Virginia Soil and Water Conservation Board
Impounding Structure (Dam Safety) Regulations Technical Advisory Committee
Tuesday, June 13, 2006
Virginia Department of Forestry
Charlottesville, Virginia

Technical Advisory Committee Members Present

Sara Bell, Dominion Generation
Connie Bennett, Department of Environmental Services, York County
Steve Billcheck, Virginia Department of Emergency Management
Jeff W. Booth, Western Virginia Water Authority
William G. Browning, Department of Conservation and Recreation
Scott Cahill, Watershed Services
David B. Campbell, Schnabel Engineering
Paul D. Castle, Lakefront Royal Property Owners Association
Douglas L. Davis, Waynesboro Police Department
Donald R. Demetrius, Watershed Projects Evaluation Branch, Fairfax County
Joseph S. Haugh
Connie Houston
Richard Jacobs, Culpeper Soil and Water Conservation District
Daniel J. Mahoney, Federal Energy Regulatory Commission
Joseph H. Maroon, Department of Conservation and Recreation
Duncan C. McGregor
Timothy A. Mitchell, City of Lynchburg
Mishelle R. Noble-Blair, City of Manassas
David E. Ogle, Virginia Department of Transportation
John W. Peterson, KEMPS Consulting, Inc.
David S. Rosenthal, City of Norfolk
Ray Scher

Technical Advisory Committee Members Not Present

Jay Day, Mountain Castles Soil and Water Conservation Districts
J. Michael Flagg, Hanover County
John W. Jones, Virginia Sheriffs Association
David Krisnitski, Virginia Game and Inland Fisheries
Mathew J. Lyons, Natural Resources Conservation Service
Peter Rainey, Lake of the Woods Homeowners Association

Facilitator

Barbara Hulburt, Director of Facilitation & Training, The McCammon Group

Department of Conservation and Recreation Staff Present

David C. Dowling, Director of Policy, Planning and Budget
Christine Watlington, Policy, Planning and Budget Analyst
Jim Robinson, Dam Safety Program Manager
Tom Roberts, Dam Safety Engineer
Michael R. Fletcher, Director of Development
Ken Turner, District Dam Engineer
David Conniff, Dam Safety Engineer
Rob VanLier, Dam Safety Engineer

Observers Present

Jan Allen, Virginia Commonwealth University
John S. Bailey, Lake of the Woods Association
Lisa Cahill, Watershed Services
Mike Claud, Timmons Group
Robert E. Cooper, Williamsburg Environmental Group
Davis Grant, Lake Barcroft Watershed District
Robin Knepper, Fredericksburg Freelance-Star
Warren Lee, Lake of the Woods Homeowners Association

Opening and Introductions

Ms. Hulburt welcomed attendees and asked members and guests to introduce themselves. She reviewed the agenda for the day.

Ms. Hulburt said at the next meeting in July at least two TAC members will give presentations. She again offered the opportunity for members to speak with DCR about time on the agenda for the next meeting. She said if members had information to share on a particular topic that they should contact DCR.

Ms. Hulburt noted that there had been several exchanges of emails concerning the issue of subgroup meetings or individual discussions between TAC meetings. She said that discussion is encouraged. She requested that, if additional meetings are scheduled with TAC members that DCR be notified in order to allow staff to answer questions regarding meeting details.

Review of May 1st minutes

There were no changes or additions to the minutes.

Discussion of Emergency Action Plan recommendations

Mr. Dowling led a discussion of the Emergency Action Plan recommendations. He referenced a copy of the discussion draft. A copy of this draft is attached as Attachment #1. He said the language provided was draft language for discussion purposes only.

The language was developed based on comments from the previous meeting, a review of the April 2004 FEMA document on EAPs, and discussion of the EAP subcommittee during a conference call and subsequent e-mails.

Mr. Dowling noted that the document provided was a complete set of the Dam Safety Regulations with new language underlined and deleted language struck through.

Mr. Dowling discussed several existing sections that reference EAPs and that required edits. Those references may be found on lines 368, 535, 599, and 614. Mr. Dowling then reviewed a new section on EAPs numbered 4VAC50-20-175 and explained the various components.

Ms. Hulburt asked if there were general comments regarding this draft. The following questions/statements were raised:

The EAP is one of the most important topics being discussed. Basically the draft looks good.

The local jurisdictions should feel part of the regulations. In the past there have been situations where the jurisdiction would not sign the EAP. That becomes a problem for the dam owner. It is important that jurisdictions understand they are responsible whether or not they sign the EAP. It is very important that they be involved.

The EAP is primarily a tool for local emergency management. The locality should have the information they need to be involved. (Referenced lines 798 through 804.)

The terms “drill”, “exercise” and “table top” have been used and could be better clarified. Drills are primarily an opportunity for dam owners to coordinated with local emergency management.

Inundation maps are very important. Sunny day failure maps can be critical. The regulations need to clarify who is responsible for preparing the map(s). This is extremely important from the cost standpoint.

The need for an EAP for Class III and Class IV dams was questioned. A member did not think it necessary.

The importance of making local jurisdictions aware of the dams was noted as a factor that is as important as the EAPs themselves. There should be downstream notification to local jurisdictions so that they can deal appropriately with zoning.

It was noted that what happens development-wise downstream of the dam after a classification, for example in 10-20 years, is more important than an EAP.

Class I and II dams are defined by the possible loss of life. Class III and IV do not, by definition, fall into those requirements. It was suggested that perhaps this should guide what requires an EAP.

It was suggested that there needs to be reporting with Class III and Class IV dams. This could be done with a simple contacts flow chart.

Ms. Hulburt clarified that members were saying that in the case of a small farm dam owner with three farms located downstream, that if there is economic damage at some level then there should be a form of notification.

A member suggested a simplification of the impounding structure classification system. For example dams would be classified as low, significant or high hazard. The classification would be determined by the impacts of a dam failure.

It was noted that an inundation zone with a sunny day breech and an inundation flood could be very different. A sunny day inundation zone is the area downstream that floods if the dam fails under normal conditions.

A member noted that a Class IV dam affects only the owner of the dam.

Another member said it was a bad precedent for a dam owner to say his dam does not require emergency action.

However, another member said uniform application could be dangerous.

It was noted that relative to the development of maps, that we should consider the cost to the dam owner.

A member endorsed the idea of a table outlining the minimum EAP requirements.

It was initially suggested that all dams be required to have an EAP. Dam owners could be required to annually report that that status of the dam has not changed.

A member said that dam safety staff should be included in the discussion of an EAP with the dam owner. The owner should understand requirements up front. Mr. Maroon noted concerns with regard to adding additional responsibilities to staff, noting that the division was already understaffed.

A member stated that what is downstream makes a difference to local emergency managers. A member said it was important to make the downstream inundation zone a matter of public record. After downstream development has occurred is too late.

It was suggested that some localities may not be interested. Another member said that it is important for emergency managers and localities to understand the significance of this issue. The Chairman of the Board of Supervisors is supposed to be the emergency manager in localities.

There may be ties to Homeland Security. Without legislative action the state cannot place requirements on localities.

A member asked if line 745, the requirement for a notification chart, should apply to all four classes. It was noted that with a Class IV, there is no loss of life and no damage to others. A member questioned the need for a Class IV classification. It was noted that if conditions change, the classification of the dam would change. For a Class IV, the damage would be all on the dam owner's property. Law enforcement would not be involved.

A member said that it would be important to have a complete catalogue of every dam. Without that catalogue, dams would not be considered in future development and zoning plans.

A member said that the discussions between the EAP and classifications should not be blurred. Saying that a Class IV should or should not have an EAP requirement is different from simply noting the existence and location of a dam.

It was suggested that there should an inundation map for everything, but an EAP is not necessary for Class IV. Mr. Dowling said that what is in the draft is the requirement for Class IVs for a topographical map and a listing of who should be notified in the event of dam failure. It was again noted that if the definition of Class IV means that no one other than the owner is affected, that may a map and notification may not be necessary.

Ms. Hulburt noted that the focus of this discussion was the EAP. What is required? She posed that if a dam is a true Class IV, should that dam be required to have an EAP?

A member said that he did not believe that an EAP would be required for Class III or Class IV. There should be an inundation map for every regulated dam so that the boundary is defined if the development changes.

It was noted that there is nothing in the EAP that will minimize the loss of property. The EAP is designed as a warning of possible dam failure.

Another member noted that an EAP forces the dam owner to take action at the dam to prevent further problems, not just evacuation.

A member noted that it was a misnomer to use the term minimal property damage. The only distinction between a Class II and Class III was the probable loss of life. If there is

no probable loss of life the dam should be classified as a Class III with regard to property damage.

A member said that a Class III could address roads below the dam. On a rural country road that could still indicate a possible loss of life.

Ms. Hulbert suggested for discussion purposes that there were seven requirements of an EAP in the draft. They were:

1. Notification
2. Certification
3. Inundation map/zone flood
4. Emergency Detection/monitoring surveillance
5. Responsibility
6. Preparedness
7. Appendices

She posed that a Class I and a Class II should have all seven requirements. There seemed to be general agreement with this statement.

A member asked if Federal guidelines for EAPs refer to only high or moderate hazard or whether they were required for low hazard. It was noted that FERC requires that all dams have an EAP, including low hazard, but does provide an exemption process.

Mr. Browning said that staff have a lot to discuss in terms of classification. He suggested it might be beneficial to move ahead with these other discussions. Ms. Hulburt said that Mr. Robinson would give a presentation regarding Table I and classifications. She suggested that perhaps the committee should first deal with classifications and then return to the EAP discussion of Class III and IV dams.

After further discussion the consensus was to remove the EAP requirement for Class IV dams if an inundation map was included. This should be a separate requirement from the EAP. It was also agreed to revisit the EAP section at a later date to consider the EAP requirements for Class III dams.

A member asked if the TAC would deal with the agriculture exemption. Mr. Maroon said the agriculture exemption was dealt with during the General Assembly session. The exemption is restricted to dams that meet a certain size and are currently being utilized for agriculture. Additional changes with regard to the agricultural exemption would require legislative action.

Mr. Browning said that effective July 1, 2006 if a dam has been classified as agricultural but is no longer being used for that purpose, it will no longer qualify for the exemption.

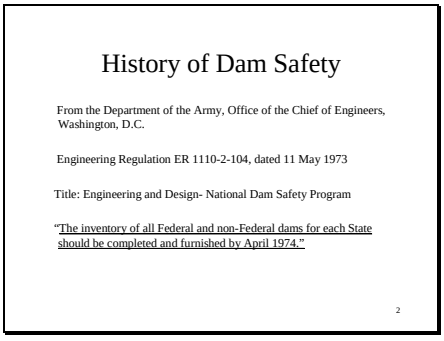
At this time the committee recessed for lunch.

Pertinent definitions and classification of VA Dams (Table 1 in DCR Regulations)

Power point presentation by Jim Robinson.

Slide 1

Slide 2



Slide 3

USACE Dam Safety History

(From Chief of NAD USACE – January 3, 1979)

"The rare possibility of extreme storms occurring above dam sites has long been an argument against their use in spillway design. However, most experts in hydrologic engineering recognize the large uncertainties connected with estimating the percent chance of exceeding any rare floods. Therefore, the probability of floods has generally not been a guiding influence in the selection of spillway design floods where dam failure could cause loss of life. The probable maximum flood concept for spillway design has been used by Federal agencies for many years. It should be noted that other countries have followed the U.S. lead and adopted the probable maximum flood as their standard. England is a relatively recent example."

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Slide 4

USACE Dam Safety History

(From Chief of NAD USACE – January 3, 1979)

"The Hydrometeorological Branch of the National Weather Service has been reviewing some 500 experienced large storms in the U.S. The purpose of the review is to ascertain the relative magnitude of experienced large storms to probable maximum precipitation (PMP) and their distribution throughout the country. Thus far, their review reveals that at least 25 percent of the major storms have exceeded 50 percent of the PMP for one or more combinations of area and duration. In fact some storms have very closely approximated the PMP values." Smethport, PA storm of July 4-5, 1939 was 97 percent of the PMP for 10 square miles and 6 hour duration. Hurricane Agnes June 19-23 resulted in 78 percent of the PMP for 72 hours over 20,000 square miles.

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USACE Dam Safety History

(Engineering Regulation ER 1110-2-106 26 Sept 1979)

2.1.1. Size. The classification for size based on the height of the dam and storage capacity should be in accordance with Table 1. The height of the dam is established with respect to the maximum storage potential measured from the natural bed of the stream or watercourse at the downstream toe of the barrier, or if it is not across a stream or watercourse, the height from the lowest elevation of the outside limit of the barrier, to the maximum water storage elevation. For the purpose of determining project size, the maximum storage elevation may be considered equal to the top of dam elevation. Size classification may be determined by either storage or height, whichever gives the larger size category.

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USACE Dam Safety History

(Engineering Regulation ER 1110-2-106 26 Sept 1979)

TABLE 1

SIZE CLASSIFICATION

Category	Impoundment Storage (Ac-Ft)	Impoundment Height (Ft)
Small	< 1000 and ≥ 50	< 40 and ≥ 25
Intermediate	≥ 1000 and < 50,000	≥ 40 and < 100
Large	≥ 50,000	≥ 100

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USACE Dam Safety History

(Engineering Regulation ER 1110-2-106 26 Sept 1979)

TABLE 2

HAZARD POTENTIAL CLASSIFICATION

Category	Loss of Life (Extent of Development)	Economic Loss (Extent of Development)
Low	**None** expected (No permanent Structures for human habitation)	Minimal (Undeveloped to occasional structures or agriculture)
Significant	**Few** (No urban developments and no more than a small number of inhabitable structures)	Appreciable (Notable agriculture, industry or structures
High	**More than few**	Excessive (Extensive community, industry or agriculture)

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USACE Dam Safety History

(Engineering Regulation ER 1110-2-106 26 Sept 1979)

TABLE 3
HYDROLOGIC EVALUATION GUIDELINES
RECOMMENDED SPILLWAY DESIGN FLOODS

Hazard	Size	*Spillway Design Flood (SDF)
Low	Small	50-Yr to 100-Yr
	Intermediate	100-Yr to ½ PMF
	Large	½ PMF to PMF
Significant	Small	100-Yr to ½ PMF
	Intermediate	½ PMF to PMF
	Large	PMF
High	Small	½ PMF to PMF
	Intermediate	PMF
	Large	PMF

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USACE Dam Safety History

(Engineering Regulation ER 1110-2-106 26 Sept 1979)

***The recommended design floods in this column represent the magnitude of the spillway design flood (SDF), which is intended to represent the largest flood that need be considered** in the evaluation of a given project, regardless of whether a spillway is provided; i.e., a given project should be capable of safely passing the appropriate SDF. Where a range of SDF is indicated, the magnitude that most closely relates to the involved risk should be selected.

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TABLE 1 - Impounding Structure Regulations

Class of Dam	Hazard Potential If Impounding Structure Fails	SIZE CLASSIFICATION Maximum Capacity (Ac-Ft)[a]	Height (Ft)[a]	Spillway Design Flood (SDF)[b]
I	Probable Loss of Life; Excessive Economic Loss	Large ≥ 50,000 Medium ≥ 1,000 & < 50,000 Small ≥ 50 & < 1,000	≥ 100 ≥ 40 & < 100 ≥ 25 & < 40	PMF[c] PMF ½ PMF to PMF
II	Possible Loss of Life; Appreciable Economic Loss	Large ≥ 50,000 Medium ≥ 1,000 & < 50,000 Small ≥ 50 & < 1,000	≥ 100 ≥ 40 & < 100 ≥ 25 & < 40	PMF ½ PMF to PMF 100-YR to ½ PMF
III	No Loss of Life Expected; Minimal Economic Loss	Large ≥ 50,000 Medium ≥ 1,000 & < 50,000 Small ≥ 50 & < 1,000	≥ 100 ≥ 40 & < 100 ≥ 25 & < 40	½ PMF to PMF 100 – YR to ½ PMF 50 – YR[d] to 100 – YR[e]
IV	No Loss of Life Expected; No Economic Loss to Others	≥ 50 (nonagricultural) ≥ 100 (agricultural)	≥ 25 (Both)	50 – YR to 100 – YR

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a. **The factor determining the largest size classification shall govern**.

b. **The spillway design flood (SDF) represents the largest flood that need be considered in the evaluation of the performance for a given project.** The impounding structure shall perform so as to safely pass the appropriate SDF. Where a range of SDF is indicated, the magnitude that most closely relates to the involved risk should be selected. The establishment in this chapter of rigid design flood criteria or standards is not intended. Safety must be evaluated in the light of peculiarities and local conditions for each impounding structure and in recognition of the many factors involved, some of which may not be precisely known. Such can only be done by competent, experienced engineering judgment, which the values in Table 1 are intended to supplement, not supplant.

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c. PMF: Probable maximum flood. **This means the flood that might be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.** The PMF is derived from the current probable maximum precipitation (PMP) available from the National Weather Service, NOAA. In some cases local topography or meteorological conditions will cause changes from the generalized PMP values; therefore, it is advisable to contact local, state or federal agencies to obtain the prevailing practice in specific cases.

d. 50-Yr: 50-year flood. **This means the flood magnitude expected to be equaled or exceeded on the average of once in 50 years.** It may also be expressed as an exceedence probability with a 2.0% chance of being equaled or exceeded in any given year.

e. 100-Yr: 100-year flood. **This means the flood magnitude expected to be equaled or exceeded on the average of once in 100 years.** It may also be expressed as an exceedence probability with a 1.0% chance of being equaled or exceeded in any given year.

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Example –Using Table 1

Consider a Class I Dam that is 32.5 feet high and has a maximum capacity of 810 acre-feet.

For Height of 32.5 feet is the mid point between 25 and 40 feet that represents a Small dam; therefore by height the SDF is the mid point between 50% PMF and 100% PMF or **75% PMF**

For maximum Capacity of 810 AF is 80 percent between 50 and 1000 AF that represents a Small dam: therefore by capacity the SDF is 80 percent between 50% PMF and 100% PMF or **90% PMF**

The required SDF would be 90% PMF

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Potential SDF Reduction

Section 4VAC50-20-130

A. 1. Operation and maintenance is determined by the director to be satisfactory and up to date;

2. Annual owner's inspection reports have been filed with and are considered satisfactory by the director;

3. The applicant proves in accordance with the current design procedures and references in Section 4VAC50-20-320 to the satisfaction of the board that the impounding structure as designed, constructed, operated and maintained does not pose an unreasonable hazard to life and property, and

4. The owner satisfies all special requirements imposed by the board.

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Potential SDF Reduction

B. When appropriate with existing impounding structures only, the spillway design flood requirement may be reduced by the board to the spillway discharge at which dam failure will not significantly increase the downstream hazard existing just prior to dam failure provided that the conditions of Section 4VAC50-20-130 A have been met.

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Dams by Certificate Type
Listed in Virginia's Dam Inventory

Construction Permit	41
Agriculture	96
Federal licensed or owned	**113**
Conditional Certificates	121
Mining Dams	**19**
Class IV Dams	22
Regular Certificates	395
Out of Compliance	9
Pre-2002 Size Exempt	**852**
Dams breached or removed	6
Unknown	13

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Pre-2002 Size Exempt Dams

Need to be brought into Regulation (by class)

I	14
II	108
III	723
IV	7

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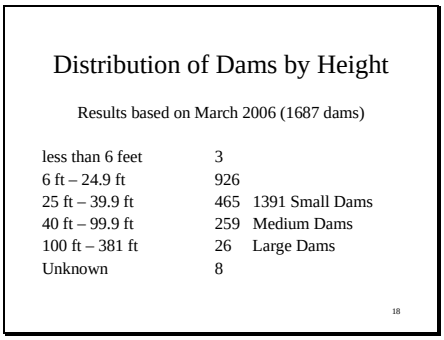
Slide 18



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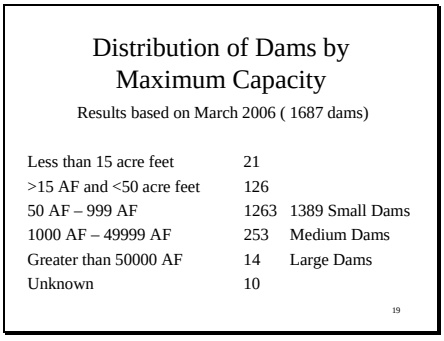


A member noted that the 121 conditional certificate dams were also out of compliance by definition.

Mr. Robinson noted that the 121 were moving to make corrections while the 9 listed as out of compliance currently had no activity.

Mr. Robinson said that many of the owners of the new dams being classified are oblivious to the fact that there is a dam safety program. These owners do not like the idea that they have been requested to hire an engineer at their expense. Not many welcome the appearance of Dam Safety staff.

Mr. Maroon noted that in terms of the magnitude of work that the agency has also to address the 852 size exempt dams noted on slide 16. In 2001, legislation changed to require the regulation of these originally size-exempt dams.

A February 2006 publication from a national dam safety organization said that there should be 8 technical full time employees per 200 dams. Mr. Maroon noted that the DCR program was severely understaffed.

Mr. Maroon said that the awareness of the magnitude of the dams is still evolving. He said that DCR is making progress and trying to help owners understand the program. He noted that some of the remaining dams not yet visited could be Class I and II dams. Mr. Maroon said that it is difficult to find engineers when competing with local government, VDOT and the consulting world.

A member noted that VDOT has been encouraged by the legislature to downsize and outsource more of their programs. He asked if DCR was being allowed to add additional staff.

Mr. Maroon said that the agency underwent substantial budget cuts in 2002. He noted that Governor Warner would not allow reductions in the dam safety division. DCR staff have already met with Governor Kaine and he has indicated that he understand the growing concern with regard to dam safety.

A member asked if the state was looking at stormwater retention ponds. Mr. Maroon said that DCR had another TAC dealing with stormwater management regulations.

Overview of Federal Technical Guidance for Dam Safety Programs

Mr. Mahoney gave an overview of Federal Technical Guidance for Dam Safety Programs.

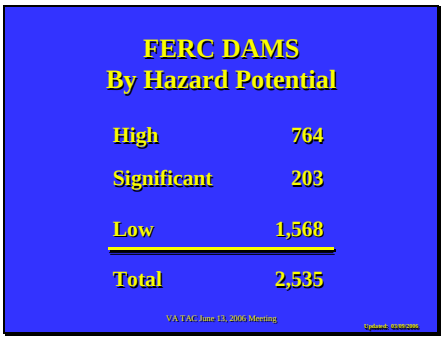
Slide 1

Good Morning, I'm Dan Mahoney and I'm the Deputy Director of FERC's Dam Safety Program.

I was asked to give you an understanding of FERC's Inflow Design Flood Guidelines which I will do very briefly.

If I am too brief, I will be able answer any specific questions you may have.

Slide 2

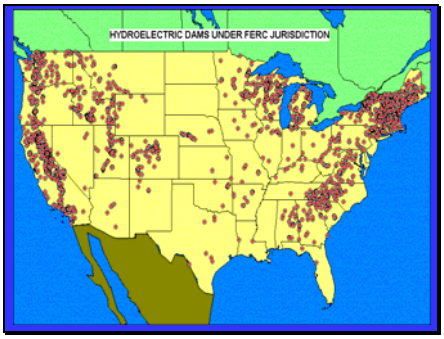


We have just over 2,500 dams in our dam safety program.

Of that number we have almost 1,000, actually 967 high and significant hazard potential dams.

As you would guess, the primary focus of our program is on these 1000 dams.

Slide 3

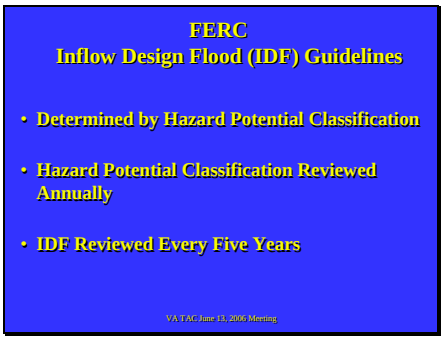


This shows the location and distribution of our dams across the United States

Slide 4

Just for reference, here is how the US is divided into our Regional Offices, in NY, Atlanta, Chicago, Portland, OR and San Francisco

Slide 5



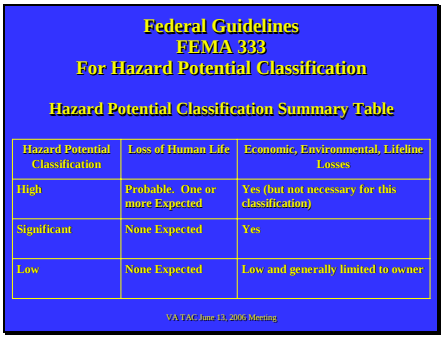
Our Inflow Design Flood (IDF) Guidelines are based solely on the hazard potential classification of the dam

We don't break it down further by height or size of impoundment

The hazard rating of all our dams is reviewed annually to make sure there is no change in our hazard potential rating

Our IDFs are reviewed at least every 5 years as part of the independent consultant inspections or more frequently if we learn something changed during the 5-year interval.

Slide 6



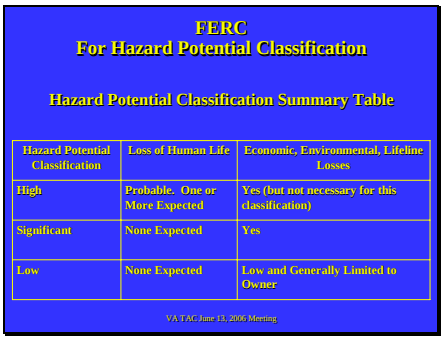
For reference, FERC complies with the Federal Guidelines for Hazard potential classification.

High requires any probable loss of life even just one person.

Significant is limited to just property damage

Low hazard dams can fail with no expected impacts

Slide 7



FERC's hazard rating classification guidelines comply with the Federal standard

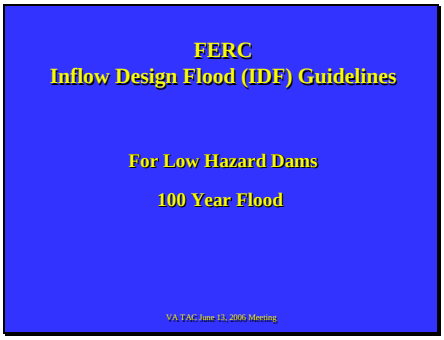
Slide 8

Our IDF guidelines are explained in Chapter 2 of our engineering guidelines,

"Selecting and Accommodating Inflow Design Floods for dams"

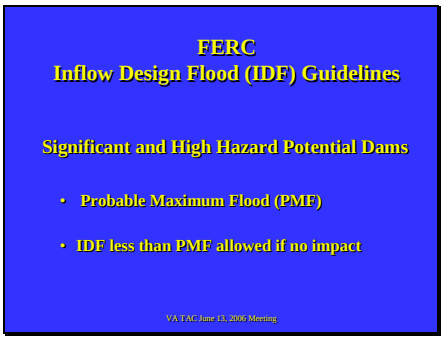
Again, our IDFs are based strictly on hazard potential classification

Slide 9



For low hazard dams, we require that they safely pass a 100-year flood

Slide 10



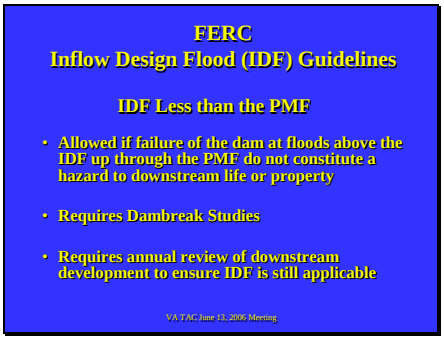
For our significant and high hazard dams we require that they safely pass the probable maximum flood (PMF).

An IDF for a dam can be less than the PMF if it can be concluded that failure of the dam under a PMF loading would not constitute a hazard to downstream life or property.

Said another way, if the owner can demonstrate that all the downstream development is already inundated from the natural flood associated with a PMF event,

or that the incremental damage from a dam failure under PMF would not create a significant additional threat to life or property over the natural flood, we would not require that the dam be modified to safety pass the PMF

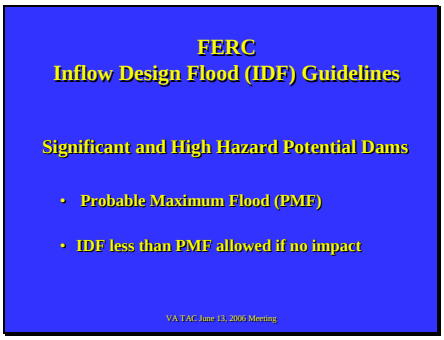
Slide 11



Accepting an IDF less than the PMF would require dam break studies for a series of flood levels from the current spillway capacity up through the PMF to make sure that there were not any flood levels that would be a threat to life or property.

One other important point, where a PMF fix is a one time do it and its over, when an IDF is approved, it requires careful monitoring of the downstream development centers to ensure that any new development doesn't change the IDF.

Slide 12

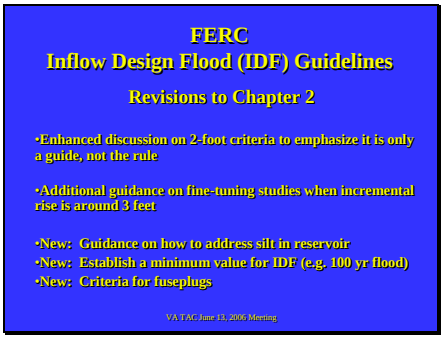


For our significant and high hazard dams we require that they safely pass the probable maximum flood (PMF).

An IDF for a dam can be less than the PMF if it can be concluded that failure of the dam under a PMF loading would not constitute a hazard to downstream life or property.

Said another way, if the owner can demonstrate that all the downstream development is already inundated from the natural flood associated with a PMF event, or that the incremental damage from a dam failure under PMF would not create a significant threat to life or property, we would not require that the dam be modified to safety pass the PMF

Slide 13



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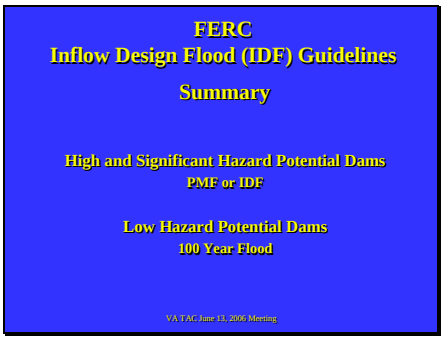

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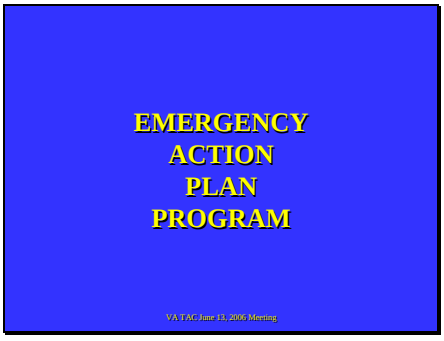

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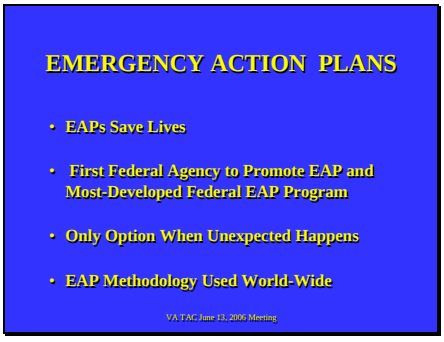

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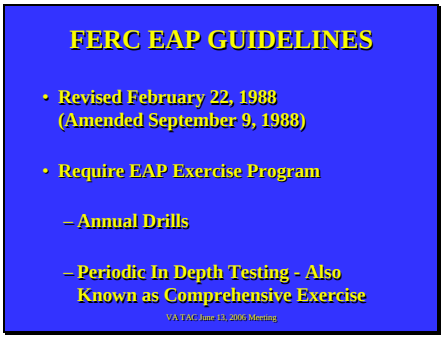

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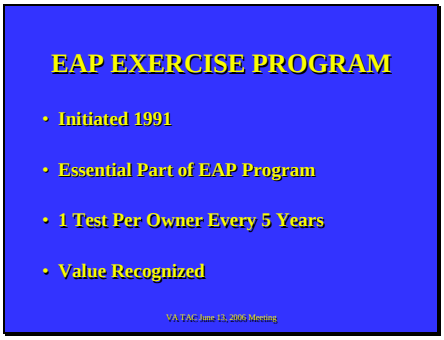

Review of Other States' Approaches to Dam Classifications

Mr. Dowling reviewed a handout with information regarding the dam classification systems utilized in other states. This document is attached as Attachment #2.

Ms. Hulburt noted that one of the issues was whether probable maximum precipitation or probable maximum flood were the best classifications.

Mr. Maroon asked what members thought about the consideration of environmental impacts.

If an owner has a reason to believe the contents of his reservoir creates an environmental hazard or toxicity they have an obligation to investigate.

Ms. Hulburt suggested that dam classification should be a topic of consideration for a subcommittee. Those topics include:

1. Should there be numbers provided in the table with respect to loss of life? What does it mean to talk about loss of life?
2. PMP vs. PMF
3. Is size a necessary component or is hazard alone sufficient?
4. 3 vs. 4 categories of classification?
5. Velocity and depth of water as a way to measure the severity of an event?

Ms. Hulburt asked how to describe in a meaningful way what the distinctions are between a high hazard and a significant hazard dam.

In public safety you cannot put a value on the number of lives. A member noted that there are dams with 5,000 people below them as well as dams with 4 people below them. It was also noted that the North Carolina model describes loss of life as one person.

A member said there should be a recognition of an acceptable loss for those who will not cooperate with an Emergency Action Plan.

Mr. Maroon said that he did not believe that the Soil and Water Board would be willing to accept an increase in the acceptable loss of life.

A member said that it is agreeable to not accept any loss of life, but the potential should be addressed.

Ms. Hulburt said if members had an interest in participating in a Table 1 subcommittee that they should talk to a DCR staff member.

Mr. Dowling said that with the agreement of the TAC, the drafting team would also move forward with the changes in the regulation required by General Assembly law revisions.

Ms. Hulburt noted that he next scheduled meetings are:

Thursday, July 13
Thursday, July 27

Locations are to be determined.

The meeting adjourned at 4:00 p.m.

Attachment #1

DISCUSSION DRAFT – NOT APPROVED

Version: Monday, June 12, 2006

VIRGINIA IMPOUNDING STRUCTURE REGULATIONS (§ 4 VAC 50-20)

Part I: General

4VAC50-20-10. Authority.

This chapter is promulgated by the Virginia Soil and Water Conservation Board in accordance with the provisions of the Dam Safety Act, Article 2, Chapter 6, Title 10.1 (§10.1-604 et seq.), of the Code of Virginia.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §1.1, eff. February 1, 1989.

4VAC50-20-20. General provisions.

A. This chapter provides for the proper and safe design, construction, operation and maintenance of impounding structures to protect public safety. This chapter shall not be construed or interpreted to relieve the owner or operator of any impoundment or impounding structure of any legal duties, obligations or liabilities incident to ownership, design, construction, operation or maintenance.

B. Approval by the board of proposals for an impounding structure shall in no manner be construed or interpreted as approval to capture or store waters. For information concerning approval to capture or store waters, see Chapter 8 (§62.1-107) of Title 62.1 of the Code of Virginia, and other provisions of law as may be applicable.

C. In promulgating this chapter, the board recognizes that no impounding structure can ever be completely "fail-safe," because of incomplete understanding of or uncertainties associated with natural (earthquakes and floods) and manmade (sabotage) destructive forces; with material behavior and response to those forces; and with quality control during construction.

D. Any engineering analysis required by this chapter such as plans, specifications, hydrology, hydraulics and inspections shall be conducted by and bear the seal of a professional engineer licensed to practice in Virginia.

E. The official forms as called for by this chapter are available from the director. [CHECK]

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §1.2, eff. February 1, 1989.

4VAC50-20-30. Definitions.

The following words and terms when used in this chapter shall have the following meanings unless the context clearly indicates otherwise:

"Acre-foot" means a unit of volume equal to 43,560 cubic feet or 325,853 gallons (one foot of depth over one acre of area).

"Agricultural purpose dams" means dams which are less than 25 feet in height or which create a maximum impoundment smaller than 100 acre-feet and certified by the owner on official forms as ~~constructed, maintained or~~ operated primarily for agricultural purposes.

"Alteration permit" means a permit required for changes to an impounding structure that could alter or affect its structural integrity. Alterations requiring a permit include, but are not limited to: changing the height, increasing the normal pool or principal spillway elevation, changing the elevation or physical dimensions of the emergency spillway or removing the impounding structure.

"Board" means the Virginia Soil and Water Conservation Board.

"Conditional operation and maintenance certificate" means a certificate required for impounding structures with deficiencies.

"Construction permit" means a permit required for the construction of a new impounding structure.

"Dam break inundation zone" means the area downstream of a dam that would be inundated or otherwise directly affected by the failure of a dam.

“Department” means the Virginia Department of Conservation and Recreation.

"Design flood" means the calculated volume of runoff and the resulting peak discharge utilized in the evaluation, design, construction, operation and maintenance of the impounding structure.

"Design freeboard" means the vertical distance between the maximum elevation of the design flood and the top of the impounding structure.

"Director" means the Director of the Department of Conservation and Recreation or his designee.

“Drill” means an emergency action plan exercise that tests, develops, or maintains skills in a single emergency response procedure. During a drill, participants perform an in-house exercise to verify telephone numbers and other means of communication along with the dam owner’s response. A drill is considered a necessary part of ongoing training. A drill is the lowest level emergency action plan exercise.

"Emergency Action Plan or EAP" means a formal document that identifies potential dam emergency conditions and specifies preplanned actions to be followed to minimize loss of life and property damage. The EAP specifies actions the dam owner must take to minimize or alleviate safety issues at the dam. It contains procedures and information to assist the dam owner in issuing early warning and notification messages to responsible emergency management authorities. It shall also contain dam break inundation zone maps as required to show emergency management authorities the critical areas for action in case of emergency.

"Emergency Action Plan Exercise" means an activity designed to promote emergency preparedness; test or evaluate EAPs, procedures, or facilities; train personnel in emergency management duties; and demonstrate operational capability. In response to a simulated event, exercises consist of the performance of duties, tasks, or operations very similar to the way they would be performed in a real emergency.

"Height" means the structural height of an impounding structure. If the impounding structure spans a stream or watercourse, height means the vertical distance from the natural bed of the stream or watercourse measured at the downstream toe of the impounding structure to the top of the impounding structure. If the impounding structure does not span a stream or watercourse, height means the vertical distance from the lowest elevation of the outside limit of the barrier to the top of the impounding structure.

"Impounding structure" means a man-made device, whether a dam across a watercourse or other structure outside a watercourse, used or to be used to retain or store waters or other materials. The term includes: (i) all dams that are 25 feet or greater in height and that create an impoundment capacity of 15 acre-feet or greater, and (ii) all dams that are six feet or greater in height and that create an impoundment capacity of 50 acre-feet or greater. The term "impounding structure" shall not include: (a) dams licensed by the State Corporation Commission that are subject to a safety inspection program; (b) dams owned or licensed by the United States government; (c) dams ~~constructed, maintained or~~ operated primarily for agricultural purposes which are less than 25 feet in height or which create a maximum impoundment capacity smaller than 100 acre-feet; (d) water or silt retaining dams approved pursuant to §45.1-222 or §45.1-225.1 of the Code of Virginia; or (e) obstructions in a canal used to raise or lower water.

"Impoundment" means a body of water or other materials the storage of which is caused by any impounding structure.

~~"Inundation zone" means an area that could be inundated as a result of impounding structure failure and that would not otherwise be inundated to that elevation.~~

"Life of the impounding structure" and "life of the project" mean that period of time for which the impounding structure is designed and planned to perform effectively, including the time required to remove the structure when it is no longer capable of functioning as planned and designed.

"Maximum impounding capacity" means the volume in acre-feet that is capable of being impounded at the top of the impounding structure.

"Normal impounding capacity" means the volume in acre-feet that is capable of being impounded at the elevation of the crest of the lowest ungated outlet from the impoundment.

"Operation and maintenance certificate" means a certificate required for the operation and maintenance of all impounding structures.

"Owner" means the owner of the land on which an impounding structure is situated, the holder of an easement permitting the construction of an impounding structure and any person or entity agreeing to maintain an impounding structure. The term "owner" includes the Commonwealth or any of its political subdivisions, including but not limited to sanitation district commissions and authorities. Also included are any public or private institutions, corporations, associations, firms or companies organized or existing under the laws of this Commonwealth or any other state or country, as well as any person or group of persons acting individually or as a group.

<u>“Tabletop Exercise” means an emergency action plan exercise that involves a meeting of the dam owner and the state and local emergency management officials in a conference room environment. The format is usually informal with minimum stress involved. The exercise begins with the description of a simulated event and proceeds with discussions by the participants to evaluate the EAP and response procedures and to resolve concerns regarding coordination and responsibilities.</u>

"Top of the impounding structure" means the lowest point of the nonoverflow section of the impounding structure.

"Watercourse" means a natural channel having a well-defined bed and banks and in which water flows when it normally does flow.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §1.3, eff. February 1, 1989; Amended, Virginia Register Volume 18, Issue 14, eff. July 1, 2002.
Effect of Amendment: The July 1, 2002 amendment revised the definitions for "director" and "impounding structure".

<u>4VAC50-20-40. Classes of impounding structures.</u>

A. Impounding structures shall be classified in one of four categories according to size and hazard potential, as defined in subsection B of this section and Table 1. Size classification shall be determined either by maximum impounding capacity or height, whichever gives the larger size classification.

B. For the purpose of this chapter, hazards pertain to potential loss of human life or property damage downstream from the impounding structure in event of failure or faulty operation of the impounding structure or appurtenant facilities.

1. Impounding structures in the Class I hazard potential category are located where failure will cause probable loss of life or serious damage to occupied building(s), industrial or commercial facilities, important public utilities, main highway(s) or railroad(s).

2. Impounding structures in the Class II hazard potential category are located where failure could cause possible loss of life or damage to occupied building(s), industrial or commercial facilities, secondary highway(s) or railroad(s) or cause interruption of use or service of relatively important public utilities.

3. Impounding structures in Class III hazard potential category are located where failure may cause minimal property damage to others. No loss of life is expected.

4. Impounding structures in Class IV hazard potential category are located where the failure of the impounding structure would cause no property damage to others. No loss of life is expected.

5. Such size and hazard potential classifications shall be proposed by the owner and shall be subject to approval by the director. Present and projected development ~~of~~ in the dam break inundation zone~~s~~ downstream from the impounding structure shall be considered in determining the classification.

6. Impounding structures shall be subject to reclassification by the Board as necessary.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §1.4, eff. February 1, 1989.

4VAC50-20-50. Performance standards required for impounding structures.

Impounding structures shall be constructed, operated and maintained such that they perform in accordance with their design and purpose throughout the life of the project. For new impounding structures, the spillway(s) capacity shall perform at a minimum to safely pass the appropriate spillway design flood as determined in Table 1.

TABLE 1--Impounding Structure Regulations

Class of Dam	Hazard Potential If Impounding Structure Fails	SIZE CLASSIFICATION Maximum Capacity (Ac-Ft)[a]	Height(Ft)[a]	Spillway Design

				Flood (SDF)[b]
I	Probable Loss of Life; Excessive Economic Loss	Large ≥ 50,000 Medium ≥ 1,000 & <50,000 Small ≥ 50 & < 1,000	≥ 100 ≥ 40 & < 100 ≥ 25 & < 40	PMF[c] PMF 1/2 PMF to PMF
II	Possible Loss of Life; Appreciable Economic Loss	Large ≥ 50,000 Medium ≥ 1,000 & <50,000 Small ≥ 50 & < 1,000	≥ 100 ≥ 40 & < 100 ≥ 25 & < 40	PMF 1/2 PMF to PMF 100-YR to 1/2 PMF
III	No Loss of Life Expected; Minimal Economic Loss	Large ≥ 50,000 Medium ≥ 1,000 & <50,000 Small ≥ 50 & < 1,000	≥ 100 ≥ 40 & < 100 ≥ 25 & < 40	1/2 PMF to PMF 100-YR to 1/2 PMF 50-YR[d] to 100-YR[e]
IV	No Loss of Life Expected; No Economic Loss to Others	≥ 50 (non-agricultural) ≥ 100 (agricultural)	≥ 25 (both)	50-YR to 100-YR

a. The factor determining the largest size classification shall govern.

b. The spillway design flood (SDF) represents the largest flood that need be considered in the evaluation of the performance for a given project. The impounding structure shall perform so as to safely pass the appropriate SDF. Where a range of SDF is indicated, the magnitude that most closely relates to the involved risk should be selected. The establishment in this chapter of rigid design flood criteria or standards is not intended. Safety must be evaluated in the light of peculiarities and local conditions for each impounding structure and in recognition of the many factors involved, some of which may not be precisely known. Such can only be done by competent, experienced engineering judgment, which the values in Table 1 are intended to supplement, not supplant.

c. PMF: Probable maximum flood. This means the flood that might be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The PMF is derived from the current probable maximum precipitation (PMP) available from the National Weather Service, NOAA. In some cases local topography or meteorological conditions will cause changes from the generalized PMP values; therefore, it is advisable to contact local, state or federal agencies to obtain the prevailing practice in specific cases.

d. 50-Yr: 50-year flood. This means the flood magnitude expected to be equaled or exceeded on the average of once in 50 years. It may also be expressed as an exceedence probability with a 2.0% chance of being equaled or exceeded in any given year.

e. 100-Yr: 100-year flood. This means the flood magnitude expected to be equaled or exceeded on the average of once in 100 years. It may also be expressed as an exceedence probability with a 1.0% chance of being equaled or exceeded in any given year.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §1.5, eff. February 1, 1989; Amended, Virginia Register Volume 18, Issue 14, eff. July 1, 2002.
Effect of Amendment: The July 1, 2002 amendment corrected the "greater than" and "equal than" signs in Table 1.

Part II: Permit Requirements

4VAC50-20-60. Required permits.

A. No person or entity shall construct or begin to construct an impounding structure until the board has issued a construction permit.

B. No person or entity shall alter or begin to alter an existing impounding structure in ~~a~~ any manner which would potentially affect its structural integrity until the board has issued an alteration permit, or in the case of an emergency, authorization is obtained from the director. The permit requirement may be waived if the director determines that the alteration of improvement will not substantially alter or affect the structural integrity of the impounding structure. Alteration does not mean normal operation and maintenance.

C. When the board receives an application for any permit to construct or alter an impounding structure, the director shall inform the government of any jurisdiction which might be affected by the permit application.

D. In evaluating construction and alteration permit applications the director shall use the most current design criteria and standards referenced in 4VAC50-20-320 of this chapter.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §2.1, eff. February 1, 1989.

4VAC50-20-70. Construction permits.

A. Prior to preparing the complete design report for a construction permit, applicants are encouraged to seek approval of the project concept from the director. For this purpose the applicant should submit a general description of subdivisions 1 through 4 of subsection B of this section and subdivisions 1 and 2 of this subsection:

1. Proposed design criteria and a description of the size, ground cover conditions, extent of current development of the watershed, jurisdictional comprehensive planning for development of the watershed, and the geologic and the geotechnical engineering assumptions used to determine the foundations and materials to be used.

2. Preliminary drawings of a general nature, including cross sections, plans and profiles of the impounding structure, proposed pool levels and types of spillway(s).

B. An applicant for a construction permit shall submit a design report on official forms. The design report shall be prepared in accordance with 4VAC50-20-240 and shall include the following information:

1. A description of the impounding structure and appurtenances and a proposed classification conforming with this chapter. The description shall include a statement of the purposes for which the impoundment and impounding structure are to be used.

2. A description of properties located in the dam break inundation zone downstream from the site of the proposed impounding structure, including the location and number of residential structures, buildings, roads, utilities and other property that would be endangered should the impounding structure fail.

3. A statement from the governing body of the local political subdivision or other evidence confirming that body is aware of the proposal to build an impounding structure and of the land use classifications applicable to the dam break inundation zone.

4. Maps showing the location of the proposed impounding structure that include: the county or city in which the proposed impounding structure would be located, the location of roads, access to the site and the outline of the impoundment. Existing aerial photographs or existing topographic maps may be used for this purpose.

5. A report of the geotechnical investigations of the foundation soils or bedrock and of the materials to be used to construct the impounding structure.

6. Design assumptions and analyses sufficient to indicate that the impounding structure will be stable during its construction and during the life of the impounding structure under all conditions of reservoir operations, including rapid filling and rapid drawdown of the impoundment.

7. Evaluation of the stability of the reservoir rim area in order to safeguard against reservoir rim slides of such magnitude as to create waves capable of overtopping the impounding structure and confirmation of rim stability during seismic activity.

8. Design assumptions and analyses sufficient to indicate that seepage in, around, through or under the impounding structure, foundation and abutments will be reasonably and practically controlled so that internal or external forces or results thereof will not endanger the stability of the impounding structure.

9. Calculations and assumptions relative to design of the spillway or spillways. Spillway capacity shall conform to the criteria of Table 1.

10. Provisions to ensure that the impounding structure and appurtenances will be protected against deterioration or erosion due to freezing and thawing, wind and rain or any combination thereof.

11. Other pertinent design data, assumptions and analyses commensurate with the nature of the particular impounding structure and specific site conditions, including when required by ~~the director~~ this chapter, a plan and profile of the dam break inundation zone~~s~~.

12. Erosion and sediment control plans to minimize soil erosion and sedimentation during all phases of construction, operation and maintenance. Projects shall be in compliance with local erosion and sediment control ordinances.

13. A description of the techniques to be used to divert stream flow during construction so as to prevent hazard to life, health and property. Such diversion plans shall also be in accordance with applicable environmental laws.

14. A plan of quality control testing to confirm that construction materials and methods meet the design requirements set forth in the specifications.

15. A proposed schedule indicating construction sequence and time to completion.

16. Plans and specifications as required by 4VAC50-20-310.

17. An emergency action plan ~~on official forms~~ developed in accordance with 4VAC50-20-175 and evidence that ~~a copy~~ the required copies of such plan ~~has~~ have been filed with the Department, the local organization for emergency management and the State Department of Emergency Management. The plan shall include a method of providing notification and warning to persons downstream, other affected persons or property owners and local authorities in the event of a flood hazard or the potential or impending failure of the impounding structure.

18. A proposed impoundment and impounding structure operation and maintenance plan on official forms certified by a licensed professional engineer. This plan shall include a safety inspection schedule and shall place particular emphasis on operating and maintaining the impounding structure in keeping with the project design, so as to maintain its structural integrity and safety during both normal and abnormal conditions which may reasonably be expected to occur during its planned life.

19. Place holder for stormwater construction permit requirement language.

20. Placeholder for cultural and historic resources?????????

C. The director or the applicant may request a conference to facilitate review of the applicant's proposal.

D. The owner shall certify in writing that the operation and maintenance plan as approved by the board will be adhered to during the life of the project except in cases of unanticipated emergency requiring departure therefrom in order to mitigate hazard to life and property. ~~At such time~~ In the case of an emergency, the owner's engineer, ~~and~~ the director, and other specified contacts shall be notified in accordance with the emergency action plan developed in accordance with 4VAC50-20-175.

E. If the submission is not acceptable, the director shall inform the applicant within 60 days and shall explain what changes are required for an acceptable submission.

F. Within 120 days of receipt of an acceptable design report the board shall act on the application.

G. Prior to and during construction the owner shall notify the director of any proposed changes from the approved design, plans, specifications, or operation and maintenance plan. Approval shall be obtained from the director prior to the construction or installation of any changes that will affect the stability of the impounding structure.

H. The construction permit shall be valid for the construction schedule specified in the approved design report. The construction schedule may be amended by the director for good cause at the request of the applicant.

I. 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, except that the applicant may petition the board for extension of the two-year period and the board may extend such period for good cause.

J. The director may revoke a construction permit if any of the permit terms are violated, or if construction is conducted in a manner hazardous to downstream life or property. The director may order the owner to eliminate such hazardous conditions within a period of time limited by the order. Such corrective measures shall be at the owner's expense. The applicant may petition the board to reissue the permit with such modifications as the board determines to be necessary.

K. The owner's licensed professional engineer shall advise the director when the impounding structure may safely impound water. The director shall acknowledge this statement within 10 days after which the impoundment may be filled under the engineer's

supervision. The director's acknowledgement shall act as a temporary operation and maintenance certificate until an operation and maintenance certificate has been applied for and issued in accordance with 4VAC50-20-110.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §2.2, eff. February 1, 1989; Amended, Virginia Register Volume 18, Issue 14, eff. July 1, 2002.
Effect of Amendment: The July 1, 2002 amendment, in the second sentence of subsection A, changed "items" to "subdivisions" twice, inserted "of this section" and "of this subsection", and deleted "below" after "1 and 2"; in subsections B and K, and in paragraph B 16, deleted "of this chapter" after theVACcitation; and, in paragraph B 17, inserted "organization for emergency management", inserted "the" before "State Department", and changed "Services" to "Management" after "Emergency".

4VAC50-20-80. Alterations permits.

A. Application for a permit to alter an impounding structure in ways which would potentially affect its structural integrity shall be made on official forms. The application shall clearly describe the proposed work with appropriately detailed plans and specifications.

B. Alterations which would potentially affect the structural integrity of an impounding structure include but are not limited to changing its height, increasing the normal pool or principal spillway elevation, changing the elevation or physical dimensions of the emergency spillway or removing the impounding structure.

C. Where feasible an application for an alteration permit shall also include plans and specifications for a device to allow for draining the impoundment if such does not exist.

D. If the submission is not acceptable, the director shall inform the applicant within 60 days and shall explain what changes are required for an acceptable submission.

E. Within 120 days of receipt of an acceptable application, the board shall act on the application.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §2.3, eff. February 1, 1989.

4VAC50-20-90. Transfer of permits.

Prior to the transfer of ownership of a permitted impounding structure the permittee shall notify the director in writing and the new owner shall file a transfer application on official forms. The new owner shall amend the existing permit application as necessary and shall certify to the director that he is aware of and will comply with all of the requirements and conditions of the permit.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §2.4, eff. February 1, 1989.

Part III: Certificate Requirements

4VAC50-20-100. Operation and maintenance certificates.

A. A Class I Operation and Maintenance Certificate is required for a Class I Hazard potential impounding structure. The certificate shall be for a term of six years. It shall be updated based upon the filing of a new ~~re~~inspection report certified by a licensed professional engineer every two years.

B. A Class II Operation and Maintenance Certificate is required for a Class II Hazard potential impounding structure. The certificate shall be for a term of six years. It shall be updated based upon the filing of a new ~~re~~inspection report certified by a licensed professional engineer every three years.

C. A Class III Operation and Maintenance Certificate is required for a Class III Hazard potential impounding structure. The certificate shall be for a term of six years.

D. The owner of a Class I, II or III impounding structure shall provide the director an annual owner's inspection report on official forms in years when no licensed professional ~~re~~inspection is required and may be done by the owner or his representative.

E. If an Operation and Maintenance Certificate is not updated as required, the board shall take appropriate enforcement action.

F. The owner of a Class I, II or III impounding structure shall apply for the renewal of the six year operation and maintenance certificate 90 days prior to its expiration in accordance with 4VAC50-20-120 of this chapter.

G. A Class IV impounding structure will not require an operation and maintenance certificate. An inventory report is to be prepared as provided in 4VAC50-20-120 B and filed by the owner on a six-year interval, and an owners inspection report filed annually.

H. The owner of any impounding structure, regardless of its hazard classification, shall notify the board immediately of any change in either cultural features downstream from the impounding structure or of any change in the use of the area downstream that would present hazard to life or property in the event of failure.

I. The owner of any impounding structure shall meet the emergency action plan submittal requirements setout in 4VAC50-20-175.

Statutory Authority: §10.1-605 of the Code of Virginia.

Historical Notes: Derived from VR625-01-00 §3.1, eff. February 1, 1989.

4VAC50-20-110. Operation and maintenance certificate for newly constructed impounding structures.

A. Within 180 days after completion of the construction of an impounding structure, the owner shall submit:

1. A complete set of as-built drawings certified by a licensed professional engineer and an as-built report on official forms.

2. A copy of a certificate from the licensed professional engineer who has inspected the impounding structure during construction certifying that, to the best of his judgment, knowledge and belief, the impounding structure and its appurtenances were constructed in conformance with the plans, specifications, drawings and other requirements approved by the board.

3. A copy of the operation and maintenance plan ~~and emergency action plan~~ submitted with the design report including any changes required by the director. The emergency action plan shall also be updated as necessary and resubmitted at this time.

B. If the director finds that the operation and maintenance plan or emergency action plan developed in accordance with 4VAC50-20-175 is deficient, he shall return it to the owner within 60 days with suggestions for revision.

C. Within 60 days of receipt of the items listed in subsection A above, if the board finds that adequate provision has been made for the safe operation and maintenance of the impounding structure, the board shall issue an operation and maintenance certificate.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §3.2, eff. February 1, 1989.

4VAC50-20-120. Operation and maintenance certificates for existing impounding structures.

A. Any owner of an impounding structure other than a Class IV impounding structure which has already filed an inventory report that does not have an operation and maintenance certificate or any owner renewing an operation and maintenance certificate shall file an application with the board.

B. The application for an operation and maintenance certificate shall be on official forms and shall include:

1. A reinspection report for Class I and II impounding structures. The reinspection report shall include an update of conditions of the impounding structure based on a previous safety inspection as required by the board, a previous reinspection report or an as-built report.

2. An inventory report for Class III impounding structures. The inventory report shall include:

a. The name and location of the impounding structure and the name of the owner.

b. The description and dimensions of the impounding structure, the spillways, the reservoir and the drainage area.

c. The history of the impounding structure which shall include the design, construction, repairs, inspections and whether the structure has ever been overtopped.

d. Observations of the condition of the impounding structure, reservoir, and upstream and downstream areas.

e. Any changes in the impounding structure, reservoir, and upstream and downstream areas.

f. Recommendations for remedial work.

3. An impoundment and impounding structure operation and maintenance plan certified by a licensed professional engineer. This plan shall place particular emphasis on operating and maintaining the impounding structure in keeping with the project design in such manner as to maintain its structural integrity and safety during both normal and abnormal conditions which may reasonably be expected to occur during its planned life. The safety inspection report required by the board should be sufficient to serve as the basis for the operation and maintenance plan for a Class I and Class II impounding structure. For a Class III impounding structure, the operation and maintenance plan shall be based on the data provided in the inventory report.

4. An emergency action plan developed in accordance with 4VAC50-20-175 and evidence that ~~a copy~~ the required copies of such plan ~~has~~ have been filed with the Department, the local organization for emergency management and the State Department of Emergency Management. The plan shall include a method of providing notification and warning to persons downstream, other affected persons or property owners and local authorities in the event of a flood hazard or the potential or impending failure of the impounding structure.

C. The owner shall certify in writing that the operation and maintenance plan approved by the board will be adhered to during the life of the project except in cases of emergency requiring departure therefrom in order to mitigate hazard to life and property, at which time the owner's engineer , ~~and~~ the director , and other specified contacts shall be notified in accordance with the emergency action plan developed in accordance with 4VAC50-20-175.

D. If the director finds that the operation and maintenance plan or emergency action plan developed in accordance with 4VAC50-20-175 is deficient, he shall return it to the owner within 60 days with suggestions for revision to meet the specified minimum requirements.

E. Within 60 days of receipt of an acceptable application if the board finds that adequate provision has been made for the safe operation and maintenance of the impounding structure, the board shall issue an operation and maintenance certificate.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes:Derived from VR625-01-00 §3.3, eff. February 1, 1989; Amended, Virginia Register Volume 18, Issue 14, eff. July 1, 2002.
Effect of Amendment: The July 1, 2002 amendment, in paragraph B 1, substituted "previous safety inspection as required by the board" for "Phase I or Phase II inspection as established by the U.S. Army Corps of Engineers"; in the third sentence of paragraph B 3, substituted "safety inspection report required by the board" for "Phase I Inspection Report"; and, in paragraph B 4, substituted "local organization for emergency management and the State Department of Emergency Management" for "local and State Department of Emergency Services".

4VAC50-20-130. Existing impounding structures constructed prior to July 1, 1982.

A. Many existing impoundment structures were designed and constructed prior to the enactment of the Dam Safety Act, and may not satisfy current criteria for new construction. The board may issue an operation and maintenance certificate for such structures provided that:

1. Operation and maintenance is determined by the director to be satisfactory and up to date;

2. Annual owner's inspection reports have been filed with and are considered satisfactory by the director;

3. The applicant proves in accordance with the current design procedures and references of 4VAC50-20-320 to the satisfaction of the board that the impounding structure as designed, constructed, operated and maintained does not pose an unreasonable hazard to life and property; and

4. The owner satisfies all special requirements imposed by the board.

B. When appropriate with existing impounding structures only, the spillway design flood requirement may be reduced by the board to the spillway discharge at which dam failure

will not significantly increase the downstream hazard existing just prior to dam failure provided that the conditions of 4VAC50-20-130 A have been met.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §3.4, eff. February 1, 1989.

4VAC50-20-140. Existing impounding structures constructed after July 1, 1982.

The board may issue an operation and maintenance certificate for an impounding structure having a construction permit issued after July 1, 1982, and shall not require upgrading to meet new more stringent criteria unless the board determines that the new criteria must be applied to prevent an unreasonable hazard to life or property.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §3.5, eff. February 1, 1989.

4VAC50-20-150. Conditional operation and maintenance certificate.

A. During the review of any operation and maintenance application should the director determine that the impounding structure has deficiencies of a nonimminent danger category, the director may recommend that the board issue a conditional operation and maintenance certificate.

B. The conditional operation and maintenance certificate for Class I, II and III impounding structures shall be for a maximum term of two years. This certificate will allow the owner to continue normal operation and maintenance of the impounding structure, and shall require that the owner correct the deficiencies on a schedule determined by the director.

C. A conditional certificate may be renewed in accordance with the procedures of 4VAC50-20-120 provided that annual owner inspection reports are on file, and the board determines that the owner is proceeding with the necessary corrective actions.

D. Once the deficiencies are corrected, the board shall issue an operation and maintenance certificate based upon any required revisions to the original application.

E. The owner of any impounding structure, whether under conditional certificate or otherwise, shall meet the emergency action plan requirements setout in 4VAC50-20-175.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §3.6, eff. February 1, 1989.

4VAC50-20-160. Additional operation and maintenance requirements.

A. The owner of an impounding structure shall not, through action or inaction, cause or allow such structure to impound water following receipt of a written report from the owner's engineer that the impounding structure will not safely impound water.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §3.7, eff. February 1, 1989.

4VAC50-20-170. Transfer of certificates.

Prior to the transfer of ownership of an impounding structure the certificate holder shall notify the director in writing and the new owner shall file a transfer application on official forms. The new owner may elect to continue the current operation and maintenance certificate for the remaining term or he may apply for a new certificate in accordance with 4VAC50-20-120. If the owner elects to continue the existing certificate he shall amend the existing certificate application as necessary and shall certify to the director that he is aware of and will comply with all of the requirements and conditions of the certificate.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §3.8, eff. February 1, 1989.

4VAC50-20-175. Emergency Action Plans.

A. In order to minimize the loss of life and property damage during potential emergency conditions at a dam, and to ensure effective, timely action is taken should a dam emergency occur, an EAP shall be required for each impounding structure. The emergency action plans shall be coordinated with the Department of Emergency Management in accordance with §44-146.18. The plans required by these regulations shall be incorporated into local and inter-jurisdictional emergency plans pursuant to §44-146.19.

B. It is the dam owner's responsibility to develop, maintain, and implement a site-specific EAP.

C. An EAP shall be submitted every six years. For a Class I, II, or III impounding structure, the EAP shall be submitted with the dam owner's renewal of their operation and maintenance certificate application. For a Class IV dam, the owner shall submit an EAP every six years with their inventory report.

D. It is imperative that the dam owner furnish all holders of the EAP section updates to the EAP immediately upon becoming aware of necessary changes to keep the EAP workable. Should a dam be reclassified, an emergency action plan in accordance with this section shall be submitted.

E. A drill shall be conducted annually for each Class I, II, or III impounding structure. A table-top exercise shall be conducted once every 3 years for Class I and II structures. Owners shall certify to the Department annually that an exercise has been completed and the statement shall include a critique of the exercise and any revisions or updates to the plan or a statement that no revisions or updates are needed.

F. Dam owners shall test existing monitoring, sensing, and warning equipment at remote/unattended dams at least twice per year and maintain a record of such tests.

G. An EAP shall contain the following seven basic elements unless otherwise specified in this subsection.

1. Notification chart (Class I, II, III and IV) - A notification chart shall be included for all classes of dams that shows who is to be notified, by whom, and in what priority. The notification chart shall include contact information that assures 24-hour telephone coverage for all responsible parties.

2. Emergency Detection, Evaluation, and Classification (Class I, II, and III) - The plan shall include a discussion of the procedures for timely and reliable detection, evaluation, and classification of an emergency situation to ensure that the appropriate course of action is taken based on the urgency of the situation. Where appropriate, the situations should address dam breaks that are imminent or in progress, a situation where the potential for dam failure is rapidly developing, and a situation where the threat is slowly developing.

3. Responsibilities (Class I, II, and III) – The plan shall specify a determination of responsibility for EAP-related tasks. The EAP shall also clearly designate the responsible party for making the decision that an emergency condition no longer exists at the dam.

4. Preparedness (Class I, II, and III) – The plan shall include a section that describes preparedness actions to be taken both before and following development of emergency conditions.

5. (a). Dam Break Inundation Maps (Class I and II, and III) – The plan shall include an inundation map that delineates the areas that would be flooded as a result of a dam failure. Such maps shall be developed in accordance with subsection H.

(b) Class IV dams shall provide a 7.5-minute U.S. Geological Survey topographic map noting any downstream features of concern.

6. Appendices (Class I and II, and III) - The appendices shall contain information that supports and supplements the material used in the development and maintenance of the EAP such as analyses of dam break floods; plans for training, exercising, updating, and posting the EAP; and other site-specific concerns.

7. Certification (Class I, II, III and IV) – The plan shall include a section that is signed by all parties involved in the plan, where they indicate their approval of the plan and agree to their responsibilities for its execution.

H. All properties identified within the dam break inundation zone shall be incorporated into the EAP's dam break inundation zone map to ensure the proper notification of persons downstream and other affected persons or property owners in the event of a flood hazard or the impending failure of the impounding structure. The requirements for a dam break inundation map are as follows:

1. Maps shall be developed for both the sunny day failure condition and the Spillway Design Flood failure condition to show the expected extremes in peak water surface elevations, travel times of the front of the dam break flood wave to critical locations, and distances downstream between the two scenarios. For a sunny day failure, the water level of the reservoir should be assumed to be the crest of the lowest open spillway that could not be plugged by debris. Inundation mapping should extend downstream until the breach flood wave would be non-damaging.

2. The map(s) shall be developed at a scale sufficient to graphically display downstream inhabited areas and structures on the map within the identified inundation area that may be subject to possible danger. To the maximum extent practicable, the inundation maps should be

supplemented with water surface profiles at critical areas showing the water surface elevation prior to failure and the peak water surface elevation after failure. The list of downstream residents with their telephone numbers should whenever possible be plotted on the map for easy reference in the case of emergencies.

3. Since local officials are likely to use the maps for evacuation purposes, a note should be included on the map to advise that, because of the method, procedures, and assumptions used to develop the flooded areas, the limits of flooding shown and flood wave travel times are approximate and should be used only as a guideline for establishing evacuation zones. Actual areas inundated will depend on actual failure conditions and may differ from areas shown on the maps.

J. The development of the EAP shall be coordinated with all entities, jurisdictions, and agencies that would be affected by a dam failure or that have statutory responsibilities for warning, evacuation, and post-flood actions. Consultation with state and local emergency management officials at appropriate levels of management responsible for warning and evacuation of the public is essential to ensure that there is agreement on their individual and group responsibilities.

K. The EAP shall at a minimum be filed with the Department, the local organization for emergency management, and the State Department of Emergency Management. Two copies shall be provided to the Department.

L. The following format shall be used as necessary to address the requirements of this section.

Title Page/Cover Sheet
Table of Contents
I. Certifications
II. Notification Flowchart
III. Statement of Purpose
IV. Project Description
V. Emergency Detection, Evaluation, and Classification
VI. General Responsibilities Under the EAP
    A. Dam Owner Responsibilities
    B. Responsibility for Notification
    C. Responsibility for Evacuation
    D. Responsibility for Termination and Follow-Up
    E. EAP Coordinator Responsibility
VII. Preparedness
VIII. Inundation Maps
IX Appendices
    A. Investigation and Analyses of Dambreak Floods
    B. Plans for Training, Exercising, Updating, and Posting the EAP
    C. Site-Specific Concerns

Part IV: Procedures

4VAC50-20-180. Inspections.

The director may make inspections during construction, alteration or operation and maintenance as deemed necessary to ensure that the impounding structure is being constructed, altered or operated and maintained in compliance with the permit or certificate issued by the board. The director shall provide the owner a copy of the findings of these inspections. This inspection does not relieve the owner from the responsibility of providing adequate inspection during construction or operation and maintenance. Periodic inspections during construction or alteration shall be conducted under the supervision of a licensed professional engineer who shall propose the frequency and nature of the inspections subject to approval by the director. Periodic inspections during operation and maintenance shall be conducted under the supervision of a licensed professional engineer at an interval not greater than that required to update the operation and maintenance certificate. At a minimum, an annual owner's inspection shall be conducted when a professional inspection is not required. Every owner shall provide for an inspection by a licensed professional engineer after overtopping of the impounding structure. A copy of the findings of each inspection with the engineer's recommendations shall be filed with the board within a reasonable period of time not to exceed 30 days subsequent to completion of the inspection.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §4.1, eff. February 1, 1989.

4VAC50-20-190. Right to hearing.

Any owner aggrieved by an action taken by the director or by the board without hearing, or by inaction of the director or the board, under the provisions of this chapter, may demand in writing a formal hearing.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §4.2, eff. February 1, 1989.

4VAC50-20-200. Enforcement.

Any owner refusing to obey any order of the board or the director pursuant to this chapter may be compelled to obey and comply with such provisions by injunction or other appropriate remedy obtained in a court proceeding. Such proceeding shall be instituted by the board or in the case of an emergency, by the director in the court which granted approval to the owner to impound waters or, if such approval has not been granted, the proceeding shall be instituted in any appropriate court.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §4.3, eff. February 1, 1989.

4VAC50-20-210. Consulting boards.

A. When the board needs to satisfy questions of safety regarding plans and specifications, construction or operation and maintenance, or when requested by the owner, the board may appoint a consulting board to report to it with respect to those questions of the impounding structure's safety ~~of an impounding structure~~. Such a board shall consist of two or more consultants, none of whom have been associated with the impounding structure.

B. The costs and expenses incurred by the consulting board, if appointed at the request of an owner, shall be paid by the owner.

C. The costs and expenses incurred by the consulting board, if initiated by the board, shall be paid by the board.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §4.4, eff. February 1, 1989.

4VAC50-20-220. Unsafe conditions.

A. No owner shall have the right to maintain an impounding structure which unreasonably threatens the life or property of another person. The owner of any impounding structure found to have deficiencies which could threaten life or property if uncorrected shall take the corrective actions needed to remove such deficiencies within a reasonable period of time.

B. Imminent danger. When the director finds that an impounding structure is unsafe and constitutes an imminent danger to life or property, he shall immediately notify the State Department of Emergency Management and confer with the owner and ensure that the emergency action plan has been implemented if appropriate to do so. The owner of an impounding structure found to constitute an imminent danger to life or property shall take immediate corrective action to remove the imminent danger as required by §10.1-608 of the Code of Virginia.

C. Nonimminent danger. The owner of an impounding structure who has been issued a report by the board containing findings and recommendations for the correction of deficiencies which threaten life or property if not corrected, shall undertake to implement the recommendations for correction of deficiencies according to a schedule of implementation contained in that report as required by §10.1-609 of the Code of Virginia.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §4.5, eff. February 1, 1989; Amended, Virginia Register Volume 18, Issue 14, eff. July 1, 2002.
Effect of Amendment: The July 1, 2002 amendment, in subsection B, changed "Emergency Services" to "Emergency Management"; and, in subsection C, changed "director" to "board", following "issued a report by the".

4VAC50-20-230. Complaints.

A. Upon receipt of a complaint alleging that the person or property of the complainant is endangered by the construction, maintenance or operation of impounding structure, the director shall cause an inspection of the structure, unless the data, records and inspection reports on file with the board are found adequate to determine if the complaint is valid.

B. If the director finds that an unsafe condition exists, the director shall proceed under the provisions of §§10.1-608 and 10.1-609 of the Code of Virginia to render the extant condition safe.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §4.6, eff. February 1, 1989.

Part V: Design Requirements

4VAC50-20-240. Design of structures.

A. The owner shall complete all necessary investigations prior to submitting the design report. The scope and degree of precision required is a matter of engineering judgment based on the complexities of the site and the hazard potential classification of the proposed structure.

B. Surveys shall be made with sufficient accuracy to locate the proposed construction site and to define the total volume of storage in the impoundment. Locations of center lines and other horizontal and vertical controls shall be shown on a map of the site. The area downstream and upstream from the proposed impounding structure shall be investigated in order to delineate the areas and extent of potential damage in case of failure or backwater due to flooding.

C. The drainage area shall be determined. Present, projected and potential future land-use conditions shall be considered in determining the runoff characteristics of the drainage area. The most severe of these conditions shall be included in the design calculations which shall be submitted as part of the design report.

D. The geotechnical engineering investigation shall consist of borings, test pits and other subsurface explorations necessary to adequately define the existing conditions. The investigations shall be performed so as to define the soil, rock and ground water conditions.

E. All construction materials shall be adequately selected so as to ensure that their properties meet design criteria. If on-site materials are to be utilized, they shall be located and determined to be adequate in quantity and quality.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §5.1, eff. February 1, 1989.

4VAC50-20-250. Design flood.

The minimum design flood to be utilized in impounding structure evaluation, design, construction, operation and maintenance shall be commensurate with the size and hazard potential of the particular impounding structure as determined in 4VAC50-20-50 and Table 1. Competent, experienced, ~~professional~~ engineering judgment by a licensed professional engineer shall be used in applying those design and evaluation procedures referenced in 4VAC50-20-320 of this chapter.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §5.2, eff. February 1, 1989.

4VAC50-20-260. Emergency spillway design.

A. Every impounding structure shall have a spillway system with adequate capacity to discharge the design flood without endangering the safety of the impounding structure.

B. An emergency spillway shall be required.

C. Vegetated earth or an unlined emergency spillway may be approved when the applicant demonstrates that it will pass the spillway design flood without jeopardizing the safety of the impounding structure.

D. Lined emergency spillways shall include design criteria calculations, plans and specifications for open channel, drop, ogee and chute spillways that include crest structures, walls, panel lining and miscellaneous details. All joints shall be reasonably water-tight and placed on a foundation capable of sustaining applied loads without undue deformation. Provision shall be made for handling leakage from the channel or under seepage from the foundation which might adversely affect the structural integrity and structural stability of the impounding structure.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §5.3, eff. February 1, 1989.

4VAC50-20-270. Principal spillways and outlet works.

A. It will be assumed that principal spillways and regulating outlets provided for special functions will operate to normal design discharge capabilities during the spillway design flood, provided appropriate analyses show:

1. That control gates and structures are suitably designed to operate reliably under maximum heads for durations likely to be involved and risks of blockage by debris are minimal;

2. That access roads and passages to gate regulating controls would be safely passable by operating personnel under spillway design flood conditions; and

3. That there are no other substantial reasons for concluding that outlets would not operate safely to fill design capacity during the spillway design flood.

B. If there are reasons to doubt that any of the above basic requirements might not be adequately met under spillway design flood conditions, the "dependable" discharge capabilities of regulating outlets shall be assumed to be less than 100% of design capabilities, generally as outlined in the following subsections C through G of this section.

C. Any limitations in safe operating heads, maximum velocities to be permitted through structures or approach channels, or other design limitations shall be observed in establishing "dependable" discharge rating curves to be used in routing the spillway design flood hydrograph through the reservoir.

D. If intakes to regulating outlets are likely to be exposed to dangerous quantities of floating ~~drift~~ debris, sediment depositions or ice hazards prior to or during major floods, the dependable discharge capability during the spillway design flood shall be assumed to be zero.

E. If access roads or structural passages to operating towers or controls are likely to be flooded or otherwise unusable during the spillway design flood, the dependable discharge capability of regulating outlets will be assumed to be zero for those period of time during which such conditions might exist.

F. Any deficiencies in discharge performance likely to result from delays in the operation of gates before attendants could be reasonably expected to reach the control for in estimating "dependable" discharge capabilities to be assumed in routing the spillway design flood through reservoir. Reports on design studies shall indicate the allowances made for possible delays in initiating gate operations. Normally, for projects located in small basins, where critical spillway design flood inflows may occur within several hours after intense precipitation, outflows through any regulating outlets that must be opened after the flood begins shall be assumed to be zero for an appropriate period of time subsequent to the beginning of intense rainfall.

G. All gates, valves, conduits and concrete channel outlets shall be designed and constructed to prevent significant erosion or damage to the impounding structure or to the downstream outlet or channel.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §5.4, eff. February 1, 1989.

4VAC50-20-280. Drain requirements.

All new impounding structures regardless of their hazard potential classification, shall include a device to permit draining of the impoundment within a reasonable period of time as determined by the owner's licensed professional engineer, subject to approval by the director.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §5.5, eff. February 1, 1989.

4VAC50-20-290. Life of the impounding structure.

Components of the impounding structure, the impoundment, the outlet works, drain system and appurtenances shall be durable in keeping with the design and planned life of the impounding structure.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §5.6, eff. February 1, 1989.

4VAC50-20-300. Additional design requirements.

A. Flood routings shall start at or above the elevation of the crest of the lowest ungated outlet.

B. All elements of the impounding structure and impoundments shall conform to sound engineering practice. Safety factors, design standards and design references that are used shall be included with the design report.

C. Inspection devices may be required by the director for use by inspectors, owners or the director in conducting inspections in the interest of structural integrity during and after completion of construction and during the life of the impounding structure.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §5.7, eff. February 1, 1989.

4VAC50-20-310. Plans and specifications.

The plans and specifications for a proposed impounding structure shall consist of a detailed engineering design report that includes engineering drawings and specifications, with the following as a minimum:

1. The name of the project; the name of the owner; classification of the impounding structure as set forth in this chapter; designated access to the project and the location with respect to highways, roads, streams and existing

impounding structures and impoundments that would affect or be affected by the proposed impounding structure.

2. Cross-sections, profiles, logs of test borings, laboratory and in situ test data, drawings of principal and emergency spillways and other additional drawings in sufficient detail to indicate clearly the extent and complexity of the work to be performed.

3. The technical provisions, as may be required to describe the methods of the construction and construction quality control for the project.

4. Special provisions, as may be required to describe technical provisions needed to ensure that the impounding structure is constructed according to the approved plans and specifications.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §5.8, eff. February 1, 1989.

4VAC50-20-320. Acceptable design procedures and references.

The following are acceptable as design procedures and references:

1. The design procedures, manuals and criteria used by the United States Army Corps of Engineers.

2. The design procedures, manuals and criteria used by the United States Department of Agriculture, Natural Resources Conservation Service.

3. The design procedures, manuals and criteria used by the United States Department of the Interior, Bureau of Reclamation.

4. The design procedures, manuals and criteria used by the United States Department of Commerce, National Weather Service.

5. Other design procedures, manuals and criteria that are accepted as current, sound engineering practices, as approved by the director prior to the design of the impounding structure.

Statutory Authority: §10.1-605 of the Code of Virginia.
Historical Notes: Derived from VR625-01-00 §5.9, eff. February 1, 1989; Amended, Virginia Register Volume 18, Issue 14, eff. July 1, 2002.
Effect of Amendment: The July 1, 2002 amendment, in paragraph 2, changed "Soil" to "Natural Resources" before "Conservation"; and, in paragraph 3, changed "or Interior" to "of the Interior".

FORMS

Dam Owner's Annual Inspection Form, DCR 199-098 (rev. 12/01).

Operation and Maintenance Application Class I, II and III Impounding Structures, DCR 199-099 (rev. 12/01).

As-Built Report for Class I, II and III Impounding Structures, DCR 199-100 (rev. 12/01).

Design Report for the Construction/Alteration of Impounding Structures, DCR 199-101 (rev. 12/01).

~~Emergency Action Plan for Class I, Class II and Class III Impounding Structures, DCR 199-103 (rev. 12/01).~~

Inventory Report for Class III and Class IV Impounding Structures, DCR 199-104 (rev. 12/01).

Reinspection Report for Class I and II Impounding Structures, DCR 199-105 (rev. 12/01).

Agricultural Certification for Impounding Structures, DCR 199-106 (rev. 12/01).

Transfer Application for Impounding Structures, DCR 199-107 (rev. 12/01).

Spillway Flow Reduction Parking Lot Items
Full scale exercise (every 2 years) and functional exercise (every 6 years) might be part of a reduction process.
Inundation maps updated more frequently
Functioning I-Flow System or other observation system
Proactive – Inundation maps driving future zoning
DCR in-depth review of the EAP require $$$'s
Automated warning/ notification system

Functional and full scale exercises shall be considered comprehensive exercises and shall only be required pursuant to section xxxx (spillway design reduction strategies).

Attachment #2

Summary of State Dam Safety Regulations June 13, 2006

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Virginia

TABLE 1--Impounding Structure Regulations

Class of Dam	Hazard Potential If Impounding Structure Fails	SIZE CLASSIFICATION Maximum Capacity (Ac-Ft)[a]	Height(Ft)[a]	Spillway Design Flood (SDF)[b]
I	Probable Loss of Life; Excessive Economic Loss	Large ≥ 50,000 Medium ≥ 1,000 & <50,000 Small ≥ 50 & < 1,000	≥ 100 ≥ 40 & < 100 ≥ 25 & < 40	PMF[c] PMF 1/2 PMF to PMF
II	Possible Loss of Life; Appreciable Economic Loss	Large ≥ 50,000 Medium ≥ 1,000 & <50,000 Small ≥ 50 & < 1,000	≥ 100 ≥ 40 & < 100 ≥ 25 & < 40	PMF 1/2 PMF to PMF 100-YR to 1/2 PMF
III	No Loss of Life Expected; Minimal Economic Loss	Large ≥ 50,000 Medium ≥ 1,000 & <50,000 Small ≥ 50 & < 1,000	≥ 100 ≥ 40 & < 100 ≥ 25 & < 40	1/2 PMF to PMF 100-YR to 1/2 PMF 50-YR[d] to 100-YR[e]
IV	No Loss of Life Expected; No Economic Loss to Others	≥ 50 (non-agricultural) ≥ 100 (agricultural)	≥ 25 (both)	50-YR to 100-YR

North Carolina

Category	Potential Loss of Life	Potential for Damage	Normal Pool Storage	Height	Inflow Design Flood
C (High)	Loss of human life * (probable loss of 1 or more human lives) * Probable loss of human life due to breached roadway or bridge on or below the dam (250 vehicles per day at 1000 ft. visibility; 100 vehicles per day at 500 ft. visibility; 25 vehicles per day at 200 ft visibility)	Economic damage (more than $200,000)	Very Large > 50,000 Large > 7,500 & <50,000 Medium > 750 & <7,500 Small < 750	> 100 > 50 & < 100 > 35 & < 50 < 35	PMP 3/4 PMP 1/2 PMP 1/3 PMP
B (Intermediate)		Damage to highways, interruption of service (25 to less than 250 vehicles per day) Economic Damage ($30,000 to less than $200,000)	Very Large > 50,000 Large > 7,500 & <50,000 Medium > 750 & <7,500 Small < 750	> 100 > 50 & < 100 > 35 & < 50 < 35	3/4 PMP 1/2 PMP 1/3 PMP 100-YR
A (Low)		Interruption of road service, low volume roads (less than 25 vehicles per day) Economic Damage (Less than $30,000)	Very Large > 50,000 Large > 7,500 & <50,000 Medium > 750 & <7,500 Small < 750	> 100 > 50 & < 100 > 35 & < 50 < 35	1/2 PMP 1/3 PMP 100-YR 50-YR

Cost of dam repair and loss of services should be included in economic loss estimate if the dam is a publicly owned utility, such as municipal water supply dam.

It is recognized that the relationships between valley slope and width, total reservoir storage, drainage area, other hydrologic factors, and specific cultural features 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 analysis is acceptable. The spillway should be sized so that the increased downstream damage resulting from overtopping failure of the dam would not be significant as compared with the damage caused by the flood in the absence of dam overtopping failure.

Maryland

Category	Potential Loss of Life	Potential for Damage	Normal Pool Storage	Height	Inflow Design Flood
I (high)	probable	Serious damage to residential, industrial or commercial buildings, public roads or RR	20,000 ac-ft or more	50 ft or more	PMF
II (significant)	Small possibility	Located in predominantly rural or agricultural areas where failure may cause damage to isolated residence or cause interruption of use or service of public utilities or roads. Damage is within the financial capability of owner to repair.	Greater than 1000 ac-ft and less than 20,000 ac-ft	Greater than 25 ft and less than 50 ft	The inflow design flood shall be the standard project flood or the largest flood of record, whichever is greater.
III (low)	Very unlikely	Damage is of same magnitude as cost of dam and within financial capability of owner to repair	Less than 1000 ac-ft	Less than 25 ft	The inflow design flood shall be one having a recurrence interval of once in 100 years or longer
IV			Less than 100 ac-ft	Less than 15 ft	Shall be as defined in USDA, Natural Resource Conservation Service, Maryland Conservation Practice, Standard Pond Code 378 (January, 2000)

Inflow Design Flood. The inflow design flood for Category I dams shall be the probable maximum flood. For Category II dams the inflow design flood shall be the standard project flood or the largest flood of record, whichever is greater. For Category III dams the inflow design flood shall be one having a recurrence interval of once in 100 years or longer. For Category IV dams the inflow design flood shall be as defined in USDA, Natural Resource Conservation Service, Maryland Conservation Practice, Standard Pond Code 378 (January, 2000), which is incorporated by reference in COMAR 26.17.02.01-1B(2). Criteria shall be provided or approved by the Administration for each of the above inflow design floods.

Category IV is reserved for those structures which have a contributing drainage area of less than 1 square mile (640 acres), and a normal depth of water less than 15 feet above the original stream bed, and a normal surface area less than 12 acres

Dams qualifying for the Category III classification may be classed in Category IV, if all of the requirements of Environment Article, §5-503(b), Annotated Code of Maryland, are met with the exception of §5-503(b)(1).

West Virginia

twenty-five (25) feet or more in height and can impound fifteen (15) acre-feet or more of water; or six (6) feet or more in height and which does or can impound fifty (50) acre-feet or more of water.

Category	Potential Loss of Life	Potential for Damage	Normal Pool Storage	Height	Inflow Design Flood
1 (high)	This classification must be used if failure may result in the loss of human life.	major damage to dwellings, commercial or industrial buildings, main railroads, important public utilities, or where a high risk highway may be affected or damaged			probable maximum precipitation of six (6) hours in duration [The design precipitation may be reduced based on Risk Assessment but in no case to less than seventy percent (70%) of the PMP.]
2 (significant)	unlikely	minor damage to dwellings, commercial or industrial buildings, important public utilities, main railroads, or cause major damage to unoccupied buildings, or where a low risk highway may be affected or damaged.			shall be designed for fifty percent (50%) of a probable maximum precipitation of six (6) hours duration [The design precipitation may be reduced based on Risk Assessment but in no case to less than twenty-five percent (25%) of the PMP.]
3 (low)	unlikely	only a loss of the dam itself and a loss of property use, such as use of related roads, with little additional damage to adjacent property. Those dams located in rural or agricultural areas where failure may cause minor damage to nonresidential and normally unoccupied buildings, or rural or agricultural land.	< 400 acre -ft	< 40 ft	shall be designed for twenty-five percent (25%) of a probable maximum precipitation of six (6) hours in duration [The design precipitation may be reduced based on Risk Assessment but in no case to less than a P100 rainfall of six (6) hours in duration.]
4 (negligible)	no potential for loss of human life	no potential for property damage and no potential for significant harm to the environment			shall be designed for a P100 rainfall of six (6) hours in duration

An impoundment exceeding forty (40) feet in height or four hundred (400) acre-feet storage volume shall not be classified as a Class 3 dam.

Pennsylvania

Category	Potential Loss of Life	Potential for Damage	Normal Pool Storage	Height	Inflow Design Flood
1	Substantial	Excessive (extensive residential, commercial, agricultural and substantial public inconvenience)	A ≥ 50,000 B > 1,000 & <50,000 C ≤ 1,000	A ≥ 100 B > 40 & < 100 C ≤ 40	PMF PMF 1/2 PMF to PMF
2	Few (no rural communities or urban developments and no more than a small number of habitable structures)	Appreciable (damage to private or public property and short duration public inconvenience)	A ≥ 50,000 B > 1,000 & <50,000 C ≤ 1,000	A ≥ 100 B > 40 & < 100 C ≤ 40	PMF 1/2 PMF to PMF 100 year to 1/2 PMF
3	None expected (no permanent structure for human habitation)	Minimal (undeveloped or occasional structures with no significant effect on public inconvenience)	A ≥ 50,000 B > 1,000 & <50,000 C ≤ 1,000	A ≥ 100 B > 40 & < 100 C ≤ 40	1/2 PMF to PMF 100 year to 1/2 PMF 50 year to 100 year frequency

Size classification may be determined by either storage or height of structure, whichever gives the higher category.

The design flood is intended to represent the largest flood that need be considered in the evaluation of a given project. When a range of design flood is indicated, the magnitude that most closely relates to the size and hazard potential shall be selected. Design flood criteria shall be as indicated in the following table:
The Department may, in its discretion, require consideration of a minimum design flood for a class of dams or reservoirs in excess of that set forth in subsection when it can be demonstrated that the design flood requirement is necessary and appropriate to provide for the integrity of the dam or reservoir and to protect life and property with an adequate margin of safety.

The Department may, in its discretion, consider a reduced design flood for a class of dams or reservoirs when it can be demonstrated that the design flood provides for the integrity of the dam or reservoir and protects life and property with an adequate margin of safety.

Kentucky

Category	Potential Loss of Life	Potential for Damage	Normal Pool Storage	Height	Inflow Design Flood
C (high)	This classification must be used if failure would cause probable loss of human life.	failure would cause serious damage to homes, commercial buildings, utilities, highways or railroads	fifty acre-feet or more	twenty-five feet or more	Class (C) $P_C = PMP$
B (moderate)	loss of life is not envisioned	failure would cause significant damage to property and project operation Such structures will generally be located in predominantly rural agricultural areas where failures may damage isolated homes, main highways or major railroads, or cause interruption of use or service of relatively important public utilities.	fifty acre-feet or more	twenty-five feet or more	Class (B) $P_B = P_{100} + 0.40 \times (PMP - P_{100})$
A (low)		failure would result in loss of the structure itself, but little or no additional damage to other property Such structures will generally be located in rural or agricultural areas where failure may damage farm buildings other than residences, agricultural lands, or county roads.	fifty acre-feet or more	twenty-five feet or more	

The responsible engineer shall determine the classification of the proposed structure after considering the characteristics of the valley below the site and probable future development.

Establishment of minimum criteria does not preclude provisions for greater safety when deemed necessary in the judgment of the engineer. Considerations other than those mentioned in the above classifications may make it desirable to exceed the established minimum criteria. A statement of the classification established by the responsible engineer shall be clearly shown on the first sheet of the plans.

In which P denotes 6-hour design rainfall, P100 refers to 6-hour, 100-year precipitation, and PMP represents 6-hour Probable Maximum Precipitation.

The establishment of the above criteria does not eliminate the need for sound engineering judgment but only establishes the lowest limit of design considered acceptable.

It is the responsibility of the design engineer to classify the structure and to determine if the design requirements are in excess of the minimum.

Tennessee

Category	Potential Loss of Life	Potential for Damage	Normal Pool Storage	Height	Inflow Design Flood
1 (high)	failure would probably result in loss of human life	failure would probably result in excessive economic loss due to damage of downstream properties; excessive economic loss, public hazard, or public inconvenience due to loss of impoundment and/or damage to roads or any public or private utilities	Large ≥ 50,000 Intermediate 1,000 to 50,000 Small 30 to 999	≥ 100 41 to 100 20 to 40	Old PMP PMP 1/2 PMP New PMP PMP 1/2 PMP
2 (significant)	Chances of loss of life would be possible but remote	failure may damage downstream private or public property, but such damage would be relatively minor and within the general financial capabilities of the dam owner. Public hazard or inconvenience due to loss of roads or any public or private utilities would be minor and of short duration.	Large ≥ 50,000 Intermediate 1,000 to 50,000 Small 30 to 999	≥ 100 41 to 100 20 to 40	Old PMP 1/2 PMP 1/3 PMP New PMP PMP 1/2 PMP
3 (low)	No loss of human life would be expected	failure may damage uninhabitable structures or land but such damage would probably be confined to the dam owner's property.	Large ≥ 50,000 Intermediate 1,000 to 50,000 Small 30 to 999	≥ 100 41 to 100 20 to 40	Old 1/2 PMP 1/3 PMP 100 year New PMP PMP 1/2 PMP

All dams shall have an emergency spillway system with capacity to pass a flow resulting from a 6-hour design storm indicated in the minimum design storm criteria for the size corresponding to the dam [Marked as new in the table]. Any new dam constructed between October 3, 1987, and February 19, 2001, shall be required to pass the Freeboard Design Storm specified in subparagraph 1200-5-7-.06(3)(b) [Marked old in table]. However, if the applicant's engineer provides calculations, designs, and plans to show that the design flow can be stored, passed through, or passed over the dam without failure occurring, or if he can successfully demonstrate to the Commissioner that the dam is a safe structure and can certify that the dam is sufficient to protect against probable loss of human life downstream, said dam design may be approved by the Commissioner. The establishment of the minimum design storm criteria does not eliminate the need for sound engineering judgment but only establishes the lowest limit of design considered acceptable.

New Jersey

Category	Potential Loss of Life	Potential for Damage	Normal Pool Storage	Height	Inflow Design Flood
1 (high)	failure of which may cause the probable loss of life. The existence of normally occupied homes in the area that are susceptible to significant damage in the event of a dam failure will be assumed to mean "probable loss of life".	failure of which may cause extensive property damage. Extensive property damage means the destructive loss of industrial or commercial facilities, essential public utilities, main highways, railroads or bridges. A dam may be classified as having a high hazard potential based solely on high projected economic loss. Recreational facilities below a dam, such as a campground or recreation area, may be sufficient reason to classify a dam as having a high hazard potential.			PMP
2 (significant)	loss of human life is not envisioned	failure may cause significant damage to property and project operation. This classification applies to predominantly rural, agricultural areas, where dam failure may damage isolated homes, major highways or railroads or cause interruption of service of relatively important public utilities.			1/2 PMP
3 (low)		failure of which would cause loss of the dam itself but little or no additional damage to other property. This classification applies to rural or agricultural areas where failure may damage farm buildings other than residences, agricultural lands or non-major roads.			24 hour 100 year frequency, Type III storm*
4 (small)			This classification includes any project which impounds less than 15 acre-feet of water to the top of dam, has less than 15 feet height-of-dam and which has a drainage area above the dam of 150 acres or less in extent.		24 hour 100 year frequency, Type III storm plus 50%*

The Department will use the following guidelines to classify dams according to hazard. Probable future development of the area downstream from the dam which might be affected by its failure will be considered in determining the hazard classification. The Department may, in its discretion, change the hazard class of any proposed or existing dam.

No dam may be included in Class IV if it meets the criteria for Class I or II. Any applicant may request consideration as a Class III dam upon submission of a positive report and demonstration proving low hazard.

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South Carolina

Category	Potential Loss of Life	Potential for Damage	Normal Pool Storage	Height	Inflow Design Flood
I (High)	failure will likely cause loss of life	failure will likely cause serious damage to homes, industrial and commercial facilities, important public utilities, main highways or railroads	Large ≥ 50,000 Intermediate ≥ 1,000 & <50,000 Small ≥ 50 & <1,000 Very Small < 50	≥ 100 ≥ 40 & < 100 ≥ 25 & < 40 < 25	PMF PMF 1/2 PMF to PMF 100-yr to 1/2 PMF
II (Significant)	failure will not likely cause loss of life	failure may damage homes, industrial and commercial facilities, secondary highways or railroads or cause interruption of use or service of relatively important public utilities	Large ≥ 50,000 Intermediate ≥ 1,000 & <50,000 Small ≥ 50 & <1,000 Very Small < 50	≥ 100 ≥ 40 & < 100 ≥ 25 & < 40 < 25	PMF 1/2 PMF to PMF 100 year to 1/2 PMF
III (Low)	loss of life is not expected	failure may cause minimal property damage to others	Large ≥ 50,000 Intermediate ≥ 1,000 & <50,000 Small ≥ 50 & <1,000 Very Small < 50	≥ 100 ≥ 40 & < 100 ≥ 25 & < 40 < 25	1/2 PMF to PMF 100 year to 1/2 PMF 50 to 100-yr frequency

Georgia

Category	Potential Loss of Life	Potential for Damage	Normal Pool Storage	Height	Inflow Design Flood
I	failure would result in probable loss of human life	Situations constituting "probable loss of life" are those situations involving frequently occupied structures or facilities, including, but not limited to, residences, commercial and manufacturing facilities, schools and churches.	Very Large ≥ 50,000 Large ≥ 1,000 & <50,000 Medium ≥ 500 & <1,000 Small < 500	≥ 100 ≥ 35 & < 100 ≥ 25 & < 35 < 25	PMP .50 PMP .333 PMP .25 PMP
II	failure would not expect to result in probable loss of human life		Not subject to regulation		

Based on visual inspection and detailed hydrologic and hydraulic evaluation, including documentation of completed design and construction procedures, up to 10 percent lower requirement (22.5, 30, 45, 90) may be accepted on existing PL566 (including RC&D structures) and PL 534 Project Dams at the discretion of the Director, provided the project is in an acceptable state of maintenance. The design storm may be reduced on existing dams if the applicant's engineer can successfully demonstrate to the Director, by engineering analysis, that the dam is sufficient to protect against probable loss of human life downstream at a lesser design storm. Earth emergency spillways shall not function until the 50-year storm.

"PMP" means probable maximum precipitation as determined by the United States Weather Service to be the greatest amount of rainfall of a six-hour duration which would be expected for a given location.

The word 'dam' shall not include: iv) Any dam classified by the director as a category II dam pursuant to Code Section 12-5-375, except that such category II dams shall be subject to the provisions of this part for the purposes of said Code Section 12-5-375 and for the purposes of subsection (b) of Code Section 12-5-376;

Massachusetts

Category	Potential Loss of Life	Potential for Damage	Normal Pool Storage	Height	Inflow Design Flood
I (High)	failure will likely cause loss of life	Dams located where failure will likely cause serious damage to home(s), industrial or commercial facilities, important public utilities, main highway(s) or railroad(s).	Large ≥ 1,000 Intermediate ≥ 50 & <1,000 Small ≥ 15 & <50 Non-jurisdictional not in excess of 15 regardless of height	≥ 40 ≥ 15 & < 40 ≥ 6 & < 15 not in excess of six regardless of storage capacity	Old 1/2 PMF 1/2 PMF 500 year New PMF PMF PMF
II (Significant)	failure may cause loss of life	failure may cause damage home(s), industrial or commercial facilities, secondary highway(s) or railroad(s) or cause interruption of use or service of relatively important facilities.	Large ≥ 1,000 Intermediate ≥ 50 & <1,000 Small ≥ 15 & <50 Non-jurisdictional not in excess of 15 regardless of height	≥ 40 ≥ 15 & < 40 ≥ 6 & < 15 not in excess of six regardless of storage capacity	Old 500 year 500 year 100 year New 1/2 PMF 500 year 500 year
III (Low)	loss of life is not expected	failure may cause minimal property damage to others	Large ≥ 1,000 Intermediate ≥ 50 & <1,000 Small ≥ 15 & <50 Non-jurisdictional not in excess of 15 regardless of height	≥ 40 ≥ 15 & < 40 ≥ 6 & < 15 not in excess of six regardless of storage capacity	Old 100 year 50 year 50 year New 100 year 100 year 100 year

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.

Washington

Category	Potential Loss of Life	Potential for Damage	Environmental Damages	Normal Pool Storage	Height	Design Step
High – 1A	More than 300	Extreme. More than 100 inhabited structures. Highly developed, densely populated suburban or urban area with associated industry, property, transportation and community life line features.	Severe water quality degradation potential from reservoir contents and long term effects on aquatic and human life.		Large $\geq$ 50 Intermediate $\geq$ 15 & < 50 Small < 15	8 (1 chance in 1 million)
High – 1B	31 - 300	Extreme. 11 to 100 inhabited structures. Medium density suburban or urban area with associated industry, property and transportation features.	Severe water quality degradation potential from reservoir contents and long term effects on aquatic and human life.			4-8
High – 1C	7 to 30	Major. 3 to 10 inhabited structures. Low density suburban area with some industry and work sites. Primary highways and rail lines.	Severe water quality degradation potential from reservoir contents and long term effects on aquatic and human life.			3-6
Significant - 2	1 to 6	Appreciable. 1 or 2 inhabited structures. Notable agriculture or work sites. Secondary highway and/or rail lines.	Limited water quality degradation from reservoir contents and only short term consequences.			3-4
Low - 3	0	Minimal. No inhabited structures. Limited agricultural development.	No deleterious materials in the reservoir contents.			1-2 (1 = 1 chance of 500 of being exceeded in any given year)

Idaho

Category	Potential Loss of Life	Potential for Damage	Normal Pool Storage	Height	Inflow Design Flood
High	Urban development, or any permanent structure for human habitation which are potentially inundated with flood water at a depth of more than 2 ft. or at a velocity of more than 2 ft. per second.	Major damage to land, crops, agricultural, commercial or industrial facilities, loss of use and/or damage to transportation, utilities or other public facilities or values.	Large ≥ 4,000 Intermediate ≥ 100 & <4,000 Small < 100	≥ 40 > 20 & < 40 ≤ 20	PMF 1/2 PMF 100 yr
Significant	No concentrated urban development, 1 or more permanent structures for human habitation which are potentially inundated with flood water at a depth of 2 ft. or less or at a velocity of 2 ft. per second or less.	Significant damage to land, crops, agricultural, commercial or industrial facilities, loss of use and/or damage to transportation, utilities or other public facilities or values.	Large ≥ 4,000 Intermediate ≥ 100 & <4,000 Small < 100	≥ 40 > 20 & < 40 ≤ 20	.5 PMF 500 yr 100 yr
Low	No permanent structures for human habitation.	Minor damage to land, crops, agricultural, commercial or industrial facilities, transportation, utilities or other public facilities or values	Large ≥ 4,000 Intermediate ≥ 100 & <4,000 Small < 100	≥ 40 > 20 & < 40 ≤ 20	500 yr 100 yr 50 yr

The inflow design flood(s) indicated in the table include specific frequency floods (2%/50yr, 1%/100 yr.) expressed in terms of exceedance with a probability the flood will be equaled or exceeded in any given year (a fifty (50) year flood has a two percent (2%) chance of occurring in any given year and a one hundred (100) year flood has a one percent (1%) chance of occurring in any given year); or PMF - probable maximum flood, which may be expected from the most severe combination of meteorologic and hydrologic conditions that are reasonably possible in the region. The PMF is derived from the probable maximum precipitation (PMP) which is the greatest theoretical depth of precipitation for a given duration that is physically possible over a particular drainage area at a certain time of year.

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Arkansas

Category	Potential Loss of Life	Potential for Damage	Normal Pool Storage	Height	Inflow Design Flood
high	YES	Excessive (Extensive public, industrial, commercial, or agricultural development); over $500,000.	Large ≥ 50,000 Intermediate > 1,000 & < 50,000 Small 50 to 1000	≥ 100 > 40 & < 100 25 to 40	PMF PMF .5 PMF to PMF
significant	NO	Appreciable (Significant structures, industrial, or commercial development, or cropland); $100,000 to $500,000.	Large ≥ 50,000 Intermediate > 1,000 & < 50,000 Small 50 to 1000	≥ 100 > 40 & < 100 25 to 40	PMF .5 PMF to PMF .25 PMF to .5 PMF
low	NO	Minimal (No significant structures; pastures, woodland, or largely undeveloped land); less than $100,000.	Large ≥ 50,000 Intermediate > 1,000 & < 50,000 Small 50 to 1000	≥ 100 > 40 & < 100 25 to 40	.5 PMF to .75 PMF .25 PMF to .5 PMF .25 PMF

Dams meeting either of the following criteria are not subject to
rules contained in this title, unless Section 701.5 of this title is successfully invoked.
A. Dams with height less than 25 feet.
B. Dams with normal storage less than 50 acre-feet.
C. Dams with crest elevations below the ordinary high water mark of the stream at that location.

All dams will be classified or reclassified as required to assure appropriate safety considerations. Hazard classification shall be based on the more stringent of either potential loss of human life or economic loss in accordance with Table 2 of this section. If doubt exists concerning classification, the more hazardous category must be selected.

Loss of human life is based upon presence of habitable structures.

The minimum hydrologic criteria may be reduced if properly prepared dam breach analyses show that dam failure during the SDF would cause an increase in flood level of one foot or less at, and downstream of, the first habitable structure or financially significant development.

Where SDF ranges are given, the spillway design flood shall be determined by straight line interpolation, based upon the effective height of dam or maximum storage, whichever computed SDF is greater.

Arizona

Category	Potential Loss of Life	Potential for Damage	Normal Pool Storage	Height	Inflow Design Flood
high	Probable - One or more expected	Low to high (not necessary for this classification)	Large ≥ 50,000 Intermediate > 1,000 & < 50,000 Small 50 to 1000	≥ 100 > 40 & < 100 25 to 40	.5 PMF to PMF .5 PMF to PMF .5 PMF to PMF
significant	None expected	Low to high	Large ≥ 50,000 Intermediate > 1,000 & < 50,000 Small 50 to 1000	≥ 100 > 40 & < 100 25 to 40	.5 PMF .5 PMF .25 PMF
low	None expected	Low	Large ≥ 50,000 Intermediate > 1,000 & < 50,000 Small 50 to 1000	≥ 100 > 40 & < 100 25 to 40	.25 PMF .25 PMF .25 PMF
very low	None expected	Economic and lifeline losses limited to owner's property or 100-year floodplain. Very low intangible losses identified.	Large ≥ 50,000 Intermediate > 1,000 & < 50,000 Small 50 to 1000	≥ 100 > 40 & < 100 25 to 40	100 yr 100 yr 100 yr

The Department shall base hazard potential classification on an evaluation of the probable present and future incremental adverse consequences that would result from the release of water or stored contents due to failure or improper operation of the dam or appurtenances, regard-less of the condition of the dam. The evaluation shall include land use zoning and development projected for the affected area over the 10 year period following classification of the dam. The Department considers all of the following factors in hazard potential classification: probable loss of human life, economic and lifeline losses, and intangible losses identified and evaluated by a public resource management or protection agency.

a. The Department bases the probable incremental loss of human life determination primarily on the number of permanent structures for human habitation that would be impacted in the event of failure or improper operation of a dam. The Department considers loss of human life unlikely if:

i. Persons are only temporarily in the potential inundation area;

ii. There are no residences or overnight campsites; and

iii. The owner has control of access to the potential inundation area and provides an emergency action plan with a process for warning in the event of a dam failure or improper operation of a dam.

b. The Department bases the probable economic, life-line, and intangible loss determinations on the property losses, interruptions of services, and intangible losses that would be likely to result from failure or improper operation of a dam.

The owner of a dam shall demonstrate that a spillway discharge would not result in incremental adverse consequences. In determining whether a spillway discharge of a dam would result in incremental adverse consequences, the Director shall evaluate whether the owner has taken any or all of the following actions: issuing public notice to downstream property owners, complying with flood insurance requirements, adopting emergency action plans, conducting mock flood drills, acquiring flow easements or other acquisitions of real property, or other actions appropriate to safeguard the dam site and flood channel