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www.epa.gov/superfund/sites
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EPA

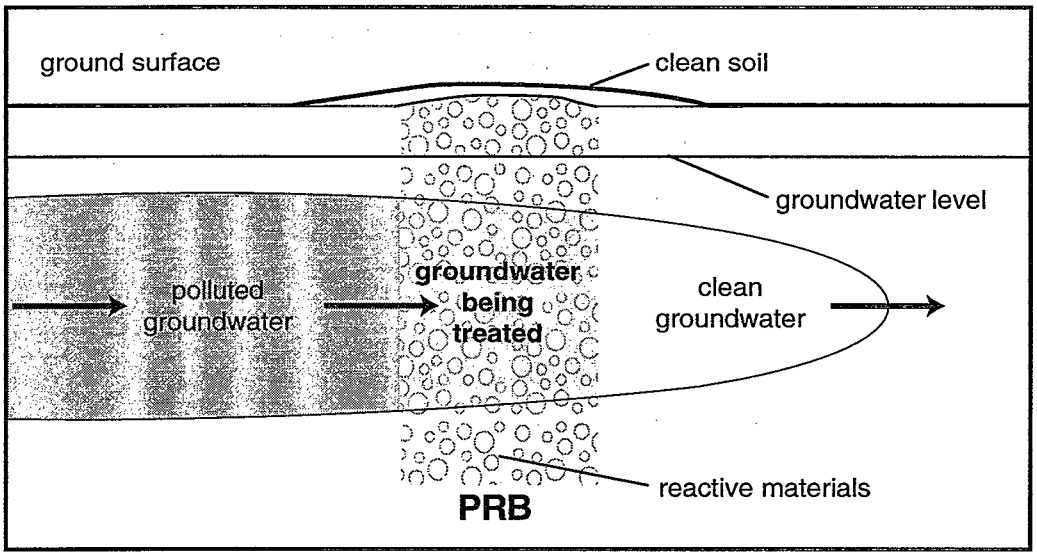
A Citizen's Guide to Permeable Reactive Barriers

The Citizen's Guide Series

EPA uses many methods to clean up pollution at Superfund and other sites. Some, like permeable reactive barriers, are considered new or *innovative*. Such methods can be quicker and cheaper than more common methods. If you live, work, or go to school near a Superfund site, you may want to learn more about cleanup methods. Perhaps they are being used or are proposed for use at your site. How do they work? Are they safe? This Citizen's Guide is one in a series to help answer your questions.

What are permeable reactive barriers?

A permeable reactive barrier or *PRB* is a wall built below ground to clean up polluted groundwater. The wall is *permeable,* which means it has tiny holes that allow groundwater to flow through it. *Reactive* materials in the wall trap harmful chemicals or change the chemicals into harmless ones. Clean groundwater flows out the other side of the wall.



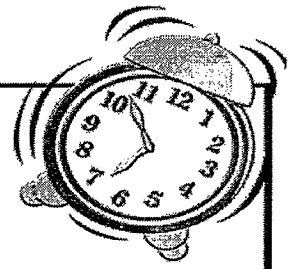
How do they work?

A PRB is built by digging a long, narrow trench in the path of the polluted groundwater. The trench is filled with a reactive material that can clean up the harmful chemicals. Iron, limestone, and carbon are common types of reactive materials that can be used. The reactive materials may be mixed with sand to make it easier for water to flow through the wall, rather than around it. At some sites, the wall is part of a funnel that directs the polluted groundwater to the reactive part of the wall. The filled trench or funnel is covered with soil, so it usually cannot be seen above ground.

The material used to fill the trench depends on the types of harmful chemicals in the groundwater. Different materials clean up pollution through different methods by:

- Trapping or *sorbing* chemicals on their surface. For example, carbon has a surface that chemicals sorb to as groundwater passes through.
- *Precipitating* chemicals that are dissolved in water. This means the chemicals settle out of the groundwater as solid materials, which get trapped in the wall. For example, limestone can cause dissolved metals to precipitate.
- Changing the chemicals into harmless ones. For example, iron can change some types of solvents into harmless chemicals.
- Encouraging tiny bugs or *microbes* in the soil to eat the chemicals. For example, nutrients and oxygen in a PRB help the microbes grow and eat more chemicals. When microbes completely digest the chemicals, they can change them into water and harmless gases such as carbon dioxide. (*A Citizen's Guide to Bioremediation* [EPA 542-F-01-001] describes how microbes work.)

How long will it take ?



Cleaning groundwater with a PRB may take many years. The time it takes depends on two major factors that vary from site to site:

- type and amount of pollution present in the groundwater
- how fast the groundwater moves through the PRB

Groundwater may move a few inches to hundreds of feet per year. Its speed varies from site to site.

Are PRBs safe?

PRBs have a good safety record. Once built, they have no moving parts, equipment, or noise. The reactive materials placed in the PRB trench are not harmful to the groundwater or to people. The polluted groundwater is cleaned underground so cleanup workers can avoid contact with it. Some soil, which may be polluted, must be removed when digging the trench. EPA makes sure that the polluted soils are handled safely. For example, they cover loose soil to keep dust and harmful gases out of the air.

EPA tests the air to make sure that dust and gases are not released. If the soil is polluted, it may be cleaned using another cleanup method. Or the soil is disposed of properly in a landfill. The groundwater is tested regularly to make sure the PRB is working.

Why use PRBs?

PRBs work best at sites with loose, sandy soil and a steady flow of groundwater. The pollution should be no deeper than 50 feet. PRBs clean up many types of pollution underground. Since there is no need to pump polluted groundwater above ground, PRBs can be cheaper and faster than other methods. Very little waste needs to be disposed of in a landfill, which also saves money. There are no parts to break, and there is no equipment above ground so the property can be used while it is being cleaned up. There are no energy costs to operate a PRB because it works with the natural flow of groundwater. PRBs have been installed at more than 40 sites in the United States and Canada.

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Further information also can be obtained at **www.cluin.org** or **www.epa.gov/superfund/sites.**