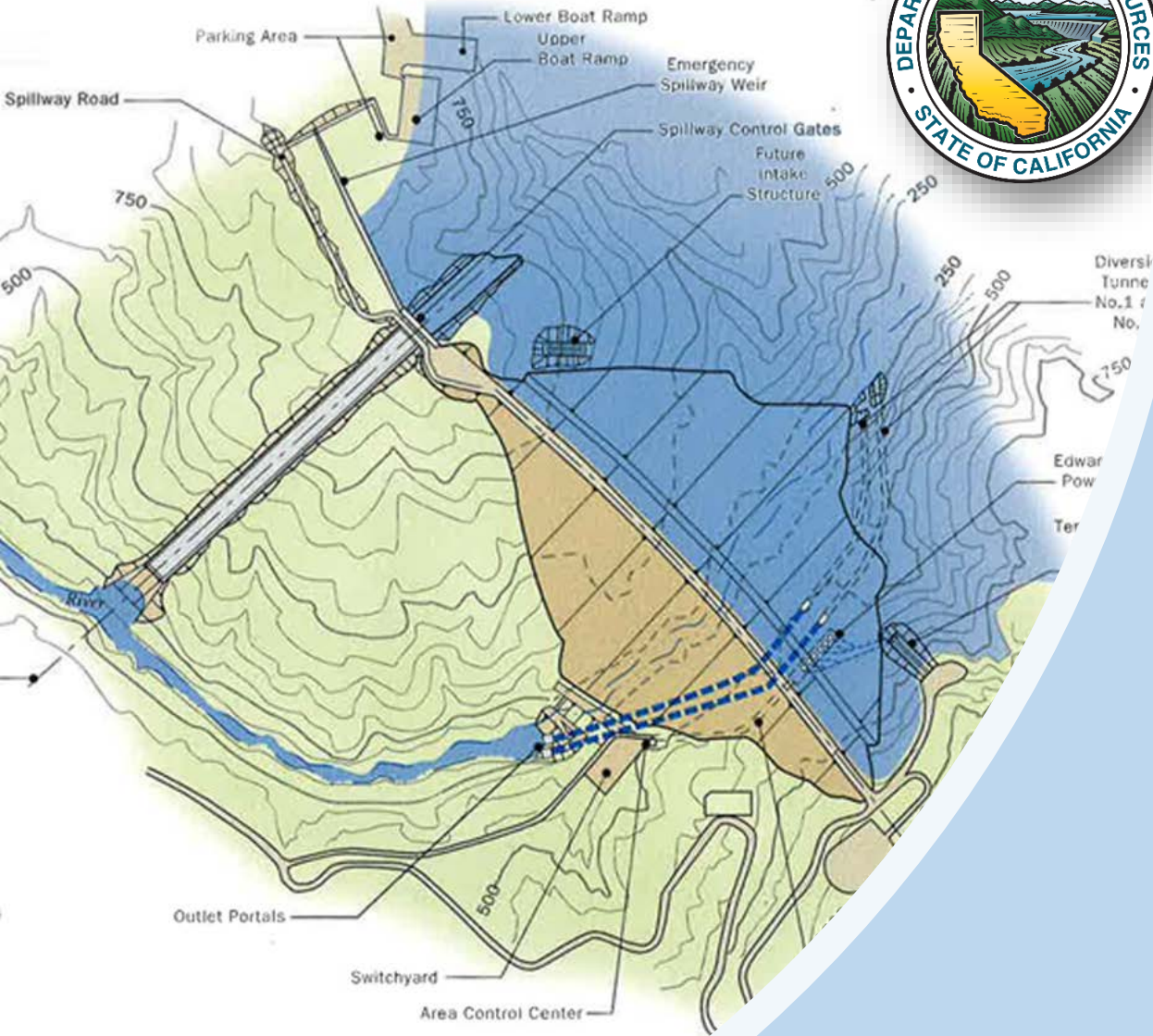




STATE OF CALIFORNIA  
DEPARTMENT OF WATER RESOURCES  
**OROVILLE DAM SAFETY  
COMPREHENSIVE NEEDS ASSESSMENT**



# Results of Alternative Plan Formulation and Evaluation

Ad Hoc Group Meeting No. 7

June 26, 2020





# Initial Outline of Comprehensive Needs Assessment

## January 12, 2018 DWR Letter to FERC

STATE OF CALIFORNIA - CALIFORNIA NATURAL RESOURCES AGENCY  
DEPARTMENT OF WATER RESOURCES  
1416 NINTH STREET, P.O. BOX 942836  
SACRAMENTO, CA 94236-0001  
(916) 653-5791

EDMUND G. BROWN JR., Governor



January 12, 2018

Mr. Frank L. Blackett, P.E.  
Regional Engineer  
Federal Energy Regulatory Commission  
100 First Street, Suite 2300  
San Francisco, California 94105-3084

FERC Project No. 2100 – Oroville Dam, Dam Safety  
Comprehensive Needs Assessment Plan and Schedule

Dear Mr. Blackett:

By letter dated June 28, 2017, the Department of Water Resources (DWR) informed the Federal Energy Regulatory Commission (FERC) of its intent to initiate a Comprehensive Needs Assessment (project) to identify measures to bolster the safety and reliability of Oroville Dam and the appurtenant structures. Over the past several months, DWR has

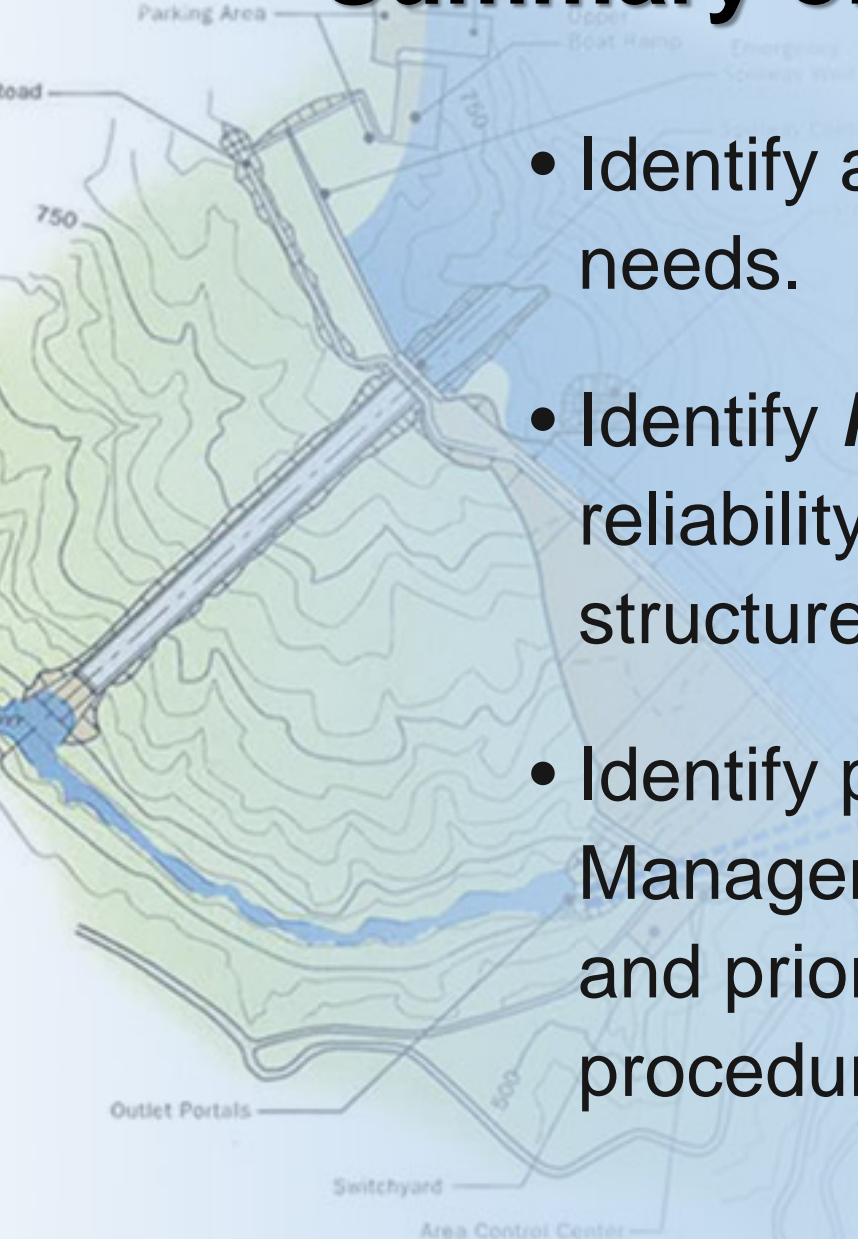
- Task 1 - Alternatives Evaluation to Restore Spillway Design Capacity to Pass the Probable Maximum Flood
- Task 2 - Operations Needs Assessment to Support Development of Alternative Reservoir Outflow Enhancements
- Task 3 - Flood Control Outlet Enhanced Reliability
- Task 4 - Alternatives Evaluation for Low-level Outlet
- Task 5 - Oroville Dam Embankment Reliability and Improvements
- Task 6 - Instrumentation and Monitoring for the Oroville Dam Complex

2019. A list of prioritized dam safety and operational reliability needs will be produced through completion of the project. Those needs will then be evaluated by DWR management and scheduled as projects through normal practices and procedures. As the project progresses, the Project manager may identify projects that provide significant public safety and risk reduction benefits. Such projects may be submitted to DWR management for early implementation. DWR will comply with FERC and other regulatory agencies' submittal, review, and approval processes as part of the implementation.

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# Summary of CNA Mission



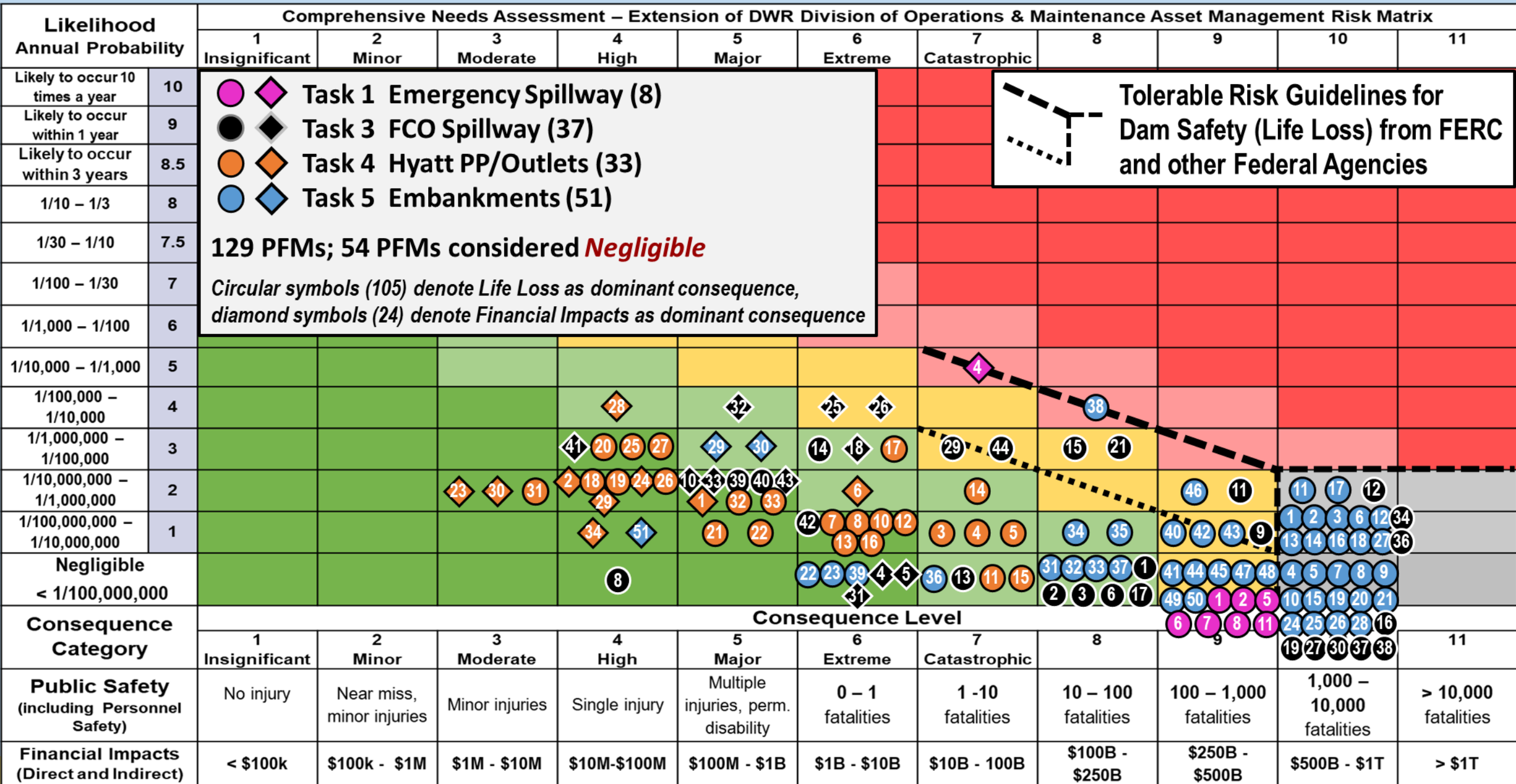
- Identify and prioritize dam safety and operational needs.
- Identify **Measures** to improve the safety and reliability of Oroville Dam and its appurtenant structures.
- Identify potential **Plans (Projects)** for DWR Management to evaluate for future implementation and prioritization through normal practices and procedures.

# Revised Extension of DWR Asset Management Risk Matrix

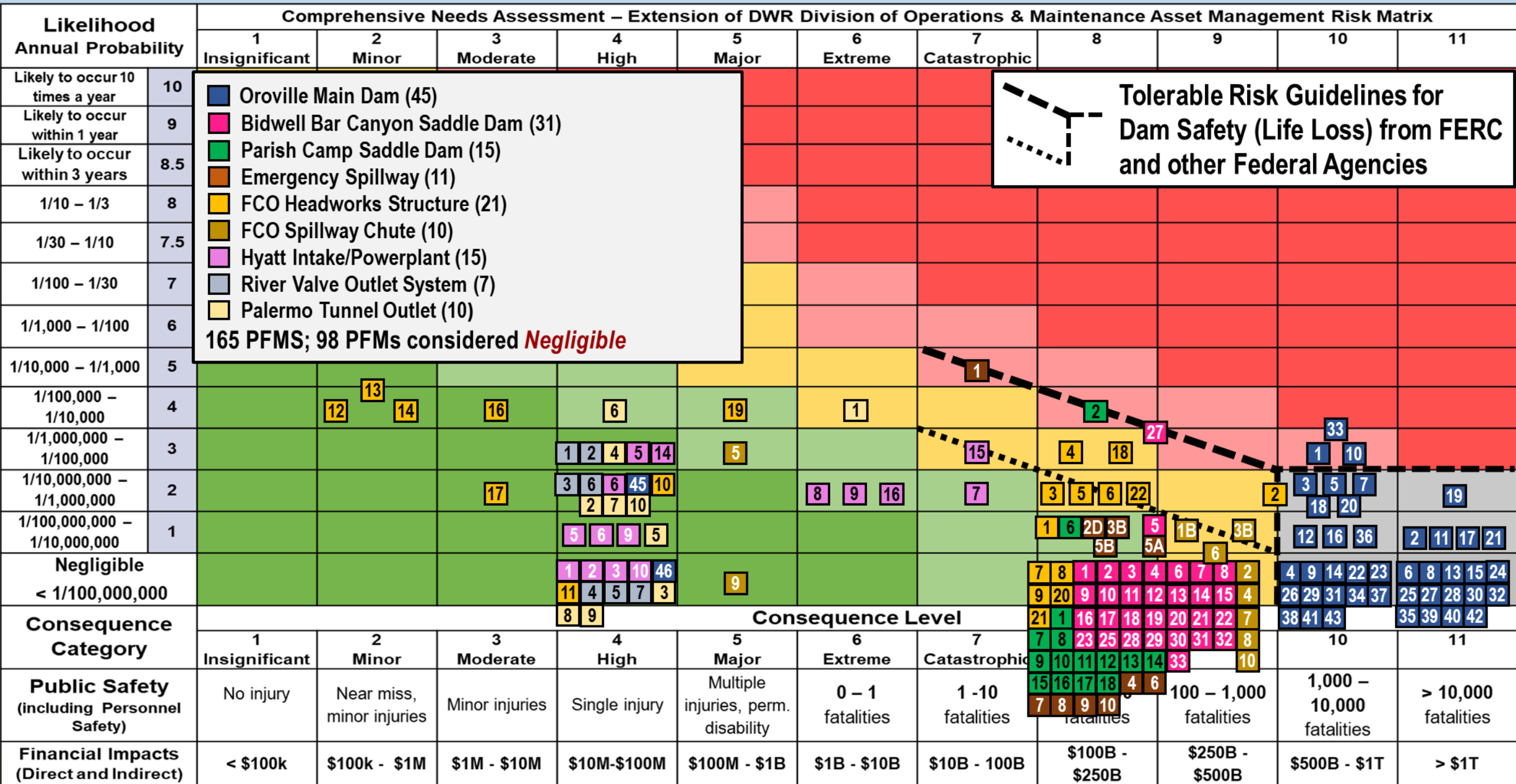
Likelihood Annual Probability		Comprehensive Needs Assessment – Extension of DWR Division of Operations & Maintenance Asset Management Risk Matrix										
		1 Insignificant	2 Minor	3 Moderate	4 High	5 Major	6 Extreme	7 Catastrophic	8	9	10	11
Likely to occur 10 times a year	10											
Likely to occur within 1 year	9											
Likely to occur within 3 years	8.5											
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 < 1/100,000,000												
Consequence Category	Consequence Level											
	1 Insignificant	2 Minor	3 Moderate	4 High	5 Major	6 Extreme	7 Catastrophic	8	9	10	11	
<b>Public Safety</b> (including Personnel Safety)	No injury	Near miss, minor injuries	Minor injuries	Single injury	Multiple injuries, perm. disability	0 – 1 fatalities	1 -10 fatalities	10 – 100 fatalities	100 – 1,000 fatalities	1,000 – 10,000 fatalities	> 10,000 fatalities	
<b>Financial Impacts</b> (Direct and Indirect)	< \$100k	\$100k - \$1M	\$1M - \$10M	\$10M-\$100M	\$100M - \$1B	\$1B - \$10B	\$10B - 100B	\$100B - \$250B	\$250B - \$500B	\$500B - \$1T	> \$1T	

**Tolerable Risk Guidelines for Dam Safety (Life Loss) from FERC and other Federal Agencies**

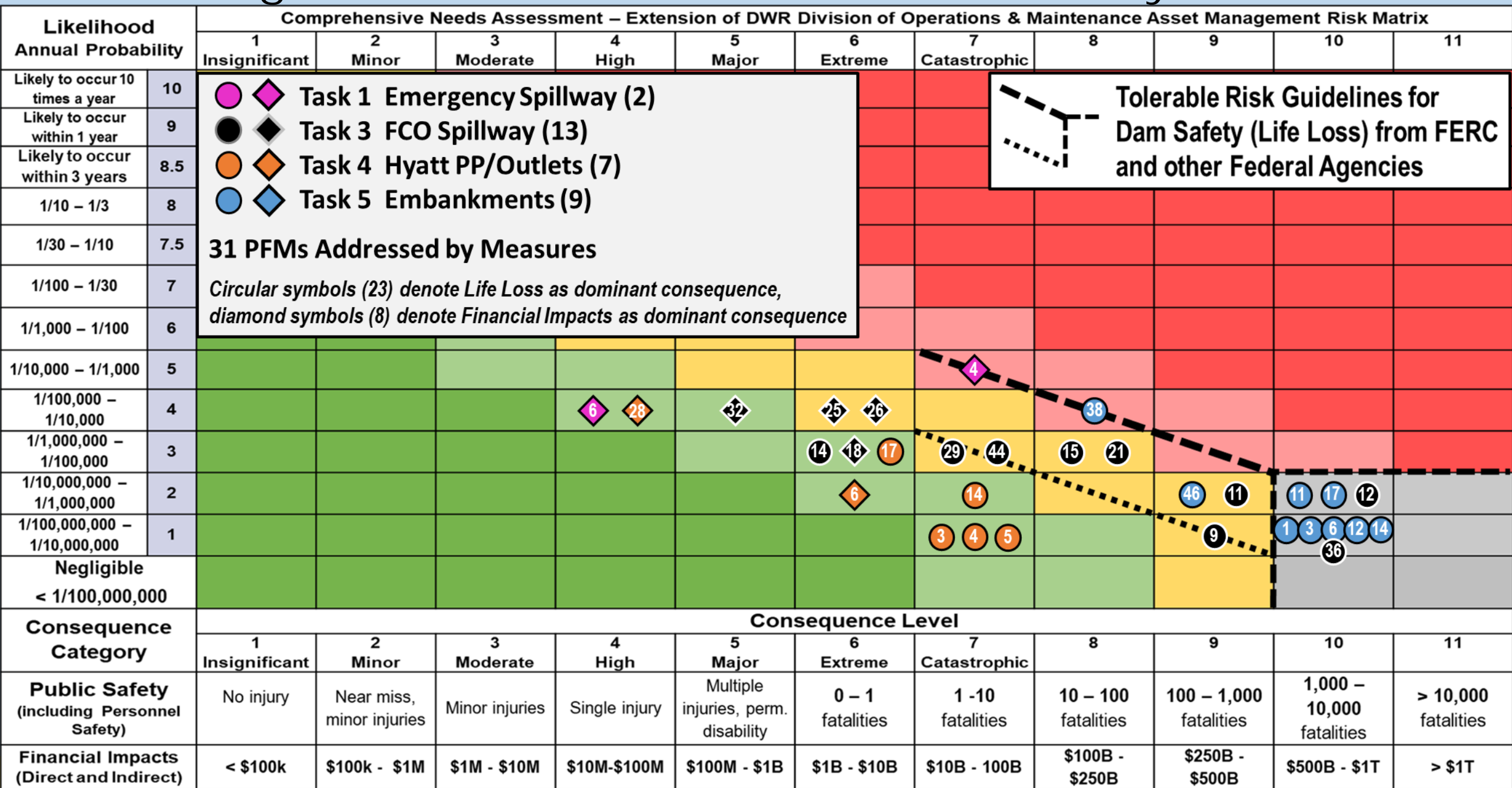
# Estimated Risks for CNA PFMs – Existing Conditions



# Estimated Risks for L2RA PFM's - Existing Conditions

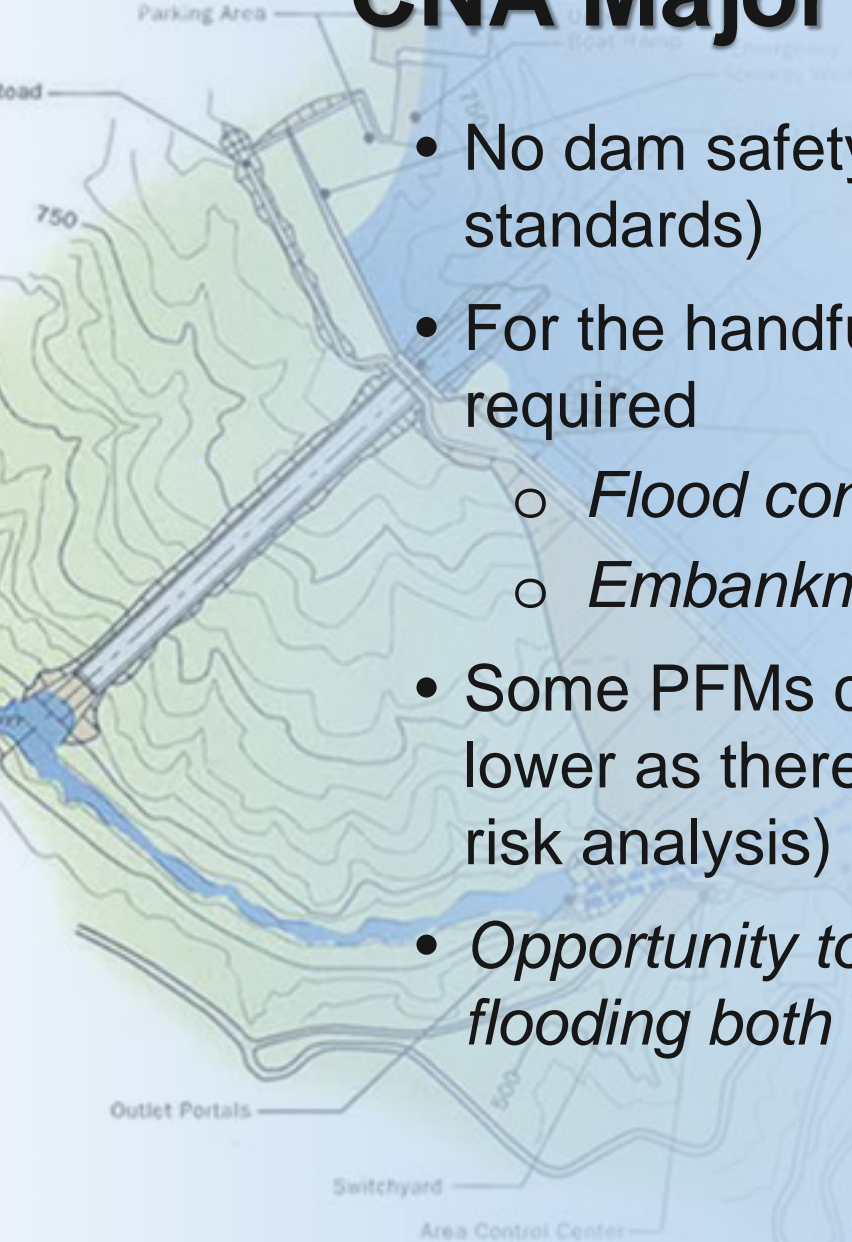


# Existing Conditions–CNA PFMs Addressed by Measures



# CNA Major Findings

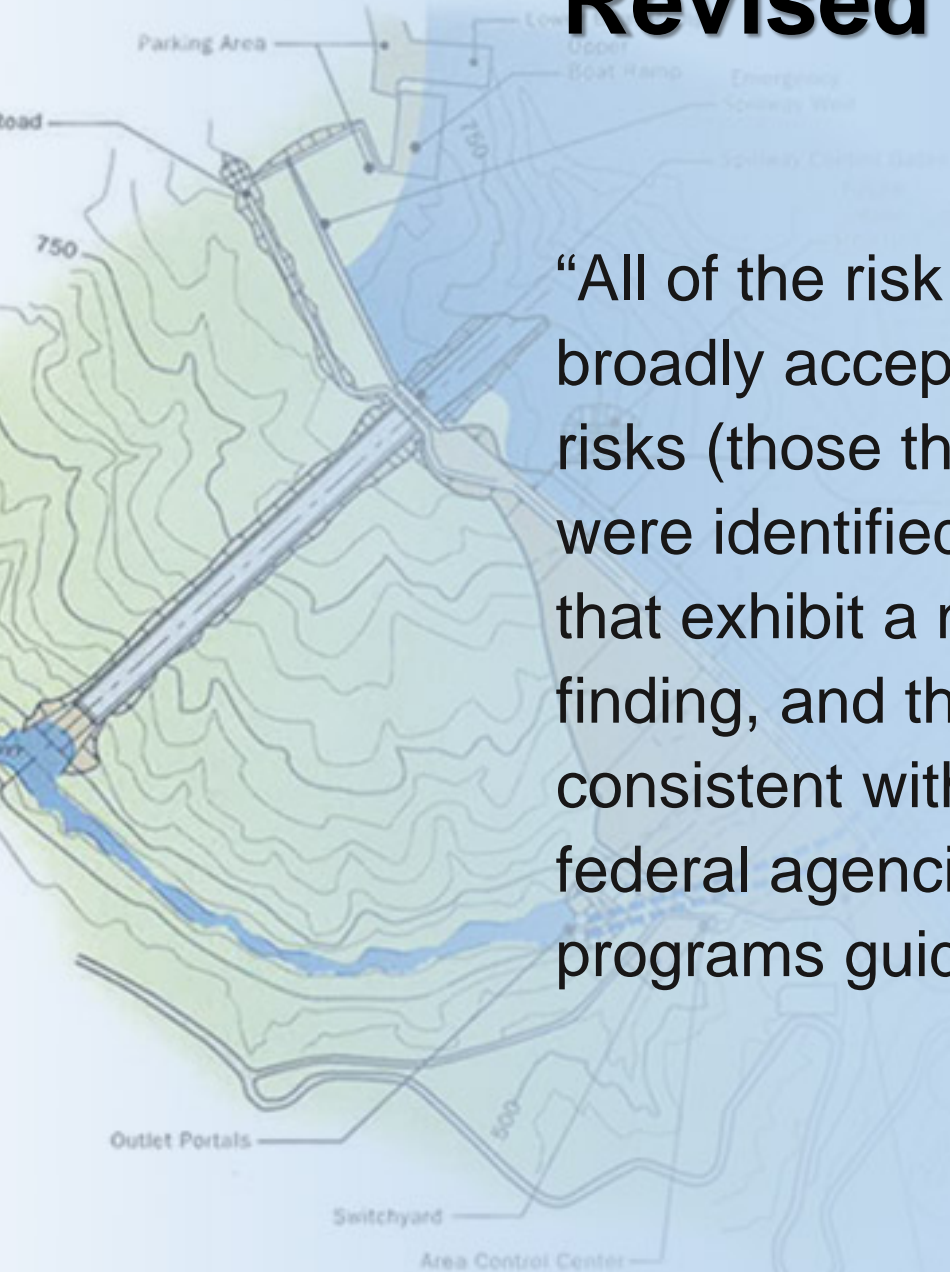
- No dam safety deficiencies were identified (FERC and DSOD standards)
- For the handful of PFMs that are the highest, additional analysis is required
  - *Flood control outlet structural analysis*
  - *Embankment/monolith 31 seepage potential*
- Some PFMs could actually be an order of magnitude higher or lower as there is still some uncertainty (this was a semi quantitative risk analysis)
- *Opportunity to further reduce risk of failure and reduce risk of flooding both identified and articulated*





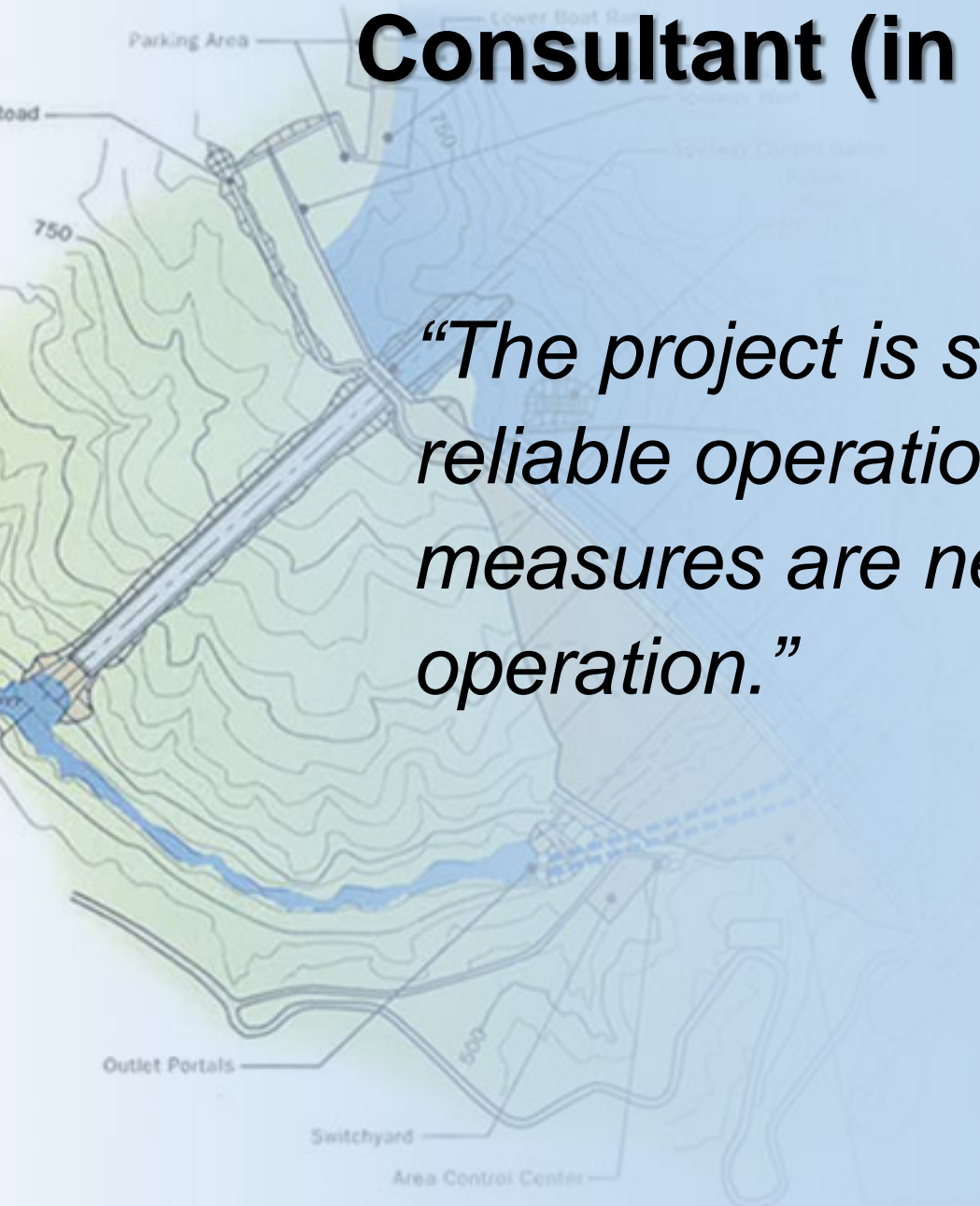
# Revised Dam Safety Finding Language

“All of the risk estimates made by the CNA teams fell into either broadly acceptable or tolerable risk zones. No unacceptable risks (those that might fall above the tolerable risk reference line) were identified. As a result, no dam safety issues were identified that exhibit a need for immediate risk reduction actions. This finding, and the use of these risk tolerance guidelines, are consistent with risk-informed decision making practices in use by federal agencies with large portfolios of dams and dam safety programs guided by risk-based approaches.”



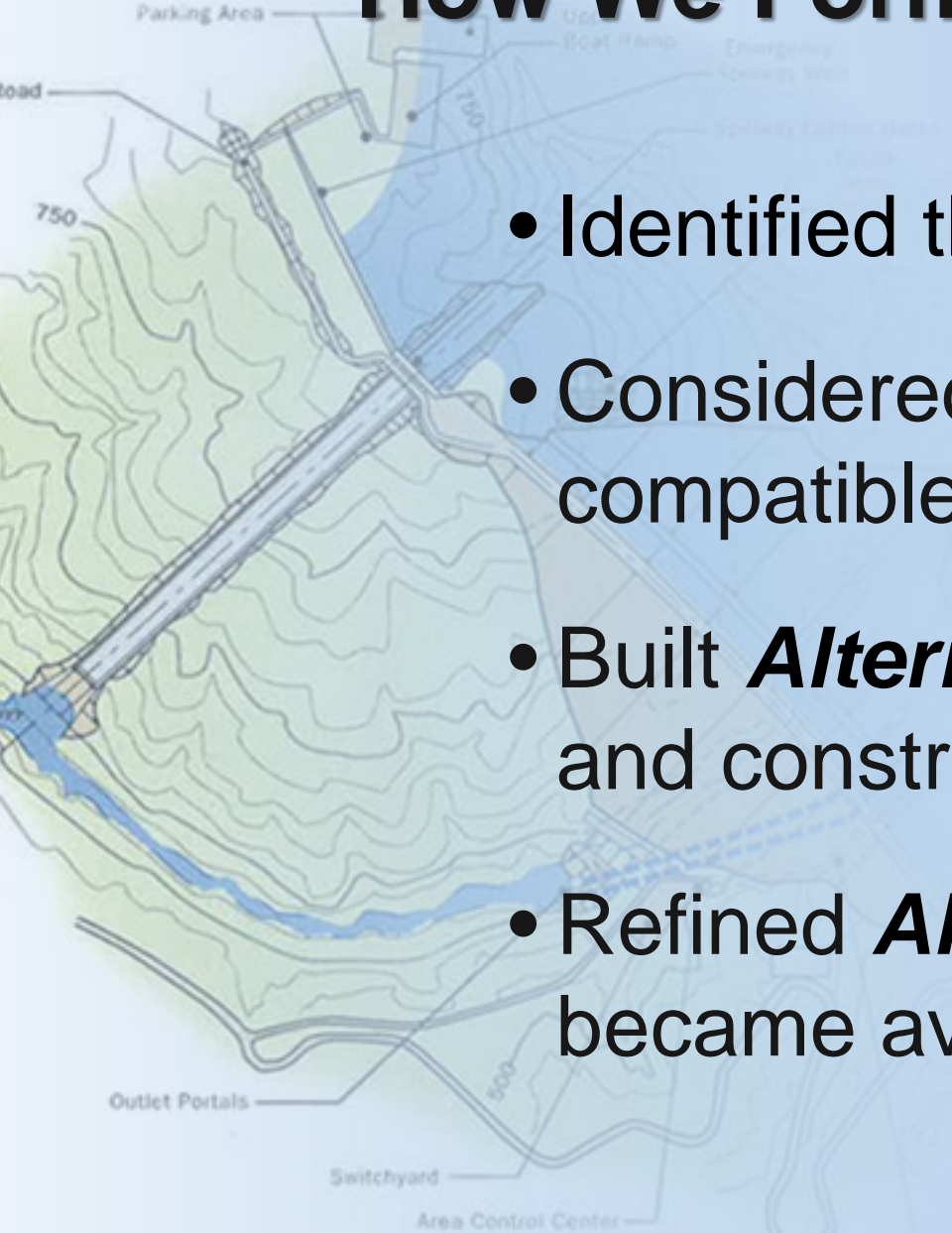
# Conclusion from 10th Part 12 Independent Consultant (in Draft)

*“The project is suitable for continued safe and reliable operation. No emergency or remedial measures are necessary for continued safe operation.”*



# How We Formulated Alternative Plans

- Identified themes, per IRB recommendation.
- Considered mixtures of different **Measures** in compatible combinations.
- Built **Alternative Plans** that meet project objectives and constraints.
- Refined **Alternative Plans** as more information became available.



# Evaluation Criteria for Scoring Effectiveness of Alternative Plans

- Achieves Risk Reduction/Residual Risk
- Promotes Resiliency (Prepare, Absorb, Recover, and Adapt)
- Adherence to Best Engineering Practices



# CNA Alternative Plans

Recommended Measures		PLAN 1	PLAN 2	PLAN 3	PLAN 4	PLAN 5	PLAN 6	PLAN 10	PLAN 7	PLAN 8	PLAN 9
T1-A	Minimally improved pilot channel					X			X	X	
T1-C	New Full length RCC chute				X						
T1-E	New FCO gated reinforced concrete chute	X	X	X			X	X			
T1-P	Hyatt Powerplant discharge portal bulkheads	X	X	X	X	X	X	X		X	X
T1-Z	Secant Pile Wall buttress					X			X	X	
T1-AW	Partial extension of RCC apron w/ minimally imp. Ch.								X		
T3-AJ	Upstream bulkhead gates*	X	X	X	X	X	X	X	X	X	X
T3-J...	Structural upgrades/retrofit*	X	X	X	X	X	X	X	X	X	X
T3-BH.2	Backup power, local starter, etc.*	X	X	X	X	X	X	X	X	X	X
T3-	Debris control structures/devices	X	X	X	X	X		X			
T4-N	Rock bolts in Hyatt Powerplant	X	X								
T4-W	Palermo Intake landslide stabilization	X	X								
T4-O	Barrier around ACC and switchyard, landslide stabl.	X	X								
T4-U	Palermo Canal Lining	X	X	X	X	X					
T4-C	New High-Level Outlet @ EI 775 ft	X									
T4-E	New Low-Level Outlet @ EI 435 ft		X	X	X	X	X		X		
T4-G	New Low-Level Outlet @ EI 340 ft	X									
T5-02	Modify portion of dam that wraps around Mon. 31*	X	X	X	X	X	X	X	X	X	X
T5-03	Modify the upper 40 ft of Main Dam	X	X	X							
T5-05	Raise Main Dam by 3 ft	X	X	X							
T5-B2	Raise Bidwell Bar Saddle Dam (BBCSD) by 3 ft	X	X	X							
T5-P2	Raise Parish Camp Saddle Dam (PCSD) by 3 ft	X	X	X	X	X	X	X	X	X	X
	<b>Total Weighted Benefit (risk reduction, resiliency, and engineering only)</b>	<b>73</b>	<b>81</b>	<b>79</b>	<b>73</b>	<b>77</b>	<b>77</b>	<b>72</b>	<b>63</b>	<b>53</b>	<b>41</b>

# CNA Alternative Plans

- No dam safety deficiencies were identified
- Plans identified through the CNA will enhance system operations and reliability
- The benefits of each plan, along with their cost, will be considered through the SWP Asset Management Program Processes

