Arkansas Water Resources Center

GIS CHARACTERIZATION OF BEAVER WATERSHED

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Publication No. PUB-159

1992

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Research Project Technical Completion Report

Project G-1549-06

The research on which this report is based was financed in part by the United States Department of the Interior as authorized by the Water Research and Development Act of 1984 (P. L. 98-242)

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Publication No. 159

July 1, 1991 - June 30, 1992

ABSTRACT

GIS CHARACTERIZATION OF THE BEAVER WATERSHED

Beaver Reservoir watershed is located in Northwest Arkansas including portions of Madison, Washington, Benton, Carroll, Franklin and Crawford counties. This watershed is important to the Northwest Arkansas region because it supplies most of the drinking water for the major towns and cities, and several rural water systems. The watershed consists of 308,971 ha with elevations ranging from approximately 341 m to 731 m above mean sea level. It includes the Springfield Plateau and the Boston Mountains provinces within the Ozark Plateau physiographic region. There are approximately 581 km of streams, 532 km of shore line, and 3712 km of roads in the watershed most of which are city streets and rural roads. The soils in the watershed vary extensively and are quite complex due to the differences in parent material, topography and time. Most parent material of the soils in the Springfield Plateau is limestone, whereas in the Boston Mountains the dominant parent material is sandstone and shale. The differences in soils have led to the differences in landuse and land cover. The near surface geology in the watershed is also divided by physiographic provinces. Most of the Springfield Plateau surface geology is limestone, whereas the Boston Mountains are primarily sandstone and shale. Spatial details of the streams, roads, soils and geology attributes in the watershed are presented in this report. The GIS database and characterization of the watershed offers an excellent beginning to future research and modeling of various water quality parameters in this and other watersheds.

H D. SCOTT AND J. M. MCKIMMEY

Completion Report to the U. S. Department of Interior, Geological Survey Reston VA, July 1992

Keywords -- Geographical Information Systems, Soils, Geology, Groundwater, Poultry Litter.

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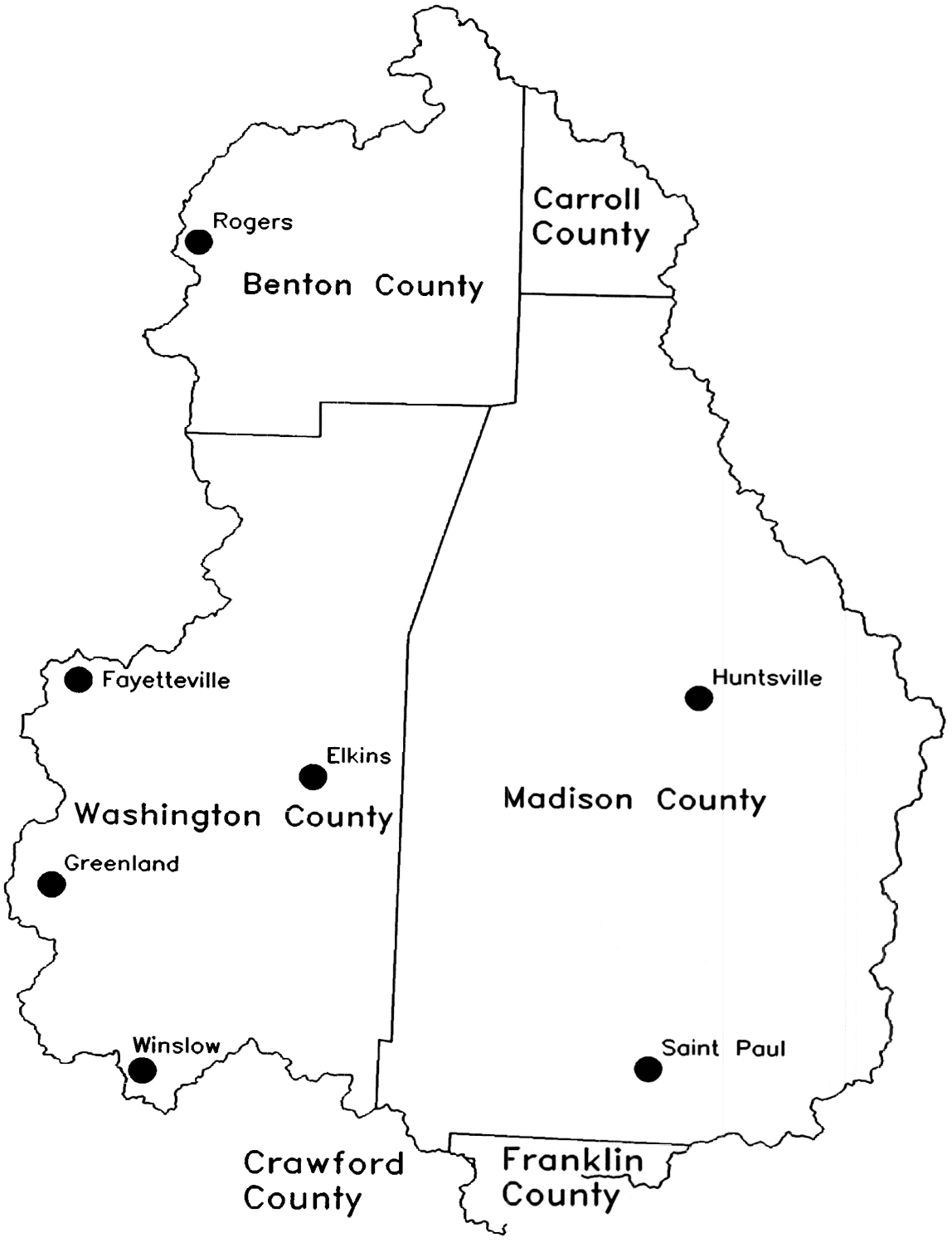


Figure 1. Spatial distribution of counties in the Beaver Reservoir watershed

input, verification, and correction of each primary attribute selected to characterize the watershed.

LITERATURE REVIEW

Beaver Reservoir Watershed

Beaver Reservoir is located in Northwest Arkansas at the head waters of the White River. The reservoir is impounded by Beaver Dam located west of Eureka Springs in Carroll county. The watershed extends north to south, from just south of the Arkansas-Missouri state line to the northern edge of Franklin county. East-west extent of the watershed is from Fayetteville in Washington county to six miles east of Huntsville in Madison county. The watershed includes portions of Benton, Washington, Crawford, Franklin, Madison, and Carroll counties. reservoir is also the main water source for the major municipalities in northwest Arkansas.

During the early 1960s the population of Northwest Arkansas was mostly rural with three small-to medium-size municipalities: Rogers, Springdale, and Fayetteville. Economic activity in the area was primarily agricultural and comprised mostly of small, individually owned farms. There was little industry associated with the three major communities. Water supplies for these three communities consisted of small reservoirs on the outskirts of the city limits During the past 30 years, however, the area has more than doubled in population (Figure 2). Types of industry have diversified from small farms to a mixture of light industry and food processing, mainly located within cities, and large poultry and swine operations in rural areas. Much of the industrial growth within the cities can be attributed to a more than adequate water supply provided by Beaver Reservoir. With the rapid increase in population, industry, and agriculture, the problems of pollution have also increased. Until 1988,

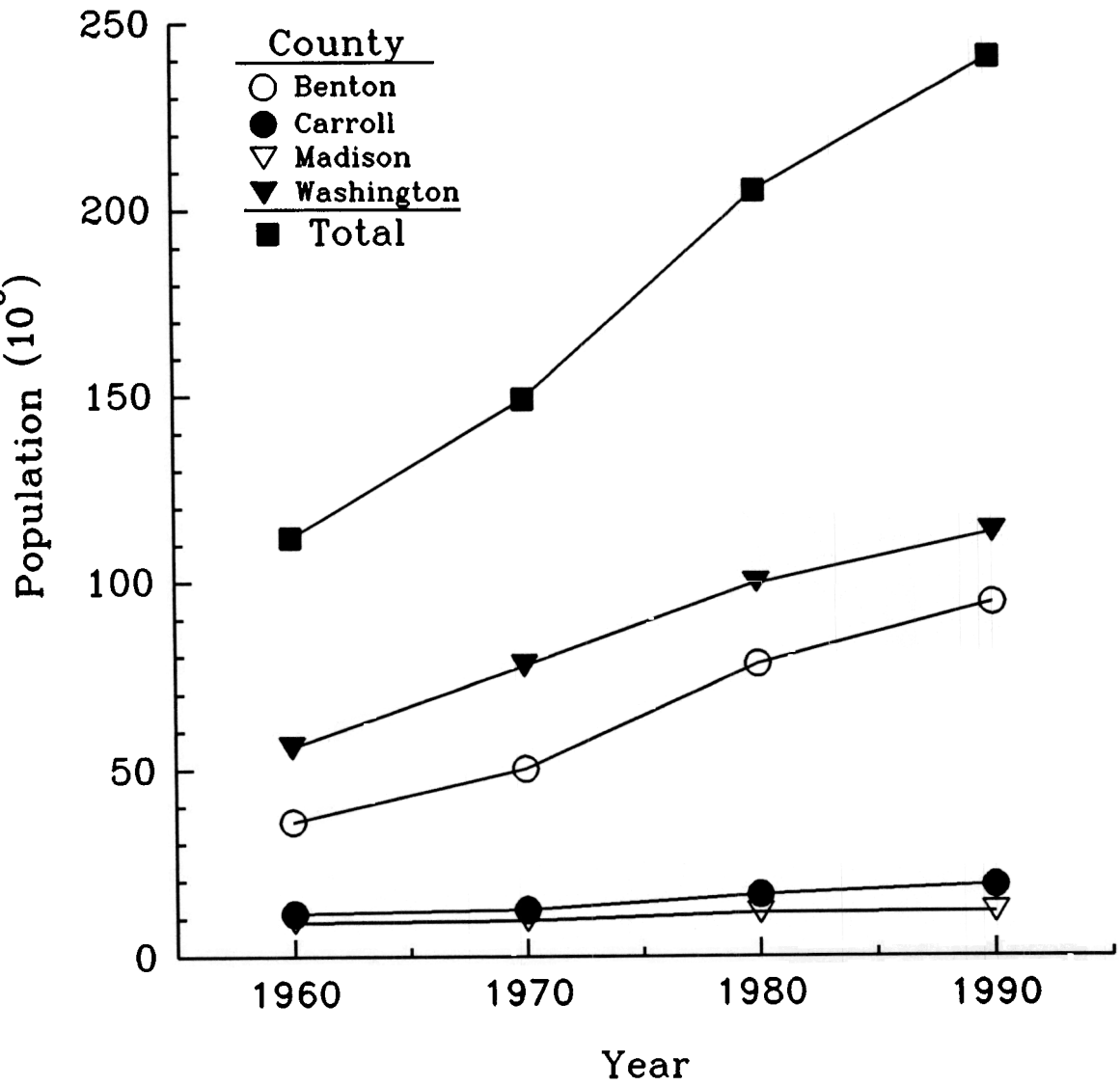
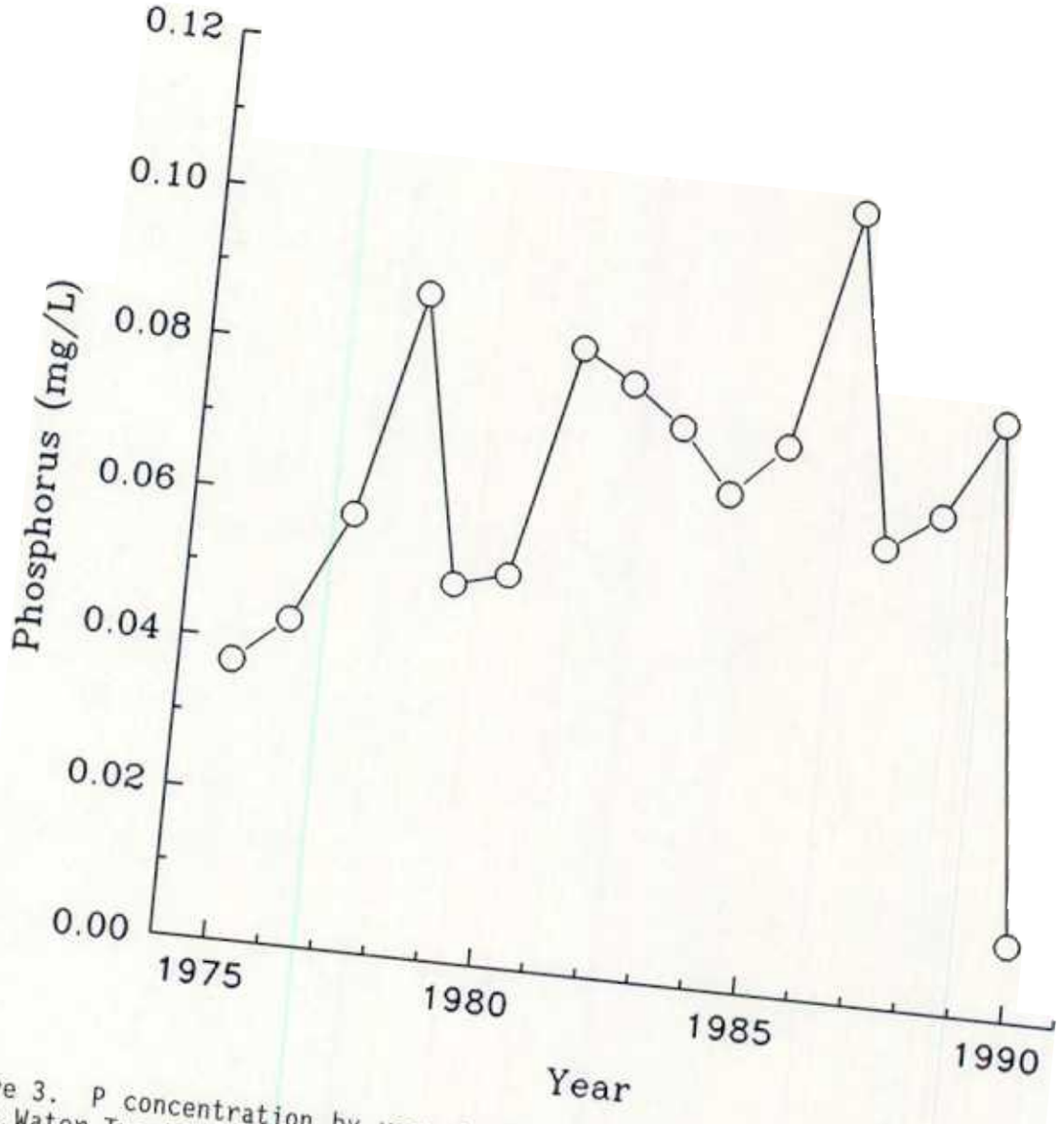


Figure 2. 30-year population change for Benton, Carroll, Madison and Washington counties in Northwest Arkansas (Source: U.S. Census Bureau 1960, 1970, 1980 and 1990).

Fayetteville waste water treatment facility discharged effluent directly into the White River, the main tributary of Beaver reservoir, approximately 16 km upstream from the reservoir. Past research noted the high levels of nitrogen (N) and phosphorus (P) in the water below the treatment plant (U.S.G.S., 1988). A marked reduction of fish species diversity and population below the sewage discharge

point was noted (Brown, 1983). The effluent from the treatment plant accounted for most of the point-source pollutants entering Beaver Reservoir (SCS, 1986). With the installation of the new waste disposal treatment plant, the levels of pollutants were supposedly dramatically reduced. Apparently, there is no research that has reported the effects of the new waste treatment facility on aquatic diversity and population below the discharge point. Although, data from water samples taken down stream suggests that P concentrations in the water have been reduced (Figure 3).

As the poultry and swine industry expanded in the area, the number of poultry and swine houses increased as well (Figure 4). These houses contain large populations of animals which result in a high density of animal waste. Waste from these houses is commonly applied broadcast to area pastures as a fertilizer. Subsequent runoff and infiltration of P from the applied animal waste has caused concern about the quality of surface runoff and groundwater. There have been few published studies on the Beaver watershed where small ponds, streams, and water wells have been sampled to evaluate water characteristics. Research has been conducted on the larger water bodies in the watershed with results generally showing a rise in P concentrations over time (SCS, 1986). Sources of P are from waste treatment facilities on the White River above Beaver Reservoir and an unknown source near Prairie Creek just east of Rogers. Before the Fayetteville treatment plant came on ine in 1988, the input of P from the facility accounted for 62% of the P entering the reservoir (SCS, 1986). Therefore, it was estimated that non-point sources are responsible for 38% of total P entering the reservoir (SCS, 1986). These sources of P could result from agricultural practices, increased urban runoff, and a dramatic increase of septic tank filter fields along the shoreline due to recent development. It has been



gure 3. P concentration by year in the White River below the Fayettevil
Waste Water Treatment facility (Source: USGS Water Resources Data 1975-1990)

public consensus that the most important P sources are from animal waste sit
uch as poultry and swine houses as well as from the use of poultry and swi
itter as a fertilizer. At this time, these suspicions have not bee
ubstantiated because of the lack of quantitative data.

The Soil Conservation Service (1986) reported on a study of animal waste
rosion and nutrient transport within the Beaver Reservoir watershed (SCS. 1986)