Recommendations for Aquatic Organism Passage at Maryland Road-Stream Crossings

Chesapeake Bay Program's Fish Passage Workgroup Presentation

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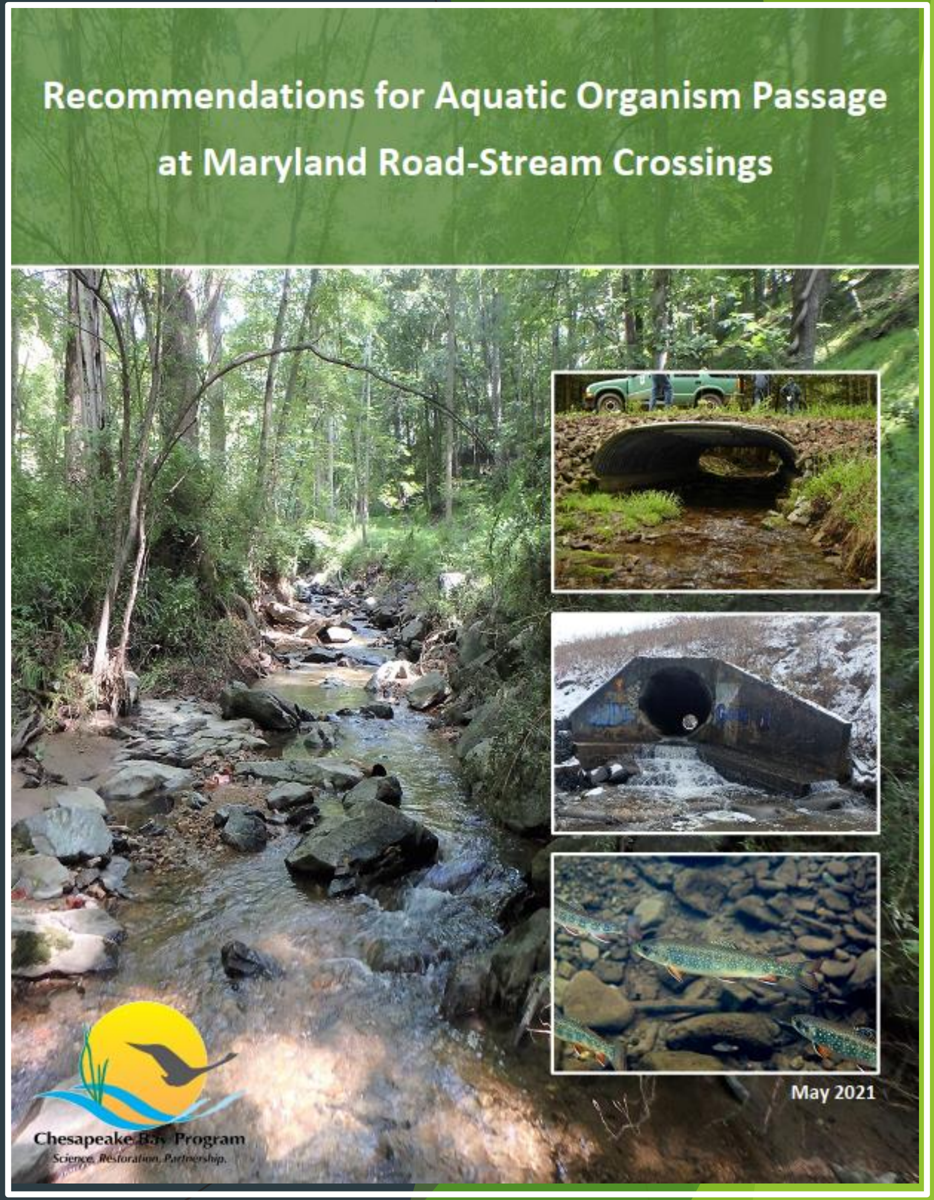
Document Background

- Literature review and inventory of standards, guidelines, and recommendations used throughout the U.S.
- Reviewed over 90 documents
- Compiled relevant sources and guidelines (53 different sources)
- Over 2/3 of sources were from the eastern U.S. (36 sources)
- Maryland stream crossing recommendations were developed, reviewed, and refined through coordination with a diverse stakeholder group
- The concept of this document and its general layout follow the *Massachusetts Stream Crossings Handbook*



Objectives

- Target a diverse audience
  - Local conservation groups
  - City and county engineers
  - Highway departments
  - Resource agencies
  - General public
- Inform on the importance of stream continuity to the health of Maryland streams
- Provide recommendations for crossing structures to improve or maintain AOP
- **NOT** a technical handbook or design manual

Document Sections

- Background and Purpose
- Introduction
- Importance of Stream Continuity for Aquatic Communities
- Common Culvert Problems and Consequences of Poorly Designed Stream Crossings
- Maryland Stream Crossing Recommendations
- Design Considerations
- Additional Considerations
- Financial Benefits of Maintaining Stream Continuity
- Case Studies (4)
- Prioritizing Efforts for Target Species
- Definitions, Additional Resources, and References

Importance of Stream Continuity for Aquatic Communities




- Access to spawning areas
- Access to coldwater habitats
- Access to forage
- Natural dispersal
- Maintaining habitat
- Genetic diversity

Consequences of Poorly Designed Stream Crossings

- Vertical barrier
- Low flow
- Unnatural substrate
- High flow velocity
- Clogging
- Scour and bank erosion

Stream Crossing Recommendations

- Based largely on geomorphic simulation design approach ("stream simulation")
- Permanent, non-tidal road-stream crossing
- New and replacement structures
- Conceptual guidance for AOP and some terrestrial organism passage under typical flows
- Primary purpose of recommendations - promote crossings that are "invisible" to aquatic organisms
- **MINIMUM** requirements for maintaining stream continuity
- These stream crossing recommendations are not prescriptive
- Used in conjunction with sound engineering and design practices to the maximum extent practicable given project and site constraints
- Project objectives and site constraints must be considered early in planning process to dictate appropriate design approach

- These recommendations are **NOT** regulations
  - Code of Maryland (COMAR)
  - Maryland State Programmatic General Permit (SPGP)
  - Regional Conditions to the Nationwide Permits (NWP) for the State of Maryland
- Each recommendation parameter includes:
  - Objective
  - General recommendation
  - Preferred recommendation

MARYLAND STREAM CROSSING RECOMMENDATIONS

Note: see **Design Considerations** on pages 9, 10, and 11.

1. Crossing Type

Objective: A single structure that allows the stream to pass through a single opening.

General: Spanning structures are recommended (bridges, bottomless arches, 3-sided box culverts, and other open-bottom culverts). One round, elliptical and box culvert can be used where its dimensions can meet the other recommendations (2-6) in this document. Use of multiple culverts should be avoided. If the use of multiple culverts is required, ensure that all flow passes through one culvert during most flow conditions and other culverts are used only in high flow conditions.

Preferred: Use a bridge.

2. Crossing Dimensions

Objective: A structure that spans the channel and banks to allow aquatic organism passage and dry passage for most terrestrial species over a short distance.

General: The structure should be wide enough to encompass a natural stable channel and banks, to allow not only aquatic but also semi-aquatic and terrestrial passage. To reduce length of passage for aquatic organisms, crossing length should be minimized, with the use of headwalls if necessary.

Preferred: A structure that is wide enough to span a natural stable channel and banks (a minimum structure width of 1.2 times the channel width) plus additional headroom to provide semi-aquatic and terrestrial wildlife passage. To achieve headroom for terrestrial species, the structure should have an *openness ratio* above the streambed, of 0.82 - 1.64 feet (0.25 - 0.5 meters). Minimize crossing length with the use of headwalls if necessary.

3. Embedment

Objective: Natural stream bottom through a crossing and stable footers for bottomless structures.

General: Per Maryland state regulations, culvert bottoms should be *embedded* below the streambed a minimum of 1 foot. Footers of bottomless structures should be placed at a depth and width to avoid destabilization through scour.

Preferred: If a bridge is not feasible due to project constraints, culvert bottoms and footers for bottomless structures should extend below the *vertical adjustment potential.*

4. Location, Alignment, and Placement

Objective: A structure that avoids unwanted aggradation and degradation inside or outside of the crossing due to unnatural slope or incorrect alignment.

General: Culverts should be aligned with the natural stream channel and skew should be minimized.

Preferred: Culverts should be aligned with the natural stream channel and skew should be minimized, not exceeding 30 degrees. The gradient should not exceed 3% for buried/sunken culverts. If the gradient exceeds 3%, a bottomless culvert or bridge should be used. When possible, crossing structures should be located at a pool feature.

5. Water Velocity and Depth

Objective: Maintain water velocity and depth, similar to conditions in the rest of the stream.

General and Preferred: Water velocity and depth within the crossing structure should match those observed at locations upstream or downstream, not impacted by the crossing. Low flow conditions should not result in reduced fish passage within the culvert, compared to upstream and downstream conditions.

6. Substrate

Objective: Natural substrate through the road-stream crossing to provide habitat for aquatic and terrestrial species, similar to conditions upstream and downstream of the crossing.

General and Preferred: Substrate should be placed within the structure, including both fine and coarse substrate, and should match the natural substrate composition found upstream or downstream in an area not impacted by the crossing. Bank and other key bed structural elements and characteristics should be resilient to high-flow events. If recommendations 1-5 of this document are used, natural aggradation and degradation of substrate should not result in excessive scour within the crossing. Channel manipulation upstream and downstream of the structure (e.g., stream restoration, stabilization, etc.) maybe be needed to fill scour holes and reduce aggradation caused by previous road-stream crossing structures. Scour protection should not result in reduced aquatic organism passage.

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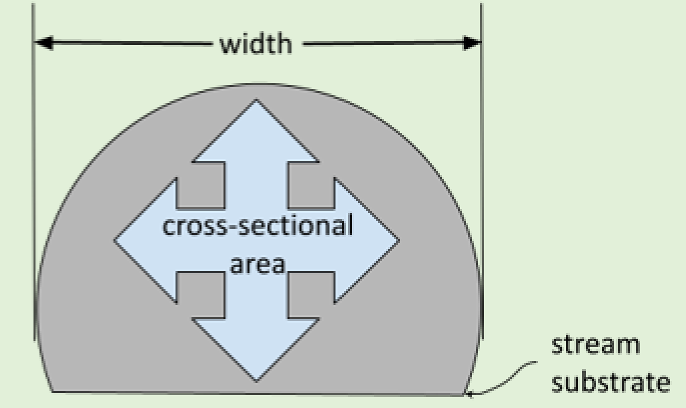
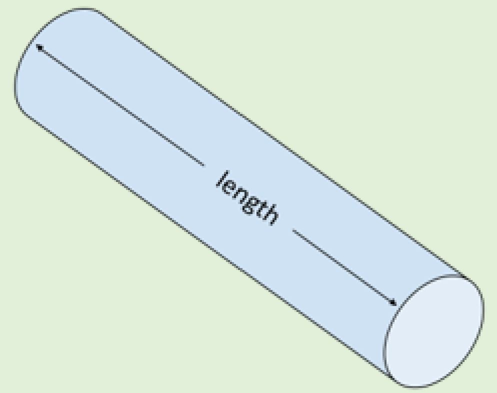


Crossing width and cross-sectional area



Crossing length

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Additional Considerations and Financial Benefits of Aquatic Continuity

- Flood resiliency
  - Future changes to watershed (e.g., development)
  - Climate change and associated changes in storm frequency and intensity

- Higher installation costs, but potential for long-term financial benefits
  - Lower maintenance costs
  - Lower risk of structure failure and roadway damage
  - Greater structure lifespan
    - Protection from bedload abrasion with bottomless or properly embedded structures

Case Study: Wolfden Run Culvert Replacement

Original multiple pipe culvert (Photo credit: Seth Moessinger, Trout Unlimited)

Replacement span bridge (Photo credit: Seth Moessinger, Trout Unlimited)

Replacement span bridge and educational plaque (Photo credit: Seth Moessinger, Trout Unlimited)

Location: Kitzmiller, MD

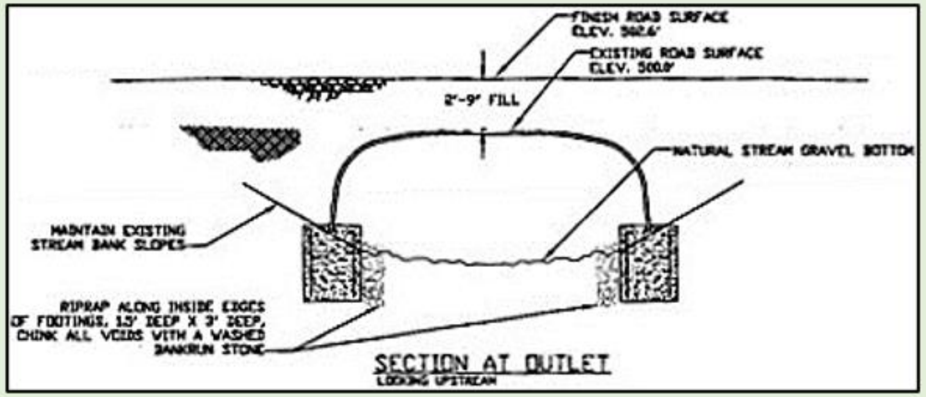
Project Partners: Maryland DNR, Trout Unlimited, USFWS, Eastern Brook Trout Joint Venture, National Fish and Wildlife Foundation

Project Cost: $156,000

Case Study: Bobbs Creek AOP Project

Original triple pipe culvert at USFS Road 116/2 (Photo credit: Brent Pence, USFS)

Replacement bottomless culvert at USFS Road 116/2 (Photo credit: unknown, USFS)



Replacement bottomless culvert at USFS Road 116/2

Location: Forest County, PA

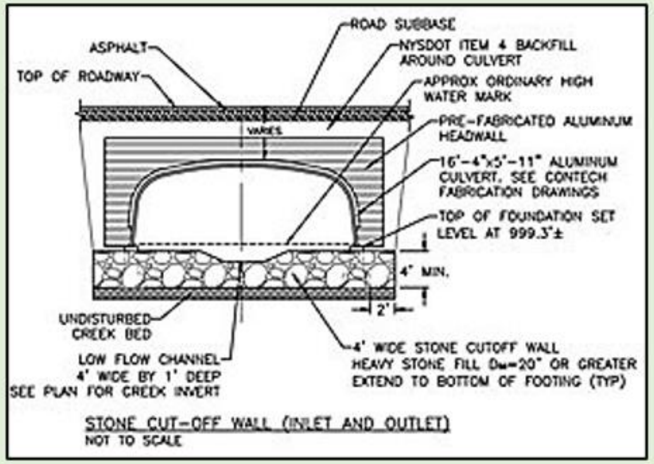
Project Partners: USFWS, Eastern Brook Trout Joint Venture, and Allegheny National Forest (USFS)

Project Cost: $93,000 per crossing

Case Study: Fish Kill Creek Culvert Replacement

Original steel pipe culvert at Douglas Road

Replacement bottomless culvert at Douglas Road



Replacement bottomless culvert at Douglas Road

Location: Newfield, NY

Project Partners: USFWS, Town of Newfield

Project Cost: $129,620

Case Study: Rutland Road Fish Passage Project

Original triple pipe culvert at Rutland Road

Replacement slab bridge at Rutland Road

Weir wall structures installed upstream of roadway

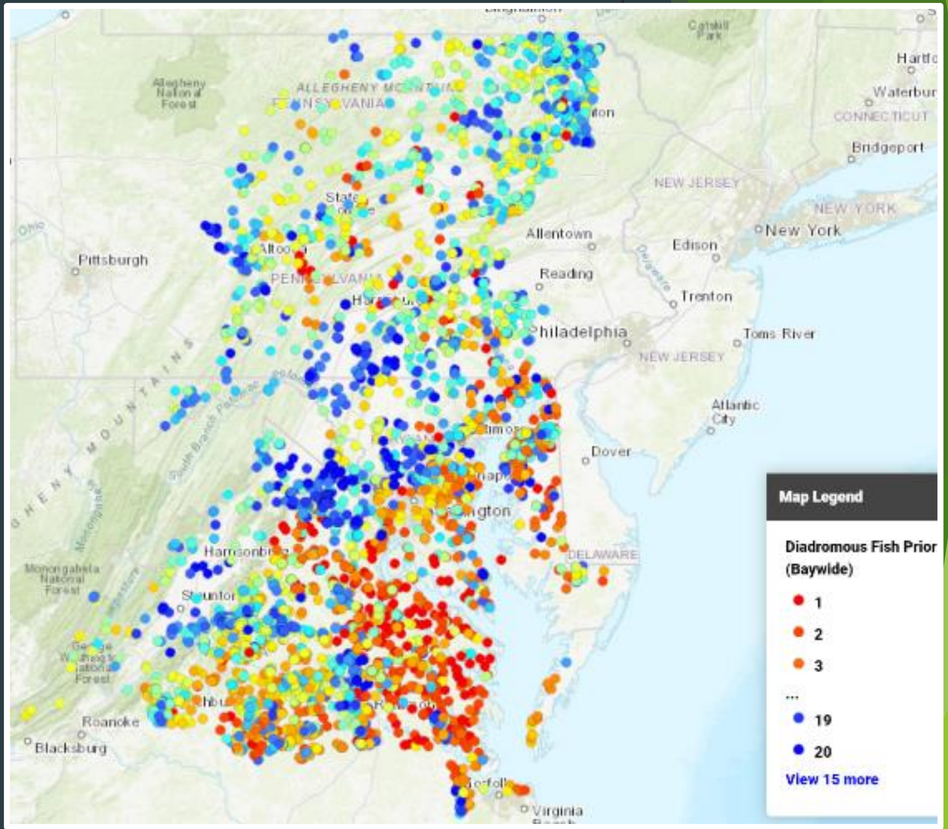
Location: Davidsonville, MD

Project Partners: Anne Arundel County BWPR; County Engineers Association of Maryland

Project Cost: $1,850,000

Prioritizing Efforts for Target Species

- Highlights target species
  - Diadromous
  - Brook trout
  - Rare, threatened, and endangered
- Provides information and source links to resources
  - Chesapeake Fish Passage Prioritization Tool
  - North Atlantic Aquatic Connectivity Collaborative database and resources
  - Prioritization tools used by other states
    - Massachusetts’ Critical Linkages and Conservation Assessment and Prioritization System



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- Gwen Gibson (MD DNR)
- Jesus Morales (USFWS)
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- MDOT SHA-MDE Hydraulics Panel Draft Review: Art Parola, Eric Brown, Wilbert Thomas, Drew Atland, Ward Oberholtzer, and Kaye Brubaker

Questions or comments?

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COASTAL RESOURCES INC.