

302 CMR 10.00: DAM SAFETY

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10.01: Purpose

The purpose of 302 CMR 10.00 is to provide regulatory guidelines for the safety of dams by establishing reasonable standards and to create a record for public review of the performance of a dam.

10.02: Application

302 CMR 10.00 shall apply to the registration of dams, safety inspections, owner responsibilities, applications for review and approval of plans for the construction, alteration, modification, repair, enlargement, and removal of dams, quality assurance of construction, acceptance of construction, notification of intent to construct, and emergency action plans. 302 CMR 10.00 shall apply to any dam, as defined in 302 CMR 10.03, constructed, altered or used to store and/or divert water in Massachusetts. Certain structures defined in 302 CMR 10.03 are exempt from 302 CMR 10.00.

10.03: Definitions

In addition to M.G.L. c. 253, § 44 as used in 302 CMR 10.00, the following terms shall have the following meanings:

(1) Undefined Terms. As used in 302 CMR 10.00 any term not defined in accordance with 302 CMR 10.03 shall have the meaning given to the term by any statutes, regulations, executive orders or policy directives governing the subject matter of the term. Examples include terms pertaining to:

(a) Wetlands, which is defined by the Wetlands Protection Act, M.G.L. c. 131, § 40, and its implementing regulations, 310 CMR 10.00: *Wetlands Protection*, and 33 USC 1341 and 314 CMR 9.00: *401 Water Quality Certification for Discharge of Dredged or Fill Material, Dredging, and Dredged Material Disposal in Waters of the United States Within the Commonwealth* regarding Water Quality Certification, as well as other statutes, regulations, executive orders, or policy directives that govern wetlands issues; and

(b) Roadways or traffic, which are defined by the Massachusetts Highway Department's Highway Access Policy (adopted September 17, 1991), its Standard Operating Procedure for Review of State Highway Access permits (adopted September 17, 1991), and the Guidelines for EIR/EIS Traffic Impact Assessment (1989, as amended) by the Massachusetts Department of Transportation and the Executive Office of Energy and Environmental Affairs, as well as other statutes, regulations, executive orders or policy directives that govern roadway and traffic issues.

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(2) Defined Terms. As used in 302 CMR 10.00, the following terms shall have the following meanings:

Abutment. That part of a valley side against which a dam is constructed. An artificial abutment is sometimes constructed as a concrete gravity section, to take the thrust of an arch dam where there is no suitable natural abutment. Right and left abutments are those on respective sides of an observer looking downstream.

Acre-foot. A unit of volumetric measure that would cover one acre to a depth of one foot. It is equal to 43,560 cubic feet. One million U.S. gallons = 3.068 acre foot.

Applicant. Any person making application for a dam safety permit.

Appurtenant Works. Structures, either in dams or separate therefrom, including, but not limited to, spillways; reservoirs and their rims; low level outlet works; and water conduits, including tunnels, pipelines or penstocks, either through the dams or their abutments.

Artificial Impoundment. As applied to dam safety, a reservoir created by a dam.

As-builts. Plans, drawings and all other descriptive and factual information that depict how a dam was actually constructed or repaired. As-builts are required to be submitted to the Commissioner at dam completion.

Axis of Dam. A plane or curved surface, arbitrarily chosen by a designer, appearing as a line in a plan or cross section to which the horizontal dimensions of the dam can be referred.

Baffle Block. A block, usually of concrete, constructed in a channel or stilling basin to dissipate the energy of water flowing at high velocity.

Base Width (Base Thickness). The maximum width or thickness of a dam measured horizontally between upstream and downstream faces and normal to the axis of the dam but excluding projections for outlets, *etc.*

Beaver Dams. Dams that are constructed by beavers and not subject to 302 CMR 10.00. Control of beaver population and removal of beaver dams is regulated by M.G.L. c. 131, 321 CMR 2.00: *Miscellaneous Regulations Relating to Fisheries and Wildlife*, and also by the Local Boards of Health and Conservation Commissions.

Berm. A horizontal step or bench in the sloping profile of an embankment dam.

Boil. A disturbance in the surface layer of soil caused by water escaping under pressure from behind a water retaining structure such as dam or a dike. The boil may be accompanied by the deposit of soil particles (usually sand) in the form of a ring (miniature volcano) around the area where the water escapes.

Certificate of Completion. A document signed and stamped by a registered professional engineer with contractor's signature and supporting as-builts, upon completion of the work, attesting that the work has been performed in accordance with the design plans and specifications and permit conditions.

Certificate of Compliance. When a dam has been evaluated, constructed, repaired, altered or removed to the satisfaction of the Commissioner under a properly issued permit, the Commissioner shall issue a certificate of compliance, on a form prescribed by the Commissioner, to the owner certifying that the permitted construction project has been completed in accordance with the plans and specifications and any requirement set forth by the Commissioner. Such certificate shall be recorded by the owner in the registry of deeds in the county where the dam lies. Issuance of such Certificate of Compliance shall release the dam owner from the requirements of the Certificate of Non-compliance.

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Certificate of Non-compliance. A certificate issued by the Commissioner when a dam or appurtenant features are in poor or unsafe condition with identified structural deficiencies. Such certificate shall be recorded by the Commissioner in the registry of deeds in the county where the dam lies.

Cofferdam. A temporary structure enclosing all or part of a construction area so that construction can proceed in a dry area. A "diversion cofferdam" diverts a river into a pipe, channel or tunnel.

Commissioner. The Commissioner of the Department of Conservation and Recreation or his or her authorized designee.

Conduit. A closed channel for conveying discharge through or under a dam.

Crib Dam. A gravity dam built up of boxes, cribs, crossed timbers, or gabions and filled with earth or rock.

Culvert. A drain or waterway built transversely under a road, railway, or embankment, usually consisting of a pipe or covered channel of box section. It includes a gallery or waterway constructed through any type of dam, which is normally dry but is used occasionally for discharging water, hence the terms "scour culvert", "draw-off culvert", and "spillway culvert". A roadway or railway culvert may not be considered a dam if its invert is at the natural bed of the water course, it has adequate discharge capacity, and it does not impound water under normal circumstances. A culvert with an installed man made water control device which impounds, releases, or diverts water may be designated by the Commissioner as a dam.

Cutoff Wall. An impervious construction or material which reduces seepage or prevents it from passing through foundation material.

Dam Any artificial barrier, including appurtenant works, which impounds or diverts water, and which:

- (a) is 25 feet or more in height from the natural bed of the stream or watercourse measured at the downstream toe of the barrier, or from the lowest elevation of the outside limit of the barrier, if it is not across a stream channel or watercourse, to the maximum water storage elevation; or
- (b) has an impounding capacity at maximum water storage elevation of 50 acre feet or more. Any other artificial barrier, including appurtenant works, the breaching of which could endanger property or safety, may be designated by the Commissioner as a dam, and shall be subject to M.G.L. c. 21, § 65 and c. 253, §§ 44 through 48.

Dam shall not mean any of the following:

- 1. any appurtenant works which temporarily impounds or diverts water used on land in agricultural use as defined pursuant to M.G.L. c. 131, § 40;
- 2. any barrier or appurtenant works which has a size classification of small or low hazard potential classification that is used on land in agricultural use as defined in M.G.L. c. 131, § 40; and
- 3. any barrier which is not in excess of six feet in height, regardless of storage capacity, or which has a storage capacity at maximum water storage elevation not in excess of 15 acre feet, regardless of height.

The Commissioner shall make such determination by taking into consideration factors such as height, type of structure, condition of structure, volume of the impoundment, extent of development downstream, and other factors deemed appropriate by the Commissioner.

Dam Breach. An eroded or failed section opening through a dam which drains the impoundment. A controlled breach is a design and constructed opening. An uncontrolled breach is an unintentional opening which allows uncontrolled discharge from the impoundment.

Dam Break Analysis. A determination of a flood hydrograph, resulting flood levels and inundation area resulting from a dam breach.

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Dam Certificate of Registration. A certificate to be issued by the Commissioner to the dam owner following completion and submittal by the dam owner of the dam registration form.

Dam Failure. A collapse of an impounding structure resulting in an uncontrolled release of impounded water from a dam.

Dam Inspection Form or Format. A form or forms prescribed by the Commissioner containing information relative to the present condition, safety and adequacy of the dam and such other information as the Commissioner may require by regulation, signed by a registered professional engineer and filed with the Department.

Dams Not Regulated by M.G.L. c. 253, §§ 44 through 48. Dams constructed by beavers, created by ice, debris, *etc.* and any other non-man-made structures.

Dam Registration Form. A form or forms to be provided by the Commissioner to be prepared by the owner and filed with the Commissioner containing the name of the owner, the location and the dimensions of the dam and such other information as the Commissioner may require by regulation.

Dam Safety Engineer. A person who is employed by the department who meets the requirements established by the Department of Personnel Administration.

Database. An electronic database of detailed information about dams. The database is owned, compiled, maintained and distributed by the Commissioner. Requests for database information are subject to M.G.L. c. 4, § 7, clause twenty-sixth (n) (Public Records) until suspended.

DEP. The Department of Environmental Protection.

Department or DCR. The Department of Conservation and Recreation, as established in M.G.L. c. 21 § 1.

Drainage Area. The area which drains to a particular point on a river or stream.

Drawdown. The lowering of water surface level due to loss of water from a reservoir.

Embankment. The fill material, usually earth or rock, placed with sloping sides which provide a permanent barrier which impounds water.

Emergency Condition. Unsafe dams with highest risk of failure, requiring immediate attention and a predetermined plan of action to reduce the highest level of risk, for the protection of public safety.

Emergency Action Plan. A predetermined plan of action to be taken to reduce the potential for property damage and/or loss of life in an area affected by an impending dam break.

Engineer/Design Engineer. *See* Registered Professional Engineer.

Factor of Safety. As applied to dam safety, the ratio of the forces or moments resisting mass movement to the forces or moments tending to produce mass movement.

Fees. As applied to dam safety, the cost of services listed under 801 CMR 4.02: *Fees for Licenses, Permits, and Services to be Charged by State Agencies* (302 CMR: Department of Conservation and Recreation) and provided by the Department.

Flashboards. A length of timber, concrete, or steel placed on the crest of a spillway or other hydraulic control structure to raise the retention water level but that may be quickly removed in the event of a flood either by a tripping device or by a deliberately designed failure of the flashboard or its supports.

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Flood Hydrograph. A graphical representation of the flood discharge and/or stage with respect to time for a particular point on a stream or river.

Flow Net. A graphical representation of families of streamlines and equipotential lines, used in groundwater studies to determine quantities, rate, and directions of flow.

Freeboard. The vertical distance between a stated water level and the top of a dam. Net freeboard, dry freeboard, flood freeboard or residual freeboard are measured by the vertical distance between the spillway design flood water level and the top of a dam.

Gravity Dam. A dam constructed of concrete and/or masonry that relies on its weight for stability.

Great Pond. A pond containing in its natural state more than ten acres of land, as defined in 310 CMR 9.02: *Definitions*.

Great Pond/Enlarged. As applied to dam safety, any change in or addition to an existing Great Pond which raises, or may raise, the normal water level of the water impounded by a Great Pond, by construction of a dam.

Hazard Potential Classification. The rating for a dam based on the potential consequences of failure. The rating is based on potential for loss of life and damage to property that failure of that dam could cause downstream of the dam. The hazard potential classification for a dam has no relationship to the current structural integrity, operational status, flood routing capability, or safety condition of the dam or its appurtenances.

Height of Dam. The vertical distance from the elevation of the dam crest to the lowest point of natural ground, including any stream channel, along the downstream toe of the dam.

Hydraulic and Hydrologic (H&H) Analyses. The analytical process of computing the inflow and outflow from the dam under normal and flood conditions. Such analysis determines normal and maximum reservoir levels, outflows and spillway design and freeboard requirements.

Hydraulic Height. The height to which water is normally retained behind a dam above the lowest point of natural ground, including any stream channel along the downstream toe of the dam.

Inspections.

(a) Additional Required Inspection means an additional inspection by a registered professional engineer of the dam, in accordance with the inspection frequency established by the Commissioner, to detect apparent signs and changes of deterioration in material, developing weaknesses or unsafe hydraulic and/or structural behavior or any other deficiencies of the dam structure or function since the initial Phase I or poor/unsatisfactory condition was determined. The additional inspection report shall follow a form as established by the Commissioner.

(b) Follow-up Inspection means an inspection of dams determined to be in poor or unsafe condition with structural deficiencies performed on a frequency determined by the Commissioner, or as otherwise required for any dam at any time. The Follow-up Inspection report shall follow a form as established by the Commissioner.

(c) Phase I Formal Inspection means the formal visual inspection of the dam, in accordance with the inspection frequency established by, at a minimum, M.G.L. c. 21, § 65, or by the Commissioner, by a registered professional civil engineer to evaluate or reevaluate the safety and integrity of the dam and appurtenant structures to determine if the structure appears to meet current design criteria. Formal inspection includes field observations to detect any signs of deterioration in material, seepage, developing weaknesses or unsafe hydraulic and/or structural conditions and a review of the records on project design, construction and performance. The Phase I Formal Inspection shall determine the overall dam condition. The final Phase I Formal Inspection report shall follow a form or format as established by the Commissioner and shall be filed with the Office of Dam Safety.

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(d) Phase II Detailed Inspection means all studies, investigations and analyses ordered by the Commissioner to evaluate the structural stability and hydraulic capacity of a dam or reservoir and appurtenant works. This inspection may include, but is not limited to, updated visual inspection, structural stability analyses, detailed hydrologic/hydraulic assessment, dam breach analyses, subsurface investigation, soil and materials testing, foundation explorations, conclusions, conceptual alternatives, cost estimate and recommendations. This inspection shall be performed by a registered professional civil engineer.

(e) VIF (Verification In Field) Jurisdictional Determination Inspection means an inspection to collect pertinent and sufficient information pertaining to a dam to determine if the Commissioner has a basis for claiming statutory and regulatory jurisdiction of a dam.

Instrumentation. An arrangement of devices installed into or near dams (*i.e.* piezometers, inclinometers, strain gages, measurement points, seepage measuring devices, *etc.*) which provide for measurements that can be used to evaluate the structural behavior and performance parameters of the structure.

Inundation Map. A map delineating the area that would be flooded by a particular flood event or dam failure.

Liability. Legal liability associated with the ownership, operation, maintenance, repair and failure of a dam.

Lien. A notice for the payment by the owner of a dam to the Commonwealth of the costs and expenses incurred by the Commonwealth for any actions taken in accordance with M.G.L. c. 253, § 47 and shall be effective upon mailing to the owner at the address shown in the Certificate of Registration and recorded at the Registry of Deeds in the county where the dam lies.

Low Level Outlet (Pond Drain). An installed pipe and operable gate or valve that can be utilized to alter water levels, empty an impoundment, or otherwise meet operational or safety needs.

Materially Alter. Any change to a dam or reservoir which affects the physical parameters and/or safety of the dam or reservoir which may include, but is not limited to, changing the height of a dam, increasing the normal pool or spillway elevation or changing the elevation or physical dimensions of an emergency spillway.

Maximum Impoundment Elevation. The maximum water surface elevation which can be contained by the dam without overtopping the embankment section.

Maximum Water Storage Elevation. The water surface elevation reached during the spillway design flood, which could be below the top of the dam or above the top of the dam.

Normal Water Level. The water surface elevation that is maintained by the dam owner under normal operating conditions.

Office of Dam Safety (ODS). The office of the Department of Conservation and Recreation, composed of technical and administrative staff responsible for administering the Commonwealth's Dam Safety Law and Regulations.

One-hundred-year Storm Event. A storm which is estimated to have a 1% chance of occurrence in any year, or a one in 100 chance of being equaled or exceeded in one year.

Operation and Maintenance Manual (O&MM). A document identifying routine maintenance and operational procedures under routine and storm conditions.

Order. A written document prepared and issued by the Commissioner which mandates specific actions to be accomplished by a dam owner within a specified time frame. Failure to comply with an order shall make the owner subject to fines as provided for in 302 CMR 10.15.

10.03: continued

Orientation.

- (a) Upstream means the side of the dam that borders the reservoir;
- (b) Downstream means the side opposite the upstream side;
- (c) Right means the area to the right when the viewer is looking downstream; and
- (d) Left means the area to the left when the viewer is looking downstream.

Owner. The person or persons, including any individual, firm, partnership, association, syndicate, company, trust corporation, municipality, agency, political or administrative subdivision of the commonwealth or any other legal entity of any kind holding legal title to a dam, but excluding the United States, its agencies or any person who operates a dam owned by the United States.

Permit or Chapter 253 Dam Safety Permit. A written approval, pursuant to M.G.L. c. 253, §§ 44 through 48, to construct, repair, alter, breach or remove a dam. The technical aspect of the Permit must be reviewed and confirmed complete by an Office of Dam Safety Engineer.

Phreatic Surface. The free surface of groundwater at atmospheric pressure.

Piezometer. As applied to dam safety, an instrument used for measuring water pressure within soil, rock or concrete.

Piping. The progressive development of internal erosion by seepage, appearing downstream as a hole or seam discharging water that contains soil particles.

Poor Condition Dam. A dam whose condition, as determined by the Commissioner, presents a significant risk to public safety located downstream from the dam. Among the deficiencies that may result in this determination are: significant seepage or piping, significant woody vegetation and tree growth on embankments and areas immediately adjacent to the dam and appurtenances, significant erosion or subsidence conditions, significant sink holes, significant sloughing of embankment, significant deficient flood routing spillway capacity and/or condition of outlet(s), significant movement or cracking of structural elements and other significant structural deficiencies.

Probable Maximum Flood (PMF). The most severe flood that is considered reasonably possible at a site as a result of the most severe combination of critical meteorological and hydrologic conditions possible in the region. PMFs are based on National Oceanic and Atmospheric Administration (NOAA) Probable Maximum Precipitation Estimates published in *Hydrometeorological Report No. 51* and applicable NOAA guidance documents.

Registered Professional Engineer. In the context of dam engineering, means a civil engineer licensed and registered in the Commonwealth of Massachusetts with experience in dam safety inspections and engineering.

Removal. The physical removal or engineered breaching of a dam to the extent that no water can be impounded by the dam.

Repairs means any work done at a dam which affects the integrity of the dam. This includes, but is not limited to, work requiring excavation into the embankment fill or foundation of a dam or work requiring removal or replacement of major structural components of a dam.

Reservoir. The area which contains or will contain the body of water impounded by a dam.

Riprap. A layer or layers of sufficiently large uncoursed stones, broken rock, or pre-cast blocks placed in random fashion on the upstream or downstream slope of an embankment dam, on a reservoir shore, on the sides of a channel or other elements of a dam to provide protection from erosion expected to be caused by wave action, freeze thaw cycles, flowing water or other erosive forces. Riprap is sometimes referred to as armoring.

10.03: continued

Risk. A measure of the likelihood and severity of adverse consequences. In dam safety applications, life-safety risk is expressed in units of loss-of-lives per year; economic, societal and environmental risks are expressed in units of dollars per year. The risk may be associated with an individual failure mode or it may be total risk, representing the cumulative risk associated with all failure modes.

Risk Assessment. As applied to dam safety, the process of identifying the likelihood and consequences of dam failure to provide the basis for informed decisions on a course of action.

Roll Dams. Low head dams usually run-of-the-river overflow weir or spillway structures that produce vertical water surface drops of one to 15 feet and change river flows from super-critical to sub-critical.

Run-of-the-river-dam. A dam situated on a river or stream whose spillway length and width of impoundment is nearly equal to the width of the original river or stream bank to bank and likely having minimal storage available for flood attenuation.

Safety Evaluation. As applied to dam safety, the process of determining the ability of a dam and its appurtenances to pass a given flood.

Seepage. The interstitial movement of water that may take place through a dam, its foundation, or its abutments.

Siphon/Inverted. A conduit or culvert to permit water to pass under an intersecting roadway, stream or other obstruction.

Spillway. A structure over or through which non-storm related and flood flows are discharged. If the flow is controlled by gates or other works of control, it is a controlled spillway; if the elevation of the spillway crest is the only control, it is an uncontrolled spillway.

Spillway/Auxiliary or Emergency Spillway. A secondary spillway designed to operate only during flood events that exceed the principal spillway capacity or operate in tandem with the principal spillway.

Spillway(s) Design Flood (SDF). The flood used in the design of a dam and its appurtenant works particularly for sizing the spillway(s) and outlet works, and for determining maximum temporary storage and height of dam requirements.

Stoplogs. Logs, timbers, steel or alloy beams placed on top of each other with their ends held in guides on each side of a channel or conduit to control water level in reservoir.

Tailwater Level. As applied to dam safety, the level of water in the discharge channel immediately downstream of the dam. Tailwater levels can be those levels that result from normal to flood flow (SDF) conditions.

Toe of Dam. The junction of the downstream face of a dam with the ground surface, also referred to as downstream toe. For an embankment dam, the junction of the upstream face with ground surface is called the upstream toe.

Unsafe Condition Dam. A dam whose condition, as determined by the Commissioner, is such that a high risk of failure exists and the dam condition presents a high risk to public safety located downstream from the dam. Among the deficiencies that may result in this determination are: severe seepage or piping, severe woody vegetation and tree growth on embankments and areas immediately adjacent to the dam and appurtenances, severe erosion or subsidence conditions, severe sink holes, severe sloughing of embankment, severely deficient flood routing spillway capacity and/or condition of outlet(s), severe movement and/or severe cracking of structural elements and other severe structural deficiencies.

10.03: continued

Uplift. As applied to dam safety, the upward pressure in the pores of a material (interstitial pressure) or on the base of a structure.

Weir. A barrier installed in an open channel stream or constructed waterway used for measuring and/or controlling the flow of water. Types of weir include broad crested weir, sharp-crested weir, ogee weir, and V-notched weir.

10.04: Exclusions

Dams owned and operated by the United States, its agencies or any person who operates a dam owned by the United States are excluded from the provisions in 302 CMR 10.00, together with dams and reservoirs licensed and subject to inspection by the Federal Energy Regulatory Commission (FERC) provided that a copy of all FERC approved periodic inspection reports are provided to the Department. All other dams are subject to 302 CMR 10.00 unless exempted in writing by the Commissioner, M.G.L. c. 253, §§ 44 through 48, or 302 CMR 10.00. Examples of exempt dams could be temporary drainage detention ponds, depending upon size and other considerations, surface impoundments (other than water) for industrial or commercial wastes which are regulated by other agencies or storage tanks.

10.05: Registration

- (1) General. The purpose of registration is to establish a public record for the dam.
- (2) The owner of any dam subject to 302 CMR 10.00 shall cause to be filed with the Commissioner, within 30 days following notice by him, on a form prescribed by him, a Dam Registration Form containing the name of the owner, the location and dimensions of such dam and such other information as the Commissioner may reasonably require.
- (3) A registration form shall not be deemed received by the Commissioner until all information required by statute or 302 CMR 10.00 is furnished.
- (4) In the event that the owner fails to file the dam registration form in the time prescribed, the Commissioner may notify the owner of such failure and offer a 30 day grace period after which a Certificate of Non-compliance will be issued and recorded at the Registry of Deeds in the county where the dam lies, with all costs of recording, and interest thereon, to be assessed against the owner.
- (5) Upon receipt and approval of the Dam Registration Form, a Certificate of Registration will be issued to each owner. Within 14 days of receipt such Certificate of Registration must be recorded by the owner at the Registry of Deeds in the county where the dam lies, and a copy of the recorded Certificate filed with the Commissioner within ten days of recording.
- (6) The owner shall notify the Commissioner by registered or certified mail, of the proposed transfer of legal title of such dam 30 days prior to any such transfer. Upon receipt of such notice, a new Certificate of Registration will be issued. Such Certificate shall contain any outstanding obligations of the registered owner under M.G.L. c. 253, §§ 44 through 50.

10.06: Size and Hazard Potential Classification

- (1) General. Dams shall be classified for purposes of establishing inspection schedules and adherence to design criteria, in accordance with their potential for damage to life or property in the area downstream from the dam in the event of failure of the dam or appurtenant facilities. This determination shall be made by the Commissioner and noted on the owner's Certificate of Registration. It may be necessary to periodically reclassify dams as additional information becomes available and/or conditions change. The criteria established in 302 CMR 10.06(2) through (4) shall be used by the Commissioner to determine the size and hazard potential classification based upon the extent of development downstream from the dam, taking into consideration factors such as height, type of structure and volume of impoundment, pursuant to M.G.L. c. 253.

10.06: continued

(2) Size Classification. The classification for size based on the height of the dam and storage capacity shall be in accordance with 302 CMR 10.06(2): *Size Classification Table*. The height of the dam is established as described in 302 CMR 10.06 with respect to maximum water storage elevation. The storage capacity of the dam is the volume of water contained in the impoundment at maximum water storage elevation measured as defined in 302 CMR 10.06(2). Size class may be determined by either storage or height, whichever gives the larger size classification.

SIZE CLASSIFICATION TABLE

Category	Storage (acre-feet)	Height (feet)
Non-jurisdictional*	Not in excess of 15 regardless of height	Not in excess of six regardless of storage capacity
Small	≥ 15 and <50	≥ 6 and <15
Intermediate	≥ 50 and <1000	≥ 15 and <40
Large	≥ 1000	≥ 40
*For dams not in excess of 6 feet in height or having maximum impounding capacity not in excess of 15 acre-feet, the Commissioner shall make jurisdictional determination by taking into consideration factors or combination of factors such as height, type of structure, volume of the impoundment, extent of downstream development, and other factors deemed appropriate by the Commissioner.		

(3) Hazard Potential Classification. The classification for hazard potential shall be in accordance with 302 CMR 10.06(3): *Hazard Potential Classification Table*. The hazards pertain to potential loss of human life or property damage in the event of failure of the dam or appurtenant works. Development of the area downstream from the dam that would be affected by its failure shall be considered in determining the classification. Dams will be subject to reclassification if the Commissioner determines the hazard potential has changed.

HAZARD POTENTIAL CLASSIFICATION TABLE

High Hazard Potential (Class I)	Dams located where failure will likely cause loss of life and serious damage to home(s), industrial or commercial facilities, important public utilities, main highway(s) or railroad(s).
Significant Hazard Potential (Class II)	Dams located where failure may cause loss of life and damage to home(s), industrial or commercial facilities, secondary highway(s) or railroad(s) or cause interruption of use or service of relatively important facilities.
Low Hazard Potential (Class III)	Dams located where failure may cause minimal property damage to others. Loss of life is not expected.

(4) Dams in Series. If an upstream dam failure has the capability to create failure of a downstream dam because of its failure flood wave, it shall have the same or higher hazard potential classification as the downstream dam. If the failure flood wave of the upstream dam will not cause failure of the downstream dam, the upstream dam may have a different hazard potential classification from the downstream dam.

(5) Failure Damage. The extent of potential damage resulting from a dam breach may justify designating damage as either major or minor.

- (a) Such a designation may be made after a detailed analysis has established the relative impact of the probable dam breach and has considered the following factors:
1. the conditions prior to and after a dam breach;
 2. the extent to which access has been affected, both before and after a dam breach; and
 3. the extent of damage.

10.06: continued

- (b) Potential damage to habitable structures will be considered minor when habitable structures are not within the direct path of the probable flood wave produced upon failure of a dam or where such structures will experience:
1. no more than 2.0 feet incremental rise of flood water above the lowest ground elevation adjacent to the outside foundation walls; or
 2. no more than 2.0 feet incremental rise of flood water above the lowest habitable floor elevation of the structure; the lower of the two elevations governing.

(6) Hazard Potential Reconsideration. An owner may at any time request the Commissioner to reconsider the hazard potential classification of their dam. The owner's request must be filed by a registered professional engineer, in a form provided by the Commissioner which provides the findings of the engineer's technical analysis and investigations which may support a change in classification. The Commissioner will issue a written decision to the owner and the registered professional civil engineer within 30 days of receipt of a request for hazard potential reconsideration, and such decision shall be final and binding upon the parties.

(7) Hazard Potential Classification Review. While it is recommended dam safety practice to review the classification of each dam during each subsequent periodic Phase I Formal Inspection, to ensure the accuracy of Hazard Potential Classification of dams, each dam owner shall hire a qualified Registered Professional Engineer to review the classification of their dam(s) at least on a frequency of ten years or as otherwise ordered by the Commissioner.

10.07: Inspection Schedule

(1) Upon the failure of an owner to file a dam inspection report within the time prescribed, the Commissioner or his or her designee, in accordance with M.G.L. c. 253, § 47 may enter upon the property on which the Department's jurisdictional dam(s) and appurtenant works lie at any time to conduct any kind of dam safety evaluation(s) and/or action(s) as required, and/or to obtain the requisite information. In addition to the assessed fines described in 302 CMR 10.15, the cost to the Commonwealth of conducting the inspection and producing the inspection report(s) plus interest shall be assessed against the owner in this case.

(2) Dam owners shall periodically inspect all dams in accordance with the following schedule. These time periods are the maximum time between inspections; more frequent inspections may be performed at the discretion of the Commissioner.

PHASE I FORMAL INSPECTION FREQUENCY

Hazard Potential	Inspection Frequency
Low	Ten Years
Significant	Five Years
High	Two Years

ADDITIONAL INSPECTION FREQUENCY

- (a) High and Significant Hazard potential dams whose condition have been determined to be poor or unsafe by inspection must be inspected and reported at least every three months by a registered professional engineer employed by the owner until the dam safety repairs are completed and the dam is found to be in satisfactory condition, unless otherwise ordered by the Commissioner. Such inspections shall be termed Follow-up Inspections and shall be submitted to the Office of Dam Safety.
- (b) Any dam determined to be in poor or unsafe condition may be required to be monitored during anticipated rain/runoff events as ordered by the Commissioner.
- (c) All inspections, monitoring data and updates on the condition of the dam shall be provided by a registered professional engineer to the Office of Dam Safety and local emergency management officials until the dam is brought into compliance with dam safety requirements.

10.07: continued

- (3) Inspections scheduled according to the time period set forth in 302 CMR 10.07(2) may be modified, at the discretion of the Commissioner, in special cases where it is desirable to observe a dam under particular conditions (*i.e.* wet season, dry season, foliage, *etc.*).
- (4) For any regulated dam, the Commissioner may require scheduled inspections on a more frequent basis if particular conditions exist which require more frequent monitoring.
- (5) When the Commissioner reschedules the inspection of a particular dam for any reason cited in 302 CMR 10.07, the date of that inspection may become the starting date from which the date of the next regularly scheduled periodic inspection will be computed.
- (6) The owner shall employ the services of a registered professional engineer experienced in the design, construction and inspection of dams, to inspect the owner's dam according to the inspection schedules determined by the Commissioner and on forms prescribed by the Commissioner.
- (7) The owner shall furnish a copy of each completed inspection report in a format determined by the Commissioner within 30 days of the date of the inspection to the Commissioner.
- (8) The inspection report shall be sealed by a registered professional engineer, as described in 302 CMR 10.00.
- (9) The owner must submit a statement of his or her intent to implement such recommendations of the registered professional engineer, if required.
- (10) Upon review and approval of submitted inspection report, the Commissioner will determine compliance and appropriate procedure(s) in accordance with 302 CMR 10.08.

10.08: Compliance with Inspection Results

- (1) The Commissioner shall determine whether the dam and appurtenant features meet accepted dam safety standards. If the Commissioner determines that the dam does not meet these standards and a threat to life and/or property exists, he shall issue a Certificate of Non-compliance. Certificates shall be recorded by the Commissioner with the Registry of Deeds for the county where the dam lies.
- (2) A Certificate of Non-compliance shall be issued if the Commissioner determines that the dam or appurtenant features are structurally deficient and in either poor or unsafe condition, as defined under 302 CMR 10.03.
- (3) If the Commissioner issues a Certificate of Non-compliance, after receiving the owner's inspection form, or at any other time, the Commissioner may order the owner of the dam to: obtain a detailed inspection of the dam by a registered professional engineer, including such tests as the Commissioner may require or recommend to determine the course of action necessary to bring the dam into compliance and a time schedule by which the work shall be accomplished; or take whatever action is necessary to reduce the safety risk, as determined by the Commissioner.
- (4) Notice of such aforementioned orders shall be served upon the owner(s) by registered or certified mail, return receipt requested, and recorded by the Commissioner in the Registry of Deeds in the county where the dam lies.
- (5) When the dam meets minimum dam safety standards, or has been corrected or removed pursuant to an order by the Commissioner, the Commissioner shall issue a Certificate of Compliance to the owner following completion of a dam safety permitted project.

10.08: continued

(6) The Commissioner has the authority, pursuant to M.G.L. c. 253, § 47, and in accordance with the Memorandum of Understanding between the DEP and the DCR relative to lake water level drawdowns/dam repair projects, to determine the maximum allowable water elevation for reservoirs and impoundments where dams have been determined to be unsafe. In determining the maximum allowable water elevation, the Commissioner may consider the recommendations of a registered professional engineer representing the owner, if the owner has retained one. The owner shall not store water in excess of the stated elevation determined by the Commissioner.

(7) When the spillway capacity of the existing dam does not meet stated criteria, the Commissioner may require the dam owner's engineer to perform a relative impact analysis. This analysis shall address such factors as: downstream impact area; capacity and/or condition of outlet work(s); overtopping potential; operation plans; consideration of incremental impacts of possible failure; and emergency action plans. A reduction in the standard design flood may be allowed to such dam upon review and approval by the Commissioner.

10.09: Dam Construction, Repair, Alteration, Breach or Removal Permit

(1) General Application. Any person(s) who proposes to construct, repair, materially alter, breach or remove a dam, pursuant to M.G.L. c. 253, must file with the Commissioner a permit application to determine whether or not a Chapter 253 Dam Safety Permit is required. Routine maintenance-related work such as mowing, brush cutting, spillway debris removal and other site maintenance does not require a Chapter 253 Dam Safety Permit. Approved permits issued by the Commissioner do not relieve the applicant from required compliance with M.G.L. c. 131, § 40, and, where applicable, M.G.L. c. 131, §§ 5C and 19. Applications shall be sent by certified mail, return receipt requested. All permit applications must comply with DCR's standard design and construction criteria (*see* 302 CMR 10.14). If the Commissioner determines that the proposed dam falls within the jurisdiction of 302 CMR 10.00, the owner must complete the construction, repair, alteration, breach or removal permit application as follows:

(a) Preliminary Report. The Permit application for any dam shall include a preliminary report. (Filing of the preliminary report prior to filing the final report, early in the site investigation and design schedule, is encouraged to assure the Commissioner's concurrence with the hazard potential classification, site investigations, design concept and required design analysis and supporting data.) The preliminary report shall be filed with the permit application and shall include, but not be limited to, the following information:

1. completion of all required information on the application;
2. maps showing the location of the proposed structure that include the county, location of state roads, access to site, and outline of the reservoir (aerial photographs or U.S. Geological Survey may be used);
3. preliminary drawings or sketches that include cross sections, plans and profiles of the dam, proposed pool levels, and type of all spillways;
4. preliminary design criteria and basis for selection including a description of the size, ground cover conditions, and extent of development of the watershed, drainage area, spillway design storm, geology and geotechnical engineering assumptions for the foundation and embankment materials, and type of materials used in the principal spillway(s); and
5. book and page number of location of the dam as recorded in the Registry of Deeds with the name of the Registry.

(b) Final Design Report. Approval or denial of a permit to construct, repair, alter, breach or remove a dam will be issued within 60 days from the time the final design report and permit application is received. The final design report shall include, but may not be limited to, the following information:

1. A report of the investigation of the foundation soils or bedrock and the borrow materials, including the location of borrow areas, that are to be used to construct or repair the dam;
2. Analysis and/or criteria to indicate that the dam will be stable during construction and filling and under all conditions of reservoir operations;
3. Computations indicating that the dam is safe against overtopping during occurrence of the inflow design flood and wave action; however, wave action need not be considered when the design flood is based on the full probable maximum precipitation (PMP);

10.09: continued

4. Criteria, design data or references to indicate that seepage flow through the embankment, foundation, and abutments will be controlled to limit internal erosion and sloughing in the area where the seepage occurs;
5. Calculations and assumptions relative to design of the spillway(s);
6. Provisions to protect the upstream slope, crest, and downstream slope of earth embankments and abutments from erosion due to wind and rain;
7. Other design data, assumptions and analysis data pertinent to individual dams and site conditions as needed;
8. A proposed construction schedule;
9. A proposed filling schedule for the reservoir;
10. A maintenance and operation plan; and
11. For all new high and significant hazard potential dams, an emergency action plan to be implemented in the event of a dam failure.

The preliminary report and the final design report may be submitted as one document.

(2) Construction Documents. Two sets of plans and specifications must be submitted along with the Final Design Report. The documents shall be detailed engineering design drawings and specifications that include the following at a minimum:

- (a) A cover sheet one showing the name of the project; name of owner; hazard potential classification of the dam; designated access to the project; and location with respect to highways, roads, streams, and any dam(s) that would affect or be affected by the proposed structure;
- (b) Maps showing the drainage area and outline of the reservoir and the ownership of properties covered by the reservoir or flood pools;
- (c) Geologic investigation, cross section, profiles, logs of borings, location of borrow areas, drawing of principal and emergency spillways, drawn in sufficient detail to clearly indicate the extent and complexity of the work performed;
- (d) The technical provisions, as may be required, to describe the method of construction and quality control for the project; and
- (e) Special provisions, as may be required, to describe technical provisions and requirements needed to ensure that the dam is modified and repaired according to the approved plans and specifications.

(3) Notification. The Commissioner shall notify the applicant in writing within 60 days following the receipt of the completed application and all required technical design submittals if the application is approved or disapproved. If the application is disapproved an explanation will be provided.

(4) Permit. Approval of construction, drawdown, repair, alteration, breach or removal of a dam will be contained in a Chapter 253 Permit to be issued by the Commissioner. A permit may be subject to written general stipulations and/or written specific stipulations deemed necessary by the Commissioner. No construction shall be performed until the permit is issued and recorded in the Registry of Deeds for the county within which the dam lies. The permit shall be valid for the construction schedule specified in the approved final design report and application. Construction must commence within two years after the permit is issued. If construction does not commence within two years after the permit is issued, the permit shall expire and a new application shall be submitted unless prior to the permit expiration date, upon written application and for good cause shown, the Commissioner extends the time for commencing construction.

(5) Recording a Chapter 253 Permit. A permit to construct, drawdown, repair, alter, breach or remove a dam shall be recorded at the Registry of Deeds in the county where the dam lies. Recording must be done prior to the commencement of construction and a copy of the recorded permit filed with the Commissioner.

(6) Notice of Construction and Drawdown Notification.

- (a) For dam safety permitted projects, at least 21 days before construction and/or controlled drawdown is commenced, the owner shall provide notice by certified and/or registered mail to the Commissioner, the local Conservation Commission and to the Commonwealth Division of Fish and Wildlife, Field Headquarters, 1 Rabbit Hill Road, Westborough, MA 01581 attn: Natural Heritage and Endangered Species Section.

10.09: continued

(b) In cases of emergency conditions, when repairs are necessary to safeguard life and property, they may be started under the provisions of M.G.L. c. 253, § 47 upon notification by the Commissioner that an emergency condition exists. The owner shall assign a registered professional engineer to monitor any drawdown for the first four hours after its commencement, observing conditions at least on an hourly basis. Thereafter, the owner or his or her registered professional engineer shall monitor the drawdown at least once each 24 hours, or as otherwise determined by the Commissioner, until drawdown has been completed. Except for emergency drawdowns in accordance with an order issued by the Commissioner, to meet standards established by the Commonwealth Division of Fisheries and Wildlife, drawdown rates should not exceed four cubic feet per second per square mile of drainage area (CFSM), as measured at the outlet structure. During re-impoundment, 0.5 cfsM should be maintained at the outflow.

(7) Entry. During construction, the Commissioner or his or her designee may enter upon the property to inspect without prior notice and may direct any additional testing or actions as required.

(8) Removal of Dams. If it is desirable to remove a dam due to new construction, abandonment or unsafe conditions, the owner shall be required to comply with 302 CMR 10.09 regarding the construction and repair of dams. Upon complete removal of the dam, the Commissioner will issue a Certificate of Approval stating that the removal has been in accordance with the approved plans and specifications, or any approved revisions thereof.

10.10: Revocation, Suspension, or Modifications of Chapter 253 Permits

Chapter 253 Permits may be revoked, suspended, modified or denied by the Commissioner for causes including, but not limited to, the following:

- (1) Violation of any permit condition;
- (2) Failure to fully disclose all relevant facts or obtaining a permit through misrepresentation;
- (3) Violation of any provisions of M.G.L. c. 253 or 302 CMR 10.00;
- (4) Change or newly discovered condition or circumstance that makes or would make the dam unsafe; or
- (5) Change of conditions develop that are hazardous to life and/or property.

10.11: Emergency Action Plans

All dams classified as High Hazard Potential or Significant Hazard Potential shall have an Emergency Action Plan (EAP) submitted to the Commissioner and the Massachusetts Emergency Management Agency. All EAPs shall be updated annually and their format shall be in accordance with guidelines established by ODS which will be posted and updated on the ODS website. Approval to construct a new Significant Hazard Potential dam or High Hazard Potential dam shall be contingent upon the submission of an EAP to the Commissioner. All EAPs are subject to approval by the Commissioner.

- (1) High Hazard Potential Dams. High Hazard Potential EAPs shall, at a minimum, contain the following:
 - (a) Identification of equipment, manpower and material available for implementation of the plan;
 - (b) A notification procedure, including Flowchart, for informing the local emergency agencies;
 - (c) A dam failure inundation map showing the stream which will be flooded, as well as the impacted downstream environment. The inundation map shall be developed by engineering modeling and methods subject to review by the Commissioner and shall display the timing and attenuation of the dam breach flood at strategic locations; and

10.11: continued

(d) A procedure for warning downstream residents if failure of the dam is imminent, and a listing of addresses and telephone numbers of downstream residents who may be affected by the failure of the dam. If an automatic notification procedure is available within the town such as a reverse 911 or comparable alert system, this may augment or substitute for a traditional telephone list, subject to approval by the Commissioner.

(2) Significant Hazard Potential Dams. Significant Hazard Potential EAPs shall, at a minimum, contain the following:

(a) Identification of equipment, manpower and material available for implementation of the plan;

(b) A notification procedure, including Flowchart, for informing local emergency agencies

(c) A dam failure inundation map showing the stream which will be flooded as well as the impacted downstream environment. The inundation map shall be developed by engineering modeling and methods subject to review by the Commissioner and shall display the timing and attenuation of the dam breach flood at strategic locations;

1. For Significant Hazard Potential Dams, an inundation map developed by engineering modeling and methods shall be required where, in the judgment of the dam owner's engineer or the Commissioner, more than several downstream interests are expected to be significantly impacted resulting from dam failure..

2. In the judgment of the dam owner's engineer, and subject to review by the Commissioner, a simplified inundation map may be allowed if there exists only one to several downstream interests that are expected to be significantly impacted by dam failure. In such a case, engineering modeling and methods may be substituted with simpler methods such as engineering judgment considering FEMA flood plain maps, review of height of dam, volume in storage, breach discharge calculations, stream channel slope, topography, proximity of the identified several interests along the anticipated flood wave route. A simplified inundation map shall locate and annotate the several downstream interests that are expected to be impacted following dam failure. An example of a setting where this paragraph may be applicable is a Significant Hazard Potential dam that carries a public roadway across the dam crest (that would collapse into a dam failure) and there are two or three occupied properties located downstream that are likely to be significantly impacted..

(d) A procedure for warning downstream residents if failure of the dam is imminent and a listing of addresses and telephone numbers of downstream residents who may be affected by the failure of the dam.

(3) Prior to submission of an EAP to the Commissioner, the owner shall submit a copy of the proposed EAP to the local and state emergency agencies, and all local emergency coordinators involved in the plan for review. The owner shall submit with the EAP, recommendations received from said agencies and coordinators, if any.

(4) Annually, the owner shall review the EAP, update it and provide the updated EAP to all involved agencies for review. Any GIS based inundation map shapefiles are to be forwarded to ODS electronically along with their copy of the completed EAP.

(5) EAPs and annual updates shall be provided by the owner in both hard copy and electronic format to the Commissioner and the Massachusetts Emergency Management Agency.

10.12: Records

Upon request by the Commissioner, an owner shall make available for inspection and review, all plans, specifications and other such pertinent material relating to the dam. The Commissioner shall return all such material upon completion of his inspection.

10.13: Liability

(1) The owner shall be responsible and liable for damage to property of others or injury to persons, including but not limited to, loss of life resulting from the operation, failure of or mis-operation of a dam.

10.13: continued

(2) 302 CMR 10.00 shall not relieve from or lessen the responsibility of any person owning, or operating a dam from any damages to persons or property caused by defects, nor shall the Commissioner be held liable by reason of any inspections, technical documents or permits issued.

10.14: Design and Construction Criteria for New and Existing Dams

- (1) General. Design and construction of dams shall comply with 302 CMR 10.14. Design and construction standards that are not included in 302 CMR 10.14, shall conform to design procedures established by: The U.S Army Corps of Engineers, the U.S. Bureau of Reclamation, the U.S. Natural Resources Conservation Service and other generally accepted engineering practices and principles. Where specific site conditions may exist which warrant appropriate changes in the following design and construction criteria, the Commissioner shall review and approve the design.
- (2) Foundations and Abutments. The foundations and abutments investigation shall consist of borings, test pits, and other subsurface exploration necessary to assess the soil, rock, and groundwater conditions.
- (3) Construction Materials. Specifications for construction materials shall establish minimum acceptance criteria so that anticipated design properties are achieved. If the use of onsite borrow materials is specified, exploration, testing, and calculations shall be performed to indicate that there are sufficient quantities of material available that meet the design criteria.
- (4) Surveys. Surveys shall be made with sufficient accuracy and scale to locate the proposed construction and to define the volume of the storage in the reservoir. The downstream area shall be investigated in order to delineate the area of potential damage in case of failure. Locations of centerlines, and other horizontal and vertical control points, shall be shown on a map of the site.
- (5) Hydrologic Investigation. The drainage area shall be determined. Present land use shall be considered in determining the runoff characteristics of the drainage area. All hydrologic assumptions and design calculations shall be included in the report.
- (6) Spillway Design.
- (a) The spillway system shall have a capacity to pass a flow resulting from a design storm, as indicated in the following table, unless the applicant provides calculations, designs and plans to show that the design flow can be stored, passed through, or passed over the dam without failure occurring.

SPILLWAY DESIGN FLOOD DESIGN STORM

Hazard Potential	Size	Existing Dams	New Dams
Low	small intermediate large	50 year 50 year 100 year	100 year 100 year 100 year
Significant	small intermediate large	100 year 100 year 500 year	500 year 500 year ½ PMF
High	small intermediate large	500 year ½ PMF ½ PMF	PMF PMF PMF

(b) Vegetated earth or unlined emergency spillway(s) will be approved when computations indicate that it will pass the design flood without jeopardizing the safety of the structure. The risk of recurring storms, excessive erosion, and inadequate vegetative cover will be considered acceptable in such a spillway when its average frequency of use is predicted to be no more than indicated in the following table.

10.14: continued

EMERGENCY SPILLWAY FREQUENCY TABLE

Hazard Potential	Size	Existing Dams	New Dams
Low	small	25 years	25 years
	intermediate	25 years	25 years
	large	25 years	25 years
Significant	small	25 years	50 years
	intermediate	25 years	50 years
	large	50 years	50 years
High	small	50 years	100 years
	intermediate	50 years	100 years
	large	100 years	100 years

(c) The Department recognizes that the relationships between valley slope and width, total reservoir storage, drainage area, and other hydrologic factors have a critical bearing on determining the safe spillway design flood. Rational selection of a safe spillway design flood for specific site conditions based on quantitative and relative impact analysis is acceptable. The spillway may be sized so that the increased downstream damage resulting from an overtopping failure of the dam (*i.e.*, the selected spillway design capacity has been exceeded) would not be significant when as compared with the damage caused by the flood in the absence of dam overtopping failure. In *lieu* of quantitative and relative impact analysis, the preceding table shall be used as spillway design criteria.

(d) Lined Spillways and Channels. The design report shall include design data criteria for open channel, drop, ogee, and chute spillways and other spillway types that include crest structures, walls, channel linings, and miscellaneous details. All masonry or concrete structures shall have joints that are relatively water tight and shall be placed on foundations capable of sustaining applied loads without undue deformation. Provisions must be made for handling leakage from the channel or under seepage from the foundation which might cause saturation of underlying materials or uplift against the undersurfaces.

- (7) Conduits. A gate or controlled conduit shall be provided to drain each reservoir.
- (a) Any new and/or existing conduit design shall include the computation of the minimum time required to drain the reservoir.
 - (b) All pipe conduits shall convey water at the design velocity without damage to the interior surface.
 - (c) Protection shall be provided to prohibit unsafe seepage along conduits through the dam, abutments, and foundations. The specific design for seepage protection along conduits shall be shown in the drawings and specifications.
 - (d) Adequate allowances shall be incorporated in the design to compensate for differential settlement and possible elongation of the pipe conduit.
 - (e) Trash racks shall be installed at the intake of conduits to prevent clogging the conduit.
 - (f) Pipe Conduit Materials.
 - 1. Pipe conduits shall be designed to support the total external loads in addition to the total internal hydraulic pressure without leakage.
 - 2. Reinforced or Prestressed Concrete Pipe Conduits.
 - a. All conduits shall be designed and constructed to remain watertight under maximum anticipated hydraulic pressure and maximum probable joint opening, including the effects of joint rotation and extensibility.
 - b. Provisions for safe movement of the barrel shall be provided at each joint in the barrel and at the junction of the barrel and riser or inlet. Cradles shall be articulated if constructed on a yielding foundation.
 - c. The owner's engineer shall submit the final design details of the proposed pipe to be used for all significant and high hazard potential dams.
 - 3. Corrugated Metal Pipe Conduits.
 - a. Corrugated metal pipe shall not be used in any dam, except for special cases where the design engineer can adequately demonstrate satisfactory performance. Any exemption which allows their use must be issued in writing by the Commissioner.

10.14: continued

4. Dissipating Devices. All gates, valves, conduits and concrete channel outlets shall be provided with an energy dissipater designed and constructed to control erosion and prevent damage to the embankment or the downstream outlet or channel.

- (g) In the case when an alternative method(s) of drawdown is requested, the proponent shall submit with the permit application reasons why a waiver should be granted (*i.e.*, contaminated sediment, funding issues, complexity of construction). The request for waiver shall demonstrate that the water in storage can be moved out of the reservoir by mechanical means. The project design report shall include a detailed description of the pumps, siphons, *etc.* that would be necessary to remove the stored water in a reasonable period of time and maintain the reservoir in a dry state if necessary. A detailed drawdown plan must be included in the design, that identifies the volume of water in storage, the rate of inflow under average inflow conditions, identification of pump equipment, or other means necessary to remove stored water and maintain a drawdown condition, the time it will take to lower the water level, *etc.* The alternative drawdown plan shall be included in the required Operation and Maintenance Manual (O&MM) and in the Emergency Action Plan (EAP), if required.
- (h) In the case where an existing conduit is in poor condition (*i.e.*, severely deteriorated, structurally compromised, leaky) and the condition could compromise the structural stability of the existing dam, the design report shall address the compromised conduit condition (relining, slip lining, grouting or other feasible means) and bring the existing conduit to safe and good condition.

(8) Seepage Control.

- (a) All dams shall be designed and constructed to prevent the development of instability due to excessive seepage forces, uplift forces, or loss of materials in the embankment, abutments, spillway areas, or foundation. Seepage analyses for design shall identify areas having high internal uplift or exit gradients.
- (b) The design shall include an embankment internal drainage system, a zoned embankment, a foundation cut-off, an upstream blanket, a sufficiently wide homogeneous section, or other methods to protect against instability from excessive seepage forces or high hydraulic gradients.
- (c) For high hazard potential dams, a flow net analysis shall be made to determine the location of the phreatic surface, flow lines, and equipotential lines within the embankment and its foundation. These analyses may be based on graphical construction, electrical or liquid analogs, soil prototype methods, or other generally accepted methods. The flow net and stability analysis shall be the maximum water storage elevation. Possible fluctuations in tail water elevation shall be included in the analysis. The flow net and seepage analysis shall be included in the final design report.
- (d) Piezometers for confirming the location of the phreatic surface assumed for seepage and slope stability analyses shall be considered by the design engineer for low and significant hazard potential dams and shall be required for high hazard potential dams. Where piezometers are required, their design, depths and locations shall be provided in the final design report.

(9) Structural Stability and Slope Protection.

- (a) Design and construction of dams to assure structural stability shall be consistent with accepted engineering practice. The scope and degree of precision that will be required for a specific project will depend on the conditions of the site and the damage potential of the proposed structure. Consideration in design for structural stability shall include, but are not necessarily limited to, the following:
1. The hazard potential of the dam under present downstream conditions and under conditions which would likely develop during the life of the reservoir;
 2. Foundation bearing capacity, compressibility, and permeability; the extent and reliability of the site investigation; and the predictability of the site and foundation conditions;
 3. The reliability of construction materials, such as borrow soils, in terms of sufficient volume to complete construction without unanticipated interruption and in terms of predictability of physical properties such as strength, permeability, and compressibility;
 4. Durability of construction materials;
 5. Construction conditions at the site;

10.14: continued

- 6. The degree of quality control to be exercised during construction;
- 7. Pore pressure build-up during construction;
- 8. The rate of filling the reservoir and the rate of possible reservoir drawdown;
- 9. Tailwater conditions and the impact of drawdown;
- 10. Possible effects of landslides and subsurface solution activity on the structural stability of the dam and spillway structures; and
- 11. The extent of the proposed use of piezometers and other devices which will be used to monitor the completed dam and the means of access for inspections.

(b) Slope stability analysis shall be considered by the design engineer for all embankment dams, or as required by the Commissioner, and is required for high hazard potential dams. Where slope stability analysis is required, documentation in the final design report, such analysis shall include the design cross section(s) showing the soil parameters assumed for analysis, the location of the phreatic surface assumed for analysis, stability computations, and the location and computed safety factor(s) for the most critical circle(s) or failure wedge(s).

(c) Minimum factors of safety are listed in the following table. Final accepted factors of safety may depend upon the degree of confidence in the engineering data available. In selecting a minimum acceptable factor of safety, an evaluation should be made on both the degree of conservatism with which assumptions were made in choosing soil strength parameters and pore water pressures, and the influence of the method of analysis used.

- 1. 302 CMR 10.14(8)(c) shall not be applicable to embankments on clay shale foundations, soft sensitive clays, or materials with large strength loss under stresses.
- 2. For embankments over 50 ft. high on relatively weak foundations, a minimum factor of safety of 1.4 shall be used.

SLOPE STABILITY ANALYSIS
MINIMUM FACTORS OF SAFETY

Loading Conditions	Minimum Factor of Safety Analyzed	Slope to be
End of construction condition	1.3	upstream and downstream
Sudden drawdown from maximum pool	>1.1*	upstream
Sudden drawdown from spillway crest or top of gates	1.2	upstream
Steady seepage with maximum storage pool	1.5	upstream and downstream
Steady seepage with surcharge pool	1.4	downstream
Earthquake (for steady seepage conditions with seismic loading using seismic coefficient method)	>1.0	upstream and downstream

* The factor of safety shall not be less than 1.5 when drawdown rate and pore water pressures developed from flow nets are used in the stability analyses and where rapid drawdown is a normal operating condition as with pumped storage reservoir.

(d) Foundation bearing capacity and sliding base analysis shall be considered for all dams and are required for high hazard potential dams. Where bearing capacity or sliding base analysis is required, documentation of assumptions, computations, and safety factors shall be included in the final design report.

(e) Resistance of appurtenant structures against flotation uplift shall be provided for all dams. If the structures are anchored by dead weight alone, the buoyant weight shall be used for analysis. If the structures are anchored to soil or rock, the minimum factor of safety for that portion of the resistance provided by soil or rock anchorage shall be 2.0 unless the design engineer provides a thoroughly documented basis for using a lower safety factor.

10.14: continued

(f) For concrete, masonry, or other similar dams of relatively narrow cross section, resistance against overturning and sliding under maximum design loading conditions shall be considered; overturning and sliding stability computations shall be required for significant and high hazard potential dams.

(g) The anticipated reservoir and tailwater drawdown conditions shall be considered in all stability computations and shall be included in the design documents provided in the final design report.

(h) The slopes shall be protected against erosion by wave action, and the crest and downstream slope shall be protected against erosion due to wind and rain. Riprap and other erosion protection shall be provided over the full range in stages between the lowest drawdown elevation and at least two feet above maximum water storage elevation. Exemptions for specific site conditions such as special use slowly rising reservoirs or waste storage facilities may be approved in writing by the Commissioner upon written request by the Applicant.

(i) All significant and high hazard potential dams shall be designed to withstand seismic accelerations of the following intensities: Zone 1 = 0.025 g., Zone 2 = 0.05 g., Zone 3 = 0.15. Zones refer to "Geologic Hazard Maps".

(j) Loading Combinations. The following conditions and requirements are suitable in general for gravity dams of intermediate size. Loads which are not indicated such as wave action or any unusual loadings should be considered where applicable.

Case I: Usual Loading Combination--Normal Operating Condition. The reservoir elevation is at the normal pool, as governed by the crest elevation of an overflow structure or the top of the closed spillway gates, whichever is greater. Normal tailwater is used. If applicable, horizontal silt pressure should also be considered.

Case II: Unusual Loading Combination--Flood Discharge. The projected inflow design flood up to and including the Probable Maximum Flood, if appropriate, that results in reservoir and tailwater elevations that exert the greatest head differential and uplift pressure upon the structure shall be used. However, unusual conditions, such as high tailwater, shall be examined on a case by case basis as it is possible that the worst case loading condition exists under other than extreme floods.

Case IIA: Unusual Loading Combination--Ice Case. Ice loading plus ice pressure, if applicable. Generally ice pressure will not be a factor in the stability analyses, but may affect the operation, or structural integrity of flashboards and spillway gates.

Case III: Extreme Loading Combination--Normal Operating with Earthquake. Case I loading except that the inertial force due to the earthquake acceleration of the dam, and the increased hydrostatic forces due to the reservoir reaction on the dam are added.

(k) Stability Criteria. Specific stability criteria for a particular loading combination shall be dependent upon the type of analysis being done (*i.e.* foundation or concrete analysis), the degree of understanding of the foundation-structure interaction and site geology, and, to some extent, on the method of analysis.

1. For new dams, preliminary analyses shall be based upon more conservative criteria than final designs. As the design process progresses, the designer has available more sophisticated and detailed foundation information and material testing results. Therefore, when the unknowns associated with the preliminary designs are reduced by the final design stage, lower safety factors may be acceptable.

2. For existing dams, assumptions used in the analysis shall be based upon construction records and the performance of the structures under historical flood loadings. In the absence of available design data and records, site investigations shall be conducted to verify all assumptions.

3. Recommended safety factors shall apply to the calculations of stress and the shear-friction factor of safety within the structure, at the rock/concrete interface and in the foundation. Safety factors shall be determined using the gravity method of analysis.

10.14: continued

RECOMMENDED FACTORS OF SAFETY Dams having a high or significant hazard potential.	
Loading Condition	Factor of Safety
Usual	3.0
Unusual	2.0
Extreme	>1.0

Dams having a low hazard potential.	
Loading Condition	Factor of Safety
Usual	20
Unusual	1.25
Extreme	>1.0

- (10) Design Life of a Dam. The selection of materials and equipment to be used in a dam and all of its appurtenant features shall either be based on sufficient quality and durability to function satisfactorily throughout the design life or to provide for safe and economical replacement within the design life span. The design life of a dam shall be the period of time the dam can be expected to perform effectively as planned. The design life of a dam shall be determined by the following:
- (a) The time required to fill the reservoir with sediment from the contributing watershed;
 - (b) The durability of appurtenances and materials used to construct the dam; and
 - (c) The time required to perform the specific function for which the dam was designed.
- (11) Additional Design Requirements.
- (a) All elements of the dam shall conform to good and generally accepted engineering practice. The safety factors, design standards, and design references that are used shall be included in the final design report.
 - (b) Monitoring or inspection devices may be required by the Commissioner for use by the inspectors or owners during construction and filling and after completion of construction. The Commissioner may also require that such monitoring or inspection devices, existing or installed by requirement, be read and documented at specified intervals and copies of such be forwarded to his or her office.
- (12) Construction Schedule. The applicant shall submit a construction schedule that includes:
- (a) Suggested techniques and work force to be used to demonstrate that the dam will be constructed according to the plans and specifications;
 - (b) An estimated time to complete the construction activities;
 - (c) Techniques to be used to divert the stream flow to prevent interference with construction; and
 - (d) The extent and method of quality control.
 - (e) A determination of the likelihood of seasonal or winter shut down and any provisions or requirements to ensure safe dam operations during shut down period.
- (13) Proposed Changes In Design. The owner shall notify the Commissioner in writing of any proposed changes in design, plans, and specifications that will affect the stability of the dam. Rationale and analysis supporting the proposed changes must be provided. Approval shall be in the form of a written addendum to the Chapter 253 Permit and must be obtained prior to installation.
- (14) As-built Plans. Two complete sets of as-built plans shall be submitted to the Commissioner within 30 days of completion of the project.

10.14: continued

(15) Engineer's Certification. The registered professional civil engineer who has inspected the construction of the dam, shall submit a written statement bearing his or her professional seal that the dam and all appurtenances have been built, repaired, altered, or removed in conformance with the plans, specifications, and drawings approved by the Commissioner and that the dam is in compliance with 302 CMR 10.00. For repairs accomplished, the certification shall be for the repairs only.

(16) Acceptable Design: Procedures and Technical References. The following represent acceptable design procedures and references:

- (a) The design procedures, manuals and criteria used by the United States Army Corps of Engineers;
- (b) The procedures, manuals, and criteria used by the United States Natural Resources Conservation Service (formerly US Soil Conservation Service);
- (c) The procedures, manuals, and criteria used by the US Bureau of Reclamation; and
- (d) Other procedures that are approved by the Commissioner.

(17) Granting of Final Approval. Unless the Commissioner has reason to believe that the dam, on completion, is unsafe or not in compliance with any applicable requirement, regulation, or law, or of any condition or specification contained within the Permit, upon completion of construction and upon receipt of the engineer's statement, the Commissioner shall issue a final Certificate of Compliance certifying that the work has been completed in conformance with plans, specifications, drawings and conditions of the permit, subject to such terms as deemed necessary for the protection of life and property.

10.15: Fines

Fines shall be levied for a failure to comply with the following nonexclusive list of requirements:

(1) Fines for Non-compliance with the Following Requirements (but not necessarily limited to):

- (a) Failure to register a dam with the Office of Dam Safety and the Registry of Deeds will result in fines up to \$5,000.00.
- (b) Failure to notify the Office of Dam Safety of the transfer of a dam from one owner to another will result in fines up to \$5,000.00.
- (c) Failure of the owners of High Hazard Potential and Significant Hazard Potential dams to hire a qualified Registered Professional Engineer to provide compliant Emergency Action Plans and required updates to the Office of Dam Safety and the Massachusetts Emergency Management Agency will result in fines up to \$5,000.00.
- (d) Failure of the owners to provide the Office of Dam Safety with an Inspection Report that is in compliance as to content and frequency of inspection as provided for in 302 CMR 10.00 will result in fines up to \$5,000.00.
- (e) Failure of a dam owner to comply with the requirements of a Certificate of Non-compliance and Dam Safety Order pursuant to a dam determined to be in Poor or Unsafe Condition will result in fines up to \$5,000.00.
- (f) Failure of an owner to obtain a Chapter 253 Dam Safety Permit prior to performing any dam work such as alteration, breach, removal or substantial repairs will result in fines up to \$5,000.00.
- (g) Failure of the owners to comply with the conditions of a Chapter 253 Dam Safety Permit will result in fines up to \$5,000.00.

(2) Any person who fails to comply with the provisions of M.G.L. c. 253 or of any order, regulation or requirement of the department relative to dam safety, shall be fined an amount not to exceed \$5,000.00 for each offense, to be fixed by the court.

(3) Each violation shall be a separate and distinct offense and, in case of a continuing violation, each day's continuance thereof shall be deemed to be a separate and distinct offense.

302 CMR: DEPARTMENT OF CONSERVATION AND RECREATION

10.16: Severability

If any section, subsection, division or subdivision of 302 CMR 10.00 shall be determined to be invalid, such determination shall apply only to the particular section, subsection, division or subdivision, and all other provisions of 302 CMR 10.00 shall remain valid in full force and effect.

REGULATORY AUTHORITY

302 CMR 10.00: M.G.L. c. 253, §§ 44 through 48 and c. 21, § 65.