

Manipulating Subsurface Colloids by Citrate Addition to a Chromium Contaminated Aquifer

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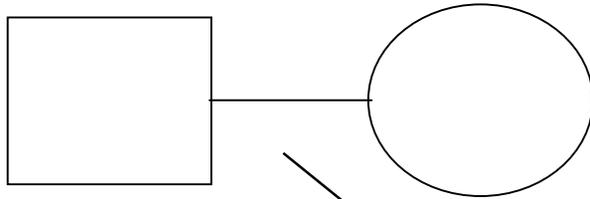
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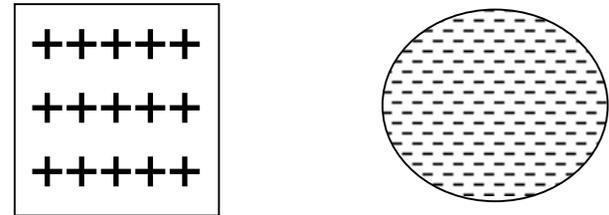
Outline

- Colloid mobilization as a remediation technique
- Application of colloid mobilization to a chromium contaminated aquifer
- Is colloid mobilization an effective remediation tool?

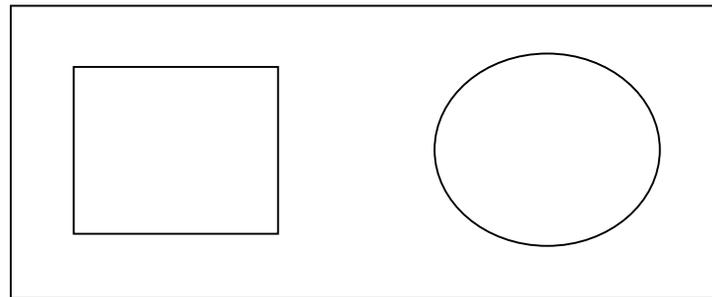
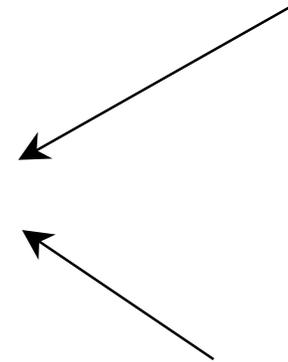
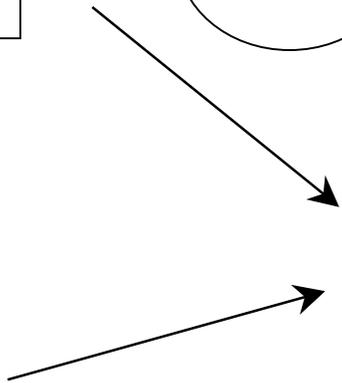
Break Bonds



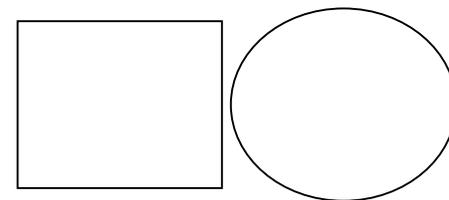
Reverse Surface Charge



Colloid Dispersal



Dissolve Encasing Cement

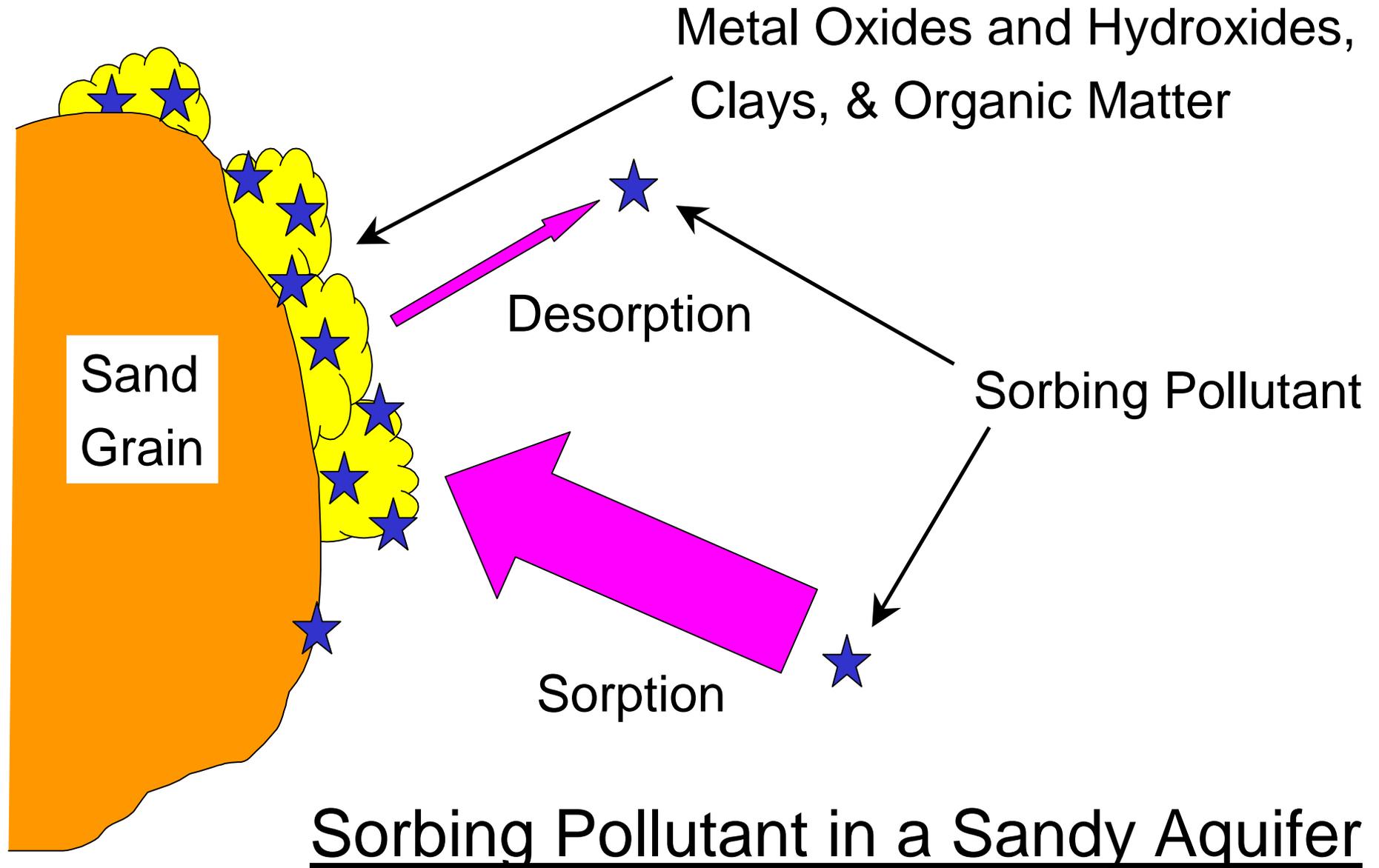


Expand Double Layers

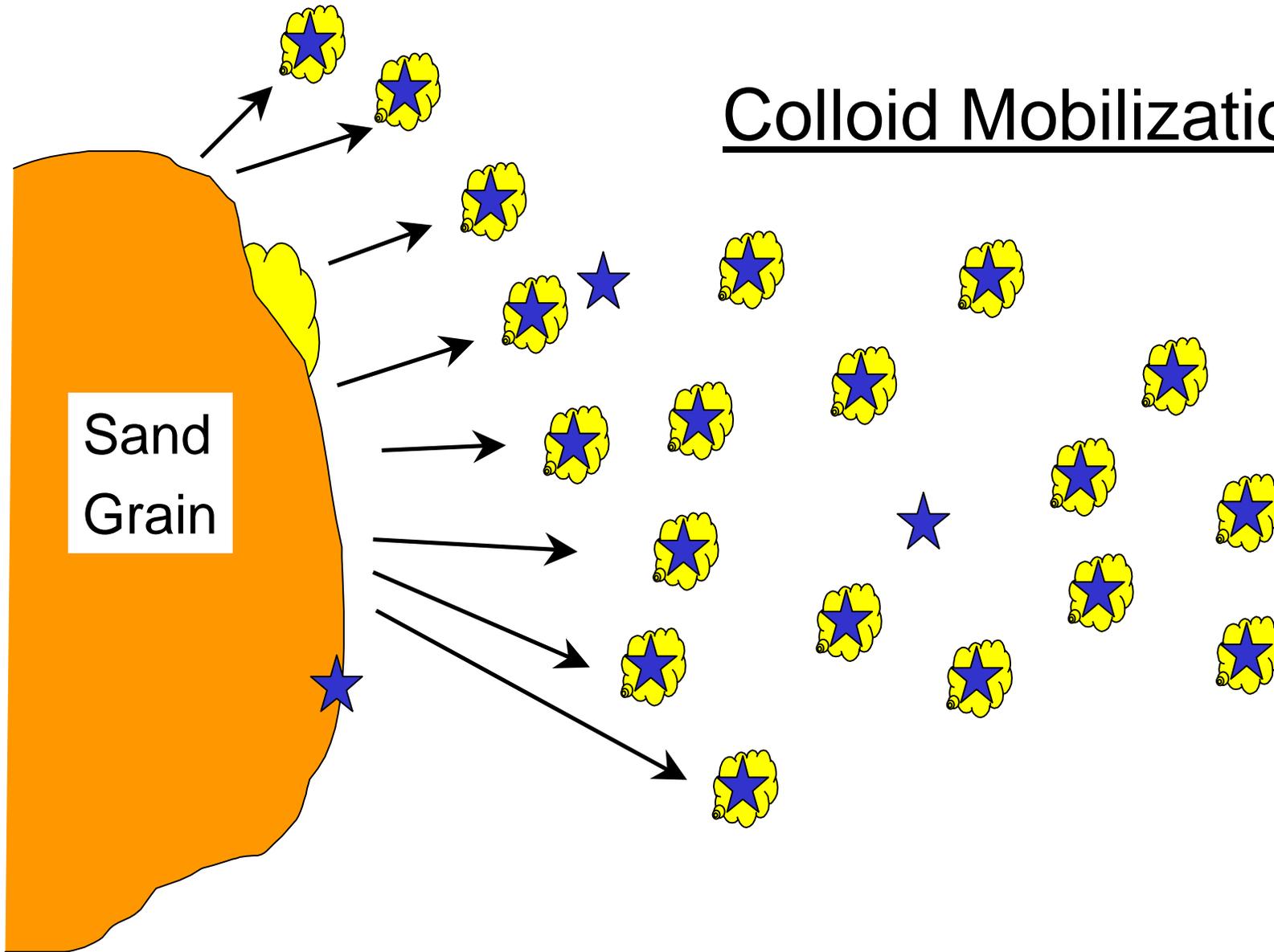
Colloid Mobilization

Goal: Increase the efficiency of pump and treat systems by eliminating the pollutant desorption step

Method: Disperse pollutant sorbents (iron and aluminum oxyhydroxides, clays, and humics) into colloidal particles by altering groundwater chemistry



Colloid Mobilization

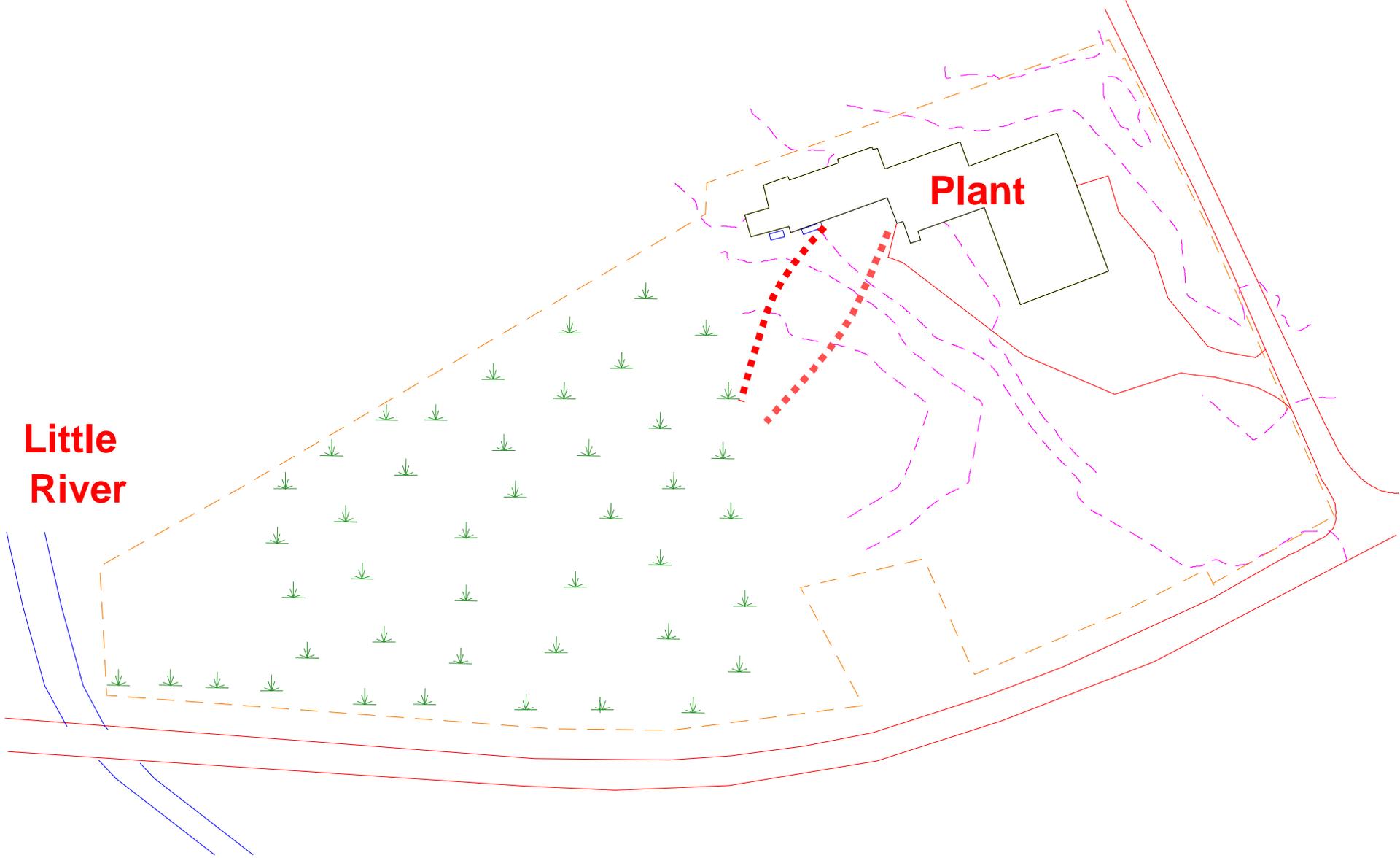


Application of Colloid Mobilization at a Chromium Contaminated Aquifer

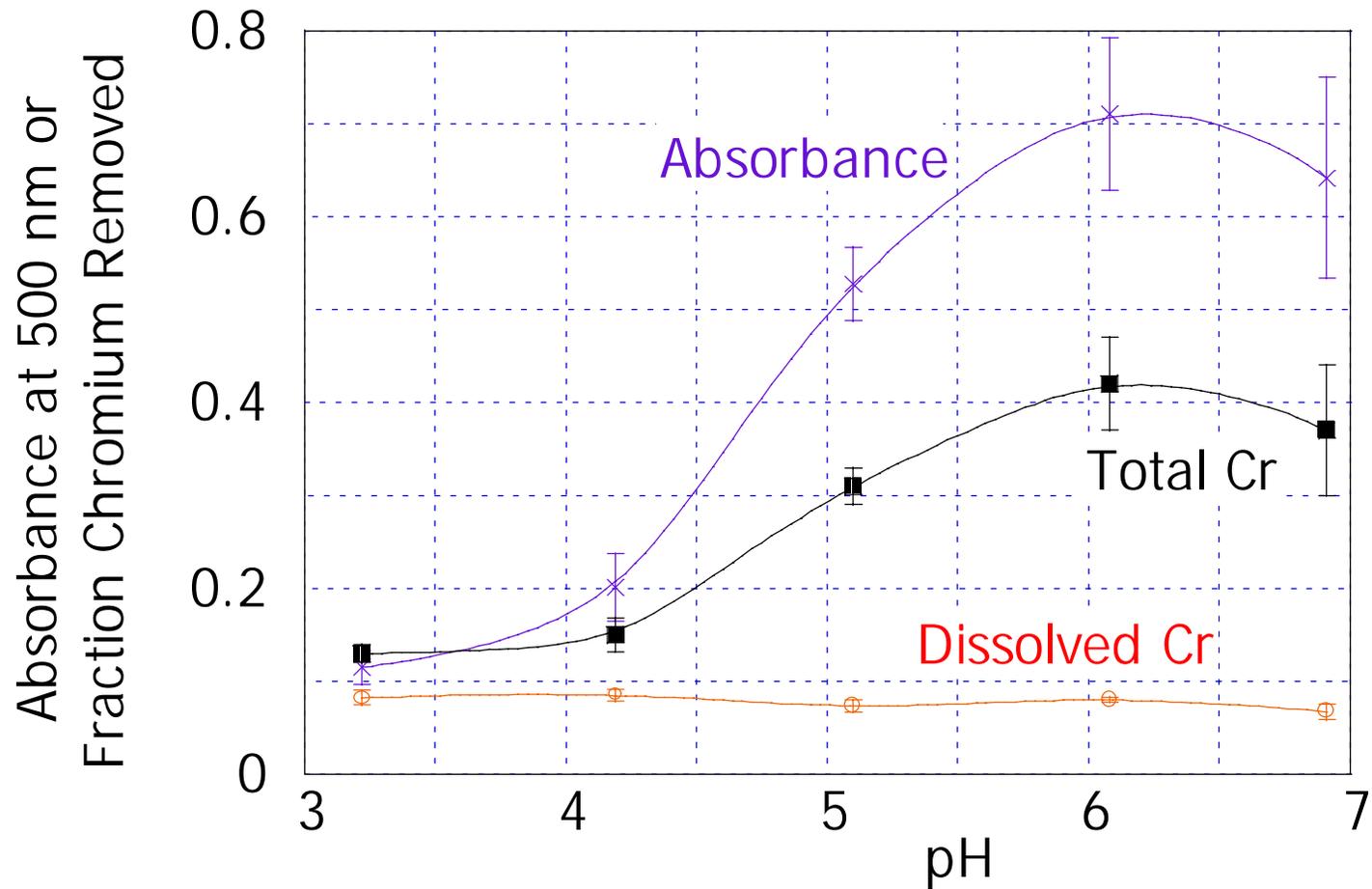
- Site description
- Colloid mobilizing solution
- Injection-withdrawal experiments
- Conceptual model explaining results

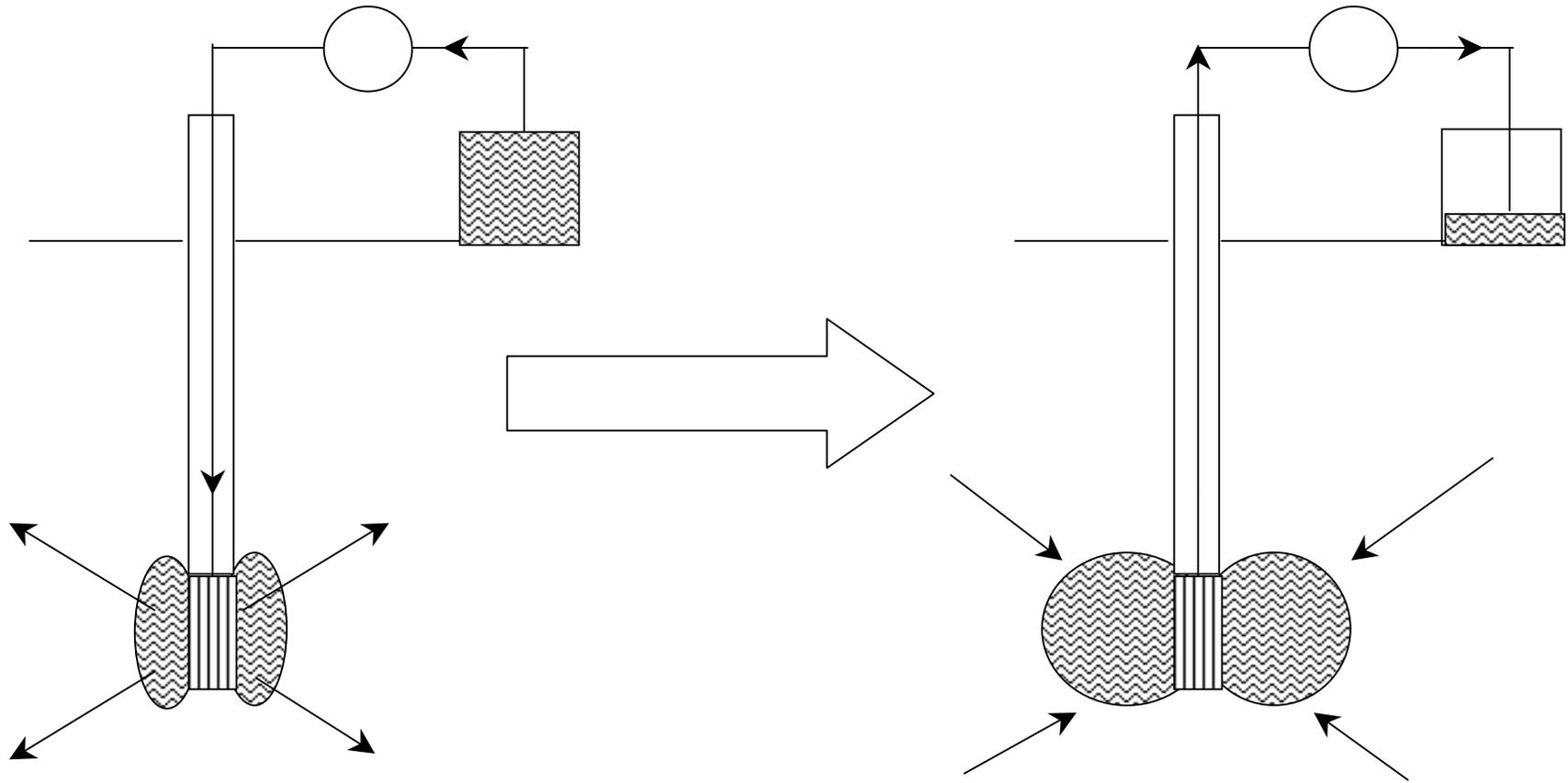
**Little
River**

Plant



Batch Test Results with Study Site Sediments (522 ug/g Cr) and 2 mM Citrate





Experimental Conditions

Colloid Mobilizing Injection

11 L of 5 mM citrate, 1.2 mM NaBr, pH = 7.1

32 L removed

Pre- and Post-Injections

12 L of 1.4 mM NaBr in groundwater

38 L removed (pre), 33 L removed (post)

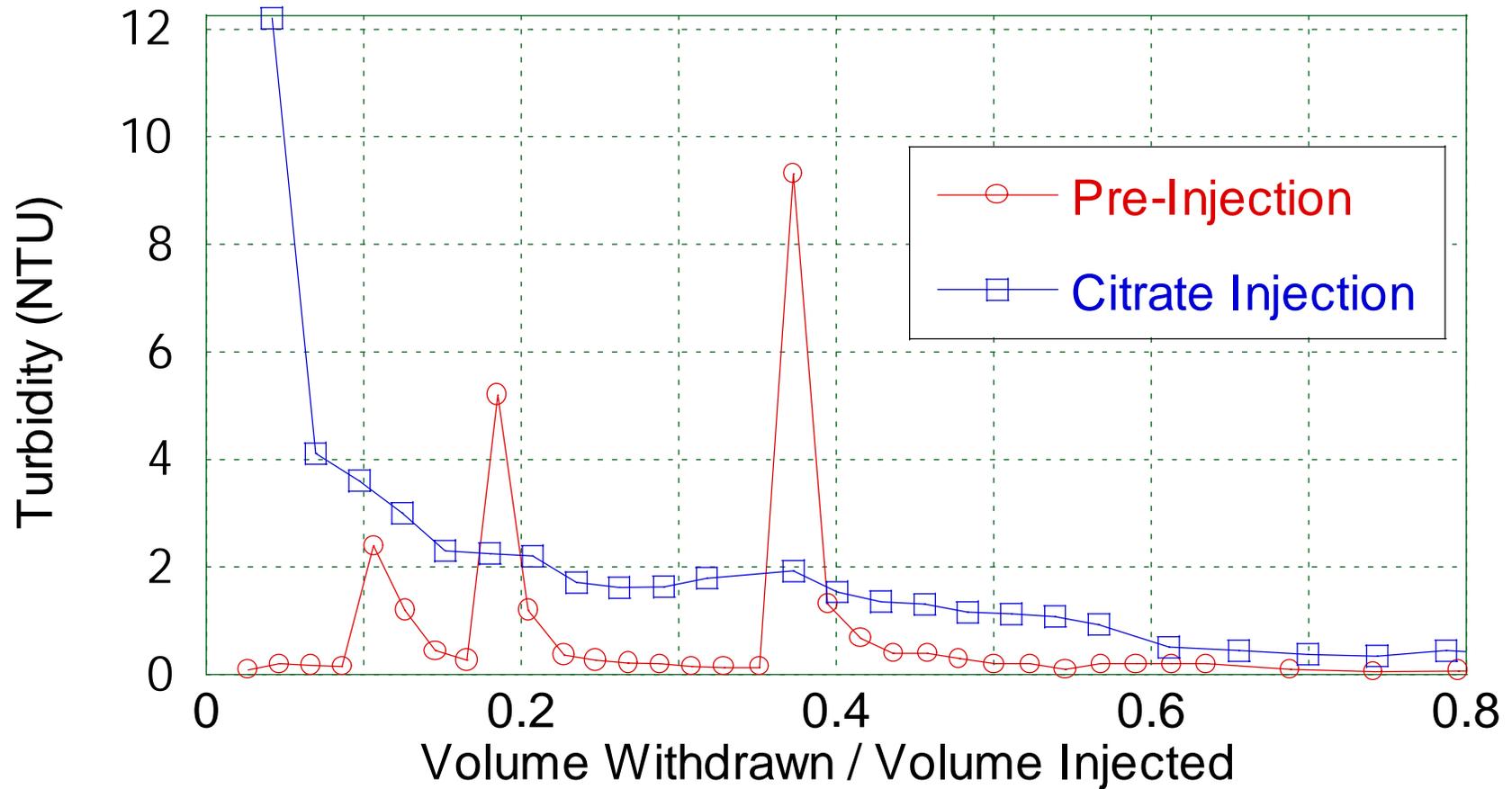
Aquifer

pH = 3.7 - 4.4, turbidity 0.05 NTU,

total chromium 1.0 mM, 590 ug Cr/g dry sediment (< 2mm)

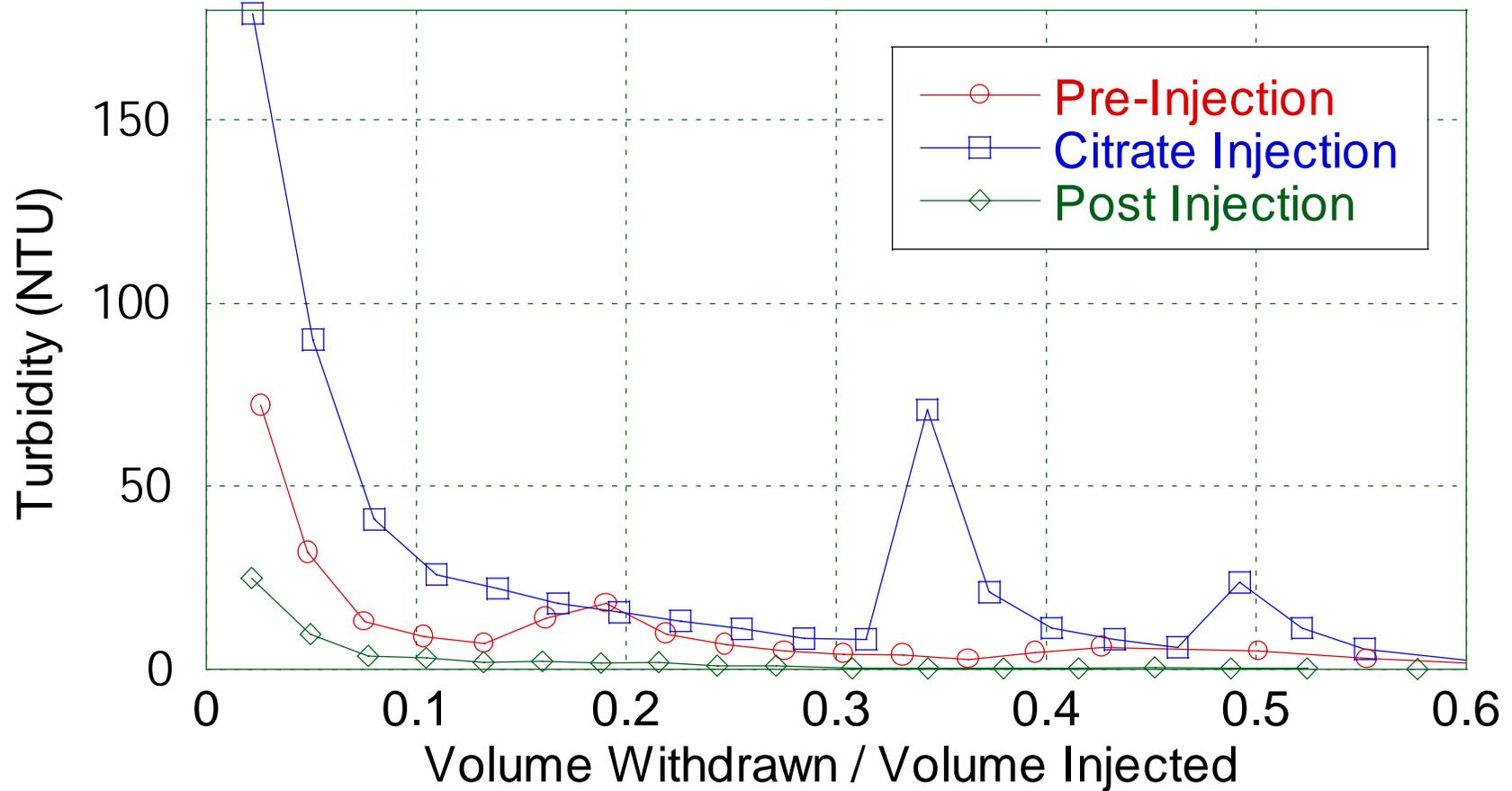
Experiment One

Turbidity vs Volume Withdrawn



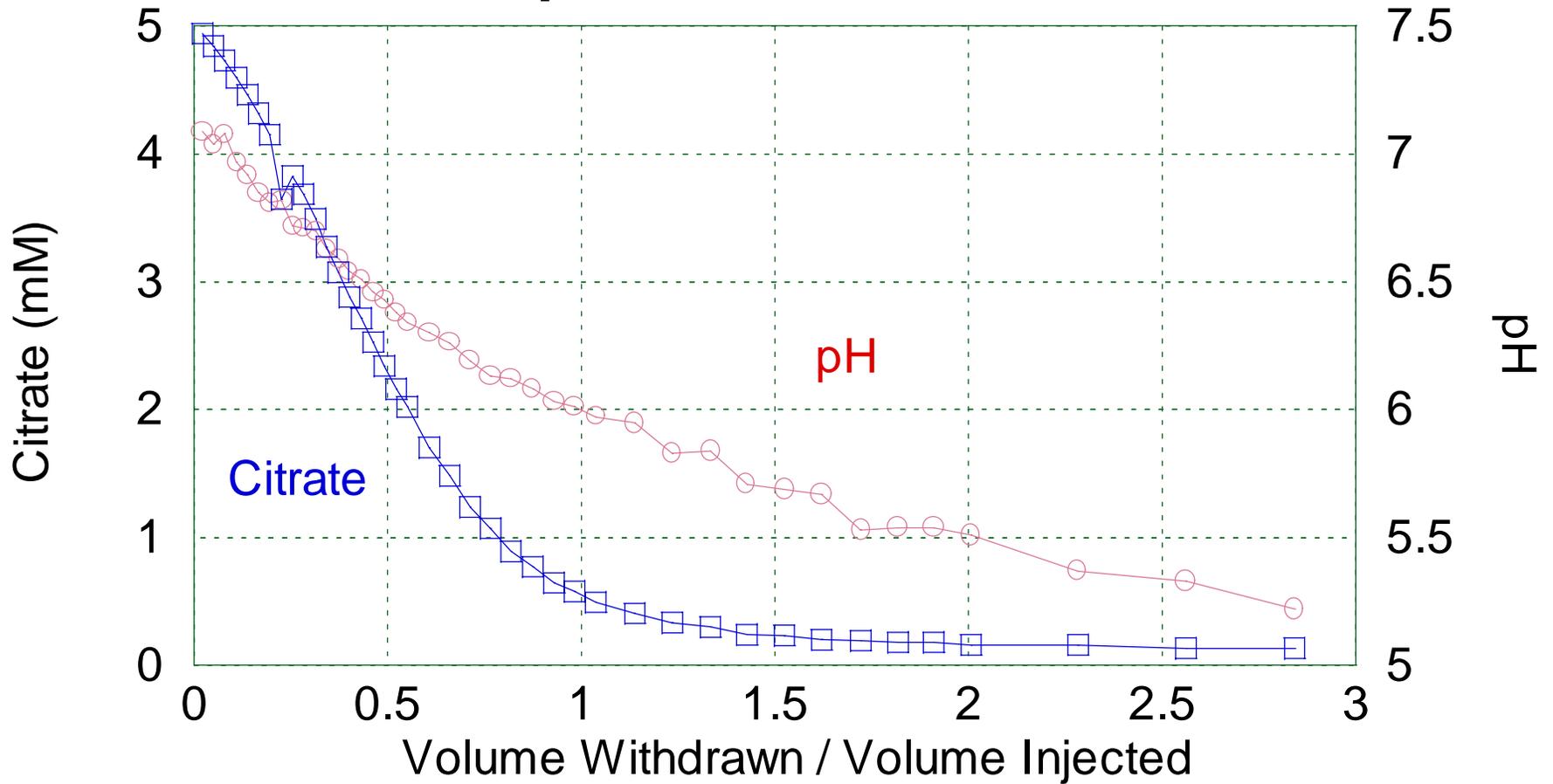
Experiment Two

Turbidity vs Volume Withdrawn



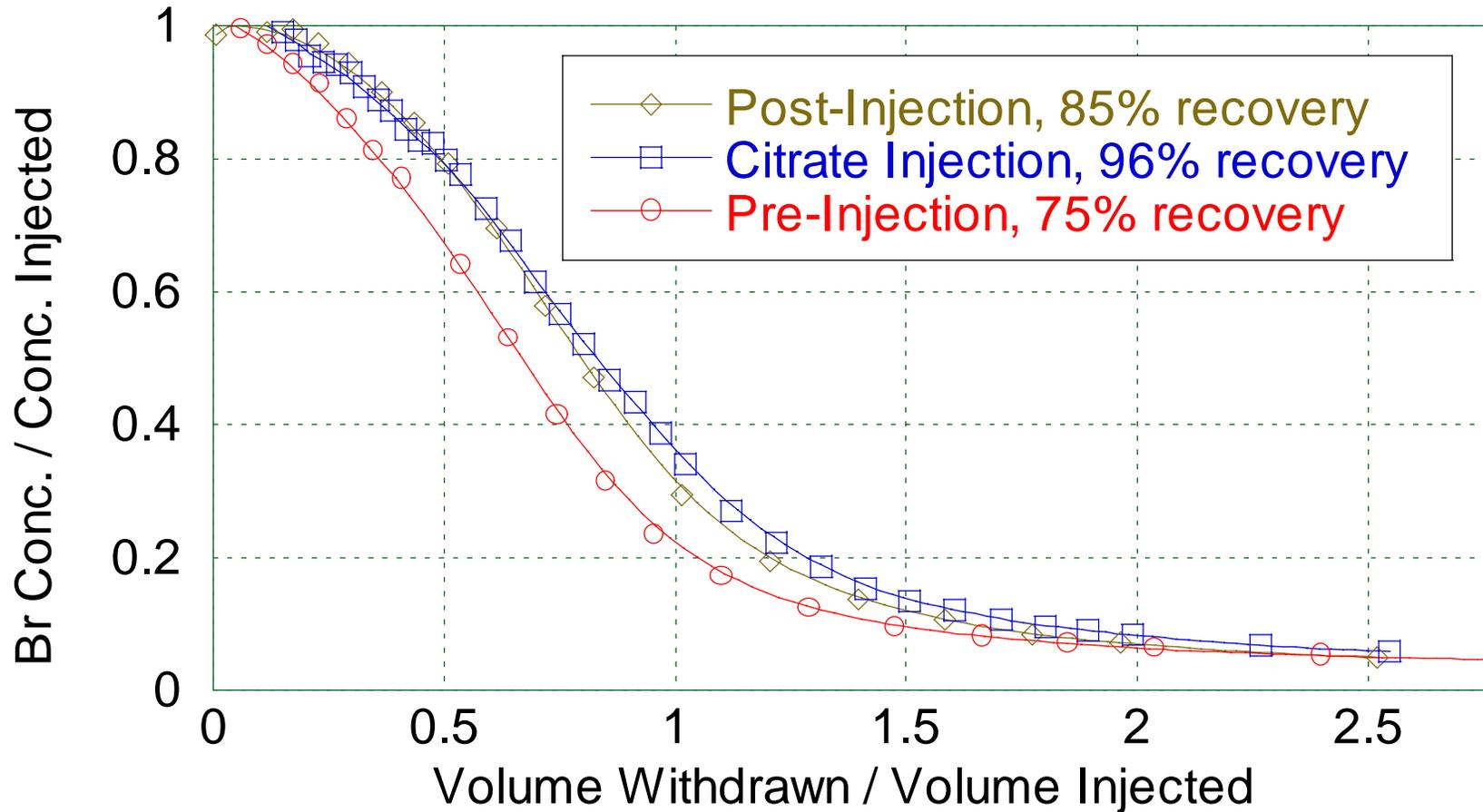
Experiment Two

Citrate and pH vs Volume Withdrawn



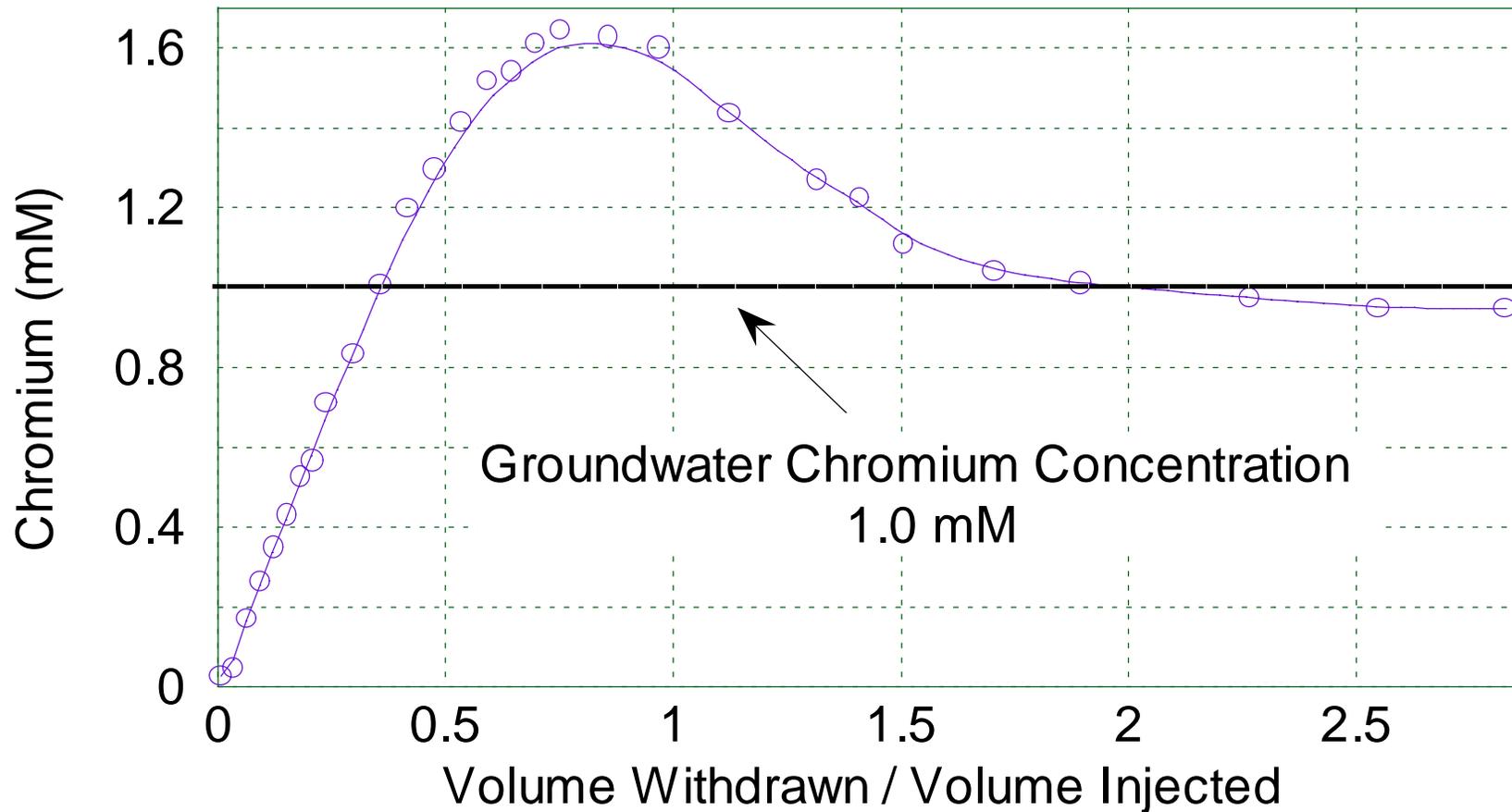
Experiment Two

Bromide Concentration vs Volume Withdrawn



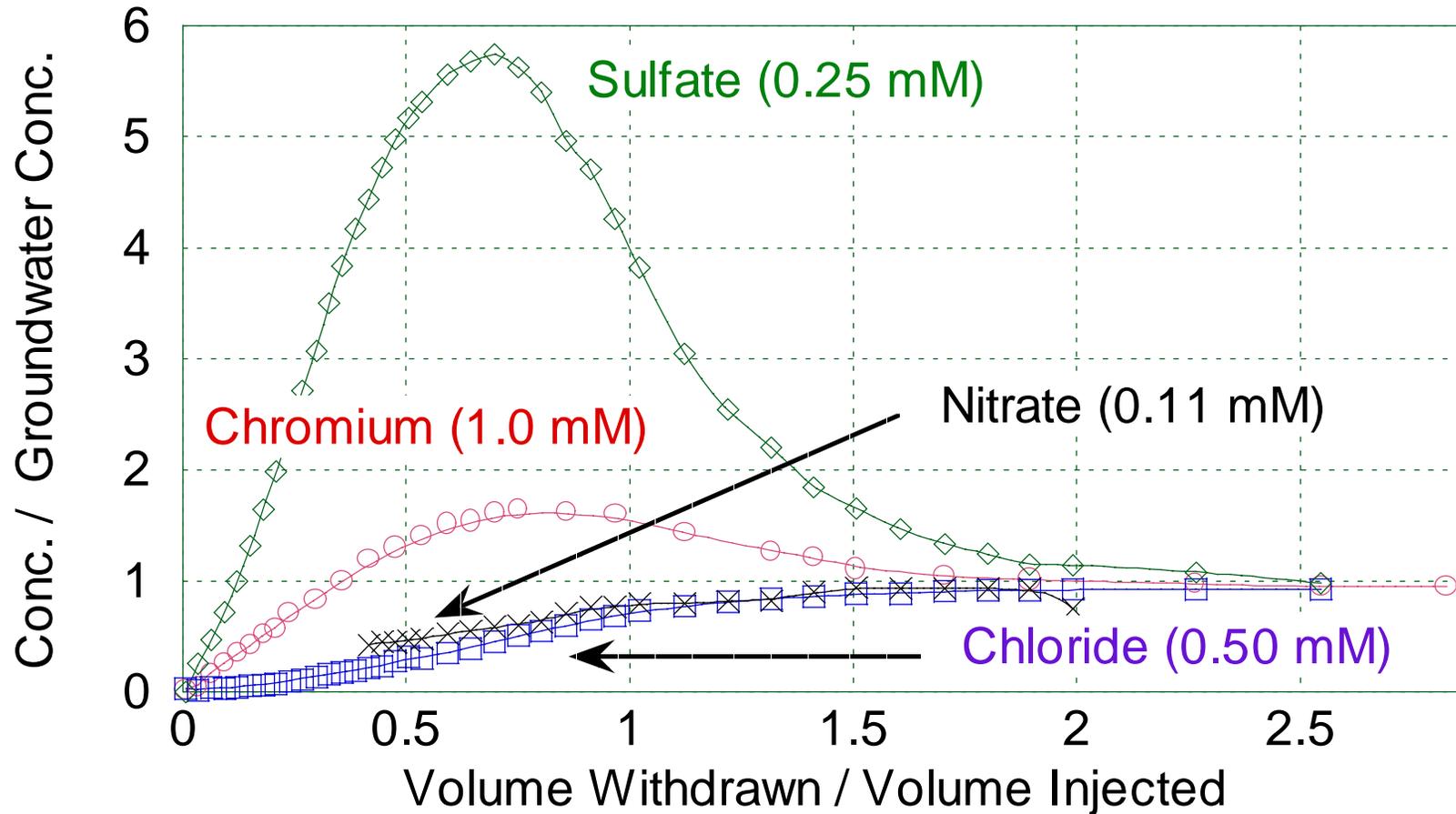
Experiment Two

Total Chromium vs Volume Withdrawn

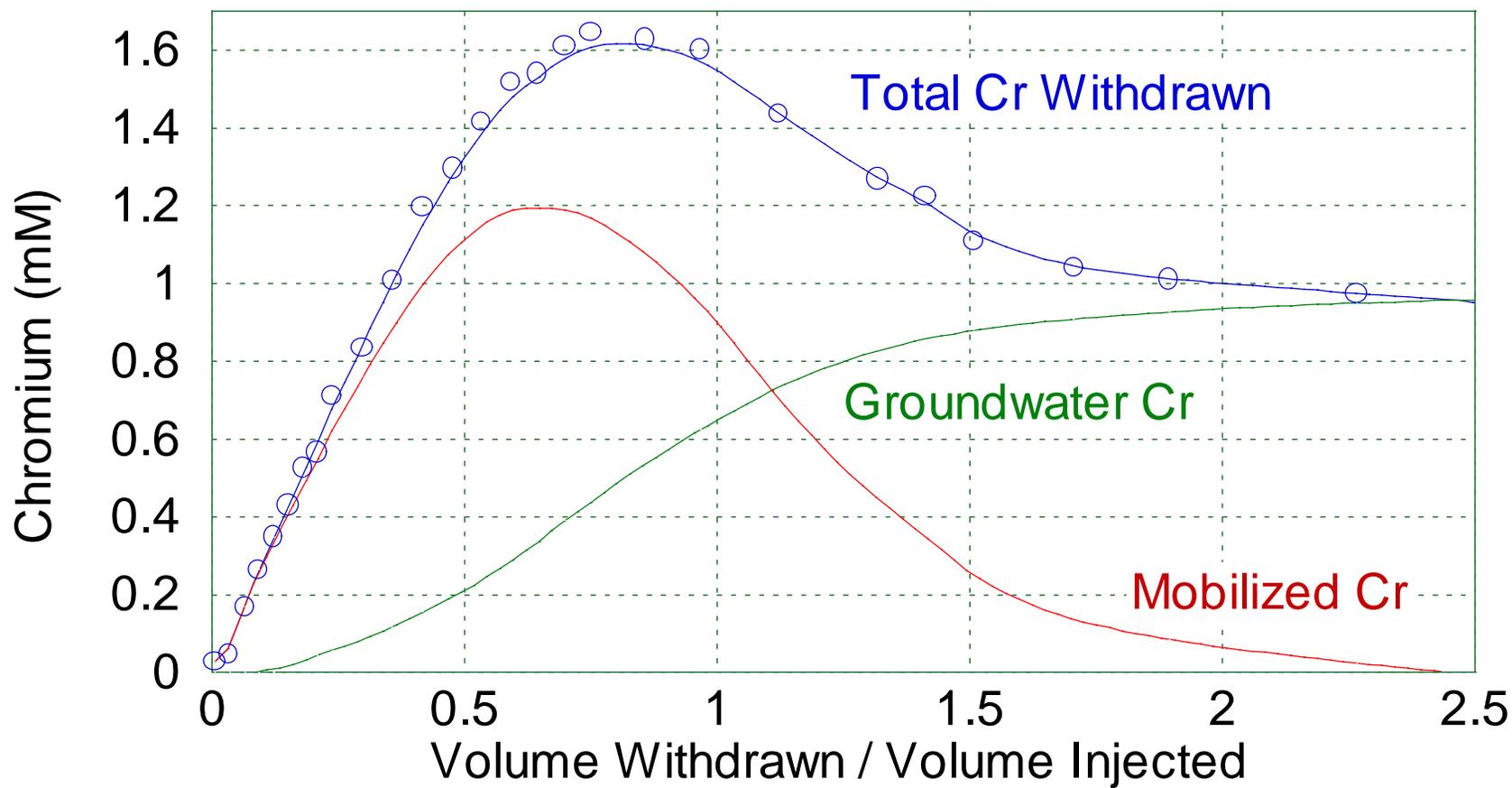


Experiment Two

Anions vs Volume Withdrawn



Mobilized Chromium Calculated from Bromide Data



Is Colloid Mobilization an Effective Remediation Technique?

- Colloids mobilized, but release not sustained
- Colloids enriched in chromium compared to aquifer sediments:
 - 590 ug/g < 2 mm
 - 3.8 mg/g < 63 um
 - 14 mg/g particles filtered from groundwater
- 21% of exchangeable chromium removed

Acknowledgements

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