



Hydrogeology and Beneficial Use of CBM Produced Water in Colorado

AWRA
Durango, Colorado
September 30, 2003

Dick Wolfe, P.E.
&
Glenn Graham, P.G.



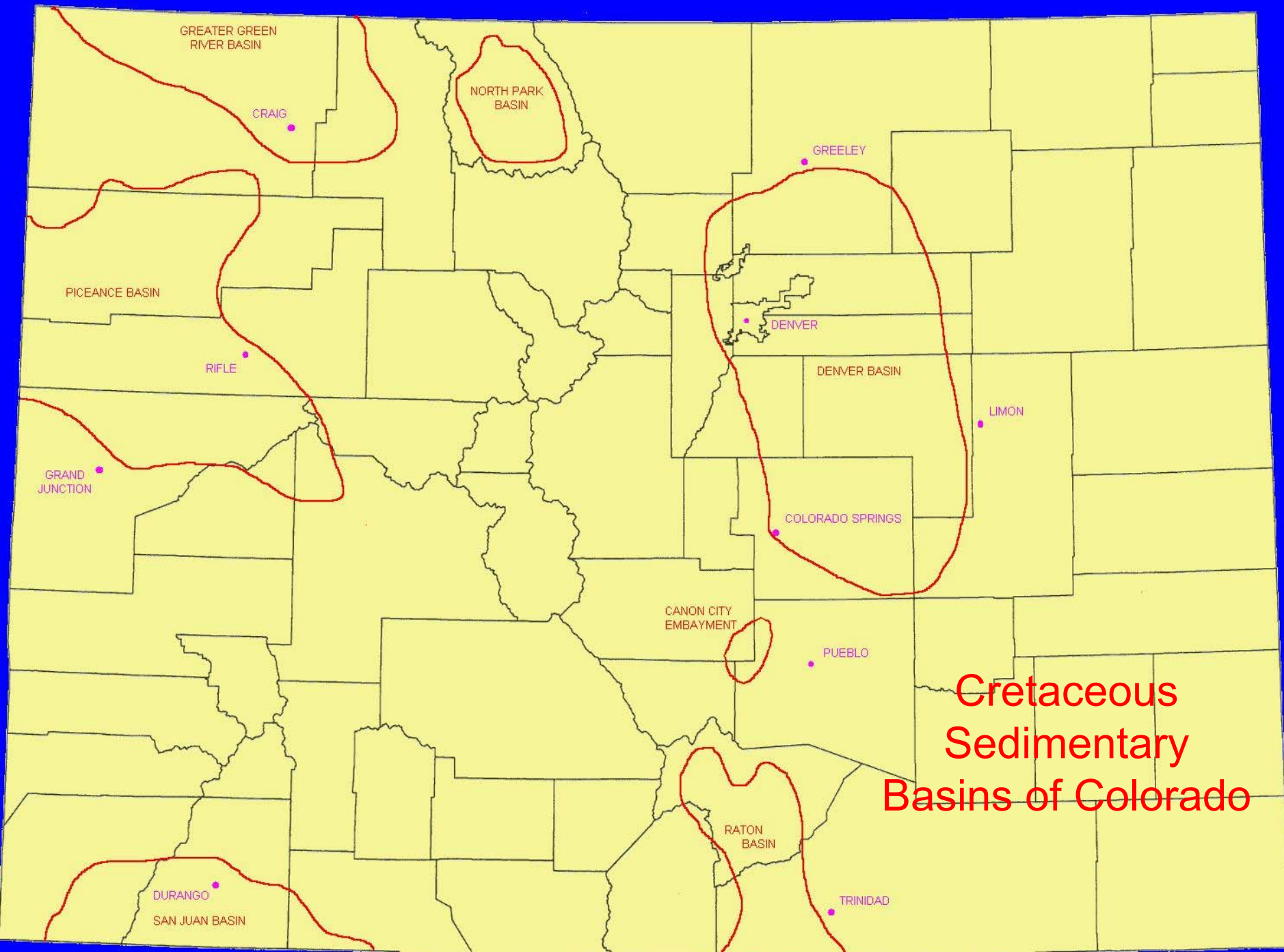
INTERIOR CRETACEOUS
SEAWAY ABOUT 65 MYBP





FRONT RANGE OF COLORADO 65 MYBP

**DENVER MUSEUM OF NATURE AND SCIENCE AND
DIANE BRAGINETZ WITH PERMISSION**



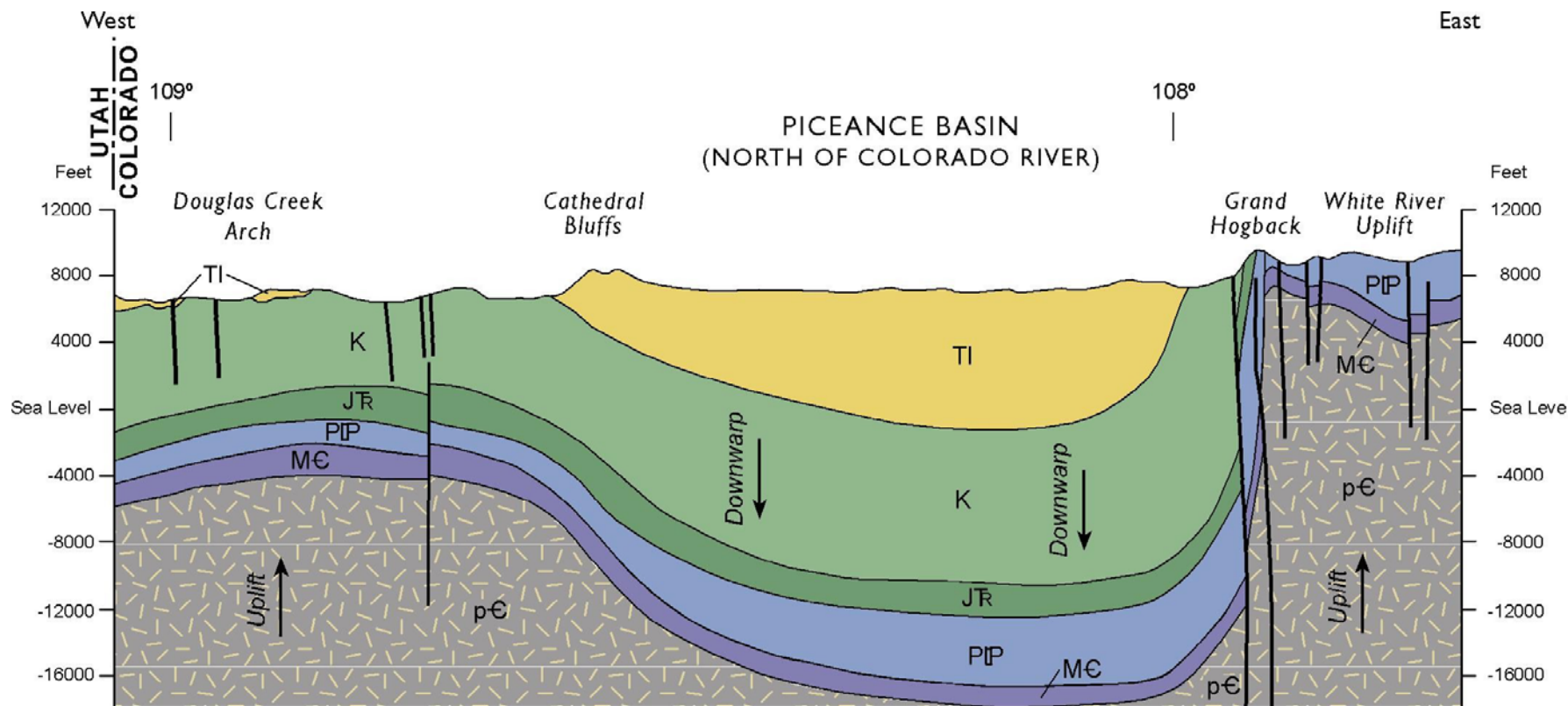


CRETACEOUS AND YOUNGER ROCKS WITH CBM POTENTIAL

CRETACEOUS AND YOUNGER ROCKS WITH CBM POTENTIAL

GEOLOGIC CROSS SECTION

PICEANCE BASIN, COLORADO NORTH OF THE COLORADO RIVER



EXPLANATION

TI Lower Tertiary sedimentary rocks

K Cretaceous sedimentary rocks

JR Jurassic and Triassic sedimentary rocks

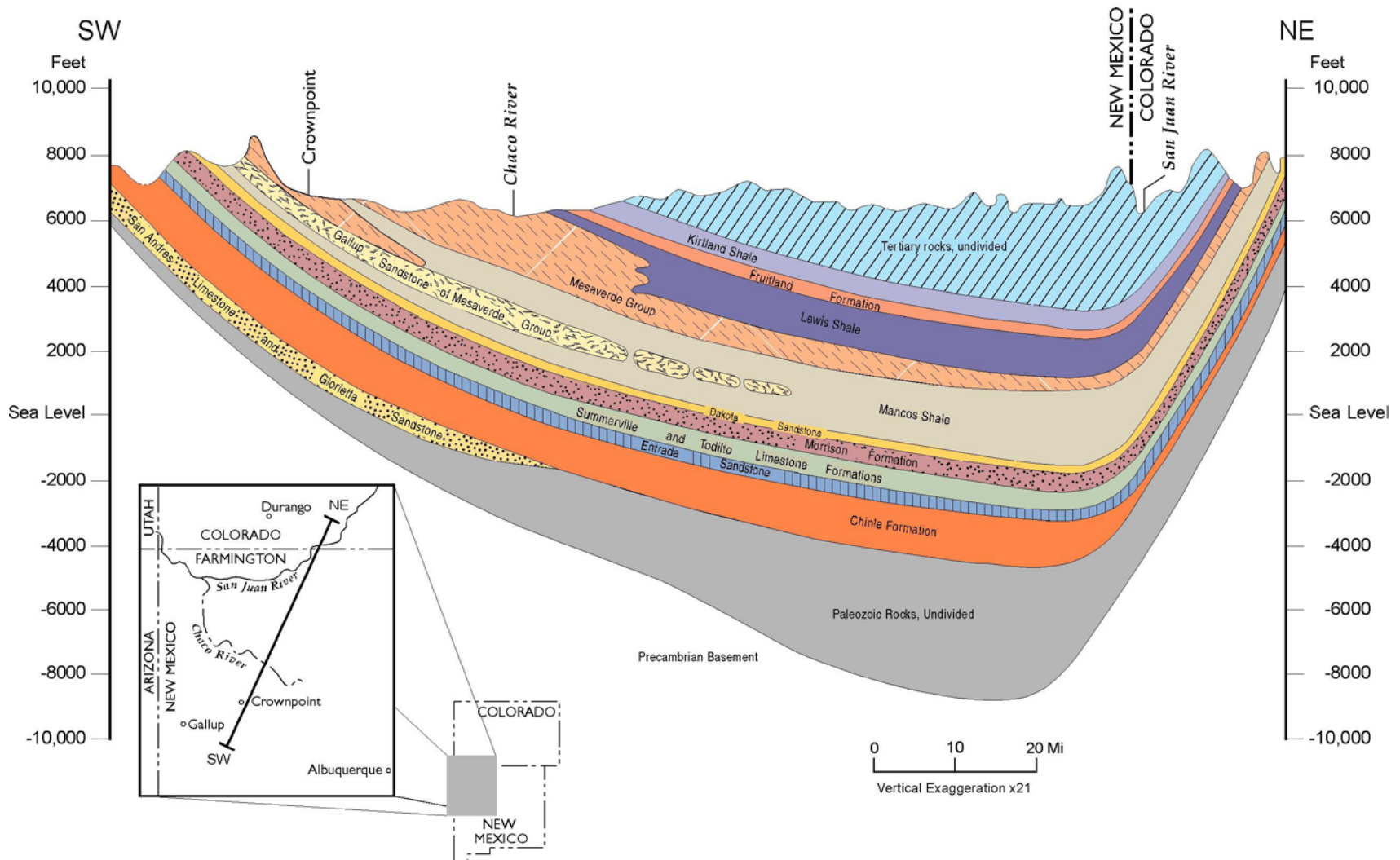
PIP Permian Pennsylvanian sedimentary rocks

ME Mississippian, Devonian, Ordovician and Cambrian sedimentary rocks

pC Precambrian rocks of unknown age and character

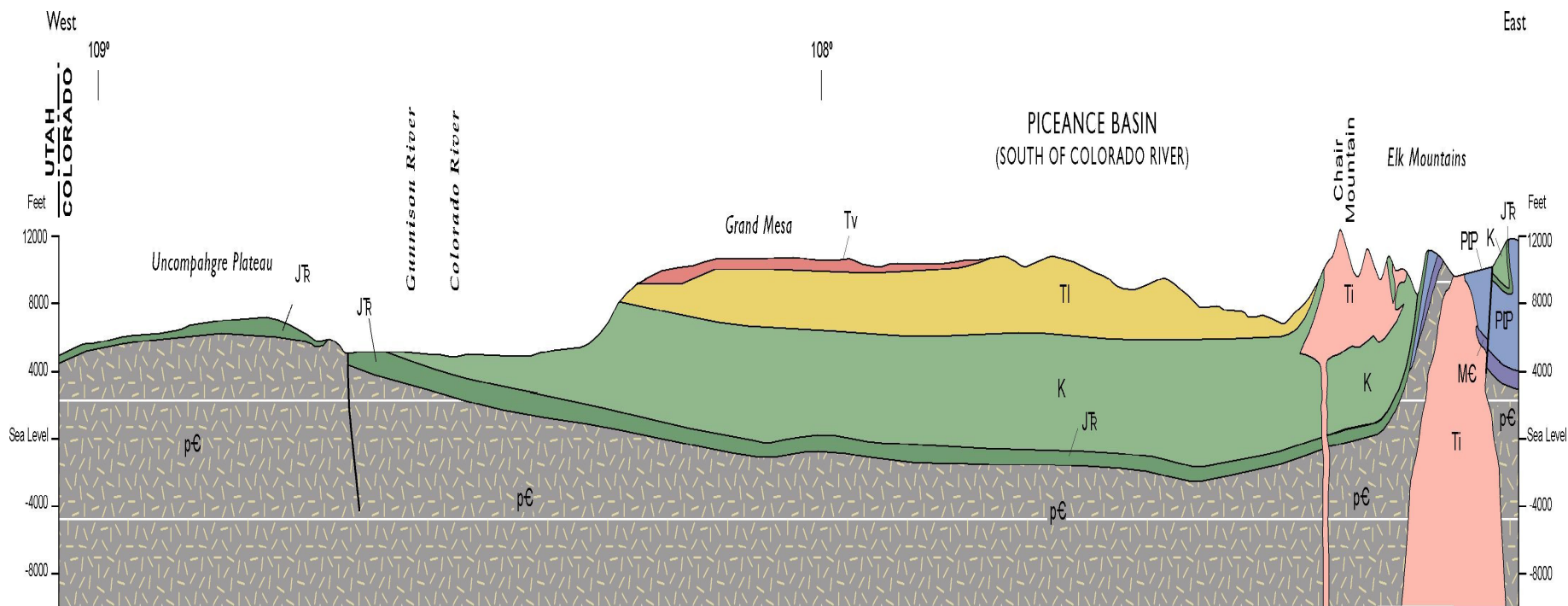
GEOLOGIC CROSS SECTION

SAN JUAN BASIN, COLORADO & NEW MEXICO



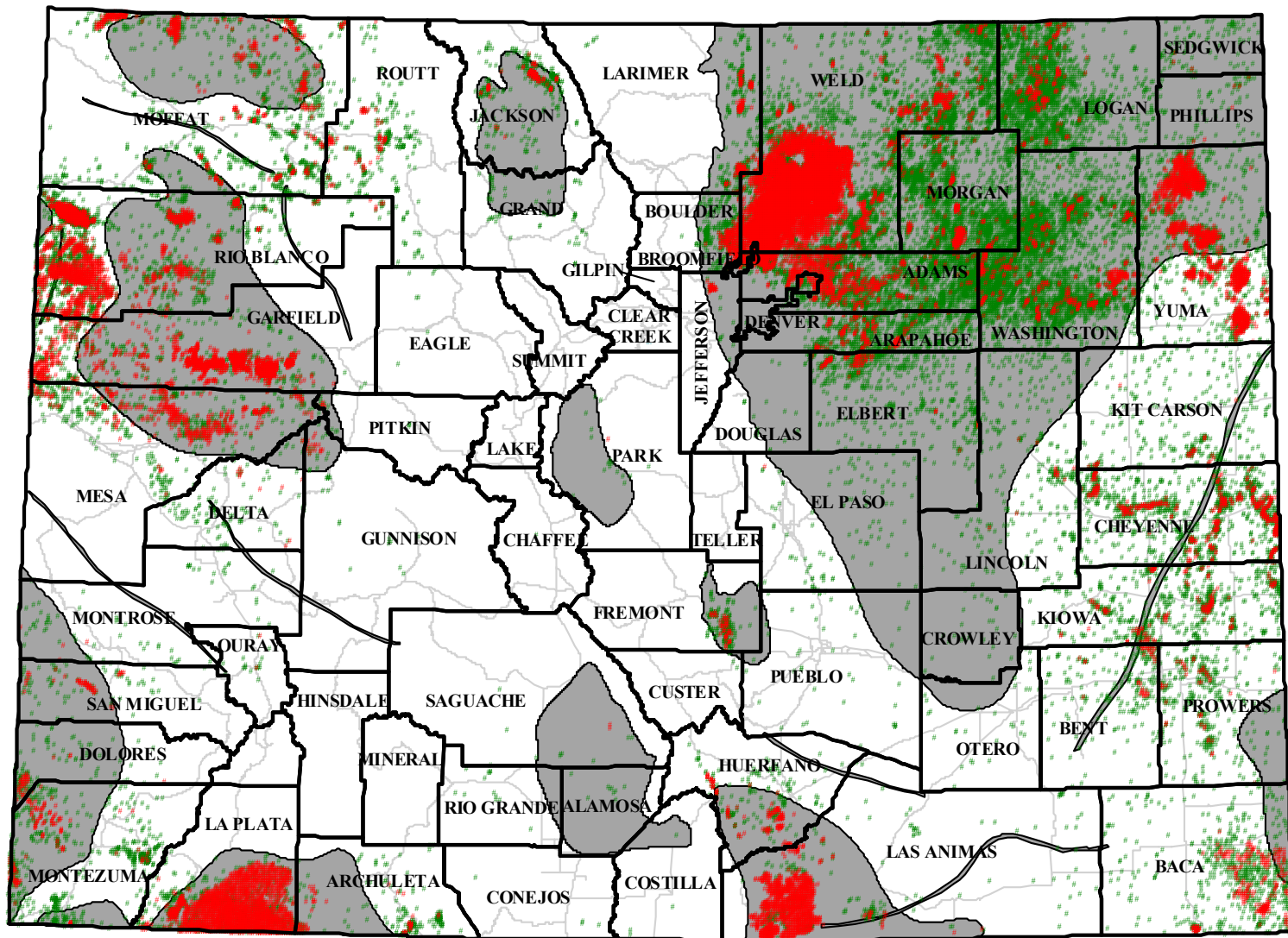
GEOLOGIC CROSS SECTION

PICEANCE BASIN, COLORADO SOUTH OF THE COLORADO RIVER



EXPLANATION

Tv Tertiary volcanic rocks	Ti Lower Tertiary sedimentary rocks	JR Jurassic and Triassic sedimentary rock	ME Mississippian, Devonian, Ordovician and Cambrian sedimentary rocks
Ti Middle Tertiary intrusive rocks	K Cretaceous sedimentary rocks	PIP Permian Pennsylvanian sedimentary rocks	pC Precambrian rocks of unknown age and character

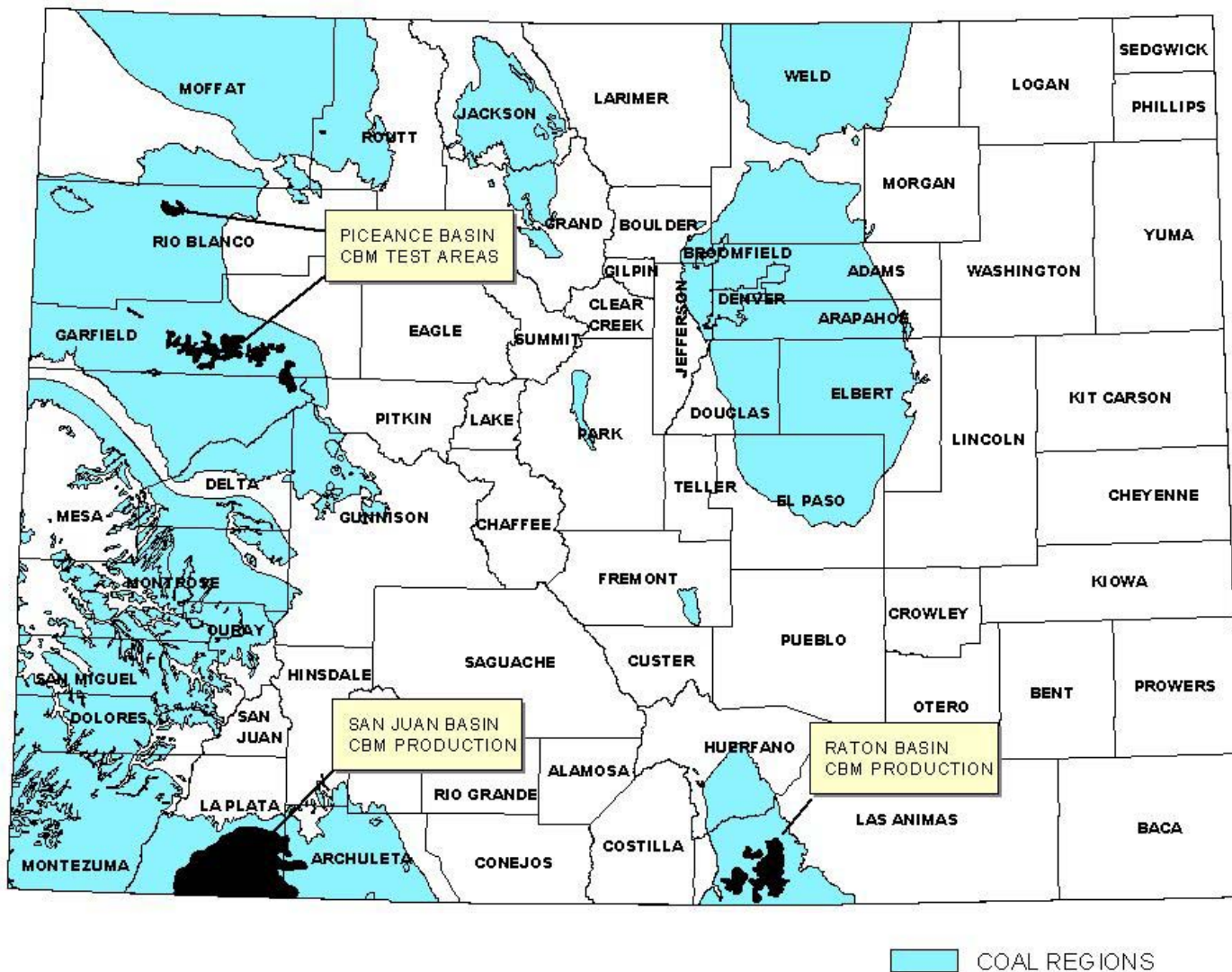


OIL & GAS WELLS OF COLORADO

SOURCE COGCC

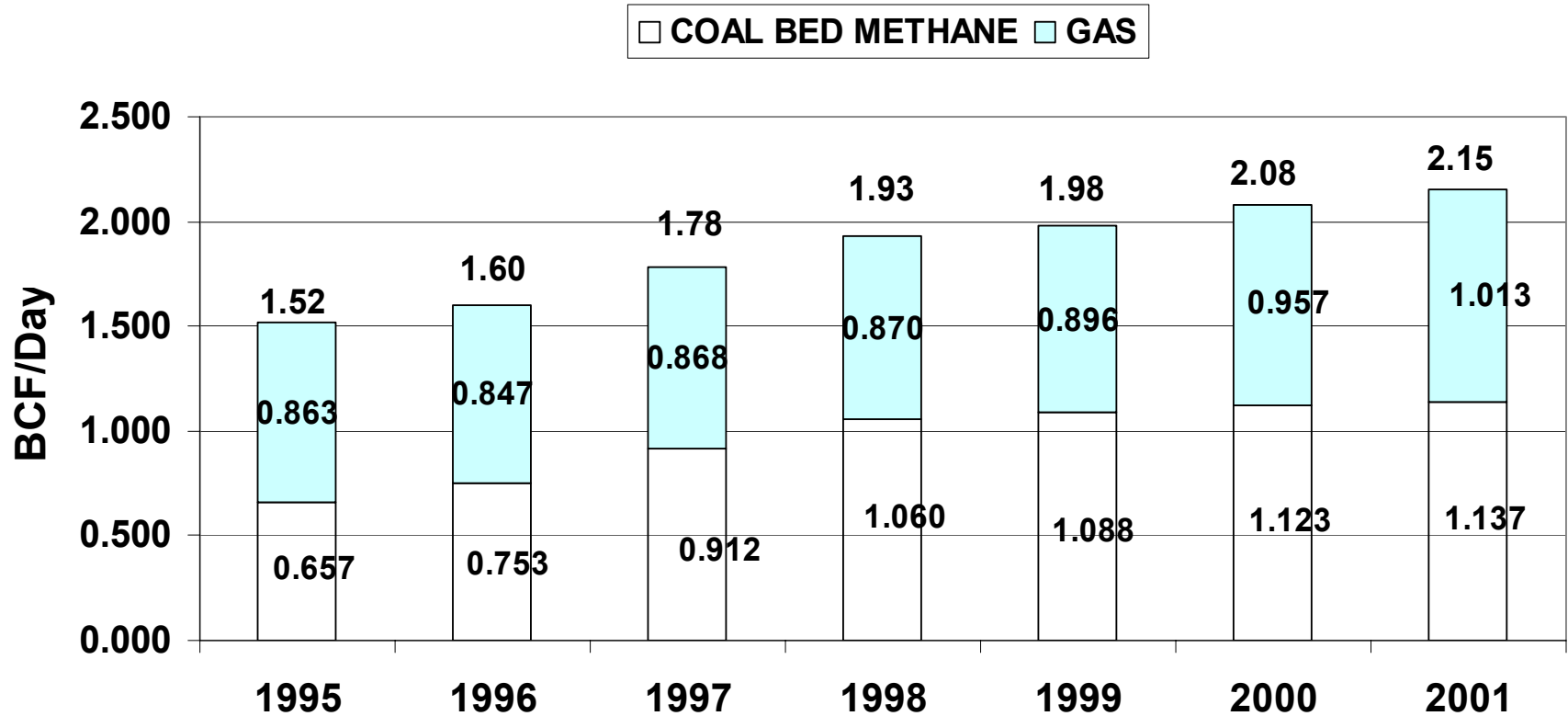
COALBED GAS IN COLORADO

2,300 WELLS



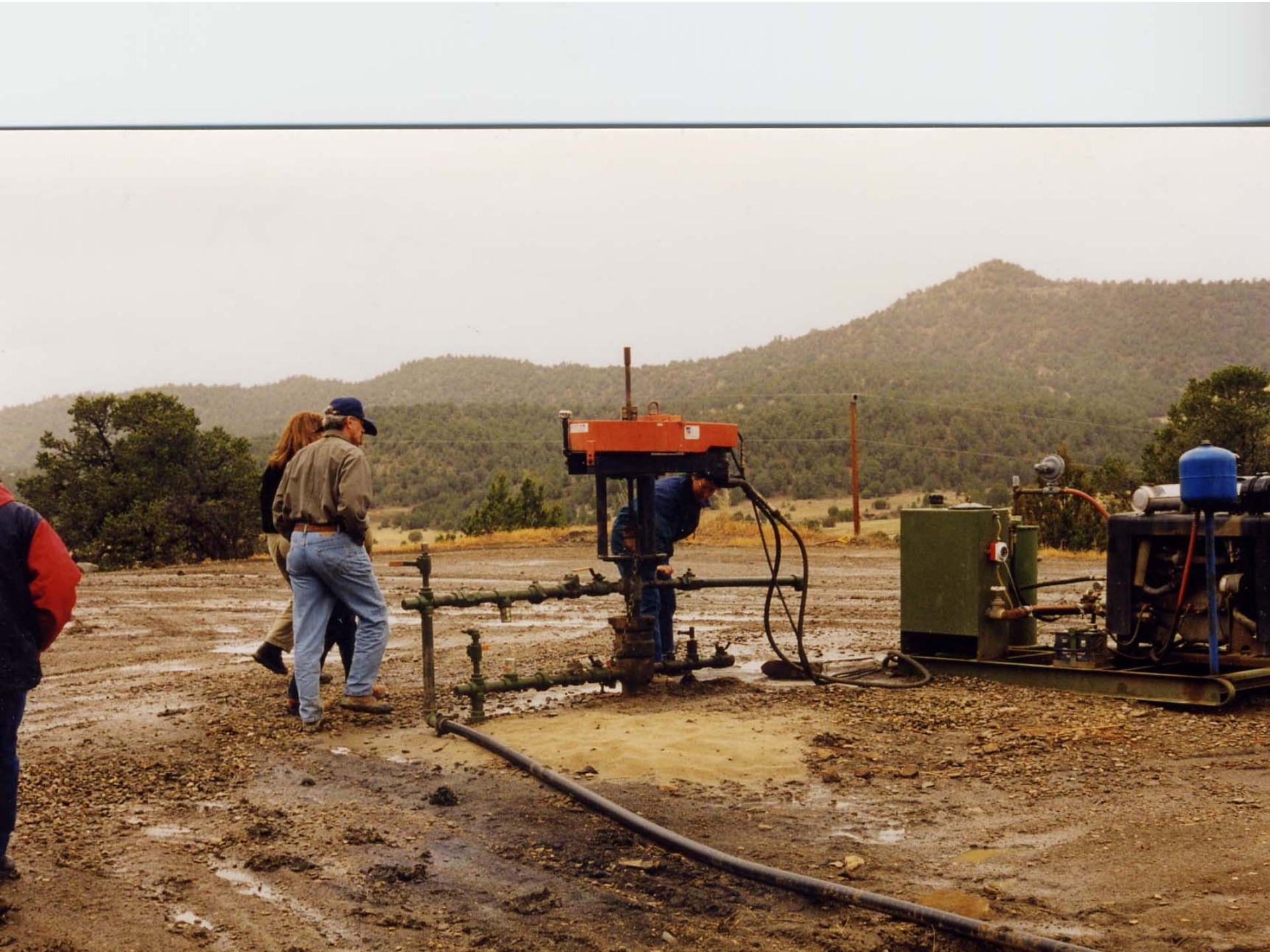
COLORADO GAS PRODUCTION 1995-2001

BILLION CUBIC FEET PER DAY



La Plata County Well Site







OIL AND GAS COMMISSION REVIEWS

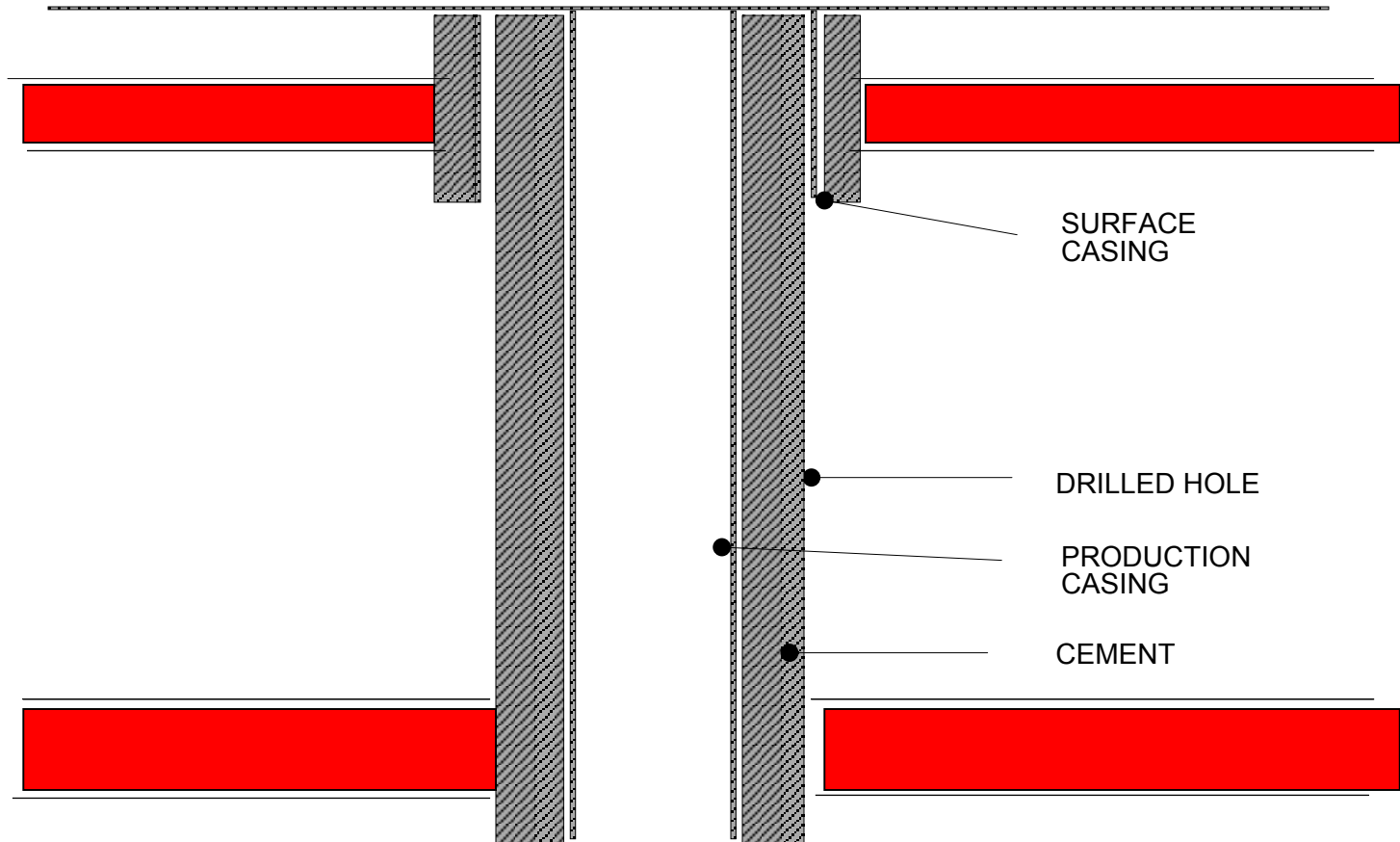
- LOCATION OF WELLS
- HOW WELLS ARE CONSTRUCTED
- SURFACE OWNER CONSULTATION
- PRODUCTION OPERATIONS
- PLUGGING THE WELL
- RESTORATION OF THE SURFACE



CBM vs GAS WELL

- COAL BED METHANE WELLS ARE DRILLED, CEMENTED, COMPLETED, PRODUCED, AND PLUGGED AS ANY OTHER WELL WOULD BE
- THE DIFFERENCE IS CBM WELLS PRODUCE MORE WATER

WELLBORE DIAGRAM

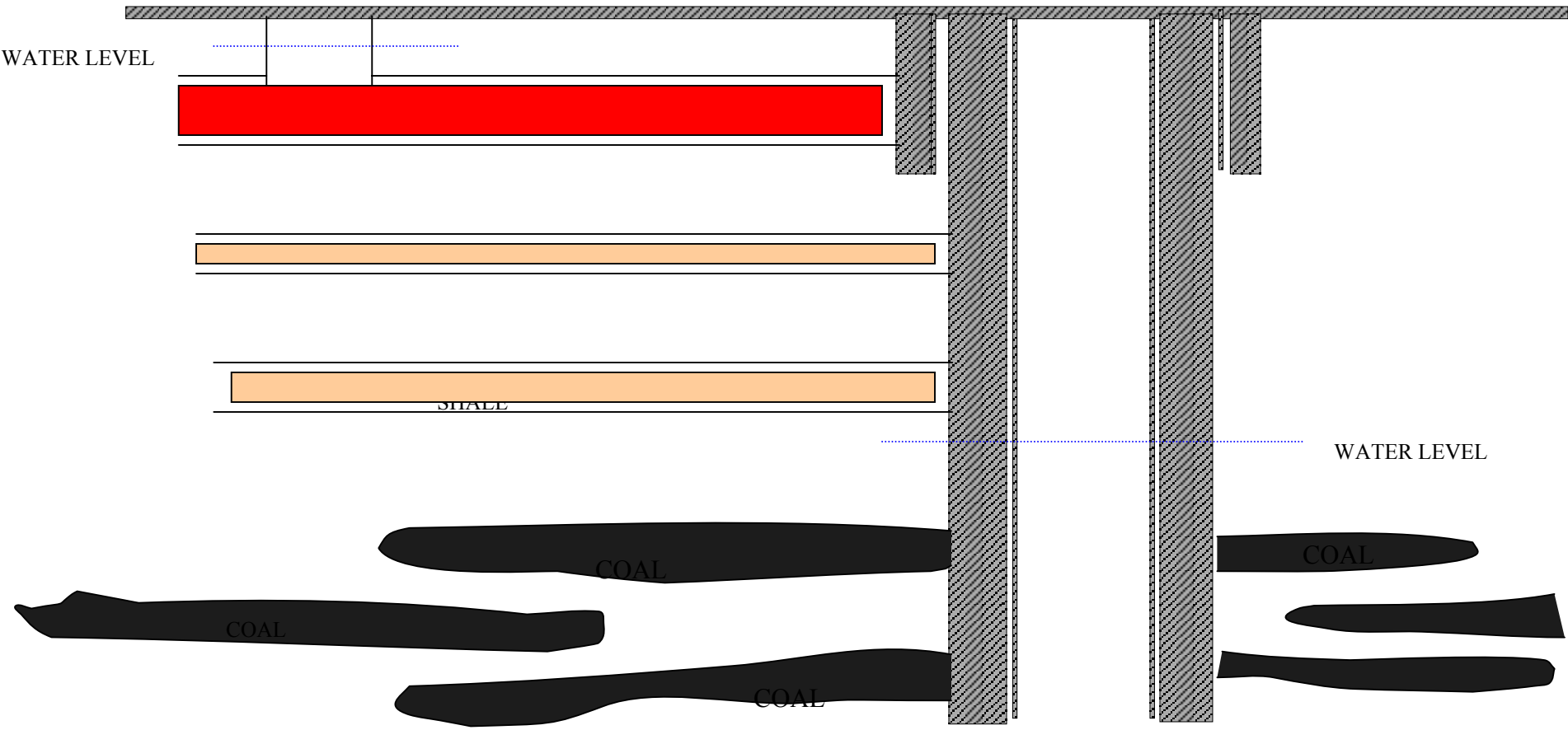


WATER WELL

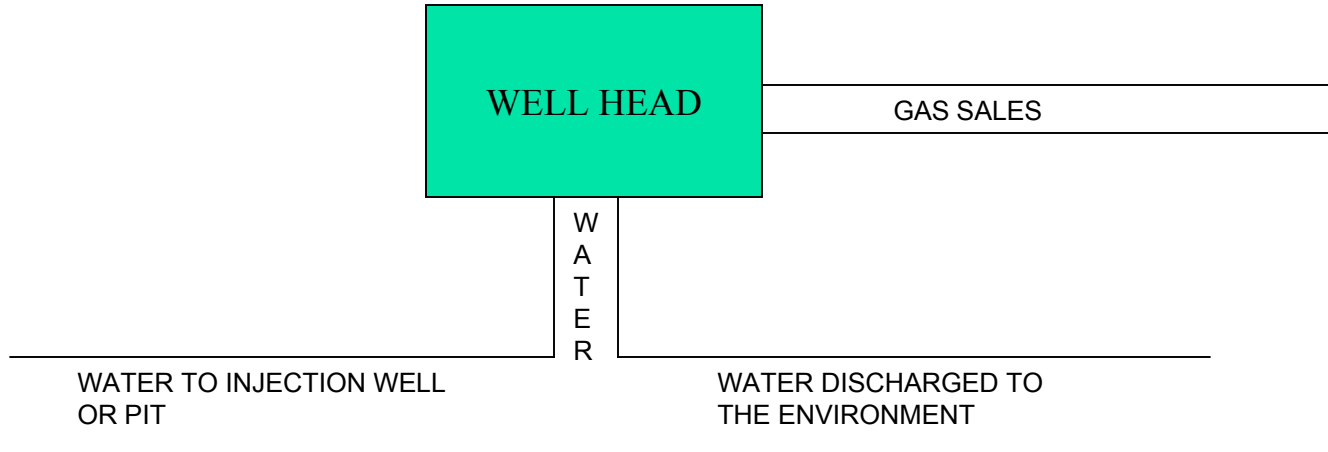
WELLBORE

WATER LEVEL

WATER LEVEL



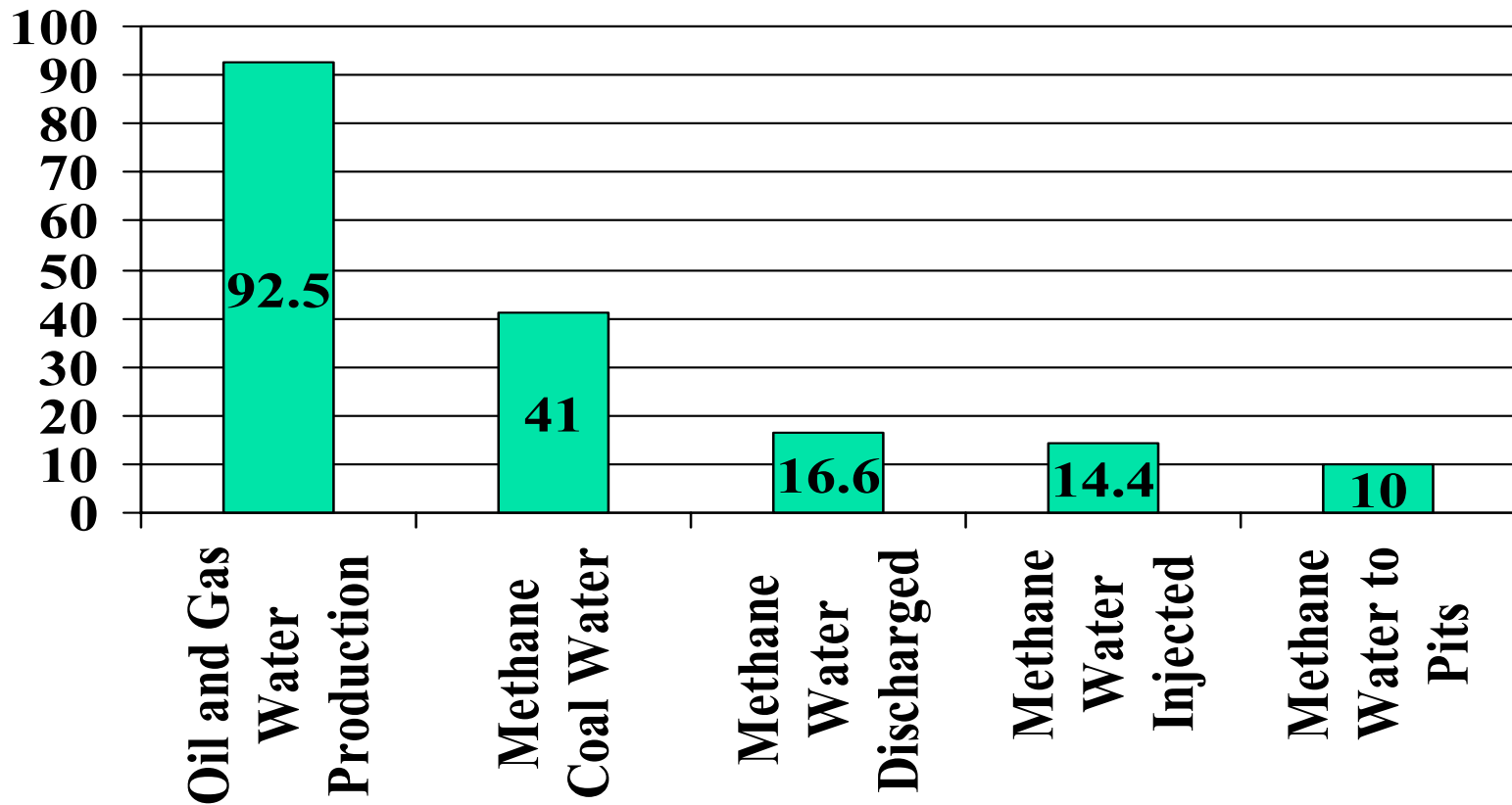
WHO REGULATES PRODUCED WATER?



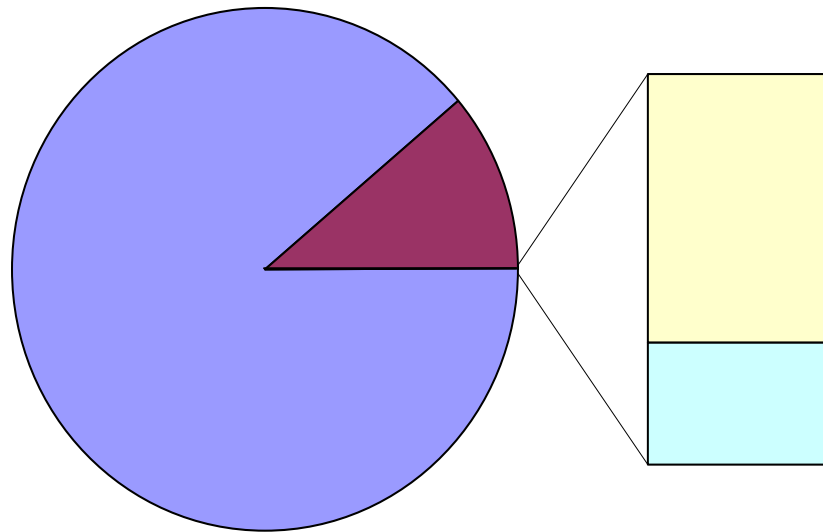
THESE WATER DISPOSAL METHODS ARE UNDER THE JURISDICTION OF THE COLORADO OIL AND GAS CONSERVATION COMMISSION.

THIS METHOD OF WATER DISPOSAL IS UNDER THE JURISDICTION OF THE COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENTAL - WATER QUALITY CONTROL DIVISION FOR APPROVAL TO DISCHARGE WATER. AFTER THE WATER IS DISCHARGED IT IS UNDER THE JURISDICTION OF THE DEPARTMENT OF WATER RESOURCES FOR ISSUES CONCERNING WATER RIGHTS.

PRODUCED WATER IN COLORADO (Volumes in acre-ft/day)



Distribution of Water



- All sources (16 MAF/yr)
- Ground water sources (2 MAF/yr)
- All oil and gas wells (0.033 MAF/yr)
- CBM wells (0.015 MAF /yr)



Methods of Use and Disposal

- COGCC Rule 907
 - Inject into a disposal well
 - Place in lined or unlined pit
 - Dispose at a commercial facility
 - Road spreading
 - Discharge into waters of the state
 - Reuse for recovery, recycling and drilling
 - Mitigation



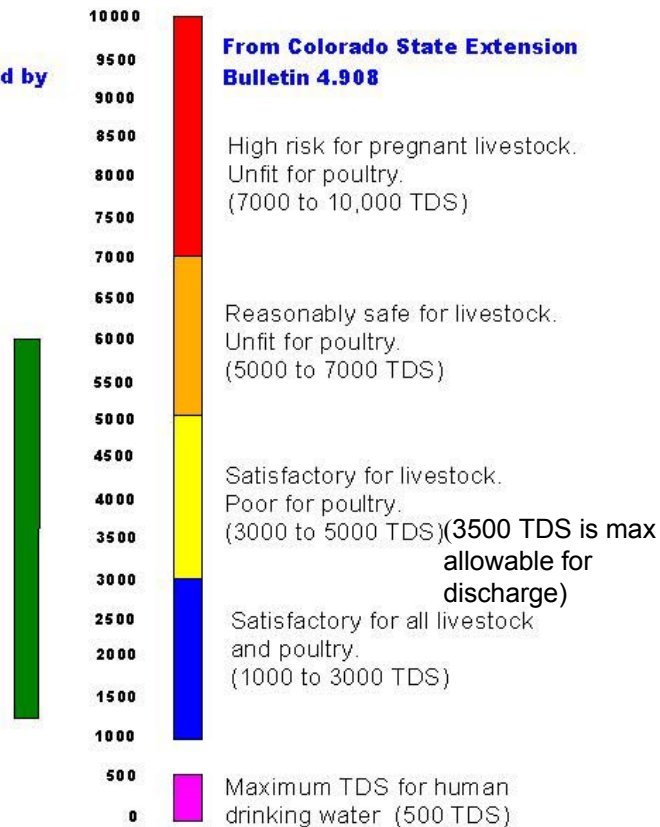
Methods of Use and Disposal

- Types of Beneficial Uses
 - Irrigation
 - Municipal
 - Domestic
 - Stock watering
 - Minimum streamflows
 - Augmentation

Total Dissolved Solids (TDS)
TDS Values in mg/l

**Produced Water Values Provided by
Evergreen Resources**

Las Animas County
Evergreen Resources
Range of TDS from 111 wells
(6000 TDS - High Value)
(1230 TDS - Low Value)
(2731 TDS - Avg. Value)



**Note: Water may be used on Crops
up to 2000 TDS**

**TDS varies with crop
(Montana Bureau of Mining & Geology)**



CBM Water Rights and Ownership

- Doctrine of Prior Appropriation (First in time-first in right)
- CDWR has jurisdiction over administration of water – right of use
- Comply with the “Water Rights Acts”
 - Ground Water Management Acts
 - Water Right and Determination and Administration Act



CBM Water Rights and Ownership

- Surface Water Discharge
 - Must comply with Water Rights Acts
 - Must have intent to use
 - Must be diverted in priority
 - Must be beneficially used
 - Must not waste
 - Must prevent material injury to vested water rights



CBM Water Rights and Ownership

- Use by Well-Nontributary
 - §37-90-137(7), CRS (2003)
 - No permit required unless beneficially used
 - Use not based on land ownership
 - Do not need to determine if unappropriated water is available
 - Must prevent material injury to vested water rights



CBM Water Rights and Ownership

- Use by Well-Tributary
 - §37-90-137(1) & (2), CRS (2003)
 - Permit required
 - Must determine if unappropriated water is available
 - Must prevent material injury to vested water rights



Summary

- CBM WELLS ARE TREATED JUST LIKE ANY OTHER GAS WELL IN COLORADO
- THE WATER FROM CBM WELLS IS NOT ALWAYS OF A USABLE QUALITY
- TO DISCHARGE PRODUCED WATER, OPERATOR MUST HAVE A PERMIT FROM THE CDPHE



Summary

- Must comply with Water Rights Acts (subject to appropriation)
- Most basins over-appropriated
- Unreliable as long-term source
- Collaboration
- Educate and communicate



Additional Information

- Division of Water Resources website at www.water.state.co.us
- Colorado Oil and Gas Conservation Commission website at www.oil-gas.state.co.us
- Colorado Department of Public Health and Environment website at www.cdphe.state.co.us