DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

Prepared in cooperation with the
MICHIGAN DEPARTMENT OF NATURAL RESOURCES,
GEOLOGICAL SURVEY DIVISION and KALAMAZOO COUNTY

WATER-RESOURCES INVESTIGATIONS REPORT 90-4028
PLATE 3

GENERALIZED SUSCEPTIBILITY OF GROUND WATER TO CONTAMINATION IN KALAMAZOO COUNTY, MICHIGAN.

USE AND DEVELOPMENT OF THIS MAP

This study defines, "ground-water susceptibility" as the ease with which a contaminant can be transported from the land surface to the water table.

The composite map of susceptibility of ground water to contamination can be used by county and local officials when deciding where they should more closely study land-use effects on ground water. The composite map can be combined with other planning tools such as land-use maps, ground-water quality data, and contamination source information to help make sound ground-water management and land-use decisions. Data for this composite map identify relative areas in the county which are more likely to be susceptible to ground-water contamination; the map does not show areas that will be contaminated, or areas that cannot be contaminated.

The map was developed using the U.S. Environmental Protection Agency Agricultural DRASTIC system. This system uses a standardized method for evaluating ground-water contamination potential using geohydrologic settings. Seven geohydrologic factors which affect and control ground-water movement are mapped.

Each DRASTIC factor is divided into either ranges or significant media types that have an effect on pollution potential. Then, each range has been assigned a rating which varies between 1 and 10. The most significant factors having a rating of 10, the least significant, a rating of 1. Each DRASTIC factor also is assigned a relative weight ranging from 1 to 5. The most significant factors have weights of 5, the least significant, a weight of 1. DRASTIC index values equal rating multiplied by weight.

These DRASTIC index maps include Depth to water, net Recharge, Aquifer media, Soil media, Topography, Impact of the unsaturated zone, and hydraulic Conductivity of the aquifer; thus forming the acronym DRASTIC.

Each of the seven Agricultural DRASTIC index maps were digitized and gridded. The seven gridded data sets were overlaid and combined forming a composite grid of DRASTIC index values. DRASTIC index values from less than 125 to greater than 200 were then contoured to reflect areas that are more likely to be susceptible to ground-water contamination. The high scores represent areas that are more susceptible to contamination. The seven DRASTIC index maps that were used in this study are explained below.

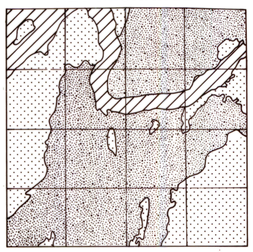
D DEPTH TO WATER

AGRICULTURAL DRASTIC INDEX

Map unit	Range (feet)	Rating	Weight	Value
	> 100	1	5	5
	75-100	2	5	10
	50-74	3	5	15
	30-49	5	5	25
	5-29	8	5	40
	0-4	10	5	50

The depth to water determines the quantity of material through which a contaminant must travel before reaching the water table. Depth to water partially controls time of travel and opportunity for decomposition of the contaminant. The longer the time of travel the smaller the potential for ground-water contamination. This map shows where the water table ranges from zero to greater than one hundred feet below land surface.

R NET RECHARGE

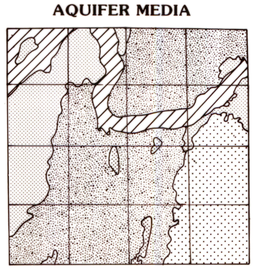


AGRICULTURAL DRASTIC INDEX

Map unit	Range (inches)	Rating	Weight	Value
	< 7	6	4	24
	7-10	8	4	32
	> 10	9	4	36

Net recharge is the quantity of water that penetrates the land surface and reaches the water table. This water is available to transport contaminants vertically to the ground-water system. Therefore, the greater the recharge, the greater the potential for ground-water contamination. Average recharge rates were assigned to the five surficial geology types based on ground-water runoff to the streams. Net recharge rates varied from greater than 10 inches in areas underlain by outwash, to less than 7 inches in areas underlain by moraines and till plain.

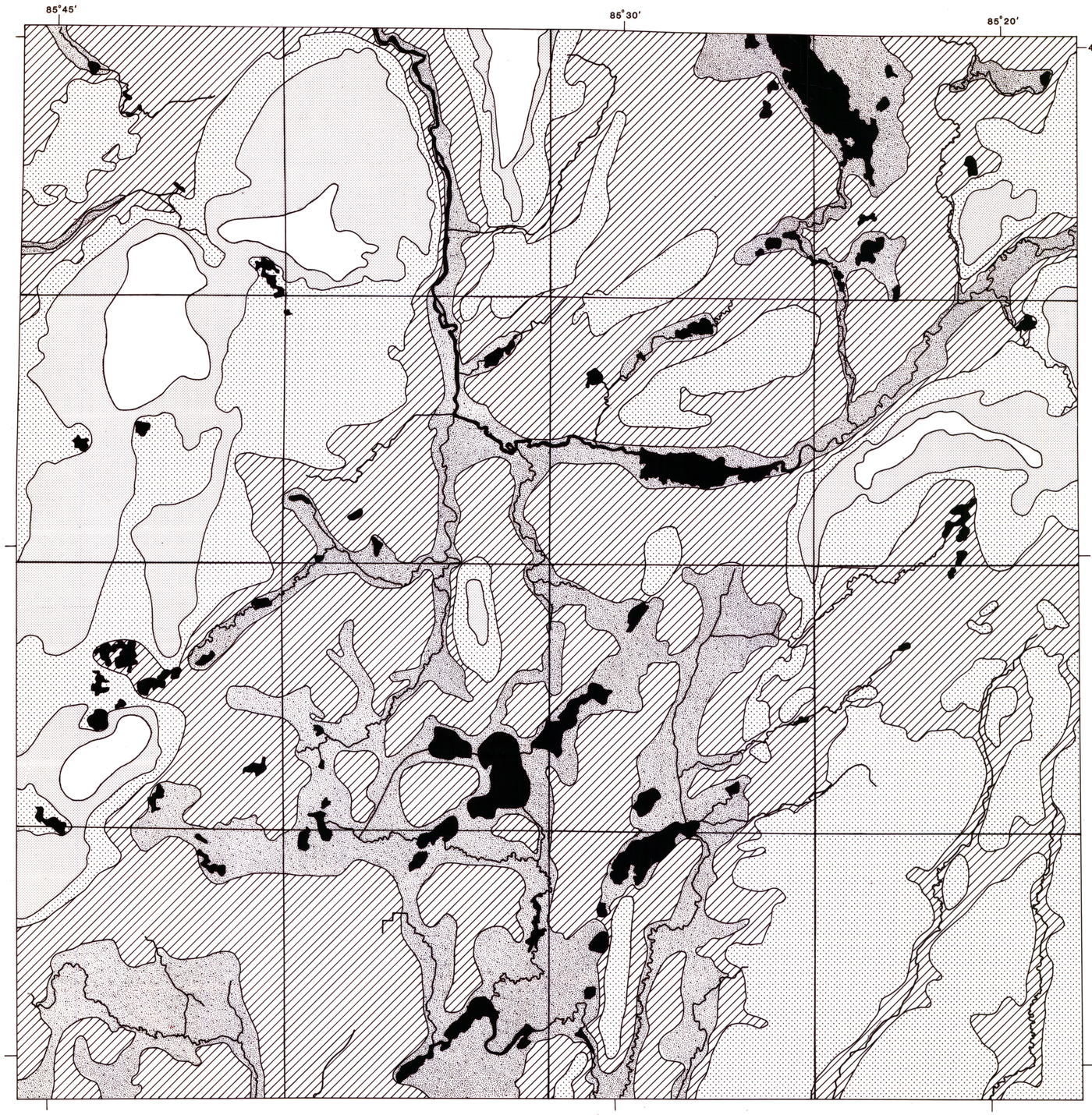
A AQUIFER MEDIA



AGRICULTURAL DRASTIC INDEX

Map unit	Range (Sand and gravel)	Rating	Weight	Value
	Moraine	6	3	18
	Till or outwash over till	7	3	21
	Glacial drainage channels	8	3	24
	Outwash	9	3	27

Aquifer media in the county refers to the unconsolidated material (such as sand and gravel) that will yield sufficient quantities of water for use. The makeup of the media partly controls the aquifer. In general, the larger the grain size, the greater the permeability, and, consequently, the faster the contaminant can spread. The five surficial geology types were categorized based on their varying quantities of fine material present. The cleaner and more coarse grained the surficial deposits, the greater the potential for contamination of the shallow aquifers.



Base from U.S. Geological Survey 1:62,500 quadrangles

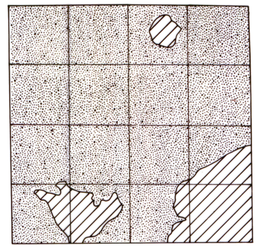
0 1 2 3 4 MILES
0 1 2 3 4 KILOMETERS

EXPLANATION

AGRICULTURAL DRASTIC INDEX VALUES

- Less than 125
- 126-150
- 151-175
- 176-200
- Greater than 200
- Water

S SOIL MEDIA

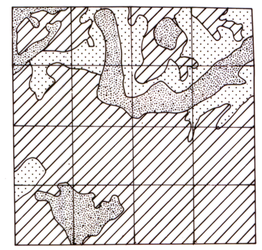


AGRICULTURAL DRASTIC INDEX

Map unit	Range	Rating	Weight	Value
	Loam	5	5	25
	Sandy loam	6	5	30

Soil media is defined as the upper weathered zone of the earth, which averages three feet or less. This is the first material through which most infiltrating water and contaminants pass en route to the water table. The soil zone can control the rate of movement, filtration, biodegradation, sorption, and volatization of contaminants. In general, the ability of a contaminant to move through the soil zone is largely affected by the clay content of the soil. Permeable soils with coarse textures are the most susceptible to infiltrating contaminants. Eight soil types were grouped into two catagories based on the quantity and type of clay present. Six soil types were categorized as sandy loam, and two soil types were categorized as loam.

T TOPOGRAPHY

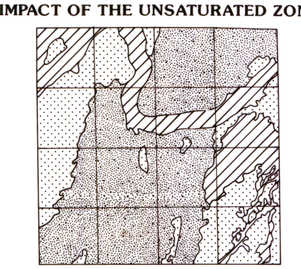


AGRICULTURAL DRASTIC INDEX

Map unit	Range (Percent slope)	Rating	Weight	Value
	7-12	5	3	15
	2-6	9	3	27
	< 2	10	3	30

Topography is defined as the slope variability of the land surface. The degree of slope of the land controls the likelihood that a contaminant will run off or remain on the surface in one area long enough to infiltrate. Therefore, the less slope, the more infiltration, and the greater the potential for contamination. Eight soil types were grouped into three categories based on their percent slope, identified by the U.S. Department of Agriculture, Soil Conservation Service. Three were classified as 0 to 2 percent slope, four as 2 to 6 percent slope, and one as 7 to 12 percent slope. The 0 to 2 percent slope area has the greatest susceptibility.

I IMPACT OF THE UNSATURATED ZONE

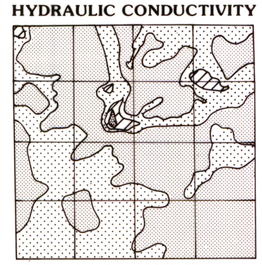


AGRICULTURAL DRASTIC INDEX

Map unit	Range (Sand and gravel)	Rating	Weight	Value
	Moraines or till	6	4	24
	Glacial drainage channels or outwash over till	8	4	32
	Outwash	9	4	36

The unsaturated zone is defined as the zone between the soil media and the water table. Infiltrating water must pass through this material en route to the water table. Therefore, like the soil media, the unsaturated zone aids in the biodegradation, neutralization, mechanical filtration, and dispersion of contaminants. In general, the effect of the unsaturated zone largely is related to the grain size of the material and the quantity of clay present. The five surficial geology types were grouped into three categories based on mixtures of sand- to gravel-sized particles and quantities of fine materials. The larger grained, well-sorted, sand and gravel deposits of the outwash plain are the most susceptible to infiltrating contaminants.

C HYDRAULIC CONDUCTIVITY



AGRICULTURAL DRASTIC INDEX

Map unit	Range (Gallons per day per square foot)	Rating	Weight	Value
	< 100	1	2	2
	100-299	2	2	4
	300-699	4	2	8
	700-999	6	2	12
	1,000-2,000	8	2	16
	> 2,000	10	2	20

Hydraulic conductivity is defined as the ability of the aquifer materials to transmit water which, in turn, controls the rate at which ground water will flow under a given hydraulic gradient. The rate at which ground water flows also controls the rate at which contaminated ground water moves away from the point at which it enters the aquifer. The ranges in hydraulic conductivity, as defined in the DRASTIC system, have been determined based on greater hydraulic conductivities have greater contamination potential. This map shows where the hydraulic conductivity ranges from less than 100 to greater than 2,000 $[(gal/d)/ft^2]$ gallons per day per square foot.