



Ogallala-High Plains Fringe Area

2009 Field Analysis Summary

May 26, 2010

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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).

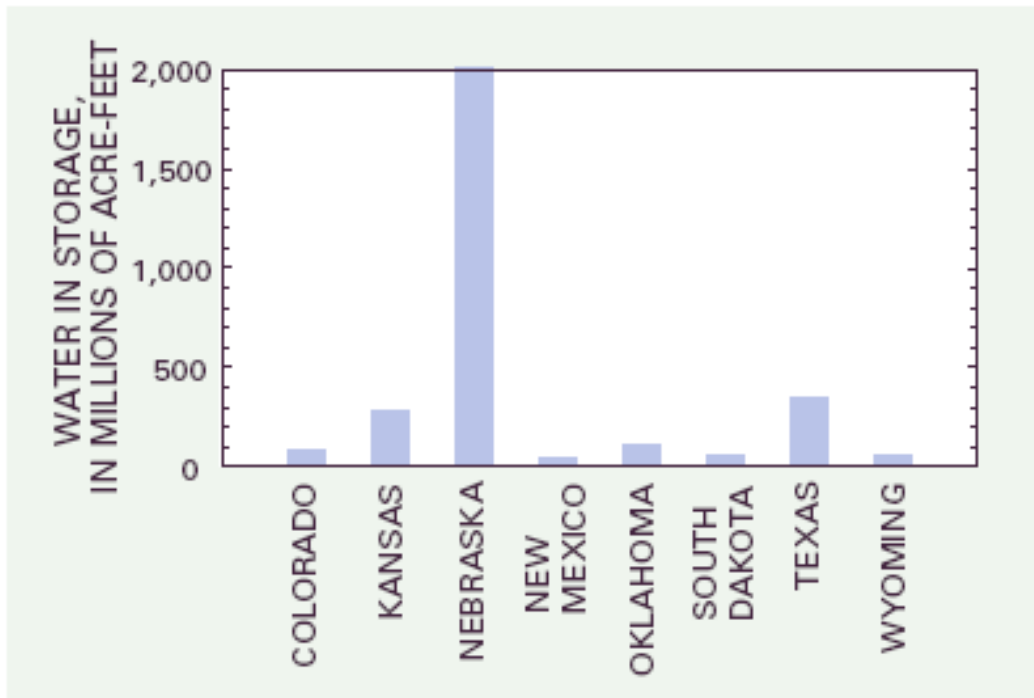


Figure 1: Water in storage in the Ogallala-High Plains aquifer, 2000, by state

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 to the Ogallala aquifer vary from 0.024 inches per year in part of Texas to about 1.9 inches per year in southwestern 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.

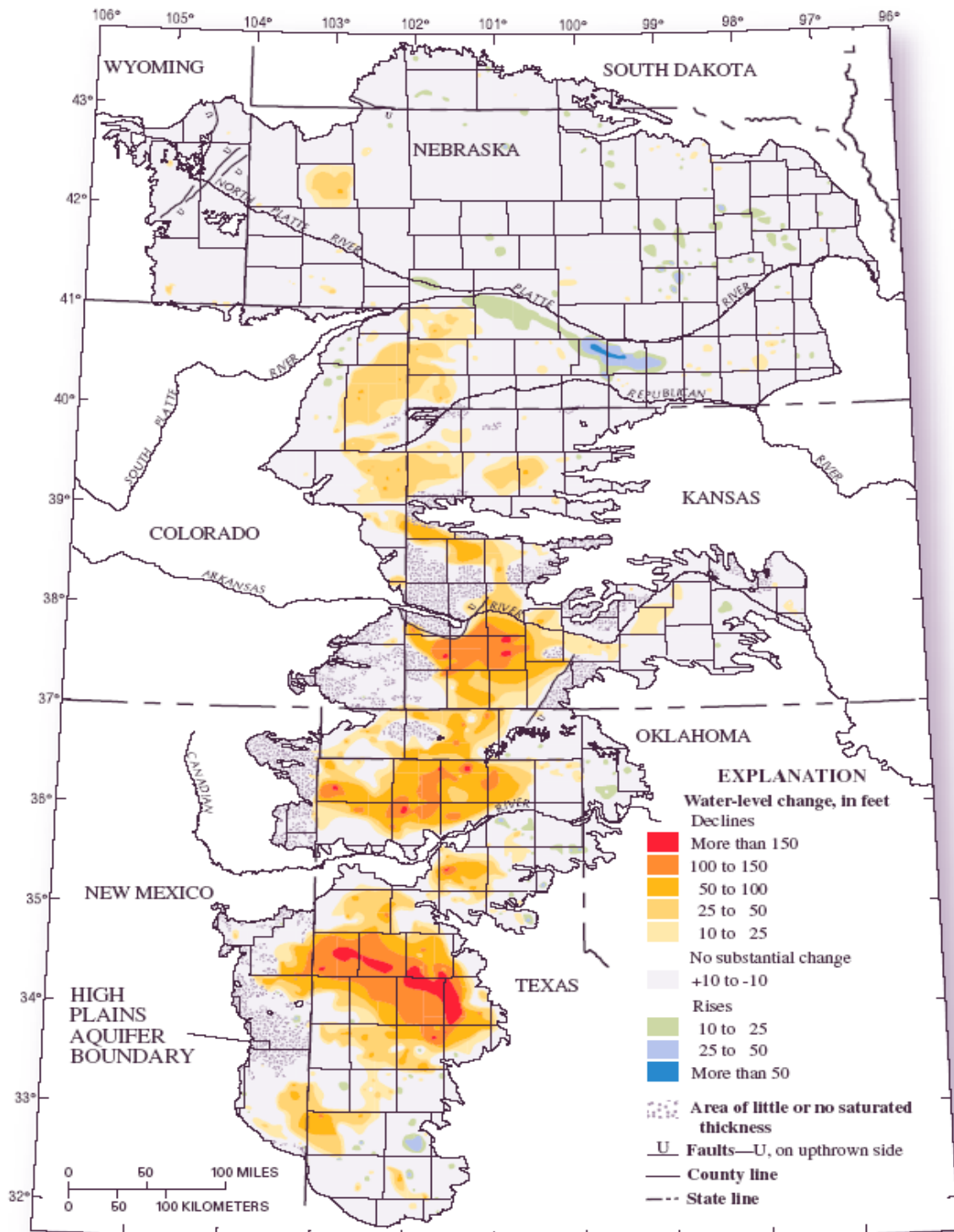


Figure 2: Water level changes in the Ogallala-High Plains aquifer, predevelopment to 2003 (Nebraska Conservation and Survey Division, 2004)

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 historically averages 20.3 inches 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 several years of precipitation below 15 inches per year. In contrast, numerous years had precipitation greater than 25 inches per year. In 2008, the precipitation total was 23.9 inches, which is above average. Annual precipitation data for these NCDC stations is currently available through 2008. Preliminary 2009 monthly precipitation is available through November and is shown in Figure 4. The highest precipitation was in May with an average of 4.1 inches, and the lowest precipitation was in March with an average of 0.1 inches. Excluding December, the total average precipitation for 2009 was 25.3 inches. This is higher than the historical annual average of 20.3 inches.

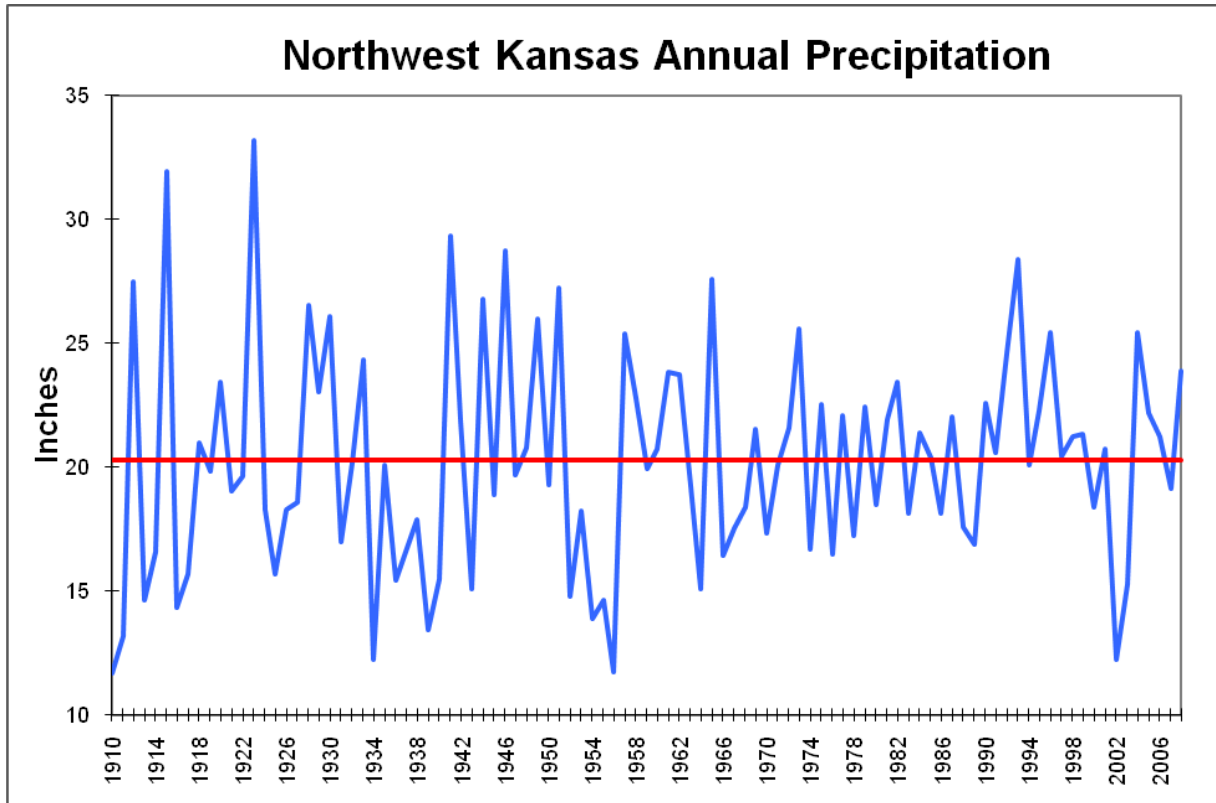


Figure 3: Annual Precipitation for Northwest Kansas, 1910-2008

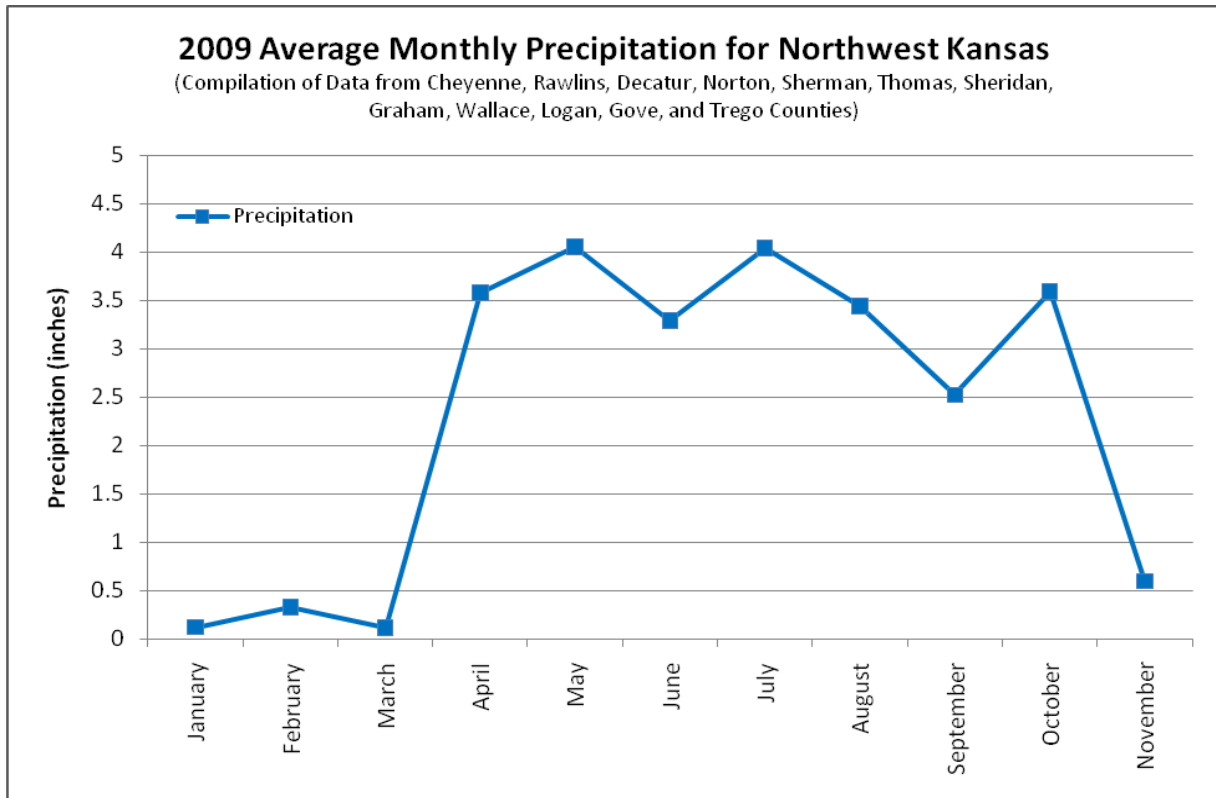


Figure 4: Average Monthly Precipitation 2009

III. Surface Water

Four tributaries in the northwest Kansas Ogallala-High Plains fringe area (outside GMD #4) have historical U.S. Geological Survey (USGS) gage data available. They include the 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.

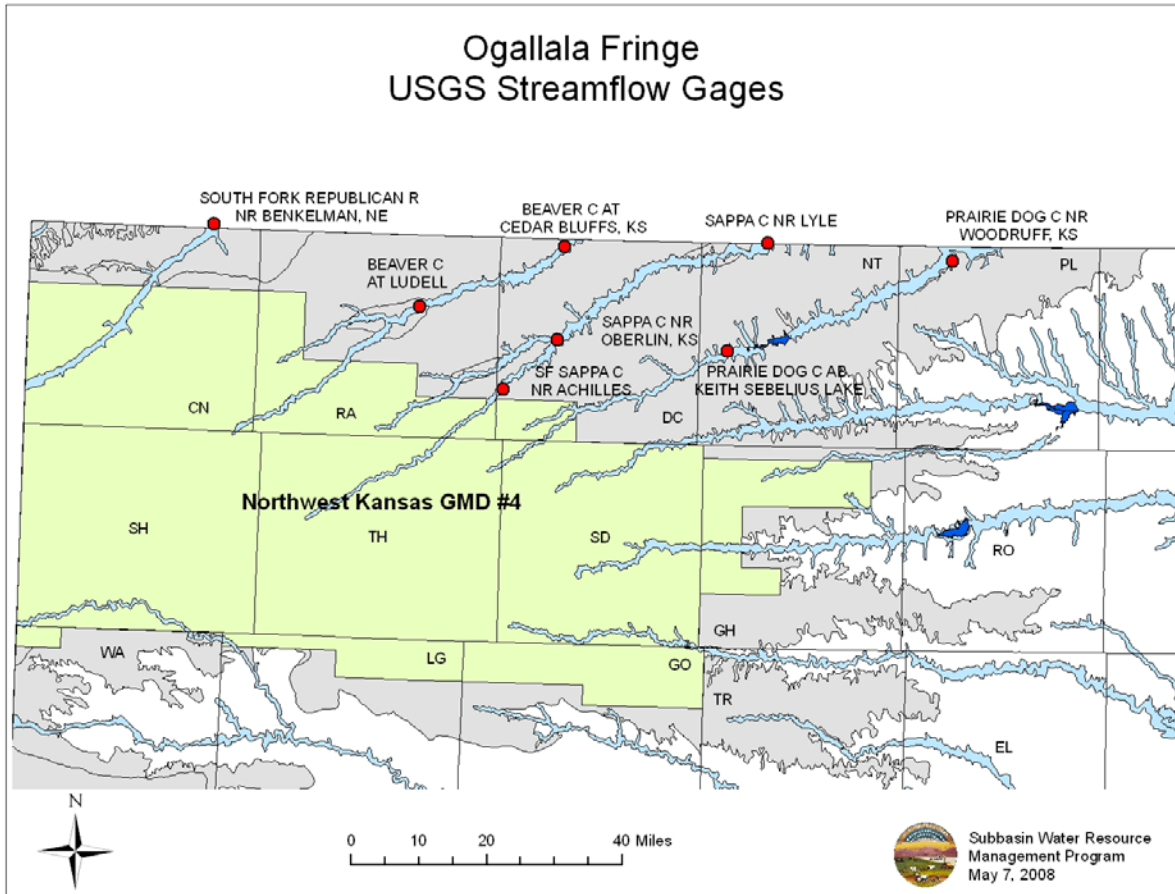


Figure 5: USGS Streamflow gages in the Northwest Kansas Ogallala-High Plains Fringe

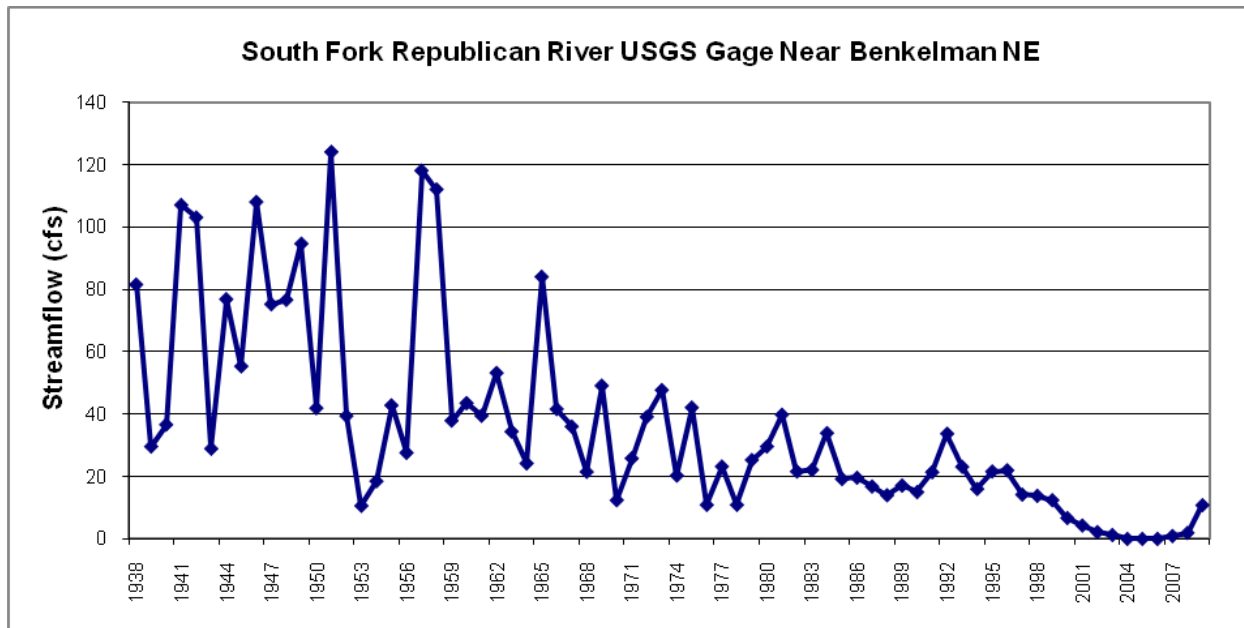


Figure 6: Streamflow for South Fork Republican River near Benkelman, NE 1938-2009

The section of the South Fork Republican River from the GMD #4 boundary to the Kansas-Nebraska state line south of Benkelman, Nebraska (Figure 5) 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 2008 annual mean data at this gage displays a significant decrease in streamflow over time (Figure 6). The long-term average streamflow is 36.26 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; however preliminary 2009 average streamflow data was up at 10.8 cfs.

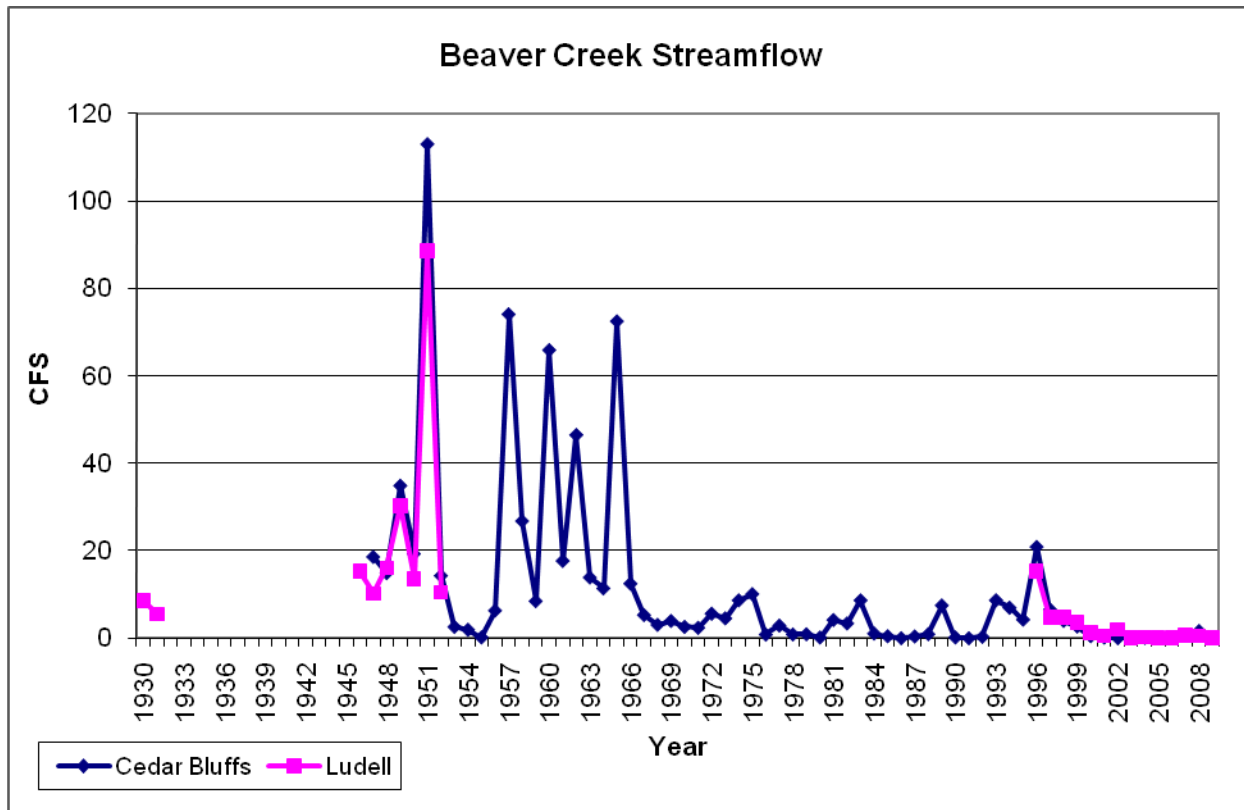


Figure 7: Streamflow for Beaver Creek at Ludell and Cedar Bluffs 1930-2009

The Ludell gage is located about five 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 11.49 cfs and 10.54 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 0.56 cfs at Ludell and 0.35 cfs at Cedar Bluffs from 2000-2008. Preliminary 2009 average streamflow shows a decrease at both Ludell and Cedar Bluffs from 2008. Ludell is down at 0.003 cfs and Cedar Bluffs is down at 0.202 cfs.

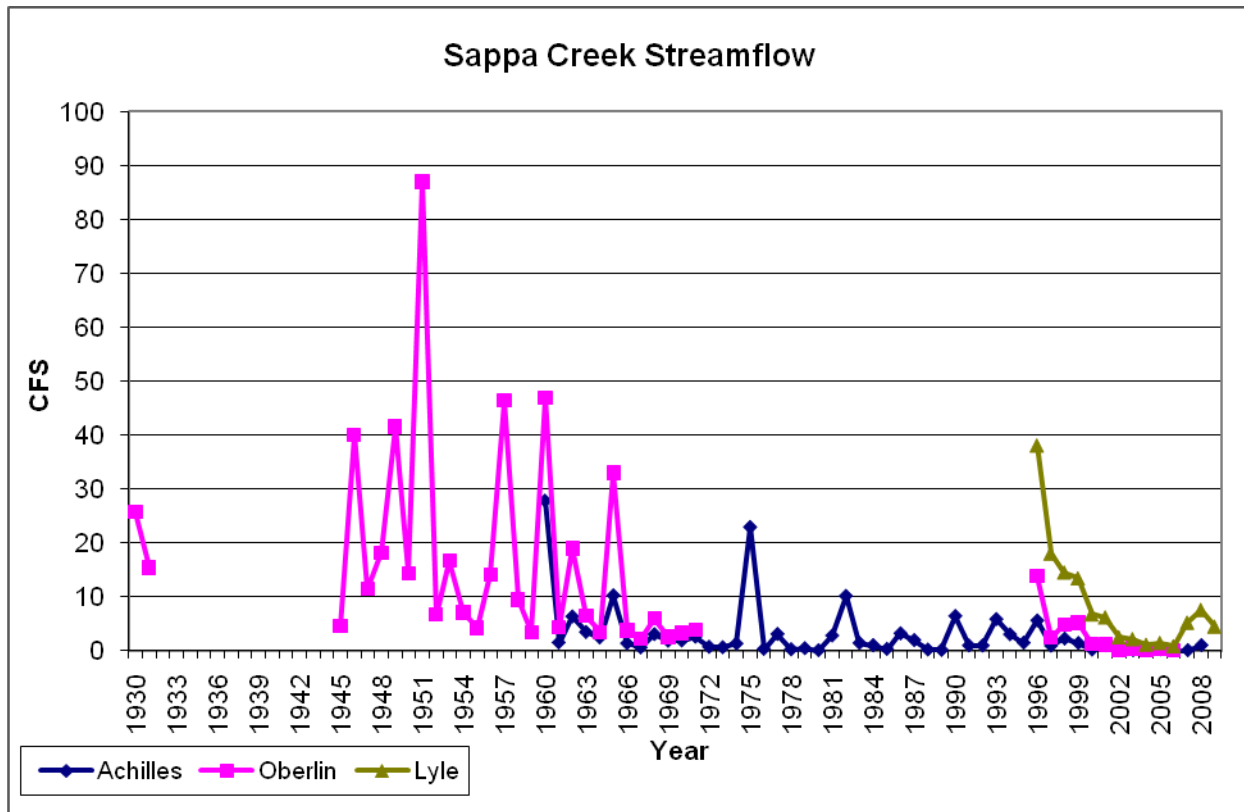


Figure 8: Streamflow for Sappa Creek at Lyle, Achilles and Oberlin 1930-2009

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 removed from 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 2.91 cfs, 13.23 cfs at Oberlin, and 9.02 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 0.24 cfs at Achilles, 0.44 cfs at Oberlin (2000-2006), and 3.70 cfs at Lyle from 2000-2008. Preliminary 2009 average streamflow through September at Achilles is 0.23 cfs. At Lyle, preliminary 2009 average streamflow is 4.44 cfs, which is below 2008 streamflow.

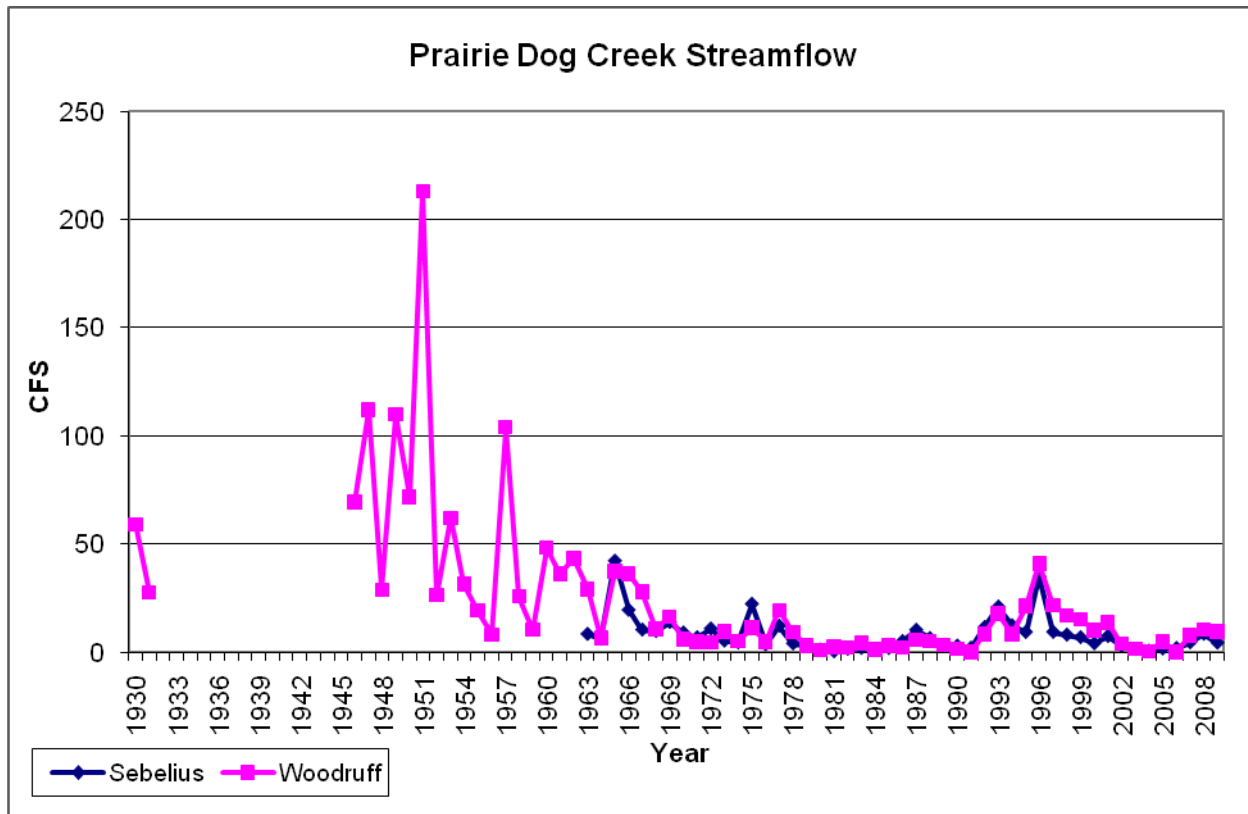


Figure 9: Streamflow for Prairie Dog Creek near Woodruff 1930-2009

The Sebelius gage is located approximately five 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 streamflow at Sebelius was 8.10 cfs and 24.39 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 3.57 cfs at Sebelius and 5.86 cfs at Woodruff from 2000-2008. Preliminary 2009 average streamflow at Sebelius is 4.24 cfs and at Woodruff is 9.62 cfs, which is lower than 2008 data.

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 Kansas Department of Agriculture, Division of Water Resources (KDA-DWR) 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 KDA-DWR measures water levels in the Ogallala-High Plains fringe areas throughout western Kansas. There are currently 156 wells measured annually. KDA-DWR collects additional water level measurements tri-annually, in the winter, spring and fall. Only winter

measurements, taken in December, January or February, are used for the monitoring well water level charts, since those measurements are considered to be the least influenced by groundwater pumping. Figure 11 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.

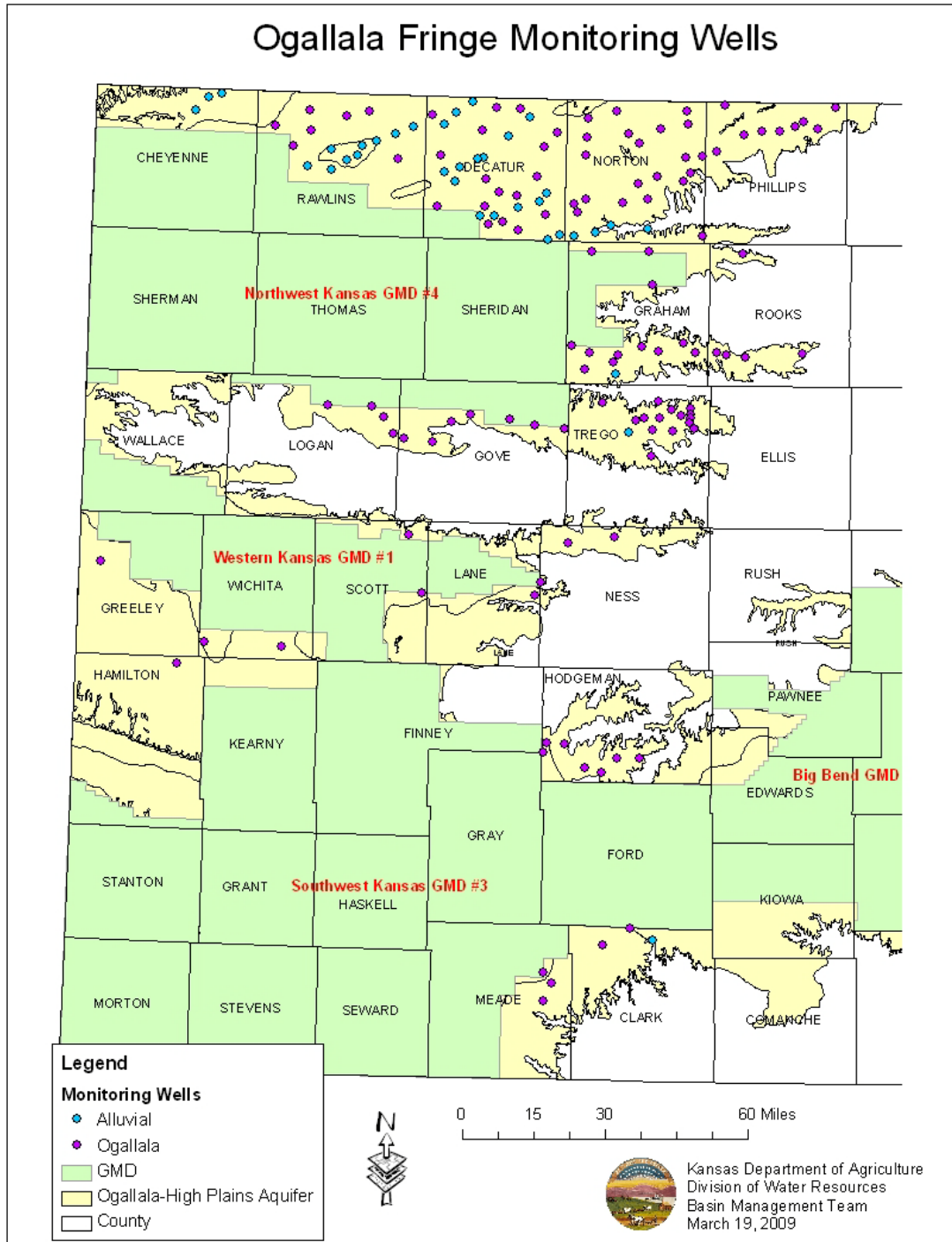


Figure 10: Monitoring wells in the fringe of the Ogallala-High Plains project area

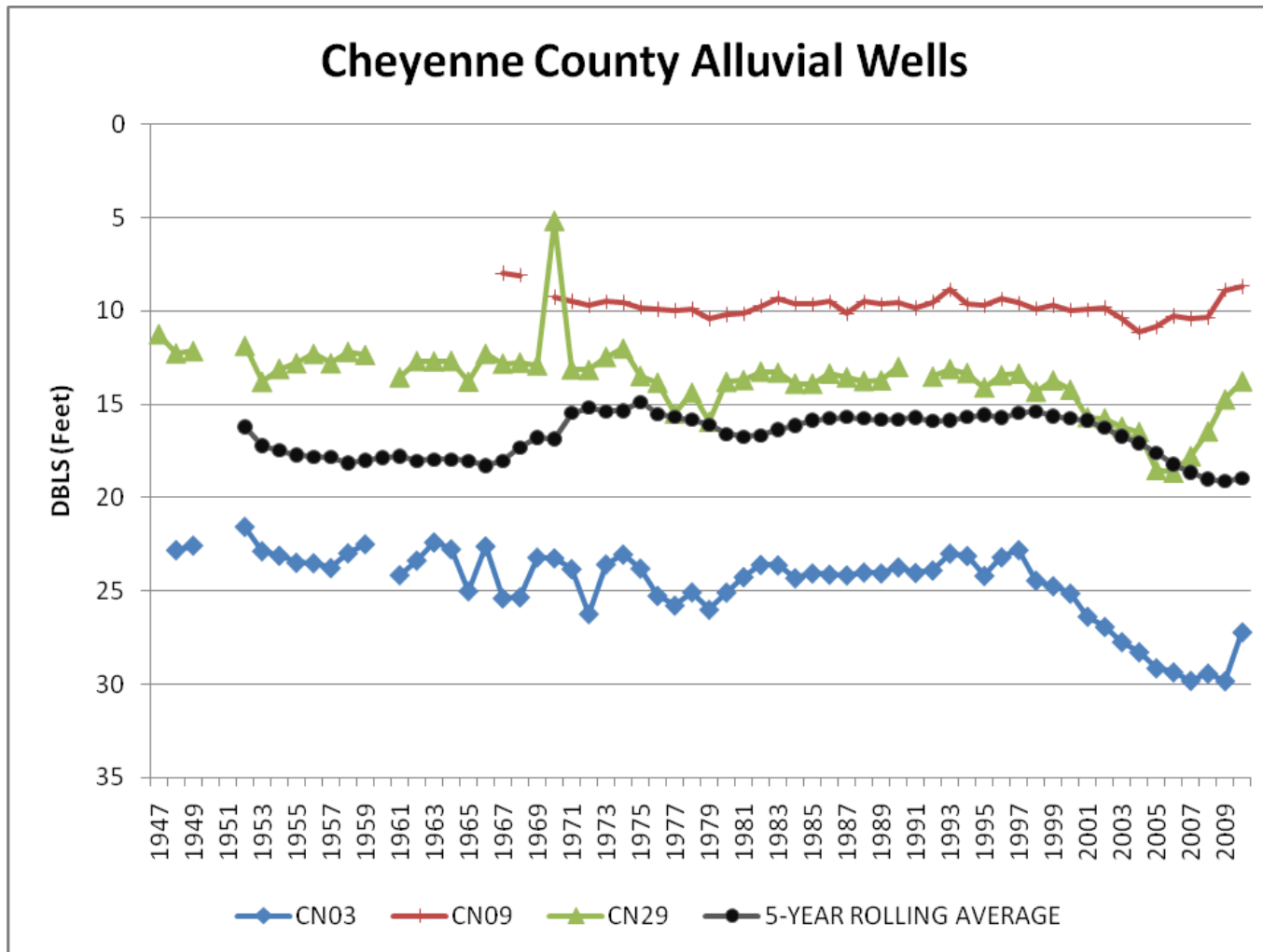


Figure 11: Alluvial Monitoring Well Levels in Cheyenne County Fringe

There are three alluvial monitoring wells in Cheyenne County. CN29 has the longest period of 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 4 feet since 1948, while CN09 and CN29 have experienced net declines of 0.69 feet and 2.5 feet respectively (Figure 11). From 2009 to 2010 CN03, CN09 and CN29 experienced increases of 2.61 feet, 0.2 feet, and 0.97 feet respectively. The five-year rolling average has declined 3.20 feet since 2000.

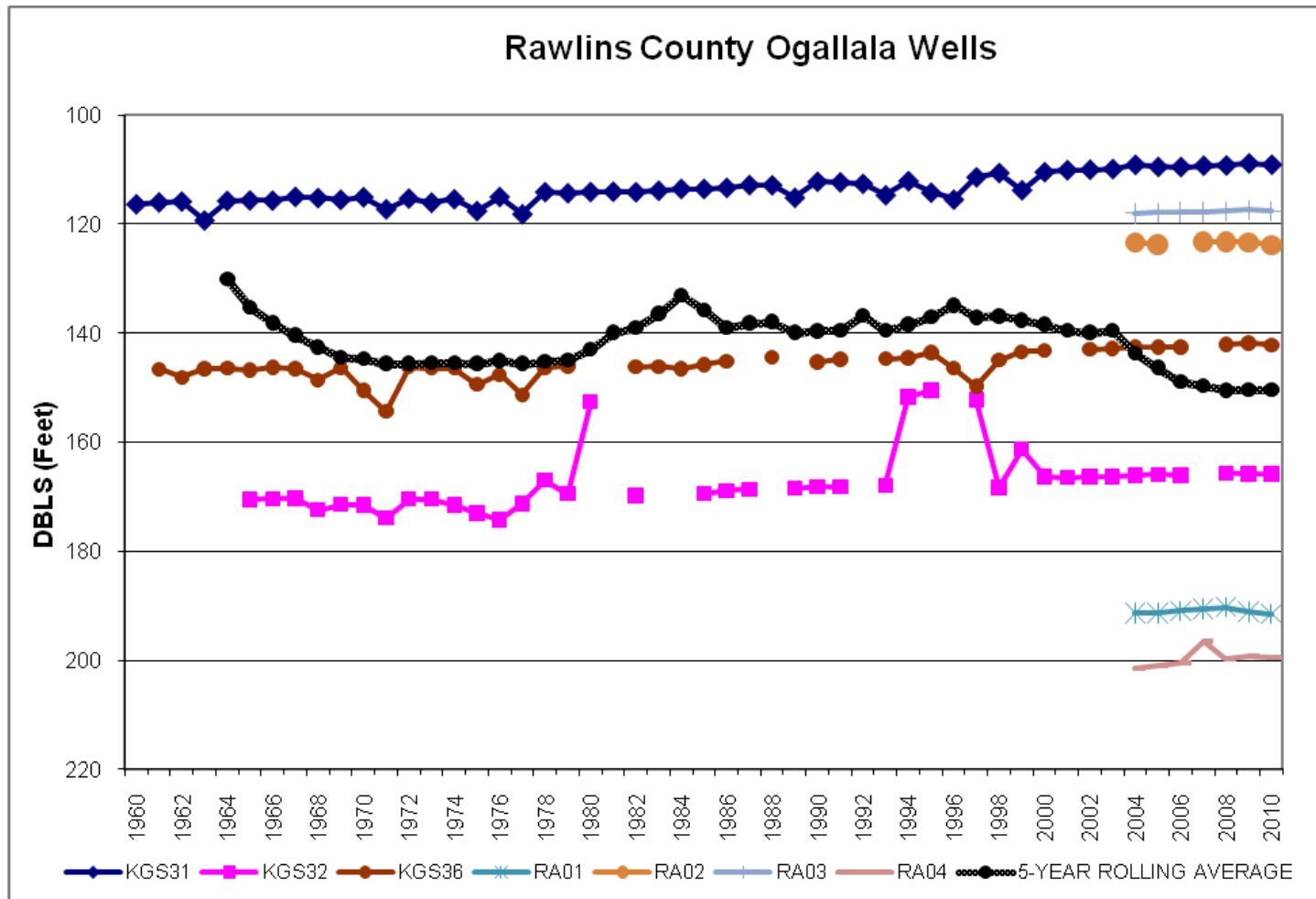


Figure 12: Ogallala-High Plains Monitoring Well Levels in Rawlins County Fringe

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. KDA-DWR added monitoring wells RA01, RA02, RA03 and RA04 to the data analysis in 2008 and these wells have measurements since 2004. From 2009 to 2010, the wells had an average overall decline of 0.26 feet. However, over the period of record, the water levels exhibit an average net increase of 2.57 feet (Figure 12). Since 1960, KGS31 has a net increase of 7.18 feet. 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.

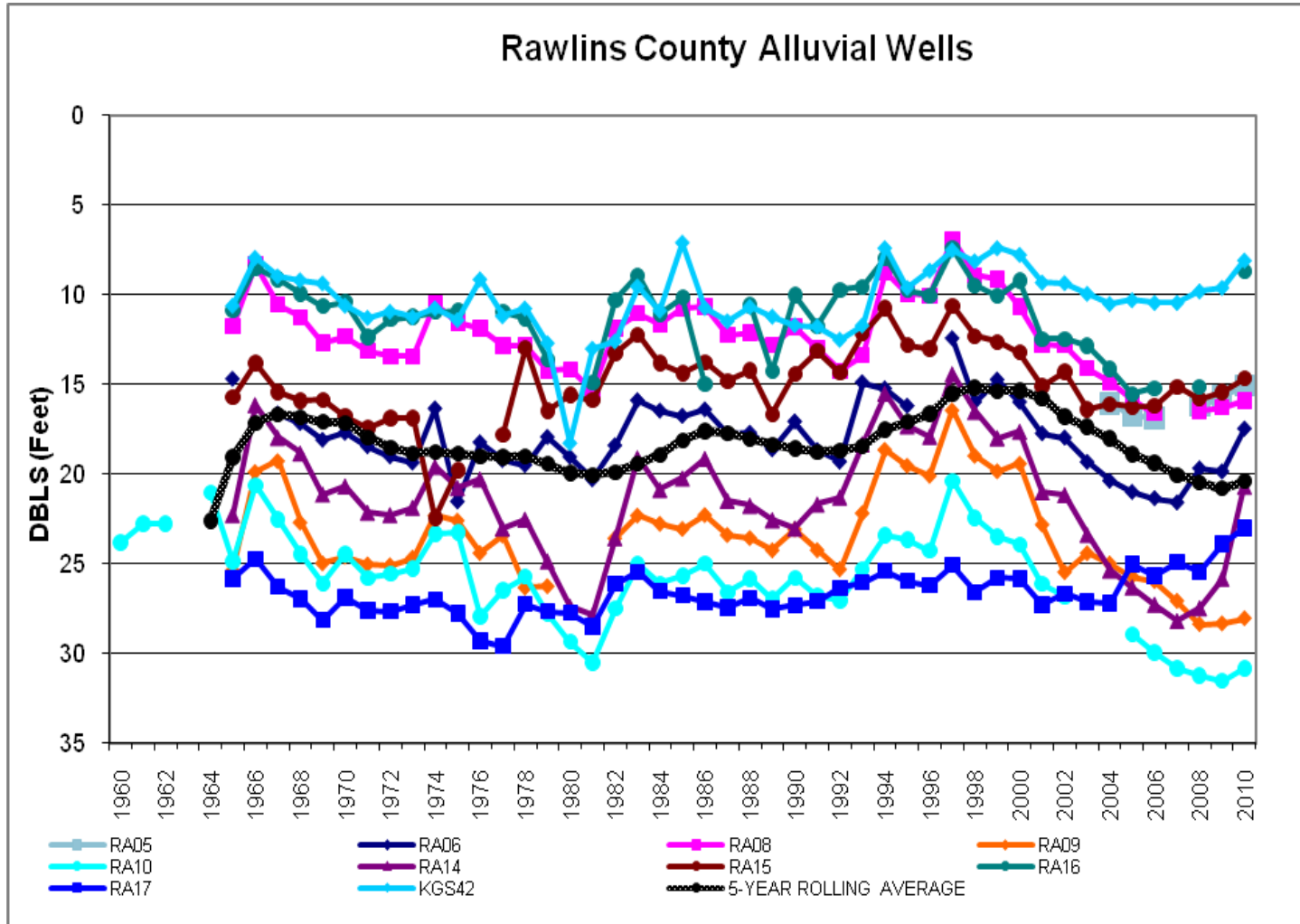


Figure 13: Alluvial Monitoring Well Levels in Rawlins County Fringe

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 feet 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 7.03 feet since 1960.

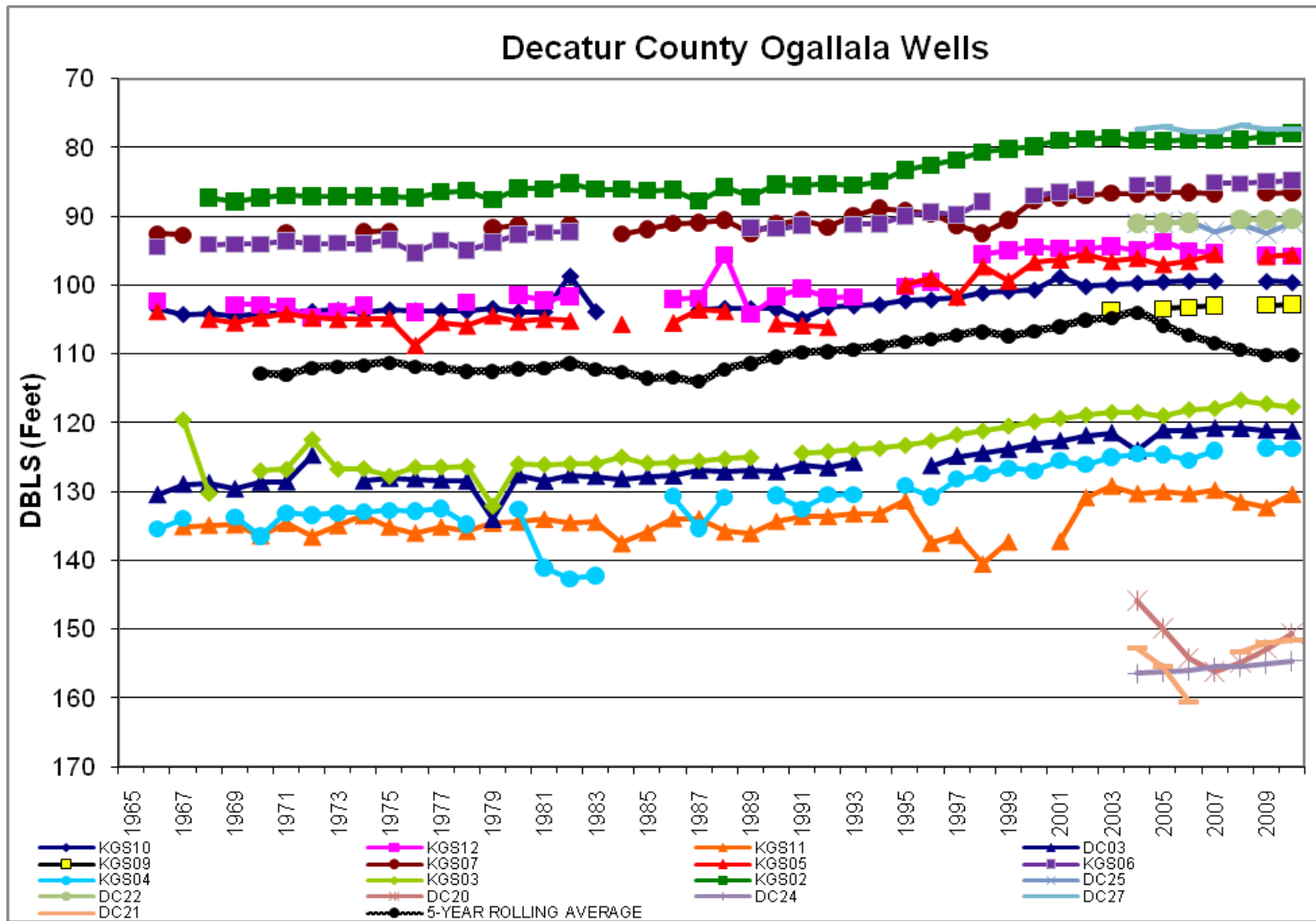


Figure 14: Ogallala-High Plains Monitoring Well Levels in Decatur County Fringe

Decatur County has a number of wells where measurements begin in 1965. Seventeen monitoring wells have been charted in Figure 13. KDA-DWR added monitoring wells DC20, DC21, DC22, DC24, DC25 and DC27 to the 2008 data analysis and these wells have measurements since 2004. Ogallala wells in Decatur County show an average 4.27 feet net increase. The addition of the deeper wells in 2004 may be pulling the five-year average down slightly.

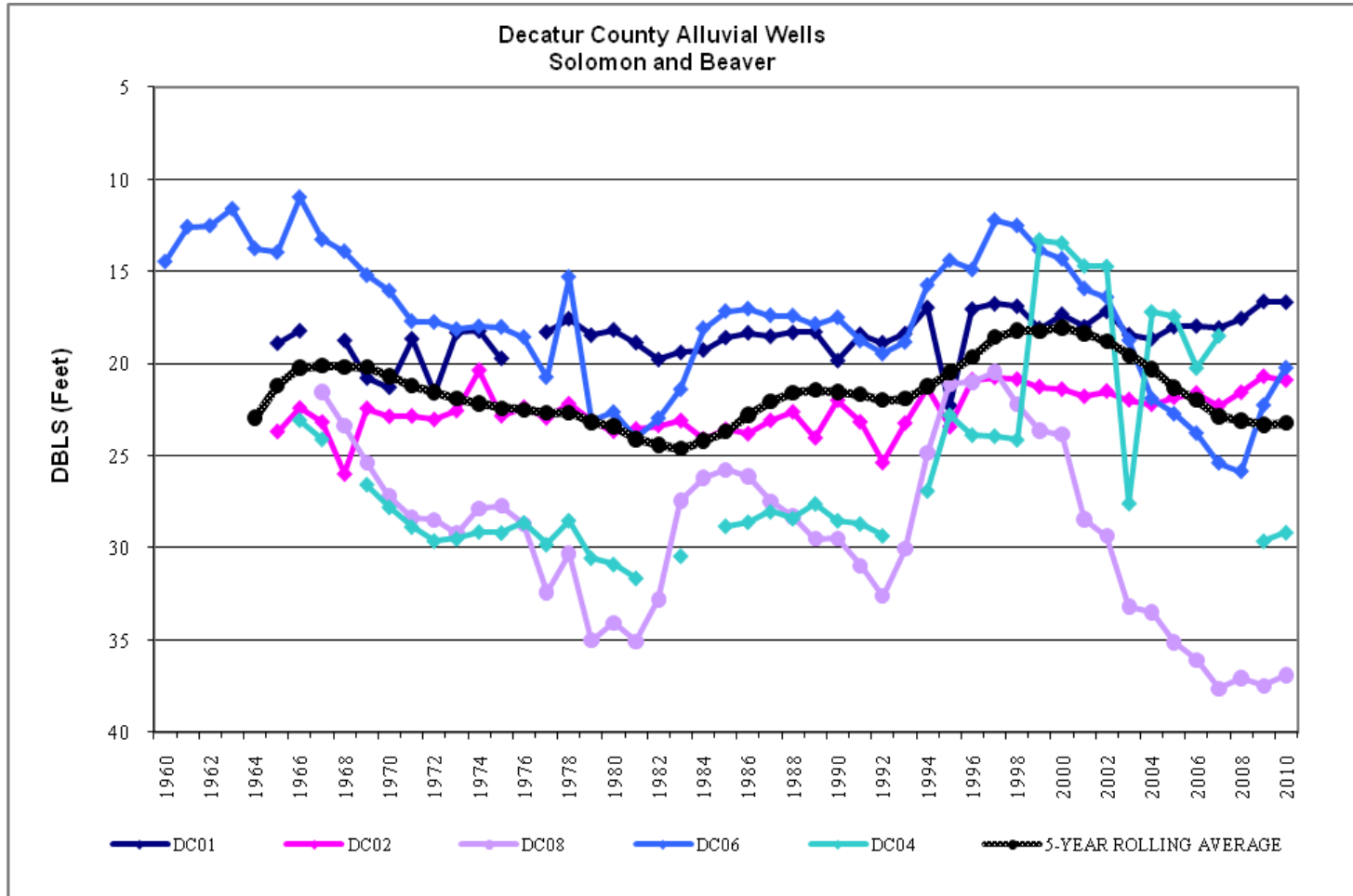


Figure 15: Alluvial Monitoring Well Levels in Decatur County, Upper North Solomon and Beaver Creek Fringe

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 2.24 feet and 2.78 feet respectively since 1965. The other three wells are in the Beaver Creek alluvium. Both DC06 and DC08 have net declines of 5.77 feet and 15.38 feet respectively; however DC06 has risen 5.62 feet since 2008. DC04 had periods of increase in the late 1990s to early 2000s, but has an overall net decline of about 6 feet. (Figure 15)

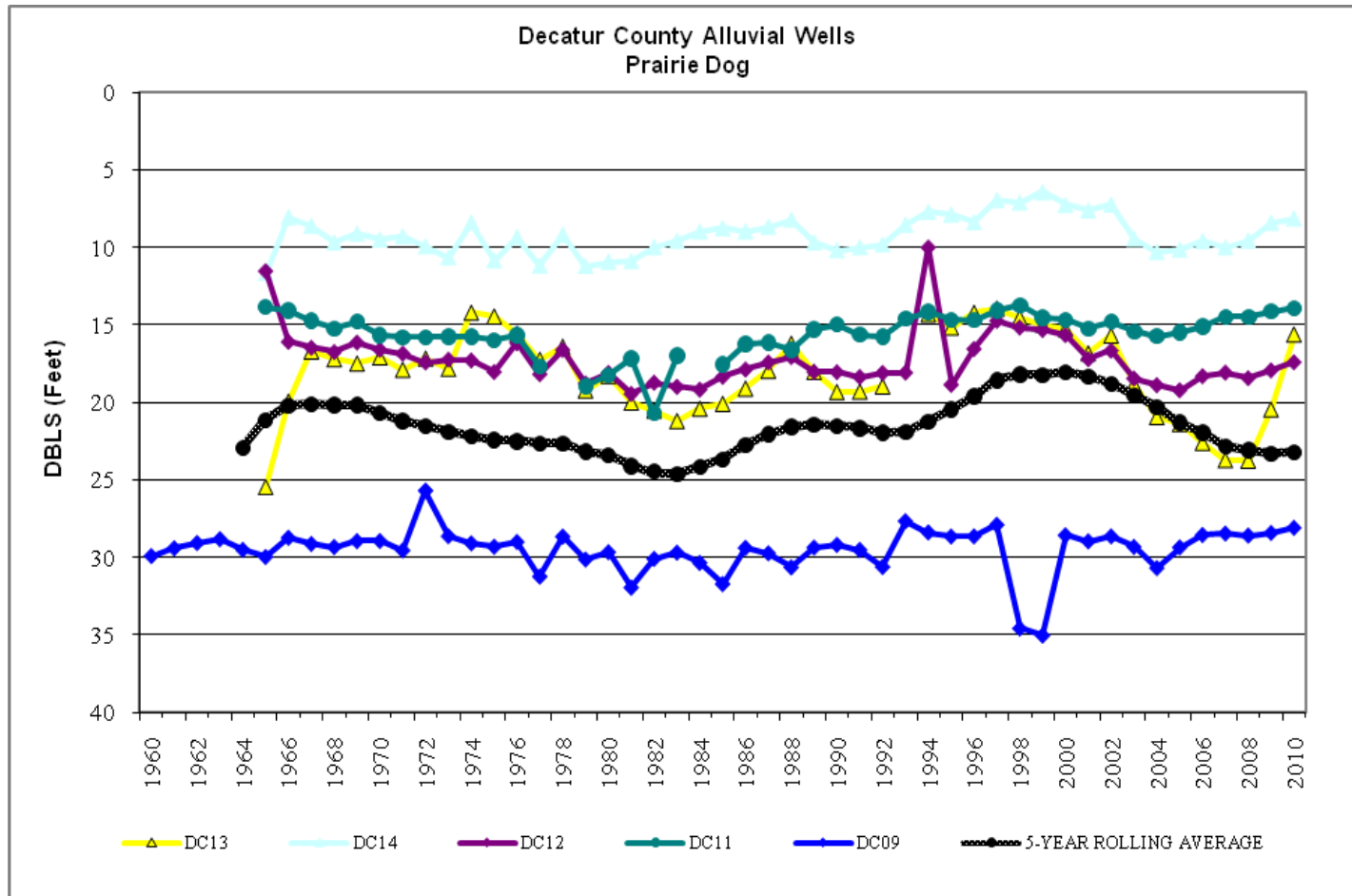


Figure 16: Alluvial Monitoring Well Levels in Decatur County, Prairie Dog Creek Fringe

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 feet) since its inception. Even with a declining trend from 2002 to 2008, DC13 has increased nearly 10 feet since 1965. The other three wells have maintained relatively stable 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, but overall remained relatively stable.

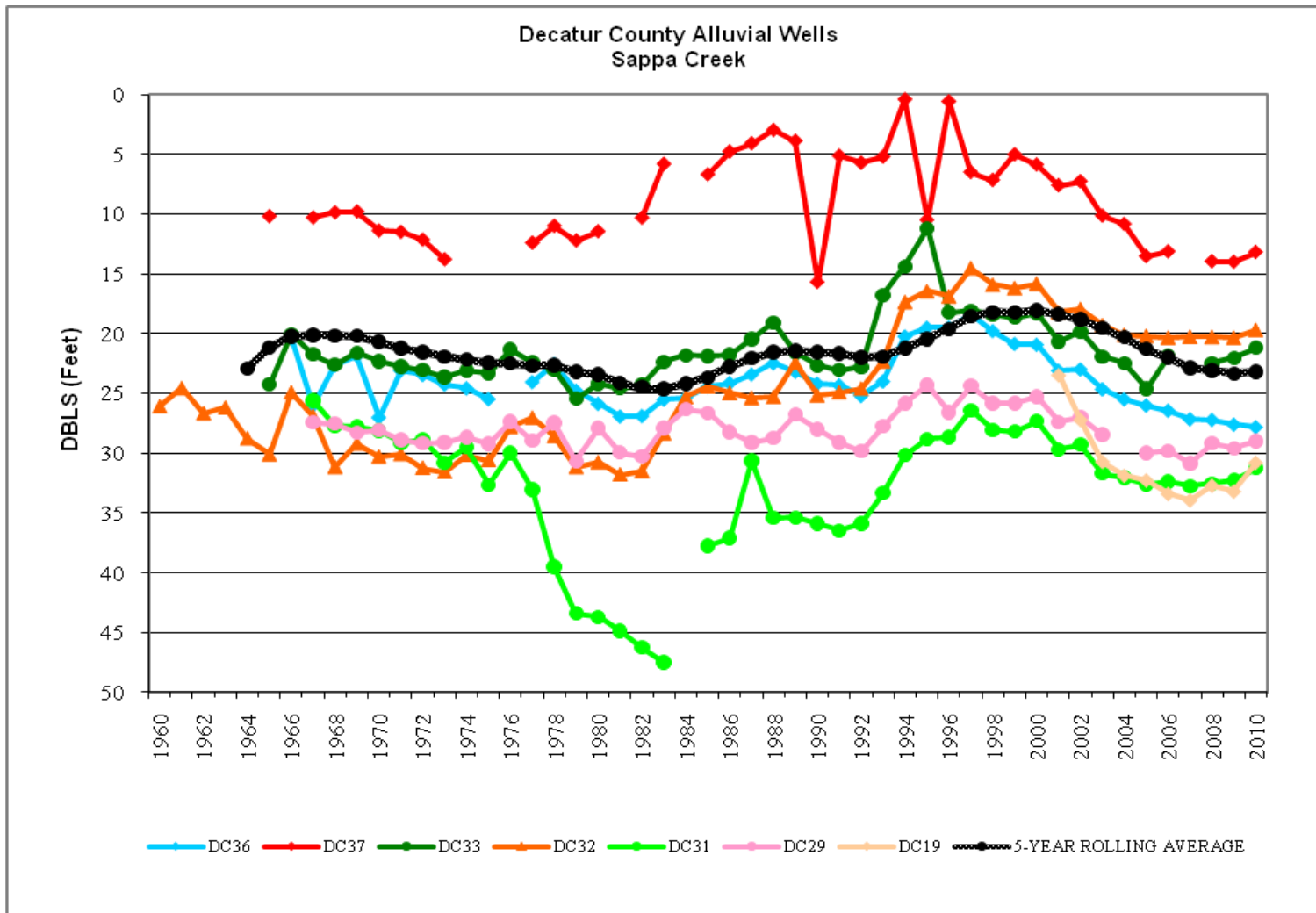


Figure 17: Alluvial Monitoring Well Levels in Decatur County, Sappa Creek Fringe

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 5.65 feet and DC19 declining 7.32 feet. DC32 and DC33 had net increases of 6.4 feet and 3.06 feet respectively (Figure 17).

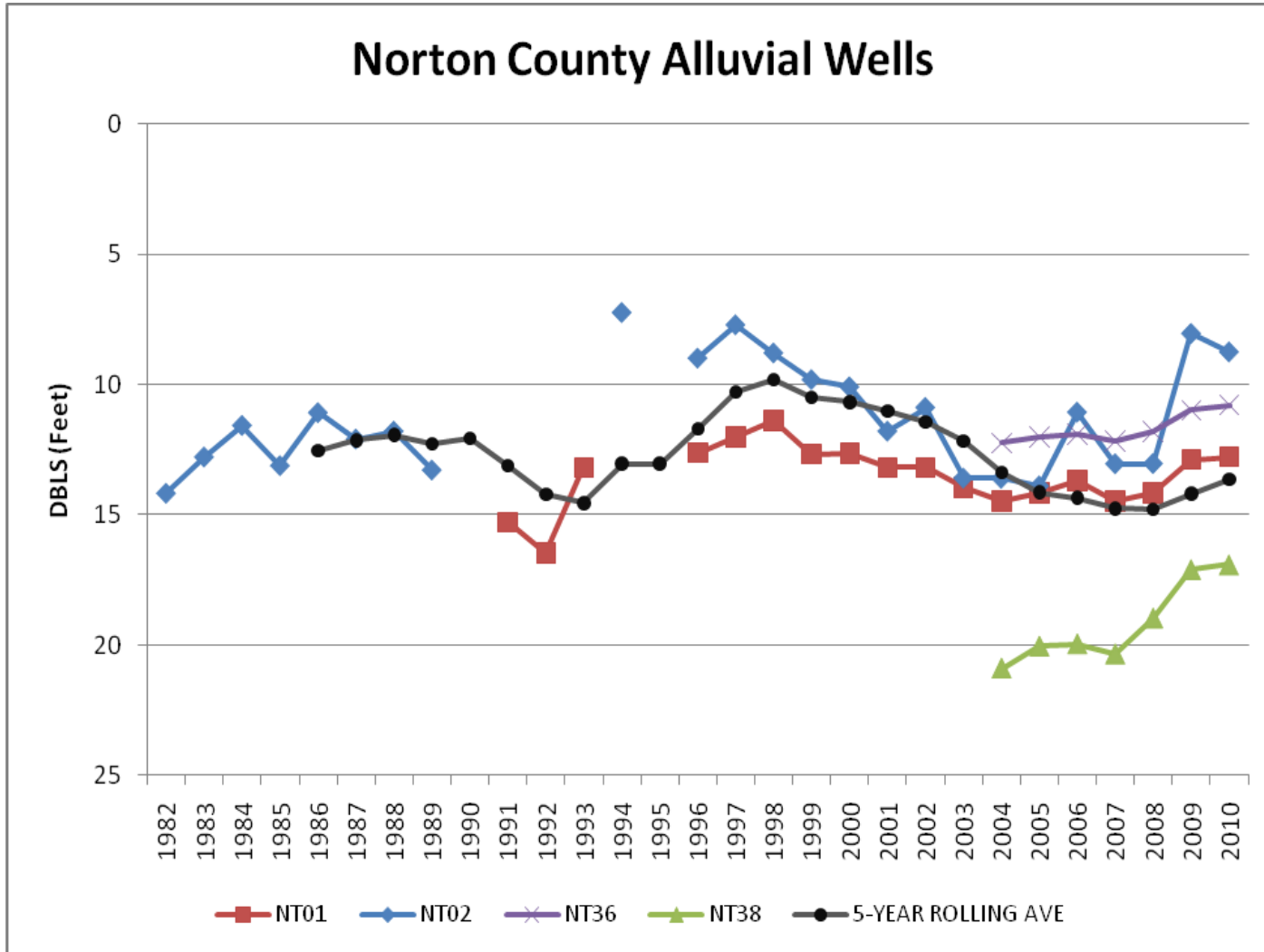


Figure 18: Alluvial Monitoring Well Levels in Norton County Fringe

Norton County has four alluvial monitoring wells. NT02 has the longest record beginning in 1982. NT01 has records from 1991, while NT36 and NT38 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 3.3 feet (Figure 18).

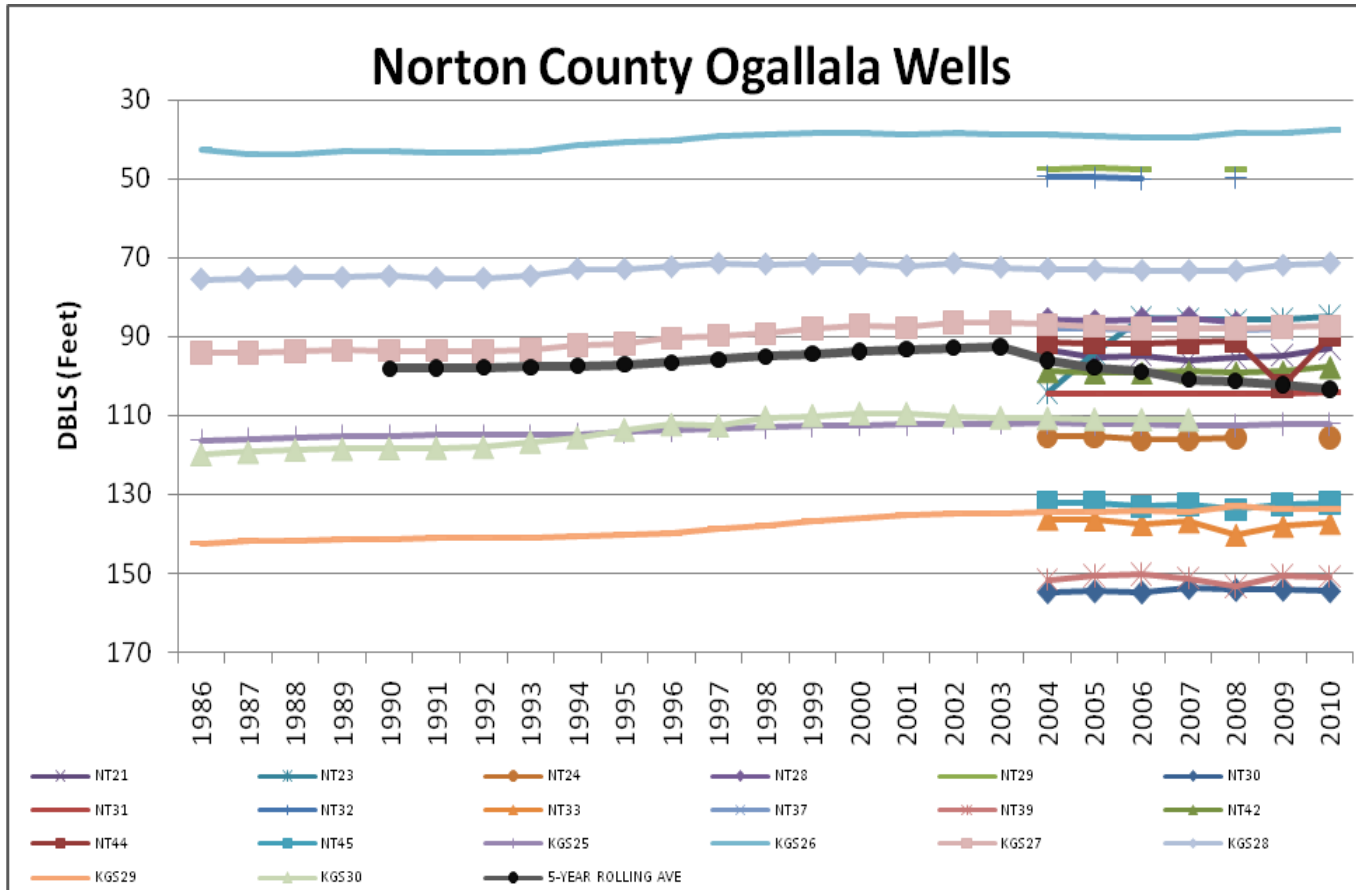


Figure 19: Ogallala-High Plains Monitoring Well Levels in Norton County Fringe

Norton County has twenty Ogallala monitoring wells. KDA-DWR added fourteen of these wells to the analysis in 2008 that have measurements since 2004. The water levels have remained relatively stable with an average increase of 1.3 feet from 2009 to 2010. The water levels ranged from an increase of 12.82 feet in NT44 to a 0.36 feet 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.

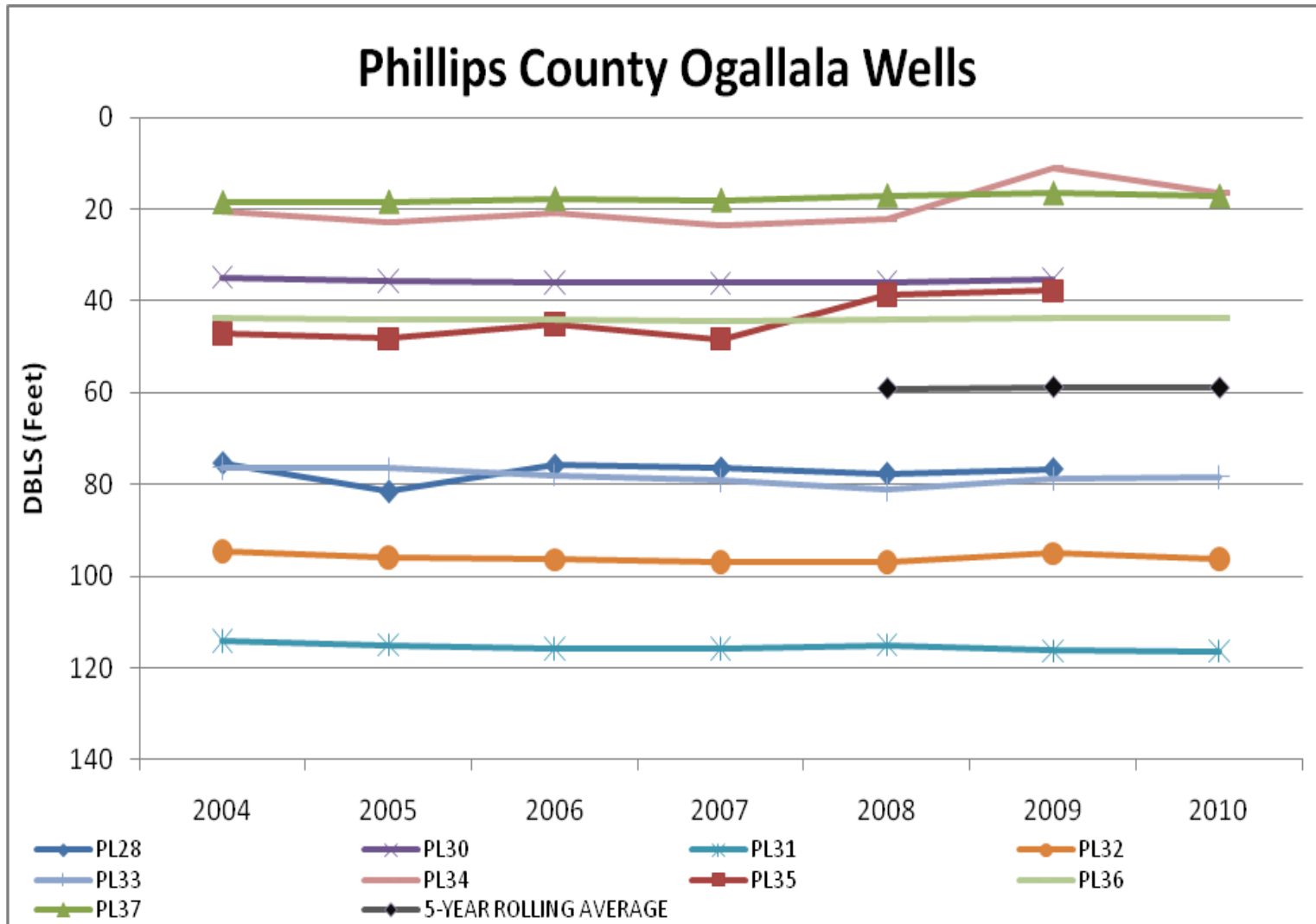


Figure 20: Ogallala-High Plains Monitoring Well Levels in Phillips County Fringe

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 0.79 feet. From 2009 to 2010, wells ranged from a decrease of 5.43 feet in PL34 to an increase of 0.35 feet in PL33.

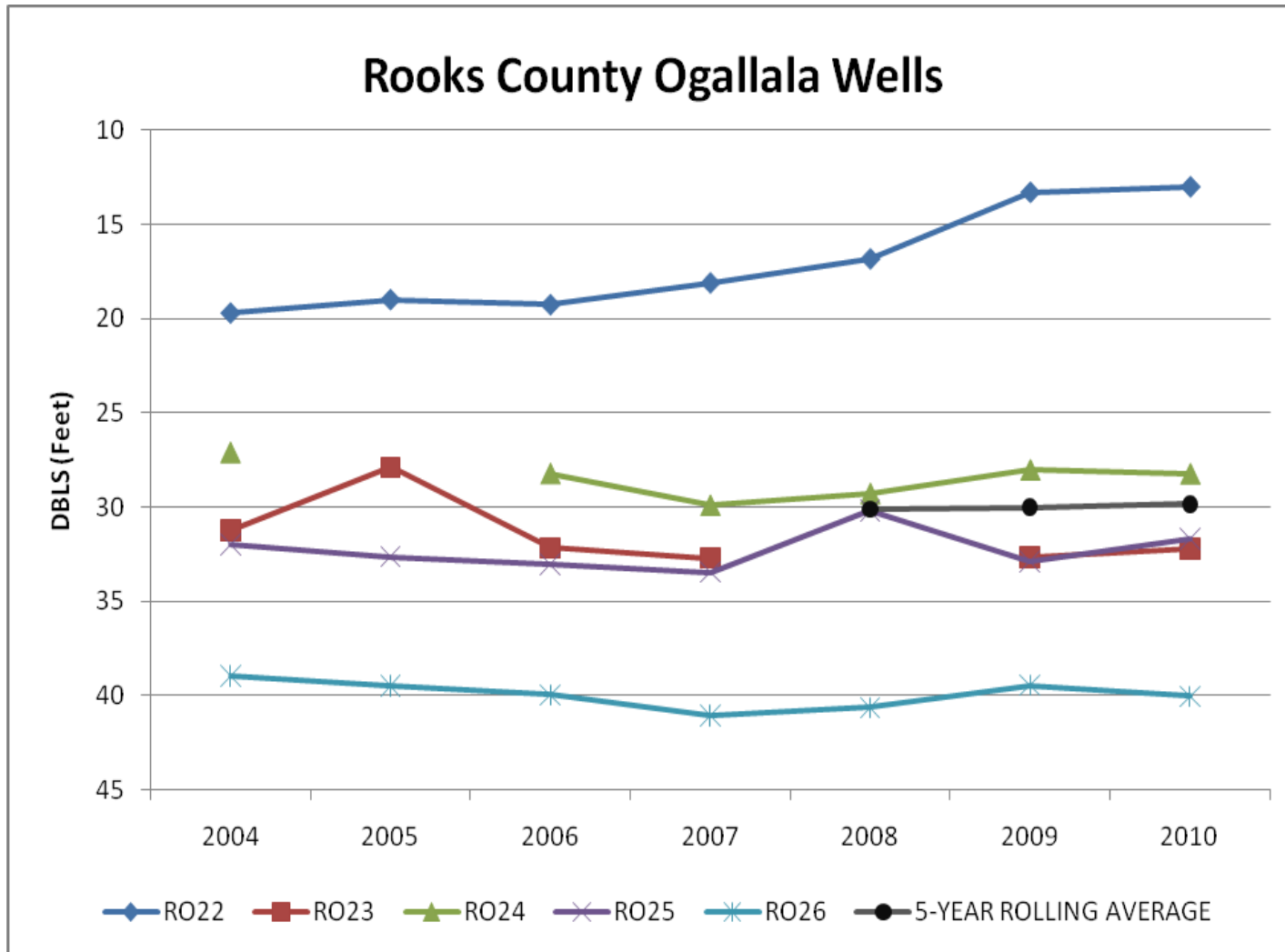


Figure 21: Ogallala-High Plains Monitoring Well Levels in Rooks County Fringe

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 0.76 feet. From 2009 to 2010, the wells increased an overall average of 0.22 feet ranging from an increase of 1.21 feet for RO25 to a decrease of 0.58 feet in RO26.

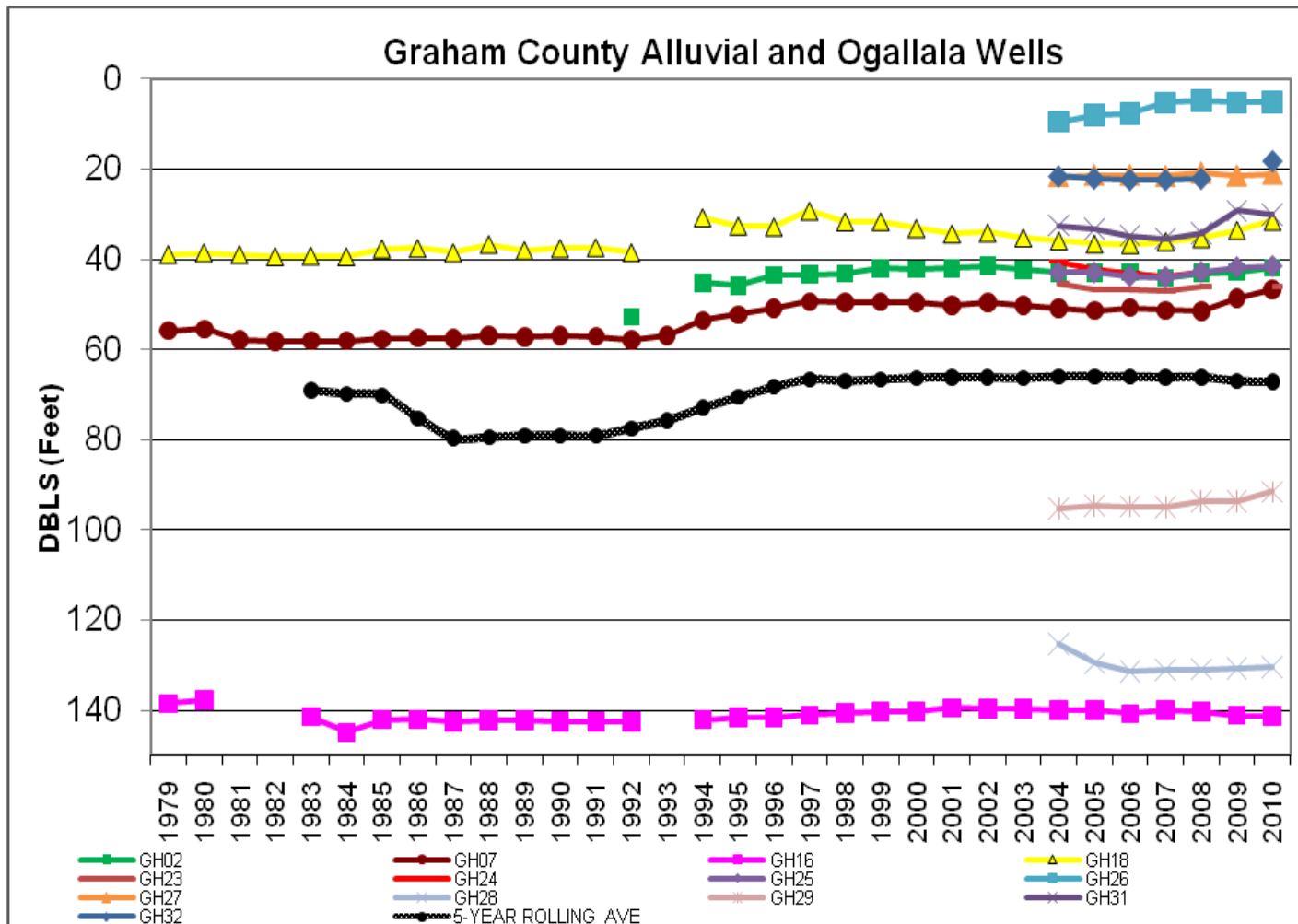


Figure 22: Monitoring Well Levels in Graham County Fringe

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 2.78 feet since 1979. Overall, the water levels increased an average of 0.72 feet from 2009 to 2010, ranging from a 0.87 feet decrease in GH31 to an increase of 2.06 feet in GH18. The five-year rolling average for Ogallala wells has remained fairly consistent since 1996.

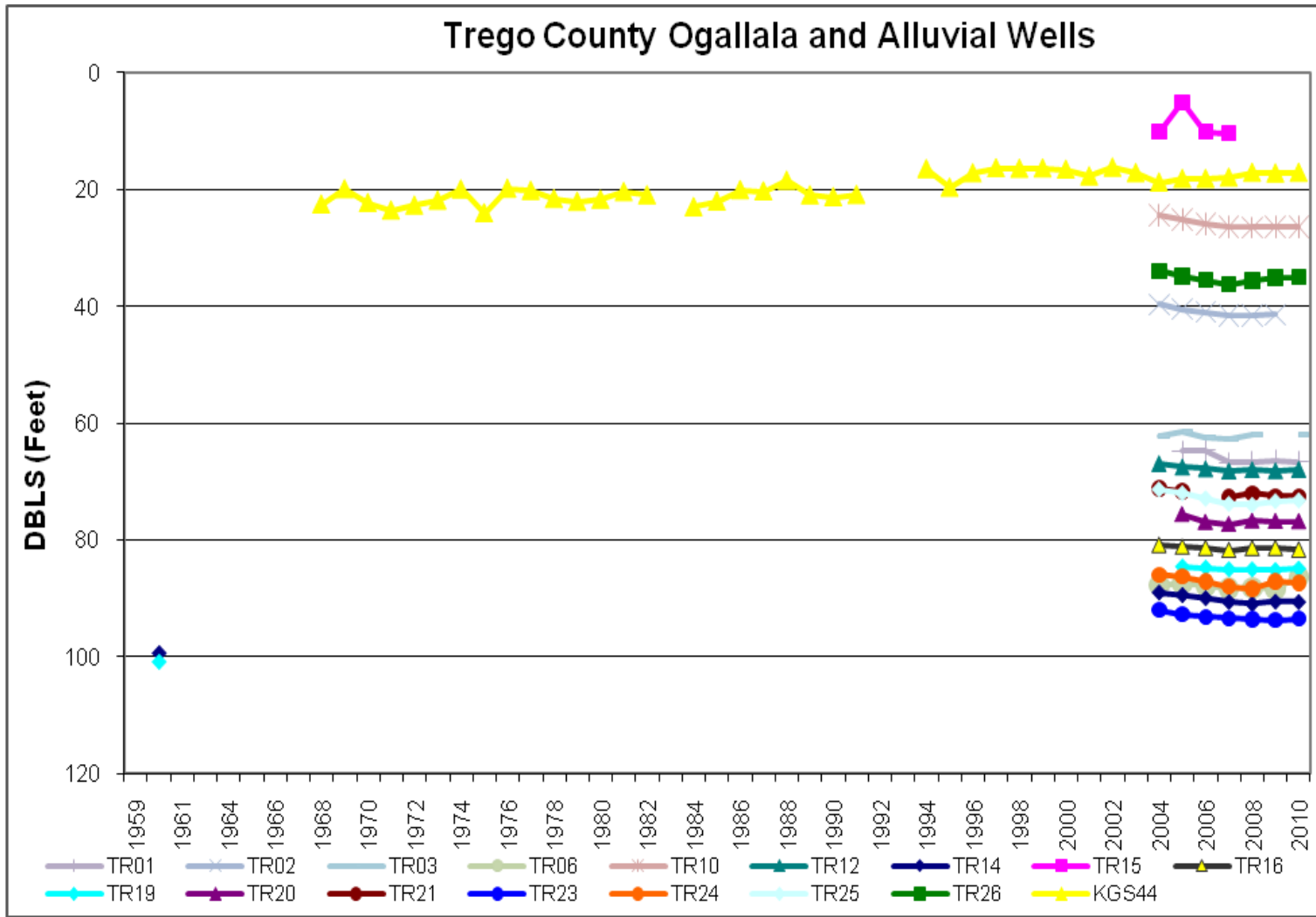


Figure 23: Monitoring Well Levels in Trego County Fringe

Trego County has 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 8.86 feet and 16.01 feet, respectively. The rest of the wells were not added to the network until 2004. KGS44 showed a net increase of 5.41 feet while the remaining wells show a net average decrease of 0.84 feet since 2004 (Figure 23).

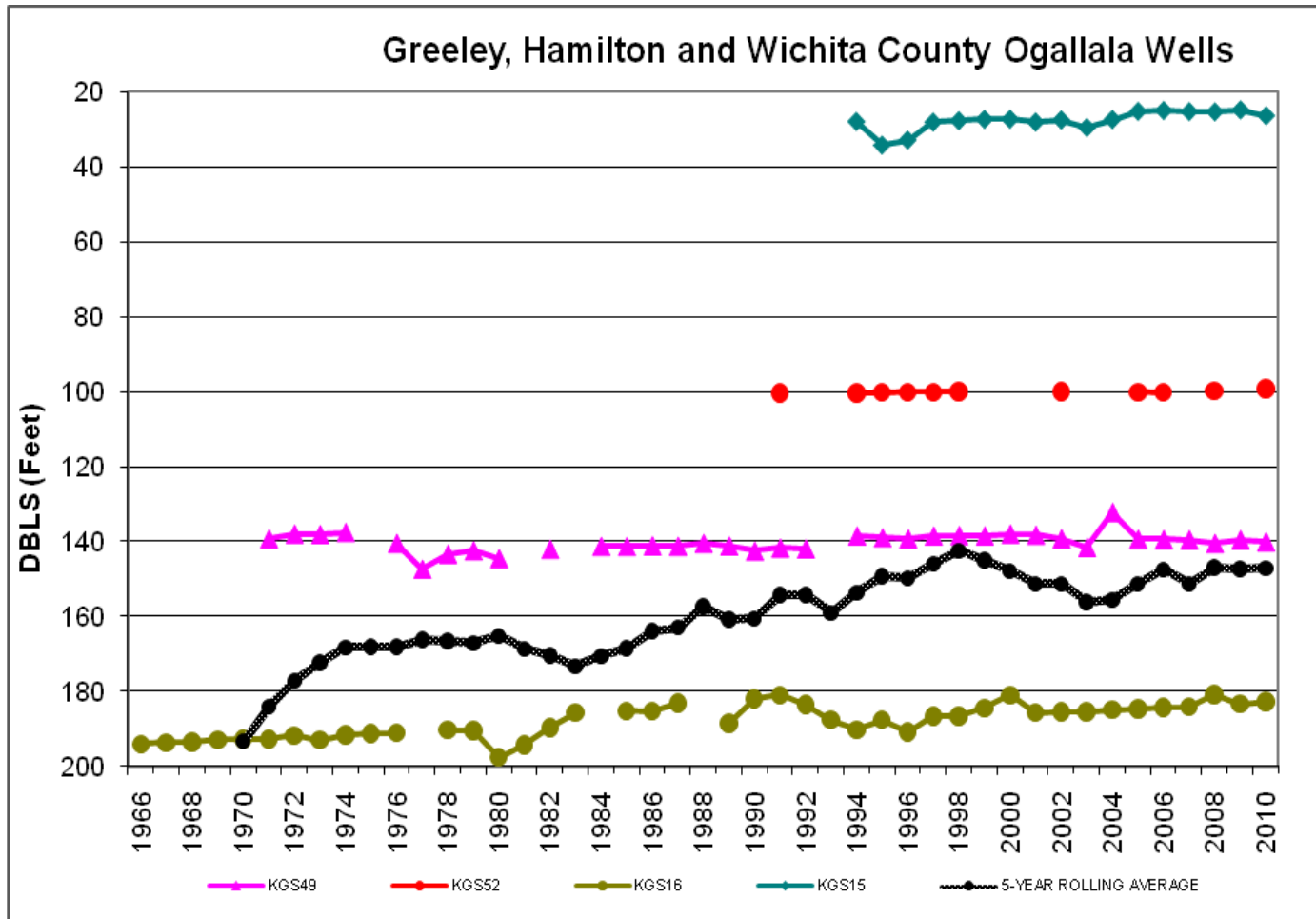


Figure 24: Monitoring Well Levels in the Fringe Area of Greeley, Hamilton and Wichita Counties

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 1.01 feet since 1991 (Figure 24). The Hamilton County well KGS16 is located outside GMD #3 and had a net increase of 11.29 feet for 1966-2010, with an increase of 0.57 feet from 2009-2010. The Greeley County well KGS15 located outside GMD #1 had a net increase of 1.53 feet for 1994-2010 (Figure 24). The five-year rolling average has fluctuated some with an overall net increase.

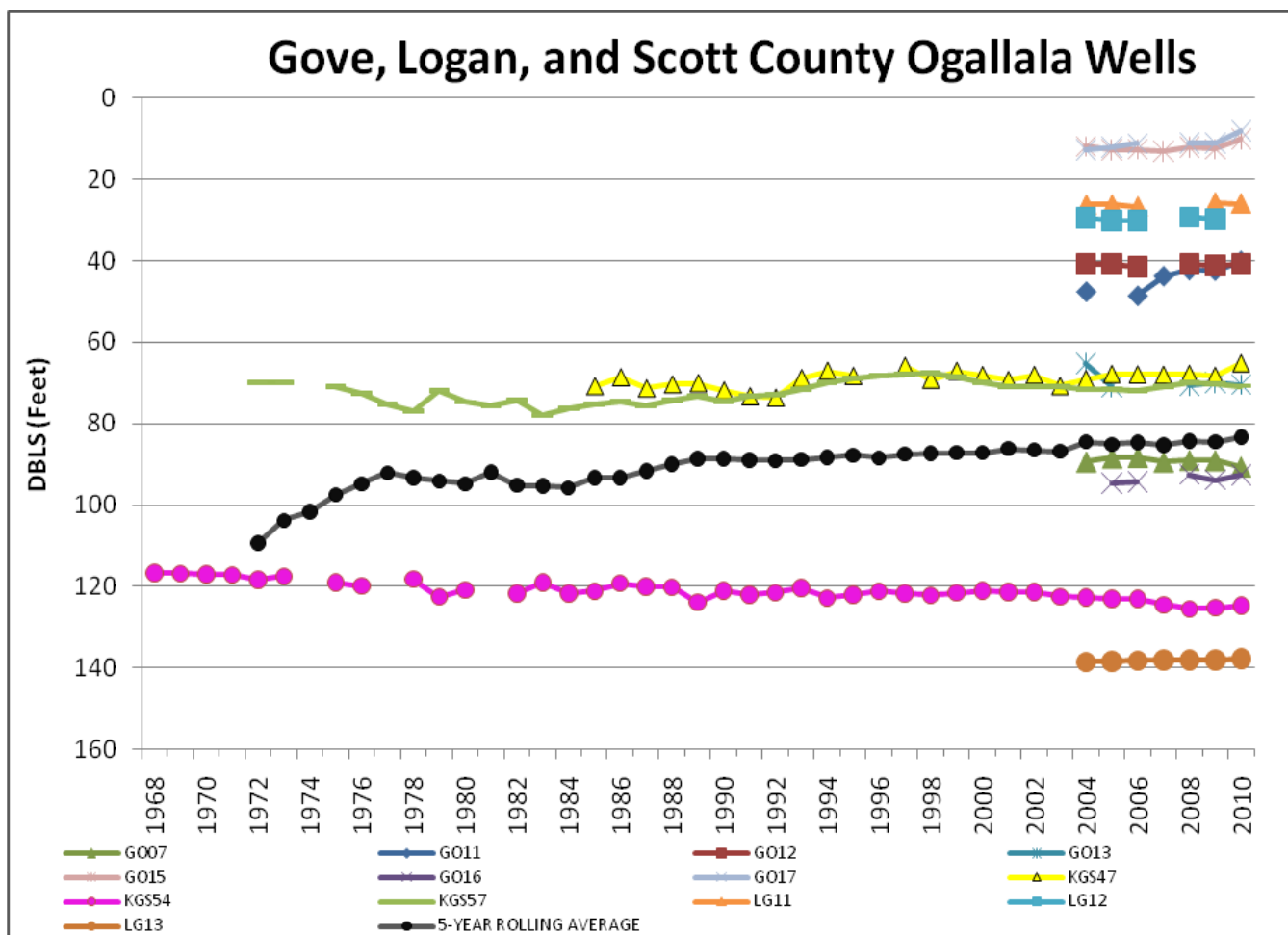


Figure 25: Monitoring Well Levels in the Fringe Area of Logan and Scott Counties

Gove, Logan, and Scott counties have 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 7.96 feet since 1968. KGS 47 has had a net increase of 5.49 feet since 1985. From 2009 to 2010, the wells increased an average of 0.87 feet. Overall, the wells have remained relatively stable with an average net increase of 0.54 feet (Figure 25).

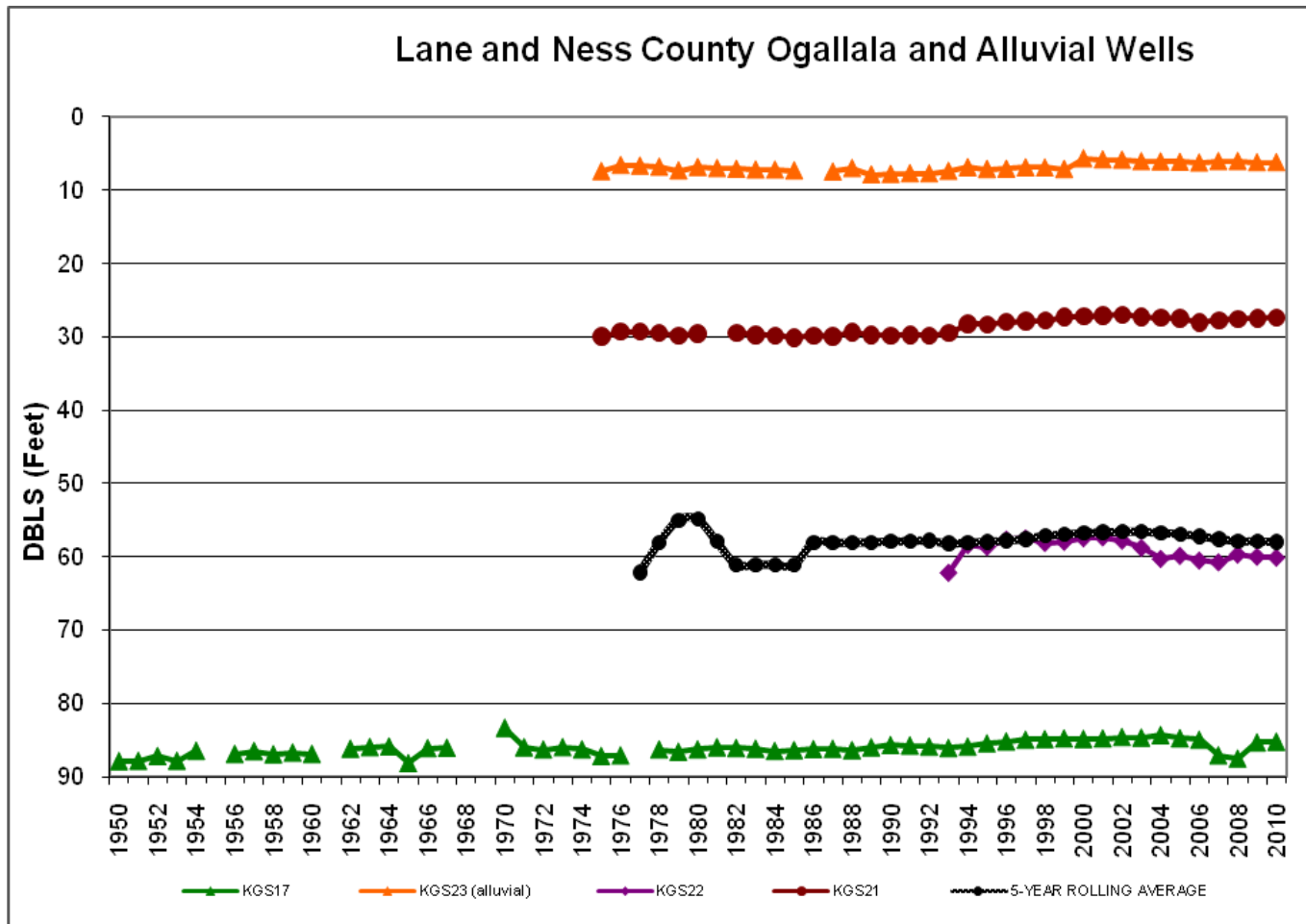


Figure 26: Monitoring Well Levels in the Fringe Area of Wallace, Lane and Ness Counties

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 2.64 feet. The three wells in Ness County, two dating back to 1974 (KGS23 and KGS21) had net increases of 1.22 feet and 2.55 feet, respectively. KGS22 had a net increase of 2.06 feet. Overall from 2009 to 2010, the wells remained relatively stable with an average increase of 0.03 feet. The five-year rolling average for Ogallala wells is showing a slight decline (0.20 feet) in water levels since 2004.

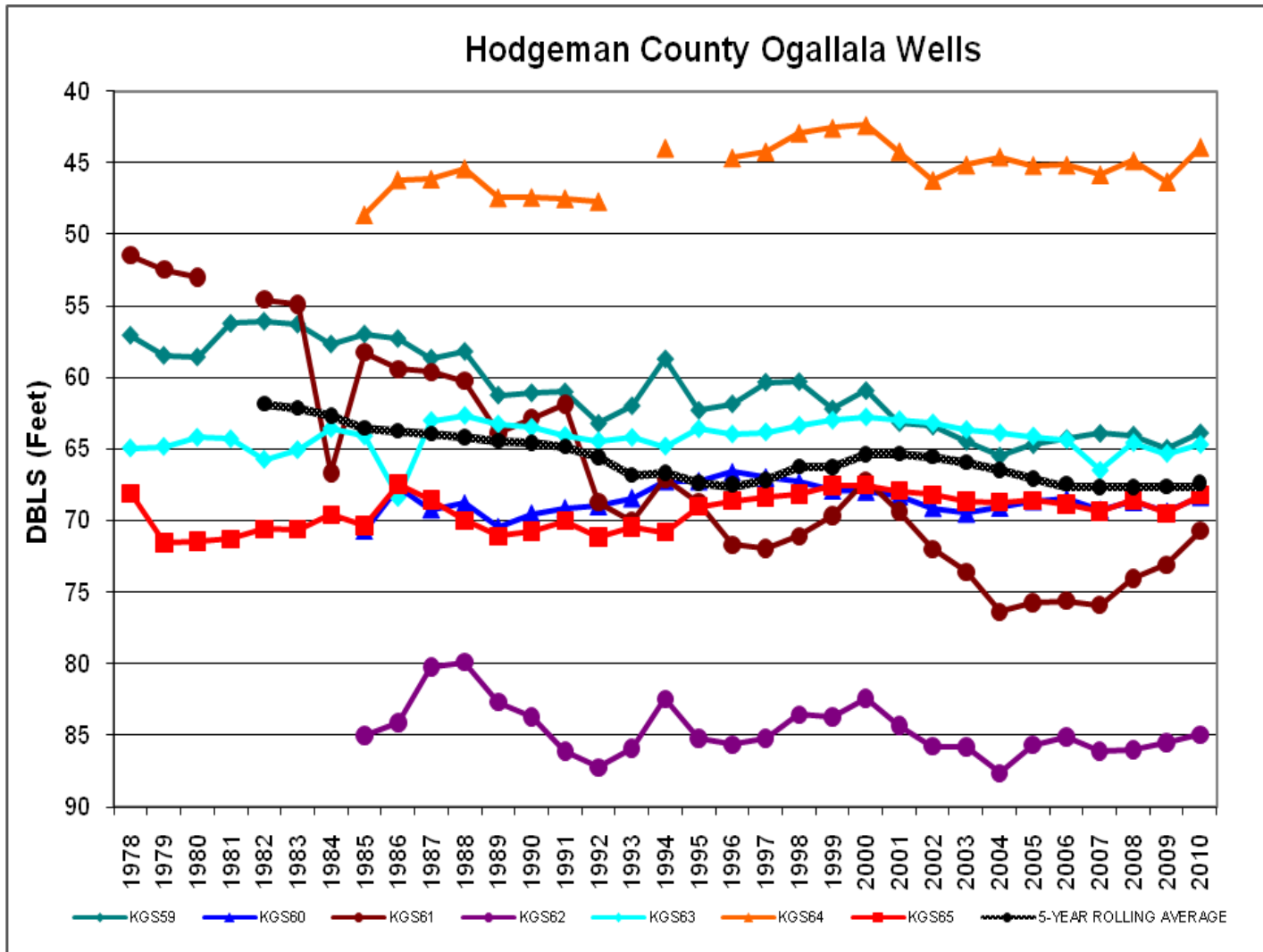


Figure 27: Monitoring Well Levels in Hodgeman County Fringe

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 2.67 feet. KGS61 has a net decline 19.24 ft since 1978. From 2009 to 2010, all wells showed an increase with an average of 1.35 feet. Increases ranged from 0.59 feet in KGS62 to 2.43 feet in KGS64 (Figure 27). The five-year rolling average has a net decline of 5.54 feet.

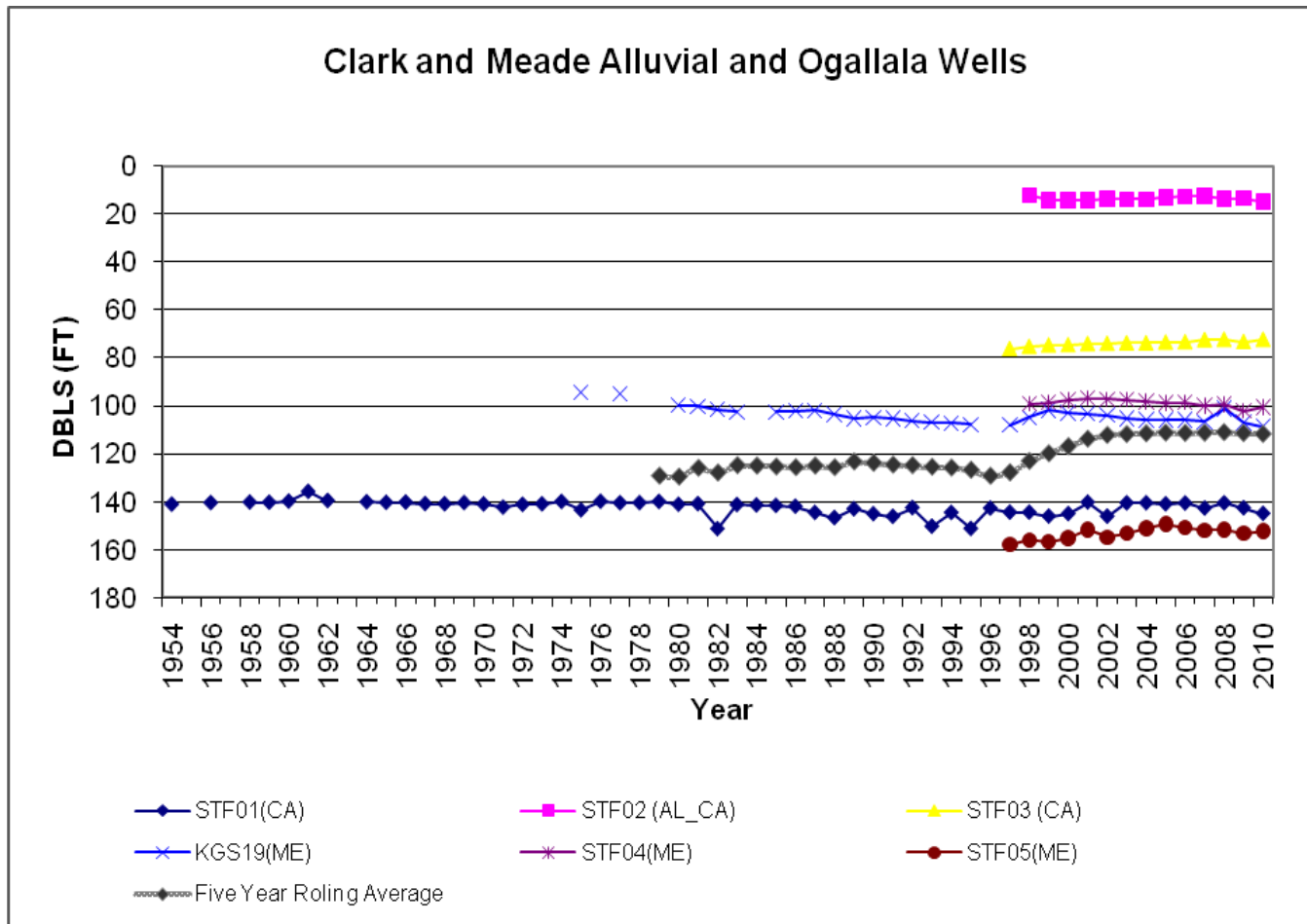


Figure 28: Monitoring Well Levels in the Fringe Area of Clark and Meade Counties

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 2.74 feet for the period of record, with a decrease of 1.47 feet from 2009 to 2010. STF01 decreased by 2.28 feet from 2009 to 2010. STF03 increased from 2009 to 2010 by 0.93 feet (Figure 28). Meade County has three monitoring wells that are all Ogallala wells. KGS19 had a net decline of 14.14 feet since 1975, with a 1.58 feet decline from 2009 to 2010. The other two wells, STF04 and STF05, had a net decrease of 1.27 feet and net increase of 5.76 feet, 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 1,368 water rights with an authorized quantity of 185,736 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-High Plains Fringe

Type	Source	No. of Rights	Authorized Quantity (acre-feet)
Vested	Surface	25	12,415
Appropriated	Surface	61	16,969
Vested	Ground	97	10,141
Appropriated	Ground	1,185	146,211
	Total	1,368	185,736

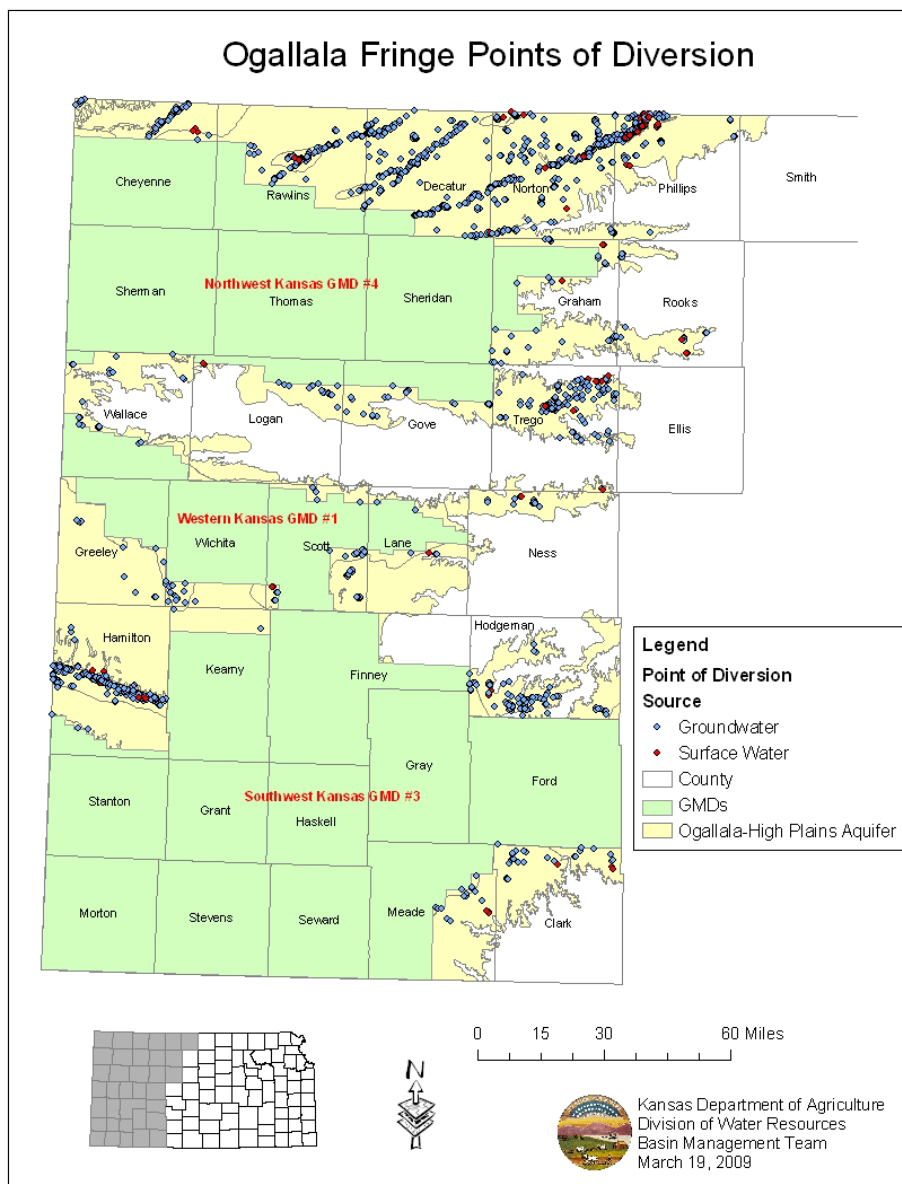


Figure 29: Points of Diversion within the Fringe of the Ogallala-High Plains Aquifer

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 91,650 acre-feet (Figure 30). Water use in 2008 (the most recent year for complete records are available) was 82,538 acre-feet. This was up from 2007, but still below average for the area (Figure 30). Average groundwater use for the Ogallala Fringe is 81,238 acre-feet and averages about 89 percent of the total water use for the twenty-two year time frame.

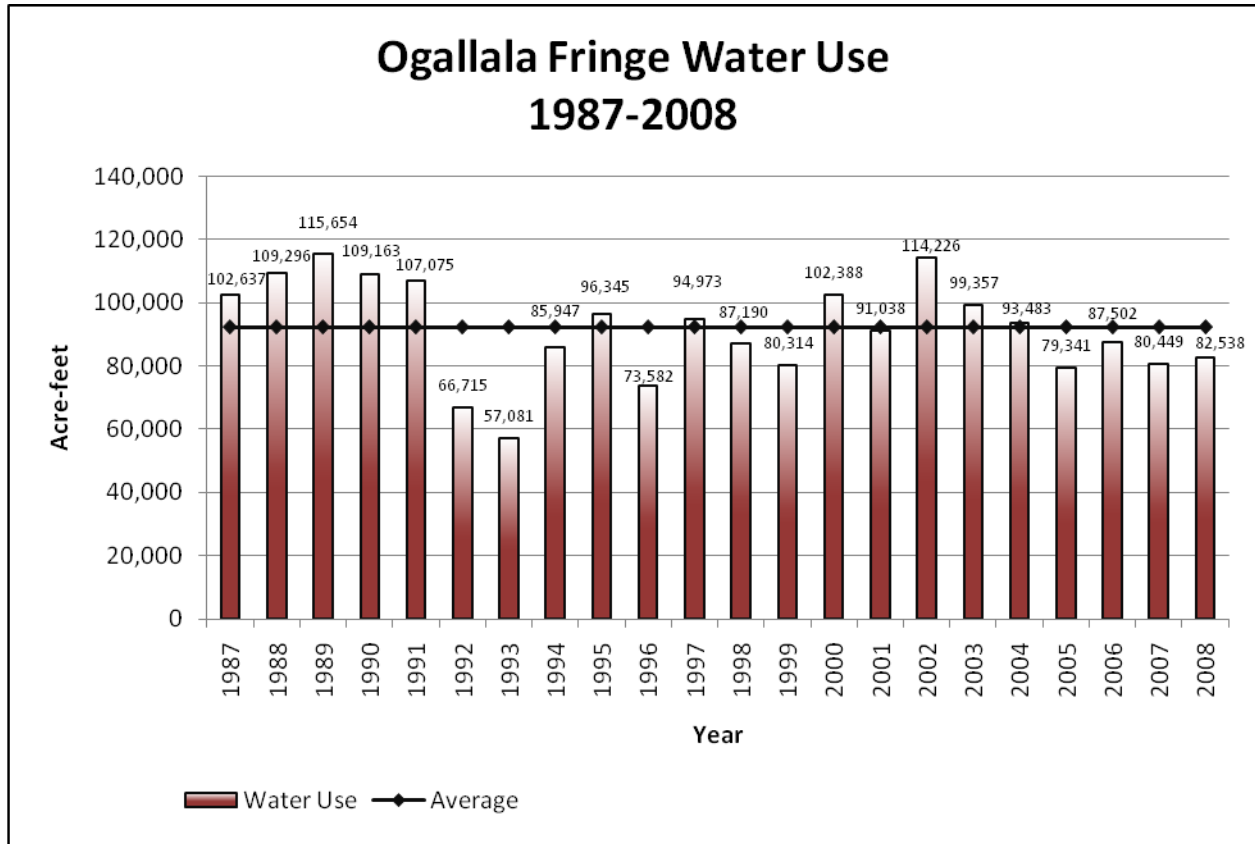


Figure 30: Surface and Groundwater Use in the Ogallala-High Plains Fringe by Year

Since 1987, Ogallala Fringe averaged 21 inches of precipitation and 14.3 inches of irrigation pumping (Figure 31) but there is significant variability in both of those figures. Irrigators in the region typically pump more water in drier years to compensate for the lack of precipitation. For instance in 2002, the subbasin received 12.3 inches in precipitation and pumped 16.3 inches. Irrigation season precipitation (Figure 32) averages 15.4 inches, which is over five inches below the annual average. In 2007, the precipitation from May-October was low at 11.9 inches, but the associated irrigation was near average. This is likely due to 7.2 inches of precipitation occurring outside of the irrigation season that year. Since 1987, the total irrigation has been on a downward trend.

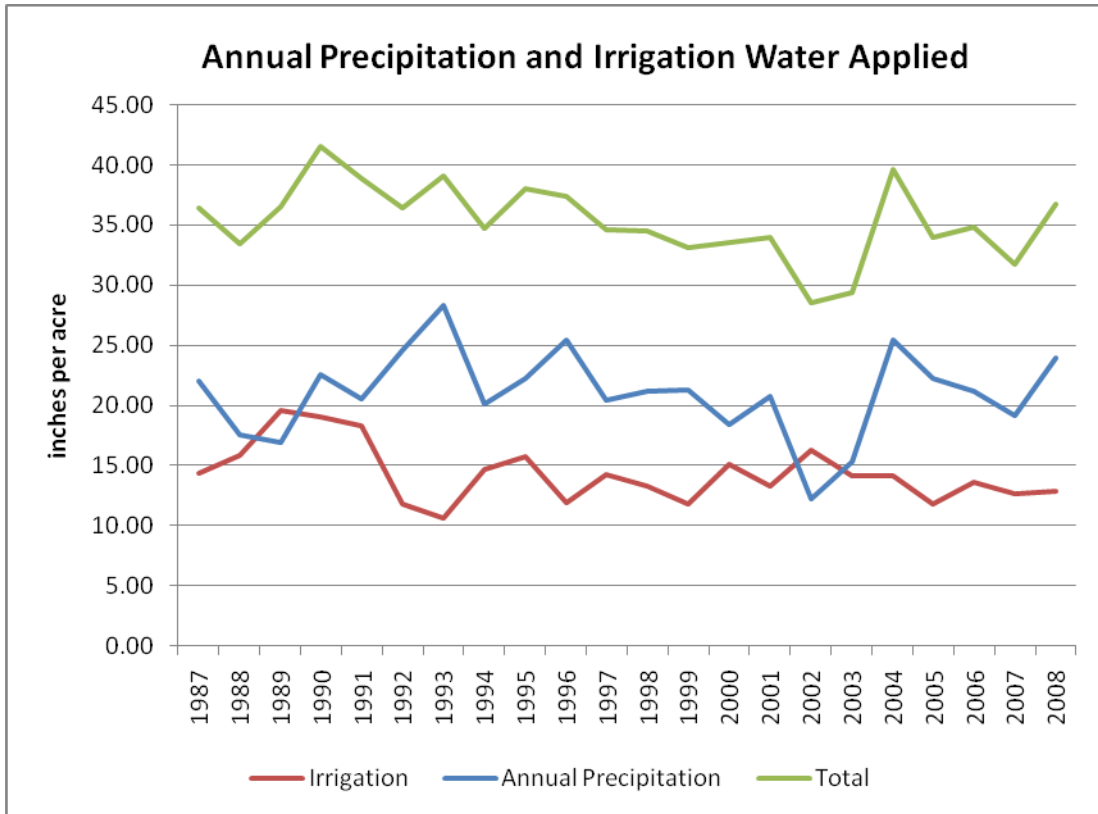


Figure 31: Annual Precipitation and Irrigation Water Applied (inches per acre) for Ogallala Fringe

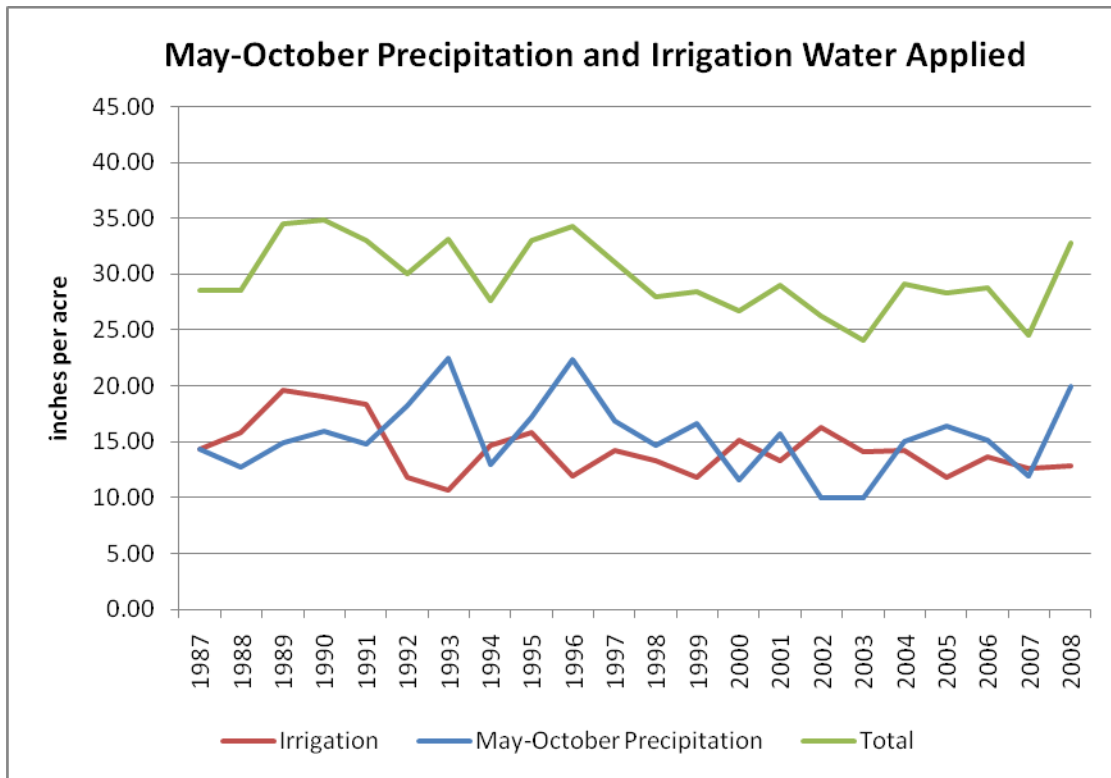


Figure 32: May-October Precipitation and Irrigation Water Applied (inches per acre) for Ogallala Fringe

VI. Conclusions

The year 2009 appears to have been an above average year for precipitation. Preliminary 2009 average annual streamflow at the USGS gages experienced minor decreases at all locations except on the South Fork Republican at the Benkelman gage, which showed an increase. Groundwater levels in most areas of the fringe continued to remain relatively consistent, with local water levels varying by region. Water use in 2008 was up from 2007, but still below average. It is important to continue to increase our understanding of the impacts of pumping, how fast the system recovers after recharge events, and other characteristics of the hydrologic system in order to evaluate the long-term effects of water usage of this subbasin, protect property rights, and ensure the benefits of these water resources to future generations.

VII. References

Lohman, S.W. 1953. High Plains of west-central United States, general aspects, Chapter 4 of subsurface facilities of water management and patterns of supply-type area studies, v. four of the physical and economic foundation of natural resources: U.S. 83d Congress, House Committee of Interior and Insular Affairs, p. 70-78.

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.

McGuire, V.L., 2004, Water-Level Changes in the High Plains Aquifer, Predevelopment to 2003 and 2002 to 2003: U.S. Geological Survey Fact Sheet FS-2004-3097, 6 p.

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 NWSSENW	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 SESENE 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
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DC27	395642100425401	01S 30W 20 SWSESW 01	Decatur
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DC31	394859100301701	03S 28W 06 NWSWSE 01	Decatur
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DC33	394715100355501	03S 29W 17 NWSWSE 01	Decatur
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GH07	393216099503801	06S 23W 13 NWNWNW 01	Graham
GH16	393223100040801	06 25W 12 SWSWSW 01	Graham
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GH23	391400099474801	09S 22W 32 NENENWNE 01	Graham
GH24	391312099573601	09S 24W 35 SESESE 01	Graham
GH25	391153099584301	10S 24W 10 SESENE 01	Graham
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KGS64	380149100122201	23S 26W 20 SWSWSW 01	Hodgeman

KGS65	380005100130401	23S 26W 31 SESESW 01	Hodgeman
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LG11	385800100500001	23S 26W 31 SESESW 01	Logan
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