

Natural Resources Management Plan for Hibernia County Park

Prepared for Chester County Parks + Preservation



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Executive Summary

This comprehensive Natural Resource Management Plan was prepared for Hibernia County Park, which has been owned and operated by Chester County since 1963. This plan aims to focus on the park's natural resources currently present in the spring of 2020. This is the first edition of a Natural Resource Plan for Hibernia County Park, which we suggest be revised after ten years. The information outlined establishes a basis for managing the various resources located on the 1,253-acre site. ArcGIS applications were utilized to create maps of the park for both staff and the general public. These maps enhance the ability of the staff to maintain the park, while providing knowledge for the public. Enclosed in this plan is information regarding the history of Hibernia Park and its relationship to its surrounding environment, a natural resource inventory of species, soils, and the impact of recreational activities in the park, methodologies to enhance community involvement, and future considerations including climate change, for park management. This plan identifies four major goals: the restoration of damaged or degraded ecosystems, further development of educational and volunteer opportunities that support the protection or restoration of natural resources, increasing engagement with community stakeholders, and enhancing the resilience of Hibernia's natural resources to further disturbance. The proposed goals each have implementable objectives that can be accomplished within the ten-year lifespan of this plan. Additionally, this plan may be an example to other park management organizations on how to advocate for an environment that has experienced significant disturbance and attracts heavy recreational use by visitors.

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Introduction

Background of Park

The property that is now Hibernia County Park was purchased by Chester County in 1963. Today, the park is managed and maintained by the department of Chester County Parks + Preservation. Their mission is to “to provide preservation, recreation, educational, and stewardship services to the residents and visitors of Chester County so they can connect with natural and cultural resources and thrive in a sustainable healthy community” (Chester County n.d.). The park is 1,253 acres in size, and provides residents with trails, woodlands, grasslands, open fields, fishing, play areas, pavilions, and campsites. Also offered at Hibernia County Park are walking tours of the famous Hibernia Mansion and ruins scattered around the site from the park’s days as an iron forge. The park is located in western Chester County, centered between Reading, Lancaster and Philadelphia (Figure 1).

Hibernia Iron Works

The first owner of the property was George Harrison who is thought to have lived on the land in 1744 (Nagy and Goode, 1965). In 1794, 190 acres were selected along the west bank of the Brandywine Creek by Samuel Downing, who built the first forge along the creek. The Brandywine Creek had already been an established source of power for producing wrought iron in the area.

By 1798, Hibernia iron works encompassed 450 acres; the expansion of property allowed six families to live on the land by creating a self-sustaining community where all items needed for everyday life could be produced in the gardens, orchards, and on the farm or the items were sold at the general store located on the property. The Downing’s, who are believed to have lived in part of the mansion which was the original farmhouse for the property, and the remaining five families labored to build and operate two forges on the Brandywine Creek. Iron production at this time consisted of refining pig iron, which was a product of a blast furnace, into blooms or bar iron. The forge refined the pig iron by heating it to extreme temperatures fueled by coal, then repeatedly striking it by a large tilt hammer controlled by the flow of creek water. This process removed impurities from the iron allowing it to be molded into horseshoes and nails.

The charcoal used to fuel the forge was created on site. When the first property was purchased, the woodlands were cleared to create a fuel source. The self-sustaining community cut down the tall trees of the area and burned them slowly and with little oxygen to produce the

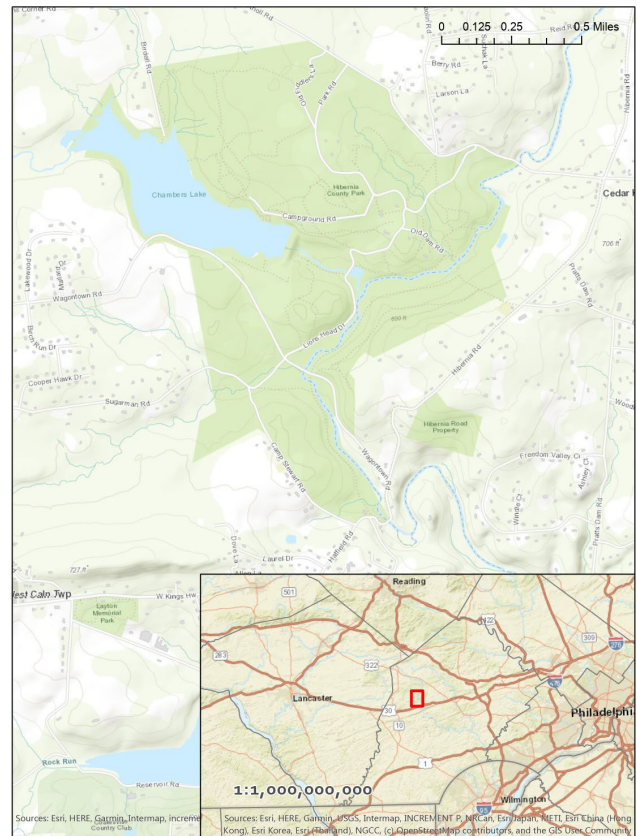


Figure 1: Location of Hibernia County Park

charcoal needed. Forges relied on charcoal to power the blast furnaces because charcoal was created in a very slow process; when it was re-lit charcoal burned at a high and steady temperature. It also produced minimal smoke and dangerous vapors which were ideal to avoid when working in close proximity to a forge. The clearing practiced 200 years ago has significantly influenced forest succession in ways that are still affecting the park's forest resources today.

In the course of the following decade the property was sold multiple times; in 1808 to Samuels' brother, Hunt Downing; in 1809 to Jacob Holderman, in 1811 to Bernard Vanleer and Company, who built a blast furnace on the land to allow for Hibernia to hold a larger portion of the production of the bar iron. In 1815, Isaac W. Vanleer of Bernard Vanleer and Company advertised in a sale advertisement that two forges were present on the property; "the lower forge is now in complete order for making bar iron, with two fires and one hammer, capable of making 150 tons per year. Within 200 yards of said forge is erected a new blast furnace driven by a separate stream, coming in on the west, and falling into said forge dam. The upper forge not in use at the time has a grand seat for a slitting; rolling or merchant mill, or distillery, or the whole as there is a great sufficiency of water for any kind of work, with fifteen feet fall" (Nagy and Goode, 1965: 5).



Figure 2: Colonel Swayne. Source: Chester County (n.d.).

In the 1800's the Brandywine Creek was home to multiple iron producing sites. The water of the creek was used to power each forge, cool the blast furnace, and cool the hammer down when pounding the iron. Each processing activity that iron went through required creek water to have a separate channel away from the original flow of the Brandywine Creek. To build multiple channels to each forge and furnace the Brandywine had to be dammed up and each path had to be hand dug. This process destroyed the natural vegetation on the banks of the creek as well as the vegetation where the water flowed through the new streams. Damming the creek and digging new streams damaged the aquatic life native to the area. This practice was especially damaging to the trout population as trout swim upstream to the origins of their birthplace to respawn; if the creek was dammed they could not swim upstream and when the new streams were created it would change the hydrology of the creek forever (Gudrais, 2004). Overall, iron production was degrading to the natural landscape of an area. It impacted air quality, surface and groundwater, and water quality as runoff from the forges and furnace ran back into the original channel of the Brandywine Creek.

Multiple buildings have been built since Samuel Downing owned the property in 1794. Most notable was a stone building that held the charcoal power to the furnace and powered the forge. The neighborhood around Hibernia abounds with tall woodlands which provided the needed resource to create the coal needed to power the iron making sites; and because of "the

sheer volume of trees present many iron mines alike found homes in this part of Southeastern Pennsylvania and the Mid Atlantic” (Nagy and Goode, 1965: 1).

The ownership of Hibernia changed hands to brothers James and Samuel Russell, in 1821 Charles Brooke took ownership of the property and became the most noteworthy ironmaster of Hibernia. He and his estate controlled the land for over 50 years. In 1879 the works was sold to William Struthers Freeman and two years later it was sold again to Thomas Costigan and his wife Margaret Costigan.

In 1894 the works was purchased by Colonel Franklin Swayne (Figure 2), where he left his legacy within the mansion’s architectural additions and furnishings. The present mansion was restored as Colonel Franklin Swayne had it before the property was inherited by Mary Matteson in 1924 (Figure 3). After this the Hibernia Mansion and the surrounding 700 acres of land stood vacant until August 15, 1963 when Chester County purchased it. The land is now known as Hibernia County Park owned and operated by Chester County.



Figure 3: The present-day Hibernia Mansion. Source: Chester County (n.d.).

Landscape Context and Relation to Other Plans

Hibernia Park’s history as an iron works and forge defined its landscape in the 20th century. Now around a hundred years later the land has begun ecological succession and the surrounding community is classified as a rural landscape. The Chester County Planning Commission describes rural landscapes as land that consists of open and wooded areas, with scattered villages, farms and residential uses. These areas are limited in development since preserving large areas of open space is critical for the natural and cultural resources of the area (Chester County Planning Commission, n.d.). Hibernia Park falls in the rural landscape category. According to the Chester County Planning Commission, rural landscapes preserve natural areas, protect agricultural land, and the preservation as well as reuse of historic buildings to their historic context (n.d.). We can see all of these preservation characteristics in Hibernia Park, from the protected land, to the Hibernia Mansion. Land use patterns in these rural landscapes include low density and clustered residential development, agricultural use, low intensity institutional use, and significant amounts of open space (Figure 4). Also, some infrastructure that may be found in these rural areas include expanded access to natural areas, parks and trails.

Hibernia Park is located in the greater Philadelphia region and falls under the jurisdiction of the Delaware Valley Regional Planning Commission or DVRPC. One of the major goals that the DVRPC has begun pursuing is planning via smart growth. Smart growth aims to cover many different types of development and conservation strategies that help protect our health and natural environment while making the community stronger financially while staying socially diverse and maintaining attractive landscapes (EPA, 2019). This approach takes into consideration the impact of transportation investment and promotes fiscally responsible development patterns, while staying as environmentally friendly as possible. Smart Growth encourages preservation of open space by concentrating development, brownfield development, and the reduction of emissions by promoting public transit and walkability (Delaware Valley Regional Planning Commission, 2017). The DVRPC’s long range plan for smart growth attempts to permanently protect one million acres of open space. By protecting this land, we are also preserving the cultural and historic values of the land similar to how Hibernia Park uses and preserves its historic features. By doing so, these cultural landscapes show aspects of the region’s origins through their true form, features, and characteristics that encourage the region's interdependence on its natural resources (Delaware Valley Regional Planning Commission, 2017).

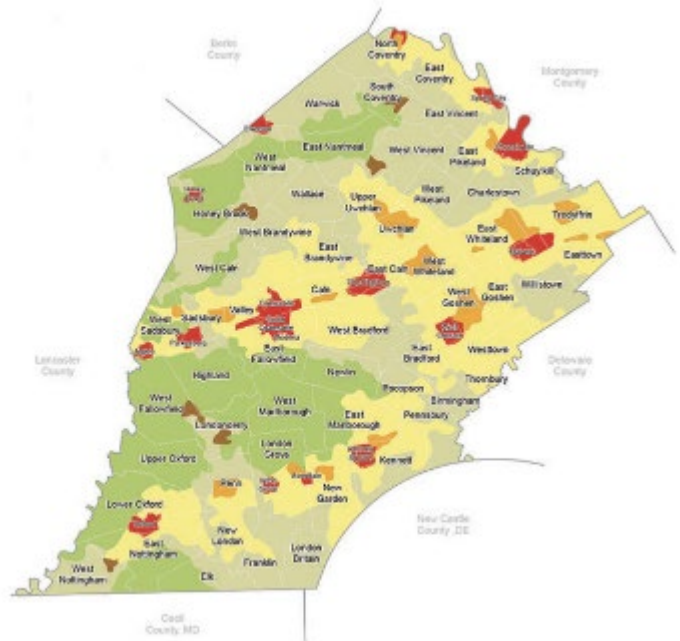


Figure 4: Rural, suburban, and urban landscapes in Chester County. Source: Chester County Planning Commission (n.d.).

Regionally, Hibernia Park could also seek out the DVRPC for support in preparation and mitigation of the effects of climate change. The regional planning commission is composed of nine counties that make up the greater Philadelphia area, five in Pennsylvania and four in New Jersey. Their major regional comprehensive planning document is called “Connection 2045.” The document can be divided into four distinct sections: trends in the greater Philadelphia region today, broad principles and goals with actionable objectives that would be implemented by 2045, current and future transportation planning projects, and citizen involvement. The area of most interest to this plan is the section on the principles and goals that would be implemented by 2045, specifically the principle on preserving the environment. To achieve the overall vision of preserving the environment, DVRPC set several goals; one in particular that is of interest to Hibernia is the goal of “preparing communities for the impacts of climate change” (DVRPC, 2017). Objectives of interest to Hibernia shown in the DVRPC plan would be incorporating hazard mitigation planning into Hibernia’s Comprehensive Plan and protecting and restoring riparian buffers. Riparian buffers should be of interest to Hibernia due to the potential increases in flooding. Larger rain events could be more easily dealt with if more vegetation was present to absorb the excess water and prevent runoff.

Meanwhile at the local level Hibernia Park could examine Chester County's Comprehensive Plan (Landscapes 3) to determine how aspects would be beneficial to Hibernia's mission. For starters, one of the pillars of the Landscapes 3 is protection, specifically regarding natural resources. That pillar includes eight unique implementation objectives. Important objectives like enhancing flood resiliency and monitoring impacts of change on water resources would both be important to Hibernia. For instance, if Hibernia wanted to enhance its flood resiliency, park officials could coordinate with several local organizations, such as the Chester County Water Resources, Chester County Conservation District, and local land trusts to design and construct solutions (Chester County Planning, 2018).

Natural Resource Inventory

Inventory of Invasive Plants and Animals

The last known inventory of vegetation in Hibernia Park was created by William D. Vanderwerff in 2003, which listed sixty different species of trees and shrubs, nine of which are invasive species. Additionally, there are dozens of species of known animals (see Appendix A).

An invasive species is any type of living organism that causes an ecosystem harm; typically these species are also not native to the ecosystem. These invasive species can cause serious harm to an environment, as well as impact the economy and even human health. While it is nearly impossible to identify where every invasive species within the park is located, the management of Hibernia was able to provide a rough estimate of where some of the larger sections of invasive species are located (Figure 5). Such invasive species include multiflora rose (*Rosa multiflora*) and autumn olive (*Elaeagnus umbellata*) which are prevalent near the main entrance of the park in the east. The tree of heaven (*Ailanthus altissima*) has its largest stand in the southeast with two other sizable stands situated in the southern and western parts of the park. In the north, burning bush (*Euonymus alatus*) has also taken over a huge section near an open field.

The introduction of a new plant species is not new and happens naturally in ecosystems. However, anthropogenic interference has accelerated the process to a level that the plant community cannot maintain its integrity. The use of planting exotics for wildlife management, erosion control, and horticulture has negative impacts on the associated ecosystems (Steckel and Harper, 2014). Invasive species pose a big problem because they are more competitive than native species and therefore overtake the area. Getting rid of invasive species, particularly plants, is expensive and does not necessarily guarantee complete success. The reason why invasive plants are so difficult to eradicate is because they drop their seeds onto the ground which gets buried in the soil and, therefore, overlooked (Vince, 2011). If the invasive plants have been eradicated there are still dormant seeds resting in the soil ready to sprout. Restoration practices and activities can aid buried invasive seeds by breaking up the soil and exposing them to sunlight and water (Vince, 2011).

Trying to get rid of all invasive species in an area is not feasible and efforts should focus on finding new ways to handle them using more efficient techniques. Rather than struggling with areas of highly degraded forest, workers should put their efforts into the restoration of the

surrounding threatened sites. Similarly, instead of attempting to completely eradicate non-native species, many reserves and parks are limiting their growth in the hopes that they no longer threaten native plants.

There are areas where human needs must be taken into account in ecosystem planning (Vince, 2011). An example is that invasive trees may aid in an area's economy due to it being valuable timber. Non-native species have become a part of local environments, so rather than spending the time and money on practices not guaranteed to work; we should focus on the more beneficial applications of these hybrid ecosystems.

Hibernia Park has its share of invasive species inhabiting the area. The invasive species threaten the native plants and animals' ability to survive and adapt. Many of these species are spread throughout the park, but there are prominent sections where these species grow in abundance. White-tailed deer (*Odocoileus virginianus*) populations have been increasing ever since the loss of their natural predators due to human interference. Since there are no predators to balance their numbers, there is an overabundance that has been negatively impacting the forest system. Deer are browsers, meaning their main source of food is tree saplings, new twigs, shrubs and tree seeds; which would not be a problem if there were not so many high-density clusters of deer (Steckel and Harper, 2014). The result is an absence of new plant growth that limits the replacement of older vegetation. Eventually, forests with higher deer concentrations will degrade into unsustainable ecosystems (Steckel and Harper, 2014).

First discovered in 2002, the emerald ash borer (*Agrilus planipennis*) is originally from Asia (Herms et al., 2014). When emerald ash borer larvae hatch, they burrow into the trunk of the white ash trees (*Fraxinus americana*) and create tunnels just underneath the bark. This impairs the trees' ability to transfer water and nutrients which results in dieback and bark splitting (Herms et al., 2014). Infestations of emerald ash borers on larger trees can last three to four years, while smaller trees can only survive one to two years (Herms et al., 2014). Currently, the park is conducting a 42-acre timber harvest in an area that has the highest concentration of white ash trees as a pre-emptive management strategy against the ash borers. Additionally, the park has been treating white ash trees with insecticide injections in order to combat the feeding emerald ash borer.

The spotted lanternfly (*Lycorma delicatula*) is a native to China, India, and Vietnam but was first seen as an invasive in Pennsylvania in 2014 (Carroll et al., 2020). These invasive insects cause trees to ooze sap, leaves to wilt, and tree dieback. They secrete a substance called honeydew, that stimulates the fast growth of black sooty mold which is incredibly damaging to plants (Carroll et al, 2020.). Their host tree, the tree of heaven, is another invasive species that the spotted lanternfly prefers to flock to. Hibernia Park has been eliminating all but a select few host trees and treating the remaining ones with a systemic insecticide in order to attract and exterminate the spotted lanternfly.

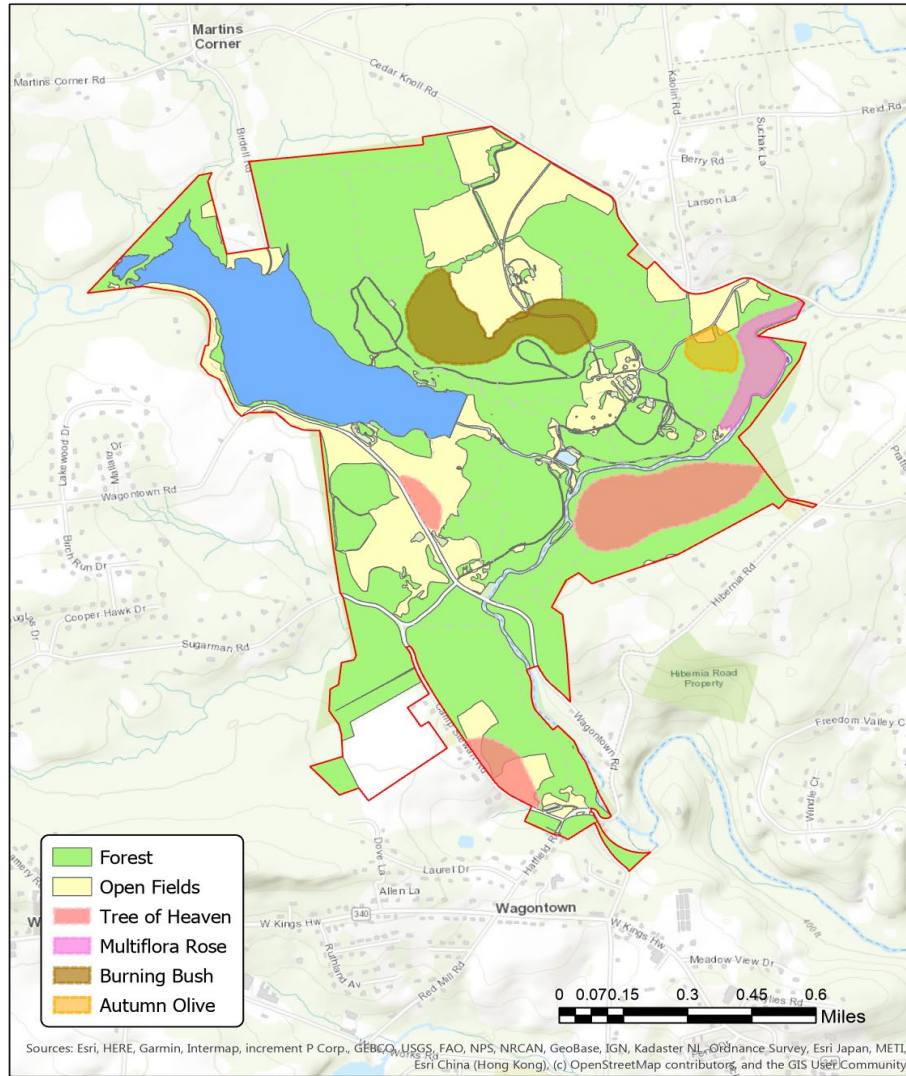


Figure 5: Approximation of known invasive species problem areas.

Forest Resource and Management Concerns

Monocultures are a collection of one singular plant or tree species within an area, unlike a polyculture, which is a multitude of plant or tree species. Monocultures can provide benefits such as treating wastewater, rehabilitating deforested watersheds and providing wood, but in many cases, they can cause major consequences to the environmental health of an area. For example, monocultures have a negative impact on soil fertility and hydrological cycles, they cause the promotion of pests and disease, they can increase the chance of a storm or fire, and they negatively impact biodiversity (Liu et al., 2018).

An example of a monoculture in Hibernia Park is the tulip poplar (*Liriodendron tulipifera*) which dominates certain regions of the park. This monoculture is likely the result of the areas of the park where the trees were cut in the early 19th century to make way for the iron forge. The tulip poplar is a pioneer species, meaning it is quick to grow and colonize previously disturbed lands and therefore it has become prevalent in the cut areas (USDA Forest Service,

2018). This ability is largely due to the durability and long lifespan of their seeds, which can exist for a long duration of time before initial growth.

Since Hibernia Park has a monoculture of various native trees, a mutual contract with a logging company was made. The contract entails that the logging company will systematically mark each tree in a given section for its intended use for after being cut - pulp, veneer, sawlogs, or fuel. Trees deemed important to the local forest by staff are marked to be preserved, even if their lumber is more valuable than the surrounding forest. If done correctly, managed logging can strengthen biodiversity, decrease soil and water degradation (Steckel and Harper, 2014). That is why it is important to provide ideal conditions, like space, sunlight, water, etc., for desired species by planning where to log beforehand in order to prevent unwanted consequences (Steckel and Harper, 2014). Hibernia Park benefits by getting hazard trees removed and diverse species replanted in their place. While the logging company is able to obtain a new client and get lumber to sell to their customers or suppliers.

By gathering historical aerial imagery from PennPilot (2020), we were able to observe how the forest canopy in Hibernia County Park has changed over time (Figure 6). The process of analyzing forest cover over time began with importing historic aerial imagery into ArcGIS Pro (Esri, 2020). Next, control points were added to the photos that corresponded with points on a map in order to accurately georeference the images. The forest polygons were then created by drawing boundaries along the existing forests in each photo, allowing for a measurement of the acreage that changed over time. One of the main purposes of having preserved land, such as parks, is to maintain and increase biodiversity. As well as allowing forests to provide habitats to many native species; it is important to ensure that forests continue to stay healthy. In the park's previous use as an iron forge, large sections of the forest were cut down in order to create charcoal to power the iron forge.

By 1940, the forest had begun to grow back considerably but was still in the early stages of forest succession. At this time, there were roughly 550 acres of forest cover, accounting for about 50% of the future park's land area.

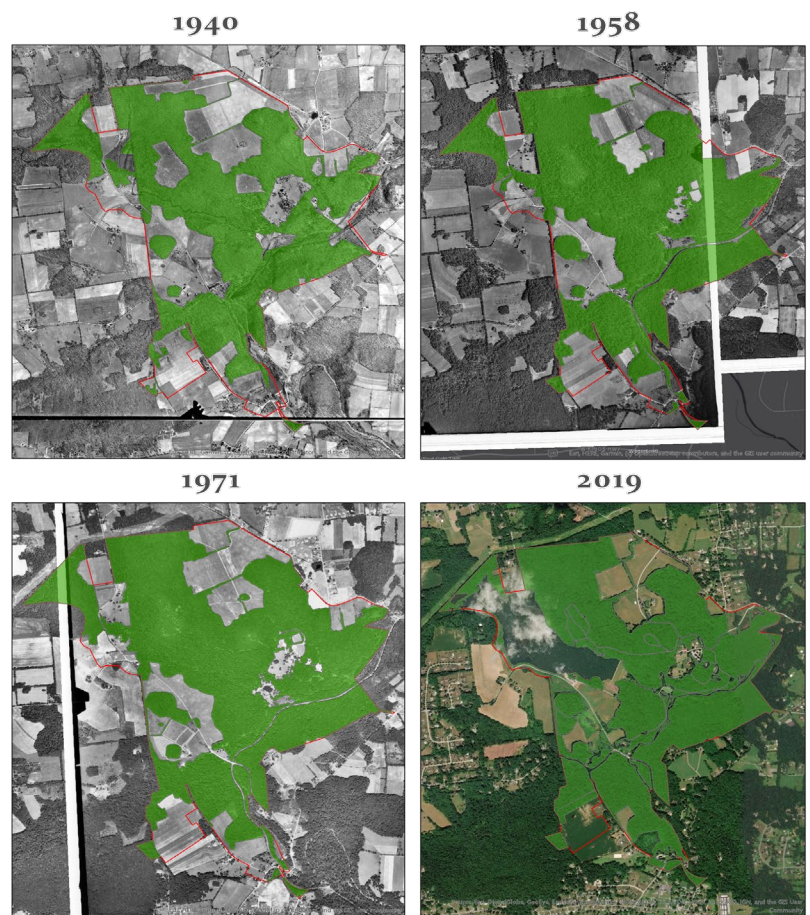


Figure 6: Forest cover change over time: 1940 - 50%, 1958 - 57.5%, 1971 - 58.6%, 2019 - 53.6%. Source: Historic air photos from PennPilot (2020).

By 1958 there was considerably more forest cover and the total acreage was around 632 acres, bringing the total forest cover of the future Hibernia County Park up to 57.5%. Growth continued into the 1960s and 1970s, and by 1971 there was roughly 644 acres of forest cover, totaling 58.6% of the park land area.

Forest growth comes with many benefits, such as carbon sequestration, carbon storage, and removal of pollutants. Using I-Tree County, a peer-reviewed web application that allows users to conduct in-depth forestry analysis, we calculated the monetary and environmental benefits of Hibernia’s forest (Table 1), and the equivalency of vehicles that would need to be removed to achieve the same benefits (Table 2). iTree was developed by the U.S. Forest Service in a partnership with Davey Tree Expert Company, The Arbor Day Foundation, Society of Municipal Arborists, International Society of Arboriculture, and Casey Trees (USDA, 2020).

Table 1: Benefits of tree cover in Hibernia Park. Source: USDA, 2020.

Benefit Description	Amount	Value (USD)/year
Carbon Monoxide removed annually	189 kg	\$140.00
Nitrogen Dioxide removed annually	1,833 kg	\$260.00
Ozone removed annually	10,977 kg	\$9,430.00
Particulate Matter < 2.5u removed annually	716 kg	\$21,235.00
Particulate Matter between 2.5-10u removed annually	3,440 kg	\$11,978.00
Sulfur Dioxide removed annually	743 kg	\$34.00
Carbon Dioxide sequestered annually in trees	396,000 kg	\$74,649.44
Total Carbon Dioxide stored in trees	43,176,000 kg	\$4,058,600.78
Total		\$4,176,327.22

Table 2: Vehicle removal equivalencies to the tree cover in Hibernia Park. Source: USDA, 2020.

Pollutant	Vehicle Removal Equivalency
Carbon Monoxide	2
Nitrogen Dioxide	289
Particulate Matter < 2.5u	727
Sulfur Dioxide	8874

This data shows that there are significant economic benefits that come with preserving green space. The trees in Hibernia Park remove some of the most harmful pollutants to our environment, providing a monetary benefit of over \$4,000,000. As the climate continues to change, a lot of places like Hibernia will be at risk for losing trees and therefore losing these environmental benefits, so it is crucial that there is significant action to preserve open space and promote the planting of trees.

Grassland Resources and Management Concerns

Hibernia Park has a mix of both warm and cool season grasses. As expected, warm season grasses thrive in warmer temperatures, and cool season grasses thrive better in cooler temperatures. The best growing range for cool season grasses is between 65-75 degrees Fahrenheit and the best growing range for warm seasons is between 90-95 degrees Fahrenheit (Department of Crop and Soil, 2016). These grasses do not only thrive during a certain time of the year, but rather whenever the area which they are located reaches the desired temperatures in which they grow best. Because of the typical climates of these areas, cool season grasses will have a longer period of time to thrive in the northern parts of the U.S. and warm seasons will do better in the southern states. There is also a transition zone where neither of the grasses will grow well compared to the north and southern parts of the U.S. This transition zone is where temperate

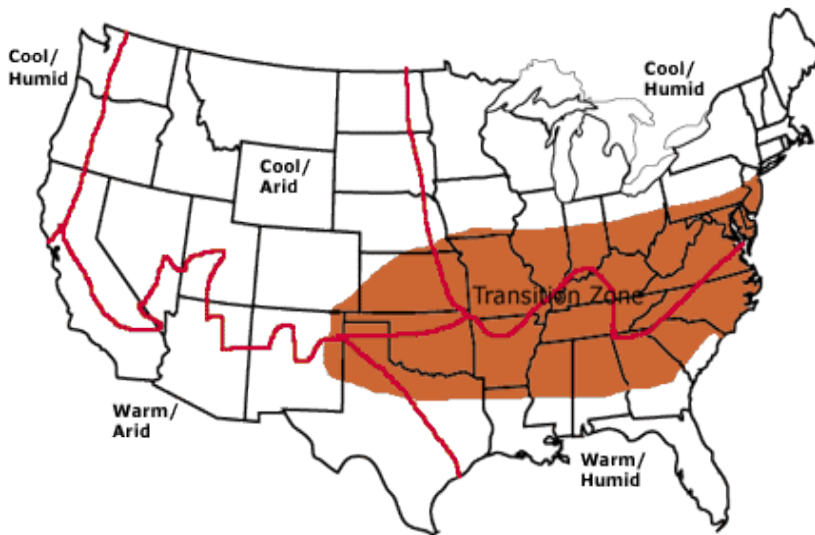


Figure 7: Transition zone between warm and cool season grasses.
Source: Brittingham, 2007.

and subtropical climates reach each other (Carignan, 2019). Southern Pennsylvania, where Hibernia Park is located, is located on the border zone of the cool season grass area and the transition zone. This border zone indicates that cool grasses will do better at the park, but since it is near the transition zone, there is not an exceptionally long thriving season for either of the types of grasses (Figure 7).

At Hibernia Park, warm season grasses will thrive during late spring and throughout the entire summer. The cool season grasses will thrive during late spring and early fall at the park. These are the times of the year at Hibernia Park in which the range of temperatures that each grassland type grows best in occurs. Cool season grasses are typically the ones which get regularly mowed at the park. They are mostly in areas which are along walking trails, near the parking lot, and in some fields in the park. The warm season grasses are mostly growing in fields at the park that are next to the Mansion. The warm season grasses are typically left to grow longer, and these areas cannot be walked through by visitors. They may be mowed a couple times per year, or another management tool may be used, such as burning the fields

toward the end of summer or fall. One area of the park where you can easily see both types of grasses and differentiate them is near the entrance. Along the road from the entrance of the park leading up to the parking lot has cool season grasses growing next to the road and then some warm season grasses on the other side.

Warm and cool season grasses have their own pros and cons relating to their presence at Hibernia Park. Warm season grasses are a habitat for small animals, and they are also great for controlling erosion year-round (Brittingham, 2007). Native warm season grasses are great habitat for small animals because they are taller and provide the cover from predators which many small rodents, snakes, and birds need to live in. Cool season grasses are mowed at the park and are mostly surrounding areas where visitors can walk on them. They do not promote as much biodiversity as they are kept short and only offer strong erosion protection at the times when they are growing the best. So, warm season grasses are mostly better for biodiversity, habitats, and erosion control while cool season grasses are best suited for areas which visitors will use (Lynn, 2004).

Aquatic Resource and Management Concerns

Hibernia Park is located in the Brandywine Creek Watershed. Some of the park's aquatic resources include the West Branch of the Brandywine, Birch Run, Cedar Hollow Run, Forge Run, Cherry Run, the Children's Pond, Chambers Lake, and the Hibernia Dam. The West Branch averages about twenty to thirty feet in width and two to three feet deep (Chester County Planning Commission, n.d.). The Brandywine Creek in Hibernia Park is a cold-water fishery which makes fishing a recreational activity that is very popular within the community. During trout season the banks of the Brandywine Creek within the park see a lot of foot traffic which impacts the soil health, density, overall stability and the fauna. Birch Run, Cedar Run, Forge Run and Cherry Run are all smaller streams which are located within the park's boundary. The one-acre Children's Pond offers fishing as a recreational activity for children and families (Chester County, n.d.). The Hibernia Dam is located at the southeastern end of Chambers Lake and at the end of Birch Run. This dam provides 260 million gallons of flood storage as well as mitigation, reduction, and prevention of downstream flooding. It also helps maintain water supply and improves recreational as well as habitat values in Chambers Lake and its adjacent riparian land (USDA Natural Resource Conservation Services, 2020). Water features promote diverse landscapes while also allowing for a wide range of species and other forms of life to thrive. Streams and lakes support the vegetation along the banks of the water and also help create a habitat for fish to thrive in (National Park Service, 2018). By maintaining healthy streams within these parks, it promotes healthy water ecosystems downstream as well as healthy rivers.

Impact of Recreational Activities on Park Natural Resources

Hibernia County Park contains over five miles of trails. Walking, cycling and horseback riding are allowed on all trails except for the Lake Trail which is off-limits to cyclists and horses. Trail erosion is one issue that park management faces. This erosion is due to normal wear on the trails, as well as stormwater runoff that travels down trails that are on steep slopes. Some soils within the park are also more vulnerable to erosion and runoff (see Appendix C for an inventory of soils within the park). Moving forward, addressing this problem will involve routine trail maintenance as well as identifying sections of trails that are particularly vulnerable to erosion and closing them down. The Lake Trail continues to see erosion from rainwater runoff and the

park staff has already taken steps to mitigate erosion by closing the trail off from visitors during wet seasons.

Local fishermen of the county are often drawn to the park as well. The West Branch of the Brandywine Creek is known to be a popular location for anglers, and it flows one mile through the park. With its fast-moving waters and fallen trees, it offers excellent angling for the county fishermen. It is mainly a cold-water fishery, and over time has become very popular within the local fishing community.

Chambers Lake is 90 acres and is stocked with warm water species like channel catfish, panfish, and small and largemouth bass. Chambers Lake is a Panfish Enhancement Area, only one of three in the state. Fishing is allowed all 24 hours of the day, but after park hours, parking is only open to fishermen. The public parking lot and boat ramp is located off Wagontown Road. The gradual slope of this area makes it ideal to launch all non-motorized/electric powered watercrafts (excluding sailboats).

The lakeside parking lot has an ongoing issue with asphalt and stone erosion, and storm water runoff from water moving off Wagontown Road and following the slope into the lake. A serious issue caused by the storm water runoff is that any substance that is on the boat launch area gets washed into the lake. Due to the high vehicle activity in the area, these pollutants include oil and other fluids from the vehicles using the ramp or traveling on Wagontown Road. Heavy vehicle activity also erodes the parking lot. This erosion affects the water quality by rubble and debris contaminating the water in the lake when it rains. These issues require routine cleaning of the parking lot as well as proper sloping to ensure the rainwater runoff from the lot is not contaminating the lake water.

Another feature centered on aquatic recreation that the park offers is the Children's Pond. This is a one-acre pond that has a fishing deck to cast from, centered on educated youth on the skills of fishing. To ensure that all children can participate the park limits harvests and usage in order to ensure a special fishing experience for all.

Fishing is not the only form of recreation allowed in the parking as hunting is allowed with specific guidelines and equipment. These guidelines permit only archery hunting and it must be done from a tree stand at least 15 feet off the ground. The archer must release the arrows at a downward angle from the tree stand and have an up-to-date hunting permit. Animals allowed to be hunted at Hibernia Park are white tailed deer and geese. With the overpopulation of whitetail deer in the park, management must be able to determine proper guidelines to the number of deer hunted by individuals, or party in order to try and control the deer population. The issue is that this is a low impact recreational activity that normally has minimal impact to the deer population. Management would need to seek proper guidance as to how they are able to legally alter the hunting regulations in the park to try and combat the overpopulation issue.

The last major form of recreation utilized at the park is camping. Camping begins in the beginning of May and goes through the summer until the end of October. The campgrounds are open each Friday and Saturday night during the season, and Sunday nights that fall on Memorial

Day and Labor Day weekend. At each campsite there are picnic tables and fire rings. Restrooms are available but the park does not offer water, showers or electric outlets.

A major issue with the campgrounds is the aspect of maintenance. One such example is the litter that some campers leave behind and how it affects the environment when consumed by animals. The burning of wood is another issue that requires a lot of attention by the park management. When campers burn the dead wood surrounding the campsites, they tend to break or cut living branches to try and keep their campfires going. This has a huge impact on the surrounding trees and their health which has a chain reaction to the air quality to the overall park. The fires also create the possibility of damage to the park if a fire becomes out of control. Additionally, heavy use of the park's campground areas results in soil compaction and, ultimately, the absence of forest understory. This has aided in the tulip poplar monoculture prevalent in the campground areas, which present a safety hazard with their high branches. Additionally, if the tulip poplar population were to die the camp would be surrounded by dead trees that would have to be removed to ensure the safety of the visitors to the campground. Taking these recreational and other park resources into account, the local community stakeholders should be engaged to encourage their involvement in the preservation of the park for the generations to come.

Community Stakeholders and Visitor Engagement

The success of a natural resource management plan for Hibernia County Park depends on the support of various stakeholders, including Chester County Parks + Preservation, the Water Resources Authority, the people who live near the park, the people who visit the park, and ultimately all residents of Chester County. Indeed, the management of natural resources is affected and can have an impact on these stakeholders, directly or indirectly, through their use of resources and decision-making regarding land use. For effective stakeholder engagement, a strategic vision of the social and institutional framework, which includes the issues that stakeholders consider most important and imperative for their well-being, is paramount. It is in this sense that a study of demographic trends will allow us to better meet these expectations. However, for Hibernia Park to effectively engage their stakeholders they need to know who makes up their audience.

In order to better engage with local stakeholders, park visitors and ensure park maintenance, three new maps were created for this project. (All GIS data that the maps are based on can be found in the complimentary ArcGIS Hibernia Hub created for this project.) The first map is the maintenance map (Figure 8). It is intended for employees of the park to use and therefore is more complex than the other maps. More points are included that would not be needed for visitors. The contour lines are more visible so the landscape can be better seen. Items that are on the map are those that maintenance will need to know and keep track of. All available forms of vegetation are present on the map

The second map created is the trail map (Figure 9). The purpose of the map is to visually depict all trails in Hibernia Park. Visitors, especially hikers, would find this map helpful as it would tell them the length of the trail, the location where the trail could be picked-up in relation

to where they are, and some general landmarks around the park. These landmarks can act as points of reference while a visitor is on a trail or searching for one.

Lastly, the third map, the visitors map (Figure 10), is intended to be utilized as a general reference in the park. It shows interesting features that the park has to offer and that can be considered points of reference. However, the map is not intended for navigation throughout the park, although the trails are marked. The map includes three zoomed-in areas of interest marked by circles. These locations are in portions of the park that have a plethora of points of interest and were expanded to help decipher them. The colors themselves were selected based on a muted pallet specifically designed so that color blind people will not struggle to be able to read the map.

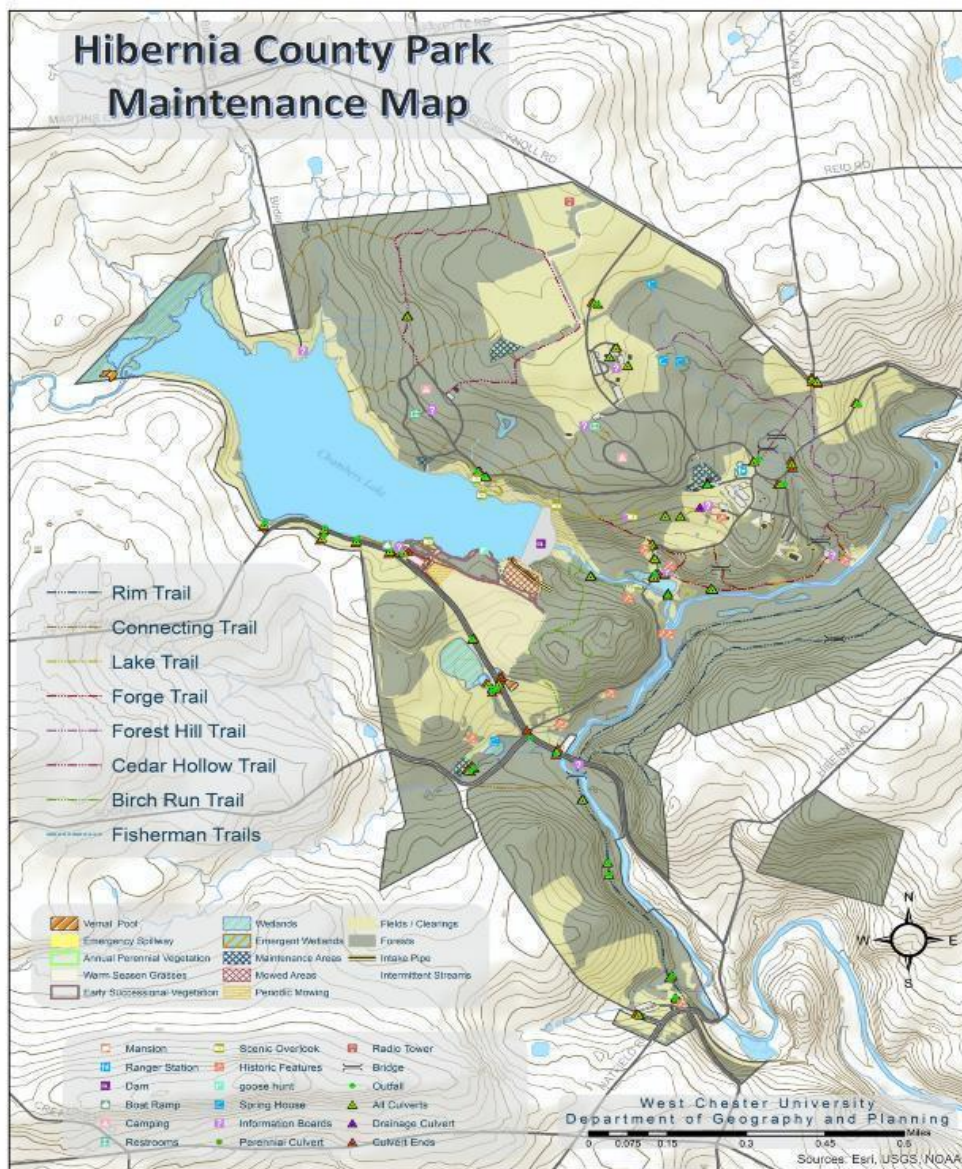


Figure 8: Maintenance map of Hibernia Park for staff.

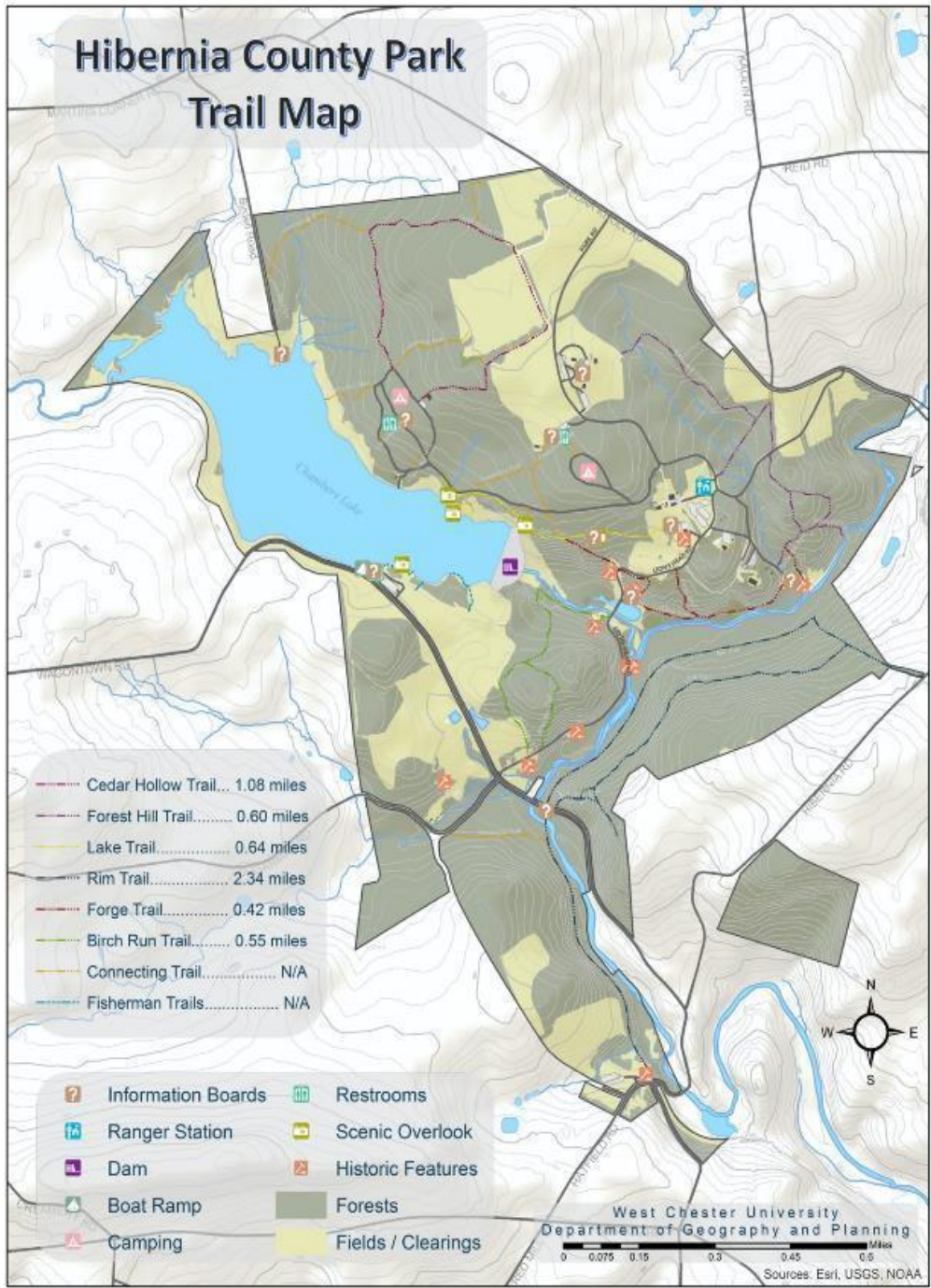


Figure 9: Map of the trail system in Hibernia Park.

Population Trends

A geospatial analysis of the community around the park was conducted in order to visualize how the population is expected to change over time. The area surrounding Hibernia Park has plenty of land for families to call home. According to Esri's Business Analyst, 5,054 people live within a zero to two-mile radius of the park (Figure 11). In the past decade, this area has seen very minor growth in the population. That could be a part of Chester County's goal of keeping rural areas at very low disturbance in order to maintain open space. The most common age group in the immediate surroundings of Hibernia park is the Baby Boomers which are people born from 1946-1964.

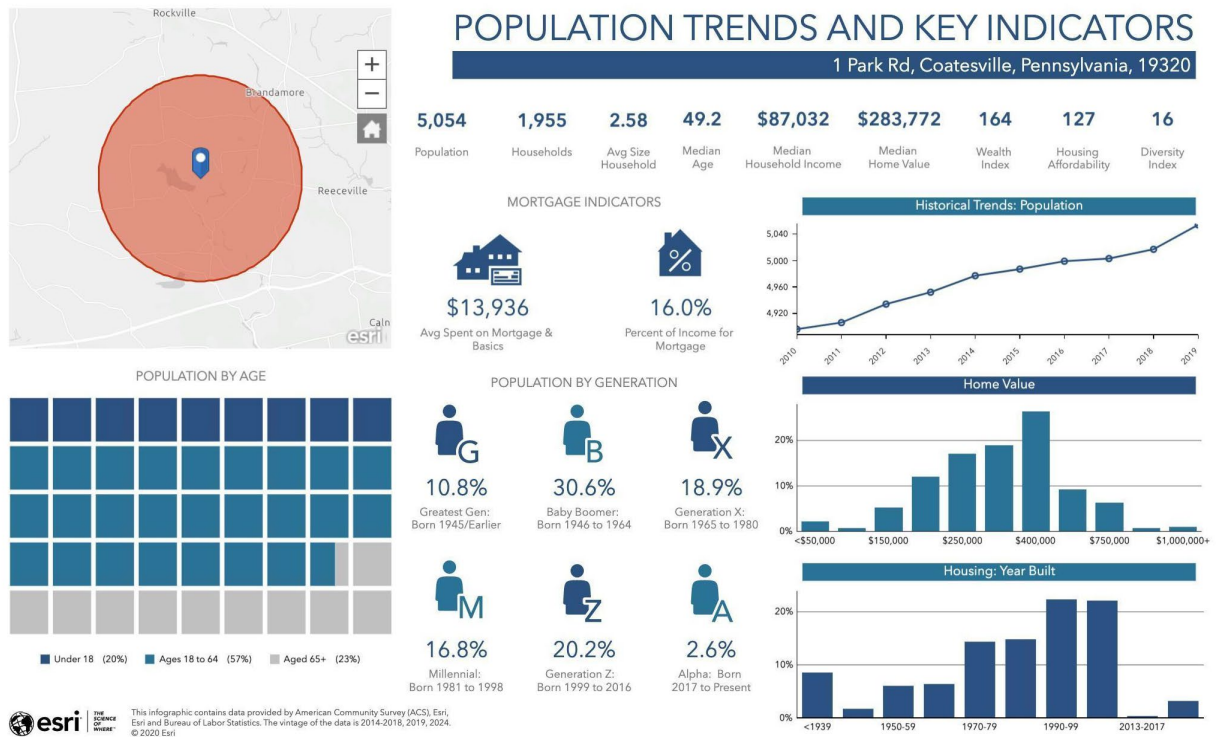


Figure 11: Population demographics within a zero to two-mile radius of the park. Source: Esri Business Analyst (2019).

An analysis of the two to six-mile buffer around Hibernia Park reveals an increase in population from 5,054 to 77,524 indicating a more densely populated area (Figure 12). Areas within this ring include Coatesville and Honey Brook. Within the past ten years, this area has seen a major jump in the population of about five thousand people. This may be part of the moderately high percentage of babies being born from 2017 to the present. This area is home to mostly millennials (born between 1981-1998) and Generation Z (1999-2016). Due to this trend, this area should see an increase of babies being born if these generations decide to stay in the area and call it home.

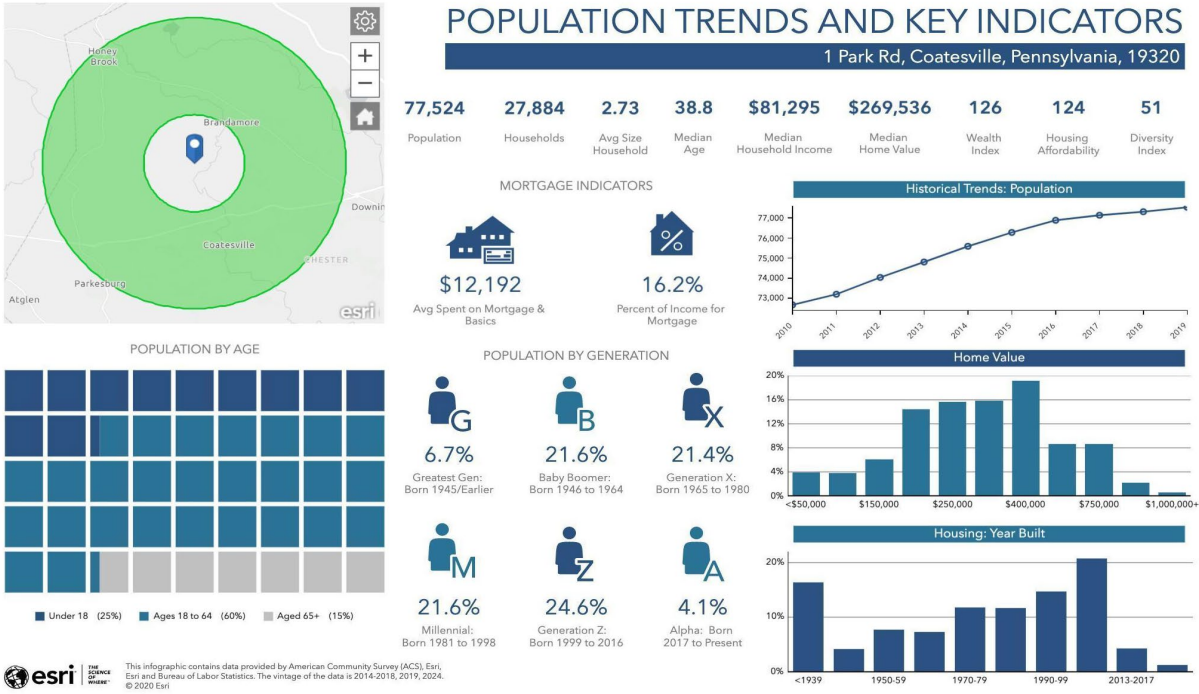


Figure 12: Population demographics within a two-six-mile radius of the park. Source: Esri Business Analyst (2019).

In an analysis of the six to ten-mile buffer around Hibernia Park, the population in this ring is 89,230, about a 14,000 increase of people from the previous buffer area. Towns in this ring include Downingtown, Parkesburg, Gap, and the outskirts of Thorndale. This area has shown a 5,000 person increase from 2010. In this ring, Generation Z (born 1999-2016) is the highest percentage of the population (Figure 13).

Overall, the areas surrounding Hibernia Park are growing (Figure 14). This growth is most prominently in the suburbs of Coatesville and Exton, in the Rt 30 corridor. Because of this, it is extremely important to manage natural resources as an increase in population has a direct correlation to the amount of natural resources being used.

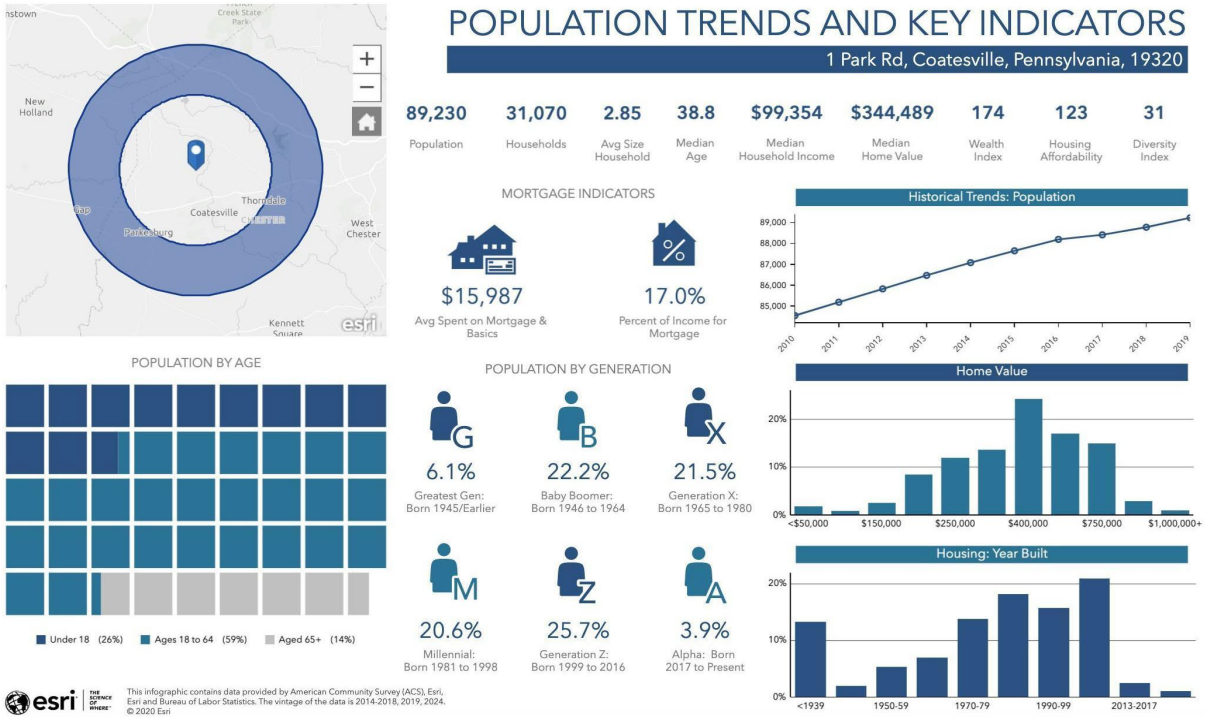


Figure 13: Population demographics within a two-six-mile radius of the park. Source: Esri Business Analyst (2019).

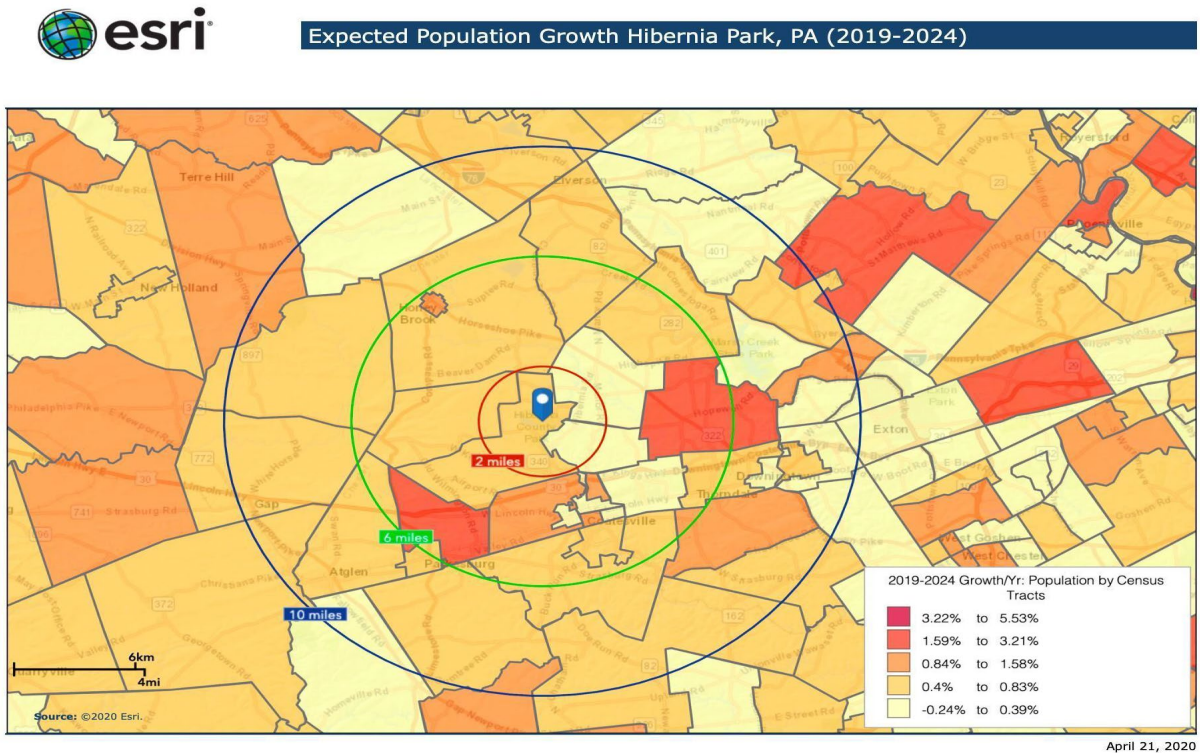


Figure 14: Estimated population growth from 2019-2024 within a ten-mile radius of Hibernia Park. Source: Esri Business Analyst (2019).

Engaging Park Visitors

Technology can be a powerful tool for community engagement in our Natural Resource Management Plan for Hibernia Park. The Parks + Preservation Office should be open, responsive, and engaging, allowing for the community members to feel they are active participants in the management and the preservation of the park. These stakeholders need to feel that their participation can influence decisions about issues that affect the park.

As part of this effort, we recommend surveying members of the surrounding community and park visitors. A well-designed survey needs to answer the following questions. What do we want to learn? How is this survey data going to help us? How can we provide a better experience of the park to the entire community? How can we improve or promote natural biodiversity in the park? There are several strategies for distributing surveys.

The park can use social media such as Facebook, Instagram, Twitter, etc. to reach as many people as possible in the community to get their comments, feelings, and contributions to the Hibernia Park Natural Resource Management Plan. There are benefits to using social media platforms such as ease of data collection, minimal costs, automation of data entry and processing, increased response rates, and design flexibility. However, there are certain disadvantages such that respondents may not feel encouraged to provide precise and honest answers. Survey responses may lead to unclear data as some response options may be interpreted differently by respondents, and custom surveys may run the risk of containing certain types of errors.

Mail surveys can be an efficient means of collecting data depending on the goals and objectives. In this approach, the Parks & Preservation office will send the questionnaires enclosed with a postage-paid envelope through the postal system to residents within a certain range of the park (0-15 miles). The participants will be asked to answer the questions and after completing the questionnaire, the respondents will send it back through the mail.

The use of a mail survey has the advantage of being relatively cheap and being able to target different segments of the population, especially residents living near the park. Among the disadvantages of a mail survey is the coverage errors and response rates. Mail surveys usually generate 3-15% response rate (Kelley, et al., 2003). Since mail surveys do not offer the opportunity for follow-ups; questions must be brief, straightforward and accurate.

When a user scans the QR code with the camera on their mobile phone, an application decrypts the information coded in the QR code. The codes allow quick response and are now gaining notoriety and popularity in the United States due to their versatile and easy use. The code itself stores huge amounts of information that is easy to scan and store on a mobile device. The Hibernia park office can display QR codes in strategic areas of the park such as rest areas to involve the greatest number of visitors. A QR code can help to inform visitors about the park maintenance, protection, expeditions of species, and invasive species of the park.

Many companies are now using code as a marketing tool to attract customers. The main advantage of a QR code is its versatility. However, a downside to QR codes and perhaps the biggest problem is its lack of familiarity within the population. Although QR codes appear

everywhere, from labels of plant specimens to library catalogs, there is a large demographic in society that still does not know what QR codes represent. The QR codes and their advantages are strictly dependent on mobile technologies, otherwise, it is useless.

To engage the community in the Hibernia Park Natural Management program, the park office can encourage citizens to get involved and participate in the development and improvement of their park throughout volunteer programs. Participating as a volunteer will not only improve the knowledge of community members about the park but it will also benefit the management of the park's natural resources.

None of these suggestions will be perfect (Table 3). Each has its pros and cons, so a combination of some of these community engagement methods should be used. If multiple outreach methods are used, this will allow as many people as possible to respond to the survey. This will allow a more complete and accurate representation of what the community thinks of Hibernia Park.

Table 3: Community Engagement Techniques Pros and Cons

	Pros	Cons
Social Media Platforms	Ease of data gathering Minimal costs Automation in data input/handling Increase in response rates and flexibility of design	Honesty of answers Sometimes lead to unclear data Risk of containing errors
Mail Survey	Minimal costs Geographical stratification Honesty of answers	Coverage errors/response rates Lack of questionnaire design
QR Codes	QR code versatility	People's lack of familiarity with QR codes QR code reliability on mobile devices

We have created a sample survey that could be used by the park. It is organized into three categories which are based on the recreational aspects of the park, questions relating to the preservation of natural resources, and demographic questions (see Appendix C).

Plan Goals and Objectives

Hibernia Park requires management recommendations on how to implement improvements that would be beneficial towards the park, park staff, visitors, and the local community. An implementation timeline is also included with the management recommendations to show which goals are more of a priority within the given timeframe of ten years, 2020-2030.

Goal 1: Restore damaged and degraded ecosystems

An updated park inventory will need to be conducted because the previous one is outdated. Additionally, a resurvey of invasive species, prevalent monocultures, and deer over-browsing should be done to see if there have been any recent changes. Inspections on the status of the riparian buffer restoration should occur within the next few years as well as the continued maintenance of the forest trails.

Goal 2: Further develop educational/volunteer opportunities that support the protection/restoration of natural resources

Updated maps and other information should be well stocked at prominent locations throughout the park. The organization and posting of tree planting events, invasive species education events, and annual/semi-annual cleanup efforts should also be spread around the park as well as social media platforms. Signage in the park of the scientific and common names of native species should continue for the benefit of park visitors.

Goal 3: Increase engagement of community stakeholders

Increase community participation by providing surveys at organized events in order to ascertain people's opinions. The feedback from recreational use surveys and natural resource preservation surveys should give the park insight on how well received they are towards the community stakeholders.

Goal 4: Enhance the resilience of the park's natural resources to further disturbance

Updating adaptive management practices for changing conditions should be drafted, and continue to be updated as conditions change. The regular monitoring of natural resources to determine carbon storage/sequestration, areas that flood during rain events, and changing climate patterns/changes in temperature should occur within the next five to ten years. Finally, the drafting of a new management plan will need to begin in five to ten years in order to stay relevant to future conditions and priorities.

Recommended Timeline for Implementation: 2020-2030

Goal 1: Restore damaged and degraded ecosystems in the park

- | | |
|--|-----------|
| 1a. Update the inventory of flora and fauna in the park | 1-5 years |
| 1b. Resurvey the status of invasive species and deer over-browsing | 1-5 years |
| 1c. Resurvey the status of prevalent monocultures | 1-5 years |
| 1d. Progress on the status of riparian buffer restoration | 1-5 years |
| 1e. Updates on streambank degradation and stream water quality | 1-5 years |
| 1f. Maintain forest trails | 1-5 years |

Goal 2: Further develop educational and volunteer opportunities for park visitors that will support the protection and restoration of natural resources in the park

- 2a. Increase flow of updated information at prominent spots in the park 1-5 years
- 2b. Organize tree planting events (social media/ information boards in park) 1-5 years
- 2c. Maintain upkeep and update signage in the park of the scientific and common names of native species 1-5 years
- 2d. Organize invasive species education events for the public/volunteers/ campers etc. 1-5 years
- 2e. Organize annual/semi-annual cleanup efforts for volunteers/scouts 1-5 years

Goal 3: Increase engagement of community stakeholders in order to better support the protection and restoration of natural resources in the park

- 3a. Collect community input on different facets of Hibernia Park through a series of recreational usage questions and natural resource preservation questions 1-5 years
- 3b. Increase community participation by providing surveys at organized events 1-5 years

Goal 4: Enhance the resilience of the park's natural resources to future disturbances including changing climate

- 4a. Update adaptive management practices for changing conditions 1-5 years
- 4b. Regular monitoring of natural resources to determine carbon storage/ sequestration 5-10 years
- 4c. Regular monitoring of areas that flood during rain events 5-10 years
- 4d. Regular monitoring of changing climate patterns 5-10 years
- 4e. Begin drafting a new management plan 5-10 years

Future Considerations

As Hibernia Park operates and evolves in the 21st century an increasing challenge to consider is the effect that climate change has on the local ecosystem. The organization that is the foremost authority on climate change and climate change policy is the Intergovernmental Panel on Climate Change (IPCC) via the United Nations. The IPCC has several reports and scenarios on climate change policy. The current goal is to contain warming to under 1.5 degrees Celsius (pre-industrial levels).

These climate challenges have forced all parks both domestically and abroad to plan for ecosystem shifts through the study of scientific data. A survey of biological and chemical factors in the U.S. National Park system found that different regions of the country had significantly different ecological needs, and suggested that natural resource management plans be proposed to determine which species had the lowest historic range of vulnerability, indicating those that would be in the most danger in adapting to a new climate (Monahan and Fisichelli, 2014).

Factors that may be of particular interest to Hibernia Park are annual temperature, annual mean precipitation, and the annual number of wet days.

At a state level, Pennsylvania is significantly concerned with climate change and the impacts it is having on our communities. According to Department of Environmental Protection (DEP), the section of Pennsylvania's government tasked with protecting environmental quality for the public health and safety of citizens, the largest impacts climate change is currently having in Pennsylvania are in four areas: increased flooding and yearly precipitation increased, heat and respiratory deaths, increased disease and pests, and disruption to agricultural systems. Generally, the DEP defines Pennsylvania as a climate that is getting warmer and wetter with mid-21st century temperatures projected to resemble those in Richmond Virginia. (DEP, 2020). Each of the above factors also becomes a concern for Hibernia Park. Increased flooding events mean that there will be fewer days when portions of the park will be usable and some that will cease to function. Increased heat and respiratory deaths could indicate a reduction in park visitors and if visitation declines so could funding. Increased disease and pests are already having an impact in the park due to the growth of invasive plant and animal species. Some invasive species include the emerald ash borer (*Agrilus planipennis*), spotted lanternfly (*Lycorma delicatula*) and burning bush (*Euonymus alatus*). Lastly, agricultural system disruption is important for the park to recognize because it is a chief economic driver in the area, especially given that Hibernia has active agricultural fields and is purchasing former agricultural lands. Therefore, if agricultural production was to be reduced, the demand for agricultural land in the community could increase.

While climate change is a tremendous challenge, adaptation is possible via sound planning. Pennsylvania is a leader on this front with a state adopted Climate Action Plan (2018) and a County Comprehensive Plan (Chester County Planning, 2018) that examines ways to address a changing climate. Across the country only 22 states, of which Pennsylvania is a part, have a climate action plan with emission goals (Center for Climate and Energy Solutions, 2020). Emission reduction is at the forefront of Pennsylvania's Climate Plan (CAP) where the state is looking to reduce greenhouse gasses 26% by 2025 and 80% by 2050; in comparison to 2005 levels. These reductions will improve our air quality and directly contribute to the goal of keeping global average temperatures to a 2-degree Celsius threshold. Specifically related to parks, the plan suggests improving habitat connectivity and allocating funds to design new adaptable infrastructure (DEP, 2018).

The global climate change crisis has affected nearly every region in the world. Currently, Pennsylvania is experiencing such phenomena as record high temperatures in the summer, excessive downpours, and flooding. The state of Pennsylvania has a heavy reliance on coal, fracked gas, and oil as its main energy sources, which are proven to be environmentally unhealthy (MediaNews Group, 2020).

Hibernia Park could be affected by the effects of climate change. Being that many of Pennsylvania's energy industries produce high levels of pollutants and greenhouse gases, the state stands to suffer the effects of climate change more than many other greener and more energy efficient states in the nation. One potential effect of climate change is the increase in acid rain (precipitation with a pH less than 7) which can affect the health of the wildlife in the park. Additionally, acid rain creates erosion, which could affect Hibernia's streams, soils, and rock formations.

With three water bodies existing within Hibernia (Chamber's Lake, the West Branch of the Brandywine Creek, and Birch's Run), excessive flooding could also occur within the park. Hibernia is located within a Special Flood Hazard Area, a place where flood insurance purchases are mandatory before being legally able to own property. Structures within these areas have a high flood risk of a 26% chance over 30 years (FEMA Zone Definitions, n.d.). As Pennsylvania lawmakers scramble to address these problems, Hibernia also needs to take its own precautions in mitigating the effects of climate change.

To promote the study of climate change and ecosystem preservation in the park, Chester County Parks + Preservation should pursue a policy of ecosystem management as opposed to traditional management. Ecosystem management emphasizes the connection between the park, its ecosystem, and the outside world. The Convention on Biological Diversity states that there are twelve principles of ecosystem management. Some of their goals include emphasizing decentralized management, long-term goal planning, and recognition that change is inevitable (Convention on Biological Diversity, 2007). There are several methods to achieve ecosystem management goals. Three of particular use to Hibernia Park are the identification of keystone species or physical features that are required for an ecosystem to function, the identification of key local stakeholders and the determination of ways to involve them in park planning, and adaptive management.

Adaptive management is a key tool for achieving a healthy ecosystem. It is defined as the procedural structure of using the scientific method to guide management decisions. It relies on "learning by doing" and refocusing goals based on collected data. Hypotheses should be formed based on long-term goals, and then tested and analyzed via statistics. If the hypothesis tested supports the long-term goal the practice should be continued but if it does not the goal should be re-evaluated (Horne et al. 2017). This ensures that data guides management policies and encourages innovation.

Ecosystems face tremendous challenges in the 21st century from climate change that can be tackled via planning with strong goals and implementable objectives. Hibernia Park should work with local and state partners to examine its largest vulnerabilities—its monocultures, flooding susceptibility, and invasive species—in order to craft a plan to fit the park's needs. Working together is the biggest strength that there is in the fight against climate change and it must be utilized.

This plan aims to focus on the park's ecosystem and natural resources currently present in the park with the goal to sustain and continue the necessary management to protect the environment for the future. This plan identifies four major goals: the restoration of damaged or degraded ecosystems, further development of educational and volunteer opportunities that support the protection or restoration of natural resources, increase engagement with community stakeholders, and enhance the resilience of Hibernia's natural resources to further disturbance. The goals proposed each have implementable objectives that can be accomplished within the ten-year lifespan of this plan if park maintenance, visitors, and Chester County Parks + Preservation work together to protect the natural resources of Hibernia Park.

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Appendix A: Inventory of Flora and Fauna in Hibernia Park

Table 1: Fish and bird species found in the park. Source: Hibernia County Park.

Fish	Birds
Brook trout	American crow
Brown trout	American goldfinch
Chain pickerel	American robin
Channel catfish	Blue jay
Largemouth bass	Carolina chickadee
Panfish	Carolina wren
Rainbow trout	Common grackle
Smallmouth bass	Chimney swift
	Dark-eyed junco
	Eastern kingbird
	European starling
	House wren
	Mourning dove
	Northern cardinal
	Northern flicker
	Song sparrow
	Tufted titmouse
	Turkey vulture
	Veery

Table 2: Trees and shrubs found in Hibernia Park. Source: Vanderwerff (2003). Scientific nomenclature and invasive status from USDA PLANTS Database (2020).

Scientific Name	Common Name	Invasive/Non-invasive Status
<i>Acer platanoides</i>	Norway maple	I
<i>Acer rubrum</i>	Red maple	N
<i>Ailanthus altissima</i>	Tree of heaven	I
<i>Alnus serrulata</i>	Smooth alder	N
<i>Aralia spinosa</i>	Hercules club	I
<i>Betula lenta</i>	Cherry birch	N
<i>Betula lutea</i>	Yellow birch	N
<i>Carpinus caroliniana</i>	Ironwood	N
<i>Carya glabra</i>	Pignut hickory	N
<i>Carya ovata</i>	Shagbark hickory	N
<i>Castanea dentata</i>	Chestnut	N
<i>Ceanothus americanus</i>	New Jersey tea	N
<i>Cephalanthus occidentalis</i>	Buttonbush	N
<i>Cornus amomum</i>	Silky dogwood	N
<i>Cornus florida</i>	Flowering dogwood	N

<i>Corylus americana</i>	Hazelnut	N
<i>Corylus cornuta</i>	Beaked hazelnut	N
<i>Elaeagnus umbellata</i>	Autumn olive	I
<i>Fagus grandifolia</i>	American beach	N
<i>Fraxinus americana</i>	White ash	N
<i>Fraxinus pennsylvanica</i>	Green ash	N
<i>Gleditsia triacanthos</i>	Honey locust	I
<i>Hamamelis virginiana</i>	Witch hazel	N
<i>Hydrangea arborescens</i>	Wild hydrangea	N
<i>Ilex verticillata</i>	Common winterberry	N
<i>Juniperus virginiana</i>	Red cedar	N
<i>Kalmia latifolia</i>	Mountain laurel	N
<i>Lindera benzoin</i>	Spicebush	N
<i>Liriodendron tulipifera</i>	Tulip poplar	N
<i>Morus alba</i>	White mulberry	I
<i>Morus rubra</i>	Red mulberry	N
<i>Nyssa sylvatica</i>	Sour gum	N
<i>Physocarpus opulifolius</i>	Ninebark	N
<i>Platanus occidentalis</i>	Sycamore	N
<i>Populus grandidentata</i>	Bigtooth aspen	N
<i>Prunus serotina</i>	Black cherry	N
<i>Quercus alba</i>	White oak	N
<i>Quercus bicolor</i>	Swamp white oak	N
<i>Quercus coccinea</i>	Scarlet oak	N
<i>Quercus prinus</i>	Chestnut oak	N
<i>Quercus rubra</i>	Northern red oak	N
<i>Quercus velutina</i>	Black oak	N
<i>Rhododendron periclymenoides</i>	Pintex flower	N
<i>Rhus copallina</i>	Broad Leafed winged sumac	N
<i>Rhus glabra</i>	Smooth sumac	N
<i>Rhus radicans</i>	Poison ivy	N
<i>Rhus typhina</i>	Staghorn sumac	N
<i>Robinia psuedo-acacia</i>	Black locust	N
<i>Rosa carolina</i>	Low pasture rose	N
<i>Rosa multiflora</i>	Multiflora rose	I
<i>Salix alba</i>	White willow	I
<i>Salix humilis</i>	Prairie willow	N
<i>Salix purpurea</i>	Basket willow	I
<i>Sambucus canadensis</i>	Common elder	N
<i>Sassafras albidum</i>	Sassafras	N
<i>Tilia americana</i>	American basswood	N
<i>Ulmus americana</i>	American elm	N
<i>Ulmus rubra</i>	Slippery elm	N
<i>Viburnum acerifolium</i>	Mapleleaf viburnum	N
<i>Viburnum dentatum</i>	Southern Arrowwood	N

Appendix B: Soil Types in Hibernia Park

The three main soil types at Hibernia Park are the Neshaminy Series (covering 52% of park area), the Gladstone Series (22%), and the Towhee series (8%) (Figure 1, Table 1) (USDA 2019). The Neshaminy and Gladstone series consist of deep, well-drained soils, while Towhee soils are deep but poorly drained. Runoff and erodibility potential vary, ranging from low to high depending on slope. A more in-depth study of soils in the park may aid in mitigation efforts by redirecting visitors away from slopes with soils more vulnerable to erosion.

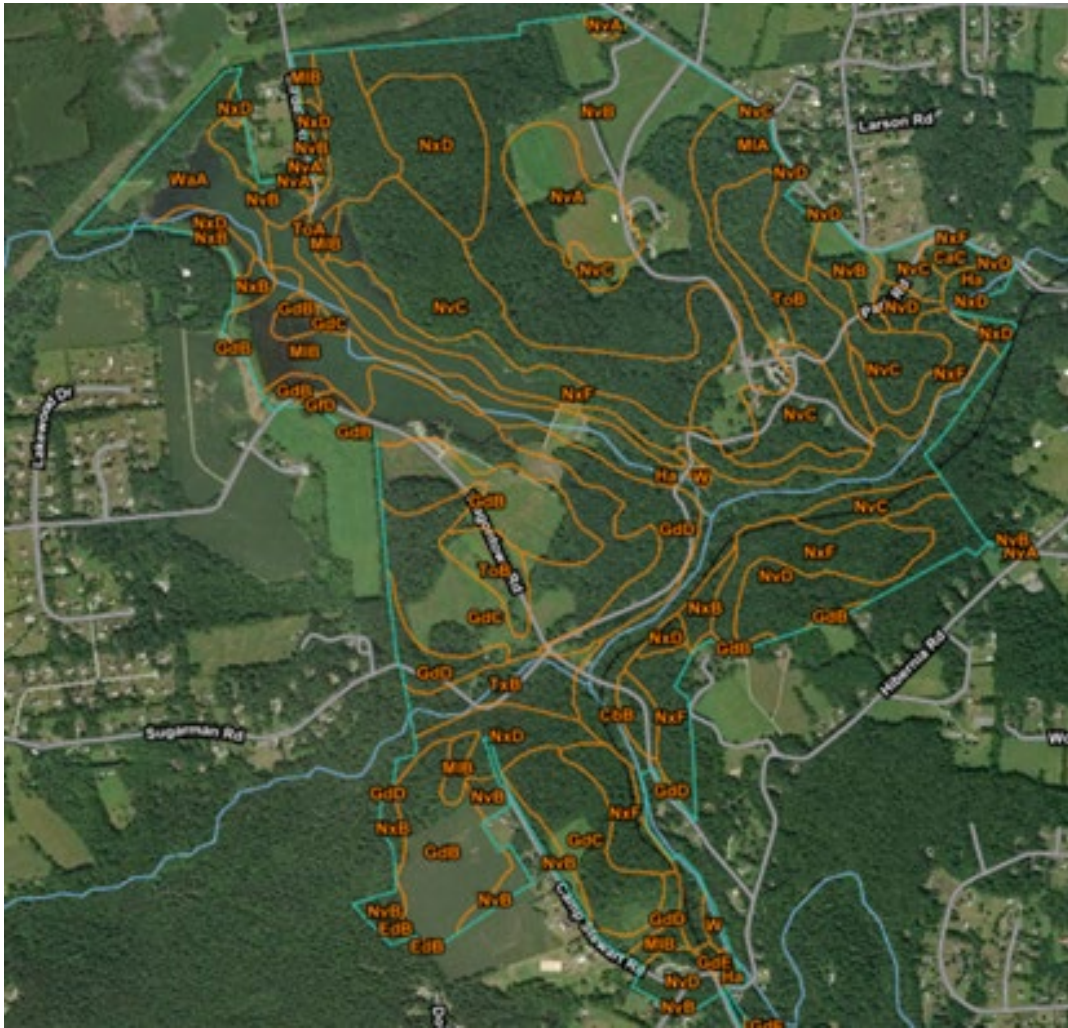


Figure 1: Soils map of Hibernia Park. Source: USDA Web Soil Survey (2019).

Table 1: Hibernia Park Web Soil Survey data. Source: USDA Web Soil Survey (2019).

	Map Unit Symbol	Map Unit Name	Acres in Park	Percent of Park
1	CaC	Califon loam, 8 to 15 percent slopes	3	0.30%
2	CbB	Califon loam, 0 to 8 percent slopes, extremely stony	4.6	0.50%
3	EdB	Edgemont channery loam, 3 to 8 percent slopes	0.5	0.10%
4	GdB	Gladstone gravelly loam, 3 to 8 percent slopes	64.6	7.00%
5	GdC	Gladstone gravelly loam, 8 to 15 percent slopes	96.2	10.50%
6	GdD	Gladstone gravelly loam, 15 to 25 percent slopes	36.9	4.00%
7	GdE	Gladstone gravelly loam, 25 to 35 percent slopes	2.4	0.30%
8	GfD	Gladstone gravelly loam, 8 to 25 percent slopes, very bouldery	0.2	0.00%
9	Ha	Hatboro silt loam	76.3	8.30%
10	MIA	Mount Lucas silt loam, 0 to 3 percent slopes	24.8	2.70%
11	MIB	Mount Lucas silt loam, 3 to 8 percent slopes	29.4	3.20%
12	NvA	Neshaminy silt loam, very deep over mafic gneiss, 0 to 3 percent slopes	24.3	2.60%
13	NvB	Neshaminy silt loam, very deep over mafic gneiss, 3 to 8 percent slopes	169.1	18.40%
14	NvC	Neshaminy silt loam, very deep over mafic gneiss, 8 to 15 percent slopes	103.5	11.30%
15	NvD	Neshaminy silt loam, very deep over mafic gneiss, 15 to 25 percent slopes	36.2	3.90%
16	NxB	Neshaminy silt loam, very deep over mafic gneiss, 0 to 8 percent slopes, very stony	9.5	1.00%
17	NxD	Neshaminy silt loam, very deep over mafic gneiss, 8 to 25 percent slopes, very stony	52.3	5.70%
18	NxF	Neshaminy silt loam, very deep over mafic gneiss, 25 to 60 percent slopes, very stony	81.3	8.80%
19	ToA	Towhee silt loam, 0 to 3 percent slopes	30.1	3.30%
20	ToB	Towhee silt loam, 3 to 8 percent slopes	30.4	3.30%
21	TxB	Towhee silt loam, 0 to 8 percent slopes, very stony	15.8	1.70%
22	UruB	Urban land-Neshaminy complex, 0 to 8 percent slopes	0.1	0.00%
23	W	Water	2.2	0.20%
24	WaA	Watchung silt loam, 0 to 3 percent slopes	26.4	2.90%
Totals for Hibernia Park			920.2	100%

Appendix C: Sample Stakeholder Survey

To effectively engage the different stakeholders in the Hibernia park management plan, it is important to create a consensus-building among stakeholders regarding the objectives and long-term vision of the park. To accomplish this a community survey will be implemented to enable the park authority to address Hibernia's complex system of conserving natural resources while providing for visitor enjoyment.

Recreation Questions

1. Are you a Chester County Resident?

Yes

No

2. What is your zip code?

3. Approximately how far did you travel to get to the park?

0 to 1/4 mile away

1/4 to 1/2 mile away

1/2 to 3/4 mile away

3/4 to 1 mile away

More than one mile away

More than 5 miles away

4. How long does it take you to get to the park?

0 to 15 minutes

16 to 45 minutes

46 minutes to 1 hour

1 hour to 2 hours

More than 2 hours

5. How do you usually get to Hibernia Park?

Walk

Bike

Drive

Public Transit

Rideshare

Other: _____

6. What time of day do you usually visit the park?

Morning

Mid-day

Afternoon

Evening

7. What are the ages of the children in your household? (Check all that apply)

- 0 to 5 years
- 6 to 10 years
- 11 to 15 years
- 16 to 18 years

7.1. If any, do they visit Hibernia Park?

- Yes, often
- Yes, sometimes
- No

8. How often do you use the park?

- Daily
- Weekly
- Monthly
- Occasionally
- Rarely

9. In general, do you come alone or with others?

- Alone
- With others

10. Do you ever bring dogs to walk at the park?

- Always
- Sometimes
- Never

11. Why do you visit this park? (Check all that apply.)

- Biking
- Bring Children
- Event
- Sightseeing
- Skating
- Time with family and/or friends
- Exercise or Jogging
- Fishing
- Hunting
- Camping
- Other:

12. Do you visit this park as part of your exercise or health and fitness routine?

- Often
- Sometimes
- Never
- No Opinion

13. Have you or your children ever participated in an event or organized program in this park?

Often

Sometimes

Never

No Programs Offered

14. If so what programs and/ or events?

15. Do you or your children use the play equipment or courts?

Often

Sometimes

Never

N/A

16. Please rate the condition of the play equipment or courts.

Good

Fair

Poor

N/A

17. Is there enough space in the park for your activities?

Enough Space

Too Crowded

18. Is there adequate available parking space when you visit?

Yes

No

19. Have you ever read the park's rule sign?

Yes

No

20. Have you ever read the park's historical sign?

Yes

No

21. Is this park normally clean?

Often

Sometimes

Never

N/A

22. Do you use the Bathroom in this park?

- Often
- Sometimes
- Never
- No Opinion

23. Do you feel safe in this park?

- Often
- Sometimes
- Never
- No Opinion

24. Is Chester County Parks + Preservation staff on site when you are there?

- Often
- Sometimes
- Never
- No Opinion

25. Is Chester County Parks + Preservation Staff friendly?

- Friendly
- Not Friendly
- No Contact
- N/A

26. What is your overall opinion of Hibernia Park?

- Excellent
- Very Good
- Fair
- Poor
- No Opinion

27. Please Note any ideas for improvement to parks features, services, or programming:

28. Would you like to volunteer through any Volunteer program for Hibernia Park

- Yes
- Not at this Time

29. Please provide us with an email address so that we may send a confirmation when you submit the survey.

Email:

Natural Resources Questions

30. Are you aware of the invasive species present at Hibernia Park?
Yes
Yes, but I do not know which species
No
31. Do you feel the invasive species at the park pose a problem to its natural ecosystem?
Yes
Somewhat
No
32. Would you be willing to volunteer in helping to remove some invasive plants at the park during organized sessions?
Yes
Sometimes
No
33. Do you feel that the park has a good hold on managing invasive species?
Yes
Somewhat
No
34. Any other comments or concerns about invasive species at Hibernia Park can be left below:
35. Generally, how do you feel about how the park's staff is managing natural plant life?
Great
Good
Fair
Poor
36. Generally, how do you feel about how the park's staff is managing natural animal life?
Great
Good
Fair
Poor
37. Generally, how do you feel about how the park's staff is managing its water systems? (ponds, streams, etc.)
Great
Good
Fair
Poor

38. Generally, how do you feel about how the park's staff is managing soils and erosion?
- Great
 - Good
 - Fair
 - Poor
39. Any other comments or concerns about natural resources at Hibernia Park can be left below:
40. How concerned are you about air pollution?
- Extremely concerned
 - Very concerned
 - Moderately concerned
 - Slightly concerned
 - Not at all concerned
41. How concerned are you about the extinction of endangered animals?
- Extremely concerned
 - Very concerned
 - Somewhat concerned
 - Not so concerned
 - Not at all concerned
42. The term "global warming" is often used to refer to the idea that the world's average temperature may be about 5 degrees Fahrenheit higher in 75 years than it is now. How concerned are you about global warming?
- Very concerned
 - Somehow concerned
 - Do not believe in global warming
 - Not concerned
 - Prefer not to answer
43. Is reducing global warming more important than improving the economy, less important than improving the economy, or about as important as improving the economy?
- Much more important
 - Somewhat more important
 - About as important
 - Somewhat less important
 - Much less important
44. When people get involved in trying to solve environmental problems, how often do you think they make things better?
- Always
 - Most of the time
 - About half the time
 - Once in a while
 - Never

45. How well do you think the environment can recover on its own from problems caused by humans?

- Extremely well
- Very well
- Somewhat well
- Not so well
- Not at all well

46. Which of the following alternative energy sources do you think will be MOST important in the next 10 years?

- Wind
- Solar
- Nuclear
- Ethanol
- Natural gas
- Coal
- Other (Please Specify)

47. Should the government provide more money or less money to support alternative energy?

- Much more money
- Somewhat more money
- Slightly more money
- About the same amount of money
- Slightly less money
- Somewhat less money
- Much less money

48. How often do you recycle?

- Always
- Most of the time
- About half the time
- Once in a while
- Never

49. How willing are you to change your lifestyle to reduce the damage you cause to the environment?

- Extremely willing
- Very willing
- Somewhat willing
- Not so willing
- Not at all willing

Demographic Questions

50. Please provide us with an email address so that we may send a confirmation when you submit the survey.

Email:

51. What is your age?

20 and under

21 to 40

41 to 60

61 and over