

**KANSAS GEOLOGICAL SURVEY
OPEN-FILE REPORT 86-15**

Stream-aquifer Interaction Study of the
Arkansas River from Kinsley to Great Bend
Progress Reports I, II and III

by

Marios Sophocleous

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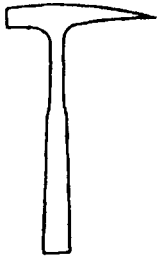
STREAM-AQUIFER INTERACTION STUDY OF THE
ARKANSAS RIVER FROM KINSLEY TO GREAT BEND

Progress reports I, II and III

by:

Marios Sophocleous

Kansas Geological Survey
Open-File Report 86-15
Lawrence, Kansas
September 1986



KANSAS GEOLOGICAL SURVEY

1930 Constant Avenue, Campus West
The University of Kansas
Lawrence, Kansas 66044-3896
913-864-5672

MEMORANDUM

TO: Joseph Harkins

FROM: Marios Sophocleous

RE: Stream-Aquifer Interaction Study of the Arkansas River from
Kinsley to Great Bend

DATE: January 6, 1986

In an effort to keep you informed on our progress on the Arkansas River project the following is a brief summary of activities to date.

1) A partial literature review on hydrogeologic studies related to the Arkansas River has been conducted. Available hydrologic, geologic, climatic, soil and other data, including numerous drillers logs, have been collected and are under periodic study. To assist us in data compilation and analysis a student assistant was hired by KGS for this project in November 1985.

2) We visited the Kinsley to Great Bend reach and selected sites near Great Bend during October, November and December 1985. We selected several possible sites for stream gauging as well as a possible site for a stream-aquifer pumping test 3 to 4 miles east of Great Bend (Sec. 32, T.19S, R.12W). During the October-November visits we noticed that the Arkansas River from southwest of Kinsley to Great Bend was dry or non-flowing, and therefore the initial plan of selecting a site for a stream-aquifer pump test near Kinsley was cancelled. Natural flow in the Arkansas River was observed only from near the intersection of Highways 56 and 281 at Great Bend eastwards. The owner of the tentatively selected field for pump testing was contacted through GMD #5 and tentative permission for running the test at his property was granted, provided we fenced the area and warning signs are posted. It should be noted that because of the dryness of the Arkansas River throughout most of its reach in the study area, the choice in site selection for a stream-aquifer test was very limited. Our tentative choice of a pumping site represents a compromise of several factors imposed by site availability and time constraints.

3) A test hole was drilled in November 1985 at the tentatively selected site to investigate the lithology of the alluvium and depth to bedrock. Samples were collected and grain size analyses on the collected sediments were performed at the KGS porous media lab. A typical grain size sample analysis and other relevant information is included in the drilling well specifications, indicated in item 4) below.

4) Detailed specifications covering the construction, sampling, development and testing of the pumping well for the stream-aquifer testing have been written and are to be submitted for open bidding to Kansas drillers shortly. A copy of the specifications is included for your information (Attachment A).

5) Most equipment outlined in the contract was selected and ordered, but not received yet. Further supplies and probably some additional equipment is yet to be ordered.

6) We organized the logistics and carried out a mass water level measurement survey for the entire Arkansas River reach from Kinsley to Great Bend, including the Cheyenne Bottoms and nearby area, during December 16 to 20, 1985. 182 wells were measured during that survey.

7) A 1/2 inch to 1 mile base map of the study reach and nearby area has been digitized and working (blue-line) copies were obtained. Available bedrock data from various sources were compiled. We are currently working with the KGS Computer Graphics facility for digitizing and displaying bedrock and water level data.

8) Water rights data were obtained from DWR and GMD #5 files and a plat with all water rights locations in the study area was compiled. The area covered was from southwest Edwards County to immediately west of Ellinwood in Barton County. In addition, all groundwater rights were tallied by year and the cumulative number of groundwater rights issued since 1945 were plotted versus time (Attachment B). This plot shows that a dramatic increase in groundwater rights issued occurred in the last decade, during which time the number of groundwater rights issued was approximately twice the total number of the previous three decades combined!

9) A soils map of the Arkansas River valley in Edwards, Pawnee, Stafford and Barton counties was prepared based on SCS reports and some air photos. We also ordered and received some air photos of the selected pump test site and vicinity. We are also in contact with the K.U. Space Technology Center for viewing ASCS slides of the Arkansas River valley on a section by section basis.

10) We are currently working on analyzing soils information (soil moisture capacities, depths, areas etc.), checking and plotting water level and bedrock data for the valley, ordering and preparing materials and equipment as well as arranging the logistics for the stream-aquifer pump testing which we plan to conduct early this coming spring. We are also arranging with our drilling services for installing observation wells near the selected stream gauging sites and elsewhere.

11) We would need the field assistance of state and local agencies with personnel available in the study area to assist in bimonthly streamgauging of a few selected sites. GMD #5 already offered to provide some assistance in this regard, but we would also appreciate some additional assistance from the DWR, preferably the Stafford field office, and also the Kansas Fish & Game Commission. Some assistance in water level measurements during the stream-aquifer testing will also be needed. We would like to take this opportunity to express our appreciation and gratitude to the GMD #5 for their valuable assistance throughout this study.

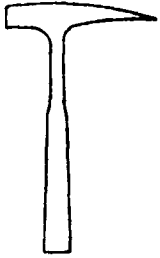
12) Finally, I would like to emphasize the close coordination and mutual assistance between the ongoing Cheyenne Bottoms study at KGS and this present study.

I will try to keep you informed as more information becomes available. If you have any questions or concerns, please feel free to contact me.

Sincerely,

Marios Sophocleous
Project Principal Investigator

cc: W. Hambleton
M. Heidari
D. Steeples
D. Pope
R. Davis
W. Hanzlick



KANSAS GEOLOGICAL SURVEY

1930 Constant Avenue, Campus West
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MEMORANDUM

TO: Darrel Eklund

FROM: Marios Sophocleous 

SUBJECT: Stream-Aquifer Interaction Study of the Arkansas River from Kinsley to Great Bend

DATE: May 22, 1986

The following is a brief summary of activities to date since the last progress report dated January 6, 1986, submitted to your agency.

- 1) Two separate data bases of bedrock data (one compiled by the USGS for the 1978 KGS Series No. 4 report on the Geohydrology of the Great Bend Prairie, South-Central Kansas by S. Fader and L. Stulken, and the other by the Groundwater Management District No. 5) were combined and digitized at KGS under the supervision of Tom McClain of KGS. This combined data base, consisting of 2019 points, was then plotted on a scale of 1:125,000 and was hand-contoured on a 50-foot contouring interval. A number of west to east channels across the entire Big Bend Prairie are evident from this bedrock map.
- 2) The water level data from the December 1985 mass measurement survey mentioned in the previous report were combined with the 1985 regular (annual) water level measurements for the Great Bend Prairie, and digitized at the KGS Computer graphics facility on the same scale as the bedrock map above. An updated water-table contour map of the region based on 363 data points was contoured.
- 3) A pump test site for the Arkansas River stream-aquifer testing program was selected. The site is located near Great Bend in T.19S, R.13W, Sec. 36 and belongs to Mr. Dale Weller of Great Bend. Mr. Weller was extremely cooperative and granted us all necessary permissions and facilities to conduct our study.
- 4) A water right permit application was then filed with the DWR and a special water right was obtained for conducting the proposed test.
- 5) A drilling contract for drilling a 20-inch irrigation well and two 5-inch observation wells, as well as renting a large capacity pump was sent out to several Kansas water well drillers for bidding. Clark Well and Equipment Inc. of Great Bend was the lowest bidder and was awarded the bid.

Darrel Eklund

May 22, 1986

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- 6) A stream-gauging program throughout the Kinsley to Great Bend study reach of the Arkansas River was initiated last March, 1986 with the DWR, GMD #5 and KP&GC cooperating in stream-gauging 9 sites in the Arkansas River valley twice a month.
- 7) Numerous lithologic drillers' logs from locations throughout the Arkansas River Valley from Kinsley to Great Bend were selected, digitized, and run through a computer program (that uses lithology and thickness) to obtain estimates of hydraulic conductivity and specific yield for the Arkansas River alluvium. Maps indicating the distribution of these hydrogeologic properties across the Arkansas River valley are in preparation.
- 8) A number of mini-piezometers and seepage meters were constructed at KGS for use at the selected pump test site by Great Bend. During the months of March and April 1986 a drilling program was undertaken near Great Bend during which the following items were installed and completed by KGS: four 5-inch observation wells, including one near Dartmouth east of Great Bend; twelve 2-inch observation wells; eight 1.5 inch well points; one neutron access tube; five minipiezometers; and seven seepage meters, including an automated one. A weather station was also installed at the site.
- 9) A large logistics and organization effort was undertaken in order to conduct a stream-aquifer test on time, before the irrigation season was well underway. Margaret Townsend, Tom McClain and Lynn Vogler, in addition to myself, were the organizing team. All necessary equipment and supplies were brought to the pumping test site. On April 21, 1986 an 8-day pumping test, at an approximate pumping rate of 1800 gal per minute, was initiated followed by several days of well recovery measurements. In addition, three stream-gauging locations at the pumping test site were selected for monitoring. Sixteen people were at hand for the first two days of the pumping test for measuring water levels in 25 observation wells, 5 minipiezometers, 4 nearby irrigation wells and the pumping well, for stream-gauging 3 sections of the Arkansas River, for running the neutron probe and 7 seepage meters, for sampling ground and surface water for quality analyses, for changing charts from numerous water-level and meteorological recorders, among other things. A tentative schematic map (not to scale) of the pump-test site layout of wells is attached. We are thankful to the DWR-Stafford Field Office for contributing up to 4 people during the intensive monitoring periods of drawdown and recovery, to the GMD #5 for contributing up to 2 people, to the KP&GC for contributing 1 person, and to the Geohydrology Section of KGS for contributing up to 10 staff members and students.

Darrel Eklund
May 22, 1986
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- 10) We are particularly appreciative of the cooperation and assistance provided to us by GMD #5, which also loaned us their neutron probe because of malfunctions of both the KGS probe and of a rental unit.
- 11) The Geophysics group of KGS also participated in this project by conducting a number of seismic reflection lines during drawdown and recovery in order to evaluate the possibility of detecting the cone of depression by seismic methods. Also, the Chemical Services group of KGS is currently analyzing numerous water samples for chemical constituents.
- 12) We are now in the process of restoring Mr. Weller's property to its original condition by leveling and reseeding his land. The pumping well is sealed and locked in place and all observation wells in Mr. Wellers property are capped and wire fenced.
- 13) A great amount of data have been collected during the prepumping, drawdown and well recovery stages of the stream-aquifer testing program. Several months will be required to fully analyse this volume of data. As soon as this data analysis is completed all cooperating parties will be fully informed as to the results.
- 14) The next two items in the agenda are a) to conduct a detailed land survey of the pump test site and b) to run a borehole geophysical survey of drilled holes.
- 15) Finally, I would like to specially acknowledge the field assistance provided by my colleagues, especially Margaret Townsend and Lynn Vogler who braved long days, including weekends, with me in the field.

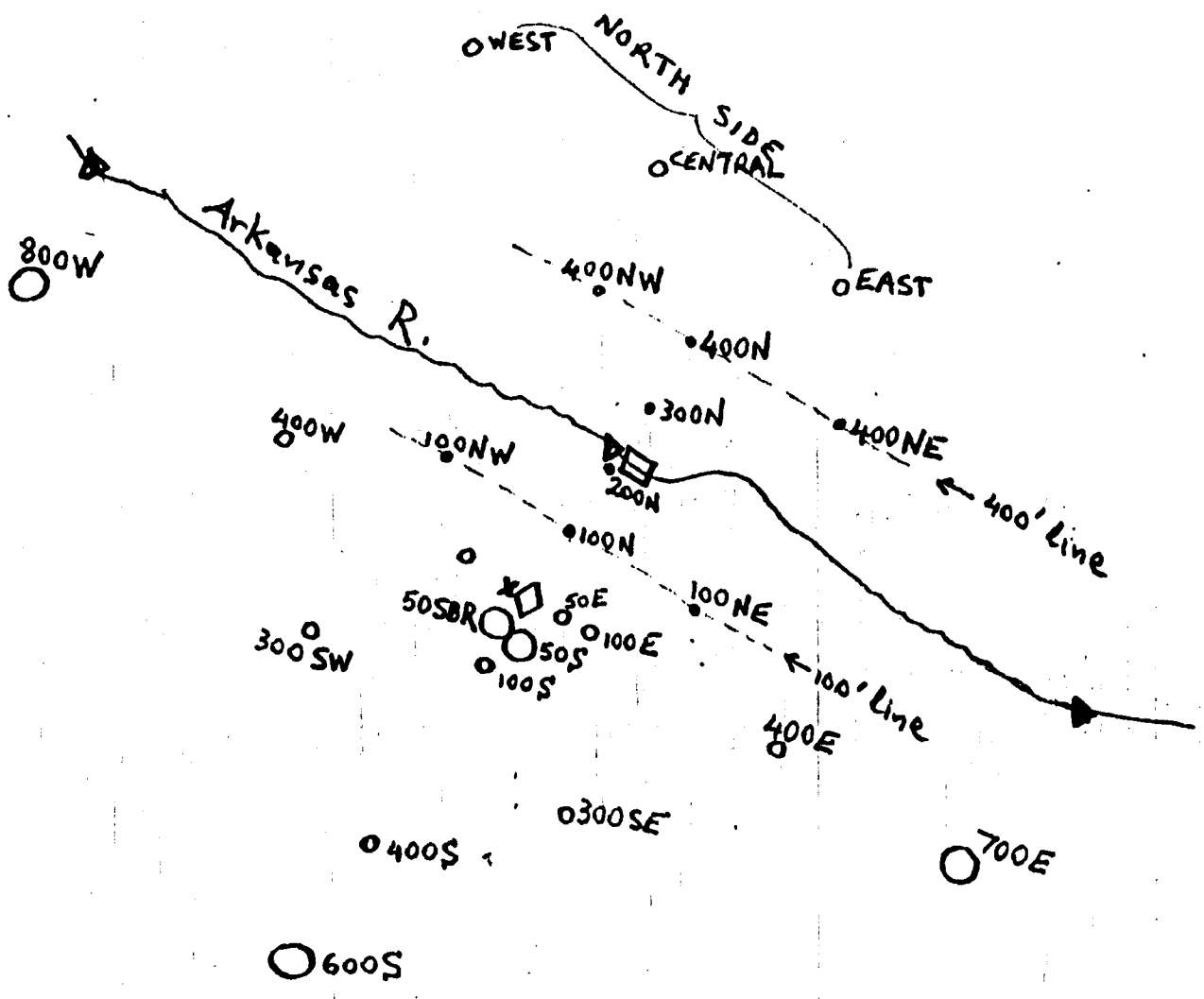
If you have any questions or concerns, please feel free to contact me.

Sincerely,



Marios Sophocleous

cc: W.W. Hambleton
D. Steeples
M. Heidari
D. Pope
B. Frisbie
R. Davis
B. Hanzlick

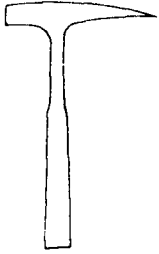


EXPLANATION

- ◇ pumping well
- 5-in observ. well
- 2-in observ. well
- 1.5-in well point
- ▲ streamgauging site
- x neutron probe
- seepage & minipiezom. site
- BR bedrock well

well designation above indicates distance and approx. direction from the pumping well (e.g. 100E = 100 ft. east of pumping well)

NOT TO SCALE



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MEMORANDUM

TO: Darrel Eklund

FROM: Marios Sophocleous

RE: Stream-Aquifer Interaction Study of the Arkansas River from Kinsley
to Great Bend

DATE: August 28, 1986

The following is a brief summary of activities to date since the last progress report dated May 22, 1986, submitted to your agency.

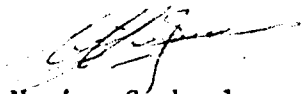
- 1) The pump test and water level recovery monitoring ended last May, after which a leveling and reseeding operation of the pump test site was undertaken.
- 2) Last June, a detailed land surveying of the pump test site was undertaken with the expert assistance of Mr. Nadeem Shaukat of the Kansas Geological Survey. A detailed location map with land surface elevations was then prepared.
- 3) Last July, a geophysical logging survey of most observation wells at the pump test site was undertaken. Natural gamma logging traces from this survey were plotted to scale, and geophysical cross sections were prepared. It is evident from these geophysical and driller's logs that no continuous layering exist at the pump test site.
- 4) Drillers logs forms were completed for all drilled wells at the pump test site and mailed to the Regulation and Permitting section of the Bureau of Environmental Geology of the Department of Health and Environment.

- 5) Another geochemical sampling program was undertaken at the pump test site last July, under the supervision of Ms. Margaret Townsend, to monitor any possible water quality changes as a result of our pumping test. All geochemical data were analyzed and graphically displayed. A preliminary evaluation of these data indicated that overall no significant water quality changes were observed at the pump test site, with the possible exception of the pumping well, whose Cl and SO₄ concentrations increased with time resulting in a field specific conductance increase from 790 μ mhos before the test to 960 μ mhos right after the test.
- 6) Most of the manually collected pump test data were entered into the KGS computer, and debugging routines were written to check all input data. Graphics routines were also written to display the pump test data in formats suitable for data analysis. Stevens recorder data are now being digitized using KGS digitizing tables. Automated pump test analysis computer programs, developed at KGS, have been adapted and compiled for analysis of our data. The current emphasis is on drawdown and recovery analysis of the pump test data.
- 7) All neutron data have been processed and graphically displayed. It is found that although the water table had dropped significantly, and very fast, in the vicinity of the pump well, drainage of the sediments in the vicinity of the prepumping static water table was very slow, with the drainage effects appearing only in the top two feet below the static water table. Also, full resaturation of the drained region during recovery was very slow, despite the extremely fast water table recovery, because of the slow diffusion of entrapped air in the dewatered sediments. The neutron data analysis was crucial in interpreting the KGS seismic reflection surveys at the site during pumping and recovery.
- 8) Analysis of streamflow and seepage measurements indicate that during the pump test, streamflow decreased at a rate of almost 1 cfs/day, as a result of pumping approximately 3.9 cfs (1750 gpm) from the alluvial aquifer near the stream. The average streamflow decreased from approximately 7 cfs just before the pump test to approximately 2 cfs by the 5th day of pumping. Also, the measured groundwater seepage to the streambed was found to decrease significantly, thus demonstrating the impact of groundwater pumping on the stream.
- 9) A hydraulic conductivity and a specific yield map of the Arkansas River valley have been constructed based on 75 selected detailed lithologic logs throughout the area. A computer program was used to compute these values from the lithology and bed thickness of the analyzed drillers logs. However, more detailed driller logs are needed to get a clearer picture of the spatial distribution of these hydrogeologic parameters.

Darrel Eklund
August 28, 1986
Page 3

If you have any questions or concerns, please feel free to contact me.

Sincerely yours,



Marios Sophocleous

cc: W.W. Hambleton
D. Steeples
M. Heidari
D. Pope
B. Frisbie
R. Davis
B. Hanzlick