

### List of Technologies the ITC has reviewed

Please note that it is the responsibility of the vendor, consultant and/or RP to determine if a suggested technology is already patented. Methods can also be combined, and are often more effective by doing so. The technologies have been subdivided into [Mechanical](#) and [Chemical](#) Methods, then listed alphabetically. This Table will be updated periodically.

<b>Mechanical Methods</b>			
<b><u>Technology</u></b>	<b><u>Applicant</u></b>	<b><u>Description of Technology</u></b>	<b><u>Eligible for Reimbursement from the UST Commercial Trust Fund</u></b>
Dual Phase Extraction		Uses a pump to extract groundwater and soil vapors simultaneously from recovery wells. Contaminated water is then treated by conventional methods.	Yes
Hydraulic Fracturing		Uses high pressure water and sand to cut a disk-shaped cavern into a saturated media to enhance permeability.	Site-specific consideration
MPE or MMPE		Multi-phase extraction uses a vacuum system to remove various combinations of contaminated groundwater, free product (LNAPL), and vapors from the subsurface. The system lowers the water table around the well, exposing more of the formation. Contaminants in the newly exposed vadose zone are then accessible to vapor extraction. Once above ground, the extracted vapors or liquid-phase organics and ground water are separated and treated. Mobile Multi-Phase Extraction (MMPE) uses a vacuum truck to do this, typically for 96 hours.	Yes
Radio Frequency (RF) Heating		Rods driven into contaminated soil emit radio waves that generate heat and volatilize hydrocarbons.	Yes
Recirculating wells		Uses large diameter wells to remove VOCs by recirculating contaminated groundwater while the negative pressure of the SVE volatilizes (strips) VOCs in water & soil.	Considered case by case
Soil Vapor Extraction (SVE)		Uses a vacuum pump to extract vapors (VOCs) by volatilization from unsaturated soils, also promotes biodegradation. This technique can also be used to remove free product from the water table.	Yes
SVE/IAS		Uses vacuum extraction from the unsaturated zone & air injection of the saturated zone (volatilizes & biodegrades hydrocarbons)	Yes
Vacuum-Sparge		Uses vacuum to induce a negative pressure on multiple wells while raising the water table to promote bubbling in the groundwater. Soil gas is extracted from the wells.	Yes

## Chemical Methods

Bioremediation by injecting air, oxygenates or nutrients.		Enhanced aerobic bioremediation. Providing oxygen or nutrients to existing microbes in the subsurface. Anything other than air injected into the subsurface will require evaluation and approval from the Underground Injection Control (UIC) permitting section.	Considered case by case.
Bioremediation using lab-cultured microbes		Using lab cultured microbes to degrade petroleum products in-situ (requires injection). This process will also require evaluation and approval from the Underground Injection Control permitting section.	Considered case by case.
Bioventing air injection		Low air flow rates (cfm) are INJECTED into unsaturated subsurface soils (enhances biodegradation)	Yes, only on soil stockpiles (ex-situ)
Bioventing air extraction		Low air flow rates (cfm) are EXTRACTED from the unsaturated subsurface soils (volatilizes & biodegrades hydrocarbons)	Yes
Cool-Ox <sup>R</sup>	Deep Earth Technologies	A “Modified Fenton” ISCO process, <i>Cool-Ox</i> <sup>®</sup> incorporates calcium peroxide, hydrogen peroxide, chelating agents, and buffer/nutrients into the formulation to slow and control the reaction of iron (the catalyst) with hydrogen peroxide. Hydrocarbon contaminants are oxidized to form alcohols and fatty acids, which provides a carbon source for the replication of microbes. Excess oxygen provides respiration boosts to intrinsic microbes.	No
EAS <sup>TM</sup> Electron Acceptor Solution (or similar)	EOS Remediation, LLC	EAS <sup>TM</sup> is a patented, sulfate-enhanced, anaerobic bioremediation process engineered for in situ treatment of petroleum hydrocarbons in the aquifer and capillary zone. An Underground Injection Control permit would be required prior to use.	Yes
ISCO In-Situ Chemical Oxidation		ISCO introduces oxidants into the subsurface to chemically transform groundwater or soil contaminants into less harmful compounds. The most common oxidants used for remediating petroleum compounds are activated sodium persulfate, catalyzed hydrogen peroxide, and ozone. Site stratigraphy, soil permeability, total oxidant demand, pH, contaminants and their concentrations must be known to design effective remedies.	Yes
iSOC (or similar)	inVentures Technologies	iSOC <sup>®</sup> (in-situ Submerged Oxygen Curtain) is a patented oxygen delivery technology that infuses high levels of oxygen into groundwater when suspended in monitoring wells. The proprietary structured polymer used in iSOC <sup>®</sup> contains hydrophobic microporous hollow fibers.	Yes
Matrix Oxygen Injection System (or similar)	Matrix Environmental Technologies	Matrix Oxygen Injection Process is a patented oxygen delivery technology that produces pure oxygen from compressed air for pulse injection into groundwater.	Yes

Natural Oil Vanish		Uses composted poultry waste with added microbes to enhance bioremediation of contaminated soil.	Yes, only on soil stockpiles (ex-situ)
Oil Gator		Bioremediation product that mixes modified cellulosic fibers, nitrogen, sulfur, phosphorus and indigenous bacteria with ex-situ contaminated soils.	Yes, only on soil stockpiles (ex-situ)
Oxygen Releasing Compound (ORC)	Regenesis	Uses a media placed in groundwater wells or open excavations to increase dissolved oxygen in groundwater, thus enhancing natural attenuation.	Considered Case by Case
Ozone Injection ISCO in gas form	H <sub>2</sub> O Engineering, Inc.	H <sub>2</sub> O Engineering's ozone sparge technology delivers ozone gas directly to the subsurface in controlled time duration sequences via in-situ oxidation points.  One of the stronger ISCO oxidants, ozone can be applied as a gas or dissolved in water. Ozone can degrade chemicals directly and forms hydroxyl radicals (OH) that are highly reactive but non-specific. It also provides an oxygen-rich environment for contaminants that degrade under aerobic conditions. <b>Due to its fast reactivity, ozone may not be appropriate for low-permeability soil, as it will be spent before it can diffuse.</b>	Yes
PetroFix	Regenesis	PetroFix™ Remediation Fluid is a water-based suspension consisting of micron-scale activated carbon and biostimulating electron acceptors. It is designed to remove hydrocarbons from the dissolved phase by adsorbing them onto activated carbon particles and then stimulating hydrocarbon biodegradation through the addition of electron acceptors using nitrate and sulfate salts.	Yes
Soil bioremediation		Treats contaminated soil ex-situ by mixing soil with nutrients and stockpiling (hydrocarbons are biodegraded). Typical of land application.	Yes
Surfactants		Surfactants are used to reduce surface tension and break down hydrocarbons to enhance biodegradation and accelerate recovery.	Yes
Trap and Treat® using BOS 200®	AST and RPI	Traps contaminants via adsorption onto activated carbon and subsequently treats them via biological degradation within the BOS 200® matrix as the product incorporates both aerobic and anaerobic biological processes. BOS 200® contains microbes and nutrients, including phosphorus and nitrogen, and electron acceptors (nitrate, ammonia and sulfate).	Yes

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