A Hydrogeophysical Investigation of the Shallow Sandy Aquifers in the Oak Openings Region of Northwest Ohio

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Background

- Northwest Ohio's Oak Openings region is responsible for shallow sandy aquifers which feed a unique ecosystem
- Sandy aquifers have not been clearly delineated
- Groundwater flux and contaminant transport not well understood

Research Questions

- What is the structure of the shallow sandy aquifer?
- How is water flowing within the sands?

Methods

Figures 1-3. Sandy soil core, GPR mobile device, and ERT device at the Stranahan Arboretum site during data collection

- Collected nine parallel colocated electrical resistivity (ERT) and ground penetrating radar (GPR) profiles at Stranahan Arboretum
- Soil cores were taken at areas where the sand was expected to be the thickest based on higher ERT values
- Conducted a sieve analysis on sand samples in order to estimate hydraulic conductivity of the sands using Shepherd's method

Geophysical Results

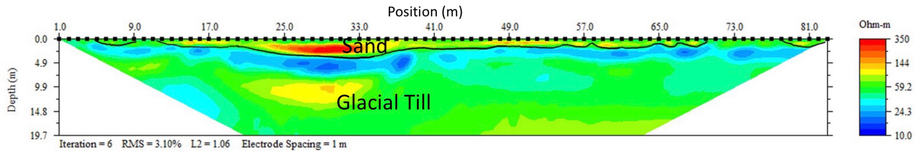


Figure 4. ERT Profile 2 example delineates the area of thick sand between ~10-40 m laterally and between 0.6-2.5 m depth with resistivity up to 350 ohm-m

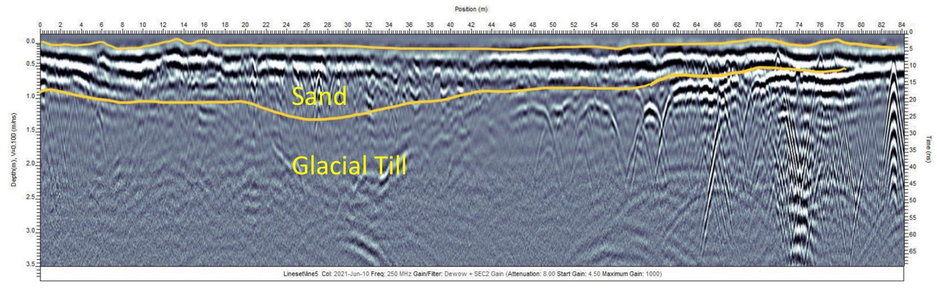


Figure 5. GPR Profile 2 example delineates the thinner, more disconnected sections of the aquifer

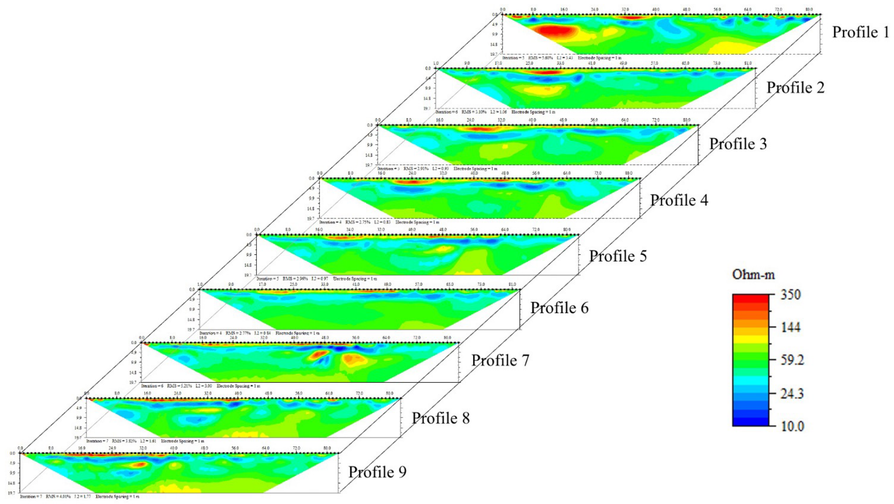
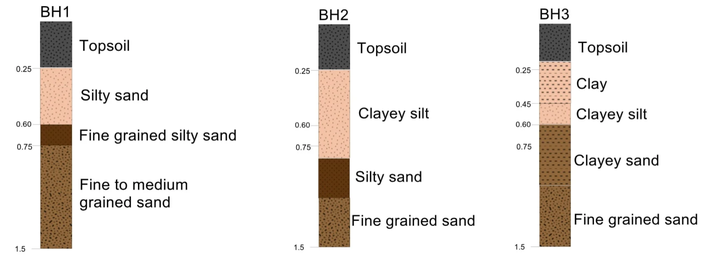


Figure 6. 3D model of all nine 2D ERT profiles which show that the sand extends laterally across all profiles with lower resistivity layers above and below it, suggesting lower permeability clayey or silty layers that could inhibit vertical contamination of the aquifer (confirmed by borehole log Fig. 7)

Grainsize Analysis and K Estimates



Figures 7. Borehole logs from Profile 9 at meter 18 (BH1), Profile 5 at meter 23 (BH2), and Profile 2 at meter 30 (BH3

Figures 8. Profile 2 example grain size graph (values between 0.285-0.33 m)

- K estimates range between 2.15-7.95 x 10^-4 m/s
- Higher K and associated transmissivity (T) values correlate with thicker sand lenses

Conclusions and Acknowledgments

- Sandy aquifer is somewhat discontinuous, with thicker sections between ~10-40 m and a maximum depth of 2.5 m
- Clayey and silty layers above and below the sandy layer could protect it from vertical contamination
- K and T values vary, with higher values associated with thicker sand lenses, which are thus more susceptible to contamination
- In the future, we plan to calculate more hydraulic properties and revise existing K estimates to improve groundwater modeling

This project was supported by a grant from the National Science Foundation Research Experiences for Undergraduates Site Grant, Addressing Environmental Challenges and Proposing Sustainable Solutions at the Lake Erie Land-Lake Interface (DBI-1852245) to the University of Toledo's Lake Erie Center, led by Dr. Jeanine Refsnider and Dr. Kevin Czajkowski. We thank Rachel Lohner and Brian Samson for logistical support. Thank you to Tony Tomalewski for photography and field work assistance as well.