



***Federal  
Remediation  
Technologies  
Roundtable***

# FRTR Web Updates

FRTR 2020 Fall Meeting



# Presentation Summary

- FRTR Updates
  - FRTR (Remediation) Technology Matrix
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## Current Publications

Following publications have been issued under the auspices of the FRTR or FRTR member agencies. Other publications related to topics of interest to FRTR are cited, as appropriate in other sections of this web site, and many background research and technology documents (more than five years old) are available in the [Archives](#) section.

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### ***Bibliography of Guidance and Information Sources on Subsurface Modeling to Support Site Remediation (September 2020)***

This document, produced by an ad hoc steering committee formed at the May 22, 2019 FRTR's *Modeling in Support of Site Remediation* meeting, is an organized search of guidance documents by FRTR agencies and industry on subsurface modeling in support of site remediation. The information sources identified in this document are to assist practitioners involved in their site remediation, contaminant source characterization, and remediation activities. To view/download this document, [click here](#).

The  
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# Federal Remediation Technologies Roundtable



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## Technology Screening Matrix

As of July 2020, the content of this old version has been replaced with a [new version](#).

**The Remediation Technologies Screening Matrix** *NOTE: This document can only be accessed by those using Netscape (Version 6 or higher) or Internet Explorer. Updated in 2007*

A user-friendly tool for screening potentially applicable technologies for a remediation project. The matrix allows you to screen 64 *in situ* and *ex situ* technologies for either soil or groundwater remediation. Variables used in screening include contaminants, development status, overall cost, and cleanup time. In-depth information on each technology is also available, including direct links to the database of cost and performance reports written by FRTR members.

[FRTR.gov/scrntools](http://FRTR.gov/scrntools)



FRTR Home

Technology Screening  
Matrix

## Technology Screening Matrix

Search Matrix

Browse Full Matrix

**A user-friendly tool for screening potentially applicable technologies for a remediation project. The matrix allows you to screen 49 in situ and ex situ technologies for either soil or groundwater remediation. Variables used in screening include contaminants, development status, overall cost, and cleanup time. In-depth information on each technology is also available, including direct links to the database of cost and performance reports written by FRTR members.**

Treatment Type

Show All ▾

Development Status

Show All ▾

Implementation Status

Show All ▾

Availability

Show All ▾

FRTR.gov/matrix



Show All

Show All

**Contaminant Class Effectiveness**

Show All

Profile	Treatment Type
<a href="#">Vapor Treatment Technologies</a>	Air emission/off-gas
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<a href="#">Constructed Wetlands</a>	Ex situ biological
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<a href="#">Soil Washing</a>	Ex situ physical/chemical
<a href="#">Environmental Dredging</a>	Ex situ physical/chemical
<a href="#">Landfill and Soil Capping</a>	Ex situ physical/chemical
<a href="#">Groundwater Pump and Treat</a>	Ex situ physical/chemical

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# Profile Example

## Federal Remediation Technologies Roundtable

 An official website of the United States government [Here's how you know](#) ▾

### Federal Remediation Technologies Roundtable

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[Phytoremediation](#)

## Phytoremediation

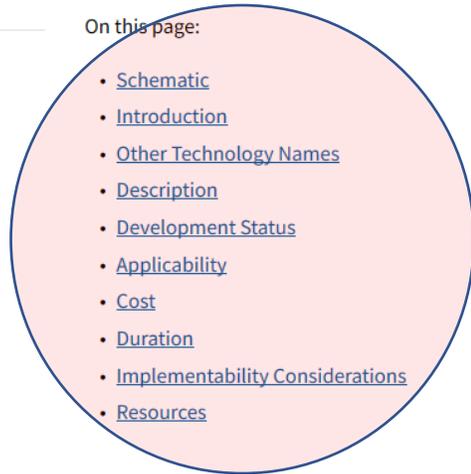
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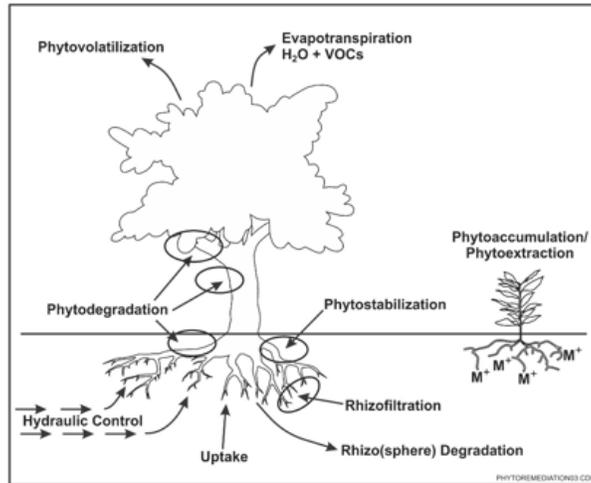
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## Schematic



Schematic of Phytoremediation Processes

## Introduction

Phytoremediation is a treatment technology that uses vegetation and its associated microbiota, soil amendments, and agronomic techniques to remove, contain, or reduce the toxicity of environmental contaminants. Phytoremediation is most commonly applied to shallow soil and groundwater, but is also applicable to sludge, sediments, surface water, stormwater, and waste water. It is generally used as an in situ technology, but can also be used as an ex situ technology using hydroponics and/or [constructed wetlands](#) (see separate profile).

# Profile Example Sections

## Other Technology Names

Phytotechnologies

Vegetation-enhanced Bioremediation

Dendroremediation (when trees are used)

[Evapotranspiration/Botic/Phyto Cover](#) (landfill applications for methane)

## Description

Phytoremediation is implemented by establishing a plant or community of plants that have been selected to provide the required remediation mechanisms. The technology exploits the natural hydraulic and metabolic processes of plants, and thus is solar driven. The technology can be applied either in situ where the technology is passive or ex situ where contaminated groundwater is extracted and treated with engineered systems (hydroponics or constructed wetlands) to treat the groundwater utilizing natural plant processes. Since the ex situ phytoremediation applications are more expensive, have a narrower focus, and are less commonly used than the in situ applications, they are not covered further here. For more information, the reader is referred to the resource section and separate profile for [constructed wetlands](#). The remainder of the technology description is focused on in situ applications of phytoremediation.

The phytoremediation mechanisms that are applicable to contaminated media are described in the paragraphs that follow.

Stabilization/Containment Mechanisms

- **Phytostabilization (phytosequestration):** Phytostabilization is the use of plants to increase sequestration of contaminants (usually metals) in the soil and/or the plant root. Soil sequestration occurs as plants alter water flux and reduce contaminant mobility. Plants and microbial enzymes bind contaminants into soil (humification). Plants also incorporate free contaminants into plant roots (lignification) and prevent wind and water erosion.
- **Hydraulic Control:** Hydraulic control is the use of plants, more specifically tree

# Profile Example Sections (Cont'd)

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## Development Status and Availability

The following checklist provides a summary of the development and implementation status of phytoremediation:

- At the laboratory/bench scale and shows promise
- In pilot studies
- At full scale
- To remediate an entire site (source and plume)
- To remediate a source only
- As part of a technology train
- As the final remedy at multiple sites
- To successfully attain cleanup goals in multiple sites

Phytoremediation is available through the following vendors:

- Commercially available nationwide
- Commercially available through limited vendors because of licensing or specialized equipment
- Research organizations and academia

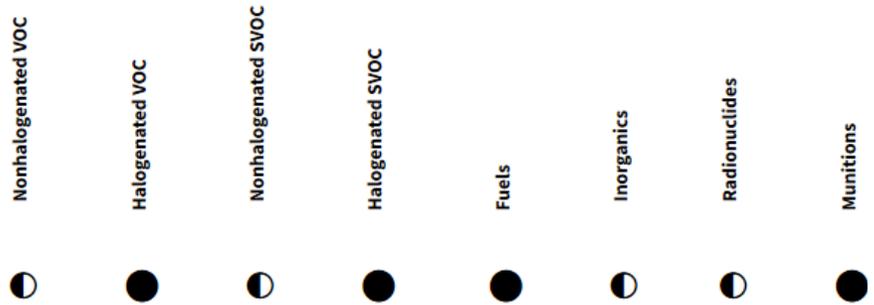
# Profile Example Sections (Cont'd)

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# Applicability

**Contaminant Class Applicability Rating for Phytoremediation**

(Rating codes: ● Demonstrated Effectiveness, ◐ Limited Effectiveness, ◑ Demonstrated Effectiveness,  
◒ Level of Effectiveness dependent upon specific contaminant and its application, ◓ I/D Insufficient Data)



Phytoremediation can be used to treat a wide range of inorganic and organic contaminants in shallow groundwater and soil, and is applicable to sites where water uptake is desirable for hydraulic/migration control or treatment. Contaminant classes for which phytoremediation has been applied include nonhalogenated and halogenated VOCs, fuels, inorganics, radionuclides, munitions, polychlorinated biphenyls (PCBs), and pesticides (ITRC, 2009). Full-scale implementation has been documented for phytoremediation for all of these contaminant classes (ITRC, 2009).

# Profile Example Sections (Cont'd)

## Cost

In situ phytoremediation is a passive technology that typically requires little equipment installation (except in some cases where elaborate irrigation systems are required), and the implementation cost is typically low compared to other more aggressive technologies. Phytoremediation is typically selected when a longer treatment time can be tolerated, and when starting concentrations are relatively low or as part of a treatment train as a polishing step. Grid planting of a large number of tree stands is a typical approach for using phytoremediation to provide groundwater hydraulic/migration control. As with all in situ technologies, application costs vary according to site conditions and contaminants. The labor and equipment associated with site preparation and planting represent the primary capital costs for phytoremediation. The cost of the plants themselves can also be a cost driver, although not in all cases. For instance, when planting 9-inch hardwood cuttings of hybrid poplars, the cost of the cuttings themselves is typically just a few hundred dollars. Major cost drivers include:

### Upfront Costs

- Degree to which existing infrastructure (e.g., buildings, pavement, and utilities) must be removed in order to plant
- Need for pilot studies or bench-scale tests to demonstrate effectiveness at a particular site
- Need for, and complexity of, irrigation and monitoring systems
- Site climate
- Selected species of plant and growth stage (e.g., hardwood cuttings versus whips)
- Size of treatment area, topography, soil type, and drainage requirements
- Degree of growing media amendments and support materials required

### Operation and Maintenance Costs

- Level of plant maintenance, including irrigation, fertilization, pest control, pruning and thinning
- Need for harvesting and disposal (for phytoaccumulation)

# Profile Example Sections (Cont'd)

## *Cost Section*

Includes a General Cost Discussion.

[Frtr.gov/matrix/cost](https://www.frtr.gov/matrix/cost)

## Duration

Operation and maintenance duration for phytoremediation will range from 1 to 30+ years. In contrast to active mechanical treatment systems, selection and operation and maintenance activities require expertise in agriculture and silviculture. The duration of operation and maintenance is dependent on the following conditions:

- Cleanup goals
- Volume of in situ media requiring treatment
- Contaminant concentrations and distribution
- Growth rate and characteristics of remediation plantings
- Climate (i.e., temperature, winds, and rain).

## Implementability Considerations

The following are key considerations associated with implementing phytoremediation:

- Employing specific plant species to target particular contaminants at a site can be difficult because of species adaptability problems.
- Climatic or seasonal conditions may interfere with or inhibit plant growth, slow remediation efforts, or increase the length of the treatment period.
- In addition to climate, site soil type, lithology, and hydrogeology characteristics may not be conducive to needed plant/tree species (e.g., insufficient groundwater yield or transmissivity for tree root systems).
- The transpiration mechanisms of phytoremediation function almost entirely during the active growing season, and during daylight hours when solar

# Profile Example Sections (Cont'd)

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# FRTR Matrix Conclusion

- 49 Profiles
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## FRTR Meetings

- Join us for the upcoming live Clu-In webinar, **FRTR at 30 Years: A Retrospective of Applied Innovative Technologies for Successful Site Remediation**. This meeting will be held on Wednesday, November 18, 2020. Click [here](#) to view the preliminary agenda and registration information.
- The **FRTR Presents...Bioremediation Advances – New Strategies, Optimization, and Performance Monitoring** two-part webinar is now archived. View the archived presentations by visiting:
  - [Session 1: May 29, 2020 live webinar](#)
  - [Session 2: June 5, 2020 live webinar](#)
- The **FRTR Presents...Synthesizing Evolving Conceptual Site Models (CSMs) with Applicable Remediation Technologies** webinars are now archived. These webinars featured presentations from the November 2019 FRTR Meeting and related material. View the archived presentations by visiting: <https://clu-in.org/conf/tio/FRTRPresents9/>
- The last meeting of the Federal Remediation Technologies Roundtable was held Wednesday, November 13, 2019. The topic for this meeting was **Synthesizing Evolving Conceptual Site Models (CSMs) with Applicable Remediation Technologies**. Click [here](#) to view the archived meeting agenda and presentations.
- FRTR member-agencies meet semi-annually, usually in the Washington, DC, area. These meetings offer a unique opportunity for federal cleanup program managers and other remediation community representatives to:
  - Identify and discuss priority cleanup issues,
  - Share lessons learned, and
  - Form collaborative working groups to pursue subjects of mutual interest.
- Archived summaries of [all past FRTR meetings](#)

# Meeting and Events Archives

CLU-IN | Training & Events | Archived Internet Seminars & Podcasts

## Training & Events

### Archived Internet Seminars & Podcasts

Over the past 21 years, we have archived 826 Internet Seminars covering a wide variety of technical topics related to hazardous waste characterization, monitoring, and remediation. Each archived offering includes the presentation materials and audio from that date.

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- Upcoming Internet Seminars
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- My Participation Records
- The Training Exchange (Trainex)
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**FRTR Spring 2020 Meeting, Session 2: Bioremediation Advances - New Strategies, Optimization, and Performance Monitoring**

Sponsor: Federal Remediation Technologies Roundtable (FRTR)

Archive of Jun 5, 2020 Seminar (2 Hours, 30 Minutes):



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**FRTR Presents...Synthesizing Evolving Conceptual Site Models (CSMs) with Applicable Remediation Technologies**

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**FRTR Presents...Modeling in Support of Site Remediation, Session 2**

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Archive of Dec 4, 2019 Seminar (2 Hours):



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# Clean-Up Information

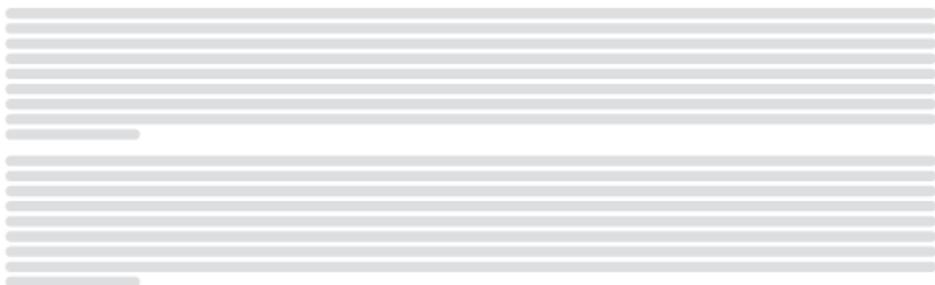
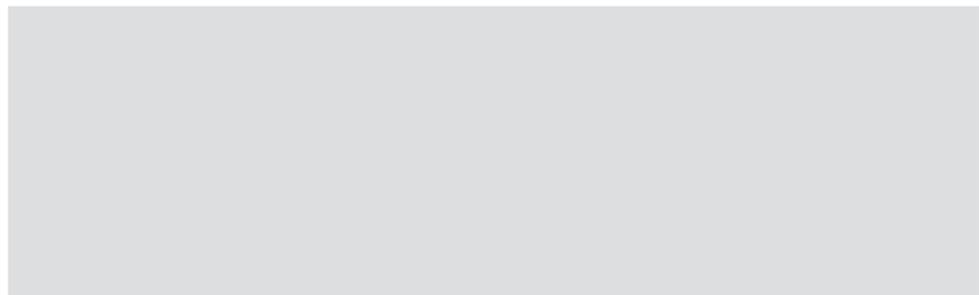
- Technologies
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Remediation Technology Guides

Fractured Rock

## Fractured Rock Characterization



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