Status of the High Plains Aquifer in Kansas

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Percent Change in Aquifer Thickness, Predevelopment to Average 2015-2017, Kansas High Plains Aquifer

Estimated Decrease in Aquifer Thickness (%)

- Increase
- 0 to 15
- 15 to 30
- 30 to 45
- 45 to 60
- Over 60

Miles

Extent of the High Plains Aquifer

[Map showing percent change in aquifer thickness with color coding for different decrease percentages]
Annual Water-Level Measurement Program

≈1400 wells measured in High Plains aquifer in 2018
About 27,700 wells with water rights overlie the High Plains aquifer. Nearly all of these now have totalizing flowmeters.
High Plains Aquifer and Groundwater Management Districts (GMDs)

Ogallala region
Total annual water use for GMDs in Ogallala region of High Plains aquifer 1996-2017

- **GMD4 - Northwest Kansas**: 7.6% decrease
- **GMD1 - West-Central Kansas**: 38% decrease
- **GMD3 - Southwest Kansas**: 13% decrease
Average annual water-level change for GMDs for network wells measured every year in Ogallala region of High Plains aquifer 1996-2017

- GMD4 - Northwest Kansas: -0.56 ft/yr
- GMD1 - West-Central Kansas: -0.47 ft/yr
- GMD3 - Southwest Kansas: -1.60 ft/yr
Short-term sustainability for GMD4 requires pumping reduction of 21% based on 2005-2017 data.

Adjustment to normal climate: 24% pumping reduction
Short-term sustainability for GMD1 requires pumping reduction of 30% based on 2005-2017 data.

Adjustment to normal climate: 32% pumping reduction

Pumping reduction for zero water-level change = 30%
Short-term sustainability for GMD3 requires pumping reduction of 26% based on 2005-2017 data.
Percent Change in Aquifer Thickness, Predevelopment to Average 2015-2017, Kansas High Plains Aquifer

Estimated Decrease in Aquifer Thickness (%)

- Increase
- 0 to 15
- 15 to 30
- 30 to 45
- 45 to 60
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Extents the High Plains Aquifer

Sheridan-6 LEMA
GMD4
Sheridan-6
LEMA

2002-2005,
2008-2012
R^2 = 0.76

2002-2005,
2008-2017
R^2 = 0.88

2006 and 2007 not included due to snow delaying 2007 winter water-level measurements.
2005-2012, $R^2 = 0.74$

2013-2016, $R^2 = 0.94$
Change in Water Levels and Water Use in Sheridan-6 LEMA

- Pumping reduction required for zero water-level change for pre-LEMA period (2002-2012): 42%
- Average annual water-level decline
  - Pre-LEMA (2002-2012): -2.1 ft
  - Post-LEMA (2013-2017): -0.44 ft
- Average annual water use decrease from pre-LEMA to post-LEMA periods for similar climatic conditions: ~30%
High Plains Aquifer and Groundwater Management Districts (GMDs)
Total annual water use for GMDs in south-central region of High Plains aquifer 1996-2007
Average annual water-level change for GMDs for network wells measured every year in south-central region of High Plains aquifer 1996-2017

Average annual water-level change for GMDs for network wells measured every year in south-central region of High Plains aquifer 1996-2017

**Average annual water-level change for GMDs for network wells measured every year in south-central region of High Plains aquifer 1996-2017**
Pumping is nearly sustainable for the short-term for GMD2 based on 2005-2017 data.

Adjustment to normal climate: 6.2% pumping reduction.
Short-term sustainability for GMD5 requires pumping reduction of 1.9% based on 2005-2017 data.

Adjustment to normal climate: 5.7% pumping reduction.
Percent Change in Aquifer Thickness, Predevelopment to Average 2015-2017, Kansas High Plains Aquifer

Estimated Decrease in Aquifer Thickness (%)

- Increase
- 0 to 15
- 15 to 30
- 30 to 45
- 45 to 60
- Over 60

Extent of the High Plains Aquifer
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www.kgs.ku.edu/HighPlains/HPA_Atlas/index.html
REFERENCES


Sheridan-6 LEMA
Water-level change and water use for 2002-2012 and 2013-2017 periods

2006 and 2007 not included due to snow delaying 2007 winter water-level measurements.
Conclusions
Ogallala Part of High Plains Aquifer

• Water levels have declined ~0.5-0.6 ft/yr in GMDs 1 and 4 and 1.6 ft/yr in GMD3 during the last 22 years.

• Pumping reductions needed to achieve stable water levels in the Ogallala are 32%, 27%, and 24% for GMDs 1, 3, and 4, respectively, adjusted for normal climatic conditions.

• Water-use reductions of ~30% (adjusted for climatic conditions) in the Sheridan-6 LEMA have significantly decreased water-level declines.
Short-Term Sustainability of Ogallala Region
(based on average annual water-level change and water-use relationships)

- Reduction in water use needed for no water-level change over one or two decades:
  - GMD4: 21% (for normal climate 24%)
  - GMD1: 30% (for normal climate 32%)
  - GMD3: 26% (for normal climate 27%)

- Reduction in water use of even half these values would decrease water-level declines in half.

- Reduction percentages are dependent on climate (whether wetter or drier conditions prevail).
Conclusions
South-Central Kansas Part of High Plains Aquifer

- Water levels have not changed significantly in GMD2 and have declined ~0.2 ft/yr in GMD5 during the last 22 years.

- Pumping would need to be reduced by ~6% for stable water levels in GMDs 2 and 5 based on 2005-2017 data and adjusted for normal climatic conditions. Sustainability is highly dependent on recharge during very wet years.
Last 22 Years for South-Central Kansas

- Average annual water-level change (trend in regression line) during 1996-2017
  GMD2: Insignificant trend
  GMD5: Slight decline; average -0.17 ft/yr
- Annual water use (regression line trend 1996-2017)
  GMD2: 3.1% increase
  GMD5: 7.0% increase
- Greater water-level fluctuation than in Ogallala
- High correlation between water-level change and water use
- High correlation between precipitation and water use
Changes Over Last 22 Years for Ogallala Region

• **Average annual water-level change (regression line trend from 1996 to 2017)**
  
  GMD4: Steady decline rate; average -0.56 ft/yr  
  GMD1: Steady decline rate; average -0.47 ft/yr  
  GMD3: Increasing rate of decline; average -1.60 ft/yr

• **Annual water use (regression line trend 1996 to 2017)**
  
  GMD4: 7.6% decline  
  GMD1: 38% decline  
  GMD3: 13% decline

• **High correlation between water-level change and water use**

• **High correlation between precipitation and water use**