Regulatory Framework for Protection of Groundwater at Montana Coal Mines

Coal and Uranium Program
MT Department of Environmental Quality
## Montana Coal Mines

<table>
<thead>
<tr>
<th>Mine</th>
<th>Company</th>
<th>County</th>
<th>Mine Type</th>
<th>Status</th>
<th>Permitted Acres</th>
<th>Tonnage 2011</th>
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<tbody>
<tr>
<td>Big Sky Mine</td>
<td>Peabody Energy</td>
<td>Rosebud</td>
<td>Strip</td>
<td>Reclaimed</td>
<td>7,633</td>
<td>0</td>
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<tr>
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<td>Ambre Energy</td>
<td>Big Horn</td>
<td>Strip</td>
<td>Active</td>
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<td>295,575</td>
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<td>Richland</td>
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<td>2,749,367</td>
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<td>Bull Mountains</td>
<td>Signal Peak Energy</td>
<td>Musselshell</td>
<td>Underground</td>
<td>Active</td>
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<td>Absaloka</td>
<td>Westmoreland Resources, Inc.</td>
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<td>Western Energy Company</td>
<td>Rosebud</td>
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<td>8,784,829</td>
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<td>Could Peak Energy</td>
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<td><strong>Total</strong></td>
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<td><strong>65,283</strong></td>
<td><strong>41,958,168</strong></td>
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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)
Ground Water Movement During Mining

Mining Progression

Overburden

Coal seam

H₂O

Underburden

Open Pit

Spoil
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
Box and Whisker Plot - TDS

TDS (mg/l)

Aquifers

D1L D1U D1 D2 D3 Spoil

Box and Whisker Plot - SO4

SO4 (mg/l)

Aquifers

D1LD1UDI D2 D3 Spoil

Legend
Max. 75 perc Median 25 perc Min.

Box and Whisker Plot - Na

Na (mg/l)

Aquifers

D1L D1U D1 D2 D3 Spoil

Box and Whisker Plot - HCO3

HCO3 (mg/l)

Aquifers

D1LD1UDI D2 D3 Spoil

Legend
Max. 75 perc Median 25 perc Min.

Figure 7
Rules address groundwater in all phases of mining:

- Baseline
- Application
- Operational
- Final Bond Release
"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

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.
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
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.
## 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 CaCO$_3$)
- Alkalinity (total as CaCO$_3$)
- Hardness (total as CaCO$_3$)
- Bicarbonate as HCO$_3$
- Carbonate as CO$_3$
- 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 CaCO$_3$)
- Alkalinity (total as CaCO$_3$)
- Hardness (total as CaCO$_3$)
- Bicarbonate as HCO$_3$
- Carbonate as CO$_3$
- 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
Decker Coal Mines

Tongue River Reservoir
Decker Spoil Well 251683

Water Elevation (ft)

TDS
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?