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Does Institutional Groundwater Management Work? Lessons Learned from Groundwater Management District #5

by

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DOES INSTITUTIONAL GROUNDWATER MANAGEMENT WORK? LESSONS LEARNED FROM GROUNDWATER MANAGEMENT DISTRICT #5

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I. INTRODUCTION

Kansas is a land of inconsistency. Traveling from east to west one discovers a vast difference in climate, soils, population, crops and vegetation, and even social norms. The contrasts are startling. Those inconsistencies are no different for the water resources within the state. Large rivers, lakes and alluvial aquifers are found in eastern Kansas due to more generous amounts of precipitation, while Western Kansas is practically devoid of large lakes and streams, and obtains most of its water from the vast Ogallala aquifer and other associated groundwater deposits. These aquifers of Western Kansas are not easily recharged, due to their depth and inadequate precipitation.

South Central Kansas is a melding of these two extremes. The area consists of smaller streams and lakes that, in many cases, are dependent upon both precipitation and shallow groundwater aquifers for its water supply. This relationship between groundwater and surface water in South Central Kansas presents a special challenge for anyone that attempts to understand the dynamics of its water supply.

While Kansas had adopted the prior appropriation doctrine for the entire state in 1945, it was not until 1972 that the legislature recognized the need for different management within some of the unique groundwater systems of the state.[1] With that, the Groundwater Management District Act ("Act") was passed to manage these unique areas.[2] The Act gave local landowners and water users the opportunity to provide input into how those areas would be managed, within the confines of state law.

Groundwater Management Districts have evolved over the years to become highly recognized entities in the management of this great resource. The Act established a mechanism whereby the people of a District could, if they so

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1. KAN. STAT. ANN. § 82a-701a (Supp. 2005).

2. *Id.* § 82a-701a (Supp. 2005).

desired, manage the water resources while fostering economic growth. The vision that the local leaders had during the formation of the District has set forth the framework that we have worked under since that time.

This article will document the efforts of Big Bend Groundwater Management District #5 ("District") in the management of groundwater according to the legislative declaration that was established in 1972. It provides an overview of the challenges facing that management throughout the years, relative to the development of policy, regulatory measures, and social and economic issues. A thorough review of the District's background and its evolution through time is necessary in order to understand all the issues. This article will then evaluate and analyze the challenges as observed by management. It concludes with a summation of the most relevant issues and the most important future challenges facing the District.

II. BACKGROUND

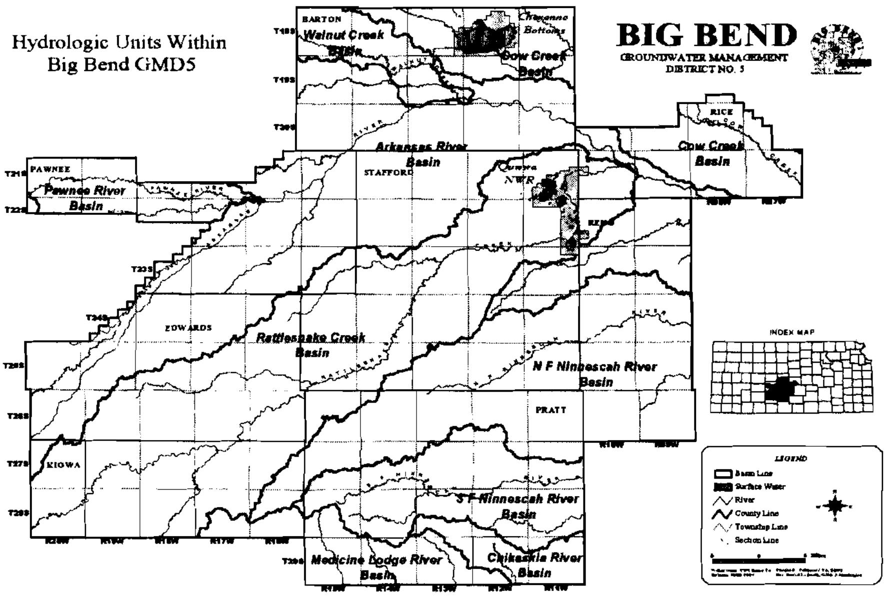
Big Bend Groundwater Management District #5 was so named because of its proximity to the large bend of the Arkansas River in South Central Kansas. It is commonly known as the Great Bend Prairie Aquifer, and forms part of the High Plains Aquifer. The underlying bedrock beneath the aquifer in the western half of the District is composed of cretaceous rocks, while Permian formations underlie its eastern half. The Permian rocks are saturated with highly mineralized water which is in direct contact with the overlying fresh water aquifer in much of the eastern half. The District encompasses 2,511,104 acres of land in all or part of eight counties: Barton, Edwards, Kiowa, Pawnee, Pratt, Reno, Rice, and Stafford. As of January 2006, there were approximately 4,500 authorized water rights within the District. Irrigation constitutes 97% of the water used in the District.

In late 1973, local water users and landowners, with the assistance of the Kansas Soil Conservation Districts and the Kansas State University Extension Service, submitted a declaration of intent to form the District to the Chief Engineer of the Division of Water Resources (DWR). A steering committee worked expeditiously over the next few months to prepare for an election to form the District. The election was held with the results reflecting a two-to-one majority in favor of creating the District. Big Bend Groundwater Management District #5 was formally organized in March 1976.[3]

During its first years, the District focused upon various programs that related both to water quality and water quantity. It began water quality studies as early as 1977; these studies assessed the impact of the natural mineral intrusion in the eastern portion of the District. The District also began in 1977 to formulate rules and regulations that would deal with future allowable appropriations

3. Big Bend Groundwater Management District Number 5, *Articles of Incorporation*, Mar. 9, 1976 (on file with author).

Figure 1: Big Bend Groundwater Management District No. 5



of groundwater. It was clear to the steering committee that such steps were needed to protect future groundwater supplies. The committee started reviewing all the data it could find. In March, 1978, Lloyd Stulken, of the United State Geological Survey, presented a paper titled "Geohydrology of the Great Bend Prairie" to the District's board of directors.[4] That report was an update to publications completed in the 1940's, and is still used as background material for more recent studies and publications.[5]

Local leaders had set forth a framework to manage the aquifer, by recognizing several potential problems: declining water levels, the over-appropriation of certain areas, and water quality problems. The District also focused upon water level monitoring programs and relevant future research projects. A great deal of thought went into the drafting of a management program for the District at that time.

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4. STUART W. FADER & LLOYD E. STULLKEN, KANSAS GEOLOGICAL SURVEY, LAWRENCE IRRIGATION SERIES NO. 4, GEOHYDROLOGY OF THE GREAT BEND PRAIRIE, SOUTH CENTRAL KANSAS (1978).

5. BRUCE F. LATTA, STATE GEOLOGICAL SURVEY OF KANSAS, BULLETIN 88, GEOLOGY AND GROUND-WATER RESOURCES OF BARTON AND STAFFORD COUNTIES, KANSAS (1950); THAD G. MCLAUGHLIN, STATE GEOLOGICAL SURVEY OF KANSAS, BULLETIN 80, GEOLOGY AND GROUND-WATER RESOURCES OF PAWNEE AND EDWARDS COUNTIES, KANSAS (1949).

III. MANAGEMENT ISSUES

A. Declining water levels

One of the first areas determined to be in need of groundwater management was the Pawnee Valley: on June 19, 1978, the District established a moratorium on new well development in the valley in Pawnee County.[6] The moratorium covered a 140 square mile area. Under the moratorium's terms, subsequent applications to appropriate water, other than for domestic use, received a priority number but were not processed until DWR made a determination as to the future availability of groundwater in the valley. That moratorium stayed in effect until July 8, 1981, when an Intensive Groundwater Use Control Area (IGUCA) was established for the Pawnee Valley.[7] It was apparent during several meetings that some people did not like the idea of restrictions being placed on the use of groundwater in their area. People who had been excited about forming the District now wondered if forming the Pawnee Valley IGUCA was the right action to take. It had started to hit home to some landowners and potential water users what serious water management really involved.

B. Safe yield and sustainable yield

The District's first rules and regulations were developed by May 1980.[8] The most significant regulations dealt with well spacing and the safe yield of the aquifer. The well-spacing regulation was developed to prevent interference between wells. The safe yield regulation would limit the amount of future development allowed throughout the District. People of the District understood the need for the well-spacing regulation, but thought the safe yield regulation was far too restrictive. Although both well-spacing and safe yield provisions were written into the District's management program, the District determined early on that these types of policies should take the form of regulations.

At the time, safe yield was defined in these regulations as "that quantity of groundwater withdrawn from a given area which approximately equals the average annual recharge to the same area."[9] The original safe yield allowed 6,000 acre-feet of water to be withdrawn from within a two-mile radius circle, and 1500 acre-feet in a one- mile circle for the Pawnee Valley IGUCA. These limits assumed five inches of recharge and four inches of return flows from irrigation. When a new application for a groundwater right was filed with the

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6. Executive Order establishing Moratorium in the Pawnee Valley, Division of Water Resources, Kansas State Board of Agriculture, (June 19, 1978).

7. DIVISION OF WATER RESOURCES, KANSAS STATE BOARD OF AGRICULTURE, FINDINGS, CONCLUSION AND ORDER ESTABLISHING AN INTENSIVE GROUNDWATER USE CONTROL AREA (1981).

8. KAN. ADMIN. REGS. § 5-25-1 (1980).

9. *Id.* § 5-25-1 (1980).

District, it was added to all of the vested rights, prior appropriation rights, and earlier priority applications which existed within a two-mile radius circle (or a one-mile radius circle for the Pawnee Valley IGUCA) whose center was the location of the proposed well. If this quantity exceeded the 6000 acre-feet limitation (or the 1500 acre-feet limitation for the Pawnee Valley IGUCA), the District would recommend that the Chief Engineer deny the application.

Subsequent research conducted by the Kansas Geological Survey (KGS) revealed much lower recharge rates within the District, and it became clear that the safe yield figure of 6000 acre-feet in a two-mile radius circle was extremely high. The research also indicated that the quantity of recharge from precipitation was less than predicted, and return flow from irrigation was considerably less than originally anticipated, lowered further by more efficient irrigation systems

Based upon this additional data, the District reduced its safe yield to 3000 acre-feet within the two-mile radius circle in November, 1984.[10] This reduction was based upon 4.5 inches of annual recharge. After this reduction took effect, a public hearing was held in the District, and a number of locals voiced their concerns about the negative economic impacts of the reduction. However, it was clear that in order to reduce fluctuations in the aquifer, the District needed to similarly reduce the safe yield limit. The need to obtain accurate recharge figures drove the Board to continue its efforts to obtain the best available data. Additional research began in 1985 through a cooperative project with the KGS to obtain additional data on the recharge component in the Great Bend Prairie.[11]

On March 9, 1990, the Board recommended to the Chief Engineer that a moratorium be placed on new development in the entire District. The moratorium would give the board time to compile additional data on recharge and water use in the District. The moratorium was reviewed every year and remained in place until May 1996, when the safe yield was reduced to 1500 acre-feet (based on 2.25 inches of annual recharge). Individual basins that were considered over-appropriated in the District were closed permanently to future development, other than small use permits, temporary, and term applications of less than one year.[12] All applications that had been held by the DWR since March 9, 1990 would be processed under the new regulations. A number of the applications were recommended for denial, and subsequently closed by DWR. The safe yield definition in the regulations was revised as well. The new definition "Sustainable yield" means the long-term yield of the source of supply, including hydraulically connected surface water or groundwater, allowing for the reasonable raising and lowering of the water table.

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10. *Id.* T-86-4 (1985).

11. Marios Sophocleous, *Groundwater Recharge Estimation and Regionalization: the Great Bend Prairie of Central Kansas and its Recharge Statistics,* 137 J. HYDROLOGY 113 (1992).

12. KAN. ADMIN. REGS. § 5-25-4 (1996).

In December 1998, the District recommended to the Chief Engineer that the remainder of the District be closed to further appropriation. Further evaluations had revealed each of the remaining basins to be over-appropriated, based upon a comparison of the amount of groundwater development to the recharge value. As of December 1998, the whole District was closed to large-scale development.

C. Flowmeters

Another important and controversial issue in the District is its need to obtain accurate information about water use in the District. After several years of board debate, the District required in-line flowmeters to be installed on the diversion works of new wells and of replacement wells applied for after February, 1984. This was the beginning of an effort to meter all wells within the District. Addressing the metering of wells as they were drilled or redrilled began a transitional program by the District to obtain and maintain vital water use information. The installation of flowmeters to measure water use would not only give policy makers and scientists more reliable data, but could help the water user become more efficient in his use of water as well.

In 1988, the Board went one step further, and adopted a policy that would enhance the District's efforts in obtaining accurate water use. The policy was designed to allow two options: (1) install a permanent in-line flowmeter, or (2) install an hour meter, along with a port placed at a location on the well where a flow rate could be determined at least once a year.

In October 1991, the board revised the metered well policy, deleting the option to install an hour meter and port, and requiring permanent in-line flowmeters on all non-domestic wells. The policy was not in regulation format, but the ability to require meters was and still is explicit in the Groundwater Management District Act.[13] The meters were required to be installed by January 1993. The board incorporated the meter policy into their regulations in May 1996.[14]

D. Existing Development: the Interaction between Surface Water and Groundwater

As originally designed, the District's sustainable yield program only addressed future well development. The policy did not consider existing development and the impact of that development on streams within the District. In 1996, base flow to streams was incorporated into the District's regulations, and would serve to protect the streams in those basins where development was still allowed.

Both the hydrological interaction between surface water and groundwater,

13. KAN. STAT. ANN. § 82a-1028(l) (2005).
14. KAN. ADMIN. REGS. § 5-25-5(a) (2003).

and the management of that interaction are contentious issues, and are becoming more so every day. The Chief Engineer's establishment in 1992 of an IGUCA on Wet Walnut Creek changed, in many ways, how the District would look at these interaction issues in the future.[15] Prior to the Walnut Creek IGUCA, surface / groundwater interaction had not been considered in the District's programs. That changed when the Kansas Wildlife and Parks, which manages Cheyenne Bottoms, an area now designated as a wetland of international importance, requested that the chief engineer initiate proceedings for the designation of an IGUCA in all areas that affect Cheyenne Bottoms water right in the Walnut Creek drainage basin. The issue of surface / groundwater interaction and the management of that interaction which had evolved from the Walnut Creek IGUCA would eventually be explored in other basins with declines in stream flow, such as the Rattlesnake Creek and Middle Arkansas River Sub-basins. Both of these basins have been the focus of state agency programs in recent years. State water plan goals were developed later on defining sustainable yield at the state level. The sub-basin management program funded through the State Water Plan and operated out of DWR was also established in the early 1990's to address surface / groundwater issues at the state level. Since then, a number of management programs have been developed to address water use and its impact on the interaction between streams and aquifers.

E. Conservation and Education

Several of the programs developed to address stream flow issues and changes in groundwater regulation hinge upon voluntary and incentive-based initiatives. The District actively promotes water conservation, and has adopted several strategies to meet the goals of these programs. The District publishes a quarterly newsletter and issues other press releases and brochures as needed. It has developed numerous educational programs to promote irrigation efficiency, water conservation, irrigation scheduling, and other practices. Farming practices such as strip till and no-till have also been promoted with success throughout the District. In 1995, the District installed the first of ten weather stations at strategically-placed locations throughout the District to give irrigators accurate evapotranspiration data for use in their scheduling the pumping and application of groundwater to crops. The District has also cooperated with several state and federal agencies to improve water conservation. The Natural Resource Conservation Service (NRCS) and the Kansas State University Extension Service have both collaborated with the District to promote wise water use. The State Conservation Commission (SCC) has also provided incentive payments to irrigators to accelerate their conversion to more efficient irrigation systems. The conversion from gravity irrigation to sprinkler irrigation in the

15. DIVISION OF WATER RESOURCES, KANSAS STATE BOARD OF AGRICULTURE, IN THE MATTER OF THE DESIGNATION OF AN INTENSIVE GROUND-WATER USE CONTROL AREA IN BARTON, RUSH AND NESS COUNTIES, KANSAS (1992).

1970's, together with the conversion from high impact sprinklers to low-pressure drop nozzles, have drastically improved both irrigation and water efficiency.

F. Water Quality

Protecting water from degradation has always been an integral part of the District's management plan. Salty water at the base of the fresh water aquifer in the eastern part of the District has required the board to conduct several research studies over the years to protect the fresh water in the aquifer. Multilayer observation wells were installed at each township corner to determine the extent of the salt water. The District conducted numerous studies in cooperation with the KGS to broaden the database on the problem, and eventually developed rules and regulations to control wells that could potentially cause the mixing of the waters. Abandoned wells also pose problems if not properly plugged, because they can be a direct conduit for contaminants. The board promotes the proper plugging of abandoned wells through their educational and public service programs.

IV. LESSONS LEARNED

The District's reduction of groundwater use and its ultimate closure to new groundwater appropriations clearly reflects the intent of local leadership to manage groundwater for future generations. Recognizing the need to obtain accurate water use information guided the board's decision to require water meters on all permitted wells, adding to its efforts to obtain accurate water use data. Continued research in water quality issues allowed the board to adopt regulations protecting sensitive areas. Conservation programs have been extensively promoted throughout the years, and public education programs continue to be an integral part of the District's efforts. It is not easy to manage a finite and fluctuating resource for the future while maintaining economically viable communities. There has always been some level of economic impact associated with every water restriction or water regulation. It is not clear what extent the impact would have been if no controls had been in place and if senior water users became impaired. Nor is it clear what the economic impact might have been under state control, since the area might have been managed differently.

Science and research involving hydrogeology has also evolved over the years, and technology is continually influencing the review and processing of scientific data. Computer models are an example of the evolution of technology in the evaluation of the groundwater resources. Predictive groundwater flow models are being used as a tool to predict future impacts of groundwater withdrawals. Groundwater modeling is also widely used and accepted throughout the world, but it is only as good as the data that is used in conjunction with it. Science is central to the development of sound groundwater policy; but it must be good science, with good data, or it will not be accepted.

The Board has always tried to develop an integrated approach to water management that encompasses all aspects water as a resource, including data collection programs and continued research aimed at enhancing policy decisions. An enormous amount of research has been conducted in the District which has highly influenced the making of policy. Future programs will depend upon the continuance of these efforts.

Probably the most controversial issue confronting the people of this District is the State Water Plan's goal of reaching and then maintaining sustainable yield in this area of Kansas. The management of the interaction between surface water and groundwater will require the District and Kansas to look at the existing development in several basins. The Wet Walnut Creek IGUCA set the stage for groundwater right reductions to meet the needs of senior surface right holders. Stream flow to others means maintaining flow for wildlife habitat, recreational uses, and even aesthetic purposes. How the District manages surface water and groundwater as a single source will become increasingly important in the future. Reorganization of District and management programs will be needed to address the issue appropriately.

The election of District directors also affects anagement decisions at the local level. As groundwater management issues become more controversial, so too will the diverse opinions and differing perspectives of the local leaders. Maintaining distinct and clear policies should help direct new management in the decision making process.

Managing groundwater by political boundaries instead of by drainage basin boundaries will become an even greater issue in the future, if this tension between hydrology and politics goes unrecognized. Where different governing bodies overlap drainage basins, collaboration will be needed to develop a holistic approach to the implementation of groundwater policies. Stream flow and groundwater conditions within a basin which is split by jurisdictional boundaries will be influenced by all of the different management practices in each jurisdiction. Determining the impact of these differences will be critical in the acceptance of any plan development. Orientation programs should be developed to educate new members of the District board on all active programs and policy. This will help broaden the individual's perspectives and philosophies and should help maintain continuity in management decisions.

V. CONCLUSION

The District has succeeded in its past endeavors, but it will become increasingly more difficult for local leaders if and when more restrictions arise to address over- appropriation and to meet the needs of senior water rights holders. The focus of state agencies in maintaining sustainable yield will bring new challenges to this area of Kansas as well. How the District addresses the sustainable yield issue will influence policy at the local level in the future. Local and state leaders must also consider the economic impact of whatever restrictions emerge. The Kansas legislature needs to be continuously aware of the potential economic impact of State Water Plan goals and should fund programs that reduce the impact. Federal programs need to be re-evaluated to promote conservation and incentive-based programs.

Efforts should continue to include innovative programs to meet the needs of all the people in the area, maintain the economy, and manage water for the future. The use of an arbitrator to resolve groundwater conflicts, whether between state and local leaders or between local water users, is another idea that needs further consideration.

Local water users need to recognize the need for water conservation programs. They need to further evaluate how to profitably produce alternative crops that reduce water use. And any plan that calls for the reduction of existing water rights will need to be based on accurate scientific data, if that plan is to be accepted by water users.

After thirty years of operation, I believe that the District has been successful in its efforts to manage groundwater in accordance with the Act. Although there will be numerous challenges in the future, groundwater management can be maintained at the local level.