

Fresno geology isn't conducive to a big quake, yet vulnerabilities exist

By Tim Sheehan

The Fresno area hasn't felt any serious effects from a major earthquake since a magnitude-6.4 temblor devastated Coalinga in 1983, injuring 47 people and causing more than \$31 million in damage.

But last weekend's 6.0-magnitude quake that struck the Napa Valley is prompting a fresh examination of the likelihood of a major quake striking the central San Joaquin Valley and the vulnerability of homes, buildings and vital infrastructure in the region.

The good news is that such a quake is unlikely here. In a state laced with faults, Fresno County is one of the safest places to live, geologists indicate.

But emergency officials have estimated what might occur here if a one-in- 2,500-years quake struck. Hundreds of people would die and billions of dollars in damage would result, the computer models show.

That remains a highly remote possibility.

"A lot of folks in other parts of the country have a tendency to look at all of California as laced with active earthquake faults," says John Wakabayashi, an associate professor in Fresno State's department of Earth and Environmental Sciences. "But when we look at the Central Valley itself, internally it doesn't have any active faults."

Wakabayashi, who specializes in the study of tectonics — the movement of the plates that make up the Earth's surface and cause earthquakes — explains that the average geologic movement, or "slip rate," of faults in California is between 38 and 40 millimeters — about 1 1/2 inches — per year. "In this neck of the woods, though, it's more like only a few hundredths or even a few thousandths of a millimeter per year."

Advantage of distance

Most of California's coastal and mountain regions are classified by the state's Seismic Safety Commission as Seismic Zone 4 — the highest of six tiers in building codes for measuring the potential for shaking from an earthquake. Fresno and much of the Valley are in Zone 3, the second-highest tier.

All of California is in either Zone 3 or 4.

The Coast Range that borders the west side of the San Joaquin Valley harbors most of the fault lines, including the notorious San Andreas and the Nuñez fault that was relatively unknown before it triggered the Coalinga earthquake. The geology underlying much of the Valley mutes the effects of even large earthquakes elsewhere, Wakabayashi says.

Plus, he adds, "We have the advantage of distance" from major faults. The force of seismic waves — like the sound of someone shouting — diminishes in intensity the farther it travels from the source.

The Napa quake, for example, caused nary a ripple in Fresno, where most folks soundly slept through it. And other big quakes in recent memory — Coalinga, the Bay Area's 6.9-magnitude Loma Prieta earthquake that interrupted the 1989 World Series, the 6.7-magnitude Northridge earthquake that rattled Southern California in 1994 and the Paso Robles 6.6-magnitude earthquake 11 years ago — were felt as only light shaking in most of the central San Joaquin Valley.

Since 1986, California requires cities and counties in Seismic Zone 4 to inventory all buildings constructed of unreinforced masonry — typically old brick buildings — and develop policies to minimize the risk of loss to those buildings by either retrofitting them to modern safety standards or demolishing them.

Coalinga and the western regions of Fresno County, which are in Seismic Zone 4, comply with the law, according to the Seismic Safety Commission. The rest of Fresno County and its cities, and much of the Valley, are outside Zone 4 and exempt from the law. Standard building code provisions for seismic safety still apply.

The big "what if ...?"

The low geologic probability for an earthquake to directly hit the central San Joaquin Valley doesn't mean the potential of serious damage or effects from a big earthquake — whether in the immediate area or elsewhere in California — is nonexistent.

"Although most of Fresno County is situated within an area of relatively low seismic activity, the faults and fault systems that lie along the eastern and western boundaries of Fresno County, as well as other regional faults, have the potential to produce high-magnitude quakes throughout the county," according to a countywide hazard plan prepared in 2008.

It describes the likelihood of earthquake as "occasional" and the county's vulnerability as "medium."

The plan includes a computer-generated evaluation of damage from a major, once-in-2,500-years earthquake striking Fresno County and producing significant ground shaking. In that stark planning scenario, computer models estimated that a midday temblor would result in:

Casualties: 102 deaths, 19 life-threatening injuries, 220 injuries requiring hospitalization and 1,234 injuries without need for hospitalization.

Building damage: Complete destruction of 2,276 structures, extensive damage to 7,502 buildings, moderate damage to 33,708 buildings and slight damage to 77,017 buildings.

Total building and income-related losses of \$4.82 billion, with 55% related to residential structures and 12% of loss from business interruption. More than 3,800 households would be displaced by the quake.

Transportation damage: Complete damage to 15 highway bridges, moderate damage to 111 highway bridges, moderate damage to 10 airport facilities, moderate damage to one bus facility, adding up to \$145 million in economic losses.

Essential facilities: At least moderate damage to two schools, two police stations and one fire station.

Utility damage: Moderate damage to one wastewater system, one oil system, eight electrical power systems and 25 communications systems; 5,956 water line breaks; 4,710 sewer and storm drain breaks; 5,035 natural gas breaks. Total economic losses to utility systems of \$697.5 million.

Households without electricity or water: On the day of the earthquake, about 13,199 households would be left without power and 225,091 would have no water service.

Within seven days, power would be restored to all but about 4,000 households, but water would still be out to 223,614 homes.

At the end of a month, 923 homes would remain without electricity, while almost 218,000 homes would be without water.

After three months, all but 18 households would have electricity, but water would still be out to nearly 190,000 homes.

Total economic losses from such a quake if it were to strike in the Fresno area were forecast at almost \$5.7 billion.

"Building codes throughout the state are set according to a certain level of expected shaking during a building's lifetime," Wakabayashi says. "And I would expect that the codes here are sufficient that homes and buildings are in good shape" even in the event of a massive quake — along the lines of a magnitude 7 or 8 — on the southern San Andreas.

Dams likely to be safe

Nearly as unnerving — and just as unlikely, Wakabayashi says — are the hazard plan's assessments of potential damage from the failure of one or more major dams in the mountains east of Fresno.

For most areas, a fault that has shown no evidence of movement in 11,000 years generally is considered inactive. "But for critical things like dams, they are engineered to an even higher standard," Wakabayashi says. "For dams, it's 35,000 years for a fault to be considered inactive.

"So even those little pipsqueak faults in the mountains, we wouldn't think about them as a source" for a problematic earthquake to damage dams.

Of 23 dams in Fresno County's dam-failure evacuation plan, four pose the greatest threat in the event of a catastrophic failure:

Big Dry Creek dam, with a capacity of about 30,200 acre-feet of water, potentially threatens more than 266,000 people downstream.

Pine Flat Dam, on the Kings River, can store up to 1 million acre-feet of water and would threaten a downstream population of almost 144,000 people.

Fancher Creek Dam, on Fancher and Hog creeks, holds only about 9,600 acre-feet but could threaten as many as 135,000 people downstream.

Friant Dam, on the San Joaquin River northeast of Fresno, has a capacity of about 520,500 acre-feet and potentially threatens 75,184 people downstream.

"The failure of any of these dams would cause downstream flooding and would likely result in loss of life and property," the hazard plan declares. "During winter months, when river flows are higher, the impact to the area would be much greater and evacuation times much less."

Emergency responses

Likely or not, the potential of a serious earthquake is something that local emergency officials must prepare for, says Dan Lynch, Fresno County's director of emergency medical services.

"There are two scenarios we have to look at: one if something happens here locally and a second if something happens somewhere else. We play a role in both of those."

The county's medical, ambulance, hospital, fire and police services all have emergency response plans that occasionally are practiced and exercised in the event of a catastrophic earthquake in the Fresno area.

Concerns for local hospitals are two-fold. "A hospital may remain standing, but lose power, so there's the ability of the hospital to keep its emergency generators going and for how long," Lynch says. And there are capacity issues — most local hospitals are running almost full with few empty beds, limiting their ability to handle a surge of casualties from a major quake or to relocate patients.

But Fresno County is part of a regional EMS system that includes neighboring Madera, Kings and Tulare counties. "If

we're overwhelmed, we could rapidly bring in assets like other ambulance services where needed," Lynch says.

If hospitals in the major urban centers are damaged or overwhelmed, those in the Valley could find themselves receiving the injured from those areas.

"Fresno is the casualty collection point for Los Angeles and the Bay Area," Lynch says. "If something big happens and they don't have the ability to take care of all those hurt and injured people, they would potentially put them on planes and airlift them to Fresno Yosemite International Airport, and we would collect them and disperse them to area hospitals to be taken care of."

The ability of Fresno and the Valley to come to the aid of the more quake-prone areas and its geographic and geologic insulation from the likelihood of big-quake damage elsewhere give the region a rare leg up over its more populous neighbors to the north and south, says Wakabayashi, the Fresno State professor.

"I'm originally from the Bay Area, and Fresno residents take it on the chin all the time from friends in Los Angeles and the Bay Area over our triple-digit heat in the summer and the winter fog," he says. "But on the flip side, they've got the earthquakes and we don't."

California's big quakes

Of more than 60 major (magnitude 6.0 or greater) California earthquakes reported by the U.S. Geological Survey since the early 1800s, only one — the May 1983 Coalinga earthquake — had its epicenter within Fresno County. Here is the top 10 (the list excludes earthquakes with offshore epicenters):

Magnitude/Location

Year

7.9 Fort Tejon (Parkfield)1857

7.9 San Francisco1906

7.8 Owens Valley1872

7.5 Kern County1952

7.3 Landers (Big Bear Lake area)1992

7.2 Mendocino1923

7.1 Ludlow (Mojave Desert)1999

7.1 El Centro1940

6.9 Loma Prieta (Santa Cruz)1989

6.7 Northridge1994

Other notable quakes

6.6 Paso Robles (San Simeon)2003

6.6 San Fernando (Sylmar)1971

6.4 Coalinga1983

Sources: California Department of Conservation; U.S. Geological Survey

The reporter can be reached at (559) 441-6319, tsheehan@fresnobee.com or [@TimSheehanNews](https://twitter.com/TimSheehanNews) on Twitter.

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