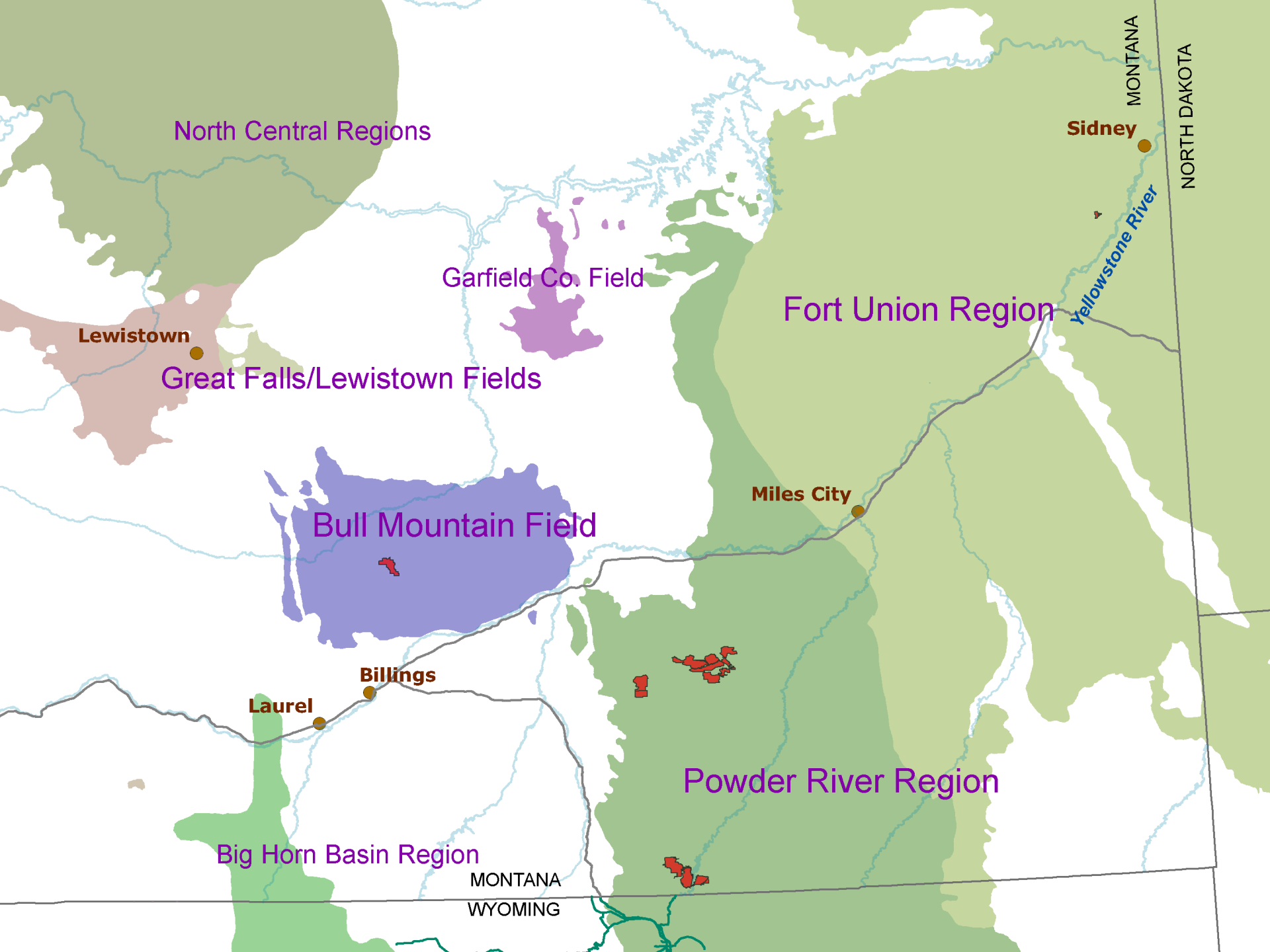
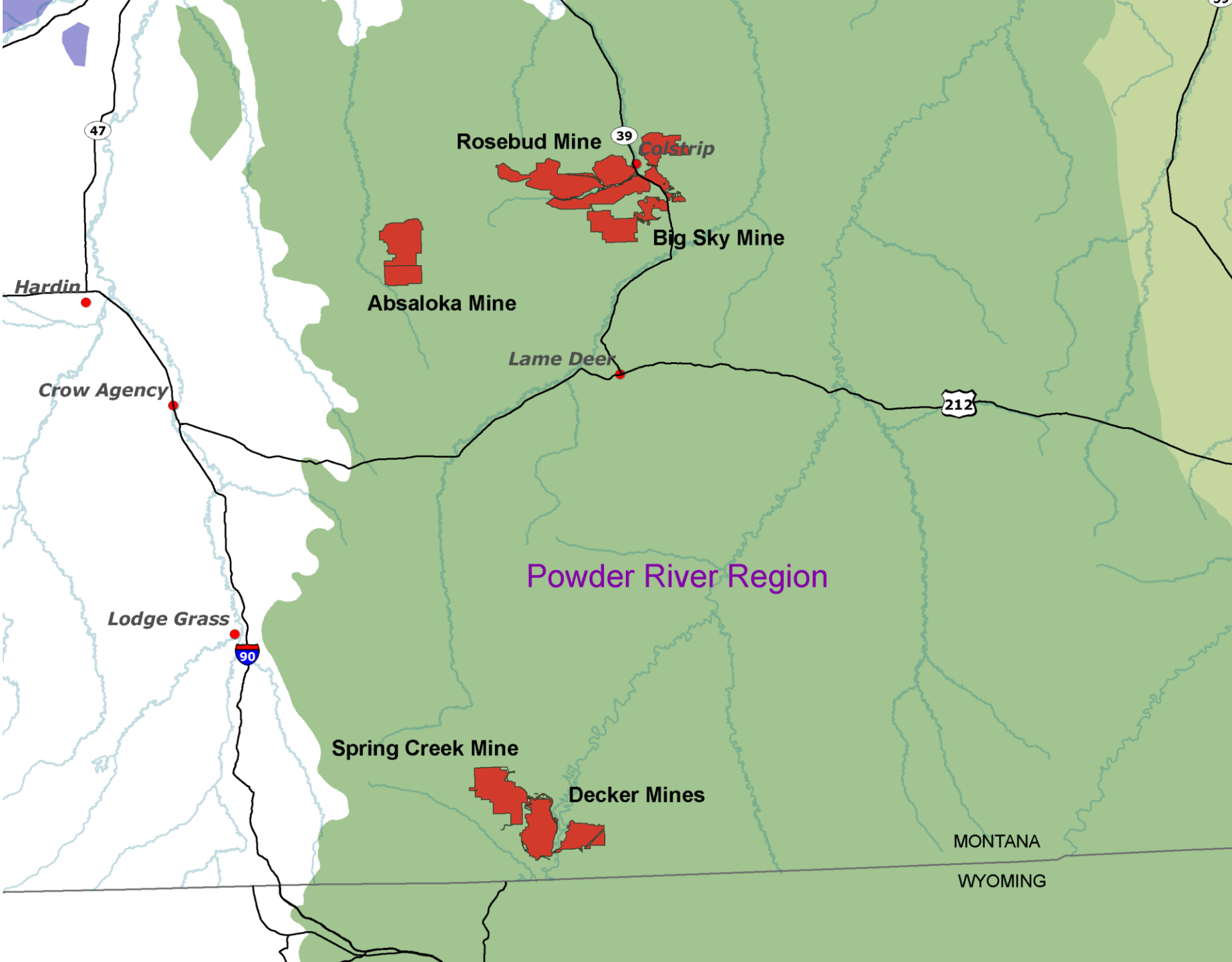
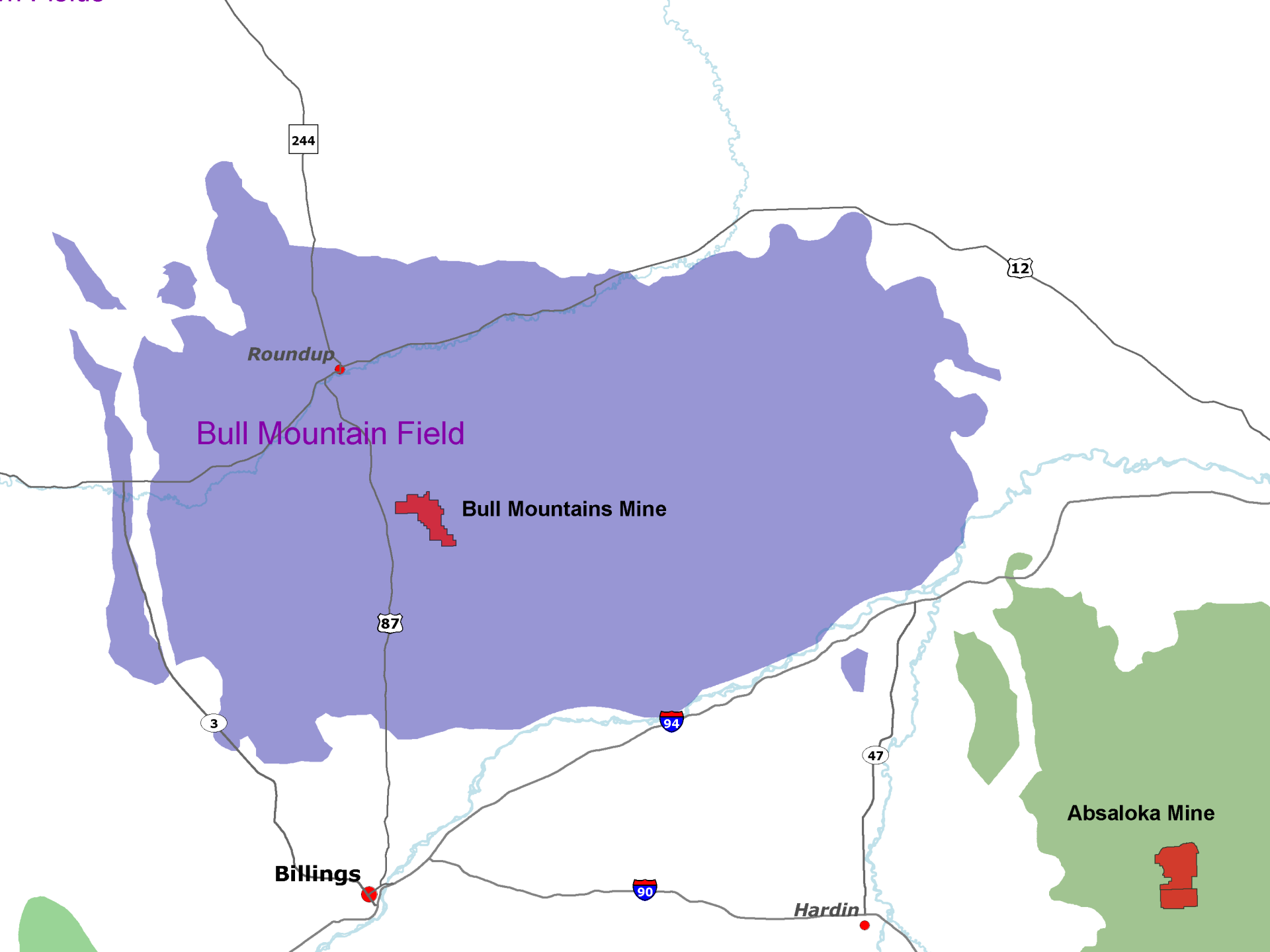
Regulatory Framework for Protection of Groundwater at Montana Coal Mines

Coal and Uranium Program

MT Department of Environmental Quality


North Central Regions
Garfield Co. Field
Fort Union Region
Lewistown
Great Falls/Lewistown Fields
Bull Mountain Field
Miles City
Billings
Laurel
Powder River Region
Big Horn Basin Region
MONTANA
WYOMING
Sidney
MONTANA
NORTH DAKOTA
Yellowstone River

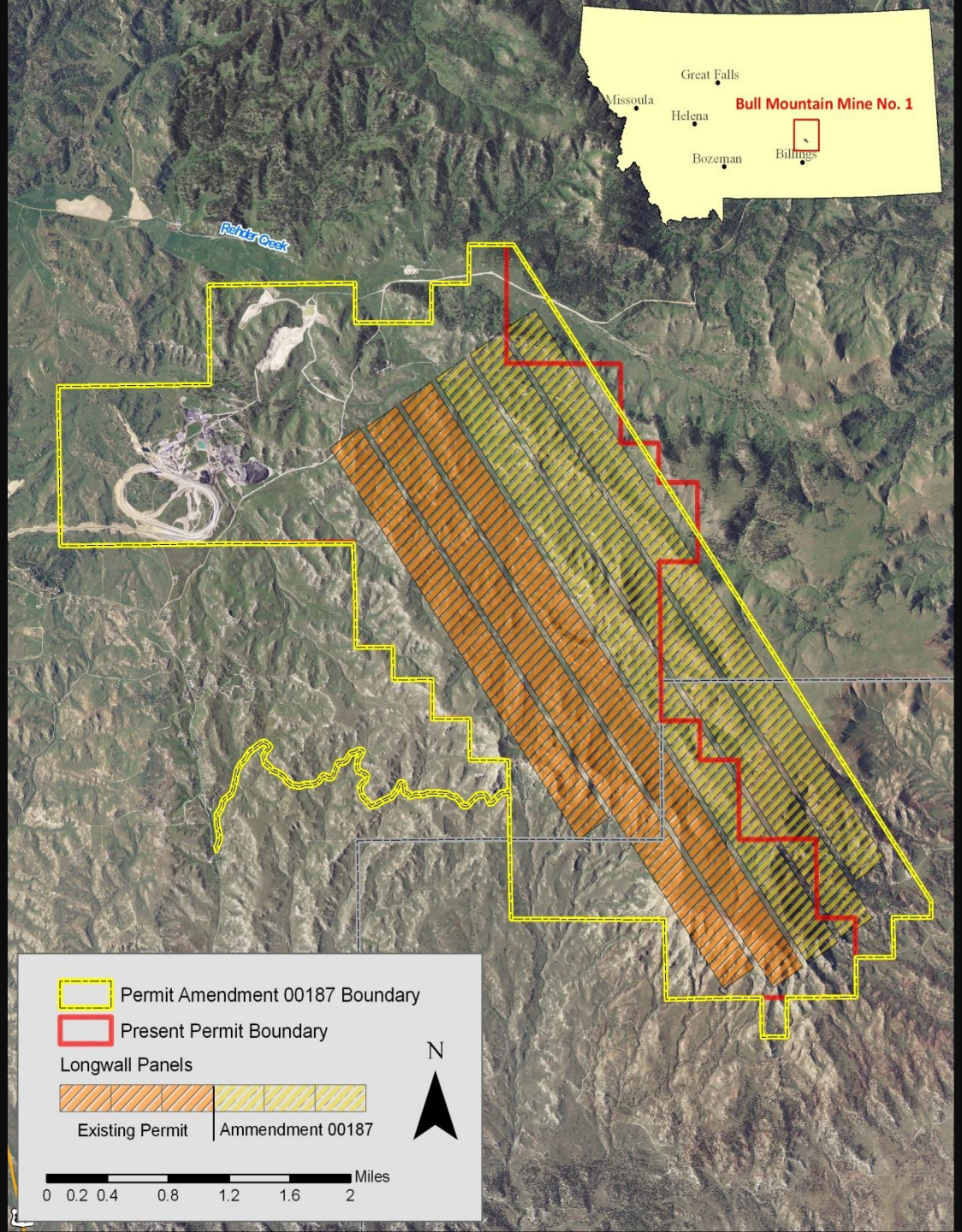

47
Rosebud Mine
39
Colstrip
Big Sky Mine
Absaloka Mine
Hardin
Lame Deer
Crow Agency
212
Powder River Region
Lodge Grass
90
Spring Creek Mine
Decker Mines
MONTANA
WYOMING


244
12
Roundup
Bull Mountain Field
Bull Mountains Mine
87
3
94
47
Absaloka Mine
Billings
90
Hardin


16
Sidney
200
23
Savage Mine
16
Yellowstone River
254
200S
Glendive
Forest Park
94

Montana Coal Mines

Mine	Company	County	Mine Type	Status	Permitted Acres	Tonnage 2011
Big Sky Mine	Peabody Energy	Rosebud	Strip	Reclaimed	7,633	0
West Decker	Ambre Energy	Big Horn	Strip	Active	7,357	295,575
Savage	Westmoreland Savage Corp.	Richland	Strip	Active	885	354, 669
East Decker	Ambre Energy	Big Horn	Strip	Active	4,361	2,749,367
Bull Mountains	Signal Peak Energy	Musselshell	Underground	Active	5,341	5,135,571
Absaloka	Westmoreland Resources, Inc.	Big Horn	Strip	Active	7,110	5,557,604
Rosebud	Western Energy Company	Rosebud	Strip	Active	25,670	8,784,829
Spring Creek	Could Peak Energy	Big Horn	Strip	Active	6,926	19,080,553
Total					**65,283**	**41,958,168**


Great Falls
Missoula
Helena
Bull Mountain Mine No. 1
Bozeman
Billings
Reholer Creek
Permit Amendment 00187 Boundary
Present Permit Boundary
Longwall Panels
Existing Permit
Ammendment 00187
N
Miles
0 0.2 0.4 0.8 1.2 1.6 2

Regulation of Coal Mining

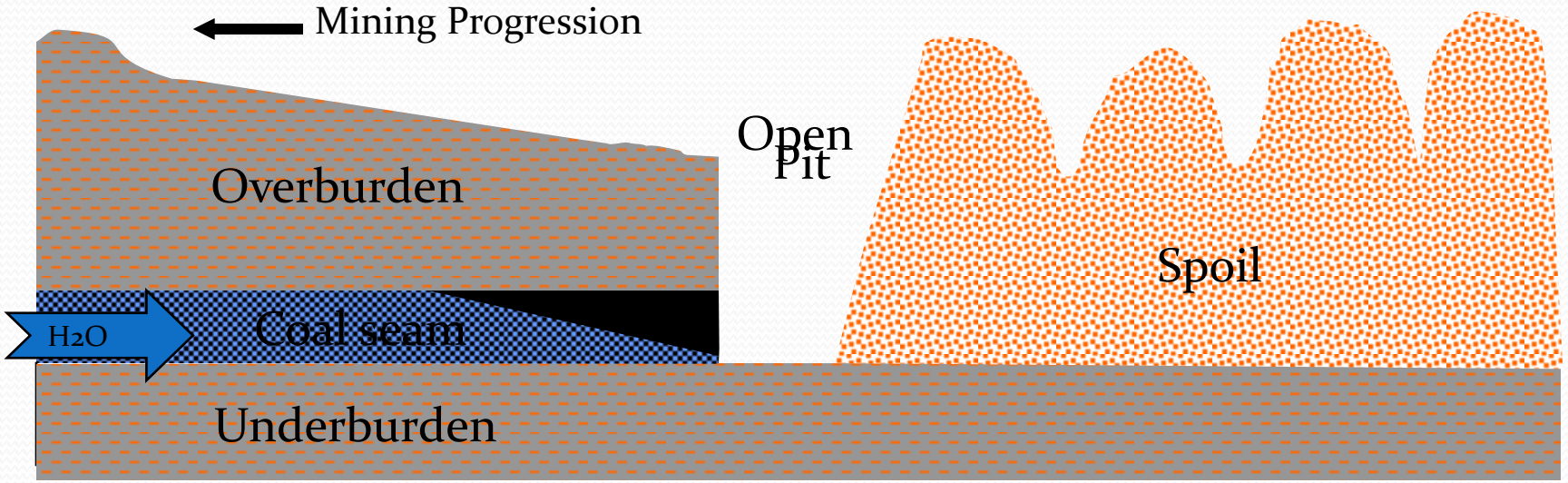
Federal

- SMCRA – Surface Mining Control and Reclamation Act (1977)
- Code of Federal Regulation (CFR), Title 30, Ch. 7

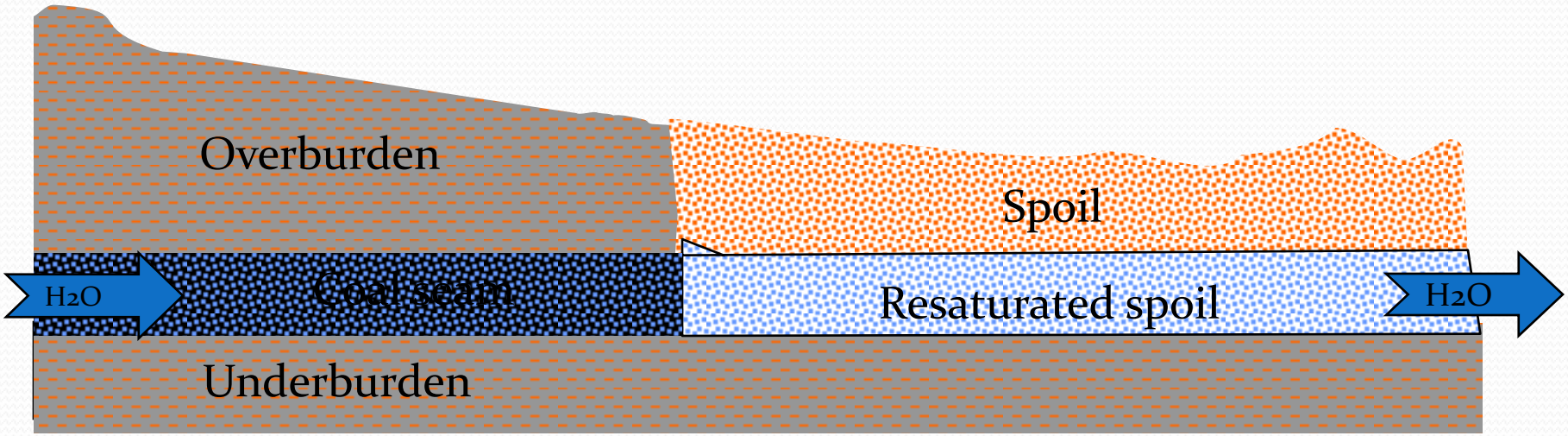
Montana

- Montana Strip and Underground Mine Siting Act (1973)
- MSUMRA - Montana Strip and Underground Mine Reclamation Act – (1978)
- Administrative Rules of Montana (A.R.M.)
  17.24.301 – 17.24.1309

Ground Water Movement During Mining



Post-Reclamation Ground Water Movement



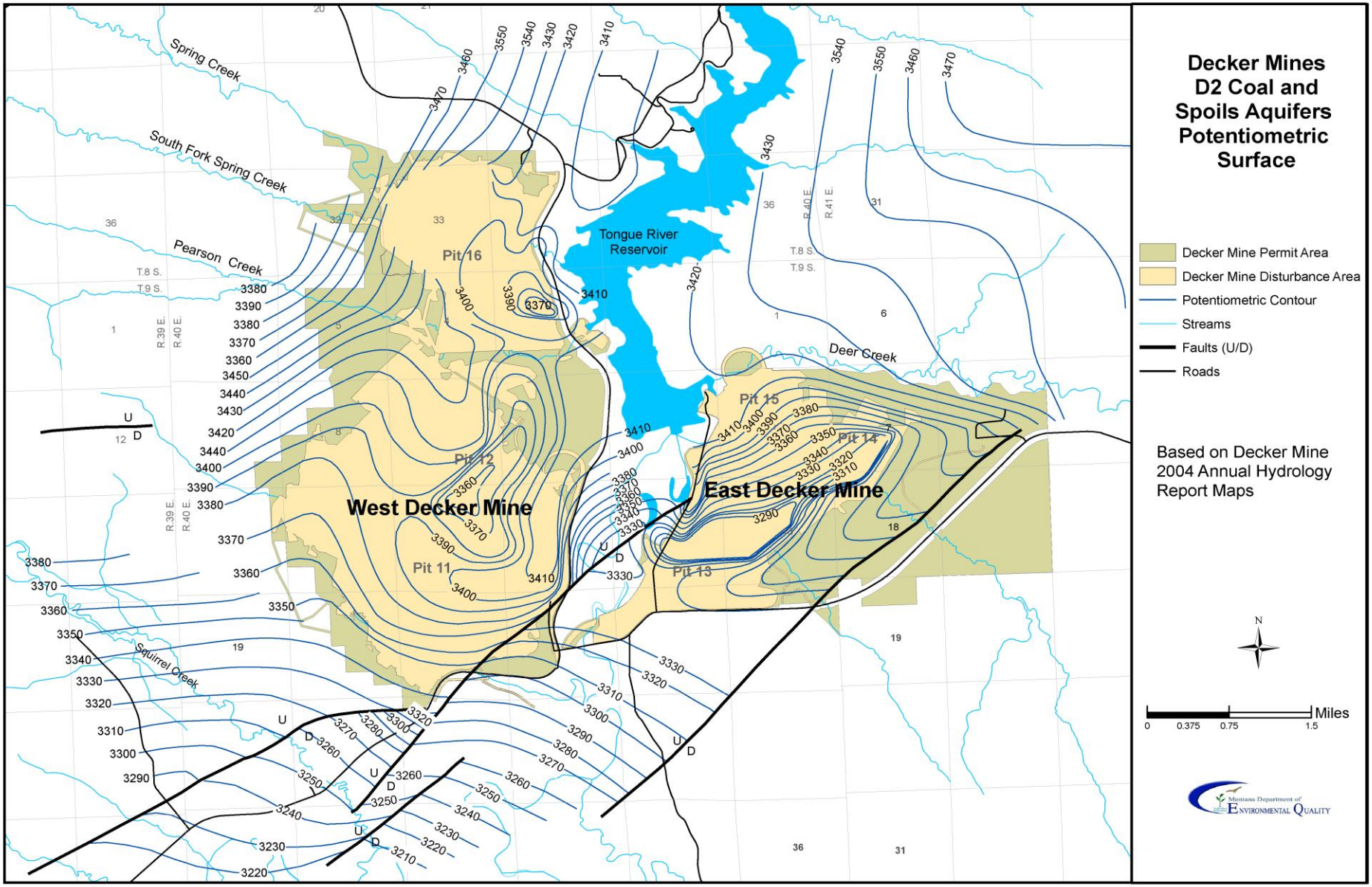
Impacts to Groundwater from Coal Mining

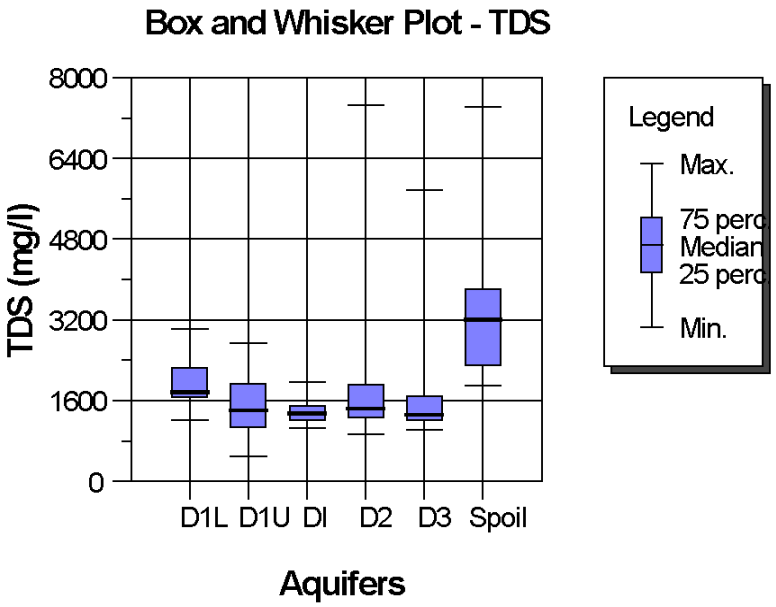
Temporary

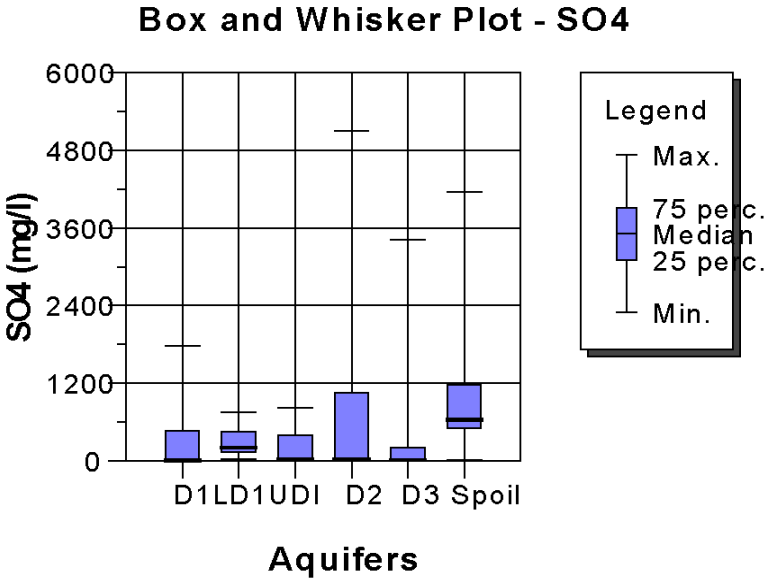
- Decline in water level
- Drawdown in adjacent aquifer
- Change in local gradient
- Decline in water quality from baseline/background

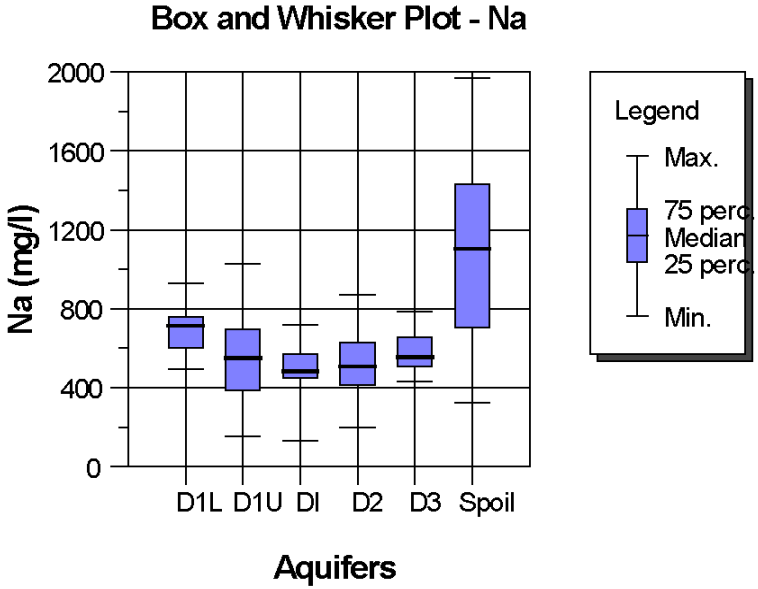
Permanent

- Removal of aquifer
- Creation of spoil aquifer
- Change in hydrologic properties (K, T, s)
- Change in local recharge


Decker Mines
D2 Coal and
Spoils Aquifers
Potentiometric
Surface
Decker Mine Permit Area
Decker Mine Disturbance Area
Potentiometric Contour
Streams
Faults (U/D)
Roads
Based on Decker Mine
2004 Annual Hydrology
Report Maps
N
Miles
0
0.375
0.75
1.5
Montana Department of
Environmental Quality
West Decker Mine
East Decker Mine
Pit 16
Pit 12
Pit 11
Pit 15
Pit 14
Pit 13
Tongue River
Reservoir
Spring Creek
South Fork Spring Creek
Pearson Creek
Squirrel Creek
Deer Creek
T.8 S.
T.9 S.
R.39 E.
R.40 E.
R.41 E.


Box and Whisker Plot - TDS
TDS (mg/l)
8000
6400
4800
3200
1600
0
D1L D1U DI D2 D3 Spoil
Aquifers
Legend
Max.
75 perc.
Median
25 perc.
Min.


Box and Whisker Plot - SO4
SO4 (mg/l)
6000
4800
3600
2400
1200
0
D1LD1UDI D2 D3 Spoil
Aquifers
Legend
Max.
75 perc.
Median
25 perc.
Min.


Box and Whisker Plot - Na
Na (mg/l)
2000
1600
1200
800
400
0
D1L D1U DI D2 D3 Spoil
Aquifers
Legend
Max.
75 perc.
Median
25 perc.
Min.

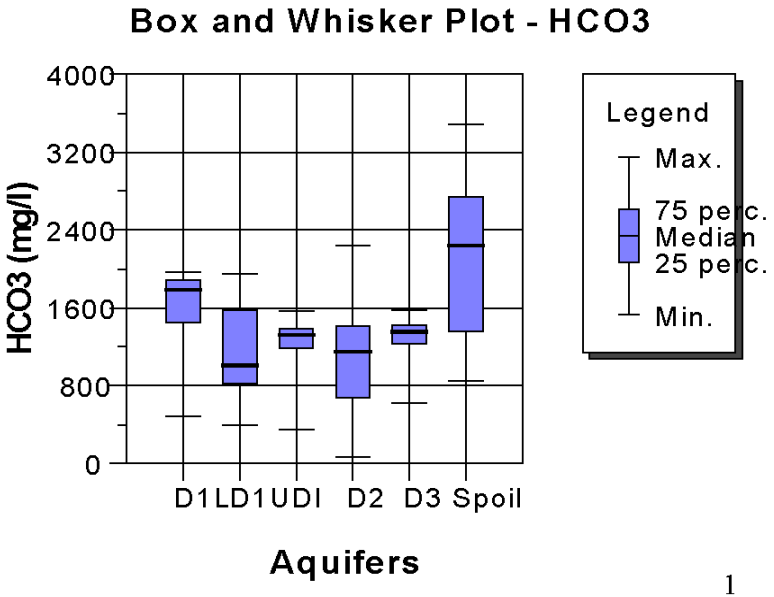

Box and Whisker Plot - HCO3
HCO3 (mg/l)
4000
3200
2400
1600
800
0
D1LD1UDI D2 D3 Spoil
Aquifers
Legend
Max.
75 perc.
Median
25 perc.
Min.

Figure 7

Rules address groundwater in all phases of mining:

- Baseline
- Application
- Operational
- Final Bond Release

Key Terms

- "**Hydrologic balance**" is the relationship between the quality and quantity of water inflow to, outflow from, and storage in a hydrologic unit ….and encompasses the dynamic relationships among precipitation, runoff, evaporation, and changes in ground and surface water storage as they relate to uses of land and water within the area affected by mining and the adjacent area.

- "**Material damage**" with respect to protection of the hydrologic balance, degradation or reduction by coal mining and reclamation operations of the quality or quantity of water outside of the permit area in a manner or to an extent that land uses or beneficial uses of water are adversely affected, water quality standards are violated, or water rights are impacted. Violation of a water quality standard, whether or not an existing water use is affected, is material damage.

- "**Probable hydrologic consequences**" means the projected results of proposed strip or underground mining operations that may reasonably be expected to alter, interrupt, or otherwise affect the hydrologic balance.

Baseline

17.24.304 - BASELINE

- All hydrologic and geologic data necessary to evaluate baseline conditions, to evaluate the **probable hydrologic consequences** and **cumulative hydrologic impacts** of mining…and to develop a **plan to monitor water quality and quantity**, including, but not limited to:
  - lithology, thickness, structural controls, hydraulic conductivity, transmissivity, recharge, storage and discharge characteristics, extent of aquifer, production data, water quality analyses …for each aquifer within the mine plan area and adjacent areas;
  - results of a minimum of one year of quarterly monitoring of groundwater for water levels and quality.
  - listing of all known or readily discoverable wells and springs and their uses located within three miles downgradient from the proposed permit area and within one mile in all other directions.

Application

17.24.314 PLAN FOR PROTECTION OF THE HYDROLOGIC BALANCE

- Each permit application must contain a detailed description of the measures to be taken during and after the proposed mining activities to **minimize disturbance of the hydrologic balance** on and off the mine plan area and to **prevent material damage to the hydrologic balance outside the permit area .**

- The measures must minimize disturbance of the hydrologic balance sufficiently to
  - sustain the approved postmining land use
  - provide protection of the
    - quality of surface and ground water systems
    - the rights of present users of groundwater
    - the quantity of groundwater within or to provide alternative sources of water.

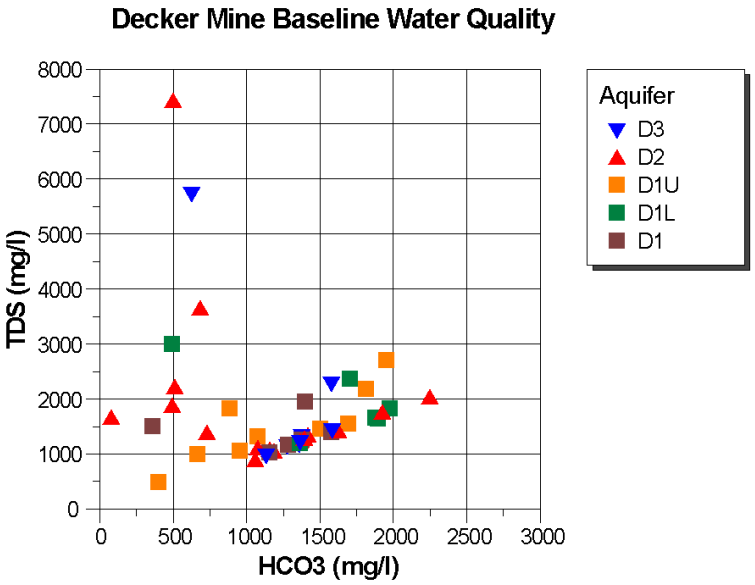
Application

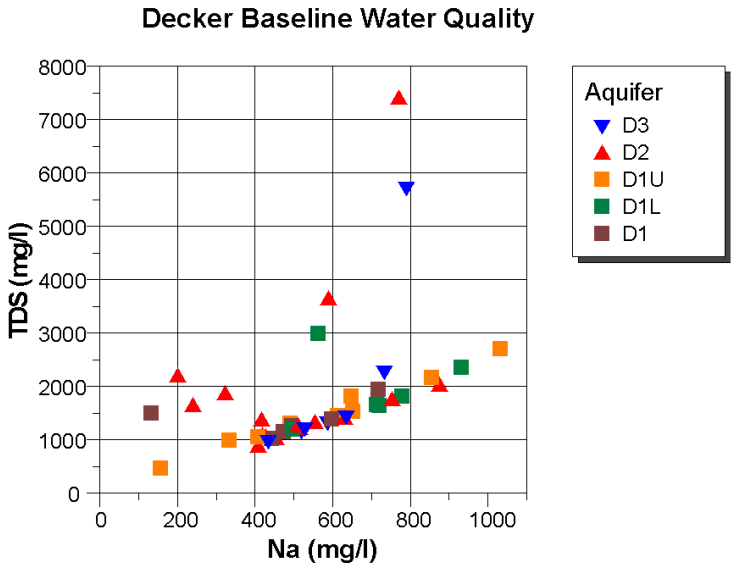
17.24.314 PLAN FOR PROTECTION OF THE HYDROLOGIC BALANCE (cont'd)

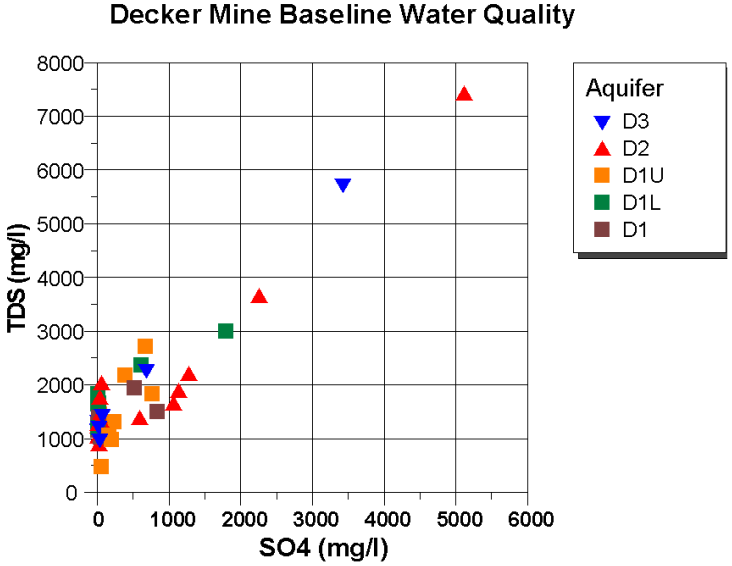
- Must include plan for monitoring and reporting of water quantity and quality data
- A determination of the **probable hydrologic consequences** of the proposed operation
- The department shall provide an **assessment of the cumulative hydrologic impacts** of the proposed operation and all anticipated mining upon surface and ground water systems in the cumulative impact area. The cumulative hydrologic impact assessment must be sufficient to determine, for purposes of a permit decision, whether the proposed operation has been designed to **prevent material damage to the hydrologic balance outside the permit area.**

Cumulative Hydrologic Impact Assessment - CHIA

- Delineation of cumulative impact area - includes all mining within an area
- Water Resource Use
- Baseline Hydrologic Conditions
- Prediction of Potential Impacts
- Material Damage Determination


Decker Mine Baseline Water Quality
TDS (mg/l)
HCO3 (mg/l)
Aquifer
D3
D2
D1U
D1L
D1


Decker Baseline Water Quality
TDS (mg/l)
Na (mg/l)
Aquifer
D3
D2
D1U
D1L
D1


Decker Mine Baseline Water Quality
TDS (mg/l)
SO4 (mg/l)
Aquifer
D3
D2
D1U
D1L
D1

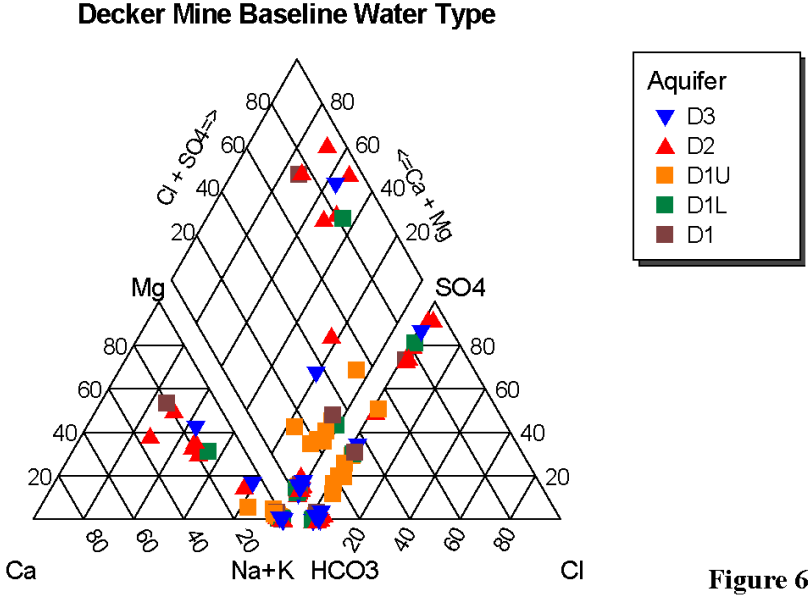
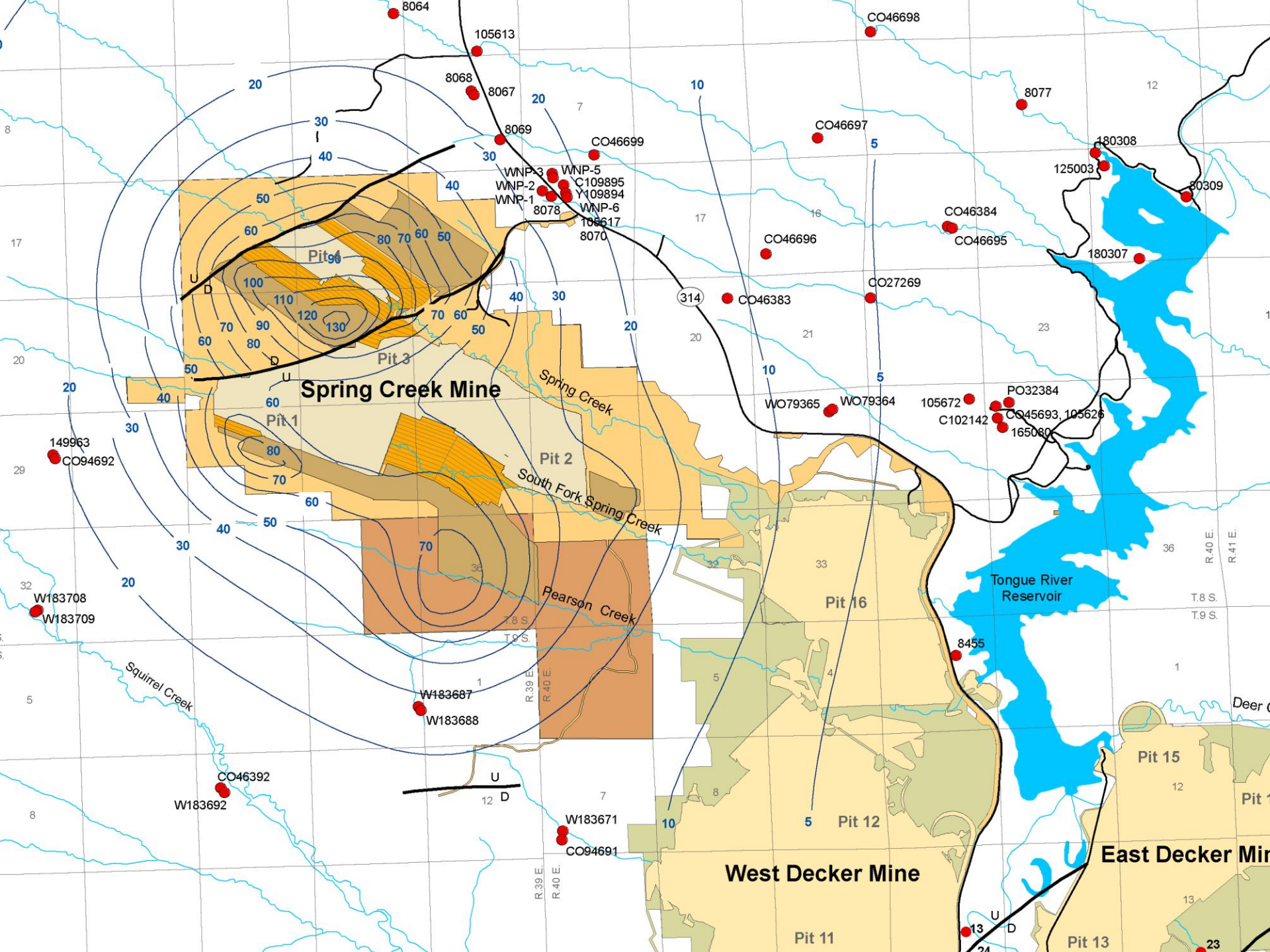
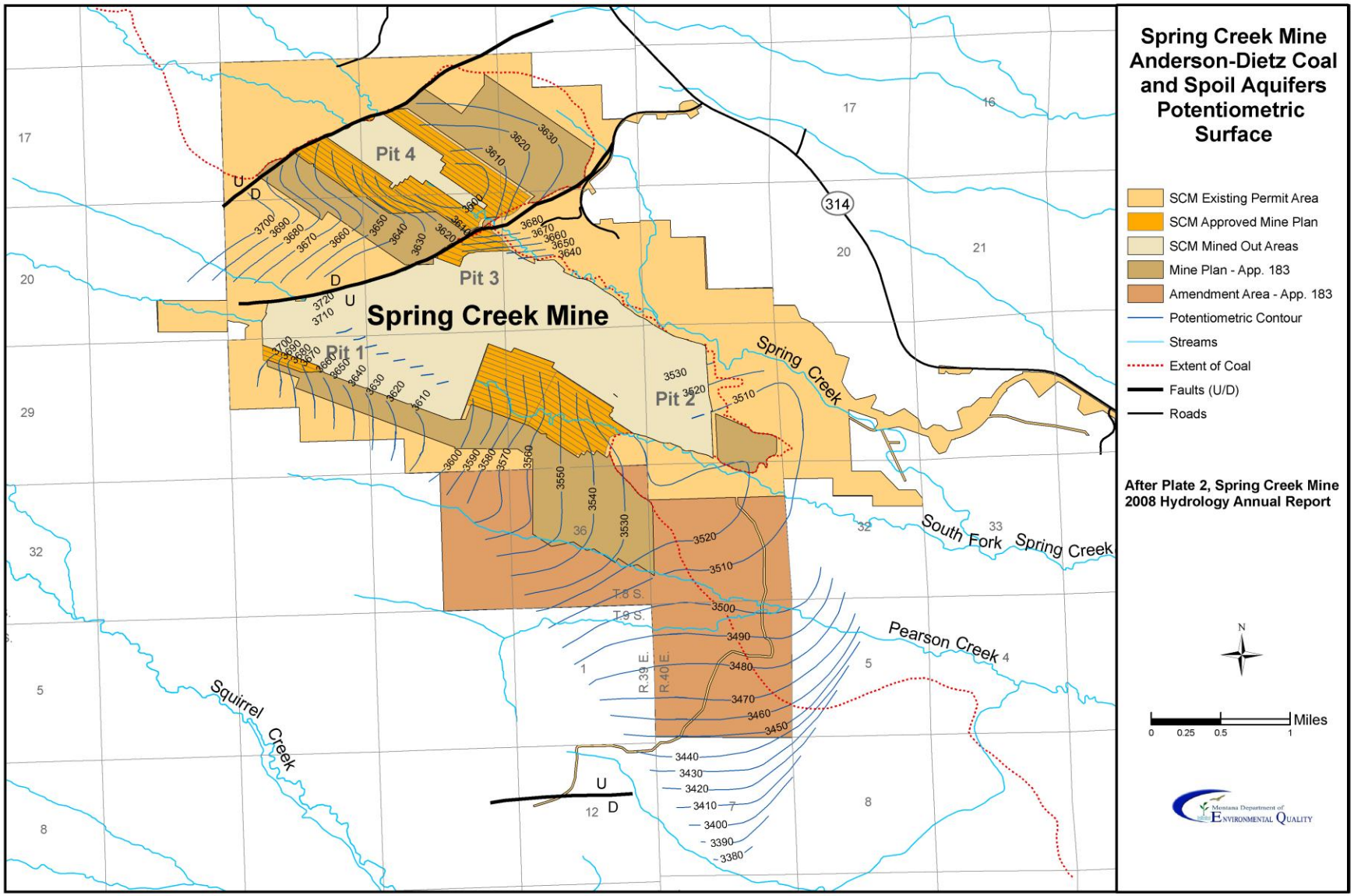

Decker Mine Baseline Water Type
Cl + SO4
Ca + Mg
Mg
SO4
Ca
Na+K
HCO3
Cl
Aquifer
D3
D2
D1U
D1L
D1

Figure 6


Spring Creek Mine
Pit 1
Pit 2
Pit 3
Pit 4
Spring Creek
South Fork Spring Creek
Pearson Creek
Squirrel Creek
Tongue River Reservoir
West Decker Mine
Pit 11
Pit 12
Pit 13
Pit 15
Pit 16
East Decker Mine
8064
105613
8068
8067
8069
CO46699
WNP-3
WNP-5
C109895
WNP-2
Y109894
WNP-1
8078
WNP-6
105617
8070
CO46698
8077
CO46697
180308
125003
180309
CO46384
CO46695
CO46696
180307
CO27269
CO46383
314
WO79365
WO79364
105672
PO32384
C102142
CO45693, 105626
165080
149963
CO94692
W183708
W183709
W183687
W183688
CO46392
W183692
W183671
CO94691
8455
R.39 E.
R.40 E.
R.41 E.
T.8 S.
T.9 S.


Spring Creek Mine
Anderson-Dietz Coal and Spoil Aquifers Potentiometric Surface
SCM Existing Permit Area
SCM Approved Mine Plan
SCM Mined Out Areas
Mine Plan - App. 183
Amendment Area - App. 183
Potentiometric Contour
Streams
Extent of Coal
Faults (U/D)
Roads
After Plate 2, Spring Creek Mine 2008 Hydrology Annual Report
Spring Creek Mine
Pit 1
Pit 2
Pit 3
Pit 4
Spring Creek
South Fork Spring Creek
Pearson Creek
Squirrel Creek
314
T.8 S.
T.9 S.
R.39 E.
R.40 E.
N
Miles
0 0.25 0.5 1
Montana Department of Environmental Quality

Operational

17.24.631 GENERAL HYDROLOGY REQUIREMENTS

- The permittee shall plan and conduct mining and reclamation operations to
  - Minimize disturbance to the prevailing hydrologic balance
  - Prevent material damage outside the permit area.
  - Minimize changes in water quality and quantity so that the postmining land use of the disturbed land is not adversely affected
  - Comply with applicable federal and state statutes and regulations
  - Minimize water pollution and shall, where necessary, use treatment methods to control water pollution
  - If pollution can be controlled only by treatment, the permittee shall operate and maintain the necessary water treatment facilities for as long as treatment is required.

Operational

17.24.643 GROUNDWATER PROTECTION

- Prevent or control discharge of acid, toxic, or otherwise harmful mine drainage waters into ground water flow systems
- Backfilled materials must be placed to minimize adverse effects on ground water flow and quality, to minimize off-site effects, and to support the approved postmining land use.

17.24.644 PROTECTION OF GROUND WATER RECHARGE

- The disturbed area must be reclaimed to restore the approximate premining recharge capacity through reclaimed areas to transmit water to the ground water system, support the approved postmining land use, minimize disturbances to the prevailing hydrologic balance…

17.24.645 GROUND WATER MONITORING

- Groundwater levels, flow and storage characteristics, quality of ground water must be monitored in all disturbed or potentially affected geologic strata, through mining and continue until phase IV bond release.

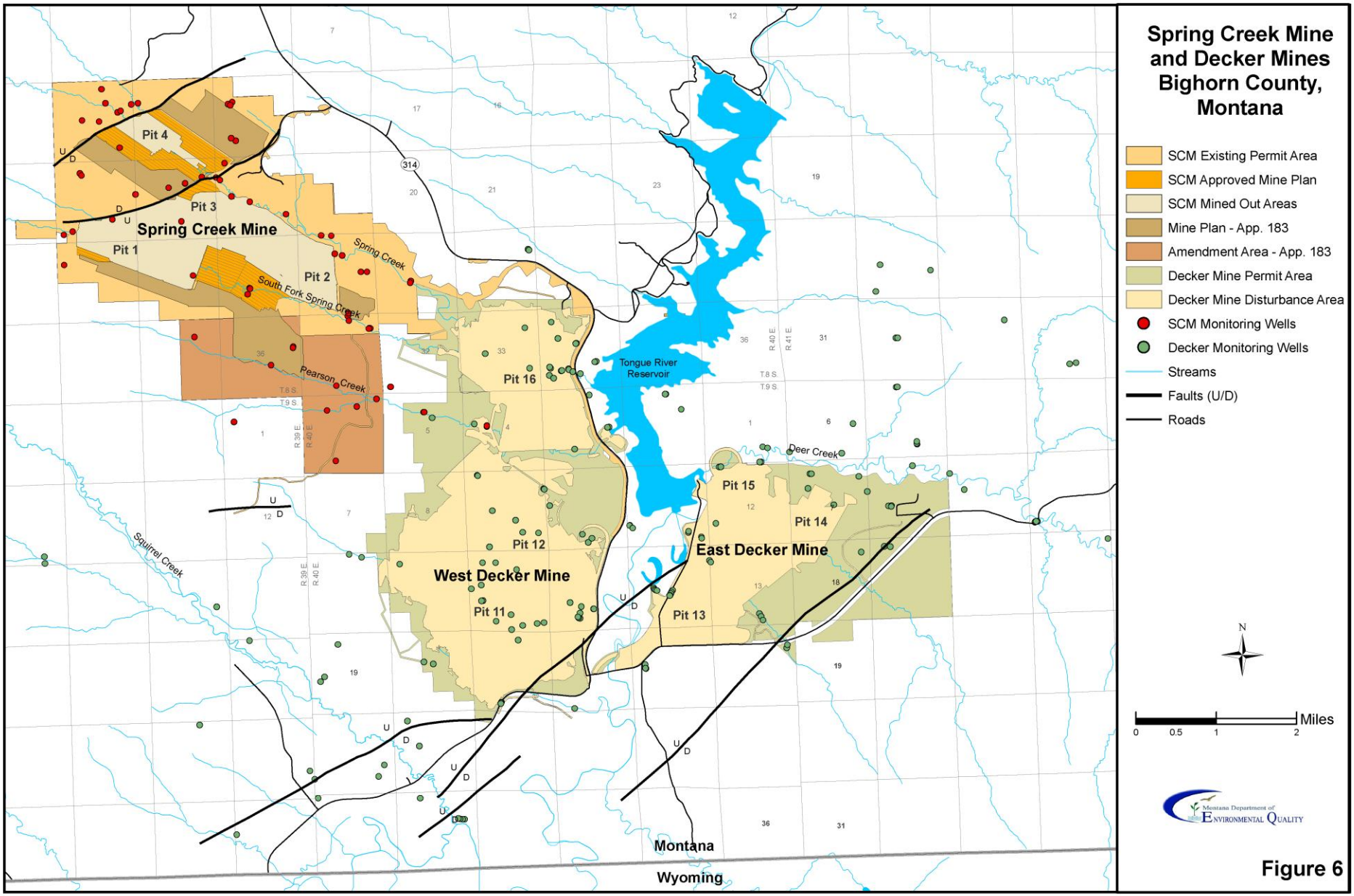

Spring Creek Mine and Decker Mines
Bighorn County, Montana
SCM Existing Permit Area
SCM Approved Mine Plan
SCM Mined Out Areas
Mine Plan - App. 183
Amendment Area - App. 183
Decker Mine Permit Area
Decker Mine Disturbance Area
SCM Monitoring Wells
Decker Monitoring Wells
Streams
Faults (U/D)
Roads
Pit 4
Pit 3
Spring Creek Mine
Pit 1
Pit 2
Spring Creek
South Fork Spring Creek
Pearson Creek
Tongue River Reservoir
Pit 16
Deer Creek
Pit 15
Pit 14
East Decker Mine
Pit 12
West Decker Mine
Pit 11
Pit 13
Squirrel Creek
314
N
Miles
0
0.5
1
2
Montana
Wyoming
Montana Department of Environmental Quality

Figure 6

Required Water Quality Analysis Suite

Groundwater Parameters

Physical Parameters

Conductivity
pH (lab)
pH (field)
Specific Conductance
Total Dissolved Solids (TDS)
Temperature (ambient water)

Common Ions

Total Anions
Total Cations
Acidity (total as CaCO3)
Alkalinity (total as CaCO3)
Hardness (total as CaCO3)
Bicarbonate as HCO3
Carbonate as CO3
Cation/anion balance %
Calcium
Chloride
Magnesium
Potassium
SAR
Sodium
Sulfate

Trace Metals (dissolved)

Aluminum
Arsenic
Boron
Cadmium
Copper
Fluoride
Iron
Lead
Manganese
Nickel
Selenium
Vanadium
Zinc

Nutrients

Nitrate-Nitrite as N
Total Ammonia as N

Surface Water Parameters

Physical Parameters

Conductivity
pH (lab)
pH (field)
Specific Conductance
Total Dissolved Solids (TDS)
Total Suspended Solids (TSS)
Temperature (ambient water)
Temperature (ambient air)
Oil & Grease

Common Ions

Total Anions
Total Cations
Acidity (total as CaCO3)
Alkalinity (total as CaCO3)
Hardness (total as CaCO3)
Bicarbonate as HCO3
Carbonate as CO3
Cation/anion balance %
Calcium
Chloride
Magnesium
Potassium
SAR
Sodium
Sulfate

Trace Metals

Aluminum (TR/D*)
Arsenic (TR/D*)
Boron (TR/D*)
Cadmium (TR/D*)
Copper (TR/D*)
Fluoride (TR/D*)
Iron (TR/D*)
Lead (TR/D*)
Manganese (TR/D*)
Nickel (TR/D*)
Selenium (TR/D*)
Vanadium (TR/D*)
Zinc (TR/D*)

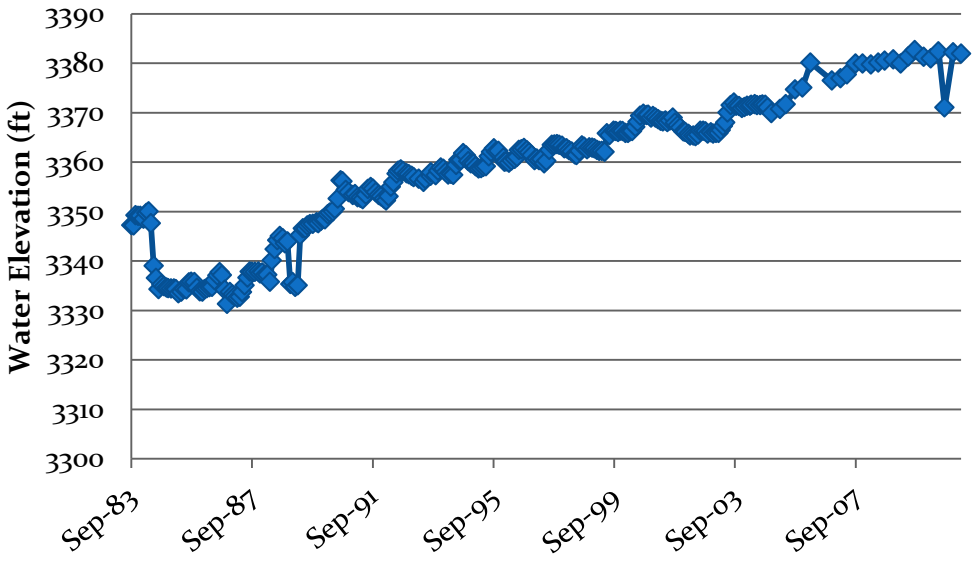
Nutrients

Total Nitrogen
Total Phosphorus
Nitrate-Nitrite as N
Total Ammonia as N

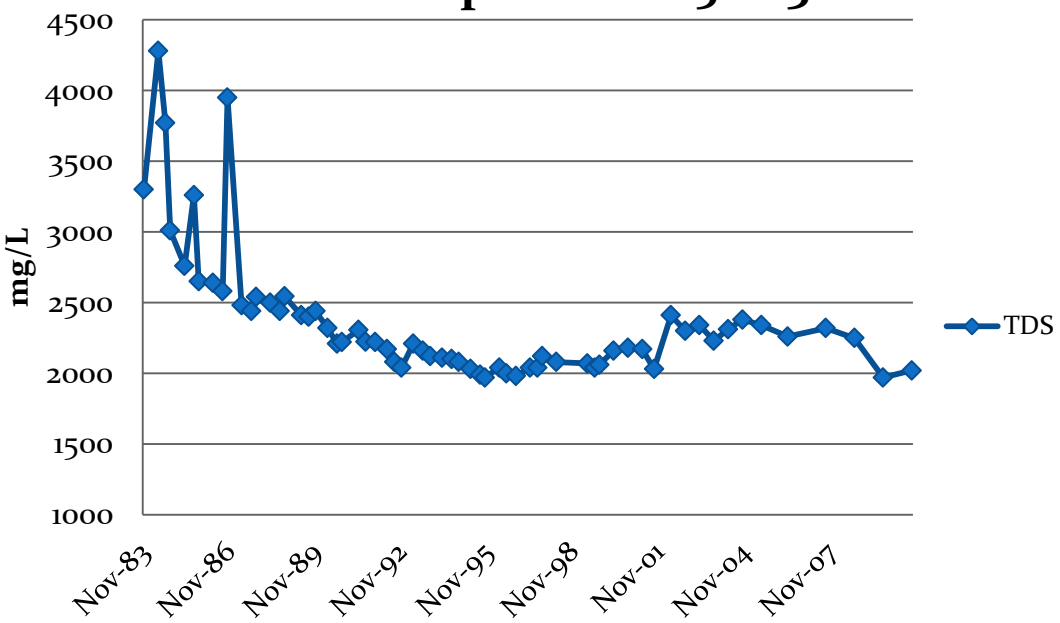
Tongue River Reservoir

Decker Coal Mines

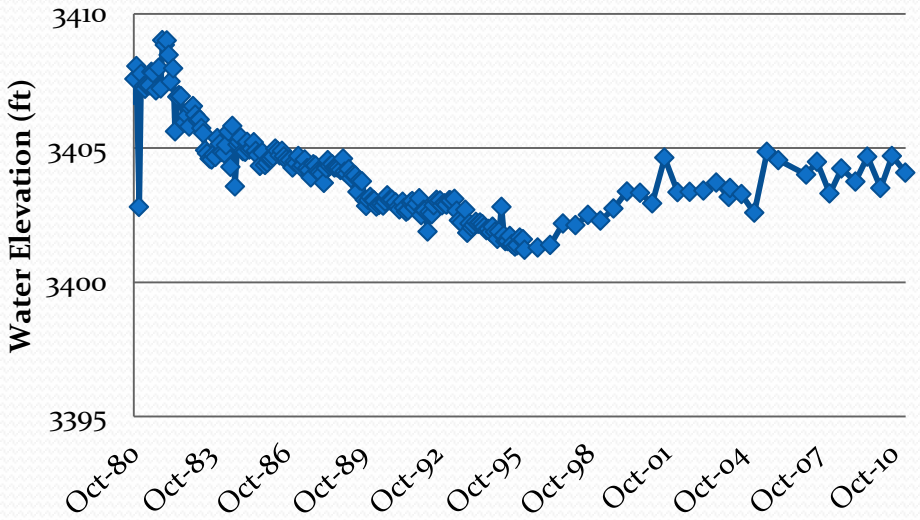
Decker Spoil Well 251683



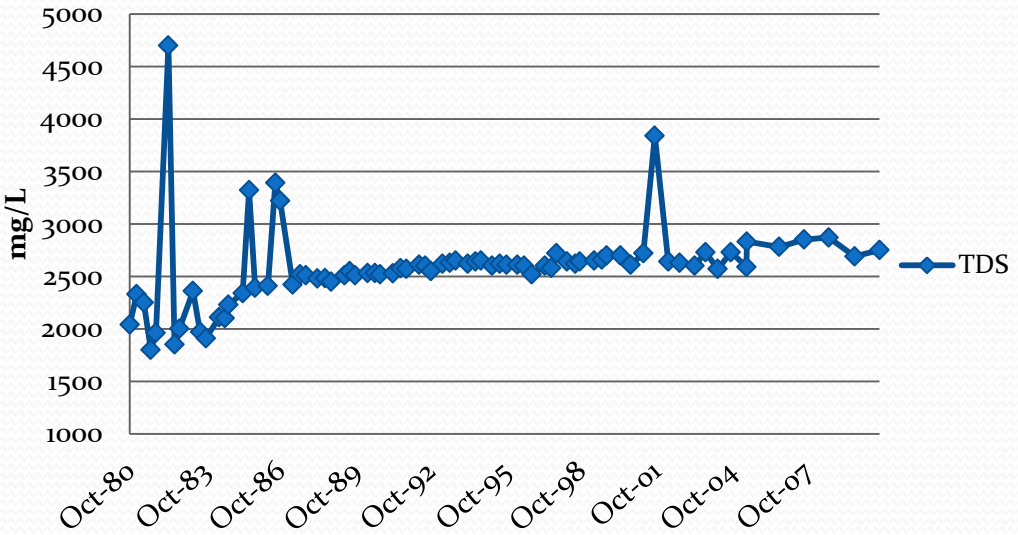
Decker Spoil Well 251683



Decker Spoil Well 204880



Decker Spoil Well 204880



Bond Release Phases in Montana

- Phase I
  - Backfilling , grading, drainage control according to plan
- Phase II
  - Soil replacement, seeding/planting with minimum of two years of growth with diversity, density, etc.
- Phase III
  - Stable landscape established and any special conditions met
- Phase IV
  - All disturbance within a drainage basin have met I, II, III
  - No material damage
  - Alternative water supplies provided, if necessary
  - Essential function of AVF's reestablished

Questions?