REPORT OF INVESTIGATION NO. 11 1951

STATE OF ILLINOIS

ADLAI E. STEVENSON, *Governor*

IRRIGATION IN ILLINOIS

W. J. ROBERTS

DEPARTMENT OF REGISTRATION AND EDUCATION

C. HOBART ENGLE, *Director*

STATE WATER SURVEY DIVISION

A. M. BUSWELL, *Chief*

URBANA, ILLINOIS

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SUMMARY

During the 1950 and 1951 growing seasons a survey was made to determine the extent of irrigation practiced in Illinois and the relation of irrigation water demands to existing municipal and industrial water needs.

Field inspection located 164 places where irrigation water is pumped. Further information indicated that there are approximately 40 additional irrigation systems in operation at various times throughout the state. The 164 systems have a total pumping capacity of over 25, 000 gallons per minute. Forty-five percent of the pumpage is from groundwater sources and fifty-five percent from rivers, ditches, lakes and ponds.

The area of the state receiving irrigation is estimated at 9000 acres devoted to five principal crops: truck, flowers, pasture, forestry and corn. This represents an investment of over $500, 000 in irrigation equipment. Forty-five percent of this acreage is located in eastern Cook and eastern Kankakee Counties and is devoted to truck and gladioli crops. Nearly all the systems are composed of sprinklers and aluminum pipe. Users are experimenting with sprinkler discharge for specific crops and better ways of moving pipe. The number of irrigation systems in the state is steadily increasing.

This report has not included data on design or agricultural aspects of irrigation since these are already covered in the literature. A few articles on these subjects are listed under References.

ACKNOWLEDGEMENT

Material for this report has been obtained by field investigations and through the cooperation of the following representatives of irrigation equipment manufacturers: John Effa, Chicago; John Te rpstra, Munster, Indiana; and E. G. Young, Woodstock. Two agricultural engineering students working in this field at the University of Illinois, George Vriend and Arnold Moodie, contributed the names of a number of growers who use irrigation equipment. Eighty-five of the state farm advisers cooperated through a questionnaire in adding data and verifying information already obtained. The report was prepared under the supervision of H. E. Hudson, Jr., Head of the Engineering Subdivision of the Survey.

INTRODUCTION

The land that is artifically watered in Illinois is probably not more than five per cent of the acreage receiving supplemental irrigation in the midwest; which, in turn, is a small area when compared to the irrigated land in the western states. Climatic laws govern this distribution; whereas a large percentage of irrigated land in the western states would be barren without efficiently operated irrigation projects, most of the land in the central states has had a good record of productivity. Thus irrigation has not been a necessity in Illinois.

Use of irrigation systems in Illinois has' been limited to farmers who have seen that supplemental moisture would materially increase the cash return from their land. They look upon irrigation systems as instruments for increasing yields rather than ensuring them. Obviously a farmer growing hybrid seed corn at $7 to $12 pex bushel can afford to invest several thousand dollars per field in a modern sprinkling system. With care he may double his yield a-nd pay off* his investment in one or two normal years. But the average Illinois corn grower would probably retire his investment only through the increased yield during extended periods of drouth.

Truck farmers show a great appreciation for supplemental irrigation. Critical deficiencies in rainfall can arise at any time during the growing season, and the application of one-half inch of moisture at a critical point during the growing season may forestall a complete crop loss.

One group of gladioli growers in Kankakee County has used irrigation equipment for over 25 years. These growers were convinced that supplemental irrigation is an absolute necessity, because the main crop, gladioli, and secondary crops, require more moisture than is normally available from precipitation durin g the growing season.

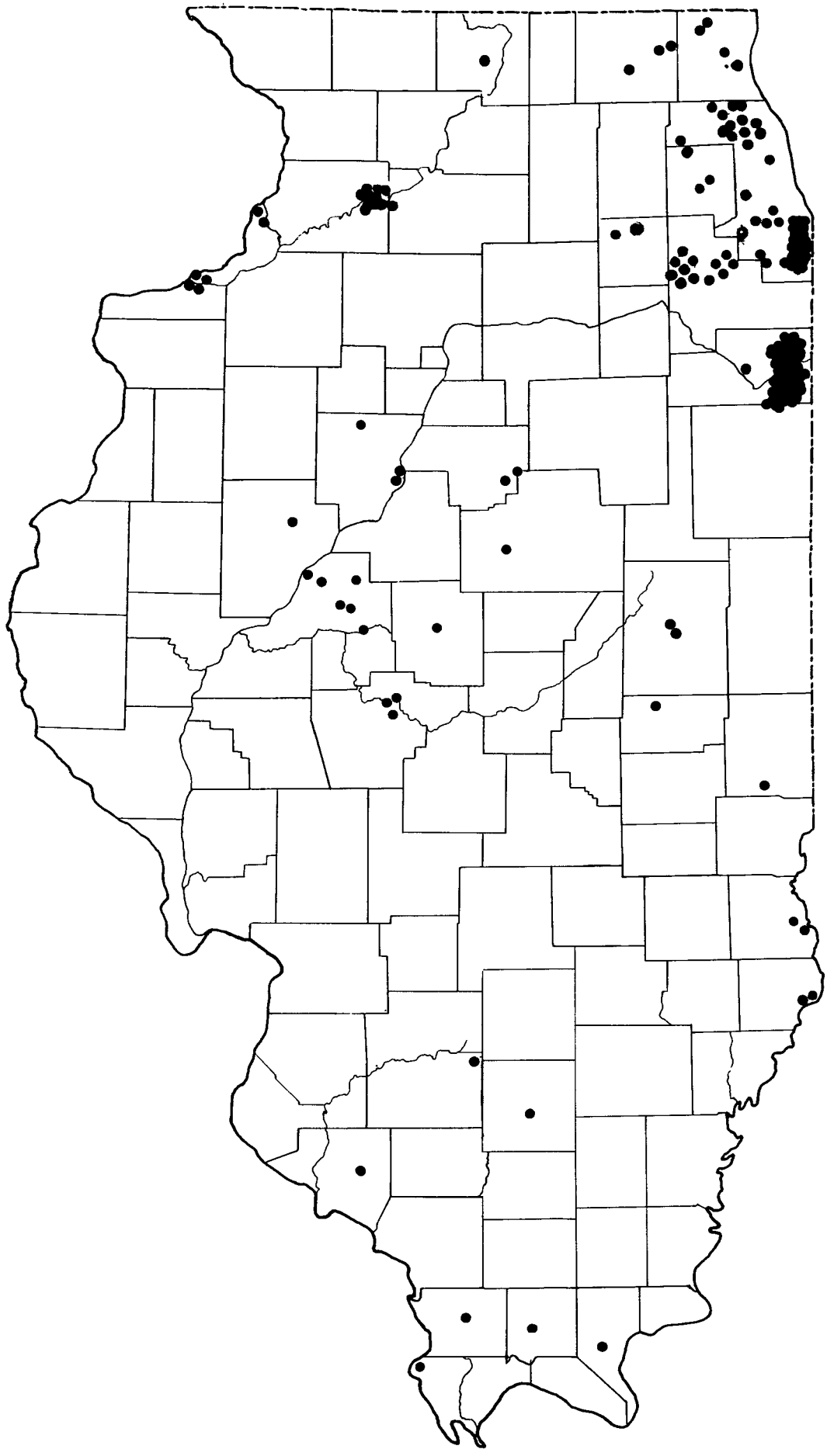

FIGURE 1. LOCATION OF IRRIGATION SYSTEMS IN ILLINOIS.

EXTENT OF IRRIGATION

Irrigation has been practiced in Illinois in certain areas for 25 years or more. Some of the gladioli growers in Kankakee County have been supplementing natural rainfall with well water since 1926. The University of Illinois and many nurseries have operated experimental plots and areas devoted to irrigation of small trees. Golf courses have equipment for watering greens and fairways, and many factories and residences regularly water their lawns. Since this study was initiated for the purpose of determing the amount of crop irrigation carried on in Illinois, fringe agricultural activities are omitted.

A survey of Illinois irrigation systems was started in the summer of 1950. Data on installations were obtained from irrigation equipment companies, farmers, farm advisers and other interested persons. From this information and field inspections made in the summer of 1951, 164 systems were located in the state. Forty additional systems are reported to be operated occasionally but no data on them have been obtained.

It is estimated that a total of 9000 acres is irrigated in Illinois. The 164 systems have an installed pumping capacity of over 25,000 gallons per minute. Fifty-five percent of the pumpage is from rivers, ditches, lakes or ponds and forty-five percent is from wells.

Figure 1 shows the locations of irrigation systems in Illinois. The greatest concentration appears to be in an area of three square miles north of St. Anne, Kankakee county, and in eastern Cook County north and east of Chicago Heights. Over 4000 acres receive irrigation in these two areas. In addition, about forty separate systems are located in Cook, DuPage and Will Counties. Most of these are near Joliet or north of Des Plaines.

A few systems are installed in Lake and McHenry Counties, and one new system has been operated in Winnebago County. A farmer in Boone County was reported to have irrigated potatoes for two growing seasons prior to 1940 but no record of later irrigation at this location is available.

There are at least ten systems in the vicinity of Sterling and Rock Falls, and six in Rock Island County.

Twenty systems are scattered through ten Central Illinois Counties and a few are found near the Wabash River in Crawford and Lawrence Counties. One grower in McLean County irrigated over 200acres of tomatoes for three successive growing seasons but discontinued irrigation in 1950 and moved his equipment to Georgia.

Four systems were located in the American Bottoms area in Madison and St. Clair Counties. One near McDaniel Lake was operated for several years prior to 1947 when the owner died. Another located on an island in Horseshoe Lake has not been used for several years. Two other systems are owned by horse-radish growers **but** they are seldom used.

There are isolated systems located in seven southern Illinois counties. One of these is located in Pope County and is operated by the University of Illinois Dixon Springs Experiment Station.

Figure 2 indicates the distribution of irrigation systems by crops in Illinois. Approximately 48 percent water truck crops and 36 percent irrigate the gladioli fields in Kankakee County. Ten percent irrigate pasture, mostly in northern Illinois and 3 percent water hybrid corn fields in Central Illinois. Another 3 percent of the systems irrigate nursery stock. Some of the specific truck crops being irrigated in the State are: mint, tomatoes, potatoes, strawberries, melons and onions. A few orchards also use irrigation systems.

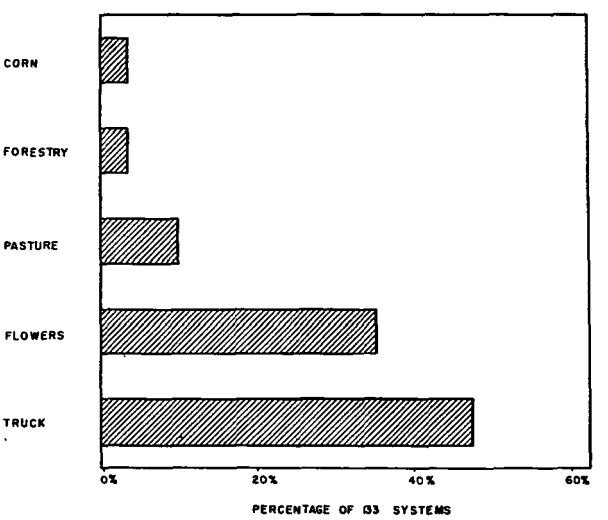

FIGURE 2. DISTRIBUTION OF IRRIGATION SYSTEMS BY CROPS.

NEED FOR IRRIGATION EQUIPMENT

Although irrigation is a relatively new agricultural practice in Illinois, it is filling a definite need for many farming groups. The gladioli growers in Kankakee County would not be without their systems. Those few growers in the area who depend entirely upon natural precipitation for a good crop are considered lucky by some of their better-equipped neighbors when their crops compare with the irrigated flowers. The sandy loam soil covering the area, is a major factor here in necessitating supplemental sprinkling; but these growers feel they cannot take a chance on lack of natural moisture during the growing season and therefore value their irrigation equipment highly.

Certain nurseries could not start some of their seedlings without additional precipitation provided by overhead sprinkling systems. Some of these systems are installed permanently as an inherent part of the nursery. At the Mason State Tree Nursery 45 of the 80 acres in the nursery are watered by a permanently installed irrigation system.

Onion and potato growers in southeast Cook County have invested heavily in sprinkler irrigation systems. The amount of water available for irrigation during a dry spell in this area is not sufficient to meet the demand when all irrigation pumps in the area are operated. In 1948 there were water shortages in two drainage ditches serving several irrigation systems in this area during a dry period in the early growing season. Fortunately these deficiencies were largely offset by above-normal precipitation during the late spring and summer and no appreciable deficiency in rainfall has occurred in this area since that time. There will be strong competition for the water available when the next drouth makes itself felt.

Truckfarmers in the Sterling region generally rate the value of their sprinkling systems highly, as do isolated vegetable and fruit growers scattered throughout the stage.

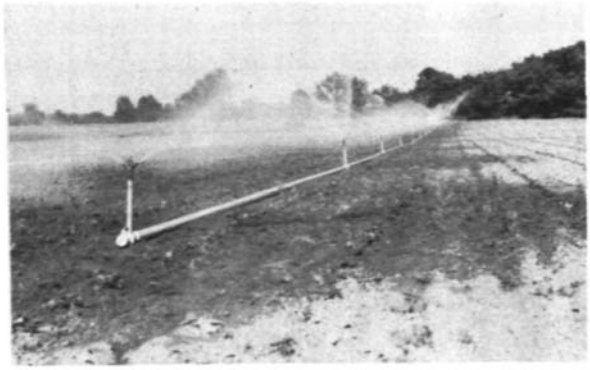

FIGURE 3. IRRIGATING STRAWBERRY PLANTS, SANGAMON COUNTY, ILLINOIS.

FIGURE 4. FIVE ACRE PASTURE IRRIGATION FIELD AT UNIVERSITY OF ILLINOIS DIXON SPRINGS EXPERIMENTAL STATION.

Two promising crops to irrigate are pastures and hybrid corn. The University of Illinois has irrigated a five-acre pasture plot at the Dixon Springs Experiment Station in southern Illinois for over three years. An adjoining five-acre pasture plot is used for control. Irrigation, in combination with fertilizer, is being tested to prevent permanent wilting of grass and allow more livestock to use pasturage during summer droughts.

A hybrid seed corn producer at El Paso, Illinois has used irrigation to increase yield of his corn and also to foster the growth of alfalfa between the corn rows. One important indirect advantage due to irrigation has been the watering of alfalfa directly after seeding. During the spring of 1950 the alfalfa planted in one 160-acre field was brought through a 3-week dry spell by constant irrigation. When the dry spell was followed by excessive precipitation, the surrounding fields were badly eroded, whereas the irrigated field had a cover of alfalfa which resisted erosion and profited from the rains.

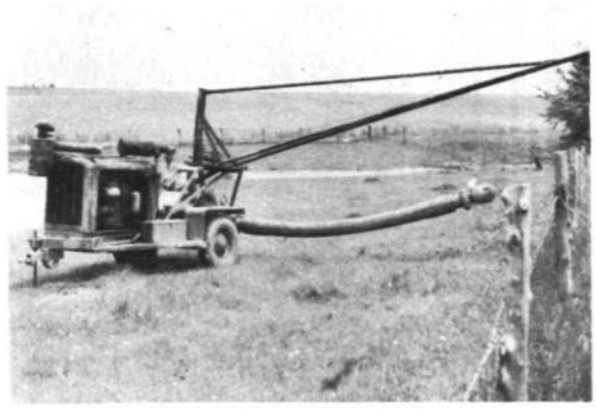

FIGURE 5. PORTABLE ENGINE-DRIVEN IRRIGATION PUMP, McLEAN COUNTY, ILLINOIS.

SOURCES OF IRRIGATION WATER

Supplying water for irrigation systems in Illinois presents varied problems. Over 40 per cent of the systems are located in two areas of the northeast part of the state. Approximately 50flower growers and truck farmers in eastern Kankakee County obtain groundwater from rock wells. The average well is 100to 150feet deep, 6 inches in diameter and the pumping level of the water is within 25 feet of the ground surface.

There are over 30 irrigation systems in the area east and north of Chicago Heights. They depend upon drainage ditches and ponds for their water supply. During periods of drouth, pumps for two or three of the systems can almost drain two of the ditches running through the area without satisfying the demand.

Approximately 20 systems are operated in other outlying sec tions of the Chicago area. These depend upon wells, ponds and ditches for their water. The systems operated in Lake and McHenry Counties in northeast Illinois, with one notable exception, use surface water. The exception is the C. J. Papas farm in McHenry County where a gravel well 75 feet deep is reported to provide up to 1,000 gallons per minute. The non-pumping water level at this point is 20 feet below the ground surface.

The irrigation systems in the Rock River valley near Sterling , obtain water from sand points. Little water is taken directly from the river for irrigation. In the Rock Island area three vegetable growers use city water while a fourth uses a pond as a source of water.

The remaining systems scattered throughout the state use whatever supply is available. At Sherman, Sangamon County, C. B. Mayfield uses a series of ponds, two of which canbe kept full by pumping from the Sangamon River. Six miles west at the Jefferies Orchards, a pond was constructed as an irrigation supply for watering strawberries. At the farm of the Lincoln State School and Colony, Logan County, five acres of corn are irrigated by using the City of Lincoln water supply, which also serves the institution.

A groundwater development for irrigation in Illinois is taking place near El Paso where Lester Pfister has two large areas of hybrid seed corn under cultivation. One 160-acrefie Id south of town has a well centrally located with pump and dieselengine installed in a frame building. Prior to drilling the wells, five test holes, each 120 feet deep, were bored to obtain information on character and extent of the water-bearing formation. The cost of test boring was £1170. The we 1 I , 12-inches in diameter and 113 feet deep, cost $3750. This includes a 60-slot screen, 24 feet long, and 90 feet of 12-inch casing. Pumping equipment consists of 750 gallon per minute turbine pump and Diesel engine which cost $8,640 installed.

The distribution system consists of 2340 feet of 6-inch steel main line pipe and twelve special couplers. This line is buried and bisects the field in a north-south direction. Laid on the surface in an east-direction are 20 lines of 6-inch welded steel laterals each 1170 feet long, three-inch pipe risers and caps are spaced every 260 feet to supply 10 sprinkler nozzles. Cost of the distribution system including welding and labor costs to lay all pipe was $23,990.

The total cost of the complete irrigation system was £37,400. This works out a cost of about £250 per acre for this system.

For puposes of comparison it may be noted that the Dixon Springs Experiment Station irrigation system, which was designed for 5 acres, and has a capacity of 300 gallons per minute, cost £1,000. This amounts to a cost of approximately £200 per acre. According to one manufacturer's representative, the average cost of an irrigation system , using 1951 prices, is $72.00per acre. It would seem from other data that this latter figure is more nearly representative for average conditions.

FIGURE 6. IRRIGATION PUMP ON C. J. PAPAS FARM McHENRY COUNTY.

LEGAL RIGHTS TO WATER

The ancient law regulates man to so use his property that no injury is done to neighbors. This limits riparian owners to a reasonable use of the water of a stream with due regard to the needs and rights of all other riparian land owners. Such use infers that the natural size, flow and purity of the stream shall be protected against any material diversion or pollution.

The law also defines the rights of adjoining land owners to use of waters resulting from natural rainfall and melting snow before they reach well-defined channels. These are called surface waters. One land owner may use or retain as much surface water as he desires and thus prevent any of it from flowing upon or percolating into adjacent land. However, he may not deflect it or artificially drain it off onto adjoining land where it does not flow under natural conditions. This is the reasonable use doctrine.

Illinois is using its groundwater more intensively than surface water. Illinois groundwaters have provided adequate water supplies for over 75 years, but at certain locations concentrated extractions have created growing problems. The Illinois Courts have held that percolating water is as much a part of the land as the other materials beneath the surface. The land owner has a right to use the well water on his property regardless of the effect on his neighbor's well. The Supreme Court in 1899 adopted this rule in the case of the Edward v. Haeger, 180 Ill. 99. While some states have limited this common-law rule to what is referred to as reasonable use of the land owner's percolating water, the Illinois Courts have not. The owner who has the most powerful irrigation pumps, or the most favorable hydrologic situation, has the legal right to render wells on surrounding property useless.

Until the Illinois Legislature speaks on water rights, the common-law prevails. However in **1945** the State Water Resources and Flood Control Board was created by Act of trie Illinois Legislature, Section 1 of the Act declared that "The general welfare of the people of this state requires that the water resources of the state be put to beneficial use to the fullest extent of which they are capable, and that the waste or unreasonable use or unreasonable method of use of water be prevented, and that the conservation of such water is to be exercised with a view to the reasonable and beneficial use thereof in the interest of the people and for the public welfare. The right to water or to the use of flow of water in this state is and shall be limited to such water as shall be reasonably required for the beneficial use to be served, and such right does not

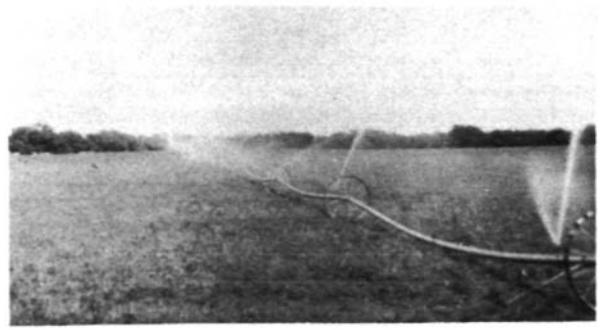

FIGURE 7. THIS 600 FOOT LATERAL, SUPPORTED BY WHEELS, IS MOVED BY ONE MAN USING A RATCHET MECHANISM.

and shall not extend to the waste or unreasonable use or unreasonable method of use or unreasonable method of diversion of water".

The Board of Water Resources and Flood Control has been given power to "arbitrate and provide ways and means for the equitable reconciliation and adjustments of various conflicting claims and rights to water by various users and uses", but no actual test cases have been brought either to Court or to the Board.

In January 1950, the President's Water Re-------- Policy Commission was established under the Executive Order 10095. The Commission has studied and made recommendations to the President regarding desirable legislation or changes in existing legislation relating to the development, utilization, and conservation of water resources. Legislative proposals based on these recommendations have been drafted but are not available as yet.

In the meantime irrigation equipment dealers, who have had experience with the water rights in western states, are urging their customers to record with their County Clerks the sources and amount of water they are removing for irrigation purposes. Any future water policy might be expected to recognize the rights of prior usage provided such use is within the doctrine of "reasonable use" enunciated but not implemented in 1945.

FIGURE 8. PERMANENTLY INSTALLED OVERHEAD SPRINKLER SYSTEM AT STATE TREE NURSERY, MASON COUNTY.

QUALITY OF IRRIGATION WATER

The purpose of irrigation is to increase the productivity of crops by replenishing the root-zone reservoir of the soil. The quality of irrigation water effects the growth of plants by altering the status of the soil where the plant is growing. There is considerable variation in composition and concentration of dissolved minerals in natural waters. Too high a mineral content is harmful and a high proportion of sodium to hardness (calcium and magnesium) causes a soil to become sticky, undrainable and hard. Hard water, on the other hand, keeps a soil softandfriable. There is sufficient normal precipitation in Illinois to prevent excessive salting of the soil by highly mineralized irrigation water. However, for efficient management of an irrigation project, attention should be given the water quality by periodic chemical analyses of both the source water and the soil.

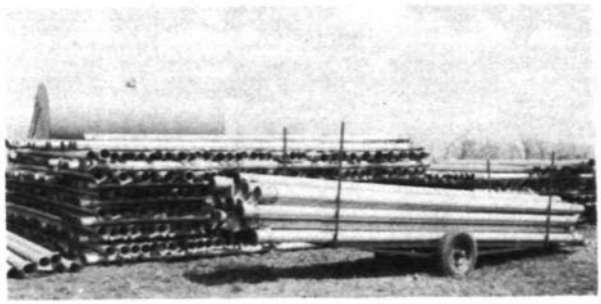

FIGURE 9. IRRIGATION PIPE USED TO DISTRIBUTE WATER TO FIELDS PRODUCING HYBRID CORN NEAR EL PASO, ILLINOIS.

DISTRIBUTION OF PRECIPITATION

The normal annual precipitation over Illinois varies from approximately 30 inches in the north to 48 inches in the south. Approximately 59 per cent of this moisture is received during the growing season, which begins in southern Illinois in early April and about May 1 in northern Illinois and continues into October. There is generally a maximum of precipitation in either March, May or June.

During the wettest years on record, average precipitation has been 149 per cent of normal, whereas the average during the driest years has been 65 per cent of normal. During the growing season, rainfall has averaged 58 per cent of normal for the driest years and 151 per cent for the wettest years.

Figure 10 shows the Illinois normal precipitation for the 45 year period 1898 to 1942.

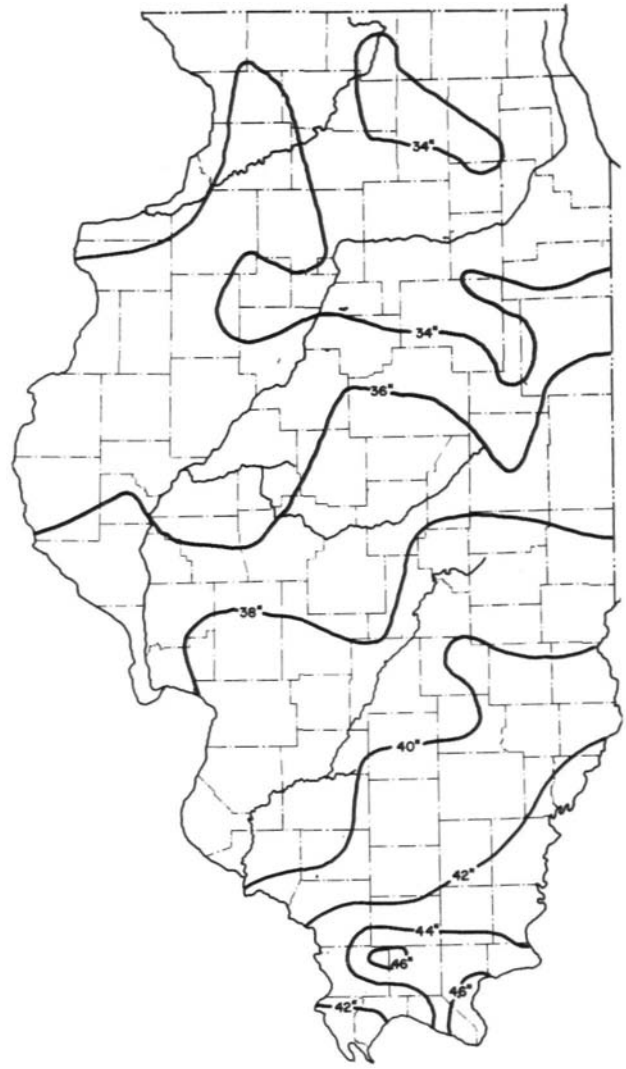

FIGURE 10. ILLINOIS STANDARD PRECIPITATION. DATA FROM UNITED STATES WEATHER BUREAU FOR 45-YEAR PERIOD 1898-1942.

FIGURE 11. PASTURE IRRIGATION ON C. J. PAPAS FARM, McHENRY COUNTY.

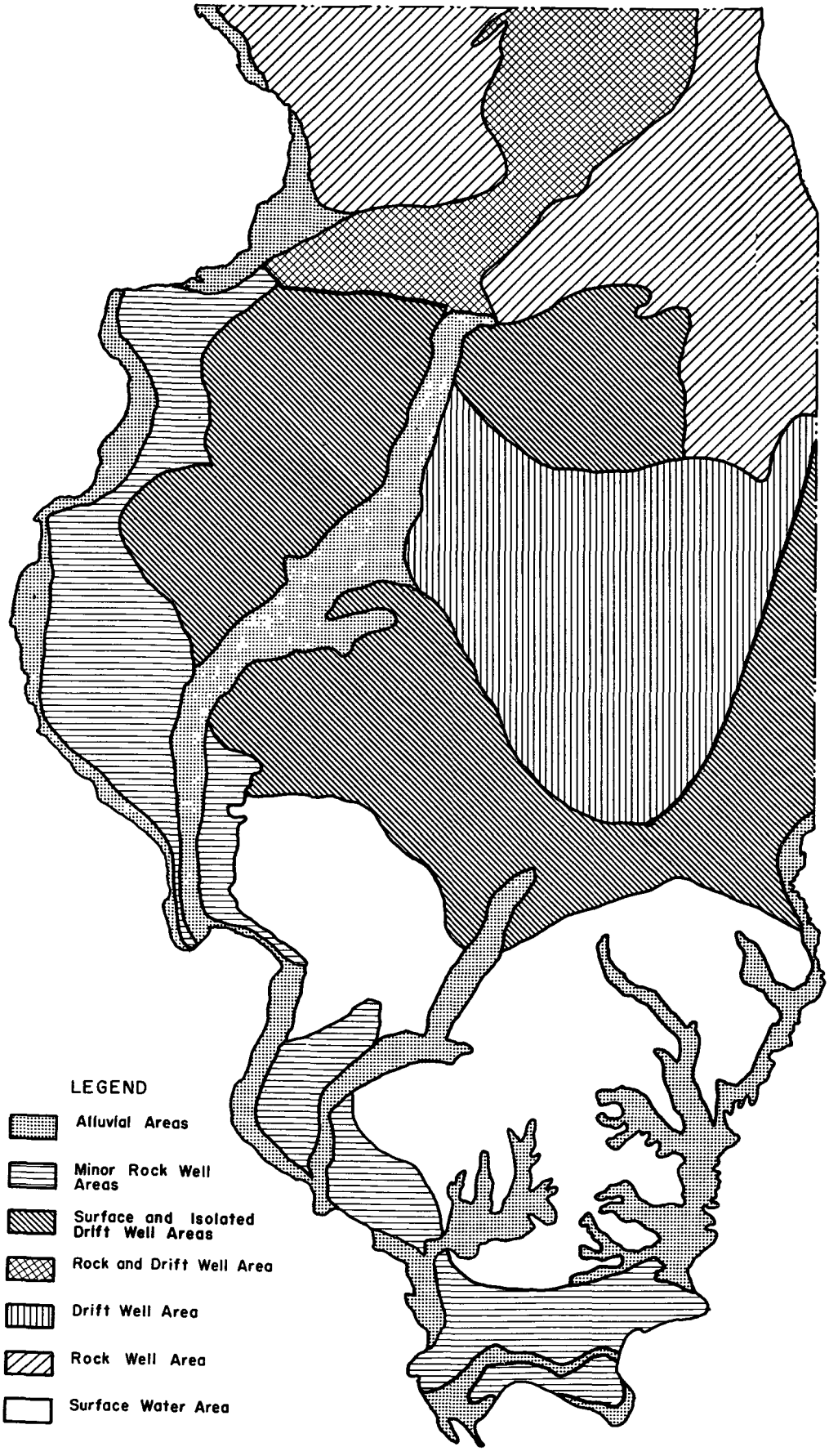

FIGURE 12. WATER RESOURCES IN ILLINOIS.

WATER RESOURCES AVAILABLE FOR IRRIGATION

It is significant that the most important irrigation installations in Illinois are located in areas of moderate to adequate water resources.

Figure 12 shows the principal sources of water supplies in the State. The legend indicates the more reliable water sources and not necessarily the sources now being used. For example, while most irrigators in the northern one-third of the State use surface water at present, they would probably find it necessary to obtain groundwater during an extended dry period. In this are the wells vary in depth from 20 to 1500 feet depending upon whether they are finished in shallow sand or deep rock aquifers. Wells penetrating the deep rock aquifers in the Chicago region have non-pumping levels from 300 to 450 feet below the ground surface.

Most systems in the Chicago areamake use of surface water because it is generally less expensive to pump. The truck farmers in eastern Cook County use surface water because adequate low cost groundwater supplies are not available. The irrigation water is pumped from drainage ditches which provide an adequate supply during years of normal rainfall but fail to meet the demands of all irrigators who need water during a drouth. Lansing Ditch which parallels the Illinois-Indiana State line in T. 35 N., R., 15 E., has a drainage area of 8.3 square miles. A stream-gaging station measures the flow at the boundary line between Sections 8 and 17. Close to this point farmers have irrigation installations that require 3000 gallons per minute. During years of normal precipitation Lansing Ditch has a mean flow of 12 second-feet (1949-1950), or 5400 gallons per minute.

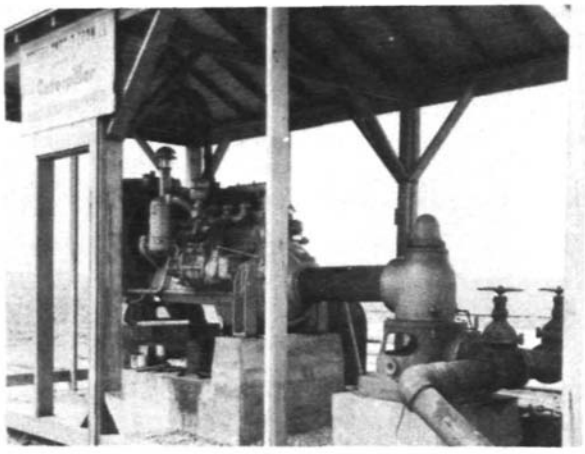

FIGURE 13. 1000 GALLONS-PER-MINUTE IRRIGATION PUMP AND DIESEL ENGINE INSTALLATION NEAR EL PASO, ILLINOIS.

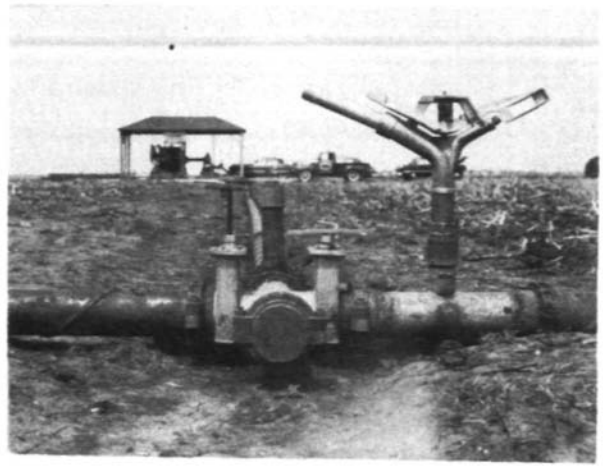

FIGURE 14. THIS NOZZLE SPRAYS 750 GALLONS-PER-MINUTE ON CORN FIELD NEAR EL PASO, ILLINOIS.

Deer Creek, with a drainage area of 24.4 square miles, has a gaging station 1.5 miles northeast of Chicago Heights. In 1949 the ditch had a mean flow of 10.4 second feet and 22.5 second feet in 1950. During a large part of both growing seasons its flow was approximately 4 second feet which was one-tenth of the available irrigation pumping capacity in the area.

In these situations, it is evident that the low flows in the waterways are not sufficient to supply the simultaneous needs of those equipped to draw from them. At present there is no system for scheduling the withdrawals by the various irrigators; in fact, the question as to whether there is enough water for all under a schedule of taking has not been investigated.

The Water Survey is the major sponsor of the cooperative stream-gaging program carried onin Illinois by the United States Geological Survey. Under this program, stream flow is systematicallymeasured at 172 locations in the state and on its borders. Records of these measurements are available at the Water Survey office and at the office of the United States Geological Survey, Champaign.

In southeastern Kankakee County practically all the growers with irrigation systems use drilled wells because groundwater at shallow depths is available and practically no surface water sources have been developed. Elsewhere in the northern third of the State, water is taken directly from streams, pond's, or through shallow sand points near rivers.

In much of Central Illinois water may be obtained from drift wells or from sand points in river bottoms. In places where drainage ditches are used the supply available for irrigation depends almost entirely on rainfall and may be unreliable during dry periods.

The southern one-third of Illinois has good groundwater deposits only at isolated locations. In many part of the area small ponds and reservoirs maybe constructed to impound a limited amount of water for irrigation purposes. Water may be obtained from shallow wells in the alluvial valleys of the Mississippi, ohio, Cache, and Wabash Rivers.

The development of an adequate source of water for a specific irrigation project requires a detailed hydrologic and economic study beyond the scope of this paper.

Adetailed groundwater study should include collection of all available data on wells in the area. A program of test hole drilling should be undertaken to determine the occurrence and characteristics of the water-yielding formations. A pumping test of the well finally constructed is valuable if accompanied by careful measurements of flow and water levels in the pumped well and of water levels in nearby observation wells. Regular observations ofwell water levels should parallel the extraction of groundwater so that the effect of pumping and the safe yield of the water-bearing formation may be determined.

Requests for water resource information at specific locations will be answered by spe- - - - - - - prepared reports on the available resources. In the case of groundwater information these reports are prepared in cooperation with the Illinois State Geological Survey.

Information on groundwater and surface water supplies for all parts of Illinois is available at the offices of the State Water Survey, Box 232, Urbana.

CONCLUSION

The present maximum use of water by irrigation systems in Illinois is only 0.0006 percent of the combined municipal and industrial use.

At present, irrigation does not compete for water with municipal and industrial demands, and there are no trends toward increasing use that cause concern.

However, there are areas in which future intensive development of irrigation could seriously tax the available resources.

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No. 2. Groundwater Resources in Winnebago County, with Specific Reference to Conditions at Rockford, 1948.

No. 3. Radar and Rainfall. 1949.

No. 4. The Silt Problem at Spring Lake, Macomb, Illinois. 1949.*

No. 5. Infiltration of Soils in the Peoria Area. 1949.

No. 6. Groundwater Resources in Champaign County. 1950.

No. 7. The Silting of Ridge Lake, Fox Ridge State Park, Charleston, Illinois. 1951*

No. 8. The Silting of Lake Chautauqua, Havana, Illinois. 1951.

No. 9. The Silting of Carbondale Reservoir, Carbondale, Illinois. 1951.

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