



**VIRGINIA SOIL AND
WATER CONSERVATION
BOARD GUIDANCE
DOCUMENT ON THE
DESIGN AND USE OF
DEVICES TO LOWER THE
RESERVOIR WATER
LEVEL**

(Approved September XX, 2020)

Summary:

This guidance document provides guidance to dam owners on which devices, methods, or systems may be used to lower the water level in a reservoir created by an impounding structure. Drains and related devices allow lowering of the reservoir ahead of a major precipitation event, during repair or maintenance of the dam, to relieve pressure on the dam as needed in response to an inspection or evaluation by a professional engineer, or in response to other operational and maintenance issues

Electronic Copy:

An electronic copy of this guidance in PDF format is available on the Regulatory TownHall under the Virginia Soil and Water Conservation Board at <http://townhall.virginia.gov/L/GDocs.cfm>.

Contact Information:

Please contact the Department of Conservation and Recreation's Division of Dam Safety and Floodplain Management at dam@dc.virginia.gov or by calling 804-371-6095 with any questions regarding the application of this guidance.

Disclaimer:

This document is provided as guidance and, as such, sets forth standard operating procedures for the Department of Conservation and Recreation in administering the Dam Safety Program on behalf of the Virginia Soil and Water Conservation Board (Board) in accordance with § 10.1-605.1. This guidance provides a general interpretation of the applicable Code and Regulations but is not meant to be exhaustive in nature. Each situation may differ and may require additional interpretation of the Dam Safety Act and attendant regulations. This is not intended to and cannot be relied on to create any rights, substantive or procedural, on the part of any person or entity.

Devices, Methods and Systems to Lower the Reservoir Water Level

I. Background:

The Virginia Dam Safety Act, §10.1-604 *et seq.*, states that the Virginia Soil and Water Conservation Board (Board) “shall adopt regulations to ensure that impounding structures in the Commonwealth are properly and safely constructed, maintained and operated.” Section 4VAC50-20-280 (Drain requirements) of the Virginia Administrative Code states:

“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. Existing drains on impounding structures shall be kept operational. When practicable, existing impounding structures shall be retrofitted with devices to permit draining.”

Additionally, section 4VAC50-20-290 (Life of the Impounding Structure) states that “components of the impounding structure, the outlet works, drain system and appurtenances shall be durable and maintained or replaced in keeping with the design and planned life of the impounding structure.”

The owner’s professional engineer has latitude in the design and use of the systems, devices, and methods used to lower the level of water in the reservoir provided the approach “permit[s] draining”, is “operational” and meets all other requirements of the Dam Safety Act and its attendant regulations.

II. Definitions (pursuant to § 10.1-604 and 4VAC50-20-30):

"Alteration" means changes to an impounding structure that could alter or affect its structural integrity. Alterations include, but are not limited to, changing the height or otherwise enlarging the dam, increasing normal pool or principal spillway elevation or physical dimensions, changing the elevation or physical dimensions of the emergency spillway, conducting necessary structural repairs or structural maintenance, or removing the impounding structure. Structural maintenance does not include routine maintenance.

"Alteration permit" means a permit required for any alteration to an impounding structure.

Board means the Virginia Soil and Water Conservation Board

Department means the Virginia Department of Conservation and Recreation, Division of Dam Safety and Floodplain Management

"Existing impounding structure" means any impounding structure in existence or under a construction permit prior to July 1, 2010.

"Impounding structure" or "dam "means a man-made structure, whether a dam across a watercourse or 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 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.

Low-level drain system means the devices, methods, or systems that are used to lower the level of water in the reservoir created by an impounding structure.

Practicable means an effective method of retrofitting an existing dam to lower the water level in a reservoir utilizing any of the designs, methods, or systems included in this guidance document or any additional designs, methods, or systems approved by the Department.

III. Authority:

The Dam Safety Act in the Code of Virginia contains the following authorities applicable to this guidance:

§ 10.1-605. Promulgation of regulations by the Board; guidance document. The Board shall adopt regulations to ensure that impounding structures in the Commonwealth are properly and safely constructed, maintained and operated...

Appendix 1 contains the Code of Virginia authorities (extended) applicable to this guidance and Appendix 2 contains the Impounding Structure Regulations authorities applicable to this guidance. These include:

§ 10.1-605. Promulgation of regulations by the Board; guidance document.

4VAC50-20-20. General Provisions.

4VAC50-20-30. Definitions.

4VAC50-20-80. Alterations Permits.

4VAC50-20-280. Drain Requirements.

4VAC50-20-290. Life of the Impounding Structure.

4VAC50-20-300. Additional Design Requirements.

4VAC50-20-320. Acceptable Design Procedures and References.

4VAC50-20-330. Other Applicable Dam Safety References.

IV. Discussion and Interpretation

In accordance with 4VAC50-20-280, all impounding structures must have a device, method, or system to lower the level of the reservoir created by the structure. Any dam to be constructed must include an approved low-level drain system designed in accordance with the requirements of the *Impounding Structure* regulations. An existing dam may need to modify or replace the low-level drain system to meet the requirements established in 4VAC50-20-280 and 4VAC50-20-290. Prior to any modification or repairs being conducted to the impounding structure, the Department may need to approve the modification or repair and issue an alteration permit (please

see 4VAC50-20-80 for additional information); dam owners must work with their Department Regional Engineer to ensure that any approvals and permit issuances are received before any work begins on the structure .

The ability to lower the level of a reservoir quickly and safely provides critical protection to the dam. (Also, see Emergency Action Plan (EAP) (PDF) guidance documents for more information on dam emergency planning.) A low-level drain system is usually engaged to address problems posing an immediate threat to the safety of the dam, when performing repairs to spillways, embankments, or other dam appurtenances, when performing maintenance, and when undertaking other efforts to reduce seasonal impacts to the dam. A low-level drain system is also used to control reservoir levels during first filling.

Below are specific examples of when a low-level drain system would be used ; this list does not include all possible scenarios where reservoir lowering may be required.

There is an immediate threat to the dam:

- Extreme floods threatening the safety of the dam and spillway system;
- Clogging of the spillway which may lead to high lake levels and eventual dam overtopping;
- Development of deep slides or cracks in the dam;
- Severe seepage through the dam which may lead to a piping failure of the dam;
- Partial or total collapse of the spillway system; and
- Landslide around reservoir rim.

There are repairs and maintenance needed at the dam:

- Routine maintenance;
- Slope protection repair;
- Spillway repairs;
- Repair and/or installation of docks and other structures along the shoreline; and
- Dredging the lake for application of aquatic herbicide.

There are actions needed to reduce seasonal impacts on the dam:

- To reduce ice damage to structures along the shoreline;
- To provide additional flood storage for upcoming spring rains;
- For periodic fluctuations in the lake level; and
- To discourage muskrat, beaver and other burrowing animal habitation along the shoreline that may lead to costly repairs and clogged spillways.

Acceptable low-level drain systems

Acceptable systems, devices or methods are:

- A valve located in the spillway riser or control structure;

- A conduit through the dam with a valve at either the upstream or downstream end of the conduit;
- A permanently installed siphon system where the siphon hose itself may be stored nearby;
- A permanently installed pumping system where a dedicated pump for this dam may be stored offsite, properly maintained in working order and accessible at all times;
- A gate, valve, or stop logs located in a drain control structure;
- Stop logs across a spillway;
- A combination of the above; or
- Any other effective system approved in writing by the Department prior to installation.

Dam owners are responsible for ensuring the following regarding the design of the low-level drain systems:

- Ensuring access to the low-level drain system is available at all times;
- Considering the possibility for operations to be conducted remotely;
- Coordinating with the Department's Regional Engineer to ensure the following:
 - The design including the hydraulic calculations, for the low-level drain system adheres to all design guidelines as required in 4VAC50-20-320;
 - The design, including the hydraulic calculations, for the low-level drain system is submitted for review even if no alteration to the impounding structure is under consideration; this will prevent unexpected changes to the configuration after installation of the low-level drain system;
 - Any application permit (either alteration or construction) documenting the design, hydraulic calculations, and specifications for the low-level drain system is submitted as required; and
 - A record report is prepared and submitted after installation of the low-level drain system is complete.

Please note: An owner must exercise extreme caution when opening an older low-level drain system. Older systems may become stuck in the open position subsequently draining the lake. Owners whose dam has an older low-level drain system which has not been properly maintained and exercised should consult their professional engineer and have a contingency plan in place to stop an uncontrolled release of water should the valve, gate or other device or system malfunction.

Operation and maintenance of low-level drain systems

All gates, valves, stems and other mechanisms of a low-level drain system should be lubricated, maintained, and tested according to the manufacturer's specifications. If an owner or their professional engineer do not access have a copy of the specifications and the manufacturing company cannot be determined, then a local valve distributor may be able to provide assistance. In most cases, the low-level drain system should be operated at least annually during the required inspection to prevent the inlet from clogging with sediment and debris and to keep all movable parts working easily. Frequent operation will help to ensure that the system will be operable when it is needed. An owner or their representative should contact local environmental officials

and Virginia Department of Environmental Quality regarding permits that may be required for a release of water or sediment.

There are several maintenance problems frequently found with low-level drain systems including:

- Deteriorated and bent control stems and stem guides;
- Deteriorated and separated conduit joints;
- Leaky and rusted control valves and sluice gates;
- Deteriorated ladders and platforms in control structures;
- Deteriorated control structures;
- Clogging of the drain conduit inlet with sediment and debris;
- Inaccessibility of the control mechanism to operate the drain;
- Seepage along the drain conduit;
- Erosion and undermining of the conduit discharge area;
- Vandalism; and
- Development of instability of earthen sections resulting in slides along the upstream slope of the dam and the shoreline caused by lowering the lake level too quickly.

V. Reference Documents related to the Design and Use of Low-Level Drain Systems and Acknowledgment

The documents below provide additional guidance regarding the design and use of low-level drain systems on impounding structures. The Department will utilize these documents when reviewing designs and permit applications that include the use of low-level outlet device systems. The Department acknowledges the utility of the New York Department of Environmental Conservation's website page on low-level outlets in developing this document.

Corps of Engineers Publication EM 1110-2-1602; CECW-EH-D; *Hydraulic Design of Reservoir Outlet Works*; October 15, 1980.

Corps of Engineers Publication ER 1110-2-50; CECW-EH-D; *Low level discharge facilities for drawdown of Impoundments*; August 22, 1975.

US Bureau of Reclamation's (USBR); *Criteria and Guidelines for Evacuating Storage Reservoirs and Sizing Low level Outlet Works* (ACER Technical Memorandum No. 3); 1990.

VI. Adoption, Amendments, and Repeal:

This document shall remain in effect until rescinded or superseded.

Appendix 1
Applicable Code of Virginia Authorities.

The Code of Virginia contains the following authorities applicable to this Guidance:

§ 10.1-605. Promulgation of regulations by the Board; guidance document.

A. The Board shall adopt regulations to ensure that impounding structures in the Commonwealth are properly and safely constructed, maintained and operated. Dam safety regulations promulgated by the State Water Control Board shall remain in full force until amended in accordance with applicable procedures.

B. The Board's Impounding Structure Regulations shall not require any impounding structure in existence or under a construction permit prior to July 1, 2010, that is currently classified as high hazard, or is subsequently found to be high hazard through reclassification, to upgrade its spillway to pass a rainfall event greater than the maximum recorded within the Commonwealth, which shall be deemed to be 90 percent of the probable maximum precipitation.

1. Such an impounding structure shall be determined to be in compliance with the spillway requirements of the regulations provided that (i) the impounding structure will pass two-thirds of the reduced probable maximum precipitation requirement described in this subsection and (ii) the dam owner certifies annually and by January 15 that such impounding structure meets each of the following conditions:

- a. The owner has a current emergency action plan that is approved by the Board and that is developed and updated in accordance with the regulations;
- b. The owner has exercised the emergency action plan in accordance with the regulations and conducts a table-top exercise at least once every two years;
- c. The Department has verification that both the local organization for emergency management and the Virginia Department of Emergency Management have on file current emergency action plans and updates for the impounding structure;
- d. That conditions at the impounding structure are monitored on a daily basis and as dictated by the emergency action plan;
- e. The impounding structure is inspected at least annually by a professional engineer and all observed deficiencies are addressed within 120 days of such inspection;
- f. The owner has a dam break inundation zone map developed in accordance with the regulations that is acceptable to the Department;
- g. The owner is insured in an amount that will substantially cover the costs of downstream property losses to others that may result from a dam failure; and
- h. The owner shall post the dam's emergency action plan on his website, or upon the request of the owner, the Department or another state agency responsible for providing emergency management services to citizens agrees to post the plan on its website. If the Department or another state agency agrees to post the plan on its website, the owner shall provide the plan in a format suitable for posting.

2. A dam owner who meets the conditions of subdivisions 1 a through 1 h, but has not provided record drawings to the Department for his impounding structure, shall submit a complete record report developed in accordance with the construction permit requirements of the Impounding Structure Regulations, excluding the required submittal of the record drawings.

3. A dam owner who fails to submit certifications required by subdivisions 1 a through 1 h in a timely fashion shall not enjoy the presumption that such impounding structure is deemed to be

in compliance with the spillway requirements of the Board's Impounding Structure Regulations (4VAC50-20).

4. Any dam owner who has submitted the certifications required by subdivisions 1 a through 1 h shall make (i) such certifications, (ii) the emergency action plan required by subdivision 1 a, and (iii) the certificate of insurance required by subdivision 1 g available, upon request and within five business days, to any person. A dam owner may comply with the requirements of this subdivision by providing the same information on a website and directing the requestor to such website. A dam owner who fails to comply with this subdivision shall be subject to a civil penalty pursuant to § 10.1-613.2.

C. The Board's regulations shall establish an incremental damage analysis procedure that permits the spillway design flood requirement for an impounding structure to be reduced to the level at which dam failure shall not significantly increase downstream hazard to life or property, provided that the spillway design flood requirement shall not be reduced to below the 100-year flood event for high or significant hazard impounding structures, or to below the 50-year flood event for low hazard potential impounding structures.

D. The Board shall consider the impact of limited-use or private roadways with low traffic volume and low public safety risk that are downstream from or across an impounding structure in the determination of the hazard potential classification of an impounding structure.

Appendix 2

Applicable Impounding Structure Regulations Authorities.

The *Impounding Structure Regulations* contains the following authorities applicable to this Guidance.

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. All engineering analyses required by this chapter, including but not limited to, plans, specifications, hydrology, hydraulics and inspections shall be conducted or overseen by and bear the seal of a professional engineer licensed to practice in Virginia.

E. Design, inspection and maintenance of impounding structures shall be conducted utilizing competent, experienced, engineering judgment that takes into consideration factors including but not limited to local topography and meteorological conditions.

F. The forms noted in this chapter are available from the department at the department's website.

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 (equivalent to one foot of depth over one acre of area).

"Agricultural purpose" means the production of an agricultural commodity as defined in § 3.2-3900 of the Code of Virginia that requires the use of impounded waters.

"Agricultural purpose dams" means impounding structures which are less than 25 feet in height or which create a maximum impoundment smaller than 100 acre-feet, and operated primarily for agricultural purposes.

"Alteration" means changes to an impounding structure that could alter or affect its structural integrity. Alterations include, but are not limited to, changing the height or otherwise enlarging the dam, increasing normal pool or principal spillway elevation or physical dimensions, changing the elevation or physical dimensions of the emergency spillway, conducting necessary structural

repairs or structural maintenance, or removing the impounding structure. Structural maintenance does not include routine maintenance.

"Alteration permit" means a permit required for any alteration to an impounding structure.

"Annual average daily traffic" or "AADT" means the total volume of vehicle traffic of a highway or road for a year divided by 365 days and is a measure used in transportation planning and transportation engineering of how busy a road is.

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

"Conditional Operation and Maintenance Certificate" means a certificate required for impounding structures with deficiencies.

"Construction" means the construction of a new impounding structure.

"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.

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

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

"Emergency Action Plan or EAP" means a formal document that recognizes potential impounding structure emergency conditions and specifies preplanned actions to be followed to minimize loss of life and property damage. The EAP specifies actions the owner must take to minimize or alleviate emergency conditions at the impounding structure. It contains procedures and information to assist the 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 should consist of the performance of duties, tasks, or operations very similar to the way they would be performed in a real emergency. An exercise may include but not be limited to drills and tabletop exercises.

"Emergency Preparedness Plan" means a formal document prepared for Low Hazard impounding structures that provides maps and procedures for notifying owners of downstream property that may be impacted by an emergency situation at an impounding structure.

"Existing impounding structure" means any impounding structure in existence or under a construction permit prior to July 1, 2010.

"Freeboard" means the vertical distance between the maximum water surface elevation associated with the spillway design flood and the top of the impounding structure.

"Height" means the hydraulic 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 downstream limit of the barrier to the top of the impounding structure.

"Impounding structure" or "dam" means a man-made structure, whether a dam across a watercourse or 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 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.

"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 of water or other materials in acre- feet that is capable of being impounded at the top of the impounding structure.

"New construction" means any impounding structure issued a construction permit or otherwise constructed on or after July 1, 2010.

"Normal or typical water surface elevation" means the water surface elevation at the crest of the lowest ungated outlet from the impoundment or the elevation of the normal pool of the impoundment if different than the water surface elevation at the crest of the lowest ungated outlet. For calculating sunny day failures for flood control impounding structures, stormwater detention impounding structures, and related facilities designed to hold back volumes of water for slow release, the normal or typical water surface elevation shall be measured at the crest of the auxiliary or emergency spillway.

"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" may include the Commonwealth or any of its political subdivisions, including but not limited to sanitation district commissions and authorities, 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.

"Planned land use" means land use that has been approved by a locality or included in a master land use plan by a locality, such as in a locality's comprehensive land use plan.

"Spillway" means a structure to provide for the controlled release of flows from the impounding structure into a downstream area.

"Stage I Condition" means a flood watch or heavy continuous rain or excessive flow of water from ice or snow melt.

"Stage II Condition" means a flood watch or emergency spillway activation or impounding structure overtopping where a failure may be possible.

"Stage III Condition" means an emergency spillway activation or impounding structure overtopping where imminent failure is probable.

"Sunny day dam failure" means the failure of an impounding structure with the initial water level at the normal reservoir level, usually at the lowest ungated principal spillway elevation or the typical operating water level.

"Tabletop Exercise" means a type of emergency action plan exercise that involves a meeting of the impounding structure 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.

"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 normally flows.

4VAC50-20-80. Alteration permits.

A. Alterations which would potentially affect the structural integrity of an impounding structure include, but are not limited to, changing the height or otherwise enlarging the dam, increasing normal pool or principal spillway elevation or physical dimensions, changing the elevation or physical dimensions of the emergency spillway, conducting necessary repairs or structural maintenance, or removing the impounding structure. Structural maintenance does not include routine maintenance.

B. An applicant for an Alteration Permit shall submit a design report. A form for the design report is available from the department (Design Report for the Construction or Alteration of Virginia Regulated Impounding Structures). The design report shall be prepared in accordance with 4VAC50-20-240. The design report shall include, but not be limited to, the following information:

1. Project information including a description and benefits of the proposed alteration, name of the impounding structure, inventory number if available, name of the reservoir, and the purpose of the reservoir.
2. The hazard potential classification in conformance with Table 1 in 4VAC50-20-50.
3. Location of the impounding structure including the city or county, number of feet or miles upstream or downstream of a highway and the highway number, name of the river or the stream, and the latitude and longitude.
4. Owner's name or representative if corporation, mailing address, residential and business telephone numbers, and other means of communication.
5. Owner's engineer's name, firm, professional engineer Virginia number, mailing address, and business telephone number.
6. Impounding structure data including type of material (earth, concrete, masonry or other) and the following configurations (note both existing and design configurations for each):
 - a. Top of impounding structure (elevation);
 - b. Downstream toe – lowest (elevation);

- c. Height of impounding structure (feet);
 - d. Crest length – exclusive of spillway (feet);
 - e. Crest width (feet);
 - f. Upstream slope (horizontal to vertical); and
 - g. Downstream slope (horizontal to vertical).
7. Reservoir data including the following (note both existing and design configurations for each):
 - a. Maximum capacity (acre-feet);
 - b. Maximum pool (elevation);
 - c. Maximum pool surface area (acres);
 - d. Normal capacity (acre-feet);
 - e. Normal pool (elevation);
 - f. Normal pool surface area (acres); and
 - g. Freeboard (feet).
 8. Spillway data including the type, construction material, design configuration, and invert elevation for the low level drain, the principal spillway, and the emergency spillway.
 9. Watershed data including drainage area (square miles); type and extent of watershed development; time of concentration (hours); routing procedure; spillway design flood used and state source; design inflow hydrograph volume (acre-feet), peak inflow (cfs), and rainfall duration (hours); and freeboard during passage of the spillway design flood (feet).
 10. Evidence that the local government has been notified of the alteration and repair plan.
 11. Plans and specifications as required by 4VAC50-20-310. The plan view of the impounding structure site should represent all significant structures and improvements that illustrate the location of all proposed work.
 12. A report of the geotechnical investigations of the foundation soils, bedrock, or both in the areas affected by the proposed alterations and of the materials to be used to alter the impounding structure.
 13. Design assumptions and analyses sufficient to indicate that the impounding structure will be stable during the alteration of the impounding structure under all conditions of reservoir operations.
 14. Calculations and assumptions relative to design of the improved spillway or spillways, if applicable.
 15. Provisions to ensure that the impounding structure and appurtenances during the alteration will be protected against unacceptable deterioration or erosion due to freezing and thawing, wind, wave action and rain or any combination thereof.
 16. Other pertinent design data, assumptions and analyses commensurate with the nature of the particular impounding structure and specific site conditions, including when required by this chapter, a plan and water surface profile of the dam break inundation zone.
 17. If applicable, a description of the techniques to be used to divert stream flow during alteration work so as to prevent hazard to life, health and property, including a detailed plan and procedures to maintain a stable impounding structure during storm events, a drawing showing temporary diversion devices, and a description of the potential impoundment during the alteration. Such diversion plans shall be in accordance with the applicable environmental laws.
 18. A plan for project construction monitoring and quality control testing to confirm that materials used in the alteration work and that performance standards meet the design requirements set forth in the specifications.
 19. Certification by the owner's engineer that the information provided pursuant to this subsection is true and correct in their professional judgment. Such certification shall include the engineer's signature, printed name, Virginia number, date, and the engineer's Virginia seal.

20. Owner's signature certifying receipt of the information provided pursuant to this subsection.

C. A plan of construction is a required element of complete permit application and shall include:

1. A construction sequence with milestones.
2. Elements of the work plan that should be considered include, but are not limited to, foundation and abutment treatment, excavation and material fill processes, phased fill and compaction, testing and control procedures, construction of permanent spillway and drainage devices, if applicable.
3. The erosion and sediment control plan, as approved by the local government, which minimizes soil erosion and sedimentation during all phases of construction.

D. Within 120 days of receipt of a complete Alteration Permit Application, the board shall act on the application. If the application is not acceptable, the director shall inform the applicant within 60 days of receipt and shall explain what changes are required for an acceptable application. A complete Alteration Permit Application consists of the following:

1. A final design report with attachments as needed, and certified by the owner;
2. A plan of construction that meets the requirements of subsection C of this section;
3. Any necessary interim provisions to the current Emergency Action Plan or Emergency Preparedness Plan. Interim provisions shall be submitted to the local organization for emergency management, the Virginia Department of Emergency Management, and the department; and
4. If the owner is requesting the deregulation of an impounding structure, the application shall specify whether the impounding structure is to be removed so that the impounding structure is incapable of storing water, either temporarily or permanently; or whether the impounding structure is to be altered in such a manner that either the height or storage capacity of the impounding structure causes the impounding structure to be of less than regulated size.

E. During the alteration work, the owner shall provide the director with any proposed changes from the approved design, plans, specifications, or a plan of construction. Approval shall be obtained from the director prior to the alteration or installation of any changes that will affect the integrity or impounding capacity of the impounding structure.

F. The Alteration Permit shall be valid for the construction sequence with milestones specified in the approved Alteration Permit Application.

G. Work identified in the Alteration Permit must commence within the time frame identified in the Alteration Permit. If work does not commence within the prescribed time frame, the permit shall expire, except that the applicant may petition the board for extension of the prescribed time frame and the board may extend such period for good cause with an updated construction sequence with milestones.

H. The board, the director, or both may take any necessary action consistent with the Dam Safety Act (§ 10.1-604 et seq. of the Code of Virginia) if any terms of this section or of the permit are violated, if the activities of the owner are not in accordance with the approved plans and specifications, if the alteration is conducted in a manner hazardous to downstream life or property, or for other cause as described in the Act.

I. Within 90 days after completion of the alteration of an impounding structure, the owner shall submit a complete Record Report. A form for the Record Report is available from the

department (Record Report for Virginia Regulated Impounding Structures). The Record Report shall be signed and sealed by a licensed professional engineer and signed by the owner and shall be sent to the department indicating that the modifications made to the structural features of the impounding structure have been completed. This report is not required when the Alteration Permit has been issued for the removal of an impounding structure. The Record Report shall include the following:

1. Project information including the name and inventory number of the structure, name of the reservoir, and whether the report is associated with a new or old structure;
2. Location of the impounding structure including the city or county, number of feet or miles upstream or downstream of a highway and the highway number, name of the river or the stream, and the latitude and longitude;
3. Owner's name or representative if corporation, mailing address, residential and business telephone numbers, and other means of communication;
4. Information on the design report, including who it was prepared by, the date of design report preparation, whether it was for new construction or for an alteration, and the permit issuance date;
5. Owner's engineer's name, firm, professional engineer Virginia number, mailing address, and business telephone number;
6. Impounding structure data including type of material (earth, concrete, masonry or other) and the following configurations:
 - a. Top of impounding structure (elevation);
 - b. Downstream toe – lowest (elevation);
 - c. Height of impounding structure (feet);
 - d. Crest length – exclusive of spillway (feet);
 - e. Crest width (feet);
 - f. Upstream slope (horizontal to vertical); and
 - g. Downstream slope (horizontal to vertical).
7. Reservoir data including the following:
 - a. Maximum capacity (acre-feet);
 - b. Maximum pool (elevation);
 - c. Maximum pool surface area (acres);
 - d. Normal capacity (acre-feet);
 - e. Normal pool (elevation);
 - f. Normal pool surface area (acres); and
 - g. Freeboard (feet).
8. Spillway data including the type, construction material, design configuration, and invert elevation for the low level drain, the principal spillway, and the emergency spillway; a description of the low level drain and principal spillway including dimensions, trash guard information, and orientation of intake and discharge to impounding structure if looking downstream; and a description of the emergency spillway including dimensions and orientation to impounding structure if looking downstream;
9. Watershed data including drainage area (square miles); type and extent of watershed development; time of concentration (hours); routing procedure; spillway design flood used and state source; design inflow hydrograph volume (acre-feet), peak inflow (cfs), and rainfall duration (hours); and freeboard during passage of the spillway design flood (feet);
10. Impounding structure history including the date construction was completed, who it was designed by and the date, who it was built by and the date, who performed inspections and dates,

description of repairs, and confirmation as to whether the impounding structure has ever been overtopped;

11. A narrative describing the impounding structure procedures for operation, maintenance, emergency action plan implementation, and structure evaluation;

12. A narrative describing the hydraulic and hydrologic data on the spillway design flood, hydrologic records, flood experience, flood potential, reservoir regulation, and comments or recommendations regarding these attributes;

13. A narrative describing stability of the foundation and abutments, embankment materials, and a written evaluation of each;

14. A complete set of record drawings signed and sealed by a licensed professional engineer and signed by the owner;

15. Certification by the owner's engineer that the information provided pursuant to this subsection is true and correct in their professional judgment. Such certification shall include the engineer's signature, printed name, Virginia number, date, and the engineer's Virginia seal; and

16. Owner's signature certifying receipt of the information provided pursuant to this subsection.

J. For altered impounding structures, a certification from a licensed professional engineer who has monitored the alteration of the impounding structure that, to the best of the engineer's judgment, knowledge, and belief, the impounding structure and its appurtenances were altered in conformance with the plans, specifications, drawings and other requirements approved by the board.

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. Existing drains on impounding structures shall be kept operational. When practicable, existing impounding structures shall be retrofitted with devices to permit draining.

4VAC50-20-290. Life of the Impounding Structure.

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

4VAC50-20-300. Additional Design Requirements.

A. Flood routings shall start at or above the elevation of the crest of the lowest ungated outlet. Freeboard determination and justification must be addressed by the owner's engineer.

B. All elements of the impounding structure 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 4VAC50-20-320. Acceptable Design Procedures and References.

4VAC50-20-320. Acceptable Design Procedures and References.

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To ensure consistency of approach, within the major engineering disciplines of hydrology, hydraulics, soils and foundations, structures, and general civil design, criteria and approaches from multiple sources shall not be mixed for developing the design of a given feature or facility without approval of the director. In all cases the owner's engineer shall identify the source of the criteria.

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. The design procedures, manuals and criteria used by the United States Federal Energy Regulatory Commission.
6. 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.

4VAC50-20-330. Other Applicable Dam Safety References.

A. Manuals, guidance, and criteria used by the Federal Emergency Management Agency, including the following:

1. Federal Guidelines for Dam Safety: Emergency Action Planning for Dam Owners, U.S. Department of Homeland Security, Federal Emergency Management Agency, October 1998, Reprinted January 2004; FEMA 64 or as revised.
2. Federal Guidelines for Dam Safety: Selecting and Accommodating Inflow Design Floods for Dams, U.S. Department of Homeland Security, Federal Emergency Management Agency, October 1998, Reprinted April 2004; FEMA 94 or as revised.

B. Manuals, guidance, and forms provided by the department. Such materials may be located on the department's website at: <http://www.dcr.virginia.gov>.