Water Management, and Completions Operations

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Piceance Basin, Western CO

- 200-300 Tcfe Piceance basin potential
- Over 14,000 wells in the basin
- One of the largest gas basins in the nation
- WPX is the largest Natural Gas Producer in Colorado
- WPX operates over 4,500 wells in the basin
- Currently 9 rigs running
- Anticipate completing ± 275 wells in 2014
- Stages per well range from 5-20 per well, 6,000-10,000 bbls per stage and 100,000-200,000 lbs of proppant per stage
- Manage ± 880,000,000 gallons of produced water yearly

Stimulation (aka: Hydraulic Fracturing or Frac’ing)

Required for commercial gas production
- Creates flow path through concrete-like rock
- "Large" volumes of water and sand pumped down the wellbore into the formation at depth
- Sand props fractures open
- Water flowed back to surface and reused
- Natural gas is piped to gas plant

Microseismic Monitoring: Fracs Stay Within Target Zones

Plan view – frac azimuth is parallel to the maximum horizontal stress

Side view of the same frac treatment
**Microseismic Monitoring Shows Hydraulic Fractures do not Grow Uncontrollably**

Industry data from Marseilles

WPR data from Western Colorado

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**Water Management Approach**

**PROBLEM:**

2007 30,000 BWPD
- Would require 300 truck loads per day
- 109,500 truck loads per year

Cost of water management
- Thousands of wells to drill
- Public pressure
- Dynamic regulations

**SOLUTION:**

- Multi Well Pad Drilling
- SIMOPS
- Remote Fracturing
- Water Management Facilities
- HDPE Lines
- Injection
- Comprehensive team approach
  - Drilling, Completions, Production
  - parties and Water Management Group
- Flexibility
- New Technology
- Community interaction

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**Our Water Goal “Recycle, Recycle, Recycle”**

Our plan is to provide our completion team cleaned produced water to cost effectively stimulate our wells.

- Secondary, we need to provide cost effective holding and storage systems for our production operations.
- All to be done to meet and or exceed regulatory requirements while working closely with our local governments to ensure good communication and feedback.

What is cleaned produced water for hydraulic fracturing operations:
- Solids and hydration clean water
- We do not address the high field household wells (THS): of the water
- The data associated to THS are beneficial to prevent clays from entering within our target formation
- Average TDS for our produced water is 12,500-16,000 PPM
- Injection well criteria from the state and EPA.
- No produced water can be injected into formations with TDS less than 3,000 PPM
- All water requirements is from the EPA to inject produced water into formations with TDS’s in the range of 3,000-16,000 PPM
- EPA drinking water 500 PPM

How much water do we manage?
- 2013 WPR produced approximately 6,891,476aks or 1,375 Acre Feet
- 2013 WPR: recirculated approximately 6,128,714 bbls or 790 Acre feet of produced water and frac flow-back for fracturing operations. - At total of 1757 stages.
- 2013 WPR: used 3,255 bbls or 0.5 Acre Feet of fresh water in our fracturing operations 0.1% of our total water used.
- 2013 WPR: disposed of approximately 615 Acre Feet, 80% to injection
- Final volume is available for future completions.

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**Centralized Water Management Facilities**

**Complex/Rigorous operating plan**
- Water treatment, monitoring, record keeping
- Planning, inspections and documentation

**State of the art operations**
- Dray weighing (physical)
- DIRO (Dissolved air flotation) technology
- Evaporation ponds
- Clarified ponds with evaporation and Microbiology
- well price for solids recovery

**Fully automated**
- Water treatment
- Nearly eliminating spills

**Fully enclosed process and systems**
- No WMS emissions are captured and / or controlled

**Provides**
- High capacity / low operating cost
- Ability to plan back out to fracturing operations for reuse or inject wells for disposal

Centralized WRF allows us to move water through pipelines eliminates 100,000’s truck loads per year!

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**Water Treatment Facility Valley Produced Water**

**SOLUTION:**

- Produced Water
- Resource
- Water Treatment
- Water Management
- Water or Salt Water
- Storage Tanks
- Water and Salt Water

**Technology**

- DAF
- Polishing & Surge Tank (Dissolved Air Flotation)
- Water
- Storage Ponds

**Flowback Water**

- Water
- Polish & Surge Tank

**Emulsion**

- Water
- Technology

**Water**

- Water
- Water for Surging

**Storage Ponds**

- Water
- Technology
DAF Performance

- Correlation between turbidity reduction and hydrocarbon reduction
- Influent: 230 ntu → 450 ppm TPH
- Effluent: 20 ntu → 30 ppm TPH
- Detailed lab analysis for compliance verification

Solids Management

- Solids Sources:
  - Inflow from Operations, sand and formation fines
  - Production: Sand, formation fines, iron sulfides
  - Drilling: Majority handled on location, small amount of solids generated in the de-watering process

Solids Management Continued

Waste Management

2014 Solids Management Tests

- Land farm
- Field solids screening
- Vacuum Press

Innovations to Solids Management: “Belt Press”

- Significant improvement over filter press
- Filter press uses perlite, 50% reduction in volume
- 80% decrease on cost

Innovation Beyond

Reverse Osmosis (RO)

- Testing 1/10th scale
- 1,000 ml/day
- Meeting or exceeding requirements
- Water resources discharge
Water Optimization, Technology and EH&S

**Injection and Pumping Facilities**
- Automated shutdowns to allow unattended operation
- Eliminated 1st-party pumping and equipment
- Reduced completions and production water costs
- High/High and Low/Low shut downs
- Water SIPS

The Science of Surface Impoundment Lining Systems

- Permitted & documented with regulatory agencies
- Voluntarily built beyond higher "E&P Waste Facility" Standards
- Professionally engineered & constructed

Putting It All Together

- Clustered Plan of Development (CPOD)
  - Well and pad
  - Efficiency rigs
  - Remote Frac SIMOPS
  - Water management

- Reductions in:
  - Drilling cycle time
  - Surface disturbances (75% less)
  - Emission traffic, noise, reductions
  - Wildlife impacts
  - Restoration time

- Huge cost savings
  - Water hauling eliminated
  - Greatly reduced efficiency rigs
  - Multi-well pads

- WFX receives awards from BLM and state agencies

Lining and Leak Detection Systems

- WPX reduces water hauling by reducing footprint
- Reduced risk of spills
- Recognized by COGCC

Recycle, Reduce and Improve

- 2014 Trucking Reduction YTD Ryan Gulch
- Reduced Truck Loads
  - Production
  - Frac Ops
  - Frac Flowback
  - Injection
  - Total
- Pumped Water (bbls)
- Reduced Truck Loads (bbls)

Creatively Reducing Risk: ‘Remote Frac’

- Used nearly 11,000 times since 2006
- Up to 4 miles away
- Reduces truck traffic by up to 50%
- Allows community and road safety, noise, and air pollution
- Eliminated nearly 600,000 heavy truck trips on public roads

- Recognized with COGCC and BLM awards

- Reduces footprint by 50%
What does stable gas prices and the oil shale success mean

- Lower Natural gas prices to the average consumer:
  - Its estimated that average home saves $1,500 per year due to low Natural gas prices.
  - Revitalization of the energy intense manufacturing in the US
  - Taking factories “jobs” away from traditions over seas area’s
  - Lower petro chemical costs- Plastics, Nylon and ??????
- Shale Oil Success
  - Gas prices low compared to Asia and Europe
  - Lower oil imports, close to energy independence
  - Investment in our economy

- Colorado
  - The Colorado Oil and Gas Industry generates 11% of the states GDP $29.6 billion
  - 110,000 direct and indirect jobs
  - Provides $682 million for schools and other public entities
  - Provides low heating costs to Coloradans, 43% less in heating bills compared to New England
  - $0.73 of every tax dollar in Garfield county comes from the Natural Gas Industry