Table A-10.A. Thermal conduction heating

Technology	Thermal Conduction Heating	Thermal conduction heating is an technique used to heat soil and mobilize and volatilize LNAPL. Heat and vacuum are applied simultaneously. Heaters are typically installed using standard drilling techniques to deliver energy to the subsurface. Heat flows into the soil primarily by conduction from heaters typically operated between 500 and 800°C. As the soil is heated, water is boiled and LNAPL constituents in the soil are vaporized. The mobilized LNAPL is recovered from extraction wells, and volatilized LNAPL is collected via vapor extraction wells. Compared to fluid injection processes, the conductive heating process is very uniform in its vertical and horizontal sweep. This heating technology does not require water to be present.	
Remediation process	Physical mass recovery	Yes	Heating reduces viscosity of LNAPL which increases its mobility and recoverability.
	Phase change	Yes	Heating volatilizes the LNAPL for recovery in the vapor phase.
	In situ destruction	No	Some destruction may occur near the heater wells, but the main process is recovery of LNAPL.
	Stabilization/ binding	No	N/A
Objective applicability	LNAPL saturation	Yes	Enhances LNAPL fluid flow, reducing LNAPL saturation to residual saturation. Mass loss also by volatilization and in situ destruction.
		Example performance metrics	Reduced LNAPL transmissivity; reduction or elimination of measurable LNAPL in wells.
	LNAPL composition	Yes	Abate accumulation of unacceptable constituent concentrations in soil vapor and/or groundwater from an LNAPL source.
		Example performance metrics	LNAPL composition change; soil VOC concentrations to below regulatory standard; soil vapor concentrations to below regulatory standard.
Applicable LNAPL type	All LNAPL types, though higher-viscosity and/or lower-volatility LNAPL takes longer to treat and/or require higher temperatures to achieve treatment.		
Geologic factors	Unsaturated zone	Permeability	Effective in all soil types in the unsaturated zone.
		Grain size	All grain sizes can be effectively heated - rates depend on water content and porosity, not grain size.
		Heterogeneity	Heterogeneous soils will heat evenly because all soils have similar thermal conductivity.
		Consolidation	Can be used in bedrock
	Saturated zone	Permeability	Effective in less permeable soils with groundwater seepage velocities less than 1 foot/day.
		Grain size	All grain sizes can be effectively heated - rates depend on water content and porosity, not grain size.
		Heterogeneity	Effective in heterogeneous soils as long as groundwater velocity remains less than about 1 foot per day.
		Consolidation	Can be used in bedrock