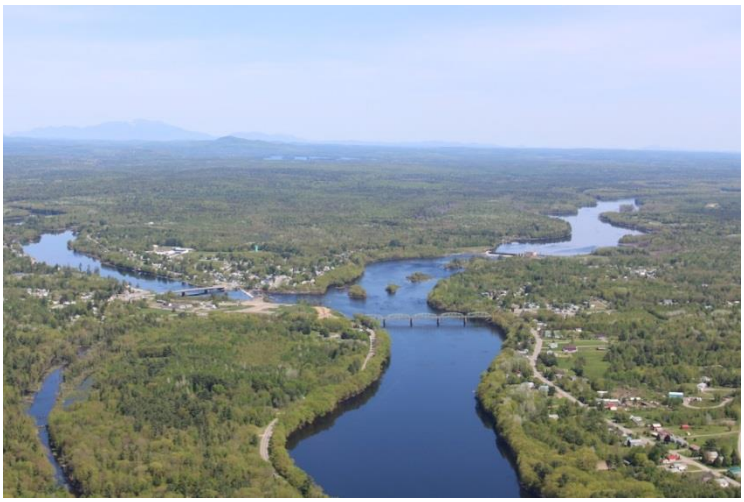
PENOBSCOT RIVER RESTORATION TRUST

Penobscot River Restoration Project
Howland Fish Bypass Project Overview

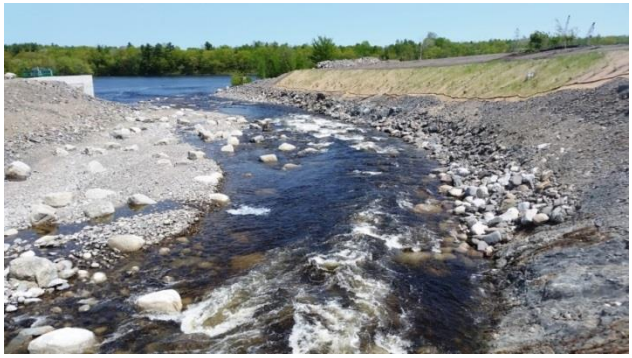
Background: The Howland bypass is a critical and final piece of restoring access for native fish in Maine's largest watershed. Capping more than a decade of work by the Penobscot River Restoration Project to restore sea-run fish and renew opportunity to Maine's largest watershed, the project constructed a nature-like bypass to allow fish to swim into the Piscataquis River where it joins the main stem of the Penobscot River. This is the last step to reconnect 1,000 miles of the Penobscot River to the sea for the first time in nearly two centuries. This landmark large-scale, collaborative effort reconnects habitat for 11 species of native sea-run fish while maintaining or increasing energy production.



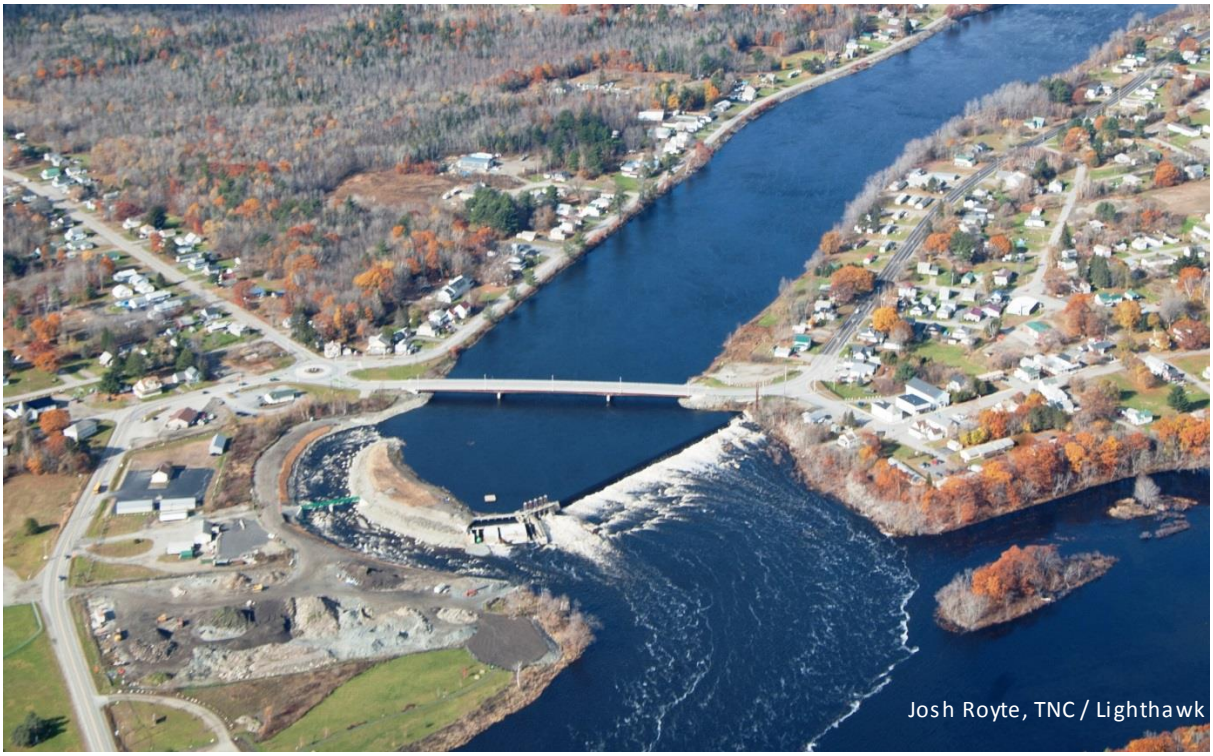
In June 2004, seven conservation groups, the Penobscot Indian Nation, state and federal resource agencies, and dam owners signed the historic Penobscot Agreement, which has served as the road map for restoration. Private and public funders joined forces to support this unprecedented collaboration. On June 16, 2010, the Federal Energy Regulatory Commission approved the Penobscot River Restoration Trust's (Penobscot Trust) applications for changes to three hydroelectric power projects in the lower Penobscot River drainage, including Howland Dam.

The trust worked to remove the two lower-most dams, Great Works (2012) and Veazie (2013), construct a fish bypass around Howland, and greatly improve fish passage on several of the remaining dams. This enhances access to nearly 1,000 miles of historic river habitat for endangered Atlantic salmon and shortnose sturgeon, threatened Atlantic sturgeon, ecologically important river herring, and other types of sea-run fish.

Nature-Like Fish Bypass Channel: Designed to be a passive stream-like system, structurally sound under a wide variety of river conditions, the Howland bypass channel lets the native sea-run fish species that had historically reached the Piscataquis River swim upstream and downstream. Each fish species has a different ability to swim upstream, influenced by water depth, velocity, and river characteristics.



Therefore, primary goals of the design process included safe, timely, and effective upstream and downstream passage of all species that historically had access at the site, quality habitat and stream connectivity, and manageable operations and maintenance.



Design: The Penobscot Trust considered a variety of factors and channel configurations. It was informed by input from agency representatives, fisheries biologists, fish passage engineers, natural channel design experts, and other professionals with pertinent expertise. A key design factor was the ability to pass multiple species of fish requiring a variety of hydrologic conditions at varying time periods. The channel is designed to effectively pass American shad, the species known to be the most difficult to move past dams.

The channel is 1050' long and about 200' wide (~150'-200'). The width at the bottom of the channel is 105'. Its profile provides the desired diversity of habitat: The compound shape has a deeper, outer radius to hold water during lower flows and a graded overbank on the inner radius to maintain passage zones as flows increase. The channel allows targeted species to swim by, and secondary downstream passage is also available through an engineered concrete channel built in one of the former powerhouse turbine bays.

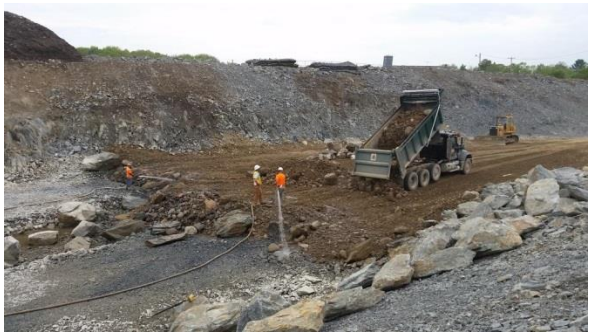
The technical design team included project lead, Kleinschmidt, a Maine-based engineering and environmental consulting firm, working with key sub-consultants Interfluve (to provide natural channel design expertise), and Haley and Aldrich (to provide geo-tech expertise). The Penobscot Trust and the consulting team developed the final design criteria for the Howland dam bypass in consultation with natural resource agencies using the following criteria:

- Effective operation at Piscataquis River flows from 250 to 10,600 cubic feet per second (cfs), typical flow range during the migration period (April – December) in the Piscataquis River
- Average velocity of 6 feet per second (fps) or less in the bypass channel, based on hydraulic modeling
- Minimum flow depth of 1.5 feet
- Allow Atlantic salmon, alewife, blueback herring, American shad, American eel, and sea lamprey to pass up- and downstream.

The bypass design was completed in consultation with agency input (Maine Department of Marine Resources, Maine Department of Inland Fisheries and Wildlife, Maine Department of Environmental Protection, Penobscot Indian Nation, U.S. Fish and Wildlife Service, National Marine Fisheries Service), and with engineering expertise to ensure that physical requirements for effective fish passage for targeted species of native diadromous fish were met.

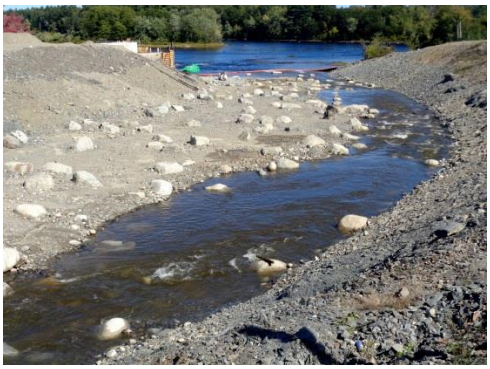
Construction: Once the design was complete, the Penobscot Trust contracted with SumCo Eco-Contracting to construct the project. SumCo is a Massachusetts-based company that specializes in stream restoration, native plantings, and ecologically based projects.

SumCo proceeded to construct the nature-like channel by excavating bedrock and overburden to a desired depth, then "building" the desired channel features by adding a graded mix of substrate to the channel bottom in several courses as specified and directed by the engineering team (see photos showing construction sequencing).



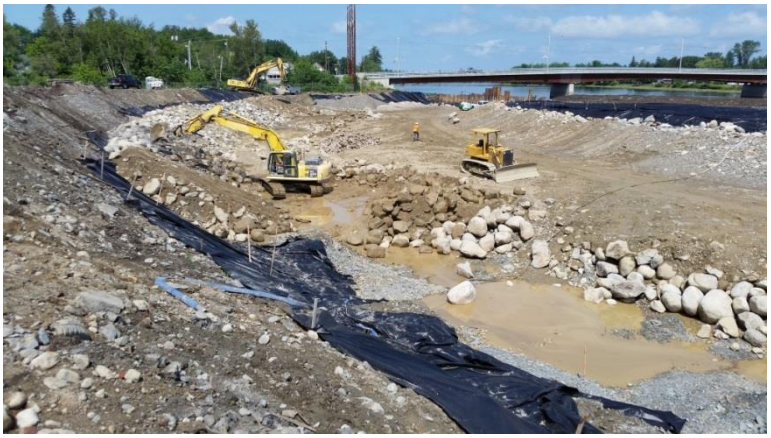
They created conditions resembling a natural stream by forming a series of resting pools and riffles through the low-flow channel, shaping a shallower overbank area, and strategically placing large boulders to generate the desired hydraulics. The result was a structurally stable channel incorporating a diverse set of river features and hydraulics, ready to pass a range of fish species under varying flow conditions.

The cost to construct the Howland bypass channel was approximately $4.8 million including extensive site preparation, demolition of remnant buildings and powerhouse, modifications related to the dam and old fishway to enhance fish passage, building the channel that will pass multiple fish species and remain stable under a range of conditions, and landscape and restore the site.

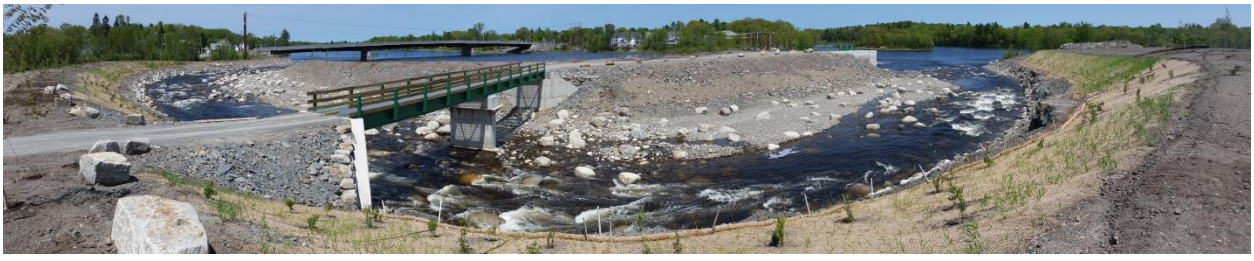


Outcomes: The constructed bypass began passing flows in 2015 and has already withstood some challenging high-flow periods, exhibiting the ability to remain stable over time. Final aspects of the implementation such as site restoration, native riparian plantings, and final removal of the remaining part of the coffer dam used to construct the bypass and other implementation details remain to be completed in 2016, but the key project element (open passage for target species of fish) is now complete.

Now, monitoring begins for up- and downstream fish, flow and physical channel, maintenance, and other activities, to ensure that the bypass functions as intended.



The Howland natural bypass channel design is one of the largest and most complex ever constructed on the East Coast. The bypass is already accommodating a wide range of flows as intended, accomplished by a team including technical experts; funding partners; state, federal, and tribal fisheries experts; and coordination with local stakeholders such as the Town of Howland.



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