WATER-RESOURCES PROGRAMS AND HYDROLOGIC-INFORMATION NEEDS, MARION COUNTY, INDIANA, 1987

By Richard F. Duwelius

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MANUEL LUJAN, JR., Secretary

U.S. GEOLOGICAL SURVEY

Dallas L. Peck, Director

For additional information
write to:

District Chief
U.S. Geological Survey
Water Resources Division
5957 Lakeside Boulevard
Indianapolis, Indiana 46278-1996

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ILLUSTRATIONS

CONVERSION FACTORS AND ABBREVIATIONS

Inch-pound units in this report may be converted to metric (International System) units by using the following conversion factors:

Multiply inch-pound unit	By	To obtain metric unit
acre	0.4047	hectare
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
foot (ft)	0.3048	meter (m)
gallon (gal)	3.785	liter (L)
inch (in.)	2.540	centimeter (cm)
mile (mi)	1.609	kilometer (km)
million gallons per day (Mgal/d)	0.04381	cubic meter per second (m^3/s)
square mile (mi^2)	2.590	square kilometer (km^2)

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

$$°C = (0.556)\ (°F - 32)$$

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called "Sea Level Datum of 1929."

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ABSTRACT

Water resources are abundant in Marion County, Indiana, and have been developed for public and industrial supply, energy generation, irrigation, and recreation. The largest water withdrawals are from surface water, and the two largest water uses are public supply and cooling water for electrical-generating plants. Water-resources programs in the county are carried out by Federal, State, and local agencies to address issues of surface- and ground-water availability and quality. The programs of each agency are related to the functions and goals of the agency. Although each agency has specific information needs to fulfill its functions, sometimes these needs overlap, and there are times when the same hydrologic information benefits all. Overlapping information needs and activities create opportunities for interagency coordination and cooperation. Such cooperation could lead to a savings of dollars spent on water-resources programs and could assure an improved understanding of the water resources of the county.

Representatives from four agencies--the Indiana Department of Environmental Management, the Indiana Department of Natural Resources, the Indianapolis Department of Public Works, and the U.S. Geological Survey--met four times in 1987 to describe their own water-resources programs, to identify hydrologic information needs, and to contact other agencies with related programs. This report presents the interagency findings and is intended to further communication among water-resource agencies by identifying current programs and common needs for hydrologic information.

Hydrologic-information needs identified by the agency representatives include more precise methods for determining the volume of water withdrawals and for determining the volume of industrial and municipal discharges to surface water. Maps of flood-prone areas need to be updated as more of the county is developed. Improved aquifer maps of the inter-till aquifers are needed, and additional observation wells are needed in the inter-till and bedrock aquifers. Finally, immediate access to instantaneous precipitation data is needed to assess flooding potential.

INTRODUCTION

Water-resources programs involving collection and interpretation of hydrologic data in Marion County, Indiana, are carried out by Federal, State, and local agencies. These agencies have different scientific and water-management responsibilities and thus have different reasons for collecting the same or related types of information. For example, an agency concerned with flooding and another concerned with water-quality assessments both need streamflow data but for different purposes. These overlapping activities create opportunities for coordination and cooperation among agencies. Unfortunately, some agencies may not be aware of the types of data that others are collecting. Timely sharing of agency plans and activities could lead to savings of dollars spent on water-resources programs and to a better understanding of water resources in Marion County.

Representatives of four government agencies that collect and use hydrologic data in Marion County met four times from April to August 1987 to describe their water-resources programs and identify hydrologic-information needs. The representatives were from the Indiana Department of Environmental Management (IDEM), the Indiana Department of Natural Resources (IDNR), the Indianapolis Department of Public Works (IDPW), and the U.S. Geological Survey (USGS).

These four agencies do not represent all the hydrologic data collectors and users in Marion County. In order to provide more complete coverage of the water-resources programs within the county, information was requested from other organizations. Those who met at least once with the four agencies, or provided information, included the National Weather Service (NWS) and the Marion County Health and Hospital Corporation (MCH&H). Other private or corporate organizations that may be potential sources of hydrologic data in Marion County include the Indianapolis Water Company, private consultants, well drillers, sand and gravel companies, and landfill operators.

The IDEM was established by the Indiana General Assembly in 1985 and began operations in April 1986. Prior to that time, the environmental regulatory functions of the State were the responsibility of the State Board of Health (Boerger and others, 1988, p. 1-1). The IDEM manages many of the programs that are necessary for various Federal water-quality regulations, such as those in support of the Clean Water Act of 1972 and the Safe Drinking Water Act of 1974. The primary duties of the IDEM are regulatory and include establishing water-quality standards, issuing discharge permits, and inspecting and monitoring facilities for compliance with the regulations.

The IDNR is concerned primarily with issues of water quantity. A large part of the IDNR's responsibility involves issues related to flooding, including regulation of floodways, flood documentation, and flood-damage mitigation. Also, the IDNR is responsible for assessing water availability, inventorying significant uses of water, and planning for the beneficial use of water resources. The IDNR has collected and stored a large amount of water-use and availability data from many sources, including Federal, State and local governmental agencies, private corporations, and individuals.

The IDPW operates two municipal wastewater-treatment plants and a solid-waste incinerator, and is responsible for liquid- and solid-waste disposal in the county. The IDPW also issues permits and regulates construction in floodways and develops drainage projects in the county. They collect hydrologic data primarily as needed to support their operations.

The USGS is responsible for assessing the availability and quality of water on a national scale. In Indiana, the USGS cooperates with Federal, State, and local government agencies in the systematic collection of hydrologic data that are used by many agencies and individuals. The USGS also conducts hydrologic studies related to the occurrence, distribution, and quality of surface and ground water in the State.

The NWS operates a nationwide network of climatic stations at which they measure air temperature and precipitation. Many stations are operated as near real-time data stations and are used, along with real-time river stage and reservoir levels, for input to their flood-forecasting models.

The MCH&H is a private corporation that works under contract with the county and is responsible for the regulation of waste disposal in the county. Activities include inspection of landfills and combined sewer overflows, regulation of septic-system installation and repair, regulation of wastewater-lagoon construction, and management of the U.S. Environmental Protection Agency's non-community public water-supply program. The MCH&H also enforces county stream-pollution regulations that involve residential, commercial, and industrial sources. These activities require a variety of hydrologic data-collection activities.

Purpose and Scope

This report summarizes the findings of the four water-resource agency representatives and describes the water-resources programs and hydrologic-information needs of governmental agencies in Marion County. Information about the hydrologic setting is included to give a better perspective on the available data base and some of the reasons for data collection. A list of publications that contain hydrologic information about Marion County is included in the "Selected References."

Acknowledgments

This report was prepared by the USGS in cooperation with the IDEM, IDNR, and IDPW. The author expresses thanks to the agency representatives: Gary Starks (IDEM), James Hebenstreit (IDNR), and Vasiliki Keramida (IDPW) for their contributions to the report. The agency representatives acknowledge the cooperation of Albert Shipe of the NWS and Robert Morse of the MCH&H, who provided information about the data-collection activities of their organizations.

HYDROLOGIC SETTING

Marion County includes an area of about 400 mi^2 (square miles) in the central part of Indiana (fig. 1). The land surface is flat to gently rolling, and land surface altitudes range from about 645 to 915 feet above sea level (Meyer and others, 1975, p. 4). For the 30-year period from 1951-1980, the temperate climate of the county had a mean annual temperature of 52 degrees Fahrenheit and a mean annual precipitation of about 39 inches (National Oceanic and Atmospheric Administration, 1982). The population of Marion County was 765,233 in 1980 (U.S. Department of Commerce, 1982, p. 16-8). The city of Indianapolis is incorporated with Marion County and is governed by a combined city-county government.

Surface Water

In Marion County, surface water generally flows from northeast to southwest. Approximately 88 percent of surface runoff in the county drains into the White River (Herring, 1974). The remaining 12 percent drains into Buck Creek in the southeastern part of the county. Buck Creek is a tributary to the East Fork White River. Because surface water generally is abundant in Marion County, it has been a source for public and industrial supply to a much larger extent than in surrounding counties.

The White River and two principal tributaries, Fall Creek and Eagle Creek (fig. 2), are important sources of water supply to the county. The average discharge of the White River at Indianapolis is 1,401 ft^3/s (cubic feet per second) or 906 Mgal/d (million gallons per day) for 58 years of record. The average discharge of Fall Creek at Millersville is 285 ft^3/s (184 Mgal/d) for 58 years of record, and the average discharge of Eagle Creek at Indianapolis is 156 ft^3/s (101 Mgal/d) for 48 years of record (Glatfelter and others, 1988).

Marion County has no natural lakes, but does have more than 100 small dug lakes or water impoundments. There are two large impoundments--Eagle Creek Reservoir and Geist Reservoir (fig. 2). Eagle Creek Reservoir is located in the northwestern corner of the county and encompasses 1,350 acres. The reservoir has a storage capacity of 7.8 billion gallons when the water surface is at an altitude of 790 feet above sea level (Herring, 1974). Geist Reservoir on Fall Creek is located partially within the northeastern corner of the county. Geist Reservoir includes a surface area of 1,800 acres and has a storage capacity of 6.9 billion gallons at the spillway altitude of 785 feet (Herring, 1974). Both reservoirs are used for water supply and recreation. Eagle Creek Reservoir was built primarily as a flood-control structure, but Geist Reservoir has little or no flood-control capacity because of its fixed-spillway construction.

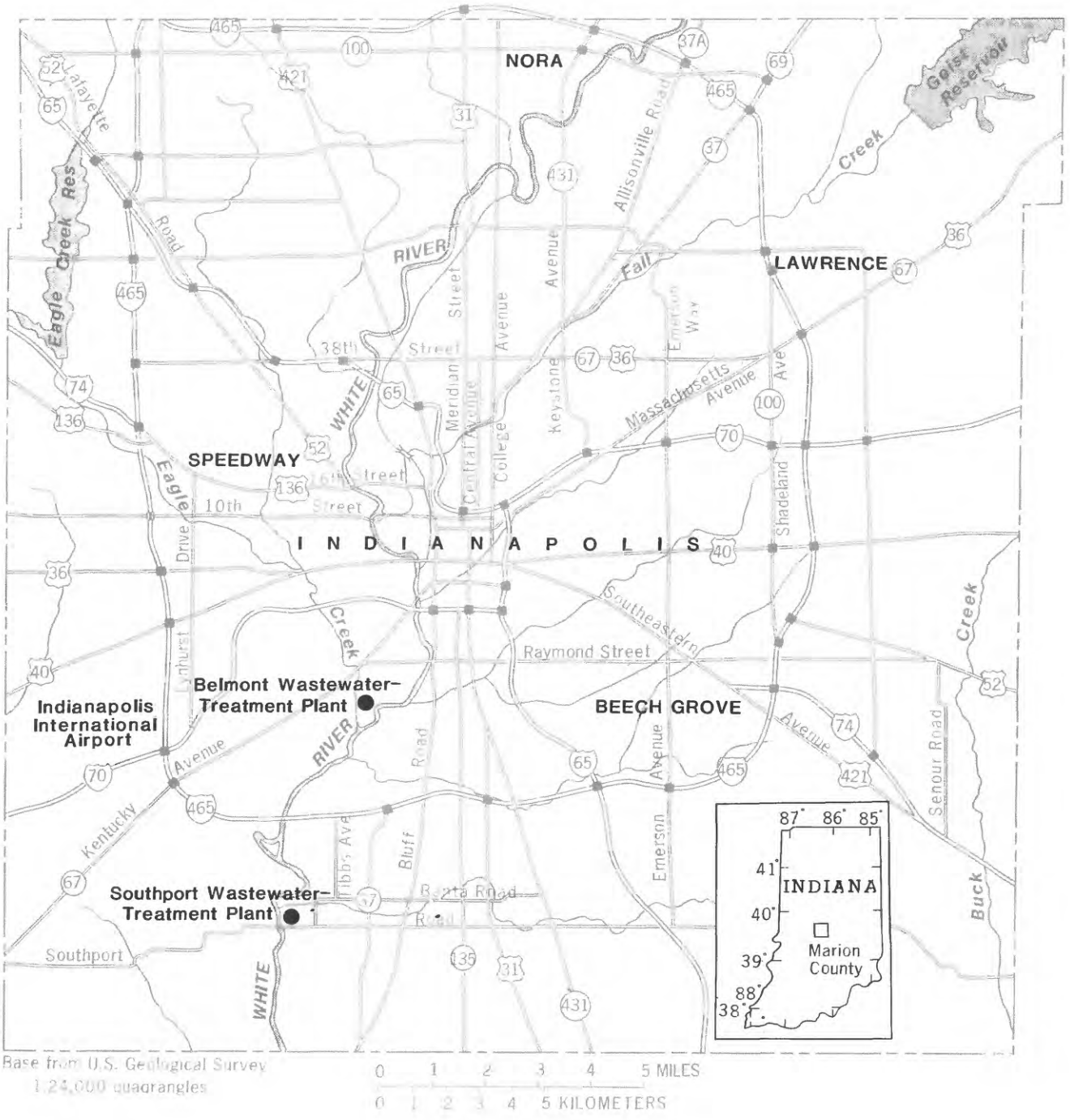


Figure 1.-- Location of Marion County and selected features.

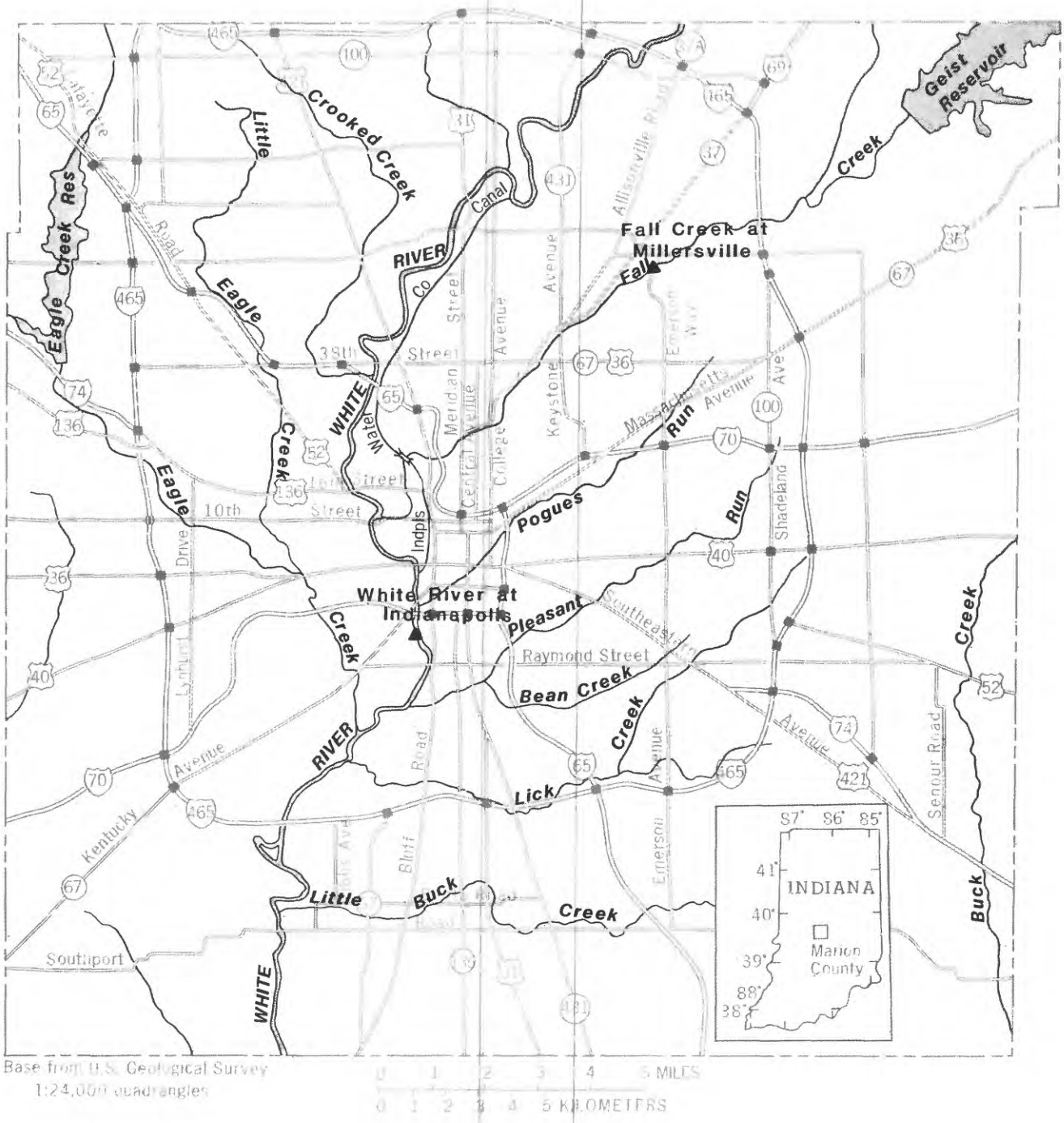


Figure 2.-- Streams and reservoirs in Marion County.

Surface water in Marion County is a hard, calcium-bicarbonate type with an average dissolved-solids concentration of about 440 mg/L (milligrams per liter) (Shampine, 1975, p. 63). Water from the White River, Fall Creek, and Eagle Creek has similar quality characteristics although Roberts and others (1955, p. 27) reported that water from Fall Creek contained less sodium and chloride and more calcium and bicarbonate than did water from the White River. Quality of water in the county streams varies considerably and is affected by discharges of effluent from municipal and industrial sources, urban and agricultural runoff, tributary inflow and reservoir releases, ground-water discharge, and water withdrawals. Human factors that affect surface-water quality are evidenced by increased concentrations of nutrients, pesticides, and metals and decreased concentrations of dissolved oxygen (Shampine, 1975, p. 63-64).

In 1987, 89 percent of the water used in Marion County came from surface-water sources. The two largest uses of water are public supply and cooling water for electrical-generating plants. Surface-water withdrawals by water utilities averaged about 131 Mgal/d, and approximately 100 Mgal/d of surface water were used for energy-related purposes in 1987. These two uses account for more than 80 percent of the water used in the county. The total volume of surface water withdrawn for all purposes in Marion County was 96 billion gallons during 1987 (Siavash E. Beik, Indiana Department of Natural Resources, written commun., 1989).

Recreational uses of surface water include swimming, water-skiing, boating, fishing, and ice-skating. Eagle Creek Reservoir and Geist Reservoir are used for many of these activities. Check dams on the White River near downtown Indianapolis cause lake-like conditions upstream and provide areas for fishing and boating. A supply-and-demand analysis indicated that the demand for all recreational uses of water greatly exceeded the supply in Marion County (Clark, 1980, p. 308).

Ground Water

Ground water is obtained from unconsolidated (sand and gravel) and consolidated (bedrock) aquifers in Marion County. These aquifers can be divided into three general categories: (1) the glaciofluvial aquifer (also called the outwash aquifer); (2) inter-till aquifers; and (3) bedrock aquifers. The glaciofluvial aquifer is unconfined. The inter-till and bedrock aquifers generally are confined.

The glaciofluvial aquifer (fig. 3) along the White River, Fall Creek, and Eagle Creek, has been studied in detail (McGuinness, 1943; Roberts and others, 1955; Cable and others, 1971; Meyer and others, 1975; Smith, 1983). This aquifer system was the first to be developed when pumping of ground water for public supply began in the early 1880's (McGuinness, 1943, p. 28). Meyer and others (1975, p. 33) observed that all the major ground-water pumping centers were located in a relatively small area of the glaciofluvial aquifer within 1 mile of one of the large streams.

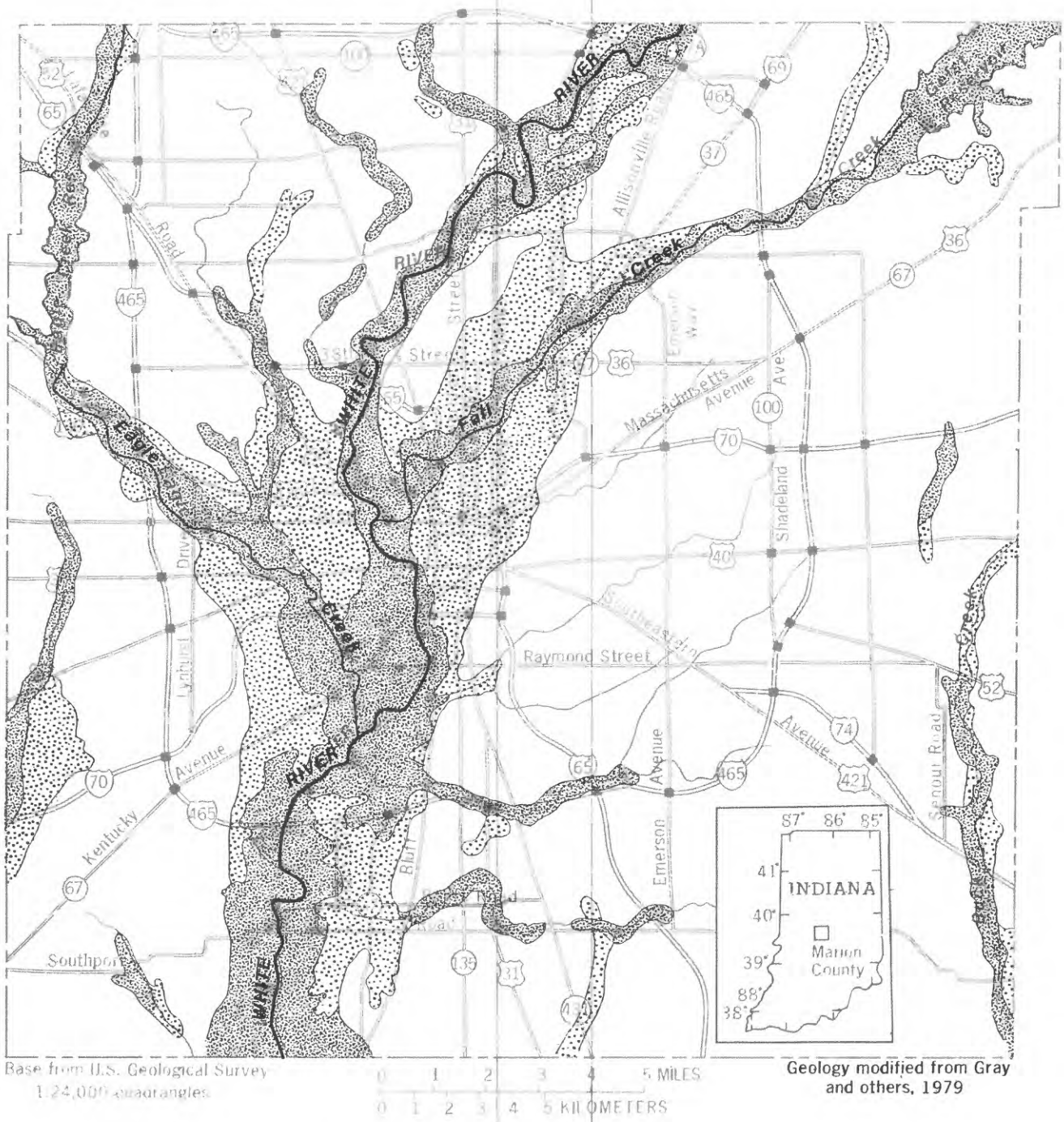


Figure 3.-- Surficial geology of Marion County.

Sand and gravel aquifers also occur in the Tipton till plain away from the large stream valleys throughout most of the county. Meyer and others (1975) mapped three confined sand and gravel aquifers in the upland areas. These inter-till aquifers are thin and discontinuous; therefore, they are less productive than the glaciofluvial aquifer. However, where they occur, inter-till aquifers are a major source of water for industrial and domestic supplies.

Bedrock aquifers in Marion County consist of limestone and dolomite. Bedrock aquifers represent a secondary ground-water source, relative to the glaciofluvial aquifer, because of larger drilling costs, smaller well yields, and generally larger concentrations of dissolved constituents. Cable and others (1971) reported that the upper 100 feet or so of the bedrock was capable of yielding water in relatively large quantities. Bedrock aquifers are of local importance in parts of the county where ground water cannot be obtained from sand and gravel.

Ground water in Marion County is generally of acceptable quality for domestic use although several areas of local contamination have been identified. The ground water is primarily a hard, calcium bicarbonate type and contains moderate to large concentrations of dissolved solids. Water quality varies considerably throughout the glacial deposits and the bedrock. Dissolved-solids concentrations of water from 32 wells in the glaciofluvial aquifer ranged from 274 to 815 mg/L (Meyer and others, 1975 p. 78). Water from 20 bedrock wells had dissolved-solids concentrations ranging from 285 to 914 mg/L (Cable and others, 1971, p. 33). Dissolved iron is found in water from all the aquifer types. Other dissolved constituents commonly found in the ground water are magnesium, chloride, and hydrogen sulfide.

There are 37 public water-supply wells and approximately 34,000 private water wells in Marion County (Indiana Department of Environmental Management, no date, p. 153-154). Several reports (McGuinness, 1943; Roberts and others, 1955; Smith, 1983) contain information about ground-water pumpage in Marion County. Herring (1974) includes a map of expected well yields. A fairly comprehensive historical account of ground-water pumpage and water-level fluctuations through 1973 is given by Meyer and others (1975, p. 33). Meyer and others conclude that total ground-water pumpage did not change substantially between the late 1940's and 1973.

Ground water supplied about 11 percent of the water used in Marion County in 1987. Ground-water withdrawals during that year were more than 12 billion gallons, with the largest volumes of ground water withdrawn for industrial use at an average rate of 16 Mgal/d. Energy-related uses of ground water amounted to about 9 Mgal/d, and water-supply utilities used almost 8 Mgal/d of ground water in 1987. Other uses of ground water in Marion County include irrigation and private domestic supply (Siavash E. Beik, Indiana Department of Natural Resources, written commun., 1989).

WATER-RESOURCES PROGRAMS AND HYDROLOGIC-INFORMATION NEEDS

In this report, water-resources programs are arranged under three general categories: surface water, ground water, and climatic data. The surface-water and ground-water categories include sections on availability, use, and water quality. Needs for hydrologic information were identified by agency representatives from the perspective of their agencies.

Surface Water

Availability and Use

The IDNR maintains data files that contain information about surface-water availability. Much of the data are collected in cooperation with other agencies such as the NWS, the Soil Conservation Service (SCS), and the USGS. The files include precipitation and climatic data, and information on stream and reservoir stage. Generalized county soil maps and detailed soil maps produced by the SCS are on file at the IDNR. The "Indiana Water Data Directory" published by the IDNR in 1987 contains information about the data-collection activities of several agencies (Interagency Water Data Committee, 1987).

Through a cooperative agreement between the IDNR and the USGS, surface-water levels are monitored at 12 locations in Marion County, including 9 rivers or streams and Eagle Creek Reservoir (fig. 4). The water levels are used to compute discharge for the streams and contents for the reservoir. Daily flow data and extremes are published annually by the USGS in "Water Resources Data, Indiana" (see U.S. Geological Survey, 1974-88).

The IDNR collects and compiles surface-water-use data. The Indiana Water Management Act (IC-13-2-6.1) of 1983 requires the registration of significant water-withdrawal facilities. A significant water-withdrawal facility is defined as one with the ability to pump 100,000 gallons of water per day. The water may come from either a surface-water or a ground-water source or a combination of both. Withdrawal facilities are required to report their monthly withdrawals on an annual basis. The data are compiled by county and have been published by the IDNR since 1986 in an information fact sheet titled "Indiana's Water Use" (see Indiana Department of Natural Resources, 1986-87).

There are few, if any, facilities that use surface water in Marion County that are not in the significant withdrawal category, therefore the registration process most likely includes nearly all of the surface-water use in the county. The largest facilities have mteres; however, most water-withdrawal facilities estimate their withdrawals on the basis of pump capacity and the number of hours pumped. It is difficult to assess the accuracy or reliability of the estimates without flow measurements.

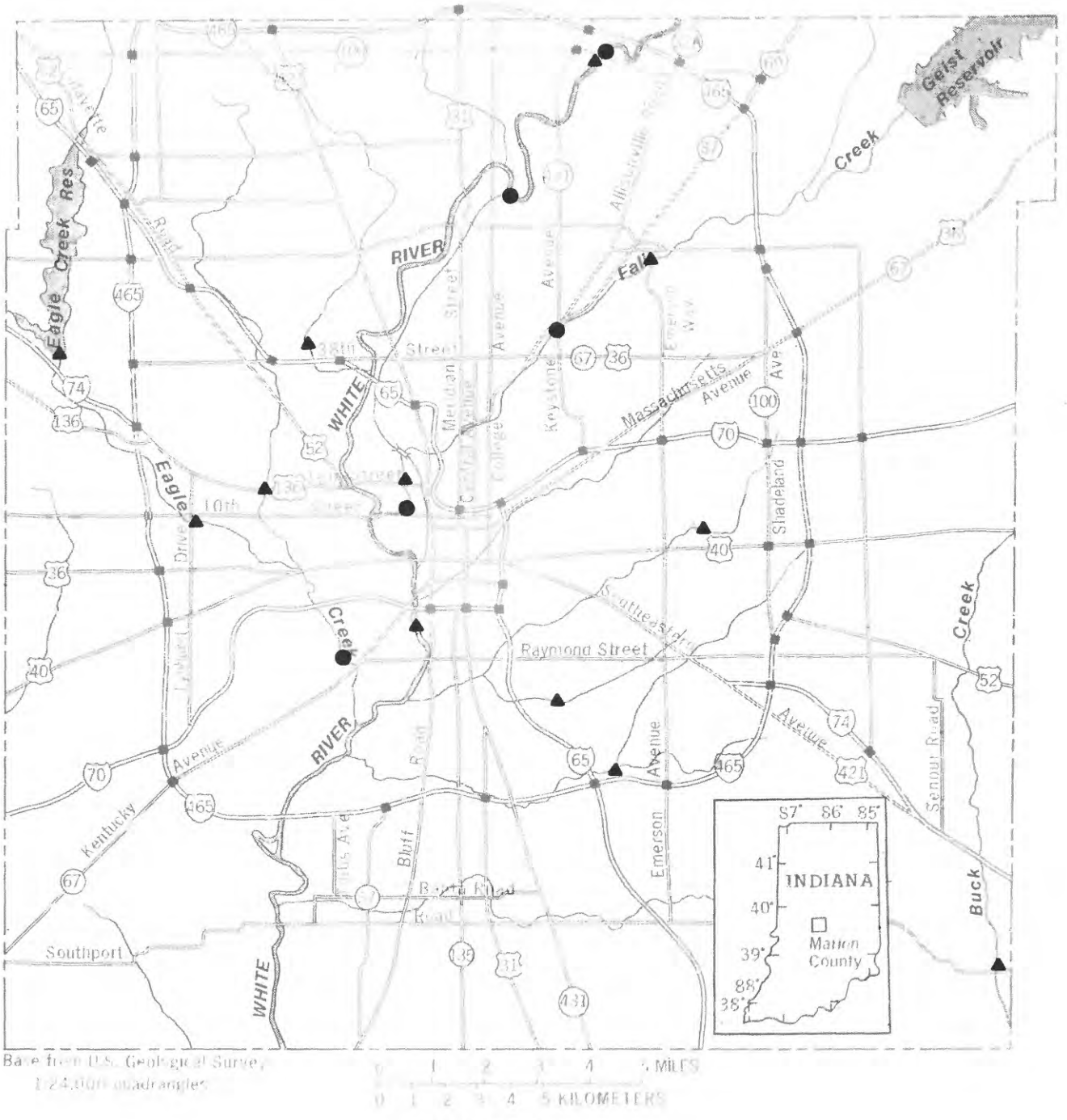


Figure 4.-- Surface-water data-collection stations in Marion County

Water-use-data needs involve the development of improved methods for measuring or estimating withdrawals and the devlopment of techniques to assess the accuracy of the data.

The IDNR also collects and compiles certain stream-morphology data, such as stream mileage and stream thalwegs. High-water-mark data are collected during some floods. Determination of flood frequencies for many Marion County streams is coordinated among four agencies: the IDNR, the SCS, the U.S. Army Corps of Engineers, and the USGS. The information is published every 2 years by the IDNR in "Coordinated Discharges of Selected Streams in Indiana" (see Indiana Department of Natural Resources, 1977). Flood-prone areas along the White River and several of the largest streams have been defined in previous investigations by the Federal Emergency Management Agency (1983) and the U.S. Army Corps of Engineers (1970 a, b; 1971; 1974). Peak discharges for floods are estimated for other streams on an as-needed basis.

The potential for flooding is always changing in an urban environment. Increased runoff of surface water from developed areas and human encroachment on flood plains can cause flooding in areas that have never had problems. Floods cause average annual damages of $10,000 to $25,000 along the White River and Fall Creek in the less urbanized parts of the county (Clark, 1980, p. 317). In the more developed urban areas, average flood damage is estimated at more than $100,000 annually (Clark, 1980, p. 317). Reports that contain maps of flood-prone areas must be updated periodically to maintain their usefulness for flood forecasts or warnings. Updated maps of flood-prone areas in Marion County are one of the needs for hydrologic information identified by water-resources agency representatives.

Industrial and municipal discharges to surface water are regulated by Indiana's NPDES (National Pollutant Discharge Elimination System) permit system. Permits are administered by the IDEM, and each permit is specific to the particular discharge and the receiving stream. Estimates of the volume of each discharge are required for the permit application; however, estimates generally are unchecked by measurements, and substantial differences between actual and estimated discharge volumes may occur. More precise methods for determination of the discharge volumes to surface water are needed to improve the accuracy of the data.

Quality

The IDEM maintains five water-quality monitoring stations on four streams in Marion County. The five stations are Eagle Creek at Raymond Street, Indianapolis Water Company Canal near the diversion from the White River, Fall Creek at Indianapolis Boulevard near 10th Street, Fall Creek at Keystone Avenue, and the White River near Nora (fig. 4). Samples for physical, chemical, and bacteriological analyses are collected monthly at each station. Results are published annually in a report titled "Water Quality Monitoring of Rivers and Streams." Data are available for most of the monitoring stations since 1971 (see Indiana State Board of Health, 1971-84 and Indiana Department of Environmental Management, 1985; 1986-87).

The NPDES permit program managed by IDEM is designed to regulate point-source discharges from industrial and municipal wastewater-treatment facilities. The NPDES permit obtained from IDEM establishes limits on the quantity and quality of discharged wastewater. To assure that the quality limits of the permit are met, the IDEM collects samples of discharged wastewater from Federal, State, municipal, and industrial facilities. The type and number of parameters analyzed depend on the type of wastewater discharged, but all analyses include the pollutants limited by the facility's NPDES permit.

The IDEM also collects samples and analyzes effluent from selected NPDES permit holders as part of a toxicity-monitoring program. Under this program, wastewater is analyzed for 129 U.S. Environmental Protection Agency priority pollutants. Wastewater effluents from private industries and the IDPW wastewater-treatment plant at Belmont have been collected and analyzed. Additionally, effluents from one industrial plant and the Speedway wastewater-treatment plant have undergone bioassays to determine if there are potential toxic effects from the wastewater.

Prior to the formation of the IDEM in 1985, the Indiana State Board of Health completed extensive water-quality surveys of Eagle Creek in 1976, 1979, 1980, and 1981. The studies were used to determine waste-load allocations for the Speedway wastewater-treatment plant, a heavy-equipment-manufacturing plant, and a metallurgy plant. The study area included the reach of Eagle Creek between Lynhurst Drive and Raymond Street in Indianapolis. Data collected during the surveys were used for model calibration and verification; results are included in the Indiana State Board of Health report "Waste Load Allocation, Lower Eagle Creek" (1983).

The effects of nonpoint pollution are investigated by the IDEM primarily through their toxics-monitoring program. This program includes regular analyses of fish-tissue samples and monitoring of aquatic invertebrates. The water-quality monitoring station at the Indianapolis Water Company Canal near the diversion from White River (fig. 4) is part of this program. Fish-tissue samples have been analyzed annually since 1979 for fish taken from this station. In 1985, Eagle Creek Reservoir and Geist Reservoir were included in the IDEM sampling program for toxic substances in fish tissue and bottom sediments. Forty parameters were analyzed in each sediment sample; 32 chemical characteristics were analyzed for each fish sample. Data-collection activities and results of IDEM programs are presented in a series of biannual reports (see Indiana Department of Environmental Management, no date).

To assess the performance of their two municipal wastewater-treatment plants in Marion County, the IDPW samples and analyzes influent and effluent, and sewage collected at selected points throughout the treatment process. Samples of sewage sludge are analyzed prior to incineration or disposal in landfills.

Many industries that formerly discharged wastewater to surface water are now connected to sewers. The IDPW has developed an industrial pretreatment program under Federal and State guidelines in which they work directly with industries to reduce the concentration of toxic and harmful substances before they are released to city sewers. The pretreatment program helps to protect the operations of wastewater-treatment plants from accumulation of toxic

substances that could upset the biological processes of the plant or pass through the plant untreated. Industrial discharges into the sewer system are monitored by the IDPW. Samples are analyzed for compliance with the pretreatment program.

The IDPW and the USGS have studied the White River in Marion County to assess water quality in the river before and after advanced wastewater-treatment plants were constructed. Beginning in 1981, monthly samples were collected at five to eight sites and analyzed for nutrients, chloride, and fecal coliform. Samples of bottom sediments were taken in the summers of 1982, 1983, 1984, and 1986 at eight locations and analyzed for metals (Jeffrey Martin, U.S. Geological Survey, oral commun, 1987). For another study, between 1984 and 1986, stream stage, water temperature, pH, dissolved oxygen, and specific conductance were monitored at three sites on White River and at one site on Fall Creek (Martin and Craig, in press).

A cooperative study in the summer and fall of 1987 by the IDPW and the USGS investigated the effects of combined sewer overflows on water quality in Fall Creek. Streamflow and water-quality measurements were made during storms at three sites on Fall Creek: 16th Street, Central Avenue, and Emerson Way. Water temperature, pH, dissolved oxygen, and specific conductance were measured during station visits, and samples were taken for analyses of bacteria, nutrients, metals, oil and grease, and other indicators of sewage effluent.

Water-quality samples will be collected monthly for 2 years beginning in February 1990 as part of the study by the IDPW and USGS to investigate the effects of urbanization on the Little Eagle Creek and Little Buck Creek watersheds. Samples will be analyzed for major ions, nutrients, selected metals, total and dissolved organic carbon, biochemical-oxygen demand, and suspended sediment.

Ground Water

Availability and Use

Ground-water levels are recorded in five wells and measured twice a year (spring and fall) in 60 wells in Marion County (fig. 5). The biannual measurements provide an approximation of the seasonal fluctuation of ground-water levels. All the observation wells are completed in sand and gravel aquifers except for one of the five recording wells that is completed in limestone. The water levels are collected through a cooperative agreement between the IDNR and the USGS.

The IDNR collects and compiles ground-water-use data in compliance with the Indiana Water Management Act of 1983. Ground-water-use issues generally are the same as those discussed previously in the surface-water section of this report. The majority of ground-water withdrawals reported to IDNR are

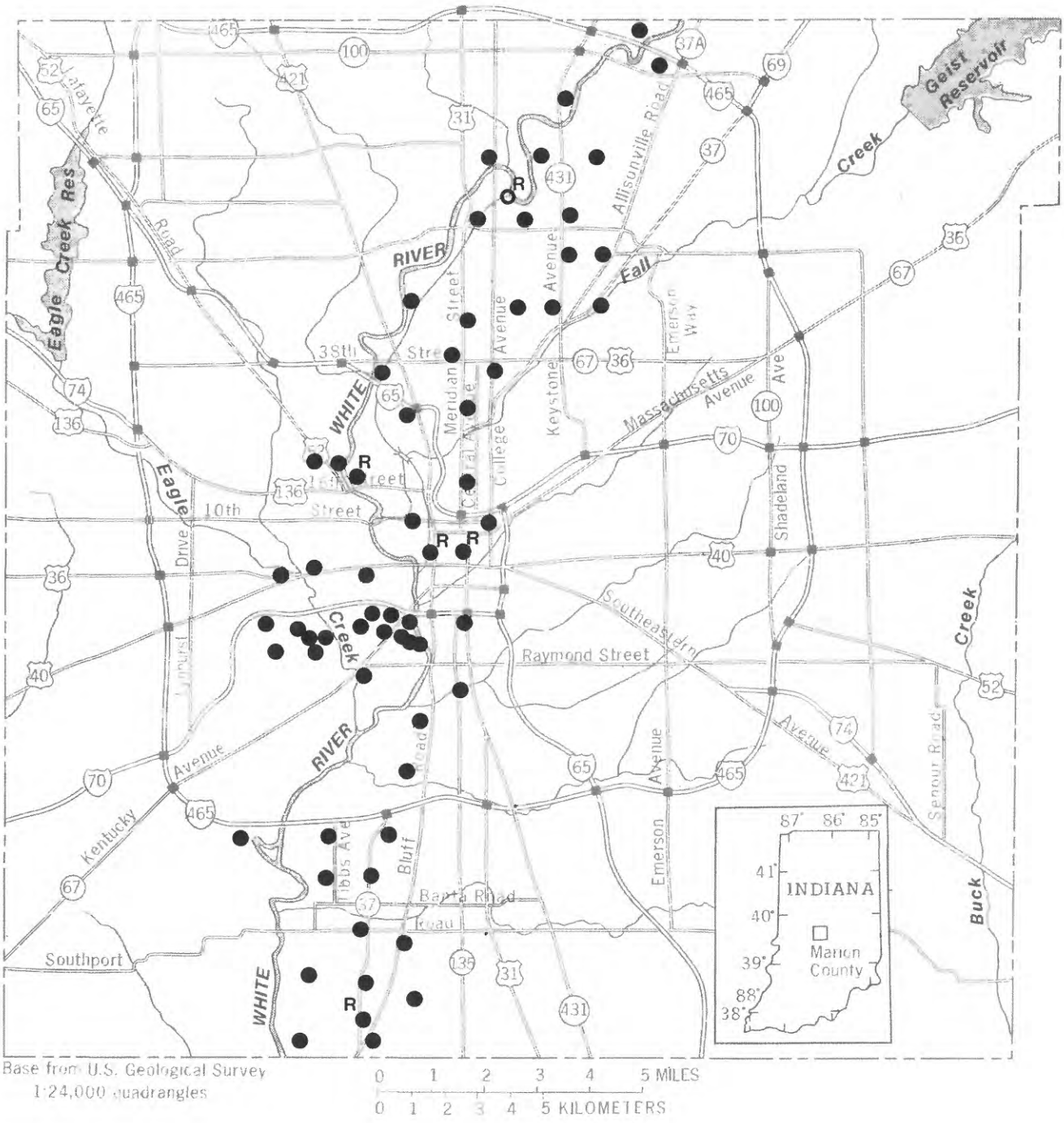


Figure 5.-- Observation-well network in Marion County.

estimated. Additionally, the amount of ground water used for private domestic supply is obtained using estimates of such factors as population, number of wells, and average daily use per person.

In the early 1980's, a large commercial office building in the Indianapolis downtown area began to use ground water for cooling. Pumpage for this building was 415 Mgal in 1986 and 371 Mgal in 1987 (James Hebenstreit, Indiana Department of Natural Resources, oral commun., 1988). Daily pumpage varies considerably and is greatest during the summer months. The pumped water is discharged by way of the Indianapolis Water Company Canal into the White River. Competition for water rights could develop if ground water were used for cooling additional buildings. If all the water were discharged at the surface, ground-water levels could decline. The IDNR has constructed, calibrated, and tested a digital computer ground-water-flow model of the glaciofluvial aquifer beneath downtown Indianapolis (Graves and Parambo, 1987). The model is used to estimate the effects of proposed large-capacity ground-water users in the downtown area.

Another area of interest is the hydraulic relation between the glaciofluvial aquifer and the White River. The river is the principal natural discharge for the aquifer. However, it is also a potential source of recharge to the aquifer as pumping wells may lower water levels below the river stage. Water levels in wells near the river indicate that the White River is a gaining stream throughout most of the county. The actual rate of ground-water seepage to the river is obscured by uncertainties in other inflows and outflows, including ground-water pumpage, surface-water diversions and returns, storage behind dams, sewage-effluent disposal, and urban runoff. In 1987, the IDNR studied three segments of the White River in central Marion County to gain a better understanding of the relation between ground-water flow and the river. These segments are located near College Avenue, near 38th Street, and near 10th Street in Indianapolis. Tests were made to determine the permeability of the streambed sediments at each location. Results of this investigation are presented in the IDNR report "Streambed permeability and seepage in White River, Marion County, Indiana" (Saul and Robinson, 1989).

Maps of aquifer thickness and extent are used to determine water availability and to assess contamination potential. Aquifer maps of Marion County have been included in only a few reports (Herring, 1974 and 1976; Meyer and others, 1975; Smith, 1983). Several thousand records that contain hydrologic and lithologic information of water wells in the county are on file at IDNR. As new well records become available, the existing aquifer maps could be updated to improve the understanding of the connections between the various inter-till aquifers and the glaciofluvial aquifer. The four agency representatives concurred that improved maps of aquifers in Marion County are needed.

Almost all the observation wells in the existing water-level network were installed during investigations of the glaciofluvial aquifer. Much less water-level information is available for the inter-till and bedrock aquifers. The four agency representatives also identified a need for additional observation wells in parts of the county outside the area along the White River underlain by the glaciofluvial aquifer.

Ground-water-quality data are collected in Marion County by the IDEM, the IDPW, the MCH&H, and the USGS. The Indiana State Board of Health monitors public drinking-water supplies. Additional information is collected by private industries, such as the Indianapolis Water Company, to determine the suitability of the water for specific purposes.

Ground-water-quality programs of the IDEM generally are intended to determine water quality associated with a particular site investigation or to assess a potential source of ground-water pollution. Ground-water samples are collected from project wells and private wells in the vicinity of the study site. Samples are scanned for indicator properties, depending on the problem being investigated. Approximately 10 sites in Marion County have been investigated by IDEM.

New Federal laws pertaining to underground storage tanks became effective in December 1988. The regulations require upgrading of older tanks by 1999. New tanks must be constructed of noncorrosive materials and be protected against overfill and spillage. Older tanks will require some form of leak detection that may include strict inventorying of stored materials, tightness tests, or monitoring wells. The IDEM is responsible for enforcement of the underground tank regulations and is compiling a statewide inventory of underground storage tanks through tank-owner registration.

The IDPW and the USGS cooperated in investigations of the effects of landfills and sludge lagoons on ground-water quality. Samples of ground water were collected quarterly between May 1985 and May 1986 from 16 wells at the landfill at Tibbs Avenue and Banta Road in southwestern Marion County and from 35 wells at the landfill near U.S. Highway 52 and Senour Road in east-central Marion County. Both landfills were used as disposal sites for stabilized sewage sludge that had been removed from lagoons at the two municipal wastewater-treatment plants. Onsite measurements of water temperature, pH, dissolved-oxygen concentration, and specific conductance were made at the time of sample collection. Samples were analyzed for dissolved inorganics and phenols by the IDPW laboratory. Results of this investigation are presented in the USGS report "Geohydrology, simulation of ground-water flow, and ground-water quality at two landfills, Marion County, Indiana" (Duwelius and Greeman, 1989).

The USGS collected samples for five quarters beginning in July 1986 from 11 wells around sludge lagoons at the Belmont municipal wastewater-treatment plant. The samples were analyzed by the IDPW laboratory for dissolved inorganics, phenols, and methylene blue active substances. Bromide and bacterial analyses were done by the USGS. Results are presented in the USGS report "Ground-water flow and quality beneath sewage-sludge lagoons, and a comparison with the ground-water quality beneath a sludge-amended landfill, Marion County, Indiana" (Bobay, 1988).

No countywide ground-water-quality survey have been made. The most extensive sampling was by the MCH&H who, since 1984, have collected about 1,000 water samples throughout the county from taps fed by private wells.

Samples were analyzed for coliform bacteria, nitrates, volatile organics, and certain inorganics. About 300 samples were analyzed for metals. About 4,000 water-well samples are analyzed each year for coliform bacteria as part of mortgage loan inspections (Robert Morse, Marion County Health and Hospital Corporation, written commun., 1987). Occasionally, samples for chemical analyses are collected from wells at three landfill sites by MCH&H.

The MCH&H is developing a ground-water-protection program with three main objectives (Parrett, 1986a):

(1) To ensure that all users of endangered wells are connected to city water or to an adequate system of private water treatment;
(2) to prevent further contamination of aquifers; and
(3) to assure users of city water that the water, as a product derived increasingly from ground water, is free from hazardous toxicants.

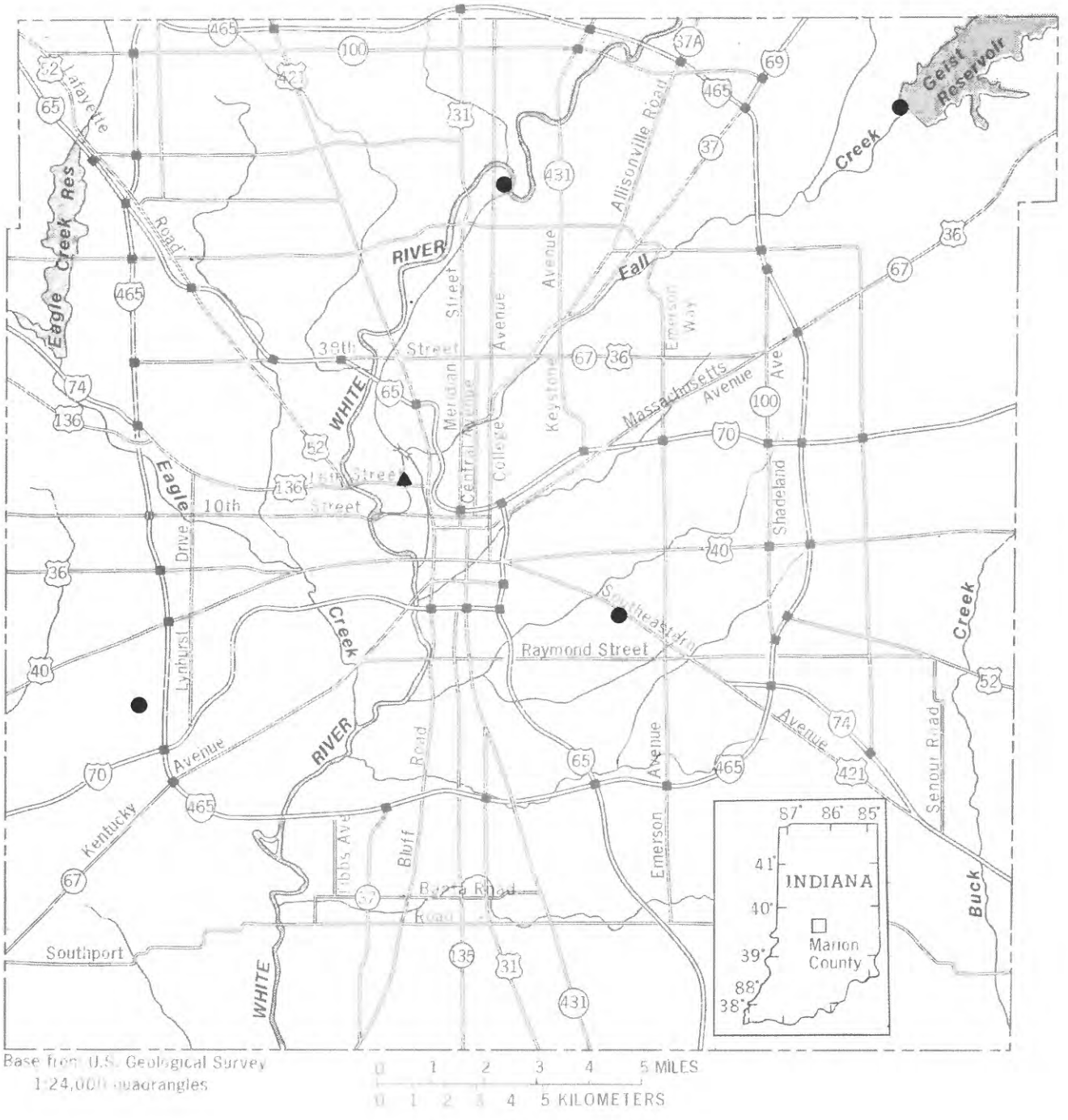
To achieve these goals, the MCH&H is involved in a variety of activities including enforcement of regulations regarding the covering of salt piles, new wastewater lagoons, and septic-system installation and repair. Potential sources of ground-water contamination have been plotted on a county map. In areas served by wells, samples are collected and analyzed at the Public Health Laboratory. Analyses include coliform bacteria counts, pH, specific conductance, and concentrations of chloride, fluoride, nitrate, and volatile organic compounds (Parrett, 1986a). The MCH&H surveys areas served by septic systems and recommends sewer-extension projects to eliminate septic systems from unsuitable areas.

Climatic Data

Records of climatic information are important to many hydrologic investigations. Precipitation records are useful to studies of recharge to ground water, low flows, flood flows and frequencies, and most studies that involve runoff and infiltration. Temperature records are useful in computing streamflows, water quality constituents such as dissolved oxygen, and runoff from snowmelt.

The NWS maintains climatic stations at four locations in Marion County (fig. 6). The stations are located at Geist Reservoir, the Indianapolis Water Company Riverside station, the Indianapolis International Airport, and near Southeastern Avenue in the east-central part of the county. The USGS maintains a precipitation gage near Fall Creek and 16th Street in Indianapolis.

NWS climatic data are available by satellite transmission on a near real-time basis. The data are compiled and published in monthly summary reports that include climatic data for the entire State. Generally, there is a lag of several months between collection and publication, and some supplemental information is not published. The USGS and IDNR precipitation measurements are not published but are available in their respective offices. The four agency representatives identified a need for real-time precipitation information to assess flooding potential during storms.



EXPLANATION

● National Weather Service climatic data-collection station

▲ U.S. Geological Survey precipitation gage

Figure 6.-- National Weather Service climatic data-Collection network and U.S.Geological Survey precipitation gage in Marion County

SUMMARY

Surface-water and ground-water resources generally are abundant in Marion County. The White River, Fall Creek, and Eagle Creek are the largest streams in the county and are important sources of water supply. Two reservoirs, Eagle Creek and Geist Resevoirs, are located in the county and are used for water supply and recreation. Eagle Creek Reservoir is also used for flood control. About 89 percent of the water used in the county in 1987 came from surface-water sources. The largest pumpage of ground water is from the glaciofluvial aquifer near the White River and other large streams.

Water-resources programs that involve the collection and interpretation of hydrologic data are carried out by Federal, State, and local agencies to address issues of surface-water and ground-water availability and quality. The IDNR collects and compiles data regarding the availability of water resources, including streamflow, flooding, ground-water levels, and water-use data. The IDEM monitors stream quality and industrial discharges, and collects data at landfills, hazardous-material spills, and underground storage tanks. The IDPW collects water-quality data for the White River and Fall Creek to assess the effects of combined sewer overflows and two municipal wastewater-treatment facilities. The USGS collects streamflow and reservoir stage data and does specific studies on surface- and ground-water availability and quality.

Several needs for hydrologic information in Marion County were identified by representatives of the IDEM, IDNR, IDPW, and USGS during four meetings in 1987. Improved methods are needed to determine the volume of water withdrawals to improve the accuracy of estimates of water use and to determine the volume of industrial discharges for permit applications. The location of flood-prone areas needs to be updated as more of the county is developed. Improved aquifer maps are needed, especially for the inter-till aquifers that are located in parts of the county away from the large streams. Additional observation wells are needed in the inter-till and bedrock aquifers. Finally, immediate access to instantaneous precipitation data is needed to assess flooding potential.

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