

2019 // RETURN ON ENVIRONMENT
Perry County

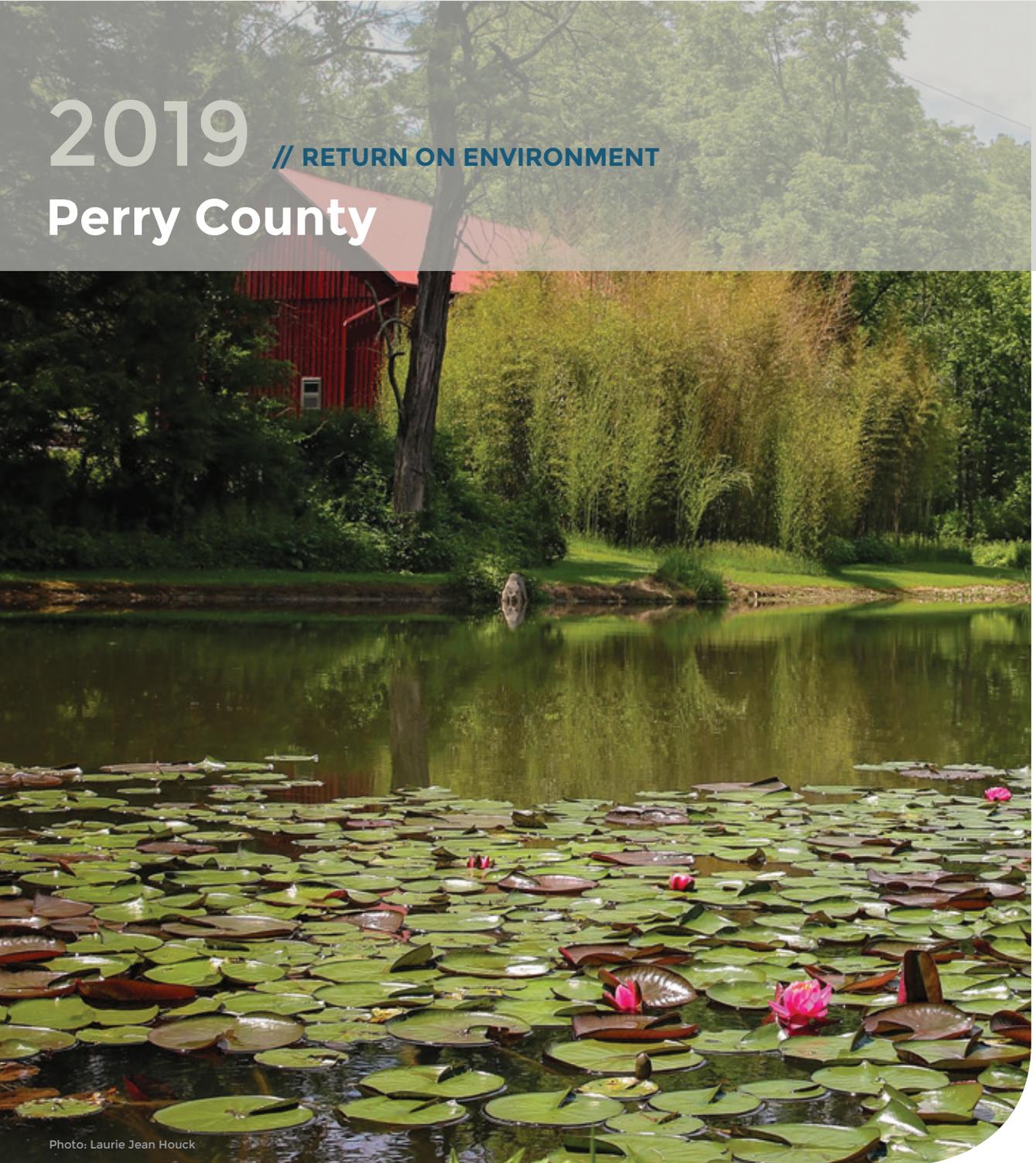


Photo: Laurie Jean Houck

Acknowledgments

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Our thanks to Bloomfield Borough for graciously providing facilities for the Perry County Return on Environment (ROE) meetings, and to the Tri-County Regional Planning Commission (TCRPC) for organizing the meetings and assisting with the report.

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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 (DCNR) Bureau of Recreation and Conservation (BRC).

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 conserve the natural, scenic, cultural, and aesthetic resources of the Kittatinny Ridge and Corridor.

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Photo: Hicham Mouhssin

Summer ride on Holman Lake in Little Buffalo State Park, Newport.

01 // EXECUTIVE SUMMARY

Nature is one of Perry County's major competitive advantages for future economic growth

The forested hills, streams, and scenic views provided by Perry County's open spaces have been a major part of its residents' natural heritage, culture, and pride since the area was settled almost 300 years ago. Perry County's open space supplies communities with sparkling-clean drinking water, flood protection, pollination, critical wildlife habitats, and impressive recreational and tourism opportunities. Outdoor recreation activities—such as hunting, fishing, and hiking—attract thousands of visitors annually and play an important role in residents' quality of life, especially during tough economic times.

More than just pretty places, Perry County's forested ridges and stream valleys are productive assets that generate over \$900 million annually in avoided costs for natural system services and air pollution removal, reduced healthcare costs, revenues from outdoor recreation and local and state taxes, and increased tax revenues from real estate premiums. In short, nature is the foundation for all of life and the economy.

Stormwater, flooding, forest fragmentation, invasive plants, and air and water pollution are long-standing issues in Perry County. Determining a dollar value for nature's services explains their financial value in easy-to-understand terms. This increases the ability of policymakers, businesses, and residents to solve established environmental problems. It also explains the financial significance and connection of nature to Perry County's economy and culture.

The biggest challenge facing Perry County is promoting sustainable economic growth while maintaining a high quality of life, low cost of living, good health, and the unique sense of place that has been the region's hallmark for hundreds of years. The careful protection, management, and use of natural resources are essential to the long-term sustainability of nature and the local and regional economies.

FIGURE 01 // PERRY COUNTY ANNUAL RETURN ON ENVIRONMENT

AVOIDED COSTS

- // Natural system services: \$830.6 million
- // Air pollution removal impact on health: \$14 million

OUTDOOR RECREATION REVENUES*

- // Outdoor recreation: \$59.3 million
- // Jobs: 622
- // Economic output: \$16.4 million
- // State and local taxes: \$3 million

AVOIDED HEALTHCARE COSTS DUE TO INCREASED EXERCISE

- // \$31.6 million

* Expected Direct Economic Impact

NATURE IS SERIOUS BUSINESS

The economic benefits presented in this report are a new way to provide government officials, businesses, and residents with a perspective on the value of natural system services, and should contribute to informed decisions concerning land use, economic development, safety, tourism, and recreation.

Natural system services are the benefits we receive from nature—free of charge. Since Mother Nature does not write receipts, nature’s financial value is often overlooked or undervalued in policy debates, investment decisions, and personal choices.

Just as financial analysts express return on investment (ROI), Return on Environment (ROE) studies explain nature’s invisible financial value in terms everyone can understand. ROE studies 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 stop taking nature for granted and begin to see natural systems as a portfolio of financial assets, rather than a commodity or added expense.

Given these financial values, it becomes apparent that it is very difficult to have a strong economy without a healthy environment and plenty of open space. Once lost, regaining nature’s full capacity can take 50 to 100 years. In the meantime, these services must be replaced at the taxpayers’ expense. That is why conservation in Perry County is a good, long-term business strategy.

FIGURE 02 // 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—and convey a level of significance or priority to allow 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 value engages stakeholders in an educational process that can help organizations with their missions, and raise the awareness of policymakers and citizens.
- // Economic valuation of natural system services and biodiversity can make the value of protecting natural system services explicit to policymakers, investors, and homeowners.

PERRY COUNTY IS A REGION ON THE EDGE

Perry County is bordered by the Kittatinny Ridge on the south, the Tuscarora Ridge on the north, and the Susquehanna River on the east. Residents are tucked away within the topography and natural features along the county’s edges. Perry County was originally part of Cumberland County and was created, in part, because residents did not want to travel over the mountain to Carlisle, the county seat of Cumberland County.¹

Nine of the counties along the Kittatinny Ridge are in the top 20 fastest-growing counties in the state. Perry County is adjacent to two of them: Cumberland and Dauphin. Cumberland is the 10th fastest-growing county in the state, and Dauphin is the 20th.² While Perry County is only one-fifth of their size, and ranks 23rd in terms of the fastest-growing counties in Pennsylvania, it is within proximity of Dauphin and Cumberland counties’ future growth.

The county’s clean air and water, scenic views, easy access to beautiful state and local parks, migrating birds, the Appalachian Trail, and many other outdoor recreation opportunities are the major quality-of-life assets that people enjoy. Many are willing to commute an hour or more to work and back to experience its beauty.

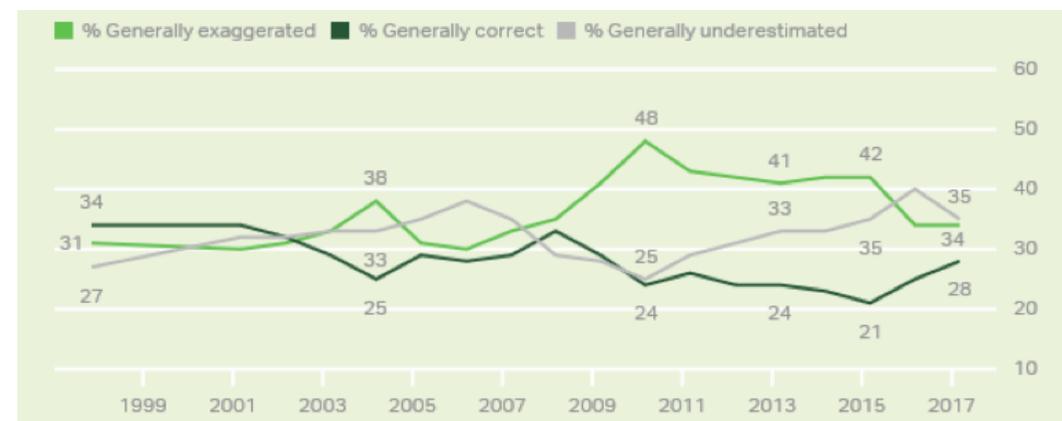
Over the next 20 years, the interests of aging adults and millennials will drive economic growth. The trends of changing demographics, growth in nearby areas, and increased demand for outdoor recreation will also shape future growth. With proper planning, the current bucolic charm and culture of this area can be maintained amidst growth.

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 65.³

American attitudes toward the environment paint a complicated picture that sometimes raises more questions than answers. Gallup’s 2017 survey found that while Americans care about the quality of the environment, they focus more on immediate environmental challenges than on issues like climate, which they consider a long-term threat. Recently, more Americans think that reports of the danger posed by the climate crisis are underestimated, but 34 percent still see it as “generally exaggerated.”⁴

FIGURE 03 // IS THE SERIOUSNESS OF GLOBAL WARMING GENERALLY EXAGGERATED, CORRECT, OR UNDERESTIMATED?



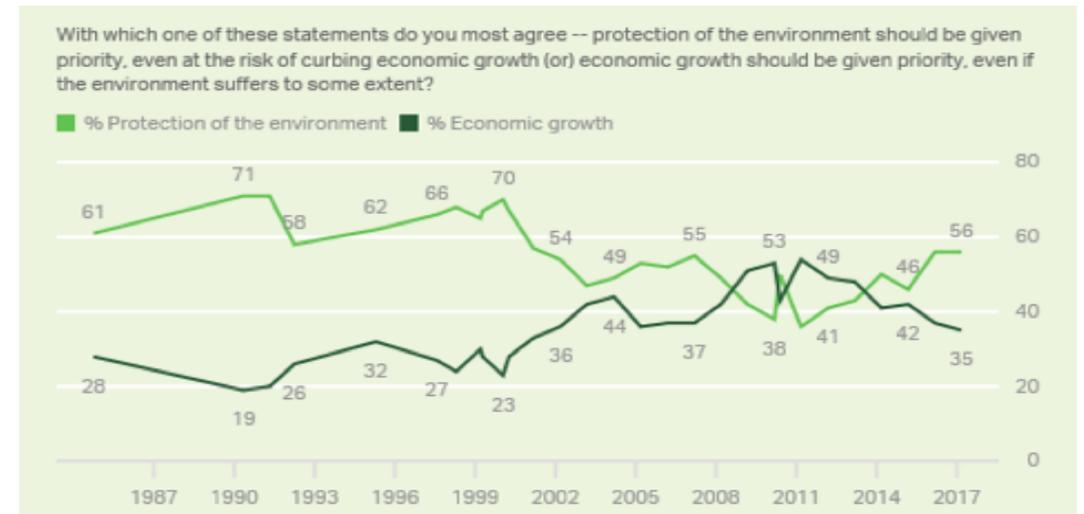
Source: Gallup

A generational shift is under way, with younger people more supportive of environmental protection than older people. Soon-to- retire baby boomers are more focused on leisure time and saving money. Millennials, born between 1980 and 2000, are more numerous than any other generation. Already comprising 25 percent of the workforce in the United States, they are beginning to make money, buy homes, and expand the economy. Millennials want opportunities to live healthy lifestyles, and seek flexible approaches to work, which has been made possible through advanced technology.⁵

Finally, the decline in environmentalism that occurred during the “Great Recession” has been reversed, as Americans again oppose economic development that threatens environmental quality.⁶ According to a new poll, 76 percent of millennials say they

are more focused on the environment than their parents’ generation. In a 2017 Gallup survey, 66 percent of millennials say there is solid evidence that the earth is getting warmer, and 75 percent of those respondents believe human activity is the cause.⁷

FIGURE 04 // ENVIRONMENTAL PROTECTION VS. ECONOMIC GROWTH



Source: Gallup

THE USE OF LAND IS BY FAR THE GREATEST OPPORTUNITY TO MAKE MAJOR FINANCIAL CHANGES⁸

Forest fragmentation, invasive plants, and air and water pollution are some of the drivers of natural system service loss and disruption. Many problems have existed for years—like sprawl, floodplain development, and large lawns—and many still continue. The greatest financial leverage on open space—and sustainable environmental and economic health is how land is used.

Traditional development requires intensive and costly additions of gray infrastructure, such as sewage and stormwater systems, to connect new neighborhood road and utility networks. In a review of 98 communities across 21 states, researchers found that, for every dollar received from residential development revenues, an average of \$1.16 was spent to provide services to the new community. Conservation design saves communities money because it consumes less land and requires fewer roads and resources, as well as less utility infrastructure. Also, studies have shown that people are willing to pay a premium to live in conservation developments, which provide greater revenues to local communities.⁹ Being uninformed about the loss of millions of dollars every year to sprawl is poor asset management.

WE NEED A NEW BUSINESS MODEL

Growth should be economically sound and enhance community culture and values. Officials need the ability to make decisions based on a full cost accounting for new development, including revenues, cost of services like maintaining roads and schools, and the loss of highly valuable natural assets. Land use planning, economic development, tourism, infrastructure, and recreation reinforce nature's balance and offer financial mechanisms to reward people for implementing good environmental stewardship. This creates financial value for the immediate community and those who live nearby and downstream.

BIODIVERSITY IS CENTRAL TO MAXIMIZING NATURE'S ECOLOGICAL AND FINANCIAL VALUE

Biodiversity creates topsoil out of rock, and helps buffer extreme weather events such as droughts and floods. It recycles nutrients, carbon, chemicals, and garbage, and even maintains the base flow, width, water quality, and temperature of streams. And now, with human-induced climate change threatening the planet, native plants and biodiversity will help remove carbon from the air and sequester it in living plants.¹⁰

The two major causes of biodiversity loss are forest fragmentation and non-native, invasive plants. Habitat size, shape, and topography all play a role in sustaining biodiversity.¹¹ The large forests of the state and local parks and the Kittatinny Ridge, as well as the stream corridors that connect them, allow nature to regenerate and sustain itself, free of charge. 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 re-established 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" will help communities and residents save even more money and, in some cases, almost double avoided costs for natural system services.

Native plants are the foundation for all life and control local biodiversity. 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 biodiversity than non-native plants.

FIGURE 05 // THE BEST WAYS TO SUSTAIN AND EXPAND NATURAL SYSTEM SERVICES

- // Protect water quality at its source in headwaters and wetlands, and along riparian areas.
- // Protect large forests, particularly on steep slopes, connect wildlife habitats, 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 of commercial, government, and residential areas surrounding parks, preserves, riparian areas, and trails.

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.¹² Thirty-one percent of Pennsylvanians surveyed during the Pennsylvania Department of Conservation and Natural Resources' (DCNR) 2014 Outdoor Recreation Participation Survey of Pennsylvania said they planned to spend more time outdoors.¹³

The demand for outdoor recreation in Perry County is larger than the business capacity to meet it, and much of the retail business related to outdoor recreation leaks into surrounding areas. About half of the region's baby boomers plan to increase their outdoor activity, compared to 25 percent of their older counterparts. Given the overall aging population of Perry County, outdoor activities are expected to grow.¹⁴ By 2025, millennials will make up 75 percent of the workforce, and these young professionals enjoy the outdoors and seek healthy and adventurous lifestyles.¹⁵

The trend for current residents is to spend more time outdoors, and this will continue with future growth. A 2015 report by the Outdoor Industry Association's 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 Perry County outdoor recreation experts agree, and add fishing, running, and nature study to the list.

Easy access to outdoor activities encourages people to exercise more by participating in these activities. The more they exercise, the healthier they are, with less money spent on healthcare costs.¹⁶

WE CAN'T AFFORD NOT TO PROTECT PERRY COUNTY'S OPEN SPACE

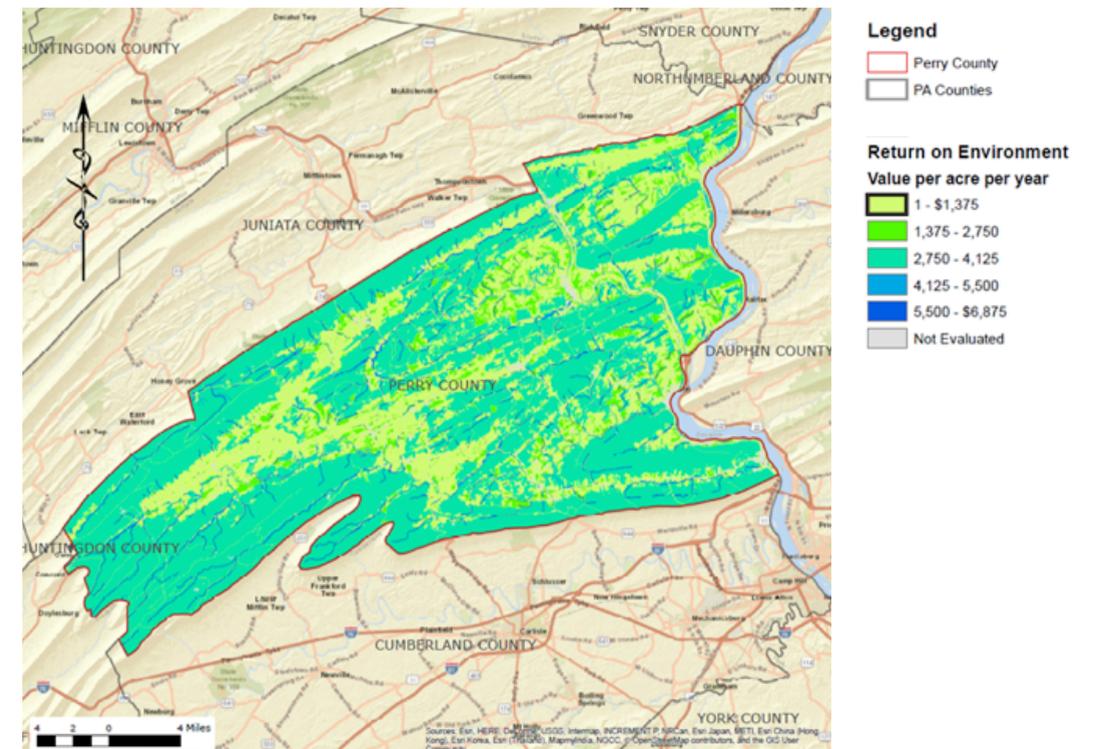
The first rule of ecology is that everything is connected to everything else, and that interconnection and interdependence impact the economic system, e.g. water supply and resource availability. Whatever we do to natural habitats—good or bad, big or small—has a ripple effect on the economy. Losing natural resources is a significant strategic choice, since natural systems provide a form of insurance or risk management. They work 24 hours a day, 365 days a year, and have been doing so for the last 14,000 years free of charge. Simply stated, the loss of open space costs us more than we know.

Following an ROE report for the Lehigh Valley, Northampton County understood the value of nature and, based on its ROE results, returned \$2.2 million to its open space budget.¹⁷ The Lehigh Valley and the TCRPC are including ROE results in their comprehensive planning. Warrington Township, Bucks County, used ROE data to support an open space referendum that raised \$3 million.¹⁸

Perry 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 Perry County establish the patterns and priorities it needs to create a sustainable environment and growing economy.

Using the values listed in this report for natural county resources, the Perry County ROE map shows higher values for more natural, undeveloped acres (darker blue) that return a higher financial value to the local economy than the more developed (yellow and gray) acres. Satellite-derived land cover data for 2011 was obtained from the Multi-Resolution Land Characteristics (MRLC) Consortium, and ArcGIS was used to calculate the acres of seven different land cover types: forests, developed open space, wetlands, croplands, pastures, water, and developed/urban.

FIGURE 06 // PERRY COUNTY ROE MAP (2011)



While difficult to see from a map at this scale, the highest ROE is in green corridors along streams and creeks, with the second highest being ridges and slopes.

PUT ROE STUDIES TO WORK

Businesses, governments, and households need to work together to manage open space in ways that result in the highest ROE. Choices made about the environment today will have a dramatic impact on the future. So, it makes sense that economic development, land use, tourism, water resources, recreation, and infrastructure decisions begin with a review of an ROE analysis.

Participants in the Perry County ROE meetings suggested the following ways to support local efforts:

- // Create incentives for stormwater management, riparian buffer restoration/expansion, and the installation of native plants (e.g., free trees).
- // Provide information on the financial value of open space for easement and land-purchase investment decisions.
- // Reinforce landscape approaches for habitat connectivity, expansion, and protection.
- // Create strategies to reduce flooding and protect water quality.
- // Promote Perry County as an outdoor adventure destination.

During committee meetings, attendees listed long-term environmental issues they felt could be addressed by placing a value on natural system services, such as building awareness of the value of the environment, addressing sprawl, promoting economic growth without adversely impacting the environment, retaining and expanding employment opportunities, preserving beautiful scenery and forested mountain views, and maintaining high-quality water and clean air.

Attendees also listed ideas they believed would help solve many of these problems. The highest-rated suggestion was to integrate ROE data into existing and new practices to help protect priority habitats and safeguard vulnerable non-renewable resources.

FIGURE 07 // PERRY COUNTY PUTTING ROE TO WORK STRATEGY

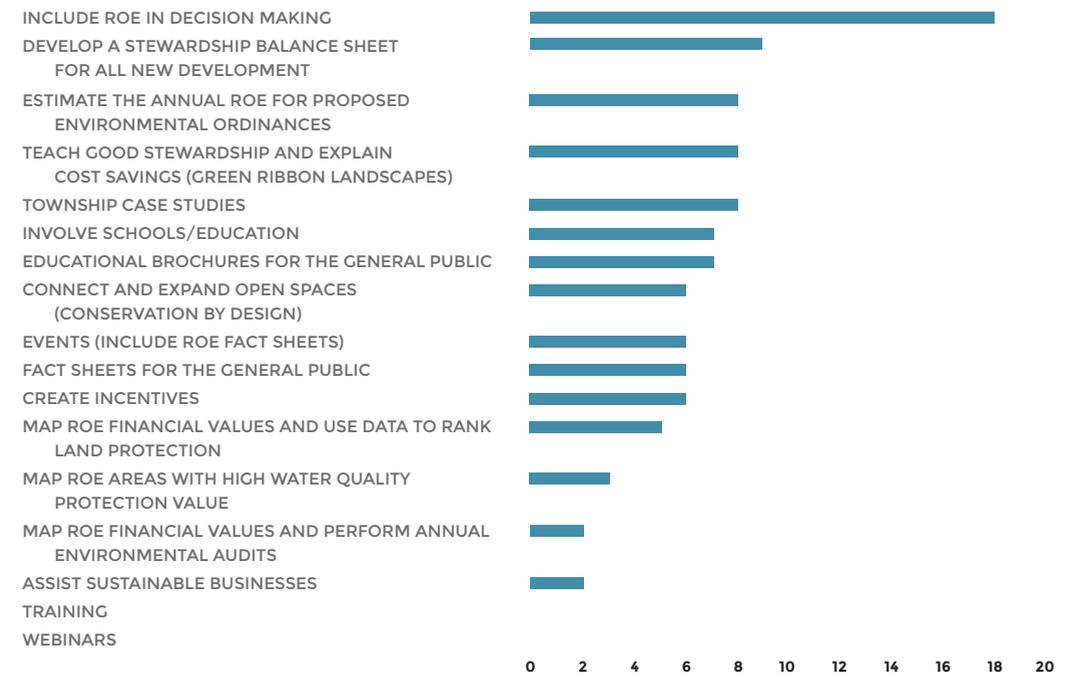




Photo: Hicham Mouhssin

The beginning of autumn splendor in Little Buffalo State Park, Newport.

02 // INTRODUCTION

Why an ROE?

Pennsylvania's constitution imposes a duty to conserve and maintain public natural resources for this generation and generations yet to come.¹⁹ If the goal is to maximize health, safety, and social welfare—and to conserve and maintain public natural resources—policy processes must distinguish clear and concrete economic values from which to choose.

Not understanding the financial value of nature to the local economy may bias decisions in favor of other investments. It is essential that we recognize the importance of trees, fields, forests, and streams in filtering our water, cleaning our air, mitigating floods and stormwater runoff, pollinating plants, and providing habitats and other environmental services.

By understanding nature's financial value, and how it is connected to our quality of life and well-being, communities are better equipped to strike an effective balance between maintaining connected, open spaces and supporting smart growth. This approach helps improve environmental quality and ensures a sustainable economy.

OBJECTIVES

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

- // Monetary value of natural system services
- // Value of improved air quality that relates to healthcare costs
- // Monetary value of outdoor recreation and the number of participants
- // Spatial distribution of resource value
- // Integration of new land use and habitat expansion tools into everyday practice

PROCESS

This study was assisted by a steering committee that attended four, two-hour meetings over the course of four months. Committee members came from diverse backgrounds—interested citizens and those with experience in nonprofits, government,

and business—and 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 Perry County's natural conundrums (i.e. long-term and major environmental issues).
6. Evaluate how ROE can help meet Perry County's future goals.
7. Identify ways to put ROE to work in Perry County.

CHESAPEAKE BAY PROGRAM

Perry County has over 1,500 miles of streams that flow to the Chesapeake Bay. The Pennsylvania Department of Environmental Protection (DEP) is implementing a bottom-up planning process for reducing nutrient and sediment pollution called 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 meeting pollution-reduction goals under the Chesapeake Bay Total Maximum Daily Load (TMDL).²⁰

Forty-three counties in Pennsylvania lie within the Chesapeake Bay Watershed, including Perry County. The DEP is engaging stakeholders to bring diverse views and expertise to make decisions about allocating resources. The DEP's aim is to support and build on local priorities and initiatives. In Pennsylvania, counties are being asked, on a voluntary basis, to write a WIP based on local resources and knowledge using the county-specific "WIP Toolbox" created by the DEP.

The counties have been placed in tiers, with Perry County being in Tier 3. Tier 1 counties are currently putting together their WIP plans. Perry County expects to receive its WIP Toolbox this spring. Selection of the organizations or groups that work on the WIP is determined at the county level. ROE can help explain and locate where restoration will provide the greatest benefits. It can also help prioritize protection efforts.²¹

CHALLENGES

For many years, Perry County has proudly retained its rural charm. Promoting sustainable economic growth while maintaining a high quality of life, low cost of living, good health, and the unique sense of place is Perry County's major challenge.

The trends of changing demographics, growth in nearby areas, increased demand for outdoor recreation, interest in healthy lifestyles and adventure experiences, investments in water quality, agriculture needs, Internet access, changing forms of business, and changing climate conditions will all impact Perry County's future. For example:

70 percent of workers leave the county for work: Serviced by routes 11/15, 22, and 322—which connect the county to the nearby city of Harrisburg and Cumberland County—Perry County has a large commuter presence.

Nearby counties are growing fast: Cumberland County is the 10th fastest-growing county in the state, and Dauphin ranks 20th. This will put increasing growth pressure on Perry County, which currently ranks 23rd.

Demographics: An aging population and lack of local jobs affect 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.

Retirees moving into the county: The rural character and scenic beauty of Perry County—combined with its closeness to major urban centers—make it a convenient place to retire.

Higher-than-average income: According to the American Community Survey 2013–2017, produced by the U.S. Census Bureau, median household income in Perry County is \$60,847, which is higher than Pennsylvania's median state income of \$56,951.

Increased demand for outdoor recreation: As millennials continue to prioritize opportunities for outdoor recreation, levels of participation rates should increase nationwide. Perry County has access to many recreational opportunities, including the Appalachian Trail and other hiking areas, hunting, and fishing.

Second-home communities: Perry County is the ideal location for second-home communities, especially those associated with recreational activities. There are an abundance of prime spots for cabins in the woods or homes with easy access to streams and rivers.

Waterfront cottages: Perry County has many historic river towns that border the Susquehanna and Juniata rivers, including Duncannon, Marysville, Millerstown, New Buffalo, Newport, and Liverpool.

Conservation tillage on farms to protect water quality: Many farmers in Perry County are working side-by-side with its Conservation District to put conservation tillage and other water-safe farming practices into use throughout the county.

High rate of borough rentals: Though owner-occupied homes still dominate in Perry County, the more concentrated residential areas within the borough offer rental properties and apartment buildings.

Climate: Perry County's climate is changing. In 2012, the U.S. Department of Agriculture (USDA) released a new plant hardiness zone map, which contours the nation according to average annual lowest winter temperatures. The new zones analyzed temperatures for the period 1976-2005. While plant hardiness zones are not a tool to measure climate change, Perry County moved one entire zone, from 6 to 7, during this period. This represents a distance change in the annual lowest winter temperature of over 60 miles in 30 years, or two miles per year.²²

These trends all point to a region in transition over the next 20 years. While the long-term impact of these changes may not be fully understood, it's clear that land use decisions can create both positive and negative impacts on the local economy and quality of life. Being able to put a dollar value on natural system services provides information to help local officials understand and monitor ROE.





Photo: Hicham Mouhssin

Winter geese on the move in little Buffalo State Park, Newport.

03 // THE PLACE

Perry County is a region on the edge, preserving rural culture near a major metropolitan area

Across the Susquehanna River northwest of the city of Harrisburg, and north of the suburban/urban hub of Cumberland County, is Perry County. A number of highways and state routes connect Perry County to its urban neighbors. A large number of the county's population commutes back and forth each day—yet urban sprawl has not breached its borders. Frequently described as “rural” or “open,” Perry County has retained much of its original character from its founding in 1820: a forested and farm-field-dotted landscape bordered by the Susquehanna River to the east and the Kittatinny Ridge to the south.

The Juniata River, the headwaters of which form in Huntingdon County, intersects Perry County to the northeast and meets its terminus in the Susquehanna River just north of Duncannon Borough. Low-lying river towns—such as Newport, Millerstown, Liverpool, Marysville, and New Buffalo—line the shores of the Juniata and Susquehanna rivers, and are some of Perry County's most historic and vibrant areas. The cultural community here is exceedingly strong. Organizations like the Historical Society of Perry County and the volunteer genealogical group, the Perry Historians, help raise awareness about the area's rich history. The Perry County Council of the Arts (PCCA)—which supports a variety of local artists and public workshops—operates its own gallery and an art-themed museum called the Landis House, a beloved, countywide institution.

The environment of Perry County is also unique. Besides being a part of the Kittatinny Ridge corridor, it is also one of the last remaining places in the world where the box huckleberry thrives. An ancient and near-extinct shrub distantly related to the blueberry, the box huckleberry only exists within a handful of locations in the mid-Atlantic. The box huckleberry is thought to be one of the oldest living plants—and one of the oldest living things in general—in the world. A colony existing between Newport and Duncannon, thought to be over 13,000 years old, was harmed by a transportation-related construction project. Today, the Hoverter and Sholl Box Huckleberry Natural Area, near New Bloomfield, has a colony that is estimated to be 1,200 years old.²³

Those who dwell in nearby Harrisburg and its associated suburbs can come to Perry County for recreational opportunities. The natural setting has made the county a popular destination for hiking, biking, and fishing. Besides easy access to the Susquehanna and Juniata rivers, Perry County also has a bevy of designated high-quality fishing waters, including Sherman’s Creek and Holman Lake. The Tuscarora State Forest covers most of the western portion of the county, with noncontiguous portions further to the north. Within the Tuscarora Forest exist three of Perry County’s four state parks: Colonel Denning, Fowlers Hollow, Big Spring, and Little Buffalo. These state parks have approximately 130 miles of local trails among them. The Appalachian Trail snakes through the southeast corner of the county, starting at Duncannon Borough and passing through several game lands on its way south to Cumberland County.

FIGURE 08 // PERRY COUNTY’S MAJOR ASSETS (PARTIAL LIST)

- // Adjacent to the city of Harrisburg, while still maintaining an open, rural character
- // High-quality fishing waters
- // Part of the Kittatinny Ridge, with beautiful mountain scenery
- // Easy access to the Appalachian Trail and other local trails
- // Historic river towns like Duncannon, Millersburg, Newport, Millerstown, Marysville, and Liverpool
- // Convergence of the Juniata and Susquehanna rivers
- // Great habitats for hunting
- // Above-average incomes per household
- // Significant amount of public land
- // Important habitat for at-risk flora like the box huckleberry and morel mushroom
- // Thriving local artist community, with many cultural events

POPULATION

As of the 2010 Census, 45,969 people live in Perry County.²⁴ This number is expected to rise slowly but steadily through 2040, with growth estimated to be 9.2 percent over the next 30 years.²⁵ Perry is the most rural of the three counties in the Harrisburg Area Transportation Study (HATS) region, which comprises Perry, Dauphin, and Cumberland counties. It has 80 percent fewer residents than neighboring Dauphin County, which is the densest in the HATS region.²⁶

HOUSEHOLDS

According to the 2010 Census, Perry County had 20,424 housing units—a 7.83 percent change from 2000—and an average household size of 2.54. Like population, the number

of households within the county is increasing, but at a slower pace than other counties in the region. Perry has a higher rate of owner-occupied housing (69.58 percent) than renter-occupied housing.²⁷

INCOME

The median household income in Perry County is \$60,847, and is higher than the Pennsylvania state average by approximately \$4,000. Perry has the second-highest median income in the HATS region, which is higher than Dauphin County but lower than Cumberland County. The median housing value for owner-occupied units is \$159,900, while the average rent is \$548 per month.²⁸

Hiking the Appalachian Trail in Perry County

In the early 2000s, Brian McPherson of Elliptsburg began a mission to hike all 2,200 miles of the Appalachian Trail. He and his friends would hike one part of the trail at a time, a practice known as sectional hiking. It took 10 years to complete, but Brian was not to be stopped. “I was bitten by the bug, and I was going to complete it.”

Brian succeeded his completion of a full hike of the Appalachian Trail in 2011—then kept going. Since then, he has re-walked at least 400 miles of it, including the entirety of the Pennsylvania section.

And he did it all in his sixties.

Though he hiked occasionally in his younger years with the Boy Scouts, Brian’s interest in trails did not start in earnest until his children were grown and out of the house. An empty-nester, with a house in the woods of western Perry County, Brian found that both time and opportunity were right on his doorstep.

Local trails offered a perfect chance to get outdoors and get moving—and Brian has hiked them all, following the Darlington Trail to Fowlers Hollow and back again. In addition, he also completed the entire Pennsylvania section of the Tuscarora Trail, and has hiked extensively in Big Spring State Park.

As Brian’s interest in hiking grew, so did other other recreational interests. He now mountain bikes, and participated in The Harrisburg Area Roadrunners Club’s (HARRC’s) Tuscarora Trails 50K Ultra.

EDUCATION

A total of 88.3 percent of Perry County residents have a high school education or higher, and 16.3 percent have a college degree or higher.²⁹

BUSINESS

Together, Perry County's location and natural resources make the region very business friendly. The quality and quantity of resources available to businesses are critical to business function. The recreational opportunities available due to open spaces benefit the region's workforce, translating into avoided medical and workers' compensation costs, as well as increased productivity.

The forested mountains offer surface and groundwater resources for businesses, ensuring clean, filtered water for both their products and their ability to meet water-quality permit standards. Other businesses provide a wide range of outdoor recreation equipment and services.

With the strong recreational presence in Perry County, there are many opportunities for supporting businesses such as outfitters, hotels/motels, specialized stores, and restaurants.

BUSINESS TYPES

Resource-dependent: Any business that requires a National Pollutant Discharge Elimination System (NPDES) permit to operate and relies on the quality of upstream water.

Resource-based: Any business that requires natural resources as part of its product's delivery process, such as water utilities, ski resorts, soft drink companies, breweries, and pharmaceutical production companies.

Recreation-based: Any business that supplies equipment or services to participants in outdoor recreation. These activities also support local restaurants, food stores, gasoline stations, and hotels.

Naturally smart: Any business that harnesses several natural system services to increase revenues or avoid costs. For example, Duncannon Borough partnered with The Nature Conservancy to place a conservation easement on 1,600 acres of property in the Sherman's Creek and Cove Mountain Preserve areas. Preventing development in this portion of the watershed will help protect the borough's drinking water supply.

TOURISM

Tourism in Perry County generates \$48.3 million annually.³⁰ It is part of the Kittatinny Ridge Conservation Corridor, has many parks and preserves that are open to the public, and is home to approximately 12 miles of the Appalachian Trail. Several festivals are held throughout the year, including Sherman's Valley Heritage Days, the Little Buffalo Festival, and the Duncannon Appalachian Trail Community Festival. Perry County is also a part of the Pennsylvania Dutch region, which has many associated farms, markets, and farm stands.

AGRICULTURE

Perry County's leading industry is agriculture, with over \$140 million total sales from about 889 farms averaging 152 acres each. Livestock and livestock product sales totaled more than \$112 million, placing Perry County third in the state for hogs and pigs, and 12th in the state for poultry, eggs, cattle, and calves. In addition, Perry County's 68,341 acres of field crops and forages had sales totaling more than \$277 million.³¹

Perry County is serious about preserving and protecting farmland for future generations. To date, Perry County has 9,264 acres preserved under the Pennsylvania Department of Agriculture's Farmland Preservation program—an impressive 31 percent of which were donated. In fact, according to Douglas M. Wolfgang, director of the

“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. Our farmers have shown themselves to be conscientious stewards of land and water resources, but meeting the goal of reducing nitrogen going into the Chesapeake Bay by 36 million pounds will take a monumental effort and a fresh approach. This county-level approach [Community Clean Water Toolbox] is another step toward that goal.”

– Agriculture Secretary Russell Redding (April 10, 2018, Pennsylvania Pressroom)

Bureau of Farmland Preservation, Perry County leads the state in the number of farms with donated development rights.³²

Perry County 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 hunting, fishing, and other outdoor activities.

The current trend of increasing farm size and decreasing farm numbers has the potential to lead to an increase of nutrients and sediment to local waters and, ultimately, the Chesapeake Bay, unless effective agriculture and stormwater management practices are consistently implemented and maintained.

In 2014, the DEP identified agriculture as the primary source of excess nutrient and sediment loads in impaired watersheds evaluated for aquatic life. Waters impaired due to agriculture account for about 3.7 percent of the total stream miles in the county. Other sources of impairment account for 3.2 percent, and urban/suburban runoff accounts for 0.5 percent. An impaired aquatic life use of a waterbody means that the overall aquatic community (fish, macroinvertebrates, plants, and algae) is unhealthy, and that there are pollutants that must be minimized or eliminated to return it to a healthy condition.³³

One best management practice that Perry County farmers have embraced has been the transition from conventional tillage to conservation tillage. A majority of these farmers have adopted and implemented conservation and minimum tillage farming practices. According to a tillage survey completed by the Natural Resources Conservation Service (NRCS) during the fall of 2015, 52.83 percent of regional farms use cover crops, and 58.32 percent maintain residue levels at greater than 60 percent.³⁴

“Pennsylvania’s economy, as well as the food supply of our region and beyond, depends on clean water and healthy, viable farms,” Secretary of Agriculture, Russell Redding, said. “You can’t have one without the other.”³⁵

NATURAL RESOURCES

FORESTS

Perry County is an important location for bird habitats. Straddling the boundary of

Cumberland County, the Tuscarora State Forest is the largest area of protected land, comprising approximately 96,025 acres. A 1,200-year-old colony of box huckleberry exists in a preserved natural area near Bloomfield.

Forests that are larger than 750 to 1,000 acres provide the habitat required to sustain breeding populations of wildlife. A broad-winged hawk, for example, uses a breeding area of mostly forest (80 percent), and of that forest, half or more of it is core forest (or forests greater than 1,000 feet from an edge)—around 750 to 1,000 acres total. Areas over 500 acres are needed by migrating songbirds.

Farm Life in Perry County

“I came to Perry County for the environment. I don’t regret it, and I don’t plan to leave any time soon.”

These are the words of Evelyn D’Elia, a 15-year resident of Perry County who is currently spending her retirement on a 20-acre farm in Juniata Township adjacent to Little Buffalo State Park. Evelyn keeps horses and chickens, but her property is home to a variety of other wildlife. From her window she can watch red-tailed hawks, wild turkeys, and deer. “One year a fox had three kits,” she says. “I could see them running through the pasture. There are coyotes in the woods here, too. I had never seen a coyote before coming here.”

For years, Evelyn dreamed of owning a farm like the one on which she currently lives. She grew up in Pittsburgh, then later attended Ohio State University. “It wasn’t easy for women to get jobs in the natural resources field in 1976. It wasn’t easy for women to get a job in any field that wasn’t administrative.” So, Evelyn joined the Peace Corps and was sent to the Philippines where she worked in freshwater fisheries development and got to know the local culture and people.

Eventually, Evelyn returned to Pennsylvania and settled in Cumberland County—and to a career in the Solid Waste Recycling Program with PA DEP. The program was then in its infancy, and Evelyn was part of the original team that helped to get it off the ground. During this time, she fulfilled another dream by purchasing a thoroughbred horse.

Living in the suburbs of Enola, Evelyn had no room for a horse on her property and had to board her thoroughbred. After a great deal of thought, she decided it was time to consider buying her own farm. And it was in Perry County that she found her 20 acres. “It was perfect—exactly what I had always been looking for—and has turned out to be more than I expected.” Now, after 23 years of working at PA DEP, Evelyn is happily retired and able to enjoy her farm to its fullest.

Tolerance to forest fragmentation varies. Forest shape can affect quality or the amount of edge. Forests less than 150 acres in long strips are lower in quality than forests 150 acres square. The goal is to maintain large, connected forests, as well as forested stream and river corridors.

The Central Pennsylvania Conservancy (CPC) and The Nature Conservancy (TNC) both hold easements within Perry County. Partnerships have recently led to significant land preservation deals along the Kittatinny Ridge. With DCNR and donor support, TNC acquired Cove Mountain Preserve, a 352-acre parcel at the base of Cove Mountain in Rye and Penn townships and Marysville. This is TNC's first nature preserve in Central Pennsylvania. CPC placed a conservation easement on 500 acres of privately-owned forested land near Tuscarora State Forest: the Reineman Wildlife Sanctuary, Waggoner's Gap Hawk Watch, county-preserved farms, and other nearby CPC easement properties, including a portion of Sherman's Creek. In partnership with TNC and DCNR, Duncannon Borough placed a conservation easement on 1,620 acres near Marysville, also protecting a portion of the Sherman's Creek Watershed from future development. This will benefit the quality of water flowing into the Susquehanna River and, ultimately, the Chesapeake Bay.

TOPOGRAPHY

Perry County is separated from Cumberland County to the south by the natural border of Blue Mountain. Blue Mountain follows Perry's southern edge through its entire length, and crosses over into Dauphin—effectively splitting Dauphin County into neat, northern and southern portions. It is also intersected by Cove Mountain and Blue Mountain in the southeast, and Half Falls Mountain and Buffalo Mountain in the northeast. The Tuscarora Mountain forms another natural barrier between Perry County and Juniata County to the north.

It should be noted that, while quite steep in some places, Perry County's landscape is neither jagged nor harsh. The slopes inland of the mountain borders can be quite gentle, and farmland hurries to fill gaps between the forested mountain areas. All of Perry's prime agricultural soils lie within the inland valley created by the two bordering mountains.

The climate of Perry County is typical of Central Pennsylvania. Though the region can experience heavy rain, and significant snowfall is common in winter, it does not suffer from the Great Lakes Effect the way that counties in the western and northern part of the state do. It is also far enough away from the coast to avoid the cooling effect associated with the ocean. Many of the hazardous weather events come from the edge effects of severe storms that hit New England or other parts of the East Coast, including Nor'easters, tropical storms, or hurricanes. Though Central Pennsylvania

will not bear the full brunt of hurricanes or tropical storms that keep to the coast, and hurricane threats are not as severe as they are in other parts of the country, there have been incidents where storms have turned inland and caused substantial damage to the region. Two examples are Tropical Storm Lee in 2011 and Hurricane Sandy in 2012.

WATER

Water is one of the chief ways we will experience more frequent and dangerous extremes of climate change, through heavier downpours and resulting floods, and longer-lasting droughts and heatwaves.

Perry County is part of the Chesapeake Bay Watershed. Its local major watersheds are the Susquehanna River, the Juniata River, Buffalo Creek, and Sherman's Creek. As of 2018, Marysville is the only municipality in Perry County to have a separate, regulated, municipal storm sewer system (MS4) with permit requirements in place.

Environmental Activism in Perry County

Born in Philadelphia, Linda Sieber moved to Carroll Township in Perry County 21 years ago. She always thought she would return to the city one day, but something about the beauty and location of Perry County drew her in. "We feel safe here—it's a wonderful place to raise children. We never had to worry about the kids going out at night."

A Penn State Master Gardener, Linda has been involved with educating adults and youth alike on environmental issues. She has noted an increase in awareness with regard to environmental education over the years, especially in the younger generation. Amish and Mennonite audiences seem particularly interested in learning principles of good stewardship.

Her home borders Sherman's Creek, which has been an important part of Linda's life since she came to Perry County. The former president and co-founder of the Sherman's Creek Conservation Association, Linda was part of a group that was instrumental in establishing long-term water monitoring along the creek. Working with the local government and residents opened her eyes to the value of connecting with the community and participating in local politics. "Becoming involved with Carroll Township was a great experience for the Conservation Association. It gave us the ability to work with people who truly cared. Looking back, I'm content that I was able to do something worthwhile here."

When it comes to water quality, Perry County has a distinct advantage over its neighbors. Perry is approximately 65 percent forested, and runoff over impervious areas is not as large a problem as it is in more urban areas. Agriculture still presents a significant challenge to water quality. The Perry County Conservation District has made great strides in promoting “No Till” agricultural and other sustainable practices, and Perry’s agricultural areas are not totally dominated by impaired streams. Buffalo Creek and Little Buffalo Creek, two of the county’s streams designated “high quality,” have been able to avoid being listed as impaired according to DEP water quality standards.

During summer 2018, The Nature Conservancy and the Duncannon Municipal Water Company began closing a deal to allow The Nature Conservancy to purchase development rights to properties in the Sherman’s Creek Watershed. Segments of Sherman’s Creek are designated as “high quality,” and the creek as a whole is impaired along its main stem and some of its tributaries. The acquisition will make great strides toward improving the creek’s integrity.

PARKS, TRAILS, AND GREENWAYS

A study conducted by Pennsylvania State University’s Department of Recreation, Park, and Tourism Management analyzed the amount of revenue each state park within Pennsylvania receives annually from both day and overnight users.³⁶ Three types of day users were identified in the study:

- // Local day users are 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 are 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 are those who live more than 50 miles from the park, and make up 16 percent of visitation and 24 percent of total day spending.

According to in-house graphic information system (GIS) analysis, all of Perry County’s residential development is within five miles of a park, trail, state forest, or other recreation area.

Appalachian National Scenic Trail (A.T.): The A.T. passes through Duncannon Borough (an official Appalachian Trail community) and travels through Penn Township and State Game Lands 170 into Rye Township before crossing into Cumberland County. There are approximately 12 miles of the A.T. in Perry County.

Little Buffalo State Park: Little Buffalo State Park is the largest of all of the state parks in the county. It comprises 923 acres and is home to several historic structures, including a functional grist mill, as well as ample hunting areas. In the park’s center is

the 88-acre Holman Lake, a popular fishing site. Little Buffalo has trails, picnic areas with playgrounds, and a swimming pool.³⁷

Tuscarora State Forest: With approximately 96,000 acres, Tuscarora State Forest is the largest state-protected area in the HATS region.³⁸ It is noncontiguous with the majority of coverage in western Perry County. There is a section of the forest in northern Perry along the border of Juniata County, and another section along the Juniata County/ Mifflin County border. Three out of four of Perry County’s state parks exist within the Tuscarora State Forest: Colonel Denning, Fowlers Hollow, and Big Spring. The Hoverter and Sholl Box Huckleberry Natural Area, with its ancient colony of box huckleberry, is considered part of the Tuscarora State Forest for administrative purposes, but exists as a separate entity in Centre Township, just south of New Bloomfield.

FIGURE 09 // ECONOMIC IMPACTS OF STATE PARKS AND TRAILS³⁹

PARKS	VISITATION	SPENDING (\$ IN THOUSANDS)	JOBS
LITTLE BUFFALO	108,309	\$5,904	85
FOWLERS HOLLOW	7,569	\$435	6
COLONEL DENNING	26,898	\$1,148	17

Beekeeping in Perry County

Daniel Heacock has lived in Perry County since 1986. Although he developed an interest in bees in his early 20s, it was purely academic. Daniel did not seriously entertain becoming a beekeeper until 2008, when he became friends with a man who sold him honey but was looking to retire from keeping hives. It was a golden opportunity, and one that Daniel said gave him a kick start. "I realized that if I wanted a mentor, I had to move quickly."

Daniel jumped into beekeeping with both feet. "There was so much to learn," he says. "It was both more work but more interesting than I expected." By the time his friend was ready to retire, Daniel was firmly invested as a hobbyist beekeeper.

Successful beekeeping, like many other nature-based endeavors, is very dependent on external forces like the weather. Natural disaster or temperatures too much outside of the average can result in major losses for hives. In the USA, the average winter hive colony loss is 34 percent.

A self-employed investment advisor, Daniel makes a profit by beekeeping but is content to be mainly a sidelinier. "I wouldn't want to do it full time. It's stressful to have your entire livelihood depend on something that can go wrong very quickly. Beekeeping is so different from what I do on a day-to-day basis that it brings balance to my life. I enjoy working with nature."

Daniel is a member of the Capital Area Beekeepers Association (CABA), an organization that offers Beekeeping 101 courses and many other resources for current or potential beekeepers, and acts as Perry County's coordinator. "I don't know how many beekeepers are in Perry County," Daniel says. "Maybe one or two per town. It's more difficult now than it used to be. Imported viruses and invasive bugs started causing grief for beekeepers."

New chemicals, pesticides, and herbicides used on lawns and crops have had their own negative effects on the bee populations—not just in Perry County, but nationwide. Daniel can remember the days before widespread use of harmful pesticides, when lawns used to be more than plain turf grass. "There used to be dandelions, violets, and clover in people's yards. A dandelion is a flower to me—and a flower to the bees."





Photo: Laurie Jean Houck

A doe steals a glance along the ridges of the Tuscarora State Forest.

04 // METHODOLOGY

How ROE values are calculated

The economic value of Perry County's open space was estimated by measuring impact in five areas:

- // Avoided costs associated with natural system services provided by Perry County's open spaces
- // Avoided costs associated with air pollution removal
- // Value of open space related to outdoor recreation (e.g., sale of goods and services)
- // Avoided healthcare costs associated with healthy lifestyles
- // Impact of open space and water on property values (e.g., higher property values and earnings from open-space-related activities)

While the most obvious natural system services include food, drinking water, and plants, the 245,458 acres of forest and 2,696 acres of wetlands in Perry County also provide many less-visible natural system services, such as climate regulation and the natural flood defense provided by forests.⁴⁰ Over time, billions of tons of carbon are stored in Perry County forests. Forests and meadows also support natural pollination and biological control of insects and rodents.

Building on previous valuation studies, and using standard economic analysis techniques, this study estimated the financial value of Perry County's open space by measuring the financial impacts of avoided costs from natural system services and air pollution removal, outdoor recreation revenues, avoided healthcare costs as a result of increased exercise, and increased property values due to proximity to open space.

In Perry County's ROE study, conservative approaches were used to estimate monetary values. For example, only major recreational activities were included, and not all natural system services. Even with this conservative approach, the analysis is subject to caveats common to any economic valuation or impact analysis. These caveats include substitution effects, double counting, and value transfer (VT).

Substitution effects are important when considering the benefits that residents enjoy by recreating and exercising in local public parks as opposed to a private facility. If all open space were developed, it is unlikely that residents would discontinue the recreational activities they now enjoy, but would instead go elsewhere. Because of this, estimates of recreational value in this study should be understood to represent only the benefits that existing open space in the county provides. Tourism is not a part of this estimate.

Double counting occurs when a value is overstated because it has been derived from two separate analyses. While this study aimed to minimize any double counting, the complexity of natural systems and their interconnections make it difficult to avoid some double counting.

Value transfer (VT) involves the adaptation of existing valuation or data from one location to a similar location. It is used as an alternative strategy when primary research is not possible or justified because of time or budget constraints. While VT is an alternative strategy, it is better than discounting natural system services and implying that their value is zero.

VT is an important tool for policymakers, since it uses existing research to reliably estimate the landscape's natural system service value for considerably less time and expense than a new primary study. VT information for this report was obtained from the 2011 satellite-derived land cover data from the MRLC Consortium.⁴¹

FIGURE 10 // VT MODEL FOR NATURAL SYSTEM SERVICES



NATURAL SYSTEM SERVICES

Natural system services represent the benefits that human populations derive, directly or indirectly, free of charge from ecosystem functions. Because natural system services are not fully captured in commercial markets or adequately quantified in terms comparable with economic services and manufactured capital, they are often overlooked or undervalued in policy debates and investment decisions.

This component of the study estimated the avoided costs associated with 11 natural system services in Perry County's open space: groundwater, stormwater and flood mitigation, carbon sequestration, air-pollution removal, wildlife habitat, aquatic habitat, erosion prevention, habitat regeneration, pollination, biological control, and nutrient uptake. These represent natural system services that, if lost, would require costly intervention to replicate at taxpayers' expense.

Since most services are natural functions, markets for these services do not exist.

When there are no explicit markets for the services, more indirect means of assessing values must be utilized, including:

- // Avoided cost (AC)
- // Contingent valuation (CV)
- // Cost of damage (CD)
- // Cost of regulation (CR)
- // Direct investment in a resource (DI)
- // Direct market valuation (DM)
- // Market valuation (MV)
- // Replacement cost (RC)
- // Tax benefits (TB)
- // Travel cost (TC)

See [Glossary](#) for full definitions.

NATURAL SYSTEM SERVICES METHODOLOGY

The value of natural system services is a reflection of what price people and governments are willing to pay to conserve, restore, and expand natural resources.⁴² This method, developed by Dr. Elliott Campbell, Maryland Department of Natural Resources, is known as eco-pricing and is used in ROE studies to develop a list of natural system services provided by forests, wetlands, and riparian and grassland areas in Pennsylvania. Most of these services do not have established markets, making estimates difficult. These estimates are based primarily on the transfer of data from peer-reviewed studies, as well as data from regulatory fines, nutrient trading, forest replanting, habitat replacement costs, tax benefits, and conservation easement values.

As part of an effort to document eco-prices relevant to Pennsylvania, the following federal and state agencies and other organizations provided information:

- // U.S. Fish and Wildlife Service
- // U.S. Environmental Protection Agency
- // U.S. Forest Service
- // Pennsylvania DCNR–Forestry Division
- // Pennsylvania Fish and Boat Commission
- // Pennsylvania Game Commission
- // Maryland Department of Natural Resources
- // Water Research Foundation (WRF)
- // Hawk Mountain Sanctuary

Campbell (2016) reviewed and summarized over 55 academic studies comprising 210 individual value estimates for the types of ecosystems present in the state of Maryland.⁴³ Weber reviewed over 80 peer-reviewed articles for Cecil County, MD.⁴⁴

Aaron Paul reviewed over 80 articles for Virginia.⁴⁵ Costanza reviewed over 100 peer-reviewed articles in a similar study in New Jersey.⁴⁶

Due to the similarity of climate, land cover, and ecosystems in Maryland, New Jersey, and Virginia, this data was relied upon as well. Data from Maryland and New Jersey were used when Pennsylvania data was unavailable. Data from elsewhere in the United States was a third choice.

Figure 11 contains 80 exchanges of money for some form of ecological work, the replacement of ecological work, or cost of damages to an ecosystem service (i.e. eco-prices). Eight economic classifications (investment, replacement cost, avoidance cost, market price, cost of regulation, cost of damages, taxes incurred, and tax benefit) were reviewed.

FIGURE 11 // STUDIES REVIEWED BY CAMPBELL, ROGERS, AND COSTANZA

NATURAL SYSTEM SERVICE	NUMBER OF FINANCIAL EXCHANGES USED IN DEVELOPING ECO-PRICES
GROUNDWATER	5
NUTRIENT UPTAKE	17
STORMWATER AND FLOOD MITIGATION	27
AQUATIC RESOURCES	3
HABITAT	19
EROSION PREVENTION	4
POLLINATION	3
BIOLOGICAL CONTROL	2

In cases where there were a range of values for a given service, the most conservative number was chosen. All dollar figures were transformed to 2017 equivalents, using an online inflation calculator (<http://www.westegg.com/inflation/>) that employs the Consumer Price Index (CPI) from the annual Statistical Abstract of the United States.

These numbers are estimates only and consider several issues, as the data are often not spatially explicit. Some services, like pollination, depend on proximity to crops, yet not all forests in the county are within pollinator range of cropland. The value of flood protection, groundwater recharge, and other services also depends on human demand relative to supply. This ratio tends to be higher in urban areas than rural.

Similarly, not all forest and wetland types provide services equally. For example, many restoration practices are focused on reducing the amount of nitrogen entering waterways. The cost of paying for this can be expressed in terms of \$/pound of nitrogen removed. Different natural systems, such as wetlands, forests, and riparian

covers, remove nitrogen at different rates on an annual basis.⁴⁷

Other examples include soils and carbon sequestration. More productive soils facilitate faster plant growth and faster uptake of carbon. Some tree species are better at carbon uptake than others.

Using eco-prices, an annual benefit can be calculated for each natural system. Further, large, contiguous blocks of forest and wetland are more likely to contain fully functioning ecosystems and provide corresponding benefits to humans. Smaller, fragmented ecosystems are more likely to be impaired.^{48 49 50 51} Retaining connectivity using configured corridors can help to offset some of the functional losses caused by fragmentation.^{52 53 54 55 56 57}

Finally, using some services may impair other services. For example, constructing trails for recreation can create more opportunities for invasive species. Proper management is therefore necessary to prevent long-term ecological degradation.

The study group attempted to overcome these concerns in the following ways:

- // Each cover type was distinguished by one or more eco-price.
- // Eco-prices varied by cover types.
- // Position in the landscape distinguished cover types (headwaters versus riparian forests).
- // Locational differences were used as separate cover types (urban versus rural).
- // Forest size was used to differentiate cover types (750 acres, 500-750 acres, 150-500 acres, and less than 150 acres).
- // Current uses or practices, like working forests and developed open space, were used to differentiate cover types.

The total natural system service value of a given type of preserved or undeveloped open space was determined by aggregating the individual natural system service eco-prices associated with each land cover type.

NATURAL SYSTEM SERVICES CATEGORIES

Water supply and groundwater: Pennsylvania cover types (e.g., forests and wetlands) and their underlying soils help ensure that rainwater is stored and released gradually to streams and rivers, rather than immediately flowing downstream as runoff. As Perry County grows, the value of infiltration and quality water to residents will continue to be very high. The sources for this eco-price were investment in water supply and the market price of municipal water supplies in Pennsylvania and Maryland.^{58 59 60}

Nutrient uptake: Forests and wetlands provide a natural protective buffer between human activities and water supplies, helping to filter out pathogens, excess nutrients, metals, and sediments. Waste assimilation benefits were derived by the amount of forest, wetland, and riparian buffer cover.⁶¹

The nutrient category included 14 eco-prices, 11 of which are prices per pound of nutrient removed.⁶² These were averaged, with the cost of implementing best management practices (BMP) cost share and cost of nutrient removal retrofits on water treatment facilities.⁶³ Also included in this category are the price of nitrogen in Pennsylvania's nutrient trading market, and studies on the value of trees in reducing water treatment costs.^{64 65}

Stormwater and flood mitigation: Many natural landscapes provide a buffering function that protects humans from destructive activities. Forests, wetlands, riparian buffers, and floodplains mitigate the effects of floods by slowing, trapping, and containing stormwater. The stormwater and flood mitigation category comprises 27 eco-prices, 24 of which are stormwater best management practices that were averaged together.^{66 67}

Biological control: Native birds and insects dynamically regulate and control invasive and unwanted species, such as pests, weeds, and disease vectors (e.g., mosquitoes). This eco-price is based on a valuation study.⁶⁸

Wildlife habitat: Contiguous patches of land cover with sufficient area allow naturally functioning ecosystems and support a diversity of sustainable plant and animal life. Intact forests and wetlands function as critical population sources for plant and animal species that humans value for both aesthetic and functional reasons. Native vegetation supports 29 times more biodiversity than non-native plants.⁶⁹

The eco-price associated with biodiversity and wildlife habitat was assumed to be investments made to preserve natural lands or habitats and the tax benefit gained by doing so. The habitat category includes five instances of investments in wildlife habitat and the calculated average yearly tax benefit of donating land for conservation. The yearly value per acre is estimated to be this tax benefit, plus the average annualized value of the conserved land.^{70 71 72 73 74 75 76 77 78 79 80}

Habitat regeneration: Natural habitats regenerate. Forests and wetland habitat regeneration is the act of renewing habitat cover by naturally establishing young plants promptly after the previous habitat has been altered. This eco-price is based on the cost to replace habitat using recent data from the U.S. Forest Service and two related studies.⁸¹

Aquatic habitat: The Pennsylvania Fish and Boat Commission (PFBC) created a wild trout designation and biomass classification system. PFBC also secures fines from activities that kill fish. Fines vary by species and fish size. Based on the average size and fine for different stream classifications, an eco-price was developed for each exceptional value and high-quality stream classification.^{82 83 84}

Pollination: Pollination is essential for native vegetation, and many agricultural crops and substitutes for local pollinators are increasingly expensive. Pennsylvania has been experiencing a severe bee colony collapse. Forests and meadows provide pollination service benefits, which are a form of insurance for farmers and nature in the event that bee colony collapse remains an issue. This eco-price is based on the cost of replanting meadows, replacing bee hives, and managing pollination in forests.^{85 86 87}

Soil retention: Soils provide many of the services mentioned above, including water storage/filtration, waste assimilation, and a medium for plant growth. Natural systems create and enrich soil through weathering and decomposition, and retain soil by preventing it from being washed away. Four eco-prices are included in the soil category: two are costs of erosion and two are costs associated with preventing erosion.^{88 89 90 91}

NATURAL SYSTEM LAND COVER TYPES

Forests over 750 acres are sustainable forests that support breeding populations of migrating birds and larger mammals.⁹²

Large regenerating forests are forests over 500 acres that support sustainable populations of songbirds and wildlife.^{93 94}

Working regenerating forests are actively harvested forests that occur on state lands. They can be small or large, with the average working forest being 200 acres. These forests generally regenerate, but have less habitat quality than larger, undisturbed forests.⁹⁵

Forests under 150 acres (small forests) allow light to penetrate from all sides, thus promoting invasive species of plants. This retards natural regeneration. The services provided by these forests are useful only as long as these forests exist.⁹⁶

Riparian forests (100 feet on either side of a stream) help stabilize banks and, due to the presence of water, attract wider biodiversity than upland forests. Some studies estimate the biodiversity to be double.^{97 98}

Urban forests can be any size, except in rare instances where the urban forest is large and connected—such as Fairmount Park in Philadelphia—where forests do not regenerate. The carbon and greenhouse gas value of these forests is significantly greater than other forests. These forests help with stormwater management, but they provide very little groundwater recharge.⁹⁹

Floodplain forests are within the 100-year floodplain boundary.¹⁰⁰

Headwater forests and wetlands (100 feet on either side of a stream), classified as first-order streams, are designated as having exceptional value and high quality. Headwaters often make up 50–70 percent of a watershed.¹⁰¹ These streams have some of the cleanest water in Pennsylvania. The water provides an excellent habitat for native trout and other aquatic organisms.¹⁰²

Forested wetlands have high biodiversity, as wildlife needs water for survival.¹⁰³

Rural wetlands provide many biodiversity benefits. What distinguishes them is their location. While their benefits impact a smaller number of people, the downstream human population benefits from their existence.¹⁰⁴

Urban wetlands impact urban populations. They have a limited role in groundwater recharge, as they are usually located at the base of streams.¹⁰⁵

Cultivated fields can change vegetation from year to year; however, they do serve a value for many species of birds and other wildlife. They help to support pollinator species and biological control.¹⁰⁶ Cultivated fields can also be a source of sediment, pesticides, and fertilizers that pollute water.

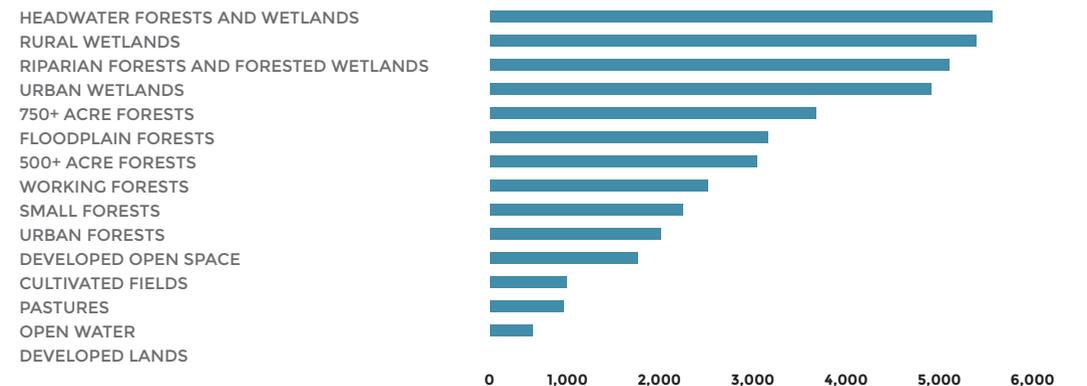
Pastures support pollinator species and biological control.¹⁰⁷ Most state-endangered bird species are associated with pastures and wetlands. However, pastures can be a source of pollution, because the soils are compacted and provide only a small value in runoff control.¹⁰⁸

Open water is great for recreation and provides groundwater recharge. Birds and other wildlife use water as part of their regular and migration habitats.¹⁰⁹

Developed open space includes parks and preserves with less than 30 percent impervious cover. Urban open space and street trees provide many benefits, including air quality, energy conservation, cooling, and pavement protection. They also can provide a habitat for many species, as long as a larger habitat is within a half mile.¹¹⁰

Developed lands are urban areas with greater than 30 percent impervious cover. These areas often create more problems than benefits for natural systems.¹¹¹

FIGURE 12 // FINANCIAL VALUE PER ACRE OF PERRY COUNTY LAND COVER TYPES



AIR POLLUTION REMOVAL

The Clean Air Act (CAA) requires the Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. A nonattainment area is any area that does not meet primary or secondary NAAQS. Once a nonattainment area meets the standards and additional re-designation requirements in the CAA [Section 107(d)(3)(E)], the EPA will designate the area as a maintenance area.

Ozone is formed by chemical reactions occurring under specific atmospheric conditions. Precursor pollutants that contribute to the formation of ozone include volatile organic compounds (VOCs) and oxides of nitrogen (NOx), both of which are components of vehicle exhaust. VOCs may also be produced through the evaporation of vehicle fuel, as well as by displacement of vapors in the gas tank during refueling. By controlling VOC and NOx emissions, ozone formation can be mitigated. Both precursor pollutants are analyzed in the transportation conformity process. Air pollution can also damage buildings and plants, disrupt many natural system services, and cause reduced visibility.

Perry County has been designated as part of the Harrisburg-York-Lebanon Combined Statistical Area (CSA) and the Harrisburg-Carlisle Metropolitan Statistical Area (MSA). Both of these regions frequently rank as having some of the highest levels of ozone and particle pollution in the United States. While the city of Harrisburg is well known

for having poor air quality, assessing Perry County air quality as separate from the CSA or MSA is difficult because of a lack of data. The last time an Air Quality Index (AQI) report was generated for Perry County was in 2014. Those numbers showed that out of 303 days with a measurable AQI, 285 days (94 percent) were ranked as “good” or “healthy,” 18 (six percent) were ranked as “moderate,” and none were ranked as “unhealthy” or “very unhealthy.”¹¹²

Currently, Perry County’s air quality has not been graded outside of the CSA, and is labeled as “incomplete” for ozone and “data not collected” for particles.¹¹³ But according to the U.S. Census and the American Lung Association, there are 3,830 adults and 874 children who suffer from asthma, 2,695 who suffer from COPD, 29 who suffer from lung cancer, and 3,526 who suffer from some form of cardiovascular disease.¹¹⁴

AIR POLLUTION REMOVAL METHODOLOGY

Total pollutant removal values for each pollutant vary depending on the amount of tree-canopy cover. Increased tree cover leads to greater pollutant removal values. As trees die and decay, they release much of their stored carbon into the atmosphere. Carbon storage is an estimate of the total amount of carbon that is currently stored in the above- and below-ground biomass of a forest.¹¹⁵

The i-Tree Landscape Model, developed by the U.S. Forest Service, was used to estimate the air pollution removal and carbon sequestration and storage rates of Perry County’s tree cover. The model uses the National Land Cover Database to estimate the amount of tree canopy, and then uses pollution-removal rates to estimate the total amount of pollutant removal. The i-Tree Landscape analyzes tree canopy, land cover, and basic demographic information by specific locations. With the information provided by the i-Tree Landscape Model, levels and financial value are calculated.¹¹⁶

FIGURE 13 // I-TREE LANDSCAPE MODEL PROCESS



OUTDOOR RECREATION

Outdoor recreation includes activities that can be performed in natural settings without causing harm to nature. Resident levels of participation and direct annual spending were tracked across 13 recreational activity categories. This list was compiled by reviewing the major activities in the DCNR 2014 Outdoor Recreation Participation Survey, and by having discussions with Perry County ROE steering committee members. Only those activities with the highest participation rates were included. Some residents may enjoy horseback riding, but the numbers are small relative to other activities. Further, motorized activities like motorcycling, snowmobiling, and driving for pleasure were not included, as these are long-distance activities associated with tourism. The major recreational activities identified for Perry County are:

- // Freshwater fishing
- // Hunting (all types)
- // Walking (on trails, in parks, and on streets)
- // Running (on- and off-road)
- // Bicycle-based recreation (on- or off-road)
- // Camp-based recreation (in a tent)
- // Water-based recreation (kayaking, rafting, and canoeing)
- // Trail-based recreation (hiking on an unpaved trail, backpacking, and climbing natural rock)
- // Wildlife viewing (wildlife watching and photography, except birds)
- // Birding (both near and away from home), bird feeding, bird watching, and photography
- // Outdoor education (nature study)
- // Mountain biking
- // Cross-country skiing

OUTDOOR RECREATION METHODOLOGY

Economic Impact Analysis for Planning (IMPLAN) is an economic impact assessment software system used to assess the change in overall economic activity as a result of change in one or several specific economic activities. Economic activity can be either outside the region or reflected in transactions among people and businesses within Perry County. This form of economic activity is often referred to as economic contributions.

Economic contributions are usually expressed as jobs, income, retail sales (expenditures), and tax revenues. For the purpose of economic modeling, economic contributions and impacts can be divided into three standard components: direct, indirect, and induced. Indirect and induced effects are the two components of the multiplier or ripple effect. Each of these is considered when estimating the overall economic effect of any activity.

Direct effects are initial purchases made by the consumer, and calculated by

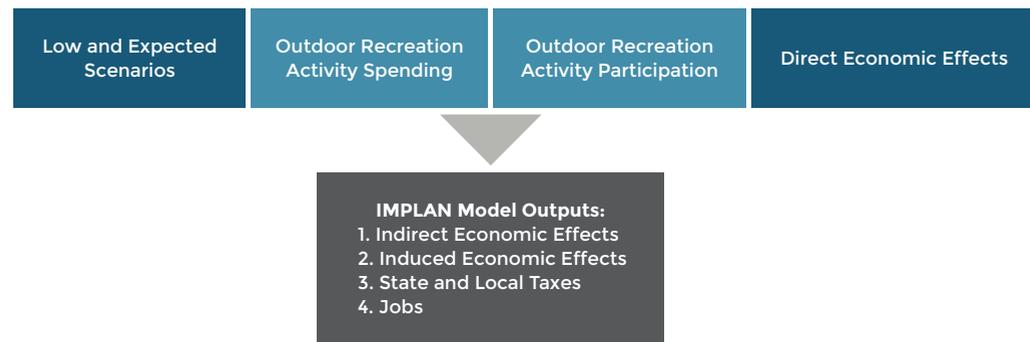
multiplying the number of participants by their average annual spending for a particular activity. Participants are defined as those who engage in a given activity at least once a year, and their recreational activity spending includes such things as travel, clothing, equipment, and fees.

Indirect effects measure how sales in one industry affect the other industries that provide supplies and support. For example, an angler buys fishing rods, hats, hip boots, gasoline, and food—which may be produced in other parts of the state, country, or world.

Induced effects result from the wages and salaries paid by impacted industries to employees who then spend their money. These expenditures are induced effects that create a continual cycle of indirect and induced effects.

The sum of the direct, indirect, and induced effects is the total economic impact or contribution. The IMPLAN economic model examined Perry County’s economic and demographic data. Indirect and induced economic effects, along with employment and state and local taxes, were analyzed for the 13 previously identified outdoor recreation activities.¹¹⁷

FIGURE 14 // IMPLAN ECONOMIC IMPACT ASSESSMENT TOOL



The first phase of this analysis focused on data gathering that included:

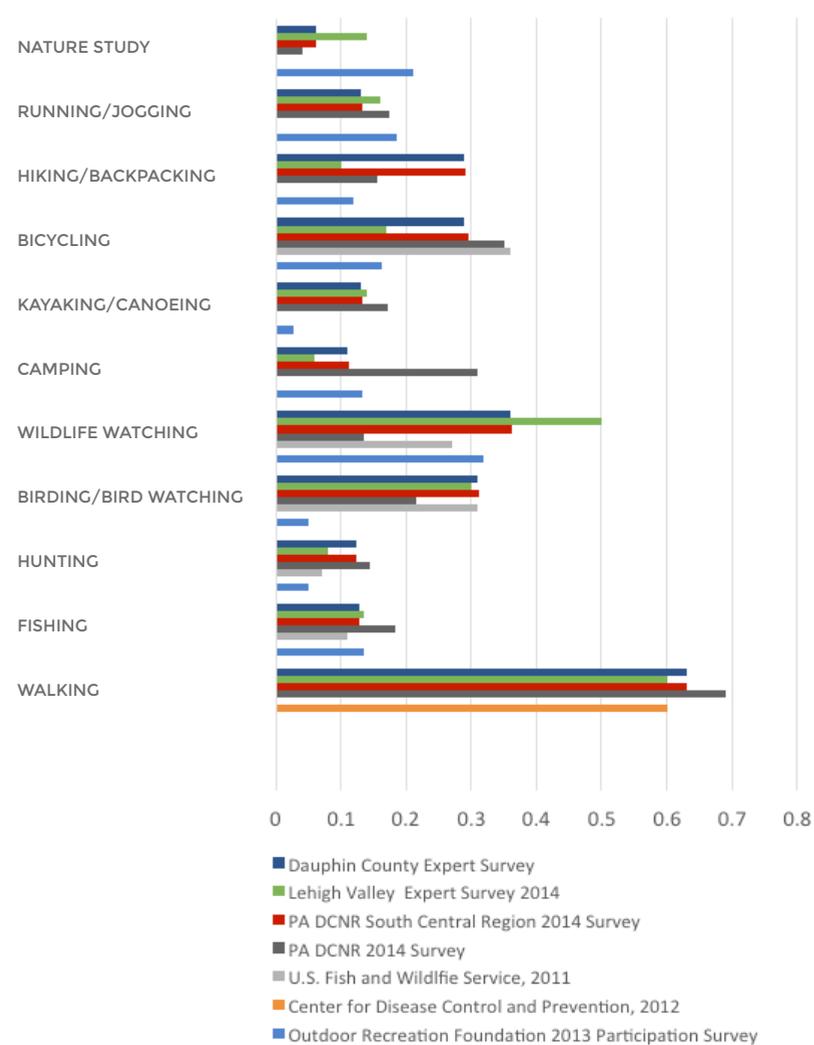
1. Researching existing published surveys that collected information on regional, state, and national participation and spending estimates
2. Estimating the total annual expenditures made by recreationists at the local, regional, and national levels for each examined category
3. Interviewing local experts on each activity to validate the survey data for participation and spending in Perry County
4. Creating a set of expected estimates for participation and spending

While not all surveys collect information in the same data categories, there are some consistencies. Most surveys provide information on a majority of activities, participation rates, and spending. The rate of participation and levels of spending depend on recreational activity. Statistics on some activities are difficult to collect. Transaction receipts are impractical, if not impossible, to collect. Therefore, the primary sources of information are surveys. Recreation surveys generally accept respondent estimates without validation and, since outdoor recreation is considered a desirable activity, respondents may overestimate their participation.

Most surveys ask people about their activities over the previous seven days, two weeks, or even a year. A natural inability to recall behavior over periods of time, combined with a tendency to remember recent events more accurately, can lead to overestimates. Nevertheless, surveys do indicate trends, several surveys may have similar outcomes, and local experts and users can help validate survey results. Creating scenarios allows results to be bracketed and presented with an accurate range of economic impacts.

Financial data is less available than participation rates and usually derived from surveys and national studies. For example, the U.S. Fish and Wildlife Service conducts a National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (FHWAR) every five years. This survey breaks down spending, demographic, and participation information, and provides information on a state-by-state basis. This survey is a well-established reference for fishing, hunting, and wildlife watching.¹¹⁸

FIGURE 15 // COMPARISON OF NATIONAL, STATE, AND REGIONAL SURVEY PARTICIPATION RATES



REDUCED HEALTHCARE COSTS

Perry County healthcare savings were derived by applying DCNR outdoor exercise participation rates to the conclusions of four recent studies. Outdoor recreation activities include walking, hiking, jogging, running, bicycling, camping, unstructured and playground play, paddle sports, bird and other animal watching, wildlife photography, hunting and fishing, and nature study. These activities are provided by open space at little or no direct cost to users. While paid fitness clubs and prescription exercise are valuable, individuals are generally actively involved for only a short time—often just three to six months.¹¹⁹

FIGURE 16 // PERCENTAGE OF OUTDOOR RECREATION PARTICIPATION (SOUTH-CENTRAL REGION)

2 OR MORE TIMES PER WEEK	39.1%
1 TIME PER WEEK	18.2%
1-2 TIMES PER MONTH	2.5%
SEVERAL TIMES PER YEAR	4.8%
1-2 TIMES PER YEAR	1.3%
NEVER	34.3%

KEY FINDINGS

- // A 2012 collaborative study of over 20,000 people between the University of Texas-Southwestern Medical Center and the Cooper Institute found that average medical claims spent for middle-aged, least-fit men were about 37 percent higher (\$5,134) than the average spent per year for most-fit men (\$3,227). The most-fit males saved \$1,907 in medical costs per year. The average medical claims spent for least-fit women were 40 percent higher (\$4,565) than the most-fit (\$2,755). The most-fit females saved \$1,810 in medical costs per year.¹²⁰
- // A University of Michigan study looked at the impact of exercise on 4,345 employees in a financial services company that started a workplace wellness program. Roughly 30 percent of employees were high risk and suffering from metabolic syndrome, a dangerous cluster of risk factors associated with diabetes and heart disease. Overall, about 34 percent of U.S. adults have metabolic syndrome. The study found that when high-risk employees accumulated the government-recommended 150 minutes of moderate-intensity exercise a week, their healthcare costs and productivity equaled that of healthy employees who didn't exercise enough. Employees with metabolic syndrome who exercised enough cost \$2,770 in total healthcare annually, compared to \$3,855 for workers with metabolic syndrome who didn't exercise enough. Pharmacy costs alone were twice as much. This represents a savings of \$1,085 per person per year.¹²¹
- // A 2015 study about "Inadequate Physical Activity and Health Care Expenditures in the United States" included 51,165 adults over the age of 21, excluding women that were pregnant or people who were unable to be physically active. The study found that the mean annual expenditure difference per capita for inactive adults compared to active adults was \$1,437, or a difference of 29.9 percent. For people who exercised, but not enough to sufficiently reach maximum benefit, the difference was \$713 per year.¹²²
- // In 2016, The Centers for Disease Control and Prevention (CDC) published a paper connecting inadequate physical activity with healthcare costs. The CDC researchers merged data from the National Health Interview Survey (2001-2010) and the Medical Expenditure Panel Survey. The National Health Interview Survey used face-to-face interviews to gather health information from individuals nationwide. The Medical Expenditure Panel Survey collected healthcare cost data from both federal agencies and private insurance companies. When these two data sets were merged, information was provided on over 58,000 individuals. The researchers evaluated the difference in healthcare costs for individuals with various levels of physical activity. Individuals who exercised more than 150 minutes per week spent about \$4,500 per year on healthcare costs. Those who did between zero and 150 minutes of exercise a week spent \$5,076 per year, and those who didn't exercise at all spent \$5,813 per year. Compared with those who are active, sedentary adults spend \$1,313 more on healthcare every year.¹²³

The conclusions of these four studies were compiled to establish an average per-capita healthcare cost reduction for Perry County.

FIGURE 17 // HEALTHCARE COST REDUCTION DUE TO EXERCISE AND OUTDOOR ACTIVITY

SOURCE	ANNUAL PER CAPITA EXPENSE
HOLOHAN, 2012	\$1,907
BAILEY, ET AL., 2014	\$1,085
CARLSON, ET AL., 2015	\$1,437
CDC, 2016	\$1,313
AVERAGE COST REDUCTION	\$1,436
INSUFFICIENT EXERCISE TO REACH MAXIMUM BENEFIT (CARLSON, ET AL., 2015)	\$713

REDUCED HEALTHCARE COST CALCULATION

For the purposes of Perry County’s ROE healthcare cost savings, the people impacted by improved healthcare costs include all residents 19 years and older. Total medical cost savings due to exercise and open space is the percent of population for each level of activity (inactive, insufficient, and active) multiplied by the average savings in medical costs per year. The total is the sum of savings in medical cost for all activity levels.

FIGURE 18 // PERRY COUNTY HEALTHCARE SAVINGS DUE TO OPEN SPACE AND OUTDOOR EXERCISE

AGE	FREQUENCY OF EXERCISE	PERCENTAGE OF POPULATION	POPULATION	ANNUAL SAVINGS IN MEDICAL COSTS	TOTAL HEALTHCARE SAVINGS
18 AND YOUNGER		22%	10,042		
19 AND OLDER	LESS THAN ONCE A WEEK	21%	9,449		
19 AND OLDER	AT LEAST ONCE A WEEK	18%	8,308	\$713	\$5,923,604
19 AND OLDER	MORE THAN TWICE A WEEK	39%	17,848	\$1,436	\$25,629,728
TOTAL			45,647		\$31,553,332

PROPERTY VALUES

ROE analyses typically include a calculation of the residential real estate premium due to proximity to open space. That is, how much more valuable is the housing stock in Perry County because homes are next to or near open space? A full property value analysis was not done for Perry County because other studies have shown a limited impact in rural areas.

Perry County is very scenic. The county is bordered by the Kittatinny Ridge on the south, the Tuscarora Ridge on the north, and the Susquehanna River on the east. River towns, including Duncannon, Marysville, Millerstown, New Buffalo, Newport, and Liverpool, dot the landscape along the Susquehanna and Juniata rivers. There are four state parks: Colonel Denning, Fowlers Hollow, Big Spring, and Little Buffalo. Perry County also is the most rural of the three counties in the HATS region. And the county’s leading industry is agriculture, with 800 farms and 9,264 acres of preserved farmland that fill in between mountainous areas and rivers.¹²⁴ Outdoor recreation opportunities, including the Appalachian National Scenic Trail, are easily available.

Perry County’s existing open space adds to the overall value of its housing stock. This increased wealth is captured by citizens through higher sale values of homes near open space, and increased government revenues via larger property tax collections and transfer taxes at the time of sale. However, because the scenic beauty of Perry County is available to the majority of the population, proximity to open space does not have a significant impact on property values.

Being near surface water, on the other hand, can make a difference in the value of housing stock. For example, existing research demonstrates that lakes can bring recreational and aesthetic value to surrounding properties, which has economic and fiscal implications due to increased property and tax assessment values.

- // Nationally, waterfront homes are worth more than double the value of homes overall. According to 2014 median home value data provided by Zillow for 247 cities throughout the U.S., the value of a single-family home was \$282,577, while the average value of a waterfront single-family home was \$697,920—a difference of more than 235 percent.¹²⁵
- // Lakes can influence the property values of surrounding homes, particularly for those closest to the lake. A 2012 analysis of property values and tax revenues in Kosciusko County, IN, found that properties within 500 feet of the county’s 41 largest lakes accounted for 37 percent of total property tax revenues. A 1995 hedonic study conducted in Central Texas found several statistically-significant recreational and aesthetic (RA) characteristics of housing, with proximity to the lake being the most important. Specifically, the study found that waterfront properties captured 75 percent of the RA value for all homes within 2,000 feet of a lake. Beyond the waterfront, the marginal RA price falls rapidly with increasing distance.¹²⁶
- // Based on other research in Pennsylvania, property values in rural counties were highest for those homes within 500 feet of a lake. This waterfront premium represents an increase of 15 to 35 percent of average total assessed property values within each jurisdiction. Although this analysis does not account for differences in home size, quality, and other characteristics, which may partially explain value disparities between waterfront and non-waterfront homes, research suggests that a significant portion of this waterfront premium is likely attributed to lake proximity.

Conversely, property values and tax revenues are subject to change based on improved or degraded water quality. A 2003 analysis conducted in Maine found that a one-meter decrease in water clarity causes property values to decrease 3 to 9 percent. Similar effects were seen in New Hampshire and Vermont, and there is indication that this effect holds true in Pennsylvania.¹²⁷



Photo: Jane Hoover

Yellow Goat's Beard blooms along Turkey Bird Road in Oliver Township near Newport.

05 // RESULTS AND FINDINGS

Nature's benefits are real and significant, and they impact a wide range of people

Results of this study indicate that open space adds significant value to the regional economy, with benefits accruing to businesses, manufacturing, agriculture, governments, and households. In addition, the ROE steering committee members determined that ROE studies can help:

- // Solve major environmental problems, such as flooding, air and water quality issues, and habitat fragmentation
- // Municipal officials make sound land use decisions and direct future growth, which is by far the greatest opportunity to make major financial changes
- // Increase appreciation for the role of nature in people's lives
- // Improve air and water quality
- // Manage risk for agricultural pollination of crops and the natural landscape
- // Identify new business opportunities
- // Expand natural system services to help drive the local economy
- // Create demand for outdoor recreation and healthy lifestyles

NATURAL SYSTEM SERVICES

Open spaces are where the majority of natural systems function and benefits are provided. When considering the importance of Perry 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.¹²⁸ By relying on nature's ability to provide these valuable services, Perry County can avoid significant expense.

Our research compiled a list of 10 natural system services that occur on 16 different land cover types. This list is not comprehensive, but expresses major services that nature provides throughout Pennsylvania. Therefore, estimates are conservative.

FIGURE 19 // SUMMARY OF NATURAL SYSTEM SERVICE VALUES PER ACRE BY COVER TYPE

NATURAL SYSTEM SERVICE	ECO-PRICE	PRIMARY SOURCE
CARBON	\$38	U.S. FOREST SERVICE I-TREE LANDSCAPE MODEL
AIR POLLUTANTS	\$7-\$122	U.S. FOREST SERVICE I-TREE LANDSCAPE MODEL
GROUNDWATER	\$110-\$409	NYC, 2016; PA WATER PLAN, 2009; CAMPBELL, 2016
NUTRIENT UPTAKE	\$76-\$1,128	WORLD RESOURCES INSTITUTE, 2011; PA NUTRIENT TRADING PROGRAM; CAMPBELL, 2016
STORMWATER MITIGATION	\$871-\$1,803	KING AND HAGAN, 2012; PA DEP, STORMWATER MANAGEMENT, 2009
EROSION PREVENTION	\$4-\$15	USDA, NCRS, 2014; U.S. EPA
WILDLIFE HABITAT (BIODIVERSITY)	\$0-\$1,791	U.S. FISH AND WILDLIFE SERVICE, 2017; PENNSYLVANIA GAME COMMISSION, 2018; WORLD RESOURCES INSTITUTE, 2006; CAMPBELL, 2016; DUCKS UNLIMITED, 2012; CONSERVATION FUND, 2014;
POLLINATION	\$0-\$68	THE BAYBANK, 2012 GA FOREST SERVICE, 2011
BIOLOGICAL CONTROL	\$0-\$62	NJ DEPARTMENT OF NATURAL RESOURCES, 2007
AQUATIC RESOURCE	\$427-\$755	NJ DEPARTMENT OF NATURAL RESOURCES, 2007 PA FISH AND BOAT COMMISSION, 2016

FIGURE 20 // PERRY COUNTY'S ANNUAL AVOIDED NATURAL SYSTEM SERVICES COSTS

HABITAT	\$427,826,201
STORMWATER	\$242,251,788
NUTRIENT UPTAKE	\$70,113,004
GROUNDWATER	\$41,014,003
POLLINATION	\$19,258,811
BIOLOGICAL CONTROL	\$17,209,891
AQUATIC RESOURCES	\$11,491,794
EROSION CONTROL	\$1,448,408
TOTAL	\$830,613,900

KEY FINDINGS

- // Perry County's open spaces provide natural system services that support quality of life, decrease cost of living, and improve health and well-being at an estimated cost savings and economic benefit of \$830.6 million annually. This represents the unnecessary cost of replacing and restoring vital ecosystem services currently provided by open space.
- // Maintaining connected habitats and corridors allows the full value of open space to be realized. These precious resources provide a more resilient environment during changing climatic conditions.
- // Pollination by native birds, bats, and insects helps protect agriculture during problematic environmental events like Pennsylvania's recent bee colony collapse.
- // A study of restoration in Pennsylvania state parks showed a \$7 return for every dollar invested. Similar results should occur in other open space projects.¹²⁹
- // We need to protect our water at its source. The value of green infrastructure in Perry County is \$366.3 million annually. This includes stormwater, nutrient uptake, groundwater, aquatic resources, and erosion control.
- // Habitat-related avoided costs amount to \$464.3 million annually. This includes habitat, pollination, and biological control.
- // 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 Perry 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.¹³⁰

FIGURE 21 // PERRY COUNTY POLLUTANT REMOVAL FROM TREES (TOTAL TONS/YEAR)¹³¹

OZONE	5,204
PARTICULATE MATTER	416
NITROGEN DIOXIDE	221
SULFUR DIOXIDE	362
CARBON MONOXIDE	61
TOTAL	6,264

KEY FINDINGS

- // The total tons of air pollutants removed each year is 6,264.
- // The total annual health benefit from trees, including carbon sequestration and air pollution removal benefits, is \$14 million.
- // Perry County's annual air pollution removal benefit value is \$4 million.
- // The total annual avoided costs provided by carbon sequestration is \$9.9 million.
- // Tree photosynthesis provides an additional 227,872 tons of carbon sequestration annually.
- // Currently, tree-covered open space in Perry County is estimated to store more than 23 million tons of carbon over the life of the trees.
- // Tree-covered urban areas have 24-29 percent lower incidence of childhood asthma.¹³²
- // Over a year, one acre of forest can consume the amount of CO₂ created by one car driving 26,000 miles.¹³³

OUTDOOR RECREATION

Perry 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 Perry County spend between \$29.6 and \$59.3 million per year on gear, accessories, vehicles, and other trip-related expenses.

FIGURE 22 // PERRY COUNTY OUTDOOR RECREATION ECONOMIC CONTRIBUTION

OUTDOOR RECREATION ACTIVITY	MINIMUM DIRECT ECONOMIC IMPACT	EXPECTED DIRECT ECONOMIC IMPACT
WALKING	\$2,629,267	\$2,760,731
FISHING	\$3,328,200	\$3,328,200
HUNTING	\$7,684,095	\$13,500,295
BIRDING/BIRD WATCHING	\$750,893	\$4,655,538
WILDLIFE WATCHING	\$1,912,062	\$5,061,339
CAMPING	\$1,643,292	\$3,012,702
KAYAKING/CANOEOING	\$479,294	\$2,967,055
BICYCLING	\$3,368,749	\$7,942,578
HIKING/BACKPACKING	\$1,278,116	\$5,295,052
JOGGING/RUNNING	\$1,163,086	\$5,340,699
NATURE STUDY	\$241,564	\$362,346
MOUNTAIN BIKING	\$3,824,762	\$3,824,762
CROSS-COUNTRY SKIING	\$1,281,768	\$1,281,768
TOTAL	\$29,585,148	\$59,333,065

KEY FINDINGS

- // Nearly 35,000 people participate in outdoor recreation in Perry County each year. Participation is greatest for walking, wildlife watching, hiking, bicycling, and birdwatching.
- // Based on outdoor recreation participation and spending estimates provided by Keystone Conservation Trust and the Outdoor Industry Association, outdoor recreation participants in Perry County spend between \$29.6 and \$59.3 million per year on gear, accessories, vehicles, and other trip-related expenses. Most notably, hunting participants are estimated to spend between \$7.7 and \$13.5 million per year.
- // Based on local purchases, gross retail sales, and output multiplier assumptions provided by IMPLAN for Perry County, outdoor recreation spending results in \$8.2 to \$16.4 million in total economic output. Most notably, spending from hunting participants results in \$1.8 to \$3.1 million in total economic output.
- // Based on tax assumptions provided by IMPLAN, outdoor recreation spending within Perry County contributes between \$1.5 and \$3.0 million in annual state and local taxes.
- // Each year, outdoor recreation spending in Perry County supports between 312 and 622 jobs, and contributes between \$6.8 and \$13.6 million in total labor income. Most notably, spending from hunting participants supports between 76 and 133 jobs, and contributes between \$1.6 and \$2.8 million in total labor income.
- // Outdoor recreation trends show increased interest in paddle sports, running, mountain biking, hiking, nature study, fishing, birding, wildlife watching, and cross-country skiing.
- // Hunting and fishing remain stable.¹³⁴

- // The outdoor recreation economy grew approximately five percent annually in the United States between 2005 and 2011, even during an economic recession.¹³⁵
- // Thirty-one percent of Pennsylvanians surveyed by DCNR in 2014 plan to spend more time outdoors.¹³⁶ About half of baby boomers expect to increase their outdoor activity, compared to 25 percent of their older counterparts. Given the aging population of Perry County, outdoor activities are expected to increase.¹³⁷
- // Employees who live healthy lifestyles are more productive and innovative and miss less work.¹³⁸
- // Open space provides contact with nature, which provides health benefits and enhances well-being.¹³⁹

OUTDOOR RECREATION AND REDUCED HEALTHCARE COSTS

Daily physical activity has declined dramatically according to the 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.

Being in contact with nature motivates people to exercise and appears to boost the benefits of exercise.¹⁴⁰ Greenery encourages exercise, is a more restorative environment than indoor settings, and has a greater positive effect on mental health.¹⁴¹ Access to open space and recreation opportunities result 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.¹⁴²

A number of studies show that outdoor recreation plays a significant role in American lives. 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, and bonds family and friends. These benefits also reduce medical care costs. Outdoor recreation participants in Perry County benefit from exercise and save roughly \$31.6 million annually.

FIGURE 23 // OUTDOOR RECREATION HELPS REDUCE HEALTHCARE COSTS

FREQUENCY OF EXERCISE	ANNUAL SAVINGS
AT LEAST ONCE A WEEK	\$5,923,604
MORE THAN TWICE A WEEK	\$25,629,728
TOTAL	\$31,553,332

KEY FINDINGS

- // Open space encourages exercise and physical activity, which have been shown to increase fitness and reduce obesity and healthcare costs.¹⁴³
- // Physically active people are typically healthier and have lower incidences of cardiovascular disease, diabetes, depression, certain cancers, and obesity.¹⁴⁴
- // Studies have found that people who exercise at least once a week save \$713 annually in healthcare costs.¹⁴⁵ Over 18 percent of people in Perry County exercise at least once a week.¹⁴⁶
- // Studies have found that people who exercise more than twice a week save on average \$1,436 annually in healthcare costs. In Perry County, 39.1 percent of people exercise more than twice a week.¹⁴⁷
- // A study in the Netherlands showed that every 10 percent increase in exposure to green space translated into a reduction of five years in age in terms of expected health problems, with similar benefits found by studies in Canada and Japan.^{148 149 150}
- // Researchers in England found that joggers who exercise in a natural green setting with trees, foliage, and landscape views feel more restored and less anxious, angry, and depressed than people who burn the same number of calories in gyms or other built settings. Research continues into what is being called “green exercise.”¹⁵¹
- // The proportion of green and open space is linked to self-reported levels of health and mental health for all ages and socio-economic groups by fostering companionship, a sense of identity, belonging, and happiness.^{152 153 154 155}
- // Contact with nature on a regular basis provides stress reduction and improvement in an overall sense of well-being and hopefulness.¹⁵⁶ It helps alleviate mental fatigue by relaxing and restoring the mind. Both visual access and being within green space helps to restore the mind’s ability to focus, can improve job and school performance, and alleviates mental stress and illness.¹⁵⁷

IMPACT OF PROPERTY VALUE ON OPEN SPACE

A full property value analysis was not done for Perry County because other studies have shown a limited impact in rural areas. Perry County, however, does have significant waterfront along the rivers and several river towns. Nationally, waterfront homes are worth more than double the value of homes overall, and lakes can influence the property values of surrounding homes, particularly for those closest to the lake. From research in other Pennsylvania counties, property values in rural counties was highest for those homes within 500 feet of a lake. Property values and tax revenues, however, are subject to change based on improved or degraded water quality.

KEY FINDINGS

- // Since the high scenic quality of Perry County is so common, proximity to parks or open space has limited measurable impact on property value.
- // Poor water clarity can reduce property values by 15 percent.¹⁵⁸ This is another reason why Perry County officials should seek to maintain high water quality.

FIGURE 24 // PERRY COUNTY PARTICIPATION RATE ANALYSIS (%)

OUTDOOR RECREATION ACTIVITY	OUTDOOR RECREATION FOUNDATION PARTICIPATION SURVEY 2013 ¹⁵⁹	CENTERS FOR DISEASE CONTROL AND PREVENTION 2012 ¹⁶⁰	U.S. FISH AND WILDLIFE SERVICE 2011 ¹⁶¹	PA DCNR SURVEY 2014 ¹⁶²	PA DCNR SOUTH-CENTRAL REGION SURVEY 2014 ¹⁶³	LEHIGH VALLEY EXPERT SURVEY 2014 ¹⁶⁴	DAUPHIN COUNTY EXPERT SURVEY 2016 ¹⁶⁵	PERRY COUNTY EXPERT SURVEY 2018
WALKING		0.6		0.691	0.631	0.6	0.63	0.63
FISHING	0.136		0.11	0.183	0.129	0.136	0.129	0.129
HUNTING	0.051		0.07	0.145	0.25	0.08	0.125	0.25
BIRDING/BIRD WATCHING	0.05		0.31	0.216	0.311	0.3	0.31	0.31
WILDLIFE WATCHING	0.32		0.27	0.136	0.363	0.5	0.36	0.36
CAMPING	0.133			0.309	0.112	0.06	0.11	0.11
KAYAKING/CANOEING	0.028			0.173	0.133	0.14	0.13	0.13
BICYCLING	0.164		0.36	0.35	0.296	0.17	0.29	0.29
CROSS-COUNTRY SKIING	0.5							5.4
HIKING/BACKPACKING	0.12			0.155	0.291	0.1	0.29	0.29
RUNNING/JOGGING	0.185			0.174	0.134	0.16	0.13	0.13
NATURE STUDY	0.21			0.042	0.063	0.14	0.063	0.063

Figure 24 shows participation data from different survey sources. Colored text identifies the recommended participation rates used in the IMPLAN model. Light blue identifies the lowest participation rates. Dark blue shows participation rates used in both scenarios. Black identifies the participation rates that best reflect local recreational use by local experts. These data meet four criteria: (1) local survey data is consistent with other surveys, (2) local expert estimates are given priority over the activities that meet the criteria above, (3) the most conservative choice is made when possible, and (4) national trends favor a given activity.

FIGURE 25 // PERRY COUNTY ROE SPENDING RATE ANALYSIS

OUTDOOR RECREATION ACTIVITY	U.S. FISH AND WILDLIFE SERVICE 2011 ¹⁶⁶	DCNR OUTDOOR RECREATION PARTICIPATION SURVEY 2009 ¹⁶⁷	OUTDOOR INDUSTRY SURVEY 2013 ¹⁶⁸	PENNSYLVANIA FISH AND BOAT COMMISSION STUDY ¹⁶⁹	DAUPHIN COUNTY EXPERT SURVEY 2016 ¹⁷⁰	LEHIGH VALLEY EXPERT SURVEY 2014 ¹⁷¹	JIM WARRENFELTZ 2013 ¹⁷²	PERRY COUNTY EXPERT SURVEY 2018
WALKING		\$96			\$96	\$96		\$96
FISHING	\$409	\$831		\$600	\$600	\$409		\$600
HUNTING	\$1,207	\$687			\$1,207	\$1,207		\$1,207
BIRDING/BIRD WATCHING	\$329	\$211			\$329	\$329		\$329
WILDLIFE WATCHING	\$308				\$308	\$308		\$308
CAMPING		\$2,529	\$2,009		\$600	\$600		\$600
KAYAKING/CANOEING			\$482		\$500	\$375		\$500
CROSS-COUNTRY SKIING			\$520					\$520
BICYCLING		\$453	\$1,196		\$450	\$600		\$450
HIKING/BACKPACKING		\$280	\$1,115		\$630	\$458		\$400
RUNNING/JOGGING		\$238			\$2,000	\$900	\$196	\$900
NATURE STUDY		\$150			\$126	\$150		\$126

Figure 25 shows several spending estimates, with light blue indicating the lowest annual spending estimates per person. Dark blue shows the spending used in both low and expected scenarios. Black is the expected annual spending rate per person. Expected direct economic impact was calculated for all recreational activities.

FIGURE 26 // PERRY COUNTY DIRECT ECONOMIC IMPACT

LOW ECONOMIC CONTRIBUTION SCENARIO

OUTDOOR RECREATION ACTIVITY	PARTICIPATION RATE	NUMBER OF PARTICIPANTS	SPENDING	DIRECT ECONOMIC IMPACT
HUNTING	25.0%	11,185	\$687	\$7,684,095
MOUNTAIN BIKING	6.0%	2,876	\$1,330	\$3,824,762
BICYCLING	16.0%	7,486	\$450	\$3,368,749
FISHING	13.0%	5,547	\$600	\$3,328,200
WALKING	60.0%	27,388	\$96	\$2,629,267
WILDLIFE WATCHING	14.0%	6,208	\$308	\$1,912,062
CAMPING	6.0%	2,739	\$600	\$1,643,292
CROSS-COUNTRY SKIING	5.0%	2,465	\$520	\$1,281,768
HIKING	10.0%	4,565	\$280	\$1,278,116
JOGGING/RUNNING	13.0%	5,934	\$196	\$1,163,086
BIRDING/BIRD WATCHING	5.0%	2,282	\$329	\$750,893
KAYAKING	3.0%	1,278	\$375	\$479,294
NATURE STUDY	4.0%	1,917	\$126	\$241,564
TOTAL				\$29,585,148

EXPECTED ECONOMIC CONTRIBUTION SCENARIO

OUTDOOR RECREATION ACTIVITY	PARTICIPATION RATE	NUMBER OF PARTICIPANTS	SPENDING	DIRECT ECONOMIC IMPACT
HUNTING	24.5%	11,185	\$1,207	\$13,500,295
MOUNTAIN BIKING	6.3%	2,876	\$1,330	\$3,824,762
BICYCLING	29.0%	13,238	\$600	\$7,942,578
FISHING	12.5%	5,547	\$600	\$3,328,200
WALKING	63.0%	28,758	\$96	\$2,760,731
WILDLIFE WATCHING	36.0%	16,433	\$308	\$5,061,339
CAMPING	11.0%	5,021	\$600	\$3,012,702
CROSS-COUNTRY SKIING	5.4%	2,465	\$520	\$1,281,768
HIKING	29.0%	13,238	\$400	\$5,295,052
JOGGING/RUNNING	13.0%	5,934	\$900	\$5,340,699
BIRDING/BIRD WATCHING	31.0%	14,151	\$329	\$4,655,538
KAYAKING	13.0%	5,934	\$500	\$2,967,055
NATURE STUDY	6.3%	2,876	\$126	\$362,346
TOTAL				\$59,333,065

Numbers for this figure are based on the 2016 estimated population of 45,647.¹⁷³

FIGURE 27 // PERRY COUNTY ECONOMIC IMPACT BREAKDOWN (IMPLAN MODEL RESULTS)



FIGURE 28 // PERRY COUNTY ECONOMIC IMPACT SUMMARY (IMPLAN MODEL RESULTS)

LOW ECONOMIC CONTRIBUTION SCENARIO						EXPECTED ECONOMIC CONTRIBUTION SCENARIO					
OUTDOOR RECREATION ACTIVITY	DIRECT IMPACT SPENDING	ECONOMIC OUTPUT	EMPLOYMENT	LABOR INCOME	STATE AND LOCAL TAXES	OUTDOOR RECREATION ACTIVITY	DIRECT IMPACT SPENDING	ECONOMIC OUTPUT	EMPLOYMENT	LABOR INCOME	STATE AND LOCAL TAXES
WALKING	\$2,629,248	\$888,509	31	\$696,191	\$145,705	WALKING	\$2,760,768	\$932,954	32	\$731,016	\$152,994
FISHING	\$3,328,200	\$921,516	35	\$765,690	\$172,392	FISHING	\$3,328,200	\$921,516	35	\$765,690	\$172,392
HUNTING	\$7,684,095	\$1,788,544	76	\$1,587,131	\$391,630	HUNTING	\$13,500,295	\$3,142,319	133	\$2,788,454	\$688,060
BIRDING/BIRD WATCHING	\$750,778	\$185,874	7	\$158,526	\$36,978	BIRDING/BIRD WATCHING	\$4,655,679	\$1,152,628	46	\$983,043	\$229,305
WILDLIFE WATCHING	\$1,912,064	\$473,379	19	\$403,731	\$94,175	WILDLIFE WATCHING	\$5,061,364	\$1,253,066	50	\$1,068,703	\$249,286
CAMPING	\$1,643,400	\$432,705	19	\$419,726	\$93,941	CAMPING	\$3,012,600	\$793,214	35	\$769,422	\$172,207
KAYAKING	\$479,250	\$115,239	5	\$100,224	\$22,706	KAYAKING	\$2,967,000	\$713,437	29	\$620,478	\$140,569
BICYCLING	\$3,368,700	\$838,260	33	\$741,347	\$164,206	BICYCLING	\$7,942,800	\$1,976,468	79	\$1,747,965	\$387,171
HIKING	\$1,278,200	\$470,759	15	\$340,072	\$71,347	HIKING	\$5,295,200	\$1,950,215	62	\$1,408,816	\$295,572
JOGGING/RUNNING	\$1,163,064	\$428,355	14	\$309,439	\$64,920	JOGGING/RUNNING	\$5,340,600	\$1,966,935	63	\$1,420,895	\$298,106
NATURE STUDY	\$241,542	\$59,800	2	\$51,001	\$11,896	NATURE STUDY	\$362,376	\$89,715	4	\$76,515	\$17,847
MOUNTAIN BIKING	\$3,825,080	\$1,292,620	45	\$1,012,832	\$211,974	MOUNTAIN BIKING	\$3,825,080	\$1,292,620	45	\$1,012,832	\$211,974
CROSS-COUNTRY SKIING	\$1,281,800	\$259,827	11	\$239,366	\$54,241	CROSS-COUNTRY SKIING	\$1,281,800	\$259,827	11	\$239,366	\$54,241
TOTAL	\$29,585,421	\$8,155,387	312	\$6,825,276	\$1,536,111	TOTAL	\$59,333,762	\$16,444,914	622	\$13,633,195	\$3,069,724



Photo: Laurie Jean Houck

When snow falls in Duncannon, children aren't the only ones entranced by its beauty.

06 // PUTTING ROE STUDIES TO WORK

A blueprint for action

Growth can fragment habitat and impact natural systems by causing water pollution, flooding, and stream bank erosion. With less open space remaining, the size, quality, location, and connectivity of that remaining open space will be critical in determining residents' future quality of life, health, and cost of living.

Today, we must do more to quantify the financial benefits provided by nature and link those values directly to the community's well-being. For example, a natural resource inventory does not explain the financial consequences of losing a habitat or species. Development proposals might not estimate the cumulative impact on stormwater, flooding, or loss of wetland functions.

Communities that understand the value of nature have a better chance of striking an effective balance between maintaining connected, resilient open spaces and smart growth. This includes arresting the decline in habitats and species and the degradation of landscapes. The strategy will help improve the quality of our natural environment and sustain the economy in Perry County and along the Kittatinny Ridge, moving to a net gain in the value of both.

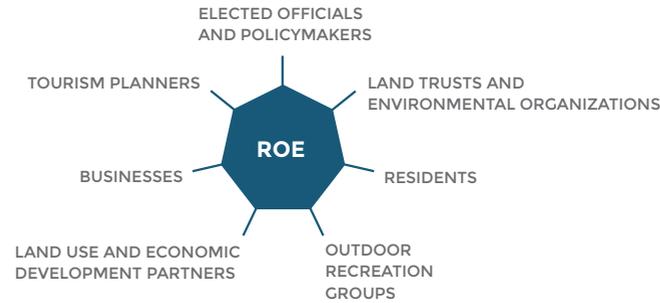
The first step to putting ROE studies to work is articulating the ways in which open space provides natural system services. Placing a dollar value on different land covers helps decision makers understand what is critical to the environment and the economy and what lands can be developed. This leads to mapping the pattern of the connected habitats required for sustainable environmental and economic benefits.

ALL STAKEHOLDERS PLAY A PART

If the economy of Perry County is to remain strong, environmental stewardship cannot be the responsibility of a few dedicated people. Environmental stewardship must become part of Perry County's everyday culture. Residents, planners, nonprofits, land trusts, businesses, and policymakers require strong alignment to succeed. Only then can Perry County ensure a foundation for a vibrant, balanced economy, high quality of life, low cost of living, good health, and well-being for current residents and future generations.

Enabling change through a process of engagement is available for stakeholders at all levels of a community. The ROE process can help elected officials, policymakers, economic development, land use and tourism planners, businesses, and residents use ROE data and planning principles.

FIGURE 29 // ROE STAKEHOLDERS



RECOMMENDED STRATEGIC ACTIONS

Stakeholders cannot afford to continue to subsidize growth. Michael E. Porter, Bishop William Lawrence University Professor at Harvard Business School, notes that businesses should strive to create a sustainable competitive advantage by “performing different activities from rivals or performing similar activities in different ways.” Thus, businesses will have far more success by creating a new game with an entirely new set of rules.¹⁷⁴

HELP COMMUNITIES PROVIDE MORE ENVIRONMENTAL, SOCIAL, AND FINANCIAL SUSTAINABILITY

Level the playing field. Map the relative financial values of natural system services to reflect financial priorities, and develop protection and risk management strategies that maintain these assets.

Incorporate ROE into decision making. Begin every land use, economic development, tourism, and recreation planning process with a clear understanding of the financial value of nature’s current financial portfolio of assets. Ask what is needed to sustain these avoided costs.

Develop a stewardship balance sheet for all new development. For every new development proposal, complete and review a balance sheet that reflects the full cost

of benefits in the form of tax revenues and jobs and the true cost of services over time, as well as the loss of natural system services that will be paid by taxpayers.

Perform environmental audits. Chronicle the change in cover types over time, estimate the financial losses, and report them to all interested groups and agencies. Fund critical projects to protect high-quality areas (mature woodlands and rare resources), as well as critical resources like headwaters and riparian and wetland areas.

Change the rules of the game. Estimate the annual ROE for all new and updated ordinances, including riparian and official map ordinances, open space referenda, open space acquisitions, and restoration projects.

Connect and expand open spaces. Develop stewardship buffer zones (green ribbon landscapes) along riparian areas and around parks, trails, and natural preserves that expand natural system services by incentivizing the use of native plants and good stewardship practices. Expanding natural system services helps grow the economy.

Teach the principles of good stewardship to landowners, and provide a clear idea of how protecting nature has financial value for them and the community. Creating change through a process of engagement is available for stakeholders at all levels of a community. The ROE process can help elected officials, policymakers, economic development, land use and tourism planners, businesses, and residents make more informed decisions.

Create incentives. Create incentives for using native plants in backyard design to protect and restore critical natural system services like green ribbon landscapes and stream buffers.

Assist sustainable businesses. Provide businesses with data on the financial impact of the environment on the local economy, as well as data on recreational and high-quality water demands, to help them understand their markets.

Involve schools. Create environmental education programs with interdisciplinary applications in science, social studies, mathematics, language arts, fine arts, and physical education.

Glossary

Air pollution

The release of harmful matter, particulates, and gases, such as sulfur dioxide, nitrogen oxides, carbon monoxide, and volatile organic compounds, into the air.

Avoided cost (AC)

Dollars that do not need to be spent on the provision of environmental services, such as improving water quality and removing air pollution.

Biological connectivity

The ability of individual plants and animals to move across complex landscapes, maintaining regional populations in the short term and allowing species to shift their geographic range in response to habitat needs and climate change.

Biological control

The dynamic regulation of species populations, including the control of invasive species and unwanted species—such as pests, weeds, and disease vectors (e.g., mosquitoes)—by beneficial insects.

Carbon sequestration

The process of carbon capture and long-term storage of atmospheric CO₂ through photosynthesis. Carbon sequestration describes long-term storage of CO₂ or other forms of carbon to either mitigate or defer global warming and avoid dangerous climate change.

Carbon storage

The estimate of the total amount of carbon currently stored in a forest's above- and below-ground biomass.

Climate change

Changes in regional or local climate patterns, particularly a change apparent from the mid-20th century onward, attributed largely to the increased levels of atmospheric CO₂ produced by the use of fossil fuels.

Conservation design

A planning process that rearranges the development on each parcel as it is being planned so that half (or more) of the buildable land is set aside for open space.

Contingent valuation (CV)

A survey-based economic technique for the valuation of non-market resources, such as environmental preservation or the impact of contamination.

Cost of damage (CD)

An estimate of monetized damages associated with the release of carbon or other pollutants.

Cost of regulation (CR)

Fines and procedures.

Direct investment in a resource (DI)

Investment in water supply facilities or the protection of land.

Direct market valuation (DM)

Obtaining values for the provision of services.

Ecosystem function

The habitat, biological, or system properties or processes of ecosystems.

Flood mitigation

The management and control of floodwater movement, such as redirecting flood runoff through the use of floodwalls and floodgates rather than trying to prevent floods altogether.

Groundwater

Water found underground in the cracks and spaces in soil, sand, and rock. It is stored in, and moves slowly through, geologic formations of soil, sand, and rock called aquifers. Groundwater is the source of water for streams and supplies water through wells.

Habitat

The area or environment where an organism or ecological community normally lives or occurs.

Habitat loss

Loss and degradation of the natural conditions that animals and plants need to survive.

Hedonic regression analysis

A model identifying price factors according to the premise that price is determined by both the internal characteristics of the goods being sold and the external factors affecting it.

Market valuation (MV)

The amount of money paid to purchase credits in a trading market, for example, the price of a carbon credit for air quality, the purchase of a nutrient credit for water quality, or the purchase of potable water.

National Pollutant Discharge Elimination System (NPDES) permit

The NPDES permit program addresses water pollution by regulating point sources that discharge pollutants to waters of the United States.

Natural capital

A portfolio of natural assets, such as geology, soil, air, water, and all living things.

Natural habitat regeneration

The process by which vegetation and habitat grow back without human intervention.

Natural system services

The flow of goods and services that benefit people, directly or indirectly, from ecosystem functions. Also called ecosystem services.

Open space

Land that is valued for aesthetic beauty, recreation, natural process, agriculture, and other public benefits.

Outdoor recreation

Activities that can be performed in natural settings without causing harm.

Pollination

The process by which pollen is transferred from the anther (male part) to the stigma (female part) of a plant, thereby enabling fertilization and reproduction.

Replacement cost (RC)

Cost to replace services with man-made systems. For example, the waste assimilation service provided by wetlands could be replaced with chemical or mechanical alternatives (such as wastewater treatment plants). The replacement cost would be the estimated cost of replacing the natural waste assimilation service with chemical or mechanical alternatives.

Riparian buffer

A vegetated area ("buffer strip") near a stream, 100 feet wide and usually forested, which helps shade and partially protect a stream from the impact of adjacent land uses. It plays a key role in increasing water quality in associated streams, rivers, and lakes, thus providing environmental benefits.

Soil retention

A system that creates and enriches soil through weathering and decomposition, preventing it from being washed away.

Tax benefits (TB)

Adjustment benefiting a taxpayer's tax liability.

Travel cost (TC)

Cost of travel and its reflection on the implied value of a service.

Water pollution

Sewage, fertilizers, pesticides, oil, silt, and other pollutants that are discharged, spilled, or washed into water, including contaminants from air pollution that settle onto land and are washed into water bodies.

Water quality

A measure of the suitability of water for a particular use (e.g., drinking, fishing, or swimming), based on selected physical, chemical, and biological characteristics.

Water supply

A source, means, or process of supplying water, including groundwater aquifers, reservoirs, streams, rivers, and pipelines.

Waste assimilation

The method by which forests and wetlands provide a natural protective buffer between natural system activities and water supplies.

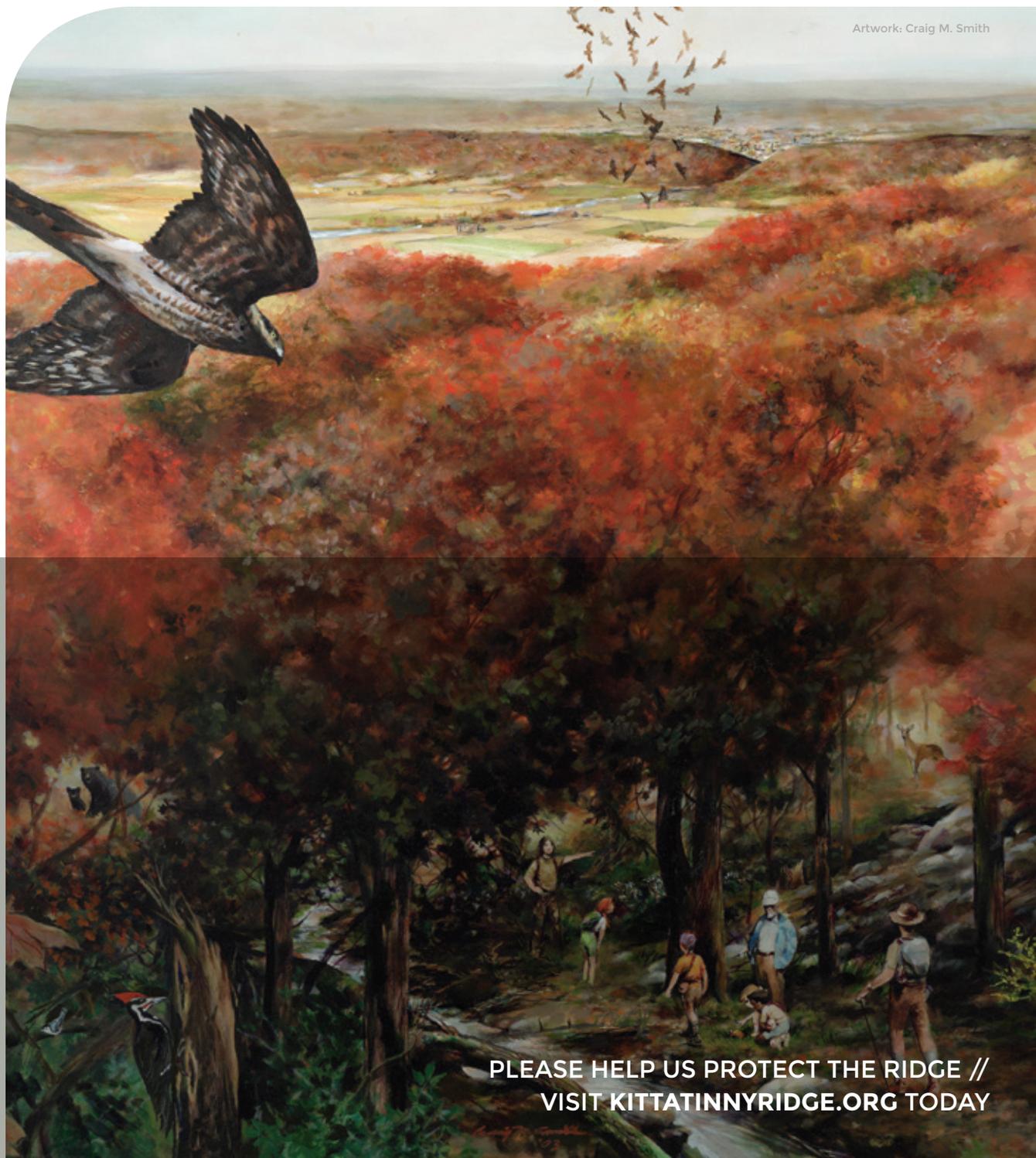
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Funding assistance has been provided by the Department of Conservation and Natural Resources, Bureau of Recreation and Conservation, Environmental Stewardship Fund.

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