

PROPOSED REGIONAL SYNTHESIS REPORTS

- Proposed start date later in Cycle II -

Ground-Water Status and Trends: Principal Aquifer Synthesis

Principal Aquifer:

Aquifer Name(s): Glacial Aquifers

Lead Contact: Kelly Warner

Proposed Report Title: Water quality of shallow aquifers underlying agricultural land in relation to sand and clay in the surficial glacial deposits

Scope: MAS and LUS data (special studies?) from glaciated areas of the United States; nutrients and pesticides (schedule 2010 and selected pesticide degradates)

Study Units: CNBR?, UMIS, EIWA, LIRB, UIRB, WMIC, WHMI, LERI, CONN, PUGT, HDBN, DELR, CCYK?, REDN, NECB

Time Period: 1991-present

Land Use(s): Agricultural

Inter-Regional Principal Aquifer Proposal? Yes/No: Explain: No

Constituents:**Expected Authors:**

Lead: Steve Kalkhoff, and Bill Morrow

Contributing: Steve Kalkhoff, and Bill Morrow

Objectives: The overall objective of this report is to document how different soil materials (sand, clay, etc) relate to the vulnerability of surficial glacial aquifers to contamination by nutrients and pesticides in agricultural areas. The objective will be accomplished by defining spatial variability of agricultural chemical contamination as it relates to differing surficial glacial deposits and by quantify the relations between nutrients and pesticides concentrations in different aquifer types (drift, valley fill, glaciofluvial, etc) with the thickness of overlying silt and clay.

Data Interpretation Approach and Feasibility: Nutrient and pesticide concentrations in ground water will be mapped to determine spatial differences that may be caused by lithological differences in shallow glacial deposits. Differences in glacial deposits will be quantified using lithological data obtained from driller's logs. Site-specific data from driller's logs will be correlated to STATSGO data to potentially extrapolate to areas where detailed NAWQA data are not available. Relations between nutrient and pesticide concentrations and soil types and or aquifer materials will be developed. The significance of water-quality differences

between aquifer types and depths will be tested using Chi Square analysis and or ANOVA or Kruskal-Wallis tests.

Number of Sites/Components (e.g., nutrients, pesticides): Nitrate, 3 or 4 most commonly used herbicides and their degradates, and other selected constituents such as chloride (a conservative constituent) collected as part of 12 study unit LUS and MAS's will be used to provide clues as to whether transport through soil and aquifer materials is physically or biogeochemical controlled. Since many of the currently used pesticides were developed and marketed during the last 40-50 years and since the use of chemical fertilizer has increased substantially from the early 1960's, dating of the water sampled using Tritium and CFC,s will allow us to determine if contaminant-free samples result from soil and aquifer material protecting the resource or from water infiltrating the aquifer before pesticides were used.

Methods: Standard graphical methods will be used to visualize spatial variability in nutrient and pesticide concentrations. Standard nonparametric statistical methods will be used to test the significance of nutrient and pesticide concentration differences among study areas, and aquifers. Ancillary data will be used extensively to better explain possible reasons for differences observed in agricultural chemical concentrations

Data Availability and Processing: Water quality data will be obtained from the NAWQA data warehouse and well construction and lithological data will be obtained from the USGS NWIS database. STATSCO soils data will be obtained from the USGS National Land Cover Characterization database (landcover.usgs.gov/natlandcover_2000.asp) State-wide fertilizer and pesticide use data will be compiled from the National Agricultural Statistics Service (NASS).

Staff Availability: Yes

Complexity: Low to medium. Approach is tried and true

Risks/Contingencies: Availability of soils data to evaluate composition of surficial material-information on full soil profile (unsaturated zone) may be difficult to determine.

Other Program Contacts: Compilation of data and interpretation of data will be in consultation with the Ground-Water Status and Trends Team; Pesticide and nutrient (Tom Nolan) National synthesis teams; and the NEET and ACT topical teams to make use of their expertise and to avoid redundant analysis.

Expected Outcome: The expected product is a USGS Scientific Investigations Report that will summarize most of the findings, water-quality results, and ancillary data. A journal article will highlight the most significant findings.

Why is this topic important to report on? This analysis will provide understanding of how agriculture, the major landuse in glaciated areas of the United States, affects the water quality of an important source of municipal and domestic water supply.

Documentation of the current status will form the basis for future studies evaluating the impact of new nutrient and pesticide criteria on ground-water quality.

Why does this topic need to be addressed now? Glacial aquifers are one of the major sources of water for industry, cities, and rural homeowners in the northern United States and thus there is a need to understand if this resource is being threatened, and if so, how. NAWQA has a decade of regional water-quality data that can be used to provide regulators, the public, and water-resource managers a large-scale perspective of intensive agriculture's impact on ground-water resources.

Why is it appropriate for this topic to be addressed by the USGS? NAWQA? This Regional Team? The USGS (NAWQA) program collected data to evaluate water quality in glacial aquifers regionally. The NAWQA glacial aquifer data set includes more pesticides measured at lower detection levels than most State and other Federal programs in the Midwest. The NAWQA program has been on the forefront of pesticide degradate investigations and now possess one of the most extensive datasets that can help understand pesticide transport and transformation.

Who cares and why?

Farmers -- need information and understanding to correctly apply pesticides to control unwanted vegetation and insects but not in excess amounts or on vulnerable areas that will contaminate ground-water resources. To assist farmers, Purdue University researchers are developing a Web based model that use site-specific variables such as soil type, weather and tillage practices to determine the risk for movement pesticides and nutrients in a field and soil profile. Purdue University agricultural engineer Bernie Engel's (<http://abe.www.ecn.purdue.edu/~engelb/>) efforts in computer modeling are creating the nation's first smart environmental regulations for ground-water contamination. For example, in Indiana alone, there are 90 major types of soil, each with its own characteristics of pesticide movement. Yet Engel's model indicates that 75% of detectable pesticides in groundwater come from 25% of farmland. It's these potential groundwater hot spots that create the greatest concern. Engel states "In effect we want to move away from blanket recommendations for herbicides and instead use the database to pinpoint specific rates to specific fields and areas".

Well owners -- Glacial aquifers are the source for much of the drinking water for domestic supplies and municipalities in the northern United States and additional understanding of the factors, such as permeability, texture, and organic content of the soil profile and unsaturated zone, that effect movement of nutrients and pesticides into and through aquifers are needed to develop ground-water models used by the U.S. Environmental Protection Agencies (<http://www.epa.gov/safewater/protect.html>) source water protection and States wellhead protection programs (Iowa example; <http://www.state.ia.us/epd/wtrsupply/iwpp/iwpp.htm>). The Wisconsin Department

of Natural Resources (<http://www.slh.wisc.edu/ehd/pamphlets/pesticide.html>) found that generally pesticides are a problem with private rather than community wells because private wells are shallower and often located near areas of pesticide use. Parts of central Wisconsin are especially vulnerable because of porous sandy soil and relatively heavy irrigation.

Other Federal Agencies - U.S. Department of Agriculture -- Documentation of the effects of soil permeability due to geological material on the transport of nutrients and pesticides to groundwater and eventually to nearby streams provides the U.S. Department of Agriculture information to quantify how their water-quality programs such as the Conservation Reserve Program (CRP's), Conservation Reserve Enhancement Program (CREP) and the Environmental Quality Incentive Program (EQIP) <http://www.fsa.usda.gov/dafp/cepd/crpinfo.htm> help agricultural producers protect environmentally sensitive land, decrease erosion, restore wildlife habitat, and safeguard ground and surface water.

Regulators (U.S. Environmental Protection Agency) - a number of pesticides are restricted use pesticides that can be applied only in areas where there is limited vulnerability for contamination. For example acetochlor containers carry the following instructions (<http://www.epa.gov/oppefed1/aceto/regagree.htm>). This chemical demonstrates the properties and characteristics associated with chemicals detected in ground water. The use of this chemical in areas where soils are permeable, particularly where the ground water is shallow, may result in ground water contamination. Information on pesticide occurrence in shallow glacial aquifers and its relations to soil properties will allow the EPA to decide if label instructions are sufficient to protect ground-water resources.

Selected References:

Budget: Preliminary Budget - see spreadsheet

FY 2004:

FY 2005: