Home & Environment

Seasonally High Water Tables and Septic Systems

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Indiana law requires septic systems to discharge wastewater into the soil for treatment and dispersal. The soil must be aerobic (contain oxygen) for treatment to occur. According to current state law (Rule 410 IAC 6-8.1), the soil aerobic zone below the soil absorption field must be at least 2 feet thick for a two-bedroom home and 2 ½ feet thick for a three-bedroom home.

In most Indiana soils, it is possible to maintain this aerobic zone thickness most of the year. However, during late winter and spring aerobic zone thickness is difficult to maintain due to snowmelt and excessive precipitation during periods of low evapotranspiration (that is, the combination of evaporation and plant transpiration of water from soil).

The purpose of this publication is to describe seasonally high water tables, how and when these high water tables occur, and the septic system designs used in areas where high water tables occur.

Necessity of Aerobic Soils

To treat wastewater, the soil layers below a septic system soil absorption field must be aerobic. When water tables are high, the soil is saturated and is no longer aerobic. Instead, the soils are anaerobic (without oxygen).

Unsaturated soils are necessary for two other reasons: first, all water moves much faster through large soil pores than through small ones. When soil is saturated, water occupies all pores — regardless of size — beneath the trench bottom. The wastewater moves very rapidly through the large pores, faster than the soil can treat it.

When the soil is unsaturated, however, the large pores contain air, so wastewater moves slowly through the smaller pores where chemical reactions and beneficial microbes living on the surfaces of soil particles have time to treat the wastewater.

Second, the specific microorganisms that operate in aerated soil, perform functions very different from microorganisms in anaerobic or saturated soil. Aerobic microbes function where they have access to oxygen and anaerobic microbes function where oxygen is scarce, such as in a septic tank. This is important because effective wastewater treatment requires both anaerobic microbes in a septic tank and aerobic microbes in soil.

Soil Conditions and High Water Tables

An area's water table is determined by boring a hole in the ground and recording how high the water will rise in

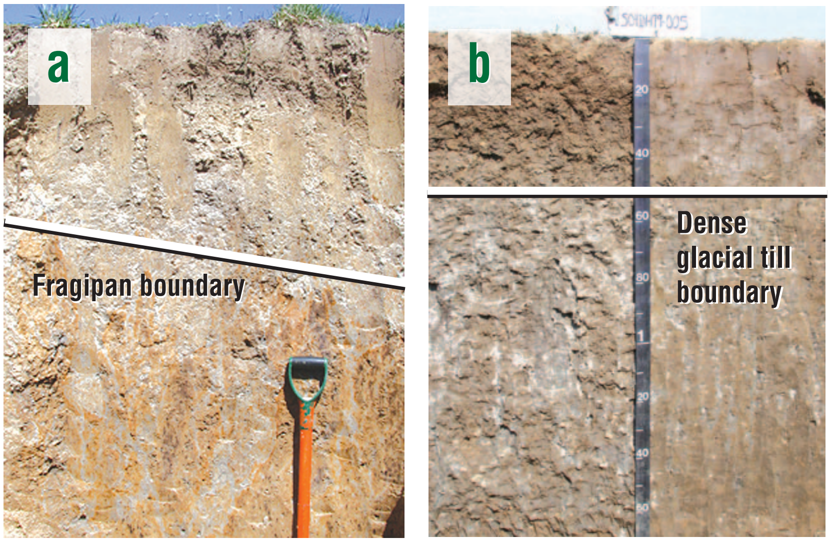

Figure 1. Cross-section of restrictive layers in soils formed by a fragipan (a) and dense glacial till (b). Water collects on top of these very slowly permeable layers in winter and spring resulting in saturated soil conditions and a seasonally high "perched" water table. Notice that the layers' upper boundaries are not always parallel to the soil surface.

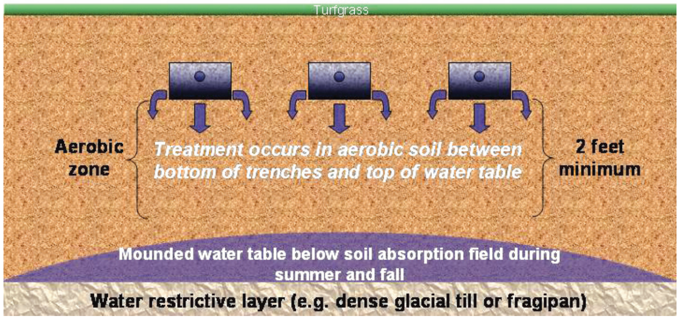

Figure 2. *Cross-section of a typical septic system soil absorption field during summer and fall, showing a mounded water table above a restrictive layer (such as dense glacial till or fragipan).*

the hole. Below the water table, all soil pores are filled with water; many soil pores above the water table contain air.

A restrictive soil layer that has slow permeability is the typical cause of a high water table. Restrictive layers are abundant in Indiana soils. In the northern two-thirds of the state, dense glacial till is a common restrictive layer. Dense glacial till was formed about 15,000-20,000 years ago when the earth's surface was compacted by the tremendous weight of glacial ice (Figure 1b).

In the southern third, restrictive layers are commonly due to fragipans, slowly permeable soil layers formed from weak cementation of soil mineral grains through weathering processes and subsequent reprecipitation of these dissolution products (Figure 1a).

Restrictive Layers in Soil

Dense glacial till. Unconsolidated material deposited and compacted beneath a glacier that has a relatively high bulk density. Dense till is typically characterized by a compact platy structure and contains coarse fragments oriented with their long axes generally parallel to the direction of ice movement.

Fragipan. A natural subsurface horizon with low organic matter, high bulk density, and/or high mechanical strength relative to overlying and underlying horizons. It has a hard or very hard consistency (seemingly cemented) when dry, but shows moderate to weak brittleness when moist. The layer typically has redoximorphic features, is slowly or very slowly permeable to water and is considered to be root restricting. Fragipans usually have few to many bleached, roughly vertical planes composed of faces of coarse or very coarse polyhedrons or prisms.

Water Tables Below Septic Systems

Wastewater flow from a home to the septic system is about 70 gallons per person per day. This consistent addition of water to a soil absorption field creates a mounded water table below the soil absorption field (Figure 2).

If a home's wastewater flow is not excessive, this mounded water table will not interfere with the aerobic zone below the soil absorption field. However, when natural water tables are high during winter and spring, mounded water tables can rise into the aerobic zone below the soil absorption field and impede wastewater treatment (Figure 3).

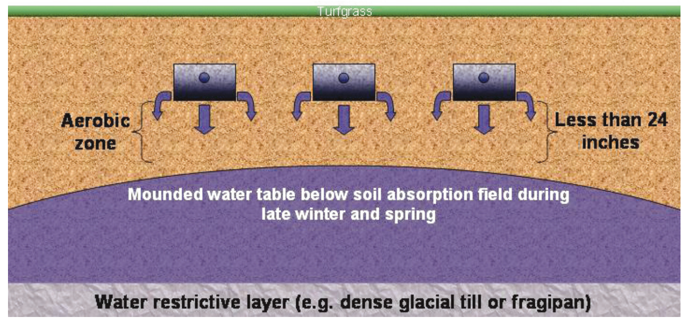

Figure 3. *In late winter and spring, the mounded water table above the restrictive layer is much higher. Adding wastewater to this high water table can reduce the area of the aerobic zone beneath the soil absorption field trenches to less than 2 feet.*

Indiana Land Drainage Practices

Average Indiana annual rainfall ranges from 34 inches in the northeast to 45 inches in the southwest. During late spring, summer, and early fall, much of this water runs off the soil surface, is taken up by plants, or evaporates. However, during the winter and early spring, plants are dormant and evaporation is low, resulting in an accumulation of water in the soil above restrictive layers. This seasonal water accumulation above a restrictive layer is called a seasonally high water table.

To deal with the seasonally high water, the agricultural industry has been installing tile drains for many years to lower the water table. Originally these tile drains were made of clay pipes with spaces between adjoining tiles. Commonly, the pipes were about 4-12 inches in diameter and about 24 inches long. A network of these tiles were installed at the depth of glacial till and fragipan to collect and transport groundwater by gravity to a ditch, creek, or river.

Since the late 20th century, drainage tile has been constructed of lightweight perforated plastic pipe (Figure

Figure 4. *Installation of a modern drain tile made of lightweight, perforated plastic, in an agricultural field.*

4). Although tiles actually made of clay are no longer used, drainpipe networks are still usually referred to as tile drains. When the soil in agricultural land becomes saturated, water flows by gravity toward the drain tile where it collects, then flows downslope to a ditch, creek, or stream. Because septic systems require unsaturated soils to adequately treat and disperse wastewater, this agricultural drain technology is often used to lower seasonally high water tables around septic systems.

Septic System Perimeter Drains

Although not well defined or prescribed in the Indiana state code, perimeter drains have been used in many counties to deal with the negative effects of seasonally high water tables on septic systems. Typically, a perimeter drain is composed of a 20-60-inch deep trench with a perforated pipe at the bottom and back-filled with gravel to within 6 inches of the soil surface (Figure 5).

At the lowest point of the perimeter drain, a solid pipe intersects the perforated pipe and transports the water from

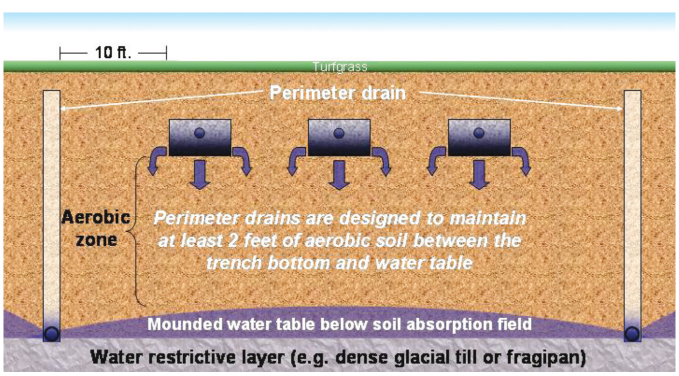

Figure 5. *Cross-section of a soil absorption field with a perimeter drain installed around the trenches. Indiana requires at least 10 feet between the soil absorption field trenches and the perimeter drain. The drain is intended to lower seasonally high water tables and maintain the aerobic zone below absorption field trenches.*

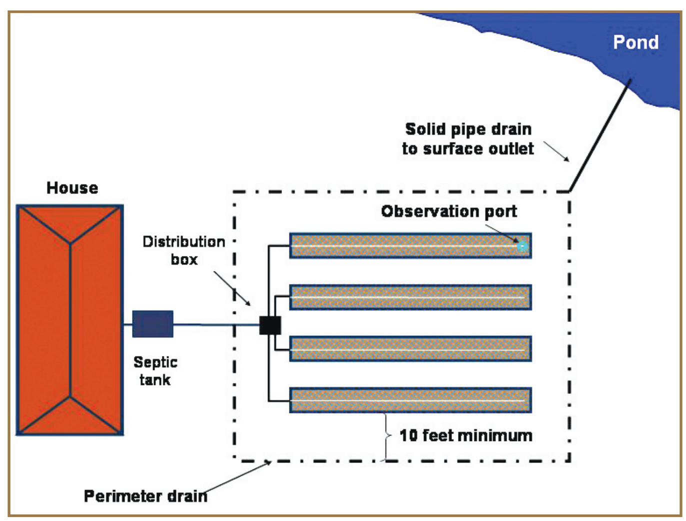

Figure 6. *A perimeter drain is constructed of perforated polyethylene pipe placed at the bottom of a gravel-filled trench surrounding a septic system soil absorption field. A junction is installed at the lowest elevation of the perimeter drain trench and the drain is connected to a solid pipe to transport water to a nearby ditch, stream, or pond, or to a lower part of the lot.*

the perimeter drain to a lower area of the landscape, like a nearby ditch or creek (Figure 6). In some areas, perimeter drains may connect to old agricultural drainage networks that remained after agricultural lands were converted into housing developments.

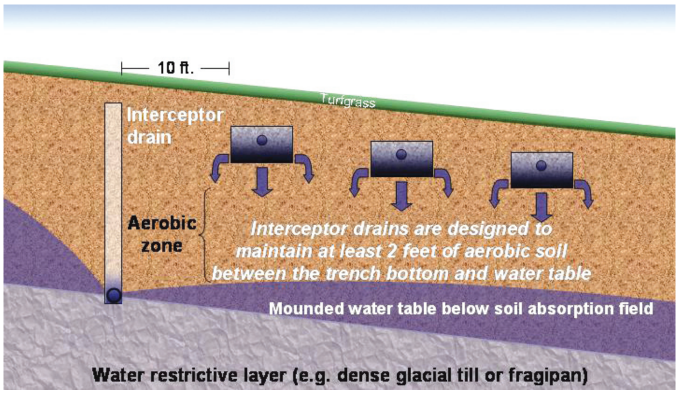

Figure 7. Cross-section view of a soil absorption field with an interceptor drain on a sloping site. Interceptor drains are similar to perimeter drains, but are only installed on the upslope sides of soil absorption fields.

Interceptor Drains

On sloping sites, a single drain on the upslope side of the soil absorption field is often used instead of a perimeter drain (Figure 7). The concept is the same, however, the single drain intercepts the seasonally high water table before it can enter the aerobic zone below the soil absorption field trenches.

Effectiveness of Perimeter Drains

Perimeter drains are assumed to maintain the required aerobic zone below the soil absorption field by intercepting the seasonally high water table and allow the soil below the absorption field trenches to remain aerobic. However, the perimeter drain designs' ability to improve septic system performance has not been evaluated thoroughly in the field. Preliminary studies suggest that some designs may not lower water tables as much as previously thought. Preliminary studies also suggest that perimeter drains can transport untreated wastewater (not just water from the water table) to downslope creeks or streams. More research needs to be done to quantify the impact of perimeter drains on surface water quality.

Summary

Indiana septic systems are designed to disperse groundwater away from the soil absorption field. In many soils, perimeter drains are installed to lower seasonally high water tables to maintain the aerobic zones that treat wastewater below septic system soil absorption fields. In this state, septic systems are assumed to be working if effluent does not pond on the soil surface and there are no complaints from homeowners or neighbors about well water quality.

However, Indiana, has never thoroughly evaluated septic system designs regarding their ability to lower water tables and treat wastewater effluent before it reaches the soil surface or surface waters. Studies are needed to help ensure the quality of our ground and surface waters.

For more information

Specific information regarding septic system perimeter drain regulations can be found in ISDH Rule 410 IAC 6-8.1. To read the rule, contact your county health department or visit http://www.in.gov/isdh/regsvcs/saneng/laws_rules/410_iac_6-8_1/410_iac_6-8_1.htm.

If your county has additional requirements, your county health department will be able to assist you with inquiries.

Other Purdue Extension bulletins in this series

HENV-1-W, *Septic System Failure*, http://www.ces.purdue.edu/extmedia/HENV/HENV-1-W.pdf.

HENV-2-W, *Increasing the Longevity of Your Septic System*, http://www.ces.purdue.edu/extmedia/HENV/HENV-2-W.pdf.

HENV-3-W, *Turfgrass Color: Indicator of Septic System Performance*, http://www.ces.purdue.edu/extmedia/HENV/HENV-3-W.pdf.

HENV-4-W, *Septic System Distribution Boxes: Importance of Equal Distribution in Trenches*, http://www.ces.purdue.edu/extmedia/HENV/HENV-4-W.pdf.

HENV-5-W, *Septic Tanks: The Primary Treatment Device of Your Septic System*, http://www.ces.purdue.edu/extmedia/HENV/HENV-5-W.pdf.

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HENV-9-W, *Water Use and Septic System Performance*, http://www.ces.purdue.edu/extmedia/HENV/HENV-9-W.pdf

HENV-10-W, *Septic Systems in Flooded and Wet Soil Conditions*, http://www.ces.purdue.edu/extmedia/HENV/HENV-10-W.pdf.

HENV-11-W, *Obtaining a Septic System Permit*, http://www.ces.purdue.edu/extmedia/HENV/HENV-11-W.pdf.

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