Table A-6.C. Technical implementation considerations for water flooding (including hot-water flooding)

Data requirements	Site-specific data for technology evaluation	Transmissivity of hydrogeologic unit containing LNAPL	Transmissivity data helps determine compatibility of formation for injection, potential injection rates, and sweep efficiency. Injected water flows preferentially through higher-permeability layers. Ideally, a confining unit is present above and below the LNAPL zone to better control the injected water.
		LNAPL fluid characteristics	Includes temperature-sensitive changes if hot-water flooding is applied.
	Bench-scale testing	LNAPL changes with temperature	If hot-water flooding is applied.
	Pilot-scale testing	Groundwater/LNAPL ROC	Aquifer tests to determine the ROC so can target water injection within the ROC to enable control of the injected water to maximize the efficiency of the sweep through the LNAPL body.
		Groundwater recovery rate, volume, and influent concentrations	Determine groundwater recovery rate, volume, and influent concentrations to assist with design of water handling, treatment, and discharge options.
		LNAPL recovery rate and volume	Determine LNAPL recovery rate and volume to assist with design of LNAPL storage, handling, treatment, and discharge options.
		Field test	Hot-water flooding may require closer well spacing due to heat loss to the formation after injection. Also, hot-water buoyancy effects should be considered in the design process.
	Full-scale design	Number of injection/ extraction wells	Determine number of required injection/extraction wells necessary to achieve adequate zone of LNAPL recovery consistent with LNAPL site objective(s).
		Conveyance piping	Determine locations, lengths, materials for all horizontal conveyance piping to/from extraction wells and recovery/treatment system. Assess pipe insulation and heat tracing needs for winter conditions, if applicable.
		Groundwater ROC	Establish groundwater capture for different groundwater pumping rates. For continuous pumping systems, determine acceptable pumping rate that may be sustained without creating unacceptable drawdown.
		LNAPL ROC	Establish LNAPL capture for different LNAPL pumping rates. For continuous pumping systems, determine acceptable pumping rate that may be sustained without creating unacceptable drawdown.
	Performance metrics	LNAPL thickness	
		Mass removed	
Further information		Ground-Water Remediation Technologies Analysis Center. 1997. In Situ Soil Flushing Technology Overview Report. TO-97-02. http://clu-in.org/download/remed/flush_o.pdf	
		EPA. n.d. “Technology Focus: In Situ Soil Flushing.” www.clu-in.net/techfocus/default.focus/sec/In_Situ_Flushing/cat/Overview	
		EPA. 1992. Chemical Enhancements to Pump and Treat Remediation. EPA/540/S-92/001. https://www.epa.gov/sites/production/files/2015-06/documents/chemen.pdf	
		INDOT. 2007. INDOT Guidance Document for In Situ Soil Flushing. https://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=2578&context=jtrp	