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Geology *and* Physical Geography *of the* Strouds Run Area

A publication of the

Friends of Strouds Run State Park

Strouds Run
Field Guide #1
Second Edition

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Publications in this series:

1. **Geology and Physical Geography of the Strouds Run Area**
2. **Spring Wildflowers of the Strouds Run Area**
3. **Invasive Exotic Plants of the Strouds Run Area**
4. **Ferns, Fern Allies and Lycopods of the Strouds Run Area**
5. **Woody Plants of the Strouds Run Area**
6. **Vascular Plant Checklist for the Strouds Run Area**
7. **Summer Wildflowers of the Strouds Run Area**

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The Geology and Mineral Resources of Athens County, Ohio, by Myron T. Sturgeon and published in 1958 by the Ohio Geological Survey was an indispensible source of information for the stratigraphy, mineral resources, and related topics.

William E. Peters' 1947 book, **Athens County, Ohio, Volume 1**, was indispensible in providing much historical and background data.

Philip Cantino, PhD, was invaluable in proofreading and editing assistance.

Geology of the Strouds Run Area

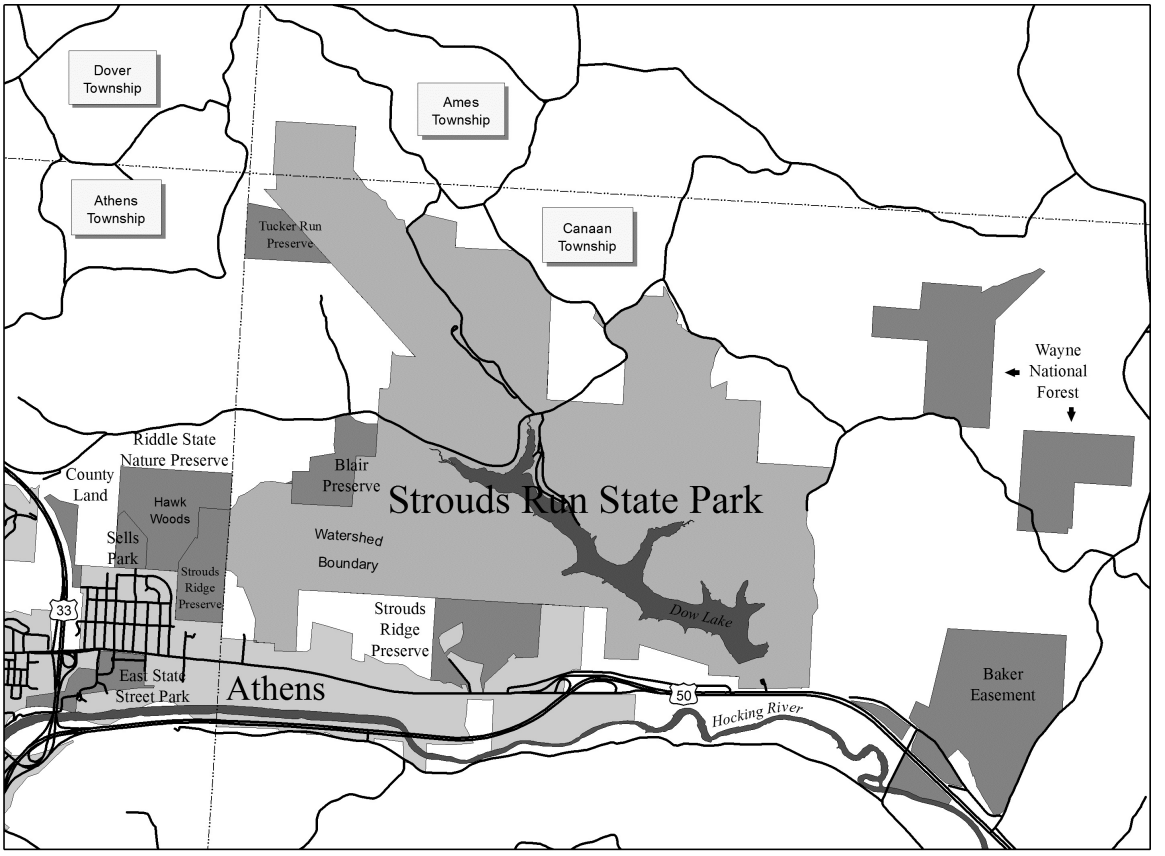
General Geography

Strouds Run State Park, about 2600 acres, mostly lies within the watershed of Dow Lake, the centerpiece of Strouds Run State Park. It includes only a portion of that watershed, (the total area of drainage that feeds the lake). The largest streams of the Dow Lake watershed are Strouds Run (once known as the Gillett Branch of Strouds Run), Labarthe Run (once known as the Labarthe Branch of Strouds Run), and Whitesel Run. Tucker Run and Gillette Run are major tributaries of Strouds Run (the stream), as well.

The state park was originally the Athens State Forest, purchased starting just after World War II and continuing into the 1960s. The lake was filled in 1961 and the land became the state park.

The area covered by this guide includes not only the state park, but also the City of Athens preserve lands (275 acres), the Athens Conservancy's Blair Preserve (75 acres), and Tucker Run Preserve (49 acres). In addition, there are two small nearby tracts of the Wayne National Forest, totaling 315 acres, and trail access onto the nearby Baker Preserve, 284 acres, managed by the Athens Conservancy.

All these lands are in Athens County, in southeast Ohio, embedded well within the unglaciated



Allegheny Plateau. This plateau is characterized by rugged, steep-sided ridges and valleys, with ridgetops at fairly even levels. These ridges and valleys begin very suddenly at the eastern edge of the glaciated area that characterizes much of Ohio. The glaciers in that area left behind a very flat land, called till plains. The unglaciated hills then gradually rise in absolute elevation and in elevation difference (between valleys and ridges), culminating in the Allegheny Front. The Allegheny Front begins the Appalachian Mountains and is followed, travelling east, by the Ridge-and-Valley Appalachians, Shenandoah Valley, Blue Ridge/South Mountain range, Piedmont (roots of very ancient mountains), Coastal Plain, then finally the Atlantic Ocean.

The land surface in southeast Ohio is called a plateau because the rock layers – called strata (singular: stratum) – are relatively flat, and the ridgetops are at roughly the same level. The ridge tops are the ancient remains of a more or less flat plain that was then lifted up, and the valleys eroded to their current level. This kind of feature has traditionally been called a "peneplain." The plateau is a roughly north-south strips, from western New York state to northwest Alabama. The western front of the plateau is some sixty to seventy miles west of the park, and the Allegheny Front is around two hundred miles to the east of the park.

Topographical Maps

Strouds Run State Park may be viewed on USGS topo maps. This is short for "United States Geological Survey 7.5-minute topographic quadrangle." A 7.5-minute quadrangle means that it spans 7.5 minutes of latitude and of longitude. "Topographic" means that the map is covered with lines drawn to show elevation above sea level.

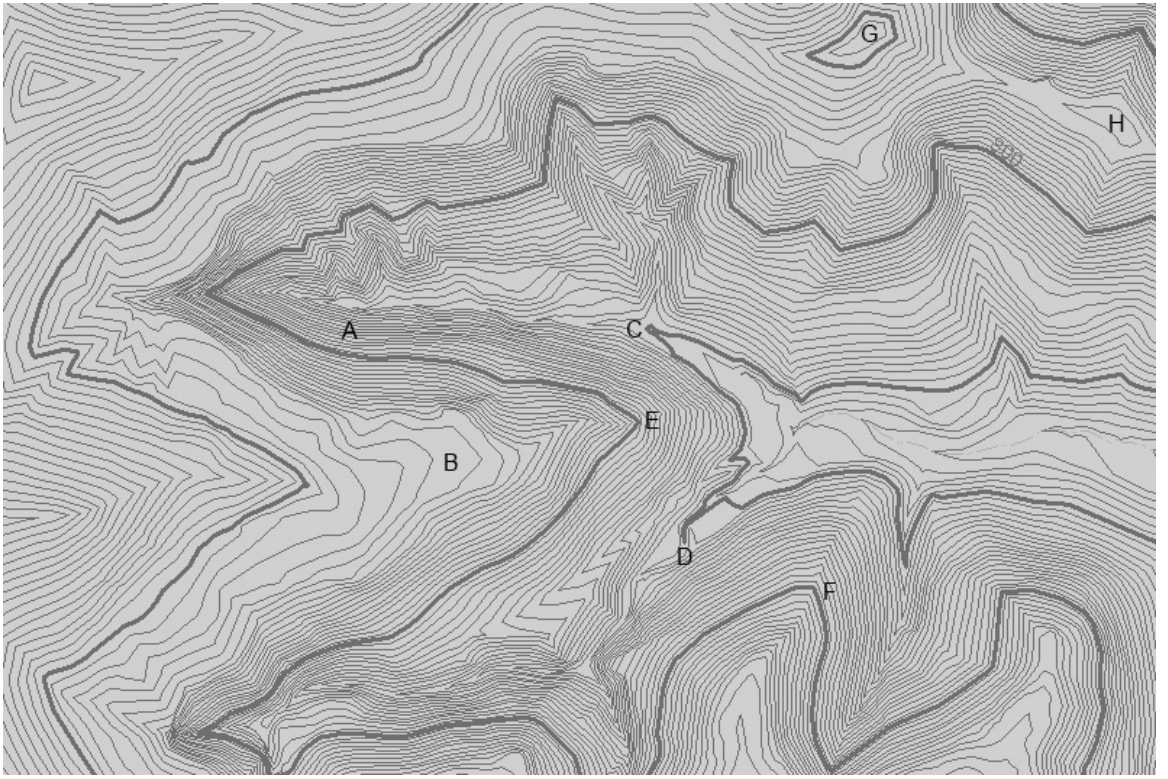
The park and associated lands lie mostly within the Athens quadrangle, which roughly covers the parts in Athens and Canaan Townships, with a small area in the Jacksonville quadrangle, which roughly corresponds with the part of the park in Ames Township. There are also coarser-scale USGS maps available, such as 15-minute maps, as well as locally-produced maps of the park with topographic layers, as shown on the next page.

A topo map should have the "contour interval" marked on it. This is the vertical distance in elevation between any two successive contours. Heavier lines generally mark 100-foot contours or other significant intervals. An 800-foot contour passes through every point on the ground surface that is 800 feet above sea level. A map in a very flat area may have a contour interval of only one foot, while a map in a very mountainous area may have a contour interval of 100 feet or more.

The map on the next page shows in detail an area of Strouds Run State Park, on the southwest side of Dow Lake. It shows a forked valley, opening to the right (east). The contour interval is 5 feet, with heavy lines at 100-foot intervals. The heavy line that lies entirely within the right half of the map represents 700 feet elevation, while the line that nearly touches the left-hand edge of the map is 900 feet elevation. Where the lines are closer together, as at "A," slopes are steeper. Where lines are far apart, as at "B," the ground surface is almost flat.

The "rule of Vs" refers to the most sharply-pointed contour lines, as can be seen at points "C" and "D." Compare these to points "E" and "F," which are not as sharp. The sharply-pointed corners ("C" and "D") are in the center of the stream channel, and point uphill. "E" and "F," on the other hand, are the points of ridges jutting out.

The "rule of Os" refers to anyplace where there is a closed circle, such as points "G" and "H." When this is seen, the inside of the circle is the highest point – unless there are small lines, like centipede legs, on the inside of the circle, which indicates that it's a hole in the ground. These are rare, however, and are mostly seen in cave country. Because the contour interval is 5 feet, it can easily be seen, by counting lines, that "G" is about 45 feet higher than "H."



Topographic maps of Strouds Run are available for sale at the park and other selected outlets.

Historic Hydrology

This area is part of the ancient Teays River drainage. The Teays River preceded the Ohio River, which was formed as a result of the last glaciation, but the Ohio River formation had little effect on the Dow Lake watershed.

The New River and Kanawha River in West Virginia were the upper part of the original Teays River, which then may have followed Trace Fork, Mud River, and Guyandot River to the Ohio, then followed the current course of the Ohio for a short distance westward, continuing to the north into Ohio about eight miles east of the present Scioto River approximately along the course of the Little Scioto River, then swinging west near Jackson to then go north in the current Scioto River valley. The old course going to the west then gets lost under glacial till. This is why the Ohio River, instead, today drains this area: because the old Teays River course became blocked by the glaciers, and drainage waters had to find a new way out. In the meantime, an immense lake, termed Glacial Lake Tight, formed, until the Ohio River eroded a deep enough channel to drain it.

In what is now Athens County, both Sunday and Monday Creeks are remnants of the pre-glacial Teays drainage (what geologists call “Chauncey Creek” was the predecessor of Sunday Creek, and “Luhrig Creek” was the predecessor of Monday Creek). Both of these creeks continued south of their present

confluence with the Hocking River, to flow together to form the "Albany River", which then followed much of the present-day course of lower Raccoon Creek, and then flowed into the ancient "Marietta River,' which drained the upper Ohio River. The united river then flowed into the Teays River west of present-day Jackson.

Present Hydrology

The Strouds Run area features a dissected, dendritic drainage pattern with trellised aspects (see Labarthe Run, below).

Dow Lake occupies about 160 acres and is fed by three main tributaries: Strouds Run, LaBarthe Run, and Whitesel Run. The first two are first-order perennial streams (also called blue-line streams), and the last is an intermittent stream. A perennial stream is one which flows year-round. A first-order stream is one that is primary, without other first-order streams flowing into it. By some analyses, all three of these streams would be second-order streams, if the intermittent stream tributaries are counted as first-order streams. The lower part of Strouds Run, inundated by the lake, was a true second-order stream in its lower reaches, because it was formed by the union of two first-order streams.

Dow Lake in winter, seen from Vista Point

Strouds Run, which follows Strouds Run Road and enters the lake at its northwest corner, in turn, has four significant tributaries: Gillette Run, along the Trace Trail, Tucker Run, along Tucker Run Road, Hunter Run, and Shadow Creek, along Shadow Creek Road. These are all intermittent streams. The Strouds Run drainage, west of the lake, has a fairly random pattern (that is, no clear drainage pattern).

LaBarthe Run flows into the lake at its north end, just after being bridged by Strouds Run Road. The lower half of State Park Road largely follows its course. Because Labarthe Run flows between parallel ridges, oriented north-northwest to south-southeast, it has a trellised pattern, with no major tributaries other than Linscott Spring. This spring joins Labarthe Run about halfway in its course. "Trellised" is a geographical term describing a drainage where smaller streams flow into a larger one at right angles, like the teeth of a comb.

Whitesel Run flows into Pine Cove on the northeast side of the lake. It is the product of two branches, which meet close to the point at which the stream enters the lake. The one that comes from the north is still Whitesel Run, while the one from the east is Groundpine Run. Each of these is further bifurcated upstream.

The total watershed of the lake is bounded by Peach Ridge Road on the west, Scatter Ridge Road on the north and northeast, Lake Hill Road on the east, and the ridge overlooking East State Street to the south. The drainage feeds directly into the Hocking River, which feeds the Ohio River, which flows into the Mississippi. Interestingly, the Ohio River actually has a greater water flow than either the Missouri or the Mississippi (if the Mississippi is measured ABOVE its confluence with the Missouri). However, the lower

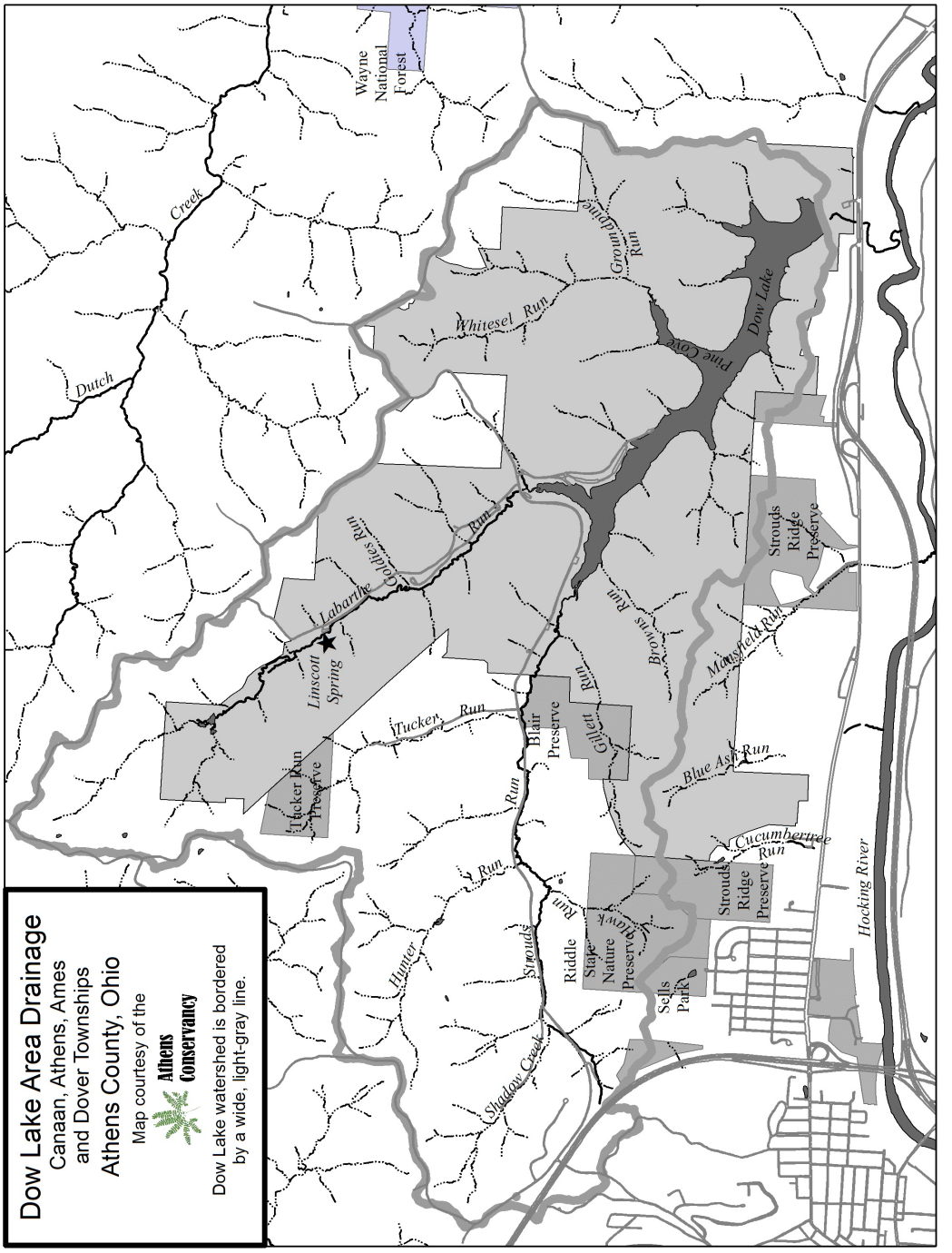
river is named the Mississippi because the upper Mississippi has a greater flow than the Missouri where the two join, while the resulting river has a greater combined flow than the Ohio where the two meet.

The watershed of Strouds Run includes a small area southwest of the US-33 bypass east of old Peach Ridge Road and east of the part of Strouds Run Road that runs from Cable Lane to Columbia Avenue.

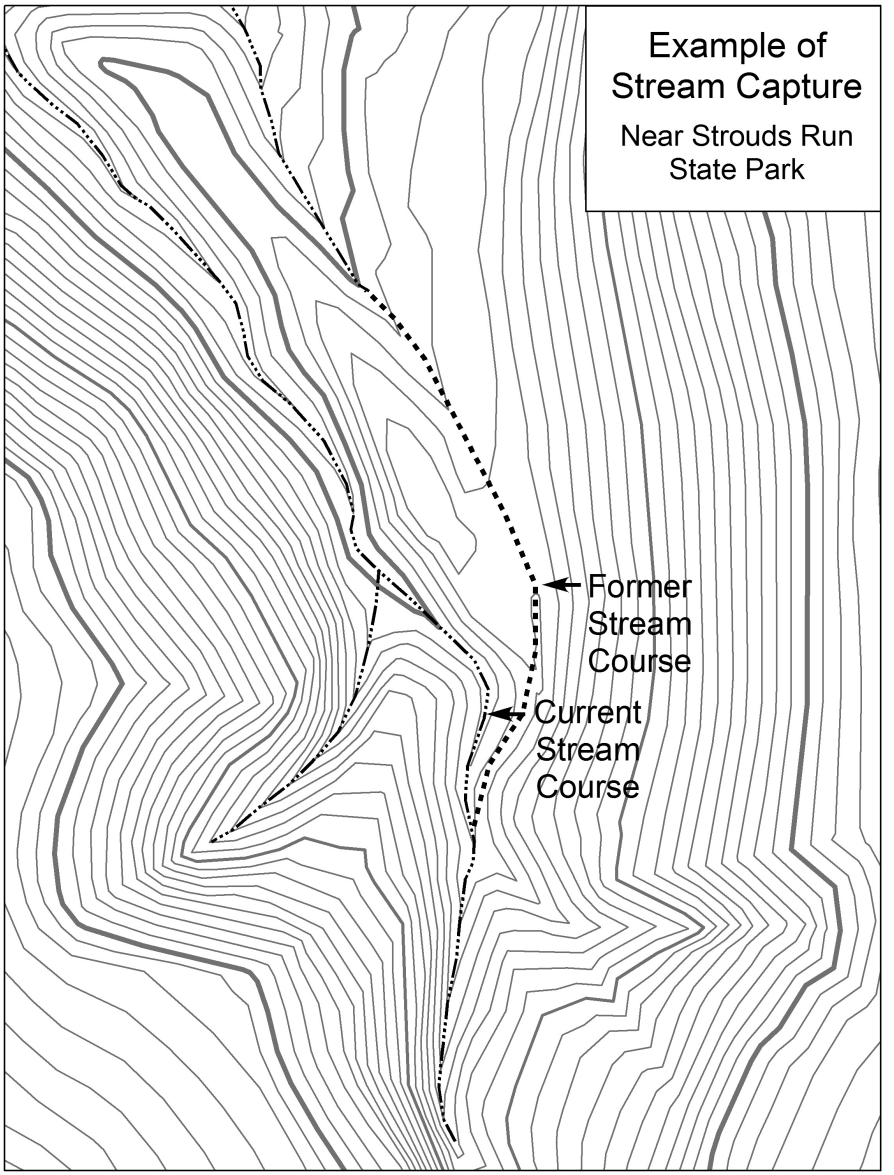
There is a fair amount of groundwater storage in the ridges of Strouds Run in rock pores and close joint space and bedding planes, but the water density overall is very low and wells do not produce well, unless they manage to locate precisely in a joint space of the Ames limestone. Deeper wells may produce saltwater and/or acid water. There are no true caves in the park (not to be confused with rock shelters, which are frequent in the park, discussed below). A number of small seepage springs flow year-round in the ridge sides. In addition, there are a few springs flowing out of the Ames limestone. There is one such limestone spring, the largest in the park, north of the lake, Linscott Spring, that feeds LaBarthe Run close to the old park headquarters. It still flows at a rate much reduced from former days in an old stone springhouse accessible to the public. To see it, park in front of the maintenance complex on State Park Road (up the road from the campground entrance), and walk to the right to the back of the maintenance buildings, where a bridge is provided to cross Labarthe Run. The spring is still a major tributary to LaBarthe Run. Much of the water supplying the spring comes from the upper watershed of Tucker Run, infiltrating down to the Ames Limestone, then flowing downhill underneath the ridge to the spring.

Linscott springhouse

There are several streams that are not part of the Dow Lake watershed, but that drain the southern part of the park area. These flow from the dividing ridge on the south side of the watershed boundary, and all feed directly into the Hocking River. From west to east are Sells Run, exposed for only a short stretch, feeding Sells Pond and draining Sells Park, but then being underground through the neighborhood to the south; Cucumbertree Run, draining the valley behind the Dance Barn and Credit Union on East State Street (along the Cucumbertree Trail), then underground in the East State Street corridor, under the parking lots south of the street; Blue Ash Run, draining the valley behind The Market on State (formerly University Mall), then underground at The Market; and Mansfield Run, draining the valley of Hope Drive.


Dow Lake Area Drainage
Canaan, Athens, Ames
and Dover Townships
Athens County, Ohio
Map courtesy of the
Athens Conservancy
Dow Lake watershed is bordered
by a wide, light-gray line.
Wayne National Forest
Dutch Creek
Whitesel Run
Grouse Run
Pine Cove
Dow Lake
Labarthe
Linscott Spring
Tucker Run Preserve
Tucker Run
Goblins Run
Blair Preserve
Gillett Run
Brownie Run
Mansfield Run
Strouds Ridge Preserve
Blue Ash Run
Cucumbertree Run
Hunter Run
Strouds Run
Riddle State Nature Preserve
Shadow Creek
Sells Park
Hocking River

An interesting phenomenon visible at several points around Strouds Run is called stream capture. When there are two drainage valleys close to one another, sometime the ridge between the two is breached and the upper part of one stream starts draining into the other stream. An example of this can be seen along the Cucumbertree Trail at McLaren's Pond. The stream, which now bypasses the pond, apparently originally flowed through the position of the pond. Another example, on private land near the park, is shown at left.



Historic Geology

Rock strata within our area are all of Pennsylvanian age; the Pennsylvanian and Mississippian periods make up the Carboniferous super-period, when most of the major coal deposits were formed. The Carboniferous is in the fourth of six great divisions of Earth's history, the Paleozoic.

The geologic time table below is based on the newest version known. It is published by the Geologic Society of America at their website and is also found on Wikipedia at "Geologic time scale." The former Tertiary period is now divided into the Paleogene and the Neogene. The Pennsylvanian and Missippian are American designations only; the rest of the world combines them into the Carboniferous. The times in the table are considerably older than previously believed.

Eon	Era	Period	Duration
Phanerozoic	Cenozoic	Quaternary[3]	2.6 million years ago to present
		Neogene[2]	23 to 2.6 million years ago
		Paleogene[1]	66 to 23 million years ago
	Mesozoic	Cretaceous	145 to 66 million years ago
		Jurassic	201 to 145 million years ago
		Triassic	252 to 201 million years ago
	Paleozoic	Permian	299 to 252 million years ago
		Pennsylvanian	**323 to 299 million years ago**
		Mississippian	350 to 323 million years ago
		Devonian	419 to 350 million years ago
		Silurian	444 to 419 million years ago
		Ordovician	486 to 444 million years ago
		Cambrian	541 to 496 million years ago
Proterozoic	Neoproterozoic	3 periods	1.0 billion to 541 million years ago
	Mesoproterozoic	3 periods	1.6 to 1.0 billion years ago
	Paleoproterozoic	4 periods	2.5 to 1.6 billion years ago
Archean (Archeozoic)	Neoarchean	Not determined	2.8 to 2.5 billion years ago
	Mesoarchean	Not determined	3.2 to 2.8 billion years ago
	Paleoarchean	Not determined	3.6 to 3.2 billion years ago
	Eoarchean	Not determined	4.0 to 3.6 billion years ago
Hadean	4 eras	Not determined	Before 4.0 billion years ago

1. The Paleogene comprises the Paleocene, Eocene, and Oligocene Epochs.
2. The Neogene comprises the Miocene and Pliocene Epochs.
3. The Quaternary comprises the Pleistocene and Holocene Epochs, the Holocene being the present.

Geologic Map

Strouds Run State Park

Riddle State Nature Preserve - Sells Park

Strouds Ridge Preserve - Blair Preserve

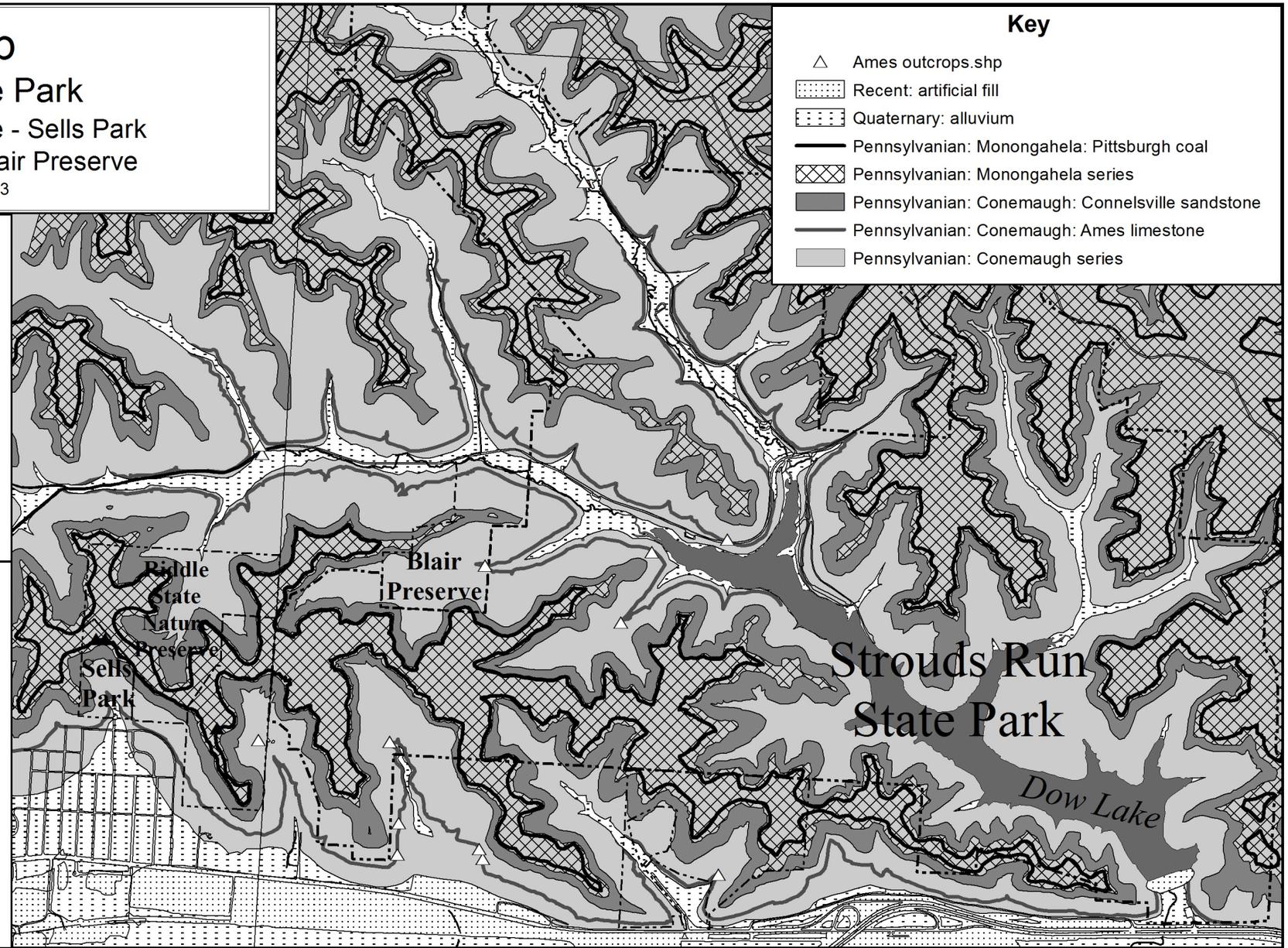
Map version of 14 August 2013

Notes on the Map

The general symbol for the Monongahela series clearly delineates the ridges, and, of course, the general symbol for the Conemaugh series shows the lower areas. The Ames limestone is not fully mapped on this map. The Pittsburgh coal is usually concealed beneath overburden, but is shown on the map because it is a consistent stratum and because it is economically significant. It is generally only one to two feet thick. The Ames limestone is generally nine to eighteen inches thick.

Athens Escarpment

The Connelsville sandstone forms a local escarpment on the east side of Athens (see page 11). This bluff-forming sandstone forms a generally westward-facing escarpment, except along the East State Street corridor, where it faces the Hocking River -- and where the river cuts through the escarpment. The escarpment is clearly visible when driving west on US-33 from East State Street to Columbus Road. On the map, the escarpment is along the gray band of the Connellsville sandstone from Dow Lake dam west to Sells Park.



0.95 0.475 0 0.95 1.9 2.85 3.8 Miles

The Proterozoic, Archean and Hadean are also grouped as the Pre-Cambrian super-eon.

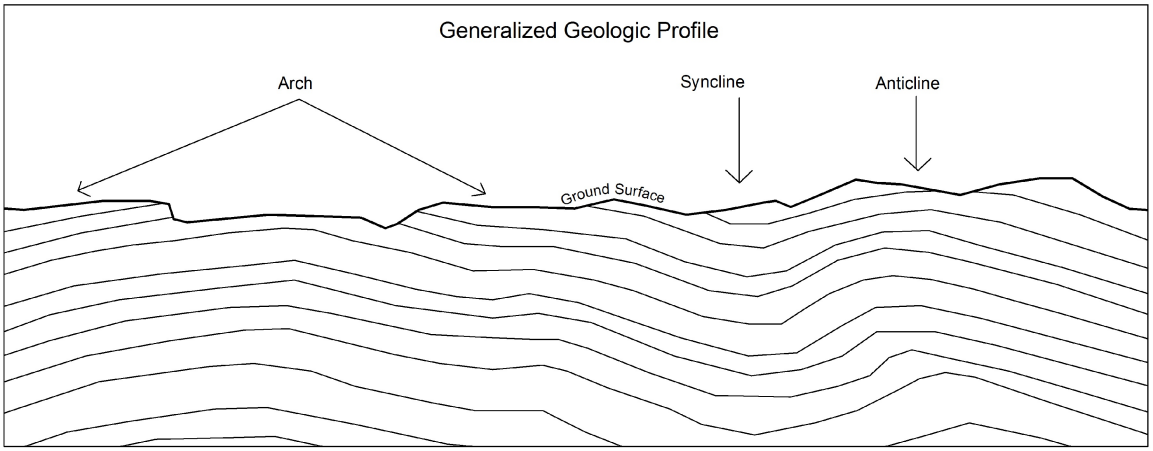
Each period is divided into epochs or series. Those used in the Appalachian area are generally quite different from those used in the rest of the world. The Strouds Run area lies within two series of the Pennsylvanian: the Conemaugh and the Monongahela. The rocks within our area are slightly over 300 million years old. Rock strata in our area generally dip gradually to the east, so in eastern Athens County, the younger Permian strata appear with the Washington and Greene series, while the older Pottsville and Allegheny series precede and underlay the Conemaugh and Monongahela series to the west.

Rock formations in the Appalachians during the Pennsylvanian and early Permian eras tended to form in curiously repeating cycles termed “cyclothems.” A cyclothem, from bottom (oldest) to top (youngest) typically includes first sandstone, then grading into shale, then possibly freshwater limestone (often nodular), then an underclay just under a coal seam, then a dark shale overlain by a marine limestone, then marine shale. This progression seems to be closely related to changing water depths, as a combination of isostasy and sedimentation made seas or lakes deeper or shallower (isostasy means the rising of land as a rebound reaction following the depression of land due to a heavy overburden, which can be ice, water, or the deposition of solids). Thicknesses in the table are average total thickness of the formation. The Ames limestone only occupies 1-2 feet of the Ames formation.

Series	Cyclothem	Characteristics	Feet
Monongahela	Sewickley	Limestone on tops of highest ridges to east, over shale	33
	Lower Sewickley	Dark to light shale, sandstone	20
	Fishpot	Yellowish nodular limestone on ridgetops over redbeds	44
	Redstone	Shale and sandstone outcropping, occasional blocky limestone	35
	Pittsburgh	Includes Pittsburgh coal; largely redbeds; upper Pittsburgh limestone (nodular); shale	40
Conemaugh	Upper Little Pittsburgh	Shale/siltsone, mostly concealed, spotty	33
	Lower Little Pittsburgh	Connelsville sandstone, massive, cliff-forming, ranges from 20-100 ft thick	54
	Little Clarksburg	Sandstone and shale, largely concealed	58
	Elk Lick	Shale and sandstone, mostly concealed	52
	Duquesne	Shale and sandstone, mostly concealed	38
	Gaysport	Shale/some limestone, mostly concealed	13
	Ames	Ames limestone over shale	17
	Harlem	Includes Harlem coal, mostly dark shale & redbeds; visible near E. State St.	36
	Upper Bakerstown	Mostly shale, mostly underground	30
	Anderson	Mostly shale, mostly underground	23

Stratigraphy

Athens County lies in an area of almost flat rock strata, although they do dip slightly to the east (actually slightly south of east, at 102.5 degrees) at a rate of about 31 feet per mile. This area is on the eastern side of the Findlay Arch, which continues northward from the Cincinnati Arch in Kentucky. This is essentially a large-scale wrinkle in the Earth's surface, where rocks are elevated most in the center, with the younger rocks eroded away to expose the older ones, and the sides gradually descend or dip down, so as one travels away from the center of the arch, the rocks encountered get progressively younger. To the east of us is the Parkersburg Syncline, a smaller structure that is more or less the reverse of the arch – the rock is folded down instead of up. There are a few more gentle structures as one travels east through the Allegheny Plateau (the Cumberland Plateau in Kentucky and Tennessee), but with rock strata mostly close to flat – until, nearing the Allegheny front, the strata rise more sharply. Then all heck breaks loose in the ridge-and-valley Appalachians, with sharp fold after sharp fold, alternating anticlines and synclines. But that's substantially east of our subject area.



Rock Types

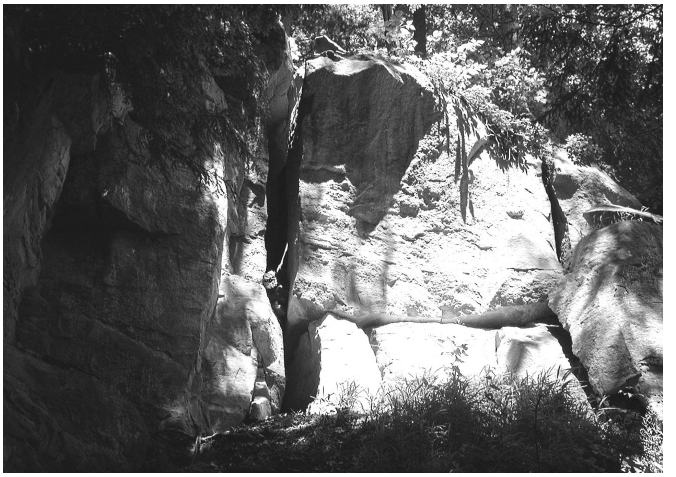
In our area, there are three main types of rock strata: shale, sandstone, and limestone. There are also coals and underclays, but these aren't structurally important, although the coal is very economically important. Some of the shale beds are a special type called redbeds. All of these types can intergrade into one another, especially the shale and sandstone, and the shale and coal.

Sandstone and Shale

Shale and sandstone are different rock types, but intergrade into each other frequently. We have more shale and sandstone than anything else, with minor incidences of siltstone, which is somewhat intermediate between the two. Sandstone is composed mostly of sand, siltstone mostly of silt, and shale mostly of clay. There are also some layers of pure clay.

The ridges around Athens stay in place because they're capped with erosion-resistant sandstone, or because the sandstone is located near the top of the ridge. The most important of these is the Connellsville sandstone, which is the one that forms the high bluffs such as Pepsi Rocks and Turtlehead Cave (a rockhouse or rock shelter) behind The Market on State. The name comes from Connellsville, Pennsylvania.

The Connellsville sandstone can be 100 feet thick, but is usually much less, often around 40 feet thick south of the lake, and in places 20 feet thick or even less – down to 9 feet – north of the lake. The boundary between the lower (older) Conemaugh series and the higher (younger) Monongahela series is on top of the Connellsville sandstone. In general, though, there are many more shale beds than there are beds of sandstone in most of southeast Ohio, including the area of the state park.



Connellsville sandstone exposed at old Crumley quarry

A phenomenon often seen in this sandstone series is known as an unconformity, which is a term used to describe some kind of historical or structural break in the series of strata. The unconformities seen in this sandstone are know as disconformities, where the rock was formed, then the surface eroded, and new rock laid down over top of it. Many of these are angular disconformities, where the underlying rock was displaced at an angle before the new deposition, as can be seen in the photograph. The underlying rock is tilted compared to the overlying rock.

Angular unconformity, US-33 near the park

Another important sandstone lies high in the ridges about 15 to 20 feet above the Connellsville. Like the Connellsville, the Redstone sandstone is massive (meaning thick, not clearly bedded) but seldom forms bluffs, usually being concealed behind steep slopes. At the very tops of the highest ridges west of the lake is a thinner, thinly-bedded sandstone, the Lower Sewickley sandstone.

East of the lake is a massive but also shaley sandstone that is represented mostly by shale west of the lake; this is best seen in a small ravine just off Route 50 just east of the Dow Lake Dam area entrance. This may be the Upper Grafton sandstone, in the Elk Lick cyclothem.

Sometimes curious patterns may be seen in sandstone, often called “honeycombing.” These typically form one of two ways: either they are the result of nodules being deposited and packed together, often with another material as a matrix, or the rock has become fractured into smaller pieces and minerals have infiltrated the cracks.

Limestone

Limestones are less frequent than sandstones and shales around Strouds Run State Park. There are only a few important limestone strata, and they're mostly only a foot or two thick. But they're often a harder rock. The Ames limestone can help to stabilize the rocks above and below it – but an exposed edge will allow the joints to spread, undermining the stability of the layer.

The Ames limestone, the most important of the limestones, is used as a geological index stratum. This means that it provides a clear reference for figuring out the identities of other rock strata. Most of the rock layers in our area fade in and out of existence, but the Ames is very consistent and easily identifiable, so it can be used to index the locations of other rock strata by their relationship to it – above or below, and how far.

Ames limestone in Gillette Run

Excellent exposures of the Ames limestone can be found in a few local stream beds, including along Browns Run (the first stream valley crossed by the Hickory Trail east of the Finger Rock Trail), and on Blue Ash Run behind The Market on State. To the east of the lake, and immediately north of the lake, this bed has dipped down so far that the exposures are underground or have been obscured by alluvium (recent natural fill deposited by water action).

This limestone caps ridges in the western part of the county, as all rock strata ascend to the west. The Ames limestone is also the source of several springs in the park, including Linscott Spring, behind the maintenance complex on State Park Road (see photograph on page 6). Springs from the Ames are usually on the eastern or southeastern sides of ridges, but there are a few exceptions, such as above the Dance Barn at the trailhead for the Cucumbertree Trail. There is no trail to this spring, which once supplied the old farmhouse near the barn.

Other limestones are within the area, all lying above the Ames. Around 60 feet higher than the Ames in Blue Ash Valley (behind The Market on State) and Mansfield Valley (above Hope Drive) to the east is a nodular limestone that may be the Elk Lick limestone, a very inconsistent formation. Nodular limestones are strata that consist of chunks of limestone embedded in a clay matrix, and not clearly bedded.

There are a few dry exposures of limestone in Strouds Run at the ends of ridges just east of the campground, where it supports a few small populations of the purple-stem cliffbrake (*Pellaea atropurpurea*), a rock fern that grows only on limestone and is rare in our area. This is thought to be the Clarksburg limestone, also a very inconsistent formation.

Farther up on the ridgetops is the Upper Pittsburgh limestone, a thin, nodular limestone that sometimes is exposed in trails and looks like crushed stone. East of the lake, limestone rocks that have weathered yellow are often seen on top of the ground; these are Fishpot limestone. Decaying redstone limestone may be seen on the Hope Drive Tract of the City's Strouds Ridge Preserve. A thin layer of Sewickley(?) limestone may be seen capping the highest ridges in the Baker Preserve.

Sells Park has a set of limestone steps and a limestone wall constructed at the west end of the dam. These are made of the Ames limestone, which was brought in from another site.

Redbeds

Redbeds are actually a type of shale but defy the idea that most people have of what rock is. The average person can take their hands and literally dig into the redbed layers, which are often quite thick. Think of moist, packed kitty litter. These strata are the most unstable, the slickest, and by far the most dangerous to build on. From the parking lot of The Market on State, look westward at the dark reddish exposed areas of the rock in the cut behind Hampton Inn: those are the redbeds. The color comes from iron oxide. Redbeds are very unstable substrata for roads and foundations.

Coal

Two coal seams are exposed within the park area, the Pittsburgh coal high on the ridges and another shaley coal below the Ames limestone. The Harlem Coal is also exposed near East State Street. These are discussed in the next section.

Economic Geology

Historically, valleys in the Dow Lake watershed were used for agriculture due to the alluvium in the stream bottoms, the availability of water in the perennial streams, and the presence of several springs in the area. Typically, hillsides were used for grazing, with most of the land deforested for lumber and firewood.

Coal

Historically, coal has been very important in southeast Ohio. A small area of the park still has mineral rights outstanding (owned by someone else), and this is probably because of the Pittsburgh (#8) coal seam. This seam is only about a foot or two thick, but is a commercially viable coal. It occurs high on the ridges, about 15 to 20 feet above the top of the Connellsville sandstone. A number of old "drift mines" are known from the area, where people in the past had mined coal for their own use or for small-scale sale. These mines were all hand-dug, and are typically found on top of the bench that occurs atop the Connellsville sandstone. Such mine traces may be seen on the Athens Trail where it climbs to the ridgetop from Sells Park (two examples), and south of the Athens Trail just west of the junction with the Finger Rock Trail (not visible from the trail). The main evidence that you will see is a trench dug in the bench for drainage of the mine; most of the old mines can no longer be seen because they've caved in.

Drift mine along Athens Trail in Sells Park.
The mine was under the rock ledge in the upper left-hand corner, and the drainage trough is in the front.

The Harlem Coal is much farther down, beneath the Ames limestone, but it is of low quality and is not commercially attractive. It can

be seen behind Hampton Inn on East State Street.

The entire area is underlain by the Middle Kittaning (#6) coal and the Lower Kittaning (#5) coal seams. These are deep underground – but could be mined in deep mines, as they were east of the park at the old Canaanville Mine. The greatest difficulties with such deep mines are removal of water and ventilation. Much of the western half of Athens County is honeycombed with old coal mines where the Middle Kittaning, often five to six feet thick, and sometimes thicker, was mined.

Overall, Athens County ranks fifth in the state of Ohio for the total amount of coal produced over its history. Most of this coal came from deep mines in the northwestern part of the county, from Nelsonville to Glouster. There are also extensive strip mines, where the upper Freeport coal was mined, in Canaan, York and Dover Townships, and a few in Ames Township.

Oil and Gas

There is some natural gas underlying the park. Gas frequently bubbles up in a couple of spots in the lake. There are recent or active gas wells in several private valleys close by, although no major pools lie under the park. There are no known oil pool resources within the park, but there are small oil pools scattered throughout the county, and gas wells tend to produce small amounts of oil with the gas.

There are the deeper strata underlying much of Athens County that are figuring into the current oil-shale or "fracking" boom. "Fracking" means horizontal fracturing of shale layers to cause release of gas and oil. The target strata are the Ordovician-age Utica shale and the Devonian-age Marcellus shale. The Marcellus shale is thought to be very thin or absent under Strouds Run, while the deeper Utica may be of moderate thickness. These are very deep – several thousand feet beneath the ground surface. If a well produces only gas, it is called a dry gas well. However, wells in our area produce a mixture of gas and oil, and are thus termed wet gas wells. Fracturing these layers could lead to potential future problems if there are earthquakes, because the geology will be less stable than now.

However, the greatest seismic problems experienced so far from fracking have resulted from injection of the contaminated saline waste water solutions back into the ground, in wells. These "injection wells," which produce additional pressure in rock strata and at the same time lubricate those strata, have been linked to many small earthquakes, including those that occurred near Youngstown in 2011.

A practical improvement in this process would be to re-use the fracking water instead of injecting it into the ground. This would still require disposal of chemical and radioactive waste that would need to be removed from the water, but the total volume of water for disposal would be far less.

Shale

The shale in our area was once extensively used in brick production, especially the production of high-quality paving block. However, there have been no brick producers locally in business for some years now. No brick production is known to have taken place within the Dow Lake watershed.

Stone

The Ames and Sewickley limestones have been quarried and are suitable for use as building materials, but the exposures in the park are, in general, poor. The Ames limestone is extremely hard and durable, but is too difficult to work and shape for general use.

The Connelsville and other sandstones were often quarried for foundation stone. Unfortunately, the effects of frost spalling tend to erode it away fairly quickly. Frost spalling is a process wherein water penetrates the surface of the rock, then freezes, and the expansion of the ice pops off small pieces of rock,

often just grains of sand in the case of sandstone. Old sandstone foundation blocks may be seen on the Trace Trail shortly after it turns off the Hickory Trail, near Strouds Run Road. The John Jackson Crumley House, overlooking East State Street east of The Market on State, used the Connelsville sandstone for its foundation, with the quarry clearly visible from the Rockhouse Trail just southeast of the White Ash Trail (just east of the county's champion black oak).

Old foundation stones at the Gillett homestead

Most of the sandstones are massively (thickly) bedded, without many bedding planes or joints, so they weather directly from large boulders to sand; consequently, rocks small enough to be used for manual construction are usually very irregularly-shaped. An exception to this is the Lower Sewickley sandstone found atop some ridges, which is an ideal thickness for building rock walls and other structures.

Salt

In the early days of settlement, salt was an important industry in Athens County. It was produced by pumping up brine from water wells and evaporating off the water to leave the salt. This was mostly done in the Beaumont-Chauncey area. No salt production is known to have taken place in the Dow Lake watershed.

Iron ore

Enough iron ore is present within some of the sandstone formations to produce iron. Iron furnaces were once in operation in the area, but mostly to the west of Athens County. Although the Connellsville sandstone (and other sandstone) does sometimes have high-grade iron veins, these are too thin and sparse to ever have been an economically viable source of iron. These can sometimes be seen as dark gray layers on sandstone boulders. Iron oxides also produce the color of redbeds. Iron oxides visibly stain some of the seepage seen from the Hickory Trail at the Browns Run crossing.

Timber resources

Timber resources are being mentioned here because they figured in the historic geography in the area, contributed to the shaping of the landforms and fueled area development. When white settlers first came into the area, most of Athens County was well-forested, except for a few hilltop prairie-like openings and buffalo beats. The county, including the Strouds Run area, was mostly deforested by the early twentieth century. Only a few pockets of woods, such as Hawk Woods (Riddle State Nature Preserve) were left more or less intact. Even steep slopes were deforested for farming purposes; nothing was too steep to be used as pasture land. This deforestation and livestock grazing on steep slopes brought about erosion and mass wasting (downslope movement of earth and rock), and thinning and impoverishment of soils, which are still recovering. Today, massive slumps (downslope movement of the ground surface that remains more or less in one mass) are very common on steep slopes – as are other downslope movements. Mass wasting will always be seen in this area due to the inherent instability of the underlying shales, but it will become less frequent as root zones of the forest become better developed.

Land Forms

If you look around at the landscape, you will notice very consistent features. Because of the plateau (peneplain), the ridgetops tend to be fairly even. All the hillsides tend to be the same in profile, because of the almost flat rock strata.

As you go down a hillside from the top, you will notice that there are steep stretches punctuated by more level stretches, which are called benches. There are bluffs and rock outcroppings interspersed between these. The rock outcrops are the most obvious at the points of ridges, and in the deepest cuts of the valleys where the streams flow. The most obvious cliffs are formed by the Connelsville sandstone. The most obvious and consistent bench is just below the Connelsville sandstone. Some benches overlie limestone, and this can be inferred from the presence of limestone-loving plants such as chinkapin oak (yellow oak, *Quercus muehlenbergii*), hackberry (*Celtis occidentalis*) and twinleaf (*Jeffersonia diphylla*).

In some places, huge boulders break off the Connelsville sandstone. These are often used by boulderers (rock climbers), especially on the west side of Crumley Ridge. In many places, the sandstone may feature a honeycomb pattern. This sandstone is not extremely hard, and is fairly easy to work with steel tools – until you hit the occasional thin reddish-black iron layer that will stop you cold.

In the deep valleys, and sometimes on the sides of ridges, are to be found shallow "caves" called rock shelters, often called rockhouses. Unlike true caves (which occur mainly in limestone), rock shelters are formed mostly by wind and frost erosion. In the winter, moisture that seeps into the face of the sandstone and shale freezes, popping off individual sand grains and flakes of shale. Sandstone weathering this way results in very sandy soils just below the rock faces.

View across ridgetops, Baker Tract

Rock shelters that are easily seen from the Rockhouse Trail include Pillar Rock just east of Sells Park, Window Rock in Boulder Cove, and Turtlehead Cave in Blue Ash Valley. This last is one of the largest rock shelters (or rockhouses) in our area. The rock shelters deep in the valleys often form small intermittent waterfalls, which can be impressive during or after a heavy rain, and can feature beautiful ice formations during cold winters, but they are dry during most of the summer.

Bluffs form because the harder sandstone resists chemical weathering. The Connelsville sandstone, for instance, may occur across a geographic area, but there are harder and softer zones within it, largely related to rock density and porosity (the presence of small air spaces). Erosion-resistant ridges mostly occur because they represent harder zones of the rocks, while the valleys often result from softer zones.

Although water, wind and frost action erode and weather exposed rocks, most of rock decomposition happens under the soil, where it is not seen, and it happens because water carries humic acids (including

tannic acid), formed from decaying leaves and other organic materials. Although sandstone is less amenable to this process than limestone, most sandstone bluffs will nonetheless be seen on south-facing and southwest-facing slopes, where the sun tends to dry out the soil, reducing the chemical weathering effect.

In the case of rock shelters, there is softer rock under the sandstone that is even more prone to chemical weathering, frost spalling and wind (also called aeolian) erosion. This tends to weather away while the sandstone then remains to form a roof.

The land surface is not stable in the long term. If you could view a hillside through an extreme time-lapse filming technique, you would not only see the hillside being pushed back and lowered because of the weathering process, but you would also notice that the earth on the hillside is constantly flowing downhill. Hillsides are like conveyer belts: Soil is constantly formed both by the rock decomposing underground, and by the organic matter decomposing aboveground, with a very slight admixture of airborne dust, which soil then flows down the hillside where it is gradually taken away by the stream at the bottom. Over just a few thousand years, the appearance of an area can change so greatly that you would no longer recognize it.

The bottoms of the larger valleys are often flat because of more recent sediments being laid down. These are called alluvium, and are deposited by streams. The flatter the valley floor, the more likely a stream is to meander. Sometimes beaver dams may cause flooded areas that over time become filled with sediment and thus flatten out.

Often, curious humps will be seen towards the base of hillsides. These are formed by earth flows, which are generically called “mass wasting” by geologists. Often, when shale beds decompose into clay soil, water will lubricate these at the base. When this occurs, large areas of earth may suddenly and catastrophically flow down the hill. Many of these formations may be seen along the Rockhouse Trail, often in somewhat moister areas.

When an area subsides all at once, but the part that settled seems to be intact, this is called a slump. A slump occurs when a slippage plane forms at the base of a volume of soil (which may include detached rock), which is lubricated by moisture, and the whole area, large or small, will move some distance downhill as a unit. Usually, these descend no more than few feet, but they can go farther.

Fossils

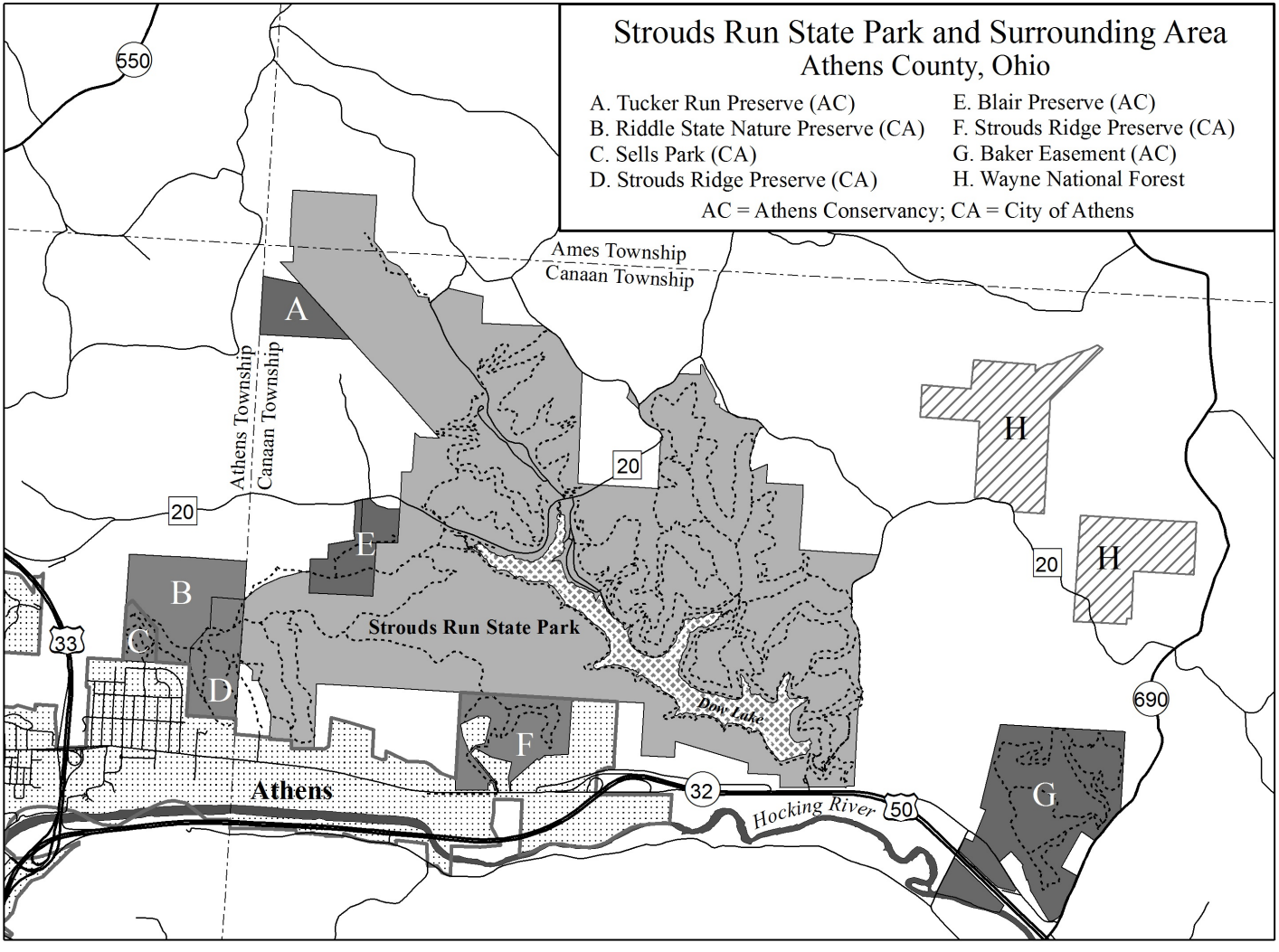
Fossils are generally rare in rocks the Strouds Run area. Only the Ames limestone has a large number of fossils imbedded in it. Typically, these are of corals or brachiopods. However, the Ames limestone is one of the hardest rocks in the area and fossils are difficult to extract. Most of the fossils present are fractured. Any limestone, of course, is worth investigating for fossils, and they are occasionally found in shale but very seldom in sandstone.

Elsewhere in Athens County, leaf fossils of ferns or seed-ferns can be found in black shale, and fossilized chunks of wood area are often found in the Shade Creek drainage, but these are not found in the park.

Because of the age of the rocks, it is always possible that a fossil hunter might discover more exciting fossils, even of vertebrates, but it is highly unlikely.

Stone Artifacts

Because there is a very long history of human settlement in this area, there are many stone artifacts of prehistoric humans embedded in the ground, mostly arrowheads or spear points. They may be found many places, but are most commonly found by the casual seeker in stream beds, where they have been washed out of the soil. These artifacts are mostly made of rock imported into the area from elsewhere, since we do not have good flint or similar-quality rocks for making these implements. They may occur, of course, in the floors of rockhouses or in Indian burial mounds, but it is illegal for the public to excavate these.


Strouds Run State Park and Surrounding Area
Athens County, Ohio
A. Tucker Run Preserve (AC)
B. Riddle State Nature Preserve (CA)
C. Sells Park (CA)
D. Strouds Ridge Preserve (CA)
E. Blair Preserve (AC)
F. Strouds Ridge Preserve (CA)
G. Baker Easement (AC)
H. Wayne National Forest
AC = Athens Conservancy; CA = City of Athens
Ames Township
Canaan Township
Athens Township
Canaan Township
Strouds Run State Park
Dow Lake
Hocking River
Athens
550
20
33
32
50
690