DATASET USER LICENSE/USE LIMITATIONS

BACKGROUND

The Carnegie Museum of Natural History (CMNH GIS Laboratory, located at Powdermill Nature Reserve, developed the CMNH Pennsylvania Unconventional Natural Gas Wells Geodatabase (UNCGDB) (hereinafter referred to as WORK PRODUCT) that vertically integrates data from the Pennsylvania Department of Environmental Protection (PADEP) database into a useful data compilation for scientific investigation. This WORK PRODUCT of CMNH offers a concise and pragmatic set of filtered and processed datasets in the public domain for unconventional wells in Pennsylvania. CMNH makes no warranty or guarantee with regard to the accuracy or completeness of the data. The WORK PRODUCT is being offered to universities and other scientific organizations without charge. As a condition of such non-royalty bearing license grant of its WORK PRODUCT to the dataset user (USER), USER accepts the following terms and conditions governing the employment of this WORK PRODUCT:

INITIALIZATION

USER of the UNCGDB accepts the terms and conditions of this license upon receipt and acceptance of the dataset from CMNH. This license shall be effective until termination of the same by either party. In either case termination shall include the return of the UNCGDB data set to CMNH uncopied. USER acknowledges that the UNCGDB dataset is the WORK PRODUCT of CMNH and is owned by CMNH. USER agrees not to use, nor directly or indirectly permit the use of, the UNCGDB dataset in a manner inconsistent with the intended use of the dataset without the written consent of CMNH.

LICENSE

CMNH grants to USER a non-exclusive, non-transferable, non-assignable license to use the UNCGDB dataset for scientific analysis and data manipulation consistent with this license. It is not the intent of CMNH to give USER any right, title, interest in its WORK PRODUCT other than the rights herein granted.

WARRANTY

CMNH makes no warranty of any variety with regard to the completeness of the data, the merchantability of the data, or the fitness of the UNCGDB dataset and data for a particular purpose of use. No representation is made as to the accuracy, currency, or completeness of the UNCGDB dataset or the data resources upon which it is based.

CONSTRAINTS OF USE

USER agrees to use the UNCGDB dataset for non-commercial scientific purposes. All publication of data associated with the UNCGDB dataset or findings resultant from USER's employment of the same shall provide proper and appropriate credit to CMNH for their WORK PRODUCT and the license granted to USER hereunder. Neither the publication of data nor the associated findings shall result in any commercial value to USER either directly or indirectly. Any sale, distribution, transfer, assignment, or sub-licensing of the UNCGDB dataset or second generation thereof is expressly prohibited without the written consent of CMNH. All employees and other recipients of USER's UNCGDB dataset shall be notified and instructed of these restrictions. USER shall use its best efforts to prevent any misuse of the UNCGDB dataset and report to CMNH any knowledge it may have regarding the same as it becomes aware of such misuse.

UPDATES

CMNH may elect to provide updates to the UNCGDB dataset as additional data is generated by or through PADEP. CMNH shall not have the obligation to generate or provide such updates. Neither the provision of such updates nor the election not to provide such updates shall have any associated liability attached to CMNH. The parties hereto shall make each other aware of any upgrades or modification to the UNCGDB on the annual anniversary of this license. All updates and modifications of the dataset shall be subject to the same terms and conditions found herein. USER shall make CMNH aware of any upgrades or modifications made by USER to the WORK PRODUCT on the annual anniversary of this license.

COMPLETENESS

This license constitutes the complete and exclusive agreement between USER and CMNH relating to the WORK PRODUCT discussed herein. This license agreement supersedes all prior arrangements, correspondence, proposals, or agreements between the parties relating to the UNCGDB dataset. This agreement may be modified only by written amendment signed by both parties. If any provision of this Agreement is determined to be invalid or unenforceable the remaining provisions of this Agreement shall continue to be valid and enforceable. Neither this Agreement nor any of the rights granted hereunder may be assigned or transferred by USER without the express written approval from CMNH. Any attempted unauthorized assignment or transfer of the WORK PRODUCT or dataset is void. The exclusive remedy for breach of this License Agreement shall be the negation of the license and the return of all dataset information in whatever form to CMNH. USER shall thereafter be prohibited from any further use of the WORK PRODUCT and/or UNCGDB dataset.

NO ENDORSEMENTS

The delivery of the WORK PRODUCT by CMNH to user under this License Agreement is not intended nor should it be construed as an endorsement of USER's employment of the same without the express written agreement to the same by CMNH. USER shall nevertheless be obligated to credit CMNH for its development of its WORK PRODUCT in all publicity and acknowledgements which may be appropriate.

ACCEPTANCE

This License Agreement shall be deemed to be accepted by the USER upon its acceptance of the delivery of CMNH's WORK PRODUCT dataset. No other acceptance shall be necessary. Should USER not agree to the terms and conditions under which this License is granted USER shall inform CMNH of its non-acceptance and shall return the UNCGDB dataset to CMNH.

ABOUT CARNEGIE MUSEUM of NATURAL HISTORY

Carnegie Museum of Natural History, one of the four Carnegie Museums of Pittsburgh, is among the top natural history museums in the country. It maintains, preserves, and interprets an extraordinary collection of artifacts, objects, and scientific specimens used to broaden understanding of evolution, conservation, and biodiversity. Carnegie Museum of Natural History generates new scientific knowledge, advances science literacy, and inspires visitors of all ages to become passionate about science, nature, and world cultures.

Powdermill Nature Reserve (PNR), the environmental research center of CMNH, has been dedicated to its mission of research, education, and conservation for over 60 years. It is a place for scientists, students, and families who are interested in the natural world. Powdermill was established in 1956 to serve as a field station and laboratory for long-term studies of natural populations—their life histories, behaviors, and ecological relationships – in western Pennsylvania.

INTRODUCTION

To help support the research efforts throughout Pennsylvania regarding natural gas production from unconventional wells, the CMNH GIS Laboratory has developed the CMNH Pennsylvania Unconventional Natural Gas Wells Geodatabase (UNCGDB) suitable for research and non-commercial use. The UNCGDB is designed to effectively unify the major natural gas datasets made available by the Pennsylvania Department of Environmental Protection (PADEP) and show the life of each well from permit to production. Therefore, CMNH distributes the geodatabase free of charge to those needing geodata for research regarding the Pennsylvania natural gas industry targeting Marcellus shale and other deep geologic layers as defined by the Act 13 legislation.

TAGS

natural gas, natural gas wells, unconventional, unconventional natural gas wells, gas wells, wells, Marcellus shale, Utica shale, geology, conservation, Pennsylvania, PA, Department of Environmental Protection, DEP, Carnegie Museum of Natural History, Powdermill Nature Reserve, CMNH, PNR

SUMMARY

The CMNH UNCGDB is a compilation of eight datasets available from the PADEP that have been unified and summarized to show the location and life, from permit to production, of unconventional natural gas wells in Pennsylvania. The geodatabase is specifically designed to meet the needs for research analysis and other non-commercial uses. Neither CMNH nor PNR make any warranty or guarantee regarding the accuracy or completeness of the data. The geodatabase is updated quarterly.

DESCRIPTION

The PADEP provides eight primary reports on natural gas well activity to the public: Permits Issued, SPUD Data, Production Reports, Waste Reports, Compliance Reports, Public Utility Commission (PUC) Act 13 Unconventional Wells Spud Report, PADEP Oil & Gas Locations - Conventional Unconventional (hosted by PASDA), and Well Formations Report.

- **Permits Issued** – Proposed natural gas well drilling sites submitted to and approved by the PADEP.
- **Spud Data** – List of new natural gas wells drilled; the SPUD date refers to the date reported to DEP by the Operator that the drilling began (or will begin) at a well site.
- **Production Reports** – Information on natural gas production submitted by well operators. Conventional wells are submitted yearly while unconventional wells are submitted every six months (January to June and July to December) through the end of 2014. Starting in 2015, production is reported monthly.
- **Waste Reports** – Waste information from operators generated by drilling the well. Conventional wells are submitted yearly while unconventional wells are submitted every six months (January to June and July to December) through the end of 2014. Starting in 2015, Waste is reported monthly.
- **Compliance Reports** – Inspections of wells, including information on violations and fines.
- **PUC Act 13 Unconventional Wells Spud Report** – List of wells that the PADEP has identified that satisfy the requirements set by the Pennsylvania Act 13 Legislation.
- **Oil & Gas Locations - Conventional Unconventional** – Shapefile of the Oil & Gas Wells in Pennsylvania that the PADEP has locational information for broken into two formation types of conventional and unconventional wells.
- **Well Formations Report** – Displays geological formation information by listing the target, oldest and producing formations for all oil and gas wells.

Each data source provides a well permit or API number for all wells, conventional and unconventional. By extracting well permits numbers from all eight data sources for any wells flagged by the PADEP as an unconventional well, a master table of permit numbers is generated of unconventional wells. By analyzing each data source, summary data is compiled to determine which wells are in the permitting process, are drilled, or are producing natural gas. Additional information includes how much gas is being produced, the number of violations, and which wells may be identified inconsistently as an unconventional well, as well as other attributes.

The source data can be found at the following websites:
- Permit, SPUD, Compliance, Waste, Production, and Well Formation Reports:
  http://www.portal.state.pa.us/portal/server.pt/community/oil_and_gas_reports/20297
- Public Utility Commission (PUC) Act 13 Unconventional Wells Spud Report:
  http://www.portal.state.pa.us/portal/server.pt/community/act_13/20789
- PADEP Oil & Gas Locations - Conventional Unconventional:
  ftp://ftp.pasda.psu.edu/pub/pasda/dep/historic/OilGasLocations_ConventionalUnconventional/

GEOGRAPHIC INFORMATION

Applies to all geographic data included in the geodatabase or as a shapefile
Name: GCS_North_American_1983
Angular Unit: Degree (0.017453292519943299)
Prime Meridian: Greenwich (0.000000000000000000)
Datum: D_North_American_1983
Spheroid: GRS_1980
Semimajor Axis: 6378137.000000000000000000
Semiminor Axis: 6356752.314140356100000000
Inverse Flattening: 298.257222101000020000

CREDITS

James V. Whitacre, GIS Research Scientist (February 2018 – Present) and GIS Manager (May 2011- May 2014), and Jake Slyder, GIS Manager (June 2014 – October 2017), Carnegie Museum of Natural History, Powdermill Nature Reserve GIS Laboratory

Contact Information:
Email: GIS@CarnegieMNH.org
Phone: (724) 593-4856
Address: 1795 Route 381, Rector, PA 15677-9605

ACKNOWLEDGEMENTS

Special thanks to Dr. John Wenzel, Director, Powdermill Nature Reserve, Carnegie Museum of Natural History; Josh Krug, former GIS Technician, Powdermill Nature Reserve; Tamara Gagnolet, The Nature Conservancy; Ephraim Zimmerman, Western Pennsylvania Conservancy; Dr. Richard Hoch, Indiana University of Pennsylvania; and Joel Gehman, University of Alberta, for their feedback and guidance while producing this dataset.

CITATION

Whitacre, J. V, and Slyder, J. B. YYYY. Carnegie Museum of Natural History Pennsylvania Unconventional Natural Gas Wells Geodatabase (v.YYYY-Q#) [computer file]. Pittsburgh, PA: Carnegie Museum of Natural History. Available download: URL: http://maps.carnegiemnh.org/index.php/projects/unconventional-wells/. Accessed: [Date of Download].

DATA DICTIONARY

The following definitions are expanded from the included Field Definitions table found below.

Unconventional Wells Definition

According to the PADEP, "An unconventional gas well is a well that is drilled into an Unconventional formation, which is defined as a geologic shale formation below the base of the Elk Sandstone or its geologic equivalent where natural gas generally cannot be produced except by horizontal or vertical well bores stimulated by hydraulic fracturing." (OOGM 2013)

For the purpose of this dataset, an unconventional natural gas well is defined as any well classified as such in any of the eight PADEP data sources used in the compilation of this dataset. Some records in the individual data sources may not be classified as unconventional. If this is the case, at least one other record in any of the eight data sources indicates the well as unconventional. This inclusive approach allows for questionable wells to be subject to further scrutiny and to allow for a greatest-number of wells scenario. It is recommended that every effort be made by users to investigate and/or disregard records that may skew one's research or analysis.

Well Permit Numbers

The PADEP roughly follows the American Petroleum Institute (API) standard for uniquely identifying wells by the well permit number (OOGM 2013). The permit number is used to unify all the datasets. Starting in 2013, the PADEP dropped the last two pair of digits in their data products. Below are two brief explanations of the API format:

"The American Petroleum Institute (API) Subcommittee on Well Data Retrieval Systems was formed in 1962 to develop a standard method for nationwide well identification for use in computerized well data systems. They created the API well number, a unique, permanent, numeric identifier assigned for identification of a well (i.e. hole in the ground) which is drilled for the purpose of finding or producing oil and/or gas or providing related services."

-API number Technical Explanation & Examples, Reference Material
http://www.ihs.com/products/oil-gas-information/training/reference-materials.aspx?tid=t5

SS-CCC-WWWWW-DD-EE

- **SS**: the code number for the state; PA is 37; this is not included in the PADEP permit number
- **CCC**: the code number for the county; this is included in the PADEP permit number
- **WWWWW**: the unique well identifier within the indicated county; this is included in the PADEP permit number
- **DD**: the directional sidetrack code; 00 is the original vertical drill, while the sequential numbers will indicate horizontal/directional sidetracks; this is not included in the PADEP permit number
- **EE**: the event sequence to distinguish between separate operations in a single bore hole; this is not included in the PADEP permit number

-Information adapted from Wikipedia
http://en.wikipedia.org/wiki/API_well_number

Current Operator

The current operator is determined by the most recent record queried from the source datasets. To determine the most recent record, priority of data sources is given in the following order: PADEP Oil & Gas Locations - Conventional Unconventional, Production, Compliance, Waste, PUC, SPUD, Permit. PADEP Oil & Gas Locations - Conventional Unconventional because it is update monthly and has seemed to be kept up to date. Production is also a good indicator of the current operator because it is the final level of data reporting and will continue to be reported throughout the producing life of the well. If a well changes operators, it will show up in the most recent Production record. If a well is non-producing, the Compliance reports are the next most recent followed by the Waste, PUC, SPUD, and Permit. The PUC and SPUD reports appear to be updated as operators change, so these datasets are also reliable. However, for the purpose of creating the datasets, the established order works best.

Location

Location information (latitude/longitude) is retrieved from each source dataset (except Compliance data which does not include location information) and is averaged. This allows the location information to be assessed for consistency between datasets. If an inconsistency is found, an inconsistency error in decimal degrees is reported in the ERROR_LOCATION field. For most inconsistent records, this error is minimal, as an error of less than 0.00001° will be less than ~3 ft (1 m). However, a few records may include errors up to 1° or more, which is very significant at more than 50 mi (80 km) of error. If all datasets report the same geographic coordinates, no inconsistency is reported.

Wells without geographic locations are included in the Unconventional Wells feature class, but contain a null point geometry. This means that a record will appear in the attribute table, but will not be mapped. Therefore, geospatial analyses will not include such records, while tabular or statistical analyses using the attribute table will include these records.

Geographic coordinates are reported in North American Datum 1983 according to the PADEP (OOGM 2013). The locational accuracy of the geographic coordinates is unknown, as this is not reported to the PADEP by the operators. The data are not analyzed for duplicate well locations. If a well is not going to be drilled at the particular location, then it technically requires a new permit.

Horizontal Wells

For the purpose of this dataset, a horizontal well is defined as a well with at least one record classifying it as a horizontal well. A horizontal well is one that starts off drilled vertically but eventually curves to become horizontal (or near horizontal) to parallel a particular geologic formation. This would include any intentionally deviated wells.

Record Discrepancies and Errors

Because not every data source includes records for every unique well, discrepancies are inherent. It is recommended that every effort be made by users to investigate and/or disregard records that may skew one's research or analysis.

Wells are analyzed for errors based on the following criteria:

- *Permit Error* – Identifies wells that do not have a permit record, but may have a SPUD record and/or a Production record indicating production greater than 0 Mcf. To query for wells without permits, use the PERMIT_COUNT field. This error is

concerned with drilling and production and the lack of a permit. Production and SPUD records indicate with more confidence that a well exists and is operating. If no permit records exist, then data is incomplete for that well.

- *SPUD Error* – Identifies wells that show natural gas production but do not have a SPUD record. Wells producing gas should have a record of when drilling commenced. If no SPUD records exist, then data is incomplete for that well.
- *Unconventional Status Error* – Identifies wells that are inconsistently classified as unconventional wells across all datasets. Well records that are inconsistently classified as unconventional wells cannot be verified. Any analysis including these wells should have strong cause to include such wells. Although, such wells should not be ignored, as the wells can be reported to the PADEP for clarification.
- *Location Error* – Identifies wells without geographic coordinates in any data source. Without geographic coordinates, a well is not able to be mapped or used in spatial analyses. Compliance reports do not include geographic coordinates. Wells without geographic locations are included as in the Unconventional Wells feature class, but as a null point geometry. See Location for more information.

Well Status

Well Status is the state of the well as of the UNCGDB date (Act 13 of 2012 2013). The Well Status is determined by using the Well Status value of Spud report, PUC report, or the PADEP Oil & Gas Locations - Conventional Unconventional shapefile. If a well does not have a record in these datasets, then the Production report Well Status is used as long as the production is greater than zero.

PADEP Well Status Definitions (Act 13 of 2012 2013):
- *Active* – Drilling of the well has commenced. The well may, or may not, be producing.
- *Regulatory Inactive Status* OR *Inactive* – The PADEP has granted inactive status for the well. (Any well that has not been used to produce, extract or inject any gas, petroleum or other liquid within the preceding 12 months, or any well for which the equipment necessary for production, extraction or injection has been removed, or any well, considered dry, not equipped for production within 60 days after drilling, redrilling or deepening, is, by definition, an abandoned well and shall be plugged upon abandonment pursuant to the Oil & Gas Act. However, the definition of an abandoned well shall not include any well granted inactive status.)
- *Plugged OG Well* – The well has been lawfully plugged. The well may, or may not, have produced prior to plugging.
- *Operator Reported Not Drilled* – The operator has reported that either the permit has expired and the well has not been drilled, or that they no longer intend to drill the well and wish to cancel the permit, although the permit is still valid.
- *Proposed But Never Materialized* – 1) A permit application was submitted, but the permit was never issued; 2) The well was entered into the database in error; 3) A permit had been issued, however Department staff have determined that the well was never drilled.
- *Abandoned* – Any well that has not been used to produce, extract or inject any gas, petroleum or other liquid within the preceding 12 months, or any well for which the equipment necessary for production, extraction or injection has been removed, or any well, considered dry, not equipped for production within 60 days after drilling, re-drilling or deepening, except that it shall not include any well granted inactive status
- *Unknown* – A well that does not have the required records to determine the Well Status. In general, such wells do not have Permit, Spud, or PUC records, but do have Production records without any gas Production or Waste records with no other records.

Well Stage

The Well Stage field represents the life stage the well is in as of the UNCGDB date. The Well Stage is determined by assessing whether a well has produced gas, has been drilled, is permitted, or if the permit has expired. This field is designed to help users understand the life history of wells.

UNCGDB Well Stage Definitions:
- *Producing* – The well has a record in the Production report with natural gas production greater than zero Mcf.
- *Drilled* – The well has a SPUD or PUC record, but no Production report record with natural gas production greater than zero Mcf.
- *Permitted* – The well has a Permit record, but no SPUD record, PUC record, or Production report record with natural gas production greater than zero Mcf.

- *Permit Expired* – The well has a Permit record, but no SPUD record, PUC record, or Production report record with natural gas production greater than zero Mcf AND the last permit date is more than a year old (366 days).
- *Unknown* – A well that does not have the required records to determine the Well Stage. In general, such wells do not have Permit, Spud, or PUC records, but do have Production records without any gas Production or Waste records with no other records.

Unconventional Wells Feature Class Fields

The table below defines the field for the Unconventional Wells feature class. When exported to a shapefile format, the field names are truncated to 10 characters.

Field Name	Field Source*	Definition Derived from:	Permit	SPUD	PUC	Waste	Compliance	Production	Oil & Gas Loc	Formations
PERMIT_NO	Source	The Permit Number issued for the well to the Oil and Gas Operator by the PADEP. See Well Permit Numbers.	X	X	X	X	X	X	X	X
PRIMARY_REPORT	Source	The data source in which a well entered the geodatabase system as an Unconventional well; the primary source of general well data.	X	X	X	X	X	X	X	X
CURRENT_OPERATOR	Source	Organizational name of the current well operator. Several operators may report during the life of the well. See Current Operator.	X	X	X	X	X	X	X	X
FARM_NAME	Source	Name given to a well by the well operator, usually the landowner at the time of permitting, which does not change. The Site/Farm Name and Well Number normally uniquely identify the well for the operator.	X	X	X	X		X	X	X
COUNTY	Source	County of well location.	X	X	X	X	X	X	X	X
MUNICIPALITY	Source	Municipality of well location.	X	X	X	X	X	X	X	X
LATITUDE	Source	Latitude in decimal degrees NAD83 for the well location.	X	X	X	X		X	X	X
LONGITUDE	Source	Longitude in decimal degrees NAD83 for the well location.	X	X	X	X		X	X	X
PERMIT_DATE_FIRST	Source	Date of the first permit issued for the well.	X							
PERMIT_DATE_LAST	Source	Date of the last permit issued for the well.	X							
PERMIT_COUNT	Calculated	Count of the total number of permit records for the well.	X							
PERMIT_UNC_COUNT	Calculated	Count of well permit records reporting an Unconventional well.	X							
PERMIT_HRZ_COUNT	Calculated	Count of well permit records reporting a horizontal well.	X							
PERMIT_WELL_TYPE	Source	The type of well: gas, combined oil and gas, coalbed methane, multiple well bore, observation, storage, test, etc.	X							
SPUD_DATE	Source	Date of the first SPUD reported for a well.		X						
SPUD_COUNT	Calculated	Count of the total number of SPUD records for the well.		X						
SPUD_UNC_COUNT	Calculated	Count of well SPUD records reporting an Unconventional well.		X						
SPUD_HRZ_COUNT	Calculated	Count of well SPUD records reporting a horizontal well.		X						
SPUD_WELL_TYPE	Source	The type of well: gas, combined oil and gas, coalbed methane, multiple well bore, observation, storage, test, etc.		X						
SPUD_STATUS	Source	Spud report Well Status on the date of download.		X						
PUC_SPUD_DATE	Source	Date of the PUC SPUD reported for a well.			X					
PUC_COUNT	Calculated	Count of the total number of PUC records for the well (should be 1 or 0).			X					

Field Name	Field Source*	Definition Derived from:	Permit	SPUD	PUC	Waste	Compliance	Production	Oil & Gas Loc	Formations
PUC_HRZ_COUNT	Calculated	Count of well PUC records reporting a horizontal well (should be 1 or 0).			X					
PUC_STATUS	Source	PUC report Well Status on the date of download.			X					
PUC_PLUGGED_DATE	Source	The completed date of well plugging activities as reported on the Well Plugging Certificate.			X					
WASTE_DATE_FIRST	Source	First period of Waste reported for a well.				X				
WASTE_DATE_LAST	Source	Last period of Waste reported for a well.				X				
WASTE_COUNT	Calculated	Count of the total number of Waste records for the well.				X				
WASTE_UNC_ COUNT	Calculated	Count of well Waste records reporting an Unconventional well.				X				
WASTE_HRZ_ COUNT	Calculated	Count of well Waste records reporting a horizontal well.				X				
WASTE_STATUS	Source	Waste report Well Status of the most recent Production record of the well.				X				
INSPECT_DATE_FIRST	Source	Date of the first inspection reported for a well.					X			
INSPECT_DATE_LAST	Source	Date of the last inspection reported for a well.					X			
INSPECT_COUNT	Calculated	Count of the total number of compliance records for the well.					X			
VIOL_DATE_FIRST	Source	Date of the first violation reported for a well.					X			
VIOL_DATE_LAST	Source	Date of the last violation reported for a well.					X			
VIOL_COUNT	Calculated	Count of the total number of compliance records with violations for the well.					X			
COMPL_UNC_COUNT	Calculated	Count of well compliance records reporting an Unconventional well.					X			
PROD_DATE_FIRST	Source	Date of the first period of production greater than 0 Mcf reported for a well.						X		
PROD_DATE_LAST	Source	Date of the last period of production greater than 0 Mcf reported for a well.						X		
PROD_COUNT	Calculated	Count of the total number of Production records for the well.						X		
PROD_UNC_COUNT	Calculated	Count of well Production records reporting an Unconventional well.						X		
PROD_HRZ_COUNT	Calculated	Count of well Production records reporting a horizontal well.						X		
PROD_STATUS	Source	Production report Well Status of the most recent Production record of the well.						X		
PROD_GAS_QUANT	Calculated	Total Mcf of natural gas production from 2000 to Present. Values include a six month overlap for some well for when Unconventional gas reporting laws were changed. See Known Issues, Production Report.						X		
PROD_GAS_DAYS	Calculated	Total days of natural gas production from 2000 to Present. Values include a six month overlap for some well for when Unconventional gas reporting laws were changed. See Known Issues, Production Report.						X		
OGLOC_COUNT	Calculated	Count of the total number of Oil & Gas Locations - Conventional Unconventional shapefile features for the well.							X	
OGLOC_UNC_COUNT	Calculated	Count of well Oil & Gas Locations - Conventional Unconventional shapefile records reporting an Unconventional well.							X	

CARNEGIE MUSEUM OF NATURAL HISTORY

Field Name	Field Source*	Definition Derived from:	Permit	SPUD	PUC	Waste	Compliance	Production	Oil & Gas Loc	Formations
OGLOC_HRZ_COUNT	Calculated	Count of well Oil & Gas Locations - Conventional Unconventional shapefile records reporting a horizontal well.							X	
OGLOC_WELL_STATUS	Source	Oil & Gas Locations - Conventional Unconventional Shapefile Well Status on the date of download.							X	
OGLOC_WELL_PAD	Source	Oil & Gas Locations - Conventional Unconventional Shapefile Well Pad name.							X	
OGLOC_SURFACE_ ELEVATION	Source	Oil & Gas Locations - Conventional Unconventional shapefile ground elevation at the well head location.							X	
FORMATION	Source	Well Formation report producing, target, or oldest formation, whichever is found first respectively.								X
ERROR_PERMIT	Analysis	Yes/No Field: Uses a formula to determine if the well indicates drilling or production without a permit record. See Record Discrepancies and Errors.	X	X		X		X	X	
ERROR_SPUD	Analysis	Yes/No Field: Uses a formula to determine if the well indicates production without a SPUD record. See Record Discrepancies and Errors.		X		X		X	X	
ERROR_UNC_STATUS	Analysis	Yes/No Field: Indicates whether a well is inconsistently identified as an Unconventional well. See Record Discrepancies and Errors.	X	X	X	X	X	X	X	X
ERROR_LOCATION	Analysis	Yes/No Field: Indicates if a well has geographic coordinates or reports inconsistency error. See Location.	X	X	X	X		X	X	X
ERROR_COUNT	Calculated	Indicates how many errors were found for a well								
UNCONVENTIONAL_ STATUS	Analysis	Indicates categorically how many well records of all records indicate unconventional: UNC WELL, UNC MAJORITY, UNC UNKNOWN, UNC MINORITY	X	X	X	X	X	X	X	X
HORIZONTAL_STATUS	Analysis	Yes/No Field: Indicates whether the well is a horizontal well. Determined by the presence of at least one record indicating horizontal. See Horizontal Wells.	X	X	X	X		X	X	
WELL_STATUS	Source and Analysis	Indicates whether a well is Active, Regulatory Inactive Status OR Inactive, Plugged OG Well, Operator Reported Not Drilled, Proposed But Never Materialized, Abandoned, Unknown. See Well Status.		X	X			X	X	
WELL_STAGE	Analysis	Indicates whether a well is Producing, Drilled, Permitted, Permit Expired, Unknown. See Well Stage.	X	X	X			X		

* The Field Source refers to where the field is from or the type of analysis: **Source**: values are derived from the PADEP source datasets; **Calculated**: values are calculated based on numeric data; **Analysis**: values are derived using an algorithm based on logical parameters; other methods could be used to determine these values

UNCONVENTIONAL WELLS TOOLS

In 2018, the **Unconventional Wells Tools v1 ArcGIS Pro.tbx** and **Unconventional Wells Tools v1 ArcMap.tbx** ArcGIS Toolboxes were released to help users make simple queries on the UNCGDB. Each tool contains detailed documention inbedded in the tool, so it is not covered in this metadata document.

Well Production Summary Fields Tool

By running the **Calculate Unconventional Well Production** tool, users can make the UNCGDB equivalent to versions prior to 2018. The following fields are summarized from the Production report and then joined to the Unconventional Wells feature class. Note that the field names changed starting in the 2017 versions of the UNCGDB to be compatible for the Shapefile.

| Field Name	Definition
GQ_[YYYY_X] or PD_[YYYY_X]	Natural gas quantity (GQ) in Mcf or production days (PD) for **yearly or six-month reporting periods**; 'YY' is the year (4 digit) and 'X' is the reporting period ('0' is annual, '1' is January-June, '2' is July to December, and '3' is a special period from July 2009 through June 2010, see Known Issues, Production Report). Ex. 2001 annual unconventional gas production is GQ_2001_1.
GQ_M_[yy_mm_bbb] or PD_M_[yy_mm_bbb]	Natural gas quantity (GQ) in Mcf or production days (PD) for **monthly reporting periods**, starting in 2015; 'yy' is the year (2 digit), 'mm' is the numeric month (2 digit), and 'bbb' is the month text abbreviation. Ex. January 2015 unconventional gas production is GQ_M-15-01-JAN.
ANN_GQ_TOTAL or ANN_PD_TOTAL	Total natural gas quantity (GQ) in Mcf or production days (PD) of **annual natural gas production from 2000 through present**.
UNC_GQ_TOTAL or UNC_PD_TOTAL	Total natural gas quantity (GQ) in Mcf or production days (PD) of **Unconventional natural gas production from July 2009 to present**.

DOWNLOAD FILES

Below is a list of the data files found in each downloadable Zip file. Beginning with 2017 versions of the UNCGDB, each different formatted instance of the UNCGDB is split up into separate Zip files for the geodatabase, shapefile, and CSV files. Additionally, the Metadata PDF file, ArcGIS Toolboxes, and ArcGIS Layer files are separate downloads. Note that the file geodatabase has been compressed to be read-only, but can be uncompressed using the ArcGIS Uncompress File Geodatabase Data tool.

File Name	File Type	Description
UnconventionalWellsPA_YYYY_Q#.gdb.zip		Zip file containing the File Geodatabase
UnconventionalWellsPA_YYYY_Q#.gdb	ESRI File Geodatabase	Geodatabase with Unconventional Wells feature class and standalone tables of all unconventional well records of each source; Relationship classes not shown
PUC	Table	All Public Utility Commission (PUC) Act 13 Unconventional Wells Spud Report records
Unc_Compliance	Table	Queried unconventional Oil and Gas Compliance Report records
Unc_PADEP_OilGasLocations	Table	Queried unconventional Oil & Gas Locations shapefile records
Unc_Permits_Issued	Table	Queried unconventional Permits Issued Detail Report records
Unc_Production	Table	Queried unconventional Production Report records
Unc_SPUD_Data	Table	Queried unconventional SPUD Data Report records
Unc_Waste	Table	Queried unconventional Waste Report records
Unc_WellFormations	Table	Queried unconventional Well Formations Report records
UnconventionalWells	Feature Class	Point feature class of Unconventional Wells; includes 1:Many relationship classes to all standalone tables
UnconventionalWellsPA_YYYY_Q#.shp.zip		Zip file containing all Shapefile files
UnconventionalWellsPA_YYYY_Q#.shp	Shapefile	Point features in shapefile format that correspond to the geodatabase Unconventional Wells feature class
UnconventionalWellsPA_YYYY_Q#_CSV.zip		Zip file containing all CSV Tables
UnconventionalWellsPA_YYYY_Q#_CSV	File Folder	Folder containing CSV tables
PUC.csv	Table	Corresponds to geodatabase PUC table
Unc_Compliance.csv	Table	Corresponds to geodatabase Unc_Compliance table
Unc_PADEP_OilGasLocations.csv	Table	Corresponds to geodatabase Unc_ PADEP_OilGasLocations table

File Name	File Type	Description
Unc_PermitsIssued.csv	Table	Corresponds to geodatabase Unc_ PermitIssued table
Unc_Production.csv	Table	Corresponds to geodatabase Unc_Production table
Unc_SPUDData.csv	Table	Corresponds to geodatabase Unc_SPUDData table
Unc_Waste.csv	Table	Corresponds to geodatabase Unc_Waste table
Unc_WellFormations.csv	Table	Corresponds to geodatabase Unc_WellFormations table
Unc_WellsSummary.csv	Table	Corresponds to geodatabase UnconventionalWells feature class
UnconventionalWells_Metadata_YYYY.pdf	PDF	Metadata Document (i.e. this document)
Unconventional Wells Tools v1 ArcGIS Pro.tbx	ArcGIS Pro Toolbox	Set of tools to help query the UNCGDB in ArcGIS Pro
Unconventional Wells Tools v1 ArcMap.tbx	ArcMap Toolbox	Set of tools to help query the UNCGDB in ArcMap
Unconventional Wells Layer ArcGIS Pro.lyrx	ArcGIS Pro Layer File	Layer for symbolizing the UNCGDB in ArcGIS Pro
Unconventional Wells Layer ArcMap.lyr	ArcMap Layer File	Layer for symbolizing the UNCGDB in ArcMap

UPDATE and VERSION INFORMATION

The CMNH UNCGDB is designed to be updated with a new release every quarter. Below is the expected annual release schedule:

Quarter	Data End Date	PA DEP Data Download Date[**]	UNCGDB Release Date[**]
1	March 31	April 7	April 15
2	June 30	August 22	August 31
3	September 30	October 7	October 15
4	December 31	February 22	February 28

[**]Date represents the week of the corresponding date. Actual download/release may occur earlier or later.

Due to differing release schedules of the PADEP source data and to ensure that all records are included for each quarter, there is a delay from the end of the quarter of at least 5 business days before the data is downloaded and another 5 business days to allow for data processing. Data for all reports, except Waste and Production reports, are updated by the PADEP on a rolling or daily basis. From July 2010 through December 2014, the PADEP releases unconventional well Production and Waste reports every six months following the periods covering January through June and July through December (OOGM 2013). Starting in 2015, the DEP began requiring producers to report monthly Production and Waste figures within 45 days after the end of the month, and the DEP now releases these reports monthly.

As of 2017, CMNH plans to maintain this roughly quarterly update schedule. Therefore, Q1 datasets will include Production and Waste records through January and all other datasets through the end of March. Quarter 3 (Q3) will include Production and Waste through July and all other datasets through the end of September. Quarter 2 (Q2) and Q4 updates will include all records (including Production and Waste) through the end of June and the end of December, respectively.

Versions of the geodatabase are identified by indicating the year and quarter the data covers, following the scheme YYYY-Q# (Example: 2013-Q1). This is important for citation purposes (see Citation). The geodatabase file name is named similarly with the dash (-) replaced by an underscore (Example: UnconventionalWellsPA_2013_Q1). Versions YYYY-Q2 and YYYY-Q4 will include the latest Production reports and therefore take longer to release.

List of Updates by Version

2019-Q4 (Released February 28, 2020)
- Records (including Production and Waste) queried through December 31, 2019; Downloaded from PADEP February 27, 2020.

2019-Q3 (Released October 23, 2019)
- Records (excluding Production and Waste) queried through September 30, 2019; Downloaded from PADEP October 21, 2019.
- Production and Waste through August 2019 downloaded and included.

2019-Q2 (Released August 20, 2019)
- Records (including Production and Waste) queried through June 30, 2019; Downloaded from PADEP August 19, 2019.

2019-Q1 (Released May 6, 2019)
- Records (excluding Production and Waste) queried through March 31, 2019; Downloaded from PADEP April 30 & May 2, 2019.
- Production and Waste through February 2019 downloaded and included.
- Analysis algorithm for PROD_DATE_FIRST and PROD_DATE_LAST was modified to be the first and last dates of production based on records that reported production of greater than 0 Mcf.

2018-Q4 (Released February 22, 2019)
- Records (including Production and Waste) queried through December 31, 2018; Downloaded from PADEP August 2018 & February 20, 2019.

2018-Q3 (Released February 6, 2019)
- Records (including Production and Waste) queried through September 30, 2018; Downloaded from PADEP August 2018 & February 5, 2019.

2018-Q2 (Released August 30, 2018)
- Records (including Production and Waste) queried through June 30, 2018; Downloaded from PADEP August 6, 7, & 28, 2018.

2018-Q1 (Released August 16, 2018)
- Records (excluding Production and Waste) queried through March 31, 2018; Downloaded from PADEP August 6 & 7, 2018.
- Production and Waste through February 2018 downloaded and included.
- Geodatabae Schema Changes
  - Unconventional Wells geodatabase now include z-values based on the OGLOC_SURFACE_ELEVATION field
  - WASTE_PERIOD_FIRST, WASTE_PERIOD_LAST, PROD_PERIOD_FIRST, PROD_PERIOD_LAST fields were changed to WASTE_DATE_FIRST, WASTE_DATE_LAST, PROD_ DATE _FIRST, PROD_ DATE _LAST, respectively
  - Well Production Summary Fields were removed from the Unconventional Wells feature class. This data is still available in the Unc_Production table
- Metadata document changes
  - Changed COMPUTER DATA FILES section to DOWNLOAD FILES
  - Added UNCONVENTIONAL WELLS TOOLS section
- ArcGIS Layer files for both ArcMap and ArcGIS Pro (.lyr and .lyrx) were added as a separate download
- A new Unconventional Wells Tools (v. 1) toolbox released; Tools include:
  - Calculate Unconventional Well Production

2017-Q4 (Released August 8, 2018)
- Records (including Production and Waste) queried through December 31, 2017; Downloaded from PADEP August 6 & 7, 2018.

2017-Q3 (Released August 3, 2018)
- Records (excluding Production and Waste) queried through September 30, 2017; Downloaded from PADEP October 9, 2017.
- Production and Waste through July 2017 downloaded and included.

2017-Q2 (Released August 25, 2017; Re-released with new schema on August 3, 2018)
- Records (including Production and Waste) queried through June 30, 2017; Downloaded from PADEP Aug 22, 2017.

2017-Q1 (Released April 24, 2017; Re-released with new schema on August 3, 2018)
- Records (excluding Production and Waste) queried through March 31, 2017; Downloaded from PADEP Apr 10, 11, & 14, 2017.
- Production and Waste through February 2017 downloaded and included.
- Workflow changes
  - Current Operator: the priority of determining the most current operator was changed to place the PADEP Oil & Gas Locations - Conventional Unconventional first
  - Location: the location is now calculated based on the average of all location coordinates
  - Well Production Summary Fields: Renamed to be compatible with shapefiles
- Metadata document changes
  - Updated field definitions and general information to be current
  - Updated source data access and download links to be current
  - Updated Credits to be current
  - Updated to be accessible for people with disabilities
- Due to the size of the geodatabase increasing as records have been added, the zip file has been split into separate zip files for the different formats for easier downloadability
- The following datasets are no longer included in the downloadable zip file to consolidate and modernize the data. The table below explains the decision to remove or how the data has been mitigated or transformed:

File Name	Explanation / Mitigation
CSV	The following CSV files are no longer included
Unc_WellsProductionSummary.csv	The fields included in the CSV file have been joined to the Unc_WellsSummary.csv table
UnconventionalWellsPA_YYYY_Q#.gdb	The following are no longer included in the Geodatabase
Counties_PA	This was removed for consolidation purposes
MarcellusShaleFormation	This was removed for consolidation purposes
MarcellusShaleFormation_PA	This was removed for consolidation purposes
Unc_WellsProductionSummary	This was removed for consolidation purposes
Unc_WellsSummary	The Unconventional Wells feature class now includes records without location data as null geometry; see Location
UnconventionalWellsPA_YYYY_Q#.mxd	The ArcMap Document was removed for consolidation purposes
Pennsylvania Unconventional Wells.lyr	The ArcGIS Layer file was removed for consolidation purposes

2016-Q4 (Released Mar 1, 2017)
- Records (including Production and Waste) queried through December 31, 2016; Downloaded from PADEP Feb 14 & 27, 2017.

2016-Q3 (Released Oct 13, 2016)
- Records (excluding Production and Waste) queried through September 30, 2016, Downloaded from PADEP Oct 11, 2016.
- Production and Waste through July 2016 downloaded and included.

2016-Q2 (Released Aug 24, 2016)
- Records (including Production and Waste) queried through June 30, 2016; Downloaded from PADEP Aug 18, 19 & 22, 2016.

2016-Q1 (Released April 12, 2016)
- Records (excluding Production and Waste) queried through March 31, 2016; Downloaded from PADEP April 8 & 11, 2016.
- Production and Waste for January 2016 were downloaded and included.

2015-Q4 (Released February 23, 2016)
- Records (including Production and Waste) queried through December 31, 2015; Downloaded from PADEP February 22, 2016.

2015-Q3 (Released October 13, 2015)
- Records (excluding Production and Waste) queried through September 30, 2015; Downloaded from PADEP October 7, 2015.
- Production and Waste for July 2015 were downloaded and included.

2015-Q2 (Released Sep 1, 2015)
- Records (including Production and Waste) queried through June 30, 2015; Downloaded from PADEP August 24, 2015.
- Monthly Production field naming convention updated to differentiate these fields from ongoing 6-month reports Production and Waste figures. Unconventional gas Production for Jan-June and July- December will remain Year-01 and Year-02, respectively, while monthly Production and Waste periods will follow the format M-15-1-JANU for January 2015, M-15-2-FEBU for February 2015, and so on.

2015-Q1 (Released Apr 8, 2015)
- Records (excluding Production and Waste) queried through March 31, 2015; Downloaded from PADEP April 8, 2015.
- Production and waste are now reported monthly; Production and Waste for the first monthly reporting period, January 2015, were downloaded and included (see Well Production Summary Fields).

2014-Q4 (Released Feb 23, 2015)
- Records queried through December 31, 2014; Downloaded from PADEP February 20, 2015.

2014-Q3 (Released October 7, 2014)
- Records queried through September 30, 2014; Downloaded from PADEP October 6, 2014.

2014-Q2 (Released August 26, 2014)
- Records queried through June 30, 2014; Downloaded from PADEP August 22, 2014.

2014-Q1 (Released May 14, 2014)
- Records queried through March 31, 2014; downloaded from PADEP April 14, 2014.
- Added two additional datasets: PADEP Oil and Gas Locations – Conventional Unconventional shapefile from PASDA and Well Formations Report.
- Added new fields: OGLOC_COUNT, OGLOC_UNC_COUNT, OGLOC_HRZ_COUNT, OGLOC_WELL_STATUS, OGLOC_WELL_PAD, OGLOC_SURFACE_ELEVATION, FORMATION, WELL_STAGE.
- Changed the WELL_STATUS definition to be in line with PADEP definition.
- Added a new analysis, Well Stage, to indicate the life stage of a well. This field will help to better determine whether a well is permitted, drilled, or has produced natural gas.
- Fixed an error with the calculation for the ERROR_UNC_STATUS that did not accurately identify wells with the error.

2013-Q4 (Released February 28, 2014)
- Records queried through December 31, 2013; downloaded from PADEP February 26, 2014.
- No updates.

2013-Q3 (Released October 15, 2013)
- Records queried through September 30, 2013; downloaded from PADEP October 7, 2013.
- No updates.

2013-Q2 (Released August 30, 2013)
- Records queried through June 30, 2013; downloaded from PADEP August 26, 2013.
- No updates.

2013-Q1 (Released June 30, 2013)
- Records queried through March 31, 2013; downloaded from PADEP May 15, 2013.
- The Unconventional Wells Summary data compilation method changed significantly, allowing for faster processing. The order of fields changed, some field names were changed, new fields were added, while others were eliminated (see Unconventional Wells Summary Fields table). Below are the important changes. Not all are listed.

14

- o WELL_STATUS – Definition changed to conform to the PADEP definition. See Data Dictionary section of metadata document. The well status is also included from the Spud, PUC, Waste, and Production reports.
- o PERMIT_WELL_TYPE and SPUD_ WELL_TYPE – Fields added to indicate PADEP well type classification.
- o PUC_PLUGGED_DATE – This field was added to show when wells were plugged.
- o VIOL_DATE_FIRST and _LAST – Violations dates were added.
- o PUC_ANALYSIS – This field was eliminated and the analysis is no longer completed.
- o PUC_FORMATION_NAME – this field was eliminated because the PADEP no longer includes the field in the PUC report data. The PADEP replaced this field with an additional report called "Oil and Gas Well Formations Report" (OOGM 2013). At this time, there is no plan to include the report or reestablish the field in a later release. If the data is desired, it is recommended to download that report, and use an attribute join to add the field.
- o All GAS_QUANTITY and GAS_DAYS fields – These fields were moved into a new table that summarizes natural gas production. It is designed to be easily joined to the Unconventional Wells Summary table.
- All tables are now available as Comma Separated Value (CSV) format instead of Microsoft Excel. This allows for more versatility and compatibility with other database software. CSV is a compatible format with Microsoft Excel.
- A quarterly release schedule was established. This also resulted in a redesigned versioning structure. See Update and Version Information of the metadata.
- The recommended data citation has changed.

2012.12 (Released February 8, 2012)
- Records queried through December 31, 2012; downloaded from PADEP January 25, 2013 (All Sources).
- The 2012 annual and second period for unconventional wells Production and Waste reports are not included as these are not released until mid-February. The next version will contain these records.
- Minor elements of the data structure were updated to help conserve storage space and allow for greater flexibility for users with earlier versions of ArcGIS. The changes include fixes that allow the file geodatabase, map document, and layer file to be compatible with ArcGIS 9.3 and above.
- The known issue regarding the truncation of text values for the INSPECTION_COMMENT field of the Compliance Report was resolved.

2012.06 (Released September 28, 2012)
- Records queried through June 30, 2012; downloaded from PADEP August 16, 2012 (Permits, SPUD, Compliance, and PUC) and September 5, 2012 (Production and Waste).
- The geodatabase changed its name from "Carnegie Geodatabase of Pennsylvania Marcellus Shale Natural Gas Wells" to "Carnegie Museum of Natural History Pennsylvania Unconventional Natural Gas Wells Geodatabase".
- Fields updated: SITE_NAME changed to FARM_NAME; Any field designated with "MS" was changed to "UNC" to reflect the geodatabase name change; LOCATION_YN changed name to ERROR_LOCATION; All GAS_PROD fields changed to GAS_QUANT;
- Fields removed: ERROR_FLAG, ERROR_NOTE
- New fields added: ERROR_PERMIT, ERROR_SPUD, ERROR_MS_STATUS, and ERROR_COUNT. The field additions listed correct for any overlapping errors. For example, if a well has a permit or a spud error and is also inconsistently identified as an Unconventional well, each error will be reflected in the new fields. This eliminates weighting the errors and will show each error independently. The error count field can now be used to see which wells have more than one discrepancy. The definitions of errors and discrepancies were expanded and described more clearly as well.
- Metadata was updated to reflect the changes listed.

2012.04 (Released May 14, 2012)
- Records queried through April 30, 2012; downloaded from PADEP May 14, 2012.
- Initial public release

2011.12 (no formal release)
- Records queried through December 31, 2011; downloaded from PADEP on April 16, 2012.
- Added Waste Reports, Compliance Reports, and PUC Act 13 SPUD Report.

2011.10 (no formal release)
- Records queried through October 31, 2011; downloaded from PADEP Fall of 2011.

- This dataset only includes Permit, SPUD, and Production records and used slightly different techniques in compiling the records due to a different data delivery system by the PADEP. In January of 2012, the PADEP released a new data query and download tool.

KNOWN ISSUES

Production Report

In 2010, the PADEP began compiling Production and Waste reports every six months for unconventional/Marcellus shale wells instead of annually. The law that issued the reporting schedule change also required that the PADEP first include one full year of only unconventional/Marcellus shale well production, beginning in July 2009 through June 2010. This resulted in a half year overlap between annual and unconventional/Marcellus shale reporting schedules, which consequently disallowed the ability to aggregate production continuously through the reporting periods. This six-month overlap of reporting cannot be calculated without using estimations. Therefore, it was the decision of CMNH to report the raw figures and not analyze or estimate Production. The fields GAS_PROD_TOTAL and GAS_DAYS_TOTAL include the six-month overlap and can therefore be considered inflated. The more appropriate method to display and analyze natural gas Production amounts is to treat annual reports separately from the unconventional/Marcellus shale only reports.

Waste Report

The 2007 Waste Report is missing a substantial number of records. According the PADEP, this data was lost due to a database system crash that resulted in the deletion of many records.

Compliance Report

In September 2014, an independent analysis of DEP paper and digital compliance reports noted "…inaccurate and incomplete information." Findings in the analysis include missing or incorrectly coded violations in the online compliance report. Since the CMNH uses the online compliance report as its source data, our dataset will the record as it is entered into DEP's digital tracking system. Therefore, our dataset is unable to identify sites where paper and digital records do not match.

There is also an issue with the Compliance Report regarding fines. Fine numbers reported in the Compliance report likely represent the summation of fines for a collection of wells owned by the same operator. In other words, the Compliance Report does not indicate fines for a single well. Fines appear to be grouped by operator and include the total amount of fines for all well violations at a given time. Therefore, fines cannot be calculated on well by well basis.

ARCHIVED INFORMATION FROM PREVIOUS VERSIONS

The information below is no longer valid for the current version of the UNCGDB, but is retained for reference for past versions of the UNCGDB.

Well Production Summary Fields (prior to 2018 Q1)

The following fields are summarized from the Production report and then joined to the Unconventional Wells feature class. Note that the field names changed starting in the 2017 versions of the UNCGDB to be compatible for the Shapefile.

Field Name	Definition
GQ_[YYYY_X] or PD_[YYYY_X]	Natural gas quantity (GQ) in Mcf or production days (PD) for **yearly or six-month reporting periods**; 'YY' is the year (4 digit) and 'X' is the reporting period ('0' is annual, '1' is January-June, '2' is July to December, and '3' is a special period from July 2009 through June 2010, see Known Issues, Production Report). Ex. 2001 annual unconventional gas production is GQ_2001_1.
GQ_M_[yy_mm_bbb] or PD_M_[yy_mm_bbb]	Natural gas quantity (GQ) in Mcf or production days (PD) for **monthly reporting periods**, starting in 2015; 'yy' is the year (2 digit), 'mm' is the numeric month (2 digit), and 'bbb' is the month text abbreviation. Ex. January 2015 unconventional gas production is GQ_M-15-01-JAN.
ANN_GQ_TOTAL or ANN_PD_TOTAL	Total natural gas quantity (GQ) in Mcf or production days (PD) of **annual natural gas production from 2000 through present**.

Field Name	Definition
UNC_GQ_TOTAL or UNC_PD_TOTAL	Total natural gas quantity (GQ) in Mcf or production days (PD) of **Unconventional natural gas production from July 2009 to present**.

Current Operator (prior to 2017 Q1)

The current operator is determined by the most recent record queried from the source datasets. Priority of data sources is given in the following order: Production, Compliance, Waste, PUC, SPUD, Permit. Production is the best indicator of the current operator because it is the final level of data reporting and will continue to be reported throughout the life of the well. If a well changes operators, it will show up in the most recent Production. If a well is non-producing, the Compliance reports are the next most recent followed by the Waste, PUC, SPUD, and Permit. The PUC and SPUD reports appear to be updated as operators change, so these datasets are also reliable. However, for the purpose of creating the datasets, the established order works best.

Location (prior to 2017 Q1)

Location information (latitude/longitude) is searched in the source datasets with the following priority: Permits, SPUD, PUC, Waste, Production. Compliance data does not include location information. This order ensures that the earliest known location information is used, ideally as reported in the permitting process. Geographic coordinates are reported in North American Datum 1983 according to the PADEP (OOGM 2013). The locational accuracy of the geographic coordinates is unknown, as this is not reported to the PADEP by the operators. The data are not analyzed for duplicate well locations. If a well is not going to be drilled at the particular location, then it technically requires a new permit.

Record Discrepancies and Errors across PADEP Datasets (prior to 2017 Q1)

Because not every data source includes records for every unique well, discrepancies are inherent. It is recommended that every effort be made by users to investigate and/or disregard records that may skew one's research or analysis.

Wells are analyzed for errors based on the following criteria:

- *Permit Error* – Identifies wells that have a SPUD record and/or a Production record indicating production greater than 0 Mcf but are missing permit information. To query for wells without permits, use the PERMIT_COUNT field. This error is concerned with drilling and production and the lack of a permit. Production and SPUD records indicate with more confidence that a well exists and is operating. If no permit records exist, then data is incomplete for that well.
- *SPUD Error* – Identifies wells that show natural gas production but do not have a SPUD record. Wells producing gas should have a record of when drilling commenced. If no SPUD records exist, then data is incomplete for that well.
- *Unconventional Status Error* – Identifies wells that are inconsistently classified as unconventional wells across all datasets. Well records that are inconsistently classified as unconventional wells cannot be verified. Any analysis including these wells should have strong cause to include such wells. Although, such wells should not be ignored, as the wells can be reported to the PADEP for clarification.
- *Location Error* – Identifies wells without geographic coordinates in any data source. Without geographic coordinates, a well is not able to be mapped or used in spatial analyses. Compliance reports do not include geographic coordinates. Records with location errors will not be present in GIS feature classes.

Well Status (prior to 2014-Q1)

Well Status is the state of the well as of the UNCGDB date (Act 13 of 2012 2013). The well status is determined by using the Spud or PUC report Well Status value. If a well does not have a record in the Spud or PUC reports, then the Production report Well Status is used as long as the production is greater than zero. If there is no production, then the well is evaluated for whether the permit is valid or expired. All other wells do not have the required information to determine a well status, and are therefore regarded as unknown.

PADEP definitions: (Act 13 of 2012 2013)

- *Active* – Drilling of the well has commenced. The well may, or may not, be producing.
- *Regulatory Inactive Status* – The PADEP has granted inactive status for the well. (Any well that has not been used to produce, extract or inject any gas, petroleum or other liquid within the preceding 12 months, or any well for which the equipment necessary for production, extraction or injection has been removed, or any well, considered dry, not equipped for production within 60 days after drilling, redrilling or deepening, is, by definition, an abandoned well and shall be plugged upon abandonment pursuant to the Oil & Gas Act. However, the definition of an abandoned well shall not include any well granted inactive status.)
- *Plugged OG Well* – The well has been lawfully plugged. The well may, or may not, have produced prior to plugging.
- *Operator Reported Not Drilled* – The operator has reported that either the permit has expired and the well has not been drilled, or that, although the permit is still valid, they no longer intend to drill the well and wish to cancel the permit.
- *Proposed But Never Materialized* – 1) A permit application was submitted, but the permit was never issued; 2) The well was entered into the database in error; 3) A permit had been issued, however Department staff have determined that the well was never drilled.

UNCGDB Definitions:
- *Permitted* – A well that has not yet been drilled with a valid permit. A permit is valid from one year of the issue date.
- *Permit* *Expired*– A well that has not yet been drilled, but the permit has expired. The permit issue date is more than one year old and does not have a Spud record.
- *Unknown* – A well that does not have the required records to determine the well status. In general, such wells do not have Permit, Spud, or PUC records, but do have Production records without any gas Production or Waste records with no other records.

Well Status (prior to 2013-Q1)

Well status is determined by a logical analysis using many fields. There are potentially other ways that well status could be determined. The following explains the logic used to determine the well status for this dataset. This method was influenced by Gehman et al. (2013). The explanation is in order of priority.
- *Producing* – Records are analyzed first to determine if a well is currently producing natural gas. This is determined by whether natural gas production values are greater than zero for the most recent annual or Unconventional Production period. If a well did not produce natural gas in the most recent annual or Unconventional Production period, it is analyzed to determine if it is Abandoned, Plugged, Regulatory Inactive, or Shut-In status.
- *Abandoned* – The Production records are searched for any record that indicates "Abandoned well" in the COMMENT_REASON field.
- *Plugged* – The Production records are searched for any record that indicates "Plugged well" in the COMMENT_REASON field.
- *Regulatory Inactive* – The Production records are searched for any record that indicates "Regulatory Inactive Well" in the COMMENT_REASON field.
- *Shut-In* – The Production records are searched for any record that indicates "Well Temporarily Shut-In" in the COMMENT_REASON field. If a well is not Abandoned, Plugged, Regulatory Inactive, or Shut-In, it is analyzed to determined Drilled status.
- *Drilled* – Records are analyzed to determine if a SPUD record, Waste record, Compliance record, or a PUC record exists. If this analysis does not return a drilled status, the Production records are searched for any record that indicates "Well spud, drilling not completed," "Drilling finished, well not yet completed," "Sold this well," or "Transferred this well" in the COMMENT_REASON field. If a well is not Drilled, it is analyzed to determined Unknown status.
- *Unknown* – If a well does not include a Permit, SPUD, and Waste record and does not produce any natural gas during the life of the well, the well status cannot be determined. All other wells left can be analyzed for Expired or Permitted status.
- *Expired* – If a well has not been drilled within one year of its permit date, it is expired. A formula calculates the expiration based on whether a well has had activity beyond the Permit records from one year before the version date. Also, the Production records are searched for any record that indicates "Never Spud Well, Permit Expired or Cancelled" in the COMMENT_REASON field.
- *Permitted* – All wells that do not fit the above categories and have a permit are considered permitted. Also, the Production records are searched for any record that indicates "Permit valid, well not spud" in the COMMENT_REASON field.

PUC Analysis (this analysis is no longer included starting in version 2013-Q1)

The source data for PUC wells, in accordance with PA Act 13, has been questioned by many. Using a logical formula to analyze all records, wells can be determined if they should be reported to the PUC. Wells are identified as a PUC well if the well was included in the Act 13, SPUD, Waste, or Compliance tables; the well has produced gas; or was flagged in the Production reports COMMENT_REASEON field as "Abandoned well," "Drilling finished, well not yet completed," "Plugged well," "Regulatory Inactive Well," "Sold this well," "Transferred this well," "Well spud, drilling not completed," or "Well Temporarily shut-in." The query of records that should be reported to the PUC can be compared to the PUC data source. It is expected that the analysis will return a greater number of wells. This method was influenced by Gehman et al. (2013).

Version Info (the version scheme changed with version 2013-Q1)

Versions of the geodatabase are identified by indicating the year and month (YYYY.MM) through which records are compiled from the begin date. For example, data through April, 2011, would be version 2011.04 and data through the December, 2011, would be version 2011.12. This is important for citation purposes (see above). The geodatabase file name is named similarly, but with the dot (".") removed and the addition of the last day of the month. Versions released covering data queries through June (YYYY.06) and December (YYYY.12) will include the latest Production reports and may take longer to release.

Compliance Reports Known Issues (this Issue was fixed in version 2012.12)

There is an issue with the Compliance Reports with the INSPECTION_COMMENT. This field is a text field designed to allow greater than 1,000 characters. However, due to the way ArcGIS handles CSV files, only 255 characters can be read from the raw CSV file. Therefore, some comments in this field are truncated. To review the entire field, it is suggested to search for the specific well of interest using the PADEP's Compliance Report viewer website.

REFERENCES

Gehman, J., Mastroianni, D., Grant, A., & Etzion, D. 2013. An Analysis of Unconventional Gas Well Reporting under Pennsylvania's Act 13 of 2012. Environmental Practice 14:262–277.

Office of Oil and Gas Management. 2013. Oil and Gas Reports [Web page]. Pennsylvania Department of Environmental Protection. http://www.portal.state.pa.us/portal/server.pt/community/oil_and_gas_reports/20297 Accessed: [6 August 2013].

Act 13 of 2012. 2013. Public Utility Commission (PUC) Act 13 Unconventional Wells Spud Report [Web page]. Pennsylvania Department of Environmental Protection. http://www.depreportingservices.state.pa.us/ReportServer/Pages/ReportViewer.aspx?/PUC/PUC_Interactive_Web Accessed: [6 August 2013].