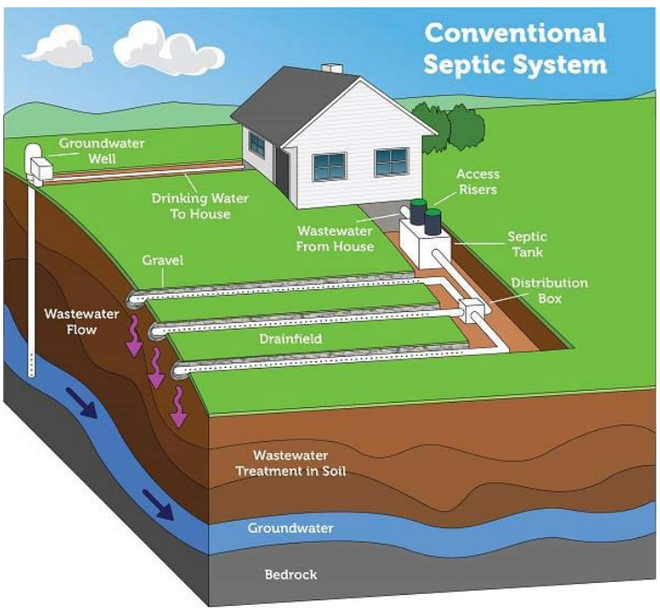
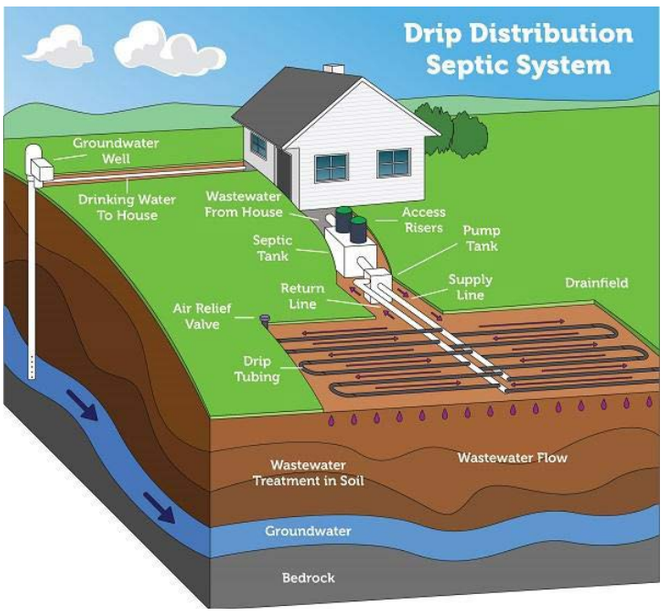
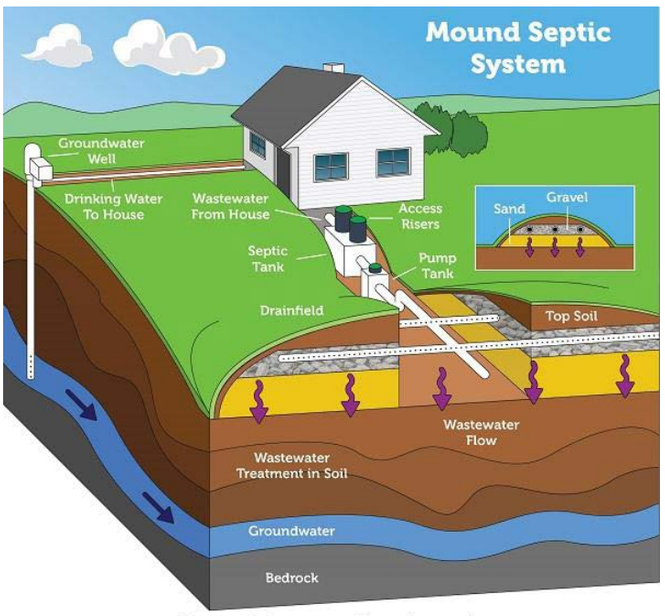
DESIGNING & MANAGING CLIMATE-RESILIENT SEPTIC SYSTEMS







Diagrams by the U.S. Environmental Protection Agency. Diagrams are not to scale.

Septic systems are common, but can pose safety risks.

About 25% of households in the U.S. rely on septic systems. A conventional septic system is a small-scale, on-site wastewater treatment system that typically consists of a storage tank for waste solids and a soil field that absorbs wastewater. Septic systems can also include natural and mechanical processes and materials to help treat and disperse wastewater.

For many sites, septic systems provide adequate treatment to protect public and environmental health, but septic systems that are poorly located or improperly designed, installed, or maintained can release pathogens, chemicals, and other pollutants into the soil and surface and groundwater. Septic systems are also vulnerable to climate change. Shifts in precipitation and temperature and rising sea level and water tables can impair septic system performance.

Scientists, government agencies, and private companies collaborate to ensure septic systems protect public health and the environment.

Scientists from 12 land-grant universities are working together to better understand the complex physical, chemical, and biological processes septic systems rely on. The multidisciplinary, multistate approach allows the team to tackle climate-related septic system issues in a comprehensive way while also tailoring recommendations to specific areas and needs. With the help of private companies, Extension educators, and policymakers, the team is designing septic systems that function under a wide range of environmental conditions and increasing the number of compliant septic systems. These efforts are protecting watersheds and communities nationwide.

Scientists tracked the amount of contaminants that make their way from septic systems into surface and groundwater.

- University of Rhode Island studies showed that advanced nitrogen-removal septic systems can reduce total nitrogen levels to levels that meet regulations for protecting coastal waters.
- Rutgers University studied the fate of pharmaceutical and personal care products in household waste.
- University of Minnesota scientists determined household practices and factors that lead to high septic system performance.

Researchers also tracked the effects of climate change on septic systems.

- University of Rhode Island modeling showed that more bacteria and phosphorus were released from septic systems in climate change scenarios and rising water tables are leading to near-shore septic systems with inadequate separation distance between drainfields and groundwater.
- University of Georgia found evidence that bacteria from septic systems are reaching streams when water tables are high.
- North Carolina State University scientists identified septic systems in coastal North Carolina that are at risk of flooding, salinization, and groundwater rise that would impair performance.
- University of Rhode Island researchers estimated that thousands of septic systems along the southern coast of Rhode Island would be affected by and need repair due to large flood events.

Scientists developed better tools for monitoring septic systems. For example, University of Rhode Island researchers found that a portable photometer is a reliable method for assessing real-time effluent nitrogen concentrations. The photometer can be used indoors or outdoors as a quick, cost-effective way to identify under-performing systems.

Project members provided education and training about septic systems and raised awareness about the impacts of climate change.

- To help homeowners take better care of their septic systems, project members developed a website that produces customized manuals for septic systems. In addition to ensuring septic systems are operating safely, this information can help homeowners save money by preventing damage and repairs.
- Researchers and Extension educators led workshops that taught septic system professionals proper design, siting, operation, and maintenance. Training helped professionals renew their licenses. Training also enabled professionals to gain regulator approval to install bottomless sand filters, which help mitigate the impacts of rising water tables.

Scientists provided research-based recommendations for septic system designs.

- A University of Minnesota risk assessment of septic systems at rest stops and truck holding facilities can be used to plan and prioritize repairs and upgrades.
- University of Minnesota recommended septic systems improvement for assisted living facilities, which can produce wastewater with high concentrations of pharmaceuticals.
- University of Tennessee scientists found combinations of oxidizers (like chlorine and UV light) that can remove hormones, antibiotics, and other pharmaceutical compounds from domestic wastewater so it can be safely used to irrigate fruit and vegetable crops. They also found that packed-bed recirculating media biofilters remove pharmaceuticals as well as large treatment plants.
- In a Michigan State University study, gravel bed vertical flow constructed wetlands effectively removed nitrate, total nitrogen, and ammonia from winery wastewater.
- University of Rhode Island scientists identified plants that can help filter septic system wastewater.
- University of Minnesota evaluated ways to increase the efficiency of water softener salt use in order to reduce salt loads in septic system wastewater.
- Ohio State University found that sand/gravel bioreactors can treat high salinity wastewater.
- Michigan State University showed that pretreating fast food restaurant wastewater can reduce the impacts of fat, oil, and grease on septic systems, prevent premature system failure, and delay costly repairs. Researchers also found ways to keep food processing wastewater from mobilizing toxic metals in the soil.
- University of Rhode Island found that soil treatment areas with layers of sawdust and sand are more effective at lowering total nitrogen than traditional soil treatment areas, offering a low-energy, non-proprietary way to protect coastal watersheds.
- Some septic systems use drip emitters spaced along a grid of tubing to disperse wastewater. University of Tennessee scientists modeled optimal emitter spacing in various soil types to determine if changes to mandated grid spacing (which would be more expensive to install) will offer environmental benefits. Researchers also provided new data on the effects of water pressure drip emitter discharge, which could convince regulatory jurisdictions to allow this method of wastewater dispersal.

Scientists found ways to capture phosphorus from wastewater for reuse as fertilizer. University of Minnesota designed a process that plugs a microbial electrolysis cell into an existing septic system to capture phosphorus. Michigan State University worked with a private company to engineer reactive iron media that removes phosphorus. Reusing recovered phosphorus locally to fertilize crops conserves this scarce resource and produces fewer greenhouse gas emissions than mining it. Removing phosphorus also protects water quality.

Project fundings & participation

This project, *NE1545: Onsite Wastewater Treatment Systems: Assessing the Impact of Climate Variability and Climate Change (2015-2020)*, was funded in part by the Multistate Research Fund through USDA-NIFA and by grants to project members at participating institutions: University of Arizona, Cornell University, University of Georgia, Georgia Cooperative Extension, University of Kentucky, Michigan State University, University of Minnesota, North Carolina State University, Ohio Cooperative Extension, Oklahoma Cooperative Extension, University of Rhode Island, Rhode Island Cooperative Extension, Rutgers University, University of Tennessee. **Learn more: bit.ly/NE1545**