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ABSTRACT

Ridley Creek is a 24-mile long tributary of the Delaware River located in southeastern Pennsylvania. Its geological history has determined the topography of its watershed. The rolling Piedmont hills along most of its length, and the flat Coastal Plain at its confluence with the river have profoundly influenced the history of human land use within this landscape.

INTRODUCTION

Ridley Creek is a 24-mile long tributary of the Delaware River located in southeastern Pennsylvania. It originates in the northeastern portion of Chester County and traverses Delaware County on its southeasterly course to the river (see Figure 1). The area drained by Ridley Creek and its tributaries consists of 38 square miles and includes parts of eleven townships, five boroughs, and one city. Only one municipality is located entirely within the watershed, the Borough of Rose Valley. The topography of the Ridley Creek watershed consists mainly of the rolling hills and incised valleys typical of the Piedmont region seaward of the Appalachian Mountains. A steep drop in elevation takes place at the Fall Line, which marks the transition between the crystalline bedrock hills of the Piedmont and the flat sandy Coastal Plain along the Delaware River.

Current land use patterns within the Ridley Creek watershed are typical of the metropolitan area surrounding the City of Philadelphia. Its headwaters in the South Valley Hills lie to the east of West Chester, the county seat of Chester County. The upper watershed lies within the suburban outskirts of West Chester, consisting of residential subdivisions and corporate parks along the PA Route 202 corridor. In contrast, just downstream are rolling pastures, historic farms, and estate homes that lie to the west of the Radnor Hunt Club in Willistown Township. The latter represent the persistence of older land use practices within the watershed. In the middle stretch of Ridley Creek is the 2,606 acre Ridley Creek State Park. It spans the entire watershed from side to side. The park consists chiefly of mixed oak and American beech and tulip poplar forest, with interspersed meadows and wetlands. These valuable habitats are contiguous with those in the adjacent Tyler Arboretum. Downstream from the park and arboretum are the mature, leafy suburbs of Upper and Nether Providence Townships and the Borough of Rose Valley, which surround Delaware County’s seat of government, the Borough of Media. In the lower portion of the watershed, the older mixed industrial and residential communities of Chester, Eddystone, and their neighbors were built upon the flat area of Coastal Plain around the creek’s confluence with the Delaware River. This is where the creek experiences the influence of the tides as well as the consequences of industrialization and de-industrialization. These communities suffer from aging infrastructure, population loss, and a decreasing tax base (I).

THE GEOLOGICAL FOUNDATION

The primary geological process taking place in the Ridley Creek watershed today is erosion. Erosion has been the primary landscape process in the Piedmont region since the breakup of the supercontinent Pangea beginning approximately 200 million years ago. The current average annual rainfall in the region is 46 inches, distributed fairly evenly throughout the year. This rainfall percolates into the ground, emerges from springs, and collects into rills and streams in a pattern that follows the structural fabric of the bedrock.

The bedrock pattern of folds and fractures results from structural stresses and strains due to the tectonic assemblage of Pangea which began about 425 million years ago. The main direction of stress during that process was from what is now the southeast, the direction from which arrived a succession of land masses that collided with what is now North America. The earth’s crust folded and fractured in a direction
perpendicular to this stress. As a result of this process, the landscape features of the entire state of Pennsylvania trend in a southwest-to-northeast direction. Locally, the fractured bedrock underlying the Ridley Creek watershed provides zones of weakness where flowing water erodes ravines and valleys. For this reason, many of Ridley Creek’s tributaries flow into it from a southwesterly or northeasterly direction while the general trend of flow of Ridley Creek is towards the southeast.

The bedrock underlying the topography of the Ridley Creek valley consists primarily of gneiss and schist. These metamorphic rocks are a result of the enormous heat and pressure from the tectonic collisions that were part of the early stages in the assembly of the supercontinent Pangea and the creation of the Appalachian Mountains. Other rocks within the Ridley Creek valley, such as serpentineite, pegmatite, and granite, were also part of these mountain building processes. Starting approximately 480 million years ago during the Ordovician Period (see Figure 2), a chain of volcanic islands formed in the ocean between the proto-North American continent of Laurentia and the southern continental landmass of Gondwana. By the Early Silurian Period approximately 425 million years ago, this chain of volcanic islands collided with the edge of the proto-North American continent. This mountain building event is called the Taconic Orogeny. Two subsequent tectonic events contributed to the formation of the Appalachian Mountain belt and completed the assembly of Pangea. The Acadian Orogeny involved the collision of various micro-continents during the Late Devonian Period. Fragments of the largest of these micro-continents, Avalonia, form portions of eastern New England and the Maritime Provinces of

Figure 1. Ridley Creek watershed with various geologic and other features mentioned in this account.
Canada. The bedrock structure in the Ridley Creek valley and the rest of the southeastern Pennsylvania Piedmont region was emplaced during a collision with a smaller micro-continent fragment around 362 million years ago. The last Appalachian Mountain building event was the Alleghenian Orogeny of the Pennsylvanian and Early Permian Periods beginning around 300 million years ago, when the southern super-continent of Gondwana collided with proto-North America and completing the formation of Pangea. The current bedrock of the southeastern Pennsylvania Piedmont was already buried so deeply that there is no structural or geochemical evidence of this event in the Ridley Creek valley (2).

Following this period of mountain building, the rifting of Pangea began around 200 million years ago at the end of the Triassic Period. The erosion and deposition that followed shifted towards the direction of the opening Atlantic Ocean. During the subsequent period, the combined effects of isostatic rebound and other factors influencing sea level variation periodically left blankets of sediment on the otherwise eroding bedrock.

Ridley Creek and its tributaries flow over bedrock that originated from various related sources, including the ancient North American continent, the volcanic island chain that collided with it beginning about 425 million years ago, the sediments that eroded from both the continent and the islands, magma that emerged towards the surface through weaknesses in the overlying layers, a possible micro-continent fragment, and from portions of the Earth’s upper mantle that were mixed with sea water as it was thrust closer to the surface.

THE FLOW OF CHANGE

The source waters of Ridley Creek emerge from the South Valley Hills, which consist of a rock formation called the Doe Run Schist. This schist is derived from the sandy and muddy sediments eroded from the edge of the proto-North American continent prior to its collision with the volcanic island chain in the Silurian Period. Rocks from this formation are thrust over the carbonate rocks of the Great Valley along a fault known as the Embreeville Thrust. The limestone of the Great Valley was part of the Great Carbonate Bank on the continental shelf of proto-North America. The shallow tropical sea conditions that produced this limestone were similar to those of the Great Bahama Bank today. The North Valley Hills on the opposite side of the valley consist of the resistant quartzite rock of the Chickies Formation, which was derived from beach and nearshore sand deposits. The more easily erodible limestone forms the valley between the more resistant quartzite of the North Valley Hills and schist of the South Valley Hills.

This valley is the flat conduit that serves as a historically important transportation route through which Lancaster Pike and the Main Line of the Pennsylvania Railroad were built, connecting Philadelphia with points west. West Chester originated as the 18th century crossroads village of Turks Head that later developed as a nineteenth century industrial town on a spur of the Pennsylvania Railroad. In the late twentieth and early twenty-first century service economy, commerce has continued to follow the old geologically determined route in and out of West Chester by way of PA Route 202. The headwaters of Ridley Creek in East Goshen Township are heavily built up with suburban subdivisions and corporate parks along this corridor where it connects with old Lancaster Pike, now U.S. Route 30.

Two of the earliest colonial roads into the interior of Pennsylvania were placed along the high ground at
the edges of the Ridley Creek watershed. The Providence Great Road was built in 1683 along the divide between the eastern edge of the Ridley Creek watershed and the neighboring Crum Creek watershed. The Edgmont Great Road was built in 1687 along the divide between the western edge of the Ridley Creek watershed and the neighboring Chester Creek watershed. By the early 18th century, a number of east-west roads traversed the watershed. Crossroads villages appeared at many of the junctures, where a variety of services such as blacksmith and wheelwright shops, taverns, and general stores were available to the farmers and the operators of the water mills along the creeks who used the road to transport their goods. Boot Road, named for the Boot Tavern (identified by the sign of the boot), crosses the watershed near its headwaters. Boot Road enters the west edge of the watershed at the former crossroads village of Goshenville. Its preserved historic buildings, including an 18th century blacksmith and wheelwright shop, are a feature within the East Goshen Township park system. The park provides the relief of public open space amidst the surrounding suburban subdivisions, shopping centers, and corporate parks. At the east end of the watershed from Boot Road is Historic Sugartown, another crossroads village with preserved historic buildings that serve as an educational and recreational attraction. Goshen Road is another 18th century east-west route that gave rise to crossroads villages. The village of Whitehorse is still recognizable with an old blacksmith shop and other buildings at the juncture of Goshen and Providence Roads on the east edge of the Ridley Creek watershed. On the west edge of the watershed along the Goshen/Strasburg Road was once the crossroads village of Rocky Hill, now a suburban subdivision in East Goshen Township. The main 18th century east-west road in the middle portion of the watershed was Baltimore Pike. The crossroads village at its juncture with the Edgmont Great Road at the west edge of the watershed was Blackhorse, of which little trace remains. At the east edge of the watershed where Baltimore Pike crossed the Providence Great Road was the village of Providence, which became subsumed by the Borough of Media when that municipality was created in 1850 as the new county seat of Delaware County (3).

The bedrock of much of the upper middle section of the Ridley Creek watershed consists of gneiss. This particular formation is referred to as the Baltimore Gneiss, as it is continuous with similar rocks farther south in Maryland. It is characterized by alternating bands of black and white minerals. Baltimore Gneiss is ancient basement rock from the continental core of North America. It dates from approximately 1 billion years ago when it was formed from an earlier tectonic event, the assembly of the preceding supercontinent, Rodinia. Within the Ridley Creek watershed, Baltimore Gneiss consists of two slices, or nappes, of the Earth’s crust, which had been thrust upwards during the later tectonic collision. From north to south, these are the West Chester Nappe and the Avondale Nappe. Within the Ridley Creek watershed, the northern edge of the West Chester Nappe is roughly along Boot Road. West Chester Pike, or PA Route 3, is roughly the boundary between the two nappes. The southern edge of the Avondale Nappe roughly coincides with Barren Road at the southern end of Tyler Arboretum and Ridley Creek State Park.

The soils formed from gneiss and schist bedrock are not as rich as soils derived from limestone, but they provide enough plant nutrients to support small farms, which was the primary land use in the Ridley Creek watershed once European settlers arrived. It was in southeastern Pennsylvania that the American ideal of the single-family farm first took root. With the arrival of William Penn and the formation of the colony of Pennsylvania, the watershed was settled from its mouth to its headwaters in a matter of decades. Its previous inhabitants, the Okehocking band of the Lenape, left the area after the 1730s as the creek in which they fished was dammed to provide water power for mills and the landscape in which they once hunted and foraged was transformed into farms. These farms were dedicated to both primary subsistence for the colonists, as well as trade in wheat and flour to the British homeland and its other colonies in the Caribbean. A typical parcel consisted of 100 to 300 acres and provided frontage on one or the other of the two roads at either edge of the watershed, with access to Ridley Creek at the other end of each parcel. Following the Revolutionary War, farms in the Ridley Creek valley turned increasingly to providing produce, meat, and dairy products to the growing metropolis of Philadelphia. The upper Ridley Creek valley remained largely agricultural well into the twentieth century. As technological innovations in transportation, refrigeration, and large-scale industrial agriculture took place, food came from farther away. The farms in the Philadelphia metropolitan area, including the Ridley Creek valley, increasingly became consolidated during the late 19th and early 20th century to form country estates and philanthropic institutions and then as residential subdivisions and

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corporate parks in the years after World War II (4).

In contrast to the relatively fertile soil derived from gneiss and schist bedrock, farmers avoided the thin, toxic soils that formed over serpentine and called those areas “barrens.” It is at the edges of the West Chester and Avondale Nappes, along the shear zones where the nappes contact the adjacent rocks through which they had been thrust, that outcrops of serpentine are found. Serpentine forms from mantle rock rock rich in olivine and pyroxene minerals, thrust up from deep underneath the Earth’s crust, and chemically modified by sea water. Due to its source from deep below the Earth’s surface, serpentine has a high ratio of magnesium to calcium, and contains high levels of nickel and chromium. This chemical composition is tolerable only to certain species of plants. The plant communities that grow on the thin serpentine-derived soils are called serpentine barrens. They are savannah landscapes with a few trees consisting primarily of pitch pines and various species of scrubby oaks. Prairie grasses are mixed with specially adapted herbaceous species, some of which are rare not only in Pennsylvania, but globally. Only two of the serpentine barrens in the Ridley Creek valley have survived intact into the twenty-first century, the Sugartown Serpentine Barren in the Willisbrook Preserve, and Pink Hill in Tyler Arboretum. Serpentine barrens require periodic fires to persist. Fires destroy the accumulation of organic matter that develops into thicker soils that allow the surrounding forest to encroach on the barren. Suppression of fires and suburban development have destroyed most of the serpentine barren plant communities in southeastern Pennsylvania. The very persistence into historic times of serpentine barren plant communities can be originally attributed to the practice of burning by the Lenape. They lit fires to promote the growth of grasslands and edge habitat for hunting and to clear plots for small-scale agriculture.

Downstream from the Doe Run Schist, as Ridley Creek crosses the Pleasant Grove and Huntingdon Valley Shear Zone and into the gneiss of the West Chester Nappe, there is serpentineite at this contact. It is here that the Sugartown Serpentine Barren in the Willisbrook Preserve can be found. It is managed by the conservation organization Natural Lands in cooperation with Willistown Township (5).

The West Chester Nappe traverses the southern two-thirds of Willistown Township. Most of this part of Willistown Township is zoned Rural. Most of this part of Willistown Township is zoned Rural, and consists of large estates and equestrian farms contiguous with the Radnor Hunt Club. The Willistown Township Open Space Fund also purchases parcels of land to preserve from suburban development, resulting in a landscape that evokes that of past centuries. One 180-acre parcel that was acquired in this manner is the Okehocking Preserve. It is a portion of the 500 acres that served as the last foothold of the local Okehocking band of the Lenape until they left in 1730 for the Susquehanna valley, which was less settled by colonists from Europe at that point. The Okehocking Preserve is at the southern end of Willistown Township along West Chester Pike (6).

The contact between the West Chester Nappe and the Avondale Nappe is called the Street Road Fault. It is located in the vicinity of where Ridley Creek flows under PA Route 3, West Chester Pike. Some serpentine outcrops occur along this fault, particularly near the intersection of West Chester Pike and Street Road, PA Route 926. No viable serpentine barren plant community remains here, however.

The Baltimore Gneiss bedrock of the Avondale Nappe underlies the mixed oak-hardwood forest and meadowlands of Ridley Creek State Park, which is largely within Edgmont Township. The 2,606-acre park was once the property of Sarah and Walter Jeffords to accommodate their interest in Thoroughbred horses. In the early twentieth century, as the agricultural needs of the region were increasingly met from farther afield, multiple farms were purchased to create the Jeffords estate. It was a gift to Sarah Jeffords from her uncle Samuel Riddle, a local industrialist, horse-bredner, and owner of legendary Thoroughbreds such as Man-o-War and War Admiral. The estate was donated to the Commonwealth of Pennsylvania by the Jeffords estate in 1972 and converted to a state park.

The Avondale Nappe also traverses most of Tyler Arboretum, which adjoins Ridley Creek State Park at its southern border with Middletown Township. Tyler Arboretum also originated as a cluster of farms. They were in the hands of the same Minshall-Painter-Tyler family continuously from 1681 until 1944 when the last member of the family bequeathed the property to a board of trustees to be operated as an arboretum. In addition to a collection of specimen trees assembled in the 19th century by the brothers Minshall and Jacob Painter surrounding its central cluster of buildings, the arboretum includes a large amount of mixed oak-hardwood forest and meadowlands contiguous with the state park (7).

The southern edge of the Avondale Nappe occurs at the Rosemont Shear Zone. Erosion along this zone of weakness has produced the valley of Dismal Run, a
major tributary of Ridley Creek within Tyler Arboretum and the southeast corner of Ridley Creek State Park. Major outcrops of serpentinite occur along the Rosemont Shear Zone, such as at the Pink Hill serpentinite barren within Tyler Arboretum and in Mineral Hill Park. The Pink Hill serpentinite barren is maintained as a thriving rare plant community by Tyler Arboretum (8).

At Mineral Hill in Middletown Township, an intrusion of magma interacted with both the surrounding serpentinite and other host rocks to produce a large diversity of minerals. The magma body is a pegmatite, characterized by large crystal development from a slowly cooling magma. Mineral Hill is of historic and educational interest and is at the core of a cluster of adjacent municipal parks that preserve the ecosystems protecting the Aqua PA drinking water outtake at the Media Water Works.

Rocks along the Rosemont Shear Zone also include those that originated within a magma chamber of the Wilmington Complex, the name given to the meta-plutonic rocks that formed the volcanoes of the volcanic island chain that collided with proto-North America. The Wilmington Complex rocks are hornblende-bearing mafic gneiss. This geological complex of related rocks in fact continues south to Wilmington, Delaware, where their bluish cast lends its name to the local minor league baseball team, the Wilmington Blue Rocks.

Downstream from the Rosemont Shear Zone, Ridley Creek flows through bedrock of the Wissahickon Formation. This micaceous schist consists of metamorphosed sediment that eroded from the flanks of the volcanic islands that collided with proto-North America. As Ridley Creek enters this zone of schist bedrock, the elevation drops more rapidly towards the Delaware River. Water mills dotted the creek along this stretch to take advantage of this elevation drop, known as the Fall Line. These were placed at strategic locations beginning with Sycamore Mills at the southern end of what is now Ridley Creek State Park, to the mills at what are now the Media Water Works, to the Rose Valley Mills, to the woolen mills of Samuel Bancroft at Upper Bank, Middle Bank, and Lower Bank, the latter of which became Sackville Mills, to the Waterville Mills, and the Sharpless family mills at the southern end of Nether Providence Township. Initially, saw mills and grist mills were established. The saw mills rendered the timber that covered the land into lumber for buildings and other uses. The grist mills rendered the harvests from the newly cleared land into food for people and farm animals. Through the early to mid-nineteenth century, many of the mills were converted to water-powered industrial manufacturing, including the tilt and blade mills, woolen mills, and wood dye mills mentioned above (9,10).

Beginning in the 1840s and into the 1850s the site of industry shifted as mill owners recovered from the depression following the Panic of 1837 and began to prosper again. They invested their capital in larger mills that were powered by newly devised coal-powered steam engines that were finally capable of large-scale work. Since the large mills were no longer dependent on water for their power, they were built on the flat, more spacious strip of coastal plain near the Delaware River where Ridley Creek enters it between the City of Chester and the Borough of Eddystone. The flat coastal plain was also an excellent transportation corridor for large scale rail transportation of raw materials and manufactured products in and out of the factories.

The same industrial changes were taking place in nearby Philadelphia under an even larger scale. After the Civil War, industry expanded even further. Philadelphia became the workshop of the world, specializing in many industries. As the city grew more crowded and dirty, many of the industrialists and people who had the means sought refuge in the country, especially during the summer. Industrialization brought with it the expansion of the railroad, which not only served the factories, but began carrying people back-and-forth between their work in the city and their now affordable leisure in the countryside.

Many industrialists bought up groups of farms on which to build their country estates, such as Sarah and Walter Jeffords. Resort hotels were established in rural communities that were easily accessible by rail, such as the Idlewild Hotel in Media. Reformists and utopians created sanctuaries in the countryside apart from the influences of the city and industrial society. Elwyn Institute originated as the Training School for Feeble-Minded Children, a philanthropic enterprise along the Ridley Creek just west of Media. St. Joseph’s Orphan Asylum and the Philadelphia Orphanage were located in the Ridley Creek valley in Upper Providence and Nether Providence Townships, respectively. In a reaction against industrialism, the architect Will Price and friends founded Rose Valley along Ridley Creek in 1900 as an Arts and Crafts community to revive the creation of hand-crafted goods (11).

After the sediments that were metamorphized as
the Wissahickon Schist were emplaced, magma intruded into it in places and formed small bodies of granite and granitic gneiss. In the Ridley Creek valley, these occur in the vicinity of Crosbyville and Irvington in what is now Nether Providence and Ridley Townships in the lower portion of the watershed. These rocks were quarried by the Leiper and Deshong families for several generations.

A rock formation recently recognized as being distinctly different from the other schist and gneiss bedrock in the Ridley Creek valley is the Chester Park Gneiss. The type locality, where it was first described, is along Ridley Creek at Chester Park. The Chester Park Gneiss has been interpreted as part of a peri-Gondwanan terrane, that is, part of a large island or mini-continental fragment that preceded the subsequent collision with the southern supercontinent of Gondwana. The collision with the main portion of Gondwana (the present-day Africa, South America, India, Australia, and Antarctica combined) completed the assembly of the supercontinent of Pangea and was the final stage in the formation of the Appalachian Mountains (2).

All the rock formations mentioned thus far exist as erosional remnants of mountain building episodes in the distant past. The sediments along the Delaware River that are part of the Coastal Plain are referred to as Quaternary alluvium. They have been deposited within the last couple million years to the present. In addition, in the Ridley Creek valley there are three sedimentary formations from what was once called the Tertiary Period. They represent depositional episodes older than the most recent sediments along the river. The oldest Tertiary deposit in the Ridley Creek valley is the Bryn Mawr Formation, which persists in remnant patches capping the hills of southeastern Pennsylvania. It consists of yellowish gravel and sand that occurs at elevations higher than 180 feet above sea level. Locally, it is found atop the Wissahickon Schist hills upon which were built the Borough of Media and the Rose Tree crossroads in Upper Providence Township. The name Sandy Bank, which is associated with an early Quaker burial ground, a school, and a street in this area, reflects the presence of the Bryn Mawr Formation. In fact, local cemeteries have been preferentially located in the unconsolidated sediment of this formation throughout the vicinity. The Bryn Mawr Formation is believed to have been deposited around 12 million years ago in the Late Miocene Epoch when the climate shifted from hot and tropical to more a more seasonal climate that was prone to flooding and erosion and subsequent deposition.

The younger two Tertiary formations in southeastern Pennsylvania are undifferentiated on geologic maps. They are called the Pensauken and Bridgeton Formations. They consist of clay-rich sand commonly stained reddish brown. They are remnants of river terraces that run parallel to the Delaware River. The Bridgeton Formation is at an elevation between 90 and 150 feet above sea level. The nearly identical Pensauken Formation ranges from 60 to 80 feet above sea level. In the Ridley Creek watershed, these can be found underneath the North Ward of Chester in the Widener University area, and in the southern portion of Nether Providence Township, particularly the Garden City neighborhood. They are also considered to be deposits from the Miocene Epoch but from later than the deposition of the Bryn Mawr Formation (12,13,14).

The most recent sediments along the Coastal Plain are given the name Trenton Gravel and were deposited in the Quaternary Period. These underlie the flat areas along the Delaware River upon which were built the South Ward of the City of Chester and the Borough of Eddystone. The flat terrain and access to the river were conducive to the development of heavy industry at the mouth of Ridley Creek. The textile industries had large operations in the 19th century, and the 20th century saw the peak of industrial activity as factories and shipyards were built to address the nation’s security needs during the two world wars. The Sun Shipbuilding & Dry Dock Company operated the largest shipyard in the world during World War II. It was located on the west bank of Ridley Creek in the City of Chester. Following World War II, industry along the Delaware River declined, leading to job loss, a reduced tax base, and increased poverty and crime in Chester. The flat coastal plain along the river continued to be used as a major transportation corridor. Interstate 95 and Amtrak’s Northeast Corridor cross over Ridley Creek. This major transportation infrastructure connects the river communities to the rest of the world, but also cuts through them and disrupts internal connections. In the early 21st century, Harrah’s Philadelphia Casino & Racetrack were built on the site of the Sun Shipyards in an official attempt to revitalize the area, but the disconnect remained. Grassroots efforts at revitalization have included the opening of new restaurants and art galleries more intimately tied to the local food culture and experience in the local landscape.

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REFERENCES AND NOTES


Mineral Collection Specimens of the Delaware County Institute of Science

- **Amphibolite Gneiss** (Springfield/Marple Area)
- **Baltimore Gneiss** (Glen Mills Quarry)
- **Granodioritic Gneiss** (Springfield Township)
- **Pegmatite** (Leiper’s Quarry)
- **Mica Schist** (Media Quarry)
- **Serpentinite** (Mineral Hill)

Photos by Craig L. Hillemann