OROVILLE DAM CITIZENS ADVISORY COMMISSION

Hosted by the California Natural Resources Agency



ROLL CALL

- Lieutenant Collins
- Supervisor Connelly
- Supervisor Conant
- Secretary Crowfoot
- Deputy Director Curry
- Supervisor Flores
- Supervisor Fuhrer
- Assemblyman Gallagher
- Supervisor Kimmelshue

- Deputy Licon
- Captain Million
- Director Nemeth
- Senator Nielsen
- Councilmember Pittman
- Mayor Reynolds
- Lieutenant Stokes
- Superintendent Teague
- Supervisor Vasquez
- Genoa Widener

ITEM 1: WELCOME AND INTRODUCTIONS

ITEM 2: ACTION ITEMS & ROADMAPS

Commission Action Items Tracker

No.	ltem	Meeting	Status
1	Tour of Joint Operations Center (State-Federal Flood Operations Center in Sacramento)	Mtg 2 11/2019	On hold due to Covid-19. Aiming for Q2 2022.
2	Report out how instrumentation performed and was managed during winter operations	Mtg 2 11/2019	Ongoing.
3	Invite State Water Contractors to future meeting(s)	Mtg 2 11/2019	On track. Invite for Q3 2021 meeting.
4	Provide regular updates and milestones developments from DWR on Forecast-Informed Reservoir Operations (FIRO) as well as Oroville and New Bullards Bar water control manual processes	Mtg 3 02/2020	On track. Update planned for Q4 2021 meeting.
5	Follow-up on the status of the Federal Energy Regulatory Commission (FERC) relicensing	Mtg 3 02/2020	Ongoing. Anticipate early 2022 update.

Commission Action Items Tracker

No.	ltem	Meeting	Status			
6	Follow-up on the status of Federal Emergency Management Agency (FEMA) reimbursement for spillway reconstruction	Mtg 3 02/2020	Ongoing.			
7	Discussion to help state agencies and local partners address homelessness concern around Feather River.	Mtg 3 02/2020	For future Commission consideration.			
8	CalOES follow up with CalTrans on the status of their post-fire mitigation along County highways	Mtg 5 11/2020	Done. Work confirmed complete.			
9	DWR updates on debris and storm inflows	Mtg 5 11/2020	DWR monitoring, will notify Commission as needed.			
10	DWR follow-up re: Hyatt Power Plant	Mtg 5 11/2020	Done. Update provided at Q2 2021 meeting.			

Commission Action Items Tracker

No	.ltem	Meeting	Status
11	Offer new members, Kimmelshue, Fuhrer and Vasquez, a Commissioner orientation.	Mtg 6 2/19/21	On track.
12	Post additional contact information on OCAC website.	Mtg 6 2/19/21	Done. Contact e-mail and phone # are available on Commission website.
13	Agendize discussion on lessons learned from 1986 and 1987 water events.	Mtg 6 2/19/21	On track. Update planned for Q4 2021.

2021 Public Meeting Agenda Roadmap

Q3 (August 27, 2021) Infrastructure

Topics

Planned Major Projects at Oroville Facilities

- Asset Management
- Annual Maintenance Plan

Status Updates Commission Report

Q4 (December 3, 2021) Operations

<u>Topics</u>

Oroville Dam Facility Operations

- Winter Operations Plan
- U.S. Army Corp of Engineers (water control manual update)

Status Updates

Commission Report Wildfire Season Update

2022 Public Meeting Agenda Roadmap

Q1 (2022) Partnerships

<u>Topics</u>

Dam Facility Partnerships

- FERC Relicensing
- Recreation Partnerships
- Public Safety Partnerships

Status Updates Commission Report

Q2 (2022) Joint Operations Center – Sacramento

Topics

Joint Operations Center

- Tour of Joint Operations Center (Commissioner only portion)
- Overview of Joint Ops and Flood Ops
- 2017 Lessons Learned and Current Procedures

Status Updates

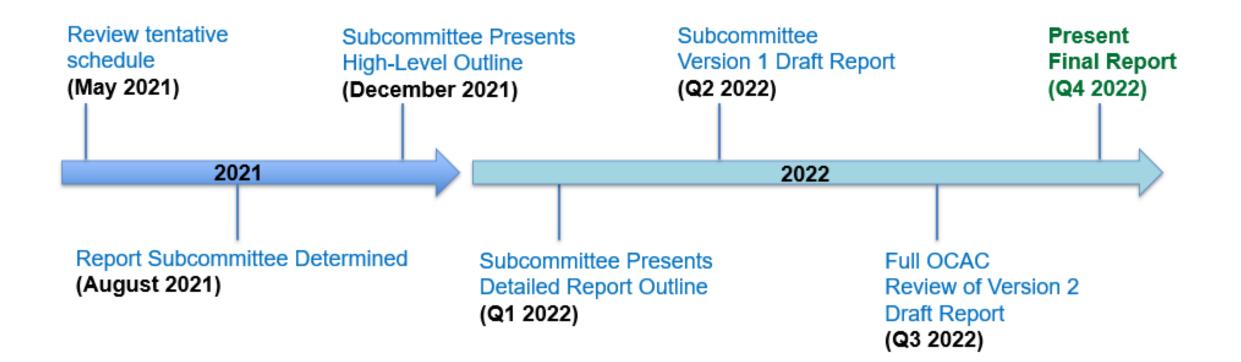
Commission Report

Commission Report Senate Bill 955 Requirements

SB 955 states the Commission will publish a report at least **once every three years** that provides the following:

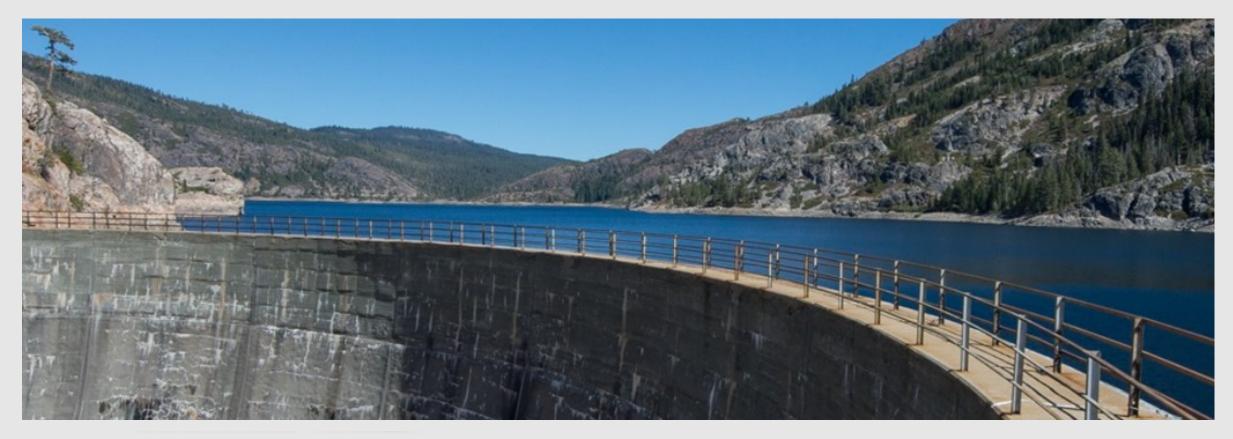
- An overview of ongoing maintenance and improvements made at the Dam and Dam complex;
- A register of communications received from State Agencies and other parties to the Commission;
- Notice of upcoming plans made by State Agencies for the Dam and Dam Complex; and
- An overview of flood management projects on the Feather River affecting public safety and flood risk reduction.

Commission Report Development Timeline



ITEM 3: DAM SAFETY PROGRAM: REGULATORY PERSPECTIVE

California's Dam Safety Program





CALIFORNIA DEPARTMENT OF WATER RESOURCES DIVISION OF SAFETY OF DAMS

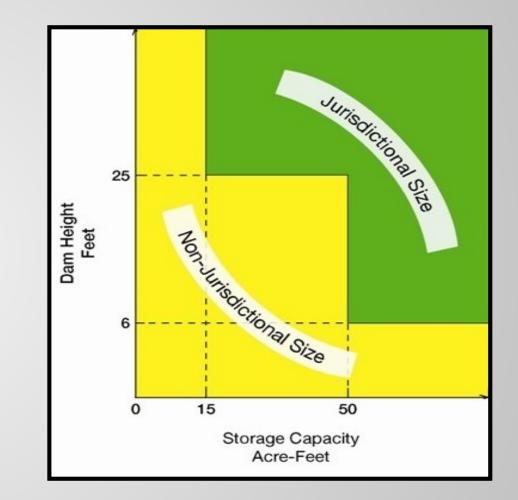
Sharon K. Tapia, P.E., PMP

May 28, 2021

Dam Safety Authorities

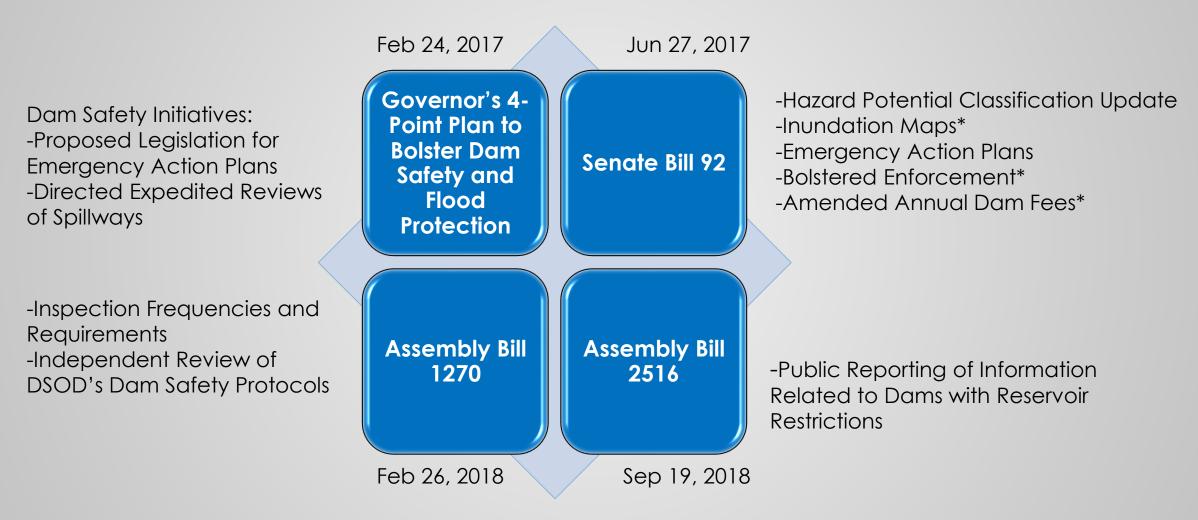
California Water Code Division 3. Dams and Reservoirs Part 1. Supervision of Dams and Reservoirs

California Code of Regulations Title 23. Waters Division 2. Department of Water Resources Chapter 1. Dams and Reservoirs





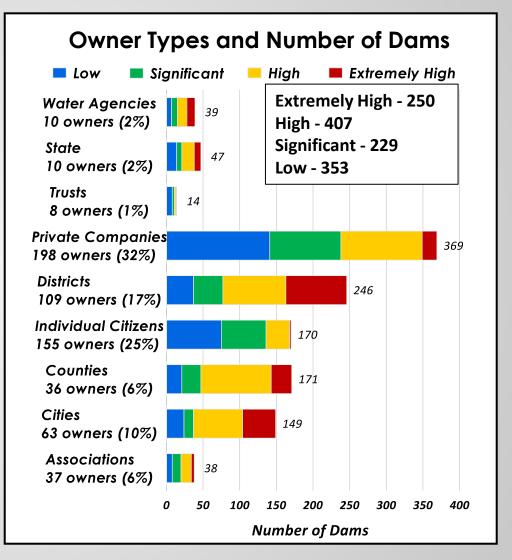
Recent Dam Safety Initiatives & Legislation





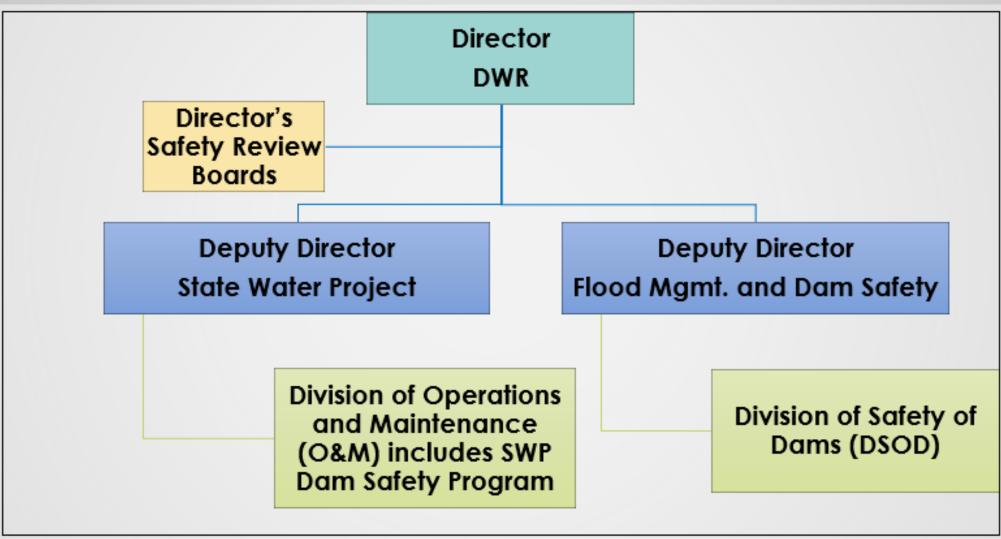
Hazard Classifications and Dam Owners







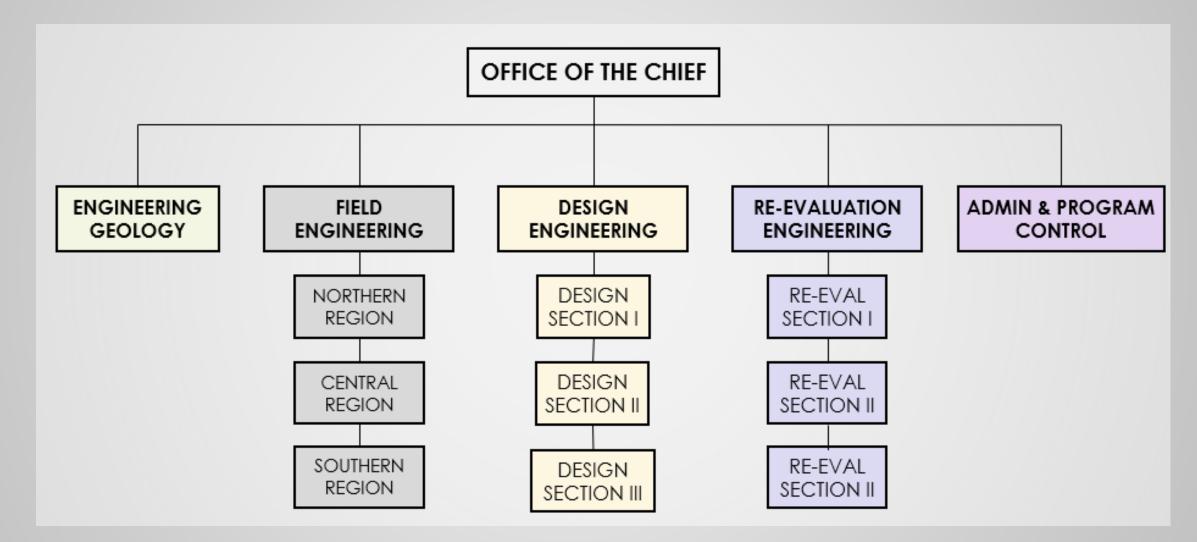
DSOD & O&M within DWR



A REPARTMENT OF WATER RECOURCES

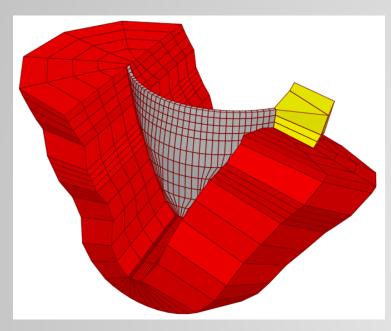


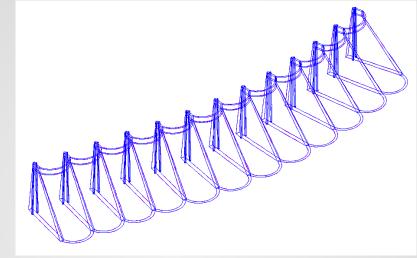
DSOD's Staffing

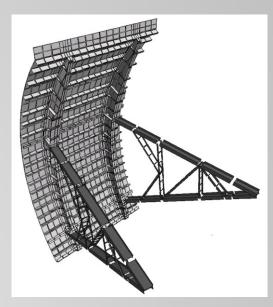


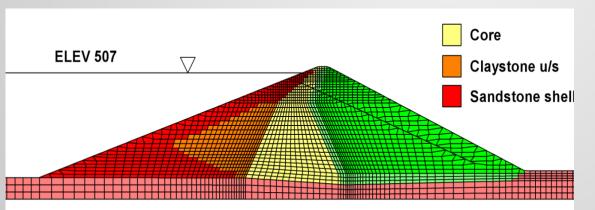


Design Reviews & Re-evaluations

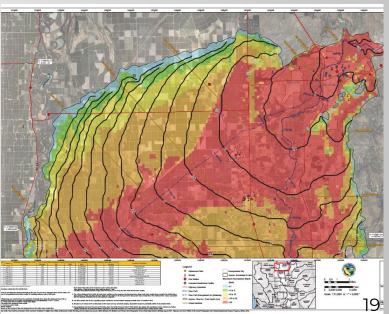












Construction Oversight











Inspections & Surveillance Monitoring

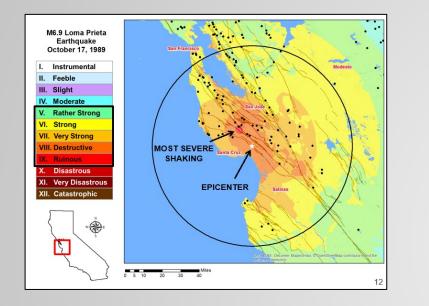
DIVISION OF SAFETY OF DAMS







Emergency Response





Source: CBS Local San Francisco





CALIFORNIA DEPARTMENT OF WATER RESOURCES DIVISION OF SAFETY OF DAMS



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ITEM 4: DAM SAFETY PROGRAM: PUBLIC SAFETY PERSPECTIVE

CALIFORNIA DEPARTMENT OF WATER RESOURCES

State Water Project Dam Safety Program



Castaic Dam - High Outlet Tower and Access Bridge, Los Angeles County

Oroville Citizens Advisory Commission May 28, 2021

Presented by: David Sarkisian, PE, CEG Chief of Dam Safety Services SWP Chief Dam Safety Engineer

26 State Water Project Dams

Field Division	Dam				
Oroville	Oroville Dam				
Oroville	Parish Camp Saddle Dam				
Oroville	Bidwell Bar Canyon Saddle Dam				
Oroville	Thermalito Diversion Dam				
Oroville	Thermalito Forebay Dam				
Oroville	Thermalito Afterbay Dam				
Oroville	Feather River Fish Barrier Dam				
Oroville	Antelope Dam				
Oroville	Frenchman Dam				
Oroville	Grizzly Valley Dam				
Delta	Bethany Dams				
Delta	Clifton Court Forebay Dam				
Delta	Del Valle Dam				
Delta	Patterson Dam				
Delta	Dyer Dam				
San Luis	O'Neill Forebay Dam				
San Luis	Sisk Dam (San Luis Reservoir)				
San Luis	Little Panoche Detention Dam				
San Luis	Los Banos Dam				
Southern	Pyramid Dam				
Southern	Quail Dam				
Southern	Castaic Dam				
Southern	Devils Canyon Second Afterbay				
Southern	Cedar Springs Dam				
Southern	Crafton Hills Dam				
Southern	Perris Dam				



Focus for Typical Industry Dam Safety Program – Pre-2000

- Surveillance & Inspections
- Dam Safety Assessments
- Reservoir Operations
- Maintenance
- Design and Construction
- Emergency Action Plans
- Independent Reviews

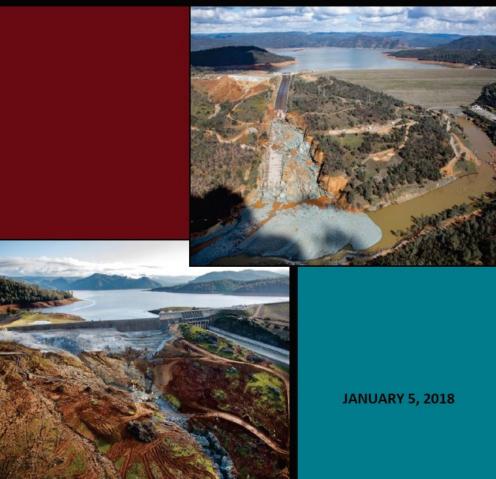


B. F. Sisk Dam (San Luis Reservoir) Glory Hole Spillway and Gianelli Pumping-Generating Plant Intake Structure

2017-2018 SWP Dam Safety Program Reviews

- Independent Forensic Team Report
- Owner's Dam Safety
 Program Audit
- ISO 55000/ASDSO Peer Review
- Management Reviews/Visits
 with Peers
- Dam Safety Program Maturity Matrices

INDEPENDENT FORENSIC TEAM REPORT OROVILLE DAM SPILLWAY INCIDENT



Common Areas Identified for Improvement

- Update the SWP Dam Safety Policy
- Define the Top-down structure
- Increase training and interaction with dam safety organizations
- Implement Cross-Divisional Dam Safety Teams
- Link the SWP Dam Safety Program to the O&M Asset Management Program
- Improve Culture of Continuous Improvement

Road-mapping of Multi-year Dam Safety Program Initiatives

- 30 initiatives or "tasks" identified
 - Solidify Guiding Documents
 - Functional Design Implementation
 - Dam-Specific Asset Management
 Plans
 - Risk Management
 - Maintenance Management
 - Data and Document Management
 - Emergency Preparedness
 - Core Competencies



WATER RESOURCES

- Outsourcing Strategy
- Business Processes
- Resource Requirements
- Training Program
- Industry Outreach
- Communication and Change
 Management

Consolidated to 16 Initiatives

- Performance Metrics
- Program Reviews

Initiative No. 1 – Solidify Guiding **Documents, Including the SWP Dam Safety Program Document**

- Updated Policy Signed by Director on **November 2, 2018**
- Public safety is the highest priority for the Department and the SWP
- Assigns responsibilities and accountability to key positions
- Formally Established Program Elements





the environment in a non-sectors indexions. Fubile calls yis the highest priority for the Devastment in its management and operation of the State Note: Project (SAP), while the use of a sector a new sectors detection of the State State. Project (SAP), while the use of a sector a se native in a their preferable and ong Department executives, and style and style stacked dens for the identification elasticities insurance part and communication of an any SWP commanity risks.

WP staff, managers, and its arread partners are responsible for implementing this policy and centrically improving the SAP Dam Safety Program SkiP managers will manager a culture that projectes the SWP dam safety original ples. The Department's Directorate shell provide all recentery resources to implement the police.

Roles and Responsibilities of SWP Dam Safety Program Leader The SWP Dam Safety Program relies on commitment and organgement, formal londs of the Dependent.

SWP Dam Safety Program Elements

These program a ements shall be documented within the SWT ODSP commont.

Surveillance - Tory netection, inspections, instrumentst or monicorring, and testing with rubust china collection and snalyzes.

1. Any extraction we see that to prefer barrier of perceived comparisons to the Crief Dam Safety Engineer for svalues on

All Department Employees:

is accountable for:

The Assistant Deputy Diractor, State Water Project,

 Establishing, communicating, and maintaining SW. polic en perceining to she callety to emphasize the importance of public safety. Ensuring that resources are properly aligned and sufficient to acclimate public solidly priorities for SWI

idams and associated infrastructure, and successful nanoution of the SWP Dam Safety Program. Communicating significant dam safety issues to the Departy Directory State Water Project, and the Director.

4. Enclacing the Chief Data Safety Enclaver, SAF

Division Chiefs, Denuty Directors and Director en program performance 5. Ensuring communication of SWP Care Ballety Program activities to a listake to dem.

The Chief Dam Selety Engineer is responsible for:

1. Admirectoring, mentaning, and continuo improving the SWF Dam Salety Program. This includes (ODSP) document wir chiefer angemeine stelles responsibilities, and SWP Danues Selection and SWP Danie Stelles, responsibilities, and SWP Danie Selecty Rogram element as

2. Prioritizing clamisates: projects and activities in with user and risk management policies. ulighteen with co-for SWP facilities. 1. Communicating significant data safety issues and this

reduction measures in a timely manner to the Assistant Doonly Directory State Water Project, and the Deputy Director, State Piater Project.

4. Communicating program activities to dom satisfy HOLD HERE.

SWP Division Chiefs support the SWP Dam Sefety Program by

Alignano resources to address program priorities as most remended by the Chief Dam Salety Trade and approved by the Assistant Deputy Director, State.

2. Developing and implementing effective procedures instructions, and standards within Divisions to fulfill the program elements.

3. Developing and implementing best practices in the design, construction, spendian, and maintenance of SVF dams and their appartmenances. 4. But cipating in the SMP Jam Safety regress Structure

Dem Safety Assessments - "values incliny conformation and design, constanting modern state and set d analysis methodologies, "referre comprehensive fact ity reviews."

· Reservoir Operations - Constant secondaries to provi public satery and protect downstream communities.

· Maintenance - Meet or exceed inclustry standards for meintown of SWP constand approximation.

 Design and Construction Enabley constructive design and construction practices in accordance with regulating requirements and readers inducey standards

 Risk Management "Variate dam safety keeps and align decision making with real menagement policy

Emergency Proparedness - Maintain and event se Emergency Action 7 prv and Sixourity Plans; partner with emergency management agenties and

· Independent Reviews - Clarcian locility reviews by example dam solary experts to sough Part 120 Independent Consultants, Director's Solary Review Security and Beards of Carte Joints

· Project Delivery - Effectively manage projects, ever. de ature set obtain service-mental ownerity and day on and construct frailines.

 Communication - Communicate and report days sofet sected and program status to internal and external students.

Documentation Organization shows program and facility documentation

 Technical Expertise - Hire, train, and develop quarted stell through documented training oregoine and partnering with external experts.

Program Reviews - Monitor program performance mention and performings or auditor indiversal menagement to promote opritinus improvement.

Source head or Solo Network a upshowing Skie Weishaed In story second like of some star of separate processed industry. The Theorem is particle to an advector transmission probability provided that and the second se

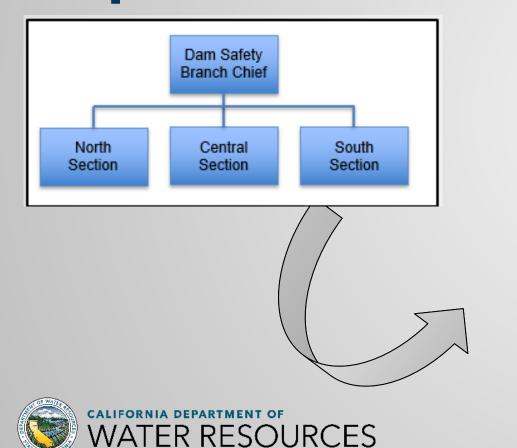
SWP Dam Safety Program Elements

- Surveillance
- Dam Safety Assessments
- Reservoir Operations
- Maintenance
- Design and Construction
- Risk Management

- Emergency Preparedness
- Independent Reviews
- Project Delivery
- Communication
- Documentation
- Technical Expertise
- Program Reviews



Initiative No. 2 – Complete SWP Dam Safety Program Functional Design Implementation





Initiative No. 4 – Enhance DWR's Approach to Dam Safety-related Risk Management Level 2 Risk Analyses

DWR Division of Operations and Maintenance Risk Matrix												
Likelit	nood		DWR Division of Operations & Maintenance Risk Matrix									
Likely to occur 10 times a year	1x10 ⁰	7	7	14 21 28 35		35	42	49				
Likely to occur within 1 year	1110	6	6	12	18	24	30	36	42			
Likely to occur within 3 years	< 1x10 ⁰ to 3.3x10 ⁻¹	5.5	5.5	11	16.5	22	27.5	35	38.5			
Likely to occur within 10 years	< 3.3x10 ⁻¹ to 1x10 ⁻¹	5	5	10	15	20	25	30	35			
Likely to occur within 30 years	< 1x10 ⁻¹ to 3.3x10 ⁻²	4.5	4.5	9	13.5	18	22.5	26	31.5			
Likely to occur within 100 years	< 3.3x10 ⁻² to 1x10 ⁻²	4	4	8	12	16	20	24	28			
Likely to occur < 1x10 ⁻² within 1000 years to 1x10 ⁻³		3	3	6	9	12	15	18	21			
Likely to occur within 10,000 years	< 1x10 ⁻³ to 1x10 ⁻⁴	2	2	4	6		10	12	14			
Likely to occur within 100,000 years or greater	< 1x10 ⁻⁴	1	1	2	3	4	5	-	7			
			Consequence									
			1	2	3	4	5	6	7			
Consequence	e Category		Insignificant	Minor	Moderate	High	Major	Extreme	Catastrophic			
Public Safety			No injury No damage to public or private property	Near miss Or minor property damage	Minor injuries not requiring medical attention Or moderate property damage	Single injury requiring medical attention Or moderate property damage	Multiple injuries or permanent disability Or major property damage	Fatality Or major property damage over large area	Multiple Fatalities			
		_			Property durinage	over large area		go urou				

Oroville Dam Comprehensive Needs Assessment: *Risk Assessment plus Risk Reduction Measures*



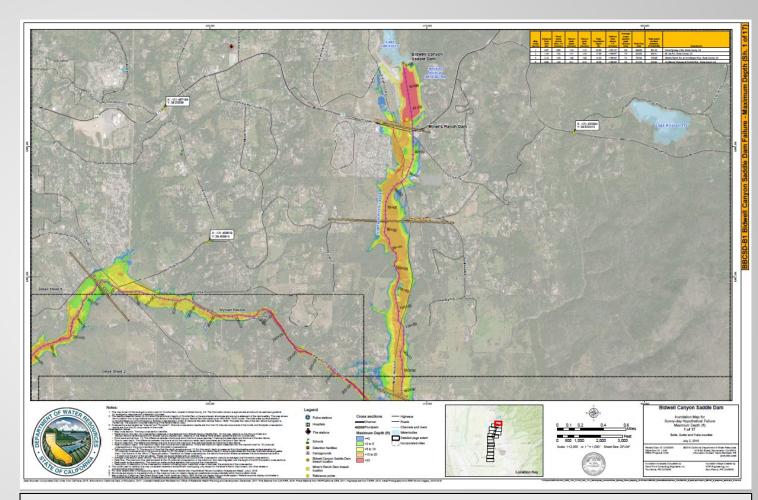
WATER RESOURCES

\checkmark	Oroville Dam
\checkmark	Pyramid Dam
\checkmark	Castaic Dam

Lik	celihood					State Water P	roject Dam Safe	ty Risk Matrix				
10 times a year 1x10 ⁰	10	10	DWR							90	100	
	9	9	18	27	36	45	54	63	72	81	90	
Likely to occur within 3 years	< 1x10 ⁰ to 3.3x10 ⁻¹	8.5	8.5	17	25.5	34	42.5	51	59.5	68	76.5	85
Likely to occur within 10 years	< 3.3x10 ⁻¹ to 1x10 ⁻¹	8	8	16	24	32	40	48	56	64	72	80
Likely to occur which 30 years	< 1x10 ⁻¹ to 3.3x10 ⁻²	7.5	7.5	15	22.5	30	37.5	45	52.5	60	67.5	75
Likely to occur within 100 years	< 5.2×10 ⁻² to 1×10 ⁻²		7	14	21	28	35	42	49	56	63	70
Likely to occur within 1,000 years	< 1x10 ⁻² to 1x10 ⁻³	6	6	12	18	24	30	36	42	48	54	60
Likely to occur within 10,000 years	< 1x10 ⁻³ to 1x10 ⁻⁴	5	5	10	15	20	25	30	35	40	45	50
Likely to occur within 100,000 years	< 1x10 ⁻⁴ to 1x10 ⁻⁵	4	4	8	12	16	20	24	28	32	36	40
Likely to occur within 1,000,000 years	< 1x10 ⁻⁵ to 1x10 ⁻⁶	3	3	6	9	12	15	18	21	24	27	30
Likely to occur within 10,000,000 years	< 1x10 ⁻⁶ to 1x10 ⁻⁷	2	2	4	6	8	10	12	14	16	18	20
Likely to occur less often than 10,000,000 years	< 1x10 ⁻⁷	1	1	2	3	4	5	6	7	8	9	10
-							Consequence					
Consequence Category		1	2	3	4	5	6	7	8	9	10	
Public Safety			No injury No damage to public or private	Near miss Or minor property damage	Minor injuries not requiring medical attention Or moderate property damage	Single injury requiring medical attention Or moderate	Multiple injuries or permanent disability Or major	Fatality 0 - 1 Or major property damage over	Multiple Fatalities 1 - 10	Multiple Fatalities 10 - 100	Multiple Fatalities 100 – 1,000	Multiple Fatalities >1,000
	Likely to occur 10 times a year Likely to occur within 1 years Likely to occur within 3 years Likely to occur within 10 years Likely to occur within 10 years Likely to occur within 1000 years Likely to occur within 10000 years Likely to occur within 1000000 years Likely to occur within 1000000 years Likely to occur within 1000000 years Likely to occur within 1000000 years Likely to occur	10 times a year 1x10 ⁹ Likely to occur <1x10 ⁹ within 3 years <0.3.3x10 ⁻¹ Likely to occur <3.3x10 ⁻¹ within 3 years <0.3.3x10 ⁻¹ Likely to occur <1.3x10 ⁻¹ Within 2 years <0.1x10 ⁻¹ Likely to occur <1.1x10 ⁻¹ Within 10 years <0.3.3x10 ⁻² Likely to occur <0.3.3x10 ⁻² Likely to occur <0.1x10 ⁻² Within 10,000 <1.1x10 ⁻² Likely to occur <1.1x10 ⁻² Within 10,000 <1.1x10 ⁻² Ukely to occur <1.1x10 ⁻³ Ukely to occur <1.1x10 ⁻⁴ Ukely to occur <1.1x10 ⁻⁵ Ukely to occur <1.1x10 ⁻⁵ Ukely to occur <1.1x10 ⁻⁶ Within 10,000,000 <1.1x10 ⁻⁷ Ukely to occur <1.1x10 ⁻⁷ Ukely to occ	Likely to occur 1x10° 10 Ubiest year 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10 15 20 25 30 35 40 Likely to occur within 10000 5 5 10 15 20 25 30 35 40 Like</td><td>Likely to occur 20 times years within 1 year 10 10 10 DWR O&M Risk Matrix (AM_02_01) 9 60 70 80 90 Likely to occur within 1 year 10 10 10 DWR O&M Risk Matrix (AM_02_01) 9 60 70 80 90 Likely to occur within 1 year 6 70 80 90 Likely to occur within 1 year 6 70 80 90 Likely to occur within 1 year 8.5 8.5 17 25.5 34 42.5 51 59.5 68 76.5 Likely to occur within 10 years 01 x10⁴ 8 8 16 24 32 40 48 56 644 72 Likely to occur within 100 years 01 x10² 7 14 21 28 35 42 49 56 63 Likely to occur within 100 wars 01 x10² 7 14 21 28 32 36 42 48 54 Likely to occur within 100000 01 x10² 5</td></t<>	Likely to occur 10 times year Likely to occur within 1 years 10 10 DWR 0&M Risk Matrix (AM_02_01) 60 9 9 18 27 36 45 54 Likely to occur within 1 years <1X10 ⁰ 0 3,3X10 ⁻¹ 8.5 8.5 17 25.5 34 42.5 51 Likely to occur within 2 years <3,3X10 ⁻¹ 8 8 16 24 32 40 48 Likely to occur within 10 years <1X10 ⁻¹ to 1X10 ⁻² 7.5 7.5 15 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Initiative No. 7 – Enhance Emergency Preparedness

- Dam Breach Inundation Map Web Publisher (ca.gov)
- Emergency Action Plans (EAPs)
- Virtual Annual EAP Seminars
- Tabletop and Functional EAP Exercises
- Internal Rapid Response and Recovery Plans



Fair Weather Failure Inundation Map for Bidwell Bar Canyon Saddle Dam, Butte County



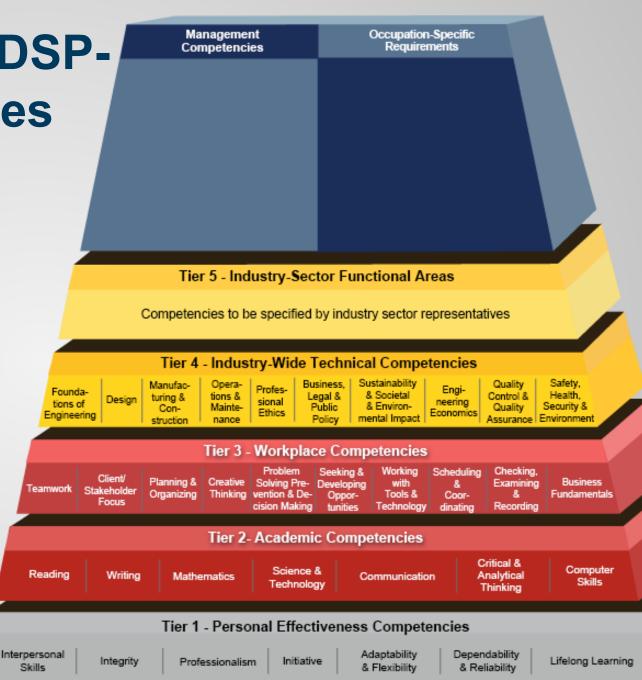
Initiative No. 8 – Identify DSPrelated Core Competencies

- Identified the knowledge, skills, and abilities required for successful execution of job duties within O&M Dam Safety Services.
- Utilized the US Dept. of Labor Engineering Competency model
- Multiple Tiers of competencies

ER RESOURCES

CALIFORNIA DEPARTMENT OF

Challenges of Tier 5 competencies

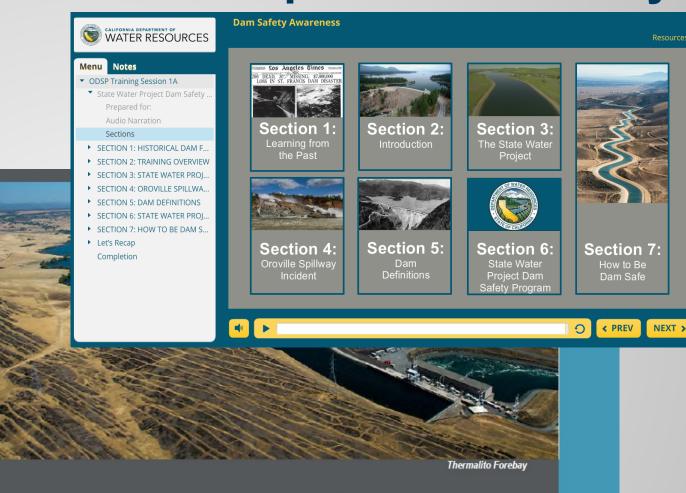


Engineering Competency Model (US Dept. of Labor, ETA)

Initiative No. 12 – Formalize and Expand Dam Safety Program Training

- Established Training Plans to require development of dam safety core competencies
- ✓ Training Contracts
- ✓ Developed SWP Dam Safety Awareness Modules 1A and 1B
- Developing Field Divisionspecific Dam Safety Training Modules





State Water Project

Dam Safety Training Oroville Field Division Session 2: Oroville Field Division Dam Characteristics, Potential Failure Modes and Visual Inspection Guidelines

Initiative No. 13 – Enhance Industry Outreach

- Increased collaboration with the U.S. Army Corps of Engineers and Bureau of Reclamation
- Increased dam safety conference and workshop attendance.
- Participation in CEATI Dam Safety Interest Group.





Initiative No. 14 – Develop DSP Management of Change Program and Communication Plan

2020

State Water Project Dam Safety Program – Plan for Communications Management and Change Management







- Early Implementation Projects
- Future Dam Safety Projects
- Emergency Action Plan-related Activities
- Inspection & Surveillance Activities (multiple responsible parties)
- Maintenance Activities
- Operational Activities
- Seasonal Forecasting
- Dam Safety Program Enhancements

Initiative No. 16 – Develop More Formal Dam Safety Program Management Review

- Bi-weekly SWP Dam Safety Program Steering Committee Meetings
- Quarterly meetings with FERC and DSOD
- Independent Verification & Validation
- Annual Program Reporting
- 5-year Program Review/Audit



Thank you



ITEM 5: RISK ASSESSMENT

Risk Management in Socio-Technical Systems *Comments from Oroville Dam CNA Process*

Dr. R. Storesund, PE., GE, Consulting Engineer, Storesund Consulting American Society of Civil Engineers, Region 9 Governor – San Francisco Section Executive Director, UC Berkeley's Center for Catastrophic Risk Management President & CEO, NextGen Mapping, Inc. (Software Development) President & CEO, Storesund Construction, Inc. (Class A, B, C-57) President & Director, SafeR³ (Non-Profit)

May 28, 2021



About Rune

- Dual Degree Program UC Santa Cruz/UC Berkeley
 - BA Anthropology (UC Santa Cruz)
 - BS Civil Engineering (UC Berkeley)
- Masters in Geotechnical Engineering (UC Berkeley)
- Doctorate in Civil Systems (UC Berkeley)



- Executive Director, UC Berkeley's Center for Catastrophic Risk Management
- Consulting Engineer, Storesund Consulting
- President & CEO, NextGen Mapping, Inc. (Software Development)
- President & CEO, Storesund Construction, Inc. (Class A, B, C-57)
- President & Director, SafeR³ (Non-Profit)













My Disaster Research

- 1986 NASA Challenger
- 2003 NASA Columbia
- 2005 Hurricane Katrina
- 2010 San Bruno PGE Explosion
- 2010 Deepwater Horizon
- 2014 Oso Landslide (WA State)
- 2015 Aliso Canyon Gas Leak
- 2017 Oroville Dam Spillway Failure
- 2017 US Navy Ship Collisions
- 2018 California Wildfires (Butte County)
- 2019 Brumadinho Landslide
- 2019 Boeing 737 MAX
- 2020 Michigan Dam Failures









Oroville Dam CNA Ad Hoc

- Served at the invitation of Senator Nielsen and Assemblyman Gallagher
- Risk Management Perspective
- Ad Hoc: July 2018 to December 2020
- May 10, 2021 Report with Reflections and Recommendations

http://safer3.world/



Community "Safety" Following Comprehensive Study - Oroville Dam

May 10, 2021





What I'd like to Talk About Today

- What is risk & crisis
- Socio-Technical Systems (people and organizations too!)
- Understanding utility of "uncertainty" as a management variable
- Setting performance expectations ("Expected" performance)
- Use of "Leading Indicators"
- Tracking skew between "Work as Imagined" and "Work as Done"
- Advanced Inquiry Methods (Dialectic, Multiple Realities, etc.)
- Focus on "Valid" and "Reliable" methods
- Avoiding E3 Errors (solving the wrong problem precisely)
- Triangulation approaches to overcome conflicting/mixed signals
- Safety Culture and Process Improvement Programs



What I Can Talk About in 20 Minutes

- What is risk & crisis
- Socio-Technical Systems (people and organizations too!)
- Understanding utility of "uncertainty" as a management variable
- Setting performance expectations ("Expected" performance)
- Use of "Leading Indicators"
- Tracking skew between "Wosk as Imagined" and "Work as Done"
- Advanced Inquiry Methods (Dialectic, Multiple Realities, etc.)
- Focus on "Valid" and "Reliable" methods
- Avoiding E3 Errors (solving the wrong problem precisely)
- Triangulation approaches to overcome conflicting/mixed signals
- Safety Culture and Process Improvement Programs



Safety

- Searching for "safety"
- DWR wants to ensure safety
- Community wants to feel safe







Risk Perception – Insurance

"Regarding dams and private insurance. My understanding, which I confirmed, is that private insurers are not insuring dams (other than surety bonds for construction) and that they don't think its a viable business opportunity because the potential losses are so high (liability insurance) and the costs of repair / reconstruction are so high (property insurance). I think it would be very difficult to get them to insure dams. "

Former California Insurance Commissioner



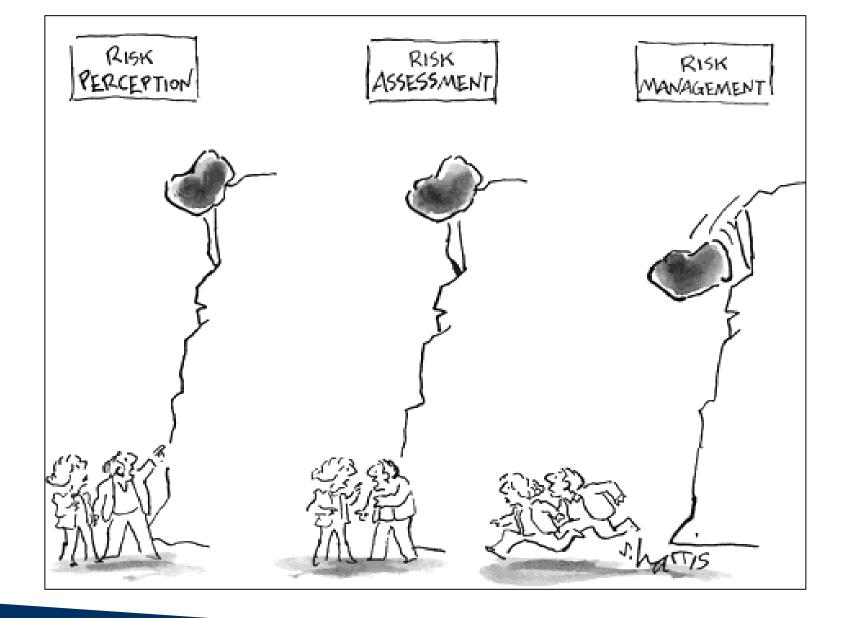




Oroville CAC "Opportunities"

- CAC has baton from Ad Hoc
- Take a leadership role in Proactive Risk Reduction
- Dam is not going to 'fail' tomorrow....BUT
 - Current techniques are deficient
 - Takes decades to implement substantial improvements
 - Aging infrastructure with unknown service life
 - Climate Change
 - Two (2) evacuations in 50 years, statistics says it will happen again!
- Critical to start laying a resilient foundation today!







Recommendations (Mini Projects)

- Re-engage the IFT to review progress on 'lessons to be learned'
- Formalize community impacts for discharges 150,000 cfs to 700,00 cfs
- Explicit definition of 'safety' (what does 'safe' mean?)
- Be financially accountable for "Performance" (Compensation Fund)
- Perform detailed assumption audits (all dam infrastructure)
- Scrutinize Asset Management (not just plans but performance)
 - What is it supposed to do?
 - What is it actually doing?
 - Where are the differences?
 - Use on both physical assets as well as methods/procedures
- Require Life-Cycle Management <u>Today</u>!
 - Target service life
 - Components
 - Assemblies
 - System (where are the 'weak' links?)
 - Target maintenance and intervals
 - Life-cycle based budgeting, then track within expectations or not?



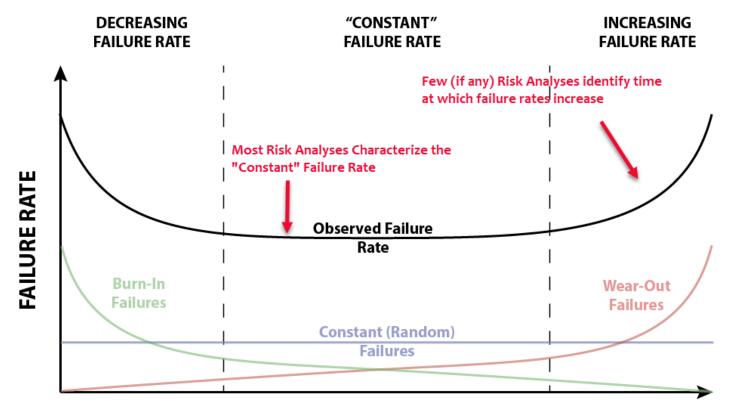
Vagueness of "Failure"

Likelihood		Comprehensive Needs Assessment – Extension of DWR Division of Operations & Maintenance Asset Management Risk Matrix										
Annual Probability		1	2	3	4	5	6	7	8	9	10	11
		Insignificant	Minor	Moderate	High	Major	Extreme	Catastrophic				
Likely to occur 10 times a year	10								Tol	erable Risk	Guideline	s for
Likely to occur within 1 year	9								Dar	m Safety (L	ife Loss) fr	om FERC
Likely to occur within 3 years	8.5							•••			eral Agenci	
1/10 - 1/3	8											
1/30 - 1/10	7.5											
1/100 - 1/30	7											
1/1,000 - 1/100	6											
1/10,000 - 1/1,000	5							·				
1/100,000 - 1/10,000	4								~~~_			
1/1,000,000 - 1/100,000	3											
1/10,000,000 - 1/1,000,000	2											
1/100,000,000 - 1/10,000,000	1							********				
Negligible												
< 1/100,000,0	00											
Consequence						Con	sequence L	evel				
		1	2	3	4	5	6	7	8	9	10	11
Category		Insignificant	Minor	Moderate	High	Major	Extreme	Catastrophic				
Public Safety (including Personnel		No injury	Near miss,	Minor injuries	Single injury	Multiple injuries, perm.	0 – 1	1 -10	10 – 100 fatalities	100 – 1,000 fatalities	1,000 - 10,000	> 10,000 fatalities
Safety)			minor injuries			disability	fatalities	fatalities	ratarties	ratainties	fatalities	rataittes
Financial Impacts (Direct and Indirect)		< \$100k	\$100k · \$1M	\$1M - \$10M	\$10M-\$100M	\$100M - \$1B	\$1B - \$10B	\$10B - 100B	\$100B - \$250B	\$250B - \$500B	\$500B - \$1T	> \$1T

Figure 10. Extended Version of DWR O&M Asset Management Risk Matrix Used in CNA Risk Evaluations



Failure is Time-Dependent

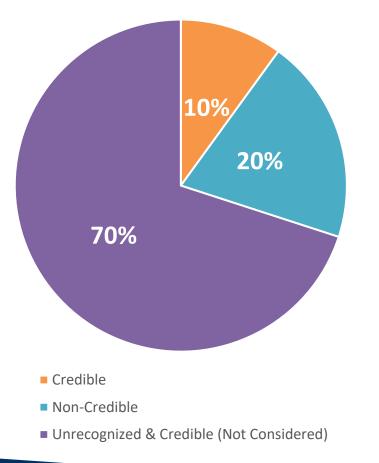


TIME



Limited "Imagination" for Scenarios

Failure Scenarios







Consequences of Failure (Cf)

	Less Uncertainty	More Uncertainty
Less Uncertainty	Traditional Quantitative Risk Analysis "Probabilities" Well-Structured	Unfolding Events Active Flooding Hurricane Aftermath
	Well-Defined Bounded BOX	I BOX 2
	BOX	BOX 4
certainty	Anticipated Events "Earthquakes"	Unanticipated Unfolding Events
More Uncertainty	"1,000 year storm" "Possibilities"	CRISIS III-Structured Un-Defined Un-Bounded

NEED DIFFERENT TOOLS/METHODS/ STRATEGIES FOR EACH REGION!

Rune Storesund, D.Eng., P.E., G.E., August 2016

NOTE, THESE REGIONS ARE NOT DISCRETE, BUT VERY FLUID AND TIME-DEPENDENT!!

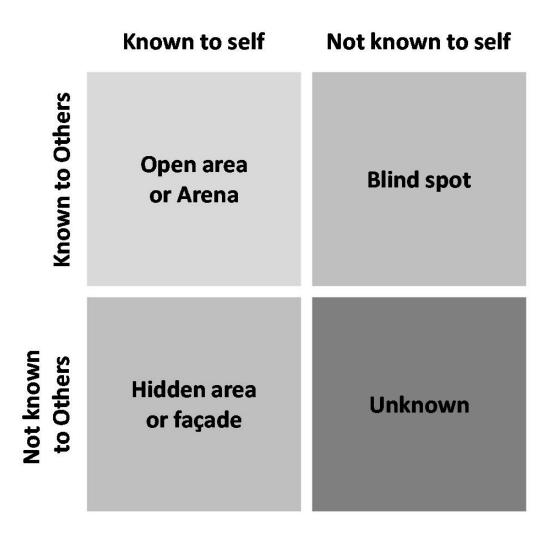


Probability of Failure (Pf)

If all you have is a hammer in the toolbox, everything looks like a nail."

– Bernard Baruch





The Johari Window Model



	Known to self (i.e. US Dams)	Not known to self (i.e. US Dams)
Known to others	PFMA/RIDM	PFMA/RIDM Triangulation Leading Indicators Reliability-Centered Maintenance Resilience Engineering High Reliability Organizations Life-Cycle Management Total Quality Management Crisis Management Preparedness
Not known to others	Detailed design calculations Design assumptions Performance characteristics	"Surprises" New Technologies



Risk Management Pledge

I State Your Name PROMISE TO APPRECIATE THE VALUE AND IMPORTANCE OF UNCERTAINTIES IN CIVIL SYSTEMS AND HELP DECISION-MAKERS AVOID 'CONFIDENT IGNORANCE' BY ARMING THEM WITH PRAGMATIC INFORMATION AND AVOIDING OVER-SIMPLIFICATION AND E3 ERRORS (SOLVING THE WRONG PROBLEM PRECISELY). I ALSO PROMISE TO TRIANGULATE ANSWERS INSTEAD OF **RELYING SOLELY ON ONE TECHNIQUE.**



Questions

Dr. Rune Storesund, D.E.ng. P.E., G.E. Executive Director Center for Catastrophic Risk Management (CCRM) University of California, Berkeley

rune@berkeley.edu +1 510 225 5389



THE STATE OF DAM SAFETY PROGRAMS IN THE UNITED STATES

PRESENTATION TO THE OROVILLE CITIZENS ADVISORY COMMISSION MEETING, 28 MAY 2021

ERIC HALPIN, PE HALPIN CONSULTANTS LLC



- As a US Army Corps of Engineers Infrastructure Leader (1980-2019):
 - Owner and Self Regulator of +3,000 Dam and Levee Systems & Safety Programs
 - Vice Chair of the National Levee Safety Program
 - Primary Interface with Accountability to the Administration, Congress, and the Government "Watch-Dogs"
 - US Government Lead for International Partnerships with Spain, Netherlands, Japan, and United Kingdom on Safety Programs
 - Registered Professional Engineer (1988)
- As Private Consultant: (2018-present)
 - The Same Thing for Clients in Industry



Pulpit Rock, Norway (2,000 feet above the fiords of Norway)

MY RISKY BACKGROUND IN SAFETY PROGRAMS

01

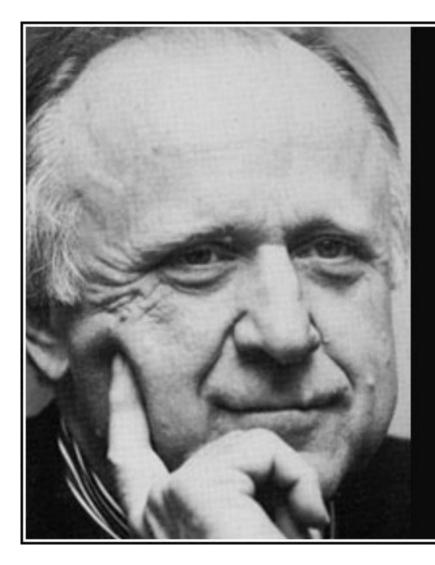
WHAT CONSTITUTES A STATE-OF- THE ART DAM SAFETY PROGRAM?

02

HOW DO SUSTAIN THE STATE-OF-THE-ART PRACTICE? 03

WHAT TRENDS SHOULD WE BE AWARE OF?

DISCUSSION TOPICS



Good governance never depends upon laws, but upon the personal qualities of those who govern. The machinery of government is always subordinate to the will of those who administer that machinery. The most important element of government, therefore, is the method of choosing leaders.

— Frank Herbert —

AZQUOTES

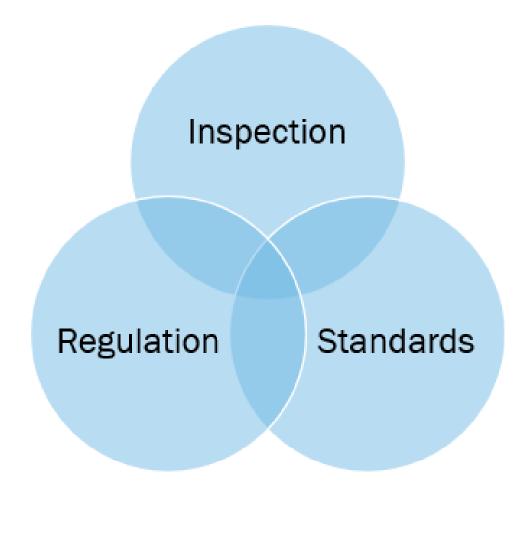


WHAT IS IN A STATE-OF- THE-ART DAM SAFETY PROGRAM?

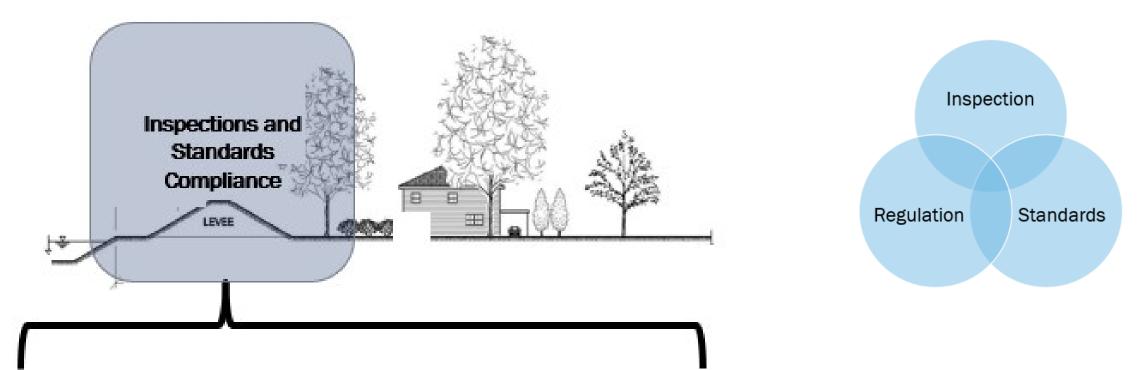
The State of the Dam Safety Industry

TRADITIONAL DAM SAFETY PROGRAM FOCUS (1968-TODAY)

- Compliance with
 Design Standards as a
 Measure of Safety
- Inspection and Monitoring for Performance Concerns
- Safety Assured by Regulation?



Traditional View of Infrastructure Safety



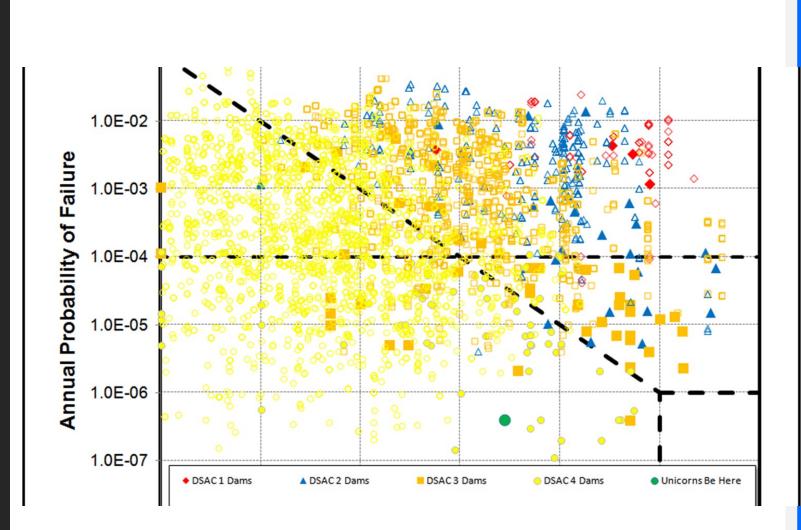
Focused on the Infrastructure (not people, hazard, or consequences)

Focused on How We Built Them, Not How They'll Perform (not integrated systems – think New Orleans)

Focused Compliance with Design Standards as a Measure of Safety, Assured by Regulation

This is what following standards only has resulted in...

- Huge Variation in Risk
- Over and Under
 Investment in Risk
 Management
- Wrong Priorities
- Poor Understanding
- o Dynamics!



One Size Doesn't Fit All!



MODERN DAM SAFETY PROGRAM FOCUS (SINCE 2000)

- Understand How Things
 Can Fail and the Risk
 Associated
- Risk Informed Decisions
- Sharing Responsibilities
 Via Improved
 Communication
- Governance: People, Process, & Policy



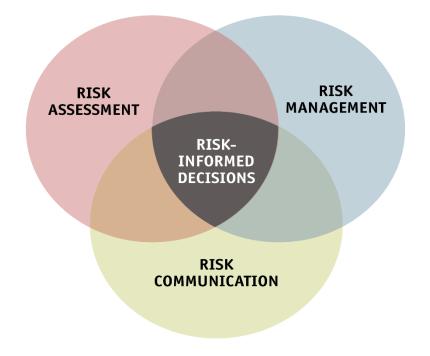
Why is a Strong Risk Framework Necessary?

Integration Via is Credibility:

- Dam Systems and the Environments they exist in are Complex and Dynamic
- Problems that You Can Understand are Problems That Can Be Solved
- Clear Relationships Within Governance: Policies, Processes, and People/Organizations

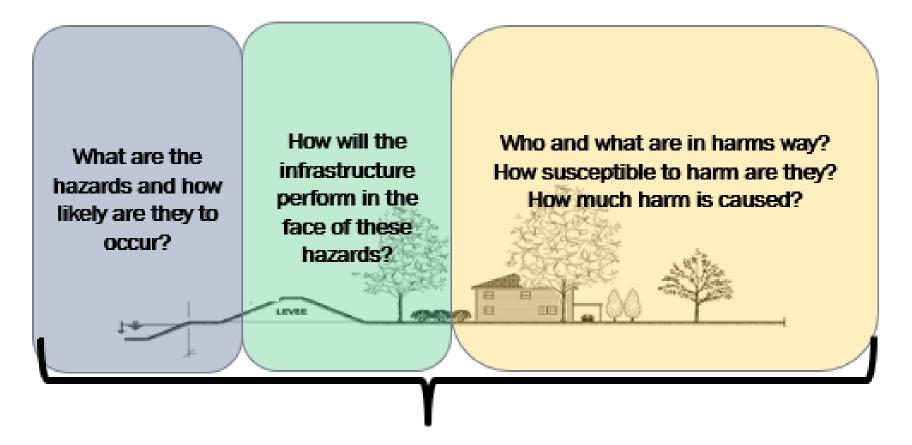
Built for the Long Haul

- Enduring Across Multiple Generations
- Adaptable to Evolving Practice, Science, Data, and Research



Risk Informed View of Infrastructure Safety

Risk = f(<u>Hazard</u>, <u>Performance</u>, <u>Consequences</u>)



Modern Infrastructure Program: Focused on People, Performance, and Risks



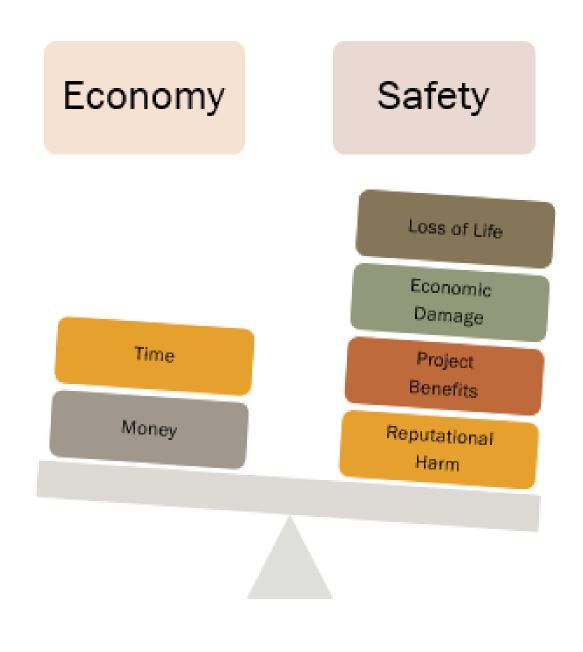
How Do We Sustain the Stateof-the-Art Practice?

State of the Dam Safety Industry

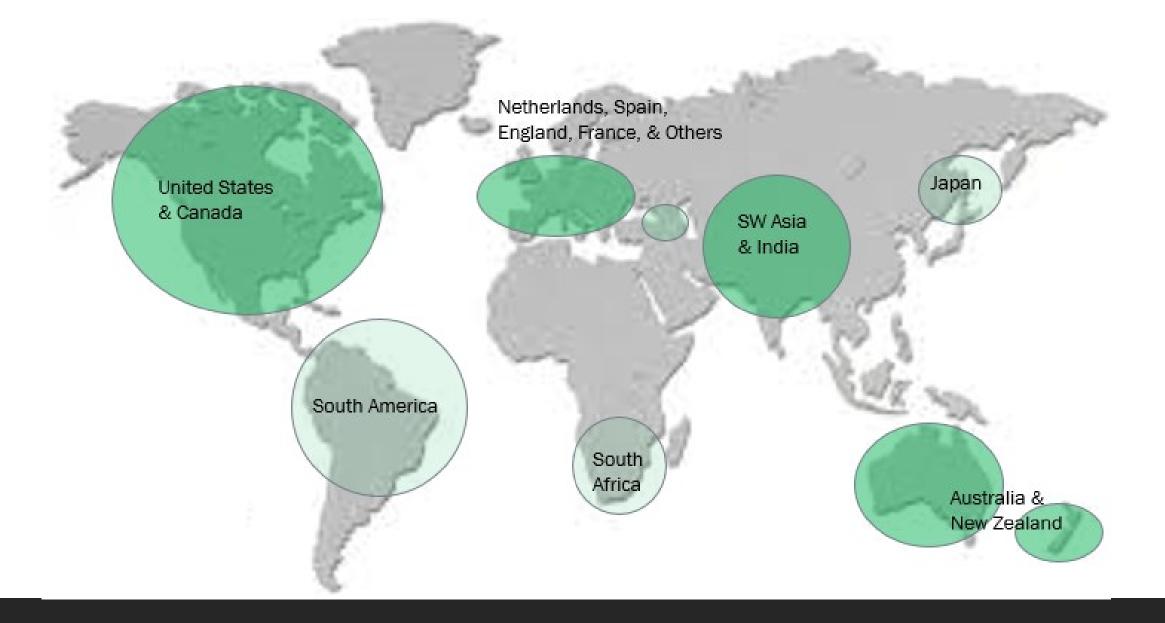
What Shapes Dam Safety Programs?

Safety Programs Constraints:

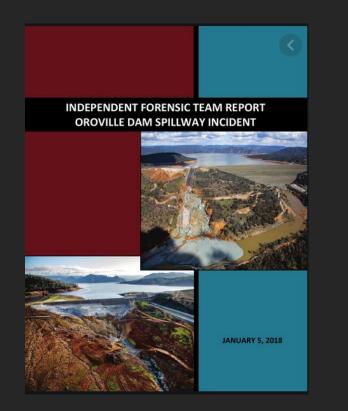
- Legislation and Regulations
- Technical Policies
- Funding
- State of the Practice



Places Where Risk Informed Safety Programs are the State of the Practice



What Industry Will Extract from the IFT Report



Change

- The "no fail" branch in some event trees can transition to failure in other failure modes*
- Large Damage States are Impactful and can transfer risk within a system*.

Sustain

- Independent Review and Challenge of Past Assessments is Necessary
 - Debate is Encouraged
 - Failure and Incident Rates are Extremely Low, But Industry Always Learns From Them
- Considerations of Systems and Human Factors Is Consistent with (and already a part of) Risk Informed Practice*

* Part of the Federal Risk Review Effort

Key Technical References for Modern Dam Safety Programs

- Guidance documents are the backbone to use of Risk in Dam Safety
- Scalable, but Consistent
- Adaptable, but Equitable
- Employed Broadly in National and International Programs

Best Practices in Dam and Levee Safety Risk Analysis





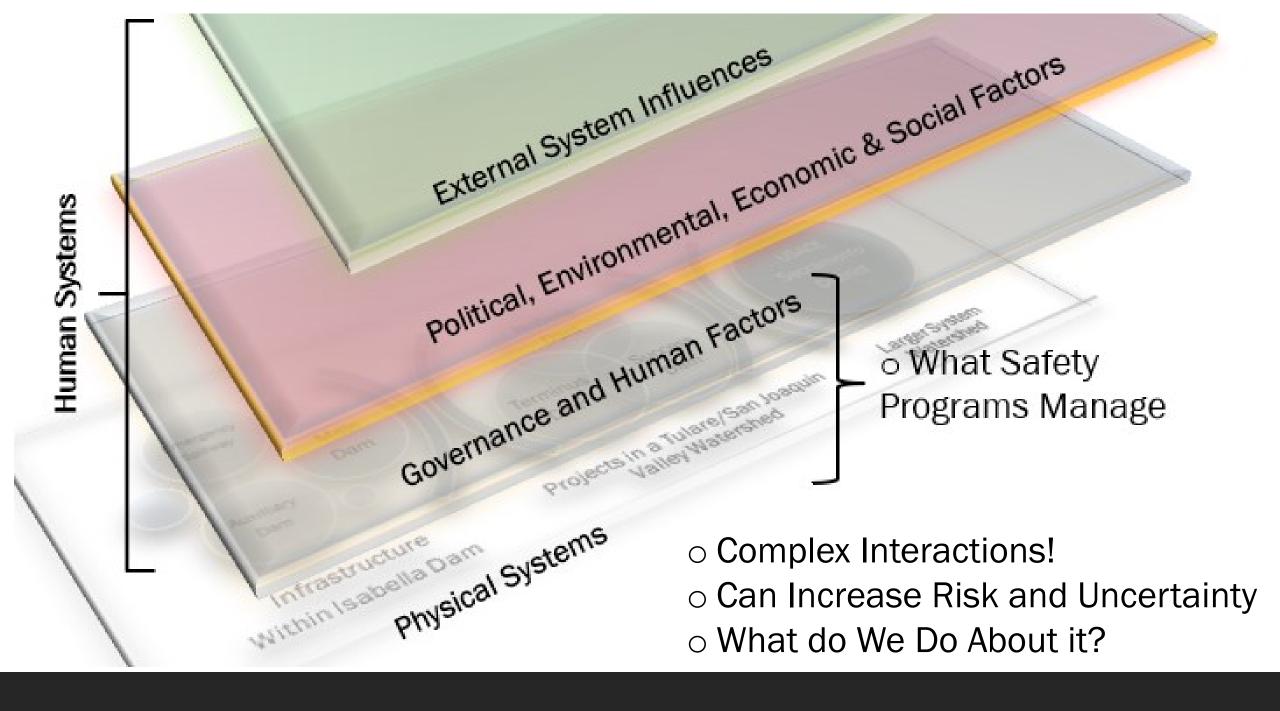
Federal Guidelines for Dam Safety Risk Management

FEMA P-1025/January 2015



Management & Communication

Assessment



How Risk Informed Safety Programs Address Complexities

Coincident Loadings Systems Operations Breach & Non-Breach Risks Gate Reliability Time Dependent Reliability Length Effects Regional Events



How Risk Informed Safety Programs Address Human Factors

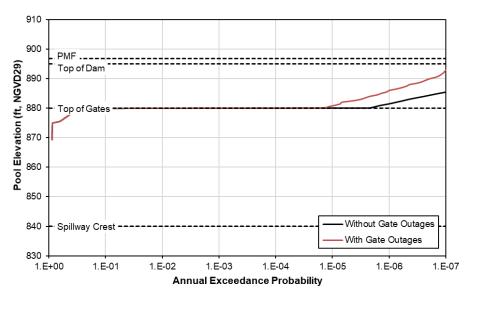
Reliability Analyses in Hydrologic Loading

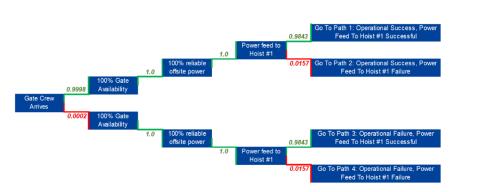
Detection and Intervention Impacts in Fragilities

Remote Operations

Issuance of Warning

Evacuation Effectiveness



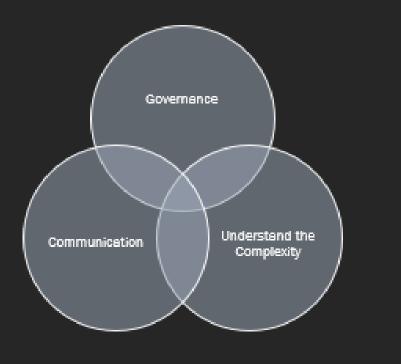


Gate Reliability Considerations:

- Remote Operations
- Site Access
- Crew Availability
- Gate Functionality
- Offsite Power
- Reliability
- Backup Power Reliability

Can Have 1-3 Orders of Magnitude in Effect on AEP of Design Loads (headwater)

Key Mitigating Measures for Human Factors



 Command and Control for Incident Decision Making

- Risk Informed Safety Programs
- Effective Communications and Public Awareness
- Collaboration with Key Stakeholders
- Training and Exercises
- Continuing and Periodic Evaluations
- Qualification Based Roles and Responsibilities

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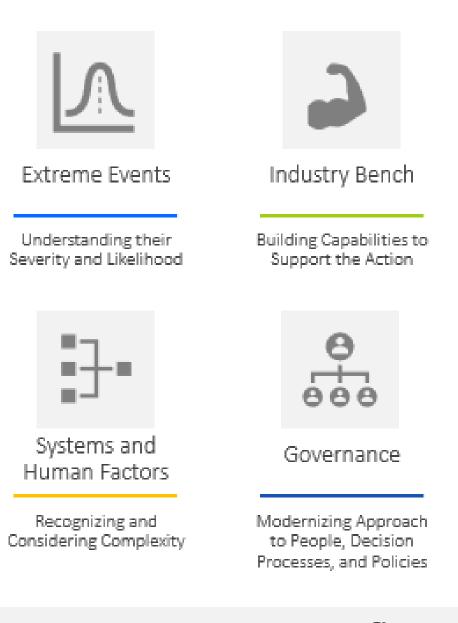
Looking Forward: Trends, Challenges, and Opportunities

The State of the Dam Safety Industry



Risk Directions

Risk Informed Decision Making Continues to Undergo Adaptive Management



Contoso Suites

85

Common Themes from Complex Incidents



Keep Improving

Sustain Independent Thought

We Need to Be Better Communicators

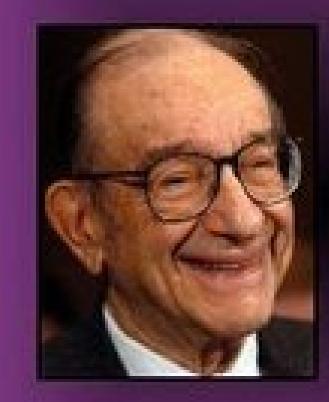
It's Rarely About the Numbers

There's a Reason It's Called Civil Engineering

Challenges for Our Industry

- Simplifying Assumptions about System Interactions and Human Factors are Necessary and Appropriate
- o Don't Forsake the Governance Lessons that Have Served Us Well: Safety Programs
- Can We Not Afford to Implement Risk Concepts in Safety Programs?





"Most of the negatives in housing are probably behind us. The fourth quarter should be reasonably good, certainly better than the third quarter."

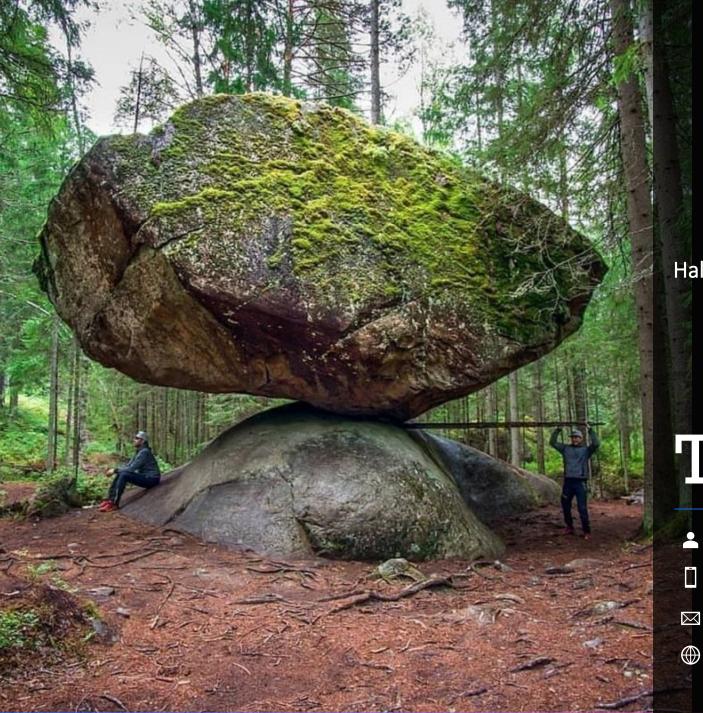
Alan Greenspan

Overconfidence Bias





"TRUST IS A RISK THAT MASQUERADES AS A PROMISE."



Halpin Consultants LLC

Thank You

💄 Eric Halpin

+1 240-383-7103

echalp83@gmail.com

ITEM 6: SPILLWAY CAMERAS



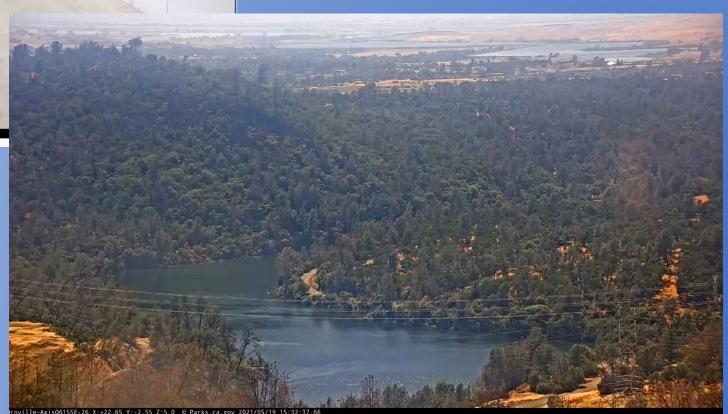
Oroville Spillway WebCam

Oroville Citizen's Advisory Commission

May 28, 2021

John Yarbrough

Webcam view of Thermalito Diversion Pool and Forebay (in distance)





Webcam view of Lake Oroville

Webcam view of Lake Oroville (looking toward Spillway Boat Ramp Cove)



ITEM 7: PUBLIC COMMENT

The Oroville Dam Citizens Advisory Commission will now take public comment.

We appreciate your input.

ITEM 8: ADJOURN

Thank you all for joining us today, our next Oroville Dam Citizens Advisory Commission meeting will be on August 27, 2021.

