

1 BIG BEND GROUNDWATER
2 MANAGEMENT DISTRICT
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REVISED MANAGEMENT PROGRAM

DRAFT

XXXXXXX, XXXX

Approved by: _____

Date: _____

Contents

1		
2	INTRODUCTION.....	<u>45</u>
3	PURPOSE OF DISTRICT	<u>56</u>
4	FORMATION OF DISTRICT	<u>67</u>
5	DISTRICT OPERATION	<u>89</u>
6	DISTRICT DESCRIPTION.....	<u>89</u>
7	A. LOCATION AND AREA	<u>89</u>
8	B. CLIMATE	<u>1011</u>
9	C. SOILS	<u>1011</u>
10	D. DRAINAGE BASINS.....	<u>1112</u>
11	E. WETLANDS.....	<u>1314</u>
12	F. GEOHYDROLOGY	<u>1314</u>
13	G. ECONOMY	<u>1516</u>
14	HYDROLOGIC MODELING.....	<u>1718</u>
15	A. BACKGROUND.....	<u>1718</u>
16	B. PURPOSE	<u>1819</u>
17	MANAGEMENT ISSUES.....	<u>1819</u>
18	A. WATER QUANTITY	<u>1819</u>
19	B. WATER QUALITY	<u>2324</u>
20	DISTRICT PROGRAMS	<u>2425</u>
21	A. CONSERVATION AND EFFICIENT APPLICATION OF WATER USE	<u>2425</u>
22	B. PUBLIC EDUCATION	<u>2526</u>
23	C. ACCURATE DATA BASE/GIS DATA MANAGEMENT	<u>2526</u>
24	D. CONTINUED RESEARCH.....	<u>2627</u>
25	E. WATER QUALITY	<u>2627</u>
26	F. FLOW METER PROGRAM:	<u>2829</u>
27	G. WATER RIGHTS ADMINISTRATION:.....	<u>2829</u>
28	ANNUAL REPORTING	<u>2829</u>
29	AREAS OF CONCERN AND ACTION PLANS.....	<u>29</u>
30	A. SUMMARY.....	<u>29</u>
31	B. PRIORITY AREAS:.....	<u>30</u>
32	C. SUPPLEMENTAL AREAS:.....	<u>30</u>
33	PRIORITY AREAS OF CONCERN	<u>31</u>
34	A. WATER QUANTITY	<u>31</u>
35	<i>Pawnee Valley Intensive Groundwater Use Control Area.....</i>	<i><u>31</u></i>
36	<i>Walnut Creek Intensive Groundwater Use Control Area</i>	<i><u>33</u></i>
37	<i>Rattlesnake Creek Region</i>	<i><u>35</u></i>
38	B. WATER QUALITY	<u>43</u>
39	<i>Chloride.....</i>	<i><u>43</u></i>
40	SUPPLEMENTAL AREAS UNDER CONSIDERATION.....	<u>45</u>
41	A. WATER QUANTITY	<u>45</u>
42	<i>Edwards-Kiowa County Region</i>	<i><u>45</u></i>
43	B. WATER QUALITY	<u>47</u>
44	<i>Nitrate.....</i>	<i><u>47</u></i>

1	BIBLIOGRAPHY	<u>5049</u>
2	<i>Revision History</i>	<i><u>5150</u></i>
3		
4	Figures & Maps	
5	Figure 1 – Annual Groundwater Appropriations	4
6	Figure 2 – Cumulative Active Water Rights.....	5
7	Figure 3 – District Boundaries	9
8	Figure 4 – Generalized Soil Types.....	11
9	Figure 5 – Hydrologic Units	13
10	Figure 6 – Bedrock Formations of the Great Bend Prairie aquifer	14
11	Figure 7 – Annual Water Use vs Appropriations.....	16
12	Figure 8 – Active Water Rights by Use	17
13	Figure 9 – District Model Boundary	18
14	Figure 10 – Percent Change in Aquifer Thickness (Predevelopment – 2022).....	21
15	Figure 11 – Percent Change in Aquifer Thickness (2002 – 2022).....	22
16	Figure 12 – 2023 Estimated Usable Lifetime	23
17	Figure 13 – Weather Station Network	25
18	Figure 14 - Pawnee Valley IGUCA	31
19	Figure 15 - Walnut Creek IGUCA.....	33
20	Figure 16 - Rattlesnake Creek Region	35
21	Figure 17 - Estimated Usable Lifetime	37
22	Figure 18 - Fringe Aquifer Regions.....	38
23	Figure 19 - Stable Water Table	39
24	Figure 20 - Declining Water Table	40
25	Figure 21 - Mineral Intrusion Area	43
26	Figure 22 - Edwards - Kiowa County Region.....	45
27	Figure 23 - Nitrate Concentrations.....	47
28		

INTRODUCTION

Big Bend Groundwater Management District Number Five was formed in 1976. From the date of inception, the District has actively developed management goals and established objectives to address water resource issues in the region. Progress has been made but there is more to be accomplished. With the combined efforts of the people of this District, problems can be met head on and resolved at the local level. Grassroots input and participation is critical to properly manage the local water resources.

Water resource development in Big Bend Groundwater Management District #5 (District) has greatly increased from the levels prior to 1960. ~~Figure 1~~ and ~~Figure 2~~ illustrate the active water rights in the District over the period of record, 1945 to 2024. The peaks in ~~Figure 1~~ can be correlated to political, technological, economical and meteorological events. Meanwhile, ~~Figure 2~~ shows the cumulative number of water rights and associated appropriated acre-feet within the District over time. There is an increasing demand for the use of this precious resource for a variety of needs including irrigation, municipal, industrial, and recreation. The high demand for the resource in this area has caused several areas of the District to become fully appropriated. As development expanded it became apparent that a need existed to properly manage the resource in terms of quality and quantity.

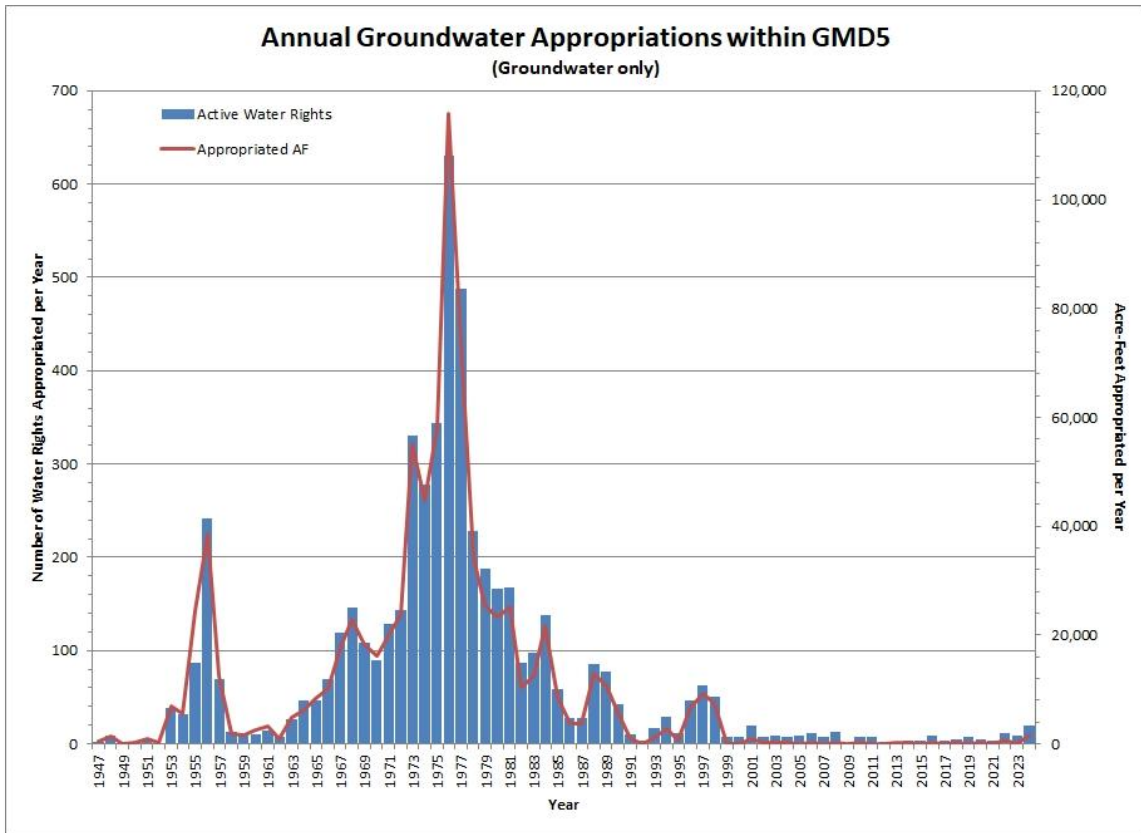


Figure 1 – Annual Groundwater Appropriations

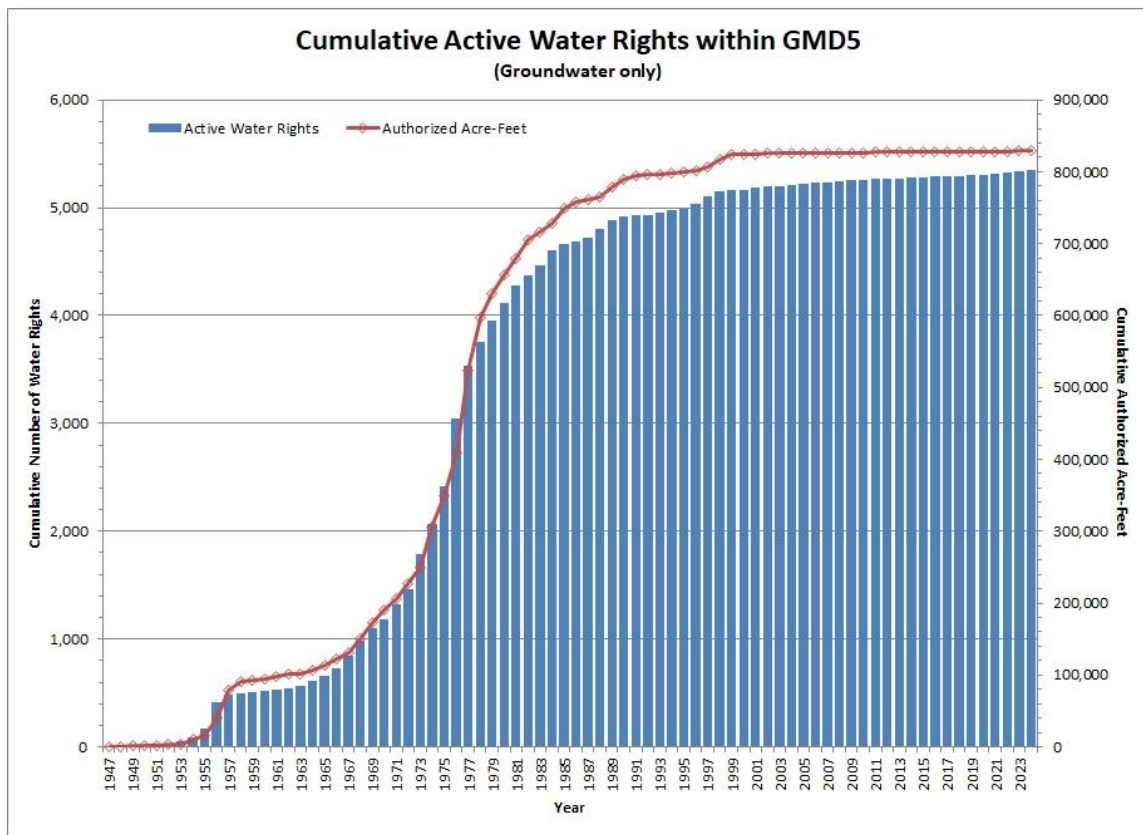


Figure 2 – Cumulative Active Water Rights

PURPOSE OF DISTRICT

The District was organized by concerned citizens to conserve, promote, and manage the groundwater resource to assure quality and quantity will be maintained for present and future needs. These citizens saw the need for the management of the groundwater resource at the local level, thus allowing local landowners and water users the opportunity to determine their own destiny with respect to the use of groundwater within the basic law of the State of Kansas.

K.S.A 82a-1020. Legislative declaration. It is hereby recognized that a need exists for the creation of special districts for the proper management of the groundwater resources of the state; for the conservation of groundwater resources; for the prevention of economic deterioration; for the associated endeavors within the state of Kansas through the stabilization of agriculture; and to secure for Kansas the benefit of its fertile soils and favorable location with respect to national markets. It is the policy of this act to preserve basic water use doctrine and establish the right of local water users to determine their destiny with respect to the use of groundwater insofar as it does not conflict with the basic laws and policies of the state of Kansas. It is, therefore, declared that in the public interest it is necessary and advisable to permit the establishment of groundwater management districts. (History: L. 1972, ch. 386, 1; July 1.)

FORMATION OF DISTRICT

Russell Herpich, irrigation engineer of Kansas State University, saw the potential of the Big Bend area for groundwater development in the 1960's and the urgent need to conserve and perpetuate this vast natural resource.

The 1972 Kansas Legislature enacted legislation enabling the formation of groundwater management districts (K.S.A. 82a-1020 et seq). The Pratt County Soil Conservation District Board of Supervisors, recognizing the benefits of such a district, called a meeting October 16, 1973, to which leaders from the area counties were invited to attend. A series of informative meetings followed, and a steering committee was formed to carry out the organization of the District according to the Kansas Groundwater Management District Act (K.S.A. 82a-1020 et seq). The following steering committee began to function April 11, 1974.

Phil Schrack, Chairman.....	Iuka, Ks
Nathan B. Hayes, Vice Chairman	Mullinville, Ks
Boyd Mundhenke, Secretary	Kinsley, Ks
Larry Panning.....	Ellinwood, Ks
Bill Ball	Sterling, Ks
Omar Schartz.....	Larned, Ks
Bob Wendelburg	Stafford, Ks
Don Brownlee*	Sylvia, Ks

*Don Brownlee represented Reno County even though he could not be a legal member of the committee - 7 being the maximum number on the steering committee.

The steering committee filed a declaration of intent and a proposed map of the District with the Chief Engineer of the Division of Water Resources, Kansas State Board of Agriculture April 16, 1974.

On October 22, 1975, the description of the lands to be included in the proposed District was certified by the Chief Engineer. A petition was then circulated by the steering committee. The petition was approved December 22, 1975, and election called for March 2, 1976, to allow eligible voters of the District the opportunity to decide if the District should be organized. Results of the election were 535 votes in favor and 211 opposed, passing by a 72% majority.

The Certificate of Incorporation was issued by the Secretary of State March 9, 1976 and has been filed in the register of deeds office in each of the eight counties within the District. An organizational meeting was held March 30, 1976, at the St. John Library for the purpose of electing directors and adopting bylaws. The following list reflects the county directors since 1976.

The District extends its sincere gratitude to the individuals who have generously volunteered their time to help make it a truly effective organization.

DIRECTORS BY COUNTY

BARTON COUNTY

Larry Panning 1974-1993
Milton Meyer 1993-1999
Philip Martin 1999-2002
David Essmiller 2002-2009
Philip Martin 2009-2023
Joe Schlessiger 2023-

EDWARDS COUNTY

Ray Cudney 1976-1984
Kenneth Keen 1984-1987
Tom Stejskal 1987-1990
Kevin Schultz 1990-2002
Mica Schnoebelen 2002-2005
Darrell Wood 2005-

RENO COUNTY

Bart Zongker 1976-1980
Eugene Horton 1980-1984
Ed Shultz 1984-2013
Justin Gatz 2013-2022
Gary Hornbaker 2022-

PAWNEE COUNTY

Omar Schartz 1976-1979
Howard Zook 1979-1986
E. Lee Musil 1986-1991
Robert Lewis 1991-2005
Ron Ashworth 2005-2006
Kraig Froetschner 2006-2011
Robert Standish 2011-2018
Kerry Froetschner 2018-

STAFFORD COUNTY

Robert Wendelburg 1974-1989
Sam Crissman 1989-2001

PRATT COUNTY

Don Fincham 1976-1977
Jerry Mott 1977-1989
Ron Schwerdtfeger 1989-1992
Eugene Stotts 1992-1998
Vernon Hirt 1998-2010
Fred Grunder 2010-

RICE COUNTY

Bill Ball 1976-1984
Greg Wellman 1984-1992
Curtis Tobias 1992-2017
Jerry Cullop 2017-2020
Craig Zwick 2020-

DIRECTOR AT LARGE

Willard McClure 1976-1979
Allen Klein 1979-1985
Kenneth Fenwick 1985-1988
Ron Arnold 1988-1994
Alan Crane 1994-2006
Kevin Schultz 2006-2011
Tom Taylor 2011-

KIOWA COUNTY

Cecil Vieux 1976-1977
John Rosenberger 1977-1982
Kenneth Rice 1982-1988
Russell Fralick 1988-1994
John Janssen 1994-2025
Kent Moore 2025-

DISTRICT OPERATION

The District office is located at 125 South Main, Stafford, Kansas. It is operated by the board of directors who are responsible for setting policy and objectives for the District. The District employs staff as necessary to carry out the programs of the District.

The board of ~~director's~~directors' focus is on best management practices to maintain quality and quantity of the local water resource. Local input is directed at new and improved methods of managing the water supply. The District supports research, education, demonstration projects and management guidelines.

The board of directors meet on the second Thursday each month to review activities of the District and develop programs. An annual meeting for all eligible voters is held early each year to provide information about the District's progress and allow additional input from the membership. Throughout the remainder of the calendar year, the District staff work closely with water users to address resource concerns and encourage proper stewardship of the regional aquifer.

DISTRICT DESCRIPTION

A. Location and Area

Big Bend Groundwater Management District #5 was named because of the proximity to the large bend of the Arkansas River in South Central Kansas. Portions of the District are located in both the High Plains section of the Great Plains physiographic province and the Arkansas River Lowland section of the Central Lowlands Province. The District encompasses approximately 2.5 million acres of land in portions of eight counties: Barton, Edwards, Kiowa, Pawnee, Pratt, Reno, Rice and Stafford (~~Figure 3~~Figure-3). ~~Table 1~~Table ~~1~~1 lists the total acreage for each county and the number of acres that have been removed from District assessment.

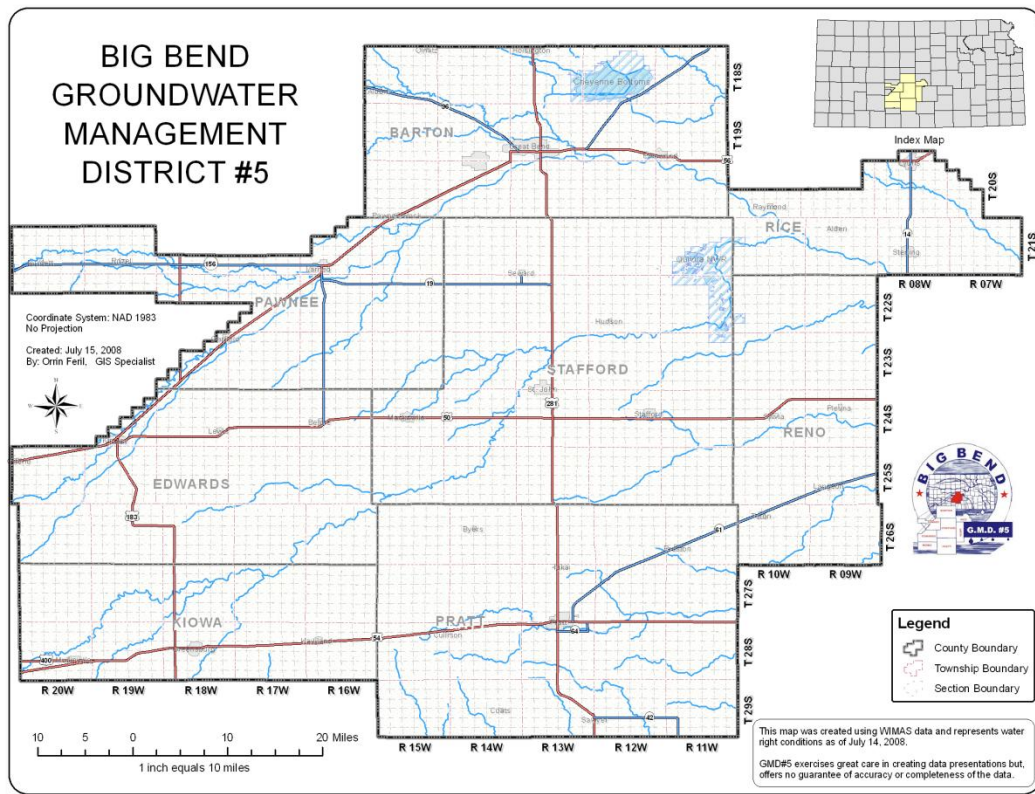


Figure 3 – District Boundaries

Acreage And Authorized Water Use Data						
10/01/2025						
County	Total Acres *	Acres Assessed **	Acres Petitioned Out	Irrigated Acres ***	Number of Wells ***	Acre-Feet Assessed
Barton	295,917	295,624	19,334	93,700	708	66,622
Edwards	297,341	297,177	5,549	156,429	1,185	147,283
Kiowa	220,052	219,969	2,313	68,707	536	77,961
Pawnee	248,660	248,397	4,184	130,652	998	113,474
Pratt	430,178	429,596	17,691	129,075	1,024	136,849
Reno	216,586	216,528	4,302	28,332	226	20,366
Rice	133,117	132,762	3,136	58,742	451	42,438
Stafford	433,146	432,628	34,108	136,803	1,000	128,235
Grand Total:	2,274,997	2,272,681	90,617	802,440	6,128	733,228

* Total acres calculated using updated GIS Data from Kansas Geological Survey
 ** Acres assessed plus acres excluded does not equal total acres due to lands exempt such as Federal land, municipalities, and tracts less than 40 acres.
 *** Irrigated Acres and Number of Wells are calculated using WIMAS data from Kansas Department of Agriculture - Division of Water Resources

Table 1 – Acres & Acre-Feet Authorized by County

B. Climate

The District is characterized by a continental-type climate. This type of climate has large diurnal and annual variations in temperature. The western half of the area has been classified by Thornthwaite as "dry subhumid" while the easternmost area of the District is classified as "subhumid" (Thornthwaite, 1948).

Precipitation varies considerably from the western edge to the eastern edge, with 20 inches of average annual precipitation in the west to 27 inches in the east. The average for the District is approximately 24 inches per year. The precipitation occurs in the form of rain, sleet, snow, freezing rain, and hail. About 75 percent of this occurs in the period from April to September associated with cyclonic and convective thunderstorm activity.

Temperature fluctuations are large in a continental type climate. Annual variations range from about -10 degrees Fahrenheit to about 105 degrees Fahrenheit. The growing season is sufficiently long so that frost is generally not a problem for most crops grown in the District.

C. Soils

The District has a variety of topographic regions ranging from the broad flat loess mantled Pawnee Valley to the active sand dunes in Edwards and Kiowa Counties. The majority of the District is characterized by low undulating dune topography on which the major drainage patterns have been superimposed. The major soils found in the District are described below and are depicted on [Figure 4](#).

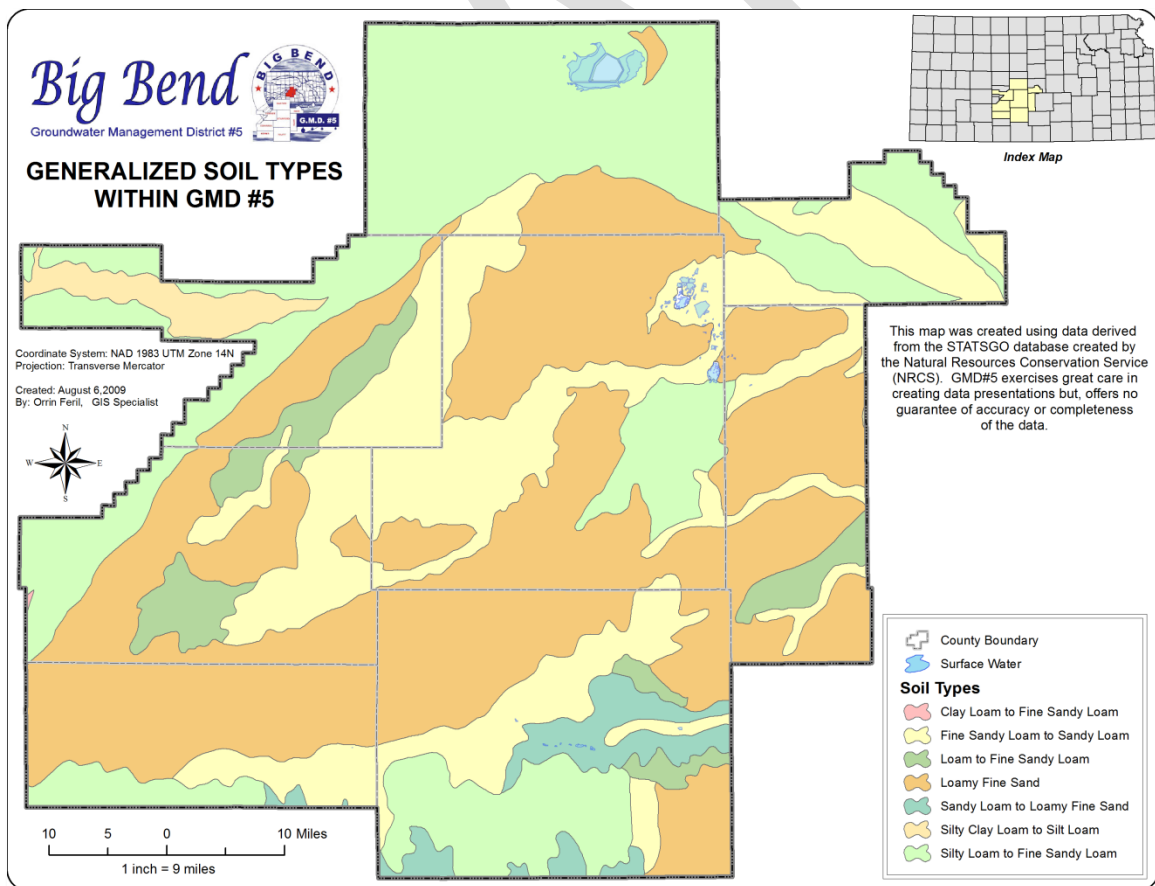


Figure 4 – Generalized Soil Types

1. The upland, hardland areas of Barton, Pawnee, Pratt, Edwards, Rice, and Kiowa Counties consist of well-developed silty and clayey soils. They are dominantly well drained, deep, fertile soils. Some small places of rock and shale occur on slopes. Water erosion and soil blowing are the major concerns of soil management.
2. The flood plain areas of the major rivers such as the Arkansas River, Rattlesnake Creek, South Fork Ninnescah River, and North Fork Ninnescah River consist of poorly drained and somewhat poorly drained sandy and loamy flooded soils. They are deep to shallow over sandy strata with a fluctuating water table. They are slightly to moderately saline. Most are frequently flooded, and some small areas have salt affected spots. The main concerns of soil management are flooding and soil blowing.
3. The flood plain areas of the Pawnee River, Walnut Creek, Blood Creek, Deception Creek, Cow Creek and Little Arkansas River consist of deep, silty and loamy soils and some smaller areas of clayey soils. These are mainly well drained but are flooded and generally have water tables at depths greater than 6 feet. The main concerns of soil management are flooding and soil blowing.
4. The uplands areas of Barton, Pawnee, Edwards, Kiowa, Stafford, Reno, Pratt, and Rice Counties are consisted of moderately sandy and clayey areas. It is the largest area of the District. It is formed in old alluvium that has been reworked upon the surface by the wind. Soils are deep and range from clay to sand. They are dominantly moderately sandy. They are fertile and well drained except small areas are low, wet, and poorly drained and formed in clayey alluvium or sandy or loamy materials underlain by clay. Other small high areas are sand hills. The main concerns of soil management are soil blowing and soil drainage of low areas. The slope gradient of this entire area is low or very low and suitable outlets for excess water are difficult to establish.
5. The terrace and uplands consisting of silty to clayey soil areas mainly in Barton, Rice and Reno Counties along the Arkansas River and Peace Creek are deep and slowly permeable to very slowly permeable and have varying degrees of salt accumulation layers. Saline and alkali spots are common. The main concerns of soil management are soil blowing and maintaining tilth and fertility.

D. Drainage Basins

Seven major drainage basins are defined within the boundaries of the District ([Figure 5](#)). The drainage basins are the Arkansas River, Pawnee River, Wet Walnut Creek, Rattlesnake Creek, North Fork Ninnescah River, South Fork Ninnescah River and Cow Creek. The Chikaskia and Medicine Lodge Rivers headwaters also originate in the southern part of the District. In addition to these areas, there are a large number of undrained areas associated with the sand dune regions in the District.

The Arkansas River enters the District south of Kinsley near the Edwards-Kiowa County line. The river makes a large bend to the northeast passing through Larned and Great Bend. From Great Bend it makes a smooth curve to the southeast passing through Ellinwood, Raymond and Sterling. Three major tributaries, the Pawnee River, Wet Walnut Creek, and Rattlesnake Creek, enter the Arkansas River as it transverses the District.

1 The Pawnee River enters the District west of Burdett and travels about thirty miles to its junction with the
2 Arkansas River near Larned.

3 Wet Walnut Creek enters the District west of Albert and travels about 25 miles to its junction with the
4 Arkansas River east of Great Bend.

5 The Rattlesnake Creek drainage basin originates in Ford and Clark Counties. The creek enters the District
6 west of Mullinville, crosses Kiowa, Edwards, Stafford, and Rice Counties and joins the Arkansas River
7 near Raymond in Rice County.

8 Both the North Fork Ninnescah River and the South Fork Ninnescah River have their headwaters located
9 within the District. The North Fork originates in southern Stafford County and travels northeast toward
10 Plevna where it exits the District. The South Fork originates near Cullison, travels east through Pratt and
11 exits the District on the Pratt-Kingman County line near Cunningham.

12 Cow Creek enters the District in northeast Barton County and travels approximately 10 miles before exiting
13 the District boundary on the east side of Barton County. Cow Creek traverses approximately 15 miles of
14 Rice County that is not included within the District boundaries before reentering the District near Lyons
15 exiting the District on the Rice-Reno County line east of Sterling.

16 While Kansas regulations separate the area into these distinct surface drainage basins per K.A.R. 5-6-15,
17 the groundwater divides, for many of the basins, are much more difficult to determine due to the aquifer
18 characteristics. In some cases, the groundwater flow may not coincide with the drainage basin boundary.
19 This underscores the importance of utilizing hydrologic models for management decisions.

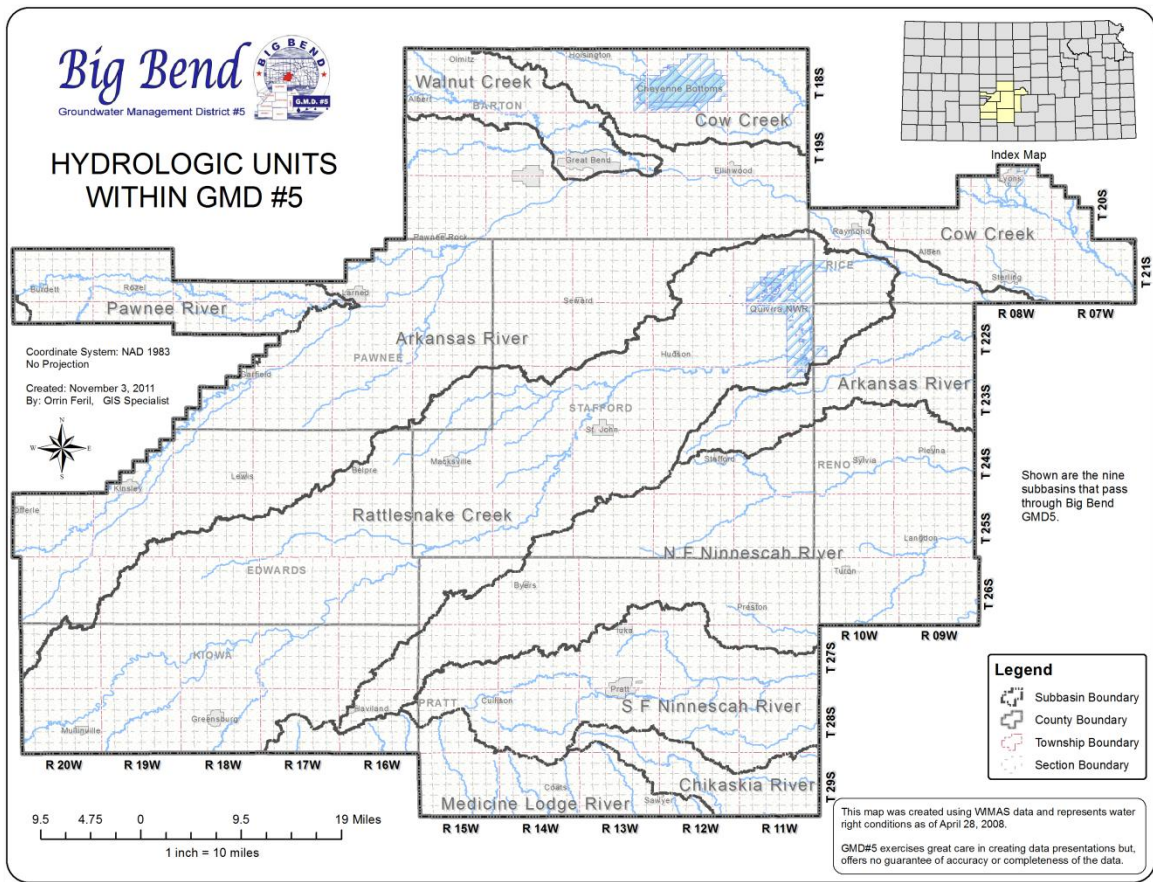


Figure 5 – Hydrologic Units

E. Wetlands

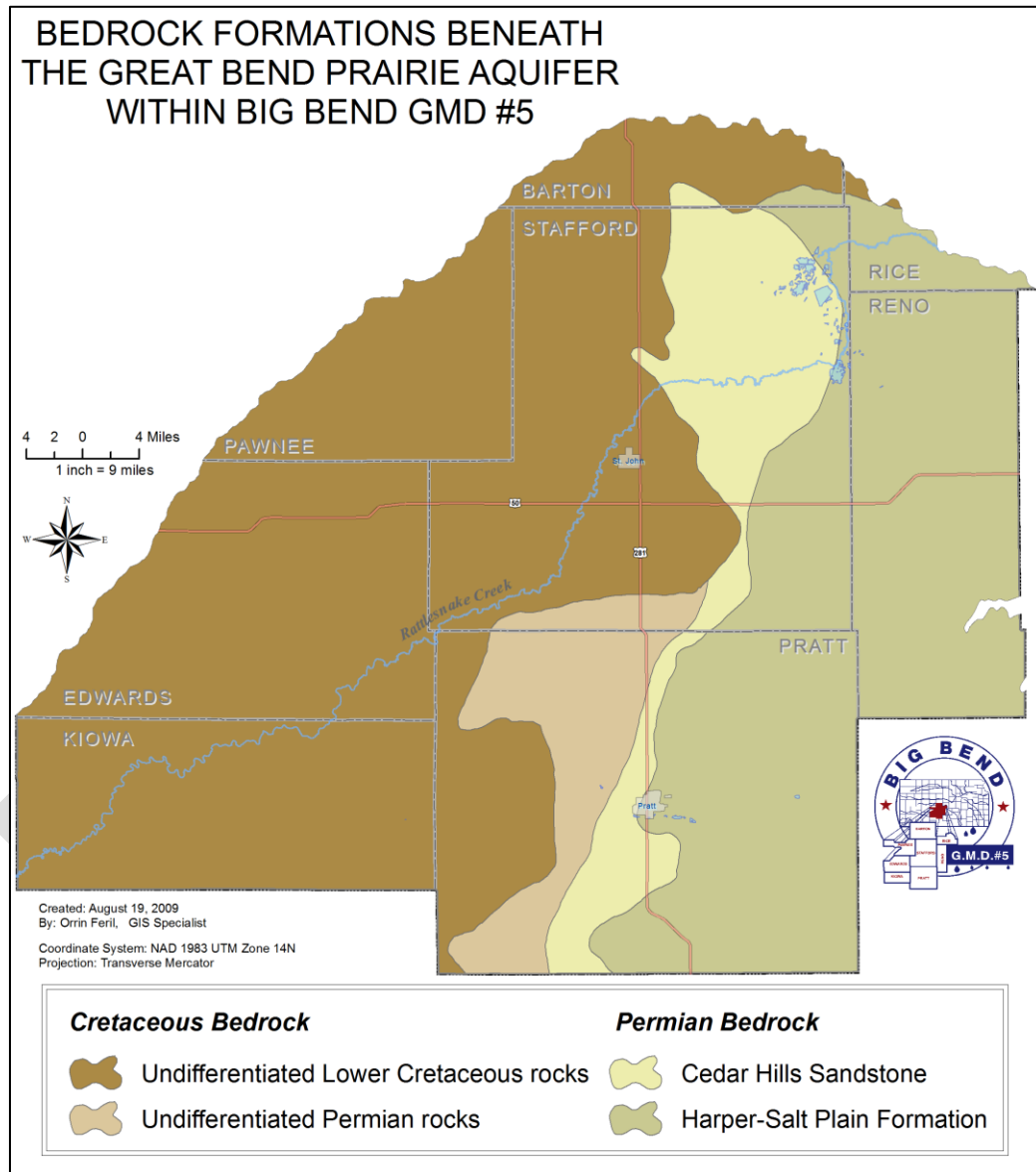
The Quivira National Wildlife Refuge, located in northeastern Stafford County, encompasses approximately 33 square miles. The naturally occurring salt marsh has been modified by man, particularly by the construction of canals and related diversion structures. The marsh and its canal system are fed by surface water from Rattlesnake Creek, local runoff, and artesian flow. The Refuge is owned by the U.S. Fish and Wildlife Service which holds a surface water right to divert water from the Rattlesnake Creek for recreational benefit.

Cheyenne Bottoms, located northeast of Great Bend in Barton County, is naturally fed by Blood and Deception Creeks and is drained by Little Cheyenne Creek. Cheyenne Bottoms encompasses approximately 31 square miles. The Kansas Department of Wildlife, Parks and Tourism also has a water right, which permits diversion of water from the Wet Walnut Creek and Arkansas River.

F. Geohydrology

The geologic units pertinent to the hydrogeology of the District vary in age from lower Permian to Holocene. The older formations of the lower Permian and lower Cretaceous form the bedrock surface in this region and are considered to be the base of the Great Bend Prairie aquifer and associated river alluvial aquifers.

1 Redbeds of Permian age underlie the eastern half of the District ([Figure 6](#)~~Figure 6~~). The units included are
2 the Harper Sandstone, Salt Plain Formation, Cedar Hills Sandstone, and undifferentiated lower and upper
3 Permian rocks of the Nippewalla Group and the Whitehorse formation. These units consist of reddish-
4 brown sandstone, siltstone, shale, salt, gypsum, anhydrite, and limestone. There are very few wells
5 withdrawing water from these formations at the present time. This is mainly due to the highly mineralized
6 water that occurs in these formations. The potential exists for limited development of Permian sources for
7 such uses as secondary oil recovery and salt solution mining.



8
9 **Figure 6 – Bedrock Formations of the Great Bend Prairie aquifer**

10 The western half of the District is underlain by rocks of the lower Cretaceous age which lie unconformably
11 on the Permian units. Included are the Cheyenne Sandstone, Kiowa Formation and Dakota Formation.
12 These consist of sandstone, siltstone, shale, and some limestone.

The chemical quality of water from the Cheyenne Sandstone and the Kiowa Formation is very poor and renders these unfit as a source of water in the District. Some excellent quality water is obtained from Cretaceous Dakota Sandstone. However, the extent of this unit is limited in the District. The Dakota formation is used as a source of supply in Barton, Pawnee, Rice, and Edwards counties. It is mainly used for domestic and stockwatering, however, there are some areas where it is used for irrigation and municipal purposes.

Quaternary age deposits form the major aquifers in the District. These are composed of unconsolidated silt, sand, gravel, and clay which unconformably overlie the Cretaceous and Permian bedrock formations. The deposits range in age from Pleistocene to Holocene. The Pleistocene sediments were deposited by lateral shifting of streams during four glacial stages (Nebraska, Kansas, Illinois, Wisconsin) and four interglacial stages (Aftonian, Yarmouthian, Sangamonian, Holocene). They were deposited on an erosional surface of Cretaceous and Permian bedrock which must have looked similar to the Smoky Hill River area in Ellsworth County and the exposed Permian bedrock area of Barber County. The deposit thickness ranges from 0 to 300+ feet and average around 120 feet. Capped by eolian deposits of the Pleistocene and Holocene age, some of the fluvial deposits have been reworked by recent stream activity to form river alluvium. It is, however, difficult to distinguish the more recent alluvial sediments from the original Pleistocene deposits.

The Quaternary deposits are an excellent source of good quality water across most of the area. Some quality problems relating to mineral intrusion from the underling Permian bedrock units render certain areas unusable. Wells obtaining water from the Pleistocene deposits will yield from a few hundred gallons per minute to over 2000 gallons per minute, thus making these units desirable for development for all water uses.

Recharge rates in the District are estimated to be between zero and seven inches, with an overall average of 2¼ inches per year. Recharge is dependent on total annual precipitation, surface soils, depth to water, and characteristics of the strata between the land surface and water table. Most important is the timing and amount of precipitation. There have been several recharge studies conducted in the District to estimate the recharge (Sophocleous, 2004). Because of the variability in precipitation, as little 14" during drought periods to nearly 40" during wet periods, recharge should be considered as a percentage of precipitation rather than an average figure.

G. Economy

The availability of plentiful and renewable supplies of good quality water has helped to make an irrigated agricultural economy a reality in the District. The spin-off from this has bolstered the well drilling industry, irrigation service groups, and irrigation equipment dealers, thus establishing off-farm jobs that help establish a healthy economic base supporting the local communities within the area.

Other industries support the economy in the District, such as the oil and gas industry, and many small industries in and around the cities and towns in the District. The District is a prime area for the location of ethanol production due to the availability of irrigated corn production and other crops.

The stabilization of agriculture and the prevention of economic deterioration are major goals outlined in the Groundwater Management District Act and are extremely important to the District. To accomplish these goals, adequate levels of good quality water must be sustained through the administration of a strong management program, which includes education, conservation, and the implementation of policies that will promote the wise use of the resource.

1 Sustainable water supplies are needed for all uses including domestic, municipal, industrial, recreational,
2 and agricultural. Sustainable yield is defined in the District’s rules and regulations “means the long-term
3 yield of the source of supply, including hydraulically connected surface water or groundwater, allowing for
4 the reasonable raising and lowering of the water table”.

5 Figure 2 illustrates the rate of development over the past seventy years. There are currently about
6 827,000 acre-feet of water appropriated for beneficial use within the District. This water is being withdrawn
7 from the groundwater system by approximately 5,300 large capacity wells and is used to irrigate about
8 450,000 acres of land as well as supply industrial, municipal and recreational needs in the District. Figure
9 7 displays the difference in the amount of water appropriated within the District vs the amount of
10 water used annually for the past 20 years.

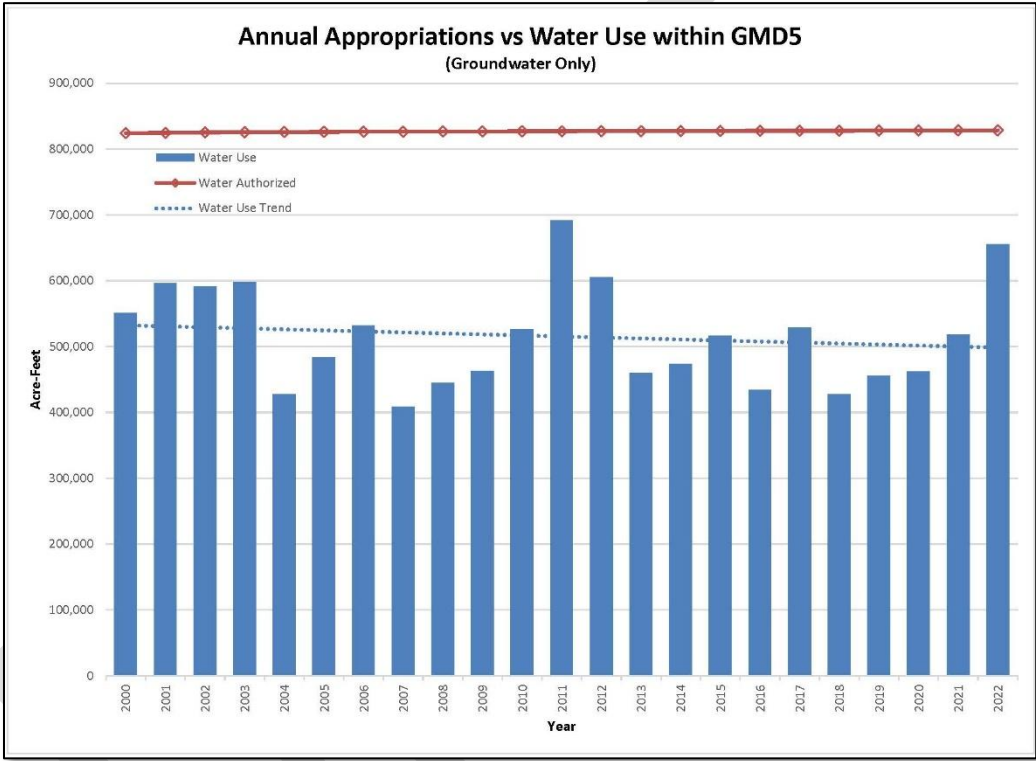


Figure 7 – Annual Water Use vs Appropriations

13 As Figure 8 shows, the use of water for irrigation purposes is by far the largest with roughly 90 %
14 of all water withdrawn applied to irrigated crops. Indeed, the greatest increase in development has been for
15 irrigated agriculture. This increased development has helped to support the economy of the region, but this
16 economy can only be maintained if the water resource is sustained.

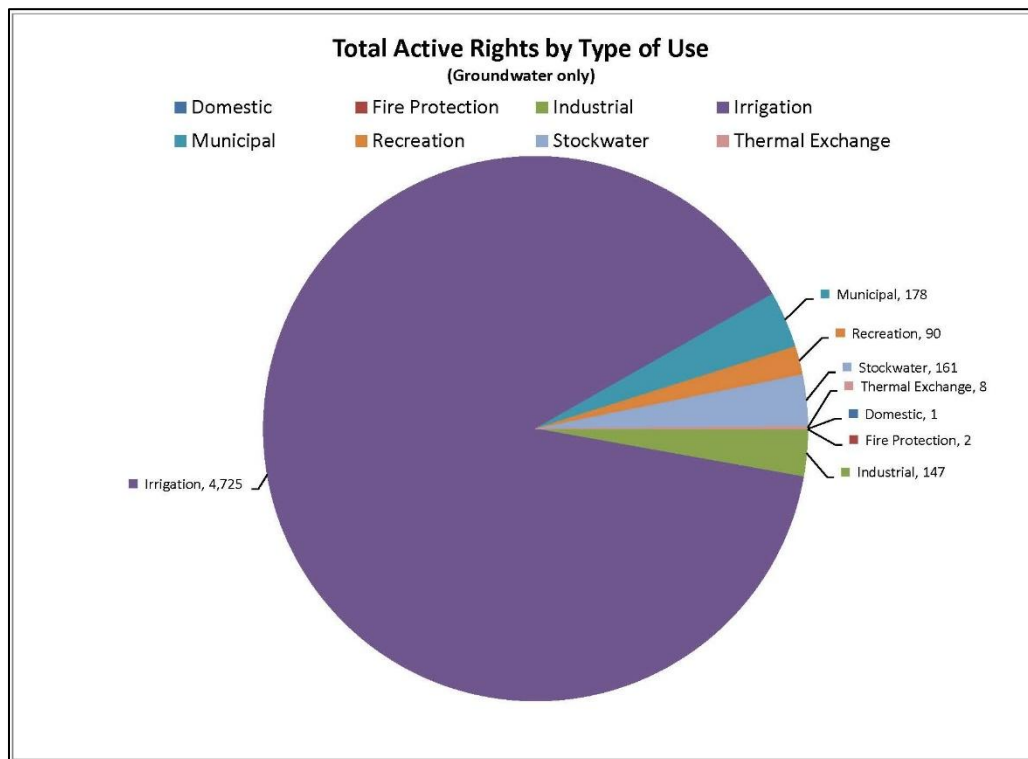


Figure 8 – Active Water Rights by Use

HYDROLOGIC MODELING

A. Background

In 2007, the District board decided it was time to have a comprehensive hydrologic model developed that encompassed the entire District area including the upland watershed areas of the Arkansas River, Pawnee River and Walnut Creek ([Figure 9](#)). The model work began in late 2008 and throughout the following year, the technical review committee provided meaningful refinements to the model. The model development was led by Balleau Groundwater, Inc. (“BGW”) with technical contributions and review by Kansas Department of Agriculture–Division of Water Resources (KDA–DWR) staff and consultant S.S. Papadopoulos and Associates, Inc., alongside feedback from KDA–DWR, Big Bend GMD No. 5, Water Protection Association of Central Kansas (WaterPACK) and the U.S. Fish and Wildlife Service (USFWS). The model (“BBGMDMOD”) and accompanying report were completed in 2010 (Balleau Groundwater, Inc., 2010).

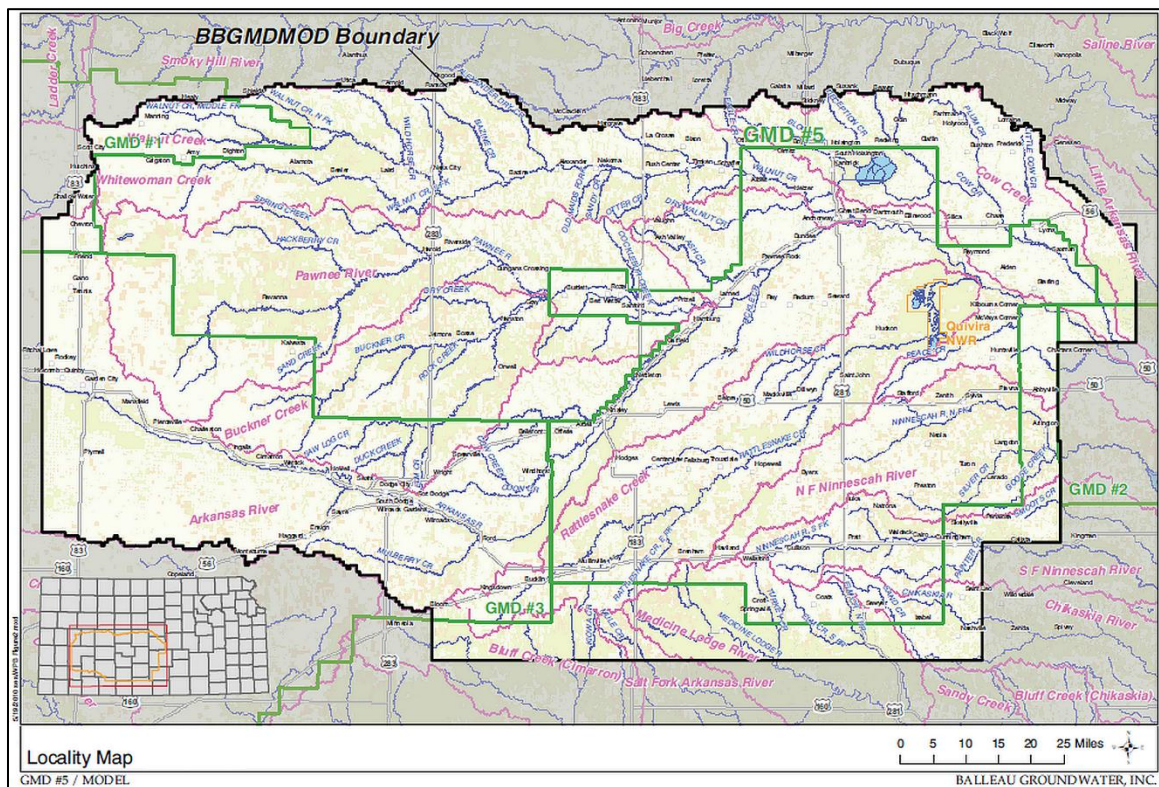


Figure 9 – District Model Boundary

B. Purpose

The purpose of developing the BBGMDMOD is to clarify the relationships between historical groundwater management activities and the associated hydrologic responses of the aquifer. With better understanding of the relationship between these actions and the aquifer responses, then management strategies can be developed that are tailor-fit to address hydrologic concerns in the future. The intent is to better predict the potential hydrologic and economic impact of management strategies. When considering management changes, the BBGMDMOD is best suited to fully analyze the impact of those changes. BBGMDMOD is currently under revision and update by BGW and is anticipated to be completed and available for use in the first quarter of 2026. The District will make routine efforts to ensure the model is maintained and updated to provide a quality tool to evaluate future management actions.

MANAGEMENT ISSUES

A. Water Quantity

Beginning in 1979, the board was aggressive in the adoption of programs restricting the amount of development. Proposed appropriations were evaluated and recommended for approval based on recharge data. The allowable amount was updated as new information became available. Many areas of the District were considered fully appropriated and closed to any further development in 1990. The remaining basins were closed in 1998. Those areas where development was allowed between 1990 and 1998 had additional restrictions put into place that would protect base flow to streams, in addition to a reduction in the sustainable yield criteria. These restrictions limited development near the streams and the number of

1 withdrawals for a given area. Streamflow nodes were established every quarter mile on all the major streams
2 and tributaries in the basins that had remained open for development until 1998. Allocations assigned to
3 each streamflow node were used in the sustainable yield calculation to determine if additional development
4 would be possible. The reduction in the allowable appropriation and the subsequent closure of the District
5 has helped reach the goals set forth in this management program and the Groundwater Management District
6 Act.

7 During the 1990's it also became apparent that management of the groundwater resource in the District had
8 evolved into a more detailed process. It was determined that in order to manage the groundwater resource
9 effectively, everything in a particular watershed should be evaluated. When using the watershed approach,
10 both water quality and quantity issues become much more relevant to each other. This watershed approach
11 is the underlying principle behind the current rules and regulations governing the District. However, it
12 should be noted that in many cases groundwater moves from one basin to another.

13 Water transfers that could potentially export water out of the District should be addressed as they arise. The
14 Kansas Water Transfer Act was developed to address such issues while allowing for District input. The
15 District should assess the local economic impact when reviewing water transfers. Transfers of water from
16 within the District may become more common in the future. Whenever possible, the most current version
17 of the BBGMDMOD should be used to evaluate potential changes and impacts to regional aquifer and
18 stream systems.

19 An additional strain on the delicate balance of the local aquifers is the invasive phreatophytes in the area.
20 Several basins in the District have seen an increased presence of invasive phreatophytic trees specifically
21 salt cedar (*Tamarix* spp.) and Russian olive (*Elaeagnus angustifolia* L.). Overall, these phreatophytes may
22 decrease baseflows in streams due to high rates of evapotranspiration from the alluvial zone (Shafroth, et
23 al., 2005) and decrease biodiversity (Zhang, Yin, & Pan, 2002). Historically, it was estimated that the
24 clearing of these trees from stream channels may result in up to 6-9 feet/year of recovered streamflow.
25 However, in field studies the evapotranspiration by salt cedar in these areas is approximately 2.5-4 feet/year
26 (Dahm, et al., 2002). These studies were conducted in the Pecos and Gila Rivers of New Mexico. Due to the
27 pervasiveness of these invasive species and the potential water savings to the stream channels, it is
28 appropriate to pursue the removal of these trees in an efficient manner.

29 An additional pressure on the local aquifer system is the proliferation of invasive emergent wetland
30 vegetation, particularly Phragmites (*Phragmites australis*). District staff have noted a rapid expansion of
31 dense Phragmites stands within riparian corridors, wetlands and shallow alluvial zones. Similar to other
32 invasive hydrophytic species, Phragmites can reduce water availability through high evapotranspiration
33 rates, competitive displacement of native hydrophytes and alteration of sediment and nutrient dynamics.
34 Studies have shown that monotypic stands of Phragmites can transpire substantially more water than
35 adjacent native vegetation, with estimated evapotranspiration ranging from 3-6 feet/year depending on stand
36 density and climatic conditions (Lenters, et al., 2011) (Mykleby, et al., 2016). Additionally, the species
37 forms thick rhizome mats and tall, dense canopies that suppress native biodiversity and reduce habitat
38 quality for wildlife (Chambers, Meyerson, & Saltonstall, 1999). Given the widespread nature of Phragmites
39 infestations and potential water savings and ecological benefits associated with reducing stand density,
40 targeted management and removal efforts are warranted to restore more natural hydrologic and ecological
41 function in affected basins.

42 Objectives outlined to reach goals of various basin programs.

1. Support the KDA–DOC Water Transition Assistance Program (WTAP). Identify and prioritize the program within all basins where water use reductions are necessary.
2. Utilize District funds in the purchase of water rights in priority areas. Whenever possible, match District funds with state and federal funding sources.
3. Support and cooperate with state and federal agencies to provide incentives for water use reductions and promote the use of such programs.
4. Seek to eliminate over-pumping of authorized quantities. Utilize field inspections and education outreach to promote proper stewardship of the water resources of the region.
5. Continue to support conservation programs such as irrigation scheduling, soil moisture monitoring, lower water intensive crops, strip till and other conservation tillage efforts.
6. Continue the required flow meter program for maintenance and accurate water use. A portion of the flow meter program is the utilization of the District’s ultrasonic flow meter to conduct comparison testing throughout the District.
7. Continue to increase awareness of water quality concerns in the region through outreach and public education. Implement water quality testing for private, domestic wells in addition to production wells to gain a better understanding of the changing water quality of the aquifer.
8. Continue to investigate methods of artificial recharge in priority areas.
9. Investigate and develop programs to increase water use efficiency.
10. Continue to work toward long-term sustainability of the local aquifer system by working with local stakeholders and federal and state agencies to develop a holistic approach utilizing the various tools available which include but not limited to:
 - a. USDA-NRCS – (CREP, CSP, EQIP, RCPP, Watershed Plan)
 - b. KDA–DWR – (IGUCA, WCA, MYFA, Streamflow Augmentation)
 - c. KDA-DOC – (CREP, WTAP, RCPP, ITI)
 - d. District – (LEMA, Water Right Purchase, RCPP, Watershed Plan)
 - e. Central Kansas Water Bank Association – (Deposit / Lease, Savings Account, CAMP)
 - f. KCC – (Cathodic Protection Boreholes)
 - g. KGS – (AWQUA)
11. Update, maintain and utilize BBGMDMOD to evaluate management changes over time.
12. Work with federal, state and local partners to proactively remove invasive phreatophytic trees and phragmites along alluvial stream channels.

The water table in the Great Bend Prairie aquifer fluctuates quite significantly depending on the timescale chosen. Due to the relatively thin saturated thickness of portions of the aquifer, water table changes depicted in feet potentially misrepresents the water availability in some of these regions. ~~Figure 10~~ and ~~Figure 11~~ depict the change in aquifer thickness by percent change to account for this variability across two different time scales. ~~Figure 10~~ shows the percent change in aquifer thickness over the past 80 years. ~~Figure 11~~ however illustrates the percent change happening in the most recent 20-year time period. An inference from these two figures is that the majority of the total depletion of the aquifer happened over 20 years ago. Meanwhile, portions of the aquifer have also seen positive trends in recent years.

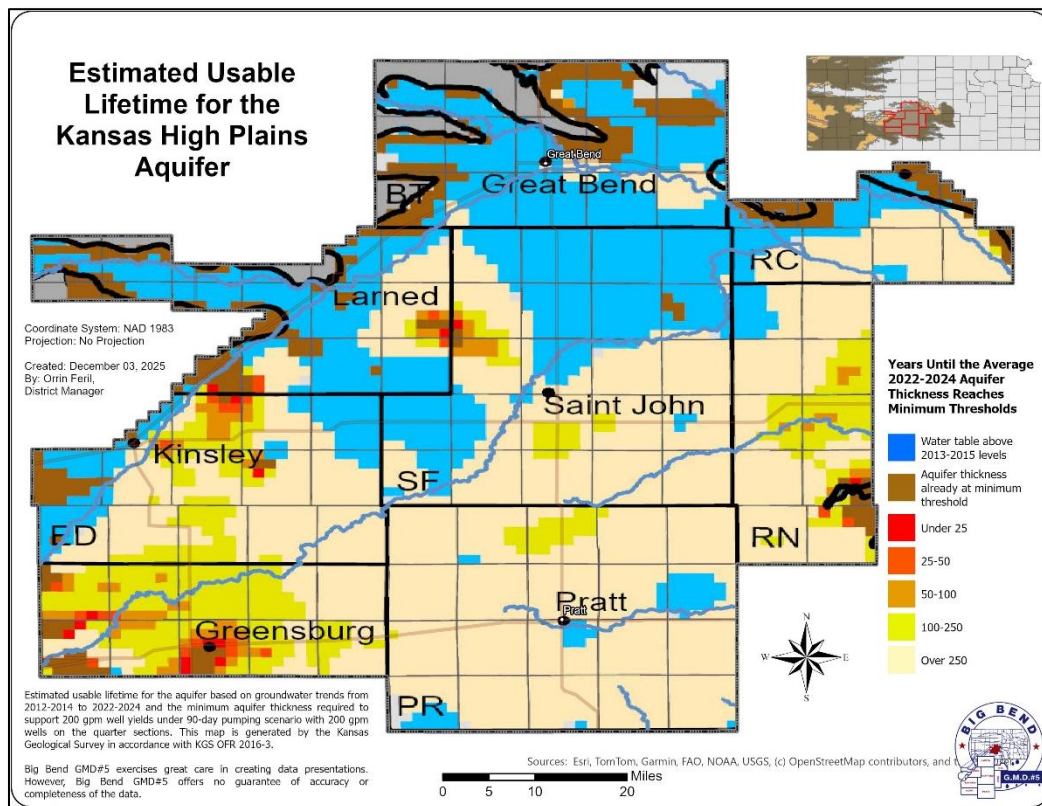


Figure 12 – 2023 Estimated Usable Lifetime

B. Water Quality

The quality of the groundwater resource is certainly as important if not more important than the quantity issue. If the quality of the resource is allowed to deteriorate, then there is no reason for restricting development from a quantity standpoint because the water will be of little value once polluted. It is extremely difficult and costly to reverse pollution once it has occurred thus the basic objective of the District is to take a preventive posture. The problems that already exist and those that will slip through the prevention program must be remedied in an orderly manner. This can best be accomplished at the local level of government, with the support of various state, federal and other local governments. Several quality issues must be dealt with by the District if we are to maintain the good quality water that we presently enjoy.

1. Natural mineral intrusion: Natural degradation of the Pleistocene sand and gravel aquifer occurs in the eastern half of the District due to dissolution of salt from underlying Permian Bedrock units. This natural intrusion has rendered the lower portion of the aquifer unfit due to the high content of sodium chloride. The dividing line between areas of no mineral intrusion and excessive mineral intrusion is approximately parallel with U.S. Highway 281. West of this divide, the Permian units are overlain by shales of Cretaceous age that form a cap that does not allow the saltwater to migrate into the Pleistocene aquifer (Figure 6). Rules and regulations have been developed that address upward movement of the chlorides into the freshwater aquifers.

2. Pollution resulting from oil and gas production: Groundwater pollution from the past and present activities of the oil and gas industry is a major problem in the District in several areas. Disposing of oil field brines in unlined pits is no longer practiced but has created many areas where the groundwater resource is

no longer usable. While the District recognizes the tremendous economic benefit gained from this industry, degradation of the groundwater resource cannot be accepted. The District continually works with landowners and the Kansas Corporation Commission (KCC) to prevent and resolve oil field related problems. This work extends into the enforcement of regulations relating to the installation of boreholes to protect against pipeline corrosion.

3. Pollution resulting from other industrial wastes: There has been extensive pollution created by the salt mining industry in Rice County. The District is currently working with the parties involved and the appropriate agencies to remediate the situation that exists southeast of the City of Lyons. This problem is a prime example of what can happen if problems are allowed to continue unattended. The cleanup cost has been staggering and could have been avoided if proper inspection and maintenance had taken place. The District continues to monitor the pollution situation in Rice County and will assist individual landowners and other entities in the mitigation of industrial wastes.

4. Agrichemical pollution: Farming has evolved over the last several decades to a highly sophisticated industry. This industry uses a wide variety of chemicals in order to maximize crop yield from the available land area. The use of these chemicals presents a potential pollution source and should be evaluated to determine the effects on the groundwater system. In recent years, the District has been monitoring increased nitrate concentrations in the aquifer. Recent studies indicate correlation with fertilizer application rates as being a source for this rise in concentrations (Lane, et al., 2020).

5. Unplugged and improperly constructed water wells: Abandoned water wells that are not properly plugged and improperly constructed water wells represent a possible source of pollution. These create an avenue for a host of contaminants to enter the aquifer. District assistance is available to landowners and other individuals who want information on plugging water wells.

6. Municipal waste lagoons, animal feedlots, and landfills: These sources of potential pollution fall into similar categories. They are currently regulated by the Kansas Department of Health and Environment (KDHE). But the question has arisen as to whether or not the levels of monitoring, inspection, and enforcement by KDHE are adequate to prevent extensive groundwater pollution. Focus efforts by the District to conduct water quality monitoring in areas around public water supplies to assist KDHE in identification of the source for water quality issues.

DISTRICT PROGRAMS

A. Conservation and Efficient application of Water Use

Irrigation scheduling and water conservation programs are actively promoted as a means to reduce consumptive use in the District while minimizing impact on the local economy. With this in mind, the District has established a network of weather stations throughout the area to allow real-time access via the phone or internet to obtain accurate and timely weather data as well as evapotranspiration (ET) or crop water use values on a daily basis (Figure 13). The information from the weather stations is utilized in irrigation scheduling programs. With the installation of the weather station network, the District focuses educational outreach designed for agricultural producers. Other programs are designed to educate District water users in reducing runoff and the reuse of tailwater, water lost to evaporation and deep percolation. The District also promotes new technologies in tillage practices, soil moisture monitoring, less water intensive crops and chemical treatments. Research on the efficient and economical use of water should be encouraged whenever possible. The District works with the appropriate entities on the management of

1 surface water drainage problems. The objective of the District is to reduce long term water use through
2 these programs. A strong educational program must be developed in order to expand the conservation
3 programs and accomplish the objectives outlined.

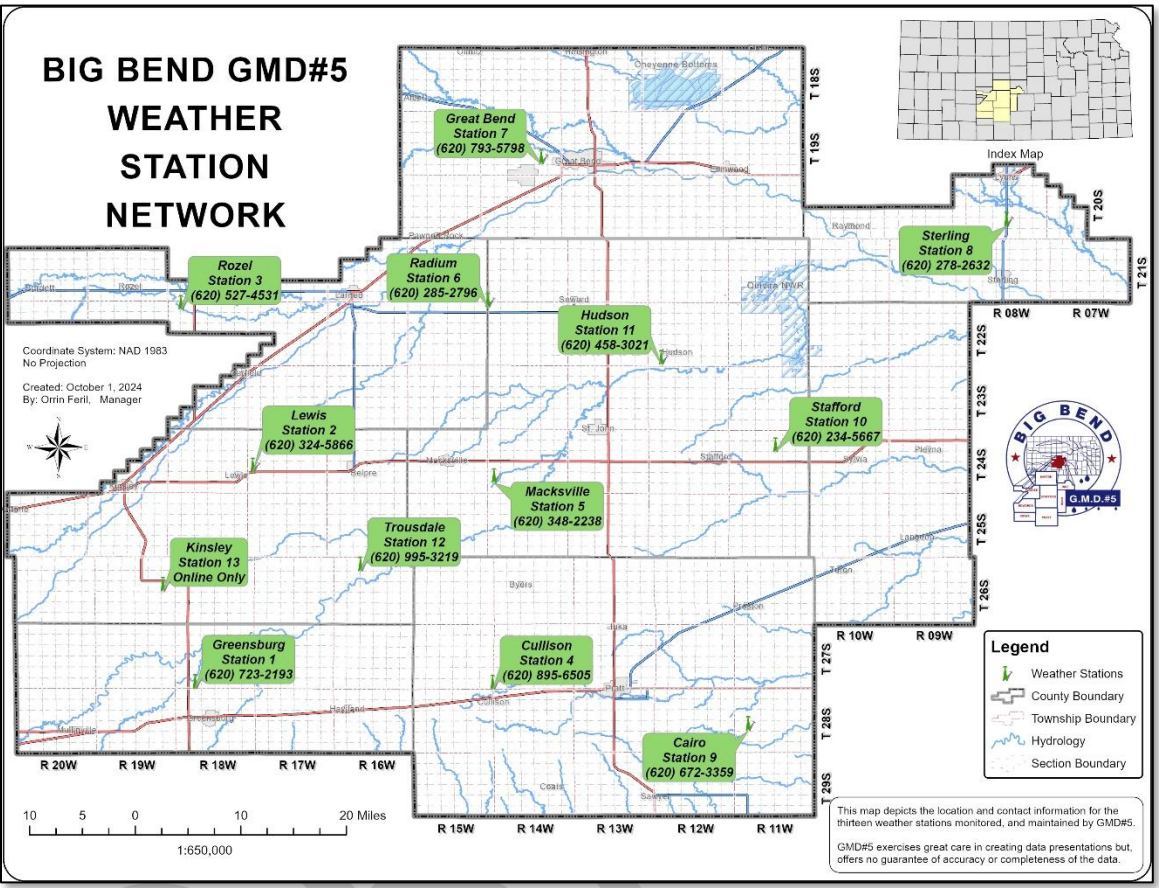


Figure 13 – Weather Station Network

B. Public Education

7 The District continues to be a source of information for District members in the areas of geology, water
8 rights, water quality, and other water-related issues. The District updates members of yearly activities at the
9 annual meeting as well as through District newsletters, educational seminars, news releases, and social
10 media. Members are encouraged to attend the regular monthly board meetings to voice their concerns.
11 District educational programs should also focus on the area youth to emphasize the importance in the
12 preservation and protection of the resource. Educational programs have been developed and are presented
13 regularly in the area school systems, local civic groups, and agricultural groups. The District actively
14 coordinates with the Great Bend Prairie Regional Advisory Committee (RAC) to address issues throughout
15 the region. The RAC serves an advisory role to the Kansas Water Authority for statewide water policy.
16 Through this coordination with the RAC, the District proactively aids in developing sound water policy.

C. Accurate Data Base/GIS Data Management

18 The District will continue to maintain a database to include the most accurate information regarding water
19 rights, land ownership, water levels, groundwater withdrawals, water quality, hydrogeologic characteristics,

1 and other pertinent information available. District data collection efforts are enhanced by the various
2 research projects and current programs ongoing in the District, and in return will be utilized in the
3 development of future programs. Documenting reductions in consumptive use through increased irrigation
4 efficiency programs will be necessary to determine water use savings. The District should encourage
5 cooperation and the exchange of data between various federal, state and other local agencies in order to
6 benefit from all available information. An example of an irrigation efficiency program the District has
7 promoted is the Conservation Innovation Grant (CIG) project in coordination with The Nature
8 Conservancy, Kansas State University Research and Extension, WaterPACK and Lee Wheeler Engineering.
9 In this project, participants demonstrated through the proper implementation of technology that water
10 savings of 10 percent or more can be achieved while maintaining crop yield outputs. The lessons learned
11 with the success of the CIG project are helping guide the District and other regions of the state in developing
12 larger projects for conserving water.

13 **D. Continued Research**

14 The District continues to conduct necessary research for a better understanding of the groundwater system
15 of the region. This will enable the formulation of more specific programs to deal with water appropriation
16 and water quality problems.

17 The District should also undertake evaluation and development of methods to increase groundwater
18 recharge. Groundwater recharge projects may be instrumental in maintaining sustainable yields in the
19 District. The District should conduct research on the interrelationship between surface and groundwater and
20 encourage the study of such relationships by the appropriate state and federal agencies in conjunction with
21 the District. Administrative programs such as water banking, water right purchases, water transfers and
22 multi-year water right programs should continue to be investigated to determine their effectiveness in a
23 management program. Continued evaluation of more efficient irrigation system equipment and technologies
24 is also needed.

25 In the 1980s KGS and the District partnered to evaluate the chloride concentrations in the portions of the
26 aquifer that experience the natural mineral intrusion from underlying Permian bedrock units. In this project,
27 several well clusters were installed near the township corners of the Eastern half of the District. These well
28 clusters include a deep bedrock well, shallow well, and intermediate wells depending on site-specific
29 lithology. The deep bedrock well was logged using the District's gamma induction probe to identify the
30 interface zone between the fresher upper zone and the brackish regions below.

31 Building on this foundation, the District should expand the network of township cluster wells throughout
32 the remainder of the District. This expansion would provide better understanding of not only the water
33 quality of the aquifer at various levels below ground but also allow for higher resolution of water quantity
34 monitoring throughout the District.

35 **E. Water Quality**

36 1. Extensive research has been conducted on the natural mineral intrusion areas of the District. The
37 purchase of an electromagnetic induction logging tool to determine the extent of the natural saltwater has
38 greatly enhanced the District's efforts. The District promulgated regulations requiring observation wells
39 near all new large capacity wells to monitor and prevent the poor-quality water at the base of the aquifer
40 from migrating upward and degrading the freshwater zone in the upper portion of the aquifer. The extensive
41 monitoring well network established by the District and the KGS should continue to be monitored.

- 1 Continued monitoring will be necessary to determine the movement of the saltwater and effects from
2 groundwater withdrawals.
- 3 2. Present oil and gas activities that need to be addressed include routine inspection of brine and crude
4 oil holding facilities to assure proper handling and disposal of waste products; the lining of drilling pits due
5 to sensitive groundwater areas, and the contamination which has already occurred from not using lined or
6 portable pits; the assurance that wells are properly plugged upon abandonment; and the elimination of brine
7 used in road construction activities. The District is working and will continue to work very aggressively
8 with the KDHE and the KCC to prevent these sources of pollution from becoming major problems.
- 9 Research has been conducted to evaluate the impact of injecting oil field brine into the Cedar Hills
10 Formation in relation to the natural mineral intrusion in the eastern half of the District. These injection wells
11 are now being phased out as they become abandoned. The District should continue monitoring of this
12 project because of the hydrologic connection between the Cedar Hills Formation and the freshwater aquifer
13 in the District.
- 14 3. Continued monitoring of industrial pollution cases such as the American Salt Plume should take
15 place. Underground storage tanks and other industrial spills are addressed by the KDHE, with most
16 contamination being addressed as each site is discovered. However, steps need to be taken when reviewing
17 proposed permits or potential industrial sites to educate the people about the vulnerability of natural
18 resources. The District's participation in the water quality area will greatly help to resolve problems in the
19 preventive mode before they become major catastrophes.
- 20 4. Three major areas concerning agricultural pollution need to be addressed. The first is the proper
21 handling, storage, and disposal of chemicals. The practice of dumping excess chemicals and washing down
22 trucks at the bulk storage facilities located in the District creates very real potential for long term pollution
23 problems. The application of chemicals through the irrigation system is another potential source of
24 pollution. This is being addressed by the chemigation safety law which mandates equipment and procedures
25 to be followed when chemigation is practiced. The third area of concern is what happens to the chemicals
26 after application. This has not been fully dealt with and needs to be evaluated in greater detail. There is
27 currently research being conducted by the state and federal government to try and resolve the many
28 unanswered questions related to the long term application of agrichemicals. The District has cooperated in
29 conducting research into the transport and effect of these chemicals and should continue such research
30 efforts.
- 31 5. The District will continue inspections and follow-up of abandoned wells to ensure that they are
32 properly constructed and abandoned to help prevent possible contamination. There should be continued
33 cooperation and support from KDHE to resolve this possible pollution threat.
- 34 6. Possible sources of pollution such as landfills, municipal waste lagoons, and animal feedlots should
35 be recognized by the District. The District should continue to offer assistance to these water users in the
36 design and placement of lagoons, landfills and other facilities of this nature.
- 37 7. Cathodic protection boreholes have been addressed by the District. Special cathodic protection rules
38 and regulations have been developed and adopted by the KCC for the District that will protect the freshwater
39 resource from the materials used in those drilling activities. Continued coordination with KCC to ensure
40 that the well drillers and industry professionals adhere to the applicable regulatory requirements to protect
41 the sensitive groundwater of the region.

1 There are many sources of pollution that should be evaluated for potential impacts to the resource. The key
2 is prevention rather than reacting to crisis and attempting remediation because the later process is far too
3 expensive, time consuming, and uncertain. The District should continue to take an aggressive approach to
4 prevent pollution of the groundwater resource from any source.

5 **F. Flow Meter Program:**

6 The District has required the installation of in-line flow meters on all permitted wells in the District and
7 continues to monitor the use of the flow meters to ensure compliance. The District also offers a testing
8 service to check the accuracy of the flow meters. Staff is certified through the KDA–DWR to test the
9 accuracy of the flow meters. The District should continue to work closely with the water users in the District
10 to ensure that the most accurate water use data is being reported. The District will continue to work with
11 KDA–DWR to assist in the completion of accurate water use reports and the development of educational
12 programs to help District water users understand the importance of reporting accurate water use with inline
13 flow meters.

14 **G. Water Rights Administration:**

15 The District, through cooperative efforts with KDA–DWR, shall review all applications to appropriate
16 groundwater for beneficial use, and all changes filed from within the District to ensure compliance with
17 District rules and regulations. The District shall recommend to the chief engineer any actions or additional
18 requirements deemed necessary. The District shall assist water users in water right related issues when
19 requested. The District may develop other criteria that are pertinent to the administration of water rights
20 which do not conflict with the basic laws of the State of Kansas.

21 **Annual Reporting**

22 **~~A. Kansas Legislature:~~**

23 As enacted in the 2023 legislative session, K.S.A. 82a-1043 requires each Groundwater Management
24 District to prepare and submit an annual report to the Kansas Legislature by January 25 each year. The
25 statute goes on to require the annual reports to be published online following approval by the respective
26 District boards of directors. The District has enacted procedures for compiling this report annually for the
27 Kansas Legislature's review.

28 **~~B. Kansas Department of Agriculture:~~**

29 In addition to the reporting requirements to the Kansas Legislature, per K.S.A. 82a-1044, each Groundwater
30 Management District is charged with identifying and setting reasonable boundaries for areas of concern
31 within their respective boundaries. Furthermore, once identified the statute requires the development of an
32 action plan to address these concerns in a reasonable time frame and submit this information to the Chief
33 Engineer of KDA–DWR.

34 ~~Recently, the Kansas Geological Survey published a technical publication which indicated the District is~~
35 ~~within 1.6% of sustainable water level fluctuations (Whittemore, Butler, Jr., & Wilson, 2023). This study~~
36 ~~looks at the average annual water level fluctuations in comparison to the annual withdrawals from the~~
37 ~~aquifer through well diversions. This does not, however, indicate that there are no issues still to address~~
38 ~~within the region but rather the goal of long term sustainability is within reach for the region. In future~~

updates to the District's management program, these areas of concern and associated action plans will be incorporated in the following section:

Areas of Concern and Action Plans

A. Summary

The District has implemented a variety of programs to address hydrologic issues throughout the region since the inception of the District in 1976. Early in the District's history this involved the development of the District's management program which resulted in the establishment of several policies and regulations that laid the foundation for the current hydrologic conditions of the region. These included strict monitoring of water use with flow meters, well spacing requirements, discouragement of waste of water and encouragement of the re-used water sources. Recently, the Kansas Geological Survey (KGS) published a technical publication which indicated the District is within 1.6% from sustainable water level fluctuations (Whittemore, Butler, Jr., & Wilson, 2023). This study looks at the average annual water level fluctuations in comparison to the annual withdrawals from the aquifer through well diversions. This does not, however, indicate that there are no issues to address, but rather the goal of long-term sustainability is within reach for the region.

The District has invested significantly in the development and application of the Big Bend GMD5 groundwater model (BBGMDMOD). The model was developed by Balleau Groundwater, Inc. (BGW) and finalized in 2010 through collaboration with District staff and a Technical Advisory Committee (Balleau Groundwater Inc, 2010). To ensure the model accurately represented regional hydrogeologic conditions, it underwent an independent peer review by S.S. Papadopoulos & Associates, Inc (S.S. Papadopoulos & Associates, Inc., 2011).

The primary objectives of the BBGMDMOD were to:

1. Evaluate the relationship between alternative groundwater management actions and their resulting impacts on aquifer and stream conditions.
2. Provide a scientifically defensible tool to address questions related to watershed management, aquifer sustainability, source-water accounting, and the condition of groundwater and surface water resources.

Since its completion, the BBGMDMOD has been utilized by the District, state agencies, and private entities to evaluate a variety of groundwater management scenarios and policy alternatives throughout the region. BGW is currently coordinating with KGS to complete a comprehensive update of the BBGMDMOD, incorporating additional data and advances in hydrogeologic understanding developed since the model's original release.

As the District works through this process, there are two subsections below: 1) Priority Areas of Concern and 2) Supplemental Areas Under Consideration. These areas have been submitted and accepted by the Chief Engineer per K.S.A. 82a-1044 in July 2024. The areas of concern and supplemental areas are published on the District's website (<https://gmd5.org/district-action-plan>) for public outreach.

The District has also established dedicated webpages for each of the areas identified:

1 **B. Priority Areas:**

- 2 • Pawnee River (<https://gmd5.org/pawnee-river>)
- 3 • Walnut Creek (<https://gmd5.org/walnut-creek>)
- 4 • Rattlesnake Creek (<https://gmd5.org/rattlesnake-creek>)
- 5 • Estimated Usable Lifetime (<https://gmd5.org/estimated-usable-lifetime>)
- 6 • Mineral Intrusion (<https://gmd5.org/mineral-intrusion>)

7 **C. Supplemental Areas:**

- 8 • Edwards – Kiowa County Region (<https://gmd5.org/edwards-kiowa>)
- 9 • Nitrate (<https://gmd5.org/nitrate>)

DRAFT

Priority Areas of Concern

A. Water Quantity

Pawnee Valley Intensive Groundwater Use Control Area

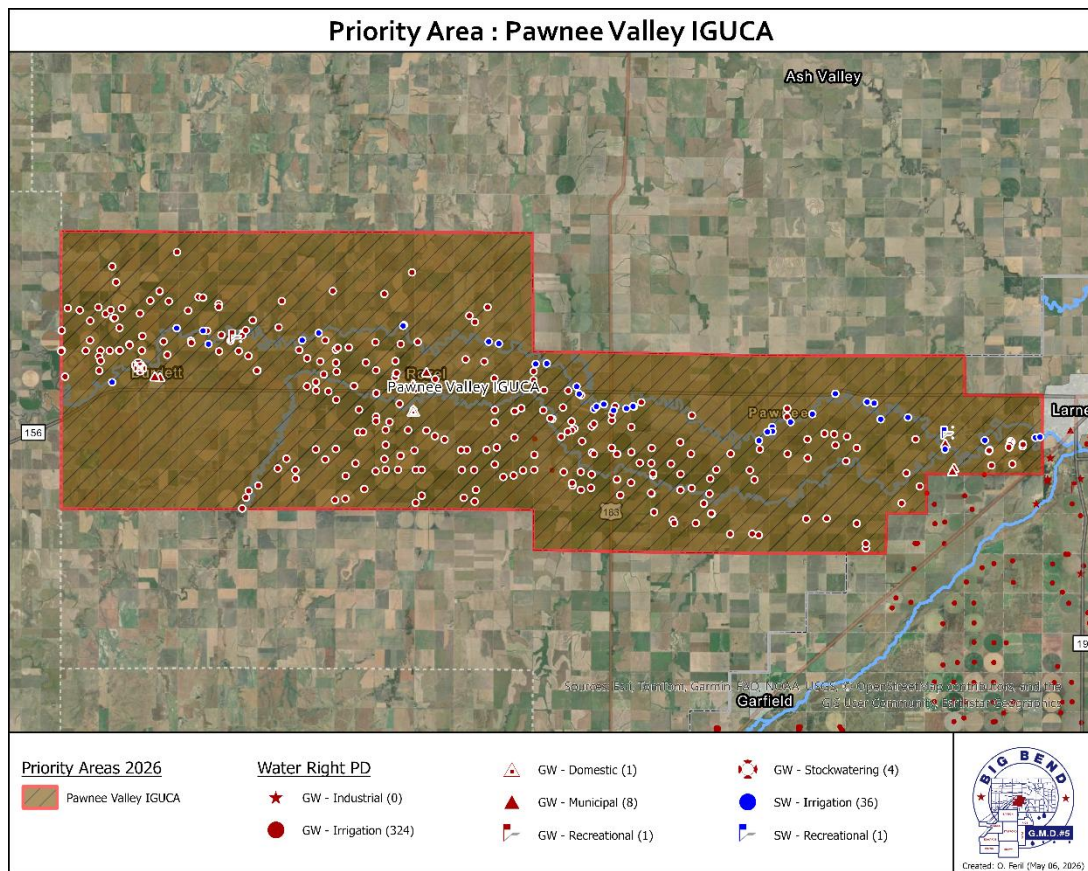


Figure 14 - Pawnee Valley IGUCA

Background

In 1980, the District noted declining water levels in the region upstream from the City of Larned along the Pawnee River. Accordingly, the District requested that the Chief Engineer initiate proceedings for an Intensive Groundwater Use Control Area (IGUCA). Following public hearings in late 1980, the Chief Engineer issued the Pawnee Valley IGUCA (PN IGUCA) order. In the years since its establishment, this order has been amended twice by the Kansas Department of Agriculture – Division of Water Resources (KDA–DWR) at the request of the District. In 2007, the Phase I order was issued to expand the IGUCA to the upstream watershed to the west. However, this expansion has not taken place at this point. The KDA–DWR maintains a website with a useful timeline and details regarding the corrective controls and copies of the PN IGUCA orders (Department of Agriculture, 2007).

The water level trends in the PN IGUCA region have stabilized and are responsive to water recharge. This trend can be attributed to several factors. 1) As a corrective control for this IGUCA, the development of new water rights was stopped, and water rights are closed to new appropriations. 2) Horsethief Reservoir has been completed and maintains routine downstream deliveries of water to the Pawnee River to aid in

1 further recharge to the underlying aquifer in the region. 3) Water metering has been required for all
2 diversions of water within the District. Through the water flowmeter program, water users are more mindful
3 of the amount of water used annually and can better manage that water use throughout the irrigation growing
4 season.

5 Outreach

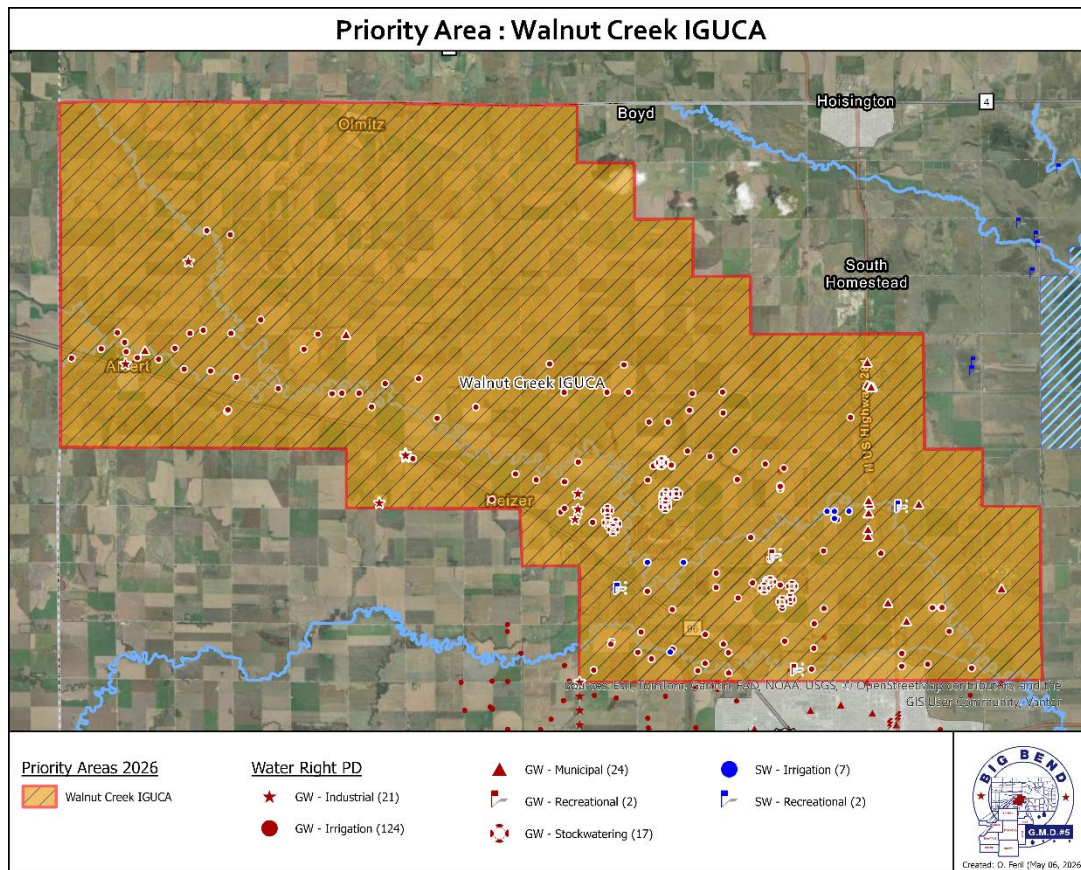
6 On October 21, 2025, District staff held a meeting in Larned at the Larned Community Center to discuss
7 regional hydrology and prospective outcomes through changes in water management in the Pawnee county
8 portion of the PN IGUCA. There were approximately 20 stakeholders in attendance at this meeting. Since
9 the meeting in October, the District has received two written comments pertaining to Pawnee County water
10 management. One of these comments pertained to the PN IGUCA. Another meeting was held at the Larned
11 Community Center on April 07, 2026, to lay out additional hydrologic information and to discuss potential
12 actions that could be taken for the PN IGUCA.

13 Implementation

14 Based on information received from the public and data collected by District staff, the District action plan
15 implementation for the PN IGUCA region will include, but are not limited to the following:

- 16 1. Request review by KDA–DWR of the PN IGUCA order based upon current hydrologic conditions
17 and water management (2027).
- 18 2. Continue monitoring the water level trends within this region.
- 19 3. Continue the water flow meter program to ensure accurate water use accounting.
- 20 4. Encourage utilization of the Irrigation Technology Initiative.

1 Walnut Creek Intensive Groundwater Use Control Area



2
3 **Figure 15 - Walnut Creek IGUCA**

4 Background

5 In early 1990, in response to reports from KDA–DWR, the Kansas Department of Wildlife and Parks, along
6 with the District, requested the Chief Engineer initiate proceedings for an IGUCA in the watershed upstream
7 of Cheyenne Bottoms Wildlife Area. There were concerns that the water withdrawals from the watershed
8 had negatively impacted the groundwater levels to an extent that Walnut Creek was negatively affected,
9 thus limiting the supply of water to Cheyenne Bottoms. Following public input and formal public hearings
10 throughout 1990 and 1991, the Chief Engineer established the Walnut Creek IGUCA (WC IGUCA) in
11 portions of Rush, Ness, and Barton counties. The KDA–DWR website has another useful timeline with
12 details regarding the corrective controls and copies of the WC IGUCA orders (Department of Agriculture,
13 2021).

14 The water level trends in the WC IGUCA region have stabilized and are responsive to water recharge. This
15 trend can be attributed to several factors. 1) As a corrective control for this IGUCA, the development of
16 new water rights was stopped, and water rights are closed to new appropriations. 2) Water right allocations
17 were established for water rights within the region that restricted the use of water by junior water rights. 3)
18 Water metering has been required for all diversions of water within the District. Through the water
19 flowmeter program, water users are more mindful of the amount of water used annually and can better
20 manage that water use throughout the irrigation growing season.

Outreach

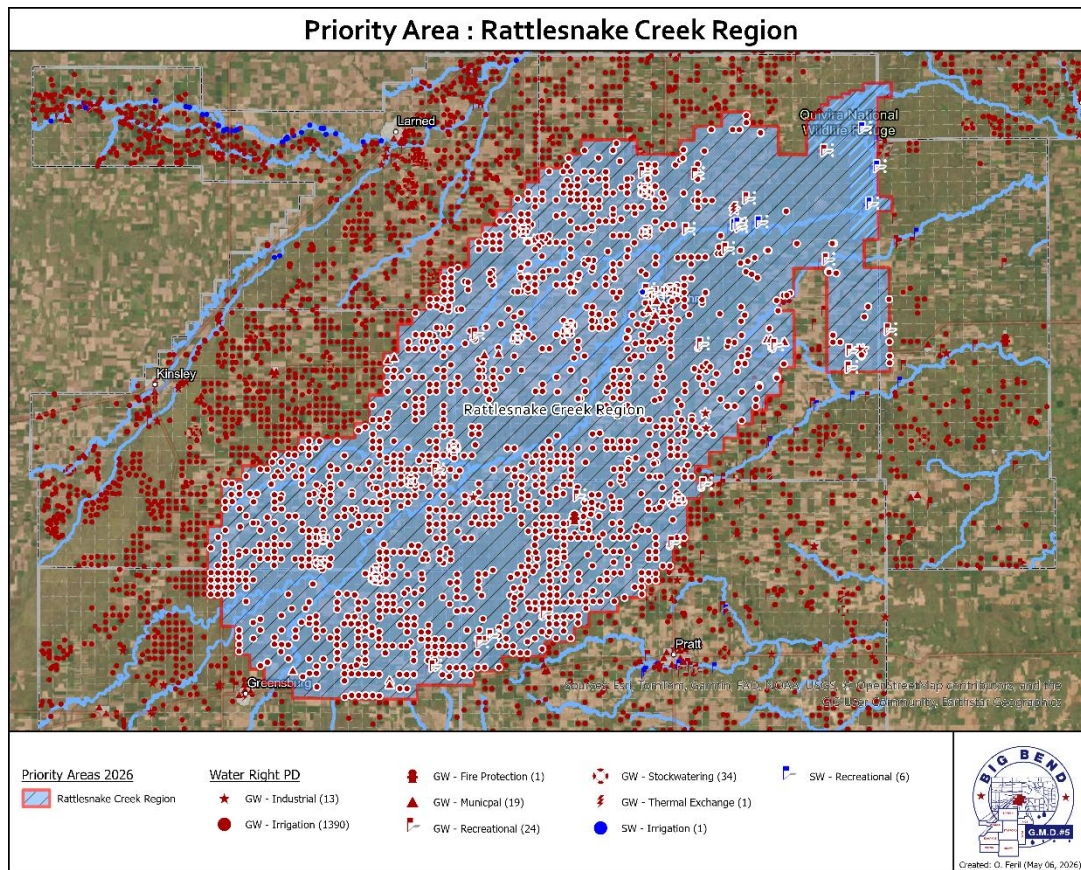
On October 21, 2025, District staff held a meeting in Great Bend at the Great Bend Chamber of Commerce to discuss regional hydrology and prospective outcomes through changes in water management in the Barton county portion of the WC IGUCA. There were approximately 20 stakeholders in attendance at this meeting. Since the meeting in October, the District has not received written comments pertaining to Barton County water management. Another meeting was held at the Great Bend Water Office on April 07, 2026, to lay out additional hydrologic information and to discuss potential actions that could be taken for the WC IGUCA.

Implementation

Based on data collected by District staff, the District action plan implementation for the Walnut Creek IGUCA region will include but are not limited to the following:

1. Request finalization of the review by KDA–DWR of the Walnut Creek IGUCA order based upon current hydrologic conditions and water management within the region (2026-2027).
2. Consider conversion of Barton County portion of the WC IGUCA to Local Enhanced Management Area (LEMA) following WC IGUCA review.
3. Continue monitoring the water level trends within this region.
4. Continue the water flow meter program to ensure accurate water use accounting.
5. Encourage utilization of the Irrigation Technology Initiative.

1 Rattlesnake Creek Region



2
3 **Figure 16 - Rattlesnake Creek Region**

4 Background

5 For several decades, the District has been working with local, state, and federal agencies to develop a long-
6 term sustainable program to address the water resource needs at Quivira National Wildlife Refuge (Refuge)
7 in Stafford County. Since 2020 the District has contracted with Olsson to conduct a thorough evaluation of
8 several alternatives for water management issues in the Rattlesnake Creek region. This highly anticipated
9 plan is nearing completion and will provide a long-term sustainable program to the region that is largely
10 funded by USDA-NRCS funds through the Watershed Protection and Flood Prevention Program. Currently,
11 the plan is finalized and awaiting record of decision from NRCS. Meanwhile, the KDA–DWR has initiated
12 a Rattlesnake Creek working group of stakeholder organizations to coordinate efforts to implement short-
13 term projects for providing water use conservation and/or streamflow improvements. The District is
14 involved in this working group effort while finalizing a larger long-term resolution for the region.

15 The Rattlesnake Creek region has been one of the most studied regions in Kansas for many decades. Over
16 that time frame, there have been several management plans and programs to stabilize the aquifer and
17 streamflow balance. Water table trends throughout the region are stable and respond very rapidly to
18 recharge events. Local conservation efforts through the Rattlesnake Creek working group can be coupled
19 with the forthcoming Watershed Plan document ensuring long-term stability in the region.

Outreach

On October 20 and 22, 2025, District staff held meetings in Pratt, Greensburg, Kinsley, and St. John to discuss regional hydrology and potential management actions for the Rattlesnake Creek region priority area. There were over 50 stakeholders in attendance at these meetings. Since the meetings in October, the District has received one written comment pertaining to water management. As part of the Watershed Plan process, the District along with NRCS completed multiple public review and comment periods for the Watershed Plan – EIS document. Pertinent revisions were made throughout the process in response to public review. More meetings were held in the same towns on April 09 and 14, 2026, to provide updated hydrologic information and to discuss potential actions that could be taken for the Rattlesnake Creek region.

Implementation

Based on information received from the public and data collected by District staff, the District action plan implementation for the Rattlesnake Creek region will include but are not limited to the following:

1. Implement the preferred alternative as outlined in the Record of Decision (U.S. Department of Agriculture, Natural Resources Conservation Service, 2026):
 - a. Complete engineering design for a streamflow augmentation wellfield (up to 28 well sites) in Stafford County capable of supplying up to 18 cfs (2026-2027).
 - b. Complete land acquisition/easement access for wellfield (2026-2027).
 - c. Complete permitting requirements for federal, state and local agencies (2027).
 - d. Construct streamflow augmentation wellfield in Stafford County (2028-2030).
 - e. Retire/Lease 2500 acre-feet of authorized water use within Zone D (Department of Agriculture, 2018) (2026-2030).
2. Continue to engage with and support local conservation efforts brought forward through the Rattlesnake Creek working group.
3. Prioritize Kansas' WTAP program for the 40 percent or greater response zones.
4. Prioritize utilization of the Irrigation Technology Initiative.
5. Continue monitoring the water level trends within this region.
6. Continue the water flow meter program to ensure accurate water use accounting.

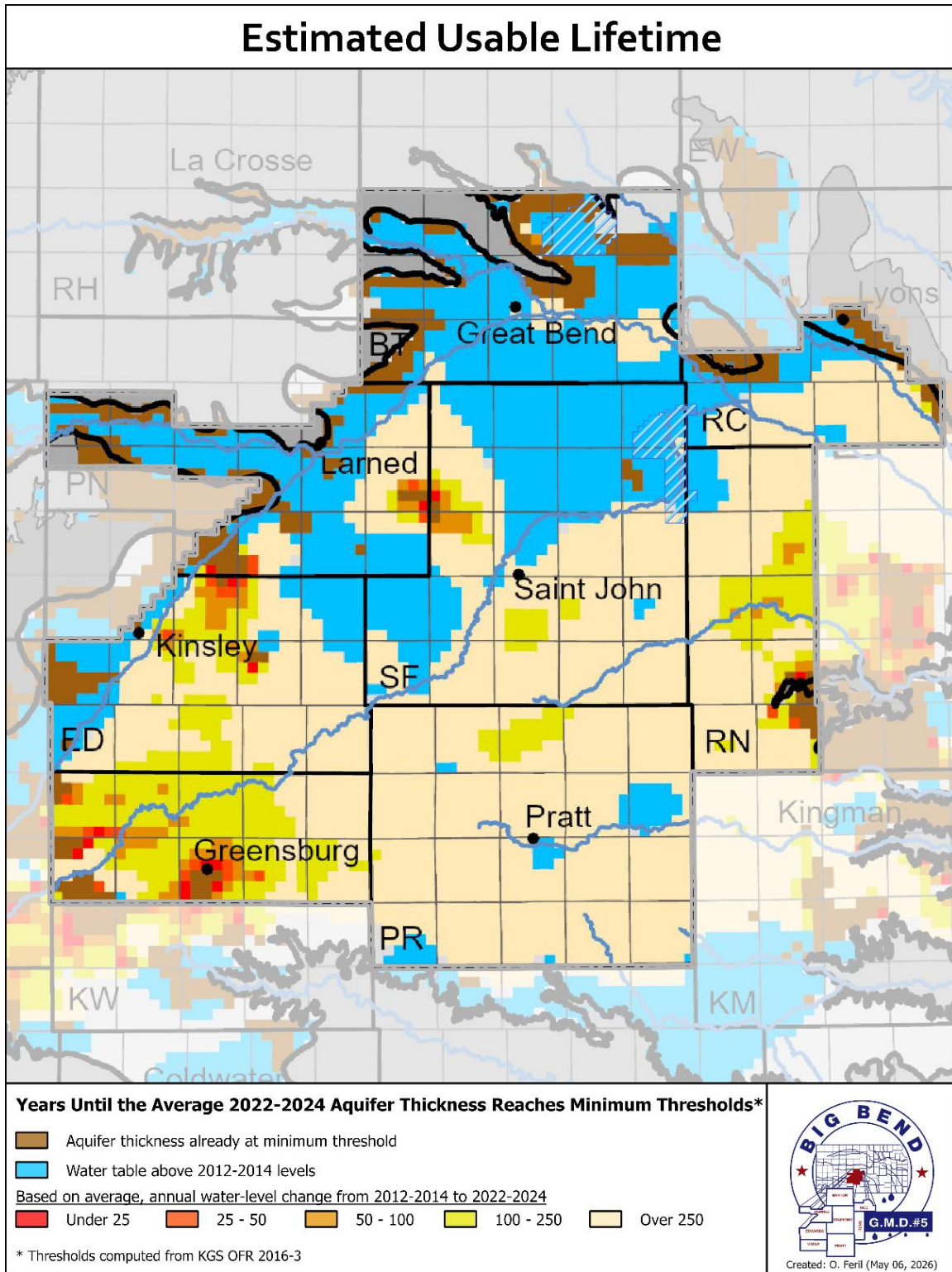


Figure 17 - Estimated Usable Lifetime

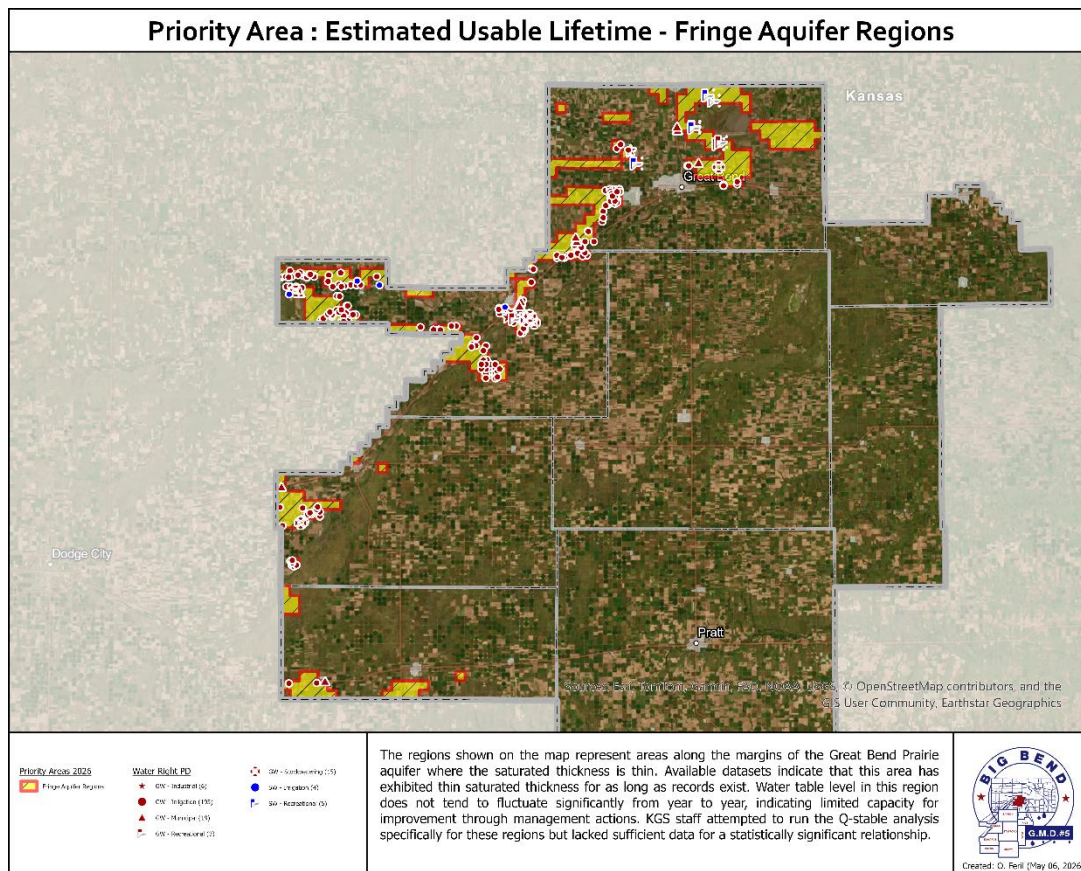


Figure 18 - Fringe Aquifer Regions

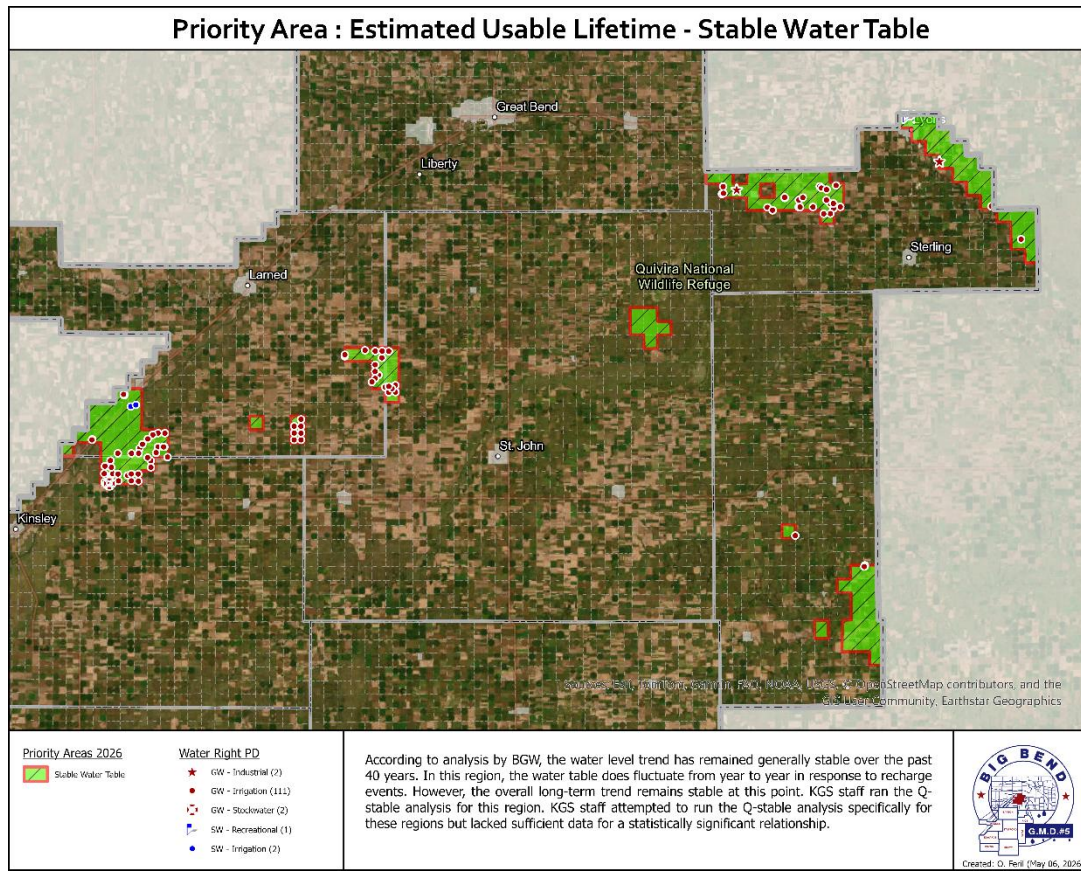


Figure 19 - Stable Water Table

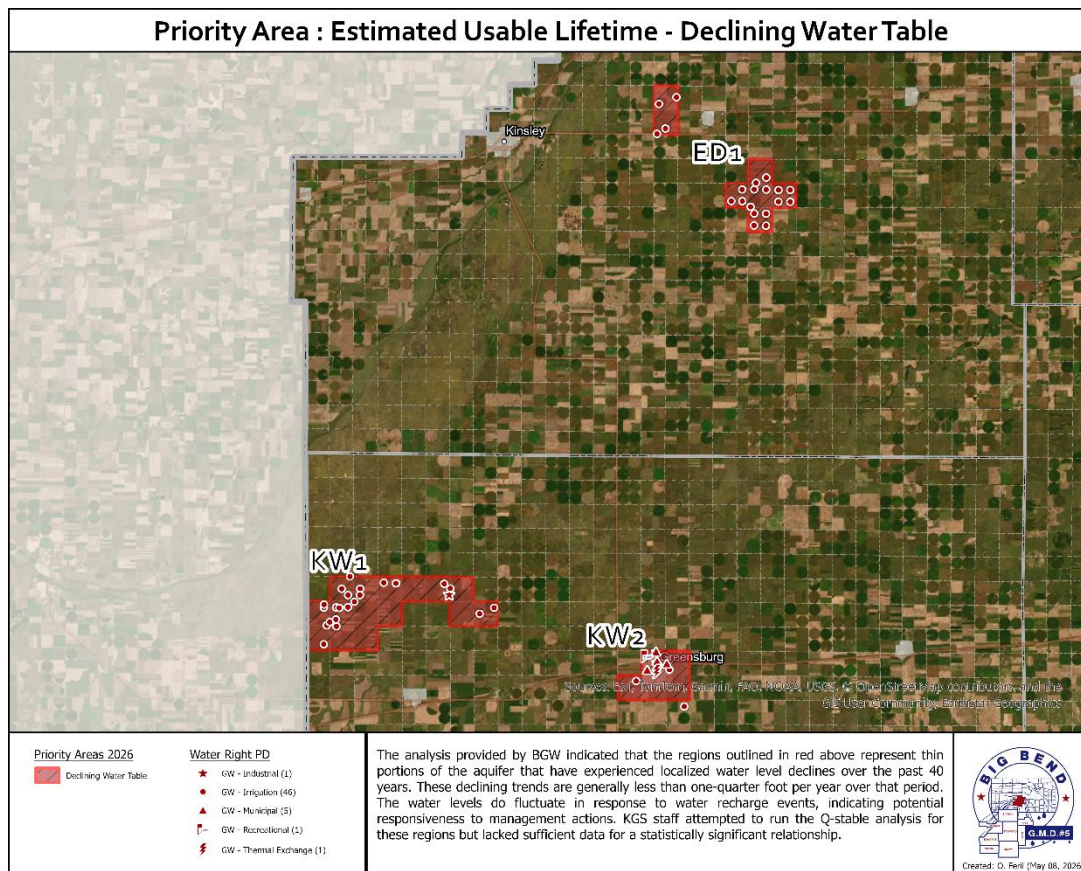


Figure 20 - Declining Water Table

Background

KGS has developed a method to project historic water-level trends into the future and estimate how long the aquifer can continue supplying reliable well yields (Wilson, Young, & Buddemeier, 2002). By combining the current saturated thickness with the previous ten years of measured water level change, KGS calculates an “Estimated Usable Lifetime” for the aquifer. This process identifies the minimum aquifer saturated thickness needed to consistently produce 200 gallons per minute from a well.

Although KGS notes that the method is most accurate for the Ogallala portion of the High Plains Aquifer located farther west of the District, it still provides valuable insight into areas that may face reduced well yields over time. The map below is the Estimated Usable Lifetime map as of 2023. Quarter sections shaded brown have already reached the minimum threshold, which in this region typically occurs along aquifer edges or over higher bedrock elevation.

In 2025, the District requested additional analysis by BGW, in coordination with the KGS, for specific areas to help determine appropriate management actions. This analysis was completed in December 2025 and presented to the Board of Directors on December 11, 2025.

The analysis indicated that areas identified within the District as having less than 50 years of estimated usable aquifer life, were in similar condition prior to large-scale water right development in the region. Specifically, these areas were characterized by thin saturated thickness during what KGS refers to as the predevelopment period (1940s–1950s). The well construction analysis of these areas indicated that out of

the nearly 300 wells installed in the regions over half of the wells were drilled into the bedrock below the High Plains Aquifer. The KGS estimated usable lifetime methodology does not consider this as it only looks at the High Plains Aquifer system. BGW staff made the recommendation to collect additional data to confirm rates of decline, along with testing of local well specific capacity. This information will enhance the estimates of usable aquifer lifetime in accordance with OFR 2002-25C (Hecox, Macfarlane, & Wilson, 2002).

The areas discussed at the December 2025 board meeting are shown in the following maps and have been designated as priority areas of concern. For management and evaluation purposes, they are categorized into three classifications:

- (1) Fringe aquifer regions
- (2) Areas with stable water levels
- (3) Areas with declining water levels

The KGS has developed a methodology to assist with local water management decisions often referred to as the Q-stable analysis (Butler Jr. J. J., Whittemore, Wilson, & Bohling, 2016). This approach compares the total pumping within an area to the net inflows into the aquifer. Q-stable is the total amount of pumping within that area that would result in stabilizing the water table. Following the identification of the regions having less than 50 years of estimated usable aquifer life, the District reached out to KGS for additional information regarding the Q-stable amount for each of these regions. The Q-stable analysis was unable to be conducted for the specific regions requested due to a limited amount of data. According to KGS staff, additional sections around the identified areas would have to be included in the analysis to be able to have enough data for a statistically significant result. As a result, using the Q-stable approach is not feasible for these regions due to the small size of the regions.

The mapped regions highlight areas of varying aquifer conditions across the District. Yellow-filled areas occur along the margins of the Great Bend Prairie aquifer where saturated thickness has historically been thin and shows little year-to-year fluctuation, suggesting limited potential for improvement through management actions. These 24 fringe regions include approximately 250 points of diversion. In contrast, green-filled areas represent generally stable water level conditions over the past 40 years, including interior “bedrock islands” where aquifer thickness is thinner than surrounding areas but still responsive to recharge events; these 12 regions contain about 120 points of diversion. Red-filled areas indicate thin aquifer zones that have experienced localized declines but still show responsiveness to recharge, suggesting potential for management impact. These seven regions include approximately 50 points of diversion, including five that supply the City of Greensburg.

Outreach

The District presented these newly identified areas at the District annual meeting in February as well as in the area meetings in April 2026. A variety of ideas were discussed in these meetings including options for potential LEMAs.

Implementation

Since these areas meet the statutory definition for areas of concern, they have been identified by the board of directors. However, based on information received from BGW and KGS more data is needed in these regions. Therefore, the District action plan implementation for the regions identified by the estimated usable lifetime map will include but are not limited to the following:

1. Gather additional information to evaluate potential LEMAs for ED1, KW1, and KW2 regions:
 - a. Analyze water use trends to better assess sustainable groundwater use within each region (2026-2028).
 - b. Install groundwater monitoring wells where needed, in coordination with KGS and BGW (2026-2028).
 - c. Conduct controlled pumping tests to determine specific capacity and refine hydraulic conductivity estimates within the BBGMDMOD (2026-2028).
2. Upon evaluation of the information gathered up to July 1, 2029, the District will determine which corrective actions are needed for the implementation of a LEMA or IGUCA, or other corrective actions to be developed in consultation with the Chief Engineer to address the hydrologic conditions in the regions.
3. The priority goal of such corrective actions should be to reasonably stabilize the hydrologic conditions in the regions within 20 years following the establishment of the corrective controls.
4. Strengthen public outreach in each region with the following goals:
 - a. Promote implementation of effective water management practices.
 - b. Increase stakeholder understanding of local water resource concerns.
 - c. Enhance peer-to-peer networking opportunities among water users.
5. Prioritize utilization of the Irrigation Technology Initiative.
6. Continue the water flow meter program to ensure accurate water use accounting.

B. Water Quality

Chloride

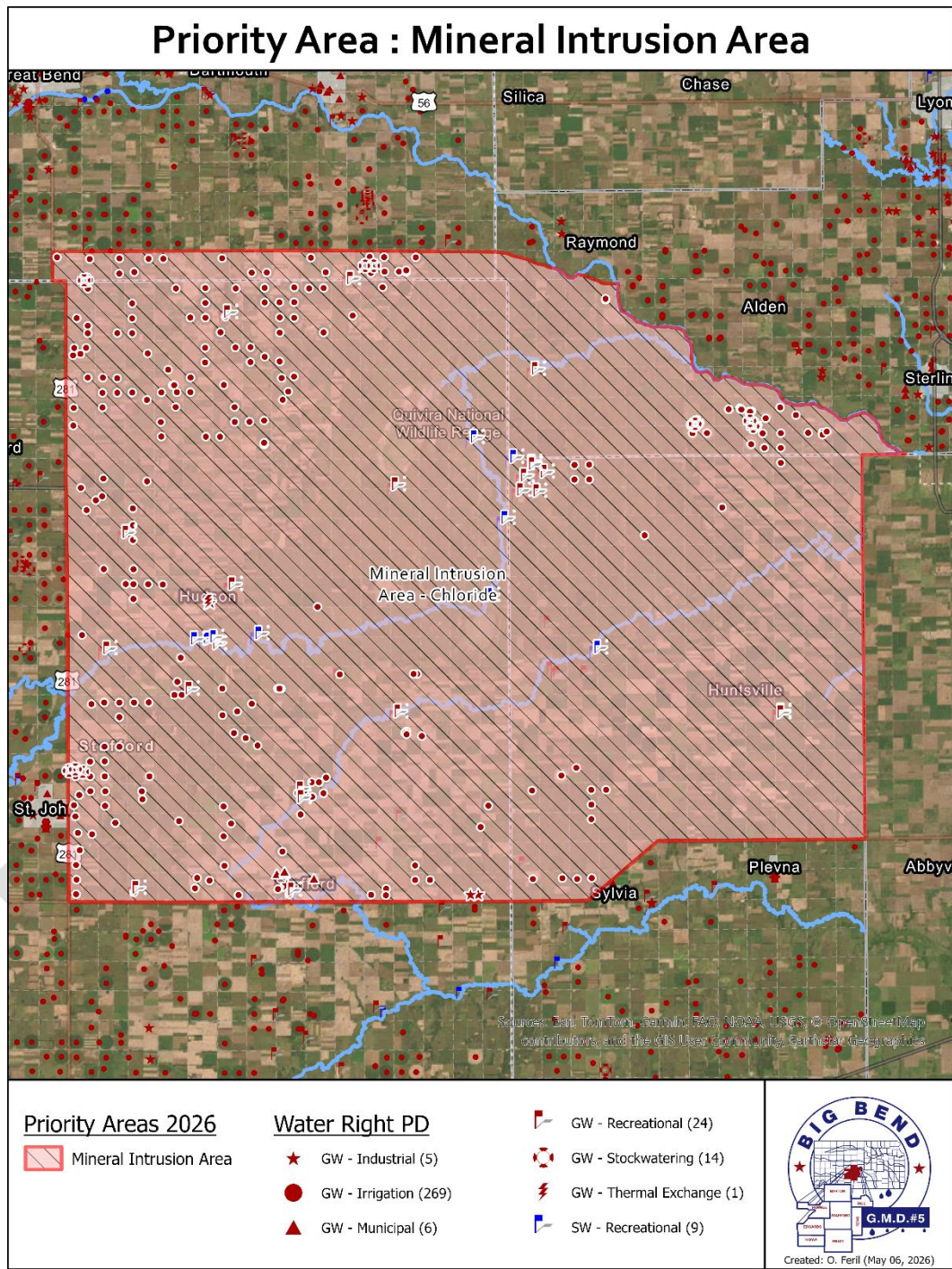


Figure 21 - Mineral Intrusion Area

Background

In the late 1970's to the early 1990's, with coordination with KGS staff, the District initiated a significant study of water quality in the eastern half of the District. Specifically, this study identified the intrusion of saltwater (from the dissolution of salt) in the Permian bedrock into the overlying Great Bend Prairie aquifer (Whittemore D. O., 1993). As a result of this study, the District identified the Mineral Intrusion area and instituted regulations to reduce the up coning of the brackish water into the Great Bend Prairie aquifer through groundwater pumping. The District maintains a network of observation wells throughout the region to collect water samples to track changes in the regional water quality.

Outreach

On October 22 and 23, 2025, District staff held meetings in St John, Sylvania and Sterling to discuss regional hydrology and prospective outcomes through changes in water management in the previously identified mineral intrusion area. There were approximately 20 stakeholders in attendance at this meeting. Since the meetings in October, the District has not received written comments pertaining to the mineral intrusion area. In April 2026, additional meetings were held in the same towns to provide additional information to the public.

Implementation

Based on data collected by District staff, the District action plan implementation for the mineral intrusion area region will include but are not limited to the following:

1. Reestablish water quality monitoring for chloride concentrations throughout the region from District observation wells (2026).
2. Review K.A.R. 5-25-10, K.A.R. 5-25-16 for metrics to ensure proper monitoring and proactive mitigation to maintain the integrity of the upper zones of the aquifer in the region (2026-2027).
3. Coordinate with KDHE and KGS to review water quality results and consider expansion of the mineral intrusion areas as necessary to properly maintain the regional water quality.

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1 reasons above, it is premature to identify this as a Priority Area of Concern, but it is being considered by
2 the District. To continue to obtain comprehensive datasets for consideration by the District as well as public,
3 KGS staff ran the Q-stable analysis for this region.

4 Outreach

5 The District held initial outreach meetings in Kinsley and Greensburg and St John in early 2024 to present
6 information to the public during the development of the areas of concern. Feedback received in those
7 meetings indicated that when considering the estimated usable lifetime of the region compared to the water
8 level trend is considered reasonable by the stakeholders. Further outreach meetings were held in October
9 2025 to outline updated hydrology for the region. Additional meetings were held in April 2026 in
10 Greensburg and Kinsley. The consensus received during the outreach meetings supports the following
11 implementation approach.

12 Implementation

13 Based on information received from stakeholder outreach during multiple outreach meetings, the District
14 will continue the following:

- 15 1. Install groundwater monitoring wells where needed, in coordination with KGS and BGW (2027-
16 2028).
- 17 2. Conduct controlled pumping tests to determine specific capacity and refine hydraulic conductivity
18 estimates (2027-2028).
- 19 3. Continue monitoring the water level trends within these regions.
- 20 4. Continue the water flow meter program to ensure accurate water use accounting.

B. Water Quality

Nitrate

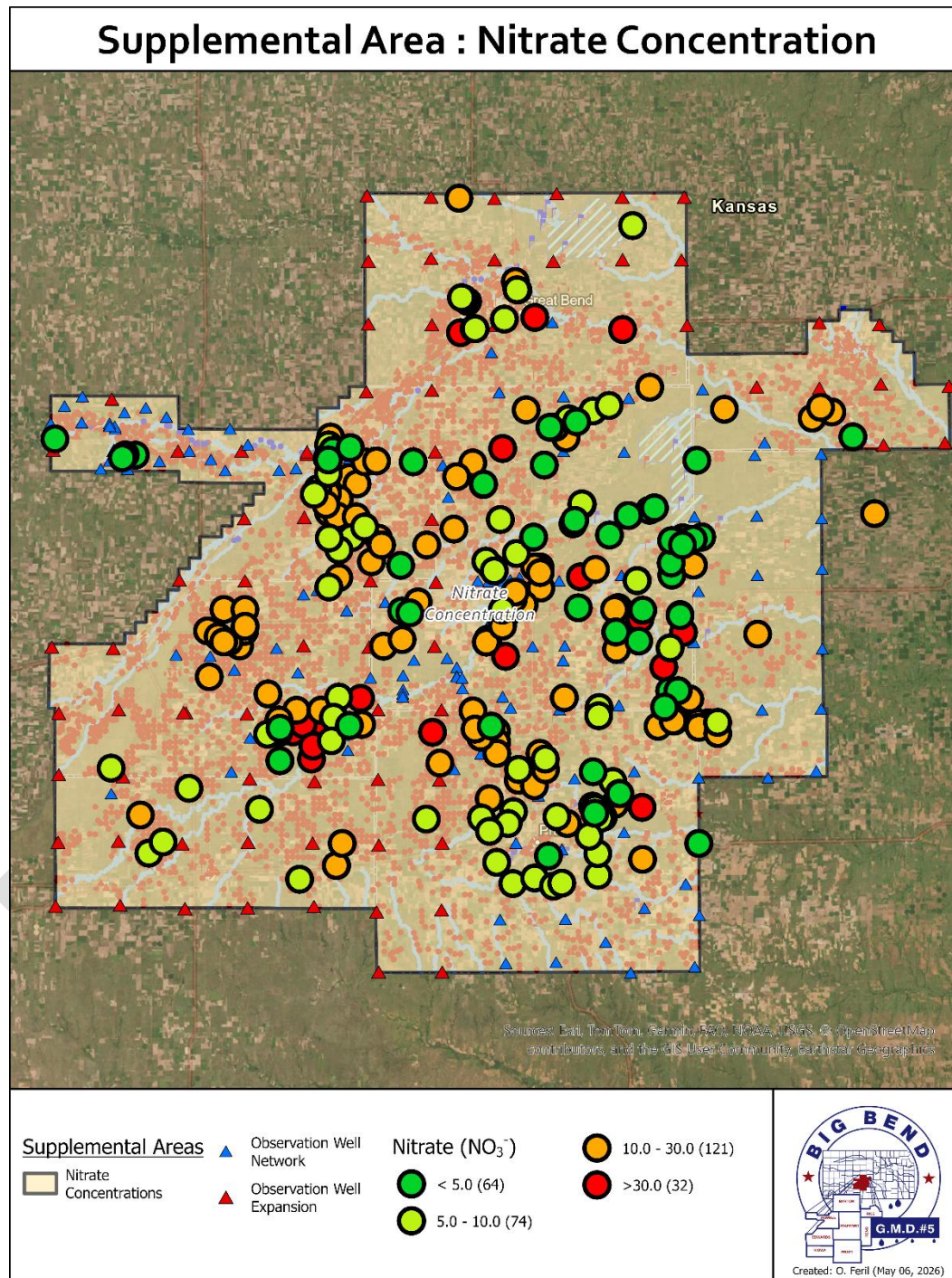


Figure 23 - Nitrate Concentrations

Background

Early KGS studies have indicated elevated nitrate concentrations in the groundwater of the District (Townsend & Young, 1995). The District is currently gathering additional data points and coordinating with KDHE to better clarify the regions within the District with elevated nitrate concentrations.

Outreach

Until such a time that a narrower area can be identified, the District is conducting a District-wide effort to inform and encourage all water users to collect and analyze their water wells for nitrate concentrations. The District is providing water bottles for public and private use to bring water samples to the District lab for analysis. The District laboratory is not KDHE-certified, but this provides a quick and economical assessment for the public while allowing the District to collect water quality data from across the District. Once more data is collected, this can be analyzed to determine focused areas impacted by elevated nitrate concentrations. Since the District has not yet received a sufficient number of samples for analysis, effective identification of Priority Areas for nitrate concentrations is not possible. The District is continuing to collect water samples from a variety of sources to track trends in nitrate concentrations over time. In the past two years, the District has collected over 300 water samples. The data is currently being compiled into a unified database that will be shared with KGS to get this information public. The District held initial outreach meetings in 2025 and 2026 to increase awareness of the concentrations of nitrate in the groundwater.

Implementation

Based on information received from stakeholders during multiple outreach meetings, the District will continue the following:

1. Install groundwater monitoring wells, where needed, in coordination with KGS and BGW (2027-2028).
2. Integrate District water quality records with KGS' water quality database for public distribution (2026).
3. Research potential mitigation techniques to determine possible future actions as needed once priority areas are identified.
4. Continue water quality monitoring throughout the District.
5. Encourage private well sampling and submit analysis results to the District.

- 1 This section of the District's management program is reserved for the areas of concern and associated action
- 2 plans that are currently being developed by the District board and staff based on input from water right
- 3 owners in the area.

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31

32 Revision History

- 33 • June 18, 1976 – Initial Management Program Approved
- 34 • January 5, 1979 – Revised Management Program Approved
- 35 • June 20, 1988 - Revised Management Program Approved
- 36 • January 2, 2019 - Revised Management Program Approved

- January 9, 2026 - Revised Management Program Approved

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