Environmental Baseline Study of the Huron River Watershed, Baraga and Marquette Counties, Michigan

Scientific Investigations Report 2010–5121

U.S. Department of the Interior
U.S. Geological Survey

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By Laurel G. Woodruff, Thomas L. Weaver, and William F. Cannon

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U.S. Geological Survey
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On the cover. Photograph looking upstream at East Branch Huron River downstream of East Branch Falls. Photograph by T.L. Weaver, U.S. Geological Survey.

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Conversion Factors

Multiply	By	To obtain
	Length	
inch (in.)	25,400	micrometer (µ)
inch (in.)	25.4	micrometer (µ)
millimeter (mm)	0.03937	inch (in.)
inch (in.)	2.54	centimeter (cm)
centimeter (cm)	0.3937	inch (in.)
foot (ft)	0.3048	meter (m)
meter (m)	3.281	foot (ft)
mile (mi)	1.609	kilometer (km)
	Area	
acre	0.4047	hectare (ha)
square mile (mi^2)	2.590	square kilometer (km^2)
	Flow rate	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
cubic foot per second per square mile [(ft^3/s)/mi^2]	0.01093	cubic meter per second per square kilometer [(m^3/s)/km^2]
inch per year (in/yr)	25.40	millimeter per year (mm/yr)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$°F=(1.8\times°C)+32.$$

Temperature in degrees Fahrenheit (°F) may be converted to degrees Celsius (°C) as follows:

$$°C=(°F-32)/1.8.$$

In this report, altitude or elevation refers to vertical distance above the National Geodetic Vertical Datum of 1929 (NGVD 29)—a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called sea level Datum of 1929.

Runoff is the quantity of water that is discharged, or "runs off" from a drainage basin during a given time period. Runoff data in this study are reported as mean discharge per unit of drainage area in cubic feet per second per square mile [(ft3/s)/mi^2].

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25°C).

Concentrations of chemical constituents in water are given in milligrams per liter (mg/L), micrograms per liter (µg/L), nanograms per liter (ng/L), micrograms per gram (µg/g), or micrograms per kilogram (µg/kg). For concentrations less than 7,000 mg/L, the numerical value is the same as for concentrations in parts per million (ppm).

Concentrations of chemical constituents in soil and streambed sediment are given in weight percent (wt. %) and in parts per million (ppm).

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Abstract

This report summarizes results of a study to establish water-quality and geochemical baseline conditions within a small watershed in the Lake Superior region. In 2008, the U.S. Geological Survey (USGS) completed a survey of water-quality parameters and soil and streambed sediment geochemistry of the 83 mi^2 Huron River Watershed in the Upper Peninsula of Michigan. Streamflow was measured and water-quality samples collected at a range of flow conditions from six sites on the major tributaries of the Huron River. All water samples were analyzed for a suite of common ions, nutrients, and trace metals. In addition, water samples from each site were analyzed for unfiltered total and methylmercury once during summer low-flow conditions. Soil samples were collected from 31 sites, with up to 4 separate samples collected at each site, delineated by soil horizon. Streambed sediments were collected from 11 sites selected to cover most of the area drained by the Huron River system. USGS data were supplemented with ecological assessments completed in 2006 by the Michigan Department of Environmental Quality using a modified version of their Great Lakes Environmental Assessment Section procedure 51, and again during 2008 using volunteers under supervision of the Michigan Department of Natural Resources.

Results from this study define a hydrological, geological, and environmental baseline for the Huron River Watershed prior to any significant mineral exploration or development. Results from the project also serve to refine the design of future regional environmental baseline studies in the Lake Superior Basin.

Introduction

The Lake Superior watershed contains a diverse set of environmental conditions ranging from nearly pristine to highly developed and locally urbanized. Human impact on the watershed and lake has occurred for well over a century. Major industrial activity has been, and will likely continue to be, related to the timber and mining industries. Growing concern over the ecological health of the lake and watershed and their restoration suggests that surveying and monitoring human-induced changes will be critical. Effective monitoring of future changes requires a well-established baseline of current conditions. The importance of such baselines was eloquently stated by Mary Lou Zoback in her 2000 presidential address to the Geological Society of America (Zoback, 2001):

> "Our long-term goal for environmental science should be to understand natural and perturbed systems well enough to predict outcomes, consequences, and impacts.... Documenting and understanding natural variability is a vexing topic in almost every environmental problem: How do we recognize and understand changes in natural systems if we don't understand the range of baseline levels?"

In that spirit, the U.S. Geological Survey (USGS) completed a detailed investigation of the Huron River Watershed in the Upper Peninsula of Michigan that mapped the current baseline chemistry of surface waters, soils, and stream sediments. A further goal of the study was to test and possibly refine the field protocols and analytical techniques used in this survey to maximize both the efficiency and effectiveness of any future, similar baseline determinations in the Lake Superior region.

The western Lake Superior region has long been a major area of mining for iron and copper. There also is potential for mining magmatic sulfides containing nickel, copper, cobalt, and platinum-group elements. Concentrations of these elements are known to occur extensively in both the Upper Peninsula of Michigan and northeastern Minnesota, all within the western part of the Lake Superior Watershed. In Michigan, owners of one magmatic sulfide deposit are currently in the permitting process required for mining and will likely move toward production in the near future. A number of other mineral prospects are also being explored. In Minnesota, roughly three billion tons of mineralized rock in several large deposits has been proven by diamond drilling, and at least one or two deposits may be in production within the decade. If other mineral deposits in the region currently undergoing evaluation move to mine development, there will be a need for environmental protection.

The Huron River is composed of several major branches and numerous smaller tributaries that drain about 83 square miles (mi^2) in northwestern Marquette and northeastern Baraga Counties in the Upper Peninsula of Michigan (fig. 1). The Huron River Watershed is sparsely populated with scattered permanent residences and recreational camps. There is little agriculture; however, extensive timber harvesting has taken

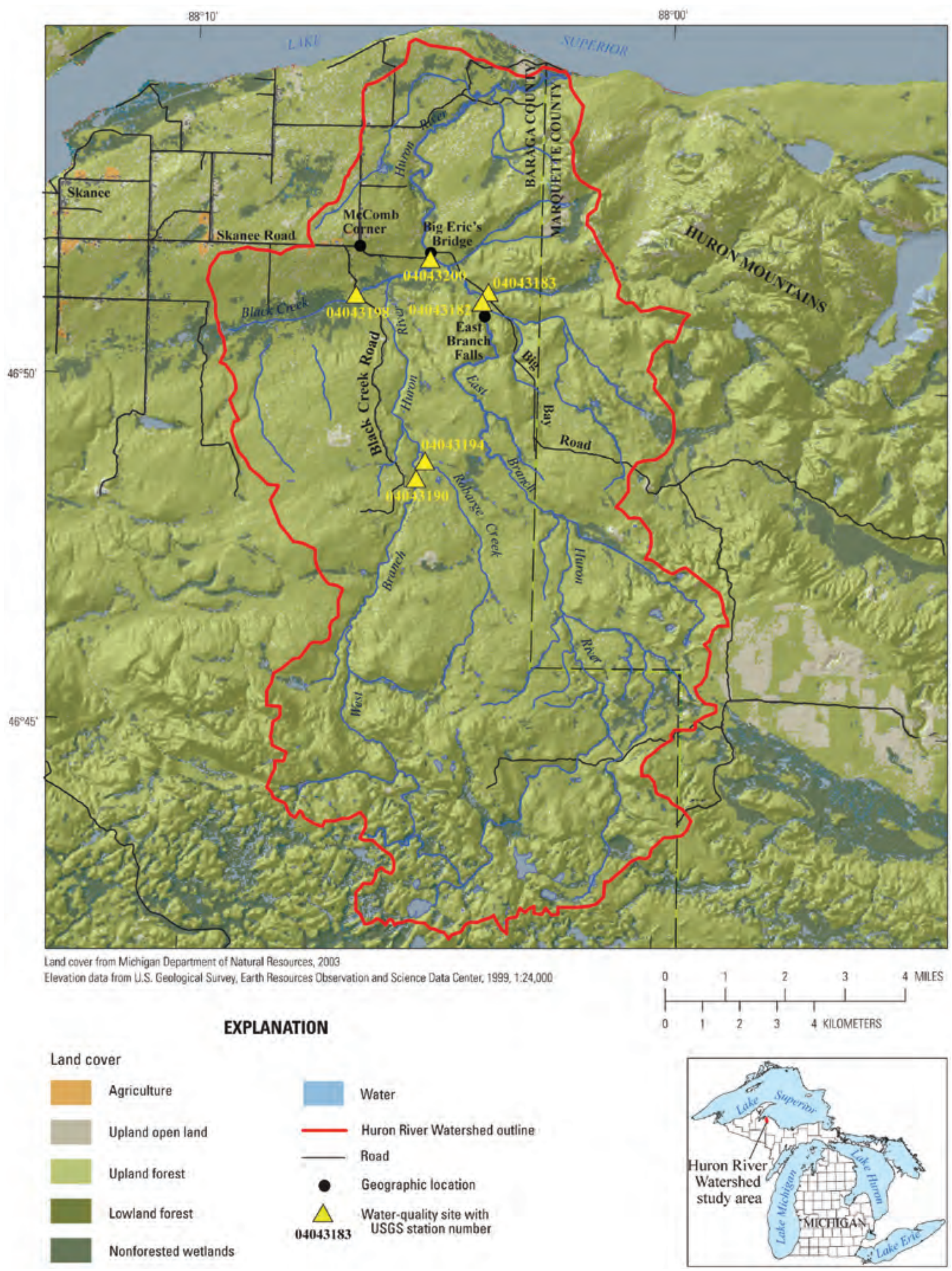


Figure 1. Map showing the Huron River Watershed study area and vicinity, Marquette and Baraga Counties, Michigan.

place for many decades. There are small areas of mineralization and small prospects, but no major mineral deposits are known in the watershed. However, there is considerable current interest in mineral exploration regionally. In the western Upper Peninsula, several significant mineral deposits have been discovered in recent years. Permits to mine a deposit about 12 miles east of the watershed (Eagle) are currently under consideration; another deposit about 20 miles west of the watershed (BIC) has been significantly explored (fig. 2). Although the environmental permitting process for a proposed mine generally requires establishment of detailed environmental baselines for the area proximal to mineralization, a more general regional baseline is also important to place these spatially restricted studies into a broader regional context to monitor potential future impacts. With current interest in Great Lakes restoration, and with the probability of continued, if not increased, utilization of forest and mineral resources in the region, it seems timely to develop regional information on current baseline conditions.

To provide such baseline data for the Huron River Watershed, the following elements were completed: (1) sampled water-quality parameters and measured streamflow at six sites at a range of flow conditions, (2) established a baseline surface water-quality database, (3) collected and analyzed soil samples from 31 sites, and (4) collected and analyzed streambed sediment

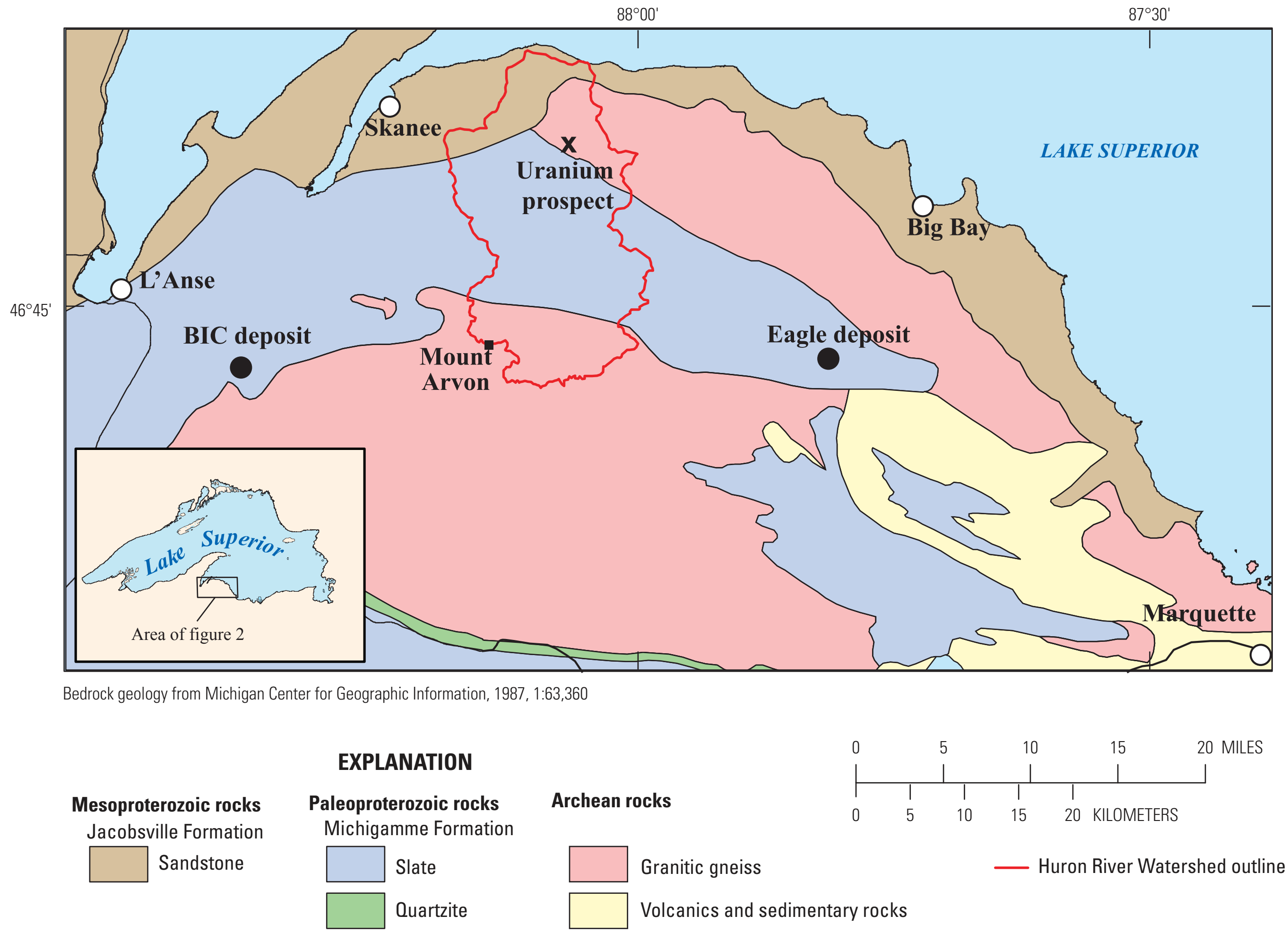


Figure 2. Map showing generalized geology of the west-central Upper Peninsula of Michigan, including geographic features, location of the Huron River Watershed, two known mineral deposits, and a small uranium prospect in the watershed.

samples from 11 sites (fig. 3*A*–*C*). An essential component of any baseline watershed study is an assessment of ecological conditions. For this study in the Huron River Watershed, the ecological assessment component utilized data collected in 2006 by the Michigan Department of Environmental Quality (MDEQ) and in 2008 by the Michigan Department of Natural Resources (MDNR) (fig. 3*D*). These data can be compiled into an established baseline geochemical database for the Huron River Watershed. Experiences in the field and an evaluation of the data suggest that similar studies might be made in other watersheds.

Description of the Huron River Watershed

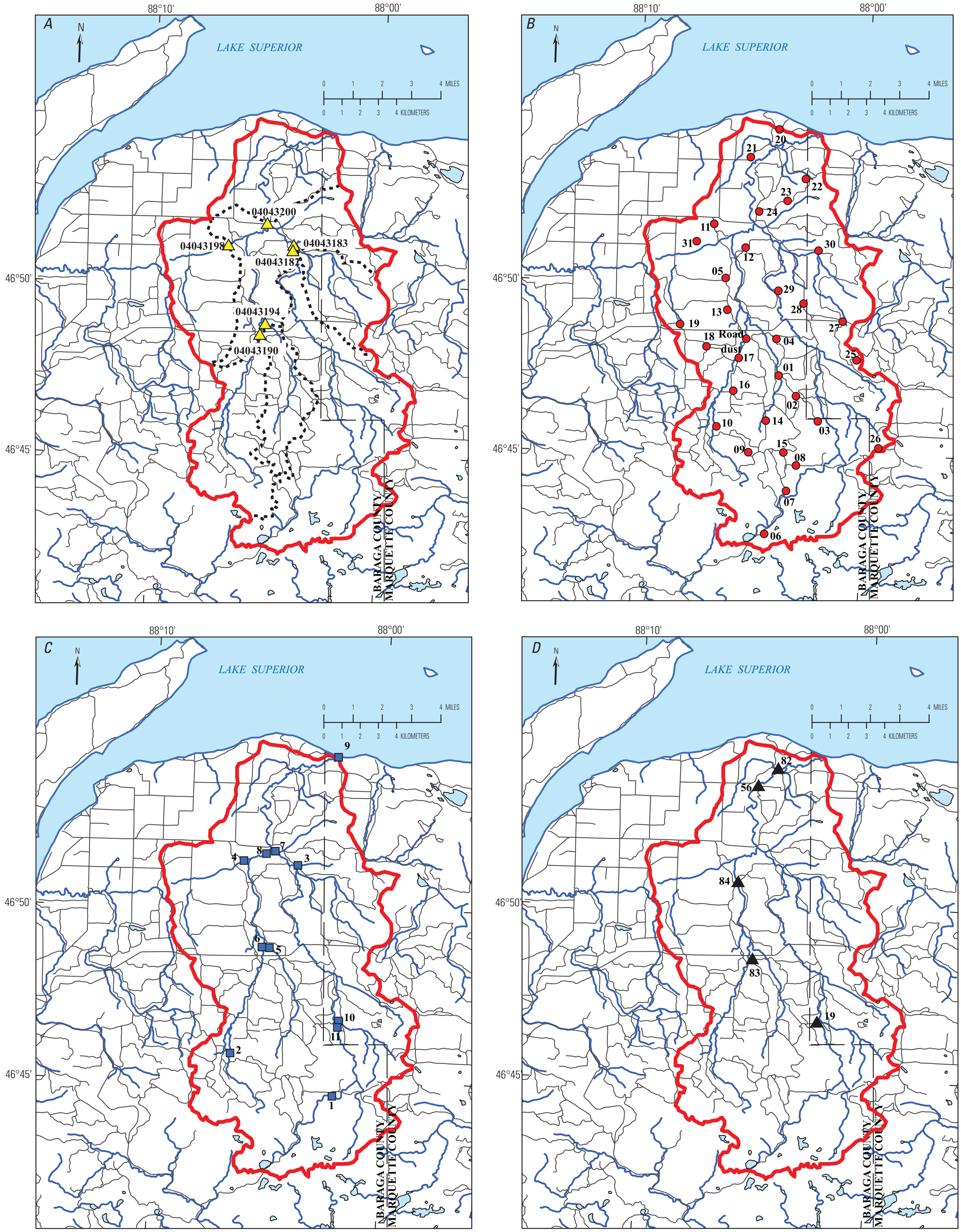
Climate

Temperature, precipitation, and snowfall data were measured by a National Oceanic and Atmospheric Administration (NOAA) cooperative climate observer at Big Bay, Michigan (located about 15 mi east of the study area; fig. 2). All climatic data for 2008 were accessed at the National Climate Data Center by David Pearson (NOAA Hydrologist, written commun., 2009).

The climate of the Huron River Watershed is typical of the northern Great Lakes Basin. Seasonal variability of climate in the watershed is appreciable, with cooler temperatures and greater precipitation occurring inland and in higher elevation areas of the watershed. Monthly precipitation measured as rain and rain equivalent snowfall at the NOAA station at Big Bay in 2008 ranged from 0.82 inches to 3.52 inches, with annual precipitation of 26.6 inches. Mean-monthly temperatures ranged from 15.5°F to 64.9°F and the mean-annual temperature is 41.0°F. The freeze-free period ranges from 100 to 140 days, averaging about 120 days.

Physiography

The Huron River Watershed is within the Superior Upland Province of the Laurentian Upland (Fenneman, 1928). The area is a glacial landscape characterized by mainly bedrock-controlled moraines and smaller areas of glaciofluvial deposits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N
LAKE SUPERIOR
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MARQUETTE COUNTY
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Road dust
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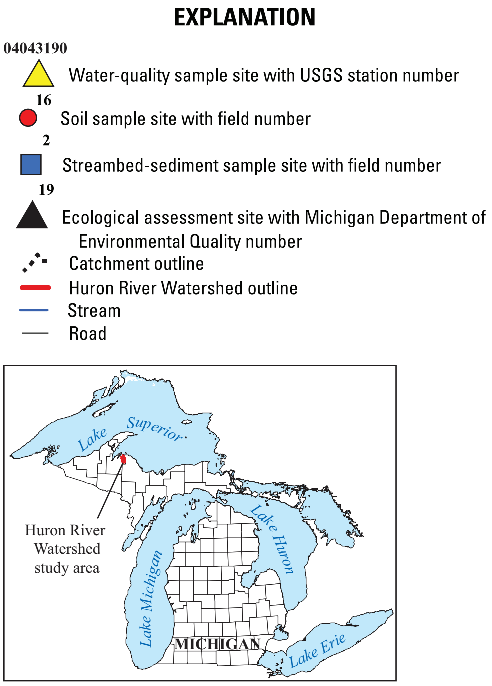


Figure 3 (facing page and above). *A*, Map showing distribution of water-quality sample sites within the Huron River Watershed study area, Marquette and Baraga Counties, Michigan. *B*, Map showing distribution of soil sample sites within the Huron River Watershed study area, Marquette and Baraga Counties, Michigan. *C*, Map showing distribution of streambed-sediment sample sites within the Huron River Watershed study area, Marquette and Baraga Counties, Michigan. *D*, Map showing distribution of ecological assessment sites within the Huron River Watershed study area, Marquette and Baraga Counties, Michigan.

dissected by numerous streams and rivers. The highest bedrock peak in Michigan, Mount Arvon (1,979 feet above sea level), is adjacent to the southwestern part the Huron River Watershed (fig. 2). Uplands support stands of mixed northern hardwoods and pine; sugar maple, oak, white ash, yellow birch, cedar, white pine, jack pine, and red pine are the dominant tree species.

Bedrock Geology

The bedrock geology of the Huron River Watershed consists of three principal units of varying age and character (Cannon, 1977). As shown on figure 4, granitic gneiss of Archean age (approximately 2.7 billion years old) underlies the southern part of the watershed and a small area of the northeastern part. The majority of the watershed is underlain by weakly metamorphosed sedimentary rocks of the Paleoproterozoic Michigamme Formation (approximately 1.8 billion years old). The Michigamme Formation in this area consists of a thin basal quartzite overlain by a thick sequence of shale and slate. Much of the slate is dark gray to black and contains appreciable amounts of organic carbon (C) as well as sulfide minerals, including pyrite and pyrrhotite. The youngest rocks in the watershed are sandstones of the Jacobsville Formation, which underlies the northern and northeastern part of the watershed. The age of the Jacobsville Formation is not well constrained but is currently interpreted as being approximately 1.0 billion years old (Roy and Robertson, 1978).

Currently, mineral exploration in the Huron River Watershed is focused on magmatic sulfides in mafic and ultramafic rocks of the 1.1 billion year old Midcontinent rift (Rossell, 2008). Other known mineralization within the watershed includes a small, undeveloped uranium prospect with unique mineralogy, including cadmium (Cd), copper (Cu), lead (Pb), nickel (Ni), silver (Ag), vanadium (V), yttrium (Y), and zinc (Zn) minerals, that crops out in a small waterfall in the East Branch Huron River (Carlson and others, 2007). Bedrock outcrops with somewhat anomalous geochemistry, such as high uranium in phosphatic materials in the northern part of the watershed, and traces of sulfides in crosscutting quartz veins have also been documented (Kalliokoski and Lynott, 1987).

Glacial Geology

Glacial deposits in the Huron River Watershed consist largely of lodgement till of various types (Peterson, 1984) (fig. 5). Based on the lithology of pebbles, most of the tills are derived from local bedrock with a smaller component derived from more far-transported material. Thus, in large part the glacial deposits reflect the character of the localized underlying bedrock. All of the glacial materials were deposited during the late Pleistocene between 10,000 and 13,000 years ago by several different ice lobes that occupied the Lake Superior Basin at that time (Peterson, 1984). Parts of the modern Lake Superior shoreline, including the mouth of the Huron River, are covered by Holocene windblown sands and beach deposits (fig. 5).

Soils

The soils of the Huron River Watershed have been mapped in detail by the National Resource Conservation Service (Berndt, 1988; Schwenner, 2007). The soil samples collected in this study are all upland soils classified in the order Spodosols and suborder Orthods. Spodosols are a group of soils that are characterized by the presence of a spodic horizon in which active amorphous organic matter and aluminum have accumulated. This spodic horizon is the B horizon as designated by horizon sampling. Orthods are a subdivision of Spodosols in which the organic carbon content of the spodic horizon is relatively low (<6 percent organic carbon). In the Huron River Watershed, soils developed on Pleistocene till are generally sandy and cobbly. The majority of the soil sample sites in this study are in moderately to well-drained soils, and a few sites near Lake Superior are in excessively drained soils. Soils were collected by horizon rather than by fixed depths. Sampled horizons include a surficial organic mat (O horizon), an underlying mineral soil rich in organic material (A horizon), a gray sandy leached mineral soil developed at some but not all sites (E horizon), the reddish

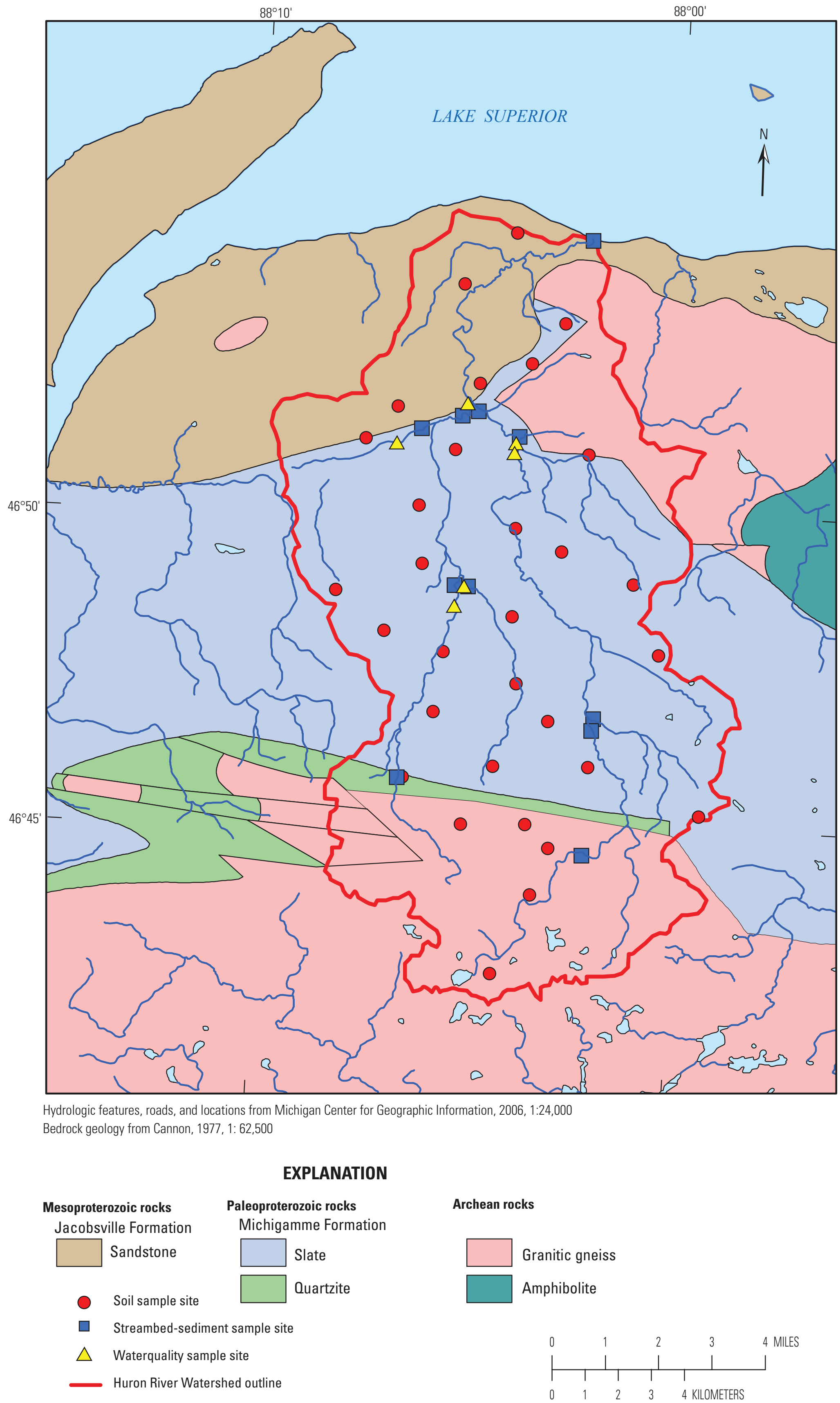
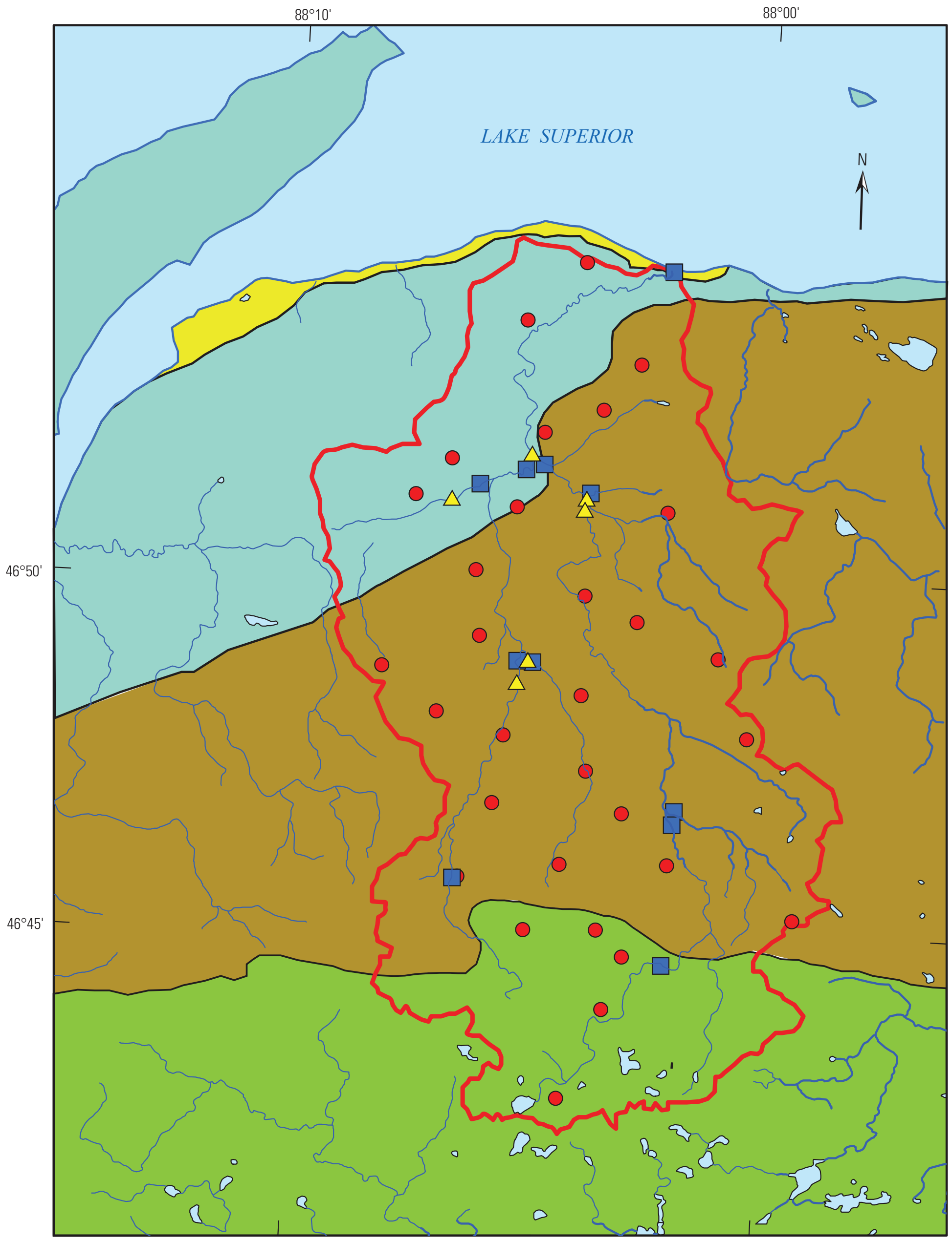


Figure 4. Map showing bedrock geology of the Huron River Watershed study area and vicinity, Marquette and Baraga Counties, Michigan.



Hydrologic features, roads, and locations from Michigan Center for Geographic Information, 2006, 1:24,000
Glacial geology from Peterson, 1984, 1: 250,000

EXPLANATION

- Red sandy to very sandy till composed largely of material from the Jacobsville Formation. Deposited by Keweenaw Bay ice lobe
- Stony, sandy gray and brown till, gravel, and sand. Deposited by Langlade, Keweenaw Bay, and Michigamme ice lobes
- Gravel, sand, and gray and brown till as thin, discontinuous veneer over bedrock. Deposited by Keweenaw Bay and Michigamme ice lobes
- Holocene windblown sand and beach deposits
- Soil sample site
- Streambed-sediment sample site
- Water-quality sample site
- Huron River Watershed outline

0 1 2 3 4 MILES

0 1 2 3 4 KILOMETERS

Figure 5. Map showing glacial geology of the Huron River Watershed study area and vicinity, Marquette and Baraga Counties, Michigan.

spodic horizon (B horizon), and the parent material (C horizon). Not all horizons were present at all sites. A soil pit showing typical soil horizon development is shown in figure 6.

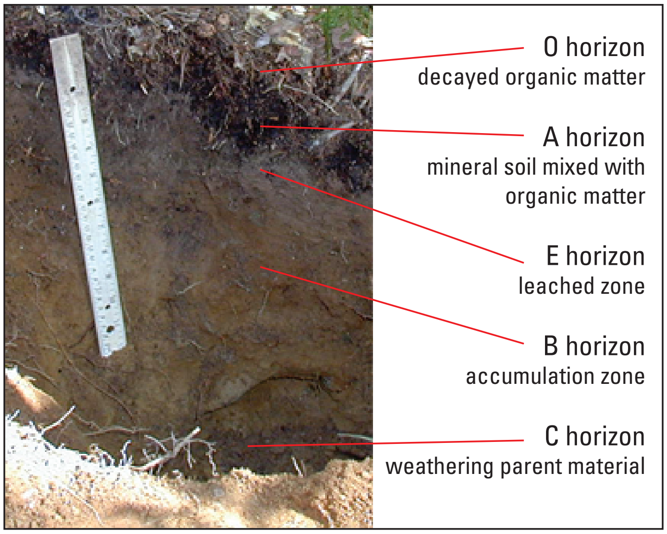


Figure 6. A soil pit showing typical horizon development. Horizons are distinguished by color variations. The ruler is 1 foot in length.

Previous Studies in the Huron River Watershed

The USGS has measured stream discharge periodically at site 04043200 on the Huron River (fig. 3*A*)—three times from 1964 to 1976 to document baseflow conditions, and six times in 2008 to establish a stage-discharge rating appropriate for clear-channel conditions. Streamflow data are available at the USGS National Water Information System (NWIS) Web site accessible at *http://waterdata.usgs.gov/nwis/sw*.

Few geochemical studies of the Huron River Watershed are known. The National Uranium Resource Evaluation (NURE) Hydrogeochemical and Stream Sediment Reconnaissance Program of the 1970s collected stream sediments and samples from groundwater wells in the Upper Peninsula of Michigan, as well as in surrounding States, primarily to document the presence of uranium (Smith, 1997). Geochemical data are available for water samples collected from two sites within the Huron River Watershed as part of the NURE Program (USGS, 2006).

The USGS has also been involved with several studies of water resources of nearby areas. These include a report for a cooperative project between the USGS and the Michigan Geological Survey on Baraga County groundwater and geology (Doonan and Byerlay, 1973); a USGS study of streams within the Keweenaw Bay Indian Community reservation (Sweat and Rheaume, 1998); and a USGS study on the Silver River Watershed by Weaver and others (2010).

Methods of Data Collection and Analysis

Streamflow Measurement and Water-Quality Sampling

Streamflow Measurement

Streamflow was measured at six sites distributed across the watershed (fig. 3*A*) using standard USGS techniques (Carter and Davidian, 1968; Rantz, 1982), typically with a vertical axis current meter and wading rod, although a boat-mounted acoustic Doppler current profiler was also used at one site during high-flow conditions when the stream was not wadeable. Each streamflow measurement made by USGS is rated by the hydrographer, ranging from poor to excellent, and intended to convey the accuracy of a measurement. A number of factors are considered when rating a discharge measurement, including but not limited to characteristics of the measurement cross section, spacing and number of observation verticals, distribution of flow in the cross section, variability of velocity during the timed interval, and extent of change in stream elevation during the discharge measurement.

Although there are no streamflow-monitoring stations located within the Huron River Watershed, there are three continuous-record streamflow-monitoring stations located 10 to 20 mi away in the adjacent Silver River Watershed. Historic and current stage and streamflow data from the Huron River and Silver River sites are available at several USGS Web sites, including *http://mi.water.usgs.gov* and *http://waterdata.usgs.gov/nwis/sw*.

Water-Quality Sampling

Water-quality data were collected at the same six sites where streamflow was measured (fig. 3*A*) using standard techniques and methods described in the USGS National Field Manual for the Collection of Water-Quality Data (USGS NFM) (available at *http://pubs.water.usgs.gov/twri9A*). All water-quality samples were analyzed at the USGS National Water Quality Laboratory (NWQL) following their Quality Assurance/Quality Control (QA/QC) plan, except unfiltered total and methylmercury samples, which were analyzed by the USGS Wisconsin Mercury Research Laboratory.

Spring sampling began shortly after ice out (when ice was fully melted on the streams) and was undertaken as soon as sites became accessible to vehicular travel and when streamflow was low enough to wade safely and not damage sampling equipment. Spring sampling was completed prior to active terrestrial vegetation growth. Summer (or low-flow) sampling was accomplished after the streams reached baseflow conditions and while vegetation was still in the growth stage (before any killing frosts). Field water-quality parameters were measured (pH, specific conductance, dissolved oxygen concentration, and water temperature) using a multiparameter meter calibrated daily following the procedure outlined in the USGS National Field Manual for the Collection of Water-Quality Data (NFM) (USGS, variously dated). Samples were collected using a proto-cleaned sampler suitable to the particular streamflow conditions at each site. In narrow, shallow streams, this was typically accomplished by means of a handheld sample bottle; the bottle is simply held by hand below the top of the water surface and moved from side to side in the channel to assure the sample is representative of the entire cross section. At wadeable sites with greater depth and higher velocity streamflows, a DH81 sampler and equal-width-increment protocol were used. The equal-width increment protocol, which is described in chapter A4 of the USGS NFM, consists of sampling the stream at a number of equally spaced verticals at a constant transit rate. The combination of the same constant transit rate and the isokinetic property of the sampler results in a discharge-weighted sample that is proportional to streamflow. Several liters of water were collected at each site and composited in a churn splitter to ensure homogeneity prior to any samples being drawn off.

Water-Quality Reporting Levels and Analysis

The USGS NWQL has established reporting levels for various analytical procedures (Childress and others, 1999), and this section largely is excerpted from that report. In the following sections of this report, tabulated data are reported as "uncensored," "censored," or "estimated." Uncensored data are data reported as an unqualified numerical value. Censored data are reported as less than a particular reporting level [for example, <0.12 milligrams per liter (mg/L)]. Censored data result either from the analyte not being present or, if seemingly present, from an inability to conclusively identify it. Estimated data are reported as qualified numerical values with an "E" before the number (for example, E0.057). Estimated values can be less than, at, or greater than the analytical reporting level. An estimated value less than the reporting level means that the analyte can be identified and measured, but with less than 99-percent confidence that it is present. Estimated values at or above the analytical reporting level can result from a poor-performance record of the analyte with the analytical method, matrix interference, or small sample volume.

Reporting levels and detection limits used by the USGS NWQL include the minimum reporting level (MRL), method detection limit (MDL), long-term method detection limit (LT–MDL), and laboratory reporting level (LRL). The MRL is the lowest measured concentration of an analyte that can be reliably reported. The MDL is the minimum concentration that can be measured and reported with a 99-percent confidence that the analyte is present. The LT–MDL is derived from the standard deviation of a minimum of 24 MDL spike samples over an extended period. The LRL generally is equal to twice the LT–MDL. The probability of reporting an analyte as non-detected when it is present is less than 1 percent at the LRL. The LRL is used when the USGS NWQL determines that an MRL is no longer appropriate to a specific analyte or analytical method. A concentration measured between the LRL and LT–MDL is reported as estimated.

Quality Assurance

An unpublished Quality-Assurance Program Plan (QAPP), prepared by the USGS Michigan Water Science Center and Keweenaw Bay Indian Community (KBIC) environmental staff for a 4-year study (2005–08) of the adjacent Silver River Watershed by Weaver and others, was also followed for the streamflow measurement and water-quality sampling parts of this study. The water-quality sampling processes outlined in the KBIC Silver River QAPP followed USGS standard practices and were approved by the USGS NWQL and U.S. Environmental Protection Agency (USEPA) region 5 prior to that study.

Soils and Stream Sediments

Soil Sampling

Soils were collected at 31 sites distributed across the watershed (fig. 3*B*). Samples were collected from hand-dug or augered excavations. Soil horizons were identified by physical characteristics observable in the field with assistance of pedon descriptions developed by the Natural Resources Conservation Service. Where possible, samples of the O, A, E, B, and C horizons were collected (fig. 6). In some cases two or more subhorizons of the B horizon were collected, based on color differences. A sample of road dust was collected from Black Creek Road (figs. 1, 3*B*). The sample was a composite of fine material gathered within a 10-meter radius in the center of the road on a dry day.

Samples were dried at room temperature and sieved through 2-millimeter (mm) screens. The O horizon was collected from a known area and weighed after air drying to allow later calculations of the amount of various chemical components per unit surface area. A-horizon soils were collected from a determined volume and also weighed after air drying to determine soil density, which can be used to determine the quantity of an element per unit area. The <2-mm-size fraction was submitted for chemical analyses.

Streambed Sediment Sampling

Streambed sediment samples were collected at 11 sites, chosen to sample streams draining the majority of the Huron River Watershed (fig. 3*C*). Samples were hand collected in September, 2008, during low flow to maximize access to depositional area. Samples were taken from depositional areas within an approximately 50-meter reach using a stainless steel scoop. Within each sampling area, between 500 and 1,000 grams of material were composited and placed into acid-rinsed polyethylene jars. In the laboratory, samples were air-dried, gently disaggregated, and dry sieved through a 150-micrometer (µm) Teflon® screen. The <150 µm fraction, comprising very fine sand, silt, and clay, was submitted for chemical analyses.

Chemical Analyses

The analytical techniques used for mineral soils and streambed sediments are similar to those employed in many recent USGS soil geochemical studies. The following description of techniques is slightly modified from that provided by Smith and others (2009) for a North American-scale survey currently underway. The prepared samples were sent to a commercial geochemical laboratory for major and trace element analysis. The analytical methods used are similar to those used by the laboratories of the USGS Mineral Resources Program, described in Taggart (2002).

For a near-total digestion analysis for the concentrations of a suite of major and trace elements, 0.25 grams of soil was decomposed using a mixture of hydrochloric acid (HCl), nitric acid (HNO_3), perchloric acid ($HClO_4$), and hydrofluoric acid (HF) at low temperature. The use of these four acids results in an almost total dissolution for most mineral constituents of soil. However, it does not fully dissolve some of the more refractory or resistant minerals. Examples of such incomplete dissolution include barium in barite, chromium in chromite, titanium in rutile, tin in cassiterite, aluminum in corundum, and rare-earth elements in monazite (Briggs, 2002). An aliquot of the digested sample was aspirated into an inductively coupled plasma mass spectrometer (ICP–MS) and an inductively coupled plasma atomic emission spectrometer (ICP–AES) and the concentrations of the optimal elements were determined. ICP–AES is best for the major elements, sulfur, and elements with relatively high concentrations not requiring a low detection limit. ICP–MS is optimal for trace elements requiring lower limits of determination near or below their crustal abundance, and elements not determined by inductively coupled plasma mass spectroscopy (ICP–AES). The 42 elements determined by this ICP–MS/AES method were aluminum (Al), antimony (Sb), arsenic (As), barium (Ba), beryllium (Be), bismuth (Bi), cadmium (Cd), calcium (Ca), cerium (Ce), cesium (Cs), chromium (Cr), cobalt (Co), copper (Cu), gallium (Ga), indium (In), iron (Fe), lanthanum (La), lead (Pb), lithium (Li), magnesium (Mg), manganese (Mn), molybdenum (Mo), nickel (Ni), niobium (Nb), phosphorus (P), potassium (K), rubidium (Rb), scandium (Sc), silver (Ag), sodium (Na), strontium (Sr), sulfur (S), tellurium (Te), thorium (Th), thallium (Tl), titanium (Ti), tin (Sn), tungsten (W), uranium (U), vanadium (V), yttrium (Y), and zinc (Zn) (Briggs and Meier, 2002). Mercury (Hg) analysis was done on a separate split of the sample by cold vapor-atomic absorption spectroscopy. Selenium (Se) analysis was done on a separate split of the sample by hydride generation-atomic absorption spectroscopy. A separate split of the sample was analyzed for total carbon using an automated carbon analyzer.

In addition to the near-total digestion technique described above, all mineral soils and bed sediments were also analyzed using a partial extraction method. A widely used extraction technique [Aliquot/methyl isobutyl ketone (MIBK)] was employed with ICP–AES (Taggart, 2002). A hydrochloric acid-hydrogen peroxide solution solubilizes metals not tightly bound in the silicate lattice of soil minerals. The metals are extracted by a 10 percent Aliquot 336-diisobutylketone (DIBK) solution as organic halides. The separated organic phase is pneumatically aspirated into a multichannel ICP instrument where the concentrations of the extracted metals [Ag, As, Bi, Cd, Cu, gold (Au), Mo, Pb, Sb, and Zn] are determined simultaneously. It is important to note that this procedure is a partial digestion and depending on an element's availability, results may be biased low when compared to other methods of analyses.

O-horizon soils were milled and split, with one portion set aside and the remainder of the sample ashed at 500°C for 13 hours at the USGS analytical laboratory in Denver, Colo. The unashed split was analyzed for mercury and selenium and the ashed portion was analyzed for the 42 elements listed above. Analysis of O-horizon soils utilized the same analytical methods as described above for mineral soils.

Quality Assurance and Quality Control for Soils and Streambed Sediments

The quality assurance (QA) focus is mainly in the domain of the analytical laboratory. Under the QA umbrella, the components of standard operating procedures, instrument logs, training records, data acceptance/rejection criteria and laboratory audits are included. Unlike the unquantifiable QA element, the quality control (QC) element measures the accuracy and precision of the data produced by an analytical method. The accuracy and precision are established through the analysis of reference materials and sample replicates, respectively. The samples taken through the analytical process for inorganic constituents received QC checks on three separate levels. The first level of quality assurance involved QC assessment by the USGS contract laboratory. In the next level, QC was assessed by the USGS Mineral Resource Team QC officer, followed by the third-level assessment by the USGS principal investigator. The USGS contract laboratory is accredited to the International Organization for Standardization Information Centre (ISO/IEC) 17025 standard, which includes both QA and QC protocols. QC is monitored by analyzing a reference material with every batch of 48 samples. The reference material most often used is a syenite rock standard developed by the Canadian Centre for Mineral and Energy Technology (Govindaraju, 1989). Shewhart Control Charts (Taylor, 1987) are generated for the reference material analyses and reviewed with every report as part of the internal quality audits. The accuracy of elements determined by the ICP–MS and ICP–AES methods was considered acceptable if recovery was within the range of 85 to 115 percent at 5 times the lower limit of detection (LLD). The accuracy for mercury and selenium was considered acceptable if recovery was within 80 to 120 percent at 5 times the LLD.

Statistical Methods for Soil and Streambed Sediment Data

Variations in soil geochemistry and streambed sediment geochemistry were evaluated using the Kruskal-Wallis one-way analysis of variance for multiple groups and the Mann-Whitney U-test to compare two groups (Systat 11.0 statistical software package; Sokal and Rohlf, 1981). These nonparametric tests evaluate the null hypothesis, which stated that there are no chemical differences among soils collected in glacial units derived from different bedrock units. Rejection of the null hypothesis at the 95-percent confidence level is denoted by a p value less than or equal to 0.05, and was taken as evidence that there existed a significant difference in the concentrations of some elements. For statistical analysis, a value of half the lower limit of detection was substituted for censored values for individual elements.

Ecological Assessment

Typically, a thorough ecological assessment is conducted in late summer or early fall for the purposes of identifying fish and aquatic macroinvertebrate populations present in a stream as well as the generalized stream-channel geometry. An ecological assessment provides an excellent “snapshot” of the general health of the sampled stream reach, and is particularly useful for documenting long-term changes in stream health when repeated regularly over a period of years. Ecological assessments of sites on the Huron River Watershed have been completed recently by the Michigan Department of Environmental Quality (MDEQ) and the Michigan Department of Natural Resources (MDNR). The study team chose to use those data rather than duplicate State of Michigan efforts for this study.

The MDEQ completed an ecological investigation of five Huron River sites in 2006. The MDEQ investigation was completed using a modified version of the MDEQ Great Lakes Environmental Assessment Section (GLEAS) procedure 51 (MDEQ, 2008), which is a qualitative biological and habitat survey protocol for wadeable streams that has been extensively employed in Michigan for several years. The GLEAS 51 protocol consists of separate qualitative evaluations of the fish community, macroinvertebrate community, and habitat quality, completed in that order to minimize disruption of the sampled communities. The USGS uses a similar, but more intensive and complex, protocol when evaluating the ecological health of streams that investigates algae, invertebrate, and fish communities (Moulton and others, 2002). In the GLEAS 51 procedure, each survey station is described by up to three numbers or metrics; one each for the fish, macroinvertebrates, and habitat. An excellent-quality stream for the ecoregion would have the most metrics performing as an excellent site, while the metrics from a poor-quality stream would be substantially different than those of an excellent site. Use of metrics creates a uniform and systematic evaluation for each site, with the result expressed as a single numerical value that is easily compared to other sites.

Fishes.—Much of the Huron River Watershed is primarily a coldwater fishery, with numbers of salmonids present at several of the sampling sites. Salmonids are members of the fish family Salmonidae, which includes salmon, trout, and whitefish. The GLEAS 51 protocol for coldwater fisheries is much simpler than for warm-water fisheries. Target streams are evaluated for the presence of at least 50 fish, and for the relative abundance of anomalies and salmonids collected (MDEQ, 2007). A fish community component of the GLEAS 51 procedure was not completed by the MDEQ in 2006 or by the MDNR in 2008 because previous MDNR fisheries surveys conducted in the watershed over the past 60 years have confirmed that brook trout (*Salvenius fontinalis*) is the primary salmonid that resides in the watershed year round. There are numerous other species of fish in the watershed as well.

Streamflow

Streamflow was measured at six sites concurrent with water-quality sampling (fig. 3*A*) and results are included in appendix 2. Geographic location information and drainage and wetland areas for the six sites are included in table 1.

Table 1. U.S. Geological Survey site number, station name, latitude, longitude, drainage area, and wetland area for water-quality sampling and streamflow-measurement sites in the Huron River Watershed, Marquette and Baraga Counties, Michigan.

[Numerical values in the table are rounded to the nearest hundredth, except drainage areas and percentages, which are rounded to the nearest tenth; all areas in square miles; NA, not applicable]

U.S. Geological Survey station number	U.S. Geological Survey station name	Latitude	Longitude	Drainage area	Wetland area	Percentage of basin comprising wetlands
04043182	EAST BRANCH HURON RIVER downstream of East Branch Falls, near McComb Corner	46º51’02”	88º03’52”	26.4	2.66	10.1
04043183	TRIBUTARY TO EAST BRANCH HURON RIVER, near McComb Corner	46º51’06”	88º03’45”	6.6	0.42	6.3
04043190	WEST BRANCH HURON RIVER, near McComb Corner	46º48’23”	88º05’15”	10.8	0.55	5.1
04043194	ROBARGE CREEK, near McComb Corner	46º48’49”	88º03’03”	5.9	0.25	4.3
04043198	BLACK CREEK, near McComb Corner	46º51’13”	88º06’32”	9.6	0.14	1.5
04043200	HURON RIVER AT BIG ERIC’S BRIDGE, near Skanee	46º51’54”	88º04’57”	73.2	4.47	6.1
Study area total		NA	NA	83.1		

East Branch Huron River, Downstream of East Branch Falls

The East Branch Huron River USGS station 04043182, downstream of East Branch Falls, is located about 0.5 miles from Big Bay Road (fig. 1). The drainage basin at station 04043182 includes an area of about 26.4 mi^2 (fig. 3*A*). The stream channel has a moderate to high gradient from East Branch Falls, located about a mile upstream of the sampling site, through the sampling site. The channel is composed of coarse gravel, rocks, cobbles, and boulders at the sampling site that grades into bedrock upstream closer to the falls. The small uranium prospect described by Carlson and others (2007) crops out near the falls upstream of this site. Several large gravel-cobble bars are located upstream and downstream of the sampling site as well, indicative of the energy present during periods of high streamflow. Hardwoods, pine, and some tag alders and other bushes dominate the near-shore vegetation (fig. 7). Water-quality sampling and streamflow measurements are easily made at the site, although the site is difficult to access and may be unwadeable during spring high flows. Measured streamflow ranged from 4.37 to 74.9 ft^3/s.

Figure 7. Looking upstream at East Branch Huron River downstream of East Branch Falls. [U.S. Geological Survey (USGS) site 04043182, April 29, 2008. Photograph by T.L. Weaver (USGS).]

Tributary to East Branch Huron River

The unnamed tributary to East Branch Huron River (USGS station 04043183) is known locally as Chink's Creek. The tributary is located about 0.4 miles from Big Bay Road (fig. 1). The drainage basin at station 04043183 includes an area of about 6.6 mi^2 (fig. 3*A*). The sampling site is located along a trail to station 04043182 and the tributary must be crossed to access station 04043182. The confluence of the East Branch Huron River with this tributary is located several hundred yards downstream of stations 04043182 and 04043183. The sampled reach has a moderate gradient and is composed of numerous riffles of rocks, boulders, exposed bedrock, and debris jams (fig. 8). Although the site is easily measured and sampled in the spring, finding adequate sections during periods of low streamflow can be difficult. Near-shore vegetation is somewhat brushier than along the East Branch Huron River. Measured streamflow ranged from 1.12 to 12.4 ft^3/s.

Figure 8. Looking upstream at tributary to East Branch Huron River. [U.S. Geological Survey (USGS) site 04043183, April 29, 2008. Photograph by T.L. Weaver (USGS).]

West Branch Huron River

USGS station 04043190 on the West Branch Huron River is located where the river is crossed by a bridge for Black Creek Road, about 5 mi from Skanee Road (fig. 1). A drainage area of about 10.8 mi^2 (fig. 3*A*) is measured at station 04043190. The stream channel is moderate-to-high gradient upstream and downstream at the station site. Numerous rock riffles are present upstream (fig. 9*A*) and a bedrock controlled waterfall is located about 35 ft downstream of the bridge and additional rock riffles are present downstream of that (fig. 9*B*). Water-quality sampling and streamflow measurements both are easily made at the site. The near-shore vegetation consists primarily of hardwoods, cedar, and pine in the area of the sampling site. Measured streamflow ranged from 2.79 to 34.8 ft^3/s.

Figure 9. Looking *A*, upstream and *B*, downstream at West Branch Huron River. [U.S. Geological Survey (USGS) site 04043190, April 28, 2008. Photograph by T.L. Weaver (USGS).]

Robarge Creek

Robarge Creek (USGS station 04043194) is located near the end of a two-track road about 0.5 mi from station 04043190 and about 0.25 mi upstream of its confluence with the West Branch Huron River (fig. 1). The drainage area at station 04043194 is about 5.9 mi^2 (fig. 3*A*). At this location the stream channel has a moderate gradient, and the streambed is composed of gravel, rocks, and cobbles, and numerous gravel bars (fig. 10). There are many sections suitable for water-quality sampling and streamflow measuring during wetter periods but finding suitable sections during low-flow periods can be difficult. Near-shore vegetation is mostly hardwoods and pines in the area of the sampling site. Measured streamflow ranged from 0.05 to 13.1 ft^3/s.

Figure 10. Looking downstream at Robarge Creek. [U.S. Geological Survey (USGS) site 04043194, April 28, 2008. Photograph by T.L. Weaver (USGS).]

Black Creek

Black Creek (USGS station 04043198) is located about 1 mi from Skanee Road where Black Creek Road crosses the creek (fig. 1). The drainage basin at station 04043198 includes an area of about 9.6 mi^2 (fig. 3*A*). The stream channel has a low gradient, flowing through wetlands upstream and downstream at this location and crosses under the road through a corrugated culvert. The channel is composed of silt, sand, and gravel at the road crossing. Hardwoods, cedar, pine, and tag alders and other bushes dominate the near-shore vegetation (fig. 11). Water-quality sampling and streamflow measurements are easily made at the downstream side of the culvert during spring sampling but lack of perceptible flow precludes use of that location in the summer. An alternate site in a channelized area several hundred feet downstream of the wetland was used during the August sampling and is a better year-round site for any future monitoring. However, this alternate site is located on private property, requiring permission to access. The stream channel at the alternate site was composed of silt, sand, and gravel. Measured streamflow ranged from 0.36 to 21.6 ft^3/s.

Figure 11. Looking upstream at Black Creek. [U.S. Geological Survey (USGS) site 04043198, April 29, 2008. Photograph by T.L. Weaver (USGS).]

Huron River at Big Eric's Bridge

Huron River at Big Eric's Bridge (USGS station 04043200) includes an area of 73.2 mi^2 (figs. 1 and 3*A*). The channel upstream of the bridge has a low-to-moderate gradient and is straight for about 100–125 ft before splitting into the East and West Branches of the Huron River (fig. 12*A*). In figure 12a, the East Branch enters from the left and West Branch enters from the right, at the confluence. The upstream channel is composed of sand, rocks, cobbles, and a few boulders. The channel becomes primarily exposed bedrock about 50 ft upstream of the bridge and becomes a series of bedrock controlled falls and riffles for hundreds of feet downstream of the bridge, where the channel cuts through several different rock types, including quartzite and granite (fig. 12*B*). Conditions for water-quality sampling and streamflow measurements are usually good, but during high-flow conditions it can become turbulent. Streamflow was measured at this site previously for low-flow quantification (most recently in August 1976, when 4.74 ft^3/s was measured) but high flows do not appear to have been measured previously. High flows were measured using a boat-mounted acoustic Doppler current profiler three times from April 17–25, 2008, for purposes of defining the upper part of a stage-streamflow rating curve (measured streamflow during that period ranged from 582 to 1,150 ft^3/s). Measured streamflow in 2008 ranged from 7.50 to1,150 ft^3/s.

Figure 12. Looking *A*, upstream and *B*, downstream at Huron River at Big Eric's Bridge. [U.S. Geological Survey (USGS) site 04043200, August 13, 2008. Photograph by T.L. Weaver (USGS).]

Results and Discussion

Water Quality of Streams in the Huron River Watershed

Factors that affect the water quality of a stream are complex and interrelated. Geological and geomorphic characteristics of a watershed, as well as hydrological and biological components of its ecosystem, all affect water chemistry. The Huron River and its tributaries drain a geomorphically diverse watershed comprised of Paleoproterozoic to Archean bedrock, Pleistocene glacial deposits, Holocene beach deposits, and soils developed on varied surficial materials (figs. 4 and 5). Water-quality samples were collected three times at six sites during the period from late April to late August 2008. Samples collected in August 2008 were also analyzed for total and methylmercury at the USGS Mercury Research Laboratory.

A summary of sampling periods and USGS NWQL lab codes and schedules used for this study are provided in table 2. Streamflow, field water-quality parameters, major ions, nutrients, metals, mercury, and suspended sediments are summarized in appendix 2; mercury is also summarized in table 4 in the text.

Table 2. U.S. Geological Survey National Water-Quality Laboratory schedules, and respective analytes used for sampling in the Huron River Watershed, Baraga and Marquette Counties, Michigan.

[NA, not applicable]

Sampling period	Schedule	Analyte
2008	Schedule 2701	Major inorganics
2008	Schedule 2702	Low-level nutrients
2008	Schedule 2044	Trace elements
2008	NA	Suspended sediment
August 2008	NA	Total mercury, unfiltered
August 2008	NA	Methylmercury, unfiltered

Field Water-Quality Parameters, Major Ions, and Alkalinity

Water samples from streams in the Huron River Watershed ranged in pH from 6.7 to 8.4 and 32 to 186 microsiemens per centimeter (µs/cm) for specific conductance. The lowest pH and conductance were measured during spring sampling, except at station 04043198 (fig. 3*A*), which was lower on June 2008. Concentrations of chloride ranged from 0.19 to 3.56 milligrams per liter (mg/L), indicating little effect from septic systems or road-deicing salt. Water samples can be classified as soft to moderately hard (Hem, 1985, p. 159), with concentrations of hardness reported as calcium carbonate ranging from 14 to 94 mg/L. The average hardness of the samples taken at each site during the three sampling visits ranges from 33 to 66 mg/L. Alkalinity, which is a measure of the capacity of a solution to react with and to neutralize acid (Hem, 1985), enables scientists to predict how easily acid rain can affect water quality of a water body. Alkalinity, in most natural waters, is related to higher levels of dissolved carbonate and bicarbonate species, with alkalinity data typically expressed in equivalent calcium carbonate units. Water samples from the Huron River Watershed range in alkalinity from 9 to 90 mg/L equivalent calcium carbonate units. The Huron River sites are considered moderate to nonsensitive to acid rain when compared to the State of Wisconsin's alkalinity standards for surface-water bodies (table 3), as the State of Michigan does not have a standard for alkalinity of surface-water bodies. The Huron River Watershed appears to be most susceptible to effects from acid rain during snowmelt and spring runoff, when alkalinity is lowest.

Table 3. Sensitivity of surface-water bodies to acid rain using alkalinity standards for Wisconsin (Wisconsin Department of Natural Resources, 2004).

[Alkalinity is in units of milligrams per liter as equivalent calcium carbonate; >, greater than]

Sensitivity	Alkalinity
High	0–2
Moderate	>2–10
Low	>10–25
Nonsensitive	>25

Nutrients

One indicator of the water quality of a stream is its biological productivity. Biological productivity may be altered from a stream's natural state when human activities cause an increase in nutrients. Levels of nutrients above a natural "baseline" most commonly result from the effects of septic systems or sewers and agricultural and domestic application of fertilizers. Sewage effluent is the largest single source of phosphorus in natural waters (Hem, 1985); however, the Huron River Watershed is sparsely populated with only a few homes or camps close enough to the streams to impact nutrient levels. There also is an established State of Michigan campground at Big Eric's Bridge (fig. 1) that has several outhouses. However, it is reasonable to assume that nutrient levels measured during this study are representative of nonperturbed or natural "baseline" conditions.

Laboratory analyses showed ranges from an estimated 0.12 to 0.83 mg/L, declining from April to August at all sites except Black Creek (site 04043198; fig. 3*A*), where concentrations of ammonia plus organic nitrogen in unfiltered water approximately doubled over the same period. Concentrations of nitrate plus nitrite in filtered water ranged from 0.02 to 0.21 mg/L. Concentrations of total phosphorus in unfiltered water ranged from an estimated value of 0.006 to 0.023 mg/L. Concentrations of nutrients in the nearby Silver River Watershed are also low. These data indicate little, if any, septic-system, outhouse, or agricultural waste impacts to water quality in the Huron River Watershed.

Manganese, Nickel, Zinc, and Copper

Concentrations of manganese ranged from 2 to 663 micrograms per liter (µg/L). Samples from all sites had concentrations of manganese below 11 µg/L, except for Black Creek (04043198; figs. 1 and 3*A*), which had concentrations of 4.6, 114, and 663 µg/L in April, June, and August, respectively. Concentrations of iron in samples from Black Creek also increased an order of magnitude between April and June to August (160, 923, and 1,540 µg/L, respectively). Concentrations of nickel ranged from 0.35 to 1.6 µg/L, with the highest concentrations found in June and August samples from Robarge Creek and Black Creek (04043194 and 04043198, respectively; figs. 1 and 3*A*). Concentrations of zinc ranged from 1.5 to 15.8 µg/L, and increased at all sites from April to June. Concentrations of copper ranged from 0.56 to 2 µg/L; concentrations in samples from all sites decreased from April to August. No samples had concentrations of copper that exceeded the MDEQ Rule 57 water-quality standard aquatic-maximum value of 7.6 µg/L (MDEQ, 2008).

Mercury

Some streams and lakes in Baraga and Marquette Counties are known to have elevated concentrations of mercury in game fish, but the source of the mercury is unknown. Outside of the Huron River Watershed, sulfide-bearing black shale of the Michigamme Formation can be locally enriched in mercury with values as high as 1.6 parts per million (ppm). Within the Huron River Watershed, a very minor occurrence of cinnabar in the small uranium deposit exposed along the East Branch Huron River is described by Carlson and others (2007). However, these potential bedrock sources are small and isolated, so it is proposed that atmospheric deposition of mercury is the dominant source of mercury to the Huron River Watershed.

Mercury cycling pathways in aquatic environments are very complex. The various forms of mercury can be converted from one to the next; most important is the conversion to methylmercury, which is the most toxic form of mercury to human and aquatic life. An important basin-scale factor that influences production of methylmercury is the abundance of wetlands (Krabbenhoft and others, 1999). Investigations initiated in the late 1980s in the northern-tier states of the United States, Canada, and Nordic countries found that fish, mainly from nutrient-poor lakes and often in very remote areas, commonly have high levels of methylmercury. More recent fish-sampling surveys in other regions of the United States have shown widespread mercury contamination in streams, wetlands, reservoirs, and lakes. As of 1995, 33 States have issued fish-consumption advisories because of mercury contamination (Krabbenhoft and Rickert, 1995).

The August 2008 samples were analyzed for unfiltered total mercury and methylmercury at the USGS Mercury Research Laboratory using established protocols and laboratory methods. Those results and measured pH are summarized in table 4. Unfiltered samples contain both dissolved and particulate forms of mercury.

The lowest concentration of total mercury was sampled at Robarge Creek (station 04043194; figs. 1 and 3*A*), and the highest concentration was sampled at Black Creek (station 04043198; figs. 1 and 3*A*). The lowest concentration of methylmercury was sampled at the unnamed tributary to East Branch Huron River (station 04043183; figs. 1 and 3*A*), and the highest concentration was sampled at Black Creek. The highest ratio of methylmercury to total mercury was at West Branch Huron River (station 04043190; figs 1 and 3*A*) and Black Creek. The ratio of methylmercury to total mercury at sites other than West Branch Huron River and Black Creek is similar to the 5 to 10 percent found in most natural waters (M.E. Brigham, U.S. Geological Survey, written commun., 2009). The ratio of methylmercury to total mercury at Black Creek is 0.27, quite high compared to other sites. This is not surprising given the proximity of the Black Creek sampling site to a large wetland area (fig. 11), although Black Creek has the smallest percentage of wetlands of any of the six sites (table 1). The ratio of methylmercury to total mercury is also high at West Branch Huron River (0.22), although the reason for such a high ratio is not obvious. The small uranium prospect reported to contain very minor cinnabar (Carlson and others, 2007; fig. 2) is upstream of the East Branch Huron River sampling site (station 04043182; fig. 3*A*). This site has the third highest value for total mercury (table 4), but it is unknown if this bedrock source contributes mercury to the river or if other factors are important.

There is a Great Lakes Basin water-quality standard for total mercury in water of 1.8 nanaograms per liter (ng/L) to protect human health from consumption of aquatic organisms

Table 4. Concentrations of total mercury and methylmercury in unfiltered water samples from the Huron River Watershed, Baraga and Marquette Counties, Michigan.

[USGS, U.S. Geological Survey; SW, surface water; QC, quality-control sample, NA, not applicable; < less than]

USGS station number	Parameter	Concentration of unfiltered total mercury, in ng/L	Concentration of unfiltered methylmercury, in ng/L	pH, in standard units	Ratio of methylmercury to total mercury
04043182	SW	1.83	0.15	7.9	0.08
04043182	QC	<0.04	<0.04	NA	NA
04043183	SW	0.93	0.09	8.2	0.10
04043190	SW	1.03	0.23	8.3	0.22
04043194	SW	0.92	0.13	8.4	0.14
04043198	SW	4.50	1.22	7.8	0.27
04043200	SW	2.03	0.27	7.8	0.13

(U.S. Environmental Protection Agency, 1995a) and 1.3 ng/L to protect wildlife health (U.S. Environmental Protection Agency, 1995b). Several samples from this study exceed both standards; however, it should be noted that these are single-point samples collected during a period of late-summer low streamflows, when streams were very clear, carrying little to no suspended load. Additional samples over the range of streamflow and conditions would need to be collected to confirm the persistence of mercury or the need for a health or fishing advisory.

Soils and Streambed Sediments

A complete dataset for mineral soils (A, E, B, and C horizons) is given in appendix 3. Data are also given for a sample of road dust collected from Black Creek Road, one of the many gravel roads in the Huron River Watershed (fig. 2). Data for organic soils (O horizon) are given in appendix 4. Appendix 5 contains the concentrations of 42 elements from the total digestion and partial extraction data for streambed sediments. Table 5 provides median values for concentrations of 41 elements according to soil horizon and for streambed sediments. Because many elements, particularly trace elements, exhibit distributions that vary significantly from normal distributions and commonly approach log-normal distributions, the median is a more valid indicator of central tendency than an arithmetic mean.

Total Digestion for Soils

Table 5 presents the median compositions of Huron River soils and average upper crustal abundances. Results for mineral soil horizons show no remarkably high concentrations compared to calculated upper crustal composition (Wedepohl, 1995) or published analyses of comparable composite samples, such as the North American Shale Composite (Gromet and others, 1984) and a worldwide greywacke composite (Wedepohl, 1995). Data in table 5 show that only arsenic, antimony, and total carbon concentrations in Huron River area soils are greater than average upper crustal concentrations, and all other elements occur at concentrations significantly lower than average upper crustal rocks. This reflects a relatively high content of quartz in these soils. Quartz is a combination of silicon and oxygen with very limited substitution of other elements, and while silicon is not one of the elements quantified by the techniques of this study, visual examination of the soils indicates that quartz is the most abundant mineral component. Because the quartz content of the soils is higher than that found in average upper crustal rocks, this quartz-dilution effect results in relatively low values of most other elements that occur in minerals other than quartz.

Vertical Variability among Soil Horizons

The five soil horizons show statistically significant chemical differences from each other for many elements as indicated by analysis of variance calculations. Figure 13 illustrates graphically the interhorizon variability as box plots. B and C horizons are the most similar to each other and most elements do not differ between the two with a significant probability as indicated by nonparametric Kruskal-Wallis analysis. Only the elements carbon, mercury, and selenium, all elevated in the B horizon relative to C horizon, have probabilities (p) <0.005 of being a single population. Other horizons have a distinctive composition for many elements indicative of various soil-forming processes. The E horizon, a zone of strong leaching, is significantly depleted in many elements compared to the underlying B horizon as shown in table 5 and figure 13. Nearly all elements have lower concentrations in the E horizon than in the underlying B horizon and 19 elements show a highly significant difference ($p<0.005$). The E horizon also differs significantly from the overlying A horizon. Fifteen elements have concentrations in the E horizon lower than in the A horizon with $p<0.005$. The A horizon, by definition, contains substantial organic compounds, which impart some distinctive trends on its chemical composition. For instance, carbon, mercury, selenium, and sulfur are not only significantly more concentrated in the A horizon relative to all underlying horizons, but all four show high mutual correlations (fig. 14). This indicates that mercury, selenium, and sulfur occur mostly bound to or adsorbed onto organic compounds. The O horizon, composed principally of variably decomposed plant matter, is the most chemically distinctive horizon. The dominance of organic matter over mineral components results in a very different set of elemental abundances and correlations compared to underlying mineral soils (table 5 and fig. 13). In particular, cadmium, mercury, phosphorus, sulfur, and zinc are enriched in the O horizon compared to all other horizons. Bismuth, lead, and selenium are also unusually concentrated in the O horizon but at concentrations comparable to the underlying A horizon.

The high concentrations of Bi, Cd, Hg, P, Pb, S, Se, and Zn in surface soils (O and A horizons) reflect the affinity of these elements for organic C, and probably multiple sources. Cadmium is commonly mobilized from deeper soils by plants and accumulates in the O and A horizons by plant decay (Gough and others, 2008). In contrast, the bulk of the mercury in surface soils in the Lake Superior region has probably atmospherically deposited from long-distance, global sources (Wiener and others, 2006). It is possible that other elements, such as bismuth, selenium, sulfur, and zinc, may have a local geologic source, and could have been deposited onto surface soils as dust. If the chemistry of the road dust sample (appendix 2) is somewhat typical of the finer material that can become airborne and transported as particulates when conditions are right, there is potential for loading of metals to forest soils along unpaved roadways in parts of the Huron River Watershed. Most soil samples were collected a minimum of 50 feet from unpaved roads, but it is impossible to estimate any impact from road dust without a more detailed study.

Lateral Variability for Soils

Soils within the watershed developed on three principal types of parent glacial deposits (fig. 5) that are derived largely

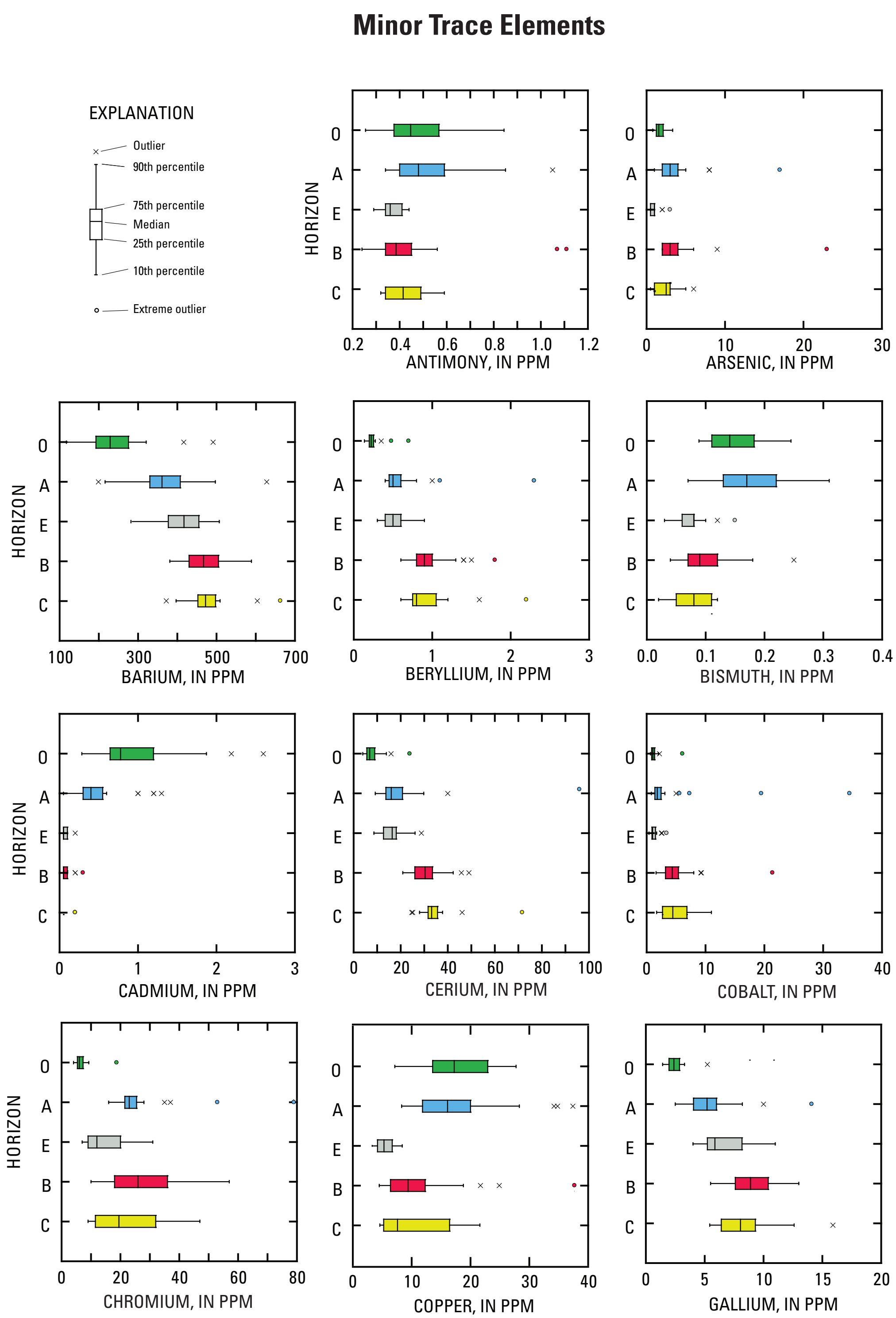


Figure 13. Box plots showing the distribution of major and minor elements in soils by horizon for the Huron River Watershed, Marquette and Baraga Counties, Michigan.

from the three principal types of underlying bedrock (fig. 4). Examination of pebble lithologies of the glacial deposits indicates that they are composed largely of local bedrock and that the makeup of the deposits should be dominated by the type of underlying bedrock.

The lateral variability of the various soil horizons, both in map form and statistically, were tested for significant changes that could be related to the geochemistry of local bedrock. Kruskal-Wallis statistical analyses were completed that used the type of underlying bedrock as a categorical variable. Results indicated a low probability that observed distributions of elements were a single population for most elements in several soil horizons. B-horizon soils show the strongest trend toward multiple populations that could be related to

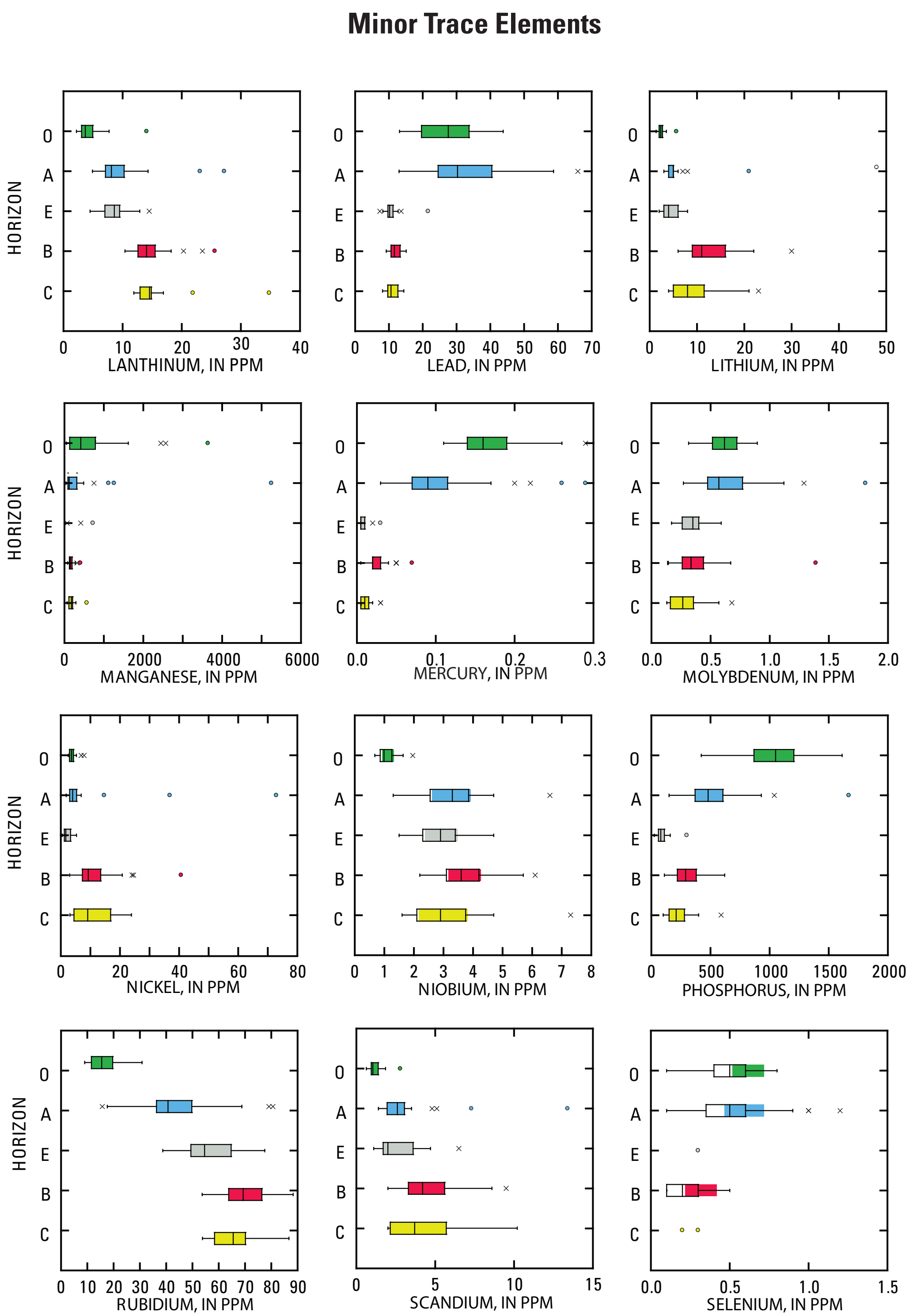


Figure 13—Continued. Box plots showing the distribution of major and minor elements in soils by horizon for the Huron River Watershed, Marquette and Baraga Counties, Michigan.

differing bedrock sources. The elements in the B horizon that likely have multiple populations [and their probabilities (*p*) of being a single population; that is, $p < 0.05$)] are: Al ($p<0.014$), Cr ($p<0.019$), Li ($p<0.020$), Mo ($p<0.003$), Ni ($p<0.013$), Pb ($p<0.084$), Sc ($p<0.017$), Se ($p<0.035$), Sr ($p<0.013$), Tl ($p<0.042$), V ($p<0.038$), and Zn ($p<0.021$). The C horizon has fewer elements with multiple population trends; however, Al ($p<0.054$), Ca ($p<0.017$), Cr ($p<0.066$), Li ($p<0.035$), Na ($p<0.029$), Ni ($p<0.050$), and Sr ($p<0.030$) all appear to record at least two populations. The A horizon is more uniform, with only cobalt, niobium, and strontium showing a tendency of multiple populations.

Kruskal-Wallis analysis does not identify the source of significant variability (such as, slate of the Michigamme

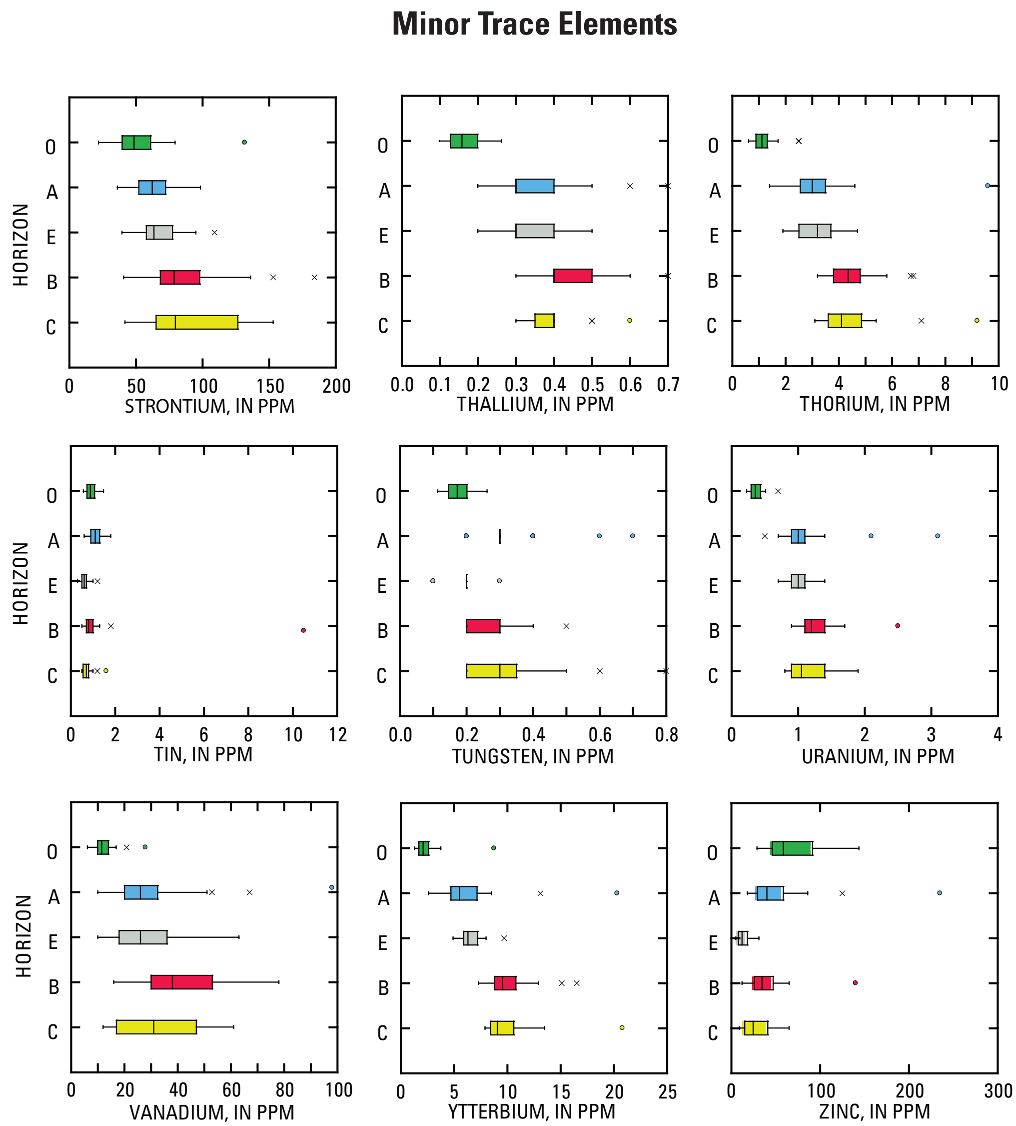


Figure 13—Continued. Box plots showing the distribution of major and minor elements in soils by horizon for the Huron River Watershed, Marquette and Baraga Counties, Michigan.

Formation versus Archean granitic gneiss), and only tests for the probability that the observed element concentrations are from a single statistical population. Other types of analysis-of-variance tests are hampered by the relatively small number of soil samples collected in some categories. For instance, only five sample sites are over the Jacobsville Formation and six sites are over Archean granitic gneiss. Therefore, the distributions of elements in map form compared to both the bedrock geology and glacial geology were examined. Two trends are evident: (1) many elements are low at sites over the Jacobsville Formation compared to sites over the other bedrock types. This probably reflects soils that formed from very sandy parent materials derived largely from the Jacobsville Formation. The sand is composed mostly of quartz and feldspar. The relative scarcity of finer grained mineral phases, such as clays or mafic minerals that are most likely to include many trace elements, is the probable cause of the observed low values; (2) most sites over the Michigamme Formation have relatively high concentrations of a number of elements, compared to soils developed over the Jacobsville Formation. Bedrock of the Michigamme Formation is the most chemically and mineralogically diverse of the bedrock types, and soils formed over it have significant enrichments of Al, Cr, Li, Mo, Ni, Pb, Sc, Se, Sr, Tl, V, and Zn. These elements are typically elevated in fine-grained clastic rocks; thus, it can be concluded that local bedrock has a significant influence on the concentrations of many elements for soils within the study area. From these two observations, it is apparent that local bedrock has a significant influence on the concentrations of many elements in soil geochemistry within the watershed.

A- and C-horizon soils from sites 02, 04, and 18 (fig. 3*B*) have relatively elevated concentrations, compared to other soils, of a small group of elements, including Fe, As, Be, Ce, Co, Cr, La, Li, Ni, P, Sc, Th, Tl, V, Y, and Z. For example, the A horizon at site 02 has 1.2 ppm cadmium, 9.6 ppm thorium, 3.1 ppm uranium, 98 ppm vanadium, and 20.3 ppm yttrium.

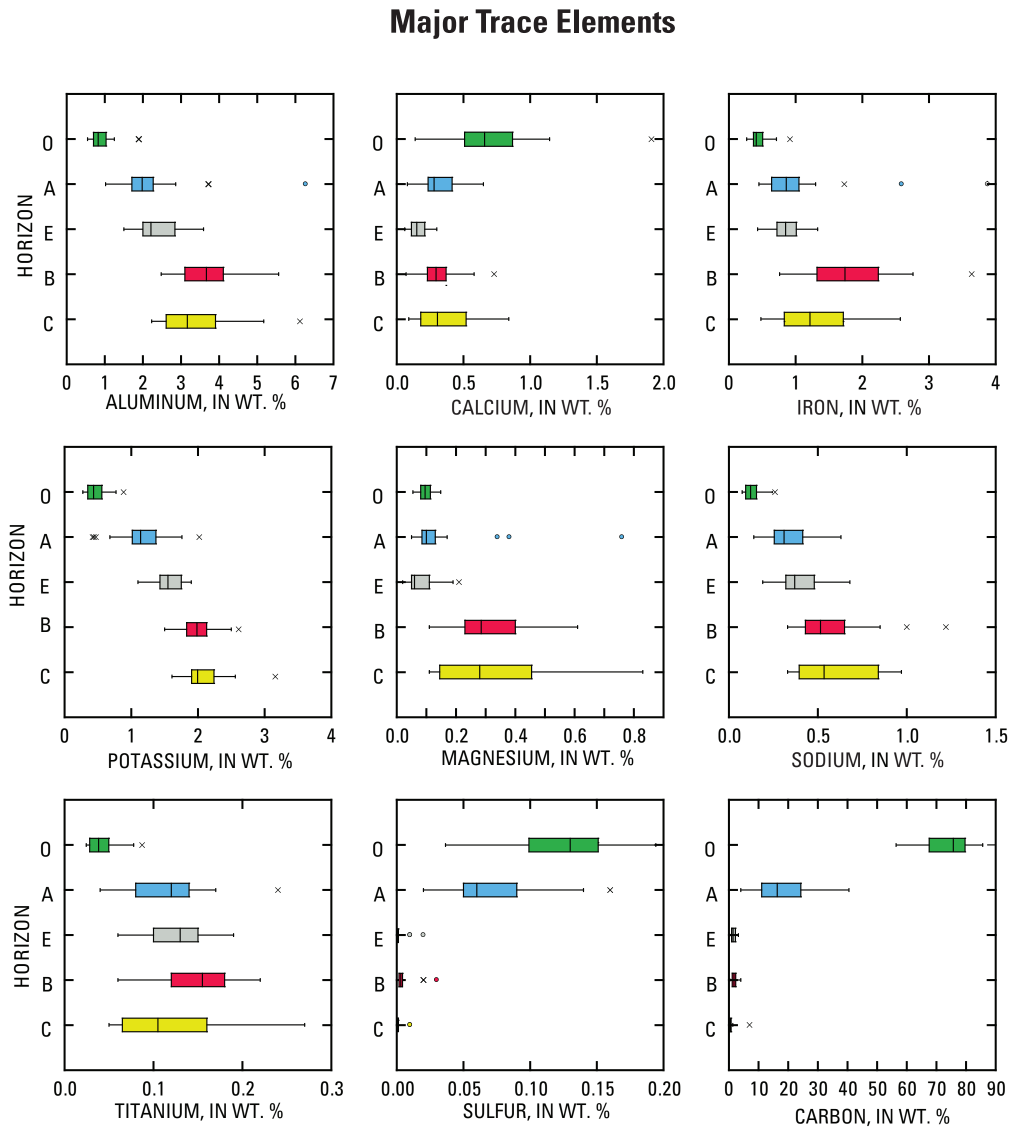


Figure 13—Continued. Box plots showing the distribution of major and minor elements in soils by horizon for the Huron River Watershed, Marquette and Baraga Counties, Michigan.

Soil from the C horizon for site 04 has 9.2 ppm thorium, 1.9 ppm uranium, and 20.8 ppm yttrium. These values are relatively elevated compared to the median values given in table 5. Both sites are down ice (in the direction of glacial transport from ice movement) from the small uranium prospect exposed in the East Branch of the Huron River described by Carlson and others (2007; fig. 2). This small prospect has unusual geochemistry that includes a suite of cadmium-uranium-vanadium-bearing minerals. It is possible that the relatively enriched values for metals and other elements in these two soil samples reflect contributions from mineralized rock incorporated during glaciation. Site 18 was very stony, with abundant rocks derived from the Michigamme Formation. Soils from the A and B horizons are relatively enriched in scandium, vanadium, and zinc, along with high iron and manganese concentrations, compared to other soils from the study area. This grouping of elements suggests enrichment of metals adsorbed to iron and manganese oxyhydroxides in the soils.

Total Digestion of Streambed Sediments

Streambed sediments represent an integration of both space and time within a stream. Streambed sediments are a product of the weathering and transport of minerals from rocks and soils and the interaction of these minerals with stream waters. Because of their typical fine-grain size, streambed sediments often are a sink for trace metals and contaminants and can, under changing environmental conditions, become suspended sediment, potentially influencing water quality. Thus, streambed sediments are an essential component to any baseline study that includes water quality and soil chemistry.

The 11 sites for this study were selected near the confluences of tributaries to integrate contributions from the majority of the watershed (fig. 3*C*). Median values for 39 elements in streambed sediments are given in table 5. Streambed sediments were not analyzed for carbon contents and most samples were below the lower limit of detection for selenium (<0.2

Table 5. Median values for concentrations of 41 elements in O-, A-, E-, B-, and C-horizon soils and from streambed sediments from the Huron River Watershed, Marquette and Baraga Counties, Michigan.

[NA, not analyzed; wt. %, weight percent; ppm, parts per million]

Element	Median O	Median A	Median E	Median B	Median C	Upper crust	C horizon/ upper crust	Streambed sediments
Al wt. %	0.81	1.98	2.21	3.67	3.17	7.7	0.41	3.96
Ca wt. %	0.66	0.28	0.15	0.30	0.31	2.9	0.11	0.74
Fe wt. %	0.41	0.86	0.85	1.74	1.22	3.1	0.39	2.41
K wt. %	0.42	1.14	1.55	1.99	2.00	2.9	0.69	2.60
Mg wt. %	0.10	0.10	0.06	0.29	0.28	1.35	0.21	0.36
Na wt. %	0.12	0.31	0.37	0.52	0.54	2.6	0.21	0.79
S wt. %	0.13	0.06	<0.01	0.01	0.01	0.1	0.05	0.02
Ti wt. %	0.03	0.12	0.13	0.16	0.11	0.3	0.35	0.30
As ppm	1.60	3.00	1.00	3.00	1.00	2	0.50	3.96
Ba ppm	228.30	361.00	417.00	467.00	472.00	668	0.71	608
Be ppm	0.20	0.50	0.50	0.90	0.80	3	0.27	0.80
Bi ppm	0.10	0.17	0.08	0.09	0.08	0.1	0.80	0.11
Cd ppm	0.80	0.45	<0.1	<0.1	<0.1	0.1	N.A.	0.20
Ce ppm	6.80	16.00	16.40	30.70	33.15	65	0.51	41.2
Co ppm	1.10	1.80	1.00	4.40	4.45	11	0.40	6.40
Cr ppm	5.90	23.00	12.00	27.00	19.50	35	0.56	34
Cu ppm	17.20	16.10	5.30	9.40	7.60	14	0.54	11.8
Ga ppm	2.30	5.20	5.87	9.00	8.05	14	0.57	9.08
Hg ppm	0.16	0.09	<0.01	0.02	0.01	0.06	0.17	0.03
La ppm	3.70	8.10	8.60	14.10	14.55	32	0.45	20.2
Li ppm	2.30	5.00	4.00	11.00	8.00	22	0.36	10
Mn ppm	407.00	121.00	85.00	149.00	175.00	572	0.31	489
Mo ppm	0.60	0.57	0.35	0.34	0.27	1.4	0.19	0.53
Nb ppm	1.00	3.30	2.90	3.60	2.90	26	0.11	5.20
Ni ppm	3.60	4.00	1.70	9.60	9.10	19	0.48	14.7
P ppm	1041.00	480.00	85.00	290.00	210.00	665	0.32	340
Pb ppm	28.00	30.30	10.20	11.70	10.60	17	0.62	14.80
Rb ppm	15.50	40.70	54.60	69.30	65.50	110	0.60	82.6
Sb ppm	0.50	0.48	0.36	0.39	0.42	0.3	1.38	0.59
Sc ppm	1.00	2.60	2.00	4.40	3.70	7	0.53	5.90
Se ppm	0.50	0.50	<0.02	0.30	<0.2	0.1	N.A..	<0.2
Sn ppm	0.90	1.10	0.60	0.80	0.70	2.5	0.28	1.00
Sr ppm	48.60	62.20	63.50	79.30	79.55	316	0.25	122.00
Th ppm	1.10	3.00	3.20	4.40	4.10	10	0.41	6.60
Tl ppm	0.20	0.30	0.30	0.40	0.40	0.75	0.53	0.50
U ppm	0.30	1.00	1.00	1.20	1.05	2.5	0.42	1.60
V ppm	11.50	26.00	26.00	38.00	31.00	53	0.58	64
W ppm	0.20	0.30	0.20	0.30	0.30	1.4	0.21	0.30
Y ppm	1.90	5.50	6.30	9.70	9.05	20	0.45	12.9
Zn ppm	58.50	40.00	12.00	36.00	24.50	52	0.47	47
C wt. %	75.70	16.30	1.50	1.70	0.50	0.3	1.67	NA

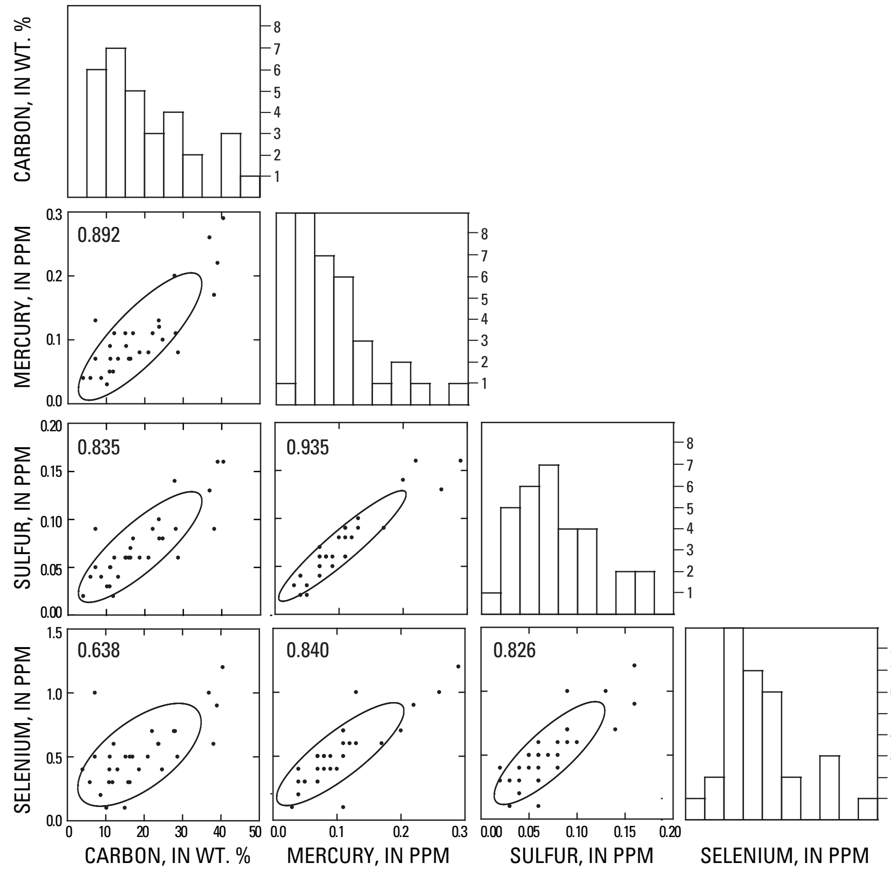


Figure 14. Scatterplot matrix showing element correlation matrices for carbon, mercury, sulfur, and selenium in A-horizon soils for the Huron River Watershed, Marquette and Baraga Counties, Michigan.

ppm). Median values for all other elements are consistently higher than comparable median values for C-horizon soils (table 5). This is likely a result of the different size fractions of the two media, <2 mm for soils and <150 µm for streambed sediments. Geochemical differences between the two size fractions are the result of mineralogic partitioning, with concentration of minerals such as quartz in a coarser fraction and clay minerals in a finer fraction (Klassen, 1998). Thus, in this study the coarser grained soil fraction would have higher quartz concentrations compared to the finer grained stream sediments. The quartz-dilution effect (discussed above) would, therefore, suppress the concentrations of all elements other than silicon (Si) in soils compared to streambed sediments.

The geochemistry of the streambed sediments (table 5) reflects the natural variability that would be expected in a heterogeneous terrane, and there is little indication of trace metal contamination. The streambed sediment sample from the East Branch Huron River, collected just upstream from the confluence with the West Branch Huron River to form the Huron River (sample 7; fig. 3*C*), has values for Fe, Ce, Hg, La, Th, U, V, and Y that are notably higher than values for the other samples. This sample was collected downstream from the small uranium prospect with similarly unusual geochemistry that crops out in the East Branch Huron River (fig.2). The somewhat anomalous geochemistry of this sample might reflect this prospect. Streambed sediment sample 3 (fig. 3*C*), which was collected just downstream from the prospect, has a mercury concentration of 0.05 ppm, somewhat higher than the median value of 0.03 ppm, but is not anomalously rich in the other elements typical of the uranium prospect. Other streambed sediments have occasional metal values somewhat greater than the median, such as 24 ppm niobium for the streambed sediment sample 5 collected at the mouth of Robarge Creek (fig. 3*C*) and 11 ppm arsenic for the bed-sediment sample 11 collected along the upper reaches of the East Branch Huron River (fig. 3*C*). These somewhat enriched metal values are interpreted to reflect a natural geochemical variability in the watershed rather than point sources for metals.

Partial Digestion of Soils and Streambed Sediments

Complete data for the partial extraction (Aliquot/MIBK) technique applied to A-, E-, B-, and C-horizon soils are included with the total digestion data in appendixes 3 and 5. This relatively weak extraction mobilizes elements loosely bound to iron and manganese oxyhydroxides grain coatings and to soil organic material. Thus, a partial extraction method provides concentrations of elements that might be easily mobilized into groundwater or surface water, and potentially relatively available for biological uptake. This is in contrast to the relatively immobile behavior of those same elements when they are part of the crystal structure of minerals. Partial extraction provides concentrations of 10 elements, 7 of which (Ag, As, Cd, Cu, Mo, Pb, Zn) were present in quantifiable amounts. Median values for those 7 elements in soils and streambed sediments are shown in table 6. Three elements (antimony, bismuth, and gold) were not detected in any of the samples.

Comparing the concentrations of six elements that are common to both the partial extraction analyses and the near-total digestion method shows a very strong correlation with each other for all elements. Nonparametric Spearman correlation coefficients for the six elements are shown in table 7. Silver is not included in this correlation because it rarely is detected in soil samples. This near identity of concentrations between the two techniques indicates that these six elements occur in a form that is relatively easily mobilized and, under suitable circumstances, could be mobilized into solution in natural waters. In the original bedrock and soil parent material, these metals would most likely have occurred in sulfide minerals, which would not react and release the metals to a weak extraction technique. Based on the correlation in table 7, apparently nearly all sulfide minerals in all soil horizons and stream sediments have broken down chemically during weathering and these six elements have been incorporated into new, readily soluble compounds.

Median partial extraction values for the streambed sediments also are higher than median values for C-horizon soils (table 6). Partial extraction values for arsenic, copper, lead, and zinc all correlate well with total extraction data, while the correlations for cobalt and molybdenum are somewhat weaker (table 7). There is no obvious pattern to these weaker correlations.

Ecological Assessment

Michigan Department of Environmental Quality (MDEQ) Study Results

During summer 2006, MDEQ Water Bureau biologists assessed biological, chemical, and habitat conditions from a number of watersheds in the Upper Peninsula of Michigan, including the Huron River Watershed. The following information is largely excerpted from an MDEQ Staff Report

Table 6. Median values for concentrations of seven elements [arsenic (As), cadmium (Cd), copper (Cu), lead (Pb), molybdenum (Mo), silver (Ag), and zinc (Zn)] from partial extractions of O-, A-, E-, B-, and C-horizon soils and from streambed sediments from the Huron River Watershed, Marquette and Baraga Counties, Michigan.

[ppm, parts per million]

Element	A Horizon	E Horizon	B Horizon	C Horizon	Streambed sediments
Ag ppm	0.65	0.51	0.60	0.42	0.80
As ppm	3.00	1.50	3.00	2.50	3.50
Cd ppm	0.45	0.13	0.16	0.12	0.36
Cu ppm	15.35	4.31	10.40	6.15	11.95
Mo ppm	0.70	0.40	0.50	0.30	0.45
Pb ppm	26.50	11.00	12.00	11.00	14.50
Zn ppm	40.25	13.45	37.30	25.35	46.75

Table 7. Spearman nonparametic correlation coefficients for total digestion and partial digestion analyses for six elements [arsenic (As), cadmium (Cd), copper (Cu), lead (Pb), molybdenum (Mo), and zinc (Zn)] common to soils and streambed sediments collected Huron River Watershed, Marquette and Baraga Counties, Michigan.

[Correlation coefficient determination for Cd is not possible because of insufficient data for cadmium concentrations in soils; --, no data]

Element	A Horizon	E Horizon	B Horizon	C Horizon	Streambed sediments
As	0.987	0.906	0.991	0.892	0.888
Cd	0.983	0.831	0.899	--	0.655
Cu	0.991	1.000	0.965	1.000	0.957
Mo	0.988	0.864	0.871	0.801	0.570
Pb	0.989	0.976	0.893	0.982	0.744
Zn	0.999	0.993	0.997	0.998	0.983

summarizing those activities (MI/DEQ/WB-07/080). Due to concerns about sedimentation from logging and other activities within the watershed, the MDEQ targeted the 6-mile reach of the Huron River from Big Eric's Bridge (USGS site 04043200; figs. 1 and 3*A*) downstream to the river's mouth (fig. 1). Locations of the 2006 MDEQ stations are shown in figure 3*D* and USGS sites are shown in figure 3*A*. To evaluate the current status of the stream, a modified GLEAS 51 procedure consisting of macroinvertebrate and habitat assessment was completed at one site within this reach (station 56) and also at a nonimpacted control or probabilistic site (station 19) located on the East Branch Huron River about 6 road miles upstream of USGS site 04043183. MDEQ also conducted habitat-only assessments at three additional sites: downstream of station 56 (station 82), on the West Branch Huron River about 0.5 miles upstream of its confluence with Black Creek (station 84), and at USGS station 04043190 (station 83). The three additional sites were assessed to evaluate sediment deposition in the upstream parts of the watershed.

Macroinvertebrate communities rated excellent at stations 19 and 56, with a total of 31 and 34 taxa, respectively. More than half of the individuals collected were taxa comprising *Ephemeroptera* (mayflies), *Plecoptera* (stoneflies), and *Trichoptera* (caddisflies). Habitat was rated excellent at the three stations upstream of Big Eric's Bridge, and good at the two downstream stations. Stations 19 and 83, which are located furthest upstream, had stable gravel banks, little sediment deposition, and a substrate dominated by cobble, gravel, and boulders. The epifaunal substrate and available cover at these sites also scored excellent. Stations 82 and 56, located downstream of Big Eric's Bridge, had moderate sediment deposition and several areas of bank erosion. The epifaunal substrate and available cover at these sites scored marginal. The substrate at station 56 was dominated by cobble and gravel, but was covered with silt while the substrate at station 82 was dominated by sand.

Michigan Department of Natural Resources (MDNR) Study Results

The MDNR subdivided the Huron River Watershed into five "valley segments." Valley segments are portions of the river that are similar in character with respect to gradient, streamflow, fish communities, and instream and riparian habitat. Within the 5 valley segments, MDNR selected 24 survey stations that would be representative of the watershed. Volunteers recorded instream and riparian physical landscape features and took digital images of specific habitat features at selected stations. Data were entered into a GIS. Survey parameters for each station included measurements of channel width and depth, substrate composition, riparian bank slope and vegetation, streamflow and velocity, and macroinvertebrate composition. Aquatic macroinvertebrates were sampled using two procedures. The first procedure comprised a general sampling of aquatic macroinvertebrates in an area and was accomplished with two people scrubbing instream woody debris, rocks, detritus, and soft vegetation for 15 minutes, after which a general assessment of abundance and types of macroinvertebrate was determined. The second procedure followed the Michigan Clean Water Corps (Mi Corps) protocols for documenting stream-habitat parameters and benthic macroinvertebrates (MDEQ, 2003).

Using the Mi Corps protocols, 11 sites within the watershed were chosen to represent the benthic character of the watershed in the study conducted in July and August 2008. The MDNR trained the volunteers prior to sampling to ensure that all volunteers were using the same terminology, methodology, and protocols. Volunteers completed a visual assessment of stream conditions and watershed characteristics on approximately 300 linear feet of stream at each sampling site. Macroinvertebrates were collected, identified to the order level, and tallied to determine diversity in the benthic community. Five sites had a stream-quality score of fair, one site scored good, and one site scored excellent. The two highest quality sites are both located in the upper part of the East Branch Huron River subwatershed. Macroinvertebrate data for 7 of 11 sites sampled in 2008 were provided by MDNR (George Madison, MDNR, written commun., 2009); however, the quality of macroinvertebrate data from 2008 study was inconsistent and was not reported here.

No fish survey was conducted concurrent with either the MDEQ or MDNR investigations, but fisheries surveys conducted in the Huron River Watershed over the past 60 years have confirmed that brook trout (*Salvenius fontinalis*) is the primary salmonid that resides in the watershed year round. Other MDNR fisheries surveys indicate numerous other species of fish in the watershed as well.

Future Baseline Studies in the Lake Superior Basin

As with any study of this type, the scope of the study is constrained not only by the purpose of the study, but also by the timeframe and budget. This study in the Huron River Watershed was designed to fit within a single sampling season and with a modest field and laboratory budget. The lessons learned from this experience suggest several possibilities for water-quality, soil, and bed-sediment sampling for a baseline study. The utility of this study was enhanced by the use of ancillary ecological data collected by other agencies, such as the MDEQ and the MDNR.

Water-Quality Sampling

In this study of the Huron River Watershed, five water-quality sampling sites were chosen that account for much, but not all, of the streamflow in the watershed upstream of the confluence of the East and West Branches of the Huron River; a sixth site at Big Eric's Bridge is downstream of nearly all major tributaries, but upstream of the low-gradient part of the stream near the mouth. In the Huron River Watershed, measured field water-quality parameters and analysis of major inorganics, nutrients, and a suite of trace metals defined a watershed that primarily has good water quality. The major inorganics were typical of Upper Peninsula streams; nutrient concentrations were very low, indicating little to no human impact, and concentrations of most metals were quite low as well. Previous studies of the fishery and the ecology of the watershed also defined a good- to excellent-quality stream.

The objective of sampling for surface-water baseline data is to obtain analyses of all constituents impacting a watershed at as many locations as possible (or necessary to adequately define conditions within the watershed), within the constraints of the scope and budget of the project. The six sites selected for this study were chosen because they comprise the bulk of the water flowing through the Huron River system and were accessible by seasonal roads. An understanding of the water chemistry of the watershed may have been improved by including additional sampling sites, particularly for several small tributaries to the East Branch Huron River, but several factors had to be considered during sample design. A primary factor for this study was the budget constraint for both field time and for analytical costs. While much of the watershed is crisscrossed by railroad grades and logging roads of various ages, vehicular access to large sections of the Huron River Watershed is limited and difficult to impassable in the spring when the roads are still covered with snow or excessively muddy. Selection of sites far from usable roads would have imposed sampling constraints for both equipment and field time. Prior understanding of the accessibility to prospective sampling sites is crucial to success of a baseline water-quality study. In addition, some tributaries in the Huron River Watershed have little or no flow during the summer months. Therefore, care must be exercised when selecting sites to ensure that they are not ephemeral and that a complete sampling cycle can be completed.

As noted previously, determining what sampling schedules and procedures would best define baseline water quality in a watershed is critical to the success of a study. For the Huron River study, samples were collected three times from April through August to capture a range of flow conditions, with major inorganics, nutrients, and trace elements analyzed for each sampling. Mercury was analyzed only from the August low-flow samples. Three sites—East Branch Huron River, Black Creek, and the Huron River—all had concentrations of total mercury exceeding USEPA standards. The sampling schedules for major inorganics, nutrients, and trace metals used in this study are probably adequate for future baseline monitoring of most streams in the Great Lakes Basin. However, collecting mercury samples over a range of streamflow conditions would provide a better understanding of the distribution of this element of environmental concern. If mercury is analyzed as part of future water-quality sampling, dissolved organic carbon would be a useful inclusion in the analytical package because much can be learned about mercury in water from the mutual concentrations of these two constituents.

Soil and Streambed Sediment Sampling

A major part of this study within the Huron River Watershed was to determine baseline soil geochemical data. For this study area, the relatively uniform climate of the limited geographic region meant that underlying surficial geology was the probable critical factor controlling soil geochemistry. This was confirmed by examining the lateral geochemistry of the soils across the differing geologic units that showed local bedrock has a significant influence on the concentrations of many elements in overlying glacial deposits, and, therefore, on soil geochemistry within the watershed.

Determining baseline soil geochemistry, which represents a snapshot in time of the distribution of various elements, requires an understanding of the vertical distribution of elements within a soil profile. The vertical geochemistry of the different soil horizons in Huron River Watershed showed considerable geochemical variability among the different horizons, which emphasizes the need to collect multiple samples at a single site. Not all sites may have an O horizon present, and so there may not be good spatial distribution of O-horizon geochemistry. Soils from an E horizon are typically leached of many elements, and thus provide little information of parent material chemistry or soil processes. The geochemistry of B-horizon soils provides valuable information on soil-forming processes, but data from the B horizon are not necessarily appropriate for soil background determination. The high-metal content of the road dust sample provides a lesson that collecting samples a sufficient distance from roads avoids any contamination from airborne particles.

The 11 streambed-sediment sites selected provided adequate coverage for the watershed. Increased sampling density could provide additional data, but results may not extend the range of background data. Results from the streambed sediment sampling point to the potential value of a followup study, with increased sampling density both upstream and downstream of the small uranium prospect on the East Branch Huron River. The somewhat elevated mercury values for the two samples downstream from the prospect suggest there could be some contribution of metals to bed sediments from these mineralized rocks, and potentially to water, but the extent of any potential contribution cannot be determined from the current set of samples.

The results from this study suggest the following for future soil and streambed geochemical baseline studies in the region: (1) Stratifying sample site selection on surficial geology rather than randomly selected or selected on a grid will help to ensure that diverse soil geochemistry across multiple soil parents is captured and adequate samples in different categories are available for statistical analysis. (2) Collecting soils by horizon rather by depth eliminates the geochemical variability that might result from the possible mixing of chemically diverse soil horizons in random percentages that can result from depth sampling. (3) Element concentrations in C-horizon soils might more closely reflect the ”natural” background concentration of an element, while the geochemistry of an A horizon might also capture the influence of human activities, as well as short- and long-distance transport and atmospheric deposition of some trace metals. Collecting, at a minimum, A- and C-horizon soils from each site would help ensure that both parameters are taken into account. (4) Streambed sediments are best collected during low flow when deposition sites are best accessed, and the finer fraction analyzed. (5) For streambed sediments and especially for soils, partial-digestion data for most elements correlated well with element concentrations from the total digestion, confirming that most elements are in a readily soluble form. It is suggested that the results from the total digestion of both samples is adequate to estimate the readily leachable fraction of this suite of metals, making an added expense for partial-digestion analysis unnecessary.

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Appendix 1. List of Abbreviations

GLEAS	Great Lakes Environmental Assessment Section
KBIC	Keweenaw Bay Indian Community
LLD	lower limit of detection
LRL	laboratory reporting level
LT–MDL	long-term method detection limit
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
MDL	method detection limit
MRL	minimum reporting level
NFM	national field manual
NOAA	National Oceanic and Atmospheric Administration
NWIS	National Water Information System
NWQL	National Water Quality Laboratory
PPM	parts per million
QA	quality assurance
QC	quality control
QAPP	Quality-Assurance Program Plan
QA/QC	quality assurance/quality control
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
wt. %	weight percent

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Appendix 2. Physical Properties and Concentrations of Major Elements, Solids, Nutrients, Metals, and Suspended Solids, East Branch Huron River Downstream of East Branch Falls Near McComb Corner, Baraga County, Michigan

Appendix 2A. Physical properties and concentrations of major elements, solids, nutrients, metals, and suspended solids, East Branch Huron River downstream of East Branch Falls near McComb Corner, Baraga County, Michigan.

[°C, degrees Celsius; mm/Hg, millimeters of mercury; ft³/s, cubic foot per second; µs/cm, microseimens per centimeter; unfil, unfiltered; mg/L, milligrams per liter; std units, standard units; E, estimated value; <, less than; fil, filtered; N, nitrogen; P, phosphorous; $CaCO_3$, calcium carbonate; µg/L, micrograms per liter; ng/L, nanograms per liter; --, no data; tons/day, tons per day; tons/acre-ft, tons per acre-foot; mm, millimeter]”

USGS site	Parameter code		Reporting units	Sampling date		
				4/29/2008	6/25/2009	8/13/2009
4043182	00010	Water temperature	°C	2.5	17.5	16
	00025	Barometric pressure	mm/Hg	745	742	739
	00061	Streamflow, instantaneous	ft³/s	75	7.2	4.4
	00095	Specific conductance	µS/cm @ 25°C	32	83	104
	00300	Dissolved oxygen, water, unfil	mg/l	13.4	9	9.2
	00400	pH, unfil	std units	7	7.8	7.9
	00453	Bicarbonate, water, fil, incremental titration	mg/l	11	41	58
	00600	Total nitrogen, water, unfil	mg/l	0.37	E.28	E.2
	00602	Total nitrogen, water, fil	mg/l	0.38	E.36	E.26
	00608	Ammonia, water, fil	mg/l as N	<.02	<.02	<.02
	00613	Nitrite, water, fil	mg/l as N	<.002	<.002	E.001
	00618	Nitrate, water, fil	mg/l as N	--	--	E.02
	00623	Ammonia plus organic nitrogen, water, fil	mg/l as N	0.32	0.33	0.24
	00625	Ammonia plus organic nitrogen, water, unfil	mg/l as N	0.32	0.25	0.18
	00631	Nitrate plus nitrite, water, fil	mg/l as N	0.05	E.04	E.02
	00660	Orthophosphate, water, fil	mg/l	--	--	E.014
	00665	Phosphorus, water, unfil	mg/l	0.009	E.007	E.004
	00666	Phosphorus, water, fil	mg/l	E.005	E.005	<.006
	00671	Orthophosphate, water, fil	mg/l as P	<.006	<.006	E.004
	00900	Hardness, water	mg/l $CaCO_3$	14	40	52
	00904	Noncarbonate hardness, water, fil	mg/l $CaCO_3$	5	6	4
	00915	Calcium, water, fil	mg/l	3.9	11.7	15.3
	00925	Magnesium, water, fil	mg/l	0.946	2.53	3.25
	00930	Sodium, water, fil	mg/l	0.58	1.11	1.36
	00932	Sodium fraction of cations, water	percent	8	6	5
	00935	Potassium, water, fil	mg/l	0.41	0.55	0.63
	00940	Chloride,water, fil	mg/l	0.19	0.38	0.46
	00945	Sulfate, water, fil	mg/l	2.65	3.18	3.81
	00950	Fluoride,water, fil	mg/l	<.12	<.12	<.12
	00955	Silica, water, fil	mg/l SiO_2	4.92	6.48	7.57
	01000	Arsenic, water, fil	µg/l	0.28	0.65	0.59
	01005	Barium, water, fil	µg/l	5	9	11
	01010	Beryllium, water, fil	µg/l	<.01	E.01	<.01
	01025	Cadmium, water, fil	µg/l	E.03	E.03	E.03

Appendix 2A. Physical properties and concentrations of major elements, solids, nutrients, metals, and suspended solids, East Branch Huron River downstream of East Branch Falls near McComb Corner, Baraga County, Michigan.—Continued

[°C, degrees Celsius; mm/Hg, millimeters of mercury; ft³/s, cubic foot per second; µs/cm, microseimens per centimeter; unfil, unfiltered; mg/L, milligrams per liter; std units, standard units; E, estimated value; <, less than; fil, filtered; N, nitrogen; P, phosphorous; $CaCO_3$, calcium carbonate; µg/L, micrograms per liter; ng/L, nanograms per liter; --, no data; tons/day, tons per day; tons/acre-ft, tons per acre-foot; mm, millimeter]"

USGS site	Parameter code	Reporting units	Sampling date		
			4/29/2008	6/25/2009	8/13/2009
01030	Chromium,water, fil	µg/l	0.24	0.18	0.14
01035	Cobalt, water, fil	µg/l	0.04	0.05	0.04
01040	Copper, water, fil	µg/l	1.4	1.4	E.65
01046	Iron, water, fil	µg/l	136	130	84
01049	Lead, water, fil	µg/l	0.1	E.06	<.08
01056	Manganese, water, fil	µg/l	3.8	2.5	2
01060	Molybdenum, water, fil	µg/l	<.2	E.2	0.3
01065	Nickel, water, fil	µg/l	0.48	0.64	0.52
01075	Silver, water, fil	µg/l	<.1	<.1	<.1
01090	Zinc, water, fil	µg/l	3.2	4.3	4.2
01095	Antimony,water, fil	µg/l	<.14	<.14	<.14
01106	Aluminum,water, fil	µg/l	100	25.9	13.6
01145	Selenium,water, fil	µg/l	0.06	0.1	0.08
22703	Uranium (natural), water, fil	µg/l	0.02	0.06	0.07
39086	Alkalinity, water, fil, inflection-point titration	mg/l $CaCO_3$	9	34	48
50284	Methylmercury, water, unfil, recoverable	ng/l	--	--	0.15
50286	Mercury, water, unfil	ng/l	--	--	1.83
70300	Residue on evaporation, dried at 180°C	mg/l	40	59	80
70301	Residue, water, fil, sum of constituents	mg/l	E20	E46	E61
70302	Residue, water, dissolved	tons/day	8.02	1.14	0.94
70303	Residue, water, fil	tons/acre-ft	0.05	0.08	0.11
70331	Suspended sediment, sieve diameter	percent <0.063 mm	67	55	71
71851	Nitrate, water, fil	mg/l	--	--	E.083
71856	Nitrite, water, fil	mg/l	--	--	E.004
71890	Mercury, water, fil	µg/l	<.01	<.01	--
80154	Suspended sediment concentration	mg/l	1	3	2
80155	Suspended sediment discharge	tons/day	0.2	0.06	0.02

Appendix 2B. Physical properties and concentrations of major elements, solids, nutrients, metals, and suspended solids, Tributary to East Branch Huron River near McComb Corner, Baraga County, Michigan.

[°C, degrees Celsius; mm/Hg, millimeters of mercury; ft^3/s, cubic foot per second; µs/cm, microseimens per centimeter; unfil, unfiltered; mg/L, milligrams per liter; std units, standard units; E, estimated value; <, less than; fil, filtered; N, nitrogen; P, phosphorous; $CaCO_3$, calcium carbonate; µg/L, micrograms per liter; ng/L, nanograms per liter; --, no data; tons/day, tons per day; tons/acre-ft, tons per acre-foot; mm, millimeter]

USGS site	Parameter code		Reporting units	Sampling date		
				4/29/2008	6/25/2009	8/13/2009
04043183	00010	Water temperature	°C	4.5	14	13
	00025	Barometric pressure	mm/Hg	745	742	739
	00061	Streamflow, instantaneous	ft^3/s	12	1.6	1.1
	00095	Specific conductance, water, unfil	µS/cm @ 25°C	53	158	186
	00300	Dissolved oxygen, water, unfil	mg/l	12.3	9.6	10.1
	00400	pH, unfil	std units	7.3	8	8.2
	00453	Bicarbonate, water, fil, inflection-point titration	mg/l	24	90	108
	00600	Total nitrogen, water, unfil	mg/l	0.46	0.35	E.29
	00602	Total nitrogen, water, fil	mg/l	0.47	0.45	0.4
	00608	Ammonia, water, fil	mg/l as N	<.020	<.020	<.020
	00613	Nitrite, water, fil	mg/l as N	<.002	E.001	E.002
	00618	Nitrate, water, fil	mg/l as N	--	E.21	E.20
	00623	Ammonia plus organic nitrogen, water, fil	mg/l as N	0.33	0.24	0.2
	00625	Ammonia plus organic nitrogen, water, unfil	mg/l as N	0.33	0.15	E.08
	00631	Nitrate plus nitrite, water, fil	mg/l as N	0.14	0.21	0.2
	00660	Orthophosphate, water, fil	mg/l	E.012	E.015	0.03
	00665	Phosphorus, water, unfil	mg/l	0.012	0.008	E.008
	00666	Phosphorus, water, fil	mg/l	0.007	0.006	0.006
	00671	Orthophosphate, water, fil	mg/l as P	E.004	E.005	0.01
	00900	Hardness, water	mg/l $CaCO_3$	24	79	94
	00904	Noncarbonate hardness, water, fil	mg/l $CaCO_3$	4	5	6
	00915	Calcium, water, fil	mg/l	7.16	24.7	29.5
	00925	Magnesium, water, fil	mg/l	1.5	4.29	4.98
	00930	Sodium, water, fil	mg/l	0.89	1.7	1.87
	00932	Sodium fraction of cations, water	percent	7	4	4
	00935	Potassium, water, fil	mg/l	0.65	0.96	0.97
	00940	Chloride,water, fil	mg/l	0.41	0.85	0.94
	00945	Sulfate, water, fil	mg/l	2.79	4.42	5.17
	00950	Fluoride,water, fil	mg/l	<.12	E.10	<.12
	00955	Silica, water, fil	mg/l SiO_2	5.96	10.5	12
	01000	Arsenic, water, fil	µg/l	0.36	0.68	0.79
	01005	Barium, water, fil	µg/l	10	22	24
	01010	Beryllium, water, fil	µg/l	0.02	<.01	<.01
	01025	Cadmium, water, fil	µg/l	E.02	<.04	<.04
	01030	Chromium, water, fil	µg/l	0.32	0.24	0.28
	01035	Cobalt, water, fil	µg/l	0.05	0.04	0.04
	01040	Copper, water, fil	µg/l	1.6	E.80	E.56
	01046	Iron, water, fil	µg/l	104	49	25
	01049	Lead, water, fil	µg/l	E.07	<.08	E.04

Appendix 2B. Physical properties and concentrations of major elements, solids, nutrients, metals, and suspended solids, Tributary to East Branch Huron River near McComb Corner, Baraga County, Michigan.—Continued

[°C, degrees Celsius; mm/Hg, millimeters of mercury; ft^3/s, cubic foot per second; µs/cm, microseimens per centimeter; unfil, unfiltered; mg/L, milligrams per liter; std units, standard units; E, estimated value; <, less than; fil, filtered; N, nitrogen; P, phosphorous; $CaCO_3$, calcium carbonate; µg/L, micrograms per liter; ng/L, nanograms per liter; --, no data; tons/day, tons per day; tons/acre-ft, tons per acre-foot; mm, millimeter]

USGS site	Parameter code	Reporting units	Sampling date		
			4/29/2008	6/25/2009	8/13/2009
01056	Manganese, water, fil	µg/l	4.5	3.9	3.2
01060	Molybdenum, water, fil	µg/l	<.2	0.2	0.3
01065	Nickel, water, fil	µg/l	0.48	0.35	0.4
01075	Silver, water, fil	µg/l	<.1	<.1	<.1
01090	Zinc, water, fil	µg/l	E1.5	2.2	3.7
01095	Antimony,water, fil	µg/l	<.14	<.14	<.14
01106	Aluminum,water, fil	µg/l	112	18.4	10.5
01145	Selenium,water, fil	µg/l	0.12	0.14	0.18
22703	Uranium (natural), water, fil	µg/l	0.11	0.32	0.39
39086	Alkalinity, water, fil, inflection-point titration	mg/l $CaCO_3$	20	75	90
50284	Methylmercury, water, unfil, recoverable	ng/l	--	--	0.09
50286	Mercury, water, unfil	ng/l	--	--	0.93
70300	Residue on evaporation, dried at 180°C	mg/l	59	104	111
80154	Suspended sediment concentration	mg/l	1	3	2
70301	Residue, water, fil, sum of constituents	mg/l	E.32	E.93	E.110
70302	Residue, water, dissolved	tons/day	1.9	0.45	0.33
70303	Residue, water, fil	tons/acre-ft	0.08	0.14	0.15
70331	Suspended sediment, sieve diameter	percent <0.063 mm	80	67	83
71851	Nitrate, water, fil	mg/l		E.906	E.887
71856	Nitrite, water, fil	mg/l		E.004	E.005
71890	Mercury, water, fil	µg/l	<.010	<.010	--

Appendix 2C. Physical properties and concentrations of major elements, solids, nutrients, metals, and suspended solids, West Branch Huron River near McComb Corner, Baraga County, Michigan.

[°C, degrees Celsius; mm/Hg, millimeters of mercury; ft³/s, cubic foot per second; µs/cm, microseimens per centimeter; unfil, unfiltered; mg/L, milligrams per liter; std units, standard units; E, estimated value; <, less than; fil, filtered; N, nitrogen; P, phosphorous; $CaCO_3$, calcium carbonate; µg/L, micrograms per liter; ng/L, nanograms per liter; --, no data; tons/day, tons per day; tons/acre-ft, tons per acre-foot; mm, millimeter]

USGS site	Parameter code		Reporting units	Sampling date		
				4/28/2008	6/24/2009	8/12/2009
4043190	00010	Water temperature	°C	4.5	17	16.5
	00025	Barometric pressure	mm/Hg	736	737	731
	00061	Streamflow instantaneous	ft³/s	35	3.9	2.8
	00095	Specific conductance, water, unfil	µS/cm @ 25°C	42	117	131
	00300	Dissolved oxygen, water, unfil	mg/l	11.9	8.9	12.5
	00400	pH, unfil	std units	7.6	8.1	8.3
	00453	Bicarbonate, water, fil, inflection-point titration	mg/l	17	65	74
	00600	Total nitrogen, water, unfil	mg/l	0.39	E.21	E.20
	00602	Total nitrogen, water, fil	mg/l	0.34	0.26	E.21
	00608	Ammonia, water, fil	mg/l as N	<.020	<.020	<.020
	00613	Nitrite, water, fil	mg/l as N	<.002	<.002	<.002
	00623	Ammonia plus organic nitrogen, water, fil	mg/l as N	0.19	0.17	E.12
	00625	Ammonia plus organic nitrogen, water, unfil	mg/l as N	0.24	E.12	E.11
	00631	Nitrate plus nitrite, water, fil	mg/l as N	0.15	0.09	0.09
	00660	Orthophosphate, water, fil	mg/l	E.009	--	E.018
	00665	Phosphorus, water, unfil	mg/l	0.011	<.008	<.008
	00666	Phosphorus, water, fil	mg/l	E.004	<.006	<.006
	00671	Orthophosphate, water, fil	mg/l as P	E.003	<.006	E.006
	00900	Hardness, water	mg/l $CaCO_3$	18	57	66
	00904	Noncarbonate hardness, water, fil	mg/l $CaCO_3$	4	4	5
	00915	Calcium, water, fil	mg/l	5.09	16.8	19.3
	00925	Magnesium, water, fil	mg/l	1.23	3.78	4.24
	00930	Sodium, water, fil	mg/l	0.65	1.34	1.48
	00932	Sodium fraction of cations, water	percent	7	5	5
	00935	Potassium, water, fil	mg/l	0.45	0.59	0.61
	00940	Chloride,water, fil	mg/l	0.33	0.27	0.34
	00945	Sulfate, water, fil	mg/l	2.92	4.7	5.11
	00950	Fluoride,water, fil	mg/l	<.12	<.12	<.12
	00955	Silica, water, fil	mg/l SiO_2	5.49	8.45	9.63
	01000	Arsenic, water, fil	µg/l	0.28	0.62	0.68
	01005	Barium, water, fil	µg/l	5	9	9
	01010	Beryllium, water, fil	µg/l	--	<.01	<.01
	01025	Cadmium, water, fil	µg/l	E.03	<.04	<.04
	01030	Chromium,water, fil	µg/l	0.22	E.11	E.11
	01035	Cobalt, water, fil	µg/l	0.05	0.04	0.03
	01040	Copper, water, fil	µg/l	1.1	1	<1.0
	01046	Iron, water, fil	µg/l	71	41	49
	01049	Lead, water, fil	µg/l	0.09	<.08	E.07
	01056	Manganese, water, fil	µg/l	5.1	1.9	1.3

Appendix 2C. Physical properties and concentrations of major elements, solids, nutrients, metals, and suspended solids, West Branch Huron River near McComb Corner, Baraga County, Michigan.—Continued

[°C, degrees Celsius; mm/Hg, millimeters of mercury; ft³/s, cubic foot per second; µs/cm, microseimens per centimeter; unfil, unfiltered; mg/L, milligrams per liter; std units, standard units; E, estimated value; <, less than; fil, filtered; N, nitrogen; P, phosphorous; $CaCO_3$, calcium carbonate; µg/L, micrograms per liter; ng/L, nanograms per liter; --, no data; tons/day, tons per day; tons/acre-ft, tons per acre-foot; mm, millimeter]

USGS site	Parameter code		Reporting units	Sampling date		
				4/28/2008	6/24/2009	8/12/2009
	01060	Molybdenum, water, fil	µg/l	E.1	0.3	0.4
	01065	Nickel, water, fil	µg/l	0.47	0.47	0.38
	01075	Silver, water, fil	µg/l	<.1	<.1	<.1
	01090	Zinc, water, fil	µg/l	2.3	2.2	3.4
	01095	Antimony,water, fil	µg/l	<.14	<.14	<.14
	01106	Aluminum,water, fil	µg/l	79.9	15.6	12.9
	01145	Selenium,water, fil	µg/l	0.06	0.05	0.05
	22703	Uranium (natural), water, fil	µg/l	0.03	0.08	0.09
	39086	Alkalinity, water, fil, inflection-point titration	mg/l $CaCO_3$	14	54	62
	50284	Methylmercury, water, unfil, recoverable	ng/l	--	--	0.23
	50286	Mercury, water, unfil	ng/l	--	--	1.03
	70300	Residue on evaporation, dried at 180°C	mg/l	39	79	86
	70301	Residue, water, fil, sum of constituents	mg/l	E25	E68	E78
	70302	Residue, water, dissolved	tons/day	3.73	0.83	0.65
	70303	Residue, water, fil	tons/acre-ft	0.05	0.11	0.12
	70331	Suspended sediment, sieve diameter	percent	36	8	33
	71890	Mercury, water, fil	µg/l	<.010	<.010	--
	80154	Suspended sediment concentration	mg/l	8	3	1
	80155	Suspended sediment discharge	tons/day	0.76	0.03	0.01

Appendix 2D. Physical properties and concentrations of major elements, solids, nutrients, metals, and suspended solids, Robarge Creek near McComb Corner, Baraga County, Michigan.

[°C, degrees Celsius; mm/Hg, millimeters of mercury; ft^3/s, cubic foot per second; µs/cm, microseimens per centimeter; unfil, unfiltered; mg/L, milligrams per liter; std units, standard units; E, estimated value; <, less than; fil, filtered; N, nitrogen; P, phosphorous; $CaCO_3$, calcium carbonate; µg/L, micrograms per liter; ng/L, nanograms per liter; --, no data; tons/day, tons per day; tons/acre-ft, tons per acre-foot; mm, millimeter]

USGS site	Parameter code		Reporting units	Sampling date		
				4/28/2008	6/24/2008	8/12/2008
4043194	00010	Water temperature	°C	5.5	17.5	15.5
	00025	Barometric pressure	mm/Hg	730	735	731
	00061	Streamflow, instantaneous	ft^3/s	13	.43	E.05
	00095	Specific conductance, water, unfil	µS/cm @ 25°C	34	79	126
	00300	Dissolved oxygen, water, unfil	mg/l	11.3	7.9	7.2
	00400	pH, unfil	std units	7.6	7.6	8.4
	00453	Bicarbonate, water, fil, inflection-point titration	mg/l	12	44	69
	00600	Total nitrogen, water, unfil	mg/l	E.26	.29	E.25
	00602	Total nitrogen, water, fil	mg/l	E.23	.33	E.29
	00608	Ammonia, water, fil	mg/l as N	<.020	<.020	<.020
	00613	Nitrite, water, fil	mg/l as N	<.002	<.002	<.002
	00623	Ammonia plus organic nitrogen, water, fil	mg/l as N	.21	.20	E.14
	00625	Ammonia plus organic nitrogen, water, unfil	mg/l as N	.23	.16	E.10
	00631	Nitrate plus nitrite, water, fil	mg/l as N	E.02	.13	.16
	00660	Orthophosphate, water, fil	mg/l	--	--	.020
	00665	Phosphorus, water, unfil	mg/l	E.007	<.008	E.005
	00666	Phosphorus, water, fil	mg/l	E.004	E.004	E.003
	00671	Orthophosphate, water, fil	mg/l as P	<.006	<.006	.007
	00900	Hardness, water	mg/l $CaCO_3$	14	36	62
	00904	Noncarbonate hardness, water, fil, field	mg/l $CaCO_3$	5	--	5
	00915	Calcium, water, fil	mg/l	4.11	10.5	18.2
	00925	Magnesium, water, fil	mg/l	1.01	2.37	3.94
	00930	Sodium, water, fil	mg/l	.73	1.27	1.80
	00932	Sodium fraction of cations, water	percent	10	7	6
	00935	Potassium, water, fil	mg/l	.44	.68	.84
	00940	Chloride,water, fil	mg/l	.35	.32	.67
	00945	Sulfate, water, fil	mg/l	2.72	2.77	5.02
	00950	Fluoride,water, fil	mg/l	<.12	<.12	<.12
	00955	Silica, water, fil	mg/L SiO_2	5.71	6.80	9.68
	01000	Arsenic, water, fil	µg/l	.27	.48	.41
	01005	Barium, water, fil	µg/l	4	9	13
	01010	Beryllium, water, fil	µg/l	<.01	<.01	<.01
	01025	Cadmium, water, fil	µg/l	E.03	E.02	E.03
	01030	Chromium,water, fil	µg/l	.28	E.10	.13
	01035	Cobalt, water, fil	µg/l	.04	.05	.03
	01040	Copper, water, fil	µg/l	1.1	1.1	E.61
	01046	Iron, water, fil	µg/l	64	37	16
	01049	Lead, water, fil	µg/l	.13	E.06	.12
	01056	Manganese, water, fil	µg/l	2.7	3.0	3.6

Appendix 2D. Physical properties and concentrations of major elements, solids, nutrients, metals, and suspended solids, Robarge Creek near McComb Corner, Baraga County, Michigan.—Continued

[°C, degrees Celsius; mm/Hg, millimeters of mercury; ft³/s, cubic foot per second; µs/cm, microseimens per centimeter; unfil, unfiltered; mg/L, milligrams per liter; std units, standard units; E, estimated value; <, less than; fil, filtered; N, nitrogen; P, phosphorous; $CaCO_3$, calcium carbonate; µg/L, micrograms per liter; ng/L, nanograms per liter; --, no data; tons/day, tons per day; tons/acre-ft, tons per acre-foot; mm, millimeter]

USGS site	Parameter code		Reporting units	Sampling date		
				4/28/2008	6/24/2008	8/12/2008
	01060	Molybdenum, water, fil	µg/l	<.2	.2	.3
	01065	Nickel, water, fil	µg/l	.59	.84	.75
	01075	Silver, water, fil	µg/l	<.1	<.1	<.1
	01090	Zinc, water, fil	µg/l	3.4	11.7	3.5
	01095	Antimony,water, fil	µg/l	<.14	<.14	<.14
	01106	Aluminum,water, fil	µg/l	75.4	15.3	5.4
	01145	Selenium,water, fil	µg/l	.06	.06	E.04
	22703	Uranium (natural), water, fil	µg/l	.03	.02	.03
	39086	Alkalinity, water, fil, inflection-point titration	mg/l $CaCO_3$	10	36	57
	50284	Methylmercury, water, unfil, recoverable	ng/l	--	--	.13
	50286	Mercury, water, unfil	ng/l	--	--	.92
	70300	Residue on evaporation, dried at 180°C	mg/l	40	54	77
	70301	Residue, water, fil, sum of constituents	mg/l	E21	E47	E75
	70302	Residue, water, dissolved	tons/day	1.42	.06	E.01
	70303	Residue, water, fil	tons/acre-ft	.06	.07	.11
	70331	Suspended sediment, sieve diameter	percent <0.063 mm	13	50	67
	71890	Mercury, water, fil	µg/l	<.010	<.010	--
	80154	Suspended sediment concentration	mg/l	2	1	2
	80155	Suspended sediment discharge	tons/day	.07	.00	E.00

Appendix 2E. Physical properties and concentrations of major elements, solids, nutrients, metals, and suspended solids, Black Creek near McComb Corner, Baraga County, Michigan.

[°C, degrees Celsius; mm/Hg, millimeters of mercury; ft³/s, cubic foot per second; µs/cm, microseimens per centimeter; unfil, unfiltered; mg/L, milligrams per liter; std units, standard units; E, estimated value; <, less than; fil, filtered; N, nitrogen; P, phosphorous; $CaCO_3$, calcium carbonate; µg/L, micrograms per liter; ng/L, nanograms per liter; --, no data; tons/day, tons per day; tons/acre-ft, tons per acre-foot; mm, millimeter]

USGS site	Parameter code		Reporting units	Sampling date		
				4/29/2008	6/24/2008	8/13/2008
04043198	00010	Water temperature	°C	3.5	18.5	15.5
	00025	Barometric pressure	mm/Hg	747	745	739
	00061	Streamflow, instantaneous	ft³/s	22	1.1	.36
	00095	Specific conductance, water, unfil	µS/cm @ 25°C	32	75	102
	00300	Dissolved oxygen, water, unfil	mg/l	9.4	6.7	3.2
	00400	pH, unfil	std units	6.8	6.7	7.8
	00453	Bicarbonate, water, fil, inflection-point titration	mg/l	12	38	49
	00600	Total nitrogen, water, unfil	mg/l	--	E.74	--
	00602	Total nitrogen, water, fil	mg/l	--	E.74	--
	00605	Organic nitrogen, water, unfil	mg/l	--	E.72	.72
	00607	Organic nitrogen, water, fil	mg/l	--	E.72	.79
	00608	Ammonia, water, fil	mg/l as N	<.020	E.014	.043
	00613	Nitrite, water, fil	mg/l as N	<.002	E.002	.002
	00618	Nitrate, water, fil	mg/l as N	--	E.02	--
	00623	Ammonia plus organic nitrogen, water, fil	mg/l as N	.42	.72	.83
	00625	Ammonia plus organic nitrogen, water, unfil	mg/l as N	.42	.72	.76
	00631	Nitrate plus nitrite, water, fil	mg/l as N	<.04	E.02	<.04
	00660	Orthophosphate, water, fil	mg/l	--	--	E.018
	00665	Phosphorus, water, unfil	mg/l	.009	.020	.023
	00666	Phosphorus, water, fil	mg/l	.007	.013	.014
	00671	Orthophosphate, water, fil	mg/l as P	<.006	<.006	E.006
	00900	Hardness, water	mg/l $CaCO_3$	14	36	50
	00904	Noncarbonate hardness, water, fil, field	mg/l $CaCO_3$	5	5	10
	00915	Calcium, water, fil	mg/l	4.20	11.1	15.4
	00925	Magnesium, water, fil	mg/l	.962	2.15	2.77
	00930	Sodium, water, fil	mg/l	.85	1.61	2.30
	00932	Sodium fraction of cations, water	percent	11	9	9
	00935	Potassium, water, fil	mg/l	.62	.62	.66
	00940	Chloride,water, fil	mg/l	.51	1.77	3.56
	00945	Sulfate, water, fil	mg/l	2.86	.37	.40
	00950	Fluoride,water, fil	mg/l	<.12	<.12	E.06
	00955	Silica, water, fil	mg/l as SiO_2	3.93	3.80	8.95
	01000	Arsenic, water, fil	µg/l	.29	.93	1.3
	01005	Barium, water, fil	µg/l	9	21	31
	01010	Beryllium, water, fil	µg/l	.02	.02	.01
	01025	Cadmium, water, fil	µg/l	E.04	.05	E.03
	01030	Chromium,water, fil	µg/l	.36	.38	.29
	01035	Cobalt, water, fil	µg/l	.06	.30	.71
	01040	Copper, water, fil	µg/l	2.0	1.5	<1.0

Appendix 2E. Physical properties and concentrations of major elements, solids, nutrients, metals, and suspended solids, Black Creek near McComb Corner, Baraga County, Michigan.—Continued

[°C, degrees Celsius; mm/Hg, millimeters of mercury; ft³/s, cubic foot per second; µs/cm, microseimens per centimeter; unfil, unfiltered; mg/L, milligrams per liter; std units, standard units; E, estimated value; <, less than; fil, filtered; N, nitrogen; P, phosphorous; $CaCO_3$, calcium carbonate; µg/L, micrograms per liter; ng/L, nanograms per liter; --, no data; tons/day, tons per day; tons/acre-ft, tons per acre-foot; mm, millimeter]

USGS site	Parameter code	Reporting units	Sampling date		
			4/29/2008	6/24/2008	8/13/2008
01046	Iron, water, fil	µg/l	160	923	1540
01049	Lead, water, fil	µg/l	.09	.16	.09
01056	Manganese, water, fil	µg/l	4.6	114	663
01060	Molybdenum, water, fil	µg/l	<.2	E.2	E.1
01065	Nickel, water, fil	µg/l	.89	1.6	1.5
01075	Silver, water, fil	µg/l	<.1	<.1	<.1
01090	Zinc, water, fil	µg/l	4.2	15.8	4.3
01095	Antimony,water, fil	µg/l	<.14	<.14	<.14
01106	Aluminum,water, fil	µg/l	<1.6	74.5	56.3
01145	Selenium,water, fil	µg/l	.10	.15	.15
22703	Uranium (natural), water, fil	µg/l	.06	.08	.05
39086	Alkalinity, water, fil, inflection-point titration	mg/l $CaCO_3$	10	32	40
50284	Methylmercury, water, unfil, recoverable	ng/l	--	--	1.22
50286	Mercury, water, unfil	ng/l	--	--	4.50
70300	Residue on evaporation, dried at 180°C	mg/l	46	84	102
70301	Residue, water, fil, sum of constituents	mg/l	E20	E41	E61
70302	Residue, water, dissolved	tons/day	2.76	.25	.10
70303	Residue, water, fil	tons/acre-ft	.06	.11	.14
70331	Suspended sediment, sieve diameter	percent <0.063 mm	86	75	81
71846	Ammonia, water, fil	mg/l NH_4	--	E.02	.06
71851	Nitrate, water, fil	mg/l	--	E.082	--
71856	Nitrite, water, fil	mg/l	--	E.005	.008
71890	Mercury, water, fil	µg/l	<.010	E.005	--
80154	Suspended sediment concentration	mg/l	2	2	8
80155	Suspended sediment discharge	tons/day	.12	.01	.01

Appendix 2F. Physical properties and concentrations of major elements, solids, nutrients, metals, and suspended solids, Huron River at Big Eric's Bridge near Skanee, Baraga County, Michigan.

[°C, degrees Celsius; mm/Hg, millimeters of mercury; ft³/s, cubic foot per second; µs/cm, microseimens per centimeter; unfil, unfiltered; mg/L, milligrams per liter; std units, standard units; E, estimated value; <, less than; fil, filtered; N, nitrogen; P, phosphorous; $CaCO_3$, calcium carbonate; µg/L, micrograms per liter; ng/L, nanograms per liter; --, no data; tons/day, tons per day; tons/acre-ft, tons per acre-foot; mm, millimeter]

USGS site	Parameter code		Reporting units	Sampling date		
				4/29/2008	6/25/2008	8/13/2008
04043200	00010	Water temperature	°C	6.0	19.5	21.0
	00025	Barometric pressure	mm/Hg	743	743	740
	00061	Streamflow, instantaneous	ft_3/s	173	17	7.5
	00095	Specific conductance, water, unfil	µS/cm @ 25°C	36	97	119
	00300	Dissolved oxygen, water, unfil	mg/l	12.3	8.7	8.4
	00400	pH, unfil	std units	7.0	8.3	7.8
	00453	Bicarbonate, water, fil, inflection-point titration	mg/l	15	53	66
	00600	Total nitrogen, water, unfil	mg/l	.39	.29	E.23
	00602	Total nitrogen, water, fil	mg/l	.34	.41	E.31
	00608	Ammonia, water, fil	mg/l as N	<.020	<.020	<.020
	00613	Nitrite, water, fil	mg/l as N	<.002	<.002	E.001
	00618	Nitrate, water, fil	mg/l as N	--	--	E.04
	00623	Ammonia plus organic nitrogen, water, fil	mg/l as N	.28	.35	.27
	00625	Ammonia plus organic nitrogen, water, unfil	mg/l as N	.33	.22	.19
	00631	Nitrate plus nitrite, water, fil	mg/l as N	.06	.06	E.04
	00660	Orthophosphate, water, fil	mg/l	--	--	E.014
	00665	Phosphorus, water, unfil	mg/l	.009	E.006	E.006
	00666	Phosphorus, water, fil	mg/l	E.005	E.004	<.006
	00671	Orthophosphate, water, fil	mg/l as P	<.006	<.006	E.005
	00900	Hardness, water	mg/l $CaCO_3$	17	46	58
	00904	Noncarbonate hardness, water, fil, field	mg/l $CaCO_3$	4	3	4
	00915	Calcium, water, fil	mg/l	4.84	13.7	17.3
	00925	Magnesium, water, fil	mg/l	1.13	2.89	3.55
	00930	Sodium, water, fil	mg/l	.71	1.30	1.58
	00932	Sodium fraction of cations, water	percent	8	6	6
	00935	Potassium, water, fil	mg/l	.50	.72	.76
	00940	Chloride,water, fil	mg/l	.34	.74	.94
	00945	Sulfate, water, fil	mg/l	2.82	3.54	4.02
	00950	Fluoride,water, fil	mg/l	<.12	<.12	<.12
	00955	Silica, water, fil	mg/l SiO_2	5.32	7.20	7.99
	01000	Arsenic, water, fil	µg/l	.31	.61	.59
	01005	Barium, water, fil	µg/l	6	13	16
	01010	Beryllium, water, fil	µg/l	<.01	<.01	<.01
	01025	Cadmium, water, fil	µg/l	E.03	E.03	E.03
	01030	Chromium,water, fil	µg/l	.26	.18	.14
	01035	Cobalt, water, fil	µg/l	.05	.06	.06
	01040	Copper, water, fil	µg/l	1.2	1.2	E.93
	01046	Iron, water, fil	µg/l	118	142	144
	01049	Lead, water, fil	µg/l	.09	E.06	E.05

Appendix 2F. Physical properties and concentrations of major elements, solids, nutrients, metals, and suspended solids, Huron River at Big Eric's Bridge near Skanee, Baraga County, Michigan.—Continued

[°C, degrees Celsius; mm/Hg, millimeters of mercury; ft³/s, cubic foot per second; µs/cm, microseimens per centimeter; unfil, unfiltered; mg/L, milligrams per liter; std units, standard units; E, estimated value; <, less than; fil, filtered; N, nitrogen; P, phosphorous; $CaCO_3$, calcium carbonate; µg/L, micrograms per liter; ng/L, nanograms per liter; --, no data; tons/day, tons per day; tons/acre-ft, tons per acre-foot; mm, millimeter]

USGS site	Parameter code	Reporting units	Sampling date		
			4/29/2008	6/25/2008	8/13/2008
01056	Manganese, water, fil	µg/l	5.0	7.4	10.8
01060	Molybdenum, water, fil	µg/l	<.2	.2	.3
01065	Nickel, water, fil	µg/l	.56	.67	.67
01075	Silver, water, fil	µg/l	<.1	<.1	<.1
01090	Zinc, water, fil	µg/l	4.4	4.9	9.6
01095	Antimony,water, fil	µg/l	<.14	<.14	<.14
01106	Aluminum,water, fil	µg/l	105	21.9	16.1
01145	Selenium,water, fil	µg/l	.07	.09	.09
22703	Uranium (natural), water, fil	µg/l	.05	.10	.12
39086	Alkalinity, water, fil, inflection-point titration	mg/l $CaCO_3$	12	44	54
50284	Methylmercury, water, unfil, recoverable	ng/l	--	--	.27
50286	Mercury, water, unfil	ng/l	--	--	2.03
70300	Residue on evaporation, dried at 180°C	mg/l	44	76	76
70301	Residue, water, fil, sum of constituents	mg/l	E24	E57	E69
70302	Residue, water, dissolved	tons/day	20.5	3.47	1.53
70303	Residue, water, fil	tons/acre-ft	.06	.10	.10
70331	Suspended sediment, sieve diameter	percent <0.063 mm	67	40	80
71851	Nitrate, water, fil	mg/l	--	--	E.153
71856	Nitrite, water, fil	mg/l	--	--	E.005
71890	Mercury, water, fil	µg/l	<.010	<.010	--
80154	Suspended sediment concentration	mg/l	2	1	1
80155	Suspended sediment discharge	tons/day	.93	.05	.02

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Appendix 3. Mineral Soils (A, E, B, and C Horizons), Huron River Watershed, Michigan

Appendix 3. Mineral soils (A, E, B, and C horizons), Huron River Watershed, Michigan.

Field no.	Latitude	Longitude	Horizon	Depth (cm)	Partial extraction Ag (ppm)	As (ppm)	Au (ppm)	Bi (ppm)	Cd (ppm)	Cu (ppm)	Mo (ppm)	Pb (ppm)	Sb (ppm)	Zn (ppm)
HR–SL–01 A	46.78747	-88.06271	A	7.5 to 8	0.99	4	<0.1	<1	0.88	25.4	0.9	14	<1	61.6
HR–SL–02 A	46.77742	-88.04971	A	0 to 15	1.04	17	<0.1	<1	1.26	37.8	2.2	27	<1	236.0
HR–SL–03 A	46.76509	-88.03342	A	0.5 to 5	0.87	2	<0.1	<1	0.61	21.9	0.7	32	<1	46.2
HR–SL–04 A	46.80586	-88.06500	A	0 to 4.5	0.69	3	<0.1	<1	0.51	12.2	0.6	23	<1	35.6
HR–SL–05 A	46.83572	-88.10330	A	1 to 3	0.64	3	<0.1	<1	0.40	15.1	0.6	26	<1	39.3
HR–SL–06 A	46.70800	-88.07032	A	2 to 4	0.63	2	<0.1	<1	0.44	12.8	0.7	36	<1	64.4
HR–SL–07 A	46.72973	-88.05520	A	2 to 4.5	0.78	2	<0.1	<1	0.52	17.3	1.0	29	<1	39.3
HR–SL–08 A	46.74261	-88.04839	A	0 to 3	0.74	2	<0.1	<1	0.66	13.3	0.7	22	<1	48.5
HR–SL–08 A dup	46.74261	-88.04839	A	0 to 3	0.87	2	<0.1	<1	0.43	11.8	0.8	19	<1	45.0
HR–SL–09 A	46.74865	-88.08341	A	2 to 5	0.85	2	<0.1	<1	0.41	11.8	0.7	19	<1	43.5
HR–SL–10 A	46.76124	-88.10713	A	3.5 to 4.5	0.70	3	<0.1	<1	0.56	15.6	0.7	26	<1	35.6
HR–SL–11 A	46.86267	-88.11263	A	0 to 12	0.62	3	<0.1	<1	0.27	8.8	0.6	15	<1	29.8
HR–SL–12 A	46.85126	-88.08941	A	5 to 6	0.39	8	<0.1	<1	0.43	17.8	1.3	38	<1	40.9
HR–SL–13 A	46.81975	-88.10149	A	4 to 5	0.53	4	<0.1	<1	0.57	19.3	0.7	38	<1	50.3
HR–SL–14 A	46.76476	-88.07135	A	2.5 to 5	0.89	3	<0.1	<1	0.45	24.2	1.3	34	<1	35.1
HR–SL–15 A	46.74901	-88.05780	A	1.5 to 3	0.84	3	<0.1	<1	1.28	27.0	0.7	41	<1	68.4
HR–SL–16 A	46.77925	-88.09563	A	0 to 2	0.80	2	<0.1	<1	0.57	16.5	0.7	20	<1	68.3
HR–SL–17 A	46.79581	-88.09223	A	0 to 3	0.52	1	<0.1	<1	0.27	8.8	0.5	13	<1	24.6
HR–SL–17 A dup	46.79581	-88.09223	A	0 to 3	0.51	1	<0.1	<1	0.26	8.2	0.4	13	<1	24.2
HR–SL–18 A	46.80113	-88.11597	A	0 to 5	0.85	8	<0.1	<1	0.56	35.2	1.7	23	1	127.0
HR–SL–19 A	46.81204	-88.13567	A	5 to 8	0.37	5	<0.1	<1	0.95	31.4	0.8	48	<1	82.4
HR–SL–20 A	46.91087	-88.06673	A	2 to 3	0.41	3	<0.1	<1	0.16	11.7	0.4	33	<1	19.1
HR–SL–21 A	46.89659	-88.08732	A	4 to 6	0.59	3	<0.1	<1	0.20	14.2	0.6	23	<1	28.0
HR–SL–22 A	46.88639	-88.04665	A	0.5 to 1.5	0.55	3	<0.1	<1	0.57	12.7	0.8	52	<1	47.8
HR–SL–23 A	46.87526	-88.05947	A	2 to 3	0.53	5	<0.1	<1	1.27	20.9	1.4	64	<1	64.1
HR–SL–24 A	46.86947	-88.08019	A	3 to 5.5	0.54	2	<0.1	<1	0.23	10.3	0.6	19	<1	19.3
HR–SL–24 A dup	46.86947	-88.08019	A	3 to 5.5	0.56	2	<0.1	<1	0.24	11.5	0.6	20	<1	20.8
HR–SL–25 A	46.79618	-88.00632	A	2 to 3	0.74	3	<0.1	<1	0.55	20.8	1.1	47	<1	61.4
HR–SL–26 A	46.75230	-87.98873	A	0 to 2	0.70	2	<0.1	<1	0.29	11.1	0.8	30	<1	29.6
HR–SL–27 A	46.81535	-88.01702	A	1 to 5	0.94	4	<0.1	<1	0.59	17.6	1.0	31	1	48.9
HR–SL–28 A	46.82391	-88.04588	A	0.5 to 1.75	0.65	2	<0.1	<1	0.38	14.5	0.7	30	<1	39.6
HR–SL–29 A	46.83004	-88.06466	A	3.6 to 4.6	0.43	2	<0.1	<1	0.14	8.5	0.4	21	<1	19.6
HR–SL–30 A	46.85067	-88.03606	A	6 to 7	0.46	7	<0.1	<1	0.44	17.6	1.4	42	<1	28.7
HR–SL–31 A	46.85381	-88.12520	A	4 to 5	0.27	4	<0.1	<1	0.29	15.7	0.7	25	<1	33.9
HR–SL–01 E	46.78747	-88.06271	E	8 to 20	0.61	3	<0.1	<1	0.21	6.87	0.8	12	<1	27.1

Appendix 3. Mineral soils (A, E, B, and C horizons), Huron River Watershed, Michigan.—Continued

Field no.	Latitude	Longitude	Horizon	Depth (cm)	Total extraction Al (wt. %)	Ca (wt. %)	Fe (wt. %)	K (wt. %)	Mg (wt. %)	Na (wt. %)	S (wt. %)	Ti (wt. %)	Ag (ppm)	As (ppm)	Ba (ppm)
HR–SL–01 A	46.78747	-88.06271	A	7.5 to 8	1.89	0.62	1.30	0.80	0.34	0.31	0.09	0.17	<1	4	298
HR–SL–02 A	46.77742	-88.04971	A	0 to 15	6.27	0.63	3.88	1.66	0.76	0.63	0.09	0.24	<1	17	497
HR–SL–03 A	46.76509	-88.03342	A	0.5 to 5	2.05	0.40	0.82	1.02	0.11	0.43	0.06	0.11	<1	3	361
HR–SL–04 A	46.80586	-88.06500	A	0 to 4.5	2.68	0.36	0.90	1.76	0.11	0.51	0.04	0.12	<1	2	465
HR–SL–05 A	46.83572	-88.10330	A	1 to 3	1.74	0.44	0.79	1.15	0.10	0.29	0.08	0.11	<1	3	351
HR–SL–06 A	46.70800	-88.07032	A	2 to 4	2.20	0.26	1.01	1.14	0.13	0.47	0.08	0.13	<1	2	327
HR–SL–07 A	46.72973	-88.05520	A	2 to 4.5	1.94	0.38	0.83	1.06	0.09	0.34	0.10	0.14	<1	2	353
HR–SL–08 A	46.74261	-88.04839	A	0 to 3	2.20	0.50	1.06	1.13	0.14	0.49	0.07	0.16	<1	2	369
HR–SL–08 A dup	46.74261	-88.04839	A	0 to 3	2.33	0.30	0.65	1.31	0.09	0.46	0.06	0.12	<1	1	413
HR–SL–09 A	46.74865	-88.08341	A	2 to 5	2.31	0.29	0.61	1.35	0.09	0.46	0.06	0.11	<1	2	409
HR–SL–10 A	46.76124	-88.10713	A	3.5 to 4.5	1.47	0.20	0.55	1.01	0.05	0.22	0.06	0.08	<1	2	351
HR–SL–11 A	46.86267	-88.11263	A	0 to 12	2.83	0.19	1.13	2.02	0.16	0.40	0.02	0.14	<1	2	486
HR–SL–12 A	46.85126	-88.08941	A	5 to 6	1.52	0.37	1.73	0.44	0.10	0.17	0.13	0.06	<1	8	216
HR–SL–13 A	46.81975	-88.10149	A	4 to 5	1.85	0.44	0.83	1.00	0.11	0.27	0.08	0.09	<1	4	341
HR–SL–14 A	46.76476	-88.07135	A	2.5 to 5	2.00	0.27	0.76	0.82	0.12	0.28	0.14	0.07	<1	3	292
HR–SL–15 A	46.74901	-88.05780	A	1.5 to 3	2.23	0.26	1.04	1.15	0.10	0.38	0.06	0.15	<1	3	402
HR–SL–16 A	46.77925	-88.09563	A	0 to 2	2.76	0.43	0.90	1.52	0.15	0.49	0.06	0.16	<1	3	455
HR–SL–17 A	46.79581	-88.09223	A	0 to 3	1.81	0.23	0.88	1.28	0.07	0.29	0.03	0.11	<1	1	378
HR–SL–17 A dup	46.79581	-88.09223	A	0 to 3	1.78	0.22	0.84	1.30	0.07	0.29	0.03	0.10	<1	1	375
HR–SL–18 A	46.80113	-88.11597	A	0 to 5	3.72	0.24	2.59	1.64	0.38	0.44	0.05	0.15	<1	8	420
HR–SL–19 A	46.81204	-88.13567	A	5 to 8	1.02	0.65	0.53	0.47	0.11	0.14	0.16	0.04	<1	5	234
HR–SL–20 A	46.91087	-88.06673	A	2 to 3	1.95	0.08	0.50	1.53	0.07	0.25	0.02	0.05	<1	3	348
HR–SL–21 A	46.89659	-88.08732	A	4 to 6	1.52	0.16	0.64	1.06	0.06	0.21	0.06	0.08	<1	3	298
HR–SL–22 A	46.88639	-88.04665	A	0.5 to 1.5	1.98	0.27	0.96	1.26	0.10	0.30	0.06	0.12	<1	3	406
HR–SL–23 A	46.87526	-88.05947	A	2 to 3	2.16	0.28	1.09	1.23	0.12	0.37	0.06	0.13	<1	4	628
HR–SL–24 A	46.86947	-88.08019	A	3 to 5.5	1.64	0.18	0.64	1.09	0.05	0.25	0.04	0.11	<1	2	362
HR–SL–24 A dup	46.86947	-88.08019	A	3 to 5.5	1.64	0.18	0.61	1.14	0.05	0.26	0.04	0.10	<1	1	355
HR–SL–25 A	46.79618	-88.00632	A	2 to 3	2.15	0.33	1.00	1.08	0.13	0.32	0.09	0.13	<1	3	333
HR–SL–26 A	46.75230	-87.98873	A	0 to 2	2.42	0.26	0.86	1.65	0.09	0.40	0.04	0.14	<1	2	466
HR–SL–27 A	46.81535	-88.01702	A	1 to 5	2.86	0.20	1.24	1.39	0.17	0.39	0.05	0.16	<1	4	401
HR–SL–28 A	46.82391	-88.04588	A	0.5 to 1.75	1.77	0.26	0.75	1.09	0.08	0.27	0.05	0.13	<1	2	337
HR–SL–29 A	46.83004	-88.06466	A	3.6 to 4.6	1.68	0.16	0.56	1.26	0.06	0.26	0.03	0.08	<1	2	361
HR–SL–30 A	46.85067	-88.03606	A	6 to 7	1.30	0.48	0.59	0.42	0.10	0.16	0.16	0.05	<1	8	199
HR–SL–31 A	46.85381	-88.12520	A	4 to 5	1.20	0.37	0.45	0.68	0.05	0.17	0.09	0.07	<1	4	258
HR–SL–01 E	46.78747	-88.06271	E	8 to 20	2.84	0.24	1.33	1.75	0.19	0.41	<0.01	0.19	<1	2	447

Appendix 3. Mineral soils (A, E, B, and C horizons), Huron River Watershed, Michigan.—Continued

Field no.	Latitude	Longitude	Horizon	Depth (cm)	Total extraction—Continued											
					Be (ppm)	Bi (ppm)	Cd (ppm)	Ce (ppm)	Co (ppm)	Cr (ppm)	Cs (ppm)	Cu (ppm)	Ga (ppm)	Hg (ppm)	In (ppm)	La (ppm)
HR–SL–01 A	46.78747	-88.06271	A	7.5 to 8	0.5	0.11	1.0	16.0	5.6	37	<5	26.2	5.5	0.11	0.03	8.0
HR–SL–02 A	46.77742	-88.04971	A	0 to 15	2.3	0.28	1.2	96.0	19.5	79	<5	37.4	14.1	0.13	0.06	27.2
HR–SL–03 A	46.76509	-88.03342	A	0.5 to 5	0.5	0.20	0.6	14.7	1.8	25	<5	23.5	5.4	0.08	0.02	7.4
HR–SL–04 A	46.80586	-88.06500	A	0 to 4.5	0.7	0.13	0.4	21.3	2.4	25	<5	10.6	6.6	0.04	<0.02	11.1
HR–SL–05 A	46.83572	-88.10330	A	1 to 3	0.5	0.13	0.3	13.6	1.4	22	<5	14.1	4.0	0.11	<0.02	7.1
HR–SL–06 A	46.70800	-88.07032	A	2 to 4	0.5	0.18	0.4	13.8	2.1	26	<5	13.1	5.5	0.10	<0.02	7.1
HR–SL–07 A	46.72973	-88.05520	A	2 to 4.5	0.6	0.19	0.5	16.6	1.4	24	<5	17.0	5.0	0.13	<0.02	8.3
HR–SL–08 A	46.74261	-88.04839	A	0 to 3	0.6	0.14	0.6	17.4	1.9	25	<5	12.0	5.6	0.07	<0.02	8.6
HR–SL–08 A dup	46.74261	-88.04839	A	0 to 3	0.6	0.11	0.4	17.9	1.4	24	<5	13.7	5.5	0.07	<0.02	9.3
HR–SL–09 A	46.74865	-88.08341	A	2 to 5	0.6	0.11	0.3	17.3	1.4	23	<5	10.8	5.5	0.07	<0.02	8.8
HR–SL–10 A	46.76124	-88.10713	A	3.5 to 4.5	0.4	0.15	0.5	12.9	0.8	19	<5	15.4	3.5	0.08	<0.02	6.6
HR–SL–11 A	46.86267	-88.11263	A	0 to 12	0.8	0.10	0.2	21.4	7.3	22	<5	8.7	6.8	0.04	<0.02	10.0
HR–SL–12 A	46.85126	-88.08941	A	5 to 6	0.6	0.30	0.4	15.3	2.4	22	<5	19.5	4.1	0.26	0.03	7.7
HR–SL–13 A	46.81975	-88.10149	A	4 to 5	0.5	0.22	0.6	15.2	1.6	25	<5	19.9	5.1	0.12	0.02	7.7
HR–SL–14 A	46.76476	-88.07135	A	2.5 to 5	1.0	0.19	0.4	24.6	5.0	23	<5	25.5	4.8	0.20	0.02	14.2
HR–SL–15 A	46.74901	-88.05780	A	1.5 to 3	0.6	0.22	1.3	19.6	1.9	28	<5	28.3	5.9	0.08	0.02	10.0
HR–SL–16 A	46.77925	-88.09563	A	0 to 2	0.7	0.13	0.5	25.0	2.8	28	<5	16.1	6.4	0.07	<0.02	12.7
HR–SL–17 A	46.79581	-88.09223	A	0 to 3	0.4	0.07	0.2	13.8	1.1	23	<5	8.3	4.9	0.03	<0.02	7.4
HR–SL–17 A dup	46.79581	-88.09223	A	0 to 3	0.4	0.07	0.2	14.3	1.0	17	<5	7.6	5.0	0.03	<0.02	7.4
HR–SL–18 A	46.80113	-88.11597	A	0 to 5	1.1	0.21	0.5	40.0	34.5	53	<5	34.8	10.0	0.07	0.03	23.1
HR–SL–19 A	46.81204	-88.13567	A	5 to 8	0.4	0.27	1.0	9.2	1.4	19	<5	34.2	2.5	0.22	0.03	4.9
HR–SL–20 A	46.91087	-88.06673	A	2 to 3	0.5	0.17	0.1	15.6	0.8	16	<5	12.0	5.0	0.05	<0.02	8.1
HR–SL–21 A	46.89659	-88.08732	A	4 to 6	0.5	0.13	0.2	12.2	0.9	19	<5	13.5	3.6	0.09	<0.02	6.3
HR–SL–22 A	46.88639	-88.04665	A	0.5 to 1.5	0.5	0.23	0.5	17.5	2.3	22	<5	11.7	5.2	0.11	<0.02	9.0
HR–SL–23 A	46.87526	-88.05947	A	2 to 3	0.5	0.31	1.2	20.2	3.1	25	<5	20.1	6.4	0.11	0.03	10.5
HR–SL–24 A	46.86947	-88.08019	A	3 to 5.5	0.4	0.12	0.2	13.4	0.9	19	<5	9.7	3.7	0.07	<0.02	7.1
HR–SL–24 A dup	46.86947	-88.08019	A	3 to 5.5	0.4	0.12	0.2	14.1	0.8	20	<5	10.2	3.8	0.07	<0.02	7.4
HR–SL–25 A	46.79618	-88.00632	A	2 to 3	0.6	0.24	0.5	19.5	2.3	27	<5	19.2	5.9	0.11	0.03	10.0
HR–SL–26 A	46.75230	-87.98873	A	0 to 2	0.6	0.15	0.2	21.7	1.8	23	<5	9.7	6.1	0.04	<0.02	10.7
HR–SL–27 A	46.81535	-88.01702	A	1 to 5	0.7	0.19	0.4	29.8	2.5	35	<5	16.1	8.2	0.07	0.03	14.3
HR–SL–28 A	46.82391	-88.04588	A	0.5 to 1.75	0.4	0.16	0.3	15.7	1.5	22	<5	14.5	4.6	0.09	<0.02	7.6
HR–SL–29 A	46.83004	-88.06466	A	3.6 to 4.6	0.4	0.11	<0.1	12.3	0.9	19	<5	8.4	4.0	0.05	<0.02	6.3
HR–SL–30 A	46.85067	-88.03606	A	6 to 7	0.4	0.27	0.5	10.7	1.5	21	<5	18.8	3.2	0.29	0.03	5.8
HR–SL–31 A	46.85381	-88.12520	A	4 to 5	0.4	0.13	0.3	10.9	0.8	19	<5	17.2	2.7	0.17	<0.02	5.6
HR–SL–01 E	46.78747	-88.06271	E	8 to 20	0.7	0.1	0.1	18.5	2.6	31	<5	7.9	9.3	<0.01	0.02	9.6

Appendix 3. Mineral soils (A, E, B, and C horizons), Huron River Watershed, Michigan.—Continued

Field no.	Latitude	Longitude	Horizon	Depth (cm)	Total extraction—Continued											
					Li (ppm)	Mn (ppm)	Mo (ppm)	Nb (ppm)	Ni (ppm)	P (ppm)	Pb (ppm)	Rb (ppm)	Sb (ppm)	Sc (ppm)	Se (ppm)	Sn (ppm)
HR–SL–01 A	46.78747	-88.06271	A	7.5 to 8	5	143	0.73	3.8	14.7	370	15.9	29.7	0.37	4.8	0.7	1.1
HR–SL–02 A	46.77742	-88.04971	A	0 to 15	48	750	1.81	6.6	72.9	1670	28.2	79.1	0.70	13.4	1.0	1.7
HR–SL–03 A	46.76509	-88.03342	A	0.5 to 5	4	91	0.56	3.3	5.8	440	37.7	36.0	0.47	2.7	0.5	1.1
HR–SL–04 A	46.80586	-88.06500	A	0 to 4.5	5	388	0.45	3.6	3.4	310	24.6	63.6	0.40	2.9	0.3	1.0
HR–SL–05 A	46.83572	-88.10330	A	1 to 3	4	115	0.48	2.6	3.4	560	26.3	39.3	0.42	1.9	0.5	0.9
HR–SL–06 A	46.70800	-88.07032	A	2 to 4	5	103	0.57	3.0	5.4	460	35.5	41.7	0.47	2.7	0.4	1.4
HR–SL–07 A	46.72973	-88.05520	A	2 to 4.5	5	373	0.81	4.6	4.2	650	34.0	40.7	0.59	2.6	0.6	1.6
HR–SL–08 A	46.74261	-88.04839	A	0 to 3	5	196	0.60	4.3	4.0	420	24.9	40.3	0.42	2.7	0.5	1.1
HR–SL–08 A dup	46.74261	-88.04839	A	0 to 3	5	155	0.56	3.7	3.2	470	19.4	47.9	0.37	2.3	0.4	0.9
HR–SL–09 A	46.74865	-88.08341	A	2 to 5	5	153	0.59	3.5	3.1	460	19.0	47.5	0.38	2.5	0.3	0.9
HR–SL–10 A	46.76124	-88.10713	A	3.5 to 4.5	3	63	0.55	2.7	2.6	330	25.6	35.4	0.49	1.6	0.4	0.9
HR–SL–11 A	46.86267	-88.11263	A	0 to 12	6	1120	0.39	2.9	3.6	380	14.8	68.8	0.37	2.6	0.4	0.8
HR–SL–12 A	46.85126	-88.08941	A	5 to 6	4	111	1.11	2.1	4.4	930	43.4	17.9	0.63	2.5	1.0	1.3
HR–SL–13 A	46.81975	-88.10149	A	4 to 5	5	165	0.59	3.2	3.9	620	43.2	36.6	0.85	2.9	0.6	1.6
HR–SL–14 A	46.76476	-88.07135	A	2.5 to 5	5	87	0.96	2.3	6.9	1040	36.1	32.1	0.56	3.3	0.7	1.2
HR–SL–15 A	46.74901	-88.05780	A	1.5 to 3	5	116	0.57	3.9	6.9	440	44.7	43.0	0.55	3.2	0.5	1.3
HR–SL–16 A	46.77925	-88.09563	A	0 to 2	7	255	0.55	4.7	5.3	510	20.9	54.5	0.37	3.5	0.3	1.1
HR–SL–17 A	46.79581	-88.09223	A	0 to 3	4	108	0.32	2.6	2.4	220	13.0	47.5	0.34	2.0	<0.2	0.6
HR–SL–17 A dup	46.79581	-88.09223	A	0 to 3	3	113	0.35	2.7	2.5	200	14.2	47.8	0.32	2.0	<0.2	1.3
HR–SL–18 A	46.80113	-88.11597	A	0 to 5	21	487	1.29	3.6	36.9	560	24.6	80.6	1.05	7.3	0.5	1.2
HR–SL–19 A	46.81204	-88.13567	A	5 to 8	3	78	0.62	1.3	5.2	850	53.6	17.6	0.66	1.5	0.9	0.9
HR–SL–20 A	46.91087	-88.06673	A	2 to 3	3	52	0.27	1.9	1.8	150	36.6	54.4	0.51	1.6	0.3	1.0
HR–SL–21 A	46.89659	-88.08732	A	4 to 6	3	88	0.45	2.5	2.7	340	24.5	37.6	0.48	1.6	0.5	1.1
HR–SL–22 A	46.88639	-88.04665	A	0.5 to 1.5	5	1260	0.59	3.5	3.2	590	58.7	46.6	0.59	2.3	0.6	1.6
HR–SL–23 A	46.87526	-88.05947	A	2 to 3	5	5250	1.02	3.4	4.5	550	65.9	45.1	0.70	2.4	<0.2	1.7
HR–SL–24 A	46.86947	-88.08019	A	3 to 5.5	3	90	0.40	2.8	1.9	290	17.5	40.0	0.39	1.6	0.4	0.8
HR–SL–24 A dup	46.86947	-88.08019	A	3 to 5.5	3	61	0.40	2.7	2.0	300	18.6	40.3	0.40	1.5	0.4	0.7
HR–SL–25 A	46.79618	-88.00632	A	2 to 3	6	141	0.92	3.9	5.0	730	48.8	40.6	0.70	3.5	0.7	1.8
HR–SL–26 A	46.75230	-87.98873	A	0 to 2	4	411	0.51	4.0	2.9	370	33.8	57.1	0.40	2.8	0.2	1.0
HR–SL–27 A	46.81535	-88.01702	A	1 to 5	8	121	0.71	4.5	5.5	540	30.3	52.0	0.58	5.1	0.5	1.3
HR–SL–28 A	46.82391	-88.04588	A	0.5 to 1.75	4	236	0.47	3.5	3.1	530	31.3	38.4	0.47	2.0	0.4	1.2
HR–SL–29 A	46.83004	-88.06466	A	3.6 to 4.6	3	58	0.29	2.2	2.3	200	21.4	43.1	0.37	1.4	0.3	0.7
HR–SL–30 A	46.85067	-88.03606	A	6 to 7	4	43	1.12	1.7	4.9	790	43.6	15.7	0.59	2.3	1.2	1.2
HR–SL–31 A	46.85381	-88.12520	A	4 to 5	3	45	0.56	2.3	2.4	480	29.5	23.8	0.42	1.4	0.6	0.7
HR–SL–01 E	46.78747	-88.06271	E	8 to 20	8	117	0.55	3.3	5.3	90	9.4	67.3	0.44	6.5	<0.2	0.9

Appendix 3. Mineral soils (A, E, B, and C horizons), Huron River Watershed, Michigan.—Continued

Field no.	Latitude	Longitude	Horizon	Depth (cm)	Total extraction—Continued									
					Sr (ppm)	Te (ppm)	Th (ppm)	Tl (ppm)	U (ppm)	V (ppm)	W (ppm)	Y (ppm)	Zn (ppm)	C (wt. %)
HR–SL–01 A	46.78747	-88.06271	A	7.5 to 8	63.1	<0.1	3.1	0.2	1.1	51	0.3	7.3	60	28.10
HR–SL–02 A	46.77742	-88.04971	A	0 to 15	97.9	<0.1	9.6	0.7	3.1	98	0.7	20.3	235	7.20
HR–SL–03 A	46.76509	-88.03342	A	0.5 to 5	80.3	<0.1	2.7	0.3	0.9	29	0.3	4.9	42	28.70
HR–SL–04 A	46.80586	-88.06500	A	0 to 4.5	91.9	<0.1	3.3	0.4	1.1	28	0.3	7.0	31	5.90
HR–SL–05 A	46.83572	-88.10330	A	1 to 3	61.7	<0.1	2.4	0.3	0.8	22	0.3	4.6	35	17.00
HR–SL–06 A	46.70800	-88.07032	A	2 to 4	73.0	<0.1	2.6	0.3	0.9	32	0.3	4.6	61	24.70
HR–SL–07 A	46.72973	-88.05520	A	2 to 4.5	70.3	<0.1	3.0	0.3	1.1	25	0.4	5.1	36	23.70
HR–SL–08 A	46.74261	-88.04839	A	0 to 3	91.8	<0.1	3.1	0.3	1.1	34	0.4	5.6	44	16.30
HR–SL–08 A dup	46.74261	-88.04839	A	0 to 3	83.6	<0.1	3.5	0.3	1.1	23	0.3	5.1	43	N.A.
HR–SL–09 A	46.74865	-88.08341	A	2 to 5	83.3	<0.1	3.2	0.3	1.1	22	0.3	4.9	41	15.90
HR–SL–10 A	46.76124	-88.10713	A	3.5 to 4.5	51.9	<0.1	2.5	0.3	0.9	17	0.3	4.6	32	18.70
HR–SL–11 A	46.86267	-88.11263	A	0 to 12	67.6	<0.1	3.5	0.4	1.1	29	0.3	7.6	26	4.00
HR–SL–12 A	46.85126	-88.08941	A	5 to 6	39.1	<0.1	3.6	0.2	0.7	52	0.3	3.8	40	36.90
HR–SL–13 A	46.81975	-88.10149	A	4 to 5	58.8	<0.1	2.6	0.3	1.0	26	0.3	5.5	49	23.80
HR–SL–14 A	46.76476	-88.07135	A	2.5 to 5	55.4	<0.1	1.9	0.3	1.0	24	0.3	8.5	32	27.80
HR–SL–15 A	46.74901	-88.05780	A	1.5 to 3	69.2	<0.1	3.3	0.4	1.1	36	0.3	6.0	64	21.00
HR–SL–16 A	46.77925	-88.09563	A	0 to 2	98.4	<0.1	4.0	0.4	1.2	31	0.4	6.7	64	16.30
HR–SL–17 A	46.79581	-88.09223	A	0 to 3	58.4	<0.1	2.7	0.3	1.0	27	0.2	5.6	24	10.20
HR–SL–17 A dup	46.79581	-88.09223	A	0 to 3	58.0	<0.1	2.7	0.3	1.0	25	0.2	5.6	21	N.A.
HR–SL–18 A	46.80113	-88.11597	A	0 to 5	67.1	<0.1	4.6	0.6	2.1	67	0.4	13.1	125	7.20
HR–SL–19 A	46.81204	-88.13567	A	5 to 8	45.2	<0.1	1.4	0.2	0.5	14	0.2	2.6	86	39.00
HR–SL–20 A	46.91087	-88.06673	A	2 to 3	36.0	<0.1	2.4	0.4	0.9	10	0.2	7.7	18	11.80
HR–SL–21 A	46.89659	-88.08732	A	4 to 6	42.3	<0.1	2.9	0.3	0.8	18	0.2	4.1	26	15.20
HR–SL–22 A	46.88639	-88.04665	A	0.5 to 1.5	56.8	<0.1	3.6	0.4	1.1	26	0.3	6.2	45	12.10
HR–SL–23 A	46.87526	-88.05947	A	2 to 3	62.2	<0.1	3.5	0.5	1.0	31	0.6	6.6	60	15.00
HR–SL–24 A	46.86947	-88.08019	A	3 to 5.5	52.4	<0.1	2.6	0.2	0.9	18	0.2	4.9	18	13.10
HR–SL–24 A dup	46.86947	-88.08019	A	3 to 5.5	53.5	<0.1	2.6	0.3	0.9	18	0.2	4.7	18	N.A.
HR–SL–25 A	46.79618	-88.00632	A	2 to 3	62.6	<0.1	3.4	0.4	1.1	33	0.4	5.3	57	22.10
HR–SL–26 A	46.75230	-87.98873	A	0 to 2	73.8	<0.1	3.6	0.4	1.1	26	0.3	7.6	26	8.70
HR–SL–27 A	46.81535	-88.01702	A	1 to 5	71.4	<0.1	4.3	0.4	1.4	44	0.3	7.5	44	11.10
HR–SL–28 A	46.82391	-88.04588	A	0.5 to 1.75	56.3	<0.1	2.7	0.3	0.9	22	0.3	4.8	35	11.00
HR–SL–29 A	46.83004	-88.06466	A	3.6 to 4.6	51.3	<0.1	2.1	0.3	0.8	15	0.2	5.0	18	10.90
HR–SL–30 A	46.85067	-88.03606	A	6 to 7	38.2	<0.1	1.8	0.2	0.7	17	0.2	2.6	28	40.50
HR–SL–31 A	46.85381	-88.12520	A	4 to 5	39.2	<0.1	1.8	0.2	0.7	13	0.3	3.7	32	38.10
HR–SL–01 E	46.78747	-88.06271	E	8 to 20	68.3	<0.1	3.5	0.5	1.2	63	0.2	7.4	24	0.10

Appendix 3. Mineral soils (A, E, B, and C horizons), Huron River Watershed, Michigan.—Continued

Field no.	Latitude	Longitude	Horizon	Depth (cm)	Partial extraction									
					Ag (ppm)	As (ppm)	Au (ppm)	Bi (ppm)	Cd (ppm)	Cu (ppm)	Mo (ppm)	Pb (ppm)	Sb (ppm)	Zn (ppm)
HR–SL–03 E	46.76509	-88.03342	E	5 to 8	0.63	1	<0.1	<1	0.19	5.67	0.6	11	<1	16.4
HR–SL–05 E	46.83572	-88.10330	E	4 to 18	0.50	1	<0.1	<1	0.10	3.54	0.3	10	<1	8.2
HR–SL–07 E	46.72973	-88.05520	E	4 to 20	0.61	1	<0.1	<1	0.13	4.33	0.5	13	<1	11.2
HR–SL–08 E	46.74261	-88.04839	E	4 to 10	0.53	2	<0.1	<1	0.12	3.90	0.5	12	<1	15.7
HR–SL–10 E	46.76124	-88.10713	E	5 to 23	0.44	<1	<0.1	<1	0.09	2.73	0.3	10	<1	5.9
HR–SL–13 E	46.81975	-88.10149	E	6 to 25	0.33	1	<0.1	<1	0.07	3.33	0.3	8	<1	6.0
HR–SL–15 E	46.74901	-88.05780	E	4 to 18	0.58	2	<0.1	<1	0.21	4.66	0.4	10	<1	17.7
HR–SL–17 E	46.79581	-88.09223	E	8 to 13	0.49	2	<0.1	<1	0.18	5.12	0.7	14	<1	14.8
HR–SL–17 E dup	46.79581	-88.09223	E	8 to 13	0.44	2	<0.1	<1	0.18	6.16	0.5	15	<1	16.1
HR–SL–19 E	46.81204	-88.13567	E	8 to 38	0.47	1	<0.1	<1	0.13	4.29	0.4	11	<1	12.1
HR–SL–21 E	46.89659	-88.08732	E	6 to 13	0.36	1	<0.1	<1	0.07	2.87	0.2	9	<1	6.4
HR–SL–23 E	46.87526	-88.05947	E	4 to 13	0.51	2	<0.1	<1	0.10	3.16	0.4	11	<1	9.7
HR–SL–25 E	46.79618	-88.00632	E	4 to 10	0.54	2	<0.1	<1	0.17	5.76	0.4	11	<1	23.7
HR–SL–26 E	46.75230	-87.98873	E	1 to 8	0.65	5	<0.1	<1	0.27	5.72	0.7	21	<1	32.6
HR–SL–27 E	46.81535	-88.01702	E	5 to 18	0.76	3	<0.1	<1	0.19	7.37	0.5	13	<1	28.2
HR–SL–29 E	46.83004	-88.06466	E	5 to 10	0.38	1	<0.1	<1	0.06	3.08	0.3	11	<1	8.3
HR–SL–31 E	46.85381	-88.12520	E	4 to 36	0.33	<1	<0.1	<1	<0.05	2.33	0.2	8	<1	5.6
HR–SL–01 B	46.78747	-88.06271	B	20 to 66	0.61	5	<0.1	<1	0.26	13.2	0.9	13	<1	63.7
HR–SL–02 B	46.77742	-88.04971	B	46 to 61	0.63	7	<0.1	<1	0.26	22.7	0.5	15	<1	59.0
HR–SL–02 B dup	46.77742	-88.04971	B	46 to 61	0.56	7	<0.1	<1	0.26	21.6	0.5	14	<1	54.1
HR–SL–03 B1	46.76509	-88.03342	B	8 to 38	0.72	3	<0.1	<1	0.18	10.7	0.8	14	<1	45.6
HR–SL–03 B2	46.76509	-88.03342	B	38 to 119	0.62	6	<0.1	<1	0.13	25.7	0.6	16	<1	40.1
HR–SL–03 B3	46.76509	-88.03342	B	119 to 135	0.50	2	<0.1	<1	0.09	10.2	0.3	11	<1	23.8
HR–SL–04 B1	46.80586	-88.06500	B	15 to 33	0.53	2	<0.1	<1	0.19	8.1	0.4	13	<1	49.2
HR–SL–04 B2	46.80586	-88.06500	B	33 to 102	0.73	3	<0.1	<1	0.18	19.0	0.5	14	<1	40.0
HR–SL–05 B1	46.83572	-88.10330	B	18 to 61	0.56	3	<0.1	<1	0.13	6.1	0.4	12	<1	42.9
HR–SL–05 B1 dup	46.83572	-88.10330	B	18 to 61	0.50	3	<0.1	<1	0.14	6.7	0.3	11	<1	39.1
HR–SL–05 B2	46.83572	-88.10330	B	61 to 76	0.63	2	<0.1	<1	0.13	13.5	0.4	12	<1	32.3
HR–SL–06 B	46.70800	-88.07032	B	18 to 46	0.61	3	<0.1	<1	0.16	9.3	0.8	12	<1	39.8
HR–SL–07 B	46.72973	-88.05520	B	20 to 41	0.57	3	<0.1	<1	0.15	6.4	0.6	13	<1	38.4
HR–SL–08 B	46.74261	-88.04839	B	10 to 46	0.62	2	<0.1	<1	0.13	6.9	0.6	14	<1	33.3
HR–SL–09 B	46.74865	-88.08341	B	18 to 53	0.75	3	<0.1	<1	0.28	6.6	0.8	14	<1	53.5
HR–SL–10 B	46.76124	-88.10713	B	23 to 31	0.68	24	<0.1	<1	0.19	10.4	0.4	12	1	24.9
HR–SL–11 B	46.86267	-88.11263	B	15 to 51	0.65	4	<0.1	<1	0.14	10.4	0.4	13	<1	31.5
HR–SL–12 B	46.85126	-88.08941	B	25 to 56	0.42	2	<0.1	<1	0.08	5.6	0.2	9	<1	14.3

Appendix 3. Mineral soils (A, E, B, and C horizons), Huron River Watershed, Michigan.—Continued

Field no.	Latitude	Longitude	Horizon	Depth (cm)	Total extraction										
					Al (wt. %)	Ca (wt. %)	Fe (wt. %)	K (wt. %)	Mg (wt. %)	Na (wt. %)	S (wt. %)	Ti (wt. %)	Ag (ppm)	As (ppm)	Ba (ppm)
HR–SL–03 E	46.76509	-88.03342	E	5 to 8	2.98	0.3	0.99	1.73	0.1	0.68	<0.01	0.15	<1	<1	486
HR–SL–05 E	46.83572	-88.10330	E	4 to 18	2.02	0.13	0.81	1.43	0.05	0.34	<0.01	0.12	<1	<1	386
HR–SL–07 E	46.72973	-88.05520	E	4 to 20	2.54	0.13	0.72	1.75	0.06	0.42	<0.01	0.14	<1	1	467
HR–SL–08 E	46.74261	-88.04839	E	4 to 10	2.84	0.25	0.79	1.53	0.11	0.58	<0.01	0.13	<1	1	455
HR–SL–10 E	46.76124	-88.10713	E	5 to 23	1.91	0.1	0.85	1.55	0.04	0.29	<0.01	0.11	<1	1	393
HR–SL–13 E	46.81975	-88.10149	E	6 to 25	1.5	0.07	0.59	1.1	0.03	0.19	<0.01	0.07	<1	<1	287
HR–SL–15 E	46.74901	-88.05780	E	4 to 18	2.7	0.2	1	1.89	0.1	0.48	<0.01	0.14	<1	<1	451
HR–SL–17 E	46.79581	-88.09223	E	8 to 13	2	0.14	0.91	1.31	0.06	0.33	0.01	0.1	<1	1	352
HR–SL–17 E dup	46.79581	-88.09223	E	8 to 13	1.89	0.13	0.92	1.26	0.06	0.31	0.01	0.11	<1	2	333
HR–SL–19 E	46.81204	-88.13567	E	8 to 38	2.21	0.15	0.8	1.47	0.06	0.37	<0.01	0.11	<1	<1	378
HR–SL–21 E	46.89659	-88.08732	E	6 to 13	1.81	0.08	0.69	1.53	0.04	0.25	<0.01	0.09	<1	<1	345
HR–SL–23 E	46.87526	-88.05947	E	4 to 13	2.11	0.15	1.02	1.43	0.07	0.37	<0.01	0.16	<1	1	361
HR–SL–25 E	46.79618	-88.00632	E	4 to 10	2.74	0.2	1.01	1.42	0.13	0.4	0.01	0.13	<1	1	424
HR–SL–26 E	46.75230	-87.98873	E	1 to 8	3.11	0.27	1.28	1.69	0.17	0.53	0.02	0.16	<1	3	507
HR–SL–27 E	46.81535	-88.01702	E	5 to 18	3.59	0.21	1.3	1.9	0.21	0.49	<0.01	0.19	<1	2	492
HR–SL–29 E	46.83004	-88.06466	E	5 to 10	2.09	0.11	0.63	1.75	0.06	0.32	<0.01	0.07	<1	<1	417
HR–SL–31 E	46.85381	-88.12520	E	4 to 36	1.73	0.06	0.43	1.71	0.02	0.23	<0.01	0.06	<1	<1	377
HR–SL–01 B	46.78747	-88.06271	B	20 to 66	4.12	0.26	2.76	2.05	0.44	0.47	0.01	0.16	<1	5	476
HR–SL–02 B	46.77742	-88.04971	B	46 to 61	4.53	0.54	2.53	2.18	0.61	0.82	<0.01	0.16	<1	6	517
HR–SL–02 B dup	46.77742	-88.04971	B	46 to 61	4.51	0.56	2.57	2.32	0.59	0.80	<0.01	0.17	<1	7	527
HR–SL–03 B1	46.76509	-88.03342	B	8 to 38	4.96	0.56	2.41	1.88	0.43	1.00	0.02	0.19	<1	3	507
HR–SL–03 B2	46.76509	-88.03342	B	38 to 119	5.56	0.73	2.57	2.07	0.61	1.22	<0.01	0.18	<1	5	558
HR–SL–03 B3	46.76509	-88.03342	B	119 to 135	3.10	0.29	1.17	2.06	0.26	0.54	<0.01	0.10	<1	2	466
HR–SL–04 B1	46.80586	-88.06500	B	15 to 33	3.55	0.32	1.30	2.13	0.24	0.59	<0.01	0.10	<1	2	489
HR–SL–04 B2	46.80586	-88.06500	B	33 to 102	5.09	0.58	2.08	2.61	0.55	0.85	<0.01	0.22	<1	3	589
HR–SL–05 B1	46.83572	-88.10330	B	18 to 61	3.75	0.30	1.69	2.13	0.24	0.53	<0.01	0.15	<1	2	475
HR–SL–05 B1 dup	46.83572	-88.10330	B	18 to 61	3.72	0.29	1.59	1.84	0.24	0.52	<0.01	0.14	<1	2	428
HR–SL–05 B2	46.83572	-88.10330	B	61 to 76	3.59	0.37	1.35	2.27	0.25	0.68	<0.01	0.15	<1	2	503
HR–SL–06 B	46.70800	-88.07032	B	18 to 46	3.90	0.52	2.04	1.78	0.40	0.76	0.02	0.17	<1	3	456
HR–SL–07 B	46.72973	-88.05520	B	20 to 41	3.60	0.32	1.87	2.18	0.24	0.58	0.01	0.15	<1	2	508
HR–SL–08 B	46.74261	-88.04839	B	10 to 46	3.88	0.42	1.52	2.03	0.26	0.83	0.01	0.13	<1	2	505
HR–SL–09 B	46.74865	-88.08341	B	18 to 53	4.16	0.50	2.31	1.79	0.28	0.79	0.02	0.20	<1	3	461
HR–SL–10 B	46.76124	-88.10713	B	23 to 31	3.04	0.25	1.16	2.10	0.16	0.51	<0.01	0.09	<1	23	463
HR–SL–11 B	46.86267	-88.11263	B	15 to 51	3.77	0.23	1.37	2.50	0.38	0.39	<0.01	0.17	<1	4	522
HR–SL–12 B	46.85126	-88.08941	B	25 to 56	2.48	0.21	0.76	1.82	0.16	0.43	<0.01	0.12	<1	2	406

Appendix 3. Mineral soils (A, E, B, and C horizons), Huron River Watershed, Michigan.—Continued

Field no.	Latitude	Longitude	Horizon	Depth (cm)	Total extraction—Continued Be (ppm)	Bi (ppm)	Cd (ppm)	Ce (ppm)	Co (ppm)	Cr (ppm)	Cs (ppm)	Cu (ppm)	Ga (ppm)	Hg (ppm)	In (ppm)	La (ppm)
HR–SL–03 E	46.76509	-88.03342	E	5 to 8	0.7	0.09	0.1	17.6	1.5	17	<5	6.7	8.33	<0.01	<0.02	9.3
HR–SL–05 E	46.83572	-88.10330	E	4 to 18	0.4	0.06	<0.1	14.5	1	9	<5	4.5	5.4	<0.01	<0.02	7.7
HR–SL–07 E	46.72973	-88.05520	E	4 to 20	0.6	0.08	<0.1	17	0.9	14	<5	5.3	6.75	<0.01	<0.02	8.6
HR–SL–08 E	46.74261	-88.04839	E	4 to 10	0.6	0.08	<0.1	18	1.4	14	<5	4.9	8.17	<0.01	<0.02	9.5
HR–SL–10 E	46.76124	-88.10713	E	5 to 23	0.5	0.06	<0.1	14.7	0.8	11	<5	3.7	5.23	<0.01	<0.02	7.6
HR–SL–13 E	46.81975	-88.10149	E	6 to 25	0.3	<0.04	<0.1	8.66	0.5	9	<5	4.3	4.01	<0.01	<0.02	4.8
HR–SL–15 E	46.74901	-88.05780	E	4 to 18	0.6	0.08	0.1	16.4	1.4	20	<5	5.7	7.41	<0.01	<0.02	8.8
HR–SL–17 E	46.79581	-88.09223	E	8 to 13	0.5	0.08	0.1	10.8	1	12	<5	6.1	5.15	0.02	<0.02	6
HR–SL–17 E dup	46.79581	-88.09223	E	8 to 13	0.5	0.09	0.1	13.3	1.1	16	<5	7.2	5.44	0.02	<0.02	7.8
HR–SL–19 E	46.81204	-88.13567	E	8 to 38	0.5	0.06	<0.1	12.4	0.9	8	<5	5.3	5.55	0.01	<0.02	6.9
HR–SL–21 E	46.89659	-88.08732	E	6 to 13	0.4	0.07	<0.1	13.1	0.8	9	<5	3.9	4.76	<0.01	<0.02	7
HR–SL–23 E	46.87526	-88.05947	E	4 to 13	0.4	0.06	<0.1	18.1	1.2	10	<5	4.2	5.87	<0.01	<0.02	9.5
HR–SL–25 E	46.79618	-88.00632	E	4 to 10	0.6	0.08	0.1	19	1.7	20	<5	6.8	7.8	0.01	<0.02	10
HR–SL–26 E	46.75230	-87.98873	E	1 to 8	0.7	0.15	0.2	26.1	3.4	20	<5	6.7	9.47	0.03	<0.02	12.9
HR–SL–27 E	46.81535	-88.01702	E	5 to 18	0.9	0.12	<0.1	28.8	2.5	22	<5	8.4	11	0.01	<0.02	14.5
HR–SL–29 E	46.83004	-88.06466	E	5 to 10	0.4	0.06	<0.1	12.7	1	9	<5	4.1	5.48	0.01	<0.02	7.2
HR–SL–31 E	46.85381	-88.12520	E	4 to 36	0.3	0.04	<0.1	8.63	0.4	7	<5	3.3	4.31	<0.01	<0.02	4.5
HR–SL–01 B	46.78747	-88.06271	B	20 to 66	1.2	0.13	0.2	34.3	5.4	52	<5	14.6	11.8	0.03	0.03	15.9
HR–SL–02 B	46.77742	-88.04971	B	46 to 61	1.4	0.11	0.2	41.3	9.2	53	<5	21.7	10.4	0.03	0.03	18.2
HR–SL–02 B dup	46.77742	-88.04971	B	46 to 61	1.3	0.13	0.2	45.8	9.2	47	<5	22.6	11.8	0.02	0.03	20.3
HR–SL–03 B1	46.76509	-88.03342	B	8 to 38	1.0	0.11	0.1	36.2	5.5	47	<5	10.4	12.1	0.04	0.03	15.5
HR–SL–03 B2	46.76509	-88.03342	B	38 to 119	1.5	0.11	<0.1	35.5	9.3	57	<5	24.9	11.8	0.07	0.03	20.3
HR–SL–03 B3	46.76509	-88.03342	B	119 to 135	0.9	0.06	<0.1	33.5	3.7	28	<5	11.0	6.8	0.02	<0.02	15.2
HR–SL–04 B1	46.80586	-88.06500	B	15 to 33	1.0	0.07	0.1	32.1	3.6	29	<5	7.9	8.5	0.02	<0.02	14.3
HR–SL–04 B2	46.80586	-88.06500	B	33 to 102	1.8	0.09	<0.1	49.0	8.0	40	<5	18.8	11.3	0.02	0.03	23.5
HR–SL–05 B1	46.83572	-88.10330	B	18 to 61	0.9	0.15	<0.1	31.5	4.3	17	<5	6.4	7.7	0.02	<0.02	13.8
HR–SL–05 B1 dup	46.83572	-88.10330	B	18 to 61	1.0	0.07	<0.1	32.6	4.8	19	<5	7.7	9.1	0.02	0.02	14.1
HR–SL–05 B2	46.83572	-88.10330	B	61 to 76	0.9	0.04	<0.1	27.8	4.3	25	<5	6.6	7.3	<0.01	<0.02	12.3
HR–SL–06 B	46.70800	-88.07032	B	18 to 46	0.9	0.09	0.1	25.5	5.8	36	<5	10.2	8.5	0.03	0.02	11.9
HR–SL–07 B	46.72973	-88.05520	B	20 to 41	0.8	0.09	<0.1	26.0	3.6	28	<5	5.4	9.7	0.03	<0.02	12.2
HR–SL–08 B	46.74261	-88.04839	B	10 to 46	0.9	0.08	<0.1	22.9	3.5	18	<5	6.3	9.3	0.02	<0.02	11.2
HR–SL–09 B	46.74865	-88.08341	B	18 to 53	1.0	0.12	0.2	30.7	4.1	29	<5	6.4	9.7	0.05	0.02	14.6
HR–SL–10 B	46.76124	-88.10713	B	23 to 31	0.7	0.18	0.1	22.5	2.7	18	<5	9.4	6.3	0.01	0.31	10.4
HR–SL–11 B	46.86267	-88.11263	B	15 to 51	1.3	0.25	<0.1	30.0	4.4	18	<5	9.4	9.0	0.02	0.02	14.0
HR–SL–12 B	46.85126	-88.08941	B	25 to 56	0.6	0.12	<0.1	23.7	2.5	14	<5	5.1	5.5	<0.01	<0.02	12.0

Appendix 3. Mineral soils (A, E, B, and C horizons), Huron River Watershed, Michigan.—Continued

Field no.	Latitude	Longitude	Horizon	Depth (cm)	Total extraction—Continued											
					Li (ppm)	Mn (ppm)	Mo (ppm)	Nb (ppm)	Ni (ppm)	P (ppm)	Pb (ppm)	Rb (ppm)	Sb (ppm)	Sc (ppm)	Se (ppm)	Sn (ppm)
HR–SL–03 E	46.76509	-88.03342	E	5 to 8	5	99	0.52	3.6	3.3	90	10.2	64.7	0.33	3.3	<0.2	0.6
HR–SL–05 E	46.83572	-88.10330	E	4 to 18	3	84	0.23	2.8	1.2	50	10.3	48.4	0.34	1.7	<0.2	0.5
HR–SL–07 E	46.72973	-88.05520	E	4 to 20	4	80	0.39	3.4	1.7	80	12.5	63.9	0.34	2.6	<0.2	0.7
HR–SL–08 E	46.74261	-88.04839	E	4 to 10	5	83	0.47	3.3	2.7	120	11.2	59.1	0.36	3	<0.2	0.7
HR–SL–10 E	46.76124	-88.10713	E	5 to 23	3	86	0.3	2.3	1.2	<50	9.7	52.2	0.35	2	<0.2	0.5
HR–SL–13 E	46.81975	-88.10149	E	6 to 25	3	45	0.23	1.6	0.7	<50	7.3	38.7	0.33	1.7	<0.2	0.3
HR–SL–15 E	46.74901	-88.05780	E	4 to 18	6	95	0.35	2.9	2.7	80	9.8	73.7	0.38	3.6	<0.2	0.7
HR–SL–17 E	46.79581	-88.09223	E	8 to 13	4	78	0.35	2.3	1.8	110	13.6	45.2	0.36	1.9	<0.2	0.5
HR–SL–17 E dup	46.79581	-88.09223	E	8 to 13	4	87	0.45	2.9	1.9	110	14.1	45.1	0.4	2.4	<0.2	0.6
HR–SL–19 E	46.81204	-88.13567	E	8 to 38	3	81	0.28	2.9	1.4	80	10	49.3	0.38	1.7	<0.2	0.5
HR–SL–21 E	46.89659	-88.08732	E	6 to 13	3	81	0.26	2.1	1	60	8.3	51.1	0.32	1.4	<0.2	0.5
HR–SL–23 E	46.87526	-88.05947	E	4 to 13	3	124	0.3	3.5	1.7	70	10.9	49.4	0.44	2	<0.2	0.7
HR–SL–25 E	46.79618	-88.00632	E	4 to 10	6	96	0.39	3.1	3.6	160	10.1	54.6	0.42	3.8	<0.2	0.6
HR–SL–26 E	46.75230	-87.98873	E	1 to 8	7	723	0.59	4.1	4.2	300	21.6	66.3	0.41	4	0.3	1
HR–SL–27 E	46.81535	-88.01702	E	5 to 18	8	155	0.4	4.7	4.8	160	12.7	77.5	0.43	4.7	<0.2	1.1
HR–SL–29 E	46.83004	-88.06466	E	5 to 10	3	80	0.25	1.7	1.6	60	11.1	56.4	0.29	1.7	<0.2	0.4
HR–SL–31 E	46.85381	-88.12520	E	4 to 36	2	47	0.17	1.5	0.5	<50	8.2	53.9	0.34	1.1	<0.2	0.4
HR–SL–01 B	46.78747	-88.06271	B	20 to 66	22	149	0.67	4.2	16.8	250	14.1	82.4	0.45	7.5	<0.2	1.0
HR–SL–02 B	46.77742	-88.04971	B	46 to 61	20	318	0.31	3.6	24.1	350	14.1	79.6	0.49	8.6	<0.2	0.8
HR–SL–02 B dup	46.77742	-88.04971	B	46 to 61	19	323	0.38	4.1	23.6	360	14.3	77.5	0.58	8.4	<0.2	1.0
HR–SL–03 B1	46.76509	-88.03342	B	8 to 38	19	178	0.55	5.0	15.2	220	15.1	63.8	0.28	5.6	0.4	0.9
HR–SL–03 B2	46.76509	-88.03342	B	38 to 119	19	211	0.33	4.9	24.6	250	14.6	73.1	0.30	8.2	0.3	0.9
HR–SL–03 B3	46.76509	-88.03342	B	119 to 135	9	125	0.15	2.3	10.4	180	10.6	70.9	0.34	4.0	<0.2	0.6
HR–SL–04 B1	46.80586	-88.06500	B	15 to 33	11	117	0.21	2.9	9.6	410	11.7	73.1	0.28	3.8	<0.2	0.7
HR–SL–04 B2	46.80586	-88.06500	B	33 to 102	16	276	0.29	6.1	16.1	390	13.3	85.1	0.43	7.9	<0.2	1.3
HR–SL–05 B1	46.83572	-88.10330	B	18 to 61	11	140	0.22	3.3	9.0	620	11.4	69.5	0.35	3.3	<0.2	0.8
HR–SL–05 B1 dup	46.83572	-88.10330	B	18 to 61	11	135	0.27	3.5	9.6	610	11.8	60.5	0.43	3.7	<0.2	0.8
HR–SL–05 B2	46.83572	-88.10330	B	61 to 76	8	149	0.19	3.3	8.3	240	10.4	75.5	0.32	3.3	<0.2	0.6
HR–SL–06 B	46.70800	-88.07032	B	18 to 46	11	187	0.35	3.6	14.4	300	11.5	62.3	0.39	5.0	0.4	0.7
HR–SL–07 B	46.72973	-88.05520	B	20 to 41	10	149	0.38	3.7	7.7	320	14.2	76.4	0.35	3.7	0.4	0.7
HR–SL–08 B	46.74261	-88.04839	B	10 to 46	9	128	0.37	3.3	8.1	210	12.5	65.9	0.27	3.6	0.2	0.7
HR–SL–09 B	46.74865	-88.08341	B	18 to 53	13	180	0.60	4.5	8.6	330	13.6	59.3	0.31	4.6	0.4	0.9
HR–SL–10 B	46.76124	-88.10713	B	23 to 31	7	110	0.28	2.4	6.9	180	11.3	69.2	1.07	2.4	0.3	10.5
HR–SL–11 B	46.86267	-88.11263	B	15 to 51	11	239	0.24	4.0	7.3	290	12.8	88.3	0.51	4.0	<0.2	1.1
HR–SL–12 B	46.85126	-88.08941	B	25 to 56	6	119	0.14	2.9	5.1	120	9.7	61.2	0.34	2.5	<0.2	0.7

Appendix 3. Mineral soils (A, E, B, and C horizons), Huron River Watershed, Michigan.—Continued

Field no.	Latitude	Longitude	Horizon	Depth (cm)	Total extraction—Continued									
					Sr (ppm)	Te (ppm)	Th (ppm)	Tl (ppm)	U (ppm)	V (ppm)	W (ppm)	Y (ppm)	Zn (ppm)	C (wt. %)
HR–SL–03 E	46.76509	-88.03342	E	5 to 8	109.0	<0.1	3.7	0.4	1	36	0.2	5.8	14	2.20
HR–SL–05 E	46.83572	-88.10330	E	4 to 18	60.3	<0.1	3.1	0.3	0.9	20	0.2	6.4	8	1.40
HR–SL–07 E	46.72973	-88.05520	E	4 to 20	70.6	<0.1	3.9	0.4	1.1	25	0.2	7.2	12	0.90
HR–SL–08 E	46.74261	-88.04839	E	4 to 10	95.0	<0.1	3.2	0.4	1.1	29	0.2	6.3	17	1.70
HR–SL–10 E	46.76124	-88.10713	E	5 to 23	56.4	<0.1	3	0.3	0.9	25	0.1	6.2	7	0.80
HR–SL–13 E	46.81975	-88.10149	E	6 to 25	39.5	<0.1	2	0.2	0.7	14	0.1	4.9	6	1.30
HR–SL–15 E	46.74901	-88.05780	E	4 to 18	77.4	<0.1	3.8	0.4	1.1	41	0.2	6.4	18	1.60
HR–SL–17 E	46.79581	-88.09223	E	8 to 13	61.6	<0.1	2.4	0.3	0.9	27	0.2	5.1	14	3.20
HR–SL–17 E dup	46.79581	-88.09223	E	8 to 13	58.8	<0.1	2.7	0.3	0.9	28	0.2	6.2	14	N.A.
HR–SL–19 E	46.81204	-88.13567	E	8 to 38	63.5	<0.1	2.9	0.3	0.9	18	0.2	6.2	12	2.50
HR–SL–21 E	46.89659	-88.08732	E	6 to 13	47.9	<0.1	2.5	0.3	0.7	18	0.2	5.9	7	0.80
HR–SL–23 E	46.87526	-88.05947	E	4 to 13	60.1	<0.1	3.4	0.3	1	26	0.2	8	9	1.10
HR–SL–25 E	46.79618	-88.00632	E	4 to 10	70.1	<0.1	3.4	0.3	1	34	0.2	6.8	22	2.20
HR–SL–26 E	46.75230	-87.98873	E	1 to 8	90.1	<0.1	4.4	0.5	1.2	38	0.3	7.9	31	3.00
HR–SL–27 E	46.81535	-88.01702	E	5 to 18	86.0	<0.1	4.7	0.4	1.4	41	0.2	9.7	27	2.10
HR–SL–29 E	46.83004	-88.06466	E	5 to 10	57.8	<0.1	2.5	0.3	0.8	16	0.1	6	8	0.90
HR–SL–31 E	46.85381	-88.12520	E	4 to 36	47.7	<0.1	1.9	0.3	0.7	10	0.1	5.6	5	n.a.
HR–SL–01 B	46.78747	-88.06271	B	20 to 66	72.4	<0.1	4.6	0.6	1.6	64	0.3	10.1	60	2.10
HR–SL–02 B	46.77742	-88.04971	B	46 to 61	119.0	<0.1	5.4	0.5	1.5	59	0.3	11.3	54	0.20
HR–SL–02 B dup	46.77742	-88.04971	B	46 to 61	118.0	<0.1	6.1	0.5	1.4	59	0.3	11.9	54	n.a.
HR–SL–03 B1	46.76509	-88.03342	B	8 to 38	153.0	<0.1	4.8	0.4	1.2	53	0.3	8.2	43	2.70
HR–SL–03 B2	46.76509	-88.03342	B	38 to 119	184.0	<0.1	6.7	0.5	1.1	53	0.4	10.3	37	0.60
HR–SL–03 B3	46.76509	-88.03342	B	119 to 135	81.5	<0.1	4.1	0.4	1.1	27	0.2	10.1	20	0.50
HR–SL–04 B1	46.80586	-88.06500	B	15 to 33	97.9	<0.1	4.1	0.4	1.3	27	0.2	9.1	47	1.30
HR–SL–04 B2	46.80586	-88.06500	B	33 to 102	136.0	<0.1	6.8	0.5	1.7	48	0.4	15.1	36	0.60
HR–SL–05 B1	46.83572	-88.10330	B	18 to 61	79.3	<0.1	4.1	0.4	1.2	36	0.3	9.8	39	1.60
HR–SL–05 B1 dup	46.83572	-88.10330	B	18 to 61	77.3	<0.1	4.4	0.4	1.2	34	0.4	10.3	38	N.A.
HR–SL–05 B2	46.83572	-88.10330	B	61 to 76	106.0	<0.1	3.5	0.4	1.1	30	0.2	9.0	25	1.10
HR–SL–06 B	46.70800	-88.07032	B	18 to 46	105.0	<0.1	3.5	0.4	1.1	51	0.3	8.2	37	2.80
HR–SL–07 B	46.72973	-88.05520	B	20 to 41	89.2	<0.1	3.8	0.4	1.2	38	0.3	8.8	34	1.40
HR–SL–08 B	46.74261	-88.04839	B	10 to 46	129.0	<0.1	3.5	0.4	1.1	31	0.2	7.3	30	2.30
HR–SL–09 B	46.74865	-88.08341	B	18 to 53	129.0	<0.1	5.0	0.4	1.2	49	0.4	8.2	50	3.70
HR–SL–10 B	46.76124	-88.10713	B	23 to 31	80.7	<0.1	3.2	0.4	1.0	24	0.2	8.1	23	1.20
HR–SL–11 B	46.86267	-88.11263	B	15 to 51	67.5	<0.1	4.8	0.5	1.4	30	0.5	12.3	28	0.80
HR–SL–12 B	46.85126	-88.08941	B	25 to 56	66.5	<0.1	3.6	0.4	1.0	20	0.4	9.1	12	0.50

Appendix 3. Mineral soils (A, E, B, and C horizons), Huron River Watershed, Michigan.—Continued

Field no.	Latitude	Longitude	Horizon	Depth (cm)	Partial extraction									
					Ag (ppm)	As (ppm)	Au (ppm)	Bi (ppm)	Cd (ppm)	Cu (ppm)	Mo (ppm)	Pb (ppm)	Sb (ppm)	Zn (ppm)
HR–SL–13 B	46.81975	-88.10149	B	31 to 69	0.48	5	<0.1	<1	0.11	10.1	0.5	10	<1	34.0
HR–SL–14 B	46.76476	-88.07135	B	13 to 25	0.56	4	<0.1	<1	0.12	11.3	0.5	12	<1	33.0
HR–SL–15 B1	46.74901	-88.05780	B	18 to 33	0.71	5	<0.1	<1	0.24	12.9	0.8	13	<1	62.0
HR–SL–15 B2	46.74901	-88.05780	B	33 to 51	0.62	5	<0.1	<1	0.21	14.7	0.7	12	<1	66.8
HR–SL–16 B1	46.77925	-88.09563	B	13 to 61	0.73	5	<0.1	<1	0.21	15.7	1.8	14	<1	63.5
HR–SL–16 B2	46.77925	-88.09563	B	61 to 66	0.64	5	<0.1	<1	0.17	15.4	0.8	13	<1	59.9
HR–SL–17 B	46.79581	-88.09223	B	13 to 66	0.43	3	<0.1	<1	0.16	7.8	0.5	10	<1	36.2
HR–SL–18 B	46.80113	-88.11597	B	10 to 25	0.73	10	<0.1	<1	0.39	37.4	2.0	16	1	146.0
HR–SL–19 B	46.81204	-88.13567	B	38 to 56	0.65	4	<0.1	<1	0.19	11.4	0.6	14	<1	45.0
HR–SL–20 B	46.91087	-88.06673	B	18 to 61	0.47	4	<0.1	<1	0.09	6.6	0.3	10	<1	23.6
HR–SL–21 B1	46.89659	-88.08732	B	13 to 25	0.50	2	<0.1	<1	0.12	7.3	0.4	11	<1	27.1
HR–SL–21 B2	46.89659	-88.08732	B	25 to 51	0.48	2	<0.1	<1	0.11	6.5	0.3	11	<1	31.1
HR–SL–22 B	46.88639	-88.04665	B	31 to 46	0.54	2	<0.1	<1	0.14	7.2	0.4	11	<1	27.7
HR–SL–23 B1	46.87526	-88.05947	B	13 to 33	0.54	3	<0.1	<1	0.13	12.6	0.5	11	<1	35.7
HR–SL–23 B2	46.87526	-88.05947	B	33 to 43	0.49	3	<0.1	<1	0.12	12.0	0.5	10	<1	33.5
HR–SL–23 B2 dup	46.87526	-88.05947	B	33 to 43	0.47	3	<0.1	<1	0.12	12.2	0.5	10	<1	32.7
HR–SL–24 B	46.86947	-88.08019	B	13 to 33	0.60	2	<0.1	<1	0.14	8.2	0.5	12	<1	21.0
HR–SL–25 B1	46.79618	-88.00632	B	10 to 31	0.72	2	<0.1	<1	0.16	11.3	0.6	11	<1	43.1
HR–SL–25 B2	46.79618	-88.00632	B	46 to 56	0.54	3	<0.1	<1	0.14	12.1	0.5	10	<1	40.4
HR–SL–26 B	46.75230	-87.98873	B	8 to 38	0.76	3	<0.1	<1	0.22	11.3	0.6	13	<1	51.2
HR–SL–27 B	46.81535	-88.01702	B	18 to 38	0.90	3	<0.1	<1	0.18	8.8	0.5	13	<1	43.3
HR–SL–28 B	46.82391	-88.04588	B	8 to 51	0.69	4	<0.1	<1	0.22	15.5	0.7	12	<1	56.4
HR–SL–29 B1	46.83004	-88.06466	B	10 to 53	0.58	3	<0.1	<1	0.16	14.7	0.4	13	<1	23.6
HR–SL–29 B1 dup	46.83004	-88.06466	B	10 to 53	0.60	3	<0.1	<1	0.16	8.2	0.4	13	<1	24.4
HR–SL–29 B2	46.83004	-88.06466	B	53 to 69	0.61	3	<0.1	<1	0.17	8.4	0.3	12	<1	22.8
HR–SL–30 B	46.85067	-88.03606	B	20 to 43	0.55	3	<0.1	<1	0.13	7.4	0.4	11	<1	28.0
HR–SL–31 B1	46.85381	-88.12520	B	36 to 51	0.41	3	<0.1	<1	0.10	3.6	0.3	11	<1	13.3
HR–SL–31 B2	46.85381	-88.12520	B	51 to 147	0.41	2	<0.1	<1	0.08	4.8	0.2	9	<1	13.8
HR–SL–01 C	46.78747	-88.06271	C	66 to 71	0.57	5	<0.1	<1	0.26	16.5	0.8	13	<1	61.20
HR–SL–04 C	46.80586	-88.06500	C	102 to 122	0.74	4	<0.1	<1	0.24	20.6	0.7	14	<1	46.00
HR–SL–06 C	46.70800	-88.07032	C	76 to 86	0.44	3	<0.1	<1	0.15	17.2	0.3	11	<1	29.30
HR–SL–07 C	46.72973	-88.05520	C	41 to 56	0.44	3	<0.1	<1	0.13	6.2	0.4	12	<1	42.30
HR–SL–07 C dup	46.72973	-88.05520	C	41 to 56	0.40	3	<0.1	<1	0.12	5.1	0.3	12	<1	40.00
HR–SL–08 C	46.74261	-88.04839	C	46 to 61	0.49	2	<0.1	<1	0.12	7.0	0.4	12	<1	26.50
HR–SL–09 C	46.74865	-88.08341	C	53 to 71	0.46	3	<0.1	<1	0.15	8.5	0.3	11	<1	29.30

Appendix 3. Mineral soils (A, E, B, and C horizons), Huron River Watershed, Michigan.—Continued

Field no.	Latitude	Longitude	Horizon	Depth (cm)	Total extraction										
					Al (wt. %)	Ca (wt. %)	Fe (wt. %)	K (wt. %)	Mg (wt. %)	Na (wt. %)	S (wt. %)	Ti (wt. %)	Ag (ppm)	As (ppm)	Ba (ppm)
HR–SL–13 B	46.81975	-88.10149	B	31 to 69	3.18	0.19	1.56	1.84	0.26	0.39	<0.01	0.11	<1	5	390
HR–SL–14 B	46.76476	-88.07135	B	13 to 25	3.04	0.25	1.32	1.91	0.26	0.50	<0.01	0.12	<1	3	426
HR–SL–15 B1	46.74901	-88.05780	B	18 to 33	3.93	0.31	2.59	1.83	0.36	0.52	0.02	0.17	<1	5	430
HR–SL–15 B2	46.74901	-88.05780	B	33 to 51	3.91	0.31	2.20	1.97	0.42	0.54	0.01	0.17	<1	5	447
HR–SL–16 B1	46.77925	-88.09563	B	13 to 61	4.47	0.35	2.51	2.12	0.52	0.63	0.02	0.22	<1	5	507
HR–SL–16 B2	46.77925	-88.09563	B	61 to 66	4.16	0.34	2.27	2.12	0.54	0.57	0.01	0.19	<1	5	484
HR–SL–17 B	46.79581	-88.09223	B	13 to 66	3.04	0.27	1.45	1.95	0.20	0.54	<0.01	0.10	<1	3	447
HR–SL–18 B	46.80113	-88.11597	B	10 to 25	4.38	0.17	3.64	1.79	0.56	0.42	0.03	0.16	<1	9	399
HR–SL–19 B	46.81204	-88.13567	B	38 to 56	4.51	0.37	2.18	2.24	0.46	0.66	0.02	0.20	<1	3	508
HR–SL–20 B	46.91087	-88.06673	B	18 to 61	2.77	0.07	0.94	2.28	0.15	0.33	<0.01	0.06	<1	4	453
HR–SL–21 B1	46.89659	-88.08732	B	13 to 25	2.93	0.18	1.49	2.02	0.15	0.38	<0.01	0.13	<1	3	444
HR–SL–21 B2	46.89659	-88.08732	B	25 to 51	2.87	0.18	1.11	1.91	0.14	0.38	<0.01	0.10	<1	2	437
HR–SL–22 B	46.88639	-88.04665	B	31 to 46	3.16	0.17	1.30	2.14	0.15	0.40	0.01	0.14	<1	2	473
HR–SL–23 B1	46.87526	-88.05947	B	13 to 33	3.44	0.37	2.24	1.65	0.32	0.48	0.01	0.20	<1	3	391
HR–SL–23 B2	46.87526	-88.05947	B	33 to 43	3.26	0.39	2.01	1.61	0.33	0.51	0.01	0.18	<1	3	381
HR–SL–23 B2 dup	46.87526	-88.05947	B	33 to 43	3.45	0.39	2.13	1.61	0.33	0.51	0.01	0.19	<1	3	361
HR–SL–24 B	46.86947	-88.08019	B	13 to 33	3.13	0.23	1.45	1.96	0.16	0.46	0.01	0.16	<1	2	477
HR–SL–25 B1	46.79618	-88.00632	B	10 to 31	3.53	0.27	2.18	1.91	0.33	0.45	0.01	0.17	<1	2	468
HR–SL–25 B2	46.79618	-88.00632	B	46 to 56	3.49	0.29	1.83	1.75	0.36	0.47	<0.01	0.14	<1	2	430
HR–SL–26 B	46.75230	-87.98873	B	8 to 38	4.11	0.36	2.16	1.88	0.39	0.65	0.02	0.18	<1	3	495
HR–SL–27 B	46.81535	-88.01702	B	18 to 38	4.10	0.25	1.79	2.00	0.34	0.48	0.01	0.21	<1	3	523
HR–SL–28 B	46.82391	-88.04588	B	8 to 51	3.73	0.21	2.55	1.75	0.31	0.38	0.02	0.17	<1	4	428
HR–SL–29 B1	46.83004	-88.06466	B	10 to 53	3.88	0.30	1.44	1.89	0.23	0.61	<0.01	0.13	<1	3	476
HR–SL–29 B1 dup	46.83004	-88.06466	B	10 to 53	4.03	0.31	1.47	2.08	0.23	0.63	<0.01	0.14	<1	2	502
HR–SL–29 B2	46.83004	-88.06466	B	53 to 69	3.85	0.37	1.35	2.15	0.29	0.73	<0.01	0.14	<1	2	547
HR–SL–30 B	46.85067	-88.03606	B	20 to 43	2.86	0.25	1.28	1.50	0.23	0.43	0.01	0.15	<1	2	389
HR–SL–31 B1	46.85381	-88.12520	B	36 to 51	3.00	0.14	1.03	1.72	0.11	0.38	0.01	0.09	<1	2	441
HR–SL–31 B2	46.85381	-88.12520	B	51 to 147	2.88	0.21	0.88	2.02	0.19	0.45	<0.01	0.09	<1	2	426
HR–SL–01 C	46.78747	-88.06271	C	66 to 71	4.35	0.30	2.57	1.89	0.52	0.53	0.01	0.16	<1	6	457
HR–SL–04 C	46.80586	-88.06500	C	102 to 122	6.12	0.84	2.56	3.16	0.83	0.97	<0.01	0.27	<1	4	663
HR–SL–06 C	46.70800	-88.07032	C	76 to 86	3.86	0.64	1.86	1.92	0.48	0.92	<0.01	0.16	<1	3	472
HR–SL–07 C	46.72973	-88.05520	C	41 to 56	3.95	0.54	1.52	1.84	0.32	0.84	<0.01	0.13	<1	3	482
HR–SL–07 C dup	46.72973	-88.05520	C	41 to 56	3.85	0.53	1.44	1.86	0.33	0.82	<0.01	0.12	<1	3	481
HR–SL–08 C	46.74261	-88.04839	C	46 to 61	3.74	0.51	1.51	1.87	0.30	0.84	<0.01	0.14	<1	3	478
HR–SL–09 C	46.74865	-88.08341	C	53 to 71	3.35	0.33	1.33	1.98	0.30	0.54	<0.01	0.11	<1	3	472

Appendix 3. Mineral soils (A, E, B, and C horizons), Huron River Watershed, Michigan.—Continued

Field no.	Latitude	Longitude	Horizon	Depth (cm)	Total extraction—Continued											
					Be (ppm)	Bi (ppm)	Cd (ppm)	Ce (ppm)	Co (ppm)	Cr (ppm)	Cs (ppm)	Cu (ppm)	Ga (ppm)	Hg (ppm)	In (ppm)	La (ppm)
HR–SL–13 B	46.81975	-88.10149	B	31 to 69	0.9	0.09	<0.1	31.7	5.1	21	<5	10.0	7.6	0.01	0.04	14.3
HR–SL–14 B	46.76476	-88.07135	B	13 to 25	0.8	0.09	<0.1	25.1	3.2	18	<5	8.6	6.8	0.04	<0.02	12.9
HR–SL–15 B1	46.74901	-88.05780	B	18 to 33	1.0	0.12	0.2	28.3	5.1	43	<5	11.0	10.1	0.05	0.04	13.8
HR–SL–15 B2	46.74901	-88.05780	B	33 to 51	1.0	0.10	0.1	27.6	6.1	40	<5	16.2	8.2	0.03	0.02	13.8
HR–SL–16 B1	46.77925	-88.09563	B	13 to 61	1.3	0.12	0.1	35.4	7.3	40	<5	12.3	10.9	0.04	0.03	17.2
HR–SL–16 B2	46.77925	-88.09563	B	61 to 66	1.0	0.10	<0.1	32.8	6.5	41	<5	12.9	9.7	0.03	0.03	16.1
HR–SL–17 B	46.79581	-88.09223	B	13 to 66	0.8	0.07	0.1	27.6	3.2	23	<5	5.1	7.3	0.01	<0.02	12.7
HR–SL–18 B	46.80113	-88.11597	B	10 to 25	1.4	0.18	0.3	42.3	21.4	50	5	37.7	11.5	0.05	0.04	25.6
HR–SL–19 B	46.81204	-88.13567	B	38 to 56	1.4	0.10	0.1	34.8	5.3	22	<5	9.1	12.4	0.02	0.03	15.9
HR–SL–20 B	46.91087	-88.06673	B	18 to 61	0.8	0.05	<0.1	28.4	1.9	10	<5	6.8	6.1	<0.01	0.02	13.1
HR–SL–21 B1	46.89659	-88.08732	B	13 to 25	0.7	0.07	<0.1	25.4	2.1	22	<5	5.9	7.7	0.03	<0.02	12.6
HR–SL–21 B2	46.89659	-88.08732	B	25 to 51	0.8	0.06	<0.1	24.8	2.3	20	<5	5.2	6.1	0.02	<0.02	12.4
HR–SL–22 B	46.88639	-88.04665	B	31 to 46	0.8	0.06	<0.1	29.9	2.9	15	<5	6.5	6.8	0.02	<0.02	13.3
HR–SL–23 B1	46.87526	-88.05947	B	13 to 33	1.0	0.09	<0.1	45.8	5.0	27	<5	10.8	9.7	0.03	0.03	16.1
HR–SL–23 B2	46.87526	-88.05947	B	33 to 43	0.9	0.07	<0.1	31.0	5.0	20	<5	10.4	8.6	0.02	0.02	14.6
HR–SL–23 B2 dup	46.87526	-88.05947	B	33 to 43	0.9	0.08	<0.1	29.2	5.3	24	<5	13.2	9.4	0.03	0.02	14.9
HR–SL–24 B	46.86947	-88.08019	B	13 to 33	0.7	0.08	<0.1	23.6	2.4	16	<5	6.3	8.3	0.03	<0.02	11.9
HR–SL–25 B1	46.79618	-88.00632	B	10 to 31	0.8	0.09	<0.1	26.8	4.4	27	<5	9.2	9.2	0.02	0.02	13.4
HR–SL–25 B2	46.79618	-88.00632	B	46 to 56	0.9	0.09	<0.1	31.2	4.7	31	<5	11.1	9.3	0.02	0.02	14.7
HR–SL–26 B	46.75230	-87.98873	B	8 to 38	1.1	0.14	0.1	33.6	6.3	32	<5	12.3	11.4	0.04	0.03	15.9
HR–SL–27 B	46.81535	-88.01702	B	18 to 38	1.0	0.12	<0.1	30.8	4.0	27	<5	9.8	13.0	0.02	0.02	15.2
HR–SL–28 B	46.82391	-88.04588	B	8 to 51	1.0	0.13	0.1	32.1	4.4	28	<5	16.5	11.8	0.05	0.03	15.1
HR–SL–29 B1	46.83004	-88.06466	B	10 to 53	1.0	0.09	<0.1	29.6	4.3	22	<5	15.7	9.3	0.05	0.02	14.1
HR–SL–29 B1 dup	46.83004	-88.06466	B	10 to 53	1.0	0.08	<0.1	30.6	4.2	24	<5	9.2	9.6	0.04	0.02	14.5
HR–SL–29 B2	46.83004	-88.06466	B	53 to 69	1.0	0.08	<0.1	32.8	5.4	22	<5	9.4	8.8	0.02	<0.02	14.8
HR–SL–30 B	46.85067	-88.03606	B	20 to 43	0.6	0.10	<0.1	20.9	3.6	22	<5	8.4	8.1	0.02	<0.02	11.2
HR–SL–31 B1	46.85381	-88.12520	B	36 to 51	0.7	0.06	<0.1	21.9	1.6	11	<5	4.5	8.1	0.02	<0.02	10.8
HR–SL–31 B2	46.85381	-88.12520	B	51 to 147	0.7	0.05	<0.1	26.8	2.7	13	<5	5.8	6.6	<0.01	<0.02	12.9
HR–SL–01 C	46.78747	-88.06271	C	66 to 71	1.2	0.12	0.2	36.50	7.7	47	<5	17.5	11.9	0.02	0.03	16.9
HR–SL–04 C	46.80586	-88.06500	C	102 to 122	2.2	0.12	0.2	71.70	11.0	44	<5	21.6	15.9	0.01	0.04	34.8
HR–SL–06 C	46.70800	-88.07032	C	76 to 86	0.8	0.11	<0.1	33.10	7.7	32	<5	18.2	8.9	0.01	<0.02	13.1
HR–SL–07 C	46.72973	-88.05520	C	41 to 56	1.1	0.11	<0.1	32.00	6.0	26	<5	7.2	9.6	0.01	<0.02	14.7
HR–SL–07 C dup	46.72973	-88.05520	C	41 to 56	0.9	0.09	<0.1	29.20	6.3	27	<5	6.1	8.9	0.01	<0.02	13.4
HR–SL–08 C	46.74261	-88.04839	C	46 to 61	0.9	0.08	<0.1	28.00	4.4	25	<5	8.0	9.0	0.01	<0.02	14.1
HR–SL–09 C	46.74865	-88.08341	C	53 to 71	0.8	0.10	<0.1	34.80	5.6	24	<5	9.5	8.0	<0.01	<0.02	14.4

Appendix 3. Mineral soils (A, E, B, and C horizons), Huron River Watershed, Michigan.—Continued

Field no.	Latitude	Longitude	Horizon	Depth (cm)	Total extraction—Continued											
					Li (ppm)	Mn (ppm)	Mo (ppm)	Nb (ppm)	Ni (ppm)	P (ppm)	Pb (ppm)	Rb (ppm)	Sb (ppm)	Sc (ppm)	Se (ppm)	Sn (ppm)
HR–SL–13 B	46.81975	-88.10149	B	31 to 69	14	116	0.26	2.8	13.5	180	9.4	68.2	0.45	4.6	<0.2	1.8
HR–SL–14 B	46.76476	-88.07135	B	13 to 25	10	118	0.35	3.1	8.8	210	10.6	65.3	0.34	3.8	0.2	0.6
HR–SL–15 B1	46.74901	-88.05780	B	18 to 33	18	176	0.61	4.1	11.9	420	13.4	69.4	0.53	6.2	0.4	1.2
HR–SL–15 B2	46.74901	-88.05780	B	33 to 51	17	189	0.49	3.6	16.5	330	11.8	72.6	0.52	5.9	0.3	0.8
HR–SL–16 B1	46.77925	-88.09563	B	13 to 61	21	210	0.61	5.0	20.1	380	14.0	82.2	0.45	7.8	0.4	1.3
HR–SL–16 B2	46.77925	-88.09563	B	61 to 66	20	199	0.47	3.6	20.8	300	12.0	79.5	0.41	7.4	0.2	1.2
HR–SL–17 B	46.79581	-88.09223	B	13 to 66	9	127	0.26	2.9	7.3	220	11.3	63.9	0.36	3.1	<0.2	0.5
HR–SL–18 B	46.80113	-88.11597	B	10 to 25	30	266	1.39	3.6	40.7	440	14.6	81.8	1.11	9.5	0.5	1.3
HR–SL–19 B	46.81204	-88.13567	B	38 to 56	16	194	0.36	5.1	10.4	400	13.6	80.8	0.45	5.1	0.2	1.2
HR–SL–20 B	46.91087	-88.06673	B	18 to 61	6	132	0.18	2.2	3.2	300	10.5	76.4	0.56	2.0	<0.2	1.0
HR–SL–21 B1	46.89659	-88.08732	B	13 to 25	7	128	0.27	3.4	4.2	250	11.5	67.2	0.36	2.4	0.3	0.7
HR–SL–21 B2	46.89659	-88.08732	B	25 to 51	7	111	0.19	2.6	4.9	290	10.2	65.6	0.35	2.3	<0.2	0.6
HR–SL–22 B	46.88639	-88.04665	B	31 to 46	8	111	0.20	3.3	5.3	220	10.8	70.6	0.36	2.4	<0.2	0.7
HR–SL–23 B1	46.87526	-88.05947	B	13 to 33	11	202	0.36	4.2	8.8	500	11.5	60.5	0.39	4.7	0.3	1.0
HR–SL–23 B2	46.87526	-88.05947	B	33 to 43	11	188	0.30	4.0	9.7	420	10.6	56.4	0.34	4.4	<0.2	0.9
HR–SL–23 B2 dup	46.87526	-88.05947	B	33 to 43	12	206	0.40	4.4	10.0	440	9.9	52.1	0.43	4.9	0.3	0.9
HR–SL–24 B	46.86947	-88.08019	B	13 to 33	7	109	0.30	3.7	5.1	290	12.0	67.4	0.24	2.6	0.3	0.8
HR–SL–25 B1	46.79618	-88.00632	B	10 to 31	15	148	0.34	3.9	10.8	330	10.8	71.7	0.35	5.0	0.2	0.9
HR–SL–25 B2	46.79618	-88.00632	B	46 to 56	14	158	0.34	3.4	12.4	260	10.5	61.4	0.42	5.2	0.2	0.8
HR–SL–26 B	46.75230	-87.98873	B	8 to 38	16	408	0.52	4.7	12.0	550	12.9	68.6	0.52	5.9	0.3	1.0
HR–SL–27 B	46.81535	-88.01702	B	18 to 38	12	199	0.44	5.7	8.2	230	12.2	82.0	0.49	5.6	0.2	1.2
HR–SL–28 B	46.82391	-88.04588	B	8 to 51	16	155	0.60	4.5	11.1	570	11.7	63.9	0.51	4.8	0.4	1.0
HR–SL–29 B1	46.83004	-88.06466	B	10 to 53	12	125	0.35	3.7	8.9	250	13.1	61.7	0.41	4.0	0.3	0.8
HR–SL–29 B1 dup	46.83004	-88.06466	B	10 to 53	13	130	0.33	3.9	9.8	270	12.8	63.8	0.42	4.0	0.3	0.7
HR–SL–29 B2	46.83004	-88.06466	B	53 to 69	9	148	0.27	3.8	10.4	180	11.4	70.3	0.40	3.9	<0.2	0.7
HR–SL–30 B	46.85067	-88.03606	B	20 to 43	9	126	0.36	3.3	7.8	110	10.6	53.7	0.38	3.8	<0.2	0.7
HR–SL–31 B1	46.85381	-88.12520	B	36 to 51	6	81	0.31	2.6	3.0	120	11.0	55.7	0.38	2.3	0.3	0.6
HR–SL–31 B2	46.85381	-88.12520	B	51 to 147	7	112	0.22	2.5	5.2	120	9.2	59.6	0.35	2.7	<0.2	0.7
HR–SL–01 C	46.78747	-88.06271	C	66 to 71	23	171	0.68	4.1	23.9	270	13.3	68.7	0.59	8.1	0.2	0.9
HR–SL–04 C	46.80586	-88.06500	C	102 to 122	21	569	0.57	7.3	21.6	590	14.3	86.7	0.49	10.2	<0.2	1.6
HR–SL–06 C	46.70800	-88.07032	C	76 to 86	10	230	0.34	3.4	17.6	250	10.3	57.0	0.44	5.8	<0.2	0.6
HR–SL–07 C	46.72973	-88.05520	C	41 to 56	10	186	0.33	3.6	15.1	400	12.5	58.4	0.36	4.6	<0.2	0.7
HR–SL–07 C dup	46.72973	-88.05520	C	41 to 56	10	175	0.29	3.2	15.2	370	11.7	59.3	0.33	4.5	0.2	0.6
HR–SL–08 C	46.74261	-88.04839	C	46 to 61	8	179	0.31	3.6	10.3	220	11.6	58.4	0.35	4.3	<0.2	0.7
HR–SL–09 C	46.74865	-88.08341	C	53 to 71	9	180	0.25	3.0	12.4	230	11.1	64.1	0.40	4.1	<0.2	0.7

Appendix 3. Mineral soils (A, E, B, and C horizons), Huron River Watershed, Michigan.—Continued

Field no.	Latitude	Longitude	Horizon	Depth (cm)	Total extraction—Continued									
					Sr (ppm)	Te (ppm)	Th (ppm)	Tl (ppm)	U (ppm)	V (ppm)	W (ppm)	Y (ppm)	Zn (ppm)	C (wt. %)
HR–SL–13 B	46.81975	-88.10149	B	31 to 69	60.0	<0.1	3.8	0.4	1.3	36	0.2	11.0	32	1.20
HR–SL–14 B	46.76476	-88.07135	B	13 to 25	76.9	<0.1	3.8	0.3	1.3	34	0.2	9.2	30	1.20
HR–SL–15 B1	46.74901	-88.05780	B	18 to 33	76.6	<0.1	4.4	0.5	1.5	61	0.3	9.0	60	4.00
HR–SL–15 B2	46.74901	-88.05780	B	33 to 51	77.6	<0.1	4.5	0.5	1.5	59	0.3	10.2	65	2.20
HR–SL–16 B1	46.77925	-88.09563	B	13 to 61	94.4	<0.1	5.8	0.5	1.7	69	0.3	10.7	62	2.90
HR–SL–16 B2	46.77925	-88.09563	B	61 to 66	82.1	<0.1	4.6	0.5	1.6	65	0.3	10.8	56	1.80
HR–SL–17 B	46.79581	-88.09223	B	13 to 66	86.9	<0.1	3.5	0.4	1.1	30	0.2	8.3	35	1.20
HR–SL–18 B	46.80113	-88.11597	B	10 to 25	59.8	<0.1	4.9	0.7	2.5	78	0.4	16.5	140	2.80
HR–SL–19 B	46.81204	-88.13567	B	38 to 56	96.0	<0.1	4.9	0.4	1.5	40	0.3	12.9	41	2.50
HR–SL–20 B	46.91087	-88.06673	B	18 to 61	40.7	<0.1	4.1	0.4	1.2	16	0.2	11.3	23	0.50
HR–SL–21 B1	46.89659	-88.08732	B	13 to 25	63.1	<0.1	4.3	0.4	1.1	31	0.2	8.9	25	1.70
HR–SL–21 B2	46.89659	-88.08732	B	25 to 51	61.0	<0.1	3.8	0.3	1.1	24	0.2	8.7	29	1.10
HR–SL–22 B	46.88639	-88.04665	B	31 to 46	63.6	<0.1	4.1	0.4	1.3	28	0.4	9.8	26	1.20
HR–SL–23 B1	46.87526	-88.05947	B	13 to 33	75.0	<0.1	5.6	0.3	1.4	57	0.3	11.6	34	2.00
HR–SL–23 B2	46.87526	-88.05947	B	33 to 43	78.0	<0.1	4.6	0.3	1.3	51	0.3	12.4	30	1.70
HR–SL–23 B2 dup	46.87526	-88.05947	B	33 to 43	79.4	<0.1	5.5	0.3	1.1	52	0.3	11.0	31	N.A.
HR–SL–24 B	46.86947	-88.08019	B	13 to 33	78.1	<0.1	3.7	0.4	1.1	31	0.2	8.2	18	3.60
HR–SL–25 B1	46.79618	-88.00632	B	10 to 31	75.6	<0.1	4.1	0.5	1.2	48	0.3	9.4	40	2.80
HR–SL–25 B2	46.79618	-88.00632	B	46 to 56	73.5	<0.1	4.9	0.4	1.2	43	0.3	9.0	41	1.80
HR–SL–26 B	46.75230	-87.98873	B	8 to 38	100.0	<0.1	4.8	0.4	1.4	46	0.4	10.0	50	2.00
HR–SL–27 B	46.81535	-88.01702	B	18 to 38	86.2	<0.1	4.8	0.5	1.5	46	0.3	10.8	39	2.20
HR–SL–28 B	46.82391	-88.04588	B	8 to 51	60.5	<0.1	5.1	0.4	1.4	55	0.4	9.9	55	2.90
HR–SL–29 B1	46.83004	-88.06466	B	10 to 53	93.7	<0.1	4.6	0.4	1.1	33	0.3	9.1	26	0.60
HR–SL–29 B1 dup	46.83004	-88.06466	B	10 to 53	98.4	<0.1	4.7	0.4	1.2	35	0.3	9.4	22	N.A.
HR–SL–29 B2	46.83004	-88.06466	B	53 to 69	111.0	<0.1	4.5	0.4	1.1	32	0.4	9.1	21	0.30
HR–SL–30 B	46.85067	-88.03606	B	20 to 43	68.3	<0.1	4.0	0.3	1.1	38	0.2	8.0	26	2.10
HR–SL–31 B1	46.85381	-88.12520	B	36 to 51	61.8	<0.1	3.5	0.4	0.9	21	0.2	7.8	12	2.20
HR–SL–31 B2	46.85381	-88.12520	B	51 to 147	68.6	<0.1	3.7	0.3	0.9	21	0.2	9.7	13	N.A.
HR–SL–01 C	46.78747	-88.06271	C	66 to 71	77.7	<0.1	5.4	0.5	1.5	61	0.5	9.5	65	1.30
HR–SL–04 C	46.80586	-88.06500	C	102 to 122	153.0	<0.1	9.2	0.6	1.9	59	0.6	20.8	47	0.50
HR–SL–06 C	46.70800	-88.07032	C	76 to 86	124.0	<0.1	3.7	0.4	0.9	50	0.3	8.6	30	0.70
HR–SL–07 C	46.72973	-88.05520	C	41 to 56	129.0	<0.1	3.7	0.3	0.9	38	0.3	8.2	42	1.10
HR–SL–07 C dup	46.72973	-88.05520	C	41 to 56	128.0	<0.1	3.7	0.4	0.9	37	0.3	8.0	42	N.A.
HR–SL–08 C	46.74261	-88.04839	C	46 to 61	131.0	<0.1	4.1	0.4	1.0	37	0.3	8.9	26	0.80
HR–SL–09 C	46.74865	-88.08341	C	53 to 71	84.4	<0.1	4.4	0.4	1.1	33	0.2	9.2	28	0.60

Appendix 3. Mineral soils (A, E, B, and C horizons), Huron River Watershed, Michigan.—Continued

Field no.	Latitude	Longitude	Horizon	Depth (cm)	Partial extraction Ag (ppm)	As (ppm)	Au (ppm)	Bi (ppm)	Cd (ppm)	Cu (ppm)	Mo (ppm)	Pb (ppm)	Sb (ppm)	Zn (ppm)
HR–SL–10 C	46.76124	-88.10713	C	31 to 117	0.36	2	<0.1	<1	0.11	7.6	0.3	11	<1	15.80
HR–SL–11 C	46.86267	-88.11263	C	51 to 53	0.56	2	<0.1	<1	0.14	6.1	0.4	13	<1	24.20
HR–SL–12 C	46.85126	-88.08941	C	56 to 152	0.33	2	<0.1	<1	0.05	4.1	0.2	10	<1	10.50
HR–SL–14 C	46.76476	-88.07135	C	25 to 76	0.37	5	<0.1	<1	0.13	14.4	0.5	10	<1	39.30
HR–SL–20 C	46.91087	-88.06673	C	61 to 94	0.41	3	<0.1	<1	0.08	4.0	0.2	9	<1	13.80
HR–SL–21 C	46.89659	-88.08732	C	51 to 122	0.31	2	<0.1	<1	0.08	4.4	0.2	9	<1	15.90
HR–SL–21 C dup	46.89659	-88.08732	C	51 to 122	0.32	2	<0.1	<1	0.08	5.1	0.3	9	<1	16.50
HR–SL–22 C	46.88639	-88.04665	C	46 to 66	0.42	2	<0.1	<1	0.09	4.4	0.2	11	<1	19.70
HR–SL–24 C	46.86947	-88.08019	C	99 to 114	0.34	2	<0.1	<1	0.07	4.1	0.2	9	<1	10.10
HR–SL–26 C	46.75230	-87.98873	C	38 to 91	0.74	4	<0.1	<1	0.15	18.3	0.4	15	<1	45.50
HR–SL–31 C	46.85381	-88.12520	C	147 to 167	0.32	2	<0.1	<1	0.06	3.6	0.6	8	<1	9.20
HR Road Dust	46.81786	-88.09723		surface	0.74	10.0	<0.1	<1	0.43	48.1	3.5	14	<1	98.10

Appendix 3. Mineral soils (A, E, B, and C horizons), Huron River Watershed, Michigan.—Continued

Field no.	Latitude	Longitude	Horizon	Depth (cm)	Total extraction Al (wt. %)	Ca (wt. %)	Fe (wt. %)	K (wt. %)	Mg (wt. %)	Na (wt. %)	S (wt. %)	Ti (wt. %)	Ag (ppm)	As (ppm)	Ba (ppm)
HR–SL–10 C	46.76124	-88.10713	C	31 to 117	3.07	0.31	0.81	2.18	0.16	0.58	<0.01	0.07	<1	1	509
HR–SL–11 C	46.86267	-88.11263	C	51 to 53	3.26	0.20	1.10	1.96	0.26	0.39	0.01	0.16	<1	2	472
HR–SL–12 C	46.85126	-88.08941	C	56 to 152	2.67	0.21	0.48	2.23	0.13	0.47	<0.01	0.06	<1	2	494
HR–SL–14 C	46.76476	-88.07135	C	25 to 76	3.05	0.36	1.57	1.61	0.43	0.56	<0.01	0.09	<1	5	372
HR–SL–20 C	46.91087	-88.06673	C	61 to 94	2.55	0.09	0.85	2.41	0.15	0.33	<0.01	0.06	<1	2	448
HR–SL–21 C	46.89659	-88.08732	C	51 to 122	2.53	0.17	0.64	2.15	0.14	0.40	<0.01	0.06	<1	<1	468
HR–SL–21 C dup	46.89659	-88.08732	C	51 to 122	2.57	0.18	0.61	2.24	0.13	0.41	<0.01	0.04	<1	1	476
HR–SL–22 C	46.88639	-88.04665	C	46 to 66	2.96	0.19	0.99	2.25	0.15	0.42	<0.01	0.10	<1	1	501
HR–SL–24 C	46.86947	-88.08019	C	99 to 114	2.27	0.16	1.04	2.01	0.11	0.33	<0.01	0.09	<1	1	430
HR–SL–26 C	46.75230	-87.98873	C	38 to 91	5.17	0.53	2.21	2.56	0.61	0.87	<0.01	0.19	<1	3	604
HR–SL–31 C	46.85381	-88.12520	C	147 to 167	2.23	0.14	0.54	1.92	0.12	0.34	<0.01	0.05	<1	<1	397
HR Road Dust	46.81786	-88.09723		surface	4.11	0.29	2.63	1.91	0.68	0.49	0.02	0.14		10	435

Appendix 3. Mineral soils (A, E, B, and C horizons), Huron River Watershed, Michigan.—Continued

Field no.	Latitude	Longitude	Horizon	Depth (cm)	Total extraction—Continued											
					Be (ppm)	Bi (ppm)	Cd (ppm)	Ce (ppm)	Co (ppm)	Cr (ppm)	Cs (ppm)	Cu (ppm)	Ga (ppm)	Hg (ppm)	In (ppm)	La (ppm)
HR–SL–10 C	46.76124	-88.10713	C	31 to 117	0.8	0.04	<0.1	31.30	3.3	14	<5	8.6	7.0	<0.01	<0.02	12.2
HR–SL–11 C	46.86267	-88.11263	C	51 to 53	1.0	0.10	<0.1	33.20	4.3	15	<5	7.1	8.7	0.03	<0.02	14.9
HR–SL–12 C	46.85126	-88.08941	C	56 to 152	0.7	0.05	<0.1	24.70	1.7	11	<5	5.1	6.5	<0.01	<0.02	12.2
HR–SL–14 C	46.76476	-88.07135	C	25 to 76	0.8	0.08	<0.1	33.40	5.6	32	<5	15.4	8.1	0.03	0.02	14.8
HR–SL–20 C	46.91087	-88.06673	C	61 to 94	0.8	0.05	<0.1	32.30	1.9	9	<5	5.0	6.3	<0.01	<0.02	14.7
HR–SL–21 C	46.89659	-88.08732	C	51 to 122	0.6	<0.04	<0.1	32.20	2.5	11	<5	5.4	5.8	<0.01	<0.02	13.6
HR–SL–21 C dup	46.89659	-88.08732	C	51 to 122	0.6	<0.04	<0.1	32.30	1.7	11	<5	6.1	6.0	<0.01	<0.02	12.3
HR–SL–22 C	46.88639	-88.04665	C	46 to 66	0.8	0.06	<0.1	37.80	2.9	12	<5	5.4	7.1	0.01	<0.02	14.8
HR–SL–24 C	46.86947	-88.08019	C	99 to 114	0.7	0.07	<0.1	33.50	4.5	12	<5	5.1	5.7	<0.01	<0.02	12.8
HR–SL–26 C	46.75230	-87.98873	C	38 to 91	1.6	0.12	<0.1	46.10	7.9	42	<5	19.3	12.6	0.02	0.03	21.9
HR–SL–31 C	46.85381	-88.12520	C	147 to 167	0.6	0.05	<0.1	25.10	1.7	11	<5	4.6	5.4	<0.01	<0.02	11.9
HR Road Dust	46.81786	-88.09723		surface	1.3	0.19	0.3	34.20	7.3	51	<5	49.1	10.8	0.08	<0.02	16.7

Appendix 3. Mineral soils (A, E, B, and C horizons), Huron River Watershed, Michigan.—Continued

Field no.	Latitude	Longitude	Horizon	Depth (cm)	Total extraction—Continued											
					Li (ppm)	Mn (ppm)	Mo (ppm)	Nb (ppm)	Ni (ppm)	P (ppm)	Pb (ppm)	Rb (ppm)	Sb (ppm)	Sc (ppm)	Se (ppm)	Sn (ppm)
HR–SL–10 C	46.76124	-88.10713	C	31 to 117	6	118	0.18	2.1	7.9	170	10.7	66.8	0.41	2.7	<0.2	0.5
HR–SL–11 C	46.86267	-88.11263	C	51 to 53	8	292	0.37	3.9	5.2	290	12.8	70.8	0.49	3.3	0.3	1.0
HR–SL–12 C	46.85126	-88.08941	C	56 to 152	5	70	0.13	1.8	4.2	150	10.3	66.0	0.32	2.0	<0.2	0.5
HR–SL–14 C	46.76476	-88.07135	C	25 to 76	13	181	0.47	2.3	16.1	200	10.0	53.8	0.50	5.6	<0.2	0.6
HR–SL–20 C	46.91087	-88.06673	C	61 to 94	5	116	0.14	2.1	3.1	150	9.2	73.9	0.58	2.2	<0.2	0.7
HR–SL–21 C	46.89659	-88.08732	C	51 to 122	5	89	0.15	1.8	4.7	120	8.7	65.0	0.33	2.0	<0.2	0.6
HR–SL–21 C dup	46.89659	-88.08732	C	51 to 122	5	82	0.12	1.5	4.4	120	8.7	67.4	0.32	2.0	<0.2	0.4
HR–SL–22 C	46.88639	-88.04665	C	46 to 66	5	110	0.21	2.8	4.8	150	10.5	69.5	0.42	2.6	<0.2	0.7
HR–SL–24 C	46.86947	-88.08019	C	99 to 114	4	121	0.17	2.1	3.5	140	9.3	58.9	0.33	2.0	<0.2	0.5
HR–SL–26 C	46.75230	-87.98873	C	38 to 91	18	265	0.28	4.7	18.4	370	14.4	80.8	0.49	8.2	<0.2	1.2
HR–SL–31 C	46.85381	-88.12520	C	147 to 167	5	69	0.13	1.6	3.6	100	8.1	58.3	0.32	2.1	<0.2	0.5
HR Road Dust	46.81786	-88.09723		surface	25	385	3.54	2.9	26.5	290	13.3	71.7	1.58	8.5	0.4	1.1

Appendix 3. Mineral soils (A, E, B, and C horizons), Huron River Watershed, Michigan.—Continued

Field no.	Latitude	Longitude	Horizon	Depth (cm)	Total extraction—Continued									
					Sr (ppm)	Te (ppm)	Th (ppm)	Tl (ppm)	U (ppm)	V (ppm)	W (ppm)	Y (ppm)	Zn (ppm)	C (wt. %)
HR–SL–10 C	46.76124	-88.10713	C	31 to 117	93.4	<0.1	3.4	0.4	0.9	19	0.2	8.2	16	0.50
HR–SL–11 C	46.86267	-88.11263	C	51 to 53	65.5	<0.1	5.2	0.4	1.3	29	0.4	11.1	23	1.50
HR–SL–12 C	46.85126	-88.08941	C	56 to 152	74.3	<0.1	3.1	0.4	0.8	12	0.2	7.9	10	0.40
HR–SL–14 C	46.76476	-88.07135	C	25 to 76	81.4	<0.1	4.5	0.4	1.5	44	0.2	10.1	40	0.50
HR–SL–20 C	46.91087	-88.06673	C	61 to 94	41.7	<0.1	4.1	0.4	1.1	14	0.3	11.5	14	0.30
HR–SL–21 C	46.89659	-88.08732	C	51 to 122	64.7	<0.1	3.6	0.3	0.9	15	0.3	8.2	16	0.20
HR–SL–21 C dup	46.89659	-88.08732	C	51 to 122	64.9	<0.1	3.8	0.4	0.9	13	0.1	8.2	16	N.A.
HR–SL–22 C	46.88639	-88.04665	C	46 to 66	67.8	<0.1	4.2	0.4	1.1	22	0.2	9.3	20	0.70
HR–SL–24 C	46.86947	-88.08019	C	99 to 114	56.9	<0.1	3.5	0.3	0.9	25	0.8	8.8	9	0.50
HR–SL–26 C	46.75230	-87.98873	C	38 to 91	132.0	<0.1	7.1	0.5	1.5	53	0.3	13.5	45	0.30
HR–SL–31 C	46.85381	-88.12520	C	147 to 167	53.0	<0.1	3.6	0.3	0.9	12	0.2	8.7	9	0.10
HR Road Dust	46.81786	-88.09723		surface	65.3	<0.1	5.6	0.7	3.0	86	0.9	12.7	100	N.A.

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Appendix 4. Organic Soils (O Horizon), Huron River Watershed, Michigan

Appendix 4. Organic soils (O horizon), Huron River Watershed, Michigan.

Field no.	Latitude	Longitude	Thickness (cm)	Ash (%)	LOI (%)	Al (wt. %)	Ca (wt. %)	Fe (wt. %)	K (wt. %)	Mg (wt. %)	Na (wt. %)	S (wt. %)	Ti (wt. %)	As (ppm)	Ba (ppm)
HR–SL–01 O	46.78747	-88.06271	7.5	14.8	85.2	0.72	0.66	0.38	0.27	0.08	0.09	0.14	0.03	3.26	164.28
HR–SL–01 O dup	46.78747	-88.06271	7.5	15.2	84.8	0.81	0.74	0.42	0.31	0.10	0.10	0.16	0.03	3.34	179.36
HR–SL–03 O	46.76509	-88.03342	0.5	19.7	80.3	0.62	0.83	0.31	0.35	0.09	0.13	0.13	0.03	0.79	157.40
HR–SL–05 O	46.83572	-88.10330	1.0	34.4	65.6	0.95	1.15	0.48	0.62	0.12	0.15	0.15	0.06	1.38	263.85
HR–SL–06 O	46.70800	-88.07032	2.0	24.3	75.7	0.83	0.27	0.45	0.43	0.08	0.16	0.08	0.04	0.97	180.31
HR–SL–07 O	46.72973	-88.05520	2.0	39.3	60.7	1.25	0.74	0.58	0.70	0.11	0.26	0.15	0.07	1.57	320.69
HR–SL–09 O	46.74865	-88.08341	2.0	23.4	76.6	0.79	1.91	0.38	0.42	0.13	0.15	0.19	0.04	1.17	416.52
HR–SL–10 O	46.76124	-88.10713	3.5	21.0	79.0	0.64	0.43	0.32	0.34	0.05	0.09	0.09	0.03	1.68	228.90
HR–SL–12 O	46.85126	-88.08941	5.0	17.5	82.5	0.97	0.56	0.64	0.28	0.08	0.11	0.13	0.04	3.33	208.25
HR–SL–13 O	46.81975	-88.10149	4.0	22.6	77.4	0.73	0.93	0.38	0.41	0.12	0.09	0.14	0.03	1.58	228.26
HR–SL–14 O	46.76476	-88.07135	2.5	25.0	75.0	1.02	0.51	0.41	0.48	0.11	0.12	0.13	0.04	1.25	252.50
HR–SL–15 O	46.74901	-88.05780	1.5	26.0	74.0	1.14	0.87	0.71	0.49	0.12	0.23	0.16	0.07	1.56	314.60
HR–SL–19 O	46.81204	-88.13567	5.0	18.3	81.7	0.61	0.96	0.34	0.33	0.11	0.09	0.16	0.03	1.46	212.28
HR–SL–20 O	46.91087	-88.06673	2.0	40.6	59.4	1.05	0.14	0.36	0.77	0.06	0.12	0.04	0.02	2.03	205.03
HR–SL–21 O	46.89659	-88.08732	4.0	31.9	68.1	0.76	0.50	0.40	0.51	0.08	0.11	0.13	0.04	1.28	223.30
HR–SL–22 O	46.88639	-88.04665	0.5	24.7	75.3	0.80	0.60	0.42	0.44	0.08	0.11	0.09	0.04	1.24	247.00
HR–SL–23 O	46.87526	-88.05947	2.5	29.6	70.4	0.95	1.06	0.52	0.52	0.13	0.15	0.17	0.04	2.07	491.36
HR–SL–24 O	46.86947	-88.08019	3.0	24.3	75.7	0.90	0.72	0.48	0.41	0.10	0.13	0.15	0.04	2.67	236.20
HR–SL–25 O	46.79618	-88.00632	2.0	33.0	67.0	1.08	0.65	0.52	0.60	0.10	0.17	0.10	0.06	1.32	239.91
HR–SL–27 O	46.81535	-88.01702	1.0	43.6	56.4	1.89	0.43	0.92	0.89	0.15	0.24	0.10	0.09	3.05	317.41
HR–SL–28 O	46.82391	-88.04588	0.5	40.9	59.1	1.08	0.78	0.49	0.73	0.09	0.16	0.10	0.08	1.23	287.12
HR–SL–29 O	46.83004	-88.06466	3.6	22.6	77.4	0.55	0.36	0.27	0.35	0.06	0.07	0.07	0.03	0.90	117.29
HR–SL–30 O	46.85067	-88.03606	6.0	14.4	85.6	0.62	0.86	0.32	0.29	0.11	0.08	0.15	0.03	2.16	133.63
HR–SL–31 O	46.85381	-88.12520	4.0	16.3	83.7	0.68	0.66	0.37	0.28	0.07	0.08	0.12	0.03	3.10	143.44
HR–SL–31 O dup	46.85381	-88.12520	4.0	16.9	83.1	0.66	0.60	0.35	0.27	0.06	0.08	0.11	0.03	2.87	132.33

Appendix 4. Organic soils (O horizon), Huron River Watershed, Michigan.—Continued

Field no.	Latitude	Longitude	Thickness (cm)	Be (ppm)	Bi (ppm)	Cd (ppm)	Ce (ppm)	Co (ppm)	Cr (ppm)	Cu (ppm)	Ga (ppm)	Hg (ppm)	In (ppm)	La (ppm)
HR–SL–01 O	46.78747	-88.06271	7.5	0.22	0.24	1.58	6.75	1.36	7.10	22.50	2.09	0.20	0.03	3.69
HR–SL–01 O dup	46.78747	-88.06271	7.5	0.23	0.24	1.69	7.68	1.46	4.71	25.23	2.16	0.19	0.03	4.03
HR–SL–03 O	46.76509	-88.03342	0.5	0.16	0.09	0.81	5.20	0.73	5.52	13.59	1.68	0.13	0.01	2.84
HR–SL–05 O	46.83572	-88.10330	1.0	0.24	0.11	0.76	7.36	1.07	5.50	17.23	2.55	0.16	0.01	4.06
HR–SL–06 O	46.70800	-88.07032	2.0	0.22	0.12	0.78	4.37	1.02	5.59	10.06	2.26	0.15	0.01	2.33
HR–SL–07 O	46.72973	-88.05520	2.0	0.28	0.15	0.71	9.00	1.06	9.04	16.98	3.23	0.14	0.02	4.95
HR–SL–09 O	46.74865	-88.08341	2.0	0.21	0.10	2.60	6.01	0.96	4.21	23.10	2.13	0.12	0.01	3.37
HR–SL–10 O	46.76124	-88.10713	3.5	0.21	0.15	0.76	4.81	0.65	5.25	17.43	1.77	0.13	0.01	2.67
HR–SL–12 O	46.85126	-88.08941	5.0	0.35	0.25	0.60	15.05	2.01	7.35	18.03	2.40	0.26	0.02	7.72
HR–SL–13 O	46.81975	-88.10149	4.0	0.20	0.14	1.45	5.74	1.11	6.78	16.88	2.07	0.16	0.01	3.12
HR–SL–14 O	46.76476	-88.07135	2.5	0.70	0.11	0.98	23.88	6.10	7.25	27.75	2.55	0.14	0.02	14.08
HR–SL–15 O	46.74901	-88.05780	1.5	0.26	0.17	1.87	8.76	1.61	7.02	24.91	3.04	0.19	0.02	4.76
HR–SL–19 O	46.81204	-88.13567	5.0	0.16	0.14	1.37	5.16	0.90	5.67	25.99	1.67	0.18	0.01	2.95
HR–SL–20 O	46.91087	-88.06673	2.0	0.24	0.15	0.28	8.97	0.69	4.06	10.27	2.84	0.11	0.01	4.75
HR–SL–21 O	46.89659	-88.08732	4.0	0.19	0.11	0.41	5.90	0.77	6.38	25.42	2.09	0.18	0.01	3.41
HR–SL–22 O	46.88639	-88.04665	0.5	0.20	0.13	0.86	6.84	1.31	4.45	12.20	2.39	0.22	0.01	3.68
HR–SL–23 O	46.87526	-88.05947	2.5	0.24	0.20	2.19	10.00	1.39	5.03	23.32	2.88	0.16	0.02	6.04
HR–SL–24 O	46.86947	-88.08019	3.0	0.24	0.22	0.44	7.41	1.02	8.02	22.77	2.55	0.17	0.02	4.01
HR–SL–25 O	46.79618	-88.00632	2.0	0.26	0.13	0.69	8.75	1.22	9.24	14.98	3.01	0.16	0.01	4.95
HR–SL–27 O	46.81535	-88.01702	1.0	0.48	0.22	0.87	13.91	2.18	18.75	17.44	5.23	0.19	0.02	7.50
HR–SL–28 O	46.82391	-88.04588	0.5	0.25	0.10	0.78	9.94	1.35	7.36	12.39	3.29	0.14	0.01	5.19
HR–SL–29 O	46.83004	-88.06466	3.6	0.14	0.11	0.38	3.89	0.77	4.07	7.14	1.43	0.15	0.01	2.19
HR–SL–30 O	46.85067	-88.03606	6.0	0.16	0.16	1.02	5.46	0.86	5.90	13.54	1.64	0.26	0.01	3.01
HR–SL–31 O	46.85381	-88.12520	4.0	0.20	0.21	0.49	5.74	0.83	6.03	16.79	1.86	0.29	0.02	3.13
HR–SL–31 O dup	46.85381	-88.12520	4.0	0.19	0.19	0.46	6.13	0.74	3.89	15.24	1.71	0.29	0.02	3.36

Appendix 4. Organic soils (O horizon), Huron River Watershed, Michigan.—Continued

Field no.	Latitude	Longitude	Thickness (cm)	Li (ppm)	Mn (ppm)	Mo (ppm)	Nb (ppm)	Ni (ppm)	P (ppm)	Pb (ppm)	Rb (ppm)	Sb (ppm)	Sc (ppm)	Sn (ppm)
HR–SL–01 O	46.78747	-88.06271	7.5	2.07	49.73	0.72	0.96	4.84	834.72	43.81	9.80	0.69	1.15	1.08
HR–SL–01 O dup	46.78747	-88.06271	7.5	2.43	60.19	0.70	0.88	5.20	969.76	45.75	10.53	0.70	1.23	1.14
HR–SL–03 O	46.76509	-88.03342	0.5	1.77	451.13	0.53	0.89	2.68	1,140.63	13.12	11.41	0.29	0.85	0.71
HR–SL–05 O	46.83572	-88.10330	1.0	2.41	626.08	0.51	1.20	3.13	1,083.60	17.03	21.16	0.39	1.03	0.72
HR–SL–06 O	46.70800	-88.07032	2.0	1.94	123.93	0.45	1.07	3.62	848.07	23.86	16.45	0.34	1.04	0.66
HR–SL–07 O	46.72973	-88.05520	2.0	3.54	1,253.67	0.78	1.57	4.17	1,057.17	20.91	25.23	0.52	1.45	1.14
HR–SL–09 O	46.74865	-88.08341	2.0	2.34	1,619.28	0.62	0.70	3.74	1,251.90	18.77	15.47	0.26	0.98	0.66
HR–SL–10 O	46.76124	-88.10713	3.5	1.68	123.69	0.62	0.84	2.86	655.20	31.71	12.41	0.74	0.84	0.88
HR–SL–12 O	46.85126	-88.08941	5.0	2.63	121.45	0.67	1.23	4.71	1,041.25	35.70	10.69	0.84	1.58	1.47
HR–SL–13 O	46.81975	-88.10149	4.0	2.49	646.36	0.49	0.88	3.57	1,179.72	28.02	14.67	0.38	1.13	0.86
HR–SL–14 O	46.76476	-88.07135	2.5	2.75	407.50	0.90	0.98	7.88	1,367.50	31.50	17.88	0.53	1.85	0.58
HR–SL–15 O	46.74901	-88.05780	1.5	3.12	829.40	0.73	1.56	5.28	1,362.40	27.56	17.78	0.51	1.40	1.07
HR–SL–19 O	46.81204	-88.13567	5.0	1.83	488.61	0.65	0.71	3.20	1,050.42	20.50	11.09	0.40	0.86	0.88
HR–SL–20 O	46.91087	-88.06673	2.0	2.03	68.21	0.39	0.81	2.64	422.24	28.87	30.33	0.40	1.02	0.77
HR–SL–21 O	46.89659	-88.08732	4.0	2.23	414.70	0.63	0.99	3.64	902.77	15.38	19.20	0.42	0.93	0.73
HR–SL–22 O	46.88639	-88.04665	0.5	2.22	2,445.30	0.48	1.19	2.64	886.73	29.15	15.46	0.45	0.96	0.96
HR–SL–23 O	46.87526	-88.05947	2.5	2.96	3,640.80	0.88	1.30	4.41	1,613.20	42.92	16.75	0.53	1.21	1.12
HR–SL–24 O	46.86947	-88.08019	3.0	2.67	255.15	0.69	1.02	4.08	1,229.58	37.67	14.65	0.71	1.36	1.41
HR–SL–25 O	46.79618	-88.00632	2.0	2.97	739.20	0.77	1.29	3.86	1,036.20	22.24	20.10	0.45	1.42	0.99
HR–SL–27 O	46.81535	-88.01702	1.0	5.67	372.78	0.87	1.96	6.89	1,246.96	39.41	30.83	0.61	2.79	1.44
HR–SL–28 O	46.82391	-88.04588	0.5	2.45	2,568.52	0.54	1.64	4.13	1,051.13	16.52	25.11	0.37	1.23	0.74
HR–SL–29 O	46.83004	-88.06466	3.6	1.36	126.11	0.31	0.68	2.53	571.78	18.58	11.71	0.30	0.63	0.57
HR–SL–30 O	46.85067	-88.03606	6.0	1.87	384.48	0.60	0.71	2.97	983.52	24.34	9.00	0.34	0.92	0.79
HR–SL–31 O	46.85381	-88.12520	4.0	2.12	141.00	0.60	0.96	2.89	792.18	37.16	10.79	0.66	1.04	1.04
HR–SL–31 O dup	46.85381	-88.12520	4.0	2.03	108.16	0.52	0.68	2.65	696.28	33.63	10.16	0.55	0.95	0.93

Appendix 4. Organic soils (O horizon), Huron River Watershed, Michigan.—Continued

Field no.	Latitude	Longitude	Thickness (cm)	Sr (ppm)	Th (ppm)	Tl (ppm)	U (ppm)	V (ppm)	W (ppm)	Y (ppm)	Zn (ppm)	Se (ppm)
HR–SL–01 O	46.78747	-88.06271	7.5	46.47	0.95	0.12	0.31	10.95	0.19	1.88	115.00	0.7
HR–SL–01 O dup	46.78747	-88.06271	7.5	51.22	1.05	0.14	0.32	12.31	0.15	1.88	129.50	0.7
HR–SL–03 O	46.76509	-88.03342	0.5	52.21	0.81	0.10	0.24	8.87	0.14	1.30	58.71	0.4
HR–SL–05 O	46.83572	-88.10330	1.0	61.92	1.27	0.17	0.38	13.76	0.17	2.61	53.32	0.4
HR–SL–06 O	46.70800	-88.07032	2.0	43.01	0.80	0.15	0.29	11.91	0.15	1.65	92.34	0.5
HR–SL–07 O	46.72973	-88.05520	2.0	75.06	1.65	0.20	0.51	16.90	0.24	2.59	60.52	0.5
HR–SL–09 O	46.74865	-88.08341	2.0	131.74	2.50	0.14	0.33	11.47	0.16	1.92	143.68	0.3
HR–SL–10 O	46.76124	-88.10713	3.5	40.74	0.80	0.13	0.25	9.66	0.13	1.60	59.43	0.5
HR–SL–12 O	46.85126	-88.08941	5.0	38.50	1.19	0.16	0.39	14.18	0.21	3.29	42.00	0.8
HR–SL–13 O	46.81975	-88.10149	4.0	48.59	0.88	0.16	0.29	10.85	0.16	1.79	90.40	0.4
HR–SL–14 O	46.76476	-88.07135	2.5	53.50	0.98	0.20	0.50	12.00	0.15	8.75	48.75	0.4
HR–SL–15 O	46.74901	-88.05780	1.5	68.12	1.35	0.18	0.44	20.80	0.23	2.29	128.96	0.5
HR–SL–19 O	46.81204	-88.13567	5.0	46.85	0.81	0.13	0.26	8.60	0.15	1.41	104.31	0.5
HR–SL–20 O	46.91087	-88.06673	2.0	21.88	1.22	0.20	0.45	8.12	0.12	3.74	28.83	0.3
HR–SL–21 O	46.89659	-88.08732	4.0	34.77	1.08	0.13	0.38	10.21	0.16	2.14	44.98	0.4
HR–SL–22 O	46.88639	-88.04665	0.5	41.74	1.11	0.22	0.32	11.36	0.17	1.85	51.38	0.5
HR–SL–23 O	46.87526	-88.05947	2.5	60.09	1.21	0.21	0.36	13.62	0.21	2.43	132.61	0.4
HR–SL–24 O	46.86947	-88.08019	3.0	56.38	1.19	0.15	0.39	13.61	0.19	2.09	46.17	0.6
HR–SL–25 O	46.79618	-88.00632	2.0	55.44	1.42	0.20	0.43	15.51	0.20	2.24	58.08	0.5
HR–SL–27 O	46.81535	-88.01702	1.0	79.35	2.49	0.26	0.70	27.90	0.26	3.75	80.66	0.6
HR–SL–28 O	46.82391	-88.04588	0.5	62.58	1.72	0.25	0.45	15.13	0.20	3.07	46.22	0.1
HR–SL–29 O	46.83004	-88.06466	3.6	25.31	0.61	0.11	0.23	6.10	0.11	1.33	35.03	0.6
HR–SL–30 O	46.85067	-88.03606	6.0	29.09	0.89	0.12	0.27	8.93	0.14	1.37	58.46	0.6
HR–SL–31 O	46.85381	-88.12520	4.0	27.38	0.90	0.20	0.33	10.27	0.18	1.73	41.57	0.7
HR–SL–31 O dup	46.85381	-88.12520	4.0	26.03	0.90	0.17	0.30	9.63	0.15	1.67	38.53	0.7

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Appendix 5. Concentrations of 42 Elements, From the Total Digestion of Samples and Partial Extraction Data for Streambed Sediments, Huron River Watershed, Michigan

Appendix 5. Concentrations of 42 elements from the total digestion of samples and partial extraction data for streambed sediments, Huron River Watershed, Michigan.

Field no.	Latitude	Longitude	Stream	Partial extraction									
				Ag (ppm)	As (ppm)	Au (ppm)	Bi (ppm)	Cd (ppm)	Cu (ppm)	Mo (ppm)	Pb (ppm)	Sb (ppm)	Zn (ppm)
HR–SS–1	46.74199	-88.03472	East Branch Huron River	1.21	3	<0.1	<1	0.50	12.1	1.1	13	<1	38.9
HR–SS–2	46.76058	-88.10914	West Branch Huron River	0.67	4	<0.1	<1	0.30	10.6	0.3	13	<1	32.0
HR–SS–3	46.85461	-88.06356	East Branch Huron River	0.82	4	<0.1	<1	0.31	19.4	0.8	17	<1	46.2
HR–SS–4	46.85709	-88.10164	Black Creek	0.81	1	<0.1	<1	0.25	5.6	0.4	13	<1	26.7
HR–SS–5	46.81690	-88.08544	Robarge Creek	0.83	6	<0.1	<1	0.53	15.6	0.9	16	<1	75.9
HR–SS–6	46.81645	-88.08615	East Branch Huron River	0.51	3	<0.1	<1	0.28	13.3	0.6	13	<1	40.1
HR–SS–7	46.86382	-88.08189	East Branch Huron River	1.15	3	<0.1	<1	0.49	13.8	0.4	18	<1	54.5
HR–SS–8	46.86406	-88.08249	West Branch Huron River	0.79	4	<0.1	<1	0.37	11.8	0.3	14	<1	53.7
HR–SS–8 dup	46.86406	-88.08249	West Branch Huron River	0.71	3	<0.1	<1	0.34	10.8	0.5	14	<1	51.0
HR–SS–9	46.90888	-88.03614	Huron River	0.52	2	<0.1	<1	0.24	12.7	0.4	18	<1	42.8
HR–SS–10	46.77843	-88.03296	unnamed tributary to East Branch Huron River	0.98	4	<0.1	<1	0.39	6.2	0.3	15	<1	47.3
HR–SS–11	46.77769	-88.03296	East Branch Huron River	0.60	11	<0.1	<1	0.49	10.4	0.5	15	<1	58.5

Appendix 5. Concentrations of 42 elements from the total digestion of samples and partial extraction data for streambed sediments, Huron River Watershed, Michigan.—Continued

Field no.	Latitude	Longitude	Stream	Total extraction						
				Al (wt. %)	Ca (wt. %)	Fe (wt. %)	K (wt. %)	Mg (wt. %)	Na (wt. %)	S (wt. %)
HR–SS–1	46.74199	-88.03472	East Branch Huron River	3.30	0.79	2.65	2.08	0.36	0.69	0.01
HR–SS–2	46.76058	-88.10914	West Branch Huron River	3.79	0.66	1.78	2.60	0.26	0.80	0.02
HR–SS–3	46.85461	-88.06356	East Branch Huron River	3.96	0.63	2.04	2.74	0.32	0.69	0.02
HR–SS–4	46.85709	-88.10164	Black Creek	4.06	0.59	0.84	2.86	0.22	0.86	<0.01
HR–SS–5	46.81690	-88.08544	Robarge Creek	4.58	0.83	3.47	2.47	0.59	0.80	0.02
HR–SS–6	46.81645	-88.08615	East Branch Huron River	3.71	0.60	1.59	2.63	0.32	0.72	0.02
HR–SS–7	46.86382	-88.08189	East Branch Huron River	3.84	0.71	6.06	2.51	0.42	0.66	0.01
HR–SS–8	46.86406	-88.08249	West Branch Huron River	4.44	0.74	2.23	2.68	0.46	0.83	0.01
HR–SS–8 dup	46.86406	-88.08249	West Branch Huron River	4.53	0.73	2.30	2.80	0.45	0.85	0.01
HR–SS–9	46.90888	-88.03614	Huron River	3.99	0.74	3.15	2.80	0.51	0.71	<0.01
HR–SS–10	46.77843	-88.03296	unnamed tributary to East Branch Huron River	3.91	0.80	2.41	2.58	0.36	0.79	0.02
HR–SS–11	46.77769	-88.03296	East Branch Huron River	4.18	0.78	2.92	2.46	0.46	0.79	0.04

Appendix 5. Concentrations of 42 elements from the total digestion of samples and partial extraction data for streambed sediments, Huron River Watershed, Michigan.—Continued

Field no.	Latitude	Longitude	Stream	Total extraction—Continued								
				Ti (wt. %)	Ag (ppm)	As (ppm)	Ba (ppm)	Be (ppm)	Bi (ppm)	Cd (ppm)	Ce (ppm)	Co (ppm)
HR–SS–1	46.74199	-88.03472	East Branch Huron River	0.75	<1	3	503	0.7	0.10	0.2	52.9	9.0
HR–SS–2	46.76058	-88.10914	West Branch Huron River	0.26	<1	4	608	0.7	0.10	0.2	34.0	5.4
HR–SS–3	46.85461	-88.06356	East Branch Huron River	0.30	<1	4	650	0.8	0.11	0.2	34.9	5.3
HR–SS–4	46.85709	-88.10164	Black Creek	0.26	<1	<1	670	0.7	0.09	0.1	30.3	2.9
HR–SS–5	46.81690	-88.08544	Robarge Creek	0.47	<1	7	596	1.0	0.15	0.4	49.8	9.5
HR–SS–6	46.81645	-88.08615	East Branch Huron River	0.23	<1	3	616	0.7	0.09	0.2	27.0	5.2
HR–SS–7	46.86382	-88.08189	East Branch Huron River	0.82	<1	4	584	1.0	0.23	0.3	95.3	9.0
HR–SS–8	46.86406	-88.08249	West Branch Huron River	0.29	<1	4	637	0.9	0.10	0.2	42.1	6.4
HR–SS–8 dup	46.86406	-88.08249	West Branch Huron River	0.30	<1	4	647	0.7	0.09	0.2	43.9	6.1
HR–SS–9	46.90888	-88.03614	Huron River	0.53	<1	3	599	0.8	0.11	0.2	41.2	7.1
HR–SS–10	46.77843	-88.03296	unnamed tributary to East Branch Huron River	0.59	<1	5	631	0.7	0.13	0.2	48.5	6.0
HR–SS–11	46.77769	-88.03296	East Branch Huron River	0.30	<1	11	591	0.8	0.12	0.4	34.6	10.0

Appendix 5. Concentrations of 42 elements from the total digestion of samples and partial extraction data for streambed sediments, Huron River Watershed, Michigan.—Continued

Field no.	Latitude	Longitude	Stream	Total extraction—Continued									
				Cr (ppm)	Cs (ppm)	Cu (ppm)	Ga (ppm)	Hg (ppm)	In (ppm)	La (ppm)	Li (ppm)	Mn (ppm)	Mo (ppm)
HR–SS–1	46.74199	-88.03472	East Branch Huron River	39	<5	13.6	7.83	0.02	0.03	27.2	7	1180	0.54
HR–SS–2	46.76058	-88.10914	West Branch Huron River	24	<5	9.6	8.42	0.02	<0.02	17.8	7	419	0.35
HR–SS–3	46.85461	-88.06356	East Branch Huron River	26	<5	18.2	9.08	0.05	0.02	18.4	10	489	0.76
HR–SS–4	46.85709	-88.10164	Black Creek	16	<5	6.1	8.37	0.01	<0.02	15.6	7	244	0.18
HR–SS–5	46.81690	-88.08544	Robarge Creek	53	<5	15.0	10.80	0.03	0.03	24.8	18	561	0.76
HR–SS–6	46.81645	-88.08615	East Branch Huron River	23	<5	13.5	8.56	0.02	<0.02	14.1	8	270	0.44
HR–SS–7	46.86382	-88.08189	East Branch Huron River	61	<5	13.7	10.70	0.07	0.04	50.2	11	740	0.71
HR–SS–8	46.86406	-88.08249	West Branch Huron River	34	<5	11.6	10.10	0.03	0.02	21.3	14	310	0.47
HR–SS–8 dup	46.86406	-88.08249	West Branch Huron River	40	<5	11.0	9.84	0.02	0.02	21.5	13	330	0.49
HR–SS–9	46.90888	-88.03614	Huron River	30	<5	11.8	9.70	<0.01	0.03	20.2	11	440	0.40
HR–SS–10	46.77843	-88.03296	unnamed tributary to East Branch Huron River	34	<5	5.9	8.52	0.02	0.02	23.6	9	928	0.53
HR–SS–11	46.77769	-88.03296	East Branch Huron River	41	<5	10.0	9.41	0.03	0.02	17.1	13	769	0.70

Appendix 5. Concentrations of 42 elements from the total digestion of samples and partial extraction data for streambed sediments, Huron River Watershed, Michigan.—Continued

Field no.	Latitude	Longitude	Stream	Total extraction—Continued								
				Nb (ppm)	Ni (ppm)	P (ppm)	Pb (ppm)	Rb (ppm)	Sb (ppm)	Sc (ppm)	Se (ppm)	Sn (ppm)
HR–SS–1	46.74199	-88.03472	East Branch Huron River	9.7	11.8	220	15.2	65.3	0.4	6.5	<0.2	1.2
HR–SS–2	46.76058	-88.10914	West Branch Huron River	4.1	8.4	340	13.6	82.3	0.5	3.9	<0.2	0.8
HR–SS–3	46.85461	-88.06356	East Branch Huron River	5.0	12.2	320	15.9	89.0	0.6	4.4	<0.2	1.0
HR–SS–4	46.85709	-88.10164	Black Creek	3.8	6.2	100	12.2	85.0	0.3	3.5	<0.2	0.7
HR–SS–5	46.81690	-88.08544	Robarge Creek	6.6	24.4	500	16.1	82.6	0.7	7.8	<0.2	1.2
HR–SS–6	46.81645	-88.08615	East Branch Huron River	3.9	14.7	250	13.6	88.6	0.6	4.3	<0.2	0.8
HR–SS–7	46.86382	-88.08189	East Branch Huron River	10.1	17.6	520	21.4	79.5	0.9	7.1	<0.2	1.9
HR–SS–8	46.86406	-88.08249	West Branch Huron River	5.2	16.6	430	13.5	87.4	0.6	6.0	<0.2	0.9
HR–SS–8 dup	46.86406	-88.08249	West Branch Huron River	4.7	16.5	400	15.1	90.4	0.6	5.7	<0.2	0.9
HR–SS–9	46.90888	-88.03614	Huron River	6.3	14.9	470	16.9	88.0	0.7	6.5	<0.2	1.5
HR–SS–10	46.77843	-88.03296	unnamed tributary to East Branch Huron River	7.6	10.7	330	14.8	76.7	0.4	5.4	<0.2	1.3
HR–SS–11	46.77769	-88.03296	East Branch Huron River	5.0	17.6	450	14.5	79.1	0.6	5.9	0.2	0.9

Appendix 5. Concentrations of 42 elements from the total digestion of samples and partial extraction data for streambed sediments, Huron River Watershed, Michigan.—Continued

Field no.	Latitude	Longitude	Stream	Total extraction—Continued								
				Sr (ppm)	Te (ppm)	Th (ppm)	Tl (ppm)	U (ppm)	V (ppm)	W (ppm)	Y (ppm)	Zn (ppm)
HR–SS–1	46.74199	-88.03472	East Branch Huron River	120	<0.1	10.3	0.4	1.7	70	0.6	15.9	37
HR–SS–2	46.76058	-88.10914	West Branch Huron River	127	<0.1	4.7	0.4	1.3	48	0.4	12.1	33
HR–SS–3	46.85461	-88.06356	East Branch Huron River	111	<0.1	6.2	0.5	2.3	58	0.3	12.4	45
HR–SS–4	46.85709	-88.10164	Black Creek	137	<0.1	5.9	0.5	1.2	24	0.2	11.0	26
HR–SS–5	46.81690	-88.08544	Robarge Creek	128	<0.1	6.8	0.5	2.1	100	0.4	15.1	82
HR–SS–6	46.81645	-88.08615	East Branch Huron River	112	<0.1	3.7	0.5	1.2	45	0.3	9.5	41
HR–SS–7	46.86382	-88.08189	East Branch Huron River	109	<0.1	17.2	0.4	3.4	176	0.4	23.7	64
HR–SS–8	46.86406	-88.08249	West Branch Huron River	128	<0.1	6.6	0.5	1.8	64	0.3	12.9	55
HR–SS–8 dup	46.86406	-88.08249	West Branch Huron River	128	<0.1	7.9	0.5	1.8	63	0.3	13.6	54
HR–SS–9	46.90888	-88.03614	Huron River	105	<0.1	6.9	0.5	1.6	94	0.4	17.8	52
HR–SS–10	46.77843	-88.03296	unnamed tributary to East Branch Huron River	131	<0.1	6.7	0.4	1.5	64	0.3	14.0	47
HR–SS–11	46.77769	-88.03296	East Branch Huron River	122	<0.1	4.7	0.5	1.6	68	0.3	11.9	62

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Woodruff and others—**Environmental Baseline Study of the Huron River Watershed, Baraga and Marquette Counties, Michigan**—Scientific Investigations Report 2010–5121