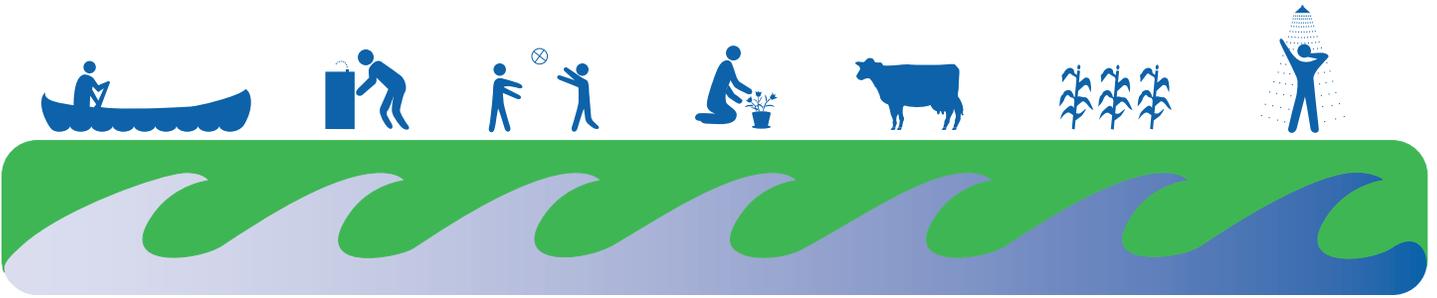


Watershed Connections



Water Resources of Clinton County, Indiana

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Clinton County

Area: 407 square miles or 260,480 acres

Elevation: from 650 feet to 940 feet above sea level

Population: 30,974 in 1990

Climate: temperate, with average monthly temperatures ranging from 24.9°F in January to 74.3°F in July, and 39 inches average annual precipitation

Introduction

Water is a vital resource for all citizens of Clinton County. Water is essential to sustain life, maintain our industrial and agricultural economy, and provide recreational activities. This publication gives basic information about the surface and ground water resources of Clinton County, and the human activities that affect them.

Water moves continuously through the environment in a pattern called the *water cycle* (Figure 1). Throughout the water cycle, a wide range of environmental factors affect both the quantity and quality of water at a specific location. For example, flooding along a local stream may be a result of changes in land use far upstream. Similarly, industrial air pollution can be carried in the atmosphere hundreds of miles from its source and deposited locally by rainfall. These examples illustrate how wide ranging and complex the issues are for water management today.

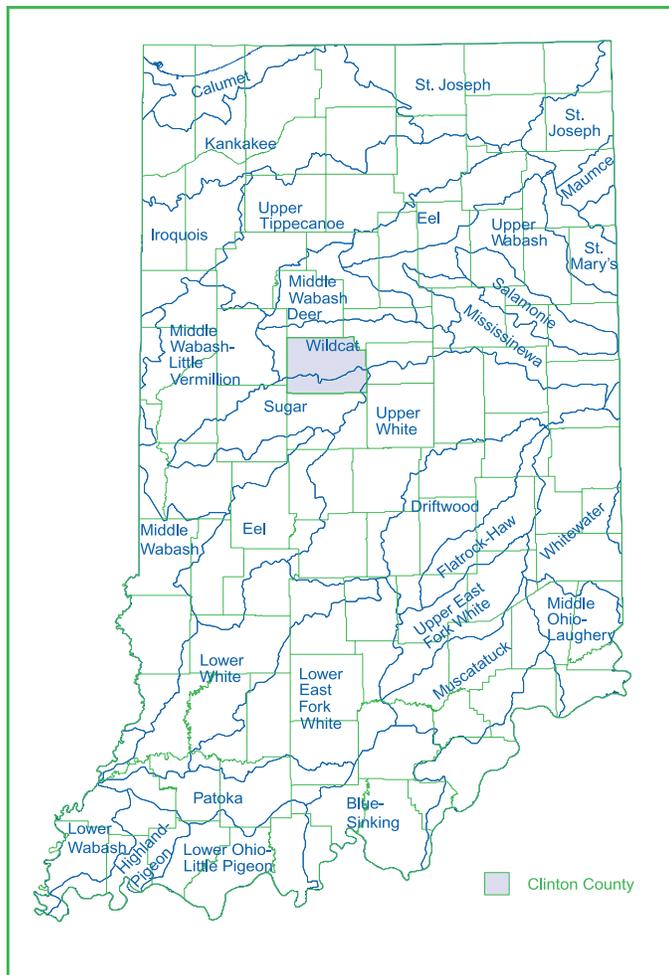


Figure 2. Major watersheds of Indiana. Clinton County is mainly in the Wildcat and Sugar Creek watersheds.

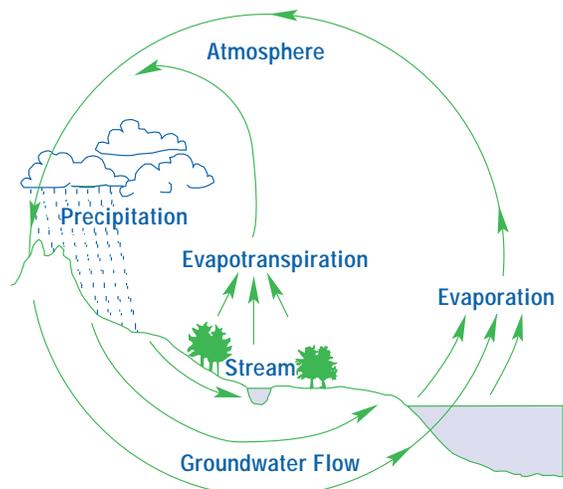


Figure 1: The water cycle.

Clinton County Surface Water and Watersheds

Waterbodies at the surface of the earth, such as streams, rivers, ponds, and lakes, are called *surface waters*. A *watershed* is a region of land that drains into a lake, stream, or river. Watersheds are important natural divisions for managing water resources. All land uses (agriculture, industry, building construction, etc.) within a watershed can affect the quantity and quality of water draining from the watershed. Changes in the water resource are almost always linked to land use changes in the watershed. Water is affected not only by what is dumped in the stream, but by everything we do on the land in the watershed and often by what we put into the air, too.

Watersheds can be any size. A few acres of land draining into a pond form a watershed. If that pond drains into a stream, the pond's watershed, along with many other acres, are part of the watershed for the stream. Small watersheds are part of larger watersheds, just as small streams flow into larger streams.

Clinton County lies within two major watersheds of Indiana as shown in Figure 2: the Wildcat Creek watershed and the Sugar Creek watershed. Both of these flow into the Wabash River watershed, which is the largest watershed in Indiana. The Wabash flows into the Ohio River, which flows into the Mississippi River and eventually to the Gulf of Mexico.

Watersheds in Clinton County are shown (in green) in Figure 3. The Middle Fork of Wildcat Creek and its tributaries drain the northern part of Clinton County. The South Fork of Wildcat Creek and its tributaries, including Kilmore Creek, drain the middle part of the county. Sugar Creek and its tributary Little Potato Creek drain the southern portion of the county.

In Indiana, *regulated drains* are drainages designated by the Drainage Board (or the Commissioners Court or Circuit Court of each county prior to 1965). These drainages are open ditches, underground tile drains, or a combination of both. Thousands of miles of subsurface tiles have been installed to improve drainage throughout the county. Land within a watershed with a regulated drain is assessed an annual maintenance fee. Contact the County Surveyor's Office for more information.

Discharge for a stream or river is the amount of water flowing per unit of time. A typical unit for measuring discharge is cubic feet per second (cfs). Gaging stations, where discharge is measured continuously in a stream or river, are operated by the U.S. Geological Survey at many sites all over the state. Two stations have been located in Clinton County (on Prairie Creek Tributary and Woods Ditch, both near Frankfort), but neither is operating currently. Highest flows generally occur in February through April, while low flows usually occur in August/September, a pattern that is typical for most streams in Indiana.

Floodplains are low areas adjacent to river or stream channels. Floodplains exist because river channels are rarely large enough to contain major floods. These areas have flooded in the past and will flood again in the future. A *floodway* (Figure 4) includes the floodplain and other land that may be flooded.

Clinton County Wetlands

Wetlands are characterized by wet soils, vegetation associated with wet soils, and a high water table or seasonal flooding. These areas have many ecological functions and also provide important benefits for humans. Wetlands help cleanse surface and ground

water by "trapping" potential pollutants, such as sediment, nutrients, and pesticides, before they reach a stream or ground water. Wetlands can hold large volumes of water, thereby reducing peak flood flows and lessening the potential for flood damage. A wide variety of animals and plants depend on wetlands for food and shelter. Wetlands are also valuable for aesthetics, hunting, fishing, and recreation.

Approximately 85% of Indiana wetlands have been converted to other uses since the 1700s. In Clinton County there are 6,106 acres of wetlands, according to the National Wetlands Inventory completed in the 1980s. This is equal to 2.3% of the total area in the county. Most of these wetlands are wooded. A map of Clinton County wetlands and information about protecting wetlands are available from the Soil and Water Conservation District.

Clinton County Precipitation

The average yearly precipitation (rain, snow, sleet, and hail) in Clinton County is approximately 39 inches. Precipitation is relatively constant throughout the year as shown in Figure 5. Average monthly precipitation is about three inches, but monthly highs and lows can vary considerably.

In addition to monthly precipitation amounts, the precipitation from a single storm can be important in causing flooding. Precipitation records over many years have been analyzed to assess the probability of various storms. Precipitation probability for a single storm is generally expressed in terms of a return period, which means the expected number of years between storms of a given size.

A "5-year storm" has a 20% chance of occurring in any one year, so it is likely to occur about every 5 years on the average. However, it is possible for a 5-year storm to occur many years in a row or even several times in a single year. A 100-year storm has a 1% chance of occurring in any year. Figure 6 shows the expected 24 hour rainfall for Clinton County for various return periods.

The 100-year storm is particularly important because the area expected to be flooded by a 100-year storm is generally considered to be the floodplain discussed earlier. Permission from the Indiana Department of Natural Resources is required before any building construction in the area that will be flooded by a 100-year storm. Consult the Clinton County Area Plan Office for restrictions on development in floodways. The Area Plan Office, County Surveyor, and Soil and Water Conservation District have maps that show detailed boundaries of floodplains, which should be viewed before planning any development that may coincide with a floodplain.

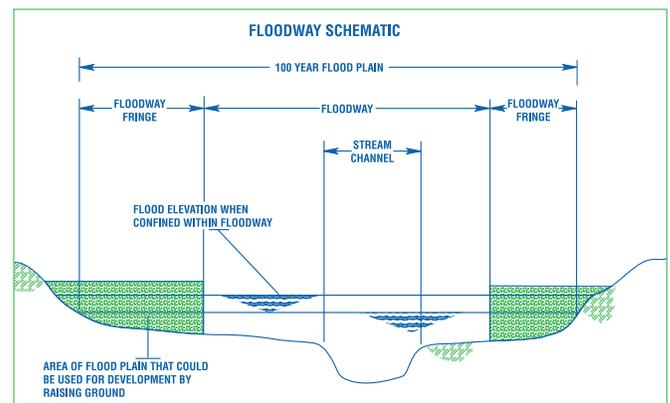


Figure 4. Diagram of a floodway (Indiana Dept. Of Natural Resources).

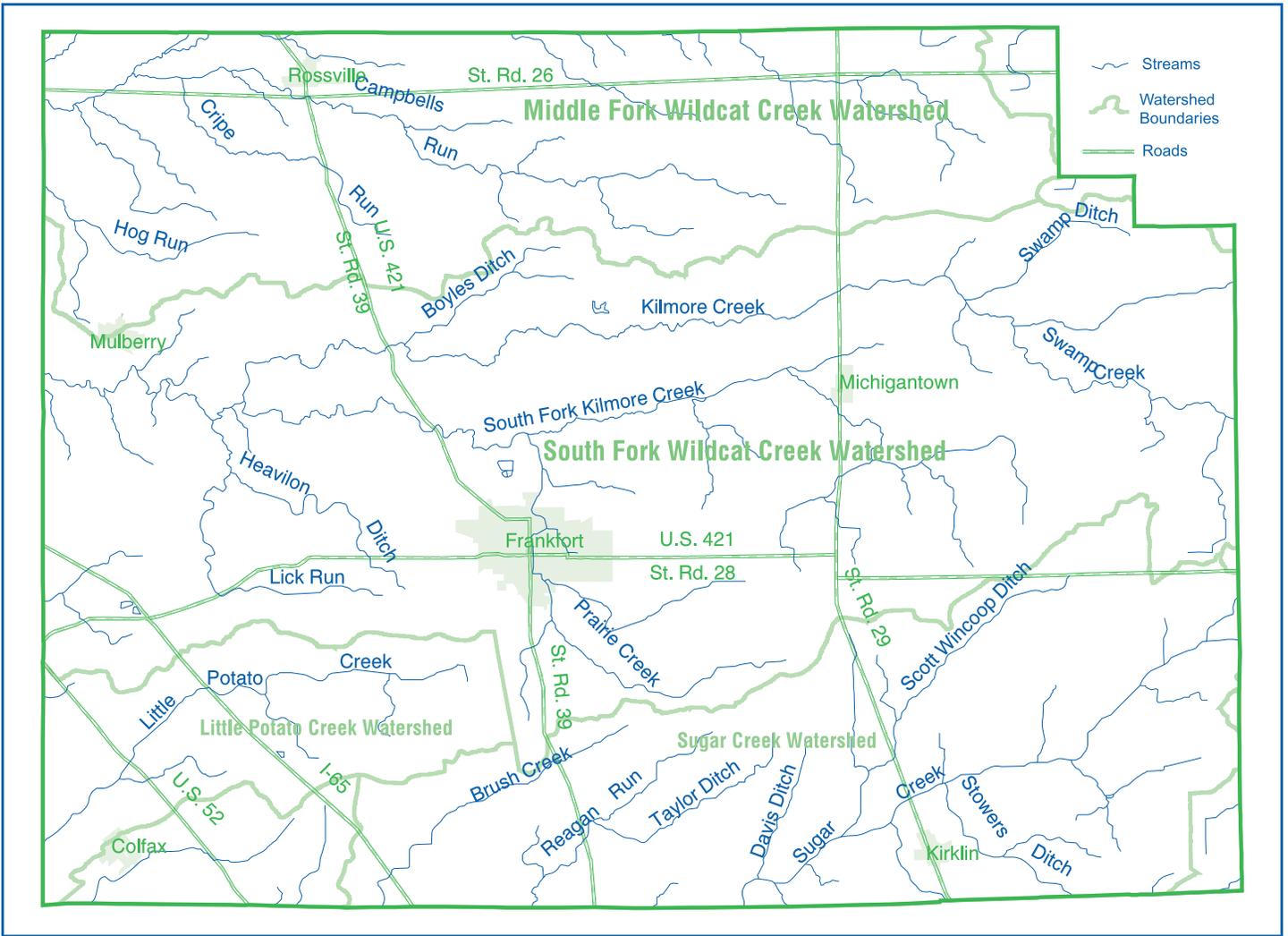


Figure 3. Streams and watersheds in Clinton County

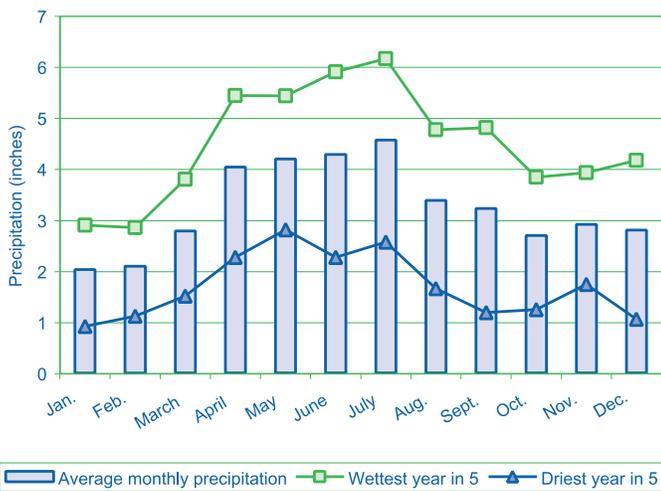


Figure 5. Average monthly precipitation in Clinton County.

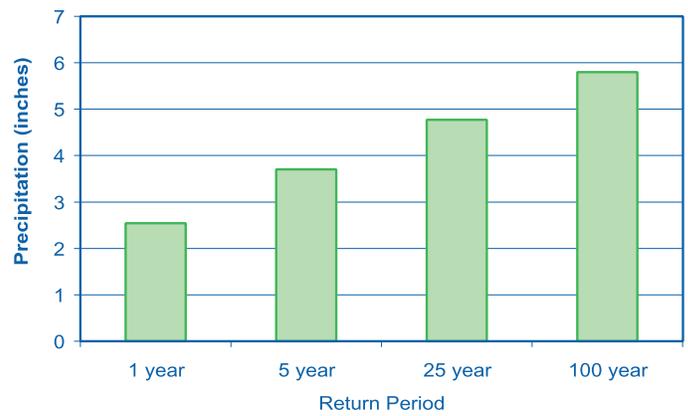


Figure 6. Rainfall expected in 24 hours for low-probability storm events.

Clinton County Geology

Clinton County is located within the recently glaciated portion of Indiana. Several glaciers have advanced and retreated over the county depositing pulverized rock material called *drift*. The bedrock beneath the drift is limestone and shale. Thickness of the glacial deposits ranges from 100 to 400 feet. The drift has different characteristics depending on how the materials were deposited. Clinton County soils formed mainly from *till* (material deposited directly by glaciers with a minimum of water action), *outwash* (material deposited by running water from melting glaciers), and *loess* (fine-grained particles deposited by wind).

Clinton County Ground Water

Water below the earth's surface occurs in two zones: the unsaturated and saturated zones. The unsaturated zone is just below the land surface where openings between soil and rock particles are filled by both air and water. At some depth, which is variable, the saturated zone begins, where all openings are filled with water. "The upper boundary of the saturated zone is commonly called the *water table*. The saturated zone is the source of *ground water*. An *aquifer* is a water bearing geologic layer that yields a usable quantity of ground water to a well or spring (Figure 7).

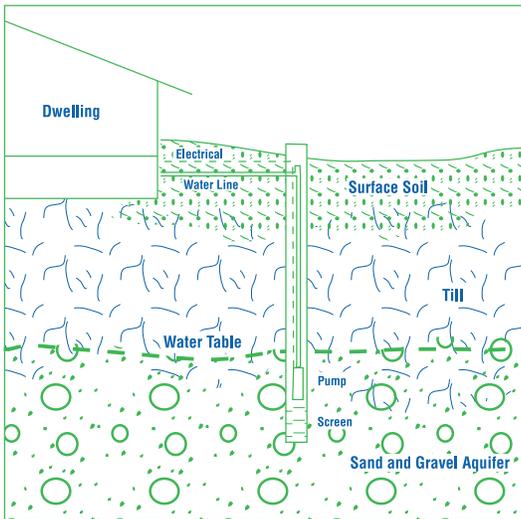


Figure 7. Diagram of a water well into an aquifer.

Ground water availability is generally good in Clinton County. Local ground water comes from glacial deposits of sand and gravel. Sand and gravel aquifers have relatively good potential water yield because the rate of water movement through these materials is relatively fast. In some locations where overlying glacial deposits are thin or do not yield a usable quantity of water, wells may be completed in other soil material or in the bedrock. Bedrock aquifers hold water in cracks or fractures in the rock.

Ground water aquifers are replenished by precipitation moving down through the soil. This process is called *ground water recharge*. Recharge areas for individual wells are similar to watersheds for streams. Precipitation falling within a recharge area contributes to the ground water supplying the well. Land use within the recharge area can affect the quantity and quality of the well water.

Clinton County Water Use

Clinton County citizens and industry use water for many purposes. The largest water use in Clinton County is for domestic purposes, which includes water in homes for washing, drinking, flushing toilets, and watering gardens. Industrial uses are the second largest. Water use in Clinton County is shown in Figure 8.

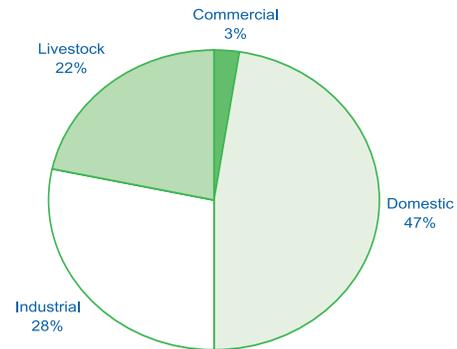


Figure 8. Clinton County water use.

Clinton County Drinking Water

Drinking water can be supplied either by public water systems or by private systems (mostly wells). In Indiana, 60% of citizens use ground water for drinking and 40% use surface water. In Clinton County, 100% of the population uses ground water, or wells, for drinking water.

About 63% of Clinton County households use ground water supplied by one of these public water systems: Colfax Water Company, Country Estates Mobile Home Park, Frankfort Water Works, Kirklín Water Department, Mulberry Water Works, Paddock's Trailer Park, Terrace Hills Mobile Home Park, and Rossville Water Works.

Public water systems must develop a wellhead protection program, identifying the recharge area and describing a management plan to protect the ground water. Federal law requires that all public water suppliers test annually, at a minimum, for a number of contaminants including:

- volatile organic compounds such as gasoline or solvents
- pesticides and other synthetic organic compounds
- lead, nitrate, and other inorganic substances
- microbial contaminants such as bacteria

Public water suppliers are required to notify consumers of contaminants detected in the water supply and describe what actions are being taken to correct the problem.

Citizens using private water supplies (37% of Clinton County households) must make a greater effort to monitor their own well water since no testing of private wells is required or conducted by government agencies. Contact the County Health Department for water testing information.

Clinton County Water Quality

The term *water quality* describes the health of a water resource. People have always used waterways to dispose of waste byproducts from homes and industry. Water resources have a capacity to assimilate certain types and amounts of waste; however, if this capacity is exceeded, destruction of the water resource soon follows. Water contamination, or pollution, has many serious, undesirable impacts including waterborne diseases resulting from exposure to raw sewage, death to fish and other aquatic animals, and loss of recreational benefits like swimming and boating.

Health Impacts

Although many waterborne diseases, such as diphtheria, have been practically eliminated as a public health threat in the United States, water contamination from certain bacteria and viruses can still cause sickness and, in some cases, death. Nationally, a greater public concern continues to grow regarding potential human health impacts associated with known carcinogens (cancer causing chemicals) and, recently, endocrine disruptors (synthetic chemicals that may interfere with normal functioning of the hormone systems of both humans and animals). These chemicals include a diverse group of products that have been detected in scientific studies of both water and air samples.

There is a great deal of scientific uncertainty regarding this issue, including issues of how serious the problem is, and whether the alleged chemicals are clearly linked to the problem. This will likely remain until many more studies have been completed to provide better answers. For more information about water quality and health impacts, begin by contacting the County Health Department, your local water supplier, the U.S. Environmental Protection Agency (EPA), or the Indiana Department of Environmental Management (IDEM).

Water Quality Legislation

Despite the contamination issues discussed above, the United States is among the countries with the cleanest and safest water supplies in the world. This is due primarily to federal regulations enacted to ensure safe water supplies. Currently, the Safe Drinking Water Act and the Clean Water Act are the major federal regulations affecting water quality.



The Safe Drinking Water Act establishes safety levels for contaminants found in drinking water and mandatory testing of public water systems. The Clean Water Act establishes a process for regulating wastewater discharges to surface water, provides funds to build wastewater treatment plants, and creates a watershed planning process to address other pollution

problems. It also establishes a process for assessing water quality based on designated uses of the water resource, such as swimming and fishing.

Various public agencies monitor (or test water samples) regularly to determine if the quality supports designated uses. A waterbody is impaired if it either partially supports designated uses or does not support designated uses. An example is a swimming beach closed due to high bacteria levels. IDEM is the primary state agency cooperating with the EPA to monitor the state's water resources and enforce regulations.

Surface Water Quality

Surface water quality in the United States has greatly improved since enactment of the Clean Water Act. Sewage treatment plants and industries, which previously discharged minimally-treated wastewater into streams, are now required to have permits. Although much remains to be done, many rivers that once barely supported fish are now fully supportive of a variety of aquatic life.

The IDEM monitors selected rivers and streams around Indiana, and reports the results every two years. The monitoring program includes testing water samples, fish tissue, and macroinvertebrate (insects, crayfish, snails, etc.) populations. Several other agencies are also involved in monitoring and protecting water quality. Citizens and students in Clinton County are participating in a volunteer monitoring program through the Soil and Water Conservation District. Contact the District for more information.

Twelve sites on Kilmore Creek, Spring Creek, and the Middle and South Forks of Wildcat Creek, were assessed in 1991. All of the sites were impaired (11 slightly and 1 moderately) based on the Macroinvertebrate Index of Biological Integrity (mIBI). Severity of the impairment depends on the type of pollutant, how often the impairment occurs and how long it lasts. The mIBI shows the healthiness and diversity of the macroinvertebrate population.

In 1998, the South Fork of Wildcat Creek was listed as impaired by cyanide contamination. This impairment has a high severity ranking. The "Indiana Water Quality Report" contains this information for other state waters (see "Sources of Information" section).

Warnings about eating fish from specific waters where fish tissue has been sampled are issued annually by the Indiana State Department of Health (ISDH). Due to widespread occurrence of polychlorinated biphenyls (PCBs) and mercury, the Indiana Department of Health advises the following for all surface waters: if no site-specific advisory is in place for a waterbody, the public should eat no more than one meal (8 oz.) per week of fish caught. This advisory is more restrictive for youth and women of child bearing age. For more information, obtain a copy of the most recent *Indiana Fish Consumption Advisory* from the County Health Department or the ISDH web site (see "Sources of Information" section).

Ground Water Quality

Information on ground water quality in Clinton County is limited. In Indiana, the most common pollutants in ground water are volatile organic compounds (gasoline and other petroleum products) and nitrate (a plant nutrient in fertilizer). Industrialized areas exhibit the highest degree of contamination; however, many private wells are contaminated by bacteria, often from nearby septic systems.

One of the few sources of information on ground water quality in Clinton County is a voluntary private well testing program carried out in 1994 by the Farm Bureau, Purdue Extension, and other agencies. Water samples were tested for nitrate (69 wells) and common agricultural pesticides (68 wells). None of the samples contained contaminant concentrations above acceptable safety levels.

With no data to suggest contamination problems, the majority of wells in Clinton County likely provide safe, clean water for drinking. Private well owners are advised to test their water annually for bacteria (possibly coming from a septic system, livestock confinement, or manure storage) and every few years for other contaminants of concern. Call the Clinton County Health Department for more information.

Potential Sources of Pollution in Clinton County

Sources of water pollution are grouped into two categories, point source and nonpoint source. *Point source pollution* refers to contaminants that enter the water from an identifiable point, usually a discharge pipe. Examples are sewage treatment plants and industrial facilities, which have permits to discharge prescribed quantities of potential contaminants into a specific stream. *Nonpoint source pollution*, by contrast, originates across the watershed and enters the water at locations that cannot be easily identified. Examples of nonpoint source pollutants include sediment, nutrients, pesticides, oil, and other chemicals. Nonpoint source pollution is not regulated directly and is the primary cause of water quality degradation in the United States today. Point and nonpoint source pollution are illustrated in Figure 9.

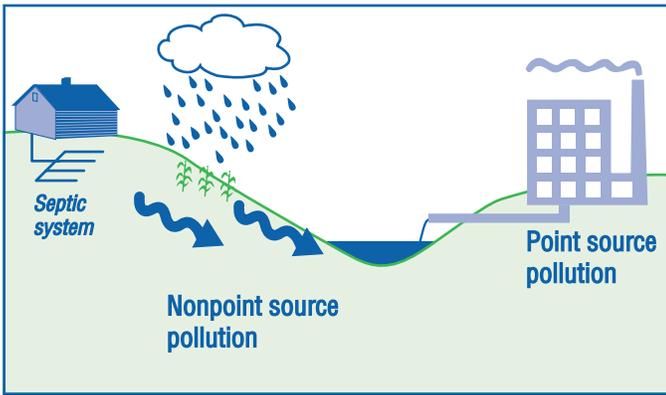


Figure 9. Point source and nonpoint source pollution.

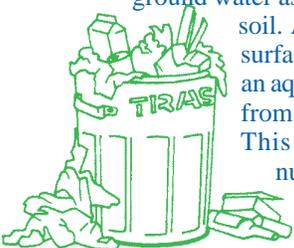
Potential Point Source Pollution

Point source discharges contain a broad range of substances used in homes, businesses, and industry. All substances that go down the drain become part of the *wastewater* flow that eventually is discharged to surface water. The task of the water treatment plant is to clean the water according to federal and state standards. Some industries also take steps to remove certain contaminants before discharging wastewater.

Because point source discharges require permits, excellent information about these discharges in Clinton County is available from the IDEM. Ten facilities (municipal sewage treatment plants, factories, schools, packing plants, etc.) are currently permitted to discharge wastewater in Clinton County. The largest discharger is the Frankfort Municipal Sewage Treatment Plant.

Potential Nonpoint Source Pollution

Potential nonpoint source pollution exists everywhere in the watershed. Nonpoint pollutants move into surface waters primarily in rainfall runoff (or stormwater) and may also reach ground water as precipitation moves down through the soil. As runoff moves over the land toward surface water, or ground water moves within an aquifer, pollutants can be transported away from where they were originally deposited. This is how many chemicals, including nutrients and pesticides, can contaminate water resources far away from the place where the chemicals were used.



Sediment is the largest nonpoint pollutant, by volume, that impacts Indiana's surface waters. Sediment fills in streams and lakes, reducing wildlife habitat and recreational uses. Nutrients, such as phosphorus and nitrogen, are potential pollutants in either ground or surface water. Nonpoint sources of nutrients include septic systems, fertilizers, and livestock manure. Excess nutrients in surface waters choke aquatic life by stimulating plant growth which in turn uses up the available oxygen required by fish and other animals. High levels of ammonia (a form of nitrogen) are toxic to fish and other aquatic animals. Finally, other chemicals (pesticides, solvents, petroleum products, etc.) are potential nonpoint pollutants impacting both surface and ground water. Sources include normal home and farm operations as well as accidents or spills. The impacts of these chemicals are varied, and in some cases not well understood, but can affect human and animal health.

Urban and Residential Nonpoint Sources

Septic systems have the potential to leach nutrients into ground water and can contaminate surface water if not functioning properly. Of the 12,100 households in Clinton County, about 65% use a septic system (or on-site wastewater treatment) for waste disposal. The other 35% of households are connected to a public sewer system. Limited information is available on how well the 4,129 septic systems in the county are performing. Septic systems can function well if installed correctly and maintained properly; however, 96.5% of the soils in Clinton County have severe limitations for conventional septic systems. Some older systems are connected to underground tile drains or discharge directly to drainage ditches. Both situations are illegal in Indiana. To ensure a properly functioning septic system, homeowners are advised to have a soil assessment completed first, hire a reputable contractor, and use a licensed hauler to empty the septic tank every three to five years.

Salt, oil, fertilizer for lawns, sediment, and antifreeze are other examples of urban pollutants that can contaminate water resources. Impermeable surfaces (where water does not soak in), such as roads and parking lots, function almost like point sources because they are designed to channel runoff to a drain or off the site. Nonpoint sources of pollutants, such as cars with oil or gasoline leaks, leaves and other road debris, are widespread. Repair fluid leaks from your vehicle to prevent toxic chemicals from contaminating surface runoff. Keep all wastes, including organic matter (leaves, grass clippings, branches) out of sewer drains.

Lawn chemicals used in residential areas are potential nonpoint pollutants. Professional applicators receive training in proper chemical application procedures; however, homeowners who apply their own chemicals may or may not be following the application instructions. Estimating the amount of lawn chemicals applied is difficult because there are no records for homeowner applications. Proper use and storage of lawn chemicals minimizes the potential for water contamination. Homeowners should read the product label and follow the instructions carefully.

Soil erosion at urban construction sites can impact nearby streams. Building contractors and homeowners can prevent sediment loss by using a variety of practices such as fabric fences, straw bales, and turf seedings. State law requires the use of water quality protection practices at certain construction sites.



Agricultural Nonpoint Sources

Agriculture is a major contributor of nonpoint source pollution. Sediment, nutrients, bacteria, and pesticides can be transported in storm runoff from cropland and fields where manure is applied. Underground drainage tiles can also carry pollutants to surface waters. Some of these pollutants can also reach ground water supplies.

Roughly 236,000 acres or 91% of Clinton County is used for planting crops. About 50% of cropped fields were in corn in 1998, 40% of fields were cropped with soybeans, and the remainder with mainly small grains. Corn and soybean production in Clinton County ranks among the highest in the state.

The county is second in annual hog production. About 350,000 finished hogs are marketed annually. Large livestock facilities are permitted by the IDEM. There are about 110 of these operations (hogs) in Clinton County. To obtain a permit, an operator must have a long-term manure storage facility and an approved manure management plan including when and where the manure will be applied to fields. Distance to water resources and existing soil nutrient levels are some of the factors that must be considered when making a manure management plan.

The Office of the Indiana State Chemist tracks agricultural fertilizer and pesticide use statewide. Information on fertilizer sales shows that 28,311 tons of fertilizer were sold in Clinton County in 1996. Fertilizer has different chemical components of which two, nitrogen and phosphorus, are more important for water quality than others. Phosphorus moves primarily in surface runoff while nitrogen moves in both surface runoff and infiltrates down through the soil to ground water. Both nutrients can affect aquatic life by reducing the amount of dissolved oxygen in a surface waterbody. Nitrate-nitrogen in ground water is also a health concern for infants and pregnant women. Contact the County Health Department for more information.

No statistics are available for pesticide use or runoff specifically in Clinton County. The Indiana Agricultural Statistics Service tracks pesticide use statewide, and this information may represent use in Clinton County. In Indiana in 1998, the most widely used pesticides for corn and soybeans were the herbicides atrazine, metolachlor, and acetochlor. Large-scale studies carried out in Indiana and elsewhere have shown that typically about 1% of applied pesticides end up in lakes or rivers.

Many farmers are changing their practices to protect water resources. Soil erosion and polluted runoff from fields can often be reduced by using conservation tillage, defined as any tillage or planting system that covers 30% or more of the soil surface with crop residue. Conservation tillage was used on 24% of the cropland of Clinton County in 1995. Many farmers regularly test soils to ensure that cropland receives only the amount of fertilizer needed, and some have installed grass waterways and buffer strips to protect water quality and provide habitat for wildlife.

Protecting the Water

There are many things you can do to protect surface and ground water quality.

1. Be Informed

This publication provides an introduction to water issues that affect Clinton County. You can obtain further information in the *Water Quality* series of publications from the Clinton County Cooperative Extension Office. The public library has materials about water resource topics. The Clinton County Soil and Water Conservation District, Natural Resources Conservation Service, and Indiana Department of Natural Resources - Soil Conservation can provide information and technical assistance to any Clinton County resident. Local contacts for more information and several useful computer web sites are listed in the "Sources of Information" section.

2. Be Responsible

Take actions in your home and yard to protect water quality. Keep your septic system in good working order. Keep litter, pet waste, leaves, and grass clippings out of gutters and storm drains. Never dispose of household, automotive, or gardening wastes in a storm drain. Always follow directions on labels for use and disposal of household chemicals. Take used motor oil, paints, and other hazardous household materials to proper disposal or recycling sites such as approved service stations or designated landfills. Contact the Wildcat Creek Solid Waste District for information about disposal alternatives. In your yard, determine whether additional nutrients are needed before you apply fertilizers. If you own or manage land through which a stream flows, protect the stream banks by planting buffer strips of native vegetation.

3. Be Involved

As a citizen, one of the most important things you can do is find out how your community protects water quality, and work together with other citizens and local resource professionals to address problems. Contact the Soil and Water Conservation District if you are interested in becoming a volunteer for water quality monitoring. Share this publication with others. Support local programs that protect water quality.

Clinton County's water resources are plentiful, of generally good quality, and are critical for health and prosperity. Everyone's help is needed to protect these vital resources.

Acknowledgments:

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Sources of Information

Local Contacts

Clinton County Area Plan Office: 765/659-6302
Clinton County Surveyor's Office: 765/659-6300
Clinton County Health Department: 765/659-6385
Clinton County Extension Office: 765/659-6380
Soil and Water Conservation District: 765/659-3971
Wildcat Creek Solid Waste District: 765/296-4166

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Clinton County Drinking Water

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- 1997 Indiana Fish Consumption Advisory. Indiana State Department of Health (ISDH), Environmental Epidemiology Section. Obtain a copy from the Clinton County Health Department, call the ISDH at (317) 233-7808, or view online at <http://www.state.in.us/doh/html/fish/fishtoc.html>
- Nitrate and Pesticides in Private Wells of Indiana. The Water Quality Laboratory, Heidelberg College and Indiana Farm Bureau Inc., 1994.

Potential Sources of Pollution in Clinton County

- *Point Source Pollution:* "Envirofacts" Permit Compliance System of the U.S. Environmental Protection Agency at: http://www.epa.gov/enviro/pcs/pcs_query.html and toxic release information at: http://www.epa.gov/enviro/html/tris/tris_query.html
 - *Septic Systems:* The U.S. Housing Census at <http://sasquatch.kerr.orst.edu/stateis.html>
 - *Crops and Tillage:* Crop Residue Management Survey results from the Conservation Technology Information Center at <http://www.ctic.purdue.edu/CRM/CRMOptions.html>
 - *Fertilizer:* Indiana Fertilizer Tonnage Report, Office of Indiana State Chemist, Purdue University, 1996.
 - *Livestock:* Agricultural Census at <http://govinfo.kerr.orst.edu/ag-stateis.html>
- Pesticide Information:* 1999 Indiana Agricultural Statistics, available at 1-800-363-0469 or <http://www.aes.purdue.edu/agstat/nass.html>

Please contact the Clinton County Purdue Extension office for information on obtaining water quality-related or other publications.

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