

**FISH AND WILDLIFE SERVICE
FISHERIES**

Fisheries

Part 710 Fishery Resources Management

Chapter 2 Evaluation of Aquatic Connectivity and Fish Passage for Service Actions 710 FW 2

TABLE OF CONTENTS

| Topics | Sections |
|---|--|
| <u>OVERVIEW</u> | 2.1 What is the purpose of this chapter? 2.2 What is the scope of this chapter? 2.3 What terms do you need to know to understand this chapter? 2.4 What is the overall policy? 2.5 What are the authorities for this chapter? |
| <u>RESPONSIBILITIES</u> | 2.6 Who is responsible for aquatic connectivity and fish passage when implementing Service actions? |
| <u>IMPLEMENTATION</u> | 2.7 Why are aquatic connectivity and fish passage important to the Service? 2.8 When should Service programs evaluate aquatic connectivity and fish passage? 2.9 How should Service programs evaluate aquatic connectivity and fish passage? 2.10 When may it <i>not</i> be appropriate to achieve aquatic connectivity and fish passage? 2.11 With what other Service policies does this chapter intersect? |
| <u>RESOURCES</u> | 2.12 What additional resources are available to Service programs for assistance in implementing this policy? |

OVERVIEW

2.1 What is the purpose of this chapter? This chapter provides policy and guidance to U.S. Fish and Wildlife Service (Service) employees about when and how to evaluate and address impacts of Service actions on aquatic connectivity and fish passage for Federal trust species.

2.2 What is the scope of this chapter? This chapter:

A. Applies to Service actions that may involve an existing or new barrier to aquatic connectivity or to fish passage for Federal trust species potentially found in waterbodies affected by such actions. See [sections 2.8](#) and [2.9](#).

B. Gives Service programs the flexibility to implement the guidance using their available authorities and in consideration of their ability to influence on-the-ground outcomes. See [sections 2.4\(A\)](#) and [2.9\(C\)](#).

C. Acknowledges the role of the Service under the Federal Power Act and does not alter our authorities under this or other Federal laws.

2.3 What terms do you need to know to understand this chapter?

A. The following terms are most important to understanding the chapter:

(1) Aquatic connectivity: Aquatic connectivity refers to physically linked pathways through which energy, matter, and organisms move from one place to another through water. It includes longitudinal

**FISH AND WILDLIFE SERVICE
FISHERIES**

Fisheries

Part 710 Fishery Resources Management

Chapter 2 Evaluation of Aquatic Connectivity and Fish Passage for Service Actions 710 FW 2

connectivity upstream and downstream, vertical movement within a water column, as well as lateral connectivity of the main waterbody to riparian and floodplain habitat, all of which play a vital role in a functioning aquatic ecosystem.

(2) Barrier: A barrier to aquatic connectivity is an obstruction that prevents or alters the natural flow of water within or between waterbodies, potentially impacting water quality, sediment movement, type of habitat, and fish passage. A barrier to fish passage is anything that prevents or reduces the ability of fish or other aquatic species to move where needed to survive and complete their life cycle within an aquatic system. The extent to which a barrier may reduce or prohibit the movement of fish or other aquatic species may vary by species and life stage. Barriers may be the result of structural impediments, such as a dam, levee, undersized culvert, or other manmade structures, or of environmental conditions, such as waterfalls, bedrock, sediment, water quality, temperature, or flow.

(a) A partial barrier to fish passage reduces movement of some individuals of one or more fish or other aquatic species some or all of the time.

(b) A complete barrier to fish passage prohibits movement of all individuals of one or more fish or other aquatic species all of the time.

(3) Federal trust species: Federal trust species includes anadromous and catadromous fish, other inter-jurisdictional aquatic species, endangered or threatened species, and species proposed for listing under the Endangered Species Act.

(4) Fish passage: Fish passage is the ability of fish or other aquatic species to move throughout an aquatic system among all habitats necessary to complete their life cycle. On a site-specific scale, fish passage is the ability of fish or other aquatic species to move between locations in an aquatic system.

B. See Exhibit 1 for a complete glossary of terms we use in this chapter.

2.4 What is the overall policy?

A. Service programs should evaluate Service actions that may include an existing or new barrier to aquatic connectivity or to fish passage for Federal trust species potentially found in waterbodies affected by such actions and, as appropriate and practicable, take steps to maintain, restore, or improve aquatic connectivity and fish passage for such species. Achieving aquatic connectivity and fish passage is often feasible and will provide benefits for ecosystems, fish and wildlife, and human communities.

B. When evaluating such actions to determine if it is appropriate and practicable to maintain, restore, or improve aquatic connectivity and fish passage for Federal trust species, Service programs should determine if the proposed action is likely to adversely impact aquatic connectivity or fish passage for one or more Federal trust species potentially found in the affected waterbodies. If Federal trust species are or could be present, and the proposed action is likely to adversely impact aquatic connectivity or fish passage for such species:

**FISH AND WILDLIFE SERVICE
FISHERIES**

Fisheries

Part 710 Fishery Resources Management

Chapter 2 Evaluation of Aquatic Connectivity and Fish Passage for Service Actions 710 FW 2

(1) The preferred approach is to prevent or remove the barrier to maintain or restore aquatic connectivity and fish passage, respectively; but

(2) If the barrier cannot be prevented or removed, Service programs should consider ways in which they could modify the barrier to improve aquatic connectivity and fish passage.

C. Service actions include on-the-ground activities the Service carries out (e.g., maintenance of Service infrastructure) as well as on-the-ground activities that other entities perform in which the Service plays a supporting role (e.g., providing technical or financial assistance, permitting, conducting environmental reviews).

2.5 What are the authorities for this chapter?

- A.** Anadromous Fish Conservation Act ([16 U.S.C. 757a-757g](#)).
- B.** Atlantic Striped Bass Conservation Act (16 U.S.C. 1851).
- C.** Clean Water Act (33 U.S.C. 1251-1387).
- D.** Endangered Species Act (16 U.S.C. 1531-1544).
- E.** Federal Power Act (16 U.S.C. 791a-828c)
- F.** Fish and Wildlife Act (16 U.S.C. 742a-742j, not including 742d-l).
- G.** Fish and Wildlife Coordination Act (16 U.S.C. 661-667e).
- H.** National Environmental Policy Act (42 U.S.C. 4321-4347).
- I.** National Wildlife Refuge System Administration Act (16 U.S.C. 668dd, et seq.).
- J.** Partners for Fish and Wildlife Act (16 U.S.C. 3771-3774).

RESPONSIBILITIES

2.6 Who is responsible for aquatic connectivity and fish passage when implementing Service actions? See Table 2-1.

**FISH AND WILDLIFE SERVICE
FISHERIES**

**Table 2-1: Roles and Responsibilities for
Aquatic Connectivity and Fish Passage within the Service**

| These employees... | Are responsible for... |
|--|---|
| A. The Director | (1) Approving or declining to approve this policy; and (2) Providing leadership, guidance, and direction to Service programs to implement the policy. |
| B. Assistant Director – Fish and Aquatic Conservation | Providing assistance to Service programs implementing the policy. |
| C. All Other Directorate Members | Directing actions to implement the policy in their Regions, programs, or other areas of responsibility. |
| D. National Fish Passage Program Coordinators | (1) Providing assistance to Service programs implementing the policy, and (2) Writing this policy and keeping it up to date. |
| E. Service Employees | Implementing this policy by evaluating the effects of Service actions on aquatic connectivity and fish passage for Federal trust species in waterbodies affected by such actions, and taking appropriate steps, as described in this chapter. |

IMPLEMENTATION

2.7 Why are aquatic connectivity and fish passage important to the Service?

A. Ecosystems depend on the flow and movement of water, sediment, nutrients, fish, and other organisms from one location to another. Many fish and other aquatic species in many life stages, including many Federal trust species, require freedom of movement for various reasons, such as migrating to spawning grounds, accessing food, finding refuge, and maintaining genetic diversity within a population. There are millions of barriers to aquatic connectivity and fish passage in the United States, which impact aquatic ecosystems and fish and wildlife populations throughout the country.

B. In some cases, barriers can have negative impacts on human communities. Barriers can disrupt the natural flow of water and can lead to safety hazards, water quality degradation, and higher water treatment costs. Undersized culverts in road crossings can cause water to back up behind the crossings during storms, often leading to culvert failure and severe road damage. Aging dams can fail, which can impact aquatic species and human health and safety. Recreational and commercial fishing and boating opportunities may be reduced due to impacts on habitat and fish populations.

C. Service actions can impact aquatic connectivity and fish passage. For example, the Service manages lands with existing fish passage barriers and operates facilities that can create barriers, such as wetland impoundments, water control structures, water diversions, culverts, low water road crossings, hatchery weirs, and fishways. In addition, the Service provides funding and technical

**FISH AND WILDLIFE SERVICE
FISHERIES**

Fisheries

Part 710 Fishery Resources Management

Chapter 2 Evaluation of Aquatic Connectivity and Fish Passage for Service Actions 710 FW 2

assistance for projects that other entities carry out, and permits and conducts environmental reviews for such projects that may affect aquatic connectivity and fish passage for Federal trust species.

D. Service actions that affect aquatic connectivity and fish passage are important to functioning ecosystems, sustainable fish populations, and healthy, safe, and resilient communities. The prevention, removal, or modification of barriers to maintain, restore, or improve aquatic connectivity and fish passage for Federal trust species supports the Service's mission to conserve, protect, and enhance fish, wildlife, plants, and their habitat for the continuing benefit of the American people.

2.8 When should Service programs evaluate aquatic connectivity and fish passage? Programs should evaluate the effects of the following Service actions on aquatic connectivity and fish passage of Federal trust species:

A. Construction, modification, or maintenance of Service infrastructure, including dams, levees, road crossings, tide gates, and water diversions;

B. Projects and plans that may involve an existing or new barrier to aquatic connectivity or to fish passage for Federal trust species that:

(1) The Service develops and implements;

(2) Other entities develop and implement and for which the Service provides financial and technical assistance; and

(3) Other entities develop and implement and on which the Service formally consults, provides permits, or conducts environmental reviews (e.g., Endangered Species Act consultations, Fish and Wildlife Coordination Act reviews, fishway prescriptions under the Federal Power Act).

2.9 How should Service programs evaluate aquatic connectivity and fish passage?

A. Service programs should determine whether:

(1) The action will affect a waterbody;

(2) One or more Federal trust species are present, or could be present, in the waterbody; and

(3) The action involves a partial or complete barrier that is likely to adversely impact aquatic connectivity or fish passage for one or more such species.

B. In making these determinations, a Federal trust species does not have to be physically present in the waterbody affected by the action if the barrier is likely to adversely impact a Federal trust species' ability to use that waterbody during the lifetime of the project. Adverse impacts on aquatic connectivity or fish passage for a Federal trust species are not limited to changes in the physical infrastructure of the waterbody, and may also take into consideration changes in water quality, flow, or temperature.

**FISH AND WILDLIFE SERVICE
FISHERIES**

Chapter 2 Evaluation of Aquatic Connectivity and Fish Passage for Service Actions 710 FW 2

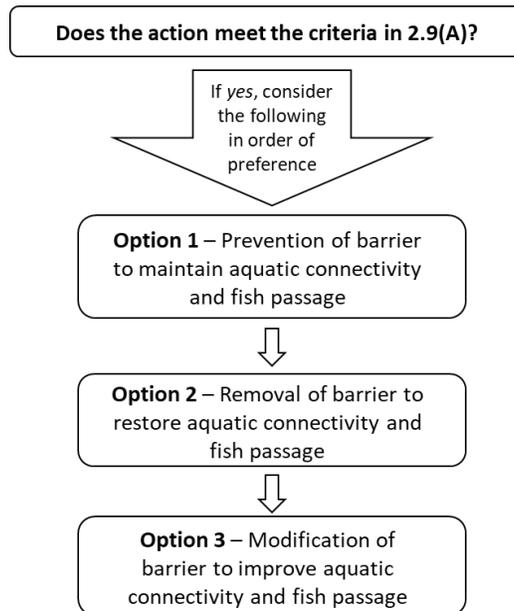
C. If Federal trust species are present, or could be present, in the affected waterbodies and the proposed action involves a partial or complete barrier that is likely to adversely impact aquatic connectivity or fish passage for the species, Service programs should strive to maintain, restore, or improve aquatic connectivity and fish passage for those species.

(1) For actions the Service carries out (see [sections 2.8A and B\(1\)](#)), Service programs should, as appropriate and practicable and consistent with available authorities, maintain, restore, or improve aquatic connectivity and fish passage for Federal trust species.

(2) For actions other entities carry out and in which the Service plays a supporting role (see [sections 2.8B\(2\) and \(3\)](#)), Service programs should, as appropriate and practicable and consistent with available authorities, recommend how to best maintain, restore, or improve aquatic connectivity and fish passage for Federal trust species.

(3) Figure 2-1 includes potential options for maintaining, restoring, or improving aquatic connectivity and fish passage, in order of preference.

Figure 2-1: Options for Maintaining, Restoring, or Improving Fish Passage and Aquatic Connectivity



(a) As noted in Option 1, the preferred approach is to maintain aquatic connectivity and fish passage by preventing the installation of barriers. This option is only available in situations where aquatic connectivity is intact and where a fish passage barrier is not already present.

(b) As noted in Option 2, the next best approach is removal of barriers that have already been constructed. When considering removal of a barrier, evaluate the current use of the structure, potential safety concerns or liabilities that may be incurred by removing it, any negative

**FISH AND WILDLIFE SERVICE
FISHERIES**

Fisheries

Part 710 Fishery Resources Management

Chapter 2 Evaluation of Aquatic Connectivity and Fish Passage for Service Actions 710 FW 2

environmental consequences, and the perspectives of affected stakeholders. Even if stakeholders raise concerns about a barrier removal during the evaluation process, solutions are often available that will address their concerns and allow the barrier removal to proceed.

(c) If barrier removal is not practicable, Service programs should evaluate modifying barriers to improve aquatic connectivity and fish passage (Option 3).

(4) When a Service program modifies or recommends modifying a barrier to improve aquatic connectivity and fish passage, the design should be specific to that particular case. The design must always integrate hydrology, hydraulics, and species biology. Fish passage structures must be designed, located, and sized appropriately considering the flows of the waterbody and the abilities of the target aquatic species. See [section 2.9D](#) below.

(a) Fish passage design typically addresses upstream and downstream migration of species, is designed to attract fish and other aquatic organisms, and also considers variability by species and life stage.

(b) Fish passage structures can be designed and constructed along a continuum from natural to more technical structures. Examples of more natural solutions include bypass channels, embedded culverts, or rock ramps, and examples of more technical solutions include steep pass, Denil, vertical slot, pool and weir fishways, and other measures for downstream passage. Some special types of technical fish passage structures include eel ladders and fish lifts.

D. Table 2-2 lists several aquatic connectivity and fish passage barriers and potential solutions, in general order of preference from natural to more technical solutions. Each solution must be designed to meet the requirements of the particular situation. There are many other types of fish passage structures, so we encourage Service programs to consider other design options that may be appropriate for the specific case and target species, and also to contact the experts we list in [section 2.12A](#).

Table 2-2: Common Barriers and Typical Solutions

| Common Barrier | Typical Solutions (in general order of preference) |
|--|--|
| Road stream crossing (e.g., undersized or perched culvert) | <ol style="list-style-type: none"> 1. Removal 2. Replacement – Bridge 3. Replacement – Culvert providing fish passage 4. Replacement – Low water crossing 5. Retrofit (e.g., rock ramp, backwatering) |
| Impoundment, dam, weir | <ol style="list-style-type: none"> 1. Removal 2. Breach or partial removal 3. Rock ramp 4. Bypass channel 5. Technical fishway 6. Fish lift |

**FISH AND WILDLIFE SERVICE
FISHERIES**

Fisheries

Part 710 Fishery Resources Management

Chapter 2 Evaluation of Aquatic Connectivity and Fish Passage for Service Actions 710 FW 2

| Common Barrier | Typical Solutions (in general order of preference) |
|--|--|
| Water diversion and other intake structures ¹ | <ol style="list-style-type: none"> 1. Removal 2. Rock ramp 3. Bypass channel |
| Levee | <ol style="list-style-type: none"> 1. Removal 2. Breach 3. Modification |
| Tide gate | <ol style="list-style-type: none"> 1. Removal 2. Install tide gate that allows fish passage 3. Retrofit tide gate to allow fish passage |
| Inadequate water quality and quantity | <ol style="list-style-type: none"> 1. Restoration of aquatic connectivity 2. Habitat restoration 3. Maintenance of adequate instream flow |

¹ In addition, always consider screens whenever there are water diversions to prevent entrainment, especially where entrainment prevents or reduces the ability of fish to pass through an area.

2.10 When may it *not* be appropriate to achieve aquatic connectivity and fish passage?

Sometimes it is necessary or desirable to construct or maintain barriers to aquatic connectivity and fish passage. In these cases, Service programs should consult the expert resources we describe in [section 2.12A](#). Following is a list of examples of such situations:

A. Natural resource management priorities: In some cases (e.g., waterfowl management, maintenance of aquatic resource genetic integrity, disease management), Service programs should consider the trade-offs in maintaining a barrier for management of one species or species group and the potential benefits of providing aquatic connectivity or fish passage, or both.

B. Invasive species control: In some cases, providing aquatic connectivity or fish passage may enable invasive species to spread. There are technical solutions that can often reduce the risk of spreading invasive species, while allowing for the passage of native species.

C. Contaminated sediment: In some cases, removing or altering a barrier to aquatic connectivity may disturb contaminated sediment. Contaminated sediment can often be properly removed and disposed of so that the barrier can be removed or altered to allow aquatic connectivity and fish passage.

2.11 With what other Service policies does this chapter intersect? Depending on the situation, when considering aquatic connectivity and fish passage, employees should also review the Service Manual chapters in Table 2-3 that may affect their determinations.

**FISH AND WILDLIFE SERVICE
FISHERIES**

Table 2-3: Other Service Policies Relevant to this Chapter

| | |
|---|--|
| Land Use and Management and Population Management Chapters | <p>505 FW 3, Review of Environmental Documents</p> <p>505 FW 4, Other Related Reviews</p> <p>573 FW 3, Natural Resource Damage Assessment and Restoration (NRDAR) Activities</p> <p>602 FW 3, Comprehensive Conservation Planning Process</p> <p>613 FW 1, Floodplain Management</p> <p>613 FW 3, Coastal Zone Management</p> <p>620 FW 1, Habitat Management Plans</p> <p>640 FW 1, Partners for Fish and Wildlife Program</p> <p>710 FW 1, Fish Passage Program</p> <p>717 FW 1, National Fish Habitat Action Plan</p> |
| Project/Construction Chapters | <p>360 FW 2, Project Management Process</p> <p>361 FW 2, Dam Safety Program Description, Definitions, and Standards</p> <p>362 FW 2, Vehicular Bridge Design and Maintenance</p> <p>372 FW 6, Planning and Executing Projects with Transportation Budgets</p> |

RESOURCES

2.12 What additional resources are available to Service programs for assistance in implementing this policy?

A. Technical assistance: The Service’s National Fish Passage Program includes experts in fish passage design, engineering, and policy. Employees should contact these experts for assistance in implementing this policy or with any concerns they may have related to aquatic connectivity or fish passage design. See the [National Fish Passage Program website](#) for more information. Employees may also contact their Region’s Assistant Regional Director for Fish and Aquatic Conservation for assistance.

B. Relevant documents: The documents below are a subset of published reference material regarding aquatic connectivity and fish passage that is available nationally. Employees should

**FISH AND WILDLIFE SERVICE
FISHERIES**

Fisheries

Part 710 Fishery Resources Management

Chapter 2 Evaluation of Aquatic Connectivity and Fish Passage for Service Actions 710 FW 2

evaluate the applicability of these documents to the specific project or program under consideration on a case-by-case basis.

- (1) Food and Agriculture Organization of the United Nations. 2002. [Fish Passes – Design, Dimensions and Monitoring](#). Food and Agriculture Organization of the United Nations. 138 pp.
- (2) National Marine Fisheries Service (NMFS). 2011. [Anadromous Salmonid Passage Facility Design](#). NMFS, Northwest Region, Portland, Oregon.
- (3) Turek, J., A. Haro, and B. Towler. 2016. [Federal Interagency Nature-like Fishway Passage Design Guidelines for Atlantic Coast Diadromous Fishes](#). Interagency Technical Memorandum. NMFS, U.S. Geologic Survey, and U.S. Fish and Wildlife Service.
- (4) United States Department of Agriculture (USDA). 2008. [Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings](#). USDA Forest Service, National Technology and Development Program. 7700-Transportation Management, 0877 1801-SDTDC.
- (5) United States Department of Agriculture (USDA). 2016. [Technical Guide for Field Practitioners: Understanding and Monitoring Aquatic Organism Passage at Road-Stream Crossings](#).
- (6) United States Fish and Wildlife Service. 2020. [Culvert Design Guidelines for Ecological Function](#), Alaska Fish Passage Program. February 5, 2020.
- (7) United States Fish and Wildlife Service. 2019. [Fish Passage Engineering Design Criteria, Region 5](#). June 2019.
- (8) United States Fish and Wildlife Service. 2017. [Roadway Design Guidelines, Organism Passage chapter](#). February 2017.

/sgd/ Martha Williams
Senior Advisor to the Secretary
Exercising the Delegated Authority of the Director
U.S. Fish and Wildlife Service

Date: January 30, 2021