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(This is a PRELIMINARY DRAFT of one part of a study on the resources and potentialities of Southern Illinois. It is being distributed in its present form on a confidential basis solely for technical review and criticism. Suggestions and criticisms may be sent to Norm Bittermann, 205 David Kinley Hall, University of Illinois, Urbana.)

WATER RESOURCES OF SOUTHERN ILLINOIS [1]

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and

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Water for domestic or industrial use comes from wells or surface sources. Southern Illinois residents are familiar with surface reservoirs, as several communities in "Egypt" rely upon artificial lakes for their water supply. Since some Southern Illinois towns use well waters, it may be advisable to explain a few ground water terms. The first word to be defined is "aquifer." This is (1) a water-bearing layer of porous or creviced rock; or (2) loose material which is often referred to as (glacial) drift. It may be artesian, that is, water in a well may rise above the top of the layer or even flow at the ground surface. An aquifer may have great areal extent or it may be confined to a lenticular or lens-shaped area. Along river bottoms, alluvial sands and gravels may be good aquifers. All these types of water-bearing formations are found in Southern Illinois, but the chemical quality of the water often limits its use. Except along the river bottoms, the ground water in Southern Illinois is generally of high mineral content and therefore is not well suited for most industrial purposes. The quality of surface supplies is generally satisfactory for industrial purposes. Water temperature is also important. Many of the good surface waters may be undesirable and on occasion valueless for some manufacturing plants when the temperatures rise above 60° F.

In this brief review of water resources of Southern Illinois, only a very general picture is presented. There is a great fund of more precise information available to persons interested in a specific area. The State Water Survey is equipped to furnish these pertinent data on request.

Sixty, or approximately one-half, of the 121 incorporated municipalities in the 16 southern counties of Illinois are served by public water supply systems. According to 1940 Census data, a total population of 183,025 have access to public water supply. This is 47 per cent of the total population of the area and 82 per cent of the people living in incorporated municipalities. Only 25 municipalities with 1940 populations of over 500 do not have access to a public water supply. Grand Tower and Tilden are the only towns with populations of over 1,000 which are not so served. There are 39 municipalities with populations of less than 500. None of these have water supplies except Beulah Heights, Colp, and Energy, which have distribution systems and purchase water from neighboring communities.

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[1] General statement and data on water supplies prepared by C. O. Reinhardt, formerly Engineer, State Water Survey.

Data on geology supplied by Robert R. Storm, Associate Geologist, State Geological Survey.

TABLE I.

MUNICIPAL WATER SUPPLIES IN SOUTHERN ILLINOIS

Municipality	**Population 1940	*Plant Ownership	Treatment *Kind	Capacities M.G.D.	*Pumpage Ave. Daily 1000 Gal.
Alexander County	25,496				
Cairo	14,407	Pr.	PC	3	2,500
Thebes	730	M	PC	0.72	26
Franklin County	53,137				
W. Frankfort	12,383	M	PC	2.0	930
Benton	7,372	M	PC	1.0	400
Christopher	3,833	M	PC	0.78	300
Zeigler	3,006	M	PC	0.5	100
Sesser	2,117	M	PC	0.5	75
Royalton	1,772	Pr.	PC	0.5	200
West City	1,017	M			
Orient	942	M	None		105
Valier	930	M			
Gallatin County	11,414				
Shawneetown	1,963	M	IC	0.22	30
Ridgway	1,167	M	SI	0.07	7
Equality	971				
New Haven	695				
Omaha	413				
Junction	320				
Hamilton County	13,454				
McLeansboro	2,528	M	PC	0.4	100

Municipality	**Population 1940	*Plant Ownership	Treatment *Kind	Treatment Capacities M.G.D.	*Pumpage Ave. Daily 1000 Gal.
Hardin County	7,759				
Rosiclare	1,774	M	PC	0.4	75
Elizabethtown	622	M			
Jackson County	37,920				
Murphysboro	8,976	Pr.	PC	2.0	300
Carbondale	8,550	M	PC	1.5	700
Elkville	951	M	PC	0.14	60?
Ava	821	M	SI	0.12	14
Johnson County	10,727				
Vienna	1,173	M	PC	0.32	15
Massac County	14,937				
Metropolis	6,287	M	None		700
Brookport	1,247	M	None		170
Perry County	23,438				
Du Quoin	7,515	M	PC	1.0	250
Pickneyville	3,146	M	PC	1.0	350
Willisville	781	M	C		35
Cutler	590	M	None		3
Pope County	7,999				
Golconda	1,301	M	PC	0.17	30

Municipality	**Population 1940	*Plant Ownership	Treatment *Kind	Treatment Capacities M.G.D.	*Pumpage Ave. Daily 1000 Gal.
Pulaski County	15,875				
Mound City	2,465	Pr.	C		175
Mounds	2,144	M	None		150
Olmsted	592	M	None		1
Randolph County	33,608				
Chester	5,110	M	PC	0.6	150
Sparta	3,664	M	PSC	0.83	150
Red Bud	1,302	M	None		30
Coulterville	1,284	M	PC	0.14	35
Steeleville	1,212	M	None		30
Percy	958	M	None		18
Evansville	693	M	PC	0.13	10
Prairie du Rocher	576	M	IS	0.07	10
Saline County	38,066				
Harrisburg	11,435	M	PC	0.9	500
Eldorado	4,891	Pr.	PC	0.32	175
Carrier Mills	2,360	M	PC	0.14	20
Galatia	986	M	PC	0.14	10
Beulah Heights	462	Pr.			
Union County	21,528				
Anna	4,092	M	SIC	0.86	300
Jonesboro	1,521	M	SIC	0.21	50
Cobden	1,098	M	SI	0.15	19
Dongola	638	M	None		19

Municipality	**Population 1940	*Plant Ownership	Treatment *Kind	Treatment Capacities M.G.D.	*Pumpage Ave. Daily 1000 Gal.
White County	20,027				
Carmi	4,098	M	PC	0.73	150
Grayville	2,240	M	None		61
Norris City	1,295	M	PC	0.11	20
Crossville	666	M	IS	0.07	17
Williamson County	51,424				
Herrin	9,352	M	PC	2.0	400
Marion	9,251	M	PC	1.16	390
Johnston City	5,418	M	PC	1.0	300
Carterville	2,893	M	PC	1.0	90
Hurst	1,012	M			
Bush	617	M			
Energy	458	M			
Colp	323	M			

** 16th Census of the United States, 1940
* From data on Illinois Public Water Supplies, June 1, 1944.

Legend:
(M) Municipal
(Pr) Private
(P) Purification
(C) Chlorination
(I) Iron removal
(S) Softening
(M.G.D) Million Gallons per Day

The total population of the 25 municipalities with population over 500 not served with a public water supply is 18,472. There are 10,013 people residing in municipalities with a population of less than 500 not served with water. All incorporated municipalities and data on existing water supply systems are presented by counties in Table I. Only five of the water supplies are owned by private capital. They are located at Cairo, Murphysboro, Eldorado, Royalton, and Mound City.

The nine municipalities in the area with populations in excess of 7,000 have surface water supplies. Except for Anna and Metropolis, which have respectively rock and drift wells, the 21 communities with populations in excess of 2,500 have surface water supplies. Cairo, Rosiclare, and Golconda take water from the Ohio River; Thebes and Chester take water from the Mississippi River; Zeigler, Royalton, and Murphysboro take water from the Big Muddy River; Carmi takes water from the Little Wabash River; and Evansville takes water from the Kaskaskia River. The remaining 21 sources of supply are impounding dams or channel dams on minor streams in the area. West Frankfort, Christopher, Sparta, Marion, and Herrin have two reservoirs each. In all, 39 municipalities with a total population of 149,723 are supplied with surface water. Benton supplies West City, Eldorado supplies Beulah Heights, Royalton supplies Hurst and Bush, Herrin supplies Energy and Colp, Sesser supplies Valier, and Rosiclare supplies Elizabethtown. Sparta softens its water and is the only town which provides any treatment othern than filters and chlorination for the surface water used.

There are 14 municipalities, with a total population of 19,156, which obtain water from rock wells. Except for Anna with a population of 4,092, all the towns have populations of less than 2,500 each. Water from eight of these supplies receives no treatment, two supplies have chlorination, two supplies have iron removal, softening, and chlorination.

Only seven towns, with a total population of 14,146 obtain water from drift wells. Metropolis, with a population of 6,287, is the only community with a population of over 2,500. Three towns have iron removal and softening plants, one town has iron removal and chlorination facilities, and three towns have no treatment.

The distribution of public water supplies is shown in Figure I.

Except for power plants at Grand Tower and Harrisburg owned by the Central Illinois Public Service Company there are no industries located in the area which use large quanitities of water. The Mississippi River is used as a source for condensing water at Grand Tower, and a small reservoir is used at Harrisburg. However, 44 small reservoirs have been constructed by mines and railroads. Data are presented in Table II showing the distribution of natural lakes, reservoirs, potential reservoir sites, and accessibility of the major streams in the area. There are 14 reservoirs now used primarily for recreational purposes. Some are abandoned mine reservoirs which have been converted by various clubs.

Figure 2 shows existing lakes and reservoirs in the area.

In the 16 Southern Counties little water for industrial processing is now obtained from ground water sources, because the amount of water available is generally insufficient and/or the chemical quality of the water generally makes it undesirable for specific industrial needs.

On the map (Figure 3) six ground water provinces have been delineated. Following is a tabulated discussion of the aquifers present in each of the provinces: [2]

TABLE II

DATA ON SURFACE WATER RESOURCES
of
16 Southern Counties of Illinois
December 1945

County	Major Streams[a]	NATURAL LAKES (3 Acres or Larger) No.	NATURAL LAKES (3 Acres or Larger) Area in Acres	ARTIFICIAL RESERVOIRS No.	ARTIFICIAL RESERVOIRS Surface Area When Full (Acres)	ARTIFICIAL RESERVOIRS Storage When Full (Million Gal.)	ARTIFICIAL RESERVOIRS Use: Public	Use: Industrial	Use: Recreation	POSSIBLE RESERVOIR SITES[b] (Pool Area Not Less than 20 Acres) No.	Pool Area (Acres)	Storage (Acre-Feet)
Alexander	I.H.C.	4	1,285	3[c]	3	4				2	1,220	27,830
Franklin	D.A.	2	155	25	1,287	2,457	7	17	1	4	2,810	21,500
Gallatin	H.G.E.B.	13	430							6	3,600	54,690
Hamilton	B.			1	15	30	1			4	2,400	24,000
Hardin	H.B.			4	8	29		4		4	3,780	73,360
Jackson	D.A.	3	155	4	247	520	2		2	9	4,900	97,480
Johnson	C.			5	36	74	1	4		10	8,330	88,440
Massac	H.C.	4	245	1	9	8		1		2	1,800	22,400
Perry	A			10	1,261	786	2	5	3	6	6,400	65,600
Pope	H.	1	50	1	88	246			1	8	13,230	293,100
Pulaski	H.C.	1	6							None		
Randolph	I.F.			5	198	317	3	2		10	9,790	123,900
Saline	B	2	145	11	362	933	4	7		12	9,750	200,000
Union	I.D.	2	123	1	10	25	1			20	12,680	247,000
White	G.E.	1	85	2	66	88	1		1	3	1,600	15,000
Williamson	D.			16	9,263	42,911	6	4	6	14	5,830	79,890
Total		33	2,679	89	12,853	48,428	28	44	14	114	88,120	1,434,190

(a) Major Streams:
Water available from:
(A) Little Muddy River
(B) North Fork Saline River
(C) Cache River
(D) Big Muddy River
(E) Little Wabash River
(F) Kaskaskia River
(G) Wabash River
(H) Ohio River
(I) Mississippi River

(b) From State Water Survey Bulletin No. 31.
(c) 3 Farm Ponds

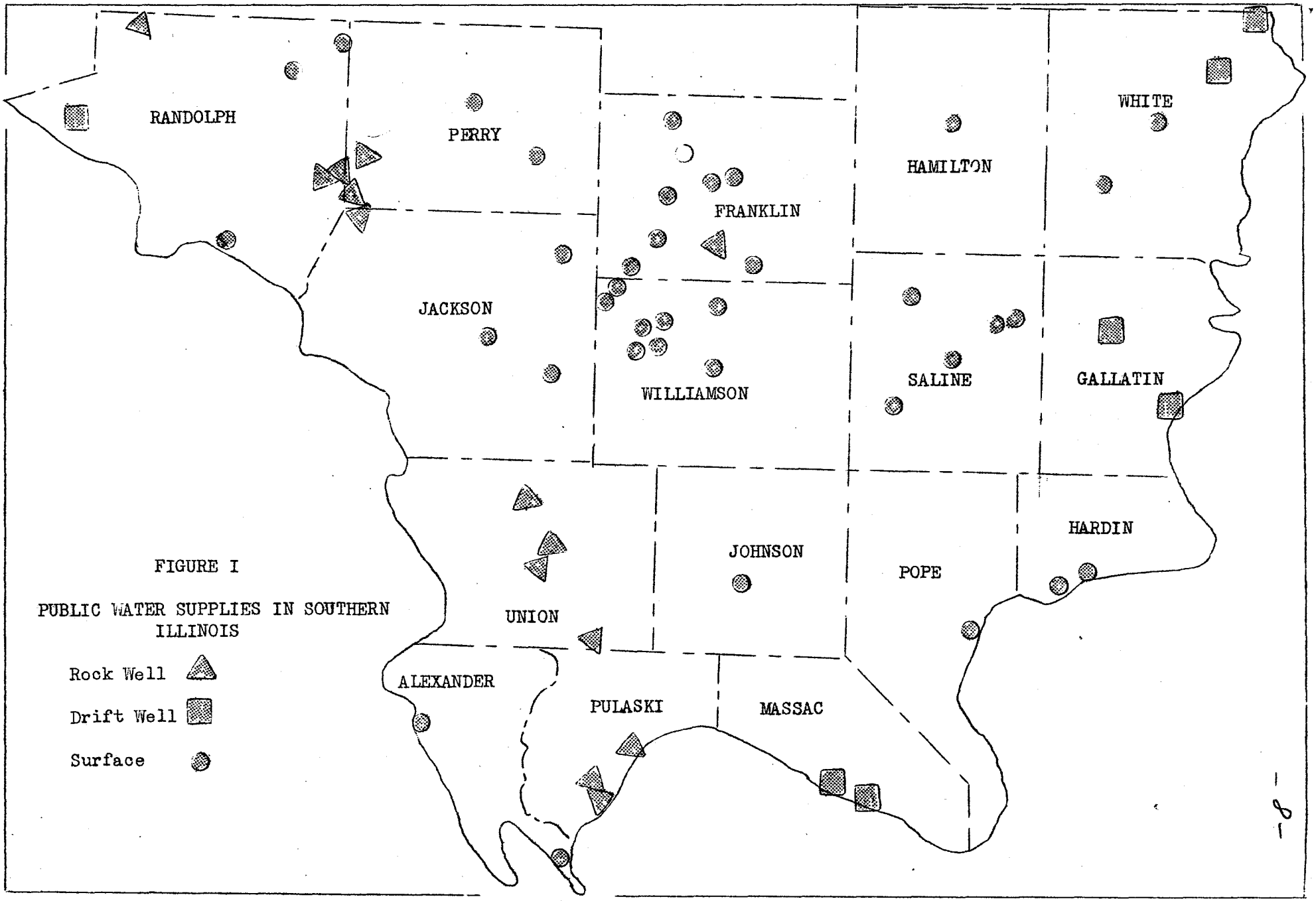
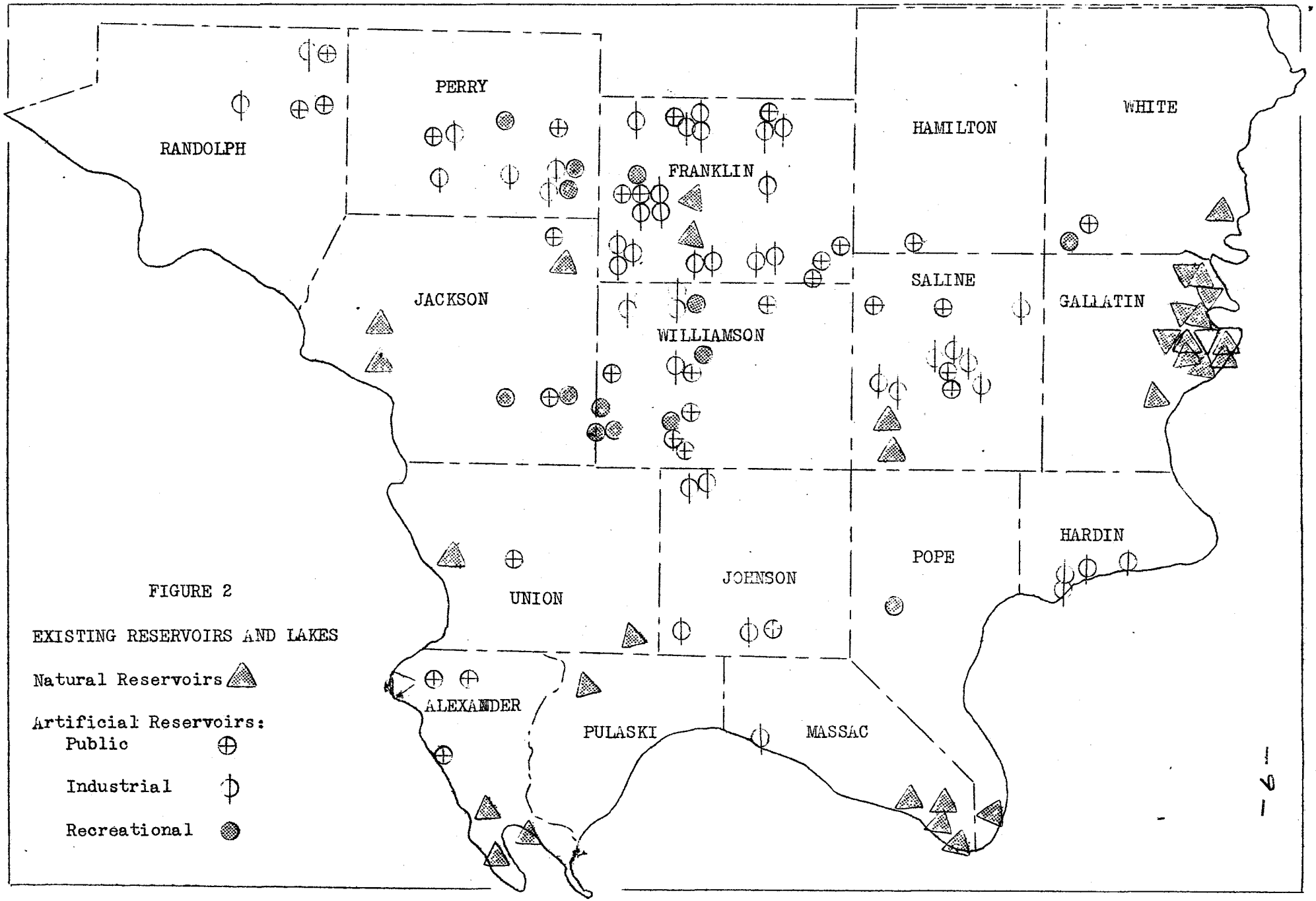


FIGURE I

PUBLIC WATER SUPPLIES IN SOUTHERN ILLINOIS


PERRY
RANDOLPH
FRANKLIN
HAMILTON
WHITE
JACKSON
SALINE
GALLATIN
WILLIAMSON
UNION
JOHNSON
POPE
HARDIN
ALEXANDER
PULASKI
MASSAC
FIGURE 2
EXISTING RESERVOIRS AND LAKES
Natural Reservoirs
Artificial Reservoirs:
Public
Industrial
Recreational

1. River Alluvium and Outwash Sands and Gravels. These areas are determined primarily by the course of the major streams in the area and will be treated in the following units.

a. Mississippi River Valley: Alluvial and glacial drift sands and gravels compose most of the fill of the Mississippi River Valley. They aggregate about 100 feet in thickness, on the average, and are known to be porous and permeable. Locally, the texture and permeability vaires widely, as does the silt content, necessitating test drilling to find the most favorable sites for well development. In general these deposits are worthy of testing at virtually all locations in the valley.

b. The Cache Valley: This area is underlain by thick deposits, averaging close to 100 feet, of water-bearing alluvial and glacial sands and gravels filling the old pre-glacial channel of the Ohio River. The deposits are widespread in the area where the Cache Valley joins the Mississippi Valley in the SW corner of the State. Tests of the materials in the valley near Perks indicate that much of the material is coarse sand and gravel of very high permeability.

c. The Wabash-Little Wabash-Saline system: These river valleys are underlain by thick deposits of sand and gravel, reaching a maximum thickness of over 200 feet in the area around Inman. The deposits become progressively thinner upstream in all cases. Many of the upstream deposits contain a relatively high percentage of backwater silt and consequently have a lower permeability. These deposits are worthy of testing throughout the area indicated on the map.

d. The Big Muddy system: Except for narrow bands adjacent to the stream in the system, these deposits are generally thin and usually contain a relatively high silt content which reduces the permeability. This is probably the least favorable of the sand and gravel areas indicated on the map.

e. The Kaskaskia River Valley: This valley is narrow in the area under consideration but is known to contain water-bearing sands and gravels worthy of testing.

f. Deposits of alluvium are present in the smaller stream valleys throughout the whole area under consideration, and locally they are sufficiently thick to serve as a source of ground water.

2. Pennsylvanian Bedrock Area. The largest area of the map is underlain by the shales and thin limestones and sandstones of the Pennsylvanian (Coal Measures) system. Some of the sandstones in the upper 200-250 feet of the bedrock may locally have sufficient permeability to be water-bearing, but the permeability is always very limited. The aquifers are always ~~thick~~ thin and lenticular and vary greatly in texture. Consideration must be given to the quality of any water obtained from Pennsylvanian sandstones. This area is the least favorable of all of those indicated for the development of ground water supplies.

3. Mississippian (Chester Series) Area. The Chester sandstones are thicker than those of the Pennsylvanian and are normally more permeable. The opportunities for recharge of these sandstones are also better than for those of the Pennsylvanian so that quantities are generally much greater. Again the problem of water quality is important and must be considered before water supply development is undertaken.

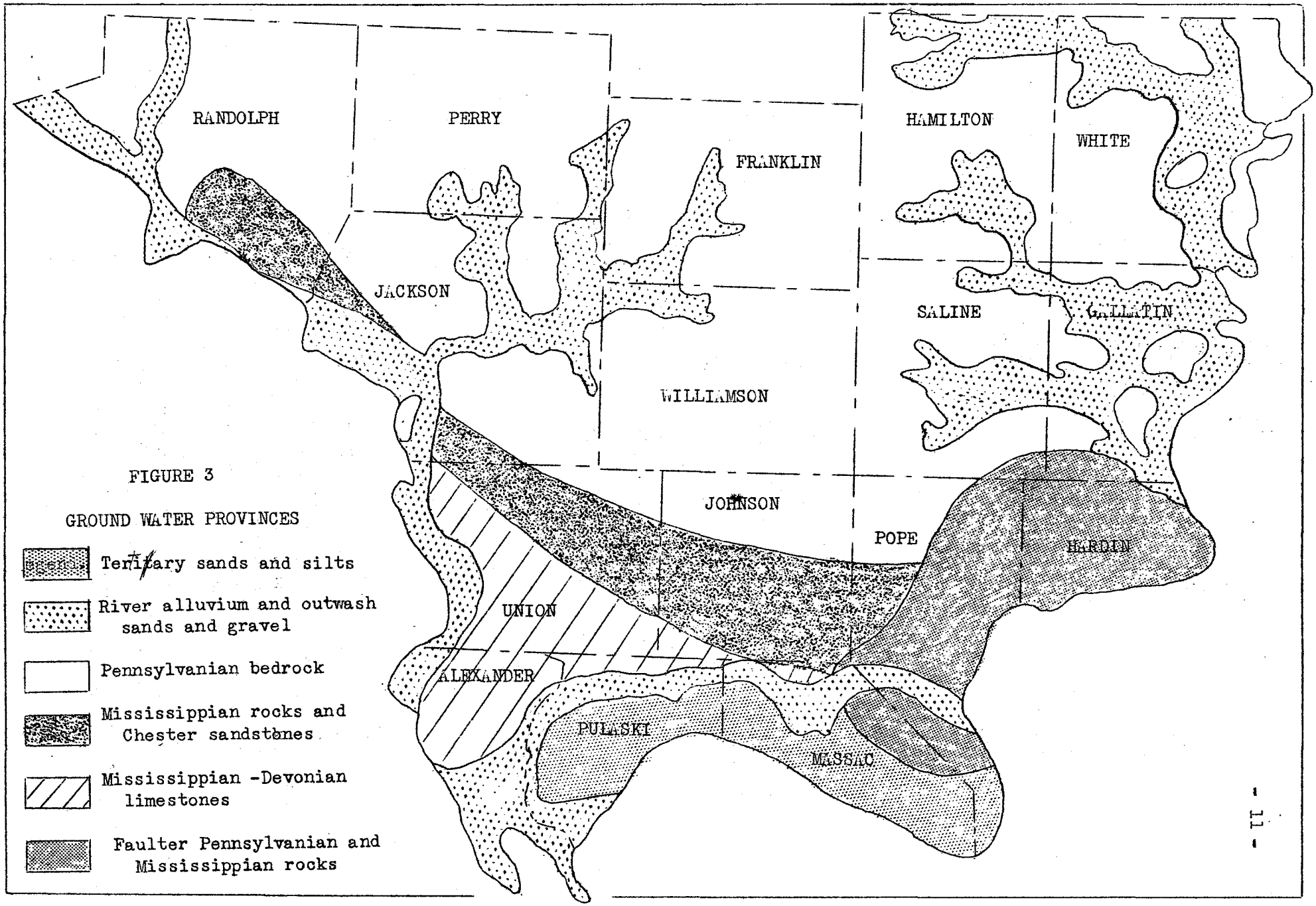


FIGURE 3

GROUND WATER PROVINCES

4. Mississippian-Devonian Limestone Area. These limestones are water-bearing only when they have become crevioed by fracturing or solution, and the distribution of such crevice systems is very erratic. Where good crevicing is present, these rocks are good aquifers. The presence or absence of crevices at any given site cannot be predicted. In general, crevice systems are well-developed throughout most of the area.

5. Faulted Pennsylvanian-Mississippian Area. The extensive faulting in this area allows fresh water recharge of aquifers to much greater depths than in any of the other areas. However, the conditions of recharge, texture, composition, and permeability vary so widely in the area that local conditions are very erratic and cannot be predicted without testing data from drill holes.

6. Tertiary Sand and Silt Area. These deposits become progressively thicker from N to S. In general they contain a number of water-bearing zones, but the high silt and clay content of most of the deposits limit the effective permeabilities of the aquifers. These Tertiary beds rest upon the Mississippian limestones and/or the Devonian limestones which have been described above. In general the recharge opportunities for the crevice zones in those limestones are not as good as in the areas where they form the bedrock.

Ground water of variable quality is available in varying quantities in each of the 16 counties. The greater portion of Pulaski and Massac counties can produce quantities of ground water of acceptable quality. No important ground water supplies have been developed in Hamilton County; very small quantities are obtained from shallow dug wells. The other 13 counties have limited ground water supplies.

Water from sand and gravel in the alluvium deposits along the Mississippi, Ohio, Wabash, and Cache rivers are of moderate mineral content with hardness varying from 150 to 250 parts per million. An appreciable amount of iron is found to be present in most cases.

The quality of water from rock wells depends largely on the local conditions and the depth from which the water is obtained. Excepting for restricted areas waters from the bedrock are found to be highly mineralized and corrosive.

All 16 counties have large quantities of surface water available within, and adjacent to their borders. The Mississippi, Ohio, and Wabash rivers, which constitute the boundaries on three sides of the area, are well known for their size; and all the numerous streams flowing in or through the area have their outfalls within the boundaries of the area. These streams are a potential source of large quantities of water.

Suitable reservoir sites (Figure 4) are available in all counties except Pulaski. Since much of the topography is relatively rugged, the total runoff is large and impounding reservoirs can usually be filled quite rapidly. The 45-year average of 21 weather stations in the region shows that the 16-county area may expect 43.02 inches of rainfall each year.

The quality of surface water varies considerably with the seasons, depending largely on rainfall. Monthly composites of daily samples collected in 1906 and 1907 showed the following salient characteristics for respresentative streams in this section of the State. (Table III). Subsequent spot tests have shown these characteristics to be similar at this time.

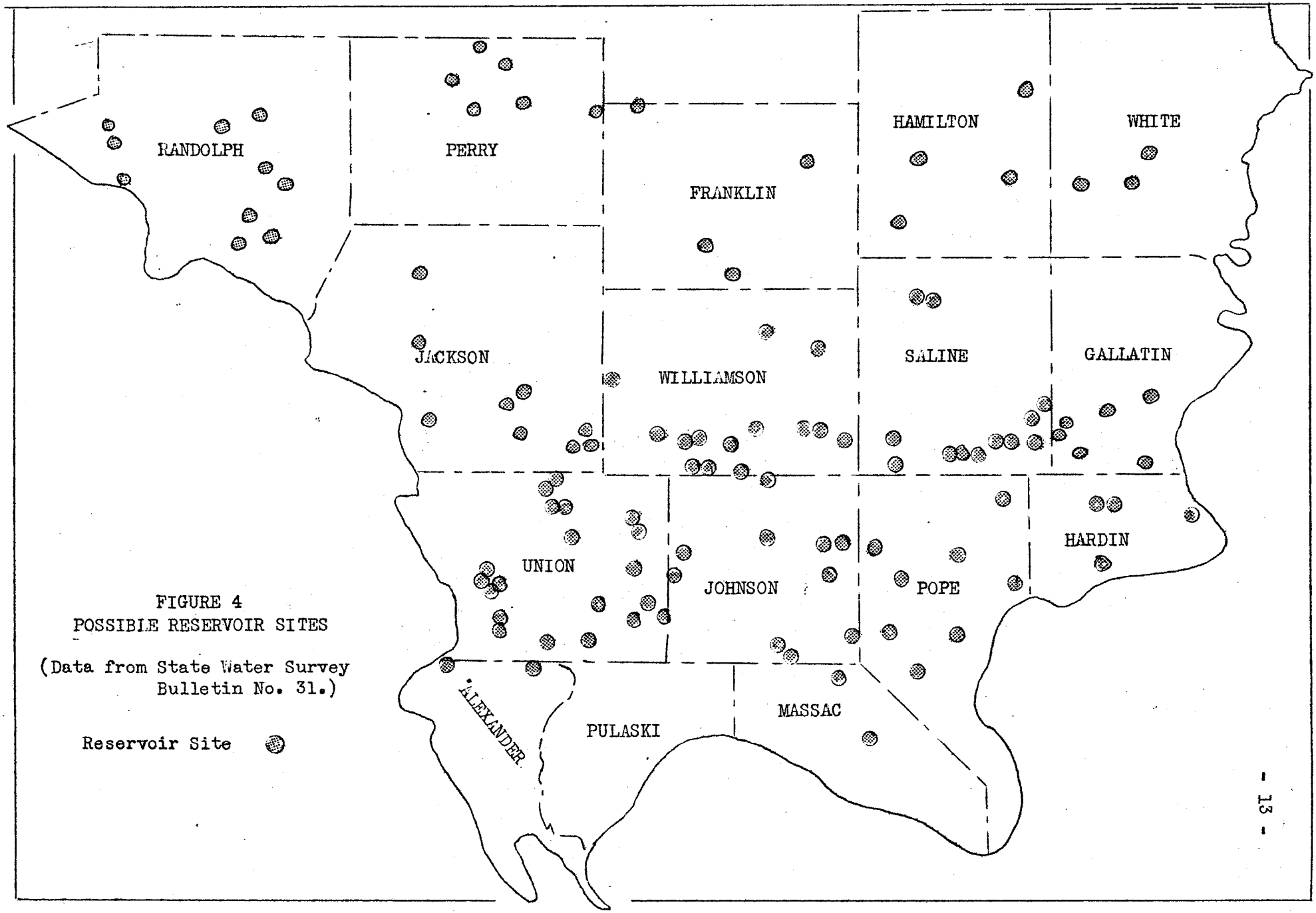


FIGURE 4
POSSIBLE RESERVOIR SITES

(Data from State Water Survey
Bulletin No. 31.)

Reservoir Site

TABLE III

MONTHLY COMPOSITES OF DAILY WATER SAMPLES IN SOUTHERN ILLINOIS

Basin	Location	Turbidity p.p.m.* max.	min.	avg.	Iron p.p.m.* max.	min.	avg.	Alkalinity p.p.m.* max.	min.	avg.	Hardness p.p.m.* max.	min.	avg.	Total Solids p.p.m.* max.	min.	avg.
(Basins)																
Crab Orchard (C.& E. I. R. R. Reservoir)	Marion	315	10	97	3.6	.05	0.9	70	14	42	105	25	70	185	121	140
Cache (C.& E. I. R. R. Reservoir)	Cypress	620	30	155	16	.06	3.7	100	26	55	115	20	75	241	89	165
Ohio (C.& E. I. R. R. Reservoir)	Joppa	300	40	116	9.9	.15	3.5	63	18	35	60	20	42	163	72	111
(Streams)																
Muddy River	Murphysboro	730	35	245	5.3	.15	2.1	126	25	59	225	42	115	424	115	225
Little Wabash	Carmi	430	20	135	9.9	.20	2.0	140	42	72	158	45	100	240	111	176
Cache	Mounds	340	20	134	7.4	.17	2.5	174	34	70	130	25	75	284	92	149
Mississippi River	Chester	2300	181	858	1.3	.04	0.4	193	96	141	215	135	175	320	214	269

*(p.p.m.) parts per million

Proper chemical treatment for purification, turbidity removel, and possibly softening would improve the quality of these waters.

Except for certain restricted and limited areas in the alluvial plain along the Mississippi, Ohio, Wabash, and Cache rivers no major ground water supplies can be developed. The potential water supplies from the major streams are largely undeveloped. These streams are capable of supplying large quanitities of water, but any water is subject to wide variations of temperature, turbidity, and mineral characteristics. Water from the Ohio River at Cairo is generally 3° F. cooler in the summer and 3° F. warmer in the winter than water from the Mississippi River at East St. Louis.

Additional dependable water supplies may be obtained throughout the area, except in Pulaski County, by construction of reservoirs. Reservoir sites are fairly numerous and well distributed throughout the area as indicated in Table II. The cost of construction of reservoirs will probably limit the development of this potential water reserve for industrial expansion unless it is subsidized. Water from reservoirs in this area would be subject to wide variations in temperature.

Summary

1. Compared with other fully developed sections of the United States, Southern Illinois has a good water resource potential.

2. The water resources in many areas of Southern Illinois are completely undeveloped.

3. Development of these resources will necessitate an evaluation of the particular needs and the available resources at each location.