GIS-Based shoreline recession Analysis in the Great lakes and

Potential Applications to New York and New Jersey

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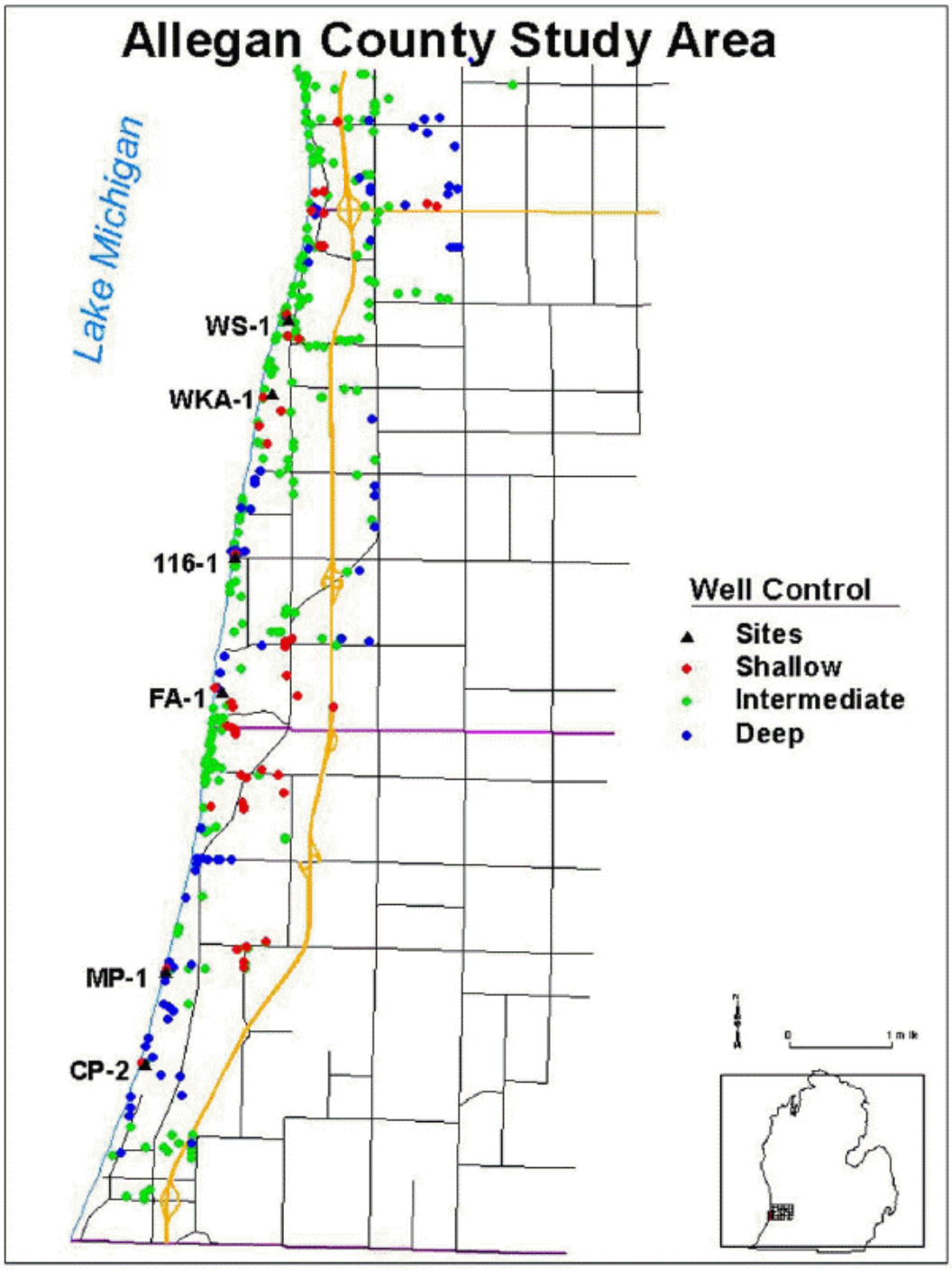
Geographic Information Systems (GIS) technology has been utilized in a variety of ways in order to analyze shoreline recession in glacial materials on the eastern shore of Lake Michigan in Allegan County, Michigan. Multiple data sets have been generated and evaluated with the help of GIS. Geologic and hydraulic head mapping was conducted using field observations and several hundred water well records. GIS was then used to characterize bluff geology and hydrogeology, which in turn led to production of a GIS-based preliminary hazard map (Montgomery et al.,1996).

Historical patterns of shoreline recession have also been determined with the help of GIS, through high-resolution registration and rectification of air photo mosaics from 1938, 1989, and 1996 (Montgomery et al., 1998). These patterns are coincident with mapped distributions of lithologic properties and hydrologic conditions as characterized in the GIS-based hazard map. Bluffs composed of interlayered sand and clay are particularly susceptible to failure and recession, whereas bluffs composed of all clay and all sand are somewhat less susceptible. Slope stability analyses (Bishop, 1955) were performed on study area bluffs with geotechnical data generated from undisturbed samples (Montgomery et al., 1997). Modeling results are consistent with field monitoring of bluff failure (Chase et al., in review), and they provide insight as to why particular lithologic and hydrologic combinations recede at different rates in the study area (Montgomery, 1998).

Certain coastal areas of New York and New Jersey may present an opportunity to apply this methodology to a new geographic area with a similar geologic setting. Long Island, Staten Island, and the New Jersey Atlantic Highlands contain cohesive, morainal Pleistocene glacial deposits similar to those found on the eastern shore of Lake Michigan. Results of geotechnical and stability analyses of fine-grained sediments in the Great Lakes (Montgomery, 1998) suggest that the environment of deposition and the history of glacial loading exert a profound influence on the ultimate shear strength of these materials, which in turn impacts recession rates. Similar determination of geotechnical properties and analysis of stability models developed for New York and New Jersey bluffs

will undoubtedly help shed light on failure mechanisms and produce further data concerning the complex glacial loading history of this area (Connally and Sirkin, 1973; Sanders and Merguerian, 1994).

Failure analysis on Staten Island is further complicated by the fact that fractured and cleaved Ordovician serpentinite underlies glacial materials and Mesozoic sediments. Pre-existing zones of weakness in this material may act as failure planes. Slope stability programs that can model these anisotropic conditions (Edris and Wright, 1992), in conjunction with the lithologic and hydrologic data mentioned above, may be required in order to accurately model and predict cohesive bluff failure in this setting.



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