Ogallala-High Plains Fringe Area

2008 Field Analysis Summary

Subbasin Water Resource Management Program

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I. Introduction

The High Plains aquifer underlies about 174,000 square miles of the central United States in the Great Plains east of the Rocky Mountains. The aquifer underlies portions of eight states including South Dakota, Wyoming, Nebraska, Colorado, Kansas, Oklahoma, New Mexico and Texas (Figure 2). The High Plains aquifer is the most abundant source of water in the region, which leads the economy of the area to depend upon it for irrigated agriculture. The volume of water in the High Plains aquifer in 2000 was about 2,980 million acre-feet, which ranged from 40 million acre-feet in New Mexico to about 2,000 million acre-feet in Nebraska (McGuire et al., 2003; Figure 1).

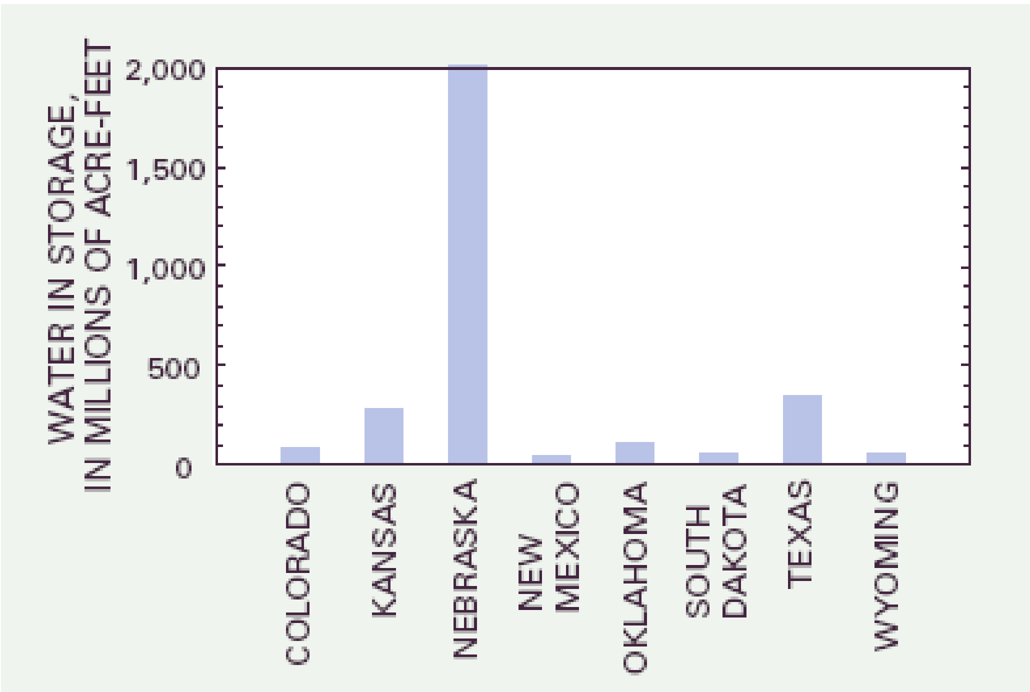

Figure 1: Water in storage in the Ogallala-High Plains aquifer, 2000, by state

The Ogallala Formation is the principal geologic unit in the High Plains aquifer, and it accounts for approximately 134,000 square miles of the High Plains aquifer. Groundwater flow is generally from west to east, at an average rate of approximately 1 foot per day, and discharges naturally to streams and springs and through atmospheric evapotranspiration. Estimated recharge rates vary from 0.024 inches per year in part of Texas to 6 inches per year in south-central Kansas.

The area is characterized as "between a semiarid to arid environment and a moist sub humid environment" (Lohman, 1953). Mean annual precipitation increases eastward across the area, from 14 inches in the west to about 30 inches in eastern Nebraska. Seventy-five percent of precipitation falls as rain during the growing season (April – September) as localized thunderstorms. Persistent winds and high summer temperatures cause high evaporation rates. The mean annual pan evaporation ranges from approximately 60 inches in northern Nebraska and southern South Dakota to about 105 inches in western Texas and southeastern New Mexico.

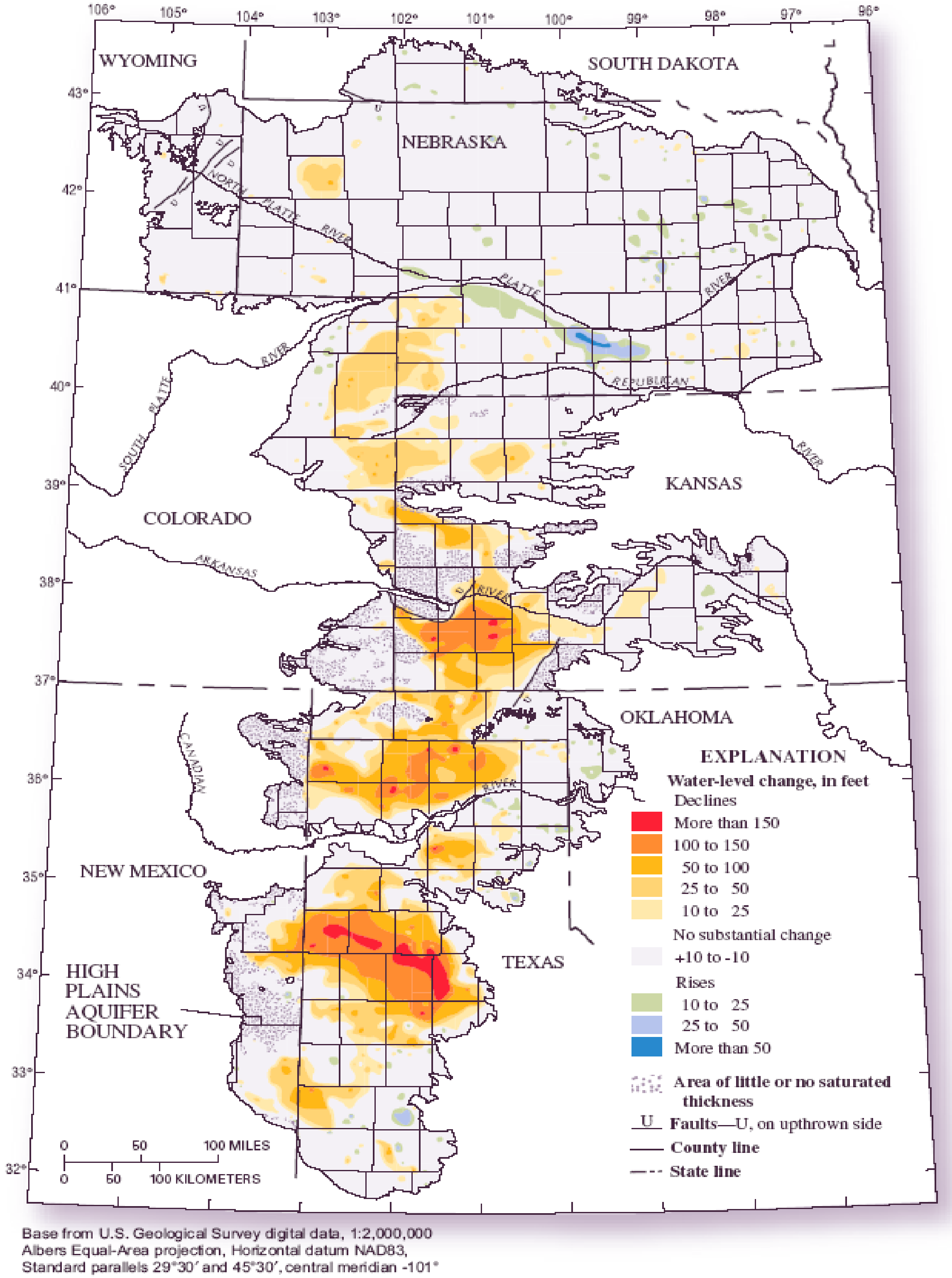

Figure 2: Water level changes in the Ogallala-High Plains aquifer, predevelopment to 2003 (Nebraska Conservation and Survey Division, 2004)

This report focuses on parts of the Ogallala-High Plains aquifer in western Kansas outside of Northwest Kansas Groundwater Management District No. 4 (GMD #4), Western Kansas Groundwater Management District No. 1 (GMD #1), and Southwestern Kansas Groundwater Management District No. 3 (GMD #3). These parts of the aquifer are known as "fringe areas" because they are generally located on the edge of the aquifer where there is marginal saturated thickness. Along the eastern edges of the fringe area, the aquifer tapers and in some locations terminates in outflow seeps to small streams. The most extensive fringe area is in northwest Kansas (Figures 5, 10).

II. Precipitation

Precipitation in northwest Kansas averages 20.17 inches (in.) per year based on 45 precipitation stations from 12 counties. Figure 3 shows the annual variation in precipitation. This chart was derived from National Climatic Data Center (NCDC) stations located in the following 12 counties: Cheyenne, Rawlins, Decatur, Norton, Sherman, Thomas, Sheridan, Graham, Wallace, Logan, Gove and Trego counties. The data is downloaded for each station and then averaged to create the following chart. The chart shows that there have been a number of years in which precipitation was below 15 in. per year. In contrast there are a number of years that precipitation has been greater than 25 in. per year. In 2007 the precipitation total was 18.74 inches, which is below average. Annual precipitation data for these NCDC stations is currently available through 2007. Preliminary 2008 monthly precipitation is shown in Figure 4. The highest precipitation was seen in October with an average of 4.94 inches, and the lowest precipitation was seen in January with an average of 0.19 inches. With these numbers, the total average precipitation for 2008 would be above average at 23.83 inches.

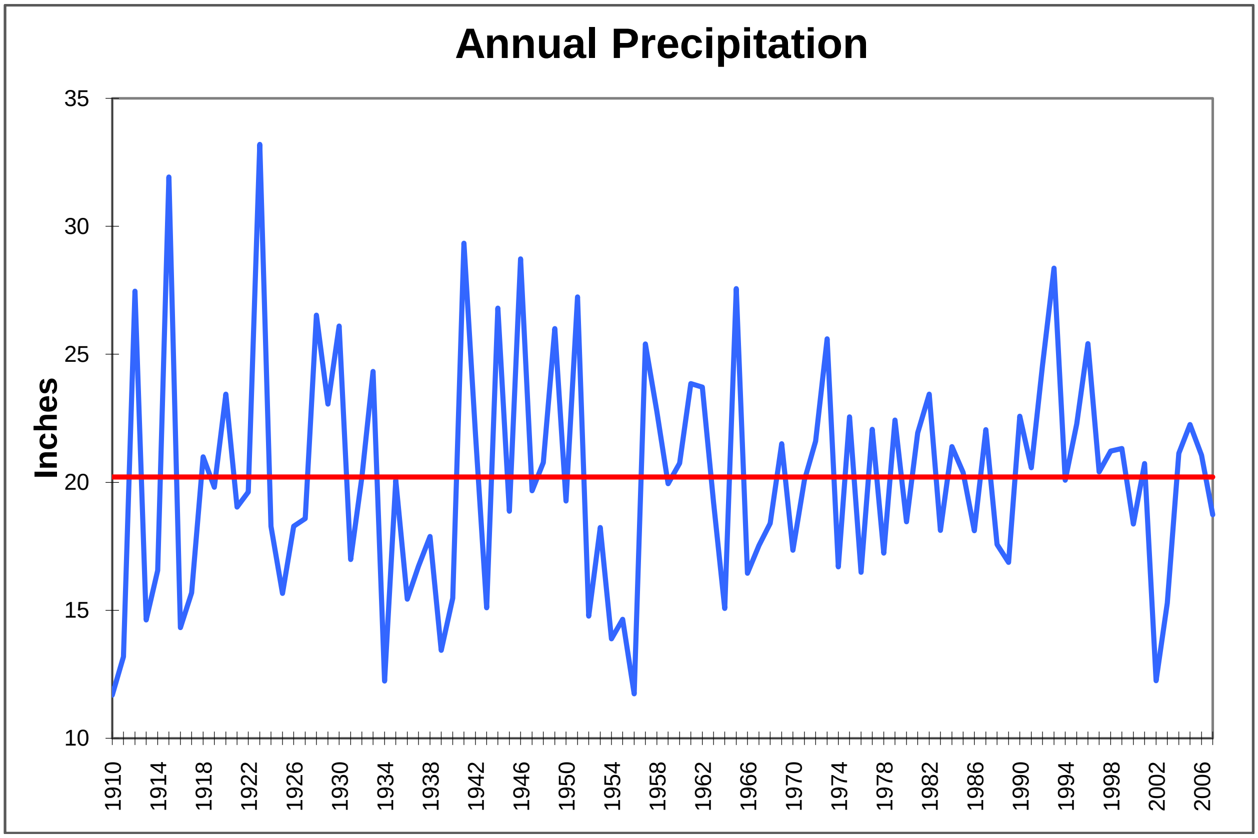

Figure 3: Annual Precipitation for Northwest Kansas, 1910-2007

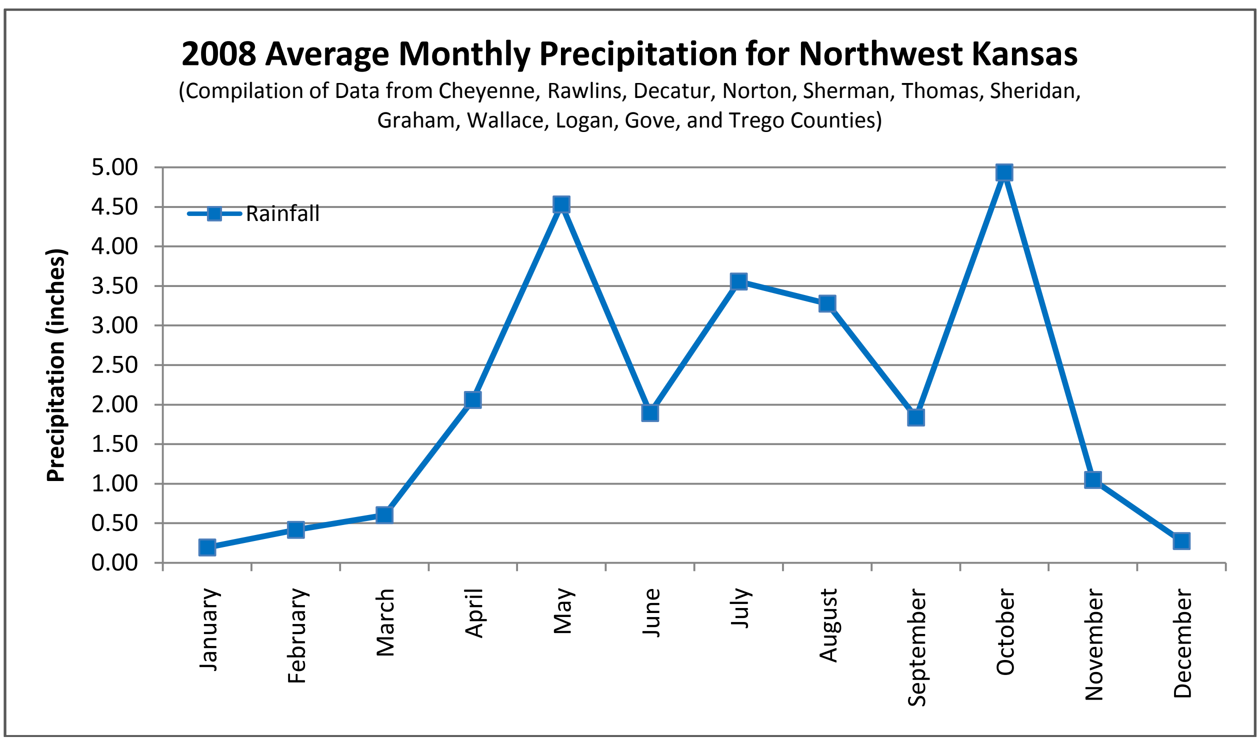

Figure 4: Average Monthly Precipitation 2008

III. Surface Water

There are four tributaries in the northwest Kansas Ogallala-High Plains fringe area (outside GMD #4) that have historical U.S. Geological Survey (USGS) gage data available: South Fork Republican River, Beaver Creek, Sappa Creek and Prairie Dog Creek (Figure 5). All four tributaries are located in portions of Cheyenne, Rawlins, Decatur, Norton and Phillips Counties.

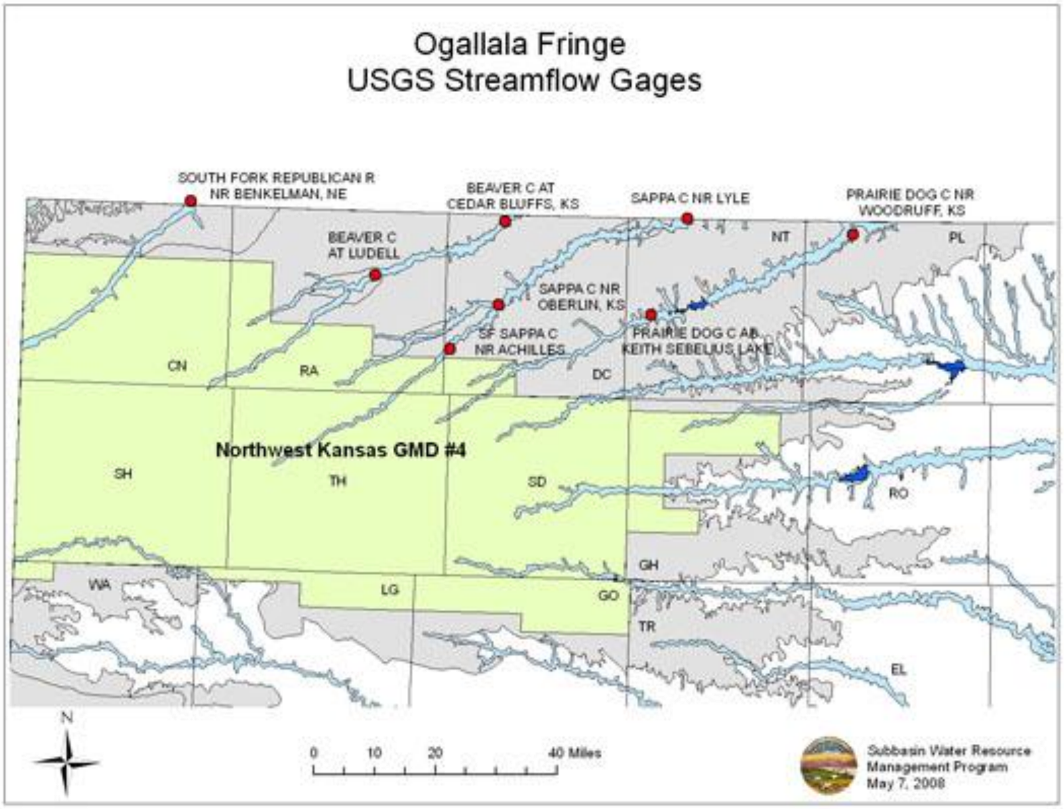

Figure 5: USGS Streamflow gages in the Northwest Kansas Ogallala-High Plains Fringe

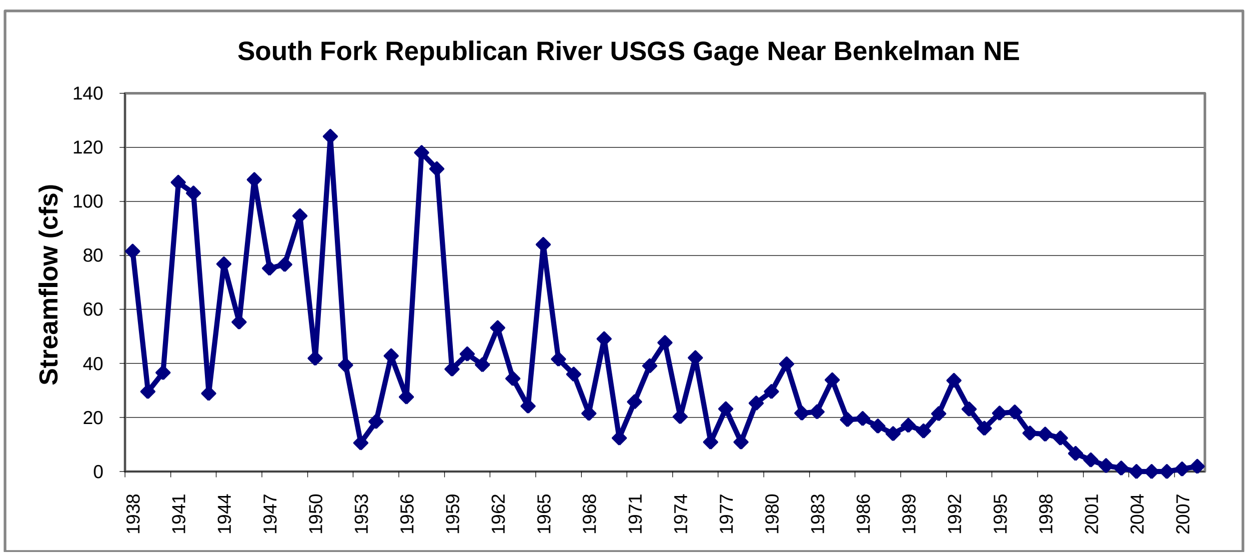

Figure 6: Streamflow for South Fork Republican River near Benkelman, NE 1938-2008

The section of the South Fork Republican River from the GMD #4 boundary to the Kansas-Nebraska state line south of Benkelman, Nebraska is of interstate significance because this gage is used for Republican River Compact accounting. Due to its proximity, the USGS gage near Benkelman is also useful for examining discharge from the northwest Kansas Ogallala fringe. The 1938 to 2007 annual mean data at this gage displays a significant decrease in streamflow over time (Figure 6). The long-term average streamflow is 36.75 cfs. The last time the annual average streamflow was over 36.75 cfs was in 1981 when it averaged 39.8 cfs. The annual average streamflow at the Benkelman gage has been at or near zero for the past several years, with preliminary 2008 average streamflow data at 1.9 cfs.

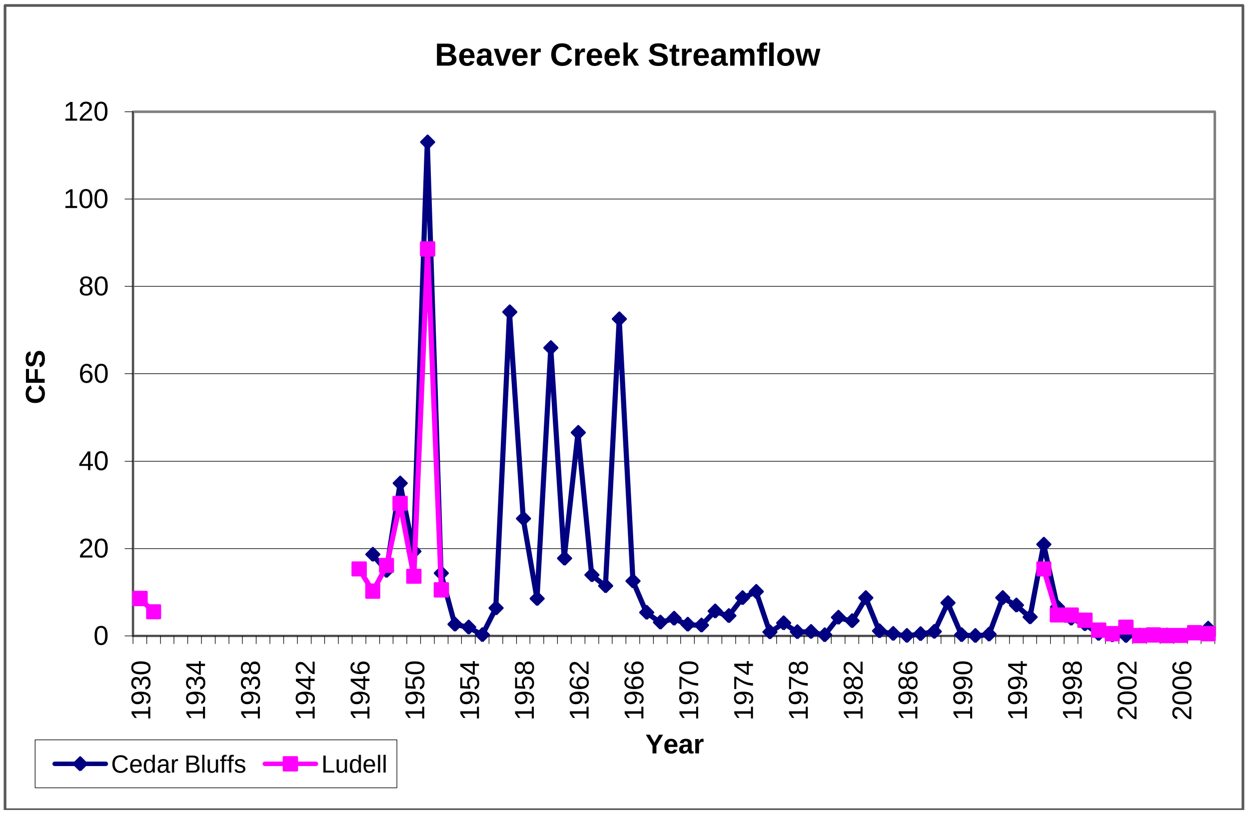

Figure 7: Streamflow for Beaver Creek at Ludell and Cedar Bluffs 1930-2008

The Ludell gage is located about 5 miles downstream of the confluence of the North and South Forks of Beaver Creek at Atwood and has a record dating back to 1930. Cedar Bluffs gage is located a little over one mile before the Beaver Creek crosses over the state line to Nebraska. It has a record dating back to 1947. Over the period of record the average streamflow at Cedar Bluffs was 11.65 cfs and 11.02 cfs at Ludell. The highest average yearly streamflow on Beaver Creek was recorded at the Cedar Bluffs gage in 1951 at 113 cfs (Figure 7). Both streamflow gages had decreasing streamflows averaging 0.57 cfs at Ludell and 0.18 cfs at Cedar Bluffs from 2000-2007. Preliminary 2008 average streamflow at Ludell is 0.47 cfs while Cedar Bluffs is 1.66 cfs.

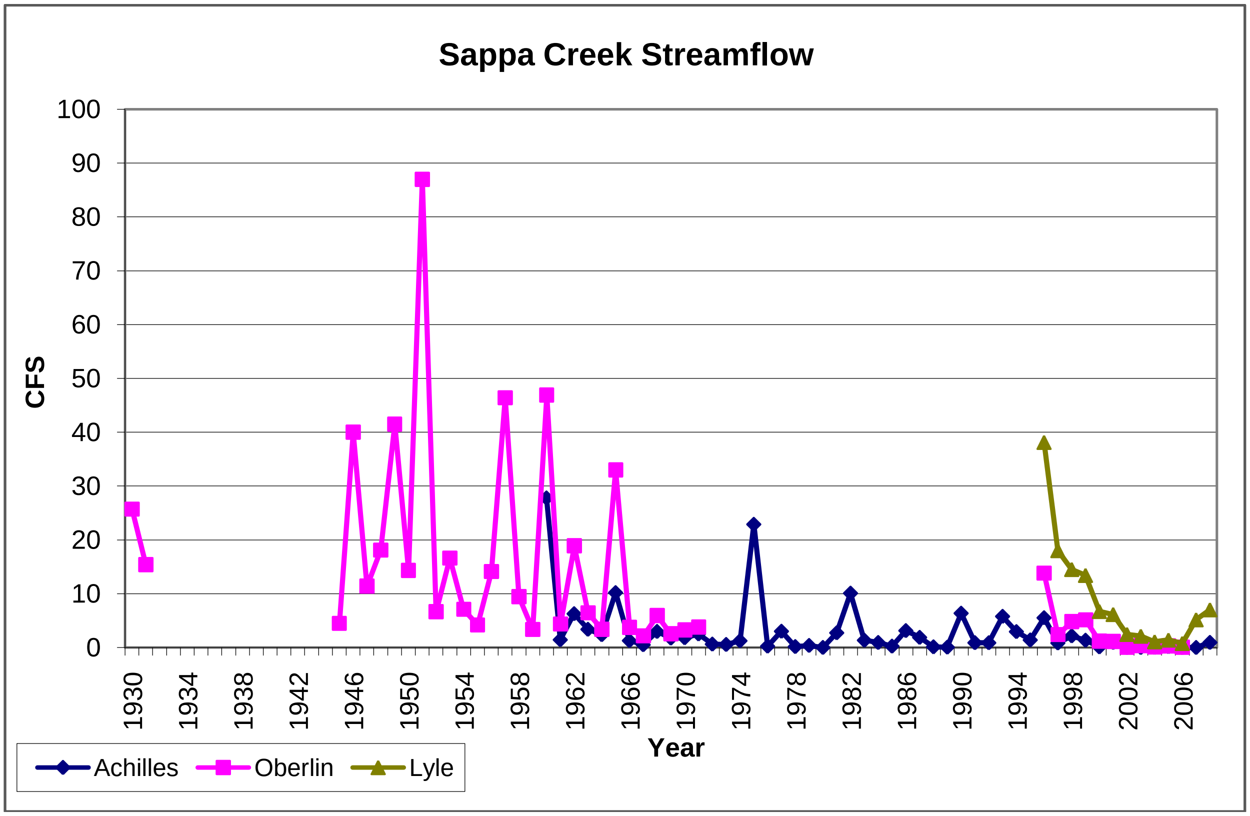

Figure 8: Streamflow for Sappa Creek at Lyle, Achilles and Oberlin 1930-2008

The Achilles gage is located on the South Fork Sappa near where baseflow typically begins and has a record dating back to 1960. The Oberlin gage was located a few miles downstream of the confluence of the North and South Forks of Sappa Creek. It has a measurement record from 1930-2007 as it was dropped off the USGS network in 2007. The Lyle gage is located on the KS-NE state line and has a record dating back to 1996. Over the period of record the average streamflow at Achilles was 2.95 cfs, 13.23 cfs at Oberlin, and 9.15 cfs at Lyle. The highest average yearly streamflow was recorded at the Oberlin gage in 1951 at 87 cfs (Figure 8). All three gages had decreasing streamflows averaging 0.16 cfs at Achilles, 0.44 cfs at Oberlin, and 3.22 cfs at Lyle from 2000-2007. Preliminary 2008 average streamflow at Achilles is 0.94 cfs and at Lyle is 7.01 cfs, which are slightly higher than 2007 streamflows.

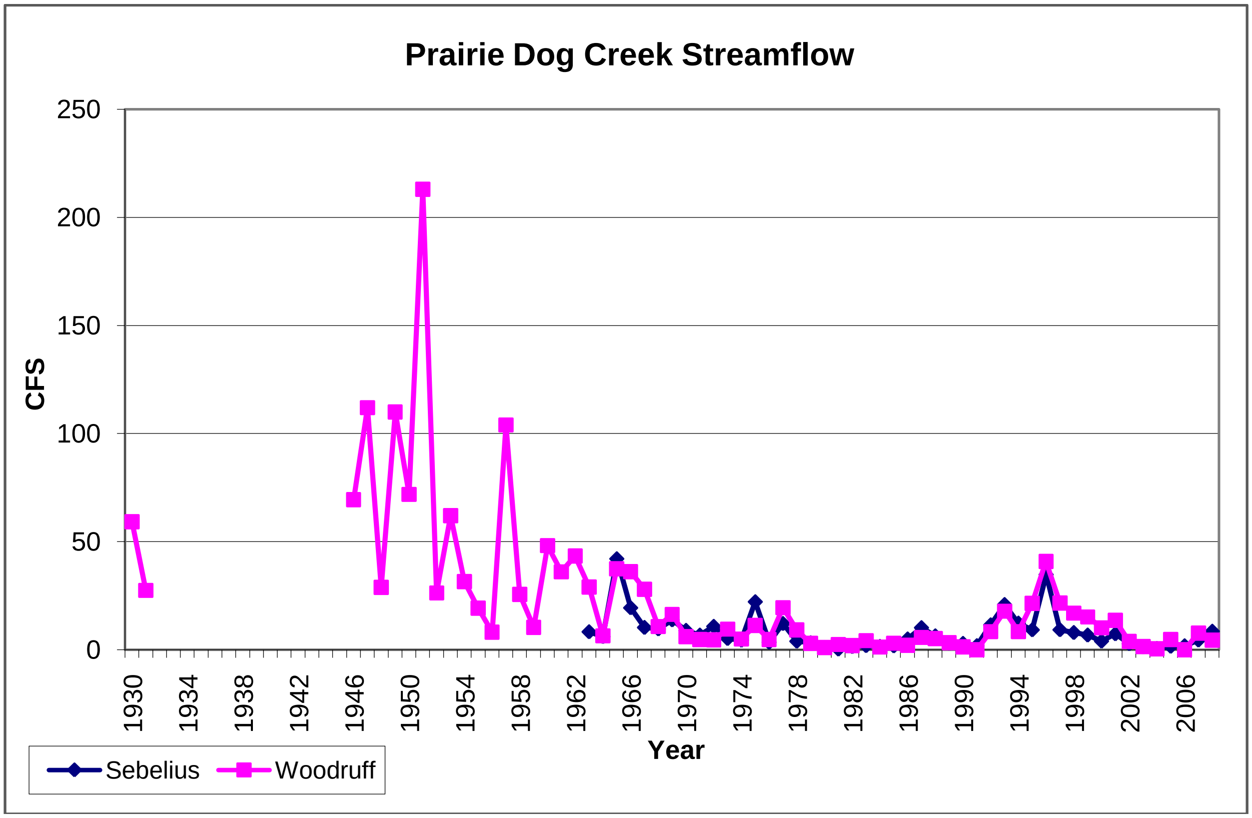

Figure 9: Streamflow for Prairie Dog Creek near Woodruff 1930-2008

The Sebelius gage is located approximately 5 miles upstream of the upper end of Keith Sebelius Reservoir and has a record dating back to 1963. The Woodruff gage is located near the KS-NE state line and has a record dating back to 1930. Over the period of record the average stream flow at Sebelius was 8.09 cfs and 24.61 cfs at Woodruff. The highest average yearly streamflow on Prairie Dog Creek was recorded at the Woodruff gage in 1951 at 213 cfs (Figure 9). Both streamflow gages had decreasing streamflows averaging 2.97 cfs at Sebelius and 5.28 cfs at Woodruff from 2000-2007. Preliminary 2008 average streamflow at Sebelius is 8.55 cfs and at Woodruff is 4.52 cfs.

IV. Groundwater

The Ogallala-High Plains fringe area has few monitoring wells with historical data. The historic fringe water level data is statistically inadequate to be applied to a section level approach, which is needed for adequate evaluation of the hydrologic conditions. In an effort to improve the water level data coverage, the Subbasin Water Resource Management Program (SWRMP) added nearly 100 wells to the annual monitoring network in northwest Kansas in January 2004 (Figure 10). This expanded the monitoring well network into Cheyenne, Phillips, Rooks, and Gove counties, as reflected in the below charts. A few of these wells are in areas that have over 100 feet of saturated thickness, which is uncommon to the fringe, a thinly saturated area.

The SWRMP measures water levels in the Ogallala-High Plains fringe areas throughout western Kansas. There are currently 156 wells measured annually. SWRMP collects additional water level measurements tri-annually, in the winter, spring and fall. Only winter (December, January and February) measurements are used for the monitoring well water level charts, since those measurements are considered to be the least influenced by groundwater pumping. Figure 12 to Figure 28 chart groundwater levels in all fringe monitoring wells (legal descriptions are available in the appendix) and the five-year rolling averages. The y-axis is labeled depth below land surface (DBLS) with units in feet (ft).

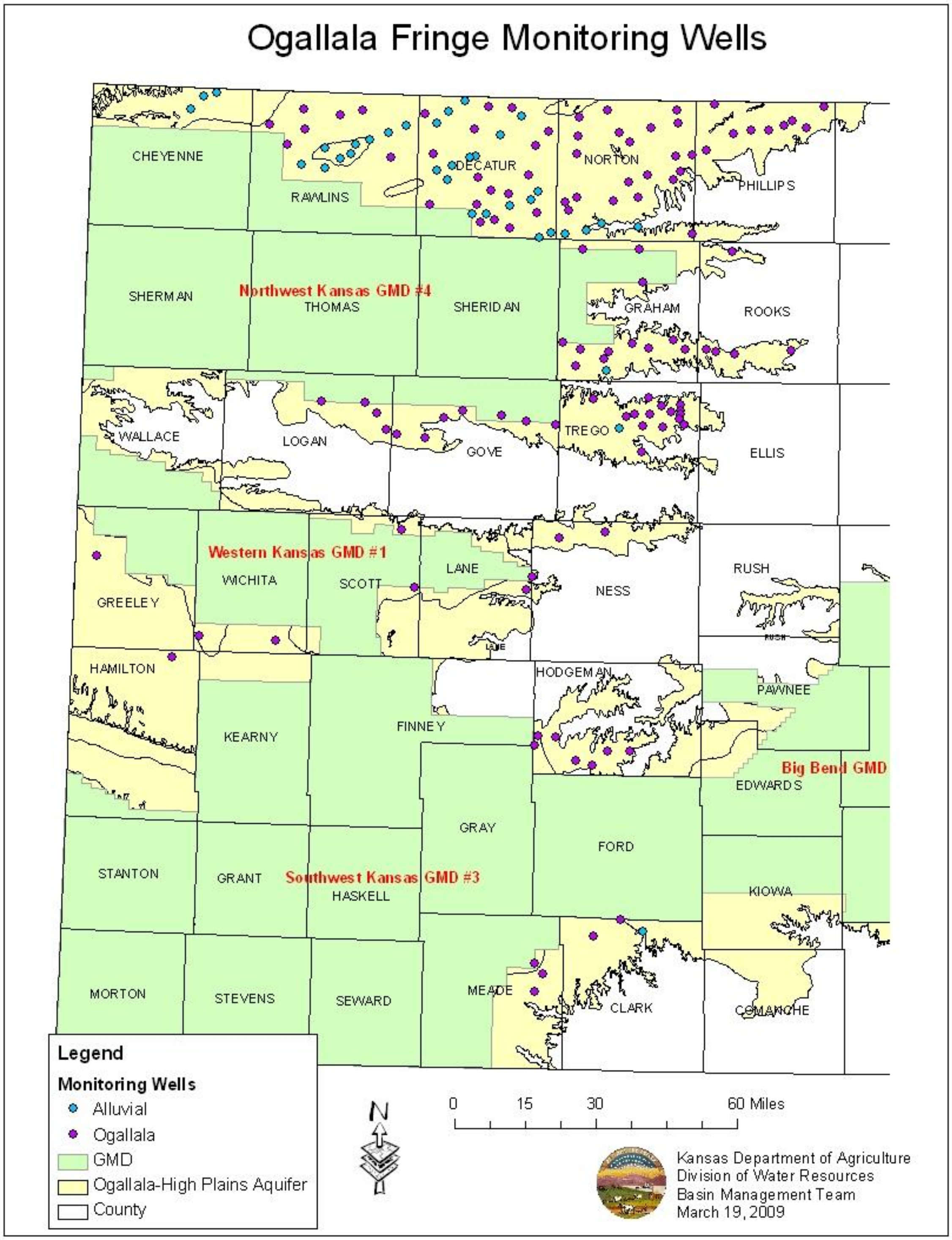

Figure 10: Monitoring wells in the fringe of the Ogallala-High Plains project area

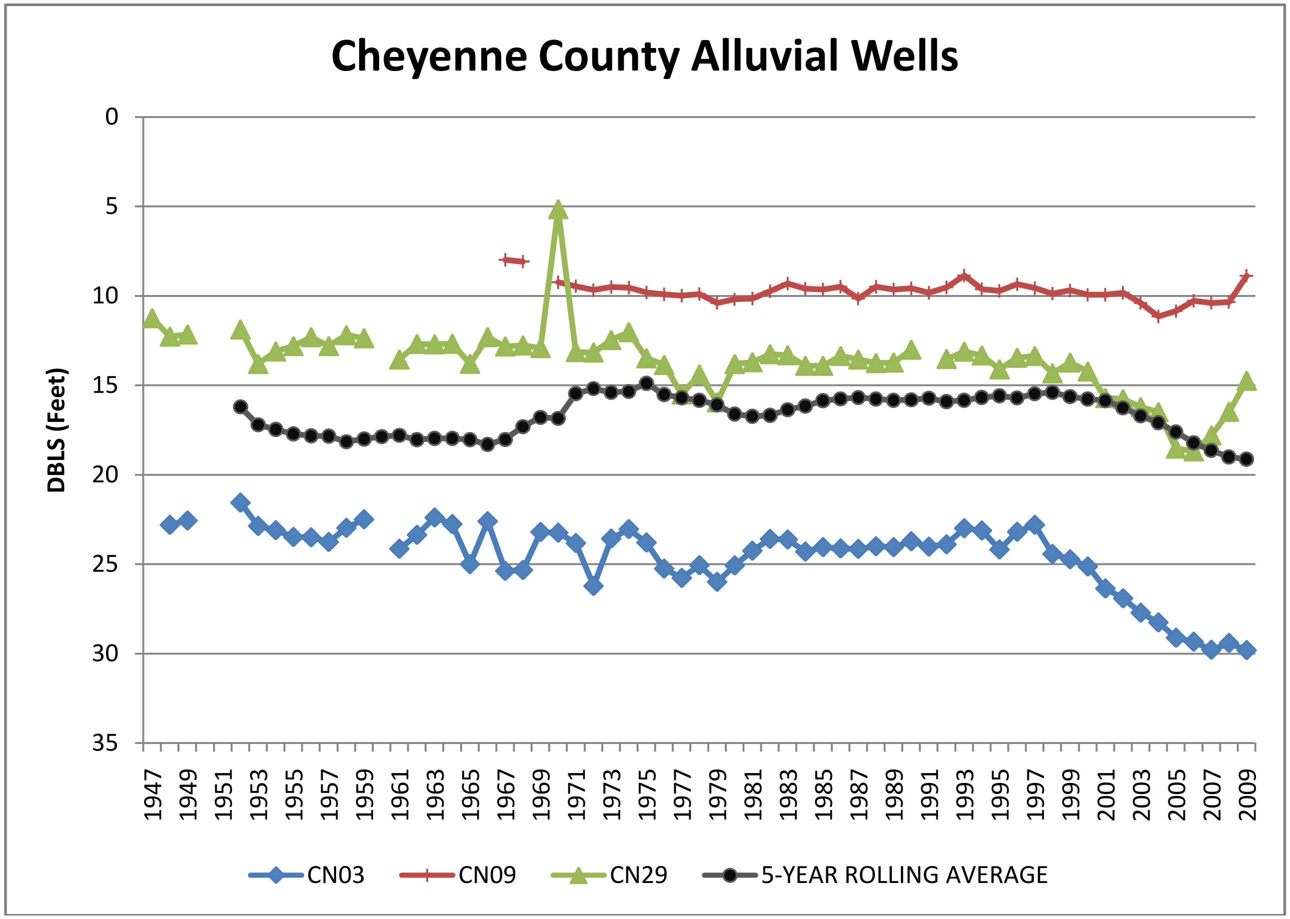

Figure 11: Annually Measured Alluvial Wells in the Fringe Area of Cheyenne County (1947-2009)

There are three alluvial monitoring wells in Cheyenne County. CN29 has the longest period or record with measurements from 1947, while CN03 and CN09 have measurements from 1948 and 1967 respectively. CN03 has had the largest net decline of about 7 ft since 1948, while CN09 and CN29 have experienced net declines of 0.89 ft and 3.5 ft respectively (Figure 11). From 2008 to 2009 both CN09 and CN29 experienced increases of 1.47 ft and 1.73 ft respectively while CN03 declined 0.4 ft. The five-year rolling average has declined 3.36 ft since 2000.

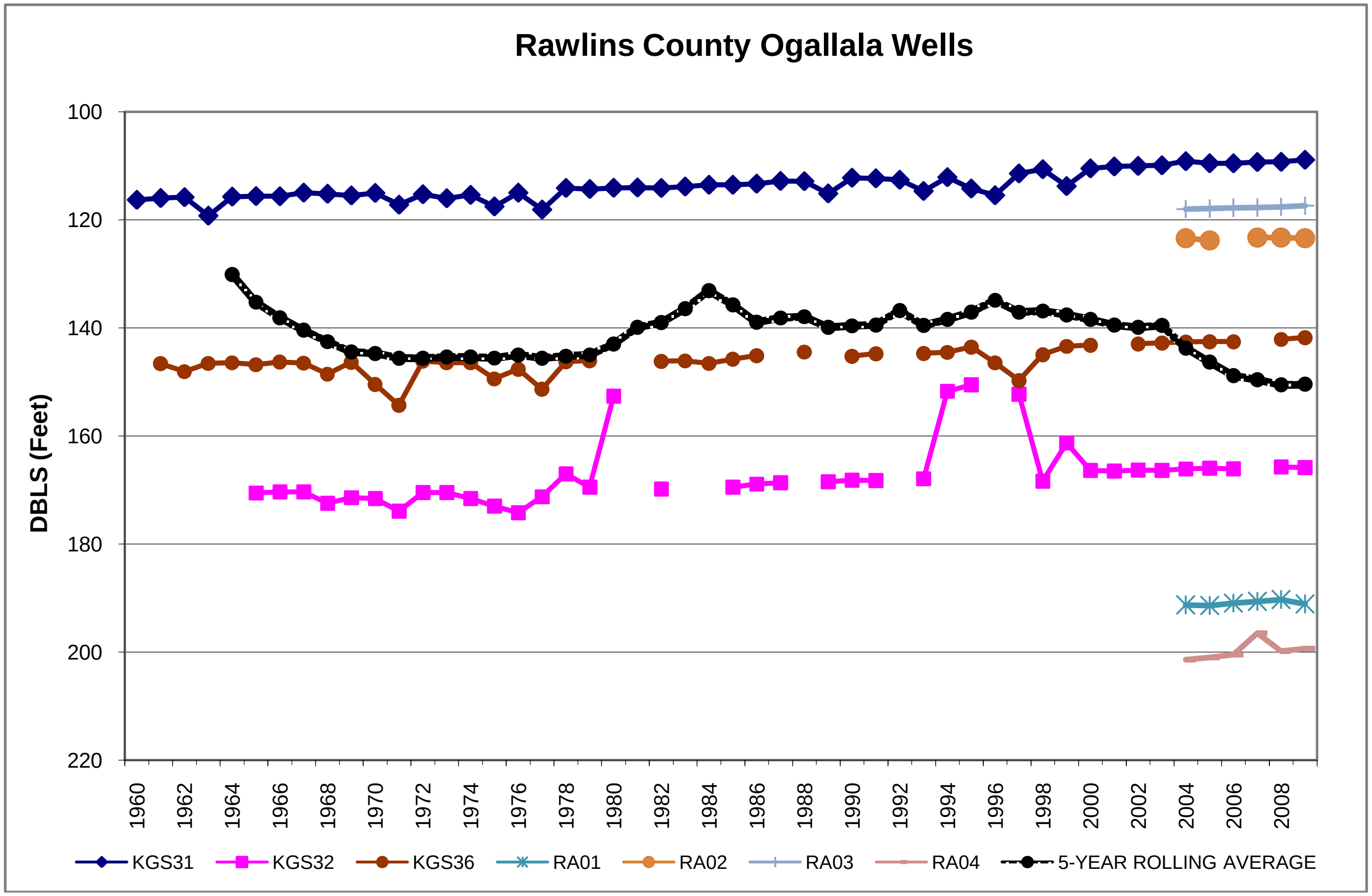

Figure 12: Annually Measured Ogallala-High Plains Wells in the Fringe Area of Rawlins County (1960-2009)

Rawlins County has both alluvial and Ogallala-High Plains monitoring wells. There are seven monitoring wells in the Ogallala-High Plains. Three of these wells have data beginning in the 1960s. Monitoring wells RA01 – RA04 were added to the data analysis in 2008 and have measurements since 2004. The water levels exhibit an average net increase of 2.83 ft (Figure 12) over the period of record. Since 1960, KGS31 has a net increase of 7.42 ft. The five-year rolling average has remained relatively stable with a declining trend starting in 2004 that is likely attributed to the addition of the deeper wells RA01 and RA04.

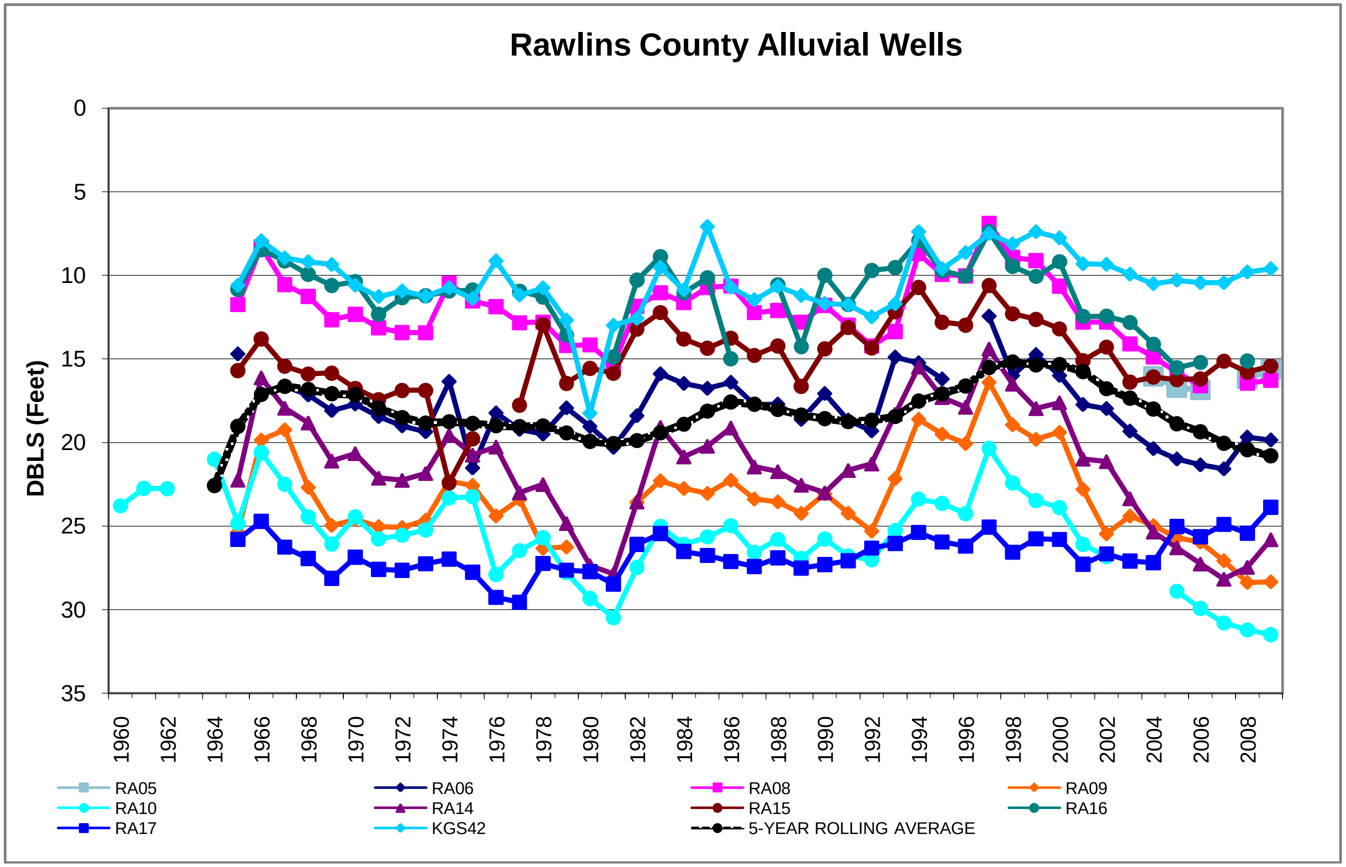

Figure 13: Annually Measured Alluvial Wells in the Fringe Area of Rawlins County (1960-2009)

Rawlins County has ten alluvial wells measured annually along Beaver and Sappa Creeks. Wells located in the alluvium along Beaver and Sappa Creek fluctuate over time and do not typically have a pronounced long term rising or declining trend (Figure 13). The five-year rolling average has steadily declined about 5.5 ft since 2000. RA10 has the longest record dating back to 1960. The water levels have increased and declined in that time period. RA10 exhibited a net decline of 7.71 ft since 1960.

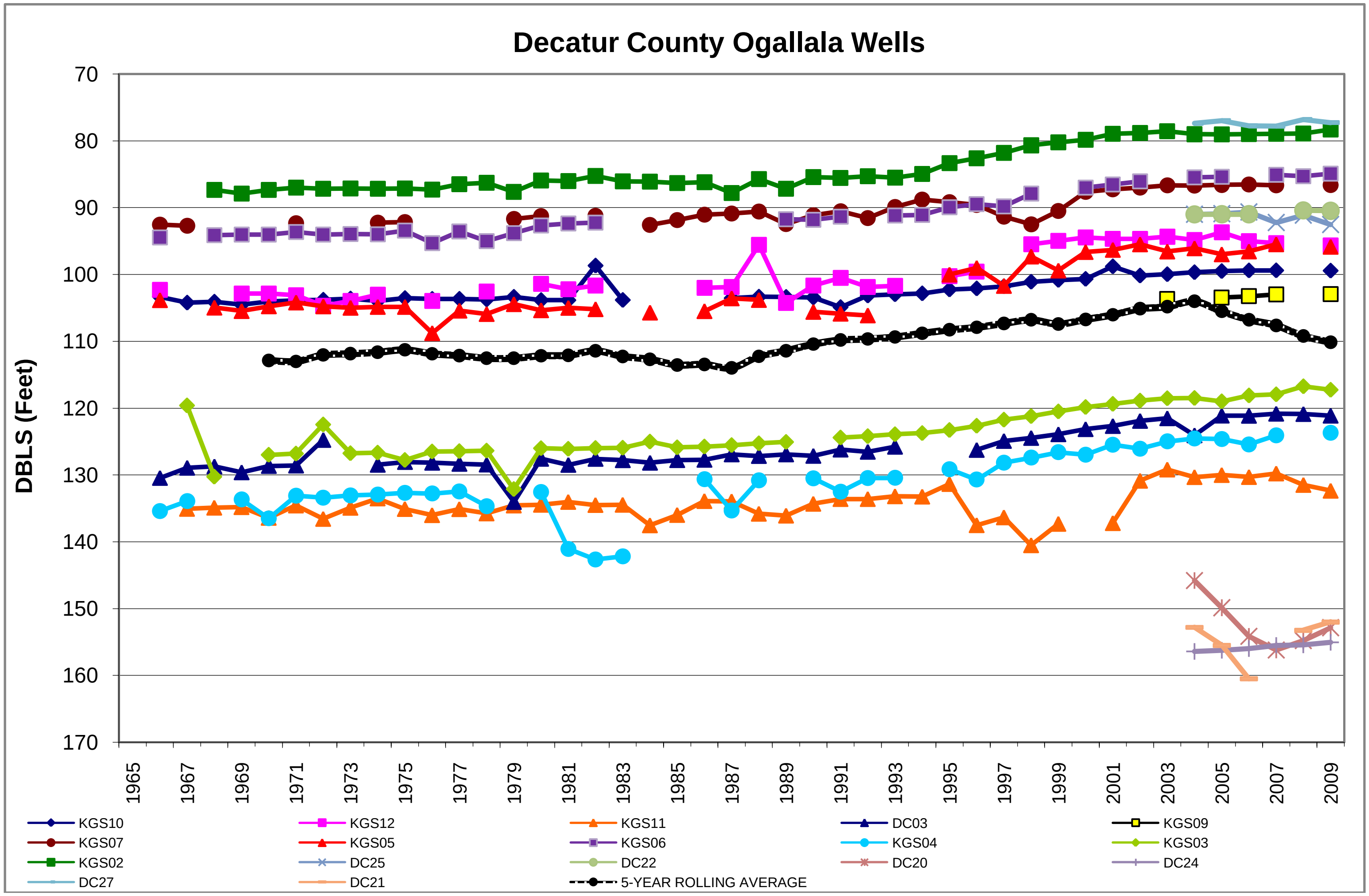

Figure 14: Annually Measured Ogallala-High Plains Wells in the Fringe Area of Decatur County (1965-2009)

Decatur County has a number of wells where measurements begin in 1965. Seventeen monitoring wells have been charted in Figure 14. Monitoring wells DC20, 21, 22, 24, 25 and 27 were added in the 2008 data analysis and have measurements since 2004. Ogallala wells in Decatur County show an average 3.89 ft net increase. The addition of the deeper wells in 2004 may be pulling the five-year average down slightly.

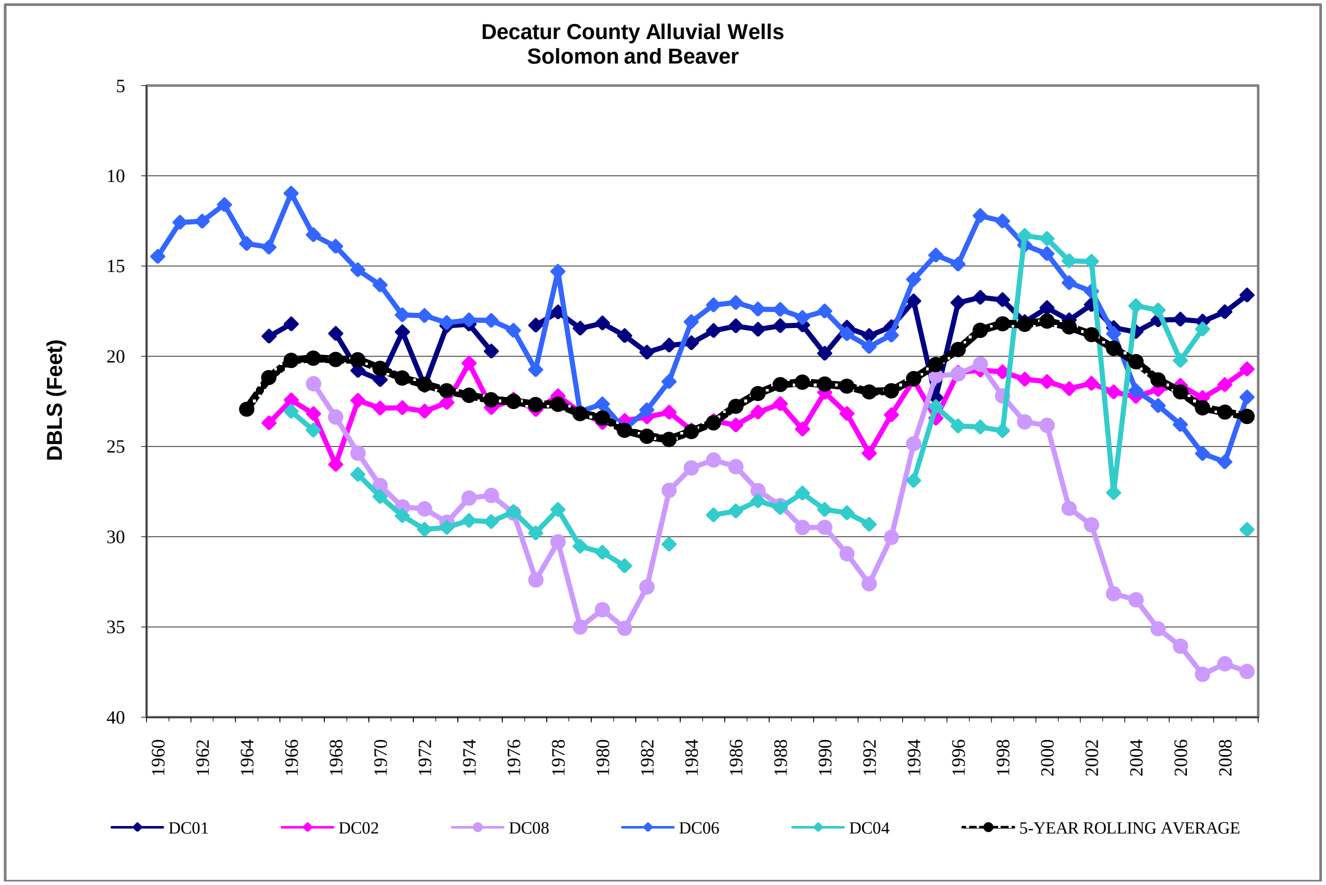

Figure 15: Annually Measured Alluvial Wells in the Fringe Area of Decatur County, Upper North Solomon and Beaver Creek (1960-2009)

NOTE: The 5-year rolling average is for all the alluvial wells in Decatur County

Decatur County has five alluvial monitoring wells. DC01 and DC02 are in the upper Solomon alluvium and have increased by a net of 2.28 and 3 ft respectively since 1965. The other three wells are in the Beaver Creek alluvium. Both DC06 and DC08 have net declines of 7.8 ft and 15.94 ft respectively; however DC06 rose 3.59 ft from 2008 to 2009. DC04 saw a net increase of 4.56 ft (Figure 15) in 2008; however an 11.11 ft drop occurred from 2007 to 2009, resulting in a 6.55 net decline.

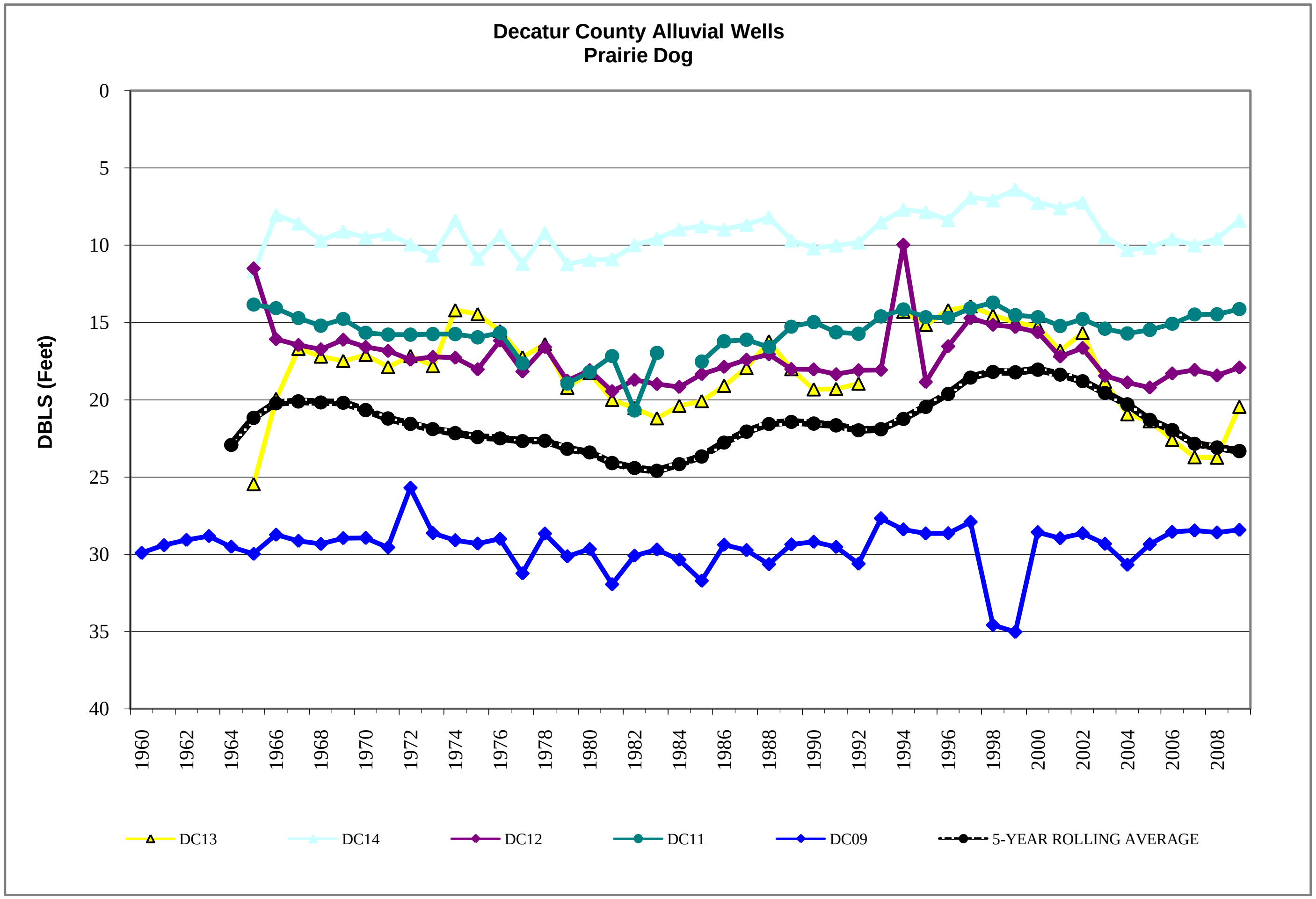

Figure 16: Annually Measured Alluvial Wells in the Fringe Area of Decatur County, Prairie Dog Creek (1960-2009)

NOTE: The 5-year rolling average is for all the alluvial wells in Decatur County

Decatur County has five alluvial monitoring wells in Prairie Dog Creek alluvium. Only DC12 has had a net decline (6.42 ft) since its inception. The other four wells have maintained water levels over time with short-term increases and decreases (Figure 16). The five-year rolling average was on a downward trend from 2001 to 2009.

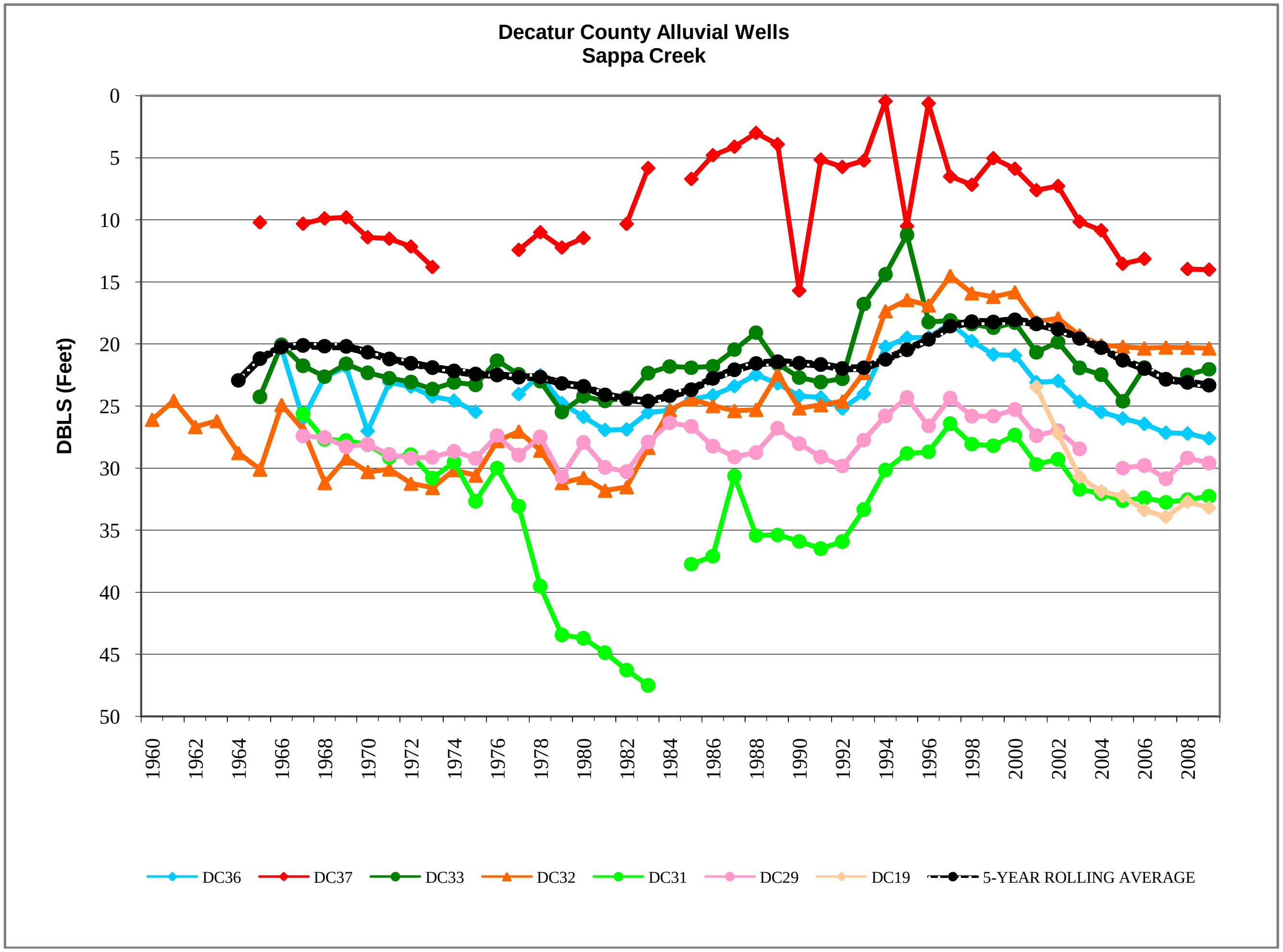

Figure 17: Annually Measured Alluvial Wells in the Fringe Area of Decatur County, Sappa Creek (1960-2009)

NOTE: The 5-year rolling average is for all the alluvial wells in Decatur County

Sappa Creek has seven monitoring wells in Decatur County. Five of the seven monitoring wells have had net declines over the period of record, with DC31 declining 6.65 ft and DC19 declining 9.72 ft. DC32 and DC33 had net increases of 5.75 ft and 2.23 ft respectively (Figure 22).

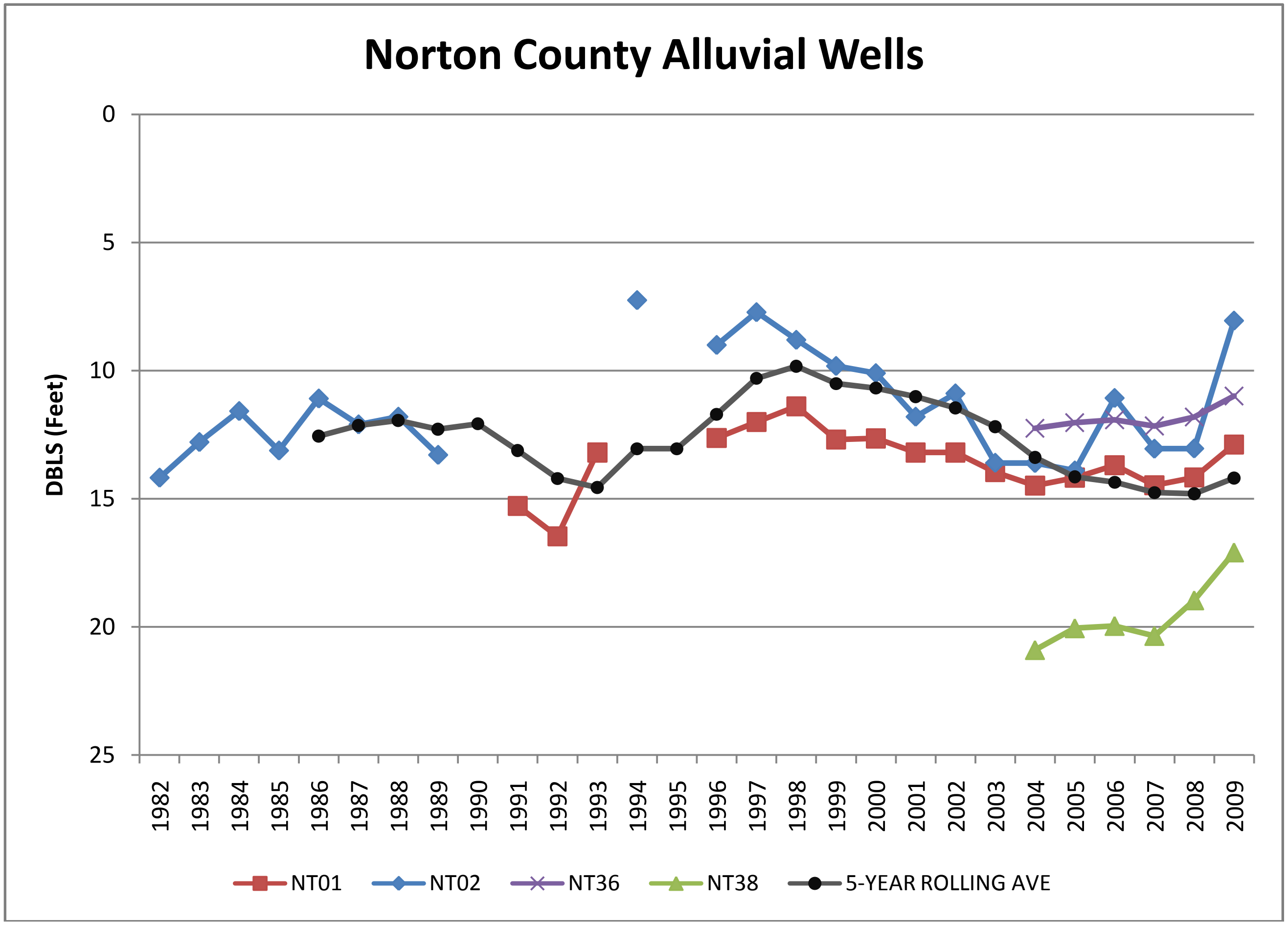

Figure 18: Annually Measured Alluvial Wells in the Fringe Area of Norton County (1982-2009)

Norton County has four alluvial monitoring wells. NT02 has the longest record beginning in 1982. NT01 has records from 1991, while NT36 and 38 were added to the analysis in 2008 with records from 2004. All wells show net increases over the period of record with the average net increase for the monitoring wells at 3.4 ft (Figure 18).

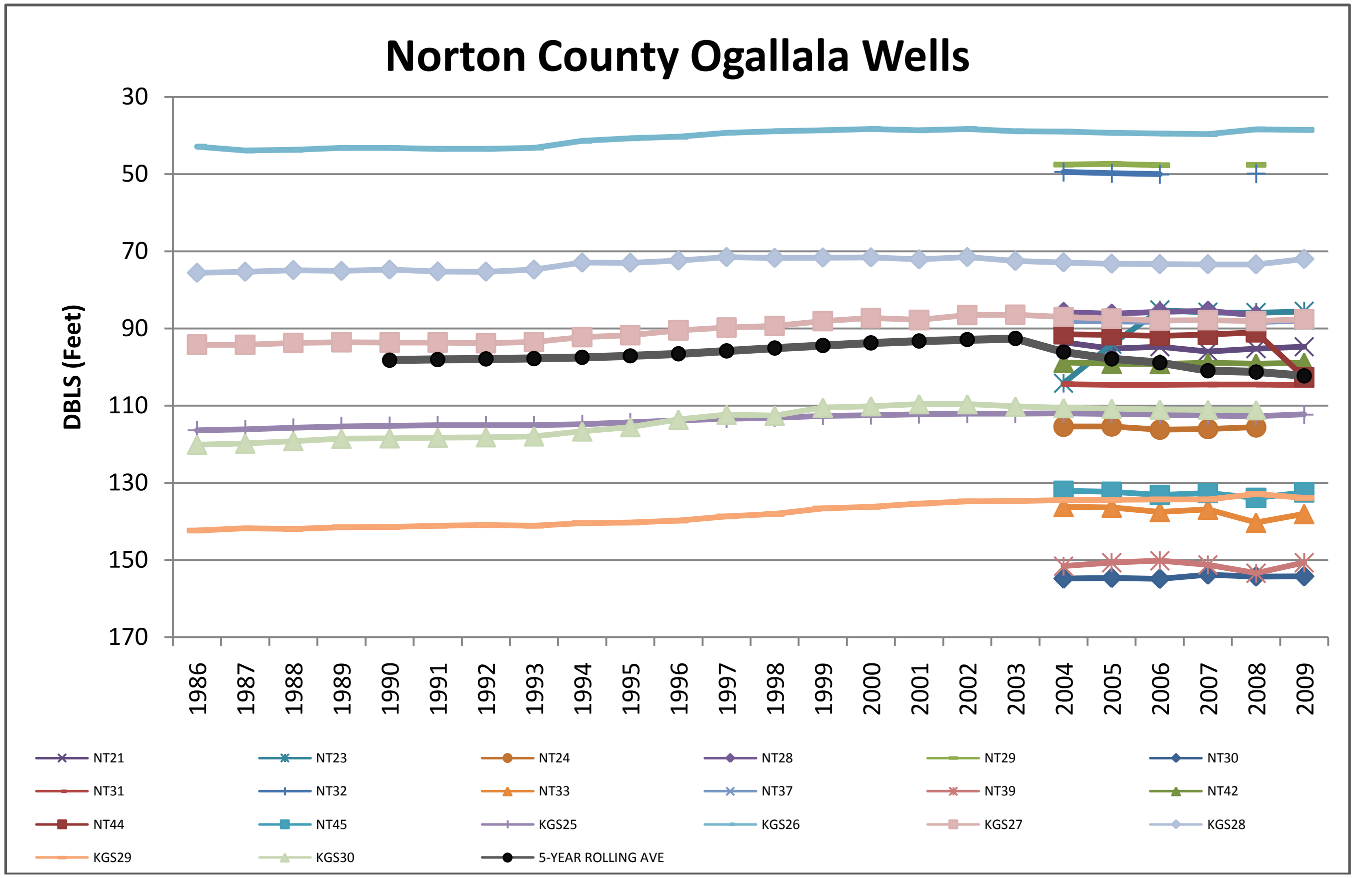

Figure 19: Annually Measured Ogallala-High Plains Wells in the Fringe Area of Norton County (1986-2009)

Norton County has twenty Ogallala monitoring wells. Fourteen of these wells were added to the analysis in 2008 and have measurements since 2004. The water levels have remained relatively stable with an average decline of 0.18 ft from 2008 to 2009. The water levels ranged from an increase of 2.71 ft in NT39 to an 11.55 ft decrease in NT44. The five-year rolling average has remained relatively stable with a declining trend starting around 2004, which is likely attributed to the deeper wells added to the analysis at that time.

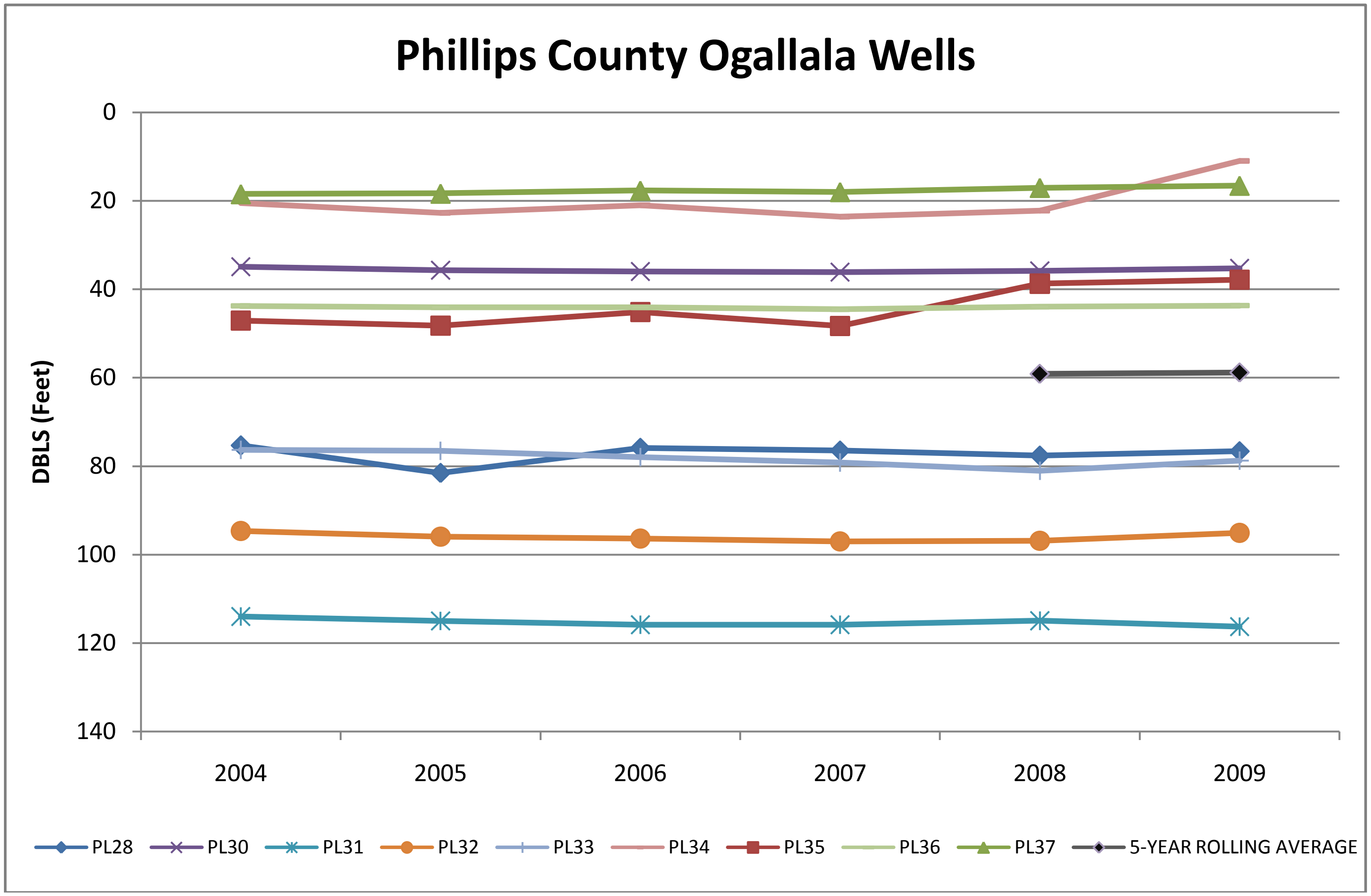

Figure 20: Annually Measured Ogallala-High Plains Wells in the Fringe Area of Phillips County (2004-2009)

There are nine total monitoring wells in the fringe area of Phillips County with measurements from 2004. Over the period of record all wells experienced an average net increase of 1.55 ft. From 2008 to 2009 wells ranged from a decrease of 1.32 ft in PL31 to an increase of 11.27 ft in PL34, with an overall average increase of 1.68 ft.

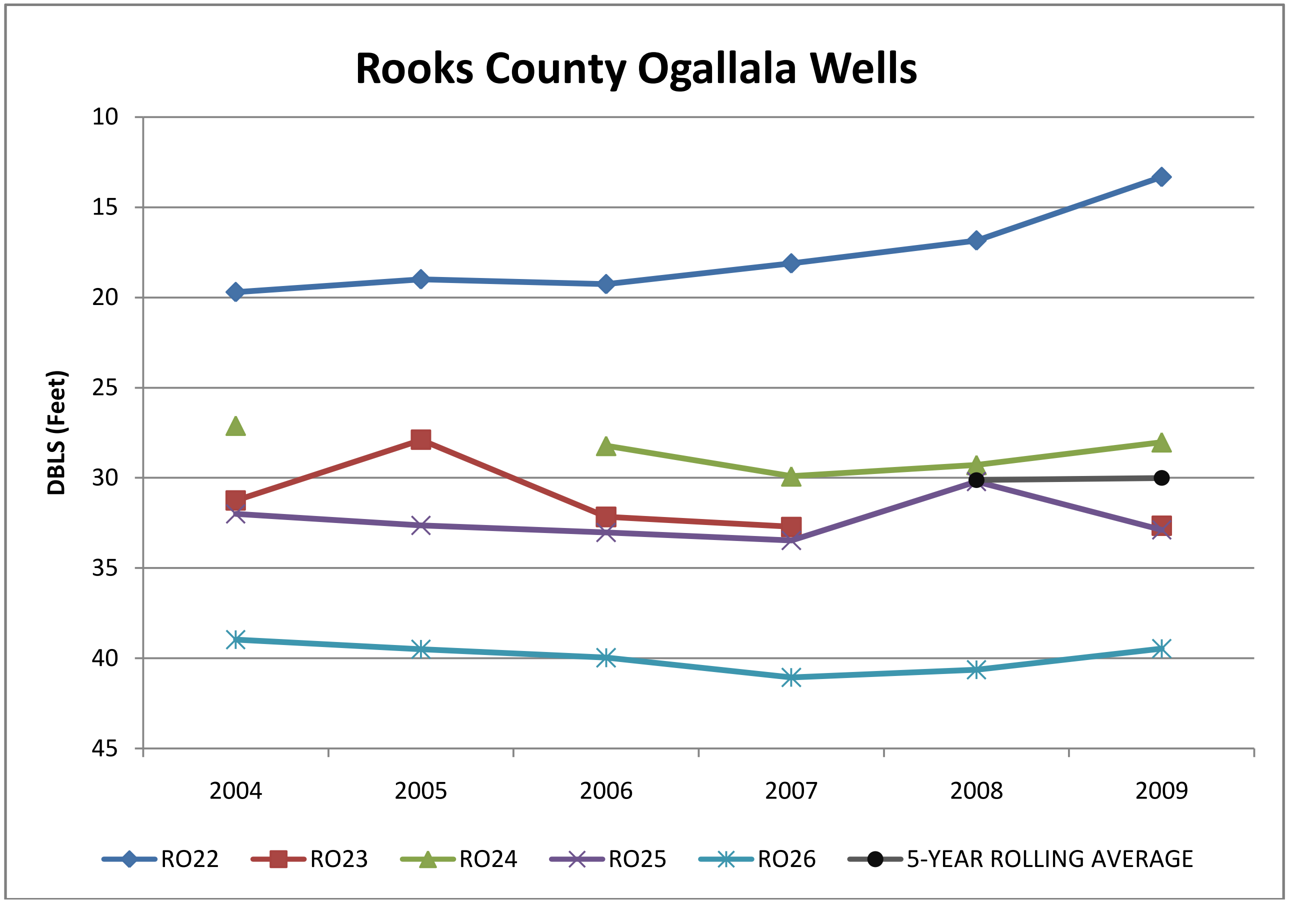

Figure 21: Annually Measured Ogallala-High Plains Wells in the Fringe Area of Rooks County (2004-2009)

There are five monitoring wells in Rooks County with measurements since 2004. Over the period of record the wells had a net average increase of 0.54 ft. From 2008 to 2009 the wells increased an overall average of 0.82 ft ranging from an increase of 3.52 ft for RO22 to a decrease of 2.68 ft in RO25.

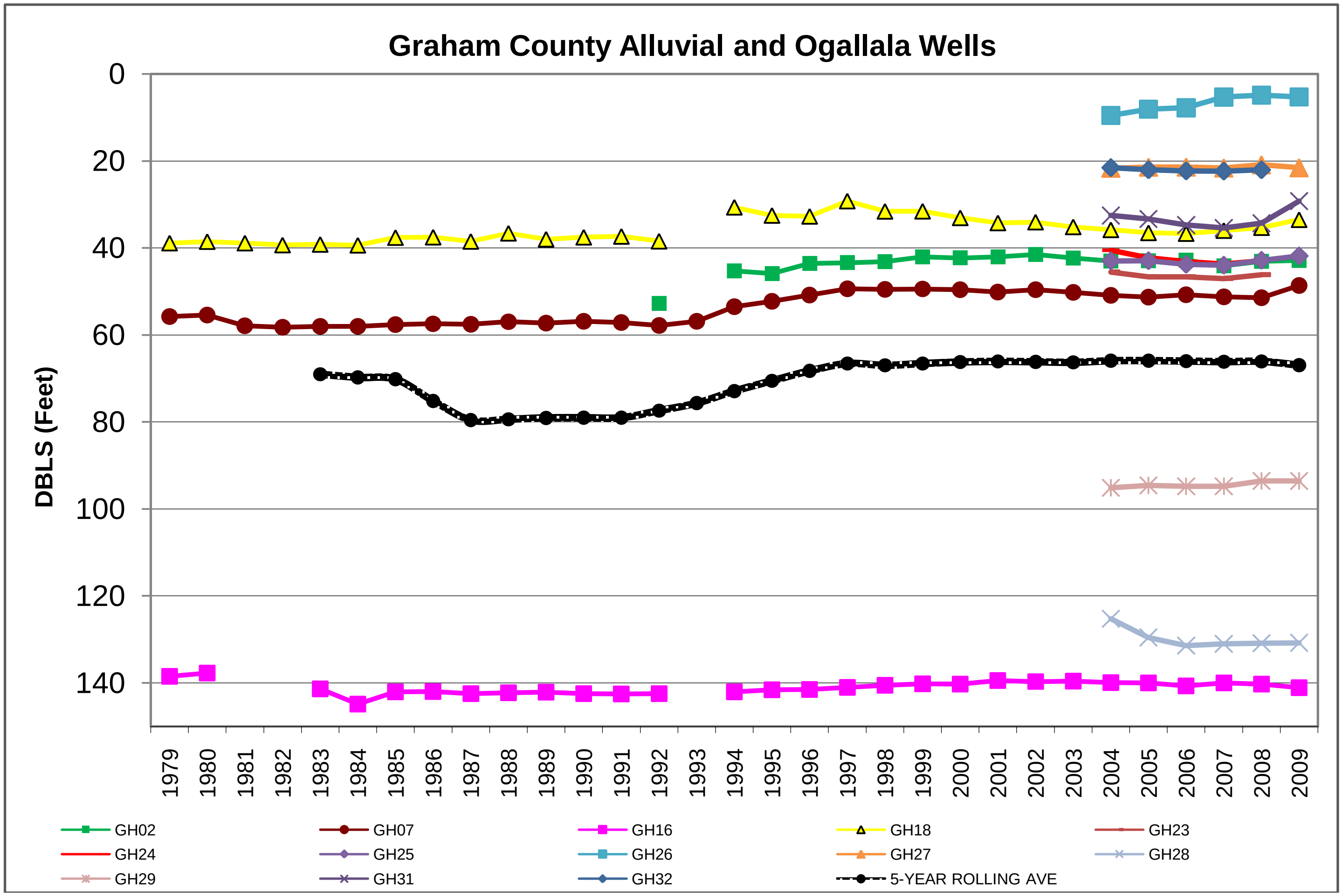

Figure 22: Annually Measured Wells in the Fringe Area of Graham County (1953-2009)

Graham County has thirteen Ogallala and alluvial monitoring wells. Measurements begin for three of the wells in 1979. GH 02 was added to the network in 1992, while the remaining wells were added in the 2008 data analysis with measurements from 2004. GH16 has had a net decline of 2.66 ft since 1979. Overall the water levels increased an average of 0.92 ft from 2008 to 2009, ranging from a 0.82 decrease in GH16 to an increase of 5.07 in GH31. The five-year rolling average for Ogallala wells has remained fairly consistent since 1996.

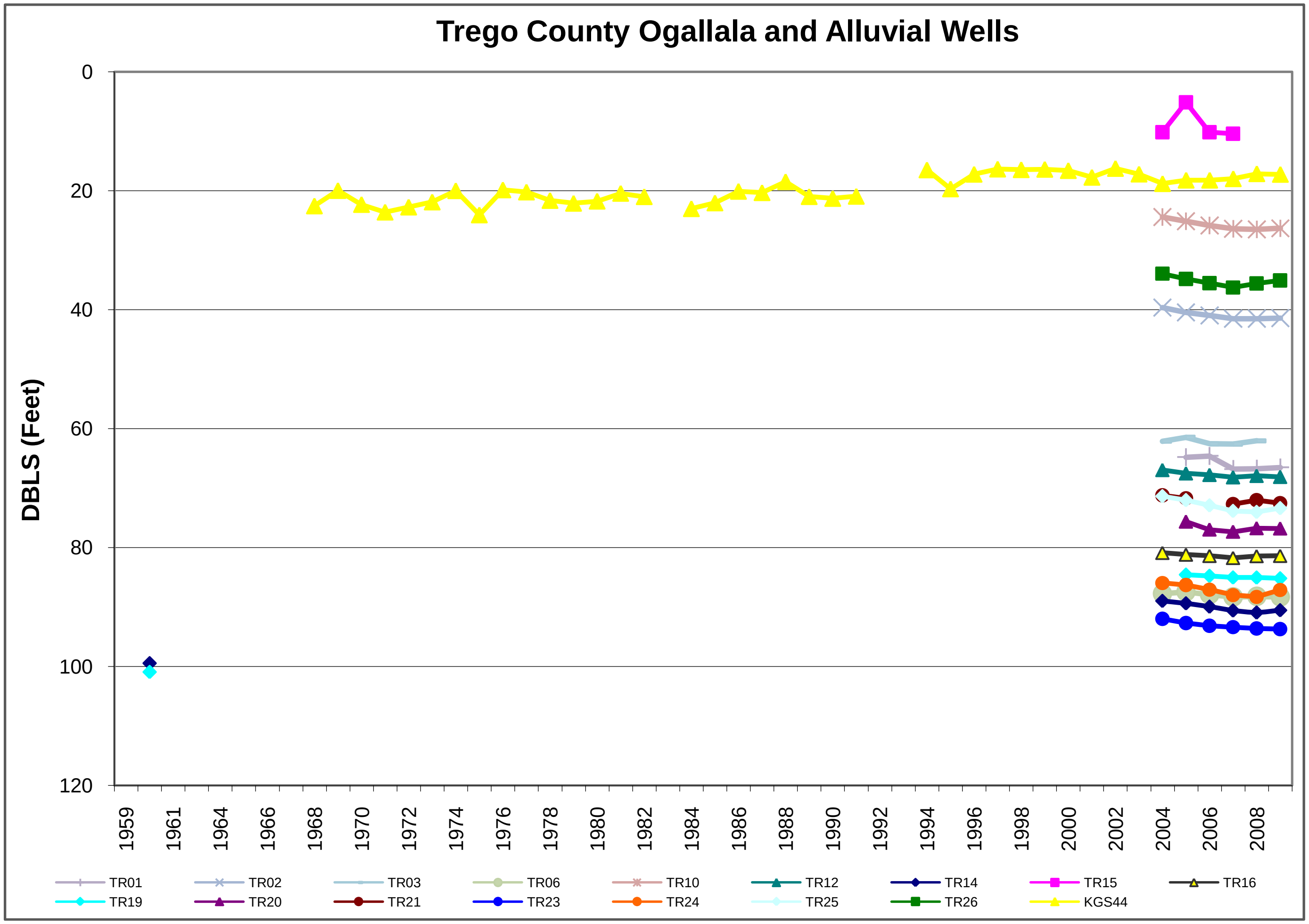

Figure 23: Annually Measured Wells in the Fringe Area of Trego County (1959-2009)

Trego County has a total of seventeen monitoring wells. KGS44 has a record dating back to 1968 and is located in the alluvium of Big Creek. TR14 and TR19, Ogallala wells, were first measured in 1960, but were not measured again until 2004 and 2005, and have a net increase of 8.91 and 15.75 ft, respectively. The rest of the wells were not added to the network until 2004. KGS44 showed a net increase of 5.31 ft while the remaining wells show a net average increase of 0.54 feet (Figure 23).

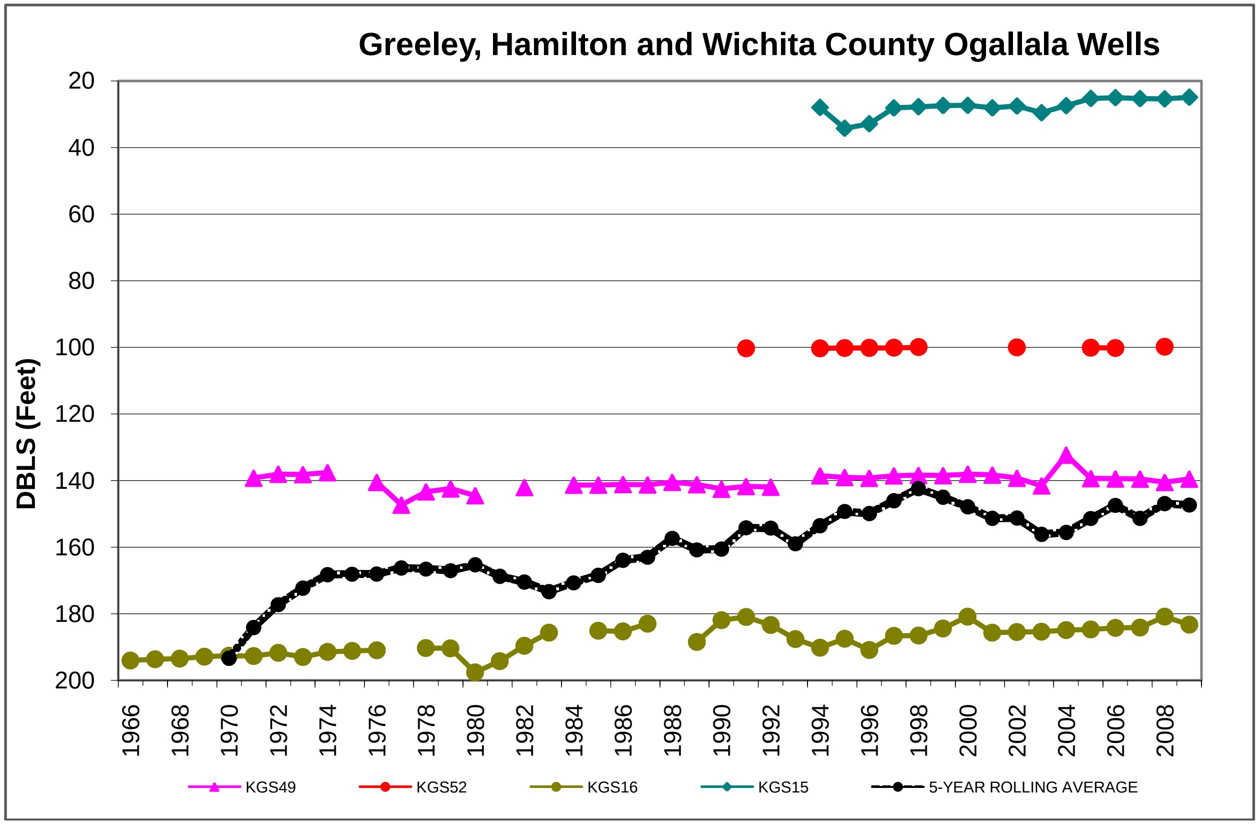

Figure 24: Annually Measured Wells in the Fringe Area of Greeley, Hamilton and Wichita Counties (1966-2009)

Hamilton County has one monitoring well, Greeley County has one monitoring well and Wichita County has two monitoring wells. KGS52 showed a net increase of 0.46 ft (Figure 24). The Hamilton County well KGS16 located outside GMD #3 and had a net increase of 10.72 ft for 1966-2009, with a decline of 2.44 ft from 2008-2009. The Greeley County well KGS15 located outside GMD #1 had a net increase of 3.07 ft for 1994-2009 (Figure 24). The five-year rolling average has fluctuated some with an overall net increase.

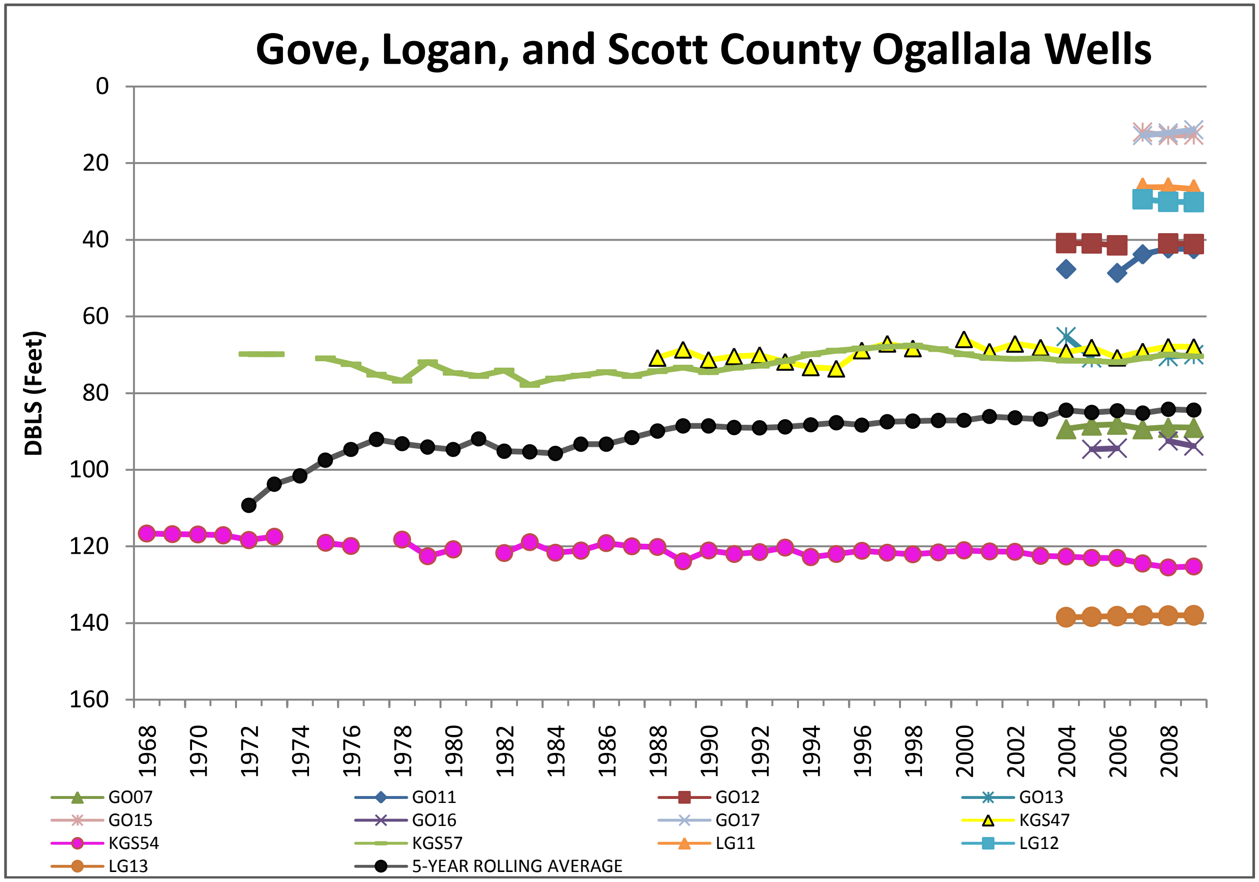

Figure 25: Annually Measured Wells in the Fringe Area of Logan and Scott Counties (1965-2009)

Gove, Logan, and Scott County have a total of thirteen monitoring wells located outside of the GMD #1. Water level measurements date back to 1968 for KGS54, 1972 for KGS57 and 1984 for KGS47. KGS54 (Scott County), has had a net decline of 8.54 ft since 1968. From 2008 to 2009 the wells decreased an average of 0.21 ft. Overall the wells have remained relatively stable with an average net decrease of 0.26 ft (Figure 25).

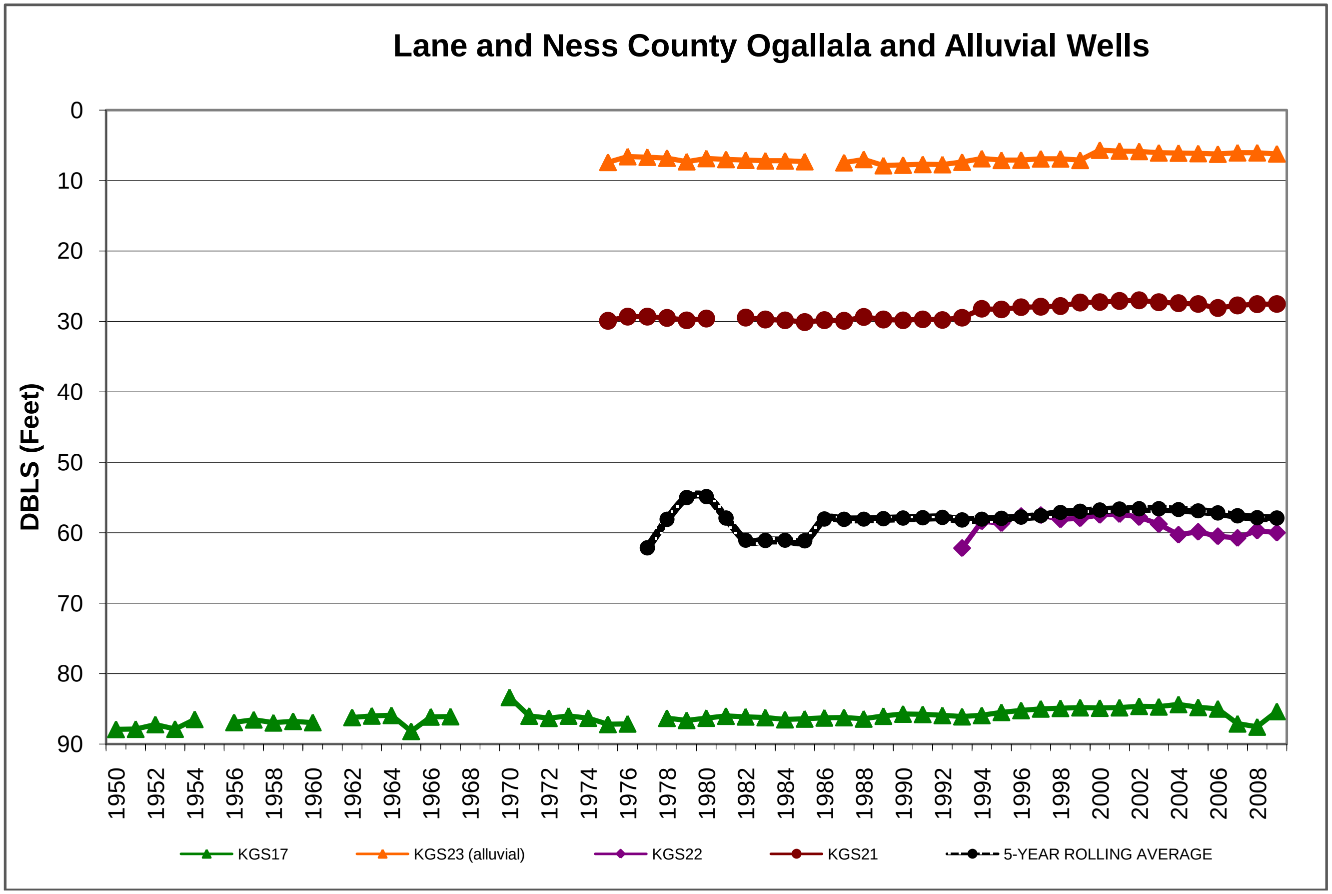

Figure 26: Annually Measured Wells in the Fringe Area of Wallace, Lane and Ness Counties (1950-2009)

Lane County has one monitoring well, KGS17, outside GMD #1 in the Ogallala. Ness County has three monitoring wells, one in the alluvial aquifer and two in the Ogallala (Figure 26). KGS17 has measurements dating back to 1950, and has a net increase of 2.54 ft. The three wells in Ness County, two dating back to 1974 (KGS23 and KGS21) had net increases of 1.21 ft and 2.4 ft, respectively. KGS22 had a net increase of 2.2 ft. Overall from 2008 to 2009, the wells had an average increase of 0.44 ft. The five-year rolling average for Ogallala wells is showing a slight decline (0.17 ft) in water levels since 2004.

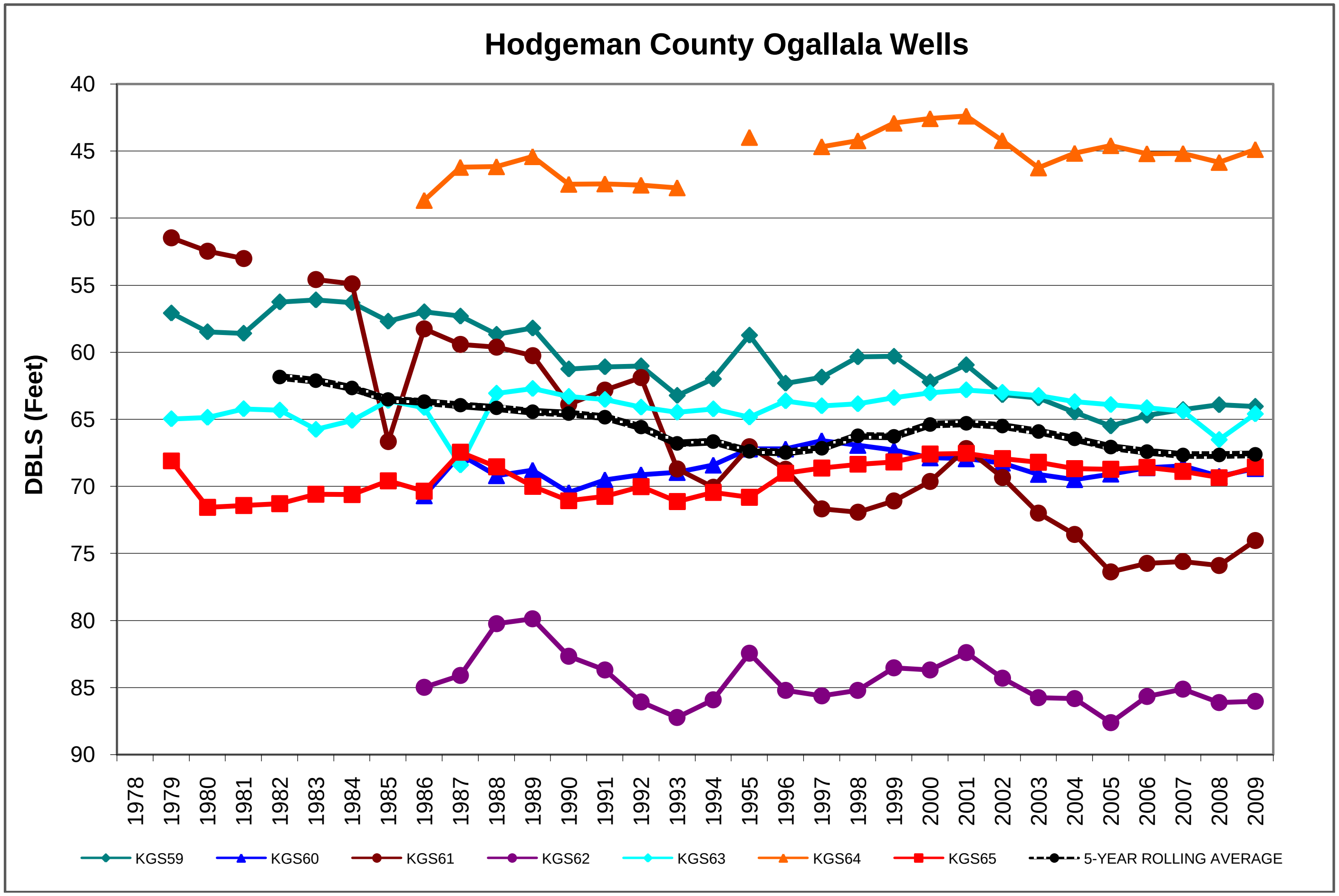

Figure 27: Annually Measured Wells in the Fringe Area of Hodgeman County (1954-2009)

In Hodgeman County there are seven monitoring wells in the fringe area outside GMD #3. From 1954 to 2009, the wells have shown an overall net decline of 4.02 ft. Well KGS61 has a net decline 21.62 ft. From 2008 to 2009 the wells averaged a 0.47 ft decline, with values ranging from a 0.95 increase in KGS61 to a 1.46 decrease in KGS64 (Figure 27). The five-year rolling average has a net decline of 5.76 ft.

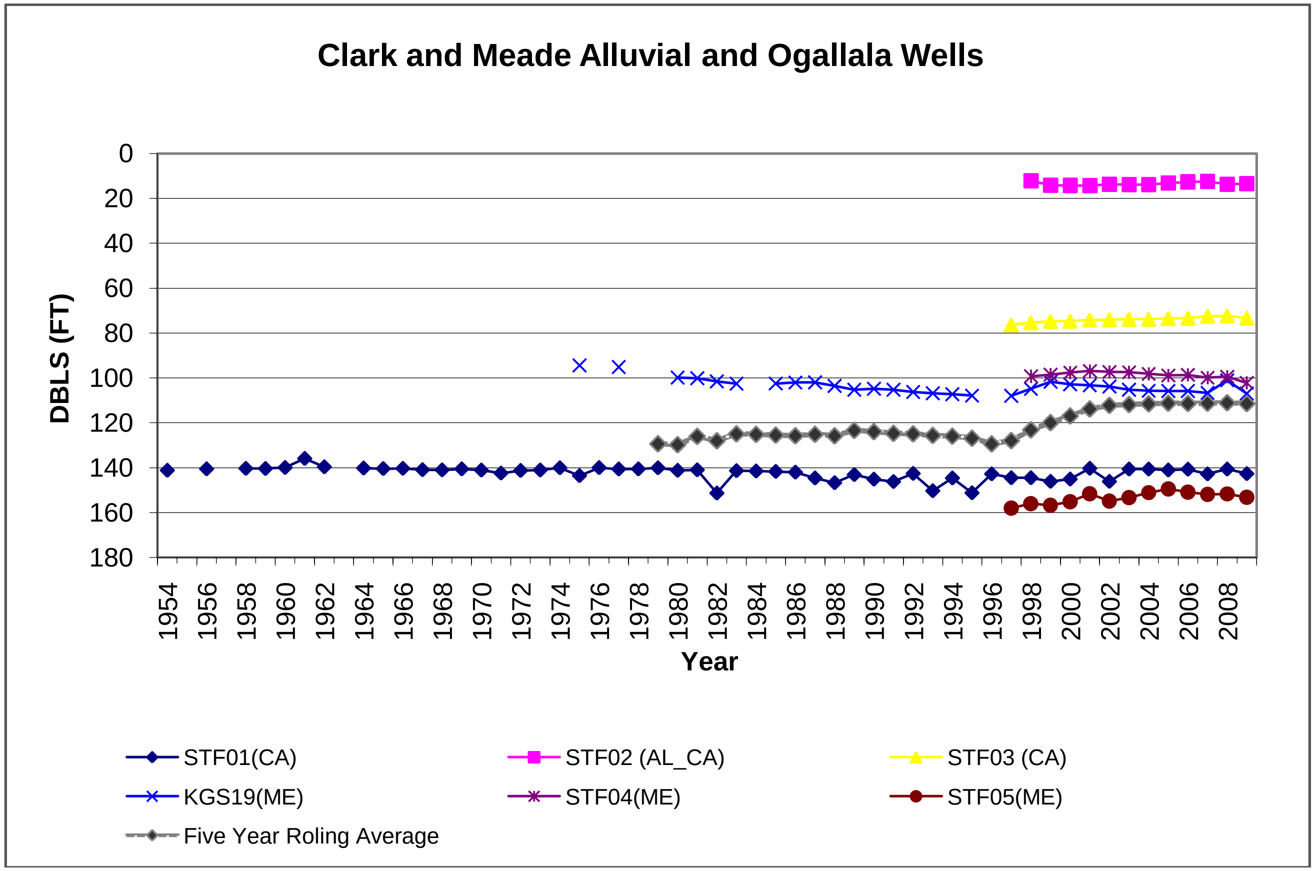

Figure 28: Annually Measured Wells in the Fringe Area of Clark and Meade Counties (1954-2008)

Clark County has three monitoring wells located in the fringe area of GMD #3. STF02 is an alluvial well where as STF01 and STF03 are Ogallala wells. STF02 has had a net decline of 1.27 ft for the period of record, with an increase of 0.21 ft from 2008-2009. KGS01 and STF03 decreased from 2008-2009 by 2.04 ft and 0.97 ft, respectively (Figure 28). Meade County has three monitoring wells that are all Ogallala wells. KGS19 had a net decline of 12.56 ft since 1975, with a 5.87 ft decline from 2008-2009. The other two wells, STF04 and STF05, had a net decrease of 2.95 ft and net increase of 4.83 ft, respectively. The increase in the five-year rolling average for the Ogallala wells in Meade and Clark counties seen in 1997 is likely due to the addition of STF03 to the network.

V. Water Use

The Ogallala-High Plains fringe area has a total of 1,390 water rights with an authorized quantity of 192,492 acre-feet (Table 1). The majority of the water rights are appropriated groundwater rights. Points of diversion and the area queried for water rights are shown in Figure 29.

Table 1: Water Rights in Ogallala - Fringe

Type	Source	No. of Rights	Authorized Quantity (acre-feet)
Vested	Surface	25	12,415
Appropriated	Surface	62	17,219
Vested	Ground	97	10,141
Appropriated	Ground	1,206	152,717
	Total	**1,390**	**192,492**

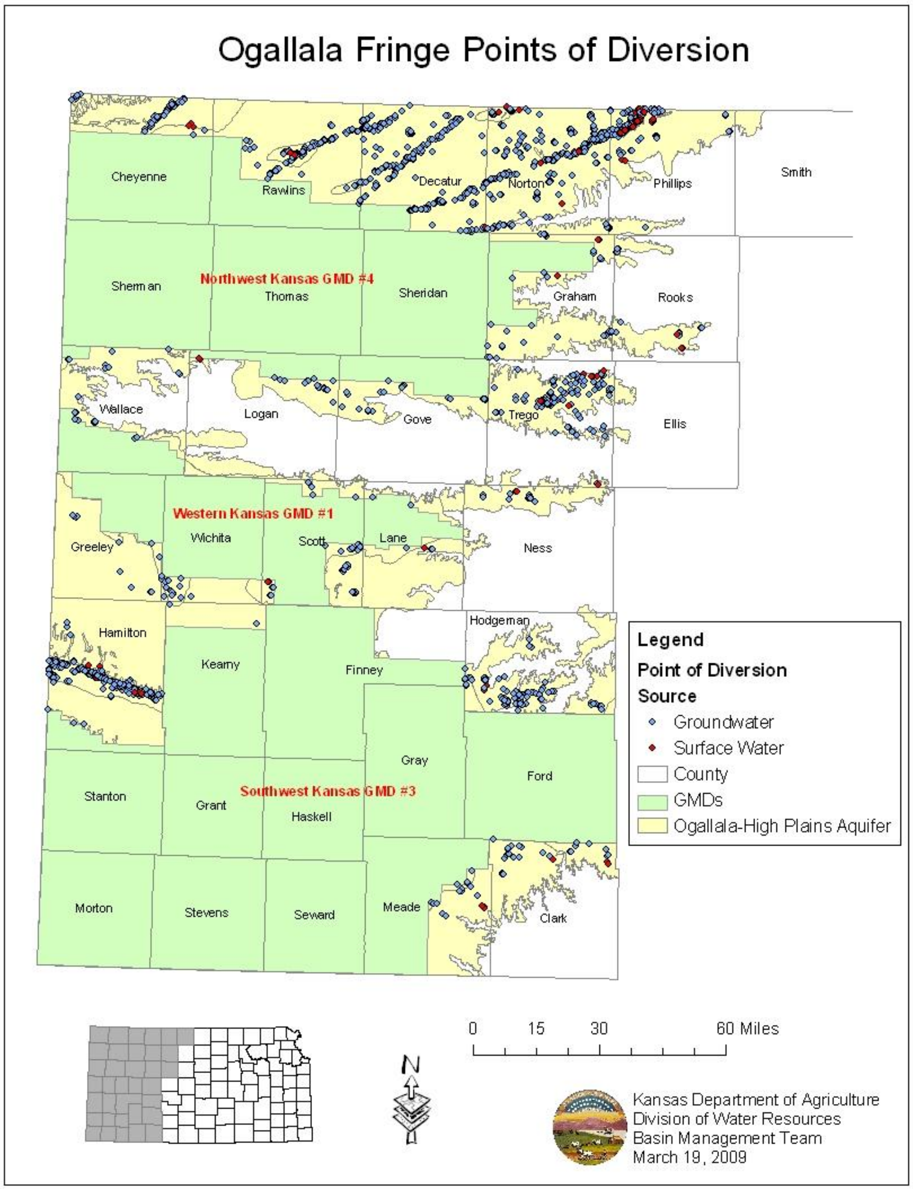

Figure 29: Points of Diversion within the Fringe of the Ogallala-High Plains Aquifer

The water use ranges from 57,081 acre-feet in 1993 to 115,654 acre-feet in 1989. The average water use over the twenty-year span was 92,084 acre-feet (Table 1). Water use in 2007 (the most recent year for complete records are available) was 80,449 acre-feet. This was down from 2006 and below the average for the area (Figure 30). Average groundwater use is 81,646 acre-feet or about 89 percent of the total usage for the twenty year time frame.

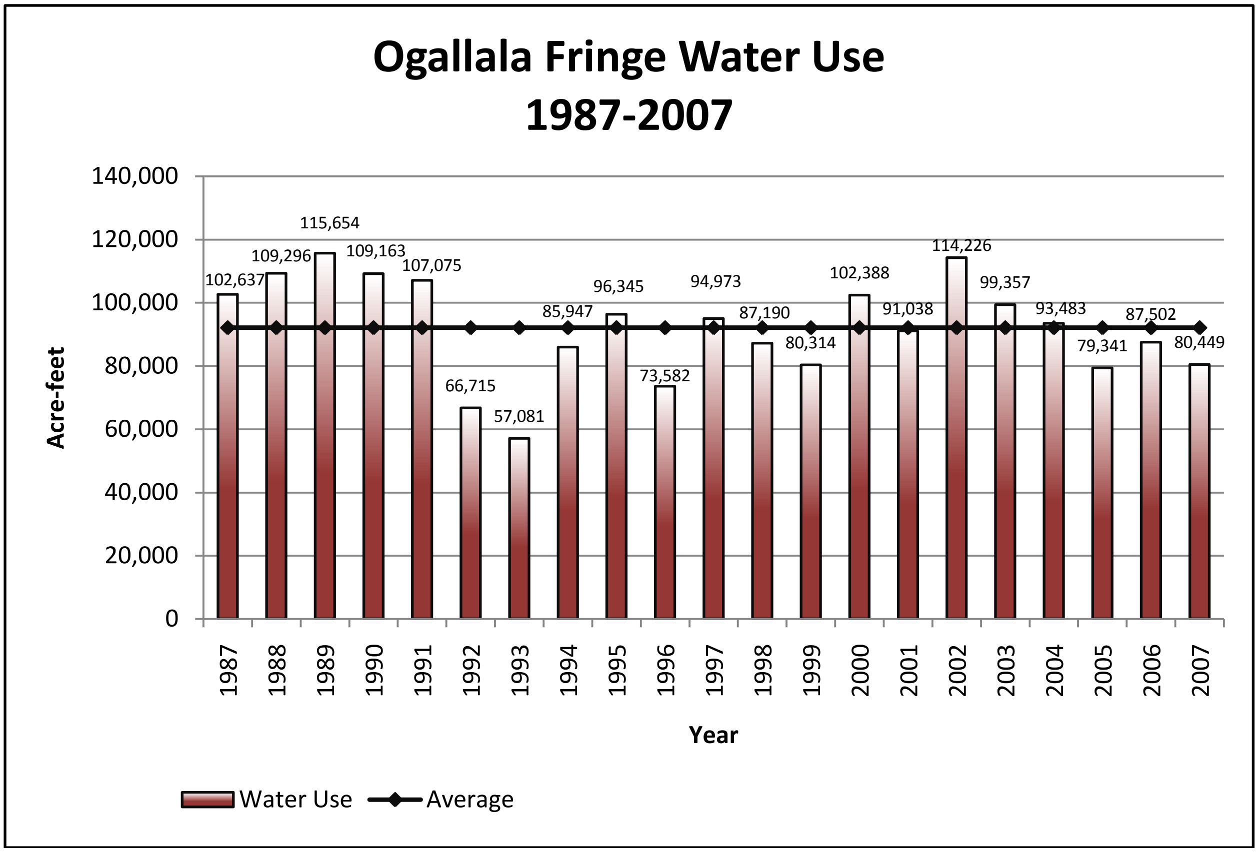

Figure 30: Groundwater Use in the Ogallala-High Plains by Year.

VI. Conclusions

The year 2008 appears to have been an above average year for precipitation. With above average precipitation, average annual streamflow at the USGS gages experienced minor increases at all locations except the Beaver Creek near Ludell, and Prairie Dog Creek near Woodruff, which experienced minor decreases. Groundwater levels in most areas of the fringe continued to remain relatively consistent, with local water levels varying by region. Water use decreased in 2007 and remained below average. Continued monitoring of hydrologic conditions and their response to climate variations is important for evaluating the long-term effects of water usage on this subbasin and protection of property rights. It is equally important to understand how fast the system recovers after recharge events as it is to understand the impacts of pumping and other factors on the hydrologic system.

VII. References

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McGuire, V.L., 2003, Water-level changes in the High Plains aquifer, predevelopment to 2001, 1999 to 2000, and 2000 to 2001: U.S. Geological Survey Fact Sheet FS-078-03, 4 p.

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VIII. Appendix

Monitoring Well ID	USGS ID	Legal Description	County
CN03	395921101331801	01S 38W 02 SWSESW 01	Cheyenne
CN09	395606101391601	01S 39W 25 SWNWSW 01	Cheyenne
CN29	395829101362501	01 38W 08 SWSWSE 01	Cheyenne
STF01	Stafford F.O.	30S 23W 06 NENENE 01	Clark
STF02	Stafford F.O.	30S 23W 13 NWSENW	Clark
STF03	Stafford F.O.	30S 24W 20 SWSWSE	Clark
DC01	393407100143101	05S 26W 33 SESWSW 01	Decatur
DC02	393505100115901	05S 26W 26 SESENE 01	Decatur
DC03	393853100150901	05S 26W 05 NESESE 01	Decatur
DC04	395925100331901	01S 29W 03 SESENW 01	Decatur
DC06	395708100370701	01S 29W 19 NWSESE 01	Decatur
DC08	395458100395501	01S 30W 34 SESESE 01	Decatur
DC09	394248100150801	04S 26W 08 SESESE 01	Decatur
DC11	394110100163301	04S 26W 19 SESWNE 01	Decatur
DC12	394005100215501	04S 27W 33 NWNWNW 01	Decatur
DC13	393814100305401	05S 28W 07 NWNWSW 01	Decatur
DC14	393820100273201	05S 28W 10 NWNWNW 01	Decatur
DC19	395636100192601	01S 27W 26 NWNWNE 01	Decatur
DC20	395405100305801	02S 29W 01 SESESE 01	Decatur
DC21	395813100272801	01S 28W 15 SWNWNW 01	Decatur
DC22	395807100215901	01S 27W 17 NESENE 01	Decatur
DC24	395115100155301	02S 26W 29 SENENW 01	Decatur
DC25	394913100404001	03S 30W 03 NWNESW 01	Decatur
DC27	395642100425401	01S 30W 20 SWSESW 01	Decatur
DC29	395307100243001	02S 28W 13 NENWNE 01	Decatur
DC31	394859100301701	03S 28W 06 NWSWSE 01	Decatur
DC32	394846100314901	03S 29W 12 NENWNW 01	Decatur
DC33	394715100355501	03S 29W 17 NWSWSE 01	Decatur
DC36	394432100370401	03S 29W 31 SWSWSE 01	Decatur
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KGS04	394504100293601	03S 28W 32 NWSWNE 01	Decatur

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GO12	385635100402501	13S 30W 08 NESENW 01	Gove
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GO15	385941100095001	12S 26W 24 NENWSW 01	Gove
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GO17	390022100363001	12S 30W 13 NWSWSW 01	Gove
GH02	391451099512701	09S 23W 26 NENENW 01	Graham
GH07	393216099503801	06S 23W 13 NWNWNW 01	Graham
GH16	393223100040801	06 25W 12 SWSWSW 01	Graham
GH18	392611099493301	07 22W 19 NWNWNW 01	Graham
GH23	391400099474801	09S 22W 32 NENENWNE 01	Graham
GH24	391312099573601	09S 24W 35 SESESE 01	Graham
GH25	391153099584301	10S 24W 10 SESENE 01	Graham
GH26	390943099580101	10S 24W 23 SWSWSE 01	Graham
GH27	391031100052901	10S 25W 22 NENENE 01	Graham
GH28	391450100083601	09S 25W 29 NWNWNW 01	Graham
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GH32	391545099420601	09S 21W 19 NWNENE 01	Graham
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KGS16	381422101385501	21S 39W 07 SWNWNE 01	Hamilton
KGS59	375912099503201	24S 23W 03 SWSWSW 01	Hodgeman
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KGS63	375636099592101	24S 24W 20 SWSWSW 01	Hodgeman
KGS64	380149100122201	23S 26W 20 SWSWSW 01	Hodgeman
KGS65	380005100130401	23S 26W 31 SESESW 01	Hodgeman
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KGS47	390252100551301	11S 32W 31 SESWSW 01	Logan
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LG12	390048100522701	12S 32W 16 NESWNE 01	Logan
LG13	390254101053801	11S 34W 33 SWSESE 01	Logan
KGS19	371931100115501	31S 26W 30 NWNWNW 01	Meade
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