



# IOWA DEPARTMENT OF NATURAL RESOURCES

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LEADING IOWANS IN CARING FOR OUR NATURAL RESOURCES

Dams 101 and the DNR Dam Safety Program

# Meeting Logistics

- All lines are muted
- We will have several Q&A breaks
- Can ask a question at any time using the Question box.
- At the end, if there is time, we may open up for audio questions.
- Meeting is being recorded and can be watched at a later time.
- Meeting slides and other resources are available for download in handout section.
  - Handout with links to other resources
  - When a permit is needed
  - How to apply for a permit
  - Dam Maintenance Manual
  - Copy of today's powerpoint slides

# Webinar Series

- **May 6: Dams 101 and DNR Dam Safety Program**
  - Learn about how dams work, what are the critical parts and features, and how they are regulated in Iowa.
- **May 13: How Dams Fail and How to Properly Maintain Your Dam.**
  - Learn about common ways that dams fail and how proper maintenance can reduce the risk of failure.
- **May 20: Dam Ownership, When and How to Hire an Engineer**
  - When do you need to call in an expert? We'll discuss when and how to find and hire qualified engineers to help with repairs and design of dams.
- **May 27: Dam Design and Permitting**
  - This webinar will go into technical engineering design requirements and what's needed to obtain a permit. We will also discuss upcoming changes to Iowa's dam safety administrative rules.

# First Poll

Let's learn about you



# Introductions

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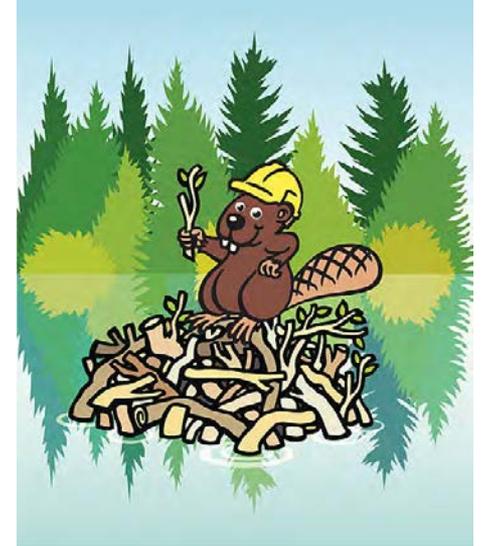


# Dams 101 Presentation Outline

- 
- Why do we have dams?
  - Types of dams
  - Examples of dams around Iowa
  - Parts of dam
  - Basic dam design considerations
  - Dam Safety in the US
  - Iowa DNR's Dam Safety Program
  - Downstream Risk and Risk Reduction

# Why do we have dams?

- Common Purposes:
  - Municipal water supply
  - Flood control
  - Fishing and recreation
  - Wetland creation/water quality improvement
  - Erosion control
  - Livestock watering
  - Aesthetics



# Types of Dams

- Earthen and Rockfill Embankment Dams
  - (Comprise about 90 Percent of the Dams in the United States)

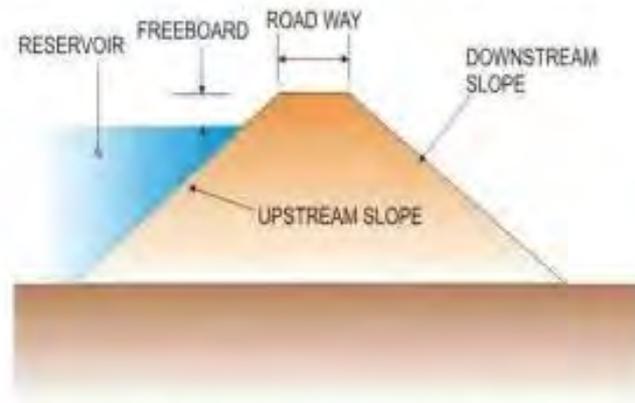


FIGURE 1. General shape of an embankment dam

# Types of Dams

- Concrete and Rock Masonry Dams (rare in Iowa)
  - Gravity dams
  - Arch dams
  - Buttress dams



# Types of Dams

- Other Dam Types
  - Steel dam
  - Inflatable Rubber dam
  - Wood/Timber



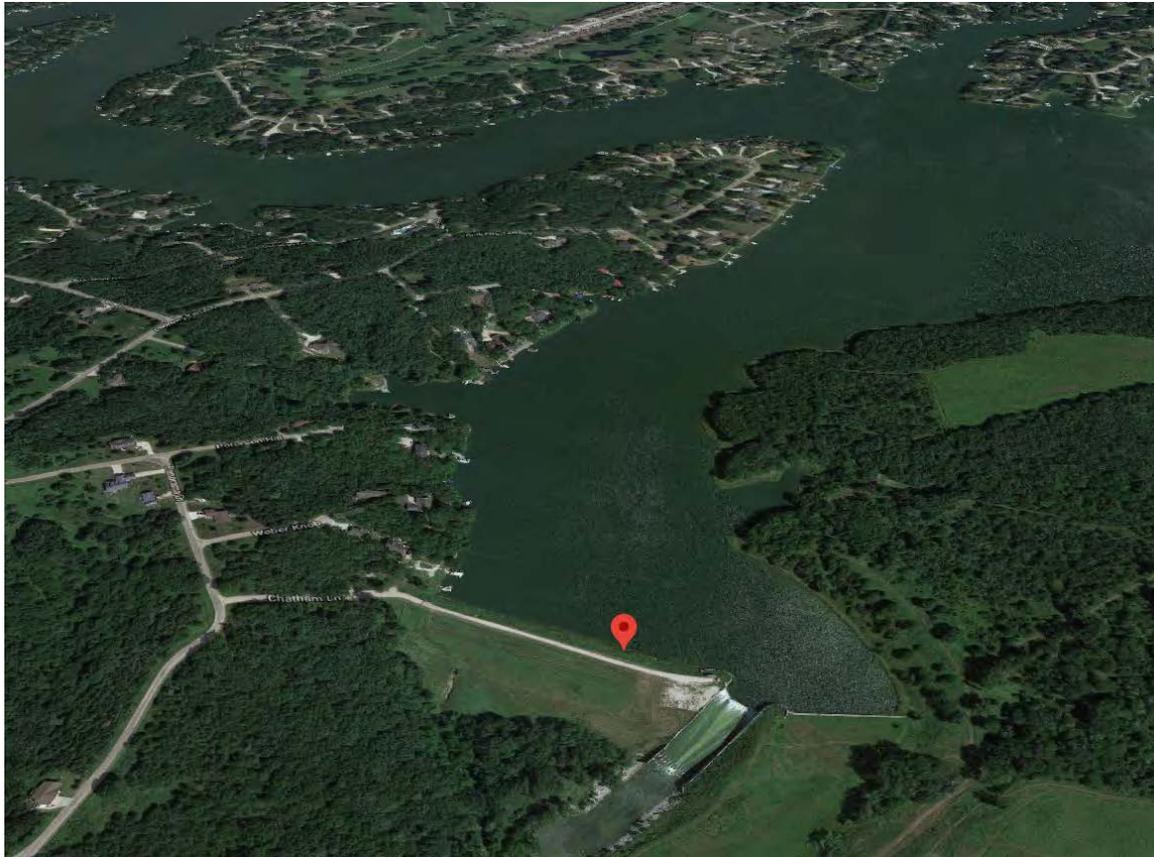


## Example Iowa Dams: Water Supply

Twelve Mile Creek Lake, Union County

Height: 66 feet

Surface Area: 633 acres



## Example Iowa Dams: Recreation

Lake Panorama, Guthrie County

Height: 70 feet

Surface area: 1260 acres



## Example Iowa Dams: Small Development Dam

Waterford Dam, Polk County

Height: 40 feet

Surface Area: 5 acres



## Example Iowa Dams: County Parks

Badger Lake Dam, Webster County

Height: 46 feet

Surface Area: 276 acres



## Example Iowa Dams: Rural Farm Pond

Meyer Dam, Crawford County

Height: 46 feet

Surface Area: 38 acres



## Example Iowa Dams: Hydroelectric

Maquoketa Hydro Dam, Jackson County

Height: 26 feet

Surface Area: 340 acres



## Example Iowa Dams: Dredge Spoil

Cedar Lake Dredge Containment, Madison County



## Example Iowa Dams: Dry Flood Control

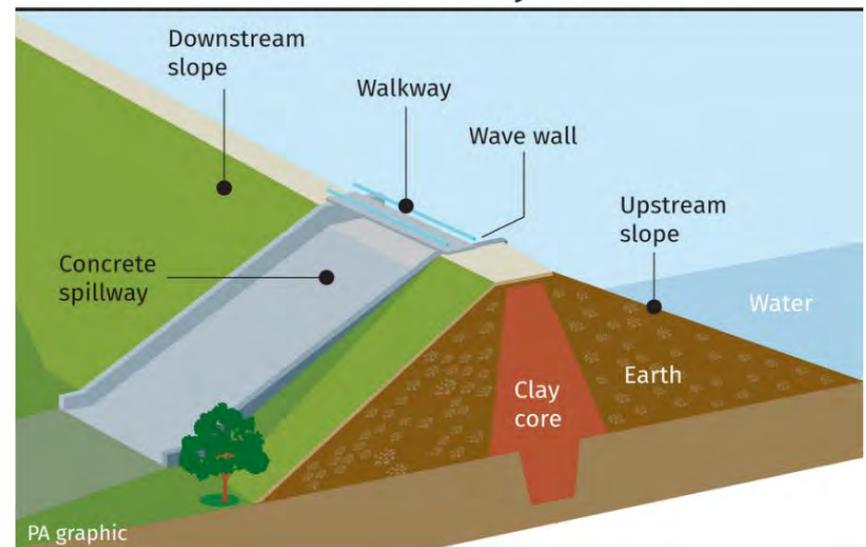
Virden Creek Dam, Black Hawk County

Height: 39 feet

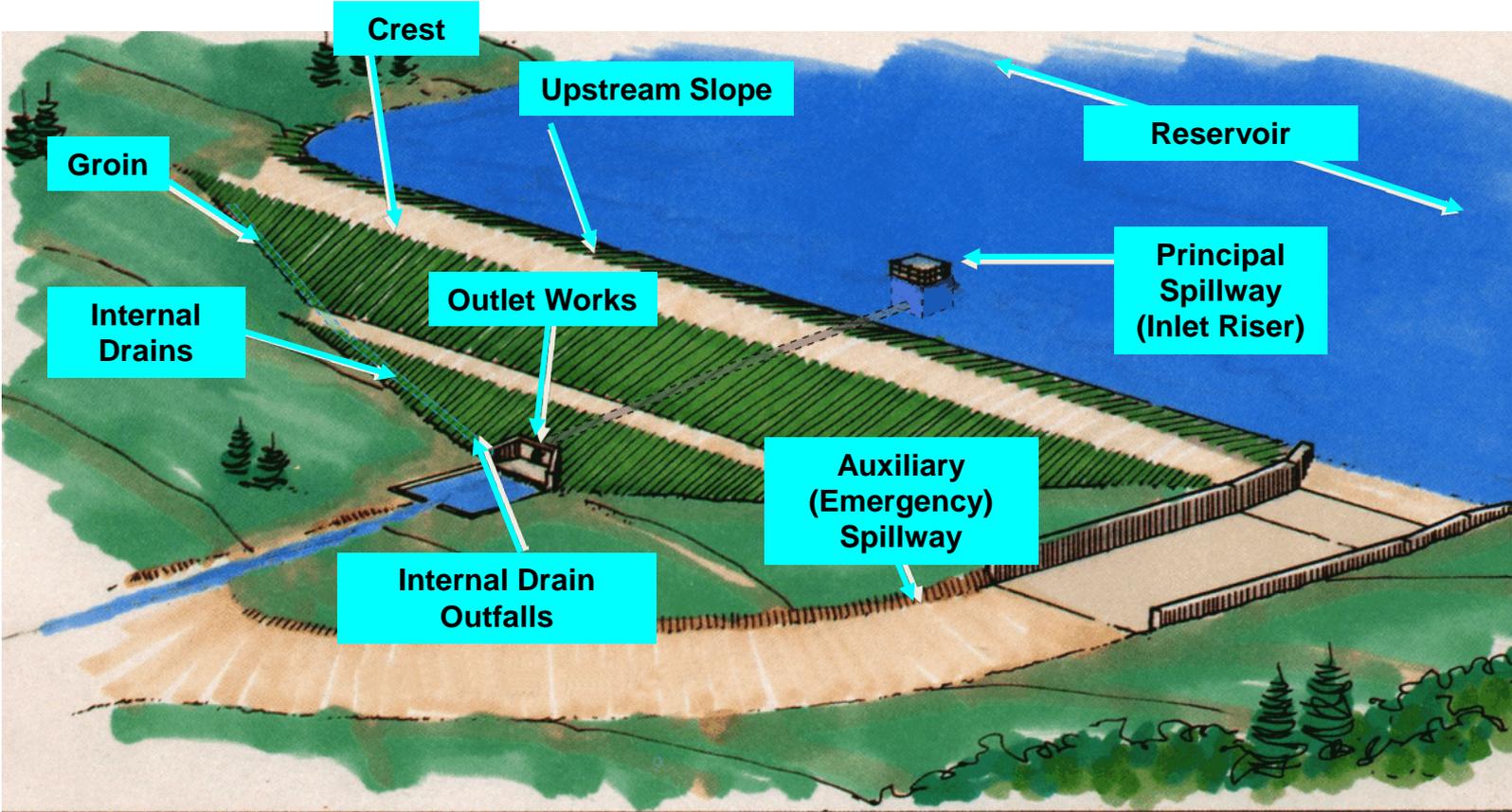
# How do dams work?

- Safely Hold Water
  - Clay soil embankments or concrete structures
  - Good foundation and abutment conditions or cutoffs
  - Internal drainage for embankment stability
- Safely Pass Extra Water
  - Spillways
  - Outlet works

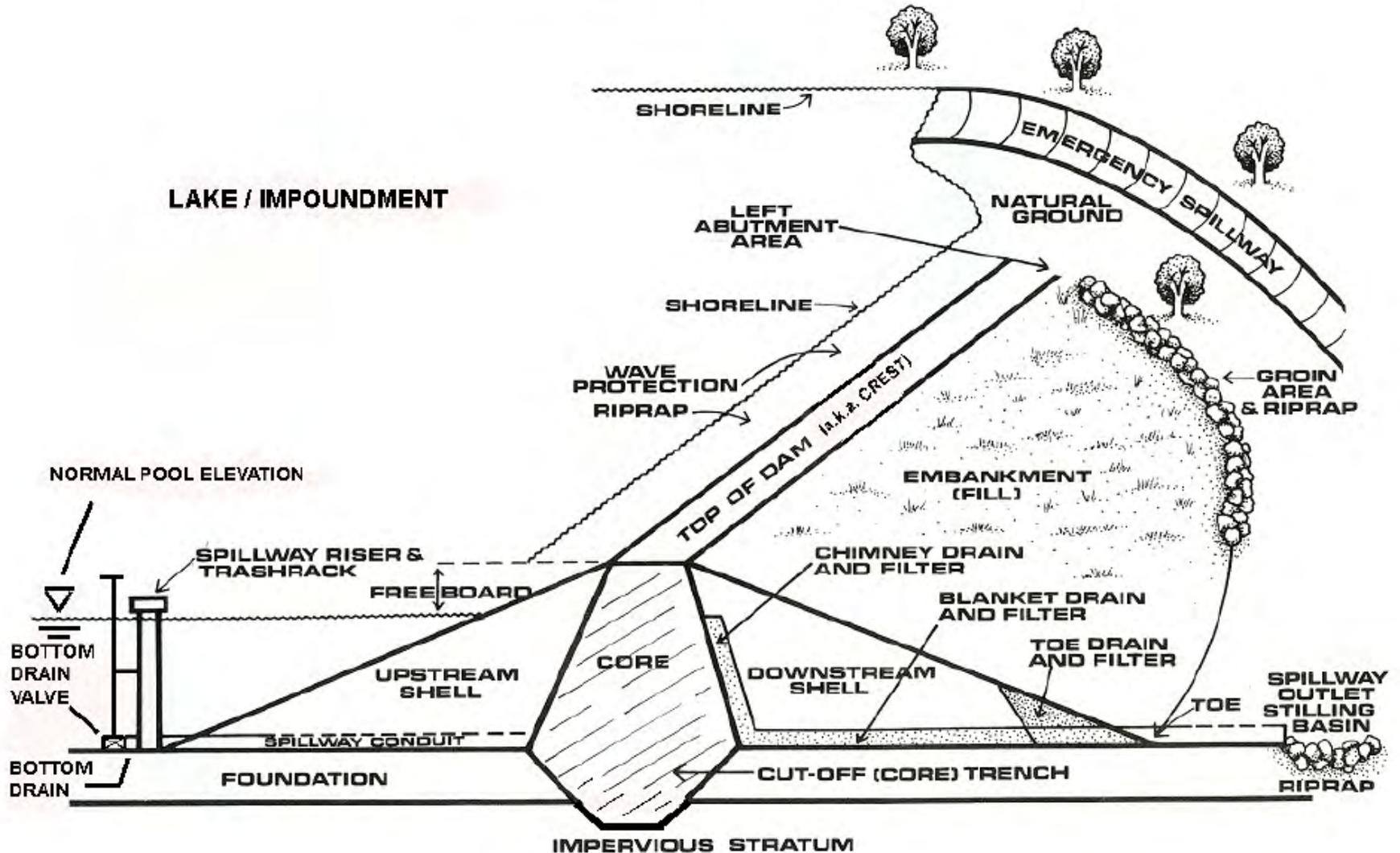
**Earth embankment dam: key features**



# Parts of an Embankment Dam



# PARTS OF AN EARTH DAM (SEE GLOSSARY FOR TERM DEFINITIONS)



# Spillways

- Need to get water over or through the dam
- Sizing depends on watershed and lake size.
  - Larger watershed => Larger Spillways
  - More lake storage available => Smaller Spillways
  - “Watershed ratio”
- Typical Practice: Two spillways
  - “Principal Spillway”
    - Handles continuous flows
    - Concrete or steel materials
    - Can be “controlled” or “uncontrolled”
  - “Auxiliary Spillway” (often referred to as Emergency Spillway)
    - Often grassed waterways
    - May be damaged during extreme flow events
    - Reduces likelihood of dam overtopping
    - Required capacity depends on hazard classification

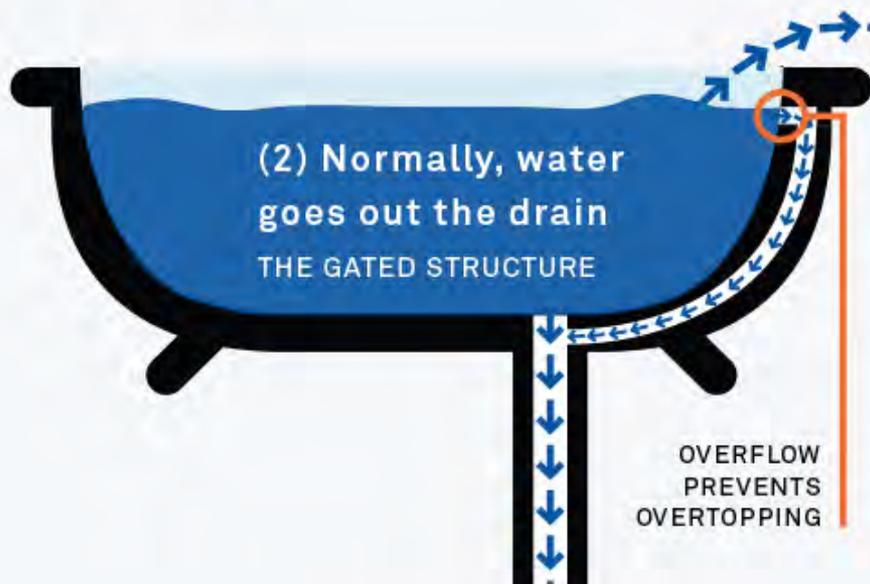




(1) The flow of water enters the tub

RAIN OR FLOW FROM UPSTREAM

## TUB CONCEPT: How the Reservoir Works



(3) If the drain can't keep up with the flow of water, eventually the bathtub overflows around and over the AUXILIARY SPILLWAY

# Spillway Example: Concrete Chute



# Spillway Example: Pipe



# Spillway Example: Riser and Pipe

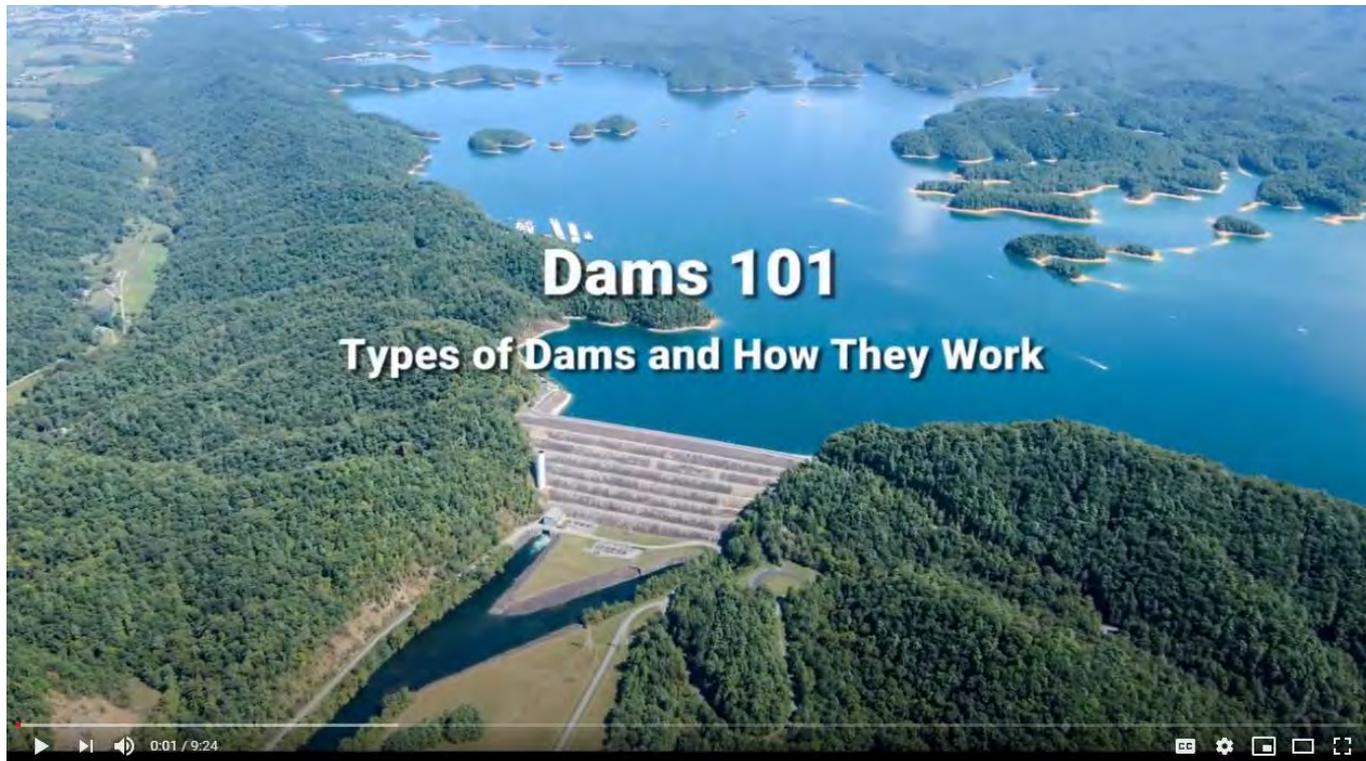


# Spillway Examples: Other



# Additional Resource: Dam 101 Video (10 minutes)

<https://www.youtube.com/watch?v=mfAbfjDp8rA&t=10s>



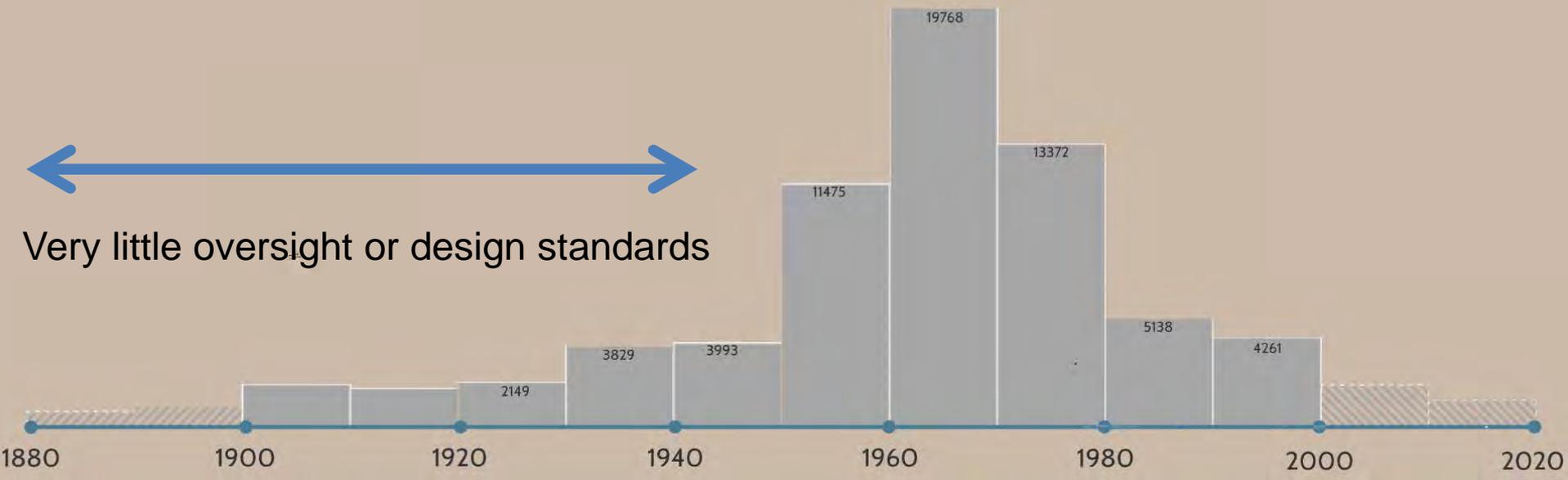
# Question Break



# Dam Safety Programs



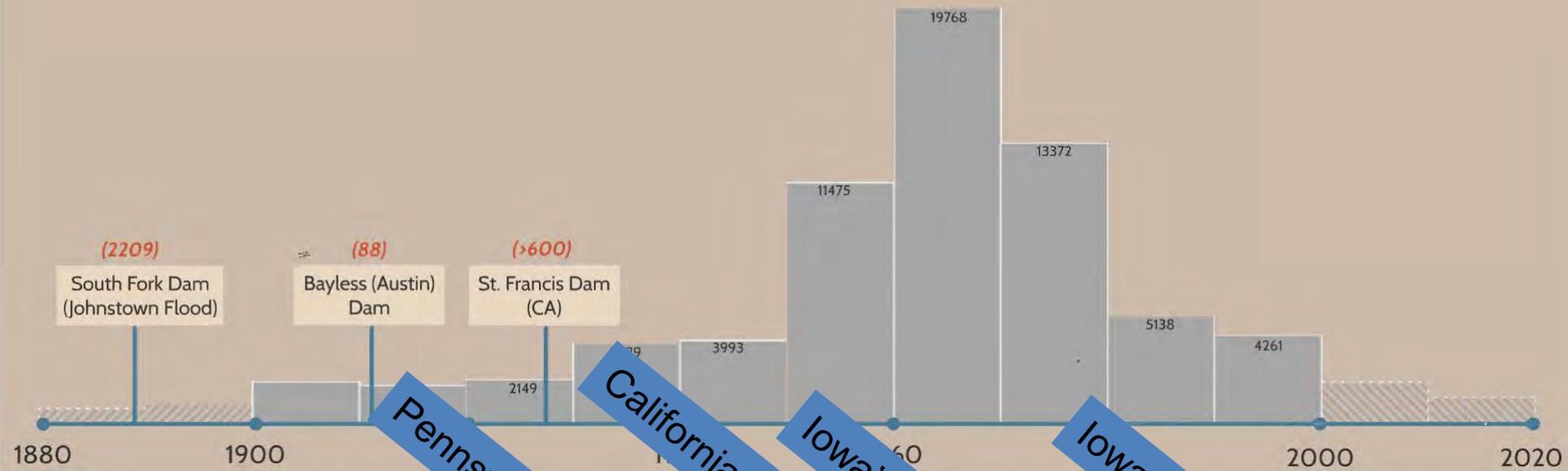
# Timeline - Dams in the USA



# Second Poll

Dam Failures in the United States

# Timeline - Dams in the USA



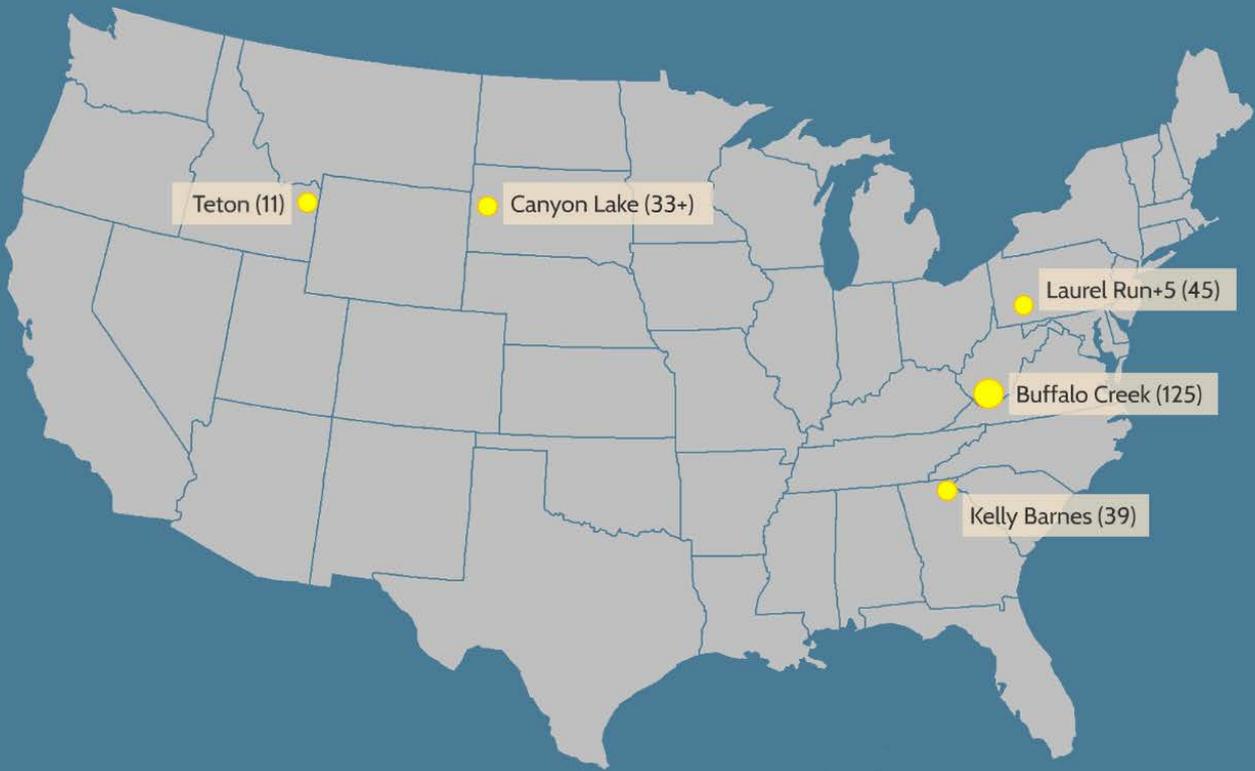
Pennsylvania Passes Dam Safety Legislation

California Passes Dam Safety Legislation

Iowa's Floodplain Management Legislation

Iowa's Dam Safety Program Started

1972



1977



# 1972 Buffalo Creek Dam Failure

- Coal Slurry Impoundment fails on February 26, 1972
- Releases 130 Million Gallons of water and sludge
- Killing 125 people
- 500 home totally destroyed
- More than 500 home damaged
- 1000 automobiles destroyed















# National Dam Inspection Act

- Public Law 92-173 Signed into law on August 8, 1972
- Required inventory of dams located in the United States
- States were surveyed and 49,329 dams were inventoried
- Approximately 20,000 dams were thought that failure could cause loss of life.
- Many states did not know exact numbers.
- Required inspections of dams by US Army Corps of Engineers
- Inadequate funding for inspections, so none initially performed.

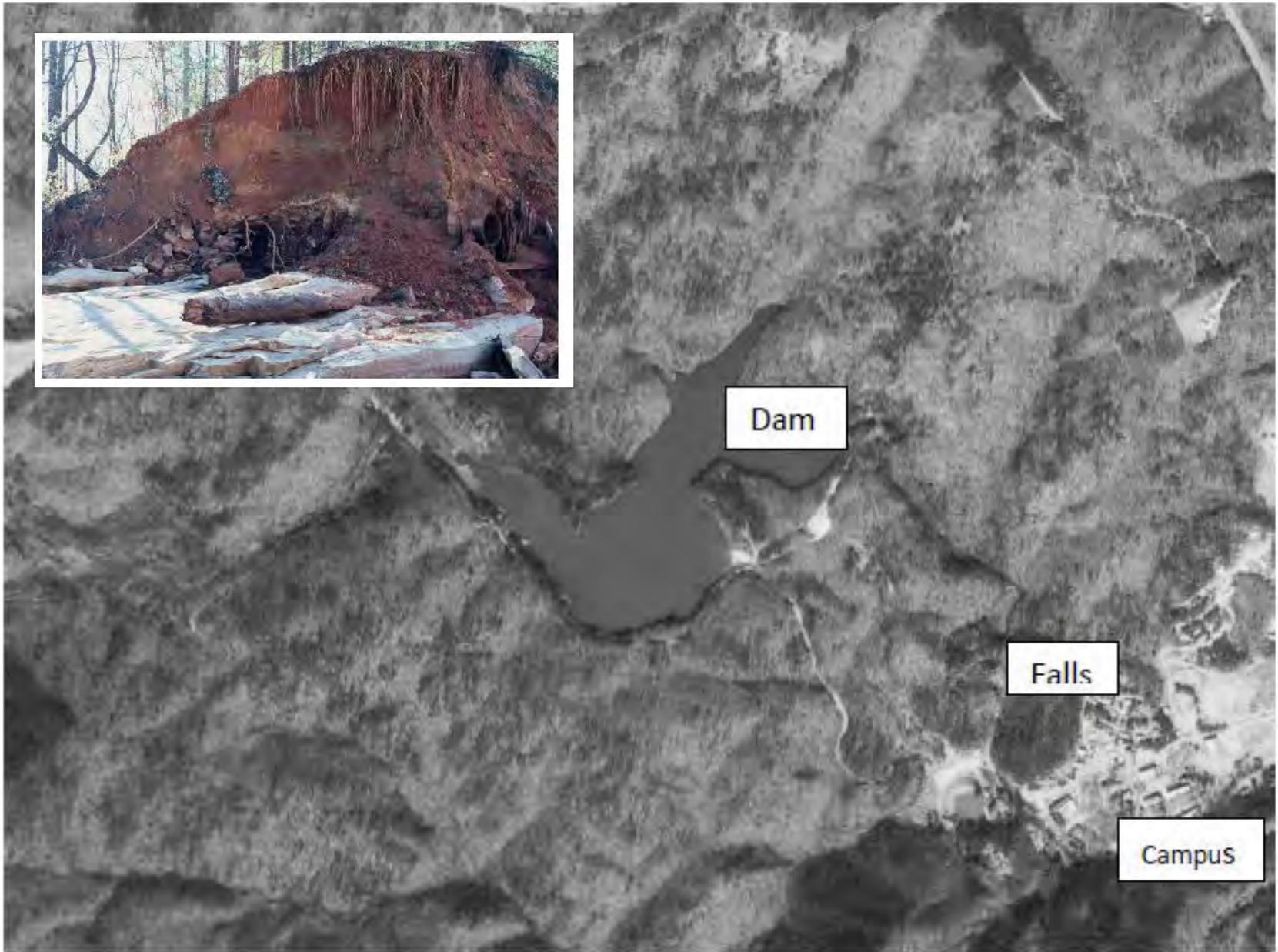
# Federal Dam Safety

- April 23, 1977, Presidential memo sent to all federal agencies.
- Called for review of the current dam safety programs in each agency.
- General disagreement about how to handle non-federal dams
  - No non-federal dam inspections have been performed despite 1972 legislation

## Kelly Barnes Dam Failure

- November 6, 1977
- Toccoa Falls, Georgia
- Built 1939-1940, 38 feet tall
- Dam provided power to downstream bible college until 1957
- Failed at 1:30am after heavy rain
- 39 deaths





President Carter in office  
(from Georgia)

Rosalynn Carter able to  
visit disaster site within hours



2nd Room THE WHITE HOUSE WASHINGTON

families of survivors -  
a young mother and  
mother-in-law  
young mother  
lost 4 year old children

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husband + 3 children  
Mrs. Arnold lost ↑  
(went in alone)

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Mrs. Kapp -  
lost husband

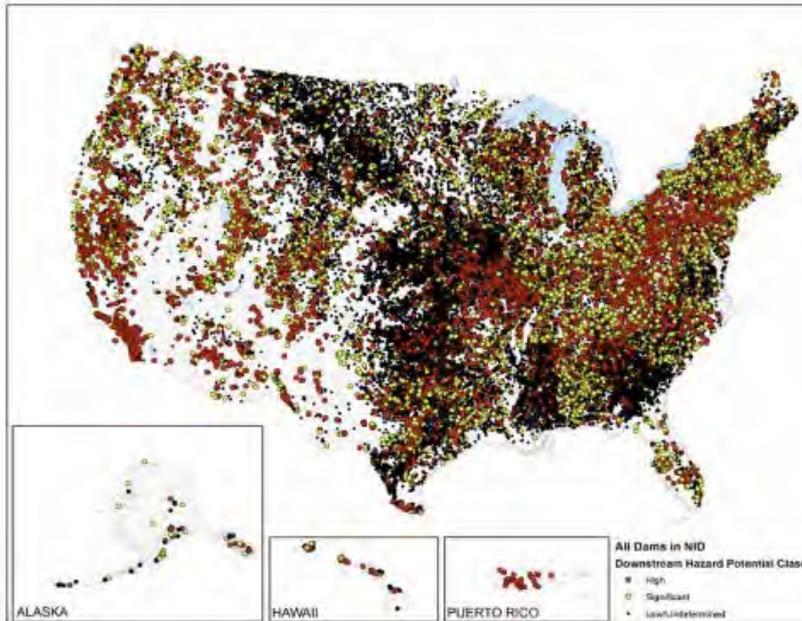


# National Dam Safety Program

- December 2, 1977, President Carter instructed the USACE to commence at once on inspections of 9000 non-federal dams.
- Prior to inspections, States required to take steps to establishing dam safety programs.

# Present Day: State Dam Safety Programs

- Currently, all states except Alabama have dam safety programs
- Federal Grants of \$7-9 Million/year given to states to help with state programs.
- National Inventory of Dams contains over 90,000 dams



State	Dams	State	Dams
Alabama	2,271	Nebraska	2,970
Alaska	107	Nevada	547
Arizona	1,257	New Hampshire	645
Arkansas	384	New Jersey	825
California	1,585	New Mexico	492
Colorado	1,737	New York	1,951
Connecticut	746	North Carolina	3,444
Delaware	83	North Dakota	898
Florida	1,203	Ohio	1,495
Georgia	5,420	Oklahoma	4,891
Hawaii	133	Oregon	869
Idaho	473	Pennsylvania	1,525
Illinois	1,607	Puerto Rico	38
Indiana	916	Rhode Island	227
Iowa	3,976	South Carolina	2,444
Kansas	6,403	South Dakota	2,565
Kentucky	1,107	Tennessee	1,237
Louisiana	557	Texas	7,395
Maine	597	Utah	833
Maryland	346	Vermont	357
Massachusetts	1,452	Virginia	2,919
Michigan	1,005	Washington	784
Minnesota	1,097	West Virginia	614
Mississippi	5,114	Wisconsin	1,106
Missouri	5,356	Wyoming	1,617
Montana	2,960		

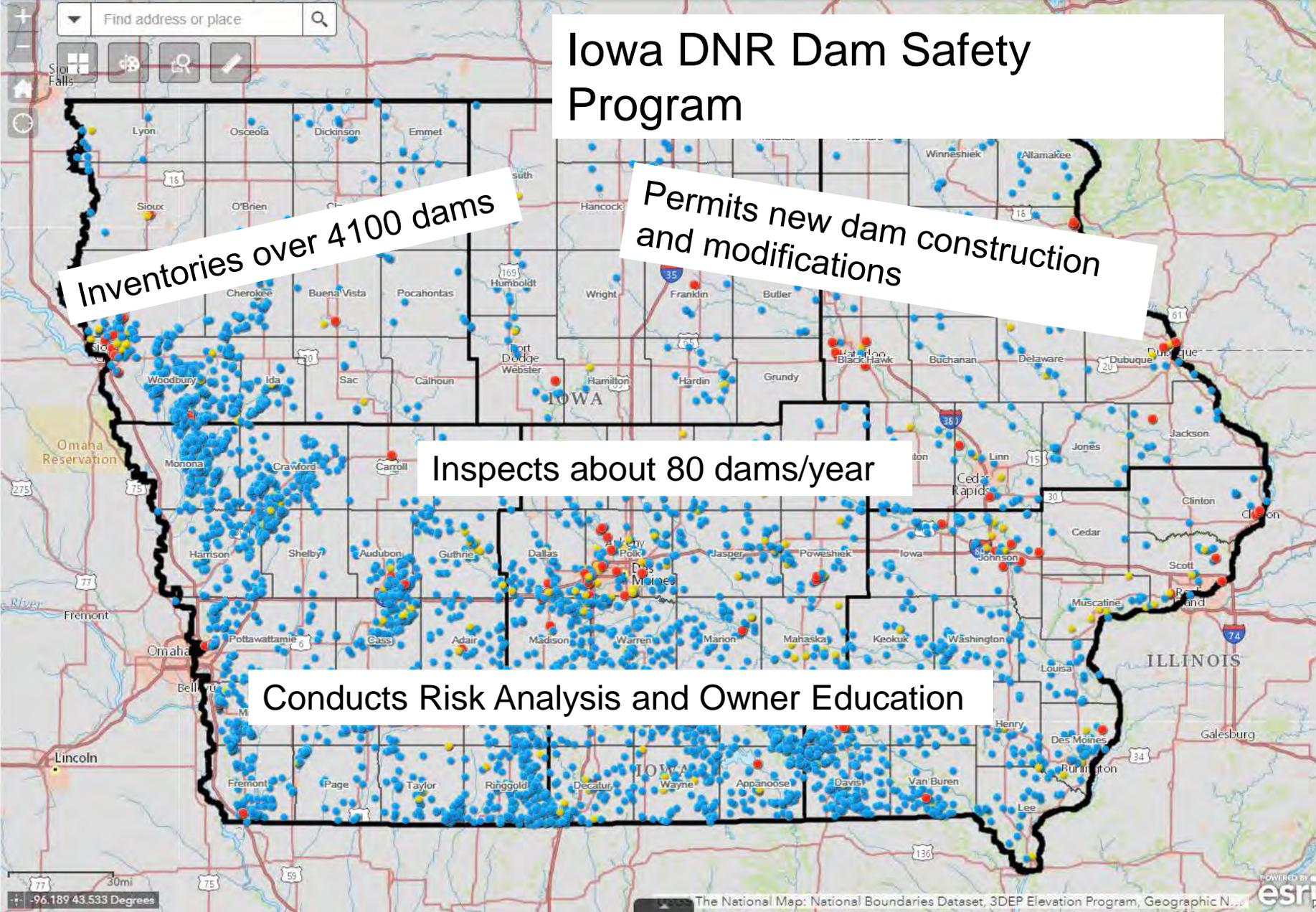
# Iowa DNR Dam Safety Program

Inventories over 4100 dams

Permits new dam construction and modifications

Inspects about 80 dams/year

Conducts Risk Analysis and Owner Education



# Dams In Iowa

- 4162 dams in the inventory
- 3961 are state regulated
- New online dam database
- Publicly accessible
- <https://iowadnr.knack.com/dams#public/>



**Iowa DNR Dam Inventory**

Public Access | DNR | Emergency Management

Public Access | Dam Details | Exit

### Dam Details

#### Aegon Dam

Map | Satellite

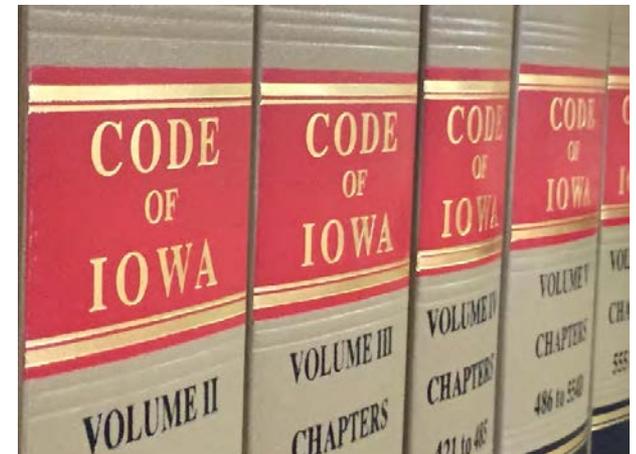
6200 S Street Southwest  
Cedar Rapids, Iowa 52604

Owner Name	Aegon Inc.	Last Inspection Date	06/26/2018
National Inventory ID	IA03001	Condition Assessment	Subfactory
Hazard Classification	High	Dam Height (ft)	15
Structure Classification	Major	Surface Area (acres)	4.6
Floodplain Permit Number	370045	Normal Storage (acre-ft)	88
Dam Former Name	McLeod Dam	Storage at Emergency Spillway (acre-ft)	0
County Name	Linn	Maximum Storage (acre-ft)	134
Section Township Range	N16W R31E T052N R01W	Drainage Area (square miles)	0.12
Designer	HALL AND HALL ENGINEERS	Dam Length (ft)	2660

# Inventory Demo

# Authority

- The DNR Dam Safety program operates under
  - Statute (Passed by Legislature)
    - Iowa Code 455B.261-278 authorizes the DNR to regulate dams and floodplain construction
  - Rules (Developed by DNR)
    - 567 Iowa Administrative Code Chapters 70-73 (Floodplain Regulation, Dam Construction and Maintenance)
    - 567 Iowa Administrative Code Chapter 51-52 (Water Storage Permits)



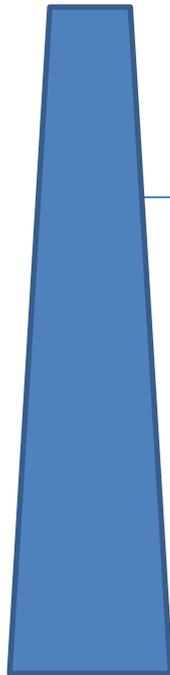
# Current Dam Permit Thresholds

- Permits required when:
  - Top of dam storage > 50 acre-ft (with emergency spillway)
  - Top of dam storage > 25 acre-ft and > 5' high (without emergency spillway)
  - Permanent storage > 18 acre-ft and height > 5'
  - Any rural area dam across a stream draining > 10 square miles
  - Any urban area dam across a stream draining > 2 square miles
  - Dam drains into and is less than 1 mile from municipality, height > 10', top of dam storage > 10 acre-ft.

# Dam Thresholds (Rural or Urban)

OR Top of Dam Storage > 50 Acre-feet  
(or 25 Acre-feet w/o Emergency Spillway)

Height > 5 feet

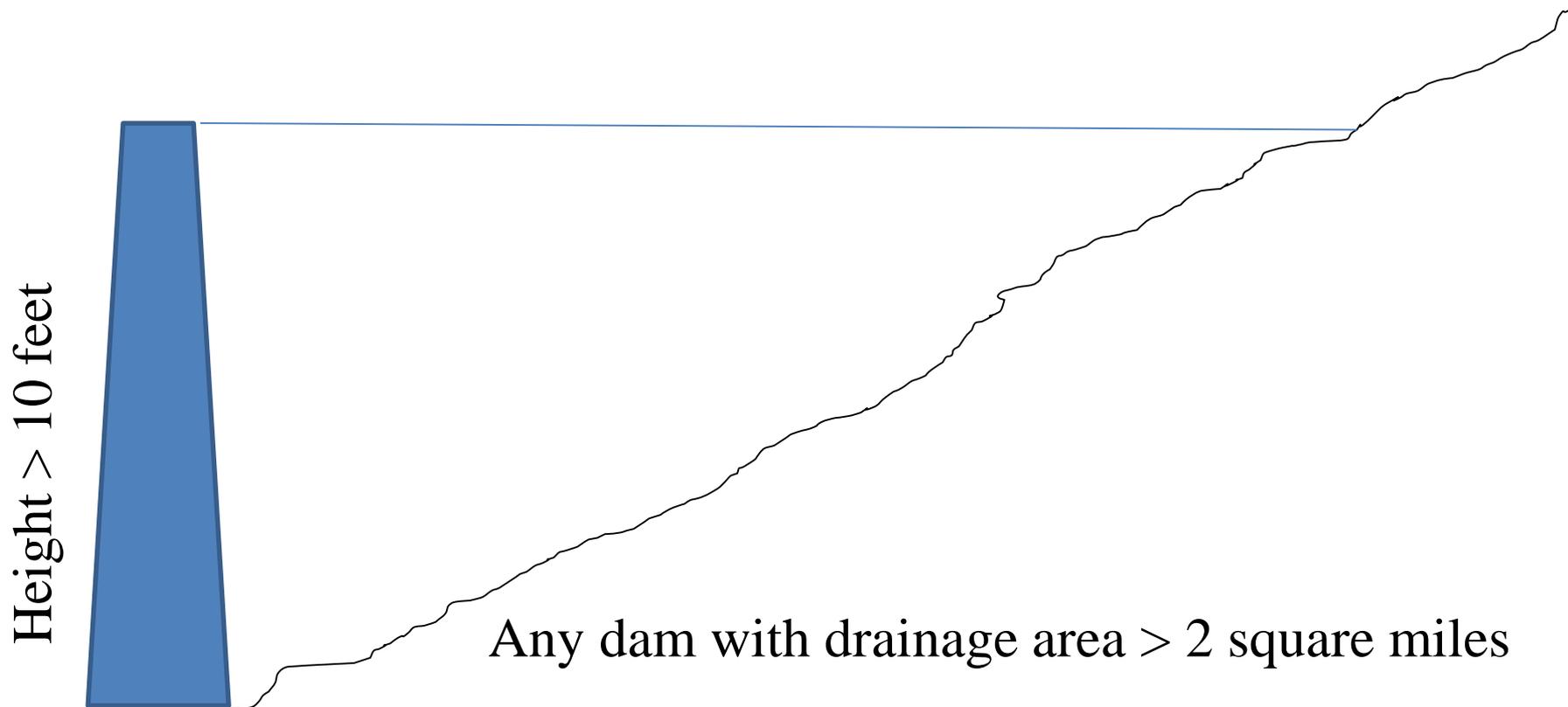


Permanent Storage > 18 Acre-feet

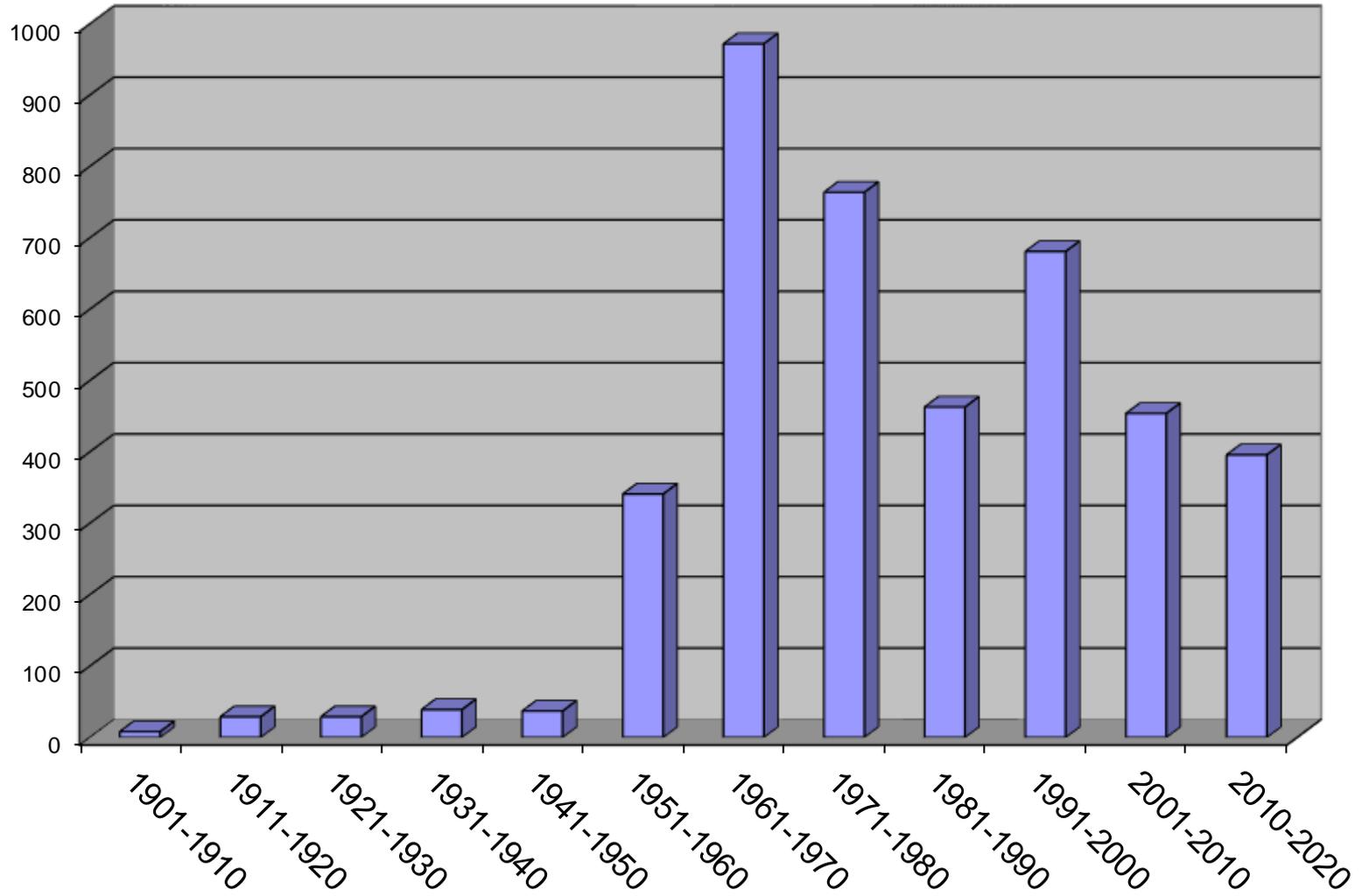
Any dam with drainage area > 10 square miles

# Dam Thresholds (Urban)

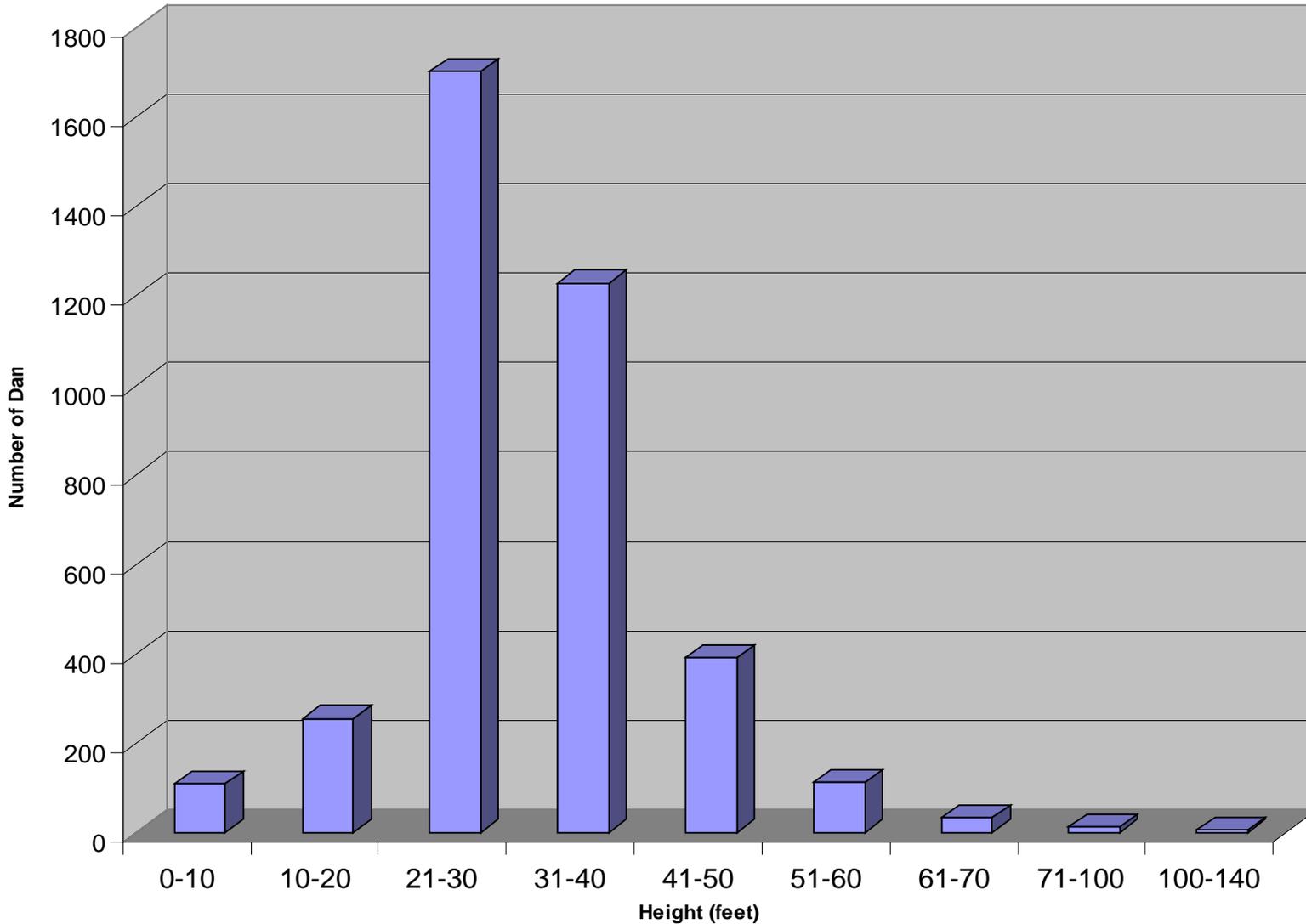
AND Top of Dam Storage > 10 Acre-feet



# Iowa Dams Constructed per Decade



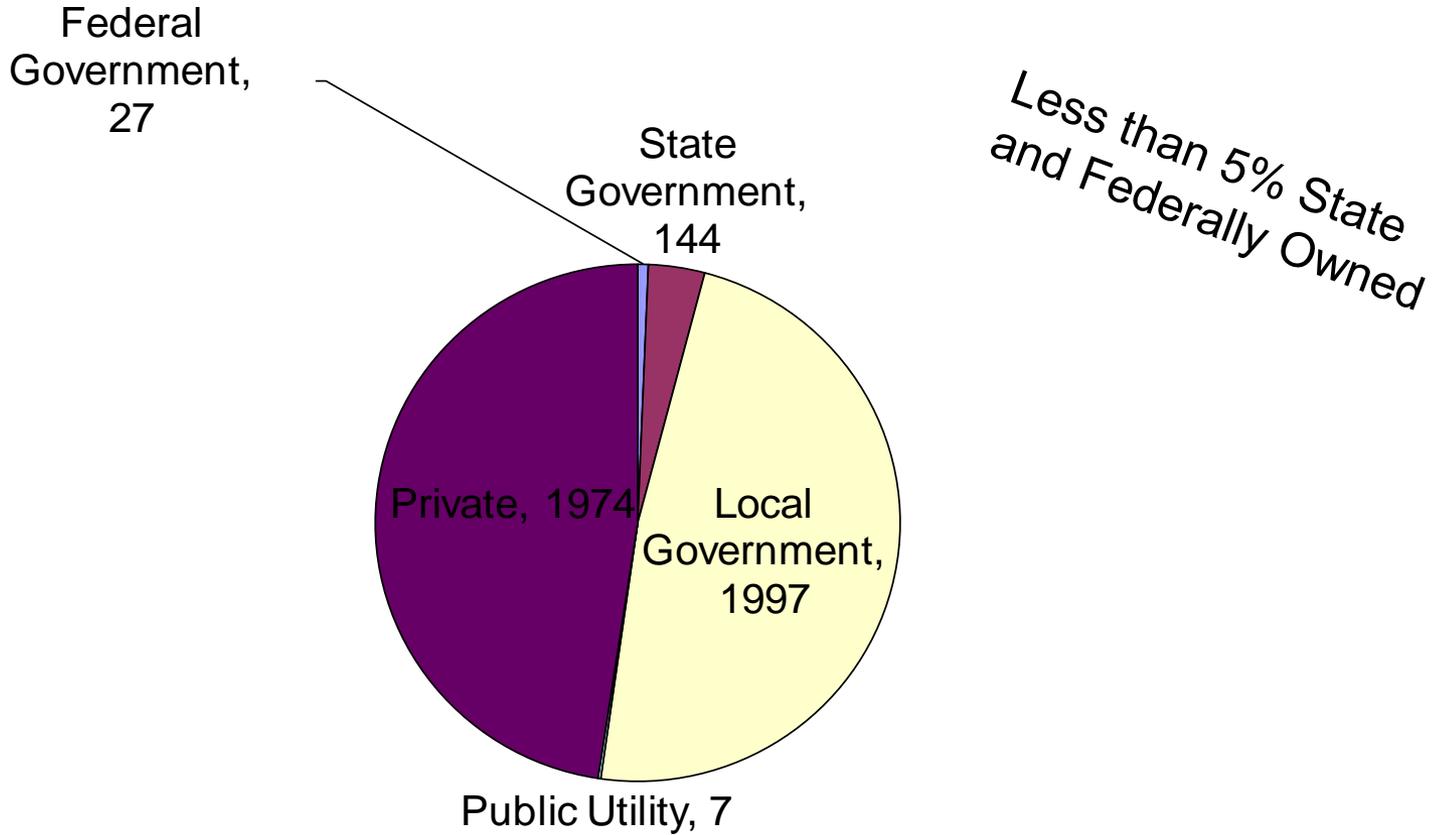
# Dam Heights



# Poll

## Dam Ownership

# Iowa Dam Ownership



Questions about permitting or thresholds?

# Iowa DNR Dam Safety

Dam Inspections



# Dam Inspections

- DNR Inspects:
  - High hazard dams every 2 years
  - Major Dams every 5 years
    - Defined as:
      - Any high hazard dam
      - Moderate hazard dam with permanent storage > 100 acre-ft and top of dam storage > 250 acre-ft
      - Any dam with storage times height > 30,000
    - Other dams as appropriate
    - 324 dams have been inspected at least once in last 10 years



# Inspection Form



IOWA DEPARTMENT OF  
NATURAL RESOURCES

## Iowa DNR Dam Inspection

Waterford Dam / IA00914 Complete

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Failed items

**5**

Dam Name	Waterford Dam
WDI#	IA00914
Conducted on:	<input type="checkbox"/> 25th Mar, 2020 <input type="checkbox"/> 11:01 AM CDT
Prepared by:	Jon Garton

Waterford Dam / IA00914

1/15

Slope appears too steep?	No
Slope has poor vegetative cover?	Yes
Slope contains trees and/or brush?	No
Sinkholes, depressions, slides or bulges evident?	Yes

— Notes

The excavation area is not uniformly graded at this time and appears to have settled beyond what would normally be expected with proper compaction.

— Photos



Photo 7

Cracks on the embankment slope?	Yes
---------------------------------	-----

— Notes

Cracks indicate settlement of the excavation backfill.

— Photos



Photo 8

Animal burrows on the embankment?	No
-----------------------------------	----

Downstream Slope Photos

— Photos



Photo 9



Photo 10



Photo 11

<b>Internal Drainage and Seepage</b>	1 Failed
Does the dam have internal embankment drains?	Yes

Waterford Dam / IA00914

5/15

# Additional Resource: Dam Inspections

<https://www.youtube.com/watch?v=xCz58JFeqpg&t=1s>

**Introduction to Inspecting Dams - A  
Webinar for Dam Owners**

**Instructor:**  
**Paul G. Schweiger, P.E., CFM**



**Recorded on July 18, 2013**  
**Visit [DamSafety.org](http://DamSafety.org) for more information and resources.**  
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0:01 / 1:57:01

# Iowa DNR Dam Safety

Risk Classification and Reduction



# Hazard Classifications



- Rates the dam based on the potential consequences of failure.
- Current Classifications are Low, Significant (moderate), and High.
- Hazard classification is not a reflection of condition.
- Different design criteria for each hazard classification

# Hazard Classifications

<b>Hazard Class</b>	<b>Estimated Loss of Life</b>	<b>Estimated Property Damage</b>
<b>Low Hazard</b>	None	Low economic and low public damages
<b>Significant Hazard</b>	None	Damage to structures, public utilities, significantly traveled roads. Significant economic losses and public damages.
<b>High Hazard</b>	Loss of Life is likely to occur	

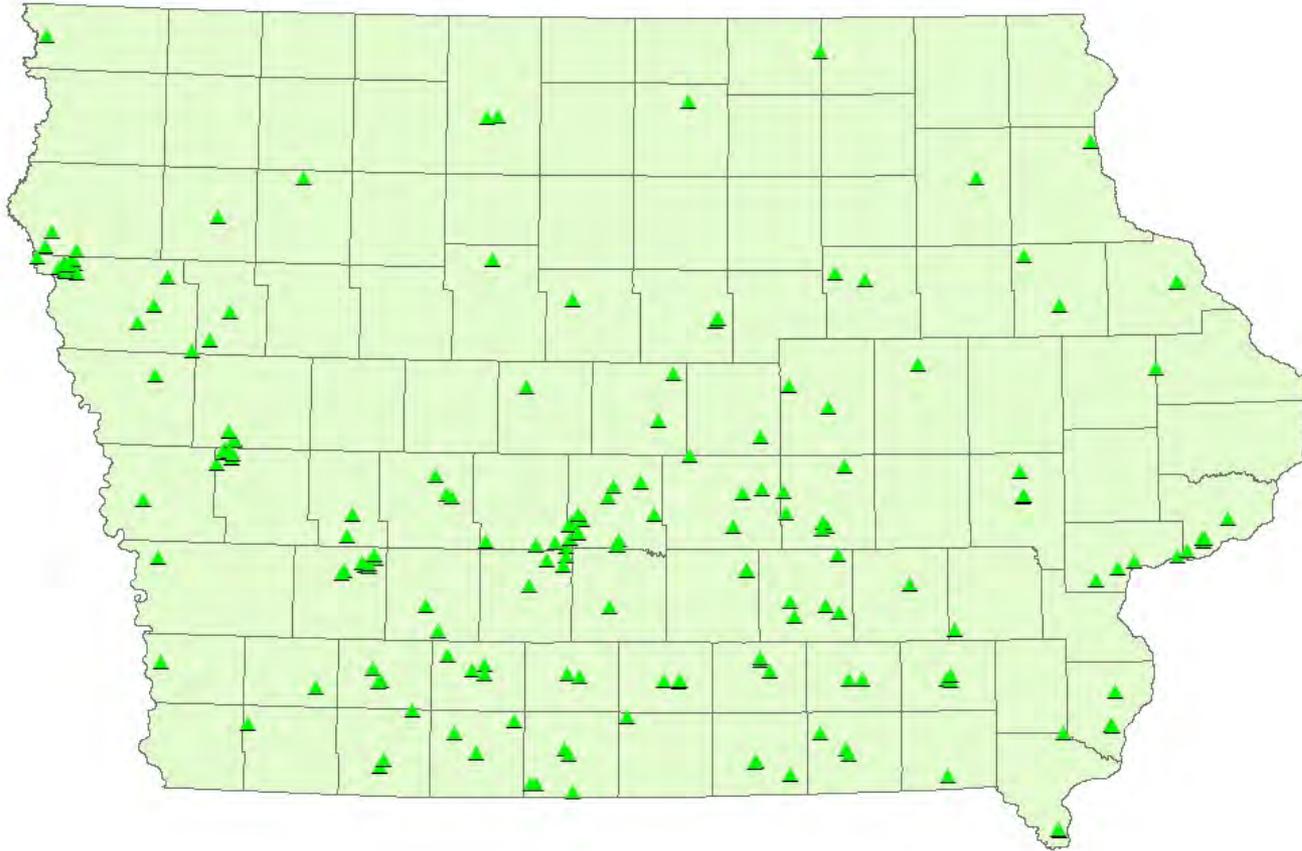
# Low Hazard Dam



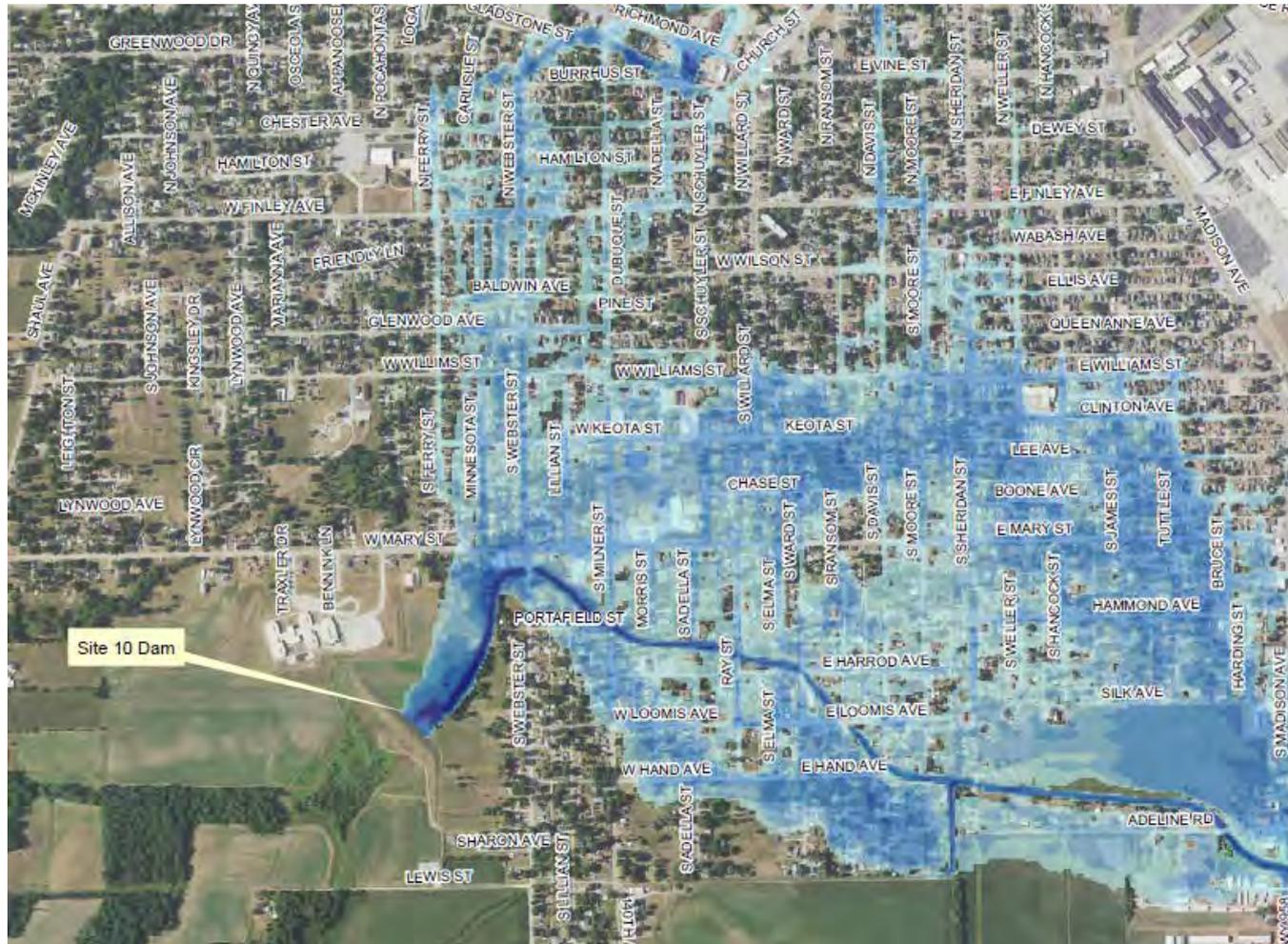
# Significant Hazard Dam



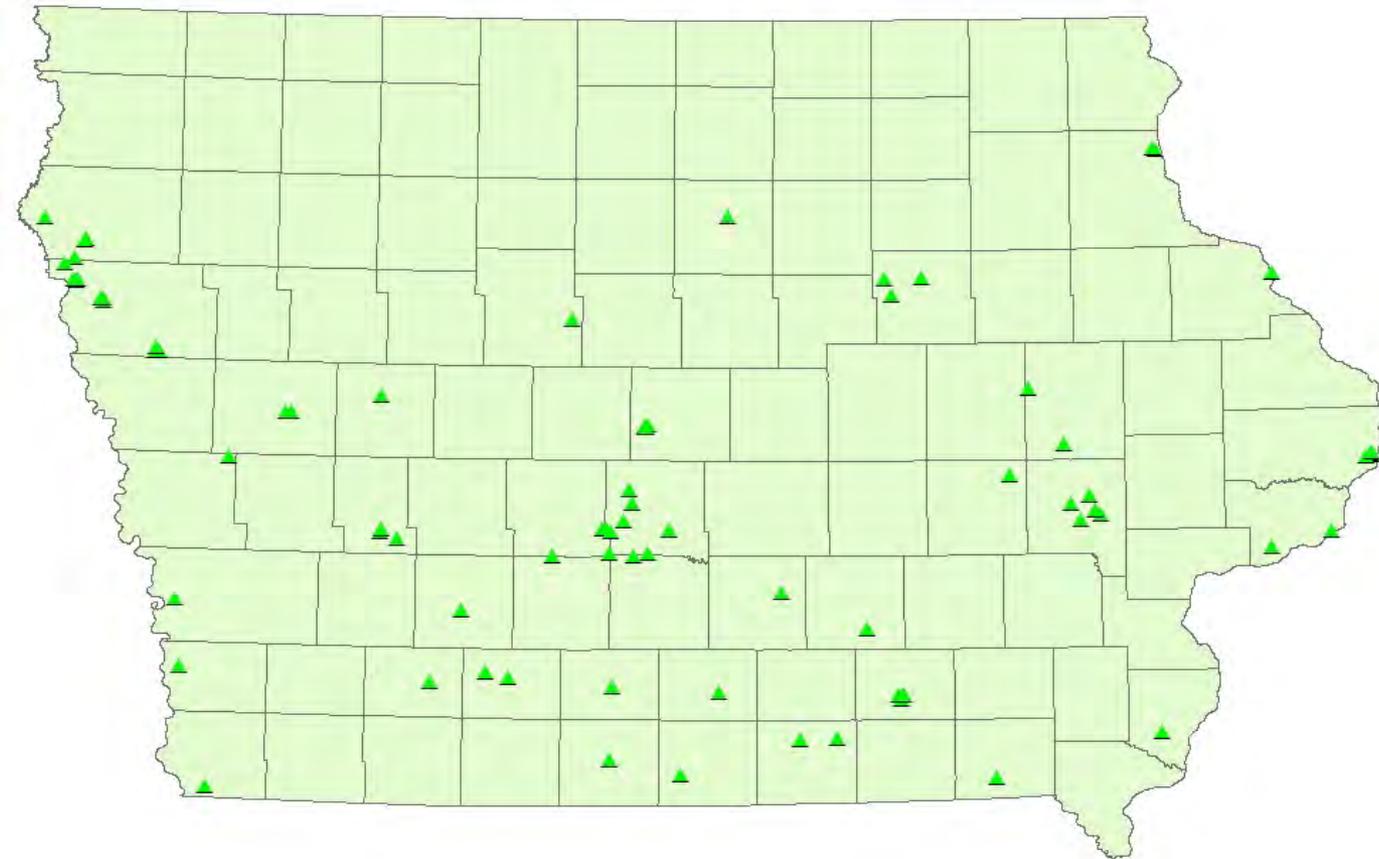
# 241 Significant Hazard Dams in Iowa



# High Hazard Dam



# 95 High Hazard Dams in Iowa



# Hazard Classification Changes

- When downstream conditions change, classification can change.
- DNR may require dam upgrades or dam removal if dam does not meet requirements for current hazard classification.
- Upgrades may include larger spillways, raising the dam embankment, or lowering the normal pool elevation.
- Dam removal may be the cheapest alternative and must be performed in a controlled manner.





## Summary – Take Aways

- Large number of dams in Iowa
- Dams serve many purposes
- Dams can fail and cause downstream damages if not properly constructed and maintained
- The DNR dam safety program regulates dams in Iowa to reduce that risk of failure

# Additional Resources

- Association of State Dam Safety Officials
  - Membership open to all dam owners, consultants, and dam safety officials
  - Many available resources both for members and general public
    - <http://damowner.org/>
    - <http://damfailures.org/>
    - <http://damsafety.org/>
- Low Head Dam Safety
  - Concrete or rock dams across a river or stream channel.
  - DNR Water Trails staff works with low head dam owners to improve safety around dams.
  - <https://www.iowadnr.gov/Things-to-Do/Canoeing-Kayaking/Low-Head-Dams>
- Iowa Ponds Website
  - DNR fisheries biologist recommendations
  - <https://www.iowadnr.gov/Fishing/About-Fishing-in-Iowa/Iowa-Ponds>

# Final Questions



# Upcoming Webinars

- **May 13: How Dams Fail and How to Properly Maintain Your Dam.**
  - Learn about common ways that dams fail and how proper maintenance can reduce the risk of failure.
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<https://www.iowadnr.gov/dams>