NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

POND

(No.)

CODE 378

DEFINITION

A water impoundment made by constructing an embankment or by excavating a pit or dugout.

In this standard, ponds constructed by the first method are referred to as embankment ponds, and those constructed by the second method are referred to 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.

PURPOSE

This practice may be applied as part of a conservation management system to support one or more of the following purposes and to provide:

- water for livestock ***consumption***
- water for fish and wildlife
- water for recreation
- water for fire control
- ***water for crop or orchard spraying***
- ***temporary storage of agricultural waste***
- maintenance or improvement of water quality
- water for other related uses.

CONDITIONS WHERE PRACTICE APPLIES

This standard establishes the minimum acceptable quality for the design and construction of low-hazard ponds where:

1. 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.
2. The product of the storage times the effective height of the dam is less than 3,000. Storage is the volume, in acre-feet, in the reservoir below the elevation of the crest of the auxiliary spillway. The effective height of the dam is the difference in elevation, in feet, between the auxiliary spillway crest and the lowest point in the cross section taken along the centerline of the dam. If there is no auxiliary spillway, the top of the dam is the upper limit.
3. The effective height of the dam is ***20*** feet or less ***for this pond standard***.

All pond or dam embankment heights greater than 20 feet and less than 35 feet shall be approved by the State Conservation Engineer.

GENERAL CRIITERIA TO ALL PONDS

Laws, regulations and permits. All federal, state and local requirements shall be addressed in the design ***and operation and maintenance***. ***Design, construction, operation and maintenance activities shall comply with all current federal, state, and local laws, rules, and regulations governing activities in or along streams, construction***

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service.

Note: Bold italics indicate information added or changes made in the National Conservation Practice Standard by WV.

of artificial barriers, pollution abatement, health, and safety.

The owner or operator shall be responsible for securing all required permits, certificates of approval and for performing all planned work in accordance with such laws and regulations. NRCS employees are not to assume responsibility for procuring these permits, rights, or approvals, or for enforcing laws and regulations. NRCS may provide the landowner or operator with technical information needed to obtain the required rights or approvals to construct, operate, and maintain the practice.

Permits may be required from the following agencies, but this is not intended to be an all inclusive list:

1. ***U.S. Army Corps of Engineers***
2. ***West Virginia Department of Environmental Protection***
    - ***NPDES permit***
    - ***Division of Water & Waste Management Dam Safety Certificate of Approval***
3. ***West Virginia Department of Natural Resources -Public Lands Corporation (Stream Activity Application)***
4. ***Local City and County permits***

A WVDEP- Dam Safety Certificate of Approval is required for <u>non-agricultural</u> purpose ponds with an embankment height (measured from the natural bed of the downstream toe of the embankment to the dam crest) of

- ***6 feet or more in height and capable of impounding 50 acre-feet or more of water.***
- ***25 feet or more in height and capable of impounding 15 acre-feet or more of water.***
- ***refer to the specific permit or rule for additional criterion.***

Agricultural farm ponds constructed and used primarily for agricultural purposes including, but not limited to, livestock watering systems, irrigation, retention of agricultural waste, or fish culture, and having no potential for loss of human life (WV DEP Hazard Class 3 or Class 4) are generally exempt from the WVDEP- Dam Safety Section Certificate of Approval.

Permanent cover. A protective cover of vegetation shall be established on all exposed areas of embankments, spillways and borrow areas as climatic conditions allow, according to the guidelines in ***West Virginia*** conservation practice standard (WV CPS) Critical Area Planting (342).

Site conditions. Site conditions shall be such that runoff from the design storm can be safely passed through (1) a natural or constructed auxiliary spillway, (2) a combination of a principal spillway and an auxiliary spillway, or (3) a principal spillway.

Drainage area. The drainage area of the pond must be protected against erosion to the extent that expected sedimentation will not shorten the planned effective life of the structure. The drainage area shall be large enough so that surface runoff and groundwater will provide an adequate supply of water for the intended purpose unless an alternate water source exists to serve this purpose.

Ponds depending on surface runoff for a stable water supply shall, as a minimum, have the following drainage area as outlined in Table 1 – West Virginia Surface Runoff; Drainage Area: Pond Volume Ratio.

The ***quantity and*** quality shall be suitable for the water's intended use.

Table 1 –West Virginia Surface Runoff; Drainage Area: Pond Volume Ratio	
Hydrologic Soil Group Classification of Drainage Area	***Ratio of Minimum Drainage Area (Acres) to Acre-Foot of Storage***
Soil Group A or B	***4H:1V***
Soil Group C or D	***3H:1V***
These minimum drainage areas may be decreased only when there is some other dependable source contributing water to	

the pond.

Reservoir area. The topography and geology of the site shall permit storage of water at a depth and volume that will ensure a dependable supply, considering beneficial use, sedimentation, season of use, and evaporation and seepage losses. If surface runoff is the primary source of water for a pond, the soils shall be impervious enough to prevent excessive seepage losses or shall be of a type that sealing is practicable.

Safety. Safety measures, such as warning signs, rescue facilities, flatter slopes, fencing, etc., shall be a considered and incorporated, as necessary, with the design.

DESIGN CRITERIA FOR *EARTH* EMBANKMENT PONDS

An earth embankment is an artificial barrier, constructed of soil to a predetermined size and shape, together with any associated spillways and appurtenant works that does or may impound or divert water.

The purpose, class of structure, effective embankment height (EEH), storage volume, and hazard potential determines the "Type" of earth embankment (I, II, III or IV). Each type of earth embankment has specific design criteria. Reference Table 2 – WV Type of Earth Embankment and Design Criteria for Pond/Dams located in the Appendix A at the end of this standard, to categorize the type of earth embankment,

Design of embankments constructed of materials other than earth shall be based on the criteria in this standard and in 210-VI TR60 or TR 60 A as appropriate.

Geological Investigations

Pits, trenches, borings, review of existing data or other suitable means of investigation shall be conducted to characterize materials within the embankment foundation, auxiliary spillway and borrow areas. Soil materials shall be classified using the Unified Soil Classification System.

Type I Earth Embankment. Refer to 210-VI-TR 60 or TR 60a for minimum design criteria. Consideration will be given to recommendations contained in soil mechanics laboratory reports. The site conditions will be investigated and a report prepared by a geologist in accordance with NEH.531 Engineering Geology.

Type II Earth Embankment. Geologic investigations shall consist of foundation, reservoir, and borrow areas and shall be conducted by an experienced geologist and/or engineer.

Site investigations shall be documented by logs of all test pits and holes, and an interpretive report shall be prepared.

Embankment foundation investigations shall be to the depth of an unyielding material or to a depth equal to one-half the embankment height, whichever is less. The foundation shall consist of material having sufficient strength to support the embankment without excessive settlement.

The foundation must consist of or be underlain by a relatively impervious material which will prevent excessive seepage losses. When a satisfactory foundation material cannot be found within the prescribed depth limitations, the investigation depth shall be increased. If satisfactory material cannot be found within a depth equal to the height of the embankment, the site shall be considered undesirable for construction of an earth embankment unless corrective measures are utilized in design and construction.

Borrow areas shall be investigated to determine that construction materials available are adequate in quantity and quality for the intended purpose. Soil materials shall be tested in a soil mechanics laboratory to determine as a minimum: grain-size distribution, plasticity index, 5-point standard proctor moisture-density curve, cohesion, angle of internal friction, and permeability.

Type III Earth Embankment. Geologic investigations shall be equal to those for

Type II Earth Embankment except soil materials testing for design purposes will not usually be required. A written log will be prepared by the individual conducting the investigation. The log will contain the approximate location of each hole or pit and will define each soil stratum.

Type IV Earth Embankment. Geologic investigation requirements shall be equal to those for Types III Earth Embankment, except that the bulk of the soils information can be extracted from a soil survey map and verified in the field.

Foundation Cutoff

A cutoff of relatively impervious material shall be provided under the dam if necessary to reduce seepage through the foundation. The cutoff shall be located at or upstream from the centerline of the dam. It shall extend up the abutments as required and be deep enough to extend into a relatively impervious layer or provide for a stable dam when combined with seepage control. The cutoff trench shall have a bottom width adequate to accommodate the equipment used for excavation, backfill, and compaction operations.

Side slopes shall not be steeper than one horizontal ***(H)*** to one vertical ***(V).***

Type II Earth Embankment Foundation Cutoff. The earth foundation cutoff shall be constructed of the most impervious material available if the compacted seepage rates are acceptable and shall extend no less than 2 feet into a foundation layer of impervious material. The minimum cutoff depth shall be four (4) feet unless bedrock is encountered at a shallower depth. The minimum cutoff depth shall extend along the centerline of the embankment and up the abutments to an elevation equal to or higher than the permanent pool elevation. The cutoff bottom width shall be a minimum of 10 feet and the side slopes shall be no steeper than 1H:1V.

Type III and Type IV Earth Embankment Foundation Cutoff. The requirements shall be the same as "Type II Earth Embankment Foundation Cutoff", except that the minimum cutoff depth shall be two (2) feet unless bedrock is encountered at a shallower depth and the minimum bottom width shall be six (6) feet.

Foundation preparation. Type II, III, and IV earth embankment foundation preparation shall consist of stripping the area of the foundation to a depth of 6 inches to remove all topsoil, brush, woody material, and other loose or perishable material. Slopes or banks shall be sloped to be 1H:1V or flatter. After stripping, the foundation will be scarified to a minimum depth of three inches. Springs, seeps, and pervious foundation materials will be drained.

Seepage control. Seepage control is to be included if (1) pervious layers are not intercepted by the cutoff, (2) seepage could create swamping downstream, (3) such control is needed to insure a stable embankment, or (4) special problems require drainage for a stable dam.

Seepage may be controlled by (1) foundation, abutment, or embankment filters and drains; (2) reservoir blanketing; or (3) a combination of these measures.

Embankment. ***The total embankment height establishes the minimum top width for the pond embankment.*** The minimum top width for a ***pond***/dam is shown in ***Table 3.***

Table *3* - *WV* Minimum Top Width for *Pond*/Dams

Total height of embankment [a]/	Top width
Feet	*feet*
Less than 10	6
10 ***– < 15***	8
15 ***– < 20***	10
20 ***– < 25***	12
25 ***– < 35***	14
35 **or more**	15

[a]/ ***The total embankment height is the difference in elevation between the original channel bottom at the centerline of the embankment and the top of the settled embankment.***

If the embankment top is to be used as a public road, the minimum width shall be 16 feet for one-way traffic and 26 feet for two-way traffic. ***If the embankment is to be used as a farm road crossing, the minimum top width shall be 12 feet.***

Guardrails or other safety measures shall be used where necessary and shall meet the requirements of the responsible road authority.

For dams less than 20 feet in height, maintenance considerations or construction equipment limitations may require increased top widths from the minimum shown in Table ***3.***

Side slopes. The combined upstream and downstream side slopes of the settled embankments shall not be less than five (5) horizontal to one (1) vertical, and neither slope shall be steeper than two (2) horizontal to one vertical. All slopes must be designed to be stable, even if flatter side slopes are required. Downstream or upstream berms can be used to help achieve stable embankment sections.

Slope protection. If needed to protect the slopes of the dam from erosion, special measures, such as berms, rock riprap, sand-gravel, soil cement, or special vegetation, shall be provided (***210-VI-***Technical Release 56, "A guide for Design and Layout of Vegetative Wave Protection for Earth Dam Embankments" and ***TR*** 69, "Riprap for Slope Protection Against Wave Action" contain design guidance. included in the design ***Pond slope protection shall be designed according to criteria contained in WV CPS 580, Streambank and Shoreline Protection.***

Freeboard. The minimum elevation of the top of the settled embankment shall be 1 foot above the water surface in the reservoir with the auxiliary spillway flowing at design depth. The minimum difference in elevation between the crest of the auxiliary spillway and the settled top of the dam shall be 2 feet for all dams having more than a 20-acre drainage area or more than 20 feet in effective height.

Settlement. The design height of the dam shall be increased by the amount needed to insure that after settlement the height of the dam equals or exceeds the design height. This increase shall not be less than 5 percent of the height of the dam, except where detailed soil testing and laboratory analyses or experience in the area show that a lesser amount is adequate.

Principal Spillway. A pipe conduit, with needed appurtenances, shall be placed under or through the dam, except where rock, concrete, or other types of lined spillways are used, or where the rate and duration of flow can be safely handled by a vegetated or earth spillway.

For ponds with effective heights of 15 feet or less, pipe conduit spillways may be located on fill through the embankment in a configuration that allows the shortest conduit length. All piped principal spillway conduit shall extend to a stable grade and outlet at the deepest part of the cross-section on the centerline of the dam or into the existing drainage way below the dam. Erosion protection measures shall be installed, as needed, at the discharge and to some point downstream.

Principal spillways other than pipe conduits must be approved by the State Conservation Engineer.

The approving employee may waive the requirement for a pipe spillway when all of the following conditions are met

- ***earth embankment effective height is 15 feet or less,***
- ***no spring flow into the reservoir at any time,***
- ***The pond is located in the land resource area shown below with a drainage area less than or equal as shown.***

WV FOTG, Section 1- Maps "Land Resource Regions and Major Land Resource Areas"	
Resource Area	***Drainage Area***
125,126,127	***≤ 6 acres***
128,147	***≤ 15 acres***

For dams with a drainage area of 20 acres or less, the principal spillway crest elevation shall not be less than 0.5 feet below the auxiliary

spillway crest elevation. For dams with a drainage area over 20 acres, this difference shall not be less than 1.0 feet.

When design discharge of the principal spillway is considered in calculating peak outflow through the auxiliary spillway, the crest elevation of the inlet shall be such that the design discharge will be generated in the conduit before there is discharge through the auxiliary spillway.

Pipe conduits designed for pressure flow must have adequate anti-vortex devices. The inlets and outlets shall be designed to function satisfactorily for the full range of flow and hydraulic head anticipated.

When the principal spillway flow is considered as part of the design of the auxiliary spillway and for all ponds with drainage areas greater than 50 acres, the principal spillway inlet shall be

- ***a drop inlet or a hood inlet with a baffle plate or canopy inlet and be equipped with an anti-vortex device and trash guard.***
- ***designed using the procedures contained in the EFH, Chapter 3, WV Supplement for Hydraulic Criteria for Canopy, Hood, and Drop Inlet Spillways to establish water surface stages.***
- ***constructed of materials compatible with the principal spillway conduit.***

The type of inlet selected will be based on site conditions, spillway location, hydraulic design, and conduit materials.

The capacity of the pipe conduit shall be adequate to discharge long-duration, continuous, or frequent flows without flow through the auxiliary spillways. The diameter of the principal spillway pipe shall not be less than 4 inches. ***Refer to Table 4- Principal Spillway Pipe Conduit Criteria (see Appendix A Table 4) for criteria.***

Pipe conduits used solely as a ***water*** supply pipe through the dam for watering troughs and other appurtenances shall not be less than 1-1/4 inches in diameter.

If the pipe conduit diameter is 10 inches or greater ***and has an inlet equipped with an anti-vortex device and trash rack***, the design discharge may be considered when calculating the peak outflow rate through the auxiliary spillway.

Pipe conduits shall be steel, ductile iron, corrugated steel, corrugated aluminum, reinforced concrete (pre-cast or site-cast), or plastic. Pipe conduits through dams of less than 20 feet total height may also be un-reinforced concrete. ***Pipe conduit principal spillway flow requiring a design based on a storm frequency will be routed in accordance with the procedures contained in the 210-VI-11, 210-Vi-NEH 650.11, for ponds with drainage areas less than 500 acres and in 210-VI-TR 20,728 for ponds with drainage areas exceeding 500 acres. The pipe size shall be no smaller than the minimum diameter shown in Table 4 – Principal Spillway Pipe Conduit Criteria.***

Pipe conduits shall be designed and installed to withstand all external and internal loads without yielding, buckling, or cracking. Rigid pipe shall be designed for a positive projecting condition. Flexible pipe shall be designed for a maximum deflection of 5 percent. The modulus of elasticity for PVC pipe shall be assumed as one-third of the amount designated by the compound cell classification to account for long-term reduction in modulus of elasticity. Different reductions in modulus may be appropriate for other plastic pipe materials.

The minimum thickness of flexible plastic pipe shall be SDR 26, Schedule 40, Class 100, or 16 gage as appropriate for the particular pipe material. Connections of flexible pipe to rigid pipe or other structures shall be designed to accommodate differential movements and stress concentrations.

The following pipe materials placed in earth embankments are acceptable for the effective heights of ponds and conditions listed in Table 5 – Acceptable Pipe Materials (see Appendix A Table 5).

All pipe conduits shall be designed and installed to be water tight by means of couplings, gaskets, caulking, waterstops, or welding. Joints shall be designed to remain

watertight under all internal and external loading including pipe elongation due to foundation settlement.

Pipe conduits shall have a concrete cradle or bedding if needed to provide improved support for the pipe to reduce or limit structural loading on pipe to allowable levels.

Joints between sections of pipe shall be designed to remain watertight after joint elongation caused by foundation consolidation. Joints shall be made watertight by the use of couplings, gaskets, caulking, or by welding.

Connections of PVC plastic pipe to less flexible pipe or structures must be designed to prevent stress concentrations and possible pipe rupture.

Watertight couplings specified for corrugated steel and aluminum pipe shall conform to one of the following.

1. ***Annular corrugated metal sheet two feet wide wrapped around butting pipes with sheet ends lapping a minimum of 6 inches. The sheet will be secured by four circumferential steel rods with tank lugs. Prior to placement of the sheet, the contacted surface shall be coated with a thin layer of trowel grade bituminous mastic compound, or a rubber sheet gasket manufactured for this purpose.***
2. ***Stamped or cut flanges continuously welded to each pipe and bolted on approximately four-inch centers with gasket.***
3. ***Pipe ends manufactured to receive a solid metal sleeve equipped with a round rubber gasket.***
4. ***Other water tight gaskets which are approved by the State Conservation Engineer.***

All steel pipe and couplings shall have protective coatings in areas that have traditionally experienced pipe corrosion, or in embankments with saturated soil resistivity less than 4000 ohms-cm or soil pH less than 5. Protective coatings shall be asphalt, polymer over galvanizing, aluminized coating or coal tar enamel as appropriate for the pipe type.

Plastic pipe that will be exposed to direct sunlight shall be ultraviolet-resistant and protected with a coating or shielding, or provisions provided for replacement as necessary.

Conduit outlet support and protection. The discharge from the conduit shall not cause excessive erosion. All principal spillways shall have the pipe extend to a stable grade at the deepest part of the cross-section on the centerline of dam, or into the existing drainage way below the dam or to a designed scour basin and not endanger the downstream slope or fill.

Principal spillway outlets will be designed to be stable and provide for release of flow at non-erosive velocities.

Designed, armored scour basins are required where erosive outlet channel conditions exist.

Pipe outlets for conduits 15 inches in diameter and larger shall have designed energy dissipating outlet measures.

Suitable ***energy dissipating*** devices such as a Saint Anthony Falls (SAF) stilling basin ***(refer to 210-VI-TR54-1 for guidance)*** or an impact basin may be used to provide a safe outlet. ***Energy dissipating outlet structures meeting the requirements of procedures contained in the 210-VI-NEH 650.07 Chapter 7 or 210-VI-DN-6 Chapter 6 will be considered for all pipe outlets.***

At a minimum, erosion protection shall be provided on all 10 inch to 15 inch diameter pipe outlets by installing a splash pad. The splash pad shall be four inches thick concrete or 12 inches thick of 3-inch to 9-inch rock riprap and be two times the pipe diameter in length and width. Rock in splash pads may be durable field stone. Splash pads should be considered for pipe diameters less than ten inches when there is a potential for excessive scouring at the outlet.

Cantilever outlet sections, if used, shall be designed to withstand the cantilever load. Pipe supports shall be provided when needed.

Pipe supports will be installed on all pipes where the length of the cantilever portion,

measured along the invert of the pipe, is more than 35% of the total length of the last joint of pipe for pipe diameters 15 inches and less, or more than 20% of the total length of the last joint of pipe for pipe diameters greater than 15 inches.

When designed energy dissipating outlet measures are installed, the last joint of the principal spillway conduit shall be installed on a slope no steeper than 4%.

The invert elevation of all principal spillway conduit outlets shall be a minimum of 1.0 foot above the outlet channel.

Anti-floatation anchorage. Risers for drop inlet spillways shall be designed with sufficient anchorage to prevent flotation and with a factor of safety of 1.5. Concrete risers five feet or less in height shall have a minimum wall thickness of 6 inches and be reinforced with one layer of welded wire fabric (6"x 6", 8 gage x 8 gage minimum). All other concrete risers shall be designed as described under structural auxiliary spillways, in this standard.

Guard rails. Guard rails are to be used on all principal spillway systems where safety hazards exist. They shall have a minimum height of three feet and openings not greater than 18 inches in the least dimension and meet WV Department of Highways (DOH) or local authority criteria. Steel pipes (1-1/4 inches diameter minimum) or angle irons (1" x 1" x ¼" thick minimum) shall be used as a minimum.

Cathodic protection. Cathodic protection is to be provided 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. If cathodic protection is not provided in the original design and installation, electrical continuity in the form of joint-bridging straps should be considered on pipes that have protective coatings. Cathodic protection should be added later if monitoring indicates the need. ***Criteria for cathodic protection of steel pipe are found in NCPS: Irrigation Pipeline-Steel 430-FF and 210-VI-DN-12 Control of Underground Corrosion.***

Seepage control. Seepage control along a pipe conduit spillway shall be provided if any of the following conditions exist:

1. The effective height of dam is greater than 15 feet.
2. The conduit is of smooth pipe larger than 8 inches in diameter.
3. The conduit is of corrugated pipe larger than 12 inches in diameter.

Seepage along pipes extending through the embankment shall be controlled by use of a drainage diaphragm, unless it is determined that anti-seep collars will adequately serve the purpose.

Drainage diaphragm. The drainage diaphragm shall function both as a filter for adjacent base soils and a drain for seepage that it intercepts. The drainage diaphragm shall consist of sand, meeting the requirements of ASTM C-33 (**at least 15% passing the No. 40 sieve but no more than 10% passing the No. 100 sieve**), for fine concrete aggregates. If unusual soil conditions exist such that this material may not meet the required filter or capacity requirements, a special design analysis shall be made. ***The sand diaphragm and drain backfill envelopes shall be installed in a saturated condition. When soils with high piping potential are used and the effective embankment height of the dam is 25 feet or greater, the gradation of the drain material will be determined using the requirements of NEH Soils 210-633.26, Gradation Design of Sand and Gravel Filters, and Soils 210-VI-SMN-3 Soil Mechanics Considerations for Embankment Drains.***

The drainage diaphragm shall be a minimum of 2 feet thick ***parallel to the centerline of the pipe*** and extend vertically upward and horizontally at least three times the outside pipe diameter ***(to a maximum of 3')*** and vertically downward at least 18 inches beneath the conduit invert. The drainage diaphragm shall be located immediately downstream of the cutoff trench, but downstream of the centerline of the dam if the cutoff is upstream of the centerline.

The outlet for the drainage diaphragm shall outlet at the embankment downstream toe using a drain backfill envelope continuously

along the pipe to where it exits the embankment**.** Drain fill shall be protected from surface erosion.

The outlet for the drainage diaphragm will be a sand bedding or envelope along the principal spillway. It will be 18 inches deep, from the pipe centerline down, and 3 times the pipe diameter wide, with a minimum width of 2 feet. It will extend to the downstream toe of the embankment. The outlet end will be protected from erosion by use of 6" thick gravel layer and a 9"thick rock riprap layer or other suitable method.

Riprap for erosion protection at the drain outlet, shall be a durable stone approximately 3" to 9" in size. If a riprap outlet structure is designed for the principle spillway, is shall meet gradation requirements of the outlet structure.

Anti-seep collars

When anti-seep collars are used in lieu **of the preferred** drainage diaphragm, they shall have a watertight connection to the pipe. Maximum spacing shall be approximately 14 times the minimum projection of the collar measured perpendicular to the pipe but not more than 25 feet. The minimum spacing shall be 10 feet. Collar material shall be compatible with pipe materials. The seepage path along the pipe shall increase by at least 15 percent due to the anti-seep collar(s). ***The length of conduit within the normal seepage path (saturation zone) shall be taken along the pipe barrel from the upstream toe to the midpoint between the centerline of the dam and downstream slope of the dam at the pipe outlet. Collars will project a minimum of two feet in all directions from the outside of the pipe, except when the pipe is bedded on rock.***

Concrete collars shall be a minimum of 6 inches thick. Concrete collars on pipes 18 inches and larger in diameter and in ponds with effective embankment heights greater than 15 feet will have one layer of steel reinforcement, meeting temperature and shrinkage requirements in 210-NEH-6 Structural Engineering, placed at the centerline of the collar (No. 4 bars at 12 inches center to center in both directions for 6-inch concrete thickness). When the fill height over collars exceeds 20 feet, the collar shall be designed with a three-inch batter, resulting in a 6 inch thickness at the top to a nine inch thickness at the bottom. Concrete collars will not be used on plastic pipe or corrugated metal pipe.

Corrugated metal pipe collars shall be the same gage or thicker, be ¼ inch thick if constructed of flat steel. Metal collars shall have appropriate coatings and cathodic protection when such protection is required for the conduit.

Plastic collars will be 8 millimeters minimum thickness with a wood, metal, or plastic frame for support during construction. Plastic collars will not be used on conduits larger than 12 inches in diameter.

Trash guard. To prevent clogging of the conduit, an appropriate trash guard shall be installed at the inlet or riser ***unless it is documented that*** the watershed does not contain trash or debris that could clog the conduit ***and the drainage area is less than 50 acres. Trash guards shall have openings no larger than three-fourths of the spillway pipe diameter and no smaller than four inches in the least dimension.***

Other outlets. A pipe with a suitable valve shall be provided to drain the pool area if needed for proper pond management or if required by State law.

Drain pipe. All ponds having a permanent pool area of one acre or more or an effective embankment height of 15 feet or more shall have a drain and valve system capable of draining the pond in 10 days.

Other ponds shall be provided with a similar system to drain the pond when needed for proper pond management. If a drainpipe is used, it shall be constructed of pipe as shown under materials in this standard, and in no case shall be less than 1-1/4 inches inside diameter.

The principal spillway pipe may be used as a pond drain when properly gated for this purpose, or the water supply pipe may be used if it provides adequate capacity and is designed accordingly.

Water supply pipe. If a watering facility for livestock is planned to be filled by the pond it should be placed down slope in an easily accessible area, away from the principle spillway outlet. A water supply pipe should be installed under or through the dam. It shall have water-tight joints and be equipped with a suitable valve and riser. It shall lead to a watering trough constructed in accordance with the 210-V-NEH Part 512 Construction and WV CPS- Watering Facility (614) and Pipeline (516).

Pipes supplying water to troughs or other watering facilities shall have a minimum inside diameter of 1-1/4 inches. The portion of the pipe under the embankment shall be constructed of pipe as shown under materials in this standard. The riser inlet shall be capped and at its upper end be perforated. The perforated standpipe shall have sufficient perforations to maintain the required flow (usually 1/4''-3/4"diameter perforations with a nominal area of openings of four times the pipe area). The standpipe perforations shall not extend below 2' above the bottom of the pond nor extend to within 1' of the permanent pool elevation.

A floating water supply inlet may be installed in lieu of a perforated riser, in which case flexible polyethylene pipe may be used for the portion of the pipe not under the embankment.

Access ramp. Where it is not possible to install a water supply pipe and trough or tank, a fence and exterior access ramp shall be provided. The ramp shall be constructed of concrete or course aggregate according to WV CPS Stream Crossing or Access (728). The ramp shall extend to the anticipated low water level at a slope no steeper than 5H:1V for livestock and be a minimum of eight feet wide with cut and fill slopes no steeper than 2H:1V.

Concrete ramps will have a troweled roughened surface for a better footing and to prevent slippage. The ramps shall be a minimum of four inches thick and placed over four inches of gravel and consideration shall be given to freeze- thaw conditions.

Gravel ramps will be four inches thick over eight inches of four-inch to eight-inch stone or woven or non-woven Class IV fabric, (WV 700 specification 746, Geotextiles) geotextile or cellular confinement system (210-VI DN -24) at a 5H:1V slope or flatter.

Auxiliary spillways. Auxiliary spillways convey large flood flows safely past earth embankments and have historically been referred to as "Emergency Spillways".

An auxiliary spillway must be provided for each dam, 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 following are minimum criteria for acceptable use of a closed conduit principal spillway without an auxiliary spillway: a conduit with a cross-sectional area of 3 ft^2 or more, an inlet that will not clog, and an elbow designed to facilitate the passage of trash.

The minimum capacity of a natural or constructed auxiliary spillway shall be that required to pass the peak flow expected from a design storm of the frequency and duration shown in Table ***6***, less any reduction creditable to conduit discharge and detention storage.

The auxiliary spillway shall safely pass the peak flow, or the storm runoff shall be routed through the reservoir. The routing shall start 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. The 10-day drawdown shall be computed from the crest of the auxiliary spillway or from the elevation that would be attained if the entire design storm were impounded, whichever is lower. Auxiliary spillways shall provide for passing the design flow at a safe velocity to a point downstream where the dam will not be endangered.

Constructed auxiliary spillways are open channels that usually consist of an inlet channel, a control section, and an exit channel. They shall be trapezoidal and shall be located in undisturbed or in-situ rock ***to the design flow elevation (Hp) at the control section***. The side slopes shall be stable for the material in which the spillway is to be constructed. ***In earth or weathered rock the***

side slopes shall be not steeper than 2H:1V and the combined inside and outside slopes shall be no less than 5H:1V. Procedures and Tables contained in 210-VI-NEH -650.11 for designing spillways with 3H:1V side slopes.

For dams having an effective height exceeding 20 feet, the auxiliary spillway shall have a bottom width of not less than 10 feet. ***For all other dams, the auxiliary spillway shall have a bottom width of not less than 8 feet.***

Upstream from the control section, the inlet channel shall be level for the distance needed to protect and maintain the crest elevation of the spillway ***(minimum 20 feet). Procedures and tables contained in the 210-VI- NEH - 650.11 for designing auxiliary spillways with 25 feet level sections may be used to design spillways with 20 feet level sections.*** The inlet channel may be curved to fit existing topography. The grade of the exit channel of a constructed auxiliary spillway shall fall within the range established by discharge requirements and permissible velocities. ***The minimum depth in the exit channel will be equal to or greater than the design depth of flow (Hp) for the spillway.***

Table *6*. Minimum Auxiliary Spillway Capacity

Drainage area (Ac.)	Effective height of dam[1] (Ft.)	Storage (Ac-Ft)	Minimum design storm[2]	
			Frequency (Years)	Minimum Duration (Hours)
≤ 20	≤ 20	< 50	10	24
≤ 20	> 20	< 50	25	24
> 20	***≤ 20***	< 50	25	24
All others			50	24

1. As defined under "Conditions where Practice Applies".
2. Select rain distribution based on climatologically region.

Structural Auxiliary Spillways. If chutes or drops are used for principal spillways or auxiliary spillways, they shall be designed according to the principles set forth in 210-VI-NEH-65010-VI- NEH, Section 5, Hydraulics; Section 11, Drop Spillways; and Section 14, Chute Spillways. The minimum capacity of a structural spillway shall be that required to pass the peak flow expected from a design storm of the frequency and duration shown in Table ***6***, less any reduction creditable to conduit discharge and detention storage.

The State Conservation Engineer must approve structural spillways.

CRITERIA FOR EXCAVATED PONDS

Site investigation. Site suitability and design shall be based on adequate investigations and surveys as described in the National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 11, Ponds and Reservoirs.

Runoff. Provisions shall be made for a pipe and auxiliary spillway, if needed, that will meet the capacity requirements of Tables ***4 and Table 6***. Runoff flow patterns shall be considered when locating the excavated pond and placing the spoil.

Side slopes. Side slopes of excavated ponds shall be stable and shall not be steeper than one horizontal to one vertical.

Inlet protection. If surface water enters the pond in a natural or excavated channel, the side slope of the pond shall be protected against erosion.

Principal* Spillway. *The approving employee may waive the requirement for an embankment pond's principal spillway if all of the following conditions are met.

1. ***Pond drainage area is less than 10 acres.***
2. ***There is no seepage or spring flow.***
3. ***An emergency spillway is installed or any needed embankment is constructed with side slopes no steeper than 3H:1V upstream and 5H:1V downstream.***

Excavated material. The material excavated from the pond shall be placed so that its weight will not endanger the stability of the pond side slopes and it will not be washed back into the pond by rainfall. It shall be disposed of 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 placed or shaped reasonably well, with side slopes assuming a natural angle of repose. The excavated material will be placed at a distance equal to the depth of the pond but not less than 12 feet from the edge of the pond.
- Shaped to a designed form that blends visually with the landscape.
- Used for low embankment construction and leveling of surrounding landscape.
- Hauled away
- ***Excavation and shaping required to permit the reservoir area to suitably serve the planned purpose shall be included in the construction plans.***

CONSIDERATIONS

Visual resource design. The visual design of ponds should be carefully considered 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.
The embankment may be shaped to blend with the natural topography. The edge of the pond may be shaped so that it is generally curvilinear rather than rectangular. Excavated material can be shaped so that the final form is smooth, flowing, and fitting to the adjacent landscape rather than angular geometric mounds. If feasible, islands may be added for visual interest and to attract wildlife.

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

Fish, *livestock* and wildlife. Project location and construction should minimize the impacts to existing fish and wildlife habitat.

When feasible;

- ***The*** structure should be retained, such as trees in the upper reaches of the pond and stumps in the pool area.
- Upper reaches of the pond can be shaped to provide shallow areas and wetland habitat.
- If fish are to be stocked, consider criteria and guidance ***and management of ponds for fish production following WV CPS Fishpond Management (399).***
- ***The reservoir should be designed for a maximum amount of water in excess of three feet in depth to reduce excessive algae and plant growth.***
- ***The development of watering facilities for wildlife shall follow WV CPS Wildlife Watering Facility (648).***
- ***The project location and construction should minimize the impacts to existing fish and wildlife habitat.***
- ***When feasible, structures should be retained, such as trees in the upper reaches of the pond and stumps in the pool area.***
- ***The upper reaches of the pond can be shaped to provide shallow areas and wetland habitat.***
- ***The side slopes of borrow excavations and excavations within the pool shall not be steeper than 2H:1V, except where the pond is to be managed for fishing or fish production. In this case the shoreline may be excavated on a maximum slope of 1H:1V to a maximum depth of 3 feet.***

For Livestock Watering. When livestock water directly from the pond, a watering ramp and fence shall be installed according to WV CPS Stream Crossing or Access (728) and Fence (328).

The required livestock watering storage shall be calculated using 1.5 times the sum of the following:

a. Minimum gallons per animal per day as required in WV CPS Watering Facility (614) for the estimated number of days to be used.

b. Net evaporation loss for the desiring days of storage.

c. Seepage loss based on the best available data.

Vegetation. Stockpiling topsoil for placement on disturbed areas can facilitate revegetation***.***

Consider placement and selection of vegetation to improve fish and 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 ground water 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.
- Potential for multiple purposes.

Water quality. Consider the effects upon the water quality especially:

- Consider the effects on erosion and the movement of sediment, pathogens, and soluble and sediment-attached substances that are carried by runoff.
- Effects on the visual quality of onsite and downstream water resources.
- Short-term and construction-related effects of this practice on the quality of downstream water courses.
- Effects of water level control on the temperatures of downstream water to prevent undesired effects on aquatic and wildlife communities.
- Effects on wetlands and water-related wildlife habitats.
- Effects of water levels on soil nutrient processes such as plant nitrogen use or denitrification.
- Effects of soil water level control on the salinity of soils, soil water, or downstream water.
- Potential for earth moving to uncover or redistribute toxic materials such as saline soils.

Stormwater management. Ponds designed for water quality improvements may be designed to

- ***Meet local and state guidelines and as an minimum designed so that the first flush of a storm event will be retained within the pond and later storm water flow will be the first flows released throughout the principal spillway.***
- ***Designed with a permanent pool deep enough to hold water and shallow areas (littoral zones) with dense vegetation shall be developed. This will increase sedimentation of suspended solids, reduce re-suspension of sediments by wave action and remove floating debris from storm water.***
- ***reducing or eliminating water quality problems involving sediment loads, fertilizers, pesticides, litter, oils and solvents by reducing the discharge peak flow to a receiving stream or water body thus slowing the water flow down and thereby carry less suspended solids.***

Recreation. The water must be free of pollution and have an acceptable pH range, especially where it is to be used for swimming. In addition the

- ***volume of water should be sufficient to exceed evaporation and seepage losses and maintain a desirable water level.***
- ***incorporation of WV CPS Fishpond Management (399) should be considered for all ponds where recreation and fishing are secondary purposes.***
- ***safety should be a major consideration when designing a pond primarily for recreation. Items such as side slope steepness, access steps for ingress and egress, fencing for protection and pond water clarity and pond bottom stability are factors to be considered.***

Fire control. Fire control shall be incorporated into the structure design by designing an underground piping system which connects the reservoir to a dry

hydrant. Minimum water storage, location of intake pipe, etc., shall meet WV CPS Dry Hydrant (432).

Crop and orchard spraying. The volume of water in the pond shall exceed the anticipated amount of water needed for spray applications and must be available when needed. A suitable means of conveying the water from the pond to the spray tank shall be provided. A backflow prevention valve shall be incorporated in the conveyance line to prevent contamination of the water supply from the spray tank. State and local laws shall govern as well as pesticide or herbicide label directions.

Fencing. Ponds will be permanently fenced when livestock will or may be present. The fence will enclose the reservoir, earthfill, and auxiliary spillway; including the outlet section. If a concrete or gravel ramp is constructed for livestock access to the reservoir, it will be fenced to allow only sufficient access for watering purposes. The fence will be located so it will not interfere with the operation and maintenance of the auxiliary spillway.

Fencing shall be constructed in accordance with WV CPS Fence (387).

PLANS AND SPECIFICATIONS

Plans and specifications for installing ponds shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

Copies of the plans and specifications shall be provided to all responsible parties such as the owner, cooperator, sponsor, contractor and long term operation and maintenance provider.

Applicable West Virginia Conservation Practices Standards and specifications which apply to components of the system.

Embankment Ponds (Type II) which have an effective height greater than 15 feet and less than or equal to 20 feet, which could result in damage to roads or farm buildings should failure occur, or are multiple purpose structures, will have specifications prepared in conformance with NEH Part 642 or, the WV 700 series, as appropriate.

Specifications for associated practices, such as for a pipeline, grade stabilization structure, watering facilities, etc. will be included as needed and specifications for items such as safety devised, recreation facilities, and fish and wildlife enhancement measures will be prepared as needed.

All other ponds will be constructed in conformance with the attached specification and the following guidelines:

1. ***The acceptable principal spillway pipe, drainpipe and/or water supply pipe (Appendix A Table 5) will be shown on the drawings.***
2. ***If riprap is used, the quality, size, and gradation will be shown on the drawings.***
3. ***Application rates for seeding and mulching materials will be shown on the drawings.***
4. ***Details and dimensions of inlet and outlet structures, anti-seep collars, seepage drains, riprap slope protection, safety measures, fences, and fish and wildlife enhancement measures shall be shown on the drawings.***
5. ***Construction specifications for pipeline and watering facilities will be included when livestock watering facilities are to be installed.***
6. ***Specifications for items such as safety devices, recreation facilities, and fish and wildlife enhancement measures will be prepared as needed.***

OPERATION AND MAINTENANCE

An operation and maintenance plan shall be developed and reviewed with the landowner or individual responsible for operation and maintenance.

The maintenance tips brochure for ponds may be used for most ponds, but will be supplemented as necessary to cover items not covered in the brochure.

The following items are to be considered in preparation of the Operation and Maintenance Plan:

Inspect regularly and repair:

- ***a. Principal spillway inlet, trash rack and anti-vortex device,***
- ***b. Principal spillway outlet.***
- ***c. Drain pipe, gates, and/or valves.***
- ***d. Water supply pipes, valves, and watering facilities.***
- ***e. Seepage drain outlets.***
- ***f. Fences, recreation facilities, safety facilities, and measures installed for fish and wildlife enhancement.***
- ***g. Unstable wet areas below the pond.***
- ***h. Application of chemicals for weed control and fertilizer for vegetation establishment shall be applied in conformance with WV CPS Nutrient Management (590) and WV CPS Pest Management (595A).***

2. Vegetation should be kept healthy by liming, fertilizing, and mowing periodically to control undesirable vegetation. Do not permit trees and brush to grow on the embankment.

3. Eroding areas on and around the pond should be vegetated and/or protected with mechanical measures such as riprap.

4. Gates, valves, and other mechanical devices should be operated no less frequently than once a year to insure their continued operation. Lubrication, as recommended by the manufacturer, should be performed on a regular basis.

5. Pollution may be controlled by:

- ***a. Diverting runoff from concentrated livestock areas, septic drain fields, and other pollution source.***
- ***b. Stabilizing sediment sources in the drainage area, regulating livestock use of water and adjacent land to prevent erosion and pollution from excrement.***
- ***c. Removing trash and debris and providing trash cans if the pond has high recreational use.***

6. Aquatic growth, growth of algae and fish species may be controlled by:

- ***a. Use of mechanical equipment.***
- ***b. Chemical treatment.***
- ***c. Deepening water at edge of pond.***
- ***d. Periodic fertilization.***
- ***e. Control of water depth and flow in the pond.***

Refer to the WV CPS Fish Pond Management-399 for more detailed information and specifications.

7. Damage by muskrats can be controlled by trapping, hunting, or discouraging burrowing with the use of linings or fence material.

8. Periodic cleanout of sediment may be required if planned for in the design or if sediment yield is greater than anticipated.

REFERENCES

NRCS 210-VI-Technical Release (TR)

TR20–Computer Program for Project Formulation Hydrology

TR56-Guide for Design & Layout of Vegetative Wave Protection for Earth Dam Embankments

TR59-Hydraulic Design of Riprap Gradient Control Structures

TR60, TR60A- Earth Dams and Reservoirs

TR69–Riprap for Slope Protection Against Wave Action

210-VI – NEH

Section 5, Hydraulic

Section 11, Drop Spillways

Section 14, Chute Spillways

Part 642 Specifications for Construction Contracting

628.50, Chapter 50, Earth Spillway Design

633.26 Soils Eng. Chapter 26 – Soil Eng. Gradation Design of Sand and Gravel Filters

650.03- EFH Chapter 3 Hydraulics and Amendment WV-34 Hydraulic Design Criteria for Canopy, Hood and Drop Inlet Spillways

650.07 EFH Chapter 7 Grassed Waterways

650.11 EFH Chapter 11 Ponds and Reservoirs

650.12 EFH Chapter 12 Springs and Wells

210-VI-Design Notes

DN – 6 Riprap Lined Plunge Pool for Cantilever Outlet

DN –12 Control of Underground Corrosion

DN – 24 Guide for use of Geotextiles

NRCS WV Conservation Practice Standards (WV CPS)

WV CPS Critical Area Planting (342)

WV CPS Dry Hydrant (432)

WV CPS Fish Pond Management (399)

WV CPS Grade Stabilization Structure (410)

WV CPS Grassed Waterway (412)

WV CPS Nutrient Management (590)

WV CPS Pipeline (516)

WV CPS Structure for Water Control (587)

WV CPS Waste Storage Facility (313)

WV CPS Watering Facility (614)

National CPS Irrigation Water Conveyance, Steel (430 FF)

WV DEP Dam Safety Section

Federal, State and Local Governments

US Army Corps of Engineers,

WV Department of Environmental Protection (DEP)

WV Department of Natural Resources (DNR);

WV DNR Public Land Corporation (PLC)

Appendix A

Table 2 – WV Type of Earth Embankment and Design Criteria for Pond/Dams						
	Type of Earth Embankment				Minimum Design Criteria	
	Type I	Type II	Type III	Type IV	WV CPS Pond 378	Technical Release 60 or 60A
EEH[1]/ > 20 feet	X					X
Class[2]/(b) or Class (c)	X					
Product of EEH (ft) and Storage[3]/ (acre-ft.) is > 3000	X					X
EEH is > 15 feet and EEH is <= 20 feet and not Type I		X			X	
Class (a) Structure and not Type I and may damage farm structures and/or roads		X			X	
Multipurpose Reservoir, not Type I		X			X	
Class (a) and EEH > 10 feet and EEH <= 15 feet and no potential hazard to roads or structures and not Type I or Type II			X		X	
Class (a) and EEH <10 feet and no potential hazard to roads or structures and not Type I, Type II or Type III				X	X	

[1]/EEH (Effective Embankment Height) is the difference in elevation in feet between the lowest open channel auxiliary spillway crest and the lowest point in the original cross section of the centerline of the dam. If no open channel auxiliary spillway, the top of the settled dam becomes the upper limit.

[2]/Classification of Dams – Class (a), Class (b), Class (c) is in accordance with the National Engineering Manual, Paragraph 520.21

[3]/ Storage is the capacity of the reservoir in acre-feet below the elevation of the crest of the lowest open channel auxiliary spillway or the elevation of the top of the settled dam, if there is not open channel auxiliary spillway.

Appendix A

Table 4 – Principal Spillway Pipe Conduit Criteria		
Drainage Area (acres)	***Effective Height (feet)***	***Pipe Diameter (inch) Minimum Design Storm***
< 10	***≤ 35'***	***4"***
10 to < 20	***≤ 35'***	***6"***
20 to < 30	***≤ 35'***	***10"***
30 to < 50	**≤ 35'**	***12"***
50 to < 75	**< =15' >15' and <=35'**	***15" [1]/ 5-yr., 24-hr. (12" min.)***
75 to < 100	**< =15' >15' and <=35'**	***18" [1]/ 5-yr., 24-hr. (15"min.)***
100 to < 150	**< =15' >15 and <=35**	***24" [2]/ 5-yr., 24- hr. (18"min.)***
150 to ≤ 200	**< =15' >15' and <=35'**	***30" [2]/ 5-yr., 24-hr. (24" min.)***
> 200	**< =15' >15' and <=20' >15' and <=35'**	***5-yr., 24-hr. (24"min.) 10-yr.,24-hr.(24"min) 25-yr., 24-hr.(24"min.)***

[1]/ Minimum pipe diameter may be reduced by as much as three inches from the diameter shown, provided a 5 yr., 24 hr. design storm is routed through the structure and the smaller diameter pipe is found to be adequate.

[2] / Minimum pipe diameter may be reduced by as much as 6 inches from the diameter shown, provided a 5 yr., 24 hr. design storm is routed through the structure and the smaller diameter pipe is found to be adequate

Note: Pipe Conduits 4"-6" diameter may easily plug and shall be protected from debris and/or trash. The conduit shall be inspected and/or cleaned out on a regular schedule.

Appendix A

Table 5 – Acceptable Pipe Materials for Use in WV Pond/ Dam Earth Embankments[a]

NRCS-210-VI-NEH 642 Material Specifications (MS) for Construction Contracts	Minimum Schedule, Thickness or Gage	Maximum Diameter (inches)	Maximum Depth of Fill over Pipe (feet)
MS–547 PP PVC[b] 1120 or 1220	ASTM D1785, Sch. 40	4" 12"	15 ft. 10 ft.
MS-547 PP PVC 1120 or 1220	ASTM D1785, Sch. 80	4" 12"	20 ft. 15 ft.
MS-547 PP PVC 1120 or 1220	ASTM D2241, SDR 26	4" 12"	10 ft. 10 ft.
MS-547 Type PS 46 or 10 Profile Gravity Sewer Installed following D2321	ASTM D1784, D-2321, F794-93a Smooth wall inside diameter	4" - 12"	10 ft.
Corrugated –Smooth wall High Density Polyethylene Tubing (HDPE) Type III, Class C, Category 4 or 5	AASHTO M252 or M294 Type S, ASTM D1248 and D3350	6" - 10" 12" - 24"	10 ft. 10 ft.
MS 542 - Reinforced Concrete Pipe	ASTM C76 ,C655, C118	48"	35 ft.
MS 543 - Non-Reinforced Concrete Culvert Pipe[c]	ASTM C14	48"	20 ft.
MS 551 - Coated Corrugated Steel Pipe CMP 6"- 10" Diameter (1-1/2" x ¼" corrugations) CMP 12"- 48" Diameter (2-2/3" x ½" corrugations)	ASTM A760 16 gage 16 gage 14 gage 14 gage 12 gage 12 gage 10 gage 10 gage	24" 30" 30" 36" 36" 42" 42" 48"	25 ft. 20 ft. 25 ft. 20 ft. 25 ft. 20 ft. 25 ft. 25 ft.
MS 552 - Aluminum Corrugated Pipe[c] 6" – 10" Diameter (1-1/2" x ¼" corrugations) 12"- 48" Diameter (2-2/3" x ½" corrugations)	ASTM B745 0.06" 0.06" 0.075" 0.075" 0.105" 0.105" 0.135"	21" 24" 24" 36" 24" 36" 30"	25 ft. 15 ft. 20ft. 15 ft. 25 ft. 20 ft. 25
MS - 554 Steel Pipe	ASTM A53,120,134,135 or 139 AWWA C200 wall thickness; wall thickness 3/16" wall thickness ¼"	4" 48"	35 ft. 25 ft.
MS 514 - Cast in Place Reinforced Concrete	Design according to NEH, Section 6	Area = 16 sq. ft.	35 ft.

[a] Acceptable pipe for ponds with an effective embankment height of 20 feet or less. [b] Plastic pipe manufactured to conform to ASTM specifications other than those listed may be used with the maximum fill limits shown provided the pipe meet or exceed requirements of the listed pipe material, wall thickness and joint water tightness. Pipe having a wall thickness different from the listed pipes may be used provided the calculated long term deflection for the designed fill height and installation conditions do no exceed 5 percent. [c] Riveted or helical fabrication

NATURAL RESOURCES CONSERVATION SERVICE

CONSTRUCTION SPECIFICATION GUIDELINES

POND (378)

SCOPE

This item shall consist of the clearing, excavation, backfill, concrete and other appurtenances required for the construction of the excavated or embankment ponds and the disposal of all cleared and excavated materials for the water impoundment.

Construction operations shall be carried out in such a manner that erosion, air, water and noise pollution will be minimized and held within legal limits as established by Federal, state and local laws, rules and regulations.

LOCATION

The location of the embankment, borrow area, auxiliary spillway, and appurtenant structures shall be as specified on the drawings or as staked in the field.

PUBLIC and PRIVATE UTILITIES

Utilities are defined to be overhead and/or underground power-lines, communication lines, gas lines, pipelines, etc. All utilities discovered to be in the work area are shown on the drawings or sketches. However, absence of indicators on the drawings or sketches does not assure the nonexistence of utilities in the work area. The contractor and owner shall be alerted to conduct their own search and discovery for utilities in order to lessen or avoid potential damages. The owner/operator is responsible and shall notify all utilities and complete WV- Eng-46, utilities inventory prior to layout or any ground disturbance and return it to NRCS representative.

CLEARING

The foundation area shall be cleared of all brush, trees, stumps, roots, brush, boulders, sod and debris as much as practicable. All material cleared from the area shall be disposed of by burning or removing from the site. All burning or disposal shall conform to local and state laws and regulations.

EXCAVATION OR SPOIL

The completed pond, berms or spoil banks and waste material shall conform as nearly to lines, dimensions, grades and slopes shown on the plans or staked on the site as skillful operations of the excavating equipment permit.

MATERIALS

Principal spillways, drain and water supply pipes.

Pipe spillways, drain pipes, and water supply pipes shall be firmly and uniformly bedded throughout their length, and shall be installed to the line and grade shown on the drawings. Inlet structures, outlet structures, anti-seep collars, seepage drains, and valves and other fittings shall be installed as detailed on the drawings.

The type, applicable specification, schedule, and wall thickness or gage of pipe will be shown on the drawings.

Anti-seep collars or seepage drains, if required, will be constructed of materials and to the dimensions shown on the drawings. Sand for seepage drains will be fine concrete aggregate meeting the requirements of ASTM C33.

Water troughs and pipelines downstream of the embankment will be installed as shown on the drawings and as detailed in the

Note: Bold italics indicate information added or changes made in the National Conservation Practice Standard by WV.

NRCS, NHCP **NRCS, WV**

July 2002 **May 2004**

specifications for pipeline and watering facility.

Concrete

Concrete used in construction of inlets and anti-seep collars shall be ready-mixed concrete (3,000 psi, 6 bags per cubic yard mix), pre-bagged commercially available concrete mix, or be hand mixed on-site. Cement will be Type I or IA meeting the requirements of ASTM C150 and aggregates will meet the requirements of ASTM C33. Coarse aggregate will be size number 57 or number 67 for ready-mix and hand mixed concrete. Hand mixed concrete shall be mixed at a ratio of 1 part cement, 2 parts sand, and three parts coarse aggregate. Pre-bagged concrete mix will be mixed according to the manufacturers' recommendations. Mixing water will be clean and free of substances that would affect the strength or durability of the concrete. Concrete will be mixed to a consistency that will allow consolidation in the forms, but not so wet that aggregates separate from the mortar (approximately 3" to 6" slump).

Concrete will be mixed and placed in the forms in a timely manner so it does not begin to set prior to placement, or cold joints are not formed between successive layers. Forms shall be mortar tight and unyielding as concrete is placed.

Reinforcing steel shall be placed as shown on the drawings and held securely in place while concrete is placed.

Riprap

Riprap for slope or pipe outlet protection, if required, will be commercially available limestone riprap or on-site field stone that had demonstrated its durability against weathering. Riprap size, gradation, and details of installation will be as shown on the drawings.

EARTH FILL PLACEMENT

Selected backfill material shall be placed, in layers not exceeding four inches in thickness, around structures, pipe conduits, and anti-seep collars at approximately the same rate on all sides to prevent damage from unequal loading, and hand compacted. Construction equipment shall not be permitted within two feet of structures or conduits.

When it is necessary to use materials of varying texture and gradation, the more impervious material shall be placed in the upstream and center portions of the embankment. All fill materials shall be obtained from required excavations or designated borrow areas.

The placing of fill shall be in horizontal layers and placed in layers not exceeding eight inches in thickness. Each layer shall be left with a rough surface prior to placement of subsequent layers. The fill shall be maintained so that surface drainage will occur in the upstream direction during placement.

Drain fill shall be protected from being contaminated by adjacent soil materials during placement by either placing it in a cleanly excavated trench or by keeping the drain fill material at least one foot above the adjacent earth fill.

Compaction of embankments with heights of ten feet or less, between the centerline low point and the auxiliary spillway crest elevations, may be accomplished by traversing the surface area of each layer with not less than four passes of the construction equipment, in lieu of a tamping roller or rubber-tired hauling equipment.

VEGETATIVE PROTECTIVE COVER

A protective cover of vegetation shall be established on all exposed surfaces of the embankment, auxiliary spillway, and borrow area where soil and climatic conditions permit. Lime and fertilizer will be spread at the rate shown on the drawings and will be disked into the soil to a depth of four inches to prepare a seedbed. Seed, sod, mulch, and soil amendments will be applied at the rate shown on the drawings. The area will be watered and maintained until a permanent cover is established. If soil or climatic conditions preclude the establishment of a permanent vegetative cover, than seasonal/temporary vegetation in combination or separately with permanent vegetation or a temporary non-vegetative

protection (mulches, gravel, etc.) measure may be used until vegetation can be established.

A perennial vegetation filter strip at least 50 feet wide will be established around excavated ponds. The embankment and spillway shall be fenced, as shown on the drawings, to protect the vegetation.

Treated areas will be fenced when necessary to protect the vegetation from grazing or traffic.

INSPECTION OF MATERIALS

All materials used in the fabrication and installation of the principal spillway, trash rack, valves and other fittings, shall be visually inspected prior to or during their installation to assure quality and integrity of material.

POLLUTION CONTROL

Construction operations shall be carried out so that erosion and sediment are controlled during construction, and air and water pollution are minimized. Best management practices (BMP's) for construction shall be installed and maintained as needed and according to NPDES permit, if required.

CONSTRUCTION OPERATIONS

Construction operations shall be carried out in such a manner and sequence that erosion and air and water pollution will be minimized and held within legal limits. All disturbed areas will be graded smooth and blend with the surrounding ground, prior to seeding operations.

Measures and construction methods that enhance fish and wildlife values shall be incorporated as shown on the drawings.

Appropriate safety measures, such as warning signs, rescue facilities, fencing, etc., will be installed as shown on the drawings.

EMBANKMENT POND

TYPE I EARTH EMBANKMENT POND

The embankment will be constructed as shown on the plans and in accordance with applicable specifications as contained the 210-VI-National Engineering Handbook.642 Specifications for Construction Contracts.

TYPE II EARTH EMBANKMENT POND

All work shall be constructed in accordance with the plans and as staked in the field. The following are guidelines to be used in preparation of the NRCS-WV, TG-IV Appendix- A Construction Specifications 700 series.

Foundation Preparation

The foundation area shall be cleared of all trees, stumps, roots, brush, boulders, sod and debris. All channel banks and sharp breaks shall be sloped to no steeper than 1H:1V. All material containing excessive amounts of organic matter shall be removed. The surface of the foundation area will be thoroughly scarified to a minimum of 3", after stripping.

Stripping consists of excavating all surface material to a depth of 6 inches, before placement of the embankment material.

Excavation and Backfill of Cutoff Trench

The cutoff trench shall be excavated to the depths, bottom width, side slopes, lines and grades shown on the drawings. The trench shall be kept free of standing water during backfill operations and be backfilled using thin layers (maximum of 8 inches) to the ground surface with suitable material and backfilled with suitable material designated by the engineer in the same manner as specified for the embankment.

Excavation and Backfill of Streams

Existing stream channels crossing the foundation area shall have banks sloped no steeper than 1H:1V and deepened and widened as necessary and to accommodate compaction equipment and to remove all stones, gravel, sand, stumps, roots and other objectionable materials as directed by the engineer. Such channels shall then be backfilled with suitable material as specified for the cutoff trench.

Spillway and Borrow Excavation. The completed spillway excavation shall conform as nearly to the lines, grades, bottom width and side slopes shown on the plans as skillful operation of the excavating equipment will permit. The channel bottom shall be constructed transversely level and the side slopes uniform. All borrow areas outside the pool area shall be graded and constructed in such a manner that they are well drained and protected from erosion by the use of diversions or other conservation measures. Side slopes of borrow areas shall be constructed in such condition that establishment of vegetation, mowing and maintenance operations will be facilitated.

Earth Fill

The embankment shall be constructed to the lines and grades as shown on the drawings.

Fill material. The fill material shall be free of sod, roots, frozen soil, stones over 6inches in diameter (except for rock fills), and other objectionable materials.

The placing and spreading of the fill material shall be started at the lowest point of the foundation (cutoff trench) and the fill shall be brought up in approximately horizontal layers not exceeding 8 inches in non-compacted thickness. Where it is necessary to use materials of varying texture and gradation, the more impervious material shall be placed in the upstream and center portions of the embankment as directed the engineer. All fill materials shall be obtained from required excavations or designated borrow areas. Special attention shall be given to compaction in the cutoff trench where it joins the abutment slopes.

The fill shall be placed in layers not exceeding 8 inches in thickness. Each fill layer will be left with a rough surface prior to placement of subsequent layers. The fill

shall be maintained so that surface drainage will occur in the upstream direction during placement.

Fill compaction. Compaction on each fill layer shall be by means of a loaded tamping roller, controlled movement of hauling equipment, or other approved equipment. Compaction shall be done in a manner to obtain a minimum compacted density of 95 percent of the maximum obtained from the standard proctor compaction test, ASTM DO698.

Drainfill shall be kept from being contaminated by adjacent soil materials during placement by either placing it in a cleanly excavated trench or by keeping the drain at least 1 foot above the adjacent earthfill.

Selected drainfill and backfill material shall be placed around structures, pipe conduits, and antiseep collars at about the same rate on all sides to prevent damage from unequal loading.

Moisture content. The moisture content of fill material shall be adequate to permit the degree of compaction specified, but not less than 4 percent below optimum as determined in the standard compaction test method. The moisture content of the fill shall be maintained within a range to:

a. Prevent bulking or dilatence of the material under the action of the hauling or compaction equipment

b. Prevent adherence of the fill material to the equipment

c. Ensure the crushing and blending of soil clods and aggregation into a homogenous mass

d. Contain adequate moisture so that a sample can be hand molded.

The completed embankment fill shall be constructed to the lines and grades as shown on the drawings. It shall conform as nearly to the lines and grades, top width and side slopes shown on the plans as skillful operation of the construction equipment will permit.

Riprap

Riprap if need, will be equipment placed to the lines and grades shown on the drawings. Some limited hand placing may be necessary adjacent to structures.

TYPE III and IV EARTH EMBANKMENT POND

Construction requirements for Type III and Type IV earth embankments are the same as Type II except as shown below.

The foundation area shall be cleared of trees, logs, stumps, roots, brush, boulders, sod, and rubbish. Topsoil having high organic matter content shall be removed. Where needed to establish vegetation, topsoil is to be stockpiled and spread on the completed dam and auxiliary spillway. When topsoil is spread in the auxiliary spillway, care should be taken to ensure the final spillway dimensions are as designed.

Foundation surfaces shall be sloped to no steeper than 1H: 1V. The foundation area will be thoroughly scarified before placement of the fill material. The surface will have moisture added or be compacted if necessary so the first layer of fill material can be compacted to the degree specified and bonded to the foundation.

The cutoff trench, auxiliary spillway and any other required excavations shall be excavated to the lines and grades shown on the plans or as staked in the field. To the extent they are suitable, excavated materials are to be used in permanent fill

The moisture content of the fill material shall be adequate to permit the degree of compaction specified. The moisture content shall be sufficient to permit molding a firm ball when firmly squeezed in one's fist. The soil shall not be so wet that water runs out when squeezed nor so dry that the ball easily crumbles when slightly deformed by a wood pencil. Water may need to be added if too dry.

Compaction shall be made by traversing the surface area of each layer with not less than four passes of a tamping roller exerting a pressure of approximately 200 psi or by a minimum of two passes with rubber-tired hauling equipment. One pass

of the rubber-tired hauling equipment is complete when the entire lift surface has been traversed by a wheel.

Compaction of Type IV earth embankment may be accomplished by traversing the surface area of each layer with not less than four passes of the construction equipment.

Excess excavation material will be disposed of in a manner that its weight will not endanger the stability of the embankment or the pond side slopes and so it will not be washed back into the pond. It will be used to widen required fills, disposed of adjacent to the pond or hauled away. When placed adjacent to the pond it will be placed at a distance equal to the depth of the pond, but not less than 12 feet from the edge of the pond. It will be shaped to blend visually with the landscape.

Topsoil excavated from the foundation area and from the auxiliary spillway and borrow areas shall be stock piled and placed on the dam, auxiliary spillway and borrow areas to facilitate establishment of vegetation.