

# Consultants Corner

Engineering for the future



## Professional Geologic Consulting Services and the Benefits of Earthquake Fault Studies

The Earth Systems Group of Companies (Earth Systems) provide professional geologic consulting services, including fault studies, for properties located throughout seismically active California. Our services assist the land developer in identifying potential earthquake faults that may affect the proposed land development, especially relating to location of habitable or critical structures.

### What is a fault study?

Prior to site acquisition or land development, developers often retain the services of Earth Systems to provide information pertaining to the geologic constraints that may affect site development. One particular geologic hazard is surface fault rupture, which is the relative displacement of earth along a defined fault, or zone where the earth on one side of the fault moves differentially with respect to the other side in response to local tectonic forces. California is a seismically active area where numerous active faults, capable of experiencing fault rupture and earthquakes, cross the state.

Current California law prohibits the location of habitable structures over active faults. As part of our consulting services, Earth Systems provides site-specific

fault studies to evaluate the presence or absence of active faulting across a particular property. These studies are provided in general accordance with California Geological Survey's

(CGS) Note 49 — Guidelines for Evaluating the Hazard of Surface Fault Rupture.

The scope of services generally includes:

- Review of select published and unpublished geologic reports and aerial photographs of the site area.
- Subsurface exploration by trenching. Earth Systems accomplishes this by excavating backhoe or trackhoe exploratory trenches, oriented perpendicular to the suspected trend of the fault. The depth of trenching is dependent upon the complexity of the site geology and the soil and rock exposed, such that we attempt to expose soil/rock profiles in excess of 11,000 years old, where possible. CGS defines active faults as those faults with seismic activity within the last 11,000 years. Once excavation is completed and the trench considered safe to enter, our geologists enter the trench and clean off bucket smear left by the backhoe.

We then observe the exposed geologic structure, including soil profiles, soil-bedrock interfaces, discontinuities (including faults) and other visible features in the walls and bottom of the trench. Features observed are graphically logged at a scale of 1 inch = 5 feet. The trench logging is performed by,

of, a Certified Engineering Geologist, is peer reviewed internally, and our findings discussed with the agency review geologist, if possible. In some cases, Earth Systems may provide



An exploratory geologic fault trench.

additional geophysical services to assist in interpreting the subsurface geology.

A formal report summarizing the results of our services is prepared and includes graphic logs of the fault trenches, geologic maps depicting the location of the fault across the property and professional recommendations for structure setbacks, if considered warranted.

### Why do I need a fault study?

Living in California entails a number of risks related to seismicity, one of which is surface fault rupture. Surface fault rupture may occur abruptly during an earthquake or slowly due to fault creep. Displacement on a fault can be horizontal, vertical, or a combination of both, and can result in damage to roads, utilities, foundations or entire structures. The California Alquist-Priolo Earthquake Fault Zoning Act specifically prohibits the location of habitable structures across active faults.

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A previously unmapped thrust fault.



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# Fault Studies...

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The act has provided numerous fault maps that depict zones throughout the state where active faulting exists. Local agencies use these maps to assist landowners or developers during the site development process. If the property is located within a current Alquist-Priolo zone or in an area not zoned but known to have potential faulting, the agency can, at its option, require a site-specific fault study.

The purpose of the study is to define the presence of active faults across the site and assist the land developer in locating habitable or critical structures and other improvements where the faults are not active or are absent. In addition, independent reviews by a geologic consultant may warrant further study. In certain cases, a nearby fault that is not shown to cross a site may have unknown fault splays that might affect the planned site development.

The primary benefits to the land purchaser, owner or developer of a fault study include:

- Protecting the health, welfare and safety of future users of the property from the direct effects of surface fault rupture.
- Compliance with state law.
- Providing cost-effective services that help define the geologic constraints (including fault rupture) that might affect the overall site development. By doing the geology studies early in the site development process, time and effort in planning and design can be saved by avoiding concepts that ultimately have to be revised to address the site geologic hazards. Design for the geology!

## CASE STUDY: Los Altos Hills

ES Geotechnologies (ESG), an Earth Systems company, recently performed a fault study at a site in the Town of Los Altos Hills. None of the maps reviewed showed a fault trace crossing the subject site.

However, our review of select geologic literature revealed a fault trace approximately 200 feet west of the site, trending toward the site. Due to the proximity of the nearby mapped fault, the Town of Los Altos Hills required that the client have a subsurface fault study performed to evaluate the potential for active or potentially active faults within the project limits. ESG excavated trenches perpendicular to the regional northwest trend of known faults in the area. One trench revealed generally horizontal Santa Clara Formation conglomerate over near-vertical Monterey Formation siltstones. The trench exposed a sheared bedrock fault zone approximately eight feet wide.

This previously unknown fault displaced the soil-bedrock interface and ESG interpreted the feature to be at least potentially active. ESG discussed the findings with the Town of Los Altos Hills review geologist. The agency geologist requested that ESG excavate another trench to determine the orientation of the fault across the property. This subsequent trench located the fault trace and verified that the fault zone passed through the location of the proposed single-family residence. ESG recommended a 50-foot horizontal setback from both sides of the fault to mitigate the potential for surface fault rupture. The setback zone prevents construction of structures intended for permanent human habitation within a 50-foot distance from the fault.

While the client initially experienced frustration with agency requirements, ultimately the client mitigated the potential for damaging fault rupture at the originally proposed residence location. Thus, a more suitable residence location was recommended that took into consideration the geologic conditions and potential hazards of the site.

Current State of California Alquist-Priolo Earthquake Fault Zones provide an excellent resource to evaluate potential fault rupture hazards. However, recent studies performed by Earth Systems and other geotechnical consultants have revealed active and potentially active faults outside the currently delineated AP zones. Thus, the lack of mapped faults within a property does not preclude the potential need to conduct a fault study. Earth Systems can assist in determining the need to trench or perform additional studies on a project during the preliminary design stage, and help to minimize the impact of geologic constraints.

*—Christopher Cecile, Staff Geologist, and  
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