

## WATER IN SOUTHERN ILLINOIS

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The portion of the State of Illinois south of the Baltimore and Ohio Railroad, or south of a line drawn eastward across the State from St. Louis, will be called Southern Illinois in this paper. As a cultural feature this boundary line exerts no influence on Southern Illinois, but as a physical feature, it marks the southern limit of thick glacial drift.

In two-thirds of the state, ground water is tapped for 80% of the public water supplies. In the southern third 75% of the public water supplies are of surface origin. (Fig. 1).

The problem of this paper is two-fold: (A) to analyze the factors responsible for the large number of surface supplies, (B) to understand the problems of rural dwellers and communities dependent on these supplies.

A study of environmental factors is of primary importance.

### 1. The character of the bedrock.—

Most of the bedrock of Southern Illinois (fig. 2) is Pennsylvanian. About four-fifths of this series consists of impervious shale, with alternating seams of coal, dense limestones and sandstones. The thicker sandstone formations occurring in the lower portion of the series contain salt water. Other sandstones yield small supplies of fresh water to shallow wells,

but even here the degree of mineralization is considerable.

The compact Devonian (fig. 2) limestone in Union and Alexander counties are unimportant as aquifers. In the Mississippian series, (fig. 2) limestones with solution cavities and sink holes are the best water bearers. Farm wells in it are only relatively successful, since a sharply defined water channel must be tapped for a supply.

The Tertiary gravels on the southern border of the state are good aquifers.

2. The character of the mantle rock and soil.—Pleistocene glaciation has left its indirect mark in the water laid sand, silt, and gravel on the large floodplains. On the upland, the thickness of the drift varies from thirty feet to ten feet near the southern limit of glaciation. The sand and gravel lenses of the drift contain sufficient water for small consumers. The northeastern quarter however, is underlain by considerable areas of impermeable drift. The loess or loess like material originating from the floodplains of the larger streams decreases in thickness with distance from the source. The proportion of clay, however, seems to increase, resulting in heavier and less porous soils in the eastern than in the western part of the state.



Fig. 1.—Seventy-five per cent of the public water supplies of Southern Illinois are of surface origin. (Drift is used in well-drillers' sense: unconsolidated material.)



Fig. 2.—The Pennsylvanian, consisting of impervious shale, seams of coal, and dense limestones and sandstones, dominates Southern Illinois.

The upland soils, derived from these parent materials are modified Gray Brown Podzolic soils without normal profiles. Characterized by claypan, they are acidic, low in organic matter and in all elements of plant food. Thus, their water absorbing capacity is low, yet their water holding capacity for surface supplies is great.

3. **The relief and drainage.**—The greater relief of Southern Illinois is evident on the map of the State showing major contours. The unglaciated Ozark ridge, classified as rough plain, is at an average altitude of 600-700 feet and above the adjacent area by 200-300 feet. The glaciated zone, only thinly mantled with drift, shows preglacial lines only slightly changed. In contrast to the rest of the State in which glaciation was relatively recent, the normal cycle of erosion has advanced farther.

Bounded by the Wabash, Ohio and Mississippi systems; the Kaskaskia, Big Muddy, Little Wabash, Embarrass, Saline and Cache are well developed systems within the State. Distinctly flat interfluvies are limited, and runoff and seepage to the drainage channels is rapid, limiting ground water storage but facilitating surface collection in the dammed valleys of small streams and creeks.

4. **The character and distribution of precipitation.**—Located in the transition zone between the humid continental and humid subtropical climates, Southern Illinois has a slight tendency toward a spring and early summer maximum of precipitation. The average precipitation of 42.38 inches (50 year period) is well distributed with 3½ inches or more recorded for each of seven months. Two months have over four inches and only one month less than three inches. Averages, however can be very misleading; this past year the average was about 32 inches, and the distribution unsatisfactory from the standpoint of surface water supply.

The rainfall is largely of thunderstorm origin. Thus variability from season to season is pronounced and within a short distance there is a wide range. The runoff resulting from the summer downpours is rapid, much of it is evaporated or used by vegetation, and only the cyclonic storms of winter bring the maximum opportunity for the replenishment of ground water resources.

5. **Cultural factors affecting ground water.**—In the coal mining district, water which enters the mines must be pumped out to facilitate mining operations. This under-pumping lowers the water table.

Clean cultivation, the removal of forest and sod, and the drainage of wet lands hasten runoff. Again, subsequent recharge of ground waters is restricted. Thus the environmental factors of rough plains, impermeable soil, well developed drainage systems, and character and distribution of rainfall which are hampering ground water storage, favor man in surface water storage.

Three traverses were made to sample water supplies of rural areas.

*The floodplains.*—The Mississippi floodplain in the vicinity of Fountain Bluff demonstrates the ease with which ground water is obtained. A pipe with a screened point is driven down from 20-50 feet. A pump is attached to the upper end of the pipe. This locally is not a "well", but a "pump".

In Gorham, most water is hard. It has to be "broken" for washing and drinking. Cistern facilities seem to be limited to the wealthier class, for there are but ten cisterns in a population of 600. The Missouri Pacific Railroad has a ten-inch well bored to a 90-foot depth. The water must be treated with lime and soda-ash for locomotive use.

Sand Ridge, nearer the Big Muddy than the Mississippi, taps soft water at about 33 feet. Fortunately, for the sand precludes the construction of cisterns, this water is adaptable to all household uses.

The ease with which water is obtained is duplicated on the Wabash, Ohio, and the larger tributary floodplains of Southern Illinois.

*The Uplands.*—The upland traverses were in two genetically different regions. The unglaciated Ozark ridge of considerable local relief contrasts markedly with the flat interfluvium of impermeable drift overlain by thin loess or loess-like material.

In the seven mile traverse of the Ozark Ridge on U. S. 51 between Cobden and Carbondale on 31 farms there are only 8 wells, dug to 35-40 foot depth. The yield is undependable, the water hard.

Cisterns are used almost exclusively for household and stock purposes, supplemented by ponds for stock and spray

mixtures. The ponds are in part dammed up draws, in part excavations of five or six-foot depth located strategically to catch runoff. With normal rainfall many ponds last through the summer, while in years of rainfall deficiency as 1935 and 1939, wells, cisterns and ponds were dry and water was purchased from Carbondale. On a number of farms additional water could have been collected in cisterns but either man takes a chance or the cost of putting in an emergency cistern is too great. Assuming that this sample is typical, one concludes that the unglaciated Ozark Ridge depends on surface water supplies almost exclusively.

The ten mile upland traverse southward from Pyramid (Junction Illinois 15 on U. S. 51) lies on the interfluvial between tributaries of the Big Muddy and the Kaskaskia system. The data are from a smaller number of cases (18), as the farms are of the general farming type in contrast with the fruit farms of the Ozark Ridge. The dependability of the wells fluctuates with precipitation. During a period of cumulative rainfall deficiency in 1934 and 1935, some of these wells went dry. A few farmers bored two-inch holes from 5-18 feet into the bedrock to tap lower aquifers, but their water has not been as palatable since that time. Since the hardness of the water varies, cisterns are supplemental for general household use or laundrying. Noteworthy exceptions were the two rural schools which had cisterns only. As wells and cisterns on one-half the farms were of the "old oaken bucket" type, stock ponds were considered essential labor saving devices.

The uplands wells thus far discussed have been relatively shallow. Their yield, however, suffices the village household or average farm demand. Stock or dairy farmers have of necessity sunk their wells to one of the water bearing rock strata which assures them of a permanent supply. Thus one may conclude that the relatively shallow upland wells vary with topography and soils, and on the basis of these traverses the Ozark Ridge is poor in ground water and the northeastern quarter underlain by impermeable drift depends on wells supplemented by surface waters.

*Municipal Water Supplies.*—In the northern third of the State, wells of varying depth tap the copious sandstone

aquifers. In the Central and Northern thirds drift wells also yield abundant water of good quality. Good and abundant water is available at low cost to municipalities. At Champaign-Urbana, the minimum domestic rate is \$1.67 per quarter for 4500 gallons or 36c per 1000 gal. per quarter. In the Southern third of the State there is neither adequate glacial drift nor bed rock to yield good water in large quantities (the drift wells on map use "drift" in well-drillers sense as unconsolidated material.)

The Coal Measures (fig. 2) which are meager in ground water have in places sufficient supplies for towns of 900-1200 population (as New Baden, Steeleville, Trenton, Red Bud, etc.) Cities over 7,000 however, such as Marion, Williamson County, and Carbondale, Jackson County, had wells at depths varying from 400-960 feet. The water contained considerable mineral matter of which sodium chloride was the most objectionable, and since the maximum pumpage was not enough to furnish the domestic users with an adequate supply, surface supplies were provided.

The karst limestones furnish water to several towns, the largest Anna (3500). During the 1934 drought the Anna city wells supplied the domestic needs of the town, the State Hospital for the Insane (2210-2400 population) and the industrial needs of the Illinois Central Railroad. The total capacity of all wells was needed for this emergency. Whether the wells could supply this amount indefinitely is not known. Residential consumers pay 62.5c per 1000 gallons per quarter. (These rates includes the new filtering plant costs installed 1937.)

As indicated in fig. 1 surface waters from rivers, and impounding reservoirs supply 63 communities. (The map omits municipalities who buy treated water from neighboring communities, [East St. Louis alone serves 11 municipalities] nor is any attempt made to show the distribution of railway, mine or industrial reservoirs).

The Mississippi, Ohio, Wabash, Kaskaskia, Big Muddy and some of their tributaries provide municipal supplies. But neither the cost of developing a source nor the provision of an adequate supply in drought years is a pressing problem.

Communities without an adequate supply from streams must impound water.

Their problems include: selection of a reservoir site, buying land for the reservoir, constructing a dam, and in common with river supplies there is the cost of laying supply pipes, and erecting a filter plant. It is self-evident that the financial obligations of such an undertaking are considerable, not to mention the continuous cost of treating water. Usually little more than the actual reservoir site is owned by the water company. Since

City A	Drainage basin	2560	A,	Storage	392 million gallons,	Lake surface when
					full	145 A.
City B	Drainage basin	2816	A,	Storage	225 million gallons,	Lake surface when
					full	85 A.
City C	Drainage basin	5862	A,	Storage	760 million gallons,	Lake surface when
					full	128 A.

City A seems to be at a disadvantage in reservoir surface as regards evaporation, and shallowness may cause the water to be excessively warm in summer.

Domestic water rates vary. Some municipalities which tap the almost unlimited river resources pay as little as 33 1/3c per 1000 gallons quarterly, most other surface water users have much higher rates, varying from 33 1/3c to \$1.16 + per 1000 gallons per month. This high cost of water, in part a result of the large investment necessary for impounding reservoirs, practically bars water systems in communities of less than 2000. Under W.P.A. aid one system was installed in a town of 1,100, but a previously existing lake was utilized, thus not charged against the cost of the system. A unified water plan would do much to reduce water costs for municipalities, mines and industries.

So far we have assumed an unailing

there is no control over the use of the watershed cultivation may at times cause the "solids" content of water to be high and sedimentation of reservoirs necessitates some dredging. Relatively small watersheds may furnish an abundance of water provided adequate storage is possible. Reservoir surface must be in proportion to storage capacity to reduce evaporation. Data for the following cities illustrates the point.

supply of water. However, variability in annual and seasonal precipitation causes much concern to the Southern part of the state. Cumulative rainfall deficiency the past year caused the cyclonic drizzles of winter to be absorbed by the parched ground. The early spring rains, the most important source of reservoir replenishment, have been below normal in amount. Although several million gallons of runoff were added to reservoirs in early April the cumulative precipitation deficiency January 1 to April 30 is 5.11 inches (Carbondale data).

The dependence of surface water supplies on rainfall, especially on rainfall that furnishes runoff is clear. Of course, an actual shortage of water need never occur if sufficient storage is available, however the cost of providing that additional storage is, at present, too high for most communities.