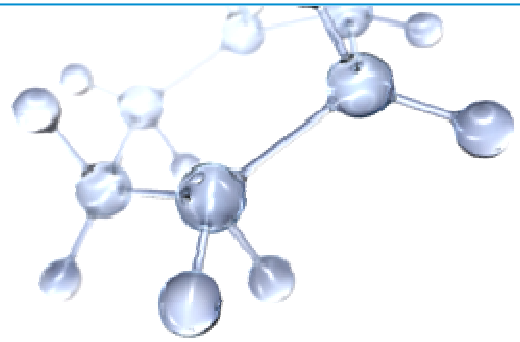
ExxonMobil

Taking on the world's toughest energy challenges.™



Responsible Development of Oil Shale

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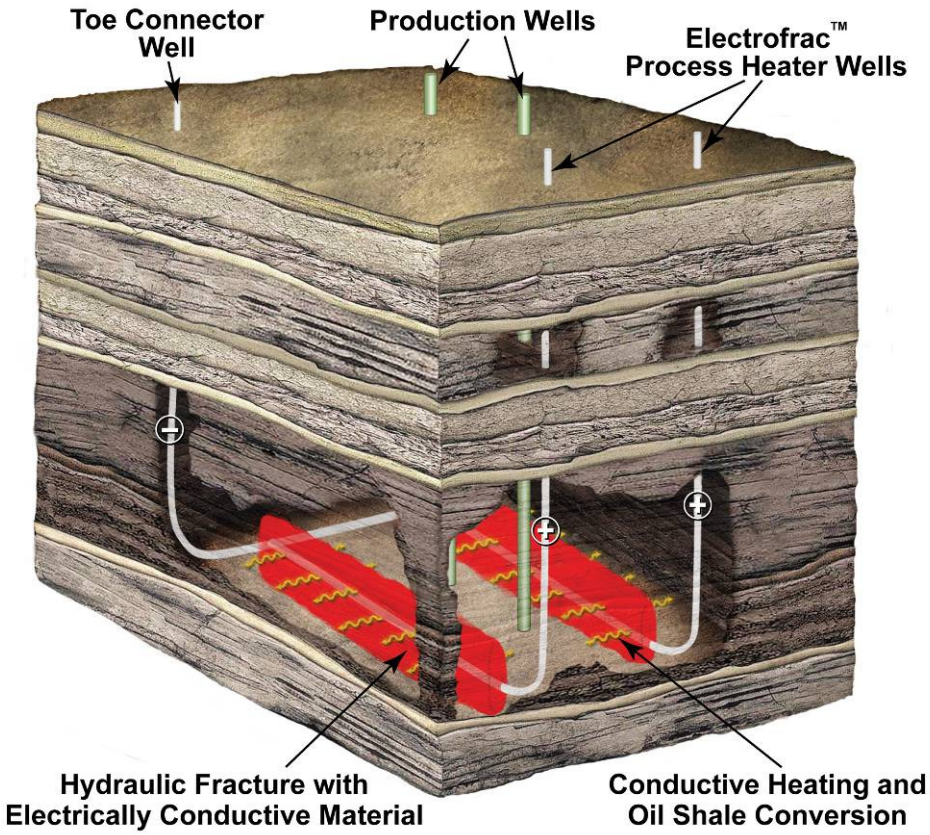
29th Oil Shale Symposium

October 19-21, 2009

Electrofrac™ Process

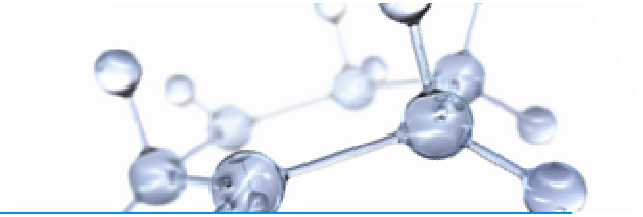
- Oil shale is heated *in situ* by a hydraulic fracture filled with an electrically conductive material*
- Electricity is conducted from one end of the fracture to the other, making it a resistive heating element
- Heat is conducted into the formation, converting the kerogen into oil and gas
- Oil and gas are produced by conventional methods
- Potential for cost-effective recovery with less surface disturbance than:
  - Mining and retorting
  - Competitive *in situ* processes
- Several years of research are required to demonstrate technical, environmental, and economic feasibility



Electrofrac™ is a potential process for the subsurface conversion of oil shale into producible hydrocarbons.

* U.S. patent 7,331,385 B2

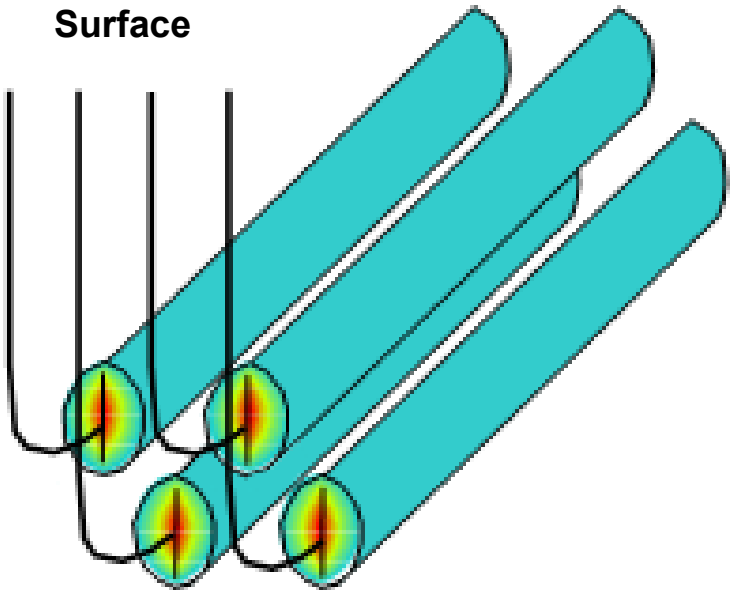
Responsible Development



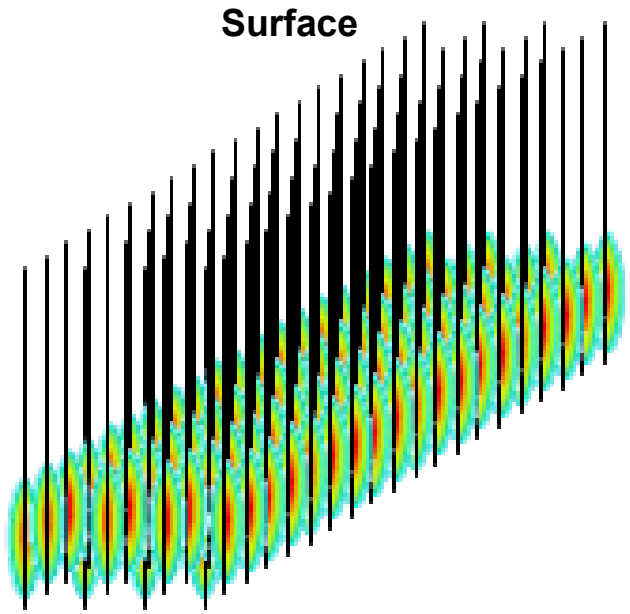
- Environmental Protection
  - Reduced surface footprint of fracture heaters *vs.* wellbore heaters
  - Reduced use of fresh water
  - Groundwater protection
  - Multimineral development: nahcolite, tight gas
  - Energy efficiency and CO_2 emissions
- Field Experiments
  - Work is underway to test process elements at Colony site
  - Environmental elements are a prominent part of R&D program

Reduced Surface Disturbance

Conductive Fractures*

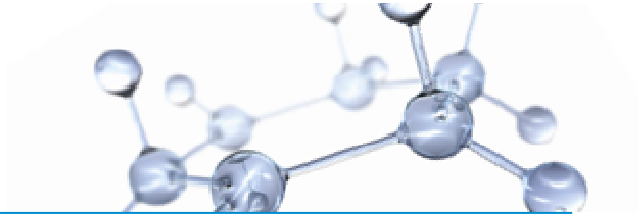


Wellbore Heaters*



* Production wells are not shown for either scenario

Water Use Estimates

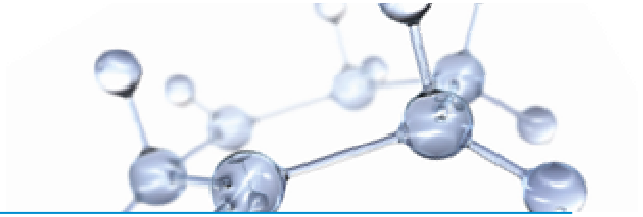


Barrels of fresh water consumed per barrel of oil produced

Consumption	First-Pass Estimates for In Situ Oil Shale	Current Technology - Alternative Water Sources
Drilling, Dust Control	0.1	0
Power Generation	1 - 3	0.1
Post-Production Flushing	1.7	0 - 1
Oil Stabilization	1	1
Total	**4 - 6**	**1 - 2**

- Current technologies can reduce needs: air-cooled power plants
- Alternative water sources can reduce needs: produced water
- New technologies may reduce water needs even further

Industry Water Demands



- Suppose we can achieve a water use ratio of 1.5 bbl water consumed per bbl oil produced

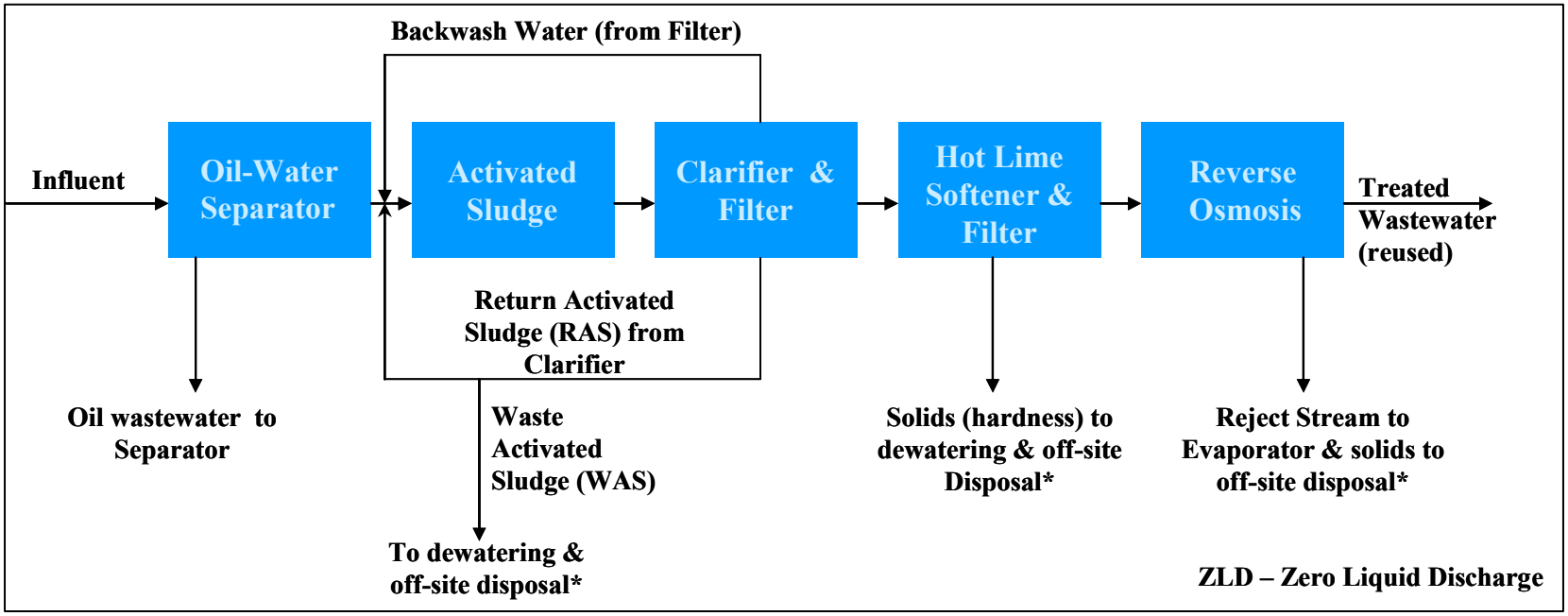
Scope	Oil Production bbl/day	Water Demand bbl/day	Water Demand ac-ft/yr*
One Commercial Project	50,000	75,000	3500
Industry (10 projects)	500,000	750,000	35,000

* Colorado annual water usage (2000): 14,000,000 ac-ft/yr (water.usgs.gov)

Water Use and Supply

- ExxonMobil water needs met with:
  - Alternative sources
    - For example, produced water from ExxonMobil tight gas operations
  - Recycled water from wastewater treatment plant
  - Fresh water as needed
    - Flexible timing can utilize peak flows

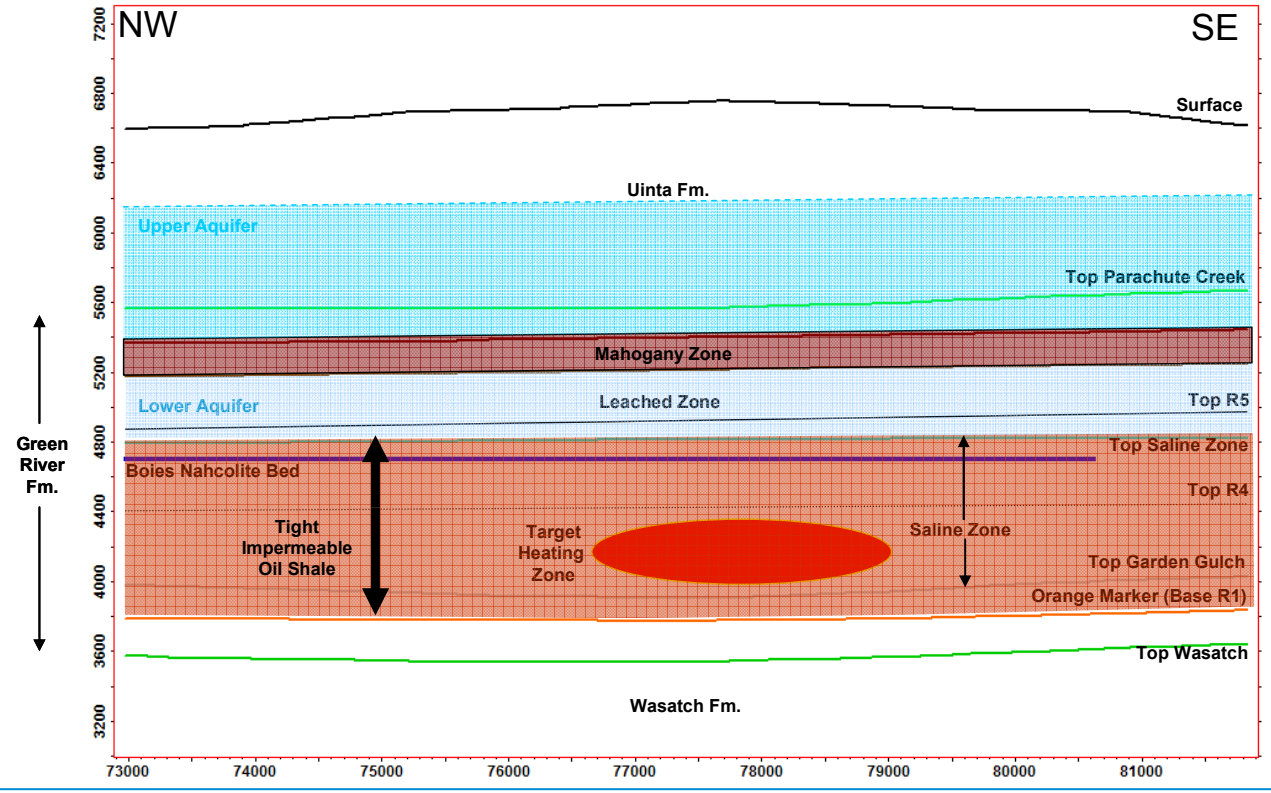
Wastewater Treatment Plant *



* Patent pending

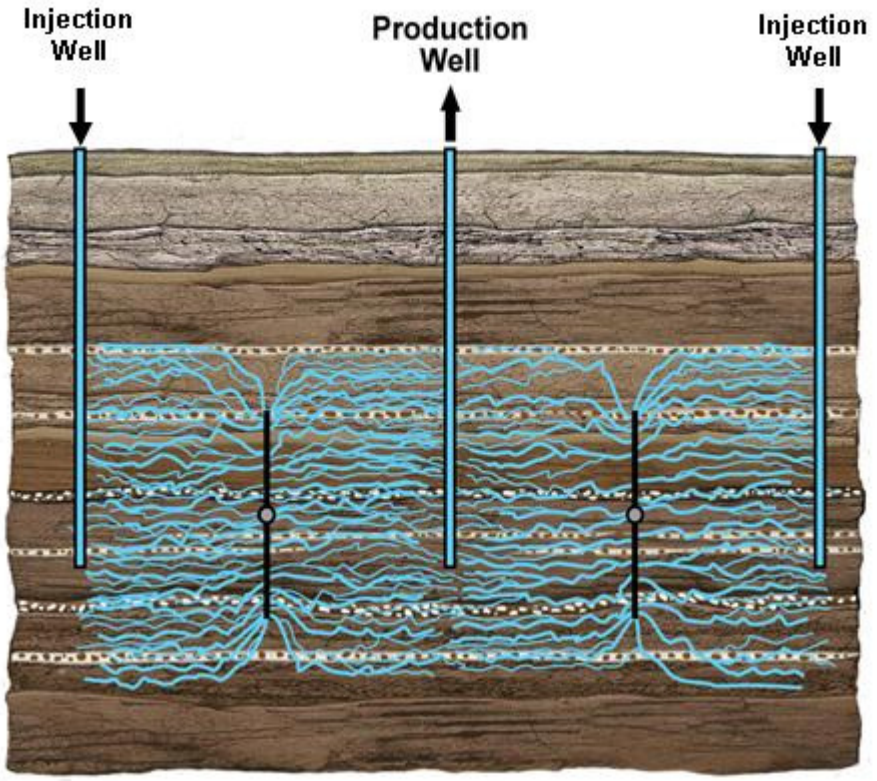
Groundwater Protection

- ExxonMobil process protects groundwater through hydraulic isolation of the converted oil shale resource below aquifers
  - Target “tight” saline zone below lower aquifer
  - Maintain unheated, impermeable seal around developed volume



Post-Production Flushing

- Synergistic process*
- Recover sodium minerals
  - At *in situ* conversion temperatures, nahcolite is converted to soda ash
  - Increased permeability allows for enhanced sodium recovery
- Remove residual hydrocarbons
  - Treat produced water and reinject

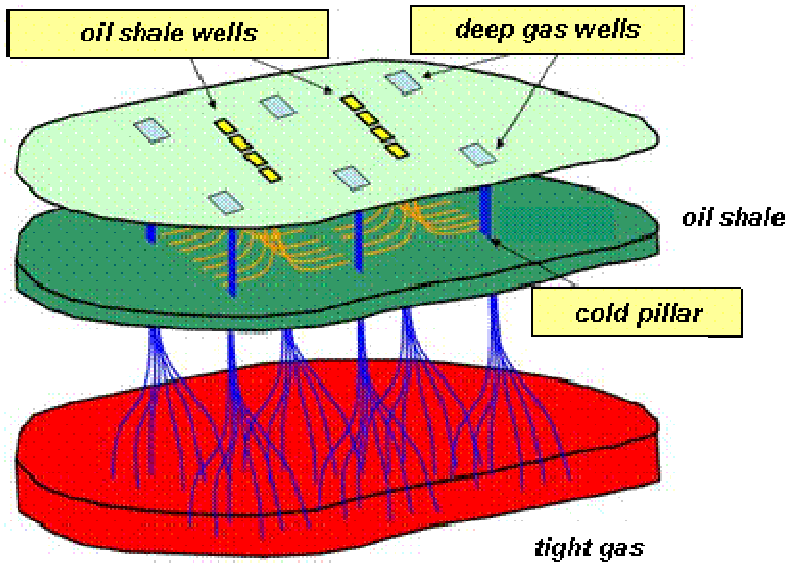


* Patent pending

Oil Shale and Tight Gas

- Concurrent development of tight gas via cold pillars in oil shale*
- Potential synergies with existing infrastructure to reduce surface disturbance
- Potential use of tight gas produced water to reduce fresh water consumption for oil shale

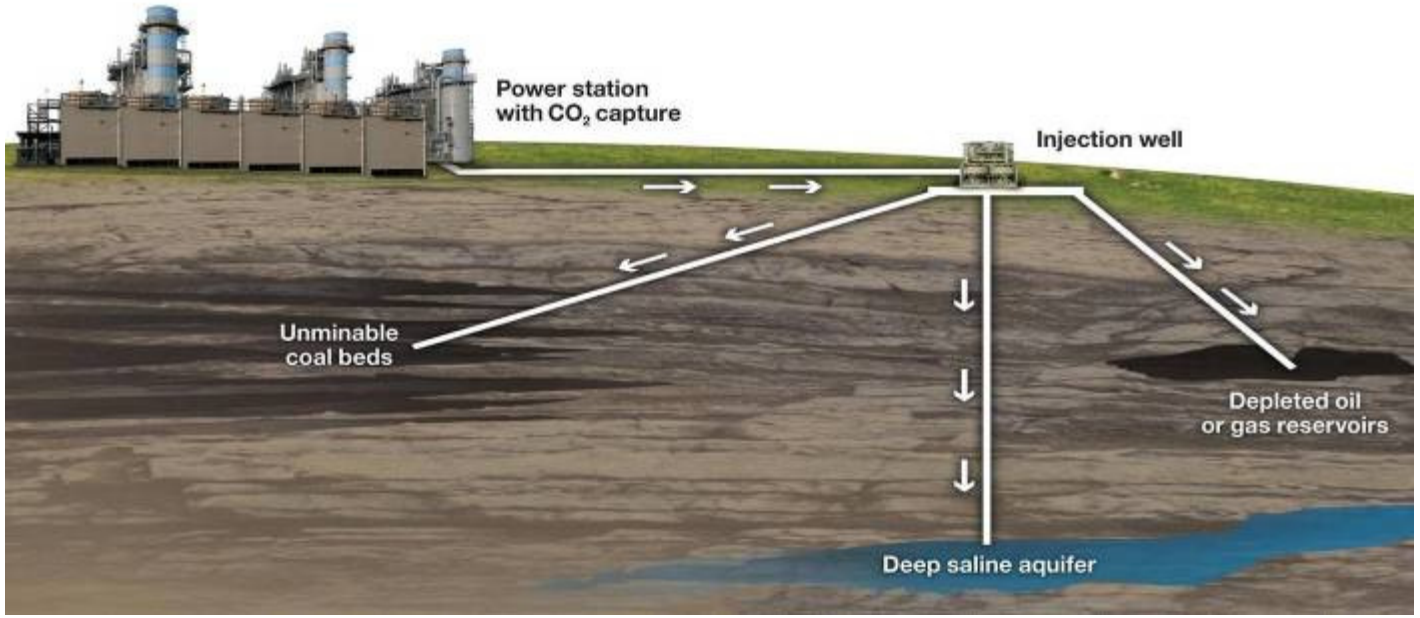
Codevelopment Plan



* Patent pending

CO_2 Emissions

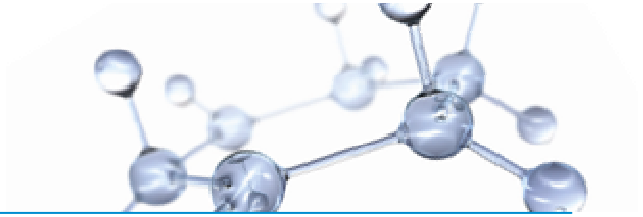
- Preliminary analysis of Electrofrac™ energy efficiency indicates an energy ratio of at least 3 to 1
  - > 3 BOE energy produced for each BOE fuel input to power plant
  - Produced gas will fuel energy-efficient gas power plant
  - Point source CO_2 emissions are amenable to CCS mitigation technologies



Field Experiments

- Field tests are underway to test Electrofrac™ process elements at ExxonMobil's Colony site, Colorado
  - Results to date support technical feasibility

Closing Comments



- Oil shale comprises an important domestic resource to meet U.S. energy demand and diversify supply
- ExxonMobil's Electrofrac™ process has significant potential for technical, environmental, and economic success
- Environmentally and socially responsible development
  - Reduced surface disturbance, water use, and CO_2 emissions
  - Groundwater protection
  - Multimineral development
- Going forward:
  - Careful, phased approach that allows for prudent technical, environmental, and social planning and execution
  - Work with all appropriate local, state, and federal agencies to develop viable options