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Burrton IGUCA Review Hearing Testimony
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Today I will present information on the review of the Burrton Intensive Groundwater Use Control Area. This is the first in a series of periodic IGUCA Reviews by the State of Kansas which will present the evidence and analyses relied upon by the Kansas Department of Agriculture, Division of Water Resources in its review and evaluation of the performance of the Burrton IGUCA. This review was performed pursuant to K.A.R. 5-20-2 which prescribes in part that the state shall have the burden of proving the need for continuance of the IGUCA designation. Guidelines from K.A.R 5-20-2 have been used to develop recommendations related to the Burrton IGUCA for the Chief Engineer through the public hearing process.

The following KDA-DWR staff members were on the review team for this report:

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The review team would like to thank Equus Beds Groundwater Management District No. 2 staff, particularly Tim Boese, Steve Flaherty, and the GMD No. 2 Board of Directors for assisting in preparing the review report and Don Whittemore of the Kansas Geological Survey for data and technical assistance.

The review team prepared this report independently from and without counsel or direction from the Chief Engineer's team.

In addition to the Burrton IGUCA review document, the review team would like to add the following documents to the written record:

- 1984 Burrton IGUCA order
- 1984 Burrton IGUCA correctional order
- Preliminary simulation of chloride transport in the Equus Beds aquifer and simulated effects of well pumping and artificial recharge on groundwater flow and chloride transport near the City of Wichita, Kansas, 1990 through 2008. Klager et al, 2014
- Distribution and Change in Salinity in the Equus Beds Aquifer in the Burrton Intensive Groundwater Use Control Area. Whittemore, 2012
- Proposed Burrton Intensive Groundwater Use Control Area: prepared for the Kansas State Board of Agriculture, Division of Water Resources. Burrton Task Force, 1984

To begin with, I will describe the purpose, objectives, and formation of the Burrton IGUCA and what all the Burrton IGUCA order entails. Then I will cover data used in the review and the procedure GMD No. 2 uses to review new applications in the area. Following that will be a walkthrough of the IGUCA Review Criteria, as stated in K.A.R. 5-20-2, along with the Review Team's recommendations associated with each criteria and conclusions.

Moving on to how the IGUCA was formed

On June 11, 1982, GMD # 2 requested DWR that proceedings be initiated to designate an IGUCA near Burrton, Kansas, on the basis of the deterioration of groundwater quality due to high chlorides from oil field brine contamination. The initial public hearing was held on Wednesday, August 4, 1982, in Burrton, Kansas, at which time the Burrton task force was developed. Members of the Burrton Task Force represented the following entities: GMD #2, Kansas Corporation Commission, Kansas Department of Health and Environment-Division of Environment, Bureau of Oil Field and Environmental Geology, Kansas Geological Survey, Kansas Independent Oil and Gas Association, Kansas Water Authority, and the Kansas Water Office.

At the second hearing, the task force report and recommendations were presented. Prior to 1931 and oil field activity, chloride concentrations in the Burrton area ranged from 10 to 100 mg/l. By 1948, chloride concentrations were found in excess of 1,000 mg/l. At the time of the task force report in 1984, the highest chloride concentration was 2,450 mg/l. At the second half of the hearing in 1984, Don Whittemore presented testimony on the source of pollution in the aquifer as that of oil-field brine based upon the bromide/chloride ratios.

On June 1, 1984 the Burrton IGUCA order was issued. The order was then amended on July 24, 1984 to extend the meter installation deadline by approximately one month.

*/*Order Conclusions*/*

The following conclusions were incorporated into the Burrton IGUCA order after the second hearing:

1. That unreasonable deterioration of the quality of water is occurring or may occur within the area in question.
2. That an IGUCA should be established and corrective control provisions initiated in order to protect the public interest.
3. That the boundaries of the IGUCA should be approximately 36 square miles in the vicinity of Burrton, Kansas, and defined those sections.
4. That in order to more accurately monitor the groundwater withdrawals in the area and the effect of those withdrawals on saltwater movement in the area, all groundwater users in the control area should be metered, except for domestic and temporary use.
5. That the public interest required all applications to appropriate water for beneficial use within the proposed IGUCA be reviewed on a case by case basis, and which may include analysis on the computer model constructed by the KGS, if appropriate.
6. That the recommendations of the Task Force should be forwarded to the other entities or agencies having jurisdiction or authority in the area.

It was ordered that GMD #2 shall annually review all hydrologic data in the IGUCA including, but not limited to, static water level information, water use information, water quality information; that annually GMD #2 may, no later than April 1, request a rehearing before the Chief Engineer on the matter of the boundaries of the IGUCA, the reconsideration of corrective control provisions or any other matters relative to this IGUCA.

*/*Data*/*

Groundwater levels, precipitation, groundwater rights, groundwater use and chloride concentration data were considered to help guide analysis of the IGUCA review.

*/*Groundwater levels*/*

Groundwater level changes within the Burrton IGUCA have not varied much between the pre-IGUCA (1960-1984) and post-IGUCA (1984-2015) time periods and levels remain relatively stable.

Though the Burrton IGUCA focuses on water quality, groundwater level changes will increase or decrease the rate of a plume's movement as hydrologic gradients increase or decrease respectively. Of particular importance are groundwater-level declines near the Wichita well field, which lies in the path of the plume (Whittemore, 2012). The Wichita well field began providing water supply in the 1940s and is located in southwest Harvey County and northwest Sedgwick County. The Wichita well field is located to the southeast of the Burrton IGUCA and groundwater level declines from pumping there have been identified as likely to increase the rate of the Burrton chloride plume movement (Hansen, 2007). Groundwater model simulations of the Burrton chloride plume by the USGS (Klager et al, 2014) showed

that even without the pumping in the Wichita well field, the Burrton chloride plume would continue to move toward the Wichita well field area

*/*Precipitation*/*

Analysis of precipitation showed very little variation in trends between pre- and post-IGUCA conditions.

*/*Groundwater rights*/*

As of September 20, 2016 there were 72 active groundwater rights within the Burrton IGUCA (**Table 1**). Total authorized quantity for rights within the Burrton IGUCA is 7,754.09 acre-feet per year. Approximately 92% of the authorized quantity for groundwater use was for irrigation. There were no surface water rights in the area at the time of this review. (**Figure 9**)

*/*Groundwater Use*/*

Average annual groundwater use within the Burrton IGUCA was 4,800 acre-feet per year over the last 10 years (2005 to 2014) and was primarily for irrigation. The Burrton IGUCA order required the monitoring of groundwater withdrawals except for domestic and temporary uses which helped to increase data quality. **Figure 8**

Moving on to Chloride Concentrations…

*/*Monitoring Network*/*

Most of the chloride data analyses and results were taken from the report Whittemore developed in 2012 for DWR. GMD #2 and the USGS monitor many wells for chlorides in and around the Burrton IGUCA and the most recent chloride data has been included from analysis and graphics prepared by GMD #2.

Whittemore used the GMD #2 groundwater monitoring network to monitor salinity changes in the Burrton IGUCA (**Figure 10**). With the establishment of GMD #2 in 1975, a groundwater monitoring network was developed to monitor water levels and quality. In the Burrton oil field area the first wells were installed and sampled in 1979 to improve knowledge about the saltwater contamination (*Whittemore, 2012 p. 2).*

The network includes:

1. EB wells: constructed by GMD #2 are generally screened at four different depth zones though not all sites have screens at each depth,
2. P wells: constructed by the City of Wichita before GMD #2 was formed and also considered part of the GMD #2 network,
3. IW wells: USGS/City of Wichita,
4. Other wells (domestic, municipal, etc.)

*/*Burrton Plume Movement 1982-2010*/*

From 1982-2010 the Burrton chloride plume migrated some 1.5 to 2 miles to the east; equivalent to about 0.8 to 1.0 foot per day (Whittemore, 2012, p. 21). The nearest municipal supply well of the City of Wichita well field was within about a mile of the 500 mg/L plume front during the reporting period (2012) and directly in the current path of migration (Whittemore, 2012, p. 31). Because saline water is denser than fresh water, the plume has also migrated to greater depths over time (Whittemore, 2012, p. 22). The migration of the saline water has also been affected by the distribution of clay layers within the Equus Beds aquifer. When the brine water came into contact with a clay layer it moved in the direction of groundwater flow along the top of the clay until it reached the edge of the clay and downward migration could continue (Whittemore, 2012, p. 24).

As the plume moves eastward and deeper into the ground, areas to the west should continue to show a decrease in chloride concentration. Whittemore suggested that areas containing water once unusable for irrigation, stock and drinking, would increasingly meet standards on the western edge of the IGUCA boundary (Whittemore, 2012, p. 29).

Since the 2010 report by Whittemore, GMD #2 has continued to sample and monitor wells within the Burrton IGUCA (**Figure 14**). 2015 chloride plume estimates for upper, middle and lower portions of the aquifer were created by GMD #2. (**Figures 15-17)**

Looking at the Future Movement of the Chloride Plume…

The highest 2010 chloride concentrations in the area were in the deep zone of EB8C at 1,900 mg/L (**Figure 18**). Towards the eastern edge at wells EB15B and EB14B, the chloride concentrations had reached 860 and 940 mg/L respectively. Similar levels have more recently moved to just outside of the current IGUCA boundary. Migration of the chloride plume to the east will eventually degrade the quality of groundwater along the southeastern part of Township 23 South, Range 3 West, and the northeast corner of Township 24 South, Range 3 West (Whittemore, 2012, p. 29).

According to Whittemore, the Burrton plume will eventually move to the cluster of municipal wells in the Wichita well field (**Figure 18**), but he expected that the plume would be diluted to a few hundred mg/L by then (Whittemore, 2012, p. 30). This study recommended additional monitoring to better track future plume movement.

Now we will look at the GMD #2 Procedures for New Applications Review.

GMD #2 staff evaluate all new applications to appropriate water that are filed within the GMD #2 boundaries to determine if the application complies with the District's rules and regulations and Revised Management Program.

On April 13, 2004, GMD #2 set the following criteria for applications filed in the Burrton IGUCA:

1. Applications filed for proposed points of diversion located down gradient of the maximum contamination areas of the saltwater plumes shall not be recommended for approval; and
2. Applications filed for proposed points of diversion located up gradient of the maximum contamination areas of the saltwater plumes shall be reviewed on a case-by-case basis by the district board of directors to determine site specific effects on the aquifer and prior appropriations.

Further information of the GMD #2's review process can be found in the Burrton IGUCA review.

Now I will step through the IGUCA Review Criteria as set forth in K.A.R. 5-20-2 and the review team's recommendations for each item:

Item (1) Continue the IGUCA with its original or current corrective control provisions.

Recommendation: **Yes**

The review team concluded that the IGUCA corrective controls are essential for protecting the public interest in water quality in the Burrton area and recommends that the current Burrton IGUCA corrective controls be maintained, subject to the implementation of recommended additional corrective controls.

Item (2) Reduce the restrictions imposed by one or more corrective control provisions within the scope and goals specified in the original IGUCA order.

Recommendation: **No**

The corrective controls are essential for protecting the public health and environment. Stronger or more specific measures may need to be considered and possibly written into the order.

Item (3) Reduce the IGUCA boundaries.

Recommendation: **No**

Even though salinity levels in the western part of the IGUCA may be decreasing, the review team recommends that these areas should still be monitored to determine if continued or increased pumping induces saline water to flow back into those areas.

Item (4) Increase any allocations within the IGUCA.

Recommendation: **No**

This IGUCA did not close the area to new appropriations or consider allocations and only addresses water quality.

Item (5) Address any other issues that have been identified in the review.

Recommendation: **Yes**

The current IGUCA corrective controls do not address chloride levels in existing authorized wells. The review team recommends that as the plume moves to the southeast, the wells in its path should be increasingly monitored and may need to have their permits modified through a subsequent hearing process if their pumping exacerbates the plume migration. The team further recommends that well operators in the path of the plume should consider well grouting practices even beyond those requirements set by KDHE.

Item (6) Revoke the IGUCA order and implement alternative measures, if necessary, to address the water issues in the affected areas.

Recommendation: **No**

This IGUCA is unique in that it addresses water quality. The review team recommends that the IGUCA remain in place to continue to protect the public interest.

Item (7) The restrictions imposed by current corrective control provisions may need to be increased or additional corrective control provisions may be needed.

Recommendation: Yes

Additional corrective controls such as more stringent well grouting requirements and modifications to the permits that authorize pumping in the path of the plume should be considered to further protect the public interest. Given the movement of the chloride plume, an expansion of the IGUCA boundaries to the southeast is recommended for consideration.

Item (8) The boundaries of the IGUCA may need to be increased.

Recommendation: Yes

To continue to protect the public interest, the review team recommends expanding the current IGUCA boundary by about 1 mile (or one section width) along the eastern and southern edges of the IGUCA, which would add nine sections to the IGUCA in the path of the plume (**Figure 21**).

Rate of plume movement was considered while proposing a potential area for expansion. Whittemore (2012) reported rate of plume movement as 0.8 to 1.0 foot per day. Based on that, it can be expected that chloride levels from 2010 may have already moved approximately a quarter of a mile as of the date of this report. It is expected that the chloride plume will move about another half of a mile in 10 years. According to Whittemore, the Burrton plume will eventually move to the cluster of municipal wells in the Wichita well field, but chloride concentrations may be diluted to a few hundred mg/L by then (Whittemore, 2012).

The review team also recommends that GMD #2's method of analyzing new applications be applied to existing water rights within the path of the plume.

To Conclude

The review team finds that the Burrton IGUCA corrective controls have been effective in protecting the public interest by establishing comprehensive water-quality based processes and criteria for processing new applications to appropriate water. The review team recommends the continuation and expansion of the Burrton IGUCA provisions.