

# Groundwater Educational Outreach Webinar Series

Webinar #4: Contaminant Plumes and Aquifer Cleanup

## Presenters:

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**Robert Whittier, Hawai'i DOH**

**Iris van der Zander, Ph.D. Hawai'i DOH**

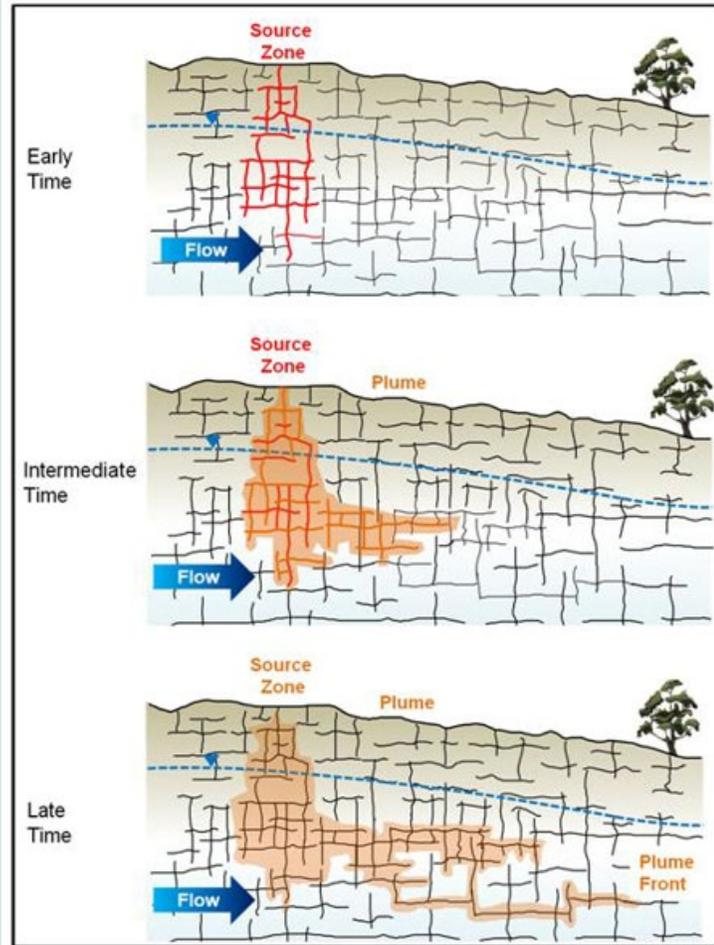
June 27, 2025



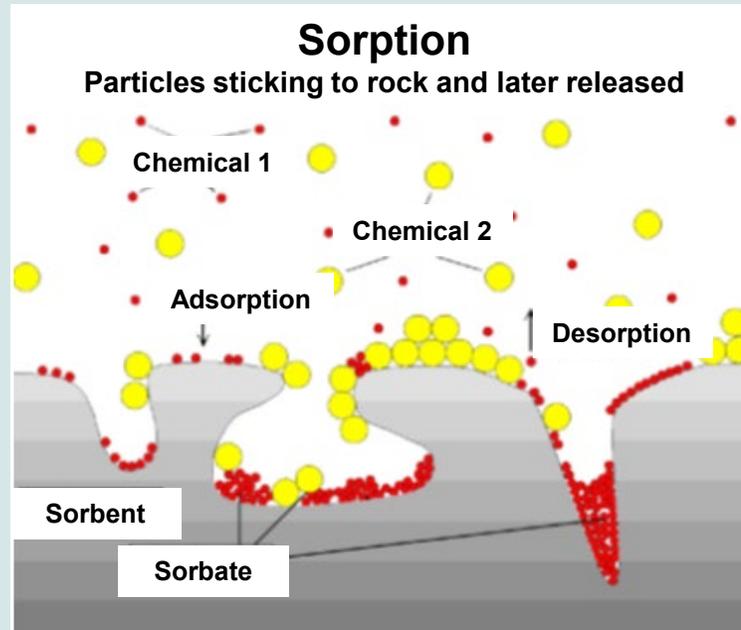
KA 'OIHANA OLAKINO

# Effects of Advection, Sorption, Diffusion, and Biodegradation on Plumes

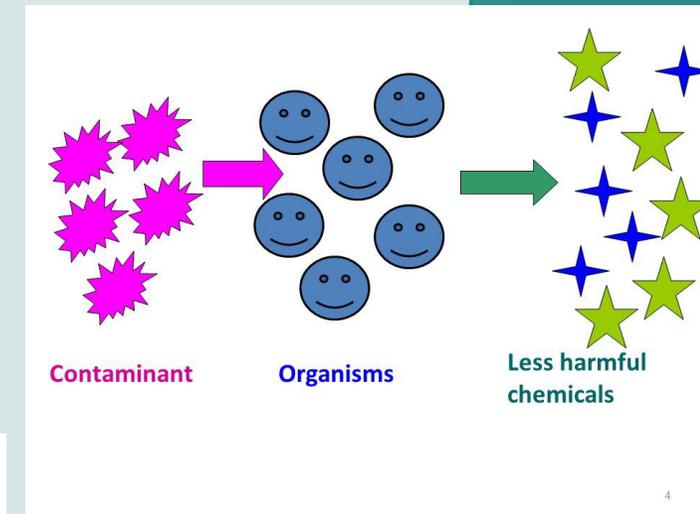
## Advection



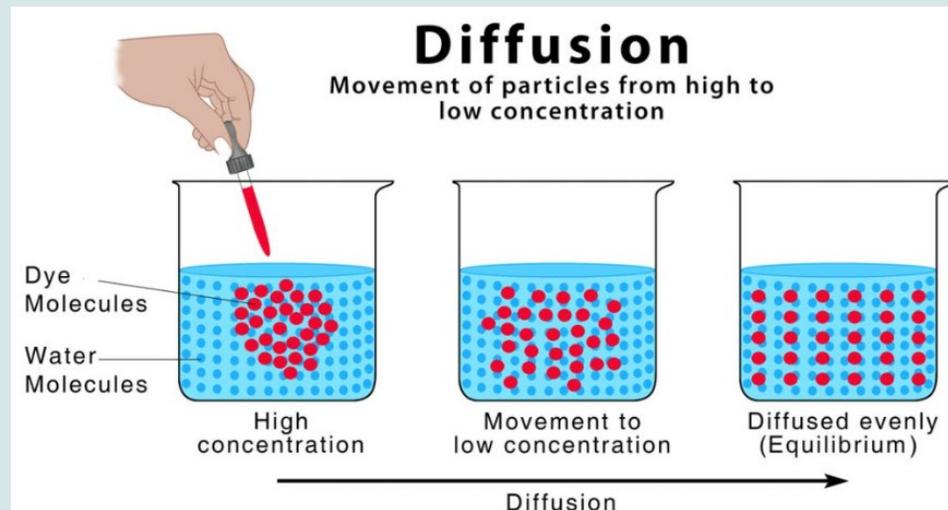
## Sorption



## Biodegradation



## Diffusion



# Groundwater Monitoring Wells



Monitoring wells are used to map contaminant distribution in groundwater and assess trends



Drilling rig for monitoring well installation



Completed monitoring well

# Groundwater Monitoring Well Sampling and Lab Analysis

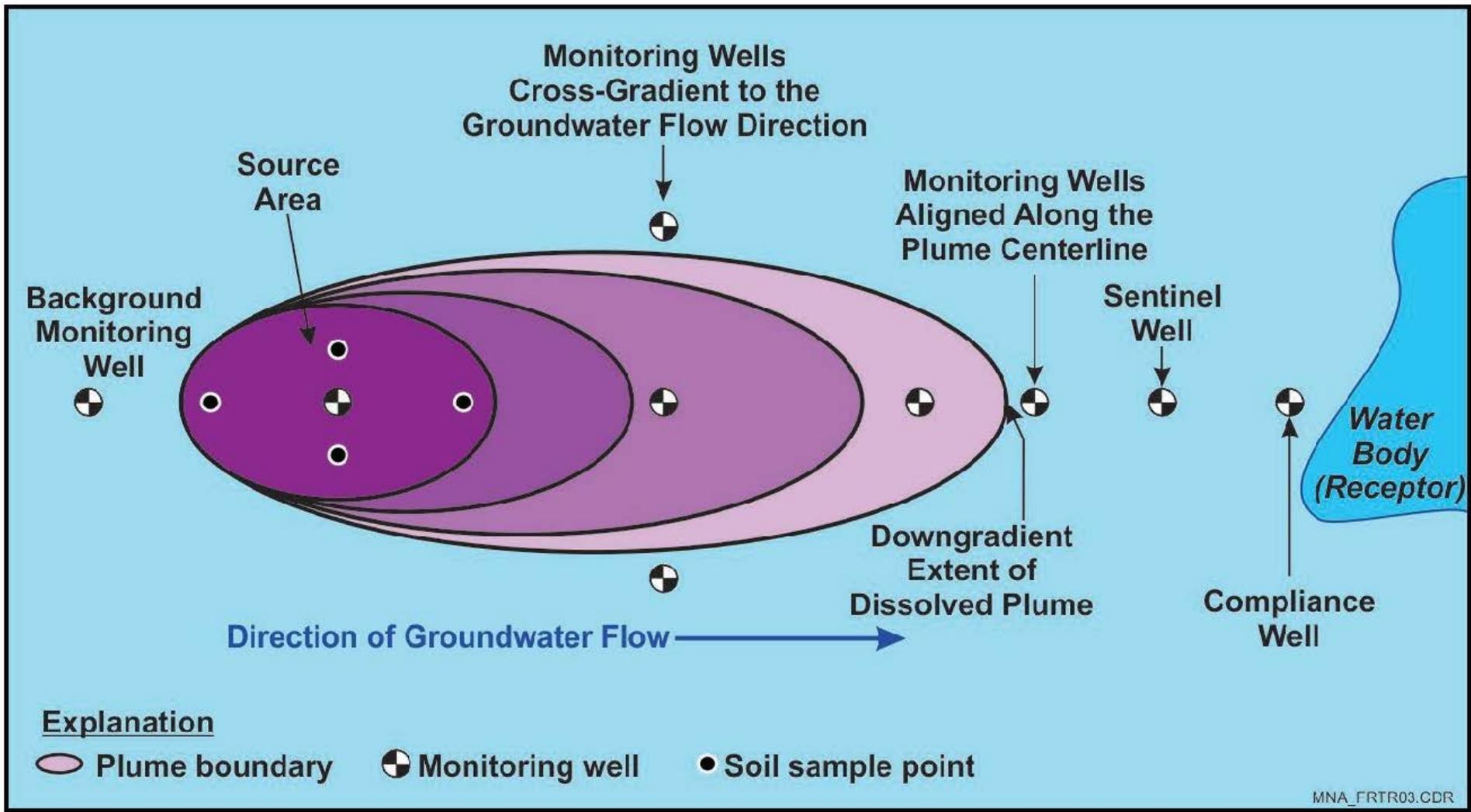


Collection of groundwater sample

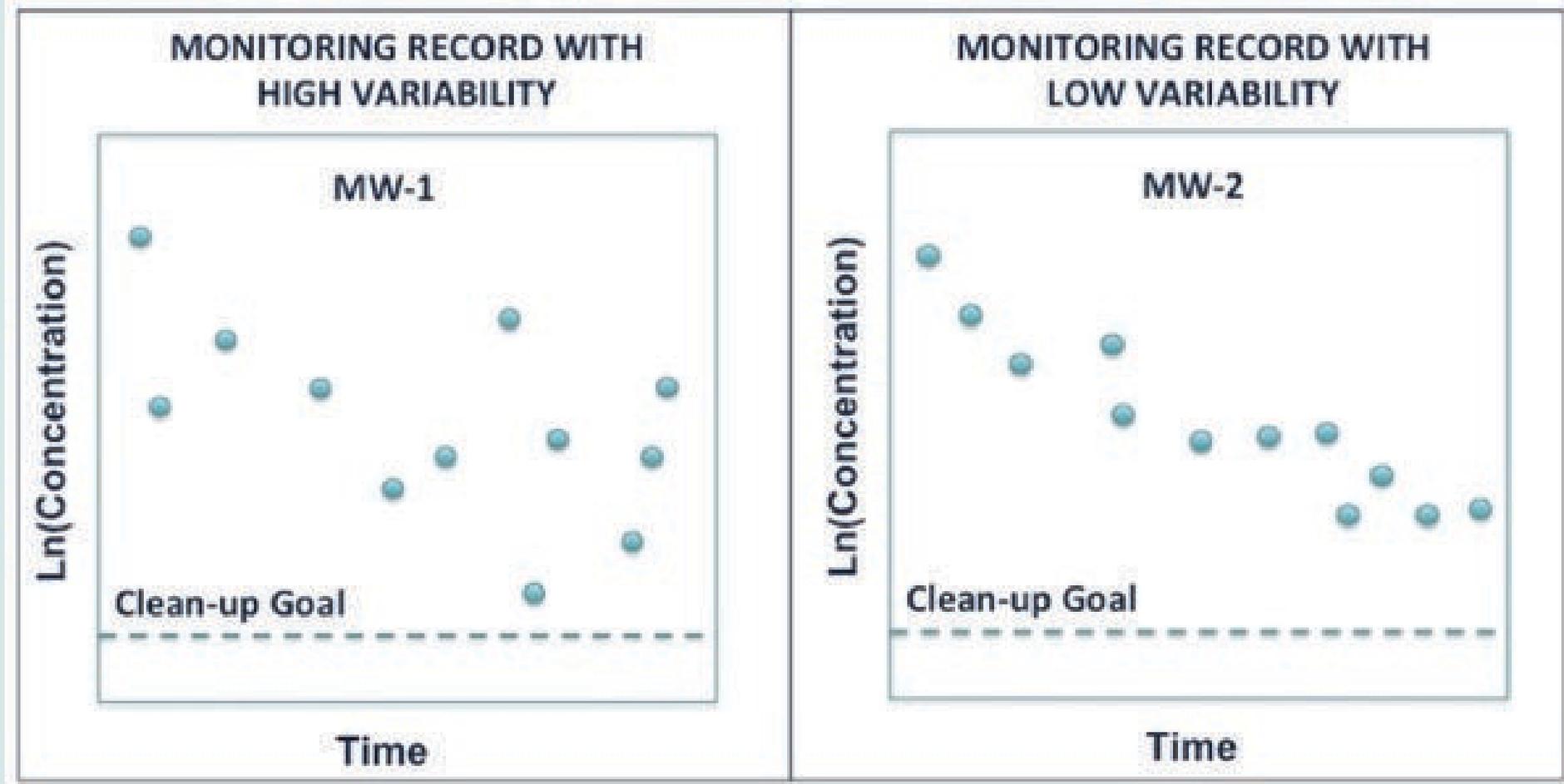


Different lab analyses needed for different chemicals

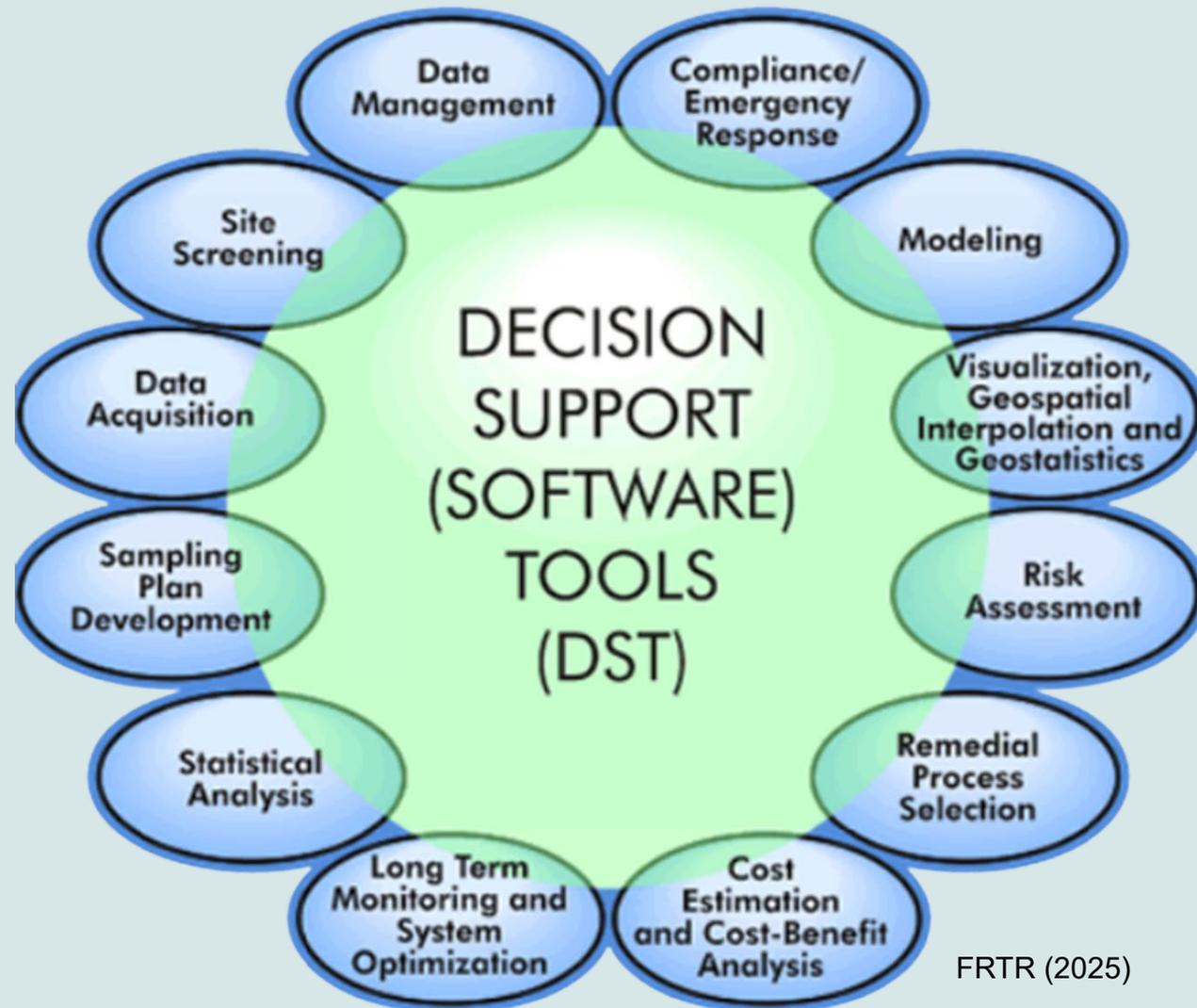
# Mapping the Extent of Impacted Groundwater



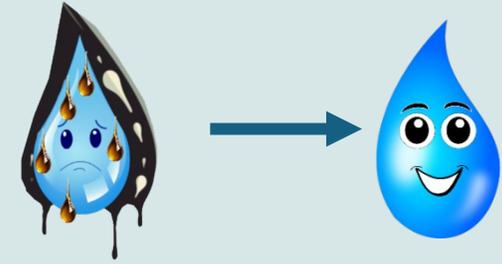
# Monitoring of Plume Concentration Trends Over Time



# Decision-Making Factors for Impacted Groundwater



# Remediating Impacted Groundwater



## In Situ

### In-Place Treatment

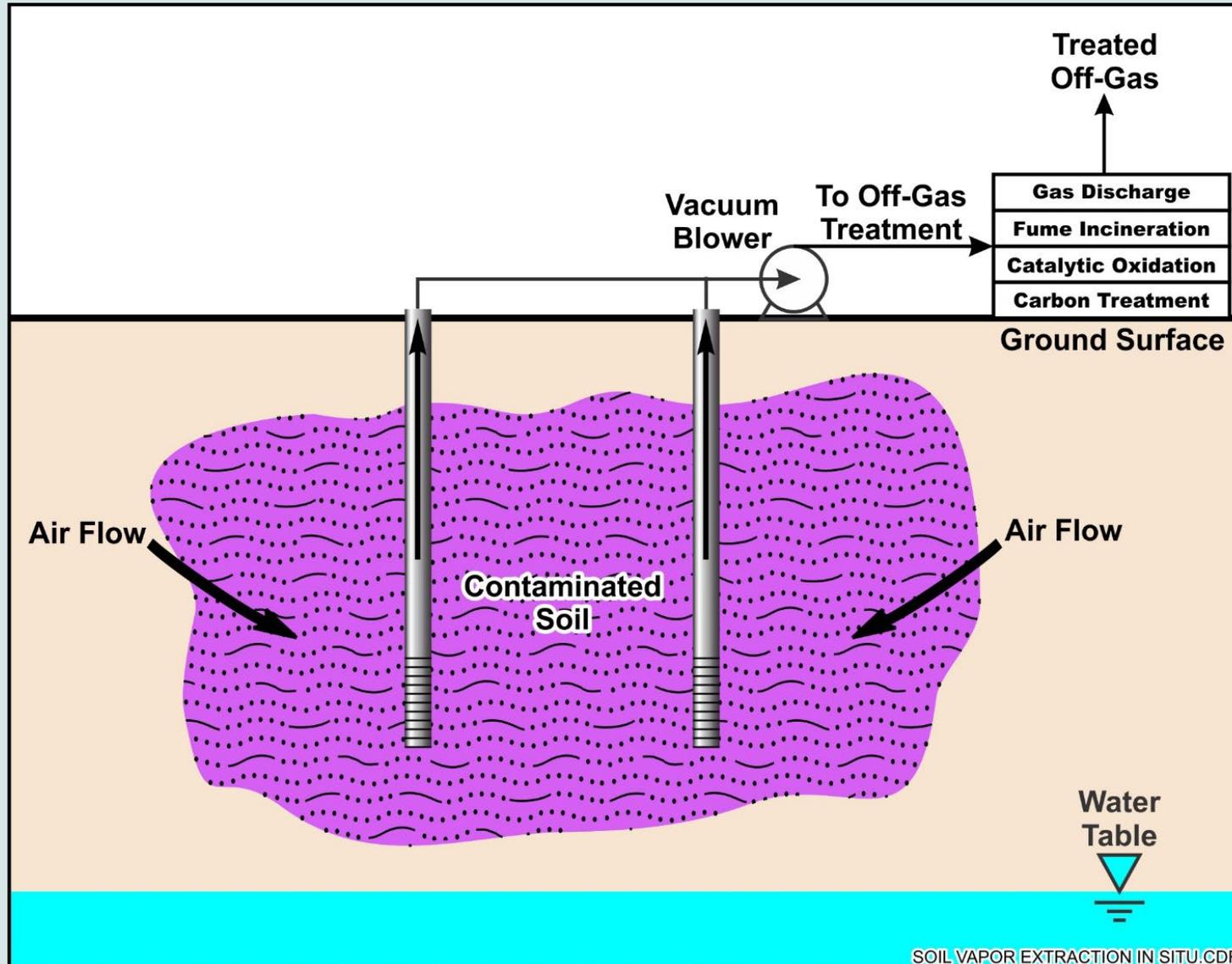
- Soil vapor extraction (SVE) and air sparging
- Chemical Oxidation (ISCO)
- Permeable Reactive Barriers (PRB)
- Bioremediation

## Ex Situ

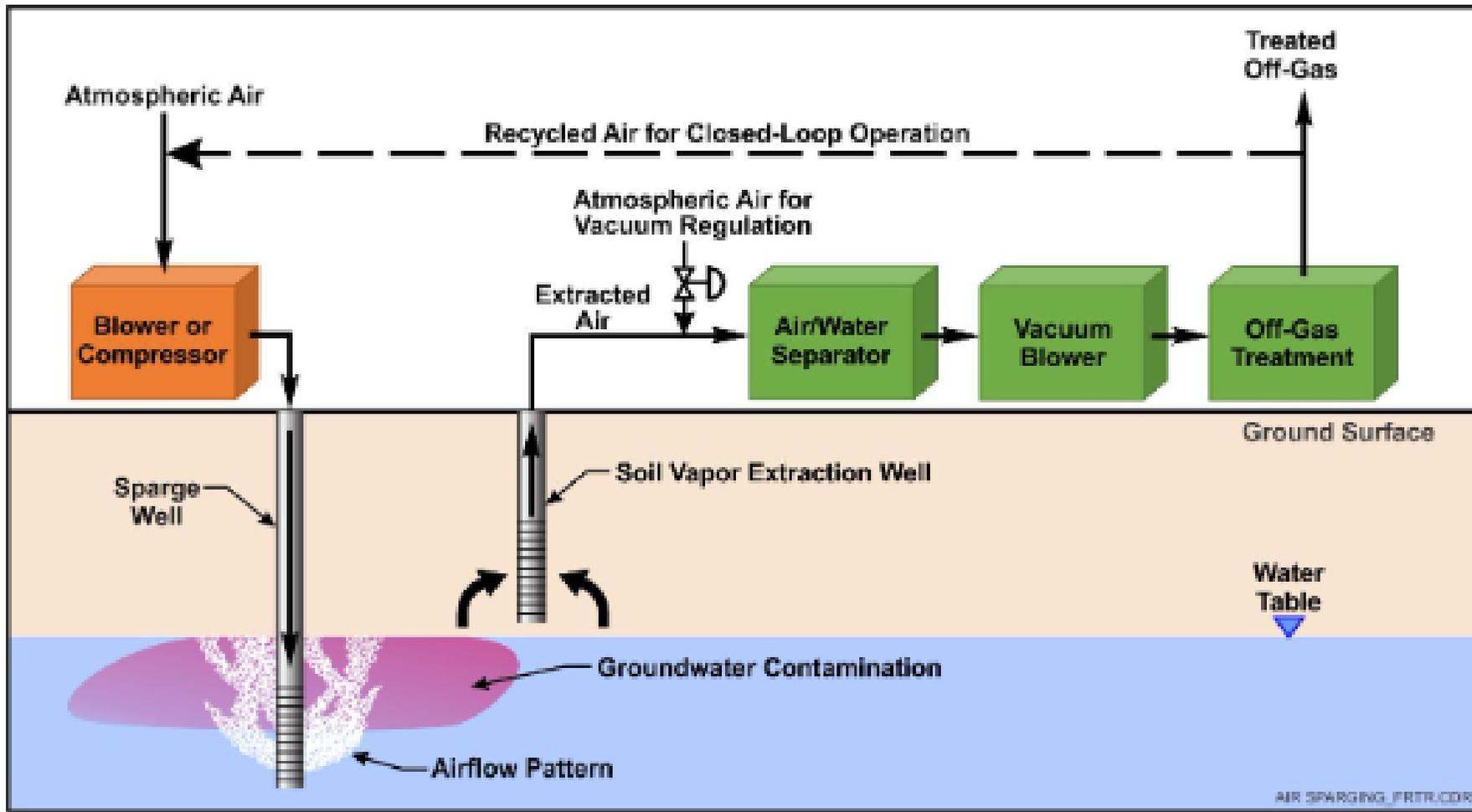
### Extracts Groundwater

- Pump-and-Treat (P&T)
- Multiphase Extraction (MPE)
- Treatment Technologies
  - Activated carbon adsorption
  - Air stripping
  - Ion exchange
  - Reverse Osmosis
  - Bioreactors

# Soil Vapor Extraction (SVE)

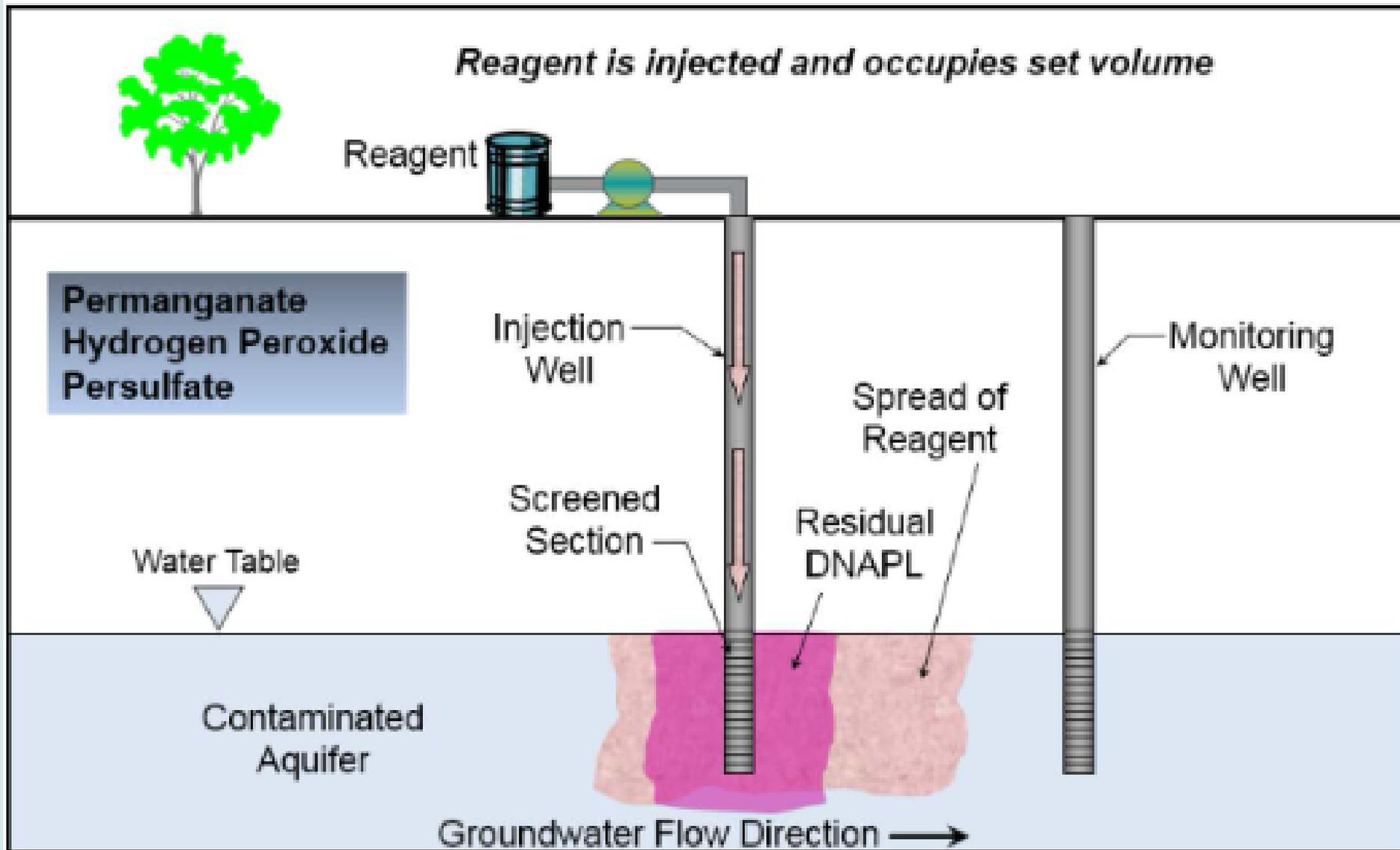


# Air Sparging

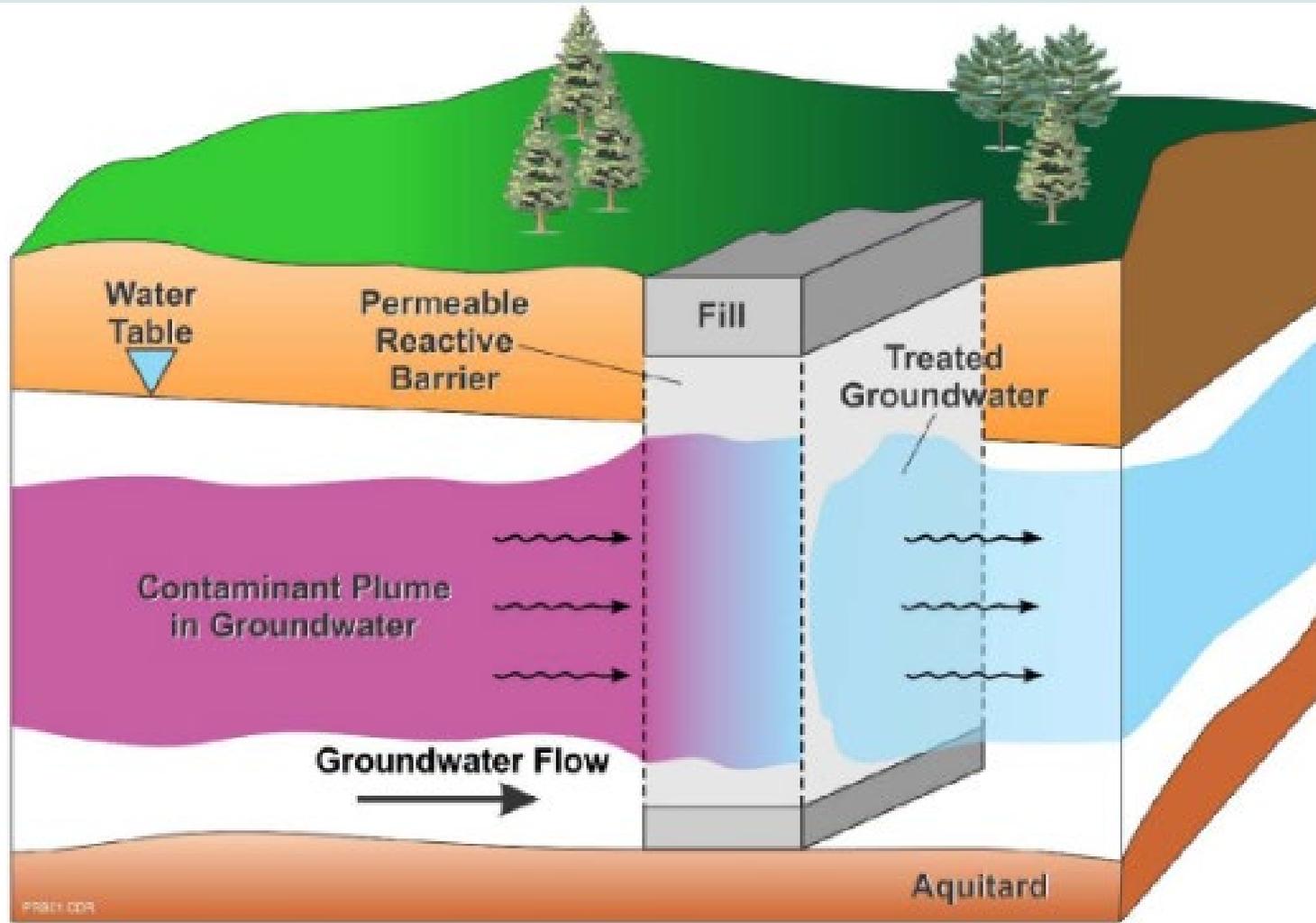


Schematic of Air Sparging

# In Situ Chemical Oxidation (ISCO)

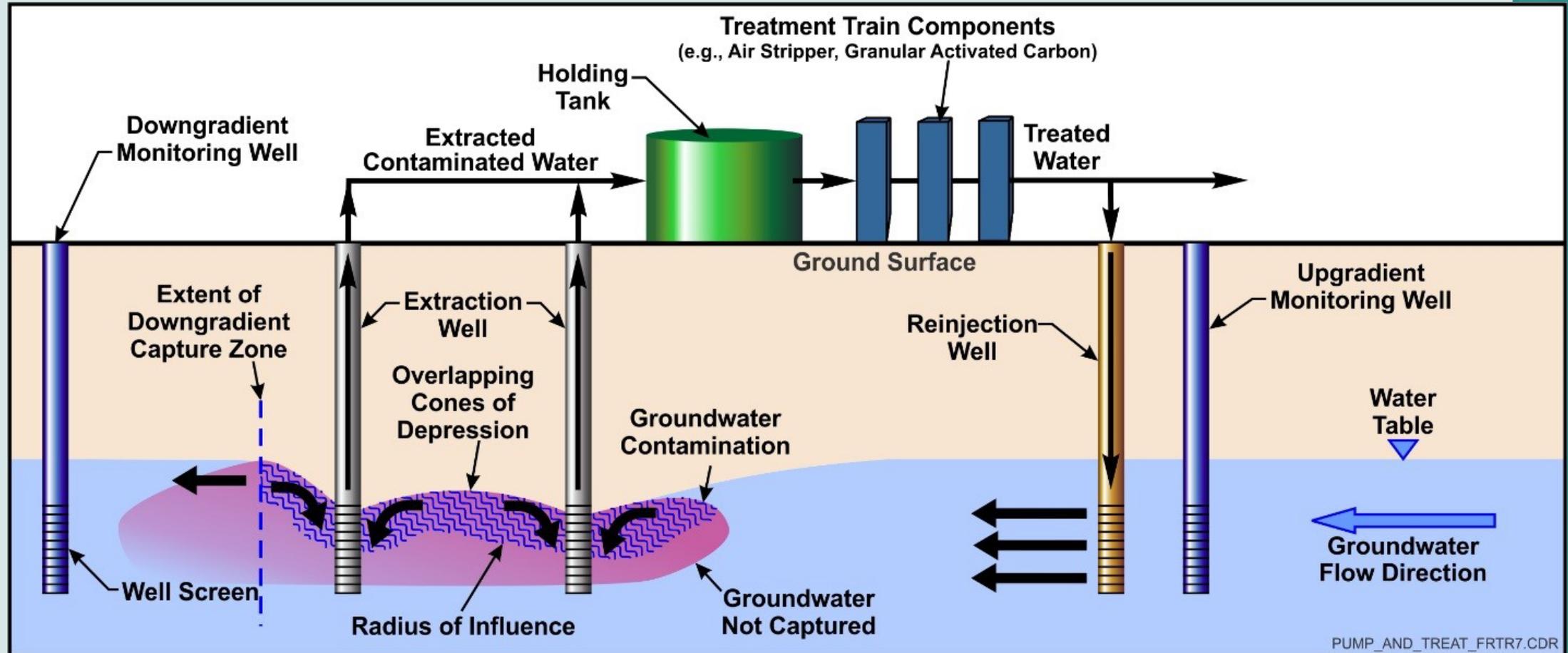


# Permeable Reactive Barriers (PRB)

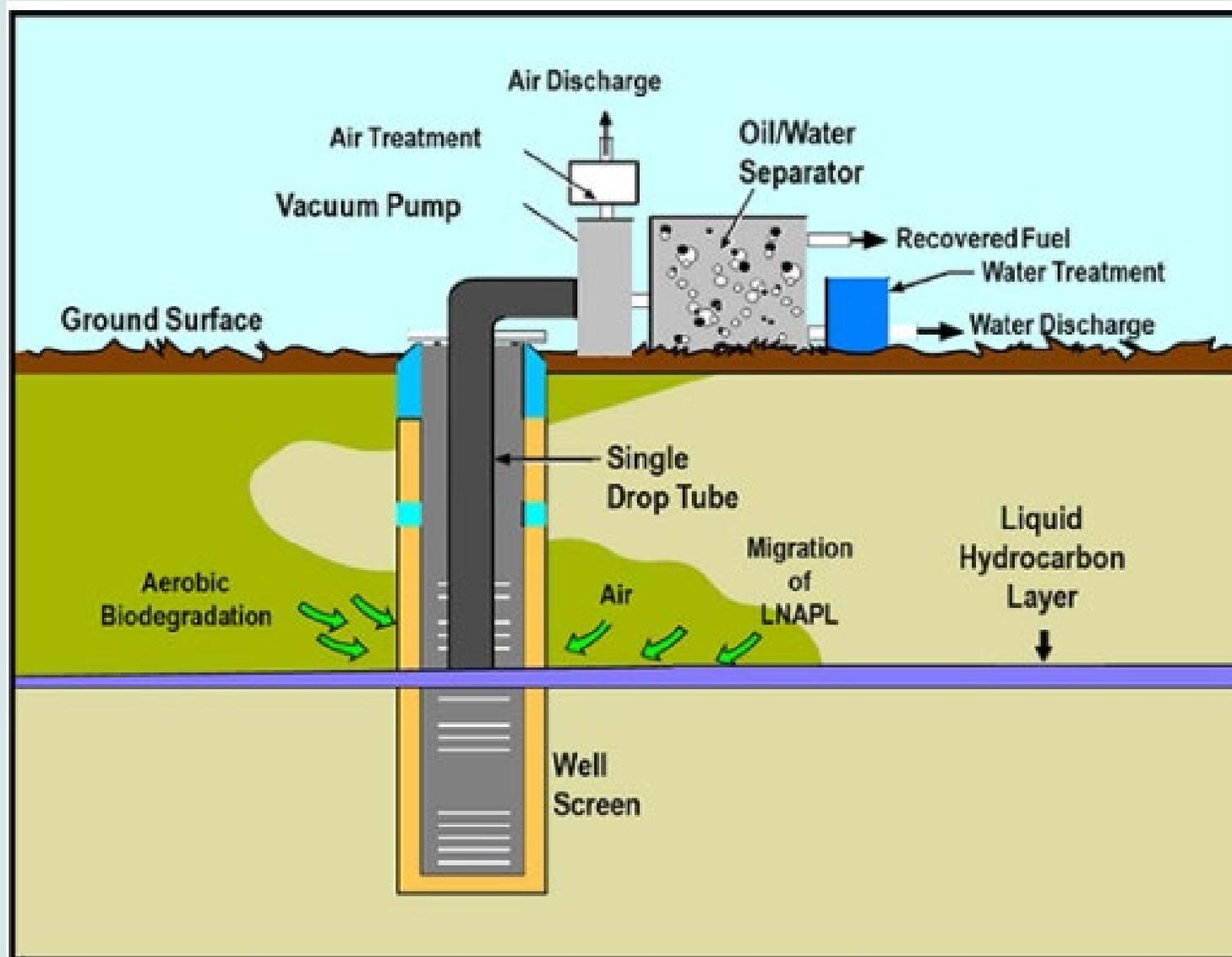


Permeable Reactive Barrier Schematic

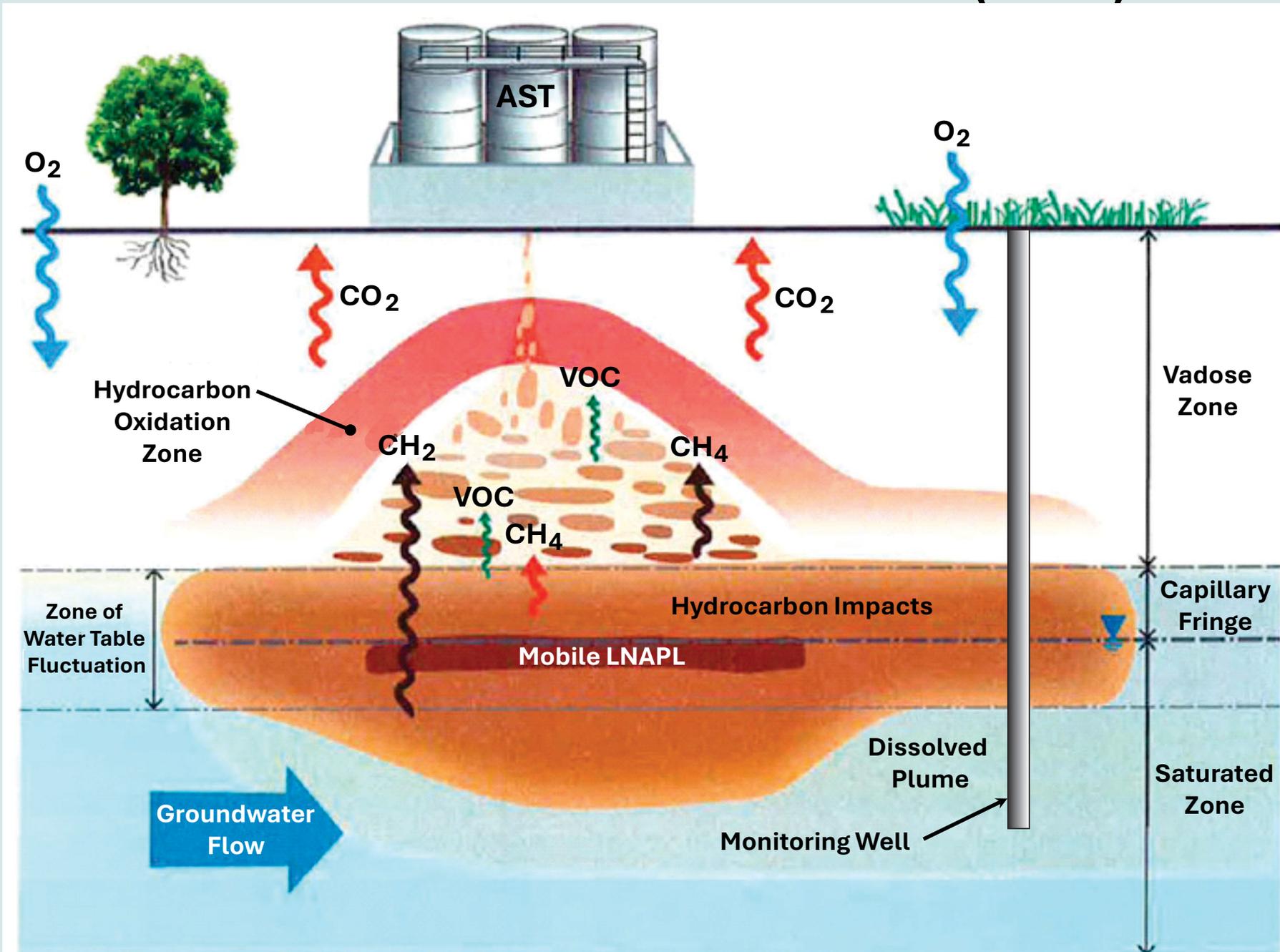
# Pump-and-Treat (P&T)



# Multi-Phase Extraction (MPE)

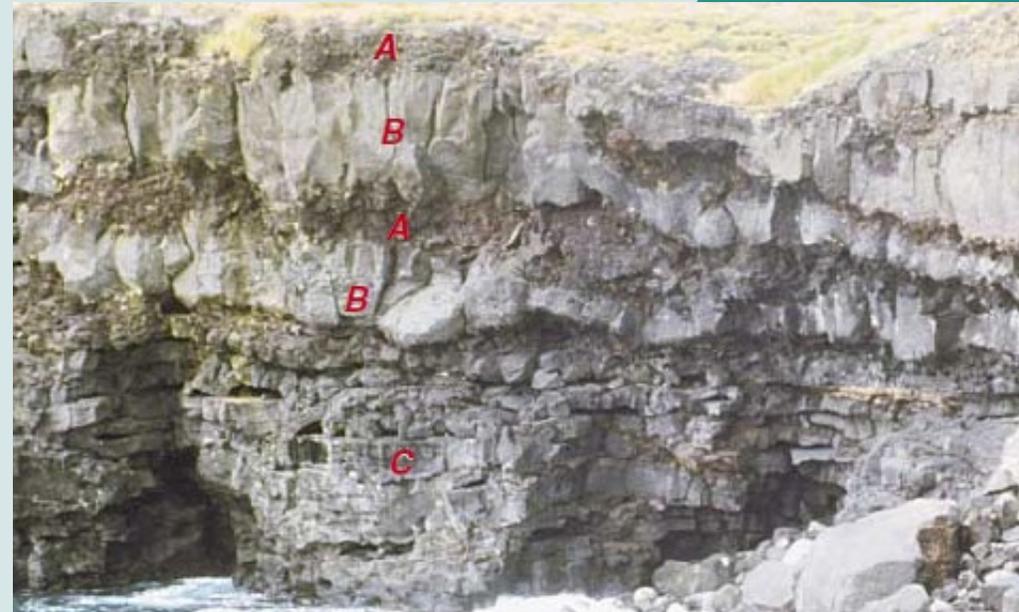


# Monitored Natural Attenuation (MNA)



# Why Does Groundwater Cleanup Take a Long Time?

- Many contaminants “stick” to sediments (low mobility) and degrade slowly (persistence)
- Some contaminants have low cleanup standards
- Complex geology with low migration rates ( inches per year) to treatment areas
- Limitations in current remediation technologies
- Long-term remediation may take decades to centuries for some sites



# Limitations in Groundwater Remediation Technologies

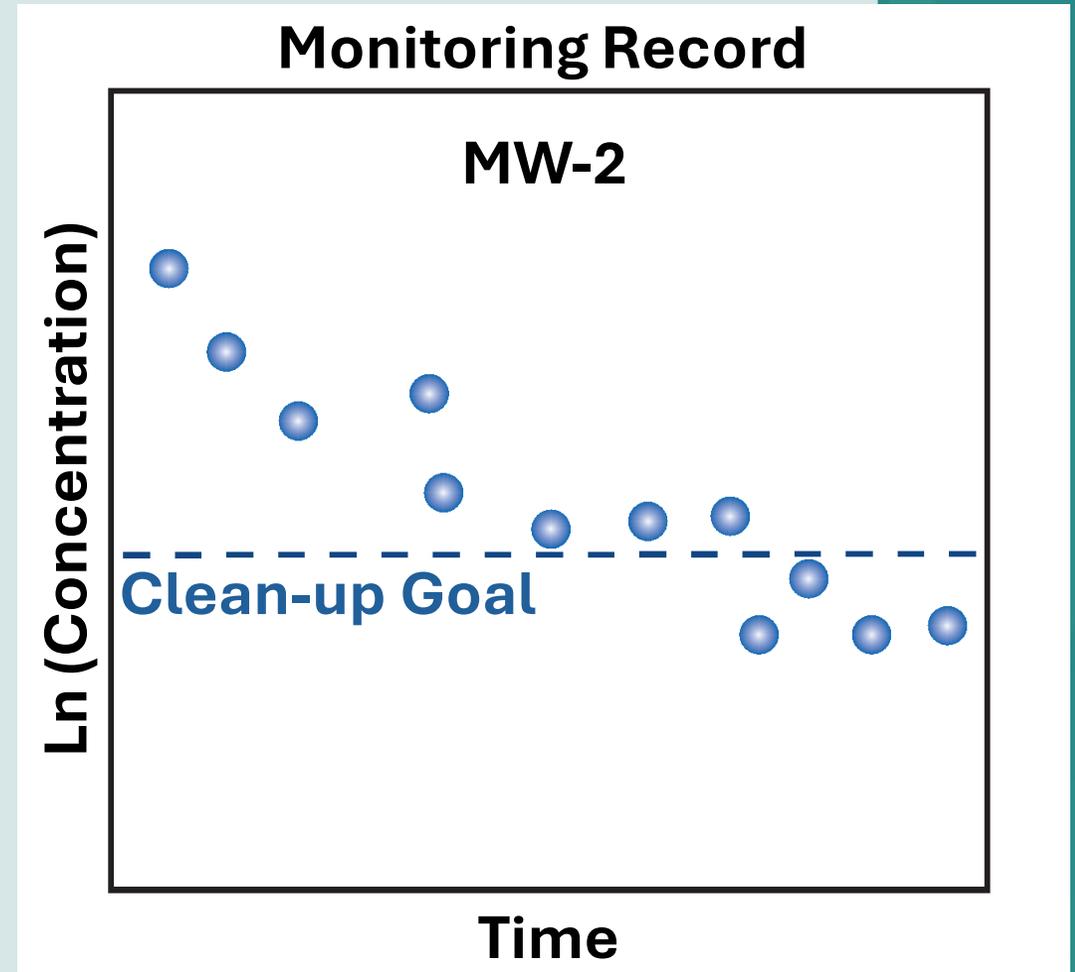
- Difficulty treating chemicals with low cleanup standards
- Accessing chemicals that slowly unstick from sediments (slow desorption)
- Addressing chemicals that slowly seep back into permeable zones (back-diffusion)
- Fully cleaning up large plumes ( > 1 mile long)
- Long-term remediation may take decades to centuries for some sites

# Complexity of Site Remediation

- Groundwater can be contaminated by various substances including heavy metals, organic compounds, pesticides, and pathogens.
- Different contaminants require different remediation techniques.
- Multiple remediation technologies may be needed.
- Logistics are difficult.
- Types of remedial measures can vary over time.

# Long-Term Monitoring (LTM) and Maintenance of Groundwater Treatment Systems

- Groundwater and effluent monitoring is required to ensure contaminants are effectively removed and do not reappear
- Maintenance of remediation systems is crucial for long-term success
- Long-term remediation (decades to centuries) may require cleanup prioritization of sites based on risk



# Groundwater Protection and Planning in Hawai'i



State Groundwater Protection

Resource & Quality Assessment

Monitoring

Protection

Corrective Actions

## Other Elements

- Data Management & Sharing
- Education & Outreach
- Integration with the Hawaii Water Plan
- Consultation with Stakeholders
- Gaps & Future Consideration

## Hawai'i Water Plan Components

Protection Policies

State Needs

Water Quality Plan

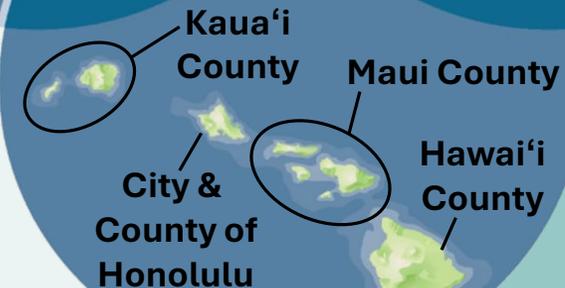
Agricultural Water Use and Development Plan

Water Resource Protection Plan

State Water Projects Plan

## Sustainability

County Water Use & Development Plans



County Needs

# Mahalo for attending!

If you have further questions or would like more information on a specific topic, please send us an email at:

**[curtis.pruder@doh.hawaii.gov](mailto:curtis.pruder@doh.hawaii.gov)**



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