Case Study 2: Garner Creek Restoration, Georgia, United States[3]

Purpose of Project: Restore the urban stream corridor to mitigate streambank erosion and flooding, and support the biological impairment total maximum daily load (TMDL)

Construction Date: 2019

Total Cost of the Project: $1.1 million USD

Top: Garner Creek before restoration

Bottom: After restoration.

Credit: Brown and Caldwell

Measures Included: Bankfull floodplain benches; in-stream habitat structures; stormwater best management practices (pocket wetland, enhanced dry swale); biotechnical bank stabilization; outdoor classroom and pedestrian trail

Multiple Benefits: Increased stream-floodplain connectivity; improved water quality; increased floodplain storage; reduced flood risk to adjacent school and local community; enhanced public education and recreational opportunities

Project Sponsors/Partners: U.S. Environmental Protection Agency; Gwinnett County Department of Water Resources; Brown and Caldwell; Jacobs Engineering Group

Project Description

Garner Creek, located in Gwinnett County, Georgia, flows through an approximately 1.2-square-mile watershed (from the project boundary) with urban and residential land uses. The project site is adjacent to a county high school and a local soccer association. In 2009, substantial

floods passed through the creek, damaging adjacent property and overturning school buses. Additionally, a TMDL identified urban runoff and nonpoint source pollution within the watershed that impaired biological (fish) habitat. Highly impervious land uses had triggered channel incision and bank erosion that contributed excessive sediment loads to the creek. Important aquatic habitat features for fish and macroinvertebrates, such as riffles, were degraded, and the floodplain was disconnected from the entrenched stream. Trash from the high school parking lot was littered throughout the stream, further degrading aquatic habitat. To address these issues, approximately 1,200 linear feet of Garner Creek and the adjacent floodplain were restored.

Nature-based Solutions Design Approach

The goals of this project were to support the TMDL and protect adjacent property from flooding by increasing flood storage and enhancing aquatic and riparian habitats. Major objectives of the restoration included the following:

- restoring 1,200 linear feet of Garner Creek and creating diverse aquatic habitat,
- providing pedestrian access and educational elements to enhance opportunities for social uses, and
- demonstrating best management practices (BMPs) using methods from the recently updated Gwinnett County Stormwater Management Manual.[4]

Stream restoration approaches included stream realignment with increased sinuosity, bank regrading including bankfull benches, biotechnical bank stabilization, installation of in-stream structures, and riparian buffer enhancement. Constructed riffles and pools, stone and log j-hooks, and brush mattresses were implemented to provide aquatic habitat and to diversify the longitudinal profile. Streambanks were stabilized with rock and wood along the toe, and with encapsulated soil lifts, coir matting, and vegetation up the slope. Nearly 1,400 linear feet of bankfull bench (counting both banks) varying from 2 to 20 feet wide were constructed to provide flood storage and enhance floodplain connectivity.

An outdoor classroom was installed in the overbank area to provide an educational space for high school students. Recreational opportunities were enhanced with a walking trail and stone steps to improve river access. Stormwater BMPs, such as a pocket wetland, enhanced dry swale, and vegetated channels, were incorporated to provide flood storage and water quality benefits.

Existing conditions for Garner Creek were determined through geomorphic, physical habitat, and biological assessments. The geomorphic assessment divided the project area into two reaches and measured typical cross-section geometry (i.e., bankfull depth, width, and area), planform (sinuosity and radius of curvature), longitudinal profile, and streambed grain size distribution. Physical habitat assessments followed Georgia Department of Natural Resources (GA DNR) protocols to visually determine the health and condition of stream habitat based on substrate, sedimentation, morphology, bank stability and vegetation, and riparian zone condition. Biological assessments were conducted to sample macroinvertebrate and fish communities and establish scores based on GA DNR indices. These assessments were supplemented with desktop analyses to identify potential threatened and endangered species and to confirm the absence of cultural resources. A portion of the project was identified within a regulatory floodway (1% annual chance of flooding), so the Conditional Letter of Map Revision and Letter of Map Revision were prepared for the Federal Emergency Management Agency records upon determining that proposed conditions changed the floodway elevation.

The existing conditions were used to inform restoration design. Stream channel dimensions were determined by combining current conditions observed in Garner Creek with methods that had proven to withstand flashy flows in urban streams throughout Gwinnett County – reference reach measurements within the county, North Carolina Piedmont Rural Regional Curves, and Piedmont Dimensionless Ratios provided by the Gwinnett County Department of Water Resources. Proposed conditions were modeled with a one-dimensional HEC-RAS model to assess whether these dimensions could convey the bankfull discharge, approximated with the 50% annual exceedance probability flow. Floodplain benches ranging from 2 to 20 feet in width, with wider benches on inside meander bends, were modeled to quantify reduction in shear stresses on streambank side slopes at flows above bankfull. Streambank and in-stream structures such

as rock vanes, toe wood, and encapsulated soil lifts were incorporated as grade control and additional protection against erosion. Rocks were sized using a relationship between bankfull maximum shear stress and minimum rock size, published in Part 654 National Engineering Handbook.[5] Native vegetation was selected to plant along the regraded banks and overbank area.

Engineering Design Considerations

The key engineering design considerations and constraints included the following:

- The left overbank area was previously used for school bus parking, and the right overbank area was a soccer field. This constricted the available width for floodplain benches.

- An adjacent high school constrained lateral limits of restoration but provided a means to incorporate educational opportunities into design.

- The highly impervious, urban watershed generated flashy hydrologic conditions that required stormwater management and flood storage. Including stormwater BMPs and re-designed pipes and headwalls in the design helped manage these flashy flows.

- Permits were required from numerous regulatory agencies, including the Georgia Environmental Protection Division, U.S. Army Corps of Engineers, Federal Emergency Management Agency, U.S. Environmental Protection Agency, and Gwinnett County.

Ecological Design Considerations

Because of the TMDL for biological impairment in Garner Creek, restoration emphasized habitat and water quality enhancements for ecological improvement. Stormwater BMPs were constructed to address urban runoff and nonpoint source pollution. Biotechnical bank stabilization techniques were utilized to reduce erosion and, thereby, sedimentation in the creek. Riffle-pool sequences and other in-stream structures that generated variable velocity and depth regimes were included in the design to improve the habitat ratings from the pre-

restoration physical habitat assessments. The restoration also included ecological design considerations to enhance the riparian buffer to support Lower Piedmont flora and fauna that were part of the watershed's pre-development habitat. Invasive species were removed, and native trees, shrubs, and herbaceous species were replanted along the streambanks and overbank areas.

Operations, Maintenance, and Monitoring

Gwinnett County Department of Water Resources was responsible for operation and maintenance of the restored site. Although the importance of post-restoration monitoring was recognized during the design phase, no specific funding was secured. Site visits were periodically conducted to qualitatively evaluate streambank erosion. This reach of Garner Creek was also assessed for the prevalence and abundance of fish species as part of a University of Georgia research study.

Lessons Learned

The following are some key lessons that were learned over the course of the project:

- A large culvert in the project site was clogged with sediment and debris, making the initial survey inaccurate. Exposing the culvert invert during construction identified correct dimensions that led to design modifications.

- Beneficial reuse of materials was a viable strategy in this urban stream. The quality of woody debris from the culvert was evaluated and, where appropriate, used to create brush mattresses. Riparian trees that were cleared for bank and floodplain regrading were utilized for a log j-hook.

- Engaging the various stakeholders (school, soccer association, residents) prior to conceptual design and with frequent, monthly meetings led to greater participation and education.

Figure 5. Plan view of one portion of the Garner Creek restoration, showing a bankfull bench and other various design features.
Plans developed by Brown and Caldwell.[6]

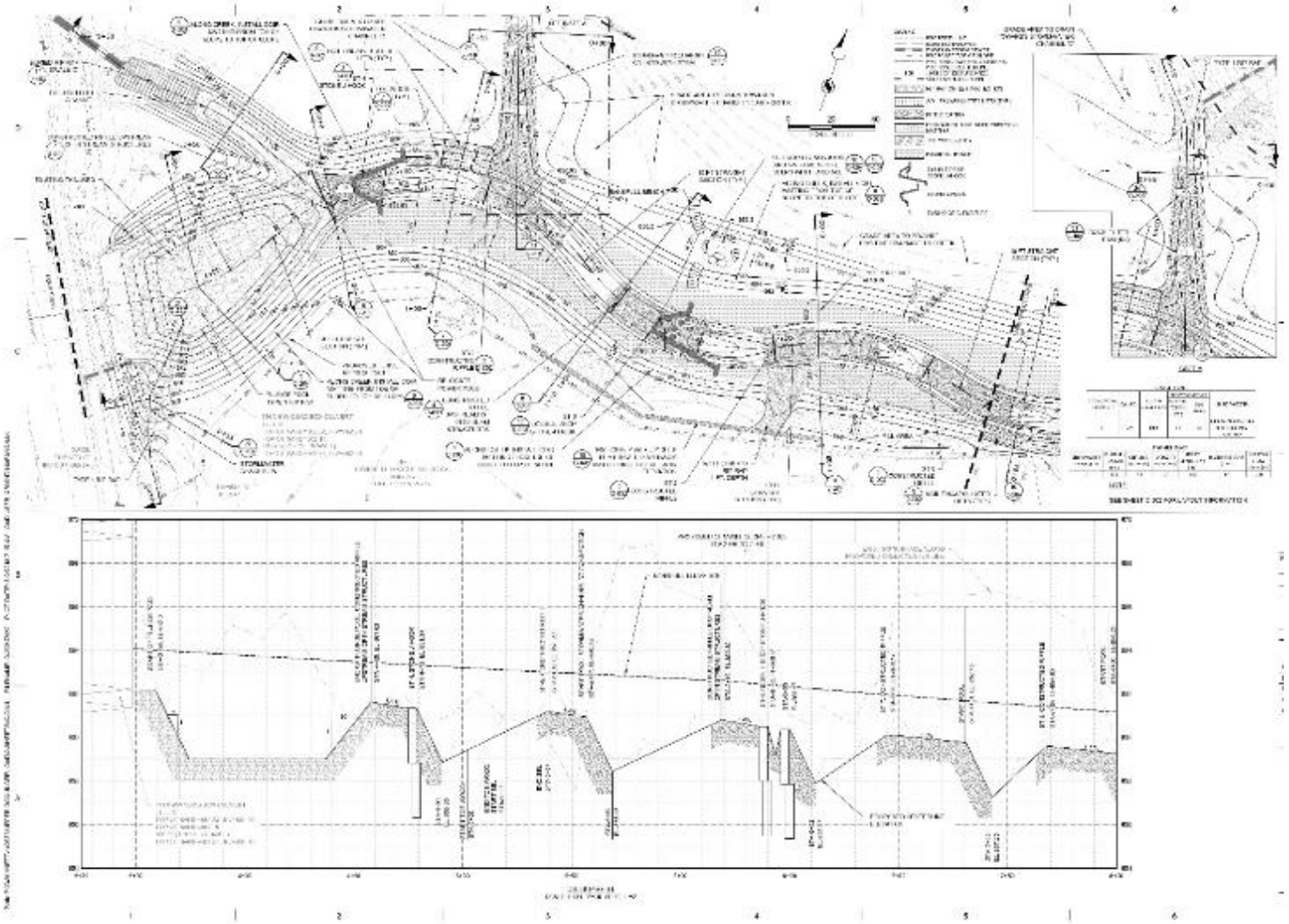
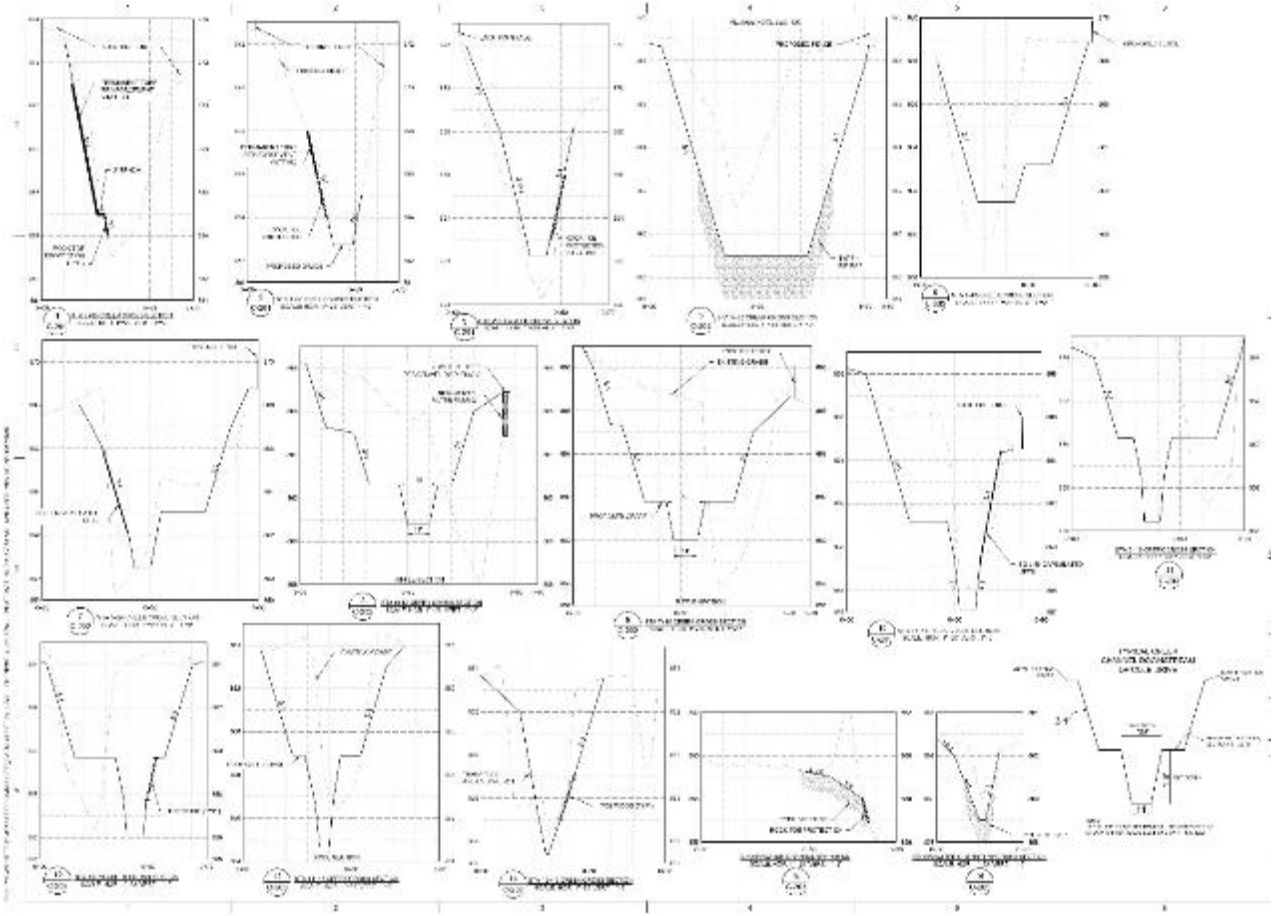


Figure 6. Select cross sections showing the bankfull bench design for the Garner Creek restoration project

Sections developed by Brown and Caldwell.[6]



References

[3] Brown and Caldwell. 2018. Pre-Construction Notification: Nationwide Permit 27. Pages 6-1 through 7-4.

[4] AECOM, Atlanta Regional Commission, Center for Watershed Protection, Center Forward, Georgia Environmental Protection Division, and Mandel Design. 2017. Gwinnett County Stormwater Management Manual. Prepared for Gwinnett County, Georgia.

[5] U.S. Department of Agriculture (USDA), Natural Resources Conservation Service. 2007. Stream Restoration Design. Part 654 National Engineering Handbook. 210-VI-NEH. August.

[6] Brown and Caldwell. 2019. Construction Plans for: Garner Creek Watershed Improvement Project. Prepared for Gwinnett County Department of Water Resources, Gwinnett County, Georgia. Drawings C-202 and C-204.