



Kansas Water Resource Conditions 2006

Kansas Water Office

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Where we've been
Measuring our Progress

Introduction to the 2006 Kansas Water Resource Conditions Report

As we look to the future of water in Kansas, it's important to look at the progress we've made. In late 1998, the Kansas Water Authority set out a series of objectives for the State of Kansas to achieve by the year 2010. There were a total of sixteen, and aptly named the 2010 Water Plan Objectives.

In 2002, the Kansas Water Office took a look at how well we had done at reaching these objectives. The baseline information from this assessment was used to target the efforts of programs across the state, from the federal to local levels, in cooperative efforts to address the areas of greatest need. More specifically, this assessment evaluated the progress toward achieving each objective.

Intermittent measures of the progress made toward reaching milestones is often helpful, not only from the standpoint of gauging the distance one has traveled from the previous assessment, but also in reviewing whether those original milestones are still applicable in an ever changing water resource environment.

This report is the next intermittent look at the progress of meeting our water needs as expressed in the 2010 Objectives. Given the uncertainties of the future and the need to make adjustments to any charted course, the information contained in this assessment is invaluable as strategies need to be constantly evaluated and updated.

Since the original development of the 2010 Water Plan Objectives, some programs have changed. The result of these program changes have affected the ability to assess certain 2010 objectives: In some instances, progress made toward achieving some 2010 objectives can not be assessed because the programs collecting the information that would be used in the assessment have been dissolved; in other instances the progress made toward achieving a 2010 objective could not be assessed because the 2010 objective itself is based upon outdated information; and in some instances existing programs have been refocused to assess a 2010 objective but have not collected sufficient information as of 2006 to provide an update on the progress made toward achieving the objective.

With that said, there has been a great deal of progress made toward achieving the various 2010 objectives. Now it is on to using it to adjust what our course of action is for the near, and not so near, future.

Comments regarding this report are welcome. Please contact us calling (888) KAN-WATER or through our web site at www.kwo.org.

1. PUBLIC WATER SUPPLY

Water Storage

“By 2010, ensure that sufficient surface water storage is available to meet projected year 2040 public water supply needs for areas of Kansas with current or potential access to surface water storage.”

Public Water Supply Demand Estimates

In order to identify potential future surface water shortfalls at the basin scale, the Kansas Water Office (KWO) has initiated a surface water demand projection project. The task of projecting water demand employs two methods:

- 1) population growth projections for municipal demand and
- 2) non-municipal water use for the industrial and commerce demand

Demands are projected for the year 2050.

Combining the total of these two methods indicates that the Kansas River annual corridor from Topeka to the Kansas – Missouri state line will increase an additional 117,448 AF/year by 2050 from the baseline year of 2004. The Marais des Cygnes River corridor’s annual surface water demand will increase by 6,818 AF/year and the Neosho River corridor’s annual demand will increase by 12,816 AF/year.

Based upon a review of public water supplier’s average demand to maximum demand ratios, the daily peak demand ratio is 2.1 and weekly is 2.0. For the Topeka to Kansas-Missouri Stateline main stem corridor this surface water peak daily and weekly demand increase would be 341 and 324.8 cfs, respectively. The Marais des Cygnes daily and weekly peak increase would be 19.75 and 18.8 cfs and the Neosho corridor daily and weekly peak increase would be 37.2 and 35.4 cfs. Peaks demands have typically occurred during July and August in these basins.

Methods

Municipal Demand Projection

State certified county level population projections were obtained from the Division of Budget (current year = 2004). The Division of Budget population projections did not go beyond 2027, so for each county in Kansas, the KWO used the growth/decline trend contained within the certified projection totals in the years 2011 through 2027 to fit a simple linear regression which extended that linear trend from 2028 to 2050.

The resulting water demand associated with the population projections is based on municipal water use (as gallons per capita day usage) reported to the Kansas Department of Agriculture, Division of Water Resources for 2000 through 2004 by suppliers in the region of interest. The regions of interest in Eastern Kansas are 7 and 8.

Past KWO municipal water demand projection methods emphasized the use of the *average* gallon per capita day (GPCD) over a period of time for a region and the anticipated population in the future. The precipitation conditions that existed during that period, which typically drives a significant portion of the GPCD, were not considered in the context of whether the period was normal, wet or dry. Within this revised method, the projection has been edited to emphasize the GPCD usage that can be expected under somewhat drier climatic conditions. Later this GPCD

usage under the drier condition will be compared to the average or normal condition. This method of estimating the two levels of GPCD usage is described below.

A relationship between GPCD and seasonal precipitation was developed for regions 7 and 8 using a bivariate fit of GPCD water use by seasonal precipitation in each of the regions for 2000 – 2004. A seasonal precipitation exceedence was calculated for each county using data from 1950 to 2005. The 80% exceedence value was selected as the assessment/planning level for the drier condition in this analysis. The 80% exceedence value for seasonal precipitation was used to solve the GPCD by seasonal precipitation regression equation developed for each region. The GPCD for this drier condition was then applied to the change in total population for a basin to estimate the expected change in municipal water usage from 2004 to 2050.

Since all population projections were created on a county level, entire counties were assigned to the assessed Eastern Kansas basins. Counties were assigned to basins based upon predominance of area *and* existence of larger incorporated area within a particular basin. The Kansas River corridor from Topeka to the stateline included Shawnee, Jefferson, Leavenworth, Douglas, Johnson and Wyandotte counties. The Marais des Cygnes corridor included Osage, Franklin, Miami, Anderson and Linn counties. The Neosho included Marion, Morris, Chase, Lyon, Coffey, Allen, Neosho, Crawford, Labette and Cherokee counties. The projected total population for the Kansas corridor in 2050 is 1,404,650 persons, the Marais des Cygnes corridor is 103,250 persons and the Neosho corridor is 165,195 persons. The GPCD estimate for all basins is based upon 80% seasonal precipitation exceedence for regions 7 and 8. The region into which each county falls determined the GPCD estimate for that county. Using the GPCD estimate and the difference between the 2004 and projected 2050 population establishes the increase in municipal water demand in each basin. The municipal demand increase (from 2005 to 2050) in the Kansas corridor is 54,593 AF/yr (or 75.5 cfs), the Marais des Cygnes corridor demand increase is 1,793 AF/yr and the Neosho is actually a *decline* of 2,021 AF/yr due to the projected population decline for the area.

In the process of reviewing the GPCD usage it was determined that the quantity of water that municipalities sold for non-domestic use was not contained in the GPCD calculation. Although it is accurate to remove this volume when calculating GPCD usage for municipalities, that volume is important when estimating and projecting *total* demand.

The largest seven municipal-to-industry sellers account for 90% of the total industrial volume sold by municipal systems in 2002. These systems were located along the Kansas and Neosho main stem (none in Marais des Cygnes). The industrial water use sold by these 7 systems from 2000 – 2004 was reviewed for trend. None of the system's annual industrial sales correlated with seasonal precipitation. Two of these 7 systems showed no trend through time, 1 showed a significant increase through time and the remaining four showed a significant declining trend through time.

A number of conservative assumptions were used while projecting this industrial water volume sale from these systems for 2050 estimate. It was assumed that the industrial water sales were from surface water main stem sources. The single system that showed an increase in industrial water sales through time was projected to increase its sale through 2050, but the linear projection did not seem realistic; a curvilinear projection (transformed fit using the square of industrial water sales) was used instead. For the other six systems that showed no trend or a declining trend with time, the reported sales were used for 2004, but the median sale for the 2000-2004 period was used for the 2050 projection of each system. The resulting projections have been added to the Industry/Commerce Demand Projections described below.

Industry/Commerce Demand Projection (Non-municipal Use)

The demand projection for industrial and commercial development to 2050 was estimated by using 2002 reported water use within each basin of interest. 2002 seasonal precipitation was drier than the average seasonal precipitation for Regions 7 and 8, which follows the method of municipal demand projection for a planning condition that is somewhat drier than the average condition.

To develop the projected water use from industry and commerce, all non-municipal surface water points of diversion within 5 miles of the main stem of each basin were selected. Reported water use was summed for the selected points of diversion whose priority dates were before 1991, then 1992, then 1993 etc. through 2002.

A bivariate fit of cumulative water use on the years 1900-2002 was created to estimate the annual rate of increase in water use from industry and commerce in each basin. The regression equation was solved for both the year 2050 and the 2004. The 2004 result was subtracted from the 2050 water use projection to obtain the estimated increase in demand from these sources. The Kansas River corridor had an estimated surface water demand increase from commerce and industry of 62,855 AF/yr by the year 2050. The Marais des Cygnes' demand increase was 5,025 AF/yr and the Neosho had a demand increase of 14,838 AF/yr.

Annual Results

Adding the estimated municipal surface water demand increase and industry/commerce demand increase results provides the final demand increase estimates (see tables 1.1, 1.2 and 1.3 below). Under the somewhat drier moisture conditions, the surface water demand for the Kansas River corridor is expected to increase by 117,448 AF/year (162.4 cfs as an annual average flow increase) from 2004 to 2050. The Marais de Cygnes demand increase was estimated as 6,818 AF/year (9.4 cfs) and the Neosho demand increase was estimated as 12,499 AF/year (17.3 cfs).

Peak Usage Estimation

Future estimated water demand is based upon average annual differences from 2004 to 2050. During dry periods, this demand can increase significantly from an average annual value. From a planning perspective, estimating the peak demand over a shorter period than annually (monthly, weekly or daily) - particularly during a dry period – is significant.

The daily water use for the City of Topeka (1985 – 2006), the City of Parsons and the City of Olathe were reviewed for their daily, weekly and monthly maximum usage in relation to that same year's daily, weekly and monthly averages. This ratio of the annual peak to average was used to estimate the potential peak usage for the 2050 water demand. Between the three listed public water suppliers, the typical average to maximum peak ratio for daily use was 2.1, 2.0 for weekly and 1.7 for monthly.

Table 1.1

Kansas River Corridor Surface Water Demand Projection			
Year	C/I (af/yr)	Pop (af/yr)	Total Demand (af/yr)
2004	43,397	147,975	191,372
2050	106,252	202,569	308,820
Demand Change	62,855	54,593	117,448

Table 1.2**MdC River Corridor Surface Water Demand Projection**

Year	C/I (af/yr)	Pop (af/yr)	Total Demand (af/yr)
2004	6,381	13,273	19,654
2050	11,406	15,067	26,472
Demand Change	5,025	1,793	6,818

Table 1.3**Neosho River Corridor Surface Water Demand Projection**

Year	C/I (af/yr)	Pop (af/yr)	Total Demand (af/yr)
2004	30,533	25,818	56,351
2050	45,371	23,797	69,167
Demand Change	14,838	-2,021	12,816

Public Water Supply Availability Estimates

While considerable work has been completed on municipal and industrial demand projections, water supply availability from storage assessment has not been completed. Historically, the state has looked at only municipal and industrial demand when evaluating whether sufficient storage will be available in the future. Additional demands for environmental needs, recreational uses both at the lake and downstream and many others are growing factors in surface water management and availability. While river / reservoir computer models have been developed for the three basins described in the demand projections as well as the Verdigris, no significant work has been accomplished to quantify the demands of the additional uses. Consequently, any conclusion regarding the availability of surface water storage to meet public water supply needs in the future is premature.

Developing all of the basic information about surface water availability has been beyond the historic scope of the public water supply work completed by the Kansas Water Office. It is anticipated that a review of the needs of all users of the surface water system will also lay the ground work for development of additional surface water management policy discussions that will position the state to address water supply challenges for the next several decades.

Capacity Development

“By 2010, ensure that all public water suppliers have adequate water treatment, storage and distribution systems and the technical, financial and managerial capability to meet Safe Drinking Water Act regulations.”

Background

The Safe Drinking Water Act Amendments of 1996 (PL 104-182) emphasize public water system capacity and capacity development. Under Section 1420, all states were required to prepare separate strategies to assist new and existing public water systems in achieving technical, financial and managerial capacity.

The Kansas Department of Health and Environment (KDHE) is the primary agency responsible for preparation and implementation of the Kansas Capacity Development strategies. KDHE has developed 2 programs to address Section 1420 requirements. The New Systems Capacity Development Strategy was approved by the EPA in September 1999. The Kansas Capacity Development Strategy for Existing Systems was approved in September 2000.

The Kansas Capacity Development Strategy for Existing Systems contains 15 recommendations, eight of which have provided the focus for KDHE implementation to date. These eight recommendations and their status are summarized in Table 1.4.

Table 1.4 – Initial Implementation Focus Kansas Capacity Development Strategy for Existing Systems	
Recommendation	Implementation Status
• TFM Surveys for all community water systems	Implemented – conducted every 3 years
• Require water use reports from all systems	Implemented – required annually by KDA Division of Water Resources
• Develop a PWS business planning guidebook	Implemented – part of KanCap
• Develop PWS finance training program	Implemented – KanCap/EFC Financial Tools
• Require all systems to install customer meters	Under development
• Expand KDHE “survival Guides” for PWS systems	Implemented
• Develop facilities management plan guidelines (Asset Management)	Under Development
• Develop board/council member education program	Implemented - KanCap
Source: KDHE - Kansas Public Water Supply Capacity Development Program, Status Report dated September 21, 2006	

The Safe Drinking Water Act (SDWA) requires the head of the state primacy agency to submit to the Governor, two years after adoption of the strategy and every 3 years thereafter, a report on implementation and efficacy of the state strategy. KDHE submitted reports to the Governor in 2002 and 2005 to comply with this reporting requirement.

Water System Capacity and Capacity Development

Water system capacity is the ability to plan for, achieve, and maintain compliance with applicable drinking water standards. Capacity consists of three elements: technical, financial, and managerial (TFM).

Technical – The physical and operational ability of a water system to meet SDWA requirements, including source water adequacy, infrastructure adequacy and the technical knowledge of system personnel.

Financial – The ability of a water system to acquire and manage sufficient financial resources to allow the system to achieve and maintain compliance with SDWA requirements, including revenue sufficiency, fiscal management and controls, and credit worthiness.

Managerial – The ability of a water system to conduct its affairs in a manner enabling the system to achieve and maintain compliance with SDWA requirements. Included are ownership accountability, staffing and organization, and effective external linkages.

Capacity development is the *process* of water systems acquiring and maintaining adequate technical, financial and managerial capabilities to ensure that systems consistently achieve the health objectives of the 1996 Safe Drinking Water Act and meet both immediate and long-term challenges.

Assessment Concept

KDHE assesses changes in the ability or capacity of Kansas community water systems to comply with applicable drinking water standards as described above. The primary data sources are 2002 and 2005 Capacity Development Surveys conducted by KDHE. Both surveyed over 900 community public water systems across Kansas. System personnel were asked to respond to questions regarding their system's technical, financial and managerial status and capability. KDHE developed a priority ranking for targeting capacity development assistance from the survey results. This ranking scheme was used with both the 2002 and 2005 Capacity Development Surveys, and was incorporated into KDHE's 2002 and 2005 Reports to the Governor.

Assessment Results and Conclusions

Table 1.5 provides a statewide summary comparison of KDHE 2002 and 2005 Capacity Development Survey results.

Table 1.5 – Capacity Development Survey Comparison		
Parameter	Survey Year	
	2002	2005
Average Tech Score	11	11
Average F&M Score	16	15
Average Total TFM Score	27	26
Highest Total TFM Score	64	66
Lowest Total TFM Score	2	2
High Priority Systems	117 (13%)	79 (9%)
Medium Priority Systems	556 (64%)	527 (60%)
Low Priority Systems	203 (23%)	270 (31%)
Total Systems Surveyed	876	876
Source: Capacity Development Survey data provided by the Kansas Department of Health and Environment		

Comparison of average and extreme scores shows little difference in community water system capacity between 2002 and 2005. More improvement is indicated by the number of water systems classified as low, medium or high priority for capacity development assistance. The number of high priority systems decreased between 2002 and 2005, while the number of low priority systems increased by 67.

River Basin Analyses

Table 1.6 compares KDHE's 2002 and 2005 Capacity Development Survey results organized by the 12 Kansas River basins. This comparison shows that the number of high priority community water systems declined between 2002 and 2005 in all but three river basins. Increases were noted in the Upper Republican and Smoky Hill-Saline basins. High priority systems remained constant in the Verdigris Basin. It should be noted that while the total number of water systems assessed was the same for both 2002 and 2005, this number varied between years in all river basins except the Neosho and Solomon basins.

Technical Capacity – The 2010 Kansas Water Plan Objective emphasizes technical capacity, ensuring all public water suppliers have adequate water treatment, storage and distribution systems.

Individual water system technical capacity scores in 2005 ranged from 0 to 34 with a median score of 9 and an average score of 11. This average score was the same as in 2002. Since technical and financial-managerial capacities received equal weight in KDHE's capacity scoring scheme, a rule-of-thumb is that if the technical capacity score exceeds the financial-managerial score, emphasis should be given to technical capacity when providing capacity development assistance. Comparison of technical and financial-managerial scores for all 876 water systems assessed in 2005 showed that 281 systems, or 32 percent of the total number, had technical scores that were higher than their financial-managerial score.

Table 1.6 – 2002 – 2005 Capacity Development Survey Comparison by River Basin		
River Basin	Number of Systems and Average Total TFM Score	
	2002 Survey	2005 Survey
Lower Arkansas	135 Systems	136 Systems
High Priority	12 (9%)	7 (5%)
Medium Priority	79 (58%)	80 (59%)
Low Priority	44 (33%)	49 (36%)
AVG Total TFM Score	25	23
Upper Arkansas	57 Systems	59 Systems
High Priority	14 (25%)	10 (17%)
Medium Priority	33 (58%)	28 (47%)
Low Priority	10 (17%)	21 (36%)
AVG Total TFM Score	31	27
Cimarron	23 Systems	24 Systems
High Priority	4 (17%)	3 (12%)
Medium Priority	13 (57%)	15 (63%)
Low Priority	6 (26%)	6 (25%)
AVG Total TFM Score	28	25
Kansas-Lower Republican	189 Systems	179 Systems
High Priority	26 (14%)	17 (9%)
Medium Priority	116 (61%)	105 (59%)
Low Priority	47 (25%)	57 (32%)
AVG Total TFM Score	28	25

Table 1.6 – 2002 – 2005 Capacity Development Survey Comparison by River Basin		
	Number of Systems and Average Total TFM Score	
River Basin	2002 Survey	2005 Survey
Marais des Cygnes	74 Systems	76 Systems
High Priority	10 (14%)	4 (5%)
Medium Priority	48 (65%)	46 (61%)
Low Priority	16 (21%)	26 (34%)
AVG Total TFM Score	27	25
Missouri	34 Systems	36 Systems
High Priority	3 (9%)	1 (3%)
Medium Priority	25 (74%)	27 (75%)
Low Priority	6 (17%)	8 (22%)
AVG Total TFM Score	28	26
Neosho	110 Systems	110 Systems
High Priority	12 (11%)	4 (3%)
Medium Priority	70 (64%)	70 (64%)
Low Priority	28 (25%)	36 (33%)
AVG Total TFM Score	26	25
Upper Republican	16 Systems	18 Systems
High Priority	2 (13%)	3 (17%)
Medium Priority	11 (69%)	12 (66%)
Low Priority	3 (18%)	3 (17%)
AVG Total TFM Score	28	30
Smoky Hill - Saline	84 Systems	89 Systems
High Priority	15 (18%)	16 (18%)
Medium Priority	54 (64%)	55 (62%)
Low Priority	15 (18%)	18 (20%)
AVG Total TFM Score	29	29
Solomon	49 Systems	49 Systems
High Priority	5 (10%)	4 (8%)
Medium Priority	34 (70%)	33 (67%)
Low Priority	10 (20%)	12 (25%)
AVG Total TFM Score	26	26
Verdigris	70 Systems	67 Systems
High Priority	8 (12%)	8 (12%)
Medium Priority	50 (71%)	42 (63%)
Low Priority	12 (17%)	17 (25%)
AVG Total TFM Score	29	27
Walnut	35 Systems	33 Systems
High Priority	6 (17%)	2 (6%)
Medium Priority	23 (66%)	14 (42%)
Low Priority	6 (17%)	17 (52%)
AVG Total TFM Score	28	21
Source: Capacity Development Survey data provided by the Kansas Department of Health and Environment		

KDHE's survey identified community water systems considered to have a high priority for capacity development assistance in 2005. 19 water systems identified with a technical focus are those having a 2005 technical capacity score of 20 or more, regardless of the system's total TFM score. In addition, 23 medium-priority systems also had a technical capacity score of 20 or more in 2005.

Conclusions

Based upon Kansas Department of Health and Environment analysis of the 2005 Capacity Development Survey and comparison with the 2002 Survey, three conclusions were drawn as reported in the *Kansas Public Water Supply Capacity Development Program – Report to the Governor* (KDHE, September 2005). These conclusions are:

1. Improvements in the priority rankings indicate that the KDHE Capacity Development Program is working and KDHE should continue to implement the Kansas Capacity Development Strategy for Existing Systems;
2. A higher rate of improvement needs to be achieved for water systems in the Medium Priority category; and
3. KDHE should continue to place special emphasis on water systems with populations of 500 or less.

Technical capacity remains a challenge for a significant proportion of the 876 community water systems that responded to the 2005 Capacity Development Survey. Nearly one-third of these water systems scored less in technical capacity than in financial-managerial capacity. The Kansas Capacity Development Strategy for Existing Systems has emphasized financial and managerial capacity development because both are necessary foundations for building technical capacity.

The Kansas Department of Health and Environment addresses technical capacity concerns through water treatment plant operator certification, revolving loan fund financial assistance, on-site technical assistance provided under contract with the Kansas Rural Water Association and technical assistance provided by KDHE district office staff.

Additional Information

Additional information including the Kansas Capacity Development Strategy, Reports to the Governor, Capacity Development Annual Reports, surveys and complete results tables are available on the Kansas Department of Health and Environment website at <http://www.kdheks.gov/pws/capdev.html>. Please call KDHE at (785) 368-7130 regarding questions about the Capacity Development Program.

Drought Vulnerability

“By 2010, less than five percent of public water suppliers will be drought vulnerable.”

BACKGROUND

Coping with drought presents a challenge for public water suppliers. During drought periods the amount of raw water available typically is reduced at the same time customer demand for water increases. While all suppliers may be potentially impacted, some are particularly vulnerable.

This vulnerability may be natural, technical or legal in nature. Natural vulnerability occurs when the yield from a supplier's raw water source is especially sensitive to drought and the supplier is unable to pump enough water to satisfy customer demands. Technical vulnerability refers to situations where raw water treatment capacity is unable to keep-up with demand or where finished water storage or distribution is the limiting factor. The legal authority to divert adequate quantities of water may also be involved in a supplier's vulnerability. Where a supplier has its own raw water source, water right quantities may be insufficient to cover demands; the water rights may be junior to those of others using the same source or they may be subject to administration for maintenance of minimum desirable streamflows. Where finished water is purchased from another supplier, the terms of the contract may include a cut-off clause during times of drought.

Previous Assessments

Several previous assessment projects, dating to the 1970's, have been conducted to identify drought vulnerable public water systems. Due to the differing methodologies employed, comparisons among these assessments may be misleading if these differences are not taken into account. Included are the following assessments.

Kansas Water Office

A Kansas Water Office (KWO) assessment of the *Kansas Water Plan 2010 Objective* was completed in 2001 which identified drought vulnerable public water suppliers in each of the years 1992, 1995 and 1998. This assessment also identified those suppliers known to have resolved their drought limitation after 1998, thus bringing the assessment up-to-date through 2000. Drought vulnerable public water suppliers were considered to be those suppliers most likely to first be adversely affected by drought. It was recognized that nearly any public water supplier might experience problems during an extreme, extended drought. The following drought limitation categories were used: 1.) basic source limitation; 2.) distribution system limitation; 3.) treatment capacity limitation; 4.) single well source limitation; and 5.) contractual limitation.

The concept used in conducting the assessment was to determine whether public water suppliers identified on the 1992 Drought Vulnerable Kansas Public Water Supplies List had resolved the factors responsible for their vulnerability. Those suppliers with contractual limitations or that relied upon purchase of water from a drought vulnerable supplier were then identified and added to the list. Similar screenings using 1995 and 1998 information were made.

A survey of public water suppliers conducted in 2000 provided information on water purchase contracts, including where drought cut-off clauses were present. Information regarding upgrades to water distribution or water treatment facilities was gathered by telephone in 2000. The total number of drought vulnerable public water suppliers in a river basin was the data parameter used in this assessment. On a statewide basis, the number of drought vulnerable public water

suppliers in 1992, 1995 and 1998 was 243, 218 and 150, respectively. This number had dropped to 133 in 2000, the most recent year for which an estimate was available.

Kansas Department of Health and Environment

In 2006, the Kansas Department of Health and Environment (KDHE) assessed the number of drought vulnerable public water supply systems in Kansas based upon the 2002 and 2005 Capacity Development Surveys. The definition of drought vulnerability and the drought limitation categories used were similar to those used in the Kansas Water Office 2001 assessment. The KDHE assessment also compared the number of drought vulnerable public water supply systems in 2002 and 2005 with the number in 1979, 1980, 1989 and 2000.

Draft summary information as of August 17, 2006, indicated the following number of drought vulnerable Kansas public water supply systems by year:

- 1979 – 187
- 1980 – 126
- 1989 – 166
- 2000 – 132
- 2002 – 46
- 2005 – 93

The KDHE assessment illustrates the progress that has been made by public water systems in reducing their drought vulnerability. A significant aspect of this progress has been related to development of public wholesale water supply districts that utilize raw water sources that are not drought sensitive.

Twenty-five wholesale districts have been organized since 1977. Of these, 10 districts are actively producing water for their members. An additional six districts are under development, with the status of the remaining nine districts being inactive, dissolved or unknown.

ASSESSMENT METHODOLOGY

All regions of Kansas have been subject to drought of varying levels of severity and duration since 1999. This has provided the opportunity to re-assess the drought vulnerability of all Kansas public water suppliers, not just those previously considered drought vulnerable.

The percentage of public water suppliers in Kansas considered to be drought vulnerable in 2006 was the parameter measured in this assessment. As was the case in the previous Kansas Water Office assessment, drought vulnerable public water suppliers were defined as those suppliers considered most likely to first experience drought-related problems.

The imposition of water use restrictions was considered evidence of such problems. No distinction was drawn between voluntary or mandatory restrictions, the number of times restrictions were imposed or their duration. Suppliers imposing water use restrictions solely because a trigger in their water conservation plan was exceeded were not considered drought vulnerable. Such restrictions were seen as preventing a problem rather than as the result of a problem.

Assessed public water suppliers included municipalities or rural water districts that provide water service. For the purpose of determining the percentage of public water suppliers that are drought vulnerable, the total number of city and rural water district drinking water systems in

KDHE's Kansas Public Water Supplier Inventory System as of January 26, 2007, was used. The Kickapoo Tribe and Prairie Band Pottawatomie Indian Reservations were also included. Suppliers such as mobile home parks, camps and correctional facilities were not included.

Primary information sources included the KWO *2010 Objective Assessment Project: Drought Vulnerable Kansas Public Water Suppliers* (August 2001) and Capacity Development Surveys distributed to all Kansas public water suppliers by the Kansas Department of Health and Environment (KDHE) in 2002 and 2005. Additional information from KDHE district office staff, the *2004 Public Water Suppliers Sources and Purchasers* list compiled by the Kansas Department of Agriculture, Division of Water Resources, and press reports were also used when available.

The previous KWO assessment identified the number of drought vulnerable systems in 1998 with notation of those public water suppliers that had resolved their identified drought limitations through 2000. Information available from KDHE's 2002 and 2005 Capacity Development Surveys included the number of times drought related water-use restrictions were imposed, their cause and whether the cause for the restrictions had been resolved. Supplier comments were also included. Where these comments were inconsistent with other information provided in the survey such as cause for restrictions or corrective actions taken, supplier drought status reflecting the comments was assumed. Survey information is available for the years 1999-2004, which coincides with the current drought period.

The most recent year for which comprehensive information was available was 2004. Where information regarding more recent water use restrictions, water system upgrades etc. was available, it was used in assessing a supplier's 2006 drought vulnerability. Year 2006 drought vulnerability was assumed to be the same as that in 2004 where more recent information was not available.

Drought Limitation Categories

As indicated, the 2001 Kansas Water Office Assessment considered public water suppliers to be drought vulnerable due to the presence of one or more of the following limitations: basic source, contractual, distribution system, single well source and treatment capacity. This assessment also included identification of drought vulnerability due to minimum desirable streamflow administration or water rights limitations. In cases where drought-related restrictions were reported but the cause is unknown, the limitation is so stated. These limitations are defined below.

Basic Source Limitation – The supplier's primary raw water source is particularly sensitive to drought as evidenced by depleted streamflow, depleted reservoir inflow and storage, or by declining water levels in wells. The following are considered as reliable water sources or as factors indicating reliability:

- Kansas River
- Missouri River
- Spring River
- Federal Reservoir
- Multipurpose Small Lake
- Assurance District membership
- Public Wholesale Water Supply District membership (active – supplying water)
- Kansas Water Marketing Program contract holder
- Purchase from non-vulnerable system without drought cut-off clause

Restrictions imposed due to inability to use a well(s) due to water quality problems were considered indicative of a basic source limitation.

Contractual Limitation – The supplier's sole water source is purchase from another system that is drought vulnerable and there is a drought-cut-off clause in their water purchase contract. In such situations where there is not a drought cut-off clause, the purchaser is considered drought vulnerable under the same limitation category as the seller.

Distribution System Limitation – The supplier has difficulty or is unable to meet drought-induced customer demand for water due to inadequate finished water storage capacity, inadequate finished water pumping capacity, inadequate transmission line sizes etc.

Minimum Desirable Streamflow – The supplier reported imposing restrictions because of minimum desirable streamflow administration. Water rights junior to those granted for maintenance of established minimum desirable flows are subject to such administration.

Single Well Source – The supplier relies upon a single well as its sole source for raw water. Suppliers with one active well and one emergency well were considered drought vulnerable because emergency wells are not a dependable long-term water source. Excessive hours of operation to meet drought-induced customer demand for water will result in the increased likelihood of mechanical breakdown with no alternative water supply source available.

Treatment Capacity Limitation - The supplier has difficulty or is unable to meet drought-induced customer demand for water due to inadequate raw water treatment capacity.

Water Right Limitation - The supplier reported imposing restrictions because the quantity of water they are authorized to divert under their water right(s) was insufficient to meet customer demands.

Protocols

The following protocols were used in determining if public water suppliers listed as drought vulnerable in 2000 (KWO original assessment) continued to be so listed and if other suppliers reporting drought-related water use restrictions during 1999-2006 (KDHE Capacity Development Surveys, supplemental information) were added to the list.

1) Continue on Drought Vulnerable List:

- a) If supplier was on 2000 list, drought-related water use restrictions were reported sometime from 1999 through 2006, and limitation has not been resolved. May add additional limitation categories as appropriate.
- b) Suppliers with an unresolved 2000 single well raw water supply source limitation are considered drought vulnerable regardless of whether or not 1999-2006 water use restrictions were imposed.
- c) Suppliers with an unresolved 2000 contractual limitation are considered drought vulnerable regardless of whether or not 1999-2006 water use restrictions were imposed.

2) Add to Drought Vulnerable List:

- a) If supplier was not on 2000 list, but drought-related water use restrictions were reported sometime from 1999 through 2006 and cause has not been resolved.

3) Remove from Drought Vulnerable List:

- a) If supplier was on 2000 list and limitation is known to have been resolved with no subsequent reported water use restrictions. Also remove if supplier has known project underway that will resolve their limitation.
- b) If supplier was on 2000 list and unknown if limitation has been resolved, but no water use restrictions were reported anytime from 1999 through 2006. (BSL, DSL, TCL)

ASSESSMENT RESULTS AND CONCLUSIONS

This assessment indicates that 133 of the 800 public water suppliers assessed, or 17 percent, were drought vulnerable in 2006.

Table 1.7 provides a summary of the number of drought vulnerable suppliers by river basin.

Table 1.7 2006 River Basin Summary of Drought Vulnerable Public Water Suppliers			
Basin	Total Number Suppliers¹	Drought Vulnerable Suppliers	
		Number	Percent
Lower Arkansas	(96 / 31) 127	13	10
Upper Arkansas	(39 / 4) 43	7	16
Cimarron	(21 / 1) 22	8	36
Kansas – Lower Republican	(102 / 53) 155	21	14
Marais des Cygnes	(46 / 28) 74	11	15
Missouri	(17 / 17) 34	3	9
Neosho	(50 / 57) 107	3	3
Upper Republican	(16 / 0) 16	3	19
Smoky Hill - Saline	(53 / 26) 79	30	38
Solomon	(38 / 10) 48	20	42
Verdigris	(29 / 37) 66	10	15
Walnut	(15 / 14) 29	4	14
KANSAS	(522 / 278) 800	133	17

1. Source: KDHE Public Water Supplier Inventory System, 1/26/07. Numbers in parentheses indicated total number of city (left) and rural water district drinking water systems.

A basic source limitation was the most common reason for drought vulnerability. The frequency with which each drought limitation category was assigned is summarized below. The total exceeds 133 because several public water suppliers had more than one limitation.

- Basic Source – 56
- Contractual – 14
- Distribution System – 21
- Minimum Desirable Streamflow – 3

- Single Well Source – 12
- Treatment Capacity – 4
- Unknown – 29
- Water Right – 8

Appendix A lists all public water suppliers considered to be drought vulnerable in 2006, by river basin. Supplier drought limitation categories are also listed.

Conclusions

1. The 2010 *Kansas Water Plan* Objective of fewer than five percent of public water suppliers being drought vulnerable has not been achieved on a statewide basis.
2. Because this assessment considered all cities and rural water districts and was not limited to those previously considered drought vulnerable, only limited comparisons can be made with the previous Kansas Water Office assessment. Of the 133 drought vulnerable public water suppliers identified, 45 were holdovers from the 2000 Kansas Water Office list, while 88 were newly added to the list. In general, those removed from the list did not report any drought related water use restrictions between 1999 and 2004, while those added to the list reported such restrictions or had known restrictions in 2006.
3. The Kansas Department of Health and Environment estimated that there were 93 drought vulnerable public water suppliers in Kansas in 2005 as compared with the 2006 estimate of 133 such suppliers from this assessment. Similar definitions and methodologies were used in both assessments. This assessment considered water-use restriction information reported by the press or the KDHE district offices in 2002 and 2006 restricts reported by the district offices that was not considered by KDHE in making its 2005 estimate. This is considered to be the likely reason for the disparity between the two assessments.
4. Comparison of the KWO 2000 and 2006 lists by river basin shows a significant increase in the number of drought vulnerable public water suppliers in most western river basins (Lower Arkansas, Upper Arkansas, Cimarron, Smoky Hill-Saline and Solomon). Substantial declines were noted in the Kansas-Lower Republican, Verdigris and Walnut basins, with little overall change observed in the Marais des Cygnes, Missouri, Neosho and Upper Republican basins.
5. Several factors may be involved with these increases and declines. In eastern Kansas, many public water suppliers' drought vulnerability was resolved when more reliable water sources were tapped through public wholesale water supply districts (PWWSD's). Among the districts that have initiated water service since 2000 have been PWWSD 18 (Banner Creek Multipurpose Small Lake) and PWWSD 20 (Quivira Boy Scout Lake). Several public wholesale water supply districts currently under development will resolve the drought vulnerability of additional suppliers in eastern Kansas.

Persistent drought conditions in the western half of Kansas through the 1999 – 2006 time period exposed the drought vulnerability of many public water suppliers in that region. Recent drought periods such as the one from 1988-1991 may not have been sufficiently severe to do so, thus these suppliers were not considered drought vulnerable in previous assessments.

6. Since water use restrictions were considered a key "symptom" of drought vulnerability in this assessment, the rigor with which they were reported is a factor in the number of drought

vulnerable systems. The KDHE Northwest District has been particularly diligent in this regard. As a result, many of the water use restrictions imposed in the Smoky Hill-Saline and Solomon basins in 2006 were reported. The 2008 Capacity Development Survey will provide a better statewide perspective of drought-related water use restrictions imposed since 2004, particularly in southeast Kansas where 2006 drought conditions were severe.

Additional Information

The August 2001 Kansas Water Office Summary Report: *2010 Objective Assessment Project Summary – Drought Vulnerable Kansas Public Water Suppliers* is available on the Kansas Water Office website at <http://www.kwo.org>. General information regarding Kansas drought conditions is also available on the KWO website.

Please call the Kansas Water Office at (785) 296-3185 regarding questions about this assessment project.

2. WATER CONSERVATION

Irrigation Use

“By 2010, reduce the number of irrigation points of diversion for which the acre feet per acre (AF/A) water use exceeds an amount considered reasonable for the area (amounts typically considered reasonable are 1.0 AF/A in eastern Kansas, 1.5 AF/A in central Kansas, 2.0 AF/A in western Kansas) and those that overpumped the amount authorized by their water rights.”

Methodology

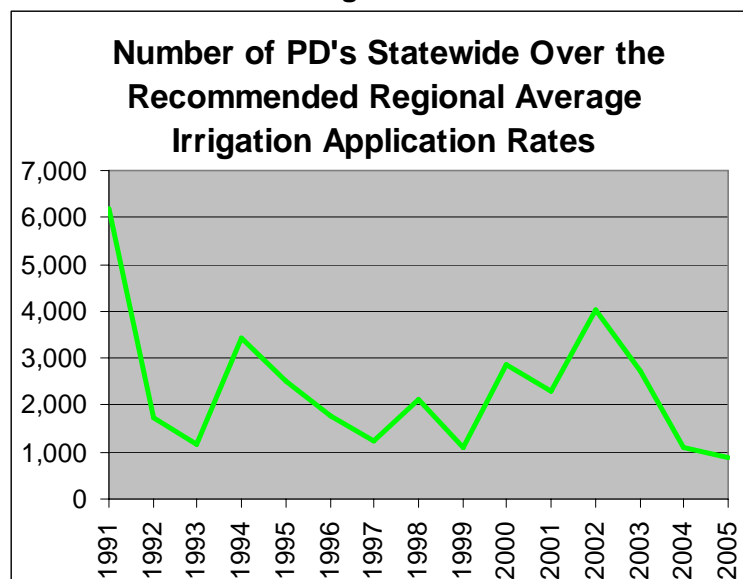
This assessment used the annual irrigation water use report data collected by the Kansas Department of Agriculture, Division of Water Resources. There were three data parameters used in the irrigation assessment: 1) the total number of irrigation points of diversion (PDs) that reported higher acre-foot per acre than the regional-based acre-foot per acre standards, 2) The total amount of irrigation water reported used over the regional-based acre-foot per acre standards, and 3) the number of irrigation water rights (which were grouped together based on how they overlap one another by either the point of diversion or place of use) that appear to use water in excess of their respective authorized quantities.

The time period used for this assessment was 1991 – 2004. 1991 was the earliest year for which both the amount of water reported diverted and the number of acres reported irrigated from the annual water use reports underwent a data quality control and assurance program. 2004 was the most recent year of data available when the assessment of this objective was initiated. The data set represents both ground and surface water based water rights and excludes water use reports from surface water ditch companies in south and northwest Kansas.

Assessment

Statewide the diversion points that reported irrigation application rates above the recommended regional average declined slightly from 1991 to 2005 (Figure 2.1). The greatest number occurred in 1991, while the fewest occurred in 1999. From 1999 the number increased again but was slightly less than the number in 1991. The distribution of these recommended regional application rates and their respective regional average was also reviewed within three geographic areas of the state.

Figure 2.1



Western Kansas

The number of diversion points in western Kansas that reported irrigation application rates over the recommended regional average declined from 1991 to 2005, from about 3,700 to less than 500. The numbers and percentage of points of diversion reporting water use above the regional average or 2 acre feet per acre fluctuated within that time period.

Central Kansas

The number of diversion points in central Kansas that reported irrigation application rates over the regional average decreased from 1991 to 2005. The numbers and percentage of points of diversion reporting water use above the recommended regional average of 1.5 acre feet per acre fluctuated within that time period, but all years 1992 to 2005 were less than the 2,338 points in 1991.

Eastern Kansas

The number of diversion points in eastern Kansas that reported irrigation application rates over the regional average declined from 1991 to 2005. The numbers and percentage of points of diversion reporting water use above the recommended regional average of 1.0 acre feet per acre fluctuated within that time period with the fewest number in 1993.

Municipal Use

“By 2010, reduce the number of public water suppliers with excessive ‘unaccounted for’ water by first targeting those with 30 percent or more ‘unaccounted for’ water.”

Methodology

“Unaccounted for water” is the amount of water that a public water supplier diverted under its water right or appropriation or purchased from other entities minus the metered amounts that are sold or distributed as metered free water.

A public water supplier may have a high percent of unaccounted for water if the supplier has: 1) inaccurately estimated the amount of water pumped or purchased due to not metering all water at the intake source or by using raw water or finished water meters that are inaccurate or improperly installed; 2) inaccurate customer meters; 3) bookkeeping errors; 4) non-metered uses such as water used in the treatment process, city buildings, churches, watering a golf course, etc. or 5) water leaks. This objective is intended to assist in determining the technical, financial and managerial capability of public water suppliers.

The Kansas Water Office calculated the percent and amount of unaccounted for water for Kansas public water suppliers by using the annual municipal water use report data collected from 2000-2004 by the Kansas Department of Agriculture, Division of Water Resources. Included in the assessment are 694 public water suppliers who reported water use every year and had 10 or more active residential service connections or served a population of 25 or more (the minimum size of public water suppliers permitted by the Kansas Department of Health and Environment). Twenty-six mobile home parks fit the criteria but were not included in the assessment. The data parameter used for the assessment was the number of public water suppliers with 30 percent or more unaccounted for water.

Findings

Figure 2.2 shows the number of public water suppliers by percent of unaccounted for water during 2000-2004. Of those that reported 30 percent or more unaccounted for water, roughly one-third (20 systems) do not report customer sales, which may be due to a flat rate schedule, the distribution of large amounts of unmetered free water, or other problems that result in 40 percent to 100 percent unaccounted for water annually.

Roughly one-third of the systems with 30 percent or more unaccounted for water have chronic problems. Systems designated with chronic problems are those with 30 percent or more unaccounted for water for at least three of the five years of the 2000-2004 period; they have also been identified through the on-site technical assistance program with the Kansas Rural Water Association. Problems include failing infrastructure (such as frequent breaks due to poor quality pipeline materials); large amounts of unmetered water use; a lack of funding; or a lack of desire to make needed repairs for recognized problems.

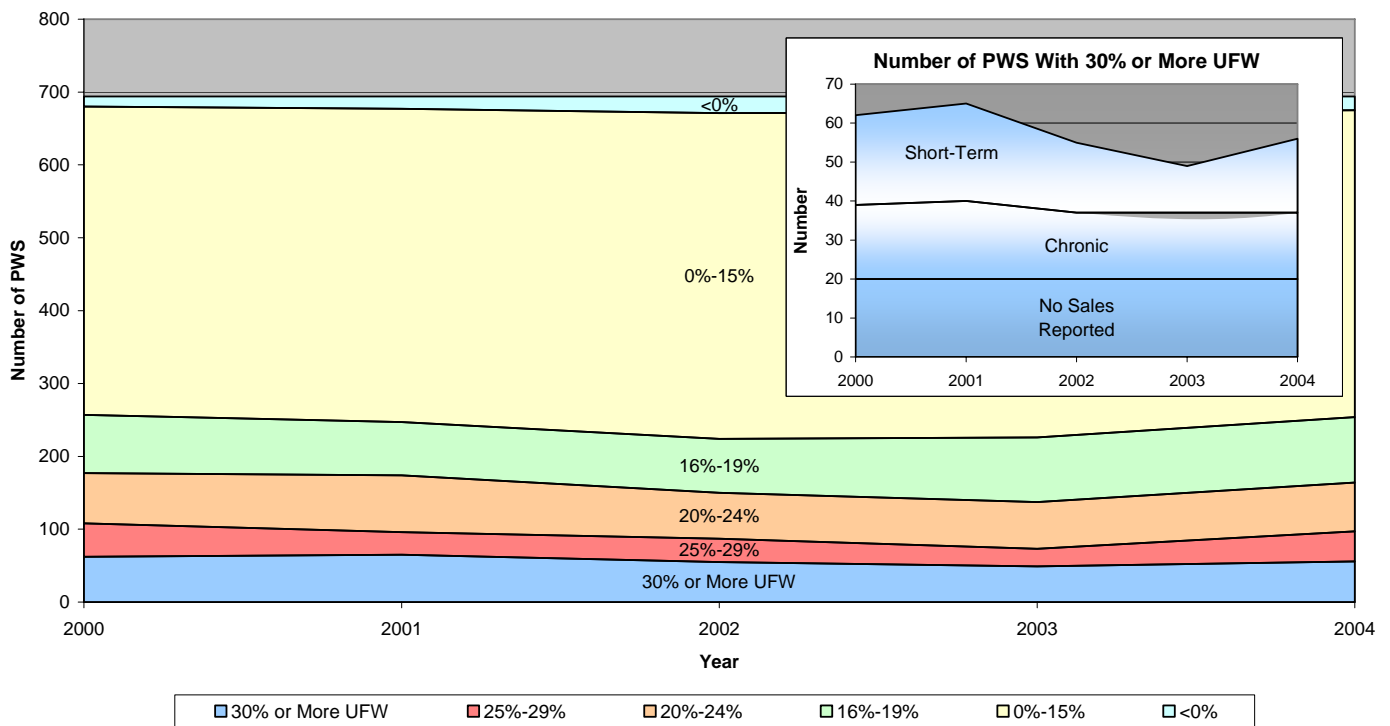
It is difficult to provide meaningful technical assistance to systems that do not meter customer sales or have chronic problems. Improvements cannot be made until the system is willing and able to make an investment in the infrastructure of both time and money.

The remaining systems with 30 percent or more unaccounted for water have short-term problems that are addressed quickly. Short-term problems include leaks, bookkeeping errors and system maintenance issues (such as tower painting). There is frequent turnover in the short-term problem systems, and while there appears to be a reduction in the number of these systems over time (from a high of 25 systems in 2001 to a low of 12 in 2003) it is difficult to

predict how many systems will have a short-term problem. For example, during periods of drought many systems experience breaks due to conditions. Technical assistance is provided to these systems until they have reduced the amount of unaccounted for water to below 20 percent for six months.

Finally, there are a number of public water suppliers who report a negative percent of unaccounted for water. In other words, they appear to distribute more water than they produce or purchase due to bookkeeping errors or meter problems. It may be beneficial to offer on-site assistance to systems with multiple years of negative unaccounted for water. The combined total of systems with 30 percent or more and those that report a negative percent unaccounted for water comprise 11 percent of all public water suppliers who report water use annually.

Figure 2.2
Number of Public Water Suppliers by Percent Unaccounted For Water
2000-2004



Conservation Plans

“By 2015, conservation plans will be required for water rights meeting the priority criteria under K.S.A. 82a-733 and it has been determined that such a plan would result in significant water management improvements.”

Methodology

This assessment report quantifies where water conservation plans are required and who made the requirement. This report will focus solely on conservation plans required under the guidelines of K.S.A. 82a-733 for water rights with authorized municipal and irrigation uses of water.

Assessment

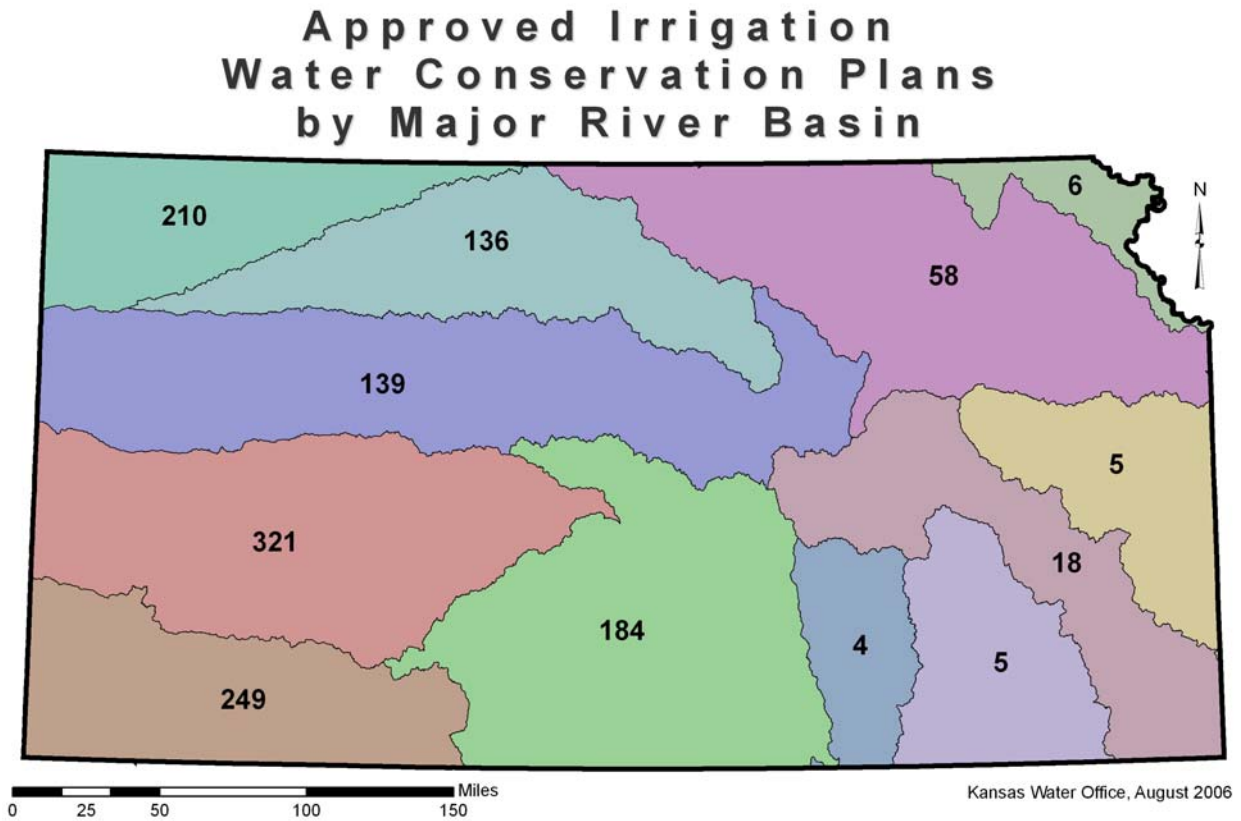
As of August 23, 2006, there are 1,430 irrigation water rights in the state with conservation plans required under K.S.A 82a-733 (Table 2.1). 1,324 of these plans, over 92 percent, were required by the KDA-DWR. 93 plans (almost 7 percent) were solely voluntarily submitted by water-right holders. Twelve plans were required by the Kansas Water Office. The requiring entity for one conservation plan could not be established from the KDA-DWR conservation database. Of the 1,430 required conservation plans, the KDA-DWR has approved 1,335 or just over 93 percent. Fifteen water rights had their conservation plan requirements waived or dismissed while 80 plans are still pending approval.

Conservation plan activity is centered in basins where irrigation development is more prevalent, specifically the western Kansas and south-central basins (Figure 2.3). The Cimarron and the Upper Arkansas basins had the greatest number of plan requirements and approvals. In eastern Kansas, where irrigation development is less, there are fewer irrigation water conservation plan activities.

Table 2.1. Irrigation Conservation Plans (as established by K.S.A 82a-733) Summary by Basin State of Kansas, 2006

KWO Basin Name	Conservation Plan Status				Conservation Plan Required by			
	Approved	Pending	Waived	Dismissed	DWR	KWO	Voluntary	Unknown
Cimarron	249	5	1	2	245	2	10	0
Kansas-Lower Republican	58	0	0	1	59	0	0	0
Lower Arkansas	184	9	0	0	184	0	9	0
Marais des Cygnes	5	0	0	0	5	0	0	0
Missouri	6	0	0	0	6	0	0	0
Neosho	18	0	0	0	11	1	5	1
Smoky-Hill Saline	139	4	2	4	147	0	2	0
Solomon	136	9	1	1	143	1	3	0
Upper Arkansas	321	44	2	0	306	3	58	0
Upper Republican	210	9	1	0	209	5	6	0
Verdigris	5	0	0	0	5	0	0	0
Walnut	4	0	0	0	4	0	0	0
Total	1335	80	7	8	1324	12	93	1

Figure 2.3. Approved Irrigation Water Conservation Plans by Major River Basin, August 2006.



Municipal Water Conservation Plans

607 public water suppliers have an approved conservation plans in place as of August 23, 2006. 543 (89 percent) were approved under 1990 guidelines. 64 were approved under the 1986 guidelines. The KWO approved 331 of the plans. 212 were approved by the KDA-DWR. As of the time of this assessment, 25 municipal conservation plans were still in development or pending final approval (Table 2.2) Kansas River basins with the higher population concentrations have a direct correlation to municipal conservation plan activity (Figure 2.3.)

Table 2.2. Approved Municipal Conservation Plans By Basin, State of Kansas, 2006

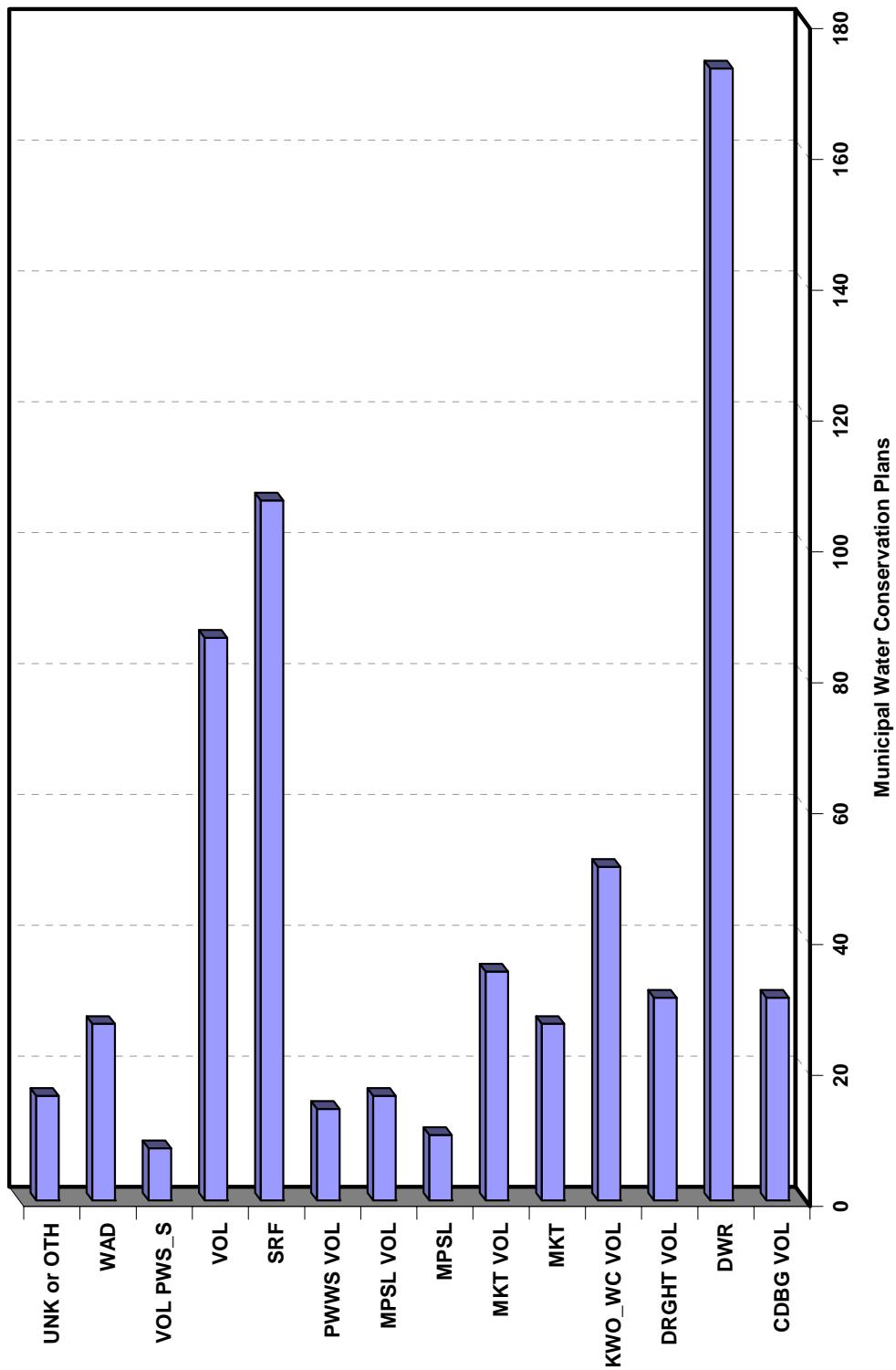
<i>Basin</i>	1986 Guidelines		1990 Guidelines		<i>Pending Approval</i>	<i>Total</i>
	Approving Agency		Approving Agency			
	<i>DWR</i>	<i>KWO</i>	<i>DWR</i>	<i>KWO</i>		
Cimarron	0	0	8	5		13
Kansas – Lower Republican	14	8	71	41	4	138
Lower Arkansas	10	0	32	36	2	80
Marais Des Cygnes	1	0	8	52	3	64
Missouri	2	0	7	8		17
Neosho	6	1	17	59	3	86
Smoky Hill – Saline	9	0	21	34	4	68
Solomon	1	0	13	20	2	36
Upper Arkansas	9	0	23	14	1	47
Upper Republican	0	0	5	6	1	12
Verdigris	2	0	6	36	4	48
Walnut	1	0	1	20	1	23
State of Kansas	55	9	212	331	25	632

Currently, approximately fifteen reasons can trigger municipal conservation plans (Table 2.3 and Figure 2.4). Most plans are directed by state statute, such as water marketing, State Revolving Loan Fund, Multipurpose Small Lake Program, or involvement with a water assurance district. In some voluntary cases, such as the water marketing voluntary and multipurpose small lake voluntary categories, the public water supplier may not be directly involved in those particular programs. However, the supplier is required to have a conservation plan because the supplier purchases water or is affiliated with another public water supplier who is directly involved in a program requiring conservation plans. There are 607 public water suppliers that have an approved conservation plan in place as of August 23, 2006. 173 of those approved plans were required by KDA-DWR as part of general water right administration. 107 were required under participation with the State Revolving Loan Fund. 86 public water suppliers submitted voluntary water conservation plans.

Table 2.3. Reasons for Developing Municipal Water Conservation Plan

<i>Code</i>	<i>Description</i>
CDBG-Vol	Community Develop Block Grant Application
Drought-Vol	Voluntary due to notice of drought or drought vulnerability
DWR	DWR Required (DWR has further sub-definitions)
KWO WC-Vol	Voluntary due to KWO Water Conservation Effort (high UFW, high volume in excess of 15% UFW)
MKT	Water Marketing Requirement
MKT-Vol	Voluntary as member of PWWS with Mkt contract
MPSL	Multipurpose Small Lake Program Requirement
MPSL-Vol	Voluntary as member of PWWS with MPSL
Vol-PWS Study	Voluntary due to PWS Study in the area
PWWS-Vol	Voluntary as a PWWS or District Member
SRF	State Revolving Loan Fund Requirement (KDHE)
Vol	Voluntary
WAD	Water Assurance District Requirement

Figure 2.4. Reasons for Requiring Municipal Water Conservation Plan Development, Statewide, August 2006.



3. WATER MANAGEMENT

Metering

“By 2015, all non-domestic points of diversion meeting predetermined criteria will be metered, gaged or otherwise measured under the authority of K.S.A. 82a-706c and K.S.A. 82a-1028(l). Criteria will include a minimal use requirement and priority area targeting.”

Methodology

This assessment report attempts to quantify where water flowmeters are required, who made the requirement, and when those requirements were enacted. In order to estimate the number of meters currently installed, KDA-DWR 2004 annual water use report data was reviewed. Water rights that reported diverting a measurable quantity of water were reviewed to see if a flowmeter was used to measure that volume at individual points of water diversion.

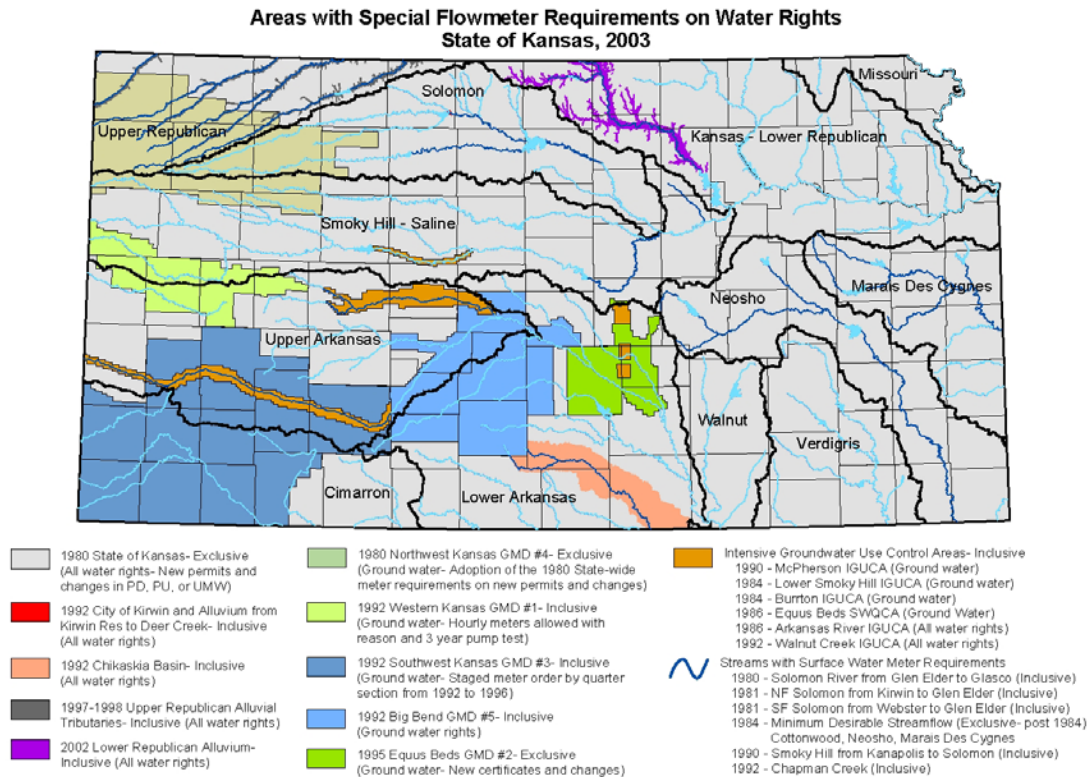
Assessment - Areas with Special Flowmeter Requirements

Several areas within the state fall under special meter orders with varying degrees of requirements (Figure 3.1). In 1992, Western Kansas Groundwater Management District (GMD) #1, Southwest GMD #3, and Big Bend GMD #5 all issued inclusive meter orders as part of their respective management plans. All water right wells were required to install flow meters before pumping would be allowed. Western Kansas GMD #1 allowed installation of hourly meters if a regular flow meter could not be retrofitted to the existing system provided that the point of diversion undergoes a flow test once every three years or if the well pumps less than 200 gallons per minute. In 1995, the Equus Beds GMD #2 required all approvals on new water right certificates and change applications (i.e. point of diversion, place of use, and/or use made of water) to have a meter installed.

The KDA has several regional areas under exclusive meter requirements. In these areas, all water rights are required to have flowmeters installed at the points of water diversions. These areas include the alluvial extent of the tributaries in the Upper Republican River Basin (1997-1998), the Chiskaskia Basin in south-central Kansas (1992), the alluvium from below Kirwin Reservoir to the confluence with Deer Creek (1992), alluvium of the Lower Republican Basin (2002), and the McPherson, Lower Smoky Hill, Burrton, Arkansas River, and Water Creek Intensive Groundwater Use Control Areas (IGUCAs).

The KDA-DWR has also issued meter orders targeted solely to surface water based points of diversion on the Solomon River from Glen Elder to roughly Glasco, Kansas (1980), the North Fork and South Fork Solomon Rivers from Kirwin and Webster, respectively, to Glen Elder (1981), Smoky Hill River from Kanopolis to Solomon (1990), and Chapman Creek (1992). Surface water meters are also required for water rights that are junior (post 1984) to and upstream from the Minimum Desirable Streamflow values on the Cottonwood, Neosho, and Marais Des Cygnes rivers.

Figure 3.1. Areas with Special Flowmeter Requirements



Metered Water Use

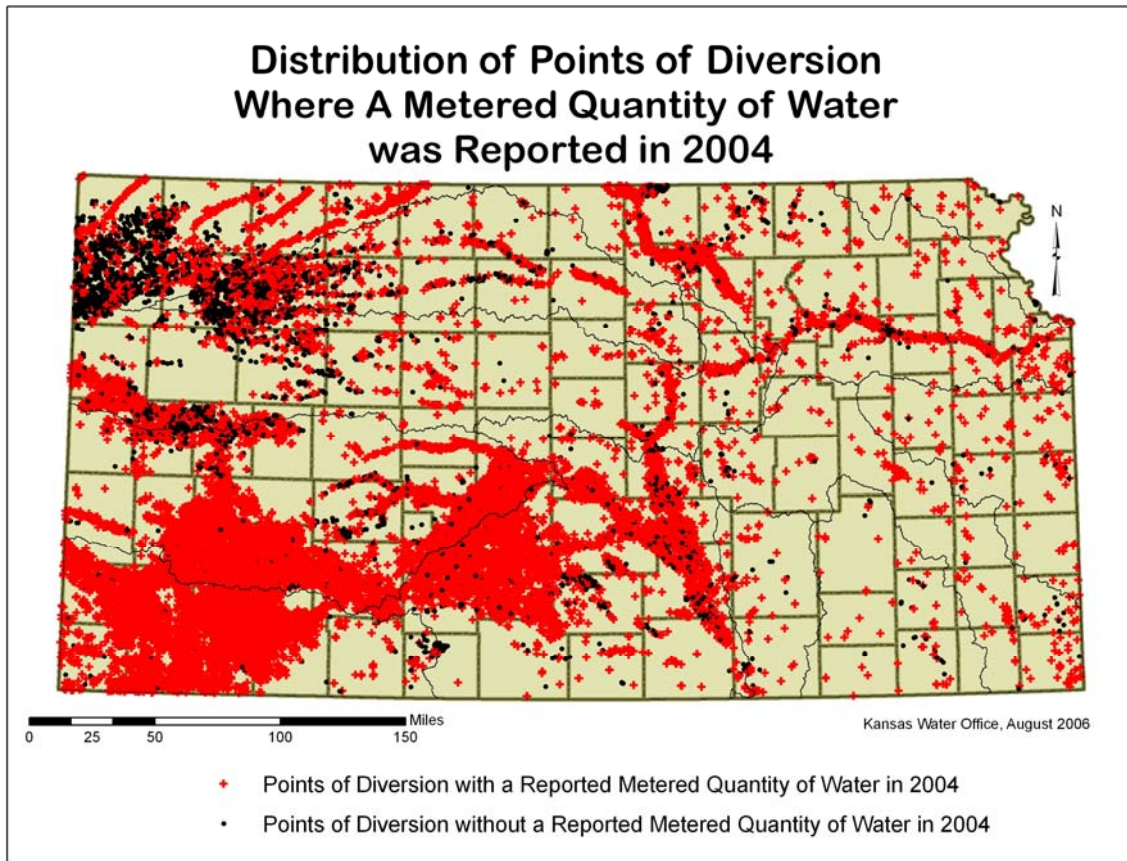
In 2004, 27,006 individual points of diversions were coded as reporting to divert a measurable quantity of water in Kansas. Of those, 21,489 individual points of diversions (79.57%) were coded in the Water Right Information System (WRIS) database as reporting a metered quantity at least once during that year (Table 3.1 and Figure 3.2).

Table 3.1. Points of Diversion Where a Water Right Reported a Metered Quantity, 2004.

KWO Basin Name	Total Number of Points of Diversion Reporting Water Diverted	Number of Points of Diversion Coded as Reported a Metered Quantity	Percentage of Points of Diversion Recorded in WRIS as having a Meter
Cimarron	4,353	4,248	97.59%
Kansas-Lower Republican	2,064	1,632	79.07%
Lower Arkansas	5,044	4,258	84.42%
Marais des Cygnes	164	138	84.15%
Missouri	74	47	63.51%
Neosho	258	213	82.56%
Smoky Hill-Saline	2,823	1,675	59.33%
Solomon	1,550	701	45.23%
Upper Arkansas	8,257	7,451	90.24%
Upper Republican	2,244	995	44.34%
Verdigris	96	79	82.29%
Walnut	79	52	65.82%
Total	27,006	21,489	79.57%

Basins in the southwest areas of Kansas, which have mandatory meter requirements, also have the highest recorded meter percentages in the state. The Cimarron Basin ranks highest with over 97 percent of the points of diversion recorded in WRIS as reporting a metered quantity of water followed by the Upper Arkansas Basin, with over 90 percent.

Figure 3.2. Distribution of Points of Diversion Where a Metered Quantity of Water was Reported in 2004



Ogallala Ground Water Declines

“By 2010, reduce water level decline rates within the Ogallala Aquifer and implement enhanced water management in targeted areas.”

Condition Assessment Methodology

Wizard water level and site data was obtained from the KGS for the High Plains aquifer consisting of 336,749 water level measurements from 4,707 sites. The High Plains aquifer was then divided into three areas due to the varying nature of the resources in northwest, west central and southwest Kansas. The regional areas, northwest, west central and southwest areas of the Ogallala are roughly equivalent to the Kansas GMD #4, Kansas GMD #1, and Southwest Kansas GMD #3, respectively.

To evaluate the rate of water level (w.l.) change in the Ogallala Aquifer, monitoring wells measurements during the winter months (Dec, Jan, or Feb) were used for assessment. Wells were selected that were Ogallala aquifer wells, removing wells that could be identified as alluvial sourced from the assessment. Wells whose measured depth to water was less than 50 feet were considered alluvial and not included in subsequent calculations. Where multiple measurements existed for a single well in a winter year the highest elevation observed was chosen to represent the water table for that well.

The median annual water level changes were calculated for each region from 1981 to 2005. These median annual changes were standardized or indexed to antecedent moisture conditions using the Palmer Drought Severity Index (PDSI) for the appropriate region.

The relationship between the annual change (from one year to the next) in median w.l. (by region) and seasonal average PDSI were used to assess the stated objective. The data were broken in two periods of similar size, pre-1993, and 1993-2005. A bivariate fit of the median annual change in w.l. by average seasonal PDSI was performed. Conceptually, the hypothesis for this comparison was to determine whether the two regression lines, one for the pre-1993 period and the other for 1993-2005 period, (see Figure 3.3) explain significantly more of the variability in the data than a single regression line for the entire period (see Figure 3.4). If the separate two regression lines in Figure 3.3 do not explain significantly more variation in the regional data than does the single regression line fitted to the entire period (Figure 3.4), then we conclude that there is no discernable change in the rate of water level declines in the region.

Figure 3.3

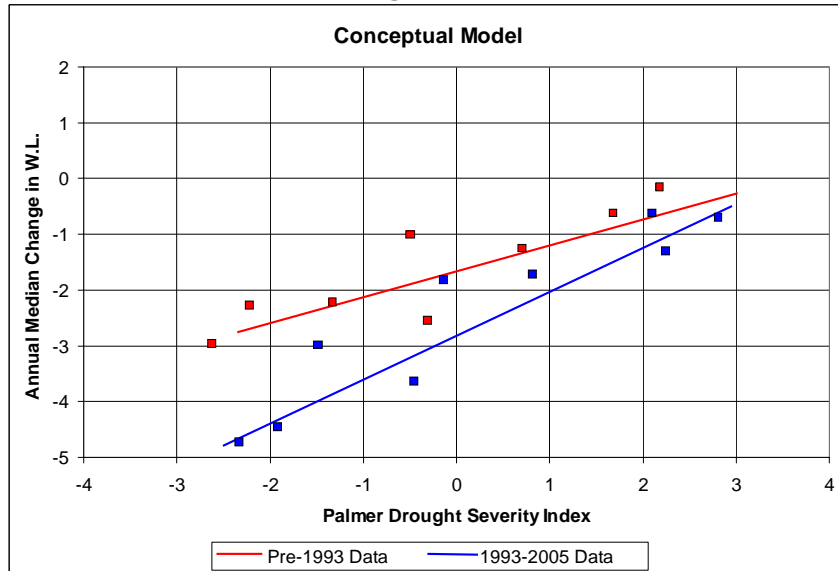
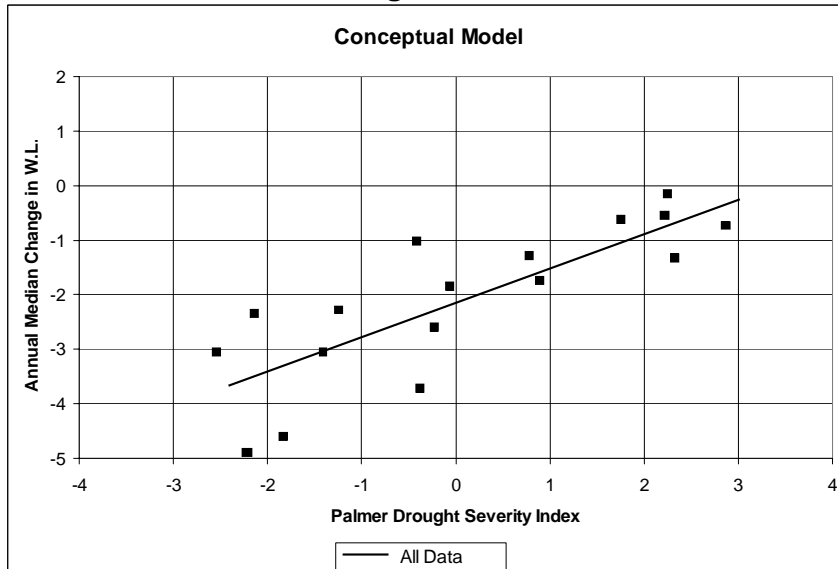


Figure 3.4



Assessment Findings

Northwest Kansas: In the northwest Ogallala aquifer area, as of 2005, there has been no statistically significant change (at a 5% error level) in the rate of decline. The least restrictive model (as in Table 3.3) was not significantly better than the most restrictive model (as in Table 3.4).

West Central Kansas: There was also no significant change (error level = 0.05) in the water level decline rate for the west central Ogallala aquifer area.

Southwest Kansas: As with the previous two area assessments, there was no statistically discernable change in the rate of groundwater declines for southwest Kansas Ogallala aquifer area (error level = 0.05).

Sustainable Yield Management

By 2015, achieve sustainable yield management of Kansas surface and ground water sources, outside of the Ogallala aquifer and areas specifically exempt by regulation. Sustainable yield management would be a goal that sets water management criteria to ensure long term trends in water use will move as close as possible to stable ground water levels and maintenance of sufficient stream flows.

Methodology

Wizard water level and site data was obtained from the Kansas Geological Survey for the areas outside the Ogallala consisting of 70,154 water level measurements from 1,997 sites. The measurement sites were then divided into areas due to the varying nature of the resource, representing the two Groundwater Management Districts (GMD#2, GMD#5).

To evaluate the rate of water level (w.l.) change outside the Ogallala Aquifer, monitoring wells measurements during the winter months (Dec, Jan, or Feb) were used for assessment. Wells were selected that were Ogallala aquifer wells, removing wells that could be identified as alluvial sourced from the assessment. Where multiple measurements existed for a single well in a winter year the highest elevation observed was chosen to represent the water table for that well.

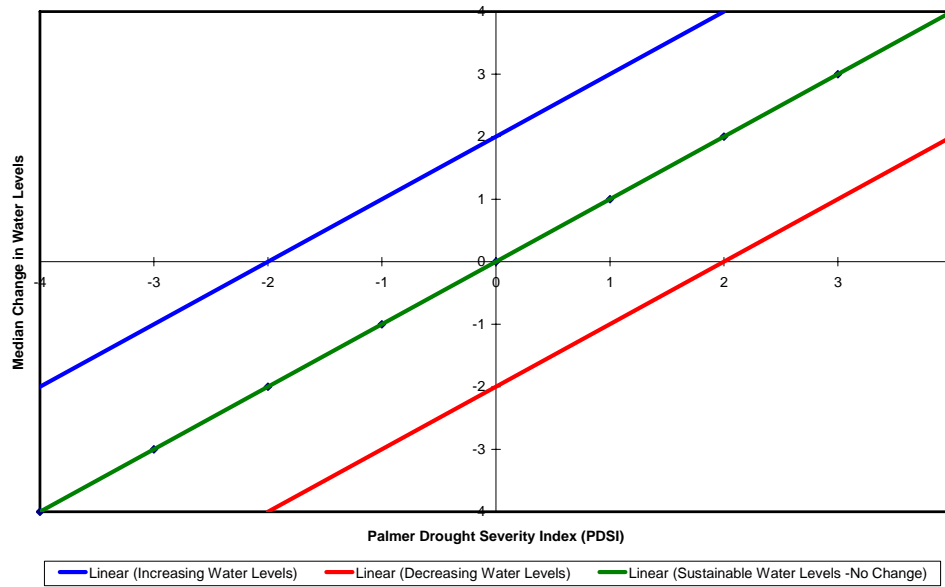
The median annual water level changes from one year to the next were calculated for each region from 1981 to 2005. These median annual changes were standardized or indexed to antecedent moisture conditions using the Palmer Drought Severity Index (PDSI) for the appropriate region. The PDSI uses temperature and rainfall information in a formula to determine dryness. It is the most effective in determining long-term drought, a factor tied to the amount of water an irrigator may pump. The advantage of the Palmer Index is that it is standardized to local climate, so it can be applied to any part of the state to demonstrate relative drought or rainfall conditions.

The relationship between the annual change in median w.l. (by region) and seasonal average PDSI were used to assess the stated objective.

Assessment

If sustainable yield has been achieved as we survey each water level measurement area, the relationship between the average PDSI and the median change in water levels would approach zero. A PDSI of zero (normal moisture conditions) would result in no change in median change in water levels across a region if the system has achieved sustainable yield. If the PDSI were lower than zero (drier than normal moisture conditions), the median change in water levels should decrease. Similarly, if the PDSI were greater than zero (wetter than normal moisture conditions), the median change in water levels should increase. The chart below (figure 3.5) is an example of the potential outcomes of the described methodology for increasing, decreasing, and sustainable water levels.

Figure 3.5 Example of Bivariate Fit of Median Change in Water Level by PDSI



Based upon the above methodology, the data assembled for the 1981 through 2005 period indicates that sustainable yield has not yet been attained in GMD#5 (Figure 3.6) and GMD#2 (Figure 3.7).

Figure 3.6 Bivariate Fit of Median Change in Water Level in PDSI (GMD#5)

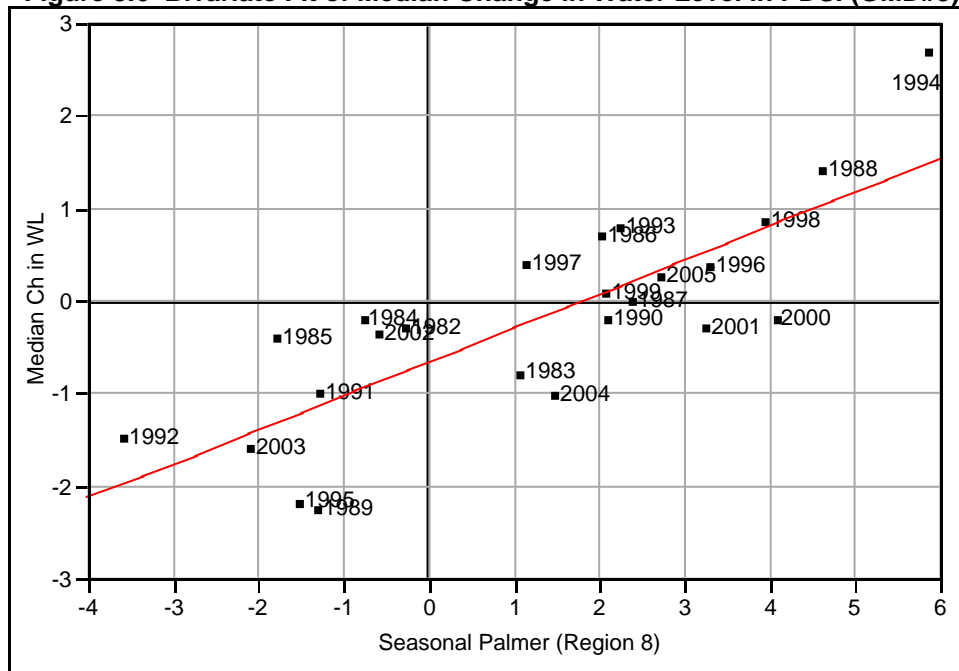
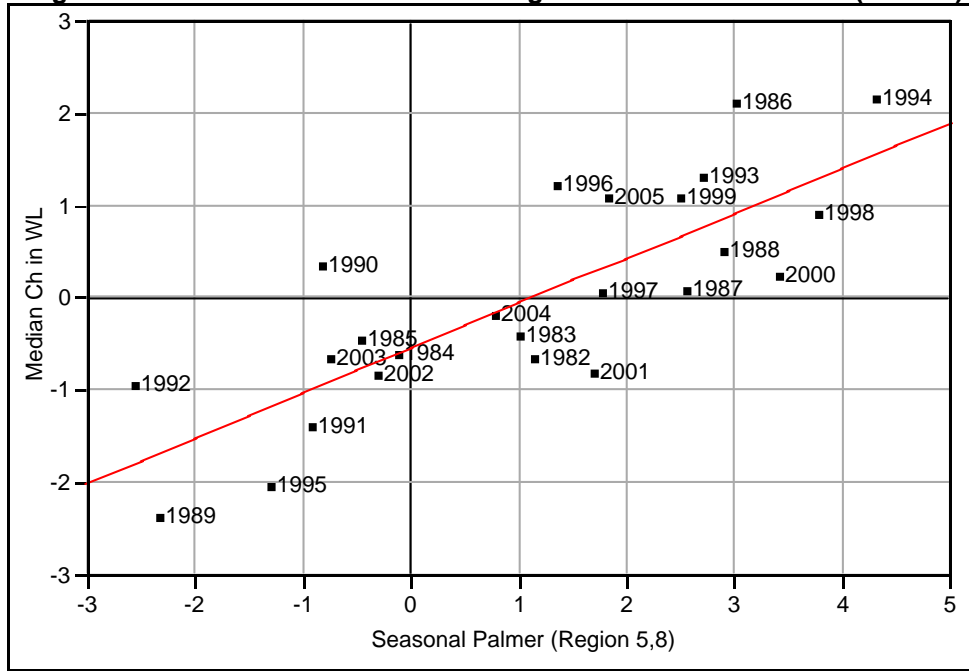
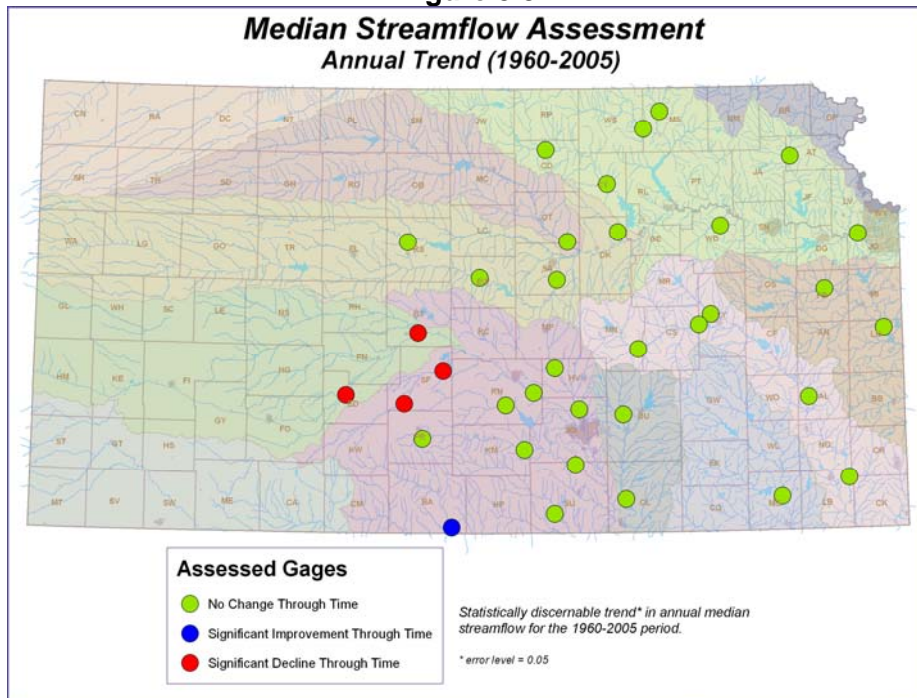


Figure 1.7 Bivariate Fit of Median Change in Water Level in PDSI (GMD#2)



The following map (Figure 3.8) identifies stream gages for which there is a statistically discernable trend (error level = 5%) in annual median streamflow for 1960-2005. In GMD#5, four of the gages assessed showed a significant decrease in median flow through time. One gage in GMD#5 demonstrated no change. All the gages assessed in GMD#2 demonstrated no change in median flow through time. There was also no statistically discernable trend in annual median streamflow for any of the gages selected in the eastern half of Kansas.

Figure 3.8



Minimum Desirable Streamflows (MDS)

“By 2015, meet MDS at a frequency no less than the historical achievement for the individual sites at the time of enactment.”

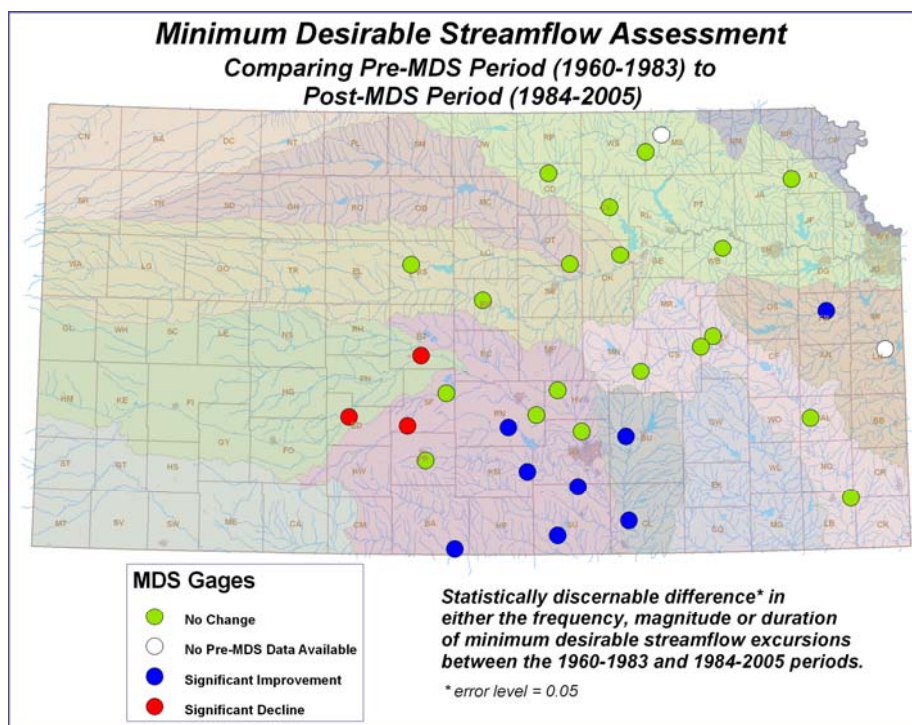
Condition Assessment Method

There are three components to streamflow: frequency, magnitude and duration. Each of these components has been reviewed at each MDS gage. The daily flow from 1960 to 2004 was summarized into annual data. The summarization parameters include:

1. The percent of time the MDS was not met (frequency of excursion).
2. The volume of flow less than MDS as calculated by the difference between MDS and reported flow (magnitude of excursion).
3. The maximum length in consecutive days that MDS was not met (duration of excursion).

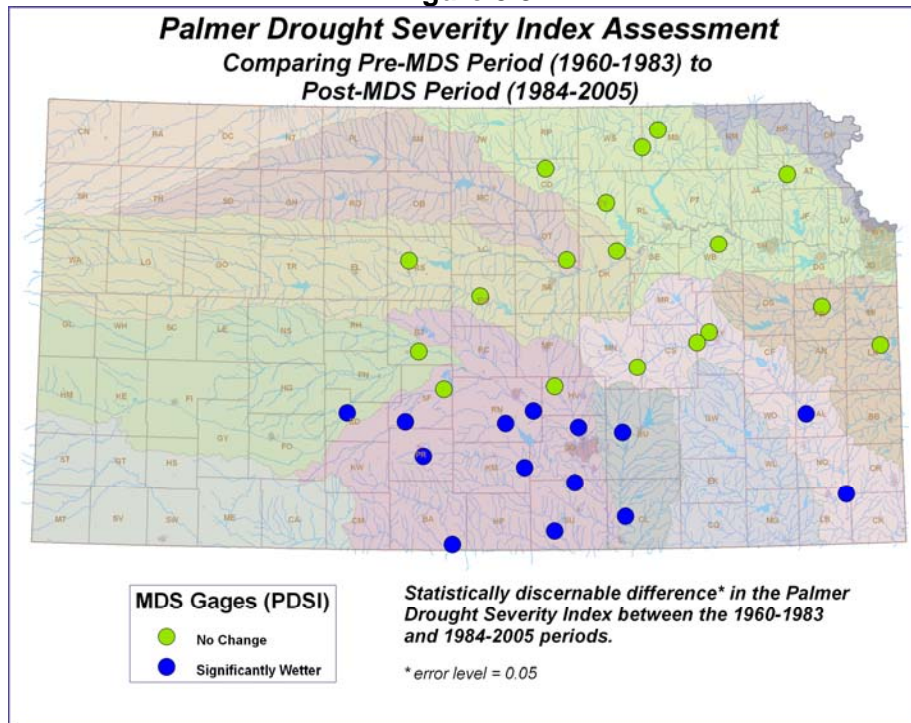
The frequency, magnitude and duration for which MDS was not met were compared for the pre-MDS years (1960 – 1983) to the post-MDS years (1984 – 2004). A nonparametric test, the Wilcoxon rank-sum, was used to determine if a statistically discernible difference existed between the pre and post-MDS period. The results of this comparison are provided in Figure 3.7, below.

Figure 3.7



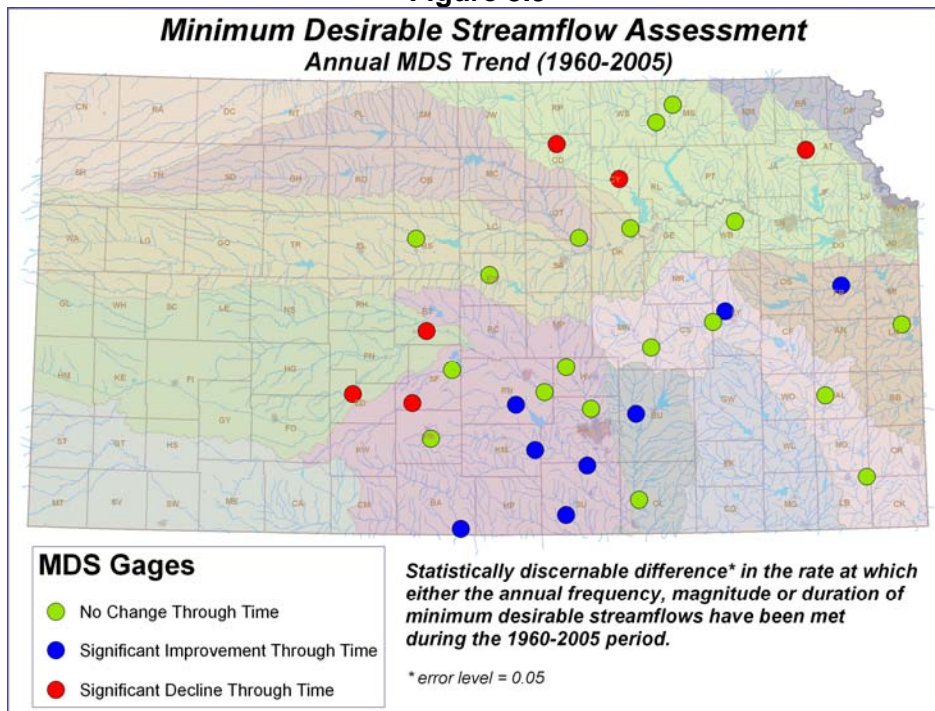
The same comparison was made using the pre and post-MDS period and the average annual Palmer Drought Severity Index (PDSI) for the region in which the MDS gage was located. This created an index for the antecedent moisture conditions (Figure 3.8) that would be a primary factor in determining each period's flow condition. One would expect that in those regions where the PDSI had become significantly greater (wetter), one should see a concomitant improvement in the magnitude, frequency or duration of the MDS condition.

Figure 3.8



Finally, the trend for the annual summarizations of the three components of flow was assessed. This assessment was used to determine whether there is a discernable trend in the annual frequency, magnitude or duration of minimum desirable stream flows through time (1960-2005). These results are shown in Figure 3.9.

Figure 3.9



4. WATER QUALITY

Surface Water Quality

“By 2010, reduce the average concentration of bacteria, biochemical oxygen demand, dissolved solids, metals, nutrients, pesticides and sediment that adversely affect the water quality of Kansas lakes and streams.”

“By 2010, ensure that water quality conditions are maintained at a level equal to or better than year 2000 conditions.”

Assessment

A five-year (2006-2010) monitoring strategy was submitted by KDHE to EPA. This strategy was subsequently approved by EPA in September 2005 and implementation began in 2006. A new component of the monitoring strategy is the Probabilistic Stream Monitoring Program (PSMP). The PSMP's goal is to provide statistically sound, unbiased information on the overall condition of streams and rivers in Kansas. The condition is measured using biological, chemical and physical parameter data collected at randomly selected monitoring sites. The PSMP intends to monitor 50 randomly selected sites each year for at least the next four years. The results of each year's sampling effort will provide a 'snapshot' of the condition of streams and rivers in Kansas. The data collected by the PSMP will help determine the stream health at the time of the sampling. With time these 'snapshots' will be used to find changes and trends in the stream water quality conditions.

The KWO finds that, by 2010, the KDHE PSMP will provide the necessary information, in the form of a consistent, unbiased sampling program, to more properly assess the intent of the Surface Water Quality Water Resource Condition. A separate assessment by KWO of the objective is not necessary at this time.

Ground Water Quality

“By 2010, reduce the average concentration of dissolved solids, metals, nitrates, pesticides and volatile organic chemicals that adversely affect the water quality of Kansas ground water.”

Reborn

Methodology

The Kansas Water Office (KWO) prepared an assessment of the year 2000 conditions present in Kansas ground water using the Kansas Department of Health and Environment (KDHE) Kansas Groundwater Quality Monitoring Network data through spring 2002. The Kansas Groundwater Quality Monitoring Network was referenced in the adopted and updates of the State Water Plan, since fiscal year 2002, as the primary source of data for the assessment of groundwater quality. This network provided ambient groundwater quality data over the entire state.

Programs and Activities Status

Ground water quality is monitored through programmatic or contamination evaluation activities. These are generally site specific in nature and center on potential or existing pollution sources. There is no statewide monitoring network or program to test ambient ground water quality routinely.

State Ground Water Monitoring Network

Kansas no longer maintains a statewide groundwater quality monitoring program, and funding for the renewal of such an enterprise appears unlikely in the near future. The earlier monitoring program (suspended in 2002 owing to budgetary constraints) evaluated groundwater quality at more than 200 sites in Kansas.

Some groundwater quality data continues to be gathered by the Kansas Department of Health and Environment (KDHE) through the efforts of its major regulatory bureaus. Many of these are primarily from the vicinity of some source of known or potential pollutant. There are nearly 200 abandoned landfills and groundwater remedial sites, 1,500 storage tank cleanup sites, a few active surface mining operations and a number of major NPDES permit holders that obtain groundwater quality data.

Public water supply systems are monitored for a wide range of parameters pursuant to the federal Safe Drinking Water Act, but most samples are collected after treatment and do not reliably reflect the condition of the groundwater source.

Other Ground Water Monitoring

Additional data is available from other sources for specific areas or aquifers. Sources include Kansas Geological Survey (KGS), Kansas Department of Agriculture (KDA), Groundwater Management Districts (GMD), and the United States Geological Survey (USGS). These efforts are generally short term, and not usable to compare trends in ground water quality statewide.

Southwest Kansas Groundwater Management District No. 3 (GMD3) has analyzed a comprehensive network of ground water monitoring within its 13 county area since 1988, but there is no comparable continuing monitoring network in other portions of the state.

Assessment

Water quality analysis of untreated water for public water supplies using ground water is the only source of statewide ground water data. For the period of 1990-2000 the state public water supply systems network analyses indicated that the MCLs were met in 90 percent of the samples from the monitoring network, and 89.5 percent of the wells. The secondary maximum

contaminant level standards (SMCL), which are recommendations only, are based on taste odor and other factors. SMCLs were met in 44.4 percent of the samples, and 42 percent of the wells. Water quality parameters exceeded an MCL or SMCL in 40 percent of the wells. A relevant standard (including action level or suggested standard as given below was exceeded in 64.6 percent of the wells at least once during the 10 year period. Figure 4.1 summarizes the 1990-2000 analyses. Table 4.1 summarizes the much smaller data set presented in the 2006 KDHE 305 (b) report for the US Environmental Protection Agency.

Previous reports by KDHE cannot be used to identify trends since the data collected differed through time; a varying number of samples, parameters and analysis quantification were used. In some cases, multiple samples from the same well were included in the analysis.

Figure 4.1. Ground Water Monitoring Data Summary from Kansas Groundwater Monitoring Network 1990-2000.

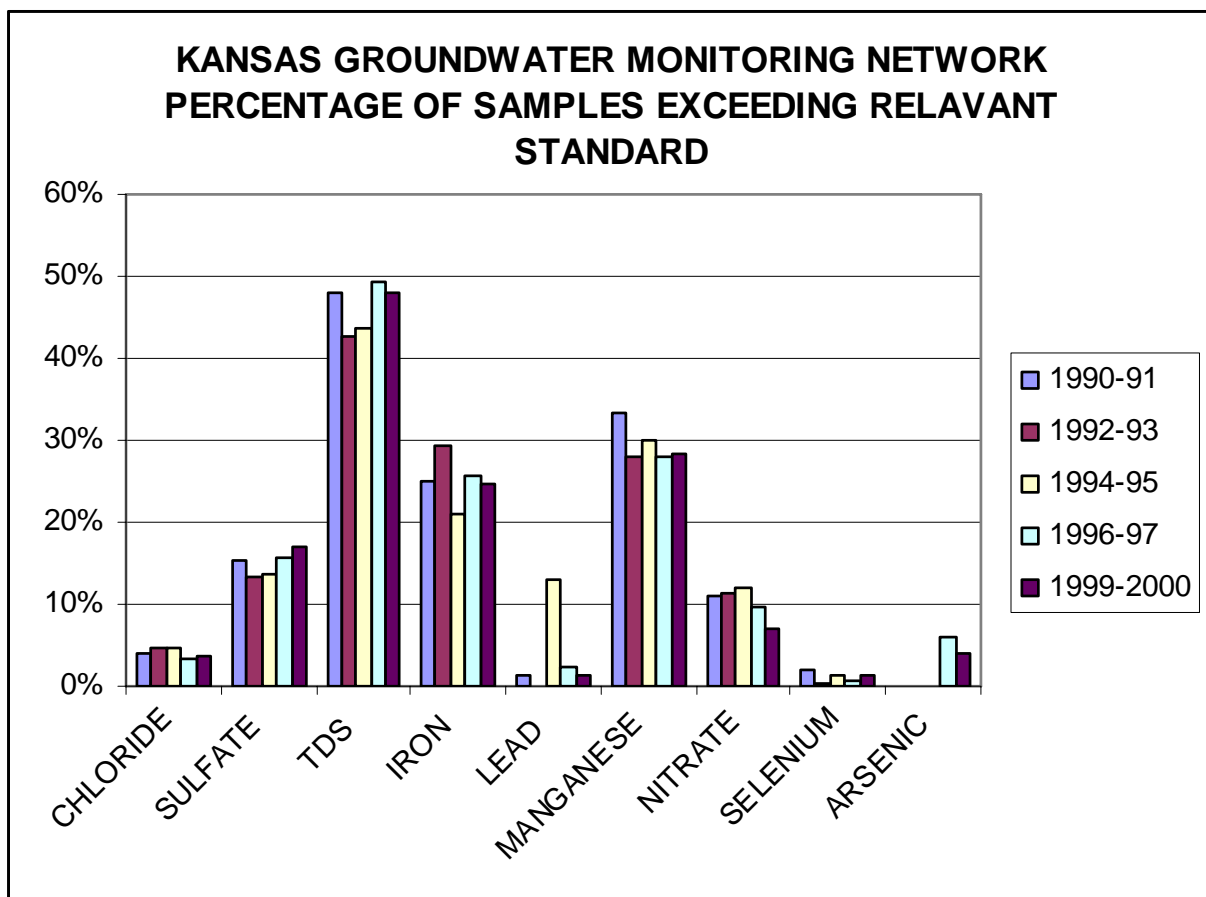


Table 4.1. Ground Water Monitoring Data Summary, 2002-2005 (305(b) report)

Sources	Total Samples	Parameter Group	No Detects	Detects	Nitrate 5mg/L or less	Nitrate greater than 5 and less than 10 mg/L	Parameters Exceeding MCL	Sources Removed from Service
26	216	VOC	109	107			6	4
23	208	SOC	123	85				2
29	220	EDB	127	3				4
60	91	ARSENIC	18	73				15
60	89	FLUORIDE	6	83				16
58	85	MERCURY	85	0				15
91	200	NITRATE	18	182	56	61	65	27
62	89	SELENIUM	17	72				15

- NOTES: (1) All data obtained from the Kansas Public Water Supply Monitoring Network
(2) Some wells and treatment plants may have been sampled more than once during the reporting period (2002-2005)
(3) Some samples may have occasional surface water under influence
(4) Some treatment plants may include a single or multiple sources
(5) Only parameters with federal drinking water MCLs were included in this summary
(6) Samples may have more than one organic parameter detected
(7) VOC = Volatile Organic Compound; SOC = Synthetic Organic Compound; EDB = Ethylene Dibromide

5. FLOOD MANAGEMENT

“By 2010, reduce the vulnerability to damage from floods within identified priority communities and areas.”

Methodology

Priority watersheds (HUC-11) for rural flood damage reduction were identified by the USDA Natural Resources Conservation Service (formerly Soil Conservation Service) in 1986. These priority areas were incorporated into basin sections of the *Kansas Water Plan* and used to target assistance for flood control measures such as watershed dam construction. Data from as far back as the 1960's was used in identifying these priority areas, which have not been revised.

In 2003, the Kansas Department of Agriculture, Division of Water Resources (DWR) identified priority communities for floodplain mapping which were incorporated into the basin sections. This mapping is conducted in conjunction with the National Flood Insurance Program (NFIP), which is administered in Kansas by the DWR. Communities (municipalities or counties) with flood hazard areas have been identified by the Response and Recovery Division (FEMA) of the Department of Homeland Security.

Kansas Water Plan flood management guidance has emphasized targeting watershed dam construction assistance to priority watersheds; encouraging participation in the National Flood Insurance Program; and preparing updated floodplain maps for priority communities.

Following two Presidential Disaster Declarations for flooding in 1998, FEMA Hazard Mitigation Grant Program priorities in Kansas were identified by the Kansas Hazard Mitigation Team as 1.) acquisition of residential properties within identified flood zones; 2.) protection of critical public facilities; and 3.) minor structural projects to improve local drainage.

This Kansas Water Plan 2010 Objective has not been previously assessed.

Assessment

This 2010 Objective cannot be assessed meaningfully as presently written. While the objective refers to reducing the vulnerability to damages from flooding, the desired level of reduction or protection is not stated. Such specificity is important and will vary according to the impact that flood damages in any given area would impose. An example is the levee failures in New Orleans caused by Hurricane Katrina. The levees were designed to provide protection from a Category 3 storm, yet failed with catastrophic consequences during the more intense Katrina.

Priority areas and communities have not been adequately identified such that they could be used to target this assessment. As indicated, priority watersheds (areas) for rural flood damage reduction were identified in 1986 using data dating back to the 1960's. These priority watersheds are no longer considered valid. Comprehensive identification of priority communities has not been done.

This objective needs to be reconsidered such that a meaningful, measurable parameter for judging progress in reducing vulnerability to flooding can be identified.

6. WETLAND AND RIPARIAN MANAGEMENT

“By 2010, maintain, enhance or restore priority wetlands and riparian areas.”

Introduction

Concerns for the protection, restoration or enhancement of wetland and riparian areas have increased in response to greater public understanding of their ecological and economic value. Wetland and riparian areas are transitional lands between aquatic and upland locations. Wetlands include areas with hydric soils where standing water or wet soil conditions predominate. Riparian areas include streamside and floodplain areas where the vegetation, soils, or topography are distinguishable from that on adjoining uplands. Benefits derived from riparian areas include erosion and sediment control, timber production, wildlife habitat, water quality protection, recreation, and aesthetic values. Wetlands in Kansas provide unique wildlife habitat, floodwater detention, ground water recharge, and water quality benefits.

Status - Programs and Activities Status

Several state, local and federal programs are available to carry out the public education, planning, technical assistance and regulatory compliance of implementation of a wetland and riparian management effort. They include:

Kansas Forest Service Forest Stewardship and Conservation Tree Planting Programs work cooperatively with the Kansas Department of Wildlife and Parks and State Conservation Commission to implement riparian forestry programs in priority areas.

State Conservation Commission Riparian and Wetland Protection Program offers cost share money via the county conservation districts to implement best management practices to better conserve and manage riparian and wetland areas. Recognition of riparian areas, tree plantings, wetland enhancement, streambank stabilization and soil bioengineering practices are utilized and encouraged where appropriate.

Kansas Water Office State Water Planning Program pursues funding, both state federal to develop and implement wetland and riparian protection and restoration plans. The Kansas Water Office Planning Unit coordinates the efforts of the various state water related agencies' riparian and wetland programs. Efforts are focused on rivers, streams, lakes and wetlands targeted in the *Kansas Water Plan* for protection, maintenance and re-establishment.

Kansas Department of Wildlife and Parks Wildlife Habitat Improvement Program provides technical advice and planning assistance to develop and improve habitat on private land.

Kansas Department of Wildlife and Parks, State Parks and Wildlife Planning and Development Program includes planning and development of state parks, wildlife areas, and state fishing lake facilities on lands under control of the Kansas Department of Wildlife and Parks. The objective of the program is to develop Kansas Department of Wildlife and Parks lands in a coordinated manner for day use, camping, boating, fishing, hunting, and a broad spectrum of recreational pursuits in a manner compatible with natural resource management.

Kansas Alliance for Wetlands and Streams provides cost share funds to landowners to develop, enhance and restore wetland and riparian areas and streambanks. Local KAWS chapters recommend projects that are evaluated by a Project Management Team and prioritized for funding if approved.

The Natural Resources Conservation Program provides cost share funds to landowners through the Environmental Quality Incentives Program and other programs to restore streambanks and riparian areas and to develop, enhance or restore wetlands.

Assessment Status

In November 2003, the Kansas Geological Survey submitted the report "Assessment of Riparian Areas Inventory, State of Kansas, November 26, 2003." The report summarizes streambank miles for assorted land-use classifications from the Riparian Area Inventory GIS dataset. The USDA Natural Resources Conservation Service developed the Riparian Areas Inventory Database in August 2001. Land use classifications represent 1991 ground conditions and are based on interpretations from 1:12,000 scale Digital Orthophotograph Quarter Quadrangles.

Results of the statewide summary indicate Pasture/Grass Land is the dominant riparian land use type in Kansas, accounting for over 142,000 bank miles or roughly 38.2 percent of all land use types. Crop land is the second leading category with over 83,000 bank miles (22.3 percent) followed by Forest land at over 67,000 bank miles (18 percent). These three land use types account for 78.5 percent of all the riparian land use bank miles in Kansas. If Pasture/Tree Mix and Crop/Tree Mix are included, these land use classifications account for over 97 percent of the state riparian land use total. Shrub/Scrub, Urban, Urban/Tree Mix, Barren Land, and Animal Production Areas account for only 2.12 % of the state total.

The spatial distribution and proportion of riparian land-use types by KWO planning basin is a reflection of the basin's drainage areas, physiographic characteristics, and regional land-use practices. In general, the western basins have greater proportions of pasture/grass and crop land while the eastern basins have greater forest and mixed tree land uses.

This assessment provides a baseline of data to assess riparian conditions in the state and by basin. It must be noted that the assessment is based on 1991 data, making it 15 years old. Since the above listed programs have been actively addressing riparian and wetland conservation issues during the past 15 years, an updated assessment is needed based on more recent orthophotography. Further, a comprehensive GIS database needs to be established to consolidate and track all program information so that wetland and riparian projects in the state can be consistently added to the database to provide a current picture of the status of these efforts on improving riparian and wetland resources.

Until this updated and consolidated information is available, this 2010 objective cannot be further assessed.

7. WATER BASED RECREATION

“By 2010, increase public recreational opportunities at Kansas lakes and streams.”

Background

The state’s rivers, streams, small lakes and reservoirs represent valuable recreational resources. The public’s access to, and enjoyment of, these resources provides quality of life benefits and is also an important part of the Kansas economy.

Fishing is a popular pastime at federal reservoirs, state fishing lakes, lakes owned by municipalities and streams. Canoeing, kayaking and other float-type activities on Kansas streams have become increasingly popular along the state’s three navigable rivers, the Kansas, Missouri and Arkansas, which are open to the public. The Kansas Department of Wildlife and Parks often works with communities and stakeholder groups to establish river access points.

Boating, water skiing and sailing are important uses of the 24 federal reservoirs in Kansas. Many of these reservoirs have private marinas, but state parks at many of these reservoirs offer boat ramps, swimming beaches and camping facilities.

Assessment Methodology

The recreation objective was assessed by identifying three measurable recreational uses of Kansas water resources which could be quantified and comparing those uses in 2001 through 2005.

Measured recreational uses:

- 1) Private ponds or streams that KDWP has leased for public fishing. (Table 7.1)
- 2) Public access points (boat ramps) on navigable streams. (Table 7.2)
- 3) State park visitation. (Table 7.3)

Resource Conditions

The Kansas Department of Wildlife and Parks maintains park facilities at 19 federal reservoirs and 48 state fishing lakes to meet recreational demands such as fishing, boating and camping. In addition to these state facilities, there are approximately 200 community lakes and wetlands which provide local recreational opportunities.

Future

In November 2006, the Kansas Water Authority adopted a policy regarding economic development at federal reservoirs, including guidance of maintaining the environmental integrity of the natural resources.

Additional river access points are being developed on the Kansas and Arkansas rivers to provide easier recreational use of these rivers. Many communities on these rivers have recognized the value of the river for recreation and economic development.

Facility and Use Tables

Table 7.1 - Fish Impoundment and Fish Habitat Summary (2001-2005)

Year	Sites	# Acres	# Stream Miles	Stream Access Sites	Counties
2001	158	1,293	88	2	48
2002	158	1,086	63	2	44
2003	188	1,245	95	3	42
2004	171	1,242	85	2	39
2005	179	1,215	83	2	41

(KDWP, 2006)

Table 7.2 - River Access on Navigable Streams (2001 and 2005)

River	2001	2005
Kansas	7	12
Missouri	3	6
Arkansas	8	10
Total	18	28

(KDWP, 2006)

Table 7.3 - Kansas State Parks, 2001 – 2005 Visitation Summaries

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(KDWP, 2006)