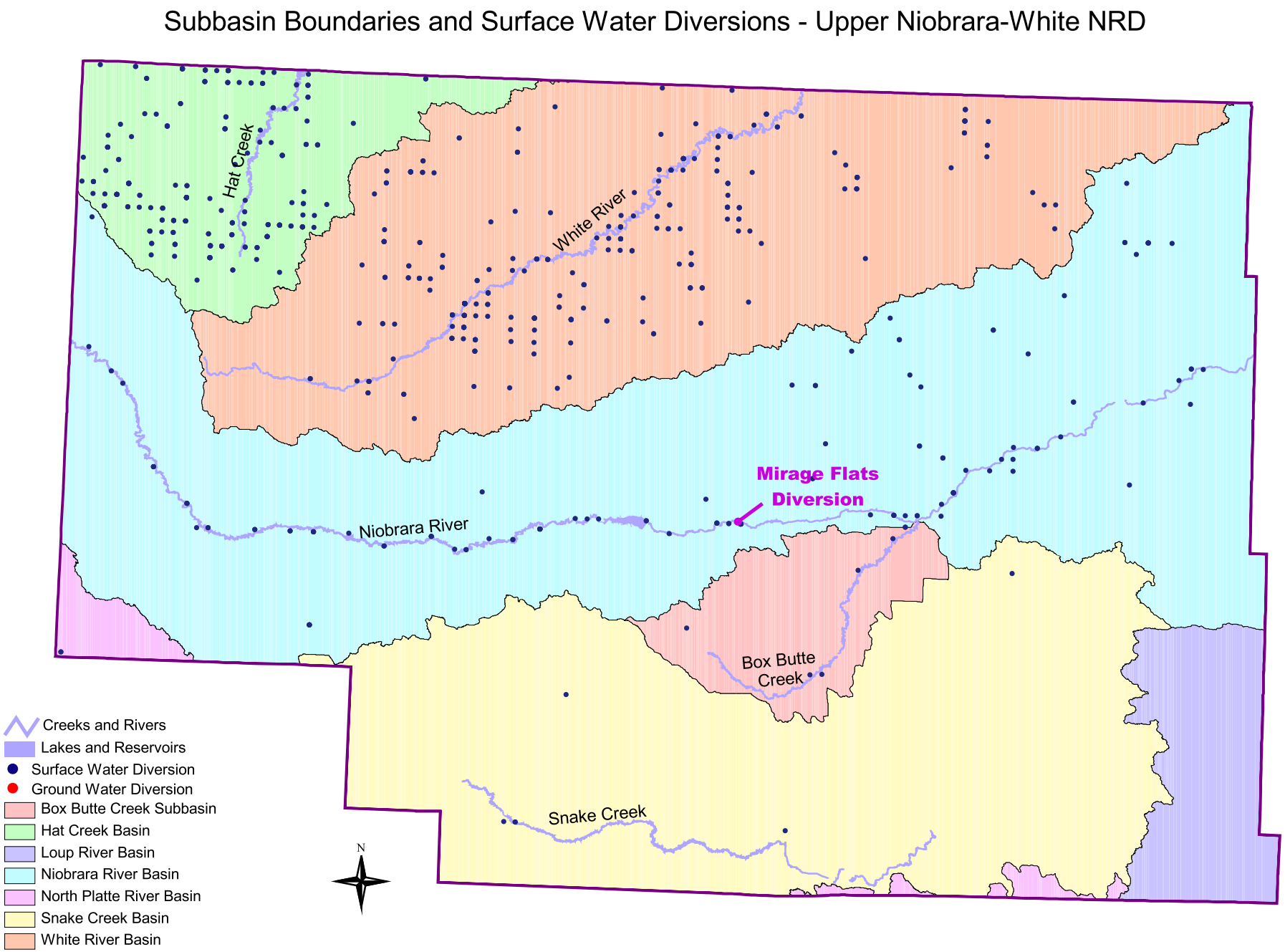
Appendix II

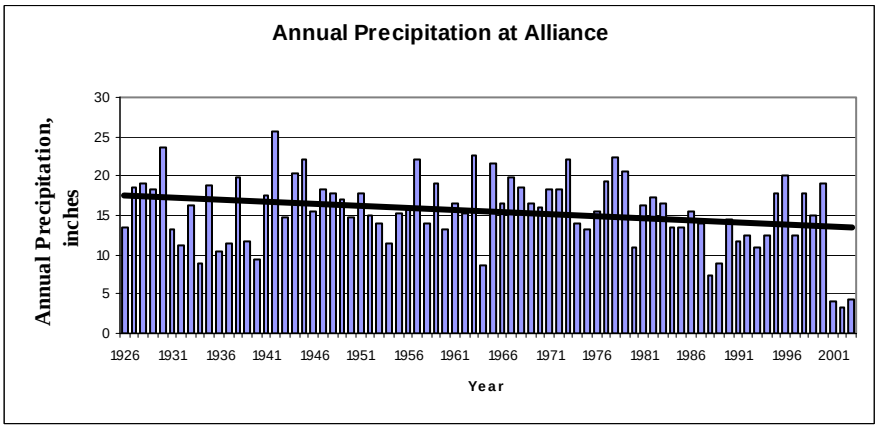
Figure 1

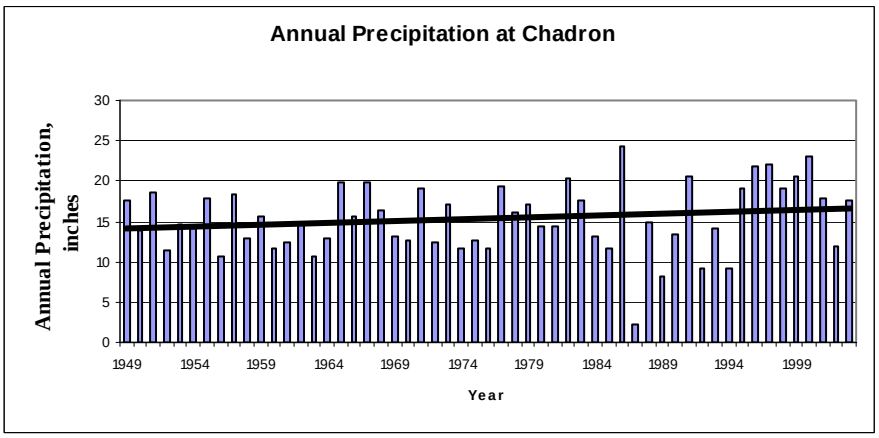


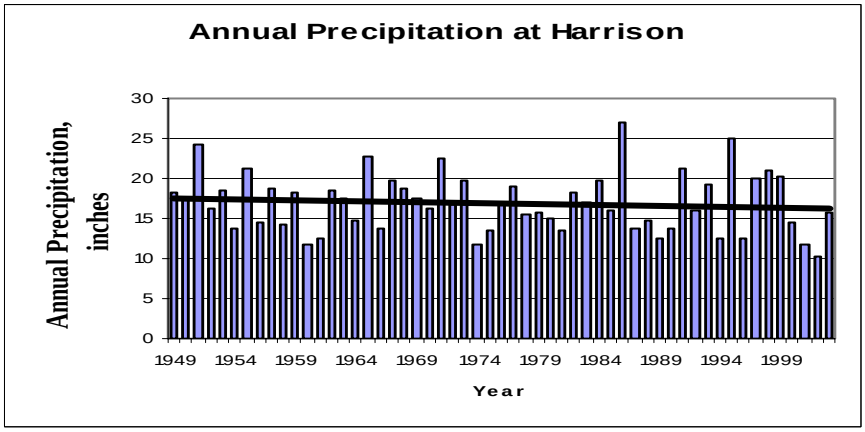
Source: Nebraska Department of Natural Resources Water Rights Database

Figure 2

Annual Precipitation at Alliance, Chadron, and Harrison By Year



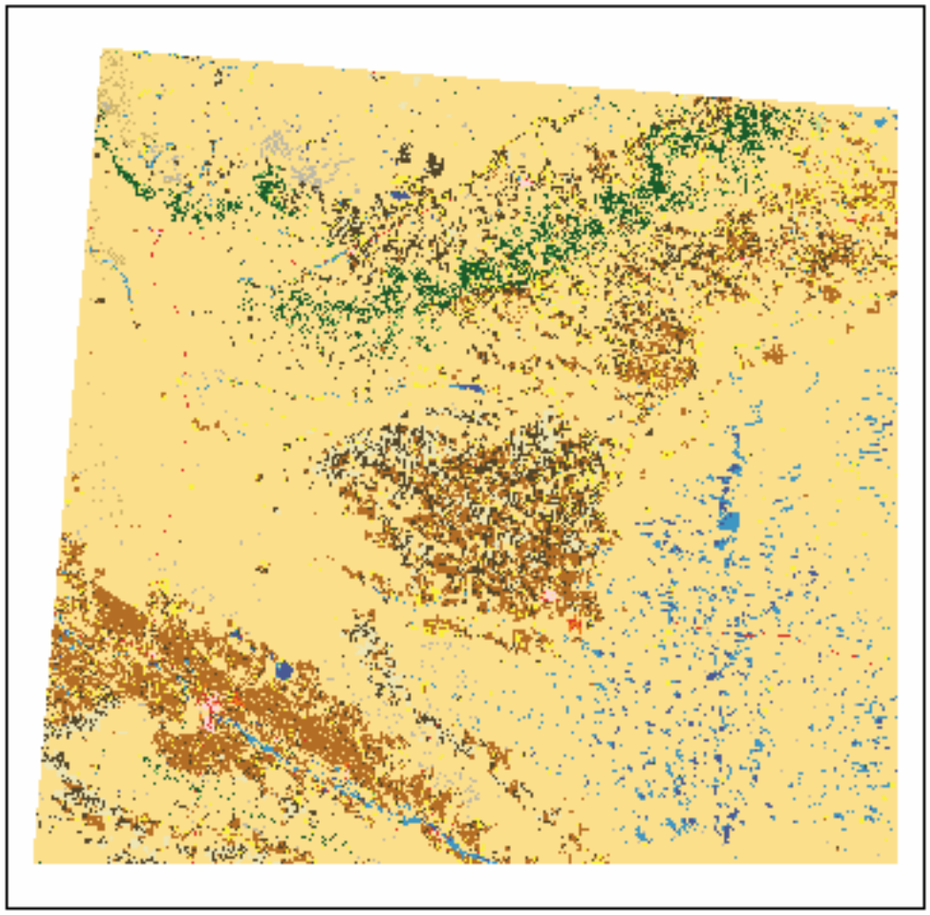




Source: High Plains Regional Climatic Center, University of Nebraska-Lincoln, Lincoln, NE.

Figure 3

National Land Cover Dataset
Northwest Nebraska



National Land Cover Dataset Classification System Legend

Color Key	RGB Value	Class Number and Name
	102, 140, 190	11 - Open Water
	255,255,255	12 - Perennial Ice/Snow
	253, 229, 228	21 - Low Intensity Residential
	247, 178, 159	22 - High Intensity Residential
	231, 86, 78	23 - Commerical/Industrial/Transports
	210, 205, 192	31 - Bare Rock/Sand/Clay
	175, 175, 177	32 - Quarries/Strip Mines, Gravel Pits
	83, 62, 118	33 - Transitional
	134, 200, 127	41 - Deciduous Forest
	26, 129, 78	42 - Evergreen Forest
	212, 231, 177	43 - Mixed Forest
	220, 202, 143	51 - Shrubland
	187, 174, 118	61 - Orchards/Vineyards
	253, 233, 170	71 - Grasslands/Herbaceous
	252, 246, 93	81 - Pasture/Hay
	202, 145, 71	82 - Row Crops
	121, 108, 75	83 - Small Grains
	244, 238, 203	84 - Fallow
	240, 156, 054	85 - Urban/Recreational Grasses
	201, 230, 249	91 - Woody Wetlands
	144, 192, 217	92 - Emergent Herbaceous Wetlands

Source:
U.S. Geological Survey (USGS) and U.S. Environmental Protection Agency (USEPA)
1992 Landsat TM Data

Figure 4

Cropland Acres and Irrigated Acres in Upper Niobrara-White NRD General Area* – 1969 to 1997

	1969	1978	1987	1992	1997
Total Cropland	1,020215	971,857	1,038,654	1,028,134	1,017,896
Total Irrigated Cropland	102,584	184,071	234,666	237,707	250,078
Harvested Cropland	585,432	597,817	611,303	553,666	616,980
Harvested Irrigated Cropland	96,125	169,771	215,524	229,488	242,379

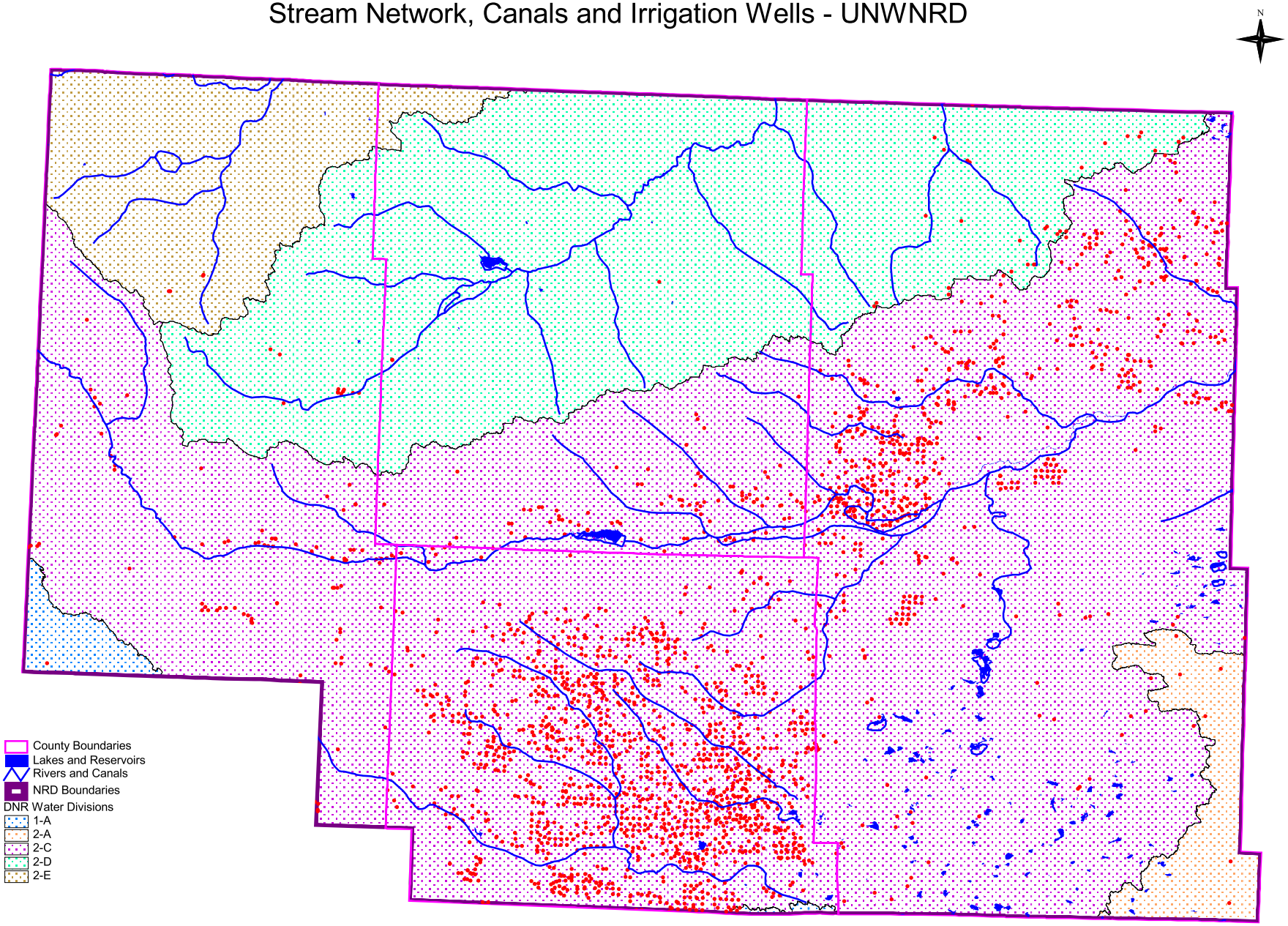
Corn for Grain and Wheat Production Upper Niobrara-White NRD, 1969 and 1997				
	1969		1997	
	Corn for Grain or Seed (Bushels)	Wheat for Grain (Bushels)	Corn for Grain (Bushels)	Wheat for Grain (Bushels)
Box Butte County	576,634	1,309,251	6,520,983	3,781,151
Dawes County	26,110	611,026	557,436	1,315,099
Sheridan County	324,356	576,569	3,455,817	1,844,016
Sioux County	272,187	65,117	1,930,956	270,842
TOTALS	1,199,287	2,561,963	12,465,192	7,211,108

Source: U.S. Department of Commerce, Bureau of the Census, Census of Agriculture, various years.

*A small portion of Sioux County is actually outside the Upper Niobrara-White NRD boundary. However, for purposes of this table the entire county is included

Figure 5

Stream Network, Canals and Irrigation Wells - UNWNRD



Source: Nebraska Department of Natural Resources Ground Water Database

Figure 6

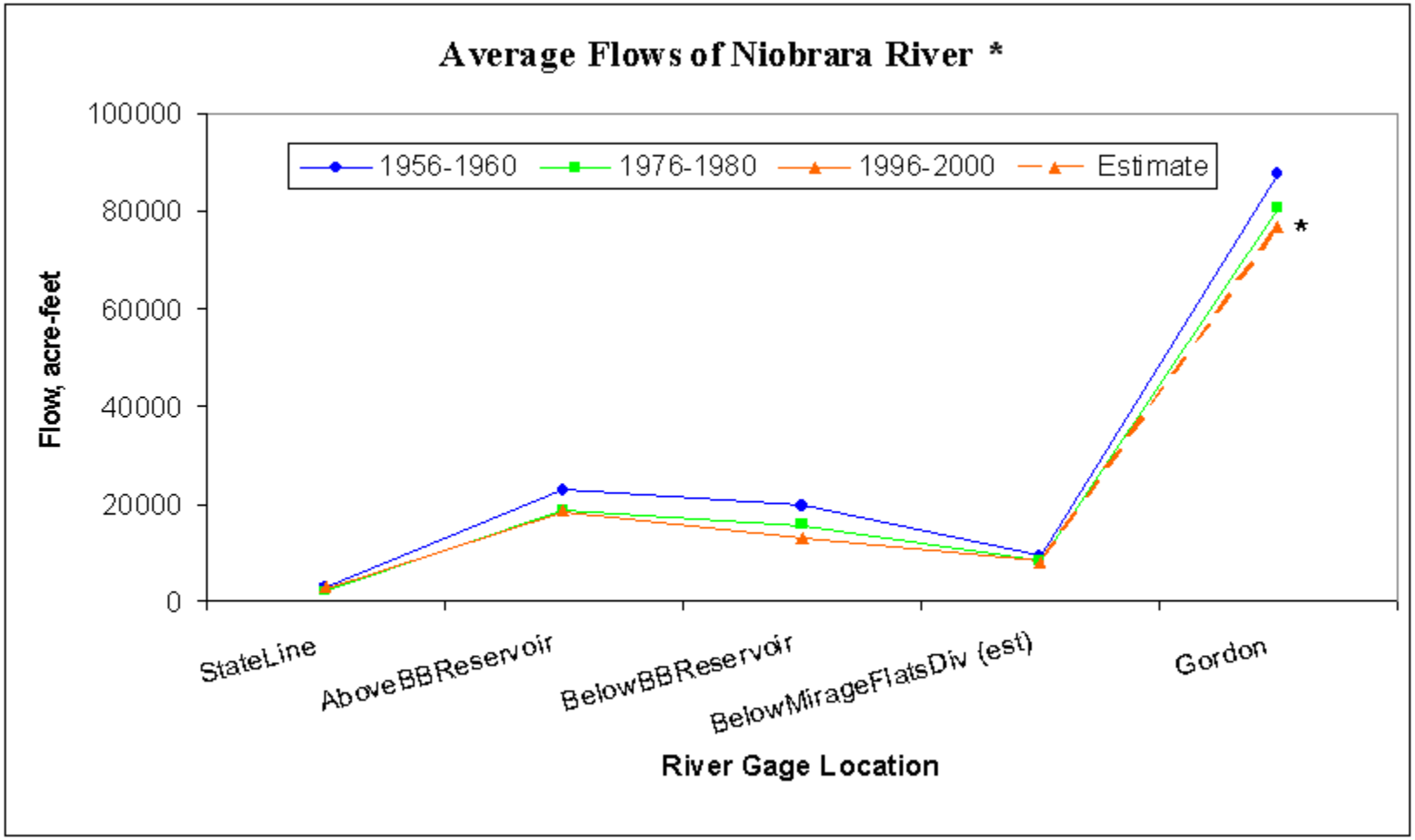
NIOBRARA RIVER AVERAGE GAGED ANNUAL FLOWS

State Line (1956-2002)	**2,615**	**Acre feet/Year**
Above Box Butte Reservoir (1947-2002)	**20,334**	**Acre feet/Year**
Below Box Butte Reservoir (1947-2002)	**17,018**	**Acre feet/Year**
Diversion 7 Miles Below Box Butte Reservoir (1956-2002)	(16,758)*	Acre feet/Year
Near Gordon (1946-1994)	**82,489**	**Acre feet/Year**

*Include diversions by Montague Canal, Licthe Canal, Mirage Flats Canal, and Potmesil Canal.

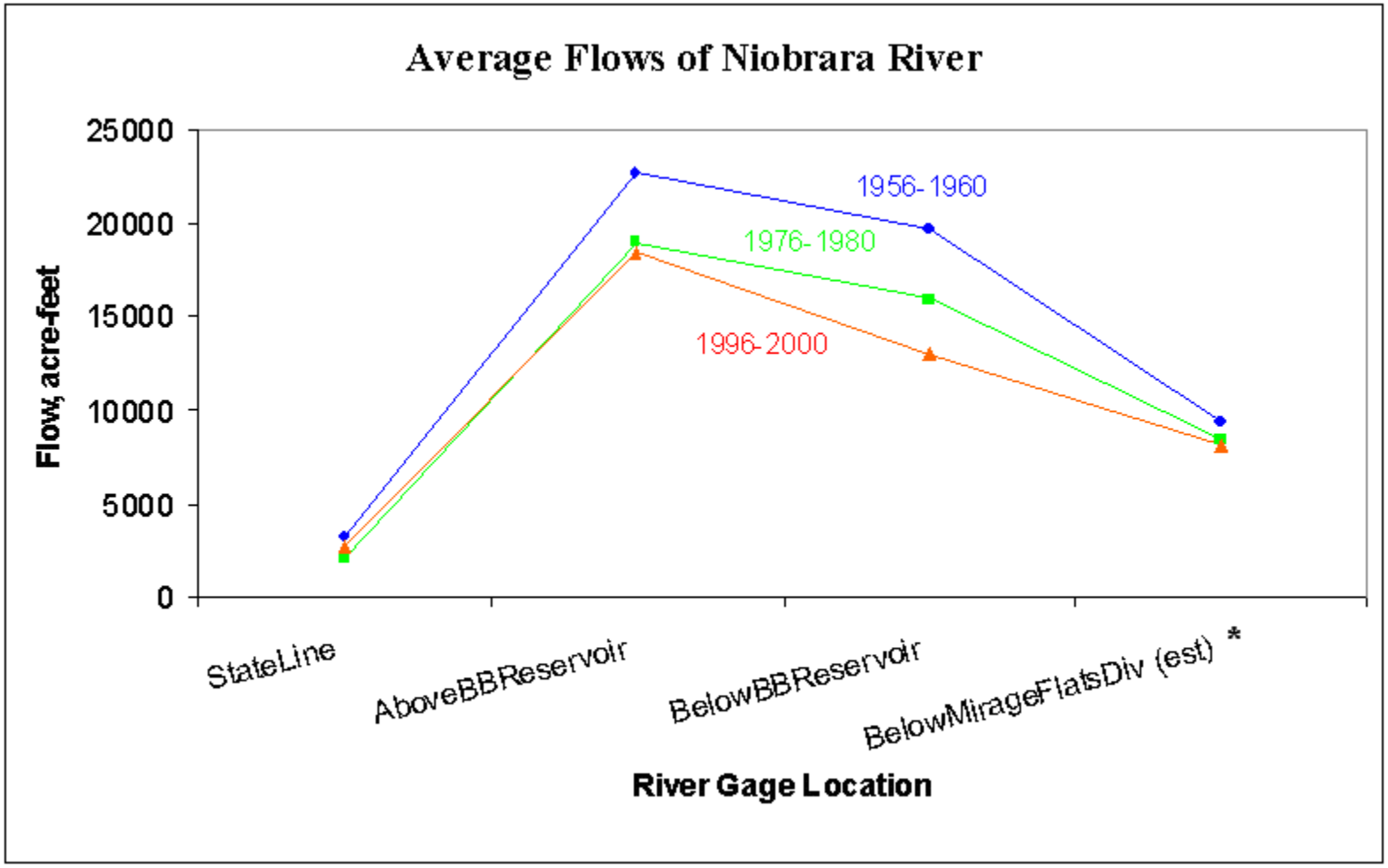
Source: Nebraska Department of Natural Resources Stream Gaging Records

Figure 7



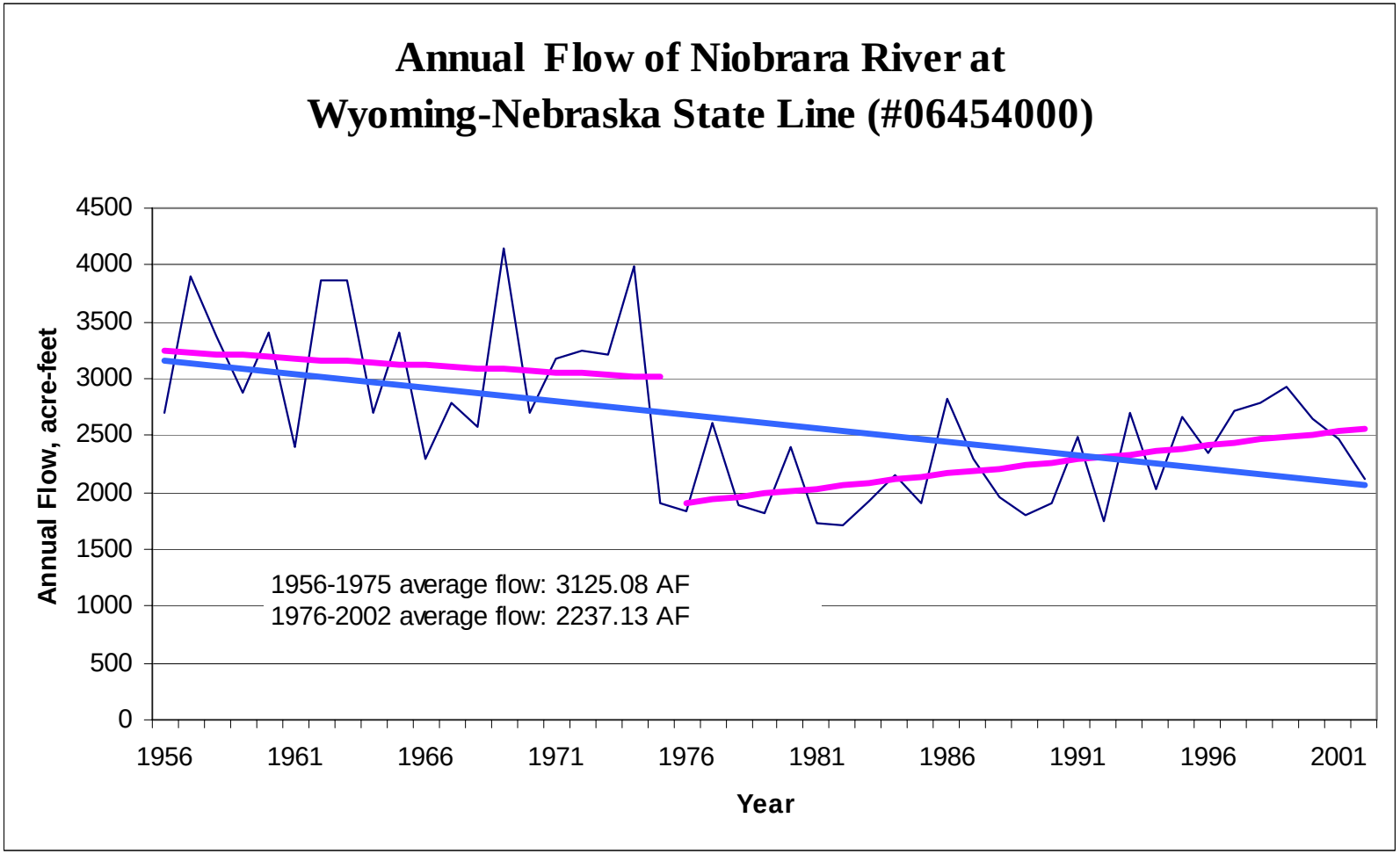
Source: Nebraska Department of Natural Resources Stream Gaging Records
* Note: Figures for below Mirage Flats are estimates based upon diversion records and non-irrigation season reach gain measurements. The 1996-2000 Figure for Gordon is an estimate.

Figure 8



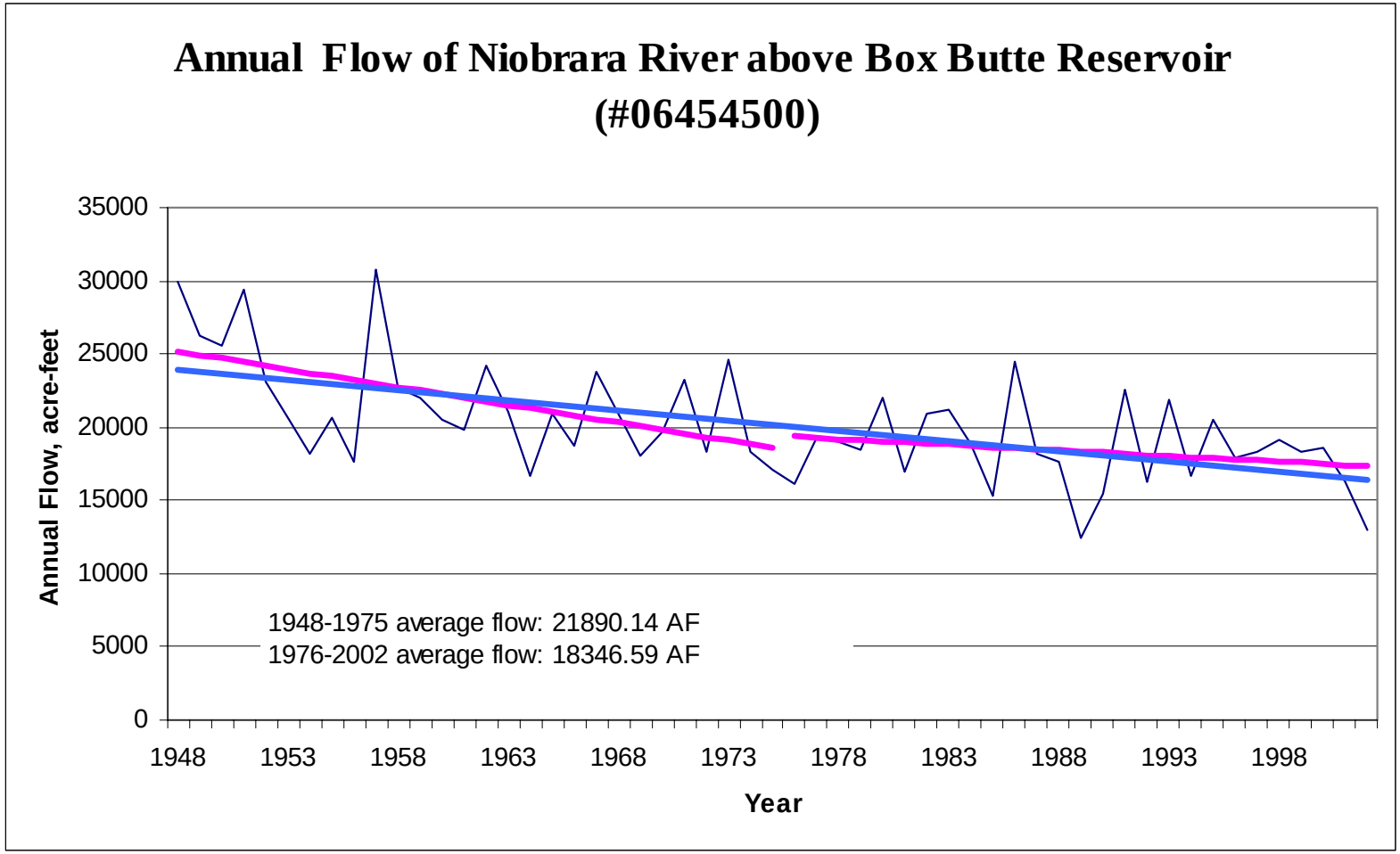
Source: Nebraska Department of Natural Resources Stream Gaging Records
* Note: The Figure for below Mirage Flats is an estimate based upon diversion records and non-irrigation season reach gain measurements.

Figure 9



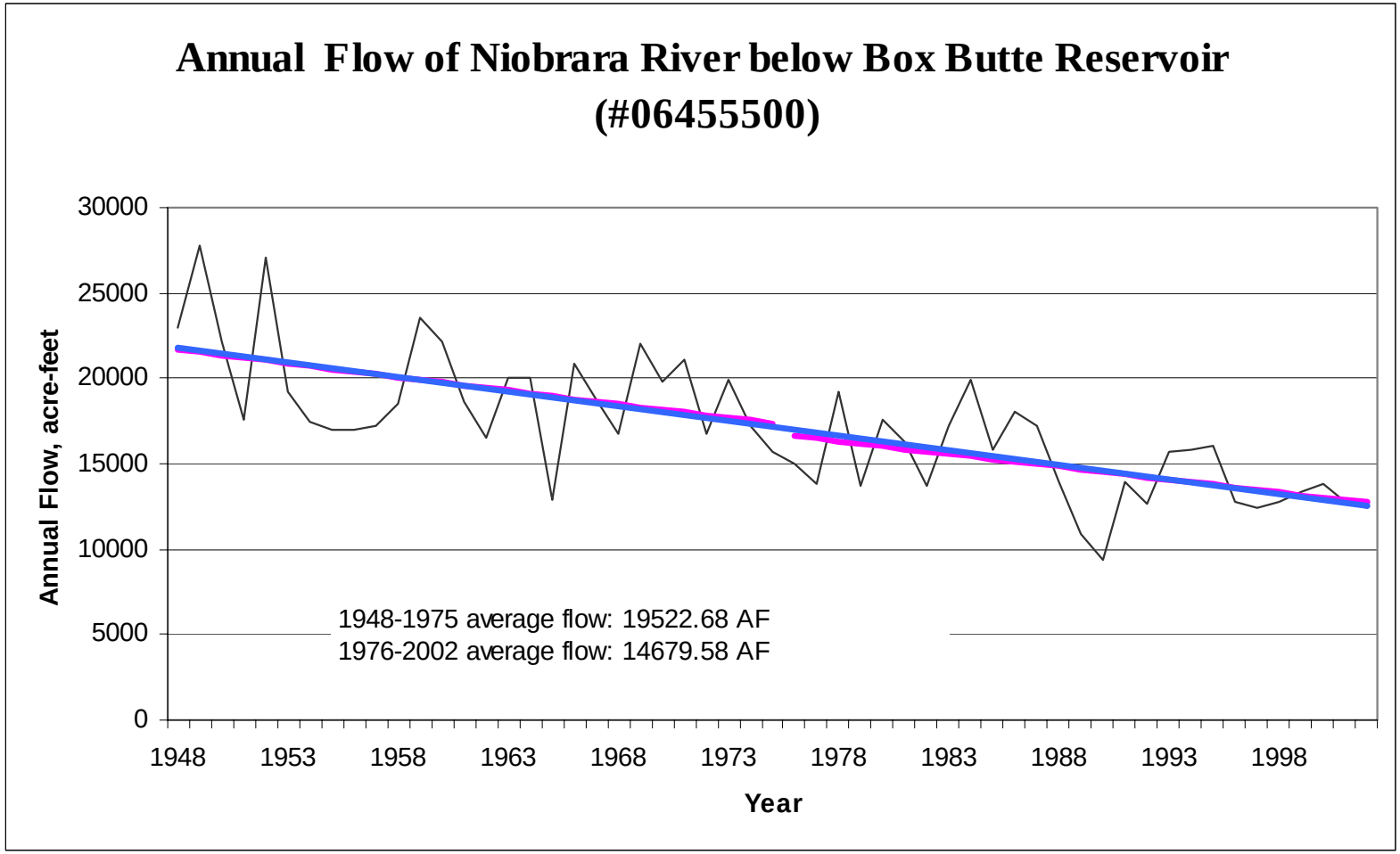
Source: Nebraska Department of Natural Resources Stream Gaging Records

Figure 10



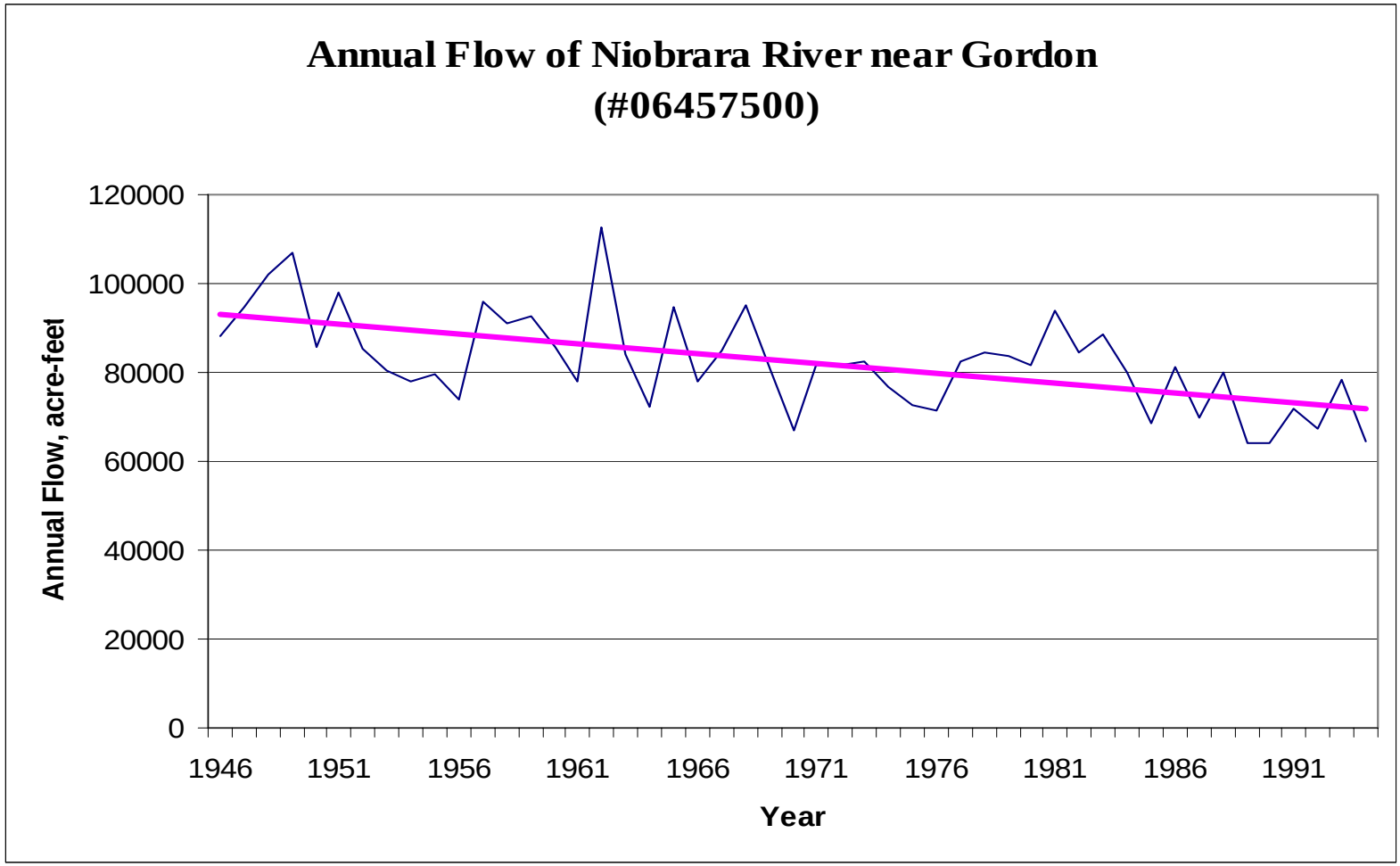
Source: Nebraska Department of Natural Resources Stream Gaging Records

Figure 11



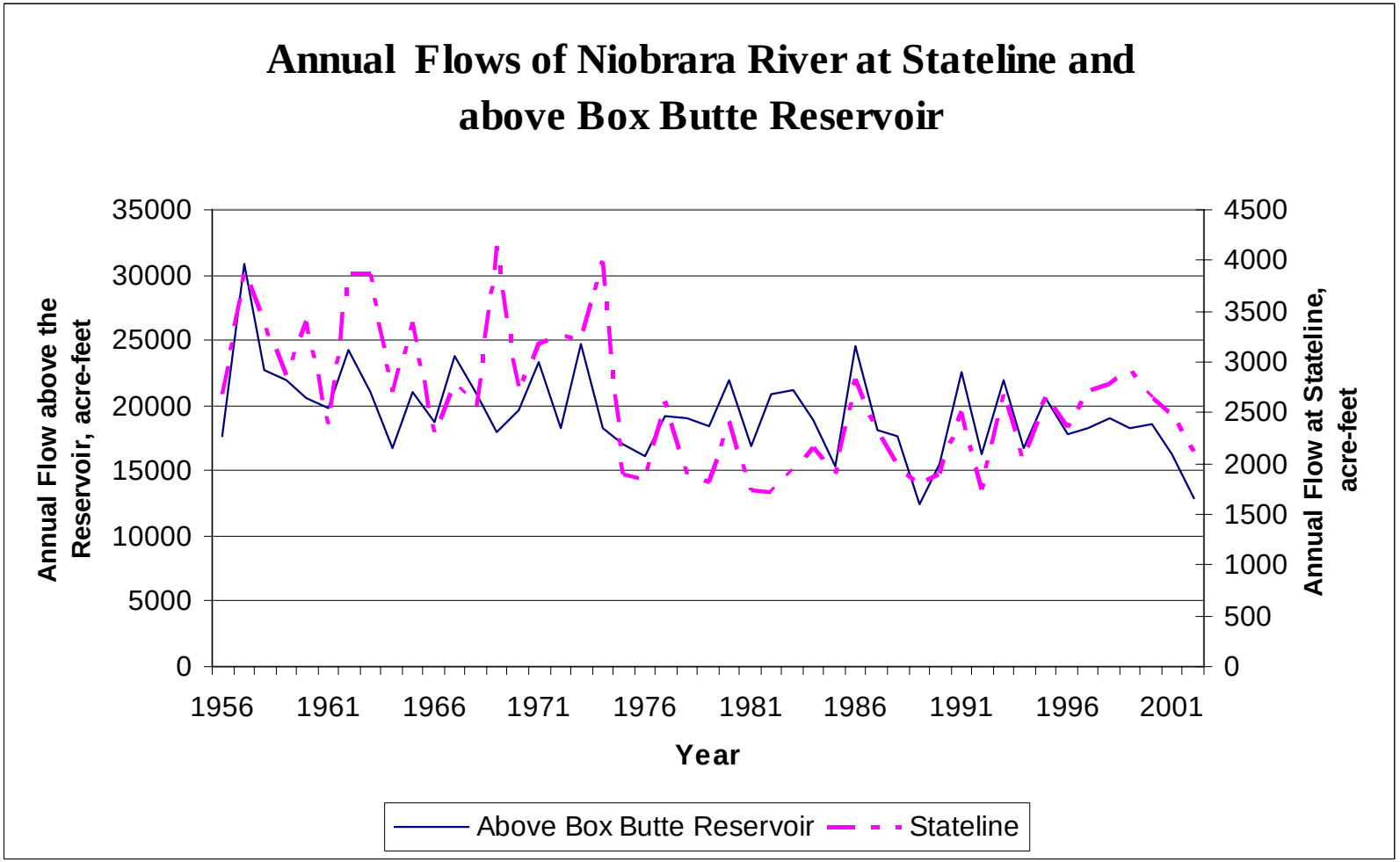
Source: Nebraska Department of Natural Resources Stream Gaging Records

Figure 12



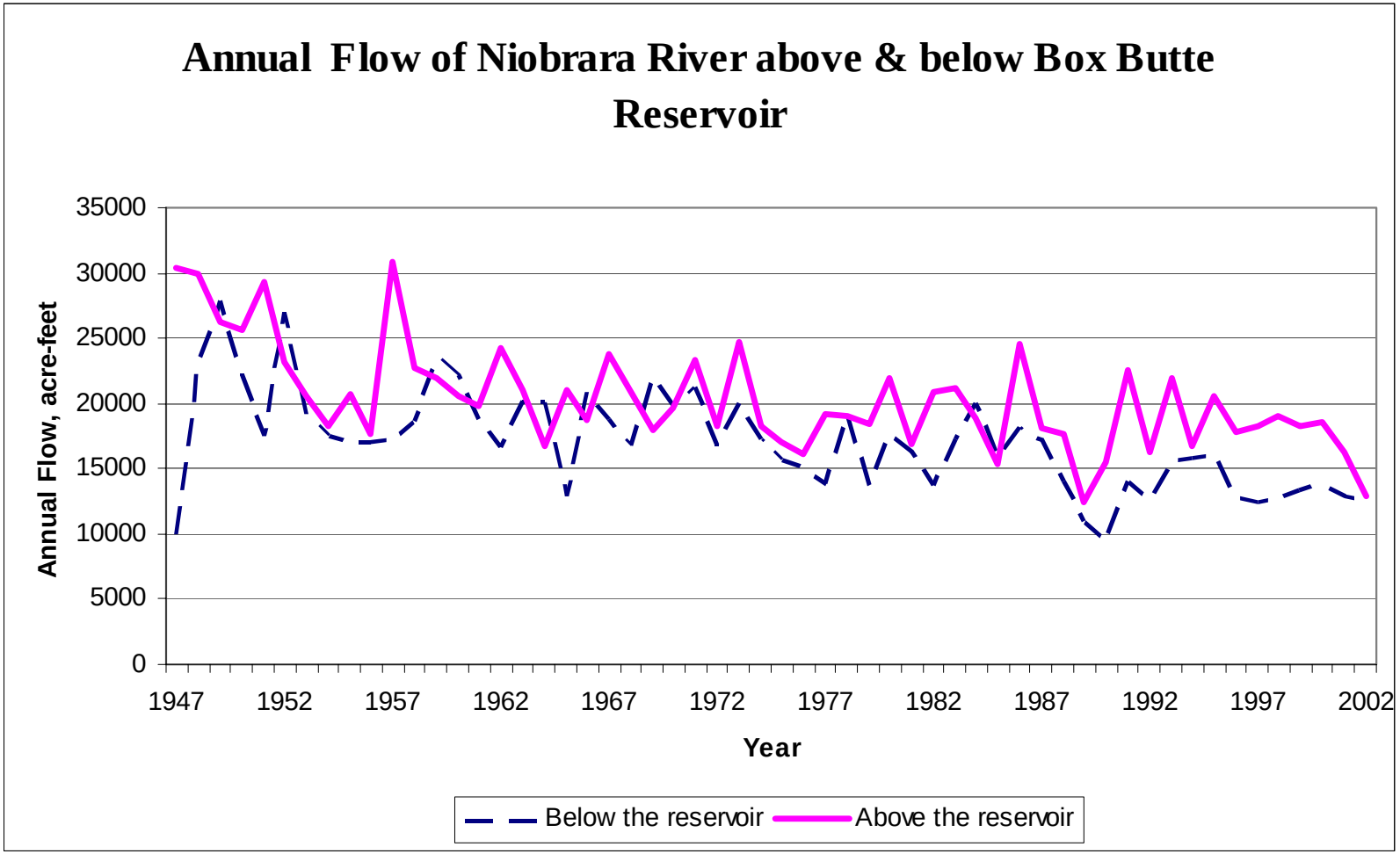
Source: Nebraska Department of Natural Resources Stream Gaging Records

Figure 13



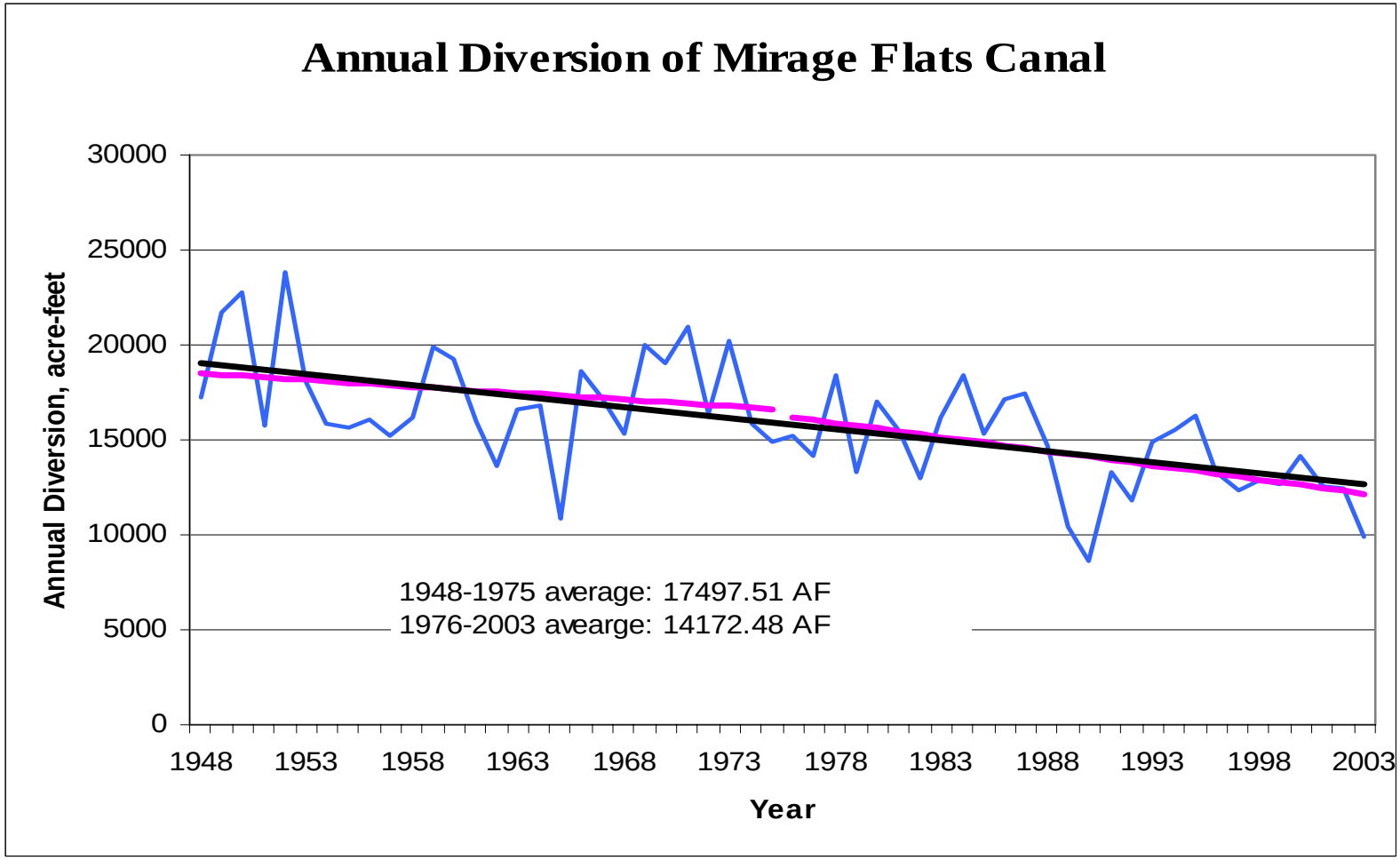
Source: Nebraska Department of Natural Resources Stream Gaging Records

Figure 14



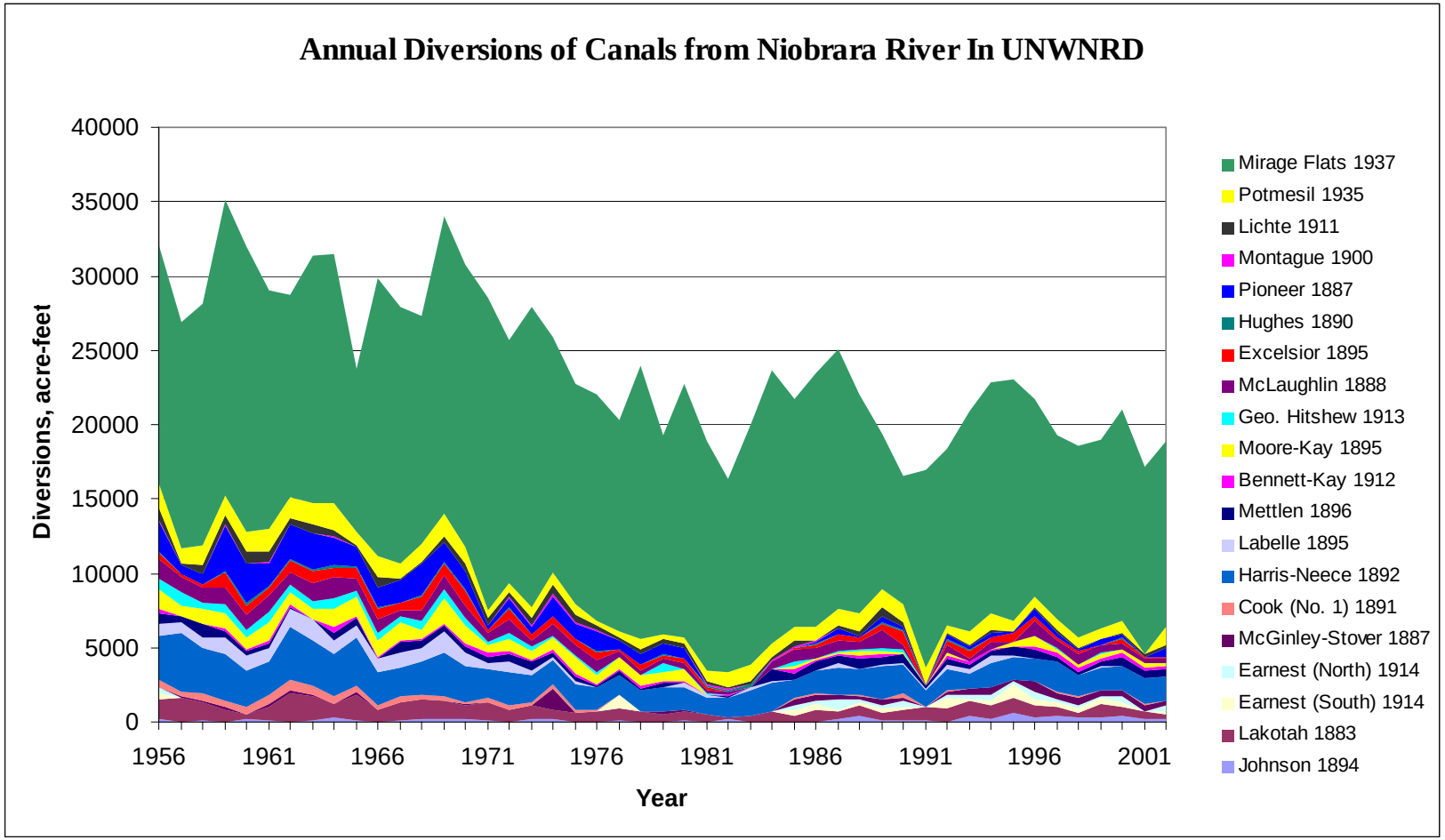
Source: Nebraska Department of Natural Resources Stream Gaging Records

Figure 15



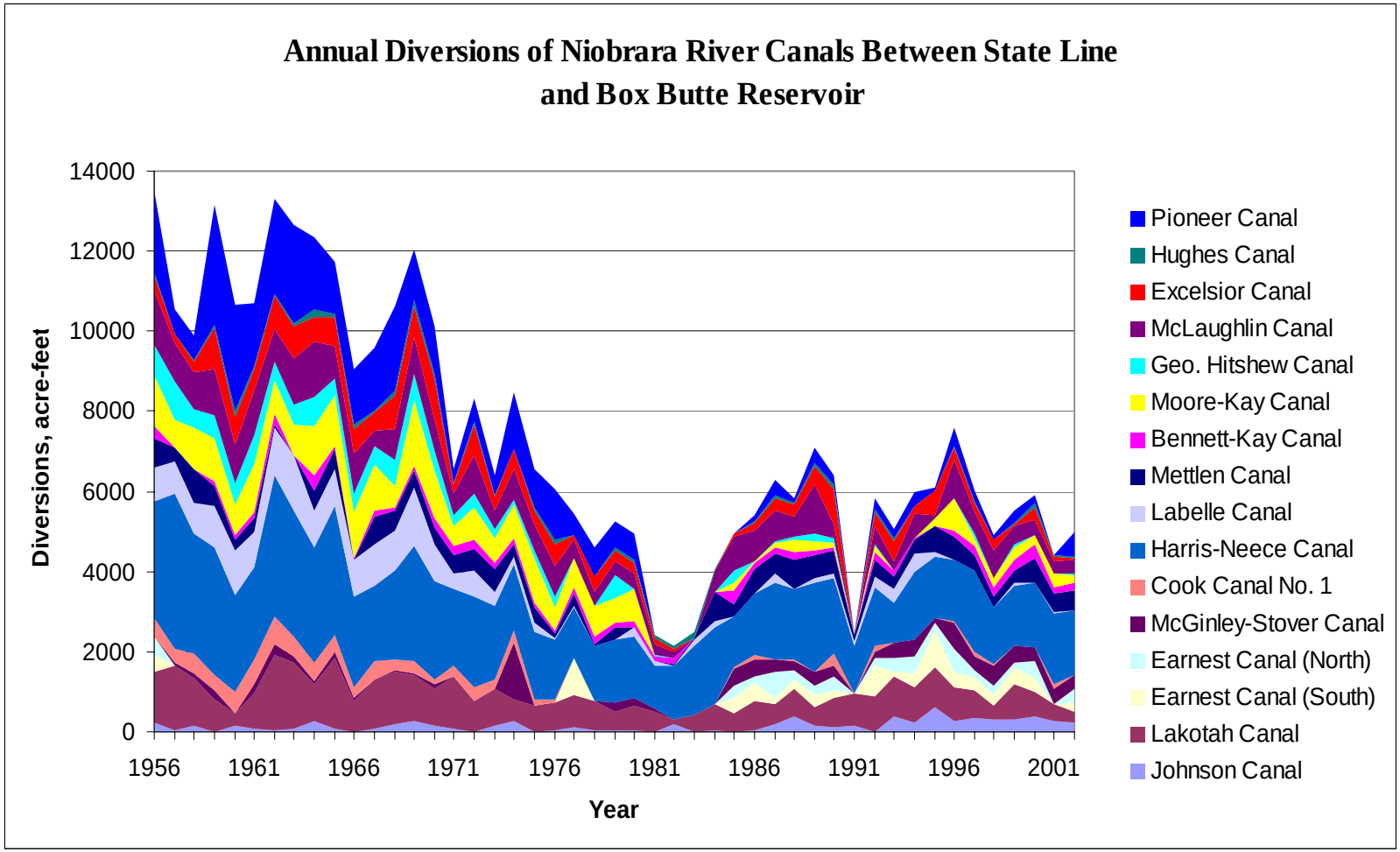
Source: Nebraska Department of Natural Resources Stream Gaging / Canal Diversion Records

Figure 16



Source: Nebraska Department of Natural Resources Stream Gaging / Canal Diversion Records

Figure 17



Source: Nebraska Department of Natural Resources Stream Gaging / Canal Diversion Records

Figure 18

Geology of the Upper Niobrara White Natural Resources District

Geology and Water Table Source: http://csd.unl.edu/general/gis-datasets.asp
The Conservation and Survey Division has produced this product using what is thought to be the most reliable information available or reproduced the material asprovided. The detail and precision of the interpretations madeare according to accepted professional standards and are dependant upon the techniques, hardware, and/or software utilized.

Legend

- UNWNRD Boundary
- County Boundaries

Geology

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

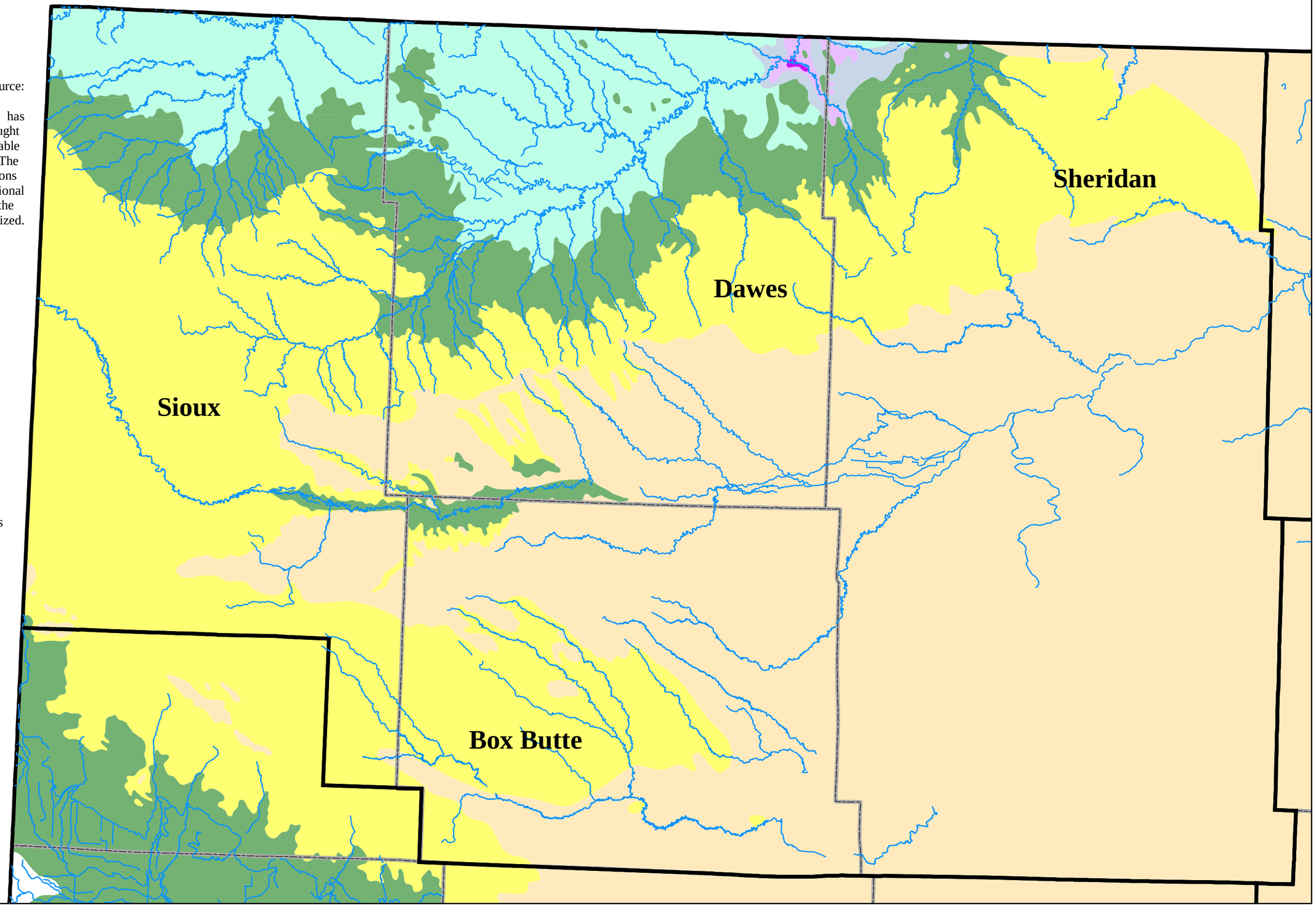
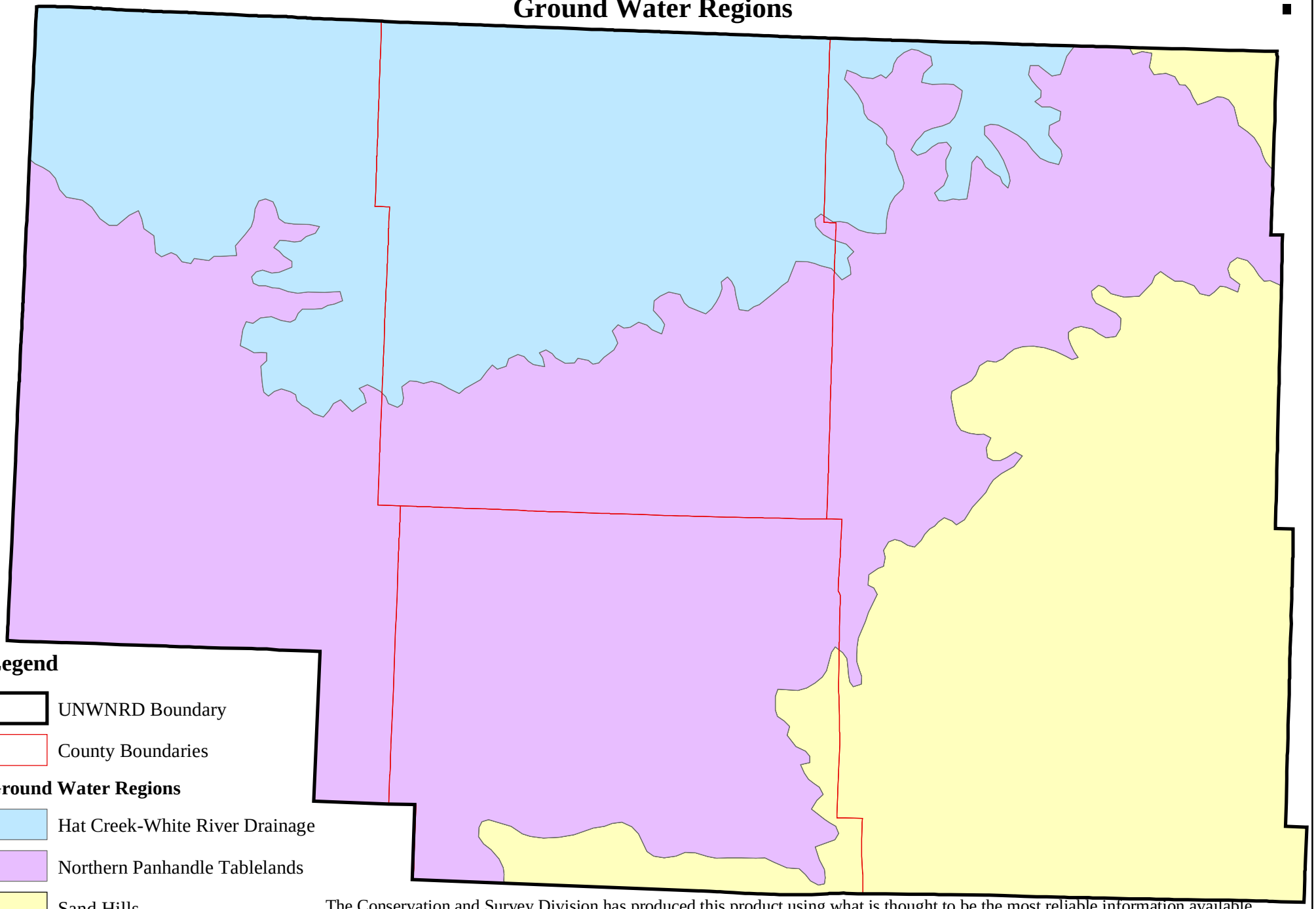


Figure 19

Ground Water Regions



Legend

UNWNRD Boundary

County Boundaries

Ground Water Regions

Hat Creek-White River Drainage

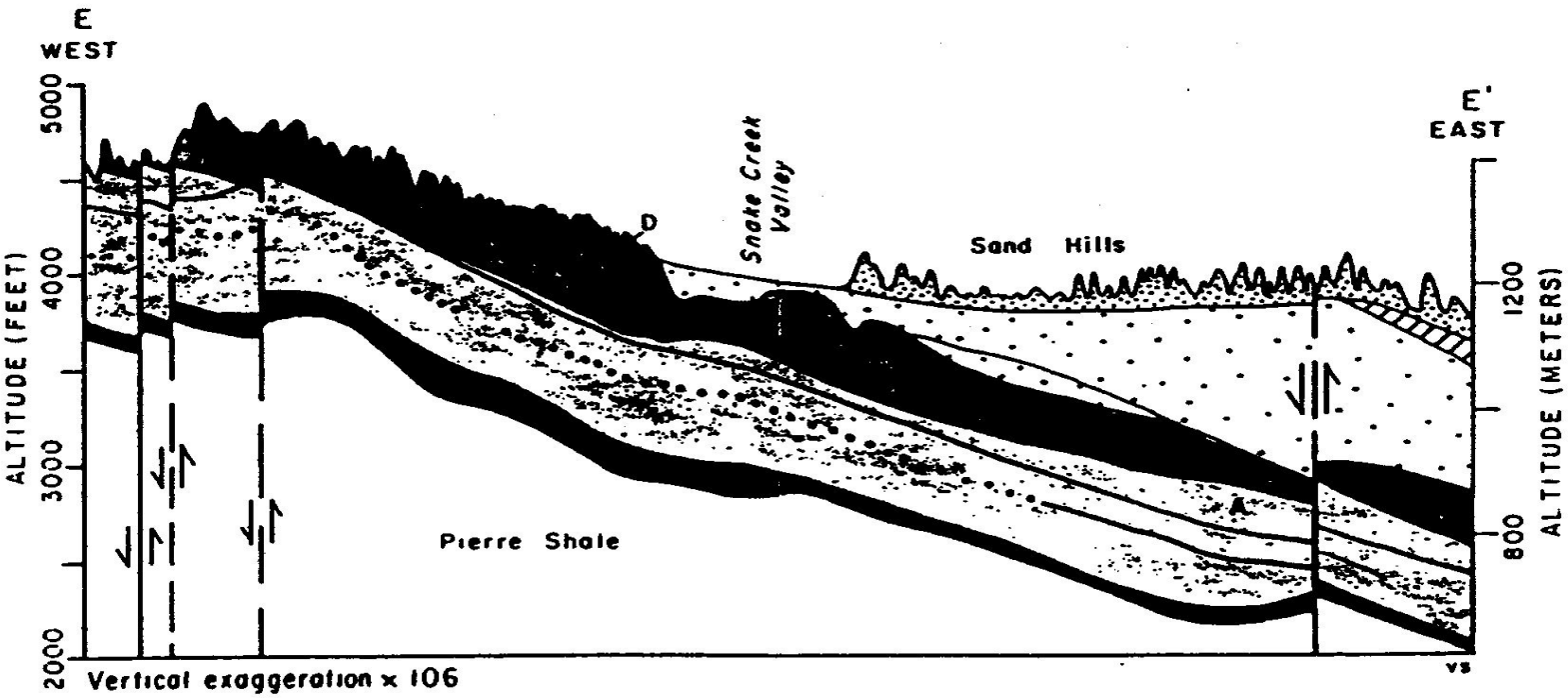
Northern Panhandle Tablelands

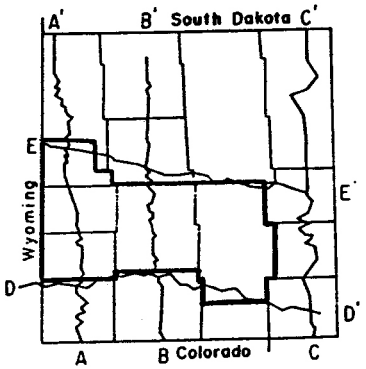
Sand Hills

Source:
http://csd.unl.edu/general/gis-datasets.asp

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. Source map was provided by Nebraska Department of Health. Groundwater 'region' is an interpreted term. CSD has a similar map done in 1968 by Eugene Reed at 1:500,000.

Figure 20





Source: Swinehart, J.B. et al., 1985

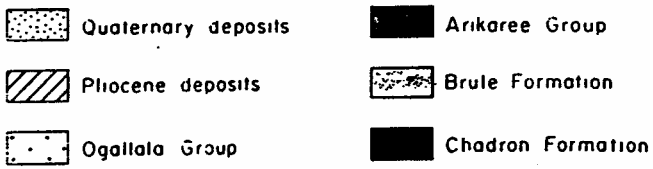
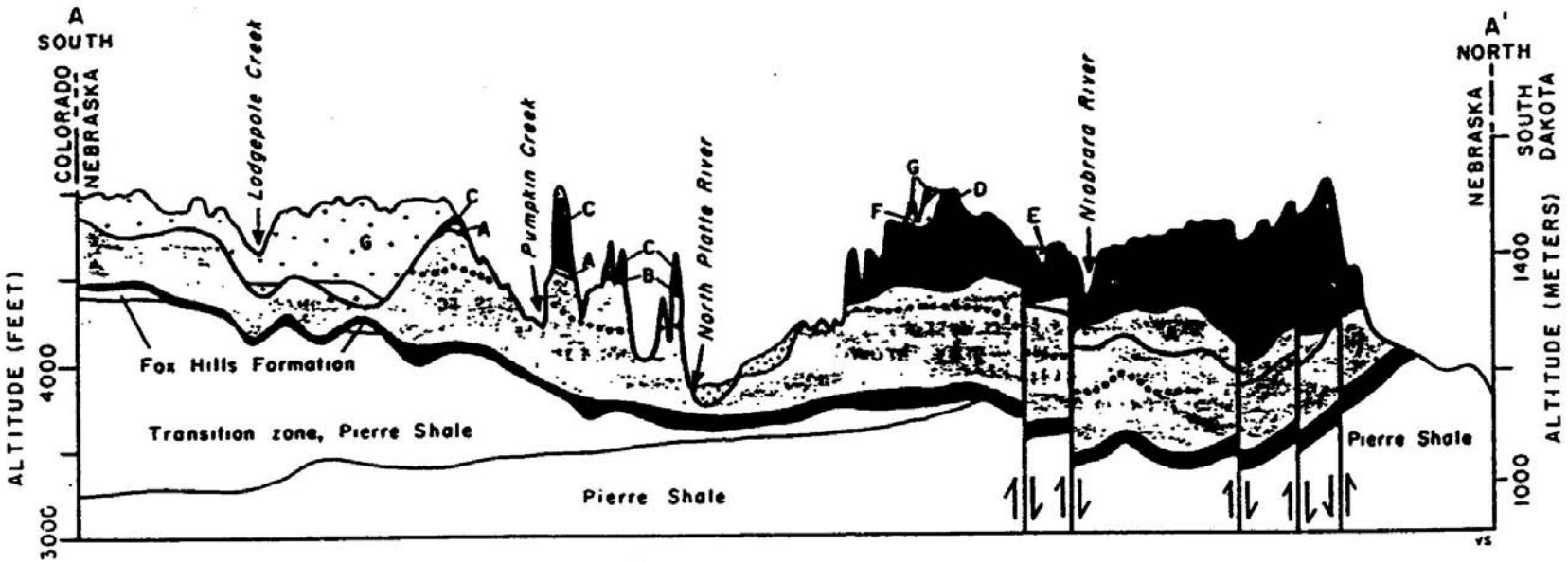
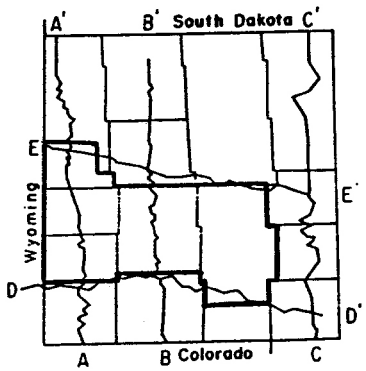


Figure 21





Source: Swinehart, J.B. et al., 1985

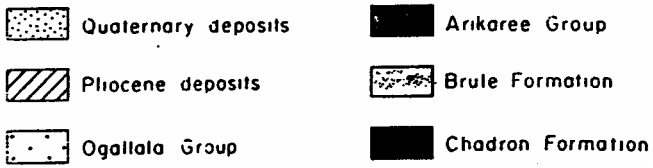
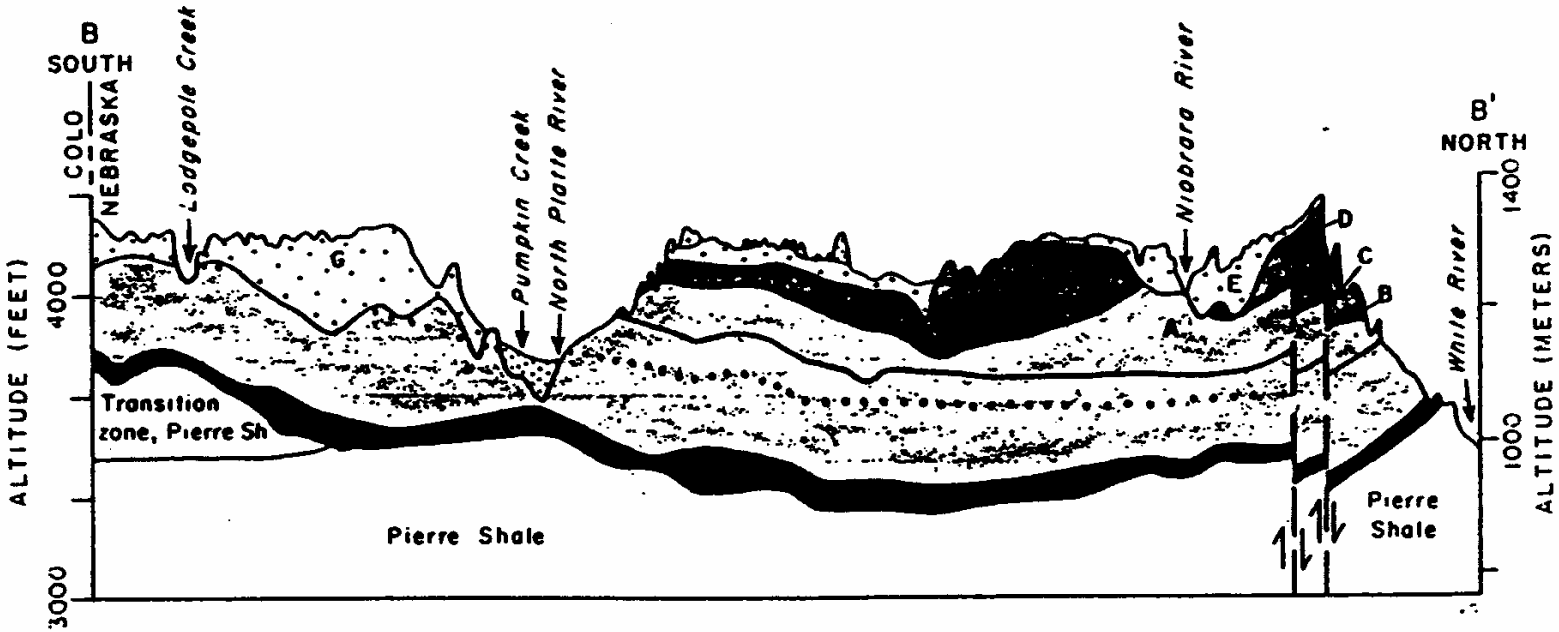
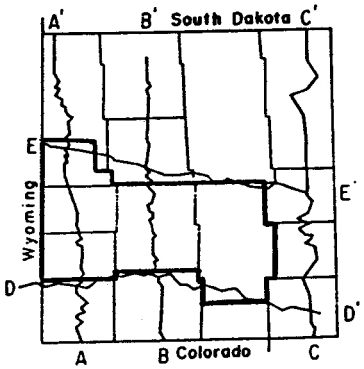


Figure 22





Source: Swinehart, J.B. et al., 1985

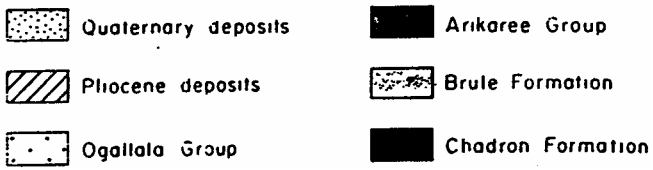
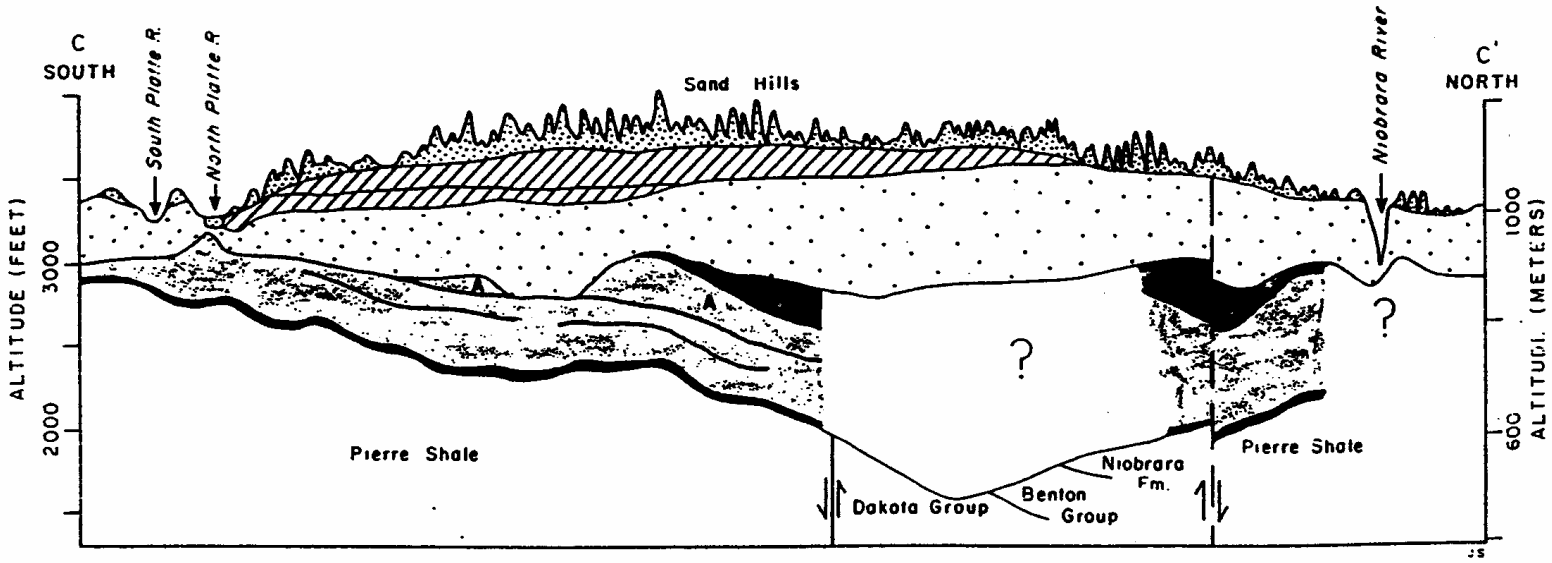
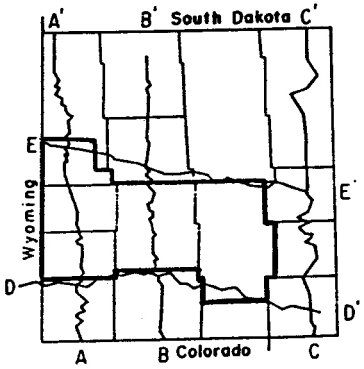


Figure 23





Source: Swinehart, J.B. et al., 1985

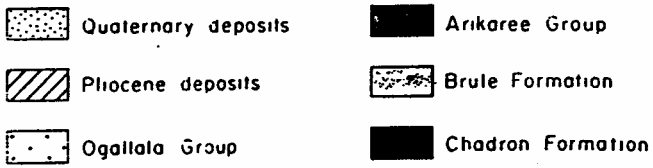
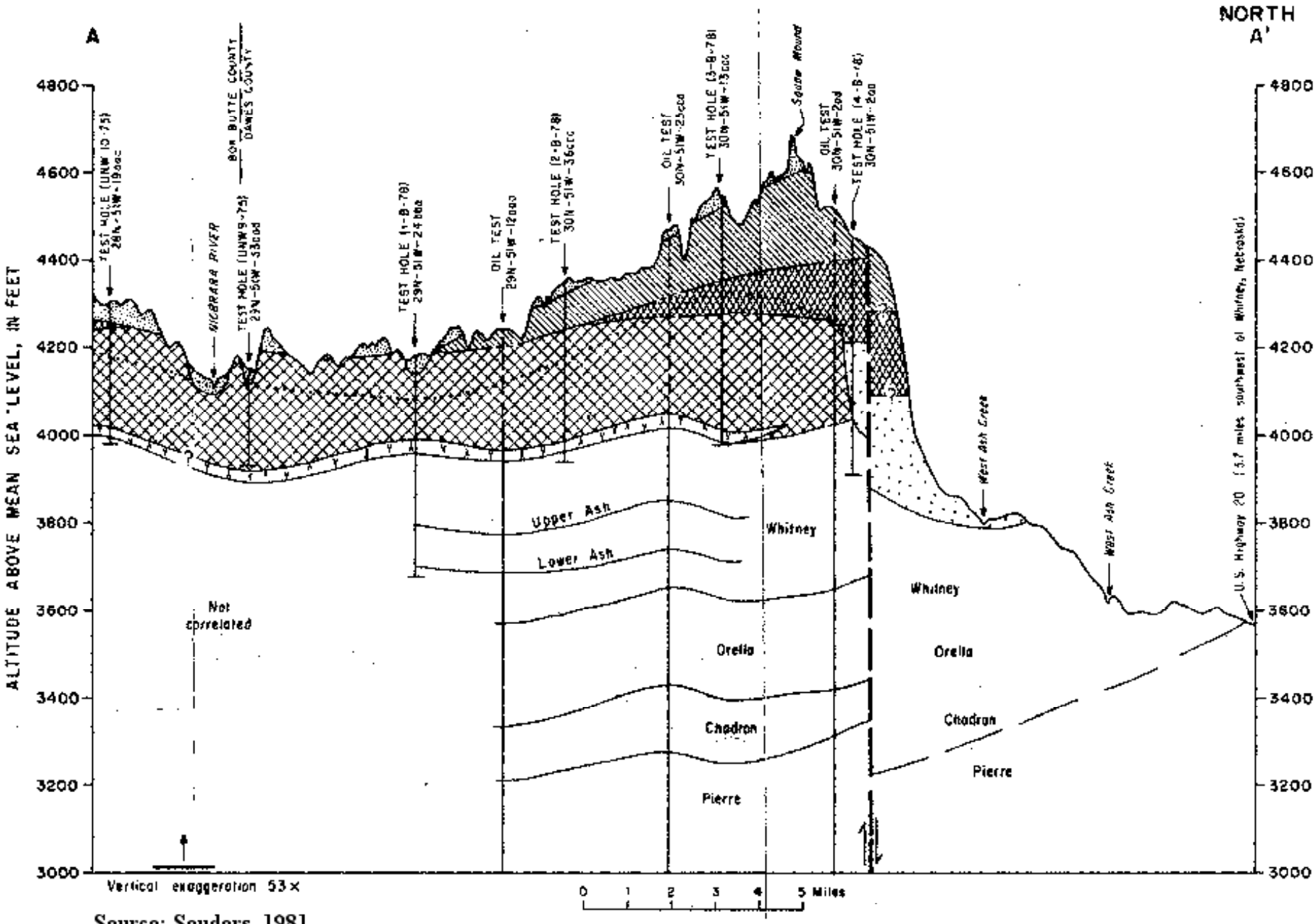
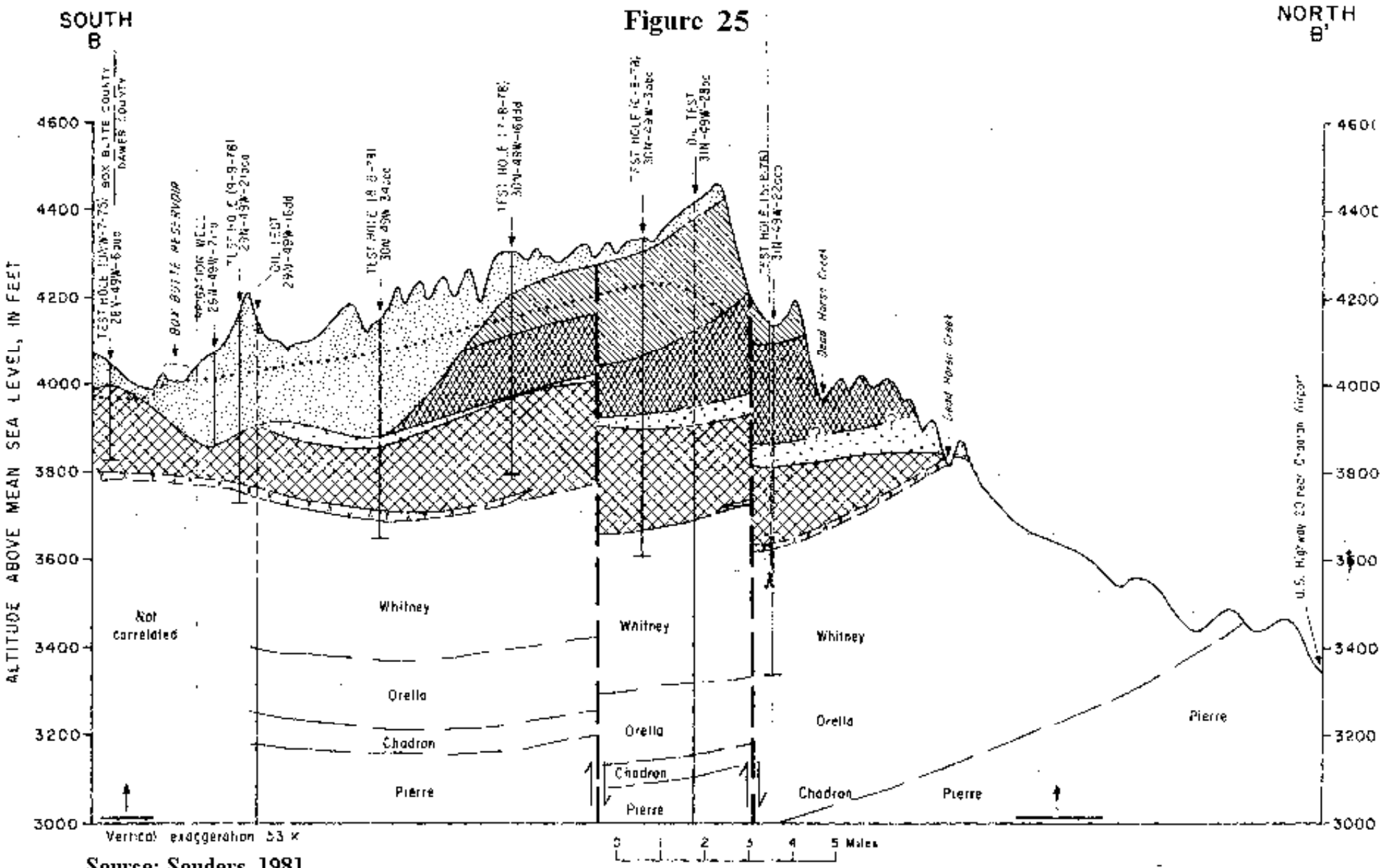


Figure 24



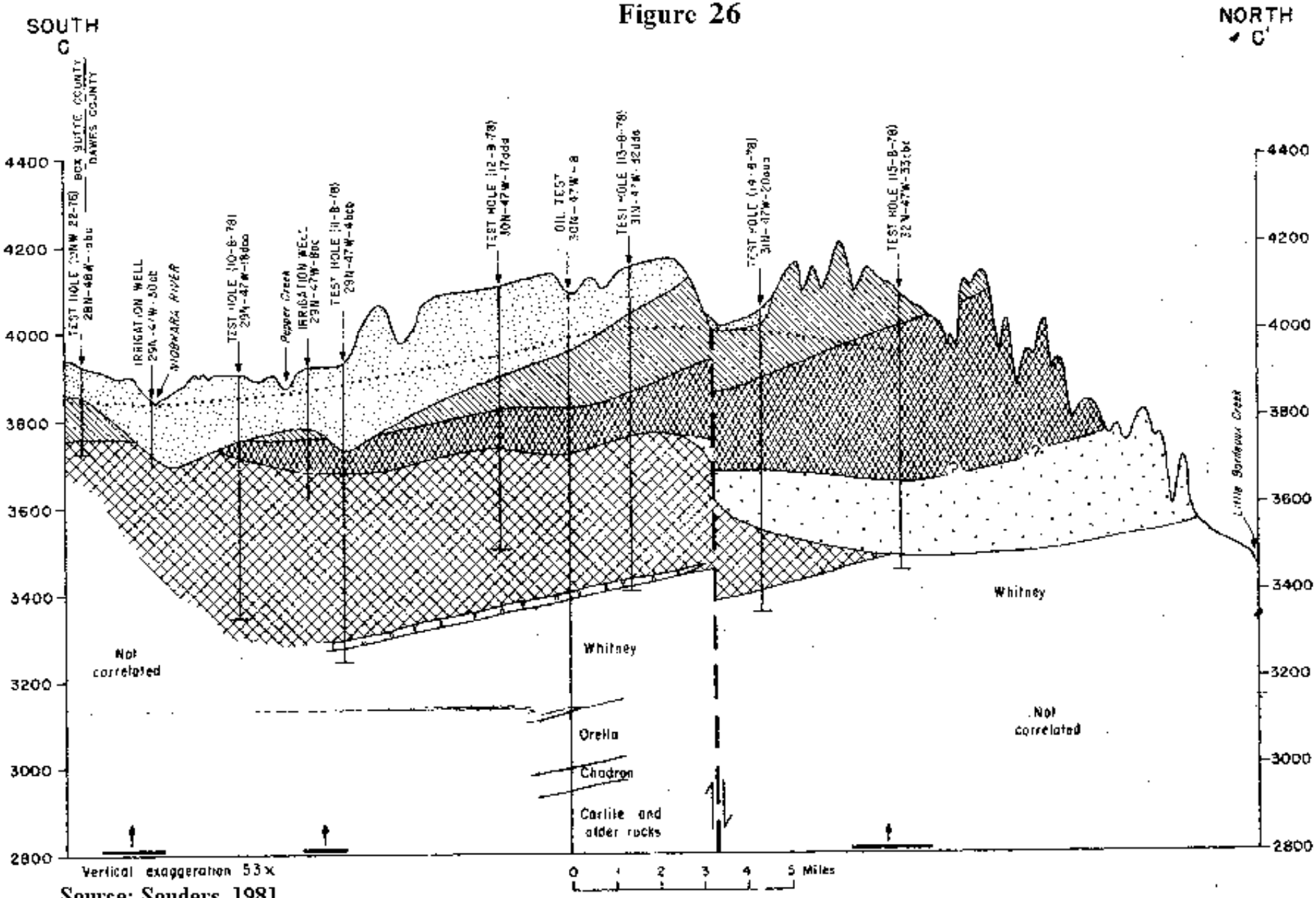
Source: Souders, 1981

Figure 25



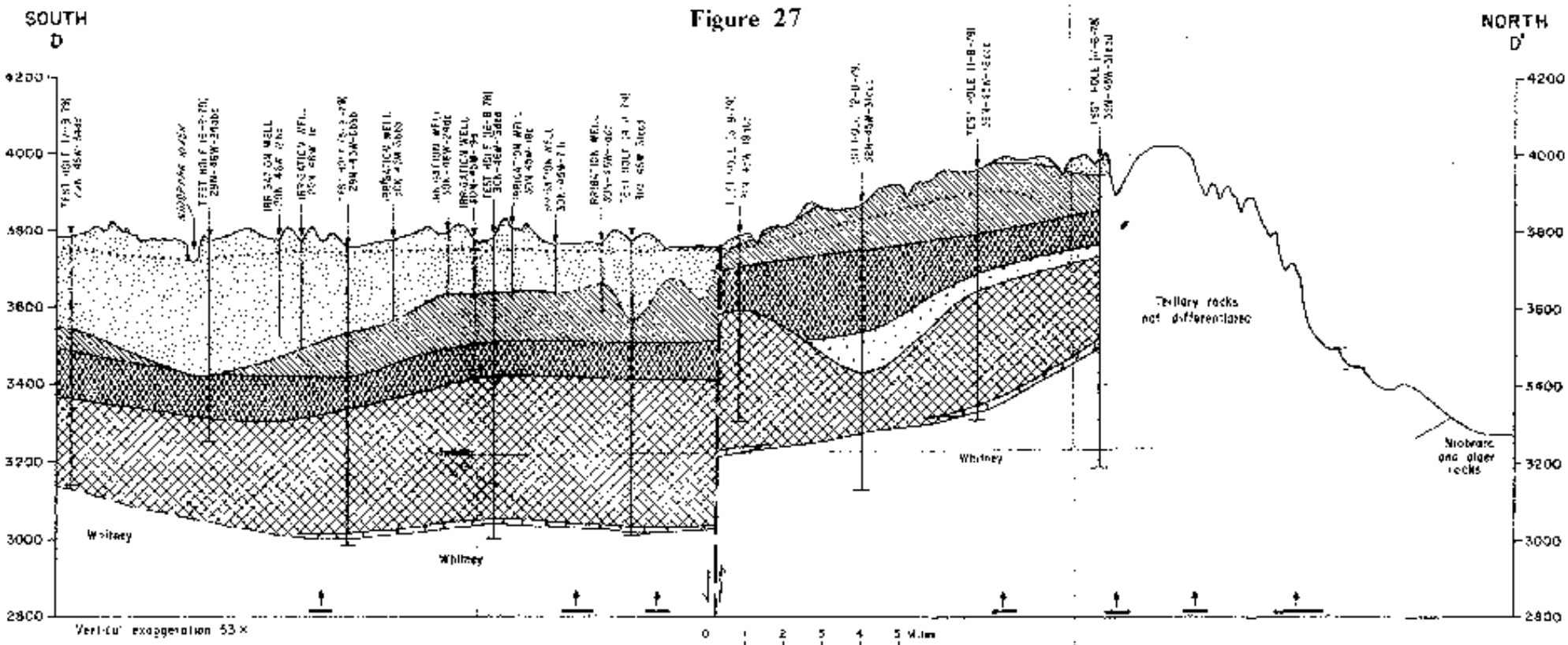
Source: Souders, 1981

Figure 26



Source: Souders, 1981

Figure 27



Source: Souders, 1981

Saturated Thickness of Principal Aquifer

Figure 28

Saturated Thickness Contour Source: http://csd.unl.edu/general/gis-datasets.asp
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.

The thickness of the principal aquifer are a series of contour lines showing the estimated thickness of the saturated sediments that serve as the source aquifer for domestic and irrigation wells. It was 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 was Vern Souders. Areas where the principal aquifer is'absent or very thin' are areas of impermeable rock or clay. Some of the areas are fractured and may yield considerable water if the well hits the fracture.

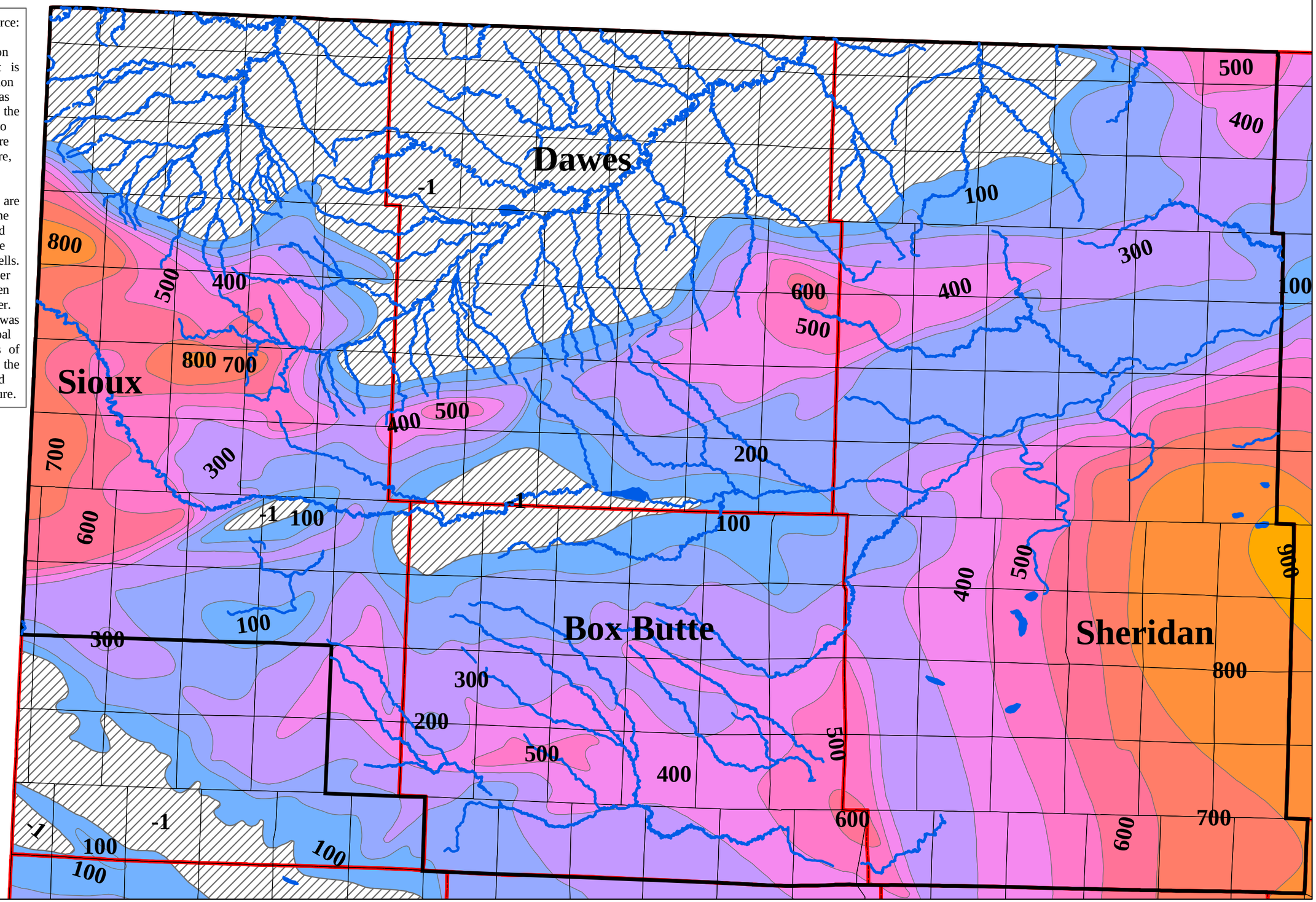


Figure 29

Geology and 1995 Water Table Contours in the Upper Niobrara White Natural Resources District

Geology and Water Table Source: http://csd.unl.edu/general/gis-datasets.asp
The Conservation and Survey Division has produced this product using what is thought to be the most reliable information available or reproduced the material asprovided. The detail and precision of the interpretations madeare according to accepted professional standards and are dependant upon the techniques, hardware, and/or software utilized.

Legend

- UNWNRD Boundary
- County Boundaries
- 1995 Water Table

Geology

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

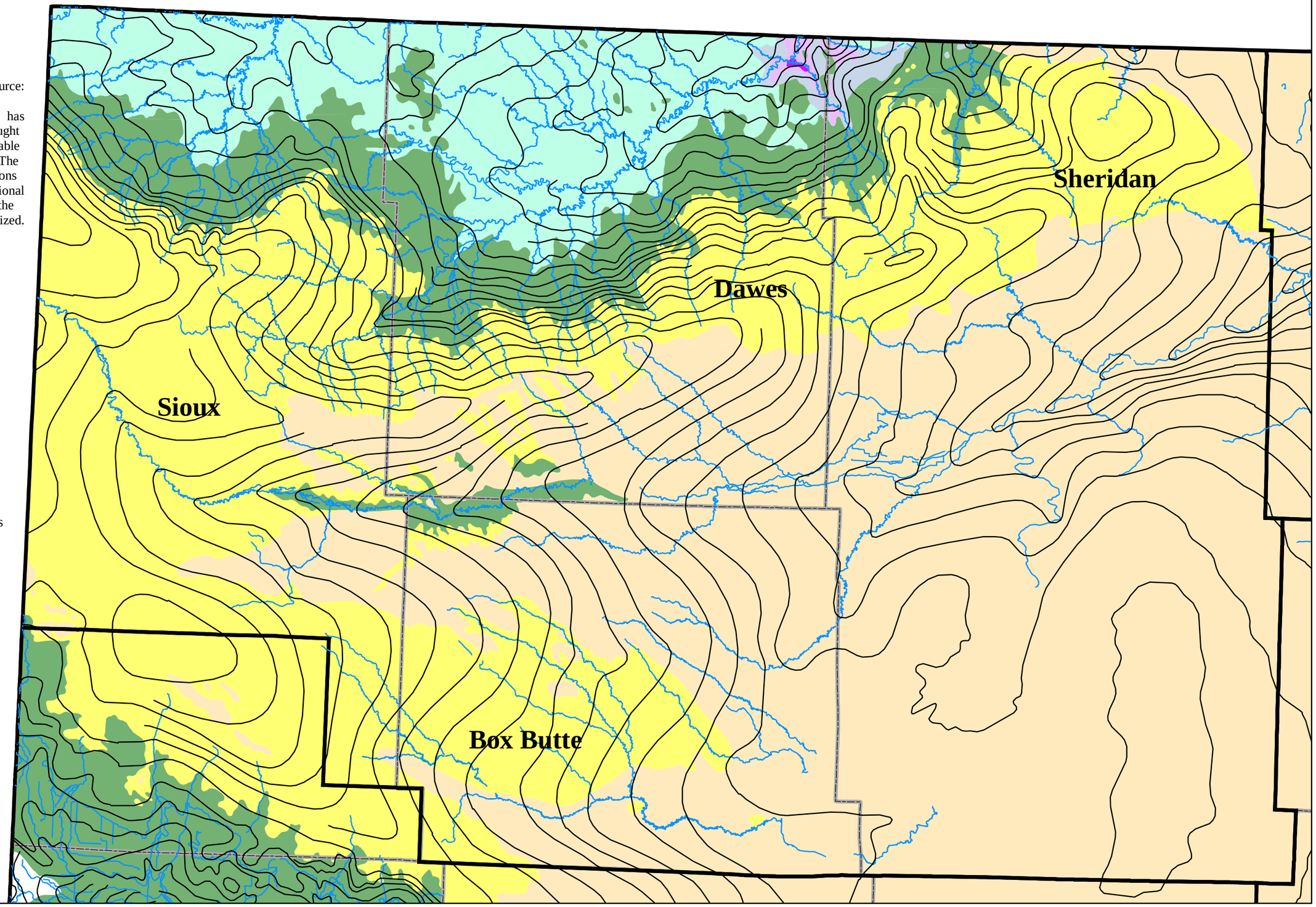


Figure 30

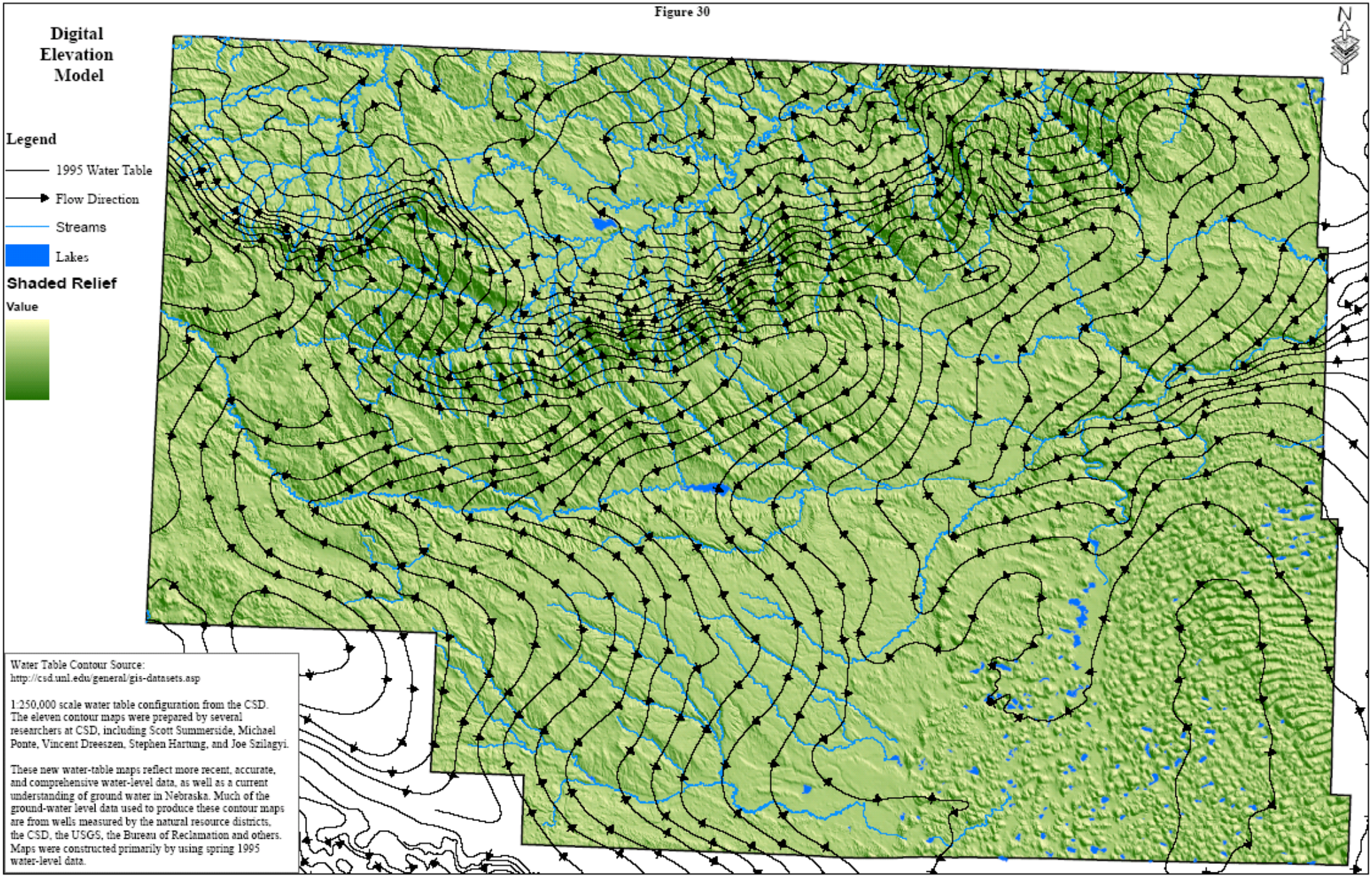
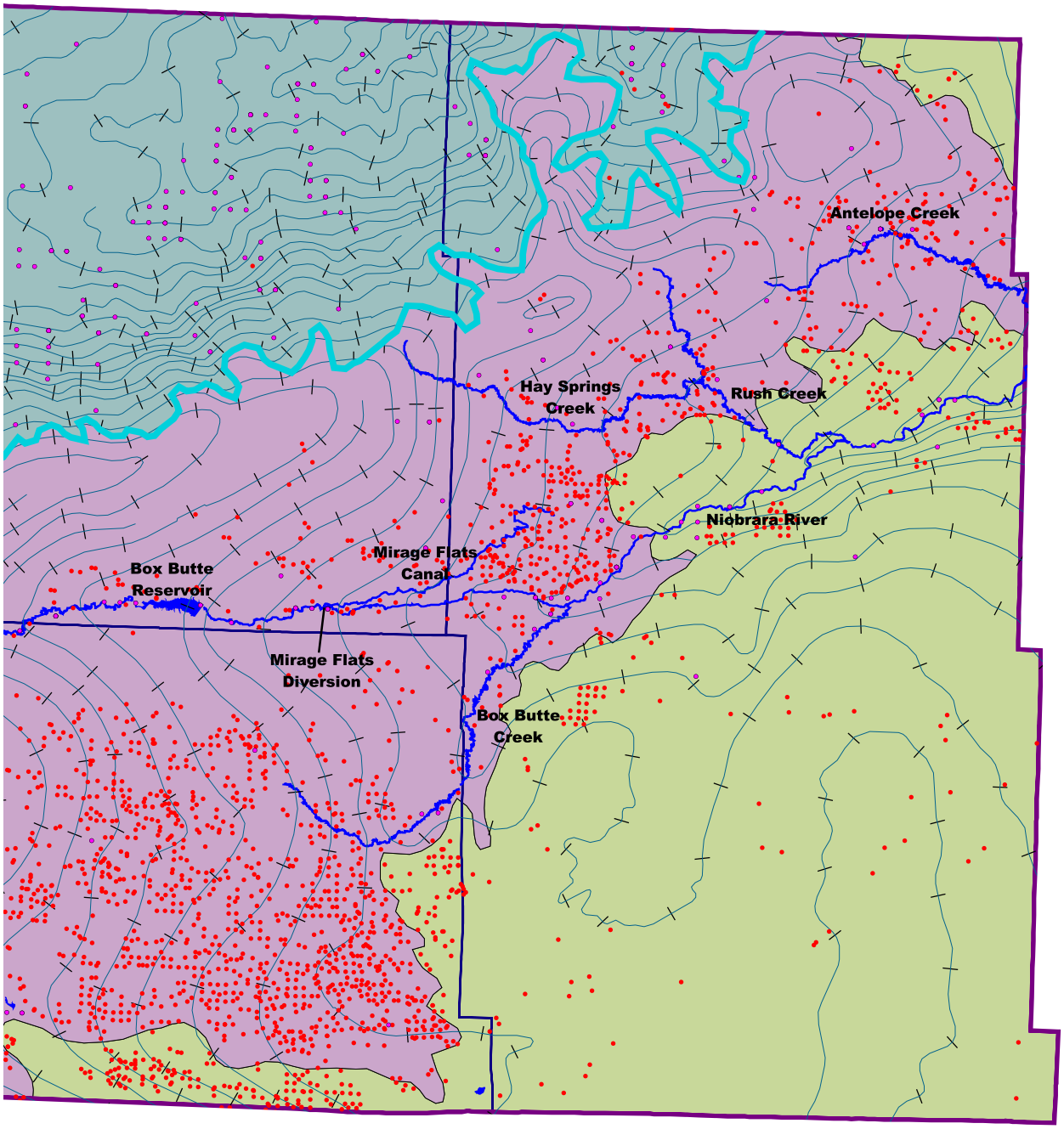

Digital Elevation Model
Legend
1995 Water Table
Flow Direction
Streams
Lakes
Shaded Relief
Value
N
Water Table Contour Source:
http://csd.unl.edu/general/gis-datasets.asp
1:250,000 scale water table configuration from the CSD. The eleven contour maps were prepared by several researchers at CSD, including Scott Summerside, Michael Ponte, Vincent Dreeszen, Stephen Hartung, and Joe Szilagyi.
These new water-table maps reflect more recent, accurate, and comprehensive water-level data, as well as a current understanding of ground water in Nebraska. Much of the ground-water level data used to produce these contour maps are from wells measured by the natural resource districts, the CSD, the USGS, the Bureau of Reclamation and others. Maps were constructed primarily by using spring 1995 water-level data.

Figure 31

Eastern Part
Upper Niobrara - White NRD

Aquifer and Surface Water Systems
Surface and Ground Water Diversions
Water Table Contours



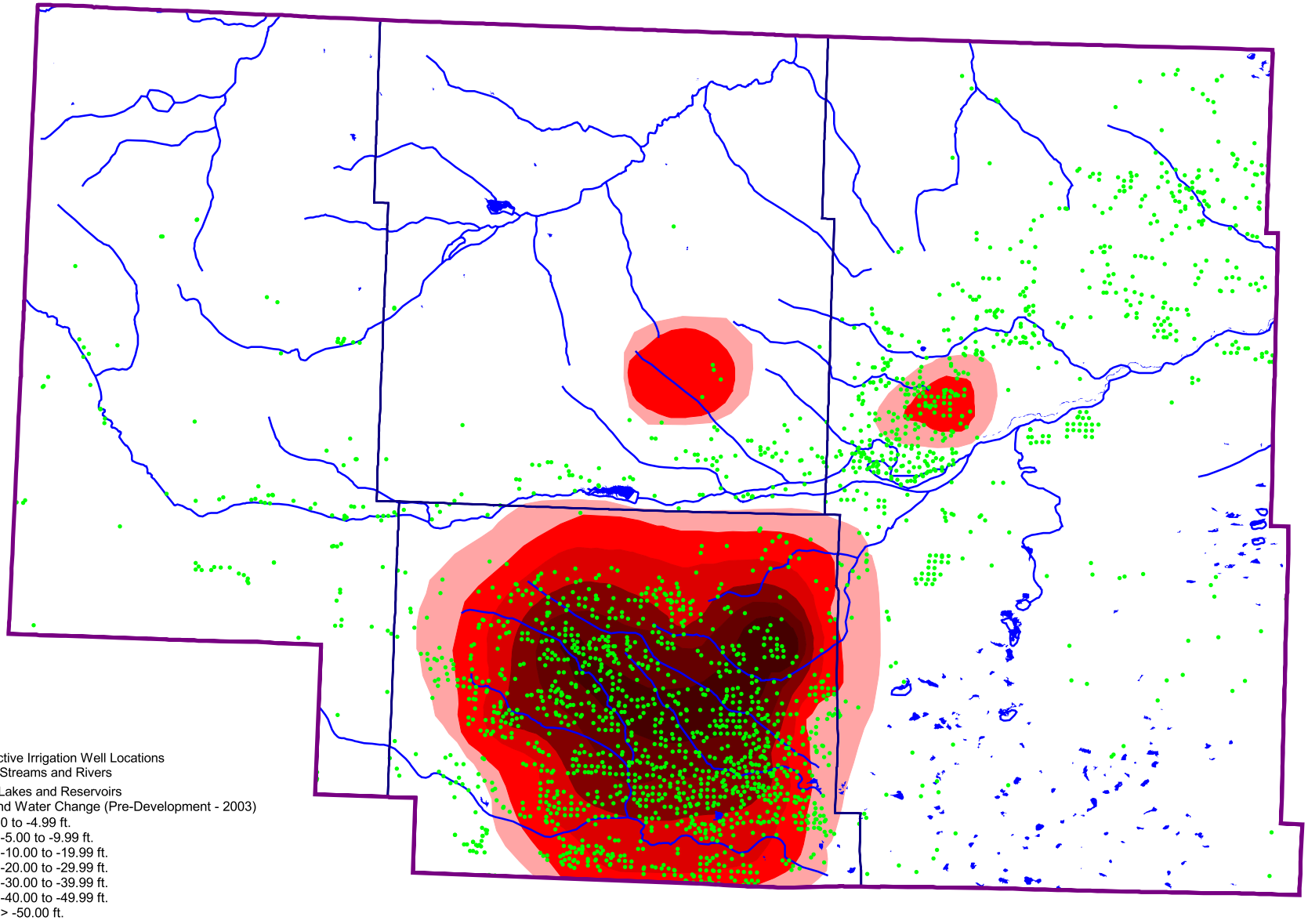
Surface Water Diversion Points
Active Irrigation Well Locations
Streams and Rivers
Lakes and Reservoirs
Ground Water Flow Direction
Water Table Contours
Harrison Aquitard
Ground Water Regions
Hat Creek-White River Drainage
Northern Panhandle
Sandhills

Source: NDNR Surface Water and Ground Water Databases, Conservations and Survey Division GIS Datasets

Figure 32

Upper Niobrara-White Natural Resources District

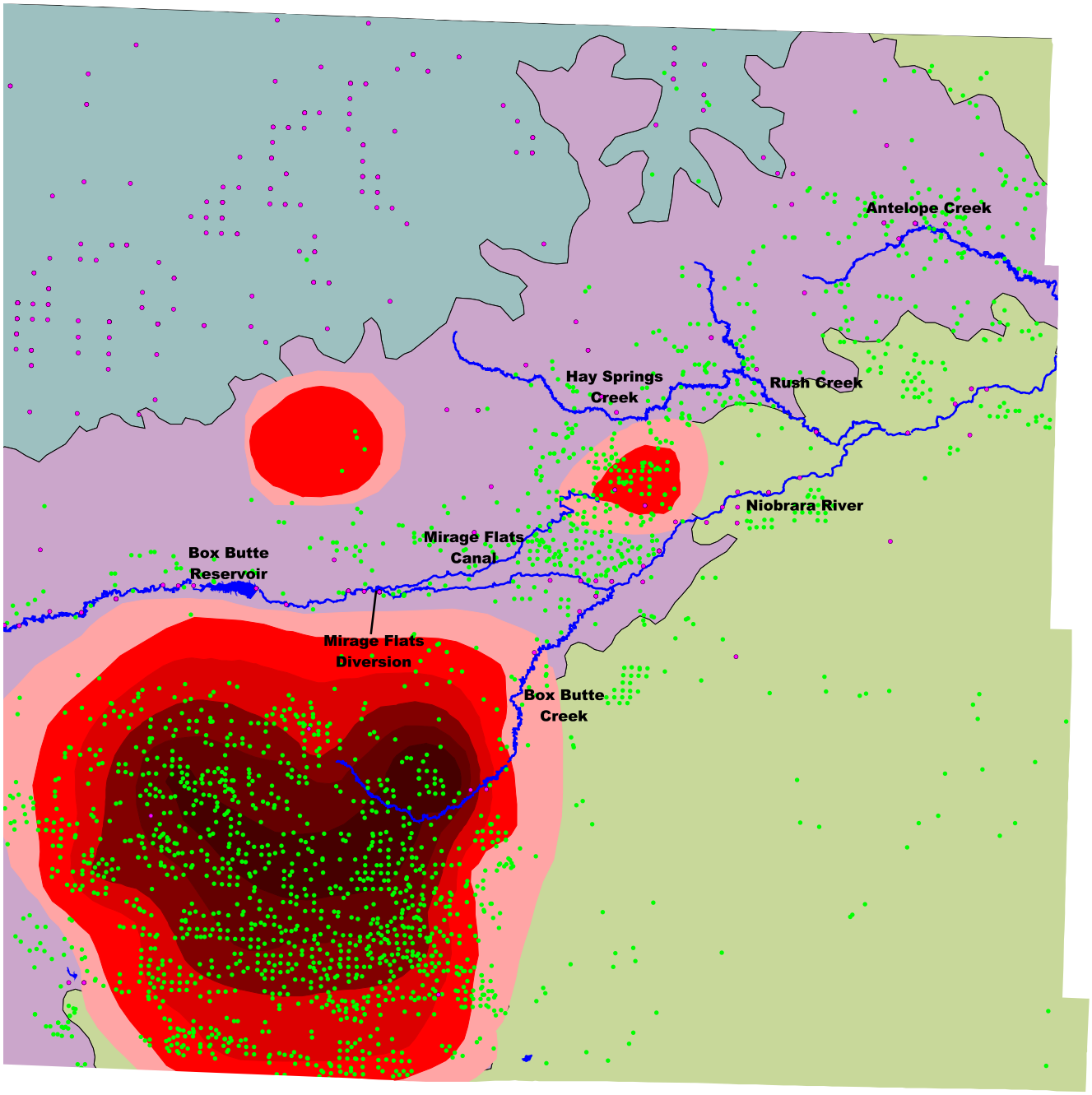
Water Level Changes - Predevelopment to Spring 2003



Source: NDNR Ground Water Database, Conservations and Survey Division GIS Datasets

Figure 33

Eastern Part
Upper Niobrara - White NRD
Ground Water Regions
Ground Water Declines (Pre-Development - 2003)
Active Irrigatin Wells



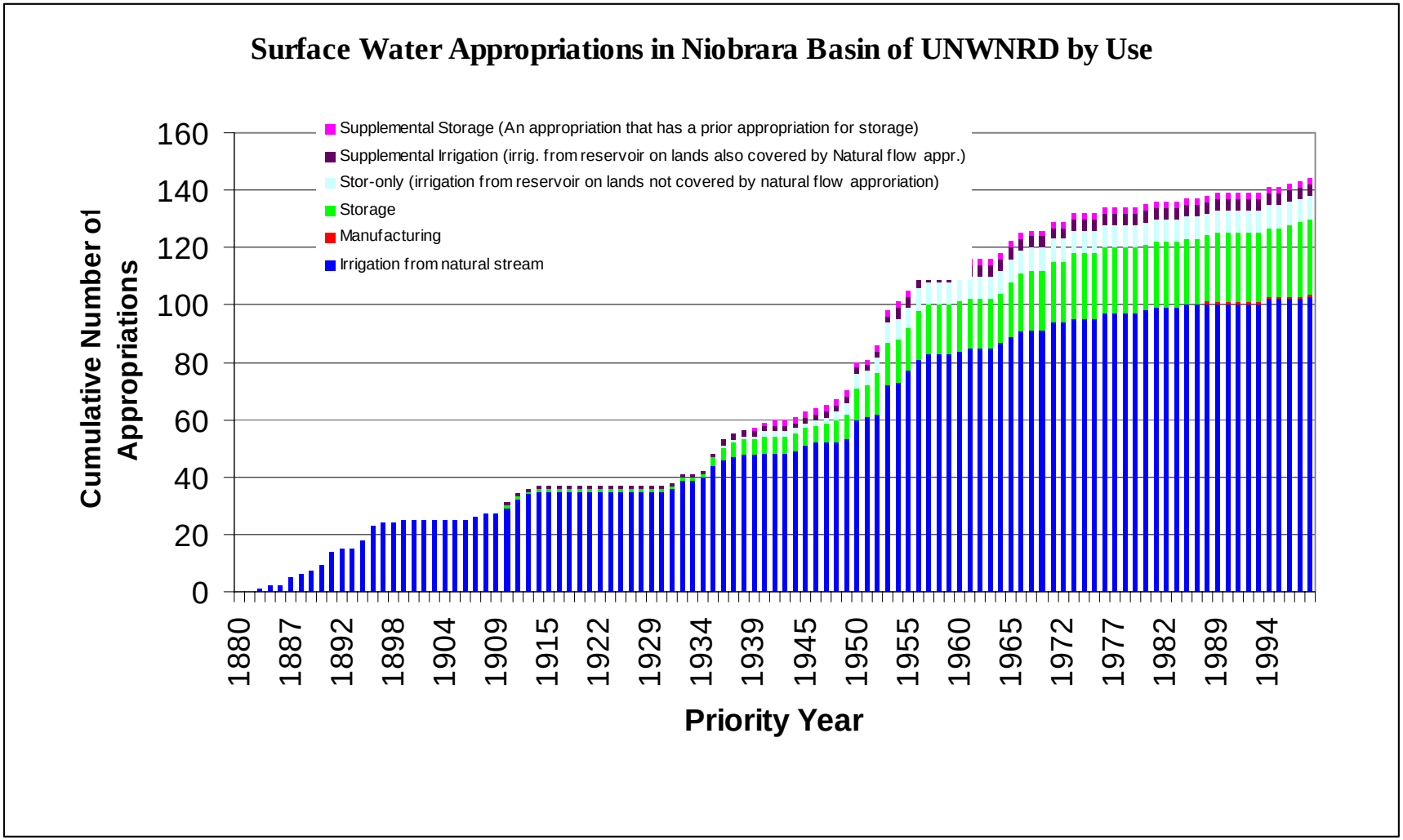
Surface Water Diversion Points
Active Irrigation Well Locations
Streams and Rivers
Lakes and Reservoirs

Ground Water Regions
- Hat Creek-White River Drainage
- Northern Panhandle
- Sandhills

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.

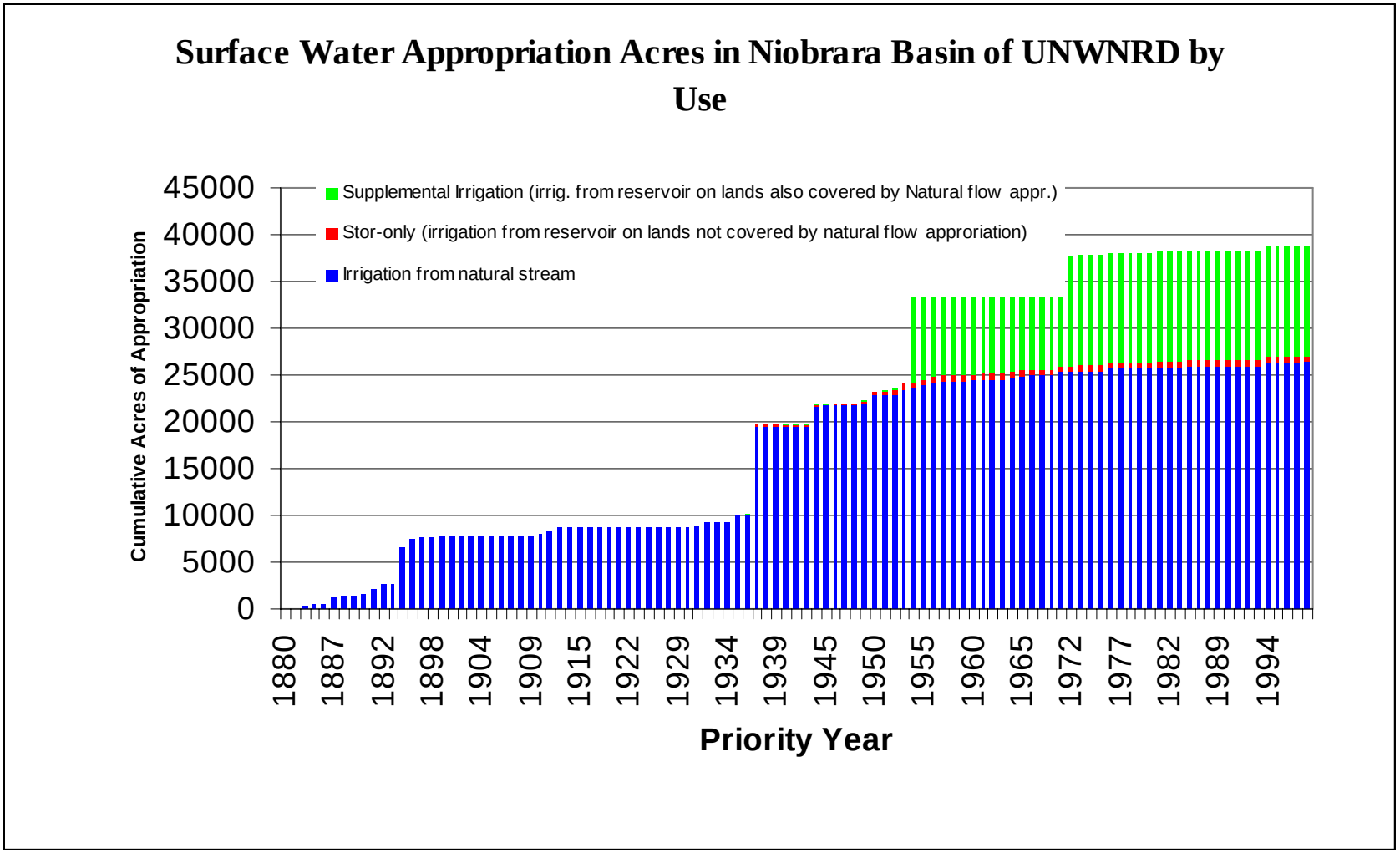
Source: NDNR Surface Water and Ground Water Databases, Conservations and Survey Division GIS Datasets

Figure 34



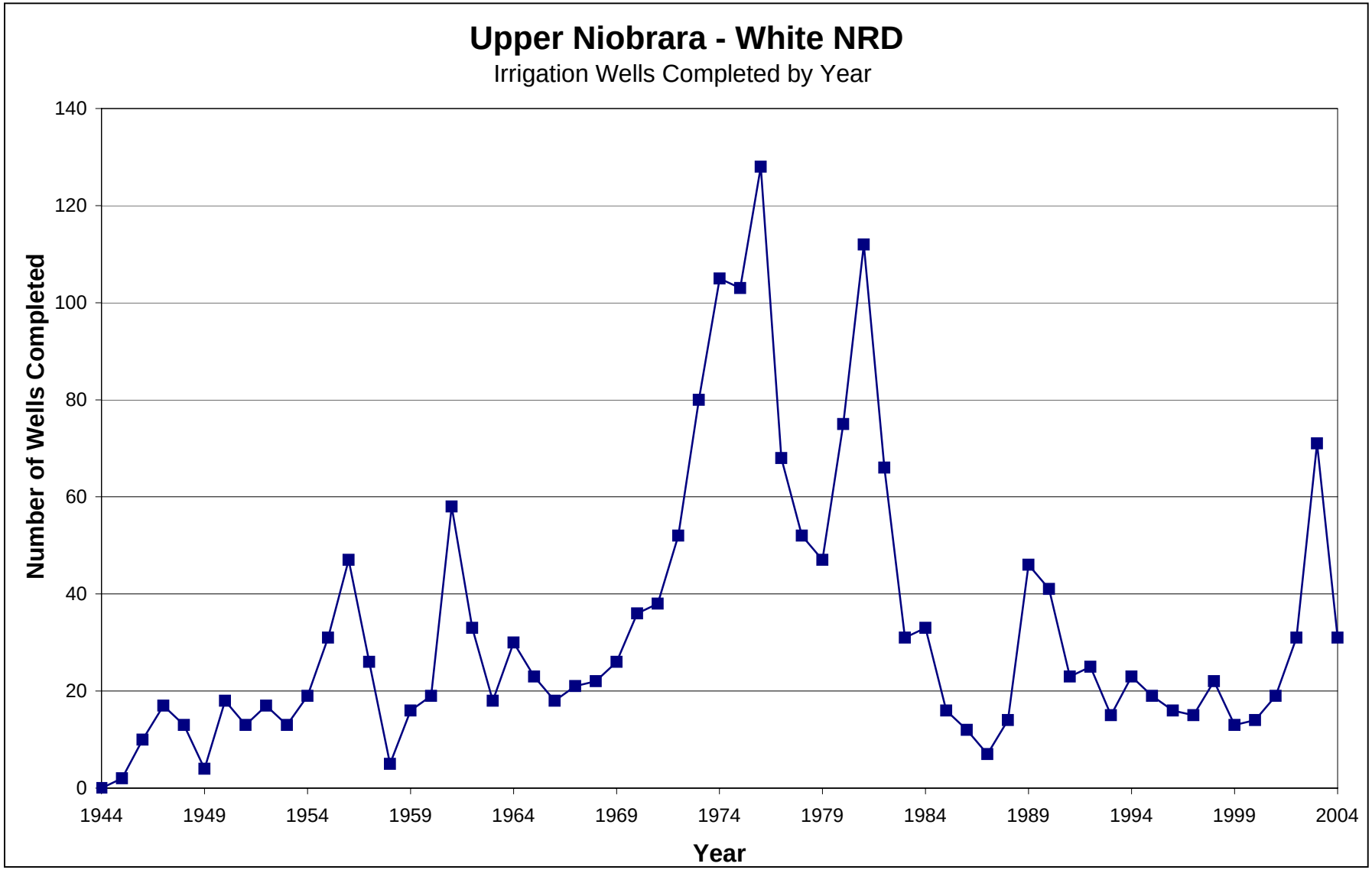
Source: Nebraska Department of Natural Resources Surface Water Rights Records

Figure 35



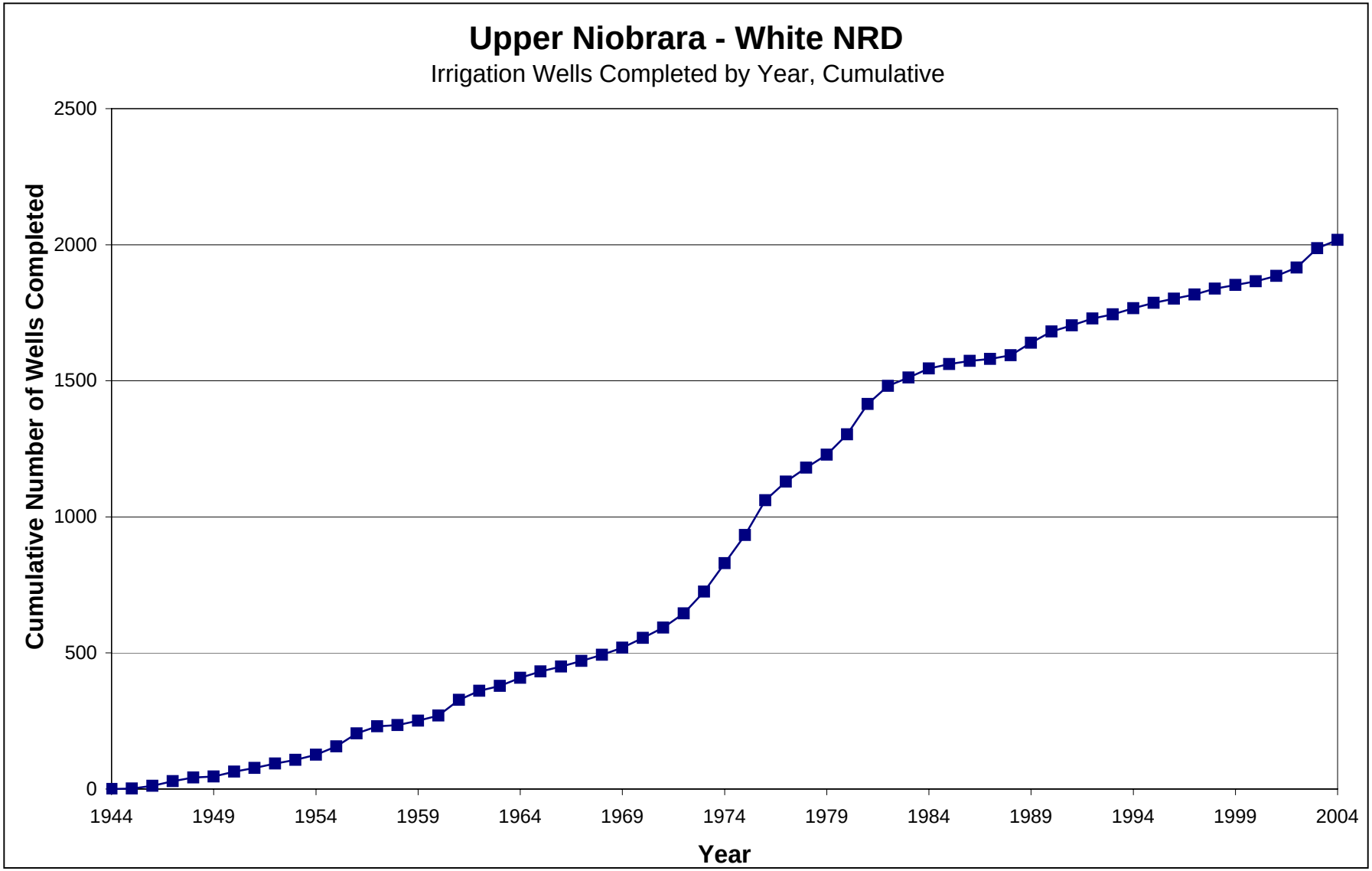
Source: Nebraska Department of Natural Resources Surface Water Rights Records

Figure 36



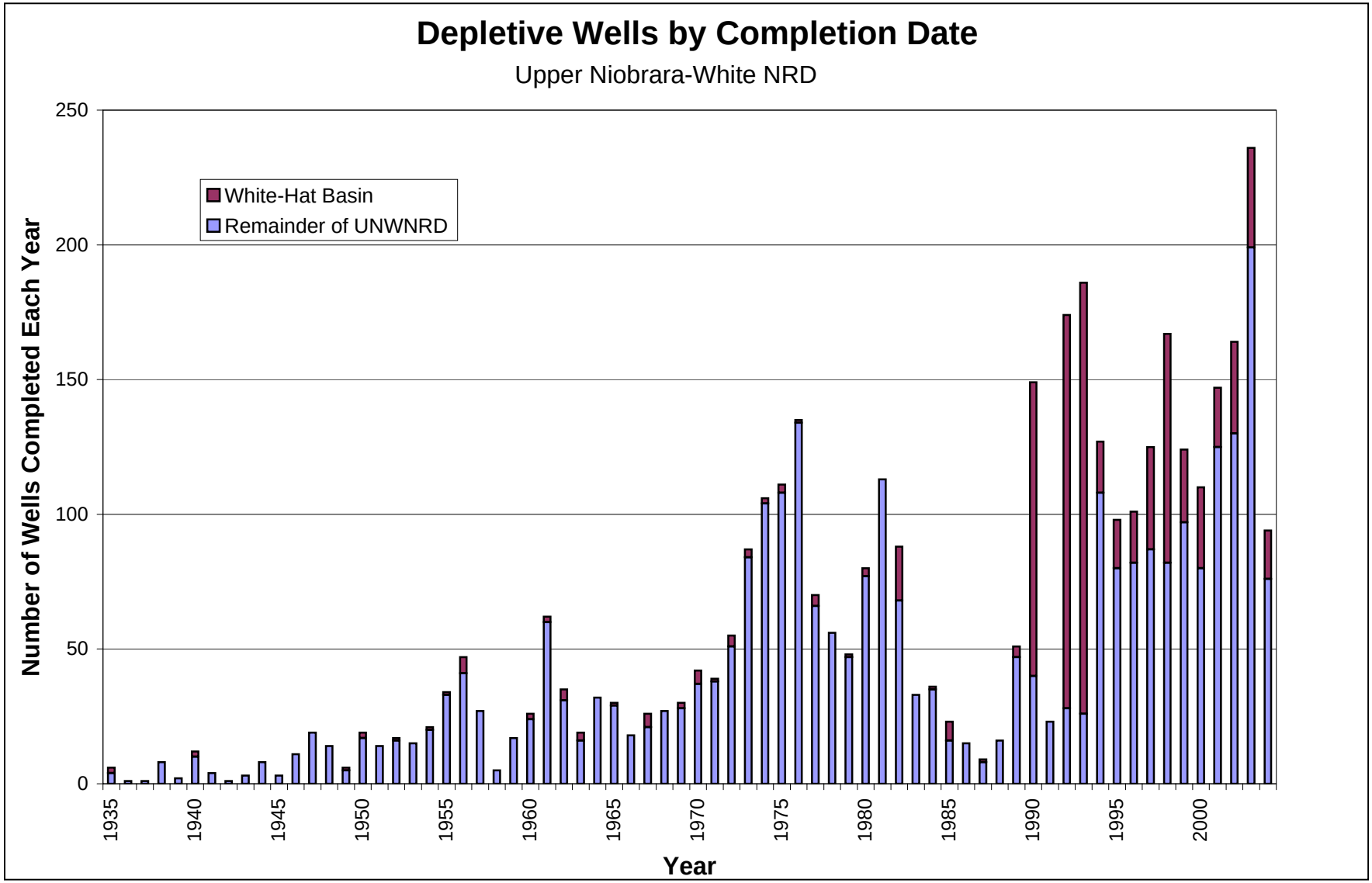
Source: Nebraska Department of Natural Resources Ground Water Database

Figure 37



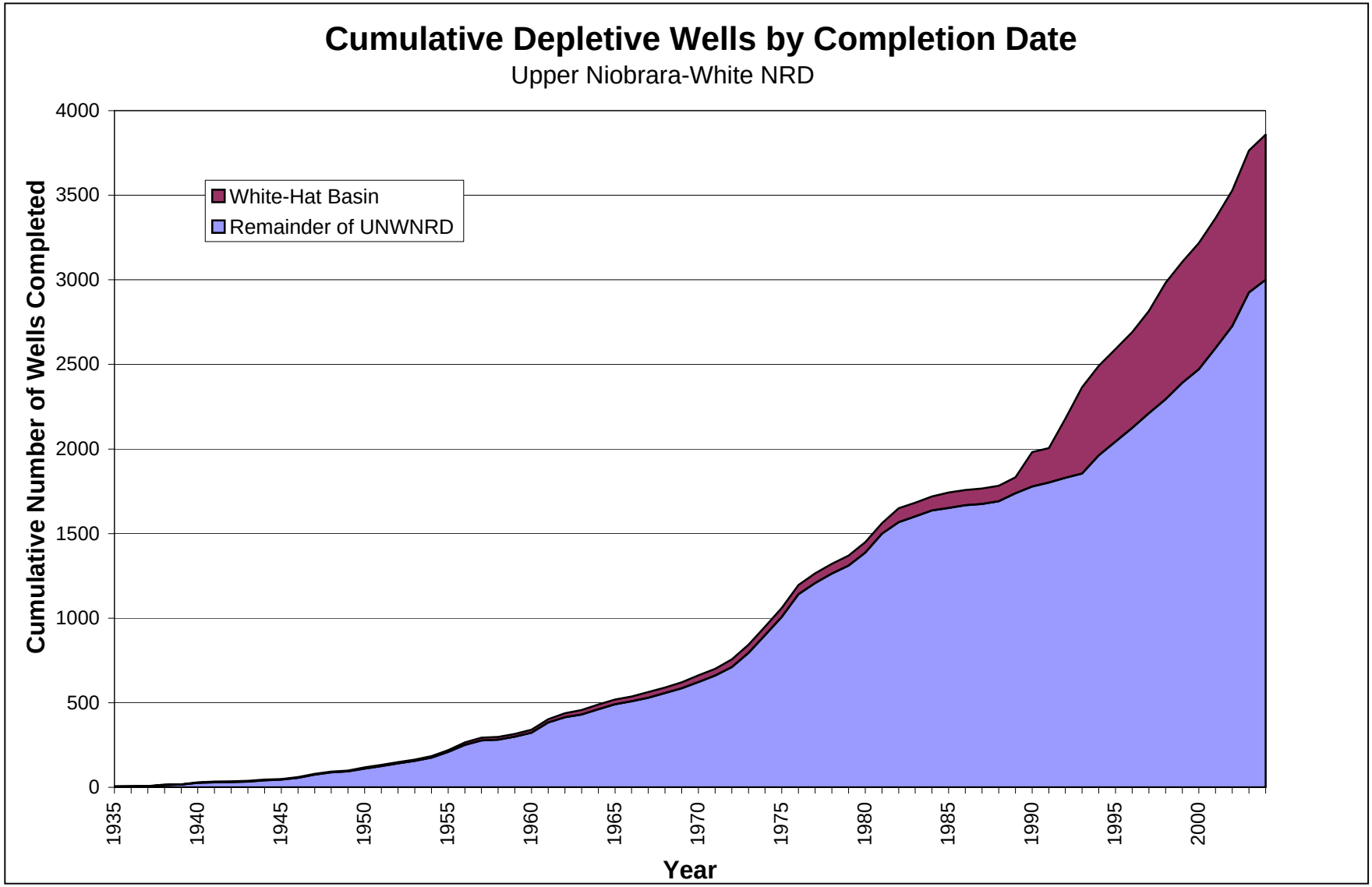
Source: Nebraska Department of Natural Resources Ground Water Database

Figure 38



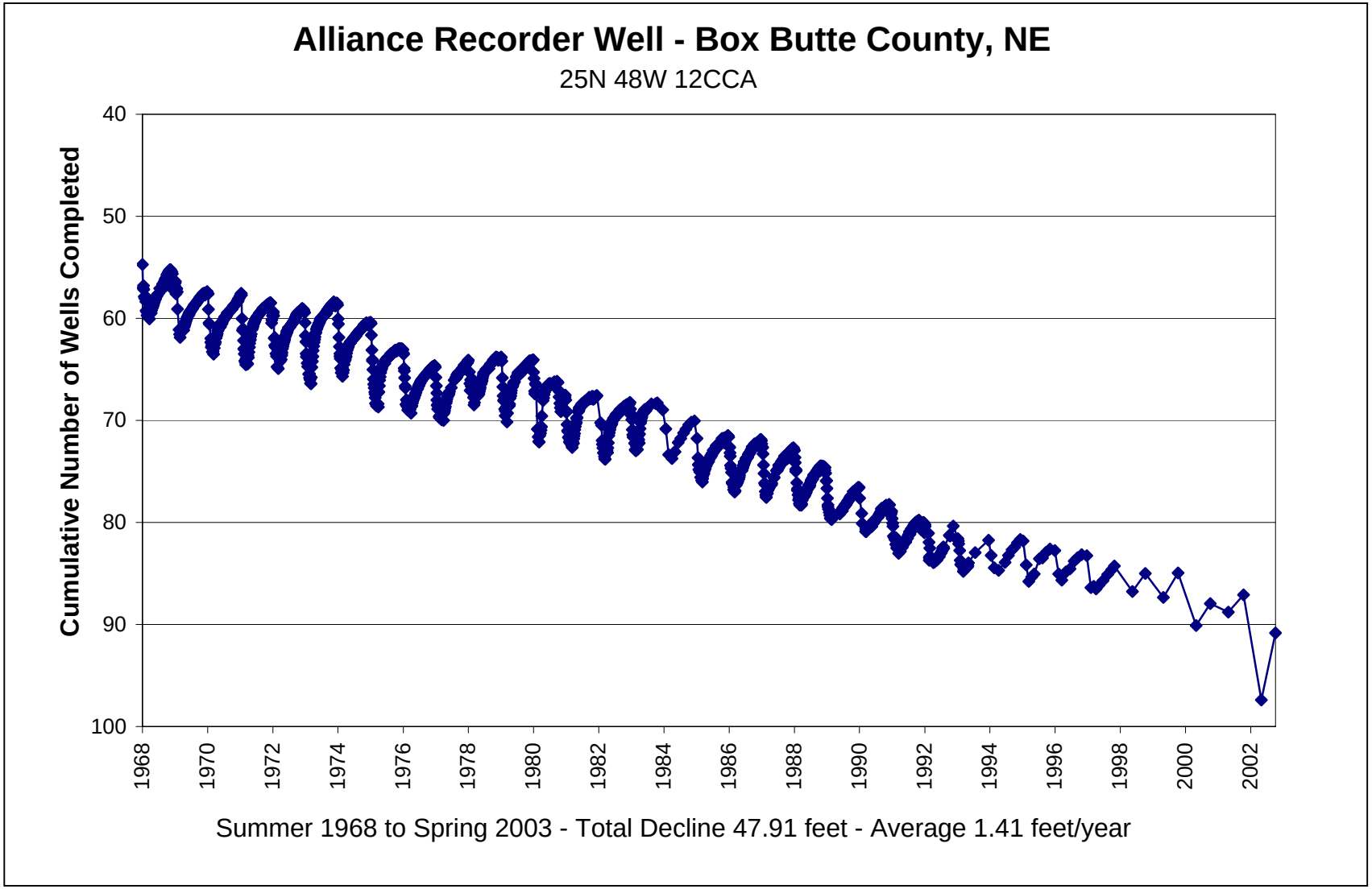
Source: Nebraska Department of Natural Resources Ground Water Database

Figure 39



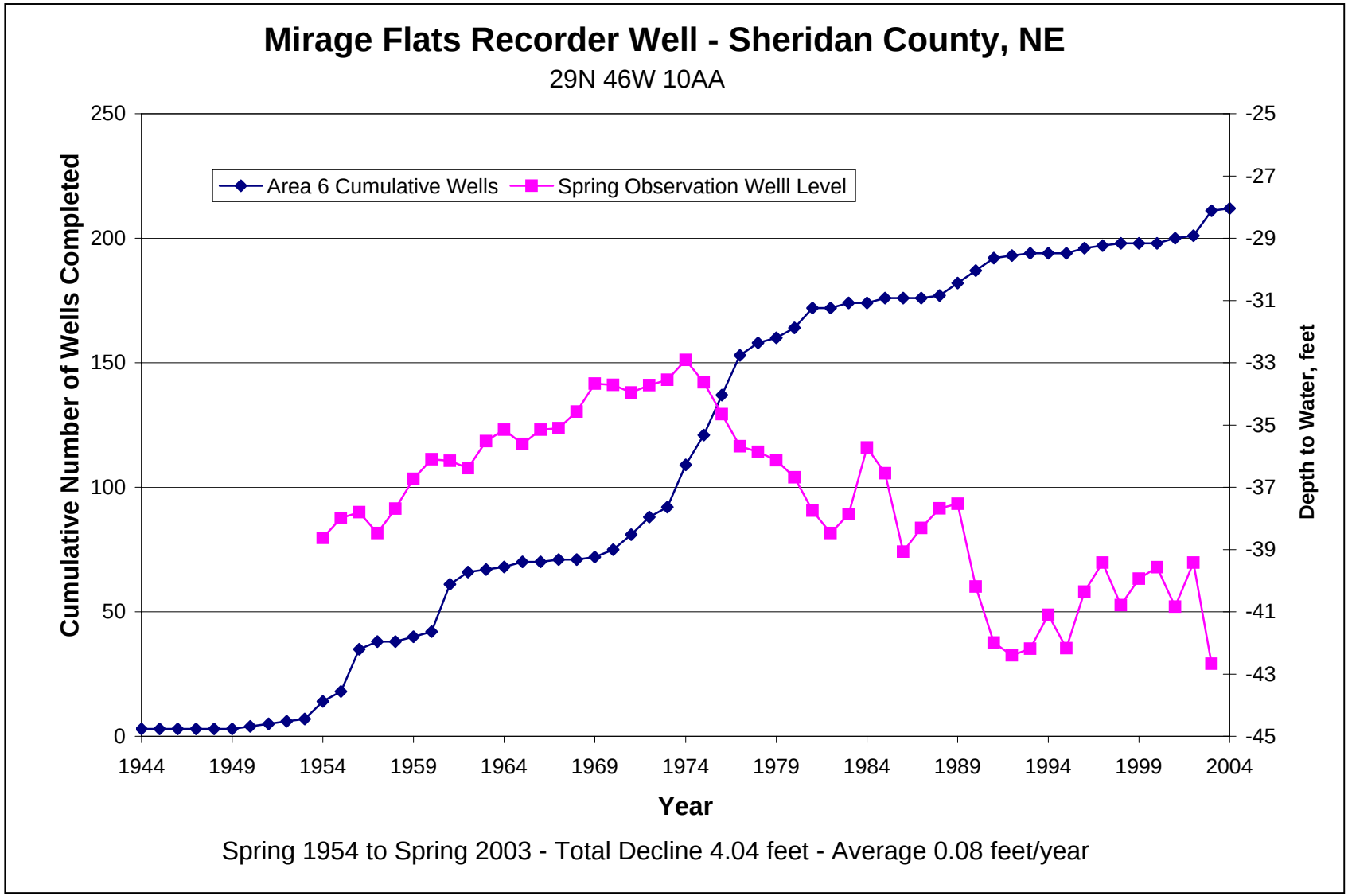
Source: Nebraska Department of Natural Resources Ground Water Database

Figure 40



Source: Nebraska Department of Natural Resources Databank, USGS Observation Well Database

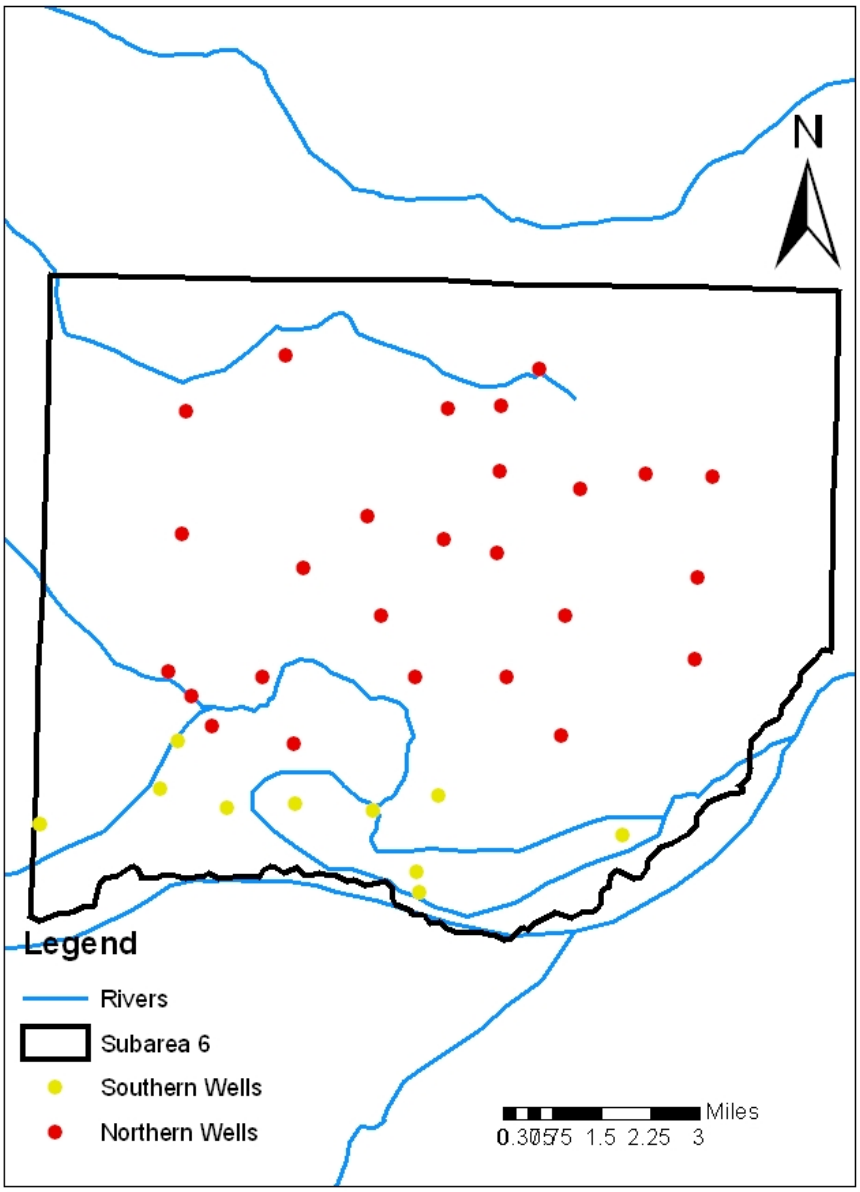
Figure 41



Source: Nebraska Department of Natural Resources Ground Water Database, USGS Observation Well Database

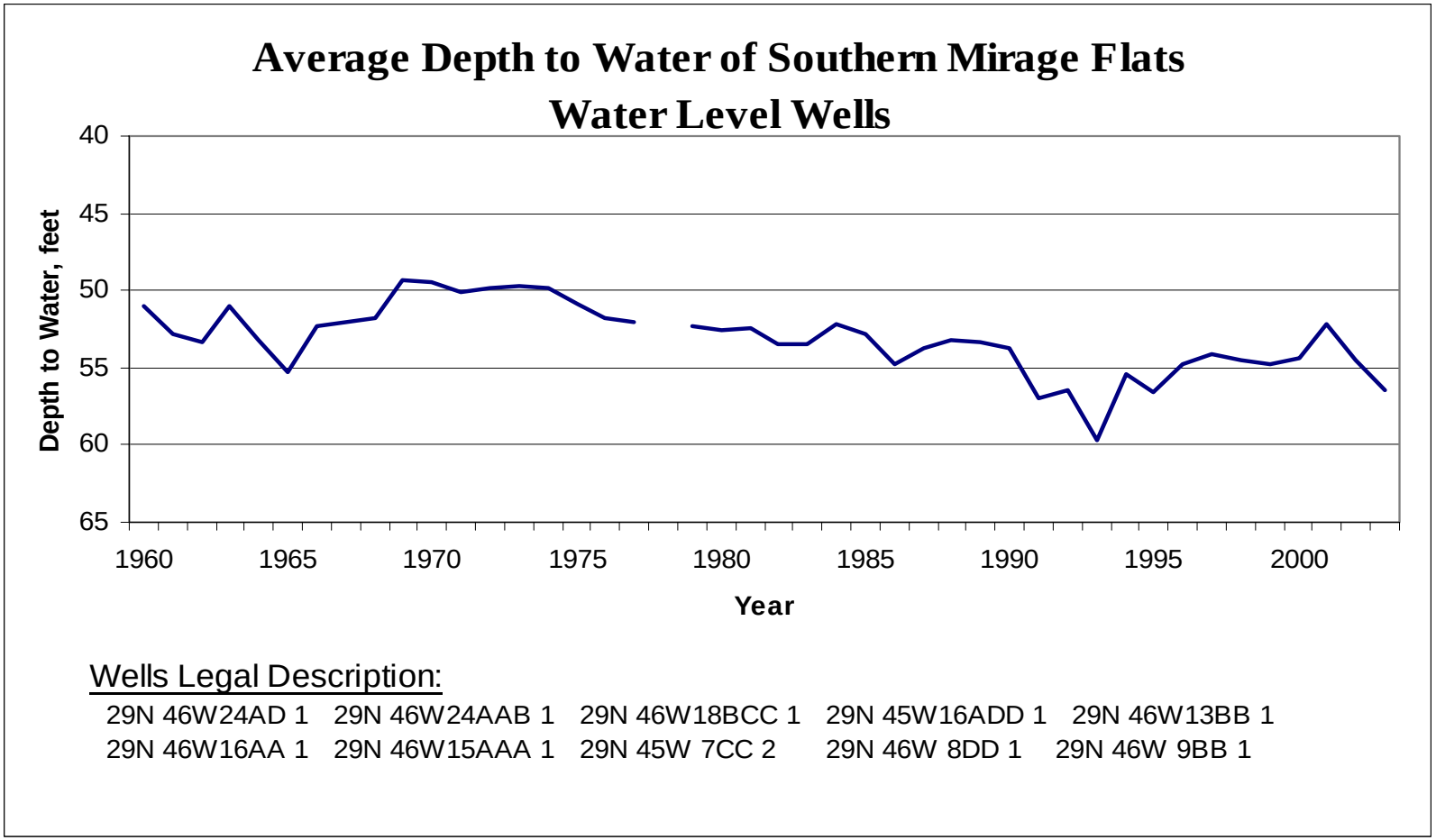
Figure 42

Water Level Wells in Mirage Flats Area



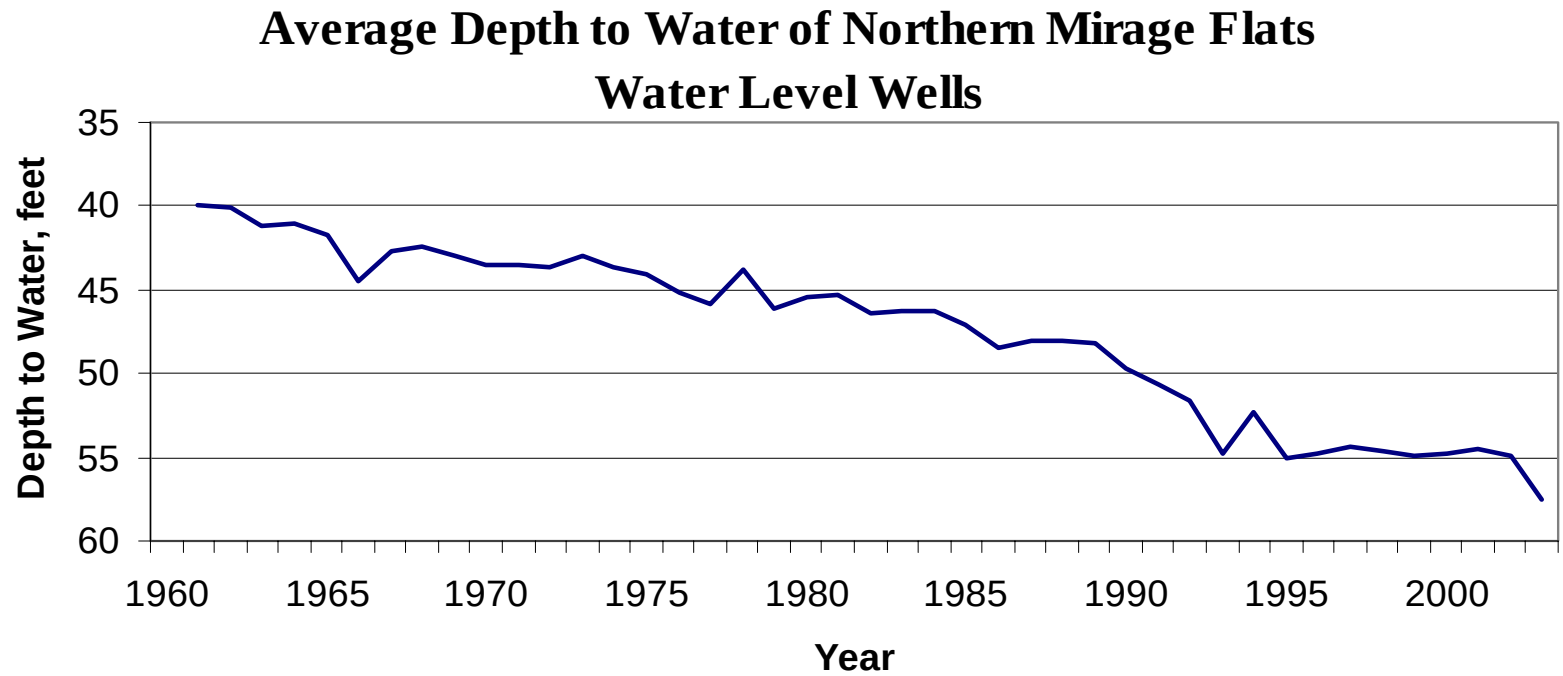
Source: U.S. Geological Survey Wells, Nebraska Department of Natural Resources

Figure 43



Source: United States Geological Survey Observation Well Database

Figure 44



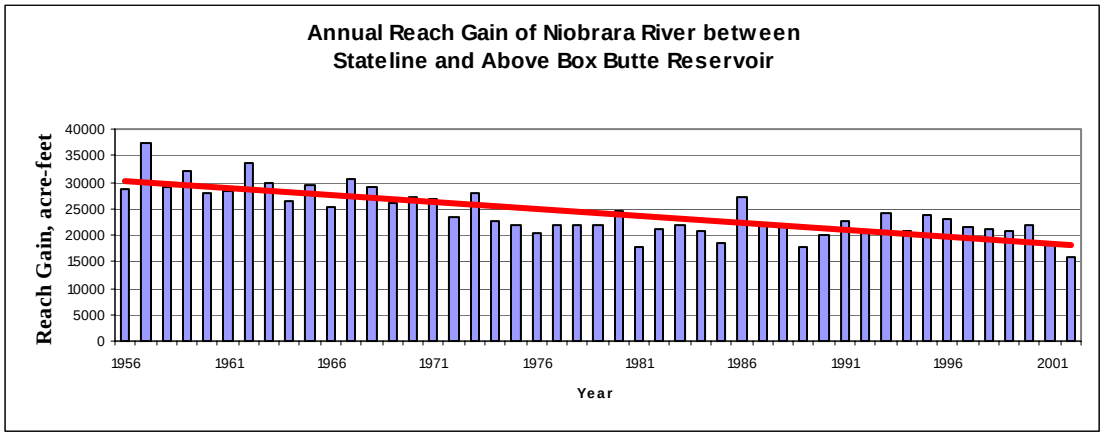
Wells Legal Description:

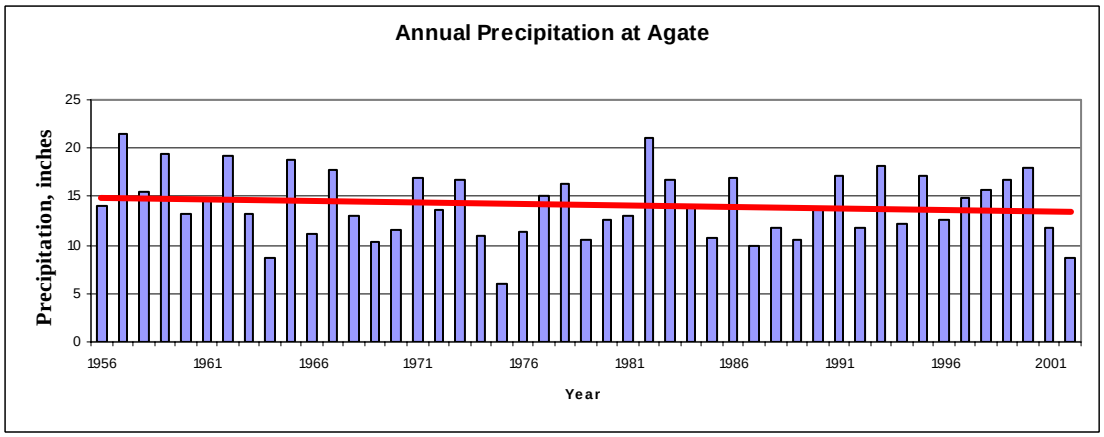
29N 46W10AA 1 29N 45W 5DDD 1 29N 46W 4DC 1 29N 46W 4BDC 1 29N 46W 3BA 1 29N 46W 1ABA 1 29N 46W 5AAA 1
29N 45W 5BBB 1 30N 45W34DAD 1 30N 46W36BB 1 30N 45W32AAA 1 30N 45W27ADD 1 30N 46W27ADD 1 30N 45W30AA 1
30N 46W21CCC 1 30N 45W19CCC 1 30N 46W23DA 1 30N 45W21BB 1 30N 45W14CC 1 30N 45W15CC 1 30N 45W18DD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

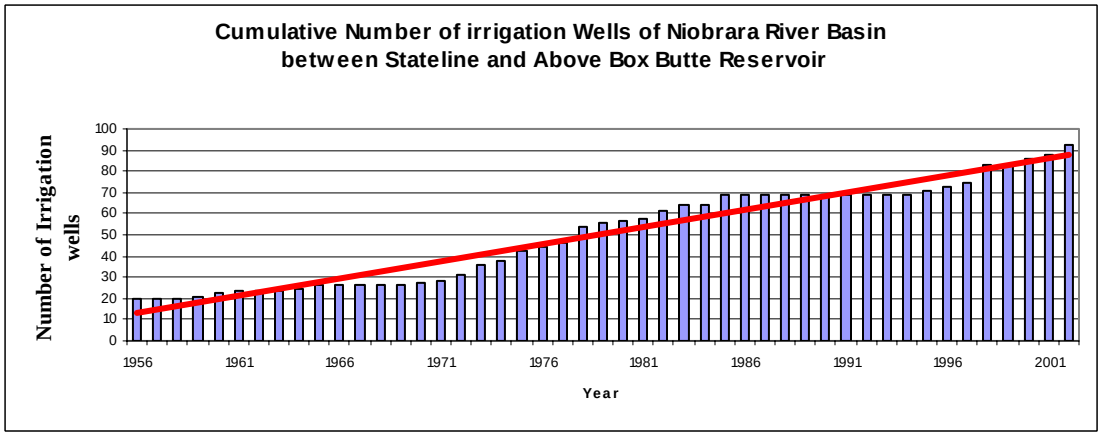
Source: United States Geological Survey Observation Well Database

Figure 45

Trend Analyses of Annual Reach Gain, Precipitation, and Number of Irrigation Wells



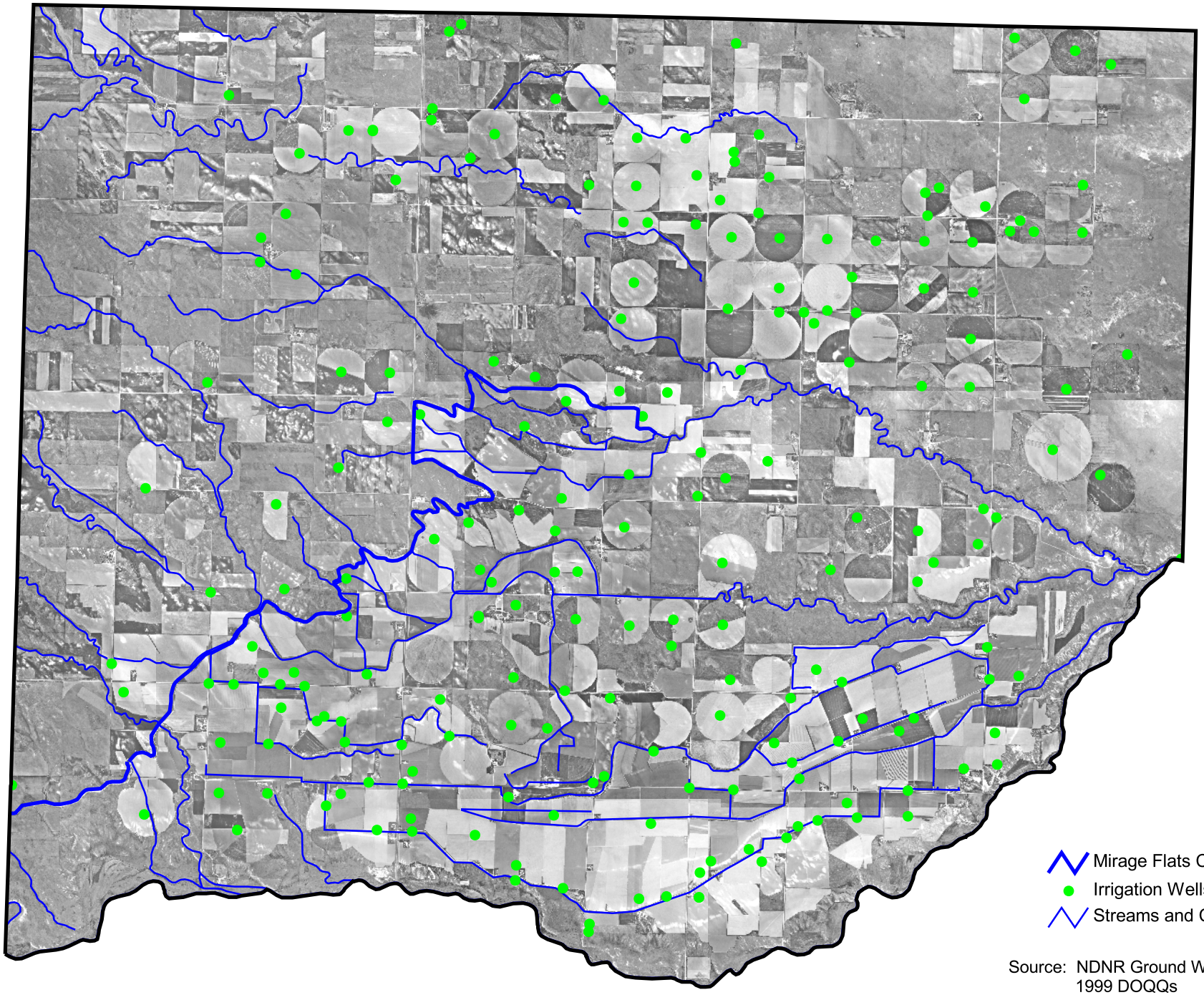




Sources: Nebraska Department of Natural Resources; Precipitation data from High Plain Regional Climatic Center, UNL, Lincoln, NE.

Figure 46

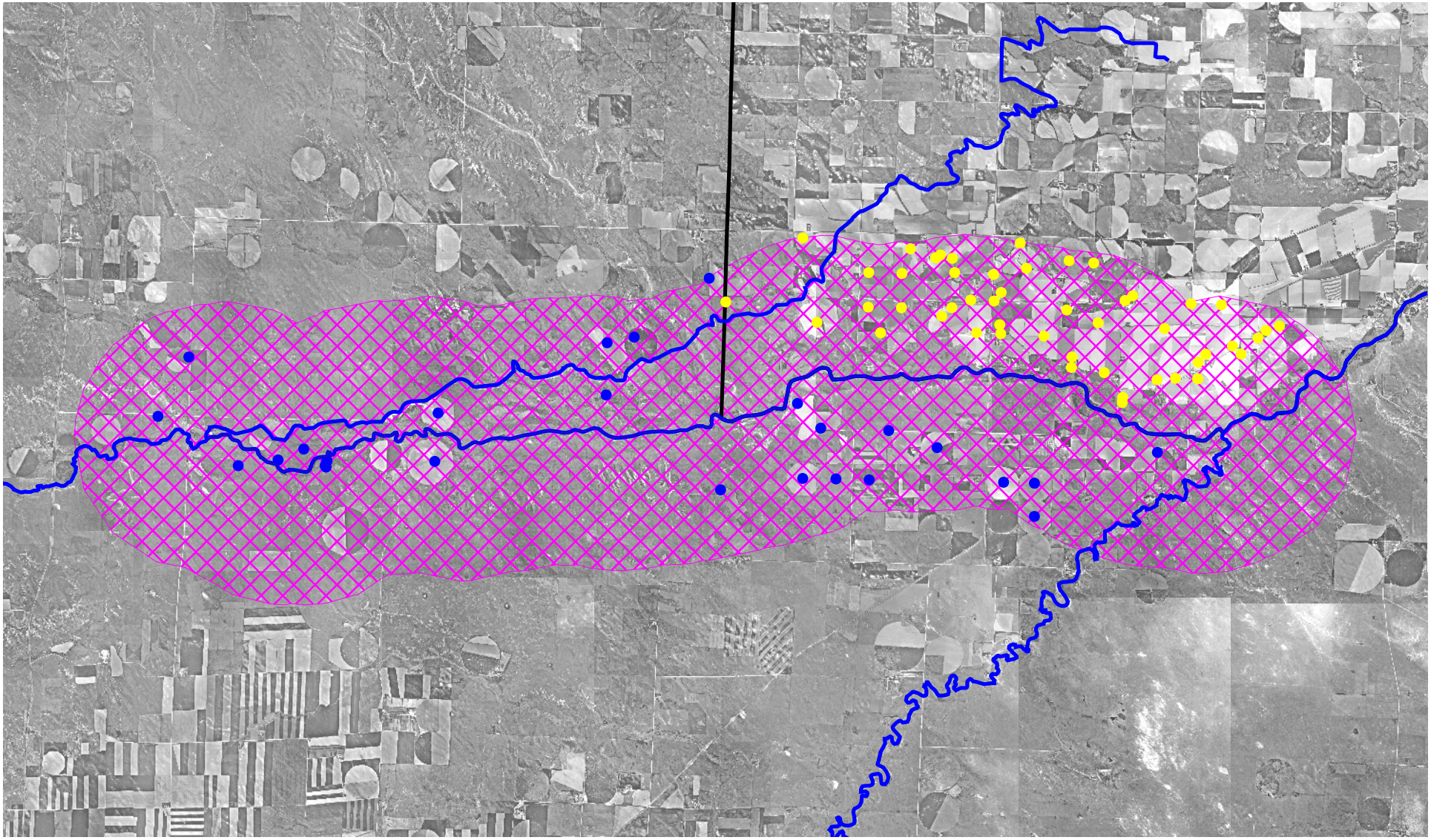
Irrigation Wells and Canals - Mirage Flats Area



Source: NDNR Ground Water Database
1999 DOQQs

Figure 47

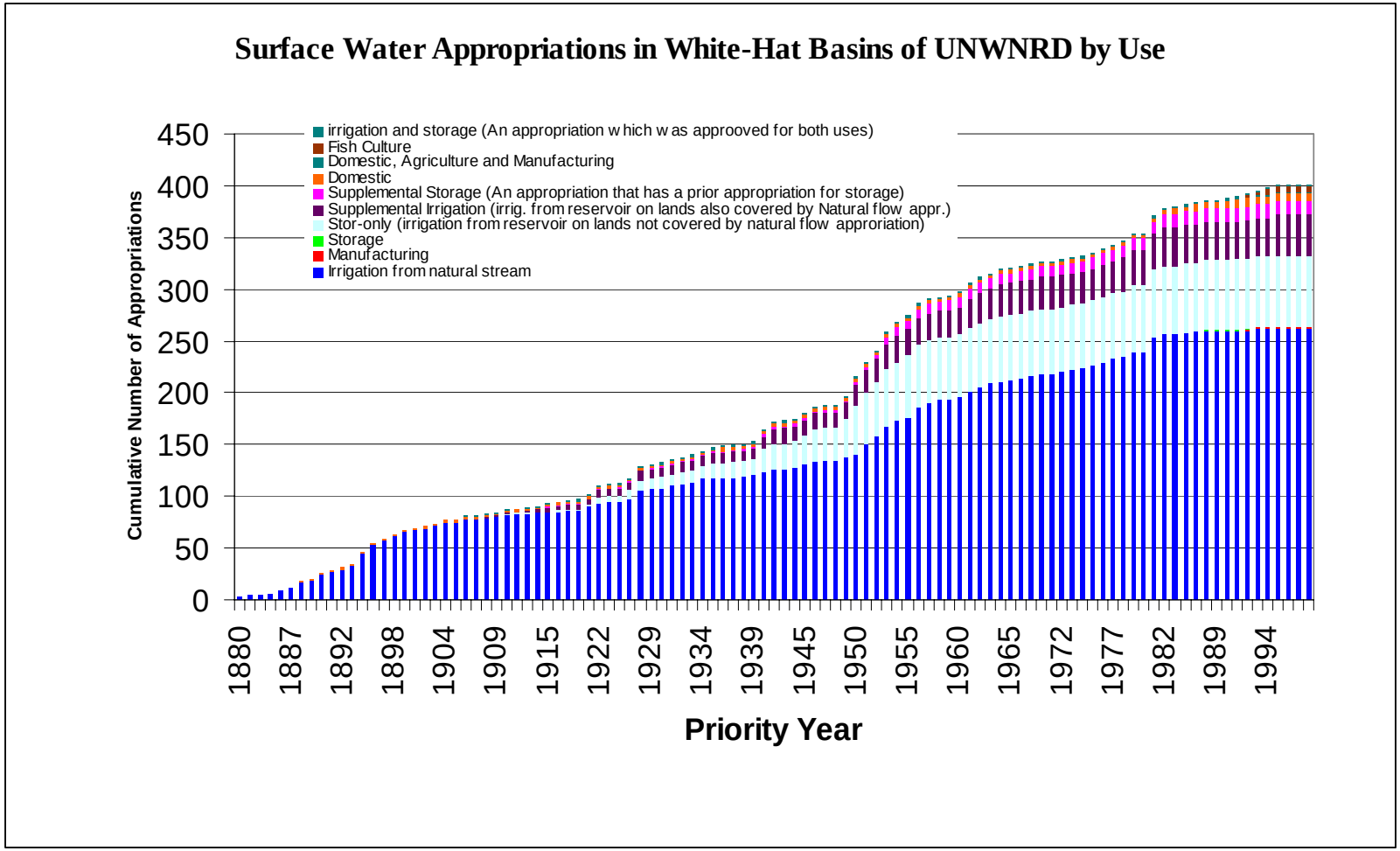
Active Irrigation Wells Within Two Miles of the Niobrara River
Mirage Flats Diversion to Box Butte Creek Confluence



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

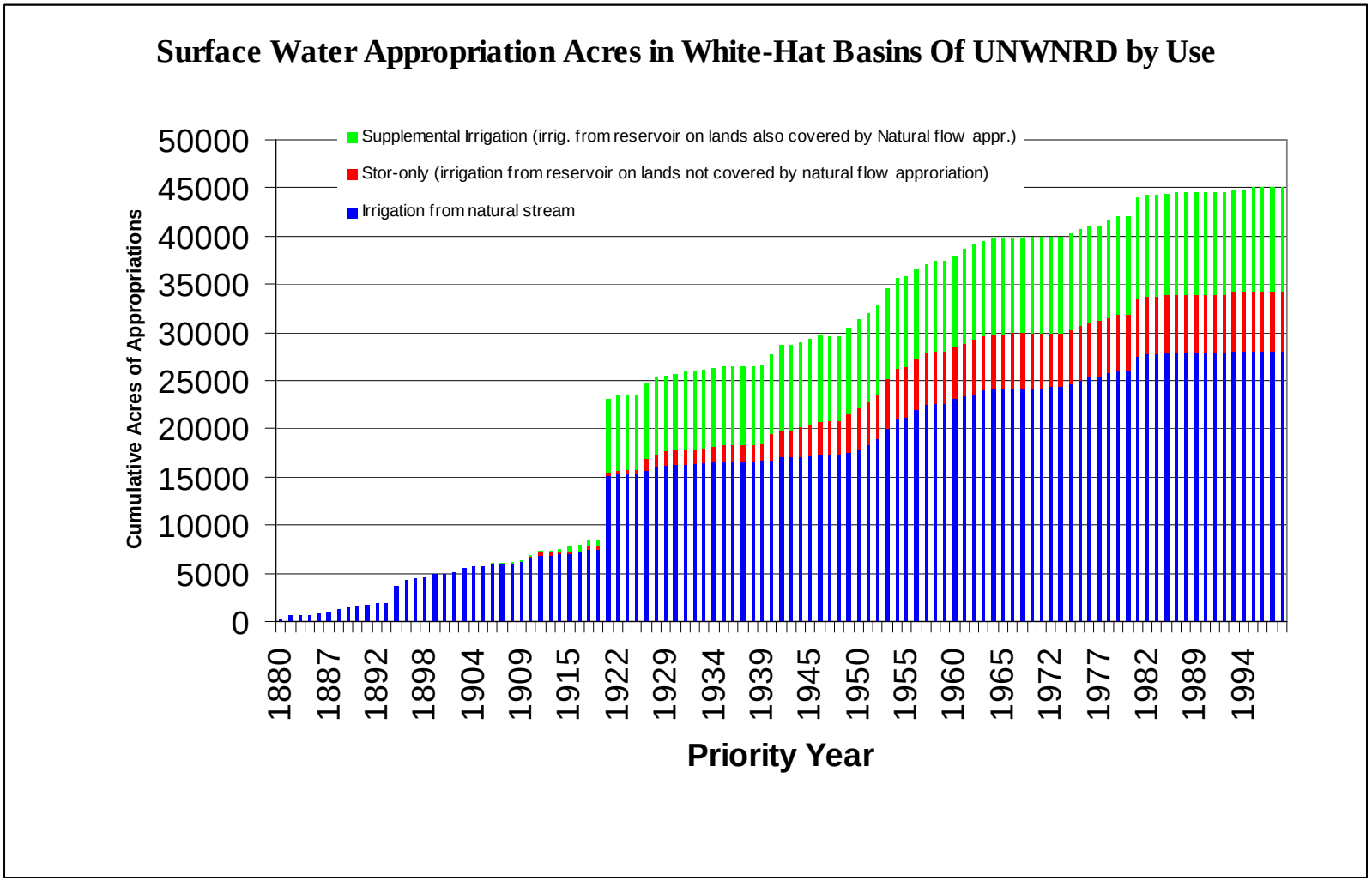
Source: NDNR Ground Water Database
1999 DOQQs

Figure 48



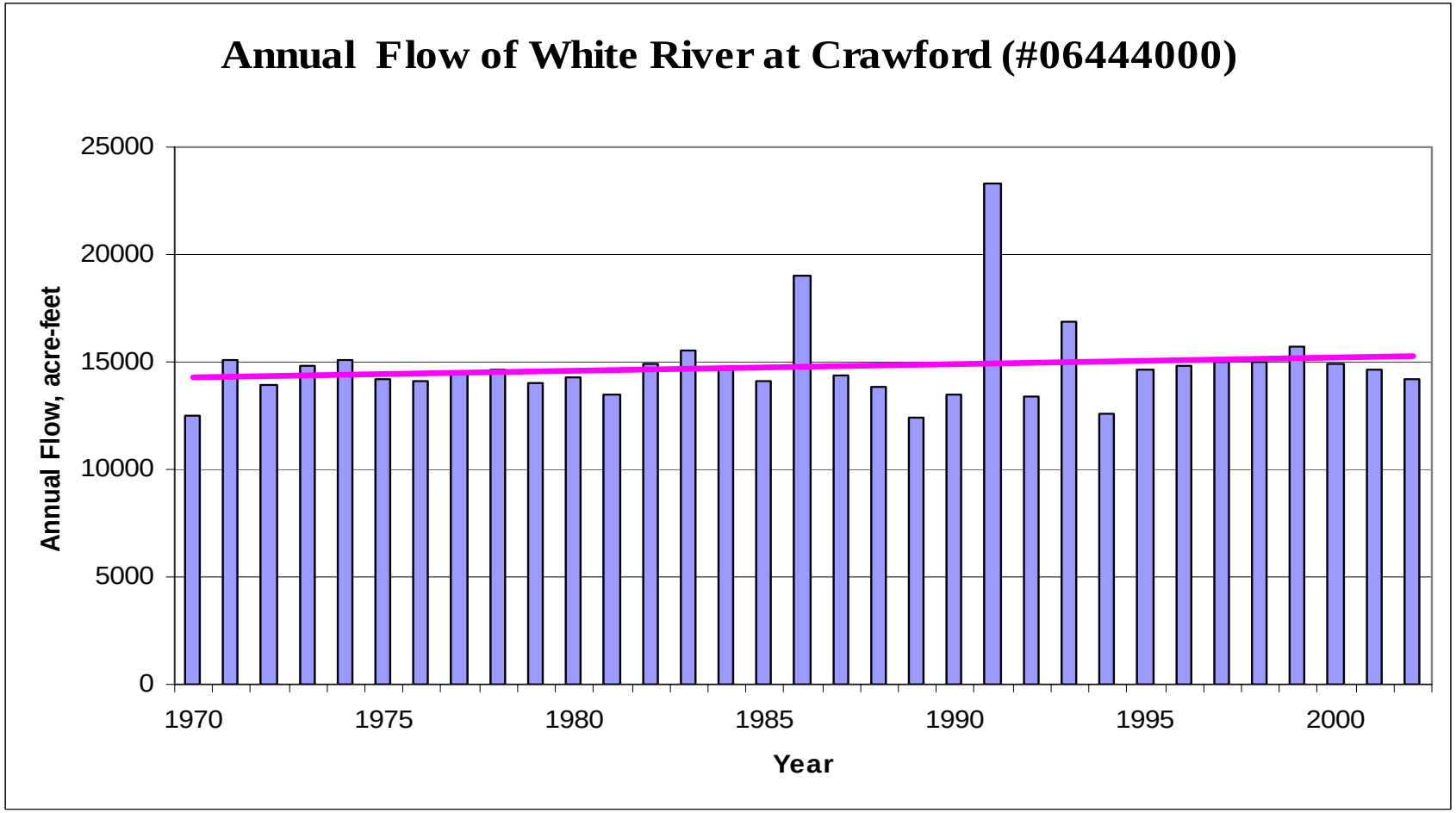
Source: Nebraska Department of Natural Resources Water Rights Database

Figure 49



Source: Nebraska Department of Natural Resources Surface Water Rights Database

Figure 50



Source: Nebraska Department of Natural Resources Stream Gaging Records