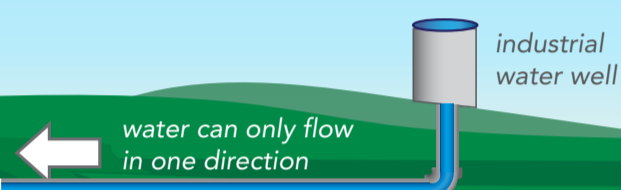


# Protecting Groundwater during Hydraulic Fracturing

4

## Backflow preventers

Drilling companies use **backflow preventers** as another means to protect groundwater supplies. Backflow preventers are essentially **one way valves** that only allow liquids to flow in one direction. They **eliminate the threat** of contaminated water from a gas well flowing into water wells used to supply drilling operations.



## Lined impoundments & storage tanks

Drilling companies use **lined impoundments** or **storage tanks** to hold the waste water, drilling mud and rock fragments that are produced during drilling and well completion.

The lining of the impoundments is sealed and monitored to provide an impermeable barrier between waste water and top soil. After the well is completed and producing gas, the contents of these impoundments are removed for proper disposal and **the site is reclaimed**.

**Storage tanks** provide an alternative to waste water impoundments that allow companies to separate solids and liquids on site and **streamline water recycling operations** and proper waste disposal.

5

6

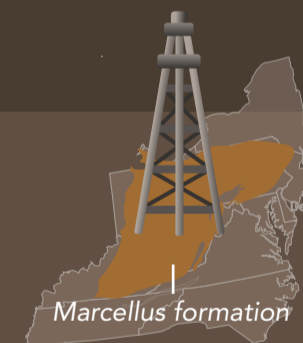
## Water recycling, reuse & waste disposal

Natural gas wells produce waste water as well as the natural gas we use in our homes. This waste water is collected at the surface and then either treated in a **mobile water recycling station**, piped to a water recycling facility or trucked away to a water injection well for **proper disposal** under regulations in the Clean Water Act.



In fact, operators of the Marcellus shale recently told the U.S. EPA that they would recycle **90% or more of the waste water** that comes from gas wells.

This water can be used to provide the water needed for hydraulic fracturing in new wells or it can be further refined and returned to the water supply.

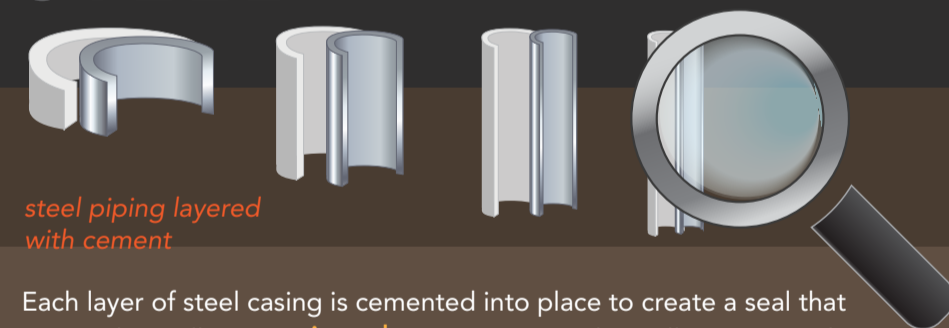


1

## Well Construction

Today's gas wells have redundant layers of cemented steel piping, called **CASING**, to provide a shield between gas production and the environment. A typical gas well is constructed with three million pounds of

### STEEL and CEMENT.



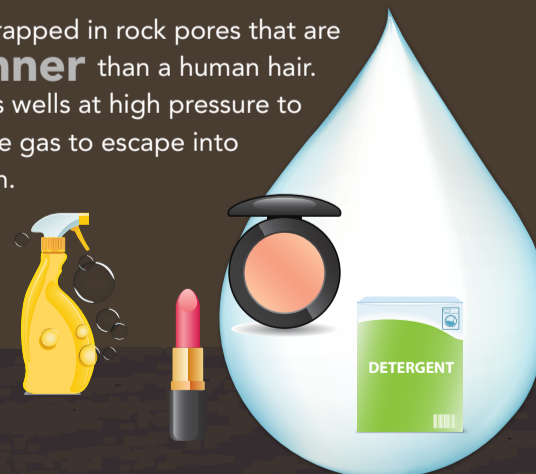
Each layer of steel casing is cemented into place to create a seal that is air tight. Drillers **monitor the pressure** in the wells to ensure the integrity of the seals.

2

## Hydraulic Fracturing

Hydraulic fracturing is used to release gas trapped in rock pores that are sometimes **20,000 times thinner** than a human hair. Hydraulic fracturing fluid is forced down gas wells at high pressure to crack the rock and provide a pathway for the gas to escape into the well and rise to the surface for collection.

Fracturing fluid is made up from **90% water, 9.5% sand and .5% chemicals**. These chemicals are largely found in common household products like cosmetics and cleaning supplies.



3

## Cap rock

Because hydraulic fracturing typically takes place **a mile or more** below the surface, underground water supplies and fracturing operations are separated by thousands of feet of **impermeable rock**. Hydraulic fracturing fluid and natural gas cannot migrate through it.



This fluid is collected at the surface for proper disposal. See how above.

1,000ft

2,000ft

3,000ft

4,000ft

5,000ft

6,000ft

Cap rock