



NCDA&CS - North Carolina Forest Service

Stream Restoration Post-Implementation Annual Monitoring Report

Year 5: 2016

Covering the Period of July 2015 through June 2016

For the N.C. Division of Water Resources (DWR)

Project #10-0493:

“DuPont State Recreational Forest Lake Julia Outfall Stream
Restoration”

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Project Background

Approximately 550 linear feet of stream reach flowing out of Lake Julia at DuPont State Recreational Forest in Transylvania County was repositioned and restored in May 2011. The outfall stream channel was originally established in its pre-restoration location at the time when Lake Julia was constructed in the mid-20th Century by a previous landowner. Over the ensuing decades, significant erosion and undercutting of an adjoining earthen embankment was contributing sediment loading into the nearby Little River, and resulting in the loss of large, mature trees atop the failing embankment. In addition, the erosion was accelerated during the first decade of the 2000's as a result of successive years of abnormal flood events from tropical-influenced rainfall systems which tracked over the southern Appalachian Mountains of the United States. The accelerated embankment erosion, if left unchecked, would have undermined the footers of a permanent vehicle access bridge located on the State Recreational Forest.

After scoping out the nature of the work that might be required, the N.C. Forest Service (NCFS) obtained funding and contracted with the Department of Biological & Agricultural Engineering at N.C. State University for planning, engineering, and construction management restoration services. The project's primary deliverable was to restore a segment of the outfall stream*, beginning at the bridge on the forest access road (known as the Conservation Road), and extending downstream to where the outfall channel joins an old, legacy stream channel, but prior to the stream's junction with the Little River.

Project Goals

- Establish a new stream channel that is positioned away from the collapsing embankment but within the stream's legacy floodplain.
- Improve the hydrological connectivity between the stream and floodplain.
- Improve the stream's substrate and channel configuration in a manner that enhances or improves aquatic habitat, including fishery habitat.
- Partially backfill the embankment to reduce further loss of trees due to soil erosion.
- Plant a diverse mix of appropriate tree species within the floodplain area to re-establish a protected forested riparian corridor.

Site Visits

Two site inspection visits were made during this reporting period: November 2015 and June 2016. It should be noted that the Forest Supervisor and other staff at DuPont State Recreational Forest pass by this restored stream reach daily as they travel along Conservation Road to/from the Forest Office. The Forest Supervisor frequently visits the project location to check on the status of the seedlings and the overall stream condition. If notable concerns are observed, the Forest Supervisor will contact the NCFS's Forest Hydrologist in Raleigh. This arrangement allows for the Raleigh-based project managers to reduce the need for extensive travel and associated costs for routine site visits.

*In some of this project's documentation, communications, and on some maps, there are instances in which the outfall stream channel may be referred to as Reasonover Creek, since this Creek is a major contributing stream into Lake Julia and would have likely been the major water course through this landscape if the lake had not been constructed. For the sake of clarity, the segment of stream which was restored, and which begins its course at the spillway of Lake Julia, is colloquially referred to as the *Lake Julia Outfall* by the NCFS. The old, legacy stream channel does not have a given name assigned to it by the NCFS.

Precipitation

The NCFS, in partnership with other state and federal agencies, operates [a remote automated weather station](#) at the “Guion Farm” area on DuPont State Recreational Forest. Precipitation totals from the current and previous reports recorded by this weather station are provided in the table below.

Weather Station Location: Latitude: 35.21° Longitude: -82.59°		
Time Interval of Data	Recorded Precipitation (inches)	Notes
July 2011 - June 2012	63.82	Five monthly precipitation totals exceeded 6". Nov. 2011 nearly reached 10".
July 2012 - June 2013	66.76	This weather station was inoperable during August 2012, so the actual precipitation is likely higher than the reported amount.
July 2013 - June 2014	59.68	This weather station was inoperable for 52 days during Nov. & Dec. 2013 and Jan. 2014, so actual precipitation is likely higher than reported.
July 2014 - June 2015	54.51	Nearly half of this total precipitation accumulated in 4 months: July (7.35"), Oct. (6.28"), Nov. (5.91") of 2014; and April 2015 (6.01)
July 2015 – June 2016	69.08	Nearly half of this total precipitation accumulated in 3 months: Oct. (9.54"), Nov. (10.5"), and Dec. (13.2") of 2015

Over the past five years, the restoration site experienced five monthly precipitation totals exceeding 10-inches. Evidence of both bank-full and over-bank flow events on the restoration site were evident in prior reporting periods, with heavily matted vegetation observed well away from the normal stream channel. The overall integrity of the restoration remains intact and functional, in spite of several heavy storm and over-bank events.

Vegetation

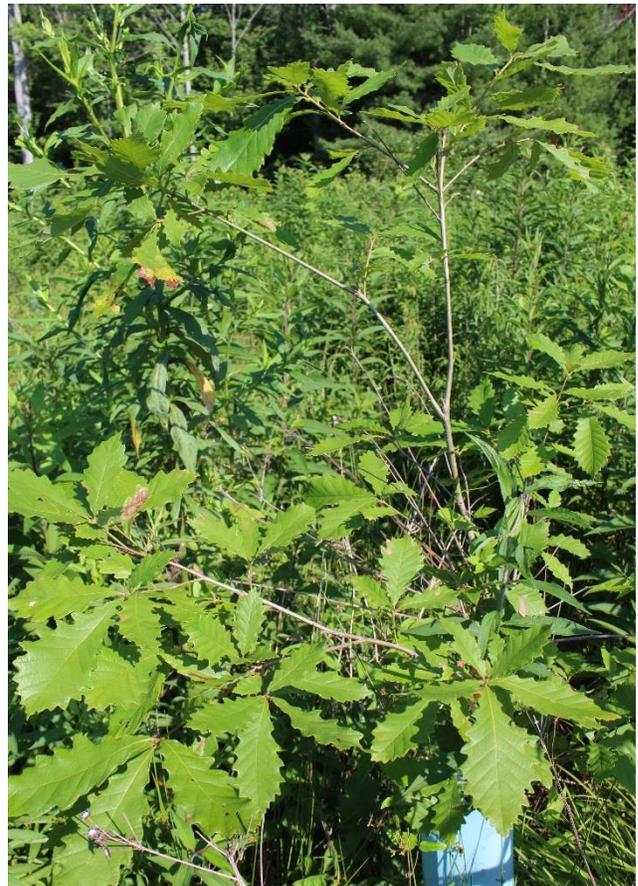
Vegetation of established seedlings continued to show good growth, despite damage to some seedlings observed in August 2013 after an intense high-water flow event that snapped off the tops of seedlings and matted down others due to the force of the floodwaters.



Photo June 2016. View looking downstream from the bridge.

Supplemental live stakes, installed along streambank edges by NCFS staff in May 2015, and other volunteer vegetation are exceedingly prolific throughout the restoration site (see photo above). Several locations along the stream bank had vegetation tall enough to begin shading parts of the stream. Exceptional growth of the transplanted alders on the right streambank (former stream channel location) were noted during the June 2016 site visit. Additionally, volunteer trees above the forest access road bridge (up-stream of the restored site) were noticeably taller than the previous year. This vegetation may reduce solar inputs to waters spilling over the reservoir's outflow weir and moving downstream.

Some tree seedling mortality was, again, observed this past year. It remains unclear on the cause of mortality. However, many volunteer yellow poplars (*Liriodendron tulipifera*), red maples (*Acer rubrum*), and alders (*Alnus* spp.) and herbaceous plants have been established on the floodplain and streambanks. Natural seed establishment from adjacent forests is expected in the future. Overall, the stream bank vegetation along the restoration sites appears to have stabilized both streambank sides and has begun to shade the stream channel.



Example of established live stake established 2 year ago along with other competing vegetation on the streambank edge (left) and oak tree seedling and competing vegetation on the restoration site (right), June 2016.

The tree shelters have not yet been removed from the seedling that have emerged over top of the shelters. The tree tube shelters will remain around the seedling in order to discourage pest damage. No adverse tree growth effects are expected due to the tree tube shelters. There have been previous observations of tree stem damage from beavers. Action may be needed to control beaver populations to assure long term growth of planted trees. A small burrow (possibility beaver or muskrat) in the

streambank was observed in June 2016 near the end of the restoration site. Continued monitoring of the site will include routine observations of nuisance animals and invasive plant growth, which may warrant future control effort.

Water Quality and Aquatic Habitat

In late June 2016, the NCFS Forest Hydrologist conducted spot-sampling of the restored reach to assess water temperature, conductivity, and dissolved oxygen, taking samples in both the riffles and pools at various depths. The findings indicated complete uniformity in both the temperature and dissolved oxygen readings, with little variability in conductivity. This indicated that water in both the pools and riffles were well mixed in late June. Water quality parameters were less ideal than the previous measure in early May of 2015. Low stream flow due to a recent onset of drought conditions was the suspected cause of the June 2016 water quality conditions. The surrounding watershed had received less than 1-inch of rainfall over the past month prior to sampling.



The upper strata heat of Lake Julia reservoir and shallow flows over bedrock into the restoration project were also suspected contributors to the June 2016 water quality measures. Temperature was 14.4 °F greater and dissolved oxygen 3.9 mg/L lower than May 2015 measures. Conductivity was again low (22.7 µs/cm), but expected given weather conditions. Water quality parameters were recorded as follows:

Temperature: 26.0 ° C (78.8 ° F)

Dissolved Oxygen: 6.3 mg/L

Conductivity: 22.7 µs/cm

Catch and release fish sampling was conducted during the drought, with specimens of largemouth bass and bluegill observed. Trout were not observed during the June 2016 sampling, as the water temperature exceeded the tolerable range for trout. This observation supports the premise that trout move downstream to cooler waters of the Little River during the warmer summer months, while warm water tolerant species, such as largemouth bass and bluegill, inhabit the restored stream reach during warm water conditions. In addition to fish observations, amphibian spawning was noted along the stream edge (see picture below).



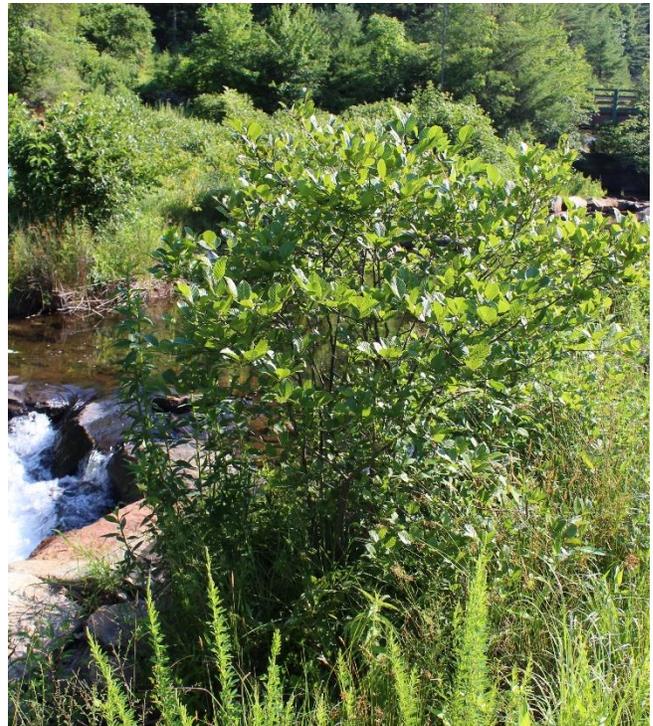
Amphibian eggs between a log vane and streambank.

Stream Stability and Function

Minor bank repair work was conducted in May 2015 at a location approximately mid-way down on the left bank of the restored reach. A nearby alder shrub was transplanted from the upland area, into a washed-out spot of the streambank to add stability. One year later, the transplant is thriving and providing bank stability.



May 2015, immediately after transplanting of an alder shrub and rootball on left-bank.



June 2016, one year after transplanting an alder shrub and rootball on left-bank.



June 2016

The right-side of the stream (where the stream was moved from) was extensively covered by alder in June 2016. While the exposed legacy embankment on the hillside remains intact, it is mostly hidden by the vegetative growth (see right side of stream in the picture to the left). Some large eastern white pine (*Pinus strobus*) were showing signs of die-back and mortality, likely due to damaged root systems caused by continued exposure to the vertical soil embankment. These trees will be monitored by the DuPont State Recreational Forest staff and felled if deemed necessary. Overall, the stream channel design (plunge pools, log and rock vanes, and brush toe materials) is intact and functioning appropriately.

An increase in the amount of substrate (cobble sized stone) along the stream bottom was observed during the June 2016 visit. The source of the substrate is

relatively unknown. However, erosional forces on the saprolitic rock along the streambank and/or streambed above the restoration project could be potential sources of this material. The addition of substrate to the restored stream reach provides improved aquatic habitat.

Outreach/Education/Training

No coordinated training events were conducted in this reporting period. A large overall interpretative exhibit sign was installed along the forest access road bridge that overlooks the project site. The sign was installed at a level suitable for short and tall viewers. Smaller signs will be installed at a future time, closer to the stream, once the site vegetation matures, the site fully stabilizes, and a walking trail can be established to allow visitors to navigate through the restoration site safely with minimal disturbance.



Kiosk and restoration project overview sign adjacent to the forest access road bridge.

Future Restoration Plan Development

In September 2014, the NCFCS was awarded a grant from the NCDENR-DWR Water Resources Development Grant Program to fund the development of an overall watershed assessment and restoration plan for DuPont State Recreational Forest. Completed in 2015, the restoration master plan can be viewed online at: http://www.ncforestservice.gov/water_quality/dupontRestoration.html. As a result of this planning, an additional restoration opportunity was identified within the upper reach of Lake Julia Outfall/Reasonover Creek, immediately upstream of the completed restoration. The master plan also evaluated other bodies of water on the Recreational Forest and areas of concern for their stabilization needs or potential for restoration; and outline what actions would be appropriate to take. This Plan is similar to the previously-funded water resource master plan prepared for the NCFCS Gill State Forest / Linville River Nursery, in Avery County.

Continuing Management

- Monitor stream bank and make adjustments as needed to assure stability.
- Continue to monitor and sample water quality and for fish population.
- Use the site for field study, educational workshops, and training as needed or requested.
- Assess vegetation within the restored area, and on the adjoining hillside, to manage for long-term stability. Monitor for invasive plants and consider options for controlling wildlife that could damage the riparian vegetation.

Chronosequence of the Project

The pictures below are a time-step of the project (before, during, and post-years after). Overall, Reasonover creek restoration project has successfully reduced annual sediment loads to trout bearing waters, enhanced hydrologic connectivity that potentially help reduce downstream flooding effects, improved wildlife habitats, helped maintain water quality, and provided outreach, education, and training opportunities.



Stream channel near the forest access road bridge in May 2009 (left). Soil loss was occurring from the exposed vertical soil embankment on the right stream bank (legacy channel) in Sept. 2009 (right).



View from the forest access road bridge during stream reconstruction in May 2011.



View from the forest access road bridge (left) and from the right bank (right) ~1 year after stream reconstruction (March 2012).



View from the forest access road bridge ~2 years after stream reconstruction (May 2013 [left] and Aug. 2013 [right]).



View from the forest access road bridge (left) and from the left stream bank (right) ~3 years after stream reconstruction (Sept. 2014).



View from the forest access road bridge (left) and from the left stream bank (right) ~4 years after stream reconstruction (May 2015).



View from the forest access road bridge (left) and from the left stream bank (right) ~5 years after stream reconstruction (June 2016 [left] and Nov. 2015 [right]).