Source Materials for Water Resource Planning and Development in Oklahoma

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It is generally recognized that the earth's capacity to support ever increasing numbers of people is contingent upon man's ingenuity in recognizing, exploiting, and re-using where possible, the earth's basic fund of natural resources. Most fundamental of all these natural resources is water, large quantities of which are available on and under the continental land surfaces. The ocean waters, with an average sodium chloride content of about 3½%, are of limited direct usefulness to man without specific treatment. Excessive amounts of salt, gypsum, and other minerals in ground water, and also in certain surface waters, especially in regions of arid and semi-arid climate, make the search for usable fresh water, on or under the land surface, a particularly compelling one. This paper is a brief report on the location, published record, and current research of the public agencies involved in the investigation and analysis of fresh water supplies in Oklahoma.

Early surveys of the topography, geology and natural resources of the American West conducted during the nineteenth century, partly under War Department and partly under Department of the Interior sponsorship, revealed with some clarity the broad environmental patterns of the dryer areas of the country where water is in short supply (Bartlett, 1962; Goetzman, 1959). The organization of the United States Geological Survey in 1879 consolidated under a single civilian agency of the Federal Government the major responsibility for surface mapping and research studies concerning surface and underground waters. Working in close collaboration with the USGS in the evaluation of Oklahoma's water resources are two major state agencies, the Oklahoma Geological Survey in Norman and the Oklahoma Water Resources Board (formerly part of the Oklahoma Planning and Resources Board), located at the Capitol Building in Oklahoma City. Because of its special responsibility with regard to flood control and navigation on internal waterways, the United States Army Corps of Engineers has also been much involved in research and development work on Oklahoma's major streams. Work of the Corps of Engineers in Oklahoma is coordinated through the Office of the District Engineer in Tulsa. The Bureau of Reclamation of the Department of the Interior, concerned with the development of water supplies for irrigation and domestic use, has been particularly active in the state in the period since World War II. The Soil Conservation Service of the U. S. Department of Agriculture has participated in the planning and construction of more than a thousand farm ponds and small reservoirs in the state. The United States Public Health Service and the Oklahoma Department of Health are both active in matters of water quality controls as related to health standards. Individual scientists in several fields at Oklahoma State University and the University of Oklahoma, particularly in such fields as Civil Engineering, Geology, Geography, and Economics, have made significant contributions to the better understanding of Oklahoma water resources and their utilization.

In the field of water use planning, the seventeen-volume report of the Arkansas-White-Red River Basin Inter-Agency Committee, issued in the early 1950's, presents a wealth of background information gleaned from many sources. The Commitee is still active, and a number of its recommendations are being acted upon by the U. S. Army Corps of Engineers, the U. S. Bureau of Reclamation, and other agencies.

The remainder of this paper is a summary report of the work of the United States Geological Survey and the Oklahoma Geological Survey on

ground water and surface water conditions in the state. These two agencies, sometimes working independently and at other times in collaboration, have produced much of the "raw data" which the action and big money-spending agencies have made use of in planning major dams, reservoirs, power sites, and irrigation works on the state's streams.

Probably the largest volume of data concerning Oklahoma's water resources is to be found in the USGS Water-Supply Papers series which began in 1896 and by 1964 included more than 1,800 research reports (USDI, Geological Survey, 1964). These reports include runoff data for all of the major and many of the minor streams of the state, as recorded by the official gauging stations, water quality and pollution studies, reports of floods and flood damage, evaluation of underground reservoirs, and a variety of engineering applications to problems of water pumping, irrigation, and municipal water supply. More than sixty of the Water-Supply Papers deal specifically with streamflow records in the Lower Mississippi River Region, including the state of Oklahoma. The first of the Water-Supply Papers to deal specifically and exclusively with Oklahoma is No. 148, "Geology and Water Resources of Oklahoma," by C. N. Gould, dated 1905. No. 147, published in the same year, entitled "Destructive Floods in the United States in 1904," includes a report by F. S. Dobson and G. B. Monk on a Canadian River flood affecting New Mexico, Oklahoma, and Indian Territory. In No. 345, Parts B and D, published in 1915, are reports of ground water conditions as related to irrigation possibilities near Enid and along the North Canadian River in the vicinity of Oklahoma City.

Later numbers in the Water-Supply Papers series include further studies of the Enid ground water situation (No. 520-B, 1925), a report on ground water for irrigation near Gage in Ellis County (No. 500 - B, 1922), reports on the June, 1921 Arkansas River flood (No. 487, 1922) and the Western Oklahoma floods of May, 1951 (No. 1227-B, 1954). The series has included annual reports on destructive floods in the United States since 1903, on water levels and artesian pressure in observation wells since 1940, on surface water quality since 1948, and on the quality of surface waters for irrigation since 1951. USGS Circular 361, published in 1955, presents a convenient summary of the annual records of the chemical quality of Arkansas River water for the period 1945-1952. Water-Supply Paper 1300, "The Industrial Utility of Public Water Supplies in the United States, 1952, Part 2, States West of the Mississippi River," published in 1954, is the best available summary of this topic. The ground water levels series is now published for individual regions—Oklahoma is in the South-Central Region, along with Texas, Louisiana, and Arkansas—in a five-year compilation, although data are available for local use in the regional USGS offices after the end of each calendar year. Similarly, beginning with 1961, the streamflow records are being published for regions on a five-year basis, but records for individual states are made available for local use after each water year ending September 30.

Before the beginning of some of the special series of publications of the USGS, such as the Bulletins, Circulars, Mineral Resources, Professional Papers, and Water-Supply Papers, the Annual Reports of the Survey incorporated many technical papers. These papers included only a few titles with any relevance to Oklahoma's water supply, but it is perhaps of interest to an audience of geographers to note that they did include a number of irrigation surveys by J. W. Powell, F. H. Newell, and H. M. Wilson (1888-1895), and also W. D. Johnson's classic study of "The High Plains and Their Utilization," published in the Twenty-first and Twenty-second Annual Reports in 1901 and 1902.

The USGS Professional Papers include a few of value in Oklahoma water studies: No. 32, N. H. Darton's "Preliminary Report on the Geology and Underground Water Resources of the Central Great Plains," 1905,

433 pp.; No. 135, F. W. Clarke's study of "The Composition of the River and Lake Waters of the United States," 1924, 199 pp.; two major evaporation studies of a central Oklahoma reservoir, No. 269, "Water-Loss Investigations: Lake Hefner Studies, Technical Report," 158 pp., and No. 270, "Water-Loss Investigations: Lake Hefner Studies, Base Data Report," 300 pp., both published in 1954; and No. 372-A, H. E. Thomas's report on "The Meteorologic Phenomenon of Drought in the Southwest, 1942-56," 1962, 43 pp.

For certain types of water resources research, the student is obviously dependent upon maps published by the USGS, the 1/500,000 base maps, periodically revised; the 1/500,000 geological map of Oklahoma edited by H. D. Miser and published in 1954; the 1/250,000 topographic series available for the entire state, and the numerous quadrangles on larger scales covering large parts of the state. The availability of the base maps and quadrangles is indicated on a frequently revised state index map which is free for the asking from the Geological Survey offices in Washington, D.C., and Denver, or from the Oklahoma Geological Survey office in Norman.

Some of the very recent USGS publications relevant to Oklahoma's water supply are Water-Supply Paper 1652-B, "Floods of April-June, 1957 in Texas and Adjacent States," by I. D. Yost, 32 pp., 1963; Water-Supply Paper 1669-K, "Correlation of Water-Level Fluctuations with Climatic Cycles in the Oklahoma Panhandle," by I. W. Marine, 10 pp., 1963; Professional Paper 372-H, "General Summary of Effects of the Drought in the Southwest," by H. E. Thomas, 22 pp., 1963; Water-Supply Paper 1800, "The Role of Ground Water in the National Water Situation," by C. L. McGuinness, 1121 pp., 1963, reprinted with a revised map in 1964; Water-Supply Paper 1669-S, "Yearly Variations in Runoff for the Coterminous United States, 1931-1960," by M. W. Busby, 49 pp., 1963; Professional Paper 372-B, "General Effects of Drought on Water Resources of the Southwest," by J. S. Gatewood and others, 55 pp., 1964; Water-Supply Paper 1681, "Magnitude and Frequency of Floods in the United States, Part 7, Lower Mississippi River Basin," by J. L. Patterson, 636 pp., 1964; Water-Supply Paper 1786, "Inventory of Published and Unpublished Chemical Analyses of Surface Waters in the Continental United States and Puerto Rico, 1961," by T. H. Woodward and S. G. Heidel, 490 pp., 1964; Water-Supply Paper 1580-D, "Factors Affecting the Occurrence of Floods in the Southwest," by M. A. Benson, 72 pp., 1964; and Hydrologic Investigations Atlas 1964, "Generalized Map Showing Annual Runoff and Productive Aquifers in the Coterminous United States," compiled by C. L. McGuiness at a scale of 1/500,000, 1964. An 8- by 11-inch folder entitled "Water Resources Investigations in Oklahoma," including a large map showing the location of stream gauging stations, observation wells, quality-of-water-sample-collection sites, and areal hydrologic studies, plus a number of other maps, was published in 1963 and is available free on request. Information on the water supply situation of Oklahoma City and Tulsa is included in Water-Supply Paper 1812, "Public Water Supplies of the 100 Largest Cities in the United States, 1962," by C. N. Durfor and Edith Becker, 364 pp., 1964.

The Oklahoma Geological Survey, organized about the beginning of this century, while it has not published as voluminously on Oklahoma water resources as the USGS, nonetheless has many creditable publications on the subject (Oklahoma Geological Survey, 1958 and 1965). Some of these state reports have been developed in cooperation with USGS ground water or surface water specialists stationed in the area. The earliest of the Oklahoma Geological Survey's Bulletin series to deal specifically with water resources is No. 59, "Geology and Ground Water Resources of Texas County, Oklahoma," by Stuart L. Schoff, 148 pp., 1939. Bulletin 64, issued in 1943, was a similarly titled study of Cimarron County.

Bulletins 72 and 73, published in 1955, present detailed ground water reports on Ottawa County, Grady County, and northern Stephens County. Bulletin 86 on southern McCurtain County, 1960; Bulletin 87 on Canadian County ,also 1960; Bulletin 91 on Okmulgee County, 1963; and Bulletin 97 on Beaver County, 1962, complete the list of state Bulletins devoted to water. A study of the "Ground Water Resources of the Barber-Wellington Sandstone," has been completed and will soon be issued, probably as a numbered Bulletin.

The Circular series of the Oklahoma Geological Survey, started in 1908, has included two shorter studies on Oklahoma water resources. Circular 28, 1951, is a report on ground water resources of the Arkansas River flood plain near Fort Gibson in Muskogee County; and Circular 61, 1963, is an evaluation of ground water resources of the Rush Springs Sandstone in the Caddo County area.

Another Oklahoma Geological Survey series entitled Mineral Reports include several additional studies of the state's ground water. Mineral Report No. 11, "Geology of Oklahoma Ground Water Supplies," by Robert H. Dott, 30 pp., 1942, was followed by five others in the Mineral Reports series, all in the 1948-1950 period. No. 18 covers "Ground Water Irrigation in the Duke area, Jackson and Greer Counties;" No. 19, "Ground Water in Kingfisher County;" No. 20, "Ground Water Supplies in the Oklahoma City Area;" No. 21, "Ground Water in the Cherokee Area, Alfalfa County;" and No. 22, "Ground Water in the Pond Creek Basin, Caddo County."

A two-color map of "Ground Water Reservoirs of Oklahoma," compiled by Stuart L. Schoff and published at a scale of 1/750,000, was published with some accompanying text describing ground water conditions in November, 1955. One additional detailed county report, "Geology and Ground Water Resources of Wodward County, Oklahoma," by P. R. Wood and B. L. Stacy, 162 pp., was announced in October, 1964, as completed and ready for inspection at the USGS office in Oklahoma City, although it seems to be still on "open file" and not available for distribution.

It is hoped that this summary report on Oklahoma water resources materials will have some usefulness for individuals planning to engage in academic research on state water problems. It might even be hoped that public agencies planning to spend large amounts of the taxpayer's money on development projects will review carefully the pertinent literature and act in the light of it, while at the same time considering changes in social, economic, and political conditions which affect the feasibility of particular projects.

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