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Fish Passage
It's Not Just Dams and Salmonids

If not properly designed, man-made structures placed across streams and rivers can block the natural movement patterns of migratory fish, often resulting in a marked reduction in fish production over the years. Fish barriers include large hydropower or flood control dams on sizable rivers as well as the more numerous mill or low-head dams on smaller streams. Culverts and utilities create additional barriers to aquatic organisms where roads and pipelines have been built across streams.

Wide, shallow flow prevents fish from moving freely upstream and downstream.

Restoring the passage above barriers to historic spawning grounds for anadromous fish species has been a major focus for fish restoration efforts throughout the Chesapeake Bay watershed. Anadromous fish, such as herring and shad, are species that live in saltwater but enter freshwater streams to spawn. Juvenile anadromous fish often relocate during their freshwater life stage in response to seasonal differences in available food and shelter; ultimately, they require downstream passage to the Chesapeake Bay and ocean.

From 1998 through 2005, the Chesapeake Bay Program states and their partners collectively restored 1,838 miles of spawning habitat by either removing dams or providing natural fishways, bypass channels, or fish ladders around barriers. The target anadromous species for restoration include American shad, hickory shad, alewife herring, blueback herring, yellow perch, and white perch. In 2005, the Bay program partners set a new fish passage goal of 100 fish passage and/or dam removal projects through the year 2014, corresponding to an additional 1,000 miles of tributary habitat for migratory and resident fish.

As the evaluation of existing blockages moves higher in the watershed to smaller tributary streams, the fisheries typically shift their focus to resident species.

American Shad: *Alosa sapidissima*

Erosion at the downstream end of a culvert creates a drop-off (waterfall), blocking fish passage.

Resident fish spend their entire lives in freshwater, though many species move upstream or downstream to seek food, shelter, or spawning habitat. While the migratory needs of resident fish have received far less attention than anadromous species, there is increasing interest in evaluating existing blockages and designing new stream crossings that effectively allow passage for resident fish and other aquatic life. In fact, many agencies in the Mid-Atlantic region now require both anadromous and resident fish passage considerations and designs for new stream crossings.

Assessing and designing a stream crossing is a complex process. A culvert is considered a blockage if it fails to allow passage of a designated species at or below a designated stream flow. The designated stream flow is generally baseflow (i.e., the typical background flow in the absence of storm-related runoff). Using statistical analysis, the baseflow is obtained from available stream gauge data for local, similar-sized watersheds.

A target species should be set for design parameters. Generally, a species with a relatively slow swimming speed and low jumping ability that is relatively abundant in local streams is chosen as the target species. Assessment of fish passage through culverts in varied stream conditions relies upon the application of models with many assumptions related to stream hydrology, culvert hydraulics, fish swimming performance, and fish behavior, especially seasonal movements. However, the value of modeling results is often constrained by the underlying assumptions, and there is currently very limited information available to validate the assumptions. The challenge is to determine and compare swimming performance of the target species and life stage with hydraulic conditions inside a culvert across a range of stream flows. Unfortunately, the amount of information currently available for resident fish species of different ages is extremely limited.

In summary, many existing stream crossing structures block the natural movement patterns of fish and reduce fish production. Design standards for fish passage will be greatly enhanced as new information is discovered on the behavior and performance of appropriate target fish. The goal for transportation-related projects will be to maintain the long-term survival and sustained production of fish and aquatic ecosystem health while continuing to provide opportunities for road construction and access.

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Ms. Kanner has a wide variety of experience as a Water Resources Engineer successfully completing conceptual through final design plans, stormwater management designs and reports, erosion and sediment control design and permitting, specifications, site layout and grading, and costs estimates. She has worked closely with regulatory agencies to meet the necessary regulatory requirements and permits for wetlands and waterways construction. She has also performed construction consultation/inspection and shop drawing reviews as related to drainage, stormwater management and erosion and sediment control for various projects within the region.

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Mr. Zimmerman is a Senior Environmental Scientist who has managed environmental resource studies and NEPA documentation for transportation projects. He has provided environmental technical support to the Departments of Defense and Army, including preparation and implementation of Integrated Natural Resource Management Plans for installations. He has also conducted and managed a wide variety of fisheries and aquatic habitat projects in the Pacific Northwest, including studies of the effects of impoundment and non-native species introductions on native fish population dynamics and community structure.

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Mr. Follweiler is an environmental engineer with 30 years of experience involving the environmental permitting of utility and roadway infrastructure for waterway, floodplain, forest, wetland and storm water impacts. He has served as a peer reviewer for the Maryland Department of the Environment on a number of interagency studies involving stream restoration issues and was project manager for developing Maryland's Waterway Construction Guidelines.