Environmental Lessons Learned and Application of Best Practices to Both New and Existing Shale Plays

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Agenda

• Introduction
• Shale Play Inter-relationships
• Best Management Practices for Shale Resources
• Leveraging Lessons Learned
• Summary
Introduction

Technology

– The development of Shale resources has served as an important example of how technologies and practices can be utilized, molded for specific circumstances and be successfully transferred on a worldwide basis.

Data

– The way in which we receive, manipulate, handle and analyze data has shed new uses for many historic practices and expanded our knowledge and the ability to develop resources in an increasingly environmentally sound manner.

Practices

– Environmentally-Sensitive and sustainable practices are being developed and implemented like no other time in the history of oil & gas resource development.

Improvement

– To reach goals such as energy independence, continuous improvement is an absolute necessity and key to that is environmental management planning by all stakeholders.
SHALE PLAY INTER-RELATIONSHIPS

Water: 99.3%

Other: 0.70%

0.11%

0.08%

0.02%

0.005%

0.004%

0.001%

Corrosion Inhibitor

August 2012

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The Role of Technology

• Obvious Technologies
  – Deep horizontal drilling
  – High volume hydraulic fracturing

• Other Technologies
  – 3-D Seismic Analysis
  – Multi-well drilling pads
  – Water sourcing and transport
  – Impact mitigation
Adaptive Management

- Flares
- Multi-Stage Fracturing
- Multi-Well Drill Pads
- Road Durability
- Water Sourcing/Transfer
- Wastewater Treatment
- Green Completions
- Wetlands Management
- Impoundments
- GHG and Air Quality
- Water Recycling
- Etc.

- Barnett
- Bakken
- Frederick-Brook
- Waipawa
- Shublik
- MS-LM
- Woodford
- Fayetteville
- Haynesville
- Utica
- Niobrara
- Eagle Ford
- Marcellus
- Horn River

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BEST MANAGEMENT PRACTICES
What are BMPs?

• Technologies, methods, and procedures that avoid, reduce, or mitigate environmental and community impacts associated with oil and gas activities
• BMPs are proactive and can also be reactive:
  – Often best incorporated early in a project
  – Site specific
  – Economically feasible
• BMPs are not required, but often allow an operator to meet a regulatory requirement
BMP Words of Caution...

• **Not – An assurance of 100% impact avoidance**
  – Some degree of impact is unavoidable if the gas resource is to be produced

• **Not – One-size-fits-all**
  – Multiple BMP options may address the same basic concern from different approaches or under different circumstances

• **Not – Universally applicable**
  – Depending on the situation, what works in Texas may be totally inappropriate for New York. Further, applicability may vary from one part of a play to another!
Variations Within a Single Play

Some Shale plays can be rather expansive, covering large portions of a state or even multiple states. This means practices specific to any number of issues may vary greatly even within a single development area.

Higher water volumes are more common in the western portion of the Eagle Ford play.

Lesser volumes of water are more predominant in the eastern portion of the play.
BMP Application & Objectives

• Apply BMPs using a hierarchical approach
  • Avoid environmental impacts.
  • Minimize environmental impacts.
  • Mitigate those environmental impacts that are unavoidable.
  • Technical and logistical details must be considered in the process.

• Objectives of BMPs
  – Environmental
    • Meet or exceed regulatory requirements
    • Environmental stewardship/responsibility
    • Achieve site-specific priorities
  – Health and safety
    • On-site workers
    • General public
  – Community
    • Quality of life
BMP Process Considerations

• BMPs can have both positive and negative impacts:
  – Identify impacts and appropriate responses early
  – Identify additive, synergistic, and countervailing effects

• Plan with an environmental protection objective in mind
• Take a cradle-to-grave approach
• Synergistic opportunities can address multiple impacts over the life of the project
Evaluating Trade-Offs

• BMPs may entail trade-offs:
  – Centralized water reservoirs may reduce water withdrawal issues but may result in additional surface disturbance and concentrated truck traffic

• Watch for unintended consequences:
  – CBM impoundments in the Powder River Basin were seen as benefit for wildlife – but increases in mosquito populations have been implicated as a cause of increasing West Nile virus in sage grouse
Recognizing BMP Evolution

- BMPs have been around a long time and resources are bountiful!
- Started as good ideas, shared within companies or between small operators
- Early compilations included
  - NYDEC’s BMPs for visual impacts in 2000
  - ALL Consulting’s CBM Best Practices in 2003
  - BLM’s BMPs for federal lands 2004
  - Western Governors Association’s CBM BMPs - 2006
  - Many others have followed
DRILLING CONSIDERATIONS

• Regulatory & Landowner Coordination
• Pre-drill/background anal.
• Community/Neighbors
• Drilling program assessment
• Well integrity & testing
• Surface disturbance management
• Erosion/Sediment Controls
• Air emissions and controls
• Pit design, use, & closure
• Roads and Traffic
• Noise & Visual impacts

Note: The above are examples and not intended as an “all inclusive” listing of considerations.
COMPLETION CONSIDERATIONS

• Regulatory & permitting
• Well integrity & testing
• Water management
  – Water sourcing/logistics
  – Timing of withdrawals
  – Storage/Impoundments
  – Wastewater Management
• Transportation
  – Roads and traffic
  – Temporary pipelines
• Chemical screening
• Flaring & air emissions
• Noise & lighting

Note: The above are examples and not intended as an “all inclusive” listing of considerations.
PRODUCTION & INTERIM RECLAMATION

- Interim Reclamation
- E&S controls
- Produced water mgmt
- Air emissions
- Noise, lighting & visual
- Routine inspection program
- Environmental monitoring & compliance

Note: The above are examples and not intended as an “all inclusive” listing of considerations.
LEVERAGING LESSONS LEARNED
Applying Practices

• Shale plays throughout the world share commonalities, whether it’s the presence of wetlands, extreme weather, arid environments, an urban or rural setting, etc.
• Examples of practices and solutions may be drawn from multiple plays in developing an environmental management plan and the most appropriate best practices.
• In some cases, correlations may seem unreasonable, but depending on the issue may offer direct applicability and benefits.
• Individual operators may have differing policies toward specific practices, thus what works for one operator may be unacceptable to another.
Alaska’s Shublik Shale

- Traffic and Routing
- HF Chemical Screening
- Water Sourcing
- Disposal Well Planning

- Wetlands Management
- Siting in Sensitive Areas
- Wildlife BMPs

- Multi-Well Pads
- Sustainable Water Mgmt
- Seasonal Logistics
- Siting and Transport
- First Nations Concerns

- Minimizing Footprint
- Well Integrity Analysis
- Managing Releases
- Erosion/Stormwater
- Watershed Mgmt

Shublik Shale
Alaska’s North Slope

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Summary

• The development and use of BMPs is nothing new. However, technology and even social media has accelerated the use and diversity of practices used in shale plays.

• Shales have many commonalities, which provides broad application of practices to be developed, used, documented, and improved.

• With new shale plays developing (e.g., Alaska’s Shublik Shale), bountiful lessons from many other shale plays are available for consideration.

• Caution should be used when directly applying practices from one area to another as site-specific circumstances may render a particular practice from one area less than ideal in another. As such, practice implementation is not typically simplistic in nature.
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0.08%

0.11%
BMP Resources

Federal Agency Links

• http://www.epa.state.il.us/p2/fact-sheets/bmp-oil-exploration.html
• http://www.wsi.nrcs.usda.gov/products/UrbanBMPs/
• http://cfpub.epa.gov/npdes/stormwater/oilgas.cfm

State Agency Links

• http://www.forestry.state.ar.us/bmp/bmp_review.html
• http://bogc.dnrc.mt.gov/webmapper_cbm_info_res.asp
BMP Resources

Association and Industry Links

- http://www.oilandgasbmmps.org/
- http://www.ipaa.org/issues/hot_topics/docs/RAPPS.pdf
- http://lingo.cast.uark.edu/LINGOPUBLIC/
- http://www.forestrybmp.net/
- http://www.bmpdatabase.org/