

# The Hayward Fault -- overdue for destruction?

Amy Miller, KQED (San Francisco television), 10-14-15

Every year around this time, millions of people around the world participate in The Great California ShakeOut. It's an opportunity for communities to think about one very unpleasant fact: big earthquakes can and do happen.

The ShakeOut happens this month because here in California, it's 'Earthquake Season'. October 17th marks the anniversary of the Loma Prieta earthquake, which shook Northern California in 1989, killing 63 people and causing an estimated \$6 billion in damage.

But there's another big earthquake anniversary in October that people don't hear much about. It predated the 1906 quake by nearly 40 years.

On October 21st, 1868, a magnitude 7.0 earthquake occurred on the Hayward Fault in the East Bay. A lesser-known cousin of the San Andreas Fault, the Hayward Fault is a crack in the earth's crust up to 20 miles deep that stretches roughly 70 miles from San Pablo Bay in the north to Fremont and Milpitas at its southernmost end.

In 1868, the towns of Hayward, San Leandro and Fremont were hardest hit. Luckily, the area had a population of only about 1000 people at the time. Still, 30 people died in the 1868 earthquake and hundreds of buildings from the East Bay to San Francisco to Gilroy were destroyed.

Research has shown that the last five big earthquakes on the Hayward Fault back to the year 1315 have occurred on average every 140 years. It has now been 147 years since the last big one.

And today, more than 2.5 million people live within a stone's throw of the Hayward Fault, including in densely populated areas like downtown Oakland. According to the U.S. Geological Survey's 2015 statewide earthquake forecast, for every year that passes without a significant seismic event, the chance of another massive earthquake on the Hayward Fault increases.

"It's constantly moving, little amounts every year," says Tom Brocher, a senior seismologist at the USGS in Menlo Park. "And it's allowing the Earth to move very slowly without creating large earthquakes. The problem is it's not moving enough. And so we'll still have big earthquakes on the Hayward Fault to make up the difference."

Over the last decade, paleoseismologists (geologists who study ancient earthquakes) at the USGS have been digging trenches across the Hayward Fault, peering into tectonic time in order to find evidence of fossil earthquakes. Once found, they are able to radiocarbon date the quakes to determine the magnitudes and dates they occurred.

They dug one trench near the Fremont BART station where they were able to find evidence of 12 major earthquakes on the Hayward Fault over the last 2,000 years. Their conclusion: the Bay Area is overdue for another big one on the Hayward Fault.

In March, the USGS updated its California earthquake forecast report. According to the report, there's a greater chance of a very large (magnitude 7.5 or greater) earthquake on the Hayward fault that was previously thought. The chance of that occurring in the next 30 years is 3.6 percent, which seems pretty low, but the probability is up 93.7 percent from the prior forecast seven years ago. It's also more likely that there

will be a 6.7 or greater earthquake on the Hayward fault in the next 30 years, with a probability of 14.4 percent, up 1.2 percent from the prior forecast.

Should we be more worried now? Andrew Alden, a geologist who runs the Oakland Geology blog, doesn't think so.

"The state of the Earth's crust is hardly different from what it was seven years ago when the USGS issued its previous forecast," he wrote recently. "It's we who have changed our knowledge and models have progressed."

Alden is referring in part to new technology that has been employed recently to deepen our understanding of tectonic activity. In May, UC Berkeley seismologist Estelle Chaussard published an earthquake model that provides the clearest picture yet of the relationship between the Hayward Fault and the Calaveras Fault, which lies just south of the Hayward Fault and runs from San Jose past Hollister.

Using a satellite-based imaging technique that very accurately surveys the ground, combined with high-resolution photography, Chaussard was able to detect the exact zones where the ground near the Hayward and Calaveras faults have been creeping.

The upshot? An end-to-end rupture of the Hayward Fault could cause an earthquake of magnitude 7.5. If that happened, there's a high probability that the quake could continue onto the Calaveras Fault, causing it to rupture and raising the magnitude to around 7.8, spreading the devastation through the entire South Bay.

Needless to say, these types of events will be devastating to the 7 million people who live and work in the Bay Area. And the cost could easily reach upwards of \$200 billion.

Stanford geophysicist Mary Lou Zoback specializes in risk and catastrophe modeling. The picture she paints of the Bay Area after a major earthquake on the Hayward Fault is nothing less than terrifying.

"Roadways will be shut down, the soft, water-saturated sandy deposits along the margin of the bay where we have airports and approaches to bridges, they're likely to liquefy, ripping apart the roads," she says. "We can assume transportation networks will be completely disrupted and destroyed. Water will likely be shut down. There will be fires because gas lines will rupture. There won't be enough water to fight the fires. Power will be down. Communications will be down. I often say it would be a lot like Katrina but here, we'd be speaking 150 languages as well."

There's nothing anyone can do to prevent earthquakes or even to predict them. So why do we need to know all this scary stuff?

"How quickly we recover from the earthquake," says Brocher, "is determined by how well we've prepared for it."

Earthquake scientists and disaster officials recommend that every household prepare a quake plan, get a kit to survive for three days after a major earthquake and make sure the buildings you live and work in are reinforced and safe.