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A STATEWIDE ASSESSMENT OF OUR GROUND WATER SITUATION

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by

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When Fred Casterline first asked me a few weeks ago if I would participate in a Kansas Irrigation Industry meeting today he asked if I would give a state-wide assessment of our groundwater situation. I agreed to do so. As I thought about an outline of how I would present a state-wide assessment I decided I would approach the topic from several viewpoints for an agriculturally oriented group of water users. With this idea in mind, I decided to discuss the groundwater with regard to the following factors.

1) Its geologic distribution, 2) its geographic distribution, 3) its general availability, 4) a brief historical summary, and 5) problems and answers. The availability of groundwater is primarily and directly related to the geology of the kind of rocks that occur in the state. Secondarily, it is related to the climate and the amount of precipitation that occurs in the different areas of the state. Essentially all of the fresh groundwater that occurs in Kansas is in the rocks we call sedimentary rocks. The sedimentary rocks are divided into two major groups. First, the unconsolidated or relatively loosely packed rocks such as alluvium or stream laid deposits, loess and dune sand as wind laid deposits, glacial deposits of various kinds and the residual soils or mantle rock. The second kind of sedimentary rocks are called consolidated or relatively compact rocks such as limestone, shale, bedded salt, gypsum, coal, and sandstone. Groundwater is contained in the pore spaces in the relatively loosely packed unconsolidated rocks and commonly 15-20 percent of a given volume of rock is void space from which the water can be removed by gravity drainage and is available water for a pumping well. Groundwater in the consolidated rocks is generally less free to move except in open fractures and joints or in the case of sandstones both pore space

and fractures and in the case of limestones, solution cavities and fractures. Wherever these rocks are buried to a depth of 30-50 feet or more they are generally not very permeable and do not allow groundwater to move through the rocks readily and little or no water is obtainable by gravity drainage except for some of the sandstones and for some of the limestones that have interconnected solution openings. Amount of precipitation across the state ranges from an average of less than 16 inches in parts of western Kansas to more than 40 inches in southeastern Kansas. Amount of water available for recharge after satisfying soil moisture rquirements therefore, is considerably different across the state. Runoff from precipitation also has a wide range, from about 1/10 of an inch of runoff in the west to about 10 inches of surface runoff in the southeast corner of the state. Groundwater levels, as shown by hydrographs reflect both the drought and the increased pumpage in some of the heavily pumped areas and where long-term records of water levels are available these two factors can generally be identified. John C. Frye in 1951 estimated that as much as 60 percent of the available fresh groundwater occurs in these unconsolidated Quaternary deposits and perhaps 20 percent in the closely related Pliocene Ogallala formation. Only about 20 percent of the fresh groundwater occurs in the consolidated rocks. From a geologic distribution standpoint, therefore, it can be readily seen that the most important rocks from the standpoint of groundwater availability are the unconsolidated Cenozoic sedimentary rocks. If we now look at the second factor or the geographic distribution of groundwater, we find that a geologic map is very useful in evaluating the groundwater resources of the state. This is Map M-1. To describe the third factor or the general availability of groundwater we need to add the information collected and interpreted from thousands of test holes, well inventory schedules, well logs, pumping tests, and water analyses and we can prepare interpretative maps such as the general availability of groundwater map M 4-A and also the saturated thickness and specific yield the Cenozoic deposits map M-5. maps M 4-A particularly and M-5 to a lesser degree have proven to be among the most popular and widely used maps that the Kansas Geological Survey has published. In describing the groundwater situation in terms of a historical summary or factor No. 4 I would like to move back in time to the late 1930's at which time groundwater studies by the Kansas Geological Survey in cooperation with the U.S. Geological Survey and with the participation of the Division of Water Resources of the Kansas State Board of Agriculture, the Kansas State Department of Health, and the City of Wichita began a geologic and hydrologic study of an area north of Wichita called the Equus Beds. Following this study further investigations were began in southwestern Kansas and gradually over most of western and central Kansas in the 1940's, 50's, and 60's. The results of these investigations have been published as a series of reports describing the geology and groundwater resources, and are the basis for much of the background information so valuable in understanding, and interpreting the changes that have and are taking place, particularly in the irrigation developments utilizing groundwater. In 1940 water level records were being obtained from 436 wells in western and central Kansas. Today, we have water well records being obtained in more than 800 observation wells and in addition, annual measurements are being made in 1,100 wells in western Kansas to maintain up to date records of water level changes that are occurring in the major aquifer systems.

I find it interesting to note the comments of Dr. Raymond C. Moore, State Geologist and author of Kansas Geological Survey Bulletin 27, entitled, "Groundwater Resources of Kansas," which was published in 1940. This report was the first general assessment of the state's groundwater resources and the groundwater conditions. Speaking of the quantity of groundwater obtainable from groundwater reservoirs Dr. Moore comments, "The amount of water that can be obtained from Kansas groundwater reservoirs depends on the areal extent and thickness of the reservoir, its porosity and to the extent to which it is waterfilled. There is a difference, however, between the amount of obtainable water and what may be termed the safe yield of the groundwater reservoir. The latter takes account the fact that no groundwater supply is inexhaustible and utilization of this resource should take account of the manner in which normal conditions operate to recharge the reservoir with new supplies of water. Otherwise, demand will exceed the ultimate supply." He further states, "Where the rates of withdrawal from an underground reservoir exceed the rate of recharge the falling water table causes steadily increased cost of lifting by the pump. Eventually, costs are greater than earnings and communities and industries built on this receding resource decline or vanish." I find it interesting to note that Dr. Moore would make such a remark in view of the fact that in the late 40's there was but little irrigation developed and little industrial development in the major aquifer systems in the western part of the state. Later, in the same publication, Dr. Moore describes groundwater regions of Kansas in which he divides the area of the state into several regions based on the general geologic and hydrologic conditions that prevail in each of these areas. One of these areas in western Kansas he describes as the Greeley District. This district encompasses essentially all of western Kansas with the exceptions of some small areas such as the Scott basin which is described separately. He makes the following discussion regarding this area, "Water in the Tertiary Beds of this district is derived partly from the local rainfall and partly from water brought eastward from Colorado. It is evident from the low rate of surface rainfall and from studies of the evaporation and transpiration in western Kansas that the annual rate of groundwater recharge is very low. It is therefore an important part of groundwater investigations in the region to determine the rate of safe use so that this enormously important resource may not be expended unwisely for such things as general crop irrigation. Somewhat intensive agricultural developments, as in the vicinity of Garden City, depend mostly on groundwater carried in the underflow of the Arkansas River. It is undoubtedly possible and may be deemed desirable to develop various small districts utilizing Tertiary groundwater in order to irrigate stock-feed crops for local use."

We see today considerable concern about declining water levels and we see also much irrigation of field crops for livestock feed. Dr. Moore did not envision the large scale irrigation that has mushroomed in western Kansas in the 1960's and 1970's nor of the development of the large cattle feedlot operations of today when he wrote in 1939.

The final or 5th factor in this groundwater assessment are the problems and answers. The principle problem is that groundwater is becoming a scarce resource and that there are competing uses for the available groundwater supply. Although, the interest of this group are primarily irrigation and agriculture I can assure you that the drought has posed problems for some of the domestic and municipal supplies and that there is a growing competition for water by industry. The availability of water for energy developments is a good example and the siting requirements for a new power plant such as the Jeffery Energy Center in Pottawatomie County and the Wolf Creek Power Plant in Coffey County. Not only must such plants have an assured and adequate water supply but they must fit into landuse restrictions, thermal and air quality restrictions. Earthquake hazards, even in Kansas, are becoming better known and somewhat greater risk factors must be engineered into the plants at higher costs than originally contemplated. The generating plant being considered for southwest Kansas has significant problems in getting adequate and suitable quality water supply. Recent studies by the Federal-State Urban Study Team in the Kansas City area and the Corps of Engineers have indicated that by the year 2000 the Kansas River and the groundwater resources of the alluvial valley fill would not be adequate to meet the needs of Johnson County during a severe drought. This is in spite of the fact that there are a number of large reservoirs with state managed water supply on the Kansas River system. Concentrations of chlorides is increasing in the Kansas River and certain other contituents exceed recommended limits already at times. In spite of what this group might think, the water problems are not restricted to western Kansas. The quality and quantity problems are present in eastern Kansas, also. The number and kind of water problems are increasing. In order to anticipate and manage the problems we must have an informed public, a well-organized management plan, and increasing amounts of reliable data to work with.

In conclusion, I can only say that water, indeed, is becoming a scarce resource and that you should individually, and cooperatively as the irrigation industry keep informed and stay abreast of what is happening. Use your irrigation systems wisely and with the best conservation practices available. There are no easy answers.