



**LB 962**  
and  
**Hydrologically Connected  
Ground Water**  
and  
**Surface Water**  
in the  
**Upper Niobrara-White  
Natural Resources District**



Nebraska Department of Natural Resources  
September/October 2004

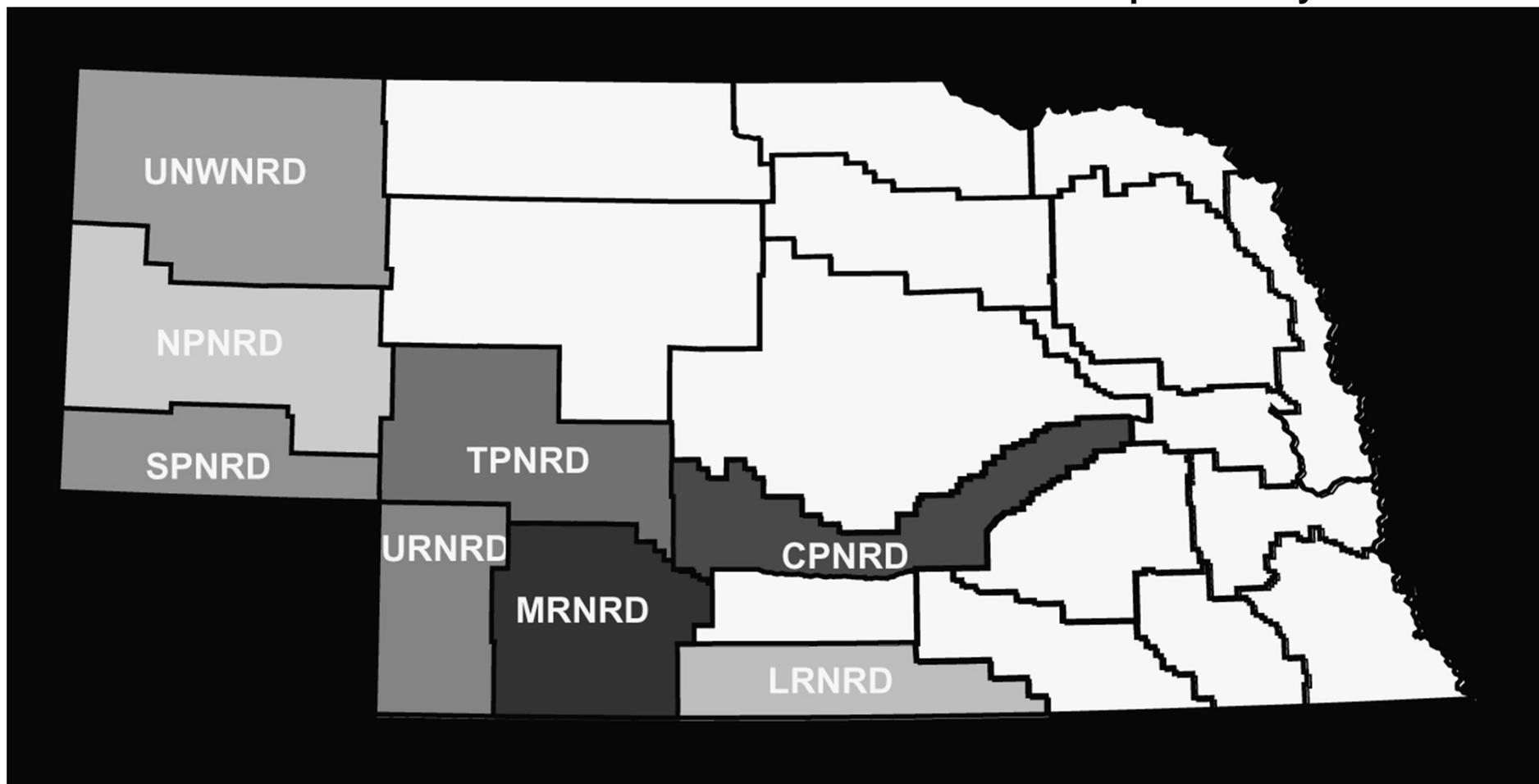
# Fully Appropriated if ...

- **DNR determines current use of hydrologically connected ground water and surface water will cause or in the reasonably foreseeable future cause:**
- **Surface water supply to be insufficient to sustain purposes for which appropriations were granted.**
- **Streamflow to be insufficient to sustain beneficial uses from wells dependent upon recharge from stream.**
- **Reduction in flow sufficient to cause noncompliance with interstate compact or decree, contract, or federal laws.**

# Areas Considered Fully Appropriated\* When LB 962 took Effect on July 16, 2004

---

\* either preliminary or final



---

# **Integrated Management Planning in Upper Niobrara White Natural Resources District**

# **UNWNRD**

## **Integrated Mgmt. Chronology**

- **January 10, 2003**  
**UNWNRD requests DNR studies/hearing on Joint Action Plan**
- **February 26, 2003**  
**DNR replies with preliminary determination**
- **July 16, 2004**  
**DNR issues notice of preliminary determination of fully appropriated for entire UNWNRD**

# Purposes of Draft Report

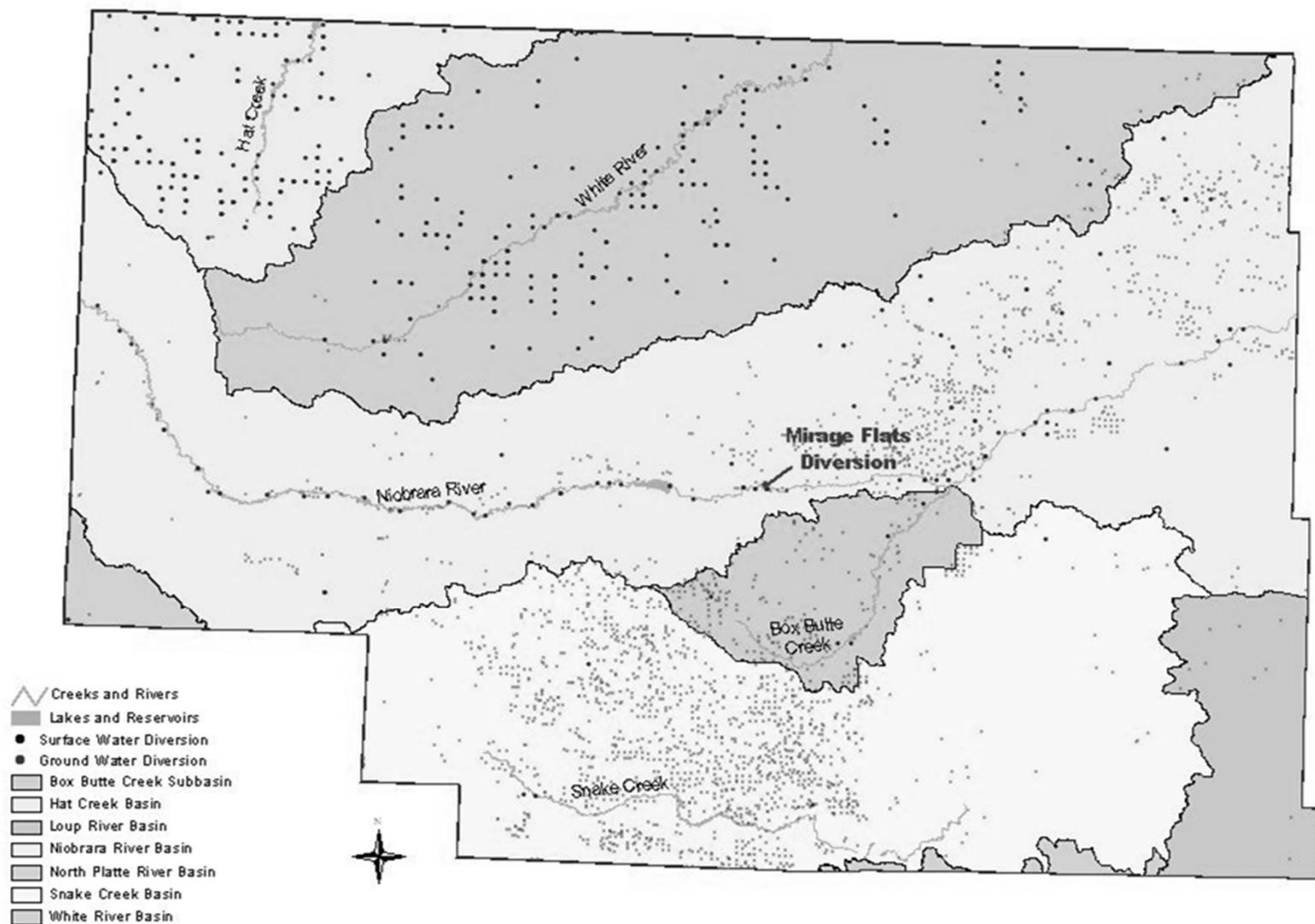
- **Describe hydrologic connection between surface water and ground water in UNWNRD**
- **Provide background information to help make determinations on fully appropriated status**
- **Support planning process**

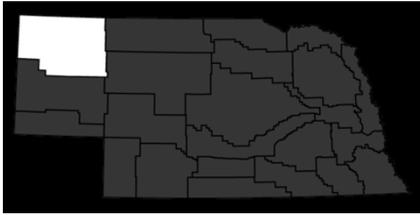
# **Areas Examined**

---

- **Niobrara Basin above Mirage Flats Diversion**
- **Niobrara Basin – Mirage Flats Diversion to mouth of Box Butte Creek**
- **Niobrara Basin – Mouth of Box Butte Creek to Cherry County Line**
- **Box Butte Creek**
- **Snake Creek**
- **White River – Hat Creek Basins**

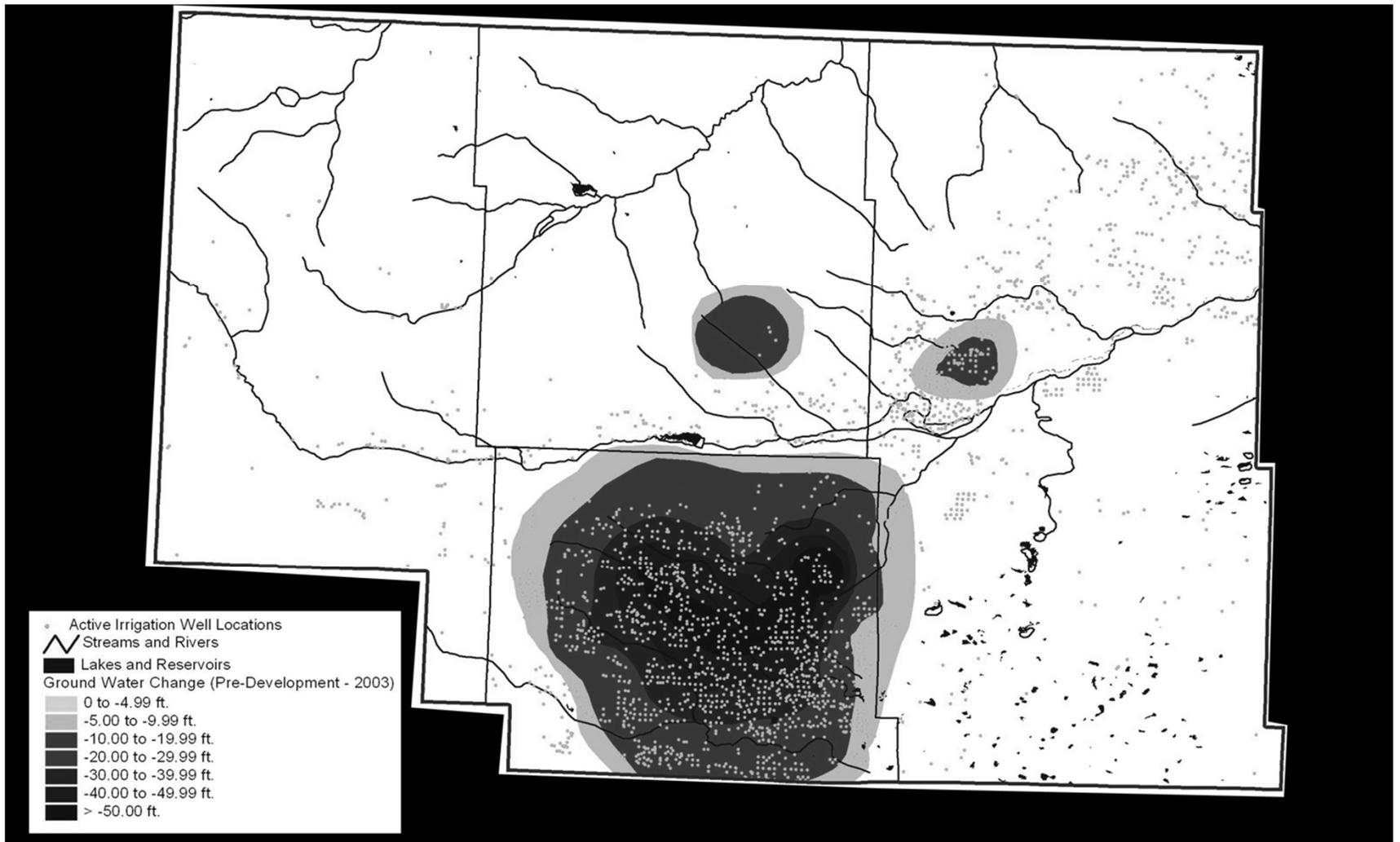
## Subbasin Boundaries and Surface Water System - Upper Niobrara-White NRD



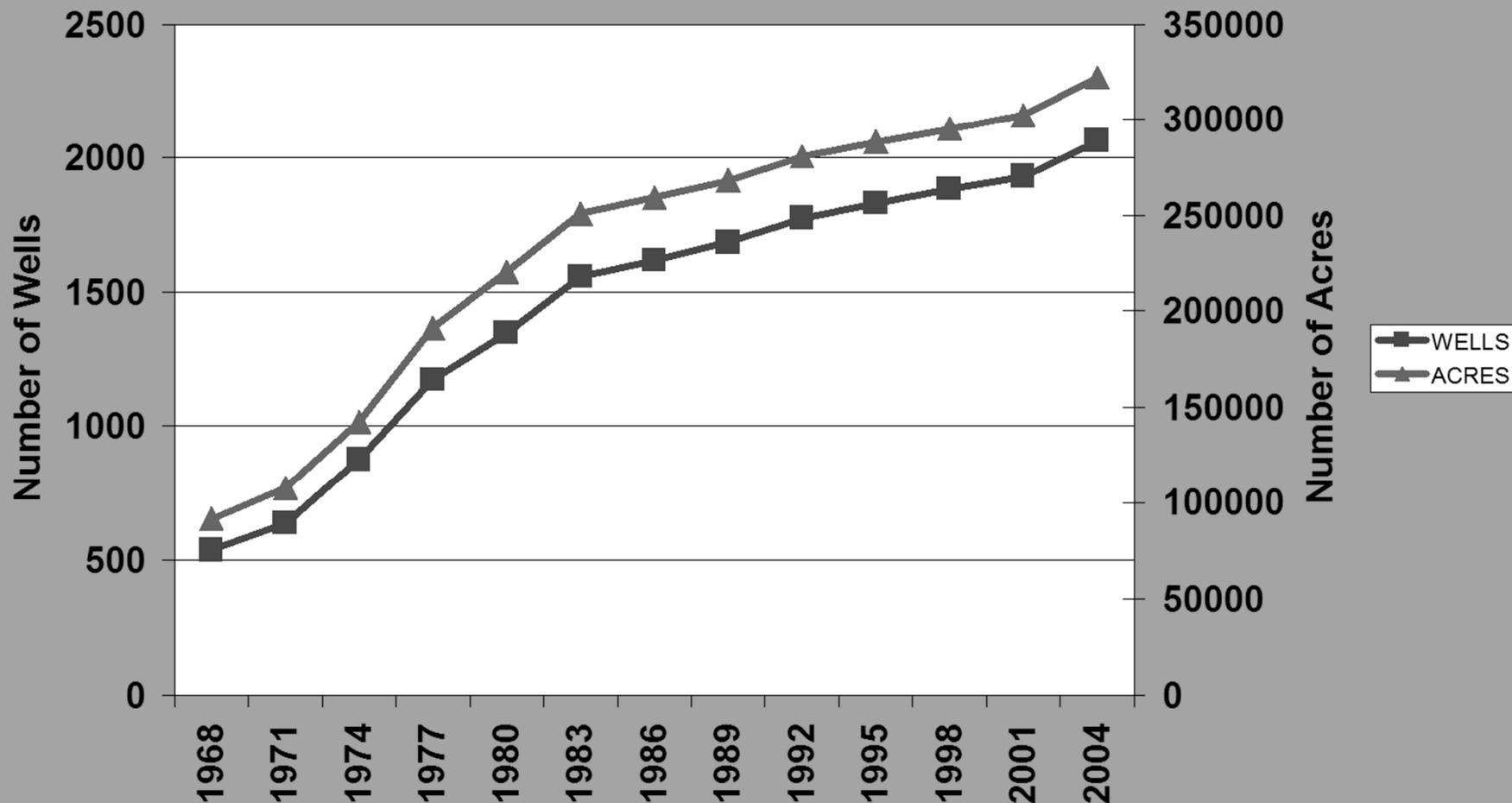


# Upper Niobrara-White Natural Resources District

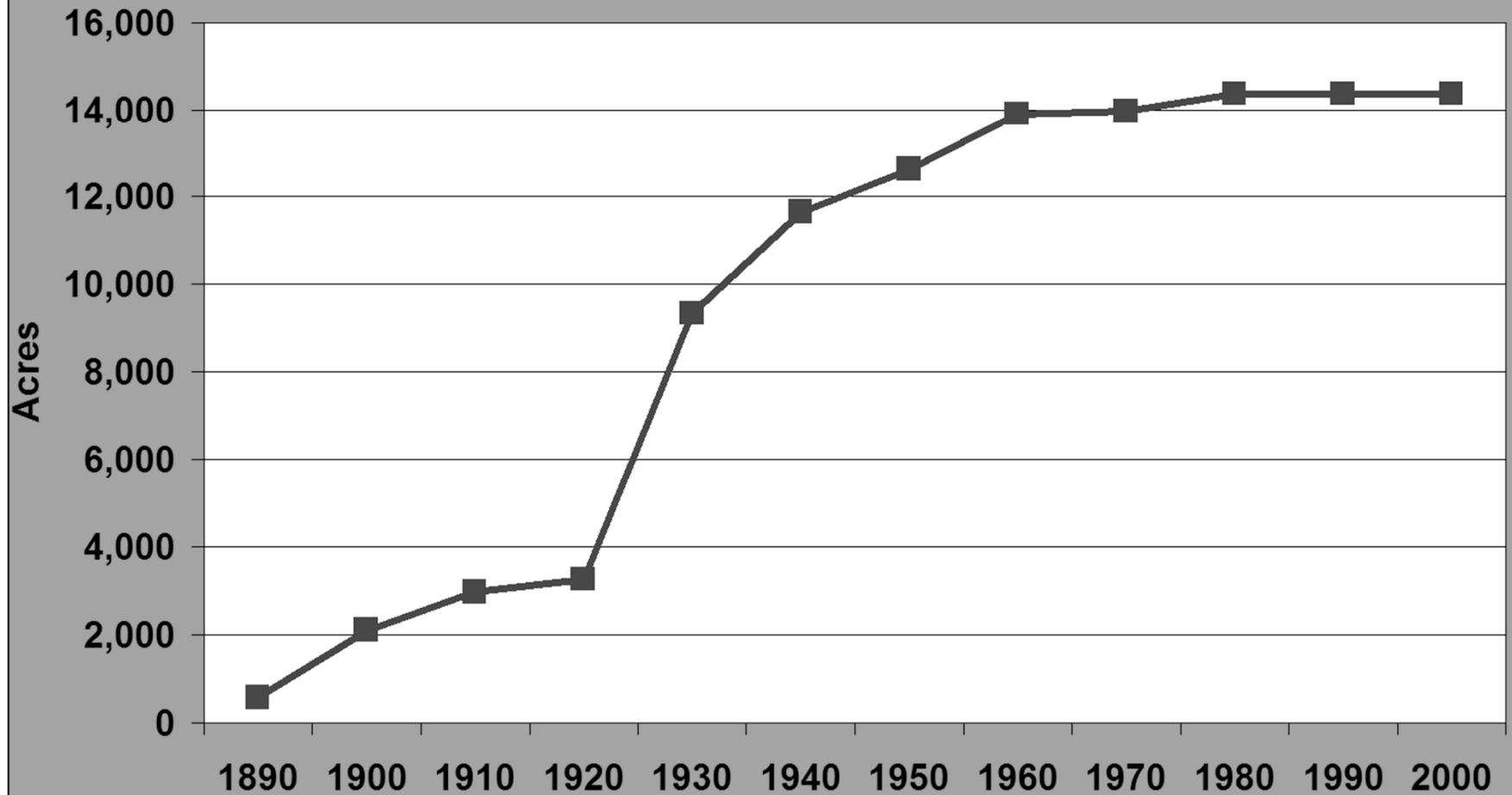
## Water Level Changes-Predevelopment to Spring 2003



# Well Statistics for the Upper Niobrara - White NRD 1968-2004

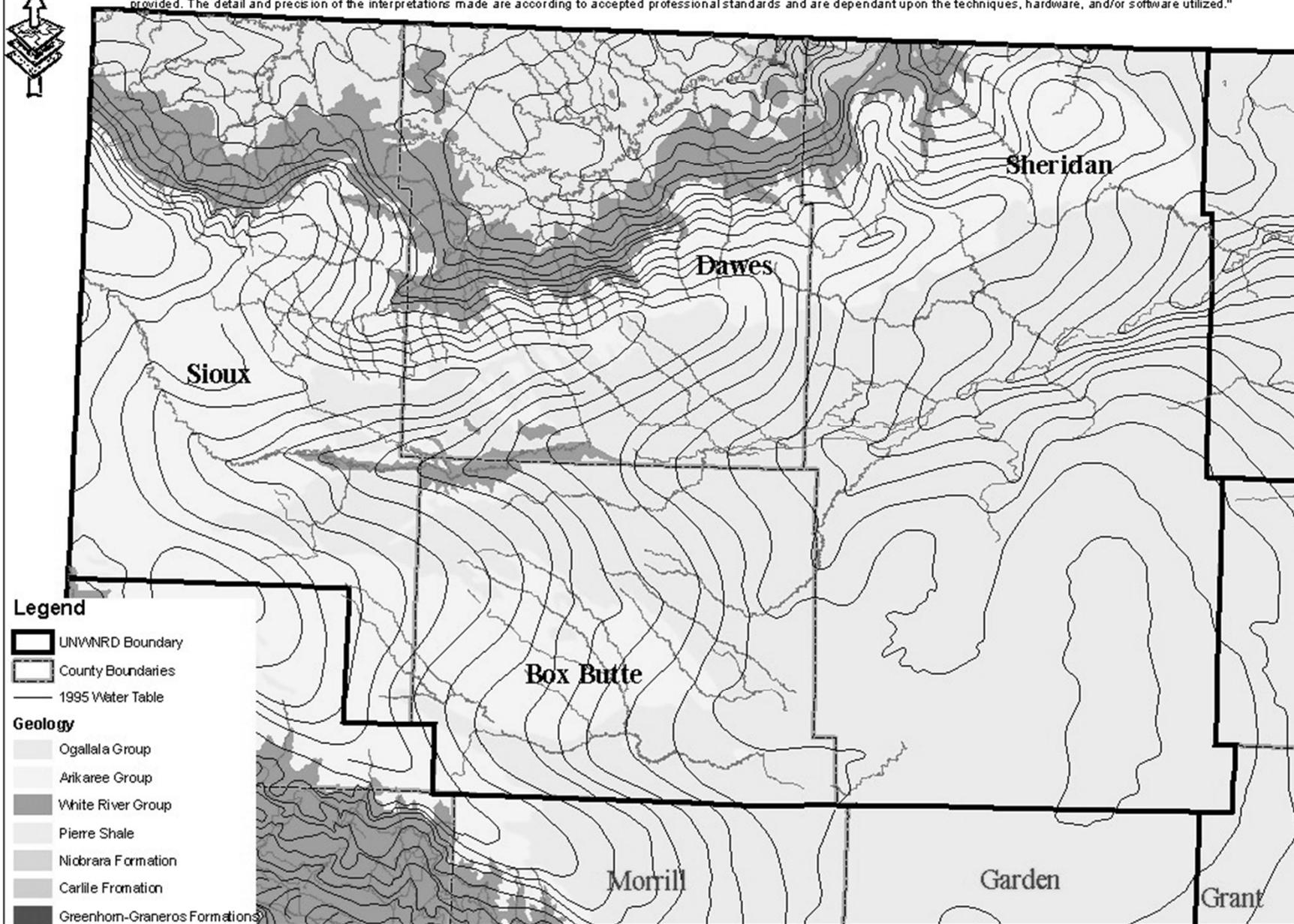


# Upper Niobrara - White NRD Surface Water Irrigated Acres 1890-2000



# Geology of the Upper Niobrara White Natural Resources District

"The Conservation and Survey Division has produced this product using what is thought to be the most reliable information available or reproduced the material as provided. The detail and precision of the interpretations made are according to accepted professional standards and are dependant upon the techniques, hardware, and/or software utilized."



## Legend

- UNWRD Boundary
- County Boundaries
- 1995 Water Table

## Geology

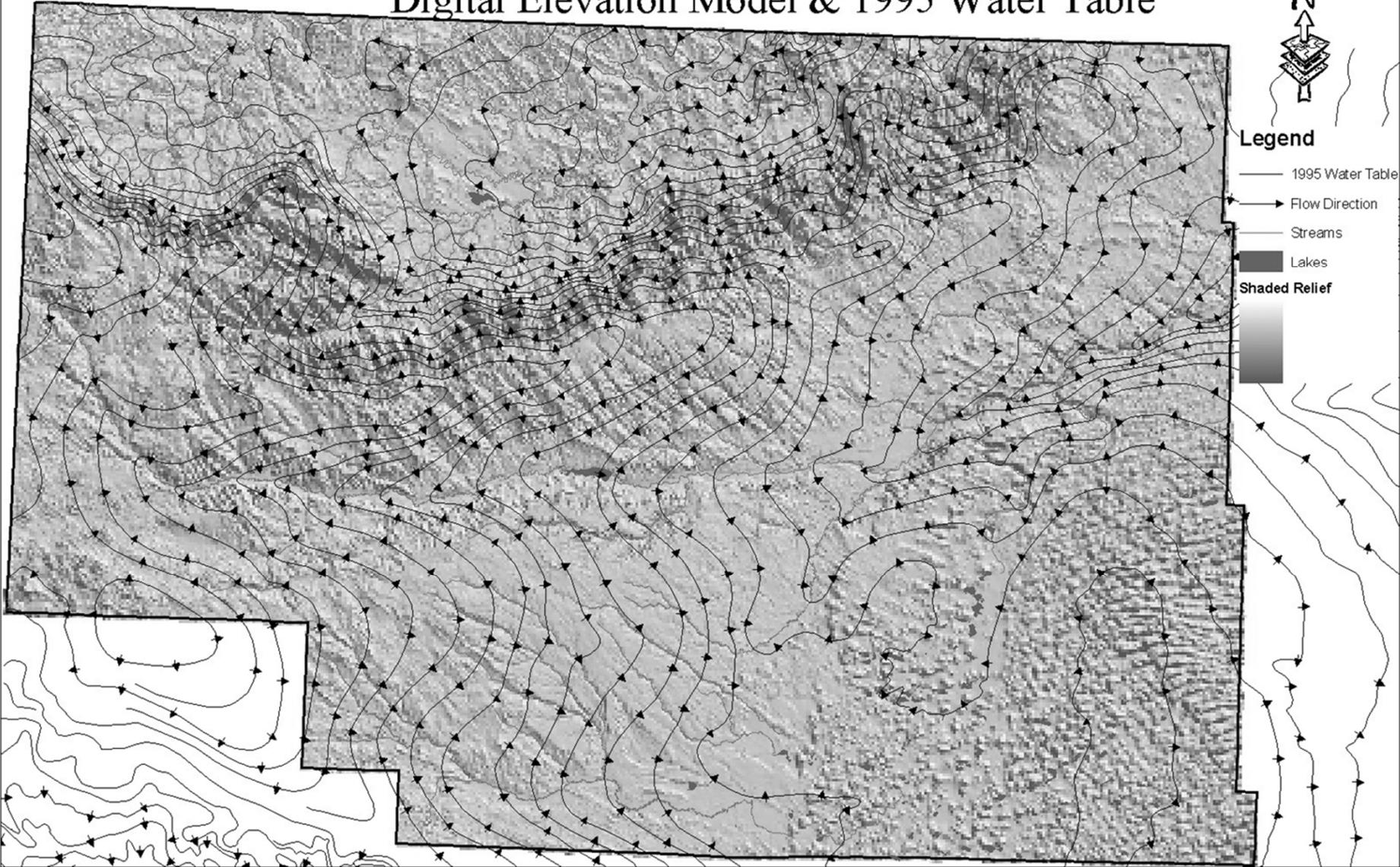
- Ogallala Group
- Arikaree Group
- White River Group
- Pierre Shale
- Niobrara Formation
- Carlile Formation
- Greenhorn-Graneros Formations

# Digital Elevation Model & 1995 Water Table



## Legend

- 1995 Water Table
- Flow Direction
- Streams
- Lakes
- Shaded Relief



# Saturated Thickness of Principal Aquifer

## Legend

□ County Boundaries

▭ Upper Niobrara Whi

### Saturated Thickness

▨ very thin or absent

■ 100

■ 200

■ 300

■ 400

■ 500

■ 600

■ 700

■ 800

■ 900



From Conservation & Survey Division Digitized Maps

The Conservation and Survey Division has prepared this product using what is thought to be the most reliable information available or reproduced material as provided. The detail and precision of interpretations made are according to accepted professional standards and are dependent upon techniques, hardware, and/or software utilized.

The thickness of the principal aquifer is shown by contour lines showing the estimated thickness of the saturated sediments that serve as the aquifer for domestic and irrigation wells. It is digitized from 1:250,000 paper maps published in 1980 and has been used as the 'normal' thickness of the aquifer. The principal CSD geoscientist is Vern Souder. Areas where the principal aquifer is 'absent or very thin' are areas of impermeable rock or clay. Some of these areas are fractured and yield considerable water if the well hits the fracture.

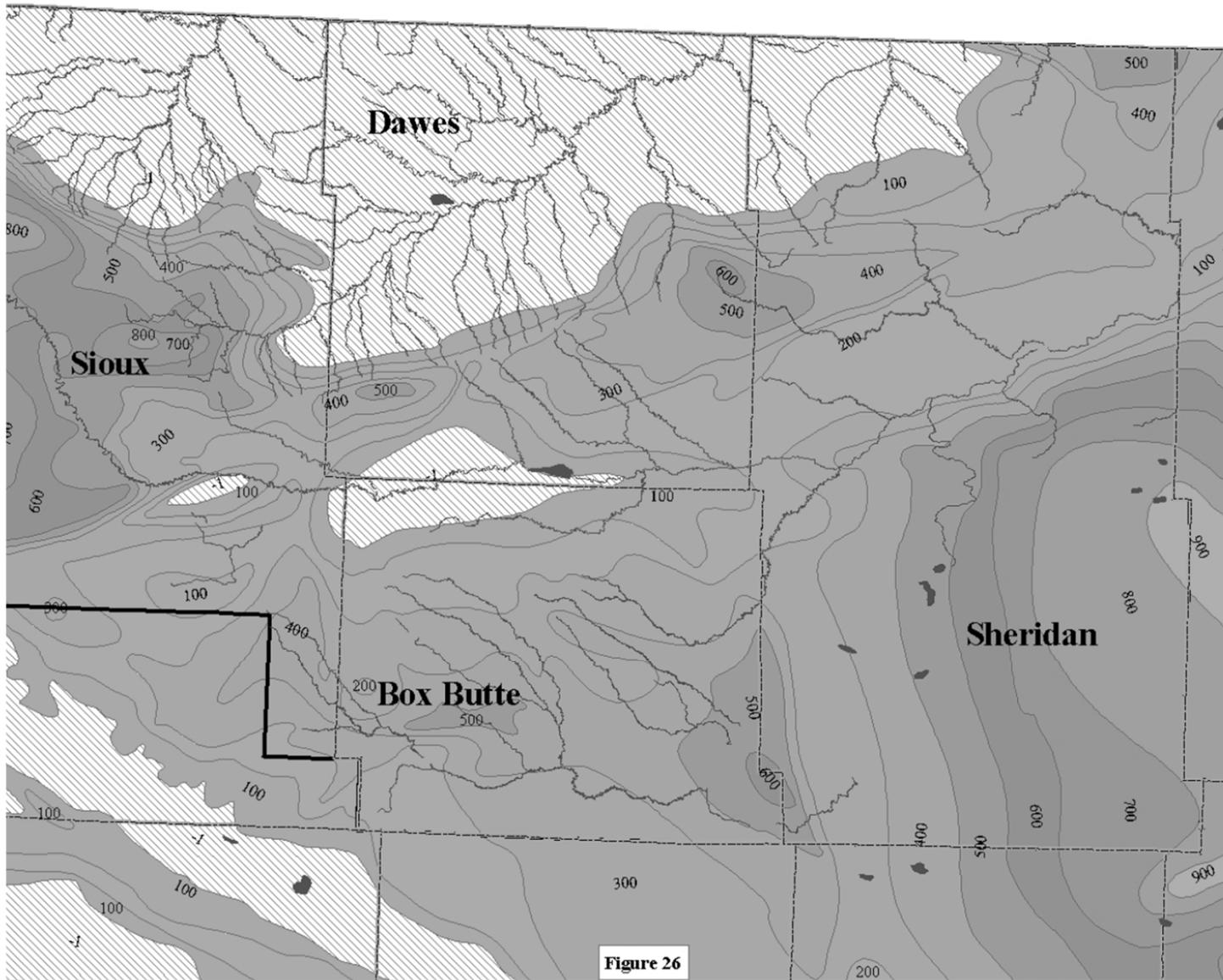
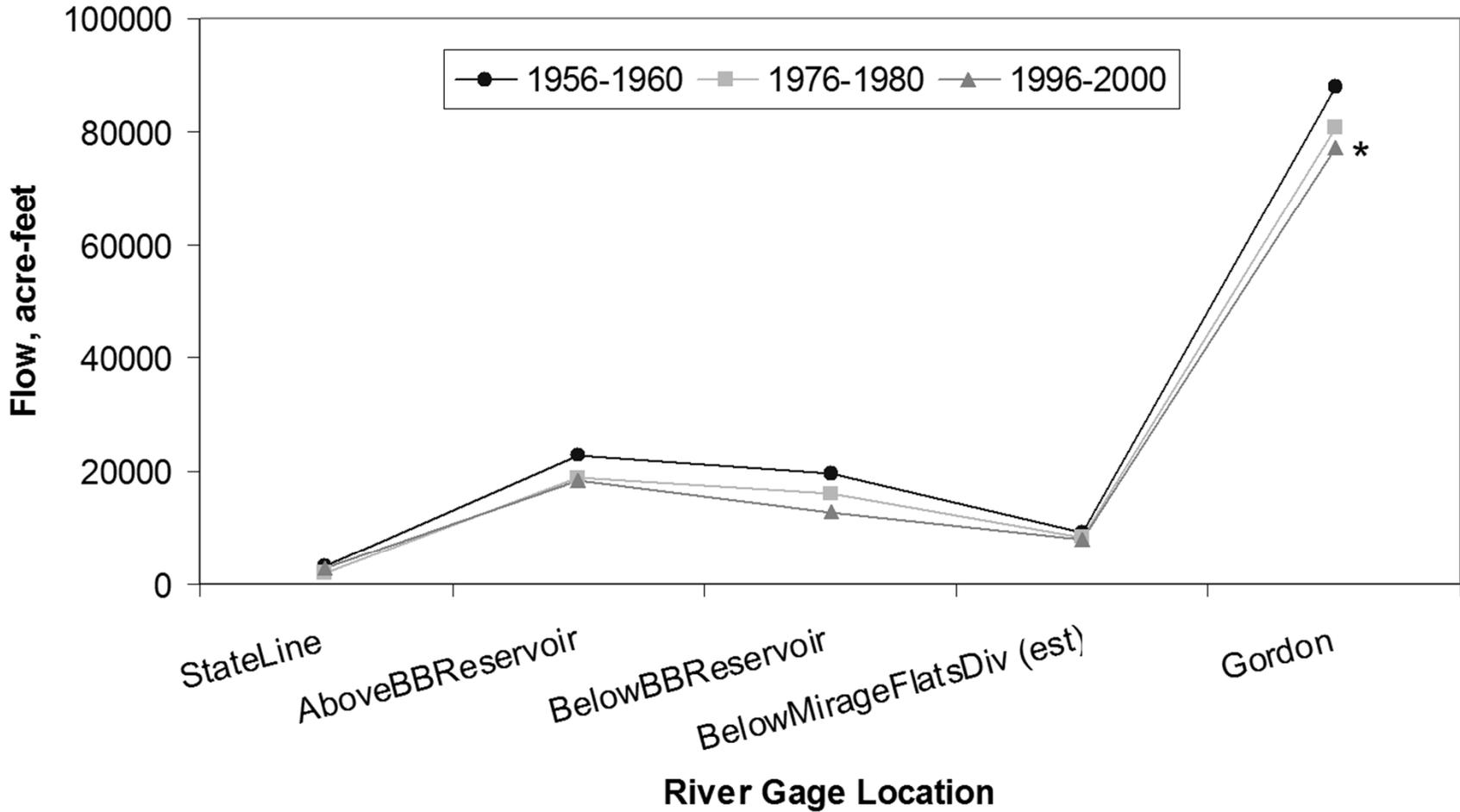


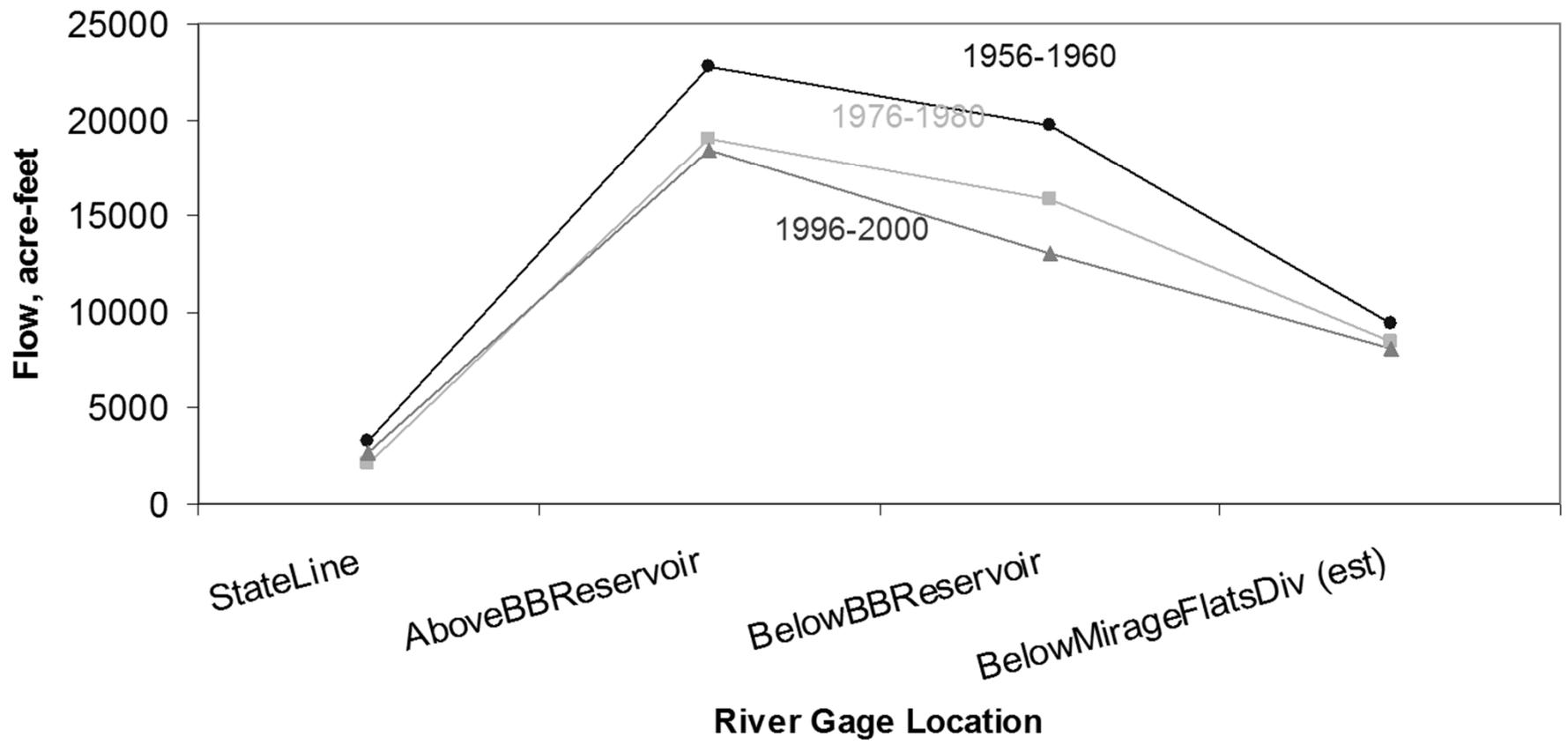
Figure 26

# Average Flows of Niobrara River

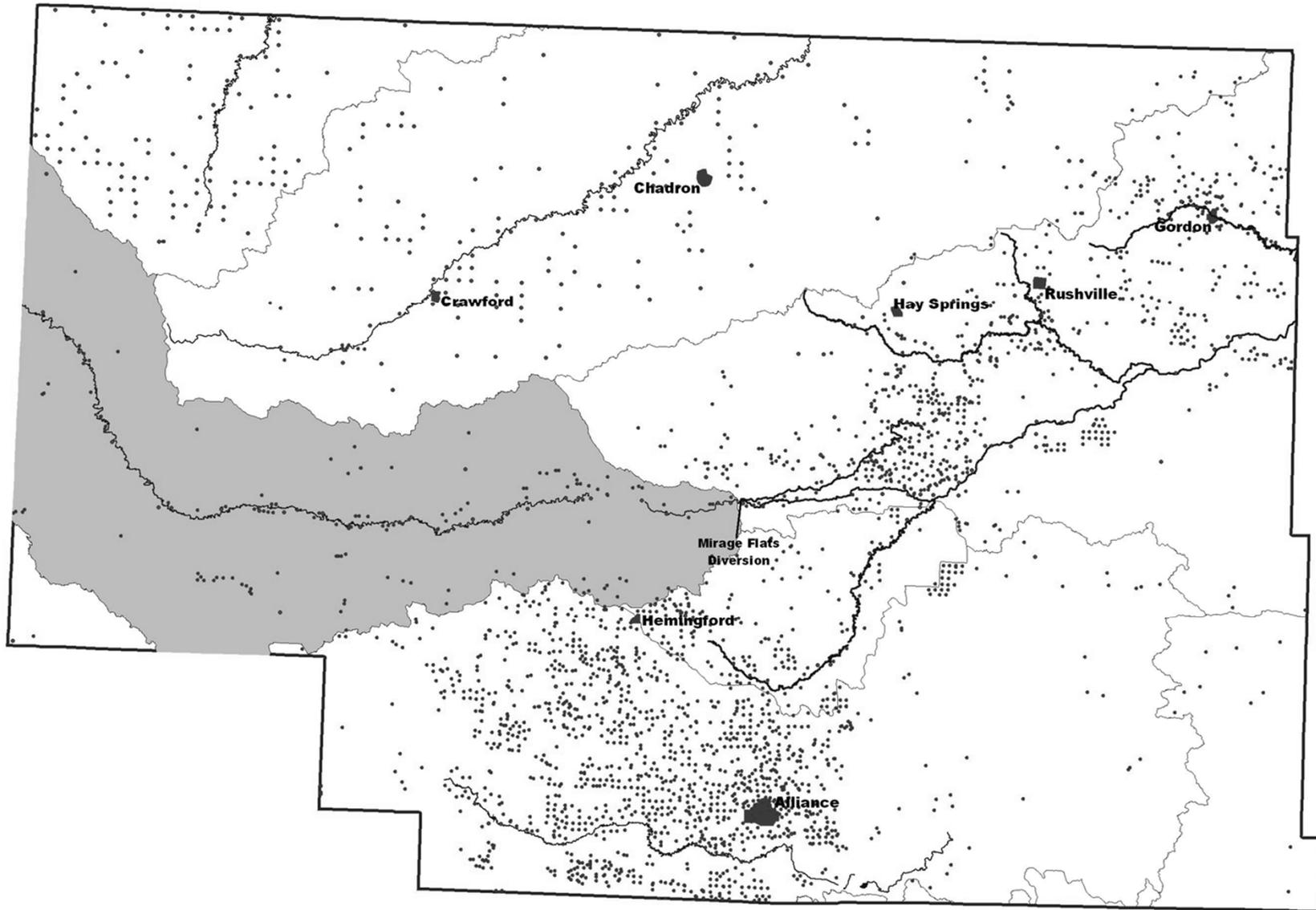


\* 1996-2000 figure of flow near Gordon was an estimate

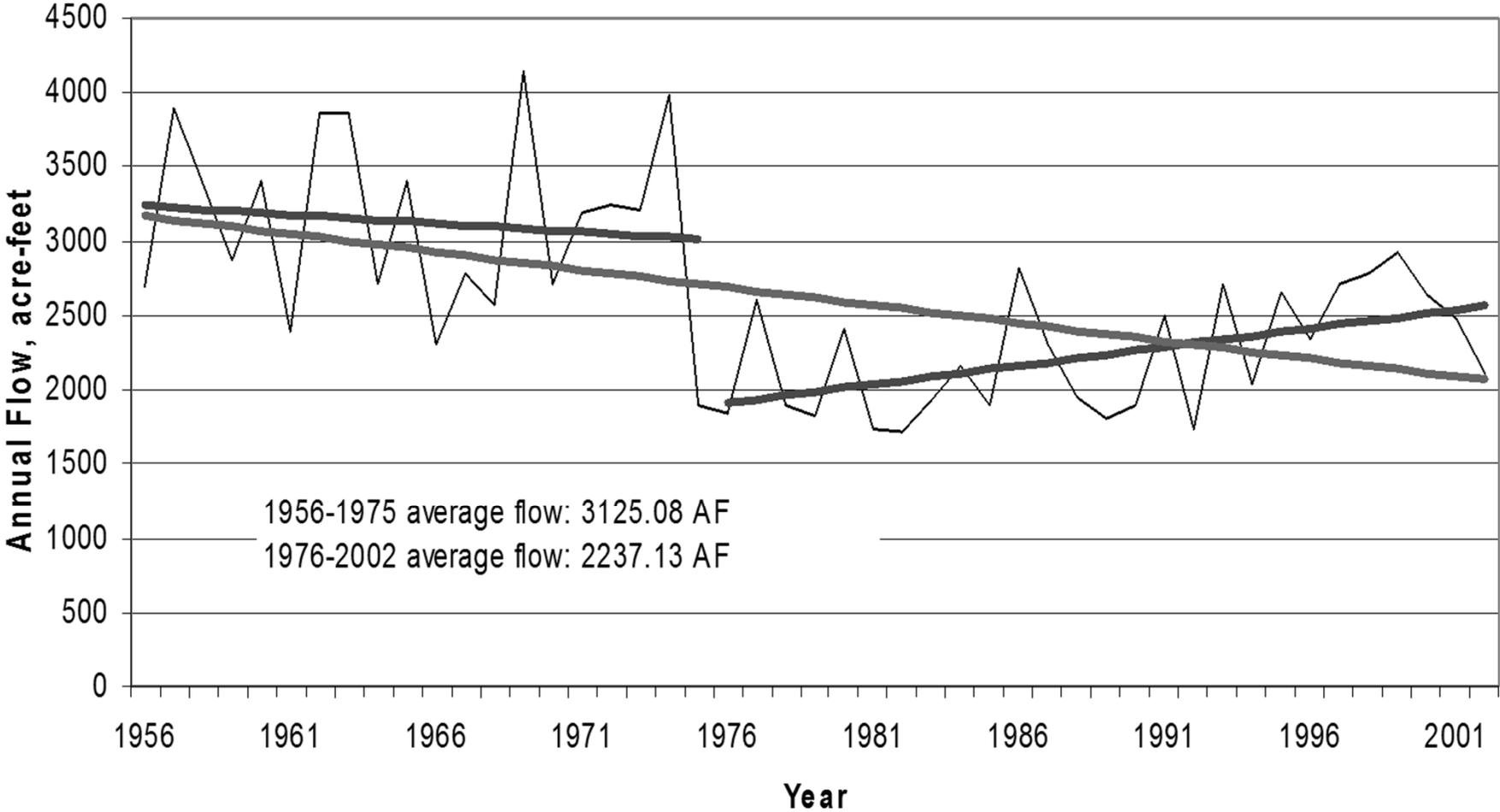
# Average Flows of Niobrara River



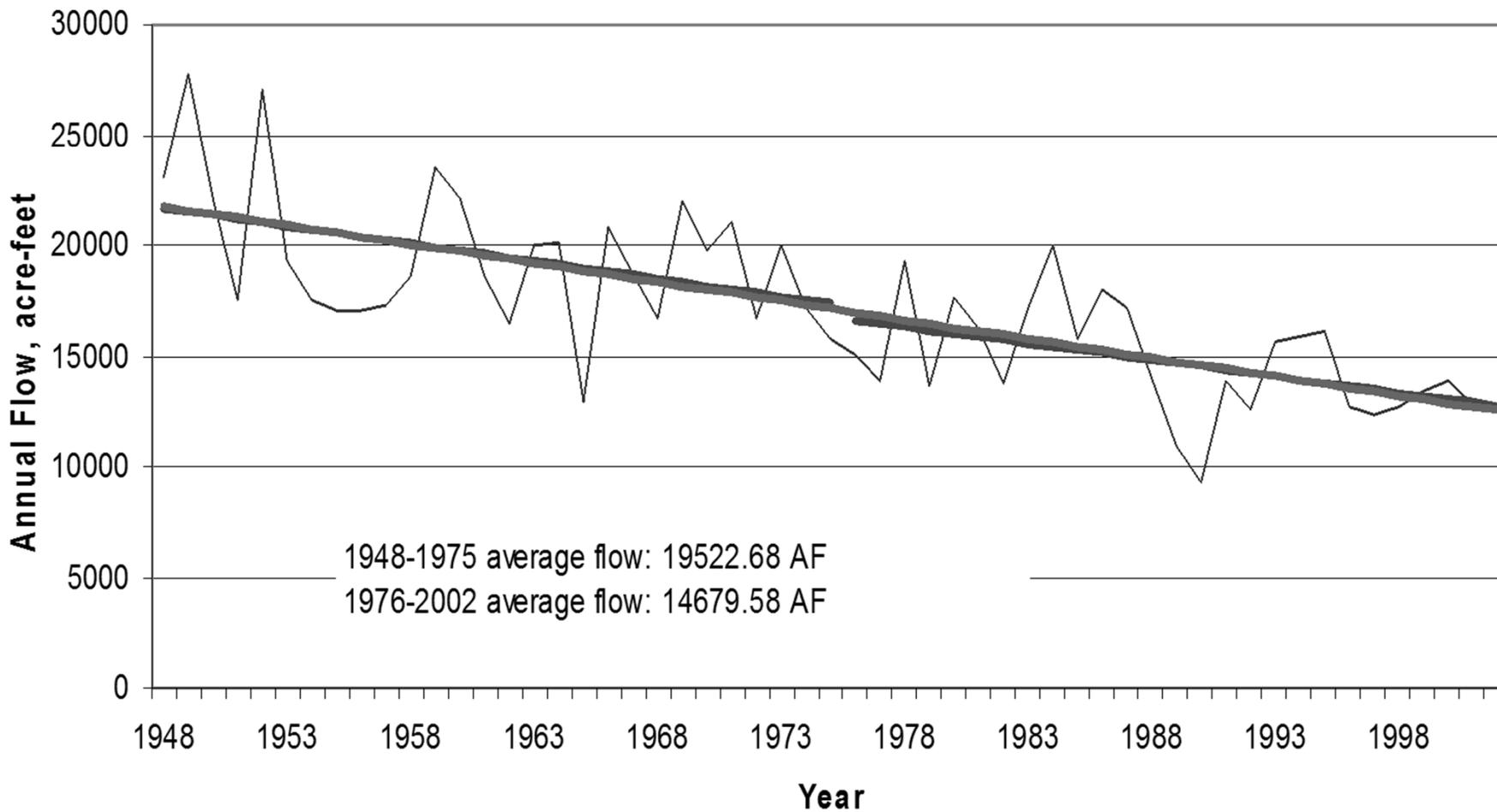
# Niobrara River Basin Above Mirage Flats Diversion



# Annual Flow of Niobrara River at Wyoming-Nebraska State Line (#06454000)



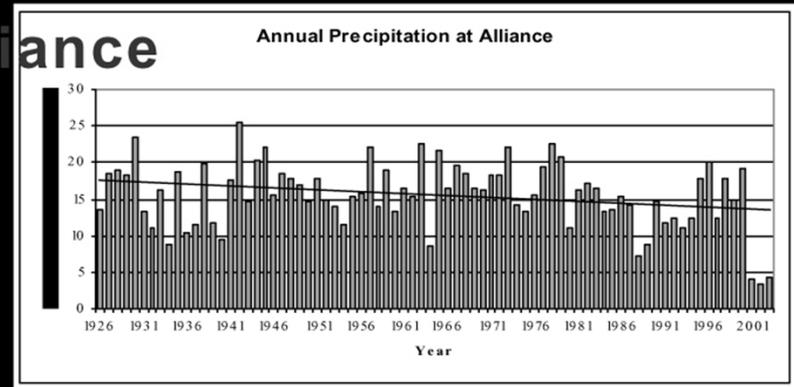
# Annual Flow of Niobrara River below Box Butte Reservoir (#06455500)



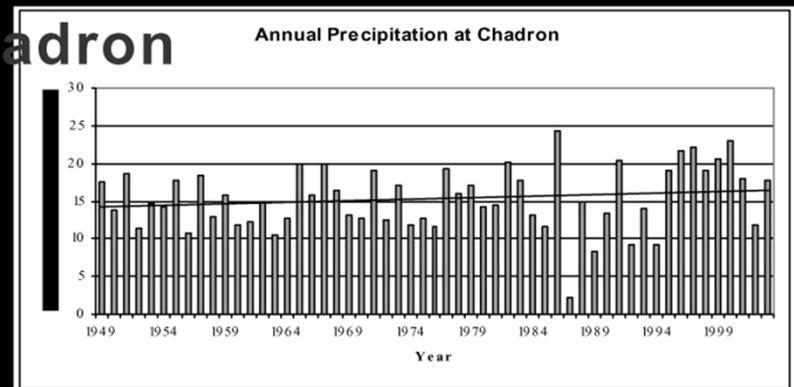
# Annual Precipitation at Alliance, Chadron, and Harrison by Year

**Figure 2**  
Annual Precipitation at Alliance, Chadron, and Harrison by Year

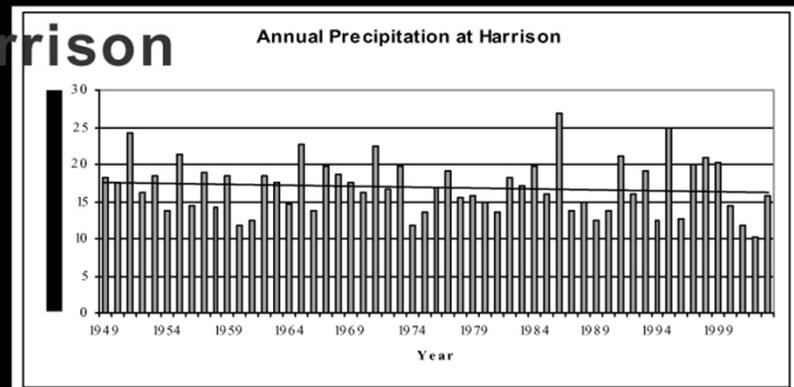
## Alliance



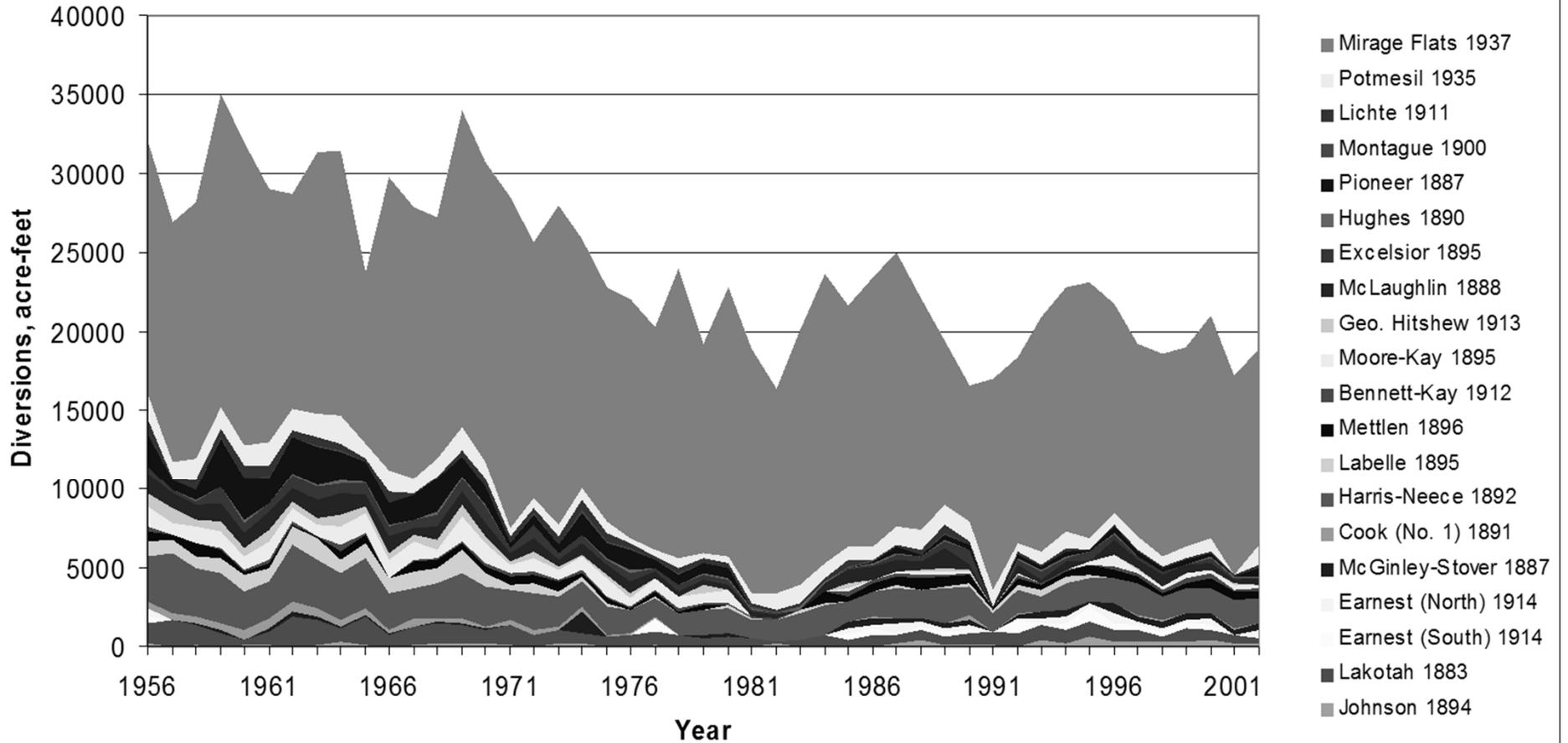
## Chadron



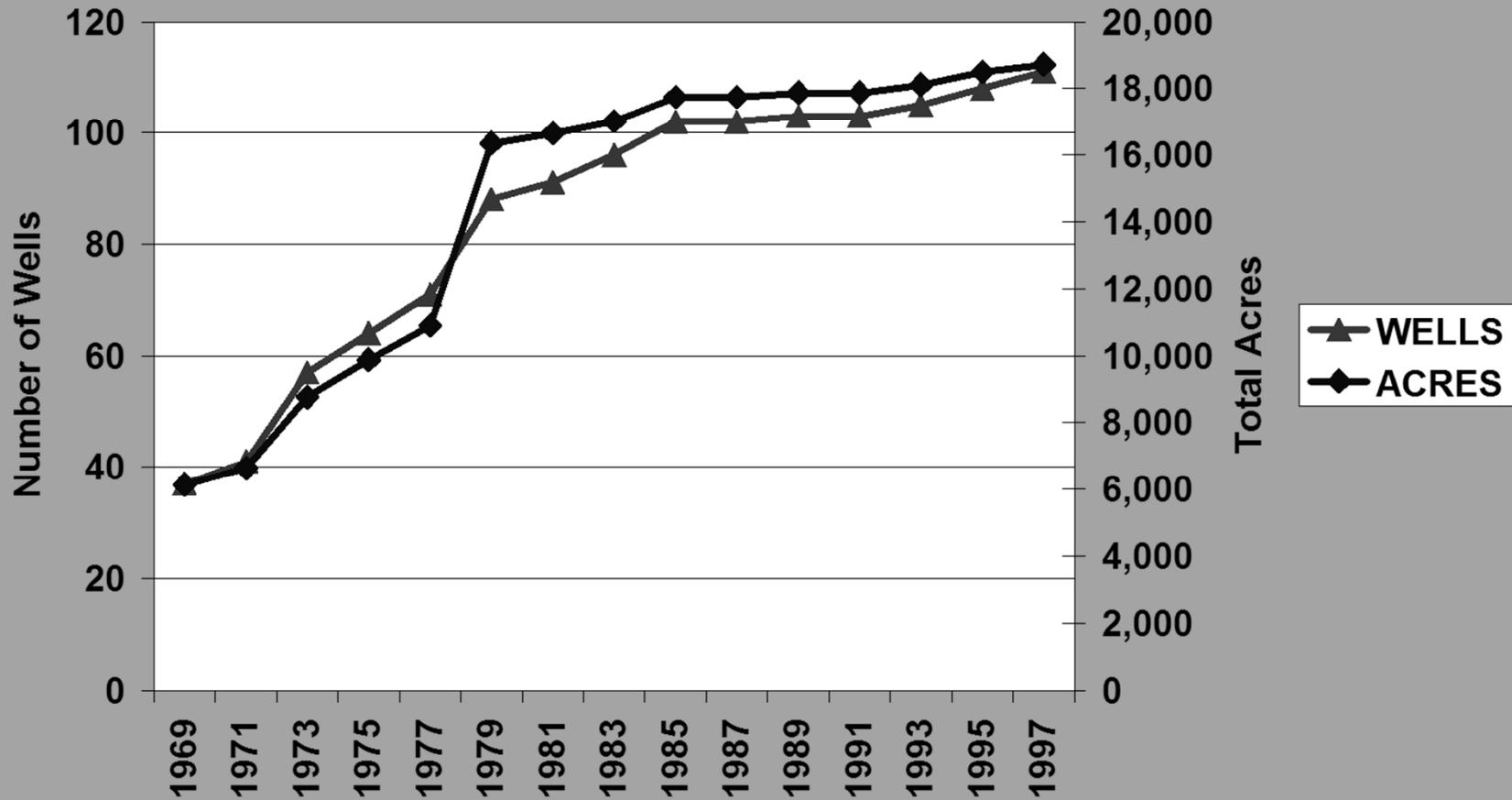
## Harrison



## Annual Diversions of Canals from Niobrara River



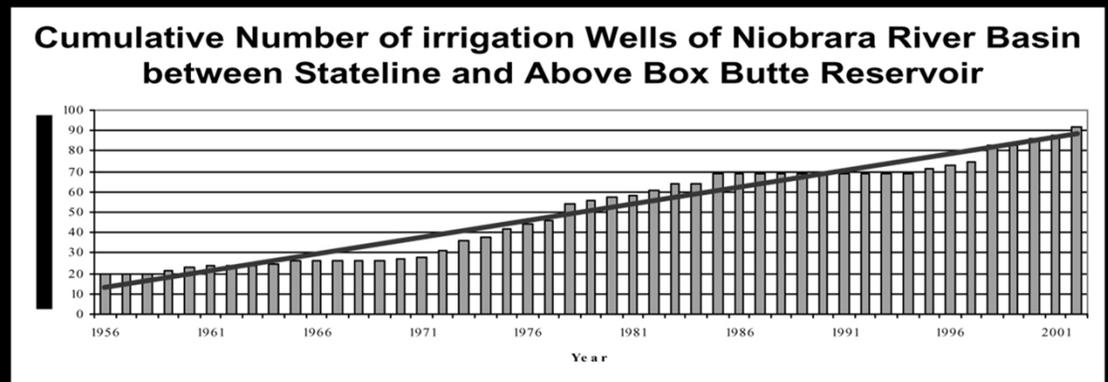
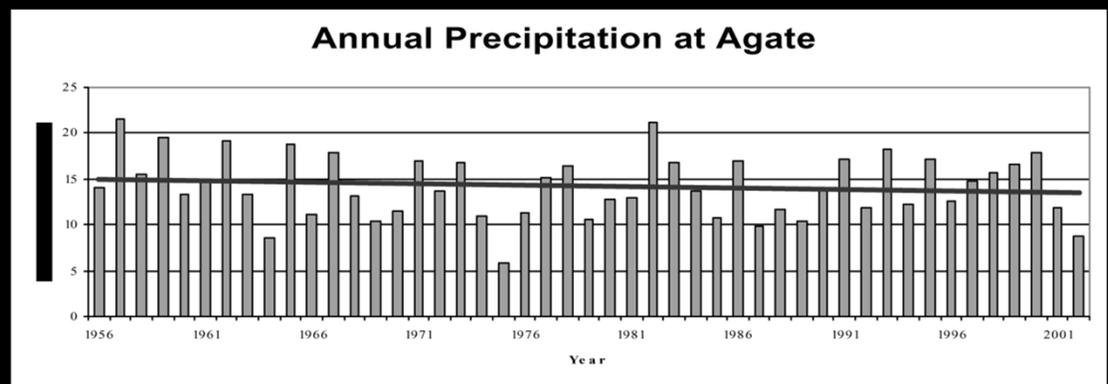
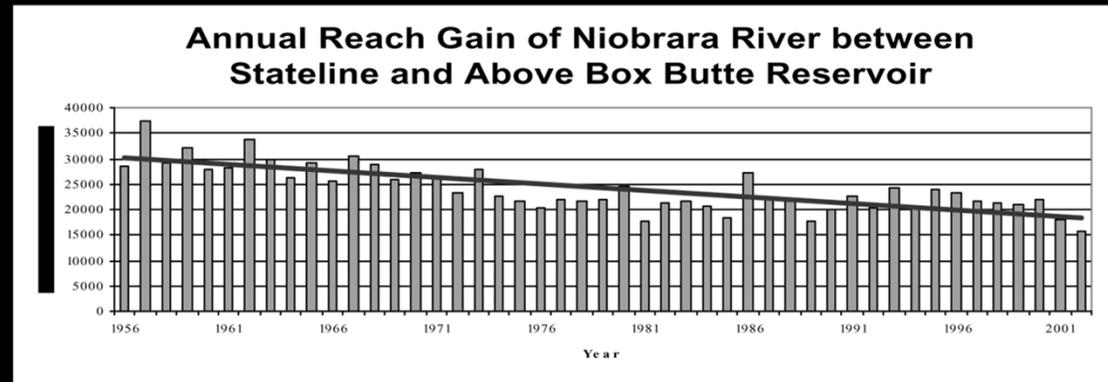
# Well Statistics Above Mirage Flats Diversion Niobrara River Basin 1939-2004



# Trend Analyses Annual Reach Gain Precipitation and Numbers Irrigation Wells

**Figure 48**

**Trend Analyses of Annual Reach Gain, Precipitation, and Numbers of Irrigation Wells**



# **Niobrara River-Wyoming Line to Mirage Flats Diversion**

---

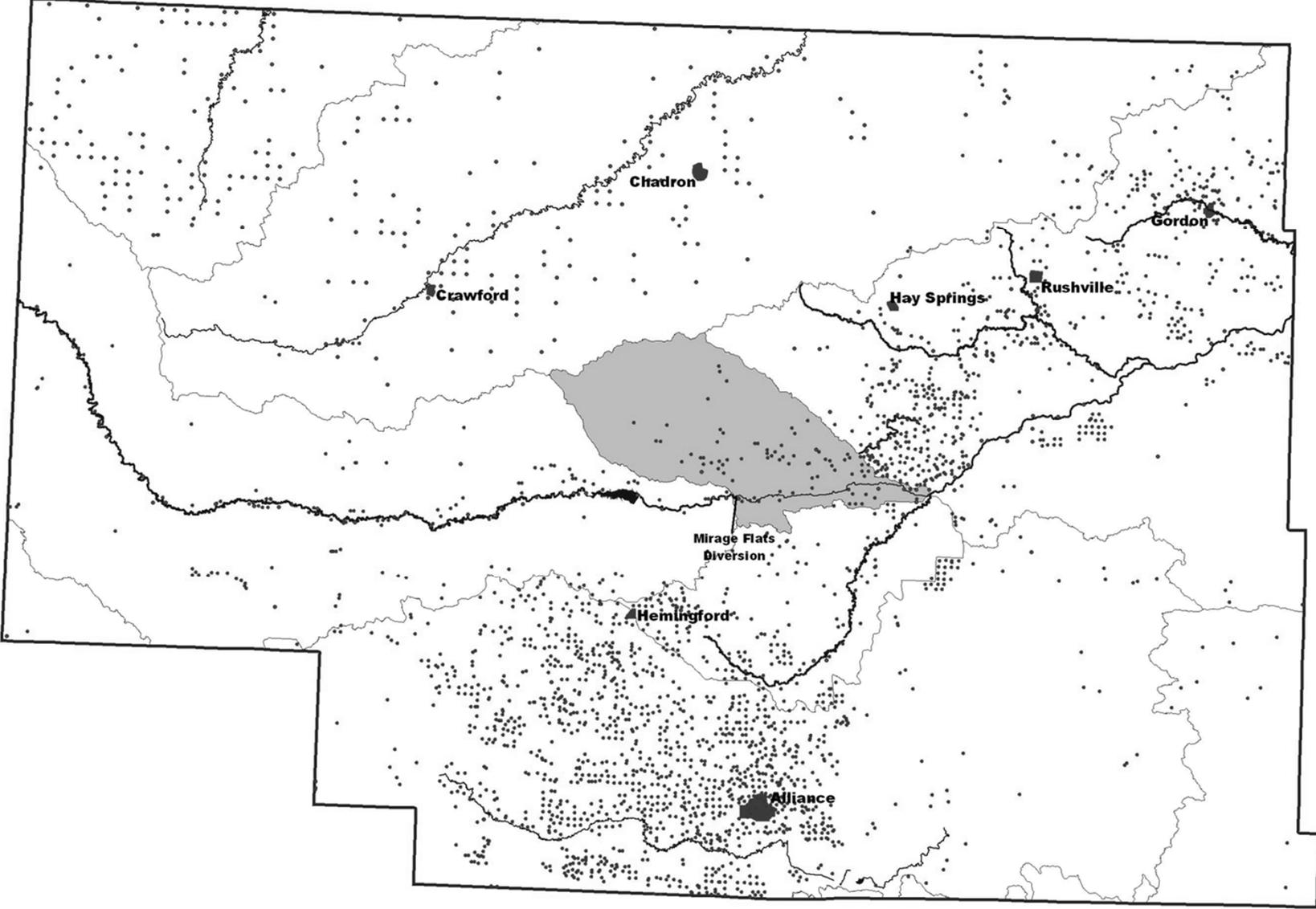
- **Inflows at State Line have decreased**
- **Formal moratorium on surface water rights above Mirage Flats canal since 1990**
- **Flows have diminished**
- **Surface water diversions have diminished (19% at Mirage Flats Diversion)**
- **Number of Irrigation wells upgradient have increased**
- **No significant change in precipitation**
- **Administration required in almost all years to meet 1937 Mirage Flats right**

# **Conclusion-Niobrara River-Wyoming State Line to Mirage Flats Diversion**

---

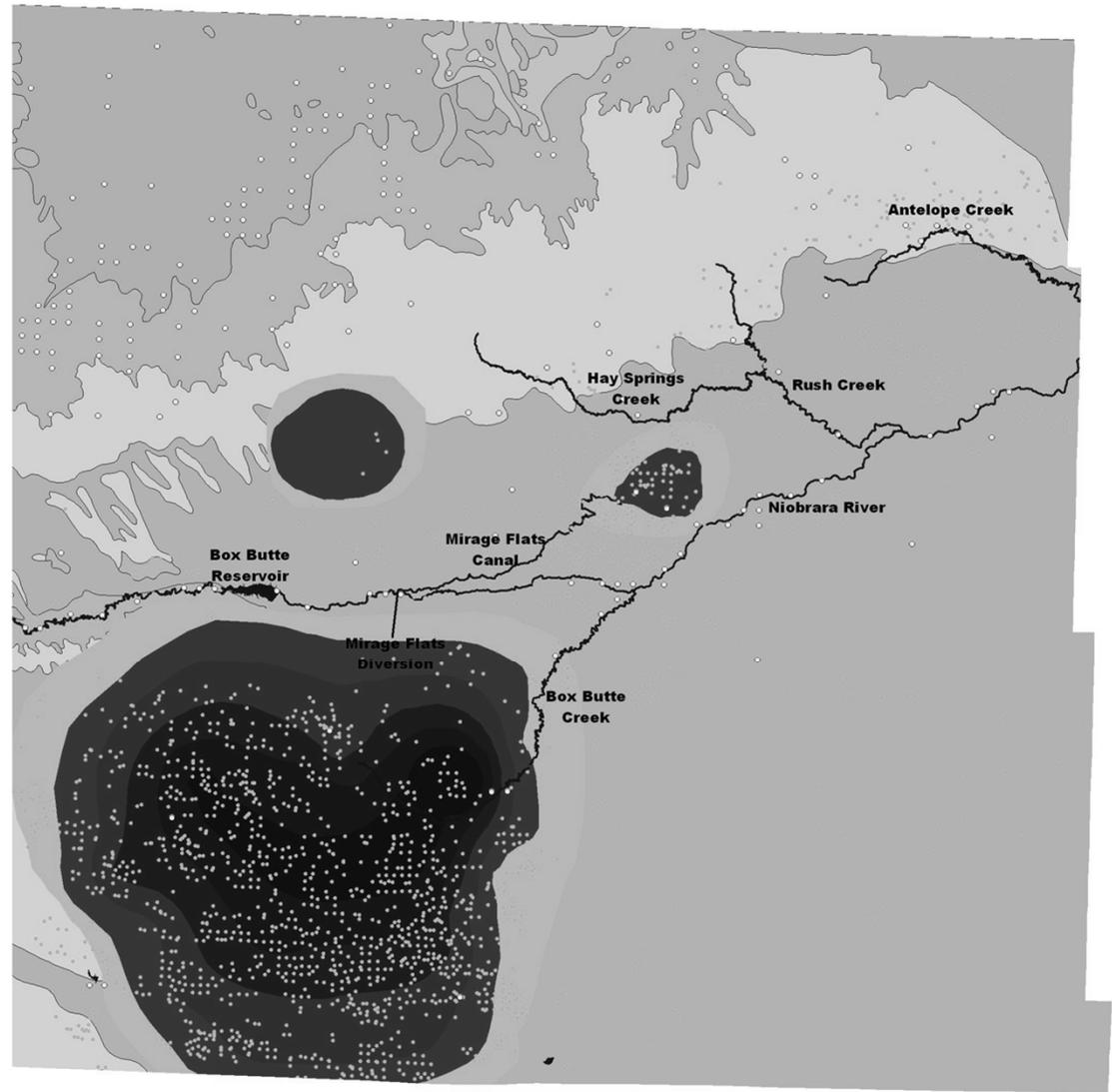
- **Ground water use is depleting the flows of the Niobrara River upstream of the Mirage Flats Diversion.**
- **The resulting level of surface water supplies appear insufficient to sustain the beneficial purposes for which the rights were granted.**

# Niobrara River Basin Between Mirage Flats Diversion and Confluence of Box Butte Creek



# Eastern Part Upper Niobrara-White NRD

Ground Water Regions  
and  
Surface and Ground  
Water Diversions



- Surface Water Diversion Points
- Active Irrigation Well Locations

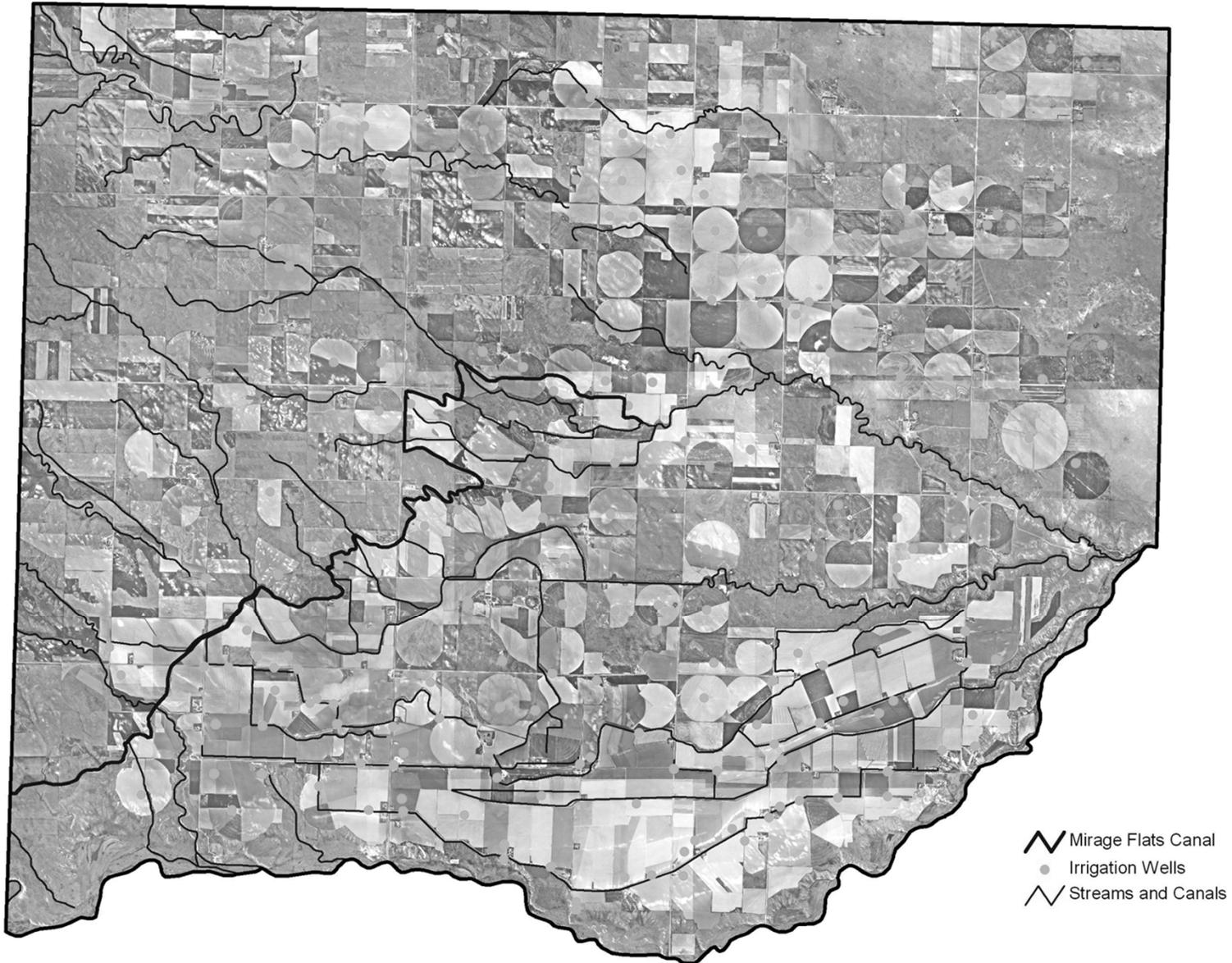
Bedrock

- █ Arikaree Group
- █ Carlile Formation
- █ Greenhorn-Graneros Formations
- █ Niobrara Formation
- █ Ogallala Group
- █ Pierre Shale
- █ White River Group

Ground Water Change (Pre-Development - 2003)

- █ 0 to -4.99 ft.
- █ -5.00 to -9.99 ft.
- █ -10.00 to -19.99 ft.
- █ -20.00 to -29.99 ft.
- █ -30.00 to -39.99 ft.
- █ -40.00 to -49.99 ft.
- █ > -50.00 ft.

# Irrigation Wells and Canals - Mirage Flats Area



# Mirage Flats Recorder Well Sheridan County, NE

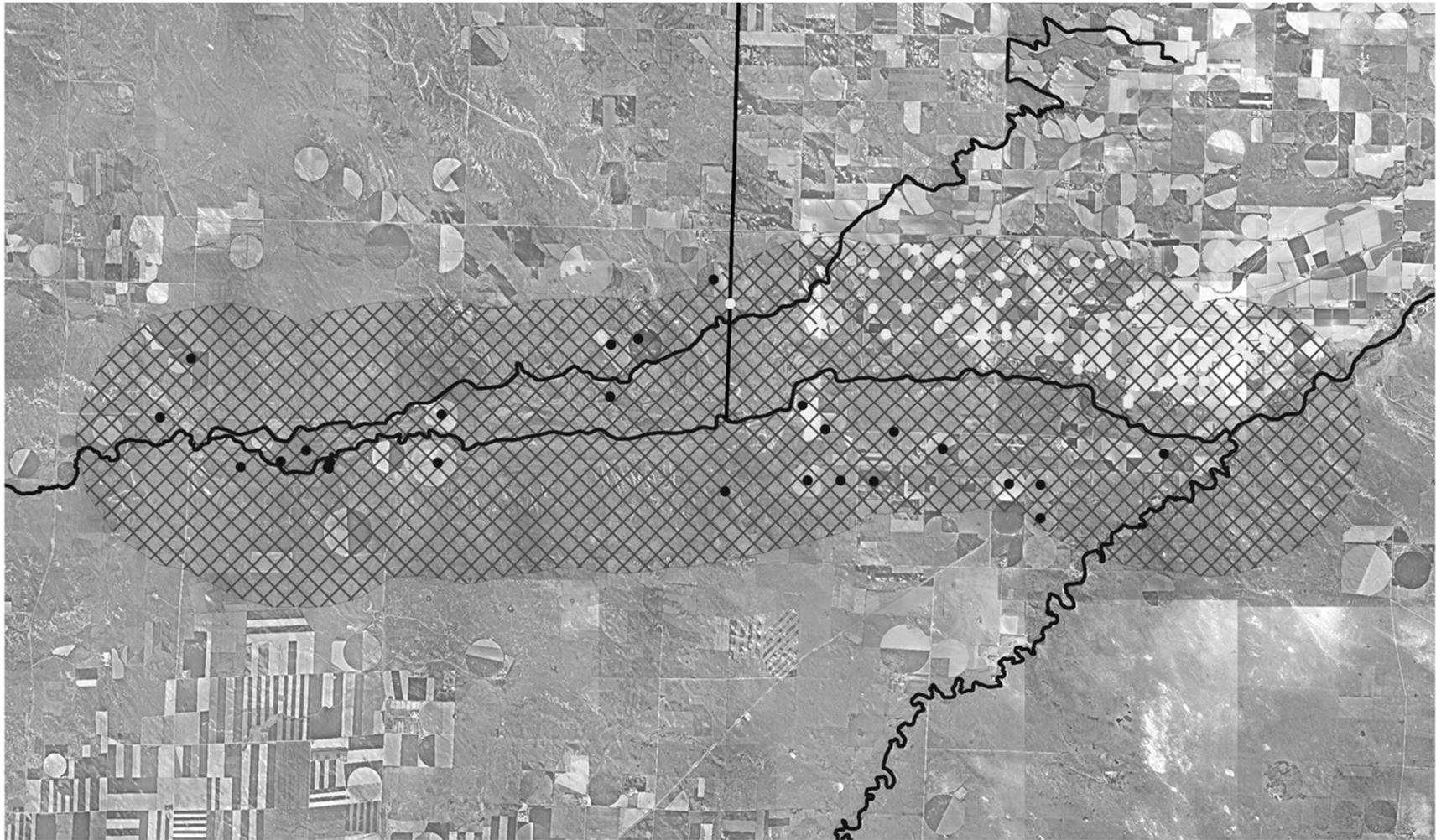
29N 46W 10AA



**Fall 1953 to Spring 2003**

**Total Decline 4.01 ft – Avg. .08 ft/yr**

# Active Irrigation Wells Within Two Miles of the Niobrara River Mirage Flats Diversion to Box Butte Creek Confluence



- Active Irrigation Well Within Area 6
- Active Irrigation Well
- ▤ Streams, Rivers, and Canals
- ▭ Area 6 Boundary
- ▨ 2-Mile Buffer - Mirage Flats Diversion to Confluence of Box Butte Creek

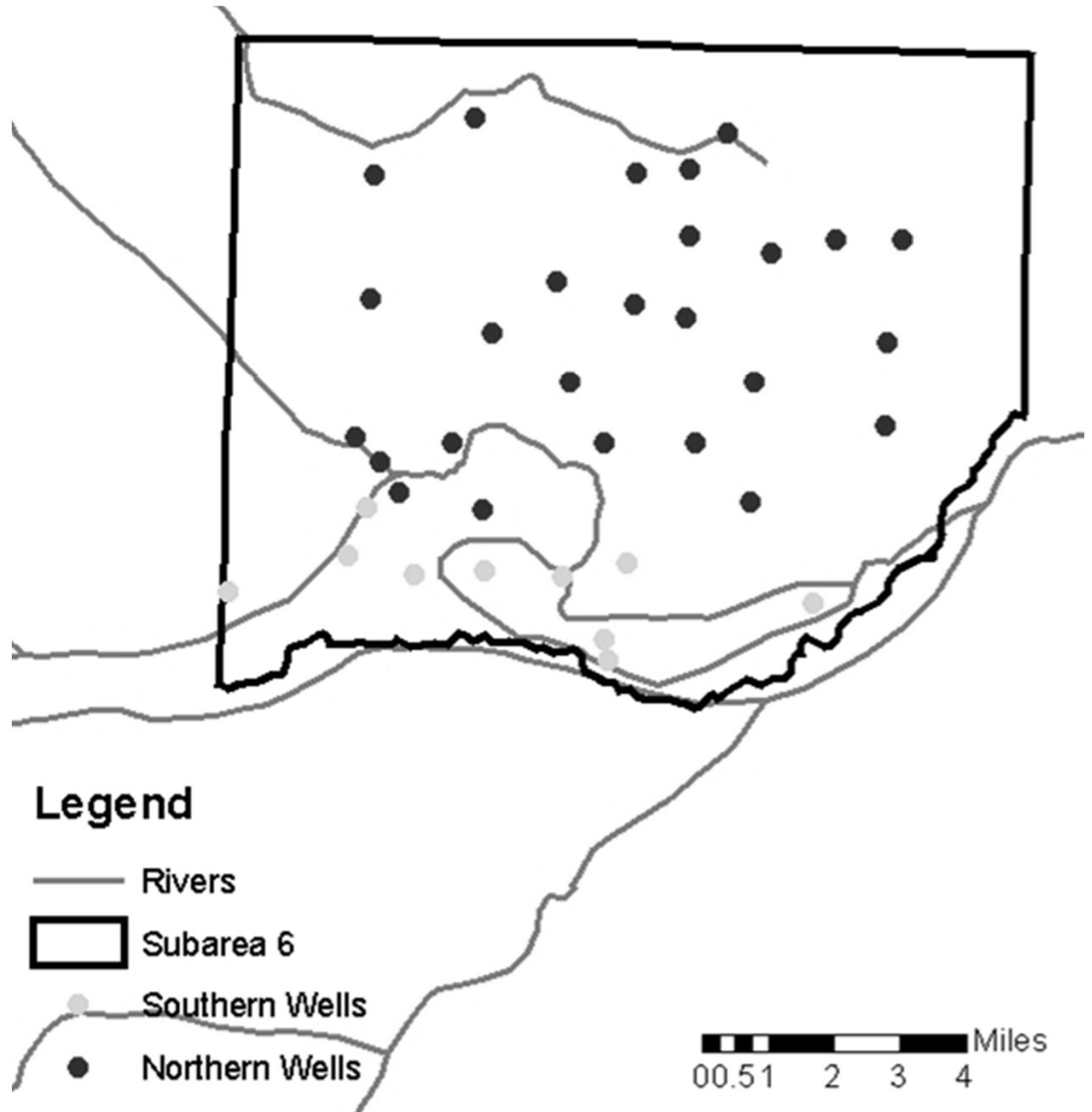
# **Mirage Flats Diversion to Confluence of Box Butte Creek**

---

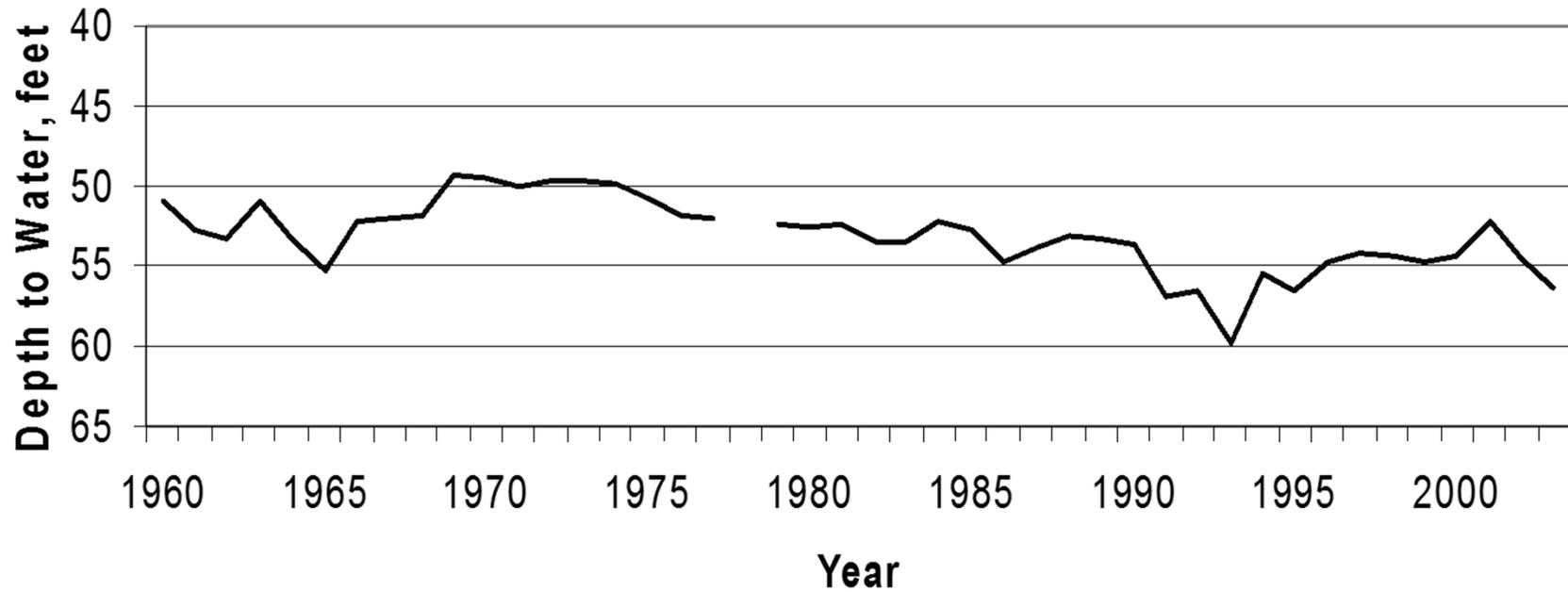
- **Most flow removed at diversion**
- **8 rights between diversion and Box Butte Creek**
- **Ground water tables declining significantly to North and 5 feet or less near creek on north side**
- **Some water found in spot measurements**
- **No calls for water administration**

# Water Level Wells In Mirage Flats Area

---



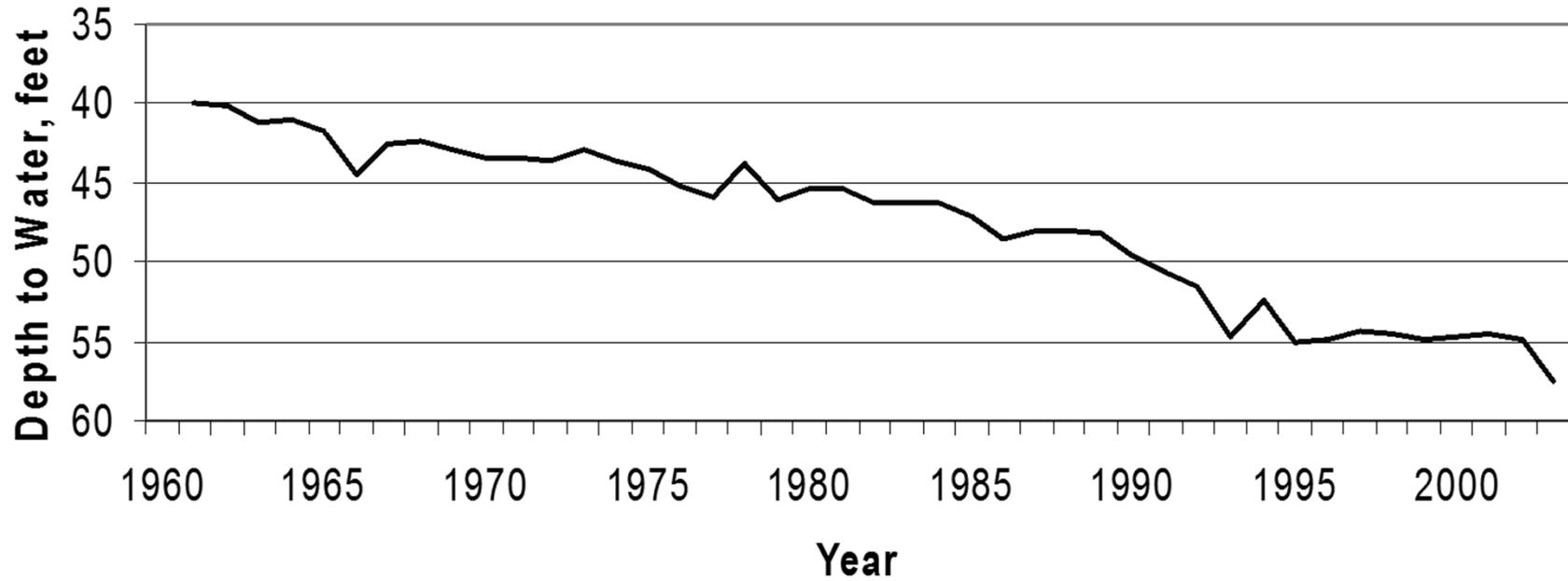
## Average Depth to Water of Southern Mirage Flats Water Level Wells



### Wells Legal Description:

29N 46W24AD 1    29N 46W24AAB 1    29N 46W18BCC 1    29N 45W16ADD 1    29N 46W13BB 1  
29N 46W16AA 1    29N 46W15AAA 1    29N 45W 7CC 2    29N 46W 8DD 1    29N 46W 9BB 1

## Average Depth to Water of Northern Mirage Flats Water Level Wells



### Wells Legal Description:

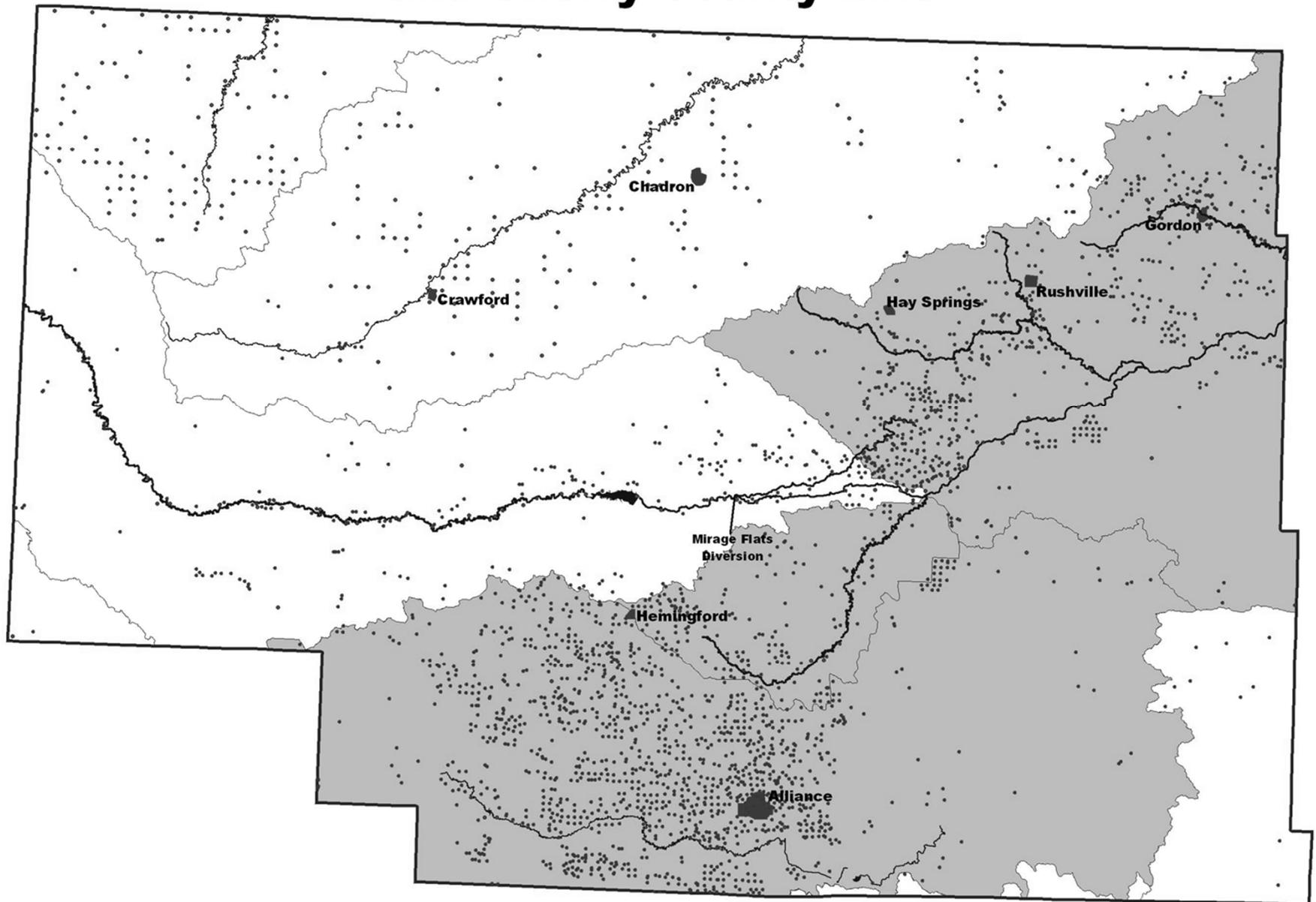
29N 46W10AA 1 29N 45W 5DDD 1 29N 46W 4DC 1 29N 46W 4BDC 1 29N 46W 3BA 1 29N 46W 1ABA 1 29N 46W 5AAA 1  
29N 45W 5BBB 1 30N 45W34DAD 1 30N 46W36BB 1 30N 45W32AAA 1 30N 45W27ADD 1 30N 46W27ADD 1 30N 45W30AA 1  
30N 46W21CCC 1 30N 45W19CCC 1 30N 46W23DA 1 30N 45W21BB 1 30N 45W14CC 1 30N 45W15CC 1 30N 45W18DD 1  
30N 46W16BBB 1 30N 45W 7CCC 1 30N 45W 7DD 1 30N 45W 8BDA 1 30N 46W10ABC 1

# **Conclusions-Niobrara River-Mirage Flats Diversion to Mouth of Box Butte Creek**

---

- **Rights are currently being met**
- **Ground water levels declining**
- **Insufficient data to determine whether ground water declines in future will cause water supplies to become insufficient for surface water rights.**
- **Additional study needed**

# Niobrara River Basin Between Box Butte Creek and Cherry County Line



# **Mouth of Box Butte Creek to NRD Eastern Boundary**

---

- **Sufficient flow to satisfy surface  
water rights**

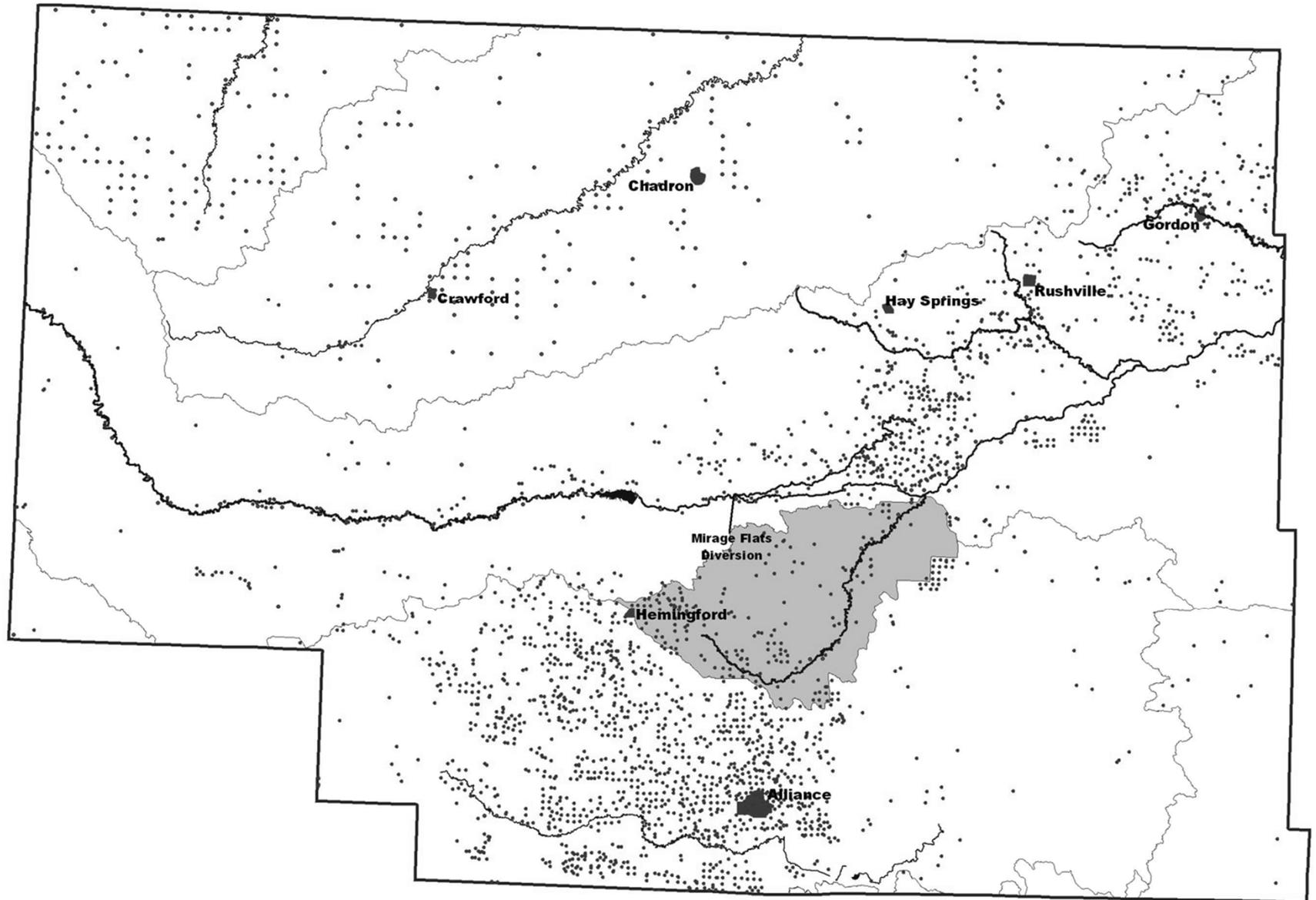
# **Conclusion – Niobrara River from mouth of Box Butte Creek to Cherry County Line**

---

- **There are sufficient sources of baseflow that surface water supplies seem likely to remain sufficient for existing rights, even in the long-term.**

# Box Butte Creek Basin

---



# **Box Butte Creek Basin**

- **3 surface water rights in Box Butte County and 4 in Sheridan County**
- **DNR at one time received calls to administer**
- **Occasional spot measurements have shown water in upper reaches**
- **All observations show flow at mouth.**

# **Box Butte Creek Basin**

**Continued**

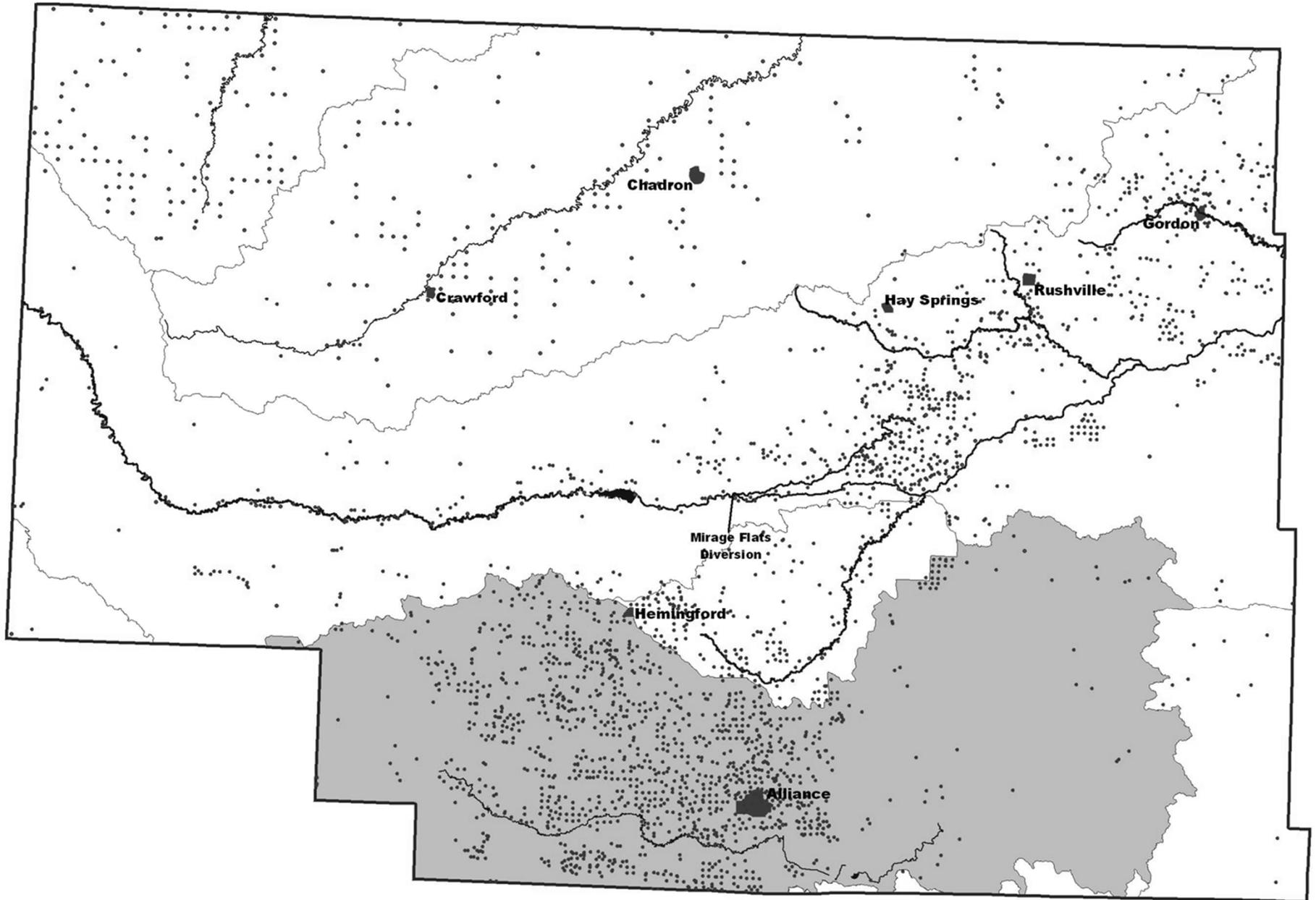
- **155 irrigation wells in surface water basin are contributing to changes in ground water levels**
- **Water table declines in area that affect rate and direction of ground water subflow in the area**

# **Conclusion – Box Butte Creek Basin**

---

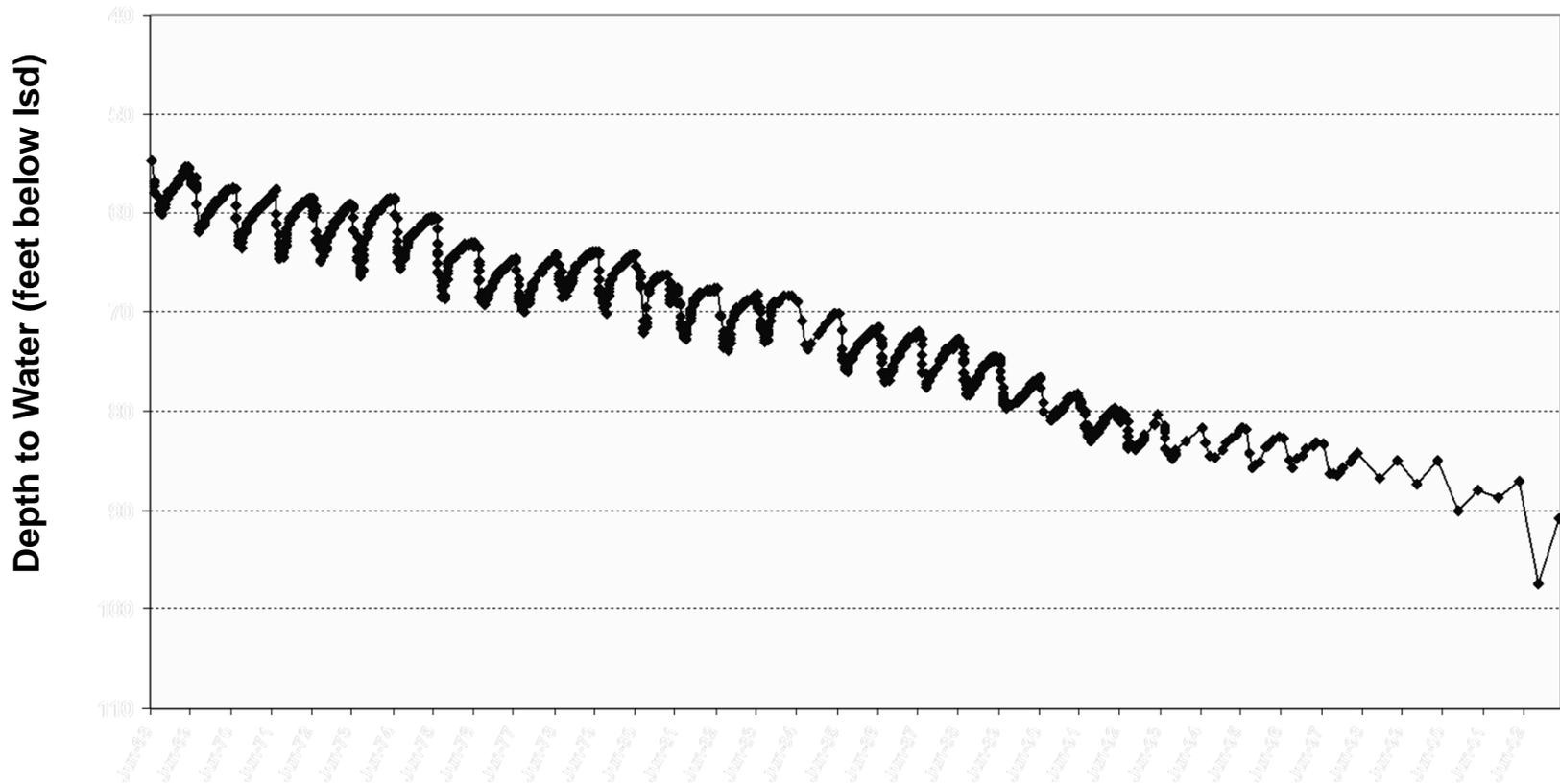
- **Ground water declines appear likely to have affected flows.**
- **Current uses of hydrologically connected groundwater water have resulted in insufficient surface water flows to sustain surface water rights.**

# Snake Creek Basin



# Alliance Recorder Well Box Butte County, NE

25N 48W 12CCA



**Summer 1968 to Spring 2003**  
**Total Decline 47.91 ft – Avg. 1.41 ft/yr**

# **Snake Creek Basin**

---

- **Five Rights – 2 for Kilpatrick Reservoir, 1 for Kilpatrick Canals, and 2 for tributaries.**
- **Recent observations and some older spot measurements indicate some decline in baseflow immediately upstream of Kilpatrick Reservoir.**
- **780 active irrigation wells in surface water basin are contributing to ground water level changes that affect rate and direction of subflow over a large area.**
- **No recent calls for surface water administration.**

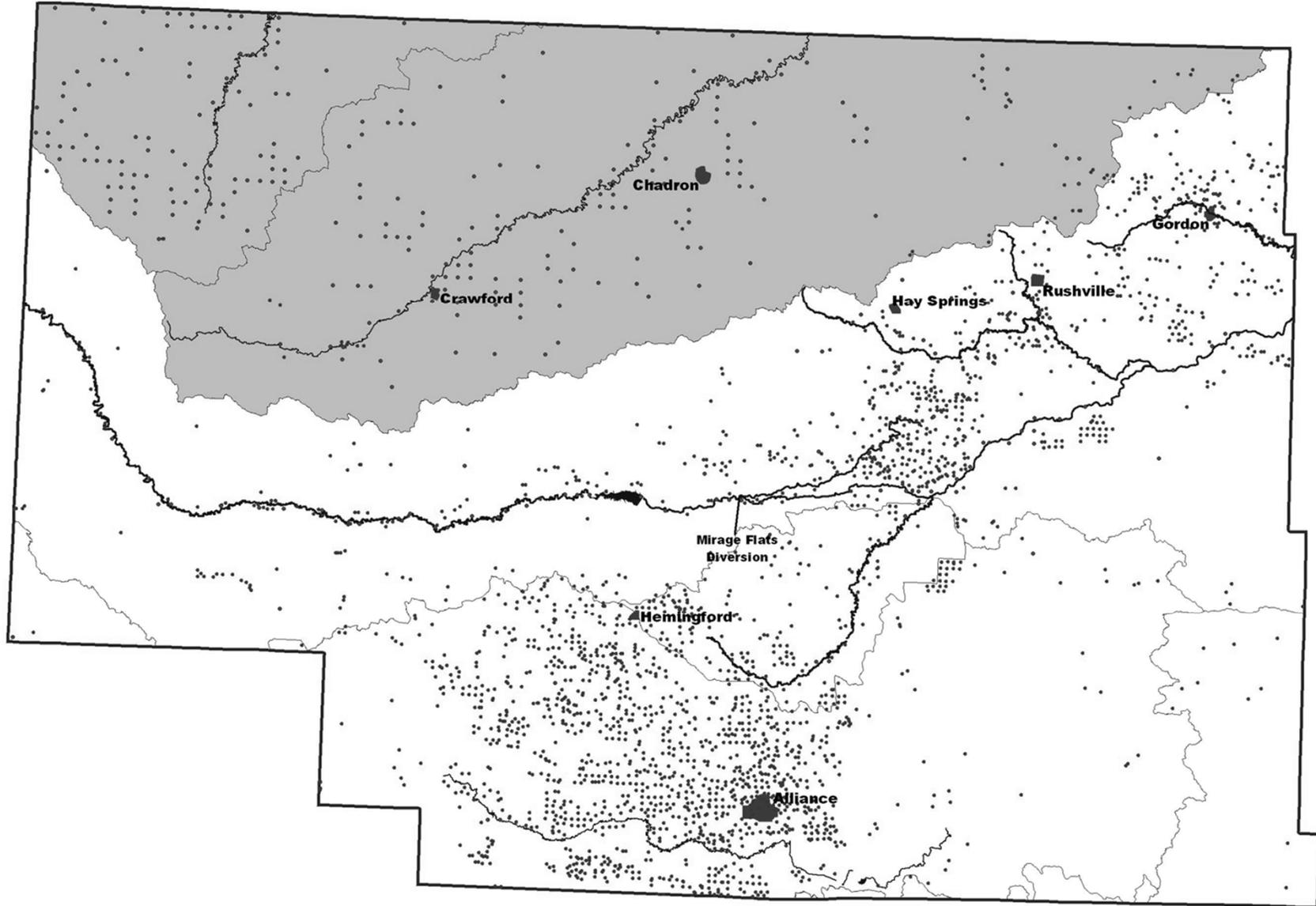
# **Conclusion- Snake Creek Basin**

---

- **Current uses of hydrologically connected groundwater have resulted in insufficient surface water flows to sustain the beneficial uses of existing surface water rights**

# White River and Hat Creek Basins

---



# **White River Basin- Hat Creek Basin**

---

- **527 surface water rights –  
(296 White, 231 Hat)**
- **24 irrigation wells – only 3 since 1980**
- **Informal moratorium on surface  
water rights since 1995**
- **No significant trends on gage at  
Crawford**
- **Increase in low capacity wells**

# **White River Basin- Hat Creek Basin**

---

**Continued**

- **Wells across divide may be a concern in a few headwaters.**
- **Most wells have a hydrologic connection to surface water but the geology is complex enough that in a few instances that may not be the case.**

# **Conclusion-**

## **White River Basin and Hat Creek Basin**

- **Any increase in high capacity wells would likely affect the ability of the streams to sustain the beneficial purposes for which the surface water rights were granted.**

---

**Out of Basin Effects  
of  
Water Development  
in the  
Upper Niobrara-White Basin**



---

**Thank You**