USING MULTI-CHANNEL ANALYSIS OF SURFACE WAVES TO GUIDE, THEN EVALUATE THE RESULTS OF A ROAD STABILIZATION PROJECT IN A KARST SETTING

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A 100-foot section of a four-lane secondary road located in Montgomery County, PA has had a history of sinkholes and settlement related to karst located beneath the roadway. In February of 2021 a sinkhole formed near the roadway outside of, but adjacent to the zone where previous issues had been observed, pushing the planned repair of this section of roadway to emergency status.

As part of the design phase of the project, multiple geophysical and geotechnical methods were conducted to characterize the karst and soil conditions to aid in the designed of an extensive grouting program to stabilize the roadway. Although multiple methods, including Electrical Resistivity Tomography, Microgravity, Multi-channel Analysis of Surface Waves (MASW), Passive H/R Seismic, Ground Penetrating Radar (GPR) were conducted by either Schnabel Engineering or Temple University, only the MASW will be discussed here.

Four MASW lines were collected over the area of concern. The results showed a clear zone with lower velocity values that correlated with the historic and visible sinkholes. This zone was used to focus the grouting program, which consisted of more than 21,000 cubic feet of grout injected into over 400 grout holes. The holes ranged from 10-100 feet deep, with an average depth of 40 feet. Grout takes were measured as a function of depth in two-foot increments, giving a detailed dataset to compare to the MASW results. The overall zones of high grout take agreed very well with the zone of low velocity values observed in the MASW pre-grout results.

The same MASW lines were re-collected after completion of the grouting program in order to evaluate the grouting program. The results from this post-grout MASW survey show that the velocity of the subsurface increased by over 20%. The details about where this velocity increase was greatest will be discussed.