

# Needs Assessment

A component of the  
Sunflower H2O  
Water Supply and Demand Study

Kansas Water Office  
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## INTRODUCTION

The state of Kansas and the Tulsa District Corp of Engineers entered into an agreement on March 7, 2011 to conduct a study of the Water System Supply and Demand for the counties in the Sunflower H2O area, under authority given in Section 22 of the 1974 Water Resources Development Act, Planning Assistance to States program. The Kansas Water Office is the non-federal Sponsor for this study. However, the members of the Sunflower H2O are active partners, having contributed cash and in-kind work to the study. A steering committee of public water supply, city and county officials has been providing leadership on the study.

The purpose of this study is to develop the baseline water supply need (demand) and current supply sources; identify the potential recreation benefits, if they exist, of a surface water supply; identify surface water supply sources; and identify additional groundwater supply sources. This study will build upon information presented in the document “Preliminary Engineering Report Phase 1: Sunflower H2O Initiative” dated January 2008.

As part of the agreement, the Kansas Water Office (KWO) is providing a needs assessment as in-kind services for this study. The work includes information gathered on existing water systems, including the following data:

- Name and service area of providers
- Size
- Capacity
- Water price to consumer
- Quantity supplied

The needs assessment includes producing three scenarios for population trends (high, midline and low), which will be used to perform a gap analysis between supply and future demand using information available.

**The bulk of the information was compiled by the Kansas Rural Water Association working under direction of the KWO. The Kansas Water Office developed separate population and demand projections. Information on the state of Oklahoma was developed by the Oklahoma Water Resources Board.**

For ease of narrative reading, all tables have been compiled at the end of the report.

## **Objective**

The Public Water Supplies (PWSs) of the four county area of Barber, Harper, Kingman, and Pratt counties were evaluated to determine their ability to meet future water supply needs. Pertinent population data, water usage, and water rights were evaluated in order to assess whether future water quantity needs can be met with existing water supplies or expansion of these existing water supplies. Water quality data and water supply operations were also reviewed to determine any affect these might have on meeting future water supply needs.

## **Basic Information on Water Suppliers**

### **Population**

There are thirty PWSs in the four county area. Table 1a lists the population served by each PWS, as well as the number and type of connection. Table 1 also contains the cost for residential customers for 5000 gallons in 2009. The total population served in the area is 20,921 persons. Table 1b. lists the suppliers with those they may sell to or buy from. The present population of each county and the four-county total are shown in Table 4. The recent 2010 census show a total, four - county population of 27,067 persons. Thus, 77% of the four-county population is served by PWSs.

### **Population and Water Use Trend Methodology**

Projections have been completed for four counties (Barber, Harper, Kingman and Pratt) and the six largest water suppliers (Anthony, Harper, Kingman, Kiowa, Medicine Lodge and Pratt) in the needs assessment. Tables 2a and b compile county information from the US Census Bureau and the KU Institute for Policy and Social Science. The KU Institute uses projections from the Census, Wichita State University and the Kansas Water Office.

Decadal population data is available at the City and County level through the U.S. Census Bureau. Projections from this data indicate varying rates of decline in each of the four counties and six largest water suppliers. These projections are compared with three additional sets of population projections: KWO projections completed in 1999; Wichita State University projections completed in 2008; and Kansas Division of Budget projections completed in 2011. While there are some differences between the projections, all indicate varying rates of decline in each of the four counties.

The scope of work requires three scenarios of population trends (high, midline, and low). The trend determined from the U.S. Census Bureau data is used as the low trend. The midline trend assumes a level population equal to that in the 2010 Census. The high trend assumes a 1% annual population growth rate, which is approximately equal to the annual growth rate in Sedgwick County from 2000 to 2010.

The historical and projected populations for each county and for the four-county area are shown in Table 2a-c. This data shows that the area has had a significant population loss in the decade of 2000 – 2010. Also, the data shows that the area will have significant population loss in the next two decades, 2010 – 2020 and 2020 – 2030. Pratt County shows a loss of 2.66% for the decade of 2010 – 2020 while the other three counties show losses for that decade in the range of 9.74% - 11.99%.

The loss of population for a water supplier many times has two significant consequences. First, the fixed cost of the water supply operation will have to be paid by fewer customers, thus necessitating increases in customers' billings. Secondly, the amount of water pumped and sold may hold steady but will more likely decrease. Both of these consequences put a financial strain on the PWSs and makes for difficult decisions for the elected officials and staff.

Projected water use for the four counties and six largest water suppliers was also calculated. Data are available for each of the water suppliers in Region 6, and a 6-year average GPCD (2005 – 2010) was used. (See Table 2d.) An average 5-year GPCD (2005 – 2009) for all of Region 6 was used for water use projections at the county level.

### **Water Diverted**

The yearly amount of water diverted for a recent ten-year period by each PWSs is shown in Table 3. Also, the yearly totals for all PWSs, the six largest PWSs, and the ten largest PWSs are shown at the bottom of Table 3.

There are several important conclusions that can be gained by the information in the Table 3 data. First the six largest PWSs represent 83% - 87% of the total water diverted. The ten largest PWSs represent more than 90% of the total water diverted. Thus, any consolidation of PWSs should include these large PWSs so as to be economical. Unfortunately, the six largest PWSs are separated by many miles.

Table 3 data shows that there has been a significant decrease in the amount of yearly water diverted since 2000. Likewise, there has most likely been the same or nearly the same decrease in water sales.

Of the six largest PWS, only Kiowa has not shown a significant decrease of water diverted. The total amount of water diverted by the six largest PWSs has gone from 1.30 billion gallons in the year 2000 to 1.05 billion gallons in 2009.

The reasons for the decrease in water diversion would likely include a decrease in population, increasing water rates and water conservation. Unfortunately, the first two and probably all three reasons may be responsible for additional decreases in water usage in the next two decades.

Table 4 summarizes the percent of unaccounted for water use in each of the systems. This percentage is a good indicator of system efficiency. Large percentages of unaccounted for water result from system losses, but can also be caused by over-reported diversion and unmetered uses.

*Source of Information: Kansas Department of Agriculture, Division of Water Resources, analyzed by KRWA*

### **Water Rights**

The purpose of this water right review was to determine the quantities, and in a lesser extent the authorized instantaneous rates of diversion, authorized under water rights with the authorized use of water of municipal use. The inset below shows total authorized by county.

<b>Total Authorized Quantities By County (Million Gallons per Year) (As of March 17, 2011)</b>	
Barber County	519.634
Harper County	626.230
Kingman County	446.547
Pratt County	1,041.739
Sumner County (part)	54.400
<b>Total</b>	<b>2,688.550</b>

Some of this total quantity is appropriated but not yet perfected. In the future, certification of the appropriations will likely result in reductions of some of the individual authorized quantities as well as the total quantity. Forfeitures and abandonments are also possible but that will likely be insignificant to the total quantity. The water rights for the PWSs are summarized in Table 5.

The public water systems owned and operated by the larger cities have a significant percentage of the appropriated quantities. In Barber County, the City of Medicine Lodge has 245.014 million gallons per year (MGY) or 47% of the total quantity authorized. The City of Kiowa has 140.000 MGY or 27%. These two water systems together have 74% of the county's total for municipal use.

In Harper County, the City of Anthony has 361.000 MGY or 58% of the appropriated quantity in the county. The City of Harper has 200.000 MGY or 32% of the appropriated quantity in the county. Combined, they have 90% of the county's total for municipal use.

In Kingman County, the City of Kingman has 339.500 MGY or 76% of the appropriated quantity in the county for municipal use.

In Pratt County, the City of Pratt has 942.000 MGY or 90% of the appropriated quantity in the county for municipal use.

All PWSs have sufficient water rights for their existing needs and most likely for their future needs.

The water rights for the six largest PWSs are discussed in the discussion of these PWSs that follow.

*Source of information: Kansas Department of Agriculture Division of Water Resources; compiled and analyzed by KRWA.*

### **Water Quality**

All the PWSs in the four county area have groundwater as the source water. In the past some wells have been abandoned and new wells constructed due to water quality reasons. Presently, all PWSs have good water quality with the exception that some PWSs are either near or are exceeding the maximum contaminant level (MCL) for nitrate.

Both Anthony and Harper have nitrate levels at or near the MCL. Both cities have an engineering consultant and have proposed to build a nitrate removal plant. At this time the two cities and the funding agencies are discussing the possibility of building one nitrate removal plant together as their well fields are within a mile of the other's well field.

The Pratt wells have increased in nitrate over the last decade. Although the nitrate levels are presently below the MCL, the city is aware that a nitrate removal plant or another source of water supply might be needed in the near future.

The Norwich wells have been for many years above the MCL for nitrate. The city has an engineering consultant for a possible nitrate removal plant. The city also has been discussing the possibility of cooperating with Argonia, Conway Springs, and Sumner Co. RWD 5 in the construction of a nitrate removal plant to serve all these PWSs that presently have nitrate levels above the MCL.

Harper Co. RWD 4 has had violations of the MCL for nitrate. RWD #4 purchases water from Argonia. When Argonia completes construction of a nitrate removal plant, RWD 4 will then be in compliance with the nitrate MCL.

*Source of information: Kansas Department of Health and Environment; analysis by KRWA*

### **Water Supply Operations**

The KDHE database was reviewed for violations and operational deficiencies. Other than the nitrate issue previously mentioned, the wells and water production facilities were found to be adequate. Most all the violations and deficiencies were distribution system issues or administration and record keeping issues.

The majority of the violations and deficiencies were those common to PWSs throughout Kansas. These include violations of the Total Coliform Rule; namely positive coliform samples from routine testing. They also included violations in issuing Public Notifications and the annual Consumer Confidence Reports. Other violations included those from lead and copper sampling of the distribution system. Violations also included not taking and recording required daily chlorine residuals. Other monitoring violations occurred due to inadvertently not sending in required water samples.

*Source of information: Kansas Department of Health and Environment; analysis by KRWA*

### **Summary of the Six Largest PWSs**

The six largest PWSs in the four-county area represent approximately 77% of the population served by PWSs and approximately 83% of the water usage. Thus, these six are discussed to provide information on their present water supply system and the capability to supply water in the future.

#### **Pratt**

The city of Pratt has a population of approximately 6,400.

The city has water rights for 942 MGY of which 442 MGY are not yet perfected. The maximum permitted pumping rate of all wells is 5,987 GPM or 8.63 MGD rate.

The city has eleven wells, one of which is to be plugged. The wells are scattered throughout the city. The individual well pumping capacities vary in the range of 430 GPM to 750 GPM. The sum of the ten wells pumping is 5,845 GPM or 8.42 MGD.

The annual amount of well water diverted peaked in 2003 at 604 MGY and has since decreased steadily to 454 MGY in 2009. The future possible startup of the nearby ethanol plant might require an additional 261 MGY (0.71 MGD) pumping.

The city has sufficient water rights and well pumping capacity for many years into the future even when the ethanol plant demand is added. The location of the water lines in reference to the wells may put some limitation on hourly production. But rotating well pumping and pumping for eight hours per day will produce 2.8 MGD, and nearly match recent historical demand.

The city wells have increased in nitrates over the last ten years. Samplings in 2010 show nitrate levels in the range of 3.3 – 9.2 mg/l for the ten city wells. If the nitrate levels increase above 10 mg/l, then new wells or

another water supply source might be needed or a treatment plant might be constructed. Blending of high nitrate well water with low nitrate well water is not easy due to the scattered locations of the wells.

### **Pratt City Airport**

The airport has water rights for 6,000 MGY with a maximum pumping rate 395 GPM. The airport has two wells. Well #1 is used but is high in nitrates so bottled water is provided for drinking. Well #2 has carbon tetrachloride contamination and is not used. The average yearly pumping for the last seven (7) years is 2.68 MG. The Airport has ample water supply.

### **Kingman**

The city of Kingman has a population of approximately 3,200. The city also provides water to Kingman Co. RWD 1, which serves approximately 250.

The city has water rights for 339.5 MGY. The maximum permitted pumping rate of all wells is 1,492 GPM or 2.15 MGD rate. However, some of these rights are for wells and springs under the direct influence of surface water. Thus, KDHE restricts the use of these wells and springs.

However, the city has three newer, main wells that were constructed so that the city could abandon the wells and springs under the direct influence of surface water. These three wells are located approximately 4.5 miles southwest of the city. The city has water rights for 312 MGY for these three wells with a maximum pumping capacity of 700 GPM for each well and 2,100 GPM for all three wells.

The three wells have actual pumping capacities of 650 GPM, 650 GPM, and 350 GPM. The sum of the three wells pumping is 1,650 GPM but the sum may be limited somewhat by the size of the water line to the city.

The annual amount of well water diverted has decreased somewhat steadily from 204 MGY in 2000 to 145 MGY in 2009.

The city has sufficient water rights and well pumping capacity for many years into the future. The water is very good quality with low total hardness and has low nitrate levels.

### **Anthony**

The city of Anthony has a population of approximately 2,300. The city also provides water to Harper Co. RWD 2, which serves approximately 600.

The city has water rights for 361 MGY. The maximum permitted pumping rate of all wells is 1,594 GPM or 2.3 MGD rate. The city has sufficient water rights for many years.

The city has five main wells. The wells are located approximately seven miles north of the city just south of the city of Harper. The individual wells have pumping capacities of 400 - 600 GPM. The well field pumping can deliver approximately 1,300 GPM with three wells operating. The water line to town is 18-inch and is scheduled to be replaced with a 16-inch pipe.

The annual amount of well water diverted has decreased somewhat steadily from 216 MGY in 2001 to 132 MGY in 2009.

The city wells have high nitrates. The city is proceeding to build a nitrate removal water treatment plant. With the completion of the plant and associated infrastructure, the city will have a good source of water supply for many years.

### **Harper**

The city of Harper has a population of approximately 1,450. The city also provides water to Harper Co. RWD 1 and RWD 5, which together serve approximately 260.

The city has water rights for 200 MGY. The maximum permitted pumping rate for all wells is 950 GPM or 1.37 MGD rate. The city has sufficient water rights for many years.

The city has three main wells. The wells are located within a mile of the southwest corner of the city. Two wells have pumping capacities of 650 GPM and 550 GPM. The third well is not presently used due to nitrates being greater than the allowable maximum contaminant level.

The annual amount of well water diverted has decreased somewhat steadily from 106 MGY in 2000 to 86 MGY in 2009.

The city wells have high nitrates. The city is proceeding to build a nitrate removal water treatment plant. With the completion of the plant and associated infrastructure, the city will have a good source of water supply for many years.

### **Kiowa**

The city of Kiowa has a population of approximately 900. The city also provides water to the city of Hazelton with a population of approximately 120 and very little water to Barber Co. RWD 2, which serves approximately 170.

The city has water rights for 140 MGY. The maximum permitted pumping rate of all wells is 925 GPM or 1.3 MGD rate. The city has sufficient water rights for many years.

The city has two main wells. From Kiowa, the wells are located fifteen miles north and three miles east; or just south of the city of Sharon. The two wells have pumping capacities of 350 GPM each. There are two standby wells in town but they are not used for drinking water.

The annual amount of well water diverted has been consistently in the range of 62.8 to 67.0 MGY.

The city has sufficient water rights and well capacity to provide a good water supply for many years.

### **Medicine Lodge**

The city of Medicine Lodge has a population of approximately 2000. The city also provides water to Barber Co. RWD 1, which serves approximately 100.

The city has water rights for 245 MGY. The maximum permitted pumping rate of all wells is 1,633 GPM or 2.35 MGD rate. Another 9.775 MGY of water rights from two KDWP wells is pending. The city has sufficient water rights for many years.

The city has ten city wells. The wells are located approximately two miles north of town. The city wells have pumping capacities in the range of 75 GPM to 150 GPM. The city also uses two KDWP wells with pumping capacities of 200 GPM and 250 GPM.

The annual amount of well water diverted has steadily decreased from a peak of 310 MGY in 2004 to 173 MGY in 2009.

The city has sufficient water rights and well capacity to provide a good water supply for many years.

*Source: Information compiled from previous with analysis by KRWA*

### **Conclusions**

The following are important considerations in assessing the viability of the present water supplies to continue to provide a good water supply source in the future.

1. The population, water usage, and water sales have been decreasing in the past and may continue decreasing in the future.
2. The PWSs have sufficient water rights for their present needs and likely future water needs. The water rights are sufficient now so they are sufficient under a future, steady or decreasing water usage scenario.
3. The PWSs present water production facilities (wells and re-pumping stations) are adequate and will be adequate for the foreseeable future.
4. The water quality is good with the exception of nitrates in the few aforementioned cases. The PWSs with nitrates are aware and are addressing the matter with the common solution of constructing a nitrate removal plant.
5. In Kansas, small cities and RWDs face many challenges. It appears that the PWSs in the Barber, Harper, Kingman, and Pratt counties are not facing a water supply constraint or shortage in the foreseeable future.

### **Emerging Issues**

During the course of development of this needs assessment, more information came to light about the interest in Kansas by energy companies of conducting deep well fracking in the Mississippian formation. This formation underlies, and fracking is currently occurring in, Barber, Meade and Comanche counties at depths around 4,800'.

Hydraulic fracturing is a process used to stimulate a well to increase its oil or gas production. The technology is not new; what is new in the current activity is using horizontally drilled wells with the fracking process. The frac job is done after the well is drilled, but before it is pumped. There may be 5 to 7 frac cycles. Water and sand make up 98% of the fluid, with the additives at 2%. The sand is to hold open the fractures created, so gas trapped can now flow to the well borehole. The used fluids, flowback, are emptied into a tank or pit that are then either reused or disposed of according to regulations. Amount and type of fluids needed for frac jobs depends on the depth, formation and pressure required.

Though estimates and information vary, water needs range from 2-5 million gallons per well that is fracked.

It is currently unknown, of course, what impact this activity may have on water resources in south central Kansas. Opportunities for local benefits do exist. For instance, dredging of Lake Anthony is currently being explored as a source of water for fracking that would then leave an improved recreational asset in the community. A temporary water use permit has been obtained from the Department of Agriculture, Division of Water Resources.

This issue is one to consider as a potential impact on the resources of the area, which also opens so opportunity for growth, however short lived it may be. The state will continue to monitor the impact and inform Sunflower H2O as the PAS study proceeds.

# **TABLES**

**Table 1a. Distributing Water: Connections and Cost**

<b>Public Water Supplier</b>	<b>KDHE Pop.</b>	<b>Total Connections</b>	<b>Residential Connections</b>	<b>Commercial Connections</b>	<b>Industrial, Stock, &amp; Other Connections</b>	<b>Cost for Residential 5,000 Gallons</b>
Anthony	2,224	1,265	1,065	183	17	\$35.81
Argonia - Sumner Co.		264	222	33	9	\$34.00
Attica	586	382	369	9	4	\$12.35
Barber RWD 01	75	42	37	0	5	\$38.00
Barber RWD 02	500	330	128	2	200	\$33.00
Barber RWD 03	220	101	76	4	21	\$41.50
Bluff City	73	48	40	7	1	\$13.00
Coats	109	51	48	3	0	\$13.00
Cullison	96	45	43	1	1	\$17.00
Cunningham	452	265	233	18	14	\$16.75
Hardtner	178	148	112	36	0	\$18.00
Harper	1,416	754	644	108	2	\$22.75
Harper RWD 01	50	43	17	0	26	
Harper RWD 02	174	274		0	0	\$53.00
Harper RWD 03		11		0	0	
Harper RWD 04	320	151	114	0	37	\$44.25
Harper RWD 05	209	99	83	2	14	\$54.50
Isabel	103	59	48	11	0	\$17.00
Iuka	182	79	68	9	2	
KDWP (Barber Co.)				0	0	
Kingman	3,110	1,609	1,351	254	4	\$24.75
Kingman RWD 01	250	111	99	11	1	\$61.75
Kiowa	967	644	500	123	21	\$13.75
Medicine Lodge	2,036	1,039	902	134	3	\$24.62
Mullinville		175	141	15	19	
Nashville				0	0	
Norwich	510	203	187	8	8	\$21.00
Pratt	6,408	3,251	2,770	461	20	\$11.96
Preston	161	84	80	3	1	\$15.50
Sawyer	121	87	70	17	0	\$15.00
Sharon	201	141	122	19	0	\$15.00
Spivey	75	46	46	0	0	
Zenda	115	80	70	10	0	\$17.75

<b>Table 1b. Distributing Water: Purchasers 2009 Information</b>		
<b>Public Water Supplier</b>	<b>Sells to PWS</b>	<b>Purchase from PWS</b>
Anthony	to Harper #2	
Argonia - Sumner Co.	-	-
Attica	-	-
Barber RWD 01	-	from Medicine Lodge & Barber #3
Barber RWD 02	-	from Kiowa
Barber RWD 03	to Barber #1	-
Bluff City	-	-
Coats	-	-
Cullison	-	-
Cunningham	-	-
Hardtner	-	-
Harper	to Harper #1 & #5	-
Harper RWD 01	-	from Harper
Harper RWD 02	-	from Anthony
Harper RWD 03	-	--
Harper RWD 04	-	from Argonia
Harper RWD 05	to Spivey	from Harper
Isabel	-	-
Iuka	-	-
KDWP (Barber Co.)	-	-
Kingman	to Kingman #1	-
Kingman RWD 01	-	from Kingman
Kiowa	to Barber #2 & Hazleton	-
Medicine Lodge	to Barber #1	-
Mullinville	-	-
Nashville	-	-
Norwich	-	-
Pratt	-	-
Preston	-	-
Sawyer	-	-
Sharon	-	-
Spivey	-	from Harper #5
Zenda	-	-

**Table2. Population Projections****2a. County Population Projections from KU Institute for Policy and Social Research**

								Percent Change	Percent Change	Percent Change
	2000	2005	2010	2015	2020	2025	2030	2000 - 2010	2010 - 2020	2010 - 2030
Barber County	5,307	4,966	4,655	4,371	4,109	3,869	3,650	-12.3%	-11.73%	-21.6%
Harper County	6,536	6,040	5,631	5,274	4,956	4,671	4,412	-13.8%	-11.99%	-21.6%
Kingman County	8,673	8,162	7,703	7,304	6,953	6,639	6,357	-11.2%	-9.74%	-17.5%
Pratt County	9,647	9,413	9,232	9,092	8,986	8,907	8,852	-4.3%	-2.66%	-4.1%
County Population	30,163	28,581	27,221	26,041	25,004	24,086	23,271	-9.8%	-8.14%	-14.5%

**2b. County Population Projections from US Census Bureau**

	2000		2010					Percent Change
Barber County	5,307		4,579					-13.7%
Harper County	6,536		5,677					-13.1%
Kingman County	8,673		7,514					-13.4%
Pratt County	9,647		9,297					-3.6%
County Population	30,163		27,067					-10.3%

**Table 2c. POPULATION PROJECTIONS - KWO****2c.(1) COUNTY POPULATION PROJECTIONS  
(Using 1990 - 2010 Data)**

Year	Barber	Harper	Kingman	Pratt
2010	4,861	6,034	7,858	9,656
2020	4,439	5,698	7,641	9,633
2030	3,939	5,361	7,424	9,610
2040	3,478	5,026	7,224	9,587
2050	3,072	4,694	7,034	9,569

**2c.(2) COUNTY POPULATION PROJECTIONS  
(Using 1980 - 2010 Data)**

Year	Barber	Harper	Kingman	Pratt
2010	4,861	6,034	7,858	9,656
2020	4,319	5,741	7,554	9,463
2030	3,777	5,448	7,250	9,269
2040	3,236	5,162	6,946	9,076
2050	2,729	4,876	6,656	8,895

**2c.(3) CITY POPULATION PROJECTIONS  
(Using 1990 - 2010 Data)****Barber County**

	Hardtner	Hazelton	Isabel	Kiowa	Medicine Lodge	Sharon	Sun City	Balance of County
2010	172	93	90	1,026	2,009	158	53	1,260
2020	159	76	83	982	1,827	109	36	1,130
2030	146	58	76	937	1,645	60	18	999
2040	133	41	69	892	1,463	11	1	869
2050	120	23	62	848	1,281	0	0	738

**2c. (4) CITY POPULATION PROJECTIONS  
(Using 1980 - 2010 Data)****Barber County**

	Hardtner	Hazelton	Isabel	Kiowa	Medicine Lodge	Sharon	Sun City	Balance of County
2010	172	93	90	1,026	2,009	158	53	1,260
2020	123	80	76	905	1,879	116	43	1,098
2030	74	66	63	784	1,748	74	32	936
2040	25	53	49	663	1,618	32	22	775
2050	0	39	35	542	1,487	0	12	613

<b>2c.(5) CITY POPULATION PROJECTIONS</b>								
<b>(Using 1990 - 2010 Data)</b>								
Harper County								
	Anthony	Attica	Bluff City	Danville	Freeport	Harper	Waldron	Balance of County
2010	2,269	626	65	38	5	1,473	11	1,547
2020	2,146	581	63	29	4	1,368	7	1,501
2030	2,022	536	61	20	2	1,262	3	1,455
2040	1,899	491	59	11	1	1,157	0	1,409
2050	1,775	446	57	2	0	1,051	0	1,363

<b>2c.(6) CITY POPULATION PROJECTIONS</b>								
<b>(Using 1980 - 2010 Data)</b>								
Harper County								
	Anthony	Attica	Bluff City	Danville	Freeport	Harper	Waldron	Balance of County
2010	2,269	626	65	38	5	1,473	11	1,547
2020	2,149	587	57	28	3	1,355	5	1,556
2030	2,029	547	49	19	1	1,238	0	1,565
2040	1,909	507	41	9	0	1,120	0	1,575
2050	1,789	468	33	0	0	1,003	0	1,584

<b>2c.(7) CITY POPULATION PROJECTIONS</b>								
<b>(Using 1990 - 2010 Data)</b>								
Kingman County								
	Cunningham	Kingman	Nashville	Norwich	Penalosa	Spivey	Zenda	Balance of County
2010	454	3,177	64	491	17	78	90	3,487
2020	414	3,230	37	510	15	73	87	3,276
2030	373	3,283	10	528	13	68	84	3,065
2040	333	3,336	0	547	11	63	81	2,854
2050	292	3,389	0	565	9	58	78	2,643

<b>2c.(8) CITY POPULATION PROJECTIONS</b>								
<b>(Using 1980 - 2010 Data)</b>								
Kingman County								
	Cunningham	Kingman	Nashville	Norwich	Penalosa	Spivey	Zenda	Balance of County
2010	454	3,177	64	491	17	78	90	3,487
2020	426	3,095	44	505	13	76	76	3,318
2030	398	3,013	25	520	10	73	62	3,149
2040	370	2,932	5	534	6	71	48	2,980
2050	342	2,850	0	548	3	69	34	2,811

<b>2c.(9) CITY POPULATION PROJECTIONS</b> <b>(Using 1990 - 2010 Data)</b>								
Pratt County								
	Byers	Coats	Cullison	Iuka	Pratt	Preston	Sawyer	Balance of County
2010	35	83	101	163	6,835	158	124	2,157
2020	30	61	92	146	7,035	149	95	2,028
2030	24	39	82	129	7,234	139	65	1,898
2040	19	17	72	112	7,433	130	35	1,769
2050	13	0	63	95	7,633	120	6	1,639

<b>2c.(10) CITY POPULATION PROJECTIONS</b> <b>(Using 1980 - 2010 Data)</b>								
Pratt County								
	Byers	Coats	Cullison	Iuka	Pratt	Preston	Sawyer	Balance of County
2010	35	83	101	163	6,835	158	124	2,157
2020	32	61	83	140	6,832	136	91	2,088
2030	29	38	65	117	6,829	114	59	2,018
2040	25	16	47	95	6,826	92	26	1,949
2050	22	0	29	72	6,823	70	0	1,880

<b>Table 2d(1)</b>							
<b>Water Demand in Million Gallons per Year</b>							
<b>(Using Census Population Projection x Gallons per Capita Day)</b>							
Year	Anthony	Harper	Kingman	Kiowa	Medicine Lodge	Pratt	Total
2010	118	69	137	65	145	504	1038
2020	112	63	133	54	138	493	993
2030	106	58	129	46	129	493	960
2040	99	52	126	38	119	493	927
Authorized	361	200	340	140	245	942	

<b>Table 2d(2)</b>							
<b>Water Demand</b>							
<b>Using Level Population Projection</b>							
Year	Anthony	Harper	Kingman	Kiowa	Medicine Lodge	Pratt	Total
2010	118	69	137	65	145	504	1038
2020	118	69	137	65	145	504	1038
2030	118	69	137	65	145	504	1038
2040	118	69	137	65	145	504	1038
Authorized	361	200	340	140	245	942	

<b>Table 2d(3)</b>							
<b>Water Demand</b>							
<b>Using 1% Annual Growth</b>							
Year	Anthony	Harper	Kingman	Kiowa	Medicine Lodge	Pratt	Total
2010	118	69	137	65	145	504	1038
2020	131	76	151	72	160	557	1147
2030	144	84	167	79	177	615	1267
2040	159	93	184	87	195	680	1399
Authorized	361	200	340	140	245	942	

**Table 3. Yearly Water Diverted in 1,000 Gallons**

<b>System</b>	<b>2009</b>	<b>2008</b>	<b>2007</b>	<b>2006</b>	<b>2005</b>	<b>2004</b>	<b>2003</b>	<b>2002</b>	<b>2001</b>	<b>2000</b>
Anthony	132,329	123,862	160,139	167,278	154,892	161,320	158,329	175,898	216,353	180,454
Argonia - Sumner Co.	31,093	29,079	27,466	31,187	31,283	27,290	30,687	29,837	43,585	53,096
Attica		48,792	40,453	42,261	36,701	33,042	37,435	44,868	41,200	46,501
Barber RWD 01	0	0	0	0	0	0	0	0	0	0
Barber RWD 02	0	0	0	0	42,752	46,144	40,156	45,908	30,545	33,816
Barber RWD 03	7,795	7,121	6,897	6,660	5,696	5,816	5,133	7,586	5,637	5,246
Bluff City	2,728	4,033	3,175	3,248	2,963	3,324	3,178	3,177	3,384	3,310
Coats	4,660	4,671	4,965	5,915	6,259	6,736	6,512	6,715	6,904	6,467
Cullison	7,287	9,084	8,810	9,649	7,365	9,337	8,074	6,187	10,360	7,758
Cunningham	29,091	25,463	25,964	30,097	29,264	26,428	34,598	35,508	38,219	38,848
Hardtner	13,268	16,691	13,462	21,581	21,846	19,928	17,165	18,189	18,036	18,512
Harper	86,457	85,782	93,626	104,360	85,119	84,363	94,062	96,314	112,256	106,769
Harper RWD 01	0	0	0	0	0	0	0	0	0	0
Harper RWD 02	0	0	0	0	0	0	0	0	0	0
Harper RWD 03	0	0	0	0	0	0	0	0	0	1,015
Harper RWD 04	0	0	0	0		0	0	0	0	
Harper RWD 05	0	0	0	0	0	0	0	0	0	0
Isabel	4,652	4,876	5,437	6,565	5,463	5,193	5,956	5,263	5,108	5,461
Iuka	4,468	4,323	4,460	5,007	4,971	4,753	5,301	6,886	6,138	5,237
KDWP (Barber Co.)										
Kingman	144,875	139,553	145,749	162,844	152,911	157,164	175,685	166,038	194,599	203,390
Kingman RWD 01	0	0	0	0	0	0	0	0	0	0
Kiowa	62,806	66,919	63,510	66,289	65,320	66,704	66,104	66,983	66,975	62,782
Medicine Lodge	173,131	187,260	203,883	226,380	232,114	309,717	278,230	242,530	242,723	240,649
Nashville	0	0	0	0	0	0	0	0	0	0
Norwich	27,363	29,985	31,652	32,841	33,307	34,875	33,727	29,126	38,605	36,474
Pratt	454,475	468,341	470,486	518,441	577,457	551,094	604,152	519,285	541,864	509,257

Preston	5,074	5,384	5,867	34,927	6,126	6,509	9,341	9,425	7,544	12,689
Sawyer	6,500	7,460	6,205	6,717	7,072	6,080	6,514	7,062	7,520	7,338
Sharon	10,328	9,432	11,175	12,371	10,051	10,824	12,255	11,738	10,863	10,122
Spivey	0	0	0	0	0	0	0	0	0	0
Zenda	4,872	4,951	5,411	6,293	6,208	6,113	6,094	5,633	6,707	6,516
Total Diverted	1,213,252	1,283,062	1,338,792	1,500,911	1,525,140	1,582,754	1,638,688	1,540,156	1,655,125	1,601,707
6 Largest PWSs	1,054,073	1,071,717	1,137,393	1,245,592	1,267,813	1,330,362	1,376,562	1,267,048	1,374,770	1,303,301
10 Largest PWSs	1,110,527	1,175,957	1,235,462	1,350,791	1,409,837	1,470,851	1,522,478	1,422,458	1,523,339	1,458,940
10 largest % of total	91.5%	91.7%	92.3%	90.0%	92.4%	92.9%	92.9%	92.4%	92.0%	91.1%

**Table 4. Percentage Unaccounted Water Use (Loss)**

<b>Public Water Supplier</b>	<b>2009</b>	<b>2008</b>	<b>2007</b>	<b>2006</b>	<b>2005</b>	<b>2004</b>	<b>2003</b>	<b>2002</b>	<b>2001</b>	<b>2000</b>
Anthony	10.92	11.11	21.40	15.00	16.68	17.55	11.57	20.71	6.58	18.03
Argonia - Sumner Co.	4.11	4.60	7.99	8.38	16.86	11.10	12.91	12.67	5.00	32.90
Attica		33.09	9.07	5.15	9.27	15.65	15.16	10.95	7.58	12.59
Barber RWD 01	100	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Barber RWD 02					30.00	28.00	26.01	21.02	8.08	18.25
Barber RWD 03	29.88	23.20	18.65	11.04	9.73	18.26	6.88	36.98	10.27	10.08
Bluff City	32.48	14.38	23.46	17.52	20.65	20.31	17.37	13.38	6.32	6.88
Coats	10.64	10.00	14.78	7.02	13.48	13.54	4.90	5.61	4.84	4.13
Cullison	24.8	25.19	19.97	22.27	23.94	18.71	25.71	12.53	17.03	21.96
Cunningham	10.84	7.86	9.00	14.86	5.19	14.31	5.59	17.25	20.05	20.41
Hardtner	37.57	3.54	9.81	7.90	1.49	2.90	3.91	3.58	2.82	3.38
Harper	10.84	6.60	10.55	12.85	11.16	13.45	15.01	14.73	18.21	18.43
Harper RWD 01								10.91	11.54	4.98
Harper RWD 02										
Harper RWD 03										3.15
Harper RWD 04	54.15	42.79	20.46	10.03		13.33	14.82	21.97	37.32	
Harper RWD 05	15.76		30.24	18.61	21.95				25.21	16.87
Isabel	1.01	4.33	14.02	14.97	13.56	16.00	19.76	20.52	6.79	17.87
Iuka	4.86	4.23	4.24	4.71	4.57	4.36	5.56	26.55	8.94	5.94
KDWP (Barber Co.)	8.95									
Kingman	23.76	9.09	10.46	11.66	13.48	15.58	9.03	15.96	20.08	24.43
Kingman RWD 01	14.68	20.24	19.51	17.72	12.45	19.21	24.31	20.22	20.78	31.40
Kiowa	14.59	18.02	13.58	13.13	12.10	9.16	5.56	15.24	12.89	11.62
Medicine Lodge	12.42	30.92	27.70	15.01	14.96	12.16	9.12	28.13	7.78	16.64
Mullinville	16.37	24.75	20.60	28.55	19.00	19.48	22.60	15.52	20.17	18.48
Nashville	9.75									
Norwich	8.44	8.76	14.08	18.43	23.45	24.59	16.70	6.42	4.22	1.39
Pratt	7.66	14.56	6.10	11.44	21.53	22.57	15.78	16.12	17.30	15.44
Preston	15.08	2.10	14.85	17.61	14.09	100.00	20.58	100.00	100.00	100.00
Sawyer	31.84	5.08	5.53	5.52	6.99	6.45	4.10	2.68	2.18	4.46
Sharon	18.51	14.65	18.23	23.50	16.79	18.15	19.51	10.79	13.11	13.39
Spivey		38.88	33.79	30.62	21.63	20.50	0.37	5.57	4.08	3.59
Zenda		18.97	35.65	18.21	17.48	19.34	5.09	3.89	14.94	4.44

**Table 5. Water Rights**

<b>5a.Barber County Water Rights</b>				
<b>PWS</b>	<b>File Nos.</b>	<b>Tot. Quantity (MGY)</b>	<b>Tot. Rate (gpm)</b>	<b>Notes</b>
City of Medicine Lodge	BA 005; 34,285 & 34,522	245.014	1633	10 Wells. Another 9.776 MGY. from KDWP pending.
City of Kiowa	BA 004; 35,809 & 35,810	140.000	925	2 Primary Wells, 2 Standby Wells.
City of Sharon	BA 001; 3,637 & 36,141	26.004	422	2 Wells.
Barber RWD 3	32,612	10.250	100	2 Wells.
City of Hardtner	BA 006 & 34,567	20.501	322	2 Wells and 1 Standby Well.
City of Isabel	BA 003 & 35,632	8.990	296	2 Wells.
Elm Mills Recreation		0.000	0	File No. 44,801 dismissed.
Barber RWD 2	24,844	57.600	370	2 Wells.
City of Hazelton	17,507	11.275	200	1 Well.
<b>Total</b>		<b>519.634</b>	<b>4268</b>	

<b>5b.Harper County Water Rights</b>				
<b>PWS</b>	<b>File Nos.</b>	<b>Tot. Quantity (MGY)</b>	<b>Tot. Rate (gpm)</b>	<b>Notes</b>
City of Anthony	HP 002	361.000	1594	13 Wells
City of Attica	HP 003; 33,204; 34,121 & 42,635	60.000	820	6 Wells
City of Bluff City	8,762	3.930	30	1 Well
City of Harper	HP 001	200.000	950	3 Wells
Harper RWD 3	20,585	1.300	60	2 Wells
<b>Total</b>		<b>626.230</b>	<b>3454</b>	

<b>5c. Kingman County Water Rights</b>				
<b>PWS</b>	<b>File Nos.</b>	<b>Tot. Quantity (MGY)</b>	<b>Tot. Rate (gpm)</b>	<b>Notes</b>
City of Kingman	KM 002; 7,686; 15,564; 31,865; 41,194; 41,195 & 41,452	339.500	1492	Wells & Springs
City of Norwich	KM 001; 20,228; 40,833 & 40,834	47.800	300	4 Wells
City of Zenda	23,997	6.000	51	1 Well
City of Spivey	24,010	5.500	30	1 Well
City of Cunningham	KM 004 & 15,907	47.747	545	2 Wells
KDWP	31,357	1.000	49	1 Well - Cheney State Park(?)
<b>Total</b>		<b>446.547</b>	<b>2418</b>	

<b>5d. Pratt County Water Rights</b>				
<b>PWS</b>	<b>File Nos.</b>	<b>Tot. Quantity (MGY)</b>	<b>Tot. Rate (gpm)</b>	<b>Notes</b>
City of Coats	29,727 & 36,449	14.030	160	Battery of 2 Wells
City of Cullison	PR 004; 36,435 & 36,436	16.630	420	Three Wells
City of Iuka	39,786	12.060	200	Battery of 2 Wells, Averaged 4.75 mg last 7 yrs.
City of Pratt	PR 002; 33,290; 33,436-9	942.000	5987	11 Wells Auth., 442 MGY. not yet perfected.
Pratt Airport Authority	34,569 & 34,570	6.000	395	Two Wells (Nos. 1 & 2), Averaged 2.68 mg last 7 yrs.
City of Preston	PR 001; 34,189 & 34,190	20.850	240	Two Wells (Nos. 2 & 4), Averaged 4.37 mg last 7 yrs.
City of Sawyer	PR 003; PR 005; 11,271 & 36,184	22.000	443	Two Wells (Nos. 1 & 2), Averaged 6.80 mg last 7 yrs.
USD 438	37,397 & 38,092	8.169	300	One Well
<b>Total</b>		<b>1041.739</b>	<b>8145</b>	

<b>5e. Sumner County Water Rights</b>				
<b>PWS</b>	<b>File Nos.</b>	<b>Tot. Quantity (MGY)</b>	<b>Tot. Rate (gpm)</b>	<b>Notes</b>
City of Argonia	SU 008; 23,692 & 40,344	54.400	850	4 Wells
<b>Total</b>		<b>54.400</b>	<b>850</b>	

<b>Total Quantity in Study Area</b>	<b>2688.550</b>
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**MGY=Million Gallons/Year**  
**gpm=gallons per minute**