

## Executive Summary

### *Background*

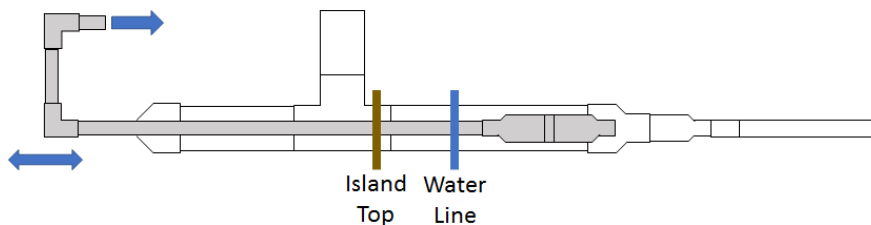
A typical trip to Lake Titicaca often includes a boat ride to the Uros Islands. These artificial islands are made of floating totora reeds. These fascinating structures provide stable land, but there is no easy way for the people of the Uros Islands to obtain water. Water is usually gathered by a bucket from the water around the island or they must take a boat to gather water from another part of the lake. Both tasks are time consuming and difficult. To reduce this burden, water pumps were developed. The pumps are easy to use and draw water from deep in the lake where there can be less contaminants. However, many of the pumps built in previous years have broken and some have not been repaired; therefore, there is a need for a better solution to draw water.

### *Project Definition*

Our project provides families with more efficient and reliable water pumps. Our objective is to improve the pump design to increase both durability and ease-of-use, while maintaining the low price of previous designs. This will provide the families with an easier and more reliable source of water and increase their time available for other endeavors.

### *Project Solution*

Our project resulted in a complete redesign of the previously used pumps: a pump that no longer relies on suction to lift the water. We instead used a direct lift force pump that removes the need for a seal. The valves were also redesigned to use a nylon bolt and marble to greatly increase their durability. Additionally, the number of parts required for the pipe was significantly reduced. Our final design can be seen in the images below (Figure 1 and 2).



*Figure 1: Simplified schematic of pump. Gray represents the inner section of pump. (Pipes not drawn to scale)*



*Figure 2: Final pump design as installed.*

The new pump can be broken down into two sections: the inner section and the outer section. The inner section is  $\frac{3}{4}$ " PVC pipe with a handle and hose at the top and a valve at the bottom. The outer section is 2" PVC pipe with a valve and  $\frac{3}{4}$ " PVC pipe at the bottom. As the inner section is lifted water fills the outer pipe through the outer valve and the inner valve closes,

keeping the water in the inner section. When the inner section is pushed down the outer valve closes keeping the water from flowing out and the inner valve lets the water in, pushing the water out the top of the inner section.

This design was selected as it allows for the easy gathering of water, in a durable and low-cost package. The major technical and social constraints that were considered and met with this design are shown below:

<b>Constraint</b>	<b>Ideal</b>	<b>Ours</b>
<b>Cost</b>	Inexpensive -- 110 soles for previous	106 soles
<b>Materials</b>	All available in Puno	All except marble and nylon screw
<b>Ease of Use</b>	Child can use it, no priming required	Child can use it, no priming required
<b>Durability</b>	Long-lasting	Expected to be long-lasting

These constraints show that the new design is an improvement for both those that have pumps and those that do not. This new design does not require priming, increasing the ease of use. Additionally, the seal was removed so it is no longer a point of failure and the valves have been redesigned to use more durable materials. Finally, the overall price of the pump did not increase. These improvements better meet the needs of the Uros Islands and will increase the ease-of-access to the water for the inhabitants.

### *Conclusions and Future Work*

We were able to successfully build and install nine pumps. This represents a good increase in the number of pumps available for use on the islands and the new design can be constructed very quickly. Some of the difficulties we encountered included: shopping in Puno, communicating while on the islands, and managing our limited time.

Our design was very effective in drawing water, but some owners complained that the water column was too heavy. We recommend reducing the length of the 2" pipe in future designs to reduce the column of water. Additionally, we did not include a handle in the original design, but this feature was requested so we added one in. This has not been tested so future teams could test the handle and suggest improvements there. Finally, the filter prevented the water from entering the pipe, so it was removed. A change in the design of the filter would be another good improvement to this project.

Although our design has room for improvement, we believe our project was, overall, a great success. By the end of the last day, nine pumps were installed, and we received positive feedback from each pump owner. We believe our project will be very useful because it is a much simpler and quicker way of obtaining water, and these pumps are expected to last significantly longer than previous designs.