~~STATE OF COLORADO~~

~~DEPARTMENT OF NATURAL RESOURCES~~

~~DIVISION OF WATER RESOURCES~~

State of Colorado

Department of Natural Resources

Division of Water Resources

Office of the State Engineer

Dam Safety

RULES AND REGULATIONS FOR DAM SAFETY AND DAM CONSTRUCTION

EFFECTIVE DATE: January 1, 2020

2-CCR 402-1

Formatted: Header

Style Definition: Normal: Font: Arial, 10 pt, Font color: Black

Style Definition: Default Paragraph Font

Style Definition: Balloon Text: Font: (Default) Segoe UI, 9 pt, Font color: Black

Style Definition: Footer: Font: Arial, 10 pt, Font color: Black, Tab stops: 3.25", Centered + 6.5", Right + Not at 3" + 6"

Style Definition: Default

Style Definition: Plain Text

Style Definition: scocode1d

Formatted: Font: Arial, Not Bold, Font color: Text 1

Formatted: Body Text, Space After: 1 pt, Tab stops: Not at 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: 12 pt, Not Bold, Font color: Text 1

Formatted: Body Text, Space After: 10 pt

Formatted: Font color: Text 1

Formatted: Body Text

1313 Sherman Street, Room 818 Centennial Building
Denver, Colorado
303-866-3581

This page left blank intentionally

Formatted: Header

Formatted: Font: 10 pt, Font color: Text 1

Formatted: Body Text

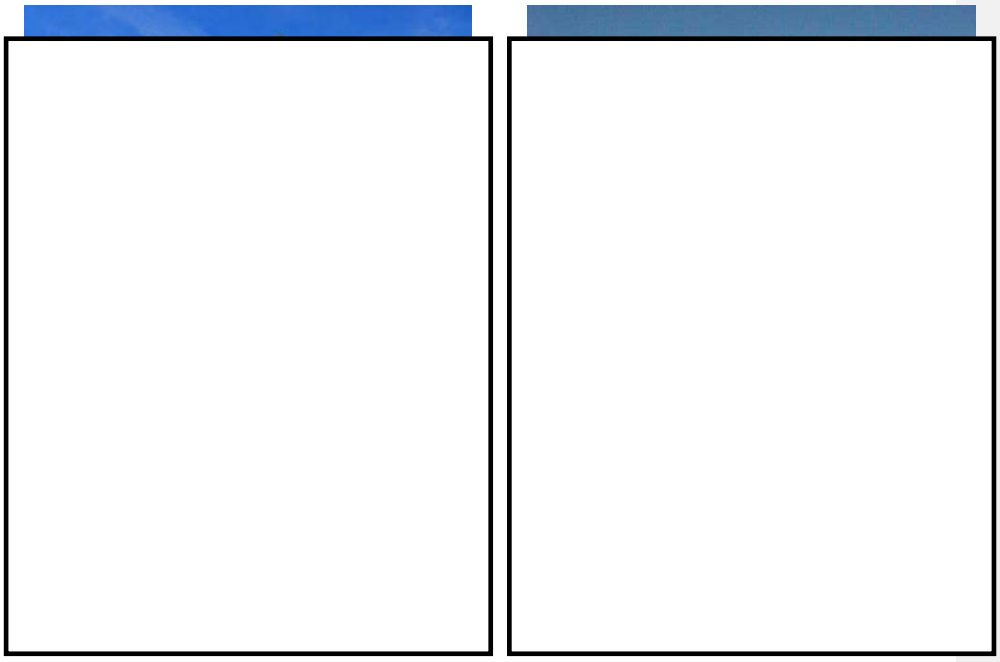
OFFICE OF THE STATE ENGINEER

~~DAM SAFETY BRANCH~~

RULES AND REGULATIONS

FOR

DAM SAFETY AND DAM CONSTRUCTION



~~EFFECTIVE DATE: JANUARY 1, 2007~~

~~2 CCR 402-1~~

~~1313 SHERMAN STREET~~
~~ROOM 818 CENTENNIAL BUILDING~~
~~DENVER, COLORADO~~
~~TELEPHONE 303-866-3581~~

COLORADO DIVISION OF WATER RESOURCES
DEPARTMENT OF NATURAL RESOURCES

Formatted: Header

Formatted: Font: 10 pt

Formatted: Body Text, Space Before: 60 pt

Formatted: Font: 10 pt, Not Bold, Not Italic

Formatted: Font: 10 pt, Not Bold, Not Italic

Formatted: Title, Left, Indent: Left: 0", Right: 0"

Formatted: Font: 14 pt, Not Italic

Formatted: Font: 12 pt, Not Bold, Font color: Text 1

Formatted: Body Text, Space After: 10 pt

Formatted: Font color: Text 1

Formatted: Body Text

Formatted: Body Text

Formatted: Font: 10 pt, Font color: Text 1

~~FACSIMILE 303-866-3589~~
~~WEBSITE:~~
~~http://water.state.co.us~~

Formatted: Header

Formatted: Header

STATE OF COLORADO

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF WATER RESOURCES

OFFICE OF THE STATE ENGINEER

RULES AND REGULATIONS

FOR

DAM SAFETY AND DAM CONSTRUCTION

2 CCR 402-1

Effective Date:
January 1, 2007

~~OFFICE OF THE STATE ENGINEER~~

~~RULES AND REGULATIONS~~
~~FOR~~
~~DAM SAFETY AND DAM CONSTRUCTION~~

TABLE OF CONTENTS

RULE **PAGE**

Formatted: Header

Formatted: Font: Arial, 14 pt

Formatted: Title, Left

Formatted: Font: Arial, 14 pt

Formatted: Title, Space After: 6 pt, Tab stops: 6.5", Right + Not at -1.17" + 6.17" + 7.5"

Formatted: Font: Arial, 14 pt, Underline

Formatted: Font: 10 pt

Formatted: Header

~~Office of the State Engineer~~

~~Rules and Regulations~~
~~For~~
~~Dam Safety and Dam Construction~~

Formatted: Font: Arial, Not Bold, Font color: Text 1

Formatted: Body Text, Space After: 1 pt, Tab stops: Not at 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Rule 1. Title~~:~~

1.1 The title of these Rules and Regulations is "The Rules and Regulations for Dam Safety and Dam Construction." They may be referred to herein collectively as the "Dam Safety Rules" or "Rules" and individually as a "Rule~~".~~."

Rule 2. ~~Rule 2.~~ Authority~~:~~

2.1 These Rules are promulgated pursuant to the authority granted the State Engineer in sections 37-87-102 and 37-87-105, C.R.S.; ~~and~~ section 37-80-102~~(1)~~k~~(1)~~(k), C.R.S.; and section 24-4-103, C.R.S.

2.2 ~~**Rule 3.**~~ These Rules do not change the meaning of any statute.

Rule 3. Scope and Purpose~~:~~

3.1 ~~3.1~~ These Rules apply to any jurisdictional or non-jurisdictional dam constructed ~~or used~~ to ~~store~~impound water in Colorado. ~~These Rules apply to applications for review and approval of plans for the construction, alteration, modification, repair, enlargement, and removal of dams and reservoirs, quality assurance of construction, acceptance of construction, non-jurisdictional dams, safety inspections, owner responsibilities, emergency action plans, fees, and restriction of recreational facilities within reservoirs.~~ Certain structures defined in ~~Rule 17~~Rule 14 are exempt from these Rules.

3.2 ~~3.2~~ The purpose of these Rules is to provide for ~~the~~ public safety ~~through the Colorado Safety of Dams Program~~ by establishing reasonable standards and to create a public record for reviewing the performance of a dam.

Rule 4. ~~Rule 4.~~ Definitions~~:~~

Formatted: Header

Formatted: Footer distance from edge: 0"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 1, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Heading 2, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Heading 1, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted ...

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted ...

Formatted: Font: Arial, 10 pt

Formatted ...

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted ...

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted ...

Formatted ...

~~4.1 **Statutory Definitions** The terms are defined in section 37-87-102, C.R.S., 37-87-122 C.R.S. and 35-49-103 C.R.S. and shall have the identical meanings when used in these Rules.~~

~~4.2 **Specific Definitions** Unless expressly stated otherwise, the following terms when used in these Rules shall have the meaning indicated by this Rule. Words in the singular shall include the plural. Words in the masculine gender include the feminine and neuter.~~

4.1 ~~4.2.1 "~~**Alteration, Modification, ~~or~~ Repair, or Enlargement of an Existing Dam and/or Appurtenant Structures**~~" means to make different from the originally approved construction plans and specifications or the existing configuration, except for ordinary repairs and general maintenance as defined in Rule 12~~. Construction that could affect the safety of the dam.

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 2, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

4.2 ~~4.2.2 "~~**Annual Exceedance Probability (AEP)**. The probability of occurrence in any one year.

4.3 **Appurtenant Structure**~~" means components.~~ Component other than the material structure of the dam itself such as the outlet works and controls, spillways and controls, access structures, bridges, and other systems directly related to the safe operation of a dam.

4.4 ~~4.2.3 "~~**Breach Order**~~" is an~~. An order issued by the State Engineer, or the State Engineer's designee, for removal of all or part of a dam to permanently reduce the maximum storage level, minimize the risk of failure, and/or the potential of damage downstream due to the failure of the dam.

4.5 ~~4.2.4 "~~**Capacity**~~" is~~. As used in section 37-87-105 (1), C.R.S., the volume of water ~~a reservoir is capable of impounding~~ impounded by a dam at the high~~-~~water line~~, expressed in acre-feet. Dead storage~~. Storage below the natural surface of the ground ~~or~~and low-level outlet is generally excluded.

4.6 ~~4.2.5 "~~**Dam**~~" means a man-made~~. A constructed barrier, together with appurtenant structures, constructed above ~~the natural~~ground surface ~~of the ground~~ for the purpose of impounding water. Flood control and storm runoff detention dams are included.

4.6.1 ~~4.2.5.1 "~~**Jurisdictional Size Dam**~~" is a~~. A dam creating a reservoir with a capacity of more than one hundred (100) acre-feet, or ~~creates a reservoir with~~ a surface area in excess of twenty (20) acres at the high~~-~~water line, or ~~exceeds 10 feet in height measured vertically from the elevation of the lowest point of the natural surface of the ground~~ where ~~that point occurs along the longitudinal centerline of the dam up to the crest of the emergency spillway of the dam. For reservoirs created by excavation, or where the invert of the outlet conduit is placed below the surface of the natural ground at its lowest point beneath the dam,~~ the jurisdictional height ~~shall be measured from the invert of the outlet at the longitudinal centerline of the embankment or from the bottom of the excavation at the longitudinal centerline of the dam, which ever is greatest.~~exceeds ten (10) feet. Jurisdictional height is defined in Rule ~~4.2.19. The State Engineer shall have final authority over determination of the jurisdictional height of the dam.~~4.7.1.

4.6.2 ~~4.2.5.2 "~~**Non-~~jurisdictional~~Jurisdictional Size Dam**~~" is a~~. A dam creating a reservoir with a capacity of one hundred (100) acre-feet or less, and a surface area of twenty (20) acres or less ~~and with a height measured as defined in Rules 4.2.5.1~~, and ~~4.2.19~~a jurisdictional height of ten (10) feet or less. Non-jurisdictional size dams are regulated

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Heading 2, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Heading 2, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted ...

Formatted: Font: Arial, 10 pt

Formatted: Heading 2, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted ...

Formatted ...

Formatted: Heading 2, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted ...

Formatted ...

Formatted ...

Formatted ...

Formatted ...

Formatted ...

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted ...

Formatted ...

Formatted ...

Formatted ...

Formatted ...

Formatted ...

and subject to the authority of the State Engineer ~~consistent with sections 37-87-102 and 37-87-105 C.R.S.~~

~~4.2.5.3 "**Minor Dam**" is a jurisdictional size dam that does not exceed 20 feet in jurisdictional height and/or 100 acre-feet in capacity (see Figure 1).~~

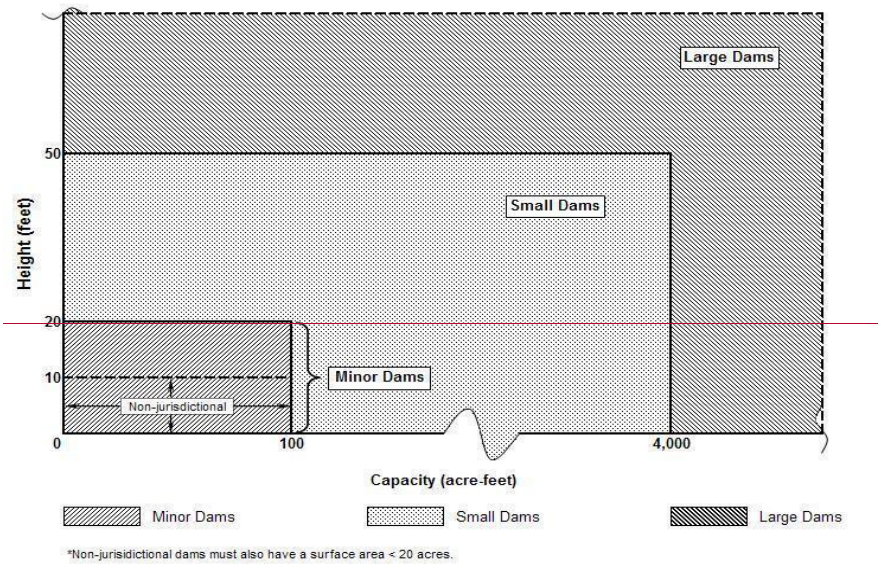
~~4.2.5.4 "**Small Dam**" is a dam with a jurisdictional height greater than 20 feet but less than or equal to 50 feet and/or a reservoir capacity greater than 100 acre-feet, but less than 4,000 acre-feet (see Figure 1).~~

~~4.2.5.5 "**Large Dam**" is a dam greater than 50 feet in jurisdictional height, and/or greater than 4,000 acre-feet in capacity (see Figure 1).~~

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right



DAM SIZE DETERMINATION

Figure 1

4.6.3 ~~4.2.5.6~~ ~~"~~**Diversion Dam**~~" is a.~~ A dam constructed for the primary purpose of diverting water from a natural watercourse into a canal, tunnel, ditch, or pipeline ~~that typically impounds an insignificant volume of water, and for which the impacts of failure are not a significant public safety hazard~~.

4.6.4 ~~4.2.5.7~~ ~~"~~**Flood Control Dam**~~" is a special purpose.~~ A dam that is normally dry and has an ~~un-gated~~ungated outlet structure for the controlled release of water impounded during and subsequent to a flood event. ~~The jurisdictional size and classification of the dam are determined using the height and capacity of the reservoir to the emergency spillway elevation, or using the elevation of the maximum routed water surface elevation if no emergency spillway is provided.~~

4.7 ~~4.2.6~~ ~~"~~**Dam ~~Failure~~ Height.** (See Figure 4.1)

4.7.1 **Jurisdictional Height**. The vertical dimension measured from the lowest point of the natural surface of the ground or the invert of the outlet pipe, whichever is lower, where the low point occurs along the longitudinal centerline of the dam crest, to the emergency spillway crest.

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: -1.5", List tab + Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: -1.5", List tab + Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

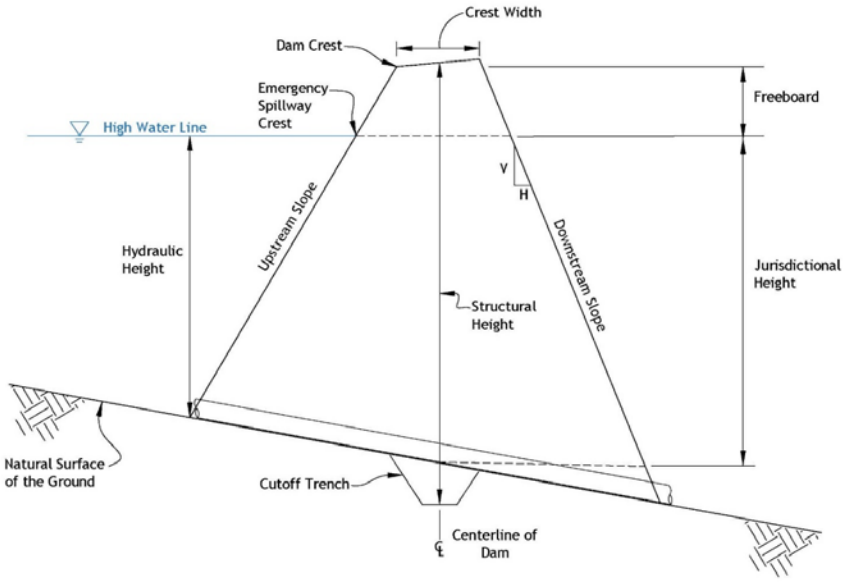
Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

4.7.2 **Hydraulic Height**. The vertical dimension measured from the lowest point of the upstream toe of the dam to the emergency spillway crest.

4.7.3 **Structural Height**. The vertical dimension measured from the lowest point of the excavated foundation to the crest of the dam.

Figure 4.1: Determination of Dam Heights



4.8 **Inundation Map**~~" is a.~~ A map depicting the area downstream from a dam that would reasonably be expected to be flooded in the event of a dam failure ~~of the dam~~.

~~4.2.7 "**Day**" as used in these Rules means a calendar day. For computation of time periods as used in these Rules, Colorado Rules of Civil Procedure 6(a) shall apply.~~

4.9 ~~4.2.8 "~~**Emergency Action Plan (EAP)**~~" is).~~ A living document containing a written ~~document prepared by the dam owner, describing a detailed~~ plan of actions ~~for~~ used by an emergency response team to ~~emergency or unusual events, including alerting~~minimize property damage and ~~warning emergency officials in the event of a potential or imminent~~loss of life in an area affected by a dam failure or ~~other emergency related to the safety of the dam and public~~large flood.

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 2, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 2, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

4.10 ~~4.2.9 "~~**Engineer**~~" means a Professional.~~ An Engineer registered and licensed in Colorado in accordance with ~~section~~article 12-~~25-101~~120, Part 2, C.R.S. The Engineer ~~must be sufficiently qualified and experienced in~~ will be in "responsible charge," as defined in section 12-120-202, C.R.S., of the design~~,~~ and of the observation of construction~~, and safety evaluation of the type of dam under consideration. The Engineer will be the Professional Engineer responsible for the design.~~. In general, the Engineer is responsible for the following:

A. ~~4.2.9.1~~ Demonstrating a minimum of five years of experience as a ~~Professional~~registered Engineer in the design, construction, and safety evaluation of the type of dam under review~~.~~;

B. ~~4.2.9.2~~ Understanding all applicable regulatory requirements of the project and the required work ~~and~~, analyses, and oversight needed to complete a safe design and to observe construction to evaluate compliance with plans and specifications of the project~~.~~;

C. ~~4.2.9.3~~ Using current state of the practice methods and means to ~~locate~~site and design dams with safety as the primary goal and to complete engineering methodology that represents the professional level of care exercised by qualified engineers~~.~~; and

D. ~~4.2.9.4 Assembling~~If necessary, assembling and supervising a team of qualified engineers, ~~engineering~~ geologists~~/~~, geological engineers, and other professionals as required to address all of the disciplines ~~necessary~~ for the design and the observation of construction of a dam.

~~4.2.10 "**Enlargement of an Existing Dam or Appurtenant Structure**" means any alteration, modification, or repair that increases the reservoir volume and/or jurisdictional height of a dam as defined in Rules 4.2.4 and 4.2.19.~~

~~4.2.11 "**Extreme Precipitation Event**" means a precipitation event based on Colorado extreme storm data approved by the State Engineer, maximized through modern meteorological techniques.~~

~~4.2.12 "**Extreme Storm Precipitation (ESP)**" means the maximum precipitation possible, as developed using the Dam Safety Branch's Extreme Precipitation Analysis Tool (EPAT) or a site-specific hydrometeorologic analysis. The greatest depth of precipitation for a given duration that is physically possible over a drainage basin through the application of modern meteorological techniques, based on Colorado extreme storm data approved by the State Engineer.~~

4.11 ~~4.2.13 "~~**Freeboard**~~" means the.~~

4.11.1 **Normal Freeboard**. The vertical dimension between ~~the crest (or invert) of the emergency~~ a spillway crest and the ~~crest of~~lowest point on the dam crest.

Formatted: Header

Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted ...
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt, Font color: Auto
Formatted: Font: Arial, 10 pt, Font color: Auto
Formatted: Font: Arial, 10 pt, Font color: Auto
Formatted: Font: Arial, 10 pt, Font color: Auto
Formatted: List Number, Indent: Left: 0"
Formatted ...
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt, Font color: Auto
Formatted ...
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted ...
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted ...
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted ...

4.11.2 ~~4.2.13.1~~ "**Residual Freeboard**~~" means the~~. The vertical dimension between the maximum water surface elevation ~~at the peak of the inflow design~~ during a flood event and the lowest point on the dam crest ~~of~~.

4.12 **Geologist**. An individual possessing specific knowledge of the geological sciences and the principles of engineering analysis and design acquired by professional education or demonstrated experience related to dams, and qualified to apply such knowledge to ensure geologic elements affecting the dam ~~at which the dam would be first overtopped~~are adequately accounted for in design and construction.

~~4.2.14~~ "**Hazard Classification ~~of a Dam~~**~~" is the placement of a dam into one~~. One of four categories ~~based on the hazard~~ defined below as determined by analysis of potential ~~derived from an evaluation of the probable incremental adverse~~ consequences ~~due to~~ from a sunny day failure ~~or improper operation~~ of the dam.

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 2, Indent: Left: 0", First line: 0", Tab stops: -1.94", List tab + Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

4.13 Conditions for evaluation are absent flooding, and the reservoir is assumed to be full to the high water line. at the time of failure. The hazard potential classification does not reflect the current condition of the dam with regard to safety, structural integrity, or flood routing capacity. (See Rule 5.4,establishes all the design criteria for a dam except for spillway size, which is controlled by the Hydrologic Hazard Classification Study, for a more detailed description of determining which hazard category a given dam shall be placed.) The Hazard Classification evaluation method must be approved by the State Engineer.defined in Rule 4.15.

4.13.1 4.2.14.1 "**High Hazard Dam**" is a. A dam for which life loss of human life is expected to result from failure of the dam. Designated recreational sites located downstream within the bounds of possible inundation should also be evaluated for potential loss of human life.

4.13.2 4.2.14.2 "**Significant Hazard Dam**" is a. A dam for which significant damage, but no life loss is expected to occur, but no loss of human life is expectedresult from failure of the dam. Significant damage is defined as damage to structures where people generally live, work, or recreate, orincluding public orand private facilities. Significant damage is determined to be damage sufficient to render structures or facilities uninhabitable or inoperable.

4.13.3 4.2.14.3 "**Low Hazard Dam**" is a. A dam for which loss of humanneither life is not expected, andloss nor significant damage to structures and public facilities as defined for a "Significant Hazard" dam is notare expected to result from failure of the dam.

4.13.4 4.2.14.4 "**No Public Hazard (NPH) Dam**" is a). A dam for which no loss of human life is expected, and whichminimal damage only to the dam owner's property will, with no life loss, is expected to result from failure of the dam.

4.14 4.2.15 "**High Water Line**" is the water surface. The elevation of the reservoir at the crest (or invert) of the emergency spillway, or, if crest. If no emergency spillway exists, at the elevation of the dam crest of the .

4.15 **Hydrologic Hazard.** Potential consequences downstream of a dam caused by floodwaters released by overtopping failure of the dam. Hydrologic hazard establishes design criteria for spillway size.

4.2.16 "**Impound Water**" means to accumulate water in a reservoir for immediate or future use, including the purpose of flood control and detention.

Formatted ...

~~4.2.17 "**Incremental Damage Analysis**" means a comparative study of two floods of differing magnitude used to identify differential impacts for loss of human life and property damage in the zone above the lesser magnitude flood (incremental zone).~~

4.15.1 ~~4.2.18 "~~**Extreme.** Life loss potential of 1 or more.

4.15.2 **High.** Life loss potential of less than 1.

4.15.3 **Significant.** No life loss potential but significant damage is expected to occur.

4.15.4 **Low.** No life loss potential or significant damage is expected to occur.

4.16 **Incremental Consequences.** The difference in impacts that would occur due to failure or misoperation of the dam over those that would have occurred without failure or misoperation of the dam or appurtenances.

4.17 **Inflow Design Flood**~~"~~ **(IDF**~~) means the~~**).** The flood hydrograph used to determine if the emergency spillway's hydraulic capacity meets the safety standards as defined in ~~Rules 5 and 6 (or in absence of a spillway, the reservoir is capable of *storing* the IDF). The required magnitude of the IDF is defined by these Rules.~~Rule 7.2.

~~4.2.19 "**Jurisdictional Height**" means the vertical dimension measured from the elevation of the lowest point of the natural surface of the ground, or from the invert of the outlet pipe if excavated below the natural surface of the ground, whichever is lower, where the low point occurs along the longitudinal centerline of the dam, up to the spillway crest of the emergency spillway. For existing dams, the jurisdictional height shall be measured by using the slope of~~

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Heading 2, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt, Bold

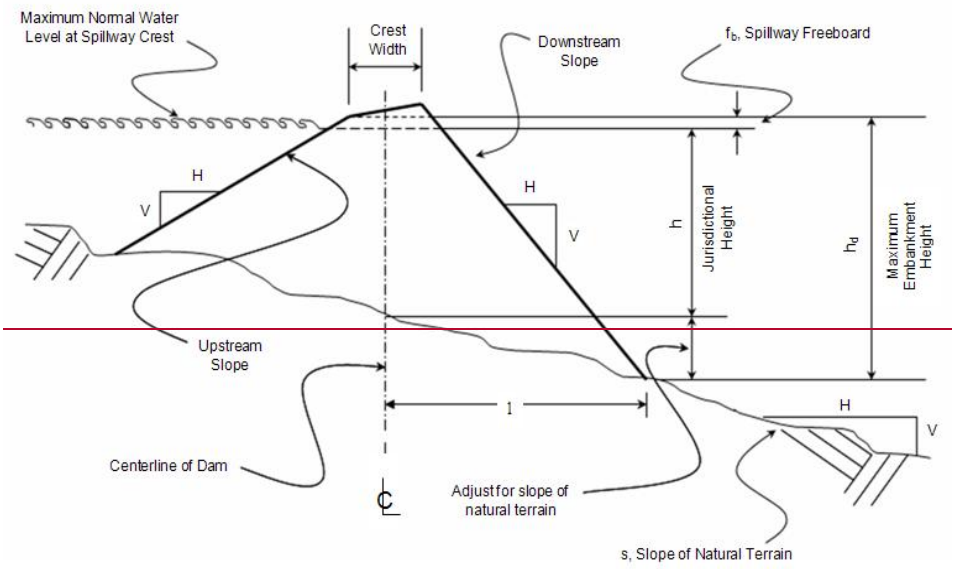
Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~the downstream channel and the height of the dam at the downstream toe by extrapolating the measured height to the longitudinal centerline of the dam. The formula for determining the vertical height of existing dams is: $h = h_d - f_b - (s*l)$; where h = jurisdictional height, h_d = height of dam from downstream toe, f_b = freeboard, s = slope of the natural surface of the ground downstream of the dam, and l = measured or computed horizontal distance between the downstream toe and the longitudinal centerline of the dam. The State Engineer shall have final authority over determination of the height of the dam (see Figure 2).~~



Determination of Dam Vertical Height at the Maximum Cross Section

Figure 2

4.18 ~~4.2.20 "~~**Natural Surface of the Ground**~~" means the.~~ The undisturbed ground surface before excavation, or the undisturbed bed of a natural watercourse.

~~4.2.21 "~~**Normal Water Line**~~" means the.~~ The elevation of the ~~water at the crest of the principal or~~ service spillway~~.~~

4.19 ~~4.2.22 "~~**~~One hundred year Flood~~**~~" means a potential flood having a magnitude (peak discharge) which is expected to be equaled or exceeded on the average once during any one-hundred-year period (recurrence interval) and has a one percent chance of being equaled or exceeded during any year (0.01 exceedance probability). The terms "one-hundred-year~~

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 2, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Heading 2, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~flood" and "one percent chance flood"~~ crest. If there is no service spillway, the normal water line and high water line are ~~synonymous~~the same.

4.20 ~~4.2.23 "~~**Outlet**~~" means a~~. A conduit (usually regulated by gates or valves) used for ~~controlled or regulated releases of~~releasing impounded water from the reservoir.

4.21 ~~4.2.24 "**Owner" means any person**~~**Owner.** The person or persons in control of the physical structure of any dam in accordance with section 37-87-104.5, C.R.S. Person or persons refers to any individual, private or non-profit company, special district, federal, state, or local government agency, or any other entity in direct routine control of a dam and reservoir, and/or directly involved in the physical operation and maintenance of a dam, and/or proposes to construct a dam~~. Changes in ownership shall be immediately filed with the State Engineer~~.

~~4.2.25 "**Permit**" means a written approval for dam construction, which will be provided by the State Engineer upon approval of the dam plans and specifications. The written approval may be signed by the State Engineer or Deputy State Engineer and identify all contingencies.~~

4.22 ~~4.2.26 "~~**Plans**~~" means all.~~ All necessary drawings, cross-sections, tables, notes, maps and other information necessary to accompany the construction specifications for design review and approval, and construction ~~observation and approval.~~ of a dam.

4.23 ~~4.2.27 "~~**Potential Failure Mode (PFM)**. A physically plausible process for dam failure resulting from an existing inadequacy or defect related to a natural foundation condition, the design or construction of the dam or appurtenant structures, the materials incorporated, the operations and maintenance, or the aging process, which can lead to an uncontrolled release of the reservoir.

4.24 **Potential Failure Modes Analysis (PFMA)**. The process by which the site-specific PFMs are identified, described in detail, and evaluated to determine the likelihood and confidence of occurrence.

4.25 **Probable Maximum Flood (PMF).** The flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the drainage basin under study.

4.26 **Probable Maximum Precipitation (PMP)**~~" means the~~**).** The theoretically greatest depth of precipitation for a given duration that is physically possible over a drainage basin~~ at any specific time of year. The PMP values are normally determined from the appropriate Hydrometeorological Report (HMR) (HMR 49 for west of the continental divide, HMR 52 for the eastern plains and HMR 55A for the Front Range). The 100-year, 50-year, and 25-year events are normally determined from the National Weather Service NOAA Atlas #2 "Precipitation-Frequency Atlas of the Western United States" Volume III-Colorado, U.S.~~

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 2, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 2, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: 10 pt

Formatted: Font: 10 pt

Formatted: Font: 10 pt

Formatted: Heading 2, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 2, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~Department of Commerce, NOAA, National Weather Service, Silver Springs, Maryland, 1973, (later amendments, editions, or subsequent publications not included).~~

4.27 ~~4.2.28 "~~**Reservoir**~~" means a.~~ A body of water impounded by a dam.

4.28 ~~4.2.29 "~~**Restriction Order**~~" means an.~~ An order issued by the State Engineer to limit the ~~maximum~~ water surface elevation of a reservoir ~~as an interim measure~~ to ~~immediately reduce~~no greater than the ~~possibility~~safe storage level.

4.29 **Risk.** The product of ~~failure and risk to~~(1) the ~~public and property until investigations~~likelihood of a ~~problem can be performed or~~structure being loaded, (2) the likelihood of adverse structural ~~modifications can be made to repair the problem or breach~~performance, and (3) the ~~dam~~magnitude of the resulting consequences.

~~4.2.30 "**Routing Capacity**" means the capability of a reservoir and spillway system to attenuate flood inflows, and is calculated as the sum of the spillway discharge(s) and surcharge storage for a specific time increment, expressed in acre-feet.~~

4.29.1 ~~4.2.31 "~~**Risk Management.** Action implemented to communicate the risks and either accept, avoid, transfer, or control the risks to an acceptable level considering associated costs and benefits of any action taken.

4.29.2 **Risk Analysis.** Qualitative or quantitative procedures that consider likelihood of failure and magnitude of resulting consequences to evaluate the significance of PFMs.

4.30 **Safe Storage Level**~~" means the.~~ The maximum reservoir water surface elevation at which the State Engineer has determined that the dam is safe to impound water based on the safety inspection and/or evaluations.

~~4.2.32 "~~**Safety Inspection**~~" means an.~~ An evaluation by an ~~engineer to be~~ Engineer in accordance with section 37-87-107, C.R.S., used by the State Engineer ~~in determining~~to set the ~~reservoir's~~ safe storage level. The ~~safety~~ inspection ~~includes, but is not limited to, the~~ shall include a review of ~~previous inspections, instrumentation results, reports~~the Emergency Action Plan and

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Heading 2, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 2, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 2, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

4.31 ~~drawings; visual inspections~~ the hazard classification of the dam ~~and appurtenances, seepage control and measurement systems, and any permanent monument or monitoring installations~~.

4.32 ~~4.2.33 "~~**Spillway**~~" means an appurtenant~~. An overflow structure ~~that conducts overflows~~through which inflow is discharged from a reservoir.

4.32.1 ~~4.2.33.1 "**Principal or**~~ **Service Spillway**~~" means the~~. The overflow structure designed to limit or control the operating level of a reservoir.

4.32.2 **Emergency Spillway**. The overflow structure designed to pass the Inflow Design Flood.

4.32.3 **Spillway Crest.** The elevation of the spillway at which uncontrolled discharge begins.

4.33 **Storage.**

4.33.1 **Normal Storage.** Volume of the reservoir impounded by a dam below the normal water line.

4.33.2 **Maximum Storage.** Volume of the reservoir impounded by a dam below the dam crest.

4.33.3 **Flood Storage**. Volume of water temporarily stored within a reservoir between the normal water line and the crest of the dam.

Rule 5. Determination of Safe Storage Level

5.1 **Authority to Determine Safe Storage Level.** The State Engineer is assigned the responsibility to determine the safe storage level for every reservoir in the state in accordance with section 37-87-107, C.R.S. The Owner shall not store water in excess of the amount so determined by the State Engineer to be safe.

5.2 **Methods to Determine Safe Storage Level.** The State Engineer will use the following methods to determine the safe storage level:

5.2.1 **Safety Inspection.** The State Engineer shall perform regular dam safety inspections at a frequency appropriate to the hazard classification of the dam. These inspections will be performed using current observation methods and tools, and adhere to current standards. Observations will be recorded in a standardized report format, and ~~first to be activated in runoff conditions. The principal or service spillway is designed to pass normal flows,~~provided to the Owner following the inspection. Interim dam safety inspections may also be performed between regular inspection cycles when warranted by either the condition of the dam or events impacting the safety of the dam.

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 2, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

5.2.2 **Potential Failure Modes Analysis.** Potential Failure Modes Analysis may be performed following identification of a concerning issue during the regular or interim inspection and ~~may not be designed to pass the entire Inflow Design Flood. The principal~~/or as part of a periodic comprehensive dam safety evaluation.

5.3 **Restriction of Storage.** If problems affecting the safe storage level of the reservoir are discovered, the State Engineer will issue a restriction order as an interim measure until the problems have been resolved. The Owner shall comply with the restriction order at all times. The restriction order will be removed or ~~service spillway is usually an open channel, pipe,~~revised by the State Engineer only after acceptance of repairs or ~~culvert~~approval of engineering evaluations indicating the problems have been adequately resolved.

~~4.2.33.2 "**Emergency Spillway**" means the appurtenant structure designed to pass the Inflow Design Flood in conjunction with the routing capacity of the reservoir and any principal or service spillway(s). Pipe or culvert spillways are not considered acceptable emergency spillways.~~

~~4.2.34 "**Spillway Crest**" means the elevation of the floor of a spillway, grade control structure, or ogee crest above which spillway flow begins.~~

~~4.2.35 "**Surcharge Storage**" means the volume of water temporarily stored within a reservoir between the high water line and the crest of the dam.~~

~~Rule 5. Requirements for Construction or Enlargement of Jurisdictional Size Dams or Reservoirs:~~

5.4 **Review of Hazard Classification**. As part of the determination of the safe storage level, the State Engineer will periodically review the hazard classification of existing dams by evaluating the consequences of failure applying the definitions of Rule 4.13. If the State Engineer's review indicates the consequences of failure have changed within the dam failure inundation area, the State Engineer will assign an appropriate new hazard classification. The State Engineer will require the dam to meet the requirements of these Rules as they apply to the new hazard classification within a reasonable period of time.

Rule 6. Design Submittal Requirements

6.1 An ~~owner~~Owner proposing to construct ~~or enlarge~~ a new jurisdictional dam or ~~reservoir~~alter, modify, repair, or enlarge an existing jurisdictional dam and/or appurtenant structures shall submit an application package~~,~~ in a form acceptable to the State Engineer. Construction activities may not commence until the State Engineer has provided written approval of the design.

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Heading 2, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

6.2 **Pre-Design Meeting**. Prior to design commencement, the Owner and Engineer shall meet with the State Engineer to discuss the project scope, objectives, and ~~shall receive approval of the construction plans and specifications and Permit for Dam Construction from the State Engineer prior to commencing construction.~~selected design criteria. Meeting minutes shall be provided by the Engineer to establish a clear understanding of the project requirements.

6.3 **Application Package**. The application package shall ~~be prepared by an engineer and shall consist of~~meet the following criteria:

6.3.1 ~~1.~~ **Format.** The application package shall be submitted in portable digital file (PDF) format unless otherwise requested by the State Engineer. All electronic submissions shall consider the following:

6.3.1.1 **File Size**. Efforts shall be made to minimize digital file size from the earliest stages of document development. Efforts may include use of file compression techniques in each step of the document development.

6.3.1.2 **Appropriate Security Settings**. Security settings shall allow for the required digital review and approval process by the State Engineer.

6.3.1.3 **Appropriate Resolution**. Digital files shall include a resolution appropriate to allow for printing both 22- by 34-inch and 11- by 17-inch (half-size) drawings without losing clarity, quality, or scalability.

6.3.1.4 **Electronic Signatures**. Appropriate engineering stamps and signatures will be required on the final version of the design documents before construction approval will be granted.

6.3.1.5 **File Name**. A table with document name, document description, and document type of all materials in the application package shall be included.

6.3.1.6 **File Transfer**. Digital file transfer methods shall be discussed and arranged in consultation with the State Engineer.

6.3.2 **Content.** The application package shall include the following:

A. Application Form,
B. ~~2.~~ Engineer's Qualification Statement and Affidavit,
C. Construction Plans,
D. ~~3.~~ Construction Specifications,
E. ~~4. Hazard Classification~~Design Report,
~~5. Hydrology Report~~
~~6. Geotechnical Report~~
~~7. Design Report~~
~~8. Instrumentation Plan~~
F. ~~9.~~ Inundation Map (High and Significant Hazard dams only),
G. Cost Estimate, and

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Heading 2, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: List Number, Outline numbered + Level: 1 + Numbering Style: A, B, C, … + Start at: 1 + Alignment: Left + Aligned at: 0.5" + Indent at: 0.75", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: List Number, Indent: First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: List Number, Indent: First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

H. ~~10.~~ Filing Fee.

~~The requirements for each of these items are as follows:~~

~~5.1~~ **Application Form~~—~~.** A completed application form shall be provided ~~by~~to the State Engineer. ~~This form will be the only information normally available to the public before the project is approved for construction.~~ The application ~~form~~ shall be signed by the ~~dam owner~~Owner or an authorized representative of the ~~dam owner. The engineer responsible for the preparation of the design and~~

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

6.4 ~~construction may not~~Owner. The Engineer may act as ~~an authorized~~ the Owner's representative ~~of the dam owner unless written authorization for the engineer to act as the owners' representative is provided by the dam owner~~if authorized by the Owner.

6.5 ~~5.2~~ **Engineer's Qualification Statement and Affidavit**. The Engineer shall submit qualifications and a signed affidavit attesting compliance with the requirements as defined in Rule 4.10.

Construction Plans ~~– Construction plans/drawings shall meet the following requirements:~~

6.6 ~~5.2.1.~~ The plans shall show the design of the dam and each appurtenant structure in sufficient detail so that the contractor or builder is able to construct the proposed structure from the plans and the specifications. Construction plans shall meet the following requirements:

6.6.1 ~~5.2.2~~**Contents.** The ~~front cover sheet of the plans~~plan set shall ~~have as~~ contain the following features:

6.6.1.1 The Engineer's seal in accordance with current practice defined by *The Bylaws and Rules of Procedure of the State Board of Registration for Architects, Professional Engineers, and Professional Land Surveyors* (4 CCR 730-1).

6.6.1.2 A cover sheet with the following information at a minimum~~, the~~:

A. The name of the dam; ~~the county~~
B. The County, Water Division, and Water District in which the dam is located; ~~and a~~
C. DAMID;
D. State Construction File Number; and
E. A project location map.

6.6.1.3 A list of the drawings that follow the cover sheet ~~should be provided~~, placed on the second sheet of the plans, and a note ~~should be added to~~on the cover sheet indicating the location of the list of the drawings. ~~The construction drawings and plans shall display the design engineer's seal (crimp type not acceptable) in accordance with current practice defined by The Bylaws and Rules of Procedure of the State Board of Registration for Professional Engineers and Professional Land Surveyors. The original signed mylar coversheet will be returned to the engineer after being approved and signed by the State Engineer. The original signed mylar cover sheet with any appropriate revisions is required to be returned to the State Engineer at the completion of the construction project in accordance with Rule 10.~~

6.6.1.4 The ~~design engineer's~~ Engineer's certification statement, the State Engineer's approval signature block, and the ~~design engineer's AS-CONSTRUCTED~~Engineer's as-constructed statement ~~shall be located~~ in the lower right quadrant of the cover sheet in the following format:

Formatted: Header
Formatted: Font: Arial, 10 pt
Formatted: Heading 2, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: DMMHGC+TimesNewRoman, 10 pt
Formatted: Heading 2, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~Design engineer signature~~

These plans have been prepared by me or under my direct supervision.

_____

[Engineer's Printed Name~~, Colo.~~]
Colorado P.E. No. [xxxxx]

Engineer's Stamp (1-5/8 inches)

Approved on the _____day of _____20___.

_____

State Engineer

State Engineer's Stamp (1-5/8 inches)

By:_____
[Name], Chief, Colorado Dam Safety
Colorado P.E. No. [xxxxx]

~~Deputy State Engineer~~

~~And,~~

These plans represent the AS-CONSTRUCTED conditions of _____ Dam to the best of ~~our~~my knowledge and judgment, based in part on information furnished by others as of the _____ day of _____, 20__.

_____

[Engineer's Printed Name]
Colorado P.E. No. [xxxxx]

Engineer's Stamp (1-5/8 inches)

~~(Engineer's printed name) (Signature)~~

Formatted: Header

Formatted: Body Text, Indent: Left: 1", First line: 0", Space Before: 24 pt, Keep with next, Keep lines together, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Body Text, Indent: Left: 1", First line: 0", Space Before: 60 pt, Keep with next, Keep lines together, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Body Text, Indent: Left: 1", First line: 0", Keep with next, Keep lines together, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt, Font color: Auto

Formatted: Font: Arial, 10 pt

Formatted: Body Text, Indent: Left: 1", Space Before: 36 pt, Keep with next, Keep lines together, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

6.6.1.5 ~~5.2.3 Drawings filed~~When appropriate, stage discharge curves and tables for spillways and outlets shall be placed on the drawings. For spillways, the curves and tables shall include the discharge for each vertical foot between the spillway crest and dam crest. For outlets, the curves and tables shall include the discharge for each vertical foot between the invert of the outlet works intake and the dam crest. Crest elevations of all spillways and the dam, and the invert elevation of the outlet shall be clearly noted on the tables. The rating data shall be referenced to both gage height and elevation.

6.6.1.6 Area capacity and stage capacity curves and tables shall be provided for all new dams and enlargements and when otherwise determined appropriate. The curves and tables shall be provided in a format determined in consultation with the State Engineer ~~shall be originals, drawn with permanent ink on high quality mylar or equivalent, or a high quality reproducible archival copy of the original, and~~ .

6.6.1.7 The plans shall clearly identify the vertical and horizontal datum used, and to the extent possible, shall include a description of vertical and horizontal translations if the proposed datum is different from that used in past projects for the same dam.

6.6.1.8 In no cases shall construction specifications be provided on the drawings.

6.6.2 **Format**. All plan sets shall meet the following format requirements:

6.6.2.1 Drawings shall be prepared in an appropriate scale so details and text are clearly legible ~~with~~on an overall sheet size of ~~24~~ 22- by 34-inches ~~high and 36~~ and half-size sheet size of 11- by 17-inches ~~wide or 22 inches high and 34 inches wide~~.

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~5.2.4~~ Drawings shall have ~~a minimum margin of two inches on the left and 1/2 inch on the right, top, and bottom.~~

6.6.2.2 ~~5.2.5 All drawings shall have~~ bar scales to allow scaling of reduced-sized drawings.

6.6.2.3 ~~5.2.6 All~~Full size drawings shall have a 1/2- by 3-inch space for the State Engineer's construction file number inside the margin in the lower right-hand corner. A unique ~~project~~construction file number will be assigned by the State Engineer prior to final approval of the project documents for construction and shall be placed in bold characters on all of the drawings.

6.6.2.4 ~~5.2.7~~ Each sheet shall be numbered sequentially with the first sheet being sheet number one along with the total number of sheets~~;~~ (e.g., sheet 1 of 6~~.~~).

~~5.2.8 Minimum lettering size on full size drawings (24 inches high and 36 inches wide or 22 inches high and 34 inches wide) shall be 12 pitch.~~

~~5.2.9 Spillway and outlet discharge rating curves and tables, and reservoir area-capacity curves and tables meeting requirements of Rule 5.9.6 shall be placed on the drawings.~~

6.7 ~~5.3~~ **Construction Specifications** ~~–~~ . Construction Specifications shall be submitted on 8½-by 11-inch paper in PDF format, and in printed format if requested by the State Engineer. Specifications shall meet the following requirements:

6.7.1 ~~5.3.1 The front cover of the specifications shall show the title or name of the dam (identical to the title on the plans), the county, the Water Division and the Water District in which the dam is located.~~ The specifications shall display the ~~design engineer's~~Engineer's seal ~~(crimp type not acceptable)~~ in accordance with current practice defined ~~in~~by *The Bylaws and Rules of Procedure of the State Board of Registration for Architects, Professional Engineers and Professional Land Surveyors.~~ (4 CCR 730-1).

6.7.2 The cover sheet shall show the following information at a minimum:

A. The name of the dam;
B. The county, Water Division, and Water District in which the dam is located;
C. DAMID;
D. State Construction File Number; and
E. Date.

Formatted: Header

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 2, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt, Italic

Formatted: Font: Arial, 10 pt, Italic

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

6.7.3 The first page behind the ~~front~~ cover shall show the ~~name of the dam (identical to the name on the plans), the county, Water Division and Water District in which the dam is located, the engineer's~~ following information at a minimum:

A. The same information as on the cover sheet; and

B. The Engineer's certification statement~~,~~ with seal and signature, and the State Engineer's approval statement as ~~follows:~~shown in Rule 6.6.1.4 (without the As-Constructed block).

~~Approved on the _____ day of _____, 20__~~
~~_____, State Engineer~~
~~By: _____, Deputy State Engineer~~

6.7.4 ~~5.3.2~~ The specifications shall have an index.

6.7.5 ~~5.3.3 Final~~Printed specifications shall be bound ~~and submitted on white 8 1/2 by 11 inch paper. Specifications bound in a loose or loose~~. Loose-leaf ~~manner, including~~ and 3-ring binders~~,~~ are not acceptable.

6.7.6 ~~5.3.4~~ The ~~general conditions~~specifications shall include ~~statements that~~a separate section with the following provisions stating the State Engineer's authority:

6.7.6.1 The plans and specifications cannot be significantly changed without the prior written approval of the State Engineer ~~in accordance with Rule 9.1.8.~~ If changed conditions are encountered after the State Engineer's approval is issued, the changes shall be documented in accordance with Rule 8.2.5.

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: List Number, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

6.7.6.2 ~~5.3.5 The general conditions shall include the provision that construction~~Construction shall not be considered complete until the State Engineer has accepted the construction in writing.

6.7.6.3 ~~5.3.6~~ The ~~specifications shall provide that the owner's engineer~~Engineer will monitor the quality of construction as specified in Rule ~~9.~~ 8.1.2. The ~~engineer~~Engineer monitoring the construction for the ~~owner~~Owner is responsible for ~~the quality of construction,~~ compliance with the approved design and specifications, preparation of the necessary documentation for the State Engineer's review and approval of all ~~construction~~design change orders, and preparation of the project completion documents ~~required in Rule 10~~, and for recommending the project for acceptance to the State Engineer.

6.7.7 ~~5.3.7~~ The specifications shall include ~~as a minimum, but are not limited to,~~ the following~~:~~ at a minimum:

A. ~~5.3.7.1 The quality~~Quality of materials used in construction~~;~~.

B. ~~5.3.7.2 The acceptable~~Acceptable quality of workmanship~~;~~.

C. ~~5.3.7.3 The reference~~References to applicable standards~~, if any;~~ as appropriate.

D. ~~5.3.7.4 The required~~ Required tests and estimated frequency of testing~~;~~, and~~,~~

E. ~~5.3.7.5 The action~~Action to be taken if unsatisfactory materials or workmanship are discovered in the construction.

~~5.4 Project Design Reports~~

6.7.8 ~~5.4.1~~ Only technical specifications shall be submitted. No contract documents or extraneous specifications unrelated to the project shall be included.

6.8 **Design Report.** A design report shall be submitted with the application package. The purpose of the design report is to present the project design criteria and all supporting engineering analyses including applicable design standards and references. The design report shall display the Engineer's seal in accordance with current practice defined by *The Bylaws and Rules of Procedure of the State Board of Registration for Architects, Professional Engineers and Professional Land Surveyors* (4 CCR 730-1). The following topics shall be addressed in the design report when applicable to the proposed project. Stand-alone reports addressing individual topics shall be sealed by the Engineer and summarized in the design report.

Formatted: Header
Formatted: Font: Arial, 10 pt
Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: List Number, Outline numbered + Level: 1 + Numbering Style: A, B, C, … + Start at: 1 + Alignment: Left + Aligned at: 0.5" + Indent at: 0.75", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted ...
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted ...
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted ...
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted ...
Formatted: Font: Arial, 10 pt
Formatted ...

6.8.1 **Introduction**. This section shall describe the project and review process, including a discussion of the project objectives and how the proposed design will meet those objectives.

6.8.2 **Project Components**. This section shall describe the dam, spillway, outlet works, and other appurtenant structures.

6.8.3 **Site Requirements**. This section shall describe any site improvements and unusual construction considerations required to construct the project.

6.8.4 **Hazard Classification ~~Report~~** ~~The~~ **.** This section shall identify the hazard classification ~~report shall identify the size and hazard classification category for the proposed dam, or enlarged existing~~for the dam. ~~A report~~This may be submitted, reviewed, and approved as a stand-alone report prior to submittal of the application package. A detailed analysis is not required for dams that are declared as High Hazard; however, a dam failure inundation map will be required for the Emergency Action Plan pursuant to Rule ~~16. The report shall include sufficient information regarding assumptions, calculations and data used to develop the dam failure flood hydrograph and an assessment of the impact of the dam failure upon the downstream floodplain. The dam shall be classified according to the definitions of Rule 4. The hazard classification report must be approved by the State Engineer, and shall be in a form that meets the State Engineer's requirements, including, but not be limited to:~~ 13.7.

~~5.4.1.1 Dam failure inundation maps are required for all dams classified as High and Significant Hazard. Inundation maps are required for dams classified as Low Hazard unless the dam is located in a remote area where no development exists downstream of the dam;~~

~~5.4.1.2 Cross-sections along the watercourse, drawn to scale, showing water surface elevations at critical locations where structures may be impacted by the flood wave. Cross-sections shall show discharge in cubic feet per second, average velocity in feet per second, and structures located in the flooded section. References to all computer programs, data sources and related documents used in the evaluation shall be included; and~~

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~5.4.1.3 Supporting documentation and tabulation of assumed parameters, including Manning's "n" values for the stream channel and the floodplain shall be included.~~

~~5.4.2 **Hydrology Report** A hydrology report is required that presents the inflow design flood (IDF) for determining the required spillway capacity. The IDF may be determined through any of the four methods described in Rule 5.9.1; Extreme Precipitation Analysis Tool (EPAT), site specific hydrometeorologic analysis (SSHMA), Hydrometeorological Report (HMR), and Incremental Damage Analysis (IDA). The precipitation determined through use of the Extreme Precipitation Analysis Tool (EPAT) and site specific hydrometeorologic analysis is the most probable extreme precipitation event for the specific basin determined through modern meteorologic techniques and therefore, the IDF determined from the analysis is probable. No reduction of IDF is allowed for dams classified as High hazard or large size Significant hazard dams. The reduction in the IDF determined through the use of Hydrometeorological Report (HMR), is allowed as provided in Rule 5.9.1.5. Spillways designed in accordance with these Rules will not be required to be enlarged due to subsequent revisions to the IDF as a result of changes to the probable maximum precipitation estimates or EPAT extreme storm database unless, in the opinion of the State Engineer, there is a substantial threat to public safety.~~

~~5.4.2.1 The hydrology report is required to be reviewed and approved by the State Engineer and shall be in a form acceptable to the State Engineer and shall include, but not be limited to the following:~~

~~5.4.2.1.1 A topographical map delineating the drainage area tributary to the dam, with the drainage area size labeled in square miles; the location of the proposed dam by quarter section, section, township, range, and principle meridian; the bearing and distance from Station 0+00 on the dam to a section corner, or, the location of Station 0+00 on the dam determined by GPS, NAD83 datum, provided as UTM coordinates; the name of the natural watercourse on which the dam is located or indicate the dam is off-stream, and the name of the primary watercourse which the dam is tributary, or the name of the drainage basin in which the dam is located; and the elevation of the dam crest;~~

~~5.4.2.1.2 A description of all basin response factors, including the topography, geology, and vegetative cover of the tributary drainage area;~~

~~5.4.2.1.3 A summary of all hydrologic parameters for the method used, the inflow design flood hydrograph, volume of the flood, and hazard classification of the dam;~~

~~5.4.2.1.4 A spillway discharge rating table (in cubic feet per second) for each foot of elevation above the spillway crest up to the crest of the dam, including the equations used for determining the discharge rate; and~~

~~5.4.2.1.5 A table showing the reservoir area (in acres) and storage capacity (in acre-feet) for each foot of elevation from the invert of the outlet to the crest of the dam; and indicating the amount of dead storage (in acre-feet), elevation of the invert of the~~

Formatted: Header

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

outlet, elevation(s) of the spillway crest(s), and elevation of the dam crest. All elevations shall be based on USGS datum, referenced to the invert of the outlet.

5.4.3 **Geotechnical Report** - A geotechnical report is required that evaluates the suitability of the foundation, stability of the dam and the slopes along the reservoir rim, and addresses issues regarding suitability and quantity of material available for construction of the dam as designed. The geotechnical report shall include, but not be limited to, the following:

5.4.3.1 A geological assessment of the dam and reservoir site is required for all dams classified as High or Significant Hazard. The geological assessment shall address at a minimum regional geologic setting; local and site geology; geologic suitability of the dam foundation and reservoir area; slope stability and seepage potential of the reservoir and abutment areas; seismic history and potential; and other potential geological hazards posed by the site and proposed construction. The geological assessment shall include the preparation of a site-specific geological map based upon field observations and mapping by a geologist or geological engineer.

5.4.3.2 Foundation investigations for High and Significant Hazard dams shall include drilling to a depth 1.5 times the height of the dam or at least 10 feet into bedrock, whichever is less; logs of borings and test pits; standard penetration or other field density tests; field and laboratory classification of soils; measurement of the water level in each drill hole; in-situ permeability tests; gradation tests of foundation materials, especially at the locations of proposed drains; determination of liquefaction potential; and whether clay type foundation materials exhibit residual strength properties and dispersivity. Where tunneling or other underground construction is anticipated, subsurface investigation depths, orientations, methods and testing shall be tailored to the geologic setting and details of underground construction anticipated at each site. All investigations for underground facilities shall be performed under the direction of a qualified professional engineering geologist with prior relevant underground experience. The boring logs in the geotechnical report shall include detailed written descriptions of each sample and stratum encountered including observations of the drilling action, drilling and sampling methods and any other observations pertinent to developing a detailed understanding of the subsurface conditions. Graphical "stick" logs alone are not acceptable.

5.4.3.3 The report shall document the suitability of proposed borrow materials or other material sources to be used in construction for High and Significant Hazard dams. The following information and data are required, as a minimum, to be included in the Geotechnical Report:

5.4.3.3.1 Standard index tests and soil classification of all materials;

5.4.3.3.2 Compressibility and/or consolidation tests of soils;

5.4.3.3.3 Permeability of placed materials;

Formatted: Header

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

Formatted: Header

~~5.4.3.3.4 Shear strength of natural and placed materials (dynamic shear strength tests if applicable);~~

~~5.4.3.3.5 Proctor Compaction tests; and~~

~~5.4.3.3.6 Identification of potentially dispersive clays.~~

~~5.4.3.4 For Low Hazard dams, the report shall include field classification of soils, logs of borings and test pits, standard penetration test results, and the requirements of Rules 5.4.3.3.1, 5.4.3.3.2, and 5.4.3.3.5. The foundation exploration shall include drilling to a depth 1.5 times the height of the dam or 10 feet into bedrock, whichever is less.~~

~~5.4.3.5 For NPH dams, the report shall include, as a minimum, field and laboratory classification of natural and placed soils.~~

~~5.4.3.6 For all dams, except Minor Low Hazard and all NPH, with a spillway located on a soil foundation, the report shall include the following:~~

~~5.4.3.6.1 Laboratory Classification of soils along the alignment of the spillway;~~

~~5.4.3.6.2 A profile of soils along the channel extending to a depth of at least five feet below the bottom of the spillway; and~~

~~5.4.3.6.3 Density or bearing capacity of foundation soils beneath spillway structures except for riprapped or unlined sections of the channel.~~

~~5.4.3.7 For all dams, except minor Low Hazard and all NPH, with spillways located on a rock foundation, the report shall include a geologic description of the rock, description of the bedding and jointing patterns, and an evaluation of the site's suitability to accommodate the spillway.~~

~~5.4.4 **Design Report** - A Design Report shall be submitted with the application package. The report shall include information sufficient to evaluate the design of the dam and appurtenances, including references and page numbers, to support any assumptions or criteria used in the design. The report shall also include information on the construction sequence needed to complete the dam along with a summary of any water quality permits that will be required prior to the start of construction. The report shall include calculations and be sufficiently detailed to accurately define the final design of the proposed dam as represented in the construction plans. The following is a typical list of topics to be addressed in the design report:~~

~~5.4.4.1 Introduction - Project description and review process.~~

~~5.4.4.2 Project Components - Main dam, spillway, and outlet works.~~

~~5.4.4.3 Site Requirements - The dam site and reservoir area design requirements.~~

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~5.4.4.4 Flood Hydrology and Results of Flood Routings (a summary of Hydrology Report) - This section should include the final results of the routing of the IDF through the reservoir and spillway system for the purpose of determining the size of the spillway or spillways.~~

~~5.4.4.5 Spillway and Outlet Works Hydraulics - This should include spillway hydraulics and the development of a spillway discharge rating curve, stilling basin hydraulics, a tailwater rating curve including effects of streambed degradation, hydraulic design assumptions for the design of entire outlet system, and development of an outlet works discharge curve. Design of stilling basins for stepped chute spillways shall include assumptions, calculations, and applicable references for estimating energy dissipation and stilling basin entrance velocities.~~

~~5.4.4.6 Foundation Designs - These designs are to include information of local geology (alluvium and topsoil nature and engineering properties), bedrock nature and engineering properties, groundwater impacts, dam foundation requirements, foundation excavation requirements, surface treatment of foundation, seepage control and foundation drainage, piping control measures, downstream erosion, and overtopping control measures. (Refer to the Geotechnical Report requirements for additional requirements, Rule 5.4.3).~~

~~5.4.4.7 Seismic Hazard Assessment - This section include seismic sources (seismotectonic setting, historical seismicity, earthquake sources), ground motion hazard (ground motion attenuation, deterministic analysis, probabilistic analysis), and recommended ground motions (time histories).~~

~~5.4.4.8 Dam Analysis and Design - This section should include material properties (earth and/or concrete, foundation geology for dam, foundation strength parameters), analysis methodology and model results (load combinations, static analysis, dynamic analysis), conclusions and recommendations. In addition for Roller Compacted Concrete (RCC) dams, this section should also include required in-situ material properties for concrete or RCC, RCC trial mix program, mix proportions, and RCC placement requirements (RCC joint treatment, contraction joint spacing, upstream and downstream facing systems).~~

~~5.4.4.9 Structural Design - This section should include structural design criteria and allowable stresses, design of spillway crest, spillway walls and slabs, design of spillway foundation anchors, design of outlet works intake and outlet structures, and outlet conduit.~~

~~5.4.4.10 Dam Instrumentation - This section should include a description of the instrumentation per the requirements of Rule 5.5 and including any other monitoring devices and equipment such as automatic data acquisition system.~~

6.8.5 ~~5.4.4.11~~ **Hydrology**. This section shall include all pertinent design analyses and assumptions necessary to determine the inflow design flood (IDF) for sizing the spillway in accordance with Rule 7.2. This may be submitted, reviewed, and approved as a stand-alone report prior to submittal of the application package.

Formatted: Header

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

6.8.6 **Hydraulics**. This section shall discuss how the proposed spillway design will protect the dam from damage during the IDF and how the proposed outlet will comply with the downstream delivery and reservoir evacuation requirements.

6.8.7 **Geotechnical Design**. This section shall include all pertinent geotechnical and engineering geology considerations for a given project. Documentation and interpretation of all appropriate field and laboratory testing programs shall be sufficiently comprehensive to support the basis of design for dam and appurtenant structure foundations. This may be submitted and reviewed as a stand-alone report prior to submittal of the application package.

6.8.8 **Structural Design**. This section shall include discussion of the design and analyses for all structural components.

6.8.9 **Instrumentation Plan**. This section shall describe the objectives and details of the proposed instrumentation.

6.8.10 **Mechanical and Electrical Design** ~~– Design of~~. This section shall include discussion of designs and analyses for all mechanical and electrical systems including, but not limited to, gates, valves, trash racks and mechanical systems, systems for operating gates and valves, ~~and~~ electrical power requirements and emergency backup power or manual override.

Formatted: Header

Formatted: Font: Arial, 10 pt, Bold, No underline

Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~5.4.4.12 Quality Assurance and Quality Control Plan - Project management plan, project quality plan, and testing procedures and frequency requirements.~~

~~5.4.4.13~~ **River Diversion ~~During~~during Construction** ~~- Anticipated construction scheduling and historical river flows, diversions hydrology and selection of diversion flood,~~. This section shall describe the means to protect the proposed ~~diversion system~~work, the stream, and ~~potential risks to~~ public safety during the proposed construction~~.~~

~~5.4.5 **Project Design Report** - A Project Design Report incorporating all of the aforementioned reports into one design document is permitted. The report should fully document and provide defendable reasoning for the design of the dam and appurtenant structures.~~

~~5.5 **Instrumentation Plan** - An instrumentation plan is~~ period as required ~~and shall meet the following requirements:~~

6.8.11 ~~5.5.1 All instrumentation shall be properly identified in the field to correspond to the identification of the instrumentation in the long-term monitoring plan required in~~ by Rule ~~10.~~8.1.1.

~~5.5.2 Gage rods shall be installed in the close proximity to the outlet on all dams. The zero mark of the gage shall be aligned with the invert elevation of the entrance to the outlet. The gage shall be clearly marked in feet and tenths of feet, and extend to within one foot of the crest of the dam. If the Division Engineer so requires, the gage shall be marked in hundredths of a foot. Markings and numbers on the gage rod shall be of sufficient size to allow for the reading of the gage rod from a distance 50 feet or further if the gage rod is placed on an intake tower within the reservoir.~~

~~5.5.3 High and Significant Hazard dams shall have the following minimum instrumentation:~~

~~5.5.3.1 Monuments that allow measurement of the horizontal and vertical movements of the dam, installed in accordance with industry standards and in a manner acceptable to the State Engineer. Control or benchmark monuments shall be placed on the abutments in areas not subject to movement;~~

~~5.5.3.2 Weirs, flumes, or other measuring devices installed in a manner acceptable to the State Engineer, to allow monitoring of seepage through the embankment or foundation. Positive drainage away from all seepage monitoring devices should be provided to prevent the device from becoming submerged;~~

~~5.5.3.3 Station markers at least every 100 feet along the crest of the dam; and~~

~~5.5.3.4 Piezometers to allow monitoring of the phreatic surface within the dam, installed in accordance with industry standards and in a manner acceptable to the State Engineer. As a minimum, the construction of the open well piezometers shall be in accordance with~~

Formatted: Header

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt, Bold, No underline

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt, Bold, No underline

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~the requirements of a monitoring well as presented in the Division of Water Resources' "Rules and Regulations for Water Well Construction, Pump Installation and Monitoring~~

Formatted: Header

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~an Observation Hole/Well Construction," later amendments, editions or subsequent publications are not included.~~

~~5.5.3.5 Piezometers or equivalent instruments shall be installed to measure uplift pressures in the dam and foundation for concrete dams, when the reduction of uplift pressures are required to meet the factors of safety and stress requirements of the design of the dam.~~

~~5.5.3.6 Where drainage galleries are provided for concrete dams, seepage measuring devices should be provided at the appropriate locations and be accessible for making the necessary readings.~~

~~5.5.4 Low Hazard dams shall have weirs, flumes or other measuring devices installed, as approved by the State Engineer, to allow monitoring and measurement of leakage through the embankment or foundation.~~

~~5.5.5 NPH dams are not required to have instrumentation other than gage rods in accordance with Rule 5.5.2.~~

6.9 ~~5.6~~ **Cost Estimate**~~.~~ A detailed cost estimate of the construction of the dam including the engineering ~~fees.~~and construction oversight tasks. The cost estimate will remain confidential until after the construction contract is executed.

~~5.7 **Fees** A filing fee of $3.00 per $1,000.00 (or fraction thereof) of the cost estimate, limited to a maximum of $3,000.00, with a minimum filing fee of $100.00.~~

6.10 ~~5.8~~ **Fee.** A fee shall be assessed in accordance with section 37-80-110(1)(e), C.R.S. A check for the fee shall accompany the application form and be made payable to Colorado Division of Water Resources.

6.11 **Design Review Approvals and Limitations.**

6.11.1 ~~5.8.1~~ **Approval of Plans and Specifications** ~~Acceptable plans and specifications~~. The State Engineer will ~~be certified by the State Engineer or designee~~approve acceptable plans and ~~approved~~specifications for construction. Unacceptable submittals will be rejected.

~~5.8.2 **Approval Limitation** If construction, alteration, or repair of a reservoir dam is not commenced within five years of approval of the application, the State Engineer's approval shall be void. The owner must resubmit the application and receive approval before commencing construction, and shall meet the requirements of the current Rules.~~

Formatted: Header

Formatted: Heading 2, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Not Bold

Formatted: Heading 2

Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

6.11.2 ~~5.8.3~~ **Design Review Limitation** ~~The design review performed by the State Engineer shall be limited to three years from the date of the review.~~. Re-submittal of the design package shall be required if resolution of the design review comments does not occur within three years. Resubmitted designs shall be accompanied by a new application package and fee.

6.11.3 **Approval Limitation**. Construction shall commence within five years of approval of the application, after which time the State Engineer's approval shall be void. The new application will be reviewed and reevaluated against current standards. Resubmitted designs shall be accompanied by a new application package and fee.

6.11.4 **Resubmittal of Rejected Designs and Expired Approvals**. The Owner is required to submit a complete application package and fee, addressing any previously identified deficiencies, before the design will be reconsidered. The new application will be reviewed and reevaluated against current standards.

6.12 **Application and Approval Requirements for Low Hazard and NPH Dams.** Plans for alteration, modification, repair, or enlargement of an existing Low Hazard or NPH dam and/or appurtenant structures of Low Hazard dams or NPH dams will be reviewed in accordance with the following procedure:

6.12.1 **Notice**. The Owner shall provide written notice to the State Engineer at least thirty (30) days in advance of construction. The written notice shall contain the name of the dam, the location of the dam, the name of the Owner, contact information for the Owner, and a clear description of the work to be performed.

6.12.2 **Determination**. The State Engineer will notify the Owner whether plans and specifications are required.

6.12.2.1 If plans and specifications are required, Rules 6, 7, and 8 will apply.

6.12.2.2 If plans and specifications are not required, the State Engineer will inform the Owner of any engineering, construction, and project documentation requirements, and will perform construction inspections as determined necessary.

Rule 7. Design Requirements

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 1

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~**Rule 1.** **5.9 Design Requirements**~~

7.1 ~~5.9.1~~ This Rule applies to design of new dams and alteration, modification, repair, or enlargement of existing dams. In the case of existing dams, only the pertinent sections will apply.

7.2 **Inflow Design Flood (IDF) ~~Requirements~~for Spillway Sizing.**

7.2.1 ~~5.9.1.1 The~~ **Prescriptive Method**. Table 7.1 provides rainfall requirements for the Inflow Design Flood (IDF ~~shall be determined considering~~) based on Hydrologic Hazard. The spillway must safely route a flood generated by Critical[1] Rainfall shown in Table 7.1.

Table 7.1: Prescriptive IDF Requirements

Hydrologic Hazard	Critical[1] Rainfall
Extreme	Probable Maximum Precipitation (PMP)
High	0.01% AEP
Significant	0.1% AEP
Low	1% AEP

7.2.2 **Consequence Estimation.** Consequence estimation for Hydrologic Hazard may be determined based on total flood depth associated with an overtopping (or other plausible hydrologic failure mode) dam failure flood or based on the incremental consequences between such dam failure flood and that caused by the spillway base flood immediately prior to dam failure. The spillway size is acceptable when it meets or exceeds the IDF requirements of Table 7.1 for a given Hydrological Hazard category.

7.2.3 **Allowable Rainfall Estimates for developing the IDF.**

7.2.3.1 **Probable Maximum Precipitation (PMP)**. The Probable Maximum Flood (PMF) shall be developed using the most current PMP estimates approved by the State Engineer.

7.2.3.2 **Precipitation Frequency Estimates**. Frequency-based IDFs shall be developed using the most current precipitation frequency estimates approved by the State Engineer.

7.2.3.3 **Site-Specific Extreme Precipitation Studies (SSEPS).** SSEPS may be used to determine the appropriate site-specific extreme storm precipitation (PMP or precipitation frequency estimates) for the determination of the IDF. The SSEPS must be approved by the State Engineer prior to acceptance.

[1] Critical refers to the controlling storm duration, spatial pattern, temporal distribution and other storm variables that result in the highest maximum reservoir water surface elevation during reservoir routing.

Formatted: Header

Formatted: Font: Not Bold

Formatted: Heading 2, Indent: Left: 0"

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

7.2.4 **Atmospheric Moisture Factor.** All rainfall depth estimates calculated by means acceptable to the State Engineer shall be multiplied by a factor of 1.07 prior to calculating runoff to account for expected increases in temperature and associated increases in atmospheric moisture availability over the 50-year period 2020 to 2070.

7.2.5 **Flood Frequency Analysis**. Using systematic records, historical flood information, and paleoflood and botanical information, flood frequency analysis may be used to determine a required frequency flood for spillway sizing purposes. Flood frequency analysis shall follow applicable, current, published guidelines and procedures, such as *Guidelines For Determining Flood Flow Frequency* (ACWI Bulletin 17C, USGS, 2018).

Hydrologic Basin Response Requirements. Rainfall-runoff modeling used to develop an IDF shall consider basin size, ~~the~~ elevation of the basin, various soil permeabilities, ~~the~~ various vegetative covers, and other factors related to the routing of the storm event. ~~Historical precipitation data of the National Weather Service may be used for determining the IDF provided applicable stochastic procedures are used as outlined in the National Weather Service NOAA Atlas #2 "Precipitation-Frequency Atlas of the Western United States" Volume III-Colorado, U.S. Department of Commerce, NOAA, National Weather Service, Silver Springs, Maryland, 1973, or other methods approved by the State Engineer.~~

~~5.9.1.2 The National Weather Service, NOAA, Atlas #2 "Precipitation-Frequency Atlas of the Western United States" Volume III-Colorado, U.S. Department of Commerce, NOAA, National Weather Service, Silver Springs, Maryland, 1973, may be used for determining the precipitation for l00-year, 50-year and 25-year rainstorm events for the purpose of calculating the magnitude of the resulting flooding.~~

~~5.9.1.3 Extreme Precipitation Analysis Tool - The Inflow Design Flood (IDF) requirements for determining the spillway capacity may be developed through the use of the Extreme Precipitation Analysis Tool (EPAT). The process and procedures for use of the EPAT are available from the State Engineer. The IDF requirement determined through the use of the EPAT Extreme Storm Precipitation (ESP) for determining spillway capacity are summarized in Table 5.1:~~

Formatted: Header

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

Formatted: Header

TABLE 5.1

INFLOW DESIGN FLOOD REQUIREMENTS

USING EPAT

DAM SIZE	HAZARD CLASSIFICATION			
	High	Significant	Low	NPH
Large	ESP	ESP	100 YR	50 YR
Small	ESP	0.5 ESP	100 YR	25 YR
Minor	ESP	100 YR	50 YR	25 YR

5.9.1.3.1 New Large, Small, and Minor High Hazard dams and enlargements shall have spillways capable of passing, as a minimum, the Inflow Design Flood (IDF) generated by the Extreme Storm Precipitation (ESP), unless an Incremental Damage Analysis (IDA) demonstrates a lesser inflow design flood is applicable.

5.9.1.3.2 New Large, Significant Hazard dams and enlargements shall have spillways capable of passing, as a minimum, the Inflow Design Flood (IDF) generated by the Extreme Storm Precipitation (ESP), unless an Incremental Damage Analysis (IDA) demonstrates a lesser inflow design flood is applicable.

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

Formatted: Header

~~5.9.1.3.3 New Small, Significant Hazard dams and enlargements shall have spillways capable of passing, as a minimum, the inflow design flood generated by 50 percent of the Extreme Storm Precipitation (ESP), unless an Incremental Damage Analysis (IDA) demonstrates a lesser inflow design flood is applicable.~~

~~5.9.1.3.4 New Minor, Significant Hazard plus new Large and Small, Low Hazard dams and enlargements shall have spillways capable of passing, as a minimum, the inflow design flood generated by a 24-hour, l00-year rainstorm event.~~

~~5.9.1.3.5 New Minor, Low Hazard dams and new Large, NPH Dams and enlargements shall have spillways capable of passing the inflow design flood generated by a 24-hour, 50-year rainstorm event.~~

~~5.9.1.3.6 New Small and Minor NPH dams and enlargements shall have spillways capable of passing the Inflow Design Flood (IDF) generated by a 24-hour, 25-year rainstorm event.~~

~~5.9.1.3.7 The minimum size spillway for all High Hazard, Significant Hazard, and Large and Small, Low Hazard jurisdictional size dams for which an IDA shows a smaller spillway is justifiable under Rule 5.9.7.1 shall be capable of passing the inflow design flood generated by a 24-hour, 100-year rainstorm event. For all other jurisdictional size dams, the minimum size spillway shall be capable of passing the IDF generated by the appropriate rainstorm event presented in the above table.~~

~~5.9.1.4 Hydrometeorological Report PMP - The Inflow Design Flood (IDF) requirements for determining the spillway capacity may be developed through the use of the most current Probable Maximum Precipitation (PMP) estimates from the Office of Hydrology, National Weather Service, NOAA Hydrometeorological Report Series. The PMP values are normally determined from the appropriate Hydrometeorological Report (HMR). Currently, HMR 52 and 55A are applicable for drainage basin located to the east of the Continental Divide and HMR 49 for drainage basin west of the Continental Divide. The IDF requirements for determining the spillway capacity using the appropriate HMR are summarized in Table 5.2:~~

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

Formatted: Header

~~TABLE 5.2~~

~~INFLOW DESIGN FLOOD REQUIREMENTS~~

~~USING HYDROMETEOROLOGICAL REPORTS (HMR)~~

~~DAM SIZE~~	~~HAZARD CLASSIFICATION~~			
	~~High~~	~~Significant~~	~~Low~~	~~NPH~~
~~Large~~	~~0.90 PMP~~	~~0.68 PMP~~	~~100 YR~~	~~50 YR~~
~~Small~~	~~0.90 PMP~~	~~0.45 PMP~~	~~100 YR~~	~~25 YR~~
~~Minor~~	~~0.45 PMP~~	~~100 YR~~	~~50 YR~~	~~25 YR~~

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

Formatted: Header

~~5.9.1.4.1 New Large and Small, High Hazard dams and enlargements shall have spillways capable of passing, as a minimum, the Inflow Design Flood (IDF) generated by 90 percent of the Probable Maximum Precipitation, unless an incremental damage analysis demonstrates a lesser inflow design flood is applicable.~~

~~5.9.1.4.2 New Minor, High Hazard dams and enlargements shall have spillways capable of passing, as a minimum, the Inflow Design Flood generated by 45 percent of the Probable Maximum Precipitation (PMP), unless an Incremental Damage Analysis (IDA) demonstrates a lesser IDF is applicable.~~

~~5.9.1.4.3 New Large, Significant Hazard dams and enlargements shall have spillways capable of passing, as a minimum, the Inflow Design Flood (IDF) generated by 68 percent of the Probable Maximum Precipitation (PMP), unless an Incremental Damage Analysis (IDA) demonstrates a lesser IDF is applicable.~~

~~5.9.1.4.4 New Small, Significant Hazard dams and enlargements shall have spillways capable of passing, as a minimum, the Inflow Design Flood (IDF) generated by 45 percent of the Probable Maximum Precipitation (PMP), unless an Incremental Damage Analysis (IDA) demonstrates a lesser IDF is applicable.~~

~~5.9.1.4.5 New Minor, Significant Hazard and new Large and Small, Low Hazard dams and enlargements shall have spillways capable of passing, as a minimum, the Inflow Design Flood (IDF) generated by a 24-hour, l00-year rainstorm event.~~

~~5.9.1.4.6 New Minor, Low Hazard dams, and new Large, NPH Dams and enlargements shall have spillways capable of passing the Inflow Design Flood generated by a 24-hour, 50-year rainstorm event.~~

~~5.9.1.4.7 New Small and Minor, NPH dams and enlargements shall have spillways capable of passing the Inflow Design Flood (IDF) generated by a 24-hour, 25-year rainstorm event.~~

~~5.9.1.4.8 The minimum size spillway for all High Hazard, Significant Hazard, and Large and Small, Low Hazard jurisdictional size dams for which an IDA shows a smaller spillway is justifiable under Rule 5.9.7.1 shall be capable of passing the Inflow Design Flood (IDF) generated by a 24-hour, 100-year rainstorm event. For all other jurisdictional size dams, the minimum size spillway shall be capable of passing the IDF generated by the appropriate rainstorm event presented in the above table.~~

~~5.9.1.5 Elevation Reduction The HMR PMP used to determine the IDF may be reduced based on the average elevation of the drainage basin. The HMR PMP value may be adjusted for the determination of the IDF for drainage basins above 5,000 (ft) MSL in accordance with Table 5.3:~~

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

Formatted: Header

TABLE 5.3

HMR PMP INFLOW DESIGN FLOOD REQUIREMENTS

REDUCED FOR ELEVATION

DAM SIZE	STORM TYPE	ELEVATION	HAZARD CLASSIFICATION	
			High	Significant
Large	General Storm East	6,000 – 12,000 ft MSL	0.80 PMP	0.60 PMP
		Above 12,000 ft MSL	0.70 PMP	0.53 PMP
	General Storm West	5,000 – 8,000 ft MSL	0.80 PMP	0.60 PMP
		Above 8,000 ft MSL	0.70 PMP	0.53 PMP
	Local Storm	10,000 – 11,500 ft MSL	0.80 PMP	0.60 PMP
		11,501 – 13,000 ft MSL	0.70 PMP	0.53 PMP
		Above 13,000 ft MSL	0.60 PMP	0.45 PMP
Small	General Storm East	6,000 – 12,000 ft MSL	0.80 PMP	0.40 PMP

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

Formatted: Header

		~~Above 12,000 ft MSL~~	~~0.70 PMP~~	~~0.35 PMP~~
	~~General Storm West~~	~~5,000 – 8,000 ft MSL~~	~~0.80 PMP~~	~~0.40 PMP~~
		~~Above 8,000 ft MSL~~	~~0.70 PMP~~	~~0.35 PMP~~
	~~Local Storm~~	~~10,000 – 11,500 ft MSL~~	~~0.80 PMP~~	~~0.40 PMP~~
		~~11,501 – 13,000 ft MSL~~	~~0.70 PMP~~	~~0.35 PMP~~
		~~Above 13,000 ft MSL~~	~~0.60 PMP~~	~~0.30 PMP~~
~~Minor~~	~~General Storm East~~	~~6,000 – 12,000 ft MSL~~	~~0.40 PMP~~	~~Not Applicable~~
		~~Above 12,000 ft MSL~~	~~0.35 PMP~~	~~Not Applicable~~
	~~General Storm West~~	~~5,000 – 8,000 ft MSL~~	~~0.40 PMP~~	~~Not Applicable~~
		~~Above 8,000 ft MSL~~	~~0.35 PMP~~	~~Not Applicable~~
	~~Local Storm~~	~~10,000 – 11,500 ft MSL~~	~~0.40 PMP~~	~~Not Applicable~~
		~~11,501 – 13,000 ft MSL~~	~~0.35 PMP~~	~~Not Applicable~~
		~~Above 13,000 ft MSL~~	~~0.30 PMP~~	~~Not Applicable~~

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

7.2.6 ~~5.9.1.6 Site Specific Hydrometeorologic Analysis~~ ~~Site Specific Hydrometeorologic Analysis (SSHMA) may be used to determine the appropriate site specific extreme storm precipitation (SSESP) for the determination of the IDF. Site-specific evaluations are subject to approval by the State Engineer. Any procedures developed and approved by the State Engineer shall be used to determine the applicable Extreme Precipitation Event.~~ Snowmelt conditions and rain-on-snow events shall be considered as base flow when appropriate. ~~The percentage reduction of the PMP as shown in Rule 5.9.1.5 are not applicable or allowed in the determination of site specific extreme storm precipitation or PMP values determined by the procedures and analysis provided for in this Rule for all High Hazard dams and Large Significant Hazard dams. The IDF requirement developed through the use of site specific analyses for determining spillway capacity are summarized in Table 5.4:~~

Formatted: Header

Formatted: Heading 3, Indent: Left: 0.44", First line: 0", Tab stops: 1.04", List tab + Not at -1" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

Formatted: Header

TABLE 5.4

INFLOW DESIGN FLOOD REQUIREMENTS

FOR SSHMA

DAM SIZE	HAZARD CLASSIFICATION			
	High	Significant	Low	NPH
Large	SSESP	0.75 SSESP	100 YR	50 YR
Small	SSESP	0.5 SSESP	100 YR	25 YR
Minor	SSESP	100 YR	50 YR	25 YR

5.9.1.7 Incremental Damage Analysis - An Incremental Damage Analysis (IDA) used to justify an Inflow Design Flood (IDF) less than the requirements of Rule 5.9.1.3 through Rule 5.9.1.6, shall be based on a comparison of two floods: first, a base flow flood of the minimum magnitude which exceeds the capacity of all spillways, resulting in overtopping of the dam routed through the downstream floodway assuming no dam is in place; and second, the dam failure flood which occurs due to overtopping, and is routed downstream with the base flow flood. The spillway capacity and IDF will be acceptable where it can be shown that the dam failure flood would cause no additional loss of life nor additional significant property damages downstream within the zone between the two floods.

5.9.1.7.1 No loss of life or significant damage is expected to occur if the increased depth of flow is two feet or less and the product of the flood flow velocity in the incremental zone and the depth of flow at critical locations along the floodway is less than seven.

5.9.1.7.2 Documentation for the IDA shall include but not be limited to: a plot showing both the base flow and dam break flood on topographic maps of the affected areas; cross-sections of the downstream channel showing flood stages, velocities, and discharges for the two floods at the critical locations; incremental damage and loss of life determinations; and a summary of all assumed hydraulic parameters. A table summarizing the results of the IDA at the various downstream cross sections showing that the criteria in Rule 5.9.1.7.1 has been satisfied shall be included in the IDA study

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~report. Documentation shall also include, if deemed necessary by the State Engineer, channel profiles with the various flood stages, aerial photographs of the affected areas, and computer printouts showing flood discharges, stage, and velocities with respect to time.~~

~~5.9.1.8 The minimum freeboard requirements for new or enlarged dams shall be based upon the dam height required to prevent overtopping by wave action, or the sum of the inflow design flood maximum water surface level plus one foot of residual freeboard, but not less than five feet unless the State Engineer approves a lesser amount. Except for concrete dams where the design engineer has demonstrated that overtopping of the dam will not be detrimental to the safety of the dam, the inflow design flood can be~~

Formatted: Header

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

accommodated with zero residual freeboard or the overtopping depth at which the dam still meets the stability and stress requirements of Rule 5.9.5.

5.9.1.9 For any dam whose spillway is not designed to pass the inflow design flood as defined previously in Rule 5.9.1, the engineer may as an alternative, provide documentation of the analysis that overtopping of the dam by floods which exceed the spillway capacity up to the design flood will not cause failure of the dam. Otherwise, overtopping protection shall be provided.

5.9.1.10 Spillway Design Exemption - Spillways designed and constructed in accordance with the requirements of the Rules dated September 30, 1988 are exempt from the requirements of these Rules.

5.9.2 **Seismicity Design Requirements**

5.9.2.1 Dams classified as High or Significant hazard shall be analyzed for seismic stability. Seismic analysis for water storage dams shall be based on full reservoir under steady state seepage conditions. Flood control dams with ungated outlets shall be designed for earthquake loads under empty reservoir conditions and need not consider steady state seepage for seismic analysis. Dams sited on active faults shall obtain a waiver from the State Engineer. To obtain a waiver, the analysis shall show that the location of the dam is unavoidable and the dam must be designed to withstand anticipated fault movement without compromising its integrity. Appropriate data sheets, calculation sheets and computer program output computations from manual or computerized analysis shall be provided. The seismic analysis shall meet the following minimum requirements:

5.9.2.1.1 A seismological investigation for the dam area and reservoir area. This study may be part of the geotechnical report for the structure, or may be a separate report. The study shall determine and justify the appropriate seismic parameters to be used for design. The seismic parameters shall be based on the following design earthquake:

5.9.2.1.1.1 Dams classified as High Hazard and with a height greater than or equal to 30 feet, other than flood control structures, shall be designed for the maximum credible earthquake or for an earthquake with a minimum 5000-year return frequency.

5.9.2.1.1.2 Dams classified as High Hazard and with a height less than 30 feet, other than flood control structures, shall be designed for either: a) the maximum credible earthquake or an earthquake with a minimum 5000-year return frequency, or b) for a peak ground surface acceleration equal to twice the acceleration for the site with a 2% chance of exceedance in 50 years (approximately 2500-year return frequency), as estimated and published by the U.S. Geological Survey.

Formatted: Header

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~5.9.2.1.1.3 Dams classified as Significant Hazard or High Hazard dams whose sole purpose is for flood control shall be designed for a 2% chance of exceedance in 50 years (approximately 2500-year return frequency).~~

~~5.9.2.2 An analysis of materials in the foundation, reservoir area and proposed embankment shall be completed to determine the potential for liquefaction, earthquake-induced sliding, or other seismic sensitivity, which may be accomplished as part of the geotechnical investigation.~~

~~5.9.2.3 Pseudostatic analysis for embankment dams will be acceptable for the following cases:~~

~~5.9.2.3.1 The embankment is to be mechanically compacted to at least 95% of the maximum standard Proctor density, ASTM D698, or at least 90% of the maximum modified Proctor density, ASTM D1557 or at least 70% relative density per ASTM D4253 and ASTM D4254, if Proctor testing is not appropriate; no materials prone to liquefaction are present in the foundation and the design peak bedrock acceleration is 0.20g or less; or~~

~~5.9.2.3.2 The embankment is to be mechanically compacted to at least 95% of the maximum standard Proctor density, ASTM D698, or at least 90% of the maximum modified Proctor density, ASTM D1557; potentially submerged portions of the embankment except for internal drain elements are constructed of clayey material; the dam is constructed on clayey soil or bedrock foundation and peak bedrock acceleration is 0.35g or less; and~~

~~5.9.2.3.3 All static stability safety factor requirements of these Rules are met; minimum freeboard requirements of these Rules are met; and the pseudostatic coefficient selected for analysis must be at least 50% of the design peak bedrock acceleration, but not less than 0.05g and the factor of safety under pseudostatic analysis shall be 1.0 or greater. In determining the factor of safety for pseudostatic analysis, a search for the critical failure surface shall be made.~~

~~5.9.2.4 Pseudostatic analysis for concrete dams will be acceptable and shall meet the requirements Rule 5.9.5.~~

~~5.9.2.5 For dams not satisfying the requirements for pseudostatic analysis, a deformation analysis is required. The resulting embankment must be capable of withstanding the design earthquake without breaching and with at least 3 feet of freeboard remaining after deformation. The analysis shall also assess the potential for internal erosion as a result of cracking during earthquake-induced deformation.~~

~~5.9.2.6 The seismic assessment shall also address the stability of appurtenant structures to the dam during the design earthquake, as appropriate, unless failure of an appurtenance due to earthquake does not represent an immediate threat to the dam, in which case a lesser operating basis earthquake may be used, as approved by the State Engineer.~~

Formatted: Header

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~5.9.3 **Geotechnical Investigation and Foundation Requirements**~~

7.3 ~~5.9.3.1~~ Geological and Geotechnical Investigations.

Geological and geotechnical ~~investigations are required to describe the geology and geotechnical conditions for construction of the dam and reservoir. The report shall include the geological and geotechnical analyses required for the design and construction of the dam. The report shall describe the foundation conditions for the dam and provide justification for foundation strength, deformation, sliding stability and seepage parameters assumed for design. The foundation requirements for design of the dam will vary based upon the foundation conditions, geology, rock jointing and faulting, dam size and use of the reservoir.~~

7.3.1 ~~5.9.3.2 Geological and geotechnical engineering exploration~~ engineering investigations shall be conducted under the supervision of ~~a Licensed Professional~~ an Engineer or ~~an Engineering~~ Geologist experienced in geotechnical or geological engineering for dams.

7.3.2 ~~5.9.3.3~~ **Geological** ~~mapping is required for~~ **Site Characterization.** A geological assessment of the dam and reservoir ~~area.~~ site is required for all dams classified as High or Significant Hazard. The geological ~~mapping~~assessment shall include, at a minimum:

A. Regional geologic setting;
B. Local and site geology;
C. Geologic suitability of the dam foundation, reservoir rim stability, and reservoir area leakage;
D. Regional and site seismicity;
E. All other potential geological hazards affecting the project; and
F. A site-specific geologic map based upon published records and field observations. The geologic mapping shall cover the reservoir area, dam, abutments, and the locations of all appurtenant structures.

7.3.3 ~~5.9.3.4~~**Subsurface Investigation Plans**. A subsurface investigation plan must be approved by the State Engineer prior to mobilization for all proposed subsurface investigations. The plan shall include the following:

A. Objective(s) of the investigation and descriptions of the specific Potential Failure Modes being addressed in the investigation;
B. Names and qualifications of the investigation team including lead geotechnical or geological engineer, field engineers, and geologists;
C. Figures and description of the existing conditions;
D. Drilling, test pits, and other in-situ testing procedures; and
E. Contingency plans.

Formatted: Header
Formatted: Font: DMMHGC+TimesNewRoman, 10 pt
Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt, Bold
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: List Number, Indent: Left: 1.25", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

7.3.3.1 Drilling methods in all dams and dam foundations shall be chosen to minimize the risk of hydraulic fracturing or otherwise damaging the strata or formations being drilled. Drilling on or within 200 feet of existing dams is prohibited unless approved by the State Engineer.

7.3.4 **Subsurface Geotechnical Investigations.** Subsurface investigations shall be conducted for all new dams and for all ~~major~~ modifications to existing dams. ~~The subsurface investigation is typically required to evaluate the depth and geologic classification of the bedrock foundation excavatability and characterize the foundation competency under the dam.~~ where appropriate. The subsurface investigation shall include~~, test holes, test pits, geophysical survey, insitu testing, water packer test, pressure meter, and block shear tests.~~ a characterization of the geotechnical and geologic foundation conditions as follows. More extensive investigation and reporting may be required, depending on project-specific needs.

7.3.4.1 ~~5.9.3.5 The number~~**High** and **Significant Hazard Dams**. Subsurface geotechnical investigations for High and Significant Hazard dams shall require the following, at a minimum:

A. Drilling at least three borings along the dam centerline to a depth 1.5 times the height of ~~test holes~~the dam and at least 10 feet into competent bedrock;
B. Additional borings or test pits within or near the dam footprint, as required;
C. Logs of borings and test pits ~~are typically based on the geological conditions, the complexity of the geological conditions and the size~~;
D. Standard Penetration Testing;
E. Field density tests, as appropriate;
F. Field classification of ~~the dam~~rock and ~~depth~~soil;
G. Measurement of the ~~reservoir. The number~~water level in each drill hole; and
H. In-situ permeability tests.

7.3.4.2 **Low Hazard and NPH Dams**. Subsurface geotechnical investigations for Low Hazard and NPH dams shall require the following, at a minimum:

A. Drilling at least three borings along the dam centerline to a depth 1.5 times the height of the dam or at least 10 feet into bedrock;
B. Field classification of rock and soil;
C. Logs of borings and test pits; and
D. Standard Penetration Testing.

7.3.4.3 **Spillways, Outlet Works, and Appurtenant Structures.** Subsurface geotechnical investigations for spillways, outlet works and appurtenant structures shall include the following, at a minimum:

A. An evaluation of the site's suitability to accommodate the spillway or structure;
B. Field classification of soils along the alignment of the spillway or under the structure;
C. A profile of soils along the spillway channel extending to a depth of at least five feet below the bottom of the spillway;

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt, Bold

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

D. Density or bearing capacity of foundation ~~drill holes shall~~ soils beneath structures except for riprapped or unlined sections of the spillway channel;

E. Erodibility of unlined natural spillway channels; and

F. For structures founded on rock, a geologic description of the foundation rock including a description of the bedding and jointing patterns.

7.3.4.4 **Underground Construction**. Where tunneling or other underground construction is anticipated, subsurface investigation depths, orientations, methods, and testing shall be tailored to the geologic setting and details of the underground construction anticipated at each site, as recommended by a Geologist.

7.3.4.5 **Borrow Sources.**

7.3.4.5.1 Subsurface geotechnical investigations for borrow sources shall include an evaluation of the availability, suitability, and quantity of all earth and rock materials proposed for construction of the dam as designed. Determination of the adequacy of borrow sources shall be based on field and laboratory testing.

7.3.4.5.2 Borrow areas shall be located so they do not ~~be less than three~~negatively impact the dam stability or foundation seepage. Borrow areas shall be located at least 200 feet outside the dam footprint, unless an analysis approved by the State Engineer indicates a lesser distance is acceptable.

~~5.9.3.6 Direct shear strength testing and compressive strength testing is required to evaluate design values for shear strength and bearing capacity. Strength properties of discontinuities and the weakest foundation materials are required, as these will generally control foundation behavior. Shear strength testing is also required on rock discontinuities including pre-existing shear planes or faults in the dam foundation. Typical test requirements could include stress-strain properties, shear wave velocity, density and tensile strength.~~

~~5.9.3.7 The geological and geotechnical basis for the foundation grouting design for the dam should be prepared. This documentation includes the basis for the design of the curtain grouting and consolidation grouting of the dam footprint.~~

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Heading 5, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~5.9.3.8 Foundation excavation requirements necessary to provide a firm foundation for the dam shall be documented in the Geotechnical Report. The Geotechnical Report shall provide excavation requirements for shaping of the foundation to provide more uniform foundation stresses or to minimize dam cracking.~~

7.3.5 ~~5.9.3.9~~ **Laboratory Testing.** Laboratory testing of all proposed native and imported construction materials, and foundation and abutment materials, shall be performed to provide engineering justification for the selected design criteria.

7.3.5.1 **High and Significant Hazard Dams**. Laboratory testing for High and Significant Hazard earth and rockfill embankment dams shall include the following tests, at a minimum:

A. Classification of all soil and rock materials based on standard index tests, including hydrometer tests as necessary for clay soils;
B. Directly measured shear strengths of all materials using test methods appropriate for the material tested;
C. Residual strength of high plasticity soils or weak rock;
D. Compressibility of all soil and rock materials;
E. Consolidation and expansion characteristics of all soil and rock materials;
F. Permeability of all in-situ and placed materials;
G. Moisture/density relationships of all materials to be compacted;
H. Potential dispersiveness and erodibility of all soils;
I. Solubility of all rock materials;
J. Density, quality, soundness, and durability of all rock materials; and
K. Corrosion potential.

7.3.5.2 **Low Hazard and NPH Dams**. Laboratory testing for Low Hazard and No Public Hazard earth and rockfill embankment dams shall include the following tests, at a minimum:

A. Classification of all soil and rock materials based on standard index tests, and
B. Moisture/density relationships of all materials to be compacted.

7.4 Embankment Dam Design.

7.4.1 **Foundation and Abutment Design**. The dam foundation and abutments shall be analyzed and design criteria selected to meet the following requirements:

7.4.1.1 Unsuitable materials shall be removed from the dam foundation and abutments, unless appropriate analyses demonstrate the unsuitable material can be adequately treated so it will not adversely affect the safety and performance of the dam. Unsuitable materials include, but are not limited to liquefiable, dispersive, organic, expansive, and collapsible soils; slaking shales; soluble rock; clay seams in rock; and poor-quality rock.

7.4.1.2 The dam foundation geometry shall be designed to prevent the creation of low stress zones in the embankment that could cause differential settlement and cracking of the dam.

Formatted: Header

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

7.4.1.3 The foundation shall be treated as required to prevent deformation or instability of the dam caused by foundation movement as a result of heave, swell, rebound, settlement, or collapse.

7.4.1.4 **Seepage Control and Foundation Drainage Design Criteria.**

7.4.1.4.1 The design shall include quantification of the anticipated seepage beneath and around the dam. Seepage through the abutments and foundation shall be minimized through adequate treatment. Foundation and abutment seepage shall be controlled through filtered exits to prevent piping and internal erosion.

7.4.1.4.2 Foundation drainage design shall be provided ~~including justification for reduction in~~ to reduce or control uplift pressures ~~on~~that would affect the stability of the dam. ~~.~~ The efficiency of the drainage system to reduce uplift pressures under the dam shall be based upon the geology of the dam foundation. ~~.~~The ability to maintain the drainage system to meet the requirements assumed for the design of the dam shall be addressed.

~~5.9.3.10 Confirmation of foundation design assumptions is required after the foundation for the dam has been exposed. The project geologist and design engineer shall confirm foundation conditions assumed for the design. Changes in foundation conditions from assumptions made in the Geotechnical Report shall be communicated to the State Engineer when they are identified during construction. Changes to the foundation design for the dam shall be submitted to State Engineer's Office in a formal Change Order Request during construction per the requirements of Rule 9.~~

~~5.9.4~~ **Embankment ~~Dam~~ Design Requirements**

~~5.9.4.1 Stability Analysis Embankment dams shall be designed to have stable slopes during construction, and under all conditions of reservoir operation, including rapid draw-down of the reservoir.~~

~~5.9.4.1.1 Factors of safety shall be evaluated by slope stability analyses methodologies that are acceptable to the State Engineer. The analysis models shall adequately represent, for the critical cross section (or sections) of the dam, the~~ . The dam embankment ~~geometry and internal zoning; shear strengths and unit weights of each material; pore water pressures; and external loading or other relevant factors. Shear strength and pore pressure assumptions used in stability analyses should be obtained from tests that appropriately model the loading condition being~~ shall be analyzed~~.~~ ~~Where appropriate, the analyses shall consider non-circular or wedge-shaped failure surfaces, as well as circular failure surfaces. All parameters and assumptions used in the analysis shall be summarized in a table, and justified in the Geotechnical Report. A scale drawing, utilizing the same scale for vertical and horizontal dimensions, shall be provided for each cross-sectional model used in the analysis, with the critical failure surface(s) identified. Appropriate data sheets and representative computer program output shall be provided in the report.~~

Formatted: Header

Formatted: Font: Arial, 10 pt, Bold

Formatted: Heading 5, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~5.9.4.1.2 Minimum factors of safety for slope stability of embankment dams for various loading conditions other than seismic loading are summarized in Table 5.5.~~

Formatted: Header

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

Formatted: Header

TABLE 5.5

MINIMUM FACTORS OF SAFETY FOR SLOPE STABILITY OF EMBANKMENT DAMS

Loading Condition	Minimum Factor of Safety[1]
Steady seepage with phreatic surface fully developed for reservoir at normal pool elevation	1.5
End of Construction	1.3
Rapid draw-down (upstream slope)	1.2

[1]Not applicable for embankment dams on clay shale foundations; residual shear strength may be appropriate and required factors of safety shall be determined on a case-by-case basis by the State Engineer.

5.9.4.1.3 For Low hazard or NPH dams, the State Engineer may waive the requirements for stability analysis if it can be demonstrated that conservative slopes and competent materials are used in the dam design. Dams classified as Low hazard or NPH shall have upstream slopes no steeper than 3:1 (horizontal:vertical), and downstream slopes no steeper than 2:1 (horizontal:vertical).

5.9.4.2 Seepage and Internal Drainage Design - The evaluation of the steady state seepage and internal drainage conditions shall be performed for all High and Significant Hazard Dams. The seepage and internal drainage analyses shall include, but not be limited to, the following:

5.9.4.2.1 Flow nets or numerical analysis computer programs shall be used in the analyses. Data sheets and output files from these analyses shall be provided or made available where requested. The hydraulic conductivity parameters used in these analyses shall be obtained from field permeability tests, laboratory permeability tests, or empirical/correlative permeability determinations, and the sources of the estimated hydraulic conductivities shall be clearly documented.

5.9.4.2.2 The analyses shall quantify the anticipated seepage beneath, around and through the dam. Seepage exiting on the downstream face of the dam shall not be permitted. Internal drains and filters shall be constructed of granular soil materials (sands and gravels), and the filter and drain zones shall be of sufficient thickness to be constructed without significant contamination or loss of continuity that would adversely impact the performance of these features.

5.9.4.2.3 The filter compatibility of the drain and embankment material shall be evaluated utilizing current state of the practice methodologies, such as those published by the Natural Resources Conservation Service, the U.S. Bureau of Reclamation or the U.S. Army Corps of Engineers.

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~5.9.4.3 For embankment dams, the following design considerations must be addressed and documented in the Design Report.~~

7.4.2 ~~5.9.4.3.1 Geometric and Design Requirements. Dam geometry shall be supported by the slope stability and seismic analysis, and shall~~ and designed to meet the following ~~minimum~~ requirements:

7.4.2.1 ~~5.9.4.3.1.1~~ **~~Crest Design.~~**

7.4.2.1.1 The crest width shall be equal to the jurisdictional height of the dam in feet divided by 5, plus 10 feet. ~~.~~The maximum crest width required shall be 25 feet.

7.4.2.1.2 ~~5.9.4.3.1.2~~ The crest shall have a camber sufficient to maintain the design freeboard, based on the anticipated magnitude of crest settlement. ~~.~~The anticipated magnitude of crest settlement shall be based on engineering analyses. ~~.~~In no case shall the camber be less than 0.5 feet.

~~5.9.4.3.1.3 Guidelines for minimum dimensions of impervious core zones for zoned embankment dams up to 50 feet high are defined in the "Design of Small Dams," United States Department of the Interior, Bureau of Reclamation, Third Edition, 1987, U.S. Government Printing Office, Washington, D.C., 20402, (later amendments, editions or subsequent publications not included). Zone dimensioning for dams over 50 feet shall be evaluated using industry standard analyses.~~

7.4.2.1.3 ~~5.9.4.3.1.4~~ The crest design shall include details to protect impervious cores from desiccation or frost penetration.

7.4.2.1.4 The crest shall be provided with adequate cross slopes to the upstream edge to prevent ponding and facilitate drainage.

7.4.2.1.5 Roads located on the dam crest shall have appropriate surfacing to provide a stable base that resists rutting and provides adequate traction for safety in wet conditions.

~~5.9.4.3.1.5 The crest design shall include details to protect impervious cores from desiccation or frost penetration, as approved by the State Engineer.~~

~~5.9.4.3.1.6 The crest shall be provided with adequate cross slopes to the upstream edge to prevent ponding.~~

Formatted: Header

Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 5, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Heading 5, Indent: Left: 0"

Formatted: Font: Arial

Formatted: Font: Arial

Formatted: Font: Arial

Formatted: Font: Arial, Condensed by 0.4 pt

Formatted: Font: Arial

Formatted: Font: Arial, 10 pt

Formatted: Heading 5, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~5.9.4.3.1.7 Minimum dimensions~~**Freeboard Design.** Freeboard for ~~internal granular filter~~ earth and ~~drain zones shall meet requirements of Rule 5.9.4.2.~~

~~5.9.4.3.1.8 The embankment shall be protected against external erosion.~~

~~5.9.4.3.1.9 The downstream slope of the~~ rockfill embankment dams shall be ~~provided with a well maintained vegetative cover to prevent surface erosion from occurring. No landscaping or planting of trees or large vegetation shall be permitted within 25 feet of the footprint of the dam.~~

~~5.9.4.3.1.10 The shear strengths of the foundation soils (including suitable factors of safety) shall not be exceeded under any foreseeable loading conditions.~~

Formatted: Header

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~5.9.4.3.1.11 Seepage through the embankment, abutments, and foundation shall be controlled to prevent internal erosion and external sloughing.~~

~~5.9.4.3.2 Compaction Requirements - Material compaction requirements shall meet the minimum requirements:~~

~~5.9.4.3.2.1 Minimum compacted density for embankment materials shall be 95 percent of maximum dry density for ASTM D698 (Standard Proctor) or 90 percent for ASTM D1557 (Modified Proctor), as found in the 2006 "Annual Book of ASTM Standards", Section 04.08, Soil and Rock; 100 Barr Harbor Drive, West Conshohocken, PA 19428, (later amendments, editions or subsequent publications not included). Impervious zones with clay fines shall be controlled using Standard Proctor criteria to maintain the plastic nature of the material; and~~

~~5.9.4.3.2.2 The minimum density for cohesionless materials shall be 65 to 75 percent relative density as determined by ASTM D4253 and D4254 as found in the 2006 "Annual Book of ASTM Standards," Section 04.08, Soil and Rock; 100 Barr Harbor Drive, West Conshohocken, PA 19428, (later amendments, editions or subsequent publications not included).~~

7.4.2.2 ~~5.9.4.3.3 Rock Riprap - Rock Riprap shall be well graded, durable and sized to withstand design wave action or channel velocities, and shall be placed on a well-graded pervious sand and gravel bedding or geotextile fabric. Soil cement for erosion protection may be used in lieu of rock riprap, but shall be~~ designed ~~and constructed~~ in accordance with ~~standards acceptable to the State Engineer. Slope protection for wave action is required to be provided on the entire upstream face of the dam, unless lesser coverage is justified based on engineering analysis and reservoir operational criteria and approved by the State Engineer.~~*Freeboard* (Design Standard No. 13, Chapter 6, Reclamation, 2012), except as follows:

7.4.2.2.1 ~~5.9.4.~~The minimum normal freeboard shall be the greater of ~~3.4 Filters~~ feet or the wave setup and ~~Drains - The design of all~~ runup generated by a sustained 100 mile per hour wind.

7.4.2.2.2 The minimum residual freeboard shall be the greater of 1 foot or a 10 percent AEP wind generated setup and runup.

7.4.2.3 **Embankment Zoning**. Shells, cores, filters, and drains~~, filter blankets, and toe~~ for embankment dams shall be designed using industry standards consistent with the current state of the practice.

7.4.2.3.1 All dam embankments shall be protected against internal erosion and piping with suitable filters and drains.

7.4.2.3.2 Shells shall be designed to support the core/impermeable barrier. Transition zones shall be provided as necessary to prevent migration of core material.

Formatted: Header

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt, No underline

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

7.4.2.4 **Seepage and Internal Drainage Design**. Evaluation of steady state seepage and internal drainage conditions shall be performed ~~in accordance with Rule 5.9.4.2~~. The seepage and ~~must~~internal drainage design shall include, but not be ~~acceptable~~limited to, the ~~State Engineer.~~following:

7.4.2.4.1 ~~5.9.4.3.5 Internal Drain Pipes - Pipes to~~ Steady state seepage shall be analyzed using numerical modeling. All modeling input parameters shall be justified and clearly documented.

7.4.2.4.2 All seepage exit points shall be filter protected.

7.4.2.4.3 Drains shall collect and ~~distribute~~convey seepage to designated monitoring points.

7.4.2.4.4 The filter compatibility of the drain, transition zone, and embankment materials shall be evaluated utilizing current state of the practice methodologies. Granular filter materials must be self-healing and free of cementitious properties.

7.4.2.4.5 Drains shall consist of slotted or perforated pipe surrounded with filter-compatible free draining gravel. The gravel shall be filter-compatible with the surrounding filter material.

7.4.2.4.6 Pipes to collect and safely route seepage flows from internal filters and drains shall:

A. ~~5.9.4.3.5.1~~ Be no smaller than 6 inches in diameter;

B. Accommodate internal inspection of the entire drain system;

C. Be designed to flow with a water depth no greater than ¼ of the diameter of the pipe for the estimated seepage flows;

D. Be provided with cleanouts and access points for internal camera inspection, cleaning, and repair;

E. Be comprised of material that is non-corrodible and non-collapsible for the estimated overlying earth pressures and anticipated settlement or ground movement associated with dam construction~~.~~;

~~5.9.4.3.5.2 Be surrounded with free-draining material that is filter compatible with the surrounding earth material in accordance with current filter criteria of such organizations as the Natural Resources Conservation Service, the U.S. Bureau of Reclamation, and the U.S. Army Corps of Engineers.~~

Formatted: Header

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 5, Indent: Left: 0", First line: 0", Keep with next, Tab stops: Not at -1" + 0.25" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: List Number, Indent: Left: 1.5", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt, Condensed by 0.6 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt, Condensed by 0.25 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~5.9.4.3.5.3 Have slots or perforations that are filter compatible with the surrounding free-draining material in accordance with current filter criteria of such organizations as the Natural Resources Conservation Service, the U.S. Bureau of Reclamation, and the U.S. Army Corps of Engineers.~~

~~5.9.4.3.5.4 Be installed in such a manner to be accessible for internal camera inspection and repair.~~

~~5.9.4.3.5.5 Be designed to flow with a water depth no greater than ¼ of the diameter of the pipe for the estimated seepage flows.~~

~~5.9.4.3.5.6 Be no smaller than 6 inches in diameter.~~

F. ~~5.9.4.3.5.7~~ Discharge freely into locations where ~~discharge flows~~flow rates can be ~~evaluated and monitored~~measured, such as galleries, manholes, ~~or daylight (ground surface) areas.~~vaults, or headwalls;

G. ~~5.9.4.3.5.8~~ Project beyond vertical walls to facilitate discharge measurement;

H. Be inspected after a maximum of 3 to 5 feet of fill placed over pipe, and again after remaining fill has been placed~~.~~;

I. ~~5.9.4.3.5.9~~ Be equipped with rodent screens in locations where the discharge ends of the pipes are accessible to animals~~.~~; and

J. ~~5.9.4.3.5.10~~ Be designed with multiple discharge points in order to isolate seepage to various sections of the dam and foundation.

7.4.2.4.7 ~~5.9.4.3.6~~ All penetrations through embankments shall be filter protected against concentrated leakage along the conduit.

7.4.2.5 Embankment Stability.

7.4.2.5.1 **High and Significant Hazard Dams**. Stability analyses shall be performed for all High and Significant Hazard dams to demonstrate that embankments are stable during construction and under all conditions of reservoir operation.

7.4.2.5.1.1 Analyses shall represent the critical cross section(s). Where appropriate, the analyses shall consider non-circular or wedge-shaped failure surfaces, as well as circular failure surfaces.

7.4.2.5.1.2 Loading conditions selected for evaluation shall be based on the full range of conditions anticipated before, during, and after construction. Soil strength parameters, pore pressure characteristics, and target minimum factors of safety for the required loading conditions shall be selected in accordance with the principles provided in *Static Stability Analysis*, (Design Standards No. 13, Chapter 4, Reclamation, 2011) or *Slope Stability*, (EM 1110-2-1902, U.S. Army Corps of Engineers, 2003).

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: List Number, Indent: Left: 1.5", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: List Number, Indent: Left: 1.5", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt, Condensed by 0.45 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: List Number, Indent: Left: 1.5", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt, Condensed by 0.5 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt, Condensed by 0.3 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: List Number, Indent: Left: 1.5", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt, Condensed by 0.35 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

7.4.2.5.2 **Low Hazard and NPH Dams.** Low Hazard or NPH dams shall be designed with upstream slopes no steeper than 3H:1V and downstream slopes no steeper than 2H:1V unless it can be demonstrated that steeper slopes will be stable.

7.4.2.6 **Settlement and Consolidation**. All dams shall be analyzed and designed to prevent deformation or instability caused by movement as a result of settlement, consolidation, or collapse.

7.4.2.7 **Cracking**. All dams shall be analyzed and designed to prevent the formation of cracks due to differential settlement or creation of low stress zones that could lead to hydraulic fracturing.

7.4.2.8 **Upstream Slope Erosion Protection.** Embankments shall be protected against external erosion. Slope protection for wave action is required to be provided on the entire upstream slope of the dam, unless lesser coverage is justified based on engineering analysis and reservoir operational criteria.

7.4.2.8.1 **Rock Riprap**. Rock riprap shall be well-graded, durable, sized to withstand design wave action, and shall be placed on a well-graded pervious sand and/or gravel bedding or acceptable geotextile fabric that is filter compatible with the underlying embankment zone.

7.4.2.8.2 **Soil Cement**. Soil cement slope protection design and construction specifications shall be based on the principles provided in *Soil Cement Slope Protection* (Design Standards No. 13, Chapter 17, Reclamation, 2013).

7.4.2.9 **Downstream slope erosion protection**. The downstream slope of earth embankment dams shall be provided with a well maintained vegetative cover to prevent surface erosion.

7.4.2.10 **Geosynthetics**~~–~~. The use of geosynthetics shall be evaluated by the State Engineer on a case-by-case basis ~~for each dam.~~ Geosynthetics will not be accepted where failure of the geosynthetic could jeopardize the safety of the dam. Geosynthetic materials shall be used in accordance with the manufacturers' recommendations and intended use for each product. ~~Use of geosynthetics shall comply with the following general design considerations:~~

~~5.9.4.3.6.1 Geosynthetics will not be accepted where the geosynthetic is the sole element employed to perform a function that is an element of the dam were failure of the geosynthetic, could result in a catastrophic release of the reservoir. Redundant design features are required whenever geosynthetics are used for these functions.~~

~~5.9.4.3.6.2 The use of a geotextile as a filter layer may be allowed if the geotextile is placed such that it does not jeopardize the stability or safety of the dam or appurtenant structures due to failure of the geotextile (such as clogging), and the geotextile can be repaired or replaced without jeopardizing the stability or safety of the dam.~~

Formatted: Header

Formatted: Font: Arial, 10 pt, Bold, No underline

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

7.4.3 ~~5.9.5~~ **Material Placement and Compaction Requirements.** Material placement and compaction shall meet the minimum requirements:

7.4.3.1 Minimum compacted density for embankment materials shall be 95 percent of maximum dry density for ASTM D698 (Standard Proctor).

7.4.3.2 Impervious zones with clay fines shall be placed at close to optimum moisture content to prevent overcompacted, brittle zones.

7.4.3.3 The density for cohesionless filter and drain materials shall range between 65- and 75-percent relative density as determined by ASTM D4253 and D4254, or other method(s) approved by the State Engineer.

7.4.3.4 Construction of filters and drains shall be based on placement procedures developed through a test fill program to verify acceptable density and avoid excessive particle breakdown.

7.4.3.5 Filter and drain zones shall be constructed with sufficient thickness to prevent contamination or loss of continuity that would adversely impact the performance of these features.

7.5 Concrete Dam Design Requirements.

7.5.1 ~~5.9.5.1~~ For all concrete dams, the following design considerations ~~must~~shall be addressed and documented in the Design Report:

~~5.9.5.1.1 Access to the dam crest shall be provided from at least one of the abutments of the dam. Access shall be provided to the side of the dam where the control of the outlet works used for the emergency release of the reservoir volume is situated.~~

7.5.1.1 ~~5.9.5.1.2~~ The crest of the dam shall have a width of not less than ~~15~~ 5 feet.

7.5.1.2 ~~5.9.5.1.3 Concrete~~If the crest of the dam ~~crests, if~~is designed to function as the emergency spillway, it shall not be overtopped ~~for~~by floods more frequent than the ~~100-year storm.~~ one percent AEP flood.

7.5.1.3 Emergency spillway discharge for flows up to the inflow design flood shall not cause excessive downstream erosion of the abutments and foundation.

Formatted: Header

Formatted: Font: Bold

Formatted: Heading 2, Indent: First line: 0", Keep with next

Formatted: Heading 3, Indent: Left: 0", First line: 0", Keep with next, Tab stops: Not at -1" + 0.25" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial

Formatted: Font: Arial

Formatted: Font: Arial

Formatted: Font: Arial

Formatted: Font: Arial

Formatted: Font: Arial

Formatted: Font: Arial

Formatted: Heading 4, Indent: Left: 0"

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

7.5.1.4 ~~5.9.5.1.4 If the design~~The design shall include provisions for installation, maintenance, and monitoring of ~~the concrete dam includes~~ drainage features ~~and the reduction in uplift pressures is required to meet factors of safety and stress requirements, a gallery.~~

7.5.1.5 A concrete mix design containing proposed aggregate properties, source of aggregate, concrete properties, and proposed cementitious contents shall be provided ~~in the dam to access, monitor.~~

7.5.1.6 Specifications shall include provisions for placing concrete under cold weather, hot weather, and ~~clean or re-drill the dam and foundation drains.~~ rain.

~~5.9.5.2 Arch Dam Design - Concrete arch dams are not specifically addressed in these Rules and shall be designed in accordance with principles provided in U.S. Bureau of Reclamation publication "Design of Arch Dams," 1977 or U.S. Army Corps of Engineers publication "Arch Dam Design" EM 1110-2-2201 1994, (later amendments, editions, or subsequent publications not included).~~

~~5.9.5.3 Gravity Dam Design - Concrete gravity dams (conventional or roller compacted concrete (RCC)) shall be designed in accordance with the following Rules and with principles provided in U.S. Bureau of Reclamation publication "Design of Gravity Dams," 1976, or U.S. Army Corps of Engineers publications "Gravity Dam Design" EM 1110-2-2200 1995 and "Roller-Compacted Concrete" EM 1110-2-2006 2000 (later amendments, editions or subsequent publication not included).~~

~~5.9.5.3.1 The structural stability and stress analyses of a concrete gravity dam for both non-overflow and spillway sections shall be performed using the gravity method of stress and stability analysis, as described in the aforementioned publications. The trial-load twist method of analysis may be used for the stability analysis when keyed or grouted transverse contraction joints are provided. The finite element method may be used to supplement the gravity method and to investigate specific features where areas of maximum stresses may occur within the dam and foundation.~~

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~5.9.5.3.2 Loads to be considered as a minimum in the stability and stress analyses are as follows: dead weight of the dam and appurtenant structures, headwater and tailwater pressures, uplift pressures in the dam and foundation, earth and silt pressures, ice pressure, seismic forces, and temperature, if appropriate. Ice pressure shall be equivalent to a force of 10,000 pounds per linear foot applied at one foot below the normal water surface elevation.~~

7.5.2 ~~5.9.5.3.3 Concrete gravity dams shall be designed for full hydrostatic uplift pressures along appropriate planes within the dam and foundation. The uplift pressure shall vary linearly from full hydrostatic pressure at the upstream face of the dam to the tailwater pressure at the downstream dam face or zero if no tailwater conditions exist. Reduction in the uplift pressures will be allowed when dam and foundation drains are provided. The~~ **Arch Dams**. Concrete arch dams shall be designed in accordance with principles provided in *Arch Dam Design* (EM 1110-2-2201, U.S. Army Corps of Engineers,1994), *Design Criteria for Concrete Arch and Gravity Dams* (Engineering Monograph No. 19, U.S. Bureau of Reclamation, 1977), *Design of Arch Dams* (U.S. Bureau of Reclamation, 1977), or *Arch Dams* (Chapter 11, Federal Energy Regulatory Commission, 2018).

7.5.3 **Gravity Dams**. Concrete gravity dams shall be designed in accordance with the following Rules and *Gravity Dam Design* (EM 1110-2-2200, U.S. Army Corps of Engineers, 1995), *Design Criteria for Concrete Arch and Gravity Dams* (Engineering Monograph No. 19, U.S. Bureau of Reclamation, 1977), *Design of Gravity Dams* (U.S. Bureau of Reclamation, 1976), or *Gravity Dams* (Chapter 3, Federal Energy Regulatory Commission, 2016) with the following additions:

7.5.3.1 When the design relies on the reduction of uplift pressures from dam and foundation drains, the effectiveness of the drains ~~will be required to~~shall be verified and monitored ~~through~~for the life of the dam via the installation of piezometers.

~~5.9.5.3.4 The following loading conditions shall be investigated in the design of a concrete gravity dam, as a minimum. Other loading condition could be required depending on site conditions:~~

~~5.9.5.3.4.1 Usual Loading Condition – Reservoir at the normal water surface with minimum tailwater pressure, uplift pressures, and earth, silt and ice pressures, if applicable.~~

~~5.9.5.3.4.2 Unusual Loading Condition – Usual loading condition with no ice pressure and with hydrostatic pressures as a result of the flooding condition produced by the appropriate inflow design flood.~~

~~5.9.5.3.4.3 Extreme Loading Condition – Usual loading condition with no ice pressure and with seismic forces in the downstream direction.~~

~~5.9.5.3.5 The minimum factors of safety and allowable stresses as a result of the loading condition shall be as provided in Table 5.6:~~

Formatted: Header

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

TABLE 5.6

MINIMUM FACTORS OF SAFETY AND ALLOWABLE STRESSES FOR CONCRETE GRAVITY DAMS

Loading Condition	Resultant Location within Base	Min. Sliding Factor of Safety	Concrete Compressive Stress	Concrete Tensile Stress
Usual	Middle 1/3	3.0	$0.3\ f'_c$	0
Unusual	Middle 1/2	2.0	$0.5\ f'_c$	$0.5\ f_t$
Extreme	Within Base	1.0	$0.9\ f'_c$	$1.0\ f_t$

Formatted: Header

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~5.9.5.4 Roller Compacted Concrete Design Requirements. Design of new RCC dams shall meet all requirements for concrete dams regarding field investigations, testing, foundation treatment, stability and stresses. RCC dam design shall also meet the following additional requirements:~~

~~5.9.5.4.1 An RCC mix design study shall be submitted with the design report, containing proposed aggregate data, source of aggregate, strength test results, and proposed cementitious contents.~~

7.5.3.2 ~~5.9.5.4.2~~ If the seismic loading scenario shows a crack may form along the base of the dam or the foundation may sustain damage, a post-earthquake analysis will be required to show that the dam and foundation can withstand the usual and unusual loading conditions in their "damaged" state.

7.5.3.3 Dams in excess of fifty feet in height shall include a drainage gallery.

7.5.4 **Roller Compacted Concrete (RCC) Dams**. Roller compacted dams shall be designed in accordance with the following Rules and *Roller-Compacted Concrete* (EM 1110-2-2006, U.S. Army Corps of Engineers, 2000) or Roller-Compacted Concrete (U.S. Bureau of Reclamation, 2017) with the following additions:

7.5.4.1 The dam design shall include adequate control of cracking in the upstream facing system and ~~RCC~~concrete mass caused by thermal shrinkage of the concrete. Crack control provisions shall ~~also~~ include ~~control of~~controlling excessive heat of hydration by use of fly ash and ~~limit~~limiting in-place concrete temperature ~~of RCC~~.

7.5.4.2 ~~5.9.5.4.3~~ Adequate cold joint treatment shall be provided in the specifications to prevent formation of unbonded lift joints that could become potential paths for seepage.

7.5.4.3 Design dimensions shall be ~~constructable~~able to be constructed with conventional earthwork equipment, particularly between the upstream face of the dam and the drainage gallery, and within the "~~"~~chimney section~~" width~~.

~~5.9.5.4.4 Adequate cold joint treatment shall be provided in the specifications to prevent formation of unbonded lift joints that are potential paths of seepage.~~

~~5.9.5.4.5 RCC dams with a structural height of 100 feet or higher shall be designed with a drainage gallery, when dam and foundation drains are provided.~~

~~5.9.5.4.6 Specifications shall include provisions for placing RCC under cold weather, hot weather, and rain.~~

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

7.5.4.4 ~~5.9.5.4.7 RCC spillway chute steps~~RCC shall be protected with conventional facing concrete, or equivalent protection~~, unless the State Engineer approves a lesser standard for good cause shown. Design of stilling basins for RCC stepped chute spillways shall include assumptions, calculations, and applicable references for estimating energy dissipation and stilling basin entrance velocities~~.

~~5.9.5.4.8 Outlet works gate and spillway towers shall be designed as temporary free-standing tower, if structures are proposed to be completed before any RCC placement.~~

7.5.4.5 ~~5.9.5.5 Roller Compacted Concrete Dam Construction Requirements~~ **Material Placement.** The construction of RCC dams shall meet the following ~~additional~~ requirements~~.~~:

7.5.4.5.1 ~~5.9.5.5.1~~ An RCC test section shall be constructed outside the dam footprint at least twenty one (21) days before production placement of the RCC. The final mix design ~~mix~~ and ~~the~~ method of construction shall be approved by the ~~SEO~~ State Engineer prior to production placement.

7.5.4.5.2 ~~5.9.5.5.2~~ The ~~Owner~~Engineer shall provide full-time observation by qualified field ~~observation~~staff during RCC test section and production placement.

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 5, Indent: Left: 0", First line: 0", Tab stops: 2", List tab + Not at -1" + 0.25" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 5, Indent: Left: 0", First line: 0", Tab stops: 2", List tab + Not at -1" + 0.25" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

7.5.4.5.3 ~~5.9.5.5.3~~ Locations of all cold joints shall be documented.

7.5.4.5.4 ~~5.9.5.5.4~~ Representative RCC cores shall be taken from the completed dam to verify design strengths. RCC cores shall be 6-inch diameter.

7.5.4.5.5 ~~5.9.5.5.5 Because a RCC dam can be completed within a short period of time, the dam~~The dam shall be allowed to ~~gain adequate~~ reach design strength before initial filling of the reservoir.

7.6 **Seismic Design Requirements.** Seismic stability shall be evaluated for all concrete dams and High and Significant Hazard embankment dams. The level of analysis required shall be commensurate with the known and anticipated site conditions and the level of effort given to developing input parameters. In general, analyses should start at a screening level and progress to more detailed analyses only when necessary. Seismic stability analyses shall be based on the principles provided in *Earthquake Analyses and Design of Dams* (FEMA-65, Federal Guidelines for Dam Safety, FEMA, 2005), *Best Practices Chapter II-3* (Reclamation and U.S. Army Corps of Engineers, 2015), *Seismic Analysis and Design* (Design Standards No. 13 Chapter 13, Reclamation, 2015), *Earthquake Design and Evaluation for Civil Works Projects* (Engineering Regulation 1110-2-1806, U.S. Army Corps of Engineers, 2016), or *Earthquake Design and Evaluation of Concrete Hydraulic Structures* (Engineering Manual 1110-2-6053, U.S. Army Corps of Engineers, 2007).

7.6.1 **Seismic Hazard Analysis**. The seismic hazards, consisting of the design earthquakes and associated ground motions, shall be determined. The seismic hazards shall be justified with due consideration to the hazard classification of the structure, regional and site-specific seismic hazard considerations, and the designated operational function of the dam.

7.6.2 **Dynamic Response Analysis**. Analyses to predict the structural response to seismic loading are required except as described in Rule 7.6.2.1. All seismic analyses shall be evaluated assuming loading and pore pressure conditions expected immediately prior to the earthquake. Acceptable methods for predicting structural response to seismic loading include, but are not limited to, post-earthquake stability, embankment deformation, and probabilistic analyses. Pseudostatic analyses are not an acceptable means of predicting structural response to seismic loading.

7.6.2.1 Dynamic Response Analyses are not required for embankment dams meeting all of the following conditions. The potential for embankment cracking (transverse or longitudinal), damage to appurtenant features (e.g., outlet-works tunnels), and overtopping due to seiche waves as the result of seismic activity are not addressed by these exceptions and shall be considered separately.

A. The dam and foundation materials are not subject to liquefaction and do not include sensitive clays;
B. The dam is reliably compacted to at least 95 percent of the laboratory maximum dry density, or to a relative density greater than 65 percent;
C. The slopes of the dam are 2.5H:1V or flatter, and/or the phreatic line is well below the downstream face of the embankment;
D. The peak ground acceleration (PGA) at the base of the embankment is less than or equal to 0.35g at 0.01% AEP;

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Heading 5, Indent: Left: 0", First line: 0", Tab stops: 2", List tab + Not at -1" + 0.25" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Heading 5, Indent: Left: 0", First line: 0", Tab stops: 2", List tab + Not at -1" + 0.25" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

E. The static stability factor of safety for all potential failure surfaces involving loss of crest elevation (i.e., slides other than shallow surficial slides) are greater than 1.5 under loading and pore-pressure conditions expected immediately prior to the earthquake;

F. The minimum freeboard is at least 3 to 5 percent of the embankment height and never less than 3 feet; and

G. There are no appurtenant features that would be harmed by small movements of the embankment, or that could create potential for internal erosion or other potential failure modes.

7.7 Instrumentation and Monitoring Requirements.

7.7.1 The Owner shall submit a plan for installation of all new instrumentation and flow measurement devices for review and approval.

7.7.2 **Instrumentation Plan**. An instrumentation plan is required and shall meet the following requirements:

7.7.2.1 All instrumentation shall be properly identified in the field to correspond to the identification of the instrumentation in the long-term monitoring plan required in Rule 13.4.

7.7.2.2 Gage rods shall be installed at all dams to accurately measure reservoir levels. The zero mark of the gage shall be aligned vertically with the invert elevation of the entrance to the outlet. The gage rod shall be located in an easily accessible location and clearly marked in feet and tenths of feet, and extend to within one foot of the crest of the dam. If the Division Engineer so requires, the gage shall be marked in hundredths of a foot.

7.7.2.3 ~~5.9.5.6 Concrete Slope~~**High and** ~~Overtopping Protection. The design of RCC~~**Significant Hazard Dams**. High and ~~soil-cement dam rehabilitation~~Significant Hazard dams shall ~~meet~~have the following ~~additional requirements.~~minimum instrumentation:

Monuments that allow measurement of the horizontal and vertical movements of the dam, installed in accordance with industry standards and in a manner acceptable to the State Engineer.

~~5.9.5.6.1 Soil-cement mix design shall meet guidelines of Portland Cement Association or the U.S. Bureau of Reclamation.~~

~~5.9.5.6.2 Soil-cement slope protection shall be designed for a minimum 56-day strength of 750 psi for durability considerations.~~

~~5.9.5.6.3 Soil-cement shall not be used for emergency spillway or embankment overtopping protection, unless it can be demonstrated that the soil-cement can withstand the anticipated flow rates and velocities.~~

~~5.9.5.6.4 RCC emergency spillway or RCC embankment overtopping protection shall not operate for floods more frequent than the 100-year storm.~~

~~5.9.5.6.5 Normal thickness of soil-cement or RCC shall be a minimum of 2 feet.~~

Formatted: Header

Formatted: Heading 4, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt, Bold, No underline

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

7.7.2.3.1 ~~5.9.6~~ Monuments shall be located with such spacing as deemed appropriate by the Engineer and approved by the State Engineer. Control or benchmark monuments shall be placed off the dam on natural ground in areas not subject to movement.

7.7.2.3.2 Weirs, flumes, or other measuring devices to provide for monitoring of seepage through the embankment or foundation, installed in a manner acceptable to the State Engineer. Positive drainage away from all seepage monitoring devices shall be provided to prevent the device from becoming submerged.

7.7.2.3.3 Station markers at least every 100 feet along the crest of the dam.

7.7.2.3.4 Piezometers to allow monitoring of the phreatic surface within the dam or uplift pressures within the foundation, installed in accordance with industry standards and in a manner acceptable to the State Engineer. A Subsurface Investigation Plan shall be submitted for approval by the State Engineer pursuant to Rule 7.3.3 prior to new piezometer construction.

7.7.2.3.5 Where drainage galleries are provided for concrete dams, seepage measuring devices shall be provided at the appropriate locations and be accessible for making the necessary readings.

7.7.2.4 **Low Hazard Dams**. Low Hazard dams shall have weirs, flumes or other measuring devices to provide for monitoring and measurement of seepage through the embankment or foundation, installed in a manner acceptable to the State Engineer.

7.8 Spillway and Outlet Works Design Requirements.

7.8.1 ~~5.9.6.1~~ **Spillway Design**~~.~~. All spillways shall be designed and constructed in a manner acceptable to the State Engineer and to meet the following criteria~~.~~:

7.8.1.1 ~~5.9.6.1.1 The spillway flows must be~~The starting water surface elevation when routing the IDF shall be the emergency spillway crest unless a lower starting water surface can be justified.

7.8.1.2 The spillway shall safely ~~routed~~route the IDF back to the natural channel or drainage way that would exist if the dam were not built. ~~Where the spillway channel discharges into an adjacent basin, apart from the drainage on which the dam is located, the owner~~The Owner shall possess title to the property, a right-of-way, or easement ~~for~~from the ~~flood~~high water line in the reservoir to the natural channel, including the stilling basin downstream ~~to the location where the maximum discharge would no longer cause damage beyond what naturally would occur on the adjacent drainage~~.

Formatted: Header

Formatted: Heading 2, Indent: Left: 0", Keep with next, Keep lines together

Formatted: Font: Arial, 10 pt, Bold, No underline

Formatted: Heading 3, Outline numbered + Level: 3 + Numbering Style: 1, 2, 3, … + Start at: 1 + Alignment: Left + Aligned at: 0.5" + Tab after: 1.25" + Indent at: 0.5", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 4, Outline numbered + Level: 4 + Numbering Style: 1, 2, 3, … + Start at: 1 + Alignment: Left + Aligned at: 0.75" + Tab after: 1.75" + Indent at: 0.75", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

7.8.1.3 ~~5.9.6.1.2~~ Log booms or other methods approved by the State Engineer shall be installed in the spillway approach where logs and other debris may block spillway flow or damage the spillway structure.

7.8.1.4 ~~5.9.6.1.3~~ Pipe emergency spillways are not acceptable.

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

7.8.1.5 ~~5.9.6.1.4~~ The ~~Design Report~~design report shall include discharge tables (in cubic feet per second) for all spillways showing the discharge for each foot of head between the crest of the spillways and dam. The equation(s) used for determining the discharge shall also be included. Crest elevations of all spillways and the dam shall be clearly noted on the ~~table~~tables.

~~5.9.6.1.5 For floodwater detention and flood control dams, the required principal spillway and outlet conduit discharge rate shall be coordinated with the Division Engineer for the Water Division in which the dam is located.~~

7.8.1.6 ~~5.9.6.2~~ **Overtopping Protection Design**. Overtopping protection for existing embankment dams may be used to safely route the IDF only where no other alternatives are feasible. The design of overtopping protection shall be based on the principles provided in *Overtopping Protection for Dams* (P-1015, FEMA, 2014).

7.8.1.6.1 Soil-cement shall not be used for embankment overtopping protection.

7.8.2 **Outlet Works Design**~~.~~. All outlet systems shall be designed and installed in a manner acceptable to the State Engineer and shall meet the following criteria:

7.8.2.1 ~~5.9.6.2.1 The outlets for High Hazard dams~~Outlets shall be capable of releasing the top five feet of the reservoir capacity in five ~~days,~~(5) days. Final outlet size should reflect consideration of seasonal reservoir inflows and ~~for all other classes of dams as required by the State Engineer.~~consequences of releases or dam failure. The outlet shall be capable of releasing the entire reservoir in a reasonable period of time. In addition, outlets shall be capable of passing inflow to the reservoir with a minimum of ten feet of head, in order to meet the demands of downstream senior water rights and the ~~owner's~~Owner's release requirements. The minimum size required for outlet conduits and controls is 12 inches. ~~For all other Hazard dams, the outlets should be sized to draw down the reservoir under emergency conditions in a reasonable period of time, as determined by the State Engineer.~~

7.8.2.2 ~~5.9.6.2.2 All principal~~All outlets connected to a pipeline shall have a ~~by-pass~~bypass valve near the dam that will meet the capacity criteria as defined in Rule ~~5.9.6.2.1.~~ 7.8.2.1.

7.8.2.3 ~~5.9.6.2.3~~ Outlet conduits for all dams, except for dams with ~~un-gated~~ungated outlets, shall have a guard gate installed at the upstream end of the conduit.

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt, Bold, No underline

Formatted: Font: Arial, 10 pt, Not Bold

Formatted: Font: Arial, 10 pt

Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Heading 4, Outline numbered + Level: 4 + Numbering Style: 1, 2, 3, … + Start at: 1 + Alignment: Left + Aligned at: 0.75" + Tab after: 1.75" + Indent at: 0.75", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 4, Indent: Left: 0"

Formatted: Font: Arial

Formatted: Font: Arial

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

7.8.2.4 ~~5.9.6.2.4~~ Intake structures for outlet works shall have trash racks ~~unless exempted by the State Engineer for good cause shown~~.

7.8.2.5 ~~5.9.6.2.5~~ The Design Report shall include an outlet discharge table (in cubic feet per second) showing the discharge for each foot of head between the invert of the intake structure and the crest of the dam. The equation(s) used for determining the discharge shall also be included. Elevations of all outlets and spillways shall be clearly noted on the table.

~~5.10 Reservoir and Water Diversion Requirements~~

7.9 ~~5.10.1~~ Reservoir and Site Requirements

7.9.1 ~~5.10.1.1~~ The area to be submerged by the new or enlarged reservoir shall be cleared of ~~logs~~trees and debris.

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Heading 2, Indent: Left: 0"

Formatted: Font: Not Bold

Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~5.10.1.2 Borrow areas shall be located at least 200 feet from either toe of the dam. The dimension of this limit may be reduced using engineering analyses indicating that the reduced dimension will not negatively impact dam stability and/or foundation seepage.~~

7.9.2 ~~5.10.1.3~~ The dam crest and appurtenant structures shall be accessible by equipment and vehicles for emergency operations and maintenance.

7.9.3 ~~5.10.1.4~~ The ~~dam owner~~Owner shall ~~possess title to the property,~~demonstrate ownership or ~~a permanent~~recorded easement~~, including~~ for the following:

7.9.3.1 Footprint of the dam, appurtenant structures, and permanent access~~,~~ for a minimum distance of ~~fifty~~50 feet or the height of the dam, whichever is greater, extending downstream from the ~~downstream~~ toe of the dam ~~for the purpose of maintenance and~~.

7.9.3.2 Spillway discharge channels meeting the ~~removal~~requirements of ~~trees~~Rule 7.8.1.2.

7.9.3.3 All areas inundated by the reservoir and ~~large vegetation along the downstream toe of the dam~~IDF surcharge.

7.9.4 ~~5.10.1.5~~ Pipelines, utility lines, or any other construction that ~~penetrate~~penetrates through the dam, abutment areas below the dam crest elevation, or that are within a distance of 50 feet or the height of the dam, whichever is greater, from either toe of the dam shall not be allowed without prior written approval by the State Engineer. ~~To be considered for approval, such penetrations must be designed to protect against seepage and piping through trench backfill materials and avoid temporary or permanent impacts to dam stability, and must be documented with as-constructed survey data and installation details submitted to the State Engineer.~~

~~5.10.1.6 The design of a new reservoir or enlargement of an existing dam and reservoir shall not result in the inundation of properties (except marina-type structures) during the Inflow Design Flood (IDF) unless the dam owner owns or obtains flood right-of-ways for all areas which may be inundated by the reservoir surcharge. The owner shall submit a written statement certifying they own the properties, or own the right-of-way on all affected properties, or possess a right-of-way easement for the reservoir inundation zone.~~

~~5.10.1.7 Flood easements for spillway discharges shall meet the requirements of Rule 5.9.6.1.1.~~

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

Rule 8. ~~5.10.2 River Diversion During~~ Construction Requirements

8.1 ~~5.10.2.1 A water diversion~~Pre-Construction.

8.1.1 Water Diversion Plan.

A plan to control surface water during construction ~~meeting the requirements of Rule 9 may~~shall be developed by the construction contractor based on information and requirements provided by ~~the~~an Engineer~~, or the Engineer may prepare these plans.~~

~~5.10.2.2 In developing the requirements of the~~. The plan ~~during~~shall state the ~~project design,~~return interval or annual exceedance probability for the ~~design~~ storm ~~for the construction period, including the estimated volume or flow rate that must be managed during construction should be clearly specified in the Design Report.~~

~~5.10.2.3 The contractor may be allowed flexibility~~event the system is designed to ~~develop the methods and means to divert the water in coordination with other aspects of the construction.~~

Formatted: Header

Formatted: Heading 1, Indent: Left: 0"

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

8.1.1.1 ~~5.10.2.4 Regardless of who prepares the detailed water diversion~~ protect against. The plan~~, the plan must be prepared~~ shall be prepared under the direction of an Engineer meeting the requirements of Rule 4.10.

8.1.1.2 The plan shall be approved by the Engineer, and submitted to the State Engineer ~~for review~~ in advance of construction of the diversion facilities ~~in accordance with Rule 9. The plan must be prepared under the direction of a qualified Professional Engineer registered in the State of Colorado~~.

8.1.1.3 ~~5.10.2.5~~ A hazard classification evaluation shall be performed by an Engineer based on consequences to the public for any proposed cofferdam. If the water diversion system is found to be High or Significant Hazard, the design shall meet the requirements of Rule 7.

The water diversion plan ~~meeting the intent of Rule 9 should include the following items.~~

~~5.10.2.5.1 Design drawings and specifications depicting the constriction of cofferdams, spillways, conduits, gates, or other temporary features that may be required to control the water.~~

~~5.10.2.5.2 Stability analysis of the cofferdam, under both normal and design flood loading condition.~~

~~5.10.2.5.3 Hydraulic calculations showing the capacity of spillways or conduits used for diversion.~~

8.1.1.4 ~~5.10.2.5.4 The plan for~~shall address the removal or abandonment of cofferdams, spillways, conduits, or other temporary features after construction is complete.

~~Rule 6. Requirements for Alteration, Modification, or Repair of an Existing Dam:~~

~~6.1 An owner proposing to alter, modify, or repair an existing dam shall submit an application package in a form acceptable to the State Engineer and receive approval of the construction plans and specifications from the State Engineer prior to construction. The provisions of Rule 6 shall apply to such application only to the extent directly related to work for which approval is being sought.~~

~~6.1.1 **Design Requirements** - The requirements of Rule 5 shall apply except as modified by Rules 6.1.2 and 6.1.3. A Hydrology Report, Geotechnical Report, Design Report, and Instrumentation Plan are required as a minimum to support the scope of the work described on the application.~~

~~6.1.2 **Application and Approval Requirements for High Hazard, Significant Hazard, and Large, Low Hazard Dams** - Plans for repair of an existing dam, or alteration of existing~~

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Heading 4, Indent: Left: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~High Hazard, Significant Hazard, and Large, Low Hazard dams to non-jurisdictional size may be approved by the State Engineer by letter without meeting requirements set forth in Rules 5.2 and 5.3, subject to the following conditions:~~

~~6.1.2.1 A completed application form provided by the State Engineer shall accompany appropriate specifications and necessary drawings depicting minimum details for the repair or alteration. Plans and specifications must be prepared by an engineer. The provisions of Rules 5.6, 5.7, and 11 shall apply.~~

Formatted: Header

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

Formatted: Header

6.1.2.2 The plans and specifications shall contain sufficient detail to enable a contractor to prepare a bid and construct the repair, or alter the dam to non-jurisdictional size. The provisions of Rule 9 shall apply. The engineer shall give the State Engineer not less than 7 days notice of the start of construction.

6.1.2.3 Upon completion of repair or alteration, the engineer shall file as-constructed plans in conformance with Rule 5 and Rule 10.

6.1.2.4 The requirement for submitting as-constructed plans for altering an existing jurisdictional size dam to non-jurisdictional size dam will be determined by the State Engineer.

6.1.3 **Application and Approval Requirements for Small and Minor, Low Hazard and NPH Dams** - Plans for repair of Small and Minor, Low Hazard dams, or NPH dams; and plans for the alteration of all Low Hazard or NPH dams to non-jurisdictional size are exempt from the provisions of Rules 5, 6, 9, and 10, except as specified in Rule 6.1.3.1 through Rule 6.1.3.3.

6.1.3.1 Notice - The dam owner must provide at least thirty days advanced written notice to the State Engineer. The written notice must contain the name of the dam, the location of the dam, the name of the owner, and a clear description of the work to be performed.

6.1.3.2 Determination - If the State Engineer determines that plans and specifications prepared by an engineer are necessary for the repair, the owner will be notified within five working days from the date the owner's notice was received. A cost estimate and filing fee will also be required. The owner cannot begin construction until the plans and specifications are approved by the State Engineer. If plans and specifications are not required, the State Engineer will inform the dam owner of engineering and construction requirements, if any, and will perform construction inspections as determined necessary.

6.1.3.3 Project Completion - The dam owner must keep the State Engineer informed of the project status and provide the State Engineer with as-constructed drawings and specifications within sixty days following completion of the work. The as-constructed drawings must be drawn on good quality mylar with permanent ink (or equivalent), and the drawings shall be reproducible, and suitable for a long lasting permanent record.

6.1.4 **Inflow Design Flood Requirements** - The inflow design flood (IDF) requirements for all existing dams shall be determined in accordance with Rule 5. Structures with spillways designed and approved prior to 1988 and in accordance with the methods published in the U.S. Department of the Interior, Bureau of Reclamation, "Design of Small Dams," Second Edition 1973, (later amendments, editions or subsequent publications not included) shall be considered adequate for the original hazard classification. If the classification has changed, then the provisions of these Rules and specifically Rule 5 apply.

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

6.1.4.1 The methods of Rule 5 apply, but may be reduced for good cause shown. Spillways designed in accordance with these Rules will not be required to be enlarged due to subsequent revisions in ESP or PMP estimates, unless, in the opinion of the State Engineer, a substantial increased threat to public safety exists.

6.1.4.2 The minimum size spillway for all existing High Hazard dams and Large and Small Significant Hazard dams, for which an incremental damage analysis shows a smaller spillway is justifiable under Rule 5.9.1.7, is the spillway size required to safely accommodate the flood generated by a 24-hour, 100-year rainstorm event.

6.1.5 **Freeboard** - The minimum freeboard requirements for an existing dam shall be the maximum required to either prevent overtopping by wave action or to pass the IDF without overtopping, but not less than three feet.

6.2 **Approval Limitation** - If construction, alteration, or repair of a reservoir dam is not commenced within five years of approval of the application, the State Engineer's approval shall be void. The owner must resubmit the application and receive approval before commencing construction, and shall meet the requirements of the current Rules and Regulations.

6.3 **Design Review Limitation** - The design review performed by the State Engineer shall be limited to three years from the date of the review. Re-submittal of the design package shall be required if resolution of the design review comments does not occur within three years.

Rule 7. Requirements for Removing or Breaching an Existing Dam:

7.1 **Breach Plan and Application** - An owner proposing to permanently remove or breach a dam shall submit an application package in a form acceptable to the State Engineer prior to commencing work. Plans for Removal or Breach of a dam shall meet the following requirements:

7.1.1 **Application** - A completed application shall be submitted on a form provided by the State Engineer.

7.1.2 **High and Significant Hazard Dams** - For High and Significant Hazard dams, a breach plan shall be prepared by an engineer.

7.1.2.1 The dam shall be excavated down to the level of the natural ground, or as necessary in accordance with Rule 7.1.2.3, at the maximum section; and shall be of sufficient width to pass the 24-hour, 100-year flood with a maximum increase in reservoir depth of five feet. However, the maximum breach width shall not exceed the width of the original natural channel before the dam was constructed, regardless of the 100-year flood magnitude unless approved by the State Engineer for improved public safety.

Formatted: Header

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

7.1.2.2 The sides of the breach shall be excavated to a slope that is stable, but not steeper than 2:1 (two horizontal to one vertical). Slope stability analysis that provides an adequate factor of safety for steeper slopes may be accepted by the State Engineer, but in no case shall the slopes be steeper than 1:1.

1.1.1.1 7.1.2.3 The breach shall be designed to prevent silt previously deposited in the reservoir and material excavated for the breach from washing downstream.

1.1.1.1 7.1.2.4 Water impounded in the reservoir area shall be released in a controlled manner that will not endanger lives or damage downstream properties.

7.1.2.5 The drawing(s) of the plan for the breach of a dam shall include the location, dimensions and lowest elevation of the breach.

7.1.2.6 The removal or breaching of the dam shall be performed under the purview of an engineer.

7.1.2.7 The engineer shall submit written notice of the completion of the removal or breaching of the dam along with as-constructed plans in conformance with Rule 10.

7.1.3 **Low Hazard and NPH Dams** For Low Hazard and NPH dams the owner shall submit a written notice of intent to breach the dam to the State Engineer. The State Engineer shall determine the size of the breach in accordance with the following:

7.1.3.1 The bottom width of the breach shall be one-half the height of the dam but not less than ten feet;

7.1.3.2 The side slopes of the breach shall not be steeper than one horizontal to one vertical;

7.1.3.3 The breach shall be to original ground at the low point in the foundation of the dam; and

1.1.1.1 7.1.3.4 The excavated material shall not be placed in the stream channel.

Rule 8. Fees:

The owner shall submit with the application for construction, enlargement, alteration, modification, or repair an amount equal to three dollars for each one thousand dollars or fraction thereof of the estimated cost of construction including engineering costs, but the maximum fee shall not exceed three thousand dollars, nor shall the minimum fee be less than one hundred

Formatted: Header

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 4, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~dollars. When an owner resubmits an application that was previously received and disapproved by the State Engineer, the owner shall submit a new filing fee in accordance with the above. Checks shall be made payable to the Colorado Division of Water Resources.~~

Formatted: Header

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~Rule 9. Construction of Jurisdictional Size Dams~~:

~~9.1 **High and Significant Hazard Dams** – For all High and Significant Hazard dams, the owner shall provide an engineer experienced in dam design and construction, who shall be responsible for the following:~~

8.1.2 ~~9.1.1 **Plan for** **Construction Observation** – **Plan.**~~ Not less than thirty (30) days prior to construction, the ~~engineer must submit to the State~~ Engineer shall submit a ~~general plan for~~ construction observation~~.~~ plan to the State Engineer. The construction observation plan shall include~~, at a minimum~~:

A. ~~9.1.1.1~~ The anticipated date of the start of construction;

B. ~~9.1.1.2~~ Names and ~~qualifications~~resumes of the ~~engineer~~Engineer and staff to be used on the project;

C. ~~9.1.1.3~~ A construction observation schedule for the ~~engineer~~Engineer and staff;

D. ~~9.1.1.4~~ For dams on rock foundations, a schedule for observations of the foundation by a ~~geologist, or engineering geologist~~Geologist;

~~9.1.1.5 A schedule for inspection of the gate installation by the gate manufacturer or its representative unless waived by the State Engineer;~~

E. ~~9.1.1.6~~ A quality assurance plan including a schedule of the construction material tests; and

F. Identification of the firm and qualifications of the personnel that will conduct the construction material tests in the field and in the laboratory~~; and~~.

~~9.1.1.7 A schedule of the construction material tests.~~

8.1.2.1 ~~9.1.2 **Approval** –.~~ Within ~~ten working~~fourteen (14) days of receipt, the State Engineer shall provide written comments and approval, or conditions for approval, of the construction observation plan. Construction shall not commence without approval of the observation plan by the State Engineer.

8.1.3 ~~9.1.3 **Pre-Construction Meeting** – Subsequent to submitting the construction observation plan, but no later than two weeks prior to~~. Prior to commencement of construction, a meeting shall be held between the ~~engineer, dam owner~~Engineer, Owner, State Engineer, and ~~the general~~ contractor. The ~~general~~ State Engineer shall be notified at least fourteen (14) days prior to the meeting. The contractor shall ~~develop~~present and thoroughly explain its construction ~~control~~work plan along with any anticipated construction difficulties. ~~During this meeting, the means used to divert and care~~

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted

Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted

Formatted

Formatted: Font: Arial, 10 pt

Formatted: List Number, Outline numbered + Level: 1 + Numbering Style: A, B, C, … + Start at: 1 + Alignment: Left + Aligned at: 0.5" + Indent at: 0.75", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted

Formatted: List Number, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted

Formatted: List Number, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted

Formatted

Formatted

Formatted: Font: Arial, 10 pt

Formatted

Formatted

Formatted

Formatted: Font: Arial, 10 pt

Formatted

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted

Formatted: Font: Arial, 10 pt

Formatted

Formatted

~~for the stream during construction will be identified by the contractor; and if reasonable, the plan will be approved by the State Engineer. The~~ The name of the ~~contractors and any principals in charge~~subcontractors shall be furnished to the State Engineer at the meeting.

Project communication protocol between the ~~owner, engineer~~Owner, Engineer, and the State Engineer shall be established at the pre-construction meeting.

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

8.2 ~~9.1.4~~ ~~Construction.~~

8.2.1 ~~Engineer's Observation~~. The ~~engineer~~Engineer shall observe the ~~construction of the dam. It is the engineer's responsibility to observe the~~ progress and quality of the construction ~~to determine whether the construction is proceeding~~ in accordance with the approved ~~plans and specifications.~~construction observation plan. The ~~engineer~~Engineer shall endeavor to prevent defects and deficiencies in the construction of the dam and appurtenant structures, and shall disapprove or reject work failing to conform to the approved plans and specifications. ~~To assure independent review and proper quality assurance, in~~In cases where the ~~engineer~~Engineer has a contractual relationship with the ~~general construction~~ contractor to provide engineering services, the ~~owner~~Owner shall provide an independent, third-party engineer to perform the engineering quality assurance observations.

8.2.2 ~~9.1.5~~ ~~Construction Records~~. The ~~engineer~~Engineer shall maintain a record of construction that, ~~as~~at a minimum, shall include~~:~~ daily activity and progress reports~~:~~, design change orders, all ~~test results pertaining to construction;~~materials testing results, gate and valve installation certifications, photographs sufficient to provide a record of foundation conditions and various stages of the construction through completion~~:~~, all geologic information obtained~~:~~, and documentation of any construction problems and remedies.

8.2.3 ~~9.1.6~~ ~~Progress Report - A construction progress report~~ Reports. Progress reports summarizing the ~~contents~~status of ~~Rule 9.1.5~~the work shall be submitted to the State Engineer ~~every 30 days or more frequently if directed by the State Engineer. A summary report of all~~during the ~~items~~ project at a minimum frequency and in ~~Rule 9.1.5 shall be submitted at~~a format agreed upon during the ~~end of construction in accordance with Rule 10~~pre-construction meeting. The progress report shall include the contractor's three-week look-ahead schedule.

8.2.4 ~~9.1.7~~ ~~Notice for Inspection~~. The ~~engineer~~Engineer shall give the State Engineer at least five (5) days advance notice of ~~initial materials placement on the dam's foundation, in the cutoff trench, outlet backfill, outlet foundation and any appurtenance requested by~~ any work items listed by the State Engineer in the ~~State Engineer in the approval of the plan for~~ pre-construction ~~observation~~meeting, to allow for observation by the State Engineer.

8.2.5 ~~9.1.8~~ ~~Design~~ Change Order~~.~~ When unforeseen site conditions or material availability require that the construction work differ significantly from the approved plans and specifications, a design change order, including details, ~~must~~shall be provided by the ~~engineer~~Engineer to the State Engineer. No change shall be executed until approved by the State Engineer. Major changes ~~must~~shall be submitted in writing with supporting documentation, and approved in writing by the State Engineer. Minor changes ~~may be transmitted verbally by~~

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted ...

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted ...

Formatted: Font: Arial, 10 pt

Formatted ...

Formatted: Font: Arial, 10 pt

Formatted ...

Formatted ...

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted ...

Formatted: Font: Arial, 10 pt

Formatted ...

Formatted: Font: Arial, 10 pt

Formatted ...

Formatted ...

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted ...

Formatted ...

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted ...

~~the engineer and approved~~ , as determined by the State Engineer ~~verbally~~, may be approved verbally and documented in the final construction documents.

~~9.1.9 **Final Inspection**.~~ The ~~engineer~~Engineer shall give the State Engineer at least ~~10~~fourteen (14) days advance ~~written~~ notice prior to the ~~projects~~project's final construction inspection.

~~9.1.10 **Completion of Construction**~~ . The ~~engineer~~Engineer shall ~~notify the State Engineer of~~document the completion of ~~the construction in accordance with Rule 10.~~

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

9.2 **Low Hazard and NPH Dams** - Low Hazard and NPH dams require the owner to provide an engineer experienced in dam design and construction, who shall be responsible for the following:

9.2.1 **Construction Plan** - Not less than 30 days prior to construction or as soon as possible for dams whose construction season is affected by freezing weather, the engineer shall notify the State Engineer in writing of the date construction will begin, the name of the engineer in charge of the project, and the name of the contractor.

9.2.2 **Engineer Observation** - The engineer shall observe, or provide for the observation by a qualified technician directly responsible to the engineer, the construction work on the dam, the cutoff trench, and outlet works foundation to see that they are in substantial accordance with the approved plans. The engineer shall endeavor to guard against defects and deficiencies in the construction of the dam, and shall disapprove or reject work failing to conform to the approved plans and specifications.

8.2.6 9.2.3 **Inspection, Testing and Reporting** - Tests of construction materials shall be taken and inspections of the construction made to verify that the work is completed in accordance with the approved plans and specifications. Periodic progress reports shall be submitted as requested by the State Engineer. The engineer shall compile a record of all tests conducted, and any problems and remedies, for submittal to the State Engineer at the end of constructionpunch list items.

9.2.4 **Change Orders** - Change orders shall be submitted in accordance with Rule 9.1.8.

9.2.5 **Final Inspection** - The engineer shall give the State Engineer at least 10 days advance written notice prior to the projects final construction inspection.

9.2.6 **Completion of Construction** - The engineer shall notify the State Engineer of the completion of construction in accordance with Rule 10.

Rule 10. Acceptance of Construction of Jurisdictional Size Dams:

8.3 10.1 **Acceptance of Construction** - Construction for which application has been made pursuant to Rule 5 or Rule 6. Construction shall not be deemed complete nor shall storage of water be permitted until the State Engineer furnishes to the ownerOwner a written statement of acceptance, unless temporary approval of storage is granted by the State Engineer.. The acceptance shall specify the vertical height, freeboard, length of thestate the as-constructed dam dimensions, the capacity of the reservoir in acre-feet, and any limitationlimitations upon, or requirements for the use of the dam. The State Engineer shall furnish the acceptance or denial within sixty (60-) days of receipt of a complete notification ofconstruction completion documents as outlined below.

Formatted: Header

Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt, No underline

Formatted: Heading 2, Keep with next, Keep lines together, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

8.3.1 ~~10.2~~ **Construction Completion Documents**~~.~~ The ~~engineer~~Engineer shall provide the following construction documentation within sixty (60) days of the final construction inspection ~~in order for the project to be deemed complete~~:

8.3.1.1 ~~10.2.1~~ A written notification that the project is complete and in general conforms with the approved plans, specifications, and design change orders~~;~~.

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 3, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~10.2.2 As-constructed drawings that meet the format requirements of Rule 5;~~

~~10.2.3 A final construction report containing the following information, if applicable, in accordance with the requirements of Rule 9; a summary of construction, problems encountered, and solutions implemented to resolve the problems; a summary of construction material tests and geologic observations; photographs of construction from exposure of the foundation to completion of construction;~~

~~10.2.4 A record of the location of permanent monuments and instrumentation as well as installation details and initial surveys and readings shall be submitted, if applicable;~~

8.3.1.2 ~~10.2.5~~ A schedule for the first filling of the reservoir specifying fill rates, water level elevations to be held for observation, and a schedule for inspecting and monitoring the dam. ~~No filling schedule is required for minor dams rated Low Hazard and all NPH dams or if waived by the State Engineer for good cause shown. The dam owner, however, shall monitor the dam frequently during the first filling; and~~

8.3.1.3 ~~10.2.6~~ As-constructed plans showing the original approved plans amended to include any major or minor changes.

8.3.1.4 A ~~long-term~~final construction report summarizing construction, problems encountered and solutions implemented to resolve the problems, and compiling the construction records as identified in Rule 8.2.2.

8.3.1.5 A record of the location of permanent monuments and instrumentation as well as installation details and initial surveys and readings, if applicable.

8.3.1.6 The approved dam observation and monitoring plan ~~for~~in accordance with Rule 13.4.

8.3.1.7 A new or updated Emergency Action Plan including current inundation map in accordance with Rule 13.7.

For new dams and enlargements ~~(except for minor Low Hazard and all NPH dams) that shall include: the frequency of monitoring; the data recording format; graphical presentation of data; and, the parties who will perform the work.~~

8.3.2 ~~10.3 The engineer~~, the Engineer, shall provide periodic review of the data included in the ~~long-term~~dam observation and monitoring plan on at least an annual basis for the first five years~~, whereupon the monitoring shall continue in accordance with Rule 15.~~ following construction completion. The ~~engineer~~Engineer shall submit the data and a written assessment of the dam's performance to the State Engineer annually.

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Heading 3, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

8.3.3 ~~10.4~~**Temporary Approval.** Upon written request by the ~~owner~~Owner and for good cause shown, the State Engineer may temporarily approve storage of water prior to ~~full compliance with Rule 10. The written request shall include a schedule for compliance with Rule 10, a certification letter signed and sealed by~~submitting the ~~engineer in accordance with Rule 10.2.1, a schedule for the first filling of reservoir in accordance Rule 10.2.5, and a monitoring plan for observing the behavior of the dam and appurtenances during the initial filling or refilling of the reservoir. For High and Significant Hazard dams, an Emergency Action Plan prepared in accordance with Rule 16 shall be developed by the owner and approved by the State Engineer prior to placing any water in the reservoir~~construction completion documents. Only a partial reservoir filling will be granted under this Rule. Final acceptance of the construction for full use of the reservoir will not be granted until the requirements of Rule ~~10~~8.3 have been satisfactorily completed. The written request shall include, at a minimum:

A. ~~10.5 The engineer~~A schedule for compliance with Rule 8.3;

B. A notification letter signed and~~/~~ sealed by the Engineer in accordance with Rule 8.3.1.1;

C. A schedule for the first filling of reservoir in accordance Rule 8.3.1.2;

D. A monitoring plan for observing the behavior of the dam and appurtenances during the initial filling or refilling of the reservoir; and

E. A new or updated EAP prepared in accordance with Rule 13.7.

Rule 9. Requirements for Removing or Breaching an Existing Dam~~owner~~

9.1 **Breach Plan and Application**. An Owner proposing to permanently remove or breach a dam shall submit an ~~Emergency Action Plan~~ application package to be approved by the State Engineer prior to commencing work. The application shall be completed on a form provided by the State Engineer and shall include the following:

9.1.1 Documentation demonstrating that notice has been given to land owners and agencies potentially impacted by removal or breach of the dam.

9.1.2 Documentation showing that all permitting requirements by local, state and federal agencies have been satisfied.

9.1.3 A breach plan meeting the following requirements:

9.1.3.1 The breach shall be designed to prevent silt previously deposited in the reservoir and material excavated for the breach from washing downstream.

9.1.3.2 Water impounded in the reservoir area shall be released in a controlled manner that will not endanger lives or damage downstream properties.

9.1.3.3 The minimum bottom width of the breach shall be one-half the height of the dam or 10 feet, whichever is greater.

9.1.3.4 The sides of the breach shall be excavated to a slope that is stable, but not steeper than 2H:1V (horizontal:vertical). A slope stability analysis that demonstrates an adequate factor of safety for slopes steeper than 2H:1V may be accepted by the State

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 3, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

Engineer. The breach dimensions shall meet water administration requirements of the Division Engineer. The dam shall be excavated down to the level of the natural ground at the maximum section, or as otherwise necessary to comply with Rule 9.1.3.

9.1.3.5 The excavated material shall not be placed in the stream channel.

9.1.3.6 ~~conforms to Rule 16~~**High and Significant Hazard Dams**. The breach plan for High and Significant Hazard dams shall meet the following additional requirements:

9.1.3.6.1 The plan shall be prepared by an Engineer.

9.1.3.6.2 The breach shall be of sufficient width to pass the twenty four (24) hour, one percent AEP flood with a maximum increase in reservoir depth of five (5) feet. However, the maximum breach width shall not be required to exceed the width of the original natural channel before the dam was constructed, regardless of the one percent AEP flood.

9.1.3.6.3 Breach side slope and channel protection may be required to prevent erosion and provide long-term stability.

9.1.3.6.4 Remaining infrastructure shall be left in a safe condition.

9.1.3.6.5 Construction plans shall meet the requirements of Rule 6 that are applicable to support the scope of work as described on the application.

9.1.3.6.6 The dewatering and removal or breaching of the dam shall be overseen by an Engineer.

9.1.3.6.7 A written notification that the project is complete and in general conformance with the approved breach plan shall be provided within sixty (60) days ~~after the final~~of completion of construction ~~inspection~~. The State Engineer will provide acceptance upon review and receipt of these documents.

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Heading 4, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Heading 5, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

Rule 10. ~~Rule 11.~~ Construction, Modification, Alteration, Repair, and Breach of Non-~~jurisdictional~~Jurisdictional ~~Size Dams~~.

10.1 ~~11.1~~ **Notice of Construction~~.~~.** Any person intending to construct a non-jurisdictional size dam other than a Livestock Water Tank or Erosion Control Dam, ~~must~~shall submit notice of the intent to construct the dam on forms provided by the State Engineer not less than forty-five (45~~ calendar~~) days prior to the proposed construction. The State Engineer shall determine the potential hazard for loss of life or significant damage due to failure of the structure, and ~~determine~~ if the submittal and approval of plans and specifications ~~and approval of the plans and specifications by the State Engineer~~ is required prior to construction. The forms shall be submitted to the Division Engineer of the Water Division in which the dam is to be located. The Division Engineer shall respond to the ~~owner~~Owner within forty-five (45) days after receipt of the complete notice of intent to construct form. All ~~dam owners~~Owners shall be required to comply with the applicable dam safety and water administration requirements.

10.2 ~~11.2~~ **Modification or ~~alteration to~~Alteration of Non-~~jurisdictional~~Jurisdictional Size ~~Dam~~ Dams.** Jurisdictional size dams proposed to be modified or altered to non-jurisdictional size shall comply with the following requirements:

10.2.1 ~~11.2.1~~ For High or Significant Hazard dams, the ~~owner~~Owner shall submit plans for approval in accordance with ~~Rule 6.1.2.~~Rule 6. As-constructed documents are required in conformance with Rule 8.3.1.

~~11.2.2~~ For Low Hazard or NPH dams, the ~~owner~~Owner shall submit written notice of the intent to alter the dam to the State Engineer ~~in accordance with Rule 6.1.3.~~

10.2.2 ~~11.2.3.~~ The ~~engineer~~Owner shall submit written notice of the completion of the project ~~and file as-constructed plans in conformance with Rule 10~~.

10.3 ~~11.3~~ **Repair ~~and~~or Breaching of Non-~~jurisdictional~~ Jurisdictional Dams~~.~~.** Repair ~~and~~or breaching of existing non-jurisdictional size dams shall meet the following requirements:

10.3.1 ~~11.3.1 Owners who intend~~ In cases where a non-jurisdictional dam has been found unsafe, the Owner shall submit written notice to the State Engineer to repair, modify, breach or entirely remove the dam prior to construction.

Formatted ...

10.3.2 Removal or breaching of a non-jurisdictional dam shall ~~submit written notice to the State Engineer prior to construction.~~comply with Rule 9.

10.3.3 ~~11.3.2~~ Modifications to, or repair of, High or Significant Hazard non-jurisdictional size dams shall ~~have the plans for repair or breaching prepared by an engineer and submitted to the State Engineer for approval before construction. The plans shall be of sufficient detail to allow review and provide for the quality control of the work and must meet the requirements of Rule 7.1.2, if the dam is being breached.~~be performed in accordance with Rule 6.

10.4 ~~11.4~~ **Spillway Requirements**~~.~~. Spillway sizing requirements shall meet the criteria for the appropriate hydrologic hazard ~~classification of the dam for a Minor size dam as specified in the appropriate Table of Inflow Design Flood Requirements in Rule 5.9.1~~category.

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 2, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

10.5 ~~11.5 **Construction**~~**Enlargement of Non-Jurisdictional Size Dams ~~under Rule 11~~**

~~The construction of non-jurisdictional size dams under these provisions with freeboard in excess of five feet with the intent to convert the dam to a jurisdictional size structure with only minor modifications to the spillway will not be approved.~~ The modification of a non-jurisdictional size dam to a jurisdictional size dam ~~will not be permitted within 10 years of the construction of the original structure and/or without meeting~~shall meet the requirements of ~~Rule 5.~~Rule 6.

Rule 11. ~~Rule 12.~~ General Maintenance, Ordinary Repairs, and Emergency Actions~~:~~

11.1 ~~12.1 **General Maintenance**~~ General maintenance and ordinary repairs that do not require prior approval of the State Engineer ~~for the purpose of this Rule shall be~~ include those activities that do not impair the safety of the dam. ~~These maintenance and~~ When questions arise concerning this Rule, the determination of general maintenance and ordinary repair will be made by the State Engineer. General maintenance and ordinary repair activities include~~:~~ the following:

11.1.1 ~~12.1.1~~ Removal of brush or tall weeds.

11.1.2 ~~12.1.2~~ Cutting of trees ~~and removal of~~with trunk diameter less than 6-inches and removing slash from the embankment or spillway. ~~Removal of small stumps is acceptable provided no excavation of more than 3 feet into the embankment occurs. An engineer must oversee removal of trees and stumps larger than 12" diameter.~~

11.1.3 ~~12.1.3~~ Rodent control, removal or extermination~~. Repair~~ and repair of minor rodent damage ~~is acceptable provided it does not involve excavation of more than 3 feet into the embankment.~~ Damage that has already weakened the dam shall be repaired in accordance with Rule 6.

Repair of erosion gullies on the embankment or in the spillway.

11.1.4 ~~12.1.4 Repair of erosion gullies on the embankment or in the spillway.~~ Large gullies that have already weakened the dam ~~must~~shall be repaired in accordance with ~~Rule 6.~~Rule 6.

11.1.5 ~~12.1.5~~ Surface grading of the embankment crest or spillway to eliminate potholes and provide proper drainage with properly compacted material, provided that the

Formatted: Header
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Heading 1, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"
Formatted: Heading 2, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Heading 3, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"
Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: DMMHGC+TimesNewRoman, 10 pt
Formatted
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted

freeboard is not reduced. ~~Material placed on the dam crest to restore the design freeboard must be compacted to specifications outlined in Rule 5. The State Engineer must be provided notice prior to placement of material on the dam crest of greater than 1 foot in depth for approval.~~ Placement of material in excess of 1 foot in depth to provide freeboard is not considered general maintenance~~.~~ and shall be performed in accordance with Rule 6.

Placement of additional riprap and bedding on the upstream slope, or in areas of the spillway that have sustained minor damage.

11.1.6 ~~12.1.6~~ ~~Placement of additional riprap and bedding on the upstream slope, or in areas of the spillway that have sustained minor damage.~~ Such placement shall be limited to restoring the original riprap protection ~~where the damage has not yet resulted in weakening of the dam. An engineer must oversee restoration of the embankment.~~ Repair of the underlying embankment is not considered general maintenance and shall be performed in accordance with Rule 6.

11.1.7 ~~12.1.7~~ Painting or caulking metal structures, or lubricating mechanical equipment.

11.1.8 ~~12.1.8~~ Patching, sealing, or caulking spalled or cracked concrete surfaces to prevent deterioration.

11.1.9 ~~12.1.9~~ Removing debris, rock, or earth from outlet conduits, outlet channels, or spillway channels.

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 3, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

11.1.10 ~~12.1.10~~ Patching or sealing surface damage to prevent further deterioration within outlet conduits.

11.1.11 ~~12.1.11~~ Replacement of worn or damaged parts of outlet valves or controls to restore to original condition.

11.1.12 ~~12.1.12~~ Repair or replacement of fences intended to keep traffic or livestock off the dam or spillway.

11.1.13 ~~12.1.13~~ Landscaping of new and existing dams and spillway channels is not general maintenance and will not be allowed without the prior approval of the State Engineer. No trees or large vegetation shall be planted within 25 feet of the footprint of the dam.

~~12.2 **Excavation and Determination of General Maintenance** - General maintenance and ordinary repair which may impair safety such as excavation into or near the dam, construction of new appurtenant structures for the dam, and repair of damage which has already significantly weakened the dam must be done in accordance with Rule 6. When questions arise concerning this Rule, the determination of general maintenance and ordinary repair will be made by the State Engineer.~~

11.2 ~~12.3~~ **Emergency Action**~~ -~~. Emergency actions not impairing the safety of the dam may be taken before consultation and guidance can be provided by an ~~engineer~~Engineer, and do not require prior approval of the State Engineer. Emergency actions are interim solutions only and may not serve as a permanent solution to the problem(s) being addressed. Additional remedial actions may be required after the emergency passes. Emergency actions may include:

A. ~~12.3.1~~ Stockpiling materials such as riprap, earthfill, sand, sandbags, and plastic sheeting;

B. ~~12.3.2~~ Lowering the reservoir level by making controlled releases through the outlet or a gated spillway, by pumping, or by siphoning. Where large releases are to be made, the Division Engineer, Dam Safety Engineer and Local Emergency Manager shall be notified;

C. ~~12.3.3~~ Armoring eroding areas by placing sandbags, riprap, plastic sheeting, or other available material;

D. ~~12.3.4~~ Plugging leakage entrances on the upstream slope;

E. ~~12.3.5~~ Increasing freeboard by placing sandbags or temporary earthfill on the dam;

Formatted: Header
Formatted: Font: Arial, 10 pt
Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"
Formatted: Font: Arial, 10 pt
Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"
Formatted: Font: Arial, 10 pt
Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"
Formatted: Font: Arial, 10 pt
Formatted: Heading 2, Keep lines together, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt, Bold
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: List Number, Outline numbered + Level: 1 + Numbering Style: A, B, C, … + Start at: 1 + Alignment: Left + Aligned at: 0.5" + Indent at: 0.75", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted ...
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted ...
Formatted: Font: Arial, 10 pt
Formatted ...
Formatted: Font: Arial, 10 pt
Formatted ...
Formatted: Font: Arial, 10 pt
Formatted ...

F. ~~12.3.6~~ Diverting flood waters around the reservoir or closing inflow diversions;

G. ~~12.3.7~~ Constructing training berms to control flood waters;

H. ~~12.3.8~~ Placing sandbag ring dikes around boils at the downstream toe to provide back pressure; and/or

Formatted: Header

Formatted: List Number, Outline numbered + Level: 1 + Numbering Style: A, B, C, … + Start at: 1 + Alignment: Left + Aligned at: 0.5" + Indent at: 0.75", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: List Number, Outline numbered + Level: 1 + Numbering Style: A, B, C, … + Start at: 1 + Alignment: Left + Aligned at: 0.5" + Indent at: 0.75", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: List Number, Outline numbered + Level: 1 + Numbering Style: A, B, C, … + Start at: 1 + Alignment: Left + Aligned at: 0.5" + Indent at: 0.75", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

I. 12.3.9 Removing obstructions from outlet or spillway flow areas.

11.3 12.4 **Emergency Excavation**. Lowering the water level by excavating the spillway or embankment is prohibited unless failure of the dam is imminent.

11.4 12.5 **Emergency Notification**. The State Engineer shall be notified as soon as reasonably possible of any emergency condition that exists and any emergency action taken with or without prior approval of the State Engineer.

11.5 12.6 **Emergency Action Plan**. For all High and Significant Hazard dams, the Emergency Action Plan mustshall be implemented in conjunction with any emergency actions taken in accordance with Rule 12.

Rule 13. Determination of Safe Storage Level:

13.1 **Authority to Determine Safe Storage Level** - The State Engineer is assigned the responsibility to determine the safe storage level for every reservoir in the state. The reservoir owner shall not store water in excess of the amount so determined by the State Engineer to be safe.

13.2 **Restriction of Storage** - If the dam safety inspection or information from other reliable sources reveals problems affecting the safe storage level of the reservoir, the State Engineer will issue an order restricting reservoir operations until the problems have been resolved. The dam owner shall comply with the restriction order at all times. The restriction order will be removed or modified by the State Engineer only after receipt and approval of engineering evaluations which indicate that the problems have been adequately remediated and after completion of required repairs.

13.3 **Review of Potential Hazard Classification** - As part of the determination of safe storage level, the State Engineer will periodically review the classification of existing dams by evaluating the consequences of failure applying the definitions of Rule 4. If the State Engineer's review indicates the consequences of failure have increased or decreased due to changes in development within the dam failure inundation area, the State Engineer will assign an appropriate new classification and will require that, the dam meet the requirements of these Rules as they apply to the new classification, within a reasonable period of time.

Rule 12. Rule 14. Safety Inspections Performed by the Owner's Engineer:

Formatted: Header
Formatted: Font: Arial, 10 pt
Formatted: Heading 2, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Heading 2, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Heading 2, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Font: DMMHGC+TimesNewRoman, 10 pt, Not Bold, No underline
Formatted: Heading 1, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"
Formatted: Font: Arial, 10 pt
Formatted: Font: Arial, 10 pt
Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

12.1 ~~14.1~~ **Owner Safety Inspection**~~.~~. An ~~owner~~Owner may provide a safety inspection report to the State Engineer ~~regarding~~recommending the safe storage level of a reservoir. The State Engineer may utilize the ~~owner's~~Owner's safety inspection report in lieu of a State Engineer safety inspection if the inspection is performed, and the report ~~if said report is~~ written ~~by a qualified engineer, as defined below. The owner's engineer must~~, by an Engineer meeting the requirements of Rule 4.10. The Owner's Engineer shall notify the State Engineer ~~and submit a written summary of qualifications~~ at least fourteen (14) days prior to the scheduled safety inspection. Inspections shall be conducted in accordance with current State Engineer policies and these Rules.

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 2, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~14.2 **Engineer Qualifications** - An engineer shall be considered qualified to provide information to the State Engineer regarding the safe storage level of a reservoir if the engineer meets the following minimum qualifications:~~

~~14.2.1 Registration as a professional engineer in Colorado;~~

~~14.2.2 Three years of experience in the field of dam safety; and~~

~~14.2.3 Experience in conducting safety inspections of dams.~~

12.2 ~~14.3 **Scope of Inspection** - Dam safety inspections by the owner's engineer shall include, but are not limited to: review of previous inspections, reports and drawings; site inspection of the dam, spillways, outlet facilities, seepage control and measurement system; and evaluation of data from permanent monument or monitoring installations, if any. The inspection shall include an assessment of all parts of the dam which are related to the dam's safety. (See Rule 15.1 for outlet inspection requirements.) The engineer~~ **Scope of Inspection.** Dam safety inspections by the Owner's Engineer shall meet the requirements of Rule 4.31. The Engineer shall prepare an inspection report that describes the findings, and lists actions the ~~dam owner~~Owner must take to improve the safety of the dam to an acceptable level. The report shall ~~include~~provide the ~~engineer's recommendation~~information necessary to allow the State Engineer to make a determination of the safe storage level of the reservoir.

~~14.4 **Retaining an Engineer** - If the owner elects to retain an engineer to conduct safety inspections, such inspections shall be conducted in accordance with current policies and Rules of the State Engineer.~~

12.3 ~~**Rule 15. Dam**~~ **State Engineer Acceptance.** The report will be reviewed by the State Engineer prior to acceptance. If the report and findings are accepted, the State Engineer will provide the Owner with a list of required actions and will notify the Owner of the safe storage level.

Rule 13. Owner's Responsibilities~~:~~

~~15.1 **Outlet Inspection** - It is the dam owner's~~**Liability**. The sole responsibility ~~to provide~~ for ~~inspection of outlet facilities associated~~the safety of the dam rests with the ~~dam. The frequency of outlet inspections and the requirements of those inspections are as follows:~~

13.1 ~~15.1.1 High and Significant Hazard dams shall receive a Type A outlet inspection in conjunction with safety inspections, and Type B inspections at least once~~ Owner, who should take every ~~ten years unless the condition indicates more frequent inspections are~~step necessary~~. A Type B inspection of the entire outlet conduit shall only be required on dams without upstream gates if ordered by the State Engineer in conformity with Rule 15.1.4. Type B inspections may be waived where the condition of the outlet conduit would not be considered detrimental to~~ to prevent damages caused by leakage or overflow of waters from the

Formatted: Header

Formatted: Heading 2, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 1, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Heading 2, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

reservoir or floods resulting from a failure of the dam. Therefore, it is in the Owner's best interest to operate and maintain the facility in a manner such that the safety of the dam and the general public are not jeopardized.

~~15.1.2 Low Hazard and NPH dams shall receive a Type A outlet inspection in conjunction with routine periodic safety inspections of the dam. A Type B inspection may be required by the State Engineer to determine the safe storage level.~~

~~15.1.3 Type A outlet inspections shall consist of observation of exposed surfaces of the inlet and discharge structures, control valves or gates and vaults; a test of the outlet valve(s) for proper operation, observation of the downstream end of the conduit and adjacent embankment for leakage; and observation of the dam (upstream slope, crest, downstream~~

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~slope or natural ground) in the vicinity of the outlet alignment for signs of distress which would indicate failure of the outlet system.~~

~~15.1.4 Type B outlet inspections shall consist of a complete Type A inspection, a close inspection of the interior of the conduits, outlet wells, and access ways, and operation of the outlet valve(s) or gates through the full operating range. In cases where the conduits are too small for a person to safely enter, the owner shall provide for an inspection using video or other remote sensing equipment capable of detecting flaws or imperfections within the conduit. A written report of inspection findings, including the opinion of the owner's engineer, must be submitted to the State Engineer unless waived by the State Engineer for good cause. A Type B inspection of the normally inundated outlet conduit of a dam without upstream guard gates shall be required only when existing baseline data available to the State Engineer is inadequate to permit an evaluation of the condition of the outlet conduit. Thereafter, such inspections shall only be required if the criteria set forth in ACER Technical Memorandum No. 6, U.S. Department of the Interior, Bureau of Reclamation, 1985, (later amendments, editions or subsequent publications not included) indicates the need for an inspection. In ordering such inspections, the State Engineer shall coordinate with the dam owner and make all reasonable efforts to prevent expense and waste of water consistent with ensuring dam safety.~~

~~15.1.5 At any time the water level in a dam without upstream gates on the outlet conduit will be lowered to the invert of the conduit, or the normally inundated conduit will be otherwise dewatered and available for inspection, the dam owner shall inform the State Engineer in writing. The dam owner is responsible to provide for inspection of outlet facilities associated with the dam and may take advantage of the low water level conditions to perform the necessary outlet inspection. The State Engineer may require an inspection of the conduit when conditions warrant and/or based on the period of time since the last outlet inspection.~~

13.2 ~~15.2~~ **Change in Ownership.** Changes in ownership of a dam shall be immediately filed with the State Engineer.

13.3 **Site Security**. The Owner shall maintain reasonable security measures to prevent intentional misoperation and damage to the facility.

13.4 **Dam Observation and Monitoring Plans**. All dams shall have an observation and monitoring plan that shall include the following minimum requirements:

13.4.1 **Owner Observations**~~.~~ . The ~~owner~~Owner is responsible for ensuring frequent observation of ~~the dam, unless prohibited by weather or difficulty of access to~~ the dam, especially at times when the reservoir is full, during heavy rains or flooding, and following an earthquake. ~~When the reservoir water level is greater than half the full storage capacity, High and Significant Hazard dams shall be observed at least twice a month, and a Low Hazard dam shall be observed at least every three months.~~ The observations shall be conducted in accordance with methods acceptable to the State Engineer. Conditions which threaten the safety of the dam ~~must be reported to the State Engineer in accordance with the Emergency Action Plan for High and Significant Hazard dams as soon as reasonably possible, after discovery of the conditions. If dam failure appears imminent, the county~~

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Heading 3, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt, Bold

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~sheriff (or local emergency manager) must be immediately notified. The owner is responsible for the safety of the dam and shall take action to lower the reservoir if it appears that the dam has weakened or is in danger of failing~~shall be reported to the State Engineer immediately.

13.4.1.1 ~~15.3~~ High and Significant Hazard dams shall be observed at least twice a month when the reservoir water level is greater than half the full storage capacity.

13.4.1.2 Low Hazard dams shall be observed at least once every three months.

13.4.1.3 For all dams, routine outlet observations shall include observation of exposed surfaces of the inlet and discharge structures, control valves, gates and vaults; observation of the downstream end of the conduit and adjacent embankment for leakage; and observation of the dam (upstream slope, crest, downstream slope, and natural ground) in the vicinity of the outlet alignment for signs of distress or changed conditions.

Monitoring Instrumentation ~~–~~. The ~~owner of a dam~~Owner is responsible for installing, maintaining, and monitoring the ~~required~~ instrumentation~~. All~~ required to adequately monitor the performance of the dam. The instrumentation ~~plans shall be submitted to the State Engineer for review and approval prior to installation of instrumentation, survey monuments, weirs, flumes or other measuring devices.~~

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt, Bold

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~15.3.1 The following minimum instrumentation is required on existing dams; however, the State Engineer may require additional instrumentation when he deems it necessary.~~

~~15.3.1.1 High Hazard dams shall have survey monuments to monitor horizontal and vertical movement of the dam and appurtenant structures, and weirs, flumes or other structures that are acceptable to the State Engineer to monitor seepage. Installation of piezometers to measure the internal water surface of the embankment or adjacent abutments and foundation of the dam may be required by the State Engineer for determination of the safe storage level in the reservoir.~~

13.4.2 ~~15.3.1.2 Significant and Low Hazard dams shall have weirs, flumes or other structures that are acceptable to the State Engineer to monitor seepage. Significant Hazard dams may require piezometers~~ shall be ~~installed as described~~monitored at a frequency detailed in ~~Rule 15.3.1.1~~the approved observation and monitoring plan.

~~15.3.1.3 All dams shall have gage rods pursuant to Rule 5.~~

13.4.2.1 ~~15.3.2 The dam owner shall measure seepage during each routine observation of the dam. Owners of High Hazard dams shall also be responsible for providing first order surveys of horizontal and vertical movement monuments. These surveys~~Monument surveys accurate to 0.01 foot are required annually for five years (including the year of installation of the monuments) on new and recently enlarged dams, and then once every five years thereafter. Monitoring of movement monuments for Significant Hazard dams is not required beyond the first five years unless otherwise deemed necessary by the State Engineer. The State Engineer may also approve other methods for monitoring movement monuments on the dam and may require monitoring at any frequency deemed necessary based upon review of inspection data and past measurement results.

13.4.2.2 ~~15.3.3~~ The ~~dam owner~~Owner is responsible for ensuring that all instrumentation data is properly recorded in an acceptable format and sent to the State Engineer annually. The State Engineer may require that instrumentation data for High and Significant Hazard dams be evaluated by the ~~owner's engineer~~Owner's Engineer and the analysis sent to the State Engineer annually, unless more frequent reporting is required ~~by the State Engineer~~.

13.4.2.3 ~~15.3.4~~ The ~~dam owner~~Owner shall promptly notify the State Engineer of any abnormal changes in the ~~dam based on the results of evaluation of~~ instrumentation data, as compared to historical patterns and trends.

13.5 ~~15.4~~ **Outlet Operation**. The Owner shall maintain the outlet works in an operable condition.

Formatted: Header

Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

13.5.1 **Outlet Inspections.** The requirements of outlet inspections are as follows:

13.5.1.1 **Outlet Exercise**. An annual test of the outlet gate(s) and valve(s) for proper operation is required. The Owner shall notify all potentially impacted parties prior to exercising the outlet gate in cases where sediment release, water quality, or downstream flooding is a concern.

13.5.1.2 **Outlet Inspection Access**. Outlet structures for all dams will be observed during safety inspections. Owners shall provide safe access for inspection of outlet facilities.

13.5.1.3 **Internal Outlet Inspections**. Internal outlet inspections shall consist of a close inspection of the interior of the conduits, outlet wells, and access ways. In cases where it is unsafe or not possible for a person to enter, the Owner shall provide for an inspection using video or other remote sensing equipment capable of detecting flaws or imperfections within the conduit. An Engineer shall oversee the inspection and provide a written report of inspection findings to the State Engineer. The State Engineer shall coordinate with the Owner and make all reasonable efforts to minimize expense and waste of water while ensuring dam safety.

13.5.1.3.1 High and Significant Hazard dams shall receive an internal outlet inspection at least once every ten (10) years unless the condition indicates that more frequent inspections are necessary. An inspection of the entire outlet conduit shall only be required on dams without upstream gates if ordered by the State Engineer.

13.5.1.3.2 Low Hazard and NPH dams shall receive an internal outlet inspection when required by the State Engineer to determine the safe storage level.

13.5.1.3.3 The Owner shall inform the State Engineer any time the water level in a dam without upstream gates on the outlet conduit will be lowered to the invert of the conduit, or any time the normally inundated conduit will be otherwise dewatered and available for inspection.

13.6 **Responsibility for Maintenance**~~.~~ . The ~~owner~~Owner is responsible for adequate and timely maintenance of the dam. The ~~owner~~Owner shall establish ~~an annual~~a maintenance plan to ensure that the maintenance, as identified in ~~Rule 12,~~Rule 11, is accomplished.

~~15.5 **Trash Racks** - The owner shall ensure that trash racks are installed on all outlet structures unless waived in writing by the State Engineer.~~

~~15.6 **Change In Ownership** - Changes in ownership of a dam shall be immediately filed with the State Engineer.~~

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Heading 2, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

13.7 ~~**Rule 16. Emergency Preparedness.**~~ Owners shall be prepared to take emergency actions to prevent unusual or emergency situations at their dams from escalating to dam failure. To the extent possible, Owners shall also make preparations to reduce the consequences of potentially dangerous reservoir releases when such releases are unavoidable or necessary.

Emergency Action Plans (EAP~~):~~

13.7.1 ~~16.1 **Emergency Action Plans (EAP)** Owners of High and Significant Hazard dams shall prepare and maintain an Emergency Action Plan. An EAP is a formal document that identifies potential emergency conditions at a dam and specifies preplanned immediate actions to prevent failure of the dam, reduce the potential for loss of life, and minimize property damage downstream. An~~ **).** An EAP shall be developed and distributed by the Owner for all High and Significant Hazard dams. The EAP shall contain~~, as a minimum,~~ the following ~~key elements~~information, at a minimum:

~~16.1.1 **Emergency Condition Detection** The conditions, incident, events, or measures for detection of an existing or potential emergency shall be described.~~

13.7.1.1 ~~16.1.2 **Emergency**~~**Essential Dam Information.** This section shall include a description of ownership and operations personnel (dam tenders/caretakers), the dam location including a vicinity map and site map, and the characteristics of the dam and appurtenant structures.

Event Level Determination ~~Guidance shall be provided for classifying the emergency level following incident detection using the system of:~~

~~16.1.2.1 Emergency Level 1 A non-emergency incident, unusual event, or slowly developing situation, which not mitigated endanger the structural integrity of the dam or result in uncontrolled release of water causing flooding downstream;~~

~~16.1.2.2 Emergency Level 2 Potential dam failure situation, rapidly developing, and;~~

~~16.1.2.3 Emergency Level 3 Urgent, dam failure is imminent or in progress.~~

~~16.1.3 **Notification and Communication** Prioritized notification lists and flowcharts applicable to each of the emergency levels shall be provided to enable communication and notification of the emergency level~~ **and** ~~with applicable Local, State and Federal emergency agencies, engineering and construction support personnel, the State Engineer's office, and other affected parties as appropriate.~~

13.7.1.2 ~~16.1.4~~ **Expected Actions**~~ Description of~~**.** This section shall include a description of the emergency level classifications and the expected actions ~~necessary to prevent a dam failure incident or to help reduce the effects of a dam failure and facilitate~~ of each of the agencies included in the emergency response ~~to an~~team for each of

Formatted: Header

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt, No underline

Formatted: Heading 3, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt, Bold

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt, Bold

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

the emergency levels. The following emergency level classifications shall be included, at a minimum:

A. High flow below dam – Non-failure,
B. Unusual condition at dam – Non-failure,
C. Potential Dam Failure – Immediate action required, and
D. Evacuation Required – Dam failure in progress or unavoidable.

13.7.1.3 **Notifications**. This section shall include a list of all members of the emergency response team. The appropriate individuals from each agency on the emergency response team shall be identified and included as well as at least one backup individual. The notification list shall include representatives from each of the following agencies/entities, at a minimum:

A. Dam Owner,
B. Local Communications Dispatch Center,
C. Local Sheriff's Office,
D. Local Emergency Managers (County, City),
E. State Division of Homeland Security and Emergency Management (DHSEM),
F. Colorado Department of Transportation (CDOT),
G. Colorado State Patrol (CSP),
H. Colorado Department of Public Safety (CDPS),
I. Division of Water Resources (DWR), and
J. National Weather Service (NWS).

13.7.1.4 **Communication**. This section shall include a description of how communication with each of the agencies on the emergency~~, including, but not limited to, identification of~~ response team shall be made when the EAP is activated at any of the emergency response levels described.

13.7.1.5 **Locally Available Resources**. This section shall identify locally available or pre-positioned equipment, manpower~~, and material available for implementation of the plan.~~ and materials to be used to prevent incident escalation and when possible, prevent the dam from failing. Resources typically identified in this section include:

A. ~~16.1.5~~ Heavy equipment contractors;
B. Rental equipment suppliers for pumps and heavy equipment;
C. Material suppliers for sand and gravel, concrete, sand bags, plastic sheeting; and
D. Diving Contractors.

13.7.1.6 **Evacuation Information**. This section shall present information provided to aid the emergency response team with the evacuation of the inundation zone below the dam. The following information shall be included, at a minimum:

Inundation Mapping~~– A dam~~. Dam failure inundation ~~map~~maps shall be provided for High and Significant Hazard dams ~~showing the stream which will be flooded, including urban and rural impacts.~~to aid emergency managers in developing evacuation plans. Inundation ~~mapping for High and Significant Hazard dams shall contain the following minimum information:~~

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Heading 4, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

13.7.1.6.1 ~~16.1.5.1~~ maps shall be provided in electronic PDF and GIS shape file formats. Inundation ~~mapping for High Hazard dams~~maps shall ~~show~~include the ~~calculated extents~~following information, at a minimum:

A. Lateral limits of the dam breach flood ~~wave. Include cross~~extending downstream from the dam to a location where the potential for loss of life and significant property damage no longer exist; and

Cross sections at critical locations along the flood path showing lateral ~~and vertical flood extents, flood wave velocity and flood wave~~ extents of flooding, depth of flooding, arrival time~~. Inundation mapping shall be extended downstream to a location where no potential for loss of life and no significant property damage exist.~~

B. ~~16.1.5.2 - Inundation mapping for Significant Hazard dams shall show the route~~ of the initial and peak flood wave (from the start of the dam breach), and flood wave~~, the estimated time of arrival of the flood wave at critical~~ velocity.

Formatted: Header

Formatted: List Number, Indent: Left: 1.25", Adjust space between Latin and Asian text, Adjust space between Asian text and numbers

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~sections, and the estimated lateral extent of inundation. The inundation mapping shall be extended downstream to a location where no significant property damage exists. The inundation mapping requirements for Significant Hazard dams may be modified for good cause, with the approval of the State Engineer.~~

~~16.1.6 **Termination** - A description of the roles and responsibilities for declaring that the emergency or incident at the dam is terminated, and a discussion of the requirements for follow-up evaluation including, but not limited to, documenting the event in a summary report.~~

~~16.2 **EAP Guidelines** - The State Engineer's guidelines are available to aid in the preparation and/or revision of EAPs for all High and Significant Hazard dams.~~

~~16.3 **EAP Distribution** - The owner shall submit a copy of the EAP to the Colorado Division of Emergency Management (CDEM), all emergency response coordinators involved in the plan, and other affected parties, as necessary. A distribution list that includes the names and contact information for all parties who have been provided with a copy of the EAP shall be included in the EAP. The owner shall incorporate reasonable recommendations from the CDEM, the State Engineer, emergency coordinators, and other parties affected by the plan.~~

13.7.1.6.2 ~~16.4~~ **Critical Infrastructure**. From examination and study of the inundation maps and consultation with local entities, critical infrastructure within the inundation area should be identified for incorporation into the local emergency managers evacuation planning.

13.7.1.6.3 **Spillway and Outlet works discharge rating tables/curves**. Spillway and outlet discharge rating curves and tables shall be provided to aid emergency response for the high flow conditions EAP activation level.

13.7.2 **Termination**. The responsibilities for termination of an EAP activation shall be described.

13.7.3 **EAP Distribution.** The Owner shall submit an electronic copy of the EAP to all members of the emergency response team as shown on the notification list.

EAP Updates~~—~~. The ~~owner~~Owner shall review the EAP annually and update as necessary and appropriate. ~~The~~EAP updates shall be ~~distributed to all parties shown on the distribution list.~~

13.7.4 ~~16.5~~ included in a single PDF containing the complete EAP and distributed electronically to all emergency response team members shown on the notification list.

13.7.5 **EAP Testing**~~—~~. The ~~owner~~Owner shall test the EAP ~~as necessary~~periodically to ensure the effectiveness of the EAP~~, that the EAP is~~. The contact information shown in the notification list shall be reviewed annually to ensure it is up to date, and to obtain information for revisions or corrections~~, as deemed necessary. All Revisions and corrections shall be distributed to all parties on the distribution list~~ as necessary.

Formatted: Header

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt, Not Bold

Formatted: Heading 3, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

Rule 14. ~~Rule 17.~~ Exempt Structures~~:~~

~~17.1 **Exempt Structures** - Existing or proposed structures not designed or operated for the purpose of impounding water above the natural surface of the ground other than flood detention are exempt from these Rules. Exempt structures include:~~

14.1 ~~17.1.1~~ **Exempt Structures.** See section 37-87-114.5, C.R.S., with the following clarifications:

14.1.1 Highways, road-fills, and railroad embankments with ~~an~~ ungated ~~outlet conduit;~~culverts are exempt.

~~17.1.2 Diversion dams if less than jurisdictional size, and all diversion dams of any size if Low Hazard or NPH;~~

~~17.1.3 Refuse embankments (e.g., solid waste disposal facilities); and,~~

~~17.1.4~~ Structures ~~which~~that store water only below the lowest point of the natural ground are exempt from these Rules, ~~-~~unless an outlet works is constructed to ~~develop water.~~

~~17.2 **Mine Tailing Impoundments** - Mill tailing impoundments which are permitted under the Colorado Mined Land Reclamation Act, sections 34-32-101 through 125, C.R.S. or the Colorado Surface Coal Mining Reclamation Act, sections 34-33-101 through 137, C.R.S. are exempt from these Rules. Any solution process impoundment permitted under the Colorado Mined Land Reclamation Act, or the Colorado Surface Coal Mining Reclamation Act, are exempt from these Rules and Regulations. Siltation structures which are permitted under the Colorado Surface Coal Mining Reclamation Act, sections 34-33-101 through 137, C.R.S. are exempt from these Rules.~~

14.1.2 ~~17.3 **Uranium Mill Tailing Dams** - Uranium mill tailing and liquid impoundment dams permitted under the authority of the Colorado Department of Public Health and Environment are exempt from these Rules. Raw and potable~~release water ~~dams, sewage effluent dams, and water treatment sludge dams associated with the uranium mill are not exempt.~~

14.2 ~~17.4~~ **Livestock Water Tanks**~~-~~. Livestock Water Tanks as defined in the Livestock Water Tank Act of Colorado, ~~Sections~~Title 35~~-~~. Article 49~~-101 through 116~~, C.R.S., are exempt from these Rules.

14.3 ~~17.5~~ **Erosion Control Dams**~~-~~. Erosion Control Dams, as defined in ~~Section~~section 37-87-122, C.R.S., are exempt from these Rules.

Formatted: Header

Formatted: Heading 1, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 3, Indent: Left: 0", First line: 0", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Heading 3, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 2, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 2, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

14.4 ~~**Rule 18.**~~ Dams or other water impounding structures regulated by other State agencies (e.g. COGCC, CDPHE, DRMS, etc.) may be exempt from these Rules to avoid dual regulation. The State Engineer may provide technical consultation as necessary for the permitting of such structures.

Rule 15. Restriction of Recreational Facilities within Reservoirs~~:~~

15.1 ~~18.1 **Restriction on Construction** -~~ No person, including any state or federal agency, quasi-municipal corporation, or political subdivision, shall construct any permanent recreational structure within a reservoir below the elevation of the ~~bottom~~crest of the spillway unless:

A. ~~18.1.1~~ The facility is capable of being restored with a minimum amount of cleaning or expense, and either,

B. The facility is constructed to withstand partial or complete inundation ~~without significant~~with minimal or no damage~~;~~, or

C. ~~18.1.2~~ The facility is necessary to the operation of the reservoir~~; and~~.

~~18.1.3 The facility is capable of being restored with a minimum amount of cleaning or expense. Boat ramps, docks, and marinas are exempt from these Rules.~~

15.2 ~~18.2 **Existing** **Notice**~~. Any person planning to construct, enlarge, or modify any facility under this Rule shall provide written notice to the State Engineer at least one hundred eighty (180) days in advance of construction. State Engineer approval shall be obtained prior to construction.

15.3 **Exemptions.** Exemptions to this Rule include the following:

A. Facilities ~~This Rule does not apply to facilities~~ completed prior to July 1, 1984, ~~but shall apply to any~~excluding subsequent enlargements or modifications to such facilities.

~~18.3 **Construction Requirements** - Any person planning on constructing, enlarging, or modifying any facility coming under this Rule shall notify the State Engineer in writing 180 days in advance of construction. The notice shall include the following information:~~

~~18.3.1 The name and location of the reservoir and/or dam;~~

~~18.3.2 Whether the recreational facility is new, or an enlargement or modification to a facility completed prior to July 1, 1984;~~

~~18.3.3 A description of the facility, its intended purpose, and its location within the reservoir including depth below the high water line; and~~

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Heading 1, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Heading 2, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: List Number, Outline numbered + Level: 1 + Numbering Style: A, B, C, … + Start at: 1 + Alignment: Left + Aligned at: 0.5" + Indent at: 0.75", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt, Font color: Auto

Formatted: List Number, Outline numbered + Level: 1 + Numbering Style: A, B, C, … + Start at: 1 + Alignment: Left + Aligned at: 0.5" + Indent at: 0.75", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt, Font color: Auto

Formatted: Font: Arial, 10 pt, Not Bold

Formatted: List Number, Outline numbered + Level: 1 + Numbering Style: A, B, C, … + Start at: 1 + Alignment: Left + Aligned at: 0.5" + Indent at: 0.75", Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~18.3.4 A description of how the facility will be able to withstand the damage from the inundation without a significant amount of cleaning or expense to restore it.~~

Formatted: Header

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

~~18.4 **Approval Prior to Construction** No person shall be allowed to construct, enlarge, or modify any facility coming under this Rule until approved by the State Engineer.~~

B. ~~**Rule 19.**~~ Boat ramps, Docks, and Marinas are exempt from the notice and approval requirements of Rule 15.2.

Rule 16. Waiver or Delay of Enforcement of Rules by the State Engineer~~:~~

The State Engineer may waive or delay the enforcement of any of the responsibilities of ~~dam owners~~Owners under the foregoing Rules ~~in particular cases~~ if, in the State Engineer's judgment, dam safety will not be reasonably impaired and the circumstances of the individual case so ~~warrants. Such circumstances may include, but are not limited to,~~warrant. The State Engineer's decision will take into account the benefits that would be realized by full enforcement, the cost or difficulty of complete compliance, the ~~owner's~~Owner's good faith efforts to comply, the expected remaining life of the structure, and the impacts to beneficial use of water in Colorado.

Rule 17. ~~Rule 20.~~ Appeal of Requirements or Approval~~:~~

The applicant or any other person affected or aggrieved by the State Engineer's approval or disapproval of plans and specifications for construction of a reservoir/dam, or the alteration, modification, repair or enlargement of a reservoir or dam which will affect the safety of the structure may request an adjudicatory hearing before the State Engineer pursuant to ~~section 1.1.~~Rule 10(4~~(2)(vi)~~(c) of the Division of Water Resources' Procedural Regulations, ~~2 CCR 402-5. Such request must be made within thirty (30) days of the date of the State Engineer's determination and must identify the person(s) requesting the hearing and the basis upon which they believe error was committed in the determination.~~2 CCR 402-5. All adjudicatory hearings will be conducted pursuant to the requirements of the Division of Water Resources' Procedural Regulations and the State Administrative ~~Procedures~~Procedure Act, section 24-4-105, C.R.S.

Rule 18. ~~Rule 21.~~ Rules by Reference~~:~~

Certified copies of the complete text of the materials incorporated by reference in these Rules shall be maintained by the Office of the State Engineer and ~~state publications depository~~State Publications Depository and ~~distribution center~~Distribution Center, and shall be available for public inspection during business hours. The title and address of the Office of the State Engineer is: 1313 Sherman Street, Room 818, Denver, CO 80203. Materials incorporated by reference do not include any later amendments or editions to those materials.

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Heading 1, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Body Text, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 1, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Body Text, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 1, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Body Text, Keep lines together, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

Rule 19. ~~Rule 22.~~ Severability~~:~~

If any portion of these Rules and Regulations for Dam Safety and Dam Construction is found to be invalid, the remaining portion of the Rules shall remain in force.

Rule 20. ~~Rule 23.~~ Revision~~:~~

The State Engineer may revise these Rules and Regulations for Dam Safety and Dam Construction in accordance with section 24-4-103, C.R.S. Such revisions may be the result of new data or technology, or the submittal of a petition by an interested person pursuant to section 24-4-103~~(7), C.R.S. and 2 C.C.R. 402-5 1.1.3.B.2.~~ (7), C.R.S., and Rule 7.B.2 of the Division of Water Resources' Procedural Regulations, 2 C.C.R. 402-5.

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 1, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Body Text, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Heading 1, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Body Text, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

Rule 21. ~~Rule 24.~~ Statement of Basis and Purpose Incorporated by Reference~~:~~

The Statement of Basis and Purpose for the adoption of these Rules and Regulations for Dam Safety and Dam Construction is incorporated by reference as part of these Rules.

Rule 22. ~~Rule 25.~~ Effective Date~~:~~

These Rules shall become effective on January 1, ~~2007.~~

Formatted: Header

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Heading 1, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Body Text, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Heading 1, Tab stops: Not at -1" + 0.25" + 0.5" + 0.75" + 1" + 1.25" + 1.5" + 1.75" + 2" + 2.25" + 2.5" + 2.75" + 3"

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: DMMHGC+TimesNewRoman, 10 pt

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

Formatted: Header

~~FOR REFERENCE~~

~~COLORADO REVISED STATUES~~
~~TITLE 37, ARTICLE 87~~

~~RESERVOIRS~~

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

Formatted: Header

37-87-101. Storage of water.

(1) (a) The right to store water of a natural stream for later application to beneficial use is recognized as a right of appropriation in order of priority under the Colorado constitution. No water storage facility may be operated in such a manner as to cause material injury to the senior appropriative rights of others. Acquisition of those interests in real property reasonably necessary for the construction, maintenance, or operation of any water storage reservoir, together with inlet, outlet, or spillway structures or other facilities necessary to make such reservoir effective to accomplish the beneficial use or uses of water stored or to be stored therein, may be secured under the laws of eminent domain.

(b) State agencies shall, to the maximum extent practicable, cooperate with persons desiring to acquire real property for water storage structures.

(2) Underground aquifers are not reservoirs within the meaning of this section except to the extent such aquifers are filled by other than natural means with water to which the person filling such aquifer has a conditional or decreed right.

37-87-102. Definitions - natural streams and use thereof by reservoir owners.

(1) As used in this article, unless the context otherwise requires:

(a) "Mean annual flood" means a flood which has a magnitude (peak discharge) which is expected to be equalled or exceeded on the average once every 2.33 years and has a forty-three percent chance of being equalled or exceeded (0.43 exceedence probability) during any year, by application of the criteria defined in subsection (2) of this section.

(b) "Natural stream" means a place on the surface of the earth where water naturally flows regularly or intermittently with a perceptible current between observable banks, although the location of such banks may vary under different conditions.

(c) "One-hundred-year flood" means a flood which has a magnitude (peak discharge) which is expected to be equalled or exceeded on the average once during any one-hundred-year period (recurrence interval) and has a one percent chance of being equalled or exceeded during any year (0.01 exceedence probability). The terms "one-hundred-year flood", "one percent chance flood", and "intermediate regional flood" are synonymous.

(d) "One-hundred-year floodplain" means that area in and adjacent to a natural stream which is subject to flooding as a result of the occurrence of a one-hundred-year flood.

(e) "Ordinary high watermark" of any stream means the visible channel of a natural watercourse within which water flows with sufficient frequency so as to preclude the erection or maintenance of man-made improvements without special provision for protection against flows of water in such channel or the channel defined by the mean annual flood, whichever is greater.

(2) Whenever the records basic to a determination of probable future water flows, either with respect to this section or by other requirements of law, extend for a period of one hundred or more years, the calculation based upon those results shall be deemed conclusive. If such records do not extend for a period of one hundred or more years the determination shall be made by interpolation and correlation to a full one hundred years of records by relating them to known records of water basins as similar as reasonably possible to the basin under consideration or by other acceptable methods.

(3) (a) In any case in which a determination of probable future surface water flows at any place in the state is required, the calculation shall be based upon past surface water runoff at the place in question supplemented as provided in this section. Such probable flows shall be determined by reference to the records of reliable stream gauging stations. A stream gauging station record shall be deemed reliable if made by the state of Colorado or the United States as part of a regular program of either of those entities, except as to any part of such records which the state engineer shall have designated as being unreliable, on the basis of facts so showing. Whenever a designation of probable future runoff is required at a place other than the location of a reliable stream gauging station, the

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

determination of probable runoff at such other place shall be made by relating the probable future runoff at that place to the recorded runoff at a comparable gauging station or gauging stations by the interpolation of reasonable hydrologic, geologic, and natural vegetative factors supplemented as provided in this section. Unless clearly unrelated, the factors of the comparison shall include, but not be limited to, the following elements or characteristics:

(I) The water basin contributing to the probable future flow at the place where probable future runoff is to be determined, considering:

(A) The size;

(B) The altitude or altitudes;

(C) The various soil permeabilities;

(D) The various vegetative covers;

(II) The known runoff as determined by reliable stream gauging stations using interpolations when necessary from comparable gauging stations and relating interpolations to the characteristics of the basin measured by the comparable gauging stations as related to the basin of runoff being determined;

(III) The slope or slopes of the terrain whose surface runoff contributes to the surface water flows at the place at which a determination of probable future surface water flows is required.

(b) The state engineer shall promulgate rules pursuant to section 24-4-103, C.R.S., which include other factors for consideration in any area or situation in which calculations based on the criteria in paragraph (a) of this subsection (3) will probably be made more accurate by use of other or additional criteria. Whenever conditions are such that records of past precipitation are an appropriate factor, he may designate any portion of official precipitation records of agencies of the United States or of the state of Colorado which are appropriate in evaluating probable future water flows. He may approve use of factors referred to in this paragraph (b) with respect to particular areas or design of specific structures when requested to do so.

(c) No dam safety requirement shall be imposed to meet a potential hazard of a flood whose magnitude is such that the hazard would probably exist whether or not the dam failed.

(3.5) Whenever a determination of probable future surface water flows, or the probability of frequency of their recurrence, at any place in Colorado is required by relation to a longer period of flow than that for which there is a reliable record of flow as defined in subsection (3) of this section, the determination shall be made by interpolation and correlation of known records to the longer period by relating known records of water basins as similar as reasonably possible to the place of determination or basin under consideration, or by use of geologic determinations, or by use of other methods reasonably calculated to formulate an accurate estimate of probable future flows or the probability of frequency of their recurrence at the place of determination of such flows.

(3.7) Calculations of probable flows or frequency of recurrence based upon application of the principles set forth in subsections (3) and (3.5) of this section shall relieve anyone acting in accordance with such principles of any liability respecting an occurrence different than that predicted. This exemption from liability shall apply to the state and its public officials or employees when acting in performance of their public duties.

(4) The owners of any reservoir may conduct the waters legally stored therein into and along any of the natural streams of the state, but not so as to raise the waters thereof above ordinary high watermark, and may take the same out again at any point desired if no material injury results to the prior or subsequent rights of others to other waters in said natural streams. Due allowance shall be made for evaporation and other losses from natural causes for the protection of all rights to the waters flowing in said streams, such losses to be determined by the state engineer.

37-87-103. Notice of release of stored waters.

The owners of reservoirs who avail themselves of the provisions of this section and section 37-87-102 shall give reasonable prior notice to the irrigation division engineer of the irrigation division in which the

Formatted: Header

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

reservoir is located or to the chief administrative water official of such irrigation division of the date on which they desire to release stored waters into any natural streams, together with the quantity thereof in cubic feet per second of time, the length of period to be covered by such releases, and the name of the ditch, canal, pipeline, or reservoir to which the water so released from storage is to be delivered, to the end that the water officials in responsible charge of any stream into which such stored water is released shall have ample time in which to make the necessary observations measurements of flow and storage and records thereof and to provide for a proper patrol of the said stream, for the protection of the reservoir owner and also all other appropriators along the stream whose interests might be affected as a result of such reservoir release. Such notice may be given to the division engineer when the reservoir from which the water is to be released and the point where the water is to be taken from the stream or again stored are in the same water district.

37-87-104. Liability of owners for damage.

(1) Any provision of law to the contrary notwithstanding, no entity or person who owns, controls, or operates a water storage reservoir shall be held liable for any personal injury or property damage resulting from water escaping from that reservoir by overflow or as a result of the failure or partial failure of the structure or structures forming that reservoir unless such failure or partial failure has been proximately caused by the negligence of that entity or person. No entity or person shall be required to pay punitive or exemplary damages for such negligence in excess of that provided by law. Any previous rule of law imposing absolute or strict liability on such an entity or person is hereby repealed.

(2) No such entity or person shall be liable for allowing the inflow to such reservoir to pass through it into the natural stream below such reservoir.

(3) (a) No stockholder, officer, or member of a board of directors of an owner of a reservoir shall be liable for any personal injury or property damage resulting from water escaping from such reservoir or as a result of the failure or partial failure of the structure or structures forming such reservoir for which the owner shall have been found liable if a valid liability insurance policy, or adequate substitute as provided in paragraph (b) of this subsection (3), has been purchased by the owner of the reservoir and is in effect at the time such damage occurs. Such insurance policy shall insure against such damages and provide coverage in an amount of not less than fifty thousand dollars for each claim and in an aggregate amount of not less than five hundred thousand dollars for all claims which arise out of any one incident. The policy may provide that it does not apply to any act or omission of a stockholder, officer, or member of a board of directors of an owner if such act or omission is dishonest, fraudulent, malicious, or criminal. The policy may also contain other reasonable provisions with respect to policy periods, territory, claims, conditions, and other matters common to such policies of insurance. The limitation of liability pursuant to this paragraph (a) shall not apply to any criminal, fraudulent, or malicious act or omission by a member of the board of directors of the owner, an officer of the owner, or a stockholder of the owner, nor shall it apply to any ultra vires act of the owner or of a member of the board of directors, an officer, or a stockholder of such owner. The provisions of this paragraph (a) shall not be deemed to impose any liability upon a member of the board of directors, an officer, or a stockholder of the owner of a reservoir beyond that provided in section 7-42-118, C.R.S.

(b) An adequate substitute for such insurance may be in the form of:

(I) A good and sufficient bond, in an amount equal to such recovery limitations duly executed by a qualified corporate surety approved by the commissioner of insurance, conditioned upon the payment by the entity or person who owns, controls, or operates a water storage reservoir of any valid and final judgment for damages imposed within the judgment limitations established in this subsection (3);

(II) A good and sufficient escrow of acceptable securities, as defined in section 24-91-102, C.R.S., or an annual irrevocable letter or annual letters of credit issued by any national or state bank or any bank for cooperatives as chartered under Title III of the "Federal Farm Credit Act of 1971", as amended, and deposited with an escrow agent pursuant to an escrow contract or agreement requiring the escrow agent to pay from the escrow account amounts necessary to discharge a valid and final judgment for damages within the limits established in this subsection

Formatted: Header

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

(3). Such escrow contract or agreement shall provide that it cannot be revoked or amended until after any claims for damage against such entity or person have been discharged or until applicable statutes of limitations pertaining thereto have expired.

(III) A combination of insurance and any of the substitutes described in this paragraph (b).

37-87-104.5. Notification of ownership of dam - when person in control deemed owner.

The person or persons actually in control of the physical structure of any dam shall be deemed, for determining liability arising from ownership of a dam and with respect to operation thereof, to be the owners thereof unless notice of the name and address of the true owner thereof, together with reasonable evidence of such ownership, has been filed in the office of the state engineer by January 1, 1985. Any change in ownership shall be immediately filed in the office of the state engineer.

37-87-105. Approval of plans for reservoir - notice of modification.

(1) No dam shall be constructed in this state to impound water above the elevation of the natural surface of the ground for the purpose of creating a reservoir with a capacity of more than one hundred acre-feet of water or with a surface area at the high water line in excess of twenty acres or if the height of the dam will exceed ten feet measured vertically from the elevation of the lowest point of the natural surface of the ground, where that point occurs along the longitudinal centerline of the dam, up to the flowline crest of the spillway of the dam before plans and specifications for that dam have been filed in the office of the state engineer and approved by him in accordance with regulations established by the state engineer governing such structures.

(2) Repealed.

(3) In making his determination for approval, the state engineer shall be guided by dam, spillway, and construction regulations established pursuant to this article. Such regulations may include less stringent requirements than those dictated by consideration of probable maximum precipitation. The state engineer shall issue his written decision regarding the approval of plans and specifications within one hundred eighty days of submittal to him. The state engineer shall have authority to require the material used and the work of construction to be accomplished in accordance with regulations which the state engineer may establish. No work shall be deemed complete until the state engineer furnishes to the owners of such structures a written statement of acceptance, which statement shall specify the dimensions of such dam and capacity of such reservoir. The state engineer shall render his written decision regarding acceptance within sixty days of written notification by the owner that construction has been completed.

(4) No alteration, modification, repair, or enlargement of a reservoir or dam which will affect the safety of the structure shall be made without prior written notice and approval in accordance with this section to the state engineer. General maintenance, ordinary repairs, or emergency actions not impairing safety shall be excluded from the terms of this subsection (4).

37-87-106. Cost of inspections and observation. (Repealed)

37-87-107. Safety inspections - amount of water to be stored.

Dam safety inspections shall be made on all dams within the state by qualified, experienced personnel as often as the state engineer deems necessary or appropriate for the protection of public health and safety so that a determination of the amount of water which is safe to impound in the reservoir can be made by the state engineer. The dam safety inspections shall include, but shall not be limited to, review of previous inspections, reports and drawings, site inspection of the dam, spillways, outlet facilities, seepage control

Formatted: Header

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

and measurement system, and permanent monument or monitoring installations, if any. Based upon inspection reports and other information affecting the safety of each dam, the state engineer shall determine the amount of water which is safe to impound in the reservoir. It is unlawful for the owners of any reservoir to store in said reservoir water in excess of the amount so determined by the state engineer to be safe.

37-87-108. Withdrawal of excess water.

If the owners of any such reservoir impound water therein to a depth greater than that determined by the state engineer to be safe, it is the duty of the division engineer of the district wherein such reservoir is located to forthwith proceed to withdraw from said reservoir so much of the water as shall be in excess of the amount so determined by the state engineer to be safe, and the division engineer shall close the inlets to the same to prevent said reservoir from being refilled to an amount beyond what said state engineer has designated as being safe. If the owners of said reservoir, or any other persons, interfere with the division engineer in the discharge of said duty, the said division engineer shall call to his aid such persons as he deems necessary and employ such force as the circumstances demand to enable him to comply with the requirements of this section. Any costs incurred by the state engineer in rectifying a failure of compliance by the owner may be recovered in a suit for civil damages.

37-87-108.5. Emergency actions.

(1) If, in the opinion of the state engineer, conditions of any dam or reservoir are so dangerous to the health and safety of life or property as not to permit time for issuance and enforcement of an order relative to construction, modification, maintenance, or restriction of storage, or the dam is threatened by any large flood, the state engineer may immediately employ remedial measures necessary to protect such life and property.

(2) (a) The state engineer shall maintain complete control of any such dam or reservoir which, pursuant to subsection (1) of this section, has been determined to be dangerous to life or property until such dam or reservoir is deemed safe, or until any emergency conditions which precipitated the state engineer taking control of any such dam or reservoir, pursuant to subsection (1) of this section, have abated. The state engineer is hereby empowered to determine the proper time at which to relinquish control of any such dam or reservoir.

(b) For purposes of this paragraph (b), measures taken by the state engineer pursuant to subsection (1) of this section shall be deemed final action by the state engineer for purposes of judicial review. The owner or operator of any dam upon which the state engineer has employed remedial measures pursuant to subsection (1) of this section may seek judicial review of the propriety of such measures by filing an action in the state district court for the district in which such dam is located.

(3) (a) Any necessary and reasonable costs and expenses incurred by the state engineer in fulfilling the duties mandated by subsections (1) and (2) of this section in connection with a remedial or emergency action shall be recoverable by the state engineer from the owner of any such dangerous or threatened dam.

(b) Any owner failing or refusing, after written notice has been given, to pay the reasonable costs and expenses incurred by the state engineer pursuant to paragraph (a) of this subsection (3) shall be, upon complaint by the state engineer to the attorney general, subject to reasonable attorney fees incurred in the recovery of such costs and expenses.

(4) (a) All moneys collected by the state engineer pursuant to subsection (3) of this section shall be credited to the emergency dam repair cash fund created in section 37-60-122.5, to the extent necessary to replenish the account. Moneys collected in excess of such amount shall be credited to the Colorado water conservation board construction fund.

Formatted: Header

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

(b) The general assembly shall make annual appropriations from the emergency dam repair cash fund created in section 37-60-122.5, for the direct and indirect costs incurred by the state engineer in the performance of those duties authorized to be carried out by the state engineer in this section.

37-87-109. Complaint that reservoir is unsafe.

Upon complaint being made to the state engineer by one or more persons residing or having property in such a location that their homes or property would be in danger of destruction or damage in the event of a flood occurring on account of the breaking of the embankment of any reservoir within the state, that said reservoir is in an unsafe condition, or that it is being filled with water to such an extent as to render it unsafe, it is the duty of the state engineer to forthwith examine said reservoir and determine the amount of water it is safe to impound therein. If, upon such examination, the state engineer finds that said reservoir is unsafe, or is being filled with water to such an extent as to render it unsafe, it is his duty to immediately cause said water to be drawn from said reservoir to such an extent as will, in his judgment, render the same safe. If water is then flowing into said reservoir, he shall cause it to be discontinued

37-87-110. Engineer may use force.

The state engineer is authorized to use such force as is necessary to perform the duties required of him in section 37-87-109 and to have and exercise all of the powers conferred upon the division engineer by section 37-87-108. If, after any of such reservoirs have been examined by said state engineer, the owners thereof, or any other person, fills or attempts to fill them, or any of them, to a point in excess of the amount the state engineer has determined to be safe, then it is the duty of the division engineer of the district wherein such reservoir is located to proceed as directed by section 37-87-108. All direct, actual, and necessary expenses incurred in performing any action authorized by this section shall be recoverable by the state engineer from the owner of the affected reservoir and if not reimbursed may be collected by action brought by the state engineer in the district court of the county in which the reservoir, or part thereof, is located.

37-87-111. Expense of examination.

The person calling upon the state engineer to perform the duty required of him by section 37-87-109, if the request is frivolous or made in bad faith, shall pay him any invoiced expenses and mileage at the rate prevailing for state officers and employees under section 24-9-104, C.R.S., for each mile actually and necessarily traveled in going to and from said reservoir, and, should the state engineer find upon examination that such reservoir is in an unsafe condition, the owners thereof shall be liable for all expenses incurred in such examination.

37-87-112. Review of action of state engineer.

Any action of the state engineer under section 37-87-110 shall be subject to review in a de novo proceeding commenced by complaint of the owner in the district court in and for the county where the affected structure is located. When the state engineer has directed that certain measures shall be taken immediately for the protection of the public safety, any such judicial proceeding shall be accelerated on the court's calendar and determined immediately upon the conclusion of such proceeding. The judgment and action of the state engineer shall control until judicial determination of the cause.

37-87-113. Breakage of reservoir - damages. (Repealed)

37-87-114. Penalty - disposition of fines.

Formatted: Header

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

(1) Any reservoir owner or operator failing or refusing, after notice in writing has been given, to obey the reasonable directions of the state engineer as to the construction or safe operation of any reservoir shall be subject to a fine of not less than five hundred dollars for each offense, and each day's continuance after time of notice has expired shall be considered a separate offense. Such fines shall be recovered by civil action in the name of the people by the district attorney, upon the complaint of the state engineer, in the district court of the county where the injury complained of occurred. The proceeds of all fines, after payment of costs and charges of the proceedings, shall be paid into the county treasury for the use of the general fund of the county.

(2) Upon the complaint of the state engineer, the attorney general is authorized to commence proceedings against any reservoir owner or operator for refusing, after notice in writing has been given, to obey the directions of the state engineer as to the construction or safe operation of any reservoir to secure compliance with any such reasonable direction necessary for public safety in the district court of the county wherein any portion of such reservoir is located, pursuant to the Colorado rules of civil procedure; except that, if it appears to the court that the public safety is in jeopardy as the result of a failure to obey the directions of the state engineer, the court shall expedite the proceedings so that determinations may be made with respect to the directions of the state engineer commencing not later than twenty days from the service of the complaint on the owner or operator of a reservoir.

37-87-114.4. Annual report.

The state engineer shall submit an annual report to the general assembly by November 1 of each year concerning the activities of the state engineer and the division of water resources relating to sections 37-87-105 to 37-87-114 for the preceding fiscal year. In addition to the copies required to be filed as provided in section 24-1-136 (9), C.R.S., a copy of such report shall be provided to each of the following: The governor and the chairmen of the committees of reference of the senate and the house of representatives dealing with agriculture and natural resources. Such report shall include but not be limited to information on the following: Approvals of plans and specifications for construction of dams and reservoirs and for alterations, modifications, repairs, and enlargements; number of safety inspections made and the results thereof; use of appropriated funds; receipts generated for inspections of dams and reservoirs; rules and regulations adopted or amended; enforcement orders and proceedings; dam failures and reasons therefor; and other available data regarding the effectiveness of the state's dam and reservoir safety program.

37-87-114.5. Applicability of provisions - exemptions.

(1) The provisions of sections 37-87-105 to 37-87-114 shall not apply to:

(a) Structures not designed or operated for the purpose of storing water;

(b) Mill tailings impoundment structures permitted under article 32 or 33 of title 34, C.R.S.;

(c) Uranium mill tailings and liquid impoundment structures permitted under article 11 of title 25, C.R.S.; except that the state engineer shall render such consultation as necessary for the permitting of such structures;

(d) Siltation structures permitted under article 33 of title 34, C.R.S.; or

(e) Structures which store water only below the elevation of the natural surface of the ground.

37-87-115. Damages.

The provisions of this article are undertaken by the state of Colorado in the discretionary exercise of its governmental authority; therefore, neither the state of Colorado nor the state engineer, any member of his staff, or any person appointed by him shall be liable in damages for any act done by him or for his failure to act in pursuance of the provisions of this article. In addition, the state engineer, any member of his

Formatted: Header

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

staff, and any person appointed by him shall have the same immunity from liability as other public employees pursuant to the provisions of article 10 of title 24, C.R.S.

37-87-116. Tax reduction where reservoirs located. (Repealed)

37-87-117. Landowner to submit plans. (Repealed)

37-87-118. State engineer's authority over construction. (Repealed)

37-87-119. Completion of dam. (Repealed)

37-87-120. Reduction in valuation for assessment. (Repealed)

37-87-121. Application to existing dams. (Repealed)

37-87-122. Erosion control dams.

(1) The provisions of sections 37-87-101 to 37-87-108 shall not apply to erosion control dams of the character defined in this section, unless such dams also come within the specification requirements of said sections.

(2) Erosion control dams for reservoirs may be constructed on watercourses, the channels of which have been determined by the state engineer to be normally dry, having a vertical height not exceeding fifteen feet from the bottom of the channel to the bottom of the spillway, and having a capacity not exceeding ten acre-feet at the emergency spillway level, upon approval of an application for such erosion control dam by the state engineer, which application shall be accompanied by a fee of fifteen dollars. The approval by the state engineer of an erosion control dam shall be chronologically numbered in order of approval and in concert with any livestock water tanks approved pursuant to section 35-49-109, C.R.S. When such reservoirs are to be constructed with such height exceeding fifteen feet and such capacity exceeding ten acre-feet, they shall be constructed in accordance with section 37-87-105.

(3) Such reservoirs may be constructed with a capacity in excess of two acre-feet if, at or below the two acre-feet level, an ungated outlet tube is installed, with twelve inches minimum diameter and large enough to assure adequate capacity to drain within thirty-six hours any impoundment in excess of two acre-feet.

(4) The state engineer shall prepare and keep on file at the office of the state engineer standard specifications for erosion control dams which shall be subject to revision by the state engineer and shall in general be used as a guide by persons proposing to construct such dams.

(5) The fees collected pursuant to subsection (2) of this section shall be deposited by the state engineer with the state treasurer, who shall credit all such fees to the general fund of the state.

37-87-123. Dam and reservoir information. (Repealed)

Formatted: Header

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

Formatted: Header

~~37-87-124. Restriction of facilities within reservoirs.~~

~~(1) The general assembly hereby declares that the prevention of seasonal flooding which causes destruction of property and crops, loss of livestock, and risk or loss of human life is manifestly of greater concern and benefit to this state than the availability of recreational facilities and other facilities, not functionally related to the operation of the reservoir, constructed below the high water level of a reservoir.~~

~~(2) In order to achieve the purposes of subsection (1) of this section, no person, including any state or federal agency, quasi-municipal corporation, or political subdivision, shall construct any permanent recreational structure within a reservoir below the elevation at the crest of the spillway of the reservoir unless such facility is constructed in such a manner as to withstand partial or complete inundation and sustain minimal or no damage thereby or unless such facility is necessary to the operation of the reservoir. Said facility should be capable of being restored to full recreational use with a minimum amount of cleaning or expense. This subsection (2) and subsection (3) of this section shall not apply to facilities completed before July 1, 1984, but shall apply to any enlargement or remodeling of such facilities.~~

~~(3) The state engineer shall order the removal of any facilities constructed, enlarged, or remodeled in violation of this section. Such order may be appealed by the affected person or enforced by the state engineer pursuant to article 4 of title 24, C.R.S.~~

~~37-87-125. Notice of intent to construct impoundment structure.~~

~~Any person proposing to construct a reservoir for the purpose of storing water, other than a reservoir specified in section 37-87-105 (1) or a livestock water tank as described in section 35-49-103, C.R.S., shall submit notice thereof to the state engineer prior to the beginning of any construction. Such notice shall include the location of such proposed reservoir with reference to section, township, and range and the dimensions of the reservoir, the dam, and the spillway. If any reservoir is constructed without the notice required by this section, the state engineer may prohibit the storage of water in such reservoir or direct the withdrawal of water from such reservoir. The provisions of this section shall not apply to structures listed in section 37-87-114.5.~~

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

Formatted: Header

~~FOR REFERENCE~~

~~COLORADO REVISED STATUES~~
~~TITLE 35, ARTICLE 49~~

~~LIVESTOCK WATER TANKS~~

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

Formatted: Header

~~35-49-101. Short title.~~

~~This article shall be known and may be cited as the "Livestock Water Tank Act of Colorado".~~

~~35-49-102. Legislative declaration.~~

~~It is the policy of the state of Colorado to encourage and improve range conditions for livestock within its borders through the construction of watering tanks, to provide a system of priorities of right of use thereof, and to protect adjudicated water rights and the public interest by providing an official record and reasonable public supervision of such watering tanks.~~

~~35-49-103. Definitions.~~

~~As used in this article, unless the context otherwise requires:~~

~~(1) "Livestock water tanks" includes all reservoirs created by dams constructed after April 17, 1941, on watercourses, the channels of which are normally dry as determined by the state engineer, having a capacity not exceeding ten acre feet and a vertical height not exceeding fifteen feet from the bottom of the channel to the bottom of the spillway to be used for stock watering purposes.~~

~~35-49-104. Statutes inapplicable.~~

~~The provisions of sections 37-87-101 to 37-87-108 and 37-87-114 to 37-87-115, C.R.S., shall not apply to livestock water tanks of the character defined in section 35-49-103.~~

~~35-49-105. Not used for irrigation.~~

~~No livestock water tanks constructed under the provisions of this article shall be used for irrigation purposes, and nothing contained in this article shall be construed as conferring upon the owner of any such livestock water tank a priority of use superior to any vested water right or to an adjudicated appropriation of water pursuant to state laws. Unless built upon an intermittent or perennial main stream, dams creating such livestock water tanks shall be deemed to have a rebuttable presumption that there is no injury to adjudicated water rights when built pursuant to the specifications set forth in section 35-49-103. If used solely for watering of livestock in areas known to be deficient in windmill water, having a pumping capacity of less than five gallons per minute, dams of greater capacity than those designated in section 35-49-103 may be constructed on any ephemeral stream, but in such event, the state engineer may require the construction of drainage facilities to reduce the water impounded in the reservoir to the capacity prescribed in section 35-49-103, within a thirty-six hour period.~~

~~35-49-106. Plans submitted to state engineer.~~

~~Anyone proposing to construct a dam for the creation of a livestock water tank, as described in section 35-49-103, shall submit to the state engineer for approval an application on a form provided by the state engineer showing the general location of such proposed dam with reference to section, township, and range, location and dimensions of spillway, and the number, location, and size of dams already constructed within the watersheds of the dry channel on which such dam is proposed to be built. Nothing contained in this section shall be construed to specify plans and specifications of such technical detail or nature as to require preparation by an engineer or construction of such stock water tanks under the supervision of an engineer; it being the intent and purpose of the provisions of this section that the state engineer shall be apprised by the completed application of pertinent information sufficient to enable the state engineer to ascertain the general location of the water tank, its operation in relation to tanks already constructed, its relative priority rights, its effect on existing appropriations of water, its capacity, its dam~~

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

dimensions, the necessary and reasonable factors of safety, and its compliance with the provisions of this article.

35-49-107. Construction requirements.

(1) The state engineer shall examine each application submitted and, if the state engineer approves the same, shall return one copy of each such application with the approval of the state engineer thereon to the person submitting the same and file the other copy at the office of the state engineer. If the state engineer disapproves such application, or any part thereof, the same shall be returned to the applicant for correction and revision. In cases where the state engineer deems it necessary, before approval thereof, the state engineer may inspect the proposed water tank site and make such independent investigation as necessary. Whether the state engineer approves such application, or disapproves it and returns the same for correction and revision, the state engineer shall act within fifteen days after the application is submitted. Until the approval by the state engineer of an application has been obtained, the construction of such dam is prohibited.

(2) The provisions of this section and section 35-49-112 specifying approval by the state engineer and providing a fee therefor shall not apply to dams having a vertical height not exceeding five feet from the bottom of the channel to the bottom of the spillway and which impound not more than two acre feet of water.

(3) Anyone proposing to construct a dam for the creation of a livestock water tank, as described in section 35-49-103, shall comply with section 35-49-106. Every owner of a proposed reservoir for stock watering purposes who desires to obtain a priority number for such structure shall comply fully with all pertinent provisions of this article.

35-49-108. State engineer to inspect dam.

When such a dam is completed the state engineer shall be notified of such completion and, thereafter, may inspect said stock water tank. If the state engineer finds that the construction fails to conform with the application approved by the state engineer, it then becomes the duty of the owner of such dam to make such change and corrections therein as the state engineer has determined to be necessary to correct such failure, and when the same have been made, the state engineer shall provide in writing approval of such structure. Approval shall be granted by the state engineer upon reasonable compliance with the approved application and standard specifications. A livestock water tank shall not be disapproved because of failure to observe technical engineering details in construction.

35-49-109. Priority determined, how.

The state engineer's certificate of approval of a livestock water tank on each normally dry stream and its tributaries shall be chronologically numbered in the order of approval and in concert with any erosion control dams approved pursuant to section 37-87-122, C.R.S. Priority of right as between such tanks located on or within the watershed of each such dry stream shall be determined by such numbers seriatim, number one being first in such right.

35-49-110. Standard plans - publication.

The state engineer shall prepare and keep in file at the office of the state engineer standard plans, drawings, and specifications for livestock water tanks, which shall be subject to revision by the state engineer and shall in general be used as a guide by persons proposing to construct such tanks. Publication of these plans shall be subject to the approval and control of the executive director of the department of natural resources.

Formatted: Header

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right

Formatted: Header

~~35-49-111. When conduits not required.~~

~~Where, in the judgment of the state engineer, tanks upon any stream and its tributaries do not require conduits for purposes of safety or the protection of prior livestock water tank rights, it is lawful for the state engineer to approve an application not calling for conduits. Nothing in this section shall abrogate the right of any owner of a vested water right or appropriation of water to require such conduits in any case where necessary to protect such senior right.~~

~~35-49-112. Fees deposited in general fund.~~

~~Each application for a livestock water tank submitted to the state engineer under the provisions of this article shall be accompanied by a fee of fifteen dollars. This fee shall be deposited by the state engineer with the state treasurer who shall credit all such fees to the general fund of the state.~~

~~35-49-113. Assignment of priority number. (Repealed)~~

~~35-49-114. Approval required for reservoir. (Repealed)~~

~~35-49-115. Penalty.~~

~~The owner of any dam or reservoir failing to comply with the provisions of this article shall be subject to a penalty of not more than twenty-five dollars nor less than five dollars, to be recovered and disposed of as are fines for violations of section 37-87-114, C.R.S.~~

~~35-49-116. Appropriation - transfer of funds.~~

~~The general assembly shall annually appropriate from the general fund moneys for the administration of this article.~~

2020.

Formatted: Body Text

Formatted: Normal, Space After: 18 pt, Tab stops: 6.5", Right