

**NATURAL RESOURCES CONSERVATION SERVICE  
CONSERVATION PRACTICE STANDARD  
AQUATIC ORGANISM PASSAGE**

(Mi.)

CODE 396

**DEFINITION**

Modification or removal of barriers that restrict or impede movement of aquatic organisms.

**PURPOSE**

Improve or provide passage for aquatic organisms.

**CONDITIONS WHERE PRACTICE APPLIES**

All aquatic habitats where barriers impede passage of aquatic organisms.

**CRITERIA**

**Planning and Evaluation**

Evaluate sites for variations in stage and discharge, hydraulics, geomorphic impacts, sediment transport and continuity, and organic debris movement. Passage features must account for the known range of variation resulting from this evaluation.

Mitigate undesirable channel plan or profile shifts resulting from the modification or removal of a passage barrier. The aquatic organism passage design must incorporate features to protect structural components from potential damage caused from channel instability.

Plan and locate passage for compatibility with local site conditions and stream geomorphology, to the extent possible.

Avoid locating fishway entrances and exits in areas that will obstruct function, increase harassment or predation, or result in excessive operation and maintenance requirements.

Refer to the Aquatic Organism Passage (396) – Culvert Design Procedures for specific

information on culvert designs for small streams.

**Design Requirements**

The passage shall accommodate present and reasonably anticipated changes in watershed conditions such as flow variations and channel stability.

The passage structures shall accommodate known swimming and leaping capabilities of target species or a similar species with comparable swimming abilities. The No Slope/Stream Simulation method described in the Aquatic Organism Passage (396) – Culvert Design Procedures should be used on small streams if criteria are not available for a target species. Criteria for water velocity and water depth in culverts and vertical jump height and jump pool depth at the culvert outlet are also provided for trout and small, minnow-like species. Larger scale projects must be planned by experienced biologists and engineers using appropriate references to accommodate the target species and watershed characteristics on a site specific basis.

The passage structures shall mimic channel geometry and morphology referenced from an adjacent reach or analog stream when the swimming and leaping abilities of target species are unknown, or when a project will benefit multiple aquatic organisms.

At a minimum, the passage structures shall provide hydraulic performance and structural integrity for 25-year, 24 hour (minimum), peak flow event.

The passage features shall minimize or avoid energy deficits, physical stress, excessive delays during migration periods, and harm to migratory organisms.

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Provide adequate attraction flow into a passage facility across the full range of discharge during which target species will move.

Use trashracks on culverts only if required or necessary and ensure they are self-cleaning and/or easily maintained.

Select construction materials that are non-toxic and resistant to degradation.

Plan construction logistics, methods, and sequencing to minimize adverse effects to aquatic organisms, riparian areas, and instream habitat.

### CONSIDERATIONS

Consider removing a passage barrier before installing or retrofitting a new facility or structure. Complete or partial barrier removal often provides better passage conditions, and is more economical than designing, constructing, operating, and maintaining many new passage structures.

Culverts or bottomless arches designed using the stream simulation approach (USFS 2008) that incorporate natural streambed substrates throughout their length are preferred over other culvert configurations for passage purposes. Natural streambeds provide numerous passage and habitat benefits to many life stage requirements for fish and other aquatic organisms compared to man-made surfaces.

Design and locate features to improve or provide passage for as many different aquatic species and age classes as possible.

Retain as much riparian and streambank vegetation as possible during project access and construction activities to maintain shade, riparian continuity, and sources of nutrient and structural inputs for aquatic ecosystems. Where appropriate, consider removing access roads or trails and restoring native vegetation representative of the site.

Replacing or removing an existing instream structure may trigger channel adjustments (e.g., aggradation and/or degradation) upstream and/or downstream of the work site. Install grade controls or other slope modifications to mitigate adverse physical or

ecological consequences. Refer to Streambank and Shoreline Protection (580) Channel Stabilization (584), and Grade Stabilization Structure (410) for additional information.

Analyze any potentially negative interactions, including hybridization, disease, competition, or predation, between target and aquatic nuisance species when passage is provided above a barrier. If serious consequences are likely, take steps to minimize adverse effects.

Consider the habitat requirements of other aquatic or terrestrial species that may be affected by a passage project. Some passage facilities may improve survival for terrestrial vertebrates by providing safe migration routes under roadways through the use of additional floodplain relief culverts.

Assess the amount of habitat upstream and downstream of a barrier to evaluate into project feasibility, cost effectiveness, and/or potential for connecting fragmented habitats. Using a watershed approach whenever possible provides a framework for project planning.

Fish Passage facilities are often associated with water diversions or intakes that may injure or kill aquatic species. Prevent fish entrainment or impingement, particularly of juveniles, into diversions, penstocks, or pumps by installing screens.

Passage projects can affect water management practices such as diversion, power generation, or storage. Strive to balance aquatic organism passage with other water management objectives.

Consider upstream and larger watershed issues that may affect passage. Common solutions may include maintaining or restoring adequate instream flow and/or other water quality parameters (e.g., temperature, dissolved oxygen).

Barrier removal, especially dams and road crossings, can significantly affect wetlands, flooding potential, existing infrastructure, and social and cultural practices and resources. Evaluate and address the full range of impacts when planning or designing barrier removal projects.

Floodplain and water development often alter historic river channel pattern and location. Consider bypassing a barrier by restoring streamflow to former, stable natural channels.

Passage facilities can assist population recovery and management. Consider local, state, or federal brood stock collection and species management initiatives when planning passage features.

In the case of low-water crossings, water quality impacts from vehicular pollutants and erosion caused by tire action can be severe. Where possible, reroute roadways or install hardened instream crossings (see Stream Crossing, code 578).

### PLANS AND SPECIFICATIONS

Provide site-specific plans for this practice. Plans will specify passage structure design, layout, and overall objectives, and include (at a minimum):

- Location map and plan view of site, description of design flows, and a short summary of operating criteria.
- Detailed construction drawings showing existing and planned site conditions including elevations, typical profiles, and cross-sections of planned structures.
- Construction specifications describing materials, logistics (including erosion control), and timing.
- Guidance for post-construction evaluation and monitoring to assess structural integrity and compliance with design criteria.

### OPERATION AND MAINTENANCE

Develop an operation and maintenance plan for all applications of this standard. Within the plan, provide for periodic inspection and corrective action should passage conditions become impaired because a structure is damaged or inoperable. At a minimum, operation and maintenance items should include:

- Specifying what entity is responsible for the daily operation and maintenance of a passage structure.

- Annual, seasonal, and/or daily operating activities necessary to ensure proper function of the structure
- Check passage structure at regular intervals to ensure it is operating within design criteria.
- Clean trashracks and debris collectors or remove debris accumulations regularly.
- Adjust gates, orifices, valves, or other control devices as needed to regulate flow and maintain a passage structure within operating criteria.
- Periodically check staff gages or other flow metering devices for accuracy.
- Annually inspect passage structures for structural integrity and disrepair.
- Inspect gate and valve seals for damage.
- Replace worn or broken stoplogs, baffles, fins, or other structural components.
- Remove sediment accumulations from within passage structure where applicable.

### REFERENCES

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WEBSITE: "Fish Xing" hosted by U.S. Forest Service  
<http://www.stream.fs.fed.us/fishxing/index.html>