WATER FACT SHEET

U.S. GEOLOGICAL SURVEY, DEPARTMENT OF THE INTERIOR

THE INTERDISCIPLINARY RESEARCH INITIATIVE: HYDROLOGIC RESEARCH IN THE SHINGOBEE RIVER HEADWATERS AREA, MINNESOTA

BACKGROUND

Effective management of our Nation's lake and wetland resources is impossible without understanding how the physical, chemical, and biological processes affect these hydrologic systems. The complex interactions of these processes require an understanding of geology, geography, hydrology, meteorology, chemistry, and biology on local and regional scales. The Interdisciplinary Research Initiative (IRI) provides the opportunity for fundamental interdisciplinary research of interactions within the hydrologic system on a watershed scale, to increase the basic understanding of watershed hydrology, and to provide information necessary for better management of our Nation's water resources.

Management of water resources often is dependent on understanding the effects of residence time on ecosystem processes. The focus of the Minnesota IRI is on aquatic systems that have greatly different water and, presumably, chemical residence times. The underlying premise is that aquatic systems that have short residence times are dominated by interaction with water and chemistry from outside the lake basin, whereas aquatic systems that have long residence times are more likely to be dominated by processes occurring within the lake. Lakes and associated rivers were chosen as the primary research sites because they integrate a large number of processes within their watersheds, and they have great importance to society.

Scientists from many disciplines participate in the IRI. Most scientists at the site are from the U.S. Geological Survey, and a growing number are from universities in Minnesota and California. A site manager assists with specialized data collection and maintains the year-round collection of essential hydrologic data.

SITE DESCRIPTION

A nationwide search for suitable paired-lake sites resulted in the selection of the upper reach of the Shingobee River watershed in north-central Minnesota (fig. 1). Williams Lake is near the head of the

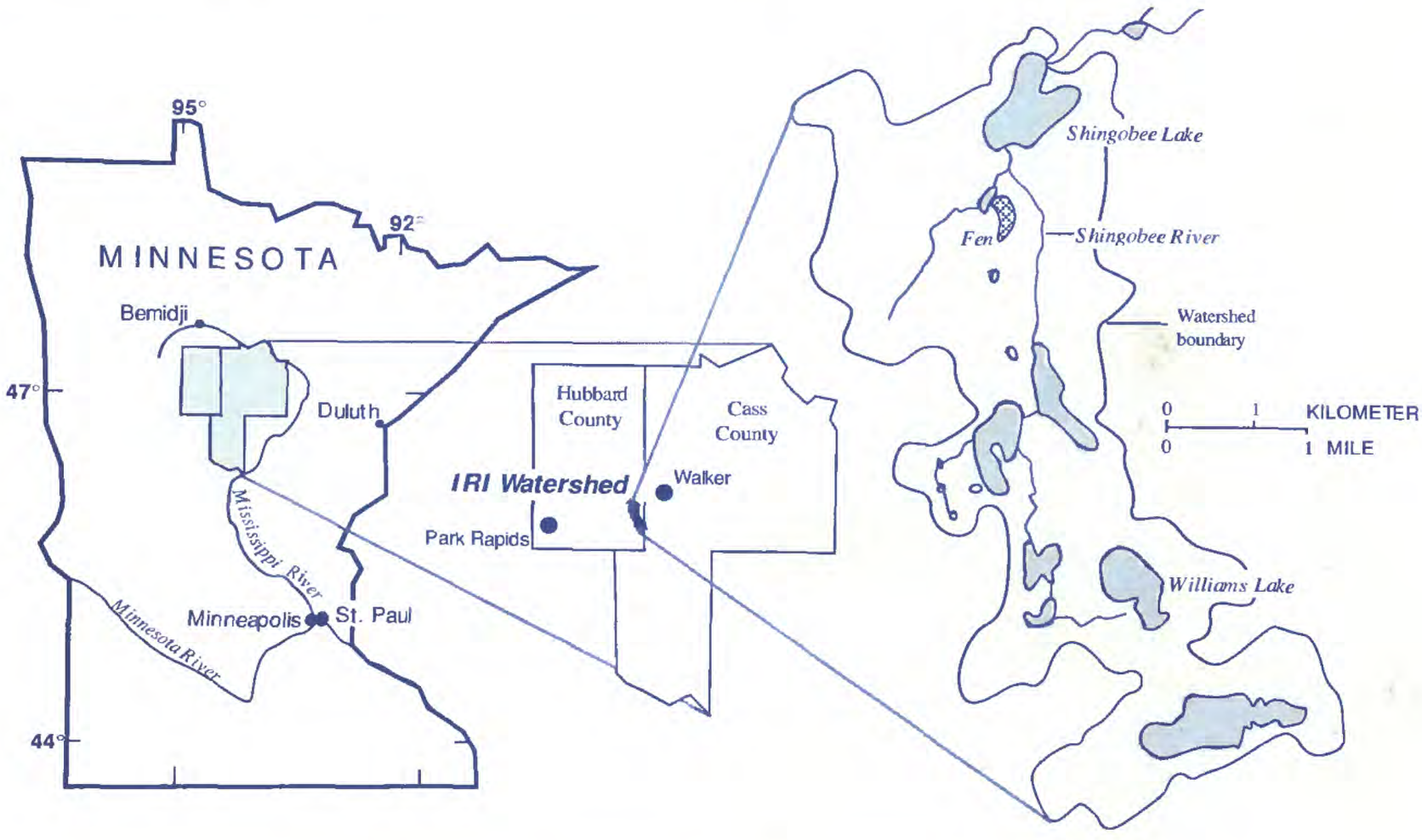

Figure 1. Location of Interdisciplinary Research Initiative (IRI) site.

Shingobee River watershed, 5 kilometers (3 miles) south-southeast of Shingobee Lake. Williams Lake has a residence time of approximately 4 years and has no channelized surface-water inflow or outflow; water in the lake interacts primarily with the atmosphere and ground water. Shingobee Lake has a residence time of approximately 7 months and its water interacts with the atmosphere, ground water, and the Shingobee River. Major features of these lakes are listed in table 1. The upper Shingobee watershed also contains other interesting hydrologic features such as ground-water seeps, wetlands, and beaver dams.

Table 1. Comparison of watershed characteristics of Shingobee and Williams Lakes

Characteristic	Shingobee Lake	Williams Lake
Lake surface area	65.6 hectares (162 acres)	39.3 hectares (97 acres)
Lake maximum depth	10.7 meters (35 feet)	9.8 meters (32 feet)
Lake volume	40.2×10^5 cubic meters (14.2×10^7 cubic feet)	20.4×10^5 cubic meters (7.20×10^7 cubic feet)
Lake residence time	about 7 months	about 4-6 years
Watershed area (excluding lake)	222 hectares (549 acres)	177 hectares (437 acres)
Surface-water inlet	Shingobee River	none
Typical discharge at inlet	0.09 cubic meters per second (3.2 cubic feet per second)	none
Surface-water outlet	Shingobee River	none
Typical discharge at outlet	0.11 cubic meters per second (3.9 cubic feet per second)	none

The climate at the IRI site is humid continental, with warm, humid summers and cold winters. Lakes are generally ice free from mid-April through mid-November. Annual precipitation averages 640 millimeters (25 inches), which is approximately equal to lake evaporation. Watersheds of both lakes are generally forested; local relief is approximately 50 meters (160 feet). Both watersheds are lightly developed.

The Williams Lake watershed is underlain by fine- to coarse-grained ice-contact glacial drift. Ground water flows into Williams Lake along its south and east shores, and lake water seeps to the ground-water system along the north and west shores. The Shingobee Lake watershed is geologically similar to the Williams Lake watershed, but has a greater proportion of fine-grained material. Ground water seeps into Shingobee Lake along its entire shoreline. Springs are abundant in the Shingobee Lake watershed but are absent in the Williams Lake watershed. The Shingobee River flows through Shingobee Lake about halfway between the headwaters of the river and its terminus in Shingobee Bay of Leech Lake, 10 kilometers (6 miles) northeast of Shingobee Lake. The river has a fairly constant flow year round.

HYDROLOGIC RESEARCH

Research on the hydrology, geochemistry, and limnology of the Williams Lake watershed began in 1978, and reports describing the hydrologic setting, limnology, and geochemistry of the site are available on request. Study of the interaction of the lake with ground water, evaporation, and biogeochemistry has continued to the present (1993). Study of the Shingobee Lake site began in 1989 at the inception of the IRI effort.

Climatic data are collected continuously at rafts located on both lakes during the open-water season, and data are collected year round at a land-based station near Shingobee Lake. Stage of the lakes and discharge of the Shingobee River upstream and downstream from Shingobee Lake are monitored continuously. Water levels in approximately 70 ground-water wells are measured biweekly to monthly; at select sites, daily water-level data are collected. Chemical and biological data are collected from both lakes and the Shingobee River biweekly during the open-water season and monthly during the months of ice cover on the lakes.

A current geochemical research priority that involves considerable interdisciplinary coordination is study of the lake carbon cycles, including quantification of fluxes of carbon dioxide and methane between the lakes and atmosphere, between lake sediments and the lake, and quantification of consumption of methane within the lake. Substantial effort also has been directed to the study of physical, chemical, and biological interactions associated with a fen near Shingobee Lake. Other research activities at the IRI site include transport of nutrients in the Shingobee River, terrestrial-water interactions, paleolimnology, watershed hydrology, atmospheric chemistry, botany, geochemistry, and glacial geology. Research at the IRI site is expected to be open ended and long term. The IRI can provide coordination, ancillary data, and logistical support for additional research efforts. New research participants with an interdisciplinary interest are welcome.

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