Marcellus shale gas development: best management practices for Maryland

Update for Maryland Safe Drilling Commission

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Progress-to-date

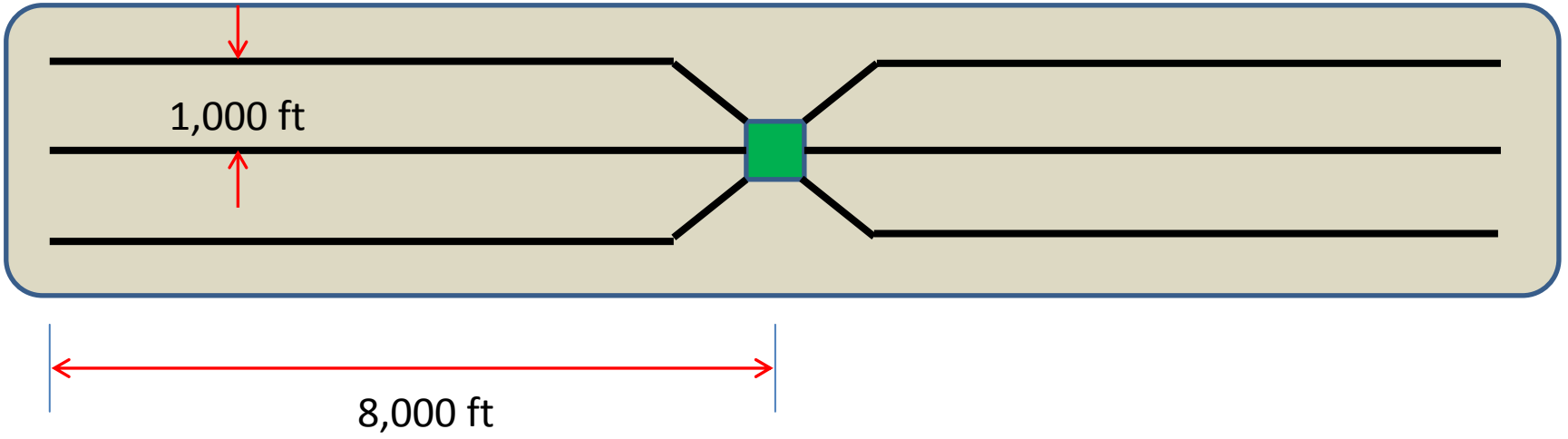
- Participated in field trips to two Marcellus drilling sites in PA
- Completed final draft of deliverable #1 ("literature review of BMPs") on 8/30/12
- Report is being reviewed by DNR and MDE
- Work on deliverable #2 ("recommendations") underway: data collection and analysis
- Two collaborators with expertise in air quality impacts and water quality impacts are now under contract
  - *Emily Elliott, Ph.D.* (Univ. of Pittsburgh): air pollution in rural landscapes
  - *Jeanne VanBriesen, Ph.D.* (Carnegie Mellon): environmental chemistry; wastewater treatment engineering

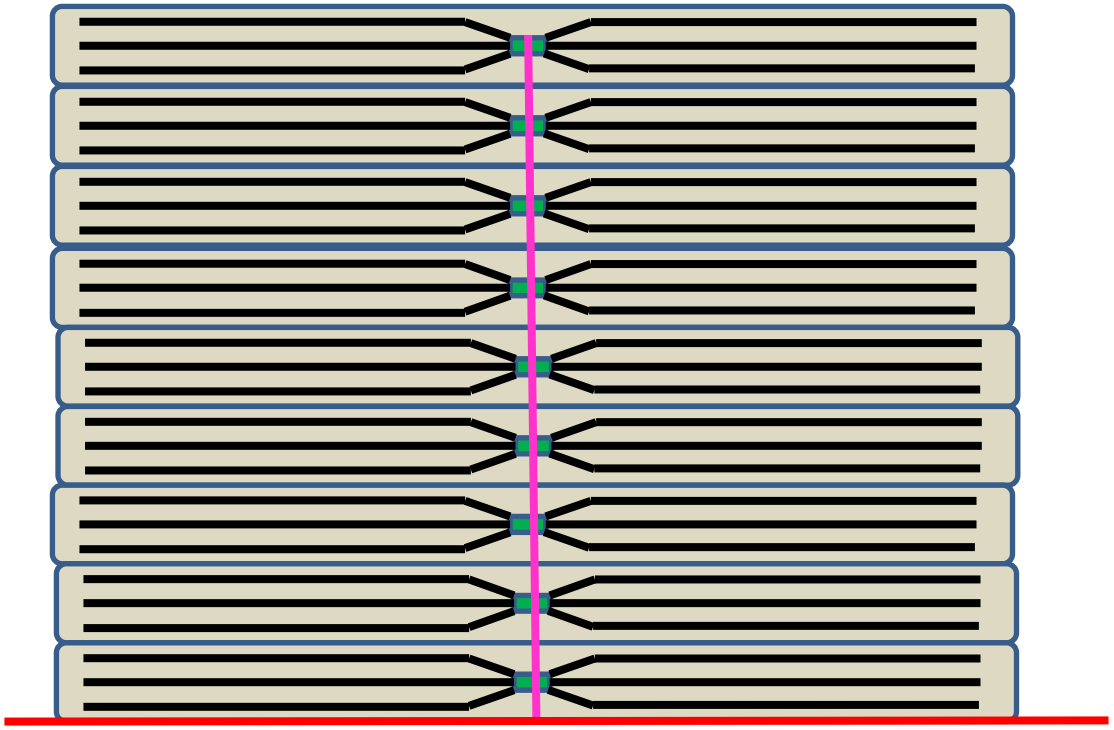
Field trips

- First-hand observations of some best practices being applied at sites on private and public lands
  - Fayette County, PA (Chevron sites): 7/20/12
  - Lycoming County, PA (Tiadaghton SF; Anadarko sites): 8/17/12
- Personally observed at least two dozen specific BMPs being employed at these sites
- MSGD represents a quasi-permanent addition of a significant industrial activity onto the landscape
  - At least in the case of PA state forests, there are no immediate plans for *land reclamation* or *restoration*
  - Goal is to maintain infrastructure to support future drilling (but not re-fracking), if necessary
- All sites visited were *multi-well pads* (itself an obvious BMP that minimizes land disturbance)

PA DCNR State Forests

- Multi-well pads (typically six wells per pad): 4-7 acres
- 8,000 ft laterals, 1,000 ft apart
- Approximately 1-2 mi^2 of target formation can be drained
  - (3000 x 16000)/(43560 x 640) = 1.7 mi^2





Existing road/pipeline

Access road, utility corridor, and compressor station on Tiadaghton SF

- *Total area drained* = 18 mi^2
- *Area of pads* = 36 acres
- *Area of roads & utility corridors* = 44 acres (assuming 75 ft wide roads/co-located gas lines)
- In this highly idealized case, *less than 1% of the land area would be disturbed*
- *Caveat:* doesn't include lands disturbed for siting of compressor stations and water impoundments

15 acre, 15 MG water impoundment on Tiadaghton SF, Lycoming County, PA

Deliverable #1 ("literature review") summary

- Based on about two dozen key documents or sets of docs (among more than 100 reviewed)
  - Regulatory programs in place (or under revision) in five states (CO, NY, OH, PA, WV)
  - Relevant API documents
  - Technical reviews by several NGOs (e.g., PEC, PIC) and one state commission (PA)
  - Docs from federal agencies and panels
  - Reviews of CO, PA, and OH regulatory programs by STRONGER
  - Many other sources (journal articles, powerpoints, consultant reports, etc.)
  - Both *existing* and *proposed* practices are included
- Relatively little going on with BMPs at the federal level
  - EPA "green completions" rule to limit VOC emissions
  - Secretary of Energy Advisory Board Shale Gas Production Subcommittee called on industry "to increase their best practices process for field engineering and environmental control activities by adopting the objective of continuous improvement, validated by measurement and disclosure of key operating metrics"
  - EPA scheduled to release preliminary results from an on-going field study of shale gas development by the end of 2012 (final report due end of 2014)
  - DOI has specified some BMPs that govern shale gas development on BLM lands (these seem mostly applicable to western systems, however)

Deliverable #1 ("literature review") summary (cont.)

- Most activity is at the state level
  - Despite obvious differences, all five states mandate practices that they ostensibly consider "best" for protecting public safety, natural resources, and the environment
  - Three of these states (OH, PA, WV) recently modified oil and gas laws/regulations and NY is working on finalizing an SGEIS to address Marcellus issues
  - BMPs can be specified in:
    - actual state acts or statutes;
    - associated legislative rules or regulations;
    - administrative rules established by a particular state agency;
    - conditions that can be imposed as part of a drilling permit; or
    - conditions specified in general lease agreements (e.g., those required to drill in PA state forests)

Deliverable #1 ("literature review") summary (cont.)

- Common features of state BMPs
  - All five states require *permits* for drilling gas wells
  - All five states (and API) specify well engineering and construction practices to ensure isolation and integrity
    - *Casing and cementing standards*
    - *Pressure testing of casing strings*
  - *Setbacks* are a primary tool used by all five states to provide some protection in the event of an accident
    - Variances can usually be granted
    - Can sometimes can be voided if landowner permission is obtained
    - Little scientific basis
    - API's stated position is for industry to follow state setbacks
  - All five states (and API) specify or recommend some level of *monitoring*
    - Mostly baseline data from GW wells to provide a benchmark for assessing damages (or as defense from presumed liability in the event that contamination is detected)
    - Virtually no attention to surface waters or other resources (e.g., air quality)
  - All five states (except CO) and API make some effort to control *water withdrawals* to prevent stream dewatering and protect aquatic habitat
  - All states require *compliance with E&S and stormwater management regulations* and regulate *handling/disposal of flowback*
    - API recommends specific practices

Deliverable #2 (“recommendations”)

- Assembling the scientific team
  - Particular need for expertise in practices related to well integrity and isolation (petroleum engineering, hydrogeology, and hydraulic fracturing)!
- Gathering the data to help support our recommendations
  - Runoff
  - Geology (depth of Marcellus shale)
  - State lands (boundaries)
  - Major gas pipelines
  - Major US/state highways & local roads
  - High density population centers
  - Land slope conditions
  - Land use
  - Contiguous forestland
  - Environmental constraints (public water supply intakes, water wells, trout streams, Tier 2/3 waters, threatened/endangered species, wetlands, historic and cultural sites, etc.)
  - Other important data (existing wells, orphan wells, underground mines, caves, caverns, etc.)
- Timeline