storage tank into the Zero Liquid Discharge (ZLD) system which then disperses the treated and disinfected effluent into the air as an exceptionally fine mist of microscopic water droplets, less than 50 microns in diameter. This allows the treated, disinfected water to evaporate into the ambient air. As the water droplet size decreases, the surface area of these water droplets increases substantially, which increases evaporation rates. Figure 3 shows a schematic of the Zero Liquid Discharge (ZLD) system.



The **NextGen Septic-ZLD** system treats all the contaminants in the influent wastewater (organic and nutrients) to an extremely high standard and then disinfects the effluent using ozone, which generates no toxic by-products prior to the misting process. The **Zero Liquid Discharge (ZLD)** treatment system can be used when there is no land available for a sub-surface/surface soil drain field or no available water body close enough for a direct discharge. The Zero Liquid Discharge (ZLD) system can be used for repairing existing failed systems or new construction on previously unbuildable parcels. The ZLDBox receives the effluent from the Technology Box which has pumped the treated effluent into the Pump Tank. When the system is ready for the misting process the ZLD pulls the effluent from the Ultrafiltration Membrane to the 20 gallon tank located in the ZLD Box.

OPERATOR SUPPLIED SPARE PARTS

The following spare parts, supplied by NextGen Septic, LLC, need to be stored by the Operator, so that there is no waiting time to replace the critical units of the NextGen Septic Zero Liquid Discharge (ZLD) system, in the event of a premature failure.

1. Submersible pump used in the Equalization and Filtration Tank.
2. Programmable Logic Controller (PLC)
3. Submersible backflush pump in the 100-gallon tank
4. Ozone Generator and Air Dryer.
5. Pump in the ZLD Box; and
6. Blower in the ZLD Box

There is a one-year warranty provided by NextGen Septic, LLC, during which NextGen Septic will pay for the labor and parts to replace any unit which fails prematurely. Warranty payment is contingent upon NextGen Septic approving the installation of the system, after the installer has installed the system at the site.

MAINTENANCE AND OPERATOR QUALIFICATIONS:

Maintenance checks need to be performed quarterly for the first year and then every 6 months during subsequent years. The Owner will need to have a signed contract for the operation and maintenance of the system through an Operator. An Operator must have a State issued Subsurface Grade 1 Certification and be Factory trained & certified by NextGen for the performance of Operation & Maintenance duties. The contract shall provide for the first year of quarterly visits and then biannual visits for the life of the system. The final signed Contract needs to be presented to the Engineer prior to the Engineers Certification process. The contract needs to be approved by NextGen (prior to owner signature). Upon presentation to the Engineer, a copy of the subsurface Grade 1 State certification and a letter from NextGen stating the qualifications of the Operator must be presented.

It is the intention of this contract for the Operator to not only be the operator but also the representative of **NextGen Septic**. It is preferred that any question the Owner may have, should first be directed to the Operator. Should the operator need assistance, then it is preferred that the operator call NextGen Septic for the answer. Inspections should include any necessary adjustment of electrical controls and servicing of the component parts and should include a visual check of hoses, wires, leads, contacts, cleaning of filters (removal of organic particles from filters) and testing of alarms to ensure proper function.

7. An effluent quality inspection report consists of a visual check for color, turbidity, scum overflow, and an examination for odors. An effluent sample should be taken from the port provided after the Ozone Treatment and sent off for analysis. This sampling, analysis, and report should be performed biannually for the first year and then annually thereafter. A copy of the report should be sent to NextGen, Engineer, Operator, Owner, and any government agency that requests the reports. The analysis report should include items specifically requested by NextGen but at a minimum the following needs to be analyzed:
 - a. CBOD
 - b. Nitrogen
 - c. Pathogens/coliforms
 - d. TSS
8. Every visit will necessitate a standard formatted operator report. This report should be emailed to the Owner, Engineer, and the Operator.
9. If corrective action needs to be made (other than routine maintenance) then a corrective action inspection report may be necessary. This report needs to state what was the issue i.e., offensive odors, part replacement, electrical issue, not meeting the analysis standards, etc. This report shall advise the owner of the problem (if it is known). Once it is determined what corrective action needs to be made, then a cost estimate needs to be prepared that summarizes the costs associated with NextGen (warranties) and the Owner (costs not associated with NextGen or the Operator). A date needs to be provided when corrective action

can be initiated and completed. Please be aware that the owner may need to prepare their property.

The Operator needs to be familiar with the warranties and services offered by NextGen Septic and should work within these parameters. Any costs not covered by these warranties are to be borne by the Owner – including installation. The annual cost of an Operator is just for the service for standard annual maintenance, cleaning, checking, testing procedures (not the lab), and adjustment in the system performance. Any replacement parts and the installation of the parts are not to be covered by the Operator's Contract. The Operator needs to make this clear to the Owner at the time of the initial meeting or at plant start-up.

NEXTGEN SEPTIC PLANT START UP

Initially the **NextGen Septic-ZLD** wastewater treatment plant is filled with clean water, usually from an owner's water supply. As stated in the installation instructions, once all proper connections have been completed and it is filled with water and the aerator compressor turned on, the system is now in operation. For the treatment plant to be biologically stable, it will take from four (4) to twelve (12) weeks after first using the plant to develop a population growth of microorganisms (bacteria). It is these bacteria which make the treatment system operate.

INSTALLER/MAINTENANCE PROVIDER OPERATION, REPAIR AND TROUBLESHOOTING

Operator should read to understand this manual for system's functions, specifications, design, proper installation procedure, start up, owner care, sampling, and operation. If at this point you are not totally familiar with the material covered, you should read it again.

Please pay particular attention to the manual for the Owner's Responsibility. This manual includes information critical to the plants proper loading and function. You will find that this same information is listed in the **NextGen Septic-ZLD** Owner's Manual. Your assurance of the owner's receipt of their manual and the explanation of its contents is most critical to the plant's proper operation. You will find, in the following sections of this manual, the information required of you as a maintenance provider and for you to provide service in compliance with NSF/ANSI Standard 40. Additionally, most states have added to the requirements of this policy. You must know and adhere to all other regulatory agency requirements concerning mechanical plant service/maintenance standards.

In the event of an alarm, the Owner has been instructed to go to the Control Panel to find the Operator's name address, phone number and email. Be sure to have this information on the panel before you leave on your first visit. A card or contact information should be provided as well.

EXAMPLE OF A ROUTINE MAINTENANCE SERVICE CALL

Routine maintenance is never routine as there are always items that need attention that

are out of the ordinary. This section is a guideline to a typical maintenance scheduled service visit.

10. Check with the Owner ahead of time and ask if they have noticed anything unusual, noticed any noises, lights, alarms, smells, etc. Let them know that you will be at their house on a certain date and an approximate time.
11. Upon arrival, inspect the area around the system for any signs of non-misting, leaking, ponding, smell, erosion, etc.
12. The Septic Tank has a baffle wall at the third point and an effluent filter that should be equal in size to the size of the incoming pipe. The tank should have risers for the front (for pumping) and the rear for cleaning the effluent filter. **We recommend yearly pumping of the solids in the first compartment of the Equalization and Filtration Tank.** These tanks should be precast concrete tanks, approved by the State with a certification and tested for leaks by the supplier at the time of its delivery. If the tanks fail, they should be replaced by the supplier at no expense to the Owner, Installer, NextGen or the Engineer. A copy of the ticket provided by the supplier of the tanks with the notation of the passing test, should be submitted to the Engineer. The Operator should check and note the level of the sludge on the bottom and note the condition of the crust on the top. This information should be noted on the standard inspection report. Arrange with the Owner when it is time for pumping the tank. Ensure that the correct tank and riser is used by the pumping company when they are performing the pumping process.
13. Control Panel: Check the system's control panel for any alarm or failure indication. Check the panel to insure proper incoming power by testing the incoming power supply. If you know power is incoming into the control panel, check the circuit feeding the control panel. Next, check all the incoming feeds to ensure that nothing has tripped, and all functions are working properly. Turn the system to the "test" position and check to ensure that each item is working. Check each toggle to ensure that each toggle is working. If required, before servicing the control panel and alarm system, disconnect the power to the control panel. Every component has been routed through the panel. Each component can be toggled on or off as needed or to test functionality.
14. The Aerobic Treatment Plant: make a quick effluent quality inspection. At this point pay particular attention to odors you notice at the plant (or pump tank if applicable). You may notice an earthy smell which is nothing more than carbon dioxide gas emitted by the aerobic bacteria in the plant.

There may be a sweet smell or no smell at all and that's good. Should you experience an obnoxious odor, something is wrong. Open the lids for the aeration mixing compartment, if necessary, to examine the mixed liquid, the biochips and air diffusion system.

- a. Check the tank water level in the tank to ensure that its at the correct level.
 - b. Check the solids level with the measuring stick.
 - c. Check the Effluent Pump and screen. Clean the screen. Make sure the pump is properly seated.
 - d. This tank is full of Biomedia and should never be pumped out.
15. Remove the lid of the Technology Box. Check for leaks, ponding water, rust build-up, etc. - be careful of spiders/snakes, etc. Review the air blowers and air diffusion system delivery system. Clean or replace the blower/aerator compressor air filters (if needed). If you experienced an offensive odor when at the plant or heard little or no bubbling, finding a clogged or extremely dirty air filter may be the problem. Turn on the system at this time and check for any air leaks between the aerator and the 3/4" Sch. 40 PVC piping. If a leak is detected, effect repair.
16. If a leak is detected, the following steps should be taken.
- a. Remove the aerator from the rubber hose connection and install a low-pressure gauge between the PVC piping and aerator. Turn on the aerator and note the pressure.
 - b. If the line pressure is below 1.5 P.S.I. then there is a leak between the aerator and the air distribution system in the treatment plant or the aerator's diaphragm is ruptured.
 - c. Determine the cause-and-effect repairs. If a pressure above 3.5 P.S.I. is noted, the air system piping or diffuser assembly is blocked. You can clear the air distribution system's blockage by charging the air distribution piping with compressed air (no more than 80 P.S.I.) Re-check the line pressure after any maintenance procedure to the plant's air distribution piping to insure the correct pressure range.
 - d. The normal line pressure should be between 1.83 PSI and 2.85 PSI.
17. Remove and clean the Stainless-steel membrane filter.
18. The Pump Tank has a baffle wall at the third point. The tank should have a single riser over the pump. These tanks should be precast concrete tanks, approved by the State with a certification and tested for leaks by the supplier at the time of its delivery. If the tanks fail, they should be replaced by the supplier at no expense to the Owner, Installer, NextGen or the Engineer. A copy of the ticket provided by the supplier of the tanks with the notation of the passing test, should be submitted to the Engineer. The Operator should check the water levels and note that the pump is supplying the 80-gallon ZLD tank the correct amount of water. This information should be noted on the standard inspection report.

At the pump tank, check the condition of the effluent pump and its electrical connections. Note the positions of the pump on, off, override and high-water float switches. Make sure they are properly positioned, operable and secured. Clean or



replace, as necessary. Check to ensure the pump is properly seated in the pump tank and note the condition of the pump's drop pipe as it extends from the pump discharge opening to the exit point out of the pump tank. The operator needs to witness the full ZLD process by operating the system through the Control Panel to ensure proper performance.

19. Open the Ultra-Filtration Tank.

- a. Check the effluent levels in the tank.
- b. Remove and clean the Ultra-Filtration membrane.
- c. Inspect the air connection (at the bottom) to ensure that air is not escaping and that there is a secure connection.
- d. Effluent in tank should look like water (clear and odorless).

20. Zero Liquid Discharge Box – open the box and inspect the interior as previous with the Technology Box.

- a. If water is ponding in the ZLD area, it may be a sign of overloading, it could also flow back into the pump tank if the in-line check valve between the pump tank and ZLD is not completely closing after each pump cycle. A gravel sump (18" x 18" by 24" deep) could be installed under the ZLD Box with drain holes so that if the ZLD Box did have some water intrusion from rain, sampling, leak then it would have a place to drain.
- b. Note any non-compliance conditions that may exist in the effluent disposal area and arrange for corrective measures with the Owner.
- c. Also note the condition of the vegetation growth in the plant area. Tall grass, weeds or bushes should be cut or trimmed. Excess growth maybe the result of the soil being saturated. Check to ensure that the stormwater is draining away from the tank. If there is a leak causing the ground saturation, then it needs to be remedied. Notify the person responsible for performing the weeding/mowing and ensure that it is completed.
- d. Check the Air Dryer and Ozone Generator. Check the pressure and feeder lines. Switches and LED indicator lights come with the generator and air dryer/compressor. Check that the indicator lights are functioning and in the correct operational parameters.
- e. Manually operate the valves to make sure that any cut-off valves are capable of closing and opening properly.
- f. There are two effluent pumps on either side of the venturi. Ensure that the venturi is receiving the ozone and properly mixing the two together. Ensure that both effluent pumps are operating efficiently.
- g. Check that the reversible pump is pulling from the 100-gallon Ultra-Filtration tank and filling the 80-gallon tank in the ZLD Box. Check that the piping is secure with no leaks. Check the water level in the 80-gallon ZLD tank to determine if it is at the operable elevation.
- h. The water atomizer and blower work as one unit. The flow from the venturi and second pump has the effluent moving at a high velocity. The venturi has also mixed the ozone into the effluent as a disinfectant. The high velocity



effluent enters the atomizer where the mist is generated while the blower sends it up through the stack and into the atmosphere. Operator is to ensure that this process is operating efficiently and effectively. Remove atomizer and clean as needed.

- i. Check if the water droplets coming out of the stack are barely visible against a sky background. This indicates that they are in the acceptable 30–50-micron range.
- j. Recommended procedures for taking effluent samples are outlined in the section titled Effluent Sampling Requirements.
- k. Aerator compressors, blowers, and pumps are used on all models of the **NextGen Septic-ZLD** wastewater treatment plants. They provide quiet energy efficient operation. Some run continuously as the treatment cycles (within the aerobic tank) continue throughout the day. Periodic aerator compressor maintenance will help you to operate the aerator in the optimum condition and insure longer aerator life. Air filters should be checked/cleaned at every visit and replaced, as necessary. **NextGen Septic** recommends that the air filters be replaced once a year. The plant's air distribution piping pressure should be measured at least once per year. Aerator compressors should be operated at the recommended output pressure range which is between 1.5 and 3.5 P.S.I. Aerator life is shortened if operations outside of the specified pressure ranges occur.

EFFLUENT SAMPLING REQUIREMENTS

When properly loaded, operated, and maintained the **NextGen Septic-ZLD** wastewater treatment plant should provide an effluent quality that exceeds the E.P.A. secondary treatment guideline parameters.

The expected final discharge from the plant should provide an effluent quality of:

- a. less than 10 mg/l. CBOD5
- b. less than 2 mg/l. TSS
- c. pH of 6 to 9
- d. less than 8 mg/l Nitrogen

Sampling and testing should occur during the first quarterly visit and the last quarterly visit during the first year and then annually each year thereafter. Results of the tests should be sent to the Owner, Engineer, NextGen and the Operator.

NextGen Septic recommends that effluent samples be taken in a sample port after the ultra-filtration tank (and before the pump tank) and at a sampling port after the venturi/ozone mixture but before the final pump to the water atomizer. This port is provided at installation. We recommend allowing the effluent to flow through the system for a minimum of two (2) minutes before taking the sample.

SAMPLING AND TESTING PROCEDURES

1. Effluent grab samples should be completed by a certified testing lab. The certified lab should provide you with information concerning proper sample collection to include volume, storage and labeling of sample. For a fee, most labs will provide the glass or plastic bottles to be used.

2. Always follow your testing lab's instructions concerning proper sample labeling, collection, and storage. For the referenced sample collection in this section, the testing lab's minimum instructions should be:

a. Label each sample to include:

- * Name and physical address of owner
- * Time and date of collection
- * Desired tests
- * Name of person collecting sample.
- * Location of Sample

b. Collect samples only in clean glass or polyethylene bottle or jar at a volume specified by the lab.

c. Store samples in a cooler to near freezing temperature as soon as samples are collected.

d. Deliver samples for analysis within six (6) hours of collection.

3. Activate the application pump and collect the sample from the sample port in the pump tank or from fresh flow in the effluent discharge line after the disinfection device.

TESTING FOR SOLIDS REMOVAL

1. If the solids in the Equalization and Filtration Tank's first compartment exceed in 50% of the liquid volume of this compartment (1,000 gallons), we recommend that the solids accumulated in this compartment should be pumped out.

OTHER TESTING

1. If there is an issue with any of the process and a sample needs to be taken as the effluent leaves the Septic Tank to determine the wastewater strength, then collect a grab sample from the flow between the septic tank and aerobic treatment plant.

2. Samples should be taken from fresh flow directly out of the pre-tank's outlet baffle. Refer to information covered earlier in this section for proper handling of a sample from the job site to a certified testing lab.

3. Influent grab samples, at a minimum, should be analyzed for BOD₅, TSS, COD, and pH. A pH test can be done on the job site by following the simple instructions with your pH test kit. BOD₅, TSS, and COD tests should be conducted by a certified lab.

4. The need to determine the concentration of other influent contaminants may arise. Collect, handle, and test the samples in the same manner as outlined in this section.

5. The typical composition of untreated residential wastewater for the suggested parameters is:

BOD5 180 to 350 mg/l

TSS 180 to 350 mg/l

COD 75 to 150 mg/l

pH 6 to 9

ORDERING OF SYSTEMS, PARTS, AND MANUALS

NextGen Septic-ZLD maintains ample supplies of parts to meet the needs of new sales, replacement parts, warranty parts, and manuals. Please feel free to call your local distributor so we can help meet these needs.

SOURCES FOR OBTAINING REPLACEMENT PARTS OR COMPONENTS

Replacement parts or components may be obtained from your installer/distributor:

NextGen Septic, LLC
1776 Mentor Avenue, STE
420
Cincinnati, OH 45212
Attn: Dr. Rakesh Govind
Cell: (513) 673 3583
Email:
rgovind@nextgenseptic.com

Service Recommendations

Maintenance Checks to be performed for the Bioreactor Tank, Technology

Box and 100 gallon Tank with Membrane

1. Remove the level sensor stick (same as in the Equalization Tank) and manually clean the rods;
2. Check the level of water in the tank using a depth stick; we recommend AdirPro 16 ft Dual Side Aluminum Grade Rod - 10ths, 5 Section Telescopic Rod with Carrying Case (\$40 on Amazon)
 - (a) If the pump in the self-cleaning filter is not running, the level in the tank should be below 15 inches;
 - (b) If the pump is running, the level of water should be at 20 inches or higher, but below the 40 inch alarm depth;
 - (c) If the level of water is 20 inches or higher, and the pump in the self-cleaning filter is not running, either there is no electrical power to the tank (check breaker at the house) or the pump has failed; If there is power to the tank, then replace the pump in the self-cleaning filter.
 - (d) If the level of water in the tank is below 15 inches, it indicates a water leak from the tank – **this is a serious problem which can only occur right after the system is installed.**

The only other reason for this is that the level stick did not function correctly and allowed the pump to keep running even after the level had attained a depth of 15 inches. If this is the case, cleaning the level stick should eliminate this problem.

NOTE: The septic tank is an underground tank, and hence has a thin plastic wall. If during installation, the installer drags the tank on top of rough ground or installs the tank with stones at the bottom, the tank can very easily develop a leak.

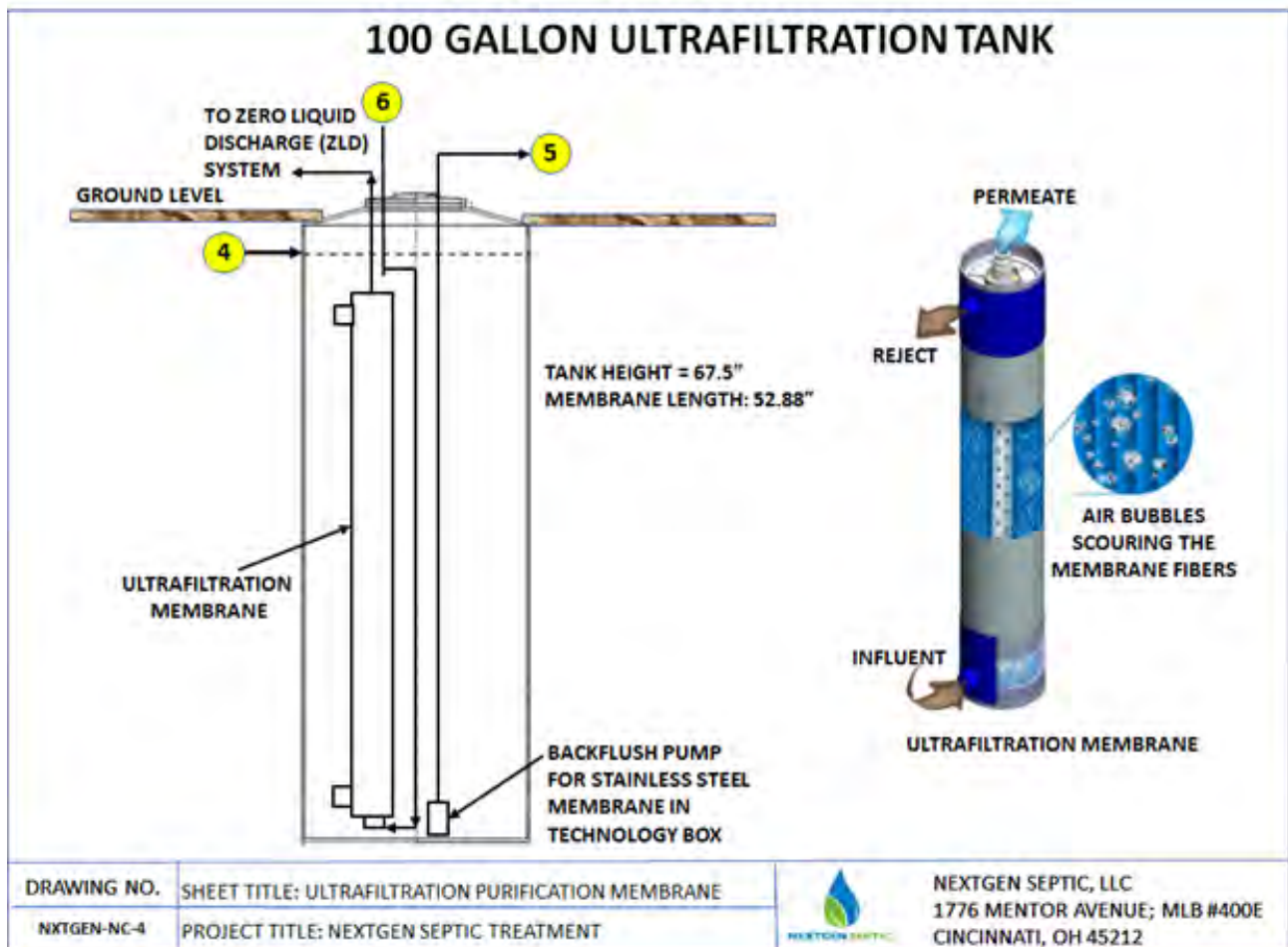
HENCE, IT IS IMPERATIVE, THAT AFTER INSTALLATION OF THE TREATMENT SYSTEM, YOU SHOULD CHECK IF THE WATER DEPTH IN THE TANK IS BEING MAINTAINED, WHEN THE POWER TO THE SYSTEM IS OFF. THIS WILL CHECK IF THERE ARE ANY LEAKS IN THE WALL OF THE SEPTIC TANK, WHICH HAVE OCCURRED DUE TO IMPROPER INSTALLATION. IN THIS CASE, THE INSTALLER IS LIABLE FOR THE COST OF TANK REPLACEMENT AND INSTALLATION OF THE SELF-CLEANING FILTER WITH PUMP IN THE REPLACEMENT TANK.

NOTE: THIS TANK HAS BIOMEDIA AND HENCE SHOULD NEVER BE PUMPED OUT.

3. Check that the air blower in the Technology Box is working. The pressure gauge installed on the exit pipe of the blower should read a gauge pressure higher than 2 psi if the blower is working. There is a spare blower provided in the event that the blower has failed. This spare blower can be used in the event of a failure for the working blower.
4. Check if there are any water leaks in the Technology Box. If there are any leaks, just tighten the screw on the joint to see if that stops the water leak.
5. Check if the air compressor is working by reading the pressure at the exit of the compressor, shown by the pressure gauge. Also, the air compressor is pushing the air into the Ultrafiltration Membrane installed in the 100 gallon tank and the air bubbles will rise inside the body of the membrane housing and bubble up to the surface of the water in the 100 gallon tank, after exiting the top of the membrane. These air bubbles coming to the water surface will be visible when the lid of the 100 gallon tank is opened.

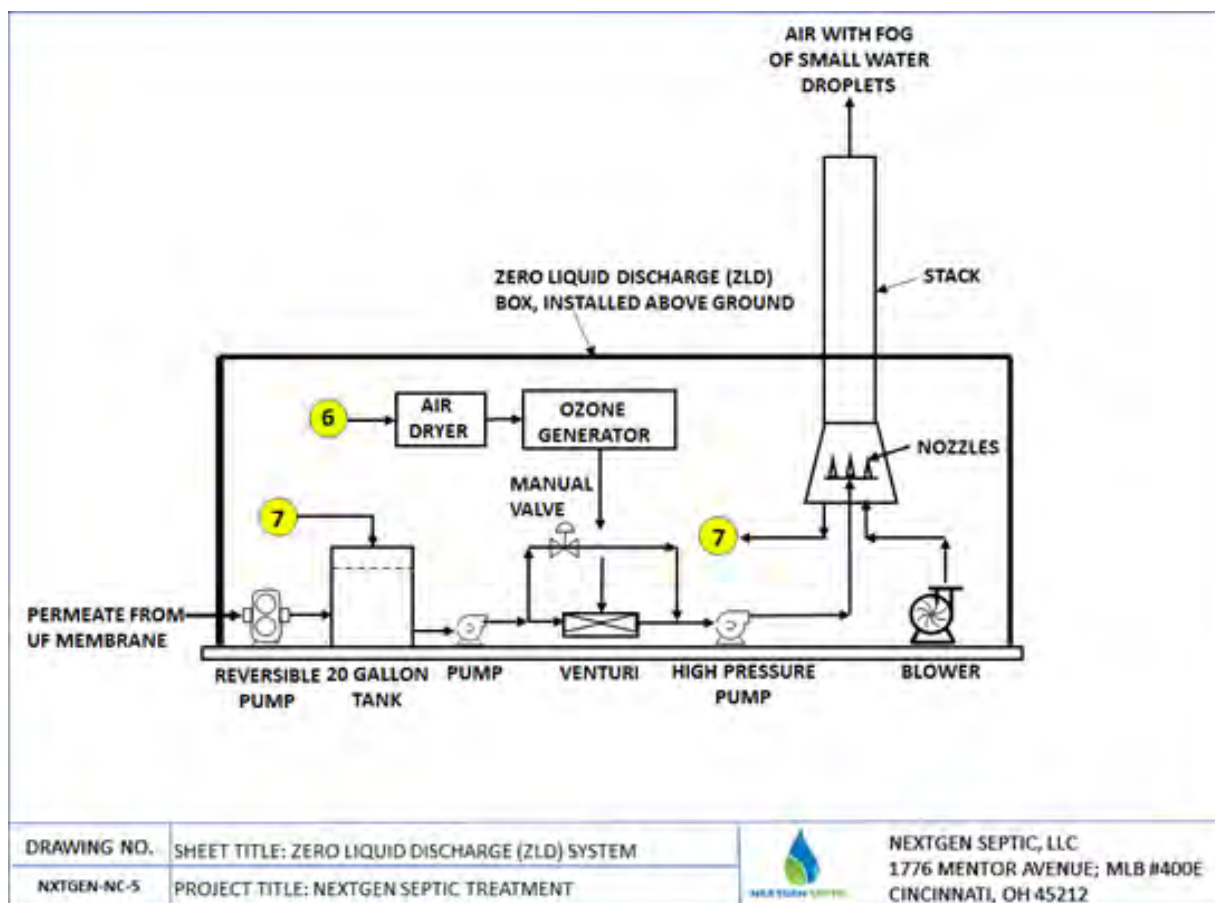
6. There is a test button provided, which when pressed will allow the following treatment system units to start and stop:
- (a) Start and stop the air blower;
 - (b) Start the stop the air compressor; and
 - (c) Backflush the stainless steel membrane, by starting the submersible pump in the 100 gallon tank.
 - (d) Check the level in the 100 gallon tank and see if there is no high level alarm

The following diagram shows the 100 gallon tank with the Ultrafiltration Membrane immersed in the water.



Maintenance Checks for the Zero Liquid Discharge System

The Zero Liquid Discharge (ZLD) schematic is shown on the following page. It is installed in a separate above-ground box, which is typically installed near the house, such that the stack can be supported by the side of the house. The Zero Liquid Discharge (ZLD) has a reversible pump, which draws the liquid from the top of the Ultrafiltration (UF) membrane and pumps it into the 20 gallon tank. The water from this tank will be pumped through a venturi which draws in ozone from an Ozone Generator. Some of the water is by-passed around the venturi and mixed after the addition of ozone.



The liquid is then atomized into 20-30 micron size droplets of water and entrained by air flow from a blower. The stack's rain cap, at the top of the stack, is located just above the roof line of

The critical unit in the ZLD system is the ozone generator, which disinfects the water before being atomized. Ozone is a very effective disinfectant, which when

dissolved in water within the venturi system, enables all viruses, bacteria and any other living form of life to be killed within a few seconds. The disinfected water is then atomized and the 30-50 micron size water droplets are entrained in a the flow of ambient air from the blower.

The following maintenance checks need to be performed on the ZLD unit:

1. There is a test button on the ZLD box, which when pressed, will turn and turn off every pump and blower in the ZLD unit. This allows each pump and blower to be tested. There are pressure gauges at the exit of each pump, which allows the pump's performance to be determined also at the same time.
2. Switches and LED status indicator lights are provided for the ozone generator and the integrated air compressor. The concentration of ozone discharged is controllable from 0 to 100% by a dial potentiometer to vary the current to the CD tube, as displayed on a 300-800 mA amp meter. The unit is protected electrically by an externally accessible fuse.
3. Check if the level in the 20-gallon tank is lower than the high level and there is no high level alarm; and
4. Check if the water droplets coming out of the stack are barely visible against the sky background, which indicates that they are in the 30-50 micron range.

INDEPENDENT TESTING REPORTS/DATA

NextGen Septic has installed several NextGen Septic treatment systems without the Zero Liquid Discharge (ZLD) option, since in most cases, direct discharge options for the treated water were available.

Field data has been collected for over 27 houses in which The NextGen Septic treatment system, without the Ultrafiltration Membrane and the Zero Liquid Discharge System, have been installed and is currently operating. The effluent flow was disinfected using the ozone disinfection system, which is housed in the Zero Liquid Discharge System, for the proposed treatment system.

Analytical report on field data for the effluent before the Ultrafiltration Membrane but with ozone disinfection for a typical house is attached in the following pages.



Pace Analytical Services, LLC
25 Holiday Drive
Englewood, OH 45322
(937)832-8242

February 13, 2019

Brenda Gradek
NextGen Septic LLC
1776 Mentor Avenue
Suite 400 E
Cincinnati, OH 45212

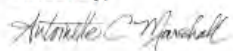
RE: Project: NextGen Septic Residence
Pace Project No.: 526702

Dear Brenda Gradek:

Enclosed are the analytical results for sample(s) received by the laboratory on February 06, 2019. The results relate only to the samples included in this report. Results reported herein conform to the most current, applicable TNI/NELAC standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,



Antoinette Marshall
antoinette.marshall@pacelabs.com
(859)341-9989
Project Manager

Enclosures



REPORT OF LABORATORY ANALYSIS

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Page 1 of 15



Pace Analytical Services, LLC
25 Holiday Drive
Englewood, OH 45322
(937)832-8242

CERTIFICATIONS

Project: NextGen Septic Residence
Pace Project No.: 526702

Ohio Certification IDs

25 Holiday Drive, Englewood, OH 45322
Florida Certification #: E871136
Ohio VAP Certification #: CL0032

Kentucky UST Certification #: 123049
Kentucky Wastewater Certification #: KY98039
Ohio EPA Drinking Water Lab #872

Northern Kentucky Certification IDs

931 Dudley Road, Edgewood, KY 41071
Kentucky Drinking Water Certification #: KY00053

Kentucky Wastewater Certification #: KY00053

REPORT OF LABORATORY ANALYSIS

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NEXTGEN SEPTIC



Pace Analytical Services, LLC

25 Holiday Drive
Englewood, OH 45322
(937)832-8242

ANALYTICAL RESULTS

Project: NextGen Septic Residence

Pace Project No.: 526702

Sample: Residence Composite		Lab ID: 526702001	Collected: 02/06/19 08:58	Received: 02/06/19 14:00	Matrix: Water			
Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total		Analytical Method: EPA 200.7 Preparation Method: EPA 200.7						
Phosphorus	5.9	mg/L	0.10	1	02/08/19 14:37	02/11/19 13:51	7723-14-0	
2130B Turbidity		Analytical Method: SM 2130B-11						
Turbidity	0.40	NTU	0.10	1		02/07/19 13:35		N2
2540D Total Suspended Solids		Analytical Method: SM 2540D						
Total Suspended Solids	ND	mg/L	5.0	1		02/11/19 09:34		
5210B BOD, 5 day		Analytical Method: SM 5210B Preparation Method: SM 5210B						
BOD, 5 day	ND	mg/L	2.0	1	02/08/19 05:10	02/13/19 10:39		N2
4500 Total Kjeldahl Nitrogen		Analytical Method: SM 4500-Norg D-11 Preparation Method: SM 4500-Norg D-11						
Nitrogen, Kjeldahl, Total	1.9	mg/L	0.50	1	02/12/19 13:00	02/13/19 13:58	7727-37-9	
5310C Total Organic Carbon		Analytical Method: SM 5310C-11						
Total Organic Carbon	10.7	mg/L	1.0	1		02/12/19 02:31	7440-44-0	
Sample: Residence Grab		Lab ID: 526702002	Collected: 02/06/19 09:17	Received: 02/06/19 14:00	Matrix: Water			
Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
MBIO E.Coli		Analytical Method: SM 9223B Preparation Method: SM 9223B						
E.coli	3.1	MPN/100mL	1.0	1	02/06/19 16:50	02/07/19 14:13		N2
Colilert-18 Fecal Coliform		Analytical Method: Colilert-18 Preparation Method: Colilert-18						
Fecal Coliforms	<2.0	MPN/100mL	2.0	2	02/06/19 16:50	02/07/19 14:07		N2
Field Data KY		Analytical Method:						
Collected By	DG			1		02/06/19 14:30		N2
Collected Date	02/06/19			1		02/06/19 14:30		N2
Collected Time	09:17			1		02/06/19 14:30		N2
Field pH by SM 4500H+B	6.85	Std. Units		1		02/06/19 14:30		N2
Field Temp-C by SM 2550 B	17.5	deg C		1		02/06/19 14:30		N2

REPORT OF LABORATORY ANALYSIS

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(937)832-8242

QUALITY CONTROL DATA

Project: NextGen Septic Residence
Pace Project No.: 526702

QC Batch: 6426 Analysis Method: EPA 200.7
QC Batch Method: EPA 200.7 Analysis Description: 200.7 Metals, Total
Associated Lab Samples: 526702001

METHOD BLANK: 31535 Matrix: Water
Associated Lab Samples: 526702001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Phosphorus	mg/L	ND	0.10	02/11/19 13:22	

LABORATORY CONTROL SAMPLE: 31536

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Phosphorus	mg/L	2.5	2.4	97	85-115	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 31537 31538

Parameter	Units	526722004 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Qual
Phosphorus	mg/L	0.59	2.5	2.5	3.1	2.9	100	93	75-125	5	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 31539 31540

Parameter	Units	526732002 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Qual
Phosphorus	mg/L	1960 ug/L	2.5	2.5	4.5	4.3	100	93	75-125	4	

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QUALITY CONTROL DATA

Project: NextGen Septic Residence
Pace Project No.: 526702

QC Batch:	6264	Analysis Method:	SM 9223B
QC Batch Method:	SM 9223B	Analysis Description:	9223B MBIO E. coli
Associated Lab Samples:	526702002		

METHOD BLANK: 30765 Matrix: Water

Associated Lab Samples: 526702002

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
E.coli	MPN/100mL	<1.0	1.0	02/07/19 14:13	N2

SAMPLE DUPLICATE: 30766

Parameter	Units	526724003 Result	Dup Result	RPD	Qualifiers
E.coli	MPN/100mL	4.0	<2.0		N2

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QUALITY CONTROL DATA

Project: NextGen Septic Residence
Pace Project No.: 526702

QC Batch:	6265	Analysis Method:	Colilert-18
QC Batch Method:	Colilert-18	Analysis Description:	COL18 Fecal Coliform
Associated Lab Samples:	526702002		

METHOD BLANK:	30772	Matrix:	Water
Associated Lab Samples:	526702002		

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Fecal Coliforms	MPN/100mL	<1.0	1.0	02/07/19 14:07	N2

SAMPLE DUPLICATE: 30773

Parameter	Units	526702002 Result	Dup Result	RPD	Qualifiers
Fecal Coliforms	MPN/100mL	<2.0	<2.0		N2

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QUALITY CONTROL DATA

Project: NextGen Septic Residence
Pace Project No.: 526702

QC Batch: 6333 Analysis Method: SM 2130B-11
QC Batch Method: SM 2130B-11 Analysis Description: 2130B Turbidity
Associated Lab Samples: 526702001

METHOD BLANK: 31086 Matrix: Water
Associated Lab Samples: 526702001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Turbidity	NTU	ND	0.10	02/07/19 13:35	N2

LABORATORY CONTROL SAMPLE: 31087

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Turbidity	NTU	1	1.0	101	90-110	N2

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QUALITY CONTROL DATA

Project: NextGen Septic Residence
Pace Project No.: 526702

QC Batch: 6498 Analysis Method: SM 2540D
QC Batch Method: SM 2540D Analysis Description: 2540D Total Suspended Solids
Associated Lab Samples: 526702001

METHOD BLANK: 31783 Matrix: Water
Associated Lab Samples: 526702001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Total Suspended Solids	mg/L	ND	5.0	02/11/19 09:33	

SAMPLE DUPLICATE: 31784

Parameter	Units	526816001 Result	Dup Result	RPD	Qualifiers
Total Suspended Solids	mg/L	12.0	12.0	0	

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QUALITY CONTROL DATA

Project: NextGen Septic Residence
Pace Project No.: 526702

QC Batch: 6394 Analysis Method: SM 5210B
QC Batch Method: SM 5210B Analysis Description: 5210B BOD, 5 day
Associated Lab Samples: 526702001

METHOD BLANK: 31426 Matrix: Water
Associated Lab Samples: 526702001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
BOD, 5 day	mg/L	ND	2.0	02/13/19 10:32	N2

LABORATORY CONTROL SAMPLE: 31428

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
BOD, 5 day	mg/L	198	204	103	85-115	N2

SAMPLE DUPLICATE: 31429

Parameter	Units	526906002 Result	Dup Result	RPD	Qualifiers
BOD, 5 day	mg/L	247	224	10	N2

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QUALITY CONTROL DATA

Project: NextGen Septic Residence
Pace Project No.: 526702

QC Batch: 6657 Analysis Method: SM 4500-Norg D-11
QC Batch Method: SM 4500-Norg D-11 Analysis Description: 4500N -D TKN
Associated Lab Samples: 526702001

METHOD BLANK: 32205 Matrix: Water
Associated Lab Samples: 526702001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Nitrogen, Kjeldahl, Total	mg/L	ND	0.50	02/13/19 13:51	

LABORATORY CONTROL SAMPLE: 32206

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nitrogen, Kjeldahl, Total	mg/L	26.4	26.0	98	81-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 32207 32208

Parameter	Units	526754001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Qual
Nitrogen, Kjeldahl, Total	mg/L	ND	10	10	8.9	8.2	89	82	81-133	8	

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QUALITY CONTROL DATA

Project: NextGen Septic Residence
Pace Project No.: 526702

QC Batch: 6579 Analysis Method: SM 5310C-11
QC Batch Method: SM 5310C-11 Analysis Description: 5310C Total Organic Carbon
Associated Lab Samples: 526702001

METHOD BLANK: 32032 Matrix: Water
Associated Lab Samples: 526702001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Total Organic Carbon	mg/L	ND	1.0	02/11/19 18:02	

LABORATORY CONTROL SAMPLE: 32033

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Total Organic Carbon	mg/L	10	10.5	105	90-110	

MATRIX SPIKE SAMPLE: 32034

Parameter	Units	526529001 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Total Organic Carbon	mg/L	4.8	4	8.5	91	80-120	

SAMPLE DUPLICATE: 32035

Parameter	Units	526529002 Result	Dup Result	RPD	Qualifiers
Total Organic Carbon	mg/L	2.7	2.7	0	

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QUALIFIERS

Project: NextGen Septic Residence
Pace Project No.: 526702

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.
ND - Not Detected at or above adjusted reporting limit.
TNTC - Too Numerous To Count
J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.
MDL - Adjusted Method Detection Limit.
PQL - Practical Quantitation Limit.
RL - Reporting Limit - The lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.
S - Surrogate
1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.
Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.
LCS(D) - Laboratory Control Sample (Duplicate)
MS(D) - Matrix Spike (Duplicate)
DUP - Sample Duplicate
RPD - Relative Percent Difference
NC - Not Calculable.
SG - Silica Gel - Clean-Up
U - Indicates the compound was analyzed for, but not detected.
N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.
Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.
TNI - The NELAC Institute.

ANALYTE QUALIFIERS

N2 The lab does not hold NELAC/TNI accreditation for this parameter but other accreditations/certifications may apply. A complete list of accreditations/certifications is available upon request.

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QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: NextGen Septic Residence
Pace Project No.: 526702

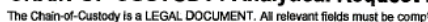
Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
526702001	Residence Composite	EPA 200.7	6426	EPA 200.7	6479
526702002	Residence Grab	SM 9223B	6264	SM 9223B	6318
526702002	Residence Grab	Colilert-18	6265	Colilert-18	6319
526702002	Residence Grab				
526702001	Residence Composite	SM 2130B-11	6333		
526702001	Residence Composite	SM 2540D	6498		
526702001	Residence Composite	SM 5210B	6394	SM 5210B	6689
526702001	Residence Composite	SM 4500-Norg D-11	6657	SM 4500-Norg D-11	6764
526702001	Residence Composite	SM 5310C-11	6579		

REPORT OF LABORATORY ANALYSIS

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PM: ACM
CLIENT: NEXTGEN

☒ NPDES ☐ GROUND WATER ☐ DRINKING WATER
☐ LIST ☐ RCRA ☐ OTHER

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Darren Grant

SIGNATURE of SAMPLER:

DATE Signed (MM/DD/YY): 2-6-19


Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Page	Samples Intact (Y/N)
			14	
			15	

*Important Note: By signing this form you are accepting Pace's NET 30 day payment terms and agreeing to late charges of 1.5% per month for any invoices not paid within 30 days

F-ALL-Q-020rev.08, 12-Oct-2007



NEXTGEN SEPTIC

 **WO#: 526702**
Client Name: **526702**

Courier: ☐ Fed Ex ☐ UPS ☐ USPS ☐ Client ☐ Commercial ☐ Other
Tracking #: _____

Custody Seal on Cooler/Box Present: ☐ yes ☒ no Seals intact: ☐ yes ☐ no

Packing Material: ☐ Bubble Wrap ☐ Bubble Bags ☒ None ☐ Other _____

Thermometer Used _____ Login IR# **3** Type of Ice: Wet ☒ Blue ☐ None ☒ Samples on ice, cooling process has begun

Cooler Temperature **4.5** **0** **4.4** Temp should be above freezing to 6°C
Uncor CF Final

Date and Initials of person examining contents: **DA 2-26-19**

Chain of Custody Present:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	1.
Chain of Custody Filled Out:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	2.
Chain of Custody Relinquished:	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	3.
Sampler Name & Signature on COC:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	4.
Samples Arrived within Hold Time:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	5.
Short Hold Time Analysis (<72hr):	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	6. E. coli Fecal BOD
Rush Turn Around Time Requested:	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A	7.
Sufficient Volume:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	8.
Correct Containers Used:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	9.
-Pace Containers Used:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
Containers Intact:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	10.
Filtered volume received for Dissolved tests	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A	11.
Sample Labels match COC:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	12.
-Includes date/time/ID/Analysis Matrix: WW		
Samples checked for dechlorination:	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	14. *
Headspace in VOA Vials (>6mm):	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	15.
Trip Blank Present:	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	16.
Trip Blank Custody Seals Present	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
Pace Trip Blank Lot # (if purchased):		

NEXTGEN SEPTIC FIELD DATA

(Samples taken in the field from actual installations of NextGen Septic were analyzed in PRD Tech, Inc.'s lab)

NEXTGEN SEPTIC INFLUENT FIELD RAW DATA							NEXTGEN SEPTIC EFFLUENT DATA					PERFORMANCE ANALYSIS			
NextGen Septic Installation (name withheld to maintain privacy)	cBOD5	TSS	NH3-N	TP	pH	Fecal Coliforms (MPN/100 mL)	cBOD5	TSS	NH3-N	TP	Coliforms (MPN/100 mL)	% Removal BOD	% Removal NH3	% Removal TP	% Removal Fecal Coliforms
1															
Home installation in Ohio	475	1030	15.7	7.8	8.0	1.39E+05	6.7	BDL	0.0	0.0	0	98.59	98.09	100.00	100.00
in Warren county, where we have experimental approval	330	990	13.8	9.0	7.8	1.41E+05	7.0	BDL	0.0	0.0	0	97.88	97.83	100.00	100.00
	400	834	11.0	10.8	8.2	2.02E+05	7.0	BDL	0.0	0.0	0	98.25	97.27	100.00	100.00
	600	1350	8.2	11.2	7.9	2.80E+05	7.0	BDL	0.0	0.0	0	98.83	96.34	100.00	100.00
	220	496	19.8	9.8	7.5	1.61E+04	7.2	BDL	0.0	0.0	0	96.73	98.48	100.00	100.00
	300	598	11.2	14.7	7.7	1.80E+04	7.0	BDL	0.0	0.0	0	97.67	97.32	100.00	100.00
	210	890	6.8	9.1	8.0	5.13E+05	6.8	BDL	0.0	0.0	0	96.76	95.59	100.00	100.00
	560	1200	19.0	16.9	8.1	7.04E+07	7.3	BDL	0.0	0.0	0	98.70	98.42	100.00	100.00
	800	2280	22.0	6.7	7.4	1.54E+04	7.6	BDL	0.0	0.0	0	99.05	98.64	100.00	100.00
	660	1400	7.8	19.0	8.2	8.79E+05	7.0	BDL	0.0	0.0	0	98.94	96.15	100.00	100.00
2															
Camargo Club Pro-shop	569	766	12.9	13.1	7.9	2.97E+05	7.1	BDL	2.3	0.9	1	98.75	97.67	82.17	100.00
Only runs for a few months from early May to end of Sept	341	881	8.2	8.1	7.5	1.08E+04	5.5	BDL	3.6	0.6	2	98.39	96.34	56.10	99.98
	272	1081	16.7	11.1	8.3	5.52E+06	7.5	BDL	4.1	1.1	1	97.24	98.20	75.45	100.00
	725	1759	8.0	8.8	8.3	3.97E+05	8.2	BDL	3.6	0.8	10	98.87	96.25	55.00	100.00
	107	437	2.9	8.5	7.9	5.42E+05	7.0	BDL	3.1	0.7	5	93.46	89.66		100.00
3															
Camargo Club Swimming Pool	225	1140	5.8	6.1	7.8	1.25E+04	7.8	BDL	4.2	0.8	4	96.53	94.83	27.59	99.97
Early may to end of Sept	141	1190	21.0	11.5	7.5	3.66E+05	5.7	BDL	3.3	0.4	5	95.96	98.57	84.29	100.00
Had issues with FOG from food canteen	604	1078	16.7	5.6	8.8	1.29E+05	5.5	BDL	2.4	0.9	4	99.09	98.20	85.63	100.00
Had to empty out the Grease trap	629	1132	10.7	18.8	9.1	5.10E+05	6.9	BDL	3.1	0.6	6	98.90	97.20	71.03	100.00
4															
Camargo Club Tennis Courts	515	1070	5.4	15.4	8.7	1.06E+04	9.5	BDL	3.3	1.1	10	98.16	94.44	38.89	99.91
Had several power failures and had to install new power line to toilet	263	924	12.7	5.5	6.9	6.83E+05	7.9	BDL	4.5	0.7	2	97.00	97.64	64.57	100.00
	143	1287	14.6	8.3	8.4	1.34E+04	9.5	BDL	2.2	0.8		93.36	97.95	84.93	100.00
	876	2701	12.7	5.4	7.8	1.59E+04	6.9	BDL	2.1	1.0		99.21	97.64	83.46	100.00
5															
Home in Kentucky	179	186	4.4	9.0	7.8	1.14E+04	4.7	BDL	3.3	0.7	8	97.37	93.18	25.00	99.93
No details available	163	0	7.2	5.6		8.49E+05	9.0	BDL	4.1	1.0	2	94.48	95.83	43.06	100.00
	168	737	19.5	10.7	8.8	8.93E+05	6.3	BDL	2.2	0.9	3	96.25	98.46	88.72	100.00
	557	1075	26.1	4.2	6.6	1.49E+04	7.2	BDL	4.5	0.9	1	98.71	98.85	82.76	99.99
	881	1543	1.6	27.5	8.2	1.58E+04	6.5	BDL	4.0	1.1	2	99.26	81.25		99.99
6															
Home in Kentucky	502	1476	6.7	11.2	9.4	1.29E+04	7.9	BDL	2.1	0.4	4	98.43	95.52	68.66	99.97
Lots of parties	316	1135	14.6	8.8	7.4	1.47E+04	5.9	BDL	4.6	1.2	3	98.13	97.95	68.49	99.98
Too social for septic	186	1570	20.8	14.2	8.2	1.76E+04	5.7	BDL	3.4	0.7	2	96.94	98.56	83.65	99.99
	712	2444	7.2	0.7	7.3	1.08E+04	6.7	BDL	4.5	1.1	11	99.06	95.83	37.50	99.90
	166	125	6.6	7.5	8.4	8.06E+07	5.4	BDL	1.9	0.9	7	96.75	95.45	71.21	100.00

NEXTGEN SEPTIC INFLUENT FIELD RAW DATA							NEXTGEN SEPTIC EFFLUENT DATA					PERFORMANCE ANALYSIS			
NextGen Septic Installation (name withheld to maintain privacy)	cBOD5	TSS	NH3-N	TP	pH	Fecal Coliforms (MPN/100 mL)	cBOD5	TSS	NH3-N	TP	Coliforms (MPN/100 mL)	% Removal BOD	% Removal NH3	% Removal TP	% Removal Fecal Coliforms
7			11.6	9.8	7.4	1.76E+04	9.7	BDL	4.3	1.3	6		97.41	62.93	99.97
Kentucky home	113		9.0	4.9	0.0	1.46E+04	6.7	BDL	3.6	0.5	1	94.07	96.67	60.00	99.99
	175	1162	21.5	10.9	9.4	1.49E+04	7.2	BDL	2.0	1.3	5	95.89	98.60	90.70	99.97
	381	1014	11.4	7.3	7.4	1.79E+04	8.2	BDL	1.8	0.5	2	97.85	97.37	84.21	99.99
	1036	2078	1.2	18.0	7.8	7.84E+05	5.9	BDL	3.9	1.2		99.43	75.00		100.00
8															
Kentucky home	677	1545	7.7	10.5	8.3	1.69E+04	6.2	BDL	3.0	0.5		99.08	96.10	61.04	
	436	1554	11.8	5.3	0.0	1.70E+04	8.0	BDL	1.9	1.3	5	98.17	97.46	83.90	99.97
	253	1753	14.7	13.0	7.6	6.25E+05	5.9	BDL	2.9	0.5		97.67	97.96	80.27	
	168	1637	4.5	0.6	7.8	4.93E+05	5.6	BDL	3.3	1.0		96.67	93.33	26.67	
	329	81	5.6	7.5	7.9	1.40E+04	5.0	BDL	2.9	1.1	14	98.48	94.64	48.21	99.90
9															
Kentucky home	115		5.5	4.7	7.8	1.33E+04	6.1	BDL	3.9	1.3	1	94.70	94.55	29.09	99.99
	170	1074	28.3	3.0	7.9	1.03E+04	7.8	BDL	3.4	0.7	9	95.41	98.94	87.99	99.91
	284	1425	8.5	5.5	8.3	1.69E+04	7.0	BDL	1.9	1.2	9	97.54	96.47	77.65	99.95
	202	1302	1.8	9.4	7.4	1.26E+04	5.9	BDL	4.2	1.3	5	97.08	83.33		99.96
10															
Kentucky home	327	1705	7.2	8.6	8.1	1.50E+04	5.8	BDL	4.1	1.0	2	98.23	95.83	43.06	99.99
	521	1660	14.1	0.5	8.3	1.80E+04	5.8	BDL	2.6	1.3	15	98.89	97.87	81.56	99.92
	188	1114	1.3	15.4	7.9	1.30E+04	5.0	BDL	2.2	1.2	0	97.34	76.92		100.00
	219	2633	5.7	0.5	0.0	1.24E+04	7.2	BDL	2.5	0.8	9	96.71	94.74	56.14	99.93
	350	78	4.7	7.1	8.2	1.74E+04	7.2	BDL	3.7	0.6	1	97.94	93.62	21.28	99.99
			23.3	16.3	8.0	1.32E+04	5.7	BDL	2.3	0.4	2		98.71	90.13	99.98
			0.0												
11															
Kentucky home	51	1578	25.0	1.0	8.2	5.32E+05	4.9	BDL	2.4	0.6	1	90.39	98.80	90.40	100.00
	251	1226	13.2	7.1	8.9	1.33E+05	8.5	BDL	3.1	0.8	2	96.61	97.73	76.52	100.00
		1203	3.0	6.7	7.7	4.36E+05	7.0	BDL	4.3	0.7	4		90.00		100.00
12															
Kentucky home	350	1241	8.3	10.5	7.8	6.63E+05	6.3	BDL	2.7	0.7		98.20	96.39	67.47	100.00
	577	3027	22.2	0.8	8.0	1.77E+04	6.4	BDL	2.6	1.3	10	98.89	98.65	88.29	99.94
	29	1099	1.0	13.7	0.0	1.78E+04	9.7	BDL	3.6	0.7	11	66.55	70.00		99.94
	351	3050	3.0	0.3	8.3	6.03E+05	6.6	BDL	3.6	1.3	4	98.12	90.00		100.00
	135	56	4.3	7.5	7.4	1.43E+04	9.2	BDL	3.7	1.1	15	93.19	93.02	13.95	99.90



NEXTGEN SEPTIC INFLUENT FIELD RAW DATA							NEXTGEN SEPTIC EFFLUENT DATA					PERFORMANCE ANALYSIS			
NextGen Septic Installation (name withheld to maintain privacy)	cBOD5	TSS	NH3- N	TP	pH	Fecal Coliforms (MPN/100 mL)	cBOD5	TSS	NH3- N	TP	Coliforms (MPN/100 mL)	% Removal BOD	% Removal NH3	% Removal TP	% Removal Fecal Coliforms
13															
Kentucky home			8.8	4.1	8.5	1.42E+04	9.0	BDL	3.4	0.7	3		96.59	61.36	99.98
	68	2430	16.2	0.3	7.7	1.78E+04	5.2	BDL	1.9	0.8	1	92.35	98.15	88.27	99.99
	64	1868	11.1	4.0	8.2	1.00E+04	7.5	BDL	4.6	0.5	14	88.28	97.30	58.56	99.86
		1742	1.3	5.7	8.3	1.44E+04	8.6	BDL	3.2	1.2			76.92		100.00
14															
Kentucky home	435	988	8.1	6.2	8.2	1.55E+04	7.6	BDL	1.9	0.7		98.25	96.30	76.54	100.00
	1030	1626	17.1	0.6	8.7	8.07E+05	7.3	BDL	2.9	1.0	2	99.29	98.25	83.04	100.00
	30	1106	0.5	11.1	8.4	2.46E+05	9.5	BDL	4.6	1.1	6	68.33	40.00		100.00
	257	4800	0.6	0.1	8.4	6.08E+05	8.1	BDL	3.5	1.1	1	96.85	50.00		100.00
	15	69	2.9	4.9	0.0	6.75E+05	9.2	BDL	3.1	1.2	1	38.67	89.66		100.00
			24.6	24.2	8.4	6.12E+05	7.1	BDL	1.9	1.1	6		98.78	92.28	100.00
15			0.0												
Kentucky home	97	2474	12.9	0.4	8.7	5.53E+05	5.2	BDL	4.0	1.0	15	94.64	97.67	68.99	100.00
	80	590	8.2	3.7	8.8	1.76E+04	8.4	BDL	2.3	1.2	13	89.50	96.34	71.95	99.93
		1876	2.0	7.3		4.60E+05	5.3	BDL	4.0	0.5			85.00		100.00
16															
Kentucky home	292	115	10.7	5.9	7.8	5.49E+06	6.7	BDL	3.0	1.1	5	97.71	97.20	71.96	100.00
Occupants had gone to Europe for	1648	1758	12.2	0.8	7.8	1.05E+04	8.3	BDL	2.5	0.8	11	99.50	97.54	79.51	99.90
	3	424	0.4	13.6	7.9	1.65E+04	9.7	BDL	3.2	0.9	2		25.00		99.99
	388	6120	0.7	0.1		1.19E+04	6.4	BDL	4.2	1.2	15	98.35	57.14		99.87
	780	60	4.0	5.7	7.2	9.11E+05	9.4	BDL	3.3	0.4	2	98.79	92.50	17.50	100.00
	850	120	16.3	8.4	7.4	1.38E+05	9.2	BDL	2.6	0.9	2	98.92	98.16	84.05	100.00
17			0.0							0.0					
Kentucky home	70	2365	10.6	0.5	7.1	7.37E+05	9.0	BDL	3.3	1.3	1	87.14	97.17	68.87	100.00
	142	744	5.4	2.2		1.71E+04	8.2	BDL	1.9	1.3	4	94.23	94.44	64.81	99.98
18											0				
Kentucky home	200	189			8.0	3.93E+05	4.8	BDL	4.5	1.2	1	97.60			100.00
Had kitchen waste connected to septic	252	166	10.3	7.8	8.8	1.32E+04	8.4	BDL	4.5	0.7		96.67	97.09	56.31	100.00
	2021	1701	7.7	1.0	7.4	1.14E+04	9.0	BDL	1.7	1.3	9	99.55	96.10	77.92	99.92
	4	143	0.5	12.4	7.6	1.49E+04	5.5	BDL	3.8	0.4			40.00		100.00
	269	8277	0.4	0.2	0.0	1.68E+04	7.4	BDL	3.7	0.4	6	97.25	25.00		99.96
	1052	14	3.2	4.6	8.2	1.79E+04	5.0	BDL	3.2	1.0	2	99.52	90.63	0.00	99.99
	1350		17.1	10.6	7.8	1.16E+04	9.2	BDL	2.7	0.6		99.32	98.25	84.21	100.00
	1100		1.8	1.9	8.6	1.24E+04	9.0	BDL	3.2	1.3	1	99.18	83.33		99.99
19															
Kentucky home	177	728	6.2	1.2	7.6	7.37E+06	5.5	BDL	3.1	0.5	1	96.89	95.16	50.00	100.00
		1356	1.1	15.5	7.3	9.59E+05	7.1	BDL	2.1	0.8	2		72.73		100.00
20			0.0			0.00E+00									
Kentucky home	700	95	7.3	7.7	7.6	1.46E+04	8.8	BDL	2.4	0.9		98.74	95.89	67.12	100.00
Had kitchen waste connected to septic	1977	1885	11.1	1.8	7.8	1.08E+04	6.3	BDL	3.0	0.4		99.68	97.30	72.97	100.00
	3	107	0.6	17.7	7.4	6.25E+05	6.3	BDL	1.8	1.1			50.00		100.00
	174	4265	0.6	0.1	8.1	1.08E+04	9.7	BDL	2.6	0.6	15	94.43	50.00		99.86
	387	4	3.8	5.9	7.7	1.24E+04	7.6	BDL	3.5	0.8	14	98.04	92.11	7.89	99.89
	470	600	24.0	11.7	8.2	3.66E+06	8.3	BDL	4.2	1.1	2	96.23	98.75	82.50	100.00

NEXTGEN SEPTIC INFLUENT FIELD RAW DATA							NEXTGEN SEPTIC EFFLUENT DATA					PERFORMANCE ANALYSIS			
NextGen Septic Installation (name withheld to maintain privacy)	cBOD5	TSS	NH3-N	TP	pH	Fecal Coliforms (MPN/100 mL)	cBOD5	TSS	NH3-N	TP	Coliforms (MPN/100 mL)	% Removal BOD	% Removal NH3	% Removal TP	% Removal Fecal Coliforms
21															
Kentucky home	370	681	12.7	0.8	7.8	1.16E+04	6.3	BDL	1.9	1.0	6	98.30	97.64	85.04	99.95
	263	1078	1.3	1.8	7.4	3.05E+05	6.5	BDL	3.1	0.7	1	97.53	76.92		100.00
	0	2216	0.3	26.4		6.19E+05	6.8	BDL	4.2	0.8	3		0.00		100.00
22															
Kentucky home	760	99	7.0	5.6		8.64E+05	8.9	BDL	1.8	1.0	5	98.83	95.71	74.29	100.00
Had kitchen waste connected to septic	2828	1936	15.7	1.8	8.0	1.23E+04	6.9	BDL	2.6	0.6	1	99.76	98.09	83.44	99.99
	3	46	0.9	24.6	7.8	1.74E+04	5.7	BDL	3.4	1.0			66.67		100.00
	109	3648	0.6	0.1		3.93E+05	7.8	BDL	4.6	0.6		92.84	50.00		100.00
	707	6	2.9	8.2	8.0	6.97E+05	5.4	BDL	2.2	0.9	11	99.24	89.66	24.14	100.00
			21.2	9.4	8.1	1.61E+04	8.3	BDL	2.1	0.4			98.58	90.09	100.00
23															
Kentucky home		654	10.7	1.0	8.4	3.88E+05	9.5	BDL	3.3	1.1	1		97.20	69.16	100.00
	122		2.1	2.4		2.04E+05	8.7	BDL	2.0	1.3	12	92.87	85.71	4.76	99.99
24	300	3060	0.6	26.4	7.1	1.67E+04	8.0	BDL	3.5	1.0	3	97.33	50.00		99.98
Kentucky home	800		0.0	0.0	8.0	4.86E+05	9.0	BDL	2.4	1.3	1	98.88			100.00
	938	18	6.0	6.0	8.7	1.63E+04	8.5	BDL	3.8	1.1	1	99.09	95.00	36.67	99.99
	1985	2082	9.4	3.2	8.2	7.01E+05	8.2	BDL	3.8	1.1	10	99.59	96.81	59.57	100.00
25															
Kentucky home	1	35	0.2	0.1		3.30E+05	5.7	BDL	3.8	1.3	6				100.00
	158	1068	2.1	10.9	7.9	1.64E+04	7.7	BDL	3.2	1.0	3	95.13	85.71		99.98
	557	5	10.8	4.7	7.9	1.54E+05	4.7	BDL	2.3	0.8	8	99.16	97.22	78.70	99.99
26															
Kentucky home	400		9.0	0.9	7.7	1.02E+04	8.8	BDL	4.4	1.0	6	97.80	96.67	51.11	99.94
	420	566	3.3	2.5	7.7	1.03E+05	7.0	BDL	4.2	0.5	1	98.33	90.91		100.00
	45		0.6	19.2	7.3	3.57E+05	9.0	BDL	2.1	1.3	10	80.00	50.00		100.00
27															
Kentucky home	0		8.3	6.7	8.3	1.71E+04	6.2	BDL	4.6	1.0	1		96.39	44.58	99.99
Construction debris	660	24	10.7	3.9	7.8	1.80E+04	9.0	BDL	2.3	0.6		98.64	97.20	78.50	100.00
	2304	2420	0.5	38.8	8.0	1.04E+04	9.0	BDL	4.2	1.1	1	99.61	40.00		99.99
	2	34	2.4		7.5		8.3	BDL	3.9	0.9	3		87.50		