BASELINE WATER QUALITY SAMPLING IN SHALE GAS EXPLORATION AND PRODUCTION AREAS
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Baseline sampling is considered a keystone in our prevention measures to protect drinking water supplies

- Risk management tool to decrease overall risk

Chesapeake has had over 31,000 baseline samples collected

- Dissolved methane has been detected in 25 percent of all baseline samples
- Methane detections have been found in Arkansas, Kansas, Louisiana, New York, Ohio, Pennsylvania, West Virginia, Colorado, Wyoming, Texas, and North Dakota
- Highest concentrations have been found in Louisiana, Pennsylvania, and Ohio
CURRENT BASELINE WATER QUALITY PROGRAM CONCEPTS

- Water Quality Analysis (pre-drill) using independent environmental consultants (sampling) and analytical laboratories (testing) based on written program documents and procedures
  - Clarifies expectations for consultants and laboratories

- On-going communications between all consultants and laboratories involved in the program
  - Consistency of sampling procedures
  - Increased comparability of data between consultants and laboratories
  - Field and laboratory auditing conducted by CHK
CURRENT BASELINE PROGRAM COMPONENTS

- Independent Consultants
  - Identify private water sources
  - Coordinate water sampling survey form delivery
    - Critical element in assisting to identify potential sources of variability, e.g. use prior to sampling
  - Schedule sampling times with residents/landowners, conduct sampling, and follow-up contact
    - Photo documentation during sampling – can prove to be a most critical element
    - Field notes, site sketch and field activities documentation – specific timeframes for conversion to electronic form
    - Verification of multiple contacts and adequate documentation of refusals for testing
    - Coordinate delivery of results to landowners & state agencies (where required)
  - Assist in Public Outreach Meetings in local community groups
CURRENT BASELINE PROGRAM COMPONENTS

- **Independent Analytical Laboratories**
  - Analyze for specific indicator parameters to establish general water quality
  - Use scientifically validated methods for testing groundwater and surface water

- **Data Internally Stored in EQuIS Format**
  - Able to utilize data for statistical reports
  - Readily access data for complaints or other uses
WATER TESTING PARAMETERS AND LANDOWNER REPORTS

- **Chesapeake Standard Baseline Parameters**
  
  - **Field Screening:** pH, Temperature, Specific Conductivity, DO, Turbidity, GE/GC/FID/PID and LEL readings, Eh, and Hydrogen Sulfide
  
  - **General Chemistry:** pH, Specific Conductance, Turbidity, Chloride, Sulfate, Bromide, Carbonate Alkalinity, Bicarbonate Alkalinity, MBAS, TDS, and TSS
  
  - **Total Metals:** Ag, As, Ba, Ca, Cd, Cr, Fe, Hg, Li, K, Mg, Mn, Na, Pb, S, Se, and Sr
    - Dissolved Metals: Fe and Mn, if field turbidity exceeds 10 NTU
  
  - **Organics:** BTEX, O&G (HEM), and Dissolved Light Gases (C₁-C₃)
    - Rush dissolved light gas results if field LEL reading is greater than 10% or sample is effervescent
  
  - **Isotopic Methane:** if dissolved methane exceeds 20 mg/L
    - Some states have a lower threshold of 1 to 2 mg/L
WATER TESTING PARAMETERS & LANDOWNER REPORTS

- Chesapeake Resident Package
  - Full Copy of Analytical Laboratory Report
    - How to Read Your Laboratory Report Fact Sheet
  - Frequently Asked Questions (FAQs)
  - Methane Fact Sheets (when dissolved methane is detected)
WATER SOURCES & SAMPLING RADIUS

- Water Sources utilized for household purposes:
  - Bathing
  - Washing
  - Drinking
  - Cooking
  - Other household uses

- Sampling Radius:
  - One Thousand feet (1000’) from well pad (surface hole) location or state regulatory requirement, whichever is greater
  - Some areas radius is extended (4,000’) based on location and available water sources
BASELINE WATER SAMPLING POINT

- **Sample Collection Point:**
  - **Non-invasive sampling**
    - Dissolved gases should be collected under water head
  - **Water Line from Water Well or Spring:**
    - Sample point/spigot at well head or prior to treatment/pressure tank
    - Base of pressure tank
    - Sink tap
  - **Springs: end of the pipe, outlet, or from cistern/water collection system**
  - **Surface water: mid-depth from center of water source**
BENEFITS OF PRE-DRILL SAMPLING & TESTING

- Better understanding of general water quality in immediate area
  - Water Well records obtained during baseline sampling surveys may be incomplete in counties where records are poorly kept
  - Landowner knowledge of water quality is documented in Water Sampling Survey
  - Help identify areas of pre-existing dissolved methane sources
BENEFITS OF PRE-DRILL SAMPLING & TESTING

- Helps establish a baseline of water quality if a complaint is made
  - Use in addition to a timeline for events prior to the complaint
  - Additional data can be gleaned from mud logger data, area data compilations, and evaluation of other possible sources (e.g., legacy wells, etc.)
BENEFITS OF PRE-DRILL SAMPLING & TESTING

- Landowners receive a full analytical report documenting their water quality
  - Provide educational fact sheets to assist landowners in understanding their resident package. Many landowners do not know even the depth of their well

- Help educate the general public in localized town hall meetings
  - Helps to overcome public perceptions
  - Presents baseline data findings for the general area
  - One-on-one sessions are made available
LESSONS LEARNED

- Operator’s program document must be written

- Photo documentation is critical
  - Consultants must act as the eyes for the operator at each site being sampled
  - Photos of wellhead, sample point and any special or unusual conditions noted
LESSONS LEARNED

- Document all attempts to provide testing
  - Consultant must document all written and oral contact with well owner to offer water sampling in order to establish due diligence
  - All refusals must be clearly documented

- In northeast, routinely offer vent caps or vent stacks if dissolved methane is over 10 to 20 mg/L
  - Installed by Chesapeake personnel or contractor
LESSONS LEARNED

- Dissolved methane sampling and analyses require careful consideration
  - Lack of consensus on sampling method for dissolved methane

  - Trained sampling crews use the same sample collection procedure so that sampling bias is consistent
  - Marcellus Shale Coalition has developed Recommended Practices which provide a sampling method which is a consensus guideline for use in the Marcellus shale
LESSONS LEARNED

- Dissolved methane analyses and isotopic methane analyses are not silver bullets
  - Multiple lines of evidence are necessary due to the complexity of the issue
    - Mud gas data, geological data, area groundwater quality data
  - When moving into a new operational area, may need to conduct more isotopic analyses,
    - Especially if there is little to no data available for groundwater in the area