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.

This practice shall be utilized in coordination with the State Biologist. Sites proposed for this practice shall be evaluated by a multi-disciplined team consisting of personnel knowledgeable in fisheries, aquatics, and/or wildlife biology; engineering and hydrology; fluvial geomorphology; and environmental compliance.

This practice is usually installed as a component of other practices such as (395) Stream Habitat Improvement and Management.

CRITERIA

Planning and Evaluation

All permits pertaining to the Clean Water Act (CWA) and other applicable laws shall be obtained prior to implementation of this practice.

Designs (including removal) of structures shall be based upon a multidiscipline evaluation as outlined above. The multidiscipline assessment will follow the guidance from appropriate sections of Part 654 of the National Engineering Handbook (NEH) including, but not limited to, Technical Supplement - 14N “Fish Passage and Screening Design”; and the “National Inventory and Assessment Procedure – For Identifying Barriers to Aquatic Organism Passage at Road and Stream Crossings”. Other assessment procedures and processes outlined in the reference section of this standard could be utilized as appropriate and approved by the State Staff Biologist.

A written analysis shall be performed to determine the need for identifying barriers to aquatic organism passage.

At a minimum hydrologic design criteria shall include the following information as applicable: velocities, depths, structural heights, attraction flows, structural lengths and pool volumes.

Plan and locate passage for compatibility with local site conditions and stream geomorphology, to the extent possible. Avoid locations that will obstruct functions, increase harassment or predation, or result in excessive operation and maintenance requirements.

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

Replacing or removing an existing in-stream structure may trigger channel adjustments (i.e. aggradation, degradation and migration) upstream and/or downstream of the work site. Grade controls or other slope modifications shall be installed to mitigate adverse physical or ecological consequences where necessary (i.e. headcut). Refer to Conservation Practice Standards (584) Channel Stabilization, (410) Grade Stabilization Structure and (395) Stream Habitat Improvement and Management.

Mitigate undesirable channel plan or profile shifts resulting from the modification or removal of a passage barrier.

Removal of barriers (e.g. dams and low water crossings) and installation of structures shall be designed and implemented such that effects to wetlands, existing infrastructure and flooding are avoided or minimized.

Design Requirements

Designs shall be based on the applicable sections and supplements of the National Engineering Handbook including Technical Supplement - 14N "Fish Passage and Screening Design". Designs shall be based on a multidiscipline approach.

At a minimum, structures shall be designed not to exceed known swimming and leaping capabilities of native species. Some native fish swimming speeds are provided in Table 1 of this standard. Contact the State Biologist for speeds and leaping abilities of other species if required. When feasible, hydraulic computations shall be utilized to document how designs satisfy the physiological requirements of target organisms.

Design passage structures to 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, design and evaluate passage structures for hydraulic performance and structural integrity at the bankfull and 25-year peak flow events.

Design passage features to minimize or avoid energy deficits, physical stress, and harm to migratory organisms.

Design passage features to minimize or avoid excessive delays during migration periods

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

Projects shall be evaluated and designed to minimize and incorporate any effect on water management practices such as diversions, power generation or storage.

Removal of barriers shall include a design to restore the original pattern, plan and profile of the stream channel to the extent practical.

Design passage to accommodate present and reasonably anticipated changes in watershed conditions.

Use trashracks on culverts or fishways only if required or necessary. Ensure that trashracks are self-cleaning and/or easily maintained.

Placement of structures shall be designed and located to improve or provide passage for as many different aquatic species and age classes as possible and practicable.

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

Construction materials and methods shall be selected that are non-toxic, minimize adverse consequences to aquatic organisms and are resistant to degradation.

Natural streambed materials shall be used over man-made surfaces when feasible.

Culvert Installation Design Criteria for Aquatic Life Passage

A multi-disciplined assessment procedure shall be utilized to determine the scope of the practice. Refer to Passage Through Crossing Assessment (National Inventory and Assessment Procedure – Nov. 2005)

The volume of fill for culverted structures is limited to the amount required to achieve transportation purposes across the waterbody.

Culverts shall be installed on the same slope as the streambed where practical.

Culverts shall completely span the bankfull channel.

The inlet/outlets must be designed in such a manner to maintain substrate in the bottom of the culvert (culverts installed in bedrock do not need to be countersunk). Either countersinking the culvert in to the sub-pavement of the streambed or the use of a bottomless culvert (preferred alternative) will satisfy this requirement.

If fills associated with the crossing extend into the floodplain, the use of floodplain culverts will be utilized where practical.

The use of baffles to reduce hydraulic force within the pipe will reduce flow capacity and makes the culvert more prone to plugging. This method is not recommended.

CONSIDERATIONS

Develop or adopt a quantitative method to identify and evaluate passage barriers (see References). Information derived from this method can assist planning and budgeting activities.

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 (see conservation practice standards Channel Stabilization – Code 584 and Grade Stabilization Structure – Code 410).

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. Refer to conservation practice (578) Stream Crossing.

PLANS AND SPECIFICATIONS

Provide site-specific plans for this practice. Unless otherwise approved by the State Biologist, the watershed and/or stream conditions shall be documented by an appropriate method which contains the following information:

- Appropriate completed sections of a site assessment (e.g. Passage Through Crossing Assessment (National Inventory and Assessment Procedure – Nov. 2005). [This methodology will satisfy the assessment described in a-d below.]
- 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.
    a) Location map and plan view of site, description of design flows, and a short summary of operating criteria.
    b) Target species
    c) Barrier type
    d) Biological assessment, general biologic design criteria, hydrologic analysis, existing conditions and environmental concerns. All alternatives, plans, designs and specifications which include:
        - Detailed construction drawings showing site elevations (including headwater and tailwater fluctuations), description and analyses of design flows, and structural operating criteria; Construction specifications describing materials, logistics (including erosion control), and timing or expected sequence of work. Guidance for post-construction evaluation and monitoring to assess structural integrity and compliance with design criteria (if applicable).
- Any practices necessary to carry out the intended function and design of this practice and all activities associated with those practices.
- 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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National Inventory and Assessment Procedure – For Identifying Barriers to Aquatic Organism Passage at Road-Stream Crossings, November 2005

NRCS, KY
November 2013

Table 1. Selected Fish Swimming Speeds

Highlighted Fish Swimming Speeds							
Selected Non Salmonid Fish Species		*SWIMMING SPEEDS feet/second*					*References*
			Adult		Juvenile		
Common Name	Scientific Name	Cruising	Sustained	Darting	Sustained	Darting	
Quillback	*Carpiodes cyprinus*	0 to 3	3 to 5	5 to 10			Bell, Fisheries Handbook, Pg. 6.3 (for Suckers in general)
River carpsucker	*Carpiodes carpio*	0 to 3	3 to 5	5 to 10			Bell, Fisheries Handbook, Pg. 6.3 (for Suckers in general)
Highfin carpsucker	*Carpiodes velifer*	0 to 3	3 to 5	5 to 10			Bell, Fisheries Handbook, Pg. 6.3 (for Suckers in general)
White sucker	*Catostomus commersoni*	0 to 3	3 to 5	5 to 10			Bell, Fisheries Handbook, Pg. 6.3 (for Suckers in general)
White sucker (7"-16")	*Catostomus commersoni*	0 to 3	3 to 5	5 to 10	1 to 3.5		Bell, Fisheries Handbook, Pg. 6.3 (for Suckers in general)
Northern hog sucker	*Hypentelium nigricans*	0 to 3	3 to 5	5 to 10			Bell, Fisheries Handbook, Pg. 6.3 (for Suckers in general)
River redhorse*	*Moxostoma carinatum*	0 to 3	3 to 5	5 to 10			Bell, Fisheries Handbook, Pg. 6.3 (for Suckers in general)
Greater redhorse**	*Moxostoma valenceinnesi*	0 to 3	3 to 5	5 to 10			Bell, Fisheries Handbook, Pg. 6.3 (for Suckers in general)
Shorthead redhorse	*Moxostoma macrolepidotum*	0 to 3	3 to 5	5 to 10			Bell, Fisheries Handbook, Pg. 6.3 (for Suckers in general)
Golden redhorse	*Moxostoma erythrurum*	0 to 3	3 to 5	5 to 10			Bell, Fisheries Handbook, Pg. 6.3 (for Suckers in general)
Silver redhorse	*Moxostoma anisurum*	0 to 3	3 to 5	5 to 10			Bell, Fisheries Handbook, Pg. 6.3 (for Suckers in general)
Goldfish	*Carassius auratus*		1 to 3.5	3.5 to 6	1 to 2		Bell, Fisheries Handbook, Pg. 6.5
Trout Perch	*Percopsis omiscmaycus*			3	1.5 to 2		Bell, Fisheries Handbook, Pg. 6.5
Emerald shiner (2.5")	*Notropis atherinoides*			4	1 to 3.5		Bell, Fisheries Handbook, Pg. 6.5
Green Sunfish	*Lepomis cyanellus*			6 to 10			Webb 1975
Bluegill Sunfish	*Lepomis machrochirus*			2.5 to 4.3			Webb 1978a
Crappie	*Pomoxis annularis*			1.1			
Yellow Walleye (9-16")	*Stizostedion vitreum*				1 to 3		Bell, Fisheries Handbook, Pg. 6.5
Smallmouth Bass	*Micropterus dolomieu*						Bell, Fisheries Handbook, Pg. 6.5
Channel Catfish	*Ictalurus punctatus*		1.5				Walenpaugh and Bettinger, 1985
Largemouth Bass	*Micropterus salmoides*						Webb 1986b
Muskellunge	*Essox spp.*			3			
Pike (14")	*Essox lucius*			11	1 to 4	4 to 8	Bell, Fisheries Handbook, Pg. 6.5
Pike (15")	*Essox lucius*			13			Harper and Blake 1991
Flathead minnow (2.5")	*Pimepales promelas*			2.6			Webb 1986b
Yellow Perch (6")	*Perca flavenscens*			3.7			Webb 1978a
Longnose sucker (4-16")	*Catostomus catostomus*			7	1 to 3		Bell, Fisheries Handbook, Pg. 6.5
Goldeye (9")	*Hiodon alosoides*			4	1 to 2.5		Bell, Fisheries Handbook, Pg. 6.5

Note: The above swimming speeds are shown as examples. Not all species shown occur in KY or are native. For other species refer to the NRCS State Biologist or KDFWR Fisheries Biologist for assistance.

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