

Restoration of Shad and Anadromous Fish to the White Clay Creek Wild and Scenic River

The mission of this project is to restore shad and migratory fish passage and habitat, increase spawning areas, and benefit the resident fish in the White Clay Creek watershed.

American Shad (*Alosa sapidissima*)



American shad were once legendary along the East Coast of the United States. Their numbers were once so prolific that the streams in which they ran were said to "blacken" and "boil" with thrashing fish. Early settlements like Shadwell, Virginia, the birthplace of Thomas Jefferson, and plants like "shadbush" were named after them. American shad were once the major commercial fish of mid-Atlantic rivers and are also an exceptional sport-fish. These fish are also well-known for their excellent flavor, the scientific name (*Alosa sapidissima*) means "most delicious herring." The American shad was a vital food source to Native Americans and colonists and an important part of early American culture.

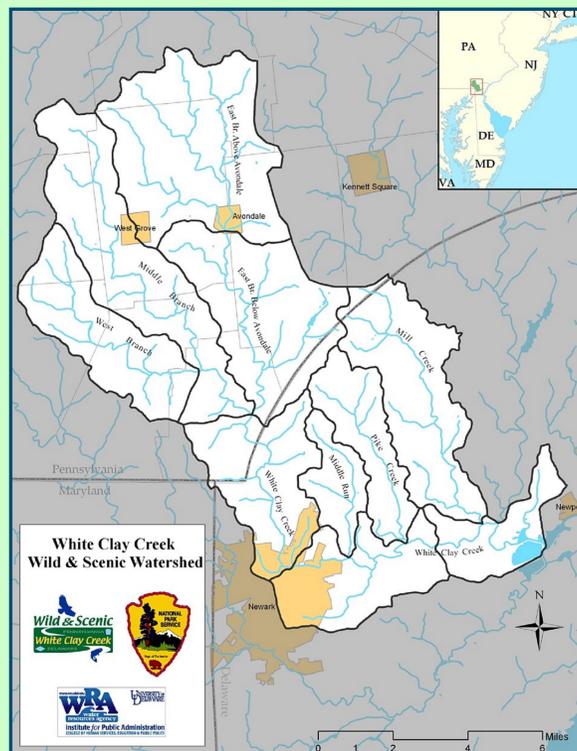
Shad, like salmon, migrate from the ocean to spawn in the freshwater rivers and creeks in which they were born. Shad habitat ranges from as far north as southern Canada and as far south as Florida. These fish may grow up to 30 inches and 8 lbs. Although shad are strong long-distance swimmers they cannot jump and thus cannot swim past barriers such as dams. Dam removal is by far the best option to restore fish passage and many dams can be removed. Fortunately, for those dams that cannot be removed, the art and science of fish passage technology is undergoing worldwide invigoration and innovation.

Today many people have never heard of shad but our community is working together to change that and restore American shad and other migratory fish to the Christina River Basin in both the White Clay and Brandywine creek watersheds. The removal or modification of the dams on the White Clay Creek and Brandywine River, along with fish stocking, will help bring thousands of shad and other migratory fish to our area.

The Wild and Scenic White Clay Creek

The White Clay Creek drains 107 square miles and is one of the four major watersheds in the 565-sq.-mi. Christina River Basin. The Christina River Basin is part of the larger 13,000-sq.-mi. Delaware River Basin. In 2000 the President signed a law adding 190 miles of the White Clay Creek and its tributaries to the National Wild and Scenic Rivers System. The White Clay Creek is the first National Wild and Scenic River in the United States designated as such on a watershed basis rather than as a single river corridor.

Approximately 55 percent of the White Clay Creek watershed is located in Pennsylvania, 45 percent in Delaware, and a negligible portion in Maryland. The northern portion of the watershed in Chester County, Pa., includes the East, Middle, and West Branches of the White Clay Creek. The White Clay Creek flows southeast into New Castle County, Del., and is joined by Middle Run and Pike and Mill Creeks before emptying into the Christina River. Towns within the White Clay Creek watershed include Newark, Del., and Avondale and West Grove, Pa. The White Clay Creek watershed includes many unique and outstanding biological, recreational, and cultural resources.



Map 2. The White Clay Creek watershed.

Project Scope and Progress

In 2010 the University of Delaware's Water Resources Agency (WRA), a unit of the Institute for Public Administration, assessed the feasibility of restoring fish passage and habitat to the Wild and Scenic White Clay Creek. This project was funded by the National Fish and Wildlife Foundation and served as an expansion of the Brandywine Conservancy's Brandywine Creek Shad Restoration effort, and was conducted in partnership with the Christina Basin Clean Water Partnership restoration efforts.

The White Clay Creek has six known dams in the Delaware portion of the watershed that have the potential to block fish passage and prevent fish migration through the entire 107-sq.-mi. watershed. Map 1 (left) and Table 1 (below) provide a spatial perspective and a brief summary of the dams in the Delaware portion of the White Clay Creek.

Since the feasibility report was developed the White Clay Creek dam removal and fish passage restoration project has gained momentum and WRA has been awarded several grants to fund the removal of Dam No. 1 at Delaware Park. Project funding partners to date include:

- National Fish and Wildlife Foundation (2010)
- Fish America (2011)
- American Rivers (2012)
- National Park Service White Clay Wild and Scenic Management Committee (2011 and 2012)

Removing Dam No. 1 will be the first dam removal project in Delaware and will open 4.8 miles of fish passage in the White Clay Creek. Dam No. 1 is a breached dam, 3-8 feet in height and approximately 100 feet wide. It is composed of timber and stone and located at river mile 4.1 on the property of Delaware Park. In 2010, DNREC conducted two anadromous fish-sampling events on the lower White Clay Creek. The catch per unit effort (CPUE) was approximately 500 CPUE below Dam No. 1, indicating that there is a significant fish population obstructed by Dam No. 1.

The cultural surveys, conducted by the University of Delaware's Center for Historic Architecture and Design, show that Dam No. 1 is a historic 18th century dam and consequently portions of the dam will be preserved intact with a public education display serving to re-tell the dam's historic past. Current fish passage restoration plans now include a partial notch in order to restore fish passage and also to preserve the historic nature of the dam.

To date, for Dam No. 1, cultural survey drawings have been completed, the permit applications are under review by the State, and the public notice period has been advertised. The next phase of this project will take a systematic look at the subsequent dams on the White Clay Creek. This process will access the historic and hydrologic impacts of removing each dam and once these aspects of each dam are fully understood WRA will work to address fish passage at each site accordingly.

For more information about the White Clay Creek project contact the University of Delaware Water Resources Agency's Jerry Kauffman (302-831-4929/jerryk@udel.edu) or Martha Corrozi Narvaez (302-831-4931/mcorrozi@udel.edu).

Table 1. Dams in the Delaware Portion of the White Clay Creek.

Dam	River Mile	Function	Owner	Recommendation
TCS (United Water Dam)	0.6	United water supply	United Water Delaware	Passable if operated in accordance with the DRBC docket
Dam No. 1 (Delaware Park Dam)	4.1	None	Delaware Racing Association	Dam removal
Dam No. 2 (Red Mill Dam)	7.6	Pools water for historic mill race	Mac Shar Enterprises and New Castle County (own adjacent parcels)	Dam removal, rock ramp with existing rocks
Dam No. 3 (Karpinski Park Dam)	9.5	Sewer line crossing	City of Newark	Dam removal, rock ramp
Dam No. 4 (Paper Mill Dam)	10.1	Hydraulic control for USGS White Clay Creek at Newark	City of Newark	Dam removal, fishway
Dam No. 5 (Newark Intake Dam)	11.1	Newark Water Supply, intake dam for raceway	City of Newark	Dam removal, bypass channel
Dam No. 6 (Creek Road Dam)	11.6	None	N/A	None necessary, passable
Dam No. 7 (Deerfield Dam)	12.7	Pools water for intake to pump water to the Deerfield Country Club	State of Delaware	Dam removal, rock ramp

A Partnership

The University of Delaware's Water Resources Agency is collaborating with multiple partners to restore fish passage and habitat to the National Wild and Scenic White Clay Creek Watershed. Project partners include representatives from federal, state, and local government as well as private and nongovernmental organizations (NGOs).

Federal Agencies:

- National Oceanic and Atmospheric Administration (NOAA)
- National Fish and Wildlife Foundation (NFWF), Delaware Estuary Program
- United State Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS), DE Office

State Agencies:

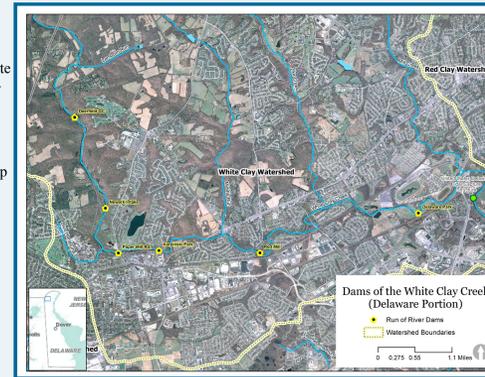
- DE Department of Natural Resources and Environmental Control (DNREC)
- Delaware State Historic Preservation Office (SHPO)
- PA Fish and Boat Commission (PFBC) |

Local Government:

- City of Newark

Private Companies and NGOs:

- Brandywine Conservancy
- Delaware Park
- Duffield Associates
- The DuPont Company
- Trout Unlimited, Delaware Chapter
- United Water Delaware
- University of Delaware Center for Historic Architecture and Design
- White Clay Creek Wild and Scenic Management Committee
- White Clay Outfitters



Map 1. Dams in the Delaware portion of the White Clay Creek.



Dam No. 1, located at Delaware Park, river mile 4.1 in the White Clay Creek.

Shad in Schools

A public education and outreach tool for elementary school students

Since 2010 the University of Delaware's WRA and the Brandywine Conservancy have been working in collaboration to implement the Shad in Schools program in the Brandywine, White Clay, and Red Clay creek watersheds in Delaware and Pennsylvania. This program originated in schools in the Washington, DC area along the Potomac River where it has been a huge success. In 2010 Robert Lonsdorf, of the Brandywine Conservancy, arranged for four schools located in the Brandywine watershed to join the program. By 2012 there are 10 schools from the Brandywine, Red Clay, and White Clay creeks participating in this program.



Students peering at their shad eggs in the shad tank.

The Shad in Schools program is an applied experience that educates students, teachers, and the public about the history, problems/decline, and life cycle of American shad while teaching math and science concepts through the balance of water conditions and temperature. The objectives of this program include:

- Educate and inform students, teachers, and the public about American shad and their significance.
- Teach students about the importance of good water quality and habitat through hands-on testing and observations that utilize and teach science and math skills.
- Assist in improving American shad populations in the Delaware River Basin.

The Shad in Schools program has a distinct timeline that must be followed each year in order to mimic the natural conditions in the stream and prepare for the arrival of the American shad eggs. In mid-April the schools receive their shad-rearing tank equipment, and the shad tank must be constructed. Once constructed, the tank runs for approximately 2-3 weeks prior to receiving the shad eggs. During this time, the students conduct water-quality tests on the system, including tests on ammonia, nitrite, nitrate, pH, and temperature.



The shad system.

Once the tank is constructed and the system is acclimated appropriately, the students are prepared to receive their shad eggs, and hope that mother nature cues the shad to begin their spawning in fresh-water streams. Shad are anadromous fish, spawning in fresh water streams and migrating to the ocean to grow and mature. Eggs are collected from the mature shad and then introduced to the student's tanks. There they will grow and hatch into fry in about 4-5 days and on the 5th day they are released into the Brandywine and White Clay creeks.

The shad fry that are released by the students will remain in the Brandywine and White Clay creeks until the water temperatures begin to drop in the fall. The shad will then swim out to the Atlantic Ocean, where they will continue to grow. They will remain in the ocean for 4-6 years before returning to the river they were released in for their first spawn.

The Shad in Schools program, an education and outreach tool, is part of the larger efforts in the Brandywine and White Clay creeks to restore shad and migratory fish passage and habitat, increase spawning areas, and benefit the resident fish in the watersheds. The Delaware River Shad Fishermen's Association and Jim Cummins of the Interstate Commission for the Potomac River Basin (ICPRB) have provided significant direction and assistance to WRA and the Brandywine Conservancy on this project.

If you are interested in bringing this program to your school in the White Clay or Brandywine creek watersheds, contact Martha Corrozi Narvaez (mcorrozi@udel.edu) or Tim Lucas (lucas@brandywine.org).

Schools from the Brandywine, White Clay, and Red Clay creek watersheds that have participated in the program (2010-2012) include:

Delaware

- Maclary (White Clay)
- Holy Angels (White Clay)
- St. Ann (Brandywine)
- Tower Hill (Brandywine)
- Wilmington Friends (Brandywine)
- St. Edmonds (Brandywine)

Pennsylvania

- Avon Grove Charter School (White Clay)
- Hillendale Elementary (Brandywine)
- Pocopson Elementary (Brandywine)
- Chadds Ford Elementary (Brandywine)
- Upland County Day School (Red Clay)



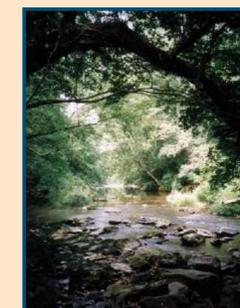
Students analyzing the shad eggs and fry prior to release.



Students analyzing the water quality at the White Clay Creek during the shad release.



Shad are an exceptional sport-fish.



The Wild and Scenic White Clay Creek