# Tuscarora & Mill Creeks Watershed

## Aquatic Connectivity Study

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CACAPON INSTITUTE

PROJECT MANAGER

Participating Agencies and Organizations

Cacapon Institute — Protecting rivers and watersheds since 1985.

Downstream Strategies — Ideas that sustain.

North Atlantic Aquatic Connectivity Collaborative — NAACC

U.S. Fish & Wildlife Service — Department of the Interior

dep

Chesapeake Bay Program — Science. Restoration. Partnership.

# Definitions

- **Passability** is a measure of the extent that a crossing allows the movement of aquatic animals. A Higher score indicates more ability for crossings
- **Crossing Site (or stream crossing)** are locations where automotive or railroad traffic crossed over or fords a stream.
- **Structures** are the man-made devices that allow for the stream crossing. Structures include rock and concrete fords, bridges, culverts, or a combination thereof.
- **Culverts** are pipe-like structures that pass water through the crossing site. Culverts are constructed of corrugated steel and/or concrete and can be round, oval, arched, and open bottom.

Examples: Every stream crossing must have a structure. A stream crossing can include multiple structures (a culvert and a bridge side by side or more than one culvert (i.e., pipe).

# Introduction

- Cacapon institute (CI) conducted assessments of culverts and other stream crossing structures for fish passage and sediment transport in Tuscarora Creek and Mill Creek, sub watersheds of Opequon Creek (WV), using the protocols developed by the North Atlantic Aquatic Connectivity Collaborative (NAACC).

- This presentation provides the results of work conducted by CI and subcontractor Downstream Strategies for the Chesapeake Bay Program Goal Implementation Team (GIT) 2019 project.

*Tuscarora Creek, bottomless arch culvert*

# Study Areas

- This study looked at Tuscarora and Mill Creek subwatersheds of Opequon Creek, Berkeley County, WV.
- Both of these watersheds are on the 303(d) list as impaired for biological criteria and fecal coliform bacteria, and have Total Maximum Daily Load studies and Watershed Based Plans in place to address these impairments.
- Tuscarora Creek drains approximately 26 square miles and the mainstem is 11.7 miles long. Karst topography results in dry sections, also, two small dams bar passage of aquatic organisms.
- Mill Creek drains approximately 29.8 square miles and the mainstem is 14.5 miles long. Two dams in the watershed create severe barriers to passage of aquatic organisms.

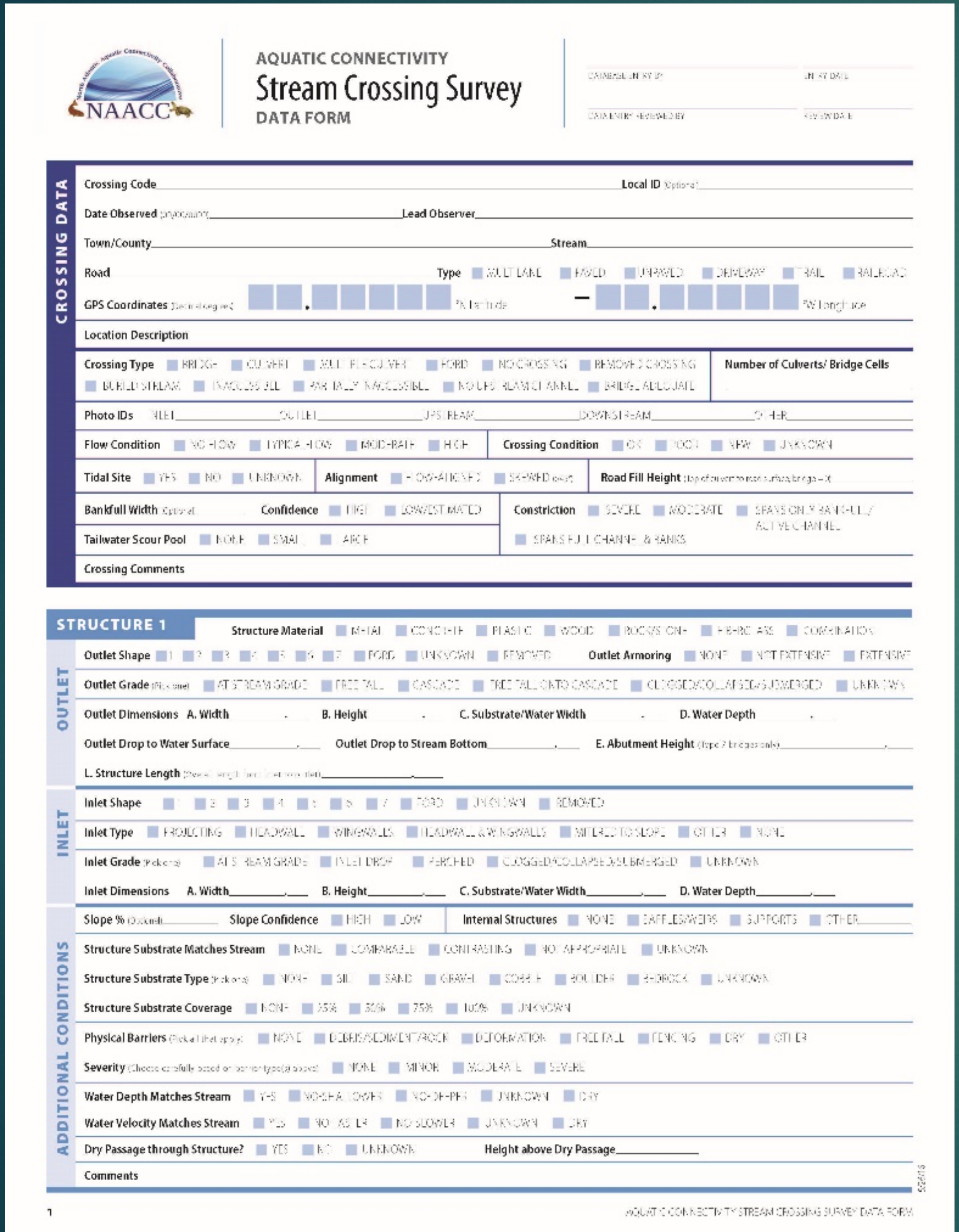
# Process

- Completed Non-Tidal Stream Protocol online training through NAACC, followed by NAACC's Non-tidal Stream Shadowing Training administered by US Fish & Wildlife staff and NAACC Coordinators.
- Conducted pre-survey:  8 interns, 4 CI staffers, and Alana Hartman (WVDEP) completed a pre-survey of all NAACC sites in ArcGIS Collector.
- Contacted private landowners with crossings to gain permissions to survey.  This was done through a mailing.
- Completed field surveys, two trained surveyors were on location for each survey completed.  All surveys were completed using NAACC Non-Tidal Protocol.
- Entered all data into NAACC's database, interoperated and reported on results

*Non-Tidal Stream Shadowing Training*

*Surveying a ford on Mill Creek*

# Field Data Sheets


AQUATIC CONNECTIVITY
Stream Crossing Survey
DATA FORM

**CROSSING DATA**

Crossing Code ____ Local ID (Optional) ____
Date Observed ____ Lead Observer ____
Town/County ____ Stream ____
Road ____ Type ☐ MULTILANE ☐ PAVED ☐ UNPAVED ☐ DRIVEWAY ☐ TRAIL ☐ RAILROAD
GPS Coordinates ____ °N latitude ____ °W longitude
Location Description
Crossing Type ☐ BRIDGE ☐ CULVERT ☐ MULTIPLE CULVERT ☐ FORD ☐ NO CROSSING ☐ REMOVED CROSSING ☐ BURIED STREAM ☐ INACCESSIBLE ☐ PARTIALLY INACCESSIBLE ☐ NO UPSTREAM CHANNEL ☐ BRIDGE ADEQUATE — Number of Culverts/ Bridge Cells
Photo IDs INLET ____ OUTLET ____ UPSTREAM ____ DOWNSTREAM ____ OTHER ____
Flow Condition ☐ NO FLOW ☐ TYPICAL-LOW ☐ MODERATE ☐ HIGH — Crossing Condition ☐ OK ☐ POOR ☐ NEW ☐ UNKNOWN
Tidal Site ☐ YES ☐ NO ☐ UNKNOWN — Alignment ☐ FLOW-ALIGNED ☐ SKEWED — Road Fill Height
Bankfull Width (Optional) — Confidence ☐ HIGH ☐ LOW/ESTIMATED — Constriction ☐ SEVERE ☐ MODERATE ☐ SPANS ONLY BANKFULL/ACTIVE CHANNEL ☐ SPANS FULL CHANNEL & BANKS
Tailwater Scour Pool ☐ NONE ☐ SMALL ☐ LARGE
Crossing Comments

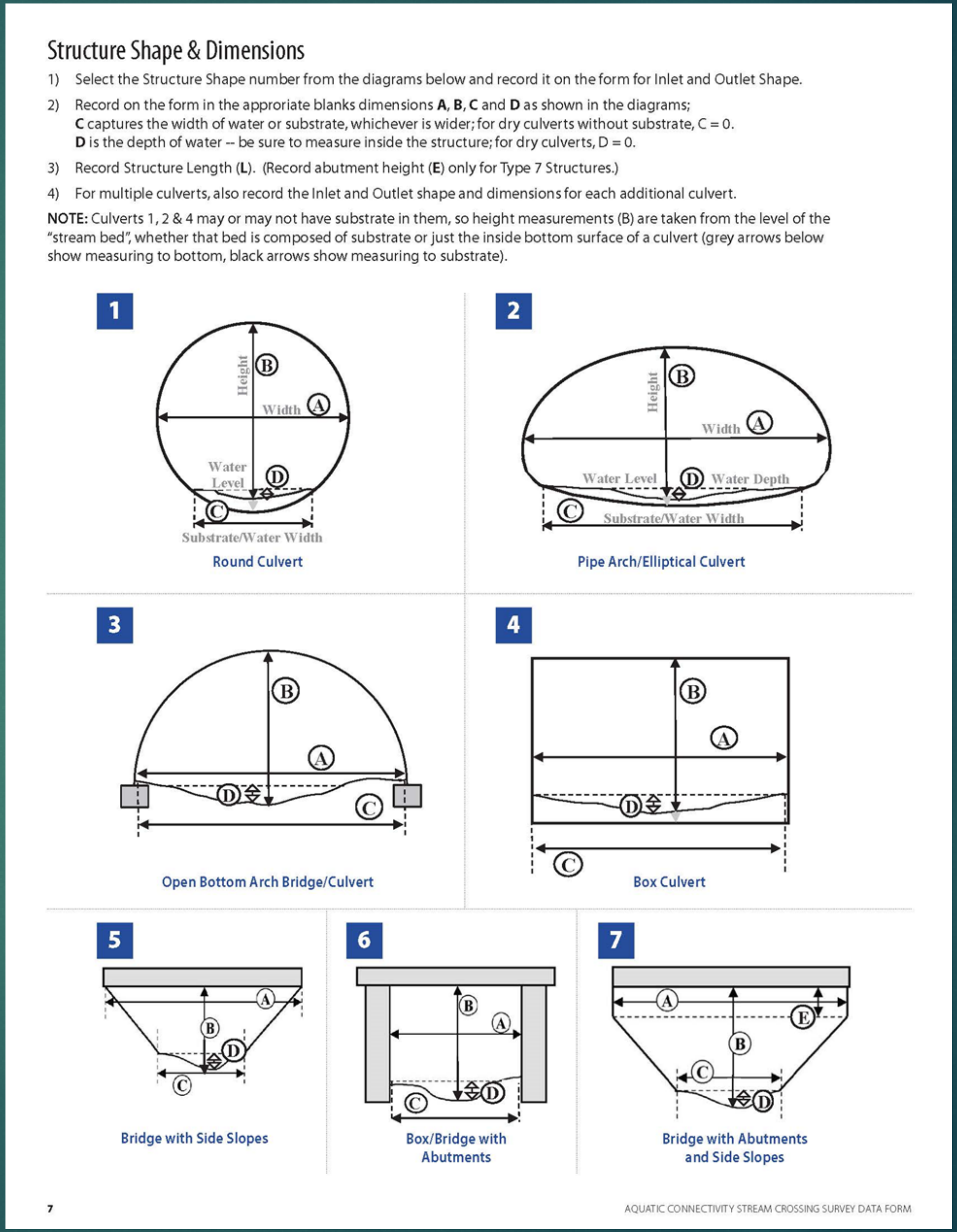
**STRUCTURE 1** — Structure Material ☐ METAL ☐ CONCRETE ☐ PLASTIC ☐ WOOD ☐ ROCK/STONE ☐ FIBERGLASS ☐ COMBINATION

**OUTLET**
Outlet Shape ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ FORD ☐ UNKNOWN ☐ REMOVED — Outlet Armoring ☐ NONE ☐ NOT EXTENSIVE ☐ EXTENSIVE
Outlet Grade ☐ AT STREAM GRADE ☐ FREE FALL ☐ CASCADE ☐ FREE FALL ONTO CASCADE ☐ CLOGGED/COLLAPSED/SUBMERGED ☐ UNKNOWN
Outlet Dimensions A. Width ____ B. Height ____ C. Substrate/Water Width ____ D. Water Depth ____
Outlet Drop to Water Surface ____ Outlet Drop to Stream Bottom ____ E. Abutment Height ____
L. Structure Length ____

**INLET**
Inlet Shape ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ FORD ☐ UNKNOWN ☐ REMOVED
Inlet Type ☐ PROJECTING ☐ HEADWALL ☐ WINGWALLS ☐ HEADWALL & WINGWALLS ☐ MITERED TO SLOPE ☐ OTHER ☐ NONE
Inlet Grade ☐ AT STREAM GRADE ☐ INLET DROP ☐ PERCHED ☐ CLOGGED/COLLAPSED/SUBMERGED ☐ UNKNOWN
Inlet Dimensions A. Width ____ B. Height ____ C. Substrate/Water Width ____ D. Water Depth ____

**ADDITIONAL CONDITIONS**
Slope % ____ Slope Confidence ☐ HIGH ☐ LOW — Internal Structures ☐ NONE ☐ BAFFLES/WEIRS ☐ SUPPORTS ☐ OTHER ____
Structure Substrate Matches Stream ☐ NONE ☐ COMPARABLE ☐ CONTRASTING ☐ NOT APPROPRIATE ☐ UNKNOWN
Structure Substrate Type ☐ NONE ☐ SILT ☐ SAND ☐ GRAVEL ☐ COBBLE ☐ BOULDER ☐ BEDROCK ☐ UNKNOWN
Structure Substrate Coverage ☐ NONE ☐ 25% ☐ 50% ☐ 75% ☐ 100% ☐ UNKNOWN
Physical Barriers ☐ NONE ☐ DEBRIS/SEDIMENT/ROCK ☐ DEFORMATION ☐ FREE FALL ☐ FENCING ☐ DRY ☐ OTHER
Severity ☐ NONE ☐ MINOR ☐ MODERATE ☐ SEVERE
Water Depth Matches Stream ☐ YES ☐ NO-SHALLOWER ☐ NO-DEEPER ☐ UNKNOWN ☐ DRY
Water Velocity Matches Stream ☐ YES ☐ NO-FASTER ☐ NO-SLOWER ☐ UNKNOWN ☐ DRY
Dry Passage through Structure? ☐ YES ☐ NO ☐ UNKNOWN — Height above Dry Passage ____
Comments

1 — AQUATIC CONNECTIVITY STREAM CROSSING SURVEY DATA FORM


## Structure Shape & Dimensions

1) Select the Structure Shape number from the diagrams below and record it on the form for Inlet and Outlet Shape.
2) Record on the form in the approriate blanks dimensions **A**, **B**, **C** and **D** as shown in the diagrams;
**C** captures the width of water or substrate, whichever is wider; for dry culverts without substrate, C = 0.
**D** is the depth of water -- be sure to measure inside the structure; for dry culverts, D = 0.
3) Record Structure Length (**L**). (Record abutment height (**E**) only for Type 7 Structures.)
4) For multiple culverts, also record the Inlet and Outlet shape and dimensions for each additional culvert.

**NOTE:** Culverts 1, 2 & 4 may or may not have substrate in them, so height measurements (B) are taken from the level of the "stream bed", whether that bed is composed of substrate or just the inside bottom surface of a culvert (grey arrows below show measuring to bottom, black arrows show measuring to substrate).


1 Round Culvert
2 Pipe Arch/Elliptical Culvert
3 Open Bottom Arch Bridge/Culvert
4 Box Culvert
5 Bridge with Side Slopes
6 Box/Bridge with Abutments
7 Bridge with Abutments and Side Slopes

7 — AQUATIC CONNECTIVITY STREAM CROSSING SURVEY DATA FORM

# Results

- 166 NAACC stream crossings
- 142 CI found stream crossings
  - 109 CI surveyed stream crossings
  - 151 structures were found in the 109 stream crossings
    - 81 single structure crossings
    - 19 double-structures crossings
    - 4 triple-structures crossings
    - 5 quadruple-structures crossings

*Bridge adequate site on Mill Creek*

**Aquatic Passability Scores for each assessed stream crossing location.**

| | No Barrier | Insignificant | Minor | Moderate | Significant | Severe | No Score |
|---|---|---|---|---|---|---|---|
| **Stream Crossings** | 32 | 42 | 15 | 6 | 4 | 8 | 2 |
| **Percentage** | 29% | 39% | 14% | 6% | 4% | 8% | 2% |

# Examples

APS (Aquatic Passability Score). The higher the score, the higher the passability

Note:

The NAACC Aquatic Passability Scoring system describes the following features as core elements for a stream crossing structure to have no impact on movement of aquatic life:

- inlet and outlet of structure are at stream grade
- no drop to stream surface at the outlet
- water depth at inlet and outlet at least 0.3 feet at typical low flow
- substrate on bottom of structure is present for the full length of the structure
- the structure contains no physical barriers

*No Barrier. APS >0.99 (Site #73784)*

*Insignificant. APS 0.80 – 0.99 (Site #73786)*

# Examples (continued)

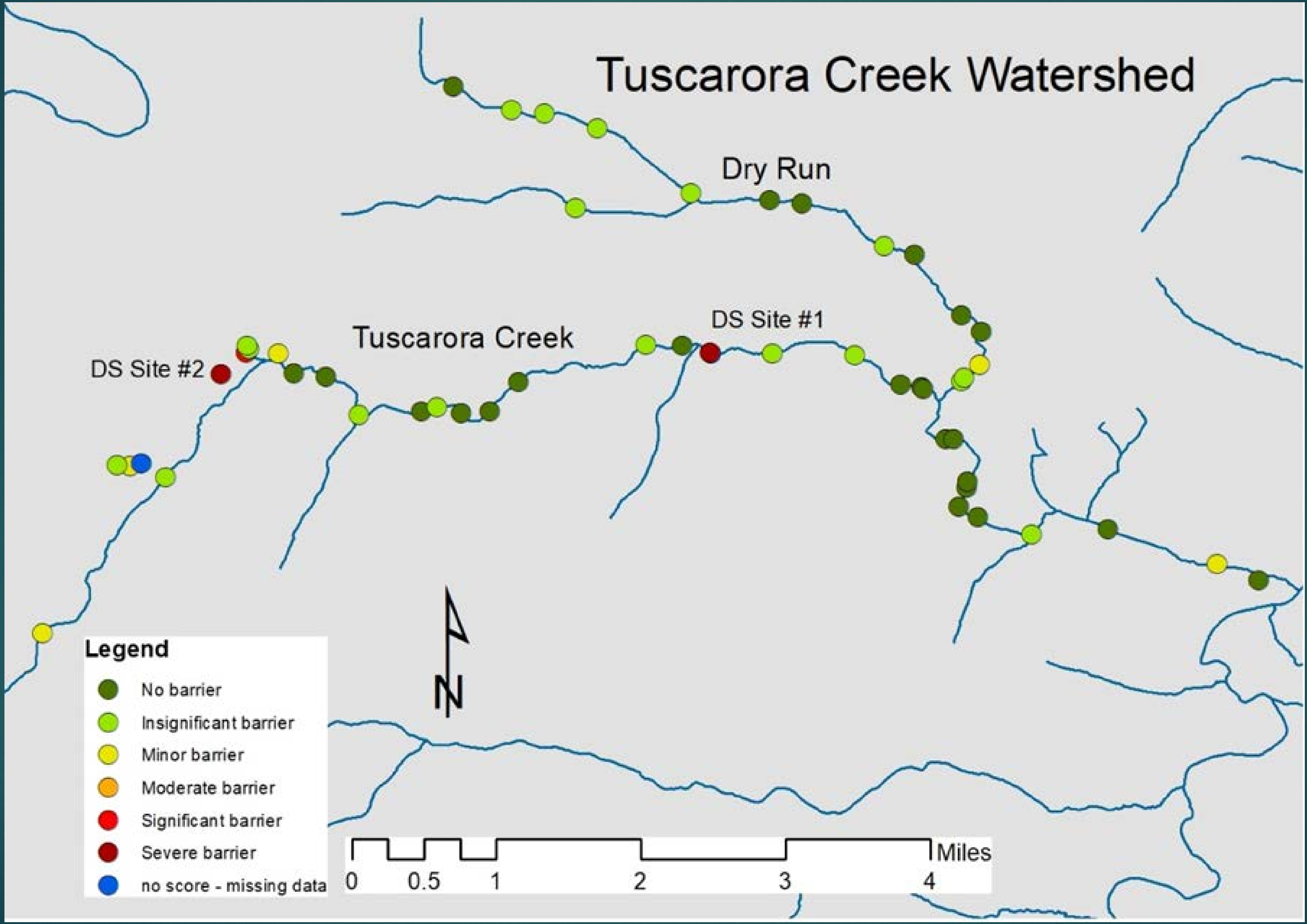
*Minor.  APS 0.60 – 0.79  (Site #73413)*

*Moderate.  APS 0.40 – 0.59  (Site #73127*

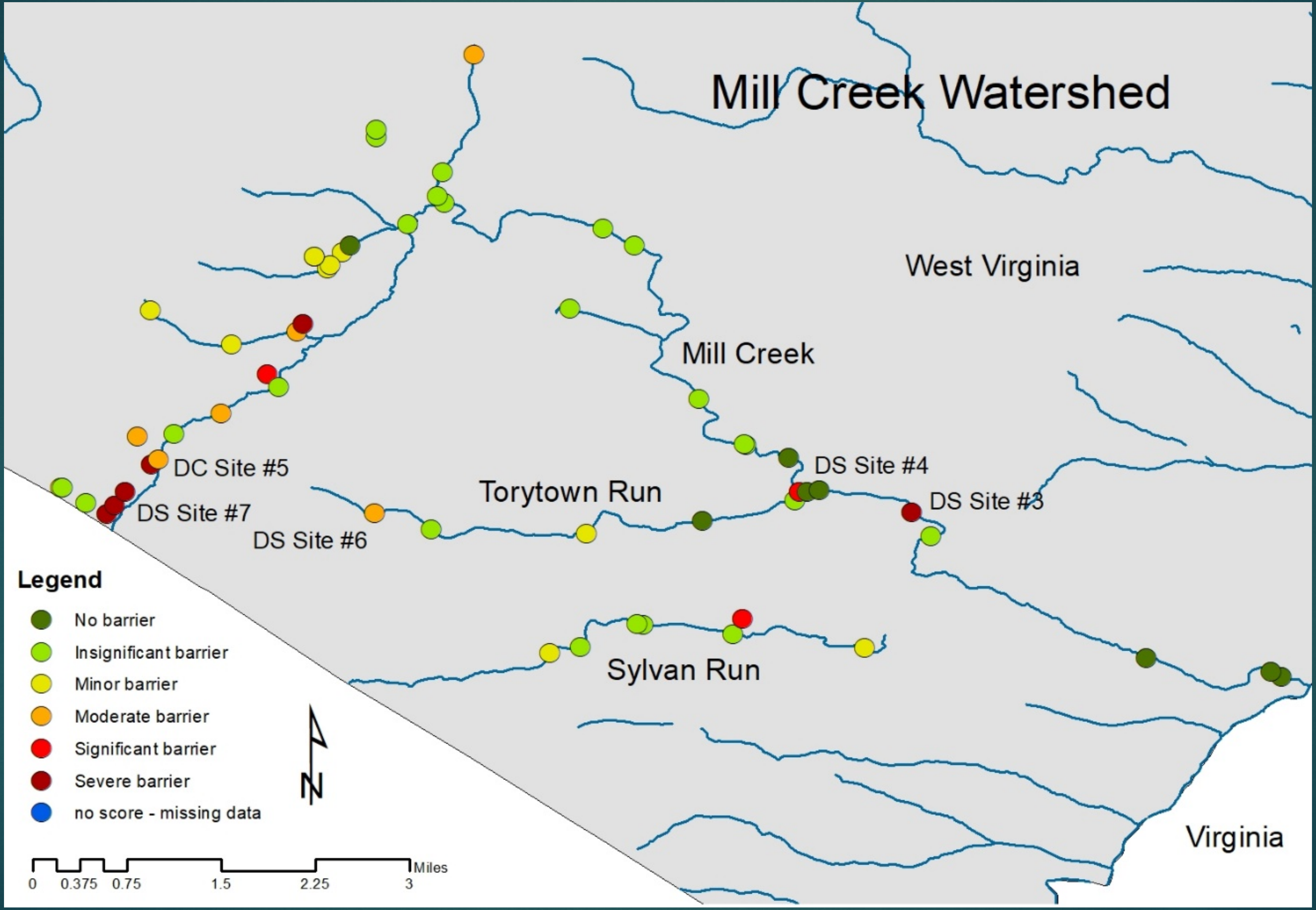
*Significant.  APS 0.20 – 0.39 (Site #74050)*

*Severe.  APS <0.19 (Site #73407)*

# Tuscarora Creek Results



# Mill Creek Results



# Downstream Strategies Assessment


Site 3: Private Ford off Route 28

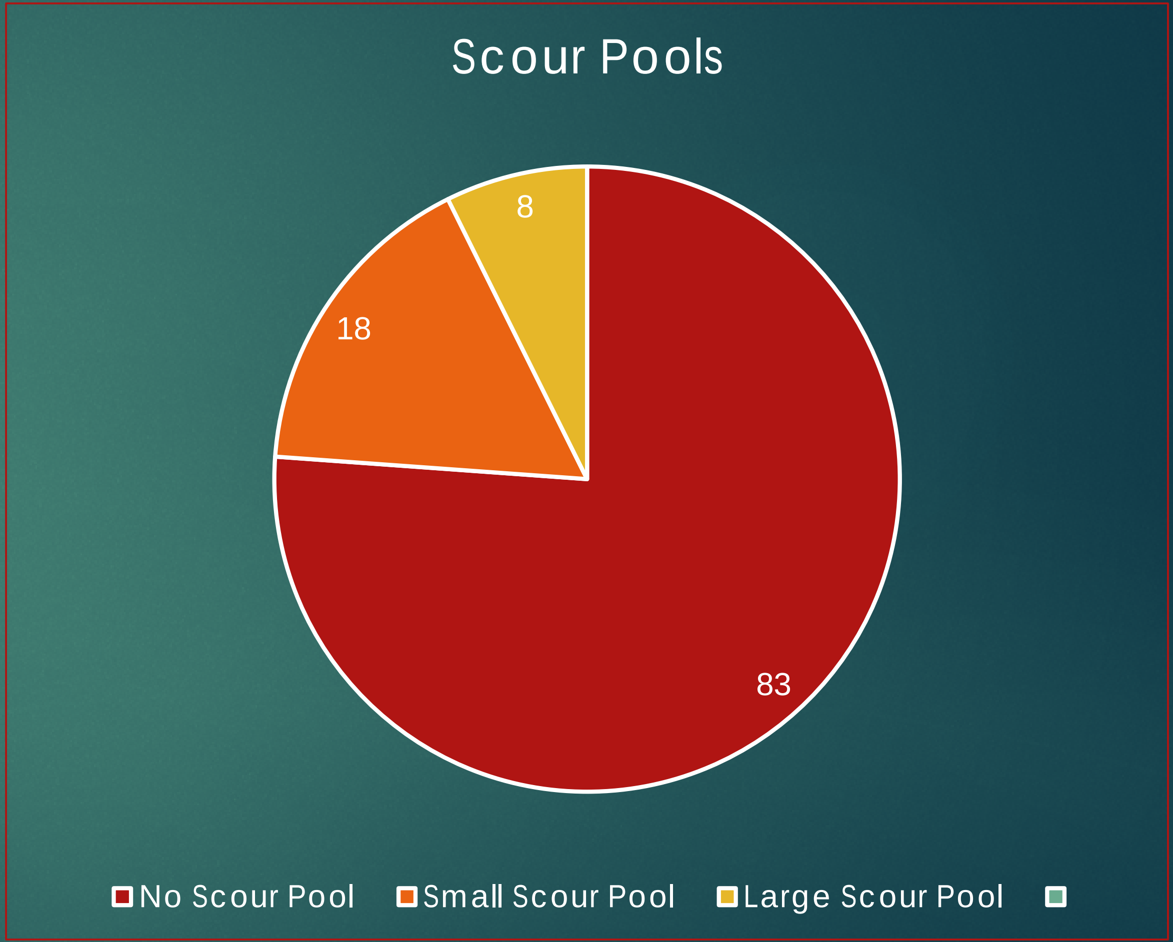

Site 5: Guthrie Drive double culvert

- Ford could be removed and replaced with hardened crossing, bankfull width bridge, or bottomless box/arch culvert.
- Banks and channel will require stabilization because the outlet drop of 5.0 feet, doing so will reduce any further degradation.

- The double culvert is likely causing the stream to widen and inducing erosion upstream and downstream.
- The end of the scour pool could be armored and raised, but a bottomless culvert or bankfull-width bridge would likely be the best BMPs for this site.

# Sediment Transfer

- Since the NAACC assessment does not address sedimentation directly, we used the scour pool information as a proxy for sites with likely erosion issues. The larger the scour pool, we believe, the more sediment the site produces.
- It would appear from this information (only eight sites had large scour pools) that stream crossings in the study watersheds were not generally a source of significant sedimentation in the study streams.



# Interesting Finds

*Mill Creek Headwaters: culvert inlet collapsed and was badly deformed*

*Mill Creek Headwaters: culvert constructed from tires, logs, plywood, and concrete*

*CSX bridge on Mill Creek*

# Discussion

| APS (Aquatic Passability Score) | |
|---|---|
| **No Barrier** | 1.0 |
| **Insignificant barrier** | 0.80 – 0.99 |
| **Minor barrier** | 0.60 – 0.79 |
| **Moderate barrier** | 0.40 – 0.59 |
| **Significant barrier** | 0.20 – 0.39 |
| **Severe barrier** | 0.00 – 0.19 |

Only two structure types can fit the ideal "No Barrier": bridges and bottomless culverts. Other structures lose points because they have less ideal characteristics (round culverts, pipe arch/elliptical culverts, box culverts, or fords). The APS is a representation of passability. Understanding the actual impact of these stream crossings will require more study.

NAACC writes (2015):
*"The concept of aquatic passability is complicated and includes: variations in the swimming and leaping abilities of individuals within a species …, variability in passage requirements for a broad diversity of species…, and the timing of passability (for what proportion of the year is the structure passable)."*

# Lessons Learned

- An informal pre-survey of the existence and condition of stream crossings from downloaded NAACC data will rapidly eliminate dubious data (we could not find 12% of total crossings). A pre-survey also allows for participation by untrained participants, e.g., volunteers or local watershed managers.

- Sending an introductory letter to all property owners near public crossings to introduce CI and NAACC proved valuable.

- Contacting private landowners through a mailing to request permission to survey. We included a self-addressed/stamped return postcard, and information to reply by phone/email. We also included an Opequon Creek Canoe Guide by way of appreciation.

# Ongoing Work

- Completed and entered many surveys done on Dillions Run, Waites Run, and Bloomery Run in the Cacapon River Watershed (WV). These tributaries are known Brooke Trout habitat.
- Completed surveys on Warm Springs Runs mainstem, which runs through Berkeley Springs (WV), and down the 522 corridor. This stream is known for flooding and has a planned bypass installation, which will increase impervious surface area.

# Moving Forward

- Multiple watershed groups expressed interest in participating and completing surveys, a training for these groups could prove valuable. With local ties, watershed groups have an advantage to gaining permission for surveys on private property.
- I was recently elevated to a L2 Coordinator, which allows me to facilitate trainings for the NAACC.