SOILS OF ADAMS COUNTY AND THEIR ABILITY TO ATTENUATE CONTAMINANTS

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Introduction

Soils usually compose only the upper 2 to 4 feet of unconsolidated materials at the earth's surface. Soils are the basis of agricultural production; they provide the foundation for buildings and roads; and, if properly used, they aid in the treatment and recycling of wastes from homes, from the production of live-stock and poultry, and from municipal and industrial sewage treatment plants. Soil characteristics (depth, texture, and permeability) are among the most significant factors that determine the rate and extent of groundwater recharge and the degree of natural protection against contamination. Land characteristics such as slope, vegetation type, and type of rock will, in conjunction with the soil, determine the overall potential of the environment to protect groundwater.

The modern landscape in Adams County has been shaped by deposits from the last major ice sheet to invade southern Wisconsin. The terminal moraines that mark the farthest advance of the ice lie generally to the east, although they do cut across the southeastern corner of the county. Behind them, soils are formed in coarse-textured tills, which are poorly sorted glacial deposits of sand, stones, and boulders.

As the ice melted, tremendous volumes of water carried off gravel, sand, silt, and clay, which were deposited in streams or lakes or, in the case of the finest particles, transported many miles away by the moving water. Much of Adams County was a large lake basin filled with sand-sized materials. Following the final disappearance of the glacier and before the land surface was stabilized by vegetation, much of that surface was extensively reworked by wind, which left sandy coverings on upland surfaces and a landscape covered with sand dunes that vary widely in relief.

Many factors influence the type of soil that develops in an area: the parent material from which the soil formed, relief, climate, natural vegetation, drainage, and the time that the soil has had to form. Over most of Adams County, soils are formed in sands that were either deposited by water or wind. Some soils have developed in alluvial deposits (flood plains), in till, and in organic materials (muck).

For mapping, classification, and interpretive purposes, soils are grouped into soil series on the basis of similar physical and chemical characteristics, type of parent material, and arrangement of horizons or layers. A grouping of individual soils based solely on physical and chemical characteristics is required to evaluate the potential of soils for attenuating contaminants. An evaluative system was developed to assess those soil properties that play a role in the attenuation of potential groundwater contaminants resulting from land-use activities.

Capacity of soils to attenuate pollutants

Attenuation is a series of complex processes, all of which are not clearly understood. During attenuation, the soil holds essential plant nutrients for uptake by agronomic crops, immobilizes metals that might be contained in municipal sewage sludge, or removes bacteria contained in animal or human wastes. The soil is an integral part of the natural protection of groundwater from surface-applied contaminants.

However, the natural purification capacity of the soil, like that of any other natural resource is limited, and sometimes soils that retain contaminants may themselves become contaminated. Cleaning contaminated soil can be as difficult as cleaning contaminated groundwater. The evaluation system presented here must be looked upon as a supplemental planning tool only, as a time- and cost-saving guide for preliminary screening of the county for areas sensitive to the impact of normal land-use activities. This soil-potential map does not replace the need for detailed on-site investigations. It does, however, reduce the number of areas to be studied in detail by identifying the areas of best and least attenuation potential. Local details have been generalized to fit the mapping scale, which cannot accommodate small local variations in soil characteristics.

This system evaluates the ability of the soil solum (the A and B horizons) to attenuate potential contaminants resulting from activities above or within the soil zone. The soil attenuation capacity is considered here only in general terms and is not contaminant specific. Contaminants may behave in various ways–some may be completely eliminated by soil organisms, some may be used by plants, some may be adsorbed on soil particles, and some may eventually pass through the soil solum unchanged.

Physical and chemical characteristics to establish soil ratings

For assessing soil potential for attenuation of contaminants in Adams County, seven physical and chemical characteristics were selected for each soil series and were given weighted values (table 1). Values assigned to each characteristic were determined subjectively, with 1 being the poorest and 10 the best attenuation potential. These values were summed, and soils with total point scores within certain ranges were grouped into four soil associations, which, in turn, reflect different attenuation potentials (table 2). Soil associations consist of two or more dissimilar series that occur on the landscape in a regularly repeating pattern.

Information needed for this assessment was taken entirely from the Adams County Soil Survey report. All soil series mapped in the county were ranked on the basis of their characteristics in a natural state. Man-induced changes, such as tiling and ditching, may affect the attenuation potential of a particular soil. In those instances where alteration has been extensive, a reassessment may be required. Sandstone bedrock is within 5 feet of the surface in only about 2 percent of the county, so the majority of soils are formed in deep, unconsolidated glacial drift.

Soil attenuation potential

Contaminant attenuation depends on water moving through the soil solum at a rate that ensures maximum contact between the percolating water that contains contaminants and the soil particles. Deep (>35 in.), medium- and fine-textured soils are best. In contrast, water moves through coarse-textured materials very rapidly; contact between contaminants and soil particles is minimal and attenuation is significantly reduced.

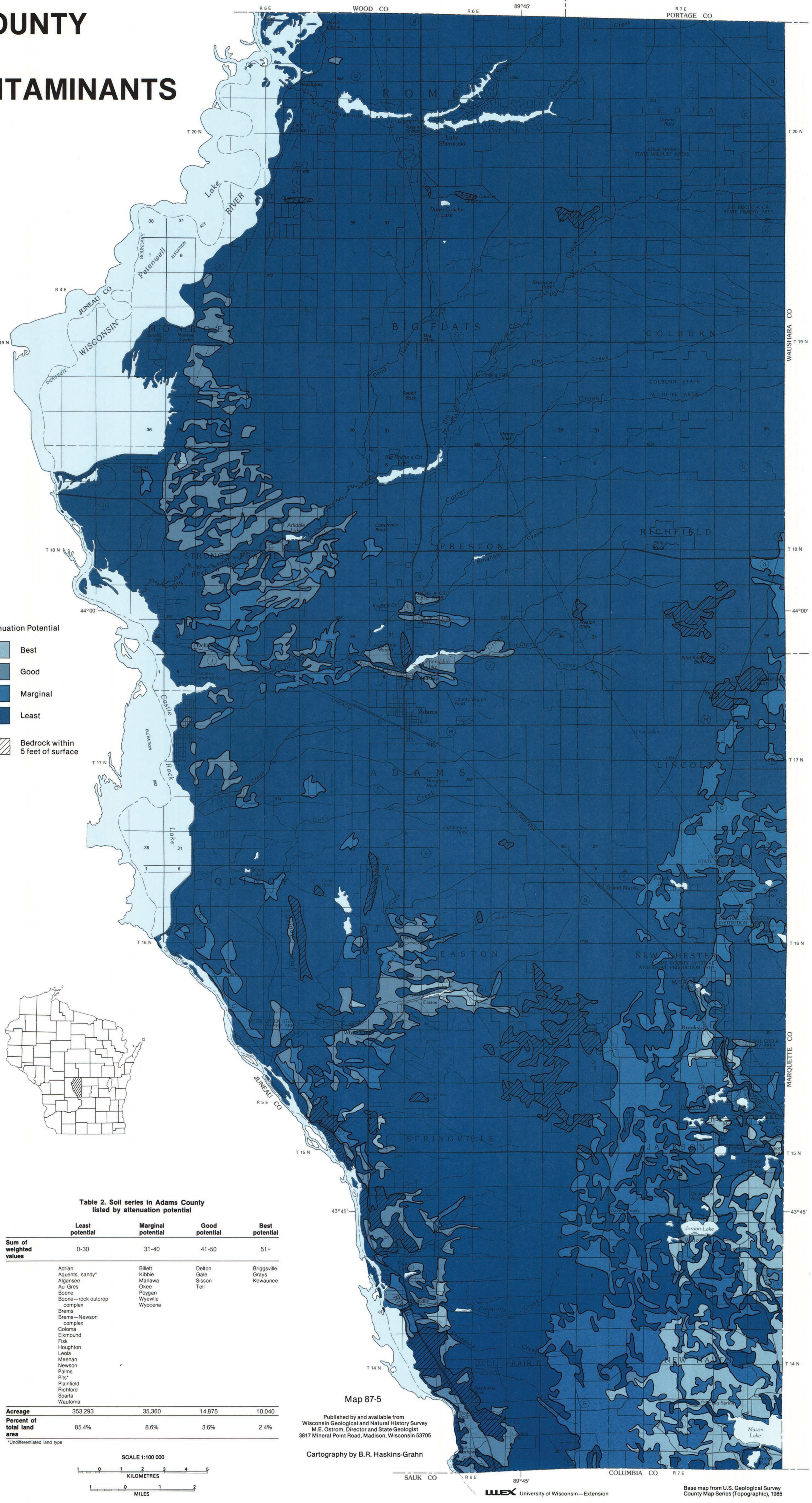
Soils that have the **least** potential for attenuation include deep sands, like Plainfield or Newson, that are excessively drained (water moves through the solum very rapidly) or poorly drained (water stands in the soil solum). The presence of free water in the soil solum for part or all of the year interrupts attenuation and often allows contaminants to be introduced into the groundwater. Boone and Elkmound soils are coarse textured and shallow over bedrock; Adrian, Houghton and Palms are organic soils that are under water most of the year.

Soils with the least potential for contaminant attenuation cover more than 85 percent of the total land area of Adams County. This suggests that all land-use activities should be carefully monitored. Sandy soils are naturally droughty; the availability of groundwater, however, makes irrigated agriculture possible in many areas of Adams County. Intensive agricultural production may increase the risk of groundwater contamination.

Soils that have the **best** potential for attenuation include Kewaunee soils, which form in up to 20 inches of silts over a clay glacial till, and Briggsville and Grays soils, which have developed in 15 to 30 inches of silts over lacustrine silts, fine sands, and clay. The presence of clay strata under 20 to 40 inches of sand gives Delton soils **good** attenuation potential. Soils with 20 to 36 inches of silts over sand (Tell) or sandstone (Gale) also have good attenuation potential. All these soils are well suited for a variety of land uses, although in Adams County, their acreages are significantly limited.

Okee soils, which form in 20 to 40 inches of coarse-textured materials over a fairly dense, sandy loam till, have **marginal** attenuation potential. They can be farmed successfully but must be managed very carefully. Manawa and Poygan soils are medium to fine textured but are naturally poorly drained. Also included in this association are sandy soils with clay substrata (Wyeville), which are also somewhat poorly drained.

The map illustrates clearly the dominance of soils that have only marginal potential for attenuating contaminants in Adams County. Because of the relative proximity of the water table to the land surface in many parts of the county, most land-use activities must be managed carefully to ensure protection of the groundwater resource.



Attenuation Potential

- Best
- Good
- Marginal
- Least
- Bedrock within 5 feet of surface

Table 1. Ranking system for evaluating the attenuation potential of soils in Adams County

Physical/chemical characteristics	Classes	Weighted values
Texture[1]—Surface (A) horizon	l, sil, scl, si	9
	c, sic, cl, sicl, sc	8
	lvfs, vfsl, lfs, fsl	4
	s, ls, sl, organic materials, and all textural classes with coarse fragment class modifiers	1
Texture[1]—Subsoil (B) horizon	c, sic, sc, si	10
	scl, l, sil, cl, sicl	7
	lvfs, vfsl, lfs, fsl	4
	s, ls, sl, organic materials, and all textural classes with coarse fragment class modifiers	1
Organic matter content[2]	Mollisols	8
	Alfisols	5
	Entisols; Inceptisols; Spodosols	3
	Histosols; Aquic suborder; and Lithic, Aquollic, and Aquic subgroups	1
pH—Surface (A) horizon	≥6.6	6
	<6.6	4
Depth of soil solum (A + B horizons)	>40 in.	10
	30-40 in.	8
	20-30 in.	3
	<20 in.	1
Permeability[3]—Subsoil (B) horizon	very low	10
	moderate	8
	high	4
	very high	1
Soil drainage class	well drained	10
	well to moderately well drained	7
	moderately well drained	4
	somewhat poorly, poorly, and very poorly drained; excessively well drained	1

[1] Soil textural classes: l = loam, sil = silt loam, scl = sandy clay loam, si = silt, c = clay, sic = silty clay, cl = clay loam, sicl = silty clay loam, sc = sandy clay, lvfs = loamy very fine sand, vfsl = very fine sandy loam, lfs = loamy fine sand, fsl = fine sandy loam, s = sand, ls = loamy sand, sl = sandy loam.

[2] Based on the ordinal, subordinal, or subgroup levels of the soil classification system; soils are assigned a lower number if they are wet or less than 20 inches thick over bedrock; see county soil survey report.

[3] Based on the particle-size class at the family level of the soil classification system, type and grade of structure, and consistency; see county soil survey report.

Table 2. Soil series in Adams County listed by attenuation potential

	Least potential	Marginal potential	Good potential	Best potential
Sum of weighted values	0-30	31-40	41-50	51+
	Adrian Aquents, sandy* Algansee Au Gres Boone Boone—rock outcrop complex Brems Brems—Newson complex Coloma Elkmound Fisk Houghton Leola Meehan Newson Palms Pits* Plainfield Richford Sparta Wautoma	Billett Kibbie Manawa Okee Poygan Wyeville Wyocena	Delton Gale Sisson Tell	Briggsville Grays Kewaunee
Acreage	353,293	35,360	14,875	10,040
Percent of total land area	85.4%	8.6%	3.6%	2.4%

*Undifferentiated land type

SCALE 1:100 000

1 0 1 2 3 4 5 KILOMETRES

1 0 1 2 MILES

Map 87-5

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