

FINAL REPORT

Survey for Protected Freshwater Mussels in Fishback Run and Tributaries to the Rappahannock River Associated with a Housing Development in Culpeper County, Virginia

by



Braven B. Beaty & Caitlin S. Carey
Daguna Consulting, LLC
7509 Pin Oak Circle
Bristol, VA 24202

for

Wetland Studies and Solutions, Inc.
5300 Wellington Branch Drive, Suite 100
Gainesville, Virginia 20155

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INTRODUCTION

The Clevengers Village housing development proposes to impact stream and riparian habitats within the Rappahannock River watershed along Fishback Run (formerly Negro Run) and an unnamed tributary to the Rappahannock. A site map indicating 8 impact sites was provided by Dylan Laygraaf at Wetland Studies and Solutions. This project could impact habitats occupied by protected freshwater mussel species including the federally endangered Dwarf Wedgemussel (*Alasmidonta heterodon*), federally threatened Yellow Lance (*Elliptio lanceolata*), and the state-threatened Green Floater (*Lasmigona subviridis*). The Yellow Lance has been detected in the Rappahannock River just upstream of US Route 211, approximately 3.9 kilometers (km) upstream of the confluence with Fishback Run. Due to the possible presence of federal and state-listed species, a “Full Mussel Survey” of the potentially impacted reaches prior to work initiation was performed. The development project footprint is centered at approximately 38.67967, -77.92501 (WGS84).

METHODS

On July 19th, 2024, biologists with Daguna Consulting, LLC (B. Beaty and C. Carey) conducted “Full Mussel Surveys” of the Rappahannock River tributaries, including approximately 550 m of the Rappahannock River mainstem, surrounding the 8 impact sites. The surveys generally extended from approximately 800 meters (m) downstream to 200 m upstream of the proposed project impact zones (Figures 1 & 2). The total surveyed study area was approximately 3.4 km in length, primarily in Fishback Run, an unnamed tributary to Fishback Run that drains a large pond, and the Rappahannock River mainstem. The approximate locations of the proposed impacts are provided in Table 1 as estimated from a project PDF file shared with Daguna Consulting. All instream habitats were visually searched (aided by viewscopes or unaided) for evidence of freshwater mussels and assessed for suitability. Viewscoping was primarily performed in greater depths, ranging from 0.3–1.0 m, while unaided visual searches were used in depths up to 0.3 m with laminar flow. Biologists spent 11.7 person-hours searching instream habitat across the designated study area. Geographical Information System (GIS) programs and GPS devices were used to georeference the boundaries of the study area, searched study reaches, location of any protected species, and location of other pertinent features.



RESULTS

Flow and Weather Conditions

Flow and weather conditions on July 19th, 2024 were suitable for conducting the mussel survey. Weather conditions were partly cloudy with morning air temperatures around 23°C (73°F) and a high of 30°C (86°F) during the survey. Discharge in the Rappahannock River near Remington (USGS gage station 01664000), located downstream of the Hazel River confluence, was 47.5 cubic feet per second (cfs); approximately 1/3 the long-term median discharge based on 81 years of data. In addition, discharge in Hazel River near Rixeyville at the time of the survey was also approximately 1/3 median flow based on 71 years of data. Water clarity in the Rappahannock River was excellent with the substratum clearly visible from all depths encountered. However, overnight storms July 18th –19th raised flows in Fishback Run and tributaries, subsequently increasing turbidity. Upon arriving on site, these streams were not searchable so the survey work began in the Rappahannock River. By the time we completed surveying the necessary section of the Rappahannock River, sampling conditions within the tributaries had returned to suitable survey conditions. Water temperature in the Rappahannock River was 24°C.

Habitat Observations

The Rappahannock River reach extending from 200 m downstream of the Fishback Run confluence to 460 m upstream of the confluence was the largest stream channel surveyed. The immediate riparian zone was primarily forested along the left-ascending bank and a thin wooded strip along the right-ascending bank ranging from 15–30 m wide with agricultural field beyond this strip (Fig. 2). The banks were steep and high, often 3–4 m above current water level (Fig. 3). Severe erosion was apparent along both banks even though trees were present along the bank tops. The channel was deeply incised. The wetted area extended the full width of the channel over approximately half the surveyed length. The remainder was characterized by sand bars with occasional boulders. The substratum was dominated by sand and silt with very little cobble/gravel substrate and only a modest amount of woody debris. The most downstream 100 m exhibited somewhat more gravel and cobble. The riverbed was unstable and moved readily underfoot while wading. Substrate composition was estimated at 80% sand, 17% silt, 2% woody debris, and less than 1% of gravel and cobble. Nutrient enrichment was evident throughout the surveyed reach with prevalent algal growth and invasive aquatic vegetation (tentatively identified as Hydrilla or Elodea) over more than 20% of the substratum (Fig. 4). However, upstream of the direct unnamed tributary the channel changed character with more gravel and cobble substrata, less algal growth, and greater sinuosity within the bank width. The channel bankfull width was uniformly



approximately 23–25 m with the wetted width ranging from 12–25 m. Depth during the survey was 0.1–1.5 m, averaging approximately 0.2 m.

Fishback Run (lower) from its confluence with the Rappahannock River upstream to the first golf cart crossing (Fig. 5) was an approximately 290 m, 3rd-order stream through a mostly forested landscape. The mean wetted width was 4–5 m, reaching a maximum of 7 m. Bankfull width varied from 1–4 m greater than wetted widths, and was typically greater than 1.5 m. The channel was highly incised as evidenced by the (mostly) tall, steep banks and frequent erosion. Bank height was 2 m above the water level throughout most of the surveyed reach. Mean water depth was 0.3 m, reaching 0.7 m at the deepest. As mentioned above, this flow followed overnight rain so may be slightly elevated from typical baseline. The substratum was comprised of 30% bedrock, 15% gravel, 15% cobble, and 40% sand/silt with a little cobble mixed in. The riparian zone was almost entirely forested.

Fishback Run (middle), from the first golf cart crossing to the first impact zone and upstream of the pond drain confluence, while still third order was narrower than the previous reach. The wetted width ranged from 1–5 m with a mean of 3 m. Bankfull widths were 1–3 m greater than wetted widths. The banks were mostly steep and high, ranging from 1–2 m above the water level. The channel exhibited some sinuosity within the channel confinement, focused in higher velocity areas where the wetted width was narrower. The substratum composition remained 30% bedrock, 15% gravel, 10% cobble, and 45% sand/silt (Fig. 6). However, approximately 30% of the substrate was occupied by aquatic macrophytes including water willow and hydrilla or elodea, particularly densely concentrated in slow velocity areas. Further nutrient enrichment evidence included extensive surface algae growth even though little filamentous algae was present. Golf balls were numerous in the stream channels within the golf course footprint. The stream was entirely encompassed by the golf course with a thin riparian buffer strip of trees and shrubs. Golf course managers had cut the riparian shrubby cover throughout approximately half of the surveyed length. Much of this cut material was pushed into the stream channel creating further bank instability and increased presence of instream woody debris.

The reach of Fishback Run (upper) from the first impact to upstream of the third impact zone exhibited different characteristics than that found downstream. The initial 75 m upstream of the second impact zone was similar to the reach below with a wetted width of 3 m, depth of 0.5–1m, and a soft substratum comprised of sand and silt, including the invasive aquatic plants. This reach was entirely surrounded by the golf course with just a continuous cover of tall grasses along the banks. The banks were approximately 1 m high and sloped so the bankfull width was 6 m greater than the wetted width. The remaining upstream portion of this reach was primarily wooded along the right-ascending bank and golf course with a single strip of trees along the left-ascending bank. The instream habitats varied with shallow riffles underlain by gravel substrates, runs with a mix



of sand/silt and substrates, and others dominated by boulder and cobble substrates, as well as a few shallow pools (Fig. 7). Depth ranged from 0.1–0.5 m, averaging approximately 0.2 m. The banks remained approximately 1 m high and sloped, creating a bankfull width approximately 6 m greater than the wetted width, which was 3–4 m. The small tributary entering Fishback Run from the right-ascending bank near the third impact zone was too small to provide suitable mussel habitat.

The tributary draining the pond contained marginal habitat for native mussels. There were 3 large stagnant pools (Fig. 8) between Fishback Run and the outflow of the pond dam, one near the confluence with Fishback Run, one near the middle of the reach, and one a little downstream of the dam. The remainder of the channel appeared modified and channelized. Some of the banks were armored with large rocks, a man-made installation, in an attempt to stabilize them (Fig. 9). The banks were generally less than 1 m high and sloped. None of the banks were wooded although a few scattered trees occurred in the immediate riparian zone (Fig. 10). Due to high turbidity in pools, water depth in the pools was indeterminate. Water depth in the remainder of the reach was approximately 0.1–0.3 m. The substratum in flowing parts of this reach was dominated by cobble. Some invasive aquatic vegetation was observed, creating ‘monocultures’. The tributary entering this reach from the right-ascending bank just downstream of impact zone 3 was too small, less than 0.5 m wide, to support native mussels and was deemed unsuitable habitat.

The unnamed tributary entering the large pond was unsuitable habitat for rare native mussels. The downstream 175 m of the pond was an open water impoundment. The upstream 225 m was shallow with a surface covering of algae and/or duckweed providing stagnant palustrine habitat. Near the proposed impact area (UNT 3), the habitat became deeply incised, silt substrate stream channel. The wetted channel was 3 m wide and the bankfull width was 1 m greater. The water depth was 0.5 m with a bankfull depth 1 m greater. The banks were steep. The riparian zone was fully vegetated with early successional plants and shrubs which provided very limited access to the stream channel. Riparian plants observed included grasses, Blackberry, Multiflora Rose, Wingstem, Locust, and Willow. The substratum was entirely silt and there was greater than 75% coverage of Hydrilla or Elodea. This was determined unsuitable habitat for native freshwater mussels. The culverts at the proposed impact area were 75% clogged, primarily with silt including some woody debris. There was very little flow.

The remaining streams indicated on the USGS topographic map and NHDPlusHR data sets were dry during the survey visit and considered to be intermittent. These streams were identified as intermittent on the USGS topographic map.

Species Observations

The survey yielded evidence of two mussel species. We observed 47 live Eastern Elliptio (*Elliptio complanata*) and 2 live Northern Lance (*Elliptio fisheriana*) in the Rappahannock River mainstem



(Fig. 11). The only other location where native mussels were observed was immediately below the outflow of the pond in the unnamed tributary draining the pond where several relic Eastern Floater and Northern Lance shells were detected (Fig. 12). No live mussels were encountered in any of the streams besides the Rappahannock River mainstem. Asian Clams (*Corbicula fluminea*) were present in Fishback Run but were not abundant. Sandy substrates that were disturbed to expose subsurface bivalves did not yield many live Asian Clams.

At least two gastropod (snail) species were observed in the study area, including one Pleurocera species and one tentatively identified as Crested Mudalia (*Leptoxis carinata*). Crested Mudalia were abundant in the Rappahannock River while the Pleurocera snails were uncommon. The snails were not abundant in the tributaries.

Crayfish were detected in both the Rappahannock River mainstem and tributaries. They were not common in either habitat but higher numbers of dead crayfish in Fishback Run indicated greater populations than observed live.

Fish were common to abundant in both the Rappahannock River and Fishback Run. Species observed in the Rappahannock River were Largemouth Bass, Northern Hogsucker, and multiple minnows (cyprinids) but no darters were observed. Only minnows were observed in Fishback Run. Spawning mounds constructed by chubs or other minnows were present in both the Rappahannock River and Fishback Run.

Aquatic insects were uncommon throughout the surveyed reaches. Most rocks overturned, when available, to search for mussels did not expose aquatic insects. This was likely due to high embeddedness of the substrates and little available habitat space under them.

DISCUSSION

Given our search efforts and the detection of only two live mussel species, both common, it is unlikely rare or protected mussels occur in this study area (3.4 km of wetted stream channel) of the Rappahannock River, Fishback Run, or the unnamed tributary watersheds. Based on an equation described by Smith (2006), and assuming a conservative minimum of 6,140 m² of the streambed surface within the study area was visually searched (i.e., if each surveyor were minimally covering a 1-m wide lane as they transversed along the 3.4 km longitudinal length of wadeable study area) and a conservatively low search efficiency of 0.20 (portion of mussels at the substrate surface available for detection and observed), we had a $\geq 99.9\%$ probability of detecting the presence of any given mussel species present at a density as low as (or greater than) 0.01 individuals/m² or 1 mussel every 100 m².



Overall, the ecological integrity of the streams was deemed to be fair to poor. Both the stream channels and the Rappahannock River were deeply incised with eroding and steep banks. The substratum was dominated by small particle sizes due to sedimentation. In addition, the deep incision has confined the stream channel limiting sinuosity and habitat heterogeneity potential. The instream habitat exhibited an over-abundance of algal and macrophyte growth on substrata, indicating a significant ongoing nutrient enrichment issue.

REFERENCES

Smith, D. R. 2006. Survey design for detecting rare freshwater mussels. *Journal of the North American Benthological Society* 25:701–711.



TABLES & FIGURES

Table 1: Limits of searched areas.

Identified Stream	Downstream Coordinates	Upstream Coordinates
Rappahannock River	38.6640, -77.90183	38.67108, -78.90171
Fishback Run lower (impact 19)	38.66802, -77.90254	38.66380, -77.90897
Fishback Run middle (impact 10)	38.66380, -77.90897	38.66718, -77.91353
Fishback Run upper (impact 5)	38.66718, -77.91353	38.67033, -77.91452
Unnamed tributary 1 – downstream of pond (impact 15)	38.66408, -77.91148	38.66343, -77.91470
Unnamed tributary 2 – off pond drain (impact 12)	38.66354, -77.90905	Unsuitable habitat
Unnamed tributary 3 – upstream of pond (impact 14)	38.66042, -77.91836	38.66016, -77.91885
Unnamed tributary 4 – (impact 20)	38.66355, -77.90908	dry
Unnamed tributary 5 – (impact 9)	38.67051, -77.90340	dry



Virginia Department of Wildlife Resources — Collection Record #1

Site #: DAGUNA07192024.1

Stream: Rappahannock River

County: Culpeper

Description: Mussel survey for the Clevengers Village development project.

Drainage: Rappahannock River Basin

Projection: WGS 84

Survey Start: 38.6640, -77.90183

Survey End: 38.67108, -77.90171

Survey Habitat: Mostly run with sand/silt substratum and occasional woody debris

GPS Accuracy: 3-5 m

Survey Date: July 19th, 2024

Survey Effort: 3.5 person-hours

Personnel: B. B. Beaty, C. S. Carey

Mollusks Observed:

Live

47 *Elliptio complanata* – size (mm) of first 29: 31, 28, 70, 78, 61, 69, 68, 62, 66, 65, 53, 75, 60, 66, 67, 64, 59, 68, 58, 62, 57, 64, 54, 47, 57, 63, 63, 70, 74

2 *Elliptio fisheriana* – size (mm): 65, 73

Asian Clams (*Corbicula fluminea*) common

Shell



Virginia Department of Wildlife Resources — Collection Record #2

Site #: DAGUNA07192024.2

Stream: Fishback Run

County: Culpeper

Description: Mussel survey for the Clevengers Village development project.

Drainage: Rappahannock River Basin

Projection: WGS 84

Survey Start: 38.66802, -77.90254

Survey End: 38.67033, -77.91452

Survey Habitat: Mixed, mostly run and riffle, substratum dominated by sand in the downstream half and gravel and cobble in the remainder. Invasive aquatic vegetation covered much of the streambed over approximately 25% of the surveyed reach.

GPS Accuracy: 3-5 m

Survey Date: July 19th, 2024

Survey Effort: 6.3 person-hours

Personnel: B. B. Beaty, C. S. Carey

Mollusks Observed:

Live

None

Asian Clams (*Corbicula fluminea*) present

Shell

Asian Clams (*Corbicula fluminea*)



Virginia Department of Wildlife Resources — Collection Record #3

Site #: DAGUNA07192024.1

Stream: unnamed tributary 1 (pond drain stream)

County: Culpeper

Description: Mussel survey for the Clevengers Village development project.

Drainage: Rappahannock River Basin

Projection: WGS 84

Survey Start: 38.66408, -77.91148

Survey End: 38.66343, -77.91470

Survey Habitat: Mixed, approximately equal parts riffle and pool, substratum dominated by sand/silt in the pools and large cobble in riffles.

GPS Accuracy: 4-5 m

Survey Date: July 19th, 2024

Survey Effort: 0.7 person-hours

Personnel: C. S. Carey

Mollusks Observed:

Live

None

Shell

Elliptio fisheriana (relic)



Virginia Department of Wildlife Resources — Collection Record #4

Site #: DAGUNA07192024.1

Stream: unnamed tributary 3 (stream upstream of pond)

County: Culpeper

Description: Mussel survey for the Clevengers Village development project.

Drainage: Rappahannock River Basin

Projection: WGS 84

Survey Start: 38.66042, -77.91836

Survey End: 38.66016, -77.91885

Survey Habitat: Run; substrate 0.4 m deep silt with 60% coverage of invasive aquatic vegetation

GPS Accuracy: 4-5 m

Survey Date: July 19th, 2024

Survey Effort: 0.2 person-hours

Personnel: C. S. Carey

Mollusks Observed:

Live
None

Shell
None



FIGURES

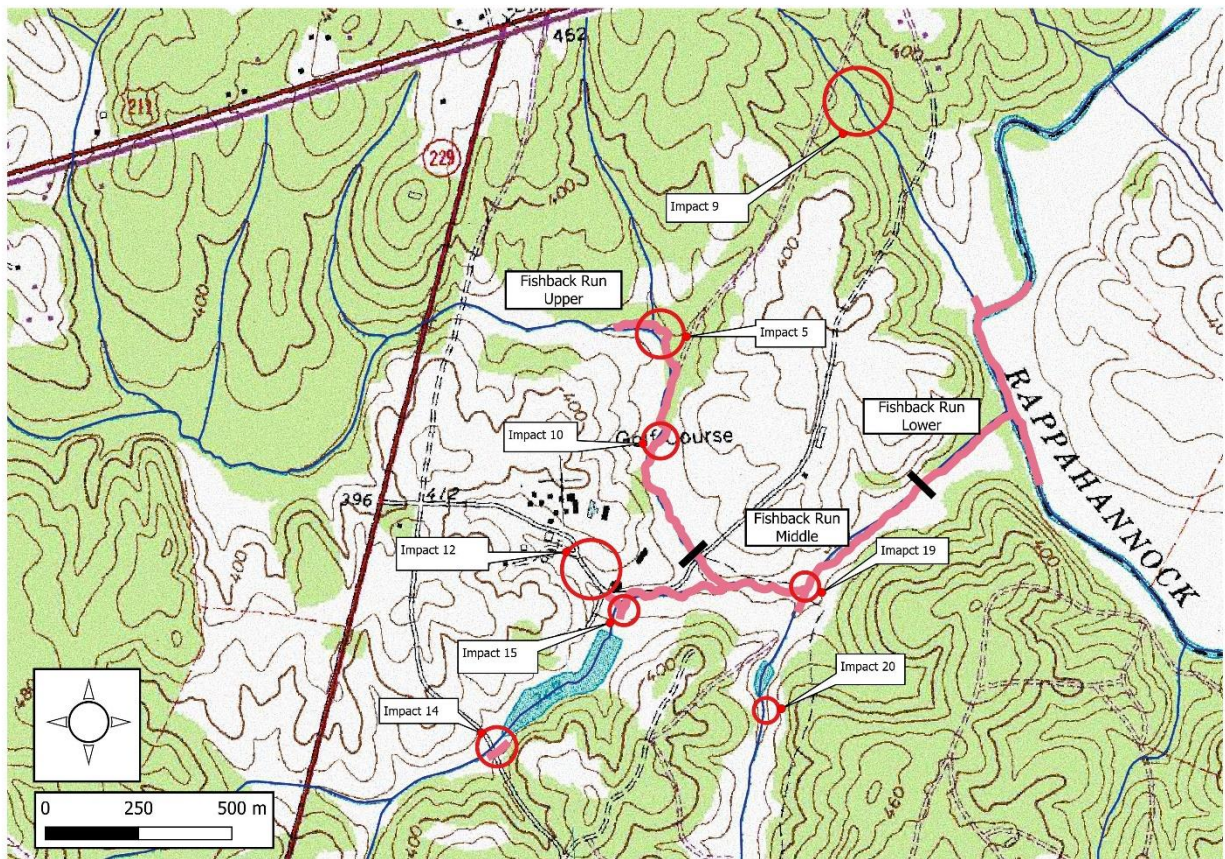


Figure 1. Topographic map showing the survey area with the searched reaches in pink and the impact areas shared by WSSI as red circles. Solid blue lines indicate streams generated by the NHD High Resolution hydrology data layer. The two black lines indicate the Fishback Run reach separations as described in the text (lower, middle, and upper).

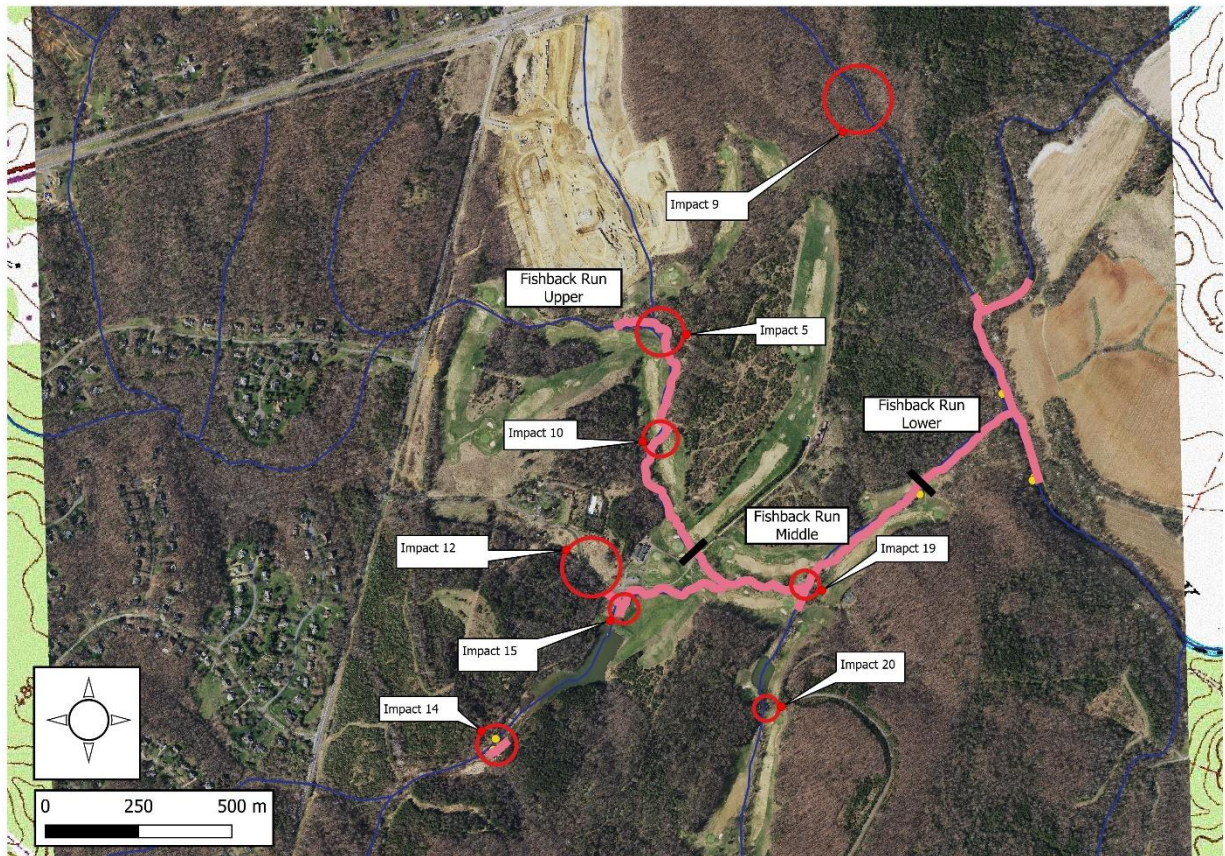


Figure 2. Aerial map showing the survey area with the searched reaches in pink and the impact areas shared by WSSI as red circles. Solid blue lines indicate streams generated by the NHD High Resolution hydrology data layer. The two black lines indicate the Fishback Run reach separations as described in the text (lower, middle, and upper).



Figure 3. Rappahannock River in the surveyed reach showing the sand substratum, steep banks, and a typical sand bar.



Figure 4. Dense aquatic macrophyte bed in the surveyed Rappahannock River reach. This was identified as either Hydrilla or Elodea.



Figure 5. Photographs of the Fishback Run lower reach showing the varied habitats including the channel incision, invasive macrophyte beds, and the limited gravel/cobble substrate.



Figure 6. Habitats within the middle Fishback Run surveyed reach.



Figure 7. Photographs of the varied habitats in the upper Fishback Run surveyed reach. Note the greater amount of cobble and boulder than Fishback Run reaches farther downstream.



Figure 8. Stagnant pool in the tributary draining the pond. The turbidity of the water prevented estimating depth and searching for mussels.

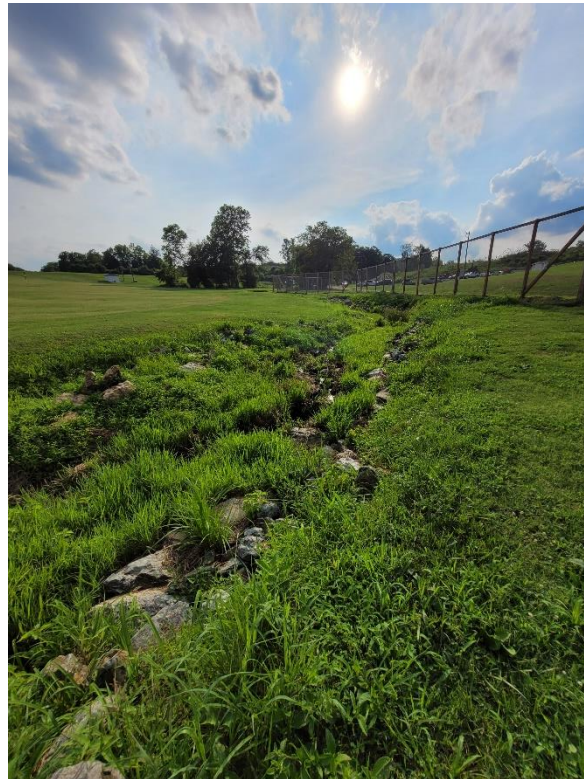


Figure 9. Photograph showing bank armoring with large rocks along the tributary draining the pond.



Figure 10. The tributary draining the pond was channelized with gradually sloped and grass covered banks.



Figure 11. Live Eastern Elliptio (*Elliptio complanata*) on left and Northern Lance (*Elliptio fisheriana*) on right observed in the Rappahannock River surveyed reach.



Figure 12. Relic shells observed in the tributary draining the pond.