WWDC Platte River Basin Plan, Groundwater Study (Level I)

WSGS – USGS – WRDS

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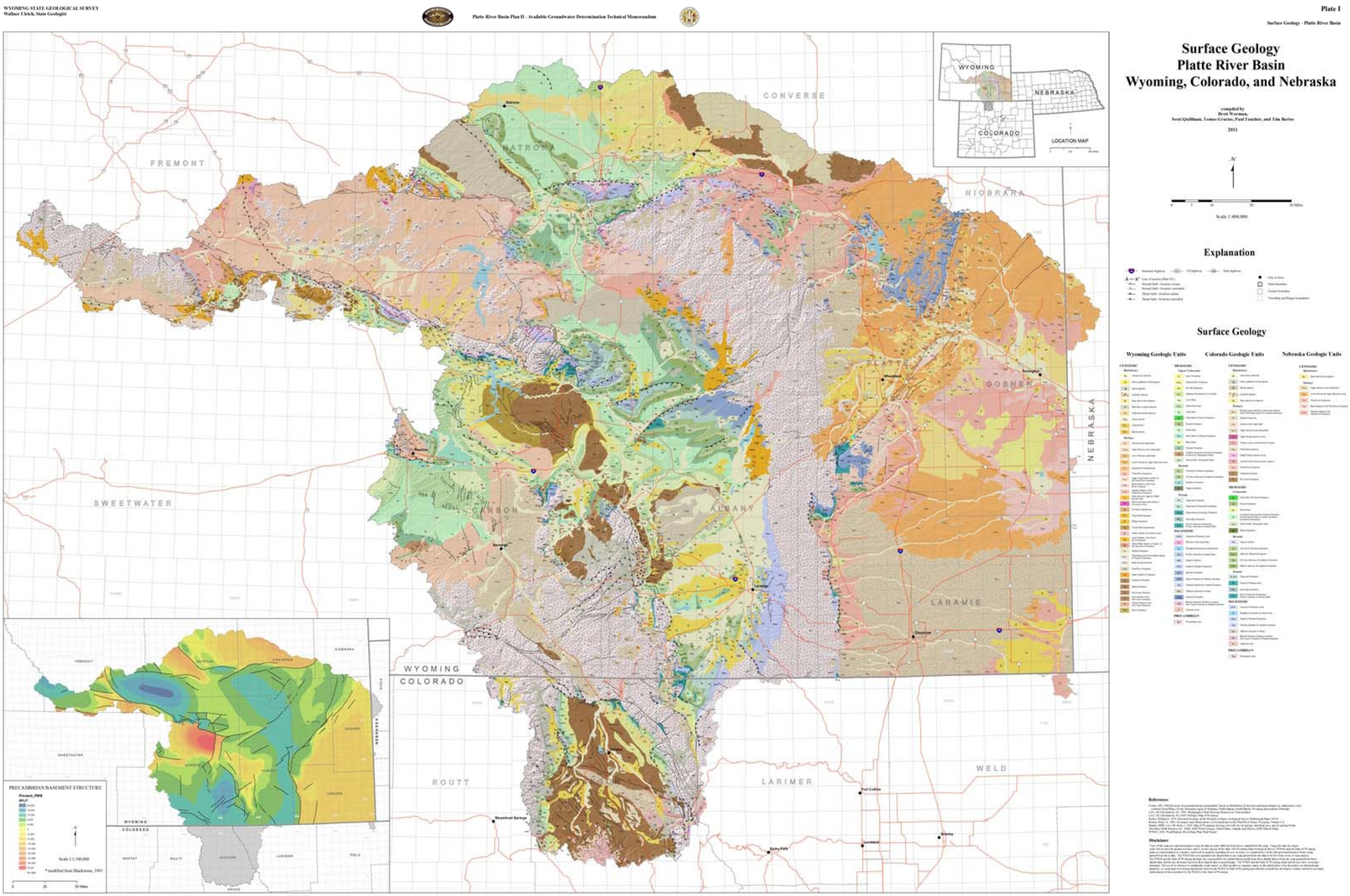
Groundwater Study Team

WWDO *Project Manager – Jodi Pavlica*

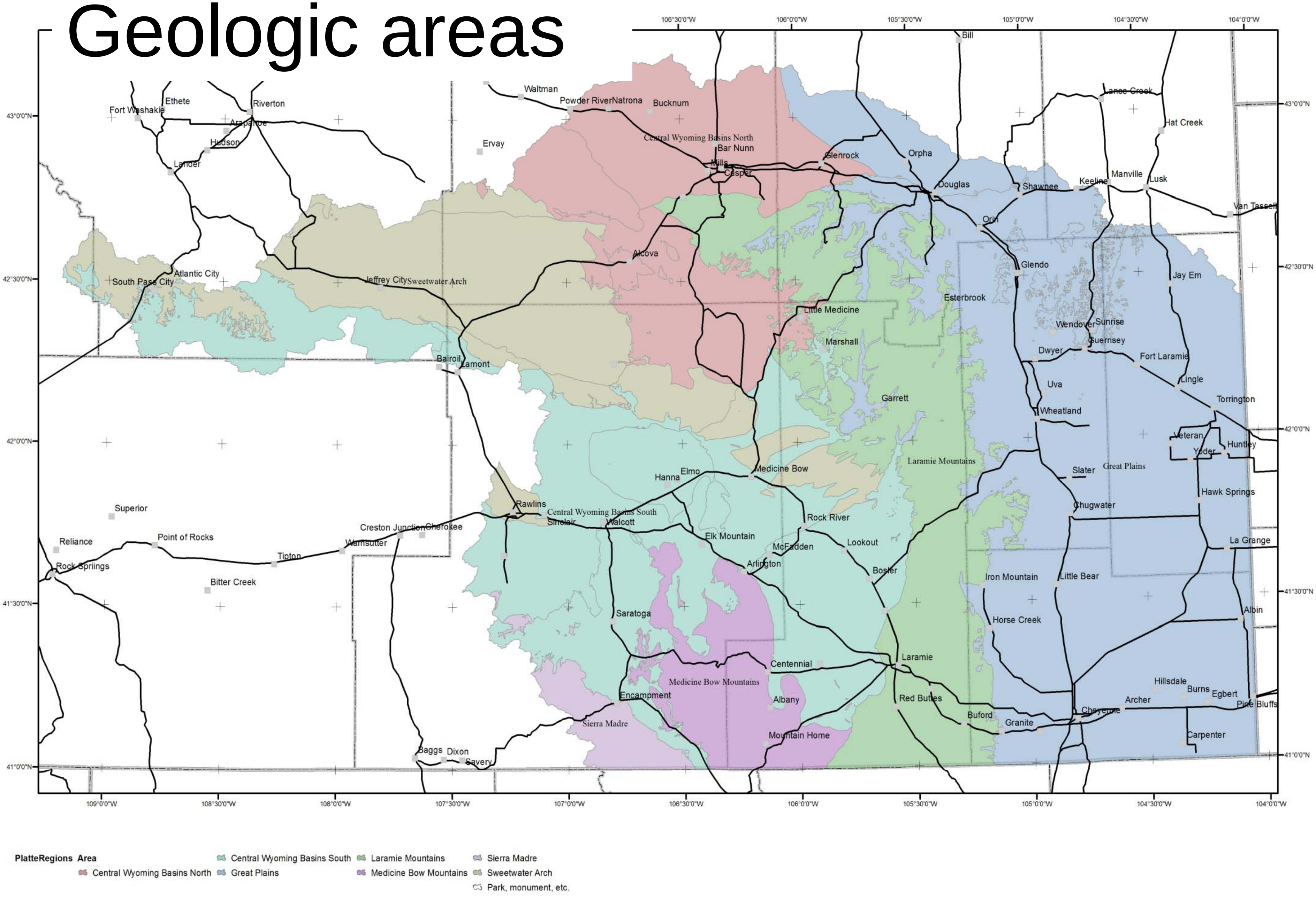
- **WSGS** – Laramie – *Scott Quillinan*
- **USGS** – Cheyenne – *Tim Bartos*
- **WRDS** – University of Wyoming – *Steve Gray*
- **Energy Compliance** - *Paul Taucher*
- **Hinckley Consulting** – *Bern Hinkley*

Platte river Groundwater Study

- Identify & inventory the “major” aquifers present within the drainage basin area
- Determine 3-dimensional configuration of the aquifers (outcrop areas, geologic structures, & depths)
- Estimate aquifer recharge rates, storage quantities, & discharge rates
- Identify areas with interaction between groundwater & surface water
- Assess the quantity & quality of groundwater available in the aquifers
- Investigate the usage of groundwater in the basin


WYOMING STATE GEOLOGICAL SURVEY
Wallace Ulrich, State Geologist
Plate I
Surface Geology - Platte River Basin
Surface Geology
Platte River Basin
Wyoming, Colorado, and Nebraska
compiled by
2011
Explanation
Surface Geology
Wyoming Geologic Units
Colorado Geologic Units
Nebraska Geologic Units
PRECAMBRIAN BASEMENT STRUCTURE
LOCATION MAP
WYOMING
NEBRASKA
COLORADO
FREMONT
NATRONA
CONVERSE
NIOBRARA
PLATTE
GOSHEN
SWEETWATER
CARBON
ALBANY
LARAMIE
ROUTT
LARIMER
WELD

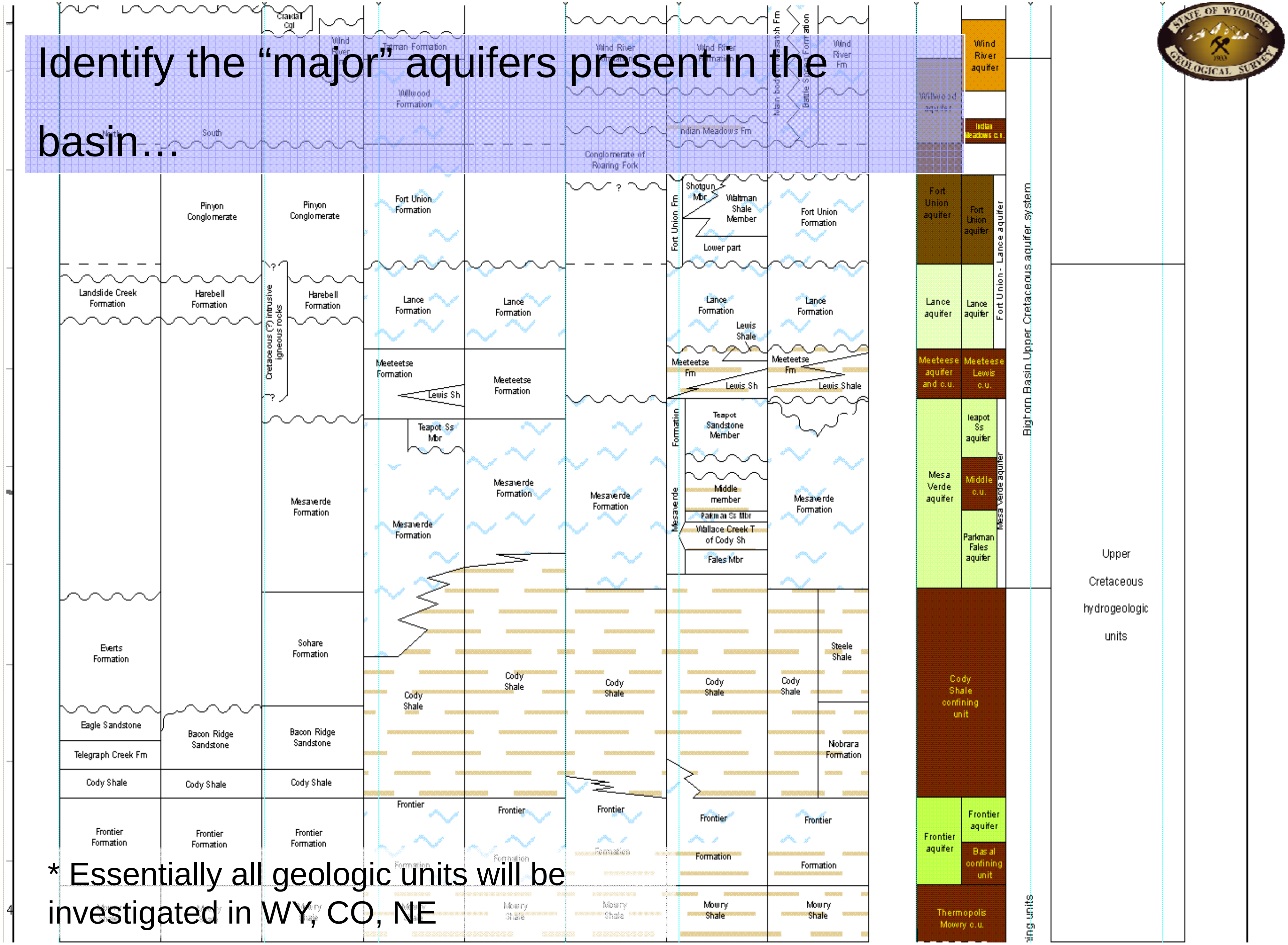
Geologic areas



Identify and evaluate existing groundwater studies…

ERA	System	Series	Stratigraphic units of Love et al. (1993) in Bighorn Basin and Owl Creek and Bighorn Mountains	Hydrogeologic divisions of Lowry et al. (1976)	Hydrogeologic unit of Libra et al. (1981)	Hydrogeologic unit of Western Water Consultants, Inc. (1982a,b) and Doremus (1982)	Hydrogeologic unit of Western Water Consultants, Inc. (1983b)	Hydrogeologic unit of Cooley (1984, 1986)	Hydrogeologic unit of Jarvis (1986) and Spencer (1986)	Hydrogeologic unit of Wyoming Statewide Framework Plan (WWC Engineering et al., 2007, fig. 4–9)	Hydrogeologic unit used in this report
CENOZOIC	Quaternary	Holocene and Pleistocene	Quaternary alluvium and terrace deposits	1	Major aquifer	Principal aquifers	Secondary aquifer			Major aquifer	Quaternary unconsolidated deposit aquifers
		Pliocene	Pliocene rocks not present								
	Tertiary	Miocene	Lower Miocene and Oligocene rocks[1]								
		Oligocene	White River Formation	2						Marginal aquifer	White River aquifer
		Eocene	Wapiti Formation[1] / Aycross Formation[1] / Wagon Bed Formation			Units not present and (or) discussed in study				Wagon Bed Formation–Marginal aquifer	Wagon Bed aquifer
			Tatman Formation[1]	3							
			Willwood Formation		Aquifer/discontinuous aquifers and confining units (Upper Cretaceous/Tertiary aquifer system)		Secondary aquifer			Minor aquifer	Willwood aquifer (Upper Cretaceous/Tertiary aquifer system)
		Paleocene	Fort Union Formation		Aquifer/discontinuous aquifers and confining units		Secondary aquifer			Major aquifer–Sandstone	Fort Union aquifer
MESOZOIC	Cretaceous	Upper Cretaceous	Lance Formation		Aquifer/discontinuous aquifers and confining units	Principal aquifer (Lance–Meeteetse–Mesaverde aquifer)	Secondary aquifer			Major aquifer	Lance aquifer
			Meeteetse Formation / Lewis Shale		Aquifer/discontinuous aquifers and confining units		Secondary aquifer			Major aquitard	Meeteetse aquifer and confining unit
			Mesaverde Formation / Teapot Sandstone Member		Aquifer/discontinuous aquifers and confining units		Secondary aquifer	Not discussed	Not discussed	Major aquifer–Sandstone	Mesaverde aquifer
			Cody Shale	4	Regional aquitard	Major regional confining unit	Leaky confining unit			Major aquitard	Cody Shale confining unit
			Frontier Formation		Minor aquifer (dle Mesozoic aquifers)	Principal aquifer (Frontier aquifer)	Alternating leaky confining units and secondary aquifers			Minor aquifer	Frontier aquifer (k Mesozoic aquifers and confining units)
			Mowry Shale		Aquitard	Leaky confining unit (Regional confining unit)	Leaky confining unit			Major aquitard	Thermopolis–Mowry
		Lower Cretaceous	Muddy Sandstone		Aquitard	Minor aquifer	Secondary aquifer			? Muddy Sandstone ?[3]	Muddy Ss aquifer
			Thermopolis Shale			Leaky confining unit	Leaky confining unit			Major aquitard	confining unit
			Cloverly Formation		Minor aquifer	Principal aquifer (Cloverly aquifer)	Secondary aquifer			Major aquifer–Sandstone	Cloverly aquifer

Identify the "major" aquifers present in the basin…



* Essentially all geologic units will be investigated in WY, CO, NE

Define the 3-D extent of the aquifers…

Identify aquifer recharge areas…

1). Map depicting the outcrop areas of all aquifers and confining units

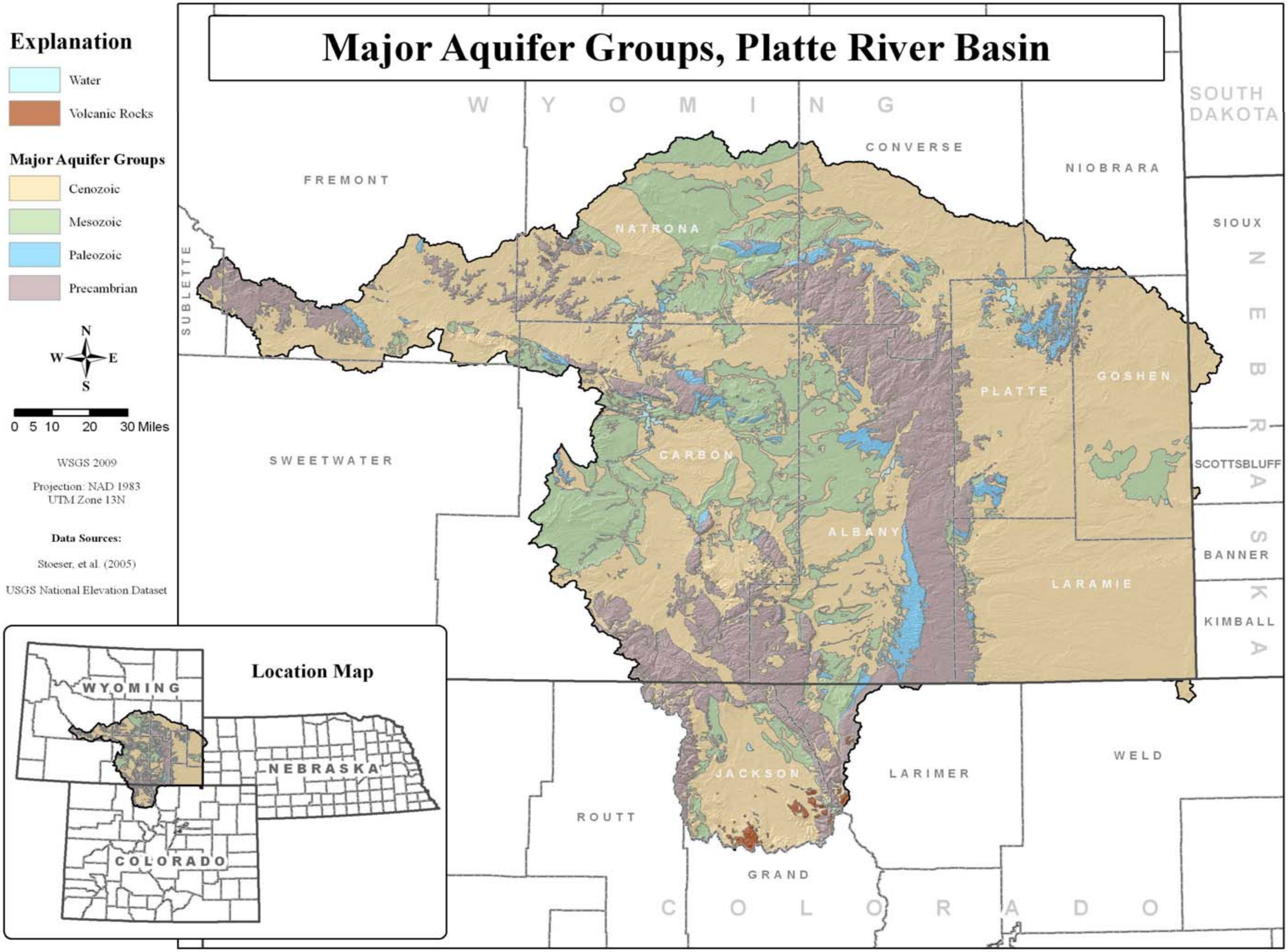
2). Series of cross-sections (small but multiple)

3). Isopach (thickness) maps are limited

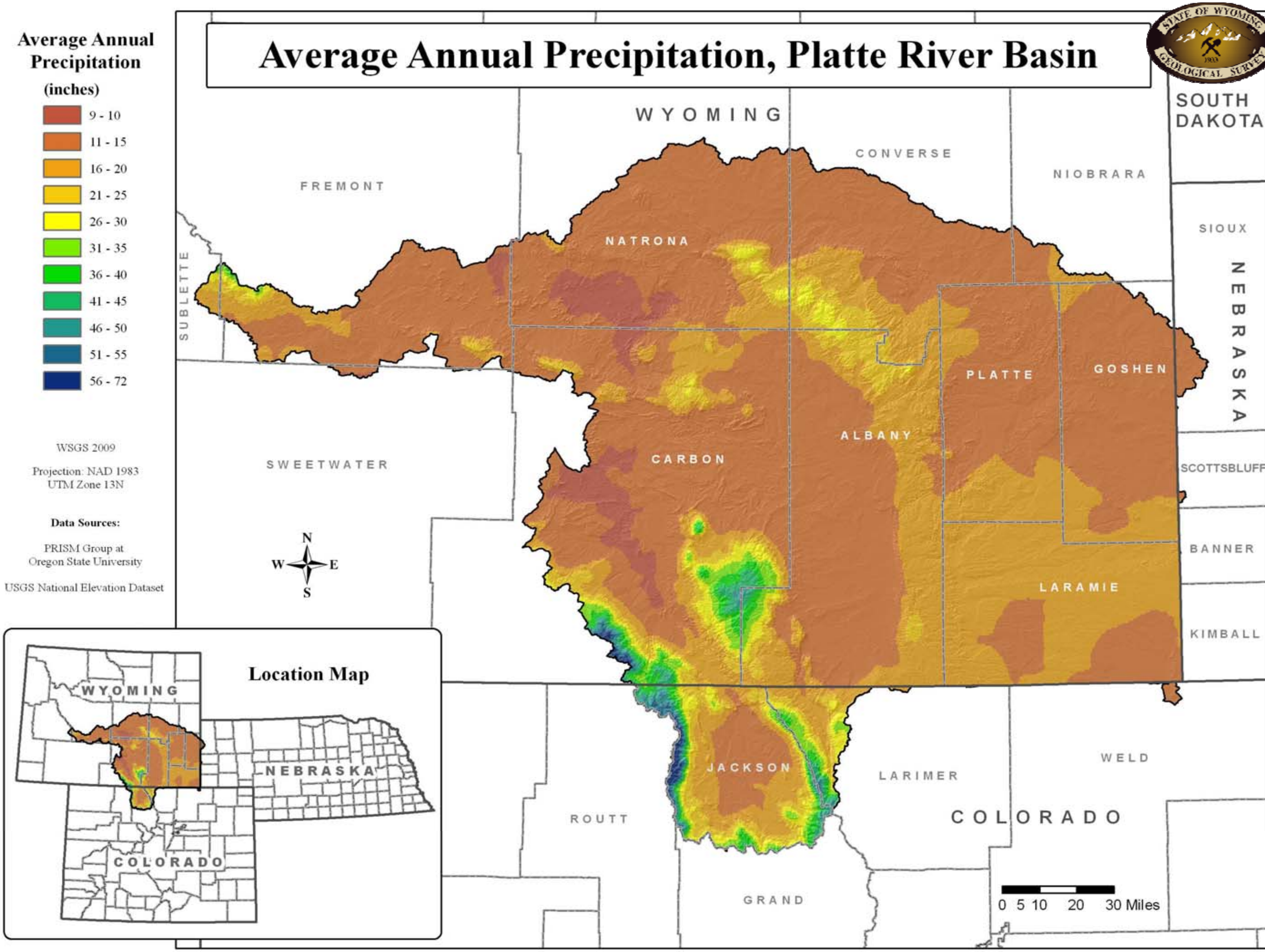
4) Some 3-D modeling has been done for Laramie County

4). Geologic structures and basement elevation

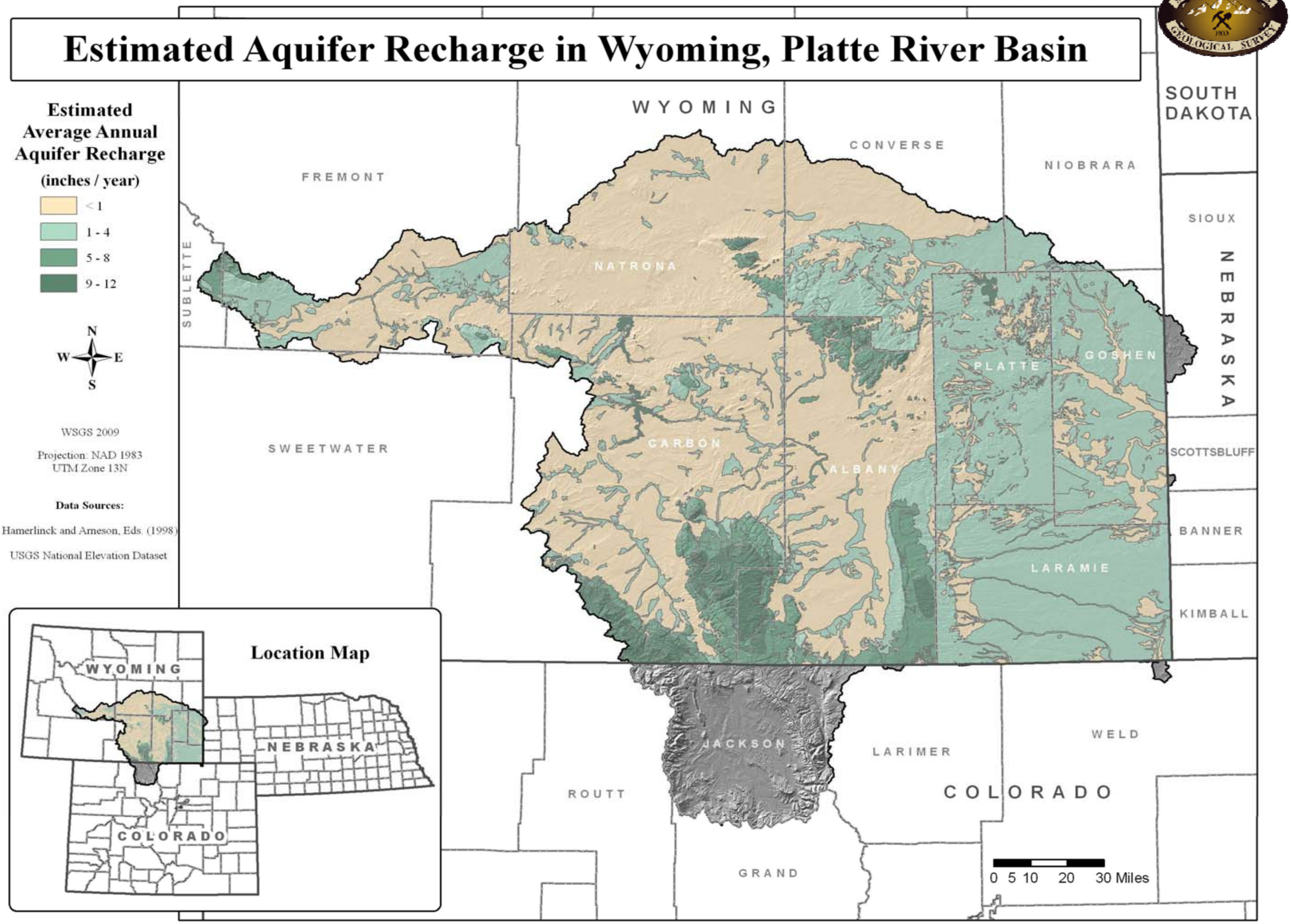
Major Aquifer Groups, Platte River Basin



Average Annual Precipitation, Platte River Basin

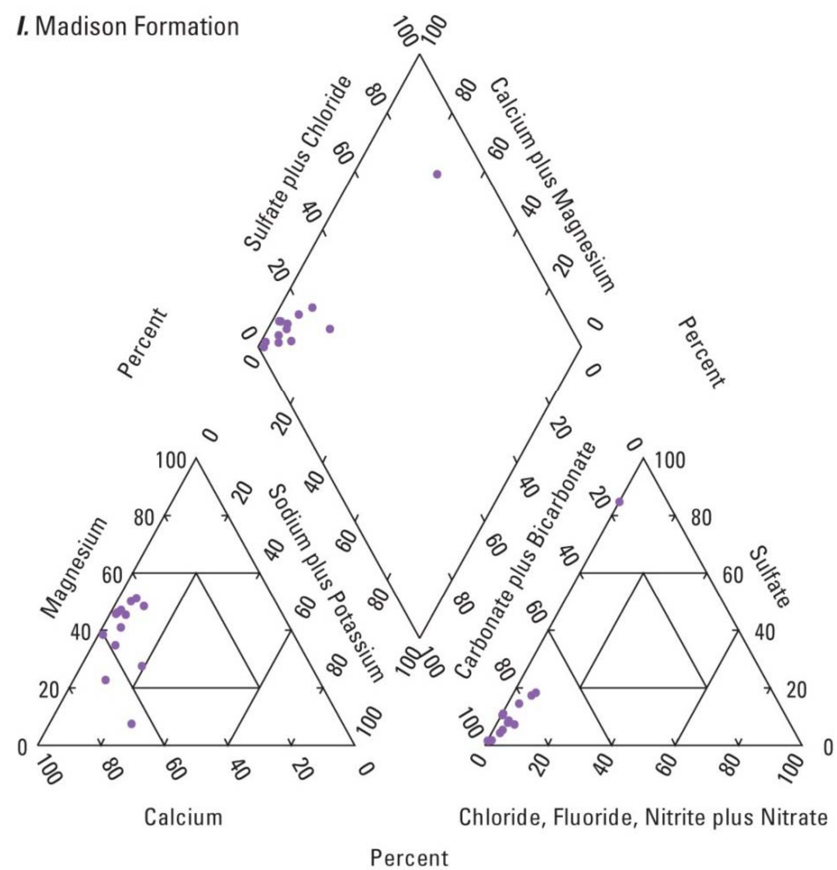


Estimated Aquifer Recharge in Wyoming, Platte River Basin



Identify the hydro-geologic, hydraulic, and hydro-geochemical....

- Compile and interpret water quality data
- Identify principal pollutants for each aquifer
- Compare water quality to state and federal regulatory standards



[--, not applicable; µS/cm, microsiemens per centimeter. Values in black are in milligrams per liter unless otherwise noted; values in blue are in micrograms per liter]

Geologic unit	Constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Sample size
Madison Formation—Continued	Silica	7.5	8.6	10.3	20.0	24.0	12
	Sulfate	3.3	9.3	17.0	27.0	560	13
	Dissolved solids	181	209	216	245	920	13
	Ammonia (as N)	--	0.020	0.020	0.030	--	5
	Nitrate+nitrite (as N)	--	0.080	0.20	0.92	--	11
	Phosphorus, unfiltered (as P)	--	0.006	0.009	0.020	--	8
	Boron	--	14.4	20.0	27.8	--	7
	Iron	--	3.0	60.0	140	--	7
	Manganese	--	0.85	20.0	80.0	--	7
	Alpha radioactivity (picocuries per liter)	--	1.2	2.7	6.8	--	6
	Gross beta radioactivity (picocuries per liter)	--	2.0	4.0	6.3	--	5
	Radium-226 (picocuries per liter)	--	0.92	1.2	2.7	--	4
	Uranium, natural	--	1.3	2.1	2.8	--	4

Summary of well yield, spring discharge, and hydraulic properties for each aquifer or aquifer system

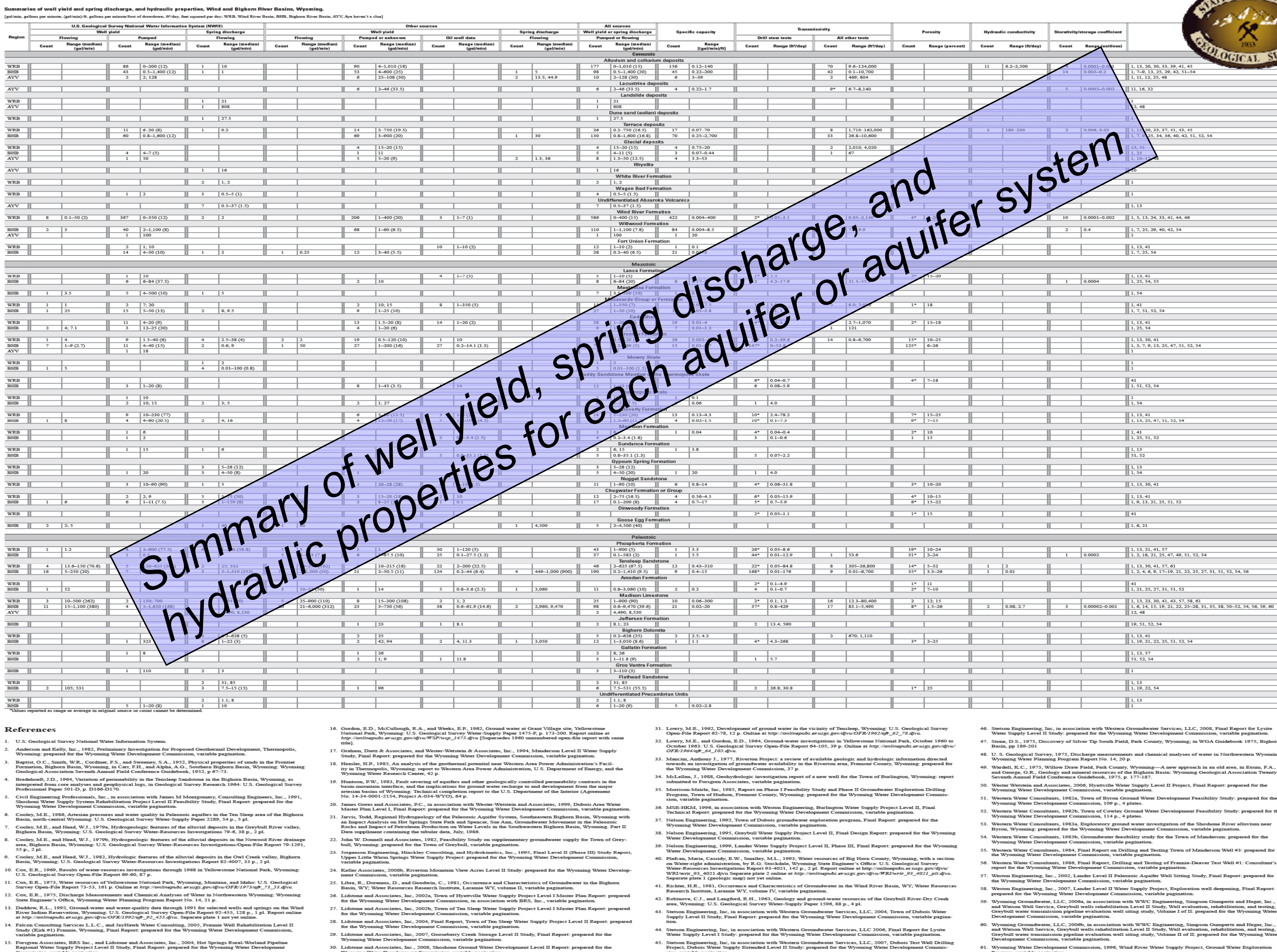


Plate X. Summaries of well yield, spring discharge, and hydraulic properties, Wind and Bighorn River Basins, Wyoming.

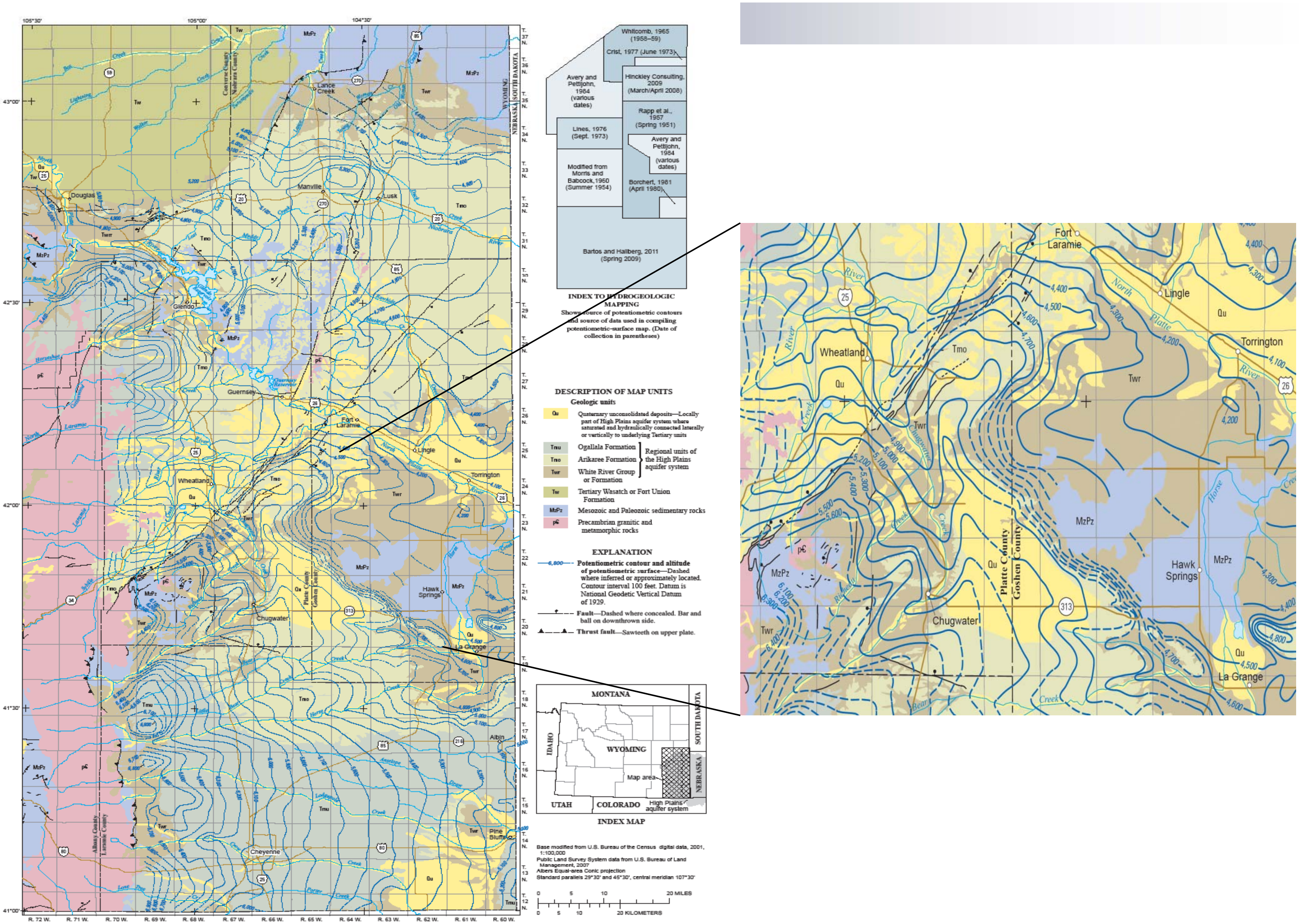
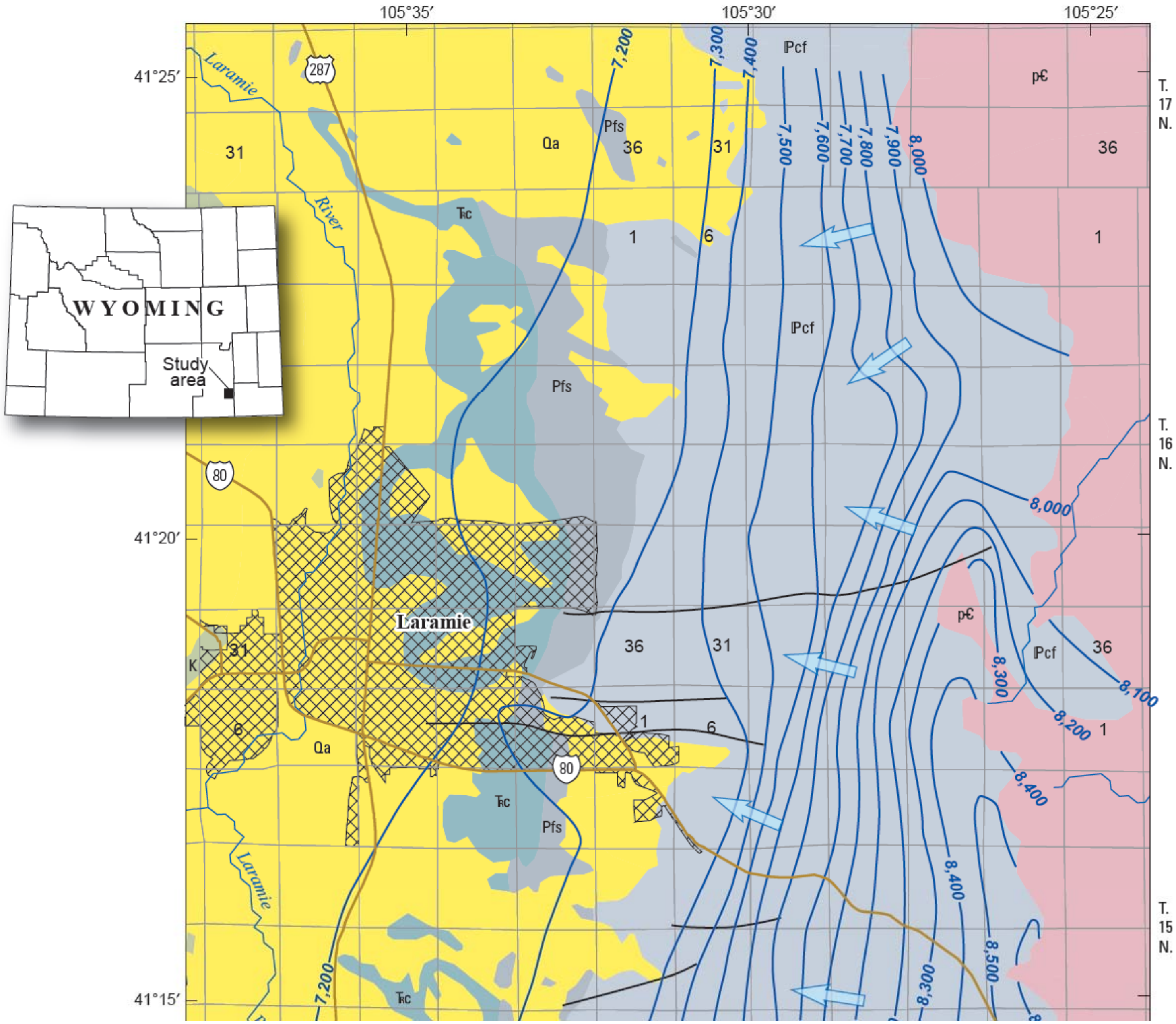
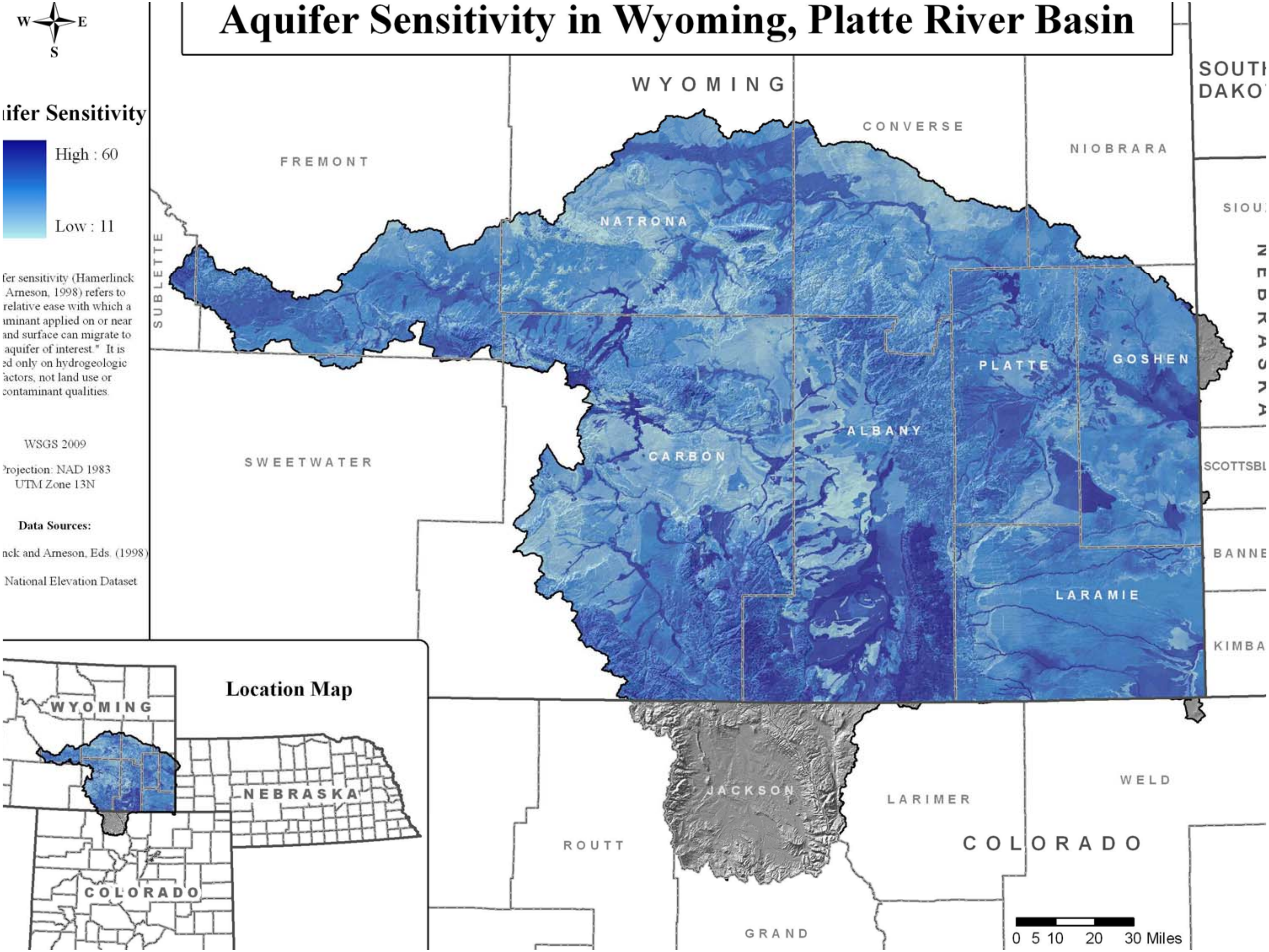


Figure 5. Generalized potentiometric-surface map of the High Plains aquifer system in southeastern Wyoming.


105°35′
105°30′
105°25′
41°25′
41°20′
41°15′
T. 17 N.
T. 16 N.
T. 15 N.
WYOMING
Study area
Laramie
Laramie River
Laramie
287
80
80
Qa
Pfs
Pcf
p€
Trc
K
31
36
1
6
7,200
7,300
7,400
7,500
7,600
7,700
7,800
7,900
8,000
8,100
8,200
8,300
8,400
8,500

Aquifer Sensitivity in Wyoming, Platte River Basin



- **WDEQ Water Quality Division:**
  - Known contaminated sites under the Groundwater Pollution Control Program
  - Class I, III, IV, V injection wells under the Underground Injection Control **(UIC)** Program
  - Wyoming Pollutant Discharge Elimination System **(WYPDES)** and National Pollutant Discharge Elimination System **(NPDES)** discharge points
  - Public Owned Treatment Works **(POTWs)** and septic systems (Water and Wastewater Program)
  - Concentrated Animal Feeding Operations **(CAFOs)**
  - Pesticides / herbicides **(Nonpoint Source Program)**

- **WDEQ Solid and Hazardous Waste Division:**
  - Known contaminated sites under the Voluntary Remediation Program **(VRP)**
  - Permitted disposal pits and other small Treatment Storage and Disposal **(TSD)** facilities
  - Landfills
  - Above and underground storage tanks

- **WDEQ Land Quality and Abandoned Mine Land Division:**
  - Active and inactive mines **(LQD/AML)**
  - Gravel Pits, Quarries, etc.

- **Wyoming Oil & Gas Conservation Commission:**
  - Class II disposal wells
  - Produced water pits

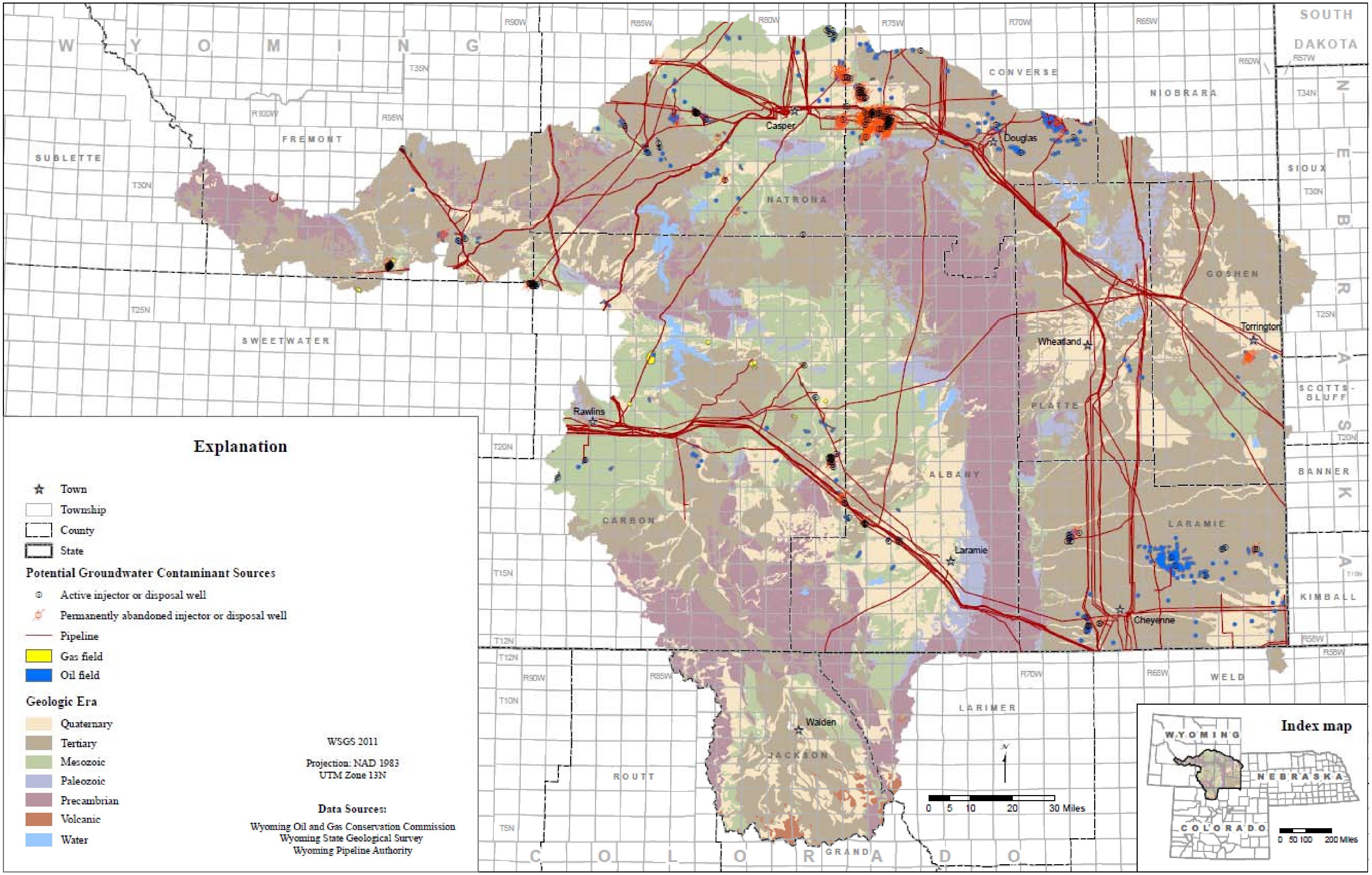
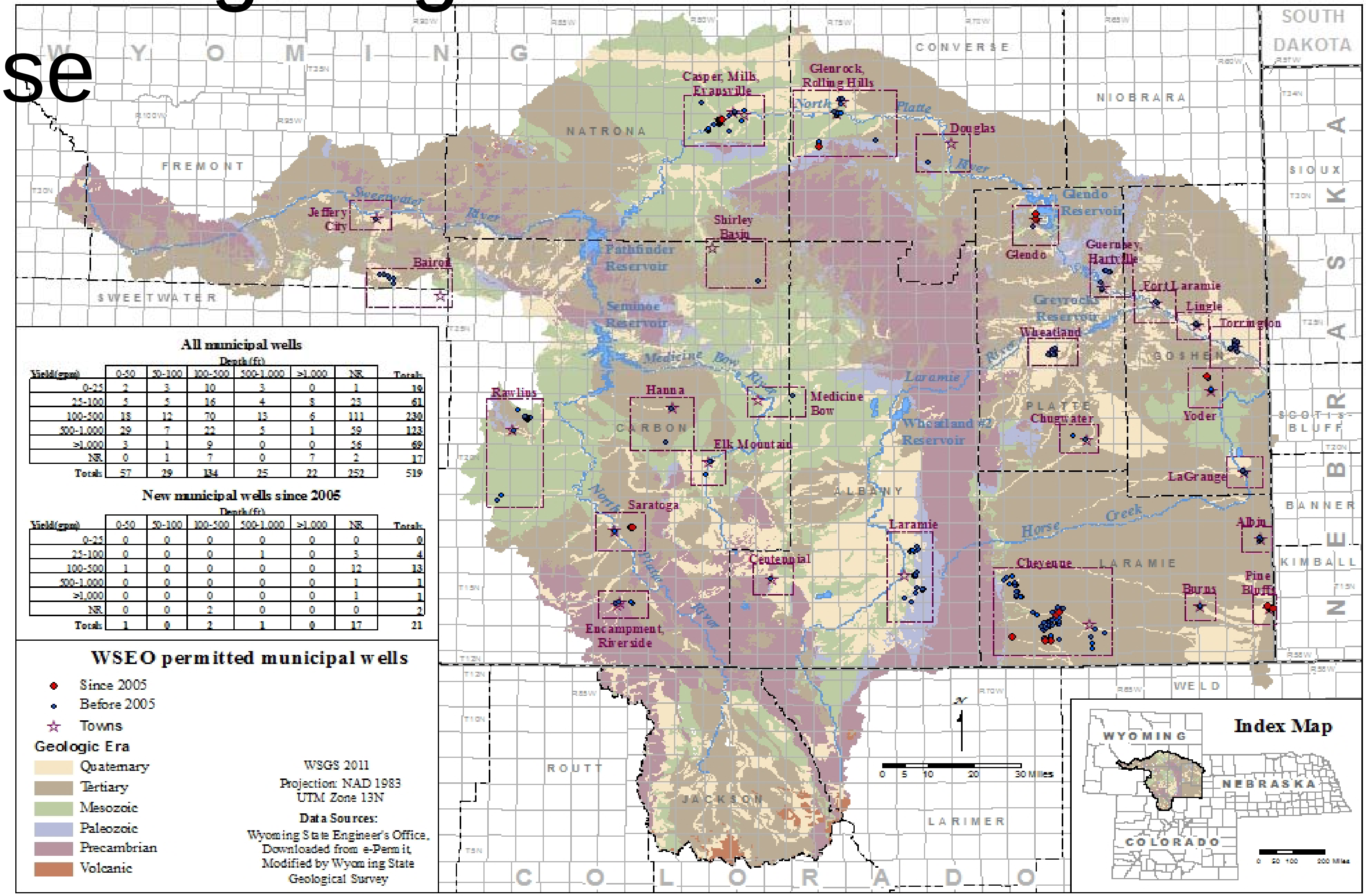


Figure x-x - Potential groundwater contaminant sources: oil and gas fields, pipelines, and Class II injection and disposal wells, Wyoming Platte River Basin.

Investigate groundwater use



All municipal wells

Depth (ft)

Yield (gpm)	0-50	50-100	100-500	500-1,000	>1,000	NR	Totals
0-25	2	3	10	3	0	1	19
25-100	5	5	16	4	8	23	61
100-500	18	12	70	13	6	111	230
500-1,000	29	7	22	5	1	59	123
>1,000	3	1	9	0	0	56	69
NR	0	1	7	0	7	2	17
Totals	57	29	134	25	22	252	519

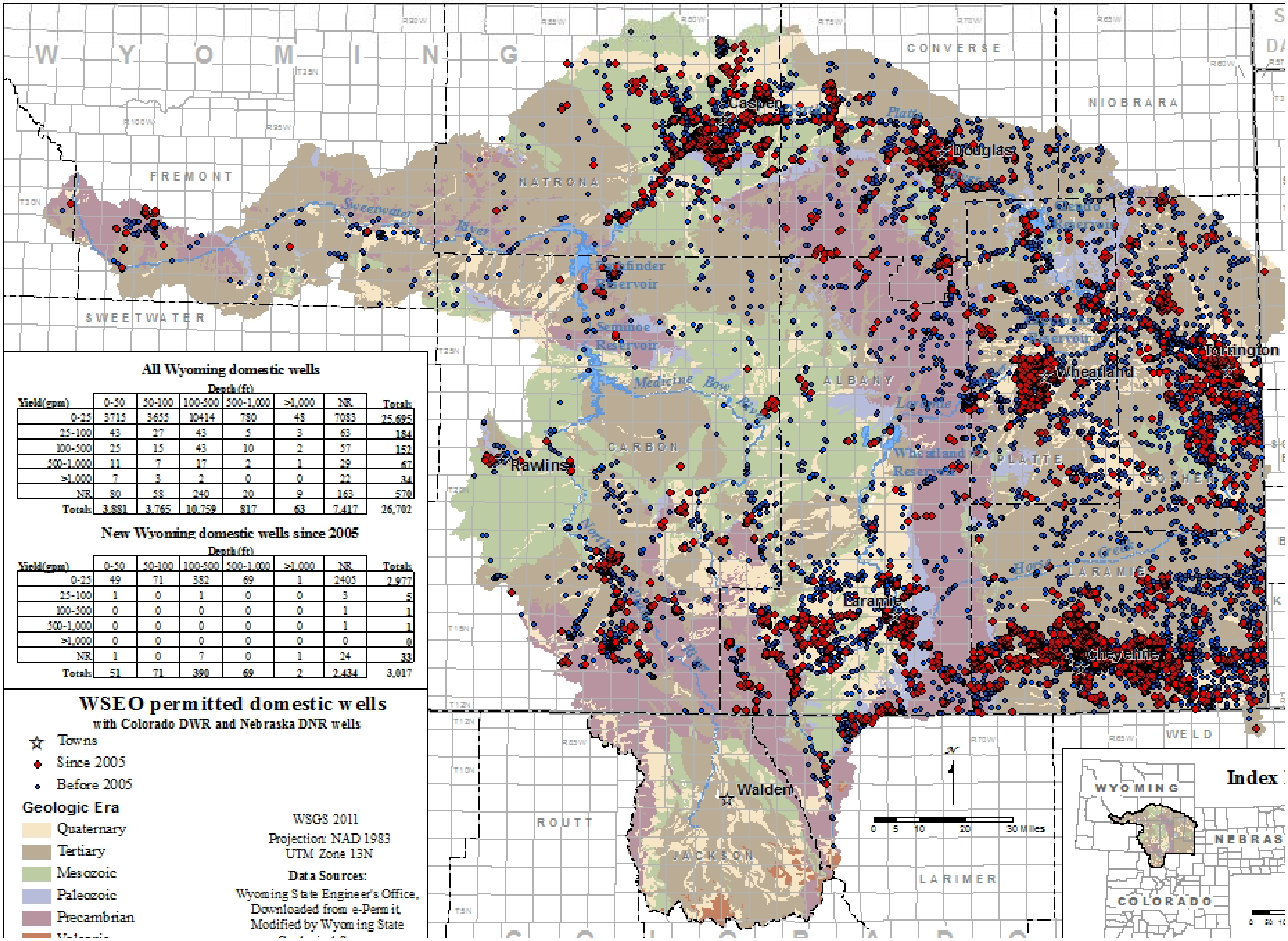
New municipal wells since 2005

Depth (ft)

Yield (gpm)	0-50	50-100	100-500	500-1,000	>1,000	NR	Totals
0-25	0	0	0	0	0	0	0
25-100	0	0	0	1	0	3	4
100-500	1	0	0	0	0	12	13
500-1,000	0	0	0	0	0	1	1
>1,000	0	0	0	0	0	1	1
NR	0	0	2	0	0	0	2
Totals	1	0	2	1	0	17	21

Figure x-x. Municipal permitted wells, Platte River Basin.

Domestic groundwater permits



All Wyoming domestic wells

Yield (gpm)	Depth (ft) 0-50	50-100	100-500	500-1,000	>1,000	NR	Totals
0-25	3715	3655	10414	780	48	7083	25,695
25-100	43	27	43	5	3	63	184
100-500	25	15	43	10	2	57	152
500-1,000	11	7	17	2	1	29	67
>1,000	7	3	2	0	0	22	34
NR	80	58	240	20	9	163	570
Totals	3,881	3,765	10,759	817	63	7,417	26,702

New Wyoming domestic wells since 2005

Yield (gpm)	Depth (ft) 0-50	50-100	100-500	500-1,000	>1,000	NR	Totals
0-25	49	71	382	69	1	2405	2,977
25-100	1	0	1	0	0	3	5
100-500	0	0	0	0	0	1	1
500-1,000	0	0	0	0	0	1	1
>1,000	0	0	0	0	0	0	0
NR	1	0	7	0	1	24	33
Totals	51	71	390	69	2	2,434	3,017

Appendix A

HINCKLEY

CONSULTING

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MEMORANDUM

TO: Matt Hoobler DATE: February 7, 2011

FROM: Bern Hinckley PROJECT: North Platte Technical Support

SUBJECT: Hydrological Connection

This memo has been prepared at the request of the Wyoming State Engineer's Office (SEO) to provide background and screening criteria for assessment of "hydrological connection" of groundwater wells in the North Platte River Basin under the provisions of the Modified North Platte Decree and the Platte River Recovery Implementation Program (PRRIP), i.e. the "28:40" connection criteria. Following discussion of the origin and associated principles, a step-by-step approach to application is suggested. The final section provides references and calculation tools.

BACKGROUND / HISTORY

MBSA, 1982. For a series of reports published in 1982, the Missouri Basin States Association developed an analysis of the impact of groundwater development on streamflow, i.e. "stream

Summary

- We are identifying and characterizing each aquifer (Define recharge areas, areal extent, thickness, hydraulic properties, water quality)
- Calculating (recharge rates, quantity, safe yield, potential contaminate areas and future development opportunities)
- Modified North Platte Decree (Appendix complete)
- Inventory potential contaminant sources (complete)
- Inventory of SEO permitted wells is (complete)
- The WSGS-USGS-WRDS team is progressing with the groundwater study for the updated Platte study.

Thank you, Questions?

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