

FISH RACEWAY OR TANK

(Feet and Feet³)
Code 398

Natural Resources Conservation Service
Conservation Practice Standard

I. Definition

A channel or tank with a continuous flow of water constructed or used for high-density fish production.

II. Purpose

- To provide a facility containing flowing water of suitable temperature and quality for dependable production of fish;
- To manipulate chemical, physical, and biological factors to enhance fish production;
- To maintain water quality.

III. Conditions Where Practice Applies

This standard applies to raceways or tanks that conduct flowing water to produce fish. It applies to earthen channels as well as those channels and tanks constructed of concrete, concrete block, timber, rock, fiberglass, or other materials.

IV. Federal, Tribal, State, and Local Laws

Users of this standard should be aware of potentially applicable federal, tribal, state and local laws, rules, regulations or permit requirements governing fish raceways or tanks. This standard does not contain the text of federal, tribal, state, or local laws.

V. Criteria

A. General Criteria Applicable to All Purposes

The facility must be designed to provide protection from flooding, sedimentation, and contamination by pollutants from outside sources.

Construction of fish raceways are generally:

- linear channels where water flows in at one end and exits at the other end, or
- circular, rectangular, or oval tanks where water enters through nozzles or jets in a manner that creates a rotary circulation within the tank and discharge typically is

through the tank center by means of a standpipe or bottom drain.

The raceway dimensions shall be designed based upon the available water and planned production level.

1. Water Requirements

a. Quantity

A water supply of sufficient volume must be available for the species being produced either by gravity flow or by pumping. Generally, this amount would equate to two complete water exchanges per hour for a raceway length of 80 to 100 feet. The water volume shall be measured during periods of low flow.

b. Quality

Water must be free of harmful gases, minerals, silt, pesticides, and other contaminants. A water analysis shall be made before design and construction unless previous use or experience indicates the quality is satisfactory for the desired species. An example of water quality requirements for trout and catfish are shown in Table 1. Uniquely different water quality parameters may be applicable to other species.

Table 1
Water Quality Requirements

Quality Parameter		Species	
		Trout	Catfish
Dissolved oxygen	Desirable Minimum	8 ppm or > 5 ppm	5 ppm or > 3 ppm
Temperature (°F)	Desirable Min./Max.	55 – 64 45 / 70	75 – 84 70 / 90
pH	Desirable Min./Max.	6.5 – 9.0 6.0 / 9.5	6.5 – 9.0 6.0 / 9.5
Carbon dioxide	Desirable Min./Max.	2 ppm or < 0 / 3 ppm	5 ppm or < 0 / 10 ppm

*Toxicity varies with dissolved oxygen concentration, temperature and pH.

2. Predators

Fences, screens, nets, wires, or other materials shall be provided as needed to prevent the loss of fish to predators. Traps or other devices that are potentially harmful for humans, livestock, or pets shall be placed only in secure locations not normally accessible except through special effort. A license or permit from the appropriate state agency may be required to perform such activities.

3. Waste Treatment

Plans for treatment, storage, or use of waste generated or caused by the operation of fish raceways or tanks shall be developed and made a part of the design and installation of the practice. Such components may include the construction of waste storage structure facilities (Standard 313), treatment lagoons (Standard 359), settling basins, or other facilities. The spreading of waste on land through irrigation or hauling is permissible if soils and land resources are available according to a nutrient management plan developed in accordance with Standard 590. Discharges into streams must meet state standards for the stream.

4. Protection

A protective cover of vegetation shall be established on all exposed surfaces that have been disturbed (Critical Area Planting - 342). If soil or climatic conditions preclude the use of vegetation, other methods may be used for protection. When revegetating the earthen components of this practice, use the same or similar species to those in the surrounding area to help minimize any visual or aesthetic disruption.

Adequate provisions must be made to protect earth surfaces from wave erosion.

Install fences as necessary to exclude human, animal, and vehicle traffic to allow for and maintain the establishment of vegetation and for safety considerations.

Road surfaces along raceways and the outer perimeter of tanks shall be treated as needed to provide access and reduce erosion.

B. Criteria for Linear Channel Raceways

1. Channel raceways may be constructed of any suitable materials or linings but are generally of two types.

a. Concrete or Concrete Block Construction

Design and construct raceways in accordance with current American Concrete Institute (ACI). Codes for Structural Concrete or Concrete Masonry. Where concrete or concrete block raceways are installed, the bulkheads or check dams must be of the same specification.

b. Earthen Channels Constructed with a Trapezoidal or Parabolic Cross Section

Bottom widths depend on the volume of water available but shall be no less than 4 feet. Side slopes shall be 1:1 or flatter depending on a saturated soil slope stability analysis. Side slopes and bottoms of raceways must be smooth and uniform to minimize dead water areas.

2. Grade

Wherever possible, design and construct raceways with a minimum bottom grade of 0.5 feet per 100 feet. The raceway outlet will control the water surface grade.

3. Length

The maximum length of each raceway section is determined by site topography and need for re-aeration of the water but should not exceed 100 feet. Depending on water volume and quality, raceway sections may be constructed in series by installing a bulkhead or check dam at the lower end of each section.

4. Width

The width of individual raceways shall be selected considering the available water supply, harvesting equipment and operating and maintenance needs of the system.

5. Freeboard

The minimum difference in elevation between the water surface in the raceway and the top of the bulkhead, dike, or levee alongside the raceway is 0.5 feet.

6. Dikes and levees

The minimum top width of an earthen dike or levee shall be 6 feet. Side slopes of earthen dikes and levees above the designed water surface shall be 2:1 or flatter. When the top of the dike or levee is to be used for a road, the minimum top width shall be 14 feet with at least 3:1 side slopes.

7. Bulkheads

Structural or earthen barriers called bulkheads are to be placed across raceway channels to create shorter sections, to establish and maintain the desired water levels, and to provide aeration of the water. In addition to serving as a barrier, they shall have an opening or throat section that allows complete drainage to the bottom of the raceway channel unless other drainage facilities are provided. Bulkheads may be constructed of earth, concrete, concrete block, rock masonry, steel or other durable metal, treated timber, or a combination of these. Earthen bulkheads are to have a minimum top width of 4 feet and side slopes of 2:1 or flatter. Structural bulkheads used in earthen raceways must extend at least 24 inches into the sides and bottom of the channel. Concrete bulkheads shall have a minimum top width of 6 inches and a minimum bottom width of 8 inches.

Openings and cores in concrete blocks shall be filled with either concrete or mortar mix. The opening or throat section of bulkheads may be constructed of concrete, concrete block, wood, or metal. It shall have slots or grooves along the vertical face that allow flashboards and screens to be installed.

8. Drains

A pipe drain with a minimum diameter of 6 inches shall be provided at the bottom of the bulkhead unless flashboards used to establish the desired water level can be removed to provide complete drainage. Where possible, each unit in a series should

be constructed so that it can be drained independently of the other units.

9. Screens

Screens shall be provided at the inlet of the system if necessary to exclude wild fish. Screens shall also be placed at each bulkhead between sections and at the exit end to prevent loss of fish. They shall be placed at least 6 to 8 inches upstream from the flashboards and shall extend at least 6 to 8 inches above the expected water level to prevent fish from escaping by jumping. Openings for screens shall be designed considering the size range of fish to be separated. The water velocity through screens shall be slow enough to prevent impinging of fish against the screen.

10. Aeration

Each bulkhead shall be fitted with a weir overfall. Flashboards in the opening or throat section of the bulkhead may be used for this purpose. The width of the weir or weirs should be equal to the bottom width of the raceway but shall not be less than 4 feet where flashboards are used to establish the desired water level. Two or more weirs separated by rigid center sections shall be installed when the width of the raceway exceeds 8 feet. To increase aeration as part of the design, arrange a splash board or series of boards to create successive splashes or place nozzles in the tank above the water surface. The minimum distance from the weir crest to the water level below should be no less than 1 foot.

C. Criteria for Tank Raceways

Tank raceways are circular, rectangular, or oval and are constructed of concrete, metal, fiberglass, or other suitable material. Fiberglass and a variety of similar materials commonly referred to as "plastic" tanks are generally suitable if construction and support are sufficient to provide strength and durability. Noncircular tanks must have an interior dividing wall to obtain proper circulation. Construct tank raceways shall be constructed at locations accessible to water supplies, management personnel, and feed and harvest equipment.

1. Water Supply

Water inlets to the tank may be through jets or nozzles or similar devices that provide a tangential force to the water in the tank. Submerged nozzles should not be near the bottom because of the problem of uplift of waste particles. The nozzles shall be positioned so that flow in the tank is counterclockwise to take advantage of the natural tendency for water in North America to rotate in this direction.

2. Waste Removal

Provisions for waste removal shall be incorporated in the design. Bottom troughs, screens, or center-positioned drain pipe shall be provided as part of the tank construction.

VI. Considerations

Considerations include additional design recommendations that are not required criteria, but may be used to enhance or avoid problems with the design and function of this practice.

- A. Water budget, especially on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge.
- B. Downstream flows and aquifers that could affect other water uses.
- C. Volume of downstream flow that might cause undesirable environmental, social, or economic effects.
- D. Visual quality of downstream water resource.
- E. Short-term and construction-related effects on the quality of the onsite and downstream water.
- F. Movement of dissolved organic and inorganic chemicals downstream and towards ground water recharge areas.
- G. Wetlands, riparian areas and water-related wildlife habitats.
- H. Impacts of cultivated non-native fish on endemic fish populations.
- I. Existence of cultural resources in the project area and any project impacts on such areas.

- J. Conservation and stabilization of any existing archeological, historic, structural, and traditional cultural properties.

VII. Plans and Specifications

Plans and specifications are to be prepared for specific field sites and include construction plans, drawings, job sheets, construction specifications, narrative statements in conservation plans, or other similar documents. These documents are to specify the requirements for installing the practice, such as the kind, amount, or quality of materials to be used, or the timing or sequence of installation activities including site-specific construction details.

VIII. Operation and Maintenance

Prepare an operation and maintenance plan shall be prepared that provides for inspection, operation, and maintenance of vegetation, pipes, valves, raceways, tanks, dikes, levees, bulkheads, filtration, and other parts of the system.