NATURAL RESOURCES CONSERVATION SERVICE
MONTANA CONSERVATION PRACTICE STANDARD

STRUCTURE FOR WATER CONTROL (NUMBER)

CODE 587

DEFINITION

A structure in a water management system that conveys water, controls the direction or rate of flow, maintains a desired water surface elevation or measures water. **These structures, where appropriate, should include an evaluation of the need to install fish screens to protect fish species from entrainment.**

PURPOSE

The practice may be applied as a management component of a water management system to control the stage, discharge, distribution, delivery or direction of water flow. **Where appropriate, to minimize targeted and non-targeted fish population losses.**

CONDITIONS WHERE PRACTICE APPLIES

This practice applies wherever a permanent structure is needed as an integral part of a water-control system to serve one or more of the following functions:

- **Where water conveyance systems have been documented to have adverse impacts on targeted and non-targeted fish populations.**
- Convey water from one elevation to a lower elevation within, to or from a water conveyance system such as a ditch, channel, canal or pipeline designed to operate under open channel conditions. Typical structures: drops, chutes, turnouts, surface water inlets, head gates, pump boxes and stilling basins.
- Control the elevation of water in drainage or irrigation ditches. Typical structures: checks, flashboard risers and check dams.
- Control the division or measurement of irrigation water. Typical structures: division boxes and water measurement devices.
- Keep trash, debris or weed seeds from entering pipelines. Typical structure: debris screen.
- Control the direction of channel flow resulting from tides and high water or backflow from flooding. Typical structures: tide and water management gates.
- Control the water table level, remove surface or subsurface water from adjoining land, flood land for frost protection or manage water levels for wildlife or recreation. Typical structures: water level control structures, flashboard risers, pipe drop inlets and box inlets.
- Convey water over, under or along a ditch, canal, road, railroad or other barriers. Typical structures: bridges, culverts, flumes, inverted siphons and long span pipes.
- Modify water flow to provide habitat for fish, wildlife and other aquatic animals. Typical structures: chutes, cold water release structures and flashboard risers.
- Provide silt management in ditches or canals. Typical structure: sluice.
- Supplement a resource management system on land where organic waste or commercial fertilizer is applied.
- To create, restore or enhance wetland hydrology.

NRCS, MT
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Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard contact the Natural Resources Conservation Service.

NOTE: This type of font **(AaBbCcDdEe 123..)** indicates NRCS National Standards.
This type of font (AaBbCcDdEe 123..) indicates Montana Supplement.

CRITERIA

General Criteria Applicable to All Purposes

This practice and all planned work shall comply with all federal, state, **tribal,** local laws and regulations. **Laws and regulations of particular concern include those involving water rights, land use, pollution control, property easements, wetlands, preservation of cultural resources, and endangered species.**

Vegetation complying with **Field Office Technical Guide (FOTG), Section IV–**Critical Area Planting Standard (Code 342) **and Specifications,** shall be established on all disturbed earth surfaces. Where soil, climate or site specific conditions preclude establishing permanent vegetation, other protective means such as mulches or gravels, shall be used.

The structure shall be fenced, if necessary, to protect the vegetation.

Structures shall not be installed that have an adverse effect on septic filter fields.

The water level upstream of water control structures shall not be raised on adjacent landowners without their **written** permission **and/ or easement**.

In Montana, if data justifies the need for screening, the design for Fish Screens shall address the following:

1. The fish screen shall be designed so fish do not suffer excessive energy deficits or undue physical stress as the fish are transported from the diversion point back to the stream. All screens installed downstream from the diversion entrance shall be provided with an efficient bypass system, designed to collect fish and safely transport them back to the river with minimum delay. (Unless fish return to the stream through the canal system.)

2. The screen shall be constructed at the diversion entrance with the screen face generally parallel to the stream flow.

3. The screen approach velocity shall be measured three inches from the screen face. For Samonid fry, less than 2.36 inches in length the approach velocity shall not exceed 0.4 feet per second. Salmonid fingerling 2.36 inches and longer, the approach velocity shall not exceed 0.8 feet per second. The screen openings should be 3/32 inch and the screen should be a wedge wire.

4. The total submerged screen area that is required is to be calculated by dividing the maximum diverted flow by the allowable approach velocity. The screen design must provide for uniform flow distribution over the screen surface, thereby minimizing approach velocity. The flowing water sweeping velocity should be at least double the approach velocity to the screen.

5. If biological justification cannot support the absence of fry-sized salmonids (less than 2.36 inches) in the vicinity of the diversion intake, fry shall be assumed to be present and the following criteria apply for screen material:

- **a. Perforated Plate: Screen openings shall not exceed 3/32 inch.**
- **b. Profile Bar Screen: The narrowest dimension in the screen openings shall not exceed 0.0689 inches in the narrow direction.**
- **c. Woven Wire Screen: Screen openings shall not exceed 3/32 inch in the narrow direction.**
- **d. Screen material shall provide a minimum of 27% open area.**

6. If biological justification can demonstrate the absence of fry-sized salmonids less than 2.36 inches in the area of the screen, the following criteria shall be followed:

- **a. Perforated Plate: Screen openings shall not exceed 1/4 inch.**
- **b. Profile Bar Screen: The narrowest dimension in the screen openings shall not exceed 1/4 inch in the narrow direction.**
- **c. Woven Wire Screen: Screen openings shall not exceed 1/4 inches in the narrow direction.**
- **d. Screen material shall provide a minimum of 40% open area.**

7. All screen material shall be corrosive resistant and durable to maintain a smooth uniform surface with long-term use.

8. Bypass pipes shall have a smooth surface and be designed to provide a condition that minimizes turbulence. The bypass conduit shall have a smooth joint design to minimize turbulence and the potential for fish injury. Fish shall not be pumped. The bypass pipe shall not be pressurized. The minimum depth of open-channel flow in the bypass conduit shall be greater than or equal to 9 inches.

9. Bypass outfalls should be located in reaches with higher velocities where possible, unless there is a risk of outfalling in very shallow or de-watered areas. It is recommended that outfalls be located in river velocities greater than 4.0 feet per second. However, many streams are less than 4.0 feet per second, and the outfall should be located in a pool area, if possible. The outfall shall be located to minimize avian and aquatic predation at an area free of eddies, reverse flow, or known predator habitat.

10. Diversion flows of less than 25 cfs, the criteria can be modified to the following:

a. The screen length for less than or equal to 4 feet, the screen orientation may be angled or perpendicular relative to the flow.

b. For screen lengths greater than 4 feet, screen-to-flow angles must be less than 45 degrees.

c. For drum screens, the design submergence shall be 75% of drum diameter; however, in many sites this may not be feasible (65% minimum if at all possible). In Montana, many sites will not meet these criteria. Site conditions may be the controlling factor.

d. The minimum bypass pipe diameter shall be 10 inches.

e. The minimum allowable pipe flow depths shall be two inches and should be controlled by designing the pipe gradient for minimum bypass flow.

CONSIDERATIONS

When planning, designing, and installing this practice, the following items should be considered:

- Effects on the water budget, especially on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge.
- Potential for a change in the rate of plant growth and transpiration because of changes in the volume of soil water.
- Effects on downstream flows or aquifers that would affect other water uses or users.
- Effects on the field water table to ensure that it will provide a suitable rooting depth for the anticipated crop.
- Potential use for irrigation management to conserve water.
- Effect of construction on aquatic life.
- Effects on stream system channel morphology and stability as it relates to erosion and the movement of sediment, solutes, and sediment-attached substances carried by runoff.
- Effects on the movement of dissolved substances below the root zone and to ground water.
- Effects of field water table on salt content in the root zone.
- Short term and construction-related effects of this practice on the quality of downstream water.
- Effects of water level control on the temperatures of downstream waters and their effects on aquatic and wildlife communities.
- Effects on wetlands or water-related wildlife habitats.
- Effects on the turbidity of downstream water resources.
- Existence of cultural resources in the project area and any project impacts on such resources.
- Conservation and stabilization of archeological, historic, structural, and traditional cultural properties when appropriate.

Design alternatives presented to the client should address economics, ecological concerns, and acceptable level of risk for design criteria as it relates to hazards to life or property.

When planning or designing fish screens in Montana, also consider the following:

1. The adequacy of any existing diversion structures along with the potential impacts on the planned fish screen.

2. The maximum and minimum system flows, water rights, potential system changes, and other water management objectives for selecting the appropriate fish screen.

3. The amount and type of trash in the stream, diversion, or canal prior to selecting the appropriate fish screen.

4. If the installation of a fish screen will cause degradation or aggradation of the channel upstream, installation of bed controls appropriate for the geomorphic conditions of the site and fish passage needs should be considered [see Field Office Technical Guide (FOTG), Section IV–Practice Standards and Specifications for Stream Channel Stabilization (Code 584) and Grade Stabilization Structure (Code 410)].

5. Consider potential positive effects of providing screening for invasive or non-native species that may hybridize with, compete with, or spread disease to native fish or other aquatic species above a barrier.

6. Consider seasonal stream flow variations and how these may impact hydraulics for which the structure is being designed.

7. Consider historical structures when planning. This practice may affect cultural resources and should comply with Montana Amendments to the General Manual–420, Part 401, during the planning, prior to installation and during maintenance of the fish screen.

8. To the extent possible, fish screens should be designed to minimize excessive predation on fish.

9. Consider seasonal and annual screen maintenance needs and requirements.

The Designing Fish Screens for Fish Protection at Water Diversions document should be considered for valuable design guidance for fish screens. This publication was written by Bryan Nordlund, P.E., National Marine Fisheries Service, 525 N.E. Oregon, Suite 500, Portland, Oregon 97232, dated June 10, 1996. The publication can be found at http://155.206.14.34/search?q=cache:jQ9d2usdT6gJ:www.nwr.noaa.gov/1hydrop/hydroweb/docs/usfws_97.htm+designing+fish+screens&access=p&output=xml_no_dtd&site=default_collection&ie=UTF-8&client=default_frontend&proxystylesheet=default_frontend&oe=ISO-8859-1

PLANS AND SPECIFICATIONS

Plans and specifications for installing structures for water control shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

The plan shall specify the location, grades, quantities, dimensions, materials, and hydraulic and structural requirements for the individual structure. Provisions must be made for necessary maintenance. Care must be used to protect the surrounding visual resources. If watercourse fisheries are important, special precautions or design features may be needed to facilitate continuation of fish migrations.

The planner and designer shall follow the Natural Resources Conservation Service, Montana Supplement to the Engineering Field Handbook, Chapter 51, Planning and Design Guide, as appropriate for documentation for planning and design.

Included within the plans and/or specifications shall be a process to pre-wash or clean all construction equipment used for installation of this practice to control noxious weeds, or other undesired vegetation as required by the landowner.

OPERATION AND MAINTENANCE

An operation and management plan shall be provided to and reviewed with the land manager. The plan shall be site specific and include but not be limited to the following: Structures will be

checked and necessary maintenance, including removal of debris, shall be performed after major storms and at least semi-annually. Water level management and timing shall be adequately described wherever applicable.

For fish screens within the maintenance plan, a program shall be established to maintain vegetative cover while controlling undesired and exotic vegetation.

REFERENCES FOR FISH LADDERS

Washington State University, Department of Civil and Environmental Engineering, Fishways-An Assessment of Their Development and Design, U.S. Department of Energy Bonneville Power Administration Division of Fish and Wildlife.

REFERENCES FOR FISH SCREENS

Norland, Bryan. 1996. Designing Fish Screens for Fish Protection at Water Diversions. National Marine Fisheries Service, Portland, Oregon http://155.206.14.34/search?q=cache:jQ9d2usdT6gJ:www.nwr.noaa.gov/1hydrop/hydroweb/docs/usfws_97.htm+designing+fish+screens&access=p&output=xml_no_dtd&site=default_collection&ie=UTF-8&client=default_frontend&proxystylesheet=default_frontend&oe=ISO-8859-1

National Marine Fisheries Service, Southwest Region, Fish Screening Criteria for Anadromous Salmonids, January 1997. http://swr.ucsd.edu/hcd/fishscrn.htm

Pierce, Ronald W., Krogstad, Ronald, and Neudecker, Gregory A., 2003. Modifications of a Turbulent Fountain for Use as a Fish Screen in Small High-Gradient Streams. Intermountain Journal of Sciences, Volume 9, No. 4-101-106.

Partners for Wildlife. 1996. Irrigation Diversion Fish Screening. U.S. Fish and Wildlife Service, Mountain-Prairie Region, Denver, Colorado.