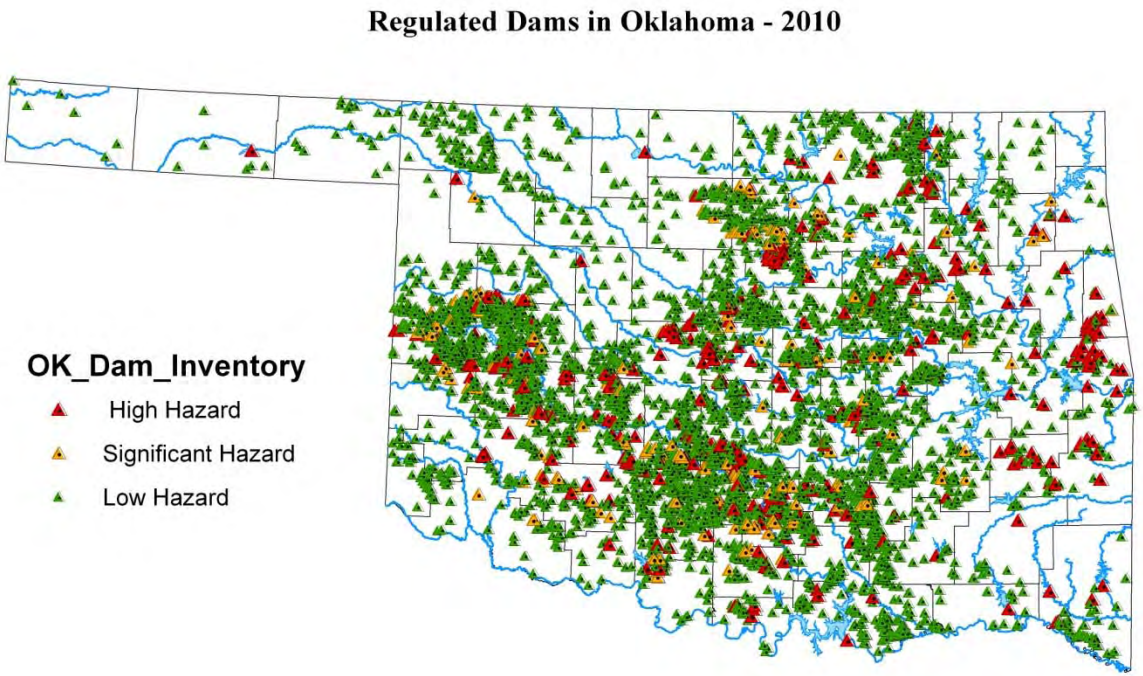
Oklahoma Dam Safety Program

What You Don't Know Can Hurt You

Dams in Oklahoma



4,540 Non-Federal Dams

4,018 low hazard

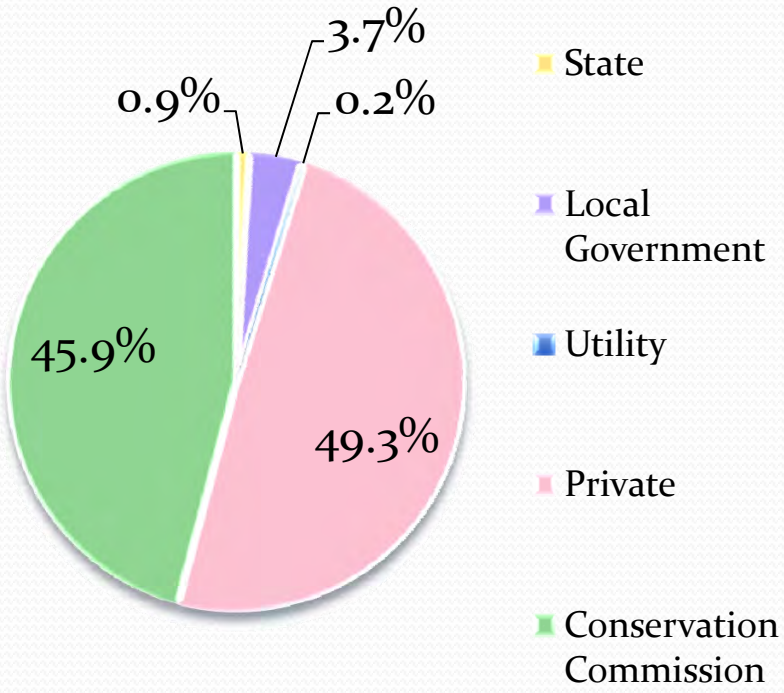
202 significant hazard

320 high hazard

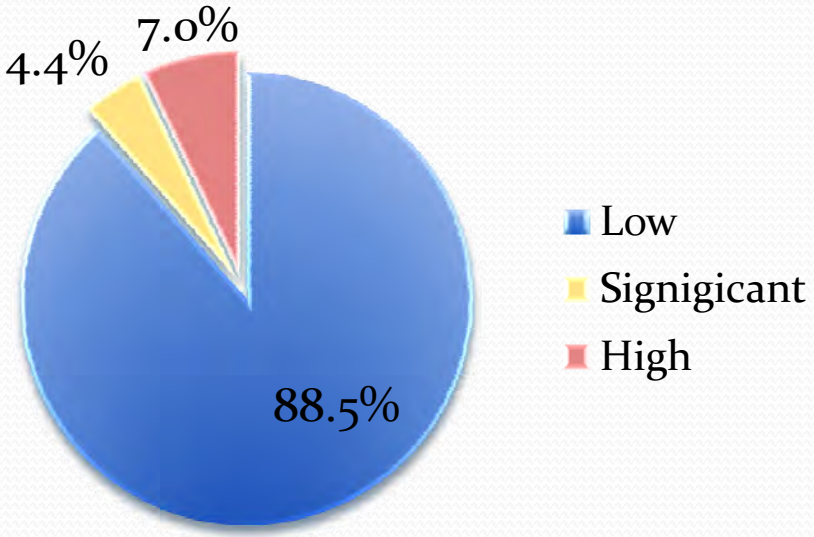
2,081 Conservation Commission (SCS) Dams

2,459 Non-SCS Dams

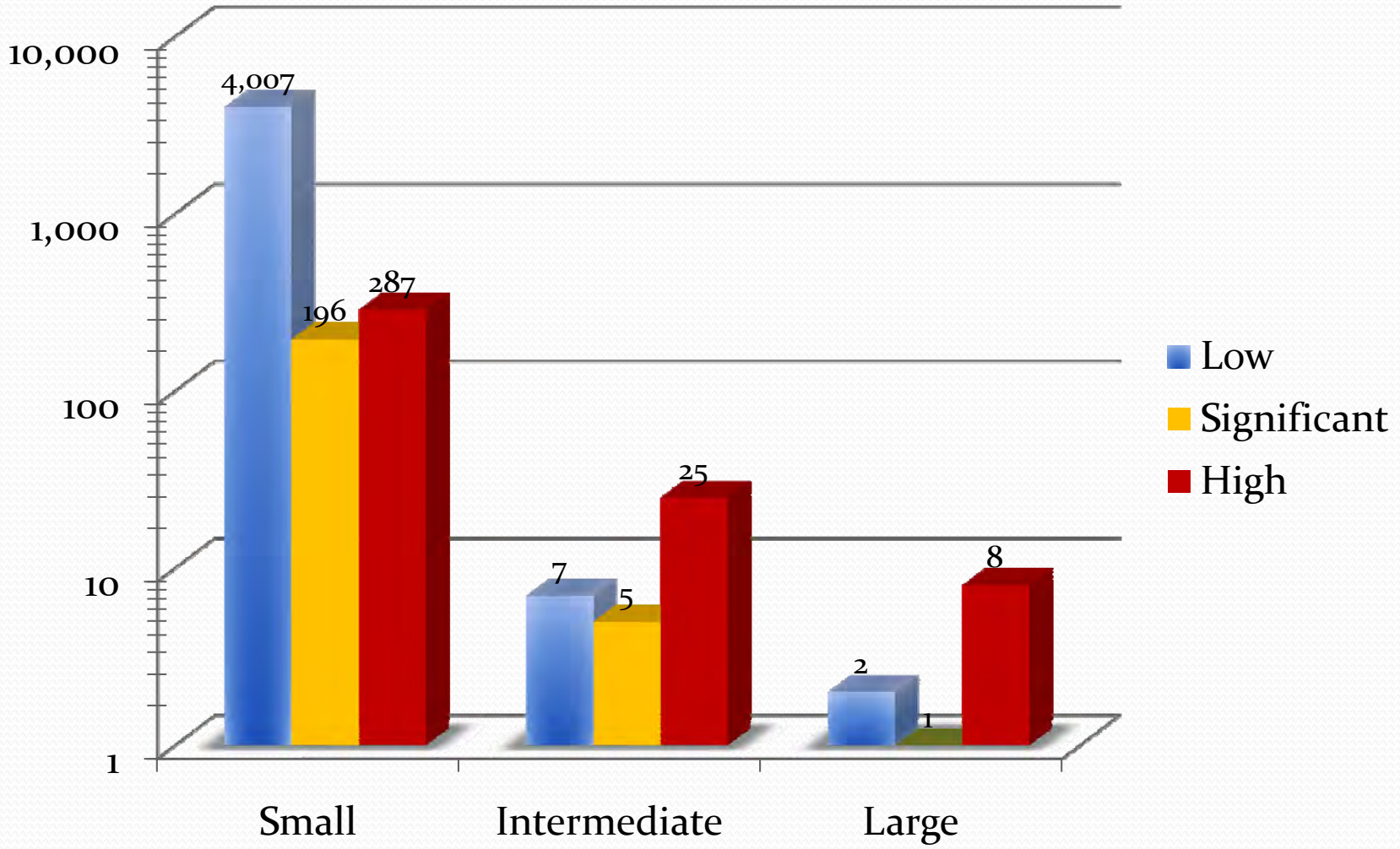
Owner Type



Hazard Classification



Size of Dams


10,000
1,000
100
10
1
4,007
196
287
7
5
25
2
1
8
Small
Intermediate
Large
Low
Significant
High

TITLE 785.
CHAPTER 25. DAMS & RESERVOIRS

Definitions

"Dam" means any artificial barrier, together with appurtenant works, which does or may impound or divert water.

"Enlargement" means any change in or addition to an existing dam or reservoir which raises or may raise the water storage elevation of the water impounded by the dam or reservoir.

"Loss of human life" means the human fatalities that would result from a failure of the dam, excluding the occasional passer-by or recreationist and without considering evacuation or other emergency actions.

"Owner" means any person who, jointly or severally, owns, controls, maintains, manages, or proposes to construct a dam or reservoir, and includes those shown by records of the county registrar of deeds to have some interest, fee, easement or otherwise, in the land on which the dam and lake lie and may also include those persons who may derive a direct pecuniary benefit from the existence of the lake [82:110.3].

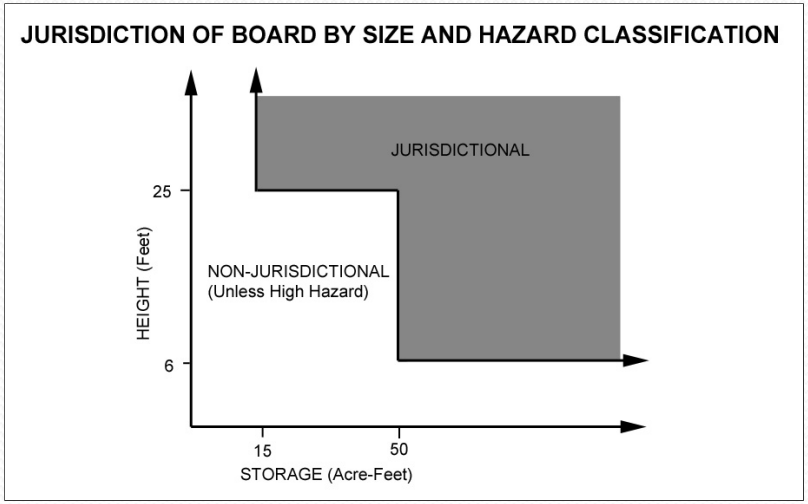
"Repairs" means only such repairs as may affect the safety of a dam or reservoir.

Subchapter 3 - Responsibility, Classification, and Design Standards

Dams subject to Board's jurisdiction

- Height of dam is 25 feet or greater and storage of 15 af or more.
- Height of dam is 6 to 25 feet and storage of 50 af or more.
- Any sized dam determined to be high hazard-potential.

*Based on maximum storage of dam.



Dams constructed by any agency of the United States Government shall not be subject to regulation under this Chapter during or after construction while such dams remain under the supervision of any officer or agency of the United States [82:110.4].

Owner's responsibility

(1) Owners of dams shall have the responsibility to provide for the safety of such works by making any necessary changes to put the works in a safe condition.

(2) Such responsibility includes but is not necessarily limited to the following: the filing of an application to construct, enlarge, alter or repair the dam pursuant to Subchapter 5 … and the adequate maintenance, operation, and inspection of a existing dam.

Classification of size and hazard potential

All dams shall be classified as to size and for potential hazards as follows:

1) Size Classification of Dams. The size classification shall be based on the following chart:

Size Classification	Maximum Storage (Acre-Feet)	Maximum Height (Feet)
Small	Less than 10,000	And less than 50
Intermediate	Between 10,000 and 50,000	Between 50 and 100
Large	Over 50,000	Over 100

(2) Classification of Hazard Potential. The hazard-potential classification of a dam is determined by the downstream risk in the event of a failure, without regard to the physical condition of the dam, as follows:

Hazard-Potential Classification	Description
Low	Those dams where failure would result in no probable loss of human life and low economic losses.
Significant	Those dams where failure would result in no probable loss of human life but can cause economic loss or disruption of lifeline facilities.
High	Those dams where failure will probably cause loss of human life.

Minimum spillway performance standards

(a) General performance standards.

(1) . . . **all dams must meet or exceed the following performance standards as determined by analysis of plans and specifications for the dam and existing site conditions**.

(2) **Owners of existing dams which do not meet the following performance standards must make necessary changes in the dam to meet the applicable performance standards.**

(3) The discharge capacity and/or storage capacity of the project shall be capable of passing the indicated spillway design flood without infringing on the minimum freeboard requirements, provided that a design which includes overtopping of the dam may be authorized if specifically approved by the Board.

(b) Minimum Performance Standards.

MINIMUM SPILLWAY

Size	Hazard	Design Flood	Minimum Freeboard
Small	Low	25% PMF	0 Feet
Small	Significant	40% PMF	0 Feet
Small	High	50% PMF	1 Foot
Intermediate	Low	25% PMF	1 Foot
Intermediate	Significant	50% PMF	1 Foot
Intermediate	High	75% PMF	3 Feet
Large	Low	50% PMF	1 Foot
Large	Significant	75% PMF	1 Foot
Large	High	100% PMF	3 Feet

* PMF means and refers to the Probable Maximum Flood and is defined as the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region as listed in Hydrometeorological Report No. 51, National Weather Service.

Prohibited construction

No construction or excavation other than that necessary for the operation, maintenance, investigation and monitoring of the dam and reservoir, shall be allowed on a dam or spillway structure or within fifty (50) feet from the line where such dam or spillway structure meets the natural grade unless otherwise ordered by the Board after a showing by substantial, competent evidence that the proposed construction will not affect the integrity of the dam or spillway structure.

Prohibited vegetation and erosion

Trees and heavy vegetation shall be removed from the slopes and crest of earthen embankments and emergency spillway area. Trees and heavy vegetation shall also be removed from an area a minimum distance from the toe of the embankment of 30 feet. Dams shall be maintained such that internal or external erosion is prevented. If erosion is present it shall be repaired utilizing appropriate engineering practices.

Subchapter 5. Applications & Approval of Construction

785:25-5-1. Application requirement

785:25-5-2. Plans and specs to be prepared by registered P.E.

785:25-5-3. Content of plans and specs

785:25-5-4. Engineer's report to accompany plans and specs

785:25-5-8. Approval or denial of application

a. Proposal is safe and not a menace to life and property and conforms with statutes and rules; approval may include prescribe conditions.

b. Construction must commence within 2 years or else approval lapses.

c. No impoundment of water until all requirements met

Subchapter 7. Post Approval Actions

1. Inspection during construction to assure substantial conformity with approved plans and specs;
2. Construction shall be under the responsible charge of a registered P.E. who must certify, upon completion and prior to impoundment, that construction was done in accord with approved plans and specs;
3. Notice of completion and filing supplementary drawings or descriptive matter showing “as built”;
4. Owner of high hazard dam shall have an emergency action plan, which provide a mechanism to warn individuals located within the dam breach inundation area, reviewed by and filed with local Emergency Management officials and OWRB;
5. Inspection after notice of completion; issuance of certificate of completion; notice and hearing of proposed modification or revocation.

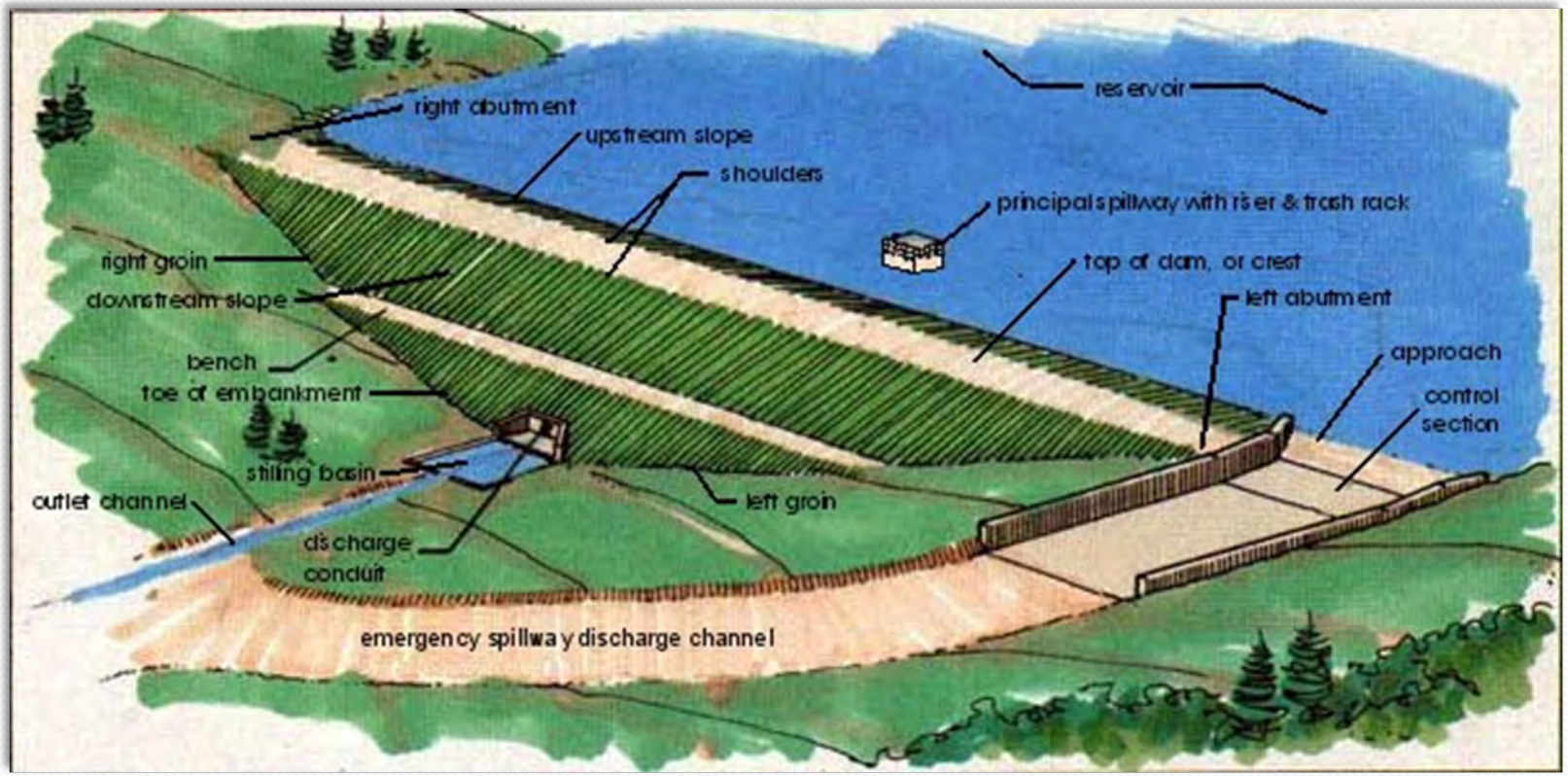
Subchapter 9. Actions After Construction

- Owners must have dams inspected
  - High hazard dams – annually by PE
  - Significant hazard dams – once every 3 years by PE
  - Low hazard dams - dam owner must assess if there has been down-stream development below their dam once every five years
- Unscheduled inspections by OWRB staff
- Owner shall promptly advise OWRB by telephone of any sudden or unprecedented circumstance affecting the dam's safety.
- Breach analysis for existing dams
  - If an existing dam does not have a breach analysis, and a failure might put lives at risk downstream, then after the next regularly scheduled inspection the Board's Engineer may direct the owner to provide a breach analysis and breach inundation map, utilizing modeling and analysis guidelines provided by the Board, and according to a reasonable schedule of compliance

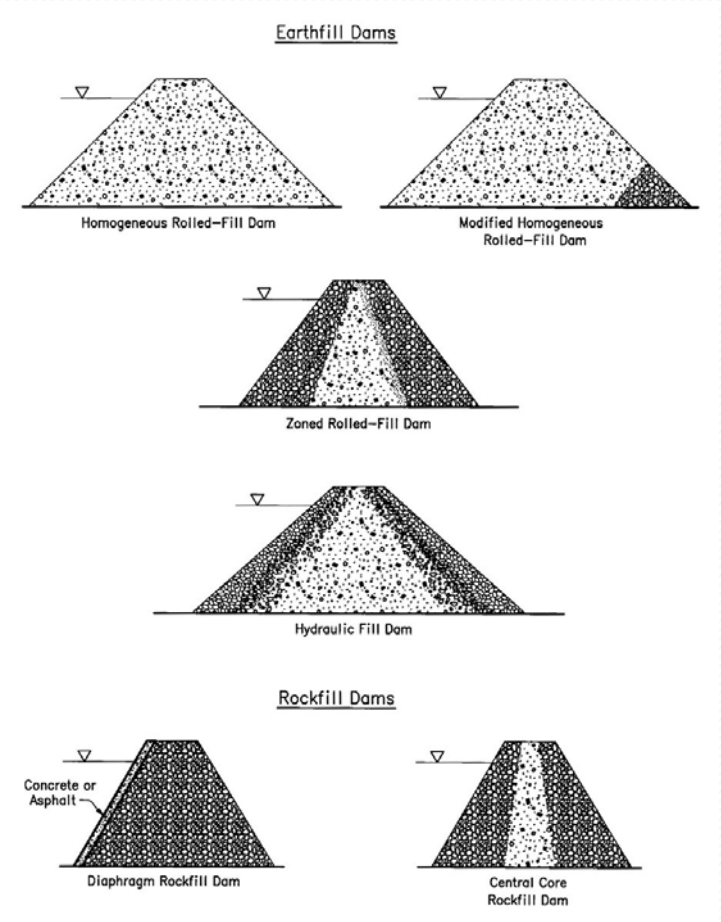
- Reclassification of the hazard-potential class of a dam
  - The Board may reclassify the hazard-potential classification of a dam at any time based on an inspection and downstream hazard evaluation.
  - If the Board determines that the hazard-potential class of a dam should be increased to a greater hazard-potential classification, then the Board shall notify the owner of that finding and of the upgrade options that are available, and set a reasonable deadline, based on the circumstances, for the owner to:
    - file an application to upgrade the dam to meet the requirements for a greater hazard potential classification; or
    - seek an individual proceeding to contest the finding: or
    - perform a breach analysis and inundation mapping or, for existing dams that lack a breach analysis, through the use of acceptable mathematical computations applied to the downstream area from the dam to a point where the necessary design flood and breach is contained within the main stream channel, utilize modeling and analysis guidelines provided by the Board to show the dam should not be reclassified to the greater hazard-potential classification.

- Upgrading dams due to downstream development
  - A**lternatives.** Instead of upgrading the dam using structural methods, an owner may seek to implement alternative methods. Such alternative methods shall include but is not limited to the following:
    - a current breach analysis and hydrologic study that demonstrates a lesser hazard potential classification is correct; or
    - a current breach analysis and design flood analyses that demonstrate existing downstream developments would not be adversely affected by more than one foot difference between breach and non-breach simulations in the affected area, or records showing the downstream development has been dedicated to non-residential and noncommercial use; or
    - a plan to permanently remove the dam.
  - **Schedule of Compliance.** An owner may seek a compliance schedule with the Board that sets the timeframes for various stages of work to be performed. In considering such applications to upgrade on a compliance schedule the Board shall evaluate whether the current dam will not significantly affect the public safety during the compliance period.

Major Components of a Dam



Earthen Embankment Dams



Concrete Dams

Keystone Dam - Tulsa

Shell Creek Dam – Sand Springs

Why Do We Care?

Dams fail which can result in extensive property damage or loss of human life.

Dam Failures

Hydraulic Failures	
Hydraulic failures result from the uncontrolled flow of water over the dam, around the dam, and adjacent to the dam, plus the erosive action of water on the dam and its foundation. Earth dams are particularly susceptible to hydraulic failure since earth erodes at relatively low velocities.	
Overtopping	Flow over embankment washing out the dam.
Wave Erosion	Notching of upstream side of dam by waves.
Toe Erosion	Erosion of toe by outlet.
Embankment Erosion	Rainfall erosion on embankment.

SCS Sugar Creek Site L44 – 2007
Caddo County, Oklahoma

Reynolds Dam - 2007
Cleveland County, Oklahoma

Seepage Failures

All dams exhibit some seepage, which must be controlled in velocity and amount. Seepage occurs both through the dam and the foundation. If uncontrolled, it can erode material from the foundation of an earth dam to form a conduit through which water can pass, which often leads to complete failure of the structure.

Progressive internal erosion of soils from downstream side of dam or foundation backward toward the upstream side to form an open conduit (pipe). Can lead to a washout of a section of dam.

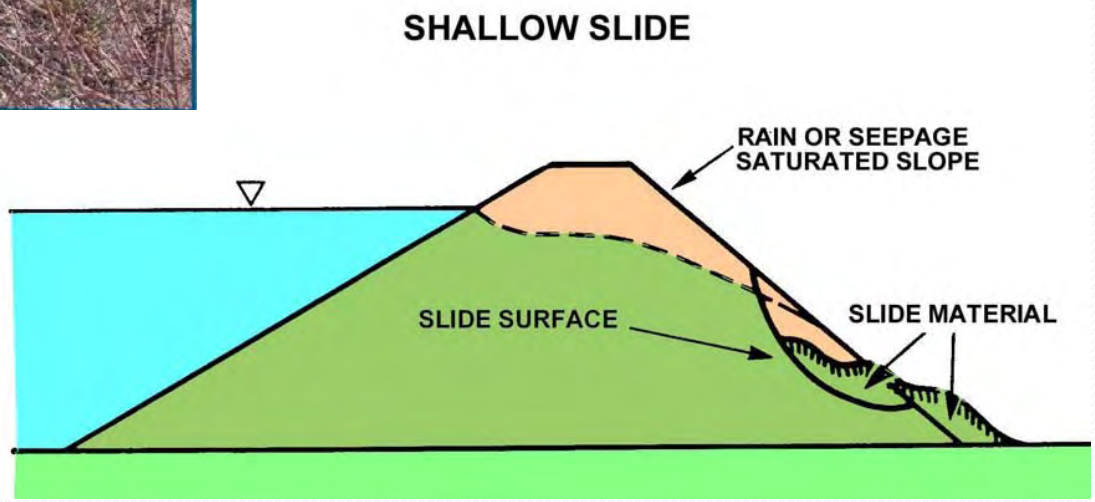
Blackman Creek Dam – 2005
Tasmania

Structural Failures

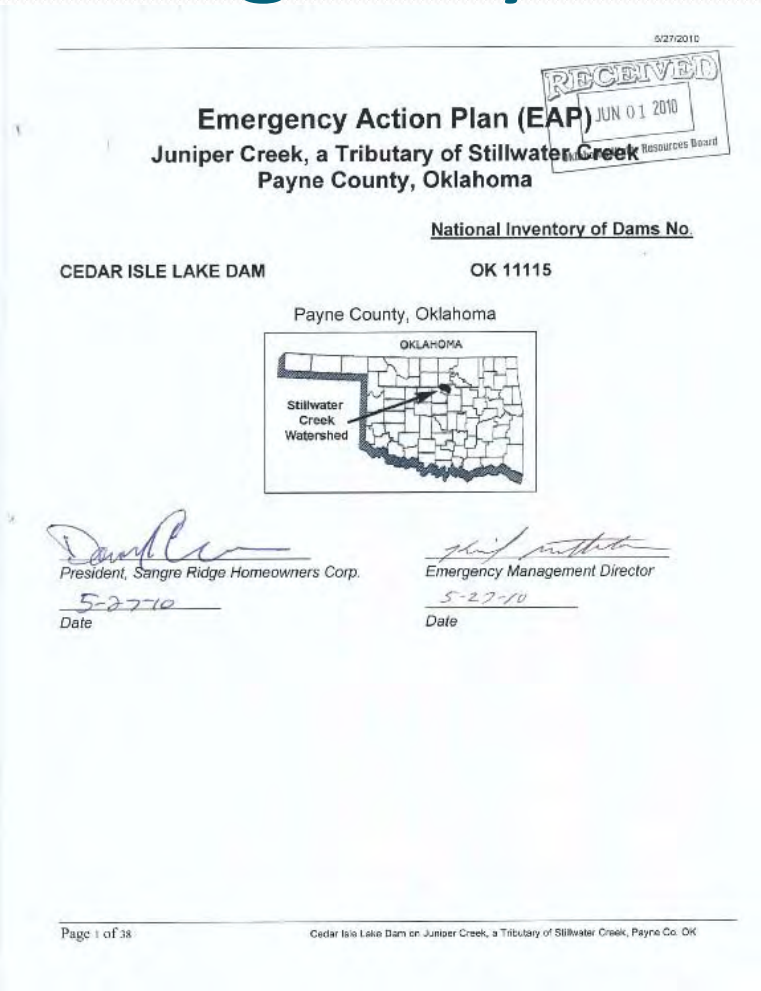
Structural failure involves the rupture of the dam and/or its foundation. This is particularly a hazard for large dams and for dams built of low strength materials such as silts, sandy soils, etc.

Foundation Slide	Sliding of entire dam, one face or both faces in opposite directions; with bulging of foundation in the direction of movement
Embankment Slide	Slide in upstream or downstream embankment face
Flow Slide	Collapse and flow of soil in either upstream or downstream direction.

Slide on Pawhuska Dam – 2009
Osage County, Oklahoma



Emergency Action Plans



5/27/2010

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Resources Board

Emergency Action Plan (EAP)
Juniper Creek, a Tributary of Stillwater Creek
Payne County, Oklahoma

National Inventory of Dams No.

CEDAR ISLE LAKE DAM OK 11115

Payne County, Oklahoma

President, Sangre Ridge Homeowners Corp.
5-27-10
Date

Emergency Management Director
5-27-10
Date

Page 1 of 38 Cedar Isle Lake Dam on Juniper Creek, a Tributary of Stillwater Creek, Payne Co. OK

- Elements of an EAP
  - Description of Dam
  - Notification Flowchart
  - Emergency Detection, Evaluation, and Classification
  - Responsibilities
  - Preparedness
  - Inundation Maps
  - Appendices

Breach Inundation Maps

Lake Delhi Dam - 2010
Delaware County, Iowa