

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD
FISH RACEWAYS OR TANK

(Mile, Feet)

CODE 398

DEFINITION

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

PURPOSE

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

CONDITIONS WHERE PRACTICE APPLIES

Where water and land resources are suitable for constructing a raceway or tank that can be used to produce a commercial fish crop.

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. It does not apply to hatchery operations that utilize troughs or barrels and are primarily indoors.

CRITERIA

Criteria Applicable to Design of all Fish Raceways or Tanks

The facility must be designed to provide protection from flooding, sedimentation, and

contamination by pollutants from outside sources.

Fish raceways are generally constructed as:

- a. linear channels where water flows in at one end and exits at the other end or
- b. 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.

Water Requirements

- A. **Quantity** – A water supply of sufficient volume must be available either by gravity or by pumping. For linear raceways, there shall be a continuous incoming water supply to provide a minimum velocity of 0.05 ft./s (0.015 m/s) flowing at a minimum average depth of 2 ft. (0.6 m).
- B. **Quality** – Water must be free of harmful gases, minerals, silt, pesticides, and other pollutants. A water analysis shall be made before design and construction unless previous use or experience indicates the quality is satisfactory. Water quality requirements for trout and catfish are in table 1.

Table 1 – Water quality requirements for Channel Catfish and Rainbow Trout

Quality parameter		Species	
		Trout	Catfish
Dissolved oxygen	Desirable	8 ppm or more	6 ppm or more
	Minimum	5 ppm	5 ppm
Temperature	Desirable	(12.8 – 17.8°C) 55 – 64°F	(23.9 – 28.9°C) 75 – 84°F
	Minimum/ Maximum	(7.2 / 21.1°C) 45 / 70°F	(15.5 / 32.2°C) 60 / 90°F
pH	Desirable	6.5 – 9.0	6.5 – 9.0
	Minimum/ maximum	6.0 / 9.5	6.0 / 9.5
Carbon dioxide	Desirable	2 ppm or less	5 ppm or less
	Minimum*/ maximum	0 / 3 ppm	0 / 10 ppm

*Toxicity varies with dissolved oxygen concentration and temperature.

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.

Waste treatment

Plans for treatment or use of waste that are 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. The treatments shall include the construction of waste storage ponds, storage structures, treatment lagoons, settling basins, or other facilities. Waste utilization by the spreading of waste on land through irrigation or hauling is permissible if soils and land resources are available. Discharges into streams must meet state standards for the stream, based on size of operation, and comply with National Pollutant Discharge Elimination Systems (NPDES) regulations.

Protection

A protection cover of vegetation shall be established on all exposed surfaces that have been disturbed. If soil or climatic conditions preclude the use of vegetation, other methods may be used for protection. Adequate provisions must be made to protect earth surfaces from wave erosion. Fences shall be installed as necessary.

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

Criteria Applicable to Linear Channel Raceways

Channel raceways are generally concrete or concrete block construction or earthen channels constructed with a trapezoidal or parabolic cross section.

- a. Concrete or concrete block raceways shall be designed and constructed according to established principles and techniques outlined in the National Engineering Manual (NEM), ACI Code, Masonry Handbook, or other approved guides as appropriate. Where concrete or concrete block raceways are installed, the bulkheads or check-dams must be of the same construction.
- b. Earthen channel raceways shall be constructed with a trapezoidal or parabolic cross section. Bottom widths depend on the volume of water available but shall be no less than 4 ft. (1.2 m). 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.

Grade

Wherever possible, raceways shall be constructed with a minimum bottom grade of 0.5 ft. per 100 ft. (0.15 m per 30 m). The raceway outlet shall control the water surface grade.

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 ft. (30 m). 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.

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-ft. (0.15 m).

Dikes and levees

The minimum top width of an earthen dike or levee shall be 6 ft. (1.8 m). Side slopes of earthen dikes and levees above the designed water surface shall be 2:1 or flatter. Where the top of the dike or levee is to be used for a road, the minimum top width shall be 14 ft. (4.3 m).

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 combinations of these. Earthen bulkheads are to have a minimum top width of 4-ft. (1.2 m) and side slopes of 2:1 or flatter. Structural bulkheads used in earthen raceways must extend at least 24 in. (61.0 cm) into the sides and bottom of the channel. Concrete

bulkheads shall have a minimum top width of 6-in. (15-cm) and a minimum bottom width of 8-in. (20-cm). 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.

Drains

A pipe drain with a minimum diameter of 6-in. (15-cm) 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.

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 in. (15 to 20 cm) upstream from the flashboards and shall extend at least 6 to 8 in. (15 to 20 cm) above the expected water level to prevent fish from escaping by jumping.

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 ft. (1.2 m) where flashboards are used to establish the desired water level. Two or more weirs separated by rigid center sections shall be installed where the width of the raceway exceeds 8 ft. (2.4 m). To increase aeration, a splash board or series of broads arranged to create successive splashes shall be considered in design. The minimum distance from the weir crest to the water level below should be no less than 1 ft. (0.31 m).

Criteria Applicable to 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, is

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. Tank raceways shall be constructed at locations accessible to water supplies, management personnel, and feed and harvest equipment.

Water supply

Water inlets to the tank may be through jets, nozzles, or similar devices that provide a tangential force to the water in the tank. These nozzles should be located above the water surface to provide aeration. They may be submerged but 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 American to rotate in this direction.

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.

CONSIDERATIONS

The cooperator's objective as well as the limitations and potentials of available aquaculture resources will dictate the level of development and management to be planned. An aquaculture resource assessment must be made to determine the feasibility of the raceway or tank culture system. Planning is complete when all practice components essential to reaching the cooperator's management objectives and maintaining the water resource have been identified.

Water Quality

Consider the effect on:

- The water budget, especially on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge.
- Downstream flows and aquifers that would affect other water use.

- The volume of downstream flow that might cause undesirable environmental, social, or economic effects.

Water Quality

Consider the effect on:

- The visual quality of downstream water resource.
- Short-term and construction-related effects on the quality of the onsite and downstream water.
- The movement of dissolved substances below the root zone and toward the ground water.
- Wetlands and water-related wildlife habitats.

Cultural resources:

Cultural resources shall be considered when planning this practice. This practice has the potential for adversely affecting cultural resources and compliance with GM 420; Part 401 during the planning process is necessary. Where appropriate, local cultural values shall be incorporated into practice design in a technically sound manner. Compliance with all applicable federal, state and local laws and regulations, including permits, permissions, or notifications is required.

PLANS AND SPECIFICATIONS

Plans and specifications for constructing raceways and tanks and their appurtenances shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

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

**CONSTRUCTION SPECIFICATION
FOR
FISH RACEWAY**

(Mile, Feet)

CODE 398

Scope: This item consists of clearing, excavating, backfilling, and installing all things required pertaining to the construction of fish raceways. Construction operations shall be done in such a manner that soil erosion and air, water, and noise pollution will be minimized and held within legal limits as specified by state regulations.

Clearing and Grubbing: All trees, brush, and other debris shall be removed from the raceway and from the dike area on which fill is either to be placed or excavation is to be performed. All stumps and roots 1 inch in diameter and larger shall be removed from the site to a depth of at least 0.5 ft. (0.15 m).

Borrow Areas: On areas from which fill materials are to be obtained, all trees, brush, logs and other debris shall be removed.

Topsoil should be stockpiled and spread over the disturbed areas when construction is complete.

Disposal of Cleared and Grubbed Materials: The residue from the above operations shall be disposed of by burning, burying at approved locations, or otherwise removed from the site and stacked in neat piles. All burning shall conform to Alabama State Laws.

Excavation – Fills: Raceways shall be constructed to the lines, grades, and dimensions as shown on the plans or as staked in the field before construction. The channel bottom shall be left transversely level and the side slopes uniform. The materials placed in the fill shall be free of all sod and stones over 6 inches in diameter. Roots and other objectionable materials shall be removed. The fill shall be brought up in about horizontal layers, not exceeding 8 inches in thickness. The construction equipment shall be operated

over the area of each layer in a manner that results in uniform compaction of the fill material.

Inlets, Bulkheads, and Weir Installation: The inlet pipe, bulkheads, weirs, drains, gates, and all other components of the raceway shall be placed on firm foundation to the lines and grades shown on the plans or as staked in the field before construction. Selected backfill material shall be placed around both the inlet pipe and drain pipes in layers not exceeding 0.33 ft. (0.10 m) thickness. Each layer shall be thoroughly compacted by either hand or power tampers.

Materials: All the components of the raceway including pipe inlets, screens, drain pipes, and timbers for weirs shall be new materials or equivalent. All construction or fabrication of these materials shall be as specified on the plans and performed in a workmanlike manner.

Concrete: Where concrete is used, the mixture shall be no less than a 5-bag mix per yard. Water content shall not exceed 6 gallons per sack. Concrete shall be placed in lifts not exceeding 24 inches in height and either vibrated or rodded sufficiently to remove voids and to densify the concrete. The aggregates shall be a standard known brand of normal Portland cement, washed sand, and gravel. Clean water shall be used in the mix.

Curing: All exposed surfaces of concrete shall be protected from direct rays of the sun for at least the first 7 days. All concrete shall be cured by either keeping continuously moist for at least 7 days after being placed or by spraying with two coats of curing compound where other concrete will not be bonded to the treated surface. Concrete shall be protected from freezing during the curing period.

Erosion Control! Treatment of all exposed areas to prevent erosion shall begin immediately after construction is finished on all areas. This treatment shall consist of vegetation, gravel, crushed stone, wood chips, or other suitable materials placed or established in such manner as to prevent or protect the area from erosion. Vegetation shall

be applied according to specifications in 342 - Critical Area Planting and shall include preparing seedbeds, seeding, liming, fertilizing, and mulching. Gravel, crushed stone, wood chips or other suitable material placed during construction shall be in accordance with specification 561 - Heavy Use Area Treatment.