# Experiment Design to Test Physical Aquifer Model Performance of a Co-encapsulated Bead Permeable Reactive Barrier for the Transformation of 1,4-Dioxane

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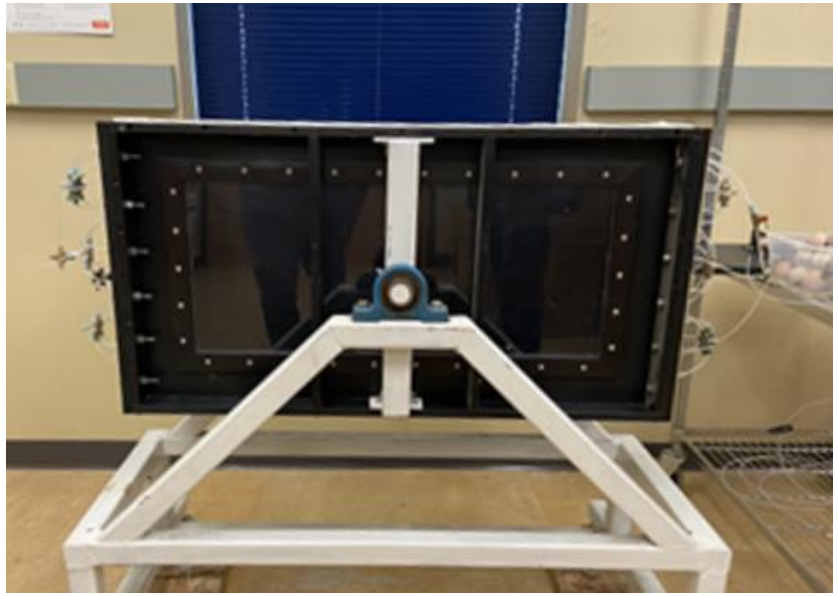
# Introduction

- Construction of a physical aquifer model combining:
  - Cometabolism
  - Co-encapsulation of microbes
  - Permeable Reactive Barriers (PRBs)
- Project Focus:
  - Contaminant removal rates
  - PRB design effect on fluid flow
  - Contaminant fate and mass transport



Side view of the 100L model aquifer before packing

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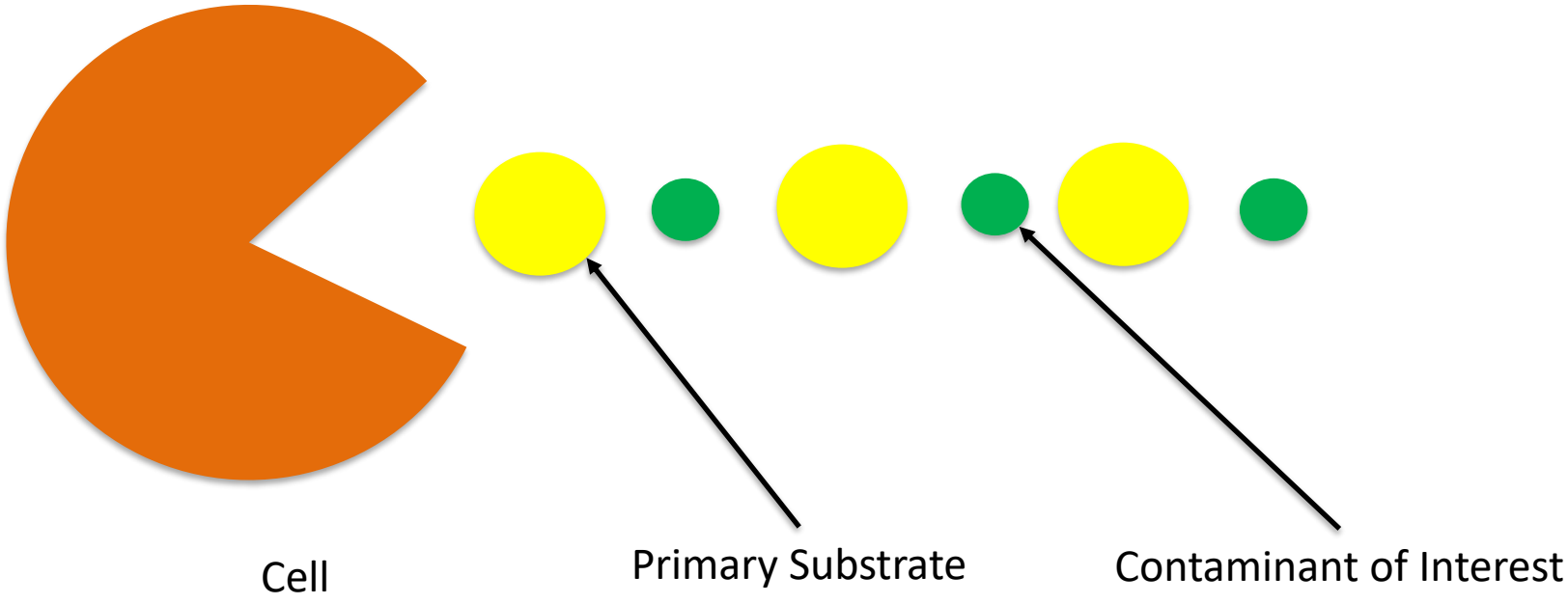
# In-Situ Remediation: Cometabolism

- Contaminant degradation mechanism



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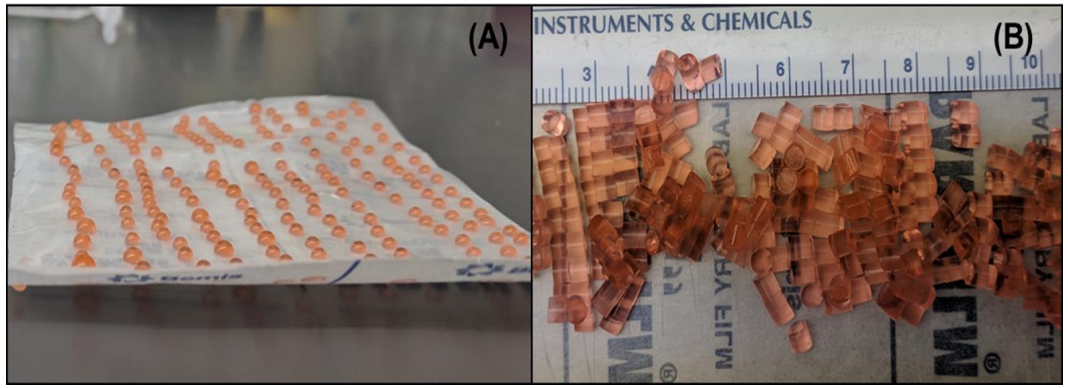
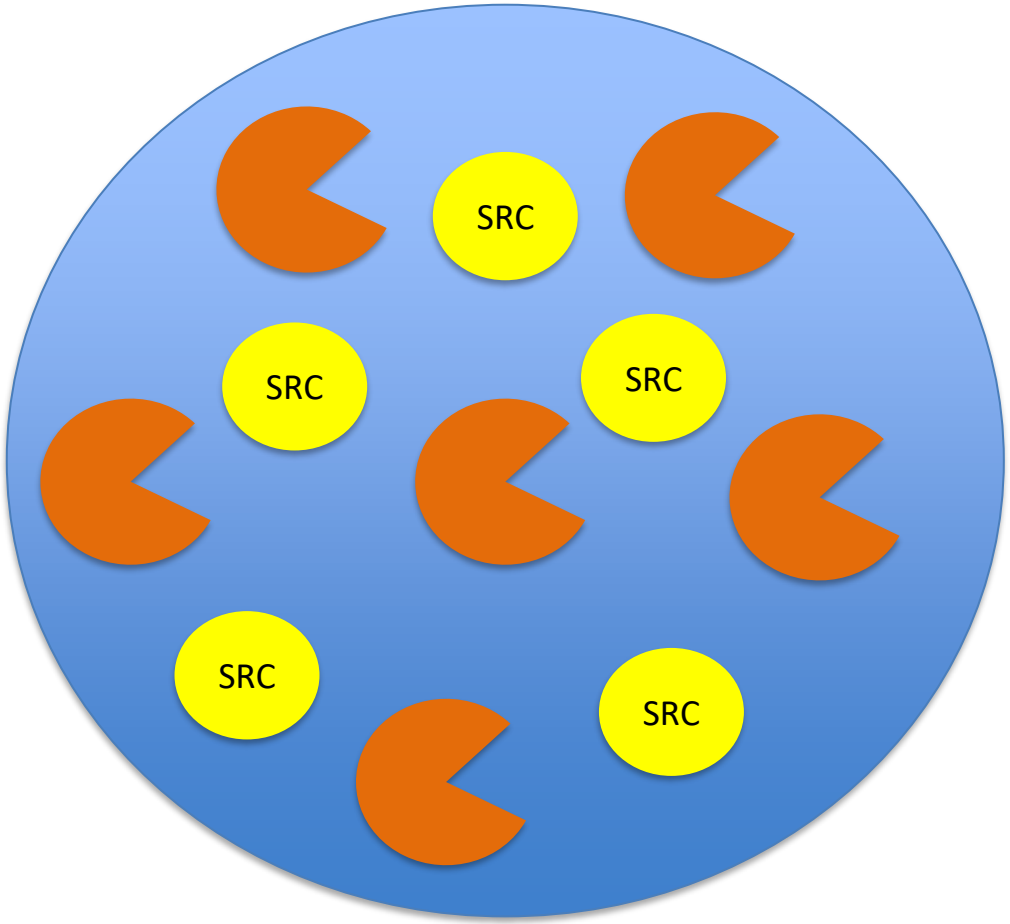
# Co-encapsulation

- Microbe delivery
  - Slow-release compound
  - Live cells
  - Varying bead material
    - Hydrogels-gellan gum



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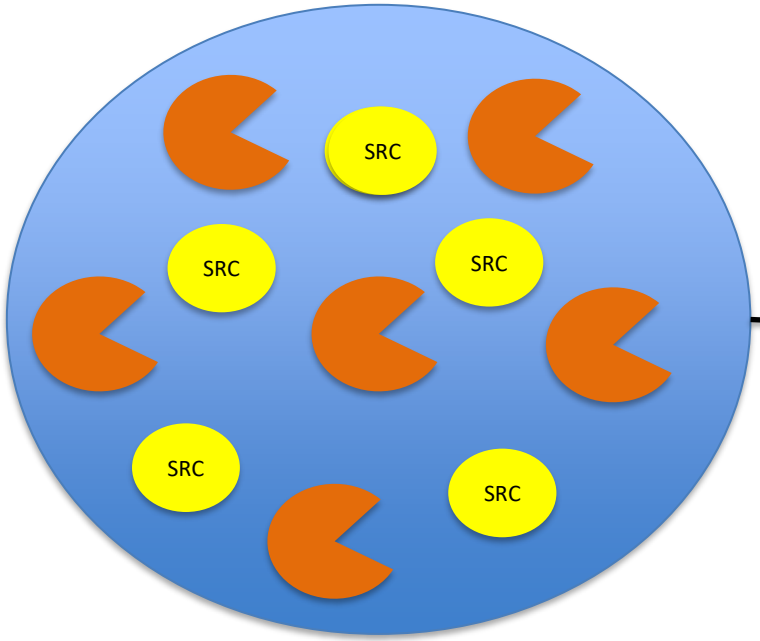
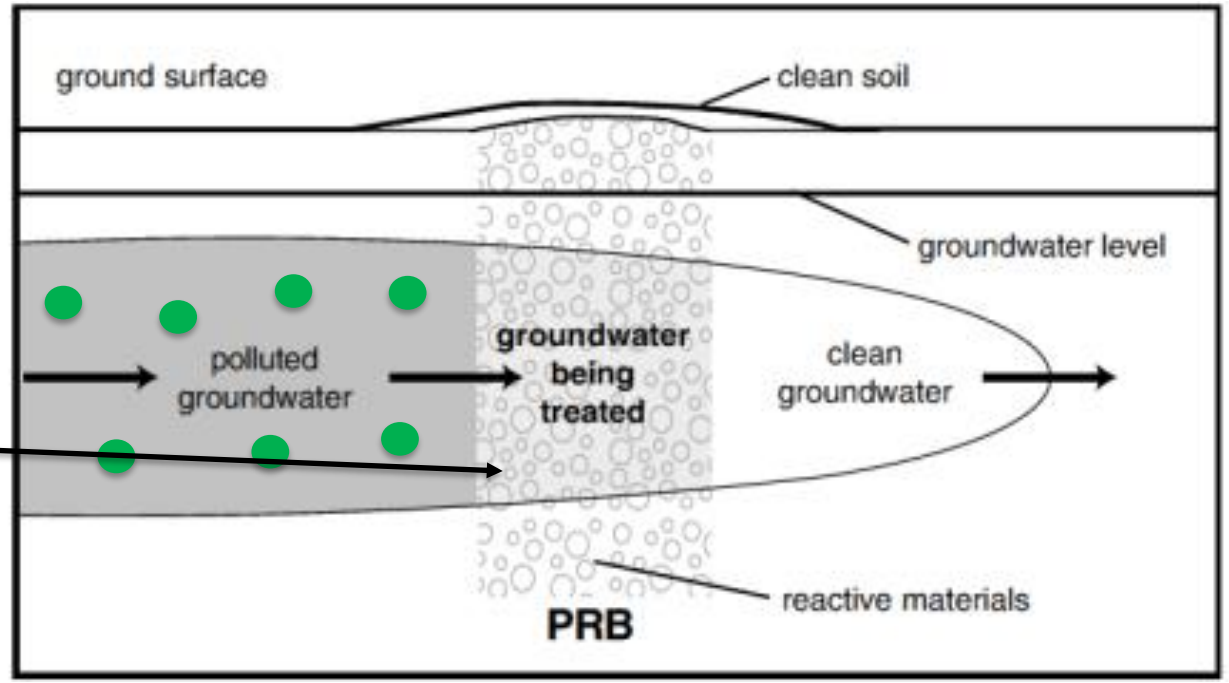
# Permeable Reactive Barrier (PRB)

- In-situ implementation




EPA. (2013). Introduction to in situ bioremediation of groundwater.

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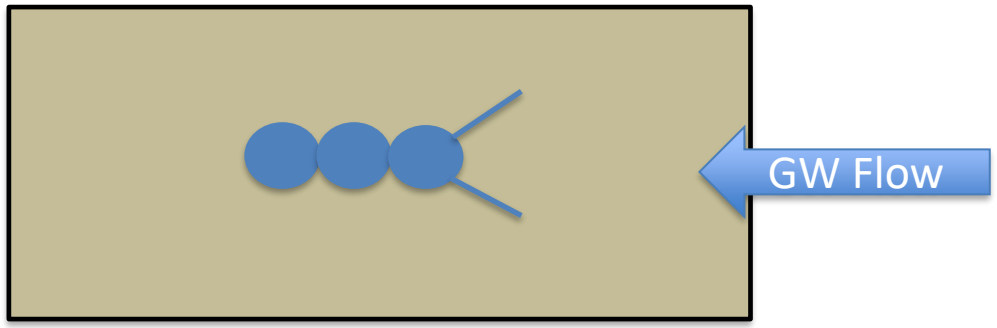
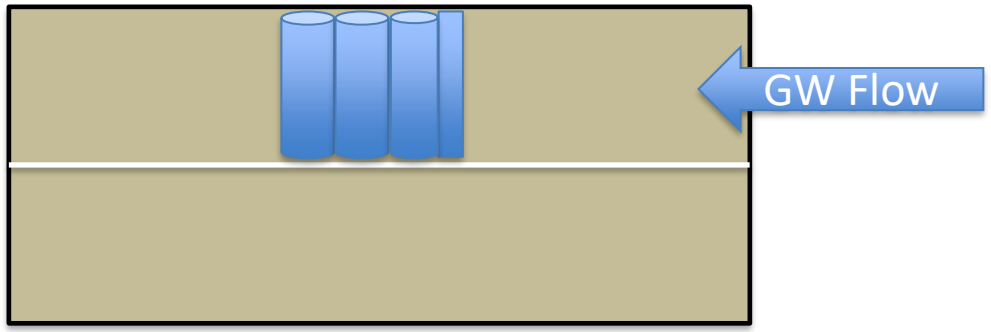
# Experiment Design

- 100L sand packed reactor
- 3 vertical columns packed with co-encapsulated gellan gum beads
- "Funnel and Gate" PRB design
- Syringe pumps for inlet groundwater feed and contaminant injection
- Contaminants of interest: 1,4-dioxane, 1,1,1-TCA, cis-DCE




Top view




Side view

# Experiment Design

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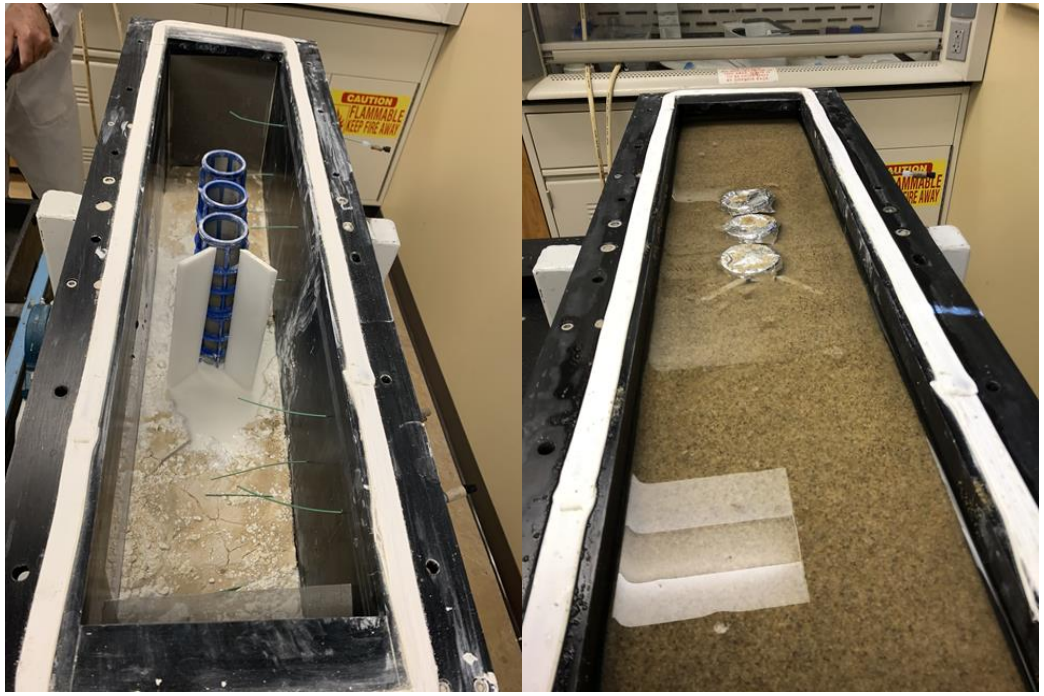
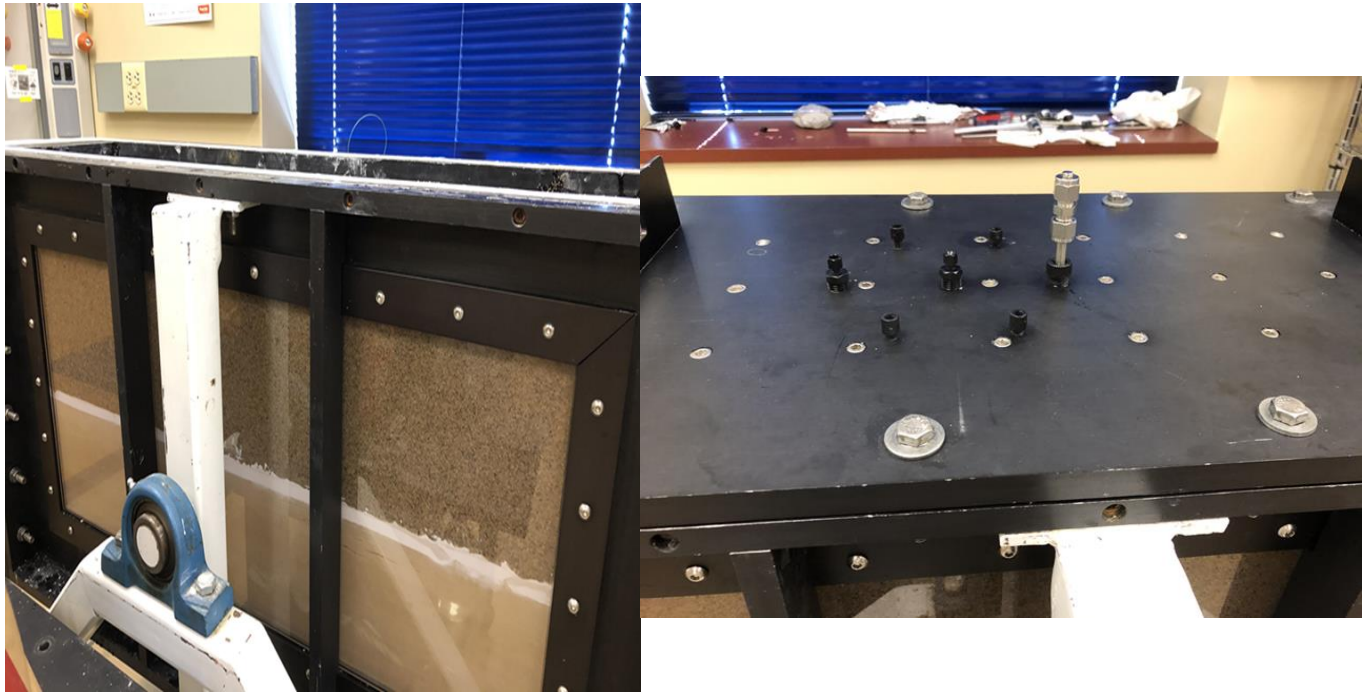



Top view of the physical aquifer model before packing with sand (left) and after (right)



Side view of the physical aquifer after sand packing (left) and top view of sample ports (right)

# Experiment Design

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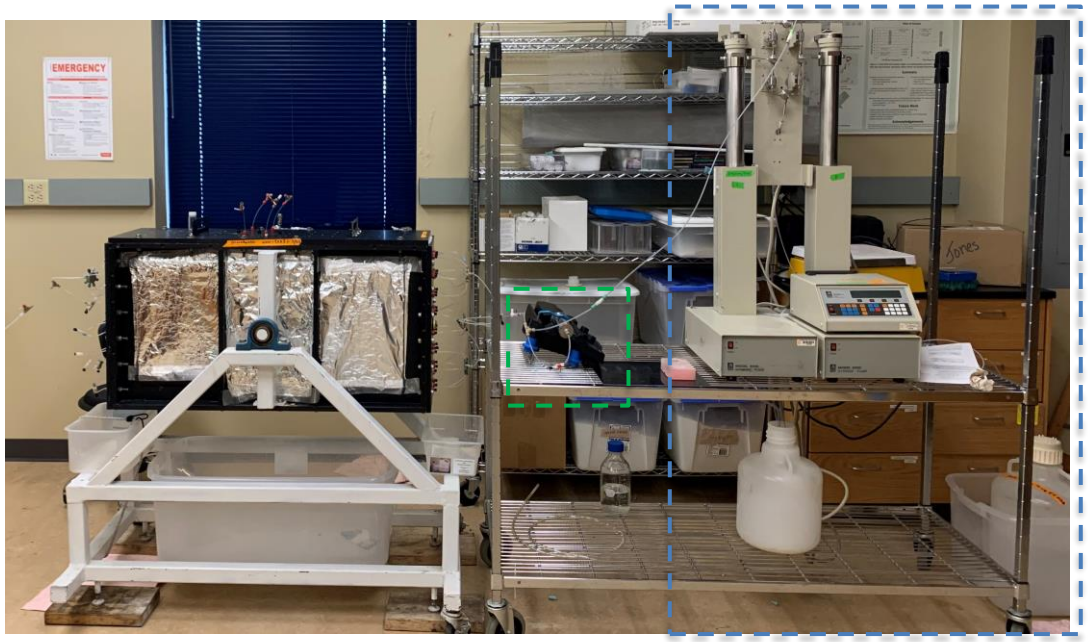
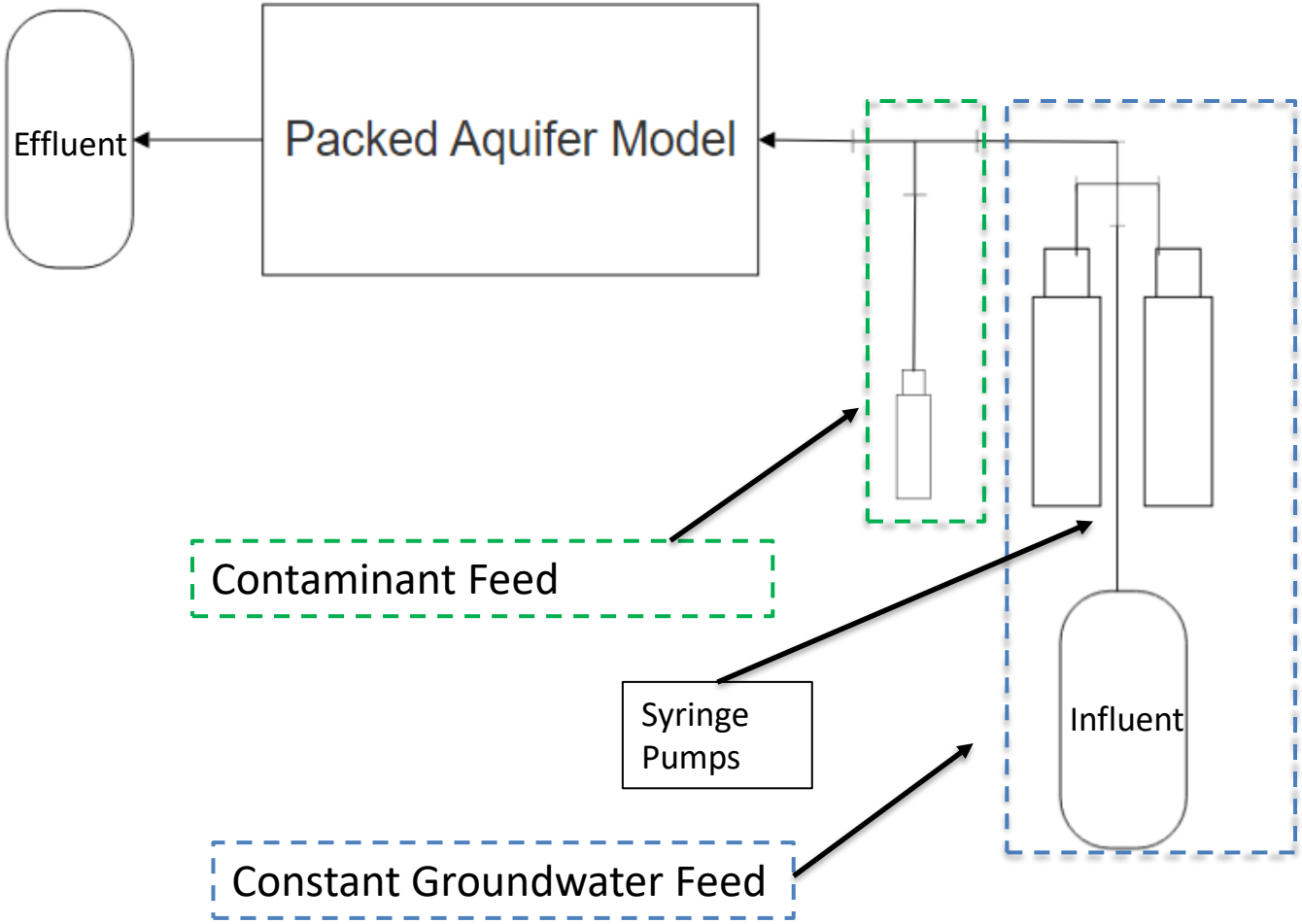



Side view of entire system (flow is from right to left)



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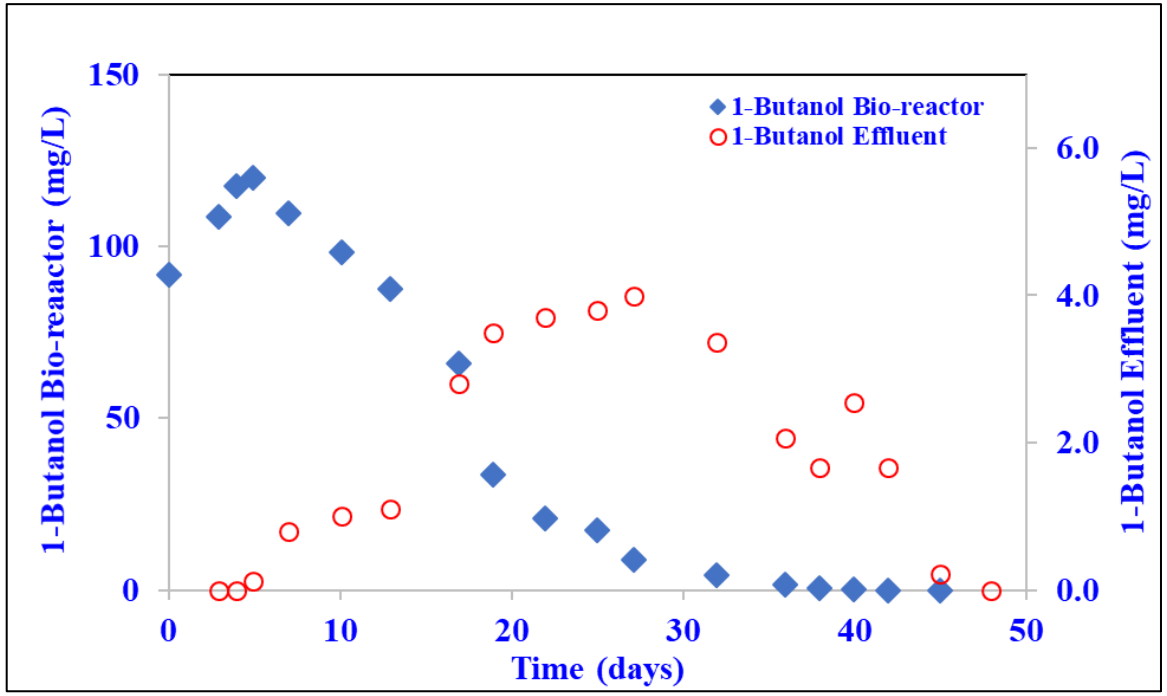
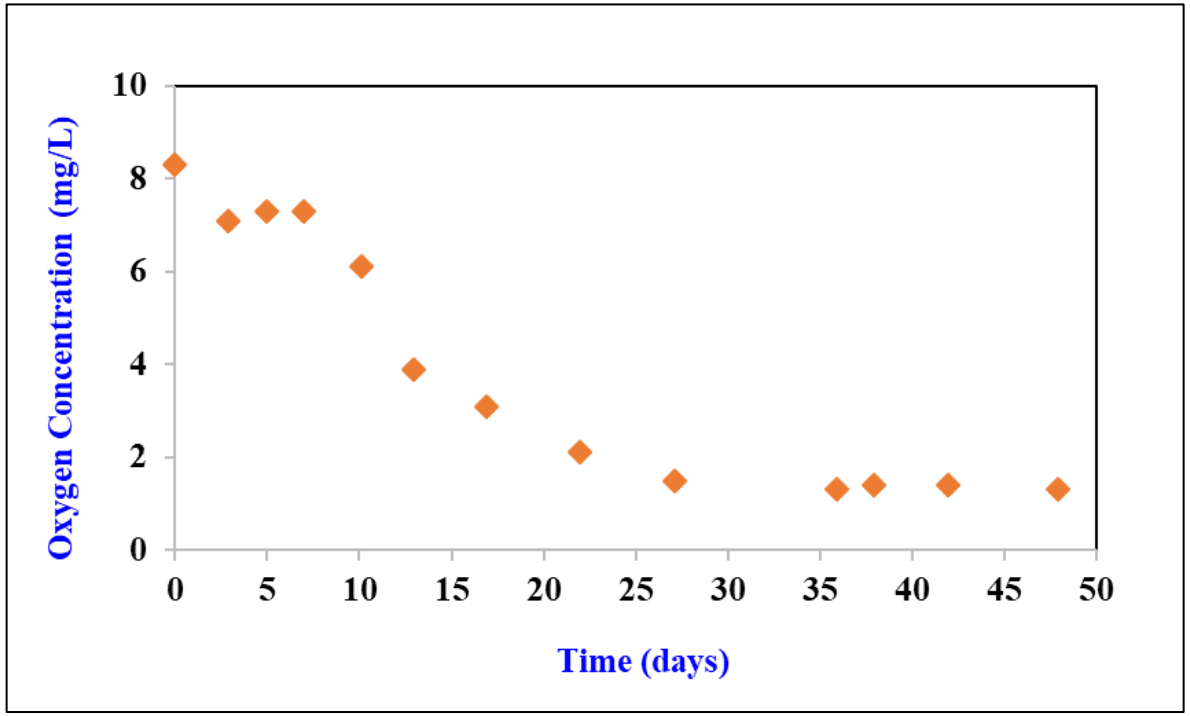
# Experimental Design: Preliminary Conditions




Butanol concentration in the Bio-reactor cylinder filled with gellan-gum macrobeads and the physical model effluent during initial operation of the physical aquifer model.




Dissolved oxygen concentrations changes in the effluent of the physical aquifer model during the initial operation with a reactive barrier cylinder filled with gellan-gum microbeads in place.

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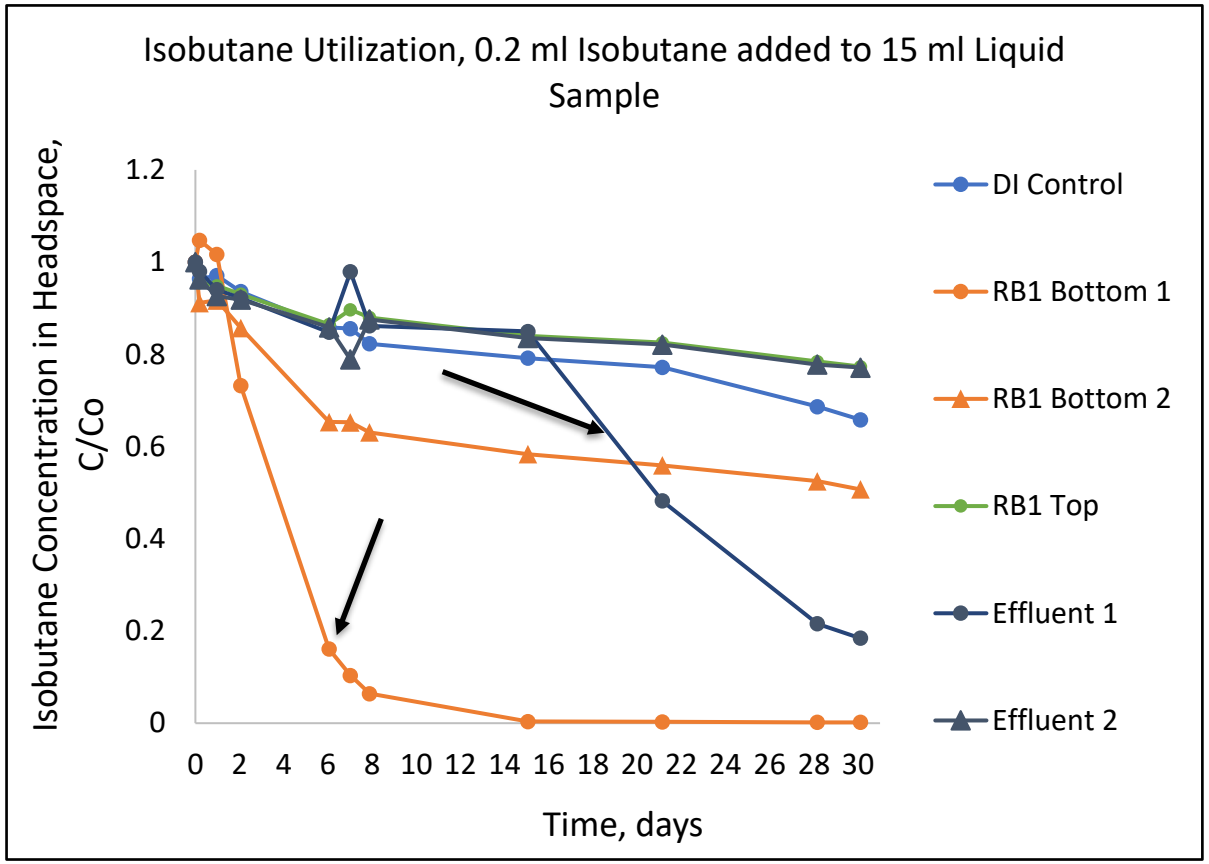
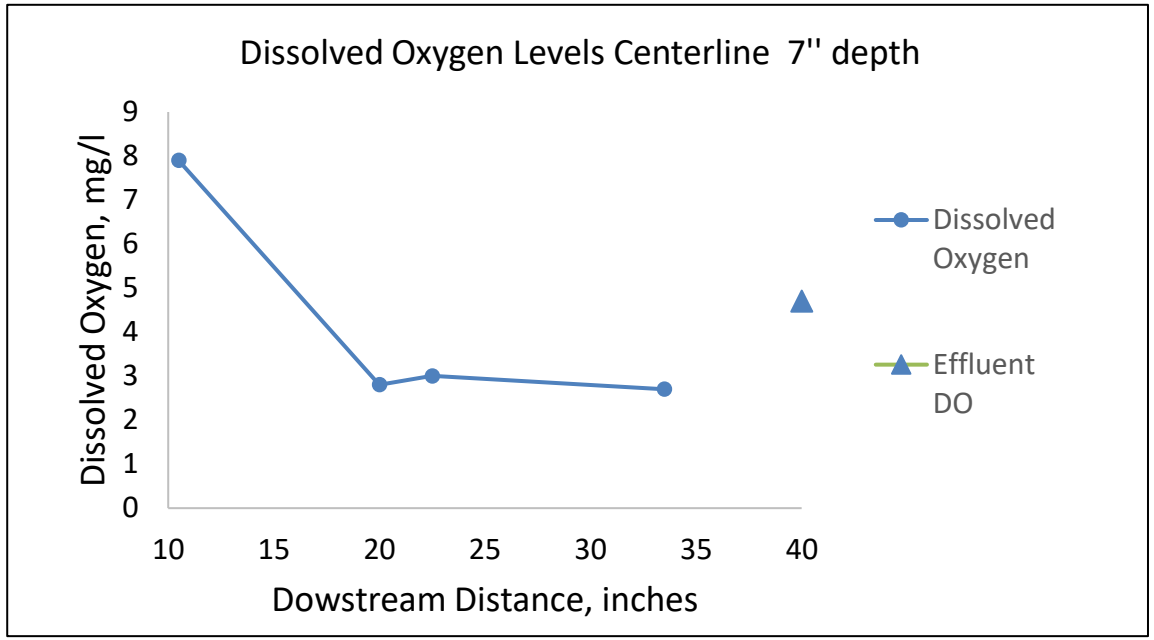
# Experimental Design: Probing for Growth

- 1st Column packed with encapsulated microbes and SRC



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# Experiment Objectives

- Determine:
  - Contaminant removal rate(s) and the performance of the co-encapsulated beads in a passive system
  - How different PRB designs affect contaminant fate and transport
- Develop data for modeling co-encapsulated bead PRB performance with regards to:
  - Contaminant transport through system
  - Microbial performance

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# Acknowledgements

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# Thank you

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