

A Citizen's Guide to Phytoremediation



What Is Phytoremediation?

Phytoremediation uses plants to clean up contaminated environments. Plants can help clean up many types of contaminants including metals, pesticides, explosives, and oil. However, they work best where contaminant levels are low because high concentrations may limit plant growth and take too long to clean up. Plants also help prevent wind, rain, and groundwater flow from carrying contaminants away from the site to surrounding areas or deeper underground.

How Does It Work?

Certain plants are able to remove or break down harmful chemicals from the ground when their roots take in water and nutrients from the contaminated soil, sediment, or groundwater. Plants can help clean up contaminants as deep as their roots can reach using natural processes to:

- Store the contaminants in the roots, stems, or leaves.
- Convert them to less harmful chemicals within the plant or, more commonly, the root zone.
- Convert them to vapors, which are released into the air.
- Sorb (stick) contaminants onto their roots where very small organisms called “microbes” (such

as bacteria) that live in the soil break down the sorbed contaminants to less harmful chemicals. (See *A Citizen's Guide to Bioremediation* [EPA 542-F-12-003].)

Phytoremediation often is used to slow the movement of contaminated groundwater. Trees act like a pump, drawing the groundwater up through their roots to keep it from moving. This method of phytoremediation is called “hydraulic control.” It reduces the movement of contaminated groundwater toward clean areas offsite.

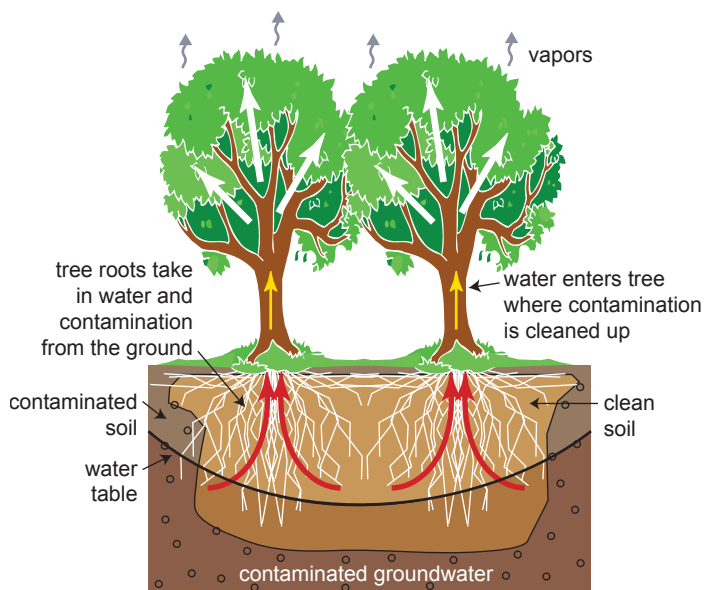
Constructed wetlands are another form of phytoremediation. A wetland may be created at a site to treat acid mine drainage that flows through it or as a final treatment step for water discharged from other treatment systems. Water treated with constructed wetlands generally has very low concentrations of contaminants that need to be removed before it may be discharged into a lake or stream. The construction of wetlands may involve some excavation or regrading of soil at the site in order for water to flow through it without pumping. The area is planted with grasses and other vegetation typical of naturally occurring wetlands in the area.

Certain plants are better at removing contaminants than others. Plants used for phytoremediation must be able to tolerate the types and concentrations of contaminants present. They also must be able to grow and survive in the local climate. Depth of contamination is another factor. Small plants like ferns and grasses have been used where contamination is shallow. Because tree roots grow deeper, trees such as poplars and willows are used for hydraulic control or to clean up deeper soil contamination and contaminated groundwater.

How Long Will It Take?

Phytoremediation may take several years to clean up a site. The cleanup time will depend on several factors. For example, phytoremediation will take longer where:

- Contaminant concentrations are high.
- The contaminated area is large or deep.
- Plants that have a long growing time are used.
- The growing season is short.



These factors vary from site to site. Plants may have to be replaced if they are damaged by extreme weather, pests, or animals. This also will add time to the cleanup.

Is Phytoremediation Safe?

Phytoremediation is a low-risk and attractive cleanup method. Fences and other barriers are constructed to keep wildlife from feeding on contaminated plants. In certain instances, plants may release chemical vapors into the air in a process called “phytovolatilization.” When this occurs, workers sample the air to make sure the plants are not releasing harmful amounts of vapors.

How Might It Affect Me?

Phytoremediation cleanups cause little disruption to the site or surrounding community. Initial work may involve grading or tilling of the soil with earth-moving equipment, and backhoes may be needed to plant trees and large shrubs. Residents and businesses near the site may hear equipment noise or detect an odor if fertilizer is added to the soil. Any airborne dust can be minimized by watering down the soil.

Plants used for phytoremediation can make a site more attractive. The use of native plants is encouraged since they are better adapted to the area’s conditions and less likely to attract nuisance animals or pests.

Why Use Phytoremediation?

EPA uses phytoremediation for many reasons. It takes advantage of natural plant processes and requires less equipment and labor than other methods since plants do most of the work. Also, the site can be cleaned up without digging up and hauling soil or pumping groundwater, which saves energy. Trees and smaller plants used in phytoremediation help control soil erosion, make a site more attractive, reduce noise, and improve surrounding air quality.

Phytoremediation has been successfully used at many sites, including at least 10 Superfund sites across the country.



Poplar trees at a phytoremediation site.

Example

Phytoremediation is being used to clean up contaminated groundwater near a former disposal area at the Aberdeen Proving Ground in Maryland. This area was used for disposal and burning of industrial and warfare chemicals from 1940 through the 1970s. Chemicals used as industrial degreasers and solvents were found to be a particular problem in the groundwater.

In the spring of 1996, 183 poplar trees were planted in a one-acre area. The trees draw in contaminated groundwater and break down contaminants in the root zone. The groundwater levels near the trees show that they are keeping the plume of contaminants from moving to clean areas. EPA estimates that within 30 years of the start of cleanup, the contaminants in groundwater at the site may be reduced by up to 85 percent.

For More Information

For more information about this and other technologies in the Citizen’s Guide Series, visit:

www.cluin.org/remediation
www.cluin.org/products/citguide
www.cluin.org/phyto

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