NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

FISH RACEWAY OR TANK

(ft and ft^3/s)

CODE 398

DEFINITION

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

PURPOSES

Provide a facility containing flowing water of suitable temperature and quality for dependable production of fish

Manipulate the chemical, physical, and biological factors to enhance fish production

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

CRITERIA

General Criteria Applicable To All Purposes

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

Fish raceways are generally constructed as:

1. linear channels where water flows in at one end and exits at the other end or
2. 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.

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 flowing at a minimum average depth of 2 ft. This is approximately two complete water exchanges per hour for a raceway length of 80 to 100 ft. The water volume shall be measured during periods of low flow.

Quality – Water must be free of harmful gases, minerals, silt, pesticides, and other pollutants. Water must be analyzed before design and construction unless previous use or experience indicates the quality is satisfactory. Water quality requirements for cold water species and warm water species are shown in Table 1.

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

Table 1. – Water quality requirements

Quality Parameter		Species	
		Cold Water Fish	Warm Water Fish
Dissolved Oxygen	Desirable	8 ppm or greater	5 ppm or greater
	Minimum	5 ppm	3 ppm
Temperature	Desirable	55 - 64 °F	75 - 84 °F
	Minimum/Maximum	45/70 °F	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			

developed and made a part of the design and installation of the practice. The treatments will 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 operation, and comply with National Pollutant Discharge Elimination System (NPDES) regulations.

Protection - A protective 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.

Additional Criteria for Linear Channel Raceways

Channel raceways are generally of two types:

a) concrete or concrete block construction or

b) earthen channels constructed with a trapezoidal or parabolic cross section.

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.

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. 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. The raceway outlet will 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. 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.

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

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.

Dikes and levees - The minimum top width of an earthen dike or levee shall be 6 ft. 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 ft.

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 and side slopes of 2:1 or flatter. Structural bulkheads used in earthen raceways must extend at least 24 in into the sides and bottom of the channel. Concrete bulkheads shall have a minimum top width of 6 in. and a minimum bottom width of 8 in. 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 minimum diameter of 6 in 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 upstream from the flashboards and shall extend at least 6 to 8 in 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.

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 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 ft. To increase aeration, a splashboard or series of boards 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.

Additional 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 referenced 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. 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 or 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 America 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 cooperators management objectives and maintaining the water resource have been identified.

Water Quantity

Consider the effect on:

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

Water Quality

Consider the effect on:

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

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.

General specifications applicable to all sites within a state or geographic area may be prepared and preprinted to assist in preparation of site-specific specifications. Specifications themselves are not a part of the practice standard.

OPERATION AND MAINTENANCE

An operation and maintenance 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.

REFERENCES

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APPROVAL

_____s/ Gary Valentine_____

State Wildlife Biologist

_____September 10, 2001_____

Date

STATEMENT OF NEED

This practice is needed in the

_____FOTG.

Natural Resource Manager

Date

CERTIFICATION

Reviewed and determined adequate without need of revision.

Zone Wildlife Biologist

Date

Zone Wildlife Biologist

Date

Zone Wildlife Biologist

Date

Zone Wildlife Biologist

Date

Zone Wildlife Biologist

Date