BASIN-SCALE MODELING OF CO_2 SEQUESTRATION IN THE BASAL SANDSTONE RESERVOIR OF THE ILLINOIS BASIN—IMPROVING THE GEOLOGIC MODEL AND EVALUATING RISK TO GROUNDWATER

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Geologic carbon sequestration offers a viable solution for removing carbon dioxide from the atmosphere with the goal of mitigating climate change. The Mount Simon sandstone is the basal sandstone reservoir in the Illinois Basin. The Mount Simon is estimated to have 27 to 109 billion metric tons capacity, which is sufficient to store 88 to 360 years of current CO_2 emissions from the basin's stationary sources. To evaluate the feasibility of future, commercial-scale, geologic sequestration within the basin, a flow and transport model has been developed and is currently being refined as new geologic and hydrogeologic data become available. The goal of the numerical modeling effort is to evaluate the migration of injected CO_2 and assess the pressure changes in this open reservoir in response to future developments. Some key questions to be addressed by this effort are—What are the major trapping mechanisms at the basin scale? Will the resulting pressure increases negatively affect the natural gas storage operations currently utilizing the Mount Simon? Will fresh water resources at the basin periphery be affected by future geologic sequestration?

A basin-scale model has been developed using TOUGH2-MP. TeraGrid/XSEDE computational resources have been used to run this large (1.2 million elements) model. We are currently revising the geologic model (e.g., porosity, permeability, geometry) based on data collected from wells in Macon County. These wells provide detailed, modern data for a small portion of the basin and add to our geologic knowledge gleaned from approximately 20 stratigraphic test holes in the basin and from natural gas storage fields located throughout the basin. In addition, CO_2 injection will begin this year and should provide valuable flow data to improve our geologic model.

We will discuss how the CO_2 plume, pressure distribution and trapping mechanisms from commercial-scale geologic sequestration within the basin may be affected by an evolving geologic model. In addition, we will describe our approach to address the potential for affecting freshwater aquifers at the periphery of the basin.