



# LIFELINES COUNCIL

## Meeting 38: March 22, 2023

# Agenda

1. Call to Order	Douglas Legg, <i>Deputy City Administrator, City Administrator's Office</i> Brian Strong, <i>Director, Office of Resilience and Capital Planning</i>	5 minutes
2. Introductions and Agenda Review	Brian Strong, <i>Director, Office of Resilience and Capital Planning</i>	10 minutes
3. Lessons from the Turkey-Syria Earthquake	Ayse Hortacsu, <i>Director of Projects, Applied Technology Council</i>	15 minutes
4. Concrete Building Safety Program	Laurel Mathews, <i>Analyst, Office of Resilience and Capital Planning</i>	20 minutes
5. Extreme Precipitation Study	Anna Roche, <i>Climate Change Project Manager, SF Public Utilities Commission</i>	40 minutes
6. Adjourn		

# Lessons from the Turkey/Syria Earthquake

*Ayse Hortacsu, Director of Projects,  
Applied Technology Council*

# Concrete Building Safety Program

Laurel Mathews, *Seismic Resilience Analyst*  
*Office of Resilience and Capital Planning*

# About 3,900 San Francisco buildings are made in the same way as Turkish ones flattened in the earthquake

Buildings made of non-ductile concrete collapsed in the Turkey-Syria earthquake. San Francisco has thousands that pose similar risks.



Claire Hao

Updated: Feb. 18, 2023 1:16 p.m.



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News > World > Americas

## The West Coast can't escape the 'big one' — but the scale of its destruction is up to us

America's Pacific coast is crisscrossed with geological fault lines, some which are historically overdue for a major earthquake. Experts tell **Io Dodds** that last month's devastation in Turkey and Syria sent a clear message — but one that not everyone wants to hear

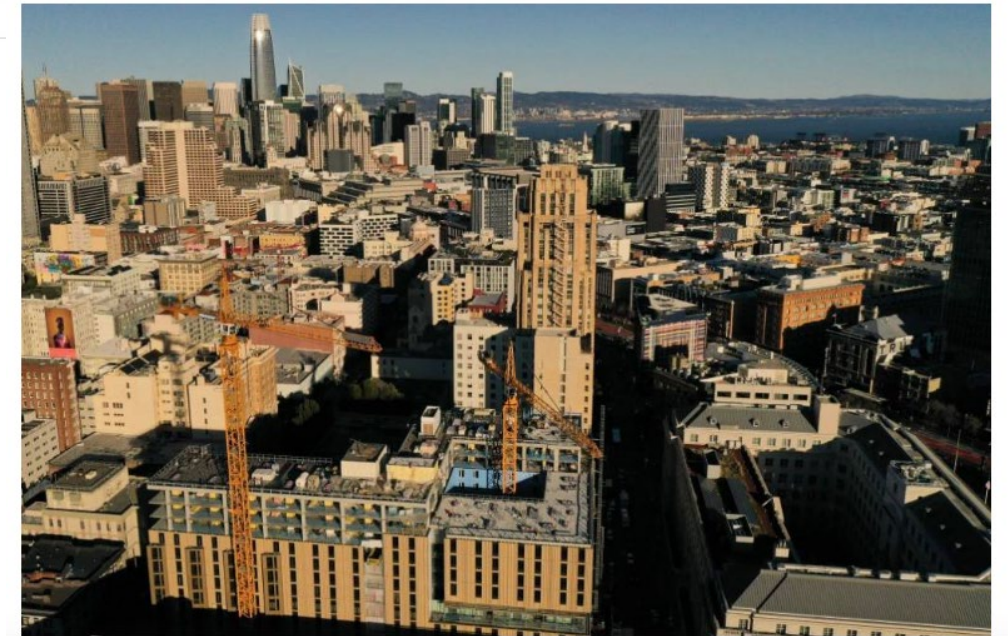
1 hour ago • Comments



NEWS

# Thousands of Buildings in the Bay Area, State Have Weakness Similar to Those Damaged in Turkey and Syria Quake

By Juan Carlos Lara, Matthew Green Feb 23 Save Article



CALIFORNIA

## California faces threat from the type of back-to-back mega-earthquakes that devastated Turkey

The earthquakes in Turkey show how big quakes are more likely to cause big aftershocks far from the epicenter. The same could happen in California.

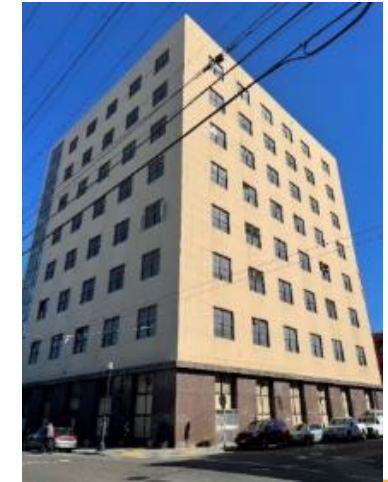
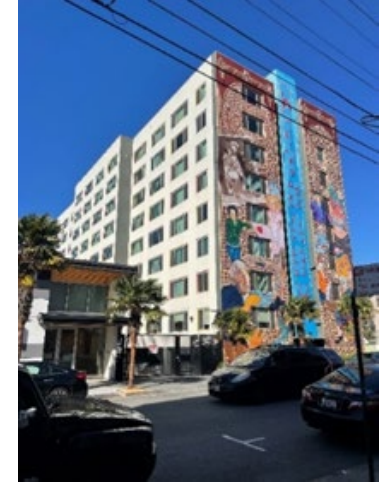
Feb. 8, 2023

# Concrete Building Safety Program Goal

Identify, evaluate, and retrofit the most vulnerable older concrete and tilt-up buildings to **prevent major structural failure** in support of the City's seismic resilience and safety goals.



# Walking Tour – October 2022



# The Concrete Building Safety Program will address two types of buildings



**Concrete Tilt-up**

*(Rigid-Wall-Flexible-Diaphragm)*



**Non-ductile Concrete**



# Concrete **Tilt-up** Buildings

- ▷ Weak connection between roof and walls
- ▷ Typically grocery stores, warehouses, auto-body shops
- ▷ ~14 California cities have retrofit ordinances in place
- ▷ Retrofit relatively inexpensive and straightforward



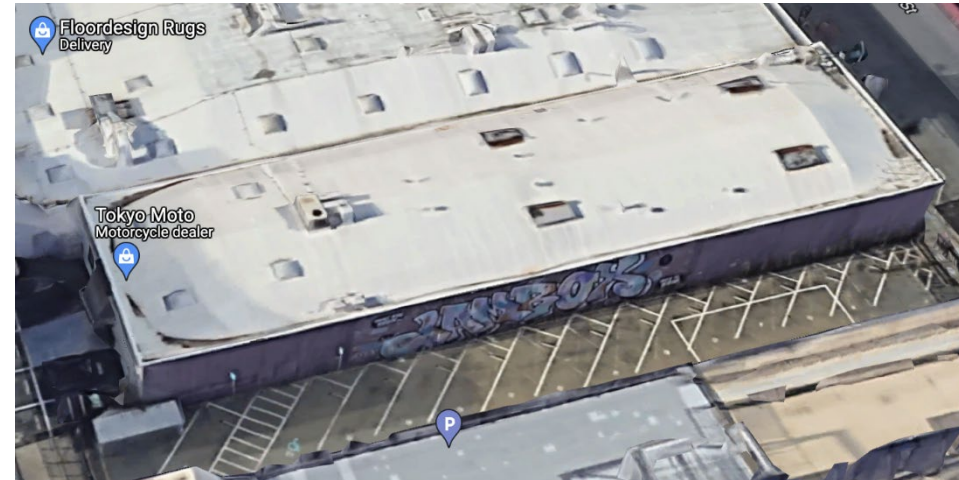
1994 Northridge (EERI in FEMA P-1026)

# Building size

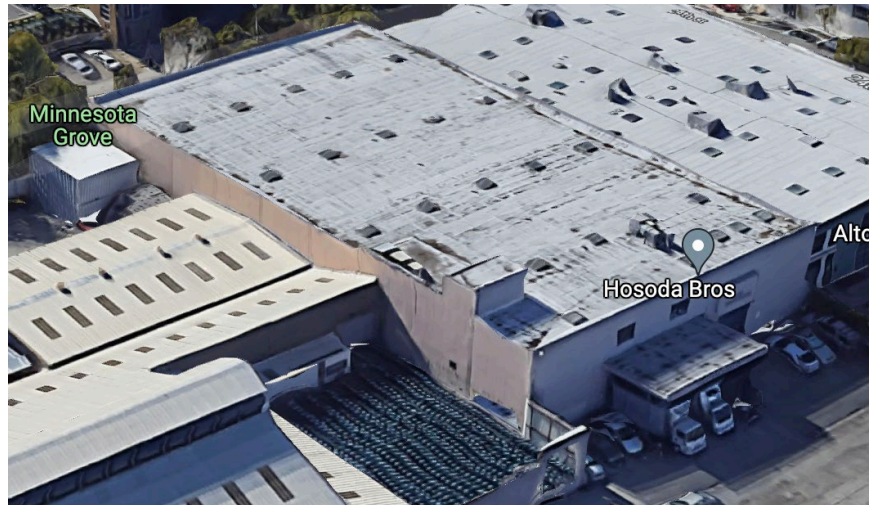
2500 sf



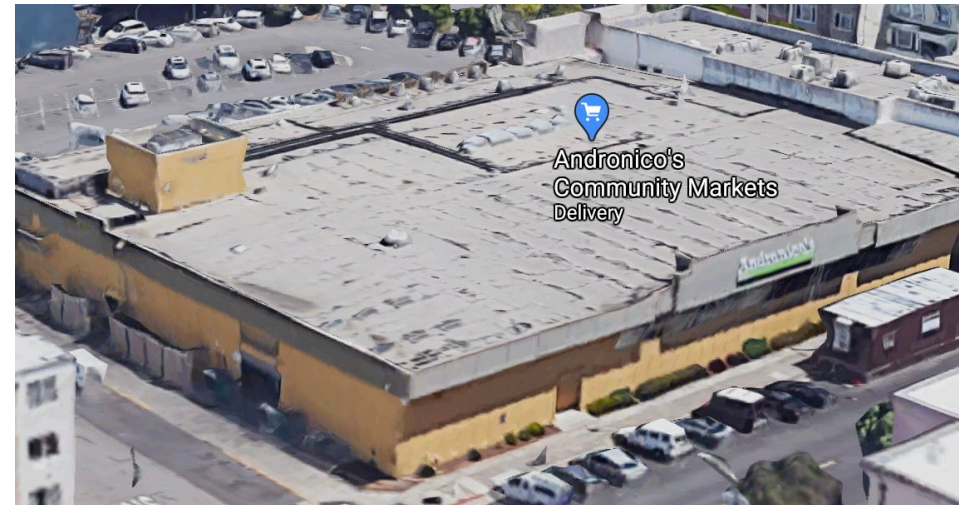
10,000 sf



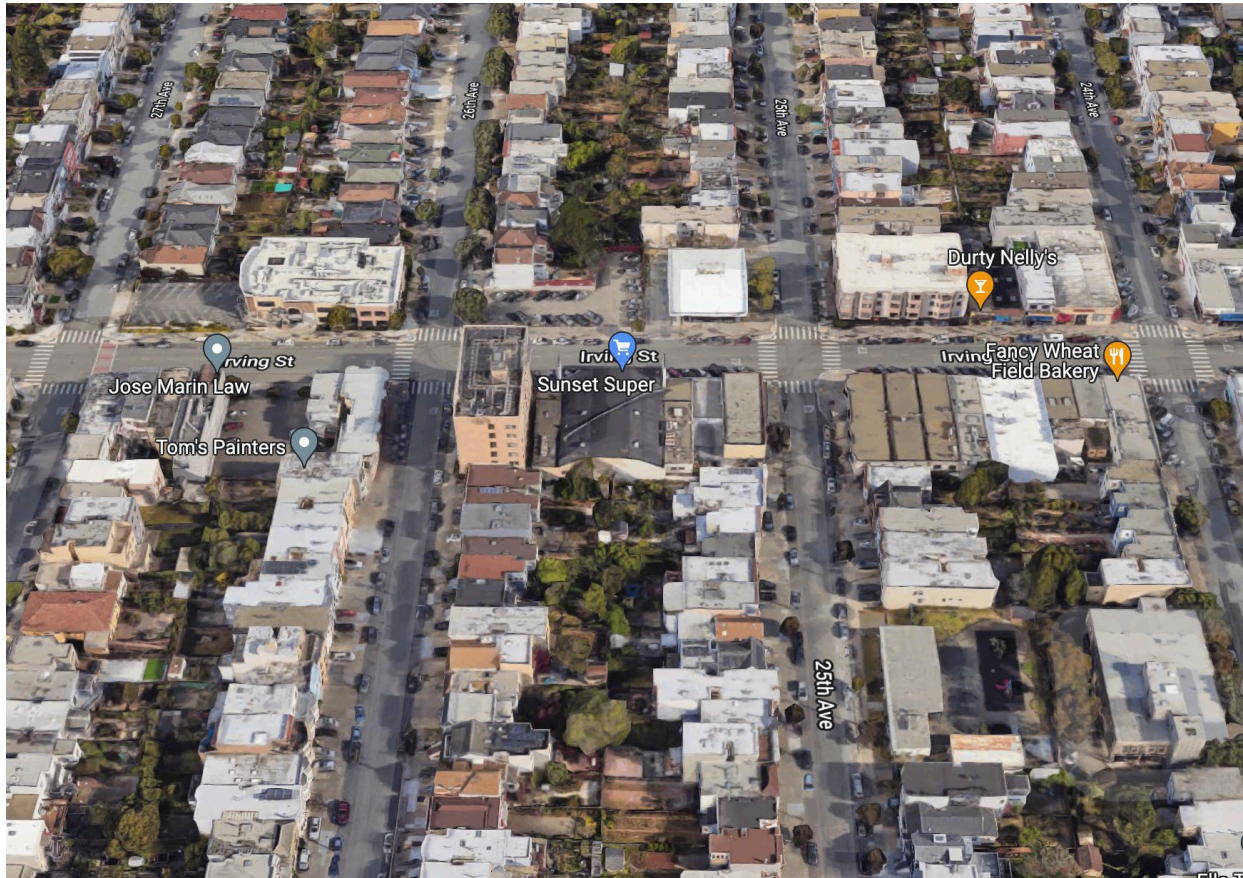
20,000 sf



40,000 sf



# PDR: Production, Distribution, Repair



San Francisco neighborhood building stock



San Francisco PDR zone

# Non-Ductile Concrete Buildings

- ▷ Contain insufficient steel reinforcement or capacity to resist collapse
- ▷ Typically housing and offices
- ▷ Los Angeles and other cities have recently mandated retrofit for non-ductile concrete buildings
- ▷ Retrofit can be complicated and expensive



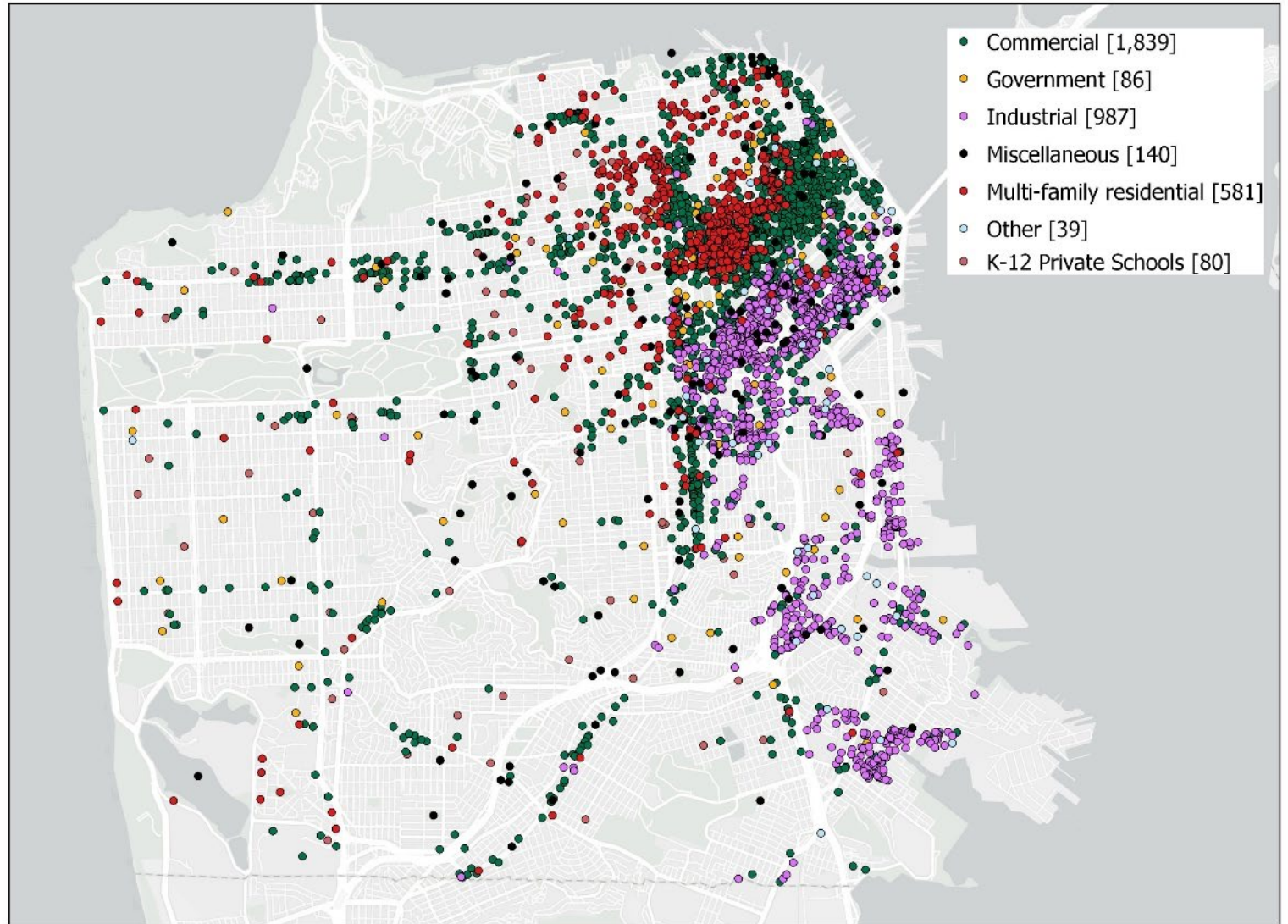
Damage to CTV building following Christchurch earthquake. Source: 1 NEWS



# Draft Map of Possible Concrete Buildings

## By Use Type:

- Commercial [1,839]
- Government [86]
- Industrial [987]
- Miscellaneous [140]
- Multi-family residential [581]
- Other [39]
- K-12 Private Schools [80]



## Concrete Buildings

Illustrated here are all concrete buildings in the city except: Post 1995 construction, public schools, colleges and universities, hospitals, SF Port Buildings, State and Federal Buildings and 1-4 unit residential buildings

3,752 Buildings Total



# Process



## **Executive Panel:**

- ▷ Provide guidance and direction
- ▷ City Administrator, Building Inspection, Emergency Management, Econ. Development, Assessor, Public Works, Housing & Community Development

## **Stakeholder Working Group:**

- ▷ Represent the concerns of stakeholders, including vulnerable communities
- ▷ Provide recommendations for program policy and design
- ▷ Ensure program products are usable

# Recap: Concrete Building Safety Program

## Program goal

Identify, evaluate, and retrofit the most vulnerable concrete buildings to protect against major structural failure.

## Building types affected

### Concrete Tilt-up

*(technical term: rigid-wall-flexible-diaphragm)*

### Non-Ductile Concrete

## Who is involved

### Project team

- SF Office of Resilience and Capital Planning
- SF Department of Building Inspection
- Applied Technology Council
- Civicmakers

### Stakeholder Working Group

### Executive Panel



# Q&A + Discussion

- What are your questions about the Concrete Building Safety Program?
- Has your organization taken any steps toward identifying and retrofitting non-ductile concrete buildings and structures in your portfolio?

# Extreme Precipitation Study

*Anna Roche, Climate Change Program Manager  
San Francisco Public Utilities Commission*

# Extreme Precipitation Study

Lifelines Council – March 22, 2023

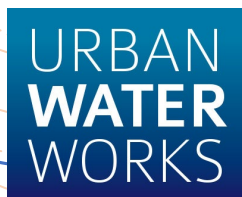


Kris May, PhD, PE  
Mike Mak, PE  
James Neher, EIT  
Juliette Hart, PhD  
Pathways Climate Institute



Michael Wehner, PhD  
Lawrence Berkeley National Laboratory

Christina Patricola, PhD  
Iowa State University



Susan Leal, Principal  
Urban Water Works



San Francisco  
Water Power Sewer  
Services of the San Francisco Public Utilities Commission

San Francisco Public Utilities Commission  
Project Manager, Climate Change  
Anna M. Roche

# Why did we do this study?

- Concern over what future extreme storms could look like in the Bay Area
- Need to be better prepared for future storms
- Need to include future precipitation data into long-range planning and design
- Desire to be industry leaders



'Bomb cyclone' lashes California, causes flooding

236K views · Oct 25, 2021  
YouTube · Reuters



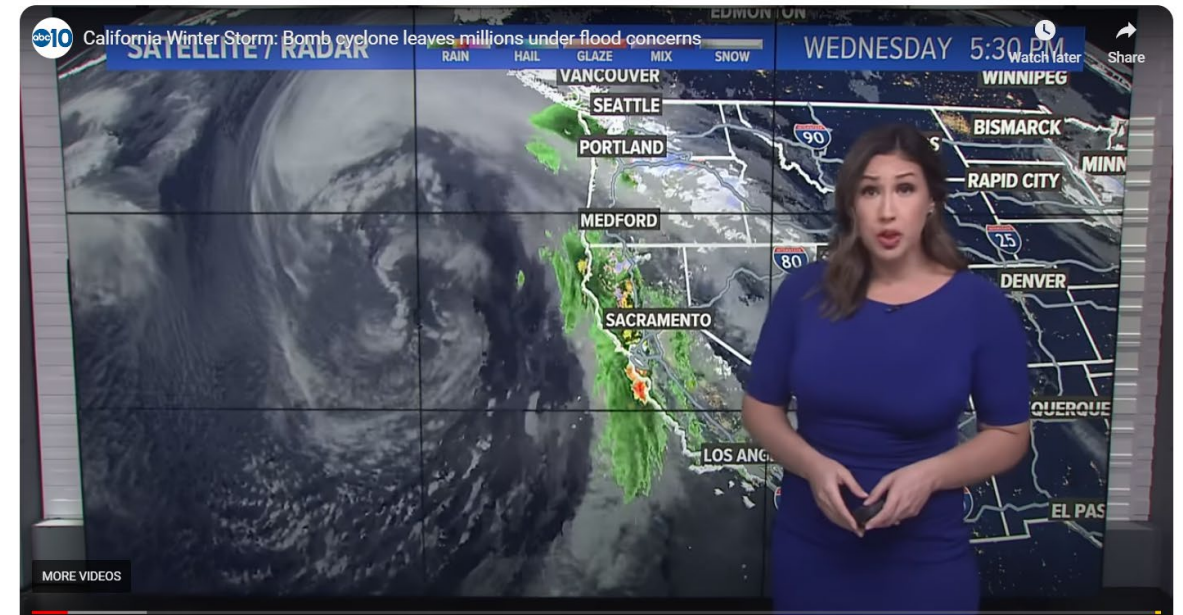
Northern California hit by bomb cyclone and atmospheric river

169K views · Oct 24, 2021  
YouTube · ABC10

California Winter Storm: Bomb cyclone leaves millions under ...

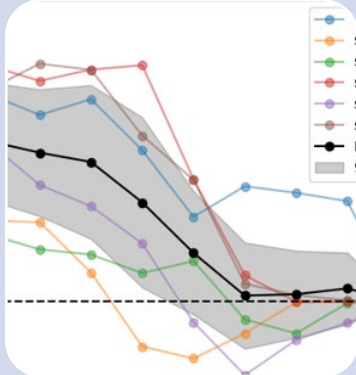
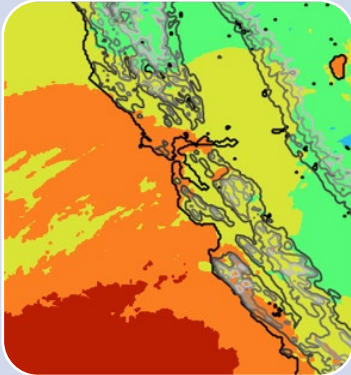
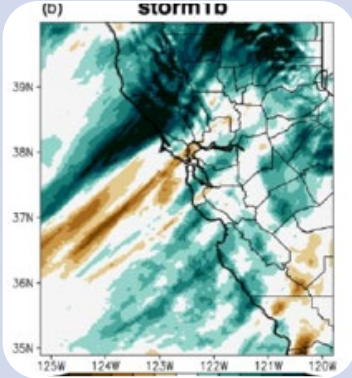
YouTube

YouTube · ABC10 · Jan 5, 2023



# Look How Far We Have Come

Year	Storm Dates	
	Storm Start	Storm End
2014	12/2/2014	12/6/2014
2014	12/11/2014	12/12/2014
1982	1/3/1982	1/5/1982
1994	11/4/1994	11/7/1994
1998	1/31/1998	2/8/1998
1995	12/10/1995	12/13/1995



**Storm Selection**

**Historic Storm Modeling**

**Future Condition Storm Modeling**

**Data Analysis**

**Deliverable: Guidebook (Vol 1)**

**Deliverable: Data and Tools (Vol 2)**

**DONE**

**DONE**

**DONE**

**DONE**

**DRAFT**

**DRAFT**

# Part 1: Extreme Storms

Identified 15 extreme storms that impacted the 3 agencies

1. Atmospheric Rivers (AR) – 2 events (13% of storms)
2. Extratropical Cyclones (ETC) – 3 events (20% of storms)
3. **AR + ETC** – 10 events (67% of storms; most common extreme storm)

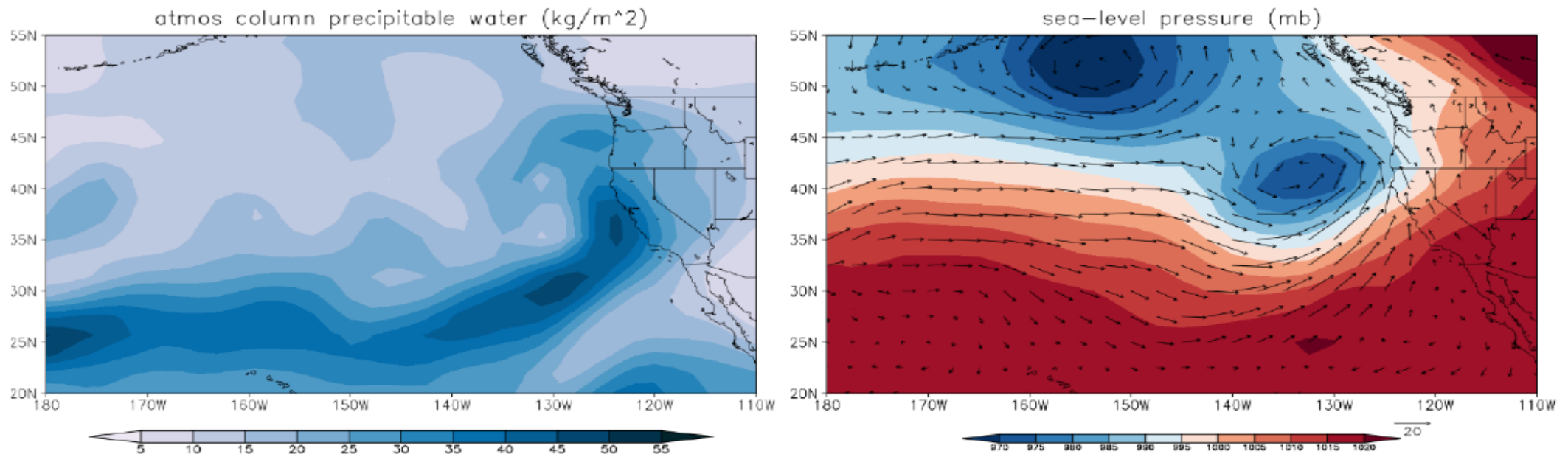


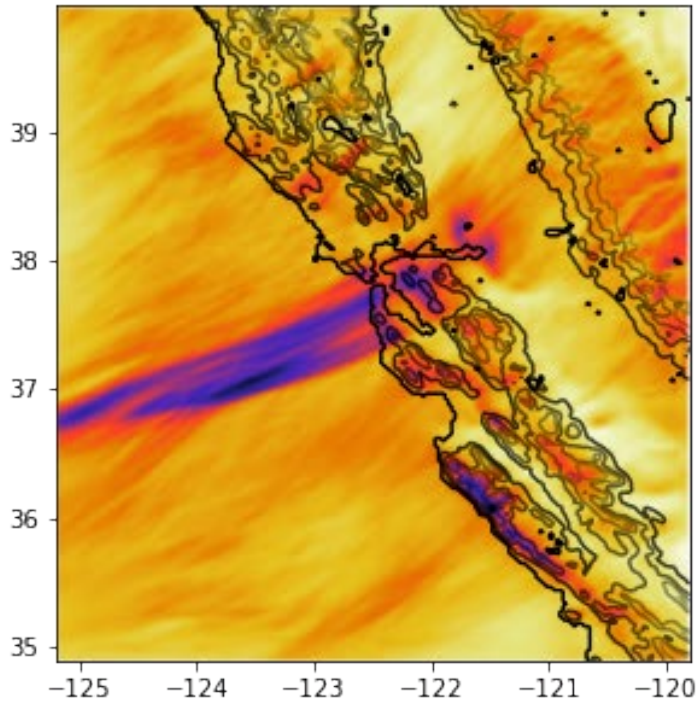
Figure 1 - Atmospheric River and Cyclone Occurring on December 12, 1995

# Key Finding: More rain expected with extreme storms

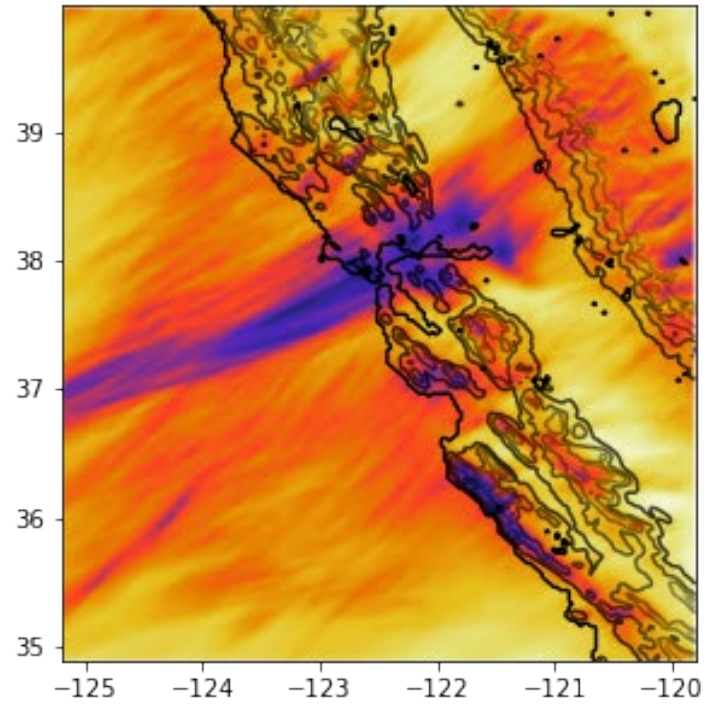
Most Common Extreme Storm	2050	2100
<b>Atmospheric River + Extratropical Cyclone</b> (67% of largest storms since 1980 are these combinations)	<b>Up to +17%</b>	<b>Up to +37%</b>

# Key Finding: Increased intensity; more rain in shorter duration

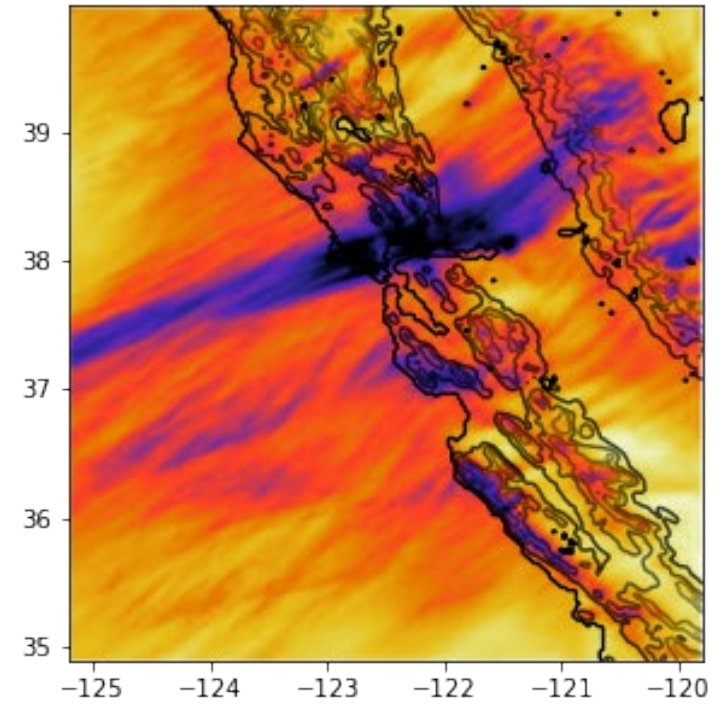
**1995 Storm**



**2050**



**2100**

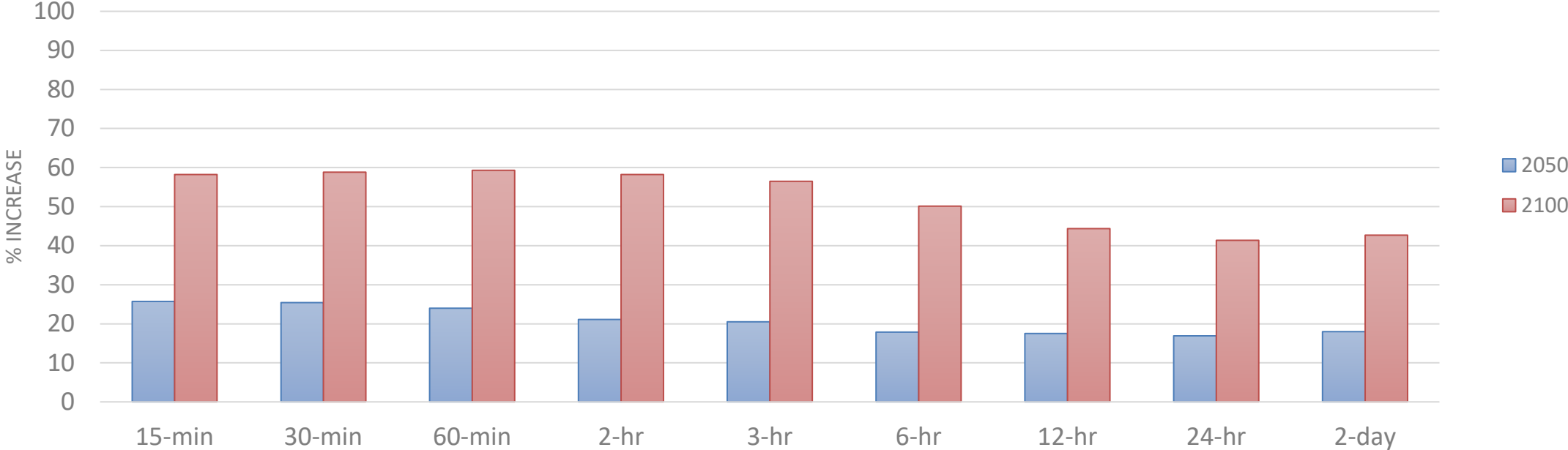




# Part 2: Smaller Storms

Analyzed smaller, more frequent storms

- 1. 5-Year Return Period (PUC system)**
- 2. 100-Year Return Period (City Streets)**



# Key Finding: Even bigger increase for smaller storms

## Changes in 5-year Return Period

2050

+ 17% for 24-hour duration

+ 21% for 3-hour duration

(+17% for Extreme Storms)

2100

+ 41% for 24-hour duration

+ 57% for 3-hour duration

(+37% for Extreme Storms)

## Changes in 100-year Return Period

2050

+ 22% for 24-hour duration

+ 26% for 3-hour duration

(+17% for Extreme Storms)

2100

+ 51% for 24-hour duration

+ 67% for 3-hour duration

(+37% for Extreme Storms)

# Why is the data trustworthy?



ScienceDirect

Journals & Books



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## Outline

Abstract

Keywords

1. Introduction

2. Data and methods

3. Results

4. Discussion and conclusions

Author contributions

Declaration of competing interest

Acknowledgements

References

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ELSEVIER

## Weather and Climate Extremes

Volume 36, June 2022, 100440



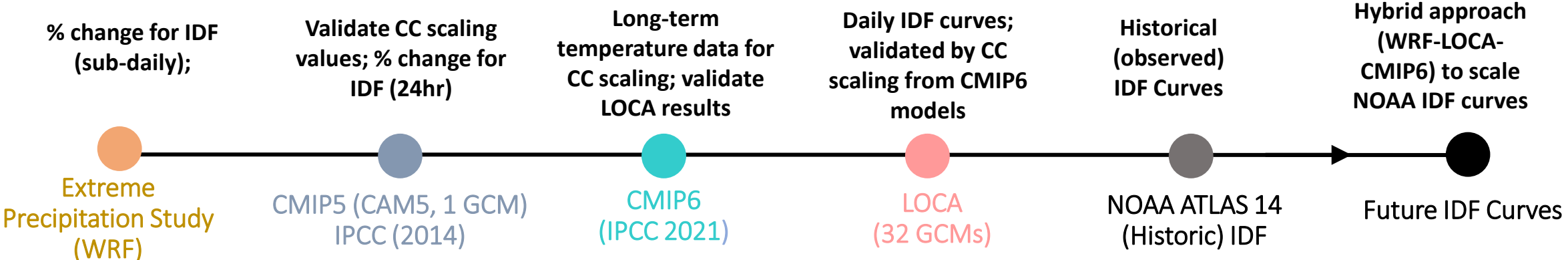
# Future changes in extreme precipitation over the San Francisco Bay Area: Dependence on atmospheric river and extratropical cyclone events

Christina M. Patricola <sup>a, b</sup> , Michael F. Wehner <sup>c</sup>, Emily Bercos-Hickey <sup>b</sup>, Flor Vanessa Maciel <sup>d, b</sup>, Christine May <sup>e</sup>, Michael Mak <sup>e</sup>, Olivia Yip <sup>f, e</sup>, Anna M. Roche <sup>g</sup>, Susan Leal <sup>h</sup>

Show more

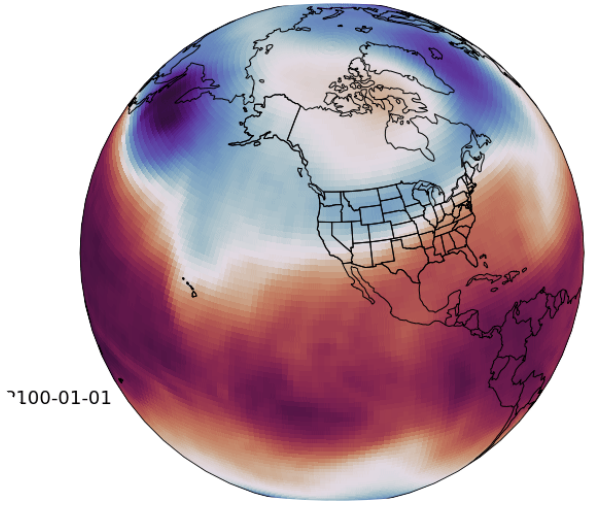
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# Why is the data trustworthy?



Data Needed for IDF	Supplement WRF (LBNL) modeling			
	WRF (LBNL)	CMIP5 (CAM5)	CMIP6 (Multi GCM)	LOCA (Multi GCM)
Convection Scale	✓			
Hourly/Sub-Hourly	✓			
Sub-Daily	✓	✓	✓	
Multi-Model			✓	✓
Long-Term		✓	✓	✓
Vertical levels	✓	✓	✓	
RCP8.5/SSP5-85	✓		✓	✓

Modeled Temperature (CMIP6)



# Key Takeaways

- Extreme storms will drop more rain in a shorter period
- Smaller storms will increase even more than extreme storms
- SFPUC WWE system **cannot** manage these changes alone

# High Level Recommendations

- Develop CCSF flood resiliency policy
- Integrate Results with other climate related data sets
- Expand department participation in Climate Resilience Program
- Refine decision making process
- Prioritize development of cross department climate change financial plan

# Discussion

What lessons learned, mitigation success stories, or challenges did your organization encounter during the recent rain events in the Bay Area?

# Mark your calendar!

Next Lifelines Council Meeting:

Wednesday, June 21<sup>st</sup>

10:00am - 11:30am



# Adjourn