

## NATURAL RESOURCES CONSERVATION SERVICE CONSERVATION PRACTICE STANDARD

### DIKE (ft.) CODE 356

#### DEFINITION

An embankment constructed of earth or other suitable materials to protect land against overflow or to regulate water.

#### PURPOSE

To permit improvement of agricultural land by preventing overflow and better use of drainage facilities, to prevent damage to land and property, and to facilitate water storage and control in connection with wildlife and other developments. Dikes can also be used to protect natural areas, scenic features and archeological sites from damage.

#### CONDITIONS WHERE PRACTICE APPLIES

**Class I dikes** are those constructed where:

Failure may cause loss of life or serious damage to homes, industrial and commercial buildings, important public utilities, main highways or railroads, and high value land, crops, or other improvements;

Unusual or complex site conditions require special construction procedures to ensure satisfactory installations;

Protection is needed to withstand more than 12 feet of water above normal ground surface, exclusive of crossing of sloughs, old channels, or low areas.

**Class II dikes** are those constructed in highly developed and productive agricultural areas where:

Failure may damage isolated homes, highways or minor railroads, or cause interruption in service of relatively important public utilities;

The maximum design water stage against the dike is 12 feet or less.

**Class III dikes** are those constructed in rural or agricultural areas where:

Damage likely to occur from dike failure is minimal;

The maximum design water stage against the dike is six feet or less for mineral soils and four feet or less for organic soils. (Exclude channels, sloughs, swales, and gullies in determining the design water stage.)

#### CRITERIA - ALL DIKES

**Laws and Regulations.** This practice must conform to all federal, state, and local laws and regulations. Laws and regulations of particular concern include those involving water rights, land use, land disturbed by construction, pollution control, property easements, wetlands, preservation of culture resources, and endangered species.

**General.** In locating dikes, careful considerations shall be given to preserving natural areas, fish and wildlife habitat, woodland, and other environmental resources. Dike construction must not encroach on or eliminate riparian buffers adjacent to streams or other areas needed to provide natural capacity for streams to carry flood flows in a manner benefiting the environment. If dike construction will adversely affect such values, concerned public agencies and private organizations shall be consulted about the project.

**Protection.** A protective cover of grasses shall be established on all exposed surfaces of the dike and other disturbed areas. Seedbed preparation, seeding, fertilizing, mulching, and fencing meet Natural Resources Conservation Service (NRCS) standard for Critical Area Planting (342).

If vegetation will not control erosion, riprap, or other protective measures shall be installed.

Conservation practice standards are reviewed periodically and updated if needed. The current version of this standard is on our eFOTG web site available at [www.sd.nrcs.usda.gov](http://www.sd.nrcs.usda.gov) or may be obtained at your local Natural Resources Conservation Service.

## CRITERIA - CLASS I DIKES

**Location.** Conditions to be considered in designing Class I dikes are foundation soils, property lines, exposure to open water, adequate outlets for gravity or pump drainage, and access for construction and maintenance. Mineral soils that will be stable in the dike embankment must be available.

**Height.** Dike design height shall be design high water depth plus freeboard of at least two feet or one foot plus wave height, whichever is greater. Design elevation of high water shall be determined as follows:

If dike failure is likely to cause loss of life or extensive high-value crop or property damage, elevation of design high water shall be the level of the 100-year-frequency flood or the maximum flood of record, whichever is greater;

If dike failure is unlikely to result in loss of life or extensive high-value crop or property damage, elevation of design high water shall be the level of peak flow that will insure the desired level of protection or the 50-year-frequency flood whichever is greater;

If the dike will be subject to stages from more than one stream or source, the criteria indicated shall be met for the combination that causes the highest stage;

Constructed dike height shall be design height plus expected settlement. Expected settlement shall be five percent or more of design height.

**Interior drainage.** If inflow from the area protected by the dike may result in loss of life or extensive high-value crop or property damage, the design shall include interior protection against a 100-year-frequency hydrograph, plus base flow, and an allowance for seepage. The design may include storage areas, gravity outlets, or pumping plants, alone or in combination.

If inflow from the area to be protected by the dike is unlikely to result in loss of life or extensive high value crop or property damage, the design shall be based on drainage requirements established for the local area or the peak flow that will insure the desired level of protection, whichever is greater. The design may include storage areas, gravity outlets, or pumping plants, alone or in combination.

In sizing outlet works for designs that include storage, minimum design storm duration for interior drainage shall be 10 days. If outlet works are designed using peak flood flows without considering storage, minimum design storm duration shall be 24 hours.

**Embankment and foundation.** Dike embankments shall be constructed of mineral soils, that will result in a stable earth fill. Organic soil shall not be used in the dike. Soils must have high specific gravity and be capable of creating a low permeability embankment. The design of the embankment shall consider available soil materials, foundation conditions, the action of water on the face of the dike, and seepage through the embankment and foundation. Design of the embankment and foundation shall be based on the length of time and height that water will stand against the dike.

Minimum top width of Class I dikes shall be 10 feet for embankment heights of 15 feet or less and 12 feet for heights more than 15 feet. If the dike top is to be used as a road, "turnarounds" or passing areas shall be provided, as needed.

Except as follows, side slopes shall be determined by stability analysis. Unprotected earth slopes shall be 3:1 or flatter on the waterside. If severe wave action is anticipated, slopes on the waterside shall be protected by erosion resistant materials or be 4:1 or flatter. Land side slopes in low plasticity soils (such as SM or ML) shall be 3:1 or flatter. Landside slopes in other soils must be 2:1 or flatter.

If dikes cross old channels or have excessively porous fills or poor foundation conditions, the land side toe shall be protected by berm. Berms shall be used to provide construction access and added stability if channel crossings are under water or saturated during construction. Berms shall be designed on the basis of site investigations, laboratory analysis, and compaction methods. The finished berm top width shall not be less than dike height above mean ground. The finished top of the berm shall not be less than one foot above mean ground and shall be sloped away from the dike.

A cutoff shall be used if foundation materials are subject to piping or undermining. The cutoff shall have a bottom width and side slopes

adequate to accommodate the equipment to be used for excavation, backfill, and compaction. Backfill shall be as required for the earth embankment. If previous foundations are too deep to be penetrated by a foundation cutoff, a drainage system adequate to insure stability of the dike shall be used.

**Ditches and borrow pits.** Land side ditches or borrow pits shall be located so the hazard of failure is not increased. Ditches for borrow pits excavated on the water side of dikes shall be wide and shallow. Plugs, at least 15 feet in top width, shall be left in the ditches at intervals not greater than 400 feet to form a series of unconnected basins.

Minimum berm widths between the dike toe and the edge of channels or borrow areas shall be two times the depth of the channel or borrow, but not less than:

Dike fill height	Minimum berm width
Less than 6 feet	12 feet
More than 6 feet	18 feet

**Drains.** A drainage system shall used if necessary to insure the safety of a dike. Toe drains, if used, shall be located on the landside and shall have a graded sand-gravel filter designed to prevent movement of foundation material into the drain.

Perforated pipe subsurface drains located closer than three times the dike design water height from the land side toe, shall be protected by a sand-gravel filter.

**Pipes and conduits.** Dikes shall be protected from scour at pump intakes and discharge locations.

All conduits through dikes shall be equipped with anti-seep collars designed to increase the distance of the seepage line along the conduit by at least 15 percent or shall be equipped with sand drainage collars described in the standard for Pond (378). Pump discharge conduits through dikes shall be equipped with a flexible coupling to prevent transmission of pumping plant vibration to the dike.

## CRITERIA - CLASS II DIKES

**Design water stage.** Maximum design water stage permitted is 12 feet above normal ground level exclusive of crossings at channels, sloughs, and gullies.

If design water depth against dikes exceeds 4 feet, the design shall be based on at least a 25-year-frequency flood or the design shall approach the 25-year flood level as nearly as possible, and relief measures such as fuse plug sections shall be installed at appropriate locations.

**Height.** Earth dike design height shall be design water depth plus freeboard of at least two feet or one foot plus wave height, whichever is greater.

Constructed dike height shall be design height plus expected settlement. Expected settlement shall be five percent or more of design height.

**Interior drainage.** Provisions must be made for adequate drainage of the area to be protected by the dike.

**Cross section.** Minimum cross sections shall be as follows:

Design water height	Minimum top width	Steepest side slope
feet	Feet	water/land
0-6	6	3:1 / 2:1
6-12	8	3:1 / 2:1

The cross sections shall be increased as required to provide additional protection against floods of long duration.

If the dike top is to be used as a road, top width shall at least 10 feet. Provide "turnarounds" or passing areas as required.

The side slopes shall be 4:1 or flatter on the waterside if severe wave action is expected or if a steeper slope would be unstable under rapid drawdown conditions. Side slopes shall be 3:1 or flatter on both sides where permeable soils of low plasticity, such as SM and ML, are used in construction, or where the purpose of the dike is to contain ag waste or other polluted material.

If dikes cross old channels or have excessively porous fills or poor foundation conditions, the land side toe shall be protected by berm. Berms shall be used to provide construction access and added stability if channel crossings are under water or saturated during construction. Finished berm top width shall not be less than dike height above mean ground. The finished berm top shall not be less than one

foot above mean ground and shall be sloped away from the dike.

**Foundation cutoff.** A cutoff shall be used if foundation materials are subject to piping or undermining. The cutoff trench shall be sufficient to minimize the hazard.

**Ditches and borrow pits.** Minimum berm widths between the dike toe and the edge of channels or borrow areas shall be two times the depth of the channel or borrow, but not less than:

Dike fill height	Minimum berm width
Less than 6 feet	10 feet
More than 6 feet	15 feet

Land side ditches or borrow areas shall be far enough away from the dike (or treated) to prevent piping through the foundation.

**Drains.** A drainage system shall be used if necessary to insure the safety of a dike. Toe drains, if used, shall be located on the landside and shall have a graded sand-gravel filter designed to prevent movement of foundation material into the drain.

Perforated pipe subsurface drains located closer than three times the dike design water height from the land side toe, shall be protected by a sand-gravel filter.

**Pipes and conduits.** Dikes shall be protected from scour at pump intakes and discharge locations.

All conduits through dikes shall be equipped with anti-seep collars designed to increase the distance of the seepage line along the conduit by at least 15 percent or shall be equipped with sand drainage collars described in the standard for Pond (378). Pump discharge conduits through dikes shall be equipped with a flexible coupling to prevent transmission of pumping plant vibration to the dike.

**CRITERIA - CLASS III DIKES**

Design shall be based on site conditions.

**Top width.** Minimum top width is four feet.

**Side slopes.** Minimum side slope is 2:1, except 3:1 where the purpose of the dike is to contain polluted material.

**Freeboard.** The minimum freeboard is one foot plus wave height. Constructed dike height shall

be design height plus expected settlement. Expected settlement shall be at least 10 percent of design height for dumped fill, and 5 percent for compacted fill.

**Foundation cutoff.** A cutoff shall be installed if necessary to insure stability.

**Embankment.** Dumped or compacted fill may be used.

**Ditches and borrow pits.** Minimum berm widths between the dike toe and the edge of channels or borrow areas shall be two times the depth of the channel or borrow area but not less than eight feet.

## **CONSIDERATIONS**

Considerations should include dike effects on wetlands and upstream and downstream flow velocities and depths. Considerations should also include visual, environmental, social and economic concerns.

## **PLANS AND SPECIFICATIONS**

Plans and specifications for constructing dikes shall meet this standard and shall describe the requirements to achieve its intended purpose.

## **OPERATION AND MAINTENANCE**

An operation and maintenance plan shall be prepared for use by the owner/operator. The plan shall provide specific instructions for operating and maintaining the system to insure that it functions properly. The plan shall also provide for periodic inspection and repair or replacement of damage.

**Maintenance.** All dikes must be adequately maintained to the required shape and height. The operation and maintenance plan must include periodic removal of woody vegetation that may become established on the embankment. Provisions for maintenance access must be provided.