Water Availability for Oil Well Development in North Dakota

Status of Water Depot Permit Applications

Issues with the COE for Access to Lake Sakakawea Water

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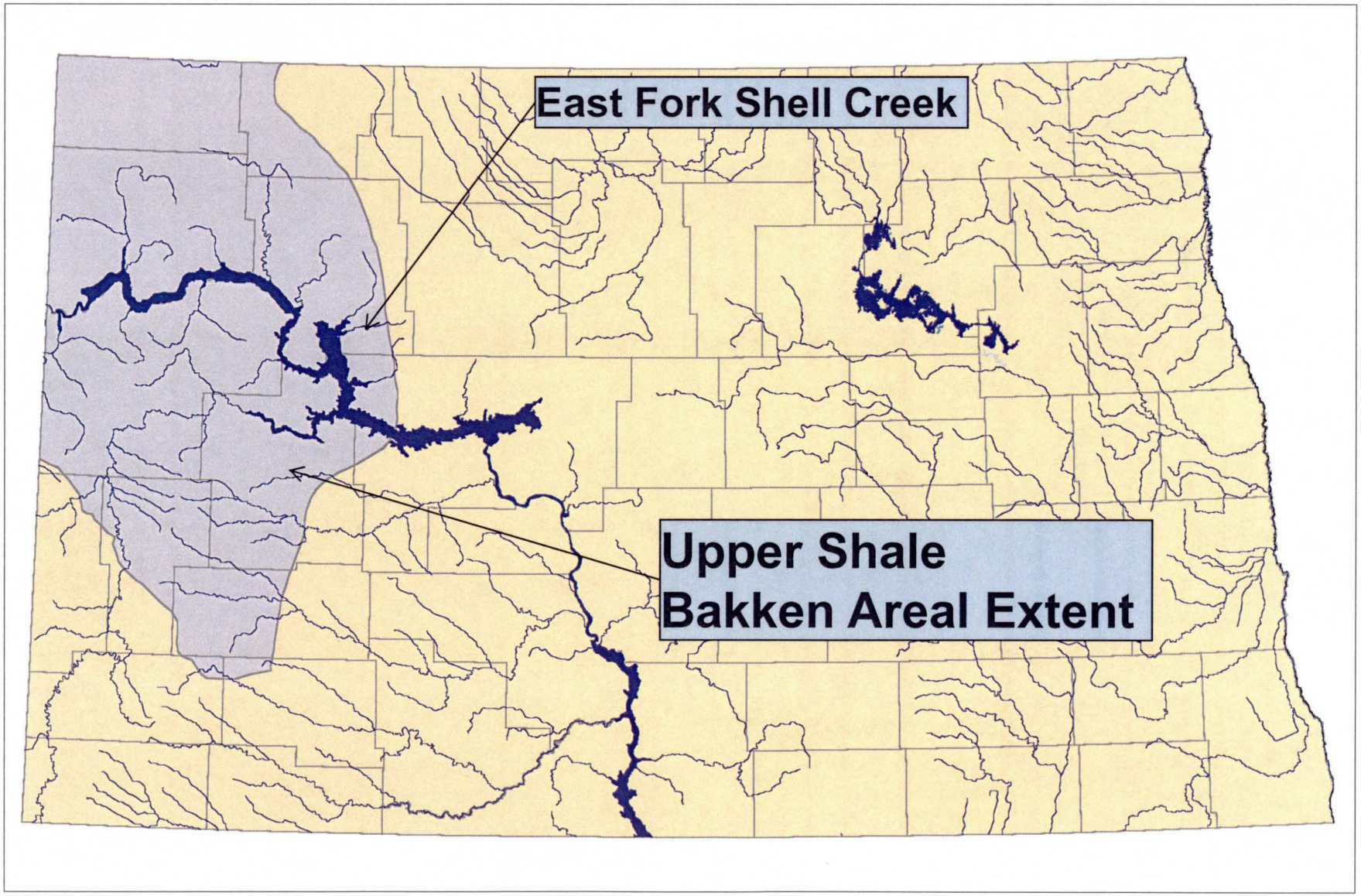
North Dakota State Water Commission

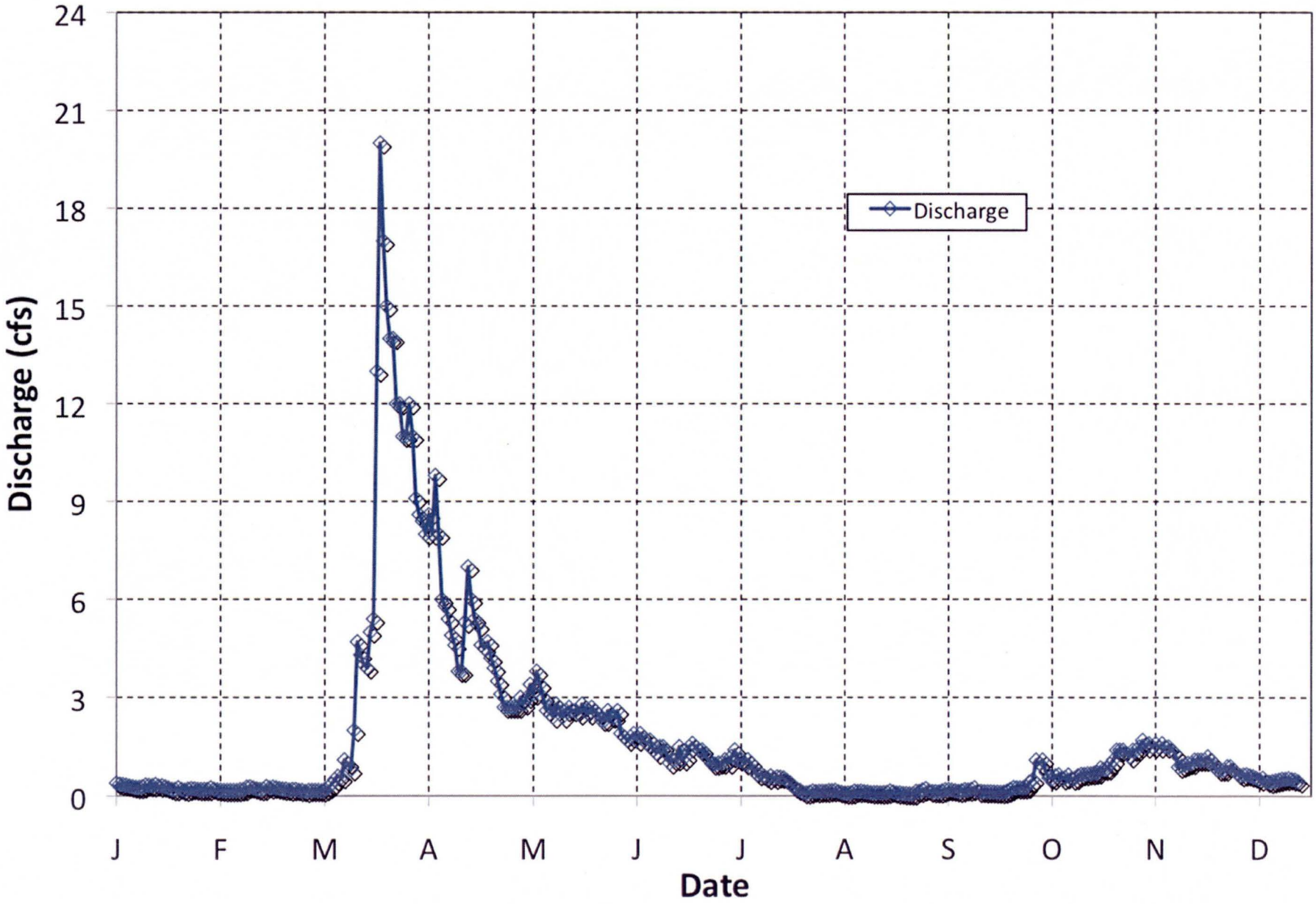
Scope of Presentation

- Surface Water Availability
- Ground Water Availability
  - Bedrock Aquifer
    - Fox Hills Aquifer
  - Glacial Aquifer
    - Killdeer Aquifer
- Status of Water Depot Permit Applications
- U.S. Army Corps of Engineers – Lake Sakakawea Permitting Issues

Surface Water Availability



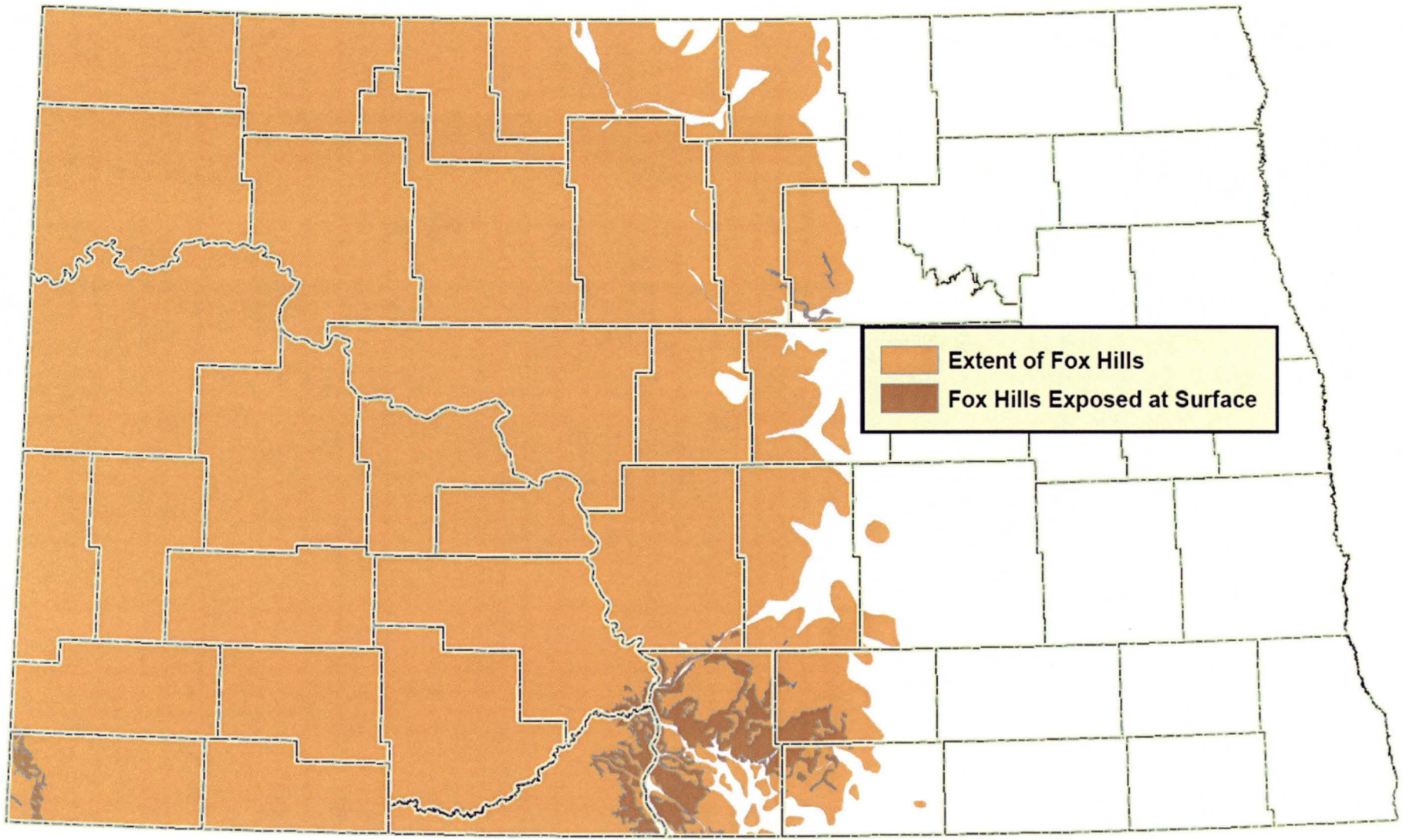
East Fork Shell Creek near Parshall, ND



Ground Water Availability Bedrock Aquifers

FOX HILLS AQUIFER

Areal Extent of Fox Hills Aquifer

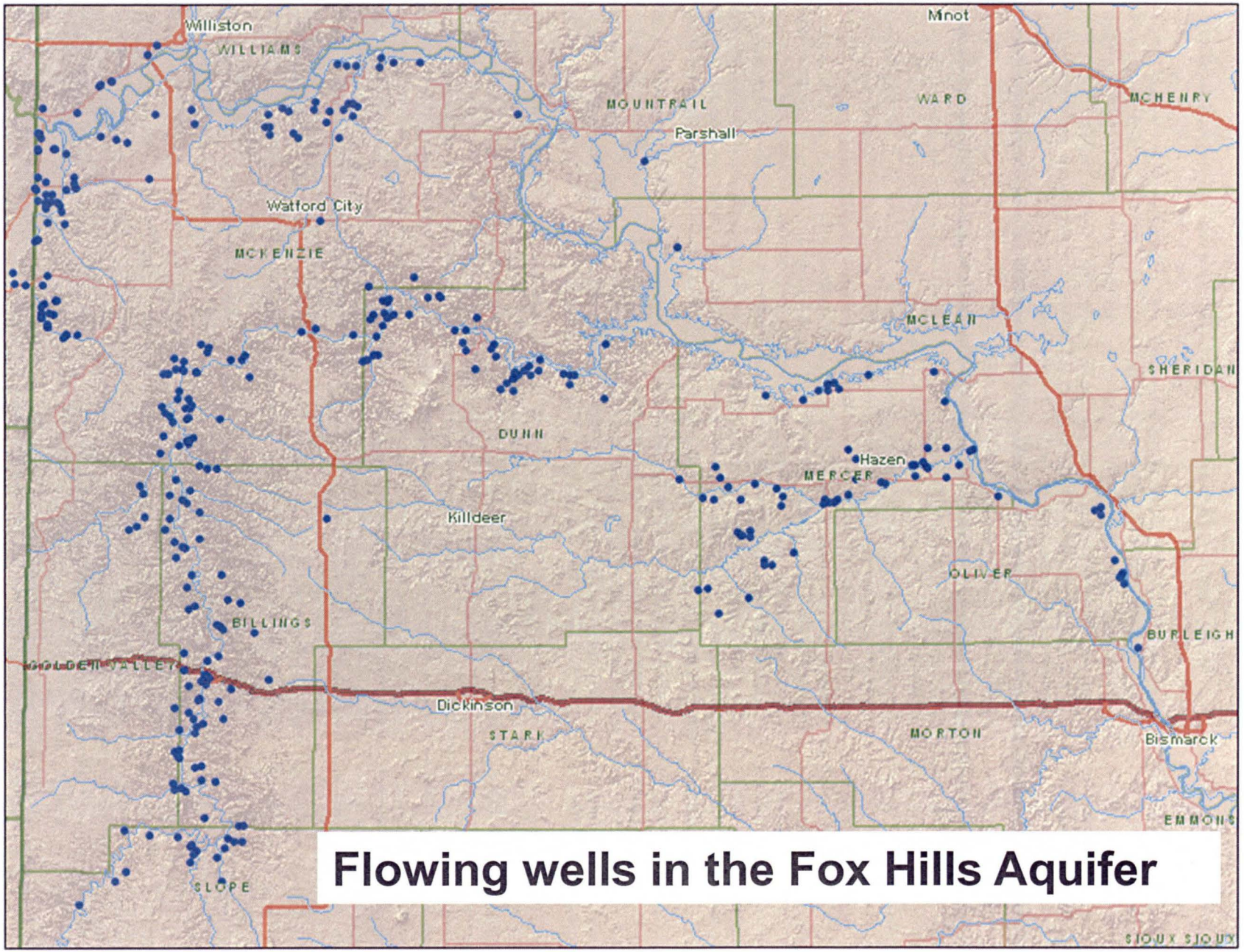


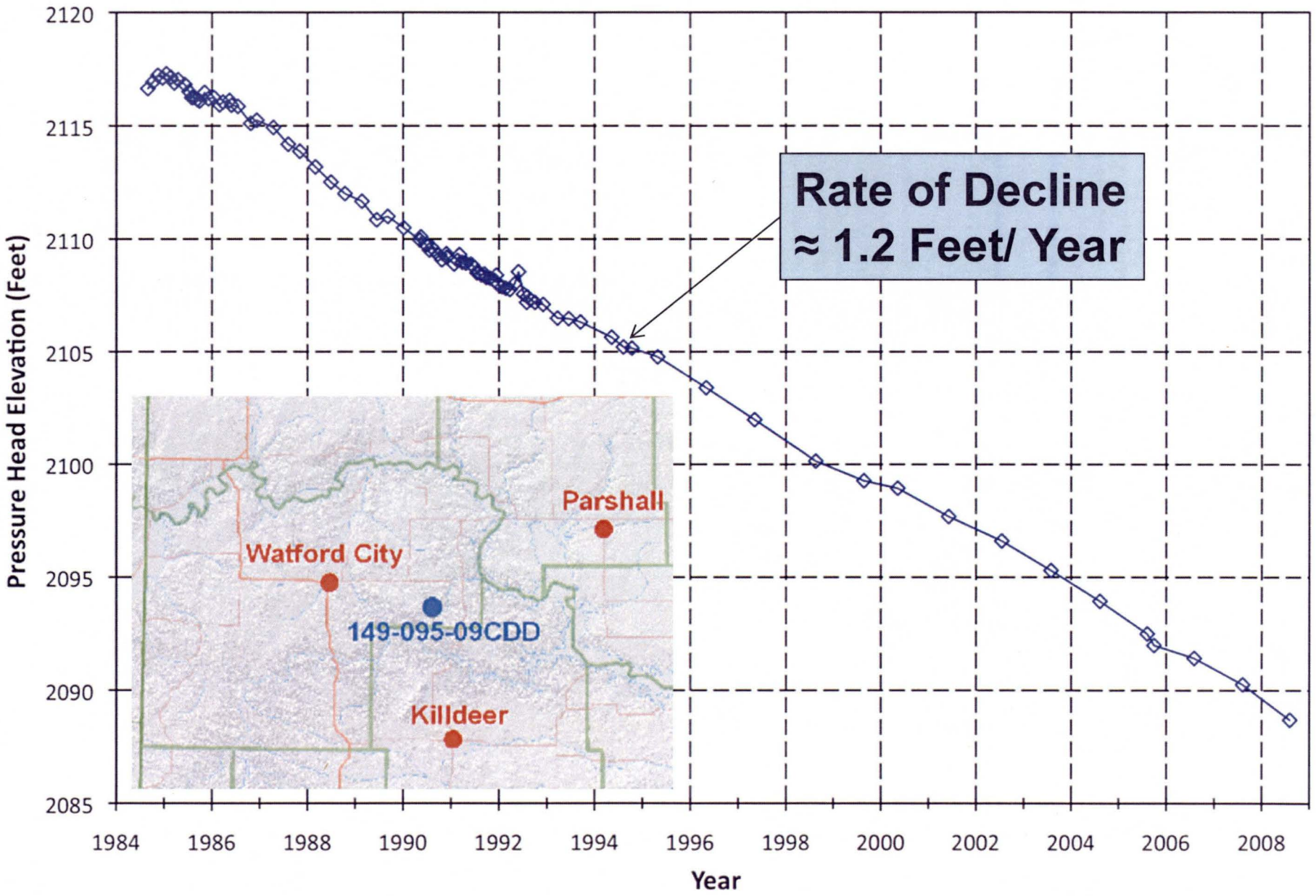
Fox Hills Aquifer

- Fox Hills Aquifer occurs from land surface to depths of ≈ 2,000 feet in west central part of state
- Well yields of up to 200 gpm
- Variable water chemistry
  - Relatively high salinity
  - Sodium-bicarbonate type water

Fox Hills Aquifer Cont.

- Major source for domestic/stock use in western North Dakota
- Monitoring since 1980s indicate pressure head declines of 1 to 2 feet/year
- Negative impact on flowing wells in Little Missouri, Missouri, and Knife River valleys


Williston
WILLIAMS
Minot
MOUNTRAIL
WARD
MCHENRY
Parshall
Watford City
MCKENZIE
MCLEAN
SHERIDAN
DUNN
Hazen
MERCER
Killdeer
OLIVER
BILLINGS
BURLEIGH
Dickinson
STARK
MORTON
Bismarck
EMMONS
SLOPE
SIOUX
Flowing wells in the Fox Hills Aquifer


Rate of Decline
≈ 1.2 Feet/ Year
Pressure Head Elevation (Feet)
2120
2115
2110
2105
2100
2095
2090
2085
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
Year
Parshall
Watford City
149-095-09CDD
Killdeer

Management of Fox Hills Aquifer

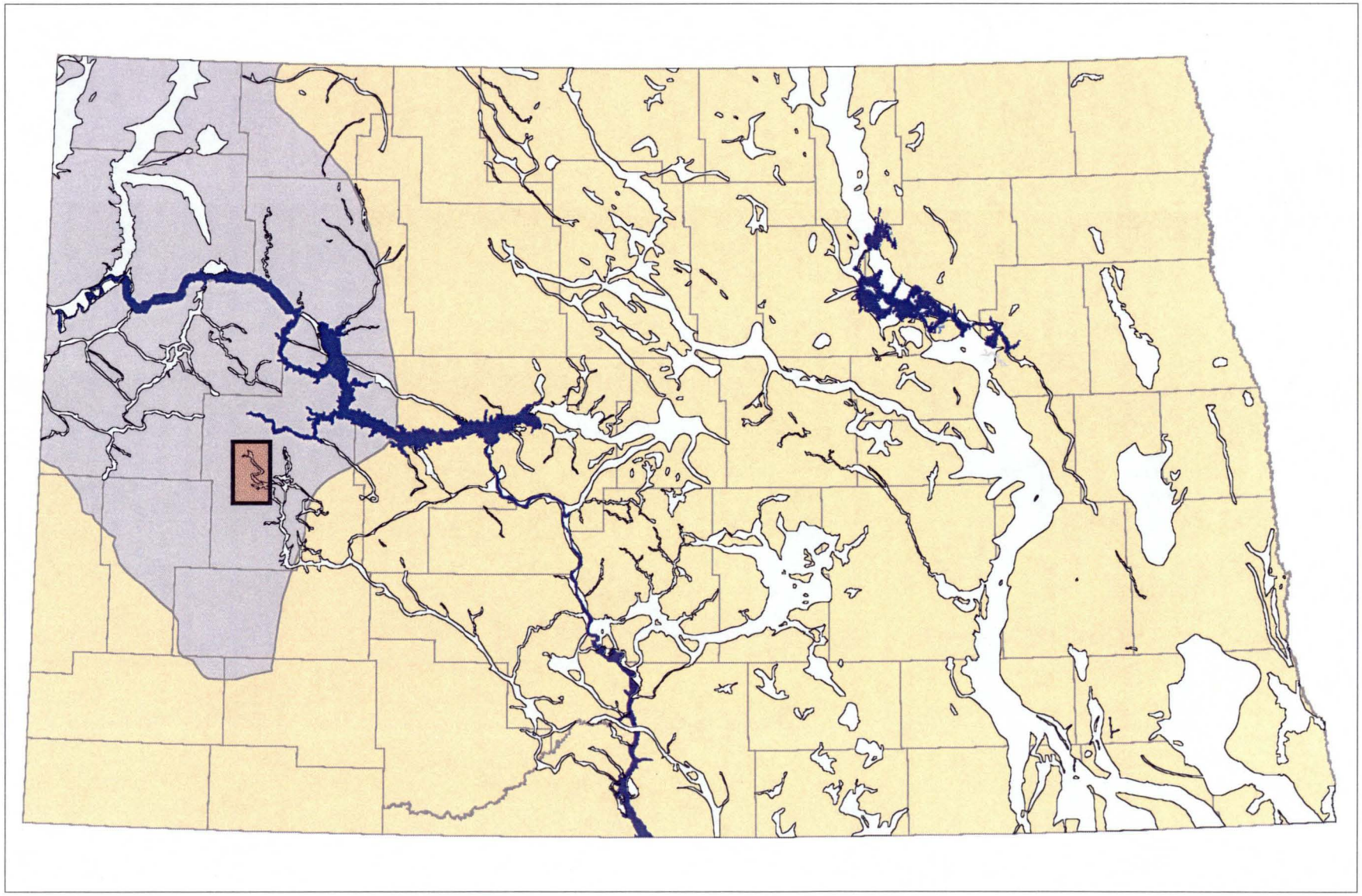
- Concerned about trends in water level declines
- Fox Hills Aquifer is an important water source
- Every effort should be made to develop large scale ground water supplies from other sources

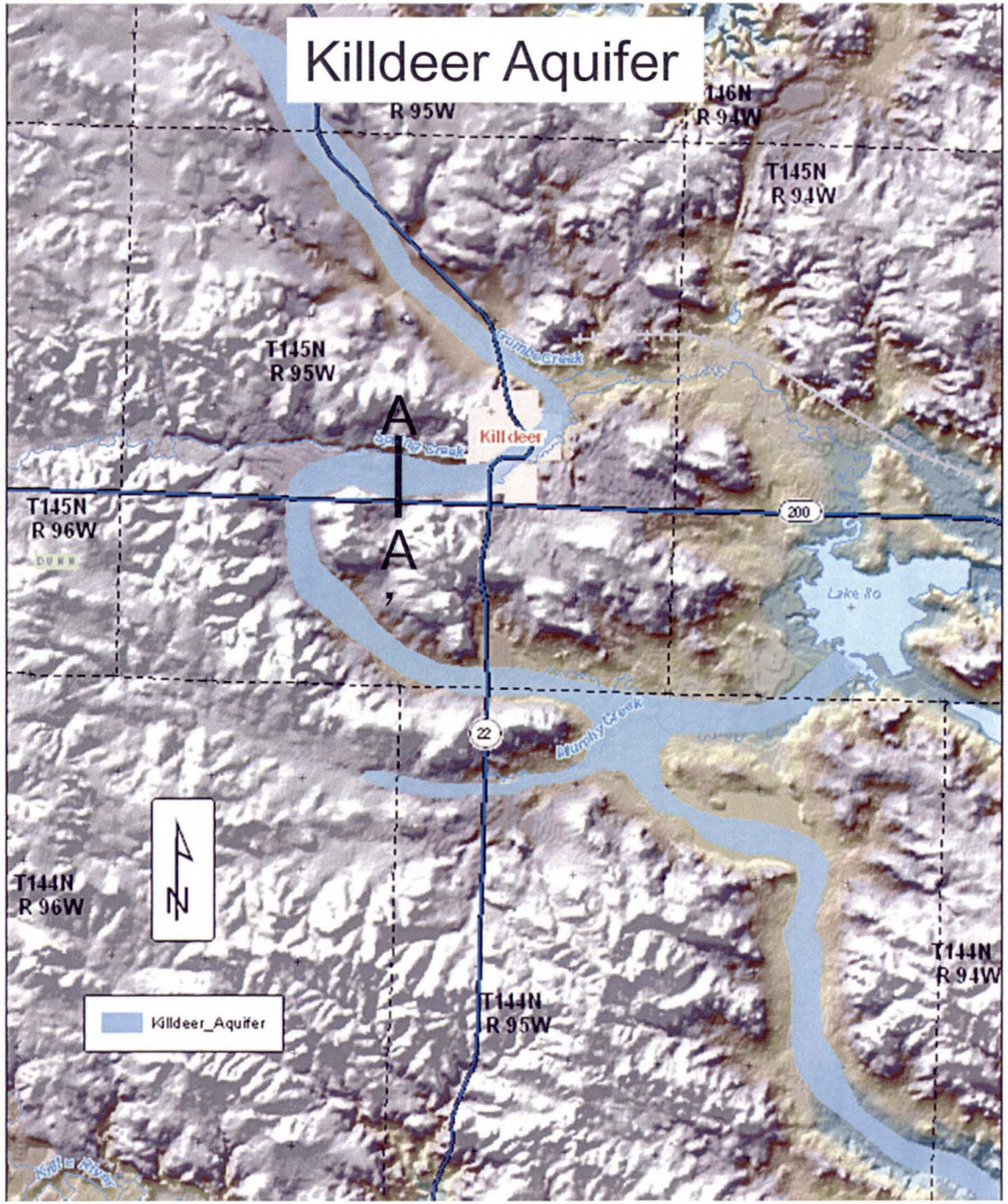
Ground Water Availability in Glacial Aquifers

KILLDEER AQUIFER

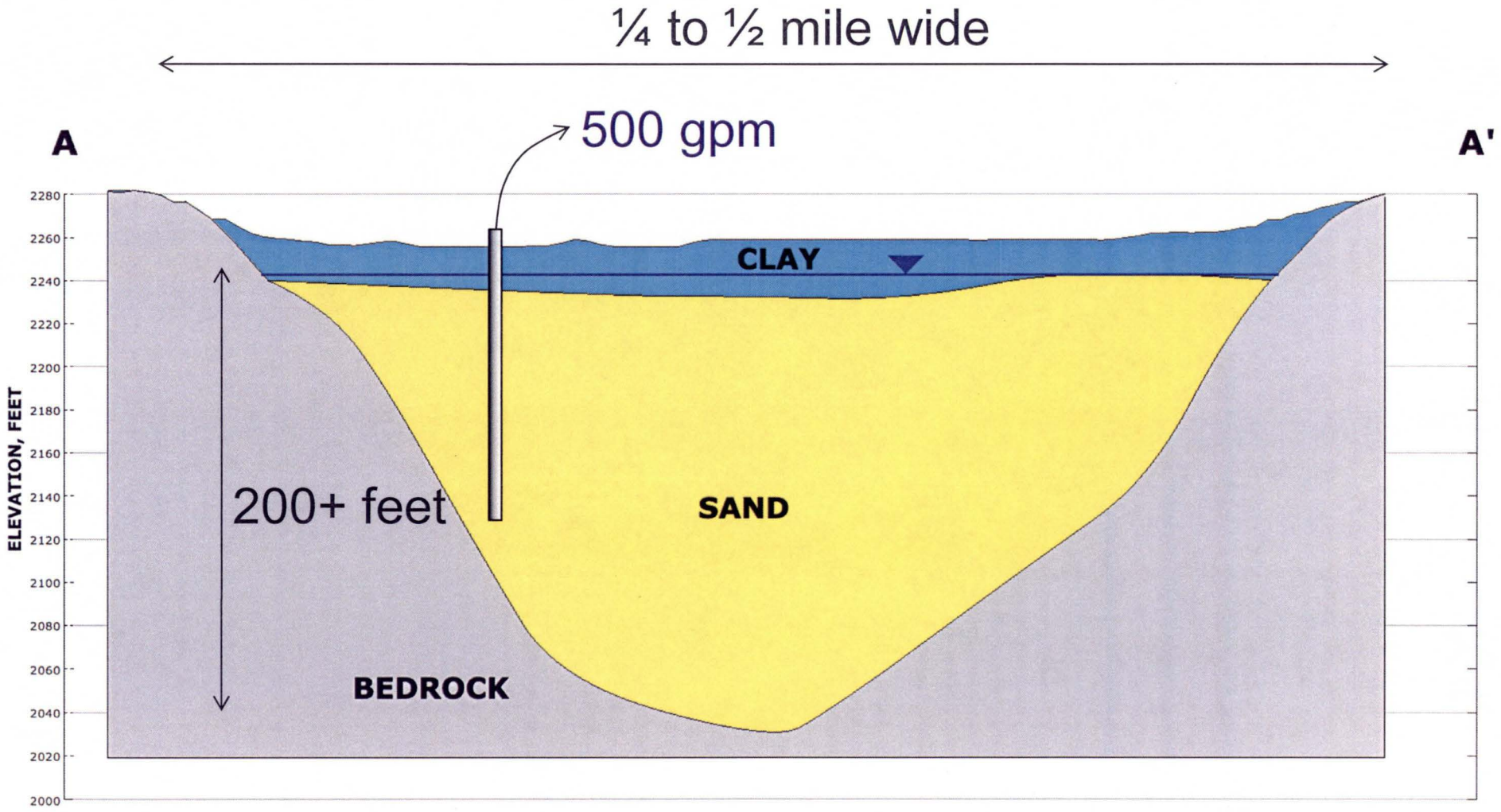
Dunn County

Glacial Drift Aquifers

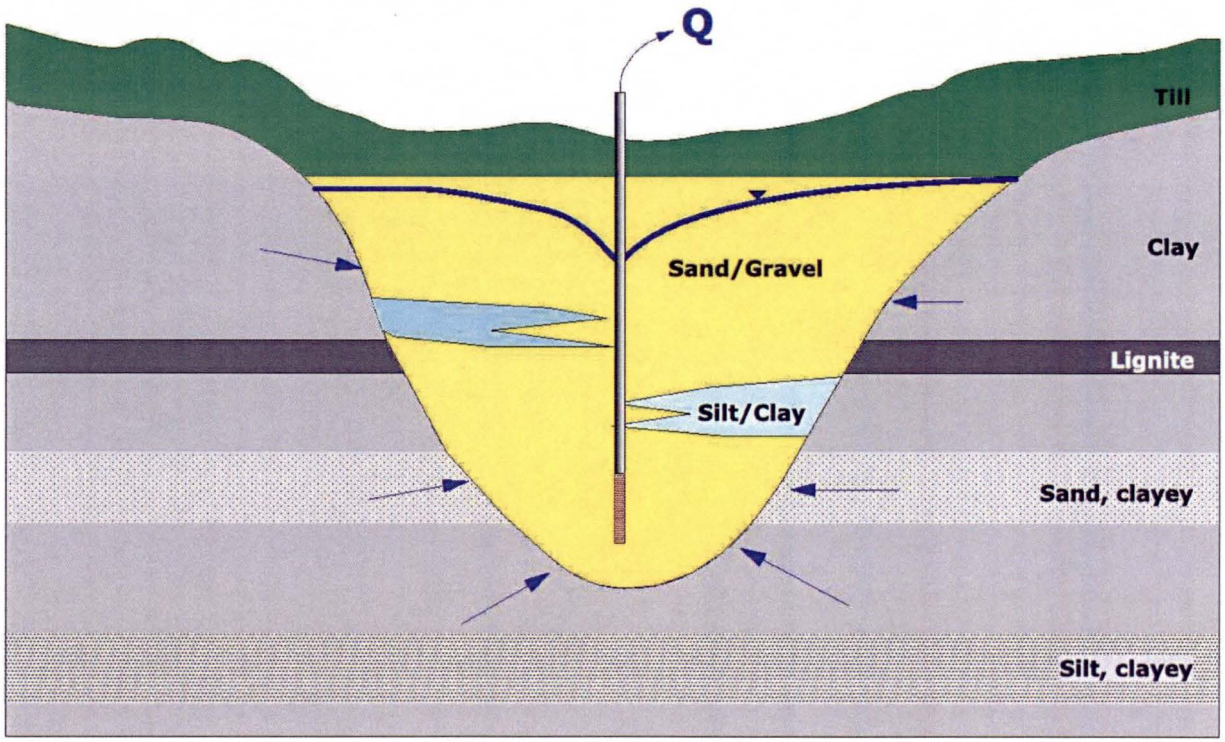


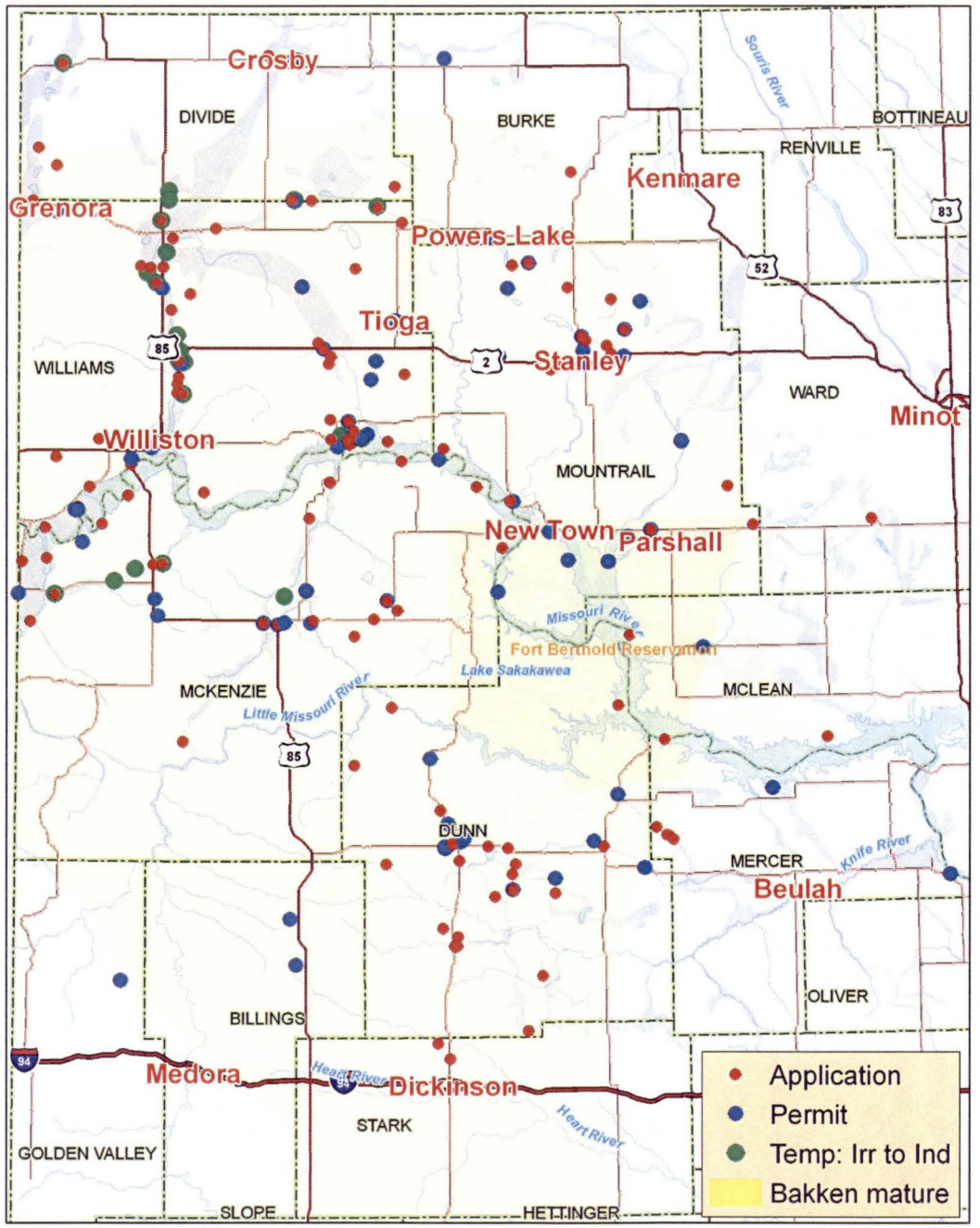

Killdeer Aquifer
R 95W
T146N
R 94W
T145N
R 94W
T145N
R 95W
A
A'
Killdeer
T145N
R 96W
200
Lake Ilo
22
Murphy Creek
T144N
R 96W
N
T144N
R 94W
T144N
R 95W
Killdeer_Aquifer

Geohydrologic Section A-A' Showing the Killdeer Aquifer



Schematic Diagram Showing Movement of Bedrock Water Into A Glacial Meltwater Channel Aquifer





Permitted water depots & pending applications, May 23, 2012
Including temporary industrial use in lieu of irrigation

0 4 8 12 16 20 24
Miles

STATUS OF WATER DEPOTS - PERMITS AND APPLICATIONS
(As of 5/23/12)

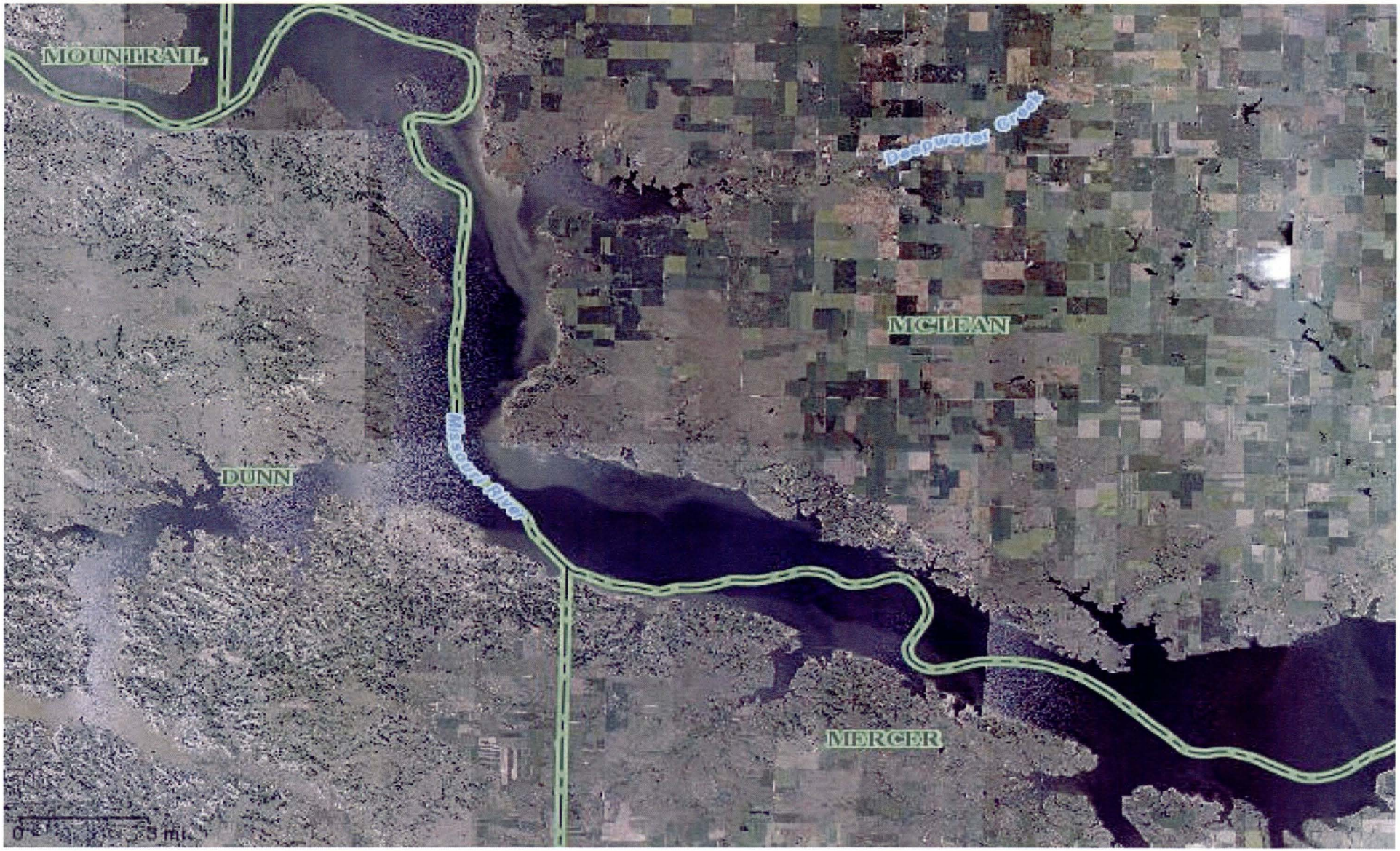
- Water permits issued – 73 (63 groundwater, 10 surface water)
  - Annual quantity of groundwater permitted – 9,122 acre-feet (3.0 billion gallons)
  - Annual quantity of surface water permitted – 33,679 acre-feet (11.0 billion gallons)

    (includes one permit approved for 24,900 acre-feet from Lake Sakakawea)

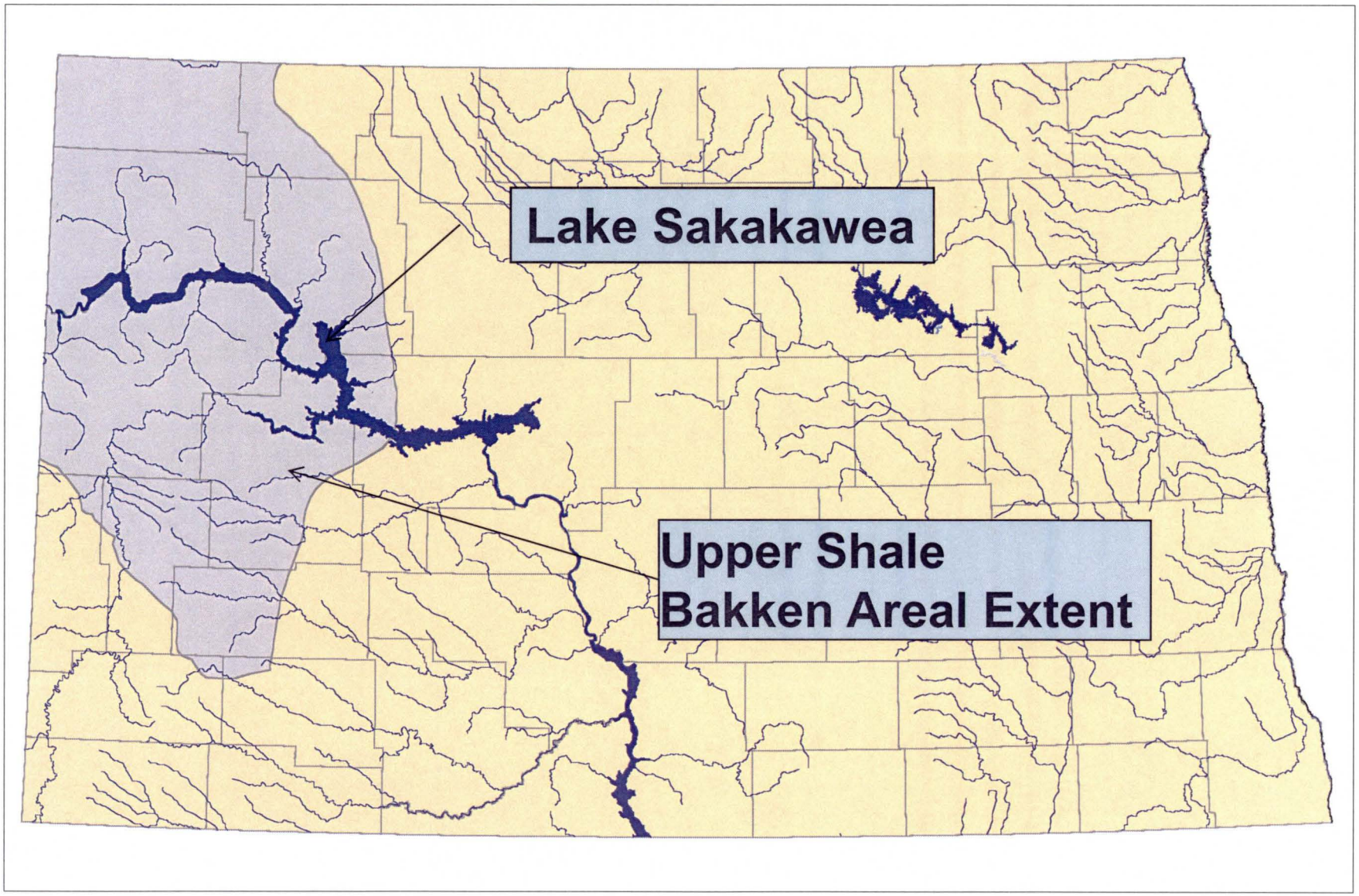
STATUS OF WATER DEPOTS - PERMITS AND APPLICATIONS

- Permits with a portion held in abeyance – 22 (all groundwater: 6,224 acre-feet /year – 2.0 billion gallons)
- Permit applications denied - 7 (6 groundwater 1 surface water)
- Permit applications to be reviewed - 123 (92 groundwater, 31 surface water)
  - Annual quantity of groundwater pending – 31,452 acre-feet (10.2 billion gallons)
  - Annual quantity of surface water pending – 86,471 acre-feet (28.2 billion gallons)
    - Includes 83,719 acre-feet/year (27.2 billion gallons) from Missouri River/Lake Sakakawea

The most reliable water supply in terms of both quantity and quality required for oil field development in western North Dakota is Lake Sakakawea and the Missouri River



Missouri River/Lake Sakakawea Strategically Located

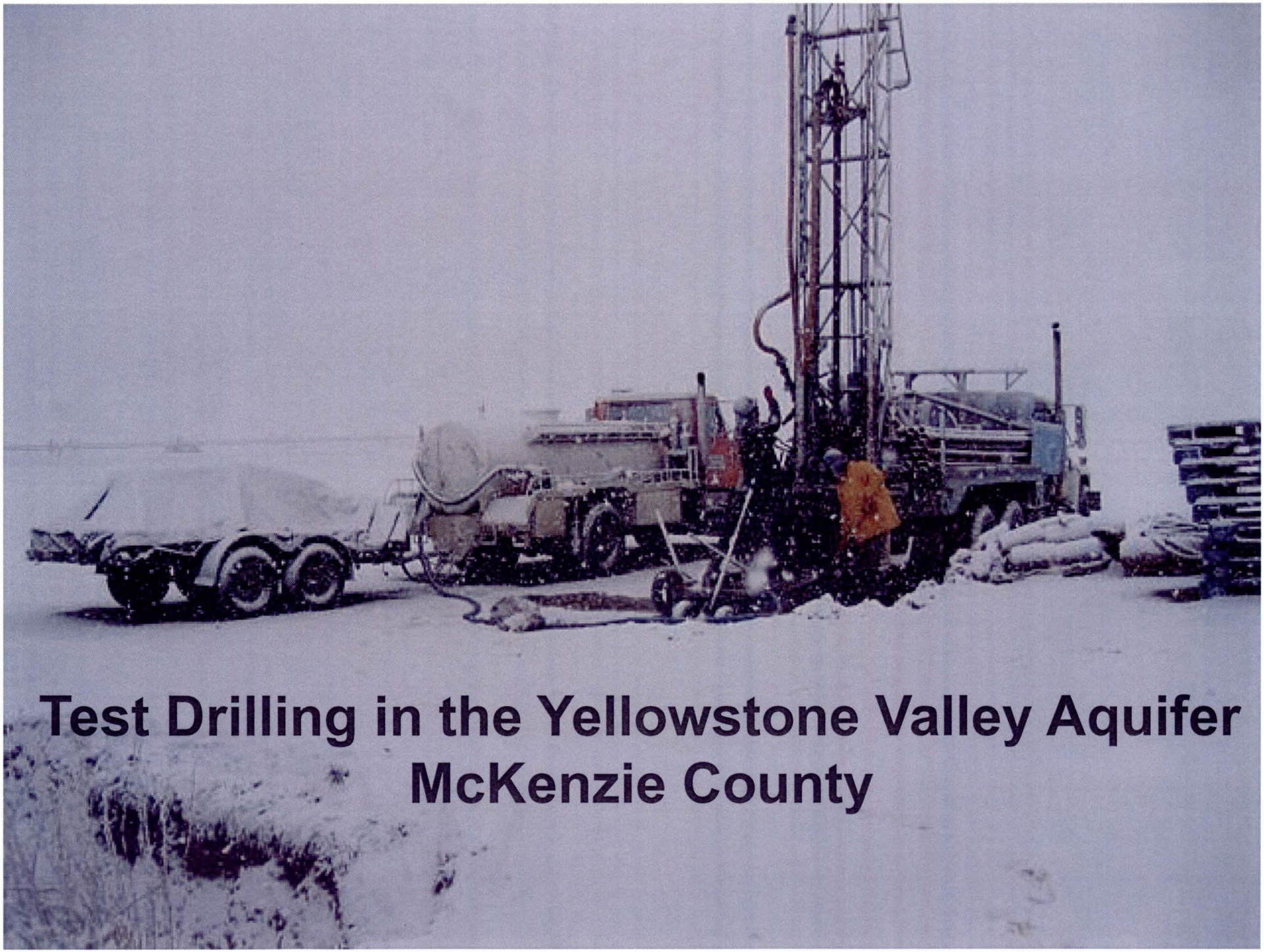


U.S. Army Corps of Engineers – Permitting Issues from Lake Sakakawea

- **Before any new permits issued for municipal /industrial water users "Surplus Storage Contracts" are required.**
- **Surplus Water Report – Environmental Assessment (NEPA)**
  - **Temporary reallocation of 100,000 ac-ft of storage (10 yr. period) to meet demands of oil industry.**
  - **EA analysis – Impact on the following environmental resources: soils, groundwater, water quality(including cold water habitat), air quality, demographics, socioeconomics, environmental justice, recreation, aesthetics, noise, cultural resources, vegetation and protected plants, fish and wildlife, and protected animals. In addition – Evaluate effects on project purposes.**
  - **COE modeling study to evaluate effects of diversion on Missouri River stage and reservoir storage.**
  - **COE will estimate annual cost of reallocated storage.**
  - **COE will determine if an Environmental Impact Statement (EIS) is necessary.**

SWC Temporary Conversion of Irrigation Permits to Industrial Permits

- **Converting existing irrigation permits to industrial permits**
  - COE will not allow temporary conversion of irrigation permits for industrial use.
  - State law does not allow for conversion of a water permit from a higher purpose of use to lower purpose of use.
  - Due to the demand and lack of timely permitting, the State Engineer developed a policy to temporarily divert irrigation use to industrial use.
  - Conditions: 1) Must forgo irrigation for calendar year during which water used for industrial use, 2) If use is from ground water source, can only divert "average" amount of water used for irrigation, 3) Must install in-line totalizing water meter to record and report annual water use.



Test Drilling in the Yellowstone Valley Aquifer
McKenzie County