USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE

Pennsylvania NRCS
STRATEGIC PLAN 2023–2027

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CONTENTS

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FOREWORD

DEAR FELLOW CONSERVATIONISTS,

Since 2010, Pennsylvania NRCS has embarked on a strategic planning process.

I am a believer that if you write it down, you are more likely to do it. Between 2011 and 2015, we installed 95,000 practices. Between 2016 and 2020, we installed 109,000 practices, and in the last two years, we have installed nearly 70,000 practices combined. That's nearly two-thirds of what we did in five years. Despite a pandemic, you, as conservationists continue to move product at higher rates and increase environmental outcomes. Within Pennsylvania, we are aiming to improve and expand communication, reduce acronyms, increase program promotion, and gear our efforts to a broader, more diverse audience.

You see, conservation is contagious. It is built on relationships. Working one-on-one with producers is the only way to get this done. Nonpoint source pollution, controlling invasive species, and building habitat is not done through an edict. When people see the science-based, well-planned, and designed conservation practices on the landscape, they want it on their own farm and in their own forests. Soon, word spreads and you all become very popular. People call it the "Elmer effect;" I call it good conservation.

Good conservation doesn't come easy and not just anyone can do it. It comes by hiring skilled individuals, who have a background in agronomy, biology, soils, engineering, economics, forestry, finance, and many other disciplines. It comes with good training, whether that be formalized training or consistent on-the-job training under the mentorship of experienced individuals. It comes with science-based, well-vetted conservation practice standards. Finally, it comes from quality control, conducting follow-up with our producers and the landscape to ensure that those practices we put on the landscape are of good quality and are functioning as planned and designed.

As you spread conservation, remember our conservation values that have proved timeless.

- Genuine land stewardship is based on conservation work that is voluntary;
- Landscape-scale results are achieved through site-specific solutions;
- Natural resource concerns cannot be treated in isolation, rather effective conservation is achieved using conservation systems, multiple practices working together to achieve optimum results;
- Coordinated action should be encouraged on a watershed or landscape scale; and
- Local leadership and coordinated partnerships are critical to success.

In the next five years, we are embarking on a new horizon. Congress has tasked us to tackle the climate change crisis that takes place on 70 percent of the Nation's lands—America's private lands. The Nation is looking to NRCS to solve an international problem. Take the above-listed timeless Agency values and change the world! Create a conservation legacy you can be proud of. Remember in 50 years from now, no one will remember or care whether we had a commitment to tax or spend policies, but they will care about whether we had a commitment to conserve our water, soil, and habitat, ensure a sustainable food supply, and mitigate against climate change.

Keep up the good work; you are making a lasting legacy!

YOURS IN CONSERVATION,

Denise Coleman

Denise Coleman | State Conservationist

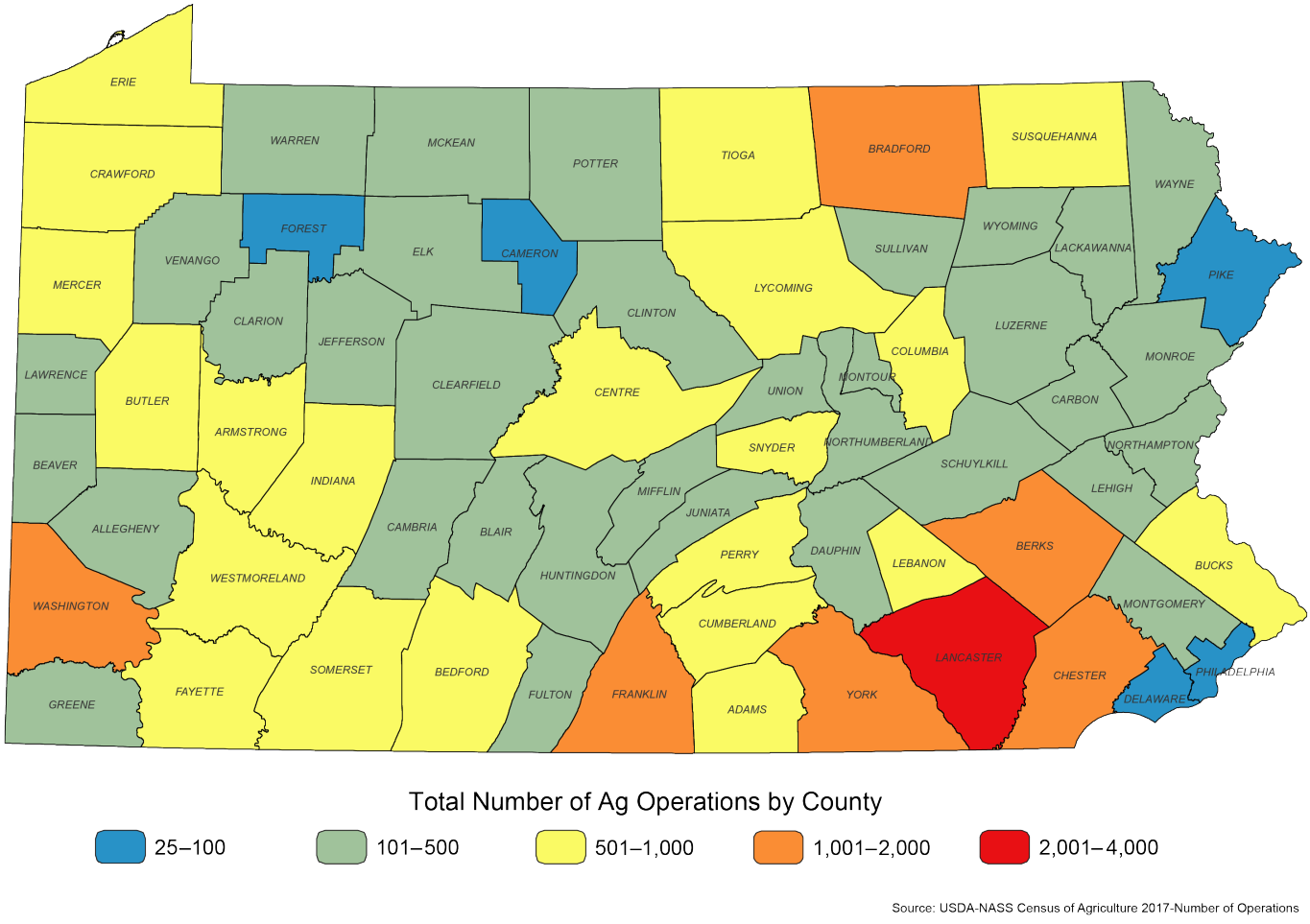
LAND AND AGRICULTURE IN PENNSYLVANIA

INTRODUCTION

Pennsylvania has a total of 52,700 farms, (NASS, 2020). The majority (90–95 percent) of Pennsylvania farms are classified as family-owned farms. The average farm size in Pennsylvania is 139 acres, which is small when compared to the average farm size in the United States of 444 acres (United States, February 2021). Pennsylvania ranks 14th nationally in both the number of agricultural producers and in the number of farms ("Understanding Pennsylvania Agriculture: 2017 Update"). In the market value of agricultural product sales, Pennsylvania ranked 19th in the United States ("Understanding Pennsylvania Agriculture: 2017 Update").

Lancaster County has the most farmed acreage in Pennsylvania, totaling 393,949 acres. Bradford County is second with 303,601 acres of land in farms (United States. National Agricultural Statistics Service). **Map 1** shows the number of farms by county according to the 2017 Agricultural Census data. **Table 1** lists the top five counties in Pennsylvania by category as determined by the 2017 Agricultural Census ("Understanding Pennsylvania Agriculture: 2017 Update").

Map 1: **Number of Farms by County, 2017**



Source: USDA-NASS Census of Agriculture 2017-Number of Operations

Table 1: **Top Five Pennsylvania Counties in Agriculture (2017)**

RANK	NUMBER OF FARMERS	LAND IN FARMS	VALUE OF FARM PRODUCT SALES	NET CASH FARM INCOME	NET CASH INCOME PER FARM OPERATION
1	Lancaster	Lancaster	Lancaster	Lancaster	Chester
2	York	Bradford	Chester	Chester	Lebanon
3	Berks	Franklin	Berks	Berks	Lancaster
4	Washington	York	Franklin	Franklin	Union
5	Chester	Berks	Lebanon	Lebanon	Franklin

In 2017, a total of 7,278,668 acres were classified as "land in farms" in Pennsylvania by the Census of Agriculture ("Understanding Pennsylvania Agriculture: 2017 Update"). "Land in Farms" is defined as agricultural land used for crops, pasture, or grazing. Cropland accounted for 64 percent of Pennsylvania's total agricultural land. Forested acreage, which includes both natural and planted woodlots used for wood products or timber, accounted for 20 percent, and pastureland used for grazing accounted for 10 percent of total agricultural land in Pennsylvania (Gill). "Other", or incidental land, which includes houses, barns, roads, ponds, waste land, or other made up approximately 6 percent of land in agricultural operations. Total farmland acreage in Pennsylvania decreased by 6 percent between 2012 and 2017 (Gill).

In Pennsylvania, agriculture accounts for approximately $84 billion in direct economic output, supporting more than 280,500 jobs directly and 300,000 jobs indirectly (Freedgood, 10). According to the most recent NRCS VIP Statewide Fact Sheet, the main commodities produced in Pennsylvania in order of economic significance are:

- Dairy products — $1.99 billion
- Chicken Eggs — $1 billion
- Cattle and Calves — $741 million
- Mushrooms — $589 million
- Broilers — $574 million
- Corn — $498 million
- Hogs — $305 million
- Soybeans — $217 million
- Floriculture — $194 million

The majority of Pennsylvania farms are small in terms of value of sales. According to the U.S. Census of Agriculture, 79 percent of Pennsylvania farms sold less than $100,000 of agricultural products in 2017, 50.8 percent sold less than $10,000, and 24 percent of farms in the Commonwealth sold less than $1,000 (Understanding the Quiet Majority: Small Farms in Pennsylvania 1). As shown on **Map 2**, roughly 96 percent of farms in counties in western Pennsylvania sold less than $250,000 of agricultural products in 2017, and the northern part of the Commonwealth has a similar number, at around 93.6 percent (Understanding the Quiet Majority: Small Farms in Pennsylvania 2). Southeastern Pennsylvania has the lowest percentage of farms selling less than $250,000 per year of agricultural products, which is likely because soil and climate conditions in the southeastern part of Pennsylvania are more conducive to agricultural production (Understanding the Quiet Majority: Small Farms in Pennsylvania 2).

In recent years, Pennsylvania has seen a dramatic increase in niche marketing at local farm markets via specialty crops and further processed commodities due to the current climate of depressed incomes associated with traditional farming operations. Specialty farming offers a larger income opportunity than traditional cropping and livestock systems. The transition from conventional agriculture to specialized agriculture has greatly expanded opportunities for beginning farmer and rancher participants throughout Pennsylvania (United States, NRCS VIP Statewide Fact Sheet). Urban agriculture is also increasing across Pennsylvania.

Given Pennsylvania's high and increasing per acre land values due to development pressure, many new or beginning farmers are forced to rent the land for their agricultural business instead of engaging in the traditional model of purchasing and owning the acreage that they farm (United States, NRCS VIP Statewide Fact Sheet).

Over the past five years, NRCS has provided a variety of funding and technical assistance to address environmental resource concerns from agricultural operations on the land. Through voluntary conservation efforts, nearly 125,000 conservation practices for addressing soil, water, and air quality were installed between 2017 and 2021. In 2021 alone, $32.4 million of USDA-NRCS funding was provided to landowners through the AMA, CSP, EQIP, and RCPP programs in Pennsylvania (United States, NRCS VIP Statewide Fact Sheet). Funding through these programs can help already struggling producers become good stewards of the land and environment while producing crops and managing livestock operations. **Table 2** tallies the funding provided for each of the major Pennsylvania NRCS conservation land programs between 2017 and 2021.

The Land Section of this Strategic Plan will explore headquarters and livestock; cropland and soil health; pastureland and grazing; development and agricultural land preservation; forests and wildlife, and urban agriculture. In this action, NRCS addresses environmental resource concerns, threats, trends, and issues associated with conservation for private lands in Pennsylvania. Each section will contain a summary with goals for Pennsylvania NRCS over the next five years formulated by local working groups

Map 2: **Percent of Farms in Each County Selling Less Than $250,000 of Agricultural Products (Pennsylvania, 2018)**

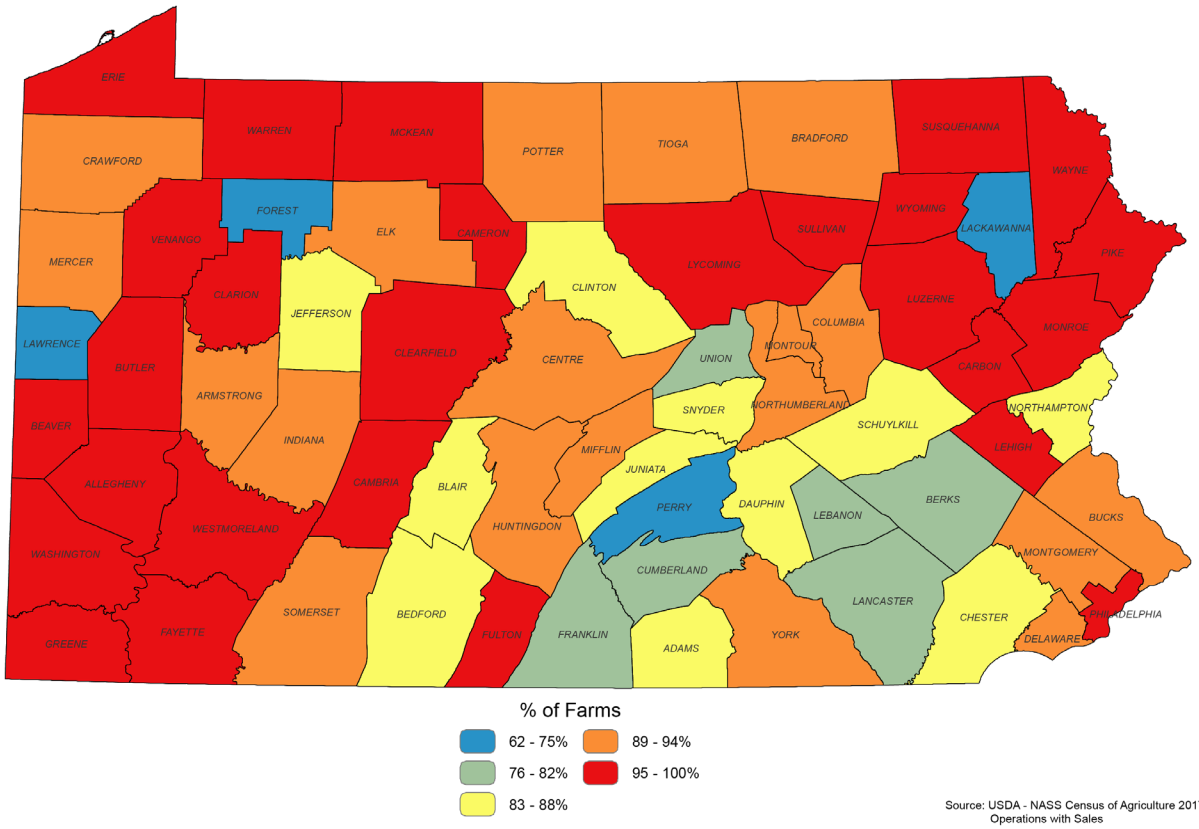


Table 2: **NRCS Conservation Funding by Program and Fiscal Year in Pennsylvania**

NRCS PROGRAM	FY 2017	FY 2018	FY 2019	FY2020	FY 2021	TOTAL
AMA	665,000	396,000	392,000	353,000	557,000	2,363,000
CSP	5,400,000	1,400,000	4,000,000	6,300,000	7,900,000	25,000,000
EQIP	24,200,000	21,600,000	25,200,000	22,700,000	22,200,000	115,900,000
RCPP	4,200,000	1,250,000	3,700,000	1,900,000	1,700,000	12,750,000
TOTAL	34,465,000	24,646,000	33,292,000	31,253,000	32,357,000	156,013,000

HEADQUARTERS AND LIVESTOCK

Current Conditions

Pennsylvania has a robust and diverse livestock industry. Typical livestock types include beef and dairy cows, hogs and pigs, sheep and lambs, and chickens (Layers and Broilers). As of 2017, livestock sales accounted for 64 percent of the market value of agricultural products sold in Pennsylvania. Cattle and calves (both beef and dairy) account for 43 percent of the total farms in Pennsylvania with 22,729 farms (2017 Census of Agriculture).

Table 3 and **Table 4** list the Pennsylvania livestock numbers, products, and their national ranking.

When animal numbers are converted to animal units (average animal weights multiplied by the number of animals), there are five counties with 60,000 or more animal units. These counties are primarily located in South Central/Central Pennsylvania, as shown in **Map 3**. The large number of animals across Pennsylvania have the opportunity to negatively impact soil, water, and air quality.

Table 3: Livestock Numbers in Pennsylvania

TYPE	ANIMAL NUMBERS	NUMBER OF FARMS IN PA	% OF TOTAL FARMS IN PA
Chickens (Layers)	26,317,523	9,290	17
Chickens (Broilers)	183,894,324	1,568	3
Milk Cows	527,617	6,914	13
Beef Cows	217,617	13,176	25
Hogs and Pigs	1,239,301	2,777	5
Sheep and Lambs	94,370	3,749	7
All Cattle and Calves	1,621,303	22,729	43

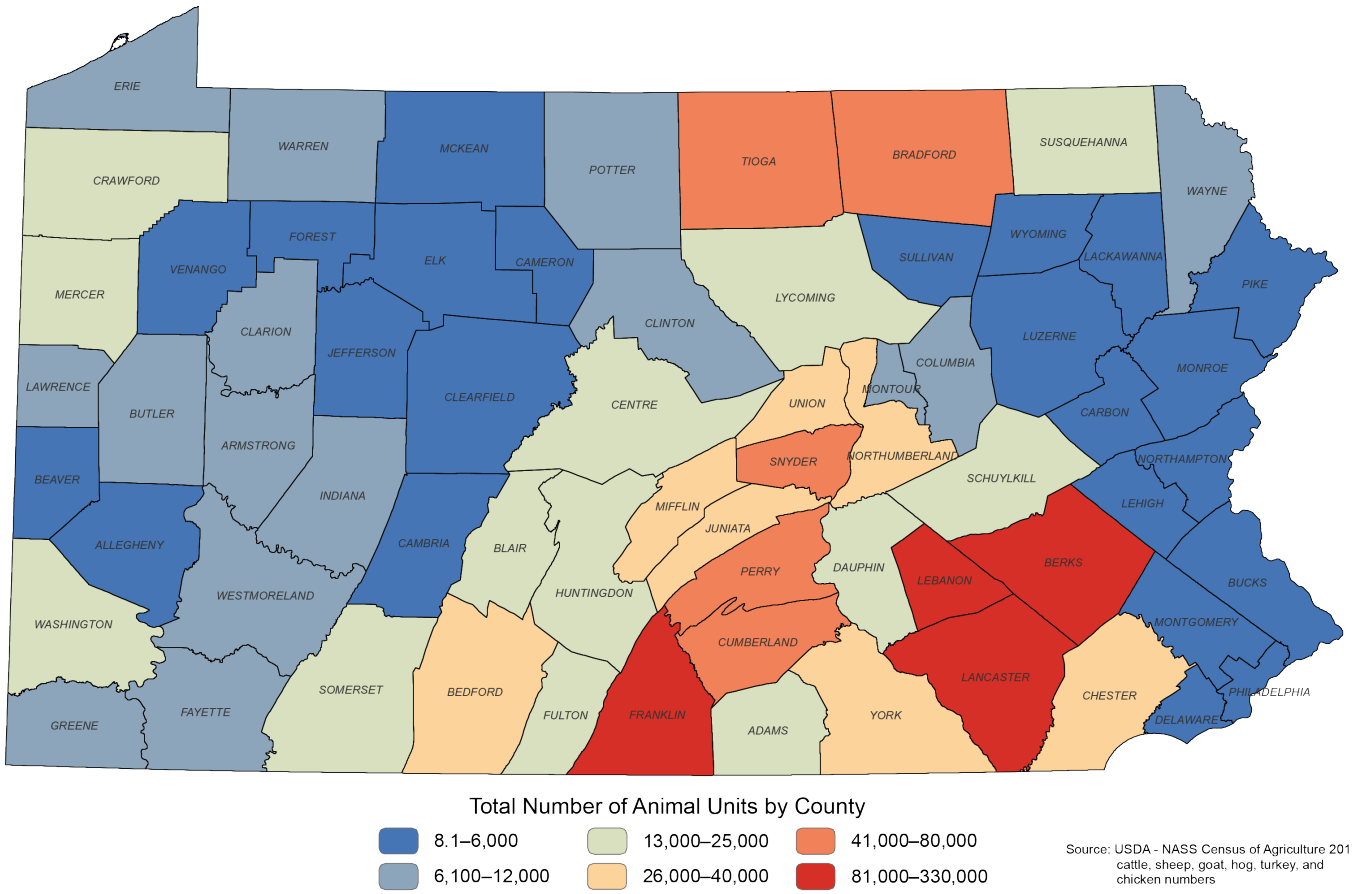
SOURCE: 2017 Census of Agriculture

Table 4: Pennsylvania Livestock Products National Ranking

LIVESTOCK, POULTRY AND PRODUCTS	SALES ($1,000)	NATIONAL RANK
Milk from Cows	1,979,362	6
Horses, Ponies, mules, burros, donkeys	44,140	7
Poultry and Eggs	1,684,535	8
Hogs and Pigs	572,495	13
Sheep, Goats, Wool, Mohair, Milk	17,140	16
Aquaculture	20,787	20
Cattle and Calves	625,530	27

SOURCE: 2017 Census of Agriculture

Map 3: Number of Animal Units by County



NRCS Assistance

In Pennsylvania, through voluntary efforts, an abundance of conservation practices addressing soil, water, and air quality resource concerns for livestock operations were funded over the past five years. **Table 5** illustrates the common conservation practices on livestock operations that were funded by NRCS financial assistance programs in Pennsylvania by Fiscal Year from 2017 through 2021.

In Fiscal Year 2023 and beyond, Pennsylvania NRCS will continue focusing financial assistance to address resource concerns on the farmsteads of livestock operations.

Climate smart agriculture will be a focus for program funding and for the conservation practices provided to producers. NRCS assistance for climate smart agriculture will be provided through traditional cost-share contracts as well as incentive contracts. Some of these practices for livestock and headquarters areas include anaerobic digesters, waste separation facilities, and nutrient management plans.

ACTION

Expand the use of mobile technology to provide assistance in all areas of agriculture, including using mobile phones to inventory farmstead issues.

While this technology has currently been adopted, NRCS plans to continue making strides in using mobile technology for efficiency, data collection, and all aspects of program management to streamline conservation planning and contracting to help field employees complete work. Expansion of mobile technology can assist with everything from in-field mapping of resource concerns to monitoring easement sites.

In Pennsylvania, NRCS also offers assistance to address runoff from concentrated animal areas. Practices to avoid manure and sediment from entering streams, as well as practices that control and trap can help to ensure water sources remain healthy and reduce opportunities for erosion.

ACTION

Develop a "Close-the-Gate" incentive to encourage producers to confine animals inside in times of high erosion/runoff periods to allow pastures to stabilize.

Livestock typically congregate in the same areas across the landscape. Any sloped area not adequately protected with productive vegetation is likely to produce gully erosion allowing sediment and nutrients to runoff these areas. This results in allowing additional offsite resource concerns. Animal injury can be a risk of deep erosion. Soil erosion resource concerns can become serious on pastures, paddocks or livestock concentration areas. It is also an issue along stream banks where livestock have access. Even fence lines that run up and down hills can be susceptible to gully erosion. Common practices to address this issue include Trails and Walkways, Stream Crossings, Fencing, Heavy Use Area Protection, and Prescribed Grazing.

Nutrient Management and Waste Storage

Nutrient management is critical in Pennsylvania and is especially difficult in geographic areas with high animal concentrations. Nutrient management on farm operations involves manure collection, transfer, storage, treatment (if applicable), and application. One of the most commonly overlooked issues involving nutrient management is proper grazing management on densely stocked pastures that consist of small acres. While the type of plan may vary in complexity, manure management is required by Pennsylvania law on any farm that applies manure. USDA NRCS provides voluntary assistance to farmers to develop a nutrient management plan and to implement practices in the plan.

ACTION

Encourage the use of incentives for manure testing through public fact sheets, YouTube videos, and producer talks.

To obtain assistance from USDA NRCS for nutrient management practices related to the storage of manure, a Comprehensive Nutrient Management Plan (CNMP) is required. A CNMP is a conservation plan that includes a combination of structural practices, management activities, and/or land management practices for an Animal Feeding Operation (AFO) associated with crop or livestock production that collectively ensures that the purposes of crop or livestock production and preservation of natural resources are compatible.

Compatible conservation practices conserve air quality, reduce soil erosion, and improve water quality related to nutrient, pathogen, and sediment impacts. Proper management practices are critical to implementing a CNMP. A producer must be willing and able to implement the management aspects of the CMNP in order for the CNMP to be successful.

ACTION

Increase allocations for CNMPs.

ACTION

Develop more Conservation Activity Plans protecting forests, endangered species, and all wildlife.

Table 5: Annual Practices by Fiscal Year

PRACTICE	UNITS	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	5-YEAR TOTAL
Roof Runoff	No.	160	107	141	259	482	1,149
Waste Storage	No.	149	114	111	119	553	1,046
Heavy Use Area	Sq.Ft.	290,551	317,224	380,000	482,000	336,000	1,805,775

SOURCE: Pennsylvania NRCS Annual Reports 2017–2021

Many dairy and beef operations in Pennsylvania have existing concentrated livestock areas, which are sometimes referred to as Animal Concentration Areas (ACAs) or animal Heavy Use Areas (HUAs) by various state and federal agencies. It is often the case that ACAs or HUAs are improperly located, lack containment or runoff controls, and/or are poorly managed.

Historically, many Pennsylvania barns were located close to streams to provide easy access to water for livestock. However, as the farm operations grew with increased animal numbers over time, the barns remained in the same location. This has created a need to relocate the ACA or HUA and storage to meet the increasing amounts of manure and accommodate larger concentrations of animals.

ACTION

Continue to promote proper siting of barnyards away from sensitive areas, like streams, wetlands, and sinkholes.

Because of exponential growth of livestock herds and farming operations over time, Pennsylvania has many livestock operations with improperly sized and/or managed manure storages. In many cases, NRCS finds that there is a need to increase storage capacity or that there is a need to increase the size of an existing manure storage to properly meet the requirements of the animals on-site and the farm nutrient needs according to the nutrient management plan.

Water Quality

Concentrations of livestock often produce an imbalance of nutrients which is a result of the large amount of feed needed to meet animal needs, much of which needs to be imported from other areas. Often, the nutrients produced from manure and obtained from fertilizer exceed crop needs. When nutrient application exceeds plant needs there is a greater risk of nutrient runoff and water quality degradation.

ACTION

Develop incentives to encourage producers to reduce nutrients in their feed.

Additionally, areas having high animal concentrations impact the environment by contributing to water quality

degradation. In high animal concentration areas, clean stormwater mixes with manure, which creates nutrient runoff that can run off into streams or leach into the groundwater. Pennsylvania is second only to Alaska in the Country for miles of streams, having over 86,000 miles of streams. Many Pennsylvania streams are continually being impacted by nutrient-laden runoff (Shane).

The Commonwealth of Pennsylvania does not regulate livestock access to streams. Cattle and other types of livestock accessing streams or other surface water has been proven to have an adverse impact on water quality. A greater number of agriculturally impaired streams exist in areas of Pennsylvania having high numbers of grazing animals. This correlation is shown on **Map 4**, which provides the number of grazing animal units of cattle, sheep, and goats by county with an overlay of Pennsylvania's agriculturally impaired streams. **Map 5** combines horse population by county with watersheds with a stream impaired by agriculture.

ACTION

NRCS will require farmers to exclude animals from streams by no less than 35 feet when heavy use areas and waste storage facilities are constructed.

Surface water isn't the only water resource that is impacted by livestock. Groundwater can also be impacted. This concern is especially relevant in Pennsylvania because of the large areas of karst topography. Karst topography is a geologic feature that only exists in a few places throughout the world. Because of their unique properties, karst aquifers supply drinking water to about 20–25 percent of the global population (Ford and Williams 441).

In Pennsylvania, karst areas contain rich limestone deposits that in some places on the landscape have helped

create unique and valuable agricultural soils. However, the limestone deposits under the soil are easily eroded by water and susceptible to pollution from surface sources. In areas where the soft, underground limestone gets dissolved by water, caves, springs, aquifers, and sinkholes can form under the soil providing a direct conduit for contaminates to reach groundwater.

Map 6 shows KARST areas in Pennsylvania. Karst landscapes are one of the most at-risk landscapes because they have more direct pathways to groundwater due to the high porosity of the underlying limestone bedrock (CEAP Soil Vulnerability Index for Cultivated Cropland 17). Karst landscapes in Pennsylvania are at greater risk of contamination of soil and groundwater from spills or leakage from manure pits, which contain toxic levels of nutrients and pathogens. Additionally, manure from concentrations of livestock on the surface can easily leach into these underground areas and degrade water resources. Limestone outcroppings near ACAs or HUAs can serve as a direct link to groundwater, which is why containing manure on the surface in karst areas is important to keeping groundwater clean.

ACTION

NRCS will require farmers to exclude animals from sinkholes and other sensitive wetland areas by no less than 35 feet when heavy use areas and waste storage facilities are constructed.

Considering the increasing focus and need to address source water protection in the United States, the 2018 Farm Bill provided increased funding for practices that protect source water quality and quantity while also helping agricultural producers. Source water is defined as sources of water (such as rivers, streams, lakes, reservoirs, springs, and groundwater) that provide water to public drinking water supplies and private wells. The areas where livestock concentrate and produce manure can be an issue for source water. More information about how water quality and source water is impacted and addressed in Pennsylvania can be found in the Water Section of this document.

Air Quality

Air quality is another livestock-related resource concern for NRCS. Air quality resource concerns can be caused by animal movement, feeding activities, and land application of animal waste. Many practices used to address air quality resource concerns are livestock conservation practices that also benefit water quality. Since 1990, national average ozone concentrations have dropped 25 percent, which shows that efforts on a local, regional, and national scale have positively impacted air quality. In October of 2015, the U.S. Environmental Protection Agency (EPA) strengthened the National Air Ambient Quality Standards (NAAQS) for ground-level ozone based on extensive scientific evidence about ozone's effects on public health and welfare.

While agriculture does not create as much of a significant source of ozone-forming pollutants as industrial and consumer manufacturing, agricultural producers can take steps to improve air quality. Some of these improvement techniques include improving pesticide application technologies installing covers on manure storages, constructing anaerobic digesters, or limiting combustion emissions from engines by reducing the number of in-field equipment passes. These practices can reduce emissions of nitrogen oxides and volatile organic compounds.

EPA projections show that the vast majority of U.S. counties would meet the updated standards by 2025 just by following the rules and programs in place or underway. The EPA has not changed this determination since 2015. Furthermore, on December 23, 2020, the EPA reviewed all scientific evidence available related to the ozone effects on public health and determined that the existing ozone NAAQS continue to protect public health adequately.

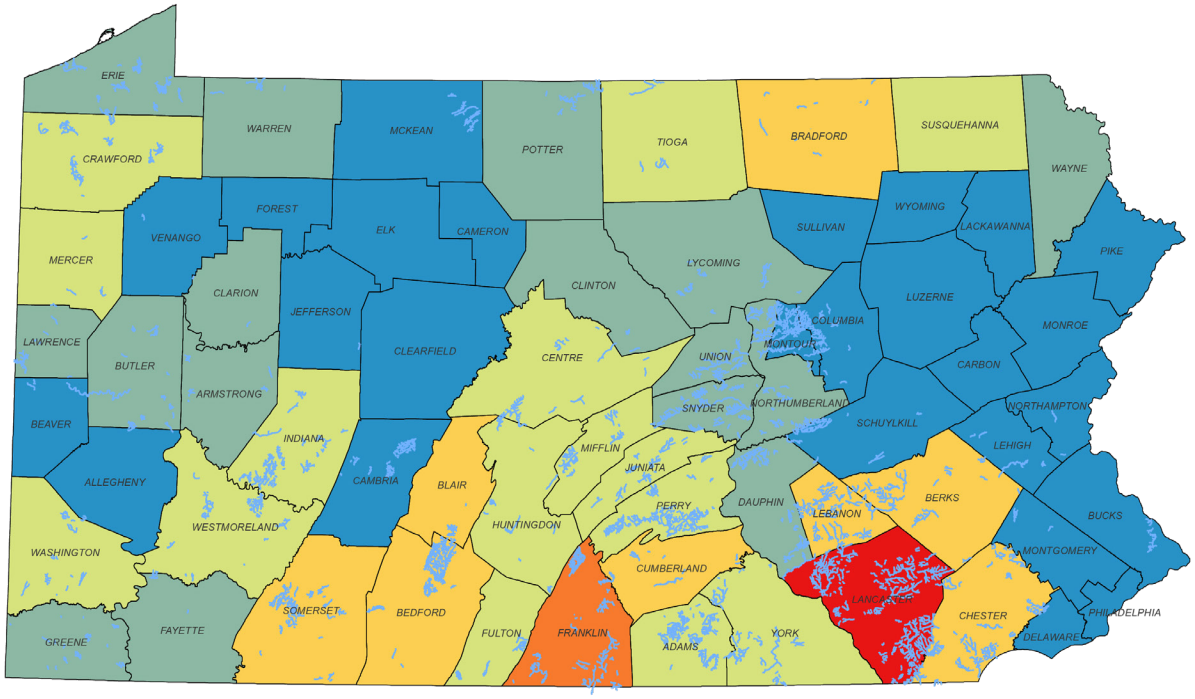
Climate Change

Sequestering carbon and climate smart agriculture will be a large focus for NRCS in the future. Pennsylvania NRCS will increase implementing climate smart conservation, which is becoming more important to reduce the impacts of climate change. Climate smart practices help reduce emissions of greenhouse gases and increase carbon sequestration on agricultural operations while helping producers to deliver agricultural products, see **Map 7.**

ACTION

Use GIS and the latest Greenhouse Gas data to increase and better target the implementation of climate smart conservation practices for agricultural producers.

Map 4: Number of Grazing Animal Units by County and Ag Impaired Streams

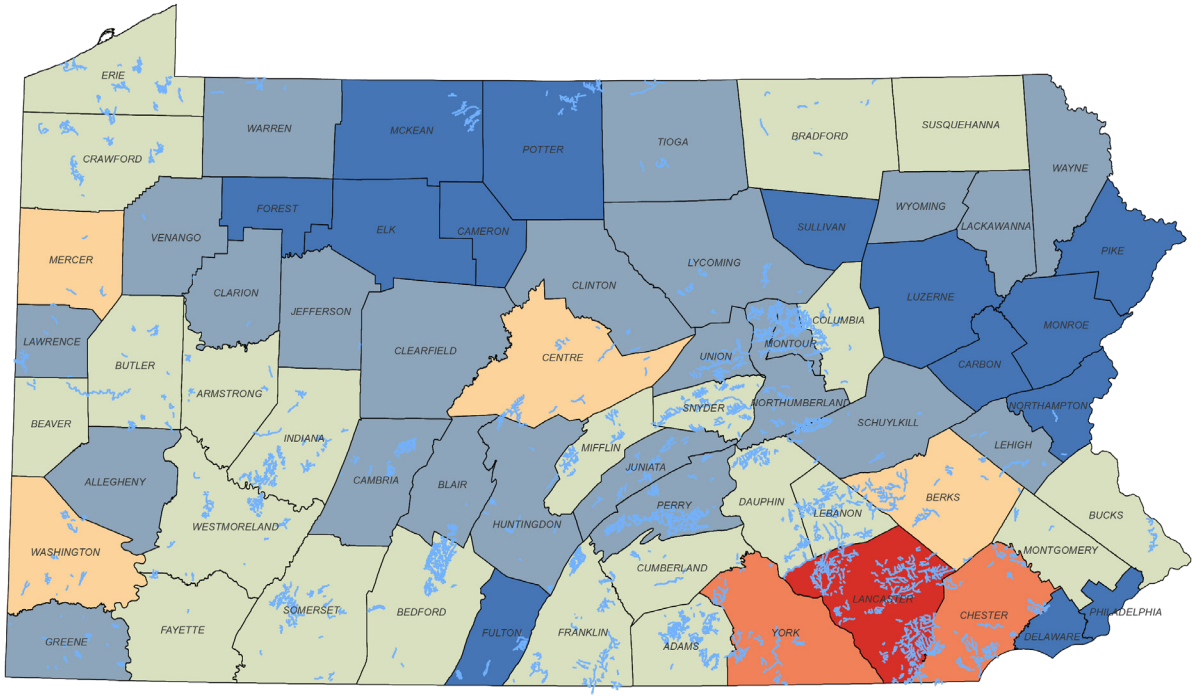


Total Number of Grazing AU by County

0 – 5,000	5,000.1 – 10,000	10,001 – 20,000	20,001 – 40,000	40,001 – 80,000	80,001 – 160,000

Source: USDA-NASS Census of Agriculture 2017-cattle, sheep, and goat numbers Impared Streams 2021-Agricultural Source

Map 5: Number of Horses/Ponies by County and Ag Impaired Streams

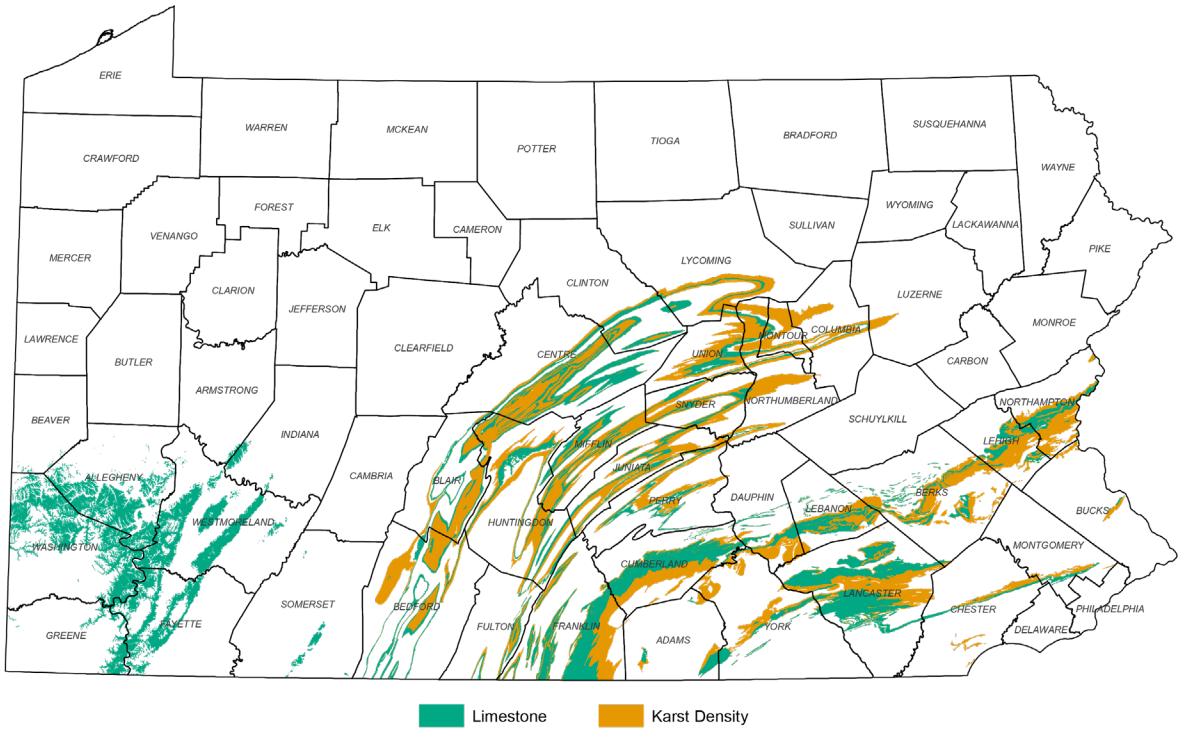


Total Number of Grazing AU by County

53 – 500	500.1 – 1,000	1,001 – 2,000	2,001 – 4,000	4,001 – 8,000	8,001 – 16,000

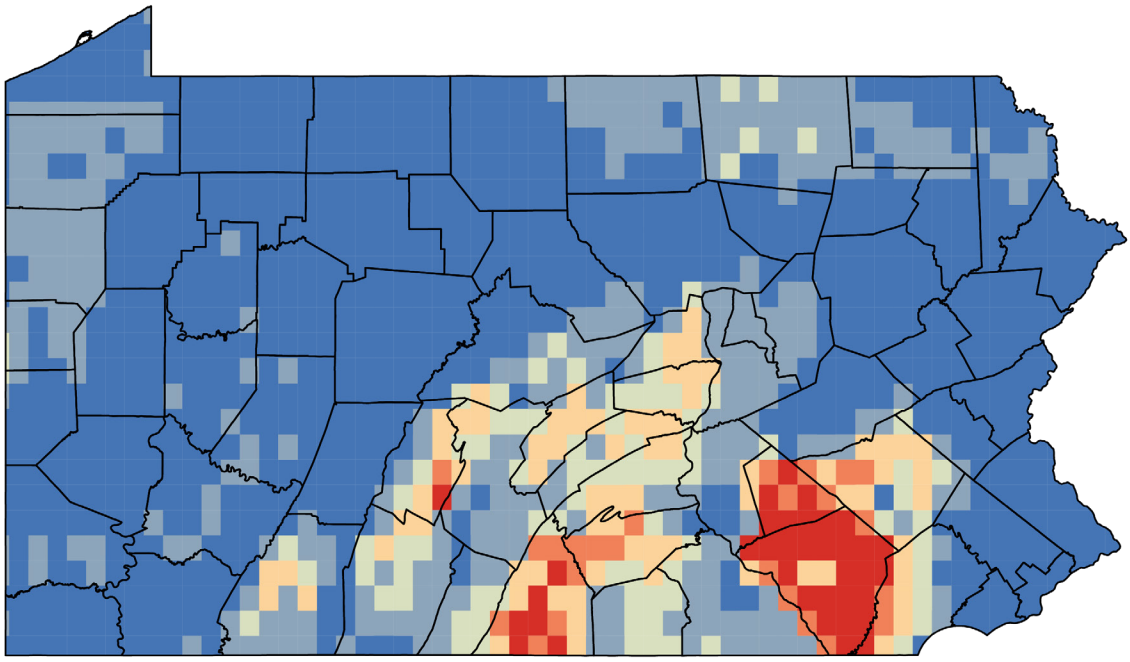
Source: USDA-NASS Census of Agriculture 2017-horse and pony numbers Impared Streams 2021-Agricultural Source

Map 6: **Karst Geology of Pennsylvania**



Source: 2018 DCNR Karst Features in PA

Map 7: **Greenhouse Gas Emissions — Methane from Agriculture**



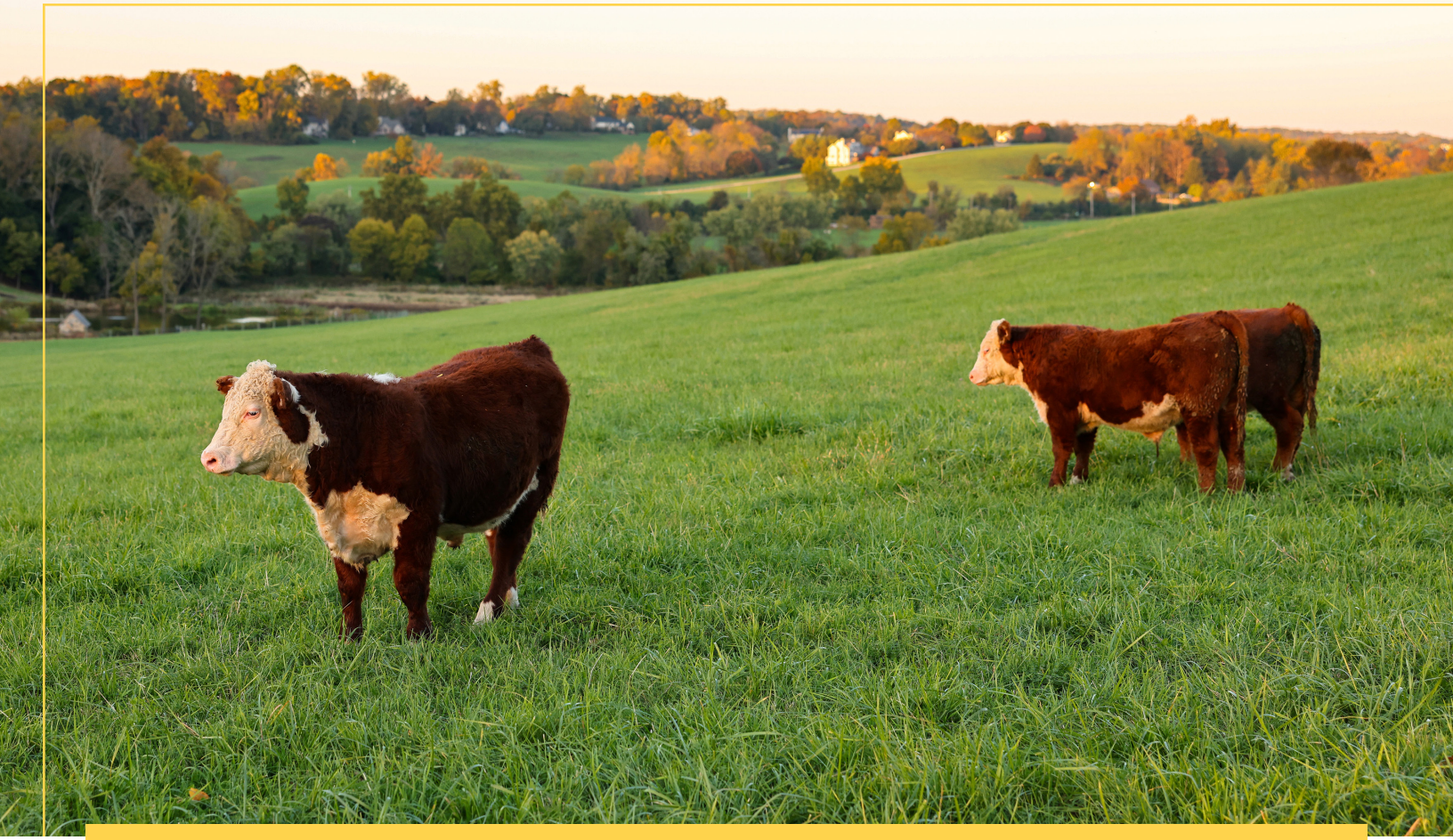
Legend

County Boundary

2012 Methane (parts per billion)

0.0 – 1.0	2.1 – 3.0	5.1 – 8.0
1.1 – 2.0	3.1 – 5.0	8.1 – 77.4

Source: 2022 NRCS RAID



PASTURELAND AND GRAZING

Current Condition

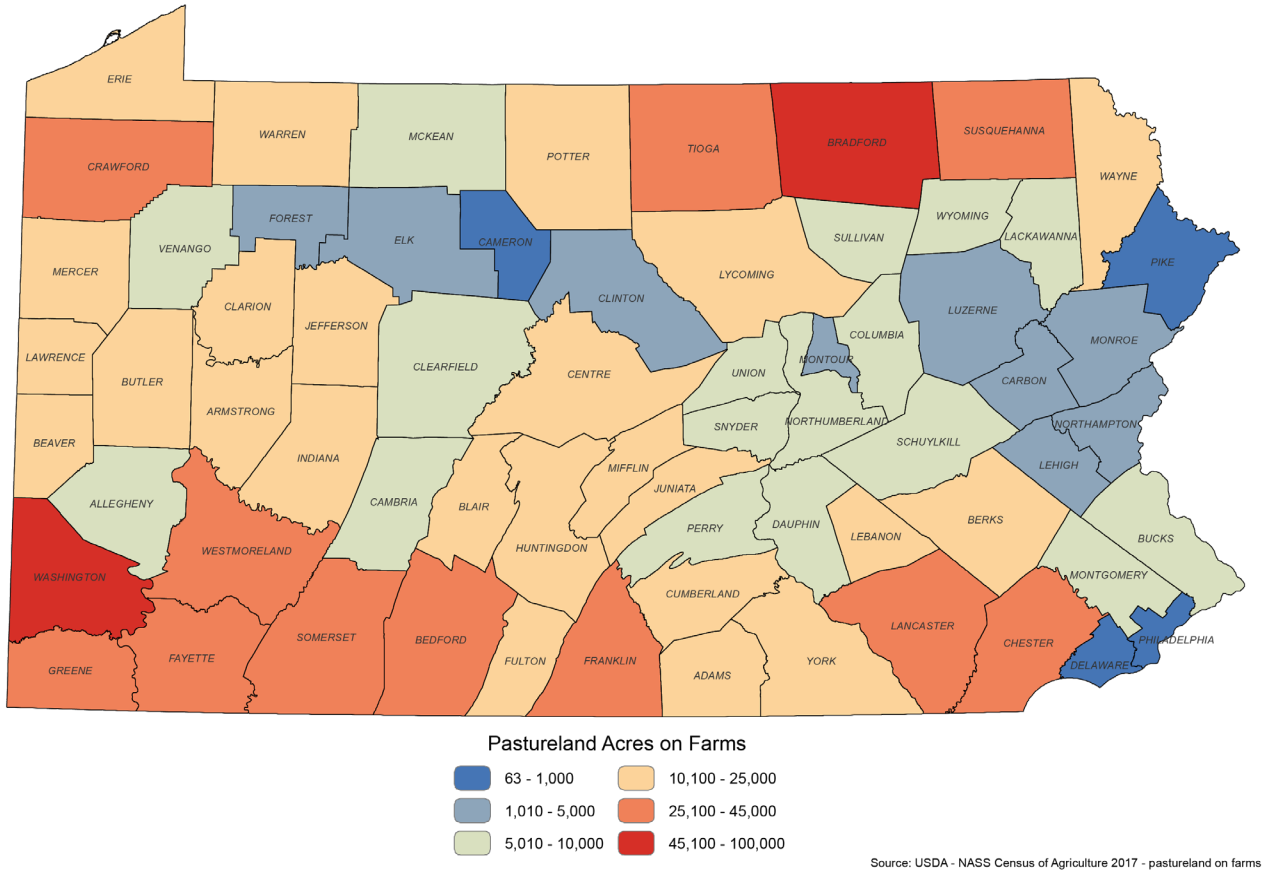
Pennsylvania has pasture and grazing land in a variety of landscapes across the Commonwealth. According to the 2017 Census of Agriculture, pastureland used for grazing accounted for 10 percent of total agricultural land in Pennsylvania (Gill). **Map 8** shows counties across Pennsylvania and the density of grazed land in each.

Pasture is a highly sustainable land use that has minimal resource concerns if managed properly. Grazing perennial forage limits soil erosion because there is minimal soil disturbance, and as a result, there can be increases in surface and deep organic matter in the soil due to the existence of a vigorous root system. The root systems decompose underground which increases soil biomass and soil fertility. Over time, soil structure improves, allowing for increased water and nutrient retention (Duiker 1). Pasture vegetative cover provides benefits for surface and groundwater as well.

Due to variations in climate, soil conditions, topography, potential noxious and invasive species, and pests and diseases that threaten pasture in Pennsylvania, grazing management can pose a challenge for operators. To be successful in implementing grazing strategies, the manager must ensure that high-quality forages are available to provide livestock with the protein, energy, and fiber needed to thrive (Grazing Calendar 2021). It is important for producers to properly manage grazing as a system approach to maintain a healthy grass stand (Grazing Calendar 2021).

To avoid resource concerns and optimize pasture acreage, agricultural producers that graze their livestock need to

Map 8: **Pastureland Acres on Farms**



apply grazing practices that assist in adapting the intensity, frequency, duration, timing, and animal numbers based on seasonal conditions. Using a suite of grazing practices ensures that pastures are meeting the nutritional needs of the herd, protecting the soil and land resources, and are economically viable. "Management-intensive" or adaptive grazing methods provide benefits to the environment such as reducing farm nutrient and sediment runoff, increasing soil health, improving water quality, sequestering carbon, and ultimately reducing greenhouse gas emissions.

Grazing animals can create soil and water resource concerns.

Properly managed grazing systems help producers reduce labor, expenses, and maintenance costs due to a reduced need for animal housing, waste storage, and farming equipment. Furthermore, animal feed costs are reduced when animals become more dependent upon grazing forage to meet their nutritional needs. Additional economic benefits are also gained when herd health improves and the need for veterinary care is reduced. Due to recent market trends, producers can also benefit economically from selling high-end products for a premium through direct-to-consumer markets, such as grass-fed meat, eggs, or dairy, which are supported by grazing systems.

Strategies for maintaining pasture soil health, forage health, and forage resilience include growing forage stands with a diverse mix of cool-season grasses, legumes, broadleaf plants, and warm-season grass species where appropriate, based on soil and site limitations. Establishing diverse stands helps to reduce the risk of pasture health decline when a season is not ideal to support one particular forage. Warm-season annuals, like sorghum-sudangrass, can be harvested as hay or haylage or grazed to provide forage, which provides a variety of options for producers (PA Grazing Calendar 2021).

Other management strategies include: rotational grazing to allow for pasture rest, vegetative recovery of the forages, or excluding livestock entirely from certain areas to allow the pasture to accumulate forage in one season to support grazing in another season, called deferment or stockpiling. Avoiding overgrazing and restricting livestock access to sensitive areas, especially in winter, is paramount. This results in the need to move livestock frequently or remove them entirely from the pasture during weather events and other times of the year when pasture damage may occur (PA Grazing Calendar 2021).

NRCS Assistance

Pennsylvania NRCS has the scientific knowledge base, funding sources, and opportunity to assist producers to transition management and maintain successful grazing systems. **Table 6** and **Figure 1** show the most commonly funded NRCS pasture practices in Pennsylvania between 2005 and 2020 (NRCS Conservation Programs Pennsylvania). These practices include fence, prescribed grazing, watering facilities, nutrient management, and livestock pipeline. Other common practices include trails and walkways, stream crossings, as well as pasture and hay planting, which are key to establishing and maintaining healthy forages within pasture systems.

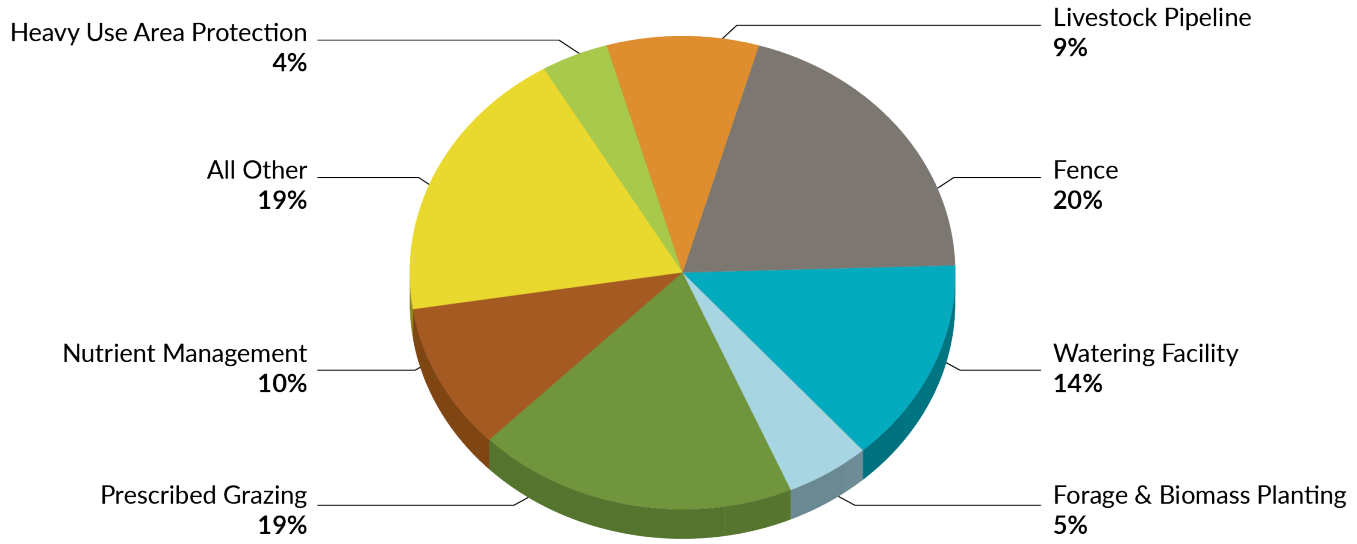
In Pennsylvania, where the majority (90–95 percent) of farms are classified as small, family-owned farms with an average size of 139 acres, it is important to ensure that smaller pasture and grazing operations also receive conservation planning and funding. Smaller farms can contribute just as much to soil and water resource concerns as larger farms, and in many cases, need more technical and financial assistance to make a management change than larger farms. Pennsylvania NRCS intends to find new ways to better connect with smaller grazing farms to address resource concerns such as feed and forage imbalance, livestock water quality and quantity, plant productivity and health, as well as plant structure and composition.

NRCS promotes practices that address soil and water quality resource concerns associated with grazing livestock. Grazing practices are implemented to "conserve and improve wildlife habitat on private grazing land; conserve and improve fish habitat and aquatic systems through grazing land conservation treatment; protect and improve water quality; improve the dependability and consistency of water supplies; and identify and manage weed, noxious weed, and brush encroachment problems" (NRCS Conservation Programs Pennsylvania). Photos (courtesy of Deanne Boyer, Willow Run Farmstead) of some installed NRCS grazing practices are shown on page 21.

Farmstead-Pasture Interface

A major challenge in grazing systems where conservation practices have been applied is the transfer of resource concerns in the interface between the headquarters/ farmstead and pasture areas. For example, when a concrete

Figure 1: **Land Unit Acres Receiving Conservation (Grazing Land Conservation FY 2005 – FY 2020)**



Heavy Use Area (HUA), Animal Walkway, Watering System, or other conservation infrastructure is installed, the practices address the resource concern in that specific area, but the resource concern footprint can end up getting transferred to another location due to livestock congregation and movement patterns.

This interface can be challenging for NRCS grazing specialists and conservation planners when planning with the producer to address pasture resource concerns. These areas of interface cause long-term negative impacts to the farm and to the local water quality. Mixed with manure, these areas provide a major source of nutrients and sediments to local streams. Because of this, it has become a goal for Pennsylvania NRCS to address these interfaces with a variety of financial and technical assistance elements.

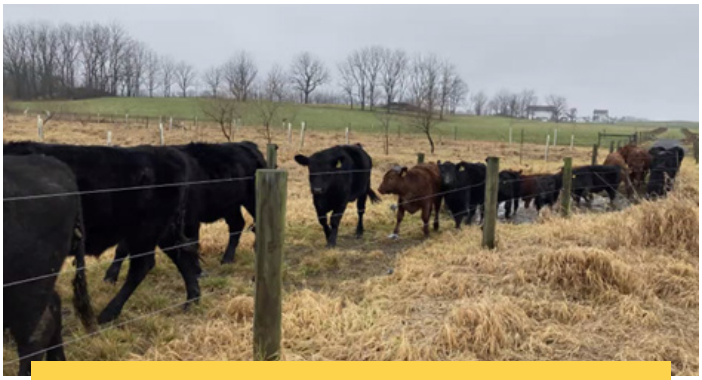
ACTION

Train conservation planners regarding pasture-based farm systems focusing on developing contingencies that prevent high-traffic interface areas where degradation can quickly occur. Assessment worksheets for planners will be incorporated into the planning process to prevent resource concerns from developing at the transition interface.

ACTION

Encourage producers to keep animals enclosed in heavy use areas when conditions are not favorable and provide producers incentive for doing so, particularly in the early spring when

Animal walkway installed by NRCS.



Fencing installed by NRCS.

Stream crossing installed by NRCS.

Table 6: **Top Five Grazing Land Practices Installed in Pennsylvania 2005–2020**

FENCE*	PRESCRIBED GRAZING	WATERING FACILITY*	NUTRIENT MANAGEMENT	LIVESTOCK PIPELINE*
120,986 ac	111,211 ac	84,040 ac	57,334 ac	56,098 ac
6,572 no	7,561 no	3,775 no	4,263 no	2,723 no

*Data reflects the geographic extent of grazing land treated with conservation practice.

pastures are at their most vulnerable.

ACTION

Incorporate Avoid, Control, and Trap (ACT) methodology into all forms of conservation planning to address nutrients and sediments leaving the farmstead and pasture areas.

One practice Pennsylvania NRCS has been working to promote on pasture is prescribed burning or patch burning. Research has proven that prescribed burning is a highly effective practice to address plant resource concerns on both forestland and pasture. Benefits of prescribed burning

Grazing animals can create soil and water resource concerns.

on pasture include invasive and woody vegetation control, insect and disease control, and nutrient release into the soil (Lemus 2020).

NRCS has the funding and opportunity to utilize prescribed burning as a conservation practice on pastureland but faces some hurdles for prescribed burning application. A lack of qualified prescribed burning "practitioners" exists (Pennsylvania. Department of Conservation and Natural Resources 217). Trained and certified NRCS Technical Service Providers (TSPs) are needed to ensure that prescribed fire activity follows the PA Prescribed Burning Standards. Both the property owner and the fire practitioner may face liabilities if the fire is not executed properly (Forest Action Plan 217).

ACTION

Work with Pennsylvania's Prescribed Burn Council to encourage more third party vendors to do prescribed burn (Also see p. 45).

Pennsylvania NRCS has implemented Prescribed Burning (CPS 338) training for planners over the past decade to provide job approval authority, enabling them to recommend prescribed burning practices for conservation plans. Pennsylvania will work with private sector TSPs to create a network of contractors able to do prescribed burning. Prescribed burning as it pertains to forest is described in more detail in the Forest Section.

Pasture Management/ Grazing Assistance

ACTION

Provide technical training for producers related to grazing and pasture management techniques through pasture walks, mentorship programs, and one-on-one grazing assistance.

Convincing farmers with conventional livestock operations to estimate the nutritional value of their forages in pastures as a resource for grazing animals is another challenge. Calculating forage value can be a difficult issue to relate to farmers, who by when utilizing intensive rotational grazing in the correct way, can save energy and increase profit margins. Grazing can be used to minimize the use of purchased forage as well as expensive, processed supplemental feed, which reduces feeding costs. Producers using grazing also see lower start-up and maintenance costs than their counterparts that rely more heavily on grain, hay, and other supplemental feed. To accomplish this, pasture state interpretations will be utilized. Pasture state interpretations contain information related to adapted plant species, production, management recommendations, and growth curves while also providing site-level ecological

context and a baseline to conduct pasture condition evaluations for improved decision-making.

Conservation Planning on Pastures

ACTION

Develop and use new tools such as "pasture state interpretations," to provide conservation planners with better site-specific information through the PA-NRCS workforce. "Pasture states" contain information related to adapted plant species, production, management recommendations, and growth curves while also providing site-level ecological context and a baseline to conduct pasture condition evaluations for improved decision-making.

Another tool to improve pasture planning in Pennsylvania is conducting pasture assessments such as Pasture Condition Scoring (PCS) and inventory protocols through the grazing lands National Resources Inventory (NRI). With PCS, the planner visually "scores" the health of the pasture using ten indicators ranked from one to five. PCS is a systematic way to assess how well a pasture is being managed and resources protected.

ACTION

NRCS will train producers how to utilize

Land Conversion

Another issue impacting pastureland and grassland in Pennsylvania is land conversion, as current development trends and patterns put grasslands at risk. Grasslands, meadows, and savannas (GMS) are defined as lands on which the existing plant cover is dominated by grasses, and they provide a large diversity of environmental and ecological benefits. Some benefits include carbon storage, groundwater recharge, aesthetic beauty, and recreation. GMS are also crucial for biodiversity and can support a wide variety of rare plant, animal, and bird species. In Pennsylvania, GMS are identified as a high priority for restoration, reclamation, and management by Pennsylvania's Wildlife Action Plan.

Only a few areas of historic grasslands existed in Pennsylvania, and these have been undergoing conversion to other uses for over 300 years. In the past 100 years, dramatic declines in most populations of grassland birds and other grassland-dependent wildlife in Pennsylvania have occurred (Latham) as grassland areas were converted to other land use due to human population growth, development, and urban, suburban, and industrial sprawl. The most severe decline in grassland habitat in Pennsylvania has been in the Great Valley (Chester County) and Piedmont regions.

Preserving these grasslands is important to prevent further grassland-dependent wildlife species decline, and to preserve agricultural grassland use and open space. The NRCS Agricultural Conservation Easement Program-Agricultural Land Easement (ACEP-ALE) has a component, Grasslands of Special Significance (GSS), that preserves grassland, hayland, and pasture on working lands. The purpose of ACEP-ALE-GSS is "to protect grazing uses and related conservation values by restoring or conserving eligible land."

In 2016, NRCS, in coordination with the State Technical Committee, set up the framework and eligible counties for ACEP-ALE-GSS in Pennsylvania. The ACEP-ALE-GSS counties were chosen based on high pasture areas, historically dominant grassland habitats, and high songbird population densities. NRCS will continue this effort to revive songbird populations.

ACTION

Enroll 2,000 acres of Grasslands of Special Significance.

ACTION

Incorporate ALE grassland ranking questions into other EQIP to encourage protection of grasslands and bird species.

CROPLAND AND SOIL HEALTH

Cropland Current Conditions

Pennsylvania has more than 7.2 million acres of farmed land (Ag Census 2017). Cropland accounts for more than half at 4.6 million acres. Helping Pennsylvania farmers to sustain crop production on 4.6 million acres in a changing climate will require NRCS to promote climate smart soil health practices, sound nutrient management, practices like cover crop grazing, and to train conservation planners to have the technical skills to assist farmers. Healthy soils as part of a conservation system enables farmland to maintain productivity while minimizing soil erosion and nutrient loss. Healthy soil readily infiltrates water and air, is biologically active, and supports healthy plants.

Table 7 provides the number of acres of field crops harvested in Pennsylvania, totaling approximately one half of the cropland at 2.2 million acres (2017 Census of Agriculture). Lancaster County had the highest acreage of harvested cropland, with over 290,000 acres. Franklin County ranked second with over 196,000 acres, and York County was third, with over 184,000 acres of harvested cropland.

Pennsylvania farmers produce a lot of forage. According to the 2017 Agricultural Census, forage production takes the largest portion of farmland acreage in Pennsylvania, totaling 1,620,334 acres on 30,269 farms. Pennsylvania ranks 13th in the United States for production of hay and forage (all hay, haylage, grass silage, and green chop).

Hay and forage are usually planted in rotation with other field crops. Corn for grain is the largest field crop in Pennsylvania with 949,375 acres. The next largest field crop in Pennsylvania is soybeans for beans at 650,111 acres. Pennsylvania has 353,212 acres of corn silage. Other grains grown in Pennsylvania include wheat, oats, barley, and sorghum. Tobacco is produced on 7,476 acres in Pennsylvania and is ranked seventh in the nation in value of tobacco produced. Pennsylvania also has 45,758 acres in vegetable crops (2017 Census of Agriculture).

The acres of the three largest crops harvested in Pennsylvania, corn for grain, soybeans for beans, and corn for silage, is provided by county in **Map 9 (P. 28).** This map also illustrates streams impaired by sediment from agriculture. Except for Washington and Greene counties in southwestern Pennsylvania (where grazing dominates agricultural activity), the water quality degradation is often attributed to cropland systems. The map shows a correlation between the two.

Pennsylvania also competes as a large producer of fruit and vegetable crops. **Table 8** provides the national ranking for production of fruits and other specialty crops. **Table 9** provides the national ranking for production of vegetables.

In the 2017 Census of Agriculture, Pennsylvania was listed as second in the United States for the number of vegetable-producing farms and seventeenth for acres of vegetables harvested. 48,063 acres of vegetables were harvested in 2017, making vegetable harvest approximately 1.2 percent of all harvested cropland in Pennsylvania. Sweet corn was the most harvested vegetable and accounted for the largest acreage at over 11,000 total acres, which is 24.0 percent of all Pennsylvania's harvested vegetable cropland.

Table 7: Crops Harvested in Pennsylvania

CROP	ACRES HARVESTED
Corn for Grain	949,375
Soybeans for Beans	650,111
Corn for Silage	353,212
Wheat for Grain	151,920
Oats for Grain	49,693
Barley for Grain	42,626
Tobacco	7,476
Sorghum for silage	6,033
Sorghum for grain	4,969

SOURCE: 2017 Census of Agriculture

Potatoes accounted for over 7,600 acres or 15.9 percent, beans for over 6,900 acres or 14.4 percent, and pumpkins for over 6,800 acres or 14.3 percent. Altogether, sweet corn, potatoes, beans, and pumpkins accounted for over two-thirds of Pennsylvania's harvested vegetables in 2017. Other commonly harvested vegetables in Pennsylvania included cabbage, cantaloupe, peppers, and squash (Harvested Cropland Vegetables in the Commonwealth).

Pennsylvania is the largest producer of mushrooms in the United States, accounting for 47 percent of all mushroom production. In 2017, Pennsylvania had over 17 million square feet of mushrooms in production, almost three times the amount of the second largest mushroom-producing state, California. Sales from mushrooms in Pennsylvania bring in around $612 million dollars per year (2017 Census of Agriculture). **Table 10** shows the national ranking of mushroom producers in the United States according to the 2017 Agricultural Census.

Pennsylvania is also a large fruit producer. In the 2017 Census of Agriculture, Pennsylvania was ranked ninth in the United States for the number of non-citrus fruit-producing

farms, and sixth for acres of non-citrus fruit harvested. As of 2017, Pennsylvania had a total of 2,343 fruit farms totaling 43,092 acres. Pennsylvania produced 528 million pounds of apples, ranking fourth in the nation for apple production. In 2017, 22,513 acres in Pennsylvania grew apples, 13,615 acres grew grapes, and 4,249 acres grew peaches. **Table 11** lists the most common fruits grown in Pennsylvania by number of farms and acreage, along with their national rank.

Organic farming is another rapidly growing agricultural industry in Pennsylvania. Between 2012 and 2017, the number of certified organic farms in Pennsylvania rose 82 percent, which is more than double the rate nationwide. Organic farm sales in Pennsylvania rose 800 percent between 2012 and 2017, compared to a national rate of 133 percent (2017 Census of Agriculture).

NRCS will encourage more organic producers to undertake soil health practices by funding projects that connect the science on soil health with organic management techniques.

ACTION

Increase the number of organic crop producers utilizing soil health practices.

ACTION

Fund Conservation Innovation Grants that incorporate soil health strategies into organic management.

ACTION

Develop a staff training program on working with organic farmers on soil health and other conservation practices.

Table 8: **Pennsylvania Crops National Ranking**

CROPS	SALES ($1,000)	NATIONAL RANK
Nursery, greenhouse, floriculture, sod	1,015,948	3
Cultivated Christmas trees, short rotation woody crops	28,893	3
Tobacco	35,994	7
Fruits, tree nuts, berries	171,575	11
Other crops and hay	360,622	13
Vegetables, melons, potatoes, sweet potatoes	187,319	18
Grains, oilseeds, dry beans, dry peas	980,977	25

SOURCE: 2017 Census of Agriculture

Table 9: **Pennsylvania Vegetables National Ranking**

VEGETABLES	FARMS	ACREAGE	NAT. RANK (BY ACRES)
Pumpkins	1,305	6,871	2
Tomatoes	1,586	3,297	7
Snap Beans	965	6,877	8
Bell Peppers	1,097	1,122	8
Cantaloupes	597	978	8
Sweet Corn	1,672	11,514	10
Cabbage, head	564	1,205	13
Squash (all)	978	1,477	15
Potatoes	1,107	7,643	20

SOURCE: 2017 Census of Agriculture

Table 10: Mushroom Production in the United States

STATE	SQ. FT. UNDER GLASS OR OTHER PROTECTION	NATIONAL RANK
Pennsylvania	17,314,135	1
California	6,250,853	2
Oregon	432,434	3
Washington	420,756	4
New Jersey	298,525	5

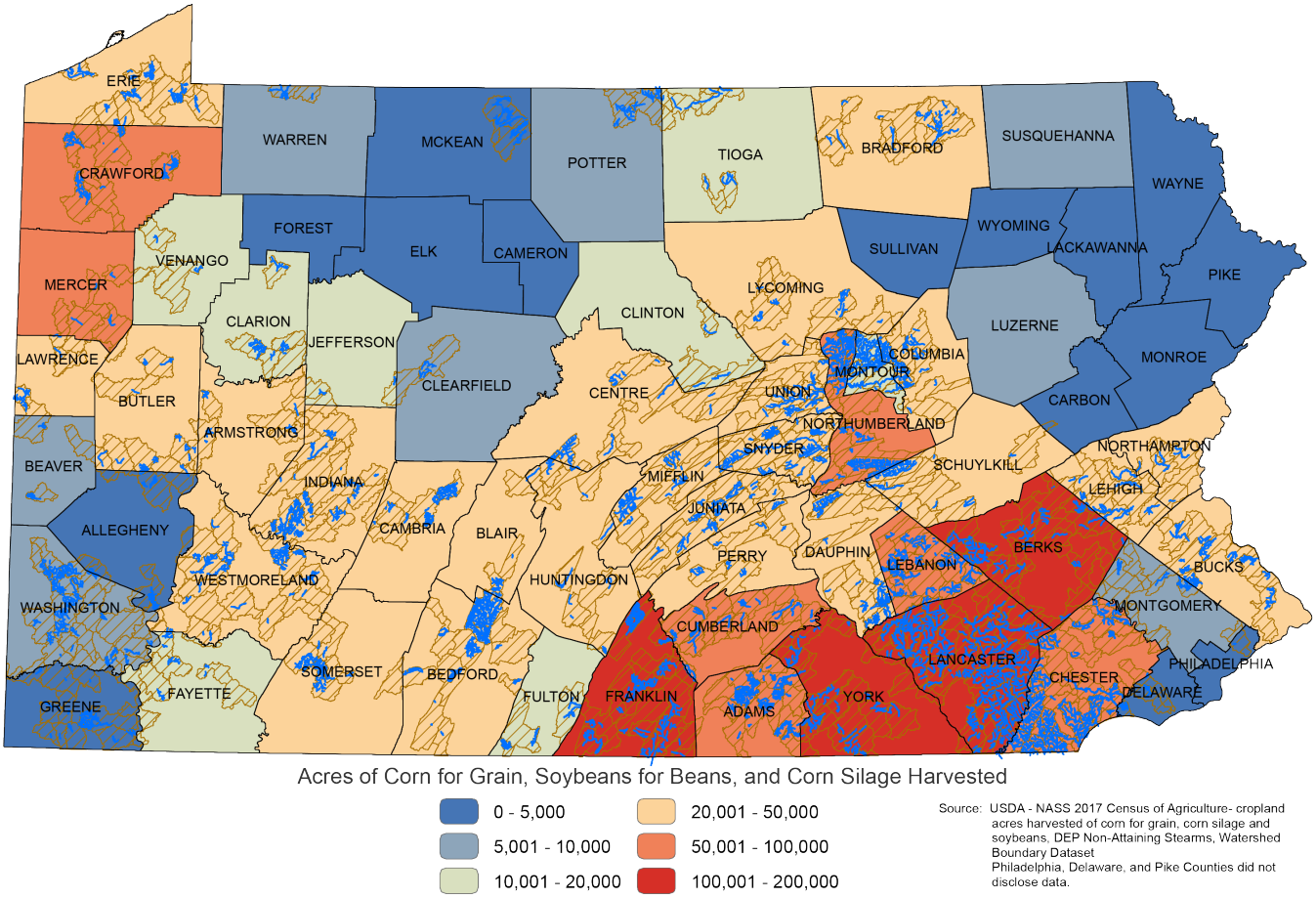
SOURCE: 2017 Census of Agriculture

Table 11: Pennsylvania Fruit Production

FRUIT	FARMS	ACREAGE	NAT. RANK (BY ACRES)
Apples	1,579	22,513	4
Peaches (all)	849	4,249	4
Pears (all)	548	947	4
Nectarines	112	312	4
Grapes	661	13,615	5
Cherries, tart	255	604	7
Apricots	99	69	8
Plums/Prunes	250	142	9
Cherries, sweet	380	382	10

SOURCE: 2017 Census of Agriculture

Map 9: Acres of Corn for Grain, Soybeans for Beans, and Corn Silage Harvested and Watersheds with a Stream Impaired by Sediment from Agriculture



Acres of Corn for Grain, Soybeans for Beans, and Corn Silage Harvested

- 0 - 5,000
- 5,001 - 10,000
- 10,001 - 20,000
- 20,001 - 50,000
- 50,001 - 100,000
- 100,001 - 200,000

Source: USDA - NASS 2017 Census of Agriculture- cropland acres harvested of corn for grain, corn silage and soybeans, DEP Non-Attaining Stearms, Watershed Boundary Dataset
Philadelphia, Delaware, and Pike Counties did not disclose data.

NRCS Assistance

In Pennsylvania, through voluntary conservation efforts of private landowners working with NRCS, an abundance of conservation practices addressing soil, water, and air quality resource concerns were installed on cropland over the past five years. The NRCS EQIP, CSP, and AMA programs all fund conservation practices that support healthy water and healthy soils for cropland. **Table 12** illustrates the most common conservation practices implemented on cropland in Pennsylvania by Fiscal Year from 2017 through 2021.

It is a goal for Pennsylvania NRCS in the coming months to prepare for increased funding dedicated to cropland health and carbon sequestration and to streamline conservation planning and program delivery. In Fiscal Year 2022, Pennsylvania NRCS was one of 11 states which began participating in a cover crop intensive program initiative. The primary focus of the initiative was to provide quicker conservation planning for agricultural producers to implement cover cropping. In the first year, Pennsylvania NRCS was able to fund 39 out of 168 applications for just under $1 million. This shows there is a demand for cover crop assistance.

Pennsylvania NRCS plans to adapt this initiative to streamline conservation planning by expediting the application, ranking, and funding obligation process. Examples of streamlining include creating templates for the NRCS-CPA-52 form and for PNDI searches. Additionally, NRCS may look to incorporate this type of streamlining for other projects, such as other types of conservation practice contracts or for soil health testing.

Table 12: Conservation Practices Implemented on Cropland by Fiscal Year 2017–2021

PRACTICE	UNITS	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	5-YEAR TOTAL
Cover Crop	Ac.	23,000	27,134	43,886	28,779	40,775	163,574
Nutrient Management	Ac.	26,727	18,684	17,791	17,341	32,847	113,390
Diversion	Ft.	24,578	35,228	29,042	27,619	29,418	145,885
Waterway	Ac.	113	190	96	113	98	607
Terrace	Ft.	42,641	28,847	47,730	20,968	42,254	182,440
Lined Outlets	Ft.	3,904	9,032	15,392	5,936	7,441	41,705

SOURCE: Pennsylvania NRCS Annual Reports 2017–2021

Climate Smart

Climate smart conservation practices are becoming more important to reduce the impacts of climate change. The Inflation Reduction Act (IRA) signed in 2022 will designate millions of additional funds for climate smart practices through the EQIP and CSP programs over the next several years. Climate smart practices help reduce emissions of greenhouse gases and increase carbon sequestration on agricultural operations while helping producers to deliver agricultural products. Some of these practices for cropland include conservation cover, conservation crop rotation, no-till, reduced till, contour buffer strips, cover crops, field borders, filter strips, grassed waterways, mulching, stripcropping, nitrogen management, and nutrient management.

Pennsylvania agricultural producers are already implementing many of these climate smart practices. According to the 2017 Agricultural Census, the number of farms using no-till as a conservation practice in Pennsylvania increased by 3 percent since 2012, with the number of acres of no-till growing by 17 percent. As of 2017, the total number of no-till acres in Pennsylvania had risen to 1.6 million. Cover crop acreage also increased by 33 percent. Pennsylvania is now tenth in the nation for the use of cover crops as a conservation practice (Smith-Brubaker 2018).

Climate smart agriculture will be a large focus for Pennsylvania NRCS in the future. Over the next five years, Pennsylvania NRCS plans to use improved technology and tools to increase and better target the implementation of climate smart conservation practices for agricultural producers. No-till, residue management, and cover crops will be a focus for program funding provided to producers through Conservation Incentive Contracts, practices and enhancements, and the increased funding through the IRA.

Soil Health Strategy

Climate smart practices and soil health go hand in hand. Increasing soil health adoption throughout the Commonwealth will involve a team of players working in different facets including public, private, NGOs, research, and corporate. The goal for Pennsylvania NRCS is to increase the transition to and implementation of soil health practices within existing and newly planned conservation systems with the effect of improving the long-term productivity, sustainability, and vitality of Pennsylvania's working lands

New NRCS Soil Health Activities

NRCS is continuing to develop and promote a series of new soil health conservation activities. These include Conservation Plan Activity (CPA) 116 — Soil Health Management Plan, Design and Implementation Activity (DIA) 162 — Soil Health Management Conservation System Design, Conservation Enhancement and Monitoring Activity (CEMA) 216 — Soil Health Testing, Conservation Practice Standard (CPS) 336 — Soil Carbon Amendment, CEMA 218 — Carbon Sequestration and Greenhouse Gas Mitigation Assessment, and CEMA 221 — Soil Organic Carbon Stock Measurement. These activities are new and will require working with the National Soil Health Division and networking with surrounding states to learn how to implement these on Pennsylvania lands.

ACTION

Publicize new soil health practices and activities to the State Technical Committee for review and comment.

ACTION

Educate Technical Service Providers (TSPs) on soil health principles and increase the number of TSPs qualified to develop soil health management plans (CPA 116 and DIA 162).

ACTION

Provide information and training to NRCS field staff on new soil health practices and programs with the goal to increase the adoption of new soil health practices and programs.

ACTION

NRCS will continue to use GIS data layers to determine areas and cropping systems that are susceptible to ephemeral and classic gullies.

ACTION

NRCS will increase field employee efficiency by using off-site highly erodible land and wetland tools.

ACTION

NRCS will set aside an EQIP Minor Soil Erosion fund pool to help landowners address sheet, rill, and ephemeral gully erosion.

Soil Erosion

Pennsylvania NRCS also plans to continue to address soil health in the form of cropland soil erosion. With an increase in rainfall, Pennsylvania NRCS will focus on efforts to make producers and field employees aware of the potential for ephemeral and classic gullies.

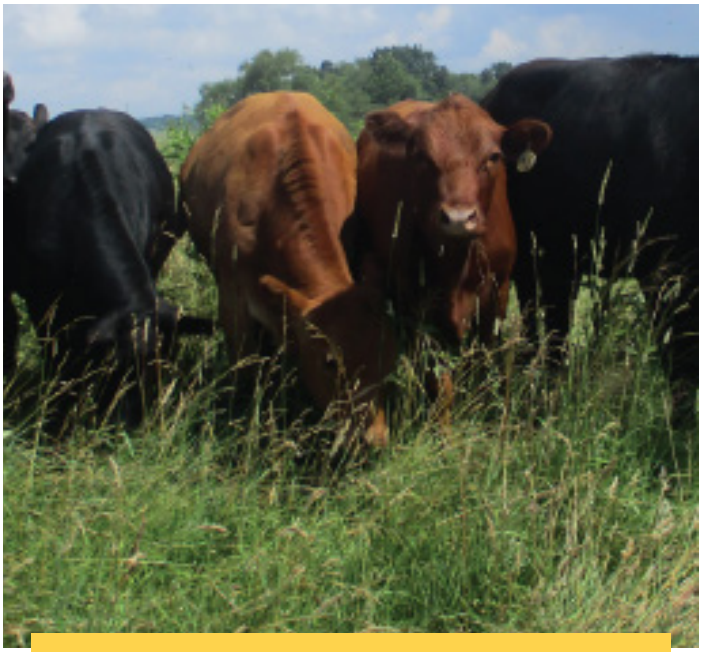
Training, Technology and Tools

Investing in the technical expertise of Pennsylvania NRCS staff and partners to understand and effectively communicate soil health principles and practices is a goal for Pennsylvania NRCS over the next five years. Regular training is required for NRCS conservation planners to retain continuity and maintain awareness of new technologies.

To achieve this, Pennsylvania NRCS will continue development and training of the Pennsylvania Soil Health Cadre, identify NRCS staff who would benefit from mentoring from the Soil Health Cadre, deliver soil health and sustainability trainings for NRCS and partner conservation planners, and expand NRCS field staff knowledge of soil health demonstration tools.

ACTION

NRCS will train employees on soil health tools, including, but not limited to, the Northeast Cover Crop Council's Cover Crop Decision tool, Pasture Condition Scorecard, the Cropland In-field Soil Health Assessment Worksheet, tabletop demonstrations, and the rainfall simulator.



Another method that can positively impact soil health on cropland is to incorporate grazing into a crop rotation. Grazing can be used to improve cropland soil health by including cover crop acres into a rotational grazing system. Adding grazing as a tool for cropland management has many benefits for the soil, such as increasing the diversity of root systems, increasing residue/cover left on crop fields after harvest to reduce erosion, and stimulating bacterial, microbial, and fungal activity in the soil (Duiker, et. al. 22). More on soil health as it applies to pastureland and grazing can be found in the Pastureland and Grazing section of this Strategic Plan.

ACTION

Provide practice specifications and payment scenarios for farmers to plan and implement perennial and annual forage cover crops.

Nutrient Management

Non-point source nutrient pollution (NPS) from agricultural sources continues to be a problem impacting water quality. NRCS recommends regular soil testing to determine the amount of each fertilizer nutrient required for each field to optimize production. Recommended nutrients may be supplied by applying fertilizer and/or manure. Manure is an excellent and often the most economical source of nutrients. It is also a rich source of organic matter for crop production. Application of fertilizer and manure on cropland should be managed to efficiently supply the recommended nutrients with minimal NPS pollution impacts to water quality. NRCS recommends the "4Rs" of nutrient management: apply the Right **amount** of nutrients from the Right **source** in the Right **place** at the Right **time**. The application of manure as a nutrient source creates challenges to the 4R system with respect to timing, rate, and placement of application.

The 2017 Census of Agriculture reports that almost 2.6 million acres (57 percent) of Pennsylvania's cropland is treated with commercial fertilizer and 1.2 million acres (26 percent) is treated with manure. The cropland with applied manure and fertilizer is illustrated in **Map 10**. The map also includes watersheds with nutrient-impaired streams.

The NRCS Conservation Effects Assessment Project (CEAP) studies effects of conservation practices on natural resource concerns. Survey data from two time periods was collected and modeled to identify where conservation practices were in place, where they were lacking, and their consequential effects on water quality.

Conservation Practices on Cultivated Cropland — A Comparison of CEAP I and CEAP II Survey Data and Modeling found that between 2006 and 2016, high-level nutrient management has declined due to a decrease in nutrient incorporation and swings in rate, timing, and method of application. The study also found an overall increase in subsurface nitrogen and soluble phosphorus losses. In terms of manure application trends, the 2022 CEAP study found that overall, the acreage receiving manure has increased substantially. Increasingly, manure is being exported from farm operations with excess manure nutrients to operations needing an economical source of plant nutrients.

The findings also show that manure testing for nutrient value was completed on less than half of the acres receiving manure, indicating many farmers did not have enough information to establish proper application rates. Without this information and an adequate nutrient management plan the potential for over application of fertilizer and/or manure nutrients continues to be a problem to address.

In response to the CEAP study findings, Pennsylvania NRCS will challenge field teams across Pennsylvania to increase producer implementation of 4R nutrient management plans to apply manure and fertilizer nutrients.

ACTION

Pennsylvania NRCS will train planners on the benefits of proper soil and nutrient testing, especially when manure and commercial fertilizer are both being applied on cropland.

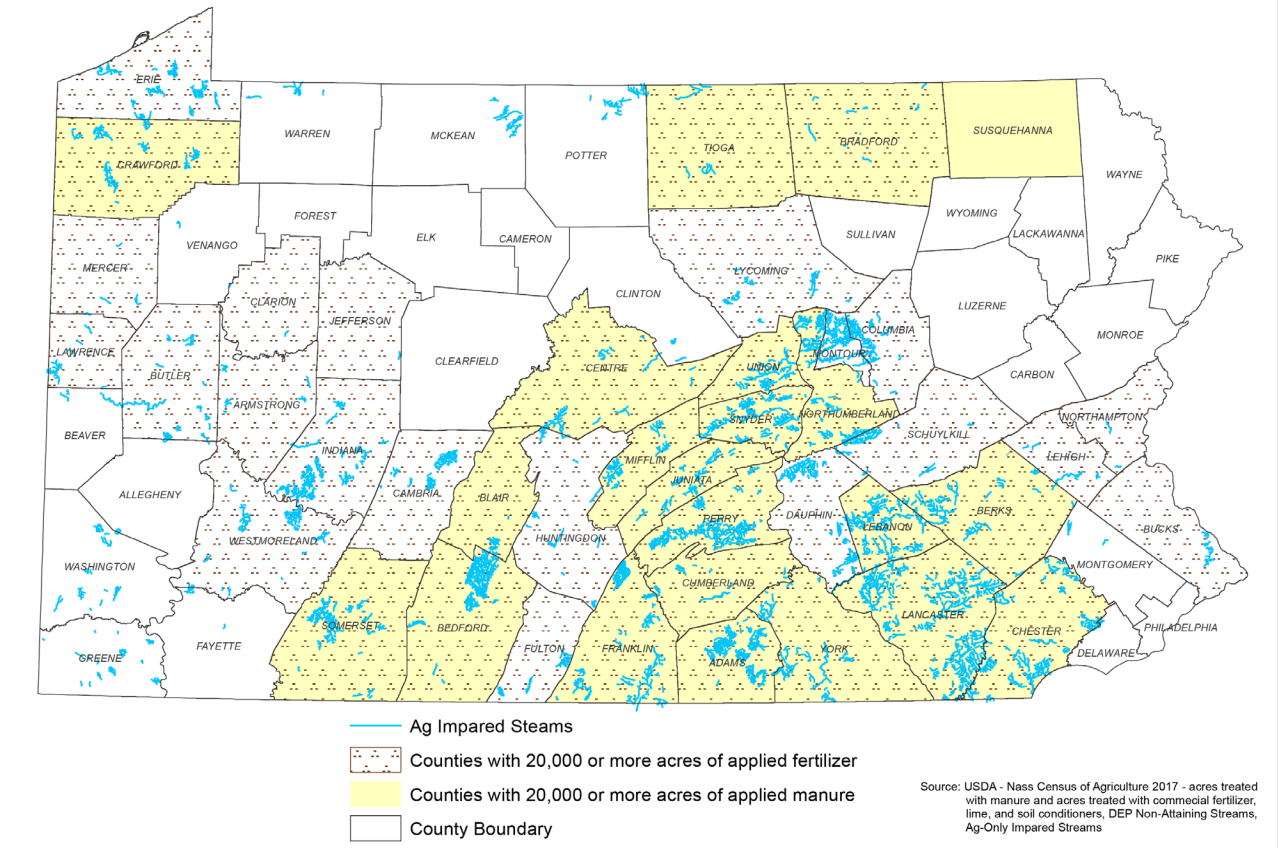
ACTION

Pennsylvania NRCS will create incentives to make manure and nutrient testing more enticing to producers.

ACTION

Pennsylvania NRCS will reward field teams that contract the most soil and manure tests and nutrient management plans.
All acres receiving manure alone, manure and commercial fertilizer, and commercial fertilizer alone should be planned to meet the 590 Nutrient Management conservation practice standard.

Map 10: Cropland with Applied Manure and Fertilizer



Public Awareness

Pennsylvania NRCS will promote soil health public awareness campaigns. Examples of this include demonstrations of soil health teaching tools, in-field soil health assessment, and hosting field days and outreach events. NRCS also plans to keep field staff apprised of upcoming soil health trainings, opportunities, and communications provided by the NRCS Soil Health Division.

ACTION

Create an annual soil health performance goal for each field office.

Employees with a rainfall simulator.

Ecological Site Descriptions and Soil Survey Mapping

As the need to address climate change grows, proper soil mapping and site descriptions will become even more critical. Technical tools, like Ecological Site Descriptions (ESD) available through the Web Soil Survey and improved mapping on Pennsylvania's mine lands, are essential.

ACTION

Continue to work with the Soil Survey Division to update the soil survey for mined areas in Western Pennsylvania.

ACTION

Train all Pennsylvania NRCS employees and partners on the purpose and use of Ecological Site Descriptions as ESDs become available.

DEVELOPMENT AND AGRICULTURAL LAND PRESERVATION

Current Condition

One of the best ways to ensure soil health, address resource concerns, and protect the environment for the future is to preserve agricultural land. In recent years, agricultural land has been quickly disappearing in the face of development pressure. According to the American Farmland Trust in its 2018 "Farms Under Threat: The State of America's Farmland" report, the United States converted almost 31 million acres of agricultural land into development between 1992 and 2012. The American Farmland Trust calculation includes woodlands associated with farms and low-density residential development that were not included in other reports, making the acreage loss to development even larger than other reports estimated. This loss in acreage is equivalent to most of Iowa or all of New York State (Sorensen, A. A., 10).

In Pennsylvania, we are losing acres of our best farmland.* According to the 2017 Natural Resources Inventory (NRI), Pennsylvania lost over 1.7 million rural acres to development between 1982 and 2017, which translates to an average loss of around 48,571 acres per year. 331,000 of those developed acres lost between 1982 and 2017 were from prime agricultural land. (2017 National Resources Inventory). Prime soils threatened by urbanization in Pennsylvania are illustrated in **Map 11**.

The benefits of protecting prime farmland and prime agricultural soils from development are many. Farmland provides substantial environmental benefits including aesthetics and open space, biodiversity, and wildlife habitat. Agricultural land also provides ecological services such as floodplain protection, groundwater recharge, and carbon sequestration. The conversion of prime farmland soils for development creates a potential resource concern because less hardy, more vulnerable soils become needed for agricultural use, which contributes to increases in soil loss through erosion.

In Pennsylvania, farmland preservation is a priority. Pennsylvania leads the nation in the number of farms and acres preserved for agriculture through the Commonwealth's Farmland Protection Program, which is administered by the Pennsylvania Department of Agriculture (PDA). The first easement under this program was purchased in 1989. As of December 2021, 5,928 farms were approved for easement purchase under the Farmland Protection Program and a total of 601,647 acres of valuable farmland were preserved in perpetuity (NRCS VIP Statewide Fact Sheet). Pennsylvania NRCS has assisted with 481 easements on more than 62,000 acres

According to the American Farmland Trust's 2020 "Farms Under Threat: The State of the States" report, Pennsylvania is one of only a dozen states having a "highest" policy response score for a state policy response to the threat of conversion of agricultural land.

Development Trends and Impacts

Preserving agricultural land is becoming increasingly more important as current development trends and patterns put high-quality agricultural land at risk in Pennsylvania. Both suburban and industrial sprawl are contributing to development pressure. Increased population density across many counties in Pennsylvania is creating a need for housing and business development to support jobs. Development in both rural areas and on the outskirts of urban areas continues to convert agricultural land and open space.

Lancaster County farm field next to low-density residential housing. Photo by Dave Harp, Bay Journal, 2019.

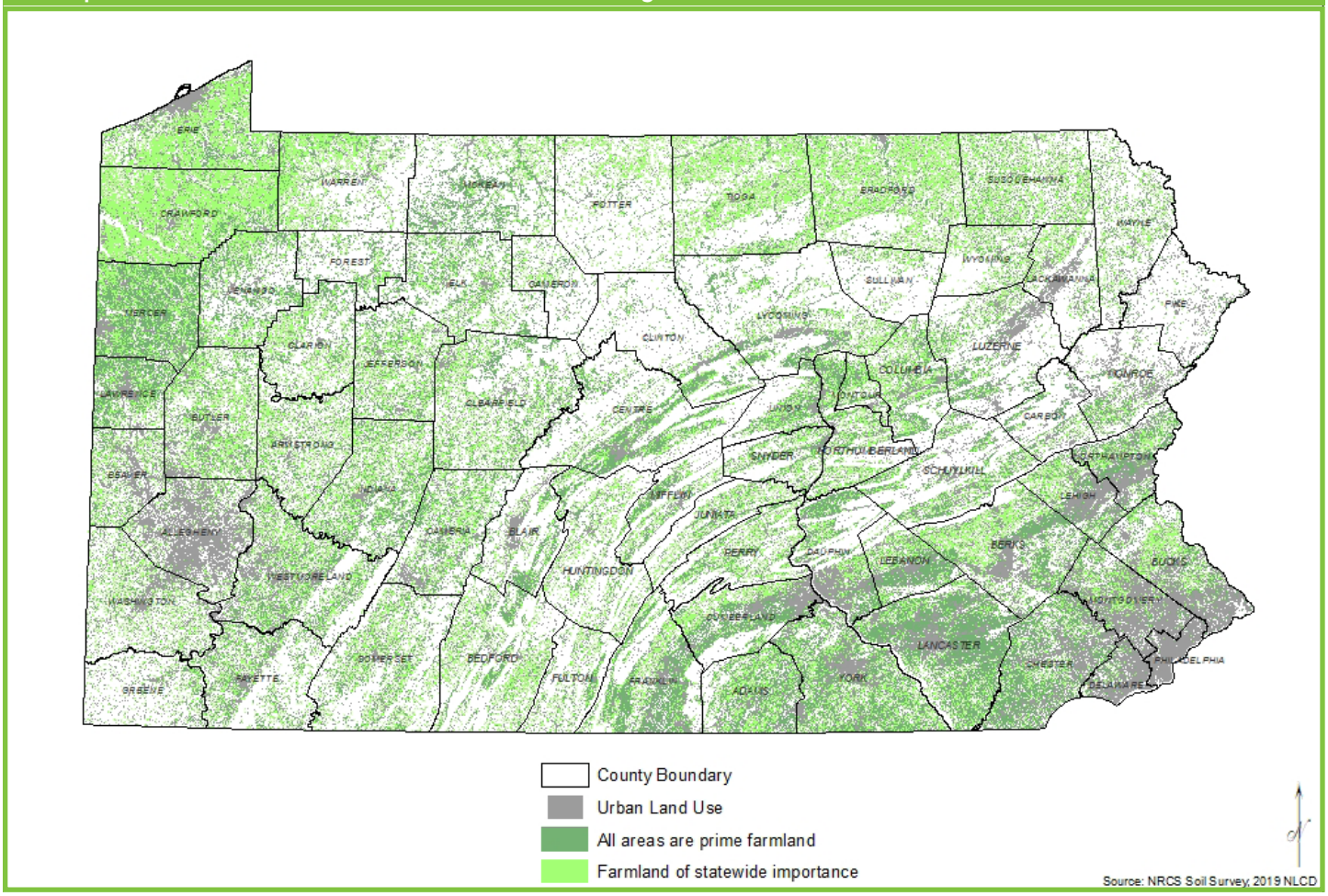
One of the current development trends threatening agriculture in Pennsylvania is suburban sprawl in the form of low-density residential housing neighborhoods. The American Farmland Trust reported in its study "Farms Under Threat: The State of the States" that Pennsylvania ranked eighth in the nation for the pace of land being converted from agriculture to low-density housing neighborhoods. In the study, the American Farmland Trust found that approximately 70 percent of the agricultural land converted in Pennsylvania between 2001 and 2016 was from low-density residential neighborhoods being built (Crable).

In addition to suburban sprawl, industrial sprawl in the form of warehouse construction is an issue in Pennsylvania. Warehouses require acres of undeveloped land. Over half of existing warehouses in the United States exceed 50,000 square feet, and larger warehouses (100,000 square feet or more) are typically needed as distribution centers for imports, exports, and wholesalers ("Average Warehouse Sizes & Space Planning Tips"). The average size of new warehouses being built in the United States between 2012 and 2017 was 184,693 square feet, or 4.2 acres of land, which is a 143 percent increase over the average size recorded between 2002 and 2007 (McMillan). Warehouses will continue to get bigger in size as e-commerce demand in the United States increases.

The building footprint of a warehouse is only one concern. More acreage is required to support parking

** The 2017 Natural Resources Inventory (NRI) conducted by USDA NRCS surveys Prime Farmland in each state. The NRI defines Prime Farmland as land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is also available for these uses. NRI estimated that there were 1,761,200 acres of cropland in Pennsylvania categorized as Prime Farmland in 2017.*

Map 11: **Prime Soils Threatened by Urbanization**



lots, access roads, and other infrastructure that support the warehouse complex. As home to one of the largest highway transportation corridors on the east coast through which goods travel from New Orleans to large cities in the Northeast, Pennsylvania's I-81, I-83, I-76, and US 11/15 interstates connect 40 percent of the American public to major ports located in Philadelphia, Newark, Baltimore, New York, and Newport. ("Quick Facts About Greater Philadelphia").

Photo by Erin Schaff, The New York Times, 05/26/2021.

In areas where suburban sprawl and industrial warehouse development occur, the loss of valuable soils and agricultural land isn't the only detrimental impact to the agricultural community. When development spreads into the rural agricultural landscape, it disrupts the agricultural community and, over time, the agricultural community is slowly lost to fragmentation. The area can no longer provide a support network for farming activity.

Farms become isolated islands of undeveloped land surrounded by warehouses and subdivisions. Tractors and other farm equipment clash with trucks and vehicle traffic on congested roads. Local farm markets and other agri-businesses that support farming begin to leave the area. Land values and property taxes increase, making it difficult for agricultural landowners to hold on to real estate. When this happens, agricultural landowners are tempted to sell to developers who are ready to pay top dollar per acre in these areas where farming has already become a challenge. In fact, the American Farmland Trust found, in its study, that agricultural land in proximity to suburban development is 23 times more likely to become urbanized than agricultural land in other areas (Crable and Cox).

Industrial and suburban sprawl will continue to increase as the population grows and metropolitan areas expand. Considering all the negative impacts that can arise from suburban sprawl and industrial warehouse development, it is vital for communities to conduct land use planning activities that envision both the short-term and long-term impacts to the community and to the environment. Community planners and leaders must impart and uphold strict zoning and land use plans that protect sensitive important areas such as floodplains, forests and open space, wildlife, and agricultural land.

However, while zoning laws and land use planning can slow development or move it in a different direction, they are not a permanent solution. The authority to permit or deny development lies in the local community, where township boards and other local governing bodies have the power to say 'no' to developer requests for zoning or land use planning changes. Communities must also be more proactive in requiring builders, where development is permitted, to give back to the community, build with environmental impacts in mind, and compensate for open space that is taken. Parks, wetlands, nature trails, and other open spaces could be a bargaining tool as an exchange for approving housing developments or warehouse complexes. Preserving sensitive wildlife areas and agricultural lands having high-value soils should be a priority and a tool for communities to use to counteract the impacts of suburban and industrial warehouse sprawl.

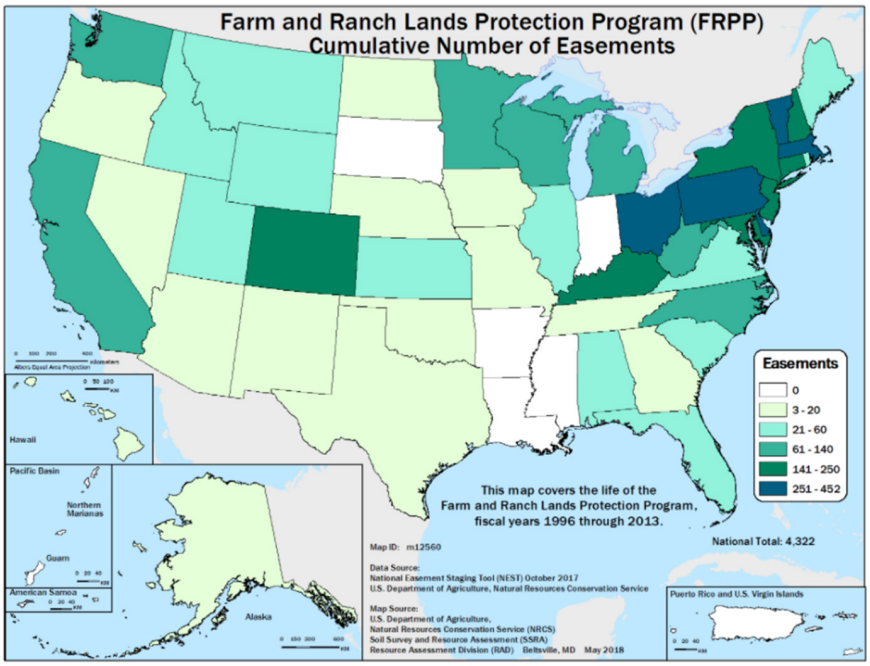
NRCS Assistance

Since 1996, USDA/NRCS, in cooperation with key preservation partners, has been working to protect agricultural land and prime soils through its voluntary agricultural preservation programs. NRCS and its agricultural land preservation partners work hand-in-hand to conduct outreach, enroll, acquire, monitor, and manage every agricultural land easement preserved with Federal funding. The success of agricultural preservation in Pennsylvania relies heavily on partnerships.

The NRCS Farm and Ranch Land Protection Program (FRPP) was authorized in 1996. Between 1996 and 2013, NRCS preserved 4,322 easements and over 1 million acres of quality agricultural land across the United States through FRPP. Pennsylvania leads the nation in the number of FRPP easements, with 452 total easements, or roughly ten percent of the USDA-NRCS FRPP easements held nationally. Pennsylvania's FRPP acreage totals 59,346 acres of permanently protected agricultural land (FRPP Report). **Map 12** shows how Pennsylvania compares to other states in the number of FRPP easements.

Under the 2014 Farm Bill, FRPP was replaced with the Agricultural Conservation Easement Program (ACEP),

Map 12: Farm and Ranch Lands Protection Program (FRPP) Cumulative Number of Easements



under which Agricultural Land Easements (ALE) are funded. Through ACEP-ALE, NRCS funding is authorized to permanently protect agricultural working lands and soils from future development. As of the date of this publication, Pennsylvania NRCS has preserved 28 farms and 3,018 acres under ACEP-ALE, FRPP's successor. **Map 13** illustrates ag easements in various programs across Pennsylvania.

FRPP has preserved some significant areas across Pennsylvania, one of which is the "Pennsylvania Fruit Belt", one of the most productive fruit producing areas in Pennsylvania. The Fruit Belt is located along the edges of South Mountain, which is part of the northern end of the Blue Ridge Mountains that terminate in Pennsylvania. **Map 14** illustrates the geographic location of the Pennsylvania Fruit Belt, which surrounds the foothills of South Mountain in Adams County.

Adams County Fruit Belt

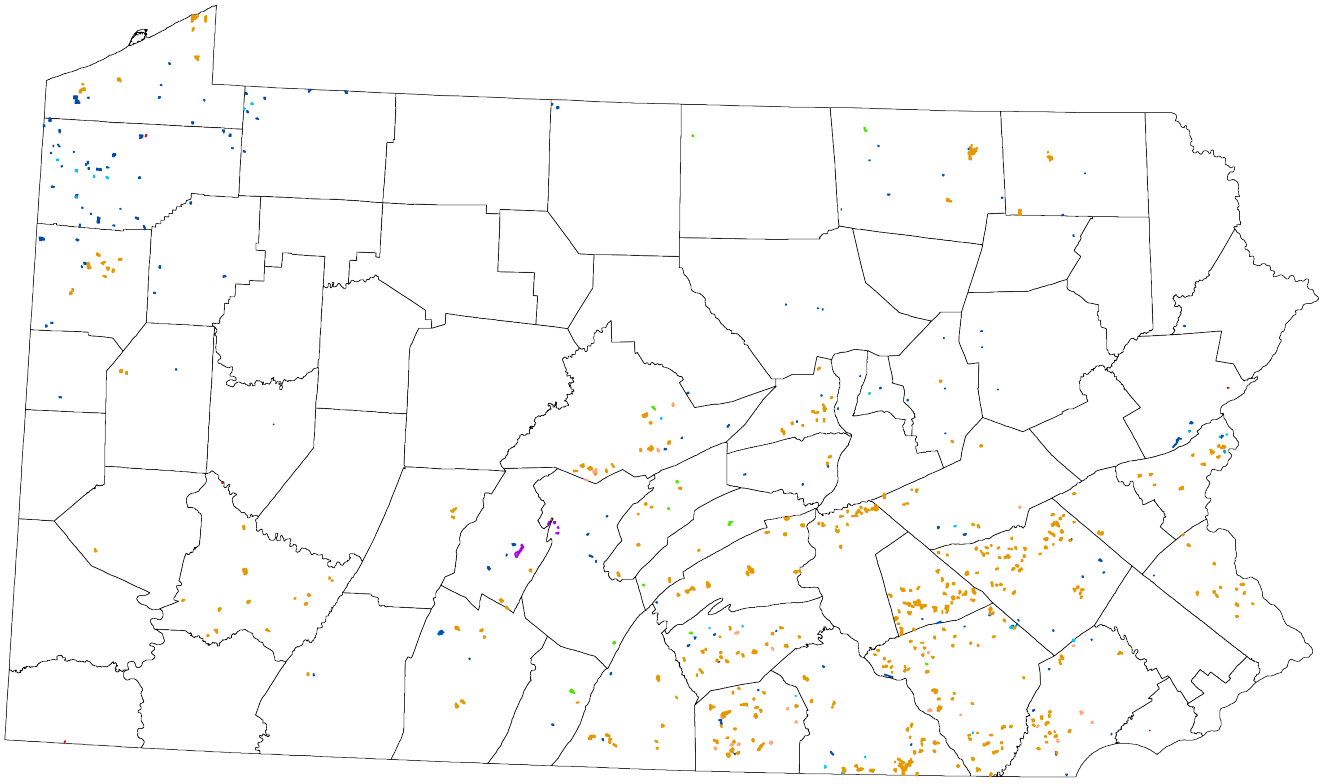
Farmers began growing orchard fruit near South Mountain in the early 19th century. From early on, it was evident that this location contained characteristics to support healthy orchard plants. Orchards in the area became more prevalent after the Civil War. Today, Adams County is home to over 20,000 acres of orchard land that makes up the Fruit Belt, which is the largest fruit growing area in Pennsylvania ("Historic South Mountain Fruit Belt — America's Orchard").

The officially designated Fruit Belt area is located along the lower slopes of South Mountain. The lower slopes provide the perfect topography, creating a microclimate that allows for the drainage of heavier, cold air away from the fruit trees, protecting them from spring frost damage. The sloping land also provides protection from wind and increases water availability.

In partnership with the Land Conservancy of Adams County (LCAC), Pennsylvania NRCS has permanently protected over 340 contiguous acres of fertile orchard land within the Adams County Fruit Belt through the Farm and Ranch Lands Protection Program (FRPP). **Map 13** illustrates the location and extent of the FRPP and other preservation easements within the Fruit Belt.

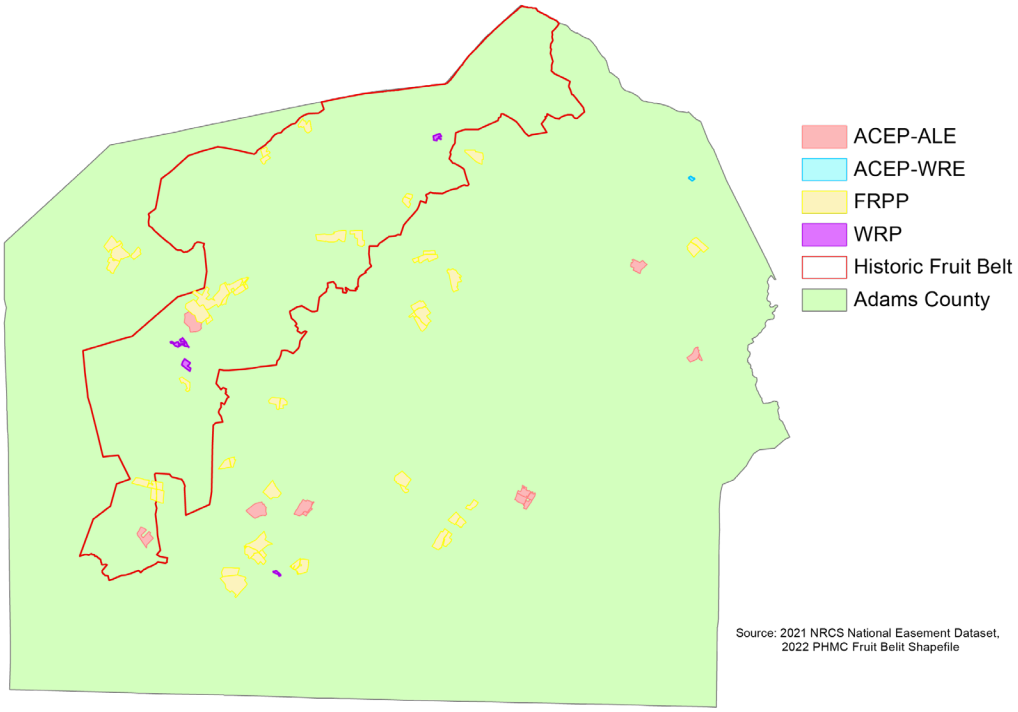
Apple orchards in bloom in the Adams County Fruit Belt, by Samuel Kuhnert in 1929. Image from PA State Archives, Manuscript Group 281.

Map 13: All Easement Locations in Pennsylvania



Source: 2021 NRCS National Easement Dataset

Map 14: All Easement Locations in the Historic Fruit Belt of Adams County



Source: 2021 NRCS National Easement Dataset,
2022 PHMC Fruit Belit Shapefile

ACTION

Expand preservation efforts in the Fruit Belt through the Agricultural Land Easement Program (ACEP) to create a larger, connected corridor of protected acreage with the goal of preserving this unique, historic, and economically valuable fruit growing region.

With the introduction of the 2014 Farm Bill, NRCS received another new program having the potential to preserve land. The new program was the Regional Conservation Partnership Program (RCPP). RCPP promotes the coordination of NRCS funding for conservation activities with partner funding and activities to address on-farm, watershed, and regional resource concerns through project implementation. Under RCPP, NRCS can engage in various partnerships to conduct agricultural land preservation. Currently, Pennsylvania NRCS has two RCPP Programmatic Partnership Agreements in place that support agricultural preservation.

Using RCPP, Pennsylvania NRCS, the Pennsylvania Department of Agriculture, and local partners are preserving other blocks of farm and forest land that are considered fundamental to Pennsylvania's rural and ecological heritage. These areas of cultural and ecological significance include the Hanover Shoe Farm in Adams County and the Kittatinny Ridge that stretches from Franklin County to Monroe County. By focusing on key corridors and special places, Pennsylvania NRCS and its state and local partners conserve natural resources, bolster agricultural and forestry economies, and increase climate change resilience.

ACTION

Work with agricultural land preservation partners to address the resource concerns created by development and to target agricultural preservation funding where it is needed most in areas experiencing high development pressure, with an emphasis on high-quality farmlands and connecting corridors.

Development and sprawl impact more than just agricultural land in Pennsylvania. Forested land, wetlands, and other valuable wildlife habitats are also impacted by land conversion. The Pennsylvania Department of Conservation and Natural Resources estimates that approximately 28,000 acres of forest are converted to development each year (Wildlife Action Plan 2-9), and according to the Pennsylvania Fish and Boat commission, "uncontrolled sprawl, and the resulting habitat loss and degradation is now the No. 1 threat to wildlife" in Pennsylvania (Wildlife Action Plan 11).

In addition to the ACEP-ALE program used for agricultural preservation, NRCS also funds the ACEP Agricultural Land Easement Grasslands of Special Significance (ACEP-ALE-GSS) program, which protects grasslands such as pasture and hayland on agricultural operations. NRCS also operates the Wetland Reserve Easement Program (WRE), which funds easements and restoration for wetlands, and the Healthy Forest Reserve Program (HFRP), which funds easements and restoration for forestland. More information about ACEP-ALE-GSS, WRE, and HFRP can be found in the Pastureland and Grazing (for GSS), Wildlife (for WRE), and Forestland (for HFRP) sections of this Strategic Plan.

ACTION

Map where easements currently exist across Pennsylvania, including easements from state and local governments, as well as easements held by non-governmental organizations and private land trusts to determine priority areas and prioritize land corridors.

ACTION

Work with partners to determine which wildlife habitat areas, watersheds, forestland, and grasslands would benefit most, and which areas of Pennsylvania are most threatened by fragmentation and land conversion to target with easement funding.

FORESTLAND

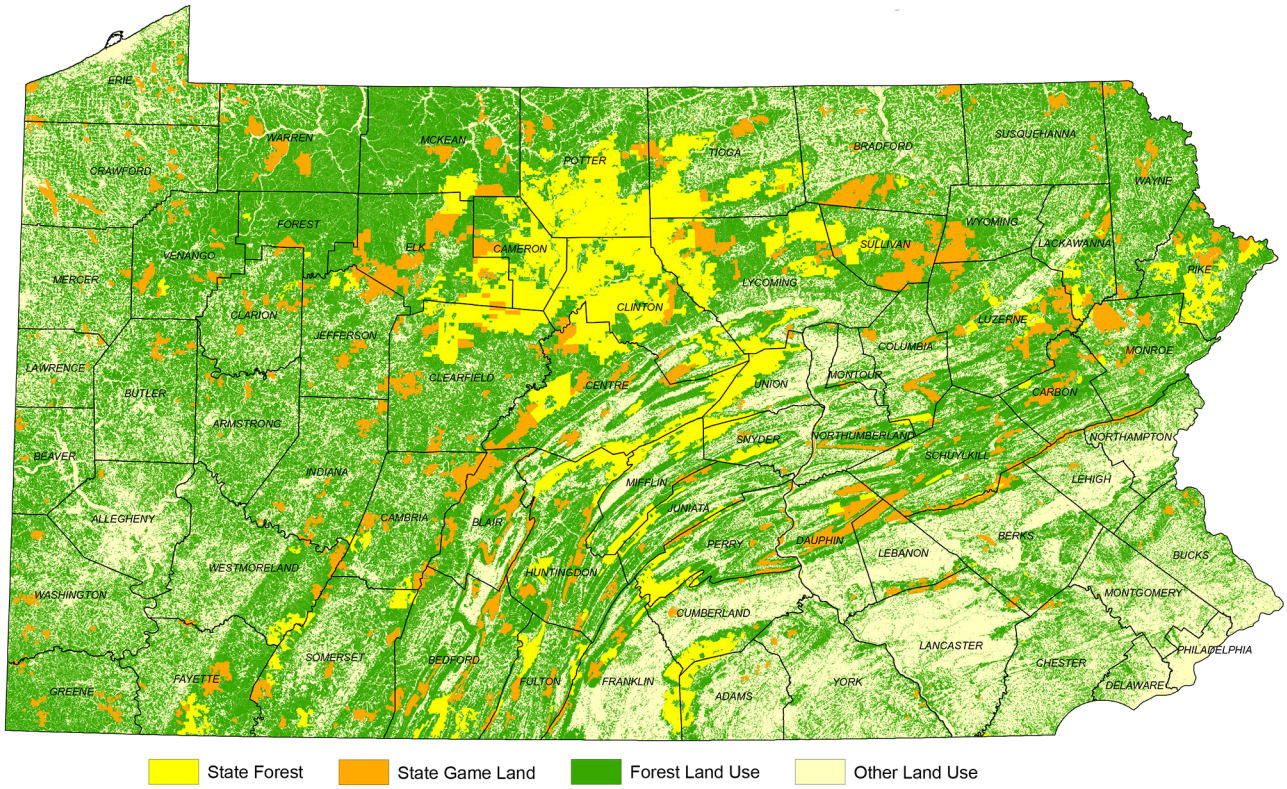
Before European settlement, Pennsylvania was covered in vast connected forests. In fact, 90 percent of Pennsylvania's 28,692,480 acres was covered in trees ("Stories from PA History"). Pennsylvania got its name from these forests. The name "Pennsylvania" translates from Latin to mean "Penn's Woods." Penn comes from William Penn who founded the Pennsylvania Colony in 1681.

Current Conditions

Today, approximately 58 percent, or 16.6 million acres of Pennsylvania land contains forest land (USDA Forest Service). This number includes all land in trees from lands under state and federal ownership, to private forests and small community forests ("Forests and Trees"). Two million acres are protected by state forest land, over 1.5 million acres are protected by public game and wildlife lands, and an additional 500,000 acres are protected by the Allegheny National Forest and the many state parks across Pennsylvania (Forest Action Plan 9-10). The geographic locations of current forested areas is illustrated in **Map 15** from the USDA Forest Service, Northern Research Station.

Pennsylvania's forests provide many ecological and aesthetic benefits. Forests filter and buffer drinking water sources and surface water and provide habitat for a variety of plant and animal species. Forests provide clean air through carbon sequestration. The United States Forest Service estimates that Pennsylvania forests sequestered an average of 7 million metric tons of carbon each year between 2007 and 2017 (Forest Action Plan 60).

Map 15: **Public and Private Ownership of Forest Land, Pennsylvania, 2012.**



Source: 2019 National Land Cover Dataset, PA Forest Stewardship Lands

The Pennsylvania Forest Action Plan of 2020 lists an assessment of forestland along with the strategies and goals recommended to improve and sustain forest health in Pennsylvania over the next ten years. The Forest Action Plan framework is based on the USDA Forest Service National Priorities from the 2018 Farm Bill and lists 11 priority issues. Based on the 11 priority Issues identified in the Pennsylvania Forest Action Plan, Pennsylvania NRCS has adopted seven priority issues which will drive NRCS strategic goals for Pennsylvania forestland.

Pennsylvania NRCS has adopted the following 7 issues for strategic planning for forestlands:

- Forest Health
- Sustainable Forest Management
- Non-Native Invasive Plants
- Climate Change
- Agroforestry Adoption
- Land Conversion and Fragmentation
- Wildlife Habitat

Conservation for Pennsylvania's forests must involve private land holders. Seventy percent of the existing forested acreage in Pennsylvania is held in private ownership, with 750,000 private landowners controlling more than 12 million acres of forest ("Forests and Trees"). Of the 12 million privately owned forest acres, 8.9 million acres are held by "family forest owners", 2.3 million acres are owned by corporations, and an estimated 800,000 acres are owned by "other" private owners, which include conservation organizations and hunt clubs (Forest Action Plan 99). An estimated 20 percent of the privately held forestlands in Pennsylvania are associated with farms, but the management of these forests is not often considered as part of the farming operation (Northeast Mid-Atlantic Forestry).

NRCS Assistance

NRCS labels privately owned and managed forests as "Non-Industrial Private Forestland". Non-Industrial Private Forest Land is defined in 7 CFR § 1466.3, as "rural land, as determined by NRCS, that has existing tree cover or is suitable for growing trees; and is owned by any non-industrial private individual, group, association, corporation,

Indian Tribe, or other private legal entity that has definitive decision-making authority over the land."

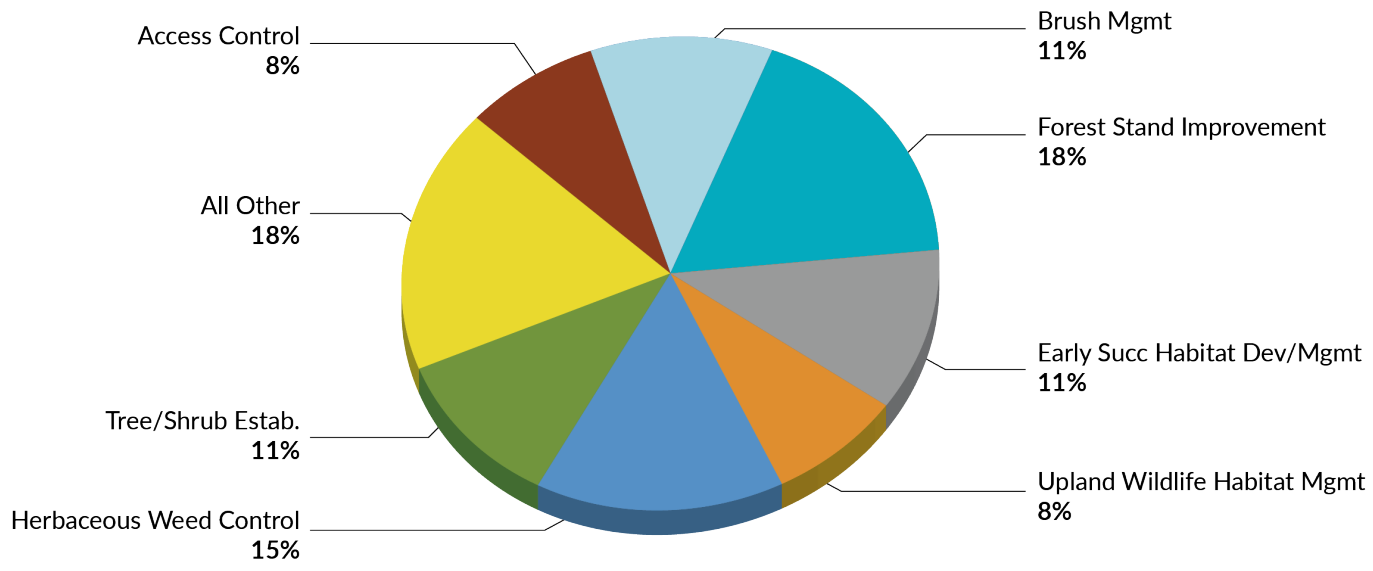
The abundance of non-industrial private forestland in Pennsylvania creates a conservation challenge, but it also presents a unique opportunity for NRCS to implement conservation projects in partnership with private forest landowners to meet strategic planning goals. NRCS planning knowledge and technology can be utilized in an impactful way to improve forest health and biodiversity and remediate resource concerns on private forestlands.

NRCS has a strong history of providing financial and technical assistance for forest land conservation in Pennsylvania. **Figure 2** shows the percentage of the most installed NRCS forest land conservation practices in Pennsylvania (by acreage amount) from 2005–2020 (NRCS Conservation Programs Pennsylvania). **Table 13** shows the total acreage and number of the top five practices installed between 2005 and 2020. Conservation assistance can be delivered on the ground with the implementation of practices through EQIP Forestry, EQIP Forest Management Plan Development, EQIP Working Lands for Wildlife Golden Winged Warbler, CSP Forestland, and RCPP, all of which share a common thread of addressing forest health.

Table 13: Top Five Forestland Practices installed in Pennsylvania (2005–2020)

FOREST STAND IMPROVEMENT	HERBACEOUS WEED TREATMENT	EARLY SUCCESSIONAL HABITAT MANAGEMENT	BRUSH MANAGEMENT	TREE AND SHRUB ESTABLISHMENT
225,044 acres	193,499 acres	166,841 acres	152,956 acres	136,552 acres
1870 no	534 no	637 no	754 no	599 no

Figure 2: Land Unit Acres Receiving Conservation (Forest Land Conservation FY 2005 – FY 2020)



Forest Health

A healthy forest can sustain itself ecologically over time and those processes leading to forest and tree decline are countered through processes of resiliency, recovery, and rejuvenation (State Forest Resource Management Plan). The prevalent issues that contribute to declines in forest health in Pennsylvania include forest pests and diseases, invasive and noxious plants, lack of adequate forest regeneration, degrading harvesting practices, and fragmentation. Pennsylvania NRCS will seek to refocus forestry conservation efforts with an emphasis on addressing factors that impact forest health through outreach, education, technical assistance, and financial assistance.

Forest health is strongly tied to maintaining biodiversity. Forest biodiversity is "key in conservation efforts regardless of the ecosystems of interest" (Forest Action Plan 13). A biodiverse forest is more resilient to threats and stressors, such as invasive non-native species, declines in forest health, loss of age class diversity, fragmentation, and climate change. Biodiverse forests are also more adept at carbon sequestration. Biodiversity can be achieved with proper forest management using NRCS conservation practices on non-industrial privately owned forestland in Pennsylvania.

A healthy forest has a diversity of species and size classes including seedlings and saplings. But forestlands described as small diameter stand size classes are decreasing across the Pennsylvania landscape. The US Forest Service's Forest Inventory and Analysis has noted that steady increases in large diameter stands have led to 71 percent of timberland being dominated by sawtimber, a rise of five percentage points since 2012. During the same time period, small diameter stands dropped from 10 percent to 8 percent of timberland area. Management of new young forests is needed to support the values and benefits of all stages of forest succession. (Albright 2017)

In addition, the forest stocking on private forestlands in Pennsylvania is increasingly shifting to moderately stocked, poorly stocked, or non-stocked. In 2014, 23 percent of privately held timberland was classified as poorly stocked or non-stocked with growing stock trees, up from 18 percent in 2004. The widening disparity between growing stock and all live stocking indicates an increasing amount of timberland dominated by trees of little commercial value (Albright, et al 2014). This decrease in fully stocked stands shows that poor management, without consideration for regeneration of a stand, is prevalent in Pennsylvania's privately owned forests. Poorly stocked stands can be difficult to manage and often require greater inputs in the form of invasive species treatments, regeneration area protection, tree establishment, and often thinning of non-commercial species.

Sustainable Forest Management

As shown in **Figure 2**, NRCS has implemented conservation practices on thousands of acres of forestland to address resource concerns since 2005.

ACTION

Use National Resources Inventory Data, and the US Forest Service's Forest Inventory and Analysis Data along with other current research to drive conservation planning goals and implement practices where they will have the most meaningful impact.

NRCS will continue to collaborate with partners, such as the Pennsylvania Department of Conservation and Natural Resources and Pheasants Forever to maximize impacts in these high-priority areas.

NRCS will also use geospatial data to understand what practices have been previously installed, where those practices have been implemented, and what impact those practices are having on addressing landscape-scale conservation concerns. NRCS will look to incorporate conservation practices, Agroforestry, and Forest Management Planning to align forest management goals for Pennsylvania NRCS with the priority issues of The Pennsylvania Forest Action Plan of 2020.

To help improve forest health and implement sustainable conservation practices across Pennsylvania, more forest management plans are needed.

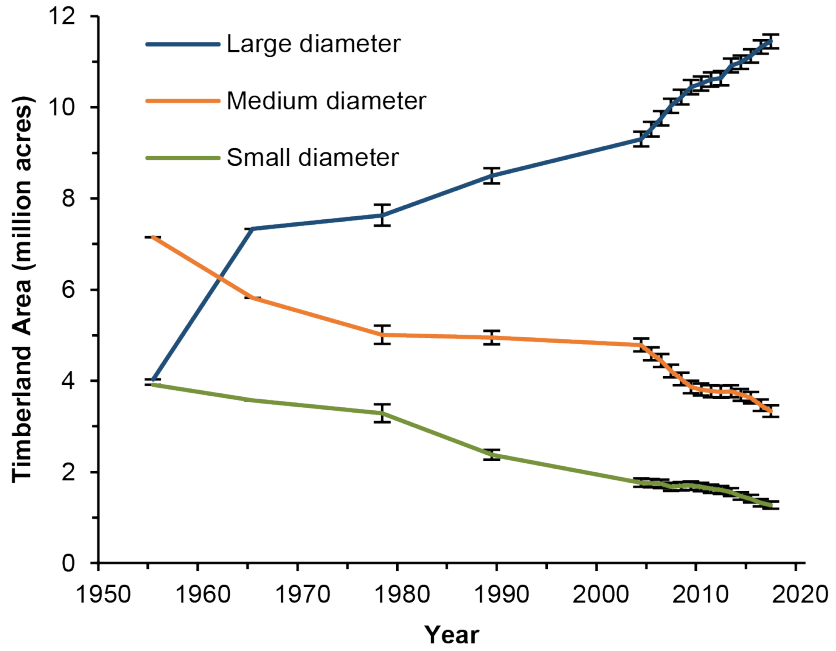
ACTION

NRCS will increase the annual total amount of financial assistance offered in the Forest Management Plan (FMP) development fund pool by 30 percent to encourage more private, non-industrial forest landowners to develop forest management plans.

Proper forest management planning is needed to prevent emerging forest health issues and to remediate existing forest resource concerns. Forest planning for private landowners can be achieved through Forest Stewardship plans, NRCS Forest Management Plan (Conservation Planning Activity 106/Design and Implementation Activity 165), Tree Farm Plans, by consultants, and plans that are required by conservation easements (Forest Action Plan 82).

Forest management plans should include silvicultural practices that incorporate conservation practices. Planning must address resources concerns in balance with landowner goals (Best Management Practices for Pennsylvania Forests, 14). Over the next five years, NRCS, working with partner agencies and Technical Service Providers, will ensure that more landowners have access to forest management plans in areas where they are needed most and will work to ensure that those forest management plans incorporate conservation practices that align with the Pennsylvania Forest Action Plan and with NRCS conservation practice standard recommendations for achieving forest health, biodiversity, sustainability, and carbon sequestration.

Figure 3: **Area of timberland by stand-size class and inventory year, Pennsylvania, 1955 – 2017.**



Albright, Thomas A. 2018. Forests of Pennsylvania, 2017. Resource Update FS-175. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 4 p. https://doi.org/10.2737/FS-RU-175.

To broaden the number of tools available to aid in sustainable forest management, Pennsylvania NRCS will seek to broaden cost-effective tools. Prescribed burning is one such tool.

Prescribed burning, or prescribed fire, is a cost-effective practice that addresses many resource concerns and can improve sustainable forest management on forestlands. Properly planned and implemented prescribed burns can spur regeneration for native plant communities and helps control non-native invasive plant species (Kreye and Kreye). Additionally, forest areas opened by fire exhibit early successional plant growth that provides valuable wildlife habitat. Prescribed burning also reduces the danger of unplanned wildfires from occurring (Kreye and Kreye).

Despite its widely known benefits, prescribed burning is rarely implemented as a conservation practice on private forestland in Pennsylvania. In 2019, 14,093 acres of Pennsylvania land received prescribed burning; however, only 340 of those acres were located on private land (Kreye and Kreye). Prescribed burning is regularly and widely used by the U.S. Forest Service, the U.S. Fish and Wildlife Service, and the National Park Service as a conservation and restoration strategy. In Pennsylvania, the Pennsylvania Game Commission and the Pennsylvania Department of Conservation and Natural Resources have begun utilizing prescribed burning more frequently to obtain conservation objectives (Kreye and Kreye).

The Pennsylvania Forest Action Plan recommends prescribed fire be "incorporated into landscape-level management" (217). NRCS has the funding and opportunity to utilize prescribed burning as a conservation practice but faces some hurdles for its application on non-industrial private forestland. A lack of qualified prescribed burning "practitioners" exists (Forest Action Plan 217). These types of experts are needed to ensure that prescribed fire activity follows the Prescribed Burning Act. Otherwise, both the property owner and the fire practitioner may face liabilities if the fire treatment is not executed properly (Forest Action Plan 217).

ACTION

NRCS, in partnership with DCNR and PGC, will work to introduce the use of prescribed burning (338) on private forest lands by training its employees on how to plan for prescribed burning practices.

ACTION

Pennsylvania NRCS will work with the PA Prescribed Fire Council, DCNR Bureau of Forestry, Pennsylvania Game Commission, Non-Profit Organizations, and private sector Technical Service Providers (TSPs) to train and develop a network of contractors qualified to implement prescribed burning on private lands in Pennsylvania. Non-Native Invasive Plant Species

Non-Native Invasive Plant Species

The prevalence of non-native invasive plant species, the abundance of which are increasing, is an issue impacting the health of Pennsylvania forests. Non-native invasive plant species are "one of the leading causes of decline among state-listed plants and plant communities in Pennsylvania" (Forest Action Plan 121). Approximately 115 invasive species inhabiting Pennsylvania are found in forest edge areas, 68 of which are plants (Wildlife Action Plan 3-27). Non-native invasive plant species can cause negative economic impacts by reducing timber yield and aesthetic beauty as well as making it more difficult to regenerate stands without implementing measures to control invasive species.

Non-native invasive plants spread more quickly in areas where development or land conversion of forest occurs and are more prevalent in forests experiencing fragmentation. Climate change is altering the range of non-native invasive plant species, making it a challenge to prevent and contain their spread. Non-native invasive plant species threatening Pennsylvania forests are listed in the PA Forest Action Plan (pg 121).

The Pennsylvania Invasive Species Management Plan cites prevention, early detection, and rapid response as recommended actions for non-native invasive plant species control. Pennsylvania NRCS will continue to work with private landowners and partners to implement conservation measures that manage invasive plant species on forestland. NRCS will educate landowners to increase non-native invasive plant species awareness and will provide technical and financial assistance where needed to control invasive plant species on private lands.

ACTION

NRCS will ensure that the most up-to-date invasive plant treatments are included in forest management plans and conservation practice recommendations.

NRCS will work with partners to determine areas of Pennsylvania having the greatest need for forest management that includes non-native invasive plant species treatments.

Climate Change

Climate change is an issue that is having a significant impact on native forest trees and the understory plants that make up forest communities. Climate change threatens forest health in Pennsylvania in many ways and is listed as one of the Pennsylvania Forest Action Plan priority issues. Some examples of climate change threats to Pennsylvania forests include longer, warmer growing seasons that benefit invasive species, changing conditions that threaten already stressed forest ecosystems, increases in extreme, damaging weather events, and changes in habitat that decrease suitability for forest dependent species (Forest Action Plan 154).

To address climate change issues for forestland, Pennsylvania NRCS will look to incorporate adaptive management planning over the next five years, adopting climate smart and climate adaptation practices.

ACTION

Pennsylvania NRCS will provide education, training, and resources to NRCS staff, affiliates, partners, and TSPs that train how to plan for forest resiliency against climate change and how to plan with climate smart adaptations for forestland.

Training and resources will draw on the collective knowledge of subject matter experts in partner agencies and organizations such as the USDA Climate Hubs and the Northern Institute of Applied Climate Science.

Part of the NRCS planning process to address climate change on forestland will include selecting tree species that survive under predicted climate models and recommending those species in forest management plans. The Northern Institute of Applied Climate Science has recommended climate change adaptive tree species for each of the physiographic regions of Pennsylvania on its Climate Change Response Framework website. NRCS will utilize these tree recommendations to develop climate smart adaptations to practices such as Tree and Shrub Establishment and other forest-related conservation practices, where applicable. This information will be a consideration for all NRCS planning on forestland. NRCS will also seek to prioritize climate change practice implementation to locations within the Climate Change Priority Areas recommended within the Pennsylvania Forest Action Plan and as identified in tools such as the USFS Landscape-scale conservation in the Northeast and Midwest mapping tool.

Carbon sequestration is tied to both climate change and forest health. Forests and forest soils in Pennsylvania sequester carbon, but not enough to offset carbon emissions (Forest Action Plan 162). Increasing the rate of carbon sequestration from forests is possible through forest management.

ACTION

Pennsylvania NRCS will support practices that lead to increased carbon sequestration in forest management planning and conservation practice development.

ACTION

NRCS will seek to collaborate with working groups such as the PA Agroforestry Brain Trust and other agroforestry-based organizations to focus on increasing awareness, education, and network building for forest farming.

Land Conversion/ Fragmentation

Forest fragmentation introduces many stressors that threaten forest health and negatively impact the “viability and ecosystem function of forest habitats” (Forest Action Plan 102). Fragmentation is often the cause of at-risk wildlife habitat decline, which has led to reduced populations of species of concern dependent upon forest connectivity (Wildlife Action Plan 2-9). Additionally, the probability for non-native invasive plant introduction and spread increases with fragmentation because invasive species are more prevalent in edge habitat areas (Pennsylvania, Pennsylvania Game Commission, Pennsylvania Fish and Boat Commission 2-9).

The Pennsylvania Department of Conservation and Natural Resources (DCNR) estimates that approximately 28,000 acres of forest are converted to development each year (Wildlife Action Plan 2-9). The data suggests that the forestland most at risk for conversion to development is the forestland at lower elevations, which is more accessible and better suited for agricultural and residential development (Wildlife Action Plan 2-9). Even though the population of Pennsylvania has remained relatively steady over the past decade, the amount of suburban and urban land converted into development continues to increase.

Development pressure is only part of the story of forestland fragmentation. In Pennsylvania, where 70 percent of forestland is privately owned by a complex diversity of

landowners, land ownership demographics are influencing how forests are inherited, purchased, sold, and potentially converted to other land uses. The average age of non-industrial private forestland owners is increasing, and large blocks of forested acreage are getting split into smaller and smaller tracts for inheritance purposes. Available data indicates that most timber harvesting, and forest fragmentation activity takes place during "ownership exchanges" (Forest Action Plan 101).

Table 14 shows that the majority of Pennsylvania's private forestland owners own less than 10 acres of forested land. This amounts to 13 percent of the Commonwealth's private forestland acres. Only 3 percent of private forestland owners own forest tracts having over 100 acres (Forest Action Plan 101).

ACTION

NRCS will utilize conservation easements through the Healthy Forest Reserve Program and Regional Conservation Partnership Program to help address the issues of forestland conversion and fragmentation.

NRCS funded forest easements provide an opportunity for forest management and restoration practices to be installed within the easement, which ensure the forested acreage will be managed in a sustainable way. The easement itself will prevent further fragmentation in perpetuity.

The Regional Conservation Partnership Program (RCPP) funds easements that can be utilized to preserve and connect forestland while improving forest health. RCPP promotes the coordination of NRCS funding for conservation activities with partner funding and activities to address on-farm, watershed, and regional resource concerns through project implementation. Under RCPP, Pennsylvania NRCS has the opportunity to engage with partners on conservation projects that preserve and restore forest health and biodiversity.

One of the RCPP Programmatic Partnership Agreements (PPA) applied to forestland in Pennsylvania involves a conservation easement acquisition in the Kittatinny Ridge area. The Kittatinny Ridge has been designated by DCNR as one of eight important Conservation Landscapes in Pennsylvania. This area was designated because it provides crucial wildlife habitat and clean water (Conservation Landscapes).

Table 14: Private Forestland Ownership in Pennsylvania

PARCEL SIZE	PRIVATE FORESTLAND OWNERS	PRIVATE FORESTLAND ACRES
Less than 10 acres	67.5%	13%
Between 10 and 99 acres	29.5%	51%
Over 100 acres	3%	36%

SOURCE: Forest Action Plan 101

Kittatinny Ridge Conservation Landscape

The RCPP project, #1847, titled "Kittatinny Ridge Conservation Landscape" is funded under the 2018 Farm Bill. For this project, NRCS partnered with the Pennsylvania Department of Agriculture and several state, local, and private conservation entities to secure over $10 million in RCPP funding for easement acquisitions. The purpose of this RCPP is to use conservation easements as buffers for key military installations in Pennsylvania by protecting sensitive forest and agricultural lands along the Kittatinny Ridge in Pennsylvania. **Map 16** illustrates the location of the Kittatinny Ridge Conservation Landscape RCPP project boundaries.

Another NRCS easement program that is well-suited for forestland conservation is the Healthy Forest Reserve Program (HFRP). Under HFRP, the United States is the easement holder and most rights to the surface of the land are purchased for easement. HFRP conservation easements protect, restore, and enhance forestland while promoting the recovery of threatened and endangered species under the Endangered Species Act. Additional goals of HFRP easements include improving plant and animal biodiversity and enhancing carbon sequestration.

In the past, HFRP program implementation in Pennsylvania included preserving easements to protect and improve critical habitat for the Indiana bat (Myotis sodalis). Land in Adams, Berks, York, Centre, Snyder, Mifflin, Huntingdon, Blair, Cambria, Bedford, Beaver, and Armstrong Counties in proximity to Indiana bat hibernacula and maternity colonies was eligible. As of the date of this publication, Pennsylvania NRCS utilized $1.4 Million to permanently preserve five properties with HFRP easements, totaling 1,049 acres. The largest property of over 800 acres connects to U.S. Fish and Wildlife Service preserved Indiana bat habitat and is in proximity to state parks inhabited by the Indiana bat. More information on NRCS conservation efforts for the Indiana bat can be found in the Wildlife Section.

The goal for the HFRP program in Pennsylvania over the next five years will be to expand the limits of HFRP to include preservation and restoration of other habitats in addition to those of the Indiana bat. Preserving and restoring connected corridors of forestland for threatened and endangered species and species of greatest conservation need as determined by the Pennsylvania Wildlife Action Plan will be a priority.

ACTION

NRCS will draft a proposal for consideration by the NRCS Easement Program Division for approval to expand HFRP eligibility targeting new species and new locations across Pennsylvania.

NRCS will study where forestland easements currently exist across Pennsylvania, including easements from state and local governments, such as the Forest Legacy Program administered by the U.S. Forest Service and led by DCNR in Pennsylvania, as well as easements held by non-governmental organizations and private land trusts to determine priority areas for HFRP easements.

ACTION

NRCS will work with the State Technical Committee members to determine which species to target with HFRP easement funding and to determine which areas are most threatened by fragmentation and land conversion.

NRCS will also seek to counteract forest fragmentation by conducting outreach to educate forest landowners about the benefits of preventing forest fragmentation and encouraging the afforestation of non-forested lands through forest management planning, conservation practices, and agroforestry practices. NRCS, working with other conservation partners, will seek areas of Pennsylvania where fragmentation and land conversion are occurring at a rapid pace and will work to implement conservation planning that protects and improves forested lands in those areas. NRCS will target conservation practice

Map 16: **Kittatinny Ridge RCPP Project Boundaries**

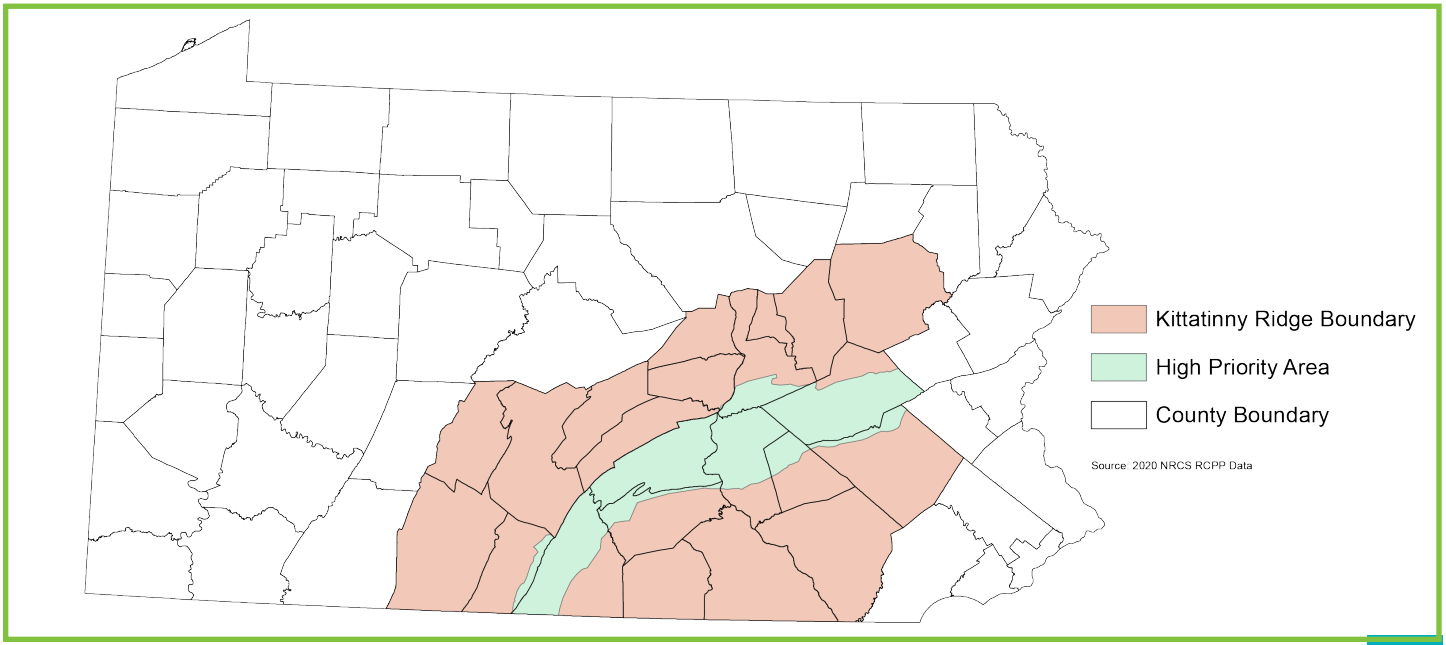


Photo by Pennsylvania Fish and Boat Commission

Wildlife Habitat

The degradation of forestland wildlife habitat in Pennsylvania is impacted by all the issues previously discussed. The current conditions of wildlife habitat are discussed in the Wildlife section of this strategic plan. In addition to conservation practice implementation, forest management planning, and conservation easements, NRCS supports and funds projects and initiatives that address specific resource concerns related to wildlife habitat which are directly aligned with addressing other issues such as improving forest health. More information on wildlife habitat in Pennsylvania can be found in the Wildlife Section of this Strategic Plan.

One such previously funded project was the "Cerulean Warbler Appalachian Forestland Enhancement" RCPP project, which focused on enhancing cerulean warbler (Setophaga cerulea) habitat on private lands across Pennsylvania, West Virginia, Maryland, Ohio, and Kentucky. Conservation efforts under this project included removing low-quality trees and controlling non-native invasive plants to improve forest regeneration, tree growth rates, acorn production, and habitat for the cerulean warbler and many other forest species. This project and others like it are an example of how NRCS can partner with other conservation agencies to attain forestland conservation on a broader scale across landscapes, and even across state lines. Pennsylvania NRCS will seek to improve partnerships over the next five years to attain new projects like this one.

Another ongoing forest-based wildlife habitat project is funded through the EQIP Working Lands for Wildlife Initiative which assists private forest landowners in creating and maintaining desirable habitat for golden-winged warblers (Vermivora chrysoptera). The initiative is focused on encouraging the growth of desirable trees, such as oak and hickory, and controlling invasive species in the forest understory. Conservation efforts supporting the golden-winged warbler promote forest health and benefit many other species that depend on similar habitat. More information about the golden-winged warbler and Working Lands for Wildlife can be found in the Wildlife section.

Special Projects/ Initiatives

A Joint Chiefs' Landscape Restoration Partnership (LRP) Project, a partnership between NRCS, the Allegheny National Forest, the Pennsylvania Game Commission, multiple conservation districts, and the Pennsylvania DCNR Bureau of Forestry was funded in 2017 through 2019. Through this project, NRCS completed work to improve and protect the health and resiliency of oak and mixed hardwood forest ecosystems in North-Central Pennsylvania. Both Pennsylvania NRCS and the Allegheny National Forest received funds for all 3 years of the project. The Joint Chiefs' LRP has served to help public and private forest landowners maintain a diversity of forest age classes and species to sustain forest ecosystems that are resilient to stressors.

ACTION

Submit a second Joint Chief's Project to focus on forest health improvement and ruffed grouse habitat development using the Pennsylvania Game Commission's grouse priority areas in the counties surrounding the Allegheny National Forest.

Pennsylvania NRCS intends to align with the priorities of several collaborating agencies and organizations such as the Appalachian Mountain Joint Venture's Allegheny Highlands Focal Landscape. More information about NRCS ruffed grouse conservation efforts in Pennsylvania is discussed in the Wildlife section.

Agroforestry Adoption

Agroforestry is the method of incorporating tree and shrub practices within an agricultural operation for the dual purpose of cultivation and conservation. Agroforestry practices, when installed and managed correctly, have the potential to address resource concerns, and, over time, these areas will promote increased carbon sequestration. Marginal farmland planted with trees and riparian buffer corridors, for example, could be converted to woodland with agroforestry practices, eventually, becoming functioning, healthy, biodiverse forest ecosystems (Forest Action Plan 163).

Agroforestry conservation practices that require frequent visits to forest lands encourage more forest stewardship. Forest Farming is a conservation practice that requires dedicated management and frequent tending to growing non-timber forest products within the forested area. Forest farming (379), previously known as multi-story cropping, maximizes the use of the forest canopy shade to grow high value specialty non-timber forest products that thrive in the forest understory, creating economic returns while controlling non-native invasive plant species. Non-timber forest products can be fundamental to the ecological functioning of healthy forests and can also play a role in generating income for producers (Chamberlain et. al., 2018). Examples of these types of non-timber forest products include mushrooms, nuts, vegetables, honey, medicinal herbs, fruit, edible flowers, botanicals, and sap products ("Forest Farming"). There is increasing opportunity for NRCS to coordinate with organizations and other agencies to encourage the adoption of the forest farming conservation practice in forestlands, including forested areas in urban settings.

Agroforestry has the potential to benefit the land by protecting topsoil and crops on cropland while providing wildlife habitat, improving water quality, and increasing productivity. Agroforestry can also help reduce chemical and energy inputs while increasing animal, plant, and landscape diversity (Agroforestry Strategic Framework 3). Common agroforestry practices include alley cropping, windbreaks (includes hedgerows and shelterbelts), forest farming, and riparian buffers.

Alley cropping (311) provides benefits to farms such as increasing farm income, increasing crop production per acre, increasing aesthetics and wildlife habitat, and alley cropping can also protect crops from pests and diseases ("Northeast Mid-Atlantic Agroforestry"). Windbreaks, shelterbelts, and hedgerows provide human (odor reduction/control), and crop protection benefits, as well as biodiversity, erosion and runoff reduction, and control of water flow ("Northeast Mid-Atlantic Agroforestry"). Riparian buffers (391) improve wildlife, diversity, and soil and water health on an agricultural operation and are more thoroughly discussed in the Water Section of this Strategic Plan.

NRCS plans to utilize conservation program funding for education and outreach to private landowners to embrace the use of agroforestry. Following guidance in the U.S. Department of Agriculture's Agroforestry Strategic Framework, Pennsylvania plans to build a strong agroforestry focus over the next five years.

ACTION

Conduct outreach to communicate with landowners and partners about the threats to Pennsylvania forests and provide education on how to address forest resource concerns through agroforestry and forestry discipline conservation practice adoption.

ACTION

Coordinate with Agroforestry researchers who are investigating agroforestry science and technology advances at the National Center for Agroforestry and partner organizations within the state and region to develop the proper agroforestry technical guidance specific to Pennsylvania ecosystems.

Using guidance from the Agroforestry Strategic Framework and the National Agroforestry Center, Pennsylvania NRCS will review the latest in agroforestry research and determine how to expand agroforestry practice use in Pennsylvania in the places where it is needed most. Pennsylvania NRCS will continue to coordinate with partnering agencies such as the DCNR Bureau of Forestry, and workgroups such as the Pennsylvania Agroforest Brain Trust to collaboratively expand technical assistance capacity and landowner knowledge of agroforestry practices. Pennsylvania plans to also find ways to incorporate agroforestry practice components within other land uses, and urban areas as appropriate.

PASA Alley Cropping Project.
Source: lancasterfarming.com; Ethan Strickler/Swallowtail Farm.

WILDLIFE

Current Condition

Pennsylvania contains many diverse wildlife habitats, including forests, wetlands, natural lakes, and shale and serpentine barrens. Pennsylvania habitats have evolved due to the influence of climate, topography, geology, soils, and natural and man-made disturbances. Geology, along with topography, climate, and hydrology impacts soil development which, in turn, impacts land use patterns, making geology and soils the "most significant predictors of species occurrence" (Anderson and Ferree 2010).

As noted in the Forest Section of this Strategic Plan, 90 percent of Pennsylvania's 28,692,480 acres was covered in trees before European settlement. Today, with 60 percent of Pennsylvania covered by forested land, forests dominate Pennsylvania's wildlife habitats.

Over 400,000 acres, or roughly 1.4 percent of the Commonwealth's total land mass, consists of wetland habitats. These include forested wetlands, scrub-shrub wetlands, and emergent wetlands. About 97 percent of the state's wetlands are palustrine or located on land. The northwestern and northeastern parts of the State, which were glaciated multiple times, contain the highest densities of wetlands. The glacial scouring and deposition left surface depressions and impermeable soils ideal for wetland development (State Wetland Program Summary).

In addition to forest and wetland habitats, smaller "patch habitats," or "open terrestrial habitats" account for the rest of Pennsylvania's wildlife habitat areas (Wildlife Action Plan 2-7). These habitats include naturally occurring barrens, native grasslands, reclaimed surface mines, and "anthropogenic sites" (Wildlife Action Plan 2-14). Some agricultural land can also be considered habitat.

Pennsylvania's varied habitats support diverse wildlife species: 480 birds and mammals, 200 fish species, 80 reptiles and amphibians, and over roughly 10,000 invertebrates exist in Pennsylvania (Wildlife Action Plan, Introduction 10). Of these species, 664 are labeled as "Species of Greatest Conservation Need" (SGCN) in the Pennsylvania State Wildlife Action Plan (ii). The SGCN list includes 90 birds, 19 mammals, 65 fish, 22 reptiles, 18 amphibians, and 450 invertebrates (Wildlife Action Plan ii). SGCN are species not yet officially designated as threatened or endangered but are at risk of becoming threatened or endangered due to stressors in and degradation of their natural habitats.

Maintaining healthy, diverse wildlife populations requires habitats of sufficient quality and quantity. Over 35 percent of Pennsylvania's available land has been converted from natural habitat into agriculture, roads, towns, and cities (Wildlife Action Plan 2-4). Land development, uncontrolled sprawl, and the resulting habitat loss and degradation are the largest threats to wildlife and are "the primary causes of species declines in Pennsylvania" (Wildlife Action Plan 2-4 and 2-11).

The Pennsylvania Wildlife Action Plan lists prevention of habitat loss and proactive conservation implementation as the best tools to support wildlife. (Wildlife Action Plan ii). As such, the goals of the Pennsylvania Wildlife Action Plan include actions tailored to "intervene at the state level before imperiled species require protection under the federal Endangered Species Act" and to proactively manage for species that are not yet imperiled (1-4).

2015–2025 Pennsylvania Wildlife Action Plan Goals

- Conserve Pennsylvania's native wildlife and its habitat by implementing conservation actions in the Wildlife Action Plan.
- Base wildlife conservation decisions on the best available science, with an emphasis on Species of Greatest Conservation Need and their habitat.
- Contribute to range-wide conservation of Species of Greatest Conservation Need.
- Strengthen the state's capacity to conserve Pennsylvania's native wildlife.
- Continue to improve cooperation within and between public agencies and other partners in wildlife conservation planning and implementation.
- Develop a knowledgeable citizenry that supports and participates in wildlife conservation.

The Pennsylvania Wildlife Action Plan lists agricultural activity as a direct threat to SGCN and wildlife habitat. Agriculture primarily impacts wildlife through land conversion and habitat loss by activities such as draining wetlands or clearing forests, and through damage to stream corridors and riparian areas by livestock and other farming activities (Wildlife Action Plan 3-73). Indirect agricultural impacts include excessive nutrients, soil erosion, and sediment entering streams.

Properly managed agricultural land can benefit both agricultural producers and wildlife. Because NRCS works extensively with private landowners and agricultural lands as part of its mission, NRCS has a unique opportunity to include wildlife habitat considerations within conservation planning on agricultural operations in Pennsylvania. Sustainable agricultural practices benefit wildlife by improving soil and water quality, and plant diversity. Those practices also benefit agricultural producers by creating resilient agricultural land that can better withstand drought, fire, and other natural disturbances (Wildlife).

NRCS Assistance

Pennsylvania NRCS can positively impact wildlife and wildlife habitat through its various programs that provide conservation planning, and conservation practice implementation assistance. NRCS programs that support wildlife practices include EQIP Working Lands for Wildlife, other EQIP fund pools, CSP Wildlife, Agricultural Conservation Easement Program (ACEP) Wetland Reserve Easement and Healthy Forest Reserve Programs and other projects and initiatives. **Table 15** shows the total acreage and number of the top five practices installed for wildlife between 2005 and 2020 (NRCS Conservation Programs). **Table 16** lists the five most commonly installed NRCS fish and wildlife habitat practices in Pennsylvania, their purpose, and how they serve the goals defined by the Pennsylvania Wildlife Action Plan.

Conservation Planning for Wildlife

One of the ways Pennsylvania NRCS incorporates wildlife into conservation planning is through its use of a Wildlife Habitat Evaluation Guide (WHEG) to measure outcomes of wildlife implementation. This system, the wildlife version of the Conservation Assessment and Ranking Tool (CART), assesses both the habitat value of a land area's existing

Table 15: **Five Most Commonly Installed Fish and Wildlife Practices**

NRCS CONSERVATION PRACTICE	PRACTICE PURPOSES	WILDLIFE ACTION PLAN GOALS
Upland Wildlife Habitat Management (645)	◆ Treat upland wildlife habitat concerns identified during the conservation planning process that enable movement, or provide shelter, cover, food in proper amounts, locations and times to sustain wild animals that inhabit uplands during a portion of their life cycle	Conserve Pennsylvania's native wildlife and its habitat, contribute to range-wide conservation of SGCN, strengthen the state's capacity to conserve Pennsylvania's native wildlife
Conservation Cover (327)	◆ Reduce sheet and rill erosion and sedimentation ◆ Reduce ground and surface water quality degradation by nutrients and sediment ◆ Enhance wildlife, pollinator, and beneficial organism habitat ◆ Improve soil health	Contribute to range-wide conservation of SGCN, strengthen the state's capacity to conserve Pennsylvania's native wildlife
Access Control (472)	◆ Achieve and maintain desired resource conditions by monitoring and managing the intensity of use by animals, people, vehicles, and equipment in coordination with the application schedule of practices, measures, and activities specified in the conservation plan	Conserve Pennsylvania's native wildlife and its habitat
Early Successional Habitat Management (647)	◆ Provide habitat for species requiring early successional habitat for all or part of their life cycle	Contribute to range-wide conservation of SGCN, strengthen the state's capacity to conserve Pennsylvania's native wildlife
Stream Habitat Improvement and Management (395)	◆ Provide suitable habitat for desired fish and other aquatic species ◆ Provide stream channel and associated riparian conditions that maintain stream corridor ecological processes and hydrological connections of diverse stream habitat types important to aquatic species	Contribute to range-wide conservation of SGCN, strengthen the state's capacity to conserve Pennsylvania's native wildlife

Table 16: **Top Five Fish and Wildlife Habitat Practices installed in Pennsylvania (FY 2005–FY 2020)**

UPLAND WILDLIFE HABITAT MANAGEMENT	CONSERVATION COVER	ACCESS CONTROL	EARLY SUCCESSIONAL HABITAT DEVELOPMENT/ MANAGEMENT	STREAM HABITAT IMPROVEMENT/ MANAGEMENT
352,805 acres	308,753 acres	193,616 acres	175,718 acres	120,728 acres
26,095 no	14,933 no	9,577 no	795 no	162 no

Acres Tally 2005–2020 (NRCS Conservation Practices Report- https://www.nrcs.usda.gov/Internet/NRCS_RCA/reports/cp_pa.html

cover and management and the habitat value achieved after the implementation of conservation practices. The Pennsylvania WHEG system has existing guides for every USDA land use, and NRCS conservation planners must complete a WHEG for every land use they plan.

Over the next five years, Pennsylvania NRCS will teach planners how to better incorporate habitat considerations into the planning process, and how to develop alternatives that consider and promote habitat.

ACTION

Provide in-field trainings that show planners physical examples of habitat activities that benefit farm operations.

Riparian buffers with permanent grass or tree plantings, pollinator corridors implemented within or on the edges of crop fields, or wetland creation in marginal soil areas where it is difficult to get crops to grow are all opportunities to advance wildlife habitat. NRCS planners will integrate habitat and agriculture in conservation planning to obtain positive benefits for both wildlife and the agricultural producer. One example of this holistic planning approach is the practical and profitable restoration of wetlands on acres that were previously converted, unsuccessfully, to crop production.

Working with Partners

Another goal over the next five years for Pennsylvania NRCS is to increase inter-agency cooperation with partners, including government and NGOs, to show partners who NRCS is and the extent of conservation services NRCS offers.

Part of enacting this goal includes NRCS facilitating a combination of meetings and meeting follow-ups managed by the State Biologist. The meetings will identify potential projects based on shared goals and resource concerns,

Northern long-eared bat.

Bat Habitat

NRCS also manages forest and wetland acres to benefit bat species like the Northern long-eared bat, the tri-colored bat, and the Indiana bat. These conservation efforts include restoring forest ecosystems by both controlling invasive plants and releasing/planting native tree species, like shagbark hickories, that provide vital roosting cover for bats in the spring and summer months. Future forest habitat improvement work will include man-made roosting structures that should increase bat species' use of wetland easements and young-forest habitats (Pennsylvania 2021 Accomplishments, 11).

establish priority species and priority areas, leading to the eventual installation of conservation practices, and then measure the effects of those practices. Possible examples of this type of partnership activity include: working with U.S. Fish and Wildlife Service to complete priority pollinator plantings or install additional bat gates in priority habitats; cooperating with the PA Fish and Boat Commission on the creation or enhancement of wood turtle habitat; and working with the PA Game Commission on ruffed grouse habitat improvement. Implementing these types of projects will simultaneously show partners NRCS's willingness and ability to install real-world projects, provide NRCS staff with training and experience opportunities, and create habitats that are valuable to species of concern.

ACTION

Host partnership meetings to strategize on how to use NRCS programs and services to assist with bog turtle, wood turtle, ruffed grouse, pollinators habitat restoration, and development.

ACTION

Use the outcomes and programs results of these meetings to form wildlife corridors, using public, private, and conservation-eased land.

Land Conversion/ Fragmentation

Another goal that Pennsylvania NRCS will pursue over the next five years is to proactively manage existing WRE easements for wildlife habitat. WRE easements are held and managed by NRCS, meaning that NRCS has the final say in the wildlife habitat improvements implemented on each WRE easement. WRE easements must be managed over time for non-native invasive plant species control and other maintenance issues, and proactive maintenance and habitat improvements will allow NRCS to avoid serious violations.

Because WRE easement areas are home to many different species of wildlife, projects that could be implemented on WRE lands include multi-species enhancements for wood turtle habitat or stream restoration work. For example, establishing grasses for ground nesting birds or pollinators in the upland areas of easements. WRE sites can be used to showcase the WRE program as an outreach tool for new landowners interested in the program. The sites would provide real-world training locations for NRCS employees and partners, illustrating how wildlife practice implementation and WRE are compatible for simultaneous wildlife habitat and agricultural use. Support for these types of maintenance and enhancement projects can come from the WRE stewardship funds available each Fiscal Year.

Another goal for Pennsylvania NRCS in the next five years will be expanding the use of conservation easements that target wildlife habitat preservation and restoration. Since both the WRE and HFRP programs list preservation and restoration of wildlife habitat as primary purposes, these programs can preserve valuable wildlife habitat across

Wood Turtles

Designated as a State Wildlife Action Plan Priority Species in Pennsylvania, Wood turtles are reliant on clean streams and un-fragmented upland forests. Wood turtle populations are at risk due to the decreasing availability of high-quality nesting sites, which is an essential component of their habitat. Water pollution, fragmentation by roadways, and illegal collection are significant threats to Wood Turtle habitats across Pennsylvania (Dinsmore).

Wood turtle found along Shaver's Creek. Photo by Carli Dinsmore

Pennsylvania. NRCS will look for ways to connect corridors of preserved wetland and forestland areas, especially those associated with threatened and endangered species, SGCN, and established wildlife priority areas. NRCS will also work with partners to determine which areas are most threatened by fragmentation and land conversion.

ACTION

Use the outcomes and programs results of meetings to form wildlife corridors, using public, private, and conservation eased land.

The WRE program, formerly WRP, falls under the authority of the ACEP program, and was established in the 2014 Farm Bill. The purpose of the WRE program is to "restore, protect, and enhance wetlands on eligible private or Tribal lands while maximizing wildlife habitat benefits and wetland functions and values", which is accomplished by taking marginal agricultural land having hydric soils out of production and restoring those hydric soils back into functioning wetland and wildlife habitat. The WRE program provides Pennsylvania NRCS an opportunity to work with private landowners to restore converted land back into wetland habitat.

Under WRE, and in the past WRP, the United States is the easement holder and most rights to the surface of the land are purchased for the easement. According to the United States Fish and Wildlife Service, Pennsylvania has lost over half of its pre-settlement naturally existing wetlands (Heist and Reiff, 330). **Table 17** illustrates the WRP and WRE easements that have been restored and preserved in Pennsylvania since 1996. **Map 17** shows the locations of all WRP and WRE easements across Pennsylvania.

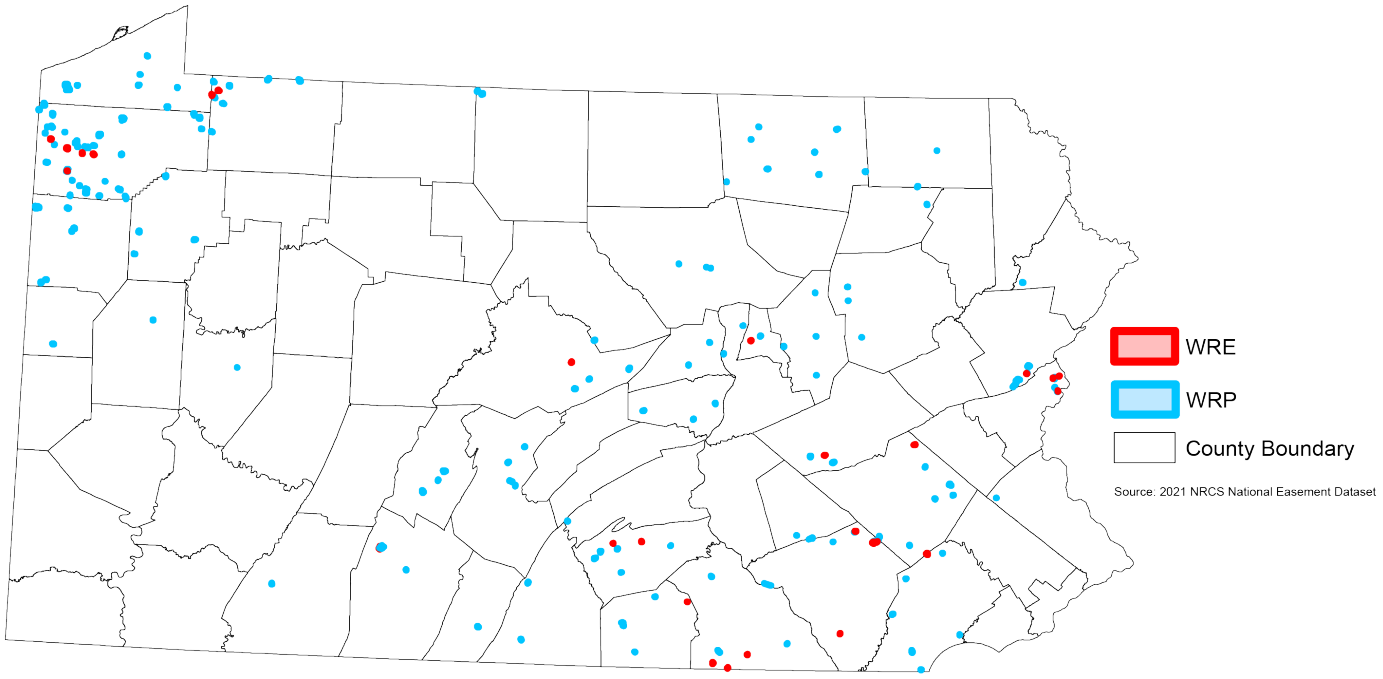
Table 17: **WRP and WRE Easements in Pennsylvania Since 1996**

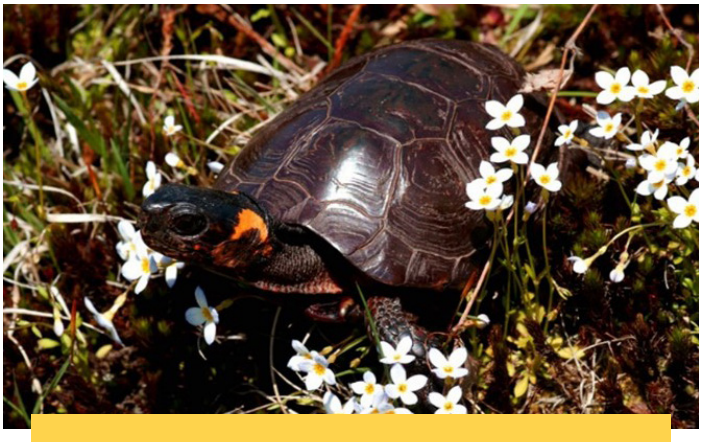
PROGRAM	NUMBER OF EASEMENTS	TOTAL ACREAGE	TOTAL FUNDING
WRP	199	8,840	$28,458,884
WRE	32	1156,	$6,003,091
TOTAL	231	9,996	$34,461,970

Thousands of acres have been restored and preserved as wetlands through both WRP and WRE. Since wildlife thrives where habitats are connected and not fragmented, the next step for this easement program in Pennsylvania is for NRCS to begin placing WRE easements in areas that expand or connect already preserved habitats, especially where there is the greatest need for these types of easements.

Two federally listed wetland species that have benefited from wetland habitat preservation and restoration through the WRE program in the past include the bog turtle (Clemmys muhlenbergii) and the Eastern massasauga rattlesnake (Sistrurus catenatus). Both species have lost habitat to development and fragmentation, but WRE is successfully securing and protecting their habitats in perpetuity.

Map 17: **WRE/WRP Easement Locations in PA**





Bog turtle

The bog turtle is imperiled or critically imperiled throughout its entire range in North America and is classified as Federally threatened by the U.S. Fish and Wildlife Service (USFWS). Bog turtle habitats are wet meadows and bogs dominated by tussock sedges and grasses. These turtles require open, sunny conditions associated with early-successional wetlands, deep mucky soils fed by groundwater seeps, and only modest amounts of open water.

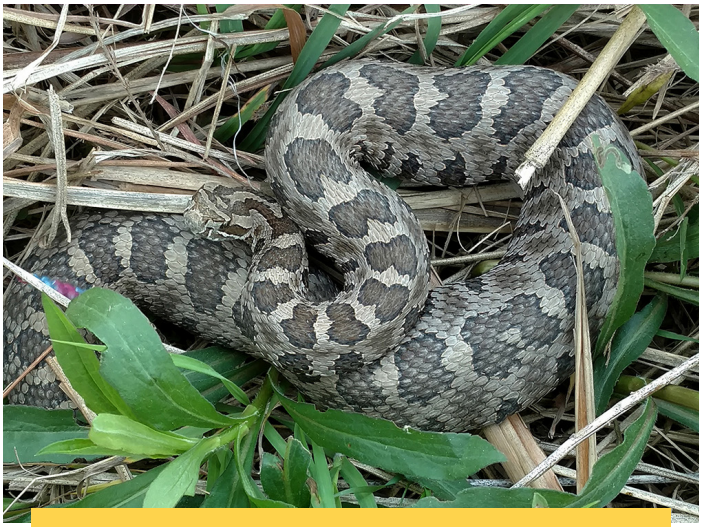
Due to habitat loss, habitat fragmentation, and forest succession, only low numbers of bog turtles exist in southeastern Pennsylvania. The species is continually threatened by wetland succession, decreased water quality, roadway mortality, predation of nests and juveniles, and collection by humans.

Since 2010, Pennsylvania NRCS has been preserving and rehabilitating critical habitat for the bog turtle in partnership with USFWS through the WRP and WRE programs. As of 2020, NRCS nationally, through the WRP and WRE programs, has been able to significantly aid the progress of this species recovery efforts. Nationwide, NRCS has protected 83 bog turtle occupied wetlands, or 45 percent of the U.S. Fish and Wildlife Service's habitat recovery goal for delisting the bog turtle as a threatened species by 2050. This success illustrates how much easement programs like WRE can assist species recovery and will likely drive WRE efforts in the future to target other imperiled species. Since 2010, Pennsylvania NRCS has preserved 56 bog turtle easements, totaling 1,497 acres, contributing greatly to the species recovery efforts.

The Eastern massasauga (rattlesnake) is also listed as a "threatened' species under the Endangered Species Act. It is also critically imperiled in Pennsylvania and has the Pennsylvania Wildlife Action Plan's highest priority listing as a Species of Immediate Concern. Habitat loss and vegetative succession are the main reasons for the rapid decline in Eastern massasauga distribution.

Long-term viability of the Eastern massasauga depends on recovery efforts on private lands which contain both wetlands and non-forested upland habitats, such as meadows and reverting agricultural fields, in close

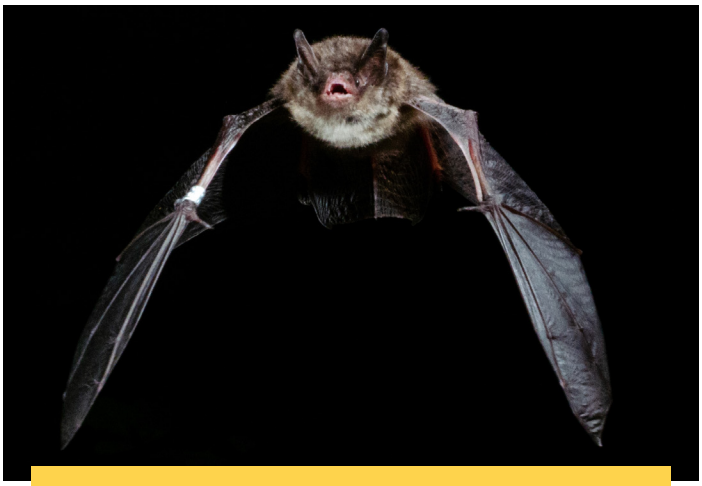
proximity. Pennsylvania massasauga populations exist in meadows of forbs and low-growing grasses with an open canopy and at most a spotty distribution of woody shrubs. Habitat is consistently found very near wetlands where the eastern massasauga will hibernate during winter months (Species Action Plan 2).



Eastern massasauga

Historically, most Eastern massasauga sites in Pennsylvania were hayed or pastured, but over time these areas fell out of agricultural use and trees have become dominant. Trees negatively impact Eastern massasauga habitat by absorbing water from the wetlands and increasing shade, which both make the habitat less suitable for long-term massasauga viability. To increase habitat for this imperiled wetland species, Pennsylvania NRCS, through the WRE program, restores massasauga habitats by removing woody vegetation and restoring the sites to forbs and low-growing grasses, recreating the necessary open canopy and spotty distribution of woody shrubs. **Table 18** shows the total number and acreage of bog turtle and massasauga habitats preserved and the WRP and WRE funding expended to date for bog turtle sites and massasauga sites.

Another easement program focused on restoration and preservation of habitats for threatened and endangered (T&E) species is the Healthy Forest Reserve Program (HFRP). HFRP conservation easements protect, restore, and enhance forestland while promoting the recovery of T&E species. Prior HFRP program implementation in Pennsylvania included easements protecting and improving critical habitat for the Indiana bat (Myotis sodalis). Land in Adams, Berks, York, Centre, Snyder, Mifflin, Huntingdon, Blair, Cambria, Bedford, Beaver, and Armstrong Counties in proximity to Indiana bat hibernacula and maternity colonies was eligible.



Indiana bat (Myotis sodalis). Photo by Will Seiter, 2019. Bats provide services to ecosystems such as spreading seeds and controlling pest populations.

Indiana bats are vulnerable to human disturbance of their roosting sites and winter hibernacula. Increasing the acreage of contiguous forests, especially old growth forest, within several miles of hibernation sites will improve bat habitat. Habitat improvement efforts are critical at this time because both the Indiana bat and the Northern long-eared bat populations have severely declined because of White Nose Syndrome (WNS), a fungal disease that weakens and eventually kills many species of bats.

Table 18: **Bog Turtle and Massasauga Habitats Preserved Through WRP and WRE**

EASEMENT TYPE	NUMBER OF EASEMENTS	TOTAL ACREAGE	TOTAL FUNDING
Bog turtle	56	1,497	$13,651,248
Massasauga	2	80	$189,889

In general, conserving and restoring forestland habitat is critical, especially since forested land is the most common habitat found in Pennsylvania. The Pennsylvania Department of Conservation and Natural Resources estimates that approximately 28,000 acres of forest are converted to development each year (Wildlife Action Plan 2-9), making it critical to preserve forest habitats. As of the date of this publication, Pennsylvania NRCS has permanently preserved five properties totaling 1,049 acres, using $1.4 million through HFRP. The largest easement, over 800 acres, connects Indiana bat habitat preserved by USFWS and is near state parks inhabited by the Indiana bat. More information on NRCS conservation efforts for the Indiana bat and forestland can be found in the Forest Section of this Strategic Plan.

However, more species can benefit from forest preservation. NRCS plans to take a number of steps to more frequently utilize HFRP or other forest protection easements.

ACTION

Expand the limits of HFRP to include preservation and restoration of other habitats in addition to those of the Indiana bat. Preserving and restoring connected corridors of forestland for T&E species and SGCN species as determined by the Pennsylvania Wildlife Action Plan will be a priority.

Healthy Forest Reserve Programs are not the only easements that can be used. Forestland easements, such as the Forest Legacy Program and easements held by non-governmental organizations and private land trusts can also be used. An example of forest protection using other funds outside of HFRP is the Kittatinny Ridge RCPP project, which protects important migration corridors.

Another easement program with the potential to improve and protect wildlife habitat is the Agricultural Conservation Easement Program-Agricultural Land Easement-Grasslands of Special Significance (ACEP-ALE-GSS) program. This program preserves grassland, hayland, and pasture on working lands. Grassland offers important habitat for many species, and preserving grasslands is important to prevent further decline of at-risk grassland wildlife. In the past 100 years, human population growth, development, and urban, suburban, and industrial sprawl has destroyed or converted grasslands (Latham). The most severe grassland losses in Pennsylvania have been in the Great Valley and Piedmont regions. Pennsylvania NRCS's goal for ACEP-ALE-GSS over the next five years is to continue preserving additional areas of hay and pastureland to prevent conversion to other uses and provide long-term habitat for grassland wildlife. More information about the ACEP-ALE-GSS program can be found in the Pastureland and Grazing Section of this Strategic Plan.

Special Projects/ Initiatives

Pennsylvania NRCS also funds habitat improvement projects through other, non-easement programs, like the EQIP, CSP, and RCPP. For example, EQIP currently supports projects that improve habitat for the ruffed grouse, the golden-winged warbler, and the cerulean warbler.

Successful habitat improvements in Pennsylvania forests often focus on developing early successional habitat and conducting other forest management activities for golden-winged warblers and cerulean warblers. Habitat areas for these warbler species are shown on **Map 18.** More information on these projects can be found in the Forest Section of this Strategic Plan.

The "Cerulean Warbler Appalachian Forestland Enhancement," completed in 2021, was a Regional Conservation Partnership Program (RCPP)— project focused on enhancing cerulean warbler habitat on private lands across Pennsylvania, West Virginia, Maryland, Ohio and Kentucky. Cerulean warbler populations have decreased by 70 percent across the entire range since 1966 (Korber and Gross). The loss of structurally complex forests has contributed to an average decline of 3.02 percent for cerulean warblers per year in the Appalachians, one of the fastest declines of all North American warblers. These birds depend on oak-dominated forests with gaps in their canopies for nesting and brood-rearing.

Conservation efforts under this Cerulean Warbler RCPP project included removing low-quality trees and controlling non-native invasive plants to increase forest regeneration, tree growth rates, acorn production and habitat for the cerulean warbler and many other forest species. The RCPP project expanded Appalachian breeding habitat and the promotion of contiguous areas of viable working forests, helping to ensure long-term conservation of cerulean warblers. This project and others like it are examples of NRCS successfully partnering with other conservation agencies to attain wildlife habitat conservation on a

landscape scale, even across state lines. Pennsylvania NRCS will seek to improve partnerships over the next five years to implement additional projects like this one.

The Cerulean Warbler Appalachian Forestland Enhancement project was officially completed in 2021, having utilized $3.3 million of RCPP funding to restore 6,192 habitat acres on 139 privately owned parcels.

In addition to the cerulean warbler, NRCS continues to help private forest landowners create and maintain habitat for golden-winged warblers. Golden-winged warblers have declined range-wide by 2.6 percent per year since 1966 (Managing Habitat for Shrubland and Young Forest Birds); in Pennsylvania the golden-winged warbler has declined by 6.8 percent per year (Bakermans 2). The decline is closely related to the loss of young open forest with a mix of tall shrubs and saplings, intermixed with smaller areas of forbs and grasses and inclusions of overstory deciduous trees that the warblers use as singing perches, as shown in the picture below.

Young open forest

The NRCS Golden-Winged Warbler Initiative (EQIP-WLFW-GWWI) focuses on encouraging the growth of desirable trees, such as oak and hickory, and controlling invasive species in the forest understory. Conservation efforts that support the golden-winged warbler benefit many other species that depend on similar habitat. Forest management is crucial in creating and maintaining habitat to sustain all

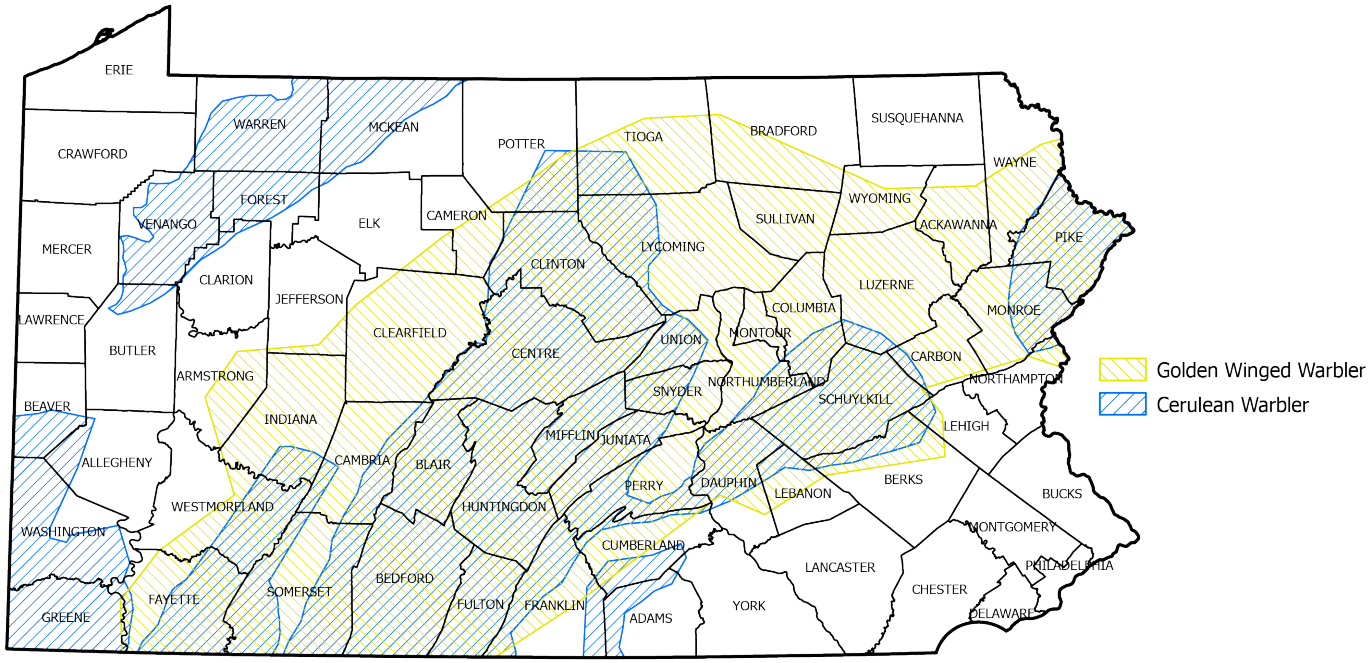
Golden-Winged Warbler

these species. More information about the golden-winged warbler and Working Lands for Wildlife can be found in the Forest section of this Strategic Plan.

Another forest species targeted by Pennsylvania NRCS programs is the ruffed grouse. The ruffed grouse, the Pennsylvania state bird, is in drastic decline across the Commonwealth due to a combination of both habitat loss and West Nile virus. Ruffed grouse use mature forests with small (greater than 2 acres) patches of early successional forest that contain downed trees and logs among dense, shrubby vegetation. Males use the logs in the dense shrub cover for “drumming” or mating displays, while females use adjacent mature forests for nesting and later rearing the grouse chicks. Unlike other forest birds with large home ranges, such as wild turkeys, the relatively small habitat patches needed by grouse make it possible to successfully manage their habitat on smaller forested parcels.

In 2021, the Pennsylvania Game Commission sent outreach letters to landowners in Pennsylvania grouse priority areas: Somerset, Fayette, Sullivan, Wayne, Indiana, Bedford, Bradford, Westmoreland, Lackawanna, Blair, Luzerne, Huntingdon, Forest, Wyoming, Pike, Mifflin, Monroe, Carbon, Juniata, Perry, Columbia, Adams, and Northampton

Map 18: Golden-Winged Warbler and Cerulean Warbler Project Areas



Ruffed Grouse

counties. Landowner interest in the program was high in some counties, and in future years, increased funding should allow the funding of many habitat projects. Grouse habitat practices can also be included in EQIP Forestry contracts or CSP Forestry contracts.

ACTION

Implement Joint Chiefs' Landscape Restoration Partnership Project proposal to encourage restoration and development of ruffed grouse habitat.

The Joint Chief's Landscape Restoration Partnership project, as previously described, has been funded beginning in 2023 and will focus on cerulean warbler and ruffed grouse habitat development using the Pennsylvania Game Commission's grouse priority areas in the counties surrounding the Allegheny National Forest. Ruffed grouse conservation efforts in Pennsylvania are also discussed in the Forest Section of this Strategic Plan.

Priority Pollinators

Over the next five years, Pennsylvania NRCS will also be planning for pollinator habitat. Agricultural producers in Pennsylvania depend on pollinators, as they are vital to healthy crops for food, fiber, edible oils, medicines, and other products. Pollinators are also essential components of the habitats and ecosystems that many wild animals rely on for food and shelter.

Native and managed pollinator populations are declining, and the resulting loss of their ecosystem benefits are being felt by the agricultural community. Human activity such as urbanization, changes in agricultural practices, and the use of broad-spectrum pesticides have caused habitat fragmentation, disruption, or destruction of pollinator habitat. Other factors leading to pollinator decline include disease and the spread of non-native invasive plant species.

In Pennsylvania, NRCS and USFWS have designated nine "Priority Pollinators": Monarch, Regal Fritillary, Frosted elfin, Early hairstreak and Columbine dusky wing butterflies; Ostrich fern borer moths; and American, Rusty-patched and Yellow-banded bumblebees. These species are declining in both numbers and distribution but are not yet listed under the Endangered Species Act. NRCS and USFWS hope to curb the loss of these priority species enough to avoid their listing in Pennsylvania. The agencies cooperated to identify species-specific plant mixes that will create the required plant communities and priority areas in which to focus habitat projects.

ACTION

Establish 1,000 acres of pollinator habitat.

URBAN LAND

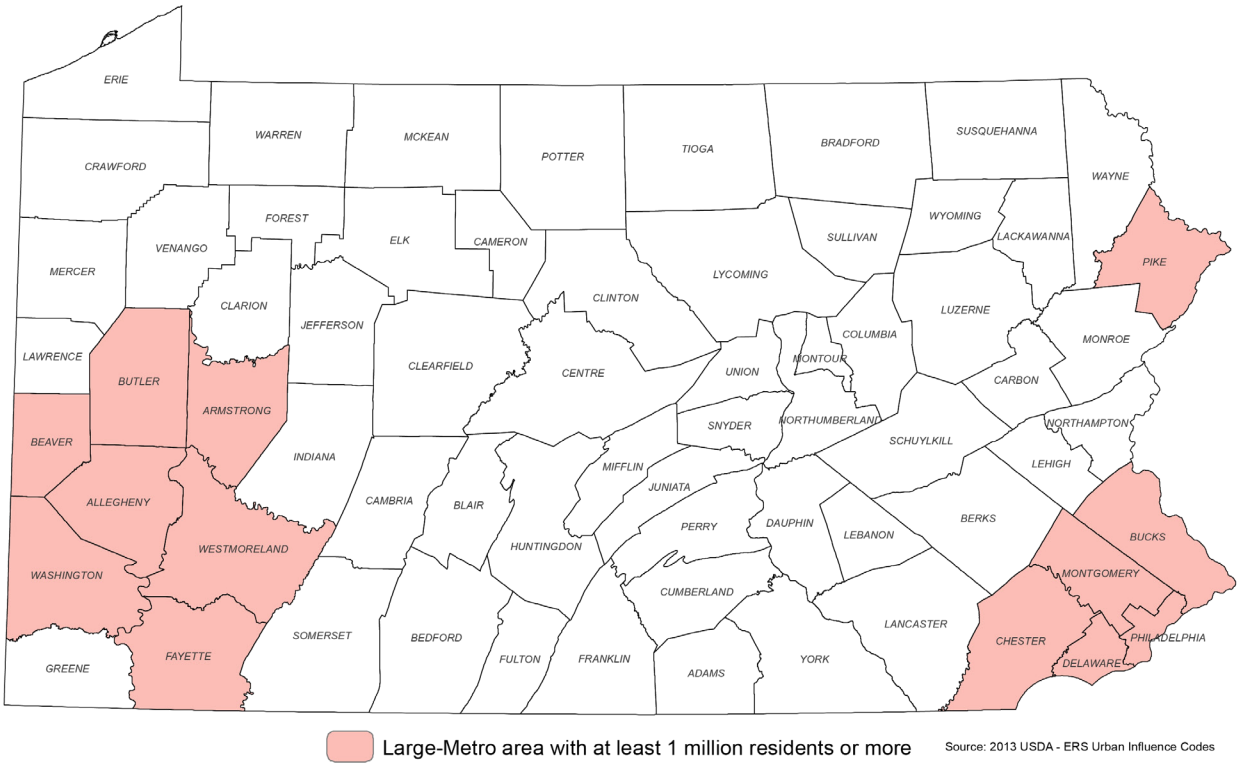
Current Condition

Seventy-nine percent of Pennsylvania's population live in urban areas. Urbanization in Pennsylvania is increasing. The U.S. Census shows that from 2000 to 2010, there was almost a 6 percent increase in population living in urban areas.

The USDA Economic Research Service (ERS) has developed an "Urban Influence Code" to help identify urban counties in the United States." For the purposes of this strategic plan, the Urban Influence Code was used to identify counties in Pennsylvania that have the greatest urban populations and therefore a potential for urban agriculture. Thirteen counties in Pennsylvania have an urban influence code of "1" meaning that these counties have a large population in a metro area with at least one million residents. **Map 19** illustrates the location of these counties across Pennsylvania.

The USDA ERS also prepared a Food Access Research Atlas (formerly named the Food Desert Locator) to provide a spatial overview of food access indicators for low-income and other census tracts using different measures of supermarket accessibility. This data was used to identify potential areas in Pennsylvania to increase local food production, markets, and community gardens, and thus prioritize these locations, when possible, for NRCS assistance. In early 2022, the Urban Agriculture Subcommittee of the State Technical Committee identified urbanized areas around the pilot cities of Harrisburg and Pittsburgh in which to expand the Urban EQIP zone. Key factors of this expansion included high population density, low food access, and Environmental Justice designations. **Map 20** identifies the ERS Urban Influence codes for each county in Pennsylvania with an overlay of four categories of ERS identified Food Deserts.

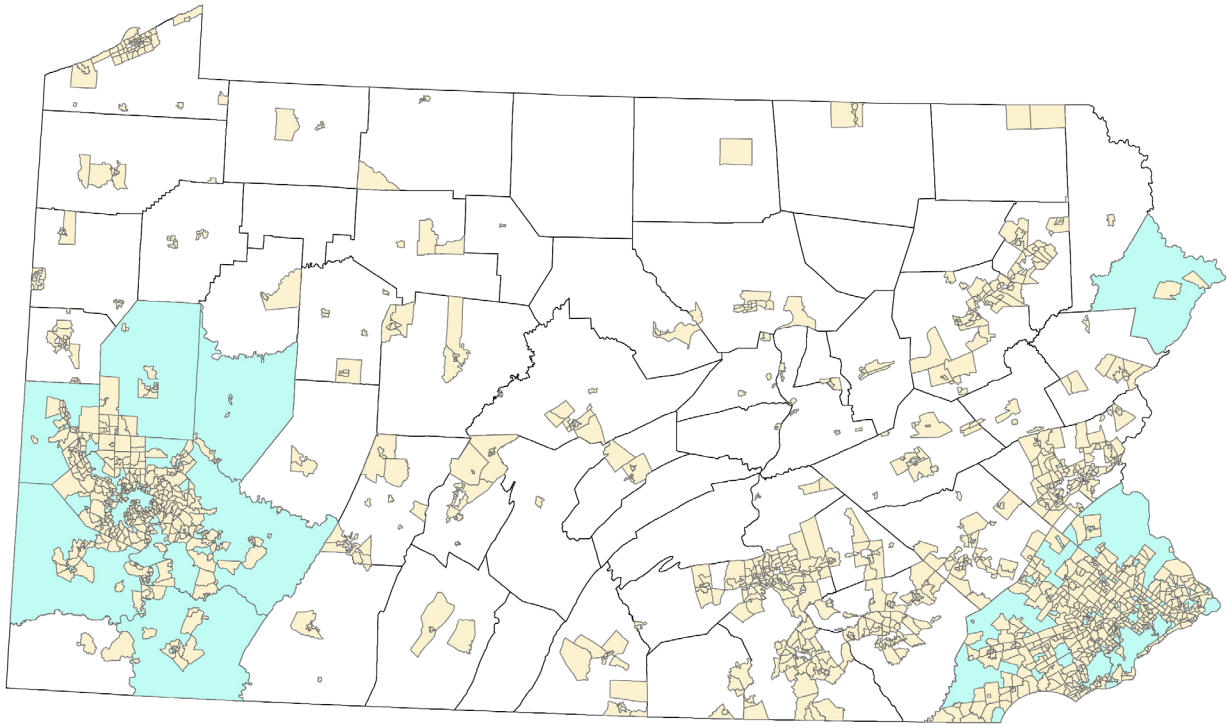
Map 19: **Counties with an Urban Code of 1**



Large-Metro area with at least 1 million residents or more

Source: 2013 USDA - ERS Urban Influence Codes

Map 20: **Counties with a large Metro area with Urban Food Deserts**



Low access, low-income population at 1 mile for urban areas and 20 miles for rural areas

Large-Metro area with resident population of 1 million or more

County Boundary

Source: 2013Source: 2013 USDA-ESA Urban Influance Codes
2019 USDA Food Access Research Atlas

Urban Agriculture

Urban agriculture, or the practice of growing food in urban and semi-urban areas where agriculture is not a primary land use, has been a practice in the United States since the 1800's (Schaffstall 1). Currently, urban agriculture is an expanding industry in the United States, where it has grown by over 30 percent in the past 30 years (Altieri). Examples of urban agriculture include community gardens, rooftop farms, hydroponic, aeroponic, and aquaponic facilities, and vertical production. Roadside urban fringe agriculture and livestock grazing in city open spaces are also part of the urban agriculture picture. Spaces where urban agriculture can be implemented include backyards, roof-tops and balconies, and vacant lots and parks, which sometimes span many city blocks.

Urban farming in Pennsylvania

Urban agriculture provides many benefits for cities and urban areas. It helps to address local food equity issues within the city and in the surrounding suburban areas by providing more available fresh food where access to grocery stores is lacking, and by donating extra produce to neighborhoods, food pantries, and soup kitchens (Mahbubur 391). Other benefits of urban agriculture include "reduced crime, greater property maintenance and values, fewer abandoned buildings, higher rates of home ownership, adaptive reuse of vacant lots, brownfield remediation, development of leadership and technical skills, and an improved sense of community and place" (Mahbubur 392). Urban agriculture also reconnects communities with how food is grown and where food comes from.

No two urban production systems are the same, but urban ag operations are often characterized by intensive management strategies, which include many different fruits and vegetables produced each season. Conversely, some types of urban agriculture involve less automation, using manual labor in controlled environments. Other types of urban agriculture in controlled environments include indoor growing, like aeroponic, hydroponic, or aquaponic systems, where the growing environment is highly controlled, and is usually managed with automation. Urban agricultural systems typically incorporate highly diversified cropping rotations and have very small acreage footprints (.05 – .25 acres). Many are also social enterprises equated with the triple bottom line: people, profit, and the planet. Urban agricultural producers are striving to produce food to feed their communities.

Urban agricultural producers often market their food directly to their surrounding community. The USDA National Agricultural Statistics Service (NASS) conducted a Local Food Marketing Practices Survey in 2020.

The survey found that over 6,200 farms in Pennsylvania sold food locally through direct marketing practices. The top five states by value of total direct food sales were California with $1.43 billion, Pennsylvania with $600 million, New York with $584 million, Michigan with $555 million, and Maine with $342 million (U.S. National Agricultural Statistics Service. News Release). Pennsylvania had over 5,000 operations engaged in direct-to-consumer sales earning $152 million (Local Food News Release).

High tunnel in Pennsylvania

Urban agriculture faces many challenges, and the challenges can differ by location. One of the largest challenges is access to available land. Most urban agricultural producers do not own their own land (Alteri). Additionally, while water is readily available in urban areas, it is expensive (Alteri).

Examples of some of the challenges facing urban agriculture in Pennsylvania include:

- Vacant lots with heavy metals and other soil contamination
- Access to and/or transportation of healthy soils or soil-enhancing elements such as compost
- Access to potable water sources especially on the surface of vacant city lots
- Lack of irrigation systems
- Lack of pollinators
- Ability to meet new USDA food safety regulations
- Ability to obtain long-term control of land, especially on vacant city lots
- Access to refrigeration
- Network and collaboration opportunities with similar urban operations
- Network and collaboration opportunities with sources of technical and financial assistance
- Lack of training in agriculture such as food production, food distribution, and marketing etc.
- Lack of access to small business management training
- Access to buildings after hours for rooftop production or gardening
- Lack of knowledge and support from city government
- Crime and damage to farm operation
- Access to funding sources
- Ability to make a livable income

NRCS Assistance

NRCS has the opportunity to assist private landowners with urban agriculture. Many agricultural practices can be funded by NRCS in urban areas, as long as the practices and agricultural producers meet NRCS program eligibility criteria. A recent analysis of NRCS-supported practices in areas identified by the US Census as "urbanized" found that approximately 225 different practices, including agroforestry practices, totaling 24,000 acres, had been supported through the EQIP program in urbanized areas nationwide.

Frequently funded practices in urban areas in Pennsylvania through the NRCS EQIP program include conservation cover (327), cover crop (340), field border (386), conservation crop rotation (328), windbreaks (380), alley cropping (311), riparian forest buffer (391), and multistory cropping (379). High tunnel (325) is one of the most frequently funded and easiest to install practices in urban settings. NRCS is also currently working on offering irrigation practices with catchment systems to contain rainwater because obtaining water for agricultural practices in urban areas is difficult for many urban producers. NRCS is working to fund pollinator plantings in urban agricultural settings. Creating and maintaining pollinators in urban areas is important because urban areas are often devoid of any pollinator habitat. Large acreage is not required for establishing pollinator habitat, making it a good fit for urban areas. Common NRCS practices geared towards creating pollinator habitat in urban settings are shown below.

Common NRCS Practices for Creating Urban Pollinator Habitat

Conservation Cover #327

Cover Crop #340

Field Border #386

Conservation Crop Rotation #328

Pennsylvania NRCS has been working in urban areas for many years, but in 2019, it introduced "Urban" fund pools to EQIP to fund practices within the urban areas of Harrisburg, Philadelphia, and Pittsburgh.

ACTION

Include additional geographic areas and new payment scenarios. Map 21 shows the locations of these expanded geographic areas.

The CSP program also shows promise to service urban agricultural producer needs. CSP is a good fit because of its smaller minimum payment rates. CSP enhancements and activities could be filtered for applicability to small, diversified, and urban farms. Using CSP could be an opportunity over the next five years for NRCS to incentivize good environmental stewardship in urban agriculture.

ACTION

Expand funding to even more urban geographic areas by adding more eligible areas around cities or adding new urban areas altogether (see Map 21).

ACTION

Expand NRCS urban agriculture in environmental justice areas and low food access areas using GIS capabilities.

Conservation Planning

Most NRCS employees in Pennsylvania are unfamiliar with how to plan practices in an urban setting because it is so different from the traditional, rural agricultural systems that employees are used to working with. NRCS employees typically have many questions about what urban agriculture is, how to plan it, and how to fit it into conservation practice standards and program eligibility. Urban agriculture conservation planning differs from the traditional conservation plan because most of the farms are small scale with highly diversified, intensive production.

ACTION

Train Pennsylvania NRCS employees on how to plan in urban areas.

Outreach and Customer Service

ACTION

Increase outreach and customer service for urban agricultural producers by motivating NRCS employees to have more frequent meetings and face time with urban agricultural producers.

ACTION

Participate in Grow NY City's training on equity and inclusion, which will teach how to do customer outreach in urban areas.

ACTION

Increase speaker engagement by 30 percent at urban conferences.

ACTION

Host an urban agriculture conference where producers could share information between the three major Pennsylvania cities at least once over the next five years.

ACTION

Establish an urban office in Philadelphia which will provide direct service for NRCS and FSA programs to urban applicants.

People's garden

People's Garden Initiative

Community gardens are a large component of what many people consider urban agriculture. Many churches and other non-profit organizations have established community gardens to support local residents with nutritious foods and provide a link to local residents with additional education and assistance opportunities, to bring green landscapes to the urban areas, provide economic development opportunities, and generally improve the local neighborhood outlook. Community gardens face many of the same challenges that private farming operations face in urban areas.

On May 3rd, 2022, Agriculture Secretary Tom Vilsack planted a tree to kick off the re-establishment of the USDA People's Garden Initiative.

School gardens, community gardens, urban farms, and small-scale agriculture projects in rural and urban areas can be recognized as a "People's Garden" if they benefit the community by providing food, green space, wildlife habitat, and education space, are a collaborative partnership effort, incorporate conservation management practices, and educate the public about sustainable gardening practices and the importance of local, diverse, and resilient food systems providing healthy food for the community. Currently, 17 People's gardens located in urban communities exist nationwide, including one garden in Philadelphia.

ACTION

Support Peoples Garden Initiatives by offering grants that support collaboration, education, and diversification of food networks in urban areas.

Urban Soil

Soil health in urban areas focuses on soil quality (including problems with urban debris, concrete and construction materials, and trash), compaction, drainage, and contamination from previous land uses. Frequent soil testing is needed in urban areas and testing for heavy metals is particularly important. Heavy metals can be transferred or absorbed by plants and food grown in soil that contains them.

NRCS is well equipped to help with soil health issues in urban agricultural areas. Currently, Pennsylvania NRCS is participating in a partner-led effort to undertake an urban soil survey update of the Pittsburgh area. This is a partnership between Pennsylvania NRCS and the NRCS Soils and Plant Science Division. This project will help implement urban agricultural conservation projects by refining soil mapping to assist NRCS planners with developing urban conservation plans.

In FY 2021, the NRCS Soils and Plant Sciences Division continued work that began in 2020 to update the Delaware County Soil Survey. Over the next five years in Pennsylvania, these types of soil mapping projects will grow. Urban agriculture is getting increased interest across Pennsylvania and the need for accurate up-to-date soils information in urban areas to support urban agriculture will increase. The complex soil subsurface in urban areas is also an issue for urban agricultural producers. Use of ground penetrating radar can assist producers in determining which soils are safe for agricultural use in urban areas. Pennsylvania NRCS plans to obtain the PXRF tool and will have an NRCS employee trained to use it in the next five years.

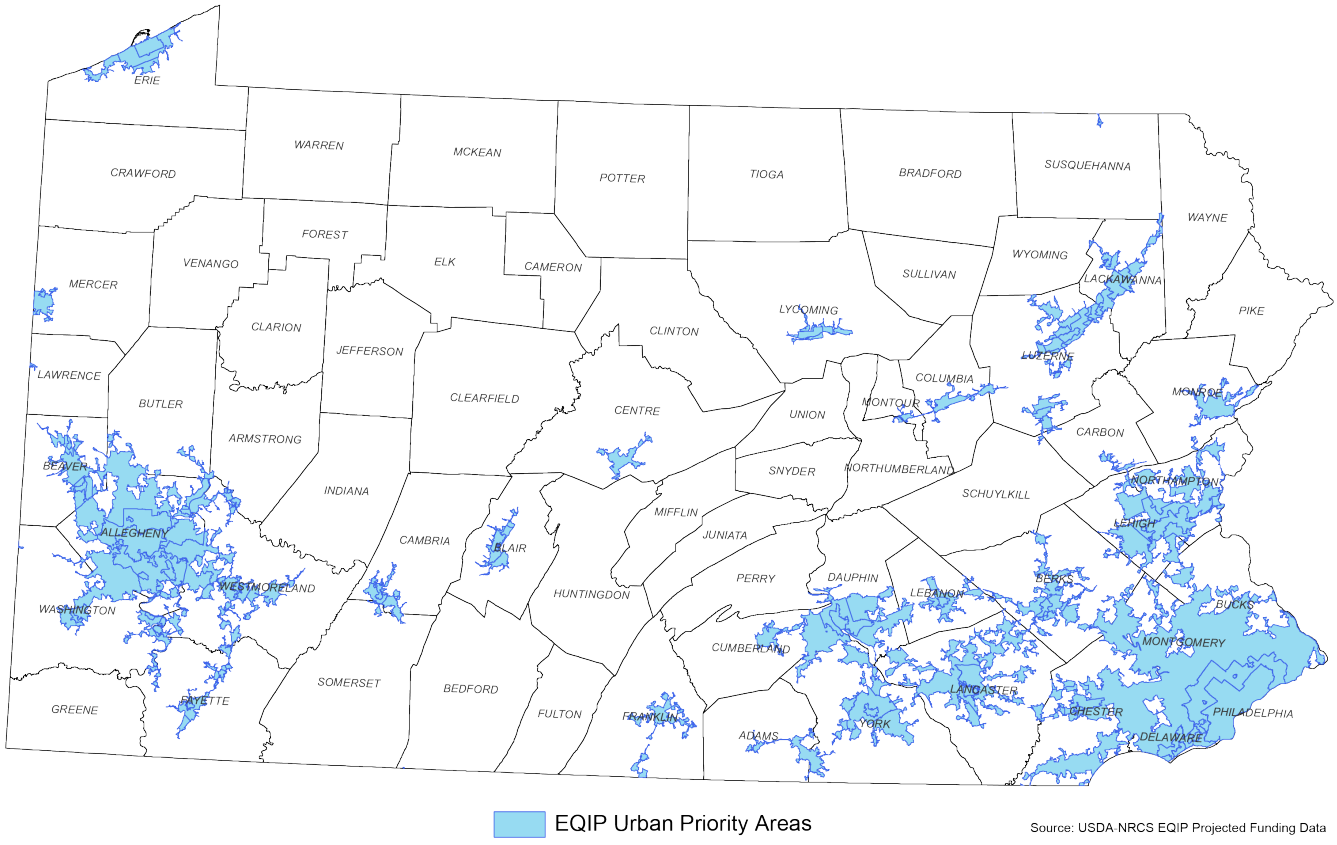
ACTION

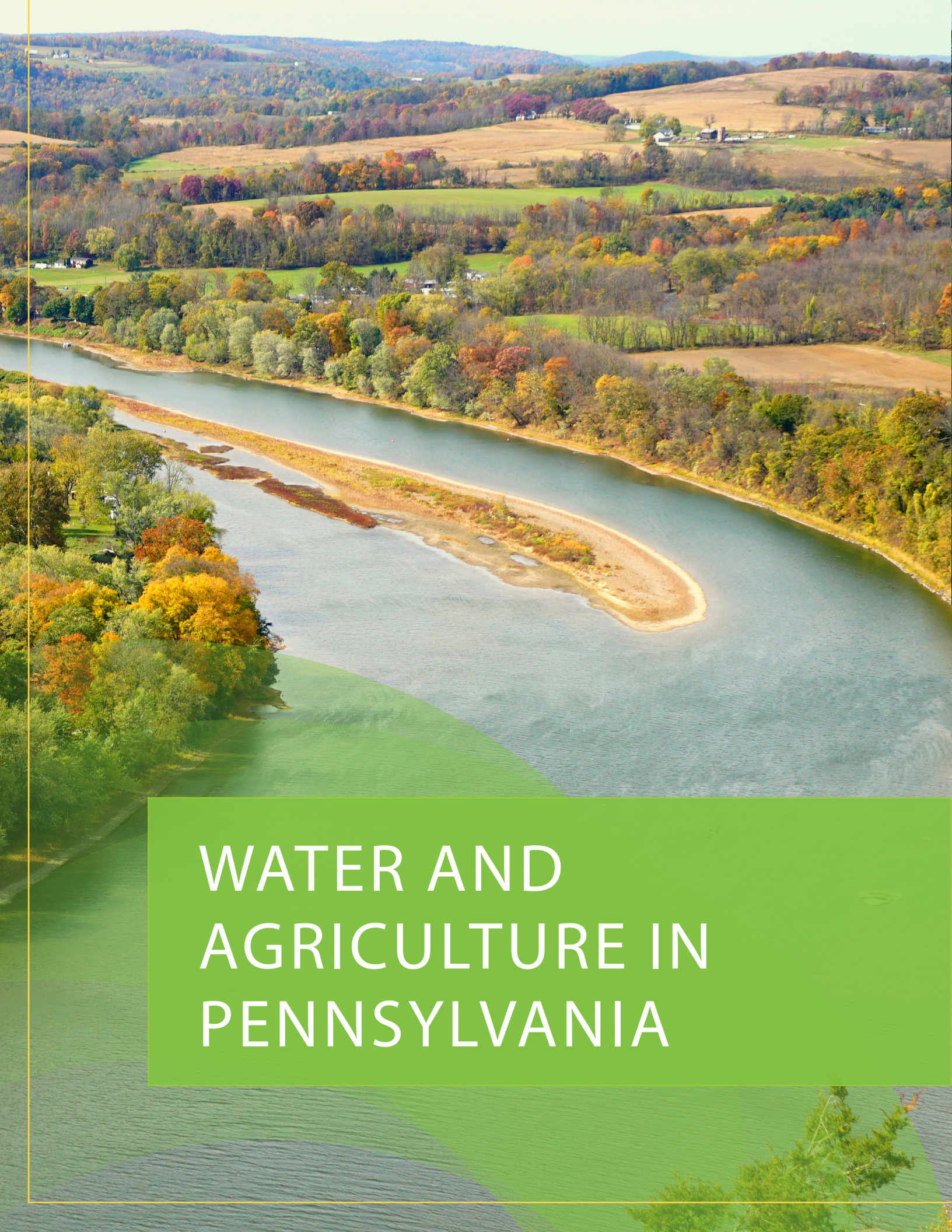
Participate in more soil mapping projects in areas surrounding Philadelphia and Pittsburgh.

ACTION

Increase utilization of soils technology and tools to assist urban agriculture, such as the PXRF or ground penetrating radar.

Map 21: **Projected FY 2024 EQIP Urban Funding Areas**





WATER AND AGRICULTURE IN PENNSYLVANIA

WATER

Streams

There are many sources of impairments that degrade water quality in streams and wetlands in Pennsylvania.

The Pennsylvania Department of Environmental Protection (DEP) has determined in its 2022 report that 27,886 miles of Pennsylvania streams are impaired ("One-Third of Pa. Waterways"). Impaired means that the waterways are now considered harmful to wildlife, and to humans in terms of water for recreation and drinking ("One-Third of Pa. Waterways").

Our rivers and streams trace their way through several different land ownerships. Therefore, it is important for as many landowners as possible to maintain healthy buffers around riparian areas. Nutrients and sediment can impair streams due to a lack of riparian buffers, forests, and wetlands. The Commonwealth of Pennsylvania is promoting

Big Spring Run experimental restoration site

the development of riparian forest buffers and has a goal of planting 95,000 acres of riparian forest buffers statewide by 2025 to improve water quality in waterways in the Commonwealth and the Chesapeake Bay.

USDA is working cooperatively with the Commonwealth of Pennsylvania in the Conservation Reserve Enhancement Program (CREP) in Pennsylvania in the Susquehanna River Watershed, the Ohio River Watershed, and the

Delaware River Watershed. Through this program the Farm Services Agency (FSA) provides financial assistance and NRCS provides technical assistance to landowners to protect highly erodible lands and lands next to streams by implementing conservation practices on that land. One of the conservation practices in CREP is riparian forest buffers. **Map 22** (P. 76) indicates watersheds with an impaired stream that have an expiring CREP contract that includes riparian forest buffers (CP22).

ACTION

Continue to target CREP expiring acres for re-enrollment.

According to the NRCS electronic field office technical guide, riparian forest buffers are areas of trees and shrubs located adjacent to surface waters like streams, lakes, ponds, and wetlands. Riparian forest buffers perform a variety of highly valuable functions in the landscape, they: intercept sediments, nutrients, and other water-borne materials being carried by runoff and prevent those materials from polluting the neighboring water body; reduce or absorb dissolved nutrients and pollutants in shallow subsurface water flow and prevent those pollutants from penetrating ground water; and minimize erosion because their vegetation anchors the edges of the water body and slow and disperse flood waters. In addition, forest riparian buffers shade the adjacent water body, lowering the water temperature and maintaining water chemistry.

They provide leaf litter and other dead vegetation that acts as the base of the aquatic food web, supporting the in-stream absorption of dissolved nutrients, and they provide valuable wildlife habitat, both as distinct, unique habitats and as corridors that provide connections across the landscape. This is important to Pennsylvania's official state fish, the Eastern book trout, the only native stream-dwelling salmonid in Pennsylvania, that requires clean water and healthy aquatic ecosystems. **Map 23** (P. 77) shows watersheds identified by the Eastern brook trout Joint Venture with reduced or declining Eastern brook trout Habitat.

The Eastern hellbender is a species of conservation need and is found in clean, fast-flowing streams with abundant rocks large enough for the Eastern hellbender to hide under. It is negatively impacted by sediment and increased runoff.

ACTION

Continue to prioritize streams occupied by Hellbender and Eastern brook trout in EQIP and CSP ranking.

In the previous strategic plan, we identified legacy sediment, sediment with attached nutrients deposited behind tens of thousands of mill dams that once existed in Pennsylvania, and subsequently built up along streambanks, with the potential to be released into Pennsylvania waterways and increase water quality impairment.

More recently, an NRCS National Conservation Innovation Grant was awarded in Pennsylvania to identify and map specific areas in Lancaster County where eroding streambanks may be causing large amounts of legacy sediments to be released into streams. The project anticipates the development of an assessment tool aimed to evaluate individual sites for greatest erosion potential. In addition to the assessment tool, the project may bring revised or new conservation practice standards to treat legacy sediment.

ACTION

Utilize CIG information to identify and restore a legacy sediment watershed.

Wetlands

Historically, Pennsylvania had as much as 1.27 million acres of wetlands (4.5 percent of Pennsylvania's land area). Today it is estimated that there are less than 500,000 acres of wetlands. The original system of streams and wetlands in Pennsylvania created a natural floodplain system. This system included stream and wetland vegetation and roots that helped slow excess water flow, filtered nutrients and sediments, and provided an aquatic food web for wildlife. Soils identified with high runoff potential are in drainage classes that are known to have high amounts of runoff due to excess soil saturation. **Map 24** (P. 77) identifies the counties by the percentage of very poor and poorly drained soils on crop and pastureland. These soils are generally found in low-lying areas that have high water tables. In addition, they are often found adjacent to streams and wetlands. Soils with high runoff potential near

streams and wetlands would benefit from riparian buffers. Some areas with high runoff potential may be candidates for wetland restoration.

ACTION

Conduct outreach to landowners owning prior converted acres to acquire WRE enrollment interest.

Watershed Protection and Flood Prevention

NRCS has assisted with the watershed surveys and planning, watershed and flood prevention project implementation, and emergency watershed protection since Congress provided authorizations in the early 1950s. Among the many watershed projects since then, the planning, design, and construction of 86 flood control dams occurred at various locations in Pennsylvania between 1960 and 1993. A high percentage of the dams were built with a 50- year life design. Thirty six of the 86 dams were built between 1960 and 1970. While some were originally built as significant hazard, all of these dams are now classified as high-hazard dams. The high-hazard designation is based on, although unlikely, failure of the dam causing loss of life or serious damage to homes, highways, railroads, or utilities. **Map 25** (P. 78) identifies the current Pennsylvania projects in the NRCS Dam Rehabilitation Program. Due to increasing development pressure, Pennsylvania has many areas that are prone to flooding. NRCS works with local sponsoring organizations to protect and restore watersheds from damage caused by erosion, floodwater, and sediment. As part of its watershed program, NRCS can help solve local natural resource and related economic problems on a watershed basis and help communities sustainably use water and land resources.

The Emergency Watershed Protection Program (EWP) was established by Congress to respond to emergencies created by natural disasters. In Pennsylvania, EWP assists with implementing critical emergency measures needed to address public safety and restoration efforts. Typical stream bank restoration projects funded under EWP include removing debris from waterways, protecting eroded stream banks, reseeding damaged areas, and, in some cases, purchasing floodplain easements on eligible land.

ACTION

In the next five years, Pennsylvania NRCS will plan six dams, design ten dams, and construct nine dams.

ACTION

Work with local municipalities that are increasingly impacted by flooding to enroll into a PL-566 flood reduction project.

Ground water

In Pennsylvania, karst areas contain rich limestone deposits that in some places on the landscape have helped create unique and valuable agricultural soils. However, the limestone deposits under the soil are easily eroded by water and susceptible to pollution from surface sources. In areas where the soft, underground limestone gets dissolved by water, caves, springs, aquifers, and sinkholes can form under the soil.

Ground

Karst landscapes are one of the most at-risk landscapes. This is because they have more direct pathways to groundwater due to the high porosity of the underlying limestone bedrock (CEAP Soil Vulnerability Index for Cultivated Cropland 17). Karst landscapes in Pennsylvania are at greater risk of contamination of soil and groundwater from spills or leakage from manure pits, which contain toxic levels of nutrients and pathogens. Additionally, manure from concentrations of livestock on the surface can easily leach into these underground areas and degrade water resources. Limestone outcroppings near ACAs or HUAs can serve as a direct link to groundwater, which is why containing manure on the surface in karst areas is important to keeping groundwater clean.

ACTION

NRCS will continue to support the use of practices, such as buffers around sinkholes and Integrated Pest Management, that reduce contaminates into the groundwater.

ACTION

NRCS will prioritize and replace manure liners that are pending lifespan expiration.

NRCS is also working with DEP to address areas of source water contamination. Providing drinking water to municipalities, source water areas are areas targeted by NRCS to address surface and groundwater contamination.

ACTION

Identify areas of high-leaching soils and prioritize applications in ranking process that install practices to reduce nitrogen leaching.

The 2018 Farm Bill mandated that 10 percent of funds authorized for conservation programs be used to protect sources of drinking water. Shown in **Map 26** (P. 78), Source water areas can be acres to many square miles. NRCS uses not only its EQIP and RCPP programs to address these areas of interest, but also the National Water Quality Incentive (NWQI) Program. NRCS has designated two areas of source water protection under NWQI: the Maiden and Swatara Creek watersheds for increased protection.

ACTION

NRCS will explore adding additional priority source water areas if funds are available.

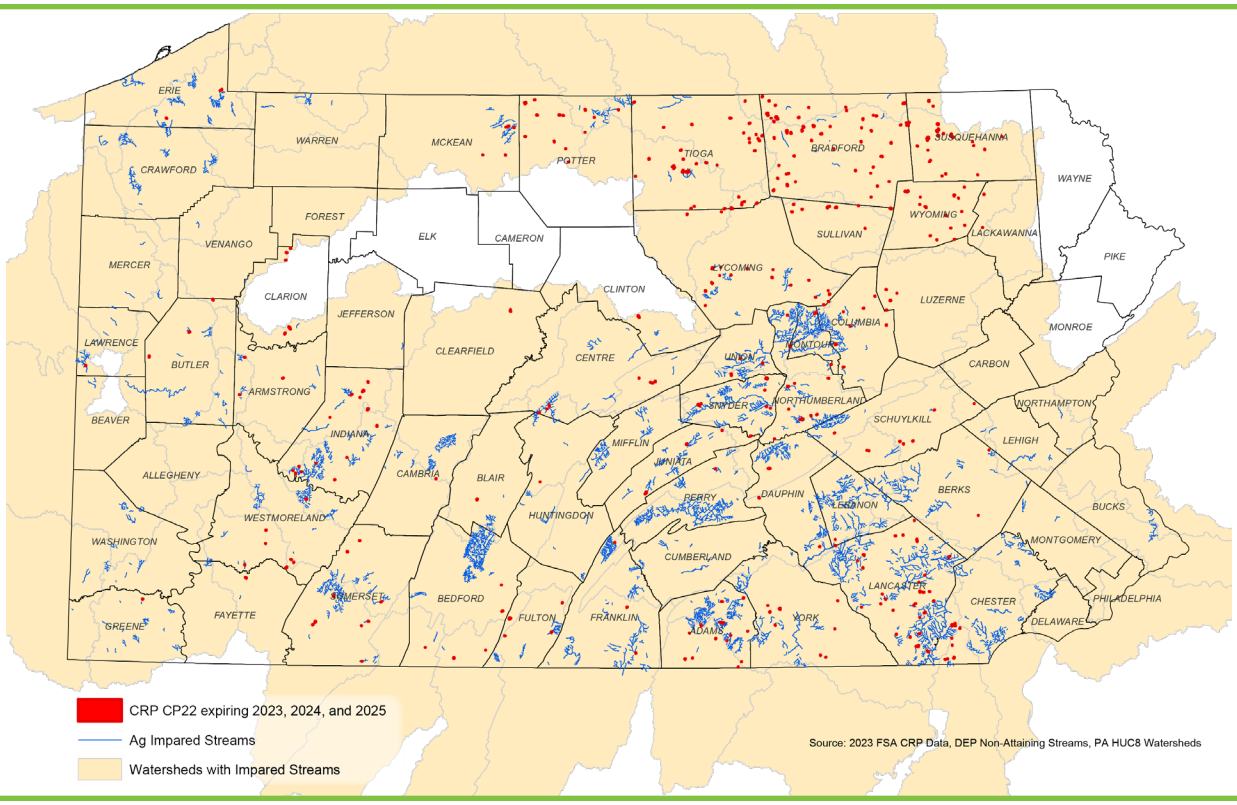
National Water Quality Initiative

NRCS provides financial and technical assistance to farmers and forest landowners interested in improving water quality in priority watersheds with ag-impaired streams through the National Water Quality Initiative (NWQI). NWQI is currently being offered in the following Pennsylvania watersheds (because of the significant natural resource challenges they face):

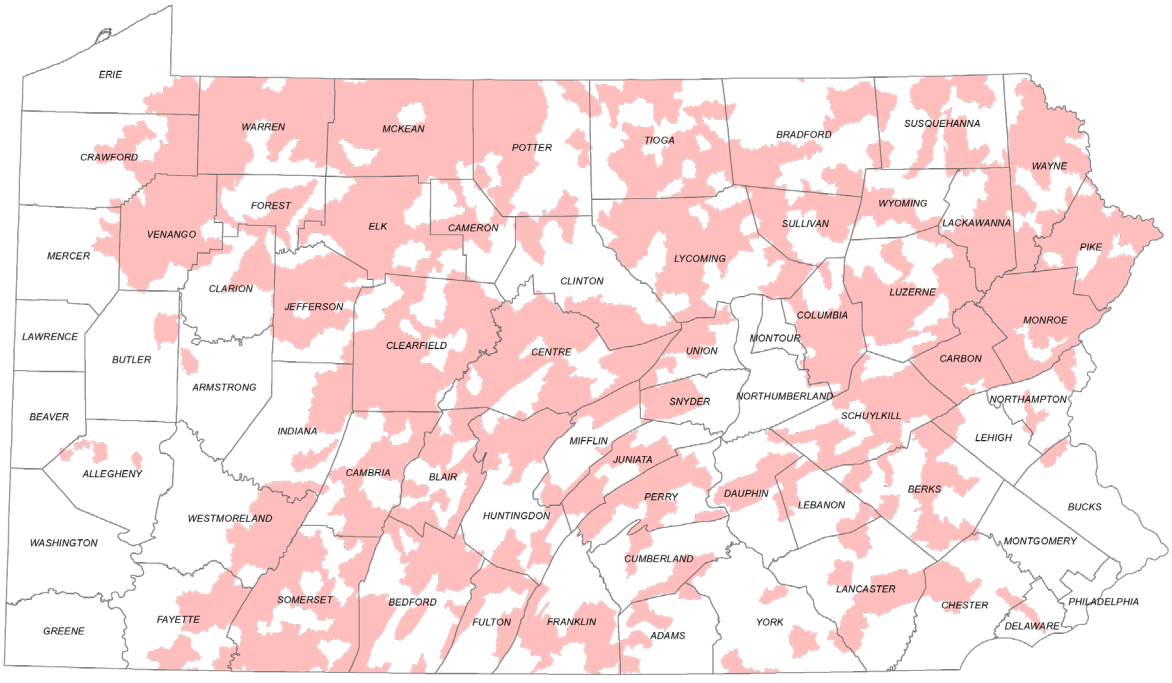
- Warrior Run
- Beaver and Upper Yellow Creeks
- Upper Kishacoquillas Creek
- Swatara Creek
- Maiden Creek

Our goal at NRCS is to improve water quality by preventing sediments and nutrients from reaching streams and source water. The ultimate goal is for the water quality to be improved, source water to be protected, or for these streams to be removed from the ag impaired streams list.

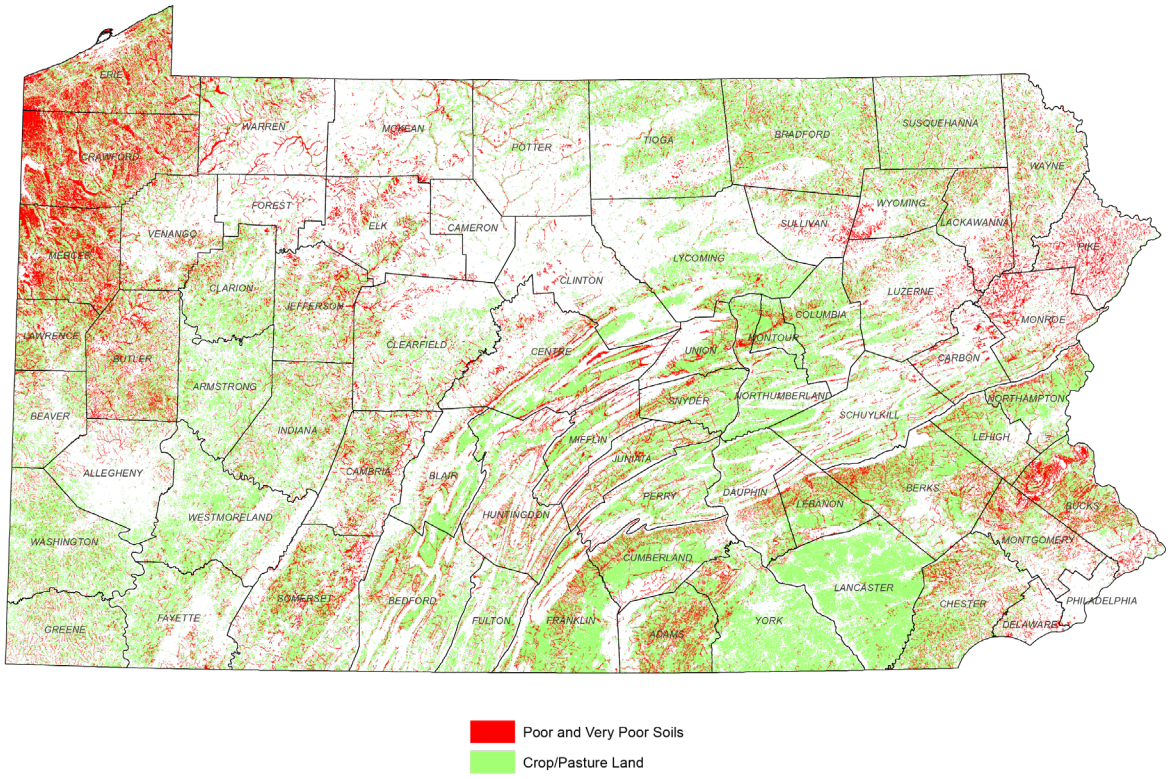
Map 22: CREP Contracts with Forest Riparian Practices (CP22) Expiring in 2023, 2024, and 2025 within Watersheds with Ag Impared Streams



Map 23: Watersheds with Reduced or Declining Eastern Brook Trout Populations

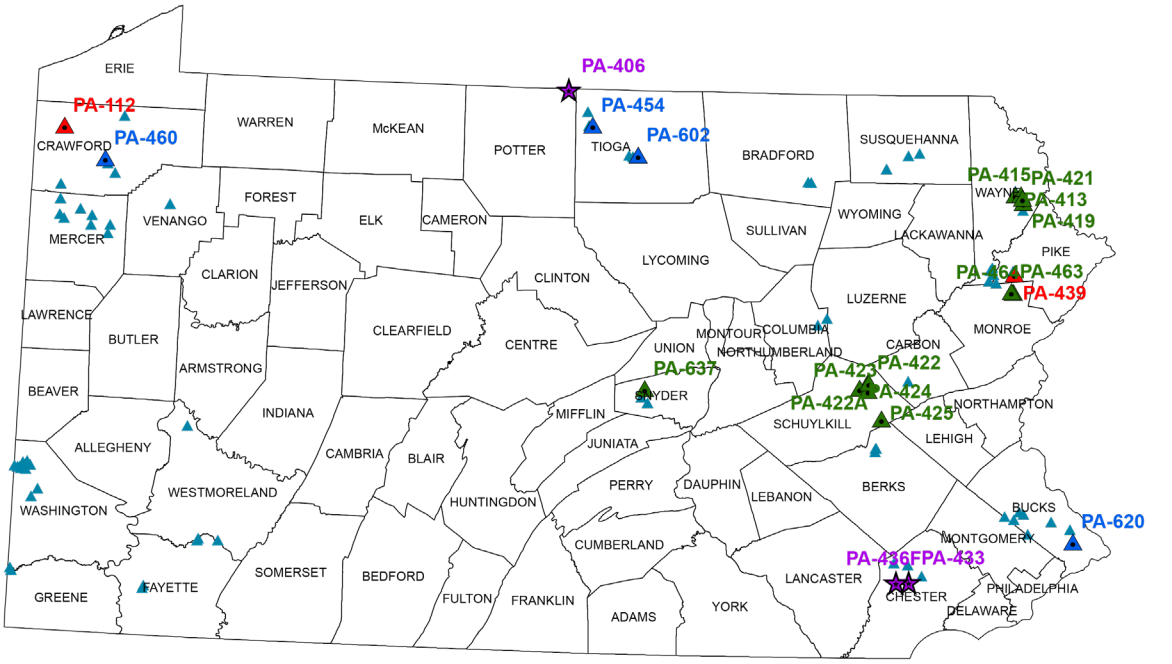


Map 24: Crop and Pastureland Acres with Poor and Very Poor Soils



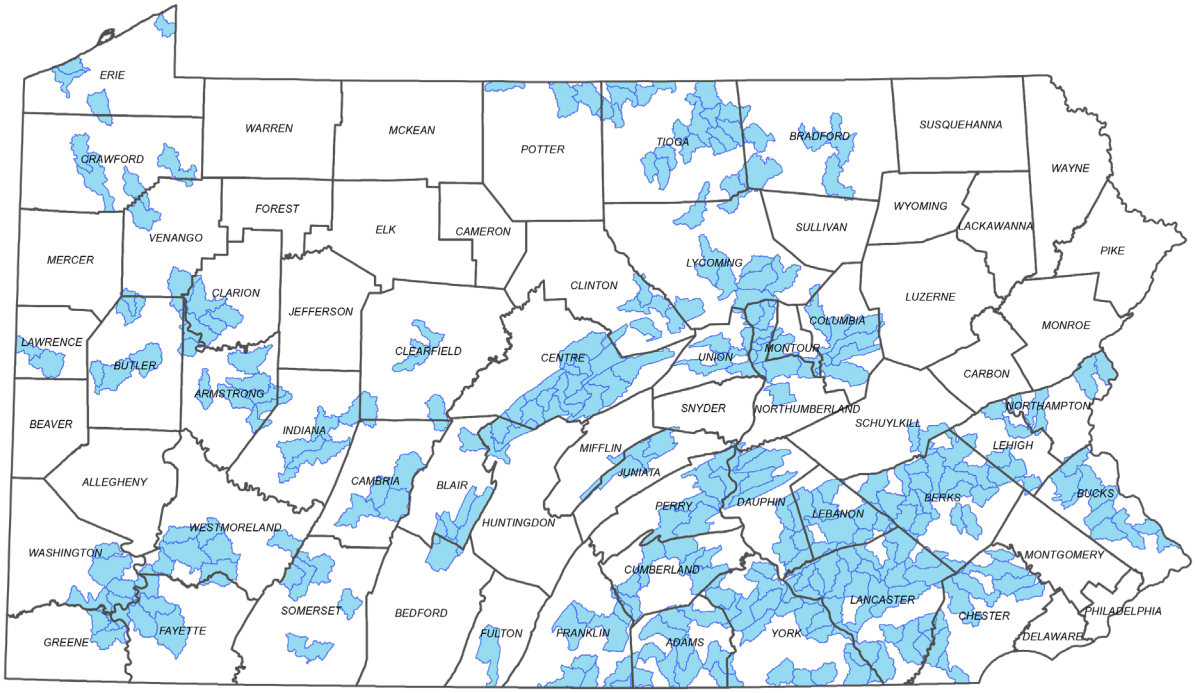
Source: 2019 National Land Cover Dataset, USDA-NRCS Soil Survey

Map 25: Phases of Dam Rehabilitation



Prepared with assistance from USDA-Natural Resources Conservation Service

Map 26: High Priority Source Water Protection Areas Pennsylvania HUC-12 Watersheds



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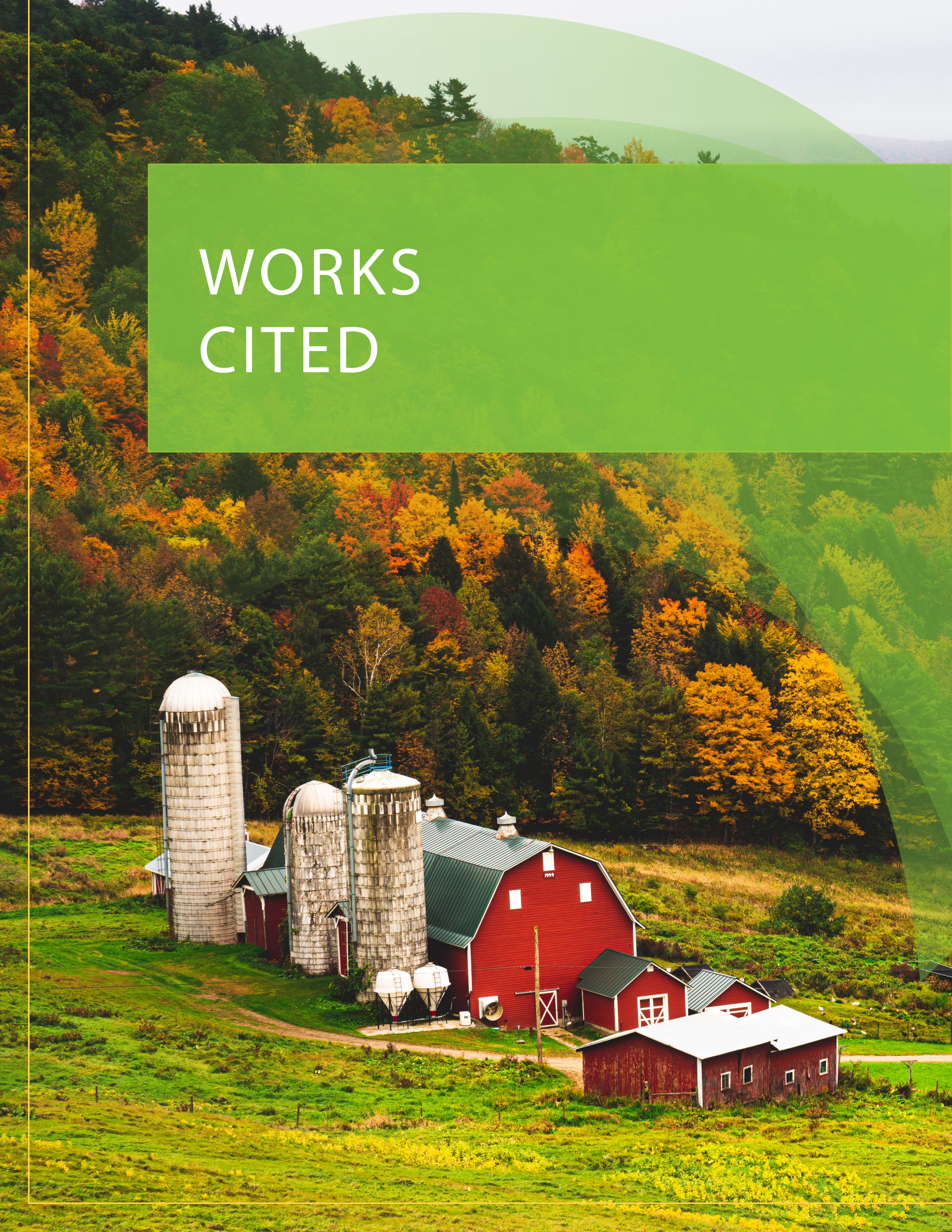

"A Case for Food Sovereignty". Sustainable Harvest International. 26 November 2020. sustainableharvest.org. https://www.sustainableharvest.org/blog/2020/11/24/a-case-for-food-sovereignty?gclid=EAIaIQobChMI0_2M6tmx9wIVmonICh33hgDiEAAYASAAEgJow_D_BwE .

"Adams County Fruit Belt Makes $ense", (guest contributor). Pennsylvania Historic Preservation, Blog of the Pennsylvania Historic Preservation Office. 31 May 2017. https://pahistoricpreservation.com/adams-county-fruit-belt-makes-ense/ .

"Agricultural Resources of Pennsylvania, c. 1700-1960, Adams County Fruit Belt, c. 1875-1960.", Pennsylvania Historic and Museum Commission PHMC. http://www.phmc.state.pa.us. Retrieved January 28, 2022.

Agroforestry Strategic Framework, Fiscal Years 2019-2024. United States Department of Agriculture. January 2019.

Albright, Thomas A., et. al. "Pennsylvania forests 2014". Resource Bulletin NRS-111. Newtown Square, PA. 2017. U.S. Department of Agriculture, Forest Service, Northern Research Station. 140 p. https://www.fs.fed.us/nrs/pubs/rb/rb_nrs111.pdf

Altieri, Miguel. "How Urban Agriculture Can Improve Food Security in US Cities." The Conversation. 13 February 2019. phys.org. https://phys.org/news/2019-02-urban-agriculture-food-cities.html#:~:text=Urban%20farming%20has%20grown%20by,can%20realistically%20ensure%20for%20cities.

Anderson, M. G., and C. E. Ferree. Conserving the stage: climate change and the geophysical underpinning of species diversity. PLOS ONE. 2010. http://dx.plos.org/10.1371/journal.pone.0011554

"Average Warehouse Sizes & Space Planning Tips". (no author). Warehouse1. 24 November 2020. wh1.com. Typical Warehouse Square Footage Sizes - Space Planning Tips | Warehouse1 (wh1.com).

Bakermans, Marja H., et. al. "Golden-Winged Warbler Habitat. Best Management Practices for Forestlands in Maryland and Pennsylvania." Appalachian Mountains Joint Venture. November 2011. Print.

Best Management Practices for Pennsylvania Forests. The Pennsylvania State University. Penn State College of Agricultural Sciences. Penn State Extension. Ag Communications and Marketing, 2001. extension.psu.edu. Retrieved March 21, 2022.

Bog Turtle Fact Sheet. Pennsylvania. Pennsylvania Natural Heritage Program. web. print. https://penandthepad.com/cite-fact-sheet-using-mla-style-writing-2978.html . Retrieved March 29, 2022.

Brown, Karl. Philadelphia Advisory Council. County Conservation District Formation Process. Speaking Notes. 30 June 2021.

CEAP Soil Vulnerability Index for Cultivated Cropland. United States Department of Agriculture. User Guide, Version 2.0, September 2019.

Chamberlain, James L., et. al. "Assessment of nontimber forest products in the United States under changing conditions." General Technical Report SRS-GTR-232. 2018. USDA Forest Service, Southern Research Station.

"Chesapeake Bay Protection and Restoration. Final Rule." Federal Register Vol. 74 No. 93 (15 May 2009): 23099-23104. Print.

"Climate Change Projections for Individual Tree Species in Pennsylvania." Climate Change Response Framework, Northern Institute of Applied Climate Science. 2022. forestadaptaion.org. Climate Change Projections for Individual Tree Species in Pennsylvania | Climate Change Response Framework (forestadaptation.org) . Retrieved March 21, 2022.

Conservation Landscapes. Pennsylvania Department of Conservation & Natural Resources DCNR. dcnr.pa.gov. Conservation Landscapes (pa.gov). Retrieved March 23, 2022.

Conservation Practices on Cultivated Cropland. A Comparison of CEAP I and CEAP II Survey Data and Modeling. United States Department of Agriculture. Natural Resources Conservation Service. March 2022. Microsoft Word - CEAP National Report BENSON FINAL 12 19 21.docx (usda.gov) .

Corkery, Michael. “A New Crop in Pennsylvania: Warehouses.” The New York Times, 26 May 2021. nytimes.com, https://www.nytimes.com/2021/05/26/business/lehigh-valley-warehouses-ecommerce.html .

Crable, Ad. “Large-lot housing popping up across PA farmland.” Bay Journal, News by Topic, 3 August 2020. bayjournal.com. Large-lot housing popping up across PA farmland | Growth & Conservation | bayjournal.com.

Crable, Ad. “Report: Third of PA Waterways Impaired”. Bay Journal. 22 September 2020. bayjournal.com. https://www.bayjournal.com/news/pollution/report-third-of-pa-waterways-impaired/article_e49334c2-d1cd-11ea-a9da-abf33a98e4d8.html#:~:text=One%20of%20every%203%20miles,last%20assessment%20two%20years%20ago .

Crable, Ad and Cox, Jeremy. “The Big Picture. Mega-warehouses take toll on environment, localities.” Bay Journal, News by Topic, 19 July 2021. bayjournal.com. Mega-warehouses take toll on environment, localities | Growth & Conservation | bayjournal.com.

“Delaware River Basin”. The Nature Conservancy. 13 April 2021. nature.org. https://www.nature.org/en-us/about-us/where-we-work/united-states/pennsylvania/stories-in-pennsylvania/delaware-river/ .

“Delaware Watershed”. Pennsylvania Association of Conservation Districts, Inc. 2009. pacd.org. https://pacd.org/?page_id=1517 . Retrieved May 18, 2022.

De Long, Aaron. Water Farming. Managing Agricultural Lands for Clean and Safe Water. PASA Sustainable Agriculture. pasafarming.org. https://pasafarming.org/resources/water-farming-managing-agricultural-lands-for-clean-safe-water/ . Retrieved April 6, 2022.

Dinsmore, Carli. “The Wood Turtle.” Penn State Outreach. Shaver’s Creek Environmental Center. Penn State. 8 August 2017. https://www.shaverscreek.org/2017/08/08/the-wood-turtle/ .

Duiker, Sjoerd W. Exploring Diversity; A Case Study of Extending the Grazing Season through Integration of Intensive Rotational Grazing and No-Tillage. Penn State Extension , 2018.

Duiker, Sjoerd W., Myers, Joel C., and Blazure, Lisa C. Soil health in Field and Forage Crop Production. U.S. Department of Agriculture Natural Resources Conservation Service and Penn State Extension, (not dated).

Duiker, Sjoerd W., and Williamson, Jessica A. Integrating Grazing in No-Till Systems on a Grain Farm. Penn State Extension, 2018.

Duiker, Sjoerd W., Williamson, Jessica A., and Wilson, David O. No-Till Annuals to Beat the Summer Slump on a Dairy Farm. Penn State Extension, 2018.

Egan, Franklin and Nawa, Sara Bay. “Soil Health Benchmarks 2021 Report.” Pennsylvania Association for Sustainable Agriculture PASA. 2021. pasafarming.org. https://pasafarming.org/soil-institute/farm-based-research/soil-health-benchmark-study/ .

“Erie Watershed”. Pennsylvania Association of Conservation Districts, Inc. 2009. pacd.org. https://pacd.org/?page_id=1517 . Retrieved May 18, 2022.

Farms and Land in Farms 2020 Summary. United States National Agricultural Statistics Service NASS. February 2021.

Farm and Ranch Lands Protection Program (FRPP) Report. United States Department of Agriculture. Natural Resources Conservation Service. https://www.nrcs.usda.gov/Internet/NRCS_RCA/maps/cp_frpp_maps.html , Retrieved February 22, 2022.

Fisher and Spangler. “Play. Pennsylvania League of Angling Youth. Winter 2019.” Pennsylvania Fish & Boat Commission. Bureau of Outreach, Education & Marketing. 2019. www.fishandboat.com. https://www.fishandboat.com/Transact/AnglerBoater/AnglerBoater2019/Documents/play-winter-01-watersheds.pdf .

Ford and Williams. “Karst Hydrogeology and Geomorphology” (revised edition), Wiliey, Chichester, England (2007).

"Forest Farming." Association for Temperate Agroforestry. aftaweb.org. https://www.aftaweb.org/about/what-is-agroforestry/forest-farming.html . Retrieved March 14, 2022.

Forests and Trees. Pennsylvania Department of Conservation & Natural Resources DCNR. dcnr.pa.gov. Forests and Trees (pa.gov). Retrieved March 02, 2022.

Franco, Edward. (Personal Interview). 10 January 2017.

Freedgood, J., et. al. "Farms Under Threat: The State of the States." American Farmland Trust, 2020. Farmland Info.org. https://farmland.org/project/farms-under-threat/.

Fritscher, Justin, et. al. "Working Lands for Wildlife: Win-win conservation for producers, communities, and wildlife". USDA, Natural Resources Conservation Service. January 2021. farmers.gov. https://www.farmers.gov/conservation/wildlife.

"Genesee Watershed". Pennsylvania Association of Conservation Districts, Inc. 2009. pacd.org. https://pacd.org/?page_id=1517 . Retrieved May 18, 2022.

"Geography & Population". Lower Susquehanna Riverkeeper. lowersusquehannariverkeeper.org. https://lowersusquehannariverkeeper.org/educate/the-watershed/geography-population/ . Retrieved May 18, 2022.

Grazing Calendar. Pennsylvania Grazing Lands Coalition PAGLC, et. al. Curator. Pennsylvania 2021. Introduction Section. Retrieved March 04, 2022.

Gill, Chuck. "Farmland acreage falls in Pa. while population rises in prime agricultural areas." Penn State University. 9 March 2021. psu.edu. https://www.psu.edu/news/research/story/farmland-acreage-falls-pa-while-population-rises-prime-agricultural-areas/ .

Gruber, Philip. "Seeing the Pasture for the Trees: Agroforestry Slowly Showing Promise in Pennsylvania." 28 February 2022. lancasterfarming.com. Seeing the Pasture for the Trees: Agroforestry Slowly Showing Promise in Pennsylvania | Main Edition | lancasterfarming.com .

"Hanover Shoe Farms". Wikipedia, Wikimedia Foundation. Hanover Shoe Farms - Wikipedia. Retrieved February 17, 2022.

Harvested Cropland Vegetables in the Commonwealth. Pennsylvania State Data Center PASDC. Research Brief. PASDC, October 2019.

Heist, Annette C. and Reif, Andrew G. "National Water Summary – Wetland Resources, State Summaries, Pennsylvania Wetland Resources." U.S. Fish and Wildlife Service. 1990. www.fws.gov. https://www.fws.gov/wetlands/data/Water-Summary-Reports/National-Water-Summary-Wetland-Resources-Pennsylvania.pdf.

"Historic South Mountain Fruit Belt – America's Orchard." Destination Gettysburg. Historic South Mountain Fruit Belt - America's Orchard (destinationgettysburg.com). Retrieved February 10, 2022.

Impacts of Conservation Adoption on Cultivated Acres of Cropland in the Chesapeake Bay Region, 2003-06 to 2011. United States Department of Agriculture. Pennsylvania Natural Resources Conservation Service. 2011.

Invaders in the Commonwealth. Invasive Species Management Plan. Pennsylvania Invasive Species Council. May 2009, revised 2016. https://www.agriculture.pa.gov/Plants_Land_Water/PlantIndustry/GISC/Documents/Five-Year Plan 09.19.17.pdf.

Johnston, April. "'That's Vinegar:' The Ohio River's History of Contamination and Progress Made." Environmental Health News. 14 November 2019. ehn.org. https://www.ehn.org/ohio-river-pollution-cleanup-2641307895.html .

Korber, Kathy, and Gross, Doug. "Cerulean Warbler – Our Forest Gem." Pennsylvania eBird. 3 May 2013. ebird.org. https://ebird.org/pa/news/cerulean-warbler-our-forest-gem .

Kreye, Jesse and Kreye, Melissa. "Prescribed Fire: Does it have a Place on My Land?" Penn State Extension. 1 October 2020. extension.psu.edu. Prescribed Fire: Does It Have a Place on My Land? (psu.edu).

Kurtz, Cassandra M., et. al. “An assessment of invasive plant species monitored by the Northern Research Station Forest Inventory and Analysis Program, 2005 through 2010.” Gen. Tech. Rep. NRS-109. 2013. Newtown Square, PA. U.S. Department of Agriculture, Forest Service, Northern Research Station. 70 p. https://www.nrs.fs.fed.us/pubs/gtr/gtr_nrs109.pdf.

Latham, R. and Thorne, J. “Keystone Grasslands, Restoration and Reclamation of Native Grasslands, Meadows, and Savannas in Pennsylvania State Parks and State Game Lands”, 30 September 2007. Print.

Lemus, Rocky. “Pasture Benefit from a Timely Prescribed Burn.” Forage News. Mississippi State University Extension. 13 January 2020. extension.msstate.edu. http://extension.msstate.edu/ .

Local Food Marketing Practices Survey – NASS invites comments to OMB on proposed expansion (by 11/15). American Economic Association. October 2015. aeaweb.org. https://www.aeaweb.org/forum/2164/marketing-practices-invites-comments-proposed-expansion .

Local Food News Release. United States National Agricultural Statistics Service (NASS). Northeastern Regional Field Office. 29 April 2022. April 2022 PA Local Food News Release (usda.gov).

Mahbubur Meenar, Alfonso Morales & Leonard Bonarek. (2017) Regulatory Practices of Urban Agriculture: A Connection to Planning and Policy. 12 October 2017. Journal of the American Planning Association. https://www.tandfonline.com/doi/full/10.1080/01944363.2017.1369359 .

“Managing Habitat for Shrubland and Young Forest Birds.” Audubon. ny.audubon.org. https://ny.audubon.org/conservation/managing-habitat-shrubland-and-young-forest-birds . Retrieved March 30, 2022.

McMillan, Kathleen. “Average Size of Newly Built U.S. Warehouses Swells Due to E-Commerce.” CBRE. 20 December 2017. cbre.us. Average Size of Newly Built U.S. Warehouses Swells Due to E-Commerce | CBRE.

Northeast Mid-Atlantic Agroforestry. Capital RC&D. https://www.capitalrcd.org/nemaagroforestry.html . Retrieved March 14. 2022.

NRCS Conservation Programs Pennsylvania. RCA Data Viewer. United States Department of Agriculture. February 2021. https://www.nrcs.usda.gov/Internet/NRCS_RCA/reports/cp_pa.html .

NRCS Project Outline Form – Field/Laboratory/Dynamic Soil Properties. United States Department of Agriculture. Natural Resources Conservation Service. 2021. Print.

NRCS VIP Statewide Fact Sheet. Agency Report. United States Department of Agriculture. 2021. Print.

“Ohio Watershed”. Pennsylvania Association of Conservation Districts, Inc. 2009. pacd.org. https://pacd.org/?page_id=1517 . Retrieved May 18, 2022.

“One-Third of Pa. Waterways Unclean for Wildlife, Drinking”. Governing the Future of States and Localities. 20 January 2022. governing.com. https://www.governing.com/now/one-third-of-pa-waterways-unclean-for-wildlife-drinking.

PA Environmental Justice Areas. Pennsylvania. Department of Environmental Protection. dep.pa.gov. https://www.dep.pa.gov/PublicParticipation/OfficeofEnvironmentalJustice/Pages/PA-Environmental-Justice-Areas.aspx . Retrieved April 25, 2022.

Pennsylvania Forest Action Plan. Pennsylvania Department of Conservation and Natural Resources. Bureau of Forestry. December 2020. dcnr.pa.gov. https://www.dcnr.pa.gov/Conservation/ForestsAndTrees/StateForestManagement/ForestActionPlan/Pages/default.aspx .

Pennsylvania NRCS FY 2021 Accomplishments. United States Department of Agriculture. Agency Report. 2021. Print.

Pennsylvania NRCS Soil Health Strategic Plan. United States Department of Agriculture. May 2020. Print.

Pennsylvania Wildlife Action Plan 2015-2025. Pennsylvania Game Commission. Pennsylvania Fish & Boat Commission. 1 October 2015. Wildlife Action Plan (pa.gov) .

“Potomac Watershed”. Pennsylvania Association of Conservation Districts, Inc. 2009. pacd.org. https://pacd.org/?page_id=1517 . Retrieved May 18, 2022.

Prime Farmland. RCA Data Viewer. United States Department of Agriculture. February 2021. https://www.nrcs.usda.gov/Internet/NRCS_RCA/reports/cp_pa.html .

"Quick Facts About Greater Philadelphia." Select Greater Philadelphia Council. selectgreaterphil.com https://selectgreaterphl.com/why-here/ . Retrieved March 10, 2022.

Reducing Food Waste. United States. U.S. Department of Agriculture. Office of Urban Agriculture and Innovative Production. May 2021.

Schaffstall, Samantha. "The Promise of Urban Agriculture: National Study of Commercial Farming in Urban Areas (Summary)." United States Department of Agriculture. Agricultural Marketing Service. December 2019. https://smallfarms.cornell.edu/projects/urban-ag/promise-urban-agriculture/ .

Shane, Rob. "86,000 Miles of Streams: Protecting Pennsylvania's Trout." Coalition for the Delaware River Watershed. 27 Nov. 2017, Coalition for the Delaware River Watershed — 86,000 Miles of Streams: Protecting Pennsylvania's Trout (delriverwatershed.org).

Smith-Brubaker, Hannah. "2017 Ag. Census Shows Positive Trends for Sustainable Agriculture in PA." PASA Sustainable Agriculture, 2018, 2017 Ag Census Shows Positive Trends for Sustainable Agriculture in Pa. - Pasa Sustainable Agriculture (pasafarming.org).

Sorensen, A. A., et. al. "Farms Under Threat: The State of America's Farmland." American Farmland Trust, 2018. Farmland.org. https://farmland.org/project/farms-under-threat/.

Species Action Plan: Eastern Massasauga. Pennsylvania Fish & Boat Commission. June 2011. Species Action Plan (fishandboat.com).

State Forest Resource Management Plan. Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry (DCNR-BOF). 2016.

Stein, Susan. "NRCS Engagement in Urban Agroforestry." Natural Resources Conservation Service. Draft report.

"Stories from PA History. Pennsylvanians and the Environment, Chapter One: Penn's Woods." ExplorePAhistory.com. ExplorePAHistory.com - Stories from PA History. Retrieved March 03, 2022.

"Stories from PA History. Pennsylvanians and the Environment, Chapter Three: Creatures Great and Small." ExplorePAhistory.com. https://explorepahistory.com/story.php?storyId=1-9-E&chapter=3 . Retrieved March 25, 2022.

"Susquehanna Watershed". Pennsylvania Association of Conservation Districts, Inc. 2009. pacd.org. https://pacd.org/?page_id=1517 . Retrieved May 18, 2022.

"The Pennsylvania State Wetland Program Summary." National Association of Wetland Managers. nawm.org. pennsylvannia_state_wetland_program_summary_090915.pdf (nawm.org). Retrieved March 29, 2022.

"The Susquehanna River". Susquehanna River Valley Visitors Bureau. 2022. https://www.visitcentralpa.org/things-to-do/the-susquehanna-river .

"Threats to Clean Water in the Delaware River Basin; Agricultural and Urban Runoff". Environment America, Research and Policy Center. Environmentamerica.org. https://environmentamerica.org/sites/environment/files/cpn/Delaware_Watershed_Factsheets/Runoff_Pollution_in_Delaware_River_Basin-Environment_America.pdf . Retrieved May 18, 2022.

Trinks, et. al. "Mapping the Urban Subsoil Using Ground Penetrating Radar – Challenges and Potentials for Archeological Prospection". Archeo Sciences. History and Evolution of the Urban Soil, 2009. journals.openedition.org. https://journals.openedition.org/archeosciences/1630 .

2017 Census of Agriculture. United States National Agricultural Statistics Service. NASS. Web Archive. https://www.nass.usda.gov/ .

2017 National Resources Inventory. United States Department of Agriculture. Natural Resources Conservation Service, Washington, DC. https://www.nrcs.usda.gov/Internet/NRCS_RCA/reports/nri_dev_pa.html . Retrieved March 3rd and 14th, 2022.

2012 Census of Agriculture. Direct Farms Sales of Food. Results from the 2015 Local Food Marketing Practices Survey. United States National Agricultural Statistics Service NASS. 2015. nass.usda.gov. https://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Local_Food/

2020-2021 Agricultural Statistics Annual Bulletin Pennsylvania. United States National Agricultural Statistics Service NASS. 2022.

Undersander, Dan. "Pastures for Profit: A Guide to Rotational Grazing (A3529)." Cooperative Extension Publishing, University of Wisconsin-Extension, U.S. Department of Agriculture. (2002).

"Understanding Pennsylvania Agriculture: 2017 Update." The Pennsylvania State University. Center for Economic and Community Development and Penn State Extension. 2020. Print.

"Understanding the Quiet Majority: Small Farms in Pennsylvania, 2017." The Pennsylvania State University. Penn State College of Agricultural Sciences, Center for Economic and Community Development. 2021. Print.

Urban Soils. United States Department of Agriculture. Urban Soils | NRCS Soils (usda.gov). Retrieved April 28, 2022.

Wildlife. United States Department of Agriculture. farmers.gov. March 2022. https://www.farmers.gov/conservation/wildlife .

"Wildlife Friendly Agriculture." The Nature Conservancy. California Conservation Science. https://www.scienceforconservation.org/science-in-action/wildlife-friendly-agriculture . Retrieved March 28, 2022.

APPENDIX A

Research and Case Studies

Pennsylvania NRCS also relies on our research partners, such as USDA/ARS, Penn State Extension, and Plant Material Centers to update NRCS grazing practices with technology advances measured through practical on-farm application. In 2021 and 2022, NRCS conducted several "pilot projects" aimed at informing our update and adoption of Pasture and Hay Planting (512), Cover Crop (340), and Annual Forages in Grazing Systems (810), as conservation practices appropriate for grazing use on cropland or pastures.

ACTION

Create videos and fact sheets to showcase the use of cover crops and the use of annual forages in grazing systems.

The Soil Survey Division is currently working on a dynamic soil property (DSP) project to study Ecological Site pasture states. The objective of the study is to evaluate dynamic soil properties of pasture states since grazing is utilized widely by livestock farming enterprises, primarily dairy and beef in Pennsylvania, but also horses, sheep, and goats (NRCS Project Outline Form 1). Study goals include developing Ecological Site pasture states for soils commonly used for pasturing animals then translating the information into a fact sheet for producers and releasing it in the next two years. Ultimately, Pennsylvania NRCS plans to utilize the information from the study to help develop predictive soil interpretations and to apply these to various management systems on pastures (U.S. Department of Agriculture. NRCS Project Outline Form — Field/Laboratory/Dynamic Soil Properties 1).

ACTION

Incorporate the findings from these cover crop and forage of CIG case studies and other research into conservation planning for grazing systems that would benefit from it.

Case Study #1 (Duiker 2018)

This case study looked at a farm in northwestern Pennsylvania, which uses a combination of both annual and perennial plants in a mix of 70 plant species of legumes, cool-season grasses and warm-season grasses to expand the grazing season, improve soil health, and reduce cost while using rotational grazing and no-till. The farm location has posed challenges for grazing because of the short growing season, poorly drained soils, and steep slopes. Best management practices to improve pastures were implemented on the farm. Intensive rotaional grazing using mobile fencing moved every few hours is used. All crops grown on the farm are harvested by grazing animals, not machinery. No-till is the only method used to re-establish forage stands. The study found that the intensive rotational grazing allows for uniform vegetation regrowth and using new varieties of perennials during rest periods helps improve pasture productivity and resilence. By adopting these grazing management practices, average soil loss was reduced to 0.10 to 0.13 tons per acre per year and diesel fuel use decreased from 3,500 gallons to 200 gallons per year, reducing the cost and air quality degradation of fossil fuels. Total grazing days increased from 120 days to 290 days per year, making the pasture acreage more profitable.

SOURCE: PennState Extension, Exploiting Diversity, Case Study, Sjoerd W. Duiker, Pennsylvania State University, 2018

Case Study #2 (Duiker, et. al. 2018)

The case study involves a cow/calf beef farm having a herd of around 90 animals. Grazing acreage on the farm consists of 43 acres of cool-season perennial pastures. Grain crops and cover crops are typically grown on 37 acres of cropland on the farm. Pasture forage health is a challenge in winter, and especially in summer when drougty soils limit vegetation growth. For the study, some strips of the a field in the cropland area were lined with electrified temporary fencing and planted with an annual pearl millet/rape cover crop mix. Animals were able to graze these areas during times of the year when pasture grass productivity was low. After the study, when soils were compared between the perennial sod areas in the field and the grazed crop field strips, the grazed cropland strip soils were more healthy on average than those in perennial sod. Soil structure, earthworm activity, erosion protection, and infiltration were all improved. The study concluded that grazing cover crops and crop residue adds soil health and increases value for animal forage in the off-season, while summer annuals could be planted in some crop fields to supplement summer forage needs. Intense rotational grazing and back fencing are needed as management to ensure better success.

SOURCE: PennState Extension, Integrating Grazing in No-Till Systems on a Grain Farm, Case Study, Sjoerd W. Duiker, Pennsylvania State University, 2018
Case Study, Sjoerd W. Duiker, Pennsylvania State University, 2018

Case Study #3 (Duiker and Williamson 2018)

This case study looked at how using no-till with annuals and cool-season perennials in rotation can better meet the forage needs of pastured dairy cows. Cool-season perennial grasses are a staple for dairy pastures, but in the northeastern United States, pasture forage is limited seasonally because forage growth slows dramatically in winter when temperatures decrease below 40 degrees F., and also decrease dramatically in summer when temperatures increase to over 80 degrees F. In Pennsylvania, this limits grazing days and the forage gains to a short season. Over two seasons, this study looked at intensive rotational dairy cow grazing in fields where annual warm-season grass and annual cool-season grass was planted with no-till. Cover crops were also planted. The study found that the forage growing season lengthened, providing dairy cow forage throughout summer months when pastures typically were not able to be grazed. Soil health also increased for the factors of erosion control, moisture retention, and temperature, and the need for fertilizer was reduced due to grazing animals providing nutrients.

SOURCE: PennState Extension,No-Till Annuals to Beat the Summer Slump on a Dairy Farm, Case Study, Sjoerd W. Duiker, David O. Wilson, and Jessica A. Williamson, Pennsylvania State University, 2018

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