

# Preparing for and Handling Common Complaints by Private Water Well Owners Related to Coal Bed Methane, Shale Gas and Other Unconventional Development

**John V. Fontana, PG**

**David M. Seneshen, PhD, PG**  
*Vista GeoScience, Golden, Colorado*

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# Outline

- **Industry's Image**
- **Domestic Water Well Facts**
- **Leading up to the Complaint**
- **The Water Well Symptoms**
- **How to Prepare for the Complaints**



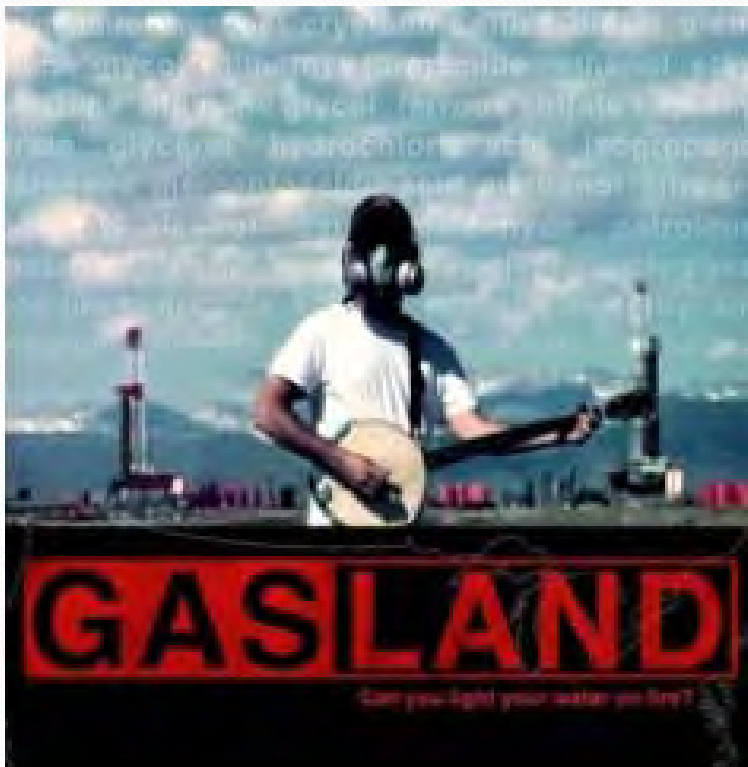
# The Environmental Rules

- **Environmental Problems are Emotional**
- **Environmental Solutions are Technical**
- **Environmental Decisions are Political**

Author Unknown



# The Public Image of Oil and Gas Development





# Google Images (1<sup>st</sup> page)

## Fracking Water



# Water Well Owner Facts

- About 95% of all rural Americans get their drinking water from a groundwater source
- 42 million depend on wells for their water
- Well Owner Associations Recommend Annual Maintenance and Testing
  - *Most Owners Don't Do Any!*
- Few Test for Methane





# How many water wells are there?

- **Raton Basin: Las Animas & Huerfano Counties**
  - **5,700 permitted water wells**  
(Colorado DWR)
  - **Compared to 3,100 Active Oil/Gas Wells**  
(COGCC)



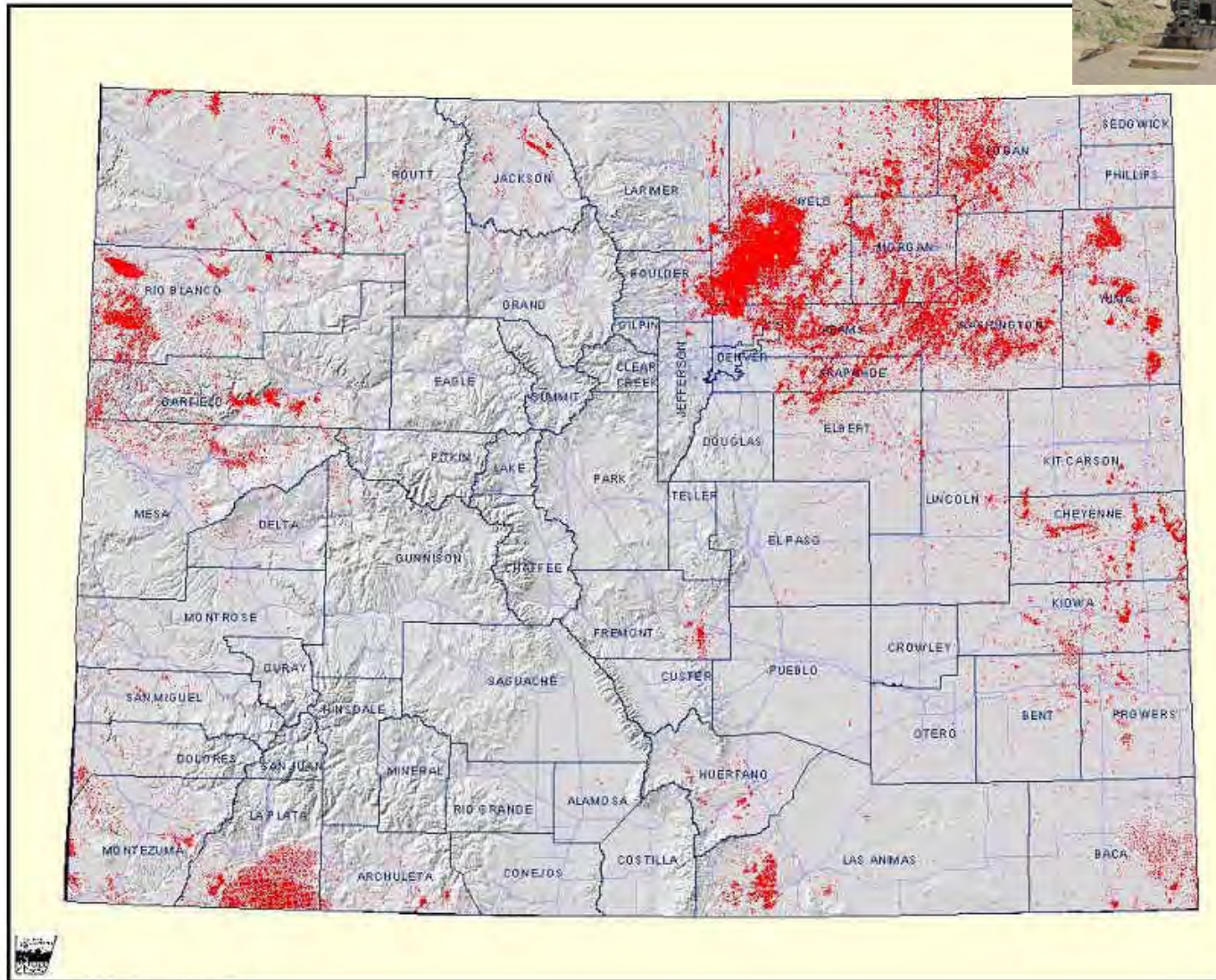
# Colorado Oil & Gas Operations

- 25,700 active wells.
- 40,000 wells are plugged and abandoned.
- Two thirds (2/3) of Colorado Counties (42 of 63) have wells located in them.
- Thirty (30)% of Colorado Counties (19 of 63) have at least two hundred wells.
- Weld County has over 10,000 (40%).
- Rio Blanco County and La Plata County each have over 2000 wells (10% each).

(COGCC, Oil & Gas Operations At A Glance)

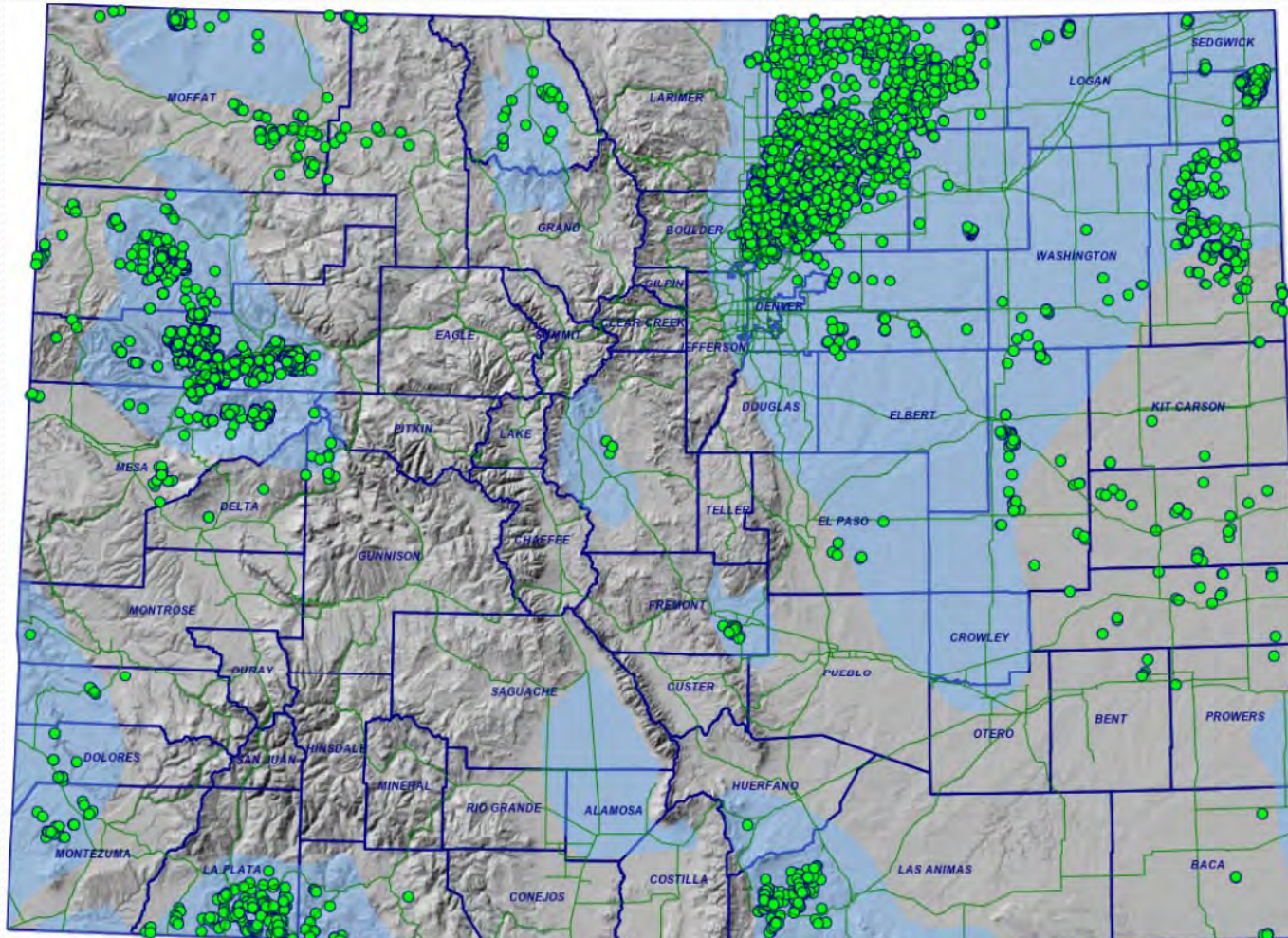


# Oil & Gas Wells in Colorado





# Oil & Gas Well Permits







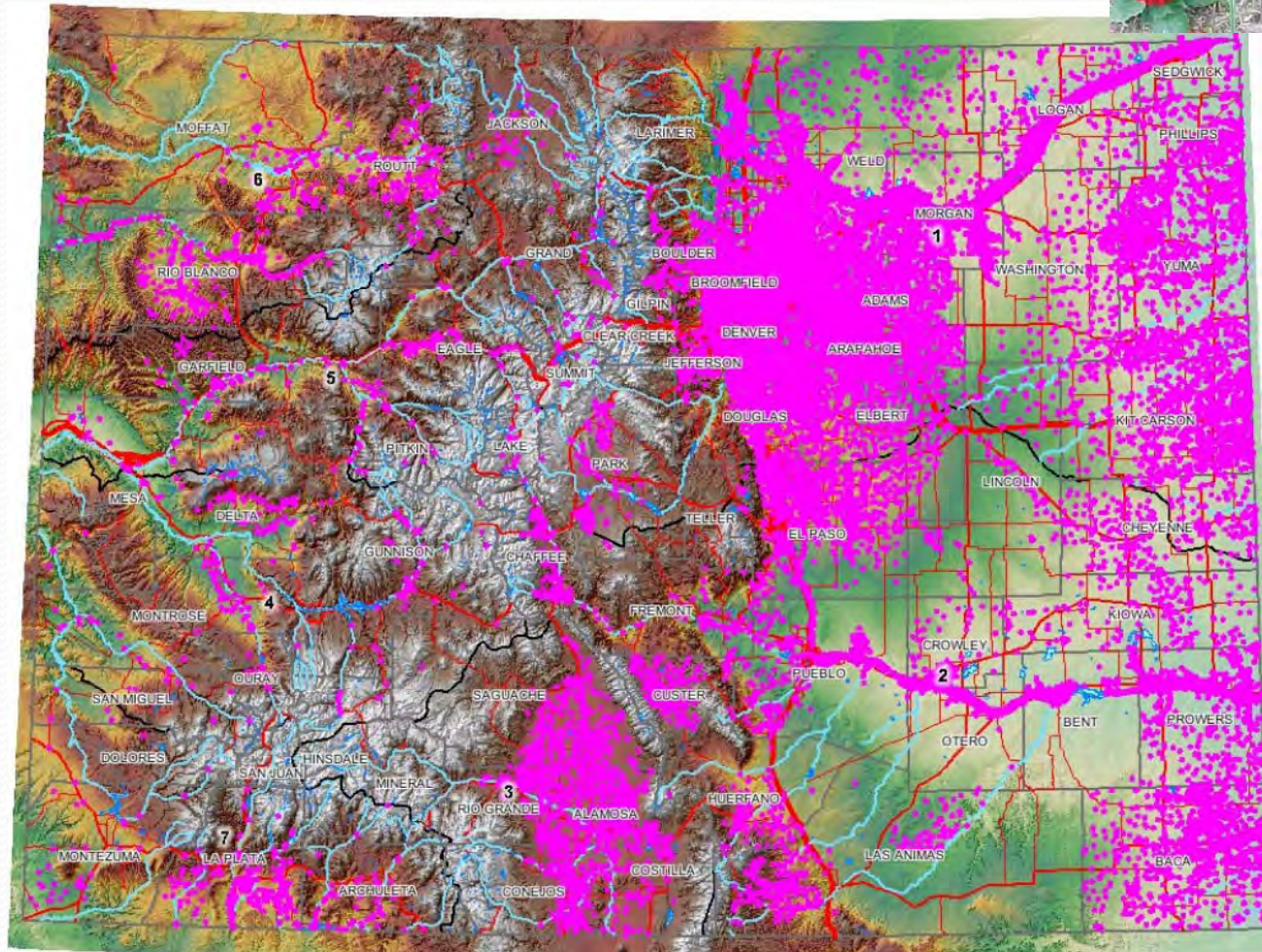
# Permitted Water Wells in Colorado

- **268,800 Total Water Wells in Colorado through 2010**
- **203,300 are classed for Residential, Household, Livestock, Irrigation, Commercial, or Municipal**
- **5,718 are classed as Industrial – (mostly permitted in 2010 in La Plata and Las Animas counties)**
- **23,000 are classed as Monitoring Wells**
- **15,000 are classed as Geothermal or Other**

(Colorado Division of Water Resources, 2010)



# Water Well Locations





# Domestic Well Problems are Common

- Lack of Routine Testing & Maintenance
- Poor Installation & Construction Practices
- Poor Aquifer Conditions



Photos Courtesy Anthony Gorody



# Private Wells Exceed EPA Standards

- *Private water wells are not required to meet EPA drinking water standards.*
- Many exceed primary or secondary standards.
- Most Domestic Water Wells Contain Measurable Dissolved Hydrocarbons (Mostly Methane)
  - Majority Contain Bacterial Gas
  - Some Contain Gas From Natural Seeps or Historic Production Activities





# The Complaint Sequence

- **CBM, Tight Sand, or Shale Play Develops**
  - No Previous Production History or...
  - Previous History Drilling – Possibly Old
  - Severed Mineral Rights
- **Leasing Acquisition**
- **Owners See Scary News Articles – Google “Fracking”**
- **Operator Begins Drilling Program, then...**
- **A Landowner’s Water Well Develops a Problem....**
- **The Land Owner Calls and Complains**



# The Complaint

- **After they drilled that oil/gas well, my water well \_\_\_\_\_!!!! (Fill in the Blank)**
  - ... Stopped Working
  - ... Went Dry
  - ... Has Sediment, or Slimy Stuff
  - ... Has Gas Bubbles, or Methane
  - ... Tastes Awful, Salty
  - ... Smells
  - ... Blew Up!



# Common Well Problems

- 1. Poor Water Production (Quantity)**
  - Well Goes Dry or has Low Yield Rates
- 2. General Water Quality**
  - Odors, Taste, Color, Staining, etc.
  - Sediment
  - Bacteria - Slime
- 3. Gases in the Water**





# Reasons for Low Yield

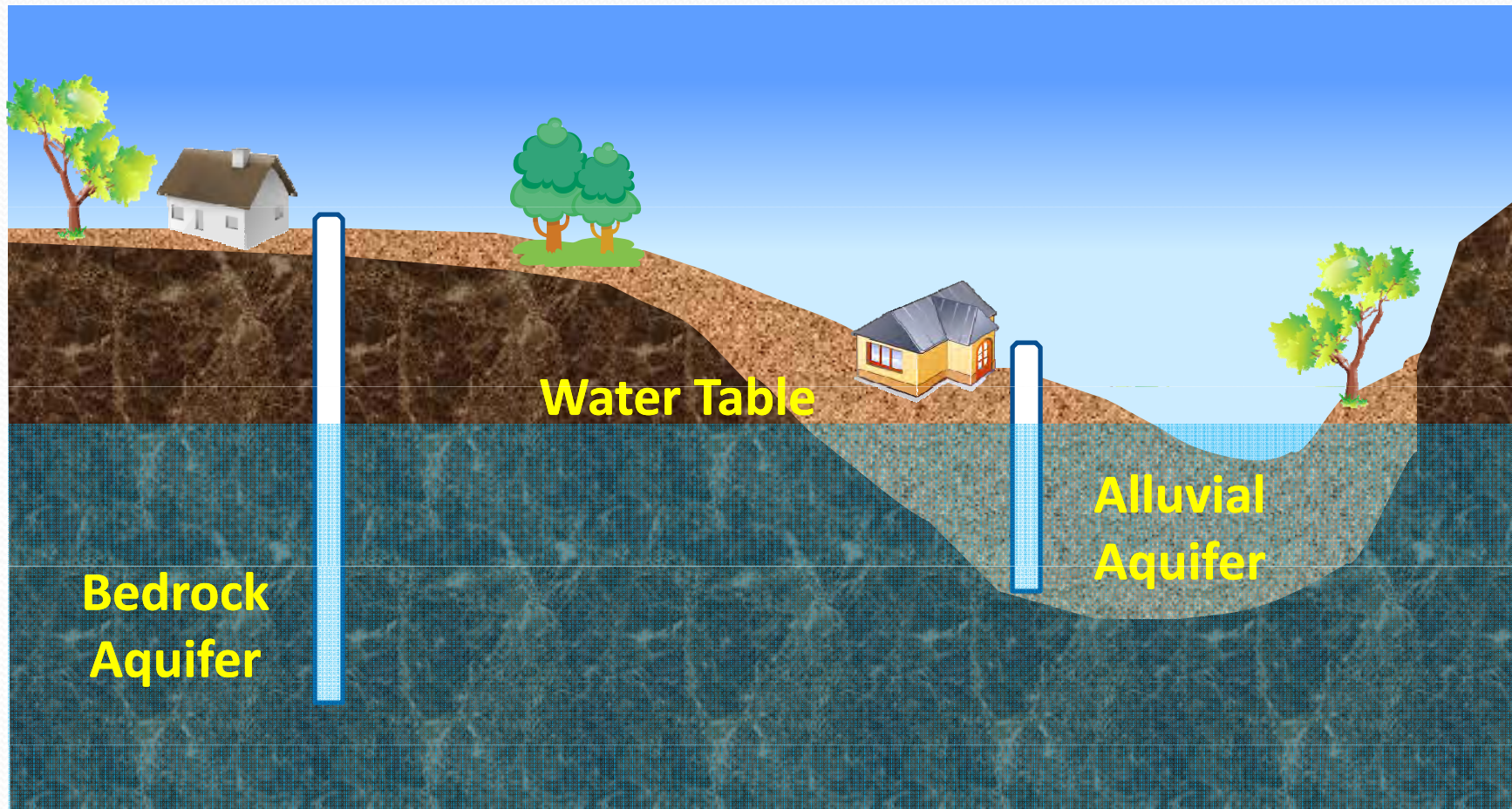
***“My well now goes dry!”***

- **Yield** is the Rate the Well Flows Water (gpm)
- **Day 1 will be your best yield ever!**
- **Potential Causes:**
  - Tight or Low-Flowing Aquifer
  - Dry Season – Low Water Table
  - Drawdown (over-pumping)
  - Fouling of the Well Screen or Pump - Sediment
  - Pump Damage, Small Size, Bad Installation
  - Poor Well Design or Construction
  - Lifespan: Yield Declines with Age of Water Well





# Common Aquifer Types





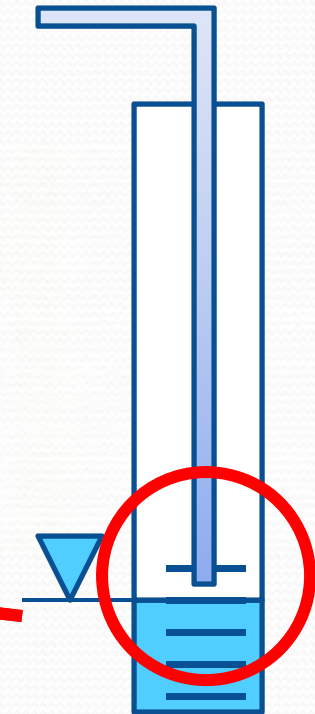
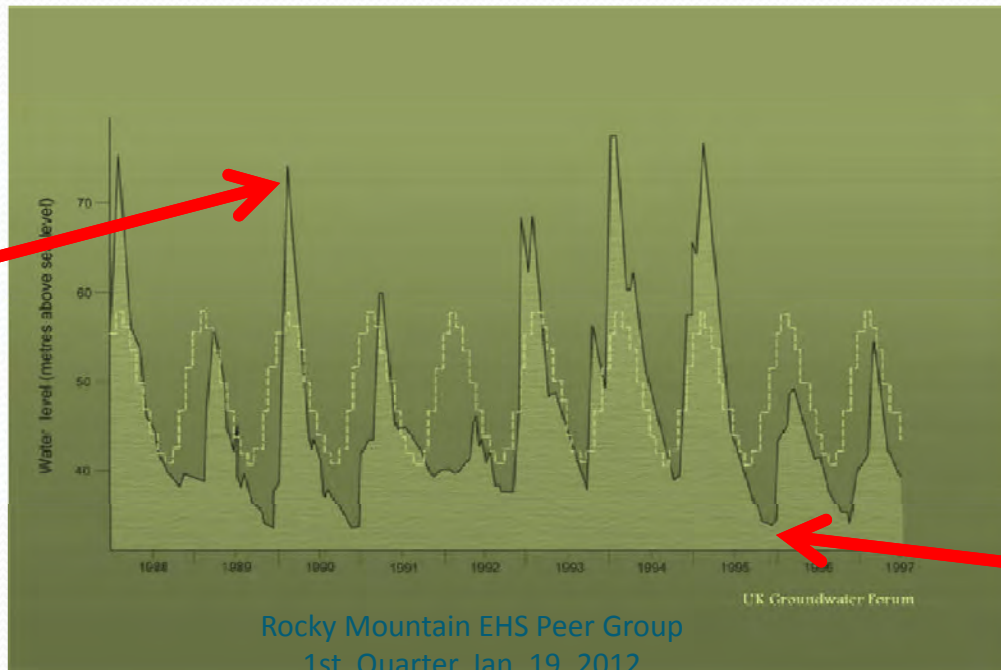
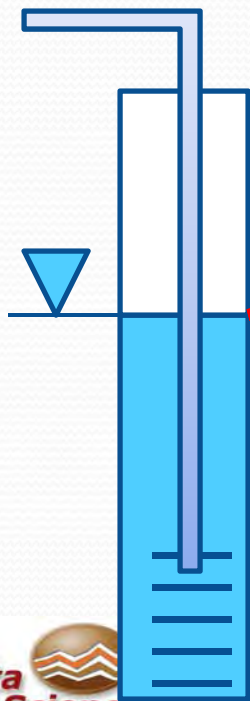
# Seasonal Fluctuation or Drought

Spring/Summer

High water level

Fall/Winter

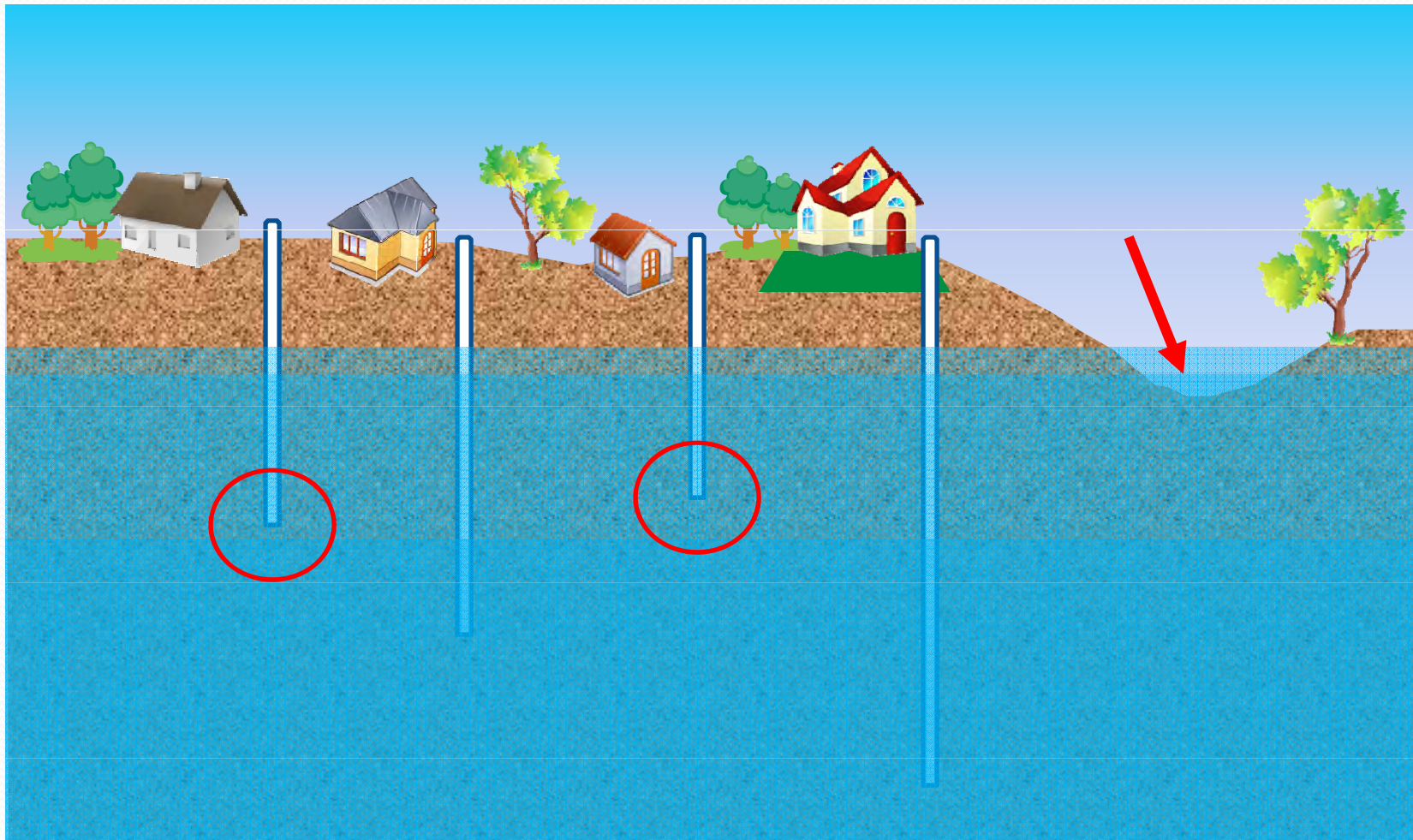
Low water level





# Localized Drawdown

## Over-Use of the Aquifer





# Fouling (blockage) of the Well Screen or Pump

- Silts and Clays
- Encrustation
  - Hard Water
  - Iron
- Corrosion
- Bio-Fouling
  - Bacteria Growth



# Poor Well Design or Construction

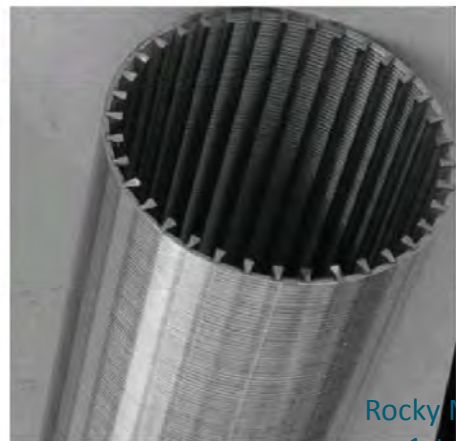


- **Minimum Construction Requirements & Rules**

– Good Enough?

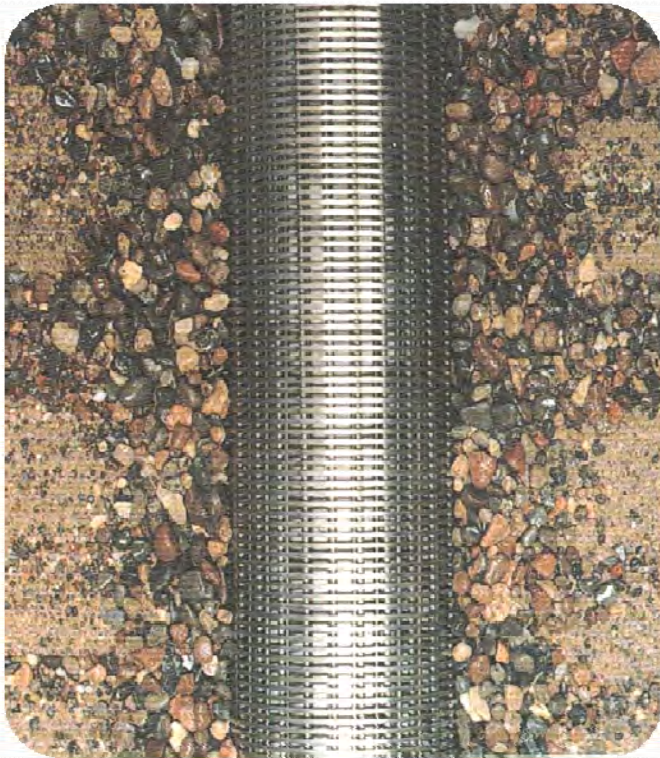
- **Maybe Not.....**

- Sand/Gravel Filter or Open Bore?
- Post-drilling well cleaning?
- Adequate Bore-Hole Diameter & Depth?
- Is the casing too small or too big?
- Well Casing Size & Screen Type?
- Pump Size & Location?





# Lifespan of a Water Well



**Years to decades based on:**

- **The Geology/Environment**
- **Well Design/Construction**
- **Maintenance**
- **Normal Corrosion/Wear & Tear**
- **Water Chemistry**
- **Amount of Use**

# Water Quality Complaints:

- **Odor**



- **Taste**



- **Color & Sediment**





# Causes of Poor Quality

- Dissolved Minerals & Salts
- Excessive Bacteria Activity
- Sediment



Photos Courtesy Anthony Gorody

# Gas Bubbles

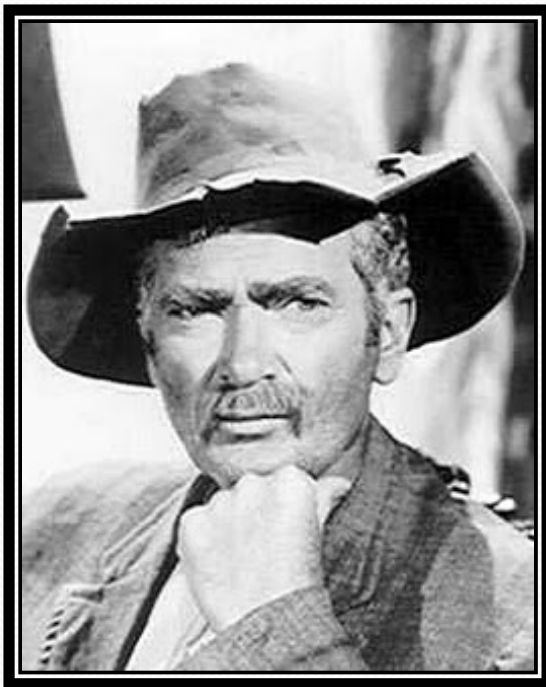
*My water fizzes like soda!*

- Causes
  - Dissolved Air or Natural Gas - Methane and/or Carbon Dioxide
- Sources
  - Natural Bacteria Gas
  - Natural Gas - Coal Bed Methane
- Radon – Uranium is potential



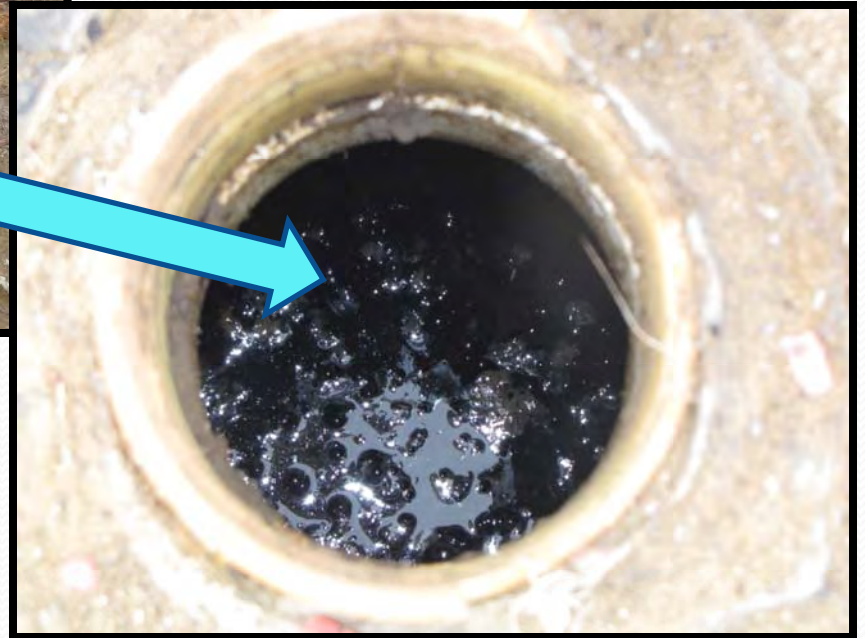


# Natural Seeps Do Exist – Ask Jed!



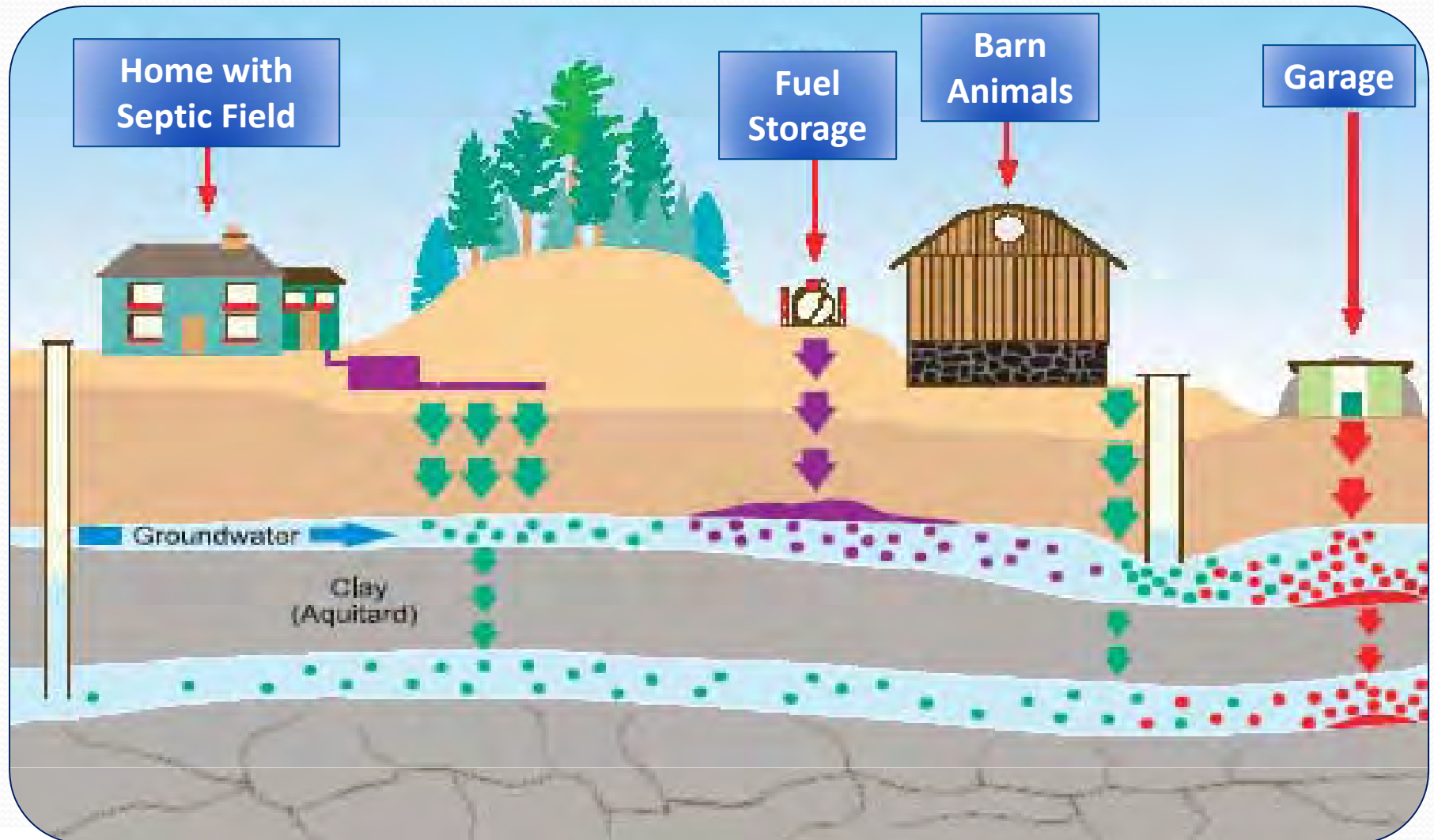


# Case History: Cistern or Septic Tank?





# Potential Impacts to Water Wells

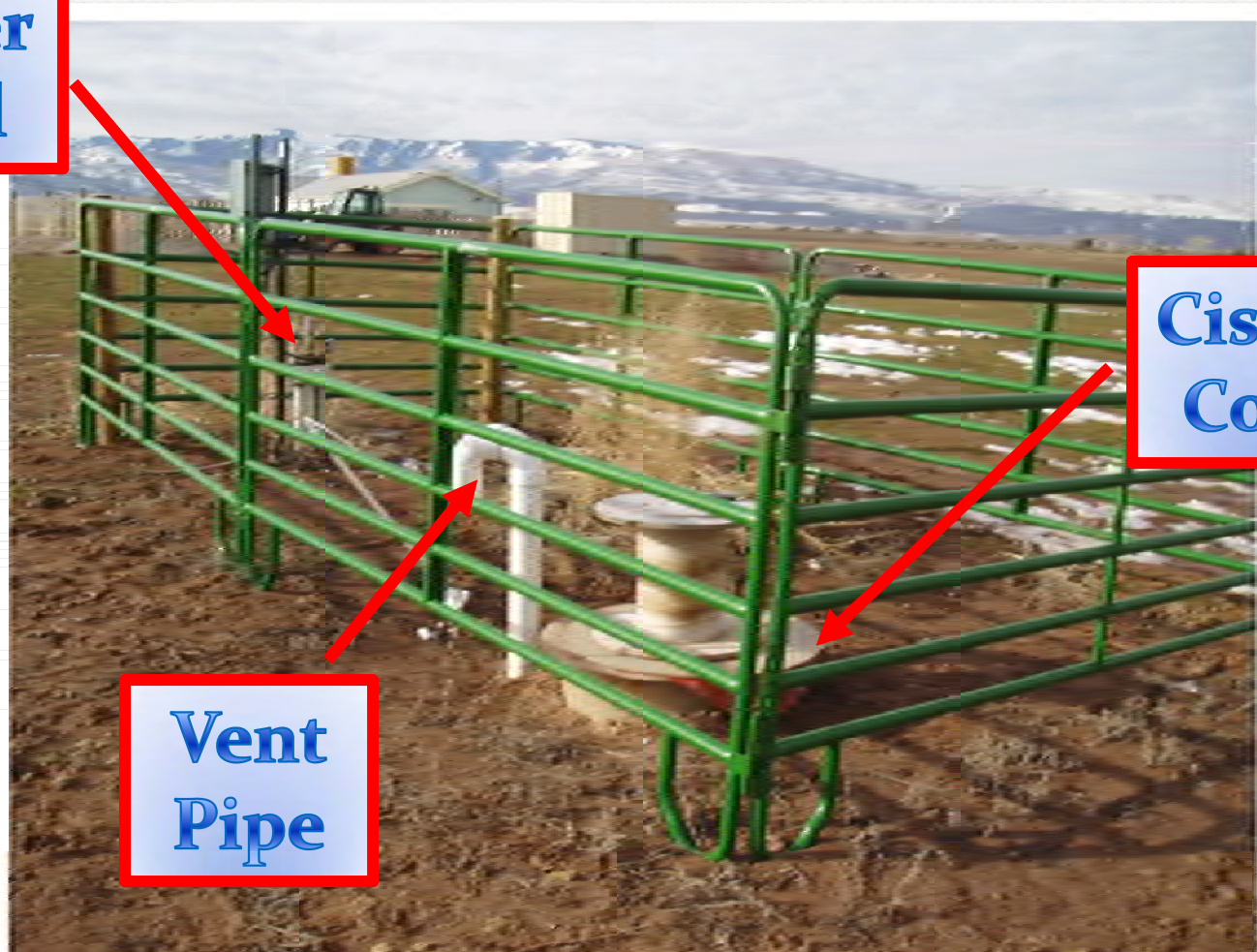


# Livestock Pen, Water Well & Cistern

Water  
Well

Cistern  
Cover

Vent  
Pipe





# Preparing for Complaints

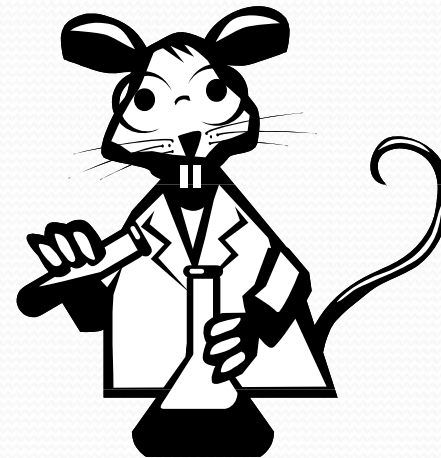
- Educate Owners on Your Efforts, Water Well Testing & Maintenance



- Establish a Baseline – Conduct Sampling
- Opportunity for Stakeholder Engagement
- Promote it as a Valuable Community Service

# Establish Baseline Water Quality & Dissolved Gas Parameters

- Fingerprint of Water and Gas
- Major Anions and Cations - Balance
- pH, eH, Conductivity, Temp, DO
- Dissolved Hydrocarbons
  - Methane (*required in CO Rule 608*)
  - **$C_1$ - $C_6$**  (*also recommended*)
  - BTEX - TPH
- Stable Isotopes of Methane
  - $\delta^{13}C$  and  $\delta D$
  - $C_2+$ ,  $CO_2$  and Water Isotopes





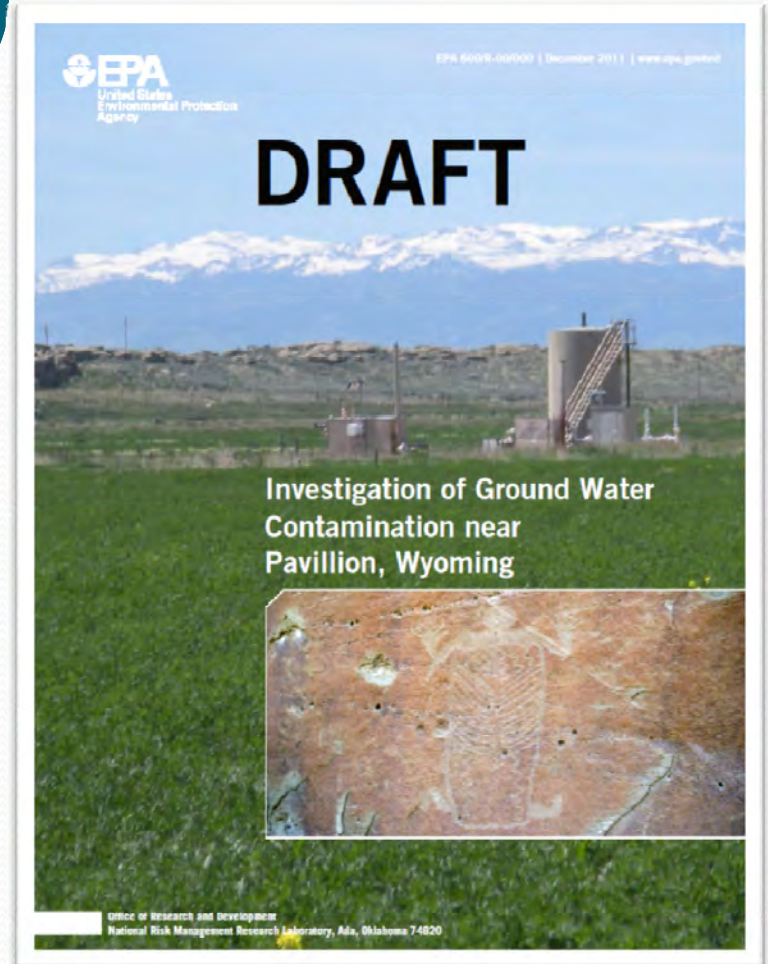
# Establish Baseline Water Quality (continued)

- **Bacteria Activity Reaction Test (BART)**
  - Iron Related (IRB)
  - Sulfate Related (SRB)
  - Slime Forming (SLYM)
- **Coliform Bacteria**
- **Nitrates**
- **Trace Elements**



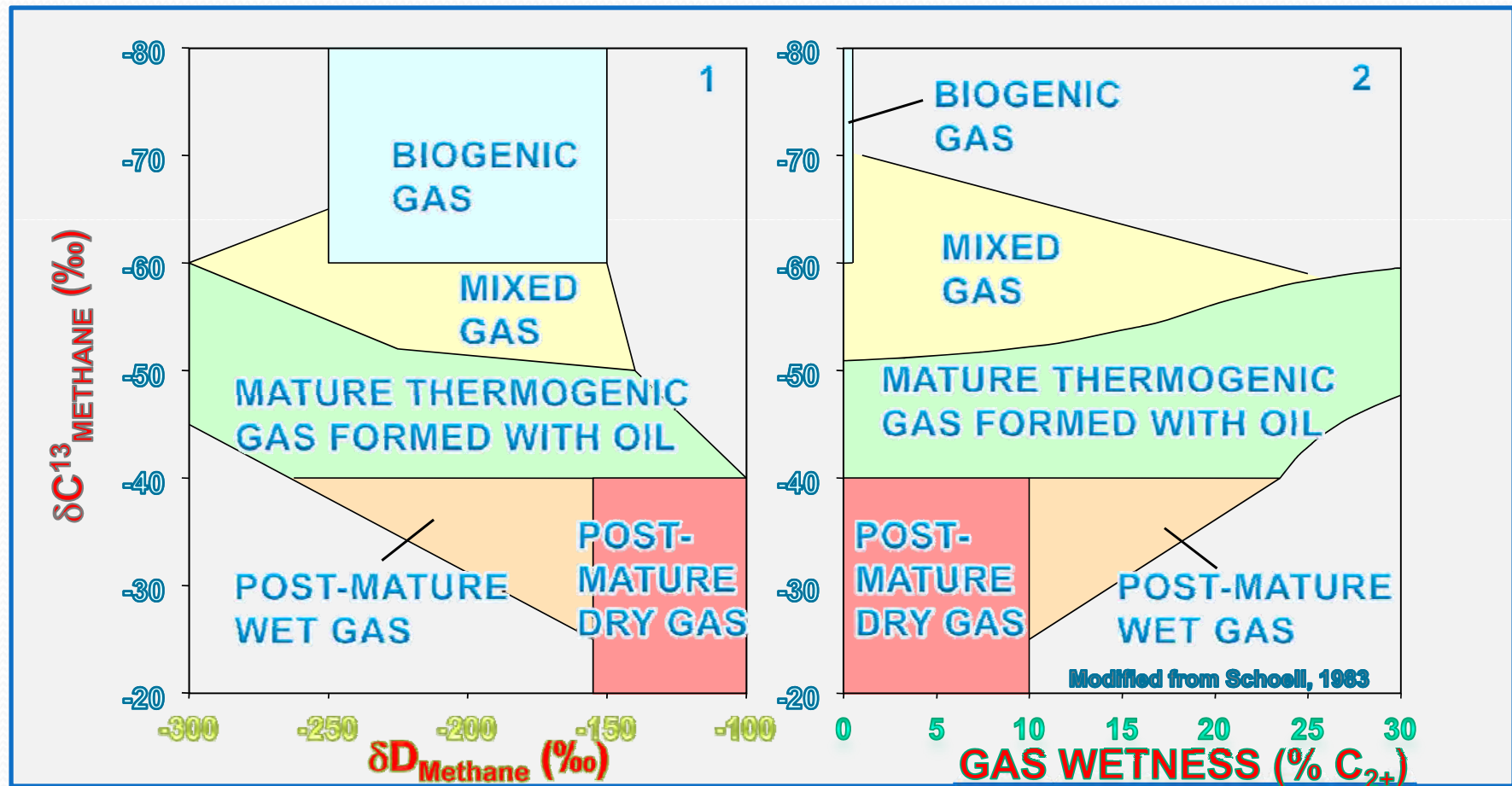
# Establish Baseline Water Quality (continued)

- Establish Data Quality Objectives
- Quality Assurance & Quality Control
- Field Protocol
- Analytical Protocol
- Expertise & Experience

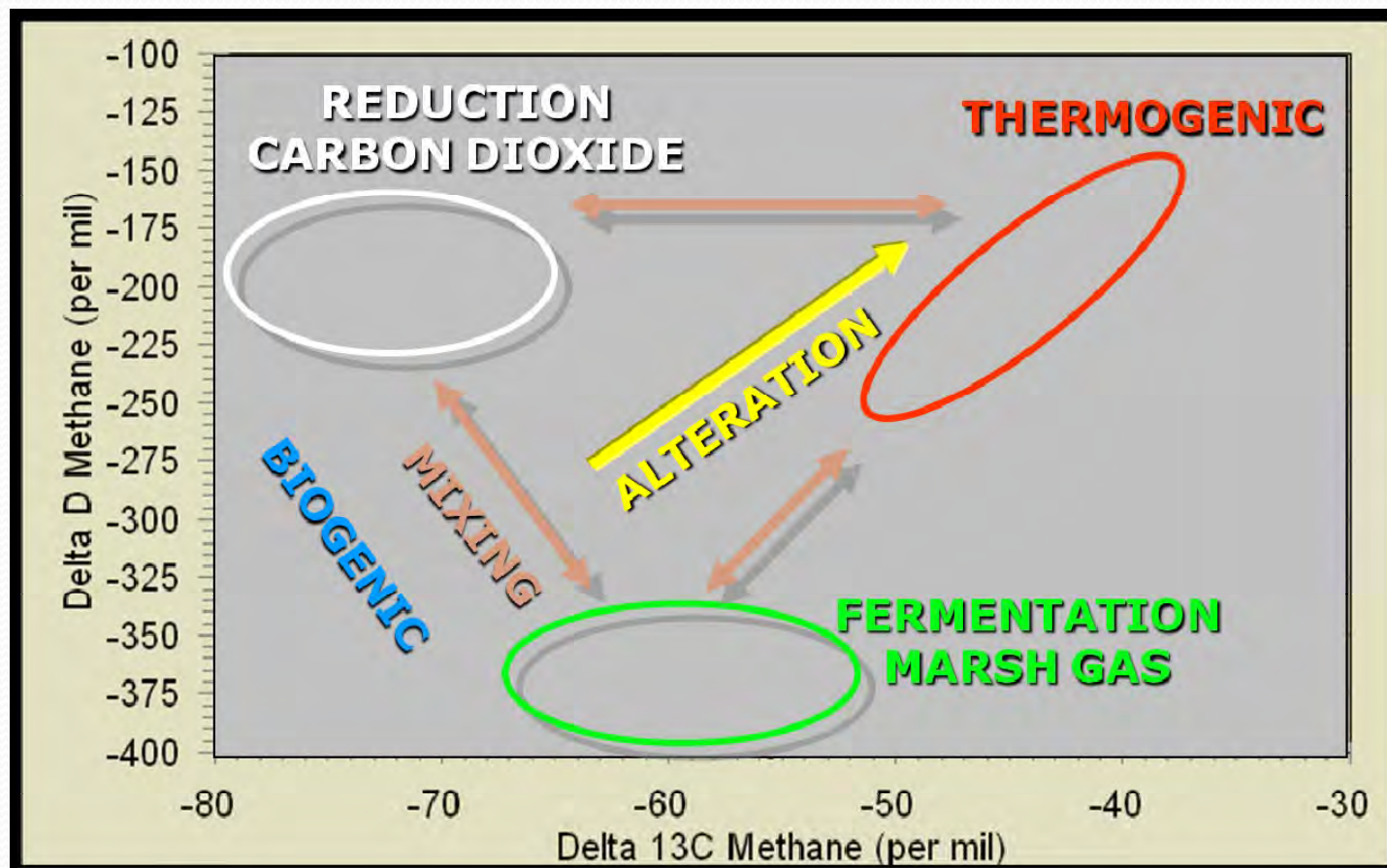




# Composition Fingerprints Source



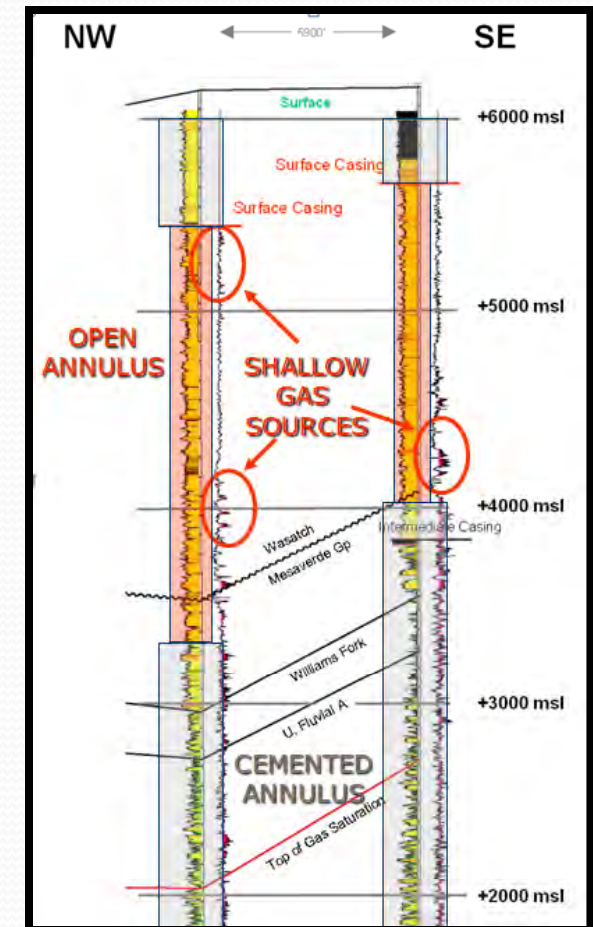
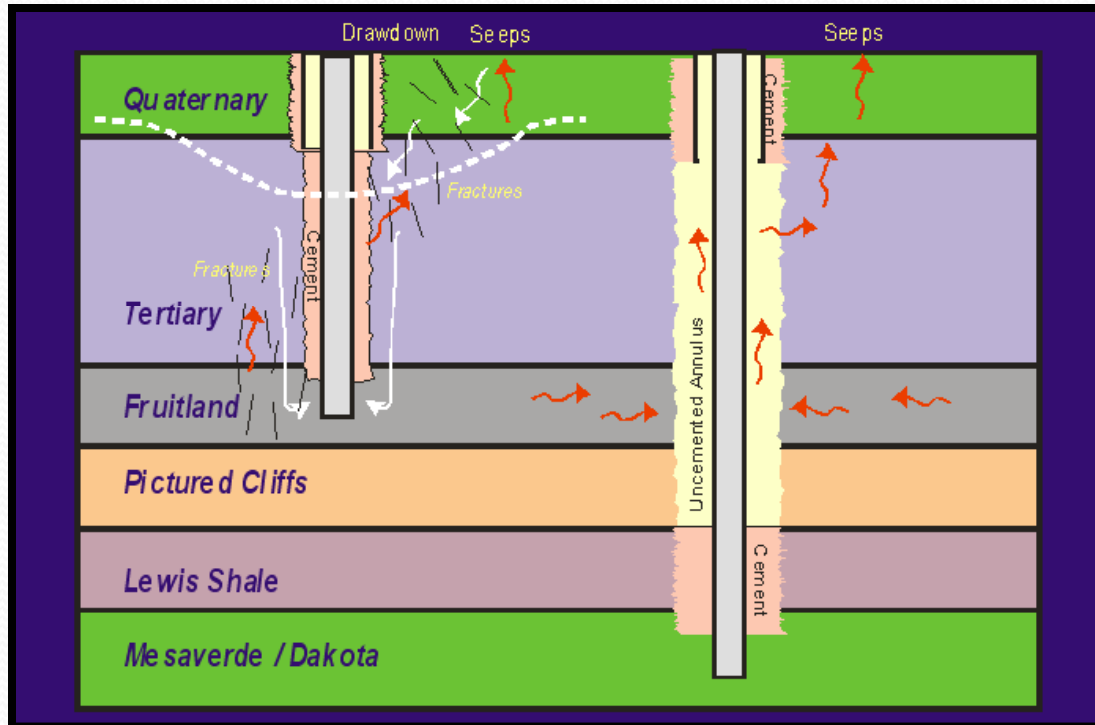
# Mixing & Alteration Create a Complex Picture





# Assess Nearby Wells for Leakage

- Old Wells or Open Annulus Can Create Cross-Communication with Aquifers



# Some Symptoms May Be Related to Your Activities

## Vibrations from Construction & Hydraulic Fracturing Activities

Distance to well	Depth of well	Maximum PPV (mm/sec)
4.5m	3-14m	0.79
13m	20-26m	0.37
25m	26-29m	0.2
50m	29-32m	0.09
100m	32-38m	0.08
150m	38-44m	0.07
300m	>44m	0.04

[http://www.planning.nsw.gov.au/assessingdev/pdf/171-7-2005\\_assessment\\_report.pdf](http://www.planning.nsw.gov.au/assessingdev/pdf/171-7-2005_assessment_report.pdf)

- **Ground motion impacts on water wells:**
  - Disturbed bottom sediment
  - Dislodging scale and bacterial slime
  - Temporary increase in suspended material
  - = *Immediate complaint*



# Summary

- ***Complaints Happen!***
- **Water Well Problems or Contaminants are a Result of:**
  - Lack of Maintenance & Testing **(most common)**
  - Poor Construction, Poor Aquifer or Lifespan of a Well
  - Historic Drilling or Mining Activities
  - Natural Migration or Seepage
  - New Releases, Casing Leaks, Spills **(least common)**
- **A Proper Baseline Sampling & Monitoring Program can:**
  - Educate Stakeholders
  - Establishes Pre-Drill Baseline Conditions
  - Prepare you with *Answers to the Complaints!*
  - Be an Effective Approach to Risk Mitigation





***Thanks***

**JFontana@VistaGeoScience.com**  
**DSeneshen@VistaGeoScience.com**  
**Vista GeoScience, Golden, CO, USA;**  
**[www.VistaGeoScience.com](http://www.VistaGeoScience.com)**



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**Universal Geoscience Consulting, Inc.,**  
**[AGorody@gmail.com](mailto:AGorody@gmail.com)**

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