United States Department of Agriculture

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

# POND

Code 378

(No.)

## DEFINITION

A pond is a water impoundment made by constructing an embankment, by excavating a dugout, or by a combination of both.

In this standard, NRCS defines ponds constructed by the first method as embankment ponds, and those constructed by the second method as excavated ponds. Ponds constructed by both the excavation and the embankment methods are classified as embankment ponds if the depth of water impounded against the embankment at the auxiliary spillway elevation is 3 feet or more above the lowest original ground along the centerline of the embankment.

## PURPOSE

A pond stores water for livestock, fish and wildlife, recreation, fire control, erosion control, flow detention, and other uses such as improving water quality.

## CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all excavated ponds. It also applies to embankment ponds that meet all of the criteria for low-hazard dams as listed below:

- The failure of the dam will not result in loss of life, damage to homes, commercial or industrial buildings, main highways, or railroads, or in interruption of the use or service of public utilities.
- The product of the storage times the effective height of the dam is less than 3,000 acre-feet$^2$. Storage is the capacity of the reservoir in acre-feet below the elevation of the crest of the lowest auxiliary spillway or the elevation of the top of the dam if there is no open channel auxiliary spillway. The effective height of the dam is the difference in elevation, in feet, between the lowest open channel auxiliary spillway crest and the lowest point in the original cross section taken on the centerline of the dam. If there is no open channel auxiliary spillway, use the lowest point on the top of the dam instead of the lowest open channel auxiliary spillway crest.
- The effective height of the dam is 35 feet or less.

## CRITERIA

### General Criteria Applicable to All Purposes

Design a minimum sediment storage capacity equal to the design life of the structure, or provide for periodic cleanout. Protect the drainage area above the pond to prevent sedimentation from adversely affecting the design life.

Design measures necessary to prevent serious injury or loss of life in accordance with requirements of NRCS National Engineering Manual (NEM), Part 503, Safety.

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service State office or visit the Field Office Technical Guide.

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 Conservation Practice Standard (CPS) Code 342, Critical Area Planting. When necessary to provide surface protection where climatic conditions preclude the use of seed or sod, use the criteria in CPS Code 484, Mulching, to install inorganic cover material such as gravel.

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

**Site conditions**. Select or modify the site to allow runoff from the design storm to safety pass through (1) a natural or constructed auxiliary spillway, (2) a combination of a principal spillway and an auxiliary spillway, or (3) a principal spillway.

Select a site with a drainage area large enough that the 50 percent chance annual yield from surface runoff exceeds the reservoir permanent water storage needs for all purposes unless an alternate water source exists to serve this purpose. Water quality must be suitable for its intended use.

**Reservoir**. Provide adequate storage volume to meet user demands for all intended purposes. Account for sedimentation, season of use, evaporation loss, and seepage loss when computing the storage volume.

Conduct a detailed survey at the site to determine the extent of planned surface and subsurface water levels near property boundaries. Obtain a signed written agreement, easement, or permit prior to construction if the water levels associated with the pond adversely affect adjacent properties or other water users.

If unable to obtain permission to impound water on adjacent properties, set the full pool level a minimum of 12 inches below the lowest adjacent property boundary elevation to prevent saturation of the soils on adjacent property unless a detailed hydrologic evaluation shows there will be no negative impacts at higher water levels.

**Criteria Applicable to Embankment Ponds.**

**Geological investigations**. Use pits, trenches, borings, and reviews of existing data or other suitable means of investigation to characterize materials within the embankment foundation, auxiliary spillway, and borrow areas. Classify soil materials using the Unified Soil Classification System (ASTM D2487). Complete indicator tests for dispersive clays (Crumb Test) for all embankment dam sites prior to the final design preparation. Sites located west of the Missouri River may require further laboratory evaluations. Analyze indicator or lab test results prior to final design for use in evaluating the need for special design features to protect the integrity of the earth embankment.

**Stripping**. Strip foundations to a minimum depth of 0.5 foot or to the depth of significant root development whichever is greater. Scarify the stripped area.

**Foundation cutoff**. Design a cutoff of relatively impervious material under the dam and up the abutments as required for preventing seepage. Locate the cutoff at, or upstream from, the centerline of the dam. Extend the cutoff up the abutments to the permanent high water elevation at a minimum and extend a minimum of 1 foot into a relatively impervious layer. Minimum depth of cutoff is 2 feet from original ground surface. Combine seepage control with the cutoff as needed. Use a cutoff bottom width adequate to accommodate the equipment used for excavation, backfill, and compaction operations.

Design cutoff side slopes no steeper than 1 horizontal to 1 vertical. Meet Occupational Safety and Health Administration regulations for trenches over 4 feet deep.

**Seepage control**. Include seepage control if (1) foundation cutoff does not intercept pervious layers, (2) seepage could create undesired wet areas, (3) embankment stability requires seepage control, or (4) special problems require drainage for a stable dam. Control seepage by (1) foundation, abutment, or embankment filters and drains; (2) reservoir blanketing; or (3) a combination of these measures.

**Top width**. Table 1 provides the minimum top widths for dams of various total heights. Total height is the vertical distance between the settled top of the dam and the lowest elevation at the downstream toe.

Design a minimum width of 16 feet for one-way traffic and 26 feet for two-way traffic for the top of dams used as public roads. Design guardrails or other safety measures where necessary and follow the requirements of the responsible road authority. For dams less than 20 feet in total height, maintenance considerations or construction equipment limitations may require increased top widths from the minimum shown in table 1.

**Table 1.** Minimum top width for dams.

| Total height of dam *(feet)* | Top width *(feet)* |
|---|---|
| Less than 10 | 6 |
| 10–14.9 | 8 |
| 15–19.9 | 10 |
| 20–24.9 | 12 |
| 25–34.9 | 14 |
| 35 or more | 15 |

**Side slopes**. Design upstream side slopes of the settled embankment with a ratio of 3 horizontal to 1 vertical or flatter. Design downstream side slopes with a ratio of 2 horizontal to 1 vertical or flatter. As required, design benches or flatten side slopes to assure stability of all slopes for all loading conditions.

**Slope protection**. Design special measures such as berms, rock riprap, sand-gravel, soil cement, or special vegetation as needed to protect the slopes of the dam from erosion. Specifically, on class 3 and above designs, counter the effect of wave action if either:

- The permanent pool surface area exceeds 10 acres and the permanent pool is deeper than 5 feet adjacent to the embankment; or
- The permanent pool surface area exceeds 5 acres, the wave heights exceed 0.5 feet when using TR-210-56 procedures, and the permanent pool is deeper than 5 feet adjacent to the embankment.

**Freeboard**. Design a minimum of 1.0 feet of freeboard between design high-water-flow elevation in the auxiliary spillway and the top of the settled embankment. Design a minimum 2.0 feet of elevation difference between the crest of the auxiliary spillway and the top of the settled embankment when the dam has more than a 20-acre drainage area or more than 20 feet in effective height. Design a minimum of 1.5 feet of freeboard above the peak elevation of the routed design hydrograph to the top of the settled embankment, when the pond has no auxiliary spillway.

**Settlement.** Increase the height of the dam by the amount needed to ensure that the settled top elevation of the dam equals or exceeds the design top elevation. Design a minimum of 5 percent of the total height of the dam associated with each dam cross section.

**Borrow area**. Strip the borrow area to remove all vegetation and material undesirable for fill. Stripped material may later be used as cover over the dam, spillway, or borrow area as needed for vegetation establishment.

**Principal spillway need**. Design a pipe conduit with needed appurtenances through the dam, except where rock, concrete, or other types of lined spillways are used, or where a vegetated or earth spillway can safely handle the rate and duration of base flow. A pipe conduit is needed when any of the following conditions are present:

- Soils in the auxiliary spillway have high erodibility and/or will not support adequate vegetation;
- The volume of water storage, less sediment design storage, in the dam at the auxiliary spillway crest elevation is less than 50 percent of the 2-year frequency, 24-hour storm yield;
- The volume of water storage at the auxiliary spillway crest exceeds 100 acre-feet;
- The product of storage times effective height exceeds 2,000;
- Significant quantities of water from wells, springs, or seeps flow into the reservoir.

**Principal spillway and pipe conduit through the embankment.** Design a minimum of 0.5-feet difference between the crest elevation of the auxiliary spillway and the crest elevation of the principal spillway when the dam has a drainage area of 20 acres or less. Design a minimum of 1.0-foot difference when the dam has a drainage area of over 20 acres.

Provide an antivortex device for a pipe conduit designed for pressure flow. Design the inlet and outlet to function for the full range of flow and hydraulic head anticipated.

For dams requiring a principal spillway, contain the design storm between the crests of the principal spillway and auxiliary (emergency) spillway when flood routed. Table 2 shows the required design storm.

Table 2. Minimum principal spillway capacity.

| Product of Height times Storage at the Auxiliary Spillway Crest (Ac.Ft.xFt.)[1/] | Min. design storm | |
|---|---|---|
| | Frequency (Years) | Min. Duration (Hours) |
| Less than 2,000 | 2 | 24 |
| 2,000-2,499 | 5 | 24 |
| 2,500-2,999 | 10 | 24 |

[1/]As defined under “Conditions Where Practice Applies.”

Design adequate principal spillway capacity to empty this flood pool in 10 days unless provisions are made to begin the routing of the auxiliary spillway storm from this 10 day drawdown elevation.

Design adequate pipe conduit capacity to discharge long-duration, continuous, or frequent flows without causing the flow through the auxiliary spillway. Design a principal spillway pipe with a minimum inside diameter of 8 inches. When principal spillway discharge is considered in calculating peak auxiliary spillway flow, design the principal spillway pipe with a minimum inside diameter of 10 inches that flows full before discharge occurs from the auxiliary spillway. Use a minimum inside diameter of 1-1/4 inches for water supply pipes or for pipes used for any other purpose.

Minimum drop inlet riser diameter is 1.25 times the horizontal pipe diameter. Design the riser and barrel for drop inlet spillways to provide full pipe flow after weir flow is exceeded. Design risers deeper than 12 feet that are located in semi-compacted fill to withstand fill settlement (vertical compression) loading.

Design pipe conduits using ductile iron, welded steel, corrugated steel, corrugated aluminum, reinforced concrete (pre-cast or site-cast), or plastic. Do not use corrugated polyethylene pipe as principal spillways or pipe conduit applications under this practice standard. Do not use cast iron or unreinforced concrete pipe if the dam is 20 feet or greater in total height.

Design and install pipe conduits to withstand all external and internal loads without yielding, buckling, or cracking. Design rigid pipe for a positive projecting condition. Design flexible pipe for a maximum deflection of 5 percent. Assume the modulus of elasticity for polyvinyl chloride (PVC) as 1/3 of the amount designated by the compound cell classification to account for long-term reduction in modulus of elasticity. Design flexible pipe conduits in accordance with the requirements of NRCS National Engineering Handbook (NEH), Part 636, Chapter 52, Structural Design of Flexible Conduits.

Specify the minimum thickness of flexible pipe as SDR 26, Schedule 40, Class 100, or 16 gage as appropriate for the particular pipe material. Design connections of flexible pipe to rigid pipe or other structures to accommodate differential movements and stress concentrations. Design information concerning the acceptable height of earthfill over various pipe materials used in earthen embankments is shown in Table 3 and 4 below. Deviation from these tables require calculations made by an engineer.

Design and install all pipe conduits to be watertight using couplings, gaskets, caulking, water stops, or welding. Design joints to remain watertight under all internal and external loading including pipe elongation due to foundation settlement.

Design a concrete cradle or bedding for pipe conduits if needed to reduce or limit structural loading on pipe and improve support of the pipe.

**Principal spillway pipe outlet.** Where a SAF stilling basin, impact basin, flared outlet, or similar pipe outlet device is not used, place principal spillway pipe outlets above outlet channel water level, and at least 1 foot above base grade of the outlet channel. When pipe supports are used, extend the outlet end of the pipe at least 5 feet beyond the point where the downstream slope of the dam fill intersects the flow line of the outlet channel or waterway. When pipe supports are not used, extend the pipe at least 5 feet downstream of the intersection of the fill and bottom of the pipe.

Support and hold the pipe outlet firmly in position by pipe supports, earth or rock fill, or other means. Provide pipe supports for cantilever outlets with 24-inch or larger pipe diameter. Where pipe supports are used, extend the supports below expected frost depth to minimize frost heave.

For pipe outlets 18 inches diameter or larger, do not exceed 5 percent for the cantilever outlet pipe slope except as designed by an engineer.

Table 3. Minimum thickness – corrugated metal pipe.

| Fill Height Above Pipe (feet) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Pipe Diameter (inches) | <15 | 15-20 | 20-25 | <15 | 15-20 | 20-25 | <15 | 15-20 | 20-25 |
| | Galv. Steel with 2 2/3 in. X ½ in. Corrugations (gage) | | | Galv. Steel with 3 in. X 1 in. Corrugations (gage) | | | Aluminum* with 2 2/3 in. X ½ in. Corrugations (wall thickness) (Inches) | | |
| 21 & less | 16 | 16 | 16 | -- | -- | -- | .06 | .06 | .06 |
| 24 | 16 | 16 | 16 | -- | -- | -- | .06 | .075 | .105 |
| 30 | 16 | 16 | 14 | -- | -- | -- | .075 | .105 | .135 |
| 36 | 14 | 14 | 12 | 16 | 16 | 16 | .075 | .105 | ** |
| 42 | 12 | 12 | 10 | 16 | 16 | 16 | ** | ** | -- |
| 48 | 10 | 10 | 10 | 16 | 16 | 14 | -- | -- | -- |
| 54 | -- | -- | -- | 16 | 16 | 12 | -- | -- | -- |
| 60 | -- | -- | -- | 16 | 14 | 10 | -- | -- | -- |
| 66 | -- | -- | -- | 16 | 14 | 8 | -- | -- | -- |
| 72 | -- | -- | -- | 16 | 14 | 8 | -- | -- | -- |

* Riveted or helical fabrication
** Not Permitted

Design cantilever outlets to withstand full pipe cantilever load plus applicable external loads such as ice or snow.

**Corrosion protection**. Provide protective coatings for all steel pipe and couplings in areas that have traditionally experienced pipe corrosion or in embankments with saturated soil resistivity less than 4,000 Ohm-cm or soil pH less than 5. Protective coatings may include asphalt, polymer over galvanizing, aluminized coating, or coal tar enamel.

**Ultraviolet protection**. Use ultraviolet-resistant materials for all plastic pipe or provide coating or shielding to protect plastic pipe exposed to direct sunlight.

**Cathodic protection**. Provide cathodic protection for coated welded steel and galvanized corrugated metal pipe where soil and resistivity studies indicate that the pipe needs a protective coating and where the need and importance of the structure warrant additional protection and longevity. Consider cathodic protection for corrugated steel pipe where the saturated soil resistivity is less than 2,500 ohms-cm, and cathodic protection is required if the saturated soil resistivity is less than 1,500 ohms-cm. If the original design and installation did not include cathodic protection, consider establishing electrical continuity in the form of joint-bridging straps on pipes that have protective coatings. Add cathodic protection later if monitoring indicates the need.

Table 4. Acceptable plastic pipe for use in earth embankments

| Pipe Material | Testing Method Designation | SDR / Pressure Rating and/or Schedule | Applicable Pipe Diameters (inches) | Maximum Fill Height Above Pipe (feet) |
|---|---|---|---|---|
| PVC 1120/1220 Plastic Irrigation Pipe (PIP) | ASTM D2241 | SDR 26 - 160 psi | 8, 10, 12, 14, 15, 18, 21, 24, 27 | 10 |
| | | SDR 21 - 200 psi | (15) | 18 |
| PVC and ABS 1120/1220/2120 Iron Pipe Size (SDR-PR) (IPS) | ASTM D2241 | SDR 26 - 160 psi | 8, 10, 12, 14, 16, 18, 20, 24, 30, 36 | 10 |
| | | SDR 21 - 200 psi | 8, 10, (12, 14, 16, 18, 20, 24, 30, 36) | 18 |
| | | SDR 17 - 250 psi | (8, 10, 12, 14, 16, 18, 20, 24, 30, 36) | 30 |
| PVC Schedule 40 & 80 | ASTM D1785 | Schedule 40 - SDR varies with diameter | 8, 10, 12, (14, 16, 18) | 8 |
| | | | (20 & 24) | 6 * |
| | | Schedule 80 - SDR varies with diameter | 8 | 28 |
| | | | 10 | 26 |
| | | | 12 & (14) | 24 |
| | | | (16 & 18) | 22 |
| | | | (20 & 24) | 20 |
| PVC Plastic Pipe, Iron Pipe Size (IPS) O.D. dia. Controlled | AWWA C905 | SDR 26 - 160 psi | 14, 16, 18, 20, 24, 30, 36 | 10 |
| | | SDR 21 - 200 psi | 14, 16, 18, 20, 24, 30, 36 | 18 |
| PVC Plastic Pipe, Iron Pipe Size (IPS) | AWWA C900 | SDR 25 - 100 psi | 8, 10, & 12 | 4 |
| | | SDR 18 - 150 psi | 8, 10, & 12 | 10 |
| | | SDR 14 - 200 psi | 8, 10, & 12 | 16 |
| Type PSM - PVC Pipe (Sewer Pipe) | ASTM D3034 | SDR 26 | 8, 10, 12, 15 | 10 * |
| PE Schedule 40 Plastic Pipe | ASTM D2447 | Schedule 40 - SDR varies with diameter | (8) | 5 * |
| | | | (10) | 4 * |
| Polyethylene Plastic Pipe (SDR-PR) O.D. dia. Controlled (IPS) | ASTM D3408, D3306, D3406, D2306, D2406, D2305, & D1404 | SDR 26 - Pressure Rating varies with Material | 8, 10, 12, 14, 16, 18, 20, 22, & 24 | 4 * |
| | | SDR 21 - Pressure Rating varies with Material | 8, 10, 12, 14, 16, 18, 20, 22, & 24 | 8 |
| | | SDR 17 - Pressure Rating varies with Material | 8, 10, 12, 14, 16, 18, 20, 22, & 24 | 10 |
| | | SDR 15.5 - Pressure Rating varies with Material | 8, 10, 12, 14, 16, 18, 20, 22, & 24 | 14 |

*Not recommended in areas with highly plastic CL or CH Soils

Note: Pipe with diameters listed within closed parentheses may have very limited availability or will only be available with large quantity Special Orders.

**Filter diaphragms**. When the effective height of the dam is 15 feet or greater and the effective storage of the dam is 50 acre-ft. or more, provide filter diaphragms to control seepage on all pipes extending through the embankment with inverts below the peak elevation of the routed design hydrograph. Use a filter diaphragm if any of the Crumb tests have an indicator of 2 or greater. Design filter diaphragms or alternative measures as needed to control seepage on pipes extending through all other embankments or for pipes with inverts above the peak elevation of the routed design hydrograph.

Locate the filter diaphragm immediately downstream of the cutoff trench, but downstream of the centerline of the dam if the foundation cutoff is upstream of the centerline or if there is no cutoff trench.

Design the vertical drain a minimum of 2 feet thick and extend from the pipe or structure vertically upward at least 3 times the outside vertical dimension of the pipe or structure except the drain is not required to extend above the permanent pool level. Extend the drainage diaphragm vertically to a point that is 2 feet or greater from the embankment surface. Extend the drain horizontally at least 3 times the vertical dimension of the pipe or structure except the drain is not required to extend more than five feet beyond excavation side slopes. Extend the drain from the bottom of the pipe or structure vertically downward at least 1.5 feet or 1 foot beyond the bottom of the trench excavation made to install the pipe or structure, except the drain is not required to penetrate solid rock.

To improve filter diaphragm performance, provide a drain outlet for the filter diaphragm at the downstream toe of the embankment. Protect the outlet from surface erosion and animal intrusion.

Ensure filter diaphragm functions both as a filter for adjacent base soils and as a drain for seepage that it intercepts. Use sand meeting ASTM C-33, for fine concrete aggregate, for the materials for the filter diaphragm, or meet the requirements of NEH Part 628, Chapter 45, Filter Diaphragms, Section 628.4503(d), Filter and Drain Gradation.

When using anti-seep collars in lieu of a filter diaphragm, ensure a watertight connection to the pipe. Limit the maximum spacing of the anti-seep collars to 14 times the minimum projection of the collar measured perpendicular to the pipe, or 25 feet, whichever is less. Locate anti-seep collars no closer than 10 feet apart. Use a collar material that is compatible with the pipe material. Design the anti-seep collars to increase the seepage path along the pipe within the fill by at least 15 percent.

**Trash guard**. Install a trash guard at the riser or pipe inlet to prevent clogging of the conduit.

**Pool Drain**. Provide a pipe with a suitable valve to drain the pool area if needed for proper pond management or if required by State law. The designer may use the principal spillway conduit as a pond drain if it is located where it can perform this function.

**Auxiliary spillways**. A dam must have an open channel auxiliary spillway, unless the principal spillway is large enough to pass the peak discharge from the routed design hydrograph and the trash that comes to it without overtopping the dam. The minimum criteria for acceptable use of a closed conduit principal spillway without an auxiliary spillway consist of a conduit with a cross-sectional area of 3 feet$^2$ or more, an inlet that will not clog, and an elbow designed to facilitate the passage of trash.

Design the minimum capacity of a natural or constructed auxiliary spillway to pass the peak flow expected from a total design storm of the frequency and duration shown in table 5, less any reduction creditable to the conduit discharge and detention storage.

Design the auxiliary spillway to safely pass the peak flow through the auxiliary spillway, or route the storm runoff through the reservoir. Start the routing either with the water surface at the elevation of the crest of the principal spillway or at the water surface after 10 days' drawdown, whichever is higher. Compute the 10-day drawdown from the crest of the auxiliary spillway or from the elevation attained from impounding the entire design storm, whichever is lower. Design the auxiliary spillway to pass the design flow at a safe velocity to a point downstream where the flow will not endanger the dam.

A constructed auxiliary spillway consists of an inlet channel, a control section, and an exit channel. Design the auxiliary spillway with a trapezoidal cross section. Locate the auxiliary spillway in undisturbed or compacted earth or in-situ rock. Design for stable side slopes for the material in which the spillway is to be constructed. Design a minimum bottom width of 20 feet for dams having an effective height of 20 feet or more.

Design a level inlet channel upstream from the control section for the distance needed to protect and maintain the crest elevation of the spillway (at least 30 feet in earth materials). If necessary, curve the inlet channel upstream of the level section to fit existing topography. Design the exit channel grade in accordance with NEH Part 628, Chapter 50, Earth Spillway Design, or with equivalent procedures.

Design the grade of the constructed exit channel within the range established by discharge requirements and permissible velocities for the operating conditions. Use the allowable velocities in the exit channel and classification of retardance found in Exhibit 11-2, Chapter 11 of the NEH, Part 650, Engineering Field Handbook (EFH) except where a soils investigation has been conducted to establish parameters for a detailed stability and integrity design. In this case, methods outlined in Agricultural Handbook Number 667 and employed by the SITES computer program may be used.

For auxiliary spillways without a constructed exit channel downstream of the control section, design the spillway to have less than 5 feet per second velocity of water through the inlet section and upstream of the crest.

For all auxiliary spillways, evaluate the natural exit channel for long-term stability and maintenance requirements.

**Structural auxiliary spillways**. When used for principal spillways or auxiliary spillways, design chute spillways or drop spillways according to the principles set forth in NEH, Part 650, Engineering Field Handbook; and NEH, Section 5, Hydraulics; Section 11, Drop Spillways; and Section 14, Chute Spillways. Design a structural spillway with the minimum capacity required to pass the peak flow expected from a total design storm of the frequency and duration shown in table 5, less any reduction creditable to the conduit discharge and detention storage.

**Table 5.** Minimum auxiliary spillway capacity

| Drainage area *(acre)* | Effective height of dam[1] *(feet)* | Detention storage *(acre-feet)* | Minimum design storm[2] | |
|---|---|---|---|---|
| | | | Frequency *(years)* | Minimum duration *(hours)* |
| 20 or less | 20 or less | < than 50 | 10 | 24 |
| 20 or less | > than 20 | < than 50 | 25 | 24 |
| > than 20 | - | < than 50 | 25 | 24 |
| All others | - | - | 50 | 24 |

[1]. Defined under "Conditions where Practice Applies."
[2]. Select rain distribution based on climatological region.

**Criteria for Excavated Ponds**

**Side slopes.** Design stable side slopes in the excavated area no steeper than 1.5 horizontal to 1 vertical.

**Watering Ramp**. When wildlife or livestock need access to stored water, use the criteria in NRCS CPS Code 614, Watering Facility, to design a watering ramp.

**Inlet protection**. Protect the side slopes from erosion where surface water enters the pond in a natural or excavated channel.

**Excavated material**. Place the material excavated from the pond so that its weight does not endanger the stability of the pond side slopes and so that the soil will not wash back into the pond by rainfall. Dispose of excavated material in one of the following ways:

- Uniformly spread to a height that does not exceed 3 feet, with the top graded to a continuous slope away from the pond.
- Uniformly place or shape reasonably well, with side slopes assuming a natural angle of repose. Place excavated material at a distance equal to the depth of the pond, but not less than 12 feet from the edge of the pond.
- Shape to a designed form that blends visually with the landscape.
- Provide for low embankment construction and leveling of surrounding landscape. If some or all of the excavated material is placed across the draw, meet the auxiliary spillway capacity as shown in Table 5. If the depth of water impounded against the embankment at the spillway elevation exceeds 3 feet, use the design criteria for embankment ponds to place the spoil.
- Haul material offsite.

## ADDITIONAL CRITERIA FOR LIVESTOCK WATER

For embankment ponds, the minimum storage for livestock shall be:

- 10 feet deep for ponds east of the Missouri River
- 12 feet deep for ponds west of the Missouri River

For excavated ponds, the minimum storage for livestock shall be:

- 10 feet deep for ponds east of the Missouri River that are not influenced by normal seasonal groundwater.
- 12 feet deep for ponds west of the Missouri River that are not influenced by normal seasonal groundwater.
- 6 feet deep for ponds that are influenced by normal seasonal groundwater.

## ADDITIONAL CRITERIA FOR FISH PONDS

Exclude drainage areas with concentrated organic wastes or other pollution.

Exclude livestock from shoreline areas except for limited lanes for livestock water. Provide a buffer of perennial vegetation at least 50 feet wide between the pond and cropland or barren areas.

Trout pond. For constant cold (45° to 60°F) inflow, minimum depth is 15 feet over 20 percent of the pond area, and minimum pond surface area is 0.5 acres. For intermittent inflow, minimum depth is 20 feet over 20 percent of the pond area, and minimum pond surface area is 1 acre.

Warm water pond. Minimum pond size is 1 surface acre. For constant inflow, minimum depth is 12 feet over 20 percent of the pond area. For intermittent inflow, minimum depth is 15 feet over 20 percent of the pond area.

## ADDITIONAL CRITERIA FOR RECREATION AND FIRE CONTROL

For recreation, consider excluding livestock from the pond shoreline. For water contact recreation, exclude livestock. For recreation ponds, provide 50 feet or wider perennial grass buffers between the pond and cropland or barren areas.

For fire control, deep water (over 15 feet) located near the withdrawal location is most desirable.

## ADDITIONAL CRITERIA FOR WILDLIFE WATER

Assure the depth, duration of water presence, and shoreline slopes are adequate for the identified species habitat needs and the identified season of use. Design a minimum sediment storage capacity equal to the design life of the structure. Apply sediment storage to the lowest portion of the pond's volume. Design to meet the criteria of Biology Technical Note 18, Wetland Topographic Design and Sediment Removal, Table 2.

Plan wildlife ponds to address inadequate habitat for the resource concern, and not to provide wildlife drinking water.

Exclude livestock from wildlife areas except for limited lanes for livestock water. Protect wildlife areas from vehicle travel and other intrusions.

## CONSIDERATIONS

**Visual resource design**. Carefully consider the visual design of ponds in areas of high public visibility and those associated with recreation. 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 pond so that it is generally curvilinear rather than rectangular. Shape excavated material so that the final form is smooth, flowing, and fitting to the adjacent landscape rather than angular geometric mounds. If feasible, add islands to provide visual interest and to attract wildlife.

**Fish and wildlife**. Locate and construct ponds to minimize the impacts to existing fish and wildlife habitat.

When feasible, retain structures 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.

**Vegetation.** Stockpile topsoil for placement on disturbed areas to facilitate revegetation.

Consider selecting and placing vegetation to improve fish habitat, wildlife habitat and species diversity.

**Water quantity**. Consider effects upon components of the water budget, especially—

- Effects on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and groundwater recharge.
- Variability of effects caused by seasonal or climatic changes.
- Effects on downstream flows and impacts to environment such as wetlands, aquifers, and social and economic impacts to downstream uses or users.
- Consider limiting livestock travel between forage and dependable water to 1 mile in gentle relief and ½ mile in rough topographic relief.

**Water quality**. Consider the effects of—

- Erosion and the movement of sediment, pathogens, and soluble and sediment-attached substances that runoff carries.
- Short-term and construction-related effects of this practice on the quality of downstream watercourses.
- Water-level control on the temperatures of downstream water to prevent undesired effects on aquatic and wildlife communities.
- Wetlands and water-related wildlife habitats.
- Water levels on soil nutrient processes such as plant nitrogen use or denitrification.
- Soil water level control on the salinity of soils, soil water, or downstream water.
- Potential for earth moving to uncover or redistribute toxic materials.
- Livestock grazing adjacent to the pond. Consider fencing to keep livestock activities out of direct contact with the pond and dam.

## PLANS AND SPECIFICATIONS

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

- A plan view of the layout of the pond and appurtenant features
- Typical profiles and cross sections of the principal spillway, auxiliary spillway, dam, and appurtenant features as needed
- Structural drawings adequate to describe the construction requirements
- Requirements for vegetative establishment and/or 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 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

## REFERENCES

American Society for Testing and Materials. Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System), ASTM D2487. West Conshohocken, PA.

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