Adequate water testing

Impact of water withdrawals

Adequate wastewater treatment

Protection of drinking water

Risk from fracking chemicals

Regulations and enforcement

Photo courtesy – Paul Hart, Hart Resource Technologies, Inc
Types of Waste Fluids

- **Top hole fluid** – freshwater encountered during drilling
- **Drilling fluids**
- **Bottom hole fluids (brine)**
- **Stimulation “flow back” fluids (major source of waste fluids from Marcellus wells)**
- **Production fluids**
Wastewater Pollutants
(~20 wastewater samples)
Waste Fluid Collection and Transport

- Pit(s) with acceptable plastic liner
- Tanks
- At least two feet of freeboard in pits
- Transport to treatment via tanker trucks
Predictions of Brine and Frac Fluids Disposal in PA

Challenges
• High volume
• Salts
• Variability

Million Gal/Day

Source: PA DEP
Deep Well Injection

- New or existing well into porous formation that can accept fluids
- Must have confining layer free of faults or fractures above injection formation (and no orphan gas wells)
- Injection pressure controlled to prevent formation of fractures
- Double containment – casing
- Costly to develop
- Very few in Pennsylvania
Traditional Wastewater Treatment

- Simple, inexpensive
- Limited capacity – Marcellus waste fluids exceed capacity
- All located in western PA
- Salt discharges – relying on dilution
- Infrastructure, permitting for new plants
Road Application of Gas Drilling Fluids

- Only production or treated brines may be used
- DEP approval required
  - Road authorization
  - Chemical analysis of brine
  - Limited application rates and frequency (monthly)
  - Other factors - weather, location of water bodies (150’), road gradient (<10%)
- The brine generator, the transporter, the applicator and the roadway administrator
Municipal / Industrial Treatment Plants

- **Advantages**
  - Readily available – many have capacity ($)
  - Convenient locations

- **Disadvantages**
  - Inadequate processes (dilution) – may cause damage, hazardous sludge, etc.
  - May interfere with existing downstream water users

- Often requires permit modification, testing of 46 parameters in waste fluids

- Now scaled back (if permitted at all)
Ultimate Treatment

- Evaporation
  - With or without recovery of distillate
- Membrane technologies
- Costs greatly increase over traditional treatment

250,000 mg/L of Brine
25% Salt
75% Distilled Water

Pictures courtesy of Paul Hart, Hart Resource Technologies
Portable or centralized treatment and re-use of frac fluids

Typically 30-40% of frac fluids return to surface

Initial frac flow back water can often be immediately re-used without treatment

Remainder may be diluted and reused or pre-treated to remove metals and scale forming substances before re-use
- Need to get TDS < 50,000 mg/L
- Hardness < 2,500 mg/L

Area of tremendous research and development
After 1/1/2011, new* sources of high TDS discharges will have to meet discharge requirements that will not impair downstream public drinking water supplies.

Treatment plants that accept gas wastewater required to have an EPA approved pre-treatment program.

Standards (in addition to current standards for pH, oil/grease, etc.):
- TDS – 500 mg/L, sulfate – 250 mg/L, chloride – 250 mg/L, total barium – 10 mg/L, total strontium – 10 mg/L

*New discharges are those that did not exist on April 1, 2009, and have a TDS concentration of 2,000 mg/L or a TDS loading of 100,000 pounds per day.
DEP Final Rules for High TDS Wastewater

- **Opportunities for Making Input**
  - Public Comments
  - Hearings
  - Meetings and other Opportunities

- **Expected Timeline for Policy Development**
  - Summer 2009 thru December 2010
Brine and Drilling/Frac Fluids Disposal in PA 2007

Estimated Volumes
- Brine 200,000 gallons/Day
- Frac/Pit 325,000 gallons/Day
- Total 525,000 gallons/Day

Future - 30% conventional treatment, 25% reuse/recycle, 25% desalinization, 10% injection wells, 10% pre-treatment to POTW

Graph courtesy of Paul Hart, Hart Resource Technologies
Publications

- Gas well drilling and your private water supply
- Water stipulations for gas leases
- Treatment options for gas waste fluids
- Gas well drilling and water resources

Web sites / webinars

- Portable Classroom DVD

Presentations

- Gas drilling and your private water supply
- Water stipulations for gas leases
- Treatment options for gas waste fluids
- Gas well drilling and water resources