

Contaminants contained in ground materials, ie soils, made ground sediments, sludges etc	VOCs (non-halogenated)	VOCs (halogenated)	SVOCs (non-halogenated)	SVOCs (halogenated)	Fuels, hydrocarbons	Metals	Non-metals	Asbestos	Radionuclides	Explosives	Gravel/sand	Silt	Clay	Peat	Made ground	Overall cost (relative indication)	Capital- or maintenance-/operation-intensive	Process reliability	Clean-up time (years)	Further information	
	<i>In-situ biological treatment</i>																				
Bioventing	Y	Y	Y	Y	Y	N	N	N	N	N	Y	Y	N	N	Y	£	Y	↑	0.5–3	E02e H96	
Enhanced bioremediation (including windrow turning)	Y	Y	Y	Y	Y	N	Y	N	N	Y	Y	Y	N	N	Y	£	Y	Av	0.5–2	E02b H95b	
Phytoremediation	Y	Y	Y	Y	Y	Y	O	N	Y	N	Y	Y	N	Y	Y	£	N	↓	>2	U98a	
<i>Ex-situ biological treatment</i>																					
Biopiles	Y	Y	Y	Y	Y	N	N	N	N	N	Y	Y	N	N	Y	£	Y	Av	0.5–2	EA02a H95b	
Landfarming	Y	Y	Y	Y	Y	N	N	N	N	Y	Y	Y	Y	Y	Y	£	Y	Av	1–3	E02c ¹ H95b ⁴	
Slurry-phase biological treatment	Y	Y	Y	Y	Y	N	N	N	N	Y	Y	Y	Y	N	N	£+	Y	Av	0.5–2	B02	
<i>In-situ physical/chemical treatment</i>																					
Chemical oxidation	Y	Y	Y	Y	Y	Y	O	N	N	O	Y	Y	?	N	Y	££	Y	Av	<1	B03	
Electrokinetic separation	O	O	O	O	N	Y	Y	N	O	N	?	?	?	?	?	£££	Y	Av	1–3	S97	
Soil flushing	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	N	N	Y	££	Y	Av	1–3	B03	
Soil vapour extraction (including thermally)	Y	Y	N	N	Y	N	N	N	N	N	Y	Y	N	N	Y	£	Y	↑	1–3	B03	

Key

N = No expected applicability

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O = Limited applicability

* = contaminant dependent

£ = Low-cost

££ = Medium-cost

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↑ = High reliability

Av = Average reliability

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B02 = Barr *et al* (2002) (etc)

E00 = Environment Agency (2000)

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enhanced SVE)																					
Solidification/stabilisation	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	££+	N	↑	<1	B03	
Ex-situ physical/chemical treatment																					
Chemical extraction (solvent extraction)	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	££+	Y	Av	0.5–1	B03	
Chemical reduction/oxidation	Y	Y	Y	Y	Y	Y	Y	N	N	O	Y	Y	Y	N	Y	££	Y	↑	<0.5	B03	
Dehalogenation	N	Y	N	Y	N	N	N	N	N	?	Y	Y	Y	N	Y	£££	Y	↓	0.5–1	B03	
Separation (including electrokinetic)	O	O	O	O	N	Y	O	N	Y	N	Y	Y	N	N	Y	££	Y	↑	<0.5	B03	
Separation (detector-based)	N	N	N	N	N	N	N	N	Y	N	Y	Y	Y	Y	Y	££	N	↑			
Soil washing	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	££+	N	↑	<0.5	B	
Solidification/stabilisation	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	?	?	Y	££	N	Av +	<0.5	B	
In-situ thermal treatment																					
Thermal treatment	Y	Y	Y	Y		Y	N	N	N	N	Y	Y	Y	Y	Y	££	Y	↑	<1	B	
Ex-situ thermal treatment																					
Incineration	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	£££	Y	↑	<0.5	B	
Open burn/open detonation	N	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	£	N	↑	<0.5	B	
Pyrolysis	Y	Y	Y	Y	Y	Li	N	N	N	N	Y	Y	N	N	Y	£££	Y	↓	<0.5	B	
Thermal desorption	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	N	Y	££	Y	Av	<0.5	B	

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	Vitrification						Y	Y	Y	Y	N	Y	Y	Y	N	Y	£££	Y	↑	<0.5
Containment																				
Capping and barriers	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	£	N	Av	<1	B
Other																				
Excavation, retrieval and off-site disposal	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	£+	N	↑	<0.5	B

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Groundwater and surface waters	VOCs (nonhalogenated)	VOCs (halogenated)	SVOCs (non-halogenated)	SVOCs (halogenated)	Fuels Hydrocarbons	Metals	Non-Metals	Asbestos	Radionuclides	Explosives	Gravel/sand	Silt	Clay	Peat	Made Ground	Overall cost (relative indication)	Capital or maintenance / operation-intensive	Process reliability	Cleanup time (yrs)	Further information
In-situ biological treatment																				
Monitored natural attenuation	Y	Y	Y	Y	Y	Y	Y	N	N	N	-	-	-	-	-	£	N	Av	1-30	E02e E00b
Phytoremediation	O	O	O	O	O		Y		N	N	-	-	-	-	-	(£)	N	↓	>10	B03
In-situ physical/chemical treatment																				
Air sparging/ <i>in-situ</i> air stripping/ <i>in-situ</i> volatalisation	Y	O	O	O	Y	O	N	N	N	N	-	-	-	-	-	(£+)	Y	Av	3-10	B03
Bioslurping	O	O	Y	Y	Y	N	O	N	N	N	-	-	-	-	-	(£)	Y	Av	3-10	B02
Chemical oxidation	Y	Y	Y	Y	Y	N	Y	N	N	O	-	-	-	-	-	(££)	Y	Av	<3	B03
Directional wells (enhancement)	O	O	O	O	O	O	O	N	O	O	-	-	-	-	-	(££)	N	Av	3-10	B03
Dual-phase vacuum extraction	Y	Y	Y	Y	Y	N	N	N	N	N	-	-	-	-	-	(££)		Av	3-10	B03
Thermal treatment	O	Y	Y	Y	Y	N	N	N	N	N	-	-	-	-	-	(££)		Av	<3	B03
Hydrofracturing enhancements	O	O	O	O	O	N	O	N	N	O	-	-	-	-	-	(££)		Av	3-10	B03
Passive/reactive barrier	Y	Y	Y	Y	O	N	Y	N	Y	N	-	-	-	-	-	(££)		Av	>10	B03
Ex-situ biological treatment																				
Bioreactors	Y	Y	Y	Y	Y	N	N	N	N	Y	-	-	-	-	-	(£)		Av	3-10	B03
Constructed wetlands	O	O	O	Y	O	Y	Y	N	Y	Y	-	-	-	-	-	(££)	N	Av	*	U01
Ex-situ physical chemical treatment																				
Adsorption/absorption	O	O	O	O	N		Y		Y	N	-	-	-	-	-	(£££)		Av	>10	B03
Air stripping	Y	Y	N	N	N	N	N	N	N	N	-	-	-	-	-	(£)	Y	Av	>10	B03

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Granulated activated carbon (GAC)/ liquid-phase carbon adsorption	Y	Y	Y	Y	Y	N	Y	N	N	Y	-	-	-	-	-	(££)	N	Av	>10	B03
Pump and treat	O	O	O	Y	O	O	O	N	O	O	-	-	-	-	-	(£££)	Y	Av	>10	B03
Ion exchange	N	N	N	N	N	Y	Y	N	Y	N	-	-	-	-	-	(££)	N	Av	>10	B03
Precipitation/coagulation/flocculation – <i>coagulants and flocculation</i>	N	N	N	N	N	Y	Y	N	Y	N	-	-	-	-	-	(££)	Y	Av	>10	B03
Separation (by phase)	Y	N	N	Y	Y	N	Y	N	N	N	-	-	-	-	-	£	N	Av	<3	
Containment																				
Physical low-permeability barriers/ encapsulation	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	-	-	-	-	-	(£)	Y	Av	>10	B03
Hydraulic containment	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	-	-	-	-	-	(£)	Y	Av	>10	
Deep well injection	O	O	O	O	O	O	O	N	O	O	-	-	-	-	-	(£)	Y	Av	N	
Membrane separation	N	N	O	O	O	O	N	N	N	O	-	-	-	-	-	(££)	Y	↓	N	B03
Air emissions/off-gas treatment																				
Biofiltration	Y	Y	Y	Y	Y	N	N	N	N	Y	-	-	-	-	-	£	N	↓	<1	V97
High-energy destruction	Y	Y	Y	Y	Y	N	O	N	N	N	-	-	-	-	-	(££)	Y	↓	N	U98b
Oxidation	Y	Y	Y	Y	Y	Y	N	N	N	O	-	-	-	-	-	(£)	Y	Av	N	U98b
Scrubbers	N	N	N	N	N	Y	Y	N	N	N	-	-	-	-	-	(£)	Y	Av	N	USEPA
Vapour-phase carbon adsorption	Y	Y	Y	Y	Y	N	O	N	N	Y	-	-	-	-	-	(£)		Av	N	B03

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