The Promise and Peril of Oil Shale Development (February 5) 2010

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# SLIDES: Energy Development Water Needs Assessment and Water Supply Alternatives and Analysis

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# Energy development water needs assessment and water supply alternatives analysis

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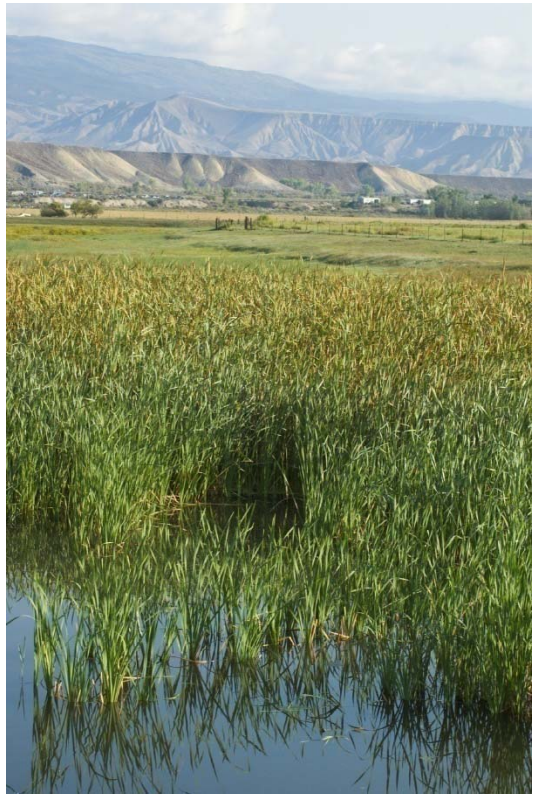
# Colorado Water for the 21st Century Act (HB 05-1177)

- **Statewide Water Planning Process**
- **Nine Basin Roundtables**
  - Formulate a water needs assessment
  - Conducting analysis of un-appropriated water
  - Propose projects or methods for meeting needs
- **Interbasin Compact Committee**
- **Funding for special studies**



# Energy Water Needs Assessment

- **Funded under the HB-1177 Process by the Colorado Water Conservation Board**
- **Project of Colorado River basin and Yampa/White River basin Roundtables**
- **Two phases:**
  - Estimating energy development water needs
  - Evaluating water supply alternatives to satisfy those needs

# Phase 1 Industry Production Scenarios

| Scale | Capacity | Water Requirement |
|---|---|---|
| Low | None (R&D) | |
| Medium | 550,000 bbl/day | 135,000 af/year |
| High | 1,550,000 bbl/day | 380,000 af/year |

# Phase 2 Approach

- **Refine Water Use Estimates**
  - Review and refine Phase I unit water use
  - Localize water use estimates
  - Develop water use scenarios
- **Evaluate use of Piceance Basin groundwater**
  - Ground water quality
  - Potential tributary connection
  - Overall feasibility of groundwater use
- **Develop  water supply project alternatives**
- **Develop model and analyze alternatives**

# Uncertainty: Industry Scale/Timing

- **Review history of Athabasca Oil Sands**
  - Surface-mined – (less overburden)
  - Separation process 1926
  - First commercial extraction 1967 30,000 bbl/day
  - 2005 production 760,000 bbl/day
  - 2006 production 1,100,000 bbl/day
  - Long-term growth rate c. 12%
- **Extrapolation to Piceance Basin**
  - Field demonstration of feasibility c. 2015
  - First commercial production c. 2035 (50,000 bbl/day)
  - 1.55 mm bbl/day by about 2060

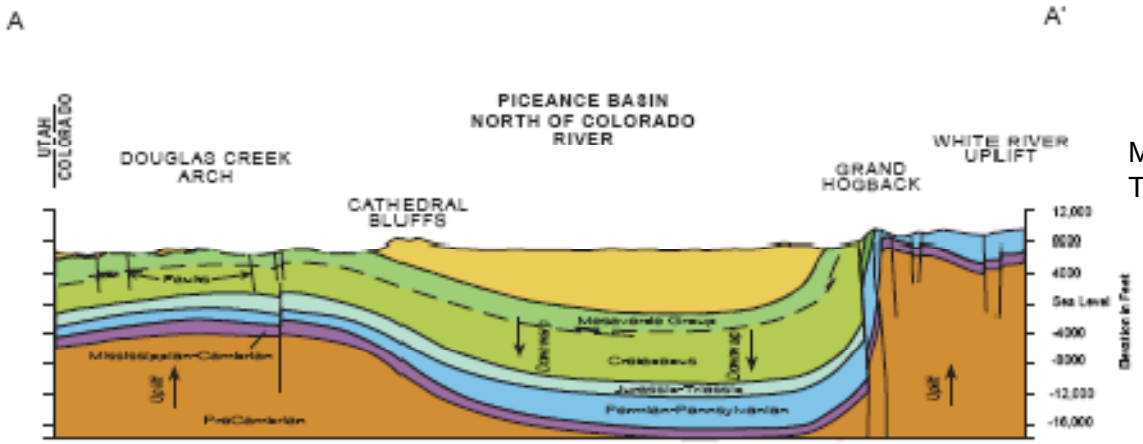
# Uncertainty: Electrical Energy

- **What in-situ technology will prevail?**
  - Electrically heated
  - Combustion or other heating metho**d**
- **Electrically Heated In-situ**
  - 120,000 GWh/year for 1.5 million bbl/day
  - Colorado total generation (2008): 53,000 GWh/year
- **What will be source of electrical energy?**
  - On-site Combined-cycle Gas Turbines (CCGT)
  - Yampa coal-fired thermal (Craig station approximately 10,000 GWh/year)
  - “Somewhere else”
- **Water requirements**
  - CCGT in-basin
  - Thermal in ????
  - Grid supplied
- **Likely winner: CCGT?**

# Phase 2 Water Needs Estimates

| Industry Case | 1,550,000 bbl/day | 550,000 bbl/day |
|---|---|---|
| Direct uses | 110,000 af/year | 42,000 af/year |
| Water for CCGT | 55,000 af/year | 19,000 af/year |
| Water for Thermal | 181,000 af/year | 61,000 af/year |
| **Colorado Total** | | |
| “Somewhere Else” | 110,000 af/year | 42,000 af/year |
| Using CCGT | 165,000 af/year | 61,000 af/year |
| Using Thermal | 291,000 af/year | 103,000 af/year |

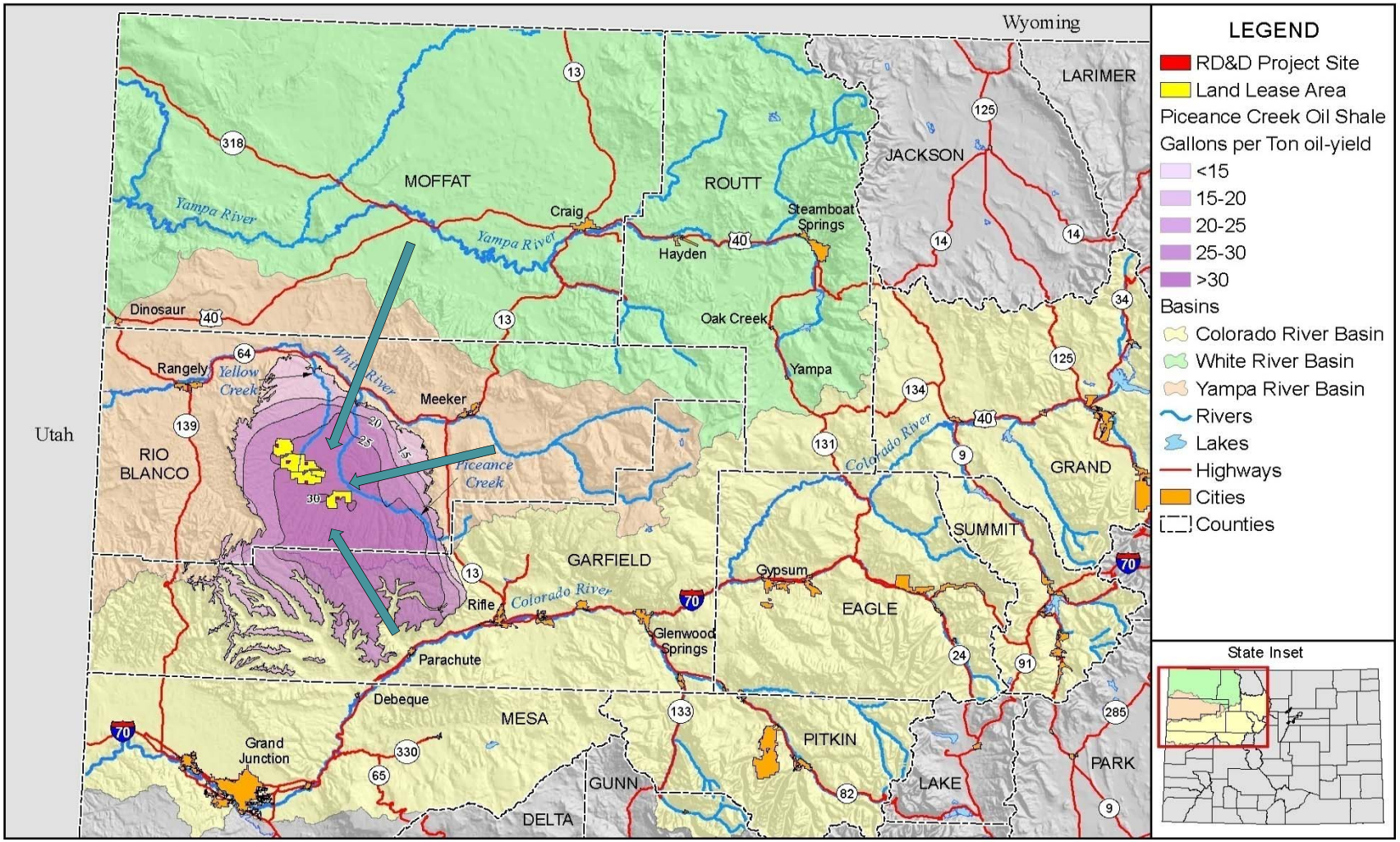
# Water Supply: Groundwater




Modified from Tweto, 1983

- Quality—
  - Ranges from moderately poor to very poor (1,000- > 10,000 mg/l TDS)
  - Hard and scale forming
  - Will require treatment
- Quantity
  - Most feasible aquifers are probably tributary
  - Feasibility of development in other aquifers will depend on site specific investigations
- Overall—Not likely to be a regional resource

# Water Supply: Surface Water

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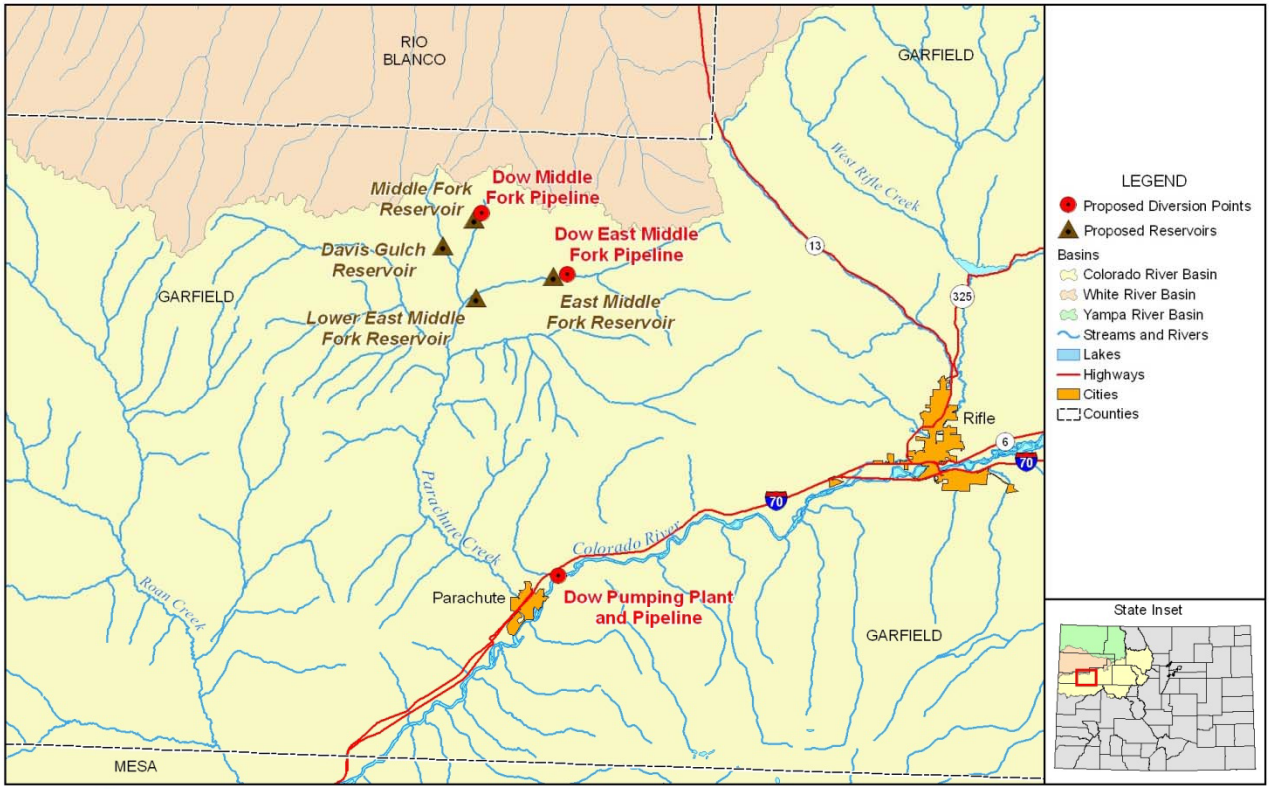
Map compiled 10/2009; intended for planning purposes only.
Data Source: Colorado's Decision Support Systems, CDOT, USGS

# Water Supply: Develop Conceptual Projects

- White River Basin
  - Identified Reservoirs
  - No feasible groundwater
- Imports from Colorado River
  - Exxon change case
  - Other projects?
- Imports from Yampa River
  - Shell proposal

# Exxon Mobil Change Case

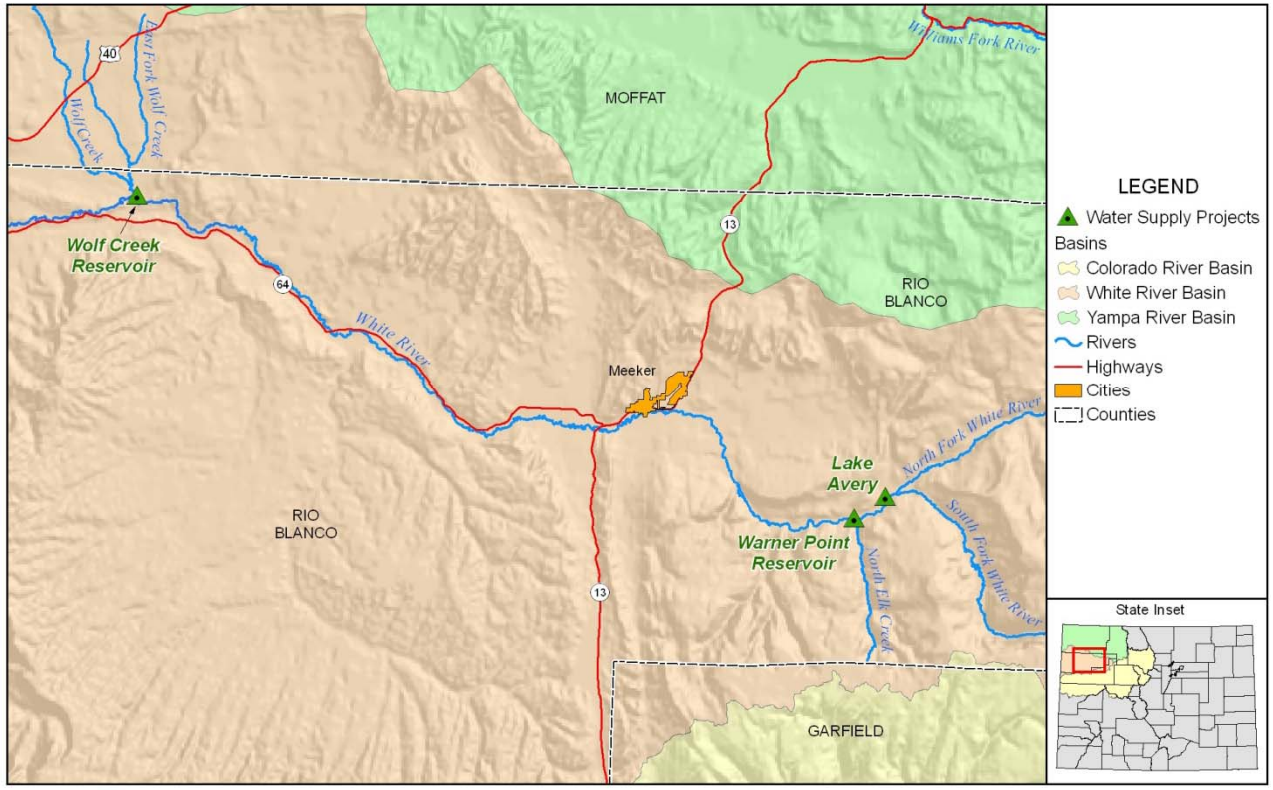
Proposed Diversion Points & Reservoirs by Exxon Mobil
(Case NO. 08CW199)




Map compiled 2/2010; intended for planning purposes only.
Data Source: Colorado's Decision Support Systems, CDOT,
Application for Case NO. 08CW199

# White River Reservoirs

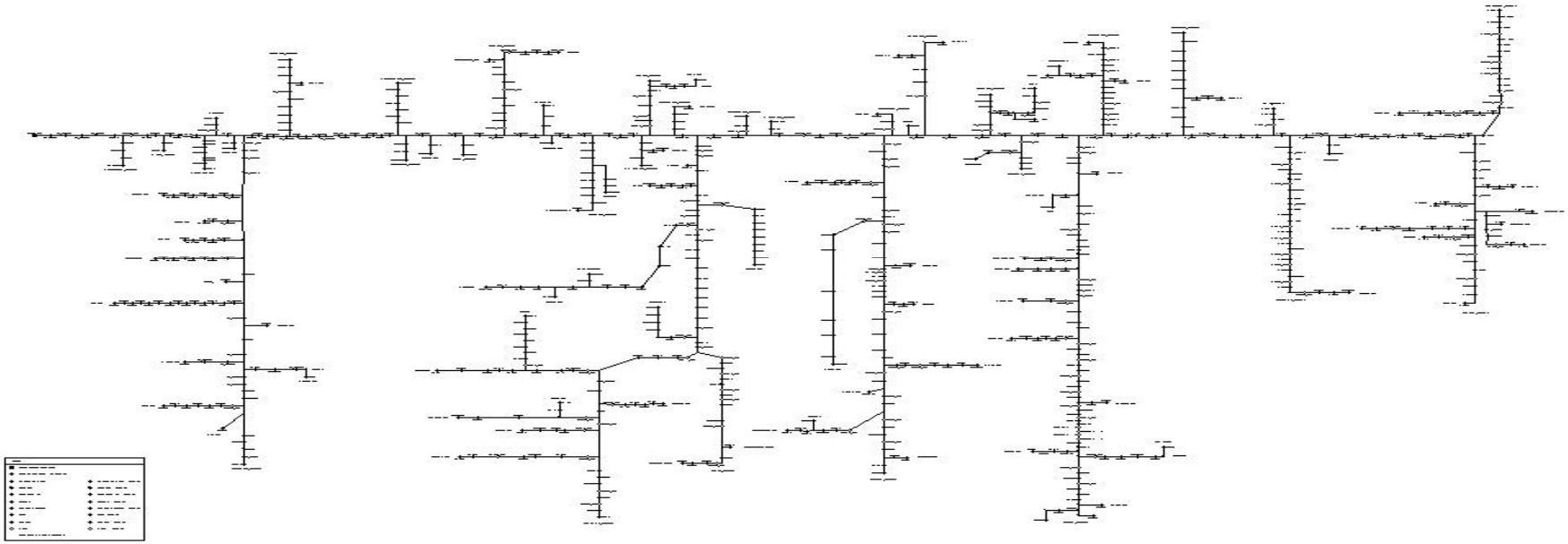
Proposed Water Supply Projects - White River Basin




Map compiled 2/2010; intended for planning purposes only.
Data Source: Colorado's Decision Support Systems, CDOT, USGS, White River Study (12/1983)

# Water Supply: Evaluating Projects

- Develop  water rights “portfolio” from identified “energy” rights
- Associate Water Rights with Facilities
- Disaggregate demands to nodes
- Disaggregate annual demands to model time step
- Evaluate performance of project/water rights



# Water Supply Uncertainties

- **Will there be any oil shale industry?**
- **If there is an industry, can its scale be managed?**
- **What in-situ technology will be used?**
- **Where will the electricity come from?**
- **Where will upgrading and refining be done?**
- **Development approach?**
  - Coordinated
  - “Scramble”
- **How much water will be available?**