Growing Limitations on Fresh Surface and Ground Water Availability

- Little increase in surface water storage capacity since 1980
- Concerns over climate impacts on surface water supplies

- Many major ground water aquifers seeing reductions in water quality and yield

(Shannon 2007)
Most State Water Managers Expect Shortages Over The Next Decade Under Average Conditions

Source: GAO 2003
Gas Shale development could be extensive and impact water availability and quality

- Water is used in drilling, completion, and fracturing
- Up to 3 million gallons of water is needed per well
- Water recovery can be 20% to 70%
- Recovered water quality varies – from 10,000 ppm TDS to 100,000 ppm TDS
- Recovered water is commonly injected into deep wells, but not appropriate for all areas
Gas Shale Site Development
Common Approach and Practices

Hydraulic fracturing

Typical drilling site

Reference: Modern Shale Gas, Development in the United States: A Primer
Groundwater Protection Council, ALL Consulting, National Energy Technology
Laboratory, U.S. Department of Energy, April 2009
# Relative Water Use of Gas Shale Development

Average shale gas well yield – 2-6 BCF

<table>
<thead>
<tr>
<th>Water Use per Unit Energy (gallons/MMbtu)</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Natural Gas Extraction</td>
<td>1-2</td>
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<tr>
<td>Coal Gasification</td>
<td>50-100</td>
</tr>
<tr>
<td>Coal Liquefaction</td>
<td>20-50</td>
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<tr>
<td>Insitu Oil Shale</td>
<td>2-10</td>
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</tbody>
</table>
Major Gas Shale Water-Related Development Issues

• Storm water runoff from drilling pad
  – Local issue

• Drinking water impacts
  – Few identified complaints, likely surface casing issue

• Finding adequate water supplies
  – Example: Permitting of 200 wells/year increasing to 1000 wells/year
  – Will limit speed of gas shale development in some areas

• Disposal of flow back
  – Local limitations for deep well injection
  – Environmental and cost issues of trucking
  – Limitations on ability to discharge to POTW - salt and chemical issues
  – Will limit speed of gas shale development in some areas