

Aquetong Spring Park Strategic Master Plan



Aquatic Habitat Restoration
November 2018

Prepared For:



Board of Supervisors

Chair - Mark Baum Baicker
Vice Chair - Kevin Morrissey
Member - Noel Barrett
Member - John S. Francis
Member - Robert A. McEwan

Solebury Township Manager

Dennis H. Carney

Aquetong Spring Advisory Committee

Chair - Frank Nassetta
Member - Dan DuPont
Member - Barry Fetterolf
Member - Michael Zolkewitz Ph.D.
Member - Michael Richardson
Supervisor Liaison - John S. Francis

Prepared By:



Additional Partners:

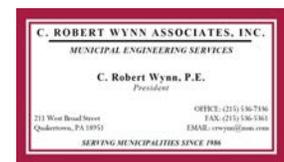


Table of Contents

1	Chapter 1 - Introduction
2	Executive Statement
3	Strategic Master Plan Purpose, Goals and Objectives
7	Previous Studies
8	Regional Context
11	Site History
15	Chapter 2 - Inventory and Analysis
16	Topography
18	Geology and Soils
18	Hydrology
20	Vegetation
24	Cultural Features
27	Chapter 3 - Action Strategy
28	Action Strategy
31	Strategic Zones
35	Chapter 4 - Implementation
36	Element 1 - Design and Permitting
36	Element 2 - Route 202 Trail Segment
39	Element 3 - 202 Tributary Riparian Restoration
39	Element 4 - Park User Improvements
39	Element 5 - Forestry Management / Tree Removal
40	Element 6 - Riparian Buffers
40	Element 7 - Trout Habitat
40	Element 8 - Stormwater Management Elements
40	Element 9 - Reforestation





CHAPTER 1 INTRODUCTION

CHAPTER 1

Executive Statement

Aquetong Spring has a long history as a revered natural resource. Its traceable history reflects the many aspects of its importance spiritually, culturally, economically, and ecologically. Human interaction with the surrounding landscape has left its mark over centuries on the Aquetong Watershed.

Today, a renewed public commitment is well underway to protect, restore, and manage the Aquetong watershed as a high-quality, cold-water, aquatic habitat.

Solebury Township owns the uppermost half mile of the Aquetong Creek below the historic spring and is committed to managing the Aquetong Spring Park as a restored and conserved aquatic habitat, that includes nature oriented recreation, environmental education for the public and scientific research at the headwaters site.

After acquisition of the site, the Township breached an earthen dam; and as a result, Solebury and its partner organizations are now addressing multiple issues to fully restore the recovering landscape within the park. Challenges include:

1. The re-established stream banks above the dam breach are susceptible to erosion.
2. The former lake area contains legacy sediment that needs to be stabilized in place to prevent migration.
3. Unchecked, untreated storm water runoff enters the site from all sides.
4. Insect damage has devastated over 1,000 Ash and Walnut trees within the park site.
5. Environmental stress due to unhealthy deer population has left a forest floor void of healthy native understory vegetation.
6. Remnants of roads, driveways, construction access, cultural trails, homesteads, and manmade water courses bisect the site.
7. Unprogrammed recreation and site uses can result in continued fragmentation of the park.

The primary stewardship goal for Solebury Township and its partners is the protection of a cold water aquatic habitat within the headwater site. All actions of the comprehensive restoration strategy are focused on a program based on science, design, and culture to achieve that primary goal. Restoration actions include:

- Streambank Stabilization / Restoration
- Riparian Buffers
- Stormwater Management
- Forest Canopy Management
- Native Habitat Restoration
- Invasive Species Management

Stabilizing and protecting a high quality, cold-water, aquatic habitat within the Solebury park site will contribute directly to Aquetong Creek water quality downstream and serve as a model for watershed restoration within the region.

The evolution of the site as it is restored to a sustainable ecological balance will provide invaluable educational and research opportunities for academic study as an environmental laboratory that is accessible as a public classroom to observe and be active partners in the site restoration.

Through visible phases of restoration, the entire park site will evolve into a healthy, functioning ecosystem. The restoration process will include a series of best management practices (BMPs) that will be carefully managed. Temporary disturbances may occur within the site – each designed to reverse severe degradations and eventually adapt the landscape, as closely as possible, to a resilient natural state. These “management” disturbances require careful execution and will all support the primary strategic goal for the park – conserving the aquatic habitat.

Strategic Master Plan Purpose, Goals and Objectives

The Strategic Master Plan is designed to provide Solebury Township with a framework for decision making, to advance the restoration and development of the Aquetong Spring Park with passive recreation and education elements that are accessible to the public. **The primary goal of restoration and conservation of aquatic habitat** will serve as the overarching principle for all decision making. Strategic objectives based on the fundamentals of environmental and cultural stewardship will articulate the process to achieve the primary goal.

This document identifies previous work and the ongoing work, while also providing an evolving conceptual design for Aquetong Spring Park that supports the goal and objectives laid out in the report.

All conservation actions will focus on water quality and public opportunities for education and research that enable the community to be active partners in local and world environmental stewardship. Priority actions to achieve the Solebury Township goal of protecting and improving water quality at the Aquetong Spring Park and the watershed below it are based on successful conservation partnership strategies that have already been established and are underway.



CHAPTER 1

Objectives

The objectives are a list of priority actions needed to achieve the primary goal at Aquetong Spring Park.

Continued monitoring of conditions will provide invaluable scientific data to inform Solebury Township decision-making to achieve its conservation goals and the implementation of two primary objectives -

- environmental stewardship
- cultural stewardship

Environmental Stewardship

Environmental stewardship focuses on objectives that address streambank stabilization restoration, riparian buffers, stormwater management, forest canopy management, native habitat restoration, and invasive species management.

Streambank Stabilization / Restoration continues to be a major priority since the dam breach in 2015. This action includes multiple riparian buffers and floodplain stabilization techniques along the banks where the Aquetong Creek mainstem and the 202 tributary have cut new courses through the legacy soils of the former lakebed. Stabilizing the new stream channels is critical to prevent on-site soil erosion that can directly threaten the stream's habitat by smothering essential benthic communities that have begun to re-establish.

Riparian Buffers - Re-establishing a riparian plant community along the sections of the Creek and tributary will support streambank stabilization against soil erosion as well as shading the waterways to reduce thermal stresses to the cold water habitat.

Stormwater Management is essential to all sites, but especially critical for the Aquetong Spring Park site, where the primary goal is to protect the aquatic habitat. The approach to managing stormwater at Aquetong

Spring Park is to address rain that falls directly within the site and manage runoff that enters the park from the relatively small adjacent areas of the watershed located upstream from the Park.

The runoff from adjacent areas into the park is considered more potentially threatening to the water quality of the Aquetong mainstem than the stormwater that originates on site – but both sources must be carefully managed to conserve the headwater habitat. Stormwater quantity and quality are both critical management objectives. On-site stormwater management is considered as primarily a soils and vegetation challenge to foster the terrestrial ecosystems so that they function to slow down, infiltrate and treat runoff before it reaches the waterways. Where new disturbances are created to conserve the park, stormwater regulations must be followed which include creating recharge facilities to compensate for new impermeable surfaces such as a parking lot, driveway, and trail. Managing stormwater that emanates from off-site locations is more complex because little can be done to address quantity or quality before it enters the Park site.

Forest Canopy Management – A study commissioned by Solebury Township reported that over 1,100 Ash and Black Walnut trees would need to be taken down due to infestation and disease. Emerald Ash Borer has affected Ash trees throughout the area, and the discovery of Thousand Cankers Disease from the infestation of the Walnut Twig Beetle has doomed the Black Walnut species. To limit the spread of these infestations, Solebury will fell all Ash and Walnut trees within the Aquetong Springs Park. The clearing permits are in place and the operation will occur in early 2019. The result, with or without the strategic felling, will be new large open areas in the tree canopy, increasing the exposure of the forest floor already damaged by heavy deer browse and invasive plants. Stabilizing the exposed forest floor is

INTRODUCTION

critical to minimize soil erosion and sediment entering the Creek.

Native Habitat Restoration – This objective includes creating habitat structures from felled logs and local rock to restore, protect and enhance a native aquatic ecosystem in the reach of the Aquetong Creek above the former dam. Since the dam breach, the capability of the stream to host native brook trout was monitored and in 2017, Bucks County Trout Unlimited received permits from PA Fish and Boat Commission to capture and release 50 brook trout, believed to be genetically pure due to their remote location. Trout Unlimited has since found fingerling brook trout that proved that there is an established reproducing population. The installation of in-stream habitat structures will help create preferred hydraulic and eddy conditions, to assure that the trout have the optimum chances to continue to breed and prosper.

Invasive Species Management - Since the dam breach, a number of invasive plant species have been identified and are being monitored. Removal of *Phragmites australis* is already underway to reduce its negative impact on the emerging landscape. Continued monitoring and management of invasive species will allow for a resilient ecosystem to be re-established on site. As a vigorous riparian ecosystem is restored, the water quality will continue to improve, furthering the success of the aquatic habitat and adding to the biodiversity on the site.

Cultural Stewardship

Appropriate public access into and through the park is critical to its conservation. The public access and services to be included in the Aquetong Spring Park will be passive, meaning that recreational programming will be nature oriented activities and will not include organized sports fields; and will be designed to advance the primary goal of conserving the headwater aquatic

habitat. These elements can be considered design and pedagogy – in that they serve multiple environmental functions as well as enabling the public to use the Park site with the least negative impacts. The inner walking trails will be designed to deliver park users to points of education and interpretation while protecting fragile ecosystem areas such as wetlands, riparian edges and steep slopes. Bringing people into Aquetong Spring Park and helping them to understand the natural systems and the human stewardship interventions is critical to engaging the public as active partners in the success of the restoration project. The priority “recreation” actions of creating community connections to the park, providing education opportunities, and ensuring that only passive recreation activities are recommended to be developed at the perimeters of the site – as much as possible to allow the restoration of large core habitat areas within the central areas of the site.



Tree planting in Nov 2016.

Image from Soleburyhistory.org

CHAPTER 1

Education - Aquetong Spring Park already provides many unique educational opportunities for users. As restoration and conservation efforts continue, and the park becomes more heavily used, it is important to balance human uses with the conservation of this unique re-emerging ecosystem as a living laboratory for exploration, education and scientific research. Signage and integrated outdoor labs and teaching venues will be included in the strategic plan for the site to inform the interested passerby to the rich industrial and environmental history, as well as, environmental processes and stewardship. Public participation in monitoring the site offers unique learning opportunities and assistance with restoration efforts.

Cultural Conservation - Native American representatives will be engaged during the park design

and development processes – especially regarding treatments to the revered spring site.

Route 202, 9/11 National Memorial Trail Segment

- The plan for public access has already begun with the approval and funding for design and construction of a regional 10' multi-use trail that will be part of the Route 202 Cross-Country Trail system, and part of the much larger 9/11 National Memorial Trail system. A section of the regional trail will be created along the perimeter of the Park site parallel and in close proximity to Route 202. This section will eventually connect eastward to the other segments already constructed by Solebury that connect directly to the Delaware Canal / D&L Trail, as well as eventually to the Route 202 Bypass Trail segment that runs westward from Doylestown Township through Montgomery Township.

Native American Gift Tree at Aquetong Spring



Previous Studies

Since the site changed from private ownership to public property, there have been several studies and reports examining the site and its implications and conditions. These tools are useful when considering restoration of the site.

2016-2018 Princeton Hydro Reports

After the Aquetong Lake was drained and a new ecosystem was emerging, Princeton Hydro (PH) was retained by Solebury Township to monitor and manage the ongoing restoration of the aquatic and terrestrial ecosystems. PH takes four annual samplings from five stations within the Park site. Surface water grab samples are collected and analyzed by a PADEP (Department of Environmental Protection) certified laboratory for Total Phosphorus, Nitrate, Ammonia, and total suspended solids. During each visit, water velocity and creek discharge flow data are collected. Additional stream flow data is gathered by data flow logger at each station. During the four visits, PH personnel gather samples of the benthic invertebrate community and fishery of the creek. The invertebrate sampling is done at each station with a D-Net. The fish sampling is done with a backpack electrofishing unit.

Seasonally, four test plots of about 10 squared meters each are used to assess the composition, density, and relative vigor of the plant community.

2014 Solebury Township Comprehensive Plan

The Comprehensive Plan is the Solebury Township guide for preserving its resources while improving the quality of life of its residents. This land management tool describes the Township's commitment to protect, preserve, and restore the many natural and historical resources that exist within their municipality, including assessments of

the existing conditions and goals for the future.

2007 Aquetong Creek Coldwater Heritage Plan, F.X. Browne, Inc

This study addressed the feasibility for re-establishing a cold water aquatic habitat within the Aquetong Creek Watershed. It renewed the recommendation for a cold water bypass system to mitigate the damaging effects of warm water temperatures from Aquetong Lake into a cold water habitat. The report also recommends the need for a sustainable approach to land development and conservation to protect and enhance the watershed through improved riparian corridors, stormwater management, and continued monitoring.

2004 Ingham Spring Dam Removal Study, F.X. Browne, Inc

This study was funded by Bucks County Trout Unlimited to examine the benefits of removing the dam at Aquetong Lake rather than rehabilitating it at an estimated price of \$1 million. It was concluded that removal of the dam would be far less expensive and restoring the stream would create approximately 2 miles of cold water aquatic habitat downstream within the watershed.

1995 Ingham Spring...A Draft Master Plan

This plan was provided to the Pennsylvania Fish and Boat Commission. It addressed the desires of the PFBC to use the site as a central location for volunteer education, provide public access to fishing waters, and protect the Aquetong Spring as a unique natural resource.

CHAPTER 1

Regional Context

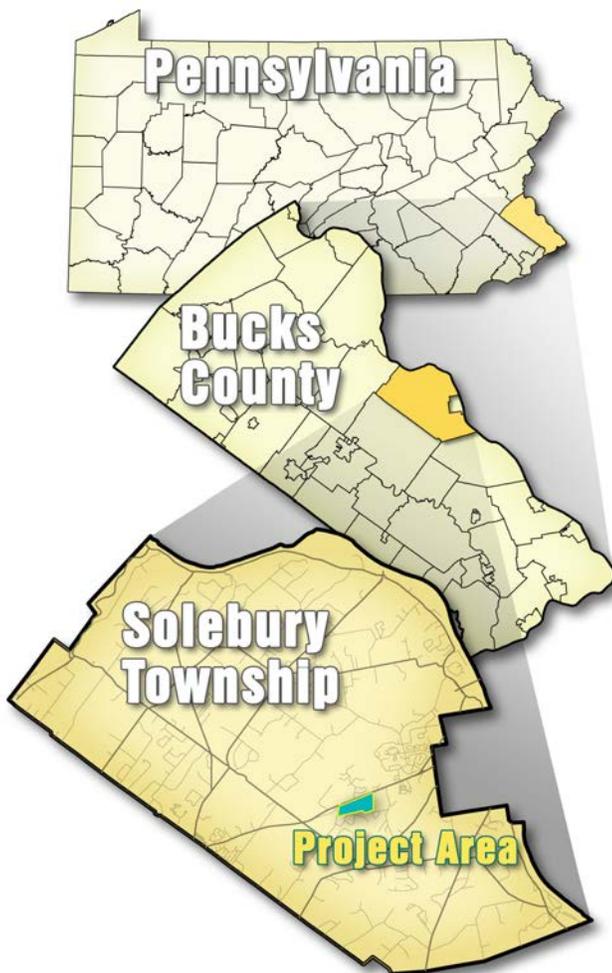
Aquetong Spring Park lies within Solebury Township. The Township boundaries are New Hope Township and the Delaware River to the east; Plumstead Township to the north; Buckingham Township to the west; and Upper Makefield Township to the south. Solebury Township is part of Bucks County, Pennsylvania.

Aquetong Spring is a headwater source for Aquetong Creek. The Aquetong Creek Watershed is a tributary to the Delaware River Watershed and is one of 8 small watersheds that exist in Solebury Township. Nearly all of the watershed lies within Solebury Township, with a very small percentage falling into neighboring Buckingham Township.

The Aquetong Spring Park is bordered by US Route 202 to the north, Lower Mountain Road to the west, Deer Park Camp and Retreat Center to the south, and The Hermitage condominium/townhouse development to the east. The site is designated as "Rural Conservation" by Solebury Township future land use classification. The future land use, which is not zoning but a broad description of predominant landscape character. Rural Conservation consists of farmland, rural, rural residential and protected open land. The park is surrounded by Mixed Use Rural-Suburban Center (higher intensity non-residential or specialized residential development) to the north and Site-Responsive Rural (conventional 1-3 acre single home development and the open or agriculture land in the vicinity) to the south. US Route 202 is the only principal arterial road through Solebury Township.

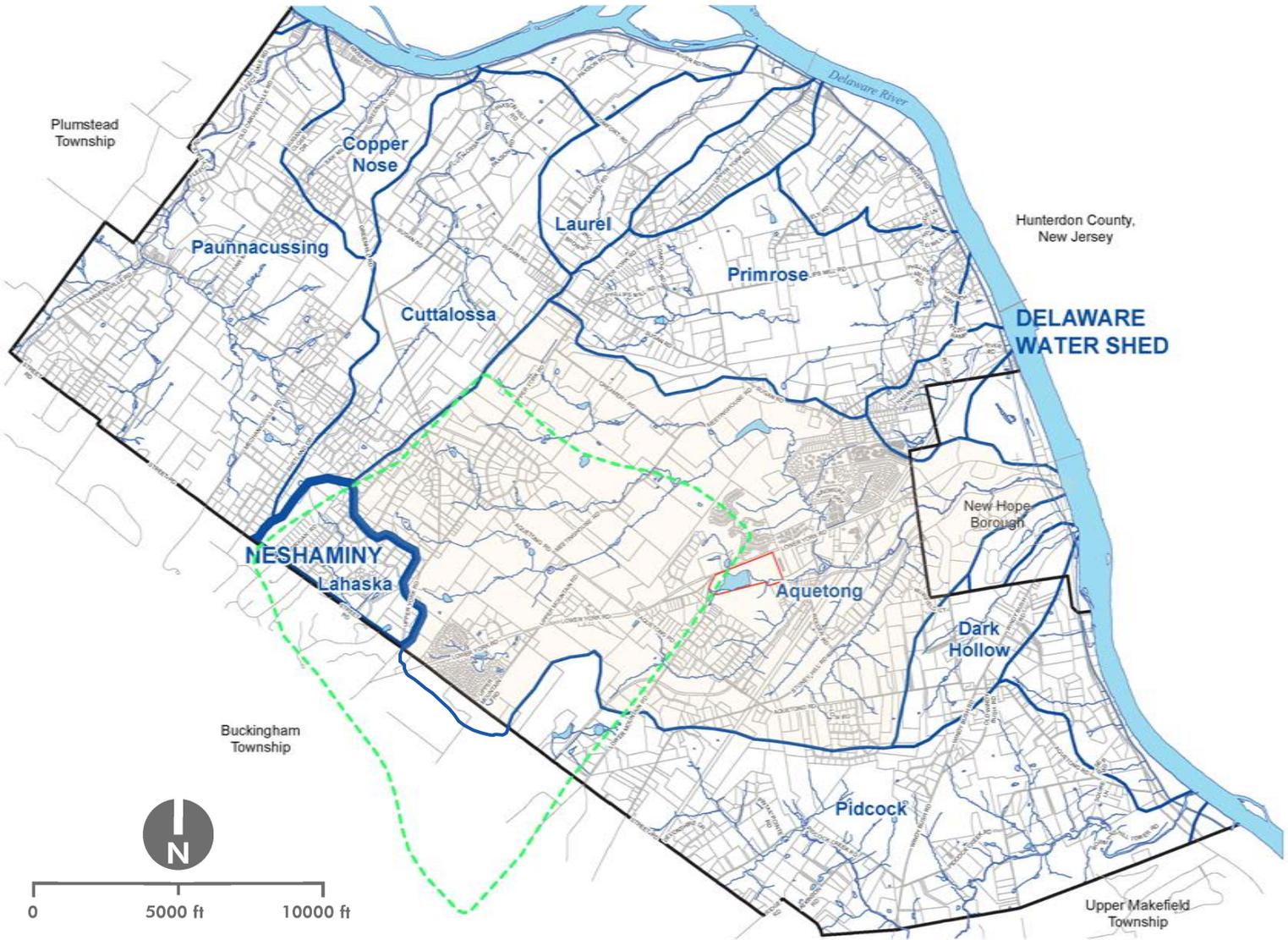
There is additional open land nearby bordering The Fox Run Preserve Adult Community to the east. North Pointe Open Space is a 104-acre space owned by Solebury Township. Additionally, the 110-acre Honey Hollow Environmental and Education Center exists approximately 2 miles to the north of the site. Both sites lie within the Aquetong Creek Watershed and drain to a minor tributary of the Aquetong Creek.

As future development and conservation practices are implemented, it will be important that reduction of thermal stress to all tributaries to the main stem of Aquetong Creek is considered to achieve the goal of a healthy and sustainable cold water aquatic habitat on the main stem, downstream from the Aquetong Spring Park site.



INTRODUCTION

Solebury Township Watershed Map

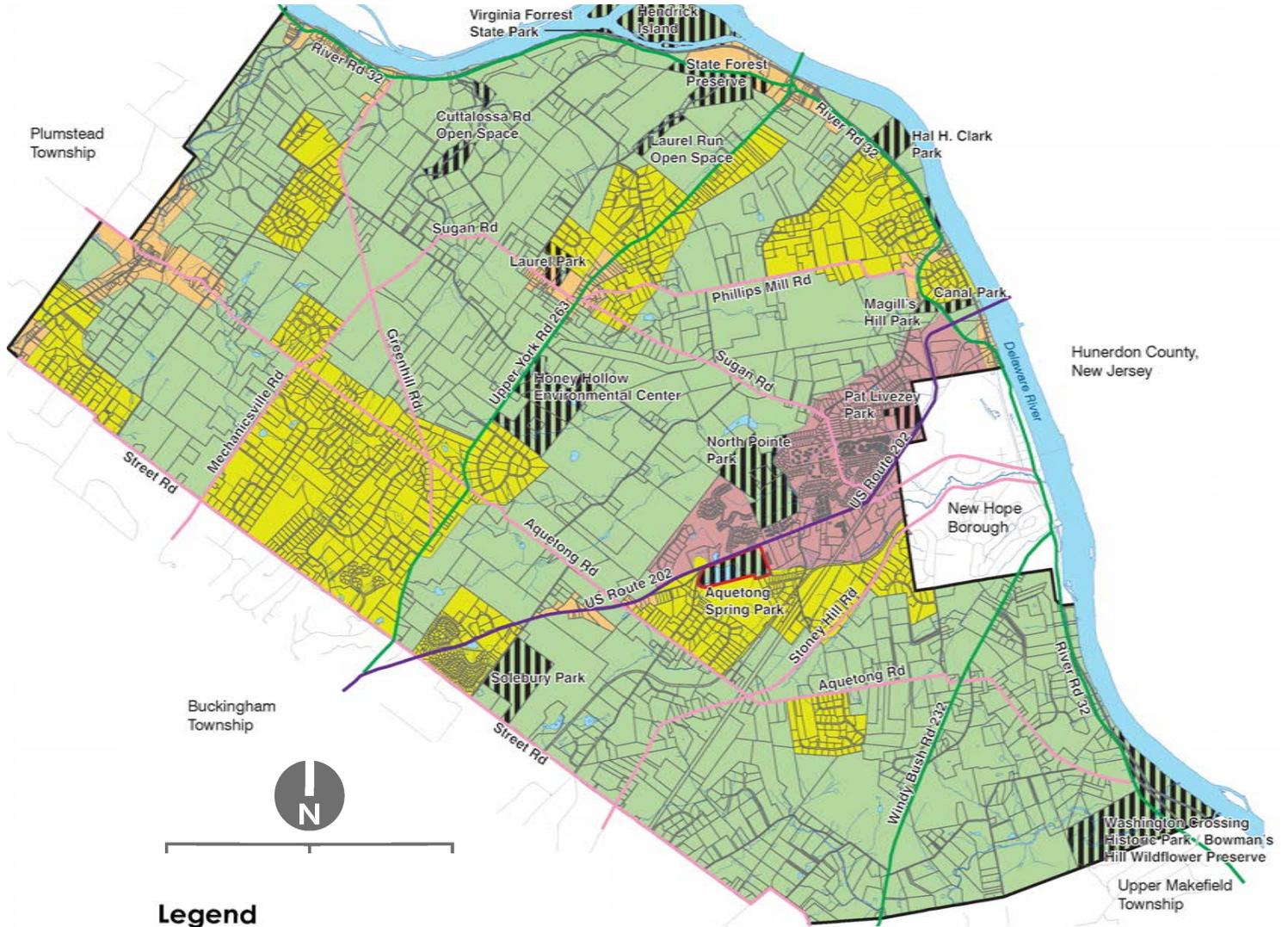


Legend

- Aquetong Water Shed
- Small Watershed
- Major Watershed
- Site Boundary
- Site Recharge Area (approximate)

CHAPTER 1

Solebury Township Context Map



Legend

-  Site Boundary
-  Parks, Recreation, and Open Space
- Future Land Use**
-  Rural Conservation
-  Site-Responsive Rural
-  Mixed Use Rural-Suburban Center
-  Historic Village
- Road Classifications**
-  Principal Arterial
-  Major Collector
-  Minor Collector

Source : Bucks County Planning Commission, 2013

Prepared by Simone Collins Landscape Architecture

Site History

Before it was purchased by William Penn in 1682, the native peoples of the area long revered the site, naming the spring area Achwe-tank, meaning “at the spring in the bushes” or “at the spring by the bushy pine trees”.

Through the 18th and 19th centuries, the site changed owners, but it was the Ingham family that owned the site for 120 years within this time. The spring became a center for industry to power nine mills along the two and a half mile stream, provide bottled drinking water, and feed a cold-water fish hatchery. In 1870, the earthen dam was built to create the 15-acre Aquetong Lake.

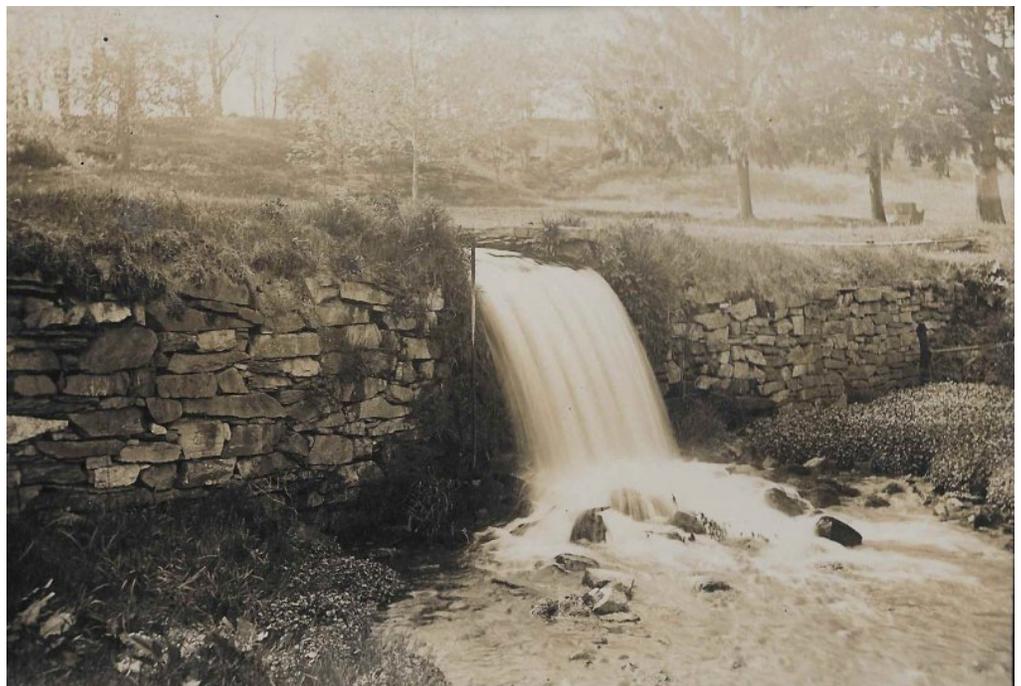
In the early 1900’s, Lower York Road was designated as US Route 202. Around the same time, Dr. Perry & Helen Bond purchased the Aquetong property and began to restore the spring and lake that had fallen into disrepair.

In 1993, The Commonwealth of Pennsylvania acquired the site. In 1996, the Pennsylvania Fish and Boat Commission (PFBC) made emergency repairs on the earthen dam, and then presented a masterplan to use

the site for an education center and recreation. It was later determined that the site could not meet the needs of the PFBC, and the property was sold to Solebury Township in 2009, excluding the approximately ¼ acre that includes the spring head area. Solebury Township negotiated a 25 year lease with the PFBC for the spring head area, with the intent to purchase in the future.

The first action by the Board of Supervisors(BOS)was to determine if the earthen dam should be restored or removed. Previous data had determined that the dam had negatively affected cold water habitat and repair of the dam would be costly. In 2013, the board voted to remove the dam.

In 2015, the Aquetong Spring Advisory Committee (ASAC) was formed to assist the BOS with redevelopment of the site as a passive park, and the BOS renamed the site Aquetong Spring Park. In July 2015, the dam was breached, allowing the creek to wind its way through the former lake bed. Since then, the Township has successfully pursued multiple sources of funding for restoration and park improvements.



Undated photograph of the Aquetong Spring pond waterfall, possibly 1890’s. Photo from Solebury Township Historical Society (soleburyhistory.org)

CHAPTER 1



1938 –Aquetong Lake is clearly visible. The majority of the area surrounding the site is use for agriculture. Most development is along the Hatboro-New Hope passenger rail road line of the Reading Company ending in New Hope. This is the time when the Bond family had moved onto the site.



1958 –In this image, US Route 202 becomes more prominent in the landscape and New Hope is growing. New development can be seen between Aquetong Creek and US 202.



1971 – Changes since 1958 appear slowly, but larger housing developments start to emerge.



2002 – In 30 years after 1971, this image shows significant growth in residential development in the areas east and south of the site. Old farm fields have been left to successional growth in some areas. To the northwest, farms still exist.

INTRODUCTION



2016 – This is one year after the dam breach. The missing lake is the most noticeable change in the area from 2002.





CHAPTER 2 INVENTORY AND ANALYSIS

CHAPTER 2

Topography

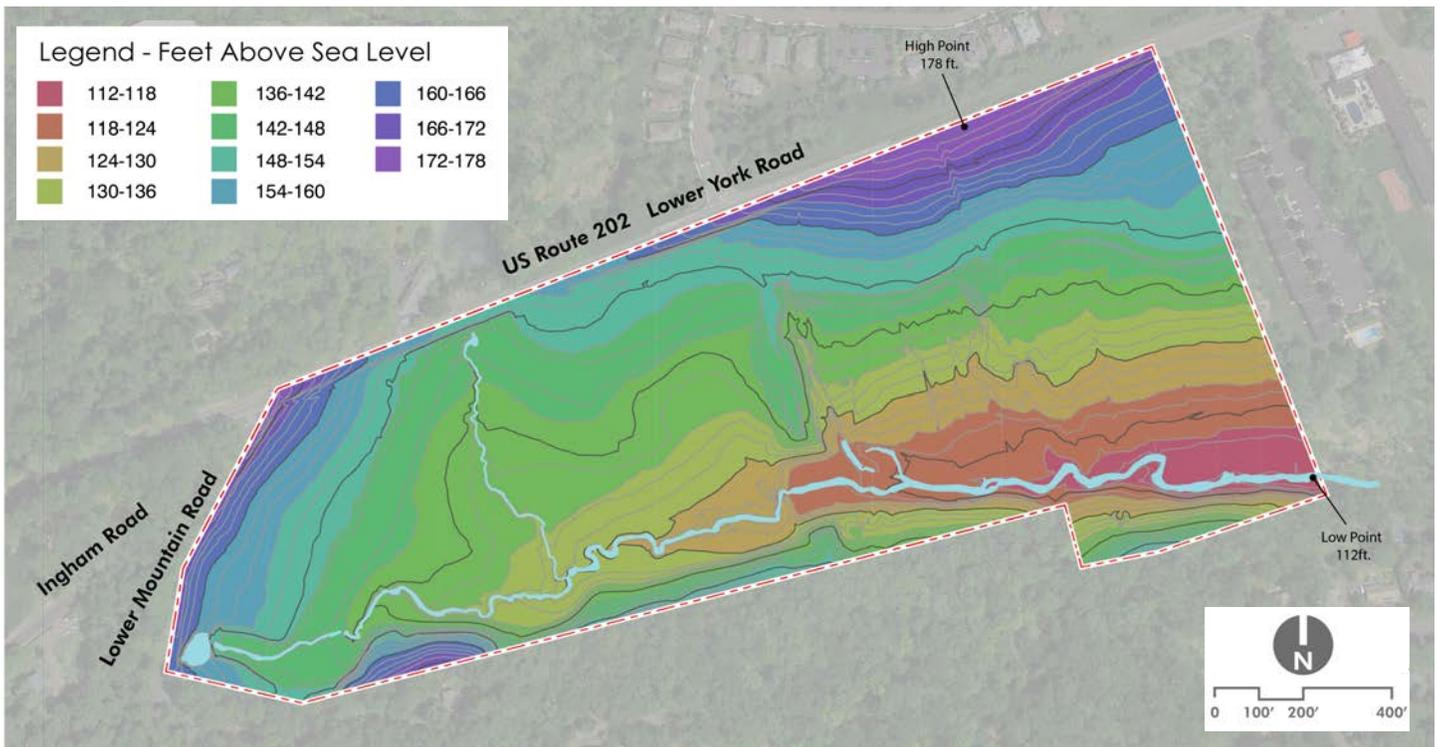
The existing topography of the Aquetong Spring Park site is typical of the piedmont region, specifically a tributary valley to the Delaware River. The elevation change is 66 feet (above sea level) from the 178 ft high point near Route 202 on the northeastern side to the low point of 112 ft stream invert where it flows off site on the eastern property line.

There are areas of steep slopes on the site that are important when considering soil erosion, storm water management, and slope stabilization. Most steep slopes of 25%+ are along the south side of Aquetong Spring Park. Steep slopes are also found along the creek edge, former millrace, and the dam remains. Slopes of 8-15%

are found on the northeastern side of the property. Areas of flatter topography lie where the lake once existed and surrounding the Bond (Judy) House.

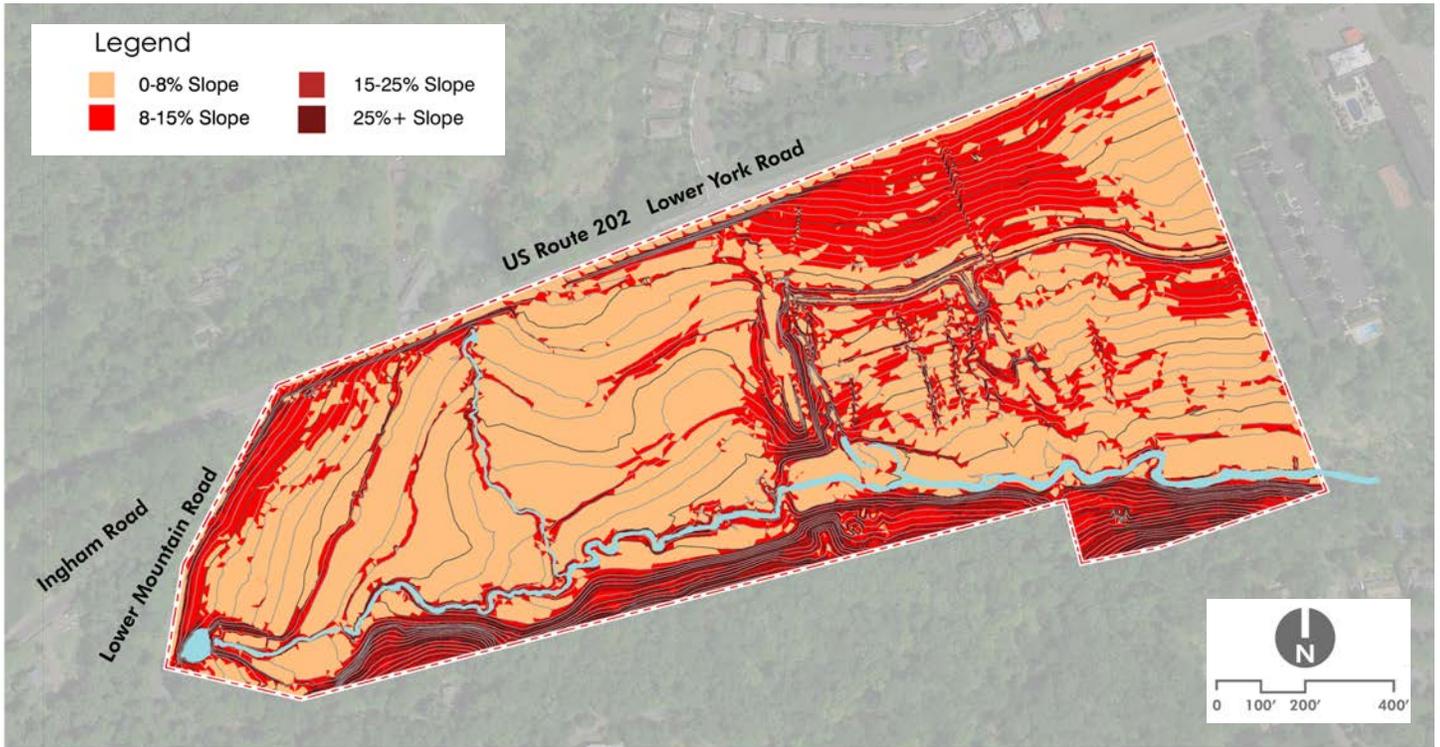
The direction a slope faces, or slope "aspect", impacts the sun exposure and micro ecology of the site. South of the creek, the slope faces north, and this hillside receives the most shade throughout the seasons. Areas of full tree canopy on the south side help provide some of the most effective shade to the waterway. North of the creek, the slope's predominant faces of south and southeast aspects foster different microclimates that broaden biodiversity on site.

Elevation Map

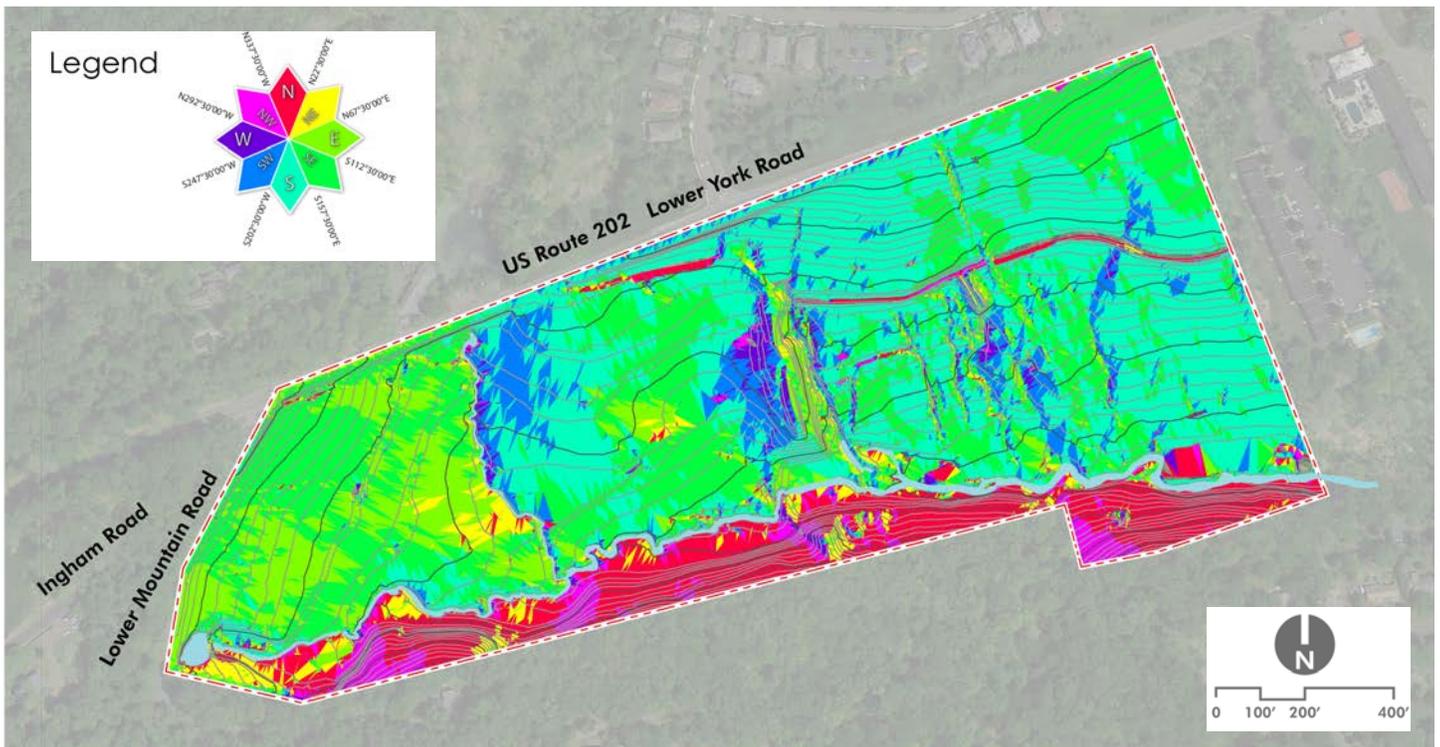


SITE ANALYSIS

Slope Map



Slope "Aspect" Map



CHAPTER 2

Geology and Soils

The unique geology of the site has produced the remarkable Aquetong Spring hydrology, where the spring lies between a strip of Allentown Formation and Brunswick Shale Formation. The Allentown Formation is made up primarily of thickly-bedded dolomite and impure limestone. The Brunswick Shale Formation consists of a reddish-brown mudstone, siltstone, and shale. Where these two formations meet, limestone is crushed between layers of shale. As the limestone erodes, channels are formed, allowing underground water to surface. In the case of Aquetong Spring, approximately 3 million gallons a day are consistently released from beneath the surface.

A variety of soils is found on site, with the majority of the site covered in Bowmansville-Knauers (Bo) silt loam, Amwell (AmC) silt loam, Brownsburg (BsC) 8-15% slope silt loam, and legacy soils where the lake once existed. Additionally, some Duffield-Ryder (DgC) silt loam, Klinesville (KIE) very channery silt loam, Brownsburg (BsB) 3-8% slope silt loams, and Urban land-Penn complex (UxB) are found around the edges of the site. The following descriptions of these soils are taken from United States Department of Agriculture's web soil survey.

Legacy silt soils comprise most of the site area. These soils were formed from settling sediment when the lake existed.

(Bo) Bowmansville-Knauers silt loam makes up approximately 25% of the soil on site. This soil lies within 0-3% slope range and is considered poorly drained. It is 72-99 inches to bedrock and about 0 inches to the water table. This soil is found around where the lake once existed and along the stream.

(AmC) Amwell silt loam makes up about 20% of the soil found on site. It lies within 8-15% slopes and is

considered somewhat poorly drained with high runoff. It is 40-99 inches to bedrock and 12-30 inches to the water table. This soil is found on the east side of the site.

(BsC) Brownsburg silt on 8-15% slope makes up about 17% of the site. It is considered to be well drained soil with medium runoff. It is 40-60 inches to bedrock and more than 80 inches to the water table. This soil is found on the north side of the property.

(BsB) Brownsburg silt on 3-8% slope makes up approximately 4% of the site and is considered to be well drained with medium runoff. It is 40-60 inches to bedrock and more than 80 inches to the water table. The soil is located on the north east part of the site.

(DgC) Duffield-Ryder silt loams only make up about 2% of the site and is located on the west side of the site. It is a well-drained soil with medium runoff. It is 48-120 inches to bedrock and more than 80 inches to the water table.

(KIE) Klinesville - a very channery silt loam, makes up about 1% of the site and is found on the hillsides on the southside. It lies on 25-45% slope and is considered to be somewhat excessively drained with high runoff. It is 10-20 inches to bedrock and more than 80 inches to the water table.

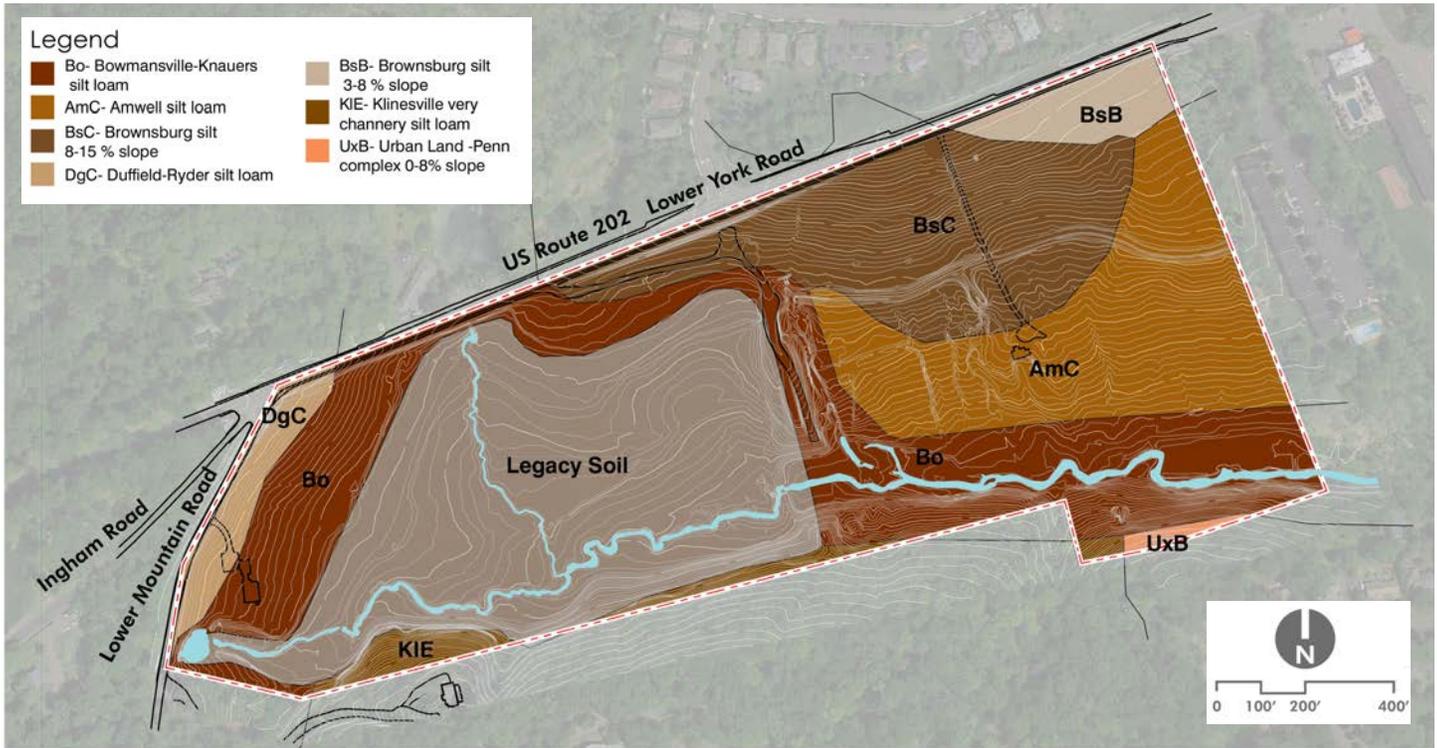
(UxB) Urban land-Penn complex in 0-8% slope is considered to be well drained soil with low runoff and is typical of urban development soils. It is 20-40 inches to bedrock and more than 80 inches to the water table.

Hydrology

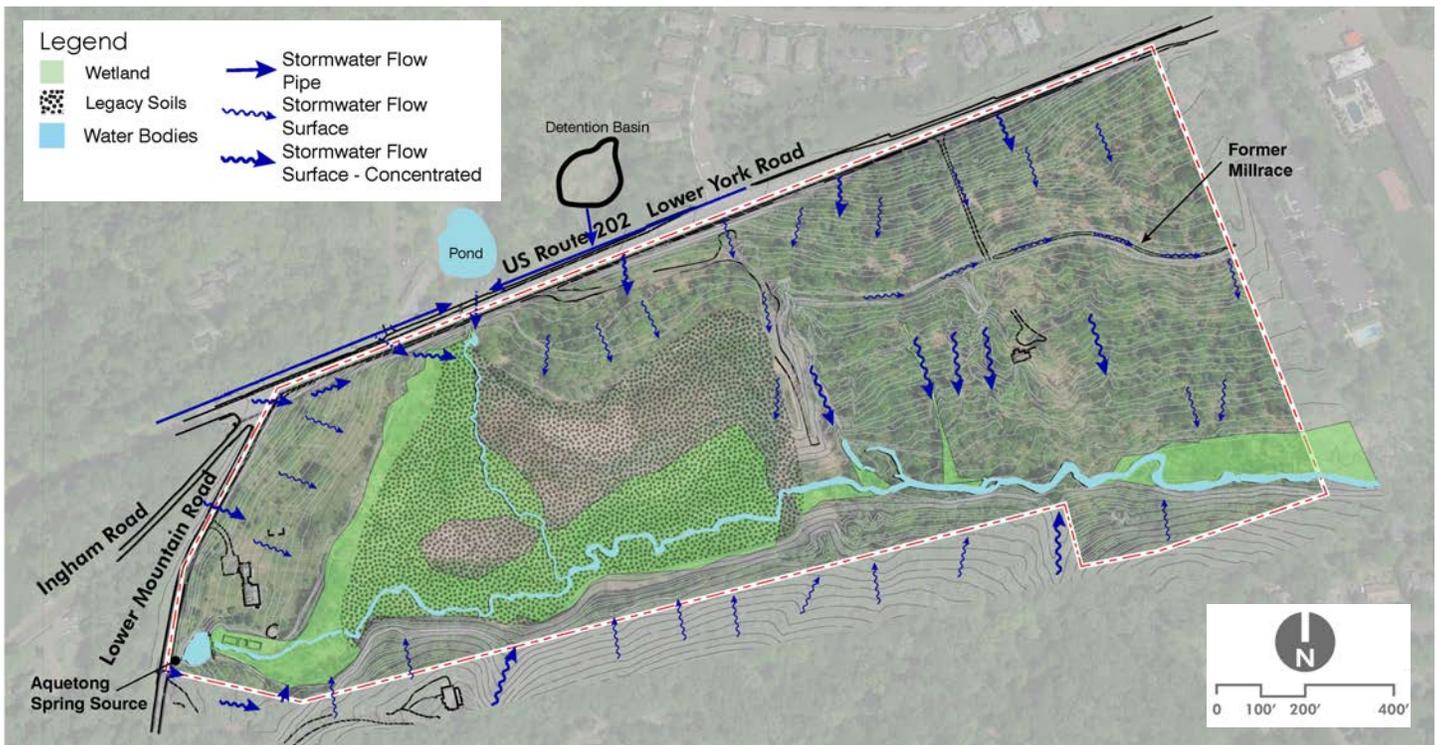
Aquetong Spring Park lies within the Aquetong Creek Watershed, that drains to the Delaware River Watershed. Approximately 239 acres drain directly into the park from higher elevations within the Aquetong Spring Watershed. Until 2015, Aquetong Lake existed behind an earthen dam built in 1870. Since the dam breach in 2015, a

SITE ANALYSIS

Soils Map



Hydrology Analysis Map



CHAPTER 2

winding watercourse has formed through the empty lake bed, flowing from the spring source at the western side of the park eastward to the confluence of Aquetong Creek and the Delaware River. The creek within the park site is fed primarily by the Aquetong Spring at a steady flow rate of approximately 2,000 gallons per minute. A small tributary beginning north of Route 202 also feeds into Aquetong Creek within the site. The tributary under Route 202 receives water from a relatively small sub-watershed to the north of the site and runoff from the Route 202 corridor. The section of tributary formerly above the lake pool level shows signs of erosion from periodic concentrations of high water velocity from stormwater above the park, and this branch serves as a direct source for pollutants to enter into the Aquetong Creek mainstem within the Park.

Additional stormwater flows within the upper sub-watershed flow from Lower Mountain Road and the small contributing area above it. These waters flow off the road, into the source spring location, or are collected in a roadway swale and piped under the road and released into the Aquetong Creek directly below the spring pool. These stormwater pathways show signs of erosion due to periodic high volumes and unmitigated runoff velocity. These sediments carried from above impact water quality of the headwaters of Aquetong Creek.

Stormwater runoff emanating from on-site areas has created several types of conditions. The former lake bed, the Route 202 tributary, and the emerging mainstem creek are all subject to erosion from on-site stormwater sources. The former millrace also acts as an interceptor channel for stormwater flowing down the north slope in the area from below the former dam to the eastern park property line. Areas of channelized water flows are evident from the obvious rill erosion primarily along steep grades. In areas of lesser grade, rain water tends to run off more slowly and "sheet flow" across the site.

A wetland area was delineated when the dam was

breached and has been re-investigated for the purpose of Phase 1 park restoration elements. A large portion of wetlands found on site exist where the lake once was. Other wetland areas are found along the main stem and tributary courses.

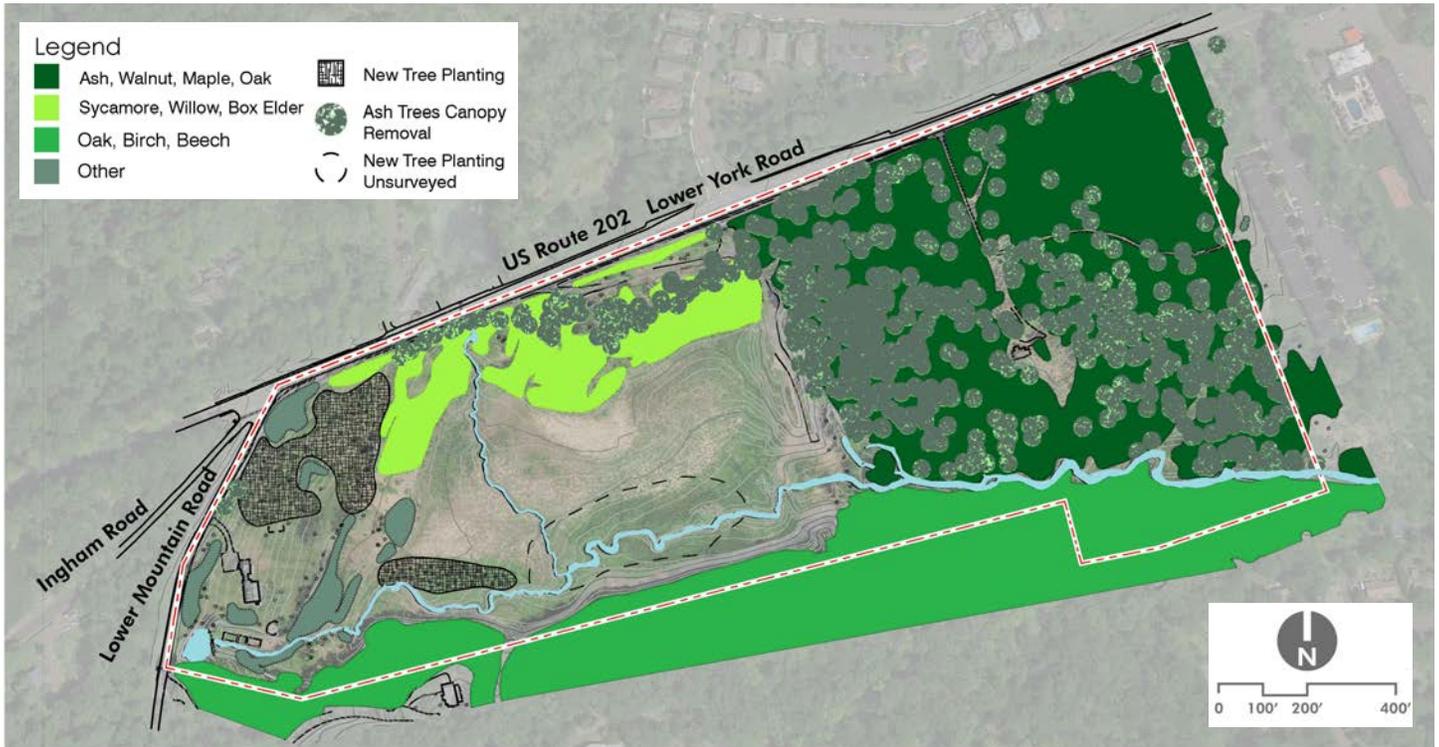
Vegetation

Tree canopy map- Three distinct woodland communities exist on site, surrounding the area that once was a lake. Some of these areas, and the former lake bed itself, have had new trees planted. The area surrounding the Bond (Judy) House should be considered as a hybrid forest restoration strategy, representing a mix of trees that were planted by previous home owners and, more recently, by the Township.

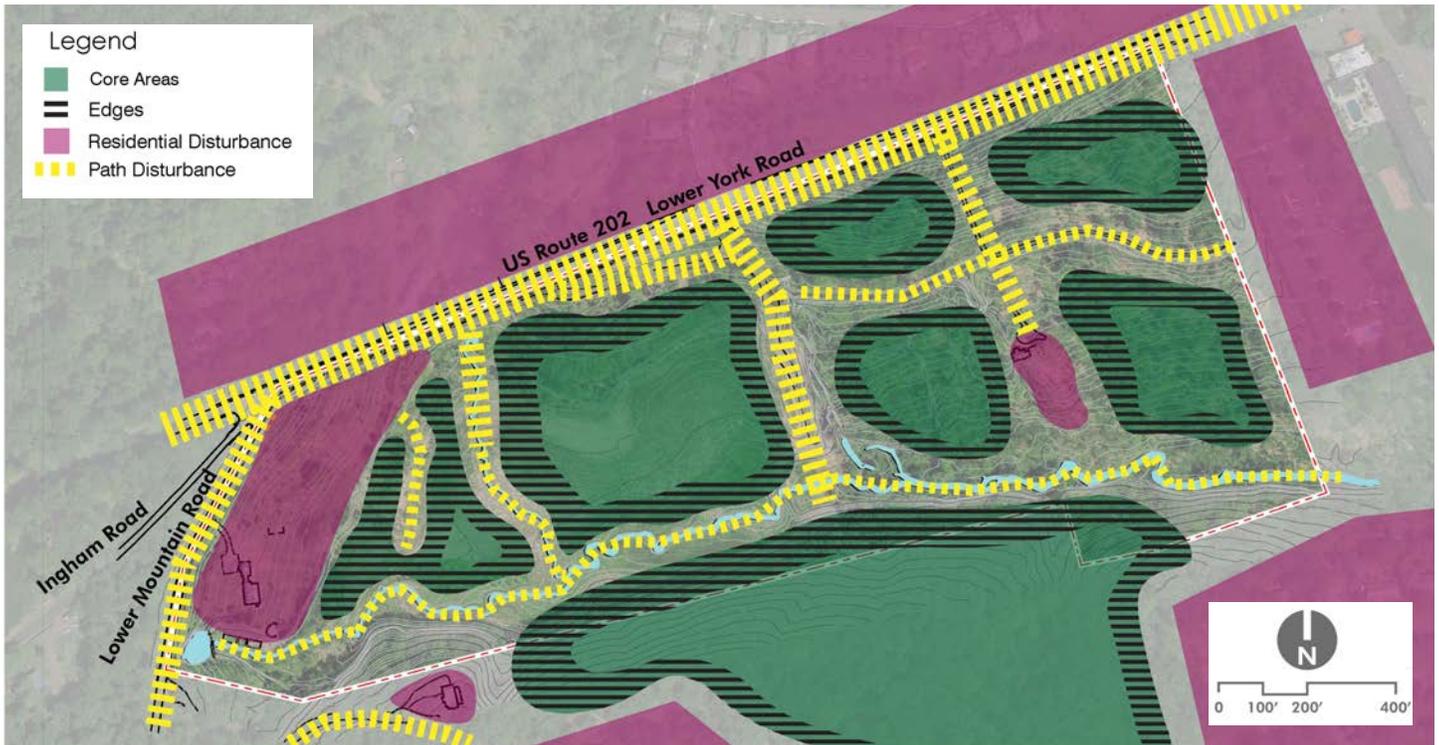
Canopy tree infestation is an ongoing issue within the area. Emerald Ash Borer is no stranger to the area has already decimated large stands of Ash trees throughout the region. More recently, Thousand Cankers Disease has been identified in Bucks County, and its effects on Black Walnut trees is equally as destructive. The disease is caused by a fungus carried by Walnut Twig Beetles. A professional forestry report commissioned by Solebury Township determined that all ash and black walnut species on site must be removed due to incurable invasive insects and disease issues. Approximately 1,100 trees will be lost across the Park site, especially concentrated on the steep north slopes below the former dam. The resulting loss of the existing tree canopy will increase the susceptibility of the heavily deer-browsed woodland floor to invasive plants and erosion. The Forest Canopy map shows about 690 trees of the nearly 1100 that are marked to be removed and provides an idea of the extensive canopy loss due to the necessary removal of these trees.

SITE ANALYSIS

Tree Canopy Analysis Map



Disturbance and Existing Habitat Core Analysis Map



CHAPTER 2

Since the dam breach, a successional plant community has begun to grow within the former lake bed. The Township has also added trees along the main stem of the creek. Some of the successional species are quick growing trees, such as poplar and cottonwood, that may need to be thinned out to allow preferred longer living species to establish. Currently, terrestrial communities are being monitored by Princeton Hydro. In previous reports, PH has identified aggressive non-native vegetation and is working with the Township to remove large stands of Phragmites (*Phragmites australis*).

In an analysis of habitat area, locations of key disturbances were identified and differentiated by residential or path. Residential disturbances occur from areas of development, removing areas of natural habitat. Pathways cause disturbance by fragmenting larger areas of habitat. The creek and tributary watercourses are considered “disturbances” since they are still downcutting through the former lake bed and creating paths of repose. Other large disturbances, such as loss

of tree canopy are occurring within the site. All these disturbances conspire to divide vegetation ecology into small “core” habitat areas. Small areas of core habitat decrease the resilience of the ecosystems to the impacts of disturbances by reducing areas of sustainable biodiversity and viable populations to survive and thrive as they can in larger core habitat areas. This core habitat fragmentation also allows for “edge communities” to become established with portals for opportunistic invasive plants and animals to invade protected habitats. Without interventions, disturbances ultimately alter the essential environmental conditions for healthy, native core habitats.



Hybrid Forest Restoration area



Looking into the former lake bed from the Bond (Judy) House area where Phragmites removal is being managed.

SITE ANALYSIS



A succession landscape is re-establishing within the former lake bed.



Existing woodland landscape below the former dam. Trees are marked blue that are to be removed.

CHAPTER 2

Cultural Features

The Bond (Judy) House remains on site and is maintained by the Township. The existing structure and surrounding cultural landscape are recognized as an asset to the Township and its partners, as the community works to determine a viable strategy for its adaptive reuse. In its current condition, the house cannot serve as a residence. Around the house are additional stone walls that may have been foundations of previous smaller structures. The area now hosts picnic tables and a stone well structure that sits within the lawn area behind the house.

There is no established date for the stone dam that forms the spring pool, but it is believed to have been constructed before the lake was impounded. There is a path to the small dam structure with a stone bridge that crosses the pool outlet as it becomes a waterfall cascading into the headwaters of the Aquetong Creek below. Below the spring pool dam exist the remnants of

the three fish hatchery structures on the north side of the creek.

The maintenance access drive located on Route 202, east of the Route 202 tributary culvert, was used for construction access to breach the lake dam and is generally in good condition. The drive lane between the highway entrance and the former dam is a compacted stone drive with a storage area to the side of the drive.

Another former driveway to the remnants of the former dwelling located below the dam is a relatively narrow, compacted stone drive with vegetation encroaching. The drive crosses the remnants of an old mill race that once powered downstream mills in the 18th and 19th centuries. The former dwelling is now only a stone and brick shell with no roof or floors. By the noticeable graffiti, it still attracts visitors.

Remains from a lime kiln also exists on site, located below the dam, on the south side of the stream.



Bond (Judy) House area

SITE ANALYSIS



Crossing the spring pool outlet

Maintenance access drive on Route 202



Former dwelling below the dam





CHAPTER 3 ACTION STRATEGY

CHAPTER 3

Action Strategy

It became clear to Solebury Township and its partners that breaching the dam and re-establishing the native stream course was only the first stage in a matrix of practices that were needed to conserve pristine water quality downstream of Aquetong Spring as aquatic habitat. Historic and emerging negative impacts to Aquetong Creek included: soil erosion from multiple sources; loss of major tree canopy; invasive species; water quality degradation from the highway and from the tributary watershed, such as nitrogen loading, reduced Dissolve Oxygen, coliforms, petrochemicals, potential spills, salt, and high temperatures - all actively threatening the goal of re-establishing native aquatic habitat in Aquetong Creek. To address these physical and bureaucratic realities, Solebury Township began its strategic planning to restore Aquetong Spring Park as a naturalized landscape with every potential conservation feature conceived to protect the aquatic habitat. The strategic plan for Aquetong Spring Park restoration is a municipal initiative within a larger scheme of township-wide watershed planning by multiple non-governmental organizations representing five major Delaware River tributary watersheds within Solebury Township.

The development of the Aquetong Spring Park is a complicated and multifaceted project that requires challenges to be handled within the context of the entire landscape. For this project to succeed, it will need the expertise of many disciplines and a team that will coordinate all the moving parts.

The Action Strategy is set forth to systematically achieve the primary goal of restoration and conservation of aquatic habitat and relies on the fundamentals of ecological principles. These include:

- Biological organization – Plants and animals (biotic) along with supporting natural systems (abiotic)

are sustained by dynamic ecological patterns and process that are interdependent.

- Native Species - Native species have evolved together and create a foundation for sustainable and diverse ecosystems. Species that have similar symbiotic requirements from the environment make up communities.
- Fragmentation – Ecosystems are made up of links that create integrated networks that are essential to supporting movement and adaptation of species. Breaks in these links create fragmented ecologies that decrease its ability to support diversity.
- Ecological Resistance – A healthy ecosystem can absorb a certain amount of disturbance or stress before it will collapse. Better health equals better resistance.

Aquetong Spring Park offers ecological, cultural, and socioeconomic values to the community. The ecological value is the restoration of the resilient and sustainable ecological processes of the site to conserve aquatic habitat. The cultural value is based on nature-oriented recreation and preservation of space with historical and/or spiritual significance. Socioeconomic value of the site is the ecosystem services that is provided such as clean air, clean water, and stormwater management.

Continued monitoring of conditions is an important element for the success of the project. It provides important scientific data to inform Solebury Township. The Township has already worked with Princeton Hydro to design and conduct many of the environmental monitoring programs that are currently in place.



File: P:\0885\Projects\0885004\GIS\MXD\Stream_Sampling_Station.mxd, 11/16/2017, Drawn by: thopper, Copyright Princeton Hydro, LLC.

**STREAM SAMPLING
STATION MAP**
 AQUETONG SPRING PARK
 SOLEBURY TOWNSHIP
 BUCKS COUNTY, PENNSYLVANIA

PH PRINCETON HYDRO, LLC.
 1108 OLD YORK ROAD
 P.O. BOX 720
 RINGOES, NJ 08551
 *with offices in NJ, PA and CT

NOTES:
 1. Stream sampling station locations are approximate.
 2. 2015 orthomagey obtained from the United States Department of Agriculture's (USDA), National Agriculture Imagery Program (NAIP).
 0 200 400 Feet
 Map Projection: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet



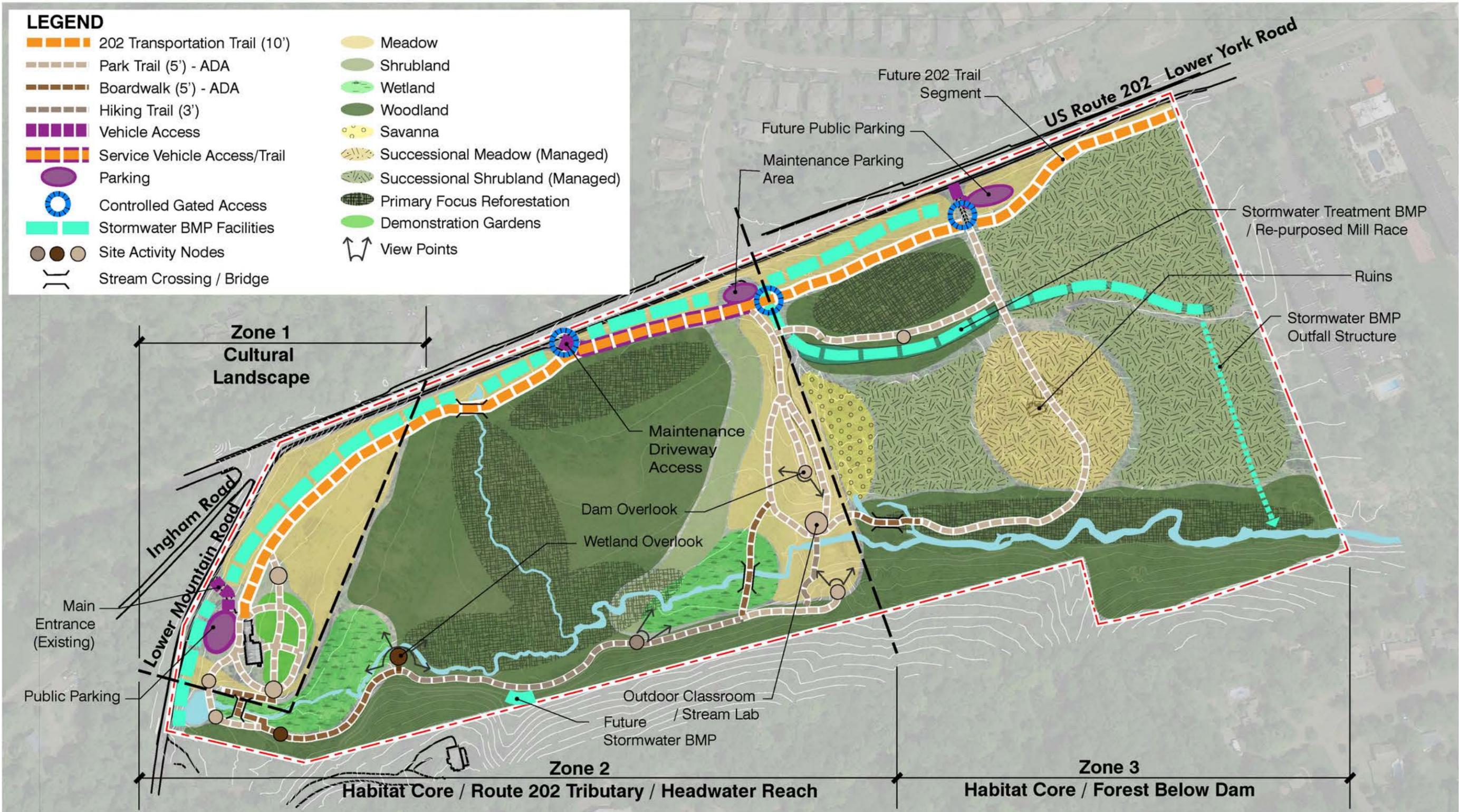
A native Brook Trout that was introduced into Aquetong Creek by Trout Unlimited in 2017.

Photo courtesy of Joseph Mihok



One of the many inhabitants of the aquatic habitat.

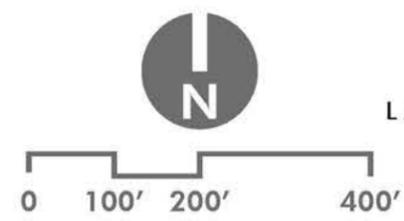
Photo by Richard Todd Halblieb



AQUETONG SPRING PARK STRATEGIC ZONES AND CONCEPT "BUBBLE" DIAGRAM

Solebury Township, Bucks County, Pennsylvania

17023.10 09/24/2018



STRATEGIC ACTION PLAN

Strategic Zones

This strategic master plan works to identify locations for preferred design elements and restoration plant communities, and conceives the site as three zones.

Zone 1 is the “cultural landscape” zone where much of the intensive public programming elements will occur. The zone 1 area was formerly used as a private residence for many years and is already “disturbed.” Focusing cultural activities in Zone 1 allows disturbances to be minimized within the core restoration areas and will protect the emerging aquatic habitat. Allowing the public access during the restoration processes is essential for the community involvement and provide learning opportunities to land ethics and to ecological services of the site. The understanding of the unique environment

that is being restored will foster a sense of stewardship within the local community.

Much of the zone can be restored to a meadow that will function to reduce and filter stormwater before it enters core habitat areas and support a wide range of wildlife. Understanding soil conditions, plant morphology, and changing environmental conditions is essential to creating a successful meadow.

Zone 2 is the area of the former lake and dam and approaching the spring head area. This zone is where much of the aquatic restoration efforts are concentrated and recreation through this area should be limited. Selected plant communities within this zone are to be managed to prevent invasive successional growth in the former lakebed and to maintain select views into



Existing conditions in zone 1 - cultural landscape 08/2018

CHAPTER 3

areas throughout the park, while consistent with riparian restoration efforts for streambank stabilization and aquatic habitat.

Public uses should be limited to trails along the perimeters of core habitats, a Native American ceremony area by the spring head, and to the area of the former dam. Trails can lead visitors to key areas within this zone to provide meaningful educational opportunities and observation points for the public.

Understanding of core habitat principles provides insight to the strategy of keeping human interaction limited and to the perimeter of key restoration areas. These include:

- Interior Habitat and Species – Dividing large patches of habitat into smaller ones reduces the size of interior habitat and population of interior species that are often of conservation importance.
- Edge Habitat and Species – Dividing large patches of habitat into smaller ones increases the size of edge communities and provides increased area for invasive species and other disturbances to enter into interior habitat. Edge width differs from abiotic influences such as solar and wind exposure. Edges also can function as a natural filter for interior patches, if properly managed. (Figure A)
- Interior and Edge Species Interaction – The more convoluted patch will increase the proportion of edge community and increase interaction, whether negative or positive, with interior species. (Figure A)
- Habitat Diversity – A large patch of habitat is more likely to contain a greater number of species with greater population, therefore creating a more healthy and resilient ecosystem. (Figure B)

Restoration of riparian ecosystems is critical to conserving aquatic habitat and is dependent on streambank stabilization and vigorous native plant communities. Soil

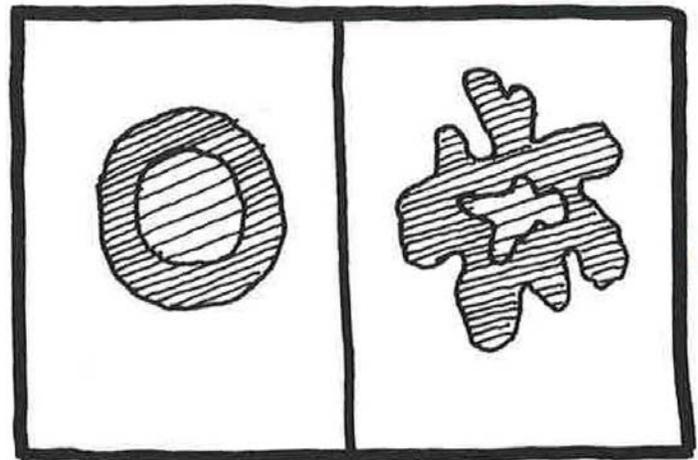


Figure A. Edge and interior - Reduced edges increase beneficial interior spaces for specialized species.

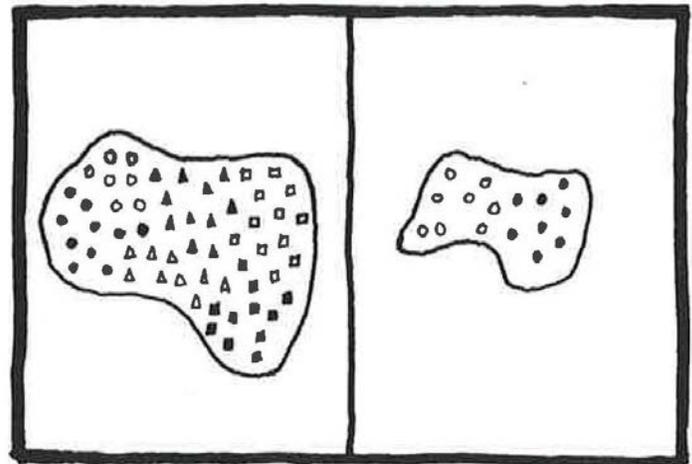


Figure B. Habitat diversity - Larger patches of habitat supports more diversity, creating a more resilient ecosystem.

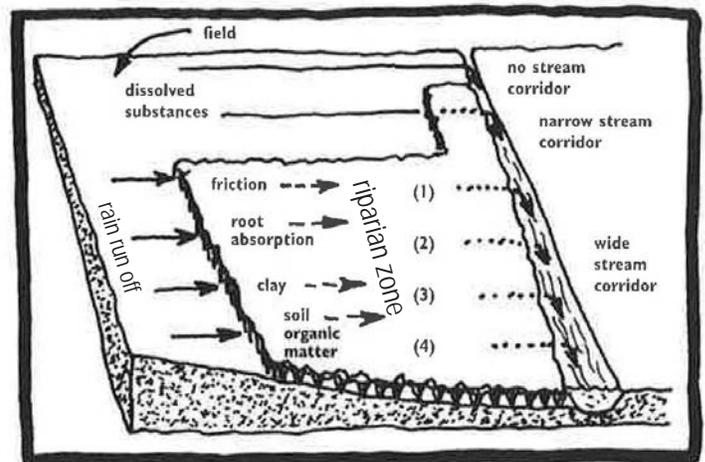


Figure C. Stream corridor and dissolved substances

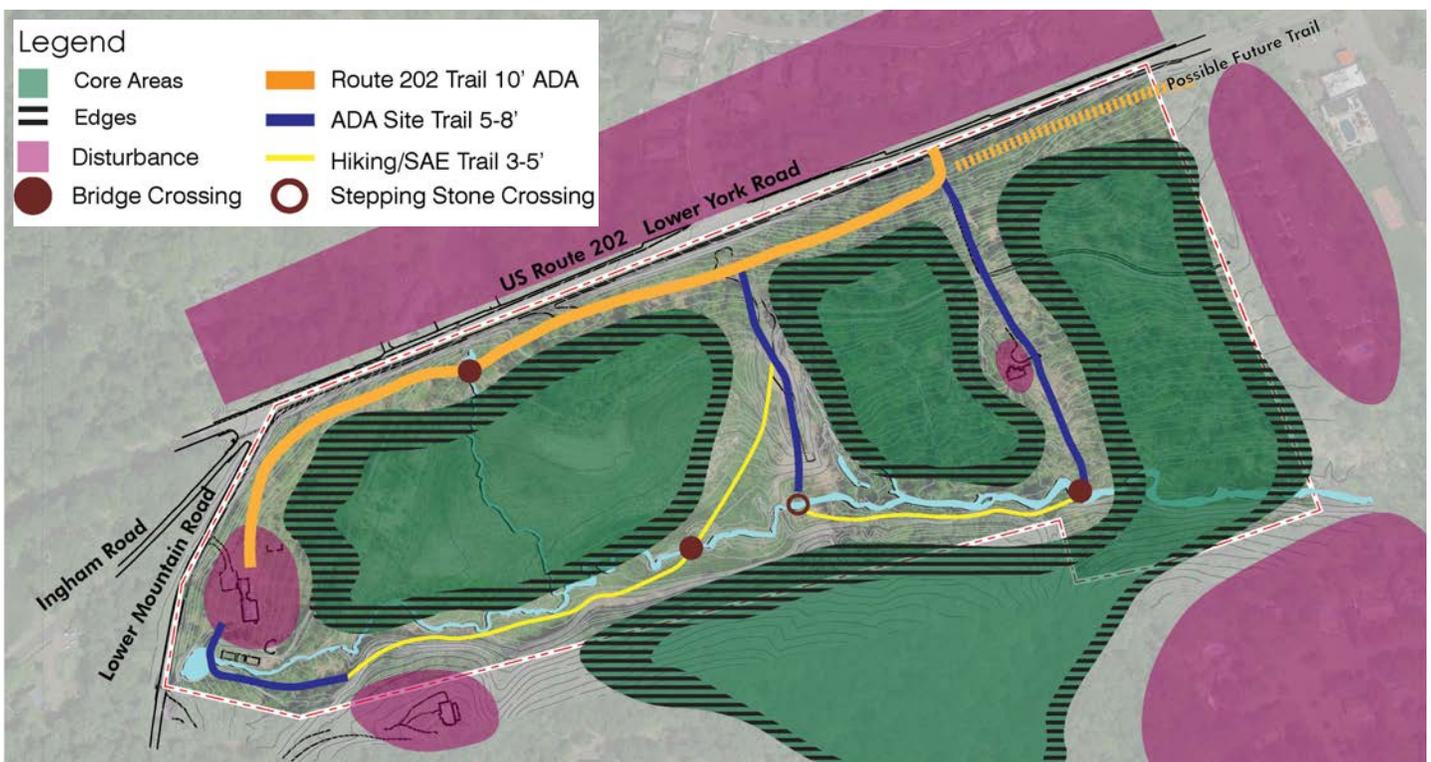
STRATEGIC ACTION PLAN

organic matter, clay, and root systems absorb or hold dissolved substances, such as nitrogen, phosphorus, and toxin, and inhibit such substance from entering the stream and negatively affecting water quality. Healthy riparian vegetation will also slow water velocity and help minimize soil erosion. Reducing vegetative gaps within the riparian ecosystem is essential to support optimum aquatic habitat conditions such as preferred water temperature and oxygen content. (Figure C)

Streambank stabilization is imperative along the new creek path that is being formed by the downcutting through the exposed lake bed along the Route 202 tributary and main stem of Aquetong Creek between the spring head and former dam.

Zone 3 is the eastern part of the site below the dam and includes the former mill site, millrace and Kate Smith House ruins. The slope in this area is steep in some locations and includes most of the afflicted mature forest that will be removed by the Township. It is critical that Solebury Township is committed to strategically reforesting vulnerable soil areas along steep slopes and riparian edges where tree removal most threatens soil erosion and water quality.

Additional plant communities can be implemented through design and management that leads to the eventual succession of a mature woodland ecosystem. Trails through this zone should be limited to reduce any further disturbance of the zone as the woodland habitat begins to establish itself.



Concept plan proposed in 08/2018 showing increased areas of Core Habitat.





CHAPTER 4 IMPLEMENTATION

CHAPTER 4

Implementation

Since the 2015 dam breach, Solebury Township has performed numerous stewardship actions at its own expense, including:

- Scientific monitoring of the legacy alluvial soils of the lake bed, as the new stream channel establishes itself;
- Professional water quality monitoring (benthic, pH, temperature) at five stations on site;
- Removal of invasive plant species in former lake bed alluvial soils, and site monitoring of conditions;
- Mitigation planting of canopy trees in the former lake bed areas;
- Professional tree survey of the ASP site, and strategy for over 1000 afflicted walnut and ash species to be removed.

Solebury Township also has continued its collaboration with non-governmental organization partners that have contributed to conservation practices at the Aquetong Spring Park, including:

- Continued water quality monitoring of Aquetong Creek by the Aquetong Watershed Association (AWA), and scientists from Princeton Hydro (PH);
- Continued monitoring of native trout from a Pocono subwatershed to Aquetong Creek by Bucks County Chapter of Trout Unlimited (TU);
- Volunteer tree re-planting on-site.

Solebury Township also has actively secured multiple sources of funding for phase 1 restoration improvements at Aquetong Spring Park. Since 2015, the Township has successfully competed and been awarded grants from multiple state and federal partners - including: recreation

funding from PA Department of Conservation and Natural Resources (DCNR); Streambank stabilization funding from PA Department of Community and Economic Development; Regional transportation trail funding from the Federal Highway Administration (FHWA) through PennDOT.

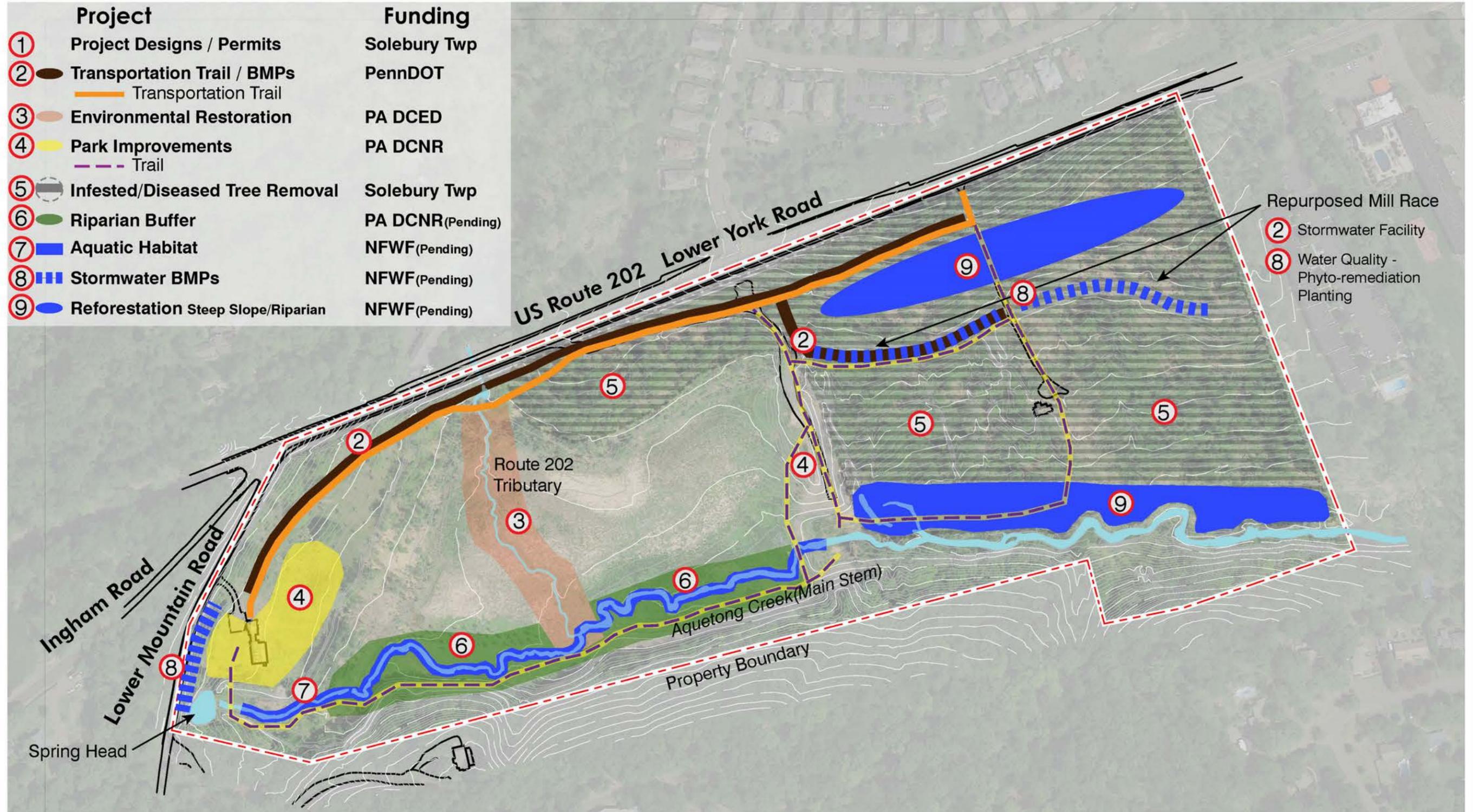
In November 2019, two additional Solebury grant applications were pending for: Riparian buffers from DCNR; and Aquatic habitat improvements from the National Fish and Wildlife Foundation.

Phase 1 Improvements are the Solebury Township priorities to be completed through 2021.

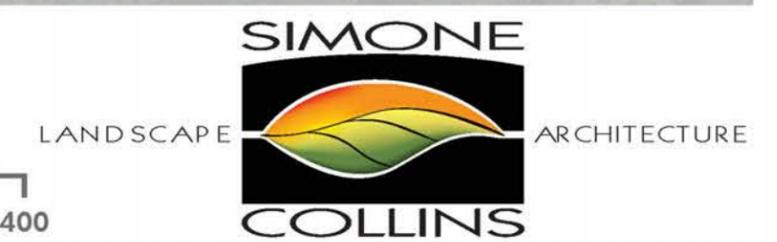
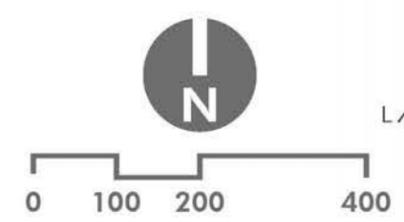
Elements 1 through 5 are capital improvement projects that are currently funded through partner programs – as described in this section. Elements 6 through 9 are capital improvement projects that are pending on funding. The Phase 1 Diagram (page 37) provides additional information in reference to these elements.

Element 1 – Design and Permitting – accounts for the costs of pre-construction tasks including investigations, design, engineering, environmental clearances and permitting needed to advance the on-site restoration improvements into construction.

Element 2 – Route 202, 9/11 National Memorial Trail Segment – PennDOT and Delaware Valley Regional Planning Commission selected the 2017 Solebury application for Federal Highway Administration “Transportation Alternatives” (TA) funds, and both agencies will administer the \$1M grant to construct a section of the Route 202 Cross-County Trail along the perimeter of the ASP site. Following Solebury Supervisor’s endorsement to join the 9/11 National Memorial Trail program, building this segment grows Solebury Township’s link to the envisioned 1,300 mile regional memorial trail. The design of the trail segment within the Park will include stormwater management facilities to intercept and treat runoff from Route 202.



AQUETONG SPRING PARK
Phase 1 Diagram
 Solebury Township, Bucks County, Pennsylvania
 17023.10 09/19/2018



Implementation Matrix Chart

Element #	Element Name	Purpose	Partners (To Be Confirmed)	Discipline	Budget	Horizon (phases) Phase 1 (1-3 Yrs) Phase 2 (4-6 Yrs) Phase 3 (7-10 yrs)	Funding Sources
1	Design and Permitting	Toward Phase 1 Elements		All	\$250,000	Phase 1	ST
2	Route 202, 9/11 National Memorial Trail Segment Phase 1/ Stormwater Management	Community Connections Regional Trail Stormwater Management		Wynn McMahon Lotus Simone Collins	\$1,000,000	Phase 1	PennDOT-TA ST
3	202 Tributary Riparian Restoration	Streambank Restoration Stormwater Management Native Habitat Restoration	Trout Unlimited (TBC) AWA (TBC)	Princeton Hydro Simone Collins	\$145,000	Phase 1	PA DCED
4	Park User Improvements	Community Connections Public Access Recreation Education	ASAC	Simone Collins	\$250,000	Phase 1	PA DCNR
5	Forestry Management Tree Removal	Diseased or Infested Tree Removal / Stabilization		Shultz Forest Princeton Hydro Simone Collins	\$100,000	Phase 1	ST
6	Riparian Buffers	Streambank Restoration	Trout Unlimited (TBC) AWA (TBC)	Princeton Hydro Simone Collins	\$250,000	Phase 1	PA DCNR - (Riparian Buffer Grant)
7	Trout Habitat Improvements	Aquatic Habitat Structures	Trout Unlimited (TBC) AWA (TBC)	Princeton Hydro	\$120,000	Phase 1	NFWF -pending
8	Stormwater Management Elements	Extend Runoff Interceptor Phytoremediation Planting		Simone Collins Princeton Hydro Wynn	\$80,000	Phase 1	NFWF -pending
9	Reforestation	Forest Canopy Management		Simone Collins Princeton Hydro	\$50,000	Phase 1	NFWF -pending
10	Invasive Species Management	Invasive Species Management	AWA (TBC)	Princeton Hydro		Phase 1-current-ongoing	ST
11	Vegetation Management	Streambank Restoration Forest Canopy Management Native Habitat Restoration	AWA (TBC)	Princeton Hydro		Phase 1-current-ongoing	ST

ST - Solebury Township, DCNR - PA Dept. of Conservation and Natural Resources, DCED - PA Dept. of Community and Economic Development, NFWF - National Fish and Wildlife Fund, PA DOT/TA - PA Dept of Transportation / Transportation Alternative, AWA - Aquetong Watershed Association, ASPAC - Aquetong Spring Park Action Committee

IMPLEMENTATION

The new regional trail segment will be an 8-10 foot wide asphalt surface that extends between the two former residential driveways on Route 202 and Lower Mountain Road. The Route 202 Trail improvements are also being coordinated with future vehicular access, parking, and maintenance access needs on site – all to contribute toward the primary goal to protect Aquetong Creek aquatic habitat.

The new Route 202 Trail segment is being designed to intercept as much stormwater as possible that runs off Route 202 and Lower Mountain Road – as well as from contributing sub watersheds on the opposite sides of those roadways. The goal is to design a stormwater diversion and treatment system within the Aquetong Spring Park that may be capable of treating rain events up to 2-year storms – or approximately 90% of annual stormwater flows. The federal grant through PennDOT includes provisions to divert off-site stormwater to the former race mill below the former dam that will be repurposed for stormwater quality treatments, where phytoremediation treatments may be added later – using plantings to remove specific toxins and to shade the stormwater before it is released back into the mainstem of Aquetong Creek. The segment of Route 202 Trail between the 202 Tributary and the former dam is envisioned to serve dual duty as a controlled-access service drive from the existing construction driveway on Route 202. In fall 2018, this element is currently being designed by the team of Robert Wynn & Associates (civil engineer), McMahon Assoc. (traffic engineer), Simone Collins Inc. (Landscape Architects), and Lotus Environmental (cultural resource specialist).

Element 3 – 202 Tributary Riparian Restoration – Solebury Township was awarded \$145,000 in Greenway Recreation and Trails Program (GTRP) funds from the PA Department of Community and Economic Development to design and install riparian stabilization measures along the “Route 202 Tributary” in the new riparian reach that

was recently exposed on the ASP site after the lake was drained. Treatments for this tributary are based on sequestration and diversion of 1 and possibly 2-year storm flows from the Route 202 right of way and from a minor branch of the watershed on the north side of the highway (as part of Element 2 – Trail / stormwater.) The GTRP-funded improvements will be integrated with the design of TA-funded stormwater infrastructure features (Element 2) and the restoration design to improve riparian buffers along the tributary reach between the Route 202 Trail and its confluence with the Aquetong Creek mainstem. Stabilizing the new stream channels is critical to minimize on-site soil erosion that can directly threaten aquatic habitat by smothering essential benthic communities that have begun to re-establish. Multiple techniques are under design by Princeton Hydro and will be managed as improvements unique to each at-risk site condition.

Element 4 – Park User Improvements – Solebury Township was awarded \$250,000 in Community Conservation Partnership Program (C2P2) funds from the PA Department of Conservation and Natural Resources to fund passive recreation features, including hiking trails, overlooks, user amenities, and ADA access features within the ASP site. The Solebury strategic master plan for ASP and the design / documentation for these amenities are instrumental to coordinate the implementation of the multiple passive recreation elements with multiple conservation elements in the overall Phase 1 site restoration strategy. This element works will evolve with continued participation by the Aquetong Spring Park Advisory Committee (ASPAC).

Element 5 – Forestry Management/Tree Removal – Solebury Township invested in a tree survey and professional forester assessment of the conditions of the mature forest canopy in Aquetong Spring Park. Shultz Forest Management & Consulting completed a report that recommended removal of over 1000 trees

CHAPTER 4

within the ASP site. Solebury supervisors voted to invest \$100,000 of Township funds to remove the blighted trees in early 2019. The outcome will be major swaths of cleared forest areas that require immediate stabilization – especially in the steep core restoration zone below the dam.

Element 6 – Riparian Buffers – Solebury Township is awaiting a decision from DCNR on a Riparian Buffer Program (RBP) grant application to design and install a variety of bio-engineered, multi-use riparian buffer features along the fragile alluvial soils of the mainstem headwater reach of the Aquetong Creek between the spring head and former dam.

Element 7 (Pending) – Trout Habitat

Improvements – Solebury Township is awaiting a decision from the National Fish and Wildlife Foundation (NFWF) regarding its application for funding from the Delaware Watershed Conservation Fund. If received, this grant will fund Phase 1 elements 7 through 9. Element seven includes design and construction of 10 in-stream trout habitat structures to be developed and the field installation overseen by Princeton Hydro. Local limestone and timber materials harvested from the park site will be used to create ten aquatic structures to enhance trout habitat and spawning within the reach of the Creek that runs through soils of the former lakebed. PH will ensure that design / installations of in-stream structures are integrated with the riparian buffer installations in the same reach (Element 6). To ensure the future of the native Brook Trout population, the introduction of non-native trout species (Brown and Rainbow Trout) will be prohibited by Solebury Township.

Element 8 (Pending) – Stormwater Management

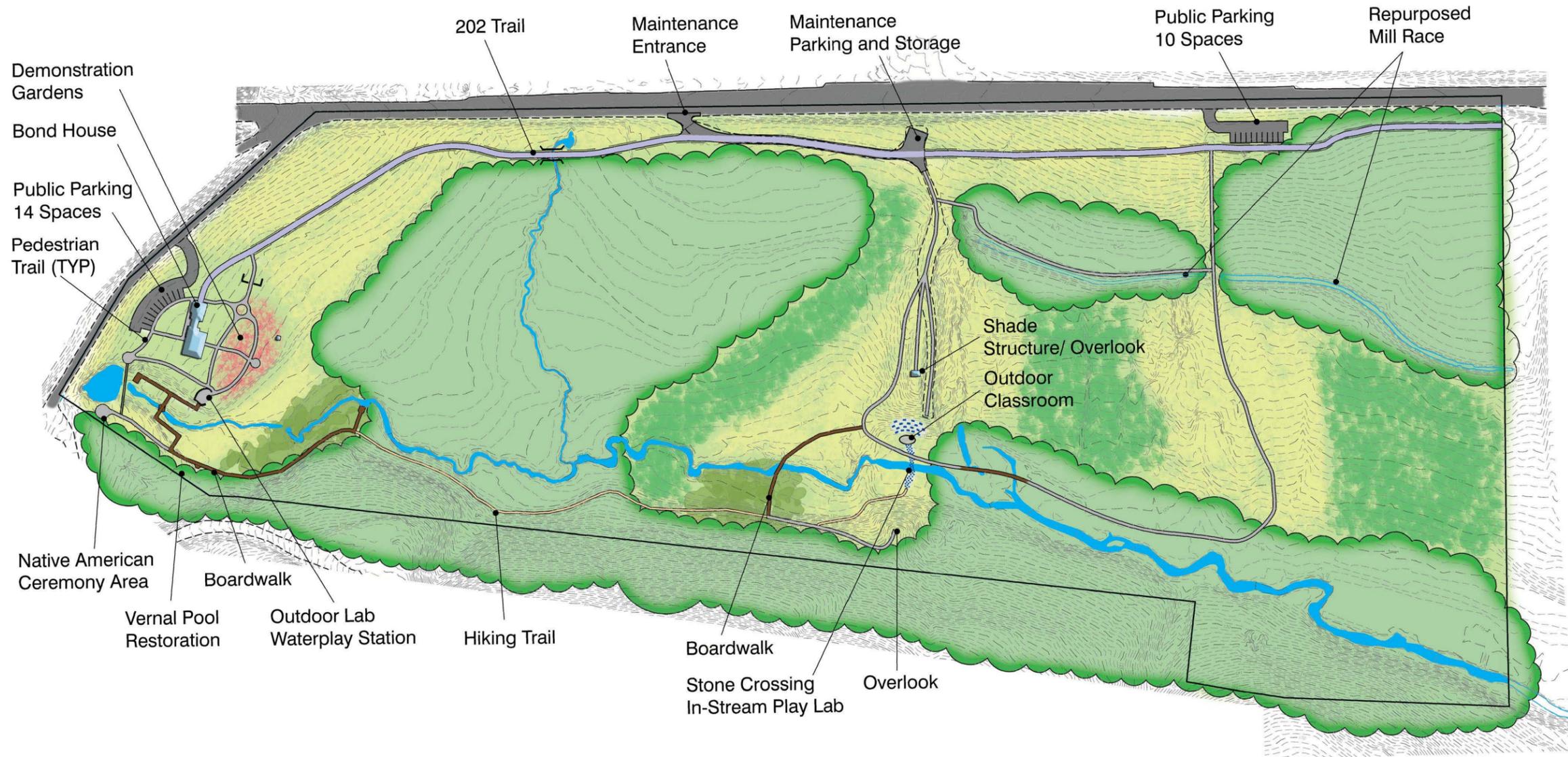
Elements – The design/installation of stormwater interceptor features located directly above the Aquetong Spring source will be integrated with the TA-funded interceptor structures to create a complete physical diversion along the entire park perimeter where it abuts

public roadways. Simone Collins will design the features that include berm / swale grading, and relocation of roadway culverts to create a complete barrier to all highway stormwater that currently flows directly into Aquetong Creek. SC will design / monitor the installation of the phyto-remediation planting for the treatment basin (the former millrace structure to be hydraulically retrofitted - Element 2,) where redirected stormwater will be treated before it is released downstream to Aquetong Creek.

Element 9 (Pending) – Reforestation – The catastrophic and immediate loss of over 1000 diseased trees within the Aquetong Spring Park site was not an issue on the radar for the ASP restoration project a year ago, but has become a proactive ecological imperative to remove the diseased ash and walnut species within public ownership sites for safety and environmental reasons. Solebury is investing in the tree removal and the restoration of the affected park acreage to achieve an initial savanna succession landscape. Princeton Hydro has confirmed that the diseased trees once felled are not continued vectors if left on site, so the timber materials will be used as soil erosion devices; stream channel habitat structures (Element 7); fauna / insect habitat; and soil building nutrients. The reforestation will be designed as a phased succession plan – with the initial 100 hardy canopy specimens to be funded by NFWF and targeted to the erosion prone steep slope and riparian edges below the dam.

Invasive species management and vegetation management remains an ongoing program element being performed by Princeton Hydro.

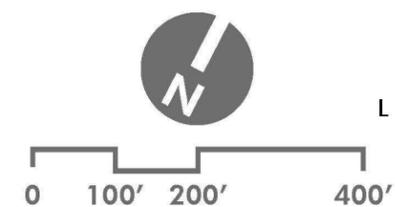
The concept site plan for the Aquetong Spring Park reflects the general locations of Phase 1 as a guide for designing future Park improvements. This concept is described through the 3 strategic zones. Zone 1 – Heritage Landscape - includes parking and trailhead services. The Bond (Judy) House is identified as a



AQUETONG SPRING PARK CONCEPT SITE PLAN

Solebury Township, Bucks County, Pennsylvania

17023.10 09/24/2018



Recommendation Matrix Chart 2

Element #	Element Name	Purpose	Partners (To Be Confirmed)	Discipline	Budget	Horizon (phases) Phase 1 (1-3 Yrs) Phase 2 (4-6 Yrs) Phase 3 (7-10 yrs)	Funding Sources
12	Core Habitat Restoration	Native Habitat Restoration Forest Canopy Management				Future Phase	TBD
13	Transportation Trail Phase 2	Community Communications Public Access	Penn DOT			Future Phase	TBD
14	Internal-walking Trails	Access Education	PA DCNR			Future Phase	TBD
15	Bond (Judy) House Re-use	Education Public Access User Services				Future Phase	TBD
16	Native American Ceremony / Programs	Cultural Education	Solebury Township Historical Society / Lenape Nation			Future Phase	TBD
17	In-stream Play Lab	Education Recreation	AWA School District			Future Phase	TBD
18	Outdoor Classroom	Education	AWA School District			Future Phase	TBD
19	Outdoor Lab Water Play Station	Education	AWA School District			Future Phase	TBD
20	Ingham House Trail Head	Community Connections Public Access				Future Phase	TBD
21	Environment / Industrial History Signage	Education	Solebury Township Historical Society (TBC)			Future Phase	TBD
22	Restoration Education	Education	Colleges (TBC)			Phase 2	TBD
23	Water System Education	Education	AWA (TBC) Colleges (TBC)			Phase 2	TBD
24	Fishing Education	Education Recreation	AWA (TBC) Trout Unlimited (TBC)			Phase 3	TBD

ST - Solebury Township, DCNR - PA Dept. of Conservation and Natural Resources, DCED - PA Dept. of Community and Economic Development, NFWF - National Fish and Wildlife Fund, PA DOT/TA - PA Dept of Transportation / Transportation Alternative, AWA - Aquetong Watershed Association, ASPAC - Aquetong Spring Park Action Committee

potential educational center and a visitor amenity. Provisions for continuing Native American ceremonies at the Spring site will be accommodated. Future rest facilities for the site should be solved in this area.

Internal pedestrian walks are envisioned as 5' wide, paved, and ADA accessible routes. Walking trail trails through the park are described as 3-5' wide – with some being ADA-accessible, and short segments of boardwalks are suggested though strategically important wetland areas, and where steep slope may be an issue to traverse. A low-impact hiking path along an existing topographic shelf within the steep slopes of southern hillside is the only path that is envisioned to not be completely ADA accessible as a- 3' wide cleared footpath.

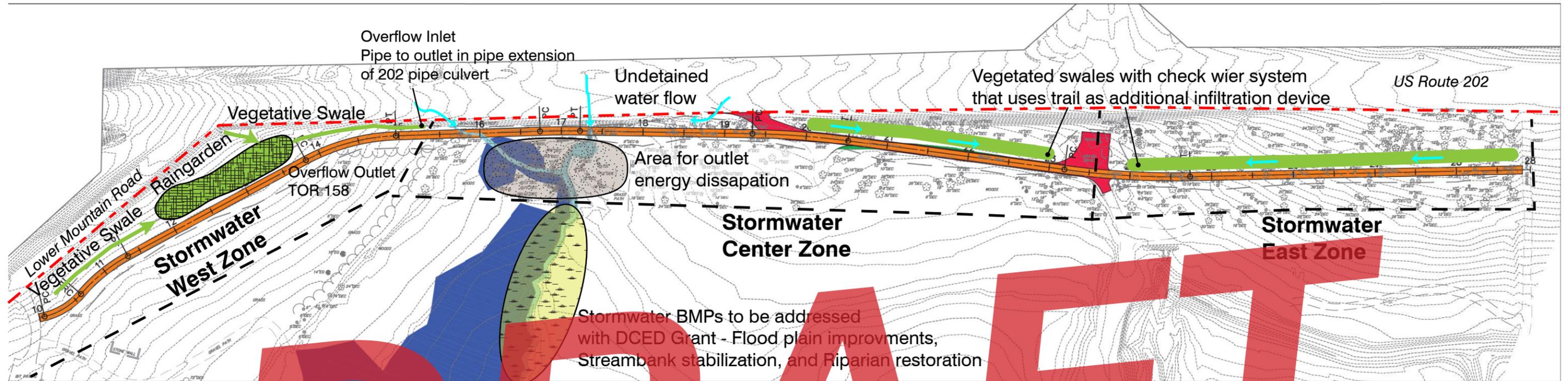
Approximately 14 parking spaces are estimated to be possible in the area at the end of the existing entrance drive. There is a space to provide educational opportunities around the spring source area. An outdoor waterplay/ lab station might be developed on a creek side platform on site. Demonstration gardens can provide mowed lawn alternatives and native plant educational space. Lawn areas should be kept to a minimum for stormwater management to reduce the volume and velocity of rain water that would sheet flow down a mowed slope into the restored lake bed area.

ADA-accessible paths from Zone 1 into Zone 2 will enable access to key locations to observe views into the large former lakebed habitat core area and restored stream in Zone 2. A "loop" walking trail network is suggested through Zone 2 to link to walking trails in Zone 3. The former dam area is recommended to provide programming opportunities, including an outdoor classroom, interpretive overlook, and a "stepping stone" crossing of Aquetong Creek that may also serve as an in-stream play lab. The multi-modal Route 202 trail will run along US Route 202 through all three zones and be the only trail within the ASP site to serve bicycle use. Possible future parking and a Route 202 trail extension eastward to the property line is proposed in zone 3.

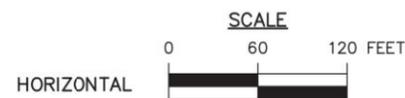
Solebury Township Technical Team

- Simone Collins Landscape Architects (SC) - Lead design of the DCNR Park Improvements (element 4); review and coordination of restoration and 202 Trail work; stream design with Princeton Hydro.
- Princeton Hydro (PH)- Environmental Engineers - Lead design on Stream and Riparian restoration (element 3); review and coordination of park and trail work.
- Robert Wynn & Assoc. (WA)- Civil Engineers - Review and coordination on Park Improvements; 202 Trail stormwater management / Trail design (element 2); coordination with tree removal
- McMahon & Assoc. (MA)- Traffic Engineer - 202 Trail Team Management / design / PennDOT Submission Navigation (element 2)
- Lotus Environmental Consulting LLC - Environmental / Cultural Resources - 202 Trail Environmental and Cultural clearance work (element 2)
- Shultz Forest Management and Consulting LLC - Forest management report and tree removal (element 5).

TASK TIME LINE	2015	2016	2017	2018	2019	2020	2021	2022
ASAC (Aquetong Spring Advisory Committee)					→			
STREAM RESTORATION								
DAM BREACH	█							
TREE RESTORATION PLANTING		█						
STREAM ASSESSMENT			█	█				
DCED GRANT AWARD			█					
RESTORATION DESIGN				█	█			
CD'S & BID STREAM RESTORATION					█	█		
CONSTRUCTION						█	█	
MANAGEMENT								→
PARK IMPROVEMENTS								
DCNR GRANT AWARD	█							
MASTER PLAN				█				
CD'S & BID PARK IMPROVEMENTS					█	█		
CONSTRUCTION						█	█	
202 MULTI-USE TRAIL								
TA GRANT AWARD			█					
CD'S & BID PARK IMPROVEMENTS				█	█	█	█	
CONSTRUCTION							█	█
FOREST RESTORATION								
REPORT				█	█			
REMOVAL OF INFESTED TREES					█			
RESTORATION PLANTING					█	█	█	
MANAGEMENT								→



- 10' MULTI-USE TRAIL
- PAVED TRAIL SHOULDER/DRIVEWAY AREA
- EXISTING GRAVEL DRIVEWAY TO BE REMOVED
- SURVEYED WETLAND AREA
- SURVEYED STREAM AREA
- APPROXIMATE LIMIT OF DISTURBANCE



AQUETONG SPRING PARK ROUTE 202 TRAIL SEGMENT - CONCEPT STORMWATER MANAGEMENT

Solebury Township, Bucks County, PA
17023.10 11/09/2018

IMPLEMENTATION

Currently, work has begun on the design of element 2- Route 202 Transportation Trail Segment. The Route 202 Trail Segment- Concept Stormwater Management diagram on page 44 shows the preferred trail alignment from the concept prepared by MA, and has been confirmed by the Solebury Township (ST) team. The preferred 202 Trail alignment was selected to avoid wetlands on site to the greatest extent possible, as well as to align the trail to the perimeter of the site as much as possible and practical - with the intention to conserve the maximum contiguous core habitat areas toward the interior of the site, and to minimize site grading and disturbances.

SC is presently working to identify preferred stormwater BMPs, including raingardens, vegetative swales, and runoff diversion options. The concept on page 44 begins to show where these devices will be located.

As the ST team continues to coordinate and use their technical expertise to implementing the various elements, the success of this project improves greatly. When completed, Aquetong Spring Park will be a treasured natural resource for the public and serve as an example for future restoration projects.



The new sign for Aquetong Spring Park erected in 06/2018.

