McHenry County Project Background:

Hydraulic Conductivity:

Hydraulic conductivity (K) is a property describing how easy it is for a fluid to move through the pore space and fractures of rocks and soils. K is expressed in units of velocity. The variables that control the velocity of fluid through a specific medium is the intrinsic permeability of the material, the degree of saturation, as well as the density and viscosity of the fluid. the potentiometric surface of geologic units reflects the K over an area and can give insight as whether that area has impermeable or permeable strata. Moreover, hydraulic properties often vary over large areas and at varying depths, especially if the specific area has a complex geologic history.

In terms of McHenry County, K varies throughout the county because of the geologic history of the Quaternary materials and the bedrock. As stated before, the geology of the county consists of deeper bedrock units and more shallow Quaternary materials. Figure 6 shows a cross section of hydrostratigraphic units across McHenry county with interlaying aquifers and aquitards. To note, aquifers are units with high K and are capable of saturation, while aquitards have low K and are unsaturated. The deeper units of the county into the tilted basement consist of pristine aquifers with high K, used for potable water in the county. Wells are often screened through like the Ironton-Gainesville and Ancell Units, which are early Paleozoic in age. The Quaternary units in the shallow section of the county’s stratigraphy also show interlaying of saturated and unsaturated units. Units that are saturated with high K also have high recharge rates because they are unconfined. The unconfined aquifers like the Haeger-Beverly (H-B) and Yorkville-Batestown Units (Y-B) are made of sand and gravels from past glacial deposition. Unconfined aquifers have high recharge because of their high K and transmissivity but are susceptible to contamination. Toxic chemicals, like chloride, can leach downward through the soil into the groundwater.

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Figures 25 and 27 show north-south vertical cross sections of the geology across the county. The western part of the county in figure 25 shows that Tiskilwa Unit – an aquitard with low K – is prominent at the surface of the county. Low K means that recharge and chemical leaching rates will be lower in these units. On the other hand, the H-B and Y-B Units are prominent throughout the eastern part of the county. The units have high K and recharge rates because they are unconfined and at the surface. In particular, the eastern part of the county is where most of the municipalities and population is in McHenry County. Consequently, the high population density situated above the unconfined H-B and Y-B Units leads to an increase in aquifer vulnerability to surface contaminants like chloride.

As we will see, K plays a critical role in determining the zones of chloride infiltration in the MT3D model. First, the K of the resulting surface geology will dictate where and how quickly chloride can leach into the groundwater. Next, roads and municipalities throughout the counties are areas where there are high concentrations of road salt and chloride contamination. K spatially dictates the rate of chloride leaching across McHenry County.

Diagram

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Chloride Inputs:

The chloride inputs in the MT3D model consist of zones of different hydraulic conductivity (K). Different areas across the county will have different chloride leaching rates based on the amount of chloride deposited, as well as the geologic K. First, K is used to determine whether areas can have a higher or lower recharge rate. Then, we look at