Risk Assessment and Groundwater Remediation Alternatives

Risk Based Corrective Action (RBCA)

- Key elements of RBCA process:
  - Exposure pathway screening
    - Groundwater ➔ drinking and dermal contact
    - Vapor ➔ inhalation
    - Soil & vegetation ➔ dermal contact

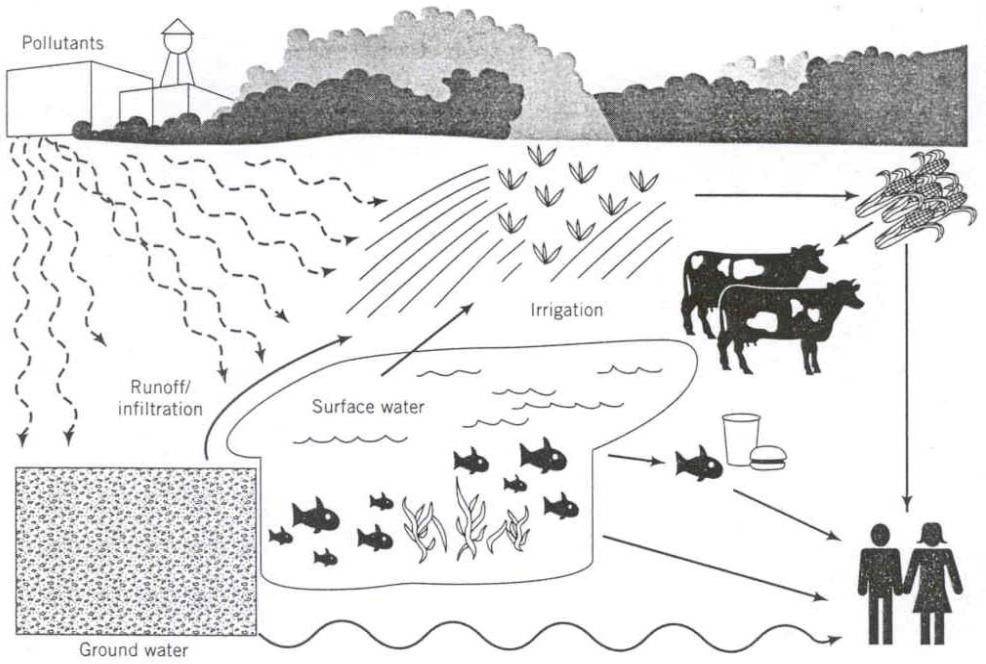
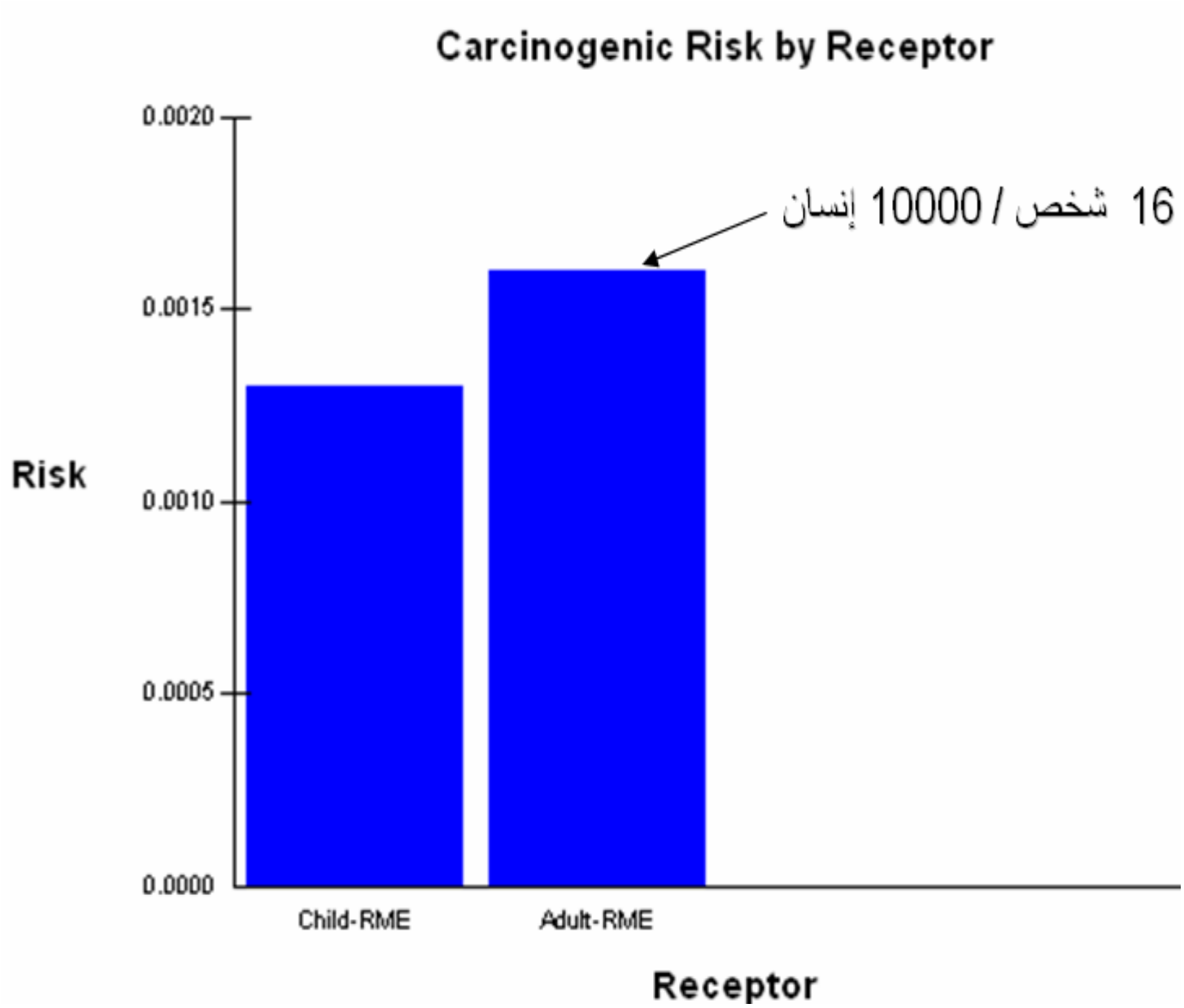


Figure 21.11 Conceptual model of a generalized water pathway from a contaminant source to humans (from FERMCO, 1994).

Risk Based Corrective Action (RBCA)

- Key elements of RBCA process:
  - Risk-based cleanup objectives
    - For each pathway, evaluate potential for exposure in excess of safe limits using a tiered (leveled) procedure.
  - Remedy selection
    - Active remediation, or
    - Natural attenuation


Carcinogenic Risk by Receptor
16 شخص / 10000 إنسان
0.0020
0.0015
0.0010
0.0005
0.0000
Risk
Child-RME
Adult-RME
Receptor

Groundwater Remediation

- Goals for Remediation
  - Limiting contaminant migration
  - Isolating and containing the source area
  - Treating affected groundwater to an acceptable drinking or irrigation standards
- Factors Affecting Remediation
  - Contaminant & Source Characteristics
    - Type: LNAPL, DNAPL, inorganic … etc.
    - High sorption potential, reactivity, or biodegradability ➔ retardation
    - Contaminant location & continuous leaching from source zone
  - Hydrogeologic
    - Aquifer heterogeneities
    - Low permeability zones
    - Fractures
  - Remediation design
    - Pumping rates
    - Recovery well location
    - Screening interval

Remediation Alternatives
Excavation

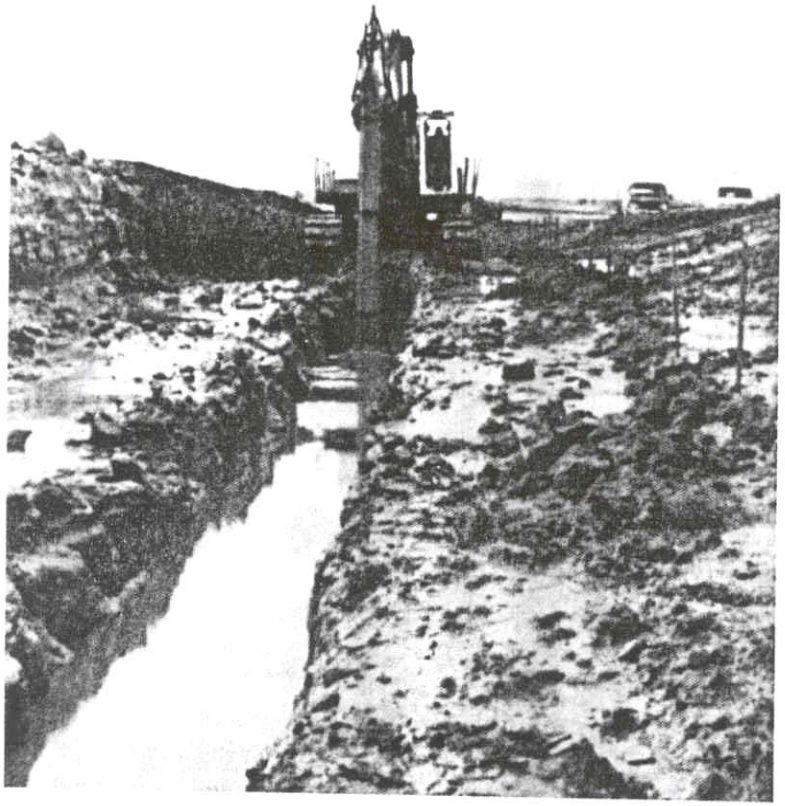


Figure 13.2 Trenching in progress. Source: Ryan, 1985 © ASTM.

Remediation Alternatives
Groundwater Flow Barriers

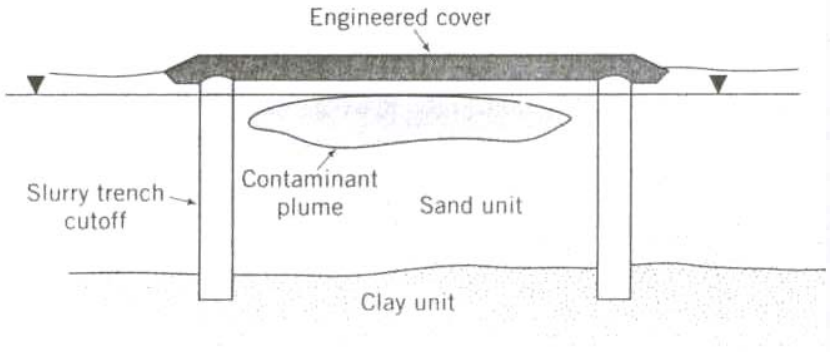


Figure 20.1 Example of a dissolved contaminant plume contained by slurry walls (modified from Knox and others, 1984).

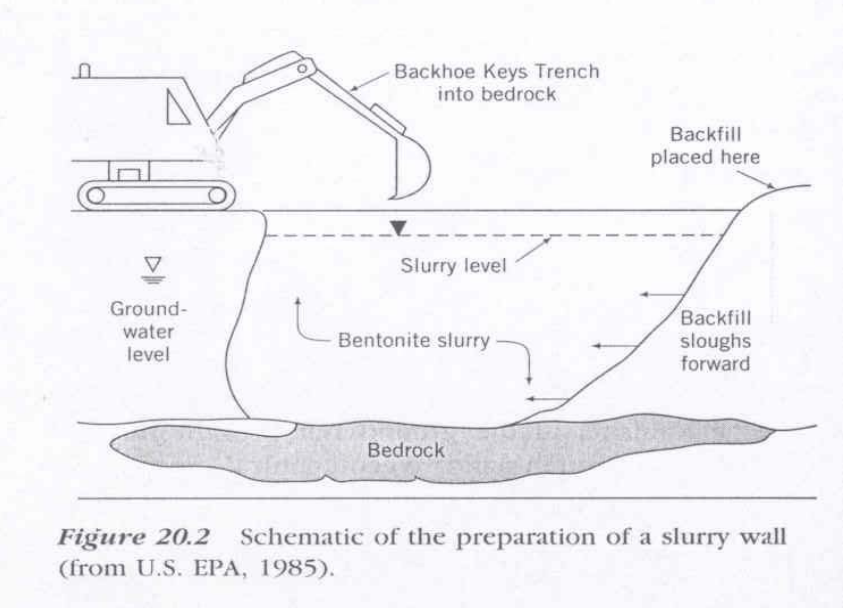


Figure 20.2 Schematic of the preparation of a slurry wall (from U.S. EPA, 1985).

Remediation Alternatives
Hydraulic Control/ Pump & Treat

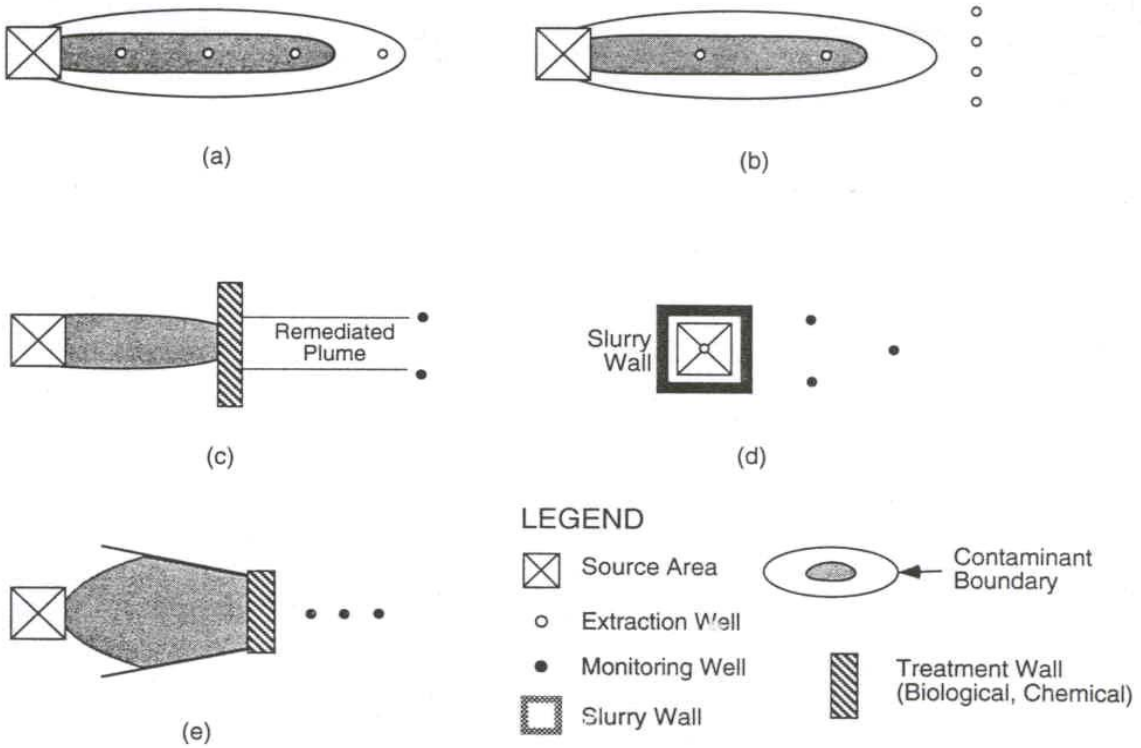


Figure 13.1 Remedial options and source control. (a) Standard pump and treat. (b) Fence line pump and treat. (c) Treatment wall system. (d) slurry wall system. (e) Funnel and gate system.

Remediation Alternatives
Bioremediation

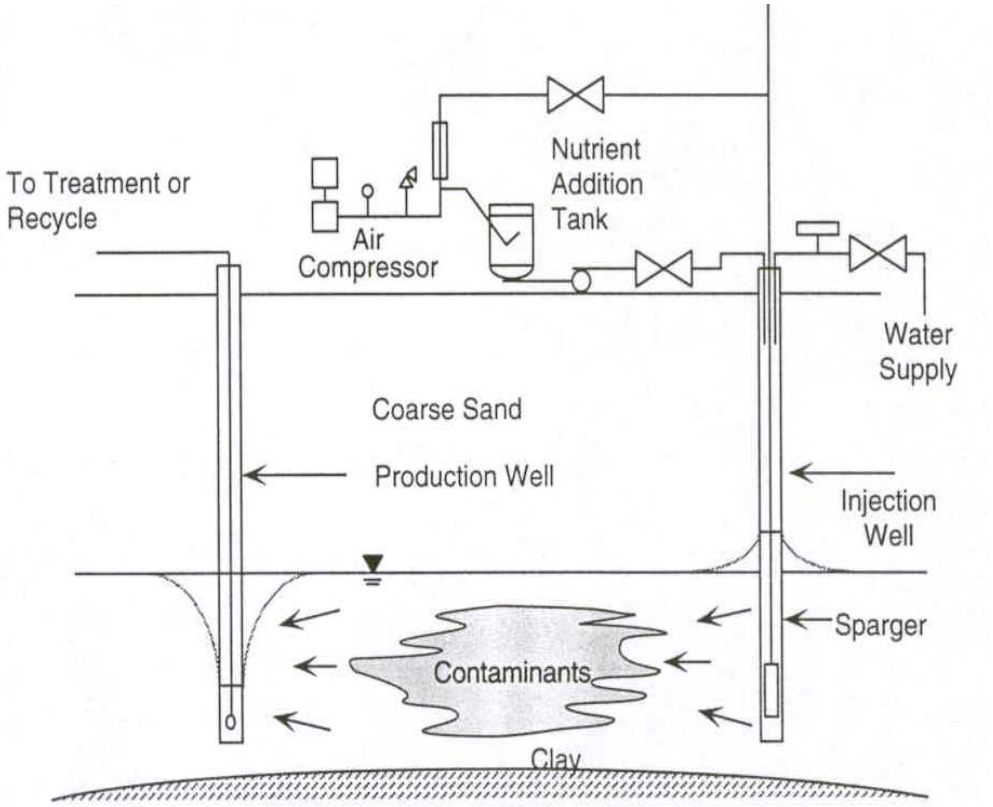
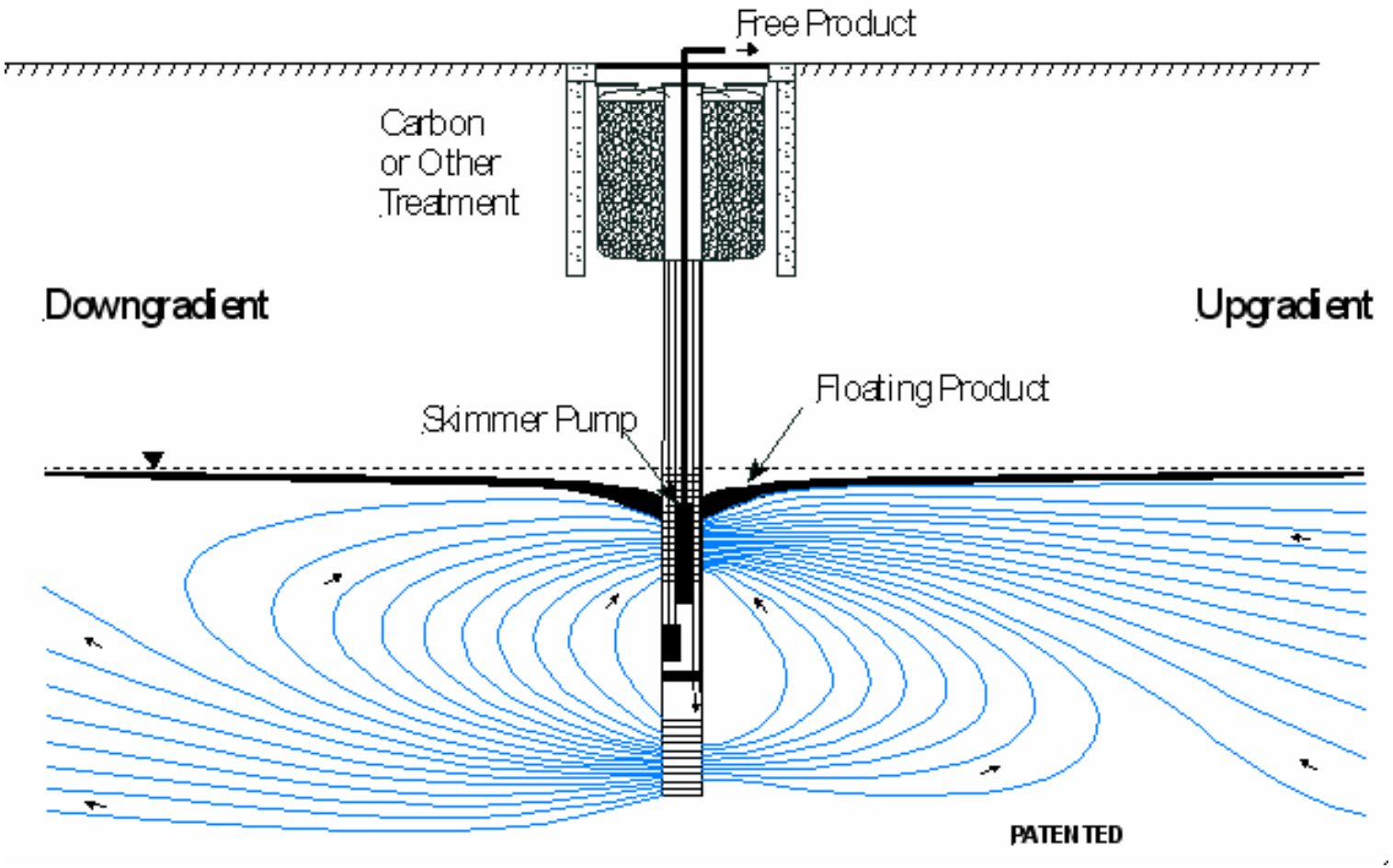
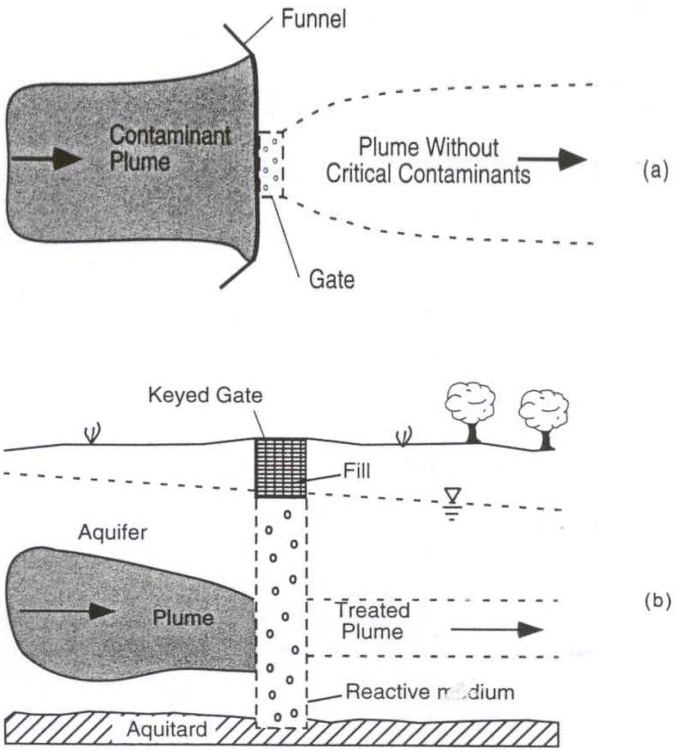


Figure 13.11 Injection system for oxygen.

Remediation Alternatives
In Situ Remediation



Remediation Alternatives
Reactive Barrier System



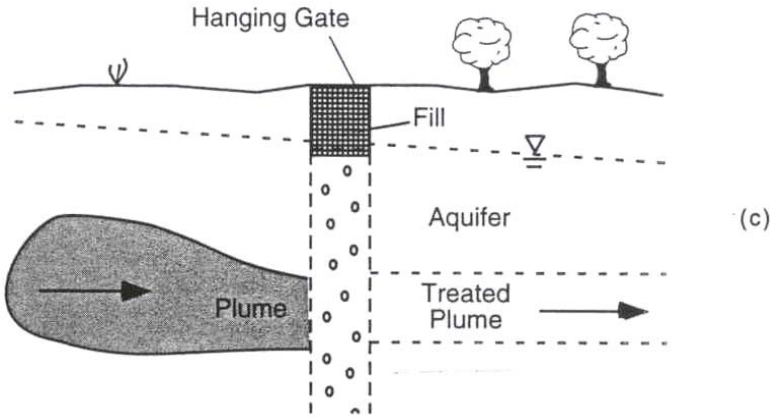


Figure 13.18 Schematic illustration of a funnel-and-gate system: (a) plan view; (b) cross-sectional view, keyed gate; and (C) cross-sectional view, hanging gate. Source: Pankow and Cherry, 1996.