Dam Safety in New Mexico – An Overview

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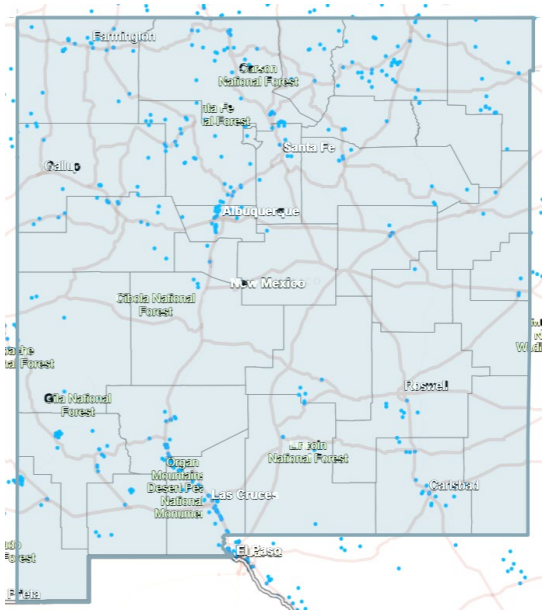
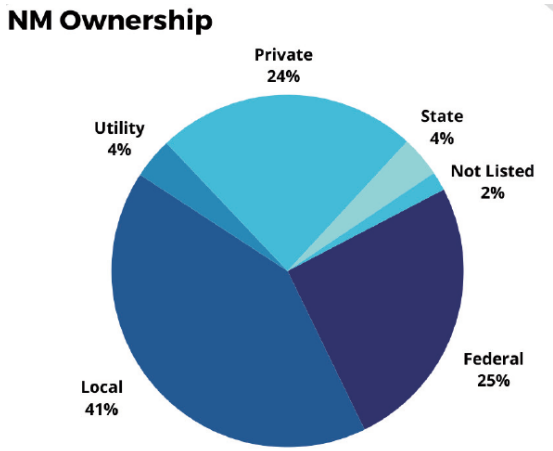
Outline

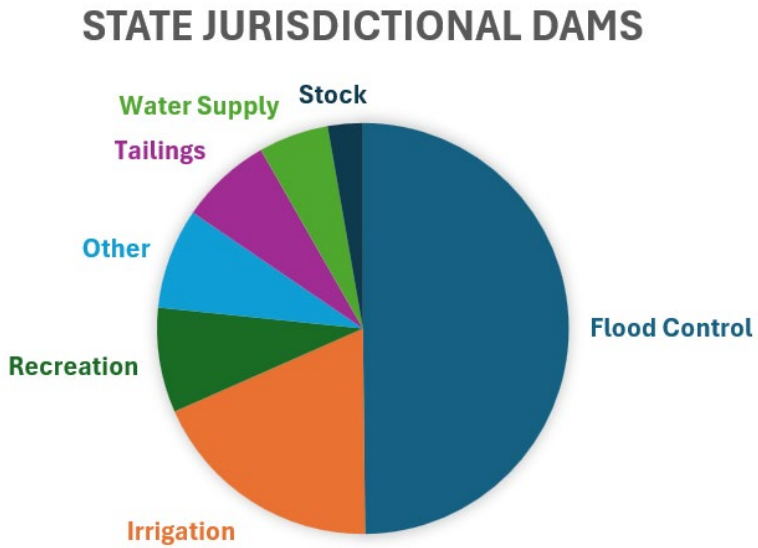
- An overview of dams in New Mexico
- Introduce Dam Safety Bureau
- Challenges
- Future Direction – Managing Risks

Dams in New Mexico - https://nid.sec.usace.army.mil/#/

- 403 Total Number of Dams
- 72% (~291 dams) are State Regulated
- 64 years - Average Age







Office of the State Engineer (OSE) – Dam Safety Bureau

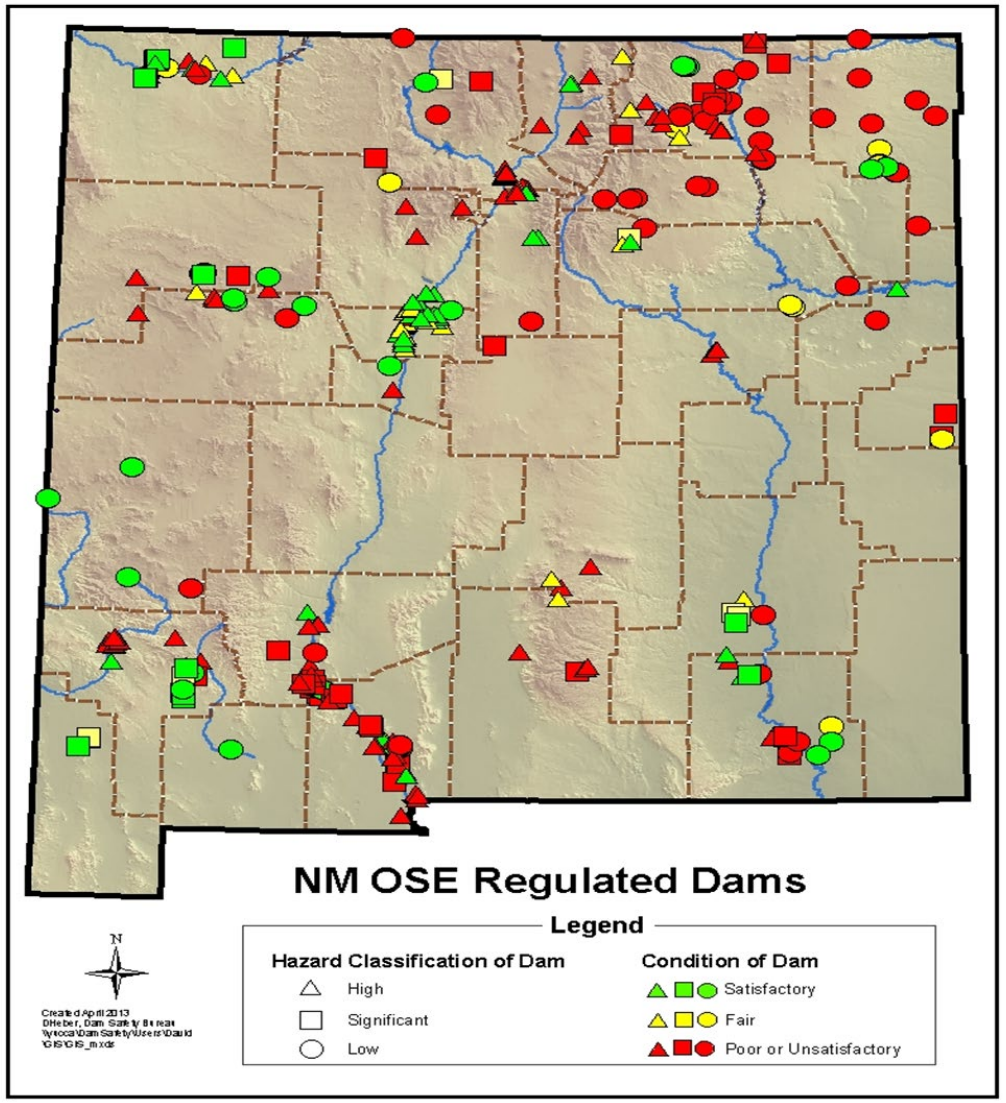
- Bureau is under Water Resources Allocation Program (WRAP) within the OSE
- 10 staff
  - 8 Dam Safety Engineers (2 vacant)
  - 1 Management Analyst
  - Bureau Chief
- Located in Albuquerque and Santa Fe
- Oversees the entire state

- Regulates dams within the state jurisdiction
  - Dams that are at least 6 ft high and store at least 50 ac-ft, or
  - Dams that store at least 15 ac-ft and are at least 25 ft high
- Reviews plans, designs, specs, construction, O&M, modification
- Requires EAP for High and Significant Hazard potential dams

Vision:

A Future where All Dams are Safe

Condition of State Regulated Dams

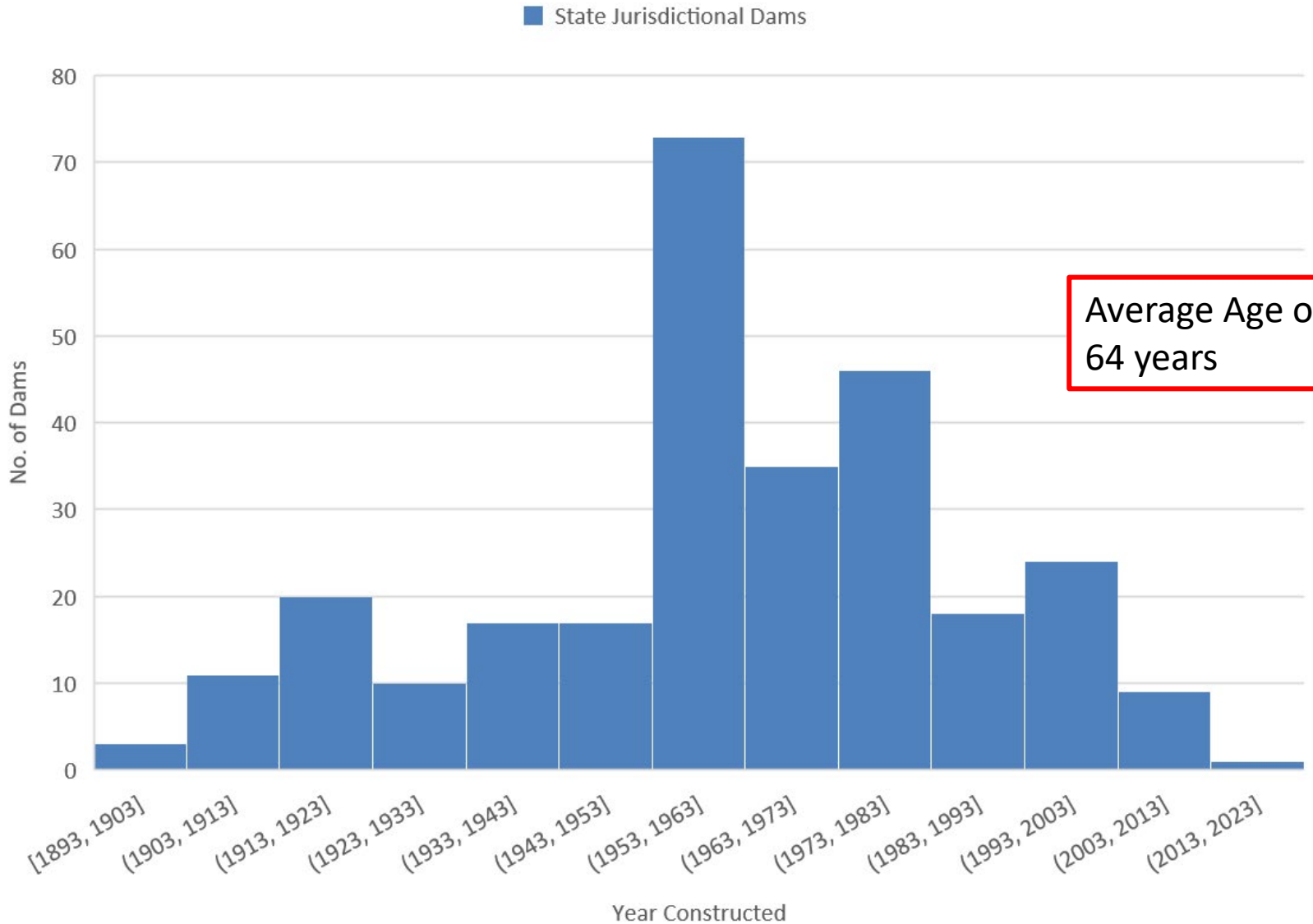


Out of 291 OSE Regulated Dams

- 62% High Hazard Potential
- 13% Significant Hazard Potential
- 25% Low Hazard Potential

High Hazard – Potential to cause loss of life
Significant Hazard – No loss of life, but Significant loss of properties or lifeline facilities or environmental impact
Low Hazard – No loss of life, damage limited to owner's properties

Approx 60% of dams are rated to be in Poor or Unsatisfactory condition



Average Age of dams - 64 years

Credit- Keith Ferguson, HDR Inc.

Key Technical Advances

Publications

People

1st research into landslides in clay strata, 1846 — University of Toronto Press, 1956

Developed Consistency and Gradation Limits for Clay Soils, 1911, 1913

Limit Equilibrium Stability (Swedish Slip Circle Method and Factor of Safety, 1916, 1926, 1936

Principle of Effective Stress, 1925 (a and b), 1936 — 1st Int. Conf. Soil Mech., 1936

Development of Direct Shear Device, 1926 — Wihelm Ernst and Son, Berlin, 1926

Development of 1st Rotation Shear Device, early 1930's — Bautechnik, 1937

Direct shear tests on slickensided Cucaracha shale, first use of reduced shear strength for design — ASCE Transactions, Vol. 114, 1949

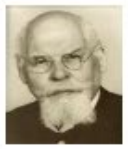
1st use of term "residual strength" for clays at large strains — Geotechnique, 1951

Reanalysis of failure case histories – failure close to "drained residual strength" — Geotechnique, 1964

Introduction of "fully softened" shear strength — Geotechnique, 1970

Introduction of SHANSEP (Stress History and Normalized Soil Engineering Properties — ASCE Geotechnical Journal, July,1974

Simplified Procedure for Estimating Earthquake-Induced Deformations — UC Berkley, College of Engineering, 1977



Alexander Collin; Albert Atterberg; Wolmer Fellenious; Karl von Terzaghi; H. Krey; B. Tiedemann; Binger and Thompson; R. Haefeli; Alec Skempton; Al Skempton; Foott; Makdisi and Seed

1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010 2020

HMR49 1977

HMR55A 1988

published Gradation Design of Sand & Gravel Filters, 1994

CO-NM REPS 2018

Liquefaction Evaluation Methods

Proctor Compaction Theory, 1933

Janbu Stability Method, 1954

Morgenstern/Price Method of Limit Eq. Analysis, 1965

Introduction of Finite Element Analysis for Slope Stability, 1974, Smith and Hobbs

Era of Outdated Filter Design

First soil classification System introduced as the Airfield Classification System by A. Casagrande, y 1940's

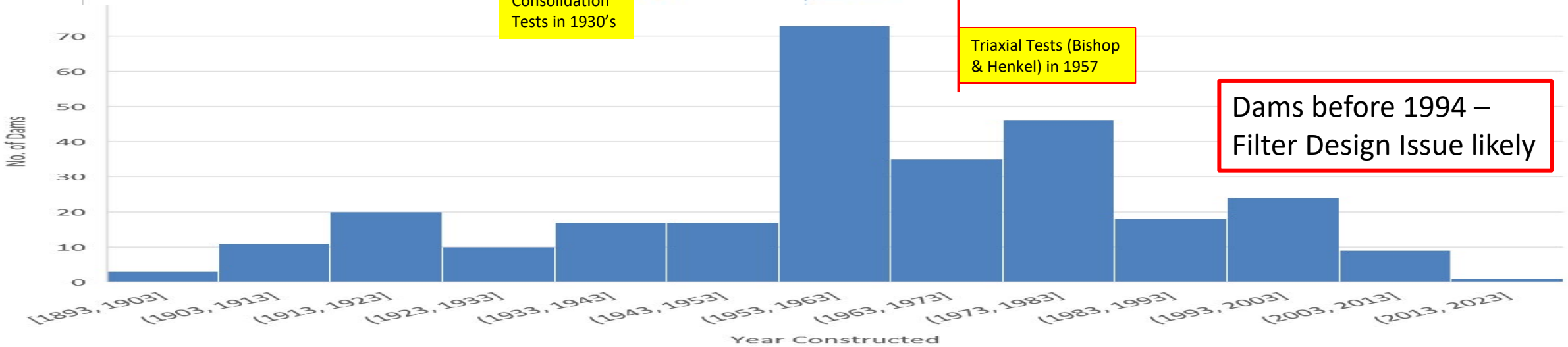
Bishop Method of Limit Eq. Analysis, 1955

Spencer Method of Analysis of Embankments, 1967

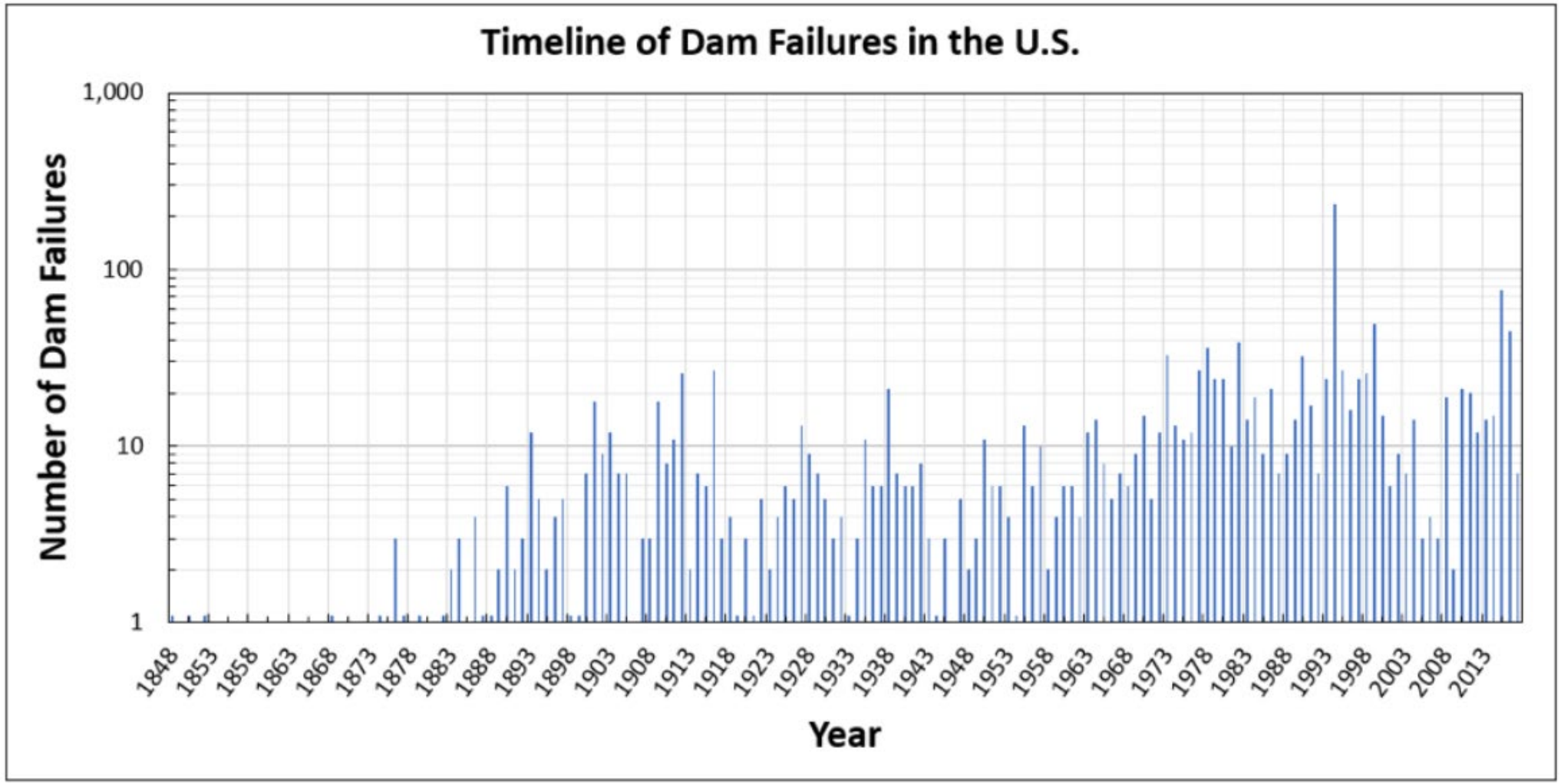
Era of Modern Filter Design

Consolidation Tests in 1930's

Triaxial Tests (Bishop & Henkel) in 1957



Dams before 1994 – Filter Design Issue likely



Credit – National Performance of Dams Program @ Stanford University

Roswell Rainfall Event – Oct. 19, 2024

Zuber Hollow Site 1
(13 Mile Draw) Dam

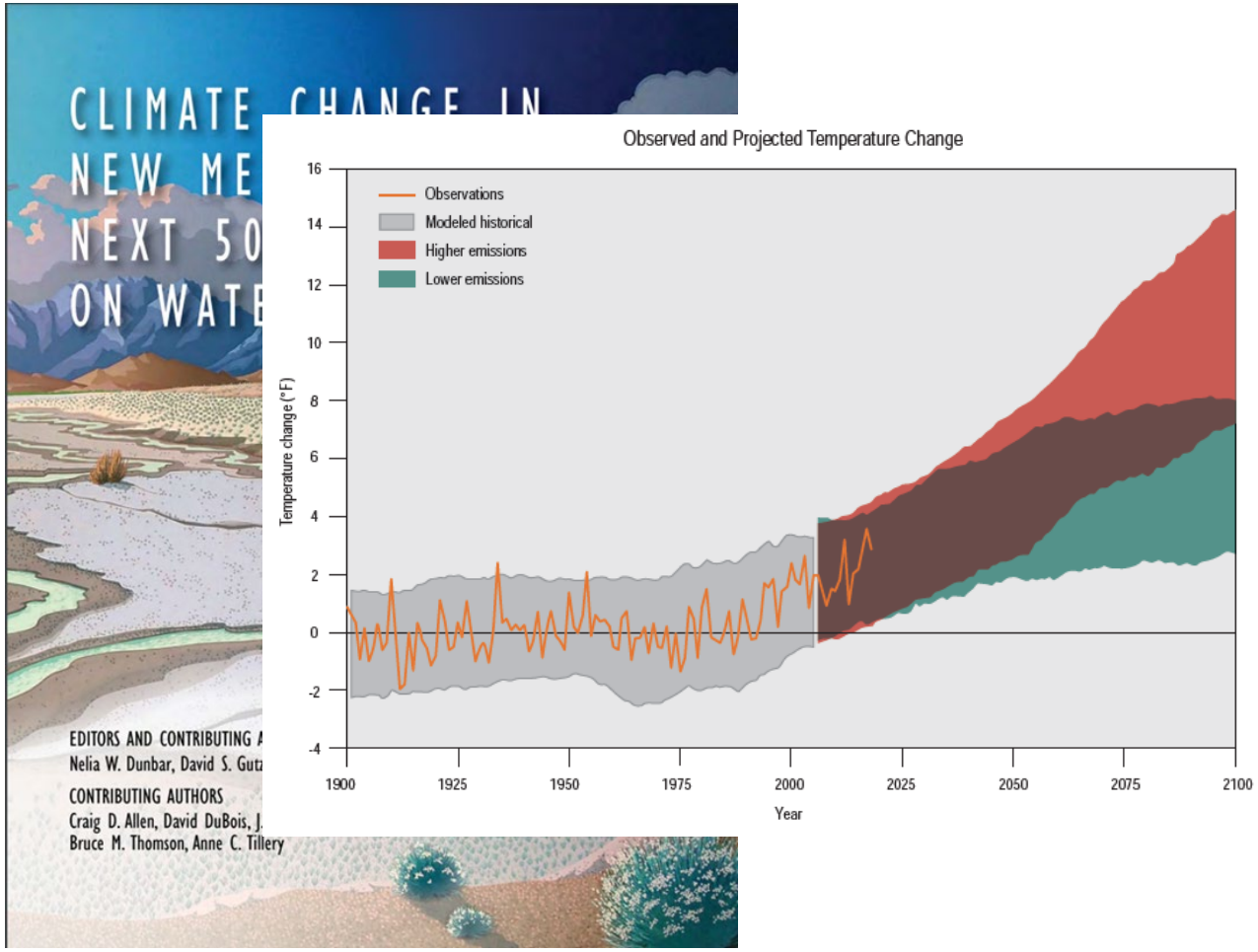
Roswell Rainfall Event – Oct. 19, 2024

Zuber Hollow Site 2
(Peters Lake) Dam

Situation Made Worse by Wildfires

- June 21, 2024 – (Impacted by Hermits Peak-Calf Canyon fire in 2022)
  - Las Vegas (NM) area received over 4 in of rain in 24-hr period causing widespread flooding along Gallinas River. Hundreds of residents were evacuated. Peterson Dam overtopped by about 2 ft of water and there was panic in the city that the dam might fail
  - The OSE Dam Safety Bureau made an emergency visit on Saturday (June 22)
- June 17, 2024 – (Impacted by South Fork Fire and Salt Fire in 2024)
  - Dams in Ruidoso area are of concerns, especially Alto Lake Dam
  - OSE Dam Safety Bureau inspected several dams in the area

Climate Change – Caution for Resiliency Design



"Annual Average Precipitation" is misleading for infrastructure design

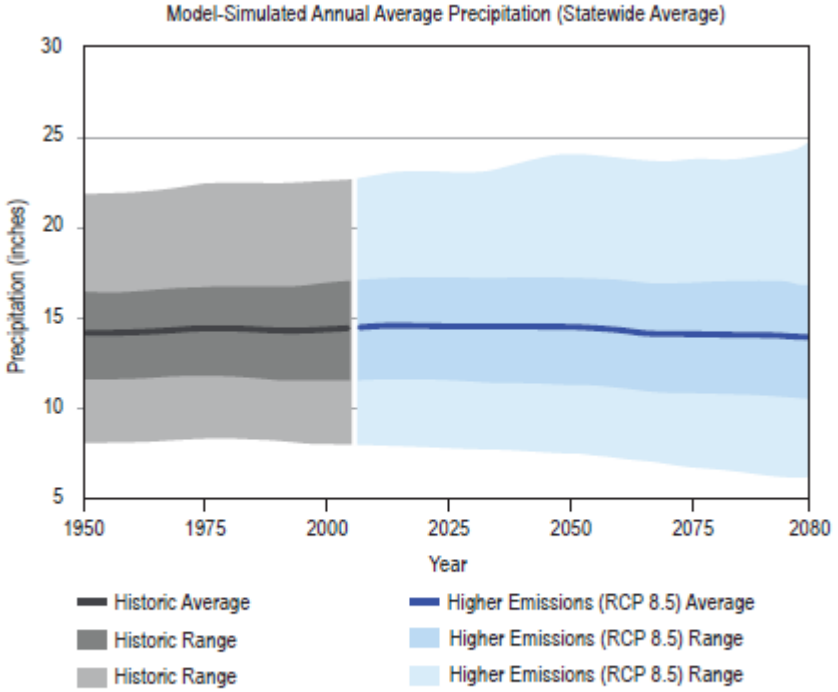
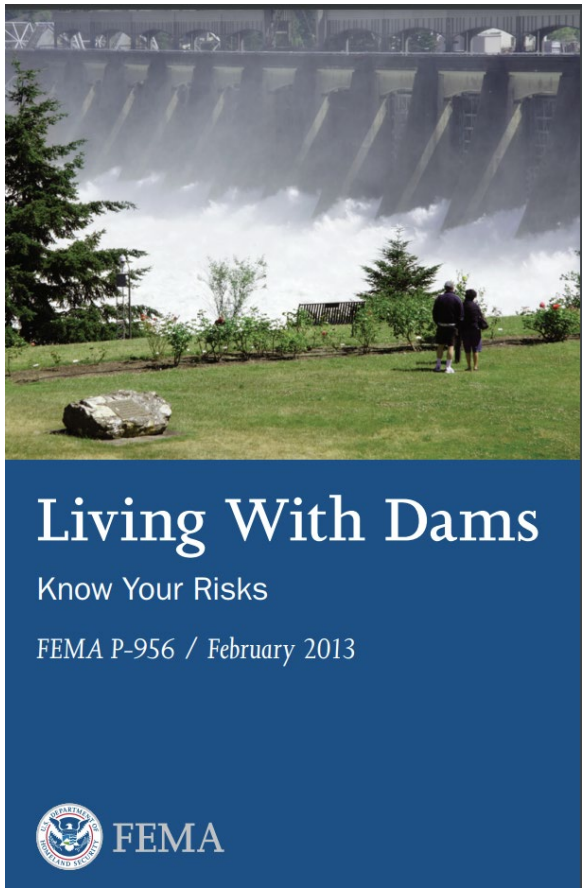


Figure 2.2. Annual average precipitation simulated by 20 CMIP5 GCMs, spatially averaged over the state of New Mexico, corresponding to the temperature time series in Fig. 2.1a.

Dam Safety is “Risk Management”



Dam Safety is a Shared Responsibility

HAZARDS

What are the hazards and how likely are they to occur?

PERFORMANCE

How will the levee perform in the face of these hazards?

CONSEQUENCE

Who and what are in harm's way?

How susceptible to harm are they?

How much harm is caused?

RISK = f (HAZARD, PERFORMANCE, CONSEQUENCE)

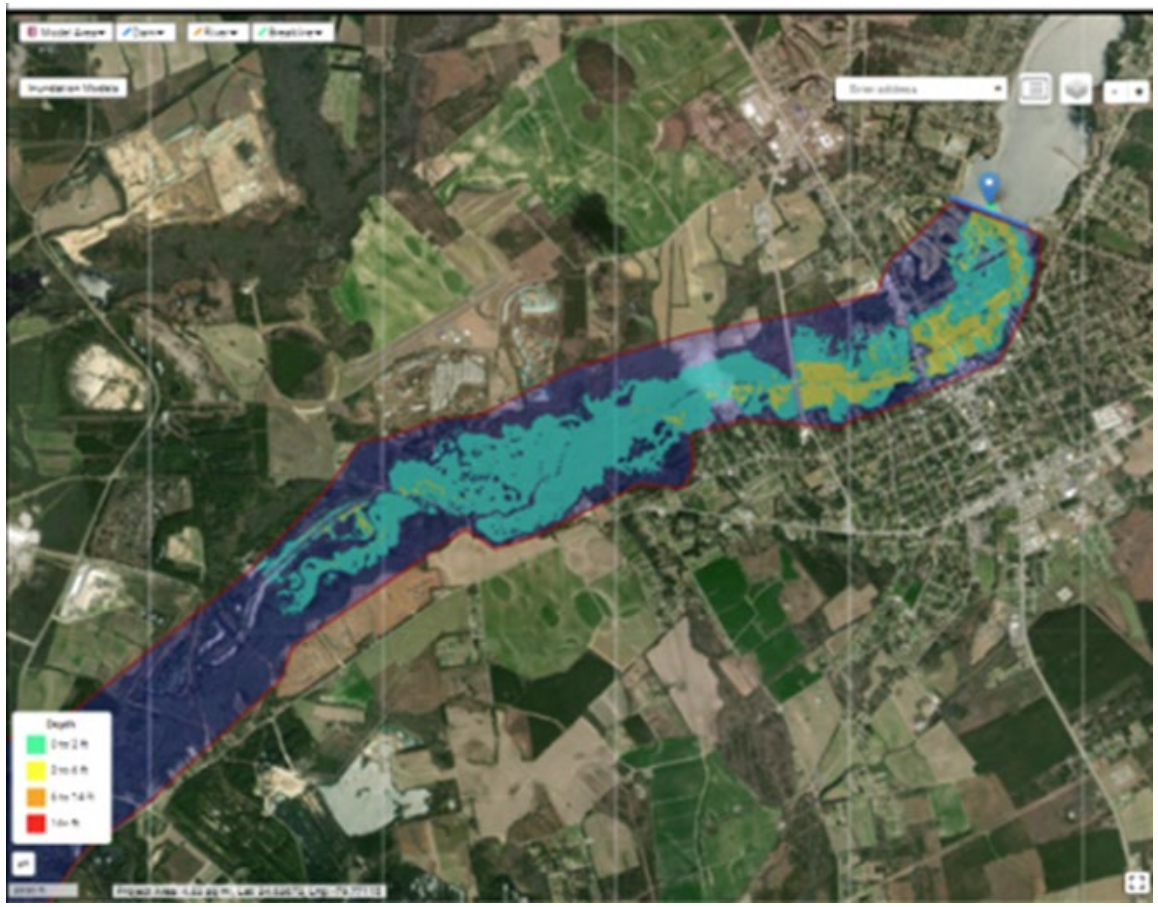
Risk Reduction Approach

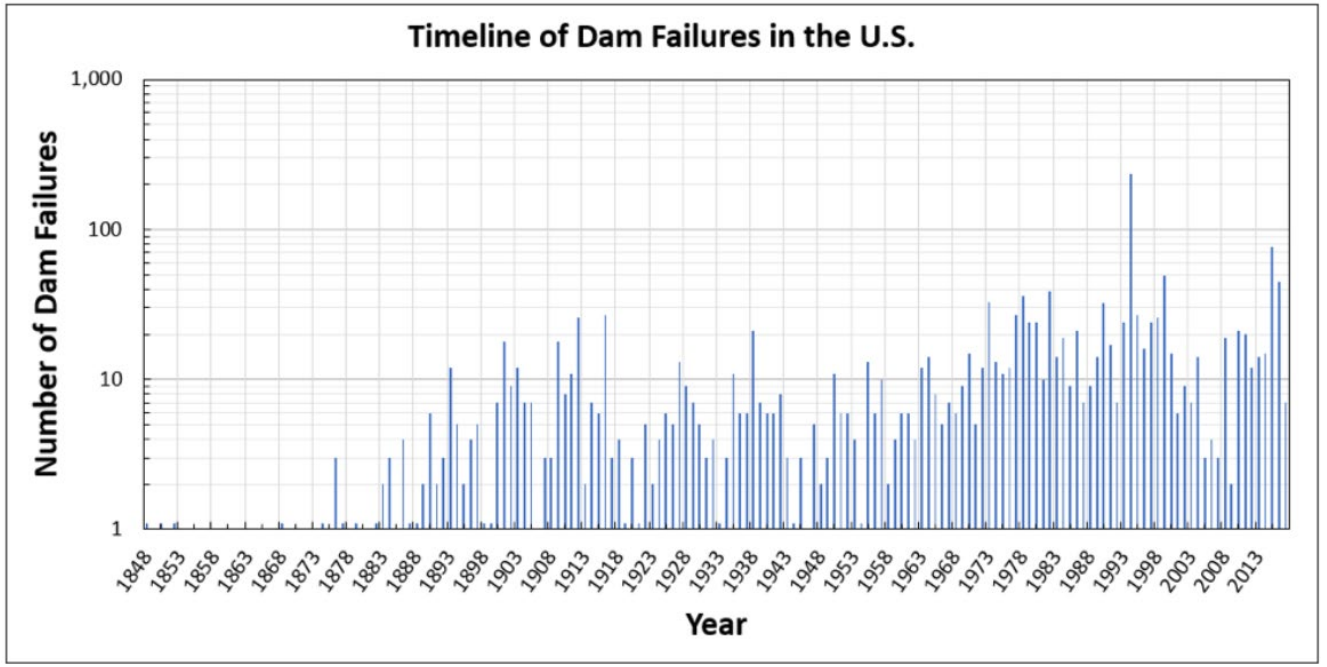
Improving Performance

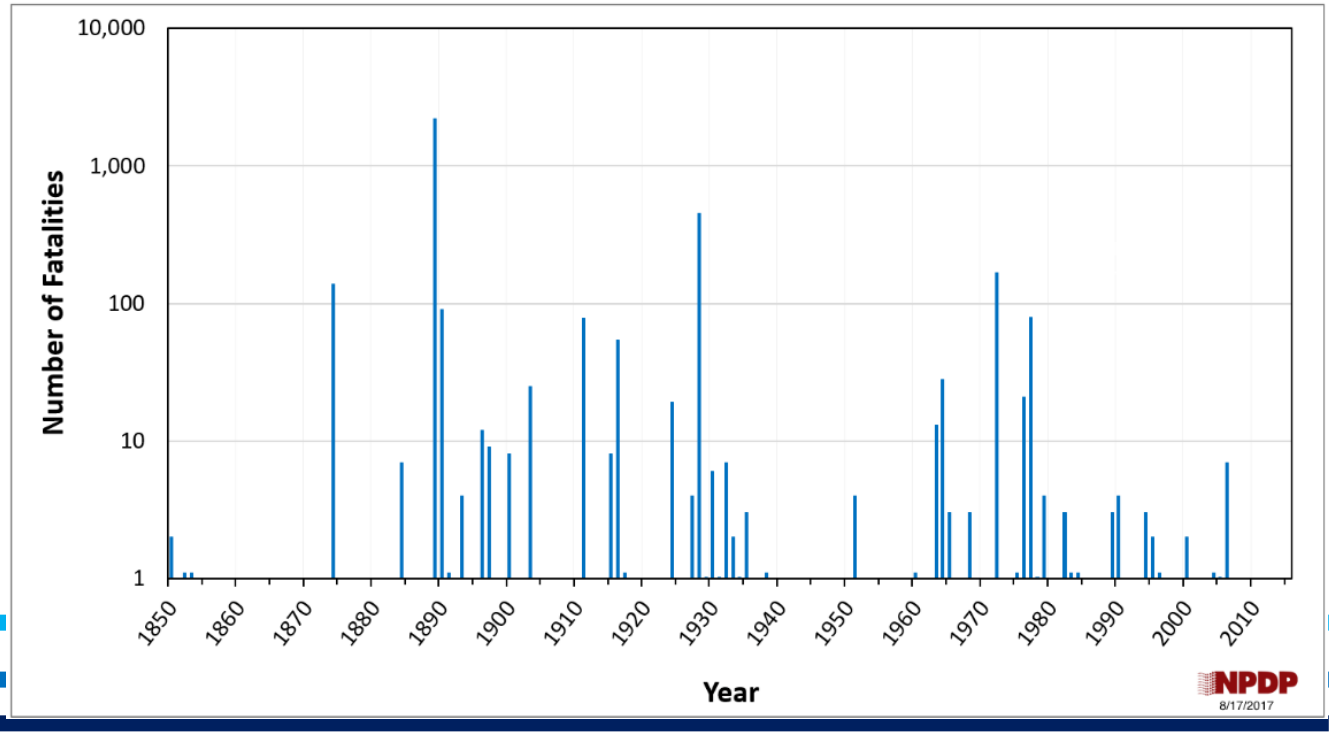
- Good Operation & Maintenance (O&M) Program
- Update dams to current state of practice

Reducing Consequence

- Emergency Action Plan (EAP)
  - About 55% of High Hazard Dams have approved EAP







Credits for reduction in loss of life –

- Advancement in Engineering & Technology
- Emergency Preparedness
- Public Education
- Successful Emergency Response

Credit – National Performance of Dams Proggram @ Stanford University

Office of the State Engineer
nm
Interstate Stream Commission

Thank you for your Attention!

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Useful Resources -
https://nid.sec.usace.army.mil/#/
https://damsafety.org/
https://damfailures.org/
https://damtoolbox.org/wiki/Main_Page
https://www.fema.gov/emergency-managers/risk-management/dam-safety