

WV COMMISSION ON OIL AND NATURAL GAS INDUSTRY SAFETY

Antero Resources Corporation

August 26th

Roughneck



Oilfield Professional



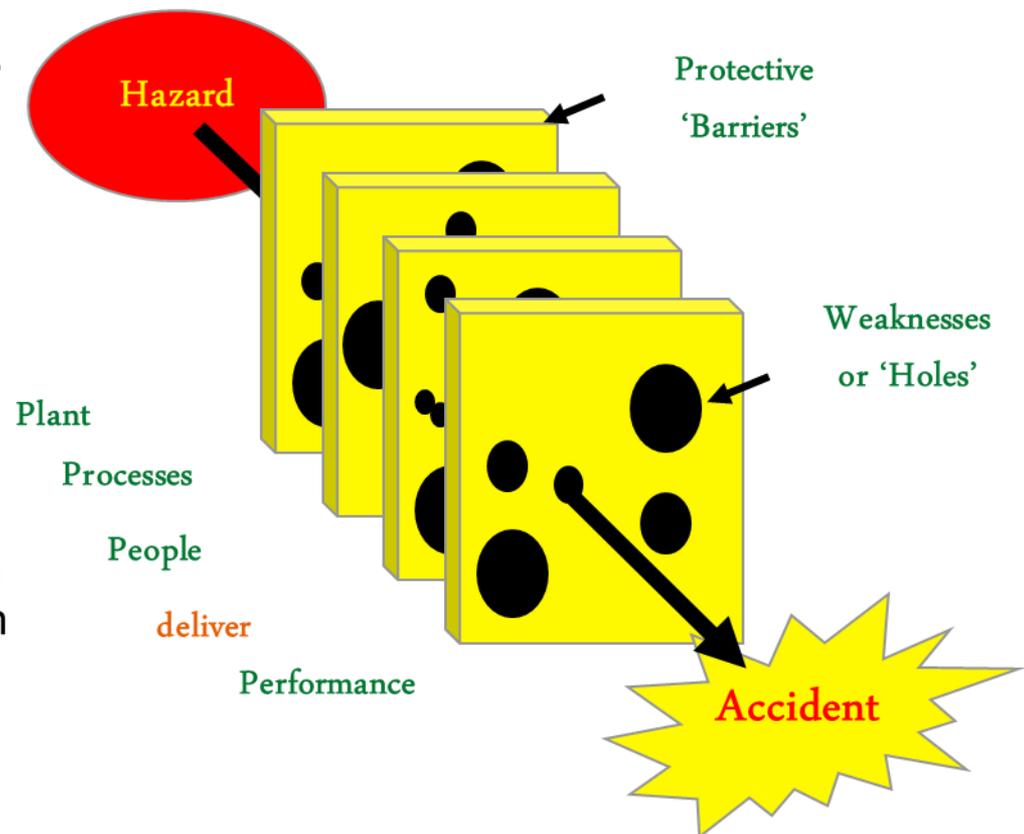
Strategic Risk Reduction Model

Performance & risk – through layers of protection to reduce the potential for major incidents and losses:

- **plant** – engineering hardware, control systems, physical layouts
- **processes** – management systems to identify, control and mitigate risks, and drive continuous operational improvement
- **people** – capability in terms of leadership skills, relevant knowledge and experience, and the organizational culture

‘Hard barriers’ are more reliable than ‘soft barriers’, but all ultimately rely on people

The ‘Swiss Cheese’ Model



Minimum Standards



- General safety procedures
- Hazard communications
- Transportation rules and regulations
- Rig Environment
- Emergency response techniques
- OSHA provisions
- General safety and health related to:
 - Fall protection
 - Means of egress
 - Stairways and ladders
 - Personal protective and lifesaving equipment
 - Hazardous Energy Control (Lockout/Tag-out, Breaking Containment)
 - Fire Safety
 - Occupational Health and First Aid

Safety Regulations and Standards Currently Governing Oil and Gas Exploration

- OSHA Part 1903: Inspections, Citations, Penalties
- OSHA Part 1904: Occupational Injuries and Illness
- OSHA Part 1910: General Industry
- OSHA Part 1926: Construction
- Chemical Safety Board
- DOT
- NFPA
- NIOSH
- DEP
- ATF (27 CFR 555)
- API (American Petroleum Institute)
- Environmental (covered in Pad Construction)

PAD CONSTRUCTION

Thorough Evaluation

Permits Required

- Air Quality Permit
- US Army Corps of Engineers Nationwide Permit
 - US Fish & Wildlife Clearance Letter
 - State Historic & Preservation Office
- Stormwater Permit (Well pads exempt)
- Stream Crossing and/or Boring Permits
- Well Work Permit
- Floodplain Permit
- Road Usage Permit and/or Agreement
- Centralized Pit/Impoundment Permit
- Associated Pit/Impoundment Permit
- Dam Permit (Size Dependent)
- Above Ground Tank Storage Registration
- Water Withdrawal Registration

Permitting Agencies

FEDERAL

- US Environmental Protection Agency
- US Army Corps of Engineers
- US Fish & Wildlife Services

STATE

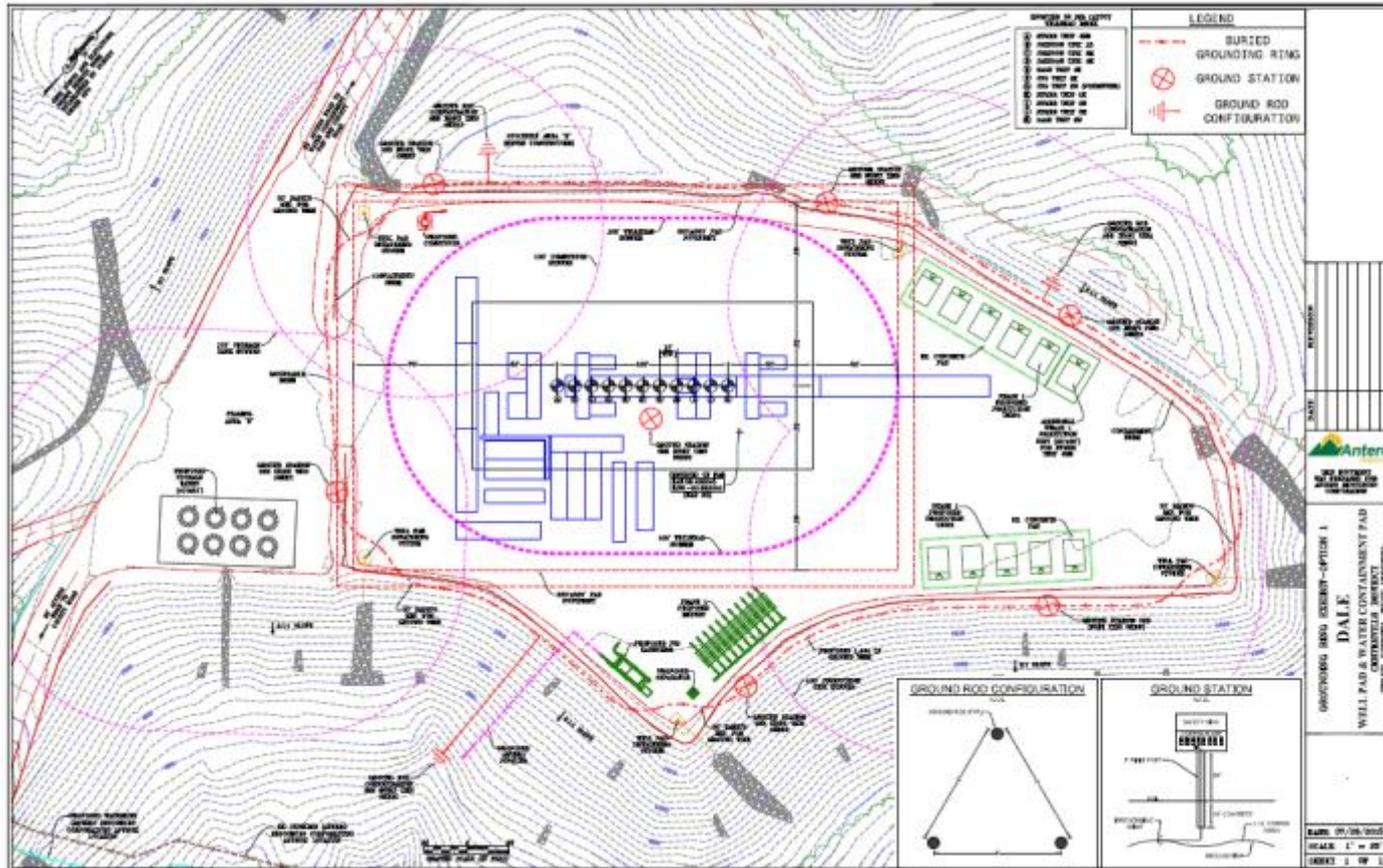
- State Historic Preservation Office
- Department of Transportation
- WV Department of Environmental Protection
 - Office of Oil & Gas
 - Division of Air Quality
 - Division of Water & Waste Management
- WV Division of Natural Resources
- OH Department of Natural Resources
 - Division of Oil & Gas Resources
- OH Environmental Protection Agency
 - Division of Air Pollution Control
 - Division of Materials & Waste Management
 - Division of Surface Water

LOCAL

- County Commissioners
- County Floodplain Managers
- Township Trustees

Equipment Layout – Safety Offsets

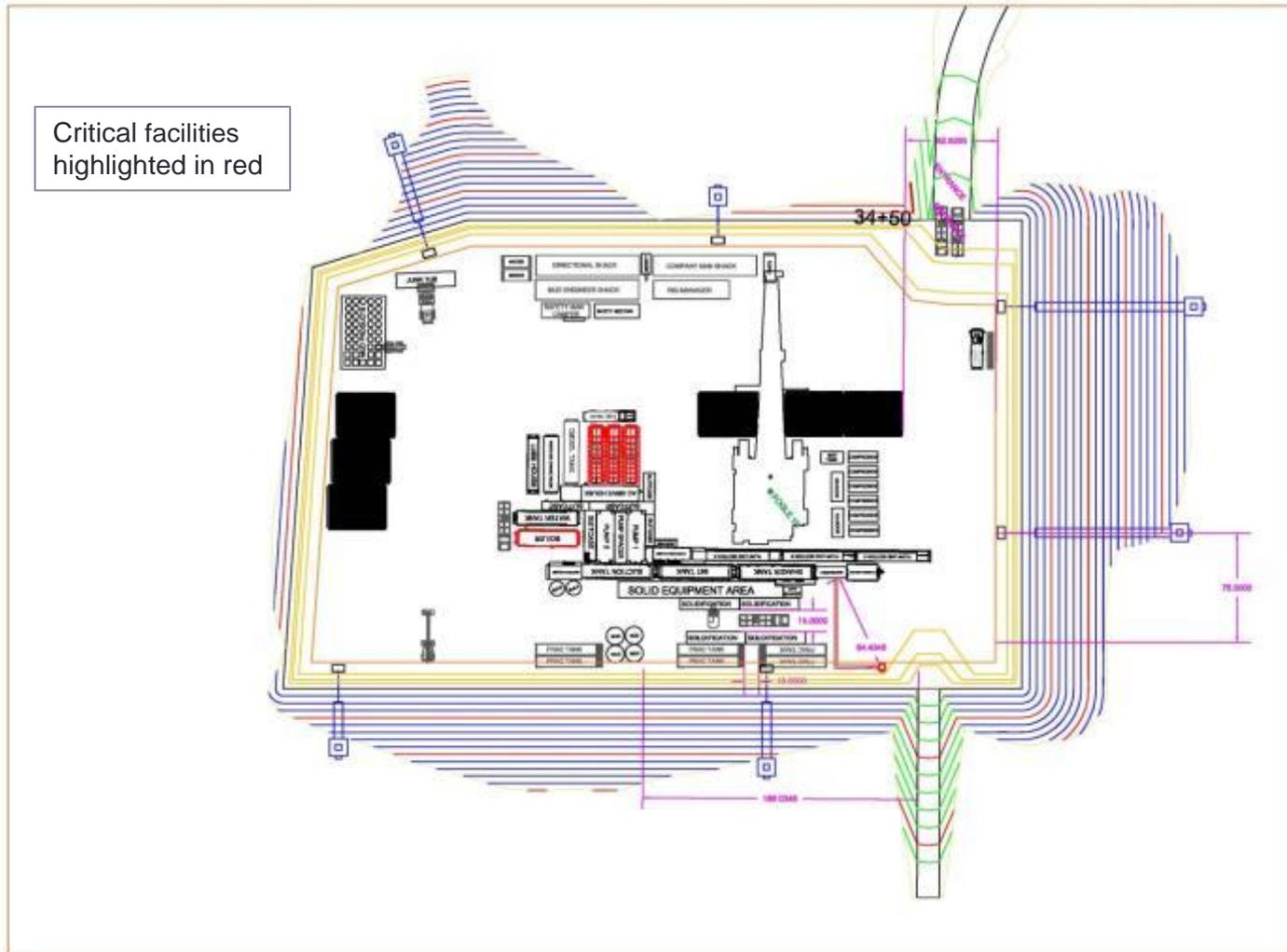
- Safety offsets pre-planned
- Radii shown to provide required space between source and ignition



Planning and Review

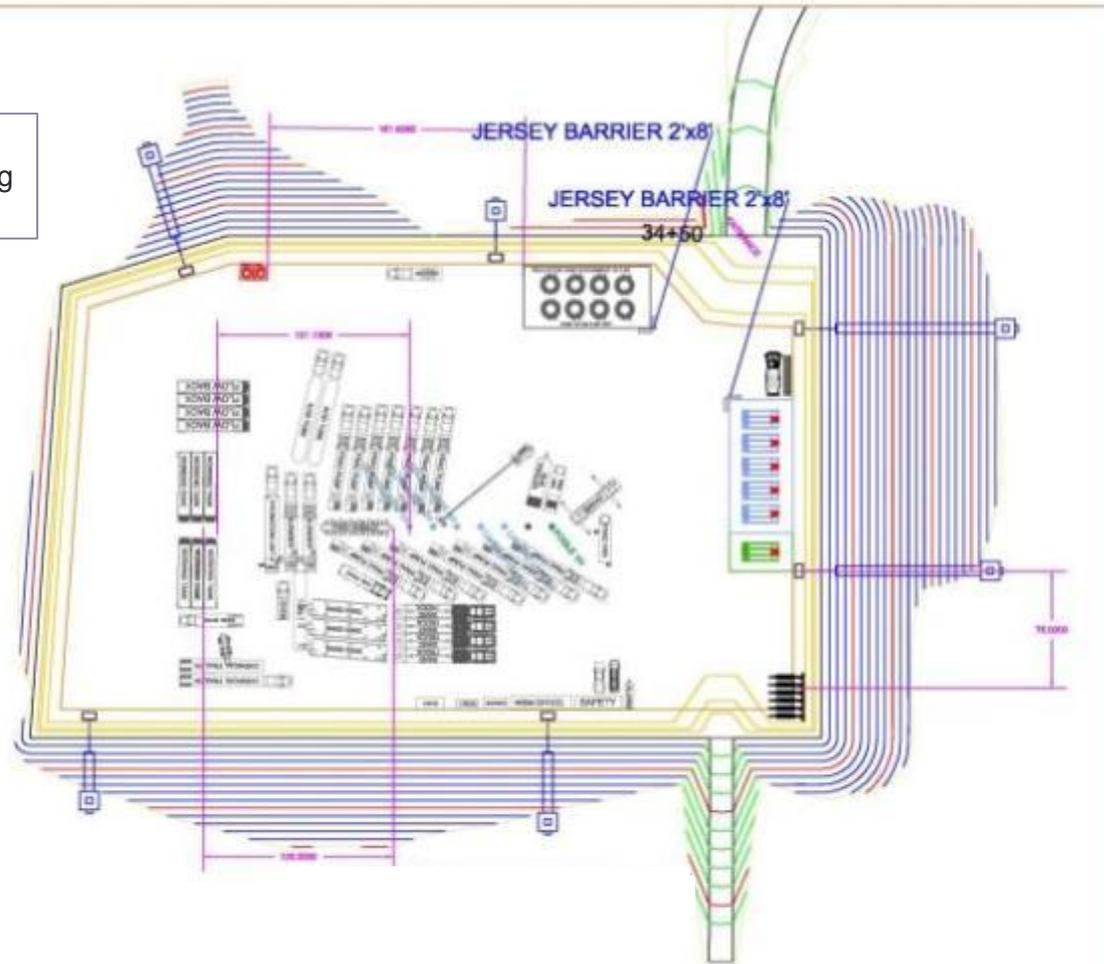
- Failure to Plan is a Plan to Fail
- Pads must satisfy complex needs from multiple groups
- Thorough credible, analytical input is needed to ensure the pad incorporates needs from all stakeholders
- Weekly meeting held to coordinate between departments
- Sign offs required to establish controls
- Internal releases required before construction and operations

Planning and Review – Drilling First Visit



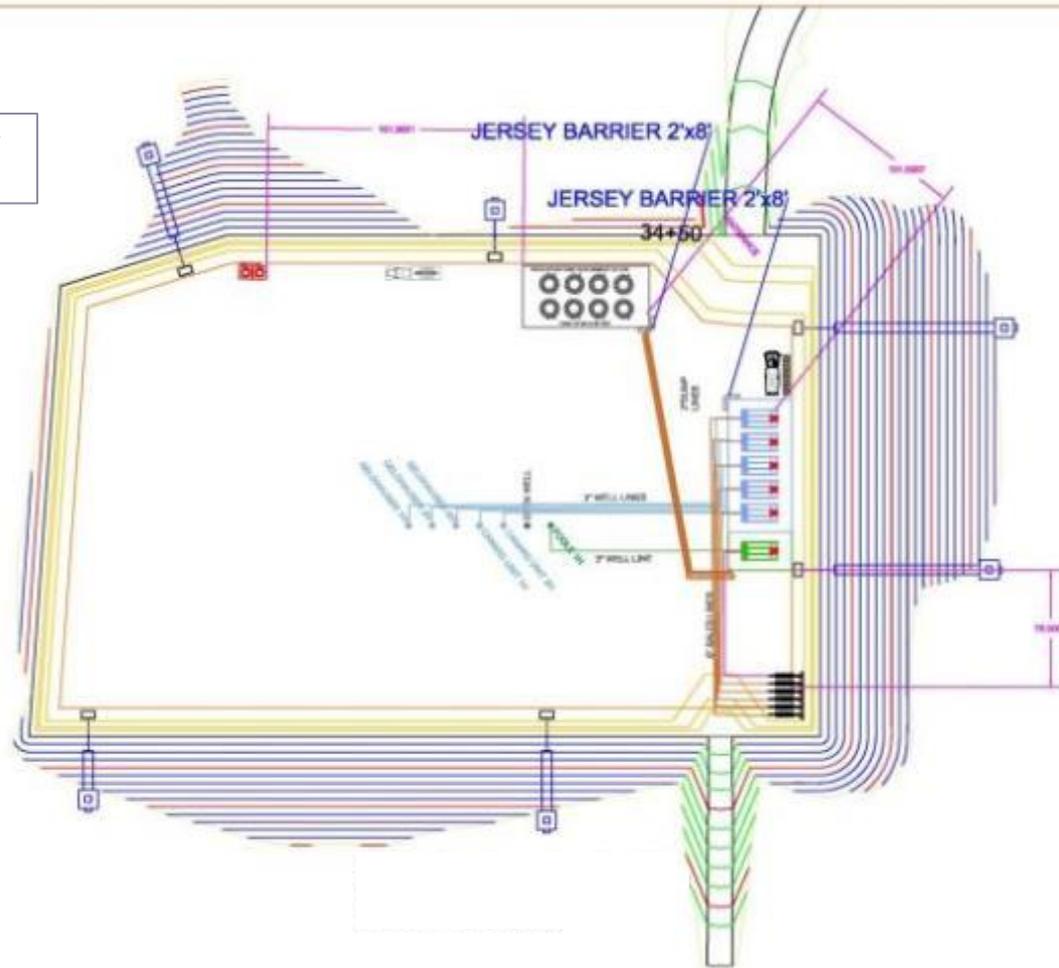
Planning and Review - Completions

Barricades used to protect existing equipment



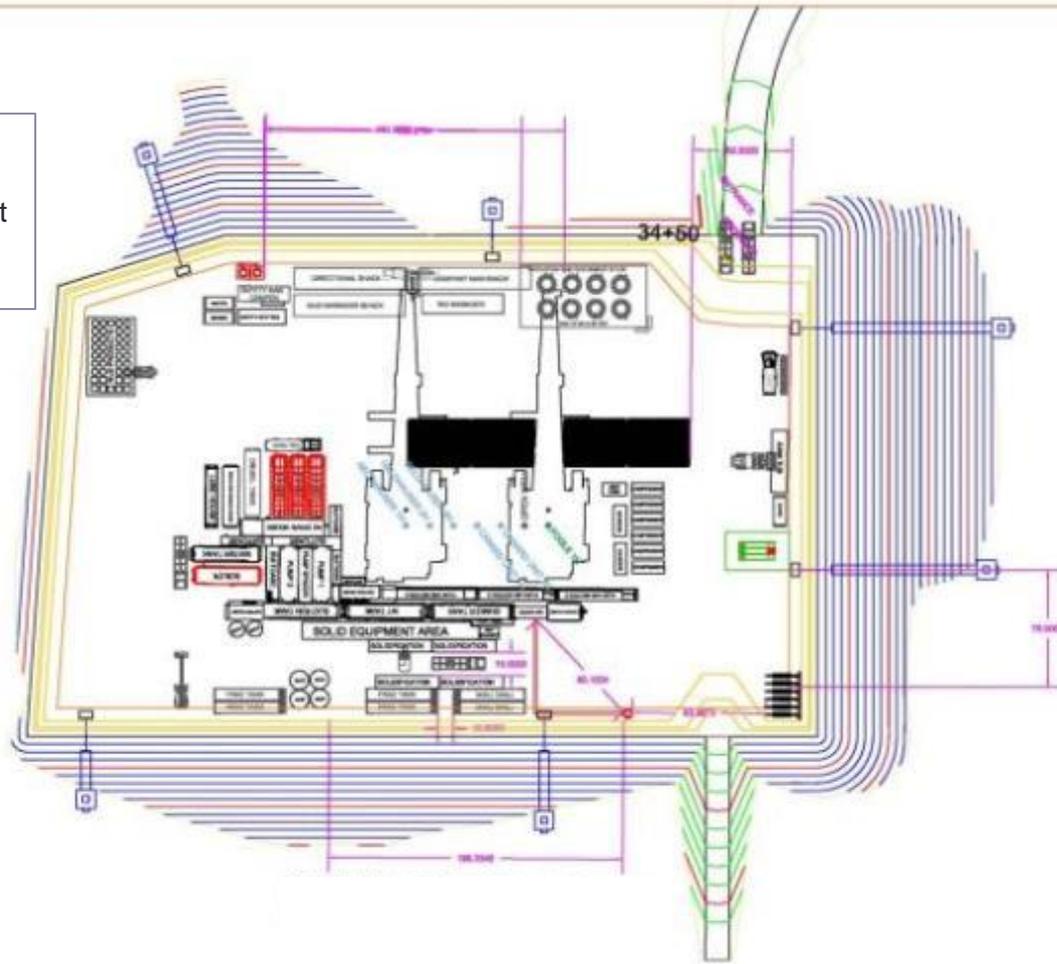
Planning and Review - Production

Lines located for
record drawings



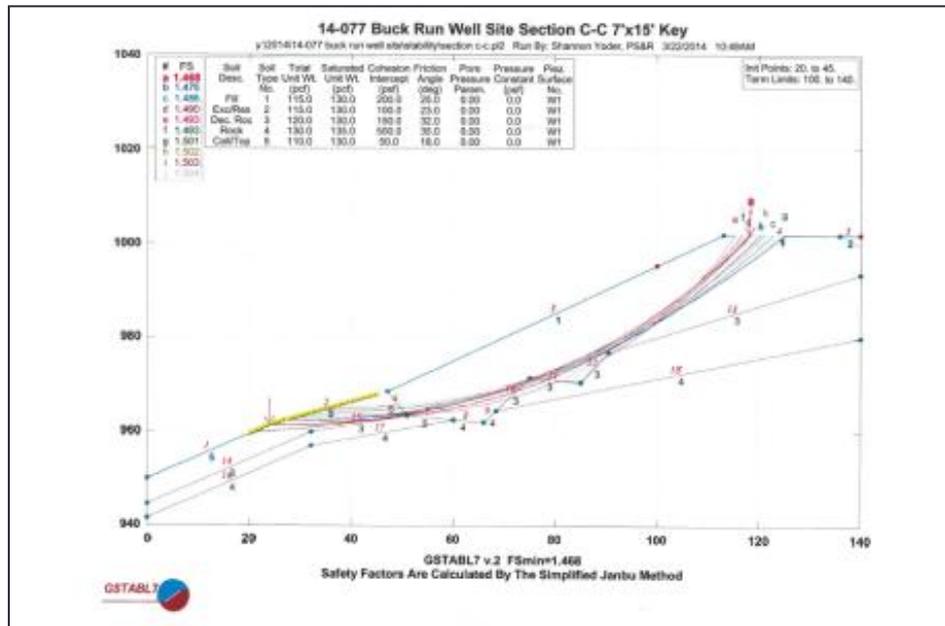
Planning and Review - Successive Visits

Stakeholders must again approve now that facilities are in place

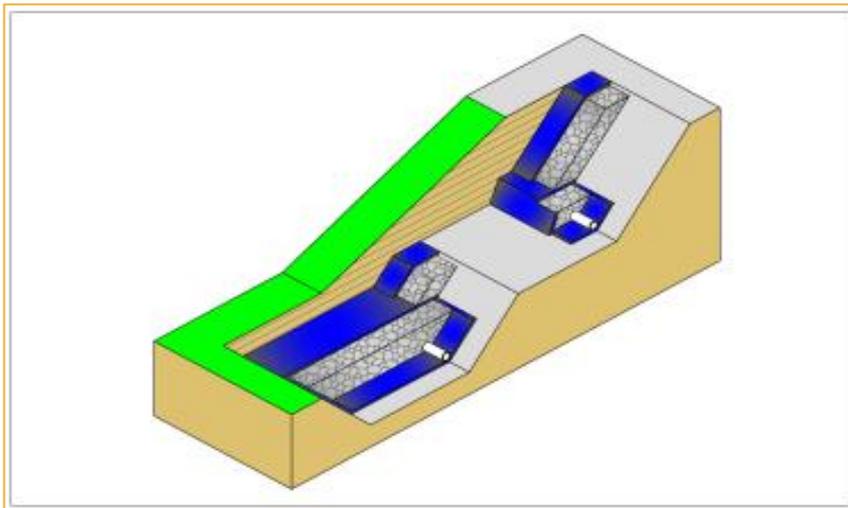
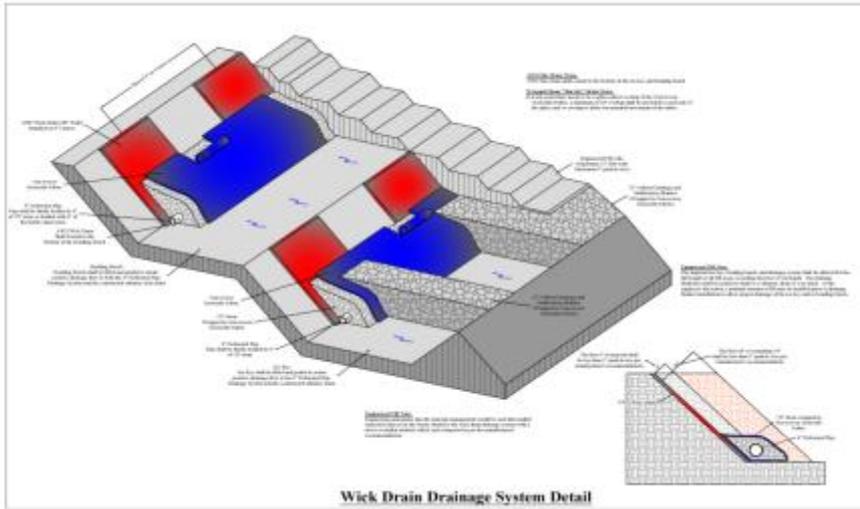


Structural Stability

- Challenging geology for structural stability
- Colluvium and slip clays are common
- Pads represent major civil infrastructure with significant geotechnical needs
- New drainage philosophy is required as opposed to more traditional rock fill construction

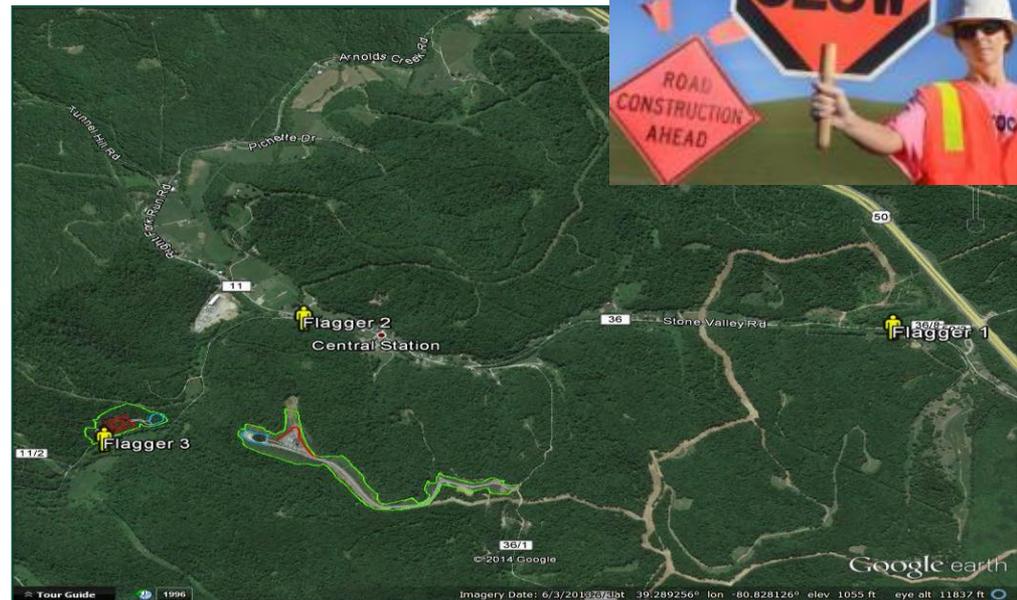
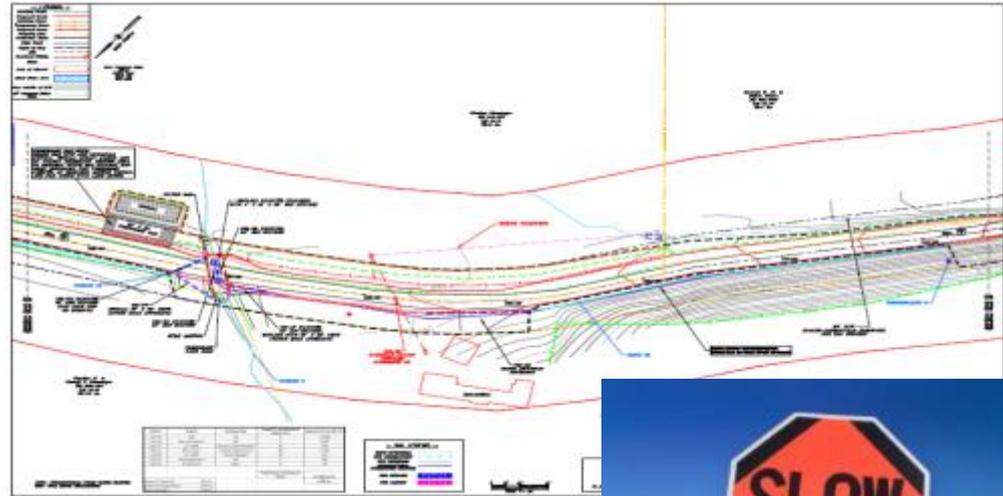


Structural Stability



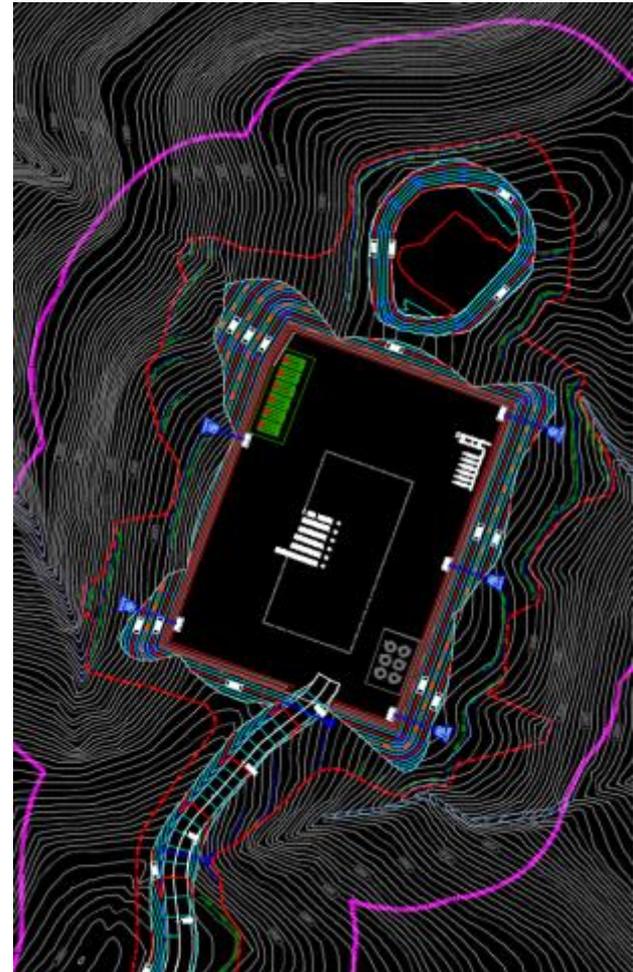
Traffic Safety – Flagging and Upgrades

- Traffic Control Plans (TCP's) are developed to ensure safety of the travelling public as well as operations
- Flagging locations evaluated by traffic engineers to satisfy intent of TCP's
- TCP's are reviewed by operations for comment
- Flaggers assigned based on ADT and geometry of road alignment
- Flagger requests centralized through traffic engineer call line
- Roads are upgraded to accommodate traffic demands of operations and approved by DOH



Plan to Implementation

- Thorough planning, engineering and administrative controls provide safe environmentally compliant pads



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Gastar Exploration

DRILLING

Typical Drilling Rig Layout



Safety Hazards

- There are many hazards associated with the Oil and Gas Industry. Companies strive to minimize or eliminate the potential of a hazard.
- Many companies may have several standards in place to minimize or eliminate a potential hazard. Three core practices that all companies tend to follow are:
 - Engineering the hazard out of the process or equipment.
 - Written program for employee safety and compliance.
 - Require appropriate PPE.

Drilling Rig Safety

- Several operations that take place throughout the course of drilling a well, as well as numerous tasks:
 - Rig Floor Operations / Trips
 - Casing Operations
 - Cementing Operations
 - Wireline Operations
- Each of these operations and tasks create some safety challenges for those who work on the rig.

Potential Hazards

- Well Control (Blowout)
- Fall Protection
- Caught in/Caught between/Struck by
- Electrical and Other Energy Hazards
- Downhole Collision
- Forklifts and Other Heavy Industrial Equipment
- Rig Move (ie.:Skidding/Walking)
- Traffic Control
- Flaring/Venting

Well Control

- Well Control procedures are necessary for the following reasons:
 - To protect all personnel and the rig
 - To stop the influx of formation fluid into the wellbore
 - To allow shut-in pressures to be determined
 - To provide for an organized method of well control



Blowout Preventer (BOP)

- Blowout Preventer is installed on top of the casing head before drilling ahead after rigging up. This is considered the second line of defense for workers and the well to prevent a blowout. The high pressure safety valves and equipment are designed to shut off the well hole and prevent the escape of the underground fluids and prevent a blowout from occurring.
- BOPs are important for the safety of the crew and environment, as well as the drilling rig and the wellbore itself, it is recommended, and regulations require, that BOPs be regularly inspected, tested and refurbished.
- Tests vary from daily test of functions on critical wells to monthly or less frequent testing on wells with low likelihood of control problems



Fire/Explosion

- To combat potential hazards associated with fire/explosion, companies develop Fire Prevention Plans to provide guidance for eliminating the causes of fire, prevent loss of life and property.
- Fire Prevention Plans provide employees with information and guidelines that assist them in recognizing, reporting, and controlling fire hazards.
- Proper grounding of all vessels or equipment that could create static electricity as an ignition source
- Employees are required to wear FR clothing when hydrocarbons may be present.

Fall Protection

- Fall Protection is designed to ensure the safety of all employees when there is a hazard of falling. Often a hazard will be removed or relocated to ground level. When this is not possible, the hazard should be mitigated through the use of handrails, restraining lines, or other mechanical devices.
- In cases where the fall hazard still exists, employees are required to wear a full-body safety harness with an energy absorbing lanyard and/or self-retracting lifeline attached to an anchor point.
- Drilling rigs are required to install a Geronimo line from derrick for quick evacuation in emergency situations.

Caught in/Caught between/Struck by



- Workers are at risk of being caught in, caught between, or struck by high pressure lines, moving equipment or vehicles, and falling equipment or tools, such as tongs.

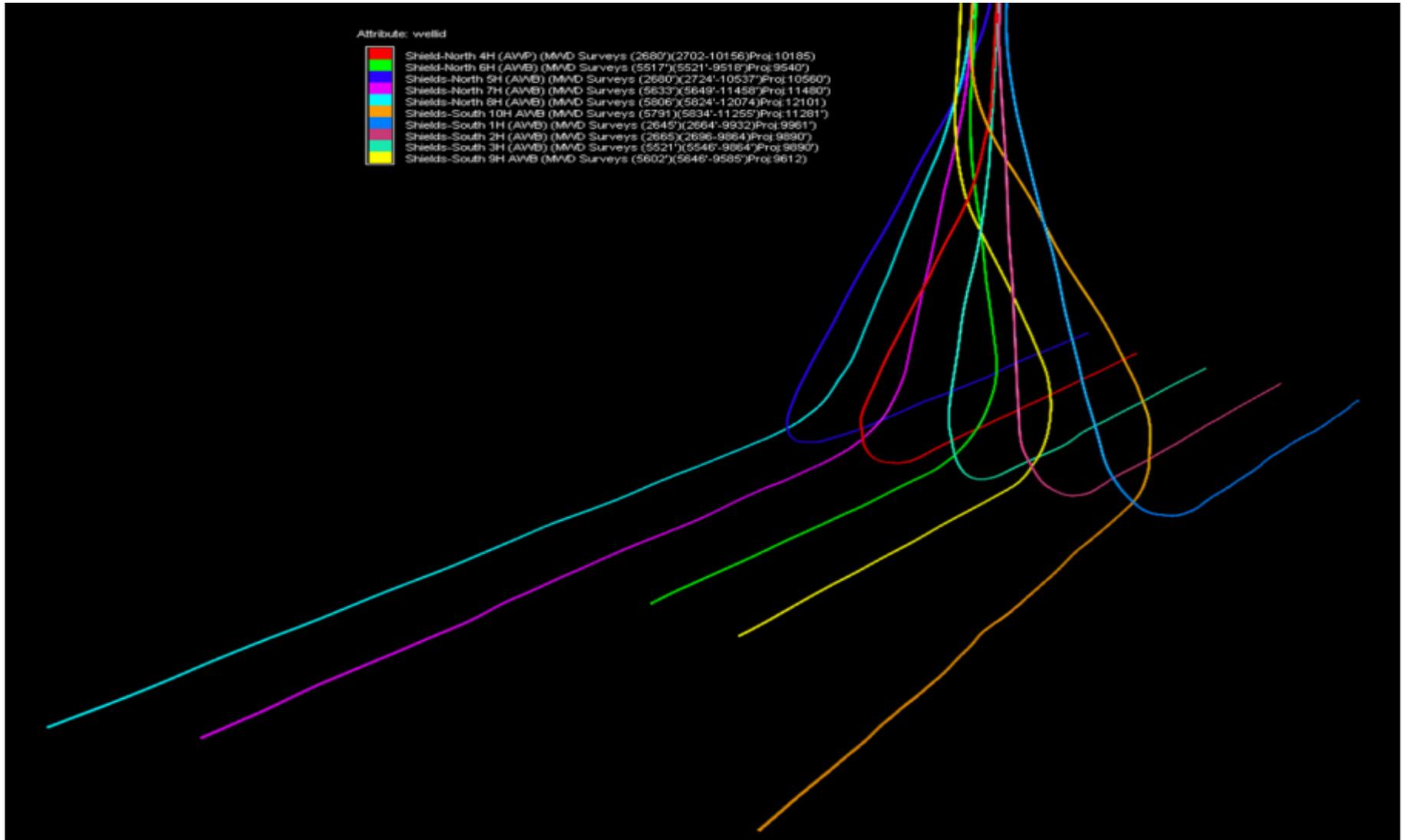
Electrical and Other Energy Hazards

- Most modern drilling rigs are Diesel Electric.
- Workers have a potential to be exposed to uncontrolled electrical and other hazardous energy sources.
- Precautions are put in place to minimize or eliminate the potential of a electrical hazard.

Preventing electrical hazards include:

- Insulation
- Guarding
- Grounding/Bonding
- Electrical protective devices
- Safe work practices
- Lock-out/Tag-out

Collision Control Critical in Pad Drilling Should Avoid Live Wells at Surface



Forklifts and Heavy Industrial Equipment

- Forklifts and other heavy industrial equipment are used throughout drilling operations. Such equipment, when operated carelessly, can be extremely dangerous. All heavy equipment is required to be operated by persons with suitable qualifications and experience.



Rig Move (ie.: Skidding/Walking Rigs)

- Skidding – Moving the rig from one well to another on pad without dismantling the structure.(derrick raised)
- Hazards associated with skidding a rig:
 - Weather Conditions/High winds
 - Stabilization of Rig Pad
 - Moving over multiple well sites
 - Crew change
 - Impact zone
 - Large supporting equipment
 - Spotters
 - Multiple critical operations

Flaring & Venting

- During drilling procedures it is possible to get an influx of gas. The pressure is greater than the hydrostatic pressure of the drilling fluid and the gas will migrate to the surface. (Taking a kick)
- Recognizing the potential of the hazard, companies monitor well pressure during operations. In the event of an influx of gas a degasser system is used to separate the gas out of the drilling fluid. The gas is then forced to a flare line where its burned off under control.
- The flare is placed at a safe distance downwind of the rig.

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Southwestern Energy

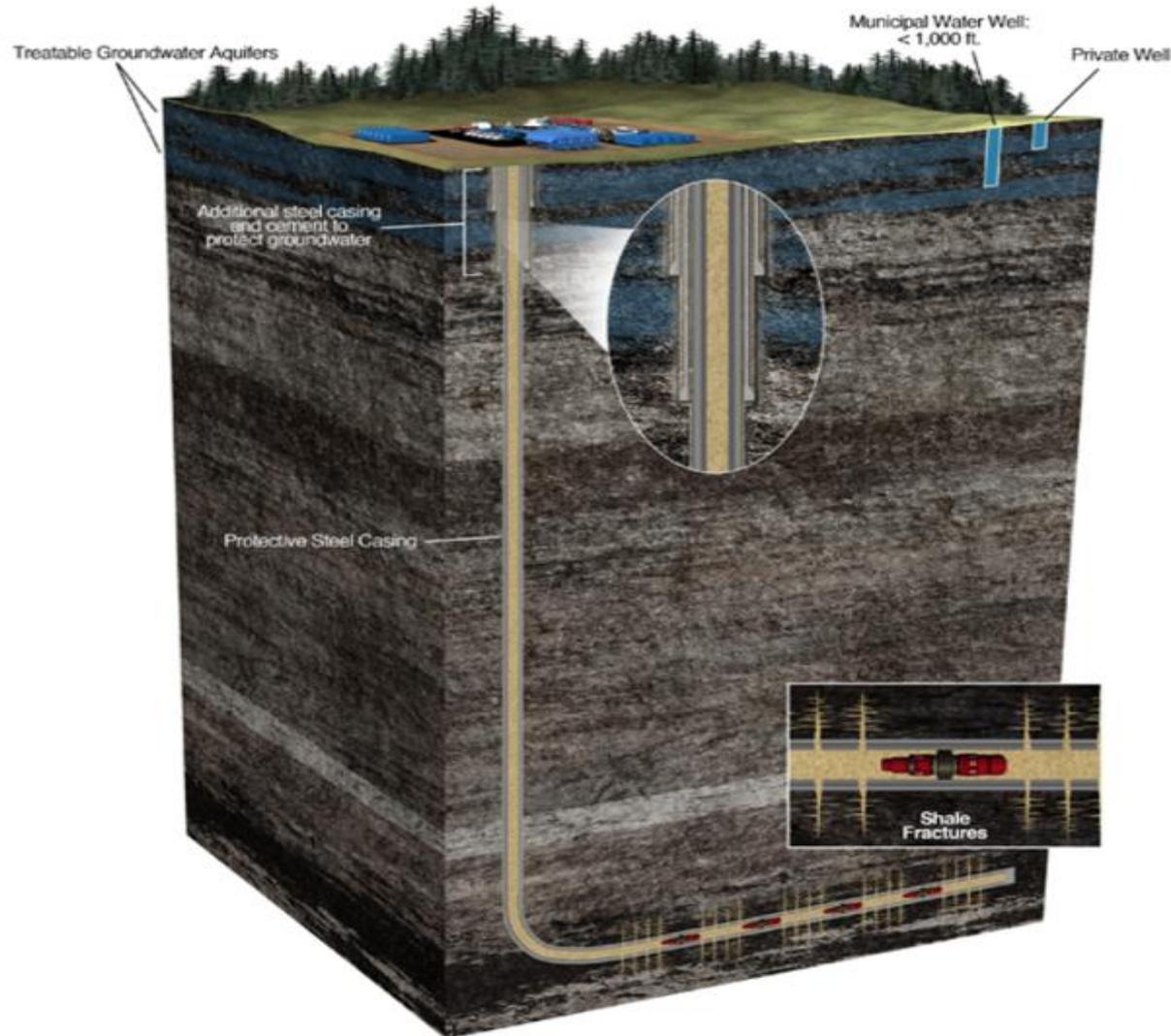
COMPLETIONS

Hydraulic Fracturing

What is Hydraulic Fracturing?

- **Hydraulic fracturing** is a well stimulation process used to maximize the extraction of underground resources; including oil, natural gas, geothermal energy, and even water. – Google
- A stimulation treatment routinely performed on oil and gas wells in low-permeability reservoirs. Specially engineered fluids are pumped at high pressure and rate into the reservoir interval to be treated, causing a vertical fracture to open. The wings of the fracture extend away from the wellbore in opposing directions according to the natural stresses within the formation. Proppant, such as grains of sand of a particular size, is mixed with the treatment fluid to keep the fracture open when the treatment is complete. Hydraulic fracturing creates high-conductivity communication with a large area of formation and bypasses any damage that may exist in the near-wellbore area.
- SLB Oilfield Glossary

What is Hydraulic Fracturing?



Equipment and Layout



HSE – Pressure Pumping

- Fracing is one of the most challenging oil & gas operations we face. It must be conducted in a skillful, professional, and respectful manner.
 - Job Safety Analysis (JSA)
 - Stop Work Authority
 - Red Zone
 - PRV(s) & Electronic Kills
 - Pressure Management & Two Barrier Policy
 - SIMOPS
 - Location Inspection
 - Well Site Supervisors – Well Control Certified



HSE – Frac Iron

- Require that all iron be tested and banded at least every six months.
 - More so dependent on volume pumped through iron.
 - Testing includes x-rays, gauging, and pressure tests.
- Restraints on iron is a requirement
- Use of 15K rated equipment in a 10K environment
- Pressure test prior to every stage
- Visual Inspections



HSE: Logistical Challenges

- The mountain state is one of the most challenging working environments to operate in.
 - Topography
 - Pad location size
 - Narrow back roads
 - Blind curves
 - Slips
 - Winter Weather



HSE: Trucking

- To promote safe driving in our operating area we have implemented several mandatory safeguards.
 - School Bus Curfews
 - Courtesy Pilot Cars & Traffic Monitoring
 - CB Communication
 - Staging Areas
 - Driver 360s & Inspections
 - DOT Inspections
 - Road Maintenance

HSE: Environmental

- Defenses against spills and environmental releases:
 - Zero discharge policy
 - Secondary Containment
 - Spill Kit on location 24/7
 - Location Berms and Drains
- Well Stimulation Chemicals must be handled with care
 - Ensure personnel are using their proper PPE for the task at hand
 - Follow procedures when handling and pumping the equipment
 - Carry MSDS (SDS) on location
 - Have Shower Trailer(s) readily available
 - Host Emergency Response Drills w/ local first responders to familiarize them with the materials and equipment



HSE – Air Quality

- Dust Control
 - Silica Dust is a hazard to employees on frac locations
 - If exposed to large quantities or silica dust for extended periods of time it could lead to Silicosis
- How to combat silica dust?
 - Silica Dust Vacuum Systems
 - Sand Ben filters or socks
 - Enclosed sand transfer systems
 - Sand coating agents



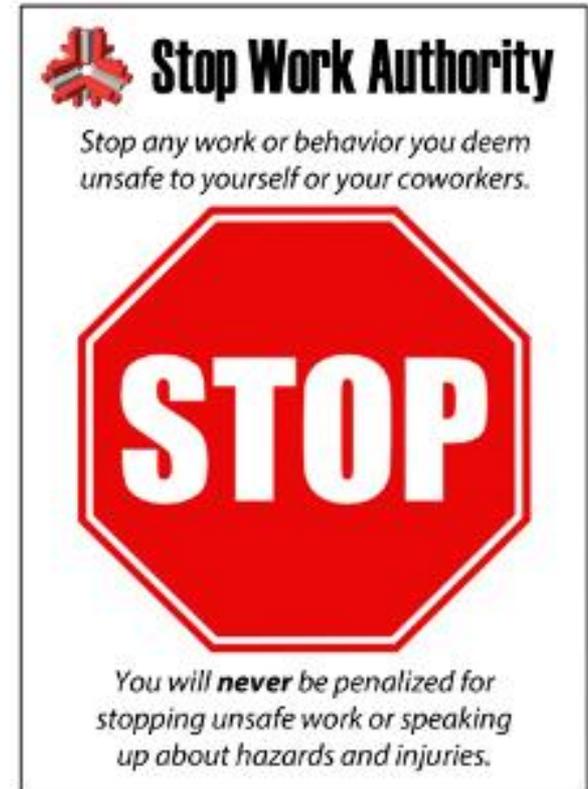
HSE – Air Quality

- Gas Monitoring
 - The use of remote gas monitoring is mandatory on SWN sites
 - WSS and key personnel carry four gas monitors on site
 - Four gas monitors – LEL, O₂, H₂S, and CO₂
- H₂S Concerns
 - Occasionally bacteria induced H₂S will formulate in flowback tanks during summer months
 - This can be neutralized with a hydrogen sulfide scavenger



HSE – STOP WORK AUTHORITY

- STOP Work Authority is a crucial instrument to the SWN HSE program.
- All SWN Employees and our 3rd Party Contractors have the obligation to STOP work.
- Promote Hazard Hunts and proactive safety reporting.
 - Not as “tattle tell” or “got you” but used as a learning opportunity
 - Praise & Reward Safe Behavior



PRODUCTION

Gastar Exploration

Typical Production Pad





Hazards Associated with Production

- Wet Gas

- Heavier than air and lays near the surface. When gas is released to air, whether intentionally or unintentionally, a hazardous situation exists.
- Unintentional release from erosion of fittings / piping from sand or fluid, corrosion, defective materials or workmanship
- Intentional release due to blowing a well to storage tank to unload fluid to improve gas flow.

- Ignition Sources

- Light plants
- GPU
- Vehicles

Precautions

- Assure gas discharge is downwind of production units
- Minimize ignition sources on location
- Properly ground tanks
- Equip wells with proper shut in equipment
- Avoid night time operations

Emergency Shutdown (ESD)



- ESD – Emergency Shutdown systems are used to protect individuals and the environment in case the process goes beyond the control margins. These systems are not intended for controlling the process itself, but rather protection.

Flame Detector Sensor

- A flame detector sensor, known as a fire eye is designed to automatically activate the ESD if a possible flame, high line pressure, or low line pressure is detected.



Well Site Time-lapse

