



2019 // RETURN ON ENVIRONMENT

Lebanon County



Photo: Courtesy Visit Lebanon Valley



Photo: Dax Roggio

The sun majestically sets behind the Kittatinny Ridge in historic Jonestown.

01 // INTRODUCTION

Lebanon County’s rural character and time-honored traditions are facing the winds of change

Nature has been part of Lebanon County’s heritage, culture, pride, and economy for over 300 years, and remains a major driver for tourism and economic development. Green, rolling hills and forested ridgelines create a striking natural backdrop for all residents, while Dutch Country roads reflect the county’s rural character, values, and traditions.

People live in and visit Lebanon County for the quality-of-life assets that nature provides, including scenic views, easy access to state and local parks, migrating birds, the Appalachian National Scenic Trail, Middle Creek Wildlife Management Area, Swatara Creek Water Trail, Lebanon Valley Rail-Trail, and many other outdoor recreation opportunities. However, the loss of farmland and scenic views, fragmentation of forests, expansion of sewers, and increasing traffic are harbingers of major changes.

Over the next 20 years, the trends of changing demographics, growth, loss of farmland, possible water shortages, air and water pollution, changes in climate, and increased demand for outdoor recreation will shape future growth.



Photo: Dax Roggio

Just beyond the Bordner Cabin, Aycrigg's Falls slows to a trickle in late autumn.

02 // WHY AN ROE?

Nature is a competitive advantage

“We can’t solve problems by using the same kind of thinking we used when we created them.”

– Albert Einstein

Pennsylvania’s Constitution imposes “a duty to conserve and maintain public natural resources for this generation and generations yet to come.”¹ If the goal is to maximize health, safety, and social welfare—and to conserve and maintain public natural resources—our policy process must distinguish clear and concrete economic values from which to choose.

Return on Environment (ROE) studies explain nature’s invisible financial value in terms everyone can understand. They do not explain nature’s intrinsic value, but rather what people have been willing to pay to replace these cost-free services once nature is disrupted or destroyed. As a result, policymakers, businesses, and residents can see natural systems as a portfolio of financial assets rather than a commodity or added expense. By understanding this financial value, Lebanon County is better equipped to strike an effective balance between maintaining connected, open spaces and supporting smart growth. This approach can help improve environmental quality and ensure a sustainable economy.

OBJECTIVES

The objectives of the Lebanon County ROE study were to document:

- // The monetary value of natural system services (the flow of goods and services that benefits people, directly or indirectly, from ecosystem functions)
- // The value of improved air quality relating to healthcare costs
- // The monetary value of outdoor recreation and the number of participants
- // The spatial distribution of natural resources’ financial value
- // The integration of new land-use and habitat-expansion tools into everyday practice

PROCESS

This study was assisted by a steering committee that attended three, two-hour meetings over the course of three months. The committee comprised individuals from diverse backgrounds—interested citizens and those with experience in nonprofits, government, and business—who provided ideas, critical thinking, innovation, and data with across-the-board support.

The process followed a basic framework:

- 1. Identify and consider the free services that nature provides.
- 2. Develop economic processes to calculate the economic benefits of these services.
- 3. Establish the monetary value of natural system services to families, local communities, and businesses.
- 4. Determine the monetary value of reduced healthcare costs due to forest canopy cover.
- 5. Assess Lebanon County’s major, long-term environmental issues.
- 6. Determine how ROE can help meet Lebanon County’s future goals.

CHALLENGES AND ISSUES

Promoting sustainable economic growth while maintaining a high quality of life, low cost of living, good health, and a unique sense of place is Lebanon County’s major challenge. A second, and more difficult, challenge is how to balance the health of natural systems to support a sustainable economy. Research shows that the most efficient way to avoid excessive future costs is to increase the connectivity of large forests and riparian corridors (ecosystems of plant life growing near natural bodies of water) so that they may function and retain resiliency under a wider range of weather conditions.² Lebanon County also faces these issues:

Population growth: Lebanon County has the second-fastest-growing population by county in the Commonwealth.³

Demographics: An aging population is impacting the local population and culture. After high school, many young people look for jobs outside the region or go on to college and have difficulty finding jobs back home once they graduate.

Water: Studies on possible water-supply shortages during drought times by 2030 have been conducted, which indicate that water supply may be an issue for future growth.⁴

Water pollution: 58.6 percent of Lebanon County’s waterways are under some level of impairment.⁵ Less than half of the riparian buffers (vegetated areas along waterways that help shade and protect from the impact of adjacent land use) in the county are

providing financial benefits. Current riparian buffers provide \$47.7 million per year in ROE.

International impact: Both the Kittatinny Ridge and Furnace Hills are internationally recognized migration areas for birds and wildlife, and land-use decisions impact the ecology of both North and South America in the Atlantic Flyway. A study published in the journal Science found that since 1970, North America has lost nearly 3 billion birds—or 29 percent of its avian population—and many species are in “conservation need,” meaning they lack adequate habitat.⁶

State and local impact: As Millennials continue to prioritize outdoor recreation opportunities, participation rates should increase. However, the demand for outdoor recreation in Lebanon County exceeds the business capacity to meet it.

Loss of farmland: Since 2012, Lebanon County has lost 11.4 percent of its farmland and 5.74 percent of its farms.⁷

Sprawl: Pennsylvanians have consumed more land per person than any other state.⁸ Sprawl accelerates the fragmentation and depletion of forests, wetlands, and other open areas where cost-free natural system services occur, and contributes to the loss of critical habitat. Commercial and industrial development, farms, and open land generate more revenue than they require in services. But, in a review of 98 communities across 21 states, researchers found that, for every dollar received from residential development revenues, an average of \$1.08 was spent to provide services like roads and schools.⁹

Climate: Pennsylvania as a whole is getting wetter and warmer. In the last century, the temperature in Pennsylvania increased 1.8°F and is expected to warm another 5.4°F by 2050. Pennsylvania will see many more days above 90°F by mid-century compared to 2000.¹⁰

These challenges and issues all point to a region in the process of significant change over the next 20 years. While the long-term effect of these changes may not be fully understood, decisions regarding the use of land can have both positive and negative impact on the local economy and quality of life.

ROE VALUATION BENEFITS

- // Nature's complex system is conveyed in a simple bottom line that is understandable to a broad audience.
- // Dollars, as a financial measure, underscore nature's connection to quality of life, health, cost of living, economy, and sense of place, while conveying a level of significance or priority that allows for a better trade-off analysis.
- // Monetary estimates of the value of natural system services can be applied within decision frameworks related to land use, tourism, and economic development.
- // Discussion of natural system cover types, services, and their values engages stakeholders in an educational process that can help organizations in their missions and raise awareness with policymakers and citizens.
- // Environmental health can be measured and incorporated into local decision-making processes.
- // Economic valuation of natural system services and biological diversity can make the value of protecting them explicit to policymakers, investors, and homeowners.
- // New business opportunities can be identified.

The steering committees for ROE studies in Dauphin, Carbon, Perry, and Lebanon counties believe that placing a dollar value on nature's services will help solve 70-100 percent of legacy environmental problems.





Photo: Dax Roggio

The Werners farm nearly 600 acres of corn, wheat, sorghum, soybeans, and canola, and raise organic turkeys.

03 // THE PLACE

Nature is serious business

“Pennsylvania’s economy, as well as the food supply of our region and beyond, depends on clean water and healthy, viable farms. You can’t have one without the other.”¹¹

– Pennsylvania Secretary of Agriculture Russell C. Redding

The Lebanon Valley is bordered by the Kittatinny Ridge to the north and Furnace Hills to the south. Frequently described as “rural” or “open,” the county has retained much of its original character from its founding in 1720: a forested and farm-field landscape bounded by Berks, Schuylkill, Dauphin, and Lancaster counties—the Dutch Country Region. Lebanon County elevations range from 469 to 1,280 feet. While quite steep in some places, the landscape is neither jagged nor harsh, with gentle inland slopes and farmland filling the gaps between the forested, mountain areas.

FIGURE 01 // LEBANON COUNTY DEMOGRAPHICS

POPULATION

// The current population is estimated at 141,314.

// The median age of residents is 41.2 years. The median age is expected to rise steadily throughout 2025, with a growth rate in 2018 of 1.25 percent.

HOUSEHOLDS

// As of 2018, the county had an estimated 58,005 housing units, with an average household size of 2.51 persons.

// Lebanon has the highest rate of owner-occupied housing in the region at 64.9 percent.

INCOME

// The county’s median annual income is \$57,698, which is less than the national median annual income of \$60,336.

EDUCATION

// A total of 86.9 percent of county residents have a high school education or higher, and 20.4 percent have a college degree or higher.

Source: United States Census Bureau, 2019 QuickFacts Lebanon County Pennsylvania

CLIMATE

Lebanon County’s climate is similar to the rest of central Pennsylvania. Though the region can experience heavy rain and significant snowfall, it does not suffer from the Great Lakes Effect that counties in the western and northern parts of the state experience. It is also far enough away from the eastern coast of the United States to avoid the cooling effect associated with the ocean. Though central Pennsylvania does not typically bear the full brunt of hurricanes or tropical storms, there have been incidents where storms have turned inland and caused substantial damage.

The 2012 United States Department of Agriculture (USDA) Plant Hardiness Zone Map is the standard by which gardeners and growers can determine which plants are most likely to thrive at a location. The map is based on the average annual minimum winter temperature, divided into 10°F zones. The plant hardiness zone has moved 100 miles north in the last 30 years. According to the USDA, most areas in the United States moved a half-zone as the temperature increased by five degrees. This translates to a 100-mile northern change in Lebanon County since 1910.¹²

The United States Environmental Protection Agency (EPA) points out that expenses associated with recovery from extreme weather impacts increased in the United States by a factor of six between 1997 and 2007.¹³

GROWTH

- // The county is located near three major urban centers—Harrisburg, Lancaster, and Reading.
- // The Lebanon VA Medical Center is one of the best hospitals in the Commonwealth, and many veterans want access to its services.
- // Distribution centers are popping up along major roads, and these companies need workers and affordable housing.
- // Families who suffered the loss of their homes following a devastating 2017 hurricane in Puerto Rico have sought refuge here.

BUSINESS

The quality of the environment impacts business location, attracts investment, stimulates tourism and recreation, and attracts wealth. Many businesses today want employees to have healthy lifestyles because active employees are happier, more creative, more productive, and miss less work.¹⁴ By 2025, Millennials will make up 75 percent of the workforce. They want opportunities to live a healthy lifestyle and have a flexible approach to work.¹⁵

The quality and quantity of resources available to businesses are critical to business function. Lebanon County’s location and natural resources make the region very business friendly. The recreational opportunities available on open spaces benefit the region’s workforce, translating into increased productivity and avoided medical expenses and Workers’ Compensation claims. The forested mountains offer surface and groundwater resources for businesses, ensuring clean, filtered water to produce their products and to meet water-quality permit standards.¹⁶

TOURISM

Lebanon County generates \$217.8 million annually in tourism,¹⁷ which is largely based on natural attractions, trails, and other outdoor opportunities. Recreation accounts for 38.3 percent of tourism spending, or \$83.4 million annually.¹⁸ Top attractions include the Appalachian National Scenic Trail, the Swatara Creek Water Trail, the Lebanon Valley Rail-Trail, hawk watching along the Kittatinny Ridge, and watching the tundra swans at Middle Creek Wildlife Management Area.

A study conducted by the Pennsylvania State University Department of Recreation, Park, and Tourism Management (RPTM) analyzed the amount of revenue each state park within Pennsylvania receives annually from day users and overnight users.¹⁹ Three types of day users were identified in the study:

- // **Local day users:** Pennsylvania residents who live within 50 miles of the park and make up 56 percent of visitation and 38 percent of total day spending.
- // **Non-local day users:** Pennsylvania residents who live more than 50 miles from the park and make up 28 percent of visitation and 38 percent of total day spending.
- // **Non-Pennsylvania resident day users:** Those who live more than 50 miles from the park and make up 16 percent of visitation and 24 percent of total day spending.

AGRICULTURE

Lebanon County’s leading industry is agriculture. In 2017, the county’s 1,149 farms, comprising 107,577 acres, had total sales of \$350 million, including \$313 million from livestock and livestock products and \$37 million from field crops and forages.²⁰

The county’s farms not only contribute to the local economy, but also provide natural system services that include groundwater recharge areas; water infiltration and nutrient uptake through wetlands, riparian corridors, and forests; wildlife and pollinator habitats; soil formation; and open space that is valued by residents and tourists for outdoor activities.

Lebanon County is serious about preserving and protecting farmland for future generations. To date, Lebanon County has preserved 19,150.05 acres under the Pennsylvania Department of Agriculture’s Farmland Preservation program, and has secured 171 easements in concert with The Lebanon Valley Conservancy (TLVC).²¹

One best management practice that Lebanon County farmers have embraced has been the transition from conventional tillage to conservation tillage. According to a 2015 USDA Natural Resources Conservation Service (NRCS) tillage survey, 52.83 percent of farms use cover crops, and 58.32 percent of farms maintain residue levels at greater than 60 percent.²²

FIGURE 02 // FARMLAND PRESERVATION BY THE LEBANON COUNTY CONSERVATION DISTRICT’S (LCCD) AGRICULTURAL LAND PRESERVATION PROGRAM IN CONCERT WITH TLVC

| MUNICIPALITY | AGRICULTURAL CONSERVATION EASEMENT (ACE) | ACREAGE |
|-------------------|--|----------|
| BETHEL | 10 | 1,421.66 |
| CLEONA | 1 | 77.27 |
| CORNWALL | 3 | 228.44 |
| EAST HANOVER | 2 | 187.92 |
| HEIDELBERG | 11 | 1120.67 |
| JACKSON | 12 | 1125.47 |
| MILLCREEK | 11 | 1556.25 |
| NORTH ANNVILLE | 8 | 1,218.84 |
| NORTH CORNWALL | 9 | 1,145.29 |
| NORTH LEBANON | 13 | 1497.18 |
| NORTH LONDONDERRY | 1 | 179.19 |
| RICHLAND | 1 | 64.98 |
| SOUTH ANNVILLE | 34 | 3,663.62 |
| SOUTH LEBANON | 26 | 2,568.83 |
| SOUTH LONDONDERRY | 12 | 1,486.88 |
| SWATARA | 3 | 698.47 |
| UNION | 0 | 69.67 |
| WEST CORNWALL | 3 | 676.19 |
| OUT OF COUNTY | 0 | 163.24 |

Source: LCCD. Note that some farms cross municipal boundaries. In these cases, the easement is counted only once, in the municipality with the most acreage.

FORESTS, WOODLANDS, AND WETLANDS

The northeastern United States is part of the Eastern Deciduous Forest biome where, for over 14,000 years, the soils and climate have produced trees. Two major forested wildlife corridors remain in Lebanon County—Kittatinny Ridge and Furnace Hills.

The Kittatinny Ridge—a Pennsylvania Department of Conservation and Natural Resources (DCNR) Conservation Landscape—is a Global Important Bird Area for more than 150 species of songbirds and 16 species of hawks, eagles, falcons, and vultures. A part of the Appalachian Mountain Ridge and Valley Region, it is an integral part of the larger Atlantic Flyway, which channels millions of migratory birds from their wintering

grounds to their nesting grounds and back. The Kittatinny lies parallel to Appalachian ridges that host many hawk-watch locations. Each autumn, birds of prey follow the Ridge south, taking advantage of updraft winds. This forested corridor allows wildlife to move north or south and has been identified as the most resilient landscape in the state for adapting to a changing climate.

Furnace Hills runs along the southern edge of Lebanon County. Like the Kittatinny Ridge, the forested hills are a corridor for birds and wildlife. Raptors, including bald eagles, nest in these forests. Nearby Middle Creek is designated as a Global Important Bird Area because it hosts a large percentage of the continent’s population of snow geese and tundra swans. Additionally, it provides a critically important migratory stopover habitat—one of two such sites in the state. Lebanon County also contains 2,324 acres of wetland habitats²³ that are found most frequently in woodlands or emergent in ponds and streams.

FIGURE 03 // SPECIES OF GREATEST CONSERVATION NEED IN LEBANON COUNTY

- 1. AMERICAN KESTREL
- 2. WOOD THRUSH
- 3. SCARLET TANAGER
- 4. EASTERN MEADOWLARK
- 5. LOUISIANA WATERTHRUSH
- 6. WILLOW FLYCATCHER
- 7. BLUEWINGED WARBLER
- 8. YELLOW-BREASTED CHAT
- 9. PURPLE MARTIN
- 10. PRAIRIE WARBLER
- 11. DION SKIPPER
- 12. BLACK DASH
- 13. BRONZE COPPER
- 14. LONG DASH

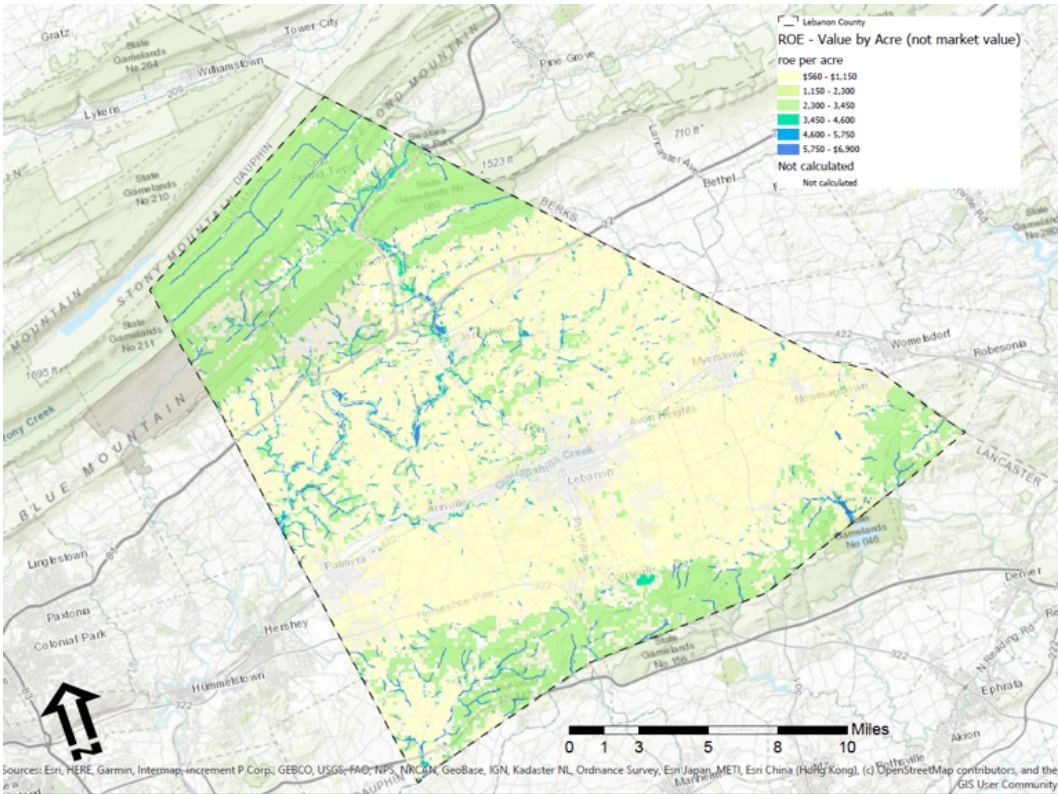
Source: 2015-2025 Pennsylvania Wildlife Action Plan

Lebanon County residents and visitors want to experience nature at its best. Areas in need of protection within the county have the highest economic value from a natural system services standpoint. These areas help define residents’ quality of life and sense of place. Using ROE data can help Lebanon County establish the patterns and priorities it needs to create a sustainable environment and growing economy. The highest priorities are protecting and connecting large forests over 100 acres, and riparian areas and wetlands. Businesses, governments, and households need to work together to manage open space in ways that result in the highest ROE.

Based on the valuation of natural resources in this report, Figure 4 shows that wet forested areas like headwaters, riparian corridors, and floodplains have the highest ROE

value (darker blue). Green areas are also relatively high in value and include large forests (over 750 acres)²⁴ and medium-sized forests (over 500 acres).²⁵ Less-valued ROE areas are shown in yellow. Gray areas are developed areas and provide minimal or no ROE. While difficult to see on a map at this scale, the highest ROE occurs in green corridors along streams and creeks, with the second-highest in forests on ridges and slopes.

FIGURE 04 // LEBANON COUNTY ROE MAP



WATER

Human-induced environmental problems (such as water and air pollution) have existed for over 100 years. Over 58 percent of all streams in Lebanon County are impaired at some level. In 2014, the Pennsylvania Department of Environmental Protection (DEP) identified agriculture as the primary source of the excess nutrient and sediment loads in impaired watersheds. These waterbodies demonstrated impaired aquatic life use, meaning the overall aquatic community (fish, macroinvertebrates, plants, and algae) is not healthy, and there are pollutants or pollution that must be minimized or eliminated to return the waterbody to a healthy condition.²⁶

As shown in Figure 5, 303.96 stream miles in Lebanon County are impaired, 232.38 of which identify agriculture as the main source of impairment. Only 64.07 miles are impaired due to a non-agricultural source. Although the LCCD has made great strides in promoting “no till” agriculture and other sustainable practices, agriculture still presents a significant challenge to water quality.

FIGURE 05 // LEBANON COUNTY AQUATIC LIFE USE IMPAIRMENTS

| SOURCE OF IMPAIRMENT | STREAM MILES |
|---|---------------|
| AGRICULTURE | 232.38 |
| ACID MINE DRAINAGE (AMD) | 21.80 |
| URBAN RUNOFF/STORM SEWERS | 26.90 |
| OTHER (INDUSTRIAL POINT SOURCE, NATURAL SOURCES, UNKNOWN) | 15.37 |
| TOTAL AQUATIC LIFE USE IMPAIRED | 296.45 |
| POTABLE WATER SOURCE | 4.67 |
| RECREATION | 2.84 |
| TOTAL IMPAIRED | 303.96 |

Source: PA DEP 2008 Pennsylvania Integrated Water Quality Monitoring and Assessment Report

CHESAPEAKE BAY PROGRAM

Lebanon County lies within the Chesapeake Bay Watershed. The local major watersheds are the Swatara, Tulpehocken, Conestoga, Chicken, Clark-Paxton, Mahantango, and Wiconisco creeks.²⁷ The county has 34 streams that flow to the Susquehanna River and on to the Chesapeake Bay.

The Pennsylvania DEP is implementing a bottom-up planning process for reducing nutrient and sediment pollution—the Phase III Watershed Implementation Plan (WIP). WIPs are detailed plans developed by the seven Chesapeake Bay Watershed jurisdictions (Delaware, District of Columbia, Maryland, New York, Pennsylvania, Virginia, and West Virginia) to help guide them in meeting their pollution-reduction goals under the Chesapeake Bay Total Maximum Daily Load (TMDL).²⁸

The DEP is engaging stakeholders with diverse views and expertise in order to make resource-allocation decisions. The agency’s aim is to support and build on local priorities and initiatives. In Pennsylvania, counties are being asked to write a WIP based on local resources and knowledge using county-specific “WIP Toolboxes.”

Developing and implementing a county-level WIP is voluntary. Selection of the organizations or groups that work on the WIPs is determined at the county level. ROE can help explain and locate where restoration will provide the greatest benefits and help prioritize protection efforts.²⁹

PARKS, TRAILS, AND GREENWAYS

With a rolling countryside and breathtaking views, Lebanon Valley provides miles of trails for all ages and skill levels. Visitors can explore the county’s scenic beauty and boomtown industrial past by hiking the Appalachian National Scenic Trail, crossing historic train-truss bridges, or kayaking the 42-mile-long Swatara Creek Water Trail.

Bicycling is popular on country roads and miles of off-road trails. Mountain bikers can test their skills on single-track or designated trails, each with unique terrains, or cycle the picturesque farmland and historic sites of Lebanon Valley’s countryside.

From bald eagles to endangered butterflies, sprawls of wildflowers to the yellow fringed orchid, Lebanon Valley hosts a wide selection of wildlife. There is an abundance of flora, fauna, streams, and expansive woods that are home to some of the oldest trees in the state.

Lebanon County’s major natural assets and protected open space:

- // Appalachian National Scenic Trail
- // Clarence Schock Memorial Park at Governor Dick
- // Fort Indiantown Gap
- // Kittatinny Ridge (a Global Important Bird Area)
- // Lebanon Valley Rail-Trail
- // Middle Creek Wildlife Management Area (a Global Important Bird Area)
- // Mount Gretna
- // Over 19,000 acres of preserved farmland
- // Stony Valley Rail-Trail
- // Swatara Creek Water Trail
- // Swatara State Park
- // The Highlands/Furnace Hills
- // Union Canal Tunnel Park



Photo: Courtesy Visit Lebanon Valley



Photo: Dax Roggio

The Kittatinny Ridge stretches 185 miles from the Delaware River to the Mason-Dixon Line.

04 // CONCLUSIONS

We can’t afford not to protect Lebanon County’s open space

“When one tugs at a single thing in nature, he finds it attached to the rest of the world.”

– John Muir

The first rule of ecology is that everything is connected to everything else. Natural system services provide a form of risk management, since for the last 14,000 years they have worked 24 hours a day, 365 days a year, free of charge. While nature can eventually replace itself, once disrupted or destroyed, natural system services will be diminished for 50 to 120 years before they again reach full capacity. The economic benefits presented in this report provide a new perspective on the value of natural system services, which should contribute to informed decisions concerning land use, economic development, safety, tourism, and recreation.

Figure 6 shows that it is difficult to have a strong economy without a healthy environment, clean water, quality habitat, and open space. Avoiding costs for services that nature already provides for free allows more money to circulate in the economy and creates jobs.

FIGURE 06 // LEBANON COUNTY ANNUAL ROE*

AVOIDED COSTS

- // Natural system services: \$309.8 million
- // Air pollution removal impact on health: \$7.1 million

OUTDOOR RECREATION REVENUES

- // Outdoor recreation: \$183.9 million
- // Jobs: 1,795
- // State and local taxes: \$9.12 million

AVOIDED HEALTHCARE COSTS DUE TO INCREASED EXERCISE

- // \$67 million

* Expected Direct Economic Impact

NATURAL SYSTEM SERVICES

Open spaces are where the majority of natural systems function and benefits are provided. When considering the importance of Lebanon County’s open space, it is essential to recognize the role of trees, fields, meadows, and wetlands in filtering water, cleaning air, controlling flooding, and providing environmental services.

The EPA Healthy Watersheds Program (HWP) noted that, in some cases, decision makers realized that the environment created infrastructure solutions that were less expensive and more reliable than engineered solutions.³⁰ By relying on nature’s ability to provide these valuable services, Lebanon County can avoid significant financial impact in the form of economic development, tourism, water treatment, water supply, flood remediation, infestations, air pollution removal, erosion control, outdoor recreation, and healthcare costs.

The ROE study identified 10 natural system services that occur on 14 different land cover types. Eight apply to upland areas and streams, and two apply to air quality. While not comprehensive, the list in Figure 7 includes major services that nature provides throughout Pennsylvania. Therefore, estimates are conservative.

FIGURE 07 // LEBANON COUNTY'S ANNUAL AVOIDED NATURAL SYSTEM SERVICES COSTS

| NATURAL SYSTEM SERVICE | ROE (\$) |
|------------------------|-------------|
| HABITAT | 158,464,946 |
| STORMWATER | 79,393,832 |
| NUTRIENT UPTAKE | 25,884,431 |
| GROUNDWATER | 22,542,373 |
| POLLINATION | 8,430,046 |
| AQUATIC RESOURCES | 7,332,489 |
| BIOLOGICAL CONTROL | 7,064,087 |
| EROSION CONTROL | 675,225 |
| TOTAL | 309,787,429 |

Key Findings:

- // An impact from sprawl is increased fragmentation of forests and invasive plants. This causes loss of critical habitat. Bird populations in North America are in a freefall. A study published in the journal Science found that since 1970, North America has lost nearly 3 billion birds—or 29 percent of its avian population—and many species are in “conservation need.”³¹
- // The financial value of current riparian buffers in the county is \$47.7 million per year.
- // Maintaining connected habitats and corridors allows the full value of open space to be realized and sustainable. These precious resources provide a more resilient environment during changing climatic conditions.
- // A study of restoration in Pennsylvania state parks showed a \$7 return for every \$1 invested. Similar results should occur in other open space projects.³²
- // The land areas with the highest ROE are headwater forests and wetlands, rural wetlands, riparian forests and forested wetlands, urban wetlands, and upland forests over 750 acres.

// The largest avoided costs are for habitat, stormwater, nutrient uptake, groundwater, and pollination.

AIR POLLUTION REMOVAL

Trees are critical to our survival, and Lebanon County’s forests help reduce health problems by removing significant amounts of air pollution and, consequently, improving environmental quality and human health. Trees remove substantial amounts of nitrogen dioxide (NO₂), sulfur dioxide (SO₂), carbon monoxide (CO), ozone (O₃), and particulate matter (PM). Trees remove gaseous air pollution, primarily by uptake via leaf stomata, though some gases are removed by the plant surface. Trees also remove pollution by intercepting airborne particles.³³

Key Findings:

- // Lebanon County’s annual air pollution removal benefit value is \$3,461,479.
- // The total annual avoided costs provided by carbon sequestration (the process of capturing and storing atmospheric carbon dioxide) is \$3,603,024.

OUTDOOR RECREATION

Lebanon County’s open space provides a desirable place for many free and low-cost recreational activities that enhance the quality of life and health for residents and visitors. It generates value by providing opportunities for people to engage in recreation and exercise. Outdoor recreation participants in Lebanon County spend between \$48.7 and \$183.9 million per year on gear, accessories, vehicles, and other trip-related expenses. This creates an expected 1,795 jobs and \$9.12 million in state and local taxes.

FIGURE 08 // LEBANON COUNTY OUTDOOR RECREATION ECONOMIC CONTRIBUTION

| OUTDOOR RECREATION ACTIVITY | MINIMUM DIRECT ECONOMIC IMPACT (\$) | EXPECTED DIRECT ECONOMIC IMPACT (\$) |
|-----------------------------|-------------------------------------|--------------------------------------|
| BICYCLING | 7,435,584 | 13,198,162 |
| BIRDING/BIRD WATCHING | 1,698,824 | 12,061,653 |
| CAMPING | 3,717,792 | 7,187,731 |
| CROSS-COUNTRY SKIING | 2,685,072 | 11,438,407 |
| FISHING | 4,646,207 | 10,533,744 |
| HIKING/BACKPACKING | 2,891,616 | 4,543,968 |
| HORSEBACK RIDING | 1,982,822 | 24,785,280 |
| HUNTING | 4,980,809 | 15,155,889 |
| JOGGING/RUNNING | 1,342,536 | 19,053,684 |
| KAYAKING/CANOEING | 1,549,080 | 6,552,608 |
| MOUNTAIN BIKING | 4,213,498 | 29,255,925 |
| NATURE STUDY | 1,171,104 | 10,688,652 |
| WALKING | 5,948,467 | 11,556,137 |
| WILDLIFE WATCHING | 4,453,089 | 7,856,521 |
| TOTAL | 48,716,500 | 183,868,361 |

OUTDOOR RECREATION AND REDUCED HEALTHCARE COSTS

Daily physical activity has declined dramatically according to the Centers for Disease Control (CDC), helping to produce an epidemic of obesity and degenerative diseases. While many people experiment with forms of physical activity that are good for them but not pleasurable, they tend to stay with activities they enjoy, often for decades.³⁴

Being in contact with nature motivates people to exercise and appears to boost the benefits of exercise.³⁵ Greenery encourages exercise, is a more restorative environment than indoor settings, and has a greater positive effect on mental health.³⁶ Access to open space and recreation opportunities results in more physical activity and better health. Howard Frumkin and Richard Louv’s research on contact with nature suggests that children and adults benefit so much from contact with nature that land conservation can now be viewed as a public health strategy.³⁷

Several studies show that outdoor recreation plays a significant role in the lives of Americans. It provides physical challenges and a sense of well-being, helps develop lifelong skills, provokes interest and inquiry, inspires wonder and awe of the natural world, and often provides an alternative to daily routines. Recreation contributes greatly to the physical, mental, and spiritual health of individuals while bonding family and friends. Outdoor recreation participants in Lebanon County benefit from exercise and save roughly \$67 million annually in healthcare costs.

FIGURE 09 // OUTDOOR RECREATION HELPS REDUCE HEALTHCARE COSTS

| FREQUENCY OF EXERCISE | ANNUAL SAVINGS (\$) |
|--------------------------|---------------------|
| AT LEAST ONCE PER WEEK | 51,800,646 |
| MORE THAN TWICE PER WEEK | 15,153,808 |
| TOTAL | 66,954,454 |

LEBANON COUNTY NEEDS A NEW BUSINESS MODEL

Growth should be economically sound and enhance community culture and values. Officials need information on full-cost accounting for new development, including revenues, cost of services, and the loss of ROE. Land-use planning, economic development, tourism, infrastructure, and recreation reinforce nature’s balance and use financial mechanisms to reward people for implementing good environmental stewardship. This creates financial value for the local community and those who live nearby and downstream.

LEBANON COUNTY’S LANDSCAPE IS UNIQUE

Both the Kittatinny Ridge and Furnace Hills are internationally recognized migration areas for birds and wildlife, which are strong biological indicators. As bird populations decrease, populations of snakes, rodents, and insects increase. The question is, how much will it cost to manage these infestations when nature is disrupted or destroyed, and what can be done to stop this from happening? Many smaller forests are important as well. Threatened and endangered species are found along the Kittatinny Ridge, like the Regal Fritillary (Speyeria idalia) butterfly at Fort Indiantown Gap.³⁸

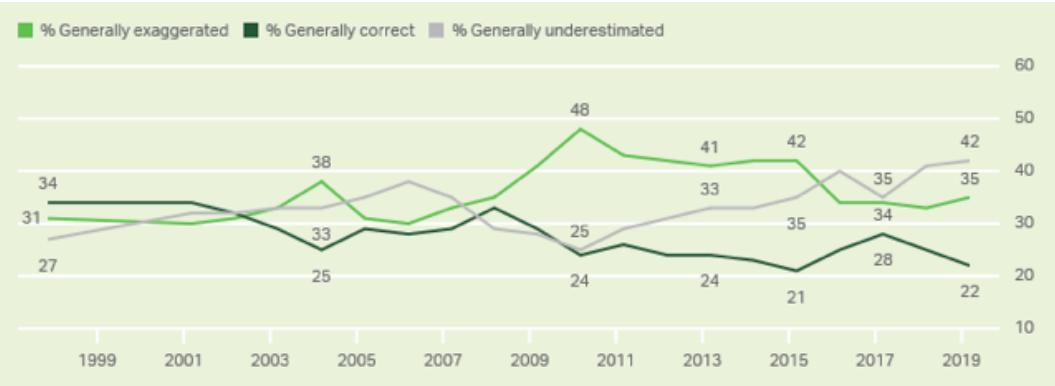
The plants and animals in these corridors are species that have lived in Lebanon County for thousands of years. Finding ways to protect or expand the forests and interconnect them with riparian corridors or upland corridors is essential for ensuring a healthy environment.

ATTITUDES TOWARD THE ENVIRONMENT ARE CHANGING

Over the past 30 years, national polls conducted by Gallup, Inc. have shown a changing attitude toward the environment over economic development. For 23 years, there was a clear preference for the environment; however, since 2008, opinions have wavered, with economic development now favored, particularly by people over age 65.³⁹

Gallup’s 2019 survey (Figure 10) found that Americans care about the quality of the environment but focus more on immediate environmental challenges rather than on issues like climate, which they consider a long-term threat. Sixty-four percent of Americans think that reports of the danger posed by the climate crisis are correct or understated, and 34 percent see climate change as “generally exaggerated.”⁴⁰

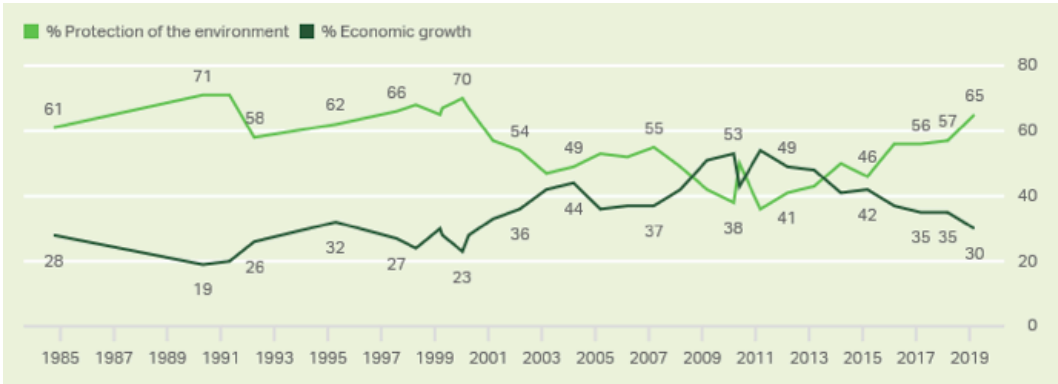
FIGURE 10 // IS THE SERIOUSNESS OF GLOBAL WARMING GENERALLY UNDERESTIMATED?



Source: Gallup

But caring for the environment is on the rise (Figure 11). A generational shift is under way, with younger people more supportive of environmental protection than older people, and soon-to-retire Baby Boomers more focused on leisure time and saving money.

FIGURE 11 // ENVIRONMENTAL PROTECTION VS. ECONOMIC GROWTH



Source: Gallup

Finally, the decline in environmentalism that occurred during the Great Recession has been reversed. Americans again oppose economic development that threatens environmental quality. According to a new poll, 76 percent of Millennials said they are more focused on the environment than their parents' generation. In a 2019 Gallup survey, 66 percent of Millennials said that the climate is getting warmer, and 75 percent of those respondents believed human activity is the cause.⁴¹

BIOLOGICAL DIVERSITY IS CENTRAL TO MAXIMIZING NATURE'S ECOLOGICAL AND FINANCIAL VALUE

Biological diversity is the sum of all plants, animals, insects, and fungi that have lived in harmony for thousands of years. It creates topsoil out of rock and helps buffer extreme weather events such as droughts and floods. It recycles nutrients, carbon, chemicals, and garbage. Biological diversity even maintains the base flow, width, water quality, and temperature of streams.

Native plants are the foundation for all life and control local biological diversity. They help drive natural system services like photosynthesis, pest control, pollination, erosion control, soil formation, water purification, and the generation of oxygen and clean air. Additionally, they support 29 times more biological diversity than non-native plants.⁴²

They even remove carbon from the air and sequester it, which helps contradict human-induced climate change.⁴³

The two major causes of the loss of biological diversity are non-native (invasive) plants and forest fragmentation. Habitat size, shape, and topography all play a role in sustaining biological diversity.⁴⁴ Connecting and expanding habitat size creates healthy and resilient biological systems that boost the performance of natural system services.

Eighty-four percent of property in Pennsylvania is privately owned. Where development has already occurred, natural system services can be reestablished and expanded along riparian corridors, surrounding parks, preserves, and forests. Riparian buffers alone can save millions of dollars a year in avoided costs for stormwater management, water quality, erosion control, habitat, and recreation. These Green Ribbon Landscapes—voluntary 300-foot setbacks that expand ROE and support a sustainable economy—will help communities and residents save even more money. In some cases, Green Ribbon Landscapes can almost double avoided costs for natural system services.⁴⁵

FIGURE 12 // THE BEST WAYS TO SUSTAIN AND EXPAND NATURAL SYSTEM SERVICES

- // Restore riparian forests to protect water quality at its source in headwaters, wetlands, and along riparian areas.
- // Protect and expand large forests (particularly on steep slopes), connect riparian forests to large upland forests, and maintain and restore tree-canopy cover.
- // Remove invasive plants by minimizing disturbances (edges, clearings) in natural areas.
- // Remove obsolete dams to improve water quality and aquatic habitats.
- // Minimize impermeable surfaces, and limit turf grass to areas essential for recreation and landscape access.
- // Practice good stewardship, and incentivize the use of native plants in the landscape surrounding parks, preserves, riparian areas, and trails.
- // Encourage townships to pass native plant ordinances.

DEMAND FOR OUTDOOR RECREATION IS INCREASING AND MAY HELP ATTRACT FUTURE GROWTH

The outdoor recreation industry is strong and growing, generating \$646 billion annually in the United States. By comparison, gasoline and other fuels yield \$354 billion annually.⁴⁶ Thirty-one percent of Pennsylvanians surveyed during the Pennsylvania DCNR's 2014 Outdoor Recreation Participation Survey of Pennsylvania said they planned to spend more time outdoors.⁴⁷

A 2015 report by the National Outdoor Foundation found that the following outdoor activities have been increasing: paddle sports, mountain biking, cross-country skiing, day hiking, bird watching, and bicycling. Local Lebanon County outdoor recreation experts add fishing, running, and nature study to the list. About half of the region’s Baby Boomers plan to increase their outdoor activity, compared to 25 percent of their older counterparts.⁴⁸ Given the overall aging population of Lebanon County, outdoor activities are expected to grow.

FIGURE 13 // PARTICIPATION IN OUTDOOR RECREATION IN LEBANON COUNTY

| FREQUENCY OF EXERCISE | PARTICIPATION (%) |
|--------------------------|-------------------|
| DO NOT EXERCISE AT ALL | 34.3 |
| LESS THAN ONCE PER WEEK | 16.3 |
| MORE THAN ONCE PER WEEK | 18.0 |
| MORE THAN TWICE PER WEEK | 31.2 |

Source: Pennsylvania DCNR’s 2014 Outdoor Recreation Participation Survey

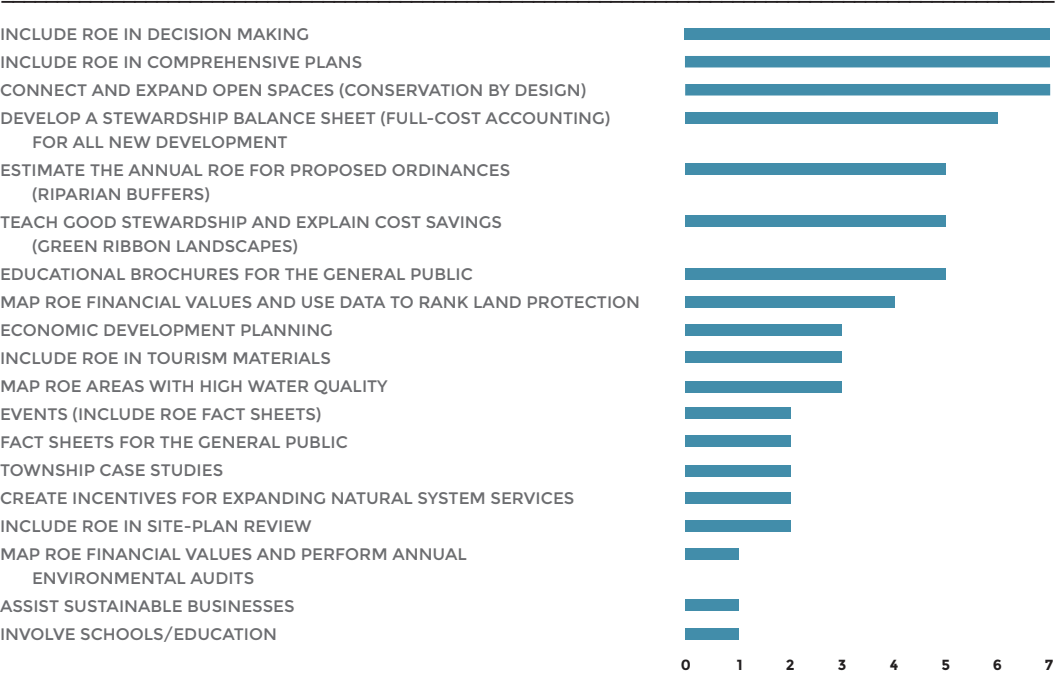
PUTTING ROE TO WORK

The ROE team examined several studies to learn how other Pennsylvania counties, municipalities, and land trusts have used ROE results:

- // Manada Conservancy prioritized land protection projects.
- // The Tri-County Regional Planning Commission and Manada Conservancy incorporated ROE into a Natural Resource Inventory for Dauphin County.
- // The Lehigh Valley Planning Commission (LVPC) and Delaware Valley Regional Planning Commission (DVRPC) used ROE results in comprehensive planning.
- // Warrington Township raised \$3 million in an open space referendum.
- // Northampton County put \$2.2 million into an open space budget.
- // Penn Township is analyzing ROE data as it relates to planning, zoning, and site-plan review.

The Lebanon County ROE Steering Committee listed ideas they believed would help solve many environmental issues. The highest-rated suggestion was to integrate ROE data into decisions related to natural resources, including land development. Second in the list was to include ROE in comprehensive land-use plans. Next was to connect and expand open spaces using cluster zones or conservation by design. Finishing in the top four was the development of a full-cost accounting approach to determine the benefits of new development along with the cost of community services and the loss of ROE (Figure 14).

FIGURE 14 // ROE BLUEPRINT FOR ACTION



If the economy of Lebanon County is to remain strong, environmental stewardship must become a community responsibility. Municipal officials, policymakers, business leaders, and local citizens need to work together to examine current policies and ensure sustainable environmental practices. Only then can Lebanon County build the foundation for a vibrant, balanced economy and a healthy, desirable community for current and future residents.

“Nature’s complex ecosystems have a huge impact on the economy of our county. The economy is strengthened by job creation and investment dollars. Exploring and appreciating the invisible financial values of nature are an important aspect in sustaining a robust economy.”

– Susan Eberly, President/CEO, Lebanon Valley Economic Development Corporation

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Acknowledgments

This report was published by Audubon Pennsylvania on behalf of the Kittatinny Coalition, an alliance of organizations, agencies, and academic institutions working with municipal officials and private landowners to preserve and conserve the natural, cultural, and aesthetic resources of the Kittatinny Ridge.

Our thanks to consultants John Rogers, Keystone Conservation Trust; Tom West, Greener Planning; and Ben Goodman Creative, as well as the Swatara Watershed Association for supporting the study and Jo Ellen Litz for providing facilities for the Lebanon County Return on Environment meetings.

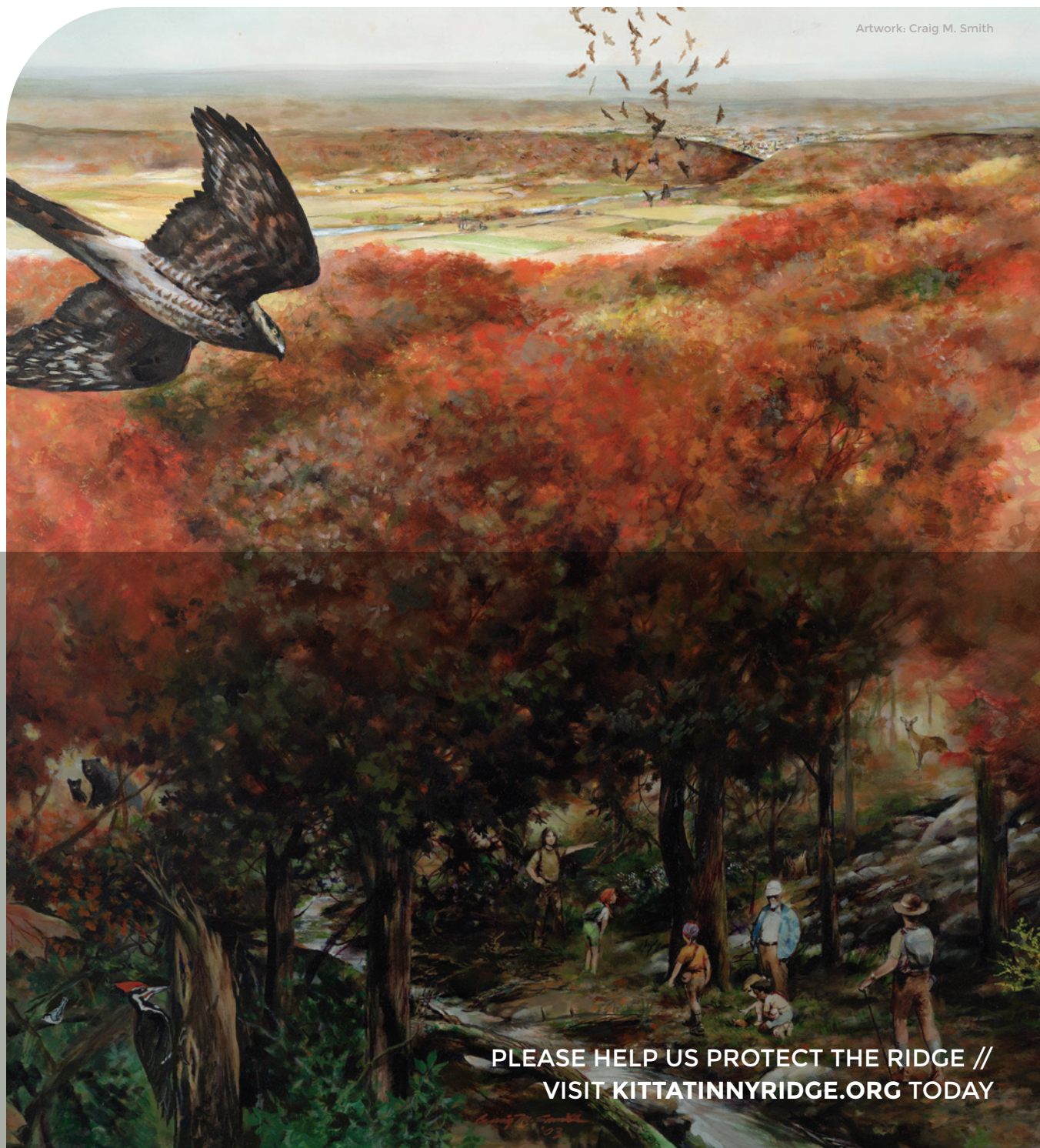
FUNDING

Funding for this report was provided by a grant from the Community Conservation Partnerships Program, Environmental Stewardship Fund, under the administration of the Pennsylvania Department of Conservation and Natural Resources, Bureau of Recreation and Conservation.

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- Lebanon County Conservation District
- Lebanon County Planning Department
- Lebanon Valley Economic Development Corporation
- Swatara Watershed Association
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Funding assistance has been provided by the Department of Conservation and Natural Resources, Bureau of Recreation and Conservation, Environmental Stewardship Fund.

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