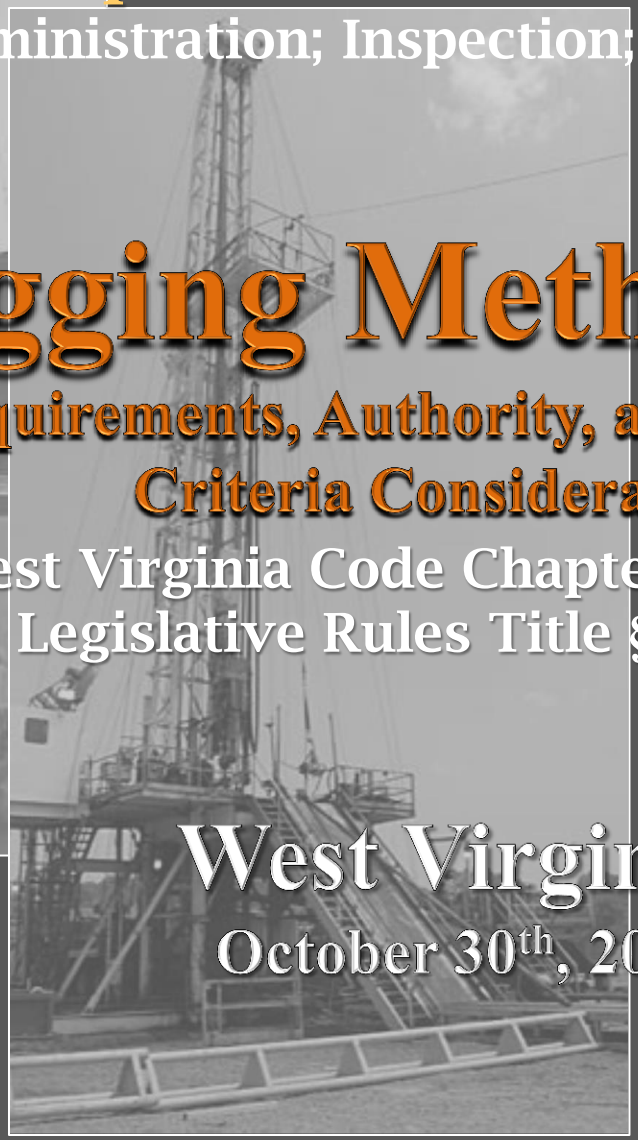


# The Office of Oil and Gas; Oil and Gas Wells
# West Virginia Department of Environmental Protection
## Administration; Inspection; Enforcement

# Plugging Methodology

## Requirements, Authority, and Standards
## Criteria Considerations

West Virginia Code Chapter §22 Article 6
Legislative Rules Title §35 Series 4

## West Virginia
October 30th, 2013

# Presentation Coverage

- What are the Objectives with Wellbore Plugging?
- Engineering and Planning.
- Plugging Methodology and Requirements -
  - §22 Article 6 Section 23  Plugging, Abandonment, and Reclamation.
  - §22 Article 6 Section 24  Plugging Methodology.

  - §35 Series 4 Section 13 Plugging, Abandonment, and Reclamation.
  - §35 Series 4 Section 14  Plugging Methods.
- Plugging Trends and Authority.
- Specific considerations and interest.

# Wellbore Engineering

## General Considerations and Constraints

- **Pre-Planning is key; well-bore records are essential in the planning.**
- Regulatory Requirements, Standards, and Minimums; State, MSHA, Coal Owner/Operator; OOG Code 22-6-24, Plugging Methodology, Rule 35-4-13 Plugging-Abandonment-Reclamation, and Rule 35-4-14 Plugging Methods.
- Wellbores are avenues for escape of fluids and gases; surface, below ground including un-cemented annulus.
- Thieving between zones; high pressure and low pressure zones; FW aquifer invasion by circulation.
- Protection of fresh water aquifers, oils-natural gases-coal horizons and reserves, etc.
- Knowledge of the area and geological issues; fresh water aquifers, open mine and voids, mine workings and active mines, and sensitive formations, etc.
- Local data / well records / experience / knowledge.
- Hole conditions, formation and depth characteristics and strengths; caving potentials, invasive fluids/oils/gases, static temperatures, deep well-bores, and wellbore stability / access; wellbore clean-out potentials / challenges.
- Plugging materials, cements, gels, CIBPs, monument/site reclaimed allowances/needs, etc.
- Wellbore Demands vs Rig Equipment, Service techniques, and Experience Needs; incl. rig type and capacity, rig crew experience, cements, mechanical plugs, gel mixtures, cable tool vs electric line services, ripping, collar shots, chemical cuts, perforating, electric line free-point, casing stretch calculations, hydraulic jacks, and others.
- Cements in place; annulus fills, free-point pipe locations, and devices in wellbores, etc.
- Casings in place; conditions, depths, characteristics of formations behind the casings.
- Quality Control and Assurance in operations; cement mixing techniques and placement, tagging plugs, prevent over fill porous formations(invasion), and killing of well/maintain static conditions.
- SAFETY OF PERSONNEL, H2S POTENTIALS, SULFATES, WELL CONTROL MAINTENANCE, SURFACE MANAGEMENT.
- API and ASTM Standards and Specifications; Materials and Cements accepted by oil and gas industry and approved by Office of Oil and Gas; API Class A cement, 6% gel type, thixotropic expanding cement, etc.

# Significant Purpose and Protection

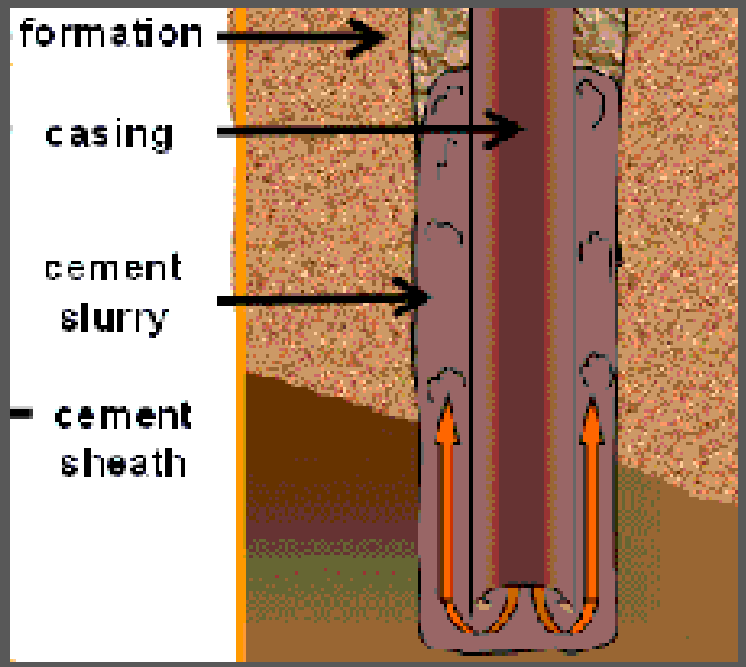
## Plugging Objectives

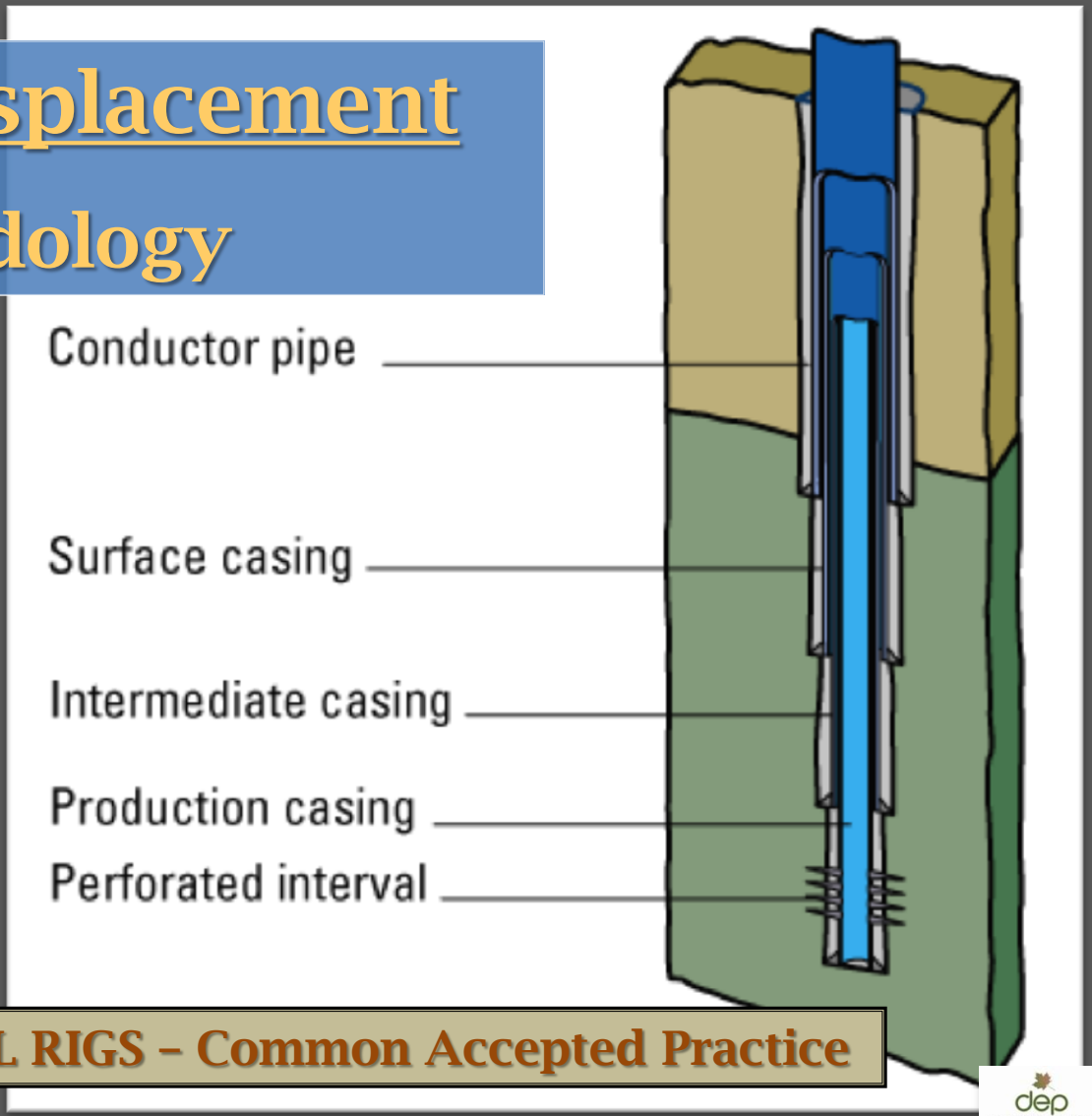
- ***Isolation and Sealing Off Strata,***
- ***Protection Throughout the wellbore***
- ***Elimination of Migrating fluids-gasses-oils, and,***
- ***Elimination of surface pollution.***
  - Oil and Gas Horizons.
  - UIC Zones and Storage Fields.
  - Migrations of Salt Bearing Zones.
  - Workable Coal Reserves 20 inch min.
  - Fresh Water Horizons and Local Supplies.
  - Surface Protection and Pollution Prevention.

# Typical Wellbore
## Applies with plugging vertical wellbores

## Positive Displacement

## Methodology




**CABLE TOOL RIGS – Common Accepted Practice**

# Stratigraphic Column

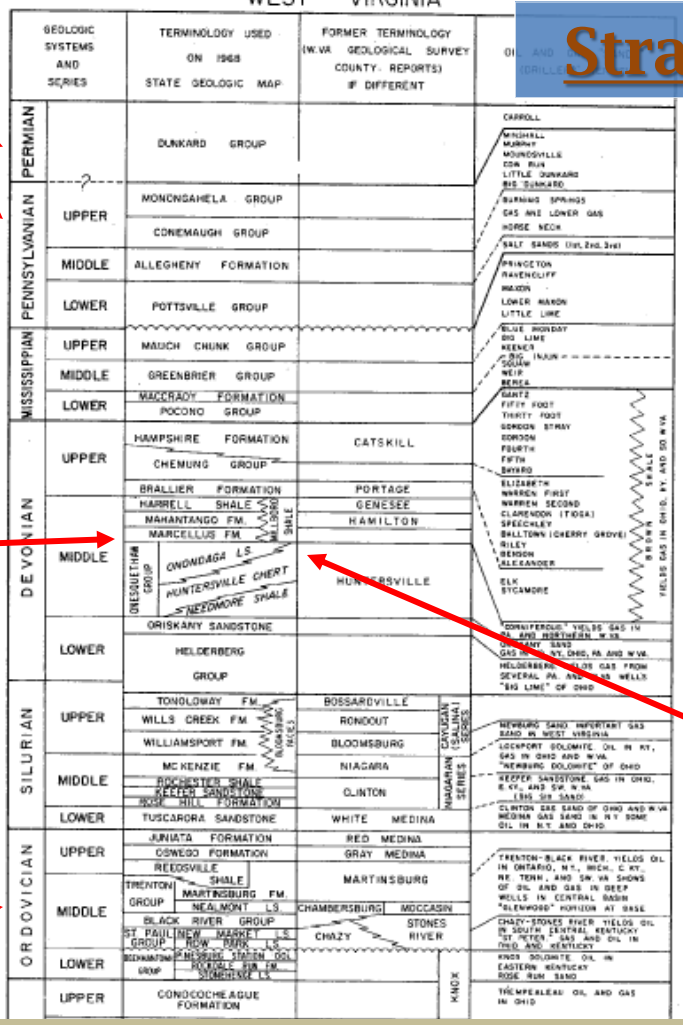
**Fresh Water Aquifers**

Coal bed methane

**Marcellus shale**

**Utica shale**

Trenton-Black River




**DEEP WELL**
**Any Wellbore Depth past 100' at Top Onondaga Ls**

**Geology / Formation / Casing Programs and Interest - Various - Statewide**

**PLUGGING APPLICATIONS – REVIEWS ARE WELL SPECIFIC!!!**

## §35-4-13 PLUGGING PERMIT APPLICATION CRITERION

- Notices to parties -
  coal owners, operators, lessees, surface owners

- Submit all drill or electric logs upon request
- Completed forms WW-4(A) and WW-4(B)
- Work Order – Manner and Method of Plugging
- Location of well including topographic maps and plat
- Kind and length of plugs - Minimum lengths (100) feet
- Plans for cementing throughout wellbore
- Plans for testing, shooting, cutting, removing casings
- Other pertinent information regarding plugging
- Includes clean out and re-plugging
- Coverage of coals and fresh water horizons
- Reasonable efforts to cut and recover casings
- Perforating and cement squeezing options
- Reclamation plan drawings not required (recommended)
- Five day objection and comment period

- Application Criteria and Permitting Procedures.
- Notices to parties and comments/objections,
  - Notify surface owners,
  - Notify coal owners, operators and lessee with declaration on file.
- Forms necessary.
- *Attach well record copies with all applications.*
- *Work Orders must be descriptive .*

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- Notices to parties and comments/objections,
  - Notify surface owners,
  - Notify coal owners, operators and lessee with declaration on file.
- Forms necessary.
- *OOG wants well record copies submitted in all applications.*
- *Work Orders must be in detail.*

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- *Work Orders must be in detail.*

## §22-6-24. Methods of plugging well.

### General Requirement

- Recover Casings and Tubulars.
- Cement Plugs - oil, gas, salts, workable coal, fresh water strata.
- 6% Gel between plugs.
- Tag plugs as necessary.
- Surface Cement Plug.
- Install Monument with API PERMIT ID (height 30 inch minimum).

### Placement of Cement Plugs

- Bottom Wellbore Plug.
- 100 Feet Cement Plugs Minimum.
- Any Oil and Gas Bearing Strata.
- Across Casing Cuts.
- Above shallowest Salt Bearing Strata.
- Workable Coal Strata (twenty inches).
- Fresh Water Bearing Strata.
- Surface Plug.

### Coal Protection Strings (Casing-Annulus Cemented)

- 100 Feet Expanding Cement below Coal Protection String.
- Coal Protection String remains (vent or 'coal degas' purpose).
- Well Left for Vent or De-Gas Purposes.

### Coal Protection Strings (Casing-Annulus Open)

- Recover Coal Protection String.
- Cement across Coal Strata.
- Surface and Fresh Water Strata plugged.
- Install Monument.

**§35-4-13 PLUGGING, ABANDONMENT, and RECLAMATION**

**§35-4-14 PLUGGING METHODS**

# CODE

## General Requirement

- Recover Casings and Tubulars.
- Cement Plugs - oil, gas, salts, workable coal, fresh water strata.
- 6% Gel between plugs.
- Tag plugs as necessary.
- Surface Cement Plug.
- Install Monument with API PERMIT ID (height 30 inch minimum).

# RULE

## General Requirements

### §35-4-13 PLUGGING, ABANDONMENT, and RECLAMATION

- **Casing/Tubular Recovery**
  - Plans locating free casings,
  - Plans testing, shooting,
  - Plans removing casing,
  - Reasonable efforts to cut and pull all recoverable casing,
  - 150% Rig capacity over string weight,
  - Reasonable efforts to perforate and squeeze cement behind casing,
  - Caution near fresh water zones.

- **Plugs Used**
  - Location (by depth),
  - Kind and Length,
  - Plans cement and fill.

# CODE

## General Requirement

- Recover Casings and Tubulars.
- Cement Plugs - oil, gas, salts, workable coal, fresh water strata.
- 6% Gel between plugs.
- Tag plugs as necessary.
- Surface Cement Plug.
- Install Monument with API PERMIT ID (height 30 inch minimum).

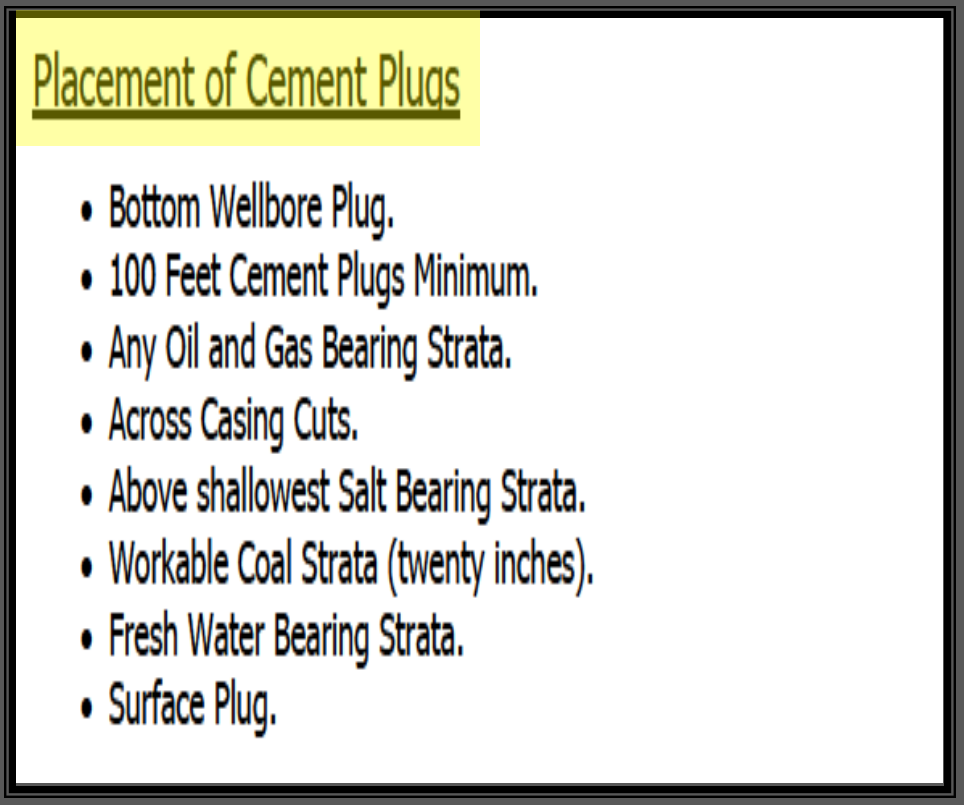
# RULE

## General Requirements

### §35-4-14 PLUGGING METHODS

- API Class A Portland Hydraulic Cement
  - No greater 3% CaCL,
  - No other additives.
- Expanding Cement
  - Coal Regions as required.
- SPACER - 6% Bentonite gel
  - 100#sk per 5bbl water mixture.
- Other Cements - Acceptance by oil and gas industry and approved by the Chief.

# §22-6-24 Plugging Methodology

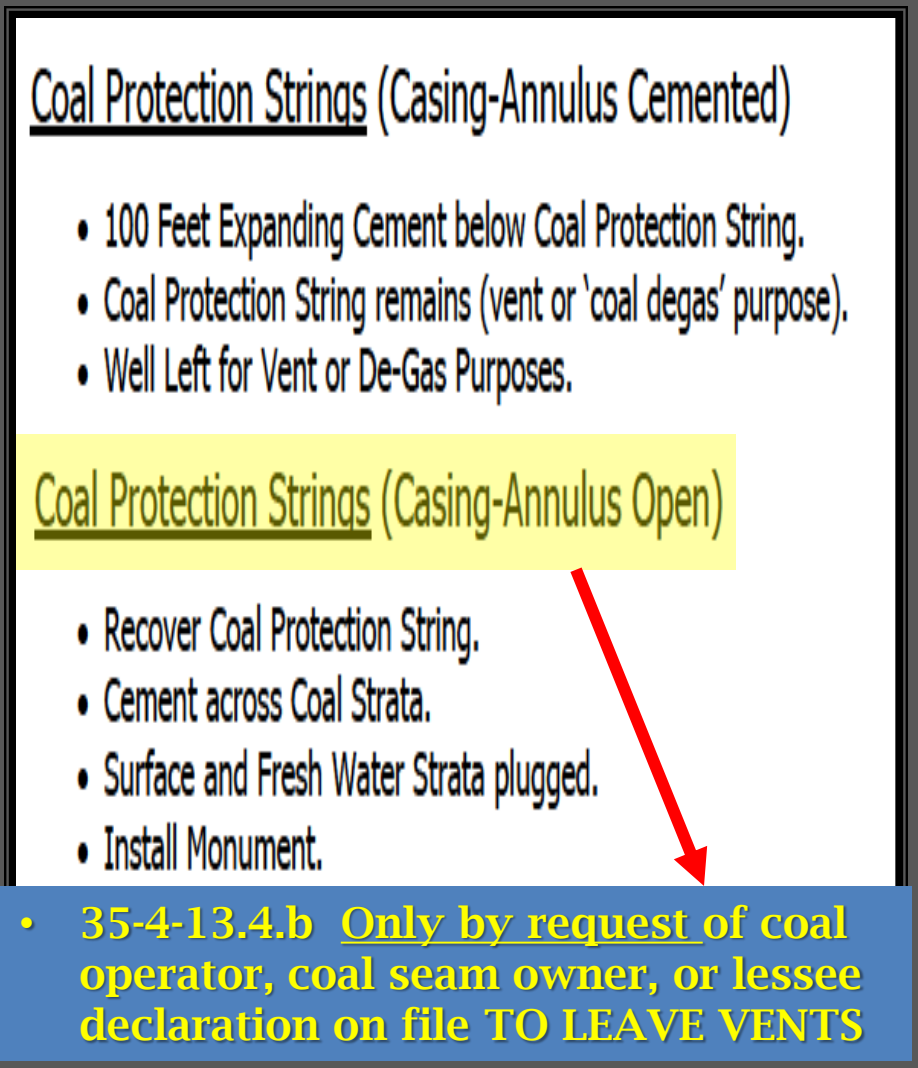



## Placement of Cement Plugs

- 100 feet cement plugs minimum per rule §35-4-13.5,
- Oil & Gas Potentials - Across, between, and above any known or potential oil and gas bearing stratum.
  - » CIBP allowed just above lowest oil/gas stratum along with a cement plug placement.
- Shot Holes - shot stratum

  §22-6-24(a)(1) If lowest in the well - cement placed not less than 20 feet above the stratum and there above **(homogenous strata-combined allowances).**
- At elevation or above shallowest salt bearing stratum whichever is shallowest.
- All Coals particularly workable seams - No less than 50 feet below workable coal to no less than 20 feet above same seam.
- Across casing shoes and casing cuts.
- Surface plug -100 feet minimum.

# "Must recover casing and set plugs"




- **35-4-13.4.b Only by request of coal operator, coal seam owner, or lessee declaration on file TO LEAVE VENTS**

## Coal Protection Strings

### Annulus Left Open NOT CEMENTED

- Recoverable Casing removed.
- Set Cement Plugs.
- 100 feet cement plugs minimum
- All coals and No less than 50 feet below workable coal to no less than 20 feet above seam.
- Compromised wellbores
  - Site specific
  - Reasonable review and attempts
  - Coal owner agreements and letters submitted with OOG for review
  - Modification approvals.
- Surface cement plug.
- Plugs across casing cuts and shoes.
- 6% gel between plugs.
- Monument set.
- Site reclaimed.

§22-6-6. Permit required for well work; permit fee; application; soil erosion control plan.

(a) It is unlawful for any person to commence any well work, including site preparation work which involves any disturbance of land, without first securing from the director a well work permit. An application may propose and a permit may approve two or more activities defined as well work.

## – Operators

- Must obtain a plugging permit prior to commencement of well work.

§22-6-23. Plugging, abandonment and Reclamation of well; notice of intention; bonds; affidavit showing time and manner.

. . .

No well may be plugged or abandoned unless prior to the commencement of plugging operations and the abandonment of any well the director is furnished a bond as provided in section twenty-six of this article.

When the plugging, filling and reclamation of a well have been completed, an affidavit, in triplicate, shall be made (on a form to be furnished by the director) by two experienced persons who participated in the work, the director or the director's designated representative, in which affidavit shall be set forth the time and manner in which the well was plugged and filled and the land reclaimed.

- Operators/Permittee
  - Must be bonded prior to issuance of plugging permits.
- Plugging Affidavits*
  - Filed with OOG.
- *By two experienced personnel who participated in the plugging operations.

§35-4-13.6.
Retrieving Casing and Completing a Seal

The operator shall make reasonable efforts to cut and pull all recoverable casing (as determined by methods approved by the chief or his authorized representative). Equipment used to pull recoverable casing shall be rated and rigged at or above one hundred and fifty percent (150%) of the estimated weight of the heaviest string of recoverable casing, unless otherwise approved by the chief or his authorized representative.

Sufficient instrumentation shall be utilized to accurately indicate the pulling force applied. When casing cannot be pulled, the operator shall make reasonable attempts to perforate the pipe and squeeze cement behind the pipe in the vicinity of the freshwater zones to prevent the contamination of the fresh water zone.

- Reasonable efforts to cut and pull all recoverable casing (Free-point, CBL, etc.)
- Rig capacity (150% over string weight recoverable including Hydraulic Jacks).
- Reasonable attempts perforate and squeeze cement behind casings.
- Cautions near freshwater zones to prevent damage and contamination.

§35-4-12.1 Well Records Made During Permitted Work.

The well operator or his contractor (drilling contractor or other contractor, as appropriate) shall keep accurate records of permitted activities . . .

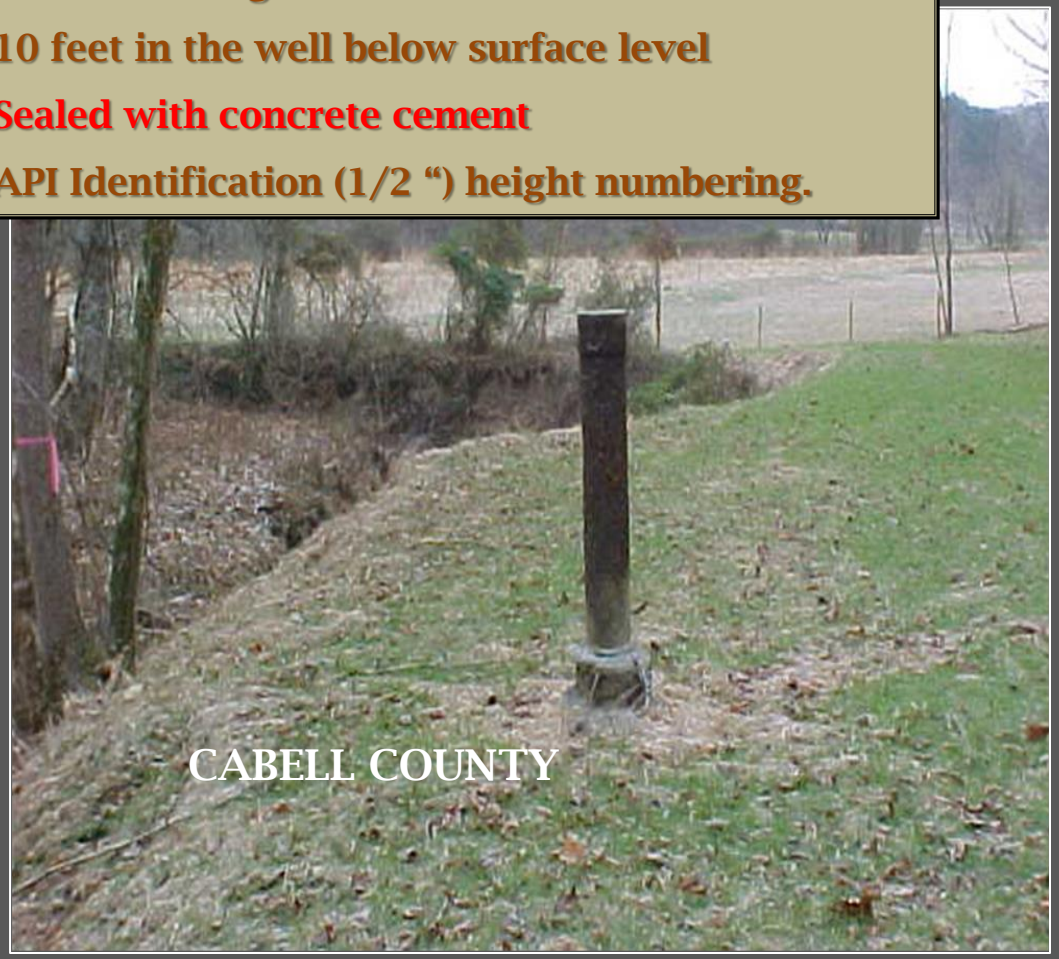
. . . The records shall be complete enough to support, as applicable, the entries of well work done and related data on Form WR-38, "Affidavit of Plugging and Filling Well," but such WR-38 shall reflect data discovered or changes made after the permitted well work has been finished and before the forms filed.

- Keep accurate records during plugging activities.
- Plugging Affidavit reflects changes if any at finish of activities.

# Reclamation Needs - Standards

## §35-4-5(5)(b) Permanent Monument - Marker

- 6 inches Minimum Diameter Metal Pipe
- 30 inches Height above surface level
- 10 feet in the well below surface level
- Sealed with concrete cement
- API Identification (1/2 “) height numbering.




- Disturbed Site
  - Vegetation standards
  - All Well Production Equipment removed including surface pipelines
  - Purging of buried pipelines
  - Fencing and gate necessities
  - Drainage allowances and maintenance ceases
  - (Landowner wants???).
- Not in authority
  - Free Gas???
  - Lease allowances and requirements???
- Surface Owner and Operator rights.
- Comments at application
  - If agreements established then filing with OOG records are recommended.
- Monument set API ID
  - Variance on request specific approvals of offset monuments; the survey bearing and distance reported with the plugging affidavit. Metal plate over well below plow depth.
- Site Closure Reclamation

§35-4-5.6.
Parties Responsible.

All contractors and drillers, including all service companies carrying on business or doing work in oil and gas fields in West Virginia, as well as lease holders and operators generally, shall take notice of and are hereby directed to observe and apply the provisions of WV Code §22-6 and this rule; and all contractors, drillers, service companies and operators shall be held responsible for violations thereof.

- **Contractors and Service Companies** are included with responsibilities and must observe and apply code and rule requirements.

# Office / Field STAFF RESPONSIBILITY

- Permit applications
- Permit field activities
- Production status
- UIC monitoring
- Record keeping
- Plugging programs
- Enforcement

– Permits

– Inspections

– Regulatory

– Monitoring

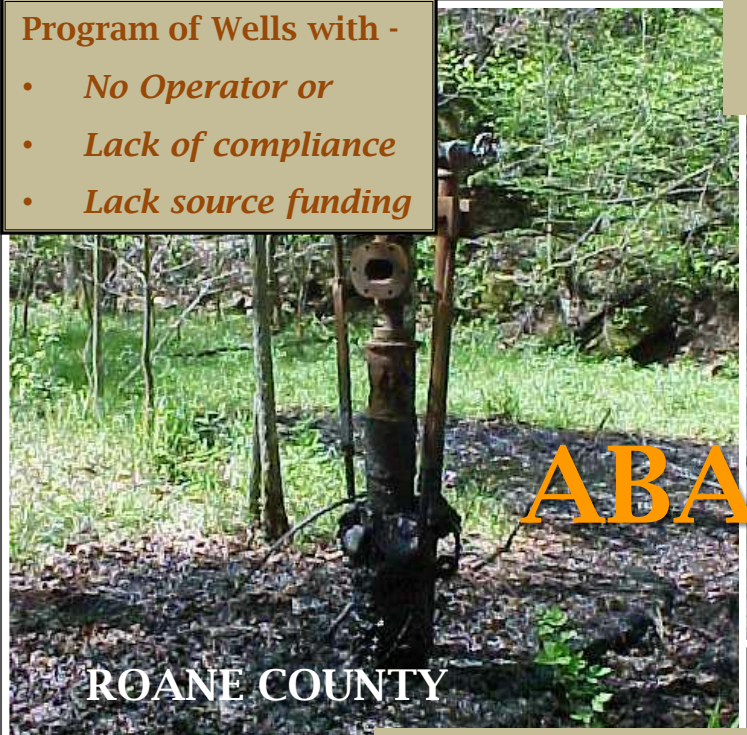
– Record Keeping

# REGULATORY PROGRAMS

Program of Wells with -

- *No Operator or*
- *Lack of compliance*
- *Lack source funding*

Priority Well Census Maintained §35-6-6






## ABANDONED WELLS

## OOG – Rec Fund, USEPA-USCG-OPA

## Office of Oil and Gas

## Plugging/Cleanup Program

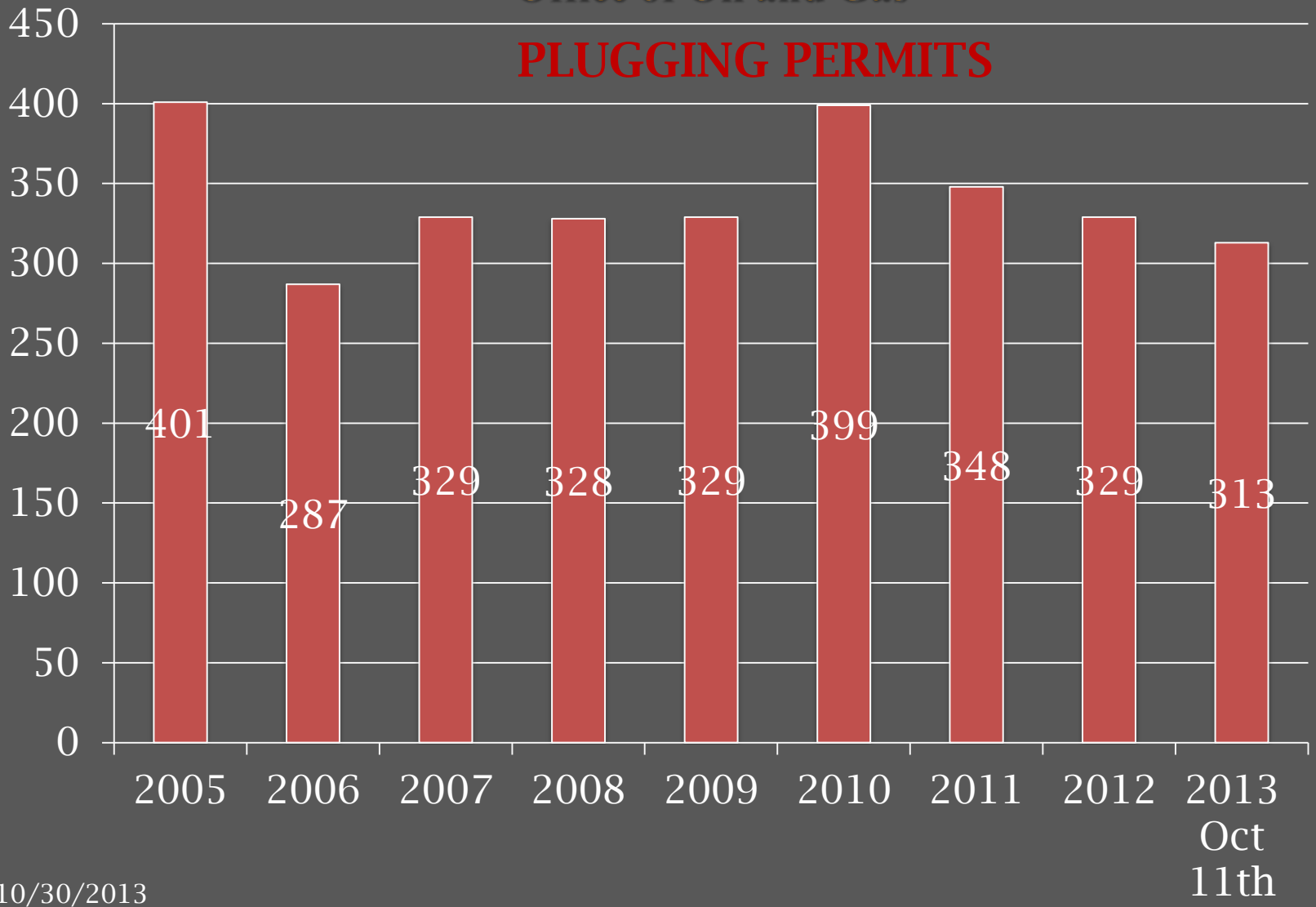
**Mandated by Legislature**

10/30/2013

# PERMIT TREND

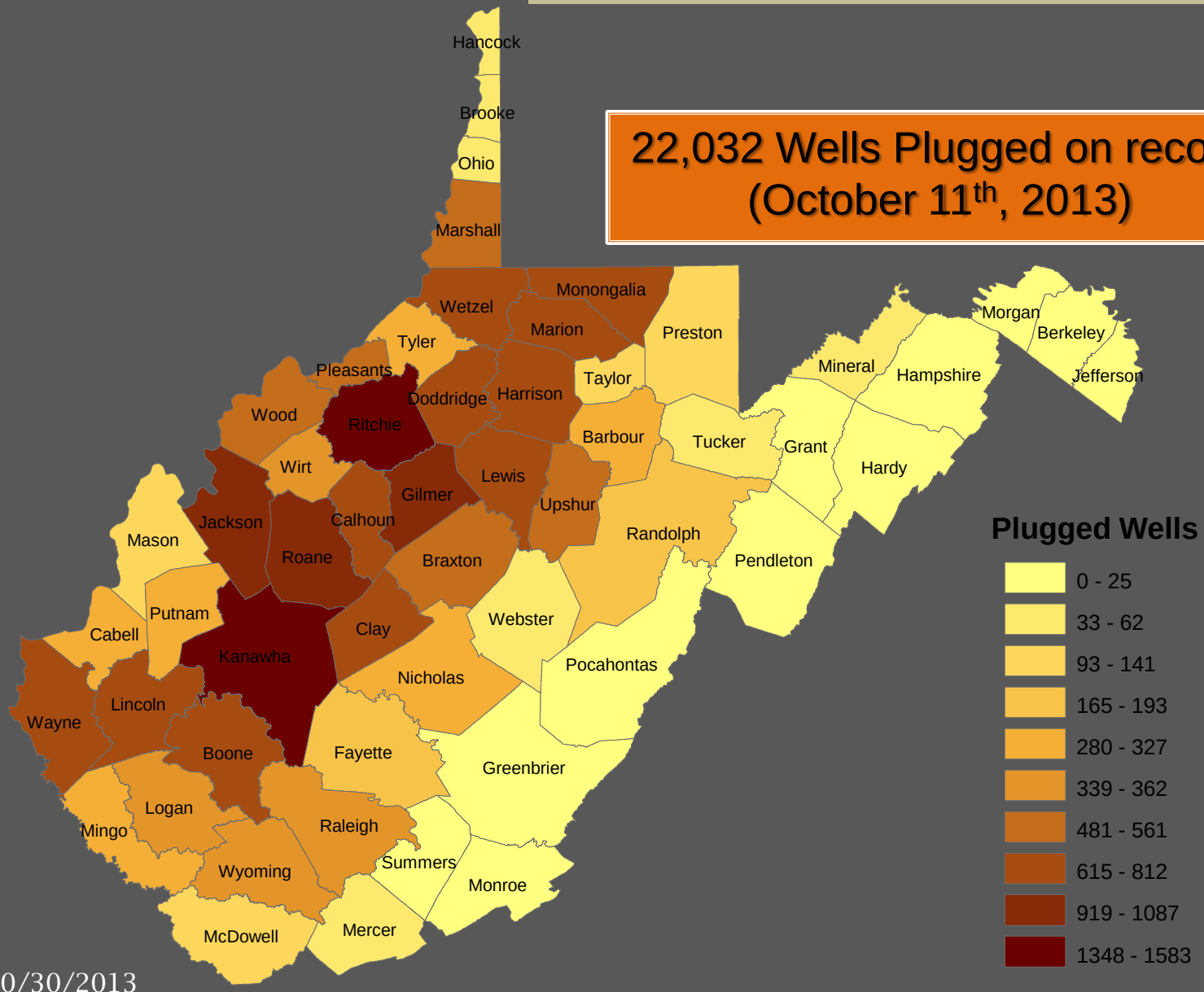
## PLUGGING PERMITS ISSUED

### Office of Oil and Gas



# Plugging Geographic Trend

22,032 Wells Plugged on record
(October 11th, 2013)




10/30/2013

# Hydrogen Sulfide Potentials

**STEL 15 ppm**

**Safety**
Hydrogen sulfide is a highly toxic and flammable gas. Being heavier than air, it tends to accumulate at the bottom of poorly ventilated spaces. Although very pungent at first, it quickly deadens the sense of smell, so potential victims may be unaware of its presence until it is too late. For safe handling procedures, a hydrogen sulfide material safety data sheet (MSDS) needs consulted.



**Death @ 300 ppm**

- **LATEX CEMENT PLUGS**
- **Oil and Gas Field Hazards**
- Contingency Plan Necessities
- OSHA Standards 29 CFR 1910.
- All Personnel H2S Trained.
- 15 PPM Short Term Exposure Limit STEL.
- **Level "B" Protection.**
- Monitors, PPE, and Rescue Equipment.

# Potential Hydrogen Sulfide [ H2S ]

## WEST VIRGINIA

**Some Coal Seams**
***'Bacteria Build Up'***
**CBM Waters Produced**

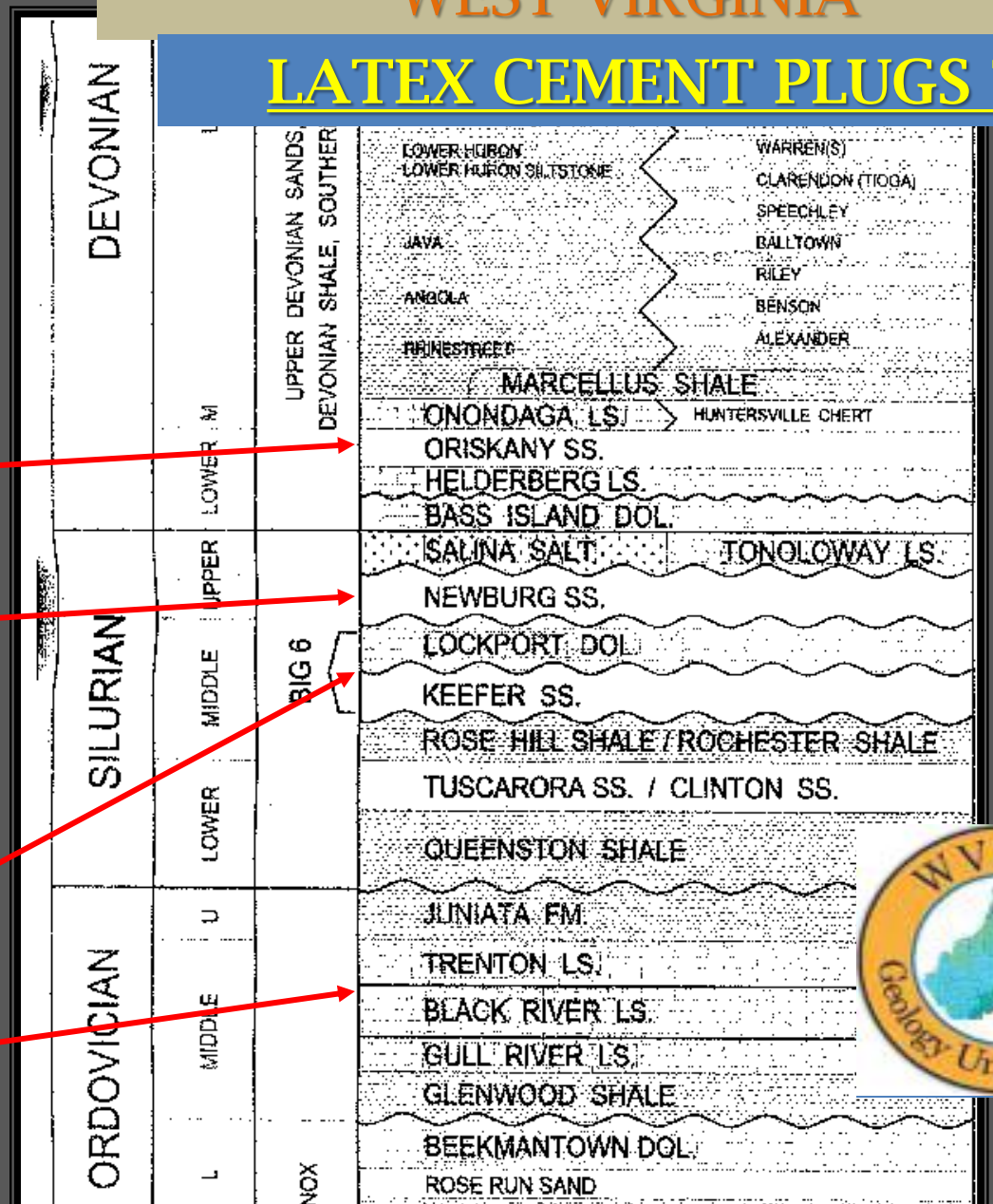
## LATEX CEMENT PLUGS ???

**Oriskany Sand (isolated areas)**

**Newburg (central)**

**Lockport (south –west)**

**Trenton / Black River**




10/30/2013

# OSHA Requirements

1910.120(p)(8) OSHA Emergency response program --

***Emergency response plan.*** An emergency response plan shall be developed and implemented by all employers. Such plans need not duplicate any of the subjects fully addressed in the employer's contingency planning required by permits, such as those issued by the U.S. Environmental Protection Agency, provided that the contingency plan is made part of the emergency response plan. The emergency response plan shall be a written portion of the employer's safety and health program required in paragraph (p)(1) of this section. Employers who will evacuate their employees from the worksite location when an emergency occurs and who do not permit any of their employees to assist in handling the emergency are exempt from the requirements of paragraph (p)(8) if they provide an emergency action plan complying with 29 CFR 1910.38.

Elements of an emergency response plan. The employer shall develop an emergency response plan for emergencies which shall address, as a minimum, the following areas to the extent that they are not addressed in any specific program required in this paragraph:

- Pre-emergency planning and coordination with outside parties.
- Personnel roles, lines of authority, training, and communication.
- Emergency recognition and prevention.
- Safe distances and places of refuge.
- Site security and control.
- Evacuation routes and procedures.
- Decontamination procedures.
- Emergency medical treatment and first aid.
- Emergency alerting and response procedures.
- Critique of response and follow-up.
- PPE and emergency equipment.

# Emergency Management

## Protection & Safe Zones

# EMERGENCY PLAN ELEMENTS

## OSHA Standards 29 CFR 1910.120

## LEVEL 'B' PROTECTION

## Oil and Gas Field Hazards

# Summary and Comments

- Plugging permit application –
  - Proper planning and descriptive work orders,
  - Utilize well records (essential), **PERMITTEE MUST SUBMIT IN APPLICATION.**
  - Approved plug placements and casing recovery,
  - During operations – Inspector inspections and approved modifications
  - Maintain supporting documents during plugging operations.

- Unacceptable practices; concrete (Quikrete) mixtures for plugs; un-approved procedures i.e. dumping bentonite pellets or ready mix concrete; prevention of foreign items lost in wellbore i.e. tools, chains, metal pipes, and wrenches, etc.

- "VERBAL PERMISSION TO PLUG" §22-6-6(c)(10) and §35-4-13(7)(a)
  - by Inspector same day by request ONLY on drilling or working permit operations. DRILL RIG OR WORK-OVER RIG MUST BE ON THE WELL BORE.
  - Operator must obtain Party(s) Waivers and PROMPTLY SUBMIT PLUGGING APPLICATION.
  - PARTIAL PLUGGING information placed on completion report-records.

# Summary and Comments (Cont.)

- "Prevent overfill (invasion) of cements in fresh water zones",
  - Prefer spotting cement over zones and allow over night setting for healing purposes vs setting bridges. Please – "No brush bridges".
- Tagging ALL cement plugs - considerations/allowances.
- Plugging "Interested Party" **§35-6-5** declaration of operator by the Chief.
- CBM Plugging – Lateral water diffusion initial phase (diffusion fluids > twice volume capacity combined laterals), site specific reviews, and alternative methods.

# Summary and Comments (Cont.)

- MSHA standards may apply in pursuance to Section 101(c) of the Federal Mine Safety and Health Act of 1977.

- Horizontal well plugging (site specific reviews) (No Rules in Place Plugging Laterals) –
  - Focus on target formation top with the start of setting plug back procedure,
  - Curve (generally CIBP and 300' cement) & the vertical wellbore section standards,
  - "Pilot holes must be plugged back completely (cement) prior to kick-off".

- "Casing recovery, cement plug and gel spacer placements are critical"
  - Circulate , bail, and remove all oils and salt waters from the wellbore,
  - Remains are only plugs and gels (set a cement plug on CIBP).

# QUESTIONS?

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