TABLE 4.1 Sources Of Ground Water Contamination

CATEGORY I	CATEGORY II	CATEGORY III
Sources designed to discharge substances	Sources designed to store, treat, and/or dispose of substances; discharge through unplanned release	Sources designed to retain substances during transport or transmission
Subsurface percolation (e.g., septic tanks and cesspools)	Landfills	Pipelines
Injection wells	Open dumps	Materials transport and transfer
Land application	Surface impoundments	
	Waste tailings	
	Waste piles	
	Materials stockpiles	
	Above ground storage tanks	
	Under ground storage tanks	
	Radioactive disposal sites	

CATEGORY IV	CATEGORY V	CATEGORY VI
Sources discharging as consequence of other planned activities	Sources providing conduit or inducing discharge through altered flow patterns	Naturally occurring sources whose discharge is created and/or exacerbated by human activity
Irrigation practices	Production wells	Ground water – surface
Pesticide applications	Other wells (non-waste)	water interactions
Fertilizer applications	Construction excavation	Natural leaching
Animal feeding operations		Salt-water intrusion/
De-icing salts applications		brackish water
Urban runoff		upcoming
Percolation of atmospheric pollutants		
Mining and mine drainage		

Office of Technology Assessment, 1984

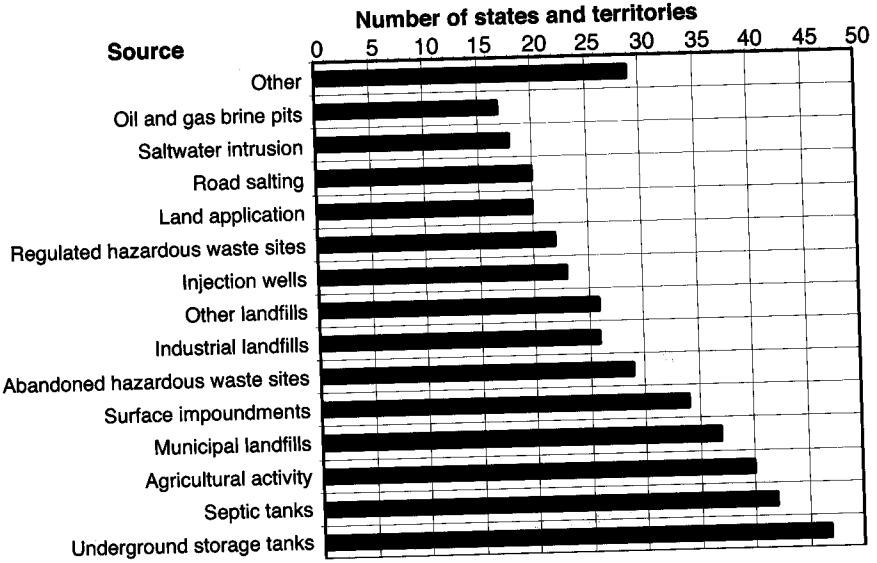


Figure 4.1 Frequency of various contamination sources considered by states and territories of the United States to be major threats to ground water quality.

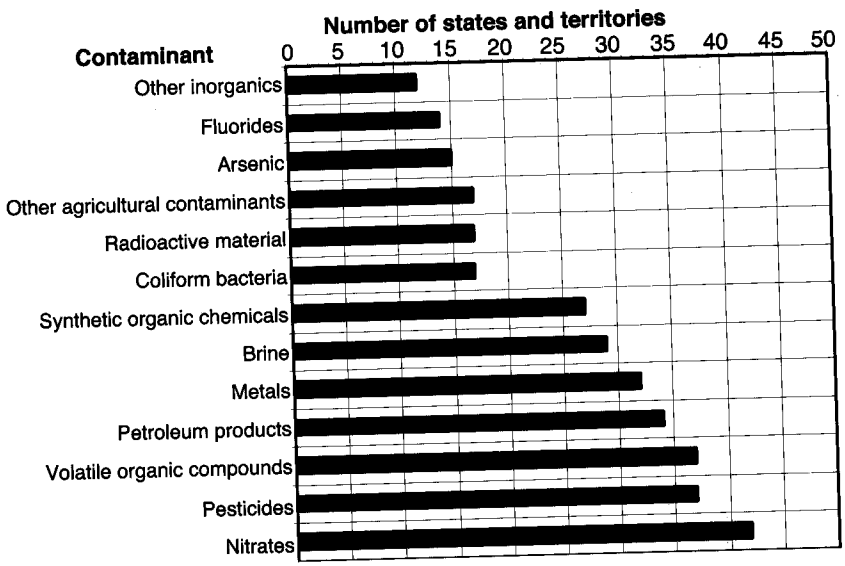


Figure 4.2 Frequency of various contaminants considered by states and territories of the United States to be major threats to ground water quality.

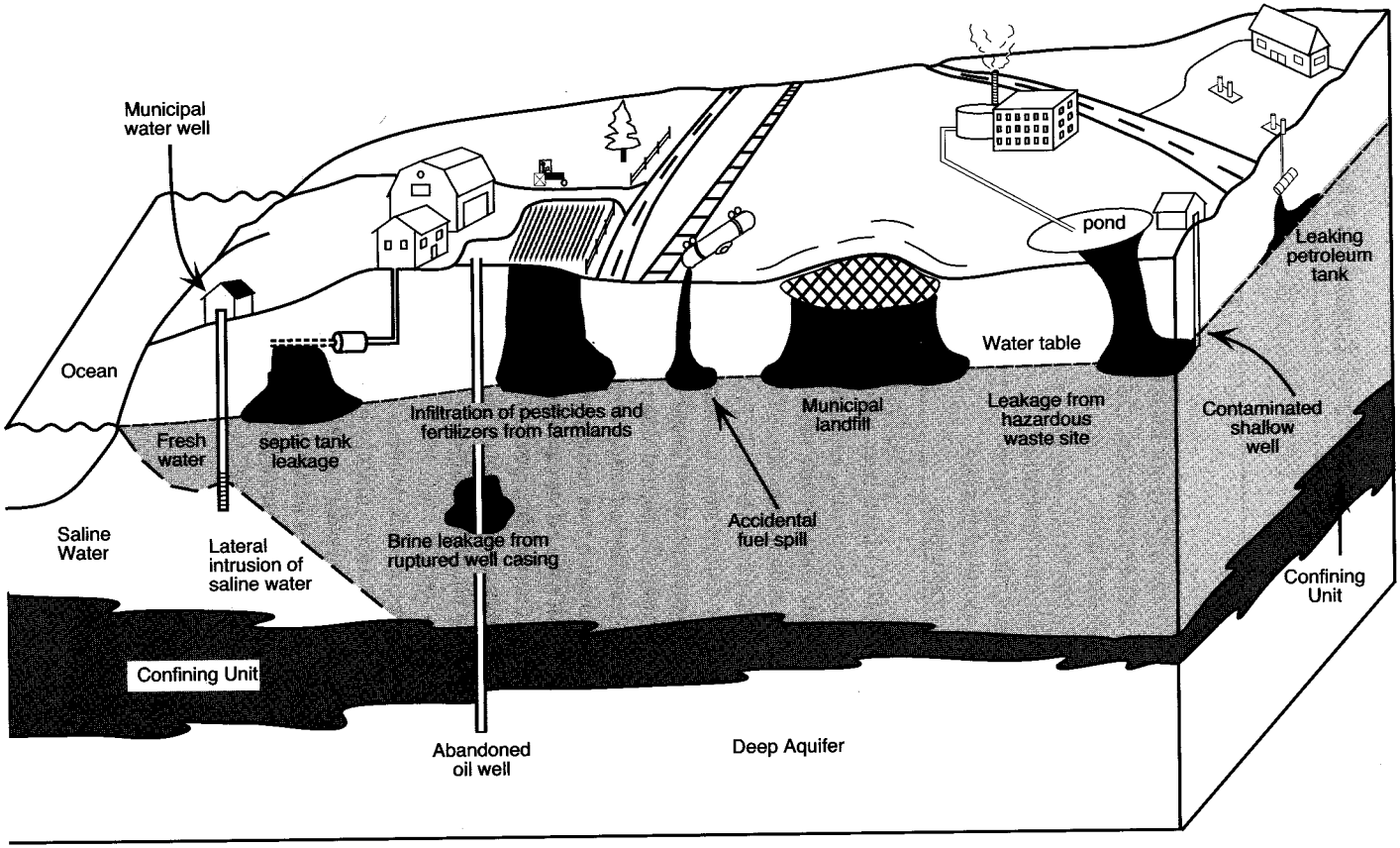
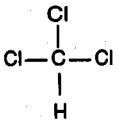
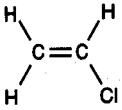
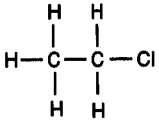
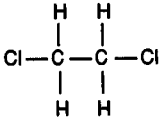
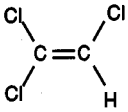
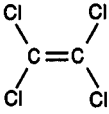
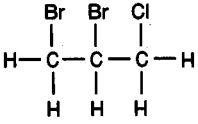
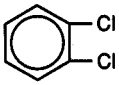


Figure 4.3 Mechanisms of ground water contamination.

Name	Structure	Uses and Other Sources
Trichloromethane (chloroform)		Liquid used in manufacture of anesthetics, pharmaceuticals, fluorocarbon refrigerants and plasics. Used as solvent and insecticide. Formed from methane when chlorinating drinking water.
Vinyl chloride (chloroethene)		Gas used in the manufacture of polyvinyl chloride. End product of microbial degradation of chlorinated ethenes.
Chloroethane		Liquid used to manufacture tetraethyl lead. Degradation product of chlorinated ethanes.
1,2-Dichloroethane		Liquid used to manufacture vinyl chloride. Degradation product of trichloroethane.
Trichloroethene (Trichloroethylene)		Solvent used in dry cleaning and metal degreasing. Organic synthesis. Degradation product of tetrachloroethene.
Tetrachloroethene (perchloroethene) (perchloroethylene)		Solvent used in dry cleaning and metal degreasing. Used to remove soot from industrial boilers. Used in manufacture of paint removers and printing inks.
1,2-Dibromo-3-chloropropane (DBCP)		Soil fumigant to kill nematodes. Intermediate in organic synthesis.
o-Dichlorobenzene (1,2-dichlorobenzene)		Chemical intermediate. Solvent. Fumigant and insecticide. Used for industrial odor control. Found in sewage form odor control chemicals used in toilets.

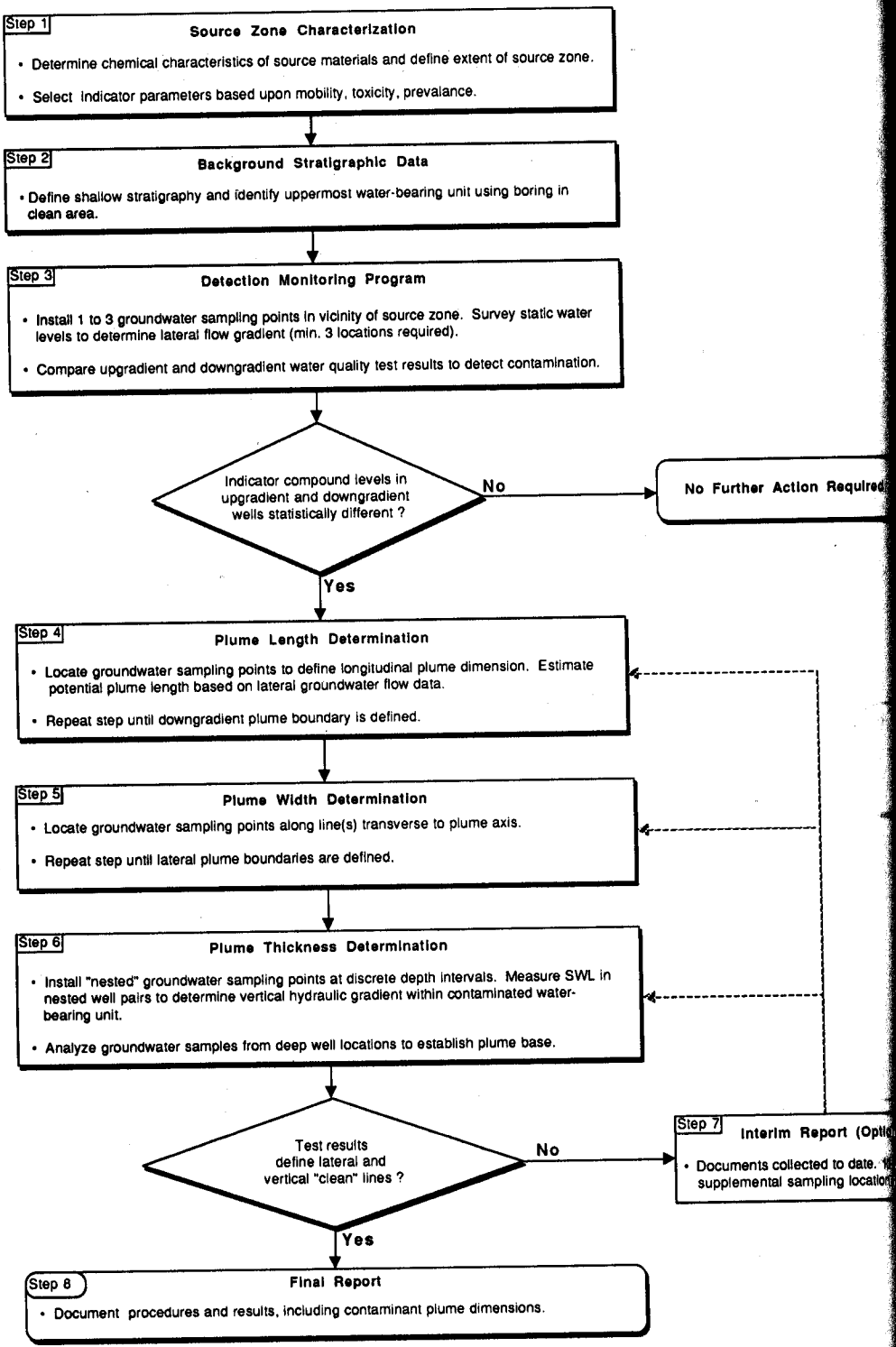
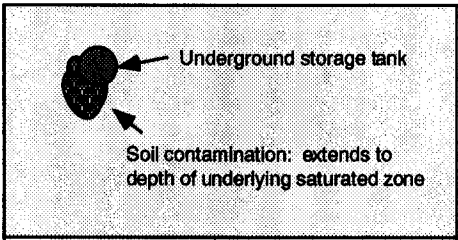
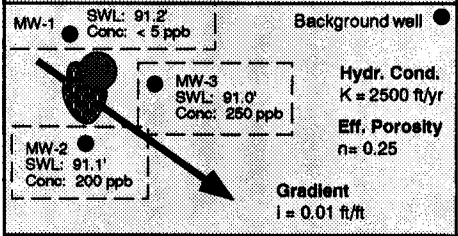


Figure 5.3 Procedures for ground water contaminant plume detection/delineation.



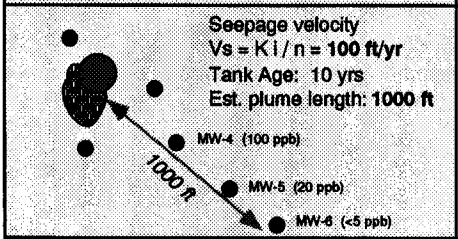
Step 1: Source Delineation

- Locate potential sources.
- Define lateral and vertical extent of soil contamination.
- Characterize contaminant properties: solubility, density, etc.
- Select indicator parameters.



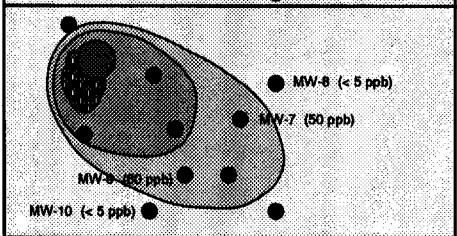
Step 2: Detection Monitoring

- Drill adjacent to source zone to define stratigraphy and identify uppermost water-bearing unit.
- If DNAPLs are indicated, use drilling precautions or outside-in strategy for detection monitoring.
- Install at least 3 wells to define ground water flow direction.
- Compare indicator compound concentrations in upgradient and downgradient wells.
- Run slug tests to define aquifer hydraulic properties.



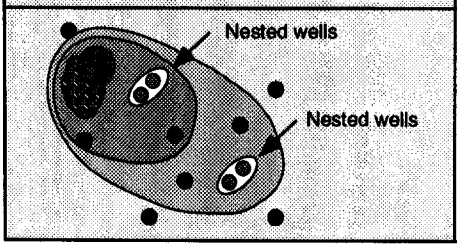
Step 3: Plume Length

- Locate wells to define plume length.
- Use gradient, porosity, and K to define seepage velocity (v_s).
- Use v_s and estimated source age to estimate plume length.
- Space downgradient wells accordingly.
- Repeat as necessary to determine length.



Step 4: Plume Width

- Locate wells on transverse line to determine plume width.
- Can estimate width using advection/dispersion equation.
- Unusual plume shapes indicate possible presence of NAPLs.



Step 5: Plume Thickness

- Install nested wells to determine depth of contamination.
- Estimate vertical gradient by comparing static water levels in deep and shallow nested wells.
- Use drilling precautions if presence of DNAPL is indicated.

Figure 5.4 Typical work program for ground water plume delineation.

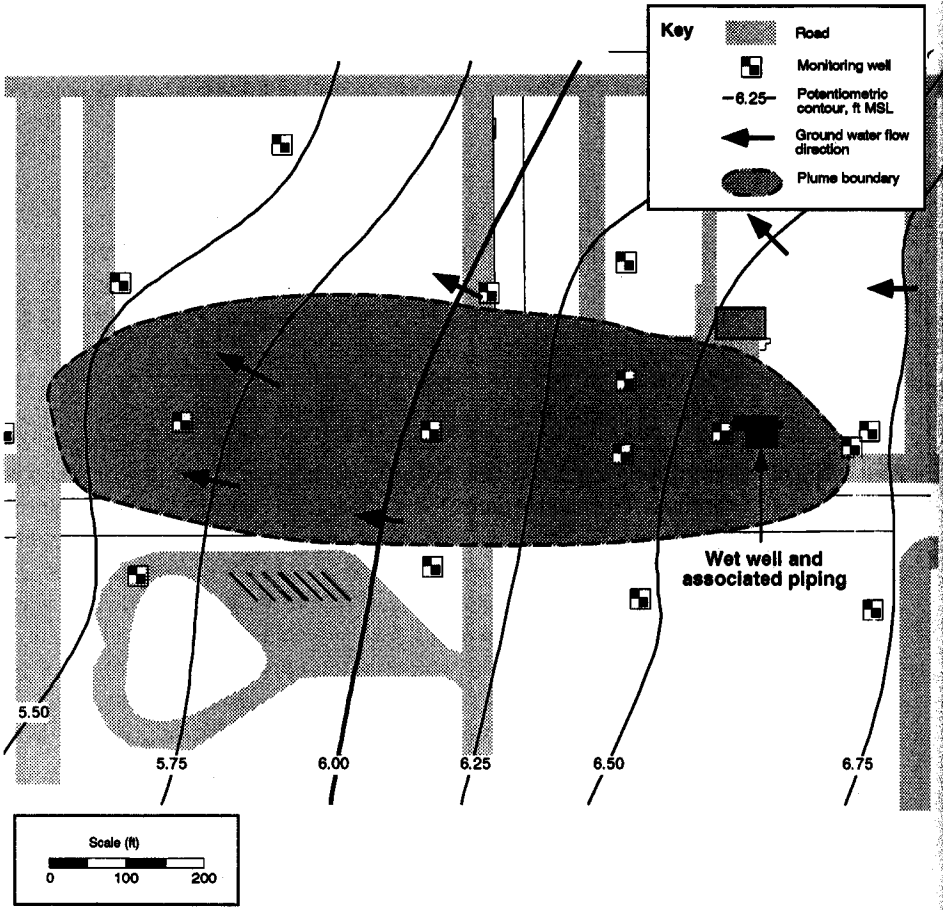


Figure 5.18 Potentiometric surface and plume location, Case Study 1.