SUMMARY: DATA RECOMMENDATIONS

Because hydrologic data forms a framework upon which management decisions are based, the adequacy of data networks for ongoing water management purposes was assessed. Unless otherwise indicated, the following discussion summarizes hydrologic monitoring needs as identified by the Division of Water.

Climate

The distribution of official National Weather Service stations is adequate; however, the availability of published climatic summaries is insufficient for characterizing climate (particularly precipitation) on a county scale. Although recently published 30-year summaries (NOAA, 1985) for South Bend and Goshen College provide sufficient precipitation and temperature data for St. Joseph and Elkhart counties, such summaries are lacking elsewhere in the basin. Because both South Bend and Goshen are located in areas affected by Lake Michigan, the development of precipitation summaries for the period 1951-80 should be considered for LaGrange, Angola and Kendallville. Period-of-record precipitation summaries for Elkhart, Ligonier, Waterford Mills, and Prairie Heights would also be beneficial. Such summaries could best be prepared (or obtained) in cooperation with Purdue University's agricultural meteorology office, where both historical and recent climatic data files are maintained.

Lakes

In general, the network of lake level monitoring stations is adequate for IDNR's ongoing management purposes. The Division of Water will continue to evaluate the magnitude and frequency of flooding around lakes as well as the effectiveness of control structures in maintaining legal levels. Crompton and others (1986) also point out that legal levels could probably be established for additional lakes with adequate data.

Rivers and Streams

As discussed earlier in this report, two stream sites could be investigated for potential installation of continuous-record gages. A gage near the mouth of Christiana Creek could provide data pertinent to both quantity and quality issues; and a gage on Solomon Creek could monitor flow in a ditched agricultural area characterized by relatively flat topography.

Because of sufficient record and the limited utility of data currently collected, three stream gages are recommended for discontinuation: (1) Lime Lake Outlet at Panama; (2) Forker Creek near Burr Oak; and (3) Turkey Creek at Syracuse.

Ground Water

Plans for improving the observation well network, as discussed in an earlier section, include the following: 1) addition of Steuben 6 (already completed) to monitor long-term water-level changes in an area not affected by large-scale pumpage; 2) installation of three nested wells near Kendallville to provide data for a deep confined aquifer; 3) removal of the continuous water-level recorder from Elkhart 6; and 4) discontinuation of IDNR funding for two ground-water/lake wells (Kosciusko 6 and 7).

SUMMARY: WATER RESOURCE AVAILABILITY

In response to a 1983 legislative mandate, the Indiana Department of Natural Resources, Division of Water published a report describing the availability, distribution, quality, and use of ground and surface waters of the St. Joseph River basin, Indiana. This report, one element of the division's statewide water management program, is intended to provide information to managers, planners, government officials, and others involved with water resources decision-making.

The St. Joseph River basin drains 2586 mi^2 in Lower Michigan and 1699 mi^2 in Indiana before emptying into Lake Michigan near Benton Harbor, Michigan. Two-thirds of Indiana's 1980 basin population (432,600) resided in the cities of South Bend, Mishawaka, Elkhart, and Goshen and their adjacent urbanized areas. The population decline of St. Joseph County is expected to continue during the next two decades, primarily as a result of the sharp drop in South Bend's population since the 1960s. Other county populations are expected to increase, particularly in LaGrange County.

Manufacturing, services and retail trade, primarily concentrated in St. Joseph and Elkhart Counties, are the largest employment classes within the basin. Agriculture is the primary land use, yet it comprised less than three percent of the basin's employed labor force in 1982. In Elkhart, LaGrange, and Kosciusko Counties, the total number of farms, sales of dairy and poultry products, and hay and oats production were among the highest in Indiana.

In general, soils of the St. Joseph basin fall within one of three categories: 1) sandy or loamy soils developed on outwash and alluvium; 2) silty or clayey soils developed on till; and 3) muck soils developed in depressional wetland areas.

Basin topography has been most significantly influenced by deposition during Wisconsinan glaciation and subsequent erosional modifications. The highly variable topography is composed of lowlands containing significant volumes of outwash sand and gravel, and uplands dominated by morainal till. Local relief may exceed 200 feet in some areas containing kame deposits. The massive Packerton and Mississenewa moraines, predominant along the basin's southern boundary, are characterized by complex sag and swell topography and by a zone of glacially formed lakes. The intermorainal lowlands are for the most part underlain by glacial till and small areas of lacustrine deposits.

Thickness of glacial deposits range from about 30 feet near Mishawaka to nearly 500 feet in the eastern part of the basin. However, most of the basin is covered with deposits ranging from 200 to 350 feet in thickness.

Three shale units primarily constitute the basin's bedrock surface: the Coldwater Shale in the northeast, the Ellsworth Shale in the west, and the Antrim Shale in the south. Bedrock elevations range from about 350 feet m.s.l. near Elkhart, where a deep narrow valley is present, to more than 900 feet m.s.l. in northeastern Steuben County.

Annual temperatures average 49° F and annual precipitation averages 35 inches. Annual snowfall averages about 35 inches, but increases to more than 70 inches at South Bend, where the climate is considerably influenced by Lake Michigan. Snowfall at South Bend accounts for nearly 20 percent of the average annual precipitation; elsewhere in the basin, snowfall accounts for less than 10 percent.

More than 200 natural lakes and an estimated 27,000 wetlands (including partially drained farmland) remain within the St. Joseph basin, despite past and present drainage modifications. The densest zone of wetlands (including lakes) occurs in LaGrange, Steuben, and Noble Counties.

Lakes, rivers and wetlands are expected to be primarily areas of ground-water discharge. Hydrographs derived from observation wells and lake gages revealed good hydraulic connections between selected lakes and the surrounding outwash aquifers. Lakes investigated for this report appear to reflect regional ground-water flow, but surface- and ground-water interactions are expected to be locally complex. Legal and environmental constraints either preclude or discourage the use of lakes and wetlands as major sources of water supply, although significant surface-water withdrawals occur on three in-basin lakes and an unknown number of wetlands.

Rivers most commonly utilized for water supply generally have developed on permeable outwash deposits. Stream flows of these rivers (including the St. Joseph, Pigeon, Fawn, and Little Elkhart Rivers, as well as Turkey and Solomon Creeks) are moderately to well sustained by ground-water contribution. Based on hydrograph separation techniques, ground water

comprises about 70 percent of the stream discharge measured at eight gaging stations. In contrast, stream flows are moderately to poorly sustained in eastern and southeastern areas of the basin (primarily in parts of Steuben and Noble Counties), where present drainage systems have developed on till.

Available data indicates that the general water quality in the St. Joseph and Elkhart Rivers is good; however, bacterial standards for whole-body and partial-body contact recreation are exceeded downstream of urban areas. Conditions necessary for well-balanced fish and benthic invertebrate communities are maintained in both rivers. Data collected on the St. Joseph River in summer 1985 revealed that for the most part, salmonid fisheries could be supported downstream of Mishawaka.

Downstream of South Bend, concentrations of PCBs and chlordane in fish flesh exceeding FDA action levels have been reported since 1979. The source of low-level PCB contamination in sediment samples collected near the mouths of five major St. Joseph River tributaries is currently under investigation.

Recent lake surveys have revealed few eutrophication problems. A 1984 fish eradication and selective restocking project at Sylvan Lake was primarily responsible for major water quality improvements at this historically eutrophic to hypereutrophic lake. Put-and-take trout fisheries are maintained in about 12 basin lakes (and on about 12 rivers and streams).

Unconsolidated deposits of glacial sands and gravels are the principal source of ground water. Yields of 200 to 500 gpm are common throughout the basin, and can increase to 1500 gpm where sand and gravel deposits are thick. Underlying bedrock is not used as a supply source. Seven major unconsolidated aquifer systems have been recognized and defined on the basis of geologic environments and aquifer characteristics.

The St. Joseph and Tributary Valley Aquifer System occurs in the western portion of the basin. It is characterized by outwash and valley train deposits of sand and gravel with local clay layers. Aquifer thicknesses of 40 feet or more are typical. Ground water availability in this system is good to excellent. High capacity wells in most of the St. Joseph and Tributary Valley Aquifer System may be expected to yield 500 to 1,000 gpm.

The Topeka Aquifer System occurs in two areas in the central portion of the basin. In this system, unconfined outwash sands and gravels overlie thick clay units containing confined intertill sand and gravel layers. Thickness of the surficial outwash is usually 30 to 50 feet while the deeper intertill aquifers are usually less than 20 feet thick. Ground water conditions here are generally good. High capacity wells may be expected to yield 150 to 500 gpm from the deeper aquifers of this system.

The Natural Lakes and Moraines Aquifer System covers a large area in the central portion of the basin. This is an intertill system with sand and gravel aquifer occurring sporadically within thick clay till sequences. Productive aquifer zones are commonly only 5 to 10 feet thick. Ground-water availability is variable, but generally good. Domestic wells throughout this system may produce 25 gpm and in local areas high capacity wells may produce up to 800 gpm.

The Kendallville Aquifer System is found in the eastern part of the St. Joseph River basin. Like the adjacent Natural Lakes and Moraines Aquifer System, the Kendallville is an intertill aquifer system. Producing aquifers occur as confined sand and gravel layers within thick clay tills. Aquifers are usually 10 feet or less in thickness. Limited to good ground water conditions exist here. High capacity wells in some areas may produce up to 1000 gpm. Domestic wells generally yield 15 to 30 gpm throughout the system.

The Howe Aquifer System covers much of the northeast area of the basin. The system is characterized by surficial outwash sands and gravels overlying tills containing sand and gravel aquifer zones. The upper outwash sand and gravel aquifers are commonly 15 to 50 feet thick. The intertill sand and gravel aquifers average 5 to 25 feet in thickness. The deeper intertill aquifers are more frequently utilized. Ground-water availability in this system is good to excellent. Domestic wells commonly produce up to 60 gpm and high capacity wells may be expected to yield up to 1000 gpm.

The Nappanee Aquifer System is an intertill system in the western areas of the basin. Zones of sand and gravel separated by thin clay layers occur within a thick till sequence. Individual sand and gravel aquifers are usually less than 30 feet in thickness. This is an area of moderate to good ground water availability. Well yields of 50 to 600 gpm may be expected from this system.

The Hilltop Aquifer System is a small outwash sand and gravel system near the western edge of the St. Joseph River basin. A few clay till lenses are present above and within the outwash. Sand and gravel thickness may approach 120 feet in this system. Ground-water availability is moderate. Domestic wells often produce 10 to 60 gpm. High capacity wells may be expected to yield 50 to 250 gpm.

Ground water in the basin is of the calcium bicar-

bonate type, and is characterized by high alkalinities, high hardness, and mostly basic pH. Overall, natural ground-water quality is good; however, iron, manganese and total dissolved solids commonly exceed U.S. Environmental Protection Agency recommended limits. Nitrate concentrations exceeded recommended limits in nine wells sampled in summer 1985, and in four other wells sampled during previous studies. The Indiana Department of Environmental Management had documented 33 sites contaminated by various chemicals as of early 1986. Also, at least one volatile organic chemical has been detected by the USEPA in seven public water supply wells.

The detection of trichloroethylene and other volatile organic chemicals in Elkhart's North Main Street well field has prompted investigative and protective action by local, state and federal agencies. Two interceptor wells installed in 1982 will remain operational for an indefinite period. In addition, an air stripper is currently under construction to treat contaminated water from production and/or interceptor wells. The City of Elkhart is also evaluating a proposed new well field about one mile northwest of the Elkhart Municipal Airport.

Ground water is the source of three-fourths of all water withdrawn in the basin. In 1985, 85 percent of registered ground-water withdrawals occurred in St. Joseph and Elkhart Counties, primarily for public supply uses. About 97 percent of all surface-water withdrawals occurred within St. Joseph, Elkhart, and LaGrange Counties, mainly for public supply and agricultural irrigation.

The major water use categories in the basin are public supply (54 MGD in 1985), irrigation (20 MGD), and industry (15 MGD). Ground water was the source of all public drinking water withdrawals, 63 percent of industrial withdrawals, and 60 percent of irrigation withdrawals. About 90 percent of both industrial and public supply uses occurred in Elkhart and St. Joseph counties, whereas 94 percent of all irrigation uses occurred in Elkhart, LaGrange, and Kosciusko counties.

Rural uses, which include large-scale livestock operations and fish hatcheries but not self-supplied rural domestic uses, totaled 3 MGD in 1985. Rural water withdrawals primarily utilized surface-water sources.

Even though the St. Joseph basin has no registered water withdrawals for energy production within its topographic boundaries, a South Bend ethanol plant near the western basin divide withdrew 3 MGD from the St. Joseph Aquifer System in 1985. Only three facilities in the basin are classified as miscellaneous. These reported uses totalled 0.11 MGD. Estimates for non-registered, domestic self-supply uses in 1985 totalled 13 MGD, while non-registered livestock uses totalled about 5.5 MGD.

Percentage increases in public water supply withdrawals are expected to be the highest in LaGrange, Noble and Steuben Counties. Significant irrigation expansion is expected to occur in Elkhart, LaGrange, and Kosciusko counties. Percentage increases in industrial withdrawals are expected to be the greatest in Steuben and Elkhart Counties. Future redevelopment of former hydropower plants or the installation of hydropower generating equipment at low-head dams is possible, but final actions can only be speculated.

Stream sites have been identified where water supplies may be developed, where demands may increase, and/or where withdrawal capacities may exceed statistical low flows. (Wastewater treatment facilities downstream of registered surface-water withdrawals were also included.) Potential development sites in urban areas have primarily been identified along the St. Joseph River. Most sites where cumulative upstream withdrawal capabilities exceed estimated low flows occur in irrigation areas.

Ground-water modeling studies and observation well hydrographs indicate that ground-water levels in outwash aquifers are not affected by current irrigation pumpage. These and other studies show that such aquifers can support considerable ground-water development. However, substantial increases in localized pumpage could create large drawdowns, decreased ground-water seepage to streams, and decreased water levels in nearby streams, lakes and wetlands. In addition, maximum irrigation development could cause temporary, local competition for both ground and surface water.

In general, however, ground-water resources of the St. Joseph River Basin are the most abundant in Indiana. Because ground-water availability in most of the basin is considered good to excellent, a significant potential exists for further water supply development. In coming decades, ground water will undoubtedly increase in overall importance as a source of supply for irrigation, municipal, industrial, and other purposes. However, streams with moderately to well sustained flows are expected to remain a major supply source for both withdrawal and instream uses. The numerous lakes and wetlands will not only continue to offer a wide range of recreational opportunities, but will also provide fish and wildlife habitat and various hydrologic benefits.

A theoretical maximum water supply for the St. Joseph basin, estimated on a monthly basis, ranges from 36,660 million gallons in September to 104,080 million gallons in April. These values represent the amount of precipitation which is not evaporated or used consumptively on a long-term basis. As additional hydrogeologic data becomes available and the interactions between ground-water and surface-water systems are better understood, better estimates can be derived for potential water supply. Moreover, an integrated water management program can be further developed to help ensure an adequate, balanced water supply for meeting future demands.