



Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

DAM

CODE 402

(no)

DEFINITION

An artificial barrier that can impound water for one or more beneficial purposes.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Reduce downstream flood damage
- Provide water storage for one or more beneficial uses such as irrigation or livestock supply, fire control, municipal or industrial uses, renewable energy systems, or recreational uses
- Create or improve habitat for fish and wildlife

CONDITIONS WHERE PRACTICE APPLIES

This practice applies only to sites meeting all of the following criteria:

- Topographic, geologic, hydrologic, and soil conditions at the proposed site are satisfactory for constructing a dam and reservoir
- Upstream conservation practices protect the watershed from erosion to the extent that the sediment yield will not significantly shorten the planned life of the reservoir
- Water is available in sufficient quantity and adequate quality to satisfy the intended purposes without impairing downstream or adjacent use or function

CRITERIA

General Criteria Applicable to All Purposes

All dams designed under this standard must comply with applicable Federal, Tribal, State, and local laws, rules, and regulations. Obtain all required permits before construction begins.

Classify dams as a low, significant, or high-hazard potential in accordance with NRCS National Engineering Manual (NEM) (Title 210), Part 520, Subpart C, "Dams"; NRCS Technical Release (TR) (Title 210) 60, "Earth Dams and Reservoirs"; and other references as appropriate for the site-specific conditions.

Title 210-TR-60 contains the minimum design criteria for all dams, with the exception of low-hazard potential earth dams and appurtenances meeting the size criteria in NRCS Conservation Practice Standard (CPS) Pond (Code 378).

Provide a principal and auxiliary spillway(s) with needed appurtenances, except where a single spillway can safely handle the rate and duration of flow for all intended purposes.

Size the outlet works to have adequate capacity to release the flow resulting from the combined demands at any time.

Provide additional outlets as required to satisfy the supply for downstream water uses such as livestock water, irrigation, or fish and wildlife needs.

Seed or sod the exposed surfaces of earthen embankments, earth spillways, borrow areas, and other areas disturbed during construction in accordance with the criteria in NRCS CPS Critical Area Planting (Code 342). When necessary to provide surface protection where climatic conditions preclude the use of seed or sod, use the criteria in NRCS CPS Mulching (Code 484) to install inorganic cover material such as gravel.

Safety

Design measures necessary to prevent serious injury or loss of life in accordance with requirements of 210-NEM, Part 503, "Safety."

Cultural resources

Evaluate the existence of cultural resources in the project area and any project impacts on such resources. Provide conservation and stabilization of archaeological, historical, structural, and traditional cultural properties when appropriate.

Additional Criteria to Reduce Downstream Flood Damage

Design flood control storage into the permanent storage volume if provisions are made to operate the reservoir for this purpose.

Size the flood-retarding storage capacity to contain the runoff expected to occur at a frequency consistent with the planned level of protection in the downstream benefited area, with proper allowance for discharge through the principal spillway. Ensure sufficient flood-retarding storage to limit the use of the auxiliary spillway to a permissible frequency and duration based upon consideration of the erosion resistance of the spillway material and the provided vegetative protection.

Additional Criteria for Permanent Water Storage Uses

Include adequate storage volume in the reservoir to meet user demands for all intended purposes of the reservoir. Consider seasonal variations in demand and the expected losses from seepage and evaporation to determine the permanent storage volume required for the intended uses.

Select the methods, materials, location, and capacity of spillways and outlet works to safely pass flood discharges and address all functional requirements necessary to facilitate the use of the stored water for the intended purposes.

For dams providing permanent storage for irrigation, use NRCS CPS Irrigation Reservoir (Code 436).

Develop site-specific design criteria that reflect the functional requirements of the reservoir, dam, and appurtenances for the intended recreational benefits.

Additional Criteria for Wildlife Habitat Creation or Improvement

Develop site-specific measures that reflect the functional requirements of the reservoir, dam, and appurtenances for wildlife benefits.

When feasible, retain existing habitat structure or features, such as trees in the upper reaches of the reservoir or stumps in the pool area. When appropriate, shape upper reaches of the reservoir to provide shallow areas and aquatic bed, emergent, or scrub-shrub wetland habitat.

When stocking fish, use criteria in NRCS CPS Fishpond Management (Code 399). For criteria related to wildlife habitat, use criteria in NRCS CPS Wetland Wildlife Habitat Management (Code 644).

CONSIDERATIONS

The plan should consider the potential for changes in the form and function of the watercourse and associated riparian corridor resulting from installation of the dam. Consider using the following recommendations, as appropriate, to mitigate unacceptable negative impacts to natural resources or other uses of the water or areas affected by the design or imposed by operational requirements of the dam.

Additional Considerations for Visual Resource Design

Consider the visual design of dams and the reservoir area in areas of high public visibility and those associated with recreation. The underlying criterion for all visual design is appropriateness. The shape and form of ponds, excavated material, and plantings are to relate visually to their surroundings and to their function.

Shape the embankment to blend with the natural topography. Shape the edge of the reservoir so it is generally curvilinear rather than rectangular. Shape excavated material so the final form is smooth, flowing, and fitting to the adjacent landscape rather than angular geometric mounds. If feasible, add both submerged and exposed (above normal water elevation) islands for visual interest and to attract wildlife.

Additional Considerations for Water Quantity

Consider the potential effects on downstream flows and impacts to the environment such as wetlands and aquifers, and social and economic impacts to downstream uses or users.

Consider the potential for depletion of downstream surface water resources resulting from runoff storage, evaporation from the reservoir surface, and seepage from the pool bottom or lake bed.

Consider the potential for increases in surface water volume during normal low flow periods caused by prolonged reservoir releases.

Consider the potential for increase in deep percolation to ground water resulting from seepage from the reservoir sides and bottom.

Additional Considerations for Water Quality

Consider the potential for improving downstream surface water quality resulting from trapping suspended sediments, bedload material, and associated nutrients and pesticides in the pool area.

Consider the potential for increased instability of channel bed and banks. Water discharged from the dam will have reduced sediment content and therefore will have increased sediment transport capacity in the reach downstream from the dam when compared to the pre-dam condition.

Consider the potential for degradation of surface water quality during construction by sediments, fuels, oils, chemicals, and other substances.

Consider the potential influence of the low water outlet elevation on the amount of absorbed nutrients and pesticides in deposited sediments and the potential for their discharge from the reservoir.

Consider the potential for changes in downstream water temperatures and dissolved oxygen content that could result from the design of the outlet structure. If possible, mitigate adverse changes in the design of the structure. Where outlet placement may reduce dissolved oxygen, plan a means of causing rapid dissolved oxygen recovery.

Consider the potential for increases in soluble nutrients, pesticides, and other contaminants in deep percolating waters caused by seepage through the reservoir sides and bottom. Natural or human-induced contaminants may originate from those used in the structure and reservoir area, or may be dissolved in waters from the watershed area.

Consider the potential effects on wetlands and water-related wildlife habitats.

Consider the potential effects of water levels on soil nutrient processes such as plant nitrogen use or denitrification.

Consider the potential effects of soil water level control on the salinity of soils, soil water, or downstream water.

Consider the potential to uncover or redistribute toxic materials, such as saline soils at the dam site and borrow areas, resulting from earth moving operations.

Additional Considerations for Fish and Wildlife Habitat

Where fish and wildlife habitat creation or enhancement is not a primary purpose of the structure, the plan should still consider maintaining habitat for fish and wildlife and the potential effects of installing the dam. For example—

- Project location and construction should minimize the impacts to existing fish and wildlife habitat.
- When feasible, retain structure such as trees in the upper reaches of the pond and stumps in the pool area. Shape upper reaches of the pond to provide shallow areas and wetland habitat.

Consider the potential for altering fish and wildlife habitat resulting from changes in the quality, quantity, timing, or duration of streamflows after installation of the dam.

Consider the potential for creating a competitive advantage for nonnative or undesirable animals or plants resulting from changes in the quality, quantity, timing, or duration of streamflows after installation of the dam.

PLANS AND SPECIFICATIONS

Prepare plans and specifications that describe the requirements for applying the practice according to this standard. As a minimum, include—

- A plan view of the layout of the dam.
- Typical profiles and cross sections of the dam.
- Details of the outlet system.
- Structural drawings adequate to describe the construction requirements.
- Requirements for vegetative establishment and mulching, as needed.
- Safety features.
- Site-specific construction and material requirements.

OPERATION AND MAINTENANCE

Prepare an operation and maintenance plan for the operator.

As a minimum, include the following items in the operation and maintenance plan:

- Periodic inspections of all structures, earthen embankments, spillways, and other significant appurtenances
- Prompt removal of trash from pipe inlets and trash racks
- Prompt repair or replacement of damaged components
- Prompt removal of sediment when it reaches predetermined storage elevations
- Periodic removal of trees, brush, and undesirable species
- Periodic inspection of safety components and immediate repair if necessary
- Maintenance of vegetative protection and immediate seeding of bare areas as needed

Emergency Action Plan

Owners and operators of high-hazard dams have a responsibility to develop emergency action plans (EAP) and to keep them current. These plans are developed to reduce the risk of loss of life and property if the dam fails. An electronic fillable form provided by NRCS may be used to develop an EAP. The template may be edited as necessary to adapt the format and content to meet State or local requirements and site-specific situations.

As a minimum the EAP should include—

- Actions the owner of the dam must take to moderate or alleviate problems at or with the dam;
- Procedures and information regarding issuance of early warning and notification of an emergency to responsible emergency management authorities; and
- Inundation maps displaying critical areas for action by responsible emergency management authorities in case of an emergency.

REFERENCES

USDA NRCS. 2019. Engineering Technical Release (Title 210), 60, Earth Dams and Reservoirs. Washington, D.C. <https://directives.sc.egov.usda.gov/>

USDA NRCS. 2008. National Engineering Handbook (Title 210), Section 3, Sedimentation. Washington, D.C. <https://directives.sc.egov.usda.gov/>

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