IN-SITU

BIO-REMEDIATION
Intro

Plants (phytoremediation)

Microorganisms
  E.g. Bacteria
  E.g. Fungi

Nutrients
  E.g. O, N, P

http://www.chickadeeusa.com/site%20remediation_files/image022.jpg

http://bioprocess.pnnl.gov/resour/rt3d.in.situ.bioremediation.htm
Plan for HSU

- HSU uses in-situ chemical oxidation
- In-situ bioremediation is a type of that
- Has been working so far
- Clay level underneath soil, helps maintain the process
Appropriate for HSU?

- Due to hydrocarbons in soil, yes!
- Microorganisms break down enzymes from oil
- Reduced risk of human exposure (in-situ)
- HSU took out much of contaminated soil
- What’s left would be ideal for bio-remediation
Limitations

- Extremely specific and dependent to the environment
- Site specific conditions must be met
- HSU has a mixture of silt, sand, and clay
- Does the pollutant serve as a sufficient energy source?
- Is the substance compatible for biodegradation? Are there any competitors in the reaction?
- Long periods of time needed for assessment
## Cleanup Status History

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Estimated Cost Analysis

Bioremediation Techniques:
--$50-$130 per cubic meter of soil

Incineration:
--$300-$1000 per cubic meter of soil

Landfill Disposal:
--$200-$300 per cubic meter of soil

Additional Cost Estimates

Bioventing:
--$13-$65 per cubic meter of soil

Solidification/Stabilization:
--$8-$1200 per cubic meter of soil

Soil Flushing:
--$75-$300 per cubic meter of soil