



Virginia's Return on Investment in Land Conservation

THE
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LAND



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The Trust for Public Land
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The Trust for Public Land creates parks
and protects land for people,
ensuring healthy, livable communities
for generations to come.

The Trust for Public Land's Conservation Economics team measures the economic value and fiscal impacts of parks and land conservation. We quantify these impacts using models developed in consultation with leading academics across the country and with our award-winning GIS team.

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Executive summary

The Trust for Public Land conducted an economic analysis of the return on Virginia's investment in land conservation through a variety of state programs that funded land acquisition statewide, and found that every public \$1 invested in land conservation returned \$4 in natural goods and services to the commonwealth. In addition, land conservation funded by Virginia supports key industries that depend on the availability of high-quality protected land and water. A summary of the key findings and the benefits of open space investments by the Commonwealth of Virginia is presented below.¹

NATURAL GOODS AND SERVICES: Lands conserved in Virginia provide valuable natural goods and services such as air pollution removal, carbon sequestration, water quality protection, and wildlife habitat. The Trust for Public Land used a benefits transfer methodology to analyze lands conserved using state funding and found that every \$1 invested in land conservation returns \$4 in economic value in natural goods and services.

LEVERAGE FEDERAL, LOCAL, PRIVATE, AND NONPROFIT FUNDS: By attracting support from other sources, the state maximizes its investment in land conservation. For example, every \$1 of spending on land conservation by the Virginia Land Conservation Foundation between 1999 and 2014 was matched by at least \$2 in contributions from federal, local, private, and nonprofit sources.

TOURISM AND OUTDOOR RECREATION: Conservation lands are critical to the state and local tourism industries. At least 46 percent of Virginia residents participate in outdoor recreation each year. In Virginia, outdoor recreation generates \$13.6 billion in annual consumer spending, which benefits Virginia communities through greater tax revenues. The tax revenue attributed to outdoor recreation spending equals \$923 million annually. Spending on outdoor recreation also helps local businesses that hire Virginia residents. Approximately 138,000 jobs in the commonwealth are directly supported by this spending, accounting for \$3.9 billion in wages and salaries. Much of that earned income is then spent in local communities, further magnifying the economic impact of outdoor recreation.

AGRICULTURE, FORESTRY, AND COMMERCIAL FISHING: The agriculture, forestry, and commercial fishing industries depend on maintaining farms, forests, and water quality. Every locality in Virginia is affected by agriculture or forest-related industries. In fact, 68 localities have total employment impacts of 1,000 jobs or more with agriculture having the largest and most dispersed impacts.

ECONOMIC DEVELOPMENT: Land conservation contributes to Virginia's economy by maintaining the scenic beauty of the state, improving quality of life for residents, and enabling the state to attract and retain new businesses and high-quality workers. Virginia businesses believe that it is important for Virginia to develop and maintain an attractive and sustainable natural environment. Employees want to live in a place that is healthy, offers outdoor entertainment, and is vibrant and livable. Employers want employees who are healthy and stimulated at work and at home.

FISCAL HEALTH: Land conservation also saves Virginia communities money through avoided costs on expensive infrastructure and other municipal services required by residential property owners, such as schools, police, and fire protection. Research conducted in six Virginia counties shows that on average, residential lands require \$1.18 in services for every dollar paid in local taxes. At the same time, working and open lands only require \$0.35 in services for every dollar contributed in property taxes. Virginia communities recognize the importance of balancing growth and conservation in a way that maintains fiscal health.

HUMAN HEALTH: Access to parks and conserved lands increases the physical activity and the health of residents and workers in Virginia. This reduces health care costs related to obesity, which, in

¹ All numbers reported in the text and tables are rounded to three significant digits unless otherwise noted. Because of rounding, some report figures and tables may appear not to sum.

Virginia, are estimated to reach between \$4.20 billion and \$9.38 billion by 2018. In 2013, 25.5 percent of the commonwealth's adults were physically inactive. In addition, in 2014, nearly 60 percent of adult women and nearly 70 percent of adult men were overweight or obese. Availability of parks and proximity to such spaces increases the physical activity of adults and children. Researchers have found that as the percentage of park area within a child's neighborhood increases, so does a child's physical activity.

THE TRUST FOR PUBLIC LAND: The Trust for Public Land has extensive experience in determining the return on state investment in land conservation. Its Conservation Economics team has published return-on-investment analyses in states across the country, including Colorado, Georgia, Illinois, Maine, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, and Wyoming. The Trust for Public Land has worked with leading academic partners to advance this research, including Colorado State University, Dartmouth College, Georgia Institute of Technology, Plymouth State University, University of Georgia, University of Minnesota, and University of Wyoming–Ruckleshaus Institute of Environment and Natural Resources.



DAVID HARP

Introduction

Virginia's landscape is diverse and beautiful – covered by forests, mountains, farms, lakes, rivers, and coastal beaches. Residents and visitors benefit from the varied geography and natural resources that extend from the Allegheny Mountains to the Shenandoah River Valley, the Blue Ridge Mountains to the Piedmont Plateau, and the Chesapeake Bay to the Atlantic Coast.

As of February 2015, over 3.95 million acres, or 15.6 percent of Virginia's total land area, have been permanently conserved across the state, including lands owned and managed by federal agencies, such as the National Park Service, state and local parks, forests, wildlife areas, and nature preserves.² Also included are lands that have been conserved through conservation easements held by the Virginia Outdoors Foundation, as well as by other state and local agencies and nonprofit organizations.³ These lands provide economic benefits to local communities and the people of Virginia in the form of natural goods and services, opportunities for tourism and outdoor recreation, support for working farms and forests, increased quality of life that attracts business and employees, avoided costs on expensive infrastructure, and places to improve health through exercise. The Commonwealth of Virginia has long recognized the importance of investing in conservation to support these critical benefits and has well-established policies, programs, and incentives to support land conservation, including the Virginia Land Preservation Tax Credit.

The economic analysis conducted for this report focuses on a subset of conserved lands in Virginia – those lands that have been conserved, through fee simple purchase and purchase of conservation easements from willing sellers, using state dollars. The goal of the analysis was to better understand the return on Virginia's direct investment in land conservation, whether those dollars are from general obligation bonds that are made available periodically for state land acquisition, or through state grant programs, which usually receive a modest amount of funding annually through the General Fund.

This study does not include lands that have been donated outright or conserved through a donation of a conservation easement by landowners who have received a Virginia Land Preservation Tax Credit (LPTC). While the LPTC plays an important role in conserving land in Virginia, spatial data linked to tax credits claimed for the individual properties conserved are not available, likely due in part to taxpayer confidentiality. The Joint Legislative Audit and Review Commission (JLARC) has studied the effectiveness of the LPTC in the context of other tax preferences in the Commonwealth of Virginia and has concluded that the LPTC is meeting its intended public policy goal of conserving land.⁴

2 Of this total conserved acreage, 59.4 percent is federal, 31.1 percent is state, 3.68 percent is local, and 5.82 percent is nonprofit. Source: "Department of Conservation and Recreation's Virginia Conservation Lands Database," Virginia Department of Conservation and Recreation, accessed March 31, 2016, <http://www.dcr.virginia.gov/natural-heritage/clinfo>.

3 The use of the term "conservation easement" is meant to represent easements that are held for a wide variety of conservation purposes, including preservation of historic and/or agricultural lands as well as open space purposes.

4 For more information, see the JLARC studies of LPTC: Joint Legislative Audit and Review Commission, *Review of the Effectiveness of Virginia Tax Preferences*, Richmond: Commonwealth of Virginia, 2012, accessed June 28, 2016, <http://jlarc.virginia.gov/pdfs/reports/Rpt425.pdf>; Joint Legislative Audit and Review Commission, *Dedication Revenue Sources for Land Conservation in Virginia*, Richmond: Commonwealth of Virginia, 2012, accessed June 28, 2016, [http://leg2.state.va.us/dls/h&sdocs.nsf/By+Year/SD32012/\\$file/SD3.pdf](http://leg2.state.va.us/dls/h&sdocs.nsf/By+Year/SD32012/$file/SD3.pdf).



JAMIE BETTS

Virginia has several agencies that administer state conservation funding programs and steward or manage state conservation land. The analysis conducted for this report includes data from the following agencies:⁵

VIRGINIA DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES, OFFICE OF FARMLAND PRESERVATION

The Office of Farmland Preservation within the Virginia Department of Agriculture and Consumer Services (VDACS) supports farmland preservation efforts through a number of programs, including assisting local governments with the creation of purchase of development rights (PDR) programs.⁶ In 2008, VDACS was given the responsibility of allocating state matching funds to local purchase of development rights programs. The 2007 budget provided \$4.25 million in state matching funds for the 2006–2008 biennium. An additional \$4.43 million has been allocated since that time. Allocations for fiscal year 2015 and fiscal year 2016 are currently \$1 million each year.⁷

VIRGINIA DEPARTMENT OF CONSERVATION AND RECREATION

The Department of Conservation and Recreation (DCR) acquires land for state parks and natural area preserves. Most of the funding for DCR land purchases has come from general obligation bonds approved by the voters in 1992 and 2002, bonds from the Virginia Public Building Authority, and, to a lesser extent, legislative appropriations, grants from the Virginia Land Conservation Foundation, and the Open Space Recreation and Conservation Fund, which is funded by voluntary contributions of income tax refunds.⁸

5 At the time of analysis, comprehensive data were not available for the Virginia Department of Historic Resources or the Virginia Outdoors Foundation's transactions involving the purchase of lands or conservation easements using state dollars. As a result, these transactions are not included in this analysis.

6 "Farmland Preservation," Virginia Department of Agriculture and Consumer Services, accessed April 7, 2016, <http://www.vdacs.virginia.gov/conservation-and-environmental-farmland-preservation.shtml>.

7 "Virginia Profile of State Programs and Policy Framework," The Trust for Public Land, accessed April 7, 2016, <http://www.conservationalmanac.org/secure/almanac/midatlantic/va/programs.html>.

8 Ibid.

VIRGINIA DEPARTMENT OF FORESTRY

The Department of Forestry (DOF) manages 22 state forests and seeks to protect forestland from fire, insects, and disease.⁹ Land conservation at DOF has been funded by general fund appropriations, Virginia Public Building Authority bonds, and the Virginia Land Conservation Foundation.¹⁰

VIRGINIA DEPARTMENT OF GAME AND INLAND FISHERIES

The Department of Game and Inland Fisheries (DGIF) is responsible for the management of inland fisheries, wildlife, and recreational boating for the commonwealth.¹¹ The agency receives funding for land conservation from transfers directed to the Game Protection Fund from the General Fund of the state. The transfers come from the collection of Watercraft Sales and Use Taxes (Code of Virginia § 58.1-1410) and from sales taxes collected on outdoor-related goods and equipment, which were allocated to the Game Protection Fund beginning in 2000 and are often referred to as “HB38” funds (Code of Virginia § 58.1-638E). The amount of funds transferred as a result of HB38 is based on an estimation of expenditures in Virginia associated with hunting, fishing, and other wildlife-associated recreation, which is calculated every five years in a national survey of hunting, fishing, and wildlife-associated recreation. The most recent survey was completed in 2011 by the U.S. Fish and Wildlife Service in partnership with the U.S. Census Bureau. The specific amount transferred to the agency is often modified by language in the Budget Bill.¹² In addition, DGIF has accessed grants from the Virginia Land Conservation Foundation as well as Virginia Public Building Authority bonds.

VIRGINIA LAND CONSERVATION FOUNDATION

The General Assembly and former Governor Jim Gilmore established the Virginia Land Conservation Foundation (VLCF) in 1999. VLCF manages the Virginia Land Conservation Fund, which gets its funding from the state’s annual budget. The Department of Conservation and Recreation provides staff and administrative support. Grants are awarded to help fund the purchase of parks and open spaces, historic or culturally significant lands, farmland, forestland, and natural areas. State agencies, local governments, public bodies, and registered (tax-exempt) nonprofit groups are eligible to receive matching grants from the foundation. An Interagency Taskforce made up of state agencies reviews and recommends grant applications to the Virginia Land Conservation Foundation’s board. Grants are awarded based on applications for 50 percent or less of total project costs. In 2013, House Bill 1398 called on the governor to include funding for VLCF and other conservation grant programs in his budget proposal each year. For fiscal year 2017 and every subsequent year, the amount called for in the legislation is \$20 million.

9 “All About the Virginia Department of Forestry,” Virginia Department of Forestry, accessed April 7, 2016, <http://www.dof.virginia.gov/aboutus/intro-vdof.htm>.

10 “Virginia Profile of State Programs and Policy Framework,” The Trust for Public Land, accessed April 7, 2016, <http://www.conservationalmanac.org/secure/almanac/midatlantic/va/programs.html>.

11 “About VDGF,” Virginia Department of Game and Inland Fisheries, accessed April 7, 2016, <http://www.dgif.virginia.gov/about/>.

12 “Financial Summary: Fiscal Year 2015,” Virginia Department of Game and Inland Fisheries, accessed April 7, 2016, <http://www.dgif.virginia.gov/about/financial-summary/2015/sources.asp#license-sales>.

Investment in land conservation

The Trust for Public Land's Conservation Almanac research team collected data on specific state investments in land conservation throughout the Commonwealth of Virginia. The funding programs and sources that were included in this study represent the breadth of state land conservation activity for which sufficient data were available at the time of analysis. State investment, location, and acreage information was derived from primary data gathered from state conservation agencies and programs as well as published reports and meeting minutes.

Data adhere to the following guidelines:

- Funding and acreage information is representative of activity between 1999 and 2014;
- Funding represents expenditures to protect land via fee acquisition or conservation easement;
- Investments represent *only* state contributions;¹³
- Acres represent land acquisitions using state funding either in-part or in-full; and
- Expenditures and acres are assigned to the year in which the project was completed.



JOHN HENLEY

¹³ The Trust for Public Land recognizes that state contributions represent only a portion of total conservation funds spent in Virginia. Other funds include those expended by federal, local, nonprofit, and private entities. Because state funding is often critical to raising and to leveraging other investments, this report focuses on state contributions.

From 1999 to 2014, Virginia funded the conservation of 89,400 acres, including lands protected through both conservation easements (i.e., voluntary conservation agreements with willing landowners) and fee simple acquisitions (i.e., lands purchased outright from willing sellers).¹⁴ During this time, an average of 10,500 acres were protected annually through state spending, using an average of \$14.0 million each year (this is nominal spending, i.e., not in today's dollars). The average expenditure per acre conserved during this period was \$1,330. Table 1 breaks out the historical acres conserved and dollars spent from the following state funding sources only: the 2002 Parks and Natural Areas Bond Act, Department of Agriculture and Consumer Services' Office of Farmland Preservation, Department of Conservation and Recreation's Open Space Recreation and Conservation Fund, Department of Game and Inland Fisheries, Virginia's General Fund, Virginia Land Conservation Foundation, and Virginia Public Building Authority bonds.¹⁵

TABLE 1. HISTORICAL ACRES AND STATE FUNDING FOR LAND CONSERVATION.¹⁶

Year	Acres	State funding
1999	703	\$12,500
2000	1,660	\$3,610,000
2001	9,600	\$4,400,000
2002	1,820	\$1,030,000
2003	396	\$312,000
2004	3,310	\$5,130,000
2005	9,730	\$10,700,000
2006	5,200	\$15,800,000
2007	2,220	\$3,360,000
2008	6,670	\$12,200,000
2009	18,600	\$35,000,000
2010	13,500	\$17,400,000
2011	6,340	\$4,700,000
2012	6,230	\$3,130,000
2013	2,170	\$1,760,000
2014	1,200	\$823,000
Total	89,400	\$119,000,000
Average	10,500	\$14,000,000

¹⁴ Historical acres and state funding for land conservation were determined using The Trust for Public Land's Conservation Almanac (www.conservationalmanac.org). The Conservation Almanac is a powerful online resource for discovering, analyzing, and mapping the results of federal, state, and local funding for land conservation across the United States.

¹⁵ At the time of this analysis, comprehensive data were not available for the Virginia Department of Historic Resources (DHR) or the Virginia Outdoors Foundation (VOF). Information on purchases of land or conservation easements using state dollars was not available; as a result, land protection projects for DHR and VOF are not included in this analysis.

¹⁶ The Trust for Public Land's Conservation Almanac currently tracks conservation activity in Virginia from 1998 to 2014; however, the programs included in this report do not have spending prior to 1999. Thus, we report on the years included in the analysis: 1999 through 2014. All numbers reported in the text and tables are rounded to three significant digits unless otherwise noted. Because of rounding, some report figures and tables may appear not to sum.

Natural goods and services

Some of the key economic benefits of land conservation come in the form of natural goods and services¹⁷ including air pollution removal, water quality enhancement and protection, fish and game habitat, food production, stormwater management, flood control, and other necessary functions.¹⁸ The following list qualitatively describes in more detail some of the natural goods and services provided by different types of ecosystems:

Forests protect water and air quality.

- Forests purify water by stabilizing soils and filtering contaminants. They also regulate the quantity of available water and seasonal flow by capturing and storing water. In fact, forests process nearly two-thirds of the freshwater supply, providing water to about 40 percent of all municipalities or approximately 180 million people across the United States.¹⁹
- Forests defray costs of erosion-related damage (e.g., repairing damaged infrastructure and treating contaminated water) because their soil stability reduces erosion and stormwater runoff.²⁰
- Forests improve air quality by absorbing carbon, releasing oxygen, and filtering particulates.²¹

Wetlands reduce flooding, improve water quality, and support biologically diverse habitats.

- A one-acre wetland can typically store about one million gallons of water. Trees and other wetland vegetation help slow the speed of floodwaters. Water storage by wetland vegetation can lower flood heights and reduce the destructive power of floodwaters.²²
- Wetlands are a fundamental part of local and global water cycles and provide other natural services such as water purification, erosion control, flood protection, and resilience to storms. In addition, these lands provide a range of services that depend on water, including agricultural production, fisheries, and tourism. Managing and restoring wetlands can lead to cost savings when compared to man-made infrastructure solutions.²³
- Wetlands act as a natural filtration system to improve water quality by absorbing excess nutrients from fertilizers, manure, and sewage. In their role as natural purifiers, wetlands reduce water treatment and infrastructure costs.²⁴
- Wetland habitats are some of the most productive habitats on earth, providing nursery grounds for shellfish, fish, and other vertebrate wildlife.²⁵

17 Natural goods and services are sometimes referred to as ecosystem services, natural capital, nature's benefits, and environmental goods and services.

18 Protected lands provide additional values, such as option value, bequest value, existence value, spiritual value, and aesthetic value. These values have not been included in this analysis owing to the complexity involved in their measurement. Ecosystem services such as recreation and tourism have not been included in the per-acre values of natural goods and services but are discussed separately in the "Land conservation supports the economy" section on page 18. The return on investment in land conservation would presumably be higher if these additional values had been included in the analysis: their omission results in a more conservative estimate (i.e., underestimate the "true" value).

19 National Research Council of the National Academies, Committee on Hydrologic Impacts of Forest Management, Water Science and Technology Board, Division of Earth and Life Studies, *Hydrologic Effects of a Changing Forest Landscape*, Washington, DC: The National Academies Press, 2008.

20 Ibid.

21 Ibid.

22 U.S. Environmental Protection Agency, *Wetlands: Protecting Life and Property from Flooding*, EPA843-F-06-001, 2006, accessed June 28, 2016, <https://www.epa.gov/sites/production/files/2016-02/documents/flooding.pdf>.

23 D. Russi et al., *The Economics of Ecosystems and Biodiversity for Water and Wetlands*, London and Brussels: The Institute for European Environmental Policy; Gland, Switzerland: Ramsar Secretariat, 2013.

24 U.S. Environmental Protection Agency, *Economic Benefits of Wetlands*, EPA843-F-06-004, 2006, accessed June 28, 2016, <https://www.epa.gov/sites/production/files/2016-02/documents/economicbenefits.pdf>.

25 "Wetlands," Virginia Department of Environmental Quality, accessed April 6, 2016, <http://www.deq.virginia.gov/Programs/Water/WetlandsStreams/Wetlands.aspx>.

Grasslands, pasturelands, and shrublands protect water quality, provide habitat, and boost agricultural production.

- Grasslands and shrublands capture water and filter pollutants, minimizing the ability of contaminants to reach water supplies.²⁶
- Grasslands, pasturelands, and shrublands provide habitat for native pollinators that are essential to agricultural production.²⁷

Agricultural lands can impact water and soil quality.

- Recent overall declines in soil erosion and improvements in soil quality in the United States are partially attributable to increased soil conservation practices such as crop residue management, land retirement, and conservation tillage.²⁸
- Conservation tillage contributes to improved water quality by reducing the runoff of soil particles attached to nitrate, phosphorus, and herbicides. Tillage practices can also protect the soil surface from the impact of rain and slow water movement.²⁹

Water bodies provide clean drinking water, flood control, and recreational opportunities.

- Water bodies, such as rivers and lakes, provide flood control and clean drinking water by storing runoff from stormwater, retaining sediment, and recharging groundwater. They support livelihoods through irrigation for crops and drinking water for livestock and create opportunities for recreation and tourism.³⁰



KEN SHERMAN

26 "Wetlands and Grassland Habitat: The Benefits of Two Key Waterfowl Habitat Types," Ducks Unlimited, accessed February 11, 2014, <http://www.ducks.org/conservation/habitat/benefits-of-wetlands-and-grasslands>.

27 "Ecosystem Services from National Grasslands," U.S. Forest Service, accessed April 29, 2014, www.fs.fed.us/grasslands/ecoservices/; Insu Koh et al., "Modeling the Status, Trends, and Impacts of Wild Bee Abundance in the United States," *Proceedings of the National Academy of Sciences* 113, no. 1 (2016): 140–145, doi: 10.1073/pnas.1517685113.

28 American Farmland Trust, *The Environmental Benefits of Well-Managed Farmland*, DeKalb, IL: Center for Agriculture in the Environment, 2005.

29 Ibid.

30 D. Russi et al., *The Economics of Ecosystems and Biodiversity for Water and Wetlands*.

Return on investment in land conservation

The Trust for Public Land conducted an analysis of the return on Virginia's investment in land conservation by comparing the state's investment with the economic value of the natural goods and services provided by conservation lands. Every \$1 invested by Virginia in land conservation returns \$4 in economic value of natural goods and services.

Methodology

To determine the natural goods and services provided by conserved lands, The Trust for Public Land analyzed the ecosystem types found within conserved lands using a geographic information system (GIS) analysis. To complete this analysis, data from The Trust for Public Land's Conservation Almanac database were utilized. This database contains GIS data (i.e., mapped boundaries) of publicly and privately held conservation easements and purchased conservation lands that were protected with state funding.³¹ The Trust for Public Land collected the best available information, which was provided by the Virginia Department of Agriculture and Consumer Services, the Virginia Department of Conservation and Recreation, the Virginia Department of Forestry, the Virginia Department of Game and Inland Fisheries, and the Virginia Land Conservation Foundation. Additional information was compiled using state reports and meeting minutes.

The Trust for Public Land was able to analyze a total of 89,400 acres protected through state investments between 1999 and 2014. This acreage was protected using \$119 million in state funding (nominal spending, i.e., not adjusted to present value). The projects that were included in the analysis represent the majority of state land conservation activity during that period (i.e., 95.6 percent of direct spending and 87.0 percent of acres protected through direct spending). Owing to the complexities of aligning spending records to spatial records, there were a small number of parcels for which the data were not available, and those were excluded from the analysis.

The Trust for Public Land then determined the underlying ecosystem types using the 2011 National Land Cover Database (NLCD 2011), which features a land cover classification scheme that uses satellite imagery to identify different types of land cover at a spatial resolution of 30 meters.³² From this analysis, The Trust for Public Land calculated the number of acres of each of the ecosystem types found within conserved lands included in the study. The most commonly acquired land cover type is deciduous forest, representing 37.5 percent of all conserved land. Table 2 breaks out the full results of the land cover analysis.

31 "Conservation Almanac" The Trust for Public Land, www.conservationalmanac.org.

32 C. G. Homer et al., "Completion of the 2011 National Land Cover Database for the Conterminous United States-Representing a Decade of Land Cover Change Information," *Photogrammetric Engineering and Remote Sensing* 81, no. 5 (2015): 345-354. While 16 types of land cover data are included in this national data set, only 15 land cover types exist in the state-protected conservation lands that are included in this analysis.

TABLE 2. LANDS CONSERVED BY LAND COVER TYPE

Land cover type	Acres	Percent land cover
Deciduous Forest	33,500	37.5%
Woody Wetland	13,400	15.0%
Evergreen Forest	11,700	13.1%
Pasture/Hay	8,380	9.38%
Shrub/Scrub	5,580	6.24%
Cultivated Crops	4,420	4.94%
Emergent Herbaceous Wetland	3,960	4.43%
Mixed Forest	3,890	4.35%
Open Space/Parks	1,840	2.05%
Grassland/Herbaceous	1,640	1.83%
Open Water	772	<1%
Developed*	186	<1%
Barren Land	120	<1%
Total Acres - All Land Cover Types	89,400	100.00%

*The developed category combines low-, medium-, and high-intensity development land cover types. This includes areas with a mixture of constructed materials and vegetation with impervious surface accounting for between 20 percent and 100 percent of the total land cover.

The natural goods and services provided by the distinct ecosystem types found within Virginia’s conserved lands, and their monetary values, were determined using the benefits transfer methodology. That is, The Trust for Public Land conducted a thorough literature review of the types of natural goods and services provided by the 15 ecosystem types identified in conserved lands using recent, relevant, and scientifically sound sources. The Trust for Public Land then used the economic values of the different ecosystem types identified in that literature to estimate a per-acre economic value of the natural goods and services provided. Benefits transfer methodology has become a common approach in environmental economics because it is a practical alternative to time-intensive and data-intensive original research. Please see the appendix for a complete methodology.

Results

Based on the per-acre economic values, 89,400 acres of conserved land provide \$918 million (present value, i.e., the value of past investments in today’s dollars) in total economic value in the form of natural goods and services from the date of purchase (i.e., beginning in 1999) to 2024 (i.e., ten years into the future).

The Trust for Public Land used this value to estimate the return on \$173 million (present value) invested in 89,400 acres of land conservation by Virginia from 1999 to 2014. The comparison of this investment with the economic value of natural goods and services generated by these lands in the past (i.e., 1999 to 2014) and future (starting in 2015 and ten years into the future, ending in 2024) finds that every \$1 invested returns \$4 in economic value. These goods and services will continue to be provided well beyond 2024, increasing the total return on investment beyond that calculated in this analysis.

Highlighting the economic value of natural goods and services

The following section describes the economic value of select natural goods and services provided by conserved lands in Virginia.

Drinking water protection

The quality of surface drinking water supplies is affected by land use in their surrounding watersheds. According to the most recent drinking water and groundwater statistics from the United States Environmental Protection Agency, 6.34 million Virginia residents, representing 89.4 percent of the population served, receive their drinking water from surface water sources.³³ Natural lands filter contaminants out of stormwater runoff. Protecting these lands also prevents contaminated runoff from entering drinking water from developed areas. As Table 3 shows, 3 percent of Virginia's population served by public water systems, or about 197,000 residents, was exposed to drinking water with reported violations of clean water protections.

TABLE 3. VIRGINIA WATER SYSTEMS, 2011

	Water system type				Source of water			CWSs with reported health-based violations	
	CWS*	NTNCWS**	TNCWS**	Total	Ground	Surface	Total	Systems	Percent
Systems	1,170	544	1,070	2,790	2,400	392	2,790	116	4%
Population	6,610,000	315,000	168,000	7,090,000	751,000	6,340,000	7,090,000	197,000	3%

* A community water system (CWS) is a public water system that supplies water to the same population year round.

** A non-transient non-community water system (NTNCWS) is a public water system that regularly supplies water to at least 25 of the same people at least six months per year but not year round. Some examples are schools, factories, office buildings, and hospitals that have their own water systems.

*** A transient non-community water system (TNCWS) is a public water system that supplies water to places such as gas stations or campgrounds where people do not remain for long periods.

Source: U.S. Environmental Protection Agency, *Fiscal Year 2011 Drinking Water and Ground Water Statistics* EPA816-R-13-003, 2013.

Land conservation and open spaces in Virginia can protect and enhance drinking water quality. By providing vegetation and pervious soils, these areas can capture runoff, enhance infiltration, and remove sediments and pollutants.³⁴ Forests safeguard drinking water quality. In fact, the more forestland around a source of drinking water, the better the water quality and lower the treatment costs.³⁵ The National Research Council reports that nearly two-thirds of the country's clean water

33 The United States Environmental Protection Agency tracks public drinking water systems in the United States that regularly supply drinking water to at least 25 people or have 15 service connections for 180 or more days per year. These statistics do not include residents served by other types of drinking water systems, such as private wells. The total population served represents water users of each system and as such some people may be counted more than once if they are served by multiple systems (e.g., schools, factories, office buildings, and hospitals). The population served is different from the state's total population, which was 8 million in 2010. Source: U.S. Census Bureau, *State and County QuickFacts: Virginia*, accessed May 26, 2015, <http://quickfacts.census.gov/qfd/states/51000.html>.

34 Julia C. Klapproth and James E. Johnson, *Understanding the Science Behind Riparian Forest Buffers: Effects on Water Quality*, Virginia Cooperative Extension, Virginia Tech, and Virginia State University, Publication 420-151, 2009, accessed June 28, 2016, <http://pubs.ext.vt.edu/420/420-151/420-151.pdf>.

35 The Trust for Public Land and American Water Works Association, *Using Land Conservation to Protect Drinking Water Supplies: Source Protection Handbook*, accessed May 28, 2015, http://cloud.tpl.org/pubs/water_source_protect_hbook.pdf.

supply is provided by forests.³⁶ Virginia's water quality is improved by forestland conservation at the federal, state, and local levels in Virginia.

For example, the George Washington National Forest is located completely within the Chesapeake Bay watershed and is a source of water that feeds into the James and Potomac Rivers, which provide water to approximately 4 million residents.³⁷

The Department of Forestry (DOF) conserves working forests that provide a host of benefits, including water quality protection, and utilizes a Water Quality Improvement Fund to aid in the implementation of best management practices.³⁸

Several communities in the southern Appalachian Mountains have recognized the economic savings provided by watershed protection. For example, the City of Roanoke, Virginia, donated a conservation easement to protect a significant portion of the watershed that provides its drinking water. In addition, Asheville, North Carolina, and Greenville, South Carolina, have protected their drinking water sources with conservation easements.³⁹

Flood control and prevention

Since January 2002, there have been three emergency declarations (Hurricanes Katrina, Irene, and Sandy) and 18 major disaster declarations in Virginia, at least nine of which included flooding.⁴⁰

In fact, between 2010 and 2014, 313 floods caused \$25.9 million in property damage in Virginia, according to the Hazards and Vulnerability Research Institute.⁴¹ The damages that result from flooding can include major road washouts, extensive debris and damage to state and local road infrastructure and facilities, and damage to private residences. Conserving land in floodplains can help to avoid these types of costs by preventing development in flood-prone areas. Wetlands and natural areas near rivers and streams also prevent costly property damage by absorbing and storing potentially devastating floodwaters.

36 National Research Council of the National Academies, Committee on Hydrologic Impacts of Forest Management, Water Science and Technology Board, Division of Earth and Life Studies, *Hydrologic Effects of a Changing Forest Landscape*.

37 Wild Virginia, *The State of Our Water: Managing and Protecting the Drinking Water Resources of the George Washington National Forest*, Charlottesville, VA: Wild Virginia, 2008, accessed May 26, 2015, <http://wildvirginia.org/wp-content/uploads/2009/01/state-of-our-water-full-report.pdf>.

38 "Cost Share Programs," Virginia Department of Forestry, accessed June 28, 2016, <http://www.dof.virginia.gov/costshare/index.htm>; "State Agencies That Protect Land," Virginia Department of Conservation and Recreation, accessed June 28, 2016, <http://www.dcr.virginia.gov/land-conservation/wheretogo3#flp>.

39 Wild Virginia, *The State of Our Water: Managing and Protecting the Drinking Water Resources of the George Washington National Forest*.

40 "Disaster Declarations for Virginia," U.S. Department of Homeland Security, Federal Emergency Management Agency, accessed April 6, 2016, <https://www.fema.gov/disasters/grid/state-tribal-government/22>.

41 Hazards and Vulnerability Research Institute, *The Spatial Hazard Events and Losses Database for the United States, Version 14.1* [Online Database], Columbia: University of South Carolina, 2016. Damages in 2014 dollars.

Dragon Run Watershed, King and Queen, Middlesex, Essex, and Gloucester Counties

Located in the historically and culturally rich landscape of the Middle Peninsula, the Dragon Run watershed is easily accessible from major urban centers of Richmond, Hampton Roads, and Fredericksburg. More than 21,000 acres of the 90,000-acre watershed have been protected as the result of a regional, collaborative conservation effort spanning 30 years and involving the Chesapeake Bay Foundation, the Friends of Dragon Run, the Middle Peninsula Chesapeake Bay Public Access Authority, The Nature Conservancy, the Virginia Department of Forestry, the Virginia Institute of Marine Science, and the Virginia Outdoors Foundation.

State investments in this project through the Virginia Land Conservation Foundation and the Virginia Public Building Authority have been matched by over \$29 million in private and federal funding: over \$7 million in grants from the U.S. Forest Service, U.S. Fish and Wildlife Service, and the National Oceanic and Atmospheric Administration; a \$10 million gift from a private individual; and \$12 million in private conservation transactions where The Nature Conservancy acquired properties, encumbered them with conservation easements, and then sold the land to private individuals.

Forest is the predominant land cover type in the Dragon Run watershed. These forests play an integral role in maintaining water quality, while serving as the backbone of the economy in the region. More than 70 percent of the Dragon Run watershed is under active forest management. For example, the state actively manages all state forestland in the Dragon Run watershed for working forest purposes. Revenue from timber managed on the property is reinvested back into the state forest. On average, between 2002 and 2012, the counties of King and Queen, Middlesex, Essex, and Gloucester produced over \$9.10 million in timber each year.⁴² All conservation easements held by The Nature Conservancy allow for timber management with protections for riparian buffers and sustainable forest management. The working nature of these lands is essential to the local economy. In fact, in 1999 the Virginia Department of Forestry valued the total economic output of the forests in the Middle Peninsula at \$845 million, generating almost 6,880 jobs.⁴³

If these lands had not been protected by the conservation partners in the Dragon Run watershed, the forests may have been converted to other uses or divided into small lots, degrading the wetlands and streams of the system. Instead, the working landscape is maintained, and residents and visitors have the opportunity to walk the pine and hardwood forests of the watershed, paddle along diverse wetlands, or fish one of the best native fisheries in the Coastal Plain.



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42 "Harvest Value Ranking," Virginia Department of Forestry, accessed May 20, 2016, <http://dof.virginia.gov/harvest/data/harvest-value-ranking.htm>.

43 Middle Peninsula Planning District Commission, *Comprehensive Economic Development Strategy*, 2013, accessed May 20, 2016, http://www.mppdc.org/articles/reports/CEDS_FINAL_140110_RED.pdf.

Leveraged federal, local, private, and nonprofit funding

Virginia's investment in conservation leverages funding from federal, local, private, and nonprofit sources. By attracting support from other sources, the Commonwealth of Virginia does not have to bear the entire cost burden of a project and therefore maximizes its investment. By leveraging funds, more local projects can be completed, creating additional economic benefits.

Every dollar spent by the commonwealth is matched by at least one dollar of federal, local, private, or nonprofit funding. For example, between 1999 and 2014, the Virginia Land Conservation Foundation (VLCF) leveraged at least \$78.1 million in federal, local, private, and nonprofit funding for conservation easements and land purchases. That is, every \$1 of spending on land conservation by VLCF was matched by at least \$2 in contributions from other non-state sources.⁴⁴



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⁴⁴ Analysis conducted by The Trust for Public Land using data from the Conservation Almanac. The Trust for Public Land, *Conservation Almanac*, www.conservationalmnac.org.

Pinnacle Natural Area Preserve, Russell County

Named for a towering rock outcrop known locally as The Pinnacle, a sheer spire of dolomite nearly 400 feet tall, this Natural Area Preserve is characterized by a diverse array of rare plants, animals, and natural communities, as well as its fascinating geological formations. The preserve is located in southwestern Virginia, about 25 miles north of Abingdon, and within the Clinch River watershed, which contains the highest number of globally imperiled freshwater species in the continental United States. The preserve borders Big Cedar Creek – a state scenic river – for two miles to its confluence with the Clinch River. The waters running through the preserve support a rich diversity of aquatic life. The preserve's habitats support at least nine rare plant species, five rare animal species, and four natural communities. Big Falls, an impressive waterfall in Big Cedar Creek, is formed where the creek passes over several layers of erosion-resistant sandstone. The geological diversity here has led to extraordinary biological diversity and created conditions suitable for several rare species.

The protection of Pinnacle Natural Area Preserve's 12 separate parcels began with a land donation in 1989 and continued over time with purchases by The Nature Conservancy and the Virginia Department of Conservation and Recreation. One-third of the parcels were secured through grants from the Virginia Land Conservation Foundation, which helped leverage other funds, including grants from the U.S. Fish and Wildlife Service. The 1992 and 2002 Virginia Parks and Natural Areas bonds also supported land acquisition for the preserve.

The preserve is open year round with public facilities including parking, a suspension foot-bridge over Big Cedar Creek, four miles of hiking trails, picnic tables, and a day-use shelter, among other amenities. Fishing is allowed within the preserve along Big Cedar Creek and the Clinch River. The preserve is especially suited for hiking, nature study, fishing, and photography. Extraordinary canoeing and kayaking opportunities are also available through the preserve on the Clinch River between Puckett's Hole and Nash's Ford where the Virginia Department of Game and Inland Fisheries manages publicly accessible boat ramps. Nearly 12,700 people visited Pinnacle Natural Area Preserve in 2014. While visitation is distributed throughout the year, it increases in the spring due to increased fishing opportunity and the display of spring wildflowers that attract hikers.⁴⁵



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45 Claiborne Woodall, Virginia Department of Conservation and Recreation, e-mail message to author, May 16, 2016.

Land conservation supports the economy

Along with providing natural goods and services, land conservation contributes to the Virginia economy in terms of jobs, business growth, taxes, tourism, and other revenue.

Providing opportunities for outdoor recreation and tourism

Outdoor recreation would not be possible without natural areas in which recreation can take place. The tourism economy depends on the abundance of natural and other amenities to attract visitors. Thus, this section includes information on the economic impacts of the outdoor recreation and tourism economies. Unfortunately, there is substantial overlap between these industries and their impacts cannot be summed; however, the following narrative describes each industry and the contribution it makes to the economy.

Outdoor recreation is an important industry in Virginia. Each year, it generates \$13.6 billion in consumer spending and \$923 million in state and local tax revenues. This spending creates 138,000 direct Virginia jobs associated with \$3.9 billion in wages and salaries.⁴⁶

Opportunities for outdoor recreation are important to Virginians. About 46 percent of the commonwealth's residents participate in outdoor recreation each year.⁴⁷ A recent survey confirmed the importance of these opportunities and demonstrated the public's commitment to the protection of natural areas. The most frequently mentioned recreational activities were walking, visiting historic sites, visiting parks, and visiting natural areas, preserves, or refuges. The survey also found that trails, access to state waters, and access to natural areas were the biggest recreation needs.⁴⁸

In addition, Virginia's scenery and outdoor recreation opportunities are an important part of the state's tourism industry, which is a key component of the commonwealth's economy.⁴⁹ In 2013, tourism expenditures totaled \$21.5 billion, generating \$1.42 billion in state and local taxes. These tourism expenditures supported 213,000 jobs, or 7 percent of total private employment in Virginia, making the tourism industry the fifth-largest employer in the state.⁵⁰ In 2014, one-fourth of Virginia leisure travelers participated in outdoor activities such as going to the beach, bird watching, camping, hiking, and visiting state and national parks, among others.⁵¹ Of those who visit and participate in sports, recreation, nature, or outdoor attractions, the average travel party spending was \$609.⁵² These visitors often come to experience the commonwealth's 35 state parks, 48 national parks and forests, numerous beaches, lakes, rivers, trails, and water trails. Key outdoor attractions include the Appalachian Trail, the Wilderness Road Trail, the Virginia Creeper Trail, and U.S. Bike 76 Route. Skyline Drive, the Blue Ridge Parkway, and the Colonial Parkway also provide opportunities for tourists to experience the natural beauty of Virginia.⁵³

46 Outdoor Industry Association, *The Outdoor Recreation Economy*, Virginia, Boulder, CO: Outdoor Industry Association, accessed May 19, 2015, https://outdoorindustry.org/images/ore_reports/VA-virginia-outdoorrecreationconomy-oia.pdf.

47 Ibid.

48 James M. Ellis et al., *2011 Virginia Outdoors Demand Survey: Report Results*, Charlottesville, VA: Weldon Cooper Center for Public Service, University of Virginia, 2012, CSR Project 11.001, accessed June 28, 2016, <http://www.dcr.virginia.gov/recreational-planning/document/vosexecsum11.pdf>.

49 Chmura Economics and Analytics, *Tourism Works for Virginia*, Richmond, VA: Chmura Economics and Analytics, 2014, accessed May 22, 2015, <http://www.vatc.org/uploadedFiles/Research/TourismWorksforVirginia.pdf>.

50 U.S. Travel Association, *The Economic Impact of Domestic Travel on Virginia Counties 2013, 2014*, accessed May 19, 2015, <https://www.vatc.org/uploadedFiles/Research/2013EconomicImpactofDomesticTravelonVirginiaandLocalities.pdf>.

51 Christina Rehklau, research manager, Virginia Tourism Corporation, e-mail message to author, June 2, 2015.

52 TNS TravelsAmerica, *Sports, Recreation, Nature/Outdoors Travel Profile to Virginia*, FY 2013, Virginia Tourism Corporation, accessed May 19, 2015, <https://www.vatc.org/uploadedFiles/Research/SportsRecreationNatureOutdoorsVATripProfileFY2013VAModule.pdf>.

53 Price Waterhouse Coopers, LLP, *Virginia State Tourism Plan: Project Overview*, Virginia Tourism Corporation, draft report, 2012, accessed June 28, 2016, https://www.vatc.org/uploadedFiles/Partnership_Alliance_Marketing/VirginiaSTP_Project%20Overview_DRAFT_10-22-12.pdf.

State parks

State parks attract visitors and tourist spending. In 2014, Virginia State Parks set a new attendance record with nine million visitors, which was 1.4 percent higher than the prior year's record attendance. This figure included over one million overnight visitors, which, when combined with day-use attendance, generated an economic impact of \$208 million. The top parks in terms of overnight attendance include First Landing State Park in Virginia Beach (132,000 overnight visitors), Pocahontas State Park in Chesterfield County, Virginia, (124,000 overnight visitors), and Douthat State Park in Bath and Alleghany Counties, Virginia, (83,800 overnight visitors).⁵⁴

State parks help foster economic development. For example, recent surveys indicate that New River Trail State Park positively impacts businesses in the community. Local business owners attribute an average 8 percent of their business revenue to the trail. In addition, the average spending by trail users was \$133 for private lodging, \$44 for restaurants, \$32 for other food, and \$43 for gasoline.⁵⁵

One study found that the creation of a state park on the Clinch River would have an economic impact on four Virginia counties. The study estimated that over 106,000 people would visit the park after the third year. About 18 percent of these visitors would be from out of state. The park's five-year development and construction would generate an annual impact of \$3.58 million and create 31 local jobs. Subsequent park development would produce approximately \$1.95 million and retain 14 local jobs. Excluding economic activity created by construction, the first five years of the park would prompt an ongoing annual economic impact of \$2.53 million and sustain 23 jobs. Furthermore, local tax revenues would be expected to increase by about \$22,000 each year.⁵⁶



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54 "Virginia State Parks 2014 Attendance and Economic Impact," Virginia Department of Conservation and Recreation, accessed June 28, 2016, <http://www.dcr.virginia.gov/state-parks/document/14parkattend.pdf>; "Virginia State Parks Visitation Continues to Reach Record Levels," Virginia Department of Conservation and Recreation Press Release, January 9, 2015, accessed June 28, 2016, <http://www.dcr.virginia.gov/pr-relz-detail?id=2015-01-13-14-31-02-396386-v3G>.

55 Stephen Cox et al., *Building Connectivity through Recreation Trails: A Closer Look at New River Trail State Park and the Virginia Creeper Trail*, Blacksburg, VA: Economic Development Studio at Virginia Tech, 2011, accessed June 28, 2016, http://www.vacrepertrail.org/sites/default/files/page_attachments/FinalReport_Impact%20of%20Trails_Fall2011Studio.pdf.

56 Chmura Economics and Analytics, *Economic Impact Analysis of the Proposed Clinch River State Park*, Richmond, VA: Chmura Economics and Analytics, 2013, accessed June 28, 2016, <https://clinchriverva.files.wordpress.com/2011/11/clinch-river-economic-impact-study-2013.pdf>.

Hunting

Hunting is a big part of the tourism economy in Virginia. Over 432,000 people hunted in Virginia in 2011, and over 106,000 of them were from out of state. In fact, Virginia ranks fifth in the country for the number of nonresident hunters and these visitors spend almost \$136 million in retail sales.⁵⁷ The Department of Game and Inland Fisheries maintains 41 wildlife management areas that are available for outdoor recreation as well as hunting, fishing, boating, and wildlife watching.⁵⁸

Heritage tourism

In addition to the commonwealth's natural beauty, its rich history and abundant cultural resources make it a top destination for visitors.⁵⁹ Virginia has over 2,800 registered historic places and 100 Civil War battlefields, which attract tourists each year.⁶⁰ National Park Service Civil War battlefields and historic sites in Missouri, Pennsylvania, South Carolina, Tennessee, and Virginia attract approximately 15.8 million people each year. These visitors spend nearly \$442 million in local communities and support 5,150 jobs. In Virginia, Civil War visitors stay twice as long as the average tourist and spend twice as much. In 2010, over 130,000 visitors to Richmond National Battlefield Park spent over \$9 million locally.⁶¹

Supporting the agriculture, forestry, and fishing industries

Land conservation supports the agriculture, forestry, and commercial fishing sectors, which play an important role in the commonwealth's economy and are among the top industries statewide. Every locality in Virginia is affected by agriculture or forest-related industries. In fact, 68 localities have total employment impacts of 1,000 jobs or more with agriculture having the largest and most dispersed impacts.⁶²

Agriculture

There are approximately 46,000 farms in Virginia, comprising over 8.30 million acres. In 2012, these farms generated agricultural sales totaling over \$3.75 billion.⁶³ Statewide, agricultural-related industries have a total impact of over \$52 billion in output and approximately 311,000 jobs.⁶⁴

Agriculture is an important part of the economy in Virginia, even in communities that appear to be largely urbanized. For example, in Virginia Beach, the state's largest city, farmland and forestland support over 200 farms and farm-related businesses.⁶⁵ Furthermore, agriculture in Fauquier County accounts for approximately 2,250 jobs and \$163 million in total output.⁶⁶

57 Southwick Associates, *Hunting in America: An Economic Force for Conservation*, produced for the National Shooting Sports Foundation in partnership with the Association of Fish and Wildlife Agencies, 2012, accessed June 28, http://www.nssf.org/pdf/research/huntinginamerica_economicforceforconservation.pdf.

58 "Wildlife Management Areas," Virginia Department of Game and Inland Fisheries, accessed May 22, 2015, <http://www.dgif.virginia.gov/wmas/>.

59 Chmura Economics and Analytics, *Tourism Works for Virginia*.

60 Price Waterhouse Coopers, LLP, *Virginia State Tourism Plan: Project Overview*, Virginia Tourism Corporation, draft report, 2012, accessed June 28, 2016, https://www.vatc.org/uploadedFiles/Partnership_Alliance_Marketing/VirginiaSTP_Project%20Overview_DRAFT_10-22-12.pdf.

61 Harbinger Group, *Blue, Gray, and Green: Economic and Tourism Benefits of Battlefield Preservation*, prepared for Civil War Trust, based on a 2006 Civil War Trust study and research by Davidson-Peterson Associates, accessed May 28, 2015, <http://www.civilwar.org/land-preservation/blue-gray-and-green.pdf>.

62 Terance J. Rephann, *The Economic Impacts of Agriculture and Forest Industries in Virginia*, Charlottesville, VA: Weldon Cooper Center for Public Service, University of Virginia, 2013, accessed June 28, 2016, http://www.coopercenter.org/sites/default/files/publications/Virginia%20AgricultureForest%202012reva_0.pdf.

63 U.S. Department of Agriculture, *Census of Agriculture, 2012 Census Volume 1*, "Chapter 2: State Level Data," accessed May 21, 2015, http://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_2_US_State_Level/.

64 Terance J. Rephann, *The Economic Impacts of Agriculture and Forest Industries in Virginia*.

65 Terance J. Rephann, *Agriculture in Virginia Beach: Impact on the City Economy*, Charlottesville, VA: Weldon Cooper Center for Public Service, University of Virginia, 2014, accessed June 28, 2016, http://www.coopercenter.org/sites/default/files/documents/VB_agriculture.pdf.

66 Terance J. Rephann, *Agriculture in Fauquier County: Characteristics, Trends, and Economic Impacts*, Charlottesville, VA: Weldon Cooper Center for Public Service, University of Virginia, 2012, accessed June 28, 2016, <http://www.coopercenter.org/sites/default/files/publications/fauquier%20county%20agriculture.pdf>.

Forestry

Virginia is a major producer of both softwood and hardwood timber.⁶⁷ There are 15.8 million acres of commercial forest in Virginia, and the forest products industry contributes \$17 billion annually to the commonwealth's economy, employing an estimated 103,000 people, or 2.5 percent of the state's workforce.⁶⁸ In 2009, the state had 129 sawmills, 8 pulp mills, and 14 other mills.⁶⁹

Fishing

Conserved lands and open space help improve and protect water quality, which is important to Virginia's commercial fishing industry. In 2013, approximately 11,500 commercial fishing licenses were sold in the commonwealth, generating over \$437,000.⁷⁰ In addition, in 2013 almost 382 million pounds of seafood were landed, at a value of over \$163 million.⁷¹ This includes over \$32.6 million in sea scallops, over \$25.3 million in menhaden, \$25.3 million in eastern oysters, \$22.3 million in northern quahog clams, and \$22.0 million in blue crab. Landings of summer flounder, Atlantic croaker, and striped bass were also over \$5 million each.⁷² Recreational fishing is also important to the economy. In Virginia, 833,000 resident and nonresident anglers fish each year and these anglers spend over \$1.14 billion on equipment and trip-related expenditures.⁷³



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67 Terance J. Rephann, *The Economic Impacts of Agriculture and Forest Industries in Virginia*.

68 Virginia Department of Forestry, *The Value of Virginia's Forests*, Charlottesville, VA: Weldon Cooper Center, University of Virginia, 2015, accessed June 30, 2016, http://www.dof.virginia.gov/infopubs/Value-of-VAs-Forests_pub.pdf.

69 Thomas J. Brandeis et al., *Economic Dynamics of Forest and Forest Industries in the Southern United States*, Asheville, NC: U.S. Department of Agriculture Forest Service Southern Research Station, 2012, e-General Technical Report SRS-152, accessed June 28, 2016, <http://www.srs.fs.usda.gov/pubs/40452>.

70 Virginia Marine Resources Commission, "VMRC Sales of Commercial License by Calendar Year," accessed May 26, 2015, <http://mrc.virginia.gov/commlicensesales.pdf>.

71 National Oceanic and Atmospheric Administration, National Marine Fisheries Service, *Commercial Fisheries Statistics: Annual Commercial Landing Statistics*, National Marine Fisheries Service, MFS Landings Query Results, from 2013 to 2013, all species combined, Virginia, accessed May 26, 2015, <http://www.st.nmfs.noaa.gov/commercial-fisheries/commercial-landings/annual-landings/index>.

72 National Oceanic and Atmospheric Administration, National Marine Fisheries Service, *Commercial Fisheries Statistics: Annual Commercial Landings by Group*, Annual Landings by Species for Virginia as of 25-MAY-2015, accessed May 26, 2015, <http://www.st.nmfs.noaa.gov/commercial-fisheries/commercial-landings/annual-landings-with-group-subtotals/index>.

73 U.S. Department of the Interior, U.S. Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau, *2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation: Virginia*, accessed April 19, 2016, <http://www.census.gov/prod/2013pubs/fhw11-va.pdf>.

James Madison's Montpelier, Orange County

In 2009, more than 700 acres surrounding James Madison's Montpelier estate were protected with conservation easements, forever preserving the context of the newly restored mansion and providing a foundation for future conservation efforts on the property and the surrounding community.

A grant of \$700,000 from the Virginia Land Conservation Foundation leveraged private donations of at least \$1 million, allowing the Piedmont Environmental Council (PEC) to work with the Montpelier Foundation and the National Trust for Historic Preservation to place easements on four distinct properties surrounding the core of the estate.⁷⁴ Two of those easements, representing the forested mountain backdrop of Madison's home, are co-held by PEC and the Virginia Outdoors Foundation. Two other easements, protecting a post-Civil War freedman's farm and the Civil War encampment of Confederate troops during the winter of 1863-1864, are co-held by PEC and the Virginia Department of Historic Resources.

The conserved properties have become an integral part of telling the story of Madison's Montpelier and are now open to the public. A trail on the Civil War encampment property illustrates the challenges faced by thousands of troops trying to survive a brutal winter in the midst of war. Likewise, living-history demonstrations at the estate's Gilmore Farm bring to life the day-to-day struggles of former slave families immediately after the Civil War.

Connecting Montpelier with the broader community throughout Orange County has been a theme that continued in 2015 with the completion of a trail connection between Montpelier and the Market at Grelen, a nearby farm, nursery, and event venue. "The trail has quickly become a popular destination among locals and visitors alike," says Dan Gregg, owner and founder of Grelen Nursery. Over seven miles of trails are now available to the public between the two sites. The trail network, along with Montpelier, provides some of the only public access to the largely conserved Madison-Barbour Rural Historic District, along with scenic vistas of the Blue Ridge Mountains.

"My hope is that the trail provides one more reason for visitors to extend their stay from a day to a weekend, so that local inns, hotels, restaurants, and other businesses benefit as well," says Kat Imhoff, president and CEO of the Montpelier Foundation.



⁷⁴ The National Trust for Historic Preservation is the owner the historic estate, which is operated by the Montpelier Foundation.

Economic development

Quality of life

Quality of life plays a critical role in Virginia's economic development because the most sought-after employees in today's economy consider more than salary when choosing places of employment. For example, one survey of high-tech workers found that a job's attractiveness increases by 33 percent in a community with a high quality of life.⁷⁵

In addition, businesses are drawn to these places to recruit the best workers. For example, Northrop Grumman Corp chose to locate in Virginia because of the state's high quality of life and business-friendly government. Governor Bob McDonnell said that the company was looking for a great place for its executives to live.⁷⁶

Open space amenities can enhance a community's quality of life. Places with beautiful scenery, clean air and water, and diverse opportunities for outdoor recreation attract skilled workers and businesses to Virginia. In 2015, *Forbes* ranked Virginia the seventh-best state for business and careers, based on a host of factors including quality of life, for which it ranked fifth in the nation.⁷⁷ Communities are continually recognizing the importance of open space and quality of life in their economic development strategies. For example, the City of Falls Church recognizes the role that its parks play in boosting the community's quality of life and ability to attract businesses.⁷⁸

Fiscal health

Land conservation also saves Virginia communities money through avoided costs on expensive infrastructure and other municipal services required by residential property owners, such as schools, police, and fire protection. Research conducted in six Virginia counties shows that on average, residential lands require \$1.18 in services for every \$1.00 paid in local taxes. At the same time, working and open lands only require \$0.35 in services for every dollar contributed in property taxes. For example, in Culpeper County, Virginia, lands used for working and open space purposes require \$0.32 in services for every dollar paid in taxes, while residential lands use \$1.22 in services for every dollar paid in taxes.⁷⁹

75 Garry Sears and Daniela De Cecco, *High-Tech Labour Survey: Attracting and Retaining High-Tech Workers*, Ottawa: KPMG and CATA Alliance, 1998, accessed June 21, 2016, <http://www.cata.ca/files/PDF/misc/High-TechLabourSurvey98.pdf>.

76 Jeff Clabaugh, "Governor: Quality of Life Attracted Northrop Grumman to Virginia," *Washington Business Journal*, April 27, 2010, accessed June 9, 2015, <http://www.bizjournals.com/washington/stories/2010/04/26/daily17.html>.

77 *Forbes*, "The Best States for Business and Careers," accessed August 4, 2016, <http://www.forbes.com/best-states-for-business/list/>.

78 Paul Stoddard, "City Views: Planning the Future of the City's Parks," City of Falls Church, Virginia, *City Views Blog*, September 3, 2014, accessed June 2, 2015, <http://www.fallschurchva.gov/Blog.aspx?IID=19>.

79 American Farmland Trust, Farmland Information Center, *Fact Sheet: Cost of Community Services Studies*, Washington, DC: American Farmland Trust, 2010, accessed June 28, 2016, http://www.farmlandinfo.org/sites/default/files/COCS_08-2010_1.pdf.

Human health benefits

In addition to ensuring clean air, clean drinking water, and local food sources, land conservation promotes a physically active lifestyle. Studies have linked access to parks and open space to increased physical activity and better health, which translates into fewer missed days of work, higher productivity at work, and fewer visits to the doctor. The Trust for America's Health reports 25.5 percent of Virginia adults were physically inactive in 2013.⁸⁰ In addition, 59.7 percent of adult females and 69.6 percent of adult males in the state were overweight or obese in 2014.⁸¹

Access to places for physical activity along with informational outreach has been shown to produce a 48 percent increase in the frequency of physical activity.⁸² Availability of parks and proximity to them increases the physical activity of children. Researchers have found that as the percentage of park area within a child's neighborhood increases, so does a child's physical activity.⁸³ While the health benefits are impressive on their own merit, they also translate into improved economic health.

The costs of obesity are substantial and include direct medical expenses and the reduced productivity of obese workers. Studies have shown that the very obese lose one month of productive work per year without considering the extra sick days taken. This costs employers an average of \$3,790 per very obese male worker and \$3,040 per very obese female worker each year.⁸⁴ Higher rates of obesity also mean higher medical costs. Obese people have medical costs \$1,430 higher than those of normal weight on average.⁸⁵ Health care spending related to obesity in Virginia is predicted to reach between \$4.20 billion and \$9.38 billion by 2018.⁸⁶

80 "Key Health Data About Virginia," Trust for America's Health, accessed March 31, 2016, <http://healthyamericans.org/states/?stateid=VA>.

81 "Overweight and Obesity Rates for Adults by Gender," The Henry J. Kaiser Family Foundation, accessed March 31, 2016, <http://kff.org/other/state-indicator/adult-overweightobesity-rate-by-gender/>.

82 Emily B. Kahn et al., "The Effectiveness of Interventions to Increase Physical Activity: A Systematic Review," *American Journal of Preventive Medicine* 22, no. 45 (2002): 73-107.

83 James Roemmich et al., "Association of Access to Parks and Recreational Facilities with the Physical Activity of Young Children," *Preventive Medicine* 43, no. 6 (2006): 437-441; James Roemmich et al., "The Neighborhood and Home Environments: Disparate Effects on Physical Activity and Sedentary Behaviors in Youth," *Annals of Behavioral Medicine* 33, no. 1 (2007): 29-38.

84 Sharon Begley, "As America's Waistline Expands, Costs Soar," *Reuters*, April 30, 2012, accessed February 11, 2014, <http://www.reuters.com/article/2012/04/30/us-obesity-idUSBRE83T0C820120430>.

85 Centers for Disease Control and Prevention, "Adult Obesity," *Vital Signs*, August 2010, accessed June 28, 2016, <http://www.cdc.gov/vitalsigns/adultobesity/>.

86 Kenneth E. Thorpe, *The Future Costs of Obesity: National and State Estimates of the Impact of Obesity on Direct Health Care Expenses*, United Health Foundation, American Public Health Association, and Partnership for Prevention, 2009, accessed June 28, 2016, <http://www.nccor.org/downloads/CostofObesityReport-FINAL.pdf>.

Conclusion

Virginia's investments in land conservation are critical to creating and protecting the places and amenities that make the state a great place to live and work. Land and water conservation contributes to a high quality of life while simultaneously stimulating economic activity across the state. This study found that every \$1 invested in land conservation by the Commonwealth of Virginia returns \$4 in economic value of natural goods and services.

In addition, because the state is able to leverage additional funds, every dollar invested is maximized in terms of the economic benefits it generates for the people, communities, and businesses of Virginia.

Furthermore, conservation lands contribute to the economic well-being of the state by attracting visitors who spend money in local communities. Protected lands also bolster the state's outdoor recreation economy, as well as the agriculture, forestry, and commercial fishing industries. These industries generate billions of dollars in output and support tens of thousands of jobs.

Finally, land conservation contributes to Virginia's quality of life, which provides economic development opportunities. Conservation lands also help communities maintain their fiscal health, and by providing a place for physical activity, these lands lead to major savings in health care costs.



DAVID W. HARP

About The Trust for Public Land

The Trust for Public Land has extensive experience in determining the return on state investment in land conservation. Its Conservation Economics team has published return-on-investment analyses in states across the country, including Colorado, Georgia, Illinois, Maine, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, and Wyoming. The Trust for Public Land has worked with leading academic partners to advance this research, including Colorado State University, Dartmouth College, Georgia Institute of Technology, Plymouth State University, University of Georgia, University of Minnesota, and University of Wyoming–Ruckleshaus Institute of Environment and Natural Resources.

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Appendix: Methodology

The natural goods and services provided by the distinct ecosystem types found within Virginia's conserved lands, and their monetary values, were determined using the benefits transfer methodology. That is, The Trust for Public Land conducted a thorough literature review of the types of natural goods and services provided by the 15 ecosystem types identified in conserved lands using recent, relevant, and scientifically sound sources. The Trust for Public Land then used the economic values of the different ecosystem types identified in that literature to estimate a per-acre economic value of the goods and services provided.

Benefits transfer methodology has become a common approach in environmental economics because it is a practical alternative to time-intensive and data-intensive original research.¹ This methodology is not without its limitations, though, which can include the levels of uncertainty that may come from utilizing data collected in one region to describe another. In addition, there may be other, more specific land types (such as urban wetlands) that are not available in existing data sets for Virginia.² However, until more time- and resource-intensive, wide-scale primary data collection can take place, benefits transfer provides a conservative estimate of the value of natural goods and services.

The Trust for Public Land followed the steps below in conducting the benefits transfer:³

STEP 1. Define the policy context. This definition should include various characteristics of the program site, what information is needed, and in what units.

STEP 2. Locate and gather original research outcomes. Conduct a thorough literature review, and obtain copies of potentially relevant studies.

STEP 3. Screen the original research studies for relevance. How well does the original research context correspond to the policy context? What is the quality of the original research?

STEP 4. Select a point estimate or average of a range of point estimates. Convert each to dollars per acre.

STEP 5. Transfer the point estimate or average value estimate. Aggregate the point estimate or average value estimate by multiplying it by the total number of acres, providing a total value for the good or service at the program site.

The Trust for Public Land considered a broad set of natural goods and services based on the availability of high-quality sources, but did not examine every natural good and service.

An analysis of additional natural goods and services would reveal further benefits and therefore is likely to underestimate the “true” economic value and return on investment examined in this study. For example, as shown in Table A, forests provide air quality improvements, carbon sequestration and storage, and water quality protection. Virginia's forests also offer other services, such as wildlife habitat-related benefits; however, the per-acre value of these benefits have not been measured in the literature. As such, they are not included in the analysis, and the value of each land cover type underestimates the true value of these natural goods and services.

Based on existing research, The Trust for Public Land determined the natural goods and services provided and estimated their values for each land cover type, as shown in Table A.

1 Robert J. Johnston and Randall S. Rosenberger, “Methods, Trends and Controversies in Contemporary Benefit Transfer,” *Journal of Economic Surveys* 24, no. 3 (2010): 479-510.

2 If more detailed data were available, it can be assumed that the analysis would result in a more specific estimate.

3 Randall S. Rosenberger and John B. Loomis, “Benefit Transfer” in *A Primer on Nonmarket Valuation*, ed. Patricia Champ, Kevin Boyle, and Thomas Brown, Norwell, MA: Kluwer Academic Publishers, 2003, 445-482.

TABLE A. ESTIMATED ANNUAL PER-ACRE VALUE OF NATURAL GOODS AND SERVICES BY LAND COVER TYPE

Land cover type*	Natural goods and services	Annual value per acre**
Deciduous Forest	Air pollution removal, carbon sequestration, carbon storage, water quality protection/erosion control	\$430
Woody Wetland	Water quality and habitat	\$1,310
Evergreen Forest	Air pollution removal, carbon sequestration, carbon storage, water quality protection/erosion control	\$428
Pasture/Hay	Carbon sequestration, biodiversity/habitat, livestock/livestock products, and pollination services	\$172
Shrub/Scrub	Biodiversity/habitat, carbon sequestration	\$16
Cultivated Crops	Food production	\$42
Emergent Herbaceous Wetland	Water quality and habitat	\$1,310
Mixed Forest	Air pollution removal, carbon sequestration, carbon storage, water quality protection/erosion control	\$428
Developed Open Space	Air pollution removal, carbon sequestration, stormwater management	\$1,800
Grassland/Herbaceous	Carbon sequestration, biodiversity/habitat, and pollination services	\$152
Open Water	Freshwater regulation and supply, wildlife habitat	\$239
Developed***	No natural goods and services provided	N/A
Barren Land	No natural goods and services provided	N/A

*In order from the most commonly conserved to the least commonly conserved.

**All values are reported in 2015 dollars.

***The developed category combines low-, medium-, and high-intensity cover types. This includes areas with a mixture of constructed materials and vegetation with impervious surface accounting for between 20 percent and 100 percent of the total land cover.

Natural goods and services included in annual value per-acre calculation

FORESTS (DECIDUOUS, EVERGREEN, AND MIXED)

The Trust for Public Land analyzed four natural services provided by Virginia forests: air pollution removal, carbon sequestration, carbon storage, and water quality protection. The annual per-acre value of these services is \$430 for deciduous forest, \$428 for mixed forest, and \$428 for evergreen forest.

Forests provide clean air by removing harmful air pollutants. The Trust for Public Land considered the removal value of four major air pollutants: ozone (O₃), nitrogen dioxide (NO₂), particulate matter (PM₁₀), and sulfur dioxide (SO₂). The volume of pollutants removed from the air on an annual per-acre basis was derived from a U.S. Forest Service analysis of urban and community forests in Virginia.⁴ Pollution-removal dollar values on a per-volume basis were obtained for each of the air pollutants from the U.S. Forest Service's iTree Vue model. These dollar amounts represent the national median externality value of each air pollutant (i.e., the estimated costs of pollution to society that are not reflected in the market price of goods and services that produced the pollution).⁵

Forests remove carbon from the atmosphere, referred to as carbon sequestration. Carbon sequestration rates for deciduous and evergreen forests in the state were obtained from published

4 David J. Nowak and Eric J. Greenfield, *Urban and Community Forests in the Southern Atlantic Region*, Syracuse, NY: U.S. Department of Agriculture Forest Service, Northern Research Station, General Technical Report NRS-50, 2009.

5 *i-Tree Vue User's Manual*, v. 5.0, accessed April 5, 2016, https://www.itreetools.org/resources/manuals/Vue_Manual_v5.pdf.

research on how to calculate carbon in forests.⁶ The Trust for Public Land utilized regional estimates of average carbon stocks for different forest types in the Southeast at time of clear-cut and at the maximum length of tree life.⁷ The amount of carbon sequestered per acre per year was calculated by subtracting the average carbon density at the time of the clear-cut from the average carbon density at the maximum length of tree life for each forest type, and dividing by the maximum length of tree life. The social cost of carbon was used as the dollar value of carbon to calculate an annual per-acre value for carbon sequestration by forests in the state.⁸ The carbon sequestration rate of mixed forest was calculated as the average of the rates of the two aforementioned forest types.

The Trust for Public Land also utilized this report to estimate the value of carbon storage by forests, including carbon stored in live trees, standing dead trees, the understory, downed dead wood, and the forest floor. Carbon stored in the soil was not included.⁹ The value of carbon storage per acre was based on the regional estimates of 40-year carbon stocks for the same forest types as used for the carbon sequestration benefit.¹⁰

The per-acre value of water quality protection and erosion control was estimated using information regarding the Conservation Reserve Enhancement Program (CREP) in Virginia. The Trust for Public Land considered the per-acre payments to participants of the Southern Rivers CREP program as well as recent CREP payments made for forested riparian buffer maintenance practices across Virginia's counties. The lowest payment amount was used in the analysis to be conservative.

WETLANDS

The Trust for Public Land estimates the value of woody and emergent herbaceous wetlands in Virginia to be \$1,310 per acre per year for water quality and wildlife habitat. This value is based on a published meta-analysis that predicted wetland service values per acre across the country.¹¹

PASTURE

The Trust for Public Land estimates the annual value of carbon sequestration, wildlife habitat, pollination services, and production of livestock goods to be \$172 per acre of pasture.

The value of carbon sequestration was calculated using the social cost of carbon and the minimum grassland carbon sequestration volume per acre from a national study of carbon sequestration.¹²

The Natural Resource Conservation Service's former Grassland Reserve Program (GRP) provides a proxy measure of the value of pastureland for wildlife habitat. The program provides landowners financial incentives to conserve their land for wildlife habitat. This report used the statewide average of GRP rates to calculate an annual per-acre value.¹³

To estimate the value of livestock production, this analysis used the rental rate paid for pastureland, which is an implicit value for the production of food and goods from livestock. Rent represents the most accurate value of land compared with values associated with production and income, which

6 James E. Smith et al., *Methods for Calculating Forest Ecosystem and Harvested Carbon with Standard Estimates for Forest Types of the United States*, U.S. Department of Agriculture, Northeastern Research Station, General Technical Report NE-343, accessed April 5, 2016, http://www.nrs.fs.fed.us/pubs/gtr/ne_gtr343.pdf.

7 The Oak-Hickory forest type was used to estimate the carbon value of deciduous forests, while the average of the Loblolly-Shortleaf Pine and Longleaf-Slash Pine forest types was used for evergreen forests.

8 U.S. Environmental Protection Agency, "The Social Cost of Carbon," accessed February 28, 2014, <http://www.epa.gov/climate-change/EPAactivities/economics/scc.html>.

9 James E. Smith et al., *Methods for Calculating Forest Ecosystem and Harvested Carbon with Standard Estimates for Forest Types of the United States*.

10 Forty years was chosen as the basis of the storage analysis because a U.S. Forest Service report that found nearly 60 percent of Virginia's forests were over 40 years old. Source: Anita K. Rose, *Virginia Forests*, Knoxville, TN: U.S. Department of Agriculture Forest Service, Southern Research Station, 2001, Resource Bulletin SRS-120, accessed April 5, 2016, http://www.srs.fs.usda.gov/pubs/rb/rb_srs120.pdf.

11 Richard T. Woodward and Yong-Suhk Wui, "The Economic Value of Wetland Services: A Meta-Analysis," *Ecological Economics* 37 (2001): 257-270.

12 Stephen Earsom et al., *Carbon Sequestration Pilot Program: Estimated Land Available for Carbon Sequestration in the National Highway System*, U.S. Department of Transportation, Federal Highway Administration, 2010, accessed June 28, 2016, https://www.researchgate.net/publication/273138611_Carbon_Sequestration_Pilot_Program_Estimated_Land_Available_for_Carbon_Sequestration_in_the_National_Highway_System.

13 U.S. Department of Agriculture, "Rental Rates for GRP," accessed March 3, 2016, https://www.fsa.usda.gov/Internet/FSA_File/4grprentates.pdf.

reflect a variety of other forces and inputs. Annual data on pastureland rent (per acre) were obtained from United States Department of Agriculture's National Agricultural Statistics Service (NASS).¹⁴

The per-acre value of pollination services was calculated based on five of Virginia's top farm commodities, including soybeans, hay, cotton lint, apples, and grapes, that also were included in a recent study on crop dependence on native pollinators.¹⁵ The Trust for Public Land used this information to determine each crop's dependence on native bees, and then calculated the average annual crop production that is dependent on native bees.

SHRUB/SCRUB

The annual value of shrub/scrubland is estimated to be \$16.40 per acre for the provision of habitat and carbon sequestration. NRCS's former Grassland Reserve Program provides a proxy measure of the value of pastureland for wildlife habitat. The program provides landowners with financial incentives to conserve their land for wildlife habitat. The Trust for Public Land used the statewide average of GRP rates to calculate an annual per-acre value. Values for carbon sequestration were averaged from the mixed-forest and grassland land cover types because of the characteristics of shrub/scrub ecosystems in Virginia.¹⁶

CULTIVATED CROPS

Virginia receives \$42 per acre in annual value for each acre of cropland for food production. The rent paid by farm operators for cropland was used as the value of cropland for food production. Rent represents the most accurate value of land compared with values associated with production and income, which reflect other forces and inputs. Annual per-acre rent data were obtained from NASS.¹⁷

DEVELOPED OPEN SPACE (I.E., PARKS)

Open space near developed areas is typically parkland or characteristically similar to parks. The Trust for Public Land analyzed the value of air pollution removal, carbon sequestration, and stormwater management provided by parks in Virginia. The annual per-acre value of these services is \$1,800. As part of the Virginia Street Tree Assessment Project (an application of i-Tree Streets), Virginia Tech has estimated stormwater, carbon sequestration, and air quality benefits provided by street trees in numerous Virginia communities. Complete inventories were available for Alexandria, Abington, Arlington, Charlottesville, Leesburg, and Lexington. These inventories were used to calculate an average value per acre.¹⁸

GRASSLAND

Grassland provides an annual economic value of \$152 per acre in carbon sequestration, pollination services, and wildlife habitat. Values for carbon sequestration, pollination services, and wildlife habitat were transferred from the pasture calculation because of the similar levels of services provided by both land cover types; however, the value of livestock products was not included.

OPEN WATER

The annual value of open (surface) water of \$239 per acre for freshwater regulation and supply and wildlife habitat was obtained from a published study that calculated a region-specific ecosystem service value for a variety of ecosystem types found on U.S. National Wildlife Refuges.¹⁹

14 U.S. Department of Agriculture, National Agricultural Statistics Service, "Quick Stats," accessed February 26, 2016, <https://quickstats.nass.usda.gov/results/5B6D8BDC-1B95-3519-B8BF-89616EEACD04>.

15 Virginia Department of Agriculture and Consumer Services, "Virginia's Top 20 Farm Commodities," accessed April 5, 2016, <http://www.vdacs.virginia.gov/agriculture-top20.shtml>; John E. Losey and Mace Vaughan, "The Economic Value of Ecological Services Provided by Insects," *BioScience* 56, no. 4 (2006): 311-323.

16 U.S. Department of Agriculture, "Rental Rates for GRP," accessed March 3, 2016, https://www.fsa.usda.gov/Internet/FSA_File/4grprentates.pdf.

17 U.S. Department of Agriculture, National Agricultural Statistics Service, "Rental Rate of Non-Irrigated Cropland," accessed February 25, 2016, http://quickstats.nass.usda.gov/?sector_desc=ECONOMICS&commodity_desc=RENT&agg_level_desc=COUNTY&source_desc=SURVEY#8D175D70-86A2-32A8-99A8-1CF0078F9D10.

18 Virginia Tech, "Virginia Street Tree Assessment Project: An Application of i-Tree Streets," accessed March 1, 2016, <http://urbanforestry.frec.vt.edu/STREETS/reports.html>.

19 Molly Ingraham and Shonda Gilliland Foster, "The Value of Ecosystem Services Provided by the U.S. National Wildlife Refuge System in the Contiguous U.S.," *Ecological Economics* 67 (2008): 608-618.



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