Surface water-groundwater interactions between the Clubhouse Wetland and Bitterroot River: a preliminary investigation

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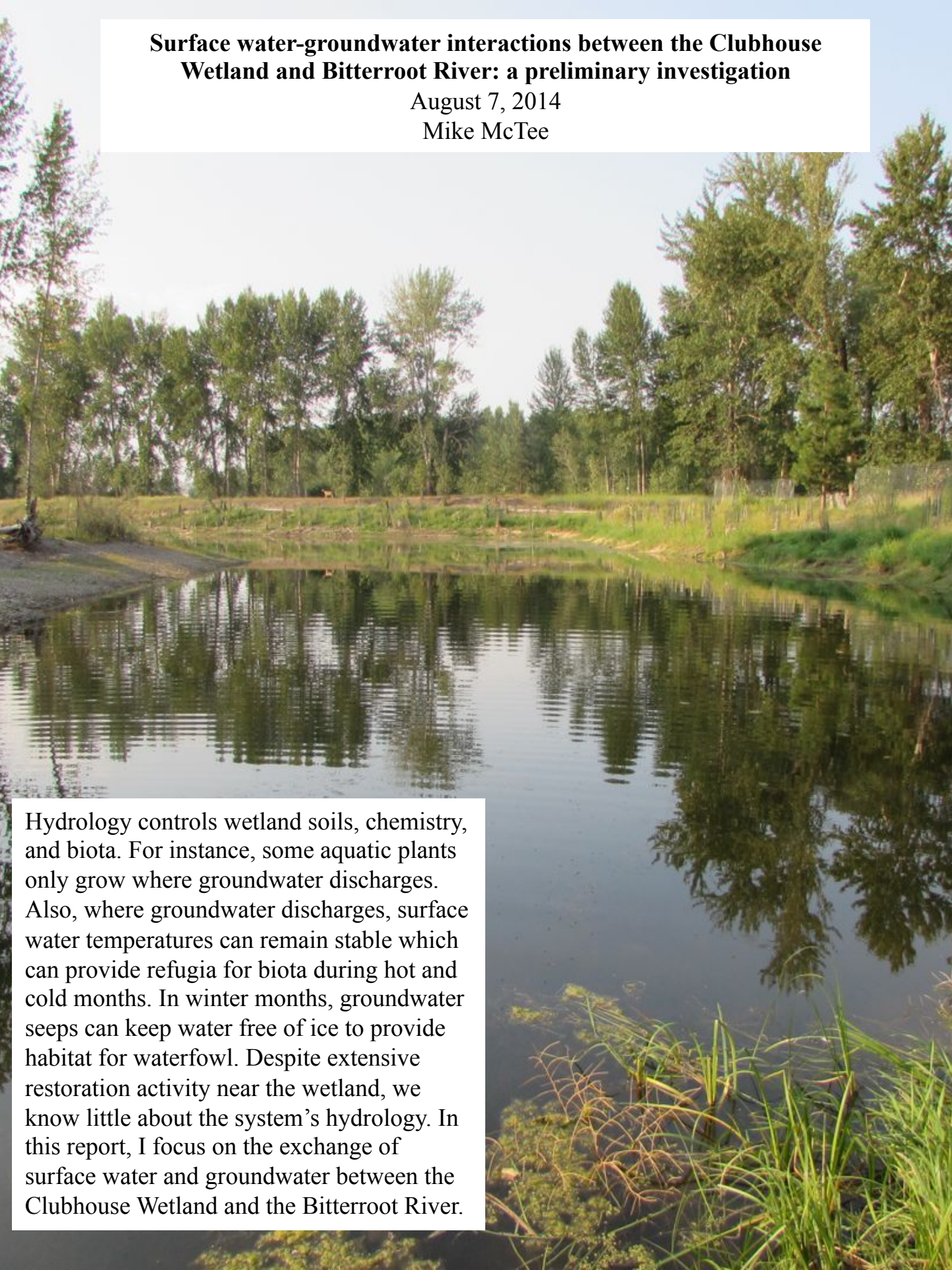
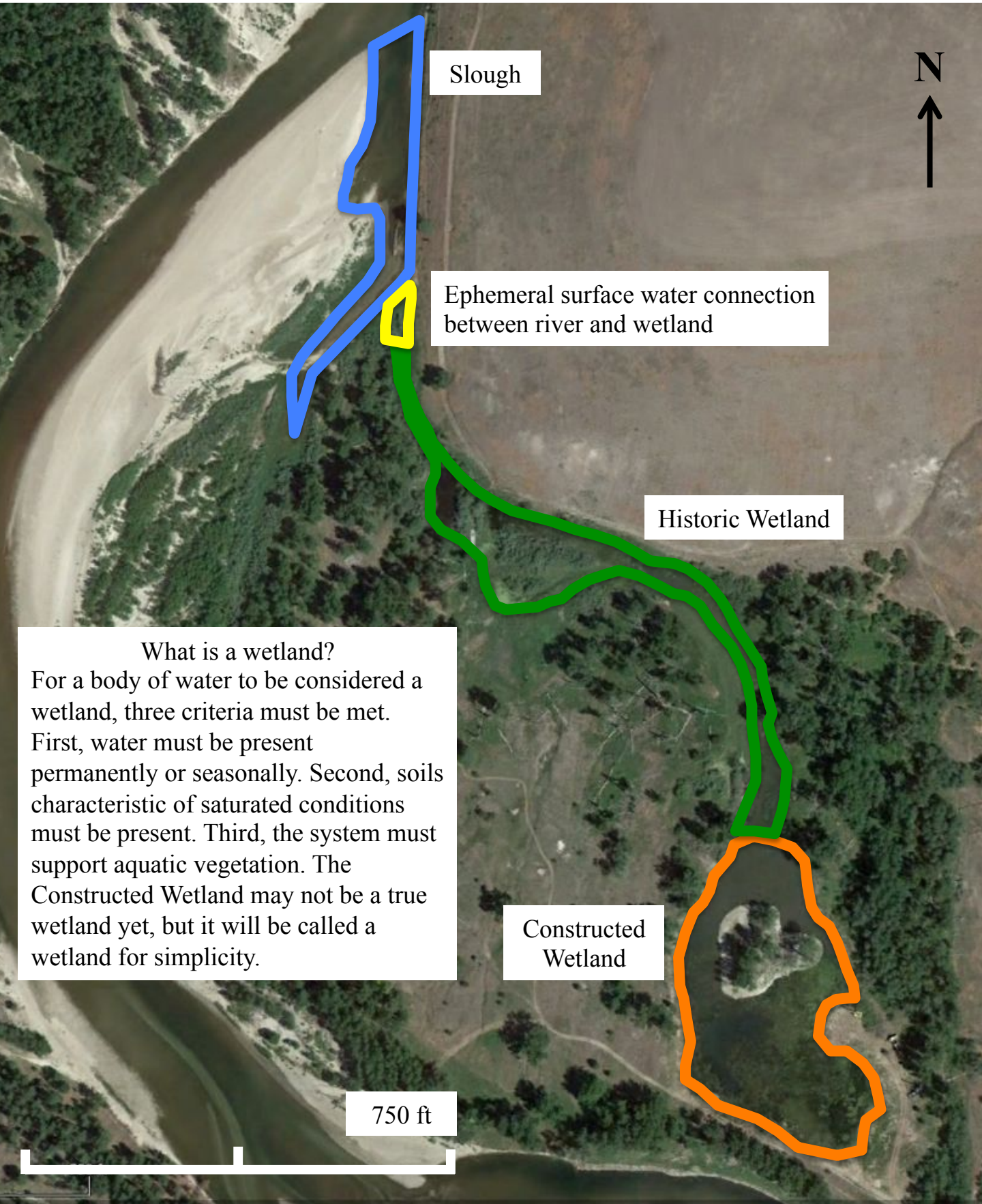


Hydrology controls wetland soils, chemistry, and biota. For instance, some aquatic plants only grow where groundwater discharges. Also, where groundwater discharges, surface water temperatures can remain stable which can provide refugia for biota during hot and cold months. In winter months, groundwater seeps can keep water free of ice to provide habitat for waterfowl. Despite extensive restoration activity near the wetland, we know little about the system's hydrology. In this report, I focus on the exchange of surface water and groundwater between the Clubhouse Wetland and the Bitterroot River.

The map shows the the study area. The “Constructed Wetland” and “Historic Wetland” compose the “Clubhouse Wetland”. The slough that empties to the river connects to the Clubhouse Wetland during spring runoff.



Piezometers

Piezometers can be cheaply installed ($2.50/instrument) to determine vertical hydraulic gradients of groundwater. Piezometers are an open ended pipe, usually perforated at the bottom (inset), that are driven into the sediments to a certain depth.

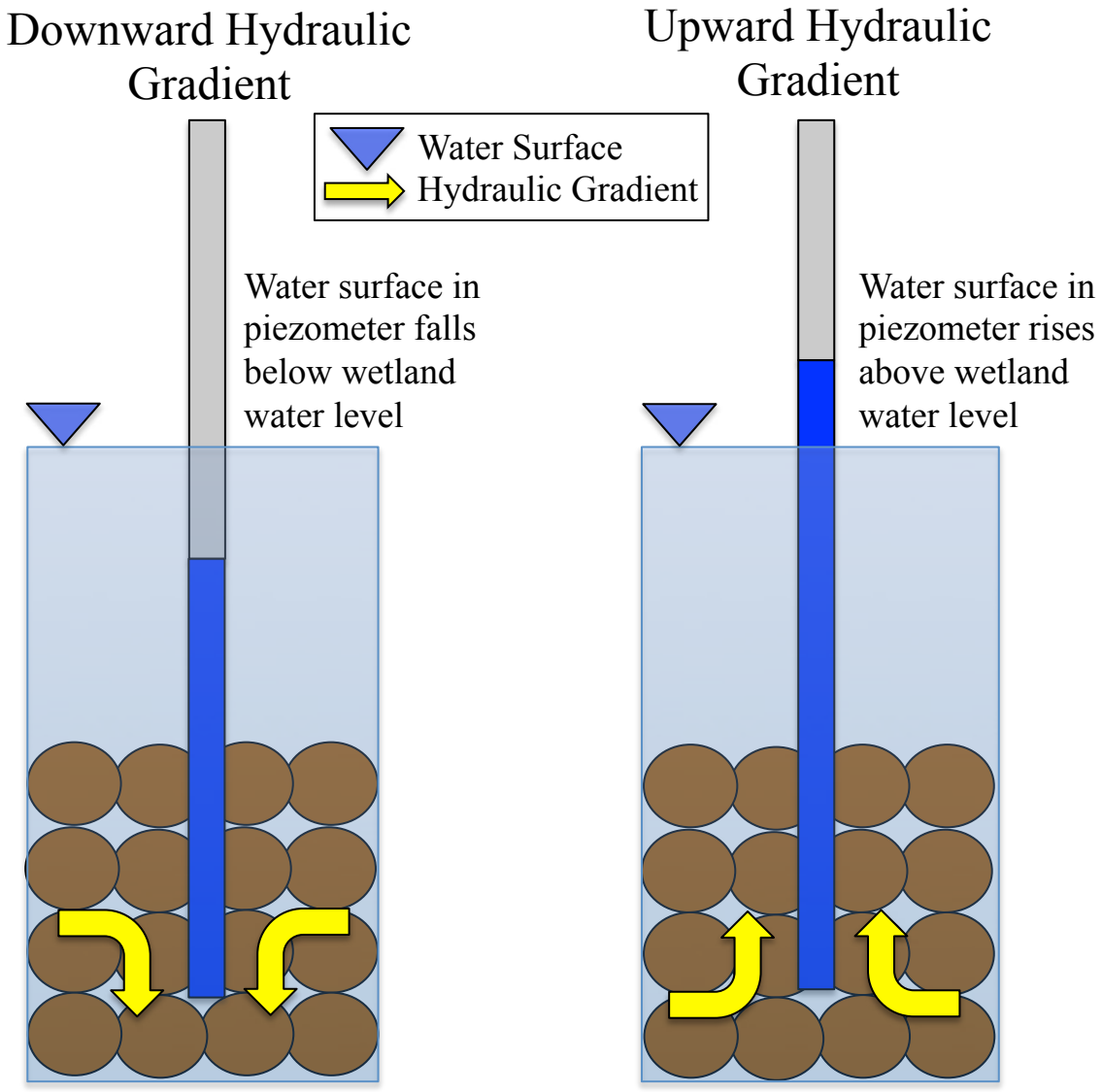
Piezometer Preparation and Installation

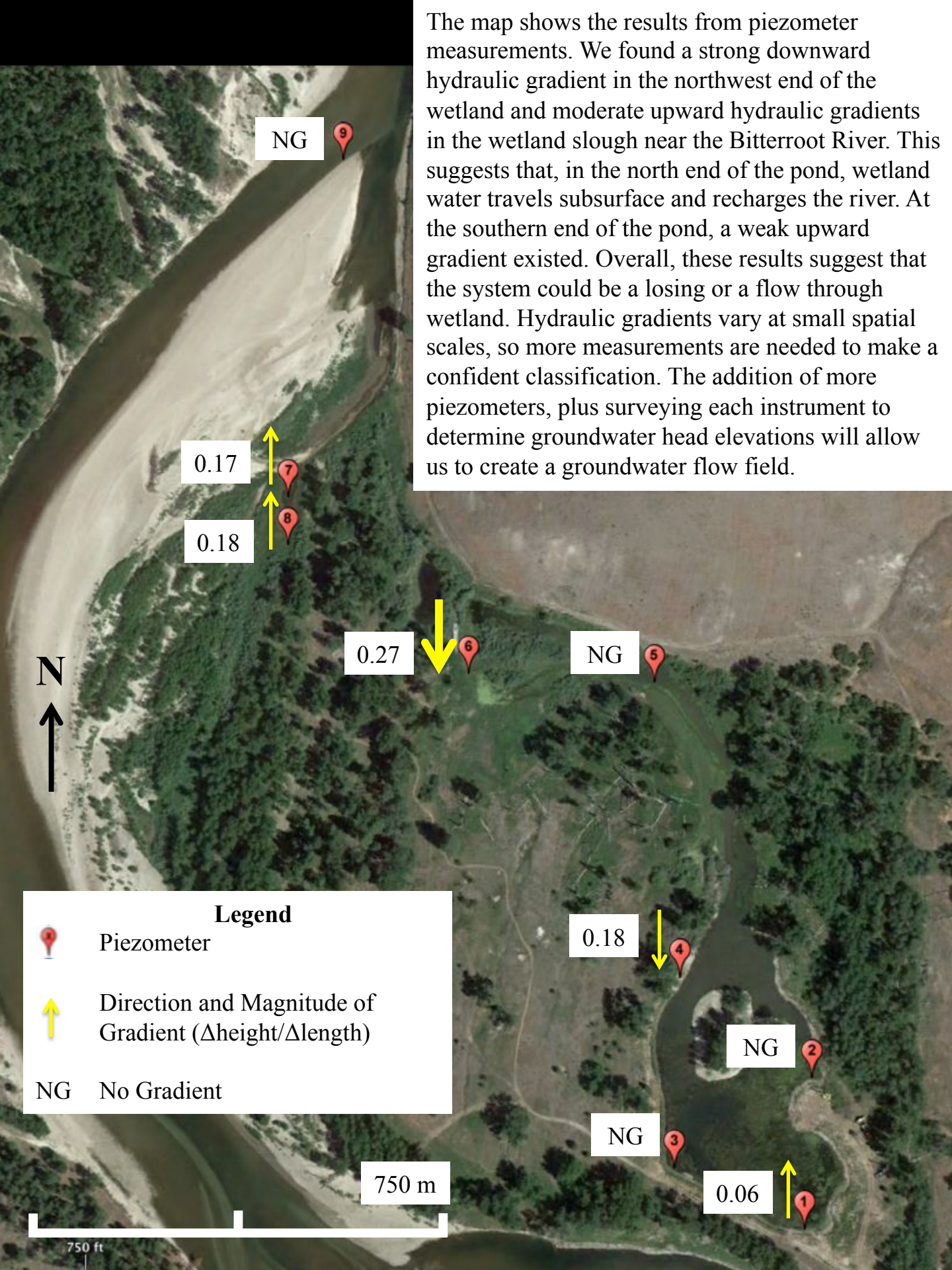
I cut half inch diameter steel pipes to five foot lengths and perforated the first five inches of pipe every 1.5 inches, starting at half an inch. Before installation, I inserted a bolt in the bottom of the pipe and taped it in place. The bolt allowed the piezometer to be driven into the sediment without the piezometer filling with debris. After installed, the piezometer was twisted to break the tape and lifted an inch to release the bolt.

Vertical Hydraulic Gradients

The water level inside the piezometer relative to the wetland surface water level reveals the vertical hydraulic gradient (below). Downward hydraulic gradients represent losing (downwelling/recharging) reaches, whereas, upward hydraulic gradients represent gaining (upwelling/discharging) reaches.

In the photo to the right, Chris prepares a water level probe. The probe can be inserted in the piezometer and the probe beeps when it touches water.





The map shows the results from piezometer measurements. We found a strong downward hydraulic gradient in the northwest end of the wetland and moderate upward hydraulic gradients in the wetland slough near the Bitterroot River. This suggests that, in the north end of the pond, wetland water travels subsurface and recharges the river. At the southern end of the pond, a weak upward gradient existed. Overall, these results suggest that the system could be a losing or a flow through wetland. Hydraulic gradients vary at small spatial scales, so more measurements are needed to make a confident classification. The addition of more piezometers, plus surveying each instrument to determine groundwater head elevations will allow us to create a groundwater flow field.

Water seeped from the bank that separates the Clubhouse Wetland with the Bitterroot River (top photo). This suggests that the north end of the wetland loses water, groundwater then travels northwest through the sediments, and discharges to the slough (bottom photo) connected to the river. Along the flow path, riparian vegetation can access water and nutrients lost from the wetland. Near this seep, we smelled a sulfur odor that suggested anoxic conditions. Strong redox gradients can exist where surface water and groundwater interact – this trait creates a complex chemical and biological setting.

Clear water can provide evidence of discharging groundwater. As groundwater flows through porous media, sediment filters out, so the discharge contains low levels of suspended sediment. We instrumented the source of this slough with two piezometers and found upward hydraulic gradients.

We placed a piezometer at the head of a riffle in the Bitterroot River before the Clubhouse Wetland slough drained to the river. Heads of riffles tend to lose water to the hyporheic zone – the subsurface zone where surface water mixes with shallow groundwater. We found no gradient. Piezometers sample a finite point in the system and so sometimes vertical hydraulic gradients go undetected.

Conclusions

These surface water-groundwater interactions are probably transient. During spring runoff, the main source of surface water in the Clubhouse Wetland may come from the Bitterroot River due to its surface water connection. From July–April, the wetland and river surface water remain disconnected, so inputs would come from groundwater inflow and precipitation. Further investigation into the hydrology of this system as it relates to ecological processes could guide future management decisions for the wetland.