

**Using Water Demand
to Determine Population Estimates and Projections
for Kansas**

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Abstract

Kansas has developed a unique method for utilizing water use data to determine not only future water use, but also to project population in the state. Additionally, this method will be used to verify the accuracy of the U.S. Census Bureau's sub-county population estimates for Kansas. This method was developed by the Kansas Water Office and approved by the Kansas Water Authority. Additionally, the projections are being considered by the Kansas Division of the Budget for presentation as the official population projections for Kansas. The importance of the Kansas method is its accuracy and similarity to the U.S. Census Bureau's newest methodology for estimating Kansas population. Also of importance is the fact that the Kansas method was conceived, developed, and implemented exclusive of the U.S. Census Bureau's method.

This paper contains the purpose and objective of the Kansas Water Office's efforts to develop and prepare population and water demand projections for Kansas and each of its counties, cities, and rural water districts. The projections were developed using linear regression for calendar years 2000, 2010, 2020, 2030, and 2040; subject to the constraint that no city or county population decline could be more than 10.0 percent per decade.

Data sources included 1980 and 1990 Decennial Census counts, U.S. Census Bureau population estimates for 1992 and 1994, time series data of active residential water service connections from public water suppliers, and extensive on-site interviews with local government officials, and other groups. Also included in the method's development was contact with every public water supplier in Kansas for input on perceived changes in population, water use, and water demand occurring in local communities or rural areas.

Introduction

In Kansas, population estimates and projections are widely used by state agencies, local governments, and individuals. The variety of uses include a diversified pool reaching from statewide distribution of tax dollars to counties and cities to individual requests by local governments for recreational grants. Because the user base is so diversified, it is necessary to present the most recent and accurate estimates and projections available. In an effort to meet this necessity, the Kansas Division of the Budget and the Kansas Water Office have combined resources to present both accurate and timely population estimates and projections.

By statute, Kansas uses the latest sub-county estimates produced by the U.S. Census Bureau as the official population. Each year on July 1 these estimates are certified by the Secretary of State. Prior to certification, the Division of the Budget reviews the estimates. The process is efficient and believed to be a responsible use of state resources because federal efforts are not duplicated at the state level. This process is not only advantageous in this manner, but is consistent with both Executive and Legislative efforts to responsibly use state resources by downsizing the state workforce. However, this process is also a disadvantage because it requires a heavier reliance on the Census Bureau. This reliance is in contrast to other states with demographics departments. Additionally, the downsizing of the state workforce has caused all demographics duties to be assumed by existing personnel. The result has been that while U.S. Census Bureau estimates still are used and an official Kansas population is certified each year, official Kansas population projections have not been produced since 1992.

Using the Kansas Water Office's method will allow Kansas to fulfill one of its obligations to its citizens, which is to provide timely, accurate, and useful data. Application of the Kansas method will not be used only to project populations on a sub-county level, but also will be an integral part of accurately forecasting water use. Additionally, this method will allow Kansas to review more efficiently the population estimates released by the U.S. Census Bureau. Both the U.S. Census Bureau method and the Kansas method use a common component—water hook-ups. Because of the common component, it is anticipated that this application will decrease significantly the number of informal challenges to population estimates sent from Kansas to the U.S. Census Bureau. Other uses include a proposal to endorse the results as the official Kansas population projections and to publish the population projections as the state's official data in *The Kansas Statistical Abstract*.

A brief background of the Kansas method follows. Also presented will be the conceptual methodology, an outline of the procedures, and finally, the results. Although population projections were formulated for all Kansas counties and cities, the results of only four selected cities are presented.

Background

There are two basic sections of current law that affect the Kansas method for reviewing population estimates and determining population projections. The first section is a direct link and is contained in KSA 11-203 *et seq.* The section specifies that the U.S. Census Bureau's latest sub-county population estimates will be verified by the Division of the Budget and certified on July 1 of each year by the Secretary of State.

The second section pertains to water use and provides a foundation for the purpose for developing the Kansas method. *Kansas Statutes Annotated, Chapter 82a, Article 9* is known as the Kansas State Water Resources Planning Act. This section states:

“...the state can best achieve the proper utilization and control of the water resources of the state through comprehensive planning which coordinates and provides guidance for the management, conservation and development of the state's water resources.”

The Kansas Water Office, as the state's water planning authority, is responsible for carrying out this general mandate. More specific responsibilities are contained in KSA 82a-903 which directs the Water Office to:

“... formulate on a continuing basis, a state water plan for the management, conservation and development of the water resources of the state.”

The activities of the Kansas Water Office are directed by the Kansas Water Authority, which acts as the governing body that formulates and approves the annual additions and modifications to the *Kansas Water Plan*. This document contains the policy recommendations and administrative guidelines established by the Water Authority.

While the Water Authority directs water policy and administration, the Water Office is responsible for selling state-owned water to public water suppliers. In April 1996, the Water Authority's Conservation and Marketing Committee discussed the management and allocation of water contracted from state-owned storage space in several of the reservoirs in Kansas. Committee members expressed concern about water demand negotiation policies used for water

marketing applicants. The concerns regarded both over-allocation problems and equity. As a result, the Water Authority directed the Water Office to chart a plan of action regarding these concerns.

In July 1996, the Water Office presented a draft methodology to forecast both population and water demand for every city, rural water district, and county in the state. The Authority authorized the use of the proposed methodology to negotiate the amount of water to sell to applicants desiring water-marketing contracts. Simultaneously, the Authority also requested the methodology be given exposure through the planning process.

In January 1997, the Water Authority approved using the methodology on a statewide basis for basin planning, regional public water supply planning, water marketing contracts, multipurpose small lake analyses, and other *Kansas Water Plan* programs. This approval allowed the Water Office to publicly distribute the basic methods used when determining the water demand needs of public water suppliers. Also, it is contended that the methodology allows for equitable and fair treatment of every public water supplier in Kansas.

Two of the first applications of the methodology included negotiating a water marketing contract with Miami County Rural Water District #2 and regional water supply planning for the Walnut Basin. A summary of each project is presented below.

Using the Method for Water Marketing

In early 1996, the Kansas Water Office's Water Marketing Program received a request from Miami County Rural Water District #2 (Miami Co. RWD #2) for additional water from Hillsdale Reservoir. Geographically, Miami County is situated on the eastern border of Kansas and is adjacent to Johnson County, which encompasses approximately one-half of the Kansas City, Kansas metropolitan area. Johnson County is the second most populous county in Kansas and has had a rapidly increasing population base for several decades.

By 1996, the population increase in Johnson County had expanded to Miami County, the result of which was a rapidly growing rural sector in Miami County. This growth translated to increased water needs. To meet the increase in water demand, Miami Co. RWD #2 submitted a request to purchase additional water. However, no official statistics supported the district's claim. In fact, the U.S. Census Bureau's estimate of the rural population in Miami County showed a decline between 1992 and 1994 from 11,976 to 11,683 residents.

An analysis of the rural water district's request was conducted by the Water Office and included on-site observance of the 100 most recent residential water service connections. Also included were four separate trips to conduct personal interviews with public water suppliers in Miami County. Analysis indicated the rural Miami County population was not declining. In fact, the rural population was growing rapidly as substantiated by the number of newly installed, active residential water meters. This very rapid growth in the installation of new active residential water meters in rural areas was accompanied by a significant, but somewhat slower growth in residential water meters installed by Miami County cities.

Combining the urban and rural growth yielded an estimated water use population that exceeded the official Kansas population projection for Miami County. In fact, application of the Kansas method indicated that the population served by Miami Co. RWD #2 will increase 273.0 percent during the 50 years between 1990 and 2040. It is anticipated that at that time, this particular rural water district will be the largest in Kansas.

Based on the Kansas Water Office population and water demand projections, the district's request for additional water was approved. In this case, if the official population

projections had been used, the water demand would have been seriously underestimated and resulted in long-term adverse effects in Miami County.

Using the Method for Regional Water Supply Planning

The other use for the population and water demand projections method is regional water supply planning. The first initial use of the method for this purpose was in the Walnut Basin which is located in south central Kansas, and encompasses the Wichita metropolitan area.

The *Kansas Water Plan* states that regional water supply planning must include an assessment and strategic analysis of the region. The assessment is used to identify and prioritize areas in need of public water supply assistance and includes population projections, water supply and demand projections, existing water supply inventory, and data from each public water supplier regarding short- and long-term needs.

In addition, the region must have a viable public water supply system. The *Water Plan* includes a subsection entitled “Ensuring the Viability of Public Water Supply Systems” which defines a viable system as one possessing a reliable water supply. The system also must possess the managerial, technical, operational, and financial capability to reliably meet performance requirements on a long-term basis. To determine the status of a system, the Water office must:

- ensure the viability of existing systems
- discourage the creation of non-viable new systems, and
- encourage the formation of regional public water supply systems and other forms of regional cooperation.

The pilot project for conducting regional water supply planning in this manner began in February 1996. At that time, six cities in south central Kansas contacted the Water Office regarding the potential for constructing Douglass Reservoir as a future water supply source. Douglass Reservoir is a project designed for flood control and must meet U.S. Corp of Engineers specifications. Congress authorized constructing the reservoir, but the project has not been funded to date. The authorization will sunset in October 1999.

Although Congress authorized constructing the reservoir, the U.S. Corps of Engineers indicated in late February 1996, that the Douglass Reservoir Project did not meet the flood control cost/benefit criteria necessary for construction through the Corps’ programs. Subsequently, the six cities requested assistance from the Water Office to explore options available for the development of future water supplies through state programs. The Water Office agreed to conduct an assessment of the area prior to planning any new supply sources. The assessment began in September 1996.

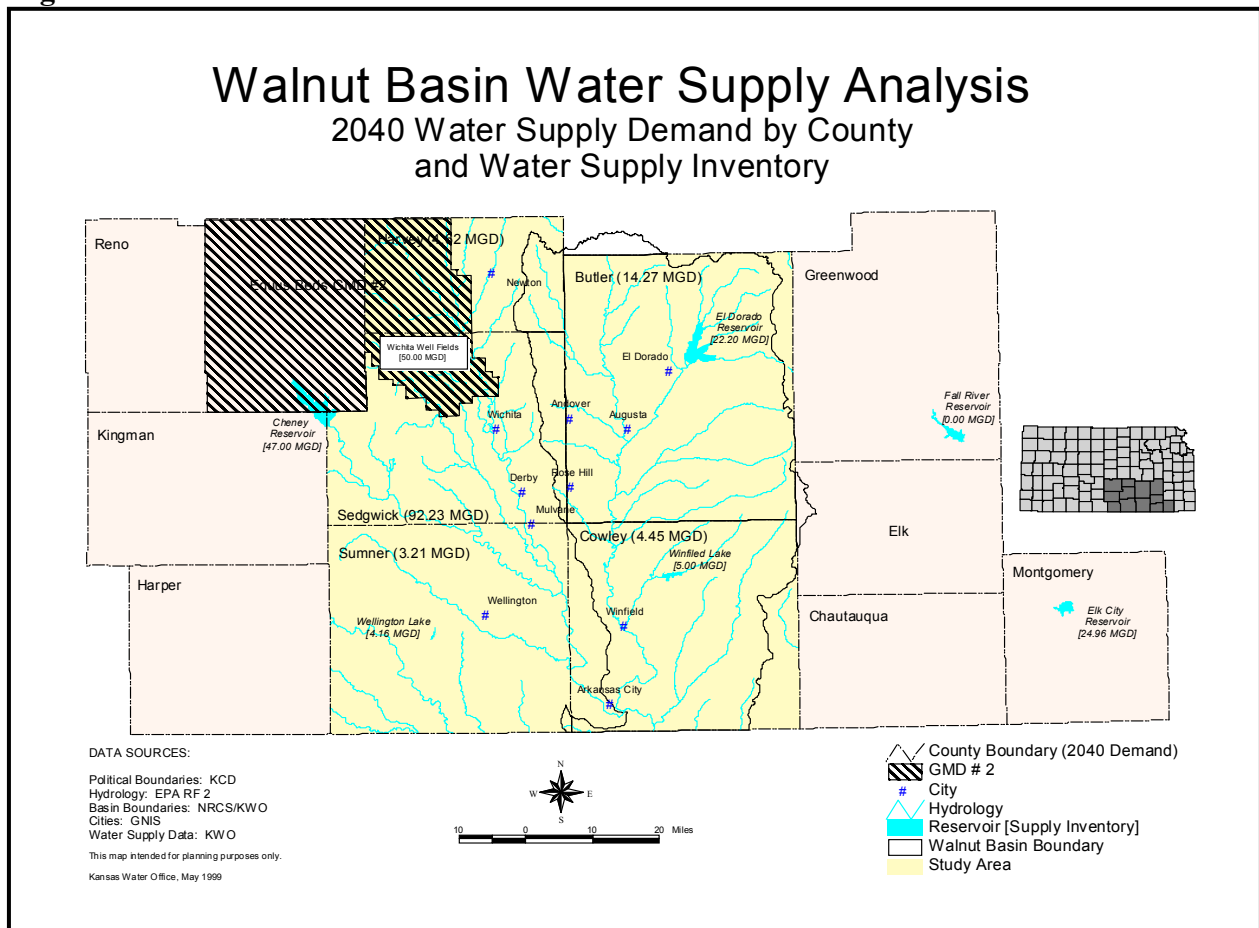
The Water Office included five counties in the study area. The counties are geographically located in south central Kansas and included Harvey, Butler, Sedgwick, Cowley, and Sumner. These five counties comprise the Walnut Basin Regional Water Supply Study Area.

As part of the population and water demand projections process, the Water Office sent preliminary projections to every public water supplier in the study area. Each public water supplier was asked to report any significant concerns they had with the Water Office’s projections and to provide information to support their concerns. They also were asked to identify the most significant short- and long-term problems perceived for their utility.

Approximately 80.0 percent of the public water suppliers in the study area reported that they had no information that would indicate significant errors in the Water Office’s population and water demand projections. The input from the local officials was used to finalize the projections. The most significant problems identified by the public water suppliers for both the short- and long-term were infrastructure and water quality.

Application of the methodology indicates that the population in the Walnut Basin Regional Water Supply Study Area is projected to increase 48.0 percent by the year 2040. During that same time frame, the five-county area’s projected water demand is projected to be 118.78 million gallons per day (MGD), and existing water supplies are projected to yield 128.36 MGD. Figure 1 presents both the projected regional water supply and demand levels for 2040.

Figure 1:



Based on these projections, developing additional water supply storage was not warranted at the time. In fact, the focus of a regional strategy for the Walnut Basin Study Area was determined to be on the development and improvement of the infrastructure of the public water utilities so that adequate service will be provided to customers. The Water Office recommended establishing a regional water utility coordinating committee, as a precursor to the formation of a public wholesale water supply district (PWWSD).

It was recommended that the focus of a coordinating committee should be the development of a regional infrastructure that would allow the efficient use of existing water

supplies and source water protection plans. These should include both wellhead and watershed protection measures. Once the regional strategy was developed and the PWWSD formed, each water utility then would develop a coordinated system plan which is both unique to the needs of the utility and consistent with the regional strategy. Following the development of those individual plans, the utilities would be ready to move forward with funding requests through the various state and federal programs. It was determined that utilities complying with the regional strategy guidelines would receive priority consideration during the funding approval process.

Conceptual Methodology and Procedures

In November 1998, the Kansas Water Office completed population and water demand projections for every county, city, and rural water district in Kansas. Historically, population projections for Kansas cities and counties have been prepared by different sources including the U.S. Census Bureau, Kansas Division of the Budget, Kansas Water Office, and various other agencies. However, the Kansas Water Office development of population **and** water demand projections for every rural water district in the state, as well as for cities and counties is believed to be the first such effort in Kansas and perhaps nationally. Although a simple regression function is used to project the population and water demand, the Kansas method contains nine components, each of which is specific to a particular geopolitical area or a utility-use area. The geopolitical areas include counties, cities, and the balance of counties which represents areas outside incorporated areas. Utility-use areas include any type of public water supplier. Each of the conceptual methodologies is presented below. The data sources include the U.S. Census Bureau's sub-county estimates for 1990, 1992, 1994, and 1997; local government officials' input; and data from public water suppliers.

Population Projections for Counties

The U.S. Census Bureau sub-county population estimates for all 105 counties in Kansas reflective of 1990, 1992 and 1994, were the primary data source. To these data points, a linear regression equation was fit to the county population estimates and used to develop county population projections for 2000, 2010, 2020, 2030, and 2040. All county population projections were subject to the constraint that no county population could decline in excess of 10.0 percent per decade.

Population Projections for Cities

Population projections for cities in Kansas were derived in a slightly different manner than the county population projections were derived. A linear regression also was used, but the data sources differed slightly. The differences include using the U.S. Census Bureau's 1980 sub-county population figures for cities, as well as the 1990, 1992, and 1994 sub-county population figures, and an additional constraint. The constraint limiting population declines to no more than 10.0 percent per decade was maintained in the city methodology.

For cities, the initial step was to determine if the population between 1980 and 1990 changed in the same direction as it changed during the 1990s. Four scenarios were possible:

Scenario A—Population increased from 1980 to 1990, and increased during the 1990's.

Scenario B—Population decreased from 1980 to 1990, and decreased during the 1990's.

Scenario C—Population increased from 1980 to 1990, but decreased during the 1990's.
Scenario D—Population decreased from 1980 to 1990, but increased during the 1990's.

If either Scenario A or B occurred, the 1980 data point was included in the regression equation, but the data point for 1994 was excluded. In addition, if the absolute value of the difference in the city's population between 1992 and 1994 exceeded the absolute value of the difference between 1980 and 1992, then the city's rate of population change after 1994 was based on a linear regression using the city's population estimates for 1980, 1990, and 1992.

The 1994 data point was excluded because aberrant growth rates occurred for cities with significant changes in estimated population between 1992 and 1994. These large changes were attributable to several factors including annexations and changes in the Census Bureau's methodology for preparing population estimates.

If either Scenario C or D occurred, then the 1980 data point was deleted and the linear regression equation included only the data points from 1990, 1992, and 1994. This exclusion of the 1980 data point was excluded because population declines were either overstated or understated. For example, military installation closings that occurred between 1980 and 1990 caused misleading rates of population decline for some cities. Using only population estimates for 1990, 1992, and 1994 led to more accurate projections for those cities. Throughout this component of the methodology, if a city lay within two counties, the population was partitioned into the respective counties on a proportional basis using the 1990 U.S. Census Bureau population figures.

Revising the Initial Population Projections for Cities that are Public Water Suppliers

In this component of the methodology, the water related data was incorporated. This process began with a comparison of the city's average annual percent change in population from 1990 to 1994 with the city's average annual percent change in the number of active residential water service connections (active connections) from 1990 to 1994. If the difference in the absolute value of the two percentages was **less than 1.0 percent**, then the initial population projections for the city were not changed. If the difference in the absolute value of the two percentages was **at least 1.0 percent**, then the percent of the city's active connections located outside of the city limits was determined. If the percent of the city's active connections located outside of the city limits was **less than 5.0 percent** then the city's 1990 population was divided by the city's total active connections in 1990 to determine the average number of persons per active connections for the city in 1990.

The city's 1994 population was then estimated by multiplying the city's total active connections in 1994 by the city's average number of persons per active connections in 1990. If the percent of the active connections located outside of the city limits was **5.0 percent or more** then the city's 1990 population was divided by the number of active connections within the city limits in 1990 to determine the average number of persons per active connections for the city in 1990. The city's 1994 population was then estimated by multiplying the city's active connections within city limits in 1994 by the city's average number of persons per active connections in 1990.

The respective City Clerk or City Administrator's Office was then contacted to determine whether the local official believed that the Census Bureau's or the Kansas Water Office's population estimate for 1994 was the most accurate. If the local official believed that the Census Bureau's population estimate for the city for 1994 was more accurate than the Kansas Water

Office's population estimate for the city for 1994, then the initial population projections for the city were not changed. However, if the local official believed that the Kansas Water Office's population estimate for the city for 1994 was more accurate, then a linear regression equation was fit to the city's data on the number of active connections for each year from 1990 through 1995. The population projections for the city were then determined by multiplying the projected number of active connections for the city for a specified projection year by the city's average number of persons per active connections in 1990.

“Balance of County” Population Projections

The “balance of county” population projections for years 2000, 2010, 2020, 2030 and 2040 were found by subtracting the sum of the population projections of all of the cities from the respective county population projections. Throughout the methodology, the “balance of county” population projections also were subject to the constraint that the projection could not result in declines in excess of 10.0 percent per decade. It should be noted that this constraint could result in a higher county population projection for a given year, than was originally developed.

1990 Population Served Estimates for Public Water Suppliers that are Cities

Data from the 1990 Census of Population Housing, Summary Population and Housing Characteristics, Kansas was used to determine the average number of persons per occupied rural housing unit in each county in 1990. However, to estimating the 1990 population served by public water suppliers that are cities, the data were compared to active connections both inside and outside the city limits and if needed, adjusted slightly.

Comparing active connections provided two scenarios. The first scenario was if the city's number of active connections located outside of city limits in 1990 **did not exceed** its total number of active connections in 1990 by more than 5.0 percent. If this was the case, then the city's 1990 population was used as the estimated population directly served by that specific city in 1990.

The second scenario was if the city's number of active connections located outside of city limits in 1990 **exceeded** its total number of active connections in 1990 by 5.0 percent or more. In this case, an estimate was made of the population that was served outside of the city limits.

In order to estimate the population served outside the city limits, the average number of persons per occupied rural housing unit in the county in 1990 was calculated. The calculation's first step involved dividing the total number of persons in rural housing in the county in 1990 by the total number of occupied rural housing units in the county in 1990. The second step was to estimate the number of persons served outside of city limits by a specific city in 1990. This estimate was calculated by multiplying the number of active connections outside of the city limits in 1990 by the average number of persons per occupied rural housing unit in the county in 1990. The estimated population served by that specific city in 1990 was then determined by adding the city's 1990 population and the estimated number of persons served outside of the city limits in 1990.

Population Served Projections for Public Water Suppliers that are Cities

After the 1990 base was established, the population projections for cities could be calculated. Again, active connections were the basis of the analysis and calculations, and two

scenarios were possible. The first scenario was if the percent of the city's active connections located outside of the city limits was **less than 5.0 percent** in 1990. If this was the case, then the city's population projections developed in the previous step were used as the projected population directly served by that specific city.

The second scenario was if the percent of the city's active connections located outside of the city limits was **5.0 percent or more**. When this scenario occurred, a linear regression equation was fit to the city's data on the total number of active connections for each year that such data was available from 1987 through 1995. These data were used to develop projections of the total number of active connections for the years 2000, 2010, 2020, 2030, and 2040.

Once the active connections were determined for each year, the projected number of persons served by the city for each of year was calculated. These projections were determined by multiplying the projected total number of active connections for the city for a specific projection year by the estimated number of persons served per active connection in 1990.

Population Served Estimates for Water Districts in 1990

The next section of the methodology involved estimating the population which was served by each water district in 1990. These estimates represent the 1990 population served by each water district that serves any of part of a specific county. This population was calculated by multiplying the estimated number of active connections used in the water district in 1990 by the average number of persons per occupied rural housing unit within that county in 1990.

The product was then multiplied by the estimated proportion of the water district's active connections for county residents in 1990. The number of residential water service connections within a district that used at least 1,000 gallons of water during June 1990, was used as an estimate of the number of active connections used in the water district in 1990.

In most cases, the proportion of a water district that was located within a specific county was determined by geographic information system coverages and it was assumed that the population that had public water service was uniformly distributed throughout the water district. These assumptions were determined on the basis of visits to water districts across the state. The visits indicated that many water districts in Kansas have a significant number of residential water service connections that are purchased by land and/or subdivision developers and are active water service connections, but are not being used at an occupied housing unit. Consequently, it was found that counting only the number of residential water service connections for which at least 1,000 gallons was used during the month of June 1990 was a much better surrogate for the number of occupied rural housing units in 1990 than simply using the reported number of active residential water service connections.

Population Served Projections for Water Districts

For each water district and each year from 1987 to 1996, the number of residential water service connections that used at least 1,000 gallons of water during June of a specific year was used as an estimate of the number of active connections used in the water district for that specific year. A linear regression equation was fit to each water district's data on the number of active connections for each year that such data was available from the 1987 to 1996 time period to develop projections for the number of active connections for the years 2000, 2010, 2020, 2030, and 2040.

Population projections for the number of persons served within a specific county then were developed for each water district for the years 2000, 2010, 2020, 2030 and 2040. This was done by multiplying the projected number of active connections used in the water district for a specific projection year by the average number of persons per occupied rural housing unit within that specific county in 1990 by an estimate of the proportion of the water district’s active connections that served residents in that county in 1990. The sum of the population served projections for each water district within a specific county and the population served by each city within a specific county was subject to the constraint that the total population served for a specific projection year, could not exceed the total population projection for the county for that specific projection year. For a specific county, the population projections were reviewed for the county and each city within the county and the population served projections were reviewed for each public water supplier to ensure that all projections appeared to be reasonable.

Water Demand Projections for Public Water Suppliers

The gallons per capita per day (gpcd) usage for each public water supplier (pws) was determined for each year from 1991-1995 by calculating:

$$\text{GPCD} = \frac{(\text{gallons of water pumped or acquired}) - (\text{gallons of water sold to other pws})}{(\text{number of days in the year}) \times (\text{population served by the pws})}$$

Each public water supplier’s gpcd for use in making water demand projections was its average gpcd for the 1991-1995 time period or its average gpcd in more recent years, if permanent changes in gpcd use were known to have occurred for that public water supplier. The water demand projections for years 2000, 2010, 2020, 2030, and 2040 for each public water supplier were determined by multiplying the population served projection for the public water supplier for a specific projection year by the public water supplier’s water demand in gpcd by 365 days.

Results

The application of the Kansas method yielded projections for both population and water use for the state. However, only selected analysis is shown and includes the cities of Bel Aire and Mount Hope, both of which are in Sedgwick County; Latham in Butler County; and Lecompton in Douglas County.

Population Projections for Cities

A comparison of U.S. Census Bureau population estimates and active connections for four selected cities in Kansas are shown in Table 1. Each of these cities had significant differences in the average annual percent change in Census Bureau population between 1990 and 1994, and the average annual percent change in the number of active connections between 1990 and 1994.

City	Population			Active Residential Water Service Connections			Comparison Between Avg. Ann. % Diff.
	1990	1994	Average Annual % Diff.	1990	1994	Average Annual % Diff.	
Bel Aire	3,695	3,934	1.62	1,210	1,495	5.89	4.27
Latham	160	203	6.72	95	95	--	6.72
Lecompton	619	832	8.60	222	228	0.68	7.92
Mount Hope	805	1,092	8.91	298	303	0.42	8.49

Population increased in all four cities and ranged from a 1.62 percent average annual percent change for Bel Aire to an 8.91 percent change for Mount Hope. Active connections also increased, but for only three of the four cities and at a significantly slower rate. Comparing the two rates indicates significant differences between estimated population growth and actual water service being provided in each of the cities.

Because the differences were so dramatic, local officials were contacted for input. Each local official indicated that the population estimate for 1994 which was based on active connections was more accurate than the U.S. Census Bureau's population estimates for 1994. A summary of the local input is shown in Table 2.

Table 2: Population Estimate Comparison--Summary of Local Officials' Input

City	Population Estimates	Local Comments
Bel Aire	a. U.S. Census Bureau: Increase of 239 people from 3,695 in 1990 to 3,934 in 1994.	Sherryl Cutter, City Clerk: <i>"The Census Bureau has revised the city's 1994 population to 4,012; which is still too low. There has been big growth. The KWO estimate is close to being right."</i>
	b. Kansas Water Office: Increase of 870 people from 3,695 in 1990 to 4,565 in 1994.	
Latham	a. U.S. Census Bureau: Increase of 43 people from 160 in 1990 to 203 in 1994.	Laura Burner, City Clerk: <i>"The city is at a standstill for growth and has been for several years. No room for growth, unless more land is annexed. Five residential water service connections are located outside the city limits."</i>
	b. Kansas Water Office: No change from 1990 to 1994.	
Lecompton	a. U.S. Census Bureau: Increase of 213 people from 619 in 1990 to 832 in 1994.	Susie Hackathorn, City Clerk: <i>"The city has a slow and steady growth rate. The Kansas Water Office's estimates are more accurate."</i>
	b. Kansas Water Office: Increase of 17 people from 619 in 1990 to 636 in 1994.	
Mount Hope	a. U.S. Census Bureau: Increase of 287 people from 805 in 1990 to 1,092 in 1994.	Glenda Dick, City Clerk: <i>"No new population growth from 1990 to 1994. Land was annexed to include existing water customers. However, there weren't many people included in the annexation. The Kansas Water Office's estimate is more accurate."</i>
	b. Kansas Water Office: Increase of 3 people from 805 in 1990 to 808 in 1994.	

After the Kansas Water Office population estimates and projections were completed for these four cities, the Kansas Division of the Budget released the Certified Kansas Population which included updated population estimates for all counties, cities, and townships in Kansas. As previously stated, the Certified Kansas Population, by statute, is the latest sub-county population estimates released by the U.S. Census Bureau. A comparison between the U.S. Census Bureau and Kansas Water Office population estimates for the cities of Bel Aire, Latham, Lecompton, and Mount Hope are shown in Figures 2 through 5, respectively.

Figure 2:

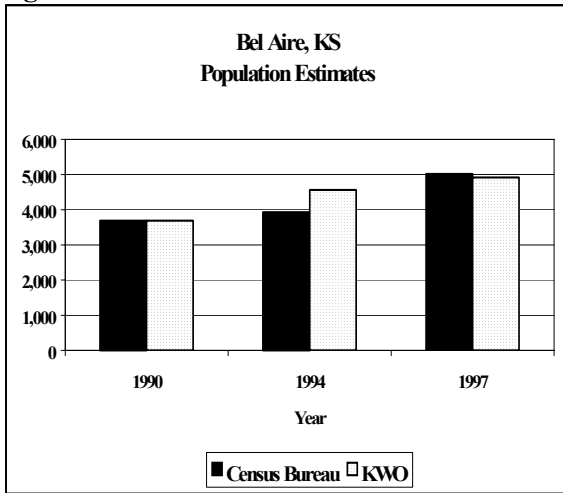


Figure 3:

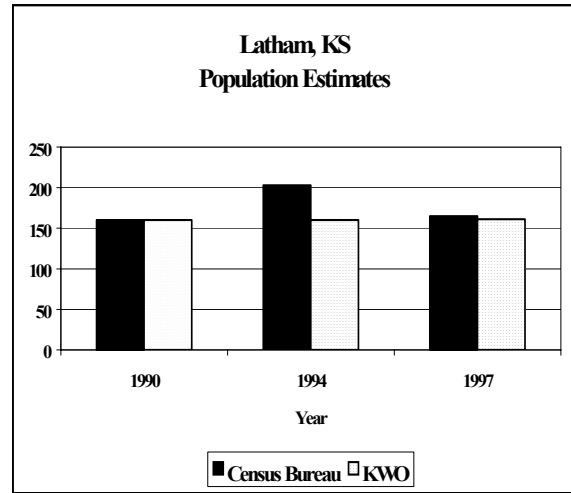


Figure 4:

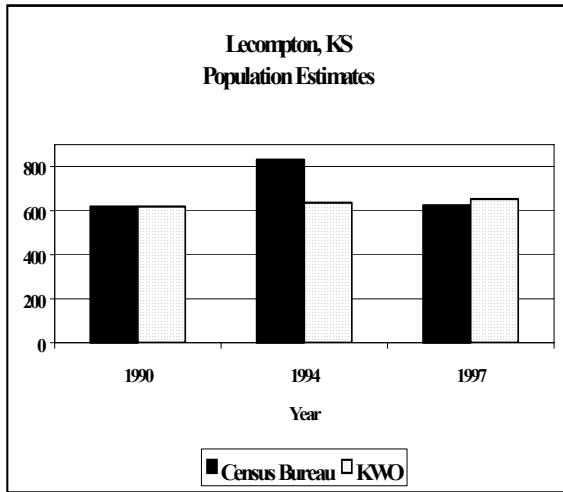
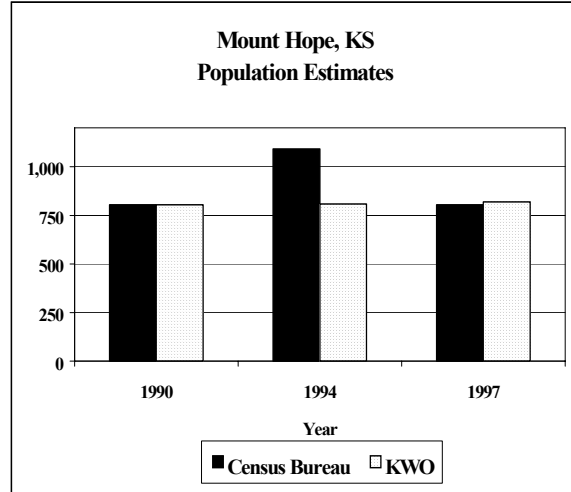


Figure 5:



For each city, it was clear that the Census Bureau's most current population estimate was much more compatible with the Kansas Water Office population estimates for 1994 and 1997. This level of compatibility is in contrast to the 1994 population estimates from both sources for the respective cities.

Kansas Water Office staff spent a significant amount of time making visits to cities across the state during the development of the methodology. A number of the smaller cities, which had significant differences between the Census Bureau population growth rates and the Kansas Water Office growth rates based on active connections, were canvassed carefully to get a first hand view of the extent of population growth that had recently occurred. Information on the number of residential building permits that had been issued between 1990 and 1994 were also examined. On the basis of these site visits, it was determined by the Kansas Water Office that the local officials were generally quite accurate when asked whether the Census Bureau population growth rates or the Kansas Water Office population growth rates were more accurate for a specific city.

Population Projections by County

The population projections indicate that significant population growth has occurred since the 1990 Decennial Census in most of our more urban counties in Kansas. These areas are generally concentrated on the eastern border of the state and include the six counties of Douglas, Johnson, Leavenworth, Miami, Shawnee, and Wyandotte. Overall, the population in this six-county area in eastern Kansas is projected to increase 71.0 percent by 2040, from 847,680 in 1990 to 1,450,527 in 2040. Also, this six-county area has a good source of both surface water and ground water.

Similarly, the population in the five-county area around the city of Wichita in south central Kansas is projected to increase 48.0 percent by 2040, from 548,183 in 1990 to 813,731 in 2040. The south central area, which includes Butler, Cowley, Harvey, Sedgwick, and Sumner counties, currently has an adequate amount of water available for future needs. In addition, continued growth is expected in southwest Kansas. This particular area currently is irrigated heavily and the source is the Ogallala Aquifer. Southwest Kansas also is experiencing an accompanying growth in feedlots and hog farms.

There is a significant decrease in the projected population in areas of the state that is primarily rural dryland farming communities. This decrease is evident especially in those counties that have neither a major town to attract residents nor a major highway to promote business growth. The Kansas population projections by county are presented in the appendix.

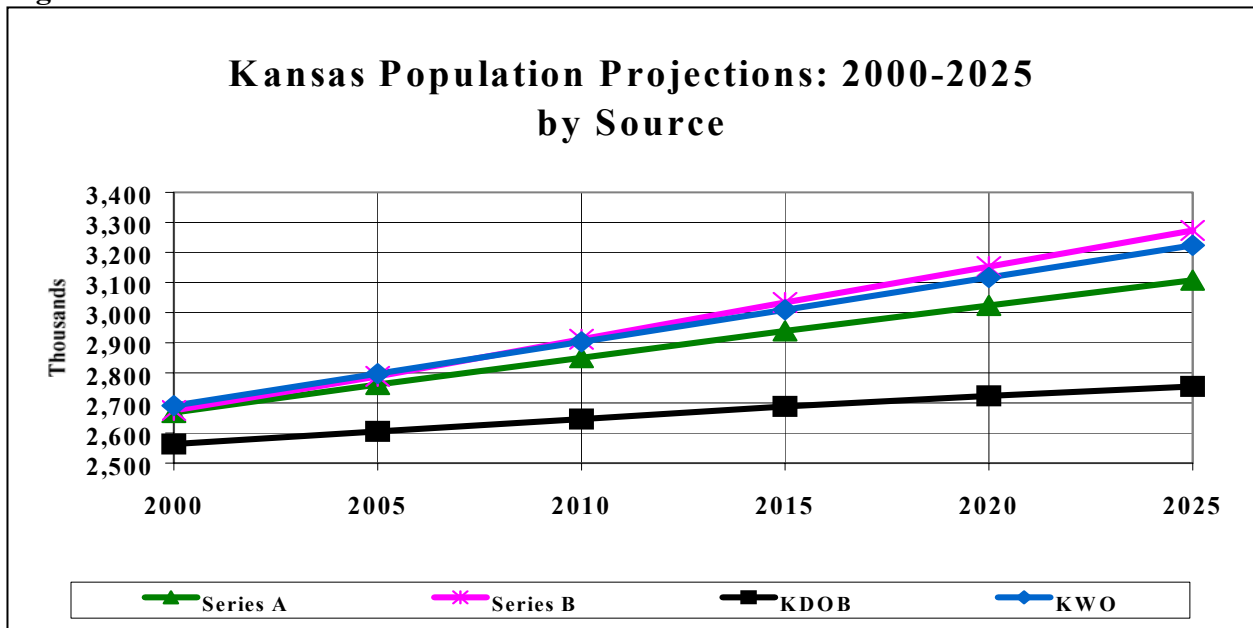
Population Projections by Source

A comparison of the Kansas Water Office's population projections with other projection sources is presented below in Table 3 and in Figure 6 on the following page. Included in the comparisons are the Kansas Division of the Budget's population projections, released in September 1992, as well as the Series A and B projections released by the U.S. Census Bureau in October 1996.

Table 3: Population Projections by Source (in thousands) KANSAS 2000-2025						
Source	Year					
	2000	2005	2010	2015	2020	2025
KWO	2,690	2,797	2,903	3,010	3,117	3,224
KDOB	2,563	2,605	2,646	2,688	2,724	2,750
US Census, Series A	2,668	2,761	2,850	2,939	3,024	3,108
US Census, Series B	2,675	2,788	2,911	3,034	3,154	3,273

Recall that the basic methodology was used to project population for 2000, 2010, 2020, 2030, and 2040. To obtain the projections for the interim years such as 2005, 2015, and 2025, the Kansas Water Office used a straight-line interpolation. For example, the Kansas Water Office’s projected population in Kansas for 2025 is 3,223,743. This projection was derived through the use of a straight-line interpolation between the 2020 and 2030 population projections. When comparing the Kansas Water Office’s population projection for 2025 with the U.S. Census Bureau’s Series A population projection for the same year, the difference was 3.7 percent. Comparing the projection with the Series B projections, the Kansas Water Office’s projection differed by only 1.5 percent. The entire comparison analysis is shown graphically in Figure 6.

Figure 6:



Conclusion

It is contended that the Kansas method for projecting water use and population is not only accurate and efficient, but is advantageous for Kansas because its application can be used in several alternative ways. The method can be used not only for its intended purpose of projecting water demand, but can be used to conserve state personnel resources as well. The conservation is realized in non-duplication of state activities related to federal population estimating and forecasting.

One alternative use for this method is that it can be used to verify the U.S. Census Bureau's sub-county estimates for Kansas. Although both methodologies have a shared variable, which is water hook-ups, the procedures are independent of each other. Thus, the Kansas method allows for a more efficient review period of the U.S. Census Bureau's sub-county estimates. It is anticipated that this enhancement to the review will reduce population challenges sent from Kansas cities and counties to the Census Bureau.

Further, because of the involvement of local governments and public water supplies, local input is cultivated and encouraged. It is contended that local governments that are given the opportunity to provide input to state agencies are more inclined to participate. This increase in opportunity was evidenced in the participation level of local governments when contacted by the Kansas Water Office. For a majority of the cities contacted by the Kansas Water Office, the local officials believed that the Kansas Water Office's estimate of the city's 1994 population, based on active residential water service connections (active connections) was more accurate than the U.S. Census Bureau's estimate of the city's 1994 population. On the basis of these site visits, it was determined by the Kansas Water Office that the local officials were generally quite accurate when asked whether the Census Bureau population growth rates or the Kansas Water Office population growth rates were more accurate for a specific city. These projections are available on the Kansas Water Office web site at <http://www.kwo.org/>.

**Appendix: Population Projections by County
Kansas 1990-2040**

County	Year					
	1990	2000	2010	2020	2030	2040
Allen	14,638	14,715	14,765	14,816	14,867	14,917
Anderson	7,803	8,144	8,497	8,850	9,203	9,556
Atchison	16,932	16,428	15,986	15,543	15,101	14,658
Barber	5,874	5,557	5,325	5,108	4,902	4,706
Barton	29,382	30,329	31,281	32,234	33,186	34,139
Bourbon	14,966	15,613	16,261	16,908	17,556	18,203
Brown	11,128	10,901	10,722	10,542	10,362	10,183
Butler	50,737	60,946	71,079	81,211	91,344	101,476
Chase	3,021	2,930	2,806	2,694	2,596	2,507
Chautauqua	4,407	4,287	4,200	4,112	4,025	3,937
Cherokee	21,374	23,029	24,729	26,429	28,129	29,829
Cheyenne	3,243	3,091	2,973	2,865	2,769	2,682
Clark	2,418	2,303	2,201	2,104	2,012	1,924
Clay	9,158	9,248	9,333	9,418	9,503	9,588
Cloud	11,023	10,721	10,663	10,631	10,617	10,625
Coffey	8,404	8,908	9,380	9,852	10,324	10,796
Comanche	2,313	2,095	1,925	1,762	1,604	1,453
Cowley	36,915	37,061	37,203	37,344	37,485	37,626
Crawford	35,582	37,287	39,165	41,042	42,920	44,797
Decatur	4,021	3,619	3,257	2,931	2,638	2,374
Dickinson	18,958	20,355	21,724	23,094	24,464	25,833
Doniphan	8,134	7,933	7,718	7,503	7,288	7,073
Douglas	81,798	101,459	121,377	141,294	161,212	181,129
Edwards	3,787	3,554	3,363	3,181	3,010	2,846
Elk	3,327	3,408	3,497	3,587	3,677	3,767
Ellis	26,076	27,379	28,301	29,269	30,280	31,326
Ellsworth	6,586	6,561	6,641	6,720	6,800	6,879
Finney	33,070	36,693	40,160	43,627	47,094	50,561
Ford	27,463	30,092	32,785	35,479	38,173	40,866
Franklin	21,994	24,933	27,968	31,003	34,038	37,073
Geary	30,648	31,440	32,293	33,146	33,999	34,852
Gove	3,231	3,109	3,008	2,920	2,841	2,773
Graham	3,543	3,206	2,905	2,634	2,390	2,170
Grant	7,159	7,999	8,719	9,456	10,208	10,974
Gray	5,396	5,546	5,728	5,926	6,142	6,375
Greeley	1,774	1,768	1,787	1,805	1,823	1,842
Greenwood	7,847	8,123	8,408	8,693	8,978	9,263
Hamilton	2,388	2,357	2,335	2,316	2,304	2,299
Harper	7,124	6,593	6,176	5,787	5,419	5,072
Harvey	31,028	32,655	34,403	36,150	37,898	39,645

**Appendix (continued): Population Projections by County
Kansas 1990-2040**

County	Year					
	1990	2000	2010	2020	2030	2040
Haskell	3,886	3,978	4,088	4,212	4,348	4,493
Hodgeman	2,177	2,272	2,377	2,482	2,587	2,692
Jackson	11,525	13,161	14,793	16,426	18,058	19,691
Jefferson	15,960	18,058	20,213	22,368	24,523	26,678
Jewell	4,251	3,900	3,582	3,293	3,030	2,792
Johnson	355,021	433,852	509,641	585,429	661,217	737,006
Kearny	4,027	4,498	4,998	5,499	6,000	6,500
Kingman	8,292	8,232	8,055	7,914	7,807	7,729
Kiowa	3,660	3,523	3,393	3,272	3,161	3,055
Labette	23,693	23,228	22,773	22,318	21,863	21,408
Lane	2,375	2,266	2,170	2,084	2,007	1,937
Leavenworth	64,393	73,749	83,061	92,373	101,685	110,997
Lincoln	3,653	3,329	3,034	2,768	2,527	2,312
Linn	8,254	9,039	9,832	10,624	11,417	12,209
Logan	3,081	3,143	3,177	3,210	3,243	3,277
Lyon	34,732	35,140	35,857	36,575	37,292	38,010
Marion	12,896	13,236	13,591	13,946	14,301	14,656
Marshall	11,705	11,589	11,517	11,444	11,372	11,299
McPherson	27,268	28,862	30,429	31,996	33,563	35,130
Meade	4,247	4,493	4,777	5,062	5,347	5,631
Miami	23,466	28,190	32,928	37,665	42,403	47,140
Mitchell	7,203	7,049	6,901	6,753	6,605	6,457
Montgomery	38,816	38,368	38,021	37,673	37,326	36,978
Morris	6,198	6,421	6,648	6,875	7,102	7,329
Morton	3,480	3,501	3,511	3,528	3,552	3,581
Nemaha	10,446	10,411	10,404	10,396	10,389	10,381
Neosho	17,035	17,681	18,306	18,931	19,556	20,181
Ness	4,033	3,741	3,528	3,327	3,139	2,956
Norton	5,947	5,765	5,638	5,534	5,447	5,381
Osage	15,248	17,470	19,706	21,943	24,180	26,416
Osborne	4,867	4,486	4,138	3,805	3,486	3,179
Ottawa	5,634	5,850	6,094	6,339	6,584	6,829
Pawnee	7,555	7,315	7,208	7,125	7,061	7,014
Phillips	6,590	6,107	5,806	5,526	5,269	5,031
Pottawatomie	16,128	19,343	22,541	25,738	28,936	32,133
Pratt	9,702	9,602	9,561	9,521	9,481	9,440
Rawlins	3,404	3,179	2,982	2,785	2,590	2,410
Reno	62,389	63,089	63,965	64,842	65,836	66,941
Republic	6,482	6,013	5,613	5,246	4,911	4,606
Rice	10,610	10,319	10,111	9,926	9,759	9,615

**Appendix (continued): Population Projections by County
Kansas 1990-2040**

County	Year					
	1990	2000	2010	2020	2030	2040
Riley	67,139	73,919	80,569	87,219	93,869	100,519
Rooks	6,039	5,771	5,511	5,251	4,991	4,731
Rush	3,842	3,740	3,611	3,490	3,380	3,278
Russell	7,835	7,605	7,440	7,275	7,110	6,945
Saline	49,301	53,131	56,670	60,209	63,748	67,287
Scott	5,289	5,560	5,820	6,095	6,383	6,681
Sedgwick	403,662	444,654	483,922	523,189	562,457	601,724
Seward	18,743	20,417	22,295	24,174	26,053	27,931
Shawnee	160,976	178,528	195,873	213,218	230,563	247,908
Sheridan	3,043	2,772	2,517	2,287	2,080	1,894
Sherman	6,926	6,981	6,877	6,789	6,715	6,652
Smith	5,078	4,585	4,251	3,917	3,583	3,249
Stafford	5,365	5,044	4,816	4,588	4,360	4,132
Stanton	2,333	2,371	2,428	2,492	2,564	2,641
Stevens	5,048	5,456	5,865	6,274	6,683	7,092
Sumner	25,841	27,310	28,798	30,285	31,773	33,260
Thomas	8,258	8,372	8,461	8,551	8,641	8,730
Trego	3,694	3,359	3,087	2,828	2,578	2,339
Wabaunsee	6,603	6,619	6,707	6,794	6,882	6,969
Wallace	1,821	1,808	1,797	1,785	1,773	1,762
Washington	7,073	6,662	6,307	5,986	5,694	5,430
Wichita	2,758	2,775	2,768	2,760	2,752	2,745
Wilson	10,289	10,265	10,328	10,390	10,453	10,515
Woodson	4,116	4,260	4,400	4,540	4,680	4,820
Wyandotte	162,026	152,667	146,087	139,507	132,927	126,347
Total	2,478,097	2,690,453	2,903,220	3,116,653	3,330,831	3,545,675

Data Sources: 1990 Population, U.S. Bureau of the Census
2000-2040 Population Projections, Kansas Water Office