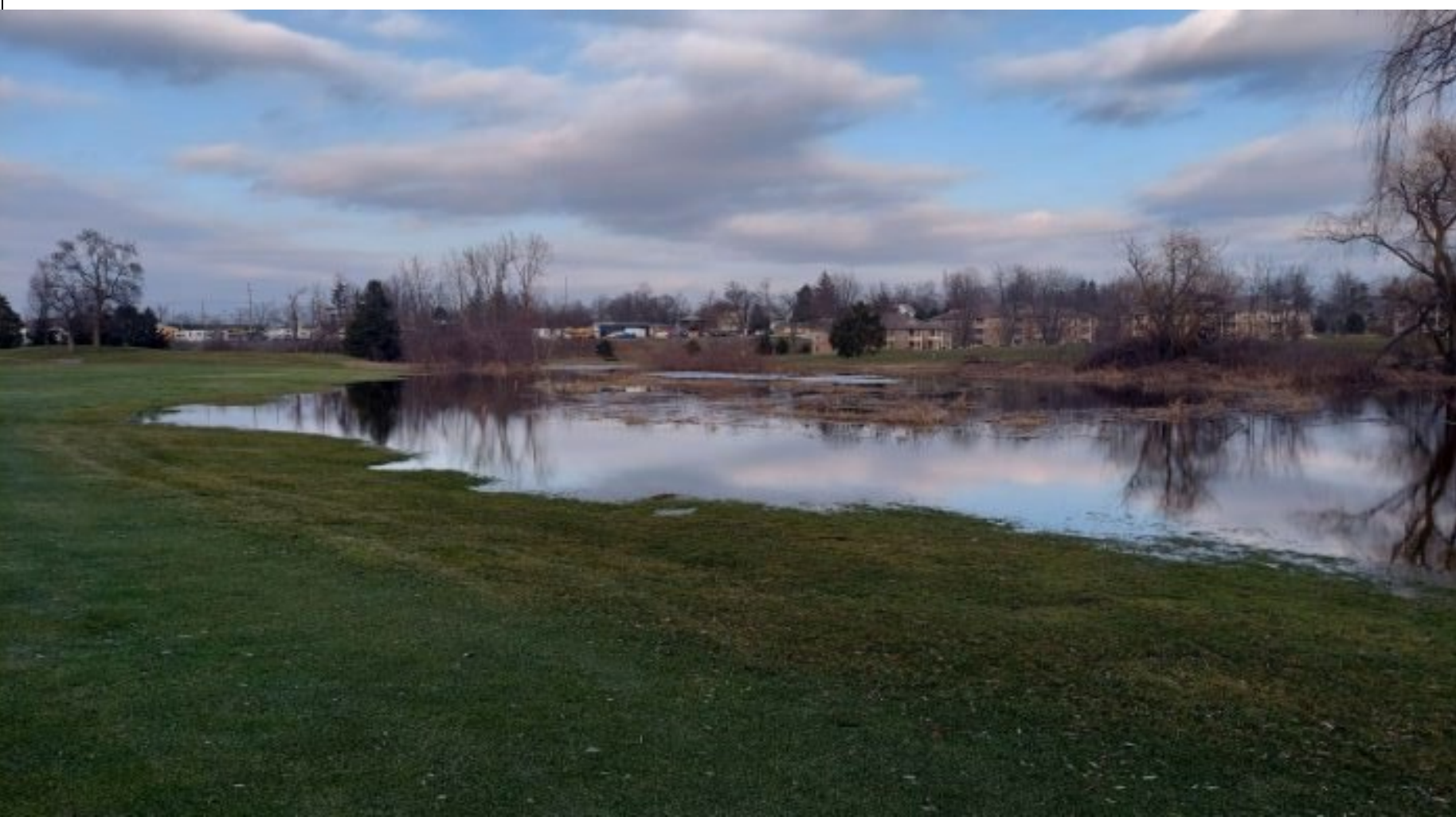


## EXISTING CONDITIONS

The pond on Hole 9 at Zollner Golf Course can't hold all the rainwater it gets during heavy storms. This causes the pond to overflow, flooding the fairway and making the area too wet to play. This happens often and makes the hole unplayable.



## GROUP MEMBERS

### AKKM Engineering

- Kevin Boncaro
- Mason Fritch
- Austin Smith
- Kameron Hill

(Left to Right)



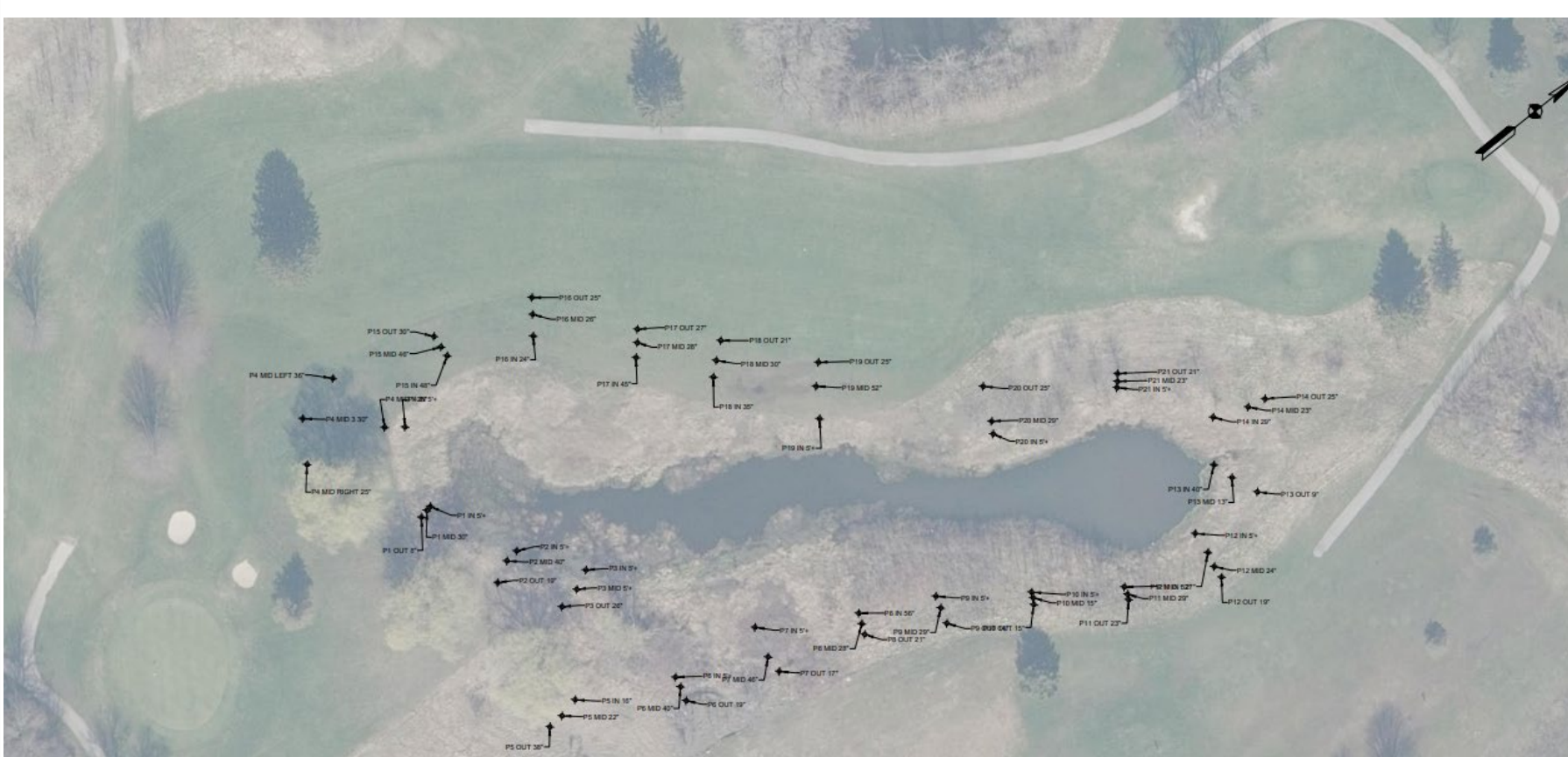
## PROPOSED SOLUTION

- Water Volume Calculation: We used TR-55 to calculate how much water the pond needs to store during heavy rainfall.
- Retaining Wall: We designed a retaining wall to keep the soil in place and prevent erosion around the pond.
- Overflow Structure: We created an overflow system with a pipe that directs excess water to a nearby water pit, preventing flooding.
- Rain Garden: We designed a rain garden near the tee box, where the ground is already wet, to help absorb and manage excess water.



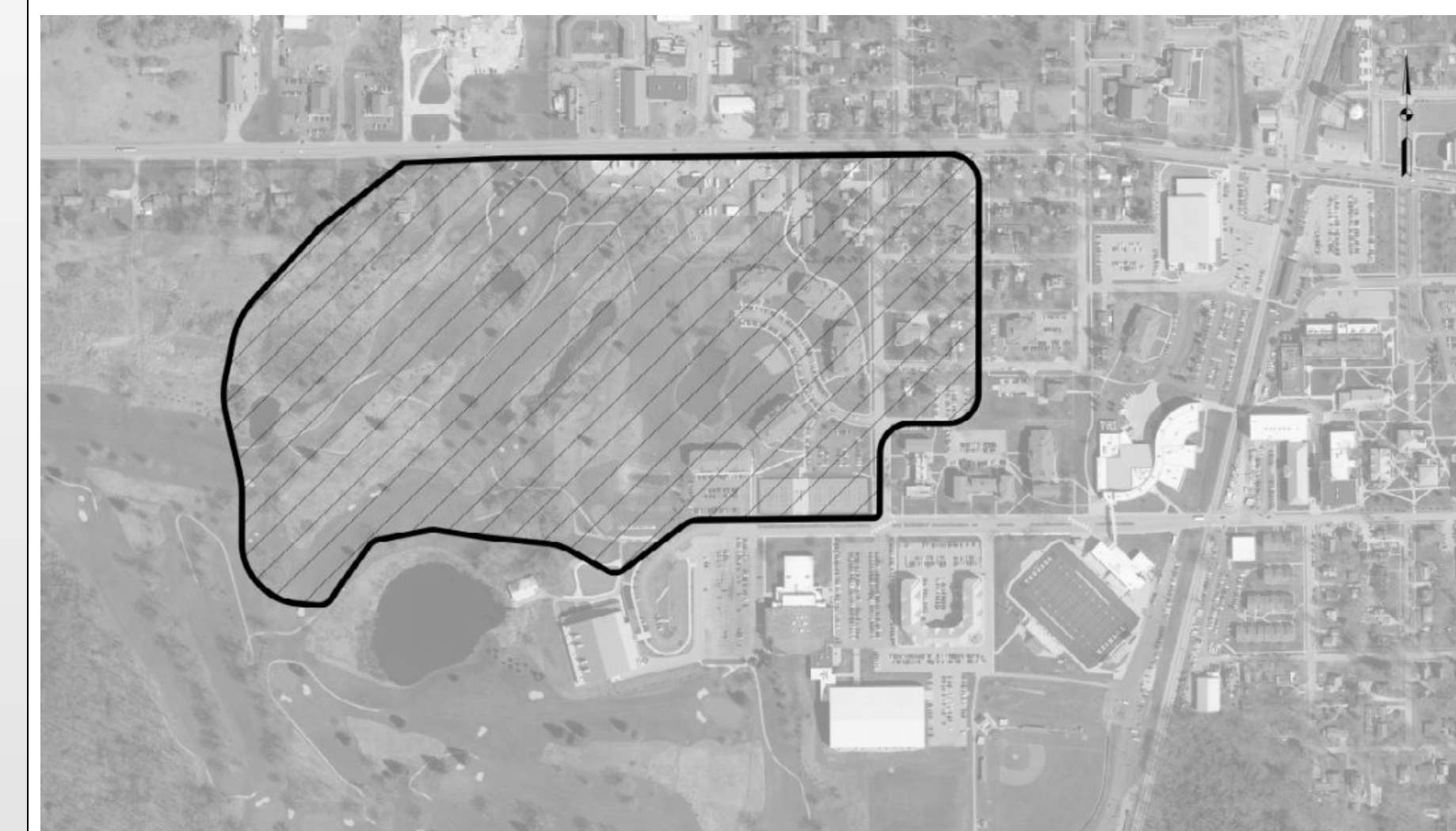
## DATA COLLECTION

The soil around the wetland is mostly Houghton muck, which doesn't drain well and causes flooding. We used muck probes and hand augers to test the soil, focusing on areas near the water. The tests showed deeper muck closer to the water. Results were confirmed with additional tests at specific locations.



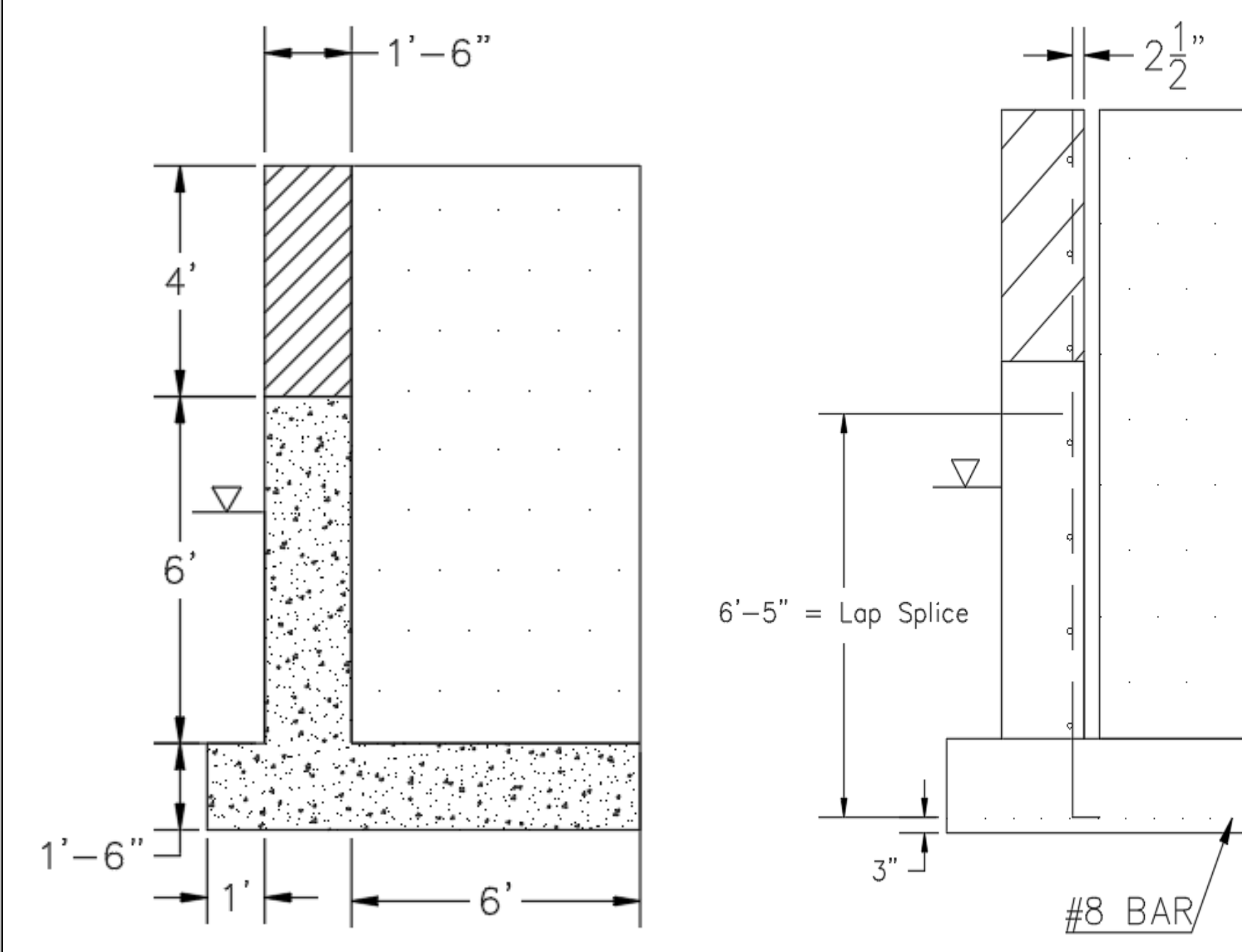
## WATER DELINEATION

To determine the pond's size, we first mapped the watershed that drains into the ponds on Hole 9 using topographical data and GIS software. The defined watershed is shown below and will guide the hydrological calculations for the pond's design and drainage system. From this area we found the water storage needs to be 567981 cubic feet.



## RETAINING WALL

The 10-foot-high reinforced concrete retaining wall shapes the new pond, designed to resist soil pressure, handle environmental loads, and blend with the surroundings. It has a base thickness of 1.5 feet, a 6-foot heel, and a 1-foot toe.



## SUSTAINABILITY

The Hole 9 Remodel focuses on sustainability by using native plants and locally sourced materials to support wildlife, reduce carbon emissions, and minimize maintenance. Alternatives were considered but were less eco-friendly. The project also enhances the community by prioritizing natural beauty and health-promoting features based on survey feedback, fostering inclusivity and well-being. Overall, the remodel addresses flooding issues while improving both the environment and the Zollner Golf Course experience for the long term.



## CONCLUSION

The Hole 9 Remodel at Zollner Golf Course focuses on improving water management, playability, and the overall aesthetic of the course. By addressing drainage issues, we used TR-55 to calculate water storage needs and designed a reinforced concrete retaining wall to shape the pond and resist soil pressures. An overflow structure was also implemented to manage excess water, while a rain garden helps absorb water near the tee box. Muck probes confirmed the presence of poor soil, guiding our design decisions. Sustainable materials and native plants support local wildlife, reduce environmental impact, and ensure minimal maintenance. The remodel, shaped by community feedback, enhances the course's functionality while promoting social well-being.