Atlas 175b

BEDROCK GEOLOGY AND COAL RESOURCES OF THE CONYNGHAM QUADRANGLE, LUZERNE AND SCHUYLKILL COUNTIES, PENNSYLVANIA

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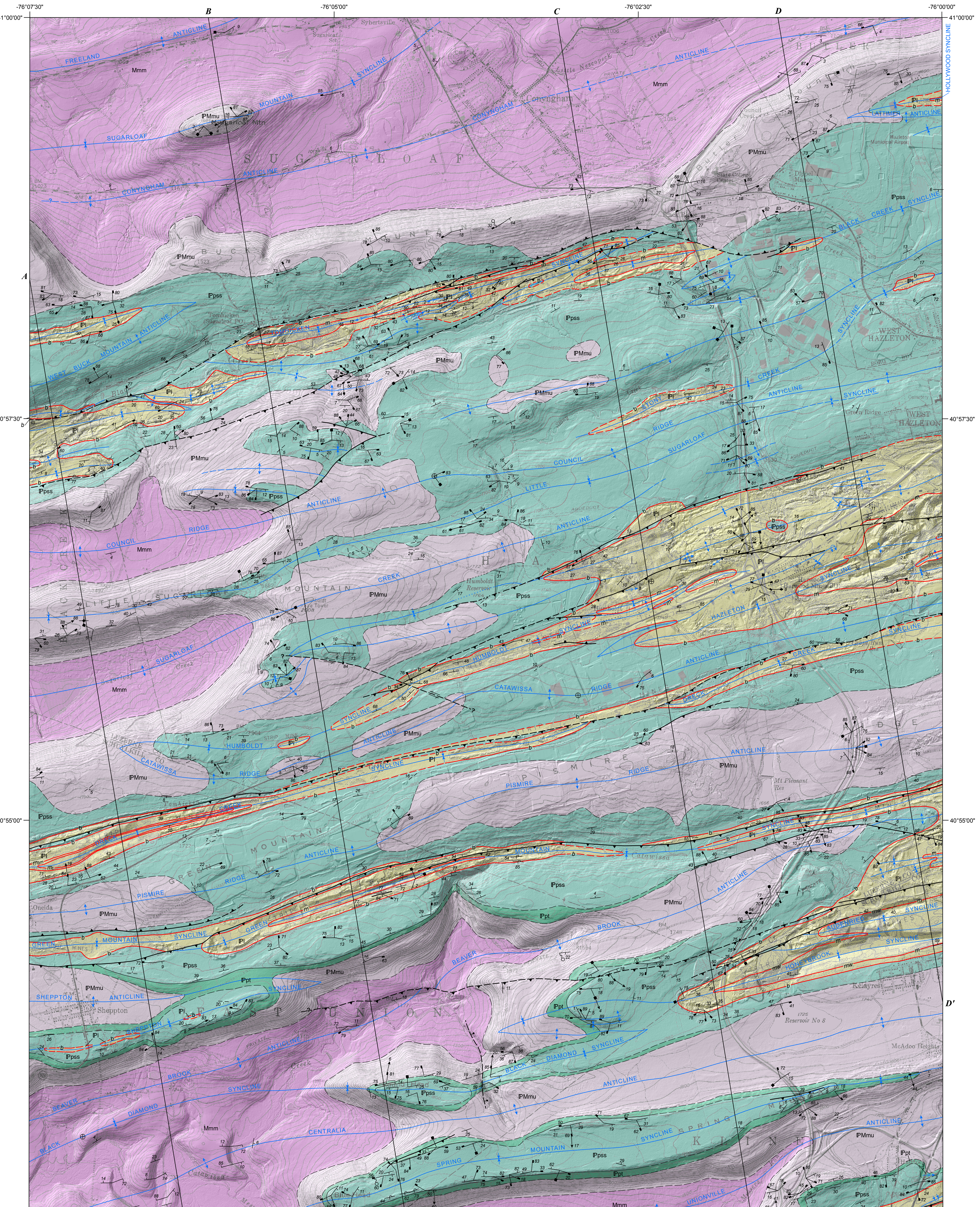

Fieldwork by Henry W. Schasse, 1979–80, and David B. MacLachlan and Jon D. Inners, 1985–86, while at the Pennsylvania Geological Survey. Cross sections by Inners. Schasse relocated to the Washington Geological Survey in 1980 and is now retired. MacLachlan and Inners retired from the Pennsylvania Geological Survey in 1996 and 2004, respectively.

Digital map production by Thomas G. Whitfield, 1999–2000, and Caron E. O'Neil, 2012, both of the Pennsylvania Geological Survey.

SCALE 1:24 000

CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Base map modified from the U.S. Geological Survey digital raster graphic (DRG) of the Conyngham (1955, photorevised 1989) 7.5-minute quadrangle—UTM projection, zone 18, NAD 1927.

Hillshade created from DEMs derived from lidar elevation data collected for the Pennsylvania Geological Survey PAMAP program in 2006 and 2008 and distributed through PASDA at http://www.pasda.psu.edu/.

BEDROCK GEOLOGIC MAP OF THE CONYNGHAM QUADRANGLE, LUZERNE AND SCHUYLKILL COUNTIES, PENNSYLVANIA

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EXPLANATION

	GEOLOGIC DESCRIPTION	UNIT	ENVIRONMENTAL CHARACTERISTICS[1,2]
PENNSYLVANIAN	Interbedded, dominantly clastic rocks commonly arranged in crude cycles that exhibit the following lithic sequence (from top to bottom): sandstone, siltstone, clay shale, anthracite, and claystone. Sandstones (quartz-lithic wackes): medium- to thick-bedded, commonly planar-crossbedded, medium-dark-gray (N4) to dark-gray (N3), medium-grained to conglomeratic, micaceous and carbonaceous, locally pyritic or sideritic; quartz conglomerate lenses up to 3 ft (1 m) thick are common—pebbles mostly subangular to subrounded, 0.4 in. (1 cm) or less in diameter; typically contain large, carbonized impressions of plant trunks and stems; in units up to 50 ft (15 m) or more thick. Siltstones: thin- to thick-bedded, medium-dark-gray to dark-gray, fine sandy, micaceous, fossiliferous (carbonized plant fragments); in units 1 to 10 ft (0.3 to 3 m) thick. Clay shales: fissile to platy, dark-gray, commonly silty, carbonaceous, highly fossiliferous (carbonized plant leaflets, stems, and so on); in units 1 to 10 ft (0.3 to 3 m) thick. Anthracites: character highly variable between and within seams, ranging from well-banded, glassy, jet-black (N1), low-ash coal to poorly banded, shaly to bony, dull grayish-black (N2), high-ash coal; in 12 or more "beds" 1 in. to 60(?) ft (2.5 cm to 18 m) thick (see "SYMBOLS" below for list of seams shown on this plate). Claystones: unbedded, hackly to subfissile, dark-gray to grayish-black, commonly silty to fine sandy and micaceous, carbonaceous, rootworked, slickensided, and fossiliferous (*Stigmaria*); locally contain pyrite balls and siderite concretions up to 1.5 ft (0.45 m) in diameter; in units 1 to 6 ft (0.3 to 1.8 m) thick. Thickness: up to 750 ft (230 m) preserved in various basins.	LLEWELLYN FORMATION IPl	Moderate to high infiltration capacity along steeply dipping joints, subsidence fractures, and bedding planes. Although strongly fractured sandstones and siltstones may transmit water readily, and vast quantities of water fill the old underground mine workings, this formation cannot be considered a significant aquifer because of the poor quality of contained groundwater. Water is generally acidic and high in iron and manganese. Mine-drainage waters from discharge points in the quadrangle have pH values that range from 3.3 to 5.6 and are locally high in sulfate (greater than 250 mg/L [milligrams per liter]). Joints are moderately to well developed, relatively planar and continuous, open, and widely spaced (2 to 10 ft, or 0.6 to 3 m, apart) in sandstones and coarse siltstones; nonplanar and discontinuous, less commonly open, and irregularly spaced (less than 2 in. to 5 ft, or 5 cm to 1.5 m, apart) in fine siltstones and claystones; anthracite beds typically show good cleat development, strongly cleaved in areas of intense deformation. Moderate stability in artificial cut slopes greater than 25 degrees; sandstones generally able to stand at steeper angles than claystones and siltstones; undercutting of dipping planar discontinuities, particularly bedding, can lead to rockslides; localized block falls commonly caused by the weathering out of coal and claystone beds beneath massive sandstones; shattered thrust fault zones are very unstable if encountered in cuts. Deep cuts may expose coal pillars and partially collapsed mine workings near which rock is badly fractured. Relatively easy (claystone and anthracite) to difficult (sandstone) excavation using heavy equipment; blasting required in most thick sandstone units. Foundation-support strength in most areas is greatly compromised by the presence of underground coal mines; construction should not be undertaken until the extent of local mining has been ascertained. Main source of anthracite mined in the quadrangle (see Plate 2 for reserve calculations). Claystones may have some potential for use in structural clay products. Thick sandstone units could be excellent sources of crushed stone for construction aggregate.
PENNSYLVANIAN	Predominantly medium- to very thick bedded, tabular-bedded to planar- and trough-crossbedded, very light gray (N8) to medium-gray (N5), moderately well sorted orthoquartzitic (oligomict) conglomerate that is typically composed of subangular to rounded vein-quartz pebbles 0.4 to 1 in. (1 to 2.5 cm) in diameter. Interbedded with conglomerates are lenses of medium- to very coarse grained, quartzose sandstones (quartz arenites) up to 1 ft (0.3 m) thick. Thin to medium beds of medium-dark-gray to grayish-black, micaceous sandstone, siltstone, clay shale, and claystone are locally developed in the middle and upper parts; finer clastic beds in the middle are associated with the Alpha anthracite seam (typically shaly to bony and less than 3.5 ft, or 1.1 m, in thickness). At the base in the central and northern portions of the quadrangle is a distinctive, discontinuous 3-ft (1-m) stratum of very light gray, coarse conglomerate composed of rounded pebbles and cobbles 2 to 6 in. (5 to 15 cm) in diameter; predominantly vein quartz, but also chert, quartzite, and metamorphic clasts; locally contains elongate, greenish-gray, clay-shale clasts up to 16 in. (0.4 m) in maximum dimension within the basal part. Thickness: thins from about 350 ft (105 m) in the south to 200 ft (60 m) in the north.	POTTSVILLE FORMATION: SHARP MOUNTAIN AND SCHUYLKILL MEMBERS, UNDIVIDED IPpss	Moderate to high infiltration capacity along gently to moderately dipping bedding planes and subvertical joints. Fractured beds of quartzitic conglomerate and sandstone have good aquifer potential, but wells may have to be drilled to considerable depth to obtain adequate yields (e.g., +150 ft, or +45 m, for domestic wells and +300 ft, or +90 m, for nondomestic wells). Yields of up to 25 gpm (gallons per minute) in domestic wells and up to 100 gpm in nondomestic wells are not uncommon. Note that many deep wells drilled in areas of Pottsville outcrop actually obtain water from the upper member of the Mauch Chunk Formation. Water is generally of good quality—soft and low in dissolved mineral matter. High iron and/or manganese concentration is a problem in some places. Because of its low dissolved solids content, water from the Pottsville Formation may be locally corrosive to metal plumbing. Joints in conglomerates and sandstones are well developed, generally planar and continuous, open, and widely spaced (1 to 16 ft, or 0.3 to 5 m, apart). Rare siltstone and claystone beds have mostly irregular, nonplanar fractures. Natural outcrops are typically very blocky and severely frost rived, commonly eroding into crags, detached tors, and "rock cities." Conglomerates break up along joints to form extremely bouldery regolith on the crests and upper slopes of mountains. Exposed conglomerate surfaces are generally deeply weathered and friable; in artificial cuts it appears that this weathering extends to depths of 10 ft (3 m) or more along open joints. Moderate to high stability in artificial cut slopes greater than 25 degrees; where proper blasting techniques are used, near-vertical cut slopes can be safely constructed through massive conglomerate units (e.g., the Spring Mountain cut on Interstate Route 81 north of Interchange 138); overblasted cut slopes, however, are prone to serious block-fall problems, especially where basal conglomerate overlies less competent Mauch Chunk siltstone and claystone (e.g., cuts on Interstate Route 81 just south of Interchange 145); undercutting of dipping bedding planes can lead to rockslides. Very difficult excavation using heavy equipment; blasting required in most deep cuts. Excellent foundation for heavy structures (assuming fractured, near-surface materials are removed) except in areas where Alpha coal was deep mined. Limited tonnages of anthracite can probably be obtained from the Alpha seam in the northern part of the quadrangle. Quartz conglomerate formerly provided good-quality dimension stone for local construction (e.g., St. Joseph's Slovak Roman Catholic Church in Hazleton).
PENNSYLVANIAN	Predominantly medium- to very thick bedded, planar- and trough-crossbedded, dark-gray to light-olive-gray (5Y6/1), poorly to moderately sorted quartz-lithic (polymict) conglomerate that is typically composed of subangular to rounded vein quartz and lithic pebbles (chert, quartzite, sandstone, and so on) 0.2 to 1.5 in. (0.5 to 3.8 cm) in diameter. Contains some medium to thick interbeds of crossbedded, medium-dark-gray, light-olive-gray-weathering, medium- to coarse-grained sandstone (quartz-lithic arenite) and fissile, dark-gray, micaceous, silty clay shale. At the base is a prominent 2- to 5-ft (0.6- to 1.5-m) layer of very thick bedded, medium-gray, limonite-stained, poorly sorted, coarse conglomerate composed of rounded pebbles and cobbles 2 to 6 in. (5 to 15 cm) in diameter; mostly vein quartz, but also chert, quartzite, sandstone, and metamorphic clasts. Thickness: thins from about 100 ft (30 m) on Spring Mountain (southern part of quadrangle) to 0 ft on Pismire Ridge (central part of quadrangle).	POTTSVILLE FORMATION: TUMBLING RUN MEMBER IPpt	
MISSISSIPPIAN	Interbedded claystone, siltstone, sandstone, and conglomerate arranged in fining-upward cycles 25 to 50 ft (8 to 15 m) thick. Claystones (at top of ideal cycles): massive, unbedded, hackly to shaly, grayish-orange (10YR7/4), greenish-gray, and grayish-red, silty, rootworked; in units 3 to 16 ft (1 to 5 m) thick, except where subdivided into thinner beds by interstratified siltstone and sandstone. Siltstones: medium- to thick-bedded, grayish-orange, greenish-gray, and grayish-red, commonly sandy and micaceous, locally shaly; sometimes in monolithic units 3 to 10 ft (1 to 3 m) thick, but typically interbedded with claystone and sandstone in units less than 6 in. (15 cm) thick. Sandstones (quartzose arenites): mostly medium- to thick-bedded, medium-gray, greenish-gray, grayish-orange, and grayish-red, very fine grained to conglomeratic, commonly micaceous; medium-grained to conglomeratic sandstones form monolithic units 3 to 25 ft (1 to 8 m) thick in the lower parts of some cycles, whereas very fine to fine-grained sandstones typically occur in 2- to 12-in. (5- to 30-cm) beds interlayered with claystones and siltstones in the upper parts of cycles. Conglomerates (polymict): medium- to very thick bedded, planar-bedded and trough-crossbedded, medium-light-gray (N6) to light-olive-gray (5Y5/2) and light-greenish-gray (5GY6/1), moderately to poorly sorted; composed of subangular to rounded, mostly 0.5- to 2-in. (1- to 5-cm) pebbles of white vein quartz, grayish-red and greenish-gray quartzite, medium-dark-gray sandstone, and dark-gray chert; typically contain elongate, dark-gray to greenish-gray, clay-shale clasts up to 6 in. (15 cm) in diameter; in units 5 to 20 ft (1.5 to 6 m) thick; the coarsest conglomerate bed (at least in the northern half of the quadrangle) lies about 350 ft (107 m) below the top, caps Sugarloaf Mountain, and is composed of pebbles up to 4 in. (10 cm) in diameter. The uppermost grayish-red unit (generally claystone or siltstone) occurs anywhere from 75 ft (23 m) to 240 ft (74 m) below the top of the member.[1] On Buck Mountain, in the northern part of the quadrangle, approximately 600 ft (180 m) below the top is a lenticular, up to 11-ft- (3.4-m-) thick bed of light-gray (N7) to dark-greenish-gray (5G4/1), sandy calcareous breccia composed predominantly of angular to rounded, poorly sorted, "limestone" fragments 0.5 to 2.5 in. (1 to 6 cm) in diameter and containing several 4 in. (10 cm) beds of medium-grained quartzose sandstone. Below this breccia bed, sandstones, siltstones, and claystones typically contain abundant, subangular to subrounded, calcareous nodules that weather out to leave pitted surfaces on rock exposures. Thickness: approximately 650 ft (198 m).	MAUCH CHUNK FORMATION: UPPER MEMBER IPMmu	Moderate to high infiltration capacity along moderately dipping bedding planes and steeply dipping joints. Variable but generally good to excellent aquifer potential. Fractured sandstone and conglomerate beds can be expected to yield 10 (domestic wells) to 50 (nondomestic wells) gpm from depths of 100 to 300 ft (30 to 90 m); shaly intervals in the middle member, however, may provide barely adequate supplies to domestic wells even from depths of 300 ft (90 m) or more. Many wells in the upland south of the Buck Mountain escarpment obtain water from the undifferentiated Pottsville-upper Mauch Chunk interval. Water is typically good quality, calcium bicarbonate type—rather soft and low in dissolved solids; high iron and/or manganese may be encountered locally. Joints in conglomerates and sandstone beds are generally planar, steeply dipping to subvertical, relatively continuous, and spaced 2 to 10 ft (0.6 to 3 m) apart; fractures in siltstones and claystones are mostly nonplanar, discontinuous, and spaced 1 to 12 in. (2.5 to 30 cm) apart. Fracture cleavage is commonly well developed in claystones, siltstones, and fine-grained sandstones; partings are irregular, spaced 0.5 to 6 in. (1 to 15 cm) apart, and intersect bedding in lineations parallel to bedding strike; cleaved units commonly exhibit rounded exfoliation surfaces. Low to moderate stability in cut slopes steeper than 25 degrees; cleaved claystones and siltstones weather easily and tend to ravel, forming chippy to hackly fragmental aprons along the toes of steep slopes; conglomerates of the upper member and sandstones of the middle member are generally stable at moderate to steep cut-slope angles, but intersections of bedding, joints, cleavage, and blasting fractures can create serious instability, leading to block falls and rockslides—especially where fractured sandstones and conglomerates are underlain by less competent claystones and siltstones. Easy (claystone) to difficult (sandstone and conglomerate) excavation using heavy power equipment; blasting required where conglomeratic beds of the upper member and thick quartzose sandstones of the middle member are encountered; closely spaced cleavage partings in some hard siltstones and sandstones may facilitate excavation locally. Moderate to high foundation-support strength, generally suitable for heavy structures if excavated to sound bedrock. For more than 50 years, the Hazleton Brick Company used upper member claystones exposed on Pismire Ridge to manufacture brick (abandoned and partially reclaimed pits are located at approximately 40°55'42"N latitude and 76°00'24"W longitude in Hazle Township). In addition to the large remaining reserves of this material in the upper member, similar claystones and clay shales in the middle member in Conyngham Valley could also have some potential for making bricks and other structural clay products. Silty claystones, siltstones, and fine-grained sandstones of both members are good sources of common borrow.
MISSISSIPPIAN	Chiefly interbedded, grayish-red (5R–10R4/2) claystone, clay shale, siltstone, and quartzose sandstone; lithologies are typically organized into fining-upward cycles 15 to 30 ft (5 to 9 m) thick. Claystones: massive, unbedded, hackly, slightly to very silty, locally calcareous (containing irregular carbonate nodules up to 1 in., or 2.5 cm, in diameter), rootworked, occasionally mud cracked; in units up to 15 ft (5 m) thick. Clay shales: fissile to platy, commonly slightly silty, locally containing greenish-gray (5GY6/1) reduction spots; in units up to 6 ft (2 m) thick. Siltstones: mostly thin- to medium-bedded, occasionally rippled, commonly micaceous, locally fossiliferous (plant fragments); in units up to 10 ft (3 m) thick. Sandstones (quartzose arenites): thin- to very thin bedded, planar-laminated, cross-laminated, and current-laminated, very fine to fine-grained, commonly micaceous, locally calcareous; in units up to 18 ft (5.5 m) thick. At or near the base of some sandstone units are 1- to 3-ft- (0.6- to 1-m-) thick, lenticular beds of calcareous-nodule and shale-clast breccia; nodules are typically 1 in. (2.5 cm) or less in diameter, and elongate shale clasts are up to 1.5 ft (45 cm) in length. A few yellowish-gray (5Y7/2) to greenish-gray shale, siltstone, and sandstone beds occur locally. Thickness: approximately 2,000 ft (600 m) exposed in quadrangle.	MAUCH CHUNK FORMATION: MIDDLE MEMBER Mmm	
MISSISSIPPIAN	Not observed in map area. Only shown in cross section.	MAUCH CHUNK FORMATION: LOWER MEMBER Mml	Not observed in map area. Only shown in cross section.

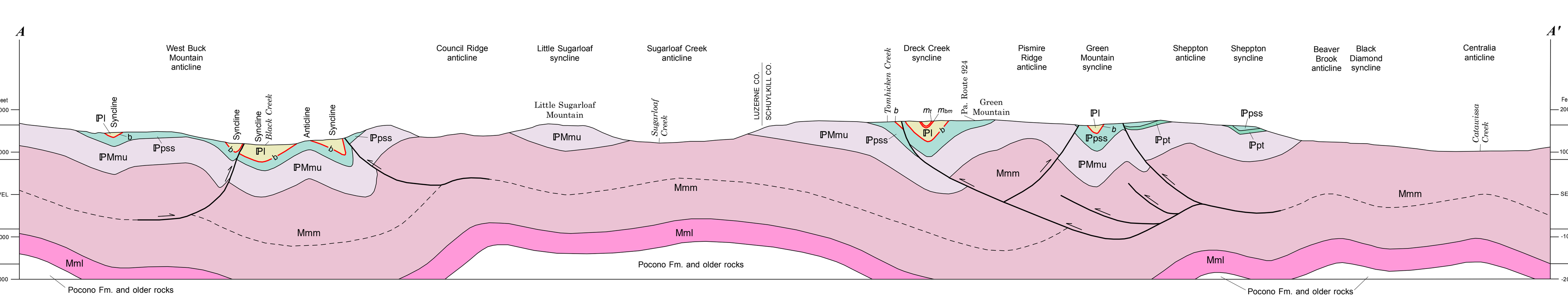
[1]In their restudy of the Pottsville Formation type section for the USGS (U.S. Geological Survey) Anthracite-region mapping project, Wood and others (1956) defined the top of the Mauch Chunk Formation as the top of the uppermost red bed in the upper member. Although USGS geologists purportedly used this criterion to map the Pottsville-Mauch Chunk contact throughout the Southern and Western Middle fields (see Wood and Arndt, 1973), they were not consistent in applying it. Both Schasse (field notes) and Inners and Lentz (1988) found that red beds in the upper part of the upper member are discontinuous and lenticular and that the uppermost red bed is useless for mapping purposes. In this report, the top of the upper member is defined as the top of the uppermost structureless silty claystone or siltstone of Mauch Chunk aspect, regardless of color. Throughout the Conyngham quadrangle, this type of lithology occurs in sharp contact with a pebble or cobble conglomerate (locally having a thin quartzose sandstone intervening) of Tumbling Run or Schuylkill-Sharp Mountain aspect (see Inners and Lentz, 1988). The redefined contact is readily recognized at outcrops and easily traced on aerial photographs.

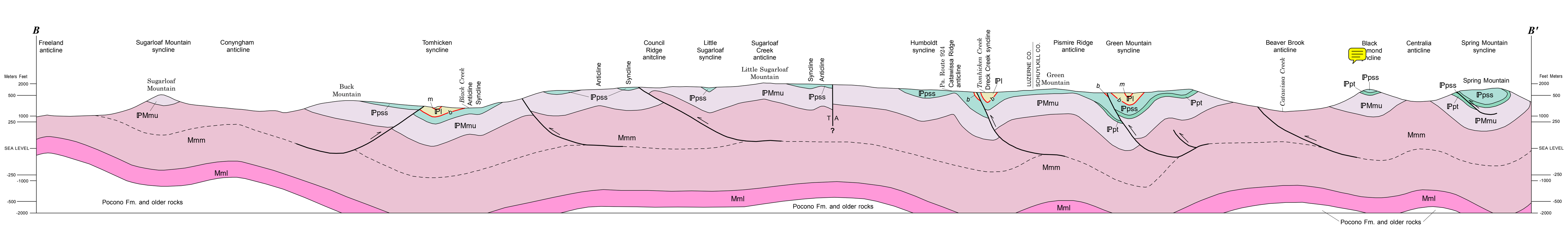
[1]Blue type refers to groundwater characteristics, red type to engineering characteristics, and black type to mineral resources.

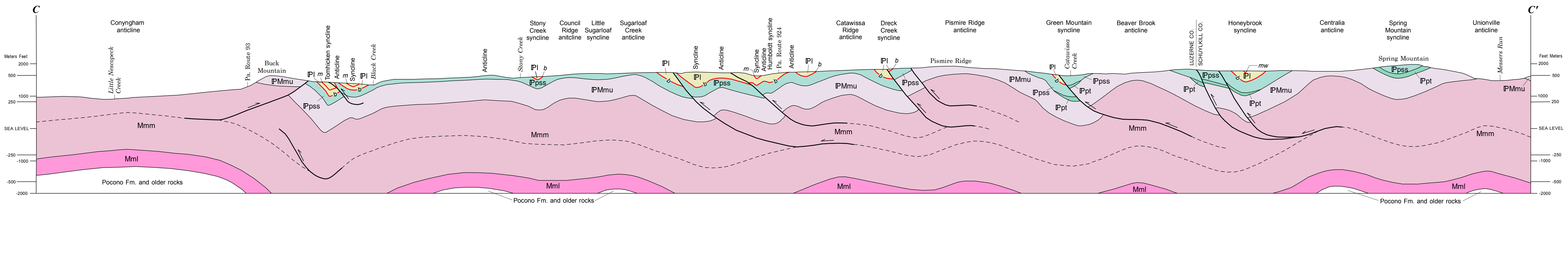
[2]Groundwater information is mainly from Growitz, D. J., and others (1985), Lohman, S. W. (1937), and Taylor, L. E. (1984).

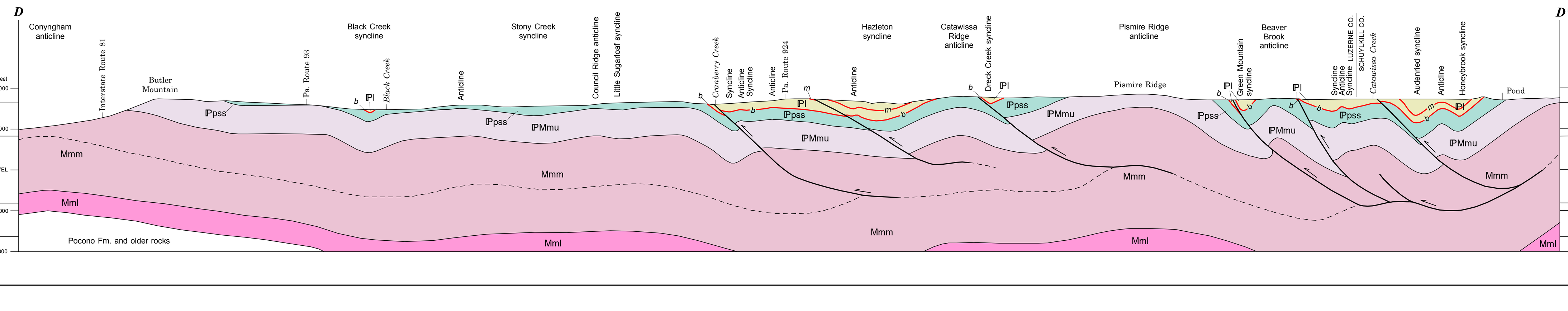
CROSS SECTIONS

(Horizontal scale same as map scale; no vertical exaggeration)









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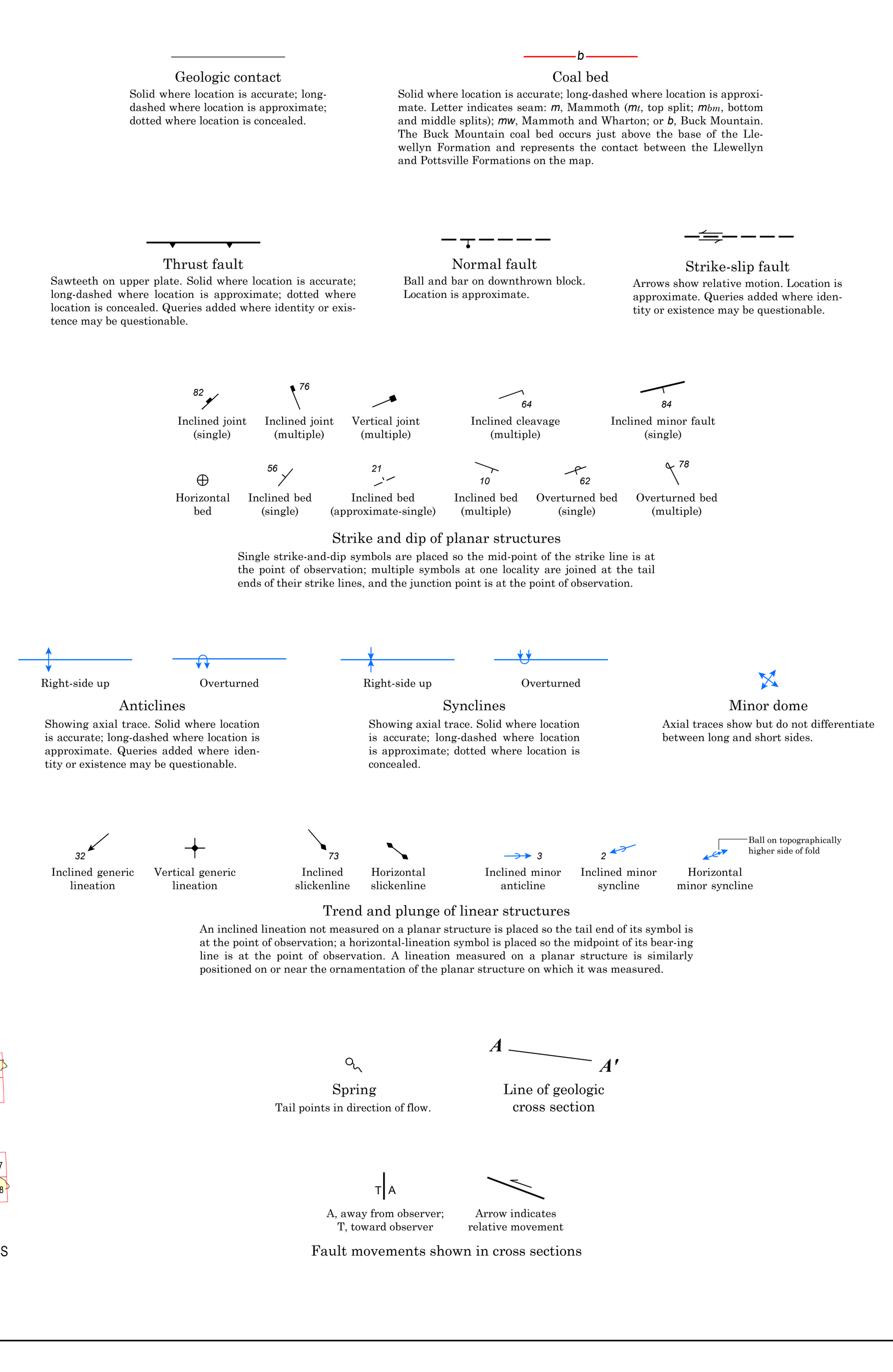
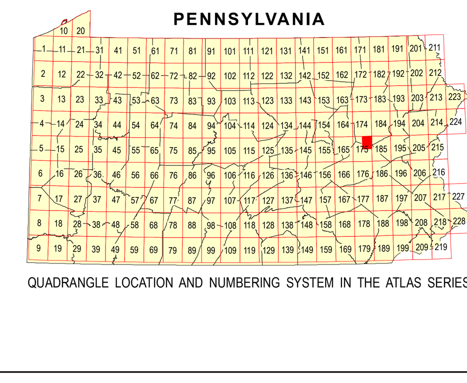
SYMBOLS





PENNSYLVANIA

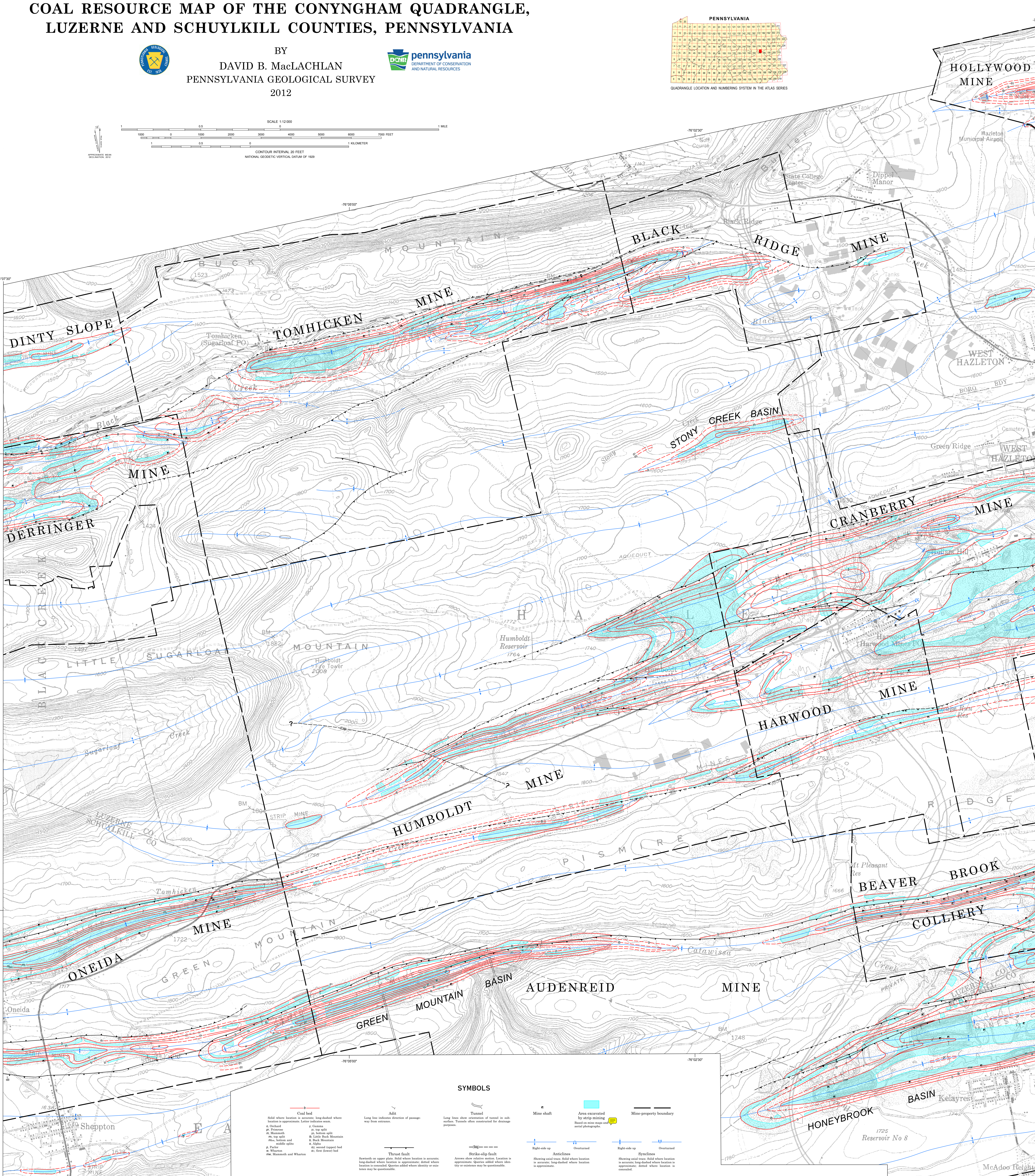
QUADRANGLE LOCATION AND NUMBERING SYSTEM IN THE ATLAS SERIES

COAL RESOURCE MAP OF THE CONYNGHAM QUADRANGLE, LUZERNE AND SCHUYLKILL COUNTIES, PENNSYLVANIA

BY
DAVID B. MacLACHLAN
PENNSYLVANIA GEOLOGICAL SURVEY
2012

QUADRANGLE LOCATION AND NUMBERING SYSTEM IN THE ATLAS SERIES

CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929



SYMBOLS

Coal bed
Solid where location is accurate; long-dashed where location is approximate. Letter indicates seam.

- *o*, Orchard
- *pr*, Primrose
- *m*, Mammoth
  - *mt*, top split
  - *mbm*, bottom and middle splits
- *p*, Parlor
- *w*, Wharton
- *mw*, Mammoth and Wharton
- *γ*, Gamma
  - *γt*, top split
  - *γb*, bottom split
- *lb*, Little Buck Mountain
- *b*, Buck Mountain
- *α*, Alpha
  - *α2*, second (upper) bed
  - *α1*, first (lower) bed

Adit
Long line indicates direction of passageway from entrance.

Tunnel
Long lines show orientation of tunnel in subsurface. Tunnels often constructed for drainage purposes.

Mine shaft

Area excavated by strip mining
Based on mine maps and aerial photographs.

Mine-property boundary

Thrust fault
Sawteeth on upper plate. Solid where location is accurate; long-dashed where location is approximate; dotted where location is concealed. Queries added where identity or existence may be questionable.

Strike-slip fault
Arrows show relative motion. Location is approximate. Queries added where identity or existence may be questionable.

Anticlines (Right-side up; Overturned)
Showing axial trace. Solid where location is accurate; long-dashed where location is approximate.

Synclines (Right-side up; Overturned)
Showing axial trace. Solid where location is accurate; long-dashed where location is approximate; dotted where location is concealed.

Coal crop lines, mined-out areas, and quantitative data by David B. MacLachlan, 1985–86, while at the Pennsylvania Geological Survey. Data based on fieldwork, coal mine maps, and interpretation of aerial photographs. MacLachlan retired from the Survey in 1996.

Digital map production by Caron E. O'Neil, Pennsylvania Geological Survey, 2012.

Base map modified from the U.S. Geological Survey digital raster graphic (DRG) of the Conyngham (1955, photorevised 1989) 7.5-minute quadrangle—UTM projection, zone 18, NAD 1927.

Table 1. *Average Thickness and Range in Thickness of Coal Beds*[1]

Coal bed	Bed thickness[2] (feet): No. of observations	Average	Maximum	Minimum	Coal thickness[2] (feet): No. of observations	Average	Maximum	Minimum	Average amount of refuse (percent)
Orchard	14	7.8	17.0	2.5	—[3]	6.9	—	—	11
Primrose	11	6.8	13.1	3.9	—	6.0	13.0	0.7	12
Mammoth (single bed and combined splits)	60	34.0	87.0	1.9	—	29.4	75.0	1.7	14
Top split	—	—	—	—	30	5.2	10.0	1.9	—
Middle split	—	—	—	—	10	3.6	5.0	1.3	—
Bottom split	4	4.5	5.8	2.8	63	3.5	5.8	1.3	23
Parlor	141	5.4	10.8	2.5	—	4.4	9.0	2.0	19
Wharton	269	8.7	21.0	1.3	—	7.1	20.0	.6	18
Gamma (single bed)	469	6.0	14.7	1.8	—	4.6	10.9	.3	23
Top split	60	4.4	9.8	1.1	—	3.1	7.3	1.0	30
Bottom split	68	5.7	15.2	1.5	—	3.8	13.1	.7	33
Little Buck Mountain	153	5.7	12.5	1.2	—	3.9	11.0	.6	32
Buck Mountain	543	6.3	16.3	1.5	—	4.9	16.1	.2	22
Alpha	28	3.1	8.0	1.2	—	2.2	5.6	.6	29

[1]Thicknesses obtained from mining company data: 1,820 observations of bed thickness and 3,068 observations of coal thickness.
[2]Bed thickness includes partings; coal thickness does not include partings.
[3]Em-dashes indicate no data available or data not noted.

Table 2. *Coal Resources of the Conyngham 7.5-Minute Quadrangle by Thickness Category and Coal Bed*

(Includes measured, indicated, and minor inferred resource categories)[1]

	Coal-bed thickness / Coal resources (millions of short tons)							
	>42 inches		28–42 inches		14–28 inches		All categories	
Coal bed	Original[2]	In place[3]	Original[2]	In place[3]	Original[2]	In place[3]	Original[2]	In place[3]
Mammoth	38.6	7.9	0.5	0.2	0.1	0.1	39.2	8.2
Parlor	10.1	3.6	.7	.6	0	0	10.8	4.4
Wharton	25.6	8.1	.9	.4	.1	.1	26.6	8.6
Gamma	25.1	12.7	4.4	2.6	1.4	1.3	30.9	16.7
Little Buck Mountain	4.8	2.0	1.1	.8	1.6	1.5	7.5	4.3
Buck Mountain	35.5	17.1	5.3	3.8	2.9	2.7	43.7	23.7
All other coal beds	2.0	.6	.1	.1	2.5	2.5	4.6	3.1
Total	142.0	52.1	12.9	8.6	8.5	8.2	163.4	68.8

[1]Owing to extensive mining, most coal thicker than 28 inches and almost all coal thicker than 42 inches are in the measured resource category.
[2]Original coal resources were computed as 0.0459 tons per cubic foot density of the original coal volumes, which were determined from mine maps and sections collected in 1985–86.
[3]Coal resources in place were calculated in 1986 from the following extraction ratios: deep mined only, 50 percent; deep mined and robbed, 60 percent; and strip mined, 100 percent. Removal of coal varies with mine practice, bed thickness, and coal quality, making the estimates of in-place resources less reliable than the estimates of original resources. Extraction ratios are intentionally conservative, that is, they tend to underestimate rather than overestimate the in-place resources at the time of calculation. Most of the thicker coals in the area have been extensively mined, and the in-place resources are in large part only accessible through strip mining.

Table 3. *Coal Resources of the Conyngham 7.5-Minute Quadrangle by Thickness Category and Depth of Overburden*[1]

(Includes measured, indicated, and minor inferred resource categories)

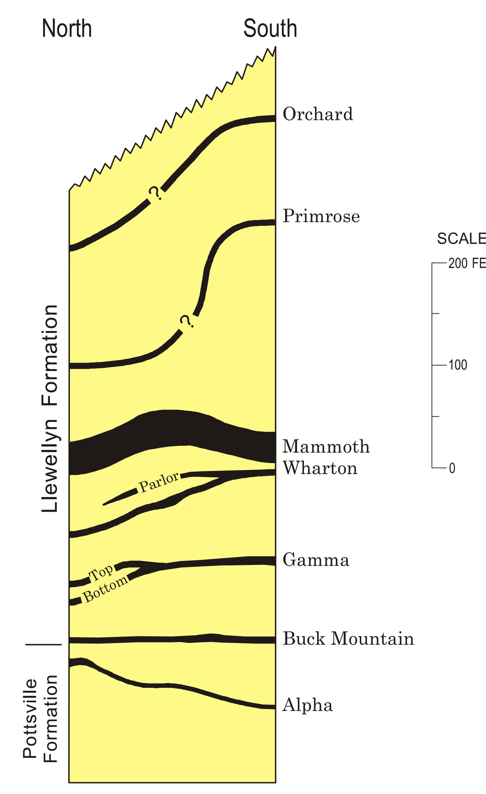
	Coal-bed thickness / Coal resources (millions of short tons)							
	>42 inches		28–42 inches		14–28 inches		All categories	
Depth of overburden (feet)	Original	In place	Original	In place	Original	In place	Original	In place
0–200	98.9	29.9	8.3	4.9	5.1	4.9	112.3	39.8
200–400	35.2	16.9	3.5	2.8	2.7	2.6	41.4	22.2
400–1,000	7.9	5.3	1.1	.9	.6	.6	9.6	6.8
Total	142.0	52.1	12.9	8.6	8.5	8.2	163.4	68.8

[1]See the footnotes on Table 2 for additional information on the resource categories, the original and in-place coal resources, and the year of calculations.

Table 4. *Coal-Seam Nomenclature*

Most prevalent usage in this area	Other names assigned to approximately the same horizon[1]
Orchard (second minable coal above the Mammoth)	
Primrose (first minable coal above the Mammoth)[2]	
Mammoth[2]	Top split, Middle split, Bottom split, Four Foot
Parlor	Wharton top split
Wharton	Wharton bottom split, Skidmore[3]
Top Gamma[4]	Gamma
Bottom Gamma[4]	Gamma, "Wharton," B vein
Little Buck Mountain	Buck Mountain, Buck Mountain top split
Buck Mountain	"Lykens," "Wharton," C vein
Alpha[5]	Lykens Valley,[3] Little Buck Mountain

[1]Names in quotes were apparently assigned for production or marketing purposes.
[2]Locally, the Primrose and Mammoth coals may include up to two coal beds.
[3]Name would be correct in the Silverbrook Mine, which is in the eastern end of the Western Middle Anthracite field and intersects the southeast corner of the Conyngham quadrangle.
[4]The Gamma zone may contain up to six coal beds locally.
[5]Locally, the Alpha coal may include up to three coal beds.



Generalized columnar diagram of coal beds in the Conyngham quadrangle showing the variations in intervals between the seams from north to south.

PRINTING INSTRUCTIONS

The opening pages of the document and this instruction page are 8.5 by 11 inches. The bedrock geologic plate (Plate 1) is 35 inches wide and 44 inches high, and the coal resources plate (Plate 2) is 37.5 inches wide and 50.5 inches high. Whether printing the atlas report from the web browser or the downloaded PDF from Adobe Reader or Adobe Pro, you can print the entire document at 8.5 by 11 inches by selecting letter paper size in the printer properties and scaling all pages to fit the printer margins. The plates will then be automatically reduced to fit on the letter-size paper.

If you wish to print the plates at full size on a plotter, you should print them separately. Set the paper size for at least the size of the plate (see above) you are printing and take care to print only the page with the specified plate. "Page Scaling" should be set to none. The illustration below shows an example of a print command window from Adobe Reader X set to print Plate 1 at full size.