# NRD Project
# Final Grant Report

**Reporting Organization**: Housatonic Valley Association (HVA)
**Project Name**: Furnace Brook Fish Ladder Restoration
**Project Location**: Cornwall Bridge, Connecticut
**Cooperative Agreement #:** F12AC00302
**Period of Agreement:** March 2012 – December 2017
**Dates covered by this Report:** Project start – March 31, 2018


**Project Objectives/Goals:**
To restore fish passage through the structure carrying Route 4 over Furnace Brook in Cornwall Bridge

Below is a brief timeline of project activities:

- May 2012: Cooperative Agreement with USFWS finalized; HVA enters into contract with Princeton Hydro
- June-August 2012: Baseline assessment of fish populations above project site conducted by HVA; Field Reconnaissance and Base Map Prep work conducted by Princeton Hydro
- September-October 2012: CT-DEEP Fisheries monitoring of fish passage success at project site
- September 2012: Preliminary designs for fishway restoration submitted to HVA and circulated to stakeholders for review
- October 24, 2012: Stakeholder meeting to review and comment on preliminary design
- January 17, 2013: Princeton Hydro submits written request to increase funds available for design work, in order to cover additional analysis requested by stakeholders at 10/24 project review meeting
- May 2012: HVA receives Engineer's Estimate of Probable Cost from Princeton Hydro, and submits this along with projected HVA budget for Phase II Cooperative Agreement
- August 2013: NRD Trustees approve additional Phase I funds and incorporates into Phase II Cooperative Agreement; Phase II Cooperative Agreement finalized
- September 20, 2013: Revised designs for Fishway Restoration submitted to HVA and distributed to stakeholders for review
- October 4, 2013: Comments from CT-DEEP Fisheries received by Princeton Hydro
- October 21, 2013: PrincetonHydro response to comments received and approved; final design endorsed by CT-DEEP
- July and August, 2014: Bid package is circulated and a construction contract is awarded to River Logic Solutions, LLC.
- September 2014: Construction completed
- Fall 2014: Fish trap installed by CT-DEEP Fisheries; monitoring begins (trial runs).
- April 30, 2015: Final version of the Furnace Brook Monitoring Plan is completed.
- Spring, Summer, and Fall 2015: Fish trap monitoring
- Spring, Summer, and Fall 2016: Fish trap monitoring; in-situ temperature monitoring
- Spring, Summer, and Fall 2017: Fish trap monitoring; in-situ temperature monitoring
- March 31, 2018: Final grant report is submitted.

**Project Tasks and status:**

## PHASE I: Design, Permitting, and Baseline Monitoring

### A. General Project Administration

HVA assumed the role of project administrator and oversaw all aspects of the project, including management of related funds, obtaining necessary landowner permissions and permits, serving as a liaison to the general public, and reporting progress to partners and funders.

***Progress Made Towards Project Objectives:*** **This task is complete.**

### B. Pre -construction monitoring

HVA, in cooperation with staff from DEEP Inland Fisheries Division and volunteers from the Housatonic Fly Fishermen's Association, developed a monitoring protocol to determine the success and efficiency of passage at the site by wild and stocked brown trout during the fall migration period (anticipated to be mid-October through late November). HVA also recruited and coordinated volunteers for a monitoring effort to occur prior to fishway repair, and for three years following fishway repair.

***Progress Made Towards Project Objectives:*** **This task is complete.**

### C. Fish Ladder Design Development

HVA subcontracted with Princeton Hydro LLC to complete baseline data collection and mapping at the site, including topographic, bathymetric and wetland surveys and hydrologic analysis. Utilizing baseline data, a design to repair the damaged fishway was prepared.

***Progress Made Towards Project Objectives:*** **This task is complete.**

### D. Solicit and incorporate feedback on the design from stakeholders and the public

Design package was circulated to key stakeholders including CT-DEEP Inland Fisheries, Housatonic Fly Fishers Association, adjacent landowner, and NRD Trustees. Comments received were incorporated into final design package.

***Progress Made Towards Project Objectives:*** **This task is complete.**

### E. Prepare Construction estimates and obtain required permits and permissions for construction activities

The following permits were obtained:
Town of Cornwall Inland Wetlands and Watercourses Commission
CT-DEEP 401 Water Quality Certification
USACE CT General Permit
***Progress Made Towards Project Objectives:*** **This task is complete.**

### F. Prepare a bid package to solicit cost estimates for construction of the fishway repair

***Progress Made Towards Project Objectives:*** **This task is complete**.

HVA with assistance from Princeton Hydro drafted a bid package, which was mailed directly to 18 contracting companies pre-selected in consultation with project partners. Bids were mailed during the last week of June. Pre-bid meeting held on 7/8/2015. Bid package/RFP and list of pre-selected contracting companies are enclosed. Review team was assembled (CT-DEEP, Princeton Hydro, TU, HVA) in anticipation of proposal review, ranking and consultant selection, however only one bid was received and most of this work was not necessary. Bid received was put forward by River Logic Solutions LLC. The bid was well within budget, firm has an outstanding reputation, and review team members signed off on the bid so consequently bid was accepted.

## PHASE II: Construction, Site Restoration and Post-Construction Monitoring

### A. Complete additional design components for Phase I

***Progress Made Towards Project Objectives:*** **This task is complete.**

$10,031 added to Phase I Task C. In practice the $3,760 designated for "permitting assistance" under the Phase II Co-Op agreement was used for additional construction supervision, and was added to Phase II Task C.

### B. Implement construction of fishway restoration

1. **Mobilization/demobilization**
2. **Erosion/sediment control, dewatering**
3. **Repair existing fishway, masonry, baffles**
4. **Site restoration**

***Progress Made Towards Project Objectives:*** **This task is complete.**

Furnace Brook flows under Furnace Brook Road (Cornwall, CT) through a 120-foot long concrete box culvert, and merges with the Housatonic River 1,000 feet downstream of the culvert. Prior to the refurbishment funded by this grant, the existing fishway passage through this culvert was 3.5 feet wide and 3 feet deep, with the steepest slope in the middle of the culvert. There were wooden baffles (cut as v notch weirs) to aid in fish passage; however, most were lost due to storm events. The last 10-foot section of the fishway was undercut and ineffective.

Figure 1. Pre-construction conditions of the fishway

To improve ease of fish passage in the existing fish ladder, a portion of the concrete floor from the 20-foot downstream end of the existing fishway was removed and modified at a steeper slope (see photos of construction process below). Bedrock under the fishway in this area was also adjusted, allowing backwater from the downstream section to back up into the fishway and improving entrance conditions. Then three prefabricated aluminum Model A Steeppass fishway 10-foot units were installed, one in the steep middle section of the fishway and two in the 20-foot downstream section of the fishway. These aluminum shoots aid in dissipating energy and allowing fish to more easily move upstream through the fishway. Additionally, a high water overflow notch in the existing fishway was saw cut. The areas between the prefabricated aluminum fishway units and the existing fishway and subgrade were backfilled with concrete as shown on the design plans. Water controls adjacent to the fishway were

required, to dewater the work area. All in-stream construction activities was completed during low-flow conditions and without the use of heavy machinery, due to site access restrictions.

Materials specified by project engineer changed from Denil baffles to Alaskan Steeppass after Award Modification was approved (8/12/2013), resulting in a $17,060 difference in materials cost. Duration of construction was extended for approximately 10 days longer than anticipated due to difficulties with excavation related to the hardness of the bedrock channel, as well as changes to the design of the fishway entrance requested by CTDEEP Fisheries staff during construction site visit that required additional excavation. This resulted in additional costs beyond the estimate for construction for contractor. The final bill from River Logic was still well within Princeton Hydro's Probable Cost estimate however, and those savings helped defray some of the additional materials cost. We ended up over budget for Phase II Task B by $8,280.

Copies of press coverage of fishway restoration enclosed.

Figure 2. Pre-construction view of the downstream end of the culvert. Note the fast, shallow water flowing over the concrete bottom.

Figure 3. Pre-construction view of the fishway entrance and the downstream outlet of the culvert. Note the high velocities in both areas.

Figure 4. Two pre-construction views of the interior of the fishway. There was no internal flow control, consequently the flows inside the fishway were too fast for fish to pass through.

Figure 5. Three Alaskan Steeppass units being delivered to the HVA offices- 450lbs of fish-moving metal (August 2014)


Figure 6. Cutting off the flow through the fishway to allow work to begin.

Figure 7. Cutting out the bottom of the existing Fishway.

Figure 8. Lowering down an Alaskan Steeppass unit

Figure 9. Positioning the three Steeppass units

Figure 10. Installing the Steeppass units (September 15, 2014)


Figure 11. Completed fishway

Figure 12. Tim Wildman (IFD) and Laura Wildman (design engineer with Princeton Hydro) observe the lower portion of the refurbished fishway.

Figure 13. The baffles of the fish ladder allow native brook trout to more easily pass through the culvert and return to primordial spawning grounds.

## C. Provide Construction Oversight

***Progress Made Towards Project Objectives*: This task is complete.**

Extended construction resulted in additional costs for both Princeton Hydro and HVA for construction oversight and support. HVA incurred $2,999 in salary supporting the construction, a cost that was not included in Phase II Task C (this line was understood to be solely for Princeton Hydro's oversight). Princeton Hydro reported additional costs of $5,272 beyond the $14,649 allocated to them under Phase II Task C.

**D. Restore Riparian Habitat**

**1. Purchase, install and water riparian plantings. Monitor for 3 years**

***Progress Made Towards Project Objectives:* This task was not completed, because it was deemed unnecessary.**

Initially, HVA anticipated that funds will be used to make improvements to the adjacent riparian buffers with the objective of providing bank stabilization and increased canopy cover/shading. The combined riparian plantings and in-stream modifications (e.g., creation of a step-pool sequence) were intended to improve thermal refuge (i.e. cold water pockets) in the vicinity of the ladder entrance, through reductions in water temperature. However, as discussed at the project site with the FWS NRD Trustee, the site is not ideal for riparian restoration. The bank areas that are open are generally quite rocky and subject to high-energy flows and scouring. Furthermore, other areas are either already well-vegetated and provide adequate cover, or are part of the adjacent landowner's existing landscape, which she is generally unwilling to modify. Riparian plantings would be difficult to establish, and would be unlikely to improve habitat or water quality in a meaningful way. Rather, this funding was reallocated to cover shortfalls under other tasks.

**E. Monitor Water Quality and Fish Use of Furnace Brook for 3 years**

1. **Gage installation**
2. **Fish and water quality monitoring**
3. **Volunteer coordination, training and oversight - We utilized HVA River Stewards instead of volunteers.**

***Progress Made Towards Project Objectives:* This task is complete.**

CTDEEP Inland Fisheries built a trap to be utilized in the reconstructed fishway, and provided HVA with a draft Monitoring Plan (enclosed). This Monitoring Plan was updated based on what was learned during attempts to fish the trap in the fall of 2014 (two consecutive days in early October 2014, and another day in mid-November 2014). HVA concluded it was not practical to leave the trap unattended in place during the Fall as the leaf load was much too heavy. HVA installed a chicken-wire fence upstream to try and catch the leaves before they entered the fishway, but this was filled up within a matter of minutes and leaves were again entering the fishway and catching in the trap. Staff checked the trap every 1.5 hours and found the fishway was significantly de-watered each visit after that short interval. On one occasion fish were found in the trap, so the fishway is passable, but staff also found fish holding just below the culvert outlet on most visits, as the bulk of the flow had shifted out of the fishway. It was realized that the trap could like not be left unattended for longer than a few hours at a time in the fall.

Trap checking was largely done by HVA staff and seasonal River Stewards. River Stewards are seasonal interns that are hired each summer to assist with HVA field work tasks. They are often college students with an interest in water conservation careers. River Stewards were trained in the fish trap-checking protocol. We were unable to rely heavily on other project partners and volunteers to check the trap, as much of the HVA volunteer base for this particular project is not local.

In early 2015, spring flows were too high to deploy the trap. Therefore the fish trap was first deployed in 2015 on May 29. The trap was deployed periodically from May to October 2015. In that time period, 8 brown trout (average size = 19.7 cm), 1 brook trout (15 cm), 1 rainbow trout (23 cm), and 1 GSF (13 cm) were captured in the fishway.

In 2016, the trap was deployed for the first time on April 18 and then deployed periodically from April to September 2016. In that time period, 25 suckers (average size = 39.8 cm) and 1 brown trout (27 cm) were caught in the fishway.

Additionally, CTDEEP Inland Fisheries sampled fish at three sites upstream of the ladder in August 2015, 2016, and 2017. Fish stocked in the mainstem Housatonic are tagged, so we were able to use the presence of tagged fish above the ladder as a measure of success. During these surveys, a total of 6 adult brown trout that were stocked in the Housatonic River were recaptured above the fishway (1 in 2015, and 5 in 2017). According to Mike Humphreys, CTDEEP Inland Fisheries biologist, "all were of a size and age that indicates they ascended after the repairs were complete" (personal communication, Mike Humphreys, CTDEEP, March 2018). Furthermore, it was discovered that six young-of-year rainbow trout spawned naturally in Furnace Brook above the fishway. These were likely produced by spring-spawning adult rainbow trout stocked in the Housatonic River by the Housatonic River Outfitters. These trout likely passed through the fishway in spring 2016 and spawned a short distance upstream. According to Mike Humphreys, this was the first documented occurrence of rainbow trout spawning above the fishway. A year later, in 2017, one of these wild-spawned rainbow trout was still present as a yearling. Mike Humphreys also provided additional anecdotal evidence of the success of the Furnace Brook Fish Ladder:

> "Probably a significant number of wild-looking Brown Trout (from fry stocking or truly wild) use the fishway, but I cannot tell with certainty which ones ascended and which were resident. Also, there are quite likely quite a few Brown Trout that ascend during the spawning runs in the fall, spawn above the fishway, then drop back to the river. Before the fishway was repaired, two different years in early November, I had seen quite a few browns jumping up onto the concrete apron adjacent to the fishway, trying very hard to get through. These fish likely get through with ease now, but are never documented (except what you are able to capture during the period when the trap is experiencing leaf clogging problems). Also you will see that a few stocked adult brown trout were captured above the fishway, all along, when it was functioning, and also after it fell into disrepair. So the evidence is strong that at least a few determined individuals were able to pass at certain flows, even when the fishway was in disrepair."

Figure 14. Deploying the fish trap. (April 18, 2016)

Figure 15. Brown Trout (July 16, 2015)

Figure 16. Mike Jastremski checking the trap (September 20, 2015)

Figure 17. Rainbow trout (October 2, 2015)

Figure 18. Savannah Judge checking the trap (April 19, 2016)

Figure 19. Fish trap full of white suckers (April 19, 2016)

Figure 20. Brown trout (July 8, 2016)

In addition to fish monitoring, HVA monitored water temperature and flow level. Temperature data was collected using HOBO® Water Temp Pro v2 (U22-001). In Furnace Brook, these temperature data loggers were deployed in both 2016 and 2017, upstream from the refurbished fishway. In 2016, the data logger was deployed on May 20 and retrieved on November 17. In 2017, the data logger was deployed on June 23 and retrieved on October 11. Table 1 shows the results of the data collected by these loggers, compared to data collected in 2010 at the mouth of Furnace Brook. All the average temperatures were within a range that indicated Furnace Brook is a Cool/ Transitional or Cold stream (as classified by Beauchene et al., 2014). Additionally, staff gages were installed in the interior fishway and the fishway entrance, and flows were monitored during the 2015 to 2017 fish trap checks. The water level was recorded each time the fish trap was checked and was generally between 0.6 feet and 1.4 feet, with two higher values (1.8 feet and 2 feet) recorded in September and October 2015.

Furnace Brook is generally an exceptional stream in terms of water quality; this is well-documented by bioassessment (benthic macroinvertebrate and fish) data from CTDEEP. We did not anticipate monitoring water quality unless it was necessary to assess some type of change in the watershed.

Table 1. Temperature data for Furnace Brook collected in 2010, 2016, and 2017, showing the mean summertime temperature (June to August), the mean July temperature, and the maximum daily mean temperature, for each year. Yellow shading indicates that the temperature is in the thermal classification range that indicates a Cool/ Transitional stream, while green shading indicates that the temperature is in the thermal classification range that indicates a Cold stream, based on the classification system published by Beauchene et al, 2014.

| Years | Collected by | Logger Serial Number | Location | Mean Summer Temp (C˚) | Mean July Temp (C˚) | Max Daily Mean (C˚) |
|---|---|---|---|---|---|---|
| 2010 | CT DEEP | N/A | At mouth | 19.22 | 20.45 | 22.35 |
| 2016 | HVA | 10015936 | 50' upstream of culvert | 19.22 | 20.03 | 23.32 |
| 2017 | HVA | 10498702 | 200' upstream of culvert | 18.97 | 19.72 | 22.10 |

Figure 21. Looking downstream, toward the Furnace Brook culvert, from the location of the 2016 temperature logger.

Figure 22. Looking downstream, toward the Furnace Brook culvert, from the location of the 2017 temperature logger.

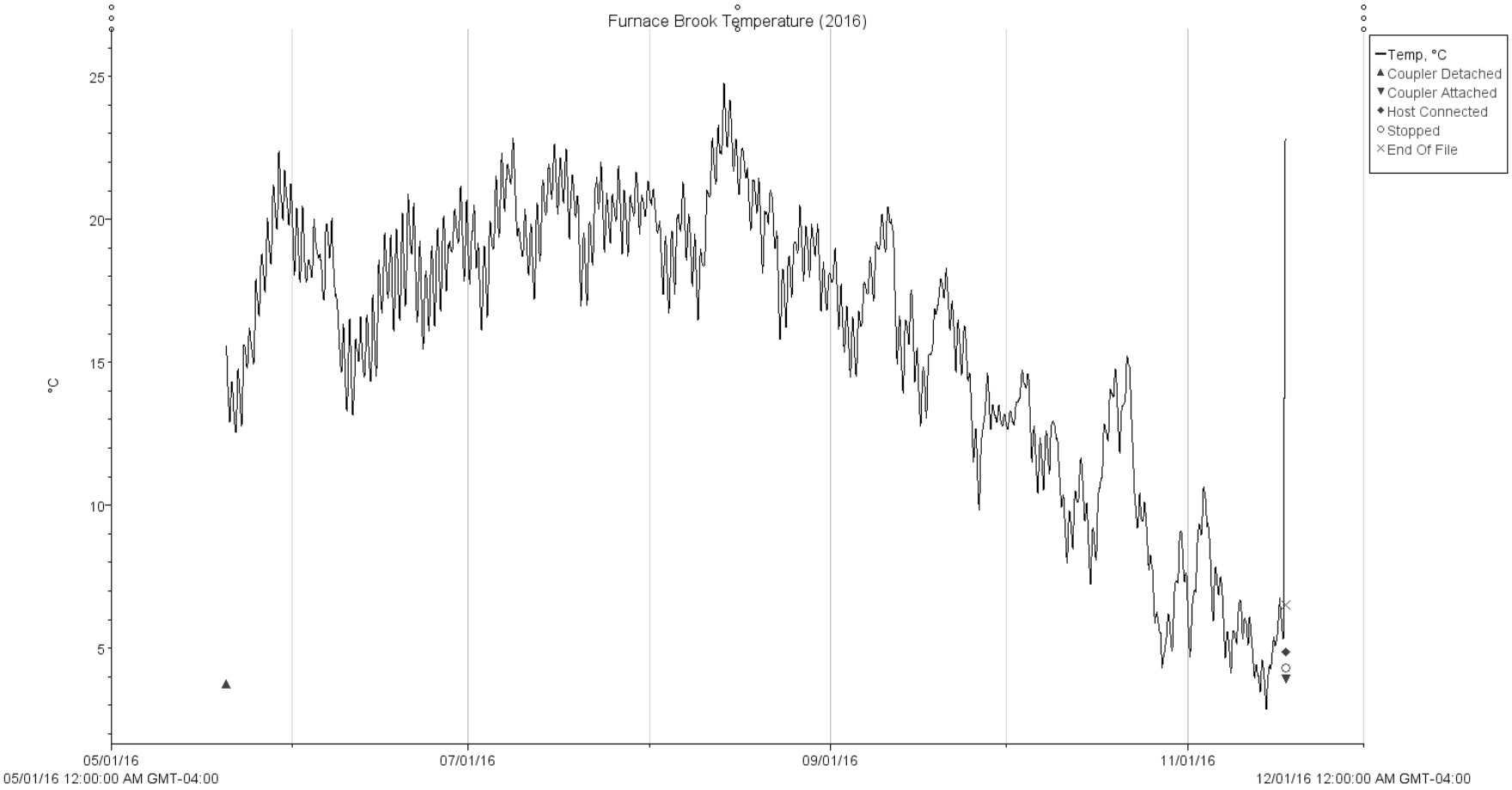


Figure 23. Temperature data (2016) for Furnace Brook, from logger placed 50 feet upstream from the refurbished fishway.

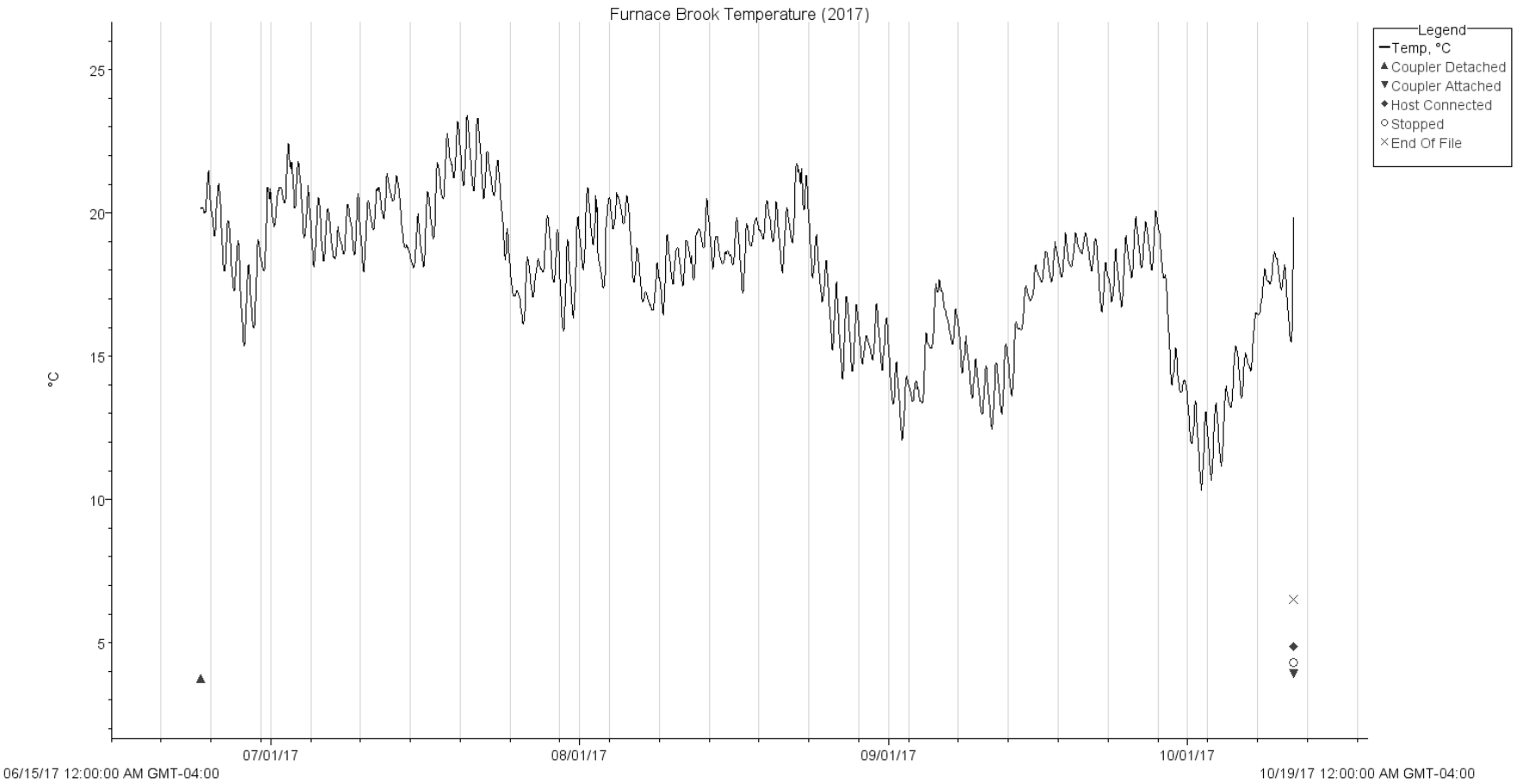


Figure 24. Temperature data (2017) for Furnace Brook, from logger placed 200 feet upstream from the refurbished fishway.

**F. Prepare Final Report**

1. Summarize and document fishway reconstruction, riparian restoration, volunteer efforts, water quality and fish utilization of Furnace Brook.

***Progress Made Towards Project Objectives:*** **This task is complete.**