

TABLE 2.5

Technology/Process Option Evaluation— Upper Vadose Zone Soils (3 feet to 35 feet below ground surface)

Page 1 of 4

General Response Action	Remedial Technologies	Process Options	Technical Implementability	Effectiveness	Cost	Comments	
No Action	None	None	Good	Poor	None	Not protective of human health due to presence of elevated COPCs. Retained for comparison, per the NCP.	
Institutional Actions	Access Restrictions	Fencing	Good	Fair	Low	Fencing to prevent access is incompatible with future redevelopment of the site.	
		Land Use Restrictions	Fair	Poor	Low	Future park already slated for site. Community acceptance not viable.	
	Monitored Natural Attenuation (MNA)	Monitoring	Good	Poor	Low	Retained. MNA or monitoring in general is critical to the implementation of any alternative.	
Containment	Surface Controls	Grading	Not applicable to upper vadose zone soils.				
		Lagoon Buttress	Not applicable to upper vadose zone soils.				
		Revegetation	Not applicable to upper vadose zone soils.				
		Capping	Clay/Synthetic Membrane	Not applicable to upper vadose zone soils.			
			Soil Cover/Vegetation	Not applicable to upper vadose zone soils.			
			Multimedia	Not applicable to upper vadose zone soils.			
		Asphalt or Concrete Cap	Not applicable to upper vadose zone soils.				
Horizontal Subsurface Barriers	Block Displacement	Good	Poor	High	Not feasible due to subsurface conditions and areal extent.		

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Page 2 of 4

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		Grout Injection	Good	Poor	High	Not feasible due to subsurface conditions and areal extent.	
<i>In-Situ Treatment</i>	Physical	Electrokinetic Separation	Fair	Poor	High	Not effective for organic COPCs.	
		Solidification/Stabilization	Good	Poor	Moderate	Not effective for high concentrations of chlorinated organic COPCs.	
		Solvent Extraction	Fair	Poor	Moderate	Difficult to capture solvents without contamination of subsurface and potential migration to groundwater.	
		Vitrification	Good	Good	High	Permanently encapsulates contaminants in a solid matrix. Considerable energy expended during process. Cost-prohibitive in relationship to levels and type of COPCs.	
			Vapor Extraction	Good	Good	Low	Retained. Highly effective for volatile COPCs.
	Chemical	Oxidation/Reduction	Good	Good	Moderate	Retained. Possible difficulty in dispersing oxidants.	
		Reductive Dechlorination	Good	Good	Moderate	Retained. Possible difficulty in dispersing reducing agents.	
	Biological	Aerobic/Bioventing	Good	Poor	Low	Not effective for chlorinated organic COPCs.	
		Anaerobic	Good	Fair	Moderate	Retained. Assume mechanism to deliver natural attenuation enhancement compounds to vadose zone.	
			Soil Flushing	Fair	Poor	High	Not effective for chlorinated organic COPCs.
Thermal	Electrical Resistance Heating	Fair	Good	High	High-energy output required to heat subsurface. Removal of organic COPCs. Treatment of soil vapor required at surface. Limited full-scale application data to date.		

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Page 3 of 4

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		Hot Air/Steam Stripping	Fair	Good	High	Difficult to implement due to presence of clay intervals in upper vadose zone soils.
		Radio Frequency Heating	Fair	Good	High	High-energy output required to heat subsurface. Limited full-scale application data to date.
Removal	Excavation	Backhoe/ Front-End Loader	Fair	Good	Moderate	Retained. Often combined with onsite treatment technologies applied to the excavated solids or offsite disposal. Increased difficulty below 20 feet.
<i>Ex-Situ</i> Treatment (Post Collection)	Physical	Soil Washing/ Solvent Extraction	Good	Fair	Moderate	Treatment plant would need to be installed at the site for the duration of the soil excavation. Plant would require a series of steps for washing out COPCs.
		Solidification/ Stabilization	Good	Fair	Moderate	Not effective for high concentrations of chlorinated organic COPCs.
	Chemical	Dechlorination/ Dehalogenation	Fair	Fair	High	Cost prohibitive compared to relative benefits.
		Oxidation/ Reduction	Fair	Fair	High	Cost prohibitive compared to relative benefits.
	Biological	Land Treatment/ Farming	Good	Poor	Low	Not effective for chlorinated organic COPCs.
	Thermal	Low-Temp Desorption	Good	Fair	High	Cost prohibitive compared to relative benefits.
		Onsite Incineration	Poor	Fair	High	Community acceptance of on-site incinerator unlikely.
		Offsite Incineration	Fair	Fair	High	Not cost competitive for soils.

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Page 4 of 4

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Disposal	Onsite	RCRA Subtitle C Landfill	Not implementable administratively due to close proximity to a residential area.			
		Backfill/ Consolidation	Fair	Fair	Low	Assume soil meets acceptable analytical levels through on-site treatment. Liability issues.
	Offsite	RCRA Subtitle C or D Landfill	Fair	Fair	High	Not cost competitive for soils.
		Soil Reclamation/ Recycling	Poor	Poor	Low	Assume soil meets acceptable analytical levels through on-site treatment. Liability issues.

Effectiveness is the ability to perform as part of a comprehensive alternative that can meet RAOs under conditions and limitations that exist at the site. Technical Implementability encompasses the applicability/feasibility of performing the process option under the regulatory, technical, and schedule constraints of the project. Cost is for comparative purposes only, relative to other processes/technologies that perform similar functions.

GAC	Granular activated carbon	RAOs	Remedial Action Objectives
GW	Groundwater	RCRA	Resource Conservation and Recovery Act
NA	Not applicable	SVE	Soil Vapor Extraction
NCP	National Contingency Plan	VOCs	Volatile Organic Contaminants
POTW	Publicly Owned Treatment Works		
TSDF	Treatment, storage, or disposal facility		