The Dual-Siphon: a low-impact, modular solution for Liberty Dam in Maryland

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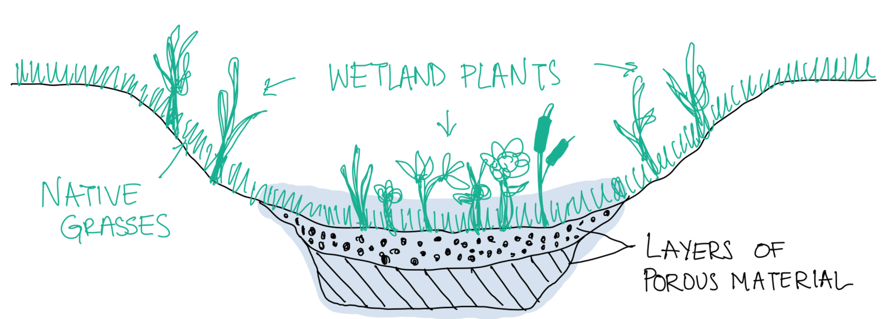
1 | Selecting Our Site

Through our research processes, we crafted these **criteria**:

- Can produce >1MW
- Low hazard potential
- Accessible to roads and the grid
- Minimal impacts on community + environment from powering
- In good condition

This led us to select **LIBERTY DAM** in Marriottsville, MD.

To address the risk of flooding, our co-development opportunity is a **green infrastructure bypass channel**.



Benefits:

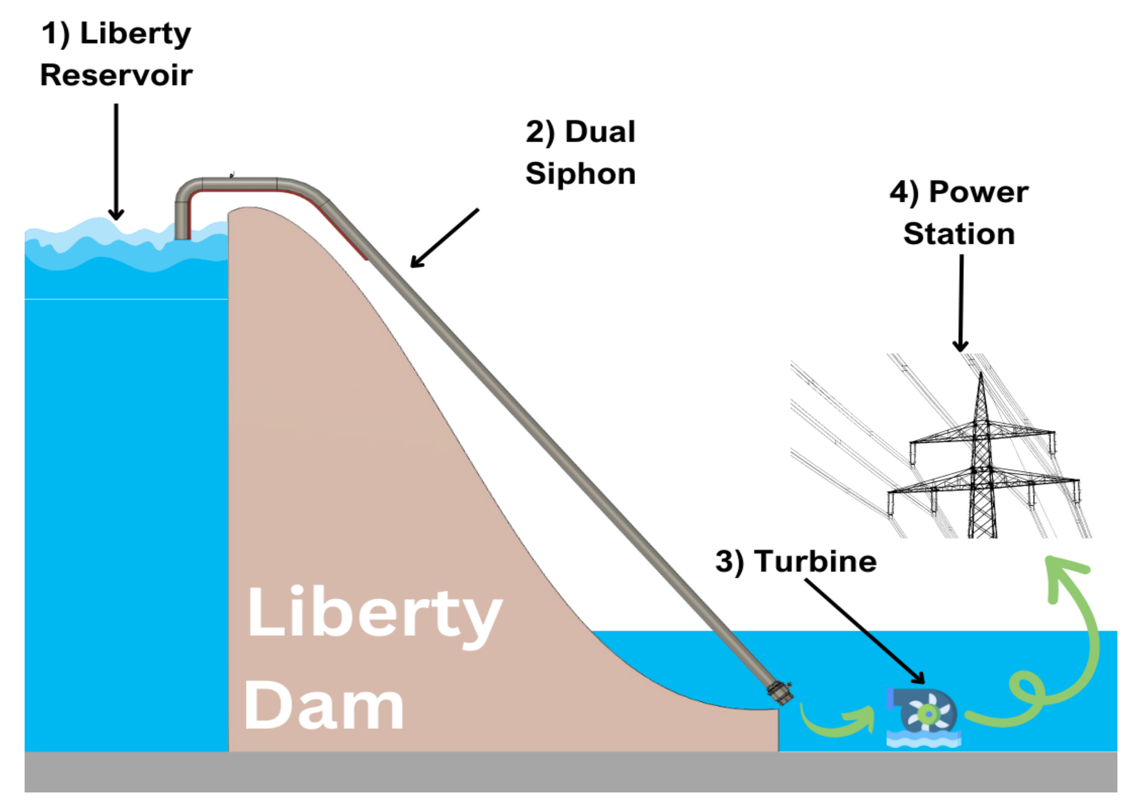
- Water to bypass dam in event of flood
- Landscape can absorb more water
- Sediment is removed from water
- Helps water quality
- Provides recreation opportunities

2 | Our Design Process

Our **design criteria** were influenced by the needs of Liberty Dam and current gaps we identified in hydropower innovation:

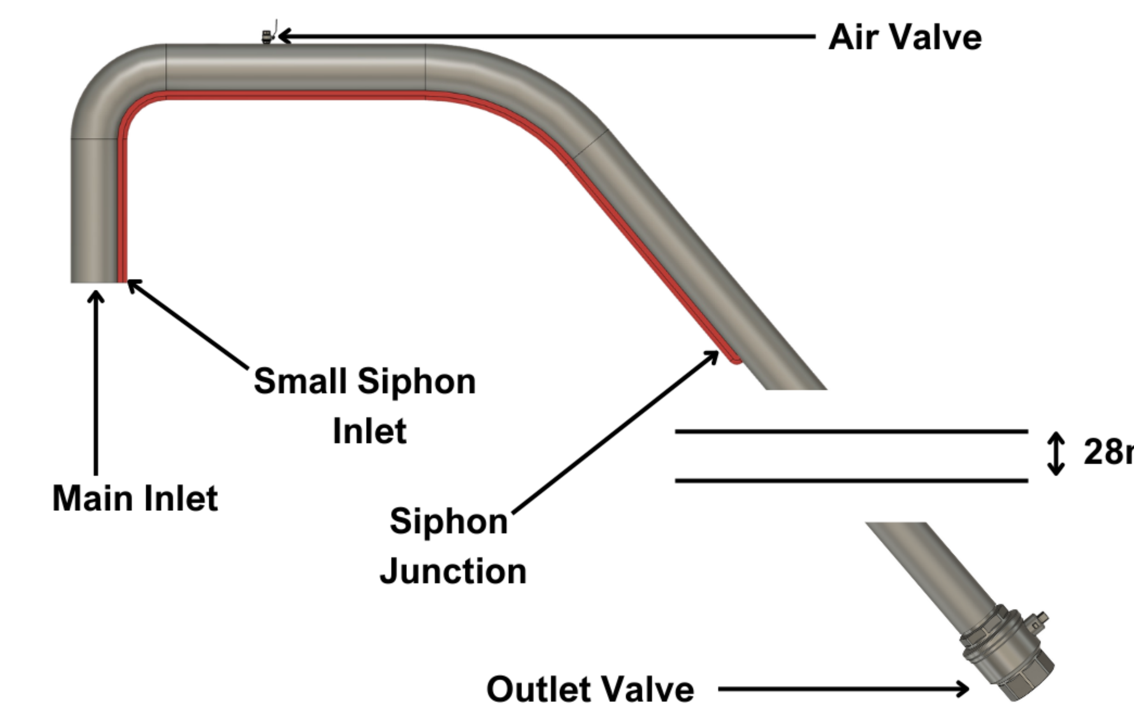
- Scalable at individual dams
- Implementable at other dams
- Does not compromise structural integrity
- Lower cost
- Minimal negative environmental impacts
- Helps to increase spillway capacity

These criteria led us to create the **Dual-Siphon System**, which brings water over the dam rather than necessitating drilling through, which is a costly and risky process.



3 | The Dual-Siphon

The siphon starts by using a smaller siphon, which means less power is required to start the system:



1. Small (red) siphon is started with a small pump
2. Small siphon fills large (grey) siphon with water
3. To start flow of water, outlet valve opens
4. Stored water falls out, generating suction force
5. Water pulled through main inlet starts siphon

4 | Implementing Our Design at Liberty Dam

Turbine: Kaplan Turbine with Fixed Speed Induction Generator
Small Siphon Diameter: 0.011 m (~7 minutes to fill large siphon)
Large Siphon Diameter: 0.61m
Pipe Wall Thickness: Schedule 20 / 12.7 mm
Pipe Material: A283 Grade D Steel

Large Siphon Diameter (m)	Flow rate (m^3/s)	Theoretical Power (kW)
0.203	0.35	82.46
0.305	0.90	185.52
0.610	**3.93**	**742.13**
0.914	10.11	1669.74
1.000	12.24	1997.05

Two dual siphons working in tandem create an estimated power generation of **1.48 MW**

Modular Two Dual Siphon Configuration (Using Scaled Down Prototype)

5 | Risk Analysis

Our FMEA analysis identified 3 major risks we plan on mitigating:

	Mitigation
Corrosion of pipes	Corrosion resistant heavy duty paint coating
Weight of siphon	Weight of siphon distributed over multiple load points with brackets
Water pressure on tubing	Carbon steel suited to withstand water pressure

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