

# Rapid Perchlorate Destruction in Soil and Groundwater Through Bioaugmentation

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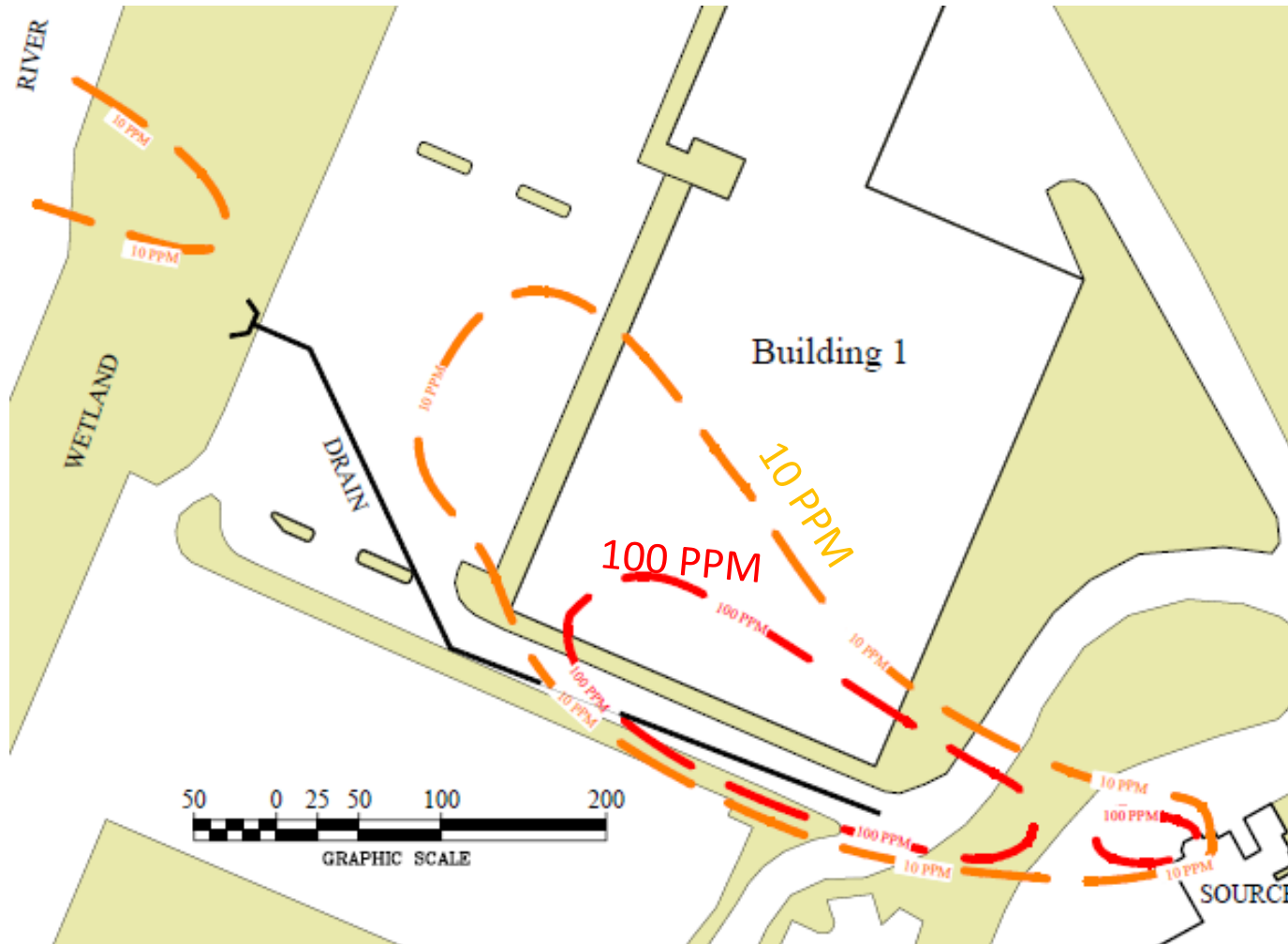
# Introduction

Full scale in-situ bioaugmentation approach for perchlorate degradation:

- Vadose zone soils
- Overburden soil and groundwater
- Wetland soils and groundwater
- Bedrock groundwater



# Background



# Important Site Conditions

- Hydraulic gradient: 40 ft per 1000 ft
- Groundwater travel rate: 100 – 200 ft/year
- Nitrate to perchlorate ratio: 3:1
- Acidic plume: pH 3.5 – 6 su



# Remediation Approach

- Initial approach: groundwater extraction with offsite disposal
  - Plume containment – 450,000 GPY
  - Collection of dry weather flow – 100,000 GPY
- Other approaches considered
  - Onsite treatment with discharge (1 PPB)
    - Ion exchange
    - Biodegradation
  - In-situ bioremediation



# In-Situ Bioremediation

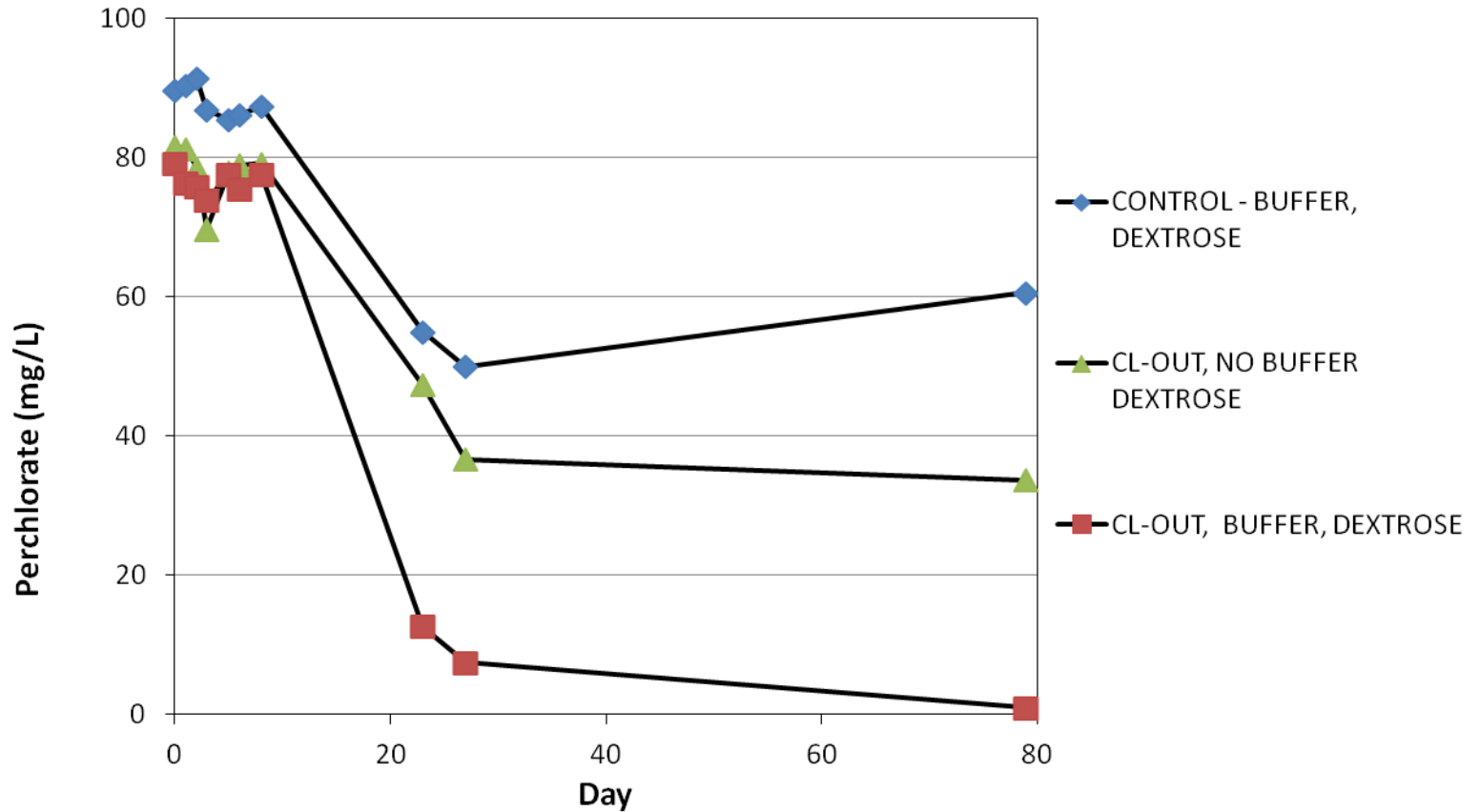
- Biostimulation
  - Native anaerobes
- Bioaugmentation
  - CL-OUT<sup>®</sup>
    - Used at sites for degrading chlorinated solvents
    - Reduce nitrate in anoxic conditions



# Benchscale Microcosm

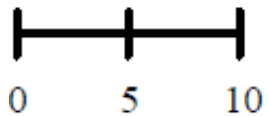
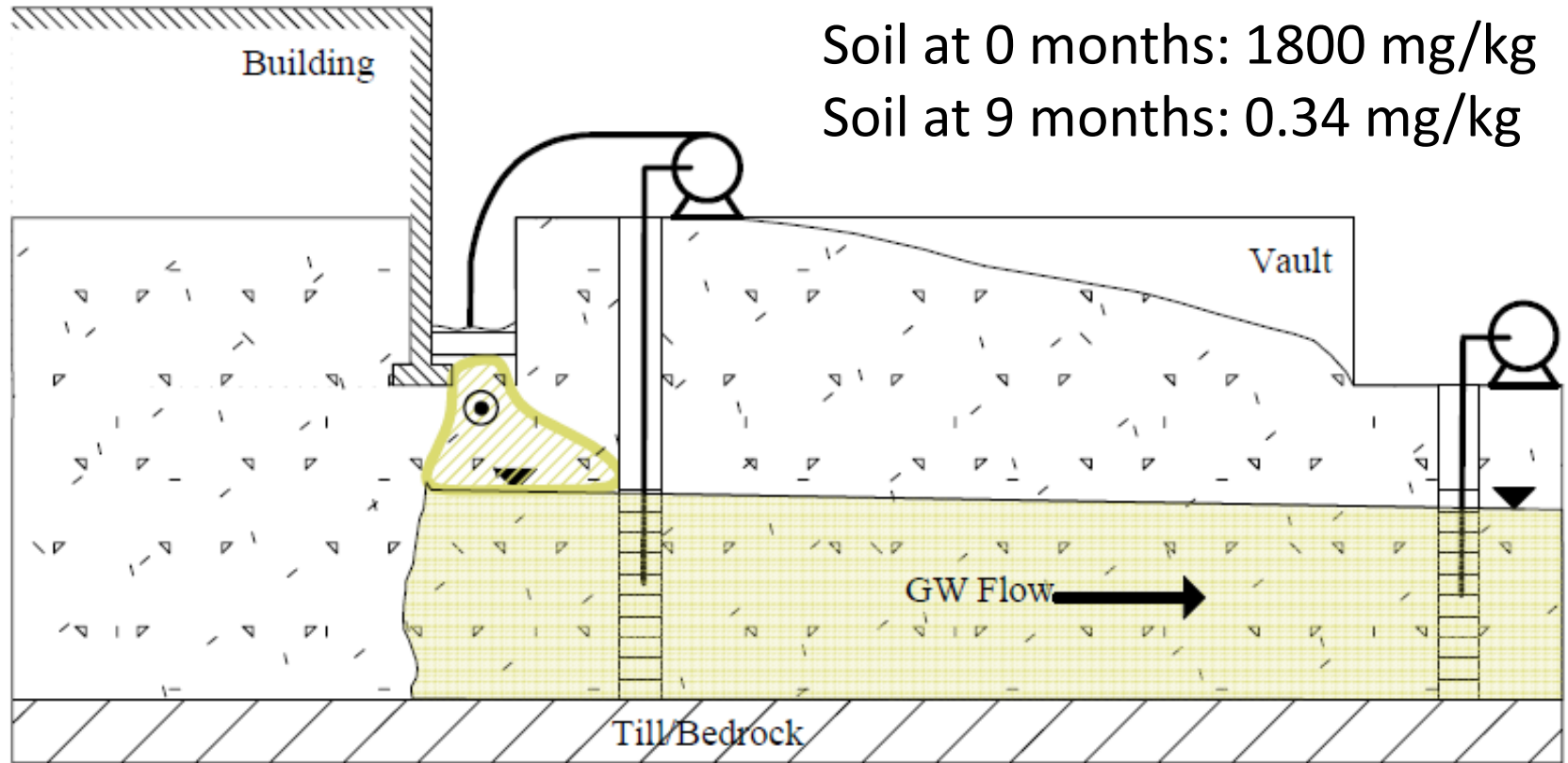


# Benchscale Results



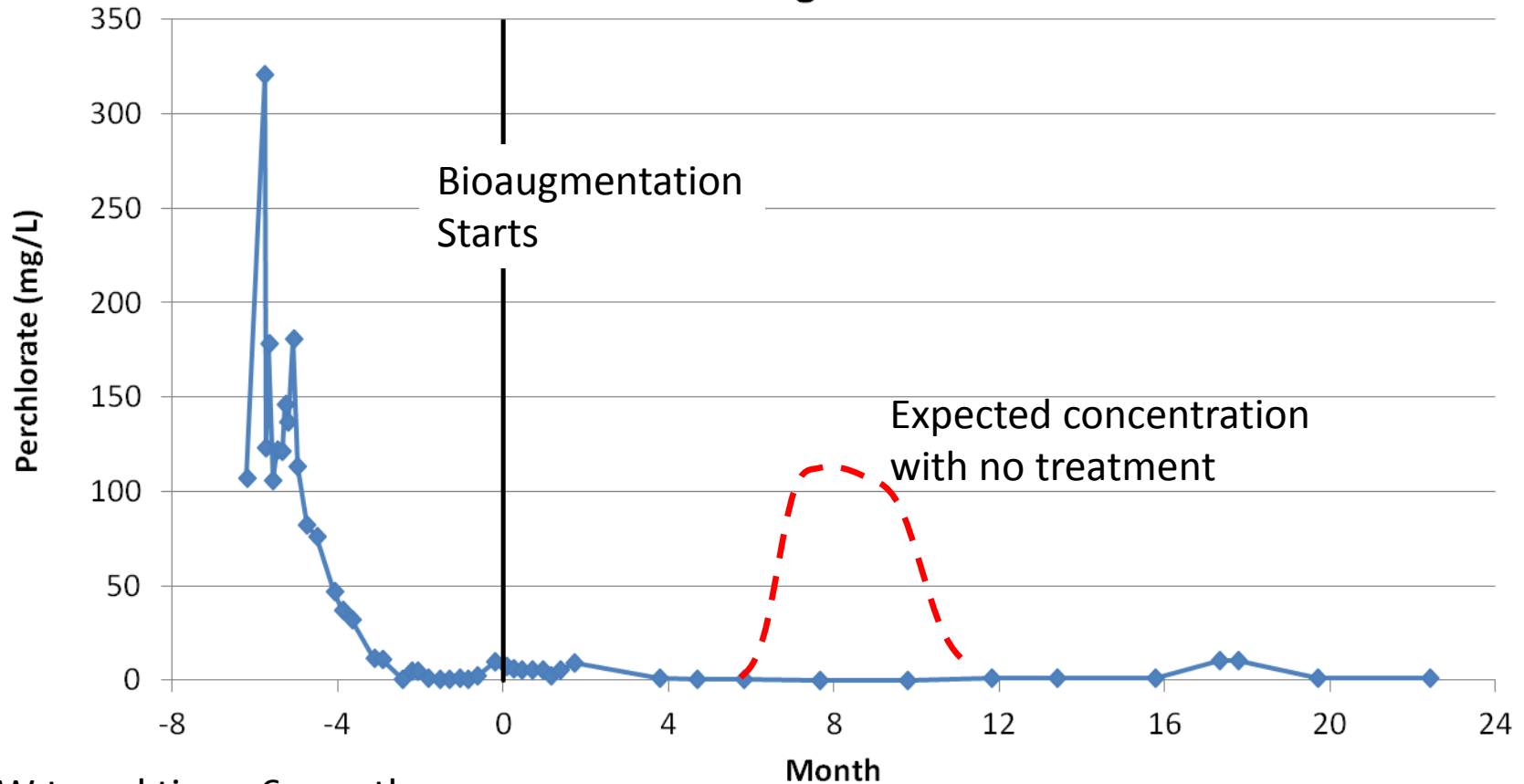


# Vadose Zone Soils Remedy



# Vadose Zone Soils

## Groundwater Perchlorate Concentrations 50 Feet Downgradient

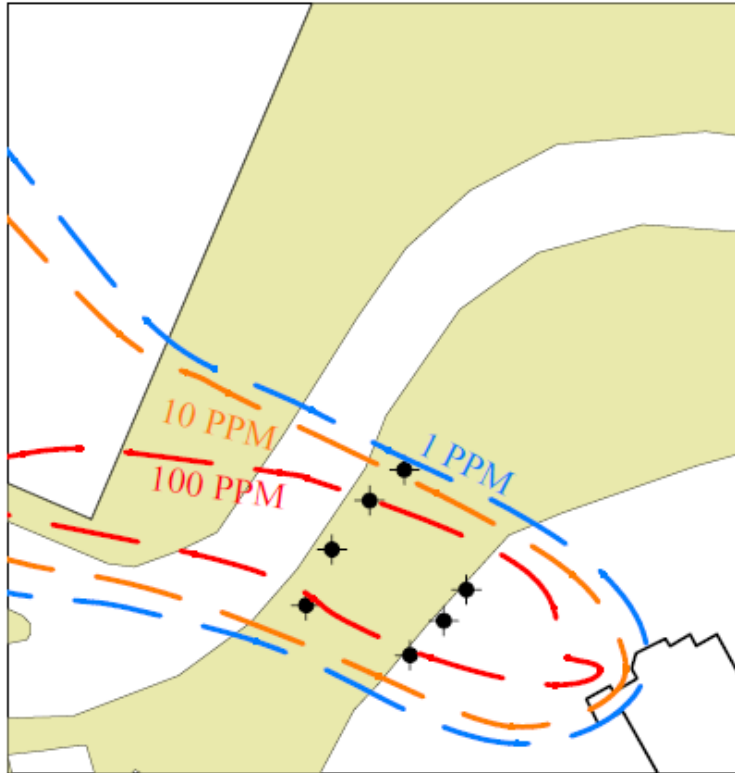


GW travel time: 6 months

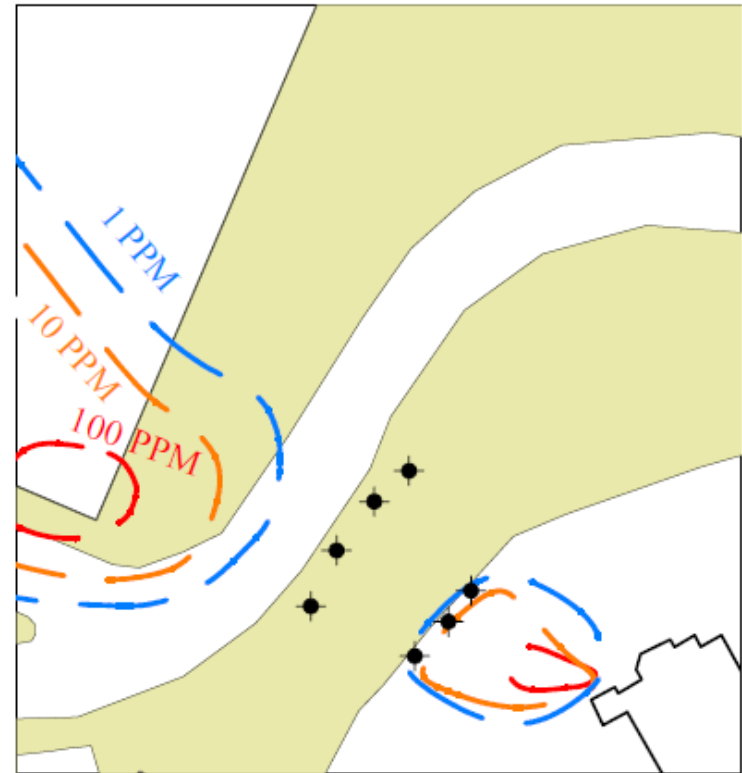


# Overburden Groundwater Remedy

BEFORE



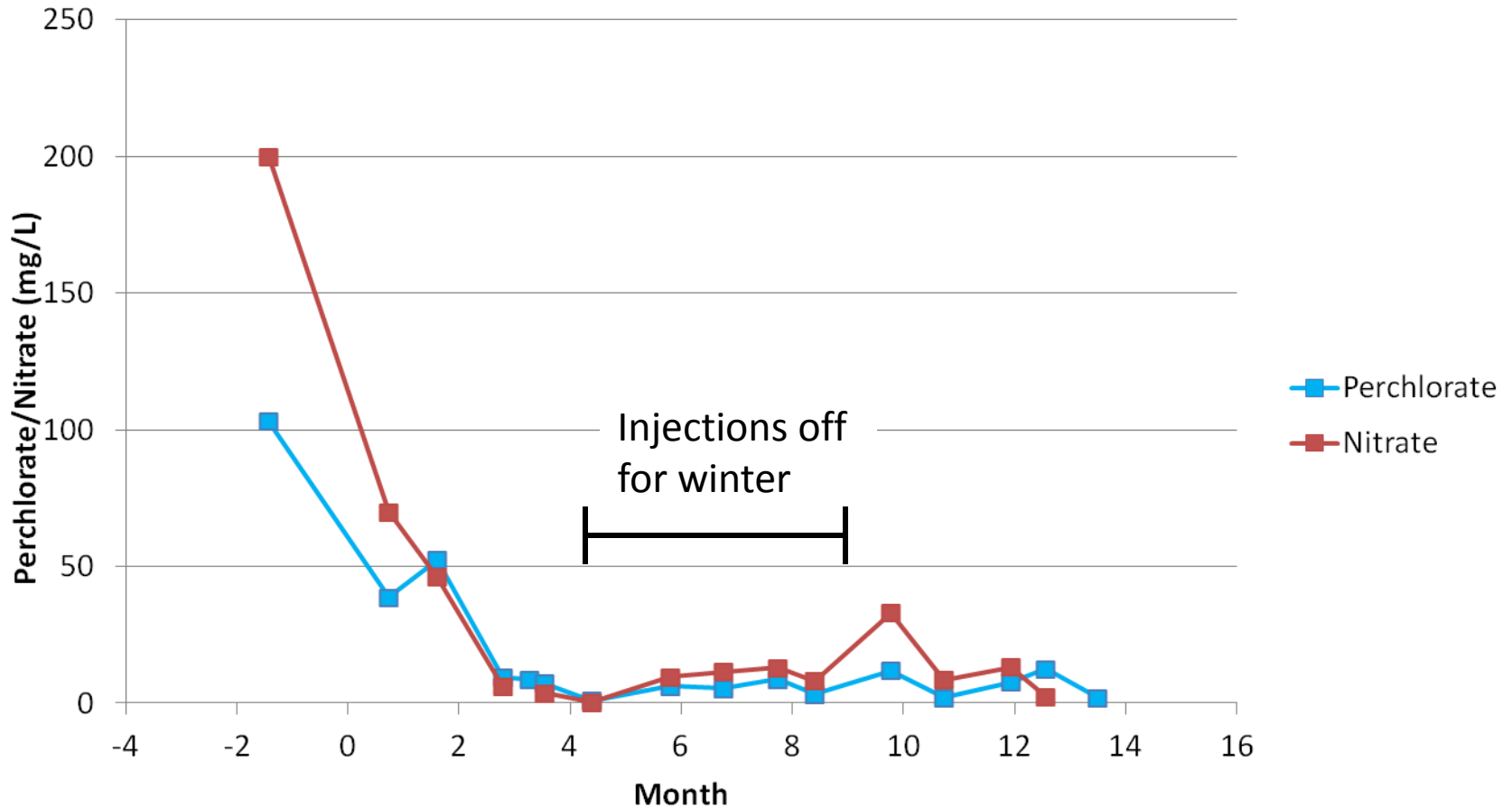
4 MONTHS LATER



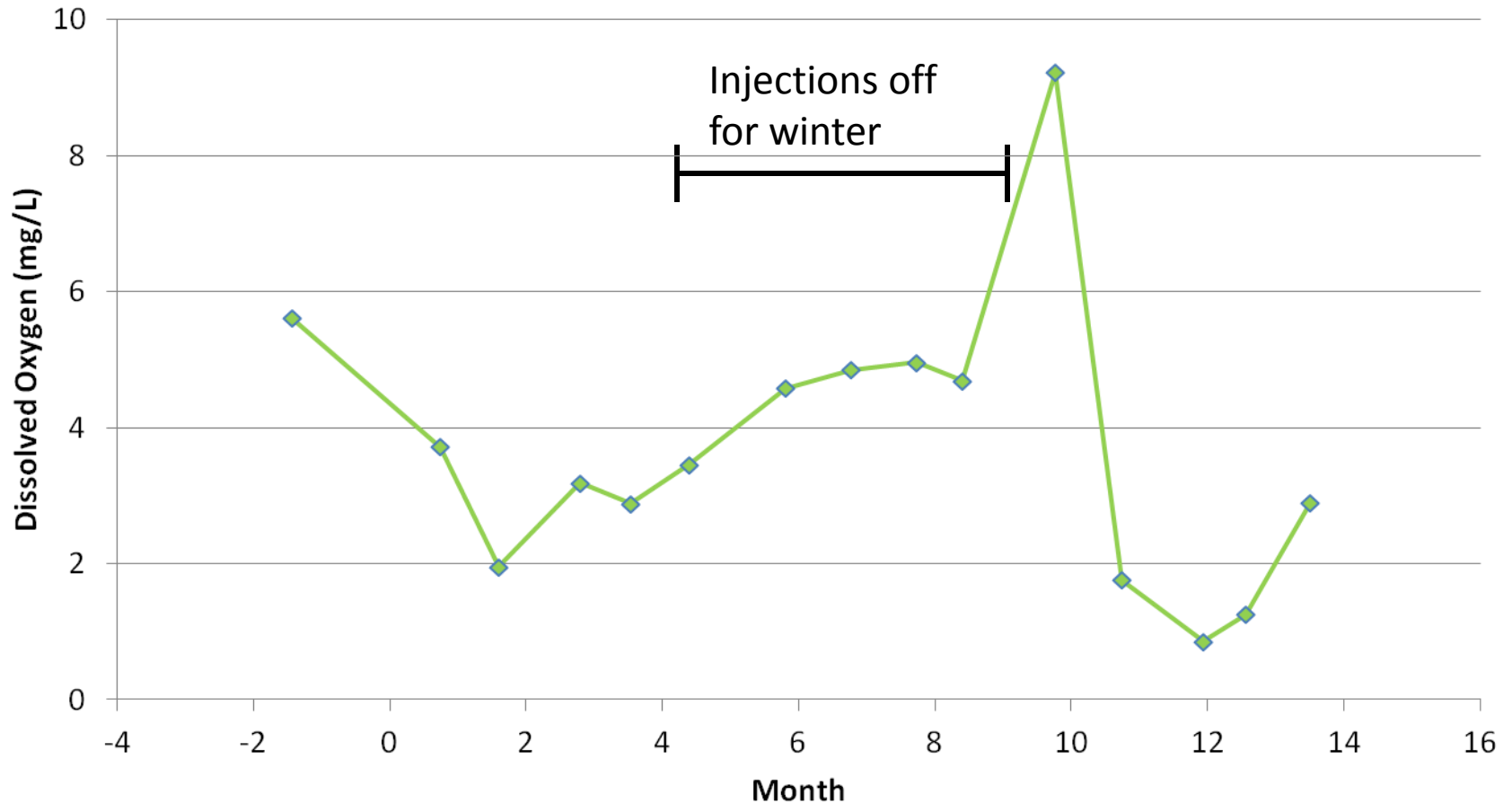
◆ INJECTION WELL



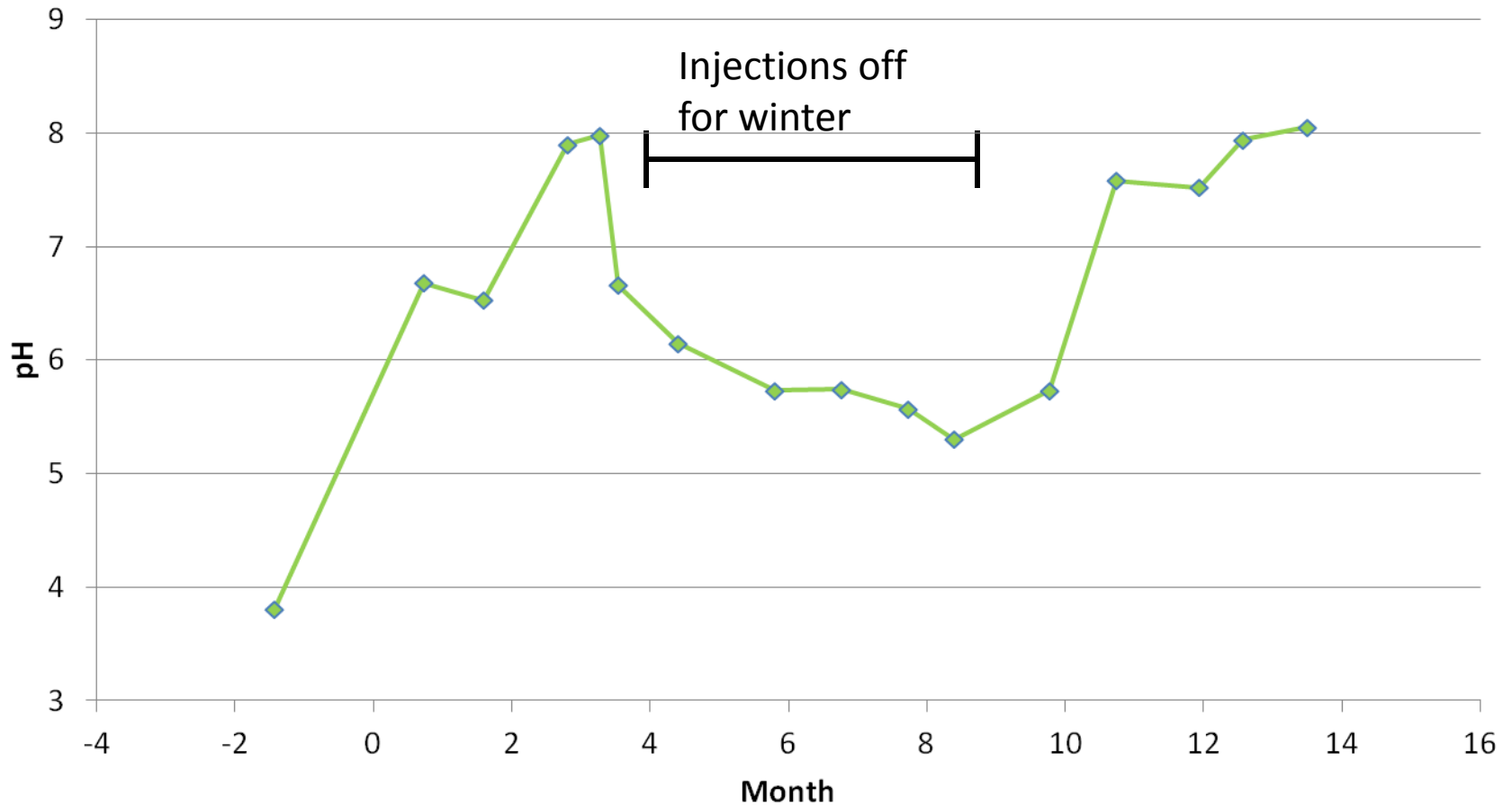
# Groundwater Remedy Perchlorate and Nitrate



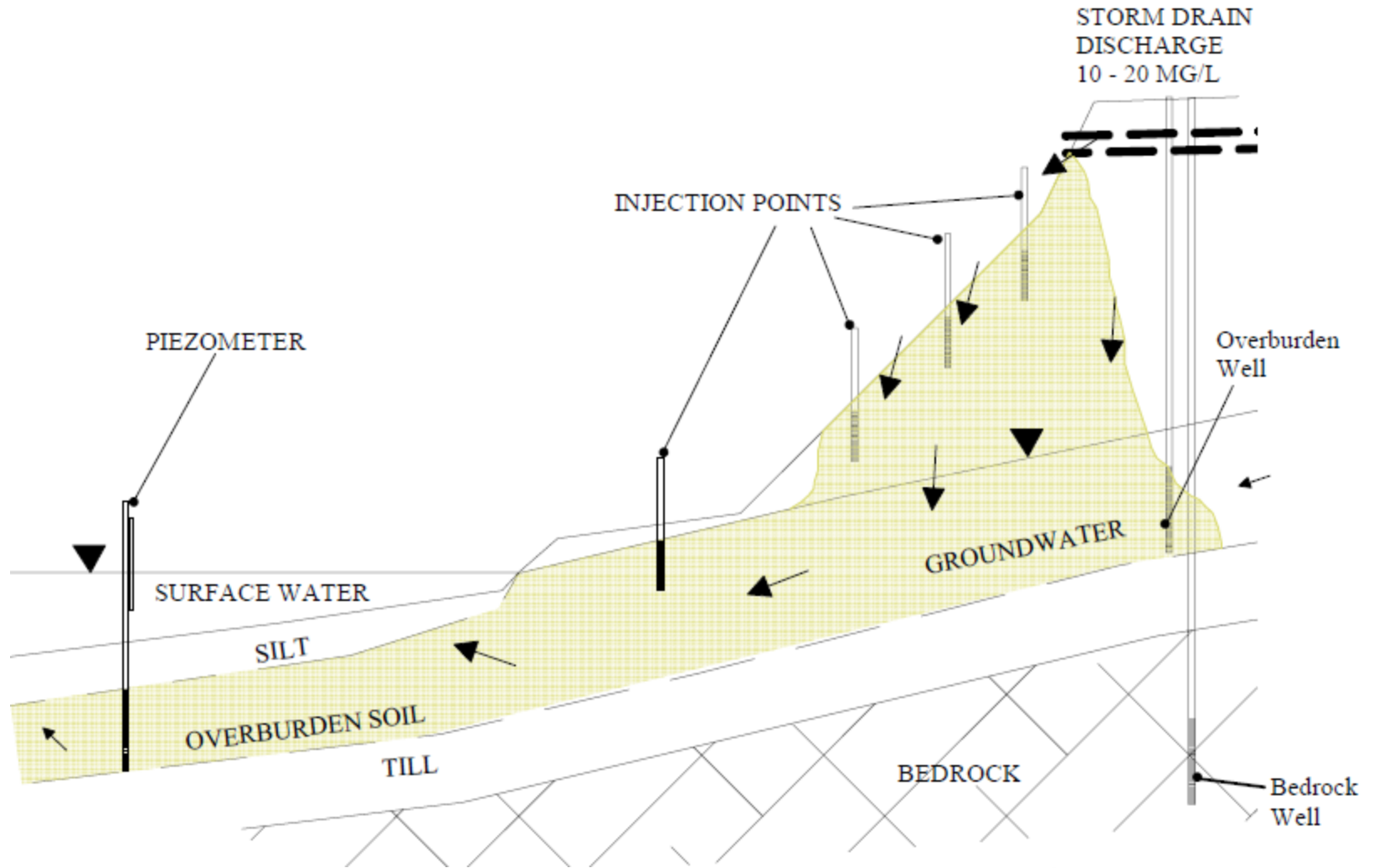
# Groundwater Remedy - DO



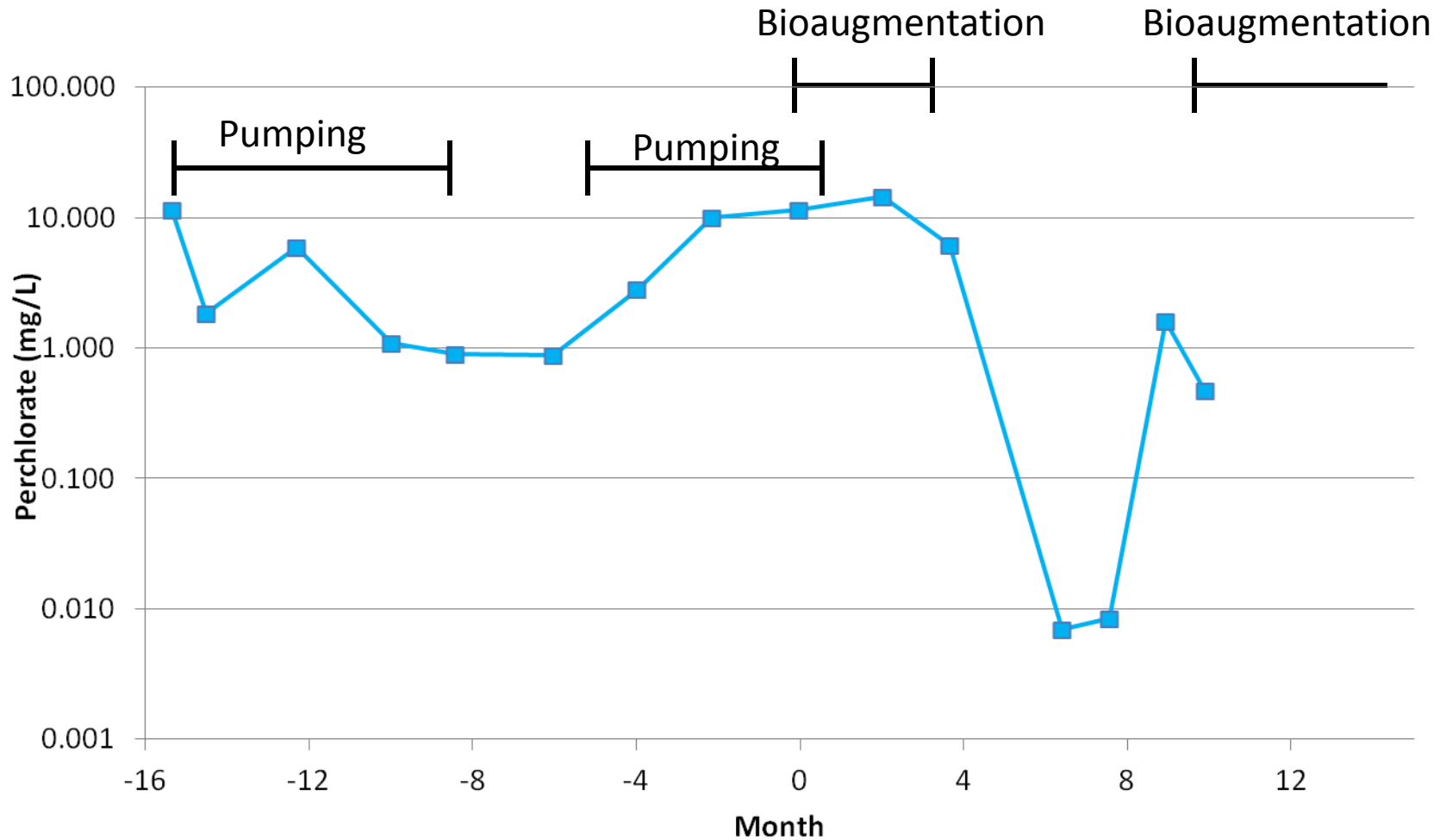
# Groundwater Remedy - pH



# Wetland Remedy

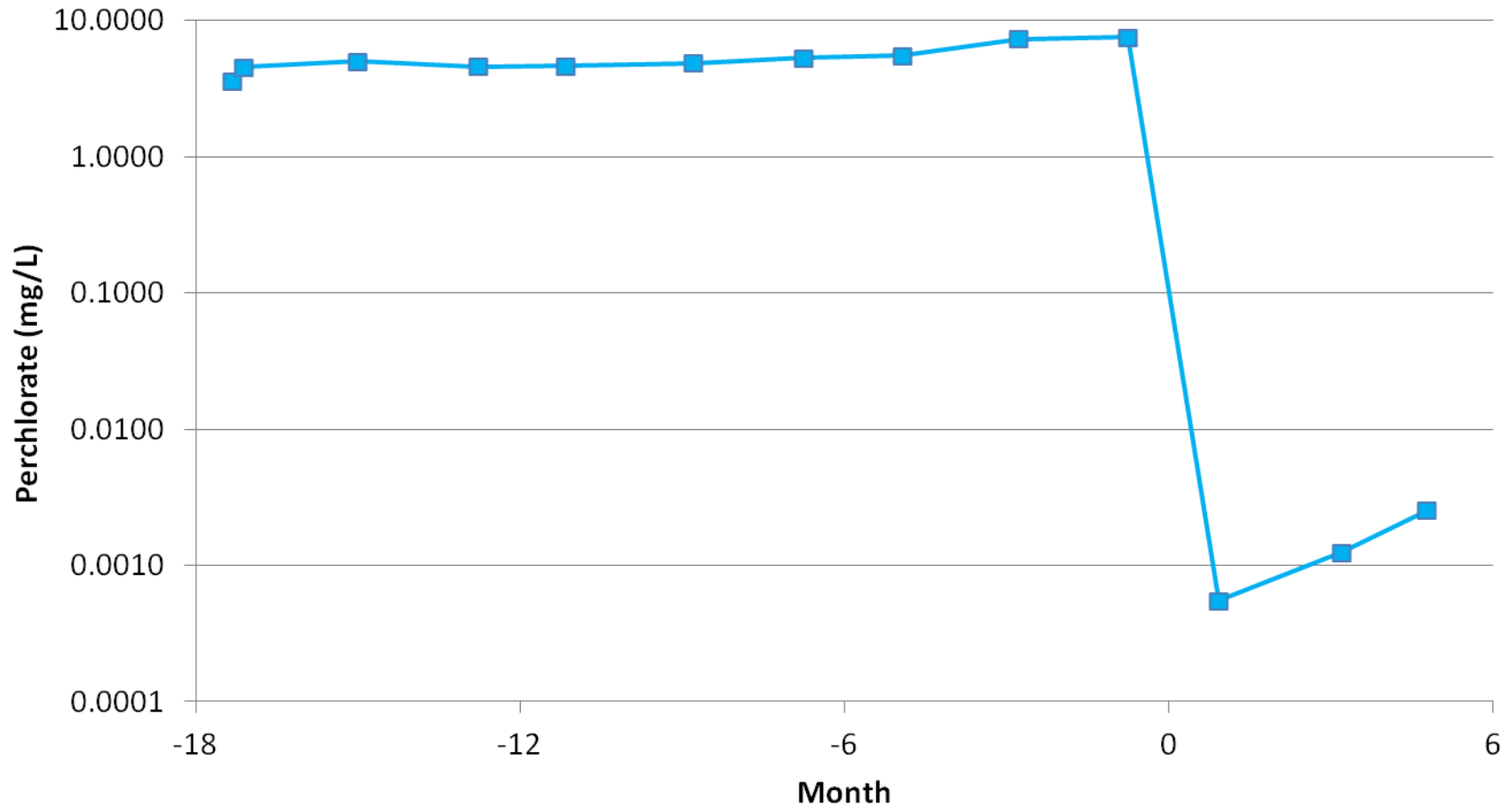


# Wetland Remedy





# Bedrock Groundwater Remedy



# Conclusion

- Regulatory approval for use in drinking water source area
- Greener remediation
- Significant in-situ reduction of perchlorate using CL-OUT<sup>®</sup>:
  - Vadose soils: 99.98%
  - Overburden GW: 95% +
  - Wetland GW: 90% +
  - Bedrock GW: 99.98%

