



Phytoremediation Gardens in Polluted Sites

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What problems still exist with remediating soil?

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How does phytoremediation address these issues?

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How can phytoremediation be seen beyond Tacoma?



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Problem

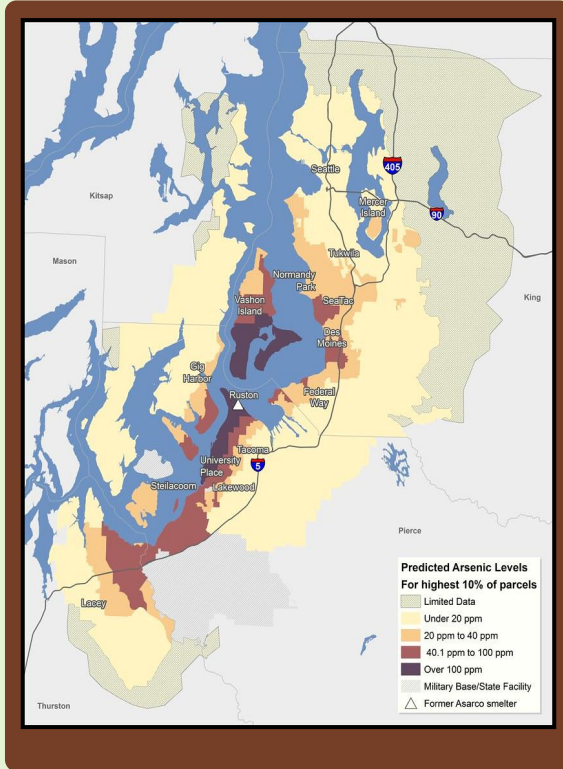


Fig 1. Arsenic levels in Tacoma Washington
Department of Ecology

Tacoma Smelter Plume

- Tacoma historically known as “grit city” for heavy industrial activity throughout much of the city
- The Asarco Copper Refinery has caused significant soil pollution in Tacoma
- Following a 94.6 million settlement with Asarco, the Washington Department of Ecology (WSDOE) has worked to clean the Tacoma Smelter Plume

Consequences of Soil Pollution



Urban Sprawl

Encourages cities to expand rather than develop internally



Brownfields

Creates unsightly brownfields with little use



Health Issues

Pollutants increased neurological, respiratory and other health risk

Current Solutions & Shortcomings

Solutions

Yard Program

Free soil clean up for sites in immediate vicinity of Tacoma Smelter Plume

Soil Remediation

The WSDOE does provide free soil sampling and paid soil remediation

Education

A lot of education regarding safe soil conduct and addressing polluted soil

1

2

3

Shortcomings

Limited Reach

The Yard Program doesn't account for all affected areas

Avoids Certain Areas

Cleanup efforts avoid trees, fencepost, and other difficult to access areas

Little On Phytoremediation

WSDOE conducted a 2005 study on phytoremediation with Chinese Brake Leaf and arsenic



2

Solution

What Is Phytoremediation?

- Phytoremediation is a broad term for utilizing plants in order to remediate/clean up pollutants from the soil such as heavy metals
- Different plants have different capabilities when it comes to remediating soil
 - Ex.) Black Nightshade lead, Chinese Brake Leaf arsenic (Kafle et al, 2022)
 - Methods vary from phytosequestration to phytodegradation (EPA, 1999)
- Understanding of phytoremediation and how it occurs has been largely synonymous with discoveries regarding pollution
- While phytoremediation itself has existed for a long time, recent discoveries have helped to grow the viability of the process

Why Phytoremediation



Ease of Implementation

Reliant mostly on upkeep of plants.



Environmental Impact

Phytoremediation uses natural processes by plants.



Versatility

Different plants adapt to different contaminants.



Cost

Cost per hectare lower than most other options.

Cost Versus Other Methods

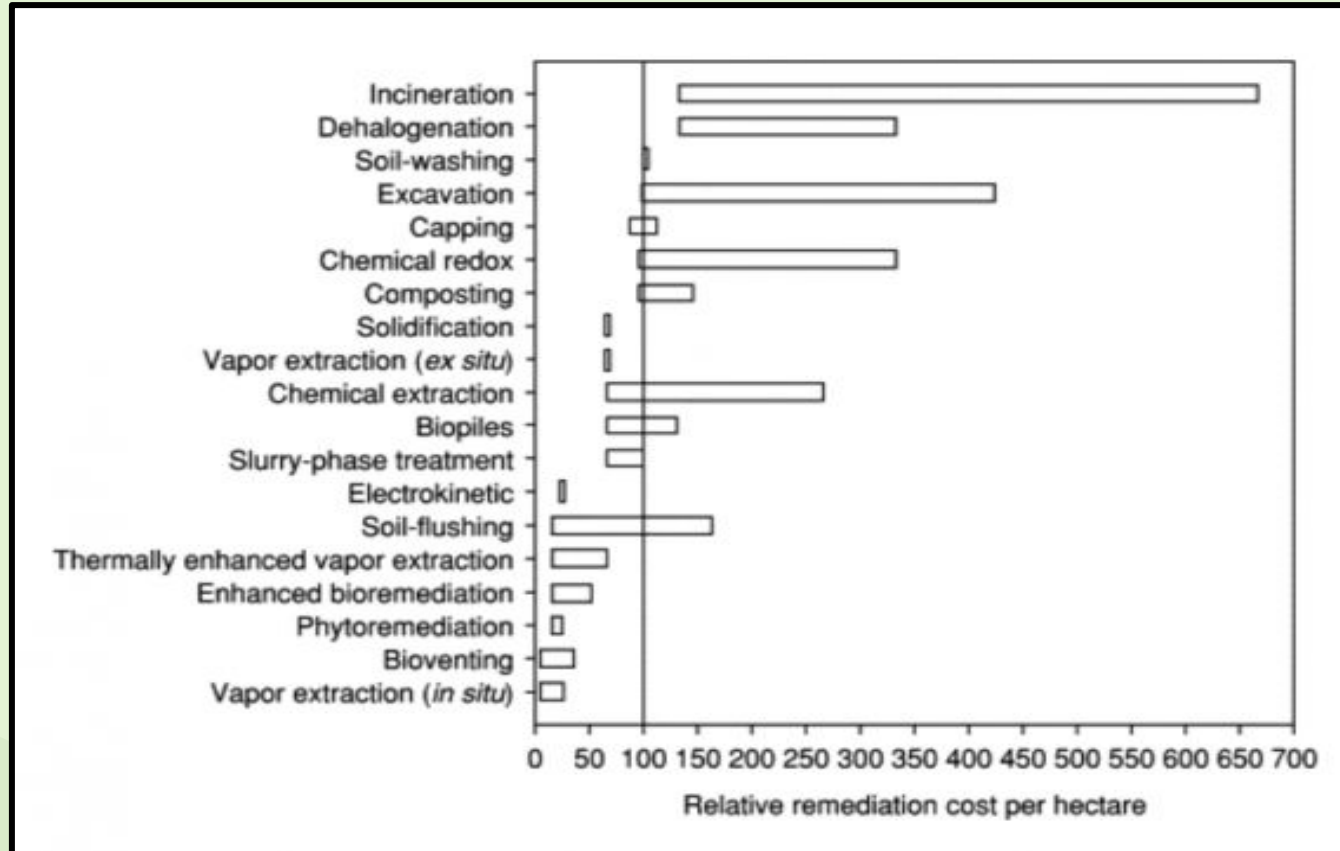


Fig 2. Soil Remediation Victor Medina and Scott Waisner

Addressing Issues of Phytoremediation

Waste Disposal

Issue

- A 2005 study by WSDOE dismissed phytoremediation due to plant waste
- Traditional disposal has done through incineration or specialized landfills

Solution

- Recent developments in phytoremediation have lead to viable disposal methods (Liu and Tran, 2021)
 - Nanomaterial synthesis
 - Microbial remediation
 - Extraction
- Research is still ongoing, but the viability of phytoremediation has grown

Varying Conditions

Issue

- While certain plants tolerate contaminated soil, certain concentrations can still be toxic
- Other conditions limit plant viability
 - Weather, nutrients, etc.

Solution

- The list of plants has continued to grow as research about phytoremediation has developed
- Focus revolves around using phytoremediation when conventional remediation is less beneficial
 - Opposite is also true



3

Implementation

The background is a light green color with stylized illustrations of trees and foliage. At the top, there are dark green leafy branches. On the right side, a brown vine hangs down. In the bottom corners, there are various green leaves, including some with holes, resembling tropical plants. The overall theme is a lush, natural environment.

Question

How can phytoremediation be implemented in Tacoma without disrupting existing solutions?

Implementation In Tacoma



Legislative Approach

Utilize existing MTCA guidelines to create and enact soil remediation projects



Community Approach

Encourage communities to create remediation projects similar to community gardens



Education Approach

Have WSDOE emphasize phytoremediation information with new information

MTCA Guidelines

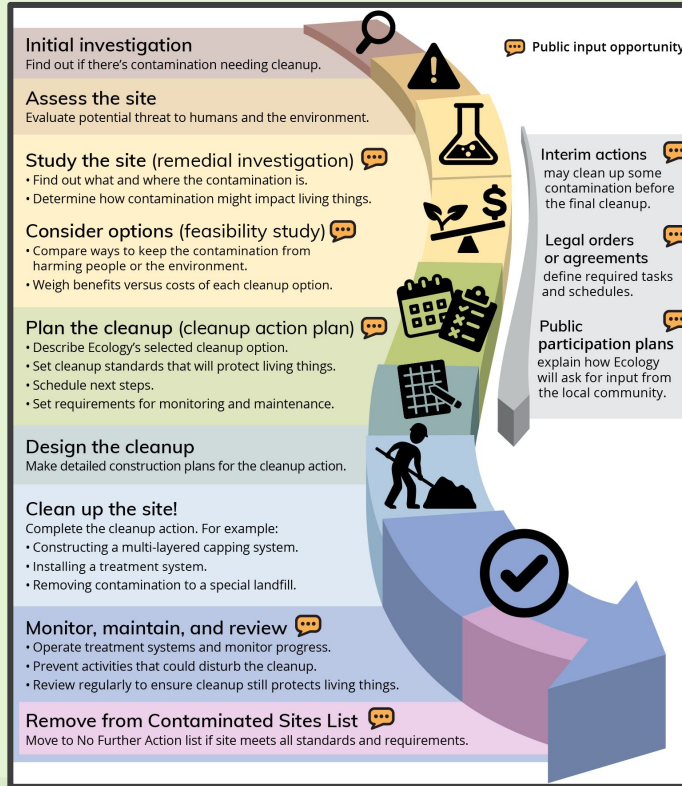
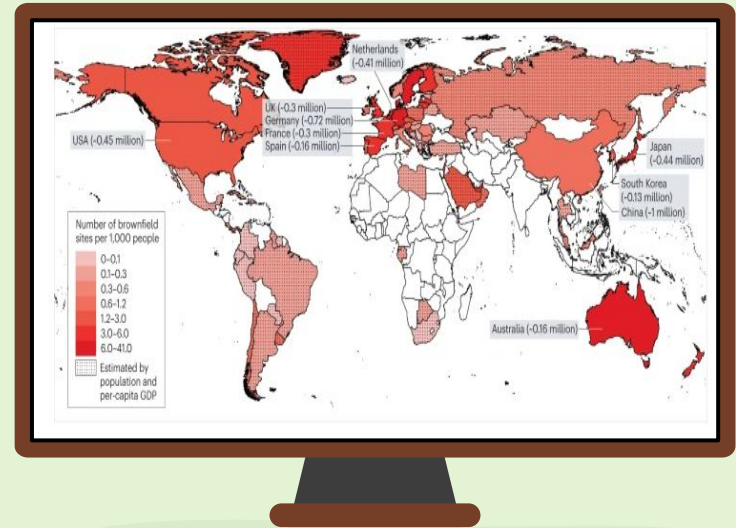


Fig 3. Washington State Department of Ecology

Beyond Tacoma

- Estimated 5 million brownfield sites throughout the world
 - Unsustainable for long form city growth in 21st century
 - Issues arise with global trend towards urbanization
- While Tacoma's case isn't necessarily the full picture for the entire world, Tacoma provides an opportunity to move beyond its industrial past through leading the path towards sustainability
 - World as a whole moving towards environment oriented mindset
- Phytoremediation provides not only a multifaceted solution to a global issue, but also an opportunity to create ecologically sustainable metropolitan areas

Fig 4. Brownfield Sites Hou et. al



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THANKS!

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