[PS]Environmental Considerations for Planning Unconventional Gas Developments*

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Abstract

The new "gas rush" created by the rise of unconventional gas technologies involves political and environmental concerns. To successfully develop unconventional gas projects, proper planning is crucial. Planning includes sensitive variables such as water requirements, well pad sizes, power generation requirements, disposal options, water treatment, country regulations or other various types of environmental pollution that could define the start of the first gas production. A multidisciplinary team could guarantee a more realistic economic evaluation for the project by taking into account all the variables in each case. This presentation intends to show the importance of environmental issues when planning unconventional gas developments.

AAPG GTW Colombia 2014:

Expanding Unconventional Resources in Colombia with New Science–From Heavy Oil to Shale Gas/Shale Oil Opportunities

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ENVIRONMENTAL CONSIDERATIONS TO SUCCESSFULLY PLAN UNCONVENTIONAL GAS DEVELOPMENTS

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Planning Unconventional Resources Include

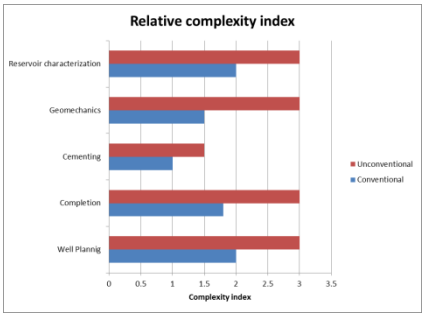
Project Variable considerations

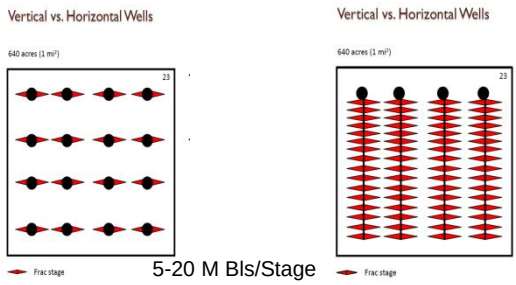
- Legislators and staff
- Regulatory agencies
- Communities
- Universities & academia
- Established media
- Social media
- Investors
- Suppliers

Technical Considerations

- Reservoir characterization
- Well pads size
- Water source and treatment
- Aquifers characterization
- Water disposal analysis
- Vertical versus horizontal development
- Formation damage

Multidisciplinary team for planning unconventional resources





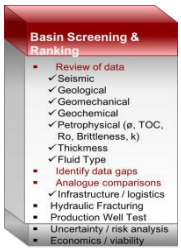
5-20 M Bls/Stage

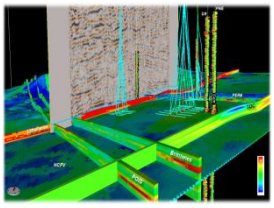
Planning: nontechnical aspects

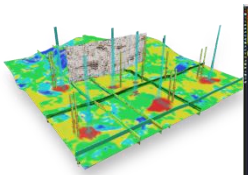
Country Regulations → Environmental study → Energy source evaluation → Social impact → Ecosystem impact → Logistic analysis → Supplies

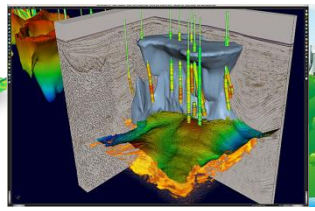
Planning: technical aspects

Screening → Evaluation & characterization → Asset appraisal → Field development → Restoration









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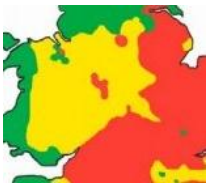
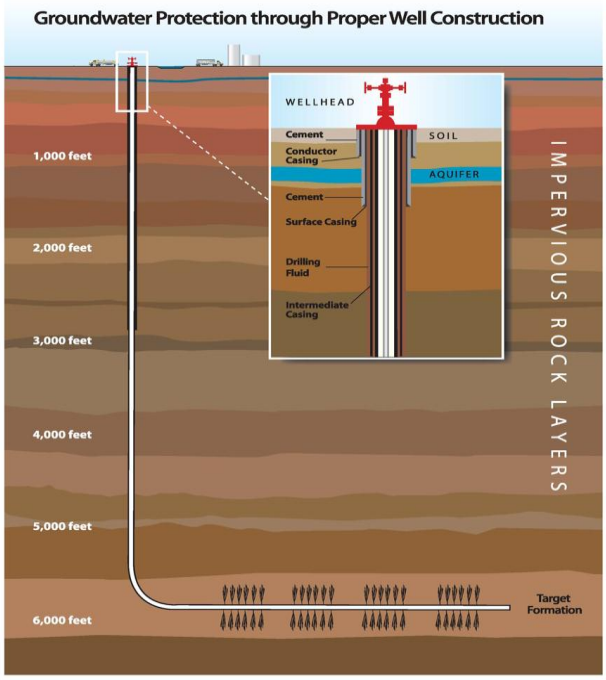
Well Construction – Protecting & Characterizing Ground Water

Multiple layers of cement and steel casing

- Protect ground water
- Restrict fluid movement between formations
- Aquifers characterization to know aquifer capability for future frac jobs, irrigation, human consumption. Water composition, Ph., salinity and hardness need to be determined in each well to generate maps.





Water Source

- Rivers

- Aquifers

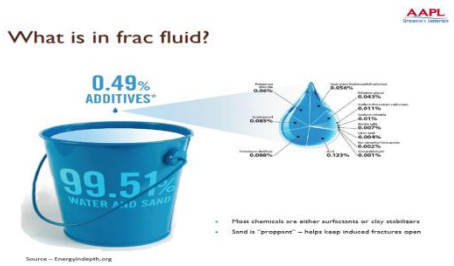
- Sea

Conduct studies in advanced to guarantee adequate water volumes for fracturing jobs.

Depending on the available water source(s), a risk analysis is necessary to visualize possible impact during water collection and disposal

Fracturing Fluid

- 99.5% Water and sand
- 0.5% Chemicals



Environmental Advancements in Fracturing

- Solar power
- Gravity feed
- Smart inventory control
- Reduces location size
- Eliminates diesel power pack

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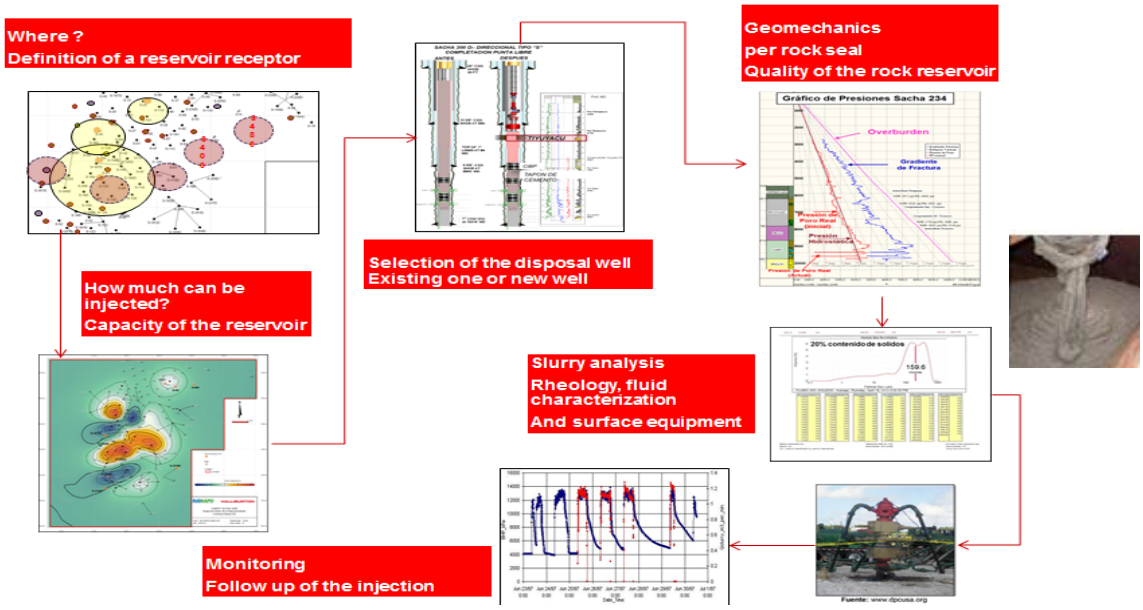
Flow Back Water and Cutting Disposal



Advancements in Fracturing to minimize Environmental impact.

- Electrocoagulation process
  - Metal ions
  - Oil and fats elimination
- Minimizes chemical usage
  - Environmental friendly products
- Reduces volume of fresh water required for fracturing treatments
- Minimizes residuals
  - Maximize water reuse
  - Water source desalination

Recommendations to ensure an Unconventional Field Development Plan

- Conduct detail studies related to water sources and water characterization
- Aquifer studies are required to know water availability and possible impacts (social, communities and environmental)
- Planning minimizes residuals during the entire process
- Use state-of-art drilling and completions techniques to help minimize drilling pads

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