

# PCPG Newsletter

Communicating Key Information & Concerns  
to Geologists and Environmental Professionals

Issue 4 / 2017

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## MESSAGE FROM THE PRESIDENT



What's coming down the pipeline?

As I was driving through southwestern Pennsylvania a few days ago, I found myself stuck in traffic. I was on a back road, running errands. I was in a construction zone, but it wasn't the roadway under construction: I was in the path of a portion of the Mariner East II pipeline. Construction crews were off-loading drill pipe for drilling horizontal bore holes. As an oil & gas geologist, and a P.G., it would have been hypocritical to lay on the horn. The infrastructure build-out is very important to the geologic community who work for natural gas exploration and production companies or the many service companies that provide seismic interpretation, well and pad permitting, water and air monitoring, well completions and many other aspects of natural gas development. As many as seventy-five P.G.'s are currently employed as inspectors at Mariner East II pipeline drilling/boring sites.



If you haven't seen these signs across Pennsylvania the last few months, you might not be running down the right roads. The jokes write themselves.

Lately, when I hear the question, "What's coming down the pipeline?", it is in reference to the "Big Crew Change": numerous young geologists are entering the professional community, while numerous experienced geologists are continuing their work, but have begun planning for life beyond the office. Our demographics are definitely bi-modal. To the younger geologists out there, prepare for your Fundamentals of Geology and Principles and Practices of Geology exams. The sooner you qualify for and take those exams (and pass them) the more opportunities open up for you. And to the more, er, experienced geologists (aren't you glad I didn't say "old") be a mentor – make sure to help those students and young professionals coming down the pipeline.

And speaking of pipelines, keep looking for more PCPG educational opportunities coming down the pipeline from the PCPG education committee. If you are interested in teaching a class or helping with the PCPG education committee, reach out to us. We'd love to incorporate your ideas.

Until next year,

Dan Billman, P.G.  
P.C.P.G. President

## UPCOMING EVENTS

**PG Review Course for the Professional Geologist and ASBOG Exam Candidate**

**February 1-2, 2017  
Cranberry Twp., PA**

**PCPG Annual Meeting**

**Red Lion Hotel Harrisburg Hershey  
Harrisburg, PA**

***Don't forget to check the "Courses & Events" calendar on PCPG's [home page](#) frequently for up to date information on upcoming educational opportunities.***

## PCPG STUDENT POSTER SESSION AND COMPETITION

The Pennsylvania Council of Professional Geologists (PCPG) is announcing our 2018 Undergraduate Student Research Poster Session and Competition. Students pursuing undergraduate degrees in the geosciences at colleges and universities located within Pennsylvania and contiguous states are eligible.

The posters must be illustrative of research performed by the entrant generally within the disciplines of geology, geochemistry or geophysics. PCPG anticipates entrants will submit abstracts covering a wide range of topics.

Enter the competition by submitting an abstract by January 29, 2018. Ten students will be selected from the abstracts to present posters at PCPG's Annual Meeting scheduled for March 20, 2018 in Harrisburg, Pennsylvania. Posters will be judged by a committee of PCPG members who will determine 1st and 2nd place poster winners.

### **Details concerning PCPG's 2018 Undergraduate Research Poster Session and Competition are, as follow:**

- Following these guidelines is a criteria for successfully being selected to present your poster and eventually winning the competition.
- Abstracts must be 300 words or less.
- Abstracts must be signed and dated by the student and their advisor.
- Abstracts must be submitted via Email to PCPG at [posters2018@pcpg.org](mailto:posters2018@pcpg.org) by midnight January 29, 2018.
- Email subject line should contain last name followed by 2018 Poster Abstract. Example: Smith 2018 Poster Abstract
- Ten students will be selected to present their posters in Harrisburg, PA on March 20, 2018 to be held at Red Lion Hotel, Harrisburg East, 4751 Lindle Road, Harrisburg, PA.
- Students will have their posters set up and ready for presentation by 10:00 AM the day of the competition. Presentation and judging will continue throughout the day.
- Posters should be on 20 to 30 pound paper, in landscape orientation, 4 feet by 8 feet in size. The posters will be displayed on the walls using poster putty supplied by PCPG.
- Each of the ten students selected to present posters will be reimbursed for travel and printing expenses up to \$200 per student and will join PCPG for lunch the day of the event.
- The 1st and 2nd place winners will be announced by the end of the day (5:00 PM).
- 1st Place winner will receive a \$2,500 award.
- 2nd Place winner will receive \$1,000 award.

Please contact [posters2018@pcpg.org](mailto:posters2018@pcpg.org) with any questions regarding the PCPG Student Poster Session and Competition, or telephone PCPG by dialing (717) 730-9745.



## PCPG's GOVERNMENT AFFAIRS COMMITTEE (GAC) UPDATE

Mark Ios, P.G., Skelly & Loy

### 2017-2018 Legislative Session

The members of the House and the Senate began the 2017-2018 legislative session on January 3<sup>rd</sup>, 2017. Since the start of the 2017-2018 legislative session a total of 76 bills and 5 resolutions of interest have been submitted in the House. A total of 46 bills and 6 resolutions of interest have been submitted in the Senate. Both the House and the Senate are on in session until December 20, 2017.

The GAC follows legislative action in both the House and Senate. Bills of interest to geologists are being tracked via an inclusive list included on PCPG's website, under Government Affairs. The list can be viewed via the following link and clicking on "[Members-Only content](#)".

### PCPG Login for GAC Information

### 2017-2018 State Budget Shortfall Funded

On June 30, 2017, the House and the Senate passed legislation regarding a \$32B budget for the Commonwealth in fiscal year 2017-2018. The problem was that the Commonwealth only had \$30.8B in income to cover the spending (a \$2.2B shortfall). In July 2017, Governor Tom Wolf allowed the spending plan to become law without his signature. In late October 2017, the Pennsylvania House and the Senate developed a plan to borrow \$1.5B over 10 years against future payments from the multi-state tobacco settlement, expand video and online gambling (expected \$200M in revenue), a grab-bag of tax adjustments expected to net \$140 million a year, and approves \$500 million in fund transfers to cover the \$2.2B shortfall. The supplemental revenue package was forwarded onto the Governor's office in late October 2017. By October 30<sup>th</sup>, the Governor signed 17 of 18 bills forwarded onto his office from the state legislature.

### Governor Wolf Orders Review of Professional Licensing in Pennsylvania

On October 25, 2017, Governor Tom Wolf called for a review of the professional licensing process in Pennsylvania to ensure costs and procedures are not more burdensome than they are in other states. Wolf has signed an executive order authorizing Commissioner of the Bureau of Professional and Occupational Affairs [Ian J. Harlow](#), who operates within [the Pennsylvania Department of State](#), to measure the commonwealth's professional licenses against national and regional standards.

The move could affect a wide range of professionals, including medical and dental practitioners, pharmacists, funeral directors, **engineers**, architects, cosmetologists, crane operators and real estate professionals.

Approximately 20 percent of Pennsylvania workers need a license to do their job, Wolf's office said, and the share of workers with an occupational license has grown rapidly since the 1950s.

Harlow's role will be to work with the state's 29 boards and commissions to study each one's licensing process, fees, training, and continuing education requirements. The commissioners will prepare a report comparing Pennsylvania's requirements with other states in the region, and across the nation.

The commissioner's findings are to be submitted to the governor within seven months. "Requiring a license to work in certain jobs helps to keep all of us safe, but those requirements should be fair relative to other states in our region and across the country," Wolf said. "Overly burdensome requirements and fees can block some workers – especially minorities or spouses in military families who move frequently – from starting a career and supporting their families."

The PCPG GAC is following the action associated with the Governor's review of the professional licensing process in Pennsylvania. PCPG members will be updated in future newsletters. Bear in mind any major changes to the professional licensing requirements would most likely require action by the legislature to make changes to the law.

### DRBC Approves Resolution to Permanently Ban the Use of Hydraulic Fracing in the Basin

In their public meeting held on September 13, 2017, the Delaware River Basin Commission (DRBC) adopted a resolution directing the executive director to develop regulations for permanently banning the use of hydraulic fracturing for oil and gas in the Delaware River watershed. The DRBC vote was three to one with one abstention in passing the resolution. [Click Here](#) for a copy of the resolution.

The Delaware River Basin, drains portions of New York, New Jersey, Pennsylvania, and Delaware. Governors of the four basin states and a federal representative serve as Delaware River Basin Commissioners, tasked with overseeing the river system. The DRBC has oversight in the basin for water quality protection, water supply allocation, regulatory review (permitting), water conservation initiatives, watershed planning, drought management, flood loss reduction, and recreation. The governors from each of the member states released public comments favoring the resolution.

*Continued on Page 4*

## GAC UPDATE *Continued from Page 3*

The DRBC resolution comes after Congressional passage December 2016 of the Delaware River Basin Conservation Act. This action effectively placed a de facto, temporary moratorium on drilling for natural gas in several Pennsylvania counties and parts of southern New York.

The [Marcellus Shale Coalition and the PA Chamber of Business and Industry sent a joint letter to Governor Wolf](#) prior to the vote which said in part, “prohibiting the development and enjoyment of one’s property rights based solely on which watershed a citizen may live or own property in is arbitrary, and sends a chilling message – far beyond the reaches of just the natural gas sector – to those who may be contemplating investing capital and creating jobs in the Commonwealth.” [Click Here](#) for a copy of the letter.

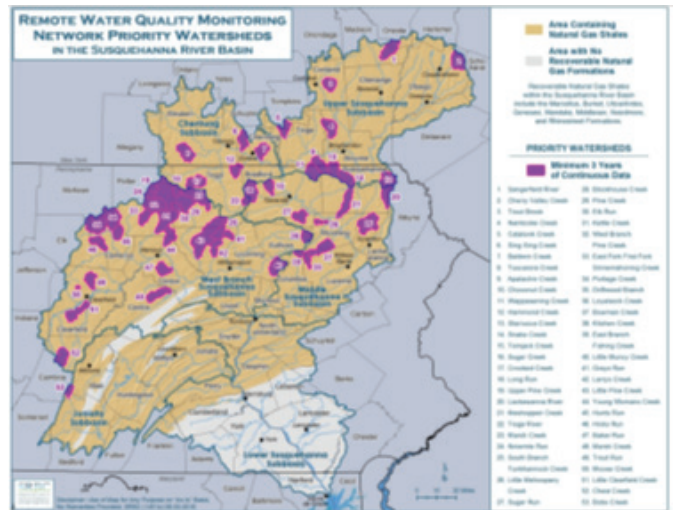
**Note** – On October 17, 2017, the Pennsylvania House of Representatives voted and approved resolution ([HR 515](#)) urging the DRBC not to permanently ban fracking.

## SRBC Water Monitoring Study Again Finds No Impacts From Natural Gas Drilling

On October 12, 2017, the [Susquehanna River Basin Commission](#) (SRBC) released its [2016 report monitoring water quality in the watershed](#) for impacts from unconventional natural gas drilling and found none.

A water quality monitoring network with more than 50 stations was put into place in 2010, as the natural gas industry was rapidly growing in the Basin. This system established a real-time, continuous remote water quality monitoring network (RWQMN) to evaluate headwater streams for potential impacts from natural gas drilling and other activities in the Basin. Most of the monitoring activity was located near headwater streams where water quality observations and data were scarce.

To date, the Commission’s network of monitors has not detected discernible impacts on the Basin’s water resources. [Click Here](#) for the full report and past reports.



## PADEP Outlines New Procedures for Handling PAG-02 Stormwater General Permits Starting In December 2017

On October 17, 2017, PADEP Executive Deputy Secretary for Programs Ramez Ziadeh told the [Citizens Advisory Council](#) that the agency will have new procedures for handling applications for the PAG-02 NPDES General Permit covering stormwater discharges from construction activities starting December 8, 2017. [Note: the PADEP [published notice](#) of these changes in the October 21 PA Bulletin.]

Ziadeh said the existing PAG-02 expires on December 7, but will be administratively extended by PADEP for one year to allow time for the agency to update PAG-02 where needed.

Permittees that are now covered by an approved PAG-02 can continue to operate under its provisions. When the new PAG-02 is finalized, after public review, PADEP will send a letter to existing PAG-02 holders advising them of any changes to requirements in the new PAG-02 they are required to comply with. They will not have to reapply for a new permit.

New applicants applying for a PAG-02 General Permit after December 7, 2017 and during the extension period will apply on the same form, with the same permit review fee and the same review process, but after PADEP or county conservation districts will review the application and approve it, the agency or district will issue an individual NPDES Water Quality permit, not a PAG-02 General Permit.

PADEP is preparing a notice for the PA Bulletin outlining the handling of the PAG-02 General Permit. Ziadeh said PADEP is also taking steps to develop a new PAG-01 NPDES General Permit covering small, low potential impact projects on five acres or less that would have otherwise been covered by the PAG-02 or a full NPDES Water Quality permit. When PADEP did an evaluation of its workload and the applications it receives, they found as many as 40 or 50 percent of the permit applications covered projects of five acres or less.

For the latest status on the PAG-02 and PAG-01, contact Ramez Ziadeh at 717-787-6490 or send email to: [rziadeh@pa.gov](mailto:rziadeh@pa.gov). For more information, visit the [DEP Citizens Advisory Council](#) webpage. Questions should be directed to Lee Ann Murray, Executive Director Citizens Advisory Council, 717-787-8171 or send email to: [LeeMurray@pa.gov](mailto:LeeMurray@pa.gov).

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## GAC UPDATE *Continued from Page 4*

### **Regulatory/Guidance Update, Chapter 250 Regulations – Development of Final Omit Rulemaking**

The Land Recycling Program has begun development of a final omit rulemaking for the Chapter 250 MSC tables. The final omit rulemaking process is used to expedite revisions to rulemakings when minor errors are discovered. This rulemaking will correct errors in three numeric values that were discovered since the latest rulemaking became effective on August 27, 2016. The three numeric values affected are:

- the residential groundwater numeric value for aldrin,
- the residential direct contact numeric value for beryllium,
- the non-residential direct contact for surface soil numeric value for cadmium.

An error was made in the transcription of the result of the Aldrin calculation, and there were errors in the toxicity values used in the beryllium and cadmium calculations.


The proposed technical amendments will be presented to the EQB at one of its meetings in the third quarter of 2017. In addition to receiving the support of the CSSAB, the Land Recycling Program will send out a mass distribution e-mail to publicize this rulemaking when it is posted on the EQB's website and published in the Pennsylvania Bulletin. A notice of the revision will be posted on the Land Recycling Program webpage.

### **PADEP Settles Major Drilling Case with Range Resources, No Enforcement Fine**


More than two years after the Pennsylvania Department of Environmental Protection (PADEP) [issued a record-breaking \\$8.9 million fine](#) against driller Range Resources about its drilling operations, the PADEP settled the case in late August 2017 without issuing any financial penalties.

The fine was issued on May 11, 2015 after the PADEP said the company continually failed to fix a gas well that polluted five residential wells, groundwater, and a stream with methane in Lycoming County. The PADEP had initially based the \$8.9M fine on levying the maximum daily amount over period which Range Resources had begun to take measures to correct the release. Based

*Continued on Page 6*



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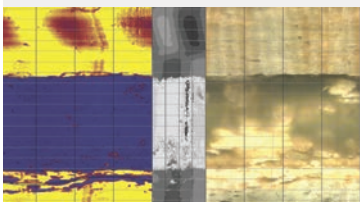
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▲ Determine Lithology	▲ Caliper
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	▲ Borehole Resistivity
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Please contact us with any inquiries or questions:  
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## GAC UPDATE *Continued from Page 5*

upon the approach which the PADEP used in calculating the fine, Range appealed the case to the Environmental Hearing Board.

The courts sided with Range Resources. The decision is expected to provide a precedent on how the PADEP calculates and assesses fines associated with notices of violation.

## **House Appropriations Committee Amends Bills With Environmental Riders**

On Monday July 10, 2017, the House Appropriations Committee amended [Senate Bill 446](#) (McGarrigle-R- Delaware) in a party-line vote to add the provisions listed below to the Administrative Code:

- **Manganese Standard:** Section 1920-A: Directs the Environmental Quality Board to propose regulations setting a point source water quality criterion for manganese to an upstream area within 5 miles or less of a known potable water supply or known private water supply within 90 days. (page 57) [Supported by the Coal Alliance adopting a standard used by West Virginia prohibiting enforcement of a manganese discharge standard unless it was within 5 miles of a water supply.]
- **Recycling Fee Extension:** Section 1937-A: Extends the Act 101 \$2 Recycling fee for three years through January 1, 2023 and funds shall not be transferred from the Recycling Fund to the Solid Waste Abatement Fund as required by Act 101. (page 57) [No doubt added as a sweetener since the Committee also reported out Senate Bill 646.]
- **Conventional Oil & Gas Wastewater Treatment:** Section 1938-A: Requires water treatment facilities providing water disposal services exclusively to conventional oil and gas wells shall be allowed to operate under existing permits through December 31, 2019. (page 58) [Supported by conventional oil & gas drilling industry and applies to three privately-operated conventional wastewater treatment facilities.]

A [House Fiscal Note](#) and summary is available.

The Committee also reported out [Senate Bill 646](#) (Killion-R-Delaware) extending the \$2/ton Recycling Fee for one year until January 1, 2021 without changes. A [House Fiscal Note](#) and summary is available.

Both bills [Senate Bill 446](#) and [Senate Bill 646](#) now go to the full House for action.

## **PADEP Rescinds Guidance Exempting Certain Public Water Supply Wells From Meeting Construction Standards**

On August 26, 2017, the Pennsylvania Department of Environmental Protection (PADEP) [published notice](#) in the PA Bulletin it has rescinded technical guidance on the Review and Approval of an Existing Water Sources at a Public Water System that provided certain exemptions from meeting water well construction standards for public water supplies. ([DEP ID: 383-2200-108](#)).

A [public water system includes](#) both community and non-community (schools, day care centers, restaurants, hospitals, campgrounds, churches, etc.). The PADEP said it was rescinding this document because it provides exceptions from present day public water supply well construction standards, including casing material, casing thickness and grouting, that pose a potential health risk to the public.

Any deviation from established construction standards is not fully protective of public health. The Department's public water supply well construction standards are measures that can prevent pollution from surface runoff and shallow aquifer zones that are above the source aquifer utilized for public water supply.

Questions regarding this technical guidance document should be directed to Michael Hess at 717-772-5679 or send email to: [michess@pa.gov](mailto:michess@pa.gov).

## **U.S. EPA Plans to Re-evaluate Obama-era effort to Regulate Coal Ash**

Federal regulators have struggled for several decades on how to address coal ash, the substance that remains when coal is burned. The residual ash material may contain low levels of mercury, cadmium, arsenic and other heavy metals. In 2015, the Obama administration imposed new standards on coal ash disposal sites by ramping up inspection and monitoring levels and requiring measures such as liners in new waste pits to prevent leaking.

In a statement released on September 15, 2017, U.S. EPA Administrator Scott Pruitt commented that it was "appropriate and in the public interest" for the agency to rethink the current regulations on managing coal ash.

The agency stressed that it had not committed to changes or that it necessarily agrees with the merits of the industry's petition. If the EPA ultimately decides to roll back the coal ash standards, it will go through the usual rulemaking procedure, which could take years. To read more, please see the following link: [Obama-era Safeguards on Coal Ash](#)

## **House Environmental Committee Changes Name of Act 13 Drilling Impact Fee To Severance Tax**

What's in a name? Apparently a lot. On September 11, 2017, The [House Environmental Resources and Energy Committee](#) approved an amendment to [House Bill 113](#) (Harper-R-Montgomery) to change the name of the existing Act 13 drilling impact fee to "severance tax" and then delete all provisions in the bill enacting a real natural gas severance tax. The amendment was offered by Rep. John Maher (R-Allegheny), the Majority Chair of the Committee, and was approved in a party-line vote Republicans supporting. The bill is currently being held in Committee to give members more time to prepare additional amendments.

## PENNSYLVANIA COAL, EPCAMR, AND THE RECLAIM ACT

Vincent M. Carbone, P.G., C.P.G.,  
HDR Engineering, Inc.

Pennsylvania has a rich and vibrant geologic heritage that includes oil and gas production. Much news has been vetted in reporting the benefits and detriments of this resource. However, Pennsylvania has other important geologic resources that we should not forget. A few facts about Coal in Pennsylvania:

- The Coal industry provides approximately 36,200 jobs in Pennsylvania with 13,000 specific to coal mining
- Pennsylvania is the fourth leading coal producing state (67,000,000 tons) in 2013
- The Coal industry contributes 4.5 billion dollars to the Pennsylvania economy.

[http://docs.wixstatic.com/ugd/203afb\\_61168e5b0c80447eacde44b1ab669d9a.pdf](http://docs.wixstatic.com/ugd/203afb_61168e5b0c80447eacde44b1ab669d9a.pdf)

With a vibrant history and continued operation in Pennsylvania the future of coal will also have to include the management and reclamation of lands historically used for coal mining. What is the future of land that lays dormant and unmanaged? What are the concerns for revitalization of lands and what benefit could they bring to communities? To answer these and other questions regarding the reclamation of mine lands, PCPG completed an interview with Robert Hughes, Director of the Eastern PA Coalition for Abandoned Mine Reclamation (EPCAMR)

<http://epcamr.org/home/>.

EPCAMR is a regional non-profit organization dedicated to the preservation and reclamation of abandoned mine lands in northeast and northcentral PA. Their board consists of 25 members representing a dozen counties, multiple watershed organizations. EPAMR

Pennsylvania has one of the highest costs to reclaim coal lands and therefore under the legislation would have the most to benefit.

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## PA COAL *Continued from Page 7*

performs much needed services in educating the public and understanding the complex hydrogeology of mines and mine coals. A short list of their function includes:

- Mine Map scanning, Georeferencing and Digitizing
- Water Quality Monitoring of acid mine drainage (AMD) and the operation of treatment systems
- Environmental Education Programs related to AMD
- Visual and biological assessment in Coal impacted streams
- 3D Mine Pool mapping and modeling

Robert has been on the forefront of information and legislation on the need to reclaim mine lands and just some of the benefits to doing so. According to Mr. Hughes:

*"Clean water from mountain streams above mining impacted areas often enters through abandoned mines through interfaces with the coal measures that have been mined out where that water becomes an additional pollution source that creates AMD. Reclamation of the land needs to occur to prevent AMD from entering our streams and rivers creating problems downstream and in our communities. Reclamation of abandoned mine lands needs to be marketed to create economic redevelopment opportunities that lead to new jobs and a just transition to new economies."*

According to Robert there are several legislative pursuits and programs that would support the reclamation of abandoned mine lands. The Revitalizing the Economy of Coal Communities by Leveraging Local Activities and Investing More Act (RECLAIM Act) is one that Robert and EPCAMR have provided testimony to and is critical to improving abandoned coal mine communities.

This bill amends the Surface Mining Control and Reclamation Act of 1977 (SMCRA) to make specified funds available to the Department of the Interior through FY2021 for distribution to promote economic revitalization, diversification, and development in economically distressed communities through the reclamation and restoration of land and water resources adversely affected by coal mining. The bill prescribes general requirements for projects to reclaim abandoned mine lands and waters that are likely to create favorable conditions for the economic development of the project site or promote the general welfare through economic and community development of the area in which the project is conducted. Any such project shall be located in a community affected by a recent decline in mining.

According to testimony provided by Mr. Hughes with EPCAMR:

*"Passage of either the house or senate versions of the bill as it stands would inject \$200 million a year for the next five years into promoting economic revitalization and development of economically stressed communities through the reclamation and restoration of resources impacted by historic coal mining operations."*

Pennsylvania has one of the highest costs to reclaim coal lands and therefore under the legislation would have the most to benefit. The estimated cost to reclaim lands in Pennsylvania is 5.02 billion dollars. Under the current version of the RECLAIM Act 338 million dollars over five years will be provided to Pennsylvania for stressed communities. This could create thousands of jobs (estimated 4,600 jobs for reclamation workers), clean up sites that cause AMD through precipitation and infiltration (estimated 1 billion dollars in abandoned mine sites), and catalyze economic and business redevelopment on coal impacted lands.

[https://static1.squarespace.com/static/564cc14be4b0f1c73e2cb294/t/57518c46c2ea515cb65c50ca/1464962129931/GENERALPrimeronRECLAIM Act.pdf](https://static1.squarespace.com/static/564cc14be4b0f1c73e2cb294/t/57518c46c2ea515cb65c50ca/1464962129931/GENERALPrimeronRECLAIMAct.pdf)

If you would like more information on this piece of legislation, or the work the EPCAMR provides to the geologic and hydrogeologic heritage of Pennsylvania please contact them directly through the links provided.



## WHAT'S THE BUZZ - THE USE OF DRONES FOR GEOLOGIC INVESTIGATIONS

*Martin F. Helmke, PhD, P.G.*

*Daniel Bochicchio, MS, G.I.T.*

*Department of Earth and Space Sciences, West Chester University of Pennsylvania*

Unoccupied aerial vehicles (UAVs, or “drones”) are valuable tools for geologic study. These aircraft include fixed-wing planes, helicopters, multi-rotor helicopters, and even blimps. Regardless of the platform, recent advances in inertial stabilizations systems, GPS, and video transmission technologies have resulted in cost-effective, commercially-available aircraft that provide a remarkably-stable platform for aerial sensors. Instrumentation includes high-resolution cameras, infrared thermal cameras, multispectral analyzers, magnetometers, gas meters, and LiDAR, to name a few. Drones may be used to collect georeferenced data that are readily converted into high-resolution maps or 3-dimensional models. These aircraft are also relatively easy to fly; capable of autonomous flight by GPS, first-person view control by transmitted video, or traditional “radio control”. Drones can even return themselves to their launch pad and land at the end of their mission.

The sky's the limit for applications of drone technology to geologic investigations, including but not limited to:

- Aerial photography,
- High-resolution geologic mapping,
- 3D digital orthogrammetry,
- Fracture trace analysis,
- Volcano monitoring,
- Volumetric measurements,
- Remediation and construction site monitoring,
- Infrared thermal analysis,
- Search and rescue,
- Natural disaster assessment,
- Precision agriculture,
- Aerial geophysics,
- Pipeline monitoring,
- Geoscience education,
- Geomorphology,
- Health and safety, and
- Earth resources exploration and management.

It is incumbent upon us as professional geologists to take advantage of this incipient industry. According to CTA, a technology advocacy group, 2.8 million drones will be sold this fiscal year, reaching approximately \$953 million in sales. The future of the industry is promising, with annual drone sales anticipated to reach \$12 billion by 2021. The rapid expansion of drone use has caused the FAA and other government agencies to heighten requirements for professional drone applications. This provides an opportunity for geologists to use these tools as responsible, licensed professionals.

Piloting a drone professionally or for research requires investment, training, and licensure. Professional-grade, consumer drone systems cost over \$1,000, increasing in price to \$12,000 and beyond for larger, custom-designed platforms. Instrumentation is similarly expensive. A high-quality infrared camera mounted to a gimbal costs \$6,000, for example. The FAA now requires a commercial drone pilot's license through 14 CFR Part 107 in order to fly professionally. Drones are subject to laws that apply to full-scale aircraft, including controlled airspace, visual flight rules restrictions, weight limitations, training, aircraft maintenance,



*Figure 1. An FAA-licensed geologist producing a 3D model of a quarry using a drone.*

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**Drones are subject to laws  
that apply to full-scale  
aircraft...**

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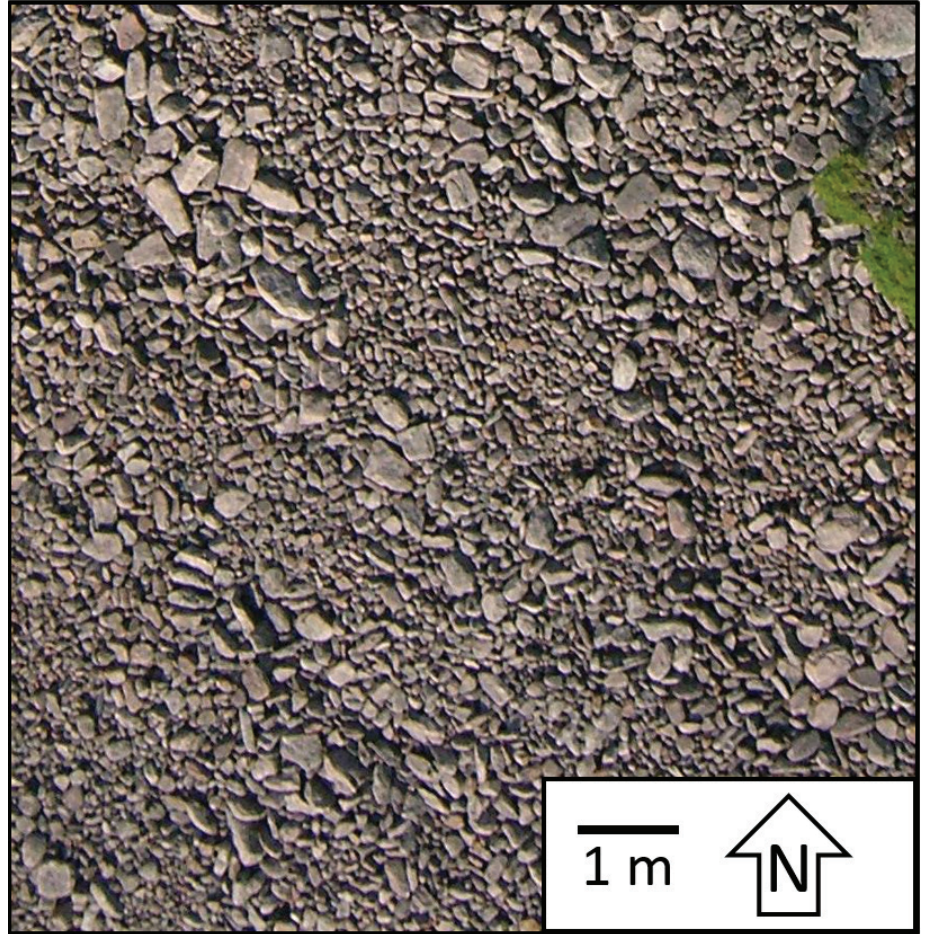
*Continued on Page 10*

## **DRONES** *Continued from Page 9*

and reporting requirements. Drone pilots must also consider \$1-5 million in liability insurance for the unlikely event of a flyaway or crash.

Our discipline has an opportunity to provide unique drone services. Although anyone passing the FAA Part 107 exam can start a drone business, licensed geologists bring much more to the table through our knowledge of instrumentation, applications, and our ability to interpret and apply results for our clients. We encourage our readers to earn their Part 107 license or work with licensed drone operators to take advantage of this emerging technology.

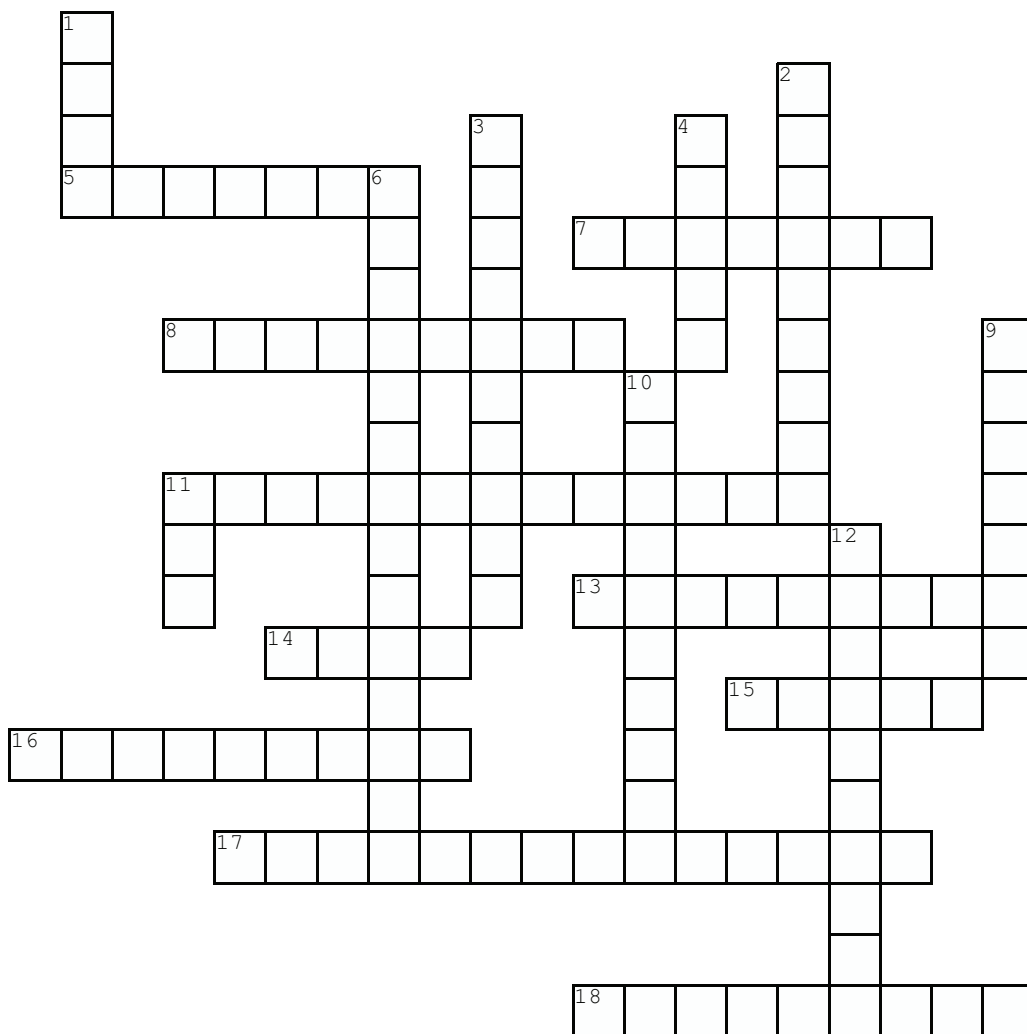
*Figure 2. Low-altitude UAV photograph revealing periglacial, patterned ground at Hickory Run Boulder Field, Carbon County, PA in 2007. Image resolution approximately 1 cm.*





# Geology Crossword

Just For Fun!



Created with [TheTeachersCorner.net](http://TheTeachersCorner.net) [Crossword Puzzle Generator](http://TheTeachersCorner.net)

## Across

5. drainage pattern found in a garden?
7. largest rock fragment to a sedimentologist and a cool town in CO
8. rock of both igneous and metamorphic origin - great name for a geology villain
11. crystal ability to split a beam of light
13. El Capitan and Half Dome, et al
14. partially decomposed vegetal matter
15. a crystal habit and a dark beer
16. branch-like crystal habit or stream pattern
17. rate at which water passes through an aquifer
18. isolated hill of bedrock in a humid, temperate climate

## Down

1. finer than sand
2. sausage structure....mmm!
3. convex upward fold
4. it's not my \_\_\_\_\_!
6. layering
9. calcium carbonate in soils of semiarid regions
10. 66-145 Ma
11. a place to find 15 across; underwater ridge created by currents
12. mass of rock moved a long distance from its origin

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