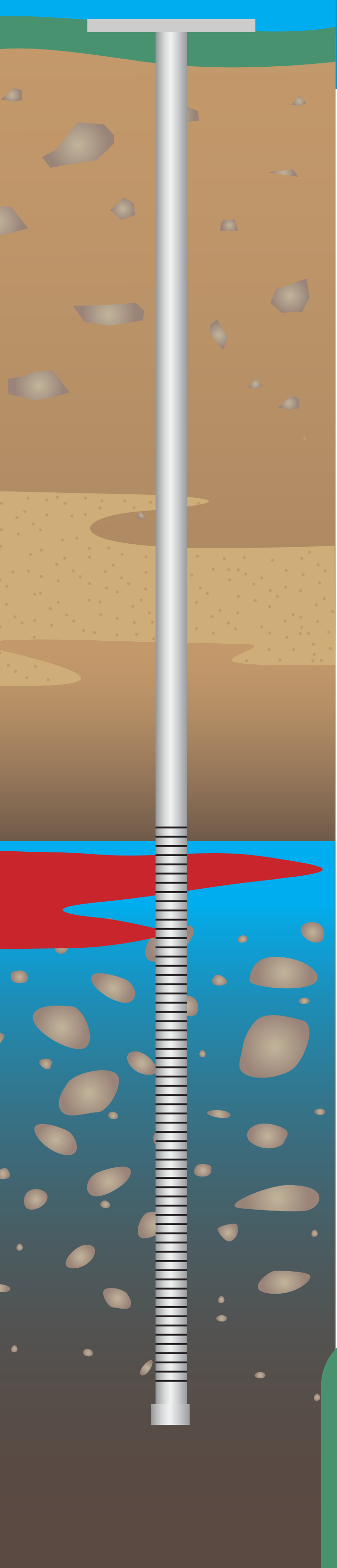


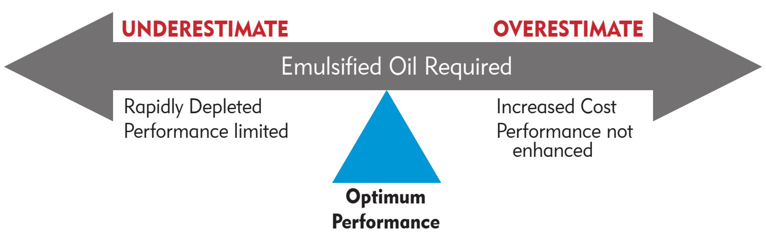
mi ORM SITE LOGIC *Design oil injections for optimal performance at minimal cost*

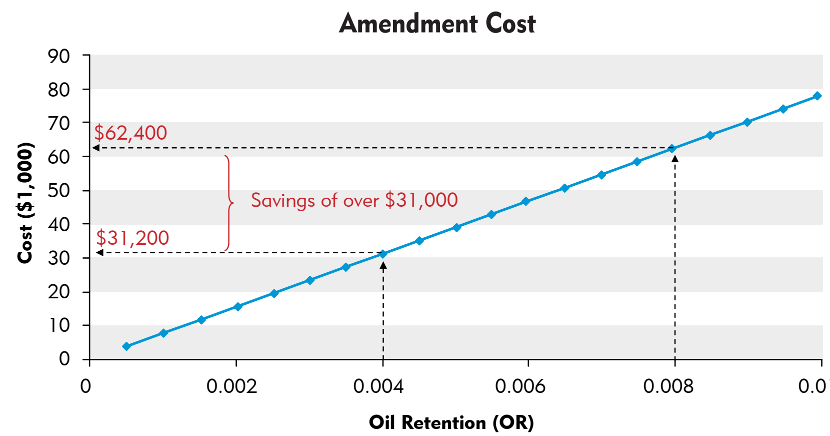
Maximum Oil Retention (OR_M)

Bioremediation of chlorinated compounds including tetrachloroethene (PCE) and trichloroethene (TCE) often relies on subsurface injection of a suitable electron donor such as an edible oil emulsion to promote biological reductive dechlorination.

Although a wide variety of site-specific variables including contaminant area, saturated zone thickness, and injection point spacing must be considered, one of the most fundamental design parameters when evaluating biostimulation as a treatment technology is the amount of emulsified oil required.

The amount of emulsified oil required is a function of the maximum amount of oil retained per mass of aquifer material (OR_M) in addition to the treatment zone dimensions. Typically, the OR_M (g oil/g aquifer material) is estimated based on the sediment type. However, reported OR_M values range from as low as 0.0004 g/g for coarse grained sands and gravel to as high as 0.01 g/g for fine, clayey sands containing kaolinite. Considering that underestimation or overestimation of OR_M can dramatically impact treatment efficiency and capital costs (see case study), determining a site-specific OR_M is a cost-effective measure to optimize biostimulation as a remedial action.





EOS Barrier to Intercept Chlorinated Solvent Plume

Site managers designed a 15 ft wide x 400 ft long EOS barrier to intercept a groundwater plume impacted by TCE (90 µg/L), TCA (5,000 µg/L), and perchlorate (8,600 µg/L).

The demand for electron donor was calculated based on concentrations of groundwater contaminants and alternative electron acceptors.

The mass of oil required, however, is also dependent on the oil retention of the aquifer material. Depending on clay content and grain size, oil retention on "clayey-sands" can range from 0.004 to nearly 0.01 g oil/g sediment.

Determining the maximum oil retention for this barrier resulted in a savings of over $31,000 in edible oil material costs.

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EOS Barrier to Intercept Chlorinated Solvent Plume

In this example, site managers are designing an EOS barrier to intercept a groundwater plume impacted by trichloroethene (TCE), trichloroethane (TCA), and perchlorate.

Site hydrogeologic conditions dictated a 15 ft wide x 400 ft long EOS barrier perpendicular to groundwater flow to stimulate reductive dechlorination of groundwater contaminants to eliminate off-site migration.

The demand for electron donor was calculated based on concentrations of groundwater contaminants and alternative electron acceptors.

The mass of oil required, however, is also dependent on the oil retention of the aquifer material. Depending on clay content and grain size, oil retention on "clayey-sands" can range from 0.004 to nearly 0.01 g oil/g sediment. In this example, determining that the maximum oil retention was 0.004 g/g instead of 0.008 g/g results in a savings of over $31,000 in edible oil material costs.

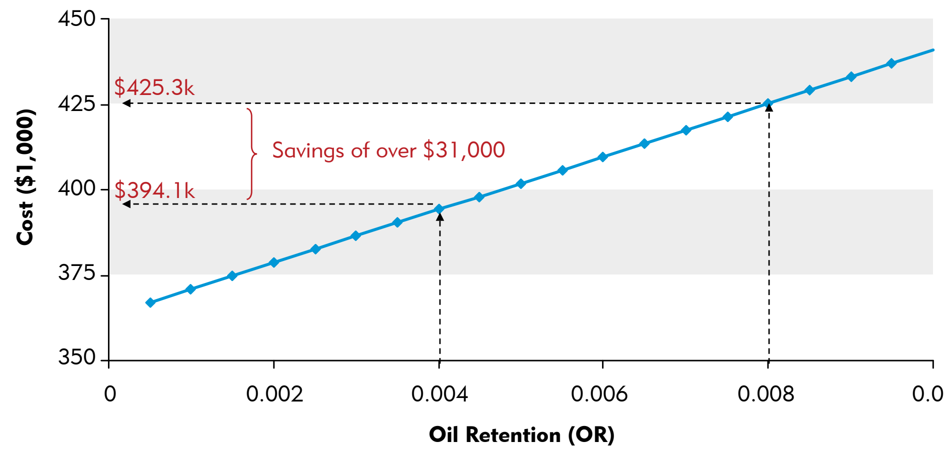
Design Considerations

Barrier Width	400 ft
Zone Thickness	9 ft
Number of Rows	3
Well Spacing	5 ft
Seepage Velocity	0.22 ft/day
Minimum Contact Time	60 days

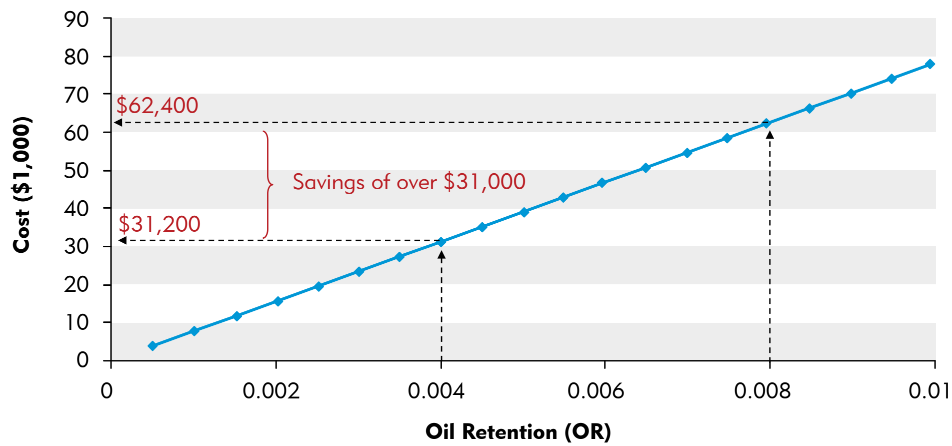
Groundwater Concentrations

TCE	90 µg/L
TCA	5,000 µg/L
Perchlorate	8,600 µg/L
DO	2.7 mg/L
Nitrate	9.5 mg/L
Fe2+	10 mg/L
Mn2+	2 mg/L
Sulfate	29 mg/L
Methane	5 mg/L

Installation and Injection Cost



Amendment Cost



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