



A Citizen's Guide to In Situ Flushing

The Citizen's Guide Series

EPA uses many methods to clean up pollution at Superfund and other sites. Some, like in situ flushing, 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 is in situ flushing?

In situ flushing is a way to clean up harmful chemicals in polluted soil and groundwater by pumping water or chemicals into the ground. This helps flush the harmful chemicals from the ground by moving them toward wells that pump the chemicals out of the ground. The process works *in situ*, which means the polluted soil is cleaned up in place and does not need to be dug up.

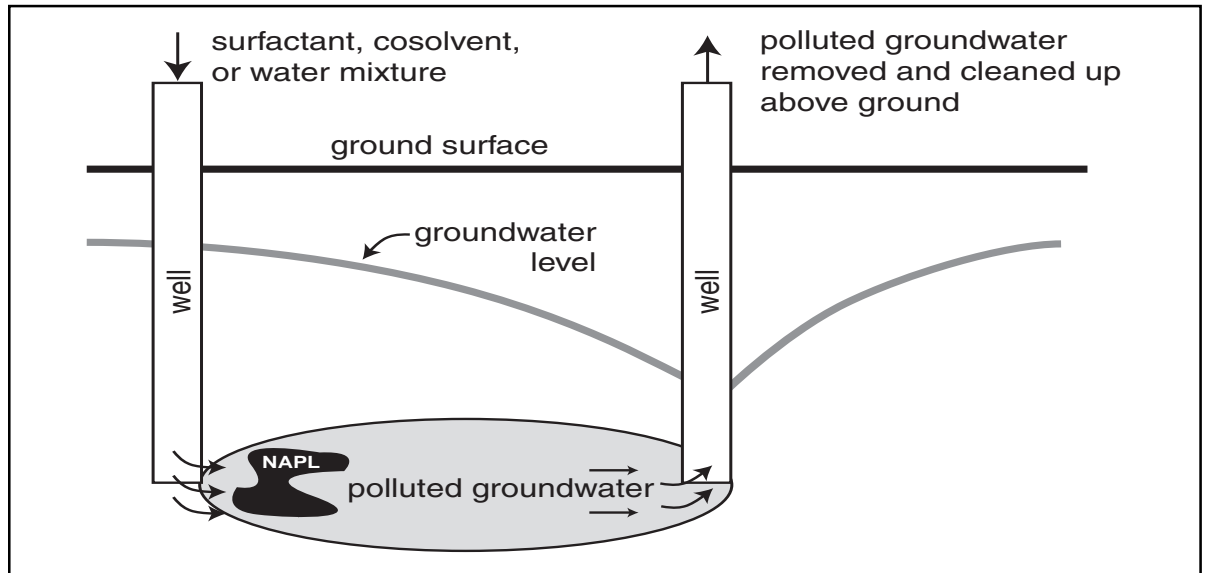
How does it work?

The goal of in situ flushing is to improve the effectiveness of *pump and treat* cleanup methods. Pump and treat methods pump polluted groundwater up through wells to the ground surface where it is cleaned up. (See *A Citizen's Guide to Pump and Treat* [EPA 542-F-01-025].) When harmful chemicals don't dissolve in the groundwater, they can't easily be pumped out of the ground. Some chemicals like solvents and heating oil exist as liquids but do not dissolve easily in water. They are called *non-aqueous phase liquids* or NAPLs. NAPLs can remain in the soil for many years and slowly dissolve into the groundwater. As a result, they can be a source of groundwater pollution for a long time.

In situ flushing using chemicals like surfactants and cosolvents can help dissolve NAPLs. Surfactants are commonly found in detergents and some food products. Cosolvents are alcohols, like ethanol or methanol. When used for in situ flushing, a surfactant or cosolvent is mixed with water. The mixture is pumped down a well, or several wells, drilled in the polluted area where it helps dissolve the NAPLs. The mixture also can help move the NAPLs toward the wells.

At some sites, the surfactant mixture may stick or *sorb* to the soil. This may increase the amount of surfactant required to remove the NAPL. If this happens, a cosolvent can be added to the surfactants mixture to prevent the surfactant from sorbing to the soil.

In situ flushing works best in soil that is very *permeable*. In other words, groundwater can flow through it easily. In situ flushing also works best if the soil underneath the polluted area is not very permeable, like clay. The clay prevents the surfactant or cosolvent from moving below the polluted area. When a clay layer does not exist, a *surfactant foam* method can be used. In this method, air is pumped underground with the surfactant and water. The air forms a foam that prevents the surfactant from moving beyond the polluted area.



Is in situ flushing safe?

In situ flushing can be quite safe, but there are some potential hazards. Workers that handle the chemicals pumped down the wells must wear protective clothing. Also, surfactant or cosolvent left behind after cleanup may be harmful. But at some sites, scientists may want to leave small amounts of surfactant or cosolvent in the polluted area to help with bioremediation. (See *A Citizen's Guide to Bioremediation* [EPA 542-F-01-001].)

How long will it take ?

The time it takes for in situ flushing to clean up a site depends on several factors:

- size and depth of the polluted area
- type and amount of NAPL
- type of soil and conditions present
- how groundwater flows through the soil (How fast? Along what path?)

Cleanup of a site can take months or years using in situ flushing.



For more information

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Further information also
can be obtained at
www.cluin.org or
[www.epa.gov/
superfund/sites](http://www.epa.gov/superfund/sites).

Why use in situ flushing?

In situ flushing is used to help pump and treat groundwater. It is one of the few methods that can help clean up NAPL in place. This avoids the expense of digging up the soil for disposal or cleanup. Depending on the number of wells and the amount of surfactant or cosolvent needed, in situ flushing can be expensive and difficult to use. However, in situ flushing has successfully cleaned up many polluted sites and has been used, or is being used, at 16 Superfund sites across the country.

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