# Bristol Marsh

## Learning Beyond the Classroom

# Pennsylvania Coastal Zone Management Program

FINAL REPORT

**"Bristol Marsh: Learning Beyond the Classroom"**

*June 2015*

**CZM PROJECT NUMBER: 2013PD05**

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HERITAGE CONSERVANCY

ACCREDITED LAND TRUST ACCREDITATION COMMISSION

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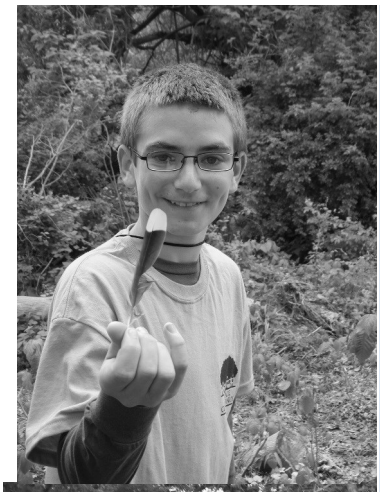
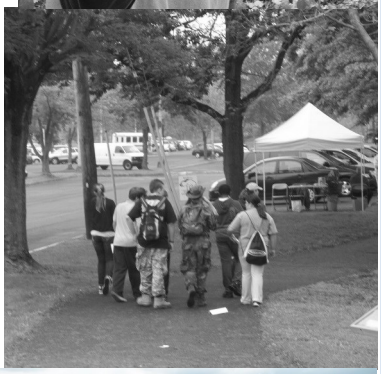
June 2015





***About this Guide….***

Bristol Marsh is a great place to connect with nature and explore a rare, yet local freshwater tidal marsh — one of the few remaining along the Delaware River in Pennsylvania.

This guide is designed to introduce teachers and students to this important wetland habitat, connect community resources with curriculum and lesson themes, and encourage hands-on learning outside the classroom.

Benefits of utilizing Bristol Marsh as a teaching tool:

**For teachers**...

- Provide a real-life example of wetland ecology that supports and enhances in-class instruction.
- Extend student learning beyond the classroom.
- Supplement standards-based lesson plans.
- Foster awareness, appreciation and understanding of the local environment.
- Educate students with an interactive approach.

**For students**...

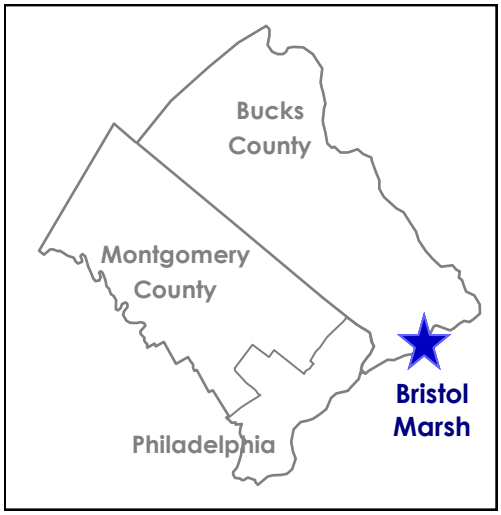
- Apply newly acquired academic skills and knowledge to real-life science.
- Explore Bristol Marsh Nature Preserve as an outdoor learning laboratory.
- Build new and different connections to the community.
- Learn environmental stewardship through hands-on investigative field study and experiences.

Our goal is to connect kids with nature – with the hope of inspiring them, as well as their parents, families and teachers, with a deeper appreciation for the environment.

***Happy Learning!***

# Bristol Marsh Nature Preserve

Bristol Marsh is located in the Borough of Bristol, Bucks County, Pennsylvania. In 1986, The Nature Conservancy established the Bristol Marsh Nature Preserve and permanently protected the wetland to safeguard its natural significance. In 2000, Heritage Conservancy became a local partner helping The Nature Conservancy manage Bristol Marsh for conservation and provide special opportunities for education. Together, these organizations perform monitoring and habitat restoration activities to protect and enhance the marsh's natural resources.




As a protected nature preserve, Bristol Marsh provides a quiet sanctuary for visitors to enjoy and appreciate its scenic and environmental resources. A paved walking path along the eastern edge of the Marsh features three observation platforms for close-up views of the freshwater tidal wetland and the Delaware River. Interpretive signs highlight the marsh's natural and cultural significance.

Bristol Marsh Nature Preserve is a collection of privately and publically owned lands. The Borough of Bristol owns approximately half of the preserve, located north of Otter Creek and adjacent to the municipal maintenance building and parking lot. The Dow Chemical Company also owns a large portion of the preserve located on the south side of Otter Creek. A small section of the marsh is owned by The Nature Conservancy. The preserve is protected by conservation easements that restrict uses to protect the marsh's water quality, wildlife, flora and fauna.

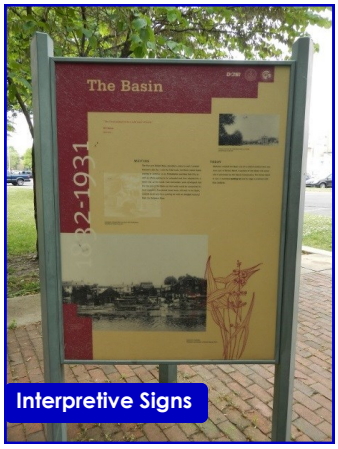
The northern side of the marsh is open to the public everyday, dawn to dusk. However, public access is not permitted within the preserve south of Otter Creek.

Heritage Conservancy and The Nature Conservancy offer guided tours, educational programming and volunteer events that provide opportunities for individuals and groups to study and appreciate this area. Visitors to Bristol Marsh are asked to respect all rules and regulations posted at the preserve.

**Amenities at Bristol Marsh Nature Preserve:**

Walking Trail

Observation Pier



Interpretive Signs

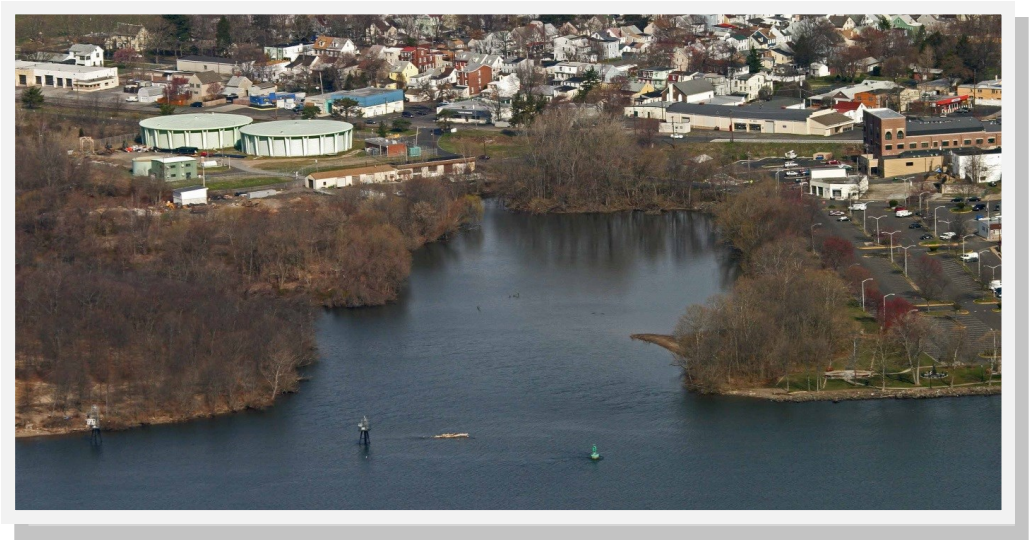
## What is a conservation easement?

A conservation easement is a voluntary legal agreement between a landowner and a land trust or government agency that permanently limits uses of the land in order to protect its conservation values. Landowners keep many of their rights, including the right to own and use the land and to sell it.

The Nature Conservancy works around the world to protect ecologically important lands and waters for nature and people by partnering with local communities, businesses, governments, and other non-profits to conserve nature.

Heritage Conservancy is a community based organization dedicated to the preservation and protection of significant open spaces, natural resources, and historic heritage. Heritage Conservancy is a nationally accredited land trust working in Bucks, Montgomery, and Northampton counties.

# Bristol Marsh - A Wetland Ecosystem



*High tide at Bristol Marsh* *PA Department of Environmental Protection*

A *wetland* is a place where the land is covered by water or the soil is very wet (hydric) for an extended period of time. Although a wetland may not be wet year round (water may evaporate during the dry season), water is the most important component of a wetland ecosystem. It controls soil characteristics and influences what types of plant and animal life will live there.

Although wetlands comprise only about six percent of the earth's surface, they are one of the most productive and valuable ecosystems on the planet. Here are some of the amazing services that wetlands offer:

- Help maintain water quality by filtering pollutants
- Control flooding
- Reduce erosion
- Provide critical habitat to rare and endangered species of plants and animals
- Recharge groundwater
- Offer open space for educational and recreational activities including bird watching, nature study, fishing, canoeing, walking, and more!

The four main types of wetlands are swamps, marshes, fens and bogs. Bristol Marsh is a freshwater tidal marsh - one of the best examples of its kind in Pennsylvania. A tidal marsh is a type of wetland influenced by tidal movement. Freshwater tidal marshes occur on major rivers and estuaries. Bristol Marsh is one of few remaining freshwater tidal marshes on the Delaware River and is located within the Delaware Estuary.

Bristol Marsh experiences tides averaging four to six feet twice a day. Tides are the result of the gravitational pull of the sun and moon on the earth. They occur approximately 12 hours and 25 minutes apart, cycling with the 24-hour and 50-minute lunar day, almost an hour longer than a 24-hour solar day.

In addition to the Delaware River, Bristol Marsh receives water from Otter Creek and is part of a larger water network known as Otter Creek Watershed.

Freshwater marshes vary in size from very small to very big. Bristol Marsh is about 28 acres – roughly the size of 21 football fields. At one time, Bristol Marsh was over four times as large as it is today - more than 115 acres or 85 football fields. Over the years, parts of the marsh were filled in for development and used as a dumping ground for waste materials.

Freshwater tidal marshes like Bristol Marsh are fragile, yet highly productive ecosystems. Specialized vegetation and shallow water provide diverse habitats for a variety of species including insects, amphibians, reptiles, birds, fish and mammals that depend on wetlands for food, shelter, breeding and nesting sites for part or all of their lifecycle. ***Almost half of federally-listed endangered animals rely on wetlands for survival.***

*Low tide at Bristol Marsh during the summer. Lush wetland vegetation emerges from below the water's surface.*

*Low tide at Bristol Marsh in the winter reveals bare mud flats.*

BRISTOL MARSH BIOBLITZ
HERITAGE CONSERVANCY

In May 2013, Heritage Conservancy organized a 24-hour BioBlitz at Bristol Marsh to identify as many plants and animals as possible. A team of scientists, students, teachers and volunteers worked together to identify **378** different species including: 7 reptiles & amphibians, 16 mammals, 68 birds, 78 invertebrates and 198 plants!

Some of the findings are featured in this guide. For a complete list of species identified during the BioBlitz, contact Heritage Conservancy.

# Wetland Plants

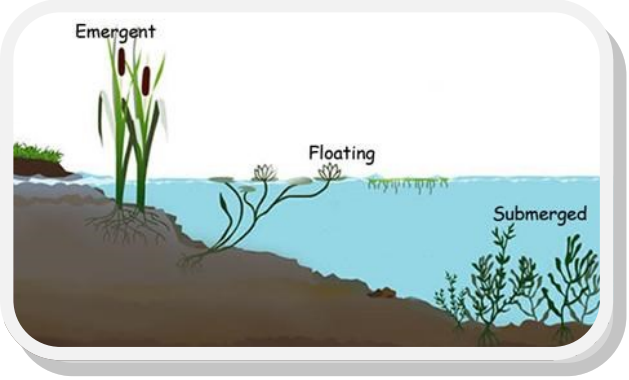
Freshwater tidal marshes, like Bristol Marsh, contain high plant diversity, but not all plants can survive in wetlands. Most plants don't grow in wetlands because the soil is too wet and their roots aren't able to breathe. Wetland plants are hydrophytes, which means they love growing in damp and water-logged places like Bristol Marsh. Overtime, hydrophytes developed characteristics that help them live and grow in very wet soil with little to no oxygen. These special features are called adaptations and explain why certain plants are found in one habitat, but not in another. For example, you won't see a cactus growing in Bristol Marsh. However, you will find a lot of other special plants that you aren't likely to find in your backyard or the local park. Almost 25 percent of threatened or endangered plant species exist in wetlands. Bristol Marsh is home to seven state rare and endangered plant species.

Most plants in the marsh are herbaceous, which means they do not have a woody stem or trunk above ground. Wetland plants generally fall into three categories:

**EMERGENTS** are rooted in the soil, but have stems, leaves, flowers and fruits that extend above the water's surface. Examples: broadleaf arrowhead, soft rush, and cattail.

**FLOATING PLANTS** have leaves that float on the surface of the water. Examples: water lily and duckweed.

**SUBMERGENTS** grow completely beneath the surface of the water. Examples: water milfoil, wild celery, and eelgrass.




BRISTOL MARSH BIOBLITZ

**PLANTS**

| | |
|---|---|
| Arrow Arum | Spatterdock |
| Bur Marigold | Pickerelweed |
| False indigo | Sweet flag |
| Jewelweed | Yellow water lily |

Pickerel weed

Sweet flag

False indigo

Yellow water lily

# Fish

The wetland habitat at Bristol Marsh is just the right ecosystem to support the reproduction of fish. Rich in food supply and low in predators, the tidal freshwater marsh is a common spawning ground for several species of fish. It is also an important nursery for juvenile fish.

Many fish species are attracted to Bristol Marsh's dense vegetation that provides plentiful food and protective cover. Fish need shelter from predators. Both adult and juvenile fish hide in the thick plant growth that many larger predators are unable to enter or navigate. The shallow water at Bristol Marsh also prevents many larger predators from entering the wetland habitat, providing larvae and juveniles with a safe nursery and feeding area. Insects and decomposed plant matter, both found in large supply at Bristol Marsh, serve as important food for nearly all fish that visit this wetland.

BRISTOL MARSH BIOBLITZ

FISH

American eel

Fall fish

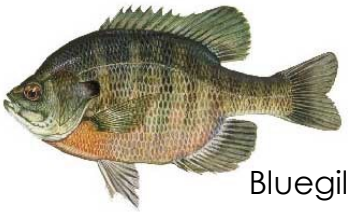
Mummichog

Redbreast sunfish

Spottail shiner

Tessellated darter

Carp



Bluegill sunfish

Banded killfish

Pumpkinseed sunfish

Fishing is a popular recreational activity at Bristol Marsh. Carp is the most frequently caught fish at Bristol Marsh. Carp often grow one to two feet in length and weigh one to eight pounds

All anglers 16 years and older must have a current Pennsylvania fishing license and obey the rules and regulations of the Pennsylvania Fish and Boat Commission. Visitors to Bristol Marsh are asked to respect any additional rules and regulations posted at the preserve. Please properly dispose of tangled fishing line to prevent wildlife from becoming trapped and injured.

# Birds

Wetlands are a great place to see a wide variety of bird life. About one-third of North American bird species use wetlands for food, drinking water, shelter, rest, nesting, breeding and rearing young. Over 140 species of birds have been spotted at Bristol Marsh!

Bristol Marsh is a refuge for birds in an otherwise urbanized landscape. Its lush vegetated cover offers shelter from weather and predators. Predators are likely to swarm where birds concentrate, breed, or raise their young. Wetlands form an important barrier to land-based predators and reduce risks to eggs or nestlings. Some birds depend on wetlands almost totally for breeding, nesting, feeding, or shelter during their breeding cycles. Many migratory birds are wetland dependent, using wetlands during their migration and breeding seasons.

The abundant and varied food sources available at the marsh are ideal for many birds. Wetlands provide a range of food sources including plants, fruits, fish, aquatic insects, invertebrates, and small mammals. Different birds seek food in different places: some forage for food in the wetland soils, some find food in the water, and some feed on the vertebrates and invertebrates that live on submerged and emergent plants. Some ducks search the mud for worms and crustaceans with their heads under water. Waders have long bills for probing the mud for small worms and mollusks. Herons stand motionless by the water's edge and stab a passing fish with dagger-like beaks. The bald eagle dives from its perch and catches fish with its sharp talons.

**Return of the Bald Eagle.** Once in danger of extinction, the American Bald Eagle population has recovered from its decline in the 1960s due to habitat destruction, illegal shooting, and harmful pesticides. In 2012, a pair of Bald Eagles was discovered nesting on Burlington Island, located across from Bristol Marsh on the New Jersey side of the Delaware River. Bald Eagles live near rivers, lakes, and marshes where they can find fish, their staple food. Eagles mate for life, choosing the tops of large trees to build nests, which they typically use and enlarge each year. Nests can reach 10 feet across and weigh a half ton!

BRISTOL MARSH BIOBLITZ

BIRDS

| | |
|---|---|
| Bald Eagle | Belted Kingfisher |
| Cooper's Hawk | Great Blue Heron |
| Osprey | Turkey Vulture |
| Yellow Warbler | Wood Duck |

# Mammals

Bristol Marsh supplies both shelter and food for mammals. Mammals such as beavers and otters make their homes in wetlands and other aquatic habitats where there is a plentiful supply of their preferred foods. White-tailed deer are frequent visitors to Bristol Marsh, where they can find water and dense vegetation for food and refuge. In turn, these mammals help wetlands flourish by dispersing seeds, providing predators with food, aerating soils with burrows, and controlling insect populations.

Like plants, some mammals that live in wetlands have developed unique adaptations that make it possible for them to live and thrive in wet habitats. These adaptations help animals survive in wet environments and are passed down from one generation to the next.

Beavers are found along streams, ponds and lakes throughout most of the United States. They have also been spotted at Bristol Marsh. Although they might be a bit clumsy on land, beavers are excellent swimmers. When beavers dive below water, their heart and metabolic rates slow down and allow them to stay underwater for up to 15 minutes!!

Sometimes, it can be difficult to spot animals in their natural habitat. They can hear, smell or see us long before we see, or even get near them. They use incredible skills of flight and camouflage to avoid interactions with humans and potential predators. Although you may not see a fox or deer when you visit Bristol Marsh, you might see signs that an animal has been there. Animals leave behind lots of clues about where they've been and what they've been doing. If you look closely, you may find paw prints, scat, fur, feathers, nests, skulls, bones, trails, chew marks, and other signs that an animal has left behind.

BRISTOL MARSH BIOBLITZ

MAMMALS

| | | |
|---|---|---|
| Beaver | Big brown bat | Domestic dog |
| Feral house cat | Grey squirrel | Groundhog |
| Hoary bat | Raccoon | Red bat |
| Silver-haired bat | Tri-colored bat | White-tailed deer |

Grey fox

Striped skunk

Eastern chipmunk

# Amphibians and Reptiles

Reptiles and amphibians share many similarities. For example, both are vertebrate animals that have backbones. They are also cold-blooded or "ectothermic," which means that they depend on external sources, such as the sun, to maintain their body temperatures. However, there are a few major differences that separate reptiles and amphibians.

**Amphibians.** Many amphibians need both aquatic (water) and terrestrial (land) habitats to survive, making wetlands like Bristol Marsh very important. In fact, the word amphibian means "double life," which describes how they spend some of their life in water and some on land.

BRISTOL MARSH BIOBLITZ
AMPHIBIANS

Most amphibians, including frogs and toads, begin life as eggs floating in the water. When an egg hatches, it begins its larva stage as a tadpole and remains in the water. As a tadpole grows into its adult form, lungs develop the ability to breathe air and the amphibian begins to live on land. The transformation that occurs from larva to adult is called a metamorphosis. Depending on the species, metamorphism can take anywhere from two months to three years.

American Bullfrog

A female frog can release up to 3,000 eggs at once! Frogs lay so many eggs because they do not look after their young and most do not survive to adulthood. From the thousands of eggs that one female may lay, it is likely that less than ten will become adult frogs. The majority of the eggs or tadpoles may be eaten by birds, fish, newts, water beetles, dragonflies or dry up before hatching.

Green Frog

Tadpoles have sharp teeth that are used to scrape off algae and plant-based material from rocks. Adult amphibians are meat-eating predators. Their prey includes insects, slugs, snails, worms, fish, and even small mammals, such as mice. Most amphibians rely on camouflage to stay safe. Frogs are the best example. Their skin color and patterns copy their surroundings. Some frogs can even change color!

Fowler's Toad

**Reptiles.** Unlike amphibians, reptiles do not have to live part of their life in water. Most reptiles can live their entire lives on land and lay shelled eggs on land. Young reptiles are born with lungs and breathe air, but do not pass through an aquatic larval stage with gills like most amphibians. The most noticeable feature of reptiles is their scales or scutes. These protective layers keep the skin from drying out and lets some reptiles live in dry places like the desert.

Reptiles, including some turtles, lizards, and snakes, have adapted to living in water and can be found in freshwater marshes and ponds. Although they have adapted to spending the majority of their lives in water, they must come to the surface to breathe air and return to land to lay their eggs.

Lizards and snakes are the largest group of reptiles. Lizards are four legged animals with a long tail. Many lizards can shed their tail to escape from predators and can then grow a new tail. Some lizards use camouflage to avoid predators. The chameleon is very good at changing its color to blend into the environment.

BRISTOL MARSH BIOBLITZ

REPTILES

Common Map Turtle

Northern Water Snake

Eastern Redbelly Cooter

Red-eared Slider

# Invertebrates

Invertebrates are animals without a backbone. The bodies of many invertebrates, including crayfish and insects, are supported by exoskeletons. Invertebrates may be small and spineless, but they are the most abundant and varied of all wetland animals. In fact, over 95 percent of all species alive today are invertebrates. Insects are the most numerous of all invertebrates. That means that vertebrates, animals with backbones, including mammals, amphibians, reptiles, fish, and birds, make up less than four percent of all animals species.

Spiders, scorpions, centipedes, millipedes, crustaceans, insects, horseshoe crabs, worms, leeches, mussels, clams, snails, squid, octopus, sea anemone, and corals, are just a few known invertebrates. Scientists are identifying new species all the time.

Invertebrates inhabit both aquatic and terrestrial environments. Macro invertebrates are large (macro) enough to be seen with the naked eye. Most aquatic invertebrates live part or most of their life cycle attached to submerged rocks, logs, and vegetation at the bottom of the marsh. Meanwhile, many types of insects, such as mosquitoes, dragonflies, and mayflies begin their life cycle in water, but become winged adults that fly in the air.

Aquatic invertebrates are excellent indicators of water quality because they are extremely sensitive to pollution. The number of invertebrates found in a wetland habitat can help determine whether the water quality is good or bad. For example, having many invertebrates in a wetland indicates that the ecosystem is healthy. However, if their population starts to decrease or they are suddenly missing that means something has changed and is likely harming the ecosystem. Biologists and conservationists monitor invertebrates to identify early signs of poor or impaired water quality.

BRISTOL MARSH BIOBLITZ

**INVERTEBRATES**

| | |
|---|---|
| Alewife floater | Aquatic earthworm |
| Eastern elliptio | Grass spider |
| Hydrobid snail | Leech |
| Ladybug | Marsh fly |
| Phantom midge | Riffle beetle |
| Sow bug | Water flea |

Carabid beetle

Flower fly

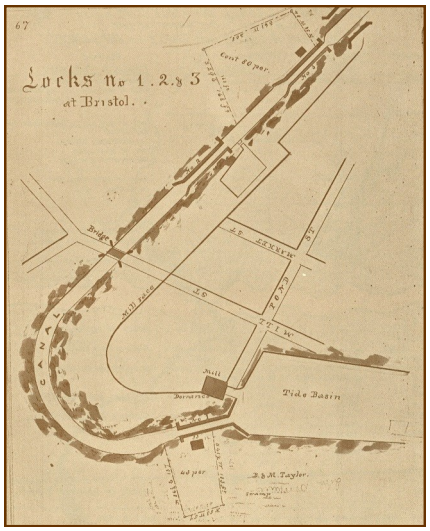
Tiger swallowtail

Whitetail dragonfly

# Bristol Marsh - A Historical Perspective

In addition to its ecological significance, Bristol Marsh is an exciting place to learn about the region's history and culture. It is located in Bristol Borough, Bucks County. Bristol Borough is the oldest town in Bucks County and the third oldest in Pennsylvania. See following pages for a brief history.

**Delaware Division of the Pennsylvania Canal**




*Early engineer's drawing of Bristol Basin and Lock Nos. 1, 2 and 3.*

One of the most notable historic features of Bristol Marsh is that it was once the terminus of the Delaware Division of the Pennsylvania Canal. The Delaware Canal was constructed between 1827 and 1832. It travels sixty miles south from Easton, Pennsylvania and served as the regions main commercial shipping corridor until 1932.

Blue bollards along the Bristol Marsh Nature Preserve trail and tree line represent the approximate location of the former canal.

The parking lot next to the marsh was once part of the larger freshwater tidal wetland habitat. However, to support canal operations, approximately five acres of the marsh were dredged and converted into a basin. Delaware Canal Lock Number 1 was located at the top of Bristol Basin. The basin provided a place to "park" boats that were waiting to be unloaded. A large concrete circle near the eastern corner of the nature preserve, marks the location where one of several huge cranes stood. Cranes were used to unload cargo from canal boats and ships. Cargo from canal boats was transported to other towns and cities including New York and Philadelphia.

*A concrete circle marks the spot of a former crane used for unloading cargo from canal boats.*

*Blue bollards represent the approximate location of the canal.*

# A Changing Landscape

Historic map of Bristol Borough shows the location of the canal basin next to Bristol Marsh, depicted at low tide.

Current aerial photograph shows the existing municipal parking lot that was built on top of the basin. Source: bing.com

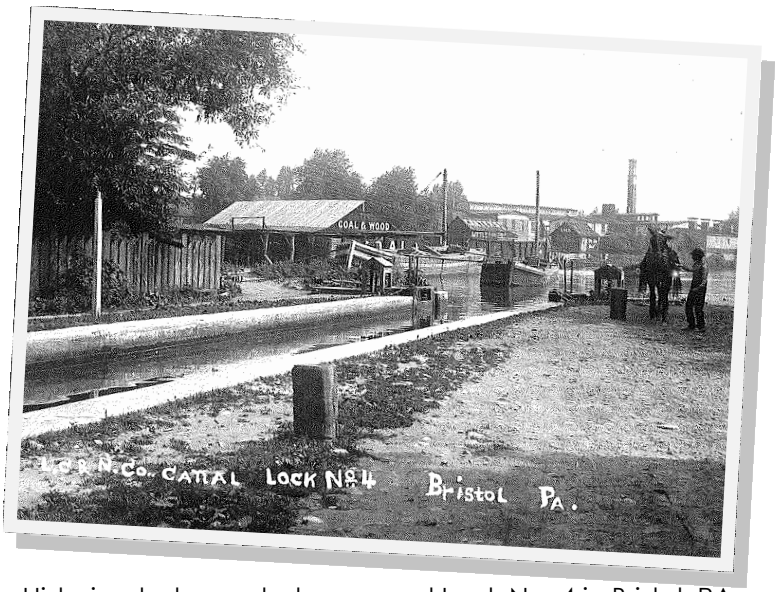
# A Brief History of Bristol Borough, PA

**1600s.** Prior to the establishment of the Commonwealth of Pennsylvania in 1681, European settlers moved to the area along the Delaware River that was inhabited by the Lenni-Lenape Indians. By 1697, settlers received permission to lay out a town. Buckingham was chosen as the town's name. After 1700, the name was changed to Bristol. "The King's Highway" was constructed in 1696 to connect Philadelphia and Morrisville. Present day Radcliffe Street follows the route, which was the first public road in Bucks County.

**1700s.** Over the course of the 18th Century, Bristol became a commercial center for the region. Mill Street was the major marketplace, where timber and grist mills processed and shipped the products of surrounding farms. From 1705 to 1725, Bristol was the County Seat. Bristol was incorporated in 1720 and became the first borough in Bucks County and the third in Pennsylvania. By 1714, a ferry linked Bristol to Burlington, New Jersey across the Delaware River. In 1740, a shipyard was built in the rear of Mill Street near Wood Street and operated throughout the 18th and 19th centuries.

From the latter half of the 18th Century through to the first quarter of the 19th Century, Bristol was a popular resort area. Many visitors were attracted to the Delaware River's scenery and cool breezes. Bristol also offered Bath Springs, a mineral spring with a hotel and racecourse. Bristol was a pleasant break from Philadelphia, then the largest city in North America. Radcliffe Street attracted affluent residents who constructed elegant homes. Many were second homes that served as retreats from Philadelphia, the young nation's capital.

**1800s** - In 1832, the Delaware Canal was completed and extended along the Delaware River from Easton to Bristol, over 60 miles. The Canal allowed coal and other products to be transported more easily and cheaply from the northern Pennsylvania regions. Goods were then shipped from Bristol to Philadelphia and New York City. A few years later, one of the nation's earliest major railroad lines was built through Bristol connecting New York City and Philadelphia. As a result, major industrial manufacturers located between the canal and the railroad.




Historic photograph show canal Lock No. 4 in Bristol, PA.

# A Brief History of Bristol Borough, PA, *continued.*

**1800s.** By the mid-1800s, Bristol's prosperity began to decline. When the railroad began transporting coal and outlet locks were constructed in New Hope, the shipping trade was lost. In reaction, the Bristol Improvement Company was founded in 1876 by local citizens. The Bristol Improvement Company built new industrial buildings between Beaver Street and Jefferson Avenue and promoted Bristol's attractions to new industries. Some of the factories built by the Improvement Company were sold to private industry, while others were leased. These efforts spurred industrial employment growth in wallpaper, carpets, iron, leather and textiles. The new factories attracted immigrants from Italy, Germany, Ireland, Poland and Czechoslovakia, among others.

**1900s** - Bristol played an important role during World War I. Ships were needed to get food, troops and equipment quickly to Europe. The Federal Fleet Emergency Corporation authorized a shipyard and workers' housing to be built just outside of Bristol. The shipyard town, Harriman, was annexed to Bristol Borough in 1923. During World War II, many Bristol residents were employed by manufacturers including Rohm & Haas and the Fleetwings companies. U.S. Steel also opened a plant near Bristol. The wartime manufacturing boom continued well into the 1950s.

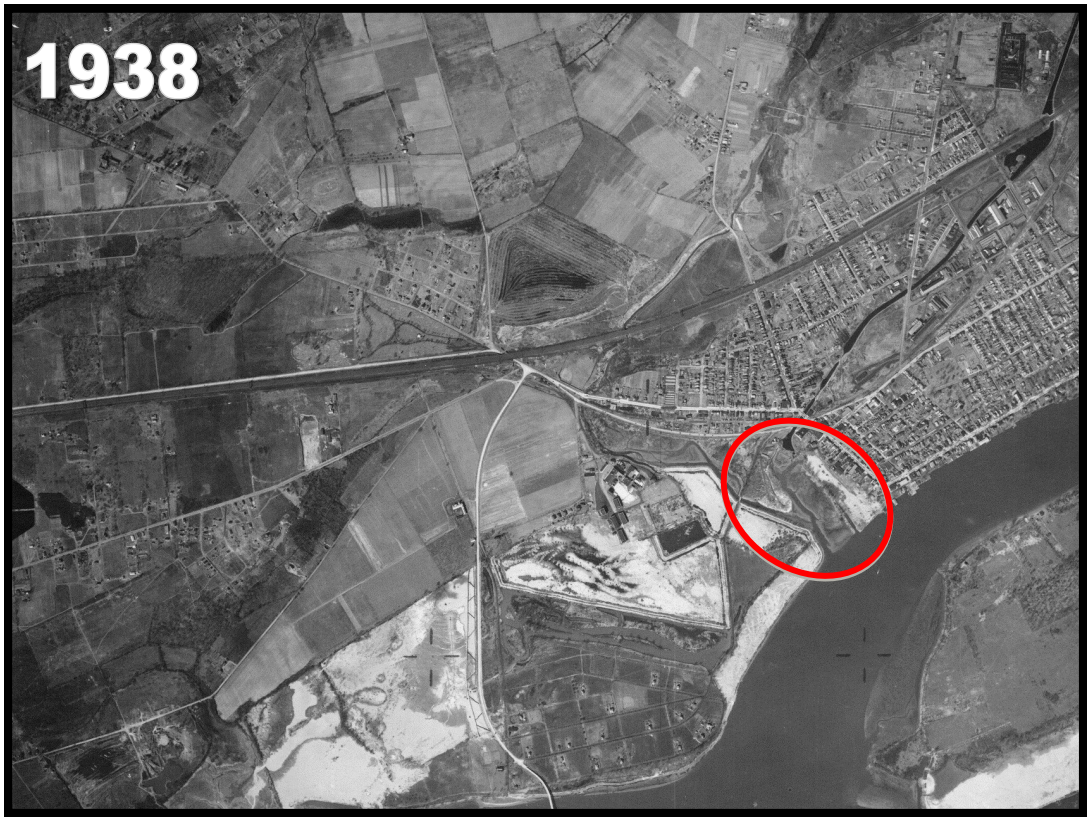
As the United States' manufacturing sector declined in the later 20th Century, Bristol Borough faced population and employment loss. Bristol turned to its past to find revitalization. Unused industrial areas were rehabilitated to attract new employers and housing development. Remnants of Bristol's manufacturing past, including sections of the Delaware Canal, Lagoon, and train station were rehabilitated as historic sites.

*(Compiled from the works of the Bucks County Planning Commission and the Bristol Cultural and Historical Foundation.)*

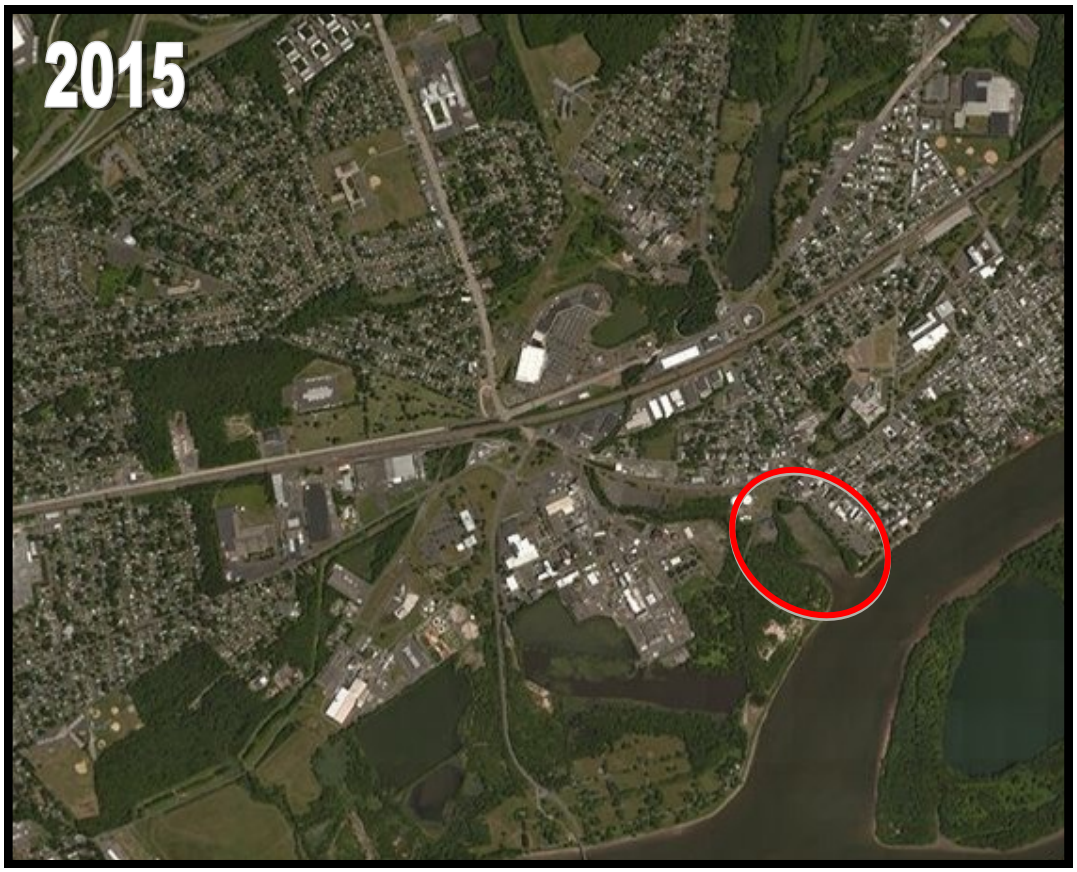
Opposite page: In less than 100 years, the area surrounding Bristol Marsh Nature Preserve experienced significant transformation. Aerial photography shows the shift from a predominantly agricultural landscape in 1938 to an urbanized setting in 2015 with dense residential, industrial and commercial development.

Bristol Marsh is circled in red on both images. In 1938, it appears that the basin was in the process of being filled to become what is currently the municipal parking lot, shown in the 2015 aerial.

# A Changing Landscape




Source: United States Department of Agriculture, Agricultural Adjustment Administration




Source: bing.com

# Water Resources

A watershed is an area of land that drains or sheds water into a specific receiving waterbody, such as a marsh, stream, lake or river. A watershed includes the land as well as an interconnected network of streams on the earth's surface and the groundwater below. Most rain water falls directly into surface waters. Rain and melting snow also filter through the soil to recharge groundwater and aquifers.

Natural landscapes like wetlands, forests, and meadows hold rain and snowmelt, allowing water to slowly get absorbed into the soil. These natural surfaces are considered porous, or pervious, and act as natural filters that help purify water and control flooding. Unfortunately, human activity often disrupts and weakens these important ecological functions resulting in impaired water quality and increased flooding.

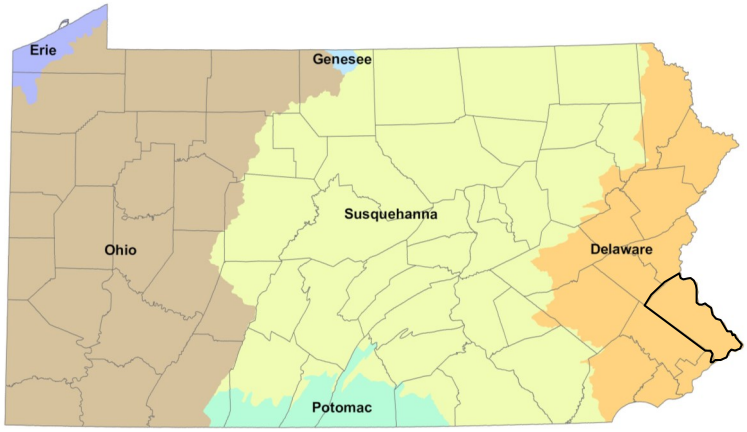
Impervious, or nonporous surfaces include houses and lawns, schools and playgrounds, shopping centers and parking lots, roads and sidewalks, and many other structures and improvements that do not absorb water. When the earth's natural surface is covered by impervious surfaces, less of the natural landscape is available to absorb and filter rain and snowmelt. Instead, water flows in large volumes and at fast speeds across the ground surface, resulting in flooding. Impervious surfaces prevent the soil from acting as a natural filter to remove pollutants.

In addition to altering the earth's surface, human activity often generates pollutants such as pesticides and fertilizers, chemicals that are used in homes, industrial plants, and farms. As water moves through the watershed, it collects and carries pollutants downstream. As a result, unfiltered contaminated runoff spreads to other streams, ponds, lakes, and wetlands in the watershed and decreases overall water quality.

All human activities impact the natural resources within a watershed, including water quality. In order to protect the health of the entire watershed, individuals and communities must make good choices to reduce or eliminate pollution. Practices and regulations applied throughout a watershed to lessen the amount of impervious surfaces can minimize negative impacts and improve the health of environment.

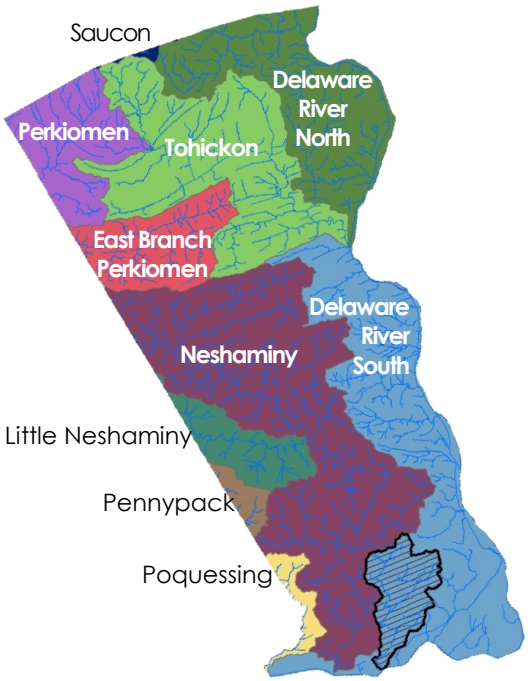
Watersheds can be very large and cover thousands of square miles, or very small and cover just a few acres. Larger watersheds are made up of smaller watersheds that are also known as sub-basins. There are more than 2,200 watersheds throughout the United States.

**Pennsylvania' Six Major Watersheds**




Pennsylvania has six major watersheds: the Ohio, Genesee, Susquehanna, Delaware, Erie, and Potomac. These watersheds are also known as river basins because they are named after the major rivers in the state. These major watersheds eventually drain into larger bodies of water, such as the Chesapeake Bay, which flows into the Atlantic Ocean.

**Bucks County Primary Watersheds**




Bucks County, located in southeastern Pennsylvania, is contained entirely within the Delaware Watershed. Bucks County includes ten primary watersheds: Delaware River North, Delaware River South, East Branch Neshaminy, Little Neshaminy, Neshaminy, Pennypack, Perkiomen, Poquessing, Saucon, and Tohickon. These primary watersheds can be further divided into 49 secondary watersheds throughout the county.

**Otter Creek Secondary Watershed**

Bristol Marsh Nature Preserve is located within the Delaware River South primary watershed and the Otter Creek secondary watershed. Tributaries that drain into the Otter Creek Watershed include: Otter Creek, Queen Anne Creek, Black Ditch Creek, as well as smaller, unnamed tributaries. Otter Creek Watershed drains into the Delaware River at Bristol Marsh.

# How *YOU* can help keep Bristol Marsh Nature Preserve Healthy…

- Visit Bristol Marsh Nature Preserve often.
- Learn more about what makes this place special.
- Tell your friends and family about Bristol Marsh.
- Volunteer at a Bristol Marsh clean-up day.
- Highlight Bristol Marsh in a science, art, or writing project for school.
- Walk or ride a bike instead of talking a car.
- Add native plants to your home garden or school landscape.
- Dispose of household hazardous waste properly.

# Outdoor Code of Conduct:

While visiting Bristol Marsh Nature Preserve, remember that you are a guest passing through the home of the plants and animals that live in this special wetland habitat. While exploring the marsh, there are many small things you can do to minimize your impact on the ecosystem and disturbance to the creatures that call it home.

**Stay on trails.** Avoid trampling and destroying vegetation and breaking branches. If you turn over rocks or logs, replace them in their original position.

**Respect wildlife.** Treat living organisms with respect and care. Don't startle or chase animals. Use binoculars and cameras to view and "capture" wildlife from observation areas and trails.

**Don't touch or feed wild animals.** It is stressful to the animal. Avoid wildlife during sensitive times: mating, nesting, raising young, or winter. Animal parents will aggressively protect their young. Getting too close to offspring could be dangerous. Animal parents may also abandon their offspring if it or the nest or den has a strange scent from human handling. Sick or wounded animals may bite, peck or scratch.

**Travel quietly.** Make as little noise as possible and move slowly. Animals, just like people, are startled by loud noises. Besides being stressful to animals, loud noises lessen your chances of seeing wildlife.

**Leave what you find.** Take photos, videos, and audio recordings. Leave the creatures, plants, stones, rocks, nests, and shells. Don't damage trees or plants by digging them up, ripping off leaves or tearing at the bark.

**Don't litter**. Pick up all trash and dispose or recycle in appropriate containers.

**Be considerate of other visitors.**
Avoid talking on cell phones, playing loud music or shouting. Share the trail and observation piers with others.

**Visit often.** Come back during different times of the day and year to see a variety of wildlife!

# Other Things to See and Do...

- **Bristol Borough Riverfront Park** is located right next door to Bristol Marsh Nature Preserve. Just follow the paved walking trail that leads visitors along the waterfront. The park is usually bustling with people fishing, walking, eating lunch, socializing, and sitting on benches enjoying the scenic views of the Delaware River. Bristol Borough organizes numerous community events at the park throughout the year. Monuments that acknowledge the town's cultural diversity and ethnic heritage are prominently displayed throughout the park.

- **Margaret R. Grundy Museum** is the former home of Senator Joseph Ridgway Grundy and sits on the bank of the Delaware River. Visitors can learn about the life of a 19th century Pennsylvania businessman and politician. The entire contents of the home were owned and used by the Grundy family.

- **Bristol Riverside Theatre** is a professional regional theatre housed in a renovated 300-seat movie house. It is located at the opposite end of Riverfront Park from Bristol Marsh. Bristol Riverside Theatre produces over 200 performances every year including children's theatre, musicales and special events.

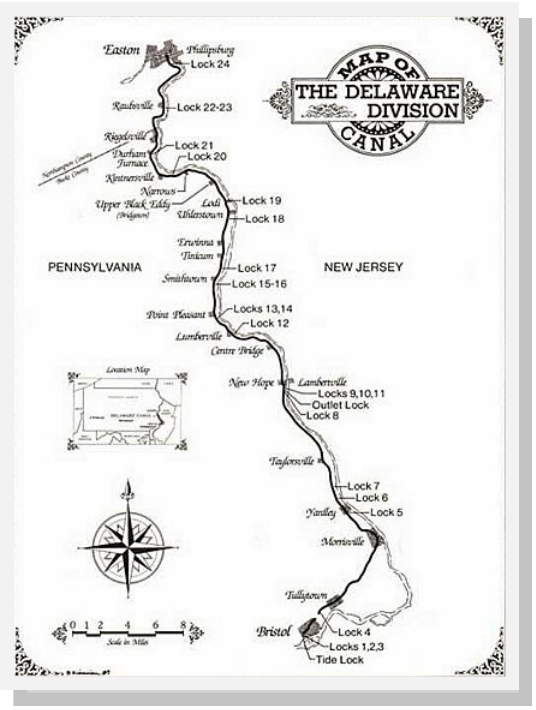
- **Radcliffe Street Historic District** parallels the Delaware River and includes over 300 buildings. The oldest known building is the Friends' Quaker Meeting House, built circa 1711. Starting at Bristol Marsh, a self-guided walking tour features 50 historic sites.

- **Mill street** features over thirty unique local shops and eateries.

- **Silver Lake Nature Center** is a 235-acre Bucks County Park that offers a variety of activities for individuals, families and groups. Over four miles of trails lead visitors through this secluded sanctuary.

- **Grundy Ice Arena** is an indoor skating facility featuring two rinks and stadium seating. The rink is open year round and offers ice skating, broomball and ice hockey.

# Take a Hike!




## Delaware & Lehigh National Heritage Corridor

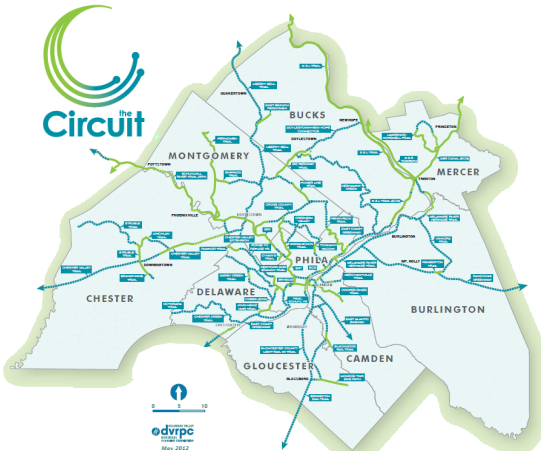
The 60-mile Delaware Canal Towpath, once traveled upon by teams of mules pulling cargo-laden boats, is one of four public trails that make up the 165-mile D&L Trail, the backbone of the National Heritage Corridor and the longest publicly-owned trail in the state. The D&L Trail winds through northern mountains and along the banks of the Lehigh and Delaware Rivers through northeast Pennsylvania, the Lehigh Valley and through Bucks County.

## 2,900 Miles from Maine to Florida

The East Coast Greenway (ECG) is a developing trail system, linking major cities between Maine and Florida. Creating safe, accessible routes for people of all ages and abilities, the ECG fosters healthy lifestyles and promotes sustainable transportation. The trail enters Pennsylvania about ten miles north of Bristol Marsh in Morrisville Borough after crossing over the Delaware River from Trenton, New Jersey. The ECG passes through lower Bucks County before continuing to Philadelphia.

## The Circuit

Both the D&L Trail and East Coast Greenway are part of a 750-mile planned trail network called the Circuit. The Circuit runs throughout the Greater Philadelphia area in Pennsylvania and New Jersey. To date, more than 300 miles have been built. When complete, these trails will serve as a gateway to the region's parks and cultural resources.



# Wetlands Word Search

ADAPTATION
AMPHIBIAN
AQUATIC
BALD EAGLE
BASIN
BEAVER
BRISTOL MARSH
CANAL
DELAWARE RIVER
EMERGENT
HUMAN IMPACT
IMPERVIOUS
INVERTEBRATES
MUMMICHOG
OSPREY
SPATTERDOCK
TIDAL
WATERSHED
WATERSNAKE
WETLANDS

**For more information, contact:**

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215-345-7020
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