

Our Journey to a Urine-Diverting Composting Toilet

One way we are meeting our mission of Zero-Waste Design



The Round the Bend Farm (RTB) team works diligently to ensure our infrastructure, programming and development is integrated into the landscape in ways that mitigate and lessen unnecessary burdens on the environment and restore the land and our connection to it. As we strive to be a living laboratory for restorative solutions we are constantly looking at ways to decrease our carbon footprint. By installing a urine diverting-composting toilet in our farmhouse we are meeting part of our mission of zero-waste design.

Recycling humanure through composting toilets, and specifically urine-diverting composting toilets, allows us to manage humanure as a resource rather than a waste product. Finished compost can be harvested and returned to local soils rather than mixed with clean water and disposed of through an expensive and environmentally taxing septic system or sewer. We believe that composting toilets serve as a root cause solution to financial and environmental problems associated with conventional wastewater management. In addition, we believe that urine-based fertilizer can be beneficial for agricultural purposes, particularly for pasture management, as many hay fields are annually sprayed with potentially harmful synthetic fertilizers.

RTB's interest in composting toilets and our desire to install one began with our friends and colleagues at Rancho Mastatal, an environmental education center in Costa Rica. For the past 15 years they have experimented with dozens of different types of composting toilets to fit their needs in a rural tropical setting. Though our own journey to installing and using a composting toilet here in the northeast was much different, we ultimately shared a common goal of responsibly managing humanure without environmental harm.

It wasn't until RTB had ownership of the farm in May of 2013 that we could act on replacing our flush toilets. In July 2015, we legally installed a Full Circle urine-diverting composting toilet in our farmhouse. When we started looking into our options it became clear that there is a general lack of clarity and awareness of what composting toilets are, the different types available, how they work, and regulations governing their use. With that in mind we set off on our journey to fully understand technical, social, and regulatory aspects of available composting toilets in hopes of shedding some light on their benefits and demonstrating how others could more easily adopt their use. Early in our endeavor, we enlisted the help of our friend Ben Goldberg, a composting



toilet installer, and ecological sanitation planner Conor Lally to guide us through the process. It was important for us to first establish goals and identify the benefits of installing a composting toilet on the farm, which helped with our research and in determining the right composting toilet for RTB.

RTB's Compost Toilet Goals and Objectives:

- Manage humanure as a resource and zero-waste design;
- Demonstrate eco-sanitation as a safe and effective alternative to the conventional wastewater systems;
- Utilize RTB's network as a driving force in the campaign to work with regulatory and cultural barriers associated with eco-sanitation;
- Safely and effectively transform human 'waste' into a hygienic, nutrient rich fertilizer; and
- Serve as a resource of information and guidance for individuals interested in better understanding and possibly implementing a composting toilet at their home, business, school or farm.

Benefits of Composting Toilets:

- Does not use water for flushing and conserves potable water supplies;
- Does not require expensive sewerage and centralized treatment infrastructure;
- Does not discharge polluted water into the environment;
- Recycles nutrients back into the soil;
- Breaks down pathogens and pharmaceuticals in human excrement;
- Provides a secure and resilient sanitation system;
- Low energy requirements;
- Requires no hazardous chemicals; and
- Supports local resource economy and job creation.

Phase 1: Identifying Our Needs and Options

As part of the planning process we conducted a thorough assessment of the existing infrastructure and the number and nature of our occupants and visitors. This step guided and informed our selection criteria for choosing which composting toilet system was most suitable for the farmhouse retrofit.

The farmhouse is a four-bedroom, two-family dwelling. Each of the two apartments has two bedrooms, one toilet, and two sinks. The house currently serves as the main gathering space for the team and visitors. The house is served by a septic system that collects and infiltrates combined greywater and blackwater through a soil absorption system (SAS). At this time, the septic system still accepts flows from sinks, showers, and the second-floor toilet. The design flow of this system is 440gpd, based on a standard estimate of 110 gallons per bedroom. Sewage flows to a 1500 gallon, two compartment tank, and then infiltrates through a 667SF leaching system. We chose to convert the first floor bathroom to a waterless urine diverting composting toilet. The number of users for the house fluctuates between about 4 and 6 full-time users, in addition to daily visitors during the growing season.

The two composting toilet systems we selected to investigate further were the Phoenix Composting Toilet and the Full Circle Composting Toilet. They differed slightly in space

requirements, maintenance procedures, and approval processes. Both systems would require some carpentry and plumbing work for the farmhouse retrofit.



Since we are a working farm with managed pasture, urine diversion quickly became an appealing option for us. Urine diversion utilizes a special toilet seat or insert that allows for urine to be collected separately from solids. The urine diverting commode directs urine to a modified plastic drum in the basement. Urine diversion was feasible for both the Phoenix and the Full Circle, although a urine diverting Phoenix has yet to be installed, whereas the Full Circle was designed to include urine diversion.

The Phoenix Composting System

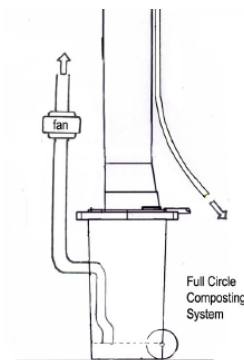
Manufactured in Whitefish, MT, the Phoenix is a single, stationary storage vessel that is usually positioned in the basement directly under bathroom, (www.compostingtoilet.com). It is vented through a 3" vent pipe and fan, and is equipped with an overflow effluent pump and would be tied to the greywater line. Weekly maintenance includes turning of the tines to maintain a uniform compost mix and aeration and recirculating liquid with a hand pump. As material accumulates, mature material is harvested through the bottom access hatch.

A major advantage of the Phoenix is that it is a fully approved system in Massachusetts. The Phoenix is approved for general use under Title 5, complies with state plumbing code standards, has NSF 41 testing approval, and a product acceptance number. The main drawback for using the Phoenix in the farmhouse retrofit was its size. As it turned out, the narrow back door and staircase into the basement could not accommodate the two halves of the Phoenix without major renovations.



The Full Circle Composting Toilet

The Full Circle system is a modular, multi-bin system and is manufactured in Putney, Vermont by Abraham Noe-Hays, (www.fullcirclecompost.org). The collection units are modified tote bins that can be wheeled in and out of position. The modular design of the Full Circle system can adapt to fluctuations in number of users. When a bin becomes full, it is unhooked from the main chute, set aside to continue composting, and an empty bin takes its place. The modular design is also well suited for smaller basement spaces with low ceiling clearance, as is the case at the farmhouse. Depending on usage and how fast bins fill up, they may require more floor space compared to the Phoenix.



A disadvantage to the Full Circle system is that it is not approved for general use under the state plumbing code, has not been tested to NSF 41 standards, and does not have a product acceptance number. It is currently approved by the Plumbing Board for piloting at the Cape Cod Eco-Toilet Center.

Field Trip

In early 2015, Desa, Geoff and Liz the RTB team leading the compost toilet charge ventured off on a field trip to Falmouth, MA to visit Hilde Maingay and Earle Barnhart at The Green Center, Inc. a non-profit educational institute. In the fall of 2012, The Green Center opened the Cape Cod Eco-Toilet Center, a showroom of compost toilet designs from all around the world, (<http://capecodecotoiletcenter.com>). Our trip allowed us to see a Full Circle system in action and to hear Earle and Hilde's endorsement of the system. They chose to replace their old Clivus Multrum with a Full Circle composting toilet as part of the Town's ecotoilet demonstration project.

Initial Cost Comparison between the Phoenix and Full Circle

The Phoenix system for the farmhouse was estimated to cost approximately \$6,000 (not including urine storage tank and installation labor). The Full Circle system is estimated to cost approximately \$2,500, but with the additional totes and urine storage tank, the total cost was closer to \$3500 (not including urine storage and installation labor).

Phase 2: Understanding Applicable Regulations and Getting Approved

A major part of our effort was to fully understand applicable regulations. If our house accommodated a Phoenix unit, the approval process would have been pretty straightforward since it is approved for general use throughout Massachusetts. However, since we decided that the Full Circle best suited our needs, we had to attain additional regulatory approvals. Relevant codes and regulations governing composting toilets in Massachusetts are summarized below.

1. Massachusetts Department of Environmental Protection

Massachusetts General Law (Chapter 176, Acts of 2002, Sec. 3) allows the use of "self-contained, zero discharge, stand-alone composting toilets." Zero discharge means the toilet does not produce an effluent that needs to be pumped out or discharged to a soil absorption system. You do not have to apply for MassDEP approval to install toilets that meet these criteria. All other humus/composting toilets not meeting the above criteria must first be approved by the MassDEP and before the local Board of Health can allow them to be installed. Note that any interior plumbing device must also be approved by the State Board of Plumbers and Gas Fitters before it can be installed in Massachusetts.

Title 5 - 310 CMR 15.00: The State Environmental Code Regulating Septic Systems

Title 5 is the state code that regulates all on site wastewater treatment systems. There are provisions that address composting toilets and greywater systems. Composting toilets are an allowed alternative system with certain conditions. There can be no discharge of liquid waste from the toilet; any liquid byproducts must be disposed of through a septic system or removed by a licensed hauler. The composting toilet must also facilitate adequate retention time of materials to allow for decomposition to occur, after which it can either be removed by a licensed hauler or buried under six inches of soil. The two year capacity does not need to be provided by a single vessel; material can be removed or relocated for further processing. The local Board of Health is responsible for local regulation of alternative wastewater systems. They are responsible for ensuring Title 5 compliance within their jurisdiction. MassDEP is the regulatory authority at the state level responsible for administering Title 5 regulations. We learned of some urine diverting composting toilet installations that were approved by the local Board of Health via a permit to construct an alternative disposal system.

There is a stand-alone 2005 document published by DEP that lists guidelines for using composting toilet and greywater systems: “The Use of Compost Toilets in Massachusetts” <http://www.mass.gov/eea/agencies/massdep/water/wastewater/regulatory-provisions-for-compost-toilets-and-greywater.html>

2. 248 CMR 10.00: Uniform State Plumbing Code

In addition to Title 5, composting toilets are also subject to the state plumbing code. The plumbing code considers composting toilets ‘fixtures’ and requires them to be manufactured to NSF 41 standards. A local plumbing permit is typically required to replace a flush toilet with a composting toilet.

3. National Sanitation Foundation, NSF 41

NSF International is a product testing, inspection and certification organization based in Ann Arbor, Michigan. “NSF/ANSI Standard 41 certifies composting toilets and similar treatment systems that do not use a liquid saturated media as a primary means of storing or treating human excreta or human excreta mixed with other organic household materials. The standard requires a minimum of six months of performance testing, which includes design loading and stress testing appropriate to the product class: residential, cottage or day-use park. A minimum of one system in a controlled laboratory setting, and a minimum of three systems in a mature field setting is evaluated.” This standard has been shown to be a barrier for new designs and manufacturers entering the market for alternative sanitation systems. Many states require fixtures to meet NSF standards, but this testing can be cost prohibitive. Initial and annual certification and testing can range from \$20,000 to \$40,000, capital that many small businesses and individual designers do not have. In addition, some self-contained composting toilet manufacturers find the standards inapplicable to the nature of their product, specifically loading rates and retention times.

As it turned out, the NSF 41 requirement was the most significant regulatory hurdle to overcome in our effort to install a Full Circle system.

4. International Association of Plumbing and Mechanical Officials (IAPMO)

IAPMO is a nonprofit organization that develops and promotes plumbing and mechanical building codes. They have recently published an updated Green Plumbing and Mechanical Code Supplement to address composting toilets and urine diversion. Although Massachusetts maintains its own plumbing codes, this is a major development in ecological sanitation regulations and could impact the way in which composting toilets and urine diverting systems are regulated.

Getting Approved

Once we had a handle on the applicable regulations, we approached our local Board of Health to inquire about the local approval process. It was important to us that we go through all proper channels to ensure compliance as well as garner support for implementing ecological sanitation methods. Our local health agent was supportive of our efforts and reviewed the Title 5 and plumbing board requirements. At the meeting, it was determined that the installation of the Full Circle, did not require any special considerations by the Board as prescribed in Title 5. Therefore, our intention to install the fixture was allowed in accordance with 310 CMR 15.00

and Dartmouth's Supplemental Regulations. Although the approval of composting toilets was kept solely to the local board of health in other towns, it was recommended that we seek a plumbing board variance for the fixture. This was an important lesson in that it demonstrated how the approval pathway can differ from town to town, and that state regulations can vary in interpretation. We found that such interpretations differed among homeowners, health agents, plumbers, plumbing inspectors, town officials, state officials, and Title 5 specialists. It pointed to a larger need for clarity surrounding alternative toilets.

With approval and a letter of support from the local board of health, we submitted an application and supplemental information to the State Board of Examiners of Plumbers and Gas Fitters for a variance request from the state plumbing code. Several weeks later we were notified that our application was received and that we were required to attend a hearing before the Board at the end of the month. Since the Full Circle had previously been approved in a pilot program on Cape Cod and the farmhouse was connected to a Title 5 Septic system, the process was fairly straightforward and our variance was granted.

Whether you are interested in installing an approved or unapproved composting toilet, we recommend you start by asking your local health agent and plumbing inspector what steps they recommend you take to ensure compliance.

Phase 3: Installation and Use

With approval from the board and health and the state plumbing board, we initiated the installation process. Over the course of two days, the following installation steps were completed:

- Flush toilet removed, pipe capped
- Urine diverting commode installed
- Twelve inch hole was cut in the floor to run a chute from commode to the bin in basement
- Full Circle bins assembled
- Three inch vent pipe was installed
- 5 watt fan installed
- 55 gallon urine storage drum installed



Using the urine diverting commode is a little bit of a transition from a flush toilet, especially considering both men and women must sit to use it properly. We've also found that guests and visitors may have questions about it and have likely never used one before. Signage in the bathroom has helped communicate proper use to newcomers. We've had a few instances where young children need some additional assistance when using the toilet, some of whom were apprehensive at first.

**Ladies AND Gentlemen
Please be Seated**

Since our farmhouse is a gathering space for both the team and visitors, the bathroom sees a lot of use. We ordered an additional three bins from the manufacturer to make sure we always have enough capacity.

Like any early adopter, we've made a few adjustments to the system:

- Our installer added a secondary vent to urine drum to stabilize pressure
- Power supply to fan was increased from 9V to 12V
- A fly barrier was installed in vent line to eliminate the potential for flies to enter the fan unit

All things considered, these were minor hiccups in implementing the system and we continue to monitor performance and provide feedback to the manufacturer.

Our humanure is composting beautifully in the bins and we are accumulating urine that we will be able to convert to a fertilizer and apply to our hay fields. Our journey to a composting toilet was challenging, eye-opening, and rewarding. We hope this is just the beginning of ecological sanitation adoption in our community. Please don't hesitate to contact us with questions!



Welcome - You are using a urine diverting, composting toilet. Enjoy!

Thank you for helping Round the Bend Farm restore the environment.

Here's how to use it:

1. **Please take a seat!** Regardless of your gender - everyone must sit on the toilet to properly use a urine diverting toilet for both #1 pee and #2 poo. Pee goes down the front compartment (blue funnel-like area) and into a storage drum. Poo goes down the rear part of the insert, down a chute and into a composting unit.
2. Only need to pee; don't add wood shavings. Toilet paper goes into the rear toilet hole (where #2 poo and shavings go).
3. Do not put anything else down the chute. Dispose of tampons and sanitary napkins in the trash receptacle under the sink.
4. If you are making a poo deposit, remember to add a scoop (~1/2 cup) of wood shavings into the rear compartment.
5. Close the toilet lid when finished.
6. Of course, always wash your hands!

