



# RETURN ON ENVIRONMENT

The Economic Value of Protected Open Space  
in Chester County, Pennsylvania

May 2019





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Photo by Joanne Phillips  
Crows Nest Preserve



From the rolling fields of Willistown to the rich farmland of Honey Brook, Chester County is among the most beautiful places in Pennsylvania. Its verdant countryside and thriving communities contain boundless opportunities to enjoy the outdoors, whether on the county's popular bike trails, in quiet nature preserves and lively parks, or just when passing by any of the tens-of-thousands of acres of scenic landscapes that have been preserved, forever.

But Chester County is about more than pretty places. The quality of life sustained by its commitment to preservation attracts employers and well-qualified workers alike. Balancing preservation and progress has helped to make Chester County one of the most economically robust counties in the state and among the best places to live in the country.

Protected open spaces—public parks, preserved farmland, and private conserved lands—provide proven and substantial economic, environmental, and public health benefits to surrounding communities. This report indicates that protected open space adds significant value to the county's economy, with benefits for businesses, governments, and households. This value occurs in different ways—some are direct revenue streams to individuals or governments, some represent appreciation in asset values, others are the result of avoided costs.<sup>7</sup>

Building off a previous regional report and using standard economic analysis techniques, this report estimates the economic value of protected open space in Chester County by measuring impacts across five areas: property values, environmental benefits, recreation and health, economic activity, and cost of community services.

The benefits presented in this report provide information to elected leaders, policy makers, and the general public on the value of protected open space and contribute to informed decisions concerning both preservation and development in the county.

*Chester County's scenic landscapes have inspired one of the country's most effective open space initiatives. As a result, some 28 percent of its acreage is protected.*

---

<sup>7</sup> Because these values differ in nature, the estimates in this study should not be added together to produce a single aggregate value of protected open space in Chester County. It is important to note that this study does not analyze the costs associated with acquiring, preserving, or maintaining land as protected open space, and does not represent a cost-benefit approach.



## Property Value

### OPEN SPACE ENHANCES HOME VALUES.

Homeowners are willing to pay a premium to live near protected open space. As a result, in Chester County the existing protected open space adds to the overall value of its housing stock. This increased wealth is captured by citizens through higher sales values of homes near protected open space, and generates increased government revenues via larger property tax collections and greater transfer taxes at time of sale. This report analyzes approximately 98,000 home sales in Chester County from 1981-2017 to estimate the effect of protected open space on residential property values and the attendant fiscal impacts. Results indicate that proximity to protected open space contributes a significant positive impact to residential property values.

#### WHO BENEFITS?

##### Households

Nearby protected open space increases home values, resulting in increased equity and wealth captured when the home is sold.

##### Governments

Property value increases attributed to nearby open space result in higher property and transfer tax revenues for local governments.

### **\$1.65 billion** added to the value of housing stock

There is an average increase of over \$11,000 in the value of homes in Chester County that are located up to a ½ mile from protected open space. When added together, this proximity to protected open space totals \$1.65 billion.

### **\$27.4 million** in annual property and transfer tax revenues

By increasing the value of homes within a ½ mile radius, protected open space also increases the amount of property taxes and transfer taxes that local governments and school districts receive. These increased property and transfer tax revenues total \$27.4 million per year.





## Environmental

### OPEN SPACE PROTECTS PROPERTY, FILTERS DRINKING WATER, AND CLEANS THE AIR.

Protected open space also provides value through naturally occurring environmental processes. If these lands were developed, Chester County would be forced to replicate vital services such as flood control and air and water pollution mitigation through costly alternative methods. In relying on the natural features on protected open spaces to provide these valuable services, Chester County and its communities avoid significant expenses. This report estimates the value and avoided costs associated with several environmental benefits provided via protected open spaces, including water supply, flood and stormwater mitigation, provision of wildlife habitat, air and water pollution removal, and carbon sequestration and storage.

#### WHO BENEFITS?

##### Governments

Local governments avoid having to spend money to artificially replicate the vital environmental benefits provided by protected open space.

##### Businesses

Businesses avoid having to pay additional taxes to replicate the environmental benefits provided by protected open space and to recover from damage caused by flooding and air pollution.

##### Households

Homeowners avoid having to pay additional taxes to replicate the environmental benefits provided by protected open space and to recover from damage caused by flooding and air pollution.

**\$97 million**  
annually through the provision of six environmental services

The six ecosystem services include replenishment of water supply, water quality improvement, flood mitigation, wildlife habitat, air pollution removal, and carbon storage in trees on protected open space. This sum represents value gained and costs avoided by not having to sacrifice or artificially replace vital ecological services currently provided by protected open space within Chester County.

**\$263 million**  
in avoided stormwater capital costs and  
**\$134 million**  
in avoided annual stormwater system maintenance and stormwater pollutant removal costs

A study of the Brandywine Creek watershed concluded that protection of the current open space lands from development similar to surrounding areas avoided \$263 million of capital construction cost for stormwater management systems, \$27 million of annual operation and maintenance expenses for those systems, and \$107 million of annual stormwater pollutant removal costs.

**\$120 million**  
in carbon storage in trees

It is estimated that trees on Chester County's protected open space store a tremendous amount of carbon that would cost \$120 million to replicate.



## Recreation and Health

### OPEN SPACE FURNISHES LOW OR NO COST RECREATION THAT SAVES MONEY AND IMPROVES HEALTH.

Park usage generates value via the benefit that residents enjoy by engaging in recreation and exercise for free or at below-market rates instead of turning to private markets for the same activities. There also are considerable health cost avoidance and productivity savings related to rigorous exercise on protected open space. This report estimates these direct use and health cost savings benefits.

#### WHO BENEFITS?

##### Households

Protected open space provides free and low-cost recreational activities that residents would otherwise have to pay for in the private market. Moderate and strenuous recreational activity on protected open space also results in healthier lifestyles and avoided medical costs.

##### Businesses

The recreational opportunities available on protected open space contribute to the health of the region's workforce, translating into avoided medical, workers' compensation, and lost productivity costs.

### \$124 million

#### in annual recreation benefits for residents

Nearly \$124 million in benefits accrue annually to residents who participate in recreational activities on protected open space within Chester County. This value represents the additional amount of money that residents in the county would be willing to spend in the private market to participate in the recreational activities that they currently enjoy on protected open space.

### \$172 million

#### in medical costs avoided annually

Physically active people typically enjoy a variety of health benefits, including lower incidence of cardiovascular diseases, diabetes, depression, certain cancers, and obesity. It is estimated that the moderate and strenuous activity that takes place on protected open space in the county accounts for almost \$325 million in avoided medical costs annually.

### \$150 million

#### in lost productivity costs avoided annually

It is estimated that businesses in Chester County avoid \$150 million in lost productivity costs per year as a result of the physical activities their employees engage in on protected open space in the region. This total represents the combined value of costs not incurred as a result of avoided productivity losses due to physical activity on the protected open space in Chester County.





## Economic Activity

### OPEN SPACE CREATES JOBS AND ATTRACTS PEOPLE WHO SPEND IN OUR COMMUNITIES.

Protected open space generates a variety of economic activities, ranging from agricultural activity on preserved farmland to tourist visitation to public park maintenance. This report estimates the spending, employment, earnings, and tax revenues associated with these activities.

#### WHO BENEFITS?

##### Businesses

Protected open space, including farmland and public parks, is a source of commerce for businesses in the five-county region.

##### Governments

The economic activity spurred by protected open space generates tax revenue for local governments in the form of income and property taxes.

##### Households

Protected open space provides economic opportunity for residents of Chester County in the form of employment and wages.

### \$238 million in annual expenditures

It is estimated that \$238 million in annual spending occurs on and because of protected open space in Chester County. Examples of these expenditures include spending related to tourism associated with protected open space, spending for the purchase of goods made on preserved farmland, and government spending for the management and maintenance of public open space.

### 1,800 jobs

Protected open space in Chester County contributes an estimated 1,800 jobs to the economy. Examples of these jobs include public maintenance workers, park administrators, and rangers; farmers, distributors, and suppliers working on protected farmland; and guides and hospitality professionals catering to tourists who visit protected open space.

### \$69 million in annual salaries

Salaries paid to individuals working jobs on or related to protected open space in Chester County total \$69 million per year.





## Community Cost Savings

### OPEN SPACE COSTS LESS FOR COMMUNITY SERVICES COMPARED TO RESIDENTIAL DEVELOPMENT.

How land is used in a community impacts the type, quality, and extent of local services provided, as well as the taxes that are needed to fund those services. Residential land often costs municipalities (through community services such as police and fire protection, road maintenance, public water or sewer, etc.) and school districts more than other land uses because of the number of students generated by residential land use. With the current school funding structure in Pennsylvania, taxes collected by school districts on residential uses generally do not keep pace with actual per-student costs. For this reason, converting open space to housing generally has a negative fiscal impact on local government.

#### WHO BENEFITS?

##### Households

Homeowners pay less tax to their municipality and school district when open space is not developed into residential uses.

##### Governments

Open space and farms provide greater tax revenues for local governments than they require in costs for services provided by local governments.

#### For every \$1 received from residential taxes, local governments spend \$1.11 on services

Residential land pays less to the community in taxes than it receives in service expenditures, and these expenditures are borne by taxpayers. Analysis for select municipalities in Chester County showed that the expenditures of required services ranged from \$1.01 to \$1.33 for every dollar in tax raised by the municipality and/or school district.

#### For every \$1 received from farm land and open space taxes, local governments spend 7 cents on services

Municipal expenditures related to farmland and open space ranged from 2 to 20 cents for every dollar of tax revenue generated by these uses. This means that farms and protected open space in these municipalities in Chester County provided more revenue than they required back in service expenditures.

FOR EVERY **\$1** IN TAXES RECEIVED

Residential  
Costs

**\$1.11**

Farmland and  
Open Space Costs

**7¢**

FOR COMMUNITY SERVICES

Chapter 1

# Introduction





Photo by Jeremy Davis  
Struble Trail



# Introduction

Protected open spaces provide substantial economic, environmental, and health benefits to surrounding communities, but these benefits are often overlooked or undervalued in policy debates and investment decisions.

A better understanding of these benefits can demonstrate how protected open space contributes to economic development and fiscal stability and can reverse the common misconception that conserved undeveloped land is non-productive and non-revenue producing.

The methodology used to estimate these benefits is based on a previous *Return on Environment* report completed in 2011 by the Greenspace Alliance and the Delaware Valley Regional Planning Commission that estimated the economic benefits of protected open space in the 5-county region of Southeastern Pennsylvania. Since the original report's publication, Chester County has made great strides in preserving open space, and as the county's economy has rebounded since the Great Recession, a closer look at the economic value of protected open space specific to Chester County is warranted to understand the true value of the policies and initiatives that support open space preservation. In addition, this report examines the impact on municipal and school district budgets when open space is developed.

This report estimates the monetary benefits associated with preserved protected open space in Chester County by measuring impact in five areas:



## Property Value

The effect that protected open space has on residential property values.



## Environmental

The value associated with environmental benefits provided by Chester County's protected open spaces.



## Recreation and Health

The recreation value and associated health benefits that accrue to users of public open spaces.



## Economic Activity

Jobs and revenue created as a result of activity on and connected to protected open space.



## Community Cost Savings

The fiscal impacts of developing open space associated with the cost of community services.



# Open Space Preservation in Chester County

The analysis in this report deals with economic benefits associated with five categories of protected open space in Chester County as of December 31, 2017 (see Figure 1.1):

- Public parks
- Private land owned or under conservation easement by land trusts
- Farmland preserved with Agricultural Land Preservation Board (ALPB) easements
- Protected land owned and managed by a homeowners association
- Other protected lands

Land owned or under conservation easement by land trusts makes up the largest share of preserved open space in the county, followed by preserved farmland and public parks. Protected land owned and maintained by homeowners associations accounts for a significant amount of protected open space as well. Other methods for protecting land are employed in Chester County including transfer and purchase of development rights and managed lands that are either owned in fee or protected by easements held by a public sector agency. Municipalities in Chester County encourage the preservation of Open Space through policy regulations, such as conservation design zoning and planned residential development where a portion of open space is required for land development. Lands protected under these methods are included in "Protected land owned and managed by a homeowners association."

Chester County's open space preservation efforts have been so successful due to a county-wide coordinated approach. The following elements have all played central roles in contributing to the success of the program:

PUBLIC SUPPORT

POLICY AND FUNDING

PLANNING

IMPORTANCE OF AGRICULTURE

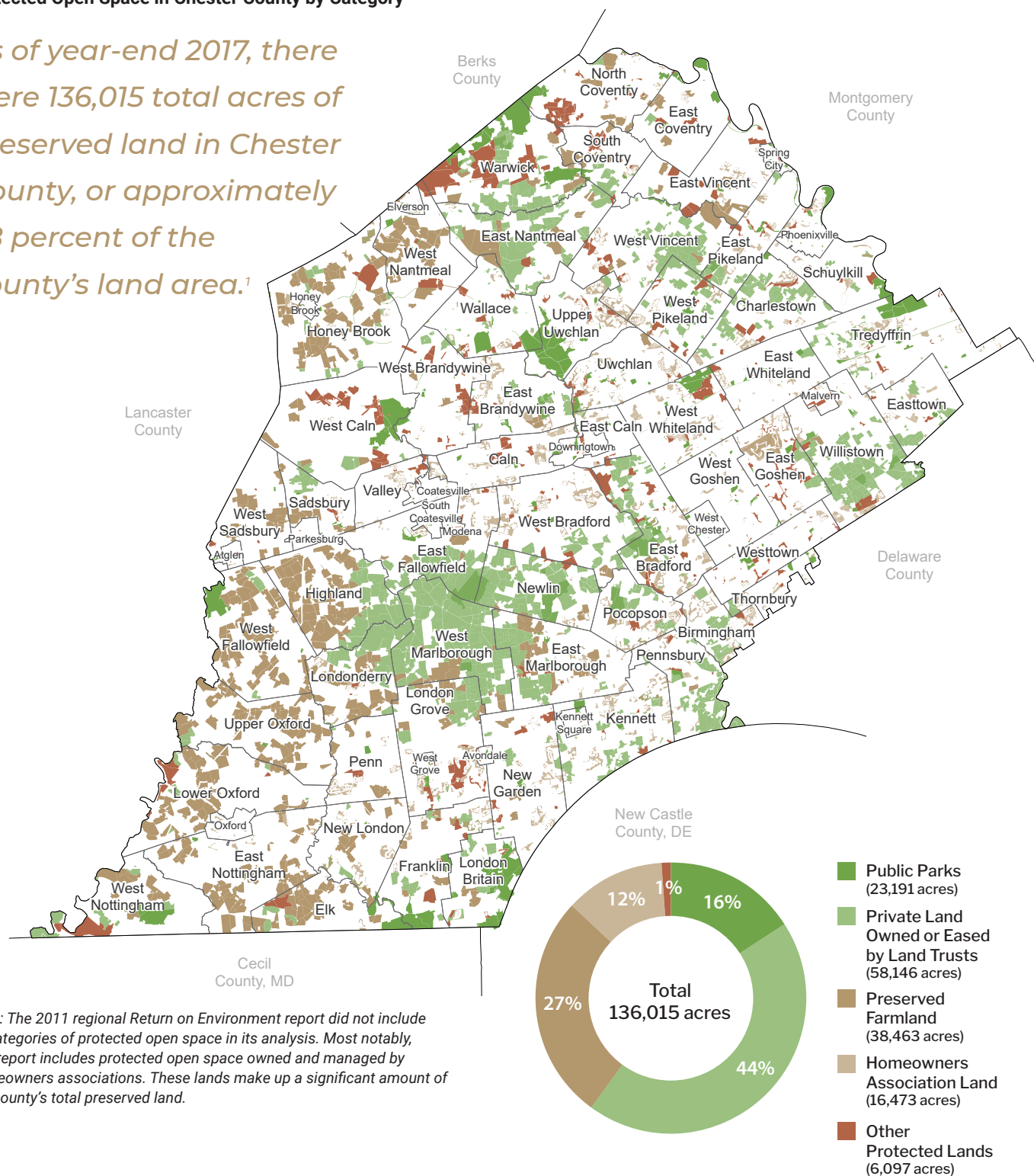
STRONG PARTNERS



Photo by Jeff Moreau  
Wolf's Hollow County Park

Figure 1.1  
Protected Open Space in Chester County by Category

*As of year-end 2017, there were 136,015 total acres of preserved land in Chester County, or approximately 28 percent of the county's land area.<sup>1</sup>*

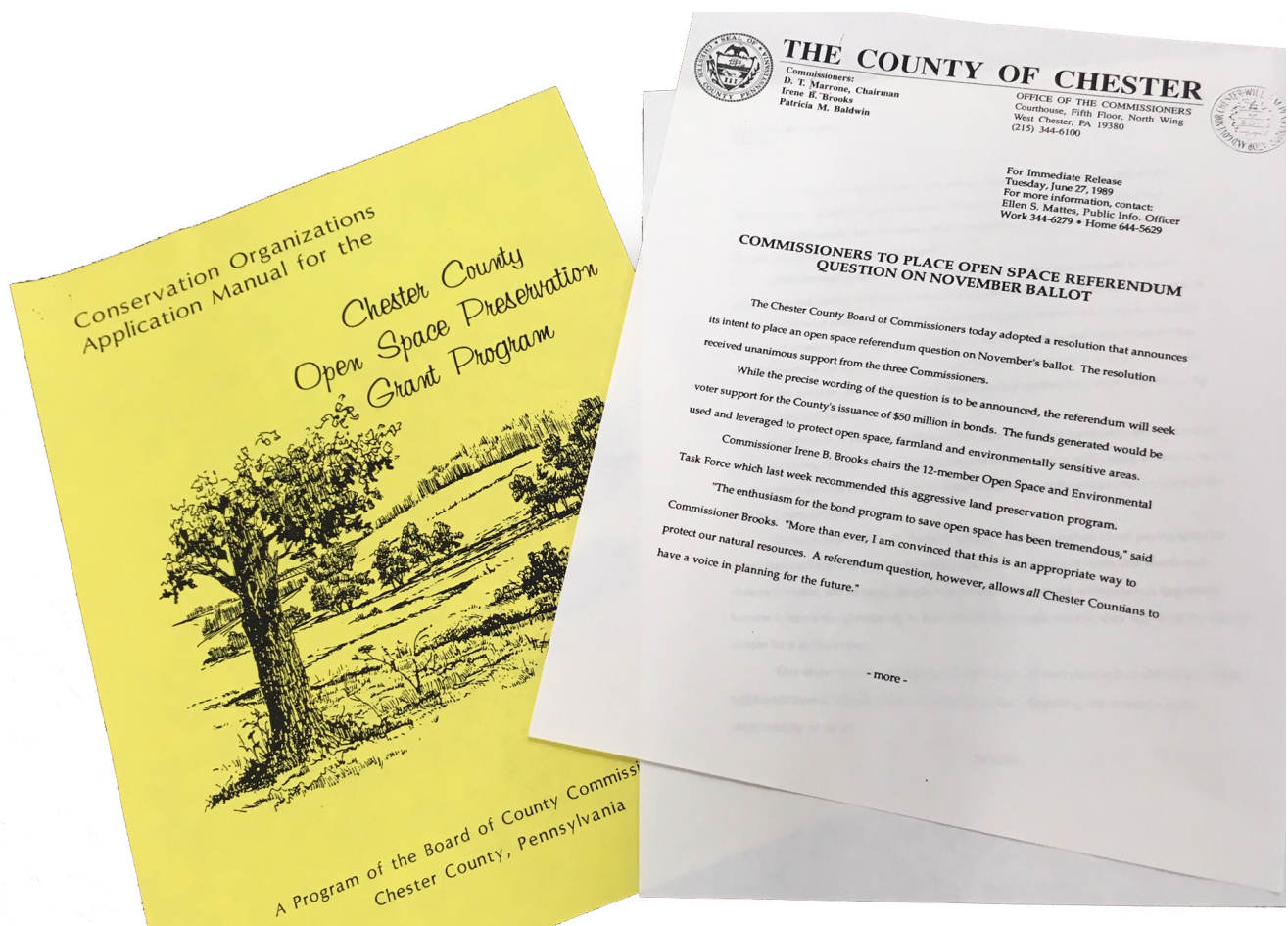


## PUBLIC SUPPORT

### A call to action

Chester County's highly successful open space preservation efforts were catalyzed by a growing concern among residents that the county's vistas and landscapes were disappearing in a tide of suburban sprawl. In the 1980s, Chester County was losing about a farm per week to residential development. In response to the public discourse, the Chester County Commissioners appointed an Open Space Task Force, which recommended the creation of a \$50 million funding program. A ballot referendum asked county voters to consider allocating funds specifically for open space preservation, and in November of 1989 there was an overwhelming 82 percent "yes" vote.

*Development pressure continues to threaten the county's quality of place—the primary reason many people choose to live here.*



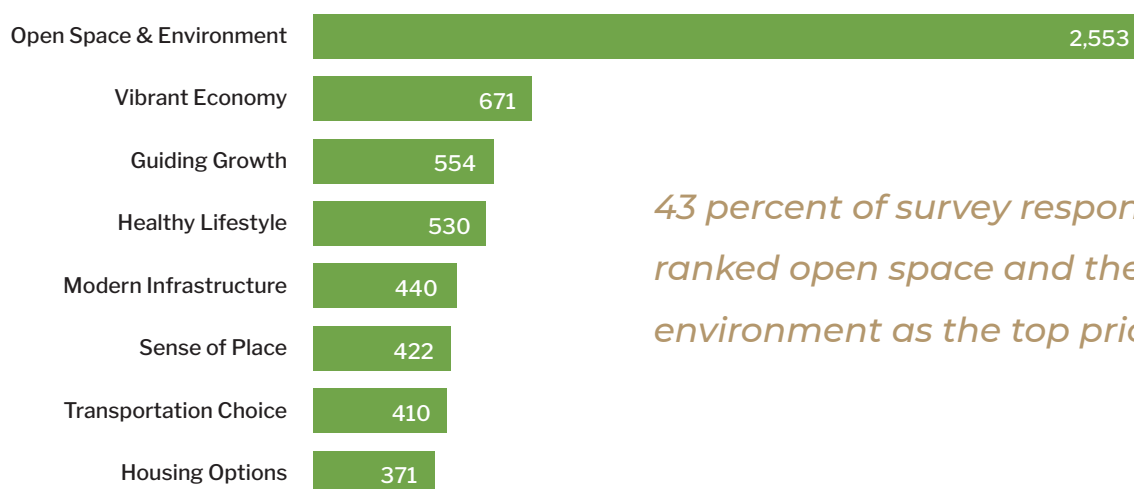


### Public survey response

Preservation of open space and the environment continue to be a very high priority for county residents today. A public survey issued in 2017 as a part of the county's comprehensive plan update process found that protected open space and the environment was by far the highest ranked issue of importance amongst county residents, with 43 percent of survey respondents ranking protected open space and the environment as the highest priority (see Figure 1.2).



Figure 1.2  
**Ranking of Issues Identified as Most Important**



*43 percent of survey respondents ranked open space and the environment as the top priority.*

Source: Landscapes3 Public Survey (2017), 5,951 total responses.



### Challenges continue

Development pressure continues to threaten the county's quality of place- the primary reason many people choose to live here. Since 2000, approximately 9.4 percent of Chester County's agricultural land has been developed-

about 1,100 acres per year, which is an area roughly equal to the entire City of Coatesville. Of the agricultural land developed, 73 percent has been for residential uses.<sup>2</sup> Figure 1.3 shows the difference between the amount of land developed in 1990 and 2015.

Figure 1.3:  
**Chester County Developed Land Over Time (1990-2015)**



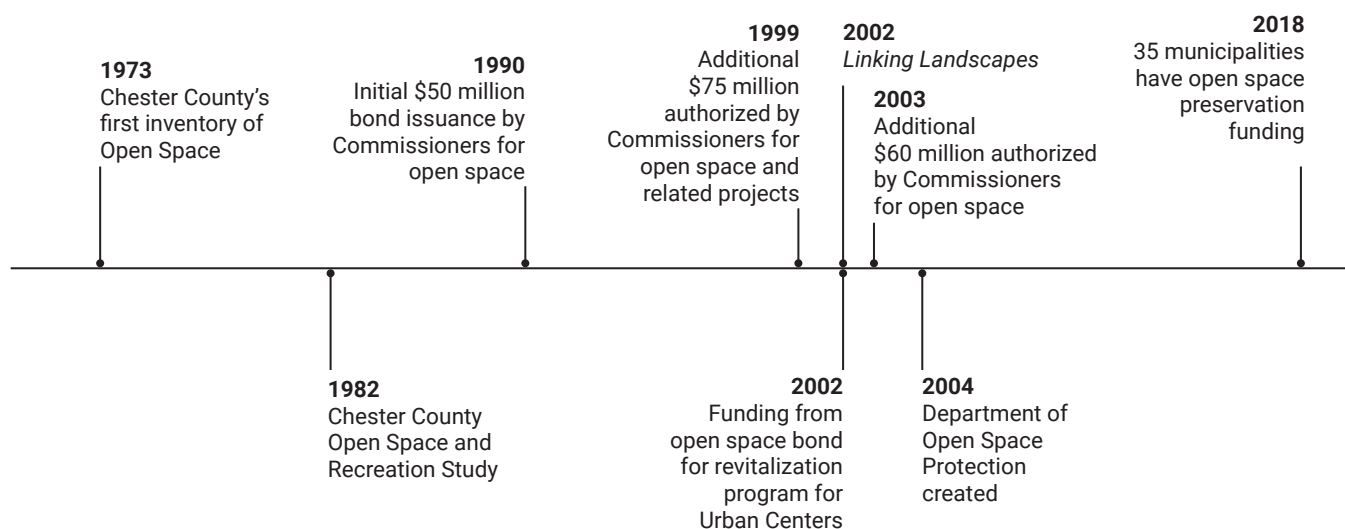
## OPEN SPACE POLICY AND FUNDING

Recognizing the powerful expression of public sentiment indicated by the voters who passed the referendum, the County Commissioners asked the Task Force to determine an effective set of policies for preserving open space. Following an extensive study, the Task Force recommended that \$50 million in spending be authorized over a 5-year period for open space and farmland acquisition, open space planning, and park improvements. A portion of the bond was used to provide matching funds for municipalities and conservancies to preserve land, and this effectively leveraged millions more in open space preservation funding. Since the initial bond issuance in 1990, Chester County Commissioners have been ardent supporters of the open space program, authorizing an additional \$75 million in 1999 and \$60 million in 2003 for the continuation of existing programs.

Throughout the formation of the county's open space preservation program, the Commissioners recognized the necessity and benefits of growth and sought to create a thoughtful and balanced approach between the two. The county's urban centers play an important role in receiving population growth as an alternative to greenfield development and beginning in 2002 the open space bond included funding for revitalization of urban centers. During this time the county also established its Vision Partnership Program, a competitive in-kind and cash grant program that provides funding for municipalities to create plans for their communities.

In 2002, the County Commissioners adopted *Linking Landscapes: A Plan for the Protected Open Space Network in Chester County, PA*, as an element of the county comprehensive plan. This document provided a county-wide comprehensive review of preserved open spaces, along with an integrated plan for implementing over 292 specific action items. Some of the key results of *Linking Landscapes* were the establishment of the Department of Open Space Preservation, and the creation of the Protected Open Space Tracking (POST) system, which continues to map newly protected open spaces throughout the county on an annual basis.

### Major Open Space Activities in Chester County Since 1973



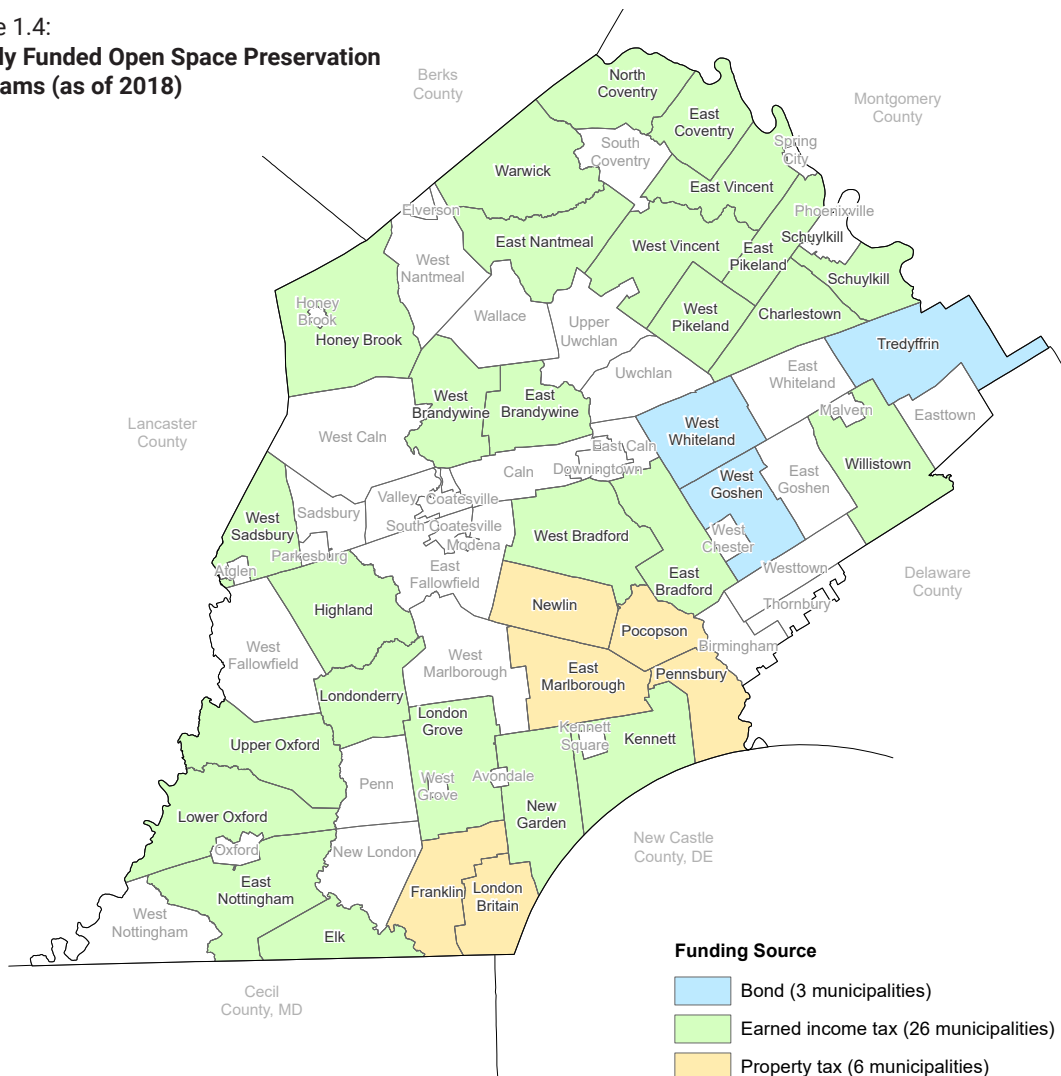


## Chapter 1: Introduction

The Department of Open Space Preservation was created in 2004, and since then the county has allocated over \$156 million toward the protection of open space. These funds have been used to purchase easements on farmland and provide grant funding to municipalities and non-profits land trusts to preserve land and construct park facilities on permanently preserved land. In addition to county support for open space preservation, more and more municipalities have established their own dedicated funding streams for open space preservation. As of year-end 2018, residents of 35 municipalities had voted to either issue a bond or dedicate tax revenue to create a fund for open space preservation in their township (see Figure 1.4).

*The Department of Open Space Preservation was created in 2004, and since then the county has allocated over \$156 million toward the protection of open space.*

Figure 1.4:  
**Locally Funded Open Space Preservation Programs (as of 2018)**

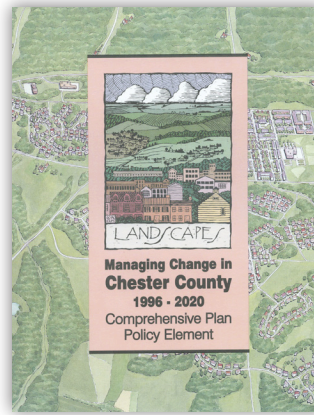


## OPEN SPACE PLANNING

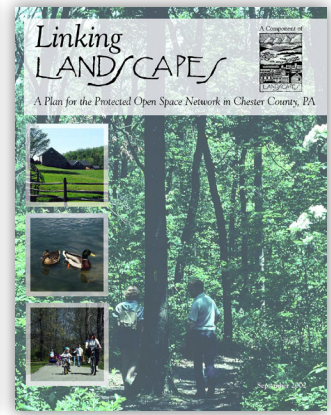
Chester County is a statewide leader in land use planning, perhaps as a result of its early imperative to plan for preservation. Several planning documents have shaped the county's strategic policy in terms of open space preservation. *Landscapes, Managing Change in Chester County 1996-2020*, was the county's first comprehensive plan and the first policy document to encourage the balance of preservation and growth. It presented a vision for the county in which all sectors of the community had a role to play in "preserving and enhancing the unique character of Chester County landscapes by concentrating growth in the most appropriate areas."

*Linking Landscapes: A Plan for the Protected Open Space Network in Chester County, PA*, was adopted in 2002 as the open space policy element of *Landscapes*. This plan envisioned the county's protected open space as an interconnected network that would provide recreational and environmental benefits as well as preserve the scenic character of the landscape. Most importantly, it provided a strategy around open space preservation.

Since its adoption in 1996, *Landscapes* has been updated twice, once in 2007 and most recently in 2018, to reflect changing conditions and priorities in the county. For example, Chester County is projected to experience the highest rate of population growth of any county in Southeastern Pennsylvania according to projections by the Delaware Valley Regional Planning Commission.



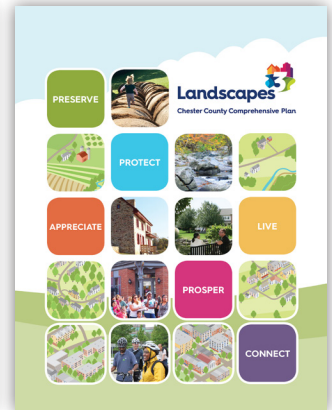
*Landscapes* (1996)



*Linking Landscapes* (2002)



*Landscapes2* (2007)



*Landscapes3* (2018)

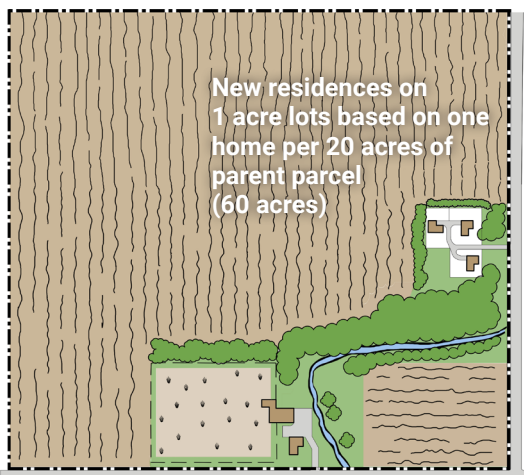


## Chapter 1: Introduction

Chester County municipalities have also undertaken extensive planning for open space preservation through their comprehensive plans and through open space, recreation, and environmental resource plans. Municipalities often implement these plans by employing a variety of planning tools through their zoning and subdivision and land development ordinances to enhance open space preservation efforts and protect the vitality of the agriculture industry. Some of these planning tools include:

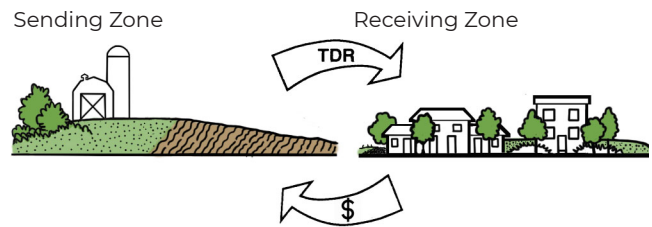
### Agricultural Zoning

Agricultural zoning reflects a community's value for its agriculture industry. It allows a municipality to preserve large lot sizes (typically 20 acres or more) and preserves a critical mass of agricultural uses in order to protect the industry. It also can be used to ensure areas of a municipality with prime agricultural soils are used for agricultural purposes.



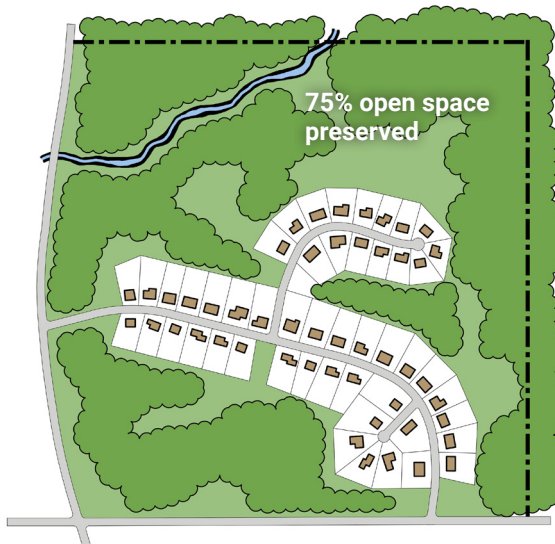
### Transfer of Development Rights

This zoning tool allows for a market-based approach to smart growth development by redirecting development in proposed preservation areas to growth areas. TDR separates the development rights from a parcel (i.e., the "sending parcel") and sells them to the owner of another parcel (i.e., the "receiving parcel"), allowing that parcel to be developed at a higher density than typically permitted, thus preserving the sending parcel for agricultural use or protected open space. This approach both preserves open space in rural or sensitive areas and strengthens existing communities.



### Conservation Zoning

Conservation or cluster development is a land development design tool that provides a means of both preserving open space and allowing development to be directed away from natural and agricultural resources considered important for protection by the municipality. Conservation development zoning can require up to 75 percent of a site's land area to be preserved in permanent protected open space.



## IMPORTANCE OF AGRICULTURE

Chester County's strong agriculture industry sets it apart from other counties in the Delaware Valley; the agriculture industry is a significant employer in the county. Most notably, Chester County is known for its robust mushroom growing industry, and for good reason: more mushrooms are grown here than in any other county in the U.S. The mushroom industry accounts for nearly two thirds of all direct sales of agricultural products in Chester County and can thrive because of its symbiotic relationship with suppliers of agricultural goods and services that proliferate in the region.<sup>3</sup>

Although mushroom growing facilities are typically not located on preserved open space, preserving active farmland is one way to ensure the industry remains viable. Fortunately, Chester County recognizes this relationship and has prioritized the preservation of active farmland in its funding for protected open space through two different programs available only to active farms. Since the establishment of the County's Department of Open Space Preservation (the department that manages the agricultural land preservation program), an average of 51 percent of county open space preservation funds have been used for purchasing development rights on farms.<sup>4</sup>

*The mushroom industry accounts for nearly two thirds of all direct sales of agricultural products in Chester County.*



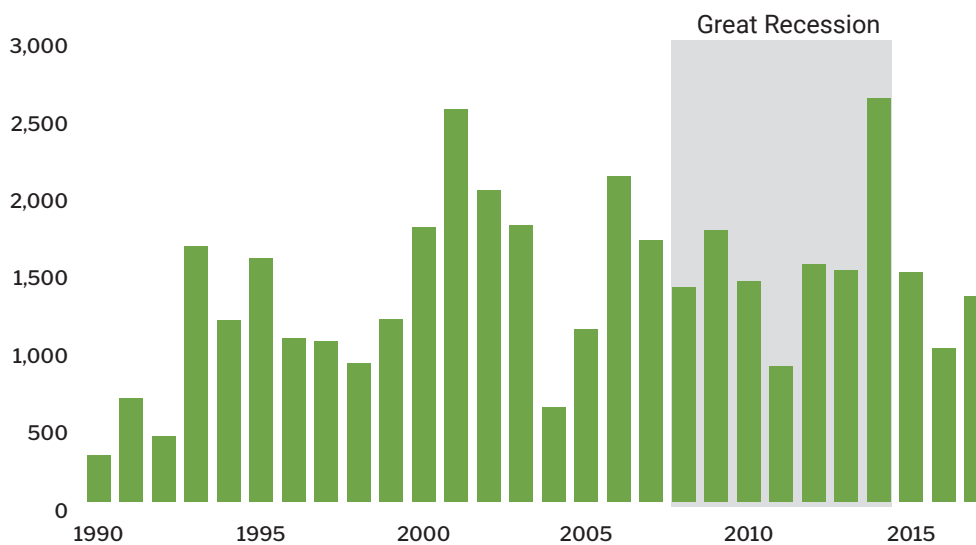


## Chapter 1: Introduction

Figures 1.5 and 1.6 show relative changes in the number of acres of farmland eased per year in Chester County and the funding that made these easements possible. Occasionally, federal USDA Agricultural Conservation Easement Program (ACEP) grants are used, but the majority of funding for preservation of agricultural land

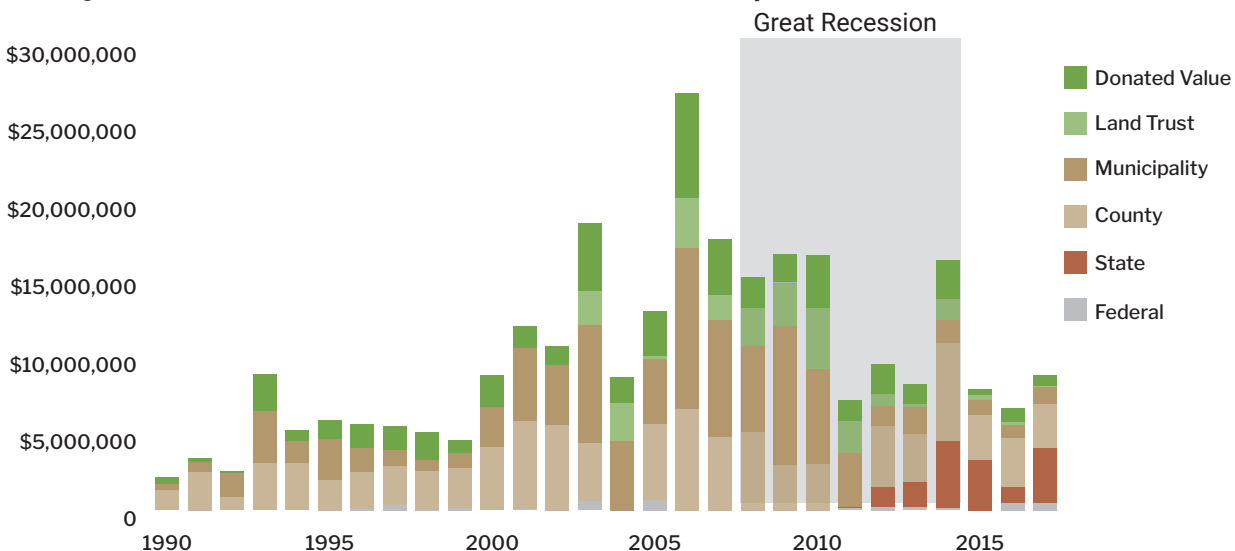
comes from the state, county, and municipalities. Despite a decline in funding at the state and county level during the Great Recession (2008-2014), the county was able to maintain levels of farmland preservation with less county funds due to an increased emphasis on leveraging funds from other sources.

Figure 1.5  
**Acres of Farmland Eased Per Year in Chester County**



Source: Chester County Department of Open Space Preservation

Figure 1.6  
**Funding Share for Farmland Preservation Over Time in Chester County**



Source: Chester County Department of Open Space Preservation

## PARTNERS

The strong culture of preservation in Chester County has given rise to multiple land trusts that operate both regionally and locally. As shown in Figure 1.0 earlier in this chapter, land owned or eased by land trusts makes up the largest share of preserved open space in the county. These land trusts have been so successful due to significant public support for their work and the availability of funding from federal, state, county and municipal sources.

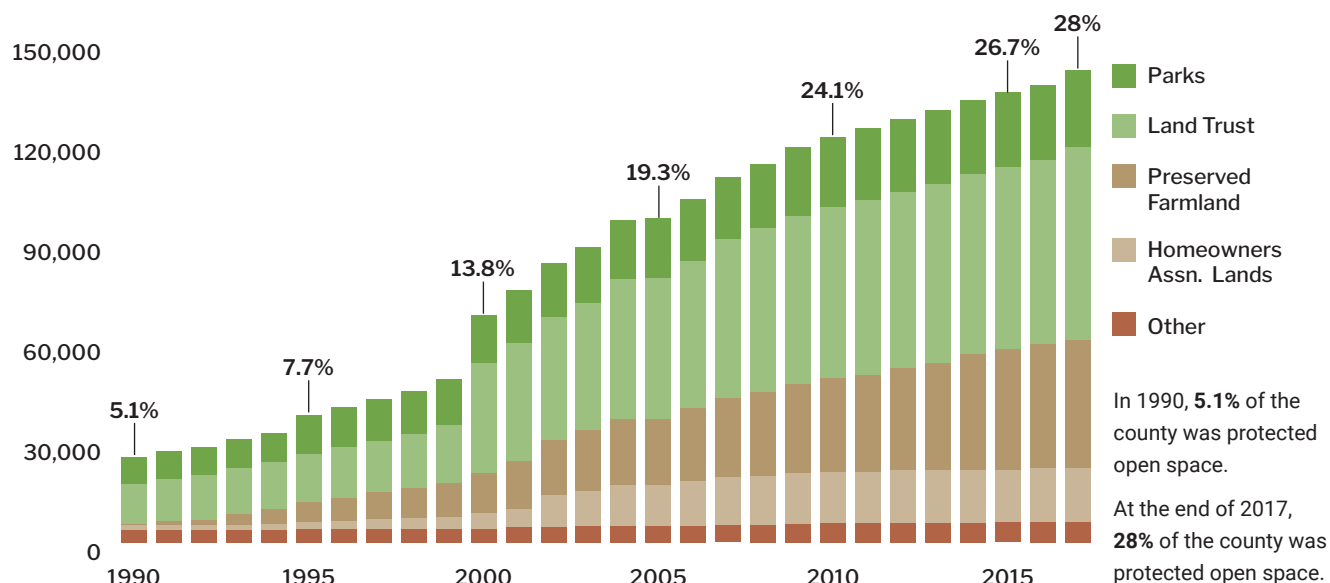


## RESULTS

Chester County's robust open space preservation program is the result of coordinated policy and funding and strong partnerships working toward a common goal for which there is much public support. As of year-end 2017, Chester County had preserved 28 percent of its total land area, or about 136,000 acres. To understand this large number, the amount of preserved land in Chester County is greater than the size of Delaware County (which is 122,221 acres).

Figure 1.7 shows the acres of each category of open space protected over time in the county and provides a glimpse into the impacts of shifts in policy. The steep increase in land preserved by land trusts that occurred in 2000 is primarily a result of streamlined data collection and reporting; however, increases in all categories of preserved land occurred in the early 2000s. Prior to 2000, Chester County's strategy was opportunistic and reactive, but in the early 2000s several county initiatives made the process of acquiring protected open space more efficient and streamlined. These included the establishment of the County's Department of Open Space Preservation, new land use planning initiatives, and better data recording and tracking.

Figure 1.7  
Acres of Open Space Protected by Category



Source: Chester County Planning Commission Protected Open Space Tracking data

# Approach

This report applies an econometric analysis to the impact of protected open space in Chester County. Here is a brief summary of how this approach was used.

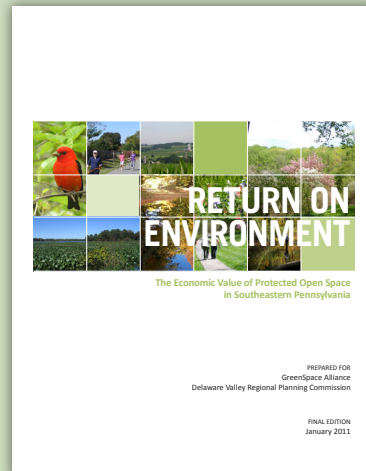
## ESTIMATING THE ECONOMIC VALUE OF PROTECTED OPEN SPACE

Protected open space creates economic value in three ways:

- **Wealth generation** (e.g., higher property values and earnings from open space-related activities)
- **Tax revenues** (e.g., increased property tax collections due to higher property values)
- **Avoided costs** (e.g., dollars that would be spent on the provision of environmental services such as improving water quality and removing air pollution in the absence of protected open space)

Recognizing these three types of value generation, this report examines the effect that protected open space has on property values; the value of environmental benefits provided by protected open space; the consumer benefit associated with recreational use on protected open space, including avoided health-related costs; the jobs and revenue created as a result of activity on protected open space; and the fiscal impacts of developing open space associated with the cost of community services (see next page).

This report does not address the economic value of several other important but more difficult to quantify benefits associated with protected open space. Some of these omitted benefits include more personal and subjective values, such as cultural, spiritual, aesthetic, and stress-reduction benefits, as well as benefits associated with increased civic capital or community cohesion and crime reduction. Some of these benefits, however, are addressed within the case study profiles that appear throughout the report.



### Relationship to 2011 Report

This report closely follows the format of the Greenspace Alliance's 2011 *Return on Environment* report, which estimated the economic benefits of protected open space in the 5-county region of southeastern Pennsylvania. While there appear to be many similarities between the findings of each report, the findings cannot be accurately compared due to updated methodology used in estimating the economic benefits in this report. The reports use different data sources for value transfer methods, and some of the accepted values for environmental benefits have increased significantly since the publishing of the previous report.





### Property Value

Homeowners are willing to pay a premium to live near protected open space. As a result, Chester County's protected open space adds to the overall value of its housing stock. This increased wealth is captured by citizens through higher sales values of homes near protected open space, and also generates increased government revenues via larger property tax collections and greater transfer taxes at time of sale. This report estimates the increase in property values associated with protected open space in Chester County and the attendant fiscal impacts.



### Environmental

Protected open space also provides value in the form of naturally occurring environmental processes. If these protected lands were developed,

Chester County government agencies, municipalities, businesses, and private land owners would sacrifice vital benefits and be forced to spend money to replicate vital and costly services such as clean water supply provision, flood control, air and water pollution removal, and stormwater management through alternative methods. Significant savings are accrued by the natural landscapes on protected open spaces providing these valuable services. This report estimates the cost savings associated with several environmental benefits that naturally occur on Chester County's protected open spaces, including provision of clean water supply, flood and stormwater mitigation, provision of wildlife habitat, air pollution removal, and carbon sequestration and storage.



### Recreation and Health

Parks provide recreation opportunities for free or below market rates. Consumer benefits accrue to those who use parks for recreation instead of turning to private markets for the same activities. There also are considerable health cost avoidance and productivity savings related to rigorous exercise on protected open space. This report estimates these recreation and health cost savings benefits.



### Economic Activity

Protected open space generates a variety of economic activities, ranging from agricultural activity on preserved farmland to tourist visitation to public park maintenance. The analysis estimates the spending, employment, earnings, and tax revenues associated with these activities.



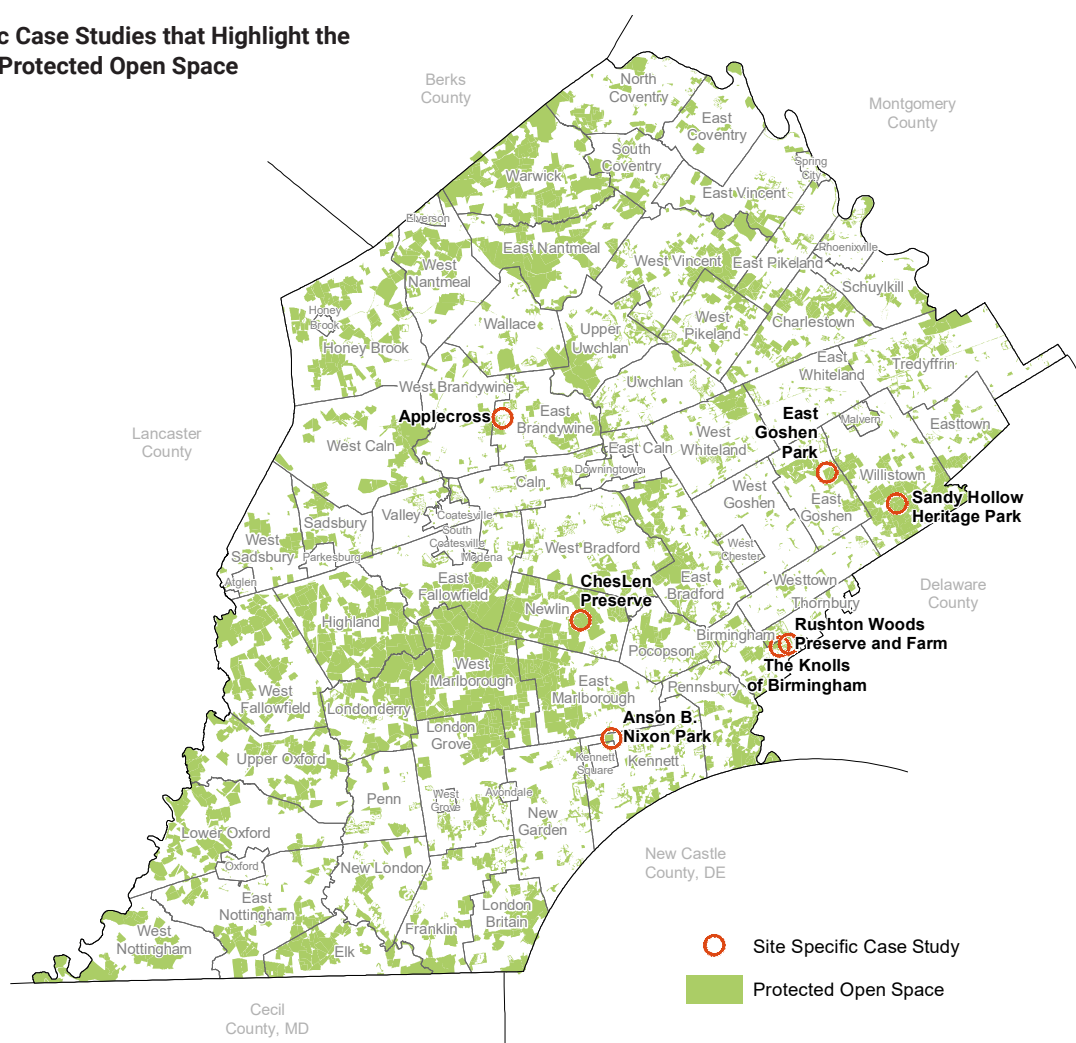
### Community Cost Savings

The development of farmland and protected open space into developed land (primarily single family residential housing) has impacts beyond increased traffic and viewshed impairment—it also has measurable impacts on a municipality and school district's financial health. Tax revenues and fees generated by new residential development do not cover the costs of municipal and educational services that such development produces, whereas farmland and open space typically generate a net surplus. The final chapter in this report highlights the often overlooked cost to municipalities and school districts of developing unprotected open space.

## CASE STUDIES

Case studies are also presented in this report to highlight the value protected open space provides in Chester County. Seven case studies focus on specific well-known and loved protected open spaces through the county (see Figure 1.8). There are also individual case studies that highlight the value added by multiuse trails throughout the county and preserved farms in West Fallowfield Township. An additional case study highlights how protected open space contributes to Chester County's high quality of place, which in turn helps county businesses attract and retain talent.

Figure 1.8  
**Site Specific Case Studies that Highlight the Benefits of Protected Open Space**





## ANALYTIC TECHNIQUES

This report utilizes several different analytic techniques and data sources to estimate economic benefits. A comprehensive regional property sales database provided the basis for calculations that isolated the effect of protected open space on residential property values. Standard input-output modeling was used to estimate spending, jobs, and earnings associated with agricultural, tourism, and park management and maintenance uses on protected open space. Where primary data collection was not feasible due to budget or time constraints, value transfer methods were used, drawing upon existing research to estimate economic values and cost savings associated with ecosystem services and recreational use on protected open space.

A planning study designed to measure the fiscal impacts of protected open space on Pennsylvania's municipalities and school districts, called a Cost of Community Services (COCS) ratio study, serves as the basis to show the economic benefits of farmland and protected open space to municipalities and school districts in Chapter 6 of this report. Revenues and expenditures for residential, commercial, industrial, and agriculture land uses are compared and cost-revenue ratios are calculated. Ratios represent the net amount each land use costs a municipality, comparing how much a municipality spent versus each dollar generated on that land use.

More information about the methodology used to estimate each type of economic benefit is included within each of the following chapters.

Where a range of approaches and estimates could have been used to arrive at an economic impact, conservative approaches were adopted so as not to overstate values. Even with this conservative approach, however, the analysis is subject to caveats common to any economic valuation or impact analysis regarding **substitution effects, double counting, and value estimation** (see below for more detail).

Acknowledging these limitations in the analysis, it is believed that any potential value overestimates due to substitution effects or double counting are more than compensated for by the use of conservative methods and value transfer estimates throughout the study.

### Substitution effect

When considering the benefits that residents enjoy by recreating and exercising on public parks as opposed to in a private facility, the substitution effect is important to keep in mind. If all open space were to be developed, it is unlikely that residents would altogether stop participating in the recreational activities they now enjoy on parkland. Instead, it is likely that residents would go elsewhere to recreate and thereby replace some of the value they currently derive from recreational activity on public parks. Because of this substitution effect, estimates of recreational value in this report should only be understood to represent the benefit that existing public parks contribute within Chester County. These estimates should not be interpreted as the amount of money that would be lost if all public parks in the county were developed.

### Double counting

Double counting occurs when a value is overstated due to it being accounted for in two separate analyses. While this report aims to minimize any double counting, it is expected that some double counting exists in the evaluation of recreational and health cost savings (i.e., people account for health care savings in their willingness to pay for recreation) as well as recreational cost savings, and property values (i.e., people include the convenience of recreational use on nearby protected open space in home sales prices). It is expected that a small amount of double counting

may occur between the environmental benefits and property value impacts and between the recreational cost savings and tourism spending estimates.

### Value estimation

Value transfer methods are utilized where data collection proves too costly or time consuming. In surveying existing studies for benefit transfer values (e.g., How much is a ton of carbon monoxide removed from the atmosphere worth? or How much is a jog in the park worth to the average individual?), there are a range of plausible values to choose from within the research literature. This report draws upon leading researchers that have evaluated many studies and, in most cases, uses an average value among the existing research to apply to this analysis. The values calculated in this economic research are based on the average consumer's "willingness to pay" for a service or activity. These estimates are not transaction-based; instead, they estimate the amount of money the average consumer would be willing to pay for a service or activity if it were not provided by protected open space. As such, the value estimates based on willingness to pay should not be understood as income or revenue, but rather as inherent consumer benefit gained from the free or low-cost services and opportunities provided by protected open space.

## INTERPRETATION

It is important to note that the economic benefits presented in this report are meant to serve as estimates, not exact values. While approximate, they are based on defensible estimation methods and represent a vast improvement over the common and incorrect implication that the economic value of protected open space is zero.

Because the estimates in this report represent different types of values—some represent wealth generation via asset appreciation or earnings, some represent additional tax revenues, some represent avoided costs—they should not be added together to produce a single number representing the total aggregate value of protected open space in Chester County.

Furthermore, it is important to note that these estimates approximate the value of the total existing inventory of protected open space in Chester County, taking into account the broad variety of land covers, economic activities, recreational activities, ecosystem services, and other factors that exist or occur on this protected open space. Because the report's estimates take such a diversity of factors into account, they should not be used in calculations estimating the economic value of specific parcels of protected open space. The case studies that appear throughout this report help illustrate the economic benefits of protected open space on a smaller scale.

In presenting these economic value estimates, this report makes no policy recommendations. However, the intention is that this analysis should lead to more informed land use, development decisions, and open space funding taking into account a more complete consideration of the economic, environmental, health, and social impacts associated with protected open space.



## Chapter 1: Introduction

### Endnotes

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<sup>1</sup> Chester County Planning Commission Protected Open Space Tracking data, 2017.

<sup>2</sup> Chester County Planning Commission analysis of DVRPC 2000 and 2015 land use GIS data.

<sup>3</sup> USDA Agricultural Census, 2012.

<sup>4</sup> Chester County Department of Open Space Preservation.

## Chapter 2



# Property Value





Kennett Township





# Introduction

The total value of a home is the sum of the values of its different features.

Homeowners are familiar with the notion that the number of bedrooms in a home will, in part, determine its value, as will its structural condition, the school district it falls within, and its community's property tax rate. Changing any of these individual components will raise or lower the total value of a home.

This section of the report investigates the effect of nearby protected open space on home values in Chester County with regard to the proximity of the protected open space, the size of protected open space, and the environment in which the home and protected open space are located. If proximity to protected open space does contribute to an increase in property values, it will also result in higher property tax revenues for counties, municipalities, and school districts.

Homes in Chester County capture a measurable increase in value as a result of protected open space. However, four primary variables impact the amount of value added:

1. Proximity to protected open space
2. Size of the protected open space
3. The environment in which the home and protected open space are located
4. Home's assessed value



# Methodology

Hedonic regression analysis was used to isolate the differences in home sale price attributable to protected open space, holding all other housing features constant (see sidebar). The analysis used more than 98,000 arms-length transactions of single family homes in Chester County from 1981 to 2017. Control variables were included to account for differences in housing characteristics as well as neighborhood characteristics. The analysis isolates the effect on home values of proximity to protected open space from the effect of other variables that influence home value.

The analysis included more than 3,700 protected open space parcels including federal parks, state land, municipal parks, county parks, land owned or eased by land trusts, and agricultural land.

The impact of a home's proximity to protected open space on tax revenue is discussed in the next section. Taxes included in this analysis include county, municipal, and school district property taxes, as well as transfer taxes that are incurred upon the sale of real property. In Chester County, transfer taxes amount to 2 percent of the sale price of the house, half of which goes to the state, and the other half is split between the local school district and the municipality.

## Hedonic Regression Analysis

The property value analysis presented in this section relies upon hedonic regression analysis, a standard technique used by economists to analyze demand and pricing for an item. Hedonic regression analysis seeks to isolate the explanatory power of a single variable of interest (like proximity to protected open space) by holding constant other relevant housing characteristics (like square footage, number of bedrooms, year built, etc.). This technique is commonly applied to housing market transaction data to evaluate the value premium associated with various amenities.



# Property Value Impacts

The closer a home is to protected open space, the more value it captures. Approximately 3.6 percent of the value of a home located between 0 and ¼ mile from protected open space can be attributed to its proximity to protected open space. The increase in value for homes ¼ mile to ½ mile away is about 2.3 percent. When added together, the increments of value that homes within a half-mile of Chester County protected open space capture as a result of their proximity to protected open space total \$1.65 billion. In other words, if all of the protected open space in Chester County were eliminated, the total value of the housing stock would decrease by \$1.65 billion. For homes within a half-mile of protected open space, this represents an average property value increase of almost \$11,380 and nearly \$13,120 for homes within a quarter-mile of protected open space.

By increasing the value of homes within a half-mile radius, protected open space also increases the amount of property and transfer taxes that the owners of these homes pay to county and municipal governments and to school districts. County-wide, these additional property tax revenues amount to \$27.4 million dollars per year for homes within a half-mile of protected open space. Figure 2.1 shows the housing value and tax revenue increases attributable to protected open space for homes within ½ mile or ¼ mile of protected open space.

Figure 2.1  
Housing value and tax revenue increases attributable to protected open space

	1/2 Mile Impact	1/4 Mile Impact
Number of Houses	144,999	76,984
Assessment Value	\$28,804,400,000	\$14,538,800,000
Market Value	\$56,100,000,000	\$28,300,000,000
\$ Value Attributed to Protected Open Space (market value)	\$1,650,000,000	\$1,010,000,000
% of Home Value Attributed to Open Space	2.94%	3.57%
\$ Value per Housing Unit (market value)	\$11,379	\$13,119
Tax Value	\$27,384,835	
Tax Value per Housing Unit	\$188	

Source: Econsult Solutions, Inc.

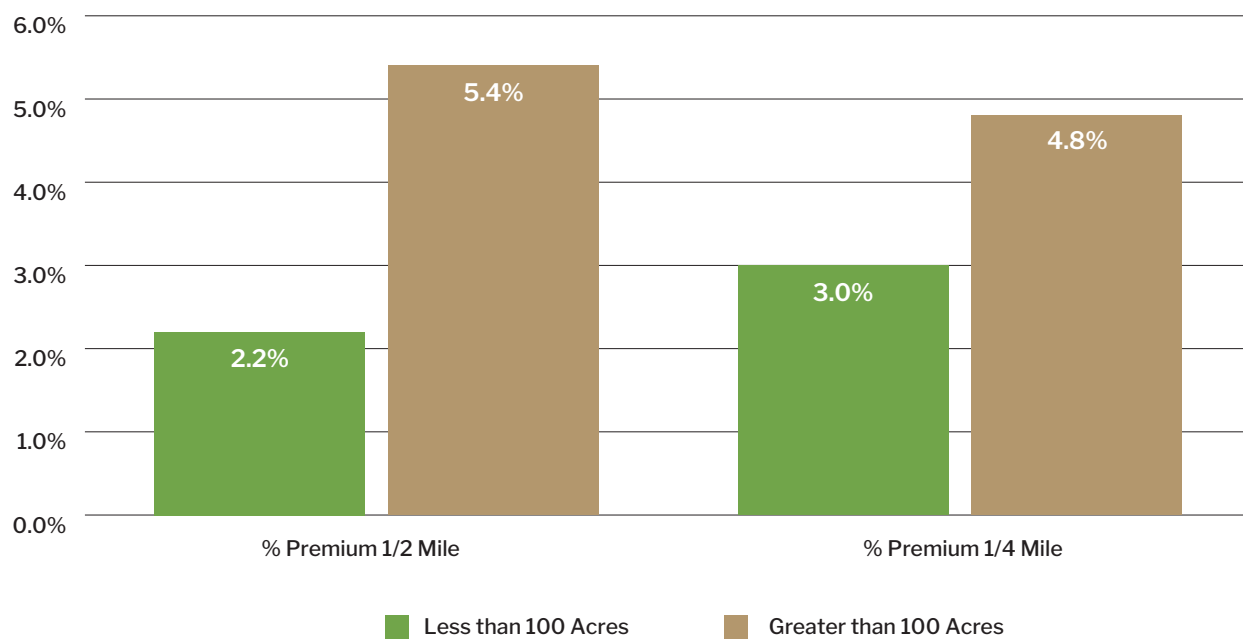




## IMPACT OF SIZE OF PROTECTED OPEN SPACE ON PROPERTY VALUE

The amount of value protected open space will add to a home's value is largely dependent on the size of protected open space. Figure 2.2 shows how much a significant acreage (over 100 acres) of protected open space adds to a property's value. The larger a protected open space, the more value it adds to a property.

Figure 2.2  
Percent Value Added by Acreage of Protected Open Space Within 1/4 or 1/2 Mile





## DEVELOPMENT PATTERN INFLUENCES

The development patterns where a home is located has an effect on how much value protected open space will add to the home. To assess these differences, an analysis of the economic and fiscal impact on housing values due to protected open space was performed according to the planning areas that exist within Chester County defined by the Delaware Valley Regional Planning Commission (DVRPC). Figure 2.3 shows where these planning areas occur in the county.

*The development patterns where a home is located have an effect on how much value open space will add to the home.*



### **Developed Community/ Mature Suburb**

The county's urban centers, railroad boroughs, and mature suburban townships.



### **Growing Suburb**

The county's significantly developed communities that are experiencing or are forecast to experience strong population and/or employment growth.

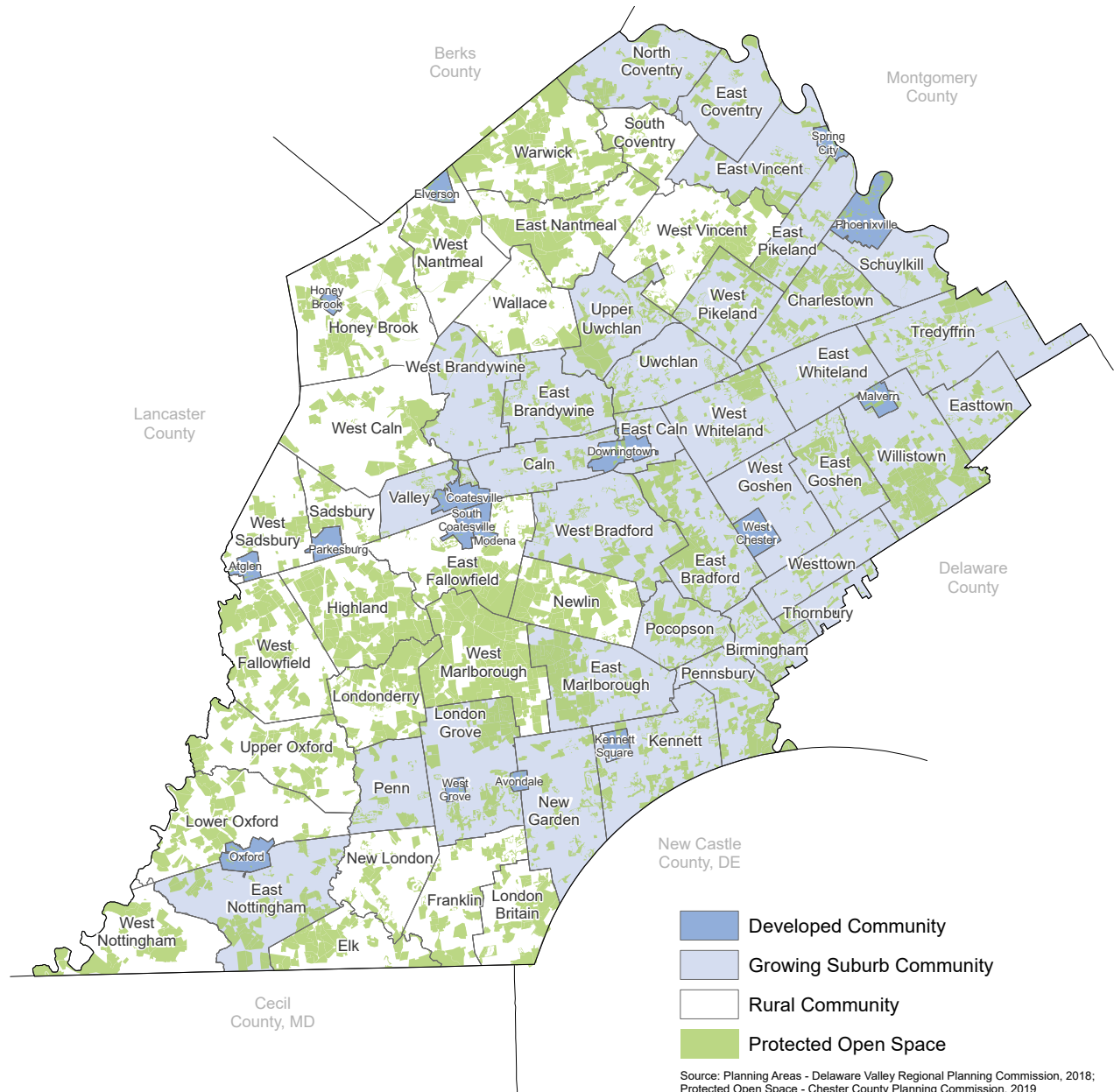


### **Rural Area**

The county's agricultural communities and communities with large remaining natural areas.<sup>1</sup>



Figure 2.3  
DVRPC Community Types in Chester County

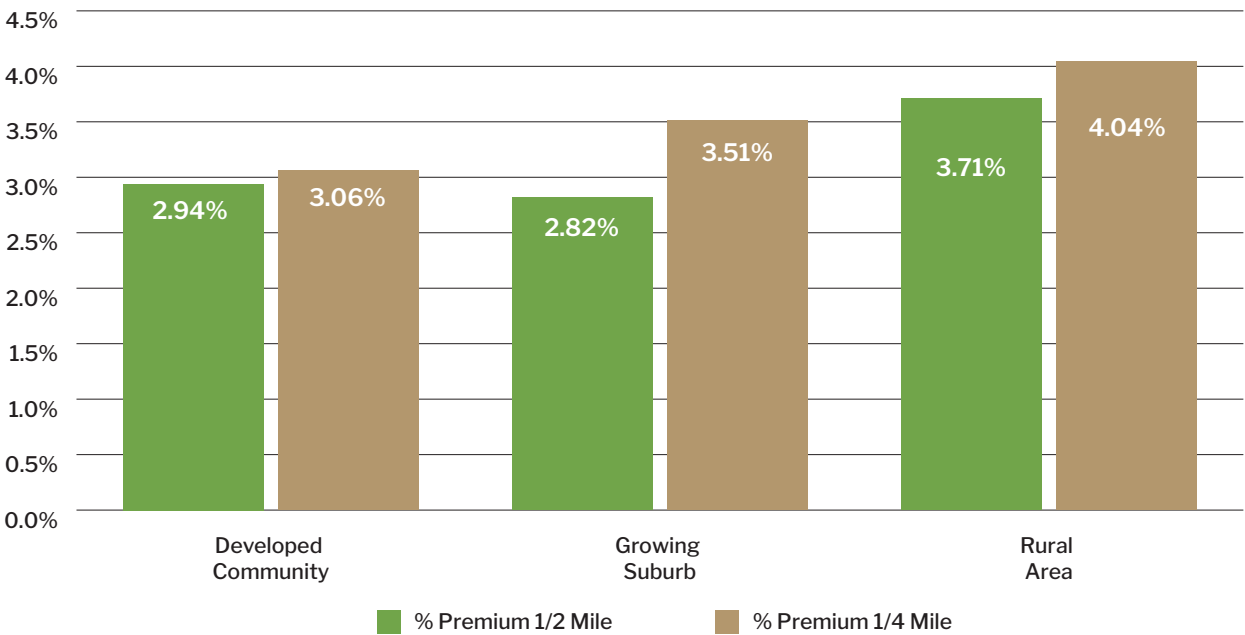




An analysis of the additional housing value generated by protected open space within these three types of development patterns reveals that a home's value is more impacted by proximity to protected open space in rural municipalities than in growing suburbs or developed communities (see Figure 2.4). Many people who choose to live in rural municipalities do so because they value protected open space and natural areas. Therefore, it makes sense that proximity to protected open space is seen more as an amenity in these locations for

which people are willing to pay a premium. However, the difference in percentage between developed communities and rural municipalities is somewhat small, and because developed communities and suburbs are more densely developed than rural municipalities, the combined value produced by homes' proximity to protected open space is likely greater in developed communities due to the fact that more homes are generating value than in rural communities.

Figure 2.4  
Percentage of Home Value Attributable to Open Space by Community Type

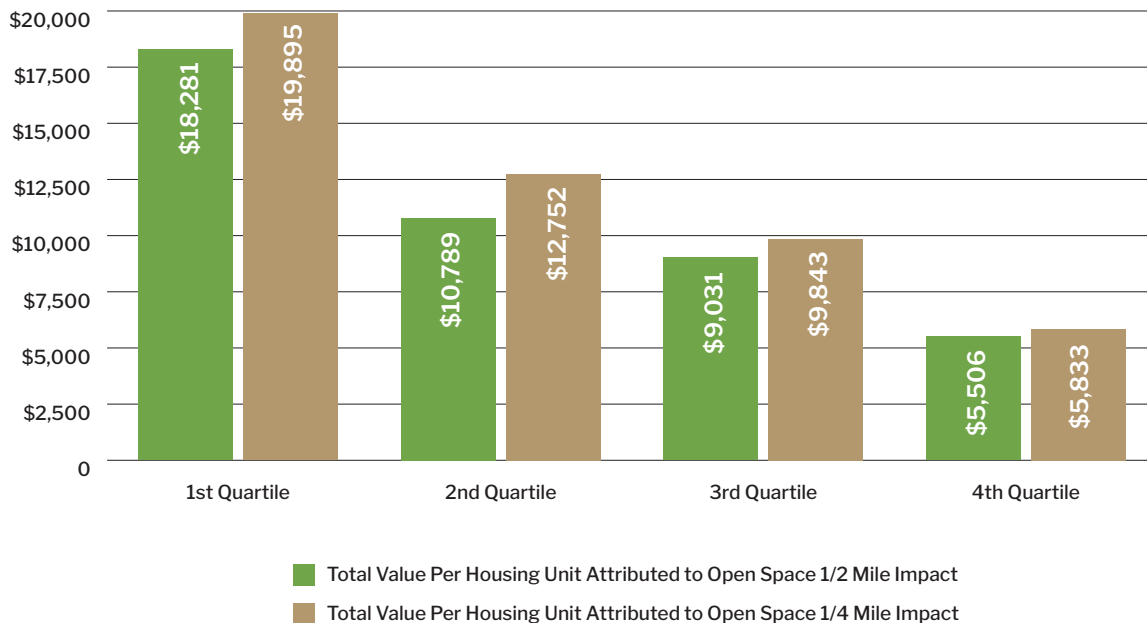




## ASSESSMENT VALUE AND THE IMPACT OF NEARBY PROTECTED OPEN SPACE

The impact that nearby protected open space has on a home's value is somewhat related to the home's assessed value. Of homes within ½ mile of protected open space, homes with higher assessed values are more impacted by nearby protected open space than homes with lower assessed values (see Figure 2.5).

Figure 2.5  
**Total Value Per Housing Unit Attributable to Protected Open Space**



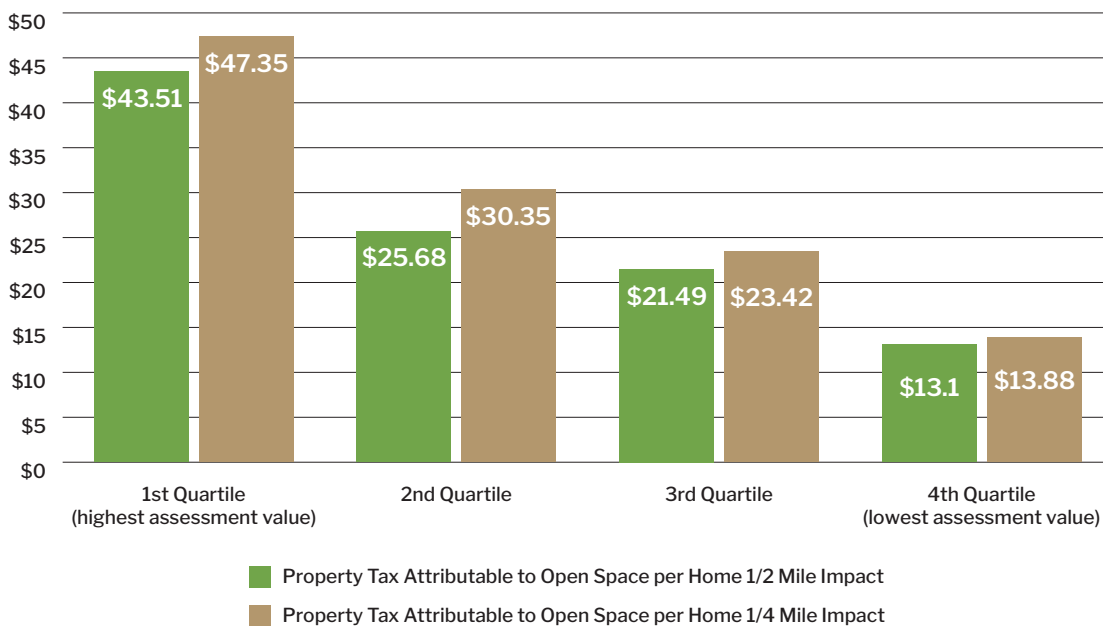
Source: Econsult Solutions, Inc.



Communities with lower housing prices may have concerns about increasing property values. Figure 2.6 shows the increases in property taxes attributable to protected open space, which is largest for homes in the highest assessment value quartile. They reflect the impact of protected open space, but do not show

the impact of new development that may occur in response to the protected open space. Aside from increased property values, many studies have shown that improvement and maintenance of protected open space in lower income communities can have significant benefits that communities find valuable (see below).

Figure 2.6  
Per-Unit Property Tax Attributable to Protected Open Space



### Greening Vacant Lots and Property Values

Although much of Chester County's protected open space acreage is located within rural and suburban areas, small green spaces within developed communities can have positive impacts on property values, especially if they are the result of converting a vacant lot into a park. A 2012 study conducted in Philadelphia found that homes located near vacant lots were valued 16 percent less than comparable dwellings in these neighborhoods.<sup>2</sup> If these vacant

lots were converted into maintained green space, the same homes saw property value increases of 2 percent to 5 percent for a total gain in value of 18 percent to 21 percent. The increase in property value equated to \$7.43 in revenue for the City for every dollar it spent to improve a vacant lot. In addition to increased property values, improved and maintained vacant lots have also been linked to reduced crime and improved health outcomes.<sup>3</sup>





# Conclusion

It is clear from this analysis that homeowners in Chester County recognize protected open space as an amenity and are willing to pay a premium to live within close proximity to it. By supporting the value of the housing stock in Chester County, protected open space plays a vital role in preserving economic prosperity of both homeowners and local governments.

### Endnotes

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<sup>1</sup>Delaware Valley Regional Planning Commission. *Connections 2035: The Regional Plan for a Sustainable Future*. Philadelphia, PA: Delaware Valley Regional Planning Commission, 2009.

<sup>2</sup>Bucchianeri, et. al. Valuing the Conversion of Urban Greenspace. University of Pennsylvania, June 2012.

<sup>3</sup>Branas, et. al. *A Difference-in-Differences Analysis of Health, Safety, and Greening Vacant Urban Space*, 2011.



# Case Study

## ChesLen Preserve

**Location:** Cannery Road,  
Unionville, PA

**Size:** 1,299 acres of woodland, meadow, and cultivated fields, including over 10 miles of public trails and almost two linear miles of the Brandywine Creek

**Owner/operator:** Natural Lands

### Introduction

ChesLen Preserve was created in 2007 by an innovative partnership between a private landowner and philanthropist, Chester County, the Commonwealth, and Natural Lands. It is a publicly-accessible and well-used “node” for passive recreation along this scenic stretch of creek and features a management/visitors’ center with sweeping views of the Brandywine valley. It also protects the “Unionville Barrens”, a serpentine-based community of globally-rare plants.

### Property Values

This report shows that homes within close proximity to large tracts of protected open space see significant gains to their property value as a result of this proximity. An estimated 11.5 percent of the value of homes within ½ mile of ChesLen Preserve is attributable to their proximity to the preserve. This amounts to approximately \$42,900 per home for a cumulative increase in market value of \$12.4 million.

### Environmental Benefits

In addition to significant gains in property values, there are environmental service benefits that are measured in the cost per year to replace them if they were lost to development. The value of environmental benefits measured in this fashion and attributable to ChesLen Preserve total \$3 million per year, and include cost savings related to water supply, water quality, flood mitigation, wildlife habitat, air pollution, and carbon sequestration. An estimated 700 tons of carbon are removed from the atmosphere annually by the trees at ChesLen, and over 18,000 tons of carbon is stored in the soils and vegetation of the Preserve.

## SPOTLIGHT

### Unionville Barrens

Essentially impossible to value economically, the globally-rare ecosystem at the Unionville Barrens only occurs in a few isolated locations across the world where ancient sea beds are exposed to the surface. This particular bedrock, called serpentine, breaks down into a low-nutrient soil with high levels of elements toxic to many plants. The assemblage of plants that can overcome the toxicity is specific to the “archipelago” of mid-Atlantic barrens sites that appear along a line from Philadelphia to Baltimore. Ironically, if such sites are left alone, more common plants can slowly creep in from their margins and ultimately push out the more delicate natives. Such was the case when Natural Lands purchased the property in 2008. Natural Lands is now implementing a detailed, multi-year plan to restore the barrens to its former extent and diversity.





# Case Study

## East Goshen Park

**Location:** Paoli Pike, East Goshen Township

**Acreage:** 168 acres adjacent to 159 acre golf club under easement

**Owner/operator:** East Goshen Township

**Amenities:** Sports fields, playgrounds, paved trails, community programming

### Introduction

East Goshen Park is comprised of two distinct sections divided by Paoli Pike. The road divides the more passive Applebrook section to the south, which is centered on a tributary of Ridley Creek, from the active area to the north, which includes parking, play fields, a stage, tot lot, and sand volleyball. An extensive paved trail system connects both parks together.

East Goshen has made an extraordinary commitment to programming, which has made this site into the “Central Park” for East Goshen, receiving nearly 225,000 annual visits from daily users, program participants, and sports leagues. The Park’s “Fit and Fun in the Park” initiative was recognized by PA Governor Tom Wolf with a “Local Government Excellence Award” as the best municipal health and wellness

program in the state in 2016, and East Goshen Park was named the “2017 Best Park” by Main Line Today. It is a busy and well-run amenity in the community.

### Property Values

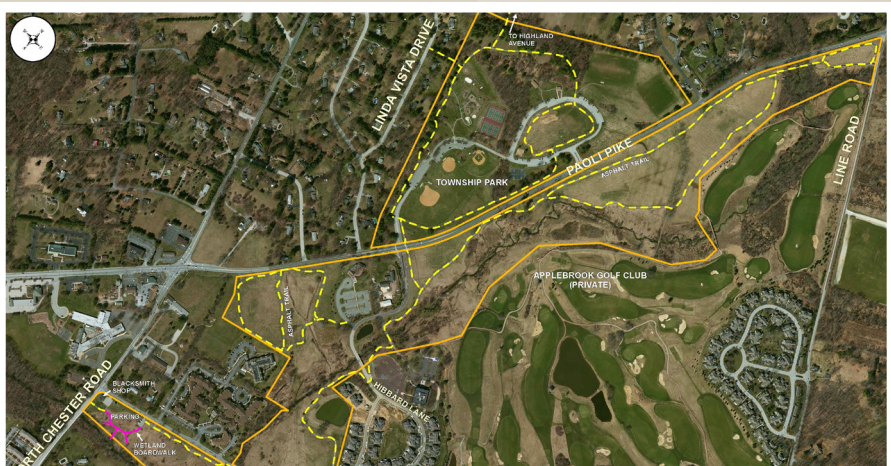
Homes close to protected open space usually show an increase in value compared to similar homes elsewhere. In the case of East Goshen Park, homes within a half mile were found to have nearly 35 percent increase in value due to that proximity. This added property value results in about \$320,000 increase in property tax revenue for the municipality.

It is worth noting that, despite some residual popular misconceptions, the presence of pedestrian trails connecting the park to abutting neighborhoods has enhanced, rather than diminished the value of these abutting properties.

## SPOTLIGHT

### Park Creation via Public/Private Partnership

The original section of the park north of Paoli Pike was purchased at a reduced price in the 1970s from the drug company that ultimately became Pfizer. The Applebrook section of the park was created during the development of the much larger, southern property once owned and managed by Pfizer as a research facility. As can be seen on the park map, that site was redeveloped into townhouses, a golf course, and the new park. This was a result of a proactive effort by the Township, which, upon learning it was to be sold, instigated a three-way investment partnership between itself, the golf course/townhouse developer, and a real estate investment trust interested in developing a portion for townhouses. East Goshen took on debt and purchased the portion of the property that became the park in 2000, with some financial assistance from Chester County.





## Chapter 3



# Environmental





Photo by Carol Slocum  
Hibernia Park





# Introduction

The natural resources associated with protected open space contribute many environmental benefits to Chester County.

This section draws on established research and new analyses to place a dollar value on several types of ecosystem services provided by protected open space: provision of water supply, water quality improvement, flood mitigation, wildlife habitat, air pollution removal, and carbon sequestration and storage. Together, these represent ecosystem functions that, if lost, would require costly measures to replicate.

In addition, protected open space helps mitigate stormwater impacts by reducing the volume of runoff created by storm events, and the associated pollutants that stormwater carries. This reduces the burden placed on communities and their stormwater infrastructure to manage the volume of runoff and pollutant loads, thereby avoiding both capital and long-term maintenance expenditures, as well as improving ecological habitats, recreational resources, and sources of current and future public water supplies. The analyses in this chapter estimate the value of these ecosystem functions and avoided stormwater impacts in the Brandywine Creek watershed.





# Methodology

## ECOSYSTEM SERVICES METHODOLOGY

Estimates in this section draw upon established research estimating the recurring value of the natural functions of water supply provision, water quality, flood mitigation, wildlife habitat, air pollution removal, and carbon sequestration, as well as the non-recurring value of carbon storage. The intensity and value of these functions, which are commonly referred to as “ecosystem services,” vary depending on the type of land cover present in a given area. Estimates of land cover variation on protected open space in Chester County were applied to the values associated with each of the ecosystem services to produce total value estimates. Dollar values, which have been adjusted for inflation to current (2018) dollar values, approximating the economic value of each of these services are based on peer-reviewed estimates of value on a per-acre basis.<sup>1</sup> These total value estimates represent the costs avoided by not having to artificially replicate the ecosystem services currently provided by protected open space in Chester County.

First, acreage of ecosystems within Chester County’s protected open space was determined using the land cover imagery from the US Department of the Interior’s Multi-Resolution Land Characteristics (MRLC) 2011 National Land Use Land Cover file. The acreage of each ecosystem type was used to calculate environmental services benefits using values from a 2006 study conducted by Costanza (see sidebar), which estimate the average value of 10 different ecosystem services.<sup>2</sup> The values provided by this study were used to calculate the total annual ecosystem service benefit provided by protected open space in Chester County.

The estimated benefits were derived by determining the acreage type for the ecosystem services, and multiplying the acreage by the ecosystem service benefit. Each ecosystem provides different ecosystem services and has associated value per acre, determined by the Costanza study, and applied to Chester County.

Next, Chester County Planning Commission’s protected open space GIS data was used to determine the environmental service benefits of protected open space based on land ownership.

The i-Tree Vue model developed by the U.S. Forest service was used to estimate the air pollution removal and carbon sequestration and storage benefits of the preserved open space. The model uses National Land Cover Datasets (NLCD) to estimate the amount of tree canopy and then uses pollution removal rates to estimate the total amount of pollutant removal that results from this canopy coverage. The i-Tree Vue model has the advantage of allowing for the adjustment of the per-acre pollution removal values. A range of pollution removal values from the academic literature as well as other similar studies was utilized to estimate the air pollution removal benefits of preserved open space. The resulting values for air pollution benefits reflect the amount society would have to pay in areas such as health care if trees did not remove these pollutants.

### Per-acre Value of Ecosystem Services

Costanza et al. (2006) compiled more than 100 academic studies that estimated the average per-acre value of more than 10 different ecosystem services. The analysis presented within this chapter draws upon this research, which is still the best analysis that is available. To ensure conservative estimates, this report does not include several ecosystem service benefits frequently quantified by Costanza and other experts including soil formation, pollination, and biological control benefits.



## STORMWATER MITIGATION METHODOLOGY

Stormwater runoff and pollutant load estimates were developed for this report by the Stroud Water Research Center using two models within Model My Watershed®, part of the WikiWatershed® suite of web tools for learning about and studying freshwater systems.<sup>3</sup> Because such data is derived from running watershed-based models, combined with project resource constraints, performing analyses across all watersheds that intersect the county is difficult. Therefore, this section focuses on the benefits of protected open space within Chester County's largest watershed, the Brandywine Creek watershed, covering 38 percent of the land area of the county, and including all or parts of 41 (56 percent) of the municipalities in the county (see Figure 3.1).

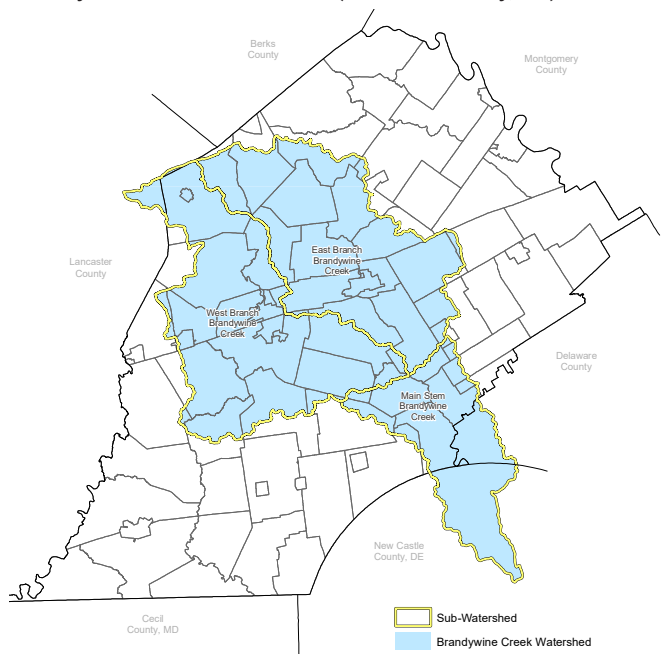
In addition to its large size, the Brandywine Creek watershed was selected for analyses because it encompasses a wide array of land cover patterns, including forests, agriculture, and residential and commercial uses (developed uses), as well as 57,244 acres of a variety of protected spaces (parks, preserved farmland, and land trust lands). Three modeling analyses for the watershed were performed to evaluate the benefits of preserved open space on the volume of runoff and pollutant loads: (1) a "Current Conditions" scenario that includes current Chester County protected open space and land cover; (2) a "Current Conditions with Agricultural Best Management Practices (BMPs)" scenario and (3) a "No Preservation" scenario. The "Current Conditions with Agricultural BMPs" scenario applied BMPs to the preserved agricultural lands within the protected open space parcels for the annual runoff volume and pollutant load modeling effort. This scenario was included because agricultural land preservation agreements typically require implementation of conservation and nutrient management plans. The "No Preservation" scenario assumed that the protected open space parcels in Chester County were developed to the

same extent and density as the remaining areas of their respective sub-watersheds.

The respective differences in results between each of the two "Current Conditions" scenarios and the "No Preservation" scenario represent the increase in runoff and pollutant loads that could be expected to occur if the open space protections had not been put in place. The "Current Conditions with Agricultural BMPs" and the "No Preservation" scenarios were compared for net change in annual pollutant loadings (total nitrogen, total phosphorus, and sediment) and volume of average annual runoff. The "Current Conditions" and the "No Preservation" scenarios were compared for net change in volume of runoff generated by a 2-year storm event. Only annual pollutant loads were calculated as they are typically used for water quality restoration efforts. A summary of the results of this analysis begins on page 62.

Further information on the stormwater mitigation methodology used and the findings presented in this section is available in Technical Appendix A, which is located at [chescoplanning.org](http://chescoplanning.org).

Figure 3.1  
**Brandywine Creek Watershed (Chester County, PA)**





# Summary of Environmental Benefits

The ecosystem services provided by Chester County's approximately 136,000 acres of protected open space impart significant economic benefits that are often overlooked. These ecosystem services include replenishing water supply, water quality improvement, mitigation of flooding and stormwater impacts, wildlife habitat, air pollution removal, and carbon sequestration and storage. It should be noted that some types of landscapes are more valuable than others for a particular type of benefit: air pollution removal and carbon sequestration are primarily a function of tree cover, and wetlands and riparian forests are major drivers of water supply, water quality, and flood mitigation benefits. Figure 3.2 shows the economic impact of these environmental benefits based on 2018 dollar value.



Nottingham Park Serpentine Barrens

Figure 3.2  
Total Environmental Benefits by Ecosystem Service

		Ecosystem Service	Total Benefit (\$ millions)
		Water Supply <sup>a</sup>	\$39.4/yr
		Water Quality <sup>a</sup>	\$8.20/yr
		Flood Mitigation <sup>a</sup>	\$18.3/yr
		Wildlife Habitat <sup>a</sup>	\$13.1/yr
		Air Pollution Removal <sup>a</sup>	\$13.5/yr
		Carbon Sequestration <sup>b</sup>	\$4.6/yr
		Carbon Storage <sup>b</sup>	\$120
Stormwater Mitigation		Capital Construction <sup>c</sup>	\$263
		Operations and Maintenance <sup>c</sup>	\$27/yr
		Pollutant Removal <sup>c</sup>	\$107/yr

Sources: Costanza (2006) <sup>a</sup>, i-Tree (2018) <sup>b</sup>, Technical Appendix A <sup>c</sup>





## WATER SUPPLY

### ECOSYSTEM SERVICE

The soil of undeveloped land absorbs water, replenishing streams, reservoirs, and aquifers. This natural system provides for the continuous recharge of Chester County's groundwater and streams. Were this ecosystem service to fail, water would have to be imported from elsewhere, or local water would have to be more extensively treated, both of which are costly endeavors.<sup>4</sup> Forests and wetlands are particularly productive land covers for water supply provision. The larger the forest or wetland, the greater the benefits derived.

Chester County realizes nearly \$40 million in annual cost savings from natural water supply services on protected open space. The cost savings is derived from an examination of the type of land cover, the type of open space preserved, and the value transfer methodology which assumes an estimated economic value associated with a particular landscape, and a per acre value associated with a particular ecosystem service.<sup>5</sup> Figure 3.3 shows the value of water supply services by category of protected open space ownership.



Chambers Lake

Figure 3.3  
**Annual Water Supply Benefit  
by Category of Protected Open Space**

Protected Open Space Category	Acres	Total Water Supply Benefit (\$ millions)
Federal	1,310	\$0.7
State	5,230	\$4.9
County	4,350	\$4.6
Municipal	12,140	\$3.9
Preserved Farmland	38,430	\$7.1
Privately Protected and Other	77,770	\$18.2
<b>Total</b>	<b>139,230*</b>	<b>\$39.4</b>

Source: Costanza et al (2006), Econsult Solutions, Inc.

\* Actual preserved land area is 136,015 acres



## WATER QUALITY

### ECOSYSTEM SERVICE

Natural landscapes, forests and wetlands in particular, provide a natural protective buffer between human activities and water supplies. This buffer prevents several types of contaminants, including pathogens, excess nutrients, metals, and sediments, from entering the water supply. Annually, Chester County receives \$8.2 million in economic benefit from the ability of protected open space to naturally enhance water quality. This service is driven largely by the proportion of forest, wetland, and riparian buffer on Chester County's protected open spaces. Without protected open space, residents, businesses, and industry would be forced to pay for alternative groundwater filtration or water treatment methods. Figure 3.4 shows the value of water quality services by category of protected open space.

Figure 3.4  
**Annual Water Quality Benefit  
by Category of Protected Open Space**

Protected Open Space Category	Acres	Total Water Quality Benefit (\$ millions)
Federal	1,310	\$0.20
State	5,230	\$0.70
County	4,350	\$0.60
Municipal	12,140	\$0.70
Preserved Farmland	38,430	\$2.80
Privately Protected and Other	77,770	\$3.20
<b>Total</b>	<b>139,230*</b>	<b>\$8.20</b>

Source: Costanza et al (2006), Econsult Solutions, Inc.

\* Actual preserved land area is 136,015 acres

## FLOOD MITIGATION

### ECOSYSTEM SERVICE

Many natural landscapes serve as a buffer protecting people and properties from destructive natural events, such as flooding. Protected open space helps to mitigate the risk of flood during storm events by slowing, trapping and absorbing floodwaters. Protection of floodplains and riparian corridors in open space provides room for flood waters to be conveyed safely, slowed and stored by natural systems. Were the county not provided with these natural services, residents, industry, businesses, and local governments would be forced to undertake costly measures to protect or recover their built environment from further damage as a result of flooding, such as constructing dams and levees, and relocating homes and businesses. The total annual benefit generated by natural flood mitigation services is equal to \$18.3 million. Figure 3.5 shows the value of flood mitigation by category of protected open space.

Figure 3.5  
**Annual Flood Mitigation Benefit  
by Category of Protected Open Space**

Protected Open Space Category	Acres	Total Flood Mitigation Benefit (\$ millions)
Federal	1,310	\$0.2
State	5,230	\$1.9
County	4,350	\$1.8
Municipal	12,140	\$2.4
Preserved Farmland	38,430	\$5.2
Privately Protected and Other	77,770	\$6.9
<b>Total</b>	<b>139,230*</b>	<b>\$18.3</b>

Source: Costanza et al (2006), Econsult Solutions, Inc.

\* Actual preserved land area is 136,015 acres



## WILDLIFE HABITAT

### ECOSYSTEM SERVICE

Chester County's protected open spaces serve as habitats for a diverse array of plants and animals, including several threatened and endangered species. Intact forests and wetlands harbor species that people value for both aesthetic and functional purposes. Values in this section estimate the amount of money that people would be willing to pay to preserve wildlife on protected open space in Chester County.

It is important to note that the value associated with wildlife habitat is of a different nature than the values associated with the other ecosystem services included in this section - it does not represent an avoided cost. To ensure a conservative valuation of the benefit derived from the preservation of wildlife habitat on protected open space, the estimates in this section are based on minimum willingness-to-pay values from the research literature.<sup>6</sup> An analysis using these values reveals that wildlife habitat on protected open space in Chester County has an estimated annual value of nearly \$13.1 million. Figure 3.6 shows the value of wildlife habitat by category of protected open space.



Photo by Carlos Alejandro  
Bobolink at Stroud Preserve

Figure 3.6  
**Annual Wildlife Habitat Benefit  
by Category of Protected Open Space**

Protected Open Space Category	Acres	Total Wildlife Habitat Benefit (\$ millions)
Federal	1,310	\$0.2
State	5,230	\$1.3
County	4,350	\$1.9
Municipal	12,140	\$1.2
Preserved Farmland	38,430	\$4.6
Privately Protected and Other	77,770	\$3.9
<b>Total</b>	<b>139,230<sup>*</sup></b>	<b>\$13.1</b>

Source: Costanza et al (2006), Econsult Solutions, Inc.

<sup>\*</sup> Actual preserved land area is 136,015 acres





## AIR POLLUTION REMOVAL

### ECOSYSTEM SERVICE

Poor air quality is common in many urban and suburban areas and can lead to a variety of human health problems, including asthma and other respiratory ailments. The pollutants that compromise air quality also can damage buildings and plants, cause smog, and disrupt the ecosystem. Trees mitigate significant amounts of air pollution through respiration processes that remove pollutants from the air. This naturally occurring air pollution removal process contributes to environmental quality and health. In order to calculate the benefit of each pollutant type, per-ton estimates were established.

An analysis of regional satellite imagery reveals that protected open space in Chester County contains more than 47,000 acres of tree canopy—about 35 percent of all protected open space. Figure 3.7 shows tree canopy acreage for each category of protected open space.

Figure 3.7  
**Acreage of Tree Canopy Cover  
by Category of Protected Open Space**

Protected Open Space Category	Acres	Acreage of Tree Canopy Cover
Federal	1,310	944
State	5,230	4,718
County	4,350	3,775
Municipal	12,140	6,134
Preserved Farmland	38,430	6,606
Privately Protected and Other	77,770	25,008
<b>Total</b>	<b>139,230*</b>	<b>47,185</b>

Source: i-Tree (2018), Econsult Solutions, Inc.

\* Actual preserved land area is 136,015 acres

Using this total tree canopy acreage and established estimates of the per-ton benefits of removing various airborne pollutants, it is estimated that trees on protected open space annually provide \$13.5 million in air pollution removal services in Chester County. Trees offer the ability to remove significant amounts of air pollution; therefore, if all this open space were developed, this is the sum that would have to be spent to maintain the current level of air quality.

This analysis includes benefits derived from the removal of five different pollutants: ozone (O3), particulate matter (PM-10), nitrogen dioxide (NO2), sulfur dioxide (SO2), and carbon monoxide (CO\*). Figure 3.8 shows the value generated for the removal of each pollutant.

Figure 3.8  
**Annual Air Pollution Removal Benefits  
by Type of Pollutant Removed**

Pollutant	\$/ton	Estimated Tons/Year	Total Air Pollution Removal Benefit (\$ millions/yr)
O3	\$10,212	766	\$7.8
PM-10	\$6,818	421	\$2.9
NO2	\$10,212	217	\$2.2
SO2	\$2,500	222	\$0.6
<b>Total</b>			<b>\$13.5</b>

Source: Costanza et al (2006), Econsult Solutions, Inc.

\* Benefits from CO removal were insignificant.



# CARBON SEQUESTRATION AND STORAGE

## ECOSYSTEM SERVICE

Trees mitigate the impacts of climate change by sequestering and storing atmospheric carbon from carbon dioxide. Carbon storage is an estimate of the total amount of carbon stored in the existing biomass of trees, both above and below ground. Given our deepening understanding of the true social costs of carbon, the scientific community's accepted monetary value of carbon sequestration and storage has increased significantly since the previous *Return on Environment* report was completed. The previous report used a value of \$21 per ton, whereas the accepted value now is \$71 per ton. Using this new value, it is estimated that trees on Chester County's protected open space store 1,684,940 tons of carbon, equating to \$120 million within existing biomass.<sup>7</sup> This value approximates the dollar value of damages associated with an increase in carbon emissions in a given year.<sup>8</sup> In other words, if the carbon currently stored in trees on protected open space were released into the air, it would cause damages that would cost \$120 million to mitigate. The storage of carbon in a tree represents a one-time benefit—the carbon is kept out of the atmosphere until the tree dies, therefore, the estimate of the value of stored carbon is not an annual measurement.

As a tree grows, it pulls carbon from the air through the process of photosynthesis. New growth on trees is responsible for carbon sequestration, which in contrast to the storage of carbon, is measured on an annual basis. Every year, new growth on the trees on protected open space in Chester County sequesters an additional \$4.6 million in carbon. This estimate accounts for the yearly release of stored carbon through the death and decay of trees. Like the carbon storage estimate, this estimate measures the monetary damages associated with each ton of carbon that is sequestered. Because this carbon is taken out of the air by trees on protected open space, these damages are avoided and produce a cost savings.

Figure 3.9 shows estimates of the tons of carbon annually sequestered and tons stored by trees for their lifetime on the protected open space in Chester County as well as the benefits derived from the storage and sequestration of carbon by these trees.

Figure 3.9

**Estimated Amounts of Annual Carbon Sequestration and Lifetime Carbon Storage and Associated Benefits**

	Tons	\$/Ton	Cost Savings (\$ millions)
Carbon Sequestration	64,198/yr	\$71	\$4.6/yr
Carbon Storage	1,684,940	\$71	\$120.0

Source: i-Tree (2018), Econsult Solutions, Inc.



Tree planting at wetlands in Embreeville.



## STORMWATER RUNOFF AND POLLUTION MITIGATION

### ECOSYSTEM SERVICE

Protected open space generates much less stormwater volume than unprotected lands and allows much less rainfall to reach streams as stormwater runoff, which helps to mitigate erosion and flooding. On average, parcels of protected open space have more tree canopy and vegetation and less impervious cover than unprotected lands. This additional vegetative and pervious cover enables these protected acres to better absorb rainfall for transpiration, evaporation, and infiltration into the ground, collectively leaving much less rainfall to become stormwater runoff. The vegetative cover also has few sources of pollutants, resulting in relatively small volumes of pollutant loads being carried to streams by stormwater runoff. These stormwater mitigation services result in much less overland flow of storm runoff, much smaller pollutant loads, and much less erosive energy than is generated by unprotected lands.

Storm runoff from unprotected lands contains pollutants, such as excess nitrogen, phosphorus and sediment (among others), which degrade water quality for humans for drinking and recreational uses, as well as degrading habitat for aquatic species. These pollutants are predominantly generated by human activities associated



with developed and agricultural lands. By generating less runoff and sources of pollutants, protected open space generates less nitrogen, phosphorus, and sediment than would be generated from these lands if they were unprotected from development. The modeling effort for the Brandywine Creek watershed demonstrated that if all of the county's protected open space in the watershed were developed at the same extent and density as nearby unprotected (developed) lands, and there were no protection requirements for implementation of conservation plans on the protected agricultural lands, the pollutant loadings of nitrogen, phosphorus and sediment in the Brandywine Creek watershed would increase significantly, as shown in Figure 3.10.<sup>9</sup> The increased pollutant loadings would require additional stormwater treatment infrastructure to be installed and maintained to reduce the pollutant loads to levels that would not impair the receiving streams.

Figure 3.10

**Avoided Increase in Annual Pollutant Loadings Due to Protected Open Space in the Brandywine Creek Watershed**

Pollutant	Total Avoided Annual Pollutant Loading	Total Avoided Annual Pollutant Loading Per Acre of Protected Open Space	Percent Increase in Pollutant Loadings—Protected Open Space vs Unprotected Lands
Total Nitrogen	198,000 lb per year	3.5 lb per acre per year	7.1%
Total Phosphorus	44,000 lb per year	0.8 lb per acre per year	31%
Sediment	62,510,000 lb per year	1,092 lb per acre per year	40%





In terms of runoff volumes, if all the county's protected open space within the Brandywine Creek watershed were developed at the same extent and density as nearby unprotected (developed) lands, along with no protection requirements for conservation plan implementation on protected agricultural lands, the annual volume of surface runoff would increase by nearly 2.1 billion gallons per year, or nearly 36,000 gallons per year for every acre of protected open space. This is an increase in runoff of 17 percent, given an average annual precipitation of 41.1 inches. To put this large amount of added runoff in perspective, the added runoff per year from the county's protected open space in the Brandywine Creek watershed, would be equivalent to 4.5 feet of water covering an area the size of the Borough of Downingtown (2.2 square miles). Likewise, it would fill nearly three Lincoln Financial Field stadiums (see Figure 3.11).<sup>10</sup>

The modeling results for annual runoff in the Brandywine Creek watershed also estimate that approximately 1.8 billion gallons of rainfall per year infiltrate into the groundwater as a result of the 57,244 acres of protected open space within the watershed in Chester County. This recharge equates to over 60 percent of the total estimated annual groundwater withdrawals from the Brandywine Creek watershed.<sup>11</sup> If the protected open space parcels were developed similar to surrounding areas, that recharge would be lost.

Pennsylvania Department of Environmental Protection requirements emphasize the need for stormwater infrastructure to be capable of managing the amount of runoff generated by a 24-hour storm with a recurrence interval of two years, otherwise known as the 2-year

storm. Over 95 percent of all rainfall events in Chester County result in rainfall depths equal to or less than the 2-year storm.<sup>12</sup> Runoff from larger storm events must also be managed, but for estimating economic benefits, this report focuses on the investment needed to manage the 2-year (and smaller, more frequent) storm events. The modeling effort treated the 2-year storm as generating 3.2 inches of rainfall over a 24 hour period.

If the Chester County protected open space acres within the watershed were developed to the extent and density typical of nearby unprotected (developed) lands, each 2-year storm would generate an additional 628 million gallons of stormwater runoff, an increase of 14 percent. This represents the volume of water not absorbed by transpiration, evaporation or groundwater recharge and instead running off the property and contributing to erosion and flooding. This added runoff can be visualized as the amount of water covering the entire area of the Borough of Downingtown with 1.5 feet of water after each 2-year storm, or the amount of water filling 85 percent of Lincoln Financial Field stadium for each storm.

On average, the absence of protected open space increases runoff by about 11,000 gallons per acre of protected open space for each 2-year storm event. Figure 3.11 summarizes the increase in volume of runoff without protected open space for average annual runoff and for the 2-year storm event and represents the investment that would be required to install and maintain stormwater management infrastructure if these lands were unprotected and subject to development.

Figure 3.11

**Avoided Increase in Annual Stormwater Runoff Due to Protected Open Space in the Brandywine Creek Watershed**

	<b>Total Avoided Stormwater Volume</b>	<b>Avoided Runoff Per Acre of Protected Open Space</b>	<b>Percent Increase In Stormwater Volume—Protected Open Space vs Unprotected Lands</b>
Average Annual Runoff (41.1 inches/yr)	2.1 billion gallons per year	36,000 gallons per acre per year	17%
2-Year Storm Event Runoff (3.2 inches/24-hours)	628 million gallons per storm event	11,000 gallons per acre per storm event	14%



## ECONOMIC BENEFITS OF STORMWATER MITIGATION

An increase in runoff and pollutant loads would require additional investment in infrastructure to manage the increased stormwater. Estimates of capital costs and accompanying annual operation and maintenance costs for the construction of the additional infrastructure required to manage the increased runoff of 2-year storm events, as well as annual cost for removal of stormwater pollutant loadings were developed based on existing research publications.<sup>13</sup> The results concluded that protected open space avoids \$263 million of capital cost for stormwater infrastructure construction, plus an additional annual investment of \$27 million to operate and maintain (O&M) this additional infrastructure, and an additional annual investment of \$107 million needed to remove annual pollutant loadings. Thus, protected open space, on average, avoids \$4,600 per acre of stormwater infrastructure construction costs, \$479 per acre per year of annual operations and maintenance costs, and \$1,870 per acre per year of annual pollutant load reduction costs, the latter two costs often being the responsibility of the municipality.

Cost estimates for these stormwater mitigation services can vary widely; however it is likely that the economic benefits presented here are conservative and actual avoided costs may be more. The economic benefits of the stormwater mitigation services provided by protected open space in the Brandywine Creek watershed are summarized in Figures 3.12 and 3.13.<sup>14</sup>

Figure 3.12

**Avoided Costs of Construction and Annual O&M to Manage 2-Year Storm Runoff Due to Protected Open Space in the Brandywine Creek Watershed**

Avoided Capital Costs for Construction of Infrastructure for 2-Year Storm Runoff	Avoided Annual Costs for Operation & Maintenance of Infrastructure for 2-Year Storm Runoff
\$0.42 per gallon runoff	\$0.04 per gallon runoff
\$263 million total capital cost	\$27 million per year O&M cost
\$4,600 per acre of protected open space	\$479 per year per acre of protected open space

Figure 3.13

**Avoided Costs of Removal of Annual Stormwater Pollutant Loads Due to Protected Open Space in the Brandywine Creek Watershed**

Pollutant	Total Avoided Annual Pollutant Load (lb/yr)	Total Avoided Annual Pollution Reduction Cost (\$/yr)	Average Annual Avoided Cost per Year per Acre of Protected Open Space (\$)
Total Nitrogen	198,000	\$923,500	\$16
Total Phosphorus	44,000	\$14.7 million	\$256
Sediment	62.5 million	\$91.4 million	\$1,595
<b>Total</b>	<b>–</b>	<b>\$107 million</b>	<b>\$1,870</b>



# Conclusion

The natural landscapes on protected open space provide valuable services, helping to avoid significant expense if these naturally occurring processes needed to be replaced. Protected open space is often attributed as an asset that helps define the quality of place in Chester County, but recognizing the value of environmental benefits provided and avoided costs is just as significant.

## Endnotes

- 
- <sup>1</sup> Inflation to 2018 dollars was calculated using the BLS CPI Inflation Calculator. Mean estimates are presented in this section of the report.
- <sup>2</sup> The 2006 study by Constanza, et al. is the most recent and applicable study for the purposes of this report.
- <sup>3</sup> An explanation of estimates and the methodologies used in calculating them is available in Technical Appendix A, which is located at [chescoplanning.org](http://chescoplanning.org).
- <sup>4</sup> Costanza, R., Wilson, M., Troy, A., Voinov, A., Liu, S., & D'Agostino, J. *The Value of New Jersey's Ecosystem Services and Natural Capital*. New Jersey Department of Environmental Protection, Division of Science, Research, and Technology, 2006.
- <sup>5</sup> Delaware Valley Regional Planning Commission. *The Economic Value of Protected Open Space in Southeastern Pennsylvania, Technical Appendix B*, 2010.
- <sup>6</sup> Loomis, J. *Updated Outdoor Recreation Use Values on National Forests and Other Public Lands*. Report Number PNW-GTR-658, U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR, 2005.
- <sup>7</sup> Nowak, D. J., Crane, D. E., & Stevens, J. C. Air Pollution Removal by Urban Trees and Shrubs in the United States. *Urban Forestry and Greening*, (2006), 4, 115-123.
- <sup>8</sup> U.S. Department of Energy. *Final Rule Technical Support Document (TSD): Energy Efficiency Program for Commercial and Industrial Equipment: Small Electric Motors*, 2010.
- <sup>9</sup> Model calculations are available in Technical Appendix A.
- <sup>10</sup> Stormwater runoff calculations are available in Technical Appendix A.
- <sup>11</sup> Chester County Water Resources Authority. Chester County Water Resources Compendium, Part 2, 2001.
- <sup>12</sup> Chester County Water Resources Authority, 2001.
- <sup>13</sup> See Technical Appendix A for more information about estimates related to capital costs and operation and maintenance costs.
- <sup>14</sup> See Technical Appendix A.





# Case Study

## Rushton Woods Preserve and Farm

**Location:** 911 Delchester Road, Newtown Square, PA

**Size:** 86 acres of woodlands, meadows, and cultivated fields, including 2 miles of public trails

**Owner/operator:** The Willistown Conservation Trust

### Introduction

The acquisition and creation of this 86-acre property in Willistown Township has been one of the most important projects the Willistown Conservation Trust has undertaken in terms of natural and scenic resources conserved and public benefits offered. Rushton Woods Preserve is also home to the Trust's Community Farm Program and Rushton Farm CSA, whose mission is to model sustainable agricultural practices and promote the values of open space and natural resource protection to a broader community.

### Environmental Benefits

Willistown Conservation Trust is recognized nationally as a leader in the field of agroecology (the study of interactions between plants, animals, humans, and the environment within agricultural systems), and uses conserved lands to test and measure high-yield sustainable farming practices designed to benefit the surrounding ecosystem. The Rushton Woods Preserve and Farm demonstrates how sustainable agriculture and protected natural areas can enjoy mutual benefits while also providing significant ecosystem services advantages. Environmental services benefits afforded by conserved lands can be measured annually in terms of the cost to provide such services if protected open spaces like Rushton were to be lost to development. The value of environmental benefits attributable to Rushton Woods Preserve total over

*"70 different species of birds were banded and over 1,000 types of insects were identified at Rushton Woods Preserve in 2018"*

– Willistown Conservation Trust Bird Conservation and Agro-Ecology staff

\$208,000 per year, and include cost savings related to water supply, water quality, flood mitigation, provision of wildlife habitat, air pollution control, and carbon sequestration and storage. An estimated 72 tons of carbon are removed from the atmosphere annually by the natural resources at Rushton, and over 1,800 tons of carbon is stored within the Preserve.





# Case Study

## Lands Preserved by Homeowners Associations

**Location:** Throughout Chester County

**Total Acreage:** Approximately 16,300 acres, or about 12 percent of all preserved open space

### Introduction

Many municipal ordinances require new residential developments to reserve a portion of land for protected open space. Protected open space owned and maintained by Homeowners Associations (HOA) can provide additional value for residents through trails, playgrounds and protection of sensitive environmental features like forests and stream corridors. It also can serve more utilitarian functions like stormwater management or buffering from adjacent uses.

## SPOTLIGHT

### Applecross

The Applecross development is located in Guthriesville in East Brandywine Township within an area growing in popularity due in part to its location within the acclaimed Downingtown School District. This 650-home development features a golf course, country club with pool, and 3.5 miles of publicly accessible paved trail within its HOA-owned and operated protected open space. Easily accessible through residents' backyards or by sidewalk, the trail is one of the most well-used amenities within the development and is planned to serve as part of a larger trail that will connect regional recreation amenities. Additionally, the HOA open space is contiguous with land owned by the Chester County Water Resources Authority and the development's golf course, which enhances the scenic character of the development.

## SPOTLIGHT

### The Knolls of Birmingham

Since 2011, the Home Owner's Association of The Knolls of Birmingham development in Birmingham Township has taken a proactive role in stewarding 50+ acres of preserved land within the development. In partnership with the Brandywine Conservancy, volunteers planted and continue to maintain over 1,500 trees and shrubs along the Radley Run, which flows through the development. This planting improves water quality, beautifies the landscape, and provides screening between homes and the development's popular trail network. In the future, the HOA is interested in converting some of its mowed landscape to wildflower meadows to attract pollinators and discourage geese around their stormwater basins to further enhance the protected open space's ecological value.



Before



After





Photo by Hannah Christopher  
Anson B. Nixon Park



## Chapter 4



# Recreation and Health





East Goshen Township Park





# Introduction

Protected open space in Chester County provides a multitude of free and low-cost recreational activities to residents.

Many of these activities consist of strenuous or moderate exercise, which contributes to physical well-being and defrays health care costs. Those who are physically active are not the only ones who derive benefits from protected open space-employers whose employees are healthier have lower health care costs, see fewer workers compensation claims, and have lower rates of absenteeism and presenteeism (coming to work while sick or injured).

This section estimates the economic value that residents capture from the use of protected open space, analyzing both the value users would be willing to pay to participate in recreational activities on protected open space as well as the economic value of avoided health care costs as a result of users' participation in strenuous and moderate exercise.





# Methodology

## RECREATION METHODOLOGY

This analysis focuses on publicly owned parks as a location for recreational activity.

A willingness to pay method was used to estimate the value of recreational protected open space in Chester County (see sidebar). This rough form of estimation seeks to quantify the amount an average consumer would be willing to pay for a service (using protected open space in Chester County for recreation) if the service were not publicly available. The analysis uses survey data collected by the Pennsylvania Department of Conservation and Natural Resources (DCNR) in 2014, which asked Pennsylvanians about the frequency in which they participated in various outdoor activities on protected open space. The resultant response rate was applied to the percentage of residents recreating in Chester County in 2018. The average frequency is then applied to the number of households in Chester County to determine the amount of times residents participate in outdoor activities on protected open space. This frequency was multiplied against a monetary amount people reported being willing to pay for different activities, producing an estimate for the economic value of protected open space in Chester County.<sup>7</sup>

The DCNR survey provided information on the category of protected open space (local, county, state, federal, or private/other) people used for recreation. This analysis primarily focuses on publicly owned parks as a location for recreational activity; however, a limited amount of survey respondents accounted for their recreational activity on private protected open space lands, as determined by the respondents themselves. In addition, on preserved farmland public access is rarely allowed and as for conservation areas, limited data is available regarding the nature of the recreational activity that takes place there.

It is important to note that the total values presented in this section estimate the value that residents derive from recreational activity on Chester County's public parks. If all of these spaces were to be developed, it is likely that residents would go elsewhere to recreate and thereby replace some of the value they currently derive from recreational activity on public parks.

### Willingness to Pay

The estimates in this section are based on research evaluating the average consumer's willingness to pay for a service or activity. These willingness-to-pay values are not based on actual transactions—they estimate the amount of money the average consumer would be willing to pay for a service or activity if it were not provided by protected open space. As such, the values in this section should not be understood as income, but as a benefit enjoyed as a result of the free or low-cost recreational opportunities provided by protected open space.



## HEALTH METHODOLOGY

Engaging in physical activity is associated with multiple health benefits, and this study seeks to quantify those benefits derived from engaging in physical activity on Chester County's protected open spaces. First, the number of working age adults in Chester County was determined using the 5-year population estimates from the U.S. Census Bureau's American Community Survey. Then this number was adjusted proportionally using data from the 2014 DCNR survey showing the number of working age people in Chester County who exercise at parks or trails in Chester County. Physically active, in this case, is defined as individuals who engage in at least a half-hour session of moderate to strenuous exercise three times per week.

Next, the benefits were divided into five categories of cost savings:

1. **Direct medical savings.** Costs saved on the treatment of illness or medical conditions caused or exacerbated by physical inactivity
2. **Indirect medical savings.** Costs saved on adverse health conditions and poor quality of life resulting from physical inactivity
3. **Direct workers' compensation savings.** The amount employers save in compensation costs due to physically active employees having fewer accidents at work
4. **Indirect workers compensation savings.** The amount employers save in reduced administrative costs due to their physically active employees submitting fewer compensation claims
5. **Lost productivity savings.** The amount saved due to less employee absenteeism (employees not coming to work because they are sick) and presenteeism (employees coming to work sick or tired, making them less productive)



*West Goshen Township Park*



# Recreation and Health Benefits

## RECREATION BENEFITS

Over \$120 million in benefits accrue annually to residents who participate in recreational activities on protected open space in Chester County. This value represents the additional amount of money that the residents would be willing to spend in the private market to participate in the recreational activities they currently enjoy on protected open space. Figure 4.1 shows the recreational value by category of protected open space. The values were derived from calculations using average willingness-to-pay values, estimates of total outdoor recreational activities per year, and estimates of how frequently residents visit different categories of protected open space to participate in recreational activities.

The \$123.7 million annual value of recreational activity on protected open space is the equivalent of \$656 per household, per year. This value represents how much the average household would be willing to pay in the private market to participate in the recreational activities its members now enjoy on protected open space.



Marsh Creek State Park

Figure 4.1  
**Total Economic Value of Recreational Activity on Protected Open Space by Category**

Protected Open Space Category	Total Benefit (\$ millions/year)
Federal	\$15.0
State	\$49.9
County	\$42.4
Local/Municipal	\$10.9
Other/Private	\$5.4
<b>Total</b>	<b>\$123.7</b>

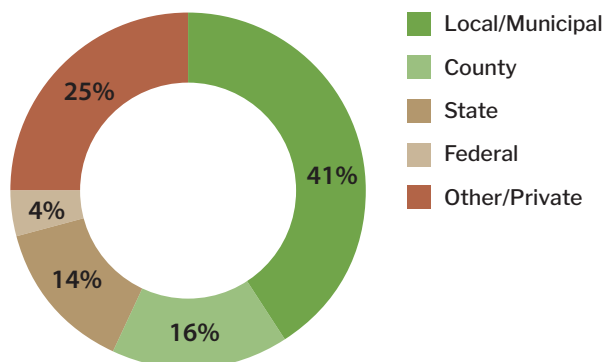




Estimates of the number of yearly outdoor recreational activities in the five-county region are based on response data from the 2014 Outdoor Recreation in Pennsylvania Resident survey conducted on behalf of the Pennsylvania Department of Conservation and Natural Resources (DCNR). This survey found that the average household in Pennsylvania participates in outdoor activities about 23 times per year. Multiplying this number by the most recent count of households in Chester County (188,631), results in 4,281,817 million instances of outdoor recreation in Chester County per year.<sup>2</sup> This estimate is likely conservative; Chester County is consistently ranked the healthiest county in Pennsylvania by the Robert Wood Johnson Foundation, so it would stand that Chester County households recreate outdoors at a higher frequency than the state average.

The DCNR survey asked respondents to indicate what categories of protected open space they visited when participating in recreation activities: federal, state, county, local/municipal, and other/private. This data was used to estimate the proportionate breakdown of recreational activity in Chester County by category of protected open space, as demonstrated in Figure 4.2.

Figure 4.2  
**Location of Outdoor Recreation Time**



Source: DCNR 2014 Outdoor Recreation in Pennsylvania Resident Survey, Econsult Solutions, Inc.

## HEALTH BENEFITS

It is well documented that engaging in moderate and strenuous activity contributes to physical well-being and reduces the risk of health problems. Physically active people typically enjoy a variety of health benefits, including lower incidence of cardiovascular diseases, diabetes, depression, certain cancers, and obesity.<sup>3</sup> This section estimates the health-related cost savings that result from the physical activity that residents engage in on Chester County's protected open space. In total, this physical activity results in avoided costs totaling \$324.6 million per year. This figure includes avoided medical costs, workers' compensation costs, and costs related to lost productivity (see Figure 4.3). These impacts, in turn, translate to lower insurance costs and improved productivity.<sup>4</sup>

Research has established the link between physical inactivity and demand for health care and demonstrated that there is a positive relationship between the number of recreational opportunities available to an individual and the frequency of his or her participation in physical activity.<sup>5</sup> Following this logic, it is likely that the opportunities to engage in physical activity made available by Chester County's protected open spaces have a positive impact on residents' physical health.

Individuals who engage in at least one half-hour of moderate or strenuous exercise three or more times a week are considered to be physically active. According to an analysis of regional responses to the 2014 Outdoor Recreation in Pennsylvania Resident Survey, approximately 105,000 Chester County residents met these criteria. The 2014 Outdoor Recreation Survey indicates that, on average, 41 percent of moderate or strenuous physical activity in Chester County is performed in a park or on a trail. According to the 2012-2016 US Census five year American Community Survey, the total number of residents in Chester County who are of working age (20 to 65 years old), is 302,097. The estimates that follow apply this percentage (41 percent)



to determine the amount of health care and labor cost savings attributable to moderate or strenuous physical activity on protected open space. These statistics were used as the basis for estimating the medical costs, workers' compensation costs, and lost productivity costs that are avoided as a result of all physical activity in Chester County.

Figure 4.3  
**Total Health-Related Cost Savings**

Savings Type	Cost Savings (\$ millions/year)
Direct Medical Cost Savings	\$42.9
Indirect Medical Cost Savings	\$128.7
Direct Workers' Comp Savings	\$0.5
Indirect Workers' Comp Savings	\$2.2
Lost Productivity	\$150.3
<b>Total</b>	<b>\$324.6</b>

Sources: Chenoweth and Bortz, 2005; PA Outdoor Recreation survey (2014); Econsult calculations.

### Medical Cost Savings

Direct medical costs are those costs incurred for treatment of illnesses or medical conditions caused and/or exacerbated by physical inactivity. These costs cover preventive, diagnostic, and treatment services administered at hospitals and in other medical facilities. Illnesses linked in part to physical inactivity include cardiovascular diseases, diabetes, depression, and certain cancers. Obesity has also been connected with physical inactivity. Using inflation-adjusted estimates of average per-capita annual savings in direct medical costs, it is estimated that Chester County avoids a total of \$42.9 million per year in direct medical cost.<sup>6</sup>

Indirect medical costs estimate the impact that adverse health conditions resulting from physical inactivity have on an individual's quality of life. These costs place a dollar value on pain and suffering associated with medical conditions linked to physical inactivity, reduction in quality of life, and shorter life expectancy attributable to physical inactivity. Existing research approximates the ratio of indirect medical costs to direct medical costs at 3:1.<sup>7</sup> Using this ratio, the estimated savings in indirect medical costs amount to \$128.7 million per year.

Together, avoided direct and indirect medical costs produce savings of \$171.6 million per year.



### Workers' Compensation Cost Savings

Research indicates that physical inactivity leads to an increased risk of suffering strains and sprains and prolongs the recovery period from injury.<sup>8</sup> When individuals incur injuries at the workplace, they can be eligible to collect workers' compensation payments. This same research estimates the average per-worker cost of workers' compensation payments as a result of physical inactivity to be between \$6 and \$12.<sup>9</sup> Using a median per-worker estimate based upon number of people who meet the criteria for performing moderate/strenuous exercise as previously described, it is estimated that workers who participate in physical activity on protected open space in Chester County are responsible for \$500,000 in avoided direct workers' compensation costs. Because employers pay private insurers to cover workers' compensation benefits, these insurance companies are likely the primary beneficiaries of avoided workers' compensation costs, with employers likely benefiting through foregone rate increases.

Indirect workers' compensation costs are administrative costs that an employer incurs due to workers' compensation claims. Research estimates that the relationship between these costs and direct workers' compensation costs is 4:1.<sup>10</sup> Using this ratio, it is estimated that employers avoided \$2.2 million in indirect workers' compensation costs as a result of the physical activities their employees participated in on protected open space in Chester County.

### Lost Productivity Cost Savings

Direct costs to businesses as a result of lost productivity are a significant contributor to overall costs of physical inactivity. Research describes lost productivity as occurring in two ways: through absenteeism, defined as, "not being present or attending to duty or work" and "presenteeism," defined as "being at work when you should be at home, either because you are ill or because you are too tired to be effective."<sup>11</sup> The cost data are presented in terms of the annual average costs per person of physical inactivity, approximately (\$2,716) per employed individual. Whereas, the lost productivity costs were based upon the median income of about \$89,000 in the study area, the number of workers in the study area (302,097) and average hours lost due to physical inactivity, which is approximately 3 percent of workload.<sup>12</sup> Using a per-worker annual lost productivity cost estimate, it is estimated that businesses in Chester County avoid \$150.3 million in costs per year as a result of the physical activities their employees engage in on protected open space in the county.





# Conclusion

Access to protected open space, trails, and local parks supports the local economy by providing healthy environments for people to recreate and increase their general well-being. In turn, those individuals who are physically active support the economy through avoided health care costs.

### Endnotes

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<sup>1</sup>Loomis, 2005.

<sup>2</sup>American Community Survey, 2013-2017.

<sup>3</sup>Cohen, D., Williamson, S., & McKenzie, T. L. *Park Use and Physical Activity in a Sample of Public Parks in the City of Los Angeles*. The Rand Corporation, 2006.

<sup>4</sup>Figure based on mean estimates of the costs of physical inactivity.

<sup>5</sup>Rosenberger, R. S., Sneh, Y., Phipps, T. T., & Gurvitch, R. A Spatial Analysis of Linkages between Health Care Expenditures, Physical Inactivity, Obesity, and Recreation Supply. *Journal of Leisure Research*, (2005) 317 (2), 216-235.

<sup>6</sup>Chenoweth, D. *The Economic Costs of Physical Inactivity, Obesity, and Overweight in California Adults: Health Care, Workers' Compensation, and Lost Productivity*. California Department of Health Services, Public Health Institute, Sacramento, CA, 2005.

<sup>7</sup>Chenoweth, 2005.

<sup>8</sup>Chenoweth, D., & Bortz, W. M. *Physical Inactivity Cost Calculator: How the Physical Inactivity Cost Calculator Was Developed*. East Carolina University, College of Health and Human Performance, Department of Health Education and Promotion, Greenville, NC, 2005.

<sup>9</sup>Chenoweth & Bortz, 2005.

<sup>10</sup>Chenoweth, 2005.

<sup>11</sup>US Census, ACS 2012-2016 estimates.

<sup>12</sup>US Census, ACS 2012-2016 estimates.  
Chenoweth & Bortz, 2005.



# Case Study

## Anson B. Nixon Park

**Location:** Kennett Square  
Borough and Kennett Township,  
Chester County, PA

**Size and Amenities:** 106 acres  
comprised of protected open  
space, walking trails, wooded  
trails, ponds, basketball,  
volleyball and tennis courts,  
athletic fields, a dog park,  
18 hole disc golf course, 3  
playgrounds, a bandstand,  
picnic pavilions, and more.

**Owner/operator:** The Kennett  
Area Park Authority Board  
(KAPA)

### Introduction

Anson B. Nixon Park is comprised of 106 acres that provide protected open space for passive and active recreation. The Park serves as a "backyard" for the neighboring community that brings together diverse populations for programming and as a hub for the Kennett Greenway. It provides a multitude of community amenities, serving as an outdoor resource to local programs and nonprofit activities, and boasts two ponds, meandering streams and over three miles of hiking and walking trails connected to the Kennett Greenway.

The park is funded primarily from grants, community donations, corporate partners, and the Borough and Township. It is free to the public from sunrise to sunset every day of the year.

### Recreation and Health

Anson B. Nixon Park receives over 170,000 visitors annually, attracted by the walking trails, playground areas, and safe opportunities to get outdoors and be active. "My children always love visiting Anson Nixon Park. . ." (Source: Trip Advisor) "They have something for everyone, from the family dog to grandparents as well." (Source: Google Review)

The park provides significant recreation benefits to users. Each year \$1.53 million accrue to users of the park as a result of not having to recreate elsewhere. As a resource for exercising, sports, socializing, and simply retreating from day-to-day demands, the park's value to the quality of life of its users and those living around it manifests in the aforementioned savings.

### Property Values

Research shows that having a park within walking distances of housing boosts property values. In addition to boosting residential property values, businesses located near multiuse trails, such as Trek Bicycles in Exton or Lowe Riders in Downingtown which are both located along the Chester Valley Trail (CVT) promote their trailside location. Similarly, the Kennett Greenway that connects with Anson B. Nixon Park, can be marketed as an asset to businesses located along the greenway and the park. The park is responsible for adding \$28.6 million to the value of homes within a half-mile of the park, or approximately \$45,000 in value per home, making it a valuable amenity for residents and visitors.





# Case Study

## Multiuse Trails in Chester County

**Location:** Throughout  
Chester County

**Mileage:** 35 miles of networked  
regional multiuse trails

**Owner/operator:** The County  
of Chester, various municipal  
governments and partner  
organizations

### Introduction

Multiuse trails are paved paths separated from vehicular traffic that are wide enough to accommodate pedestrians and cyclists. These trails are envisioned to form an interconnected network for recreation and transportation. Chester County has taken the lead on developing the network's major spine trails such as the 14 mile Chester Valley Trail (CVT), and many municipalities have begun to develop trails to connect their communities to these spine trails. The East Branch Brandywine Trail, a 2.5 mile trail along the Brandywine Creek, is an example of such a trail.

### Recreation and Health

Multiuse trails are cherished amenities in Chester County communities and offer safe opportunities to get outdoors and be active. DVRPC's most recent trail user counts (October 2018) for the CVT show an average daily use of 524 cyclists and 322 pedestrians per day, which equates to over 309,000 users per year. According to the "Willingness to Pay" methodology discussed on page 40, the estimated economic value of this trail to its users is \$2.96 million annually. According to trail counts conducted by DVRPC in October 2018, the East Branch Brandywine Trail receives an average of 84 cyclists and 273 pedestrians per day for a total annual usage of 130,000. The estimated economic value of this trail to its users is \$1.28 million annually.

### Property Values

Well-maintained multiuse trails like the Chester Valley Trail can enhance residential property values- sometimes significantly. According to an analysis of real estate sales within a quarter mile of the trail, proximity to the Chester Valley Trail equates to an average increase in property value of \$20,499 per home. In addition to boosting residential property values, businesses located near multiuse trails often promote their trailside location to recruit new employees looking for commuting alternatives, and businesses choose to locate in communities that offer amenities such as parks in order to attract and retain workers. For example, in the Valley Creek Office Complex in West Whiteland Township, both Analytical Graphics Inc. (AGI) and HomeNet Automotive use the trails as part of their HR package and discuss the CVT as an amenity which they have direct access to, with a trailhead adjacent to their office space.





## Chapter 5



# Economic Activity





Photo by Mark Williams  
Bryn Coed





# Introduction

Chester County's protected open space drives a significant amount of economic activity.

This section estimates both the annual economic and fiscal impacts associated with three types of economic generators:

1. Agricultural activities occurring on **protected farmland**
2. Management and maintenance expenditures at **public parks** (federal, state, county, and municipal)
3. Expenditures associated with **protected open space tourism**

Economic impact is measured in terms of expenditures, employment, earnings, and tax revenues. In addition to the three types of economic generators related to protected open space, this chapter includes an analysis of the impact that those economic activities have upon state and local tax revenue.





# Methodology

This economic impact analysis takes into account direct, indirect, and induced economic activity. **Direct economic activity**—such as the sale of crops grown on protected farmland—takes place on protected open space itself. **Indirect economic activity** arises from all intermediate rounds of production in the supply of goods and services. For example, economic activity on private farmland supports various contractors, who have to make their own purchases of materials from suppliers, who thereby indirectly benefit from economic activity on protected open space. **Induced economic activity**, on the other hand, measures the impact of the spending of wages generated by the direct activities as well as by the indirect activities of supplying firms. For example, workers on protected farmland will spend their earnings on various items, such as food, clothing, and housing. State and local economic impact, in the form of the sum of direct, indirect, and induced expenditures, and of the employment and earnings supported by that composition and scale of total expenditures, were estimated by utilizing an economic impact model developed by Econsult Solutions which incorporates data from the U.S. Department of Commerce's Bureau of Economic Analysis.<sup>7</sup>

Taking these types of impact into account, estimates of total economic and fiscal values were calculated for the three distinct types of economic generators: agricultural activities on protected farmland, management and maintenance expenditures at public parks, and protected open space tourism. The results and methodology used to calculate the economic impact of each of these elements follows.

## AGRICULTURAL ACTIVITY OCCURRING ON PROTECTED FARMLAND METHODOLOGY

Three pieces of information are used to estimate the direct, indirect, and induced economic impact of agricultural activity on protected open space:

1. **Total sales by commodity type in Chester County.** This data was obtained from the 2012 Agricultural Census.
2. **Total acres of protected farmland in Chester County.** County GIS data shows preserved farmland occupies 42,660 acres.
3. **Revenue from agricultural commodities produced on farmland in Chester County.** Using the proportion of agricultural commodities by revenue per acre of protected farmland, a calculation produced the estimated revenues.



## MANAGEMENT AND MAINTENANCE EXPENDITURES AT PUBLIC PARKS METHODOLOGY

Public parks make up about 10 percent of the protected open space in Chester County (approximately 14,000 acres). Economic activity on this land results from management and maintenance expenditures of these federal, state, county, and municipally-owned parks. Using calculated expenditures for federal, state, and municipal parks, a combined expenditure number was derived that was applied to all public park acres in Chester County.

**Federal Park Expenditures.** The budget for Hopewell Furnace National Historic Site was used to estimate a per-acre maintenance and management expenditure that was then applied to approximately 1,300 acres of federally-controlled parkland in Chester County.

**State Park Expenditures.** The average expenditures per acre were estimated using the state park budget from the 2017-2018 Governor's Executive Budget, excluding a proportional amount based upon the acreage of State Game lands which were extracted from the state park category. The state park budget data is applied to acreage associated with Marsh Creek and White Clay Creek State Park, which totals approximately 3,799 acres.

**County Park Expenditures.** Parks and Recreation expenditures from Chester County's budget was used to determine county park expenditures.

**Municipal Park Expenditures.** For local parks, annual expenditures for park maintenance were identified by studying townships with park space greater than 200 acres.



## EXPENDITURES ASSOCIATED WITH OPEN SPACE TOURISM METHODOLOGY

To calculate the direct, indirect and induced economic impacts of tourism spending attributable to protected open space in Chester County, data from the 2015 and 2016 Economic Impact of Travel and Tourism in Pennsylvania report was used.<sup>2</sup> Traveler spending associated with recreation in Chester County was used to determine direct economic impacts through a conservative calculation estimating that two percent of tourism activity was attributable to protected open space. Not all spending associated with protected open space is for recreation only: for example a tourist visiting a Chester County park may go to a restaurant nearby and the server from that restaurant will spend money in the local economy, accounting for indirect and induced economic impacts. Utilizing the 2015 and 2016 Travel and Tourism data for associated spending and a conservative two percent estimate as well, the direct and induced economic impacts of protected open space were identified.

## TAX REVENUES GENERATED BY PROTECTED OPEN SPACE METHODOLOGY

State and local economic impact, in the form of the sum of direct, indirect, and induced expenditures, and of the employment and earnings supported by that composition and scale of total expenditures, were used by Econsult to develop a fiscal impact model to generate detailed estimates of the increases in state and local tax collections that result from these expenditures, employment, and earnings. The local economic impact data was based off of modeling that integrated U.S. Census Bureau County Business Patterns to produce estimates relating to employment, earnings and income taxes by county. Pennsylvania business and sales taxes estimates were based on recent data of average sales tax base per employee by major industry utilizing data from the Pennsylvania Department of Revenue.<sup>3</sup>





# Economic Impacts

## AGRICULTURAL ACTIVITY ON PRIVATELY OWNED PROTECTED OPEN SPACE

### Annual Expenditures

Direct expenditures for protected farmland include expenses for goods and services farms incur to produce their farm products, and indirect and induced expenditures occur off of the farm as a result of the farm's spending on goods and services as well as wages for its employees.

Annually, farmers of protected farmland put about \$135 million back into the economy.

Direct Expenditures	\$95M
Indirect and Induced Expenditures	\$40M
<b>Total</b>	<b>\$135M</b>

### Annual Employment

Agricultural jobs associated with protected farmland make up almost 49 percent of employment related to protected open space in Chester County, totaling 880 jobs. This total estimate comprises primarily direct employment related to agricultural activity on protected farmland, and a limited amount of indirect employment related to agricultural activity on protected farmland.

Direct Employment	640
Indirect and Induced Employment	240
<b>Total</b>	<b>880</b>

### Annual Salaries

Salaries paid to workers in jobs related to the agricultural activity that take place on protected farmland total approximately \$29 million per year.

Direct Salaries	\$16M
Indirect and Induced Salaries	\$13M
<b>Total</b>	<b>\$29M</b>

Chester County's largest agricultural sector is mushroom farming, which, while it does not generally occur on preserved farmland, does rely upon inputs from many farms that are in farmland preservation. To more accurately reflect the estimated revenues produced by preserved farmland in Chester County, mushrooms have been excluded from the commodities used in the calculation. However, it should be noted that the list of commodities that are included in the conservative estimated value is significantly tied to growing mushrooms.

Mushroom growers use local hay and used stable bedding from the equine industry as ingredients in mushroom compost (both of these components are very common on preserved farms). In fact, need from the mushroom industry for these ingredients is so high that local production is insufficient to meet their total demand, but what growers are able to get locally helps reduce the cost of inputs. In addition, the mushroom industry benefits local farmers that grow field crops (there are significant amounts of field crops on preserved farmland) because farmers use spent mushroom substrate on their fields as a fertilizer.



West Goshen Township Park

# MAINTENANCE OF PUBLIC PARKS

## Annual Expenditures

Direct public expenditures on public parks—money spent for the management and maintenance of these spaces—account for an estimated \$43 million. This economic activity, a government expense, supports an additional \$37 million in indirect and induced expenditures.

Direct Expenditures	\$43M
Indirect and Induced Expenditures	\$37M
<b>Total</b>	<b>\$80M</b>

## Annual Employment

Jobs related to the management and administration of public parks account for almost 38 percent of all employment associated with protected open space, or approximately 680 positions. This estimate includes jobs that take place directly on or because of public parks, including park rangers, groundskeepers, and public administrators. It also accounts for indirect employment associated with public parks, examples of which include jobs selling and repairing equipment used for park maintenance, and jobs arising from private concessions run on public parkland.

Direct Employment	470
Indirect and Induced Employment	210
<b>Total</b>	<b>680</b>

## Annual Salaries

Earnings for workers with jobs related to the management and maintenance of local public parks make for an estimated \$32 million per year, accounting for 46 percent of all earnings related to protected open space in Chester County.

Direct Salaries	\$22M
Indirect and Induced Salaries	\$10M
<b>Total</b>	<b>\$32M</b>



## TOURISM ASSOCIATED WITH PROTECTED OPEN SPACE

### Annual Expenditures

Tourist activity associated with protected open space in the form of travel spending generates approximately \$14 million in annual direct expenditures, which in turn support an additional \$9 million in indirect and induced expenditures.

Direct Expenditures	\$14M
Indirect and Induced Expenditures	\$9M
<b>Total</b>	<b>\$23M</b>

### Annual Employment

Jobs in Chester County's tourism industry that can be attributed to protected open space account for an estimated 240 positions, or 20 percent of all employment associated with protected open space. These jobs include employment directly related to tourism on protected open space, such as tour guides at historic sites on protected open space, jobs at travel agencies that offer packages related to Chester County's national and state parks, and jobs in agritourism. This figure also includes jobs in the tourism industry that indirectly arise as a result of protected open space. Examples include jobs at bed and breakfasts or hotels that host visitors to protected open space and jobs at restaurants or other retail establishments that cater to the same clientele.

Direct Employment	190
Indirect and Induced Employment	50
<b>Total</b>	<b>240</b>

### Annual Salaries

Employees in the tourism industry earn approximately \$8 million annually as a result of the tourist draw of local protected open spaces.

Direct Salaries	\$5M
Indirect and Induced Salaries	\$3M
<b>Total</b>	<b>\$8M</b>



Bondsville Mill Historic Park, East Brandywine Township





# TAX REVENUES GENERATED BY PROTECTED OPEN SPACE

The economic activity discussed above generates tax revenues via income, sales, and business taxes.<sup>4</sup> All economic activity associated with protected open space in Chester County generates an estimated \$4.3 million annually in state and local taxes. State tax revenues make up 80 percent of this estimate; local tax revenues account for the remaining 20 percent.

State tax revenues associated with protected open space total approximately \$3.5 million per year. Economic activity associated with protected farmland accounts for the majority—51 percent, or \$1.8 million—of these revenues. Tourism activity on protected open space contributes 11 percent of these state taxes, and activity associated with the management and maintenance of public parks makes up the remaining 38 percent. Figure 5.1 shows state tax revenues generated from these three economic activity generators related to protected open space.

Local sales, income, and business tax revenues associated with protected open space total around \$870,000 thousand per year. Tourism activity related to protected open space accounts for more than three-quarters of these revenues, or about 70 percent. Economic activity associated with public parks contributes 12 percent of local taxes, and activity related to protected farmland generates 18 percent. Figure 5.2 shows a breakdown of estimated local tax revenues.

Figure 5.1  
Estimated Annual Tax Revenue Impact Related to Protected Open Space to the Commonwealth of Pennsylvania

Tax Type	Protected Farmland	Protected Open Space	Open Space Related Tourism
Income Tax (\$ millions)	\$0.6	\$0.5	\$0.1
Sales Tax (\$ millions)	\$0.9	\$0.6	\$0.2
Business Tax (\$ millions)	\$0.3	\$0.2	\$0.1
<b>Total State Tax Revenues (\$ millions)</b>	<b>\$1.8</b>	<b>\$1.3</b>	<b>\$0.4</b>

Source: Econsult Solutions Tax Impact Model

Figure 5.2  
Total Local Tax Revenues Associated with Protected Open Space

Local Tax Revenue Type	\$ millions/ year
Public Parks	\$0.10
Protected Farmland	\$0.16
Protected Open Space-Related Tourism	\$0.60
<b>Total</b>	<b>\$0.87</b>



# Conclusion

Expenditures, earnings, employment, and tax revenue comprise the many ways that protected open space contributes to the economy. Employment opportunities and wages earned, income and property taxes generated for local governments, and local commerce associated with protected open space are the direct benefits for the individuals and organizations that make up the local economy.

## Endnotes

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<sup>1</sup>Econsult, 2011.

<sup>2</sup>Pike, C. & Sacks, A. The Economic Impact of Travel and Tourism in Pennsylvania County Data. Tourism Economics for the Pennsylvania Department of Community and Economic Development, 2015 and 2016. <https://visitpa.com/articles/economic-impact-travel-report>

<sup>3</sup>Econsult, 2011.

<sup>4</sup>Figures in this section do not include federal fiscal impact.



# Case Study

## Preserved Farms in West Fallowfield Township

**Location:** West Fallowfield Township

**Total Township Acreage:**  
11,672 acres

**Preserved Farm Acreage:**  
4,019 acres preserved through Chester County's Agricultural Preservation Program

### Introduction

Since colonial times, Chester County has had a strong farming identity and today agriculture remains one of Chester County's leading industries. This is due to the long growing season combined with consistent rainfall, amazing swathes of prime agricultural soils, and being close to Mid-Atlantic markets. Recognizing the importance of this industry and that the land is usually the farmer's primary asset, County officials in the 1990's began the farmland preservation program. This program offered the farmer a way to preserve the farm by selling the development rights. At the end of 2017, there were 38,463 acres, or roughly 8 percent of the county's 485,600 acres, of permanently preserved farms, protected forever through the County's Agricultural Preservation Program. This number is even higher when you add the farm acres preserved by the county's numerous dedicated non-profit land preservation organizations.

An excellent example of how farmland preservation insures the economic viability of farming is found in West Fallowfield Township.

### Economic Impact

West Fallowfield Township is located on the western edge of Chester County, bordering Lancaster County. Agricultural activities dominate land use in the Township—the Township's roots lie in agriculture and today over 71 percent of the Township land remains in agricultural use. To date, over 4,000 acres (34 percent of the Township and 50 percent of its agricultural lands) are preserved farmland. The farms are predominantly in dairy or in a 3-crop rotation (wheat, soybean, corn). There are also some beef cattle, equestrian, and vegetable/cash crops raised.

The economic benefits of the preserved farms are realized in a variety of ways. The direct value of the economic activity, or output, of the preserved farms totals \$14.7 million per year. But the supporting facilities such as grain storage facilities, The Oxford Produce Auction, Mid Atlantic Tractor, and other supporting agri-businesses amounts to another \$6.7 million per year—a total economic output of \$21.4 million annually.

This agricultural economy on just 4,019 acres also provides 110 local jobs, with \$3.9 million in annual earnings.

*"Agriculture in West Fallowfield Township is a quiet engine driving the Township's economy"*

—John Goodall, Brandywine Conservancy

Having multiple farmers in proximity participating in land preservation creates a market stability. Farmers rarely only farm their own land. Knowing that they can depend on long term leases on adjoining preserved lands means that they can do long-term business planning that integrates leased lands. Knowing the ground will stay in agriculture also means that the children can look to the farm and think of farming as their future because they know it will be there. By removing the development rights, value is also lowered. This creates a lower bottom line necessary to buy into farming, making transition farming more accessible to next generation farmers. It also reaffirms a rural way of life, and in some ways, society's investment encourages the next generation to continue in farming. Incidental data shows that preserved land rarely becomes available for sale in West Fallowfield and when it does, it sells faster than in areas that do not have the critical mass necessary to guarantee the supporting infrastructure.

The West Fallowfield Farmland Preservation case study is a classic example of a private industry-government partnership created to insure the economic viability of a critical local commercial resource.





# Case Study

## Sandy Hollow Heritage Park

**Location:** Birmingham Township, Chester County

**Acreage:** 42 acres of protected lands with 1.1 mile paved pedestrian path

**Owner:** Birmingham Township, Chester County

**Means of Acquisition:** Dedicated to township as part of a protected open space conservation development requirement

### Introduction

Protected historic landscapes can serve as a valuable community amenity. Sandy Hollow Heritage Park serves as a model for preserving a critical historic landscape while also providing public access for passive recreation and heritage education. The land still looks much as it did in 1777 when it witnessed fierce combat in the largest single day land battle of the American Revolution, the Battle of Brandywine. The park provides a genuine cultural landscape setting for heritage interpretive education, such as informational panels and battle reenactment events, and affords a well-used passive recreation walking path for nearby residents.

### Economic Activity

Heritage interpretation is an economic force in Pennsylvania. In 2017 Birmingham Township organized a battle reenactment at the Park that attracted around 10,000 attendees over a 2-day period and 900 reenactors from across the U.S. and Canada. The economic impact of this single event is estimated at \$1.5 million in direct and indirect sales and \$0.4 million in employee earnings. On a regular basis, this park hosts school group tours and local visitors. It is also part of the larger 35,000 acre battlefield historic landscape that features heritage centers, historic sites, and preserved lands that can be experienced through self-guided driving tours or in some cases by biking or walking.

### Property Values

In addition to the economic impact through tourism, historic resources, whether buildings or landscapes, contribute to an area's authenticity and sense of place and accordingly can have a positive impact on property values. Homes within ½ mile of Sandy Hollow Park see gains of about \$49,800 in property value, for a cumulative total of \$34.5 million. This equates to an additional \$77,000 in total annual property taxes (or about \$112 per property) generated for the municipality and school district. Additionally, the Battlefield's history, protection, and proximity are increasingly being used to market the area's real estate for its sense of place and unique character.





# Case Study

## Open Space, Quality of Place and the Chester County Economy

A documentation of the economic benefits of protected open spaces in Chester County, such as those measures contained within this report, would not be complete without making the connection between those parks, preserves, trails and farms and the high quality of place that Chester County's residents and businesses enjoy and experience.

Chester County is one of the most highly desirable locations in the nation for individuals and businesses, in part because of Chester County's preservation and open space heritage. While not as easily measured as some of the other items described in the *Return on Environment* report, quality of place plays an increasingly important role in the ability of companies to attract and retain top level talent.



Chester County has the kinds of quality of place amenities that the new generation of workers value: walkable downtowns, trails, parks, preserves and lots of open space.

Why is this factor more critical than ever? As the world of work in the 21st century continues to evolve, the pendulum now favors the employee side of the equation. The historical model of finding a job and then moving to a community close to the job is being upended by a generation of workers whose first decision becomes choosing a desirable place to live for themselves and their families—and then securing a job.

This is especially true for the top level of talent. In a world where the best workers are in great demand, companies are learning that their location—in terms of quality of place—is a primary factor in recruitment and retention.

This trend is augmented by the increasing opportunities for workers to perform their jobs remotely—often from home—which adds increased importance to the quality of place factor.

Communities that have—and can sustain—a high quality of place become a significant asset to companies in the perpetual need to attract and retain the best talent possible. And in choosing their business locations, these companies bring the jobs and the tax base—and the economic diversity—that is the lifeblood of a healthy local economy.

The perspective of local business leaders corroborates this:

*“CTDI and the Parsons Family applaud the collective efforts of the state, county and local agencies to preserve open space in Chester County. From our beginnings 44 years ago, CTDI has always been proud that Chester County is home to our global headquarters. We know that beautiful and abundant open space adds to the unmatched quality of living and the outstanding working environment that Chester County provides.”*

—Jerry Parsons, Chairman & CEO, CTDI

Chester County's historic and ongoing Chester County investment in open space preservation has long been lauded for its success—for its contributions to preserving farmland, for providing substantial environmental benefits, for securing scenic landscapes and for guaranteeing its citizens a broad array of high quality outdoor recreation activities. It shouldn't be surprising that these same preservation efforts—as the foundation of quality of place measures—have been hugely influential in contributing to the strength of the Chester County economy as well.

## Chapter 6



# Community Cost Savings









# Introduction

How land is used in a community impacts the quality and amount of local services provided as well as the taxes that are needed to fund those services.

Residential land often costs municipalities and school districts more than other land uses because it is the only land use that contributes students to the local school district, and school-related taxes collected do not keep pace with actual per-student costs. For this reason, converting open space to housing generally has a negative fiscal impact on local taxes.

A planning tool that is designed to measure the fiscal impacts of protected open space on Pennsylvania's municipalities and school districts, called a Cost of Community Services (COCS) ratio study, can be used to show the economic benefits of farmland and protected open space to municipalities and school districts. This tool was developed by the American Farmland Trust for use in New England but has since been applied in other parts of the country, including Pennsylvania.



# Methodology

The American Farmland Trust's model Cost of Community Services (COCS) ratio study was tailored for Pennsylvania's municipalities by Timothy W. Kelsey, Associate Professor of Agricultural Economics with Penn State University's College of Agricultural Sciences. A Pennsylvania State University Cooperative Extension Service publication prepared by Dr. Kelsey entitled *"Calculating a Cost of Community Services Ratio for Your Pennsylvania Community, 2004"* provides a step-by-step explanation of how to conduct such a study (see sidebar for summary).<sup>1</sup>

The COCS study specifically analyzes the fiscal relationships between municipal and school district services, and four major land uses: residential, commercial, industrial, and agriculture. Farms and protected open space fall within the agriculture category, while farm houses fall in the residential category. The fiscal impact of land uses within the municipality is determined by comparing the expenditures for municipal and school district services with the tax and non-tax revenue generated within these four land uses. The study is a snapshot of a single year's revenues and expenditures and shows which land uses were "paying their way" in terms of their municipal and school district costs.

The methodology relies upon county property tax assessments and municipal and school district financial data for a given year (or school district budget year). County taxes and services are not included, as this exercise analyzes the finances and land uses for specific municipalities and their associated school districts.

Actual tax revenues generated by the major land uses are different for every township and/or school district, depending on the combination of levied taxes (e.g., property, real estate transfer, earned income, per capita). Non-tax revenues include license and permit revenues,

public service fees, highway aid, and school district funding from the Commonwealth, called the Equalized Subsidy for Education. The expenditures spent on the major land uses range from police and fire services, to parks and recreation, to highway, school, planning and zoning, and other governmental services.

Revenues and expenditures as well as the municipality's portion of its school district revenues and expenditures are allocated to each of the major land uses, based either on how the funds were actually generated or spent, or by using a "default" allocation method derived from the property tax base.

### Steps to Estimate Cost of Community Services

#### Background

1. Collect data from the municipality, school district, and county tax assessment office.

#### Municipal Calculations

2. Determine property tax base percentages by land uses.
3. Determine municipal tax revenues and allocate by land uses.
4. Determine municipal non-tax revenues and allocate by land uses.
5. Determine municipal expenditures and allocate by land uses.

#### School District Calculations

6. Determine school district tax revenues and allocate by land uses.
7. Determine school district non-tax revenues and allocate by land uses.
8. Determine school district expenditures and allocate by land uses.

#### Results

9. Calculate Cost of Community Services ratios and actual dollar differences by land uses.
10. Interpret the results.





# Summary of Fiscal Impacts

After all the revenue and expense figures are entered, allocated, and tallied, gross revenues and expenditures for each land use are compared, and cost-revenue ratios are calculated. Cost revenue ratios depict the net impact of each land use, comparing how much was spent on that land use for each dollar the land use generated.

The information on the right shows the results of a COCS study for Elk Township, Chester County that examined the overall impact on the Township and the school district. The results from the study show that residential land in Elk Township pays less to the community than it receives in expenditures. That is, for every dollar generated in revenue, residential land required \$1.11 in services. Both agricultural and commercial land generated substantially more tax revenue than they received in services. When using dollar numbers rather than ratios, differences between expenditures and revenue for the major land use categories can be more dramatic.

## Elk Township, Chester County Cost of Community Services (2015)

FOR EVERY **\$1** IN TAXES PAID

Residential  
Costs

**\$1.11**

Agricultural  
Costs

**4¢**

Commercial  
Costs

**8¢**

FOR COMMUNITY SERVICES



## COCS STUDIES AND FINDINGS IN CHESTER COUNTY

As of November of 2018, eleven Chester County municipalities have conducted COCS studies. Figure 6.1 summarizes the findings. In all eleven municipalities, one (or more) COCS studies show that residential land contributed less, on average, to municipal and school district revenue than it required back in expenditures. In Highland Township for example, for every dollar in revenue that was received from residential land, \$1.14

was spent on services for that land. By contrast, farmland in Highland Township provided a net benefit of 97 cents to every dollar of revenue generated. In summary, farm and protected open space land in these municipalities provided more than they required back in expenditures.

Many of these eleven municipalities have used their study findings to show that the preservation of farmland and other protected open space can help their residents avoid the significantly higher costs of services that would be required if those lands were in residential use. In this case, the return on preserved open space is the savings to all taxpayers by eliminating the potential for farms and open land to be converted to residential land.

Figure 6.1

Summary of Findings, Cost of Community Services Studies in Chester County<sup>2</sup>

Township	Residential	Commercial	Industrial	Agricultural
East Nottingham	\$1.11	4¢	4¢	4¢
Elk	\$1.11	8¢	—	4¢
Highland	\$1.14	5¢	—	3¢
Honey Brook	\$1.07	6¢	6¢	6¢
Kennett	\$1.12	51¢	12¢	12¢
London Britain	\$1.01	20¢	—	20¢
London Grove	\$1.13	14¢	15¢	19¢
Londonderry	\$1.08	2¢	2¢	2¢
Lower Oxford	\$1.08	2¢	2¢	2¢
West Fallowfield	\$1.13	3¢	3¢	3¢
West Sadsbury	\$1.33	3¢	3¢	3¢

**THE COST FOR  
COMMUNITY  
SERVICES**

**FOR EVERY**

**\$1**

**IN TAXES PAID**



## RESIDENTIAL GROWTH AND SCHOOL DISTRICT BUDGETS

The primary reason for the shortfall between residential expenditures and revenues comes from residential demands on the local public school system. Although residents contribute only a portion of the full costs required to support local public school students, they receive all the benefits, for the simple reason that all students come from residential land uses.

For example, in 2014-2015, total expenses for the Oxford Area School District (OASD) in southern Chester County were reported at \$56,828,634—double the expenditures ten years earlier of \$27,892,691. That same year the OASD reported a total of 3,869 students, whereas in 2003 there were 3,306 students. In 2003, it cost an average of \$8,437 to educate each student, but in 2014-15 it cost \$14,688 per student.

In 2014-2015, 5.2 percent of the district (OASD), or 201 students, came from Elk Township. Accordingly, it cost approximately \$2,952,328 to educate Elk Township students this year. Even though the students are entirely a product of residential areas, only \$1,777,982, or \$8,846 per student, came to the school district directly from the residents of Elk in the form of taxes. This meant a shortfall of \$5,842 per student. While the deficit is partly subsidized by taxes on commercial and agricultural land, and partly by state and federal education subsidies, the per-student shortfall adds up quickly for a township that sends hundreds of students to their public school.





# SLOWING TAX INCREASES THROUGH OPEN SPACE PRESERVATION

In contrast to the permanent increase in costs and taxes caused by new residential development, lands that are preserved normally require a one-time financial commitment. Every dollar spent to protect open space and farmland avoids the larger, perpetual costs of providing municipal and school district services, not to mention the positive effects on a community's scenic resources, food security, and open space (see side bar). Any locally-required management or maintenance costs (such as where public access is allowed or for parks) are much smaller than the preservation costs and can be supplemented by grants, private donations, volunteer work or other funding sources.

As evidenced through the COCS studies conducted in Chester County, preserving farmland and protected open space can slow rising municipal and educational costs by protecting land that would otherwise be converted to new housing. The expense of protecting farmland and open space (through purchase of development rights or fee simple purchase of land) may require a modest initial increase in taxes, yet these expenses can be quickly recouped and surpassed and are a good financial investment. As mentioned in Chapter 1, many municipalities in Chester County have recognized these benefits and have passed modest ballot initiatives to create dedicated funds for preservation of open space. Not only does the municipality avoid new school and municipal costs when farmland is preserved, farm tax income is maintained. Using local funds to preserve agricultural lands greatly improves the chances of a property's acceptance into county, state, and federal farmland preservation programs, and potentially leverages other private funding sources.

### Example Scenario

Suppose a 150-acre farm property could accommodate 100 new homes based on the municipality's zoning ordinance, and those 100 homes generated 60 students to district schools (conservatively). Using the \$5,842/student shortfall calculated in the Elk Township example, these 60 students would generate an annual shortfall of \$350,520. By buying the farm's 100 development rights at \$4,676 each, Elk residents would spend \$467,600, but would enjoy permanent substantial tax savings relating to that property:

4,676 per development right X 100  
development rights = \$467,600 in  
conservation easement acquisition costs

\$476,600 divided by \$350,520/year shortfall  
= a little under 1.5 months break-even  
period.

Such a preservation effort, fully funded by Elk Township, would be paid back in a little over a year of tax savings. Ten years ago in Elk Township, the break-even period for local funding to preserve open space was over two years; costs have risen now so that the Township can recoup its costs for preserving farmland and protected open space within the same budget year.



# Conclusion

Preservation of farmland helps residents avoid the significantly higher costs of services that would be required if those lands were in residential use. The return on preserved open space is the savings to taxpayers recognized by eliminating the potential for farms and open land to be converted to residential land.

## Endnotes

<sup>1</sup>This publication is free to the public as a download at <https://www.chesco.org/DocumentCenter/View/5684/>.

<sup>2</sup>**East Nottingham**

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**West Sadsbury**

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# Glossary



## Glossary

**Agricultural activity-** Activities that occur on protected farm land in direct support of the production of an agricultural product.

**Arms-length transaction-** The sale of property from one party to another where both parties are acting in their own self-interest. Analyzing only arms-length home sale transactions most accurately captures a property's market value.

**Best Management Practice (BMP)-** A technique to most appropriately conserve natural resources and manage surface runoff on a site based on unique site conditions, planning, and engineering requirements. A BMP involves site development design that incorporates the most suitable technique or combination of techniques to best manage the resource and/or to prevent or reduce surface runoff and water pollution.

**Community Supported Agriculture (CSA)-** An arrangement between a farm and local residents designed to financially support a farm operation so that the farm becomes the "community's farm." Consumers pay the farm for a "share" of their crop prior to the beginning of the growing season, thereby mitigating the farmer's risk in growing.

**Easement, agricultural-** An interest in land, less than fee simple, which represents the right to prevent the development or improvement of a parcel for a purpose other than agricultural production. This voluntary easement may be granted by the owner of the land to a third party or to the Commonwealth, to a county governing body, or to a unit of local government. The easement is granted in perpetuity, as the equivalent of covenants running with the land. The Chester County Agricultural Land Preservation Board administers the County's farmland preservation program, which includes funding from the County, the Pennsylvania Agricultural Conservation Easement Purchase Program, and the federal government.

**Easement, conservation-** An interest in land, less than fee simple, that is a voluntary and legally binding agreement between a landowner and a land trust or government that limits certain uses on a property to achieve conservation objectives while keeping the property in the landowner's ownership and control. The holder of the conservation easement has the right to block inappropriate uses while the owner may continue to use the land within the constraints set in the easement. Conservation easements do not create a right for the public to access a property, unless specifically established, and bind present and future landowners.

**Economic value-** This report measures economic value in relation to three aspects: wealth generation, tax revenues and avoided costs. It does not attempt to measure other important but difficult to quantify measures of economic value such as cultural, spiritual, aesthetic and stress reduction benefits.

**Ecosystem services-** Any positive benefit that wildlife or ecosystems provide to people as a result of their natural functions. This report estimates the economic benefits associated with the ecosystem services of provision of water supply, water quality improvement, flood mitigation, wildlife habitat, air pollution removal, and carbon sequestration and storage that results from the natural environments on protected open space.

**Environmental benefits-** The economic benefits derived from ecosystem services.

**Floodplain-** The area adjoining a stream, river or watercourse that has been flooded or may experience flooding in a storm event.

**Homeowners association-** A corporation formed by real estate developers of a residential development prior to the sale of homes. The Covenants, Conditions and Restrictions, or the HOA's Declaration, sets forth detailed rules of membership and property ownership in the community, including the ownership of communal open space. For more information, refer to <https://www.hoa-usa.com/home/pa.aspx>

**Input-output modeling-** This economic modeling technique is used to represent the flow of money in an economy. In an inter-connected economy, every dollar spent generates two spill-over impacts: First, some proportion of spending on locally-purchased goods and services is circulated back into an economy. This represents an "indirect effect" and reflects the fact that local purchases of goods and services support local vendors, who in turn create business-to-business transactions when they purchase from their own set of vendors. Second, some proportion of that expenditure that goes toward employee salaries is circulated back into an economy when those employees spend some of their earnings on goods and services. This represents what is called the "induced effect" and reflects that fact that some of those goods and services will be purchased from local vendors, further stimulating a local economy.

**Land cover-** Patterns of vegetation or man-made features that occur on the earth's surface. Examples of land cover include forest, pasture, wetland and developed area.

**Multi-use trails-** Facilities commonly used by bicyclists, pedestrians, and other non-motorized modes of travel such as equestrians, cross country skiers, rollerbladers, baby strollers, and those utilizing wheelchairs. Multi-use trails are primarily found within state parks, municipal parks or as regional trails, such as Chester County's Chester Valley and Struble Trails.

**Protected open space-** Land or water areas that have little or no development; are used for working lands, recreation or preserving cultural or natural resources; and are either permanently protected from development by an easement, owned by a governmental agency, or protected through a municipality's zoning ordinance. In some instances only a portion of a property is subject to a conservation or agricultural easement; Chester County's open space calculations are based on the protected acreage only. This report divides protected open space into the following categories:

- **Public parks**, which include federally owned and managed National Historic Sites and Parks, state parks, county parks and other undeveloped open space owned by Chester County; municipal active and passive recreation parks and other undeveloped open space owned by municipalities.

- **Private land owned or under conservation easement by land trusts**, which includes nature preserves open to the public as well as private property.
- **Farmland preserved with Agricultural Land Preservation Board (ALPB) easements** (see Easements, agricultural)
- **Protected land owned and managed by a homeowners association**, which include open space created through the subdivision and land development process, typically required by zoning or subdivision ordinances.
- **Other protected lands**, which include properties whose development rights have been purchased or transferred by a municipality, state game lands, managed lands with easements held by the Chester County Water Resources Authority and managed lands owned in fee by the public sector, including Chester County Water Resources Authority, the PA Fish and Boat Commission, the PA Game Commission, or a municipality.

**Riparian corridor-** The corridor of land immediately adjacent to a stream or water body that serves as a transition between aquatic and terrestrial environments and which directly affects and/or is affected by the adjacent water body.

**Smart growth-** An approach to development that encourages a mix of building types and uses, diverse housing and transportation options, development within existing neighborhoods, and community engagement. The overall goal of smart growth is to concentrate development and its supporting infrastructure to limit sprawl, maximize resources and create vibrant, healthy places.

**Value transfer-** An estimation method that assigns a monetary value to something non-monetary to gauge how much people value the asset/service and would be willing to pay for it if they had to. This method is used where data collection proves too costly or time consuming. An example of value transfer is asking someone how much they would be willing to pay to remove a ton of carbon from the atmosphere.



