SOILS OF BARRON COUNTY AND THEIR ABILITY TO ATTENUATE POLLUTANTS

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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 they serve, if properly used, as treatment and recycling facilities for wastes from homes, from the production of livestock 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 pollution. 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.

In Barron County, soils are formed primarily in till (a poorly sorted mixture of silt, sand, and boulders transported by the glaciers that moved across the land thousands of years ago) or in outwash (sand and gravel carried off the ice by meltwater). When the ice disappeared, silt-sized material called loess was deposited by the wind on top of the till and outwash, usually to depths of about 2 feet. In parts of the county not covered by glacial materials, loess was deposited directly on top of the sandstone bedrock. Some soils also formed in alluvial deposits (flood plains) and in organic materials (peat and muck).

Many factors influence the type of soil that develops in an area: the type of parent material from which the soil formed, relief, natural vegetation, drainage, and time the soil has had to form. On the basis of these differences, the U.S. Soil Conservation Service has placed the soils of Barron County in 30 soil series and 13 miscellaneous land types and soil complexes. The soils have been further subdivided into 115 soil types and phases according to differences in surface texture, degree of slope, degree of erosion, and soil depth (Robinson and others, 1958).

However, a grouping of individual soil series based solely on physical and chemical characteristics is required to evaluate the potential of soils for attenuating pollutants. An evaluative system was developed to assess those soil properties that play a role in the attenuation of potential groundwater pollutants resulting from land-use activities.

Capacity of soils to attenuate pollutants

Attenuation is a complex process that is 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 pollutants.

However, the natural purification capacity of the soil, like that of any other natural resource is limited, and sometimes soils that retain pollutants may themselves become polluted. Cleaning polluted soil can be as difficult as cleaning polluted 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 map in no way replaces 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 helps evaluate the ability of the soil solum (the A and B horizons) to attenuate potential pollutants resulting from activities above or within the soil zone. The soil attenuation capacity is considered here only in general terms and is not pollutant-specific. Different pollutants may behave differently–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 pollutants in Barron County, seven physical and chemical characteristics were selected for each soil series and were given weighted values to a maximum of 10 (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 categories, which, in turn, reflect different attenuation potentials (table 2).

Information needed for this assessment was taken entirely from the Barron County soil survey report (Robinson and others, 1958). Rankings were based on soils in their 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.

Those areas in Barron County where the sandstone is within 5 feet of the land surface are also indicated on the map. Even though the rock may be covered with 2 to 4 feet of soil materials with good capacity for pollution attenuation, the proximity of the sandstone to the surface still limits subsurface and surface land-use activities.

Soil attenuation potential

Fairly extensive areas of sandy soils having a low potential for attenuating pollutants (Omega, Chetek) are found primarily in the southeastern part of the county. Many soils in the southern third of the county are formed in a thin loess that overlies shallow sandstone (Arland). If the loess is relatively thick (more than 24 in.), these soils have good attenuation potential for surface-applied pollutants; subsoil uses are severely restricted. Much of the landscape in the northwest and northeast is covered by shallow soils that have very limited ability to attenuate pollutants. These shallow soils developed in acid, sandy till mixed with organic soils (Milaca [Amery], Cloquet, muck, peat). In some places where they occur in the vicinity of former ice-walled lakes, they are covered with up to 15 inches of loess, which improves their attenuation capacity. Throughout west-central, central, and east-central Barron County are extensive areas of deep silts (20 to 36 in.) over sand and gravel. These soils have the best potential for attenuating pollutants that result from normal land-use activities. In some areas, the finer-textured soils (Antigo, Onamia) have somewhat thinner silt caps and should be used more cautiously.

Group 1: least potential for attentuation. Soils that fall into this group include: shallow (less than 10 in.), sandy soils formed from bedrock; coarse-textured soils generally associated with lakes and/or perennial or intermittent streams; and organic soils (muck and peat). None are particularly well suited for any intensive land use. The shallow sandy soils tend to occupy steep slopes and are generally forested, which protects them from overuse or misuse. They should not be subjected to any other land use because they have a limited ability to attenuate pollutants. Well drained, deep, sandy soils that also occur in this group have no ability to attenuate pollutants.

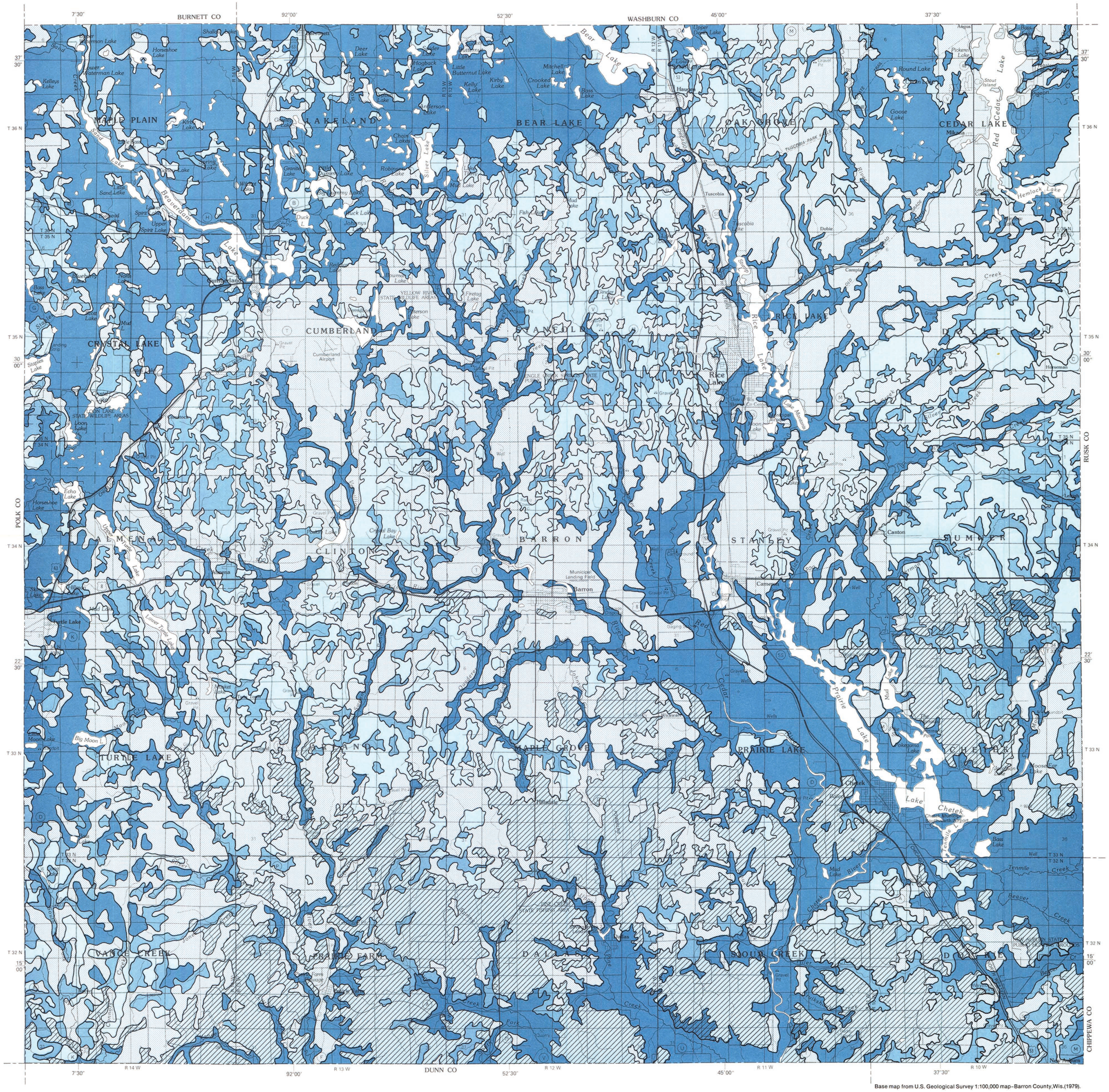
In areas of coarse-textured soils, water moves in and through the soils very quickly, providing rapid recharge of aquifers. Contact between the soil particles and percolating water is minimal, allowing little attenuation of pollutants. This is particularly significant in permeable soils on irrigated outwash plains. Irrigation water may carry excess amounts of chemicals applied on irrigated fields (fertilizers and pesticides) through the soil very quickly. Once these pollutants pass through the soil, they move basically unchanged to the groundwater. In modern flood plains or in areas where natural drainage is blocked, the water table is at or near the soil surface for most of the year, thus severely limiting their uses.

Group 2: marginal potential for attenuation. Most of the soils in this group are formed in varying thicknesses of silts (and, to a lesser extent, loamy materials) that overlie sandy loam tills or sand and gravel outwash. Even though the silt cap may be as deep as 60 inches, natural soil drainage is poor or somewhat poor, which suggests that the presence of the water table in the soil solum severely limits attenuation. Where the silt cover is thin (less than 15 in.), attenuation ability is likewise limited even though the soils are naturally well drained. Materials coarser textured than silts have reduced capacity to attenuate contaminants. Many soils in this group are, however, fairly well suited to a variety of land uses, particularly agriculture. They can be quite productive, but they must be carefully managed. Commercial fertilizer and animal waste applications must be closely tied to crop needs to avoid leaching of excess nutrients to the groundwater. These soils are not suitable for the application of municipal sludge.

Group 3: good potential for attenuation. These soils consist primarily of well drained soils formed in 20 to 40 inches of silty materials that overlie dense sandy loam tills or sandstone bedrock. Good natural soil drainage and medium-textured soils of the A and B horizons provide suitable conditions for pollutant attenuation. Those soils underlain by sandstone are obviously limited for subsurface uses, but the silt cover provides adequate protection under normal and carefully managed surface-use activities.

Group 4: best potential for attenuation. The soils of this group are formed in well drained, deep silts that are 20 to 40 inches thick over sand and gravel or that are 20 to 60 inches thick over dense, sandy loam till. These soils lend themselves to a wide variety of land uses and are particularly well suited to agricultural production.

Map 87-2b
A part of the Barron County Atlas
Cartography by K.M. Campbell



Base map from U.S. Geological Survey 1:100,000 map–Barron County,Wis.(1979).

Table 1. Ranking system for evaluating the attenuation potential of soils in Barron 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 Barron County listed by attenuation potential

	Least potential	Marginal potential	Good potential	Best potential
Sum of weighted values	0-30	31-40	41-50	51+
	Alluvial land Boone Chetek Cloquet Milaca (Amery)*—Cloquet-Peat Complex Omega Peat & muck Pitted outwash Riverwash Stoney steep land Terrace escarpment Wallkill Warman	Adolph Almena Altoona Barronett Auburndale Burkhardt Comstock Freer Milaca (Amery)* Poskin Scott Lake	Arland Brill Chaseburg Crystal Lake Freeon Gale Hixton Spencer	Antigo Campia Onamia Otterholt Santiago
Acreage**	181,705	72,825	103,100	189,450
Percent of total land area**	33.3%	13.3%	18.8%	34.6%

*Modern soil series name
**The remaining 120 acres contain gravel pits.

References

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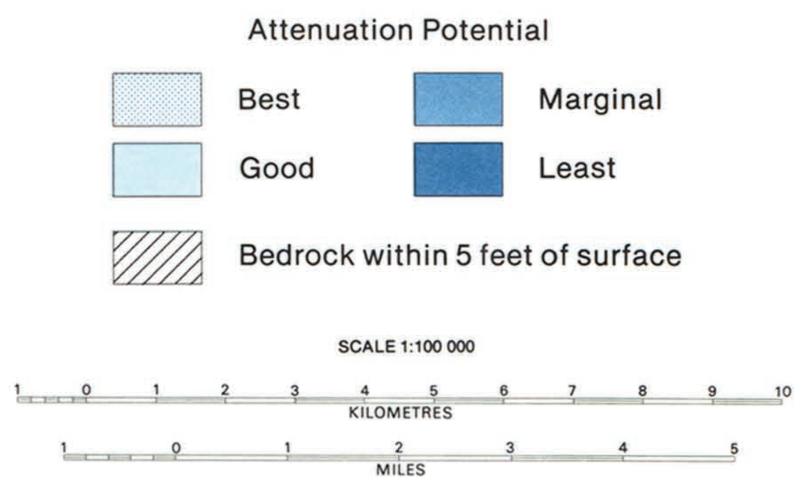

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