19th Native American

WATER ASSOCIATION CONFERNCE

ROSEBUD SIOUX TRIBAL WATER RESOURCES AND IMPACT OF KEYSTONE XL PIPELINE ON THE ROSEUD RURAL WATER SYSTEM

July 16-18, 2014

by

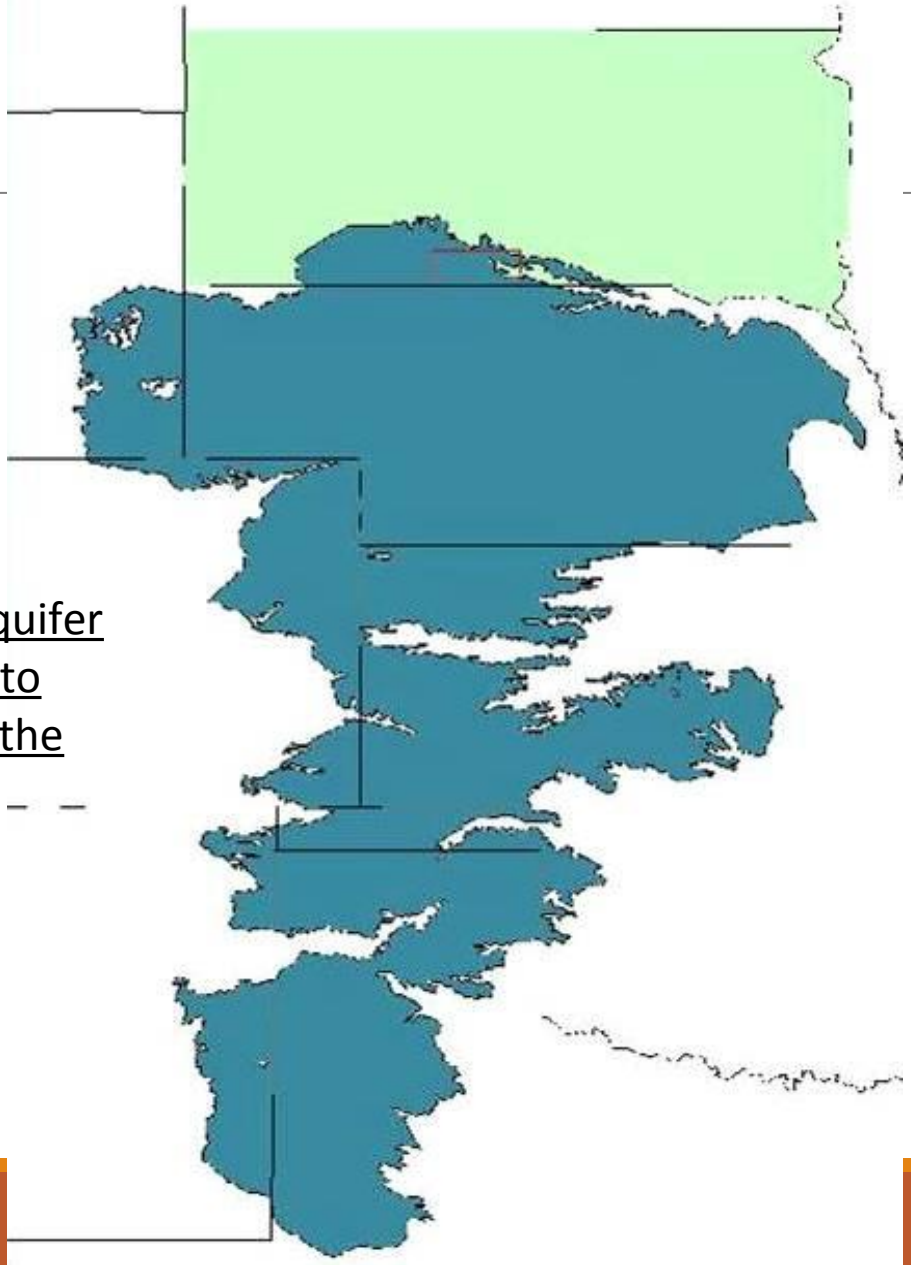
Syed Huq, *Director*

John Whiting, *Assistant Director*

Source Groundwater Protection

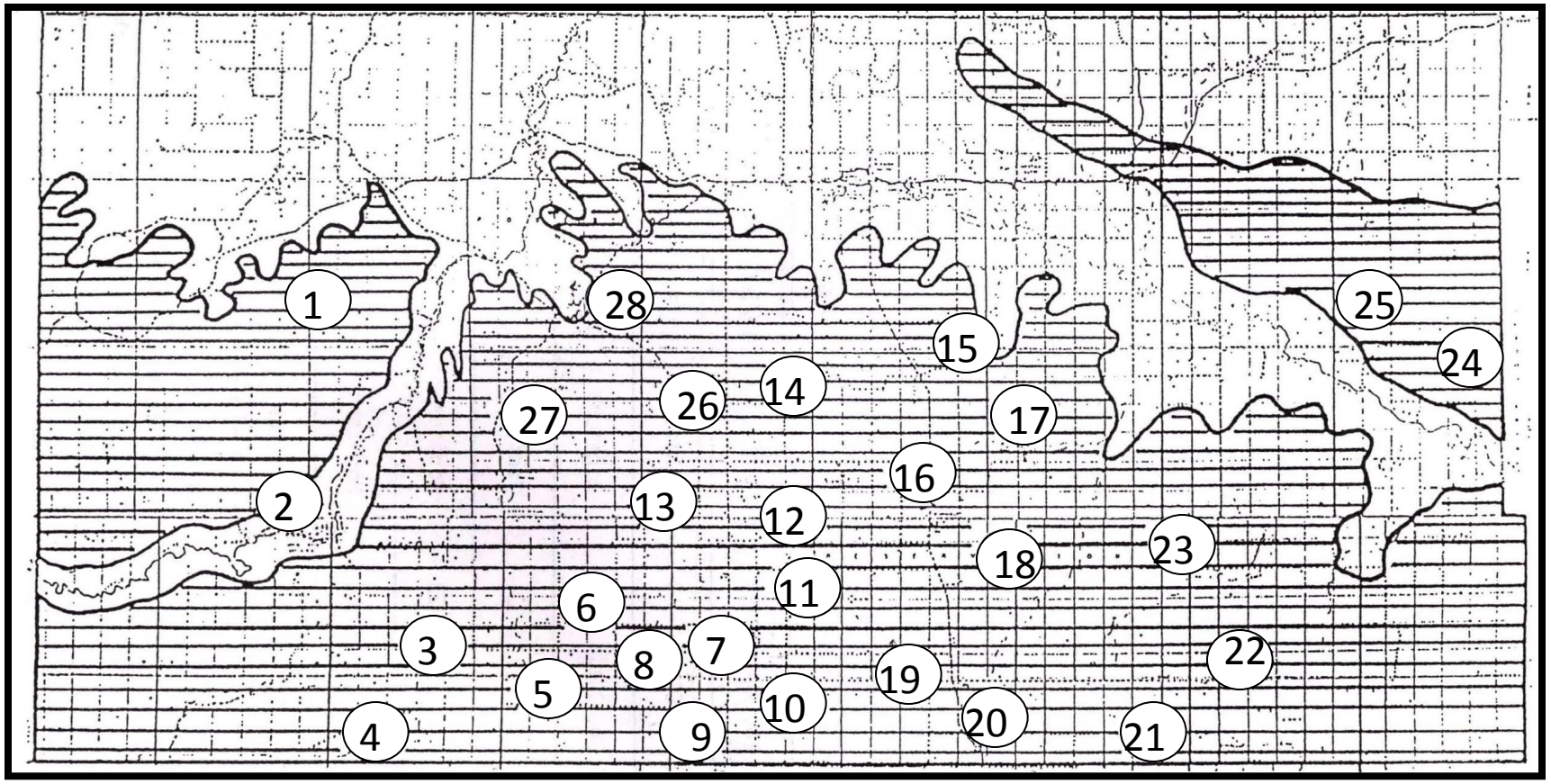
- Proactive measures toward protection of vital water supply.
- 1996 Amendments to the Safe Drinking Water Act require source water assessment on every public water supply.
- Delineation of source water protection area and inventory of potential source of contamination.
- Management Strategies.

Ogallala Aquifer



Extent of the Ogallala Aquifer from Texas in the south to Rosebud Reservation in the north.

Rosebud Reservation, TODD COUNTY



Location of Monitoring Wells On
The Ogallala Aquifer Rosebud Reservation

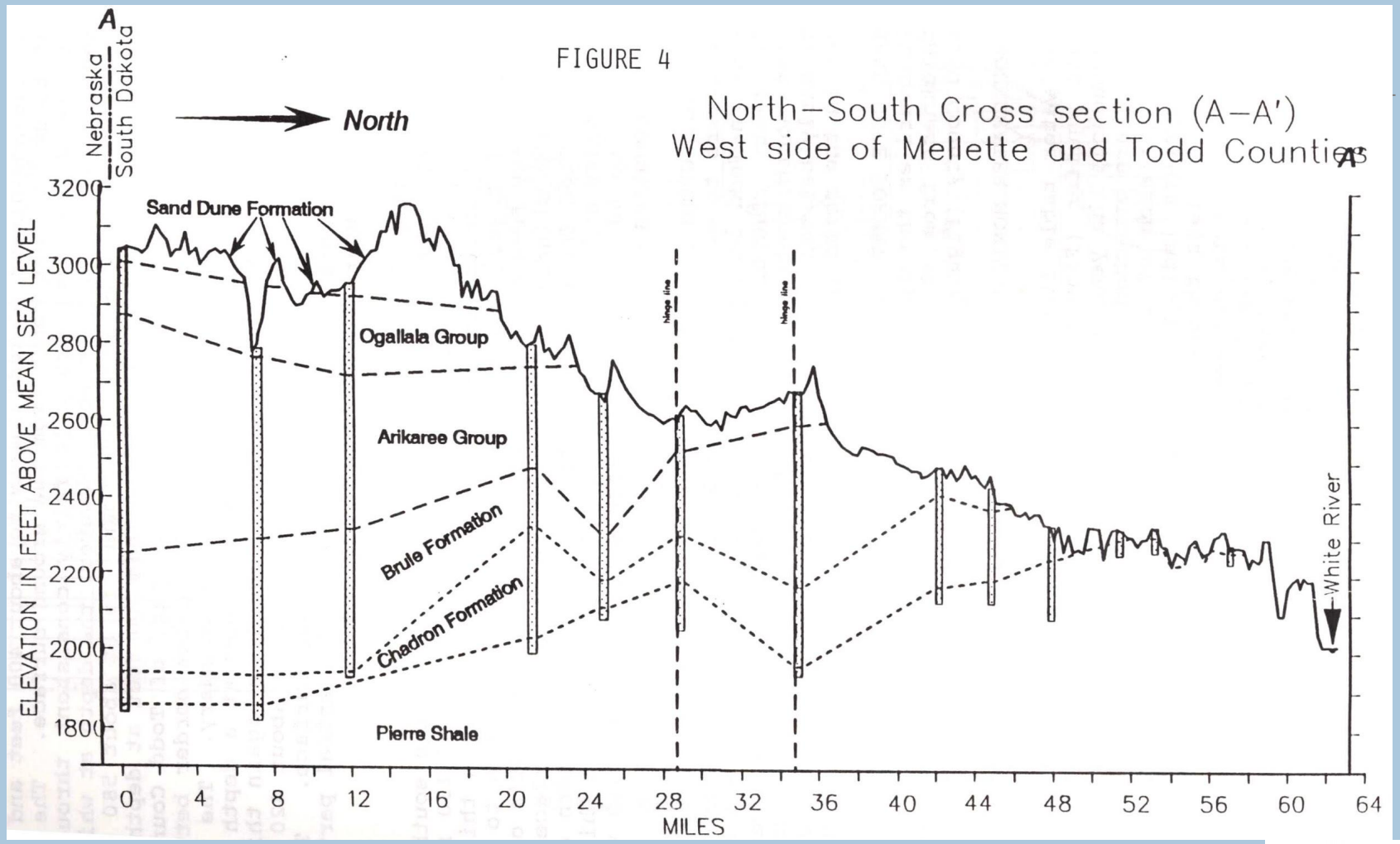
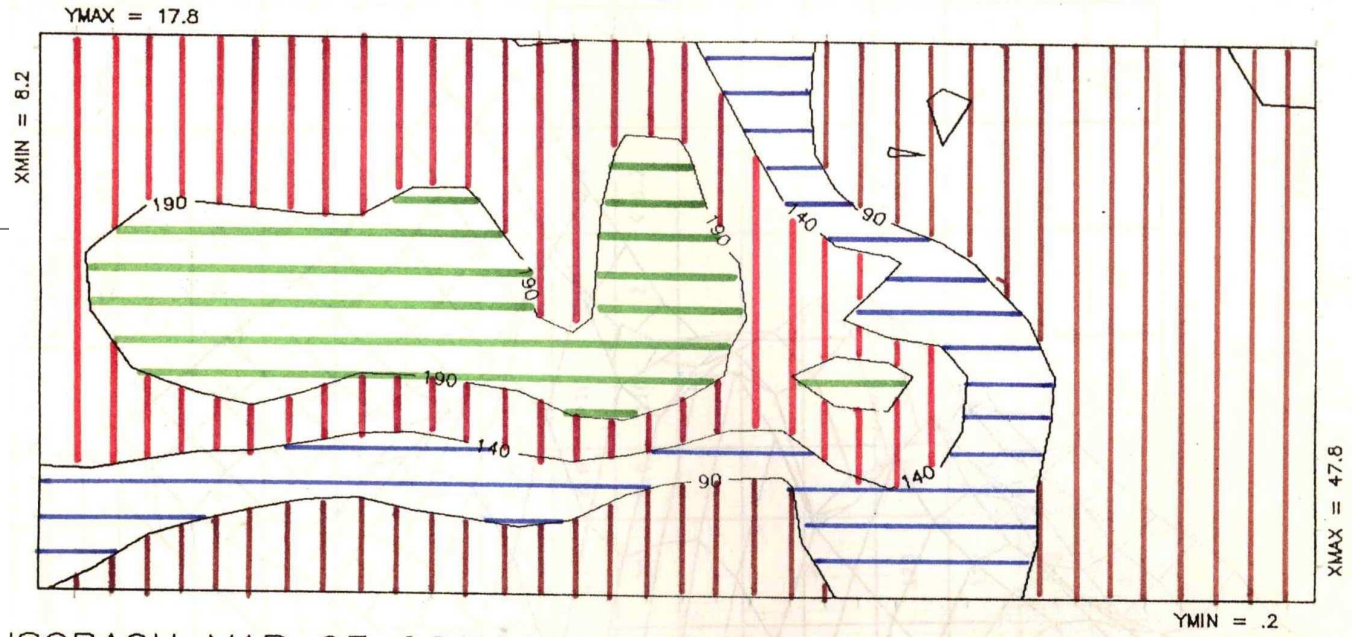


FIGURE 4
North–South Cross section (A–A')
West side of Mellette and Todd Counties
A
A'
Nebraska
South Dakota
North
ELEVATION IN FEET ABOVE MEAN SEA LEVEL
3200
3000
2800
2600
2400
2200
2000
1800
Sand Dune Formation
Ogallala Group
Arikaree Group
Brule Formation
Chadron Formation
Pierre Shale
hinge line
hinge line
White River
0
4
8
12
16
20
24
28
32
36
40
44
48
52
56
60
64
MILES

Fig. 15



ISOPACH MAP OF OGALLALA FORMATION IN ROSEBUD RES.

LEGEND

Thickness

< 90

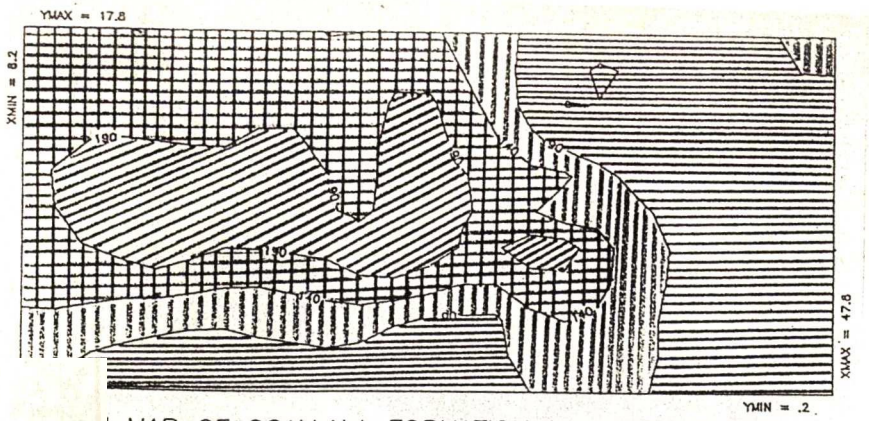
90-140

140-190

> 190

Contour interval 50 feet

Isopach Map Of Ogallala Formation in Rosebud Reservation

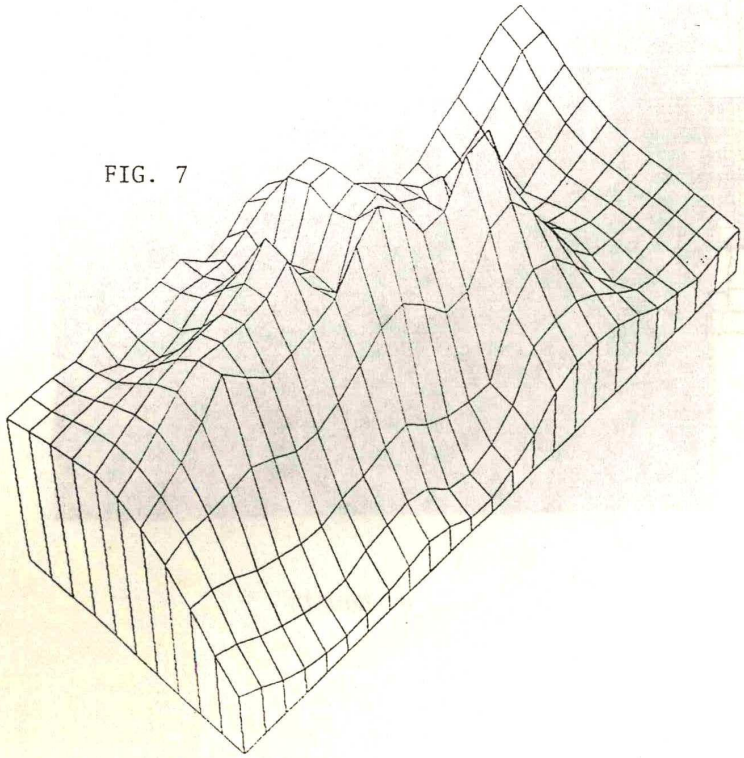


MAP OF OGALLALA FORMATION IN ROSEBUD RES

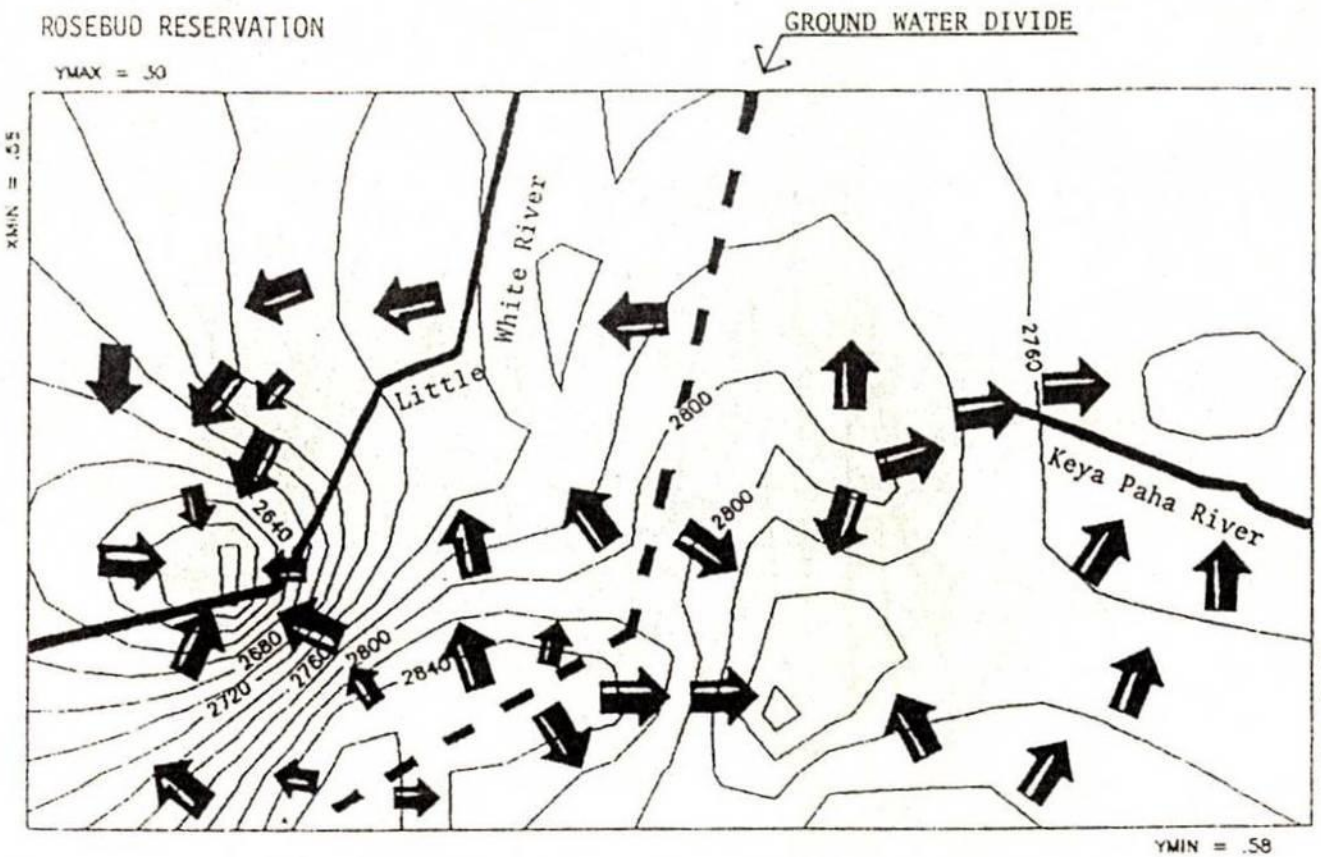
FIG. 7

. 6

Contour interval 50 feet



3D SURFACE MAP OF OGALLALA FRM. IN ROSEBUD RES.



GROUNDWATER FLOW DIRECTION IN OGALLALA AQUIFER, R.R.

FIG. 16

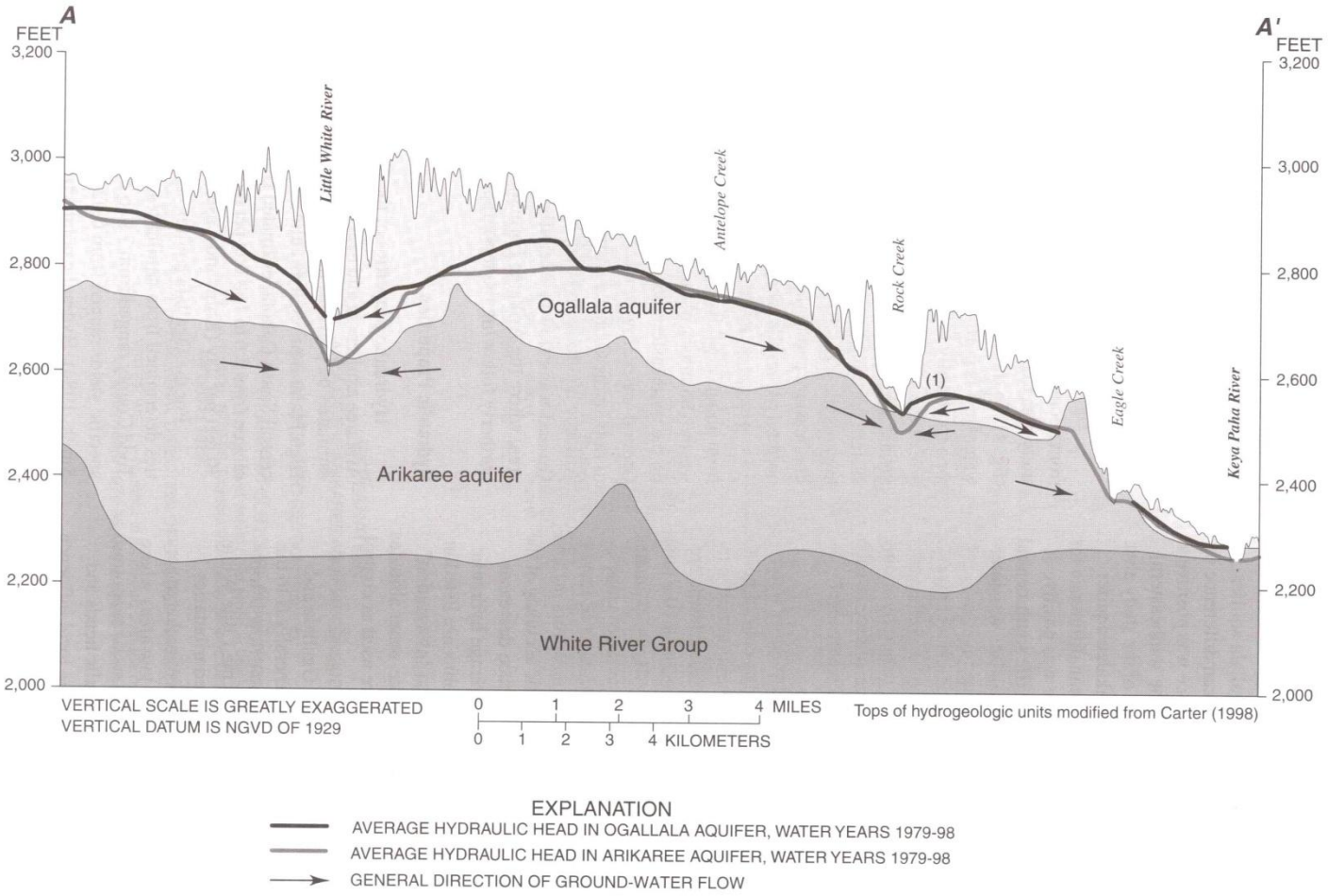


Figure 6. Relation between average hydraulic head, hydrogeologic units, and topographic features. Location of section is shown in figures 4 and 5. This section shows an area (1) of intermittent saturation, which is not included in the area of the Ogallala aquifer considered in figure 4.

Potential Sources Of Contamination

Center Pivot Irrigation Systems

Septic Tanks

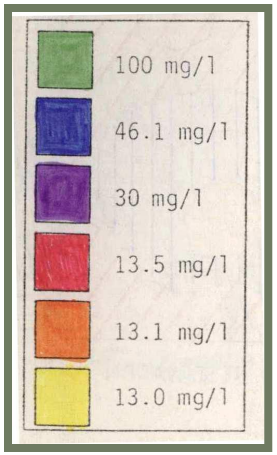
Lagoons

Junk Yard & Maintenance Shop

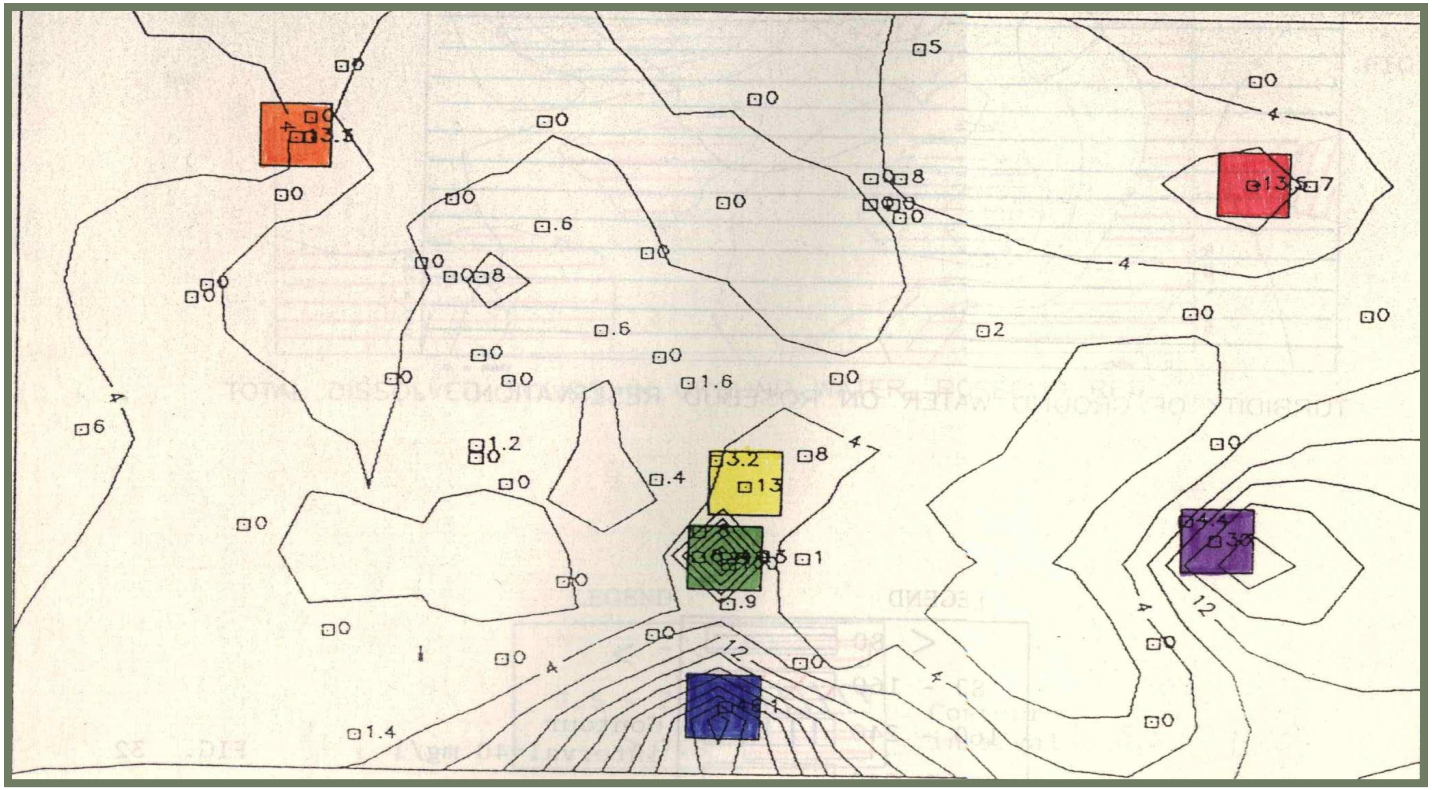
Gas Stations

Land Fills/Garbage/illegal dumping

Legend

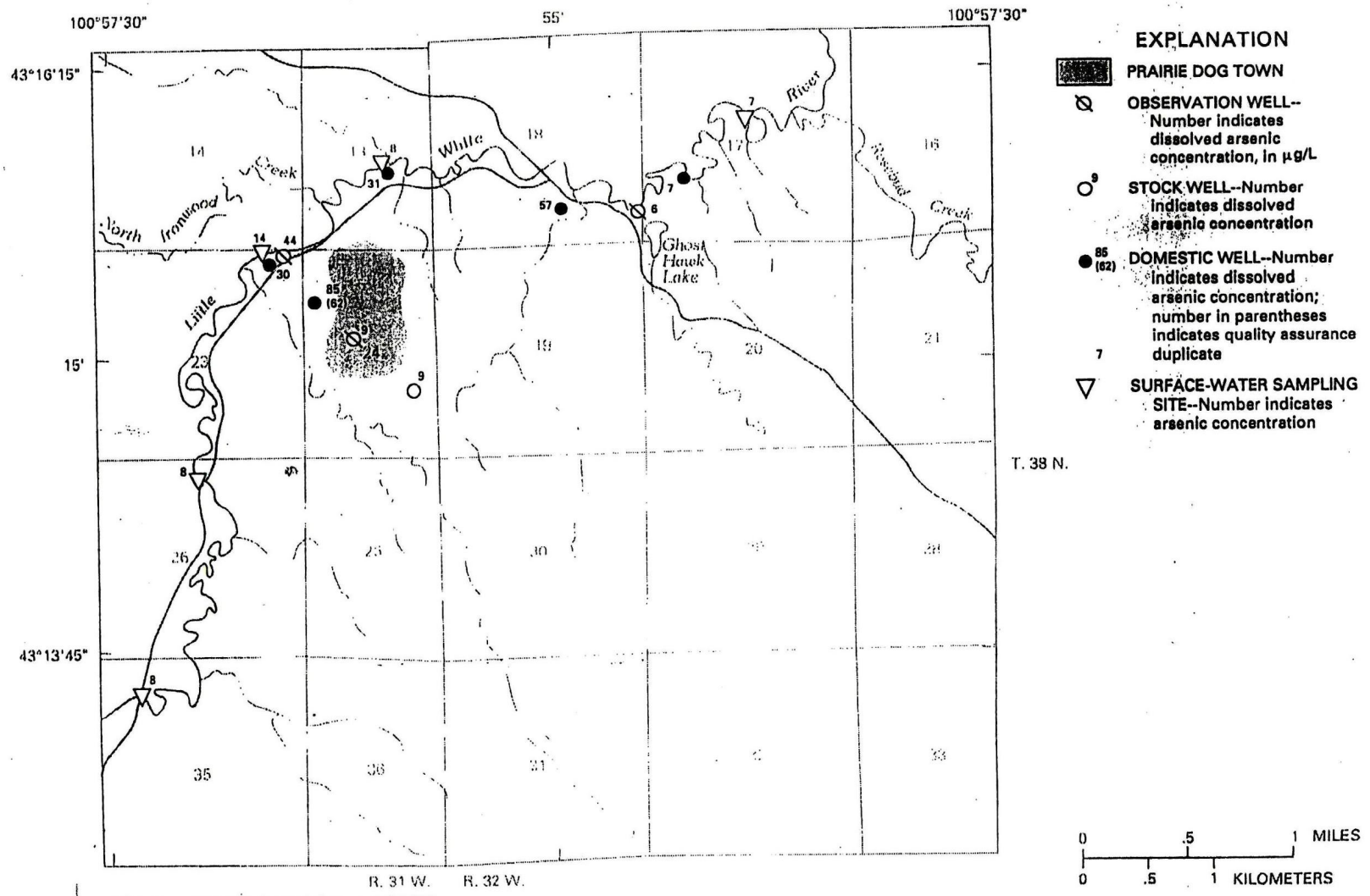


NITRATE
MCL = 10 mg/l



CONCENTRATION OF NITRATE IN GROUNDWATER, ROSEBUD RESERVATION

Dissolved Arsenic in ground water and surface water in Grass Mountain



Base from U.S. Geological Survey 1:24,000, Soldier Creek and St. Francis, 1969

Figure 7.--Concentrations of dissolved arsenic in water samples collected from wells and the Little White River in the Grass Mountain area.

Groundwater Contamination by Hydrocarbons

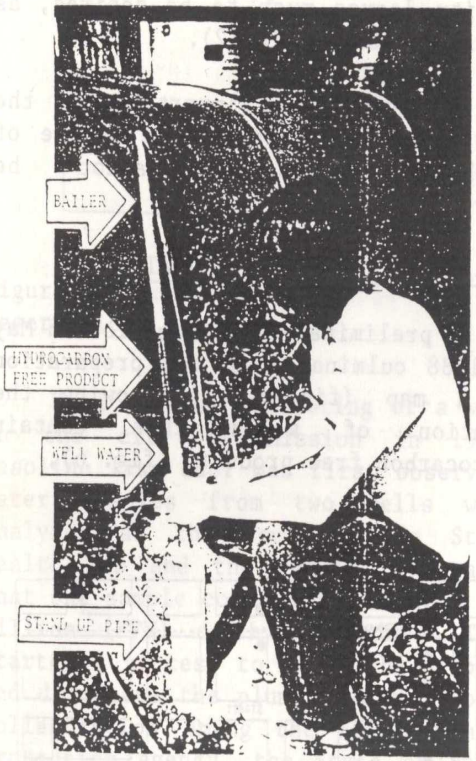


Figure 6: Free product in bailer

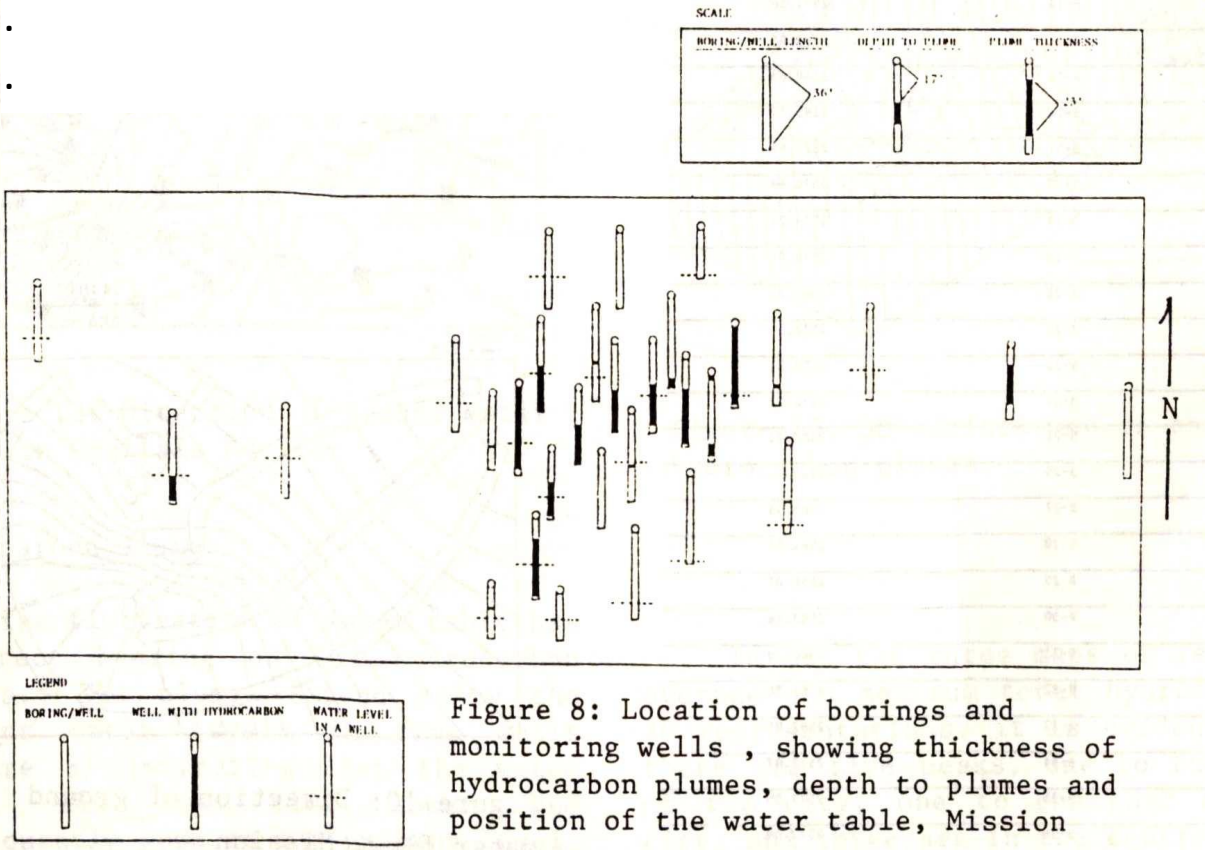


Figure 8: Location of borings and monitoring wells , showing thickness of hydrocarbon plumes, depth to plumes and position of the water table, Mission

A Survey on Groundwater Contamination Around The Mission Area

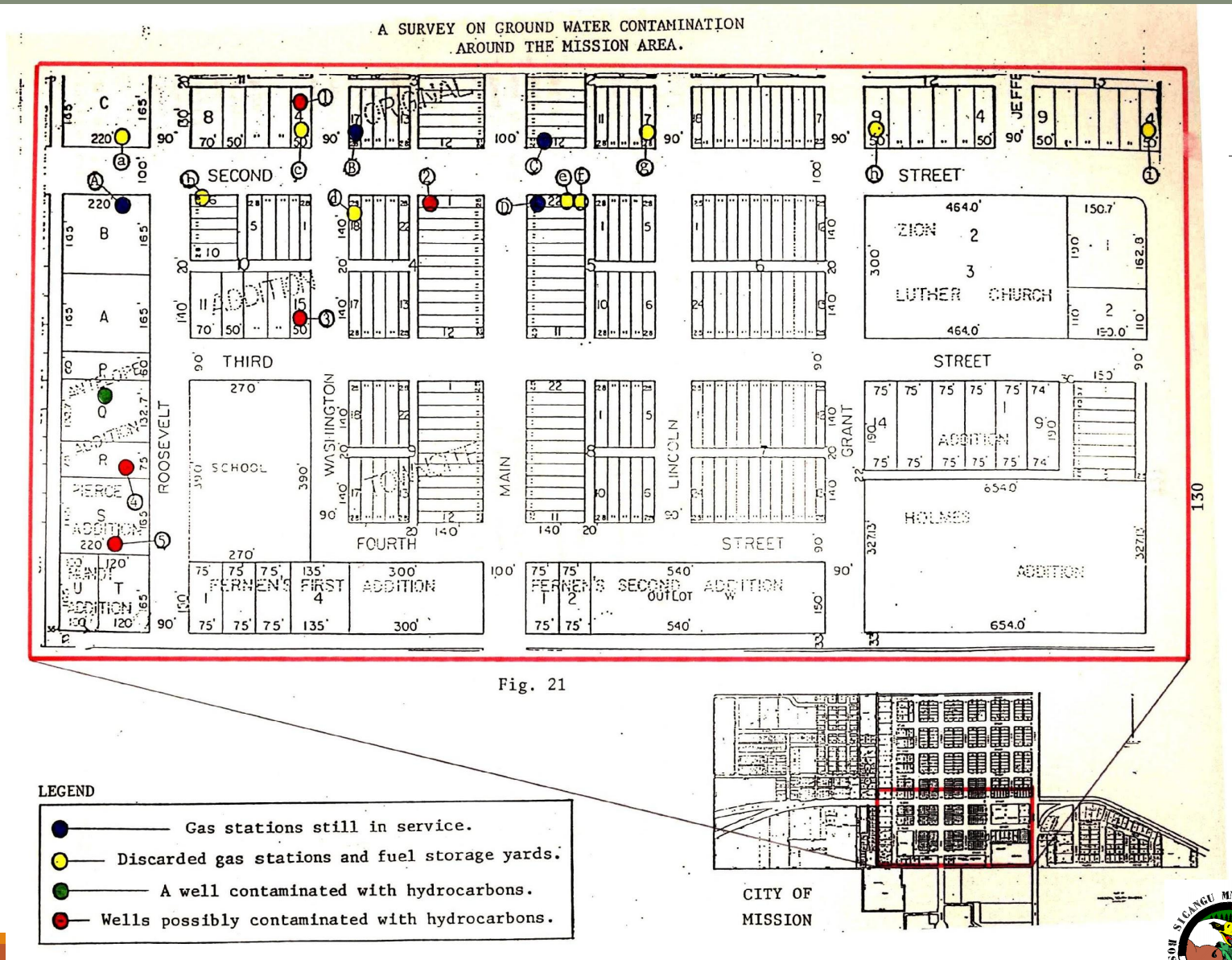
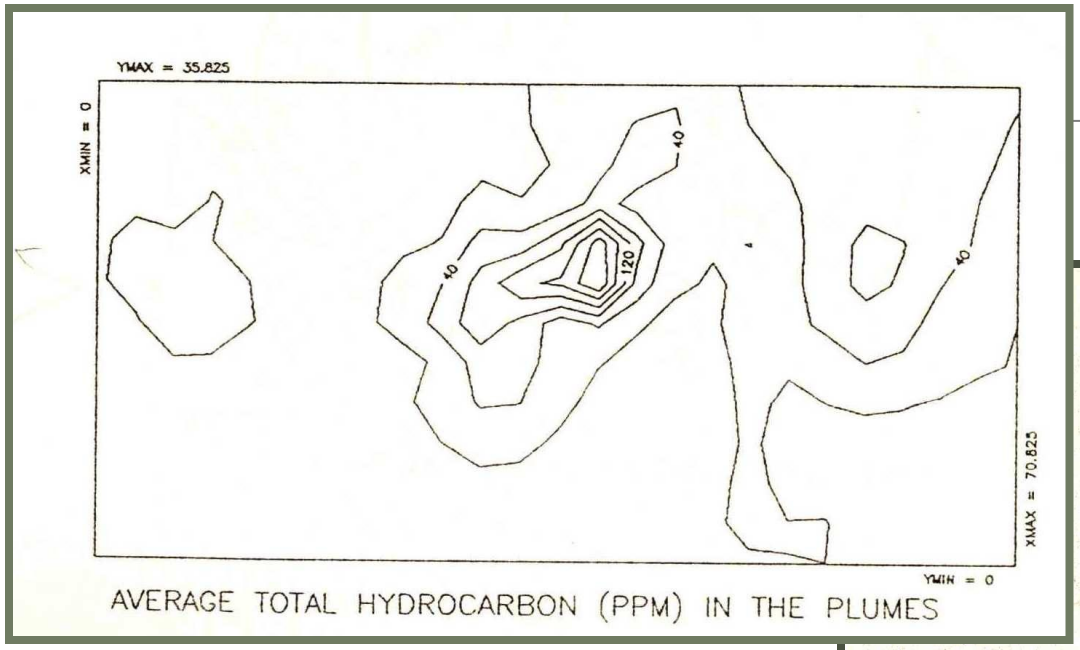


Fig. 21

Contour & 3D Surface Map Of The Hydrocarbon Plumes



AVERAGE TOTAL HYDROCARBON (PPM) IN THE PLUMES

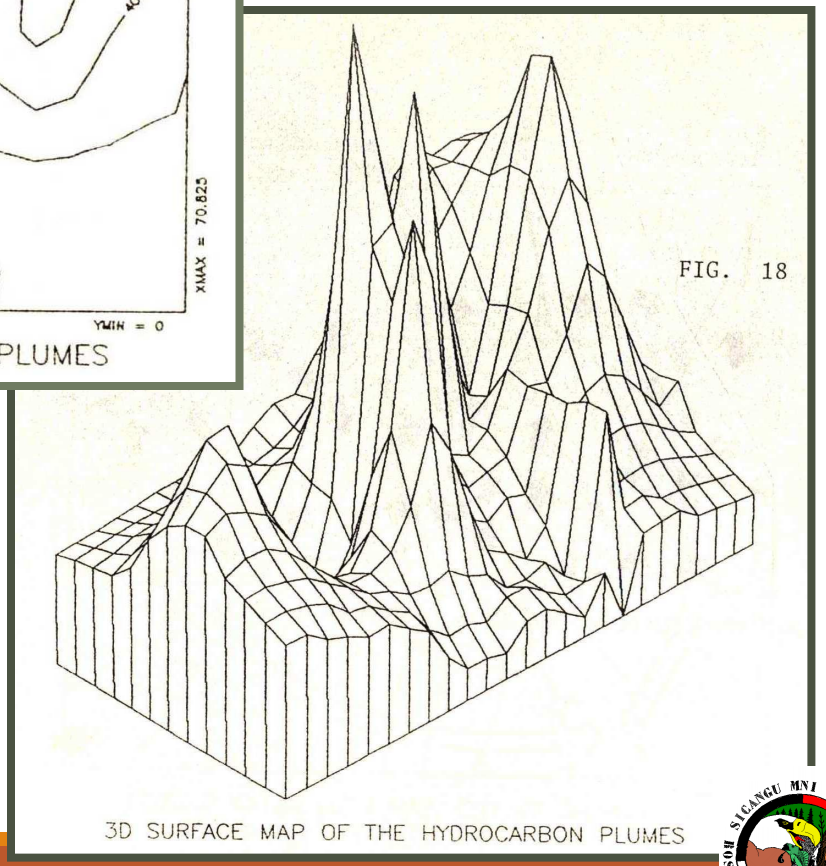
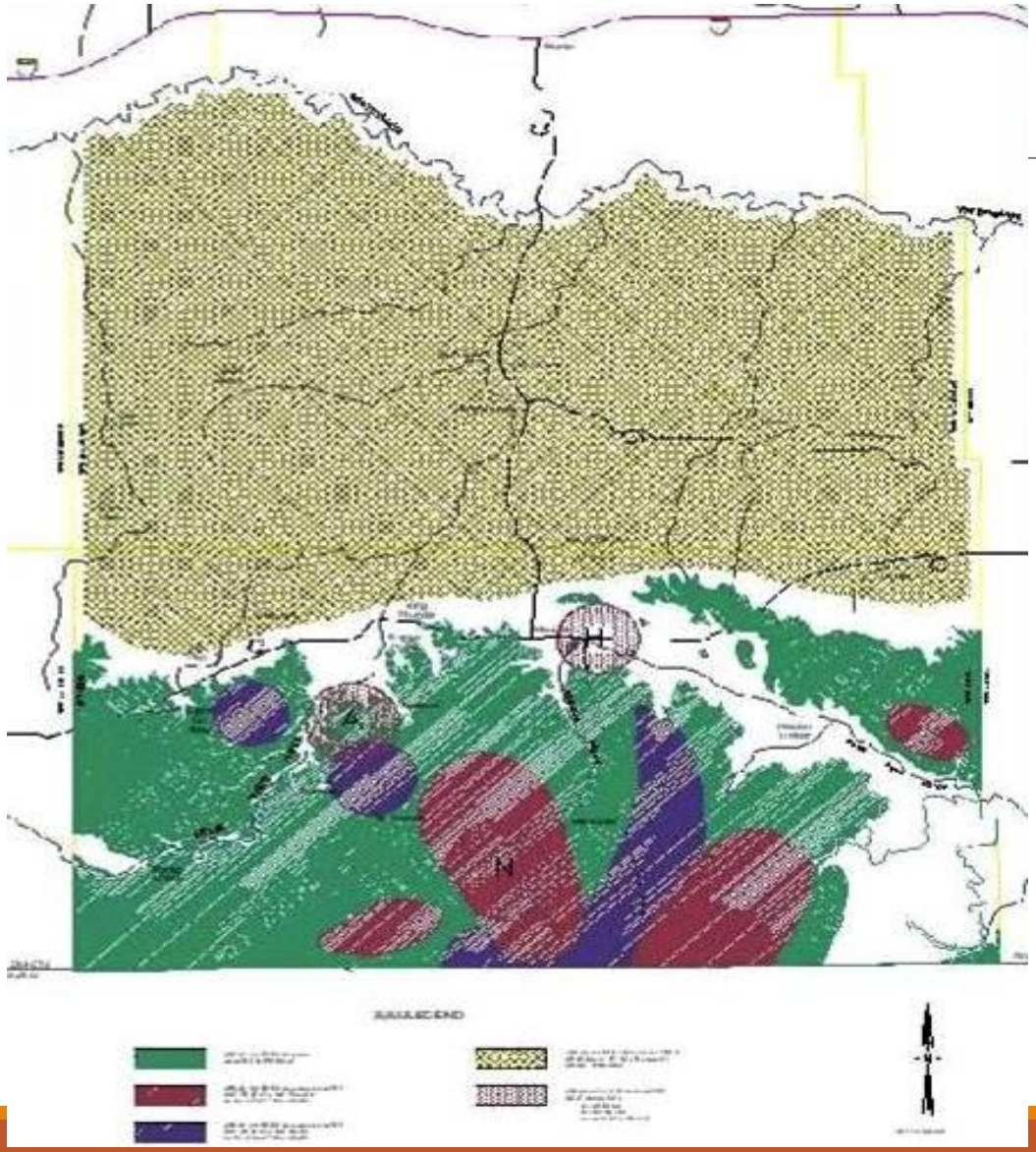


FIG. 18

3D SURFACE MAP OF THE HYDROCARBON PLUMES

Groundwater Contamination

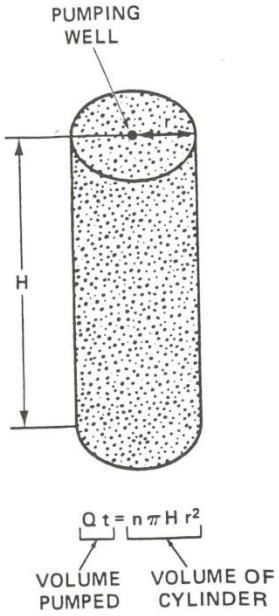


- Nitrates
- Arsenic
- Hydrocarbons

Protection Strategies

Well Head Protection Area

METHODS: CALCULATED FIXED RADIUS



$$r = \sqrt{\frac{Q\,t}{\pi\,n\,H}}$$

WHERE
Q = Pumping Rate of Well
n = Aquifer Porosity
H = Open Interval or Length of Well Screen
t = Travel Time to Well

(Any consistent system of units may be used.)

Figure 6. Calculated Fixed Radius.

METHODS: ARBITRARY FIXED RADIUS

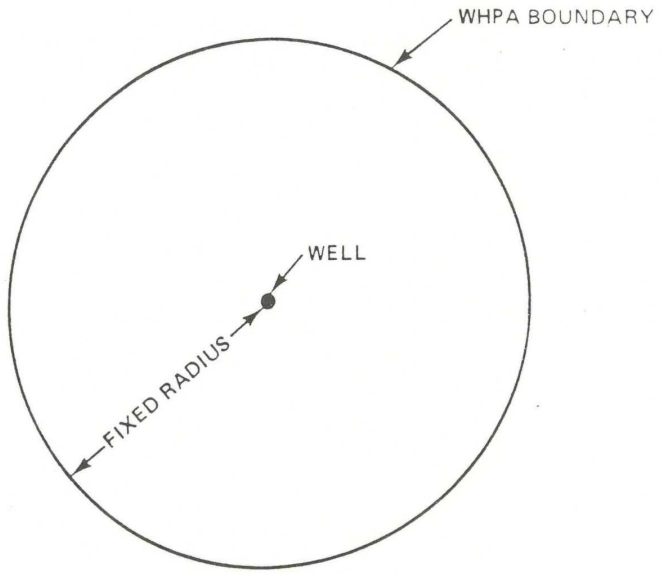


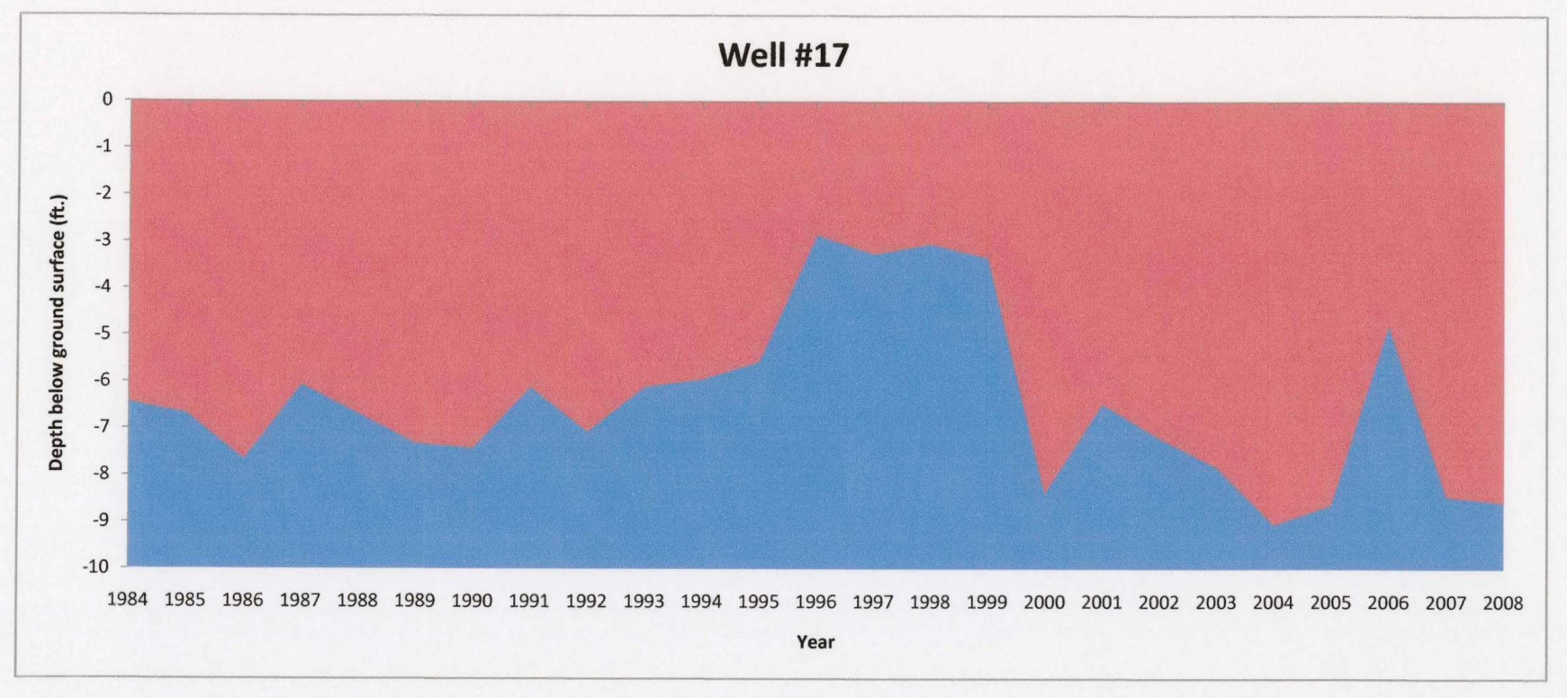
Figure 5. Arbitrary Fixed Radius.

Water Code

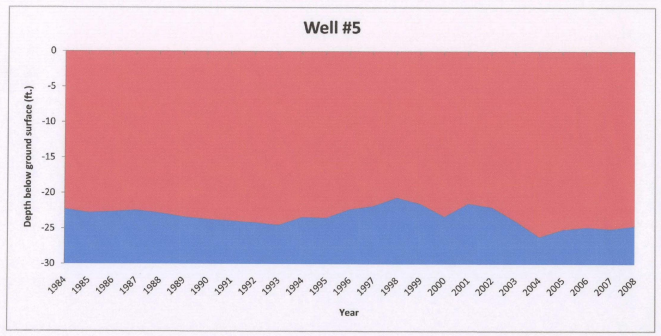
- Moratorium By BIA
- Implementation over non-Indians can result in legal battles

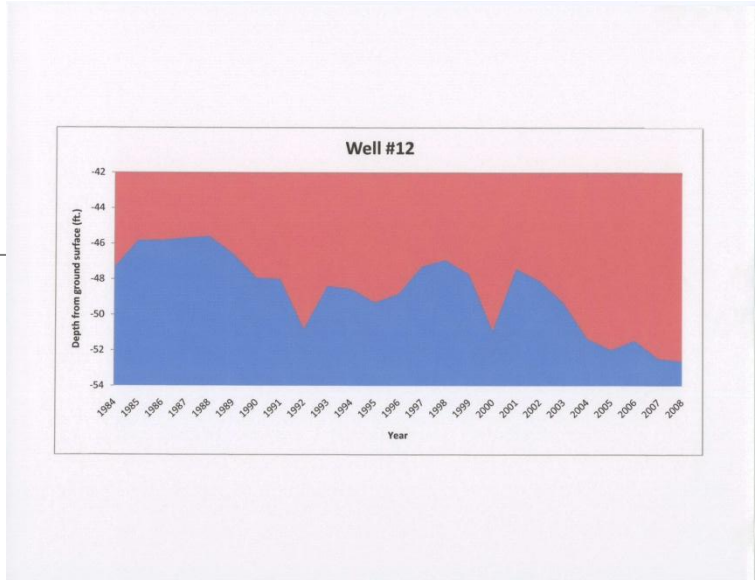
WATER AND ENVIRONMENTAL CODES ARE EXCELLENT TOOLS

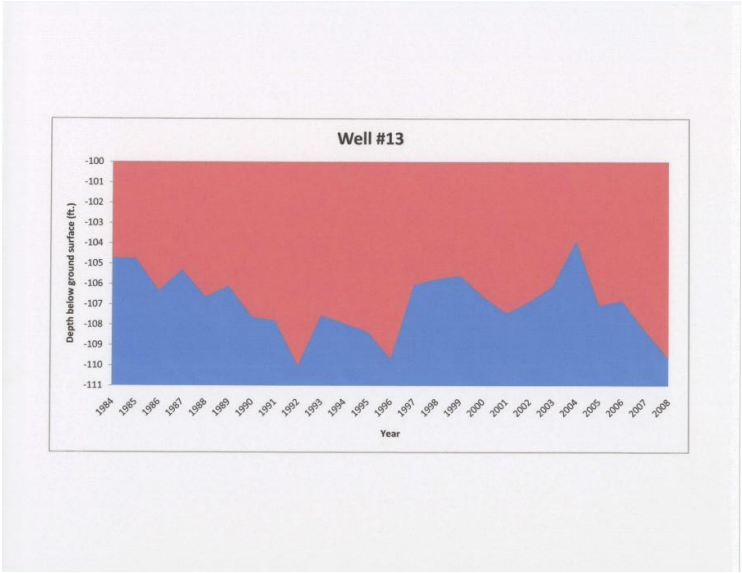
Water Table Fluctuation , Ogallala Aquifer

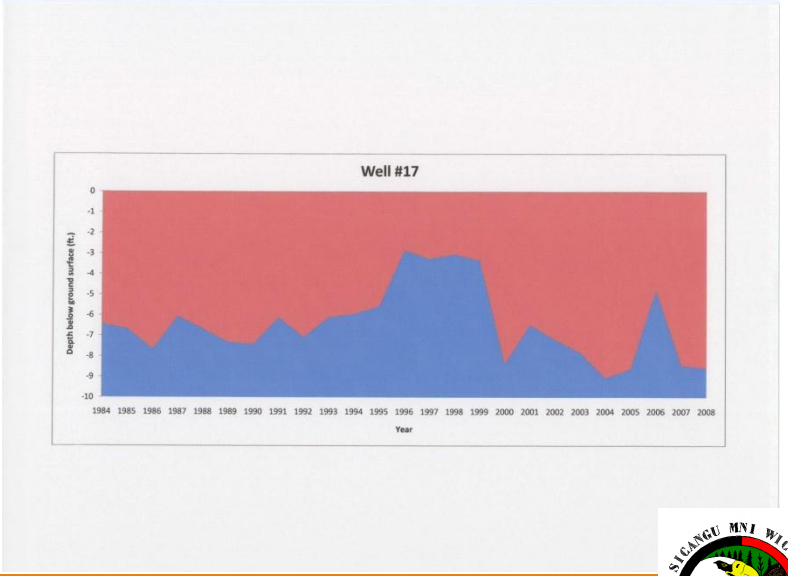


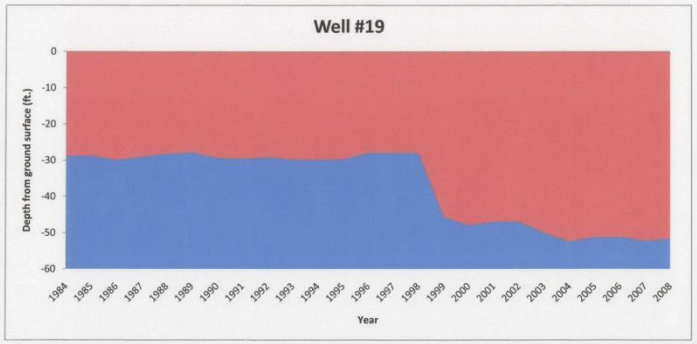
Water Table Fluctuation , Ogallala Aquifer

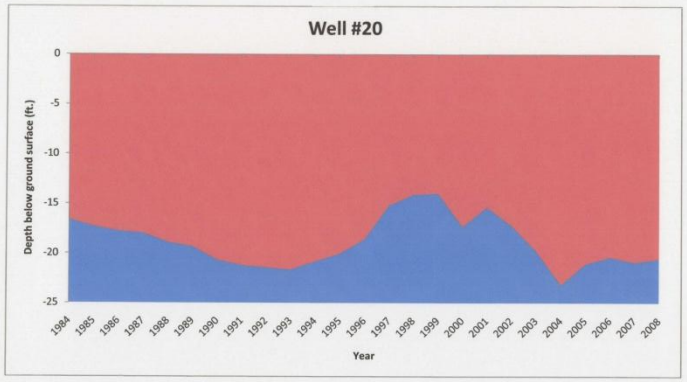


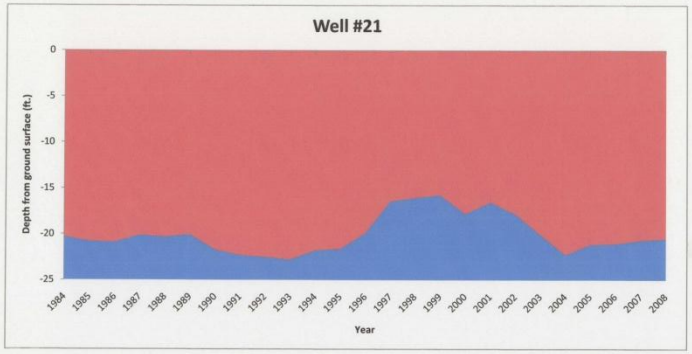


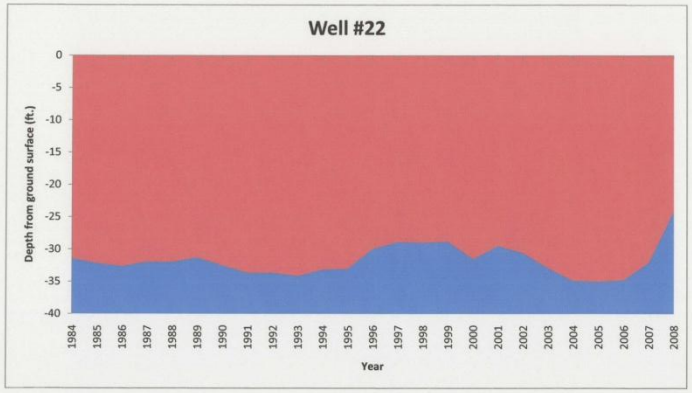




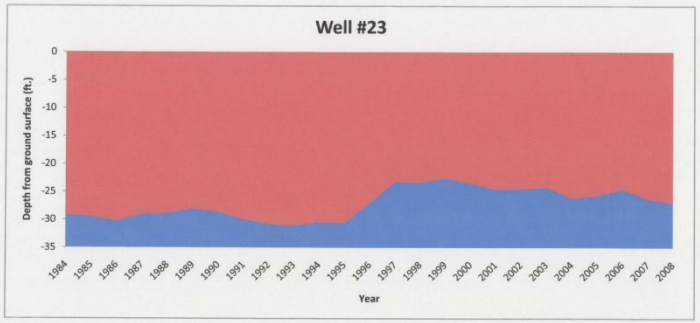

Well #19
Depth from ground surface (ft.)
0
-10
-20
-30
-40
-50
-60
1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008
Year

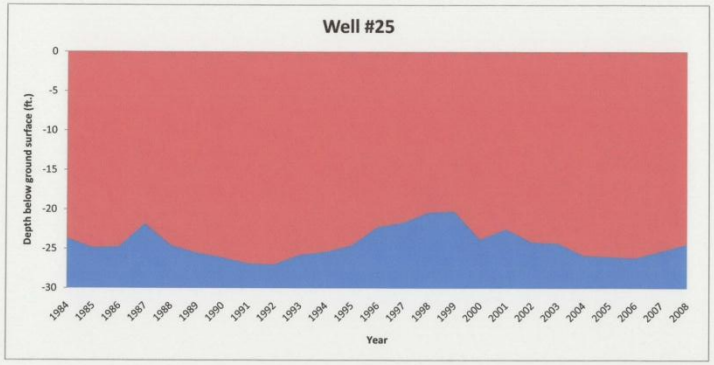

Well #20
Depth below ground surface (ft.)
0
-5
-10
-15
-20
-25
1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008
Year

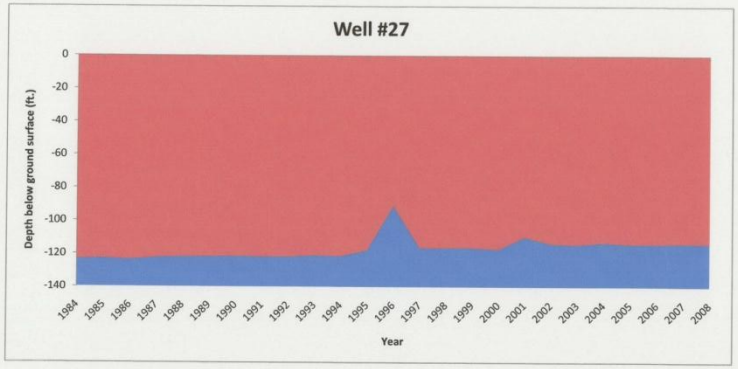

Well #21
Depth from ground surface (ft.)
0
-5
-10
-15
-20
-25
1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008
Year


Well #22
Depth from ground surface (ft.)
0
-5
-10
-15
-20
-25
-30
-35
-40
1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008
Year

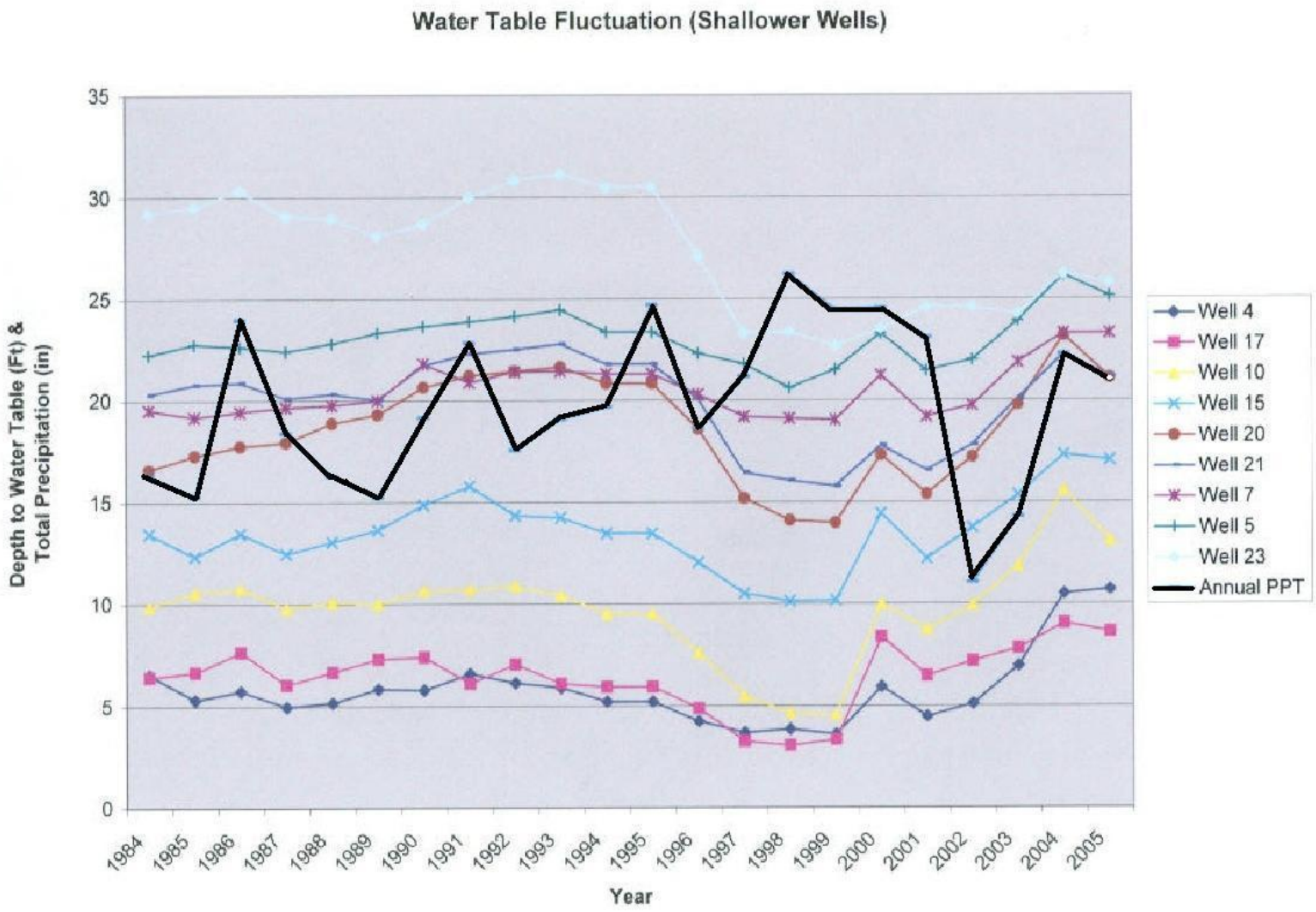
Water Table Fluctuation , Ogallala Aquifer







Water Table Fluctuation (Shallower wells)



Public Water System Sicangu Mni Wiconi
Rosebud Rural Water System, South Dakota

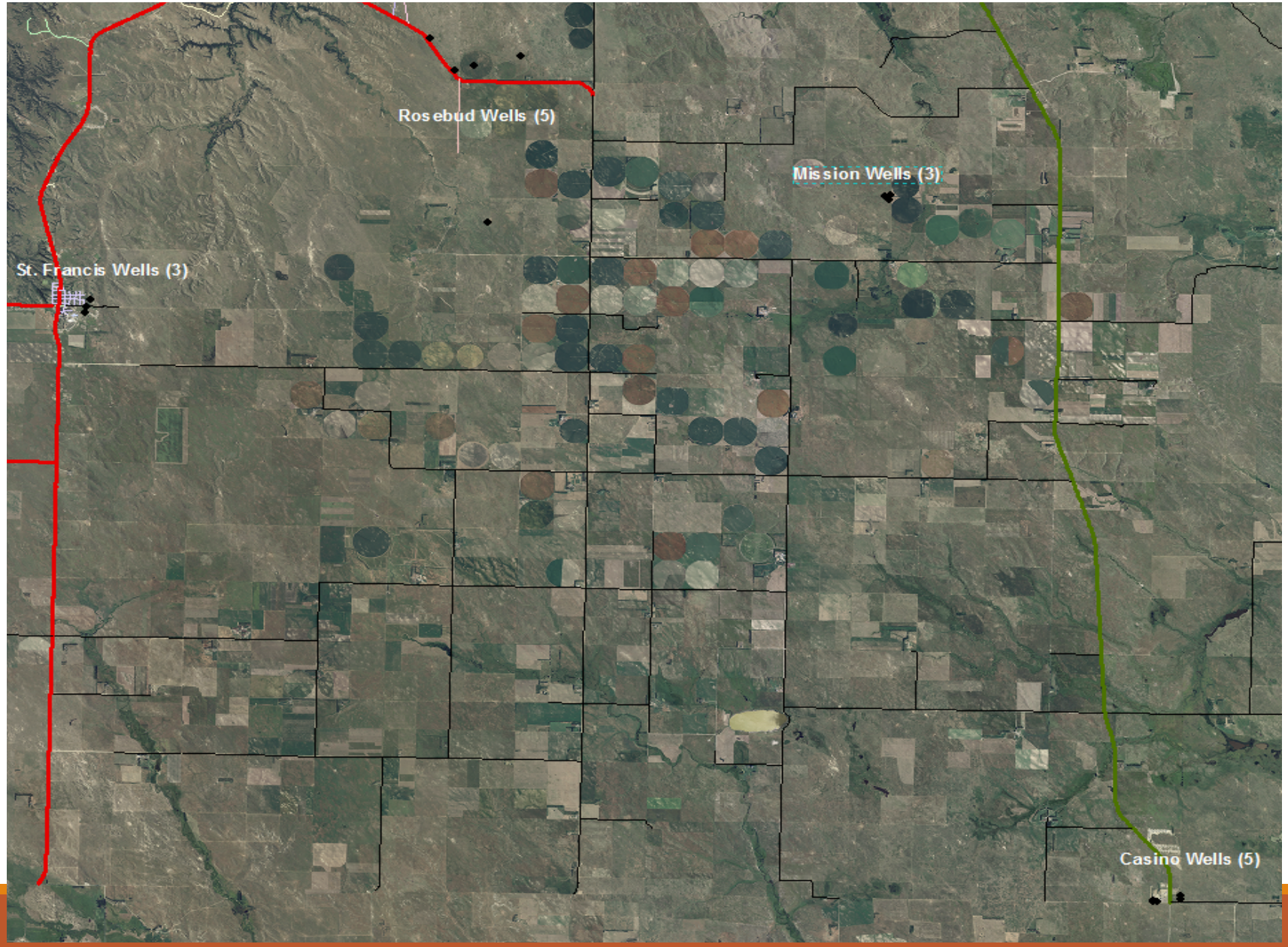
Also includes:

- Saint Francis System
- Mission Water System
- Sicangu Village Water System

GROUND WATER SOURCE: OGALLALA AQUIFER

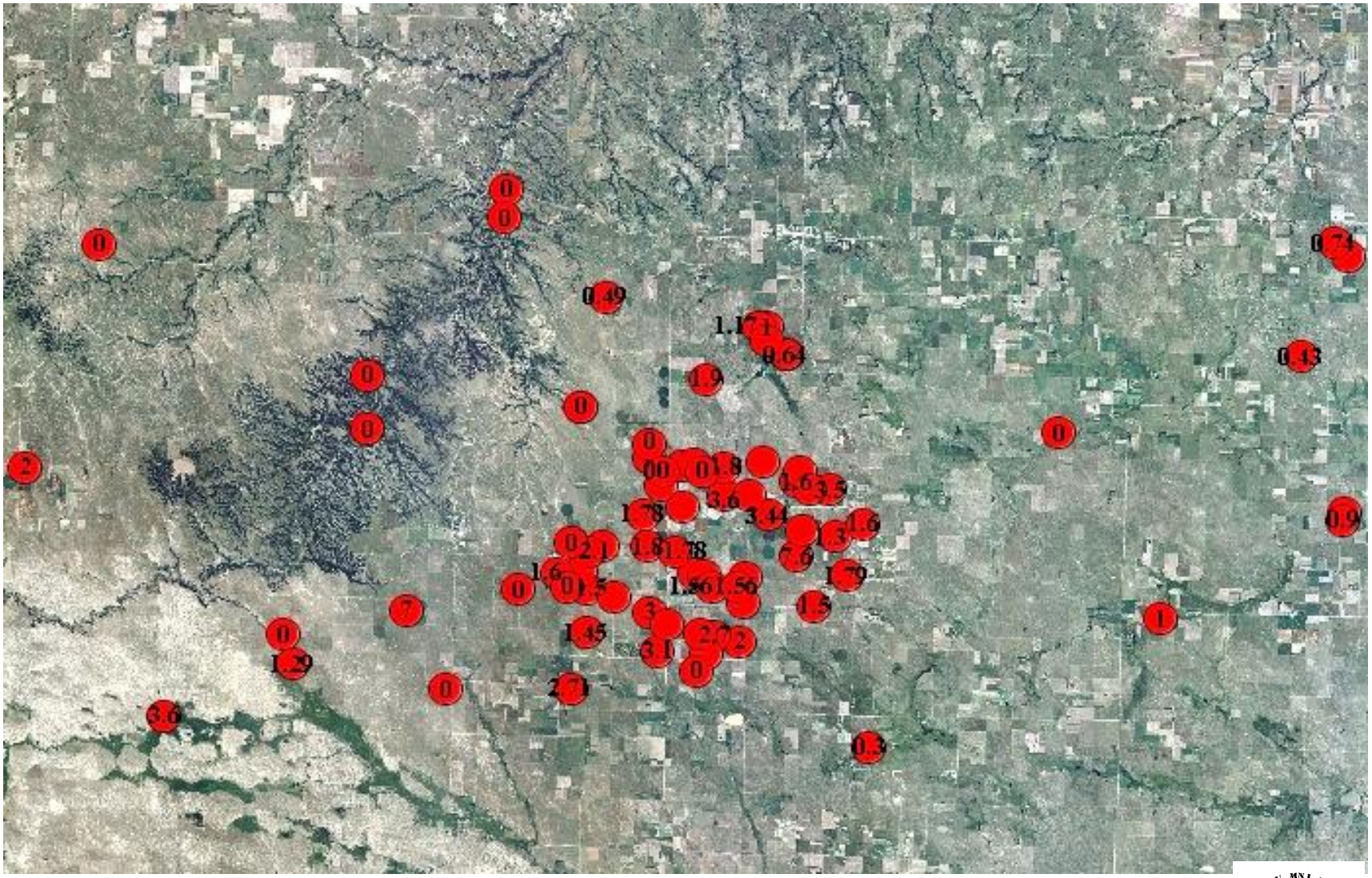
- Design Population- 17,000
- Design Requirement- GPM 3,971
- 50% Groundwater- 1985 GPM equals 4.42 CFS

Location Of Production Wells



PRODUCTION WELLS

Location of Irrigation Wells



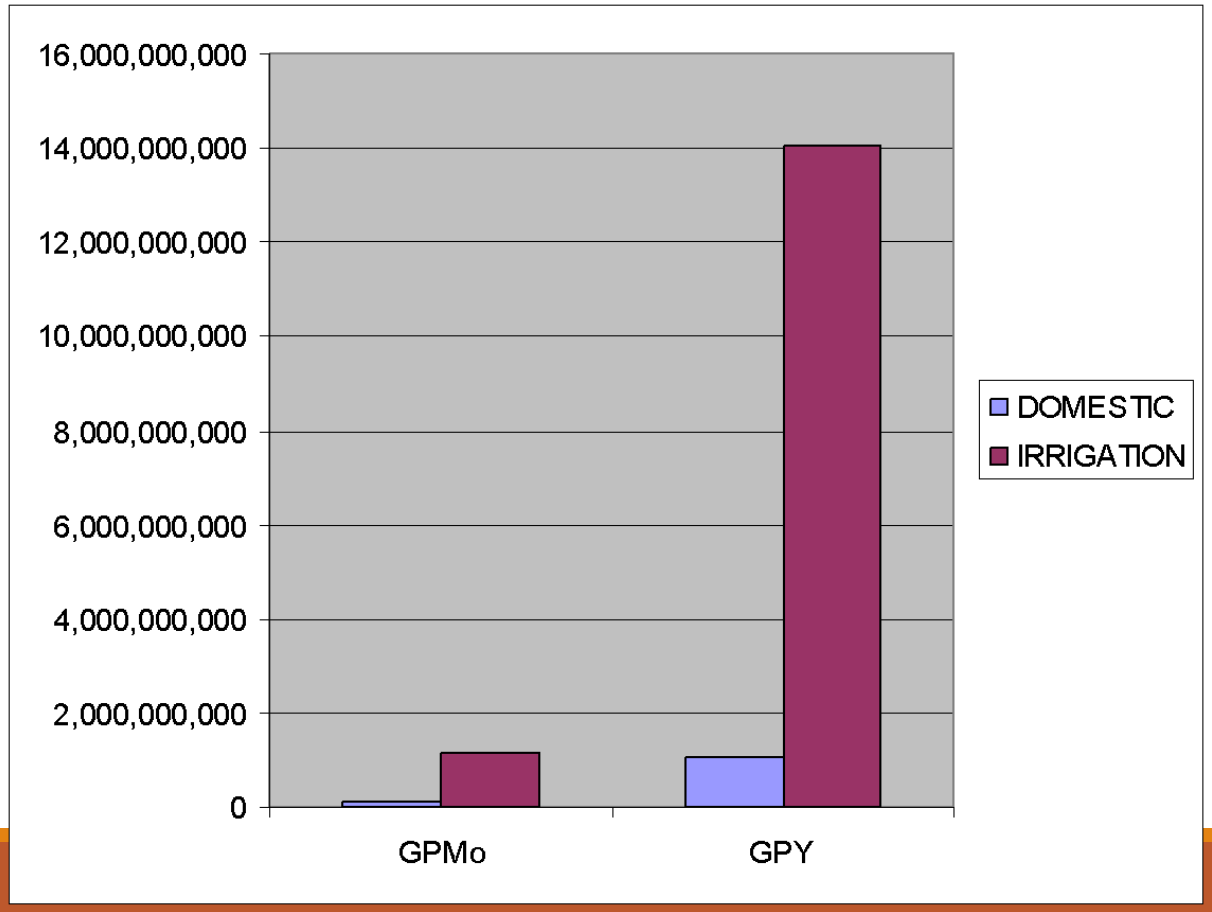
Total Irrigation Water Use – 2,752,149,300 GPM

(Equals 14,035,961,430 GPY)

(Based on 5-Month Irrigation Season)

Total Domestic, Municipal. & Industrial Use – 86,964,900 GPM

(Equals1,043,578,880 GPY)



3D-Drought

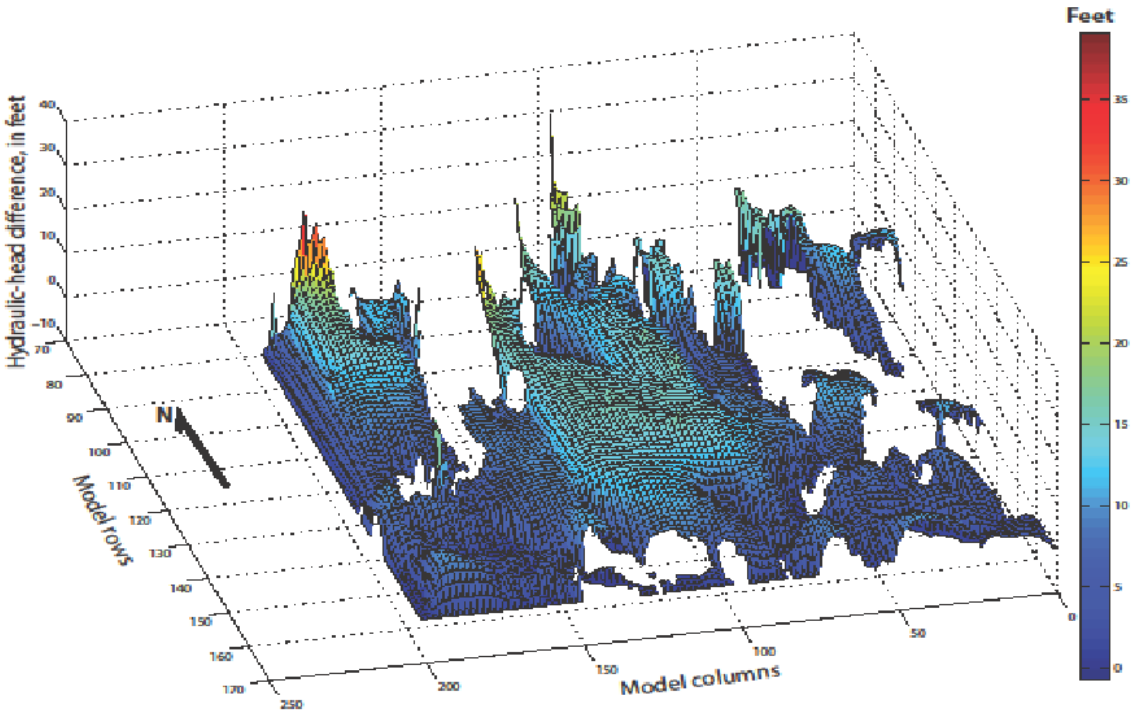


Figure 24

Three dimensional plot of the differences in hydraulic-head values between results of the calibrated model and the drought scenario at the end of the 30-year simulation period for the Ogallala aquifer.

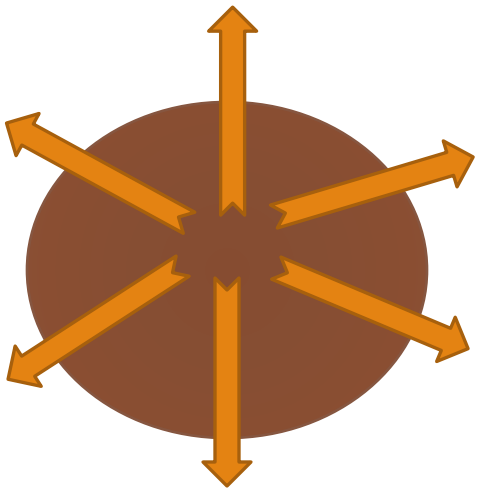
Increased Public awareness.

- *Radio*
- *News Paper*
- *Placing Signs*

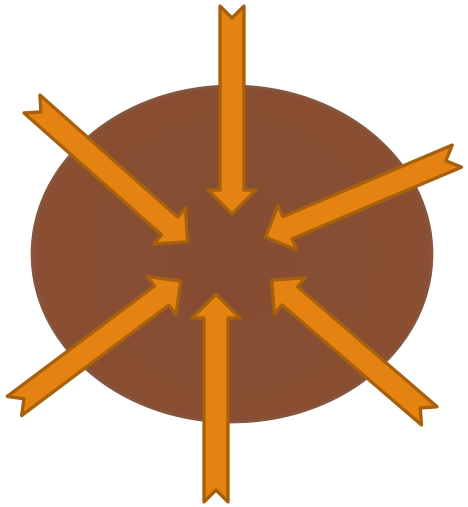
Environmental Protection & Zoning ordinance Title 18+19 Of Environmental code.

- *Land use and Environment Commission*

Purchase of land to control and manage sensitive area.



Recharge area highly sensitive



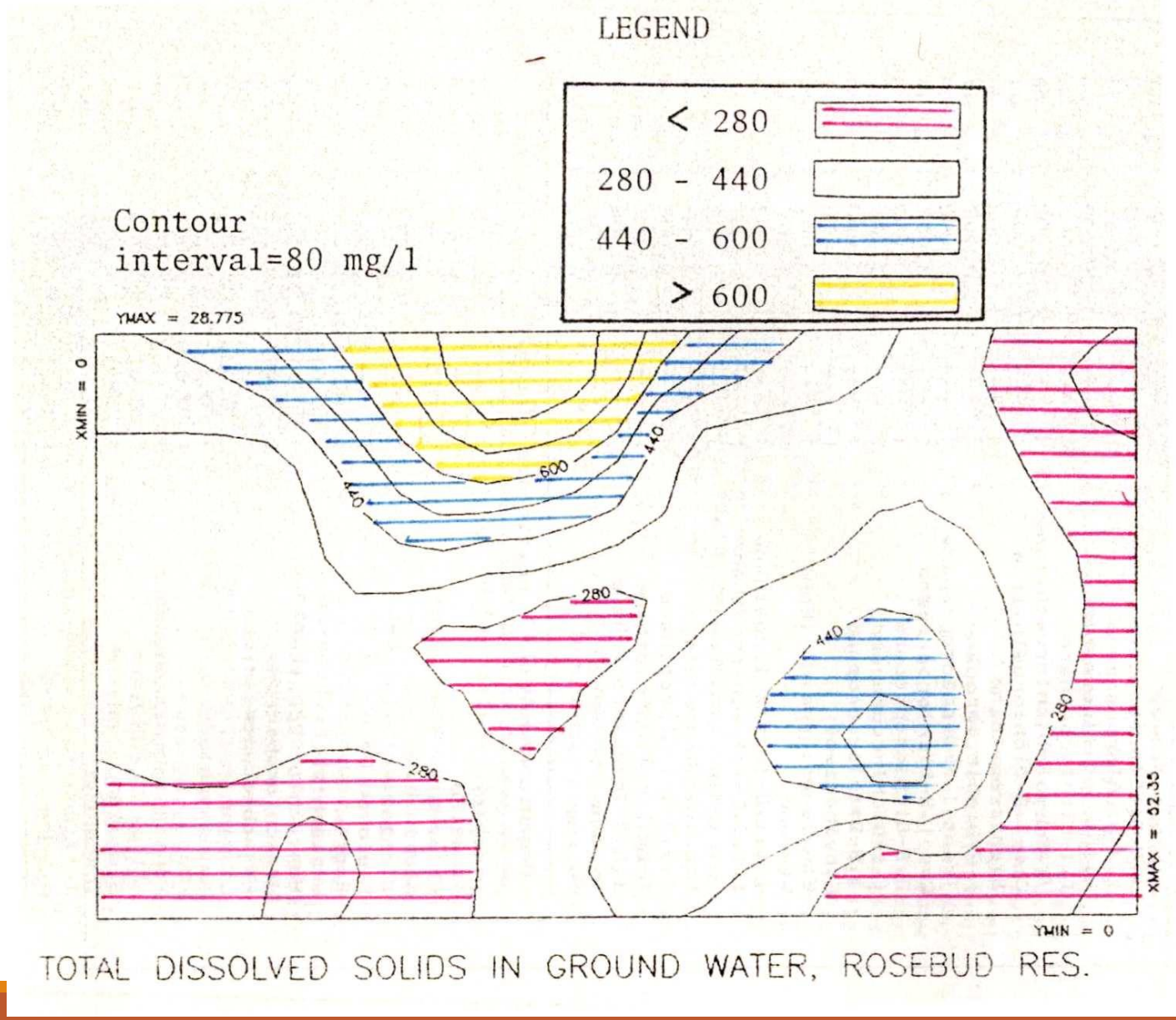
Discharge area less sensitive

ROSEBUD SIOUX TRIBE PUBLIC WATER SYSTEMS

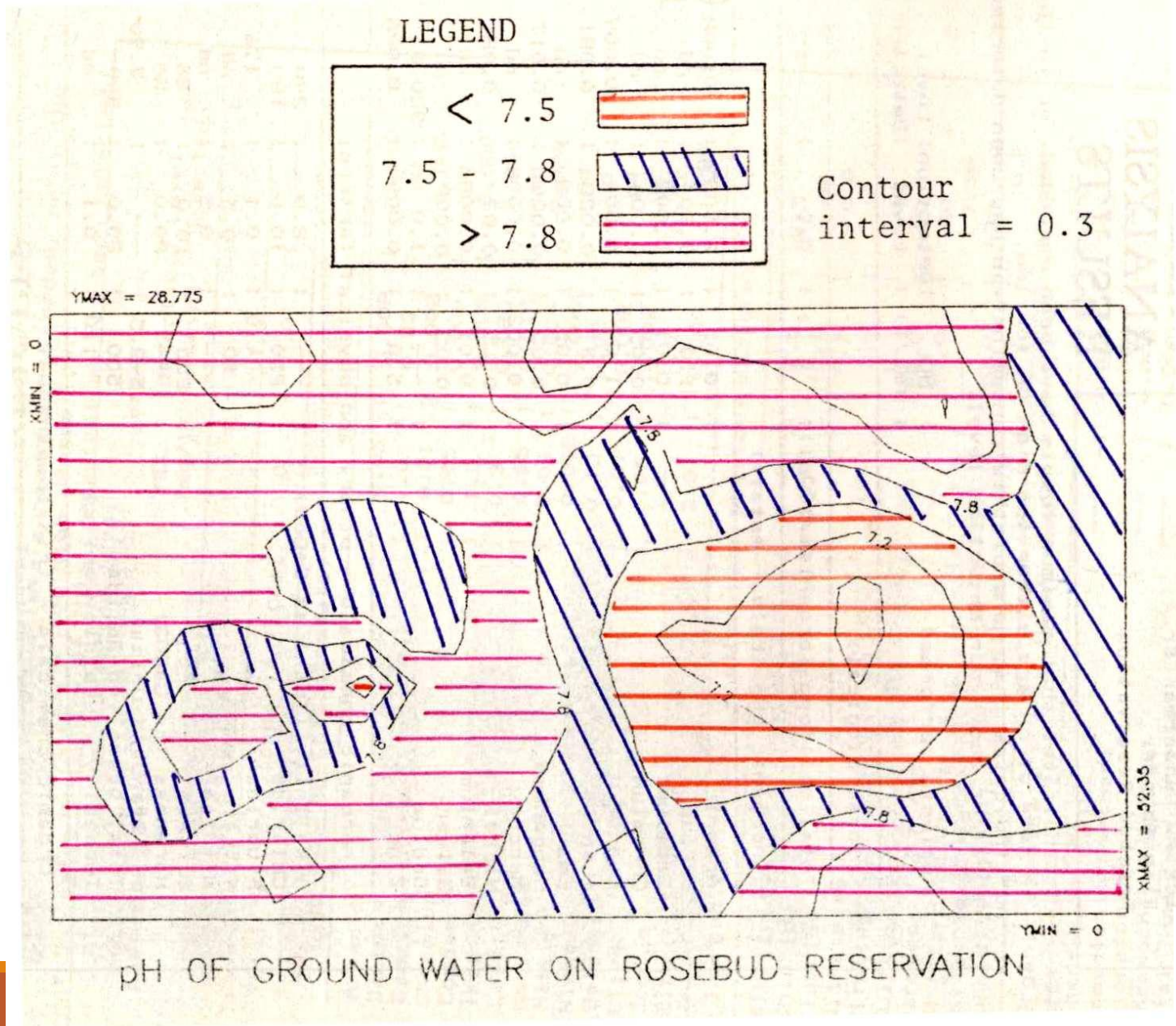
PRODUCTION WELL WATER QUALITY

PARAMETERS		LEVELS	MCL	
Inorganics				
	Cyanide	ND	0.005	mg/L
	Sodium	11		mg/L
Nutrients				
	Nitrates	1.1	10	mg/L
Radionuclides				
	Gross Alpha	3	15	pCi/L
	Uranium	0.0024	0.03	pCi/L
	Radium 228	ND	5	pCi/L
	Uranium Activity	1.7	20	pCi/L
Metals				
	Arsenic	0.003	0.10	mg/L
Volatile Organic Compounds (VOCs)				
	Benzene, Vinyl Chloride, Xylenes gasoline, paints, solvents	ND		
Synthetic Organic Compounds (SOCs)				
	Pichloram, 2,4-D, Alachlor Pesticides, dyes, industrial chemicals	ND		

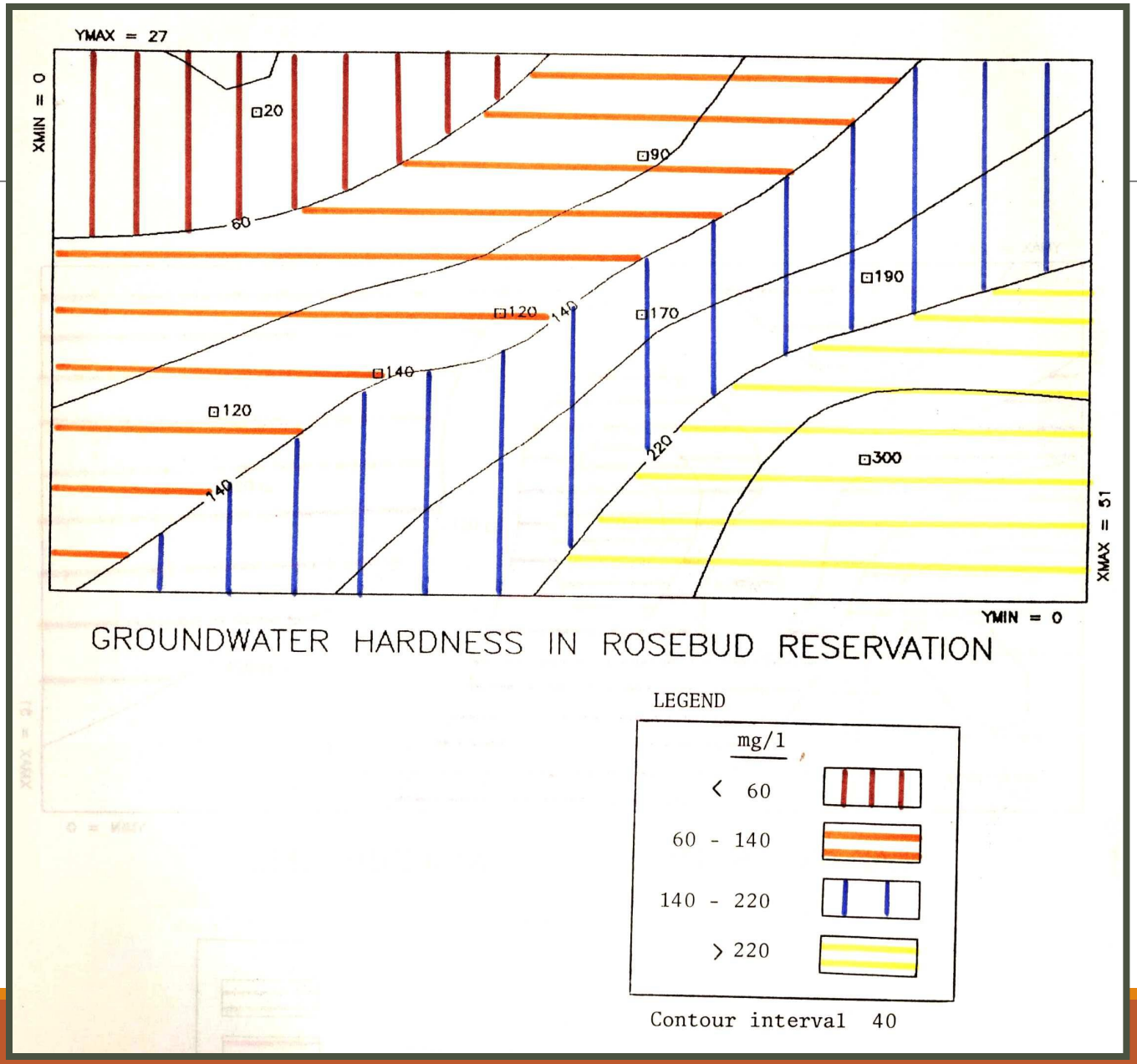
Total Dissolved Solids in Groundwater, Rosebud Reservation



pH Of Groundwater



Groundwater Hardness in Rosebud Reservation



Lead in Groundwater Rosebud Reservation

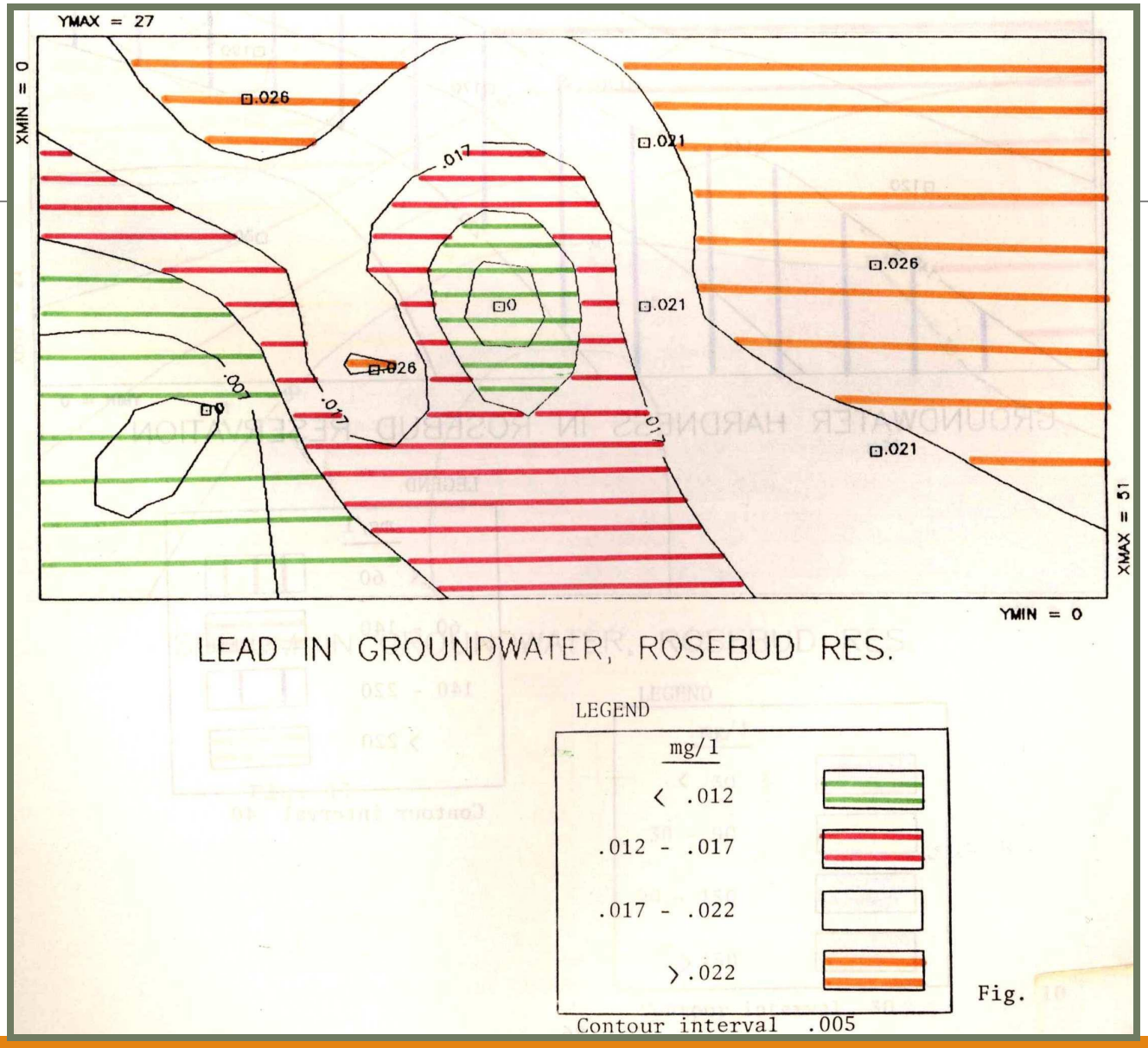


Fig.

3D-Pump

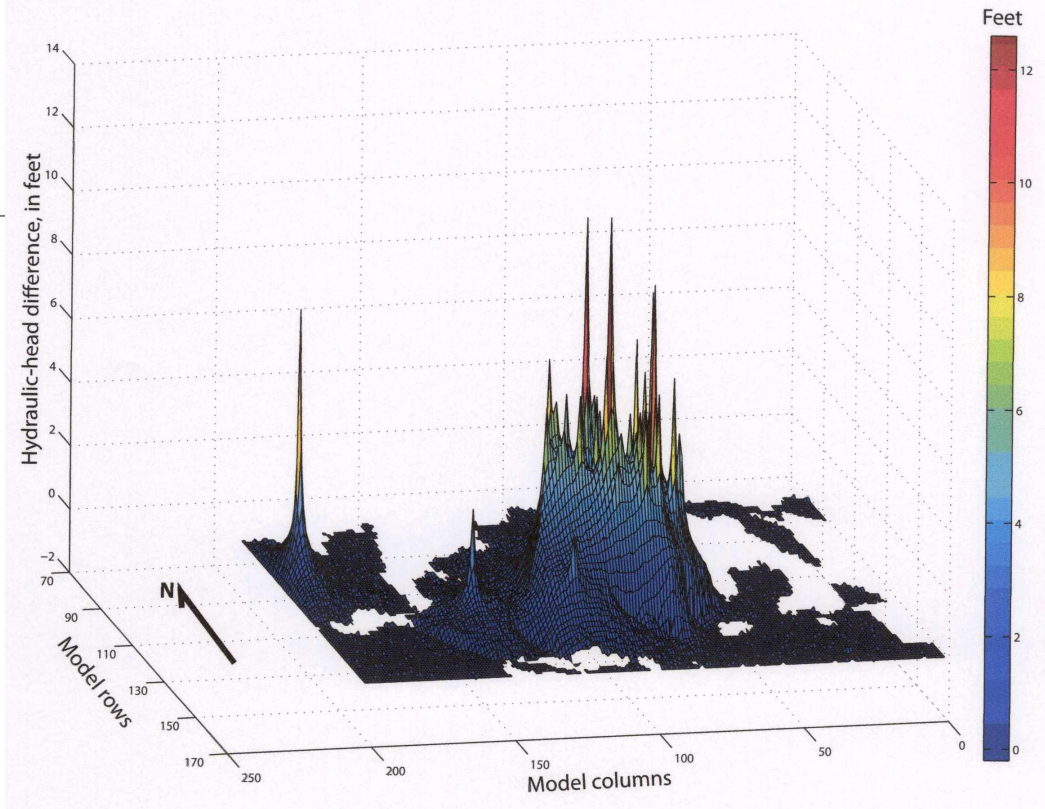


Figure 24

Three dimensional plot of the differences in hydraulic-head values between results of the calibrated model and the increased pumping scenario at the end of the 30-year simulation period for the Ogallala aquifer.

Interesting Math on the Ogallala Aquifer on Rosebud Reservation (A simplistic View)

Groundwater use – irrigation & Rural, Municipal & industrial

Approximately 15 billion gallons/ year
325,000 gallons per acre feet
Equals 46,153 acre feet of water use/ year

Water Storage in Ogallala Aquifer on Rosebud Reservation is 17,000,000 acre feet

Specific yield is 0.03
Equals 510,000 acre feet of water that can be drained by gravity

Area of Ogallala Aquifer on Rosebud Reservation

is 950 square miles
Equals 26,484,480,000 square feet

Approximate Recharge is 3 inches = 0.25 feet

Recharge over the area is 6,621,120,000 cubic feet
= 49,525,977,600 gallons
=152,387 acre feet of recharge/ year

Interesting Math (A simplistic View continued)

17,000,000 - acre feet in storage
- 46,153 - acre feet of water use/ year
16,953,847 acre feet of storage left
+ 152,367 acre feet of recharge/ year
17,106,214 acre feet back in storage

Specific yield 0.03

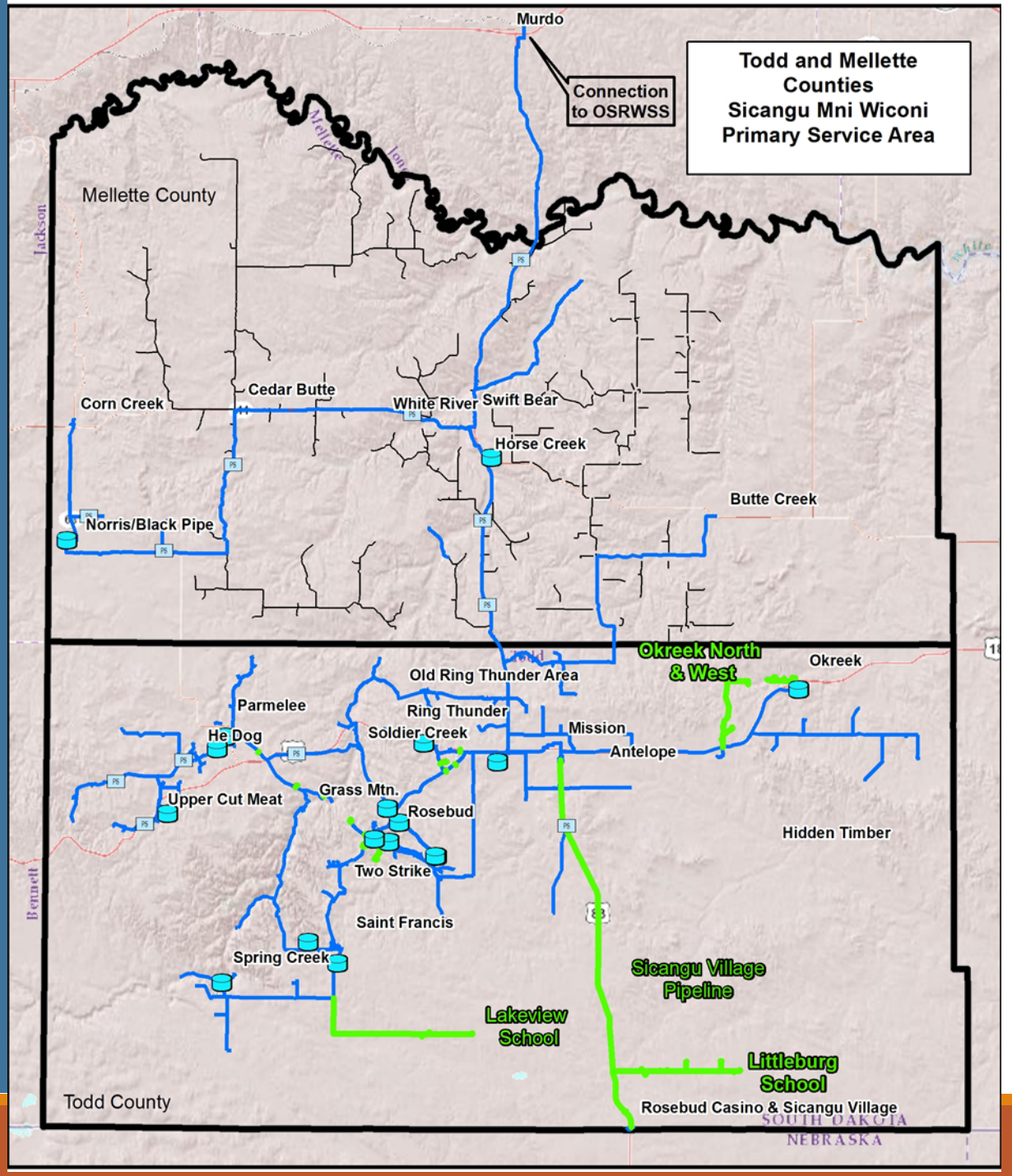
Yield is back to 513,186 acre feet that can be drained by gravity

Hence the Aquifer is in somewhat state of equilibrium and in a few monitor wells the water level has risen. The stressed area or where the water table is falling is where the center pivot irrigation systems and some of the production wells are pumping groundwater.

KEYSTONE XL PIPELINE

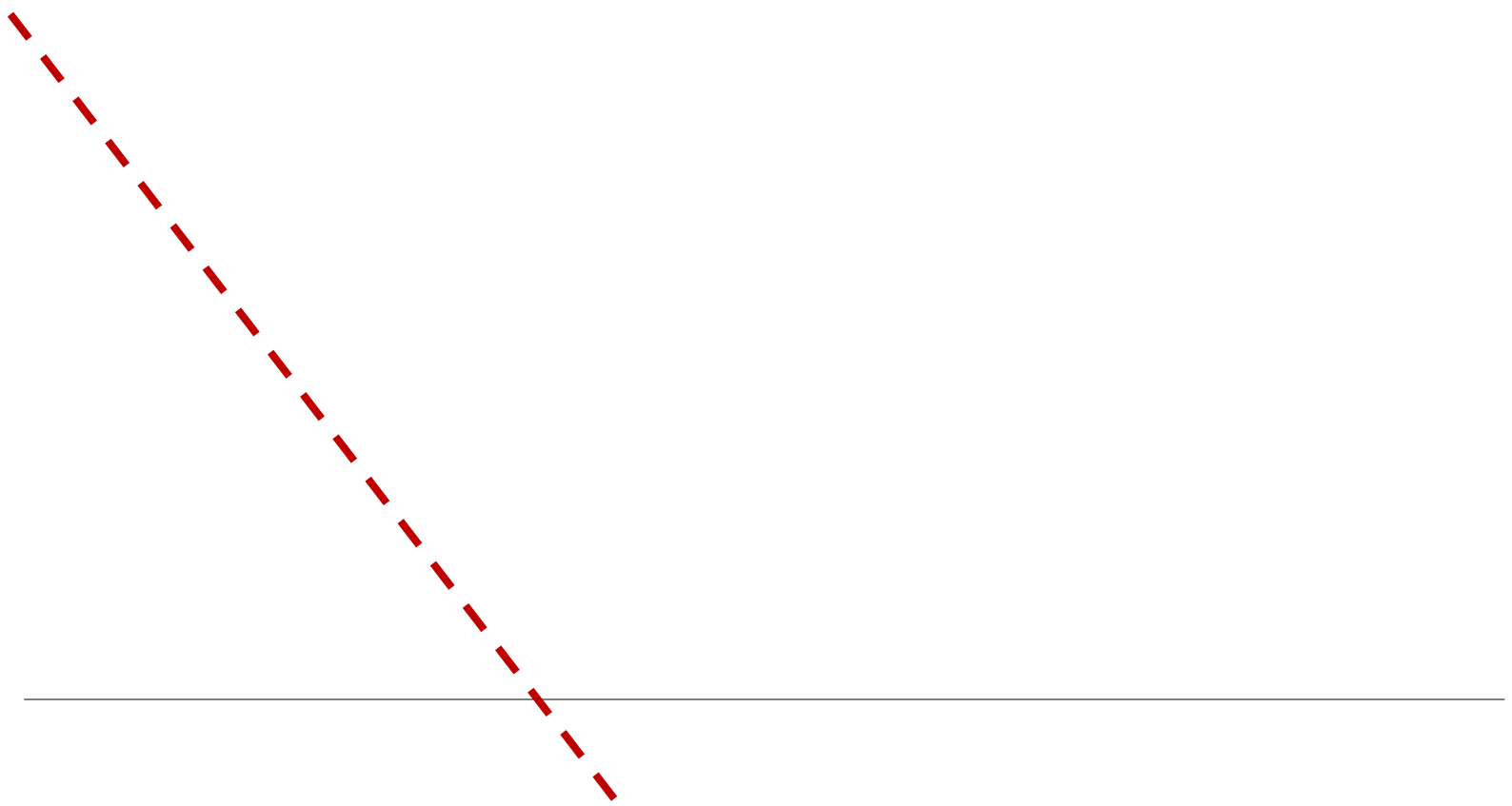
ISSUES AND CONCERNS

Sicangu Mni Wiconi Project/ Rosebud Sioux Rural Water System

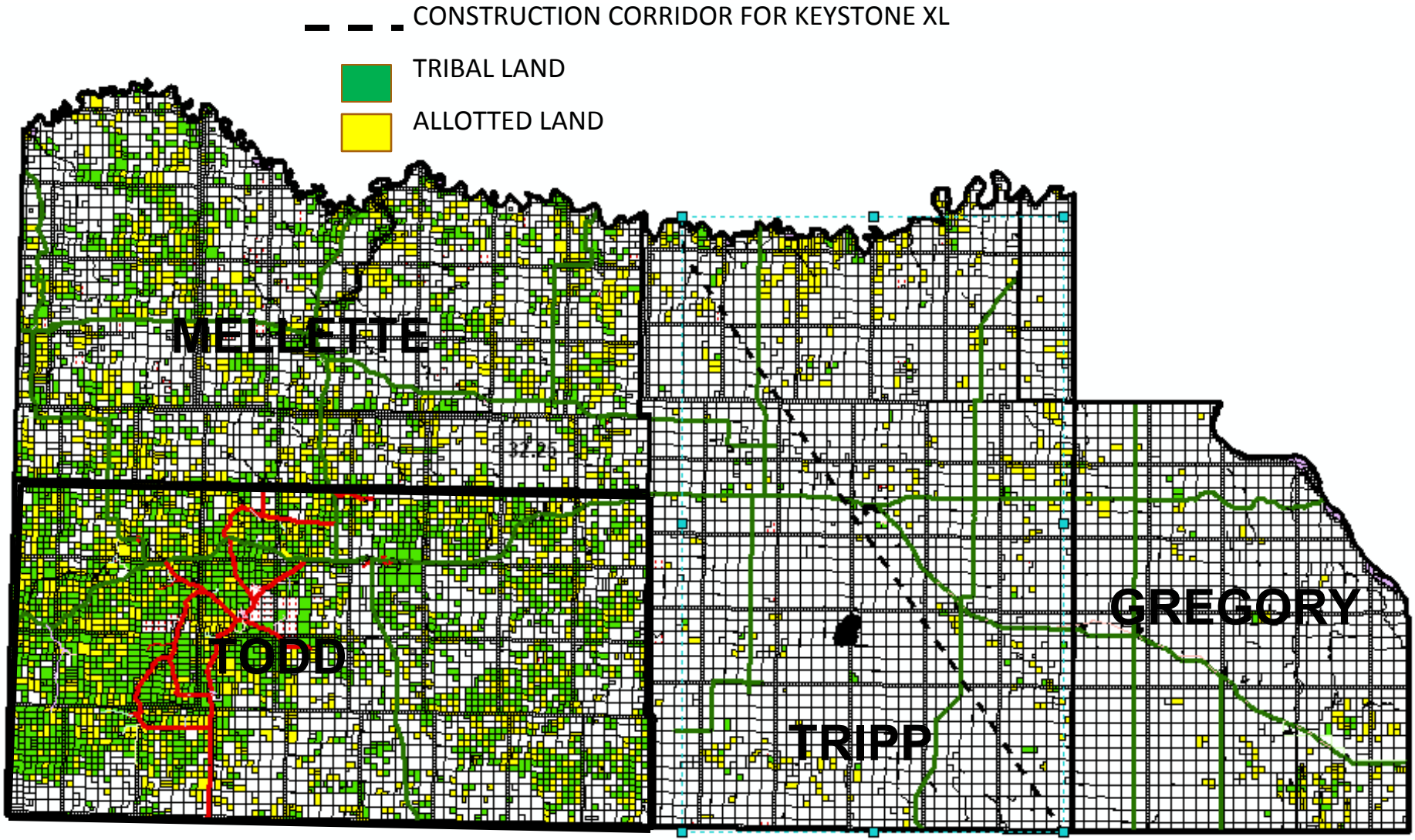


High Plains Aquifer

Approximate Keystone XL Route

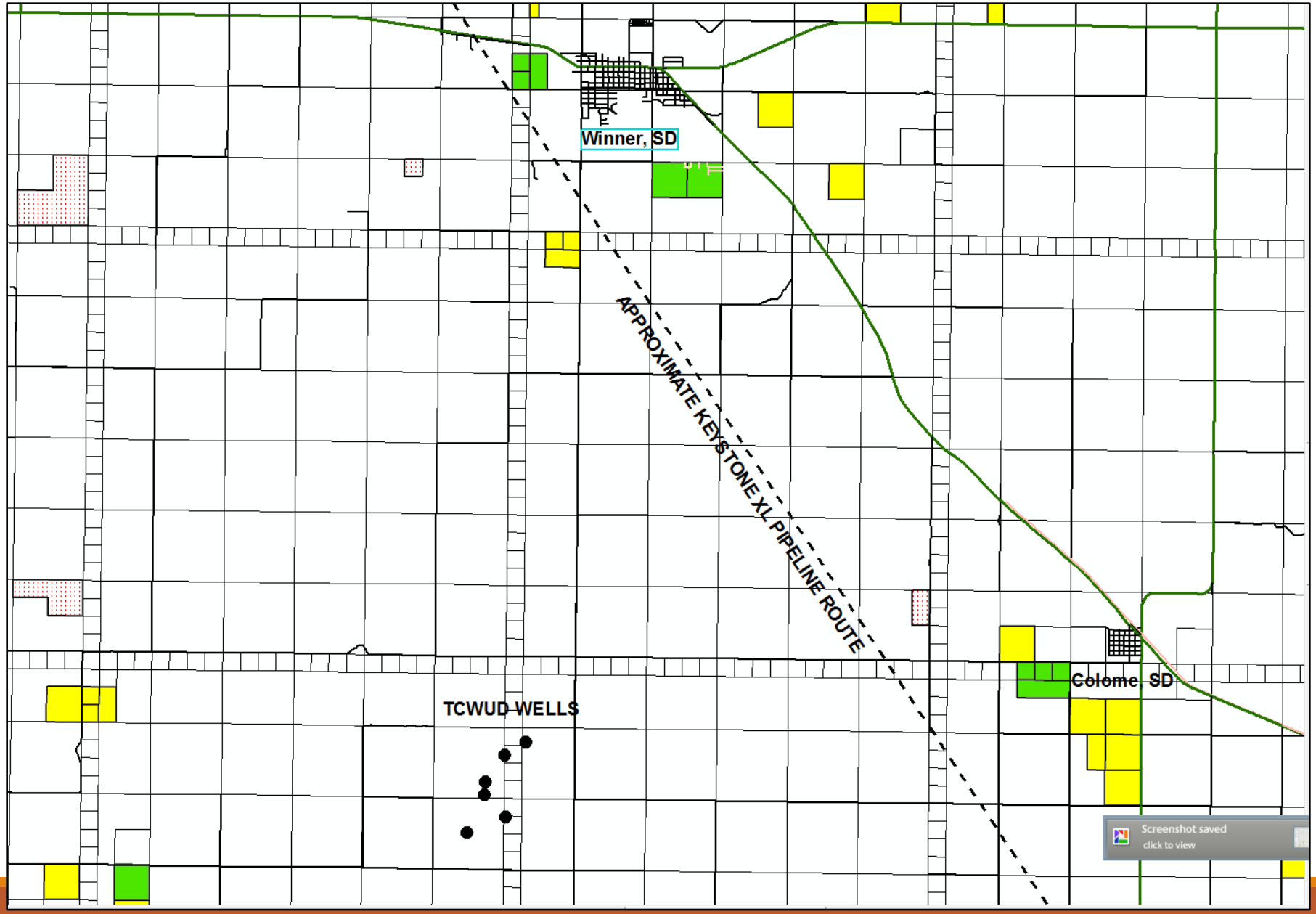


HISTORIC ROSEBUD RESERVATION 1889

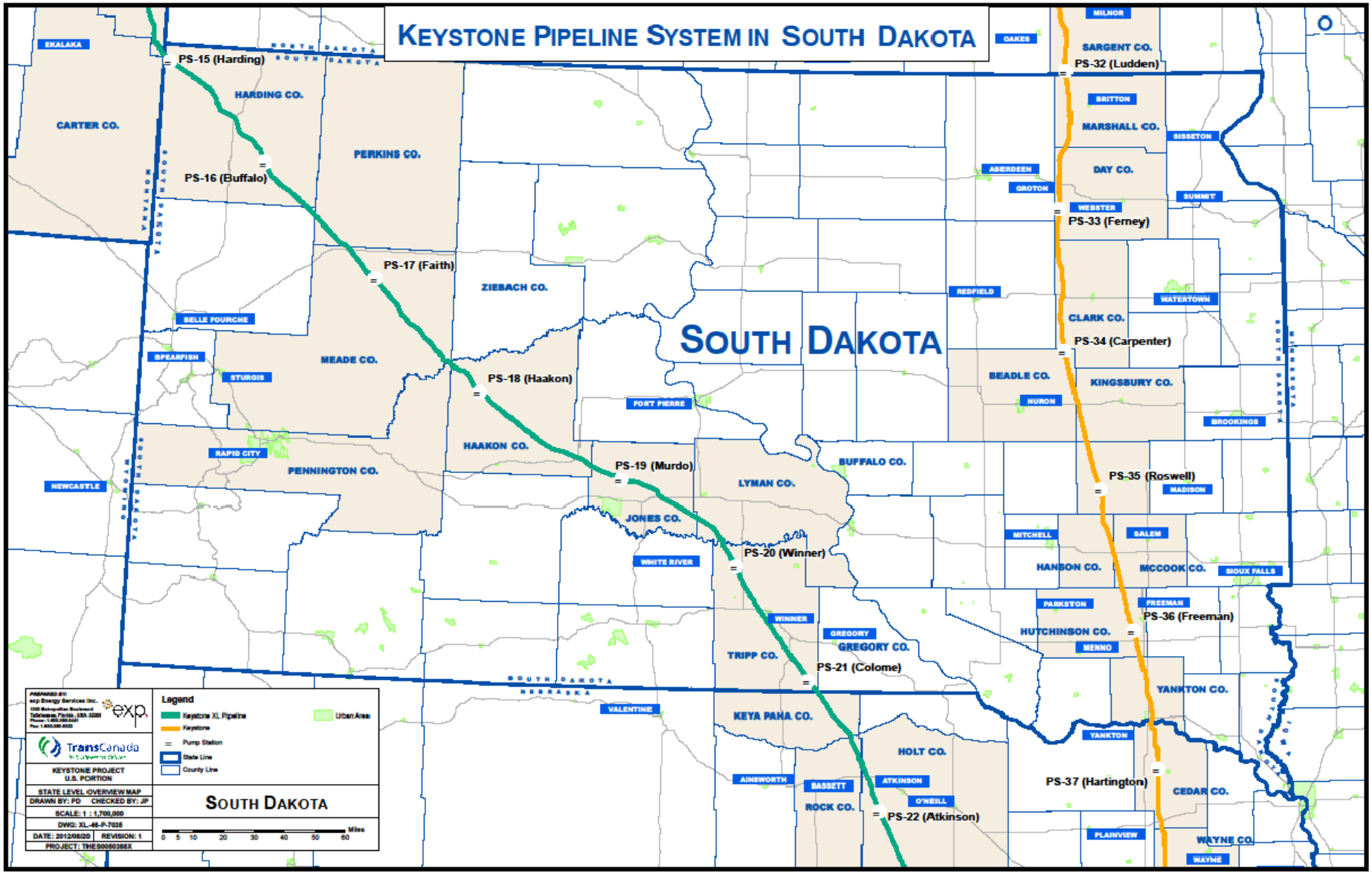


ROSEBUD v. KNEIP 1976

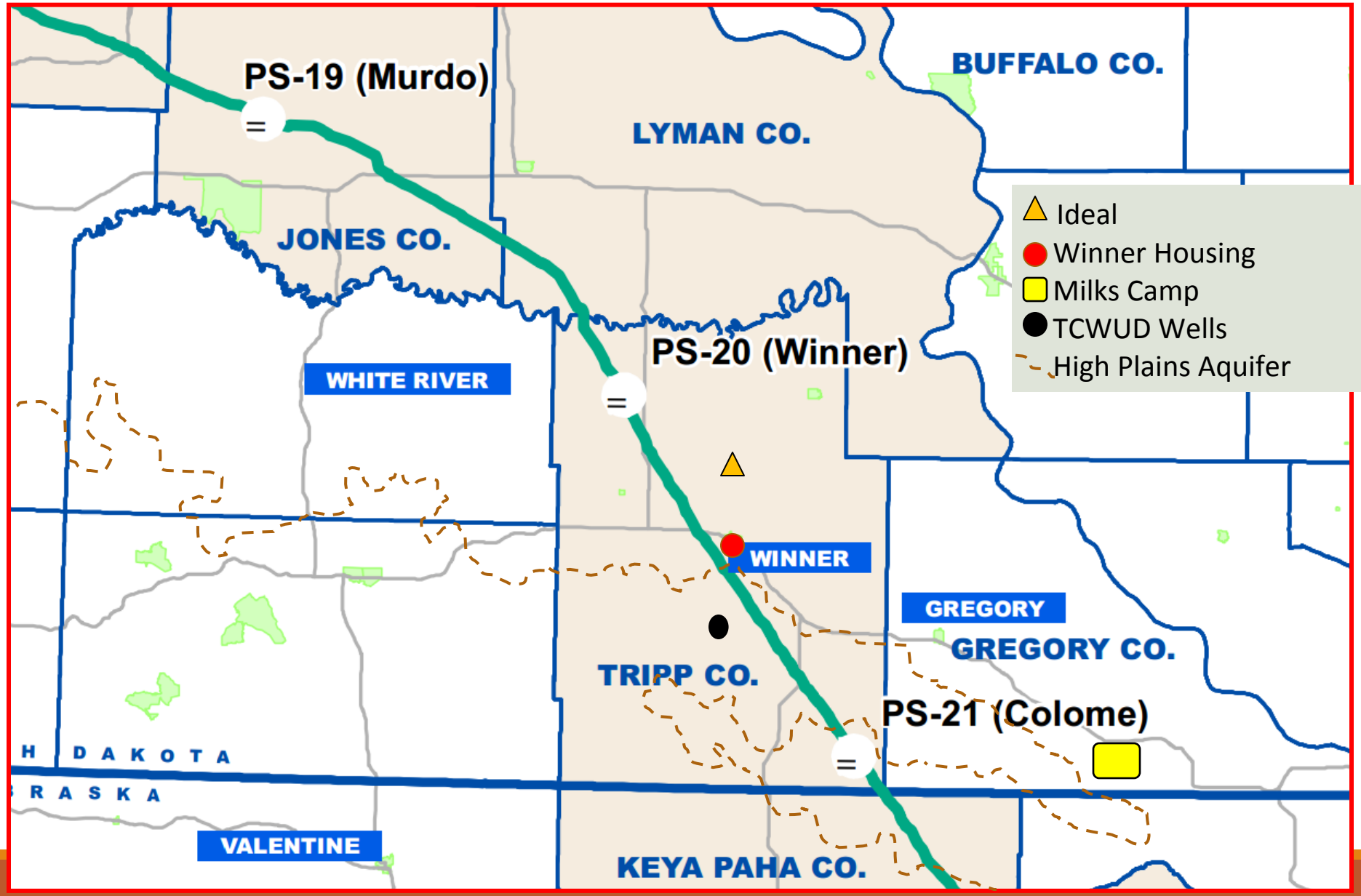
TRIPP COUNTY WATER USER DISTRICT WELL FIELD



KEYSTONE XL PIPELINE



Proposed Keystone XL Pipeline Route



Newly Approved Route of Keystone Pipeline Moved From the Original Route.

Other Pipeline Considerations