This is the third article in a three-part series that addresses groundwater.

Deepwells: The Underground Subject

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Waste is a by-product of manufacturing processes that create thousands of the products we use in the course of everyday living. Also, we unavoidably generate massive volumes of municipal waste or trash each and every day. While we continue to research and implement ways to reduce waste by recycling and improving manufacturing processes, generated wastes still require disposal.

There are many acceptable and environmentally safe ways to dispose of wastes including waste incineration, biological or chemical treatment, and landfills. Wastewaters or liquid waste represent a large portion of our waste. While some areas have rivers or other water bodies at the surface that can receive this treated water stream, others are very sensitive waters that make disposal of this wastewater unsafe and impractical.

One of the most safe and environmentally acceptable ways to deal with these wastewaters in many parts of the United States is disposal through injection wells. Injection wells penetrate thousands of feet below the earth's surface into rock formations where the waste is isolated from Underground Sources of Drinking Water (USDWs).

Underground injection is the placement of fluids into the subsurface through a well bore. Many of the wells used for injection are "high tech" in their construction and require highly regulated construction standards, operations, monitoring and maintenance. To dispose of fluids safely, the wells need to be in an ideal geologic setting, properly constructed, operated, maintained, and monitored. However, dug wells, certain septic systems, and other shallow fluid distribution systems are very simple and do not have the same standards.

In the late 1960's, the realization that subsurface injection could contaminate groundwater if wells were not properly located and operated prompted many states to develop programs and methods to protect underground sources of usable water. Additionally, to increase groundwater protection, a federal Underground Injection Control or UIC program was created. The UIC program was established under the authority and standards of the federal Safe Drinking Water Act (SDWA) of 1974. The goal of the program is the effective isolation of fluids from USDWs.

The US EPA oversees approximately 700,000 injection wells of various types in the U.S. The injection well program consists of six classes of injection wells and each well class is based on the type and depth of the injection activity as well as whether it will be injecting waste and if it is commercial or not. Each type of wells must be located, designed, constructed, operated and monitored to protect drinking water supplies.

Class I wells, the most sophisticated and stringently regulated, are used to inject hazardous and non-hazardous wastes into deep, isolated rock formations which keep the fluids away from USDWs. The two deepwells currently being considered in Newton County are non-hazardous Class I wells and will not accept waste other than from the company's landfills.

Since groundwater is a major source of drinking water in the U.S., the UIC Program requirements were designed to prevent contamination of USDWs resulting from the operation of injection wells. A USDW is defined as an aquifer that contains less than 10,000 milligrams per liter of total dissolved solids. Most groundwater used as drinking water today contains less than 3,000 milligrams per liter of total dissolved solids (TDS). Since the passage of the SDWA, state and federal regulatory agencies have modified existing programs or developed new strategies to protect groundwater by establishing even more effective regulations to control the permitting, construction, operation, maintenance, monitoring, and closure of injection wells.

Class I wells typically inject anywhere from 1,700 to over 10,000 feet beneath the earth's surface. Most geologic formations containing potential drinking water sources are much shallower, often less than 1,000 feet. In Newton County, the base of the deepest USDW is approximately 790 feet below ground. The proposed Newton County Landfill wells will be injecting between 3,000 and 5,000 feet below the surface – over three times the depth of the USDW.

The suitability of any injection well depends on the availability of appropriate underground rock formation combinations that have the natural ability to accept, yet confine, the wastes. It is this long-term confinement that makes deep well disposal an environmentally sound waste disposal method.

Because these wells inject waste below the deepest USDW, there is little chance of any negative effects on potentially usable groundwater. In fact, in a study of Class I wells, the EPA said that "the probability of loss of waste confinement due to Class I injection has been demonstrated to be low" and "existing Class I regulatory controls are strong, adequately protective, and provide an extremely low-risk option in managing the wastewaters of concern."

In Newton County, the Mt. Simon Formation would serve as the injection zone for the Newton County Landfill Class I injection wells. This deep geologic formation is approximately 3,000 feet below land surface and is approximately 1,980 feet thick at the proposed injection site. The Mt. Simon isn't a stranger to injection. There are approximately 50 deep injection wells in operation that are completed in the Mt. Simon throughout Indiana, Michigan, Ohio, and Illinois.

The receiving formation must be far below any usable groundwater and be separated from them by confining layers of rock, which prevent upward fluid migration. In Newton County, the proposed injection zone is capped by approximately 660 feet of the Eau Claire Formation, a geologic confinement that has low permeability and prevents the upward movement of fluids into the shallow drinking water sources.

The process of selecting a site for a Class I disposal well involves evaluating many factors. One of the biggest considerations is the determination that the underground formations possess the natural ability to contain and isolate the injected waste.

The primary objective in the construction of a Class I injection well is the protection of groundwater by assuring containment of the injected wastes through a multilayer protection system, beginning with the construction of the well itself. Several layers of steel and cement provides multiple barriers that protects the groundwater. Electronic logs are run throughout the well construction process to validate the well was properly installed.

An injection packer, which is like a drain plug with a hole in the middle, is located inside the well casings above the injection zone. A smaller protective pipe, known as injection tubing, is placed inside the multiple strings of casing and through the packer. The space between the casing and tubing, called the annulus, is then filled with a corrosion inhibiting fluid. The pressure in the annular space is constantly monitored so that any change, indicating a failure of safety systems, would cause the well to be shut down immediately for repairs.

Before waste can be injected, the mechanical integrity of the well is tested and only if it passes can injection begin. Mechanical integrity testing is conducted at a frequency determined by the US EPA.

Thousands of data points including the pumping pressure for fluid disposal, annulus pressure, and fluid data are continuously monitored and recorded through sophisticated computers and digital equipment. Alarms are connected to alert the operator if anything out of the ordinary happens, and if unusual pressures are sensed by the monitoring equipment, the well automatically shuts off. Disposal in the well does not resume until the cause of the unusual event is investigated.

The wells are also tested regularly, using special tools that are inserted into the well to record data about the well and surrounding rock formations, providing a geologist or engineer with a wealth of information on wellbore conditions. Regulators review all the data about the well operations, monitoring and testing, and regularly inspect the well site to make sure everything is operating according to the requirements put in place to protect drinking water sources.

Over the years some have questioned the advisability and safety of injecting fluids underground. While there are risks associated with any method of waste disposal it is important to recognize that the alternatives to underground injection carry much greater inherent risk because of their proximity to the near surface environment. In the final analysis, it could be said that if the success of a regulatory program is measured by the prevention of environmental harm, the UIC program is a candidate for the most successful environmental protection program in history. It’s a “mature” regulatory program that suggests the major processes are working smoothly, the principal issues are well understood, and significant problems encountered have been solved.