

Winter Weather Cycles

El Niño, Atmospheric Rivers, and EmComm

September 3, 2026

Steve Hill

260903.1526



CARES mission

The mission of Cupertino Amateur Radio Emergency Service (CARES) is to maintain and train Amateur Radio volunteers capable of providing professional emergency communications, increasing the City's emergency response effectiveness, and speeding the recovery effort.



California's Winter Weather Cycles

El Niño, Atmospheric Rivers, and EmComm

Or...

Why Northern California experiences repeated disaster cycles and, more importantly, what those patterns mean for emergency communications?

The question is:

"Was 2023 unusual...or was history just repeating itself?"



Why we should care

Its not all about meteorology...

But about Emergency communications. Winter storms produce:

- flooding
- landslides
- debris flows
- levee failures
- power (and communications) outages
- road closures
- shelter operations
- need for evacuation support



California has always swung between drought and flood

Timeline

- 1861-62 The Great Flood
- 1906-07 Major floods
- 1955 Northern California floods
- 1964 Christmas Flood
- 1982 Bay Area storms
- 1986 Flooding
- 1997 New Year's Flood
- 1998 Strong El Niño
- 2017 Oroville spillway
- 2023 Atmospheric Rivers
- 2026-27? Current forecasts

The point:... California doesn't have "normal." It swings!



The Great Flood of 1861-62

What was the Great Flood?

- The largest flood in the recorded history of California, Oregon, and Nevada, inundating the Western United States and portions of British Columbia and Mexico.
- Preceded by weeks of continuous rains and snows that began in Oregon in November 1861 and continued into January 1862.



The Great Flood of 1861-62

One of California's greatest disasters... Interesting facts:

- In 1862, the two biggest cities in California were San Francisco and **Sacramento**.
- Sacramento was underwater for months
- State Legislature temporarily moved to SF
- Central Valley became an inland sea
- Thousands were killed
- Thousands of cattle were lost

Very few Californians know this story!



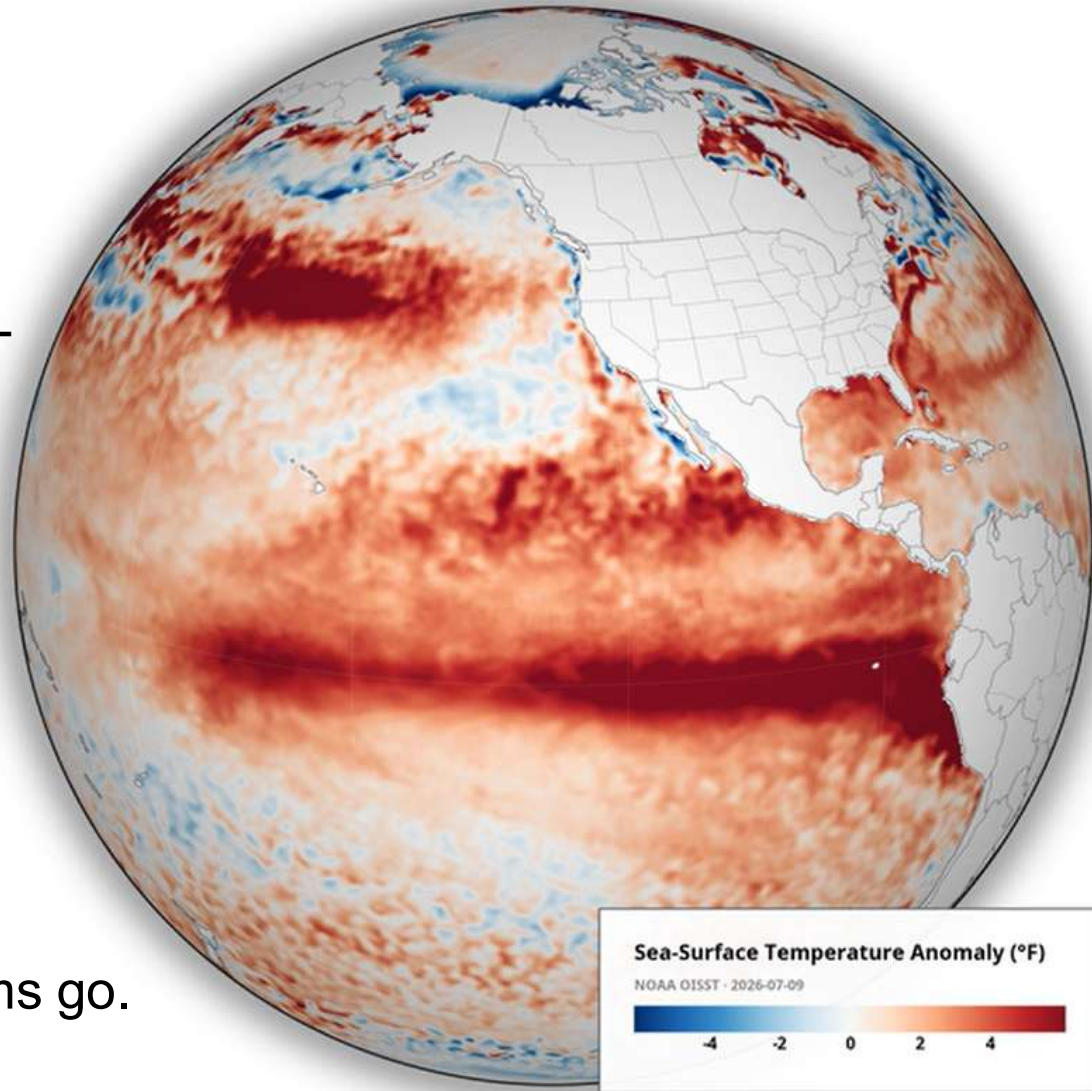
What is El Niño?

How El Niño Works

- **Warm water shifts:** It moves warm ocean water across the Pacific Ocean.
- **Jet stream moves:** It pushes the high-altitude wind path, or jet stream, into new positions.
- **Storm track changes:** It guides existing weather systems and rain storms toward different regions than normal.

In short:

- El Niño does NOT create storms.
- It changes the odds of where storms go.



What is El Niño?

Higher probability of:

- wetter California
- stronger winter storm track
- more atmospheric rivers

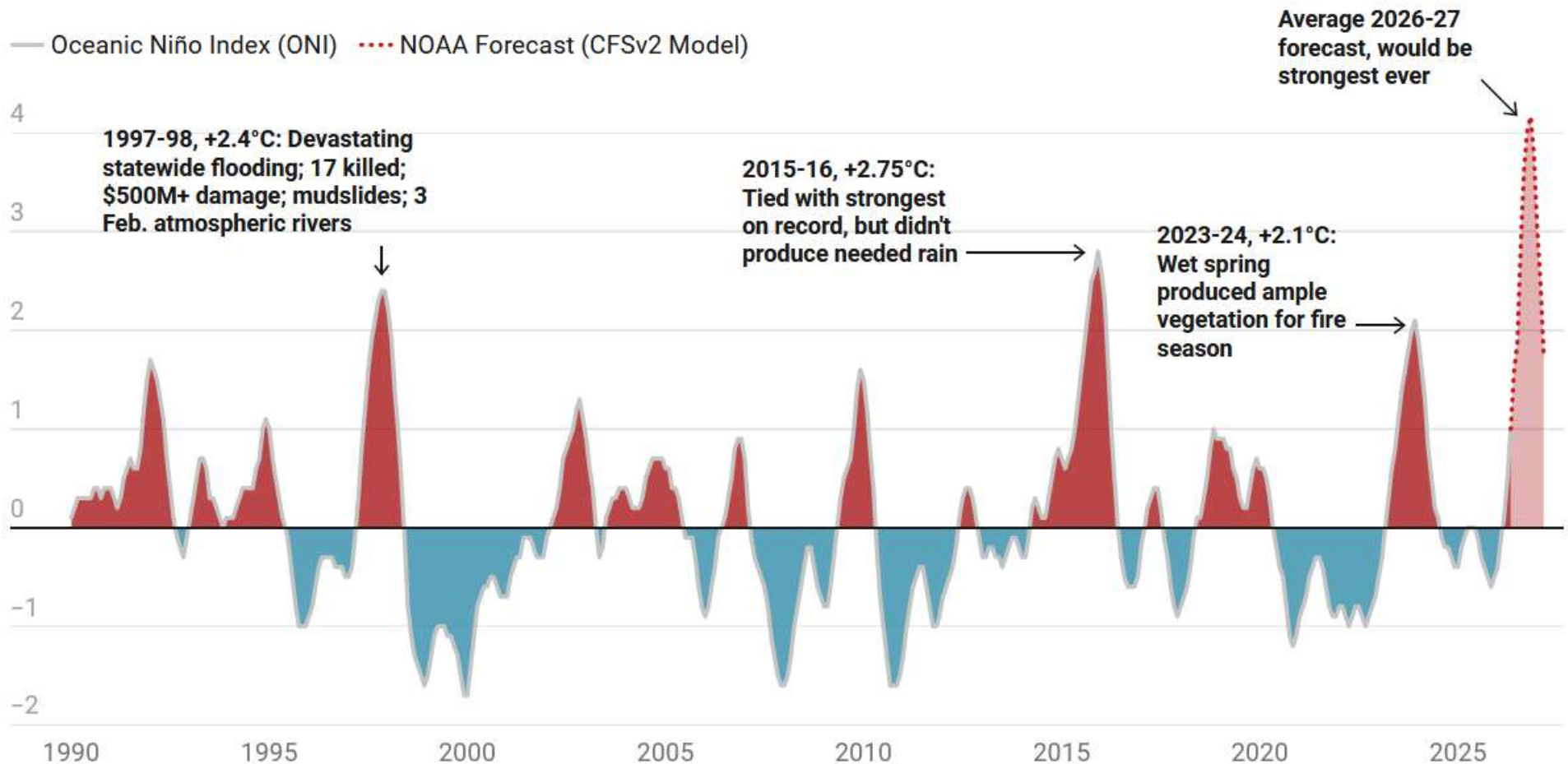
But...

- Not every El Niño is wet.
- Not every wet year is El Niño.



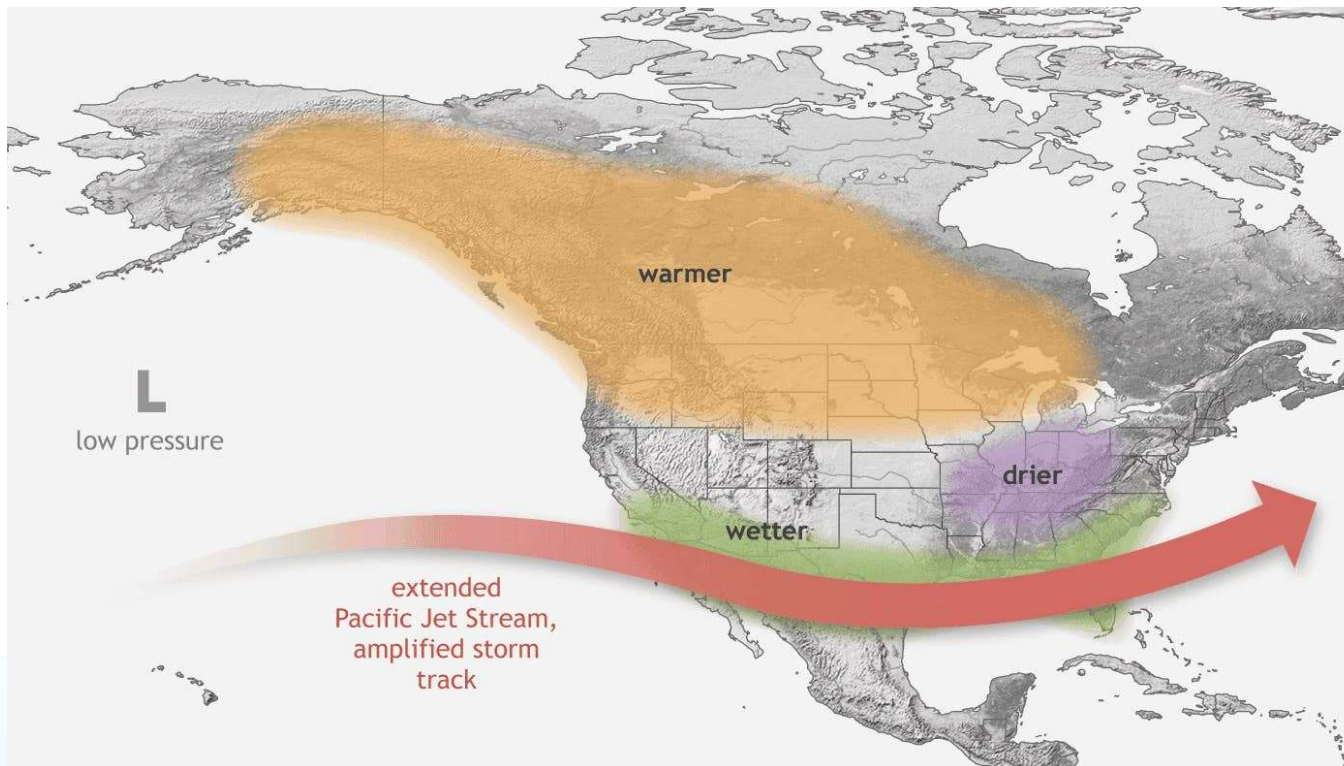
The coming super El Niño could be the strongest in generations, if not ever

The Oceanic Niño Index measures the sea surface temperature anomaly in a region of the eastern equatorial Pacific. Threshold for El Niño is +0.5 degrees Celsius on the Oceanic Niño Index.



The coming super El Niño could be the strongest in generations, if not ever

- **Historic Snow Map Shows Which States El Niño Could Hit Hardest This Winter**
 - NOAA put the chance of a very strong El Niño at 81 percent in July. A month later, the Climate Prediction Center raised that above 90 percent for fall and winter 2026-27 and gave October to December a 69 percent chance of exceeding every El Niño in a record that reaches back to 1950.



Cupertino ARES/RACES

The coming super El Niño could be the strongest in generations, if not ever

- Expecting the strongest El Niño event ever observed.
 - Forecasters have said Southern California may be in for an intense winter, with a powerful El Niño expected to increase rainfall, raise tides, and heighten flood risk across the region
- As 3 dangers converge, California's coast faces rare winter of big waves, erosion, flooding
 - A rare convergence of a
 - powerful El Niño,
 - super king tides and
 - sea level rise of up to one foot by end of September, spurred by climate change could menace California with record coastal flooding this winter.

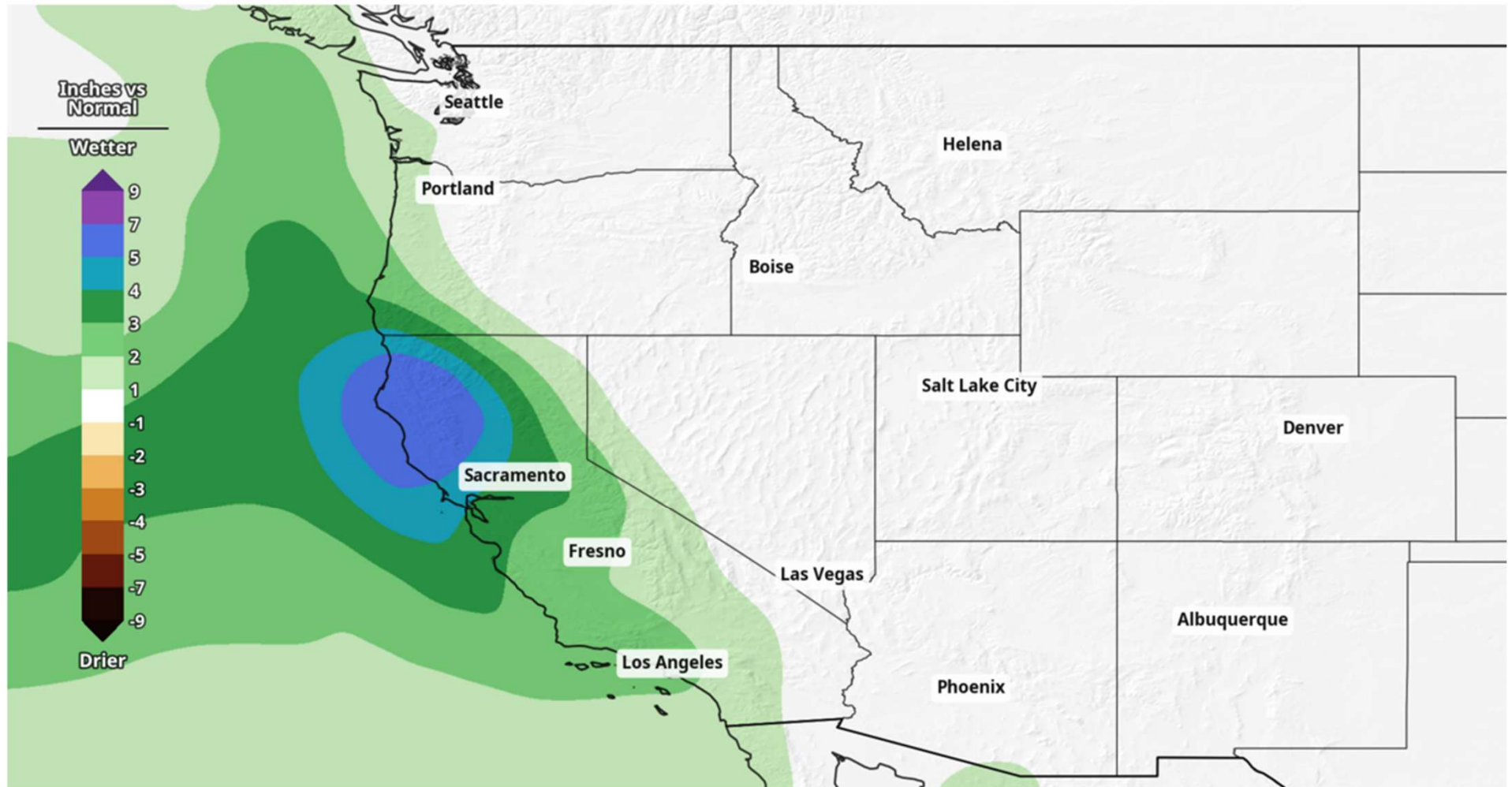


Strong El Niño can bring California more winter rain, floods

Precipitation Anomaly Outlook — December 2026

Sean Macaday, Sacramento Bee

Source: NOAA CFSv2 (16-member ensemble) · anomalies vs 1992–2019 hindcast climatology

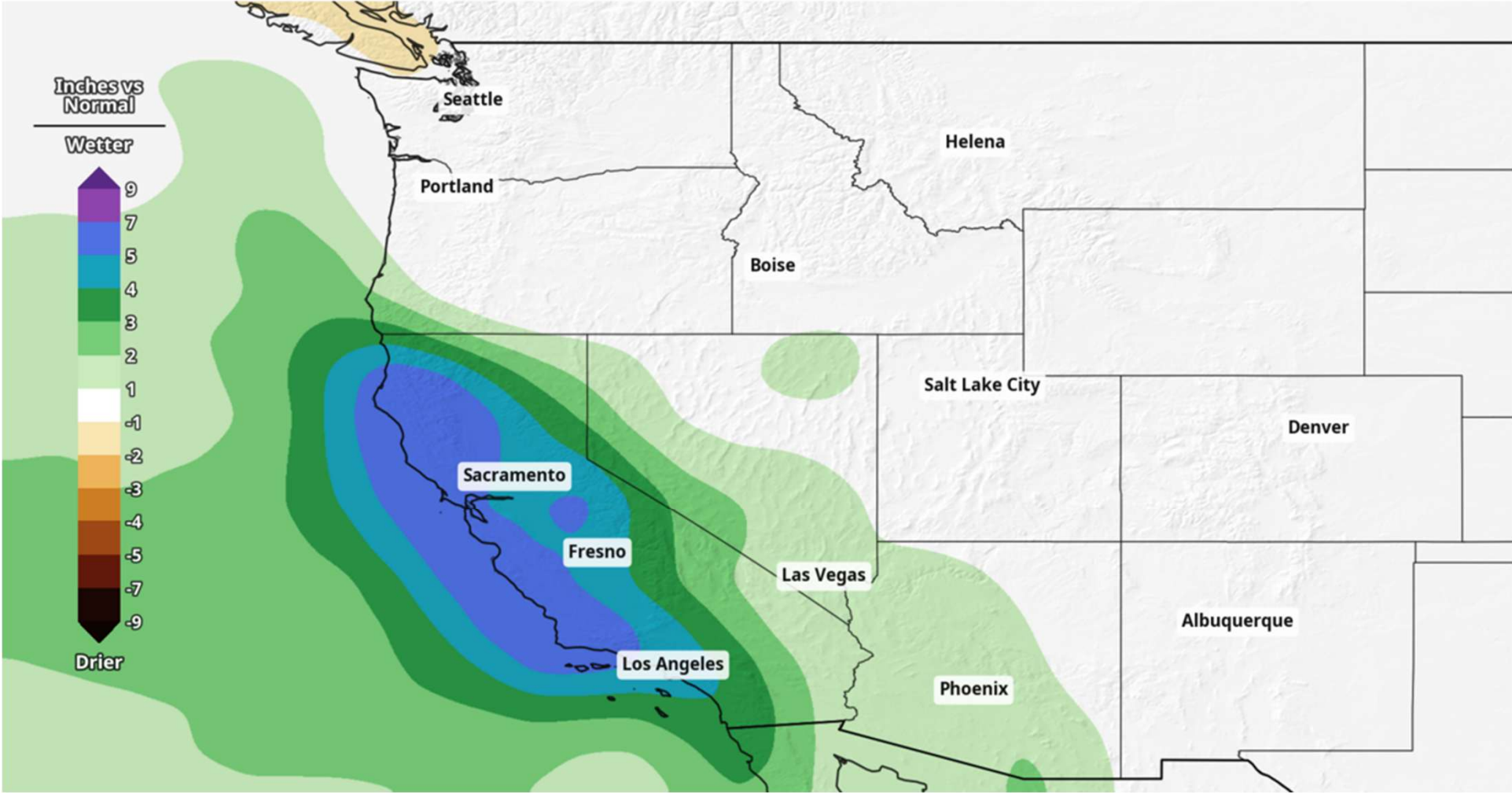


Strong El Niño can bring California more winter rain, floods

Precipitation Anomaly Outlook — January 2027

Sean Macaday, Sacramento Bee

Source: NOAA CFSv2 (16-member ensemble) - anomalies vs 1992-2019 hindcast climatology



How much water can we save before the next drought?

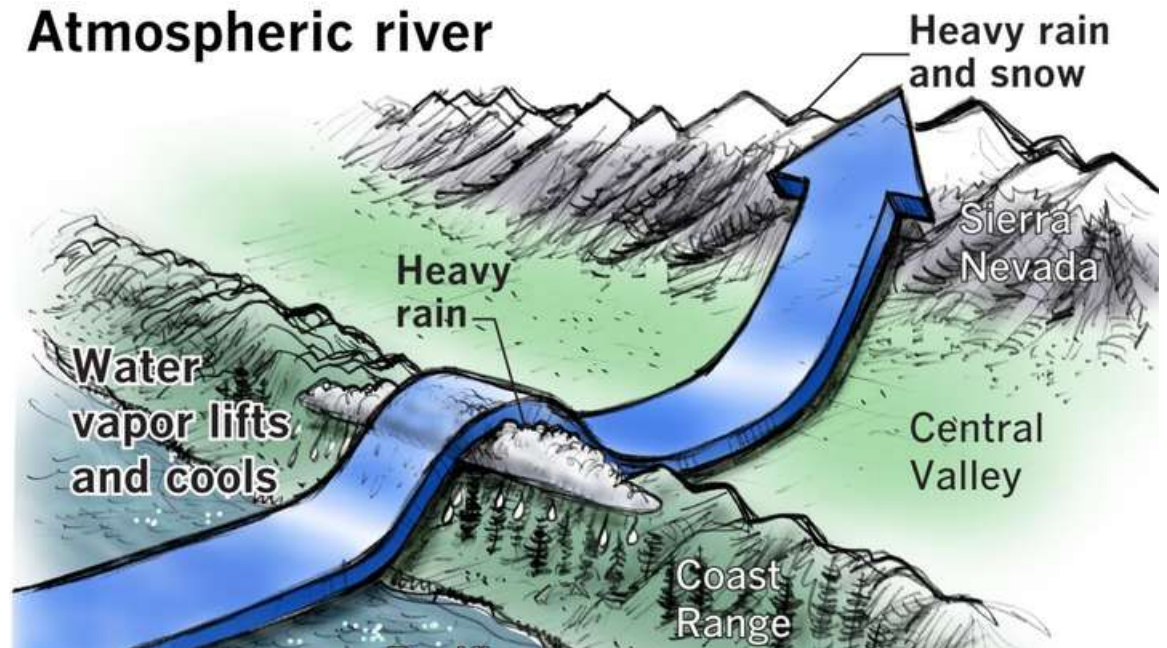
- The question isn't 'how much water weather systems like El Niño will bring to California'; it's 'how much water we can capture before the next drought inevitably arrives?'
- Weather challenges keep getting more complicated.
 - The National Oceanic and Atmospheric Administration says there's an 80% chance this El Niño develops into one of the strongest on record.
 - For Southern California, that could mean significantly more rainfall and potential flooding.
 - For Northern California, including the Bay Area, the picture is less predictable. **El Niño doesn't always translate into above-average rainfall or a record Sierra snowpack here.**
- In the winter of 2022-23, nine atmospheric rivers delivered an estimated 31 trillion gallons of water to California in just three weeks — enough to dramatically improve drought conditions, but arriving so quickly that it also caused widespread flooding, landslides and 21 deaths. The Bay Area experienced its wettest three-week period in 161 years, with San Francisco and Oakland each receiving more than 17 inches of rain.
- Some of that water was captured and used to recharge groundwater and fill reservoirs, but much more flowed through creeks and rivers and ultimately out to the Bay.

Weather Forecasting Terminology

- Major winter storm
- Pineapple Express
- Bomb Cyclone
- Atmospheric Rivers
- El Niño / La Niña
- Super El Niño
- Snow Eater
 - Unseasonably warm weather that rapidly melts snowpack is becoming more widespread in the U.S. West and happening earlier in the year.
 - Forces early release of reservoir water to make room for runoff.

Atmospheric Rivers

"What is an Atmospheric River?"



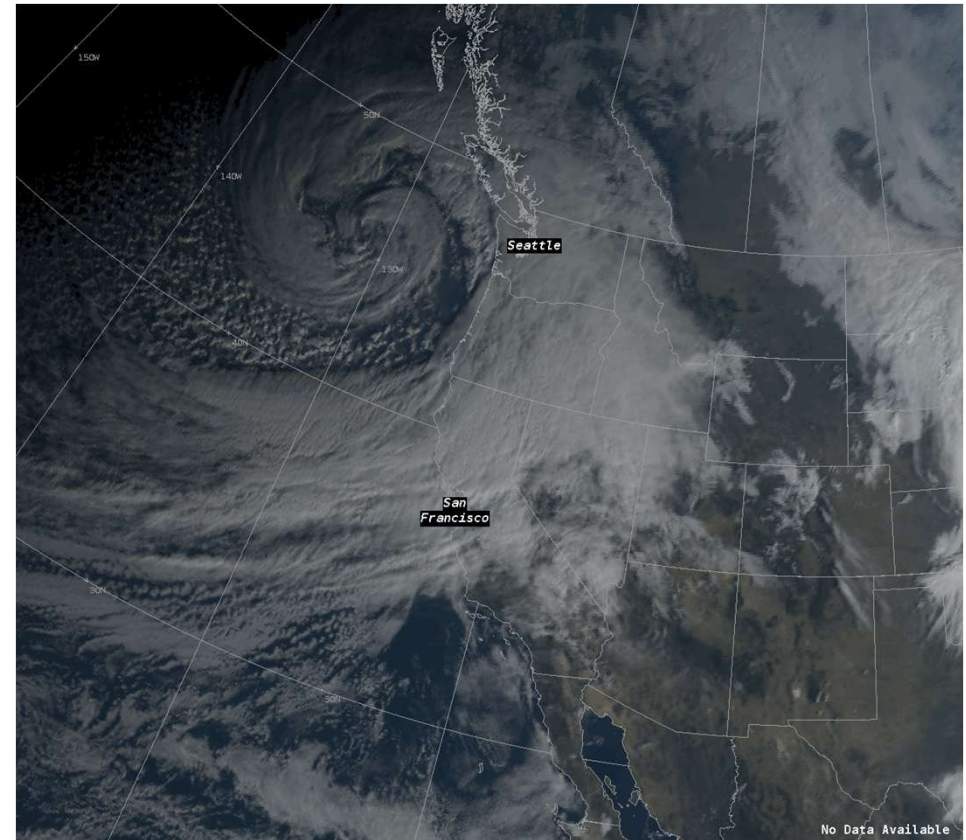
Cupertino is in the rain shadow of Black Mountain (2,800 ft.)



Atmospheric Rivers

Atmospheric Rivers can carry more water than the Mississippi River. When several occur close together, we get...

- saturated soils
- rivers rise
- levees stressed
- landslides
- urban flooding



Atmospheric Rivers happen every year.

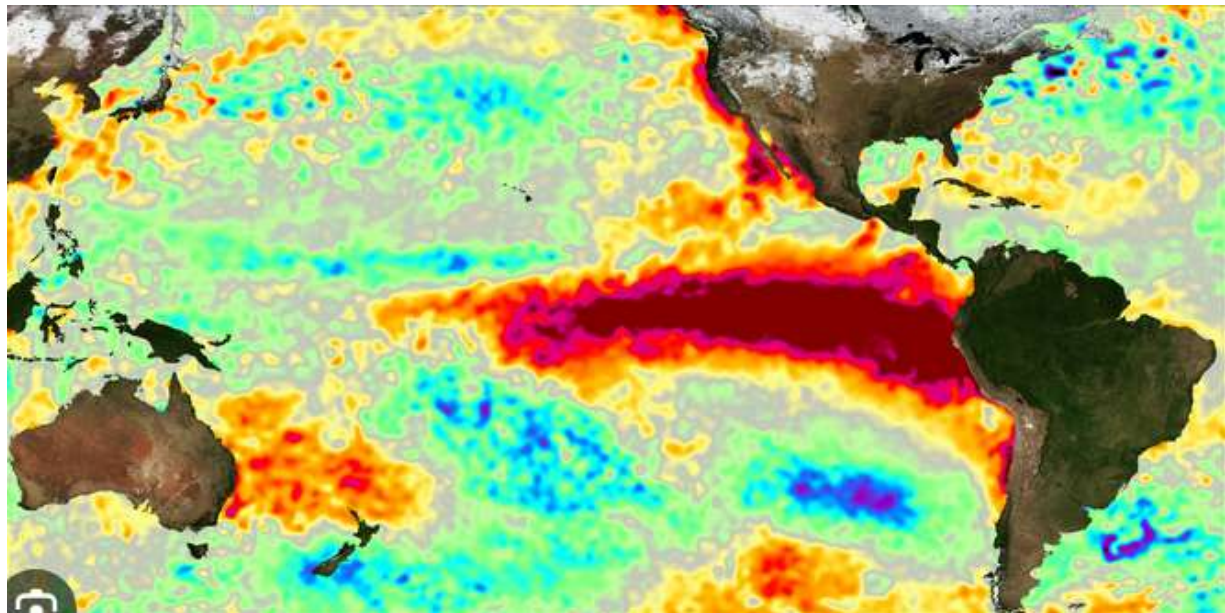
El Niño simply changes their likelihood and often their track. Even during some **La Niña** years, atmospheric rivers have produced very wet California winters.



Case Studies

1997-98 El Niño... One of the strongest.

- Flooding
- Mudslides
- Infrastructure damage
- Large emergency response
- This is still the benchmark many meteorologists use.



Video: <https://svs.gsfc.nasa.gov/30551/>
(Watch the incrementing date)



Case Studies

2017 El Niño

- Oroville Spillway
- Not simply "lots of rain."
- Successive storms
- Reservoir management
- Evacuations
- Communication challenges

2023 El Niño

- Series of Atmospheric Rivers
- Repeated storms
- Power outages
- Road closures
- Flooding
- Mutual aid
- ARES activity in many counties



Local Impact

Highway 17

- Ford pick up truck is removed from Highway 17 after being destroyed by a mudslide, Feb. 7, 2017
- Flooding in Santa Cruz Mtns and down town. Up to 25" of rain recorded in Santa Cruz County



Local Impact Sonoma

Jan 6, 1982

Argus-Courier

Serving Southern Sonoma County Since 1855

Petaluma, Calif.—Wednesday, Jan. 6, 1982

Vol. 148, No. 123

25 CENTS

Slides close 101, weaken Waldo tube



Mudslides at Waldo Grade have closed Highway 101 and further threaten to erode the soil underneath the roadway and collapse the tunnel

Sausalito woman dies in mudslide

SAUSALITO, Calif. (UPI) — A massive mudslide ripped one home from its foundation and sent it crashing into another today, killing one woman and prompting the evacuation of 600 residents from the picturesque community of hill-dwellers overlooking San Francisco Bay.

Weakening foundation earth threatened more slides and again forced the closure of the Golden Gate Bridge linking Marin County to San Francisco, closed earlier then reopened during a furious Pacific rainstorm.

Despite the closure of the bridge and the highway, Golden Gate Transit was operating full bus service between Petaluma and San Francisco today. Routes 74 and 76 went to the city's financial district via the Richmond-San Rafael Bridge and the Oakland Bay Bridge this morning.

"We won't know from CalTrans if the roadway will be open on Waldo Grade until midday," said Bruce Solby of Golden Gate. "If it won't be open, buses will take the reverse route coming back. If it is open, they'll come back on Highway 101."

Marin commuters were bused to the Larkspur ferry terminal this morning, where the district had all three vessels operating at 725-passenger capacity.

Late this morning, CalTrans officials announced they hoped to have some lanes at Waldo Grade open to traffic by the evening commute period.

Authorities suspended all movement through the town, cutting off the one remaining direct road access to San Francisco.

"We closed down right now," said Volunteer Fire Chief Gene Poole, "and it looks like we will be closed down for quite some time."

The slide in which the unidentified woman was killed sent one house skidding downhill into another a block away then both structures plunged another two blocks before coming to a halt. Officials feared more of the weakened hillside — covered with

Case Study Summary

<u>Winter</u>	<u>El Niño / La Niña</u>	<u>Atmospheric Rivers</u>	<u>Major Flooding</u>	<u>Notable Impacts</u>
1982–83	✓ Strong El Niño	✓ Repeated	✓ Yes	flooding, landslides, coastal damage widespread power outages
1997–98	✓ Strong El Niño	✓ Repeated	✓ Yes	Flooding, mudslides, infrastructure damage throughout California
2016–17	✗ Weak La Niña	✓ Repeated	✓ Yes	Oroville Dam spillway crisis, flooding, levee concerns, evacs
2023–24	✓ Strong El Niño	✓ Repeated	✓ Yes	Multiple atmospheric rivers, flooding, landslides

Common Thread:

California's major winter floods are caused by atmospheric rivers. El Niño increases the chances of an active storm season, but it is not the direct cause of flooding.

Our take-away:

Watch the atmospheric river forecasts — not just whether it's an El Niño year. El Niño tells us **the odds** of a busy winter, but atmospheric rivers tell us **when** and **where** emergency response is likely to be needed.



Looking ahead

Current outlook

The Sacramento Bee article is useful because it emphasizes that forecasters are watching for a potentially very strong El Niño and noting increased odds—not guarantees—of a wetter California winter with stronger atmospheric rivers and higher snow levels.

However...

- Forecast $\neq$ certainty.
- Preparedness matters regardless.



Emergency Communications Lessons

If this winter becomes severe, what should we expect?

Possible missions:

- EOC and city Field staffing (Creek Watch)
- shelter support (City Parks and Rec, Red Cross)
- hospitals (SCCo RACES MAC assignment)
- damage assessment (CARES)
- backup communications
- public information (All of CCC)

Preparedness:

- Add these to your winter Go-Kit
 - Wader boots
 - Yellow poncho (disposable)



Reservoir Management

- Function of reservoirs is to capture precipitation runoff
 - Maximize acre-feet for urban and agricultural use
 - Minimize releases that flow to ocean
 - Avoid danger of overtopping the dam
- The two perils of Stevens Creek Dam are:
 - Overtopping caused by large, unexpected rain event
 - Failure from internal breach by water



Watershed for Stevens Creek Reservoir



Stevens Creek Dam and Reservoir

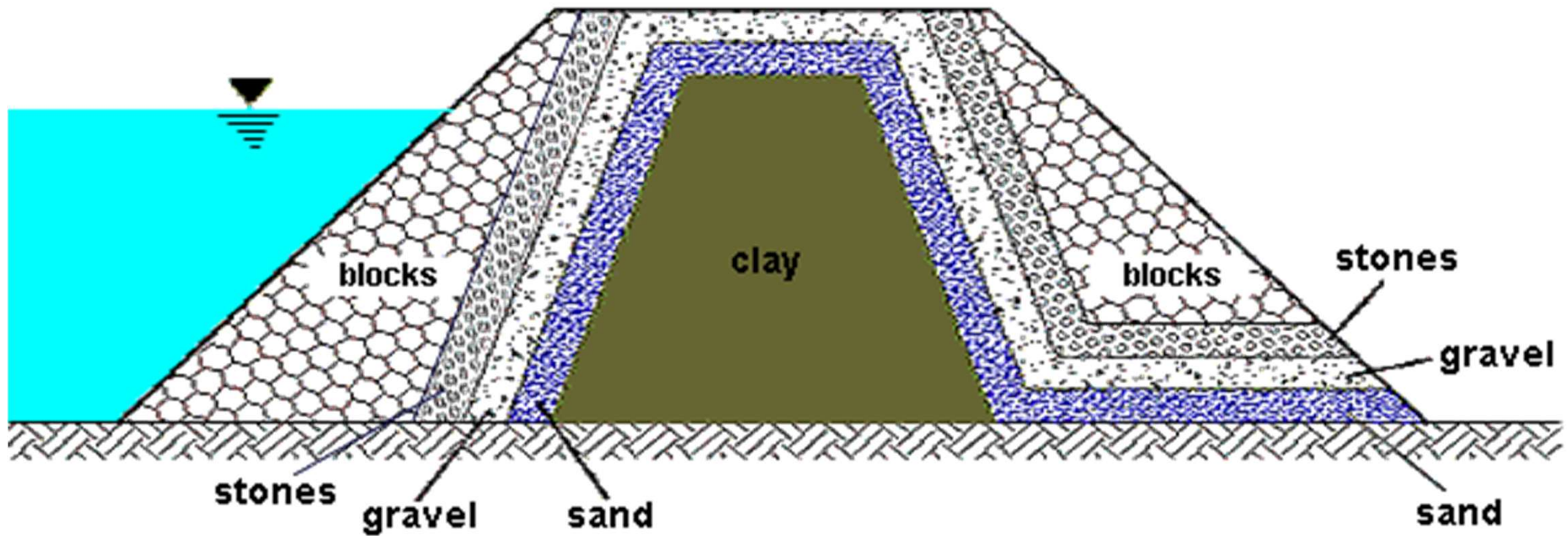
We need to determine safe places for:

- dam watcher
- creek watchers

Dam built 1935



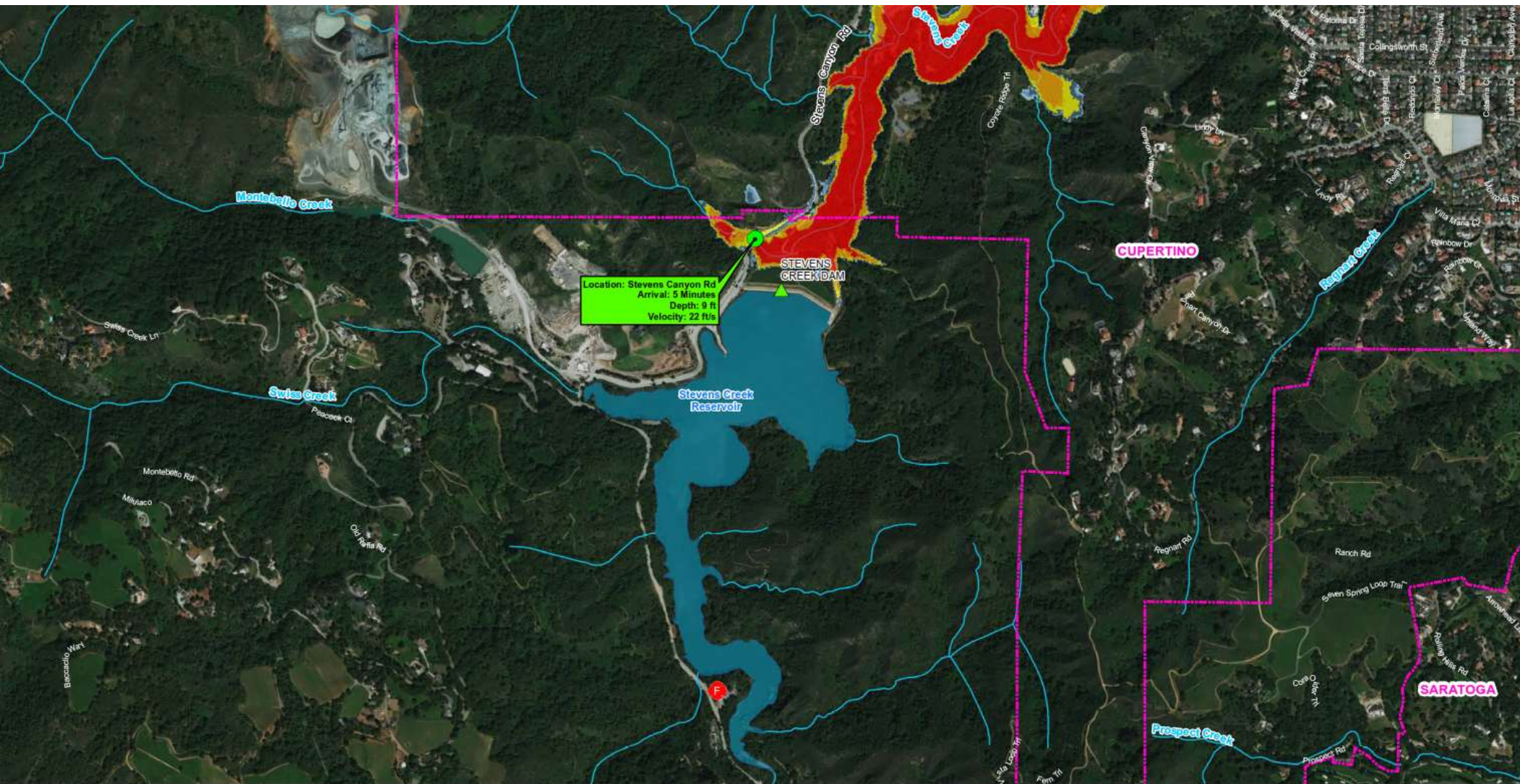
Cross Section Earthen Dam



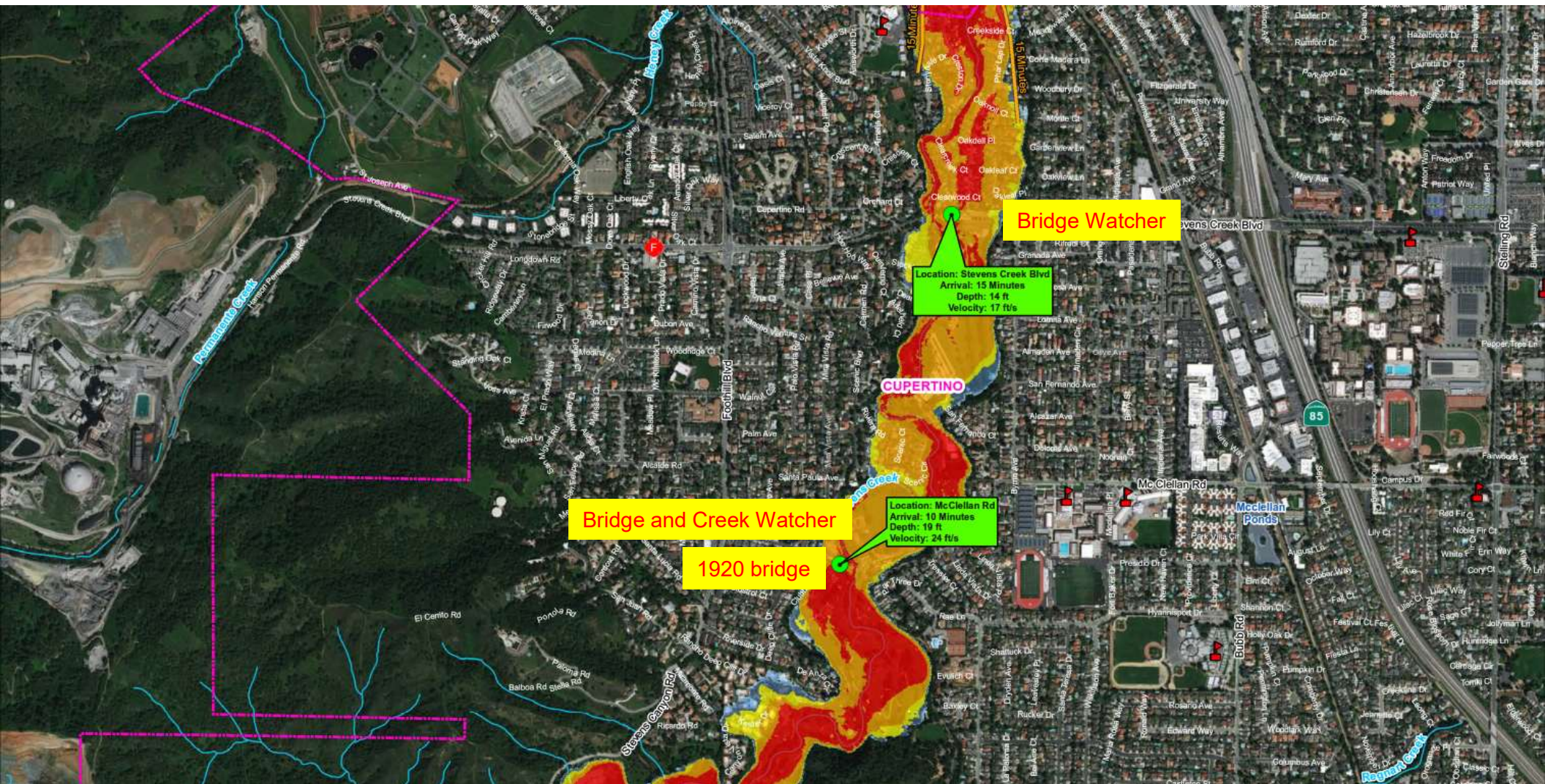
Stevens Creek Dam height = 132 feet



Inundation Zone



Inundation Zone: Cupertino





Potential CARES duties in a flooding event

- **Dam watcher**

- Located in front of dam on high ground

- **Creek watchers**

- McClellan Rd: Watch both creek and bridge
- Stevens Creek Blvd.: Watch creek from high ground

- **Need to ascertain watcher locations**

- Both east and west sides?
- Must be able to reach a repeater
- SAFE location



Resident Lessons

What we should remember:

- Weather changes.
- Preparedness doesn't.

We need to aware and understand:

- El Niño
- Atmospheric Rivers
- Local hazards
- Flood history

Because...

"Every generation thinks its storms are unprecedented...until they learn California's history."



Finally...

Could another 1861-62 flood happen?

Most scientists answer:

Yes...

- Not because of climate change.
- Not because of El Niño.
- But because California has done it before—and the same atmospheric processes still exist.
- Modern development, larger populations, and infrastructure could make the impacts even greater if a similar event occurred.

History is one of our best preparedness tools.



References

1. <https://www.sacbee.com/news/california/article316467041.html>
2. <https://www.noaa.gov/news/rain-when-good-thing-becomes-too-much-of-good-thing>
3. https://www.youtube.com/watch?v=6RQMEgXV_Mg
4. <https://abc7news.com/post/bay-area-storm-1982-flooding-deadly-storms-ca-san-francisco/12660616/>



Thank you

Any Questions?

