



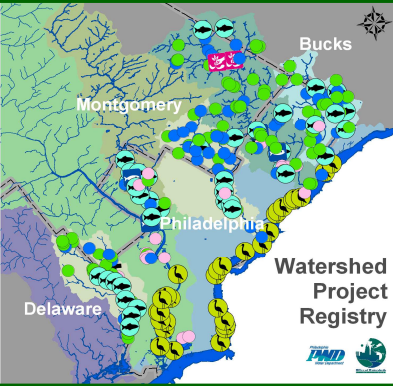
FISH PASSAGE



Overview

Before urbanization, fish were able to swim freely throughout the streams in Philadelphia. Fish were able to migrate between feeding and spawning areas as well as other seasonal movements. As development occurred in Philadelphia, thousands of culverts, dams and barriers were installed along our waterways prohibiting fish passage through our rivers. PWD has identified several project locations which will create fish passage by removing dams or creating rock ramps over existing barriers.

A study commissioned by the Fairmount Park Commission (FPC), entitled the Natural Lands Restoration Master Plan, was conducted in 1999. In the Master Plan, the Natural Lands Restoration and Environmental Education Program (NLREEP) stated that several dams within Philadelphia should be modified or removed. The dams should be altered because the dams can have a damaging effect on streams. Most importantly, dams can block the passage of fish and other aquatic organisms from passing through. Dams can also create backwaters resulting in higher water temperatures and depleted oxygen conditions.



Many of the dams along the rivers within the City of Philadelphia are falling apart and have become safety hazards. Based upon ecological benefits, the FPC recommended that all of the dams should be removed, but cautioned that dam removal is not always feasible. Many of these dams have historical significance that FPC would not want to destroy. In these cases, there are ways to save some of the historical significance of these dams such as saving the abutments along the sides of the dams which will allow for fish passage through the center of the channel. There is another option of creating one or more V-shaped notches in the top of the dam which will allow for better passage of water, sediment and fish.

Dam removal involves the use of large machinery to remove the manmade elements. Some dams may have underlying bedrock or rock falls, which would remain as a natural waterfall. Mud flats adjacent to the banks would be planted with native vegetation and some bank stabilization measures may be required after demolition. Removing these abandoned dams will serve as a long-term benefit to the stream and will require little to no future maintenance.

A rock ramp fishway is a collection of rocks configured underwater to create a "ramp" for fish over an impassable barrier, such as a protruding sewer pipe or a low-head dam. Well-designed rock ramps mimic natural river features so that they blend with their surroundings and the average passerby would not notice their presence. While imperceptible to some, these structures can provide important alterations to immovable barriers that allow fish such as American shad, hickory shad, river herring and striped bass to pass with ease.





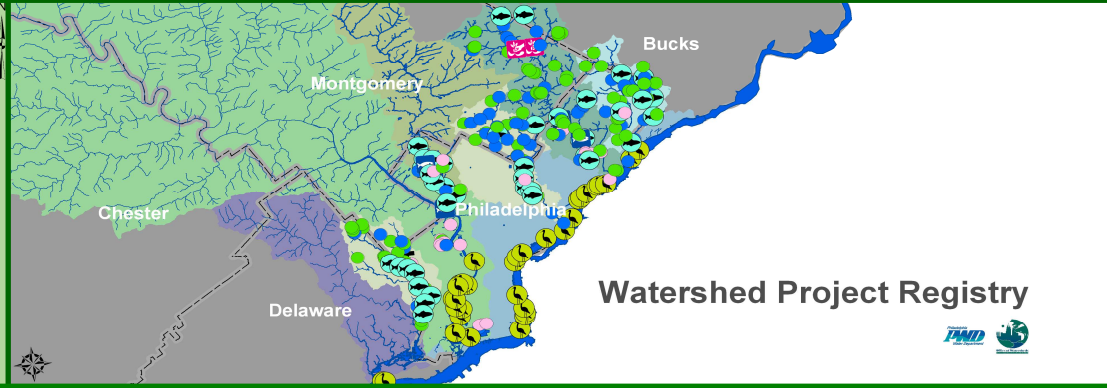
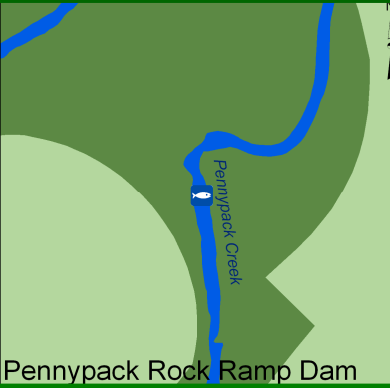
Pennypack Rock Ramp Fish Passage

Following the wave of momentum created by the removal of three dams on Pennypack Creek, all owned by Fairmount Park Commission (FPC), the Philadelphia Water Department (PWD) constructed a rock ramp fish passage at a PWD sanitary sewer line that crosses the Pennypack. PWD also completed stream bank stabilization and riparian plantings in the project area. This will restore access to approximately 4.5 miles of suitable spawning habitat for migratory fishes as well as enhance stream habitat for resident fish populations.

Migratory and semi-migratory fishes that have been documented in the Pennypack downstream of Frankford Dam include American shad, blueback herring, striped bass, American eel, and white perch. Other migratory species that could benefit from the project that have not been documented include hickory shad and alewife. The Philadelphia Fish and Boat Commission (PFBC) stocked approximately 1.2 million hickory shad fry in the Pennypack during 2004 to support the re-establish a population imprinted to the watershed. Additional stockings are planned in the future. Resident (non-migratory) fishes that will benefit from the project include smallmouth bass, rock bass, channel catfish and several species of non-game fishes and other aquatic organisms.

"The health of our nation's rivers has a direct impact on the health of our communities," said Rebecca Wodder, President of American Rivers. "Long-term restoration of recreational fisheries in Pennsylvania has a potential economic impact of \$36 million, the potential to change lives."





Pennypack Rock Ramp Dam



Like the other restoration projects on Pennypack Creek, the installation of the rock ramp fishway has been a partnership effort. Funding for the design was provided through the partnership between American Rivers and NOAA, while the Philadelphia Water Department paid for all of the construction work. It is the hope of PWD that this project was only the beginning of what will be a long-standing partnership to restore Philadelphia's rivers.

PWD has completed phase one of the physical monitoring activities planned for the rock ramp, by installing a stream gage and recording stream stage to correlate to the nearby Rhawn St. USGS gage station. A detailed post-construction survey of the rock ramp has been conducted which was used to create a River2D hydraulic model of the rock ramp. PWD has estimated velocity vectors within the rock ramp at varying river flow conditions and has compared physical conditions to fish swimming behavior.





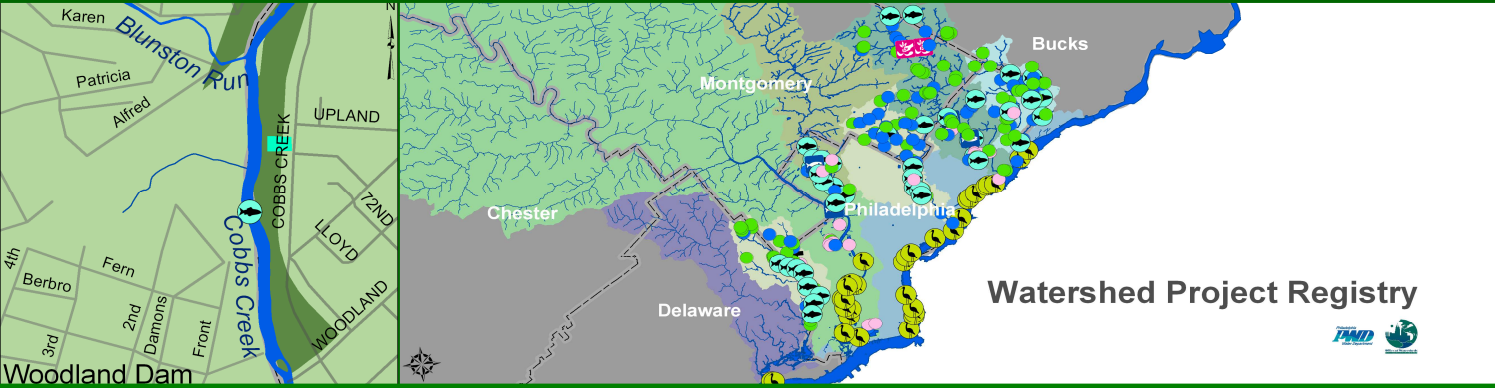
Woodland Dam Fish Passage

The Woodland Dam is located along Cobbs Creek just upstream of the intersection of Woodland Avenue and Cobbs Creek Parkway. The Woodland Dam serves as a dividing boundary between Delaware County and Philadelphia County. The Woodland Dam was originally constructed in 1645 making it the first European water-powered mill in Pennsylvania. Since that time, many alterations on the dam have occurred changing the aesthetics of the dam from a nice stone masonry freely flowing dam to a concrete dam with two notched channels.

Currently, the dam above Woodland Avenue creates a large pool behind it. In 2003, PWD performed a fish survey on Cobbs Creek below and above Woodland Dam. According to this survey, 19 species were identified above the Woodland Dam and 43 species were identified below the dam. The identified species included Blueback herring (*Alosa aestivalis*), American shad (*A. sapidissima*), Striped bass (*Morone saxatilis*), Gizzard shad (*Dorosoma cepedianum*), and white perch (*M. americana*).

PWD is currently putting together a Scope of Work with USACE to investigate, select, design, and construct the best alternative to reestablish fish passage along Cobbs Creeks.





Although the dam has historical significance, the Fairmount Park Commission (FPC) recommended the modification or removal of this dam in a study entitled the Natural Lands Restoration Master Plan, which was conducted in 1999. FPC also recommended to stabilize the adjacent banks with bioengineering techniques once the dam is removed. Furthermore, FPC recommended to replant the mudflats that will appear upstream of the dam with native vegetation 6-12 months after the dam removal to allow the stream to realign itself.

If PWD and USACE determine that complete or partial dam removal is not feasible at this site, several other options for fish passage will be evaluated, such as pool and weir, baffle fishway, vertical-slit fish passage, natural bypass channel and rock ramp.

Throughout this process, PWD and USACE will work closely with FPC to ensure that the historical significance of the dam will be retained in an acceptable manner. PWD plans to continue public outreach and the historical mitigation process with all interested stakeholders, specifically FPC and the Pennsylvania Historical Museum and Commission (PHMC).





FISH PASSAGE

Livezey Dam Fish Passage

According to research conducted by the Friends of the Wissahickon (FOW), the Livezey Dam was most likely constructed during the mid 1700s. Livezey Dam is located downstream of Valley Green Inn. Adjacent to Livezey Dam is the historic Livezey House, also known as Glen Fern. The mill that was powered by Livezey Dam, which was the largest mill along the Wissahickon Creek. The Fairmount Park Commission (FPC) purchased the house and mill in 1868.

Despite the historic significance, the FPC recommended the modification or removal of this dam in a study entitled the Natural Lands Restoration Master Plan, which was conducted in 1999. The modification of Livezey Dam could



LIVEZEY HOMESTEAD AND MILL

Mill owner Thomas Livezey wrote:

... here I dwell, where these sweet apples grow.

And little rivulets from the rocks add beauty to my grove.

I drink the wine my hills produce, on wholesome food I dine.

My little offspring round me are like clusters on the vine.

Across the creek stands Glen Fern, the Livezey family homestead for over 120 years, but a big fire burned down the house, resulting more with mill, the site of the Livezey Mill. Built in the 1700s, the mill ground wheat, flour and oak.

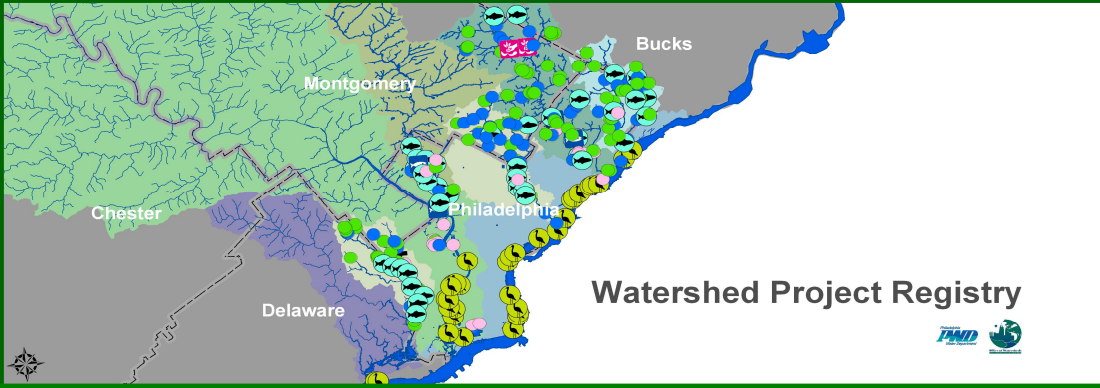
Mills along the Wissahickon

For nearly 100 years, two great waterfalls were used with millstones. Beginning in the 1600s, over 50 mills later, the Wissahickon Creek. Powered by the rushing water, they made everything from the paper to the 1820s, these mills were used for food and lumber.

In 1868, this area became part of Fairmount Park. The last mill was removed in the 1880s. The trees grew back and again were restored.

The Livezey

The Livezey Mill was the largest stone mill still standing along the Wissahickon, 1820s. Source: F. and G. 1880.



consist of notching or removing the center of the dam. This would allow the historic significance of this dam to be retained along the sides of the dam. This modification would also create fish passage through the notched section and it would also prevent pooling of the Wissahickon Creek.

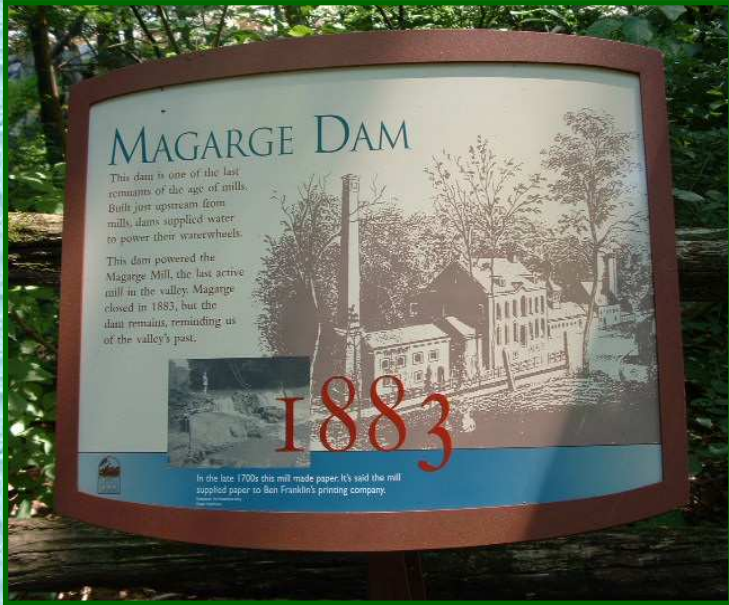
Tropical Storm Floyd damaged Livezey Dam in 1999. Approximately two feet was removed from the top of the dam which resulted in the reduction of water level in front of Valley Green Inn. In order to remove or modify this dam, large machinery would have to be used in order to remove the large stone wall in the center of the channel. The large machinery could access this dam from Livezey Lane. Coordination with and approval from several parties, including the Philadelphia Water Department, FPC, FOW and Pennsylvania Historical Museum and Commission (PHMC), would be required for the modification or removal of Livezey Dam. To increase the success of fish passage through the Wissahickon Creek, the Magarge Dam should also be modified or removed around the same time.





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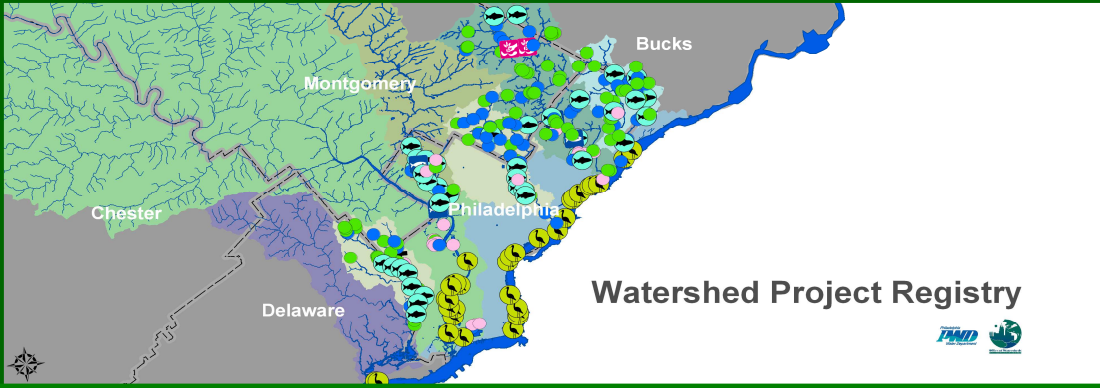
Magarge Dam Fish Passage



The Wissahickon Creek was once highly utilized by mills and dams during the 1700 and 1800s. Only five of these dams still remain today. The Magarge Dam is located on the Wissahickon Creek just upstream of the confluence of Wissahickon Creek and Wises Mill Run. Magarge Dam is one of the last remnants of the age of mills. Dams were constructed just upstream from mills to supply power to their waterwheels. This Magarge dam powered the Magarge Mill, which was the last active mill in the valley. Magarge Mill closed in 1883, but the dam still remains.

Although there is historic significance associated with this dam, the Fairmount Park Commission recommended that it may be beneficial to remove or modify Magarge dam in the 1999 Natural Lands Restoration Master Plan. Removal of this dam would allow migratory fish to travel upstream within the Wissahickon Creek.





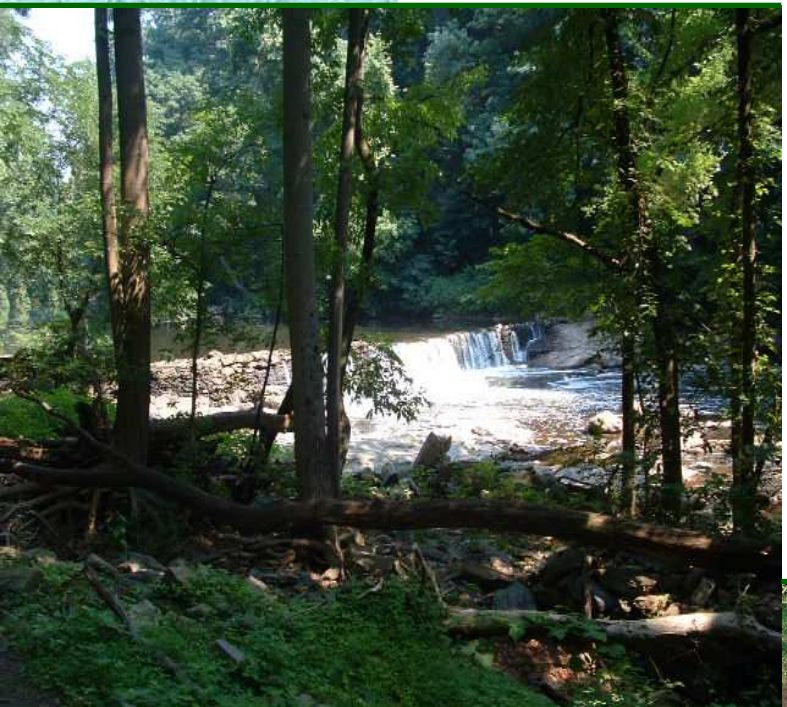
Watershed Project Registry



Dam removal would also allow the Wissahickon Creek to return to a natural flowing stream and remove upstream impoundments.

Flooding from Tropical Storm Floyd in 1999 caused damage on several tributaries and creeks within the City of Philadelphia. In particular, the Magarge Dam was severely

damaged during the storm and breached the right side of the dam. Because of this damage, water flows around the downstream right side of the dam instead of flowing directly over the dam. This dam has caused severe erosion on the right stream bank and over time will encroach upon Forbidden Drive, a popular and well-used road for walking, biking and jogging. This dam is a major safety hazard to the public and should be removed. Removal would allow for fish passage and prevent the pooling of the Wissahickon Creek. Also, the removal of this dam would reduce the number of Phytoplankton Blooms at this impoundment. Phytoplankton blooms are a common occurrence during the springtime in the city of Philadelphia. In order to have a successful project at Magarge Dam, close relationships must be established with the FPC, the FOW, and the PHMC in order to ensure that the historical and aesthetic conditions are preserved in an acceptable manner.





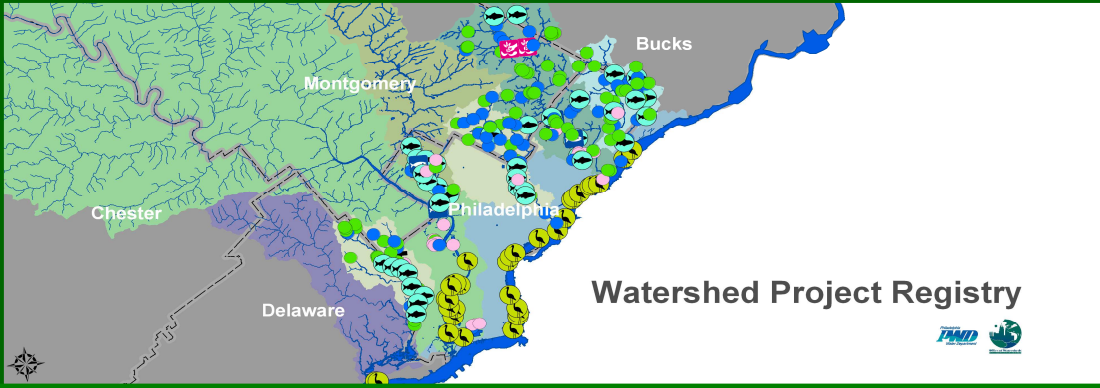
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Fairmount Dam Fishway

Migration of anadromous fish species; such as American shad, blueback herring and striped bass; into freshwater tributaries along the Delaware River Basin has been impeded throughout history by anthropogenic influences. Dam structures have minimized upstream fish passage to areas of spawning habitat and thus, diminishing successful reproduction in freshwater tributaries. Prior to 1979, anadromous species migrating into the Schuylkill River shared the same fate. The Fairmount Dam, located approximately 8 miles upstream from the Schuylkill River confluence with the Delaware River, has prevented passage of migratory species from construction in 1818 until 1979. The Fairmount Dam Fishway was designed to allow fish passage around the Fairmount Dam and was completed in the spring of 1979. In 2006, a total of 16,850 fishes representing 26 species were counted passing through the fishway including 345 American shad, 9 hickory shad, 61 striped bass and 7 river herring.

Great improvements in fishway technologies have been realized in the past 20 years since the Fairmount fishway was constructed. Pennsylvania Fish and Boat Commission surveys downstream from the fishway indicate that American shad are returning to the Schuylkill in ever increasing numbers. Repairs and improvements to the facility were completed in 2009. The

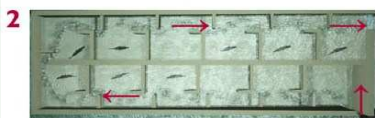




Watershed Project Registry



1 A fish following its instinct to swim upstream in the Schuylkill River encounters the turbulent water of the Fairmount Dam's spillway. A current of water, produced by the fishway, flows into the river from the fishway entrance, serving as a guide for the fish, and attracting them to swim through the entrance into the first chamber.



2 The water, pouring through the slots connecting each chamber, guides the fish through the fishway. The water levels, in each chamber, are slightly higher than the chamber before it, allowing the fish to gradually bypass the dam. Additional chambers were added to the fishway, decreasing the effort required by the fish to swim from one chamber to the next.



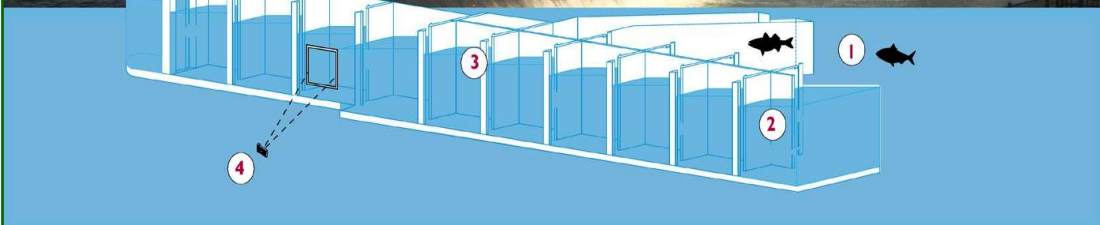
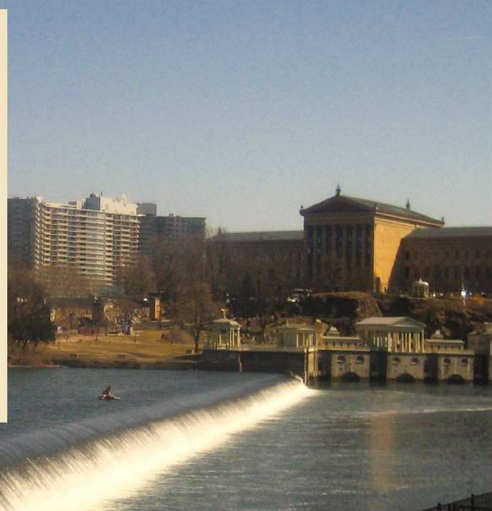
3 The slots between adjacent chambers maintain the varied water levels throughout the fishway. The slots were widened to ease the passage of fish through the fishway.



4 Live images are captured by a camera through a window in one chamber of the fishway, which are then transmitted to the web and to the Fairmount Water Works Interpretive Center across the river. The live camera feed can be accessed at www.fairmountwaterworks.org.



5 Fish exit the fishway through the gate and swim into the waters beyond the Fairmount Dam.



American Shad *Alosa sapidissima*

River Otter *Lutra canadensis*

slots between the chambers of the fishway have been widened, the flow through the chambers has been modified, and the entrance and exit channels have been redesigned, in hopes of increasing the variety of species and the numbers of fish using the fishway. It has been estimated by a U.S. Fish and Wildlife Service expert, that with these improvements to the fishway, 200,000 to 250,000 American shad per year may utilize this structure during upstream migrations. It has been estimated that the Schuylkill River has habitat to support 700,000 to 800,000 shad.

While shad is the target species for this project, blueback herring, striped bass, American eel and other species will also benefit from it. In addition, resident fish species will be better able to reach suitable spawning and nursery habitats, and benefit from a larger forage base provided by juvenile anadromous species. The new fishway will provide access for migratory fish to approximately 12.2 miles of river, up to the Flat Rock Dam north of Manayunk.

Additional benefits that are expected as a result of this project are an increase in educational potential of this facility through increased public access and an increased public education focus. A more aesthetically pleasing area has been established for visitors to the ladder. The Philadelphia Water Department (PWD) and other agencies and organizations have plans to further increase the educational potential conducted on site for school groups and members of the public. Part of the PWD educational programs will include viewing the real-time video camera at the amphitheater and outdoor educational activities by trained fisheries biologists. The Fairmount Dam Fishway will bring societal and biological benefits to the region by increasing the aquatic habitat values of the Schuylkill River.

