

Problem Definition

Motivation: Untreated wastewater contaminates groundwater and water bodies causing illness and algal blooms which pose serious threats to marine ecosystems and environmental health. This is often the result of insufficient infrastructure which is especially common in rural low income communities.

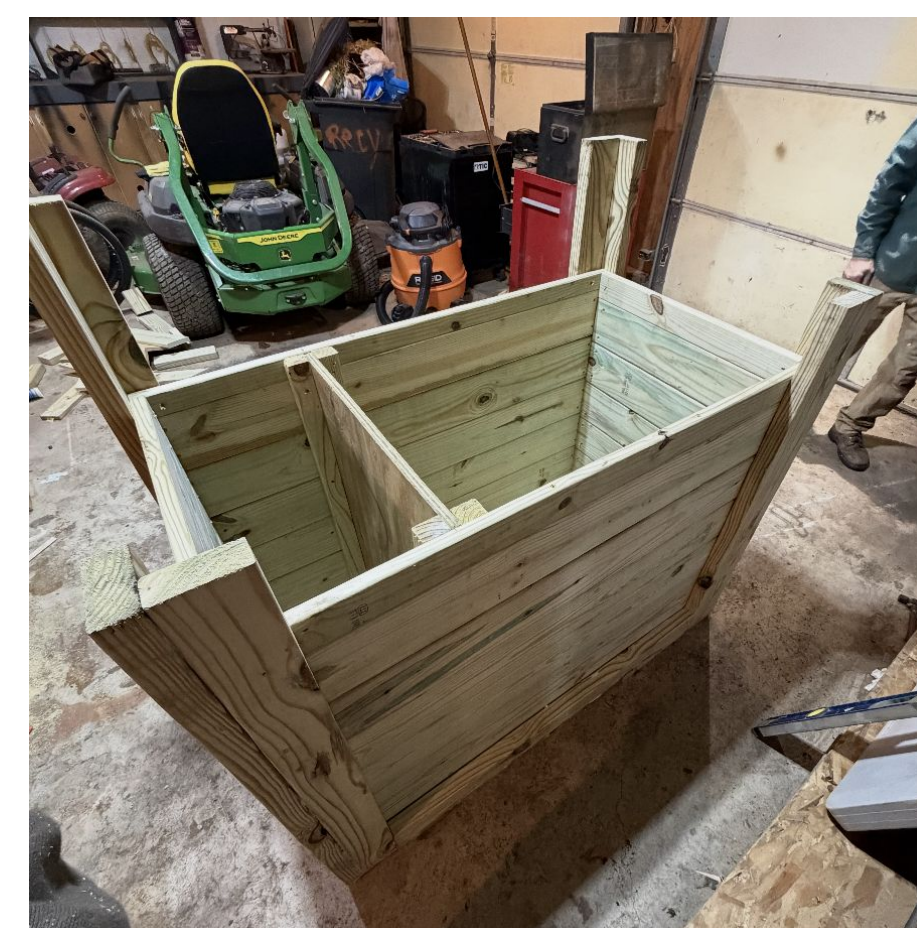
Project Objectives and Hypothesis

RTR solution: Ridge to Reefs developed an affordable, low maintenance bioreactor garden that removes harmful nutrients of septic water through treatment layers similar to those naturally found in the environment.



Our goal: Enhance RTR's design by integrating a recirculating air pump that allows effluent to pass through the layers twice to improve nutrient removal efficiency beyond RTR's baseline of 87% nitrogen, 83% phosphorus and 95% TSS removal.

The Construction Process



Construct Container

- Used CAD design specifications to develop wooden frame
- 2:1 ratio following RTR original design
- Maintained the original layer depths
- Transport to testing location on UMD campus



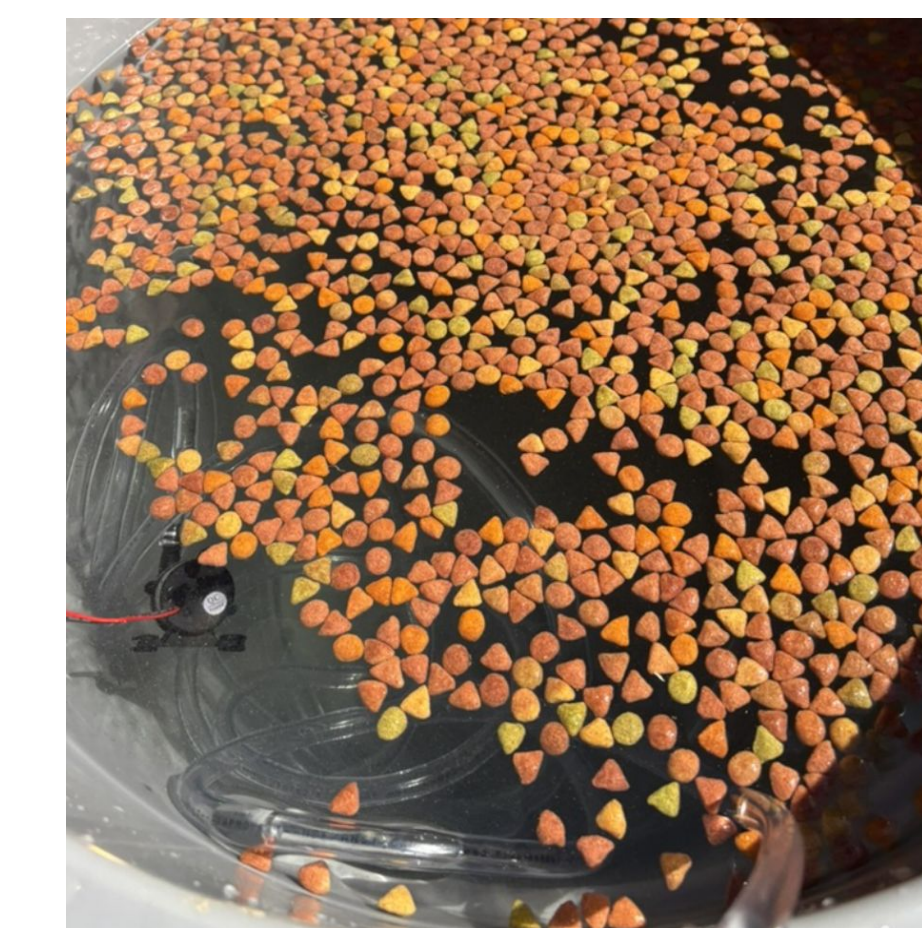
Pond Line and Fill Layers

- Lined Container with Pond liner
- Filled in layers; woodchip, gravel, biochar, and vegetation
- PVC piping laid for drainage and sample collection



Finalize Compartments, Add Pumps

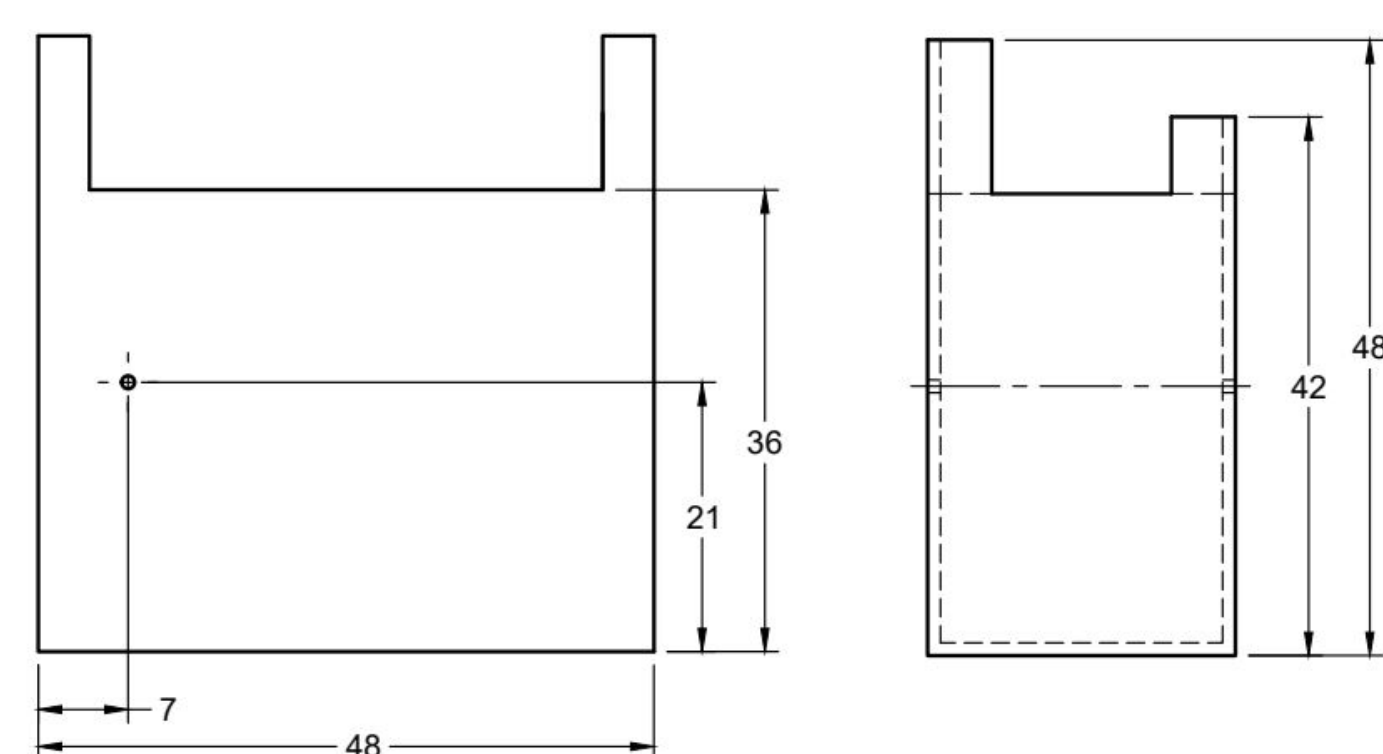
- Finalize layers in both compartments,
- Add sealant to outflows
- Attach effluent and sample collection containers of around 55 gallons
- Connect pumps from effluent containers to garden



Create Effluent and Run

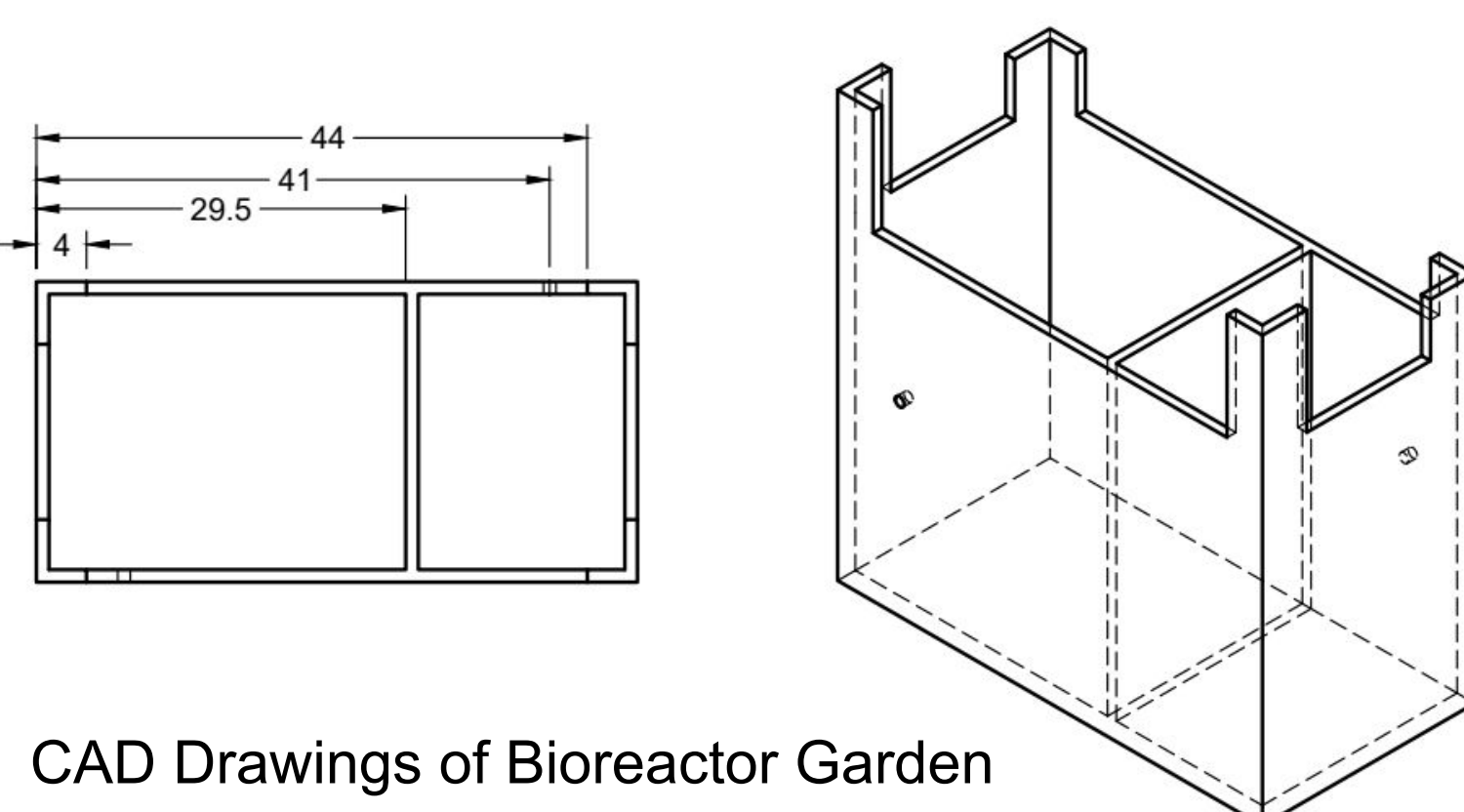
- Create simulated effluent using tap water, dog food and ammonia additive
- Start pumps and run effluent into the garden
- Wait 18 hours for water to fully pass and collect sample for testing

The Design

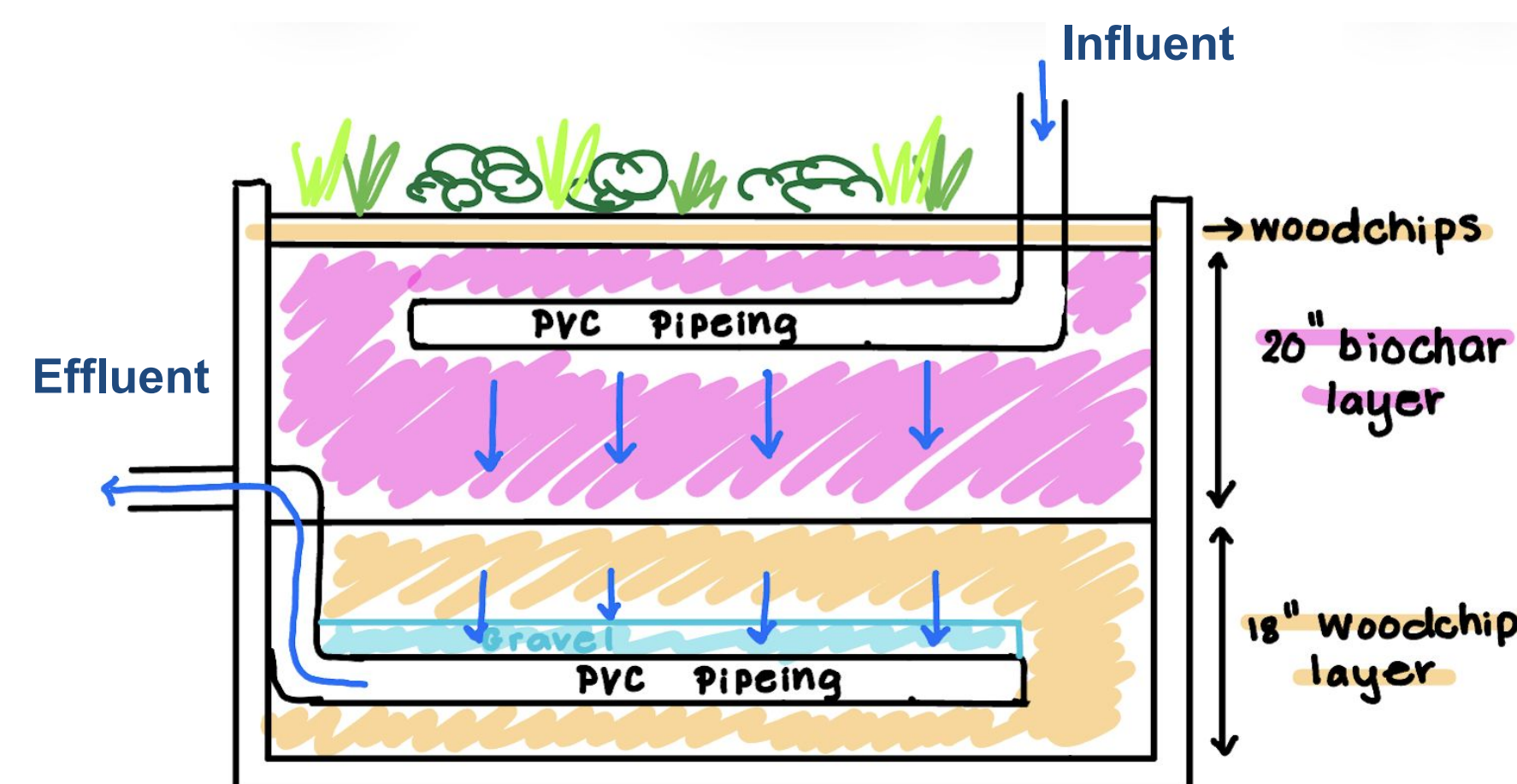


Design Specifics:

- Recirculating System (To create 2 passes)
- Solar panel powered pump to create loop
- Two compartment garden
- Simulated natural treatment processes through woodchip, gravel, biochar, and plant layers



CAD Drawings of Bioreactor Garden



Process Diagram of Bioreactor Garden

Sampling Results and Data Analysis

- While container issues limited our sampling, we were able to successfully conduct and extract one tap water, influent and effluent trial, which were then analyzed in the Civil and Environmental lab.
- Analyzed effluent for TSS, Phosphate, and Nitrogen
- **Results Discussion:**
 - Results do not reflect expectations.
 - Retention Time was likely too short to see effects
 - Biochar & Woodchips contain leachable nitrogen and phosphorus. When water is not retained for a long enough time, the nutrients can temporarily appear in the effluent.
- **Goals achieved:**
 - Reducing footprint of garden via implementation of biochar
 - Decrease weight by 90%
- **Next Steps and Future Recommendations:**
 - Using a mixture of sand and biochar rather than only biochar
 - Splitting garden in half rather than 1/3 & 2/3
- **Final Product and Deliverable:**
 - Documentation and media of model garden with recirculating system
 - Material list documenting material ratios

	Nitrogen mg/L	Phosphorus (mg/L)	TSS mg/L
Original	42.51	.5023	666.67
First Pass	101.1	7.528	666.67

Pictures to Include



Go With the Flow: development of hands-on, at-home fluid dynamics experiments

Team Members (alphabetical order by last name)



A. JAMES CLARK
SCHOOL OF ENGINEERING

The poster should contain the following four headings in 72 pt. type:

- Problem Definition
- Design Calculations and Analysis
- Final Design
- Test Results (and prototype)