



2013 End of Year Oil and Gas Development Radiation Study Report

Throughout Pennsylvania many companies perform oil and gas exploration and production activities by conventional and unconventional drilling through various subsurface layers of shale and rock to produce oil and natural gas. The Department of Environmental Protection (DEP) is currently engaged in the most extensive and comprehensive study ever undertaken to examine the levels of naturally occurring radiation in a variety of equipment, materials and media associated with the development of oil and gas resources, as well as the potential environmental impact and exposure to the public and workers.

By-products of the oil and gas well development process such as produced water, flowback water, and drill cuttings are potentially impacted with naturally occurring radioactive material (NORM) and/or technologically enhanced naturally occurring radioactive material (TENORM). The Comprehensive Radiation Study Plan for Oil & Gas Operations (study) is focused on the quantification of TENORM in:

- Ambient air
- Drill cuttings (vertical and horizontal)
- Natural gas
- Natural gas processing pipes and equipment
- Waste water generated on drilling sites
- Sludge resulting from the processing of waste water from the well pad development process
- Landfill leachate

DEP announced it would study the naturally occurring levels of radioactivity in materials associated with oil and gas development on Jan. 24, 2013. Perma-Fix Environmental Services of Pittsburgh, Pennsylvania, the agency's consultant for health physics and radiological issues, collaborated with DEP on the peer-reviewed study plan and is assisting DEP in implementing the study.

On April 3, 2013, the final study plan was posted on DEP's website. The plan consists of a Scope of Work, Field Sampling Plan, Facilities Checklist and Quality Assurance Project Plan. One set of questions and observations was received. Based on these questions and observations, minor changes were made to the study plan including the addition of well pads to the list of those already scheduled to be sampled.

The field work portion of the study commenced on April 15, 2013. As of Dec. 31, 2013, 184 field visits had taken place at 114 individual locations across the state. These efforts resulted in the collection of 911 samples that have been processed by DEP's Laboratory. The field work was conducted at a variety of facility types including the following:

- Twenty well pads were visited through the various phases of development on 41 occasions.
- Three rounds of waste water treatment plant sampling at 25 facilities were completed on Dec. 16, 2013.
- Thirteen sites were sampled in the northern part of the state where brine from conventional gas wells was applied for dust suppression.
- A facility that stores well casings from decommissioned conventional wells was visited for the collection of radiation surveys of that material.
- Seven facilities that compress, store, and utilize natural gas for electricity generation were visited for data collection.
- Forty-eight landfills across the state were visited for sampling.
- A shipment of waste water treatment plant sludge was surveyed at its originating location, followed to a landfill, and surveyed again to assess the effect of transport on the radiological characteristics of that material.

Significant field work remains to be completed in 2014 along with final report preparation. An estimated 51 data-collection visits to 49 sites remain to be conducted to complete the field work portion of the study. The majority of these visits are scheduled to take place at well pads to collect samples during the production phase of operations. The balance will include visits to well pad wastewater impoundments, beneficial use sites, gas operations facilities, landfills and sludge shipment sampling opportunities. The majority of the field work is planned for completion by the end of February. Detailed summaries of the completed and remaining field work follow this overview. March through August will be primarily dedicated to data analysis, report preparation, peer reviews and edits. The final report is planned for release in 2014.

Completed Field Work: [184 Data Collection Visits to 114 Sites]

- Well Pads: (41 visits to 20 well pads)
 - o 3 Companies
 - o 9 Vertical Drilling Phase Visits
 - o 9 Horizontal Drilling Phase Visits
 - o 8 Fracking Phase Visits
 - o 6 Flowback Phase Visits
 - o 9 Production Phase Visits
 - o 6 visits to 2 Utica Formation Pads
 - o 1 visit to a conventional Oriskany Producing Well
 - o 34 visits to 17 Marcellus Shale Pads
 - o Located in 8 counties covered by the SWRO, NWRO, NCRO, and NERO
 - o Field work commenced on 6/17/2013 and is ongoing

- Waste Water Treatment Plants: (73 visits to 25 facilities)
 - o 3 visits to each of the facilities
 - o 6 Publicly Owned Treatment Works (POTWs)
 - o 8 Zero Liquid Discharge Facilities (ZLDs) permitted under Waste Program GP-123
 - o 11 Centralized Waste Treatment Facilities (CWTs)
 - o Facilities located in 31 counties covered by the SWRO, NWRO, NCRO, and NERO
 - o Field work commenced on 4/17/2013; third round completed 12/16/2013

- Beneficial Use Sites: (13 visits to 13 sites)
 - o Locations distributed over 3 north-central counties
 - o Field work commenced on 10/16/2013 and is ongoing

- Decommissioned Well Pad Hardware: (1 visit)
 - o Well casings from a Shell Decommissioned Well were surveyed for the presence of radiation on 10/22/2013

- Gas Operations: (7 visits to 7 facilities)
 - o 4 Underground gas storage sites
 - o 2 Transmission line compressor stations
 - o 1 Gas-powered electric generating facility
 - o Facilities located across 5 counties covered by the SCRO, SWRO, and NCRO
 - o Field work commenced on 5/14/2013 and is ongoing

- Sludge Loads from WWTPs to Landfills: (1 event)
 - o To evaluate the effect of transport on sludge radiological properties
 - o WWTP in Lycoming Co. and landfill in Columbia Co.
 - o Field work commenced on 12/18/2013 and is ongoing

- Landfills: (48 visits to 48 landfills)
 - o Leachate samples were collected at 39 landfills
 - o More extensive data were collected at 9 landfills
 - o Field work commenced on 4/26/2013 and is ongoing

Remaining Field Work Summary: [51 Data Collection Visits at 49 Sites]

- Well Pads: (18 visits to 11 well pads)
 - o 4 Companies
 - o 2 Vertical Drilling Phase Visits
 - o 1 Horizontal Drilling Phase Visit
 - o 2 Fracking Phase Visits
 - o 3 Flowback Phase Visits
 - o 10 Production Phase Visits
 - o 4 Visits to 2 Utica Formation Pads
 - o 2 Visits to 2 Conventional Producing Wells
 - o 12 Visits to 7 Marcellus Shale Pads
 - o Located in 8 counties covered by the SWRO, NWRO, NCRO, and the NERO
 - o Last sampling to be completed in May 2014

- Wastewater Impoundments: (2 visits to 2 facilities)
 - o 2 Companies
 - o Washington Co. and Susquehanna Co. locations in the SW and NE Regions, respectively
 - o Tentatively planned for January and February 2014

- Beneficial Use Sites: (4 visits to 4 sites)
 - o Locations to be selected in the NW and SW Regions, respectively
 - o Tentatively planned for February 2014

- Decommissioned Well Pad Casings: (1 site)
 - o Perform radiological surveys of well casings from decommissioned conventional wells as opportunities are presented

- Sludge Loads Following/Landfill ‘Bulking’ Activities: (7 events at 12 sites)
 - o Done to evaluate the potential effect of transport on sludge radiation readings

- 5 Wastewater treatment plant/landfill pairs located across the NC, NW, and SW DEP Regions
- 'Bulking' to be evaluated at 2 NE Region Landfills
- Field work to be conducted in January and February 2014

- Gas Operations Facilities: (8 visits to 8 facilities)
 - 4 Underground gas storage sites (while discharging gas)
 - 2 Gathering compressor stations
 - 1 Gas processing facility
 - 1 Gas-powered electric generating facility
 - Facilities located across 6 counties covered by the SWRO and the NCRO

- Landfills: (11 visits to 11 facilities)
 - 6 landfills to have ambient air radon detector samplers recovered
 - 5 landfills to be sampled for leachate
 - Field work to be conducted in January and February 2014