

# Fremont Earthquake Exhibit

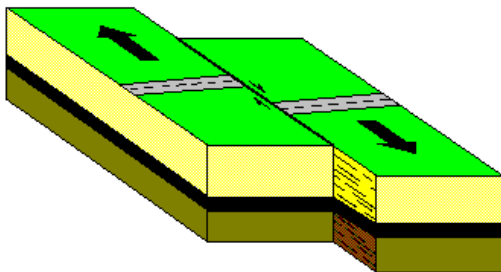
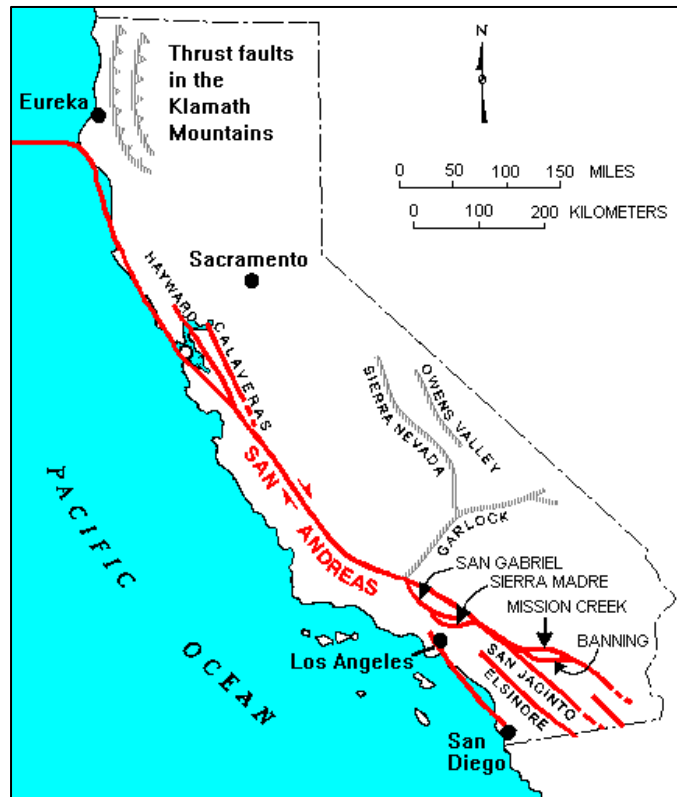
## WALKING TOUR of the HAYWARD FAULT

*(Tule Ponds at Tyson Lagoon to Stivers Lagoon)*

### BACKGROUND INFORMATION

The Hayward Fault is part of the San Andreas Fault system that dominates the landforms of coastal California. The motion between the North American Plate (southeastern) and the Pacific Plate (northwestern) create stress that releases energy along the San Andreas Fault system. Although the Hayward Fault is not on the boundary of plate motion, the motion is still relative and follows the general relative motion as the San Andreas.

The Hayward Fault is 40 miles long and about 8 miles deep and trends along the east side of San Francisco Bay. North to south, it runs from just west of Pinole Point on the south shore of San Pablo Bay and through Berkeley (just under the western rim of the University of California's football stadium). The Berkeley Hills were probably formed by an upward movement along the fault. In Oakland the Hayward Fault follows Highway 580 and includes Lake Temescal. North of Fremont's Niles District, the fault runs along the base of the hills that rise abruptly from the valley floor. In Fremont the fault runs within a wide fault zone. Around Tule Ponds at Tyson Lagoon the fault splits into two traces and continues in a downwarped area and turns back into one trace south of Stivers Lagoon. When a fault takes a "side step" it creates pull-apart depressions and compression ridges which can be seen in this area. Southward, the fault lies between the



from the valley floor. In Fremont the fault runs within a wide fault zone. Around Tule Ponds at Tyson Lagoon the fault splits into two traces and continues in a downwarped area and turns back into one trace south of Stivers Lagoon. When a fault takes a "side step" it creates pull-apart depressions and compression ridges which can be seen in this area. Southward, the fault lies between the

lowest, most westerly ridge of the Diablo Range and the main mountain ridge to the east. Coyote reservoir, Leroy Anderson reservoir, and San Felipe Lake all lie on the fault. It joins the San Andreas Fault near Hollister.

### 1868 "Great Earthquake"

October 21, 1868 was a day that people in the East Bay would not forget for a long time. At 7:53 am a very large earthquake shook the San Francisco Bay area. The energy released was so great it had surface rupture from Berkeley to Fremont. The estimated right lateral strike slip motion for the event is up to 1.9 meters (about 6.5 feet) on the Hayward Fault. The magnitude of the earthquake is projected to be between a 6.9-7 on the Richter Scale (this scale was not invented until 1930) so this is a projected magnitude. The epicenter was in what is now Castro Valley (Cull Canyon).



***From the "San Francisco Morning Call"***

Thursday, October 22, 1868

### THE JAIL SHAKEN DOWN—FATALITY.

At San Leandro the shock was more sensibly felt than at any other point on that side of the Bay. All the buildings there were terribly shaken, adobes were tumbled to the ground, brick structures, and even frame buildings were demolished. The Court House and County Jail were shaken down. The prisoners were in the cells, in the basement, and when the building fell, the scene which follows may be better imagined than described. Many of the prisoners rent the air with their cries for help, while the others were engaged in prayer, calling on the Almighty to save them from the peril which surrounded them. The keys of the cells, which were in the safe, were after some trouble gotten out, and the prisoners were rescued and taken to the Calaboose in Oakland. Mr. J.W. Jossely, Deputy Clerk, was in the

Court room at the time of the shock, and before he could make this escape the building fell, and he was buried amidst the ruins.

Back of San Leandro, in one of the canyons, the ground opened for a distance of over two miles. In some places the fissure is eight feet wide. When the ground opened, an immense cloud of smoke arose, which was followed by water gushing up through the fissure.

San Leandro Creek, which for some time past had been dry, now has a foot and a half of water in it.

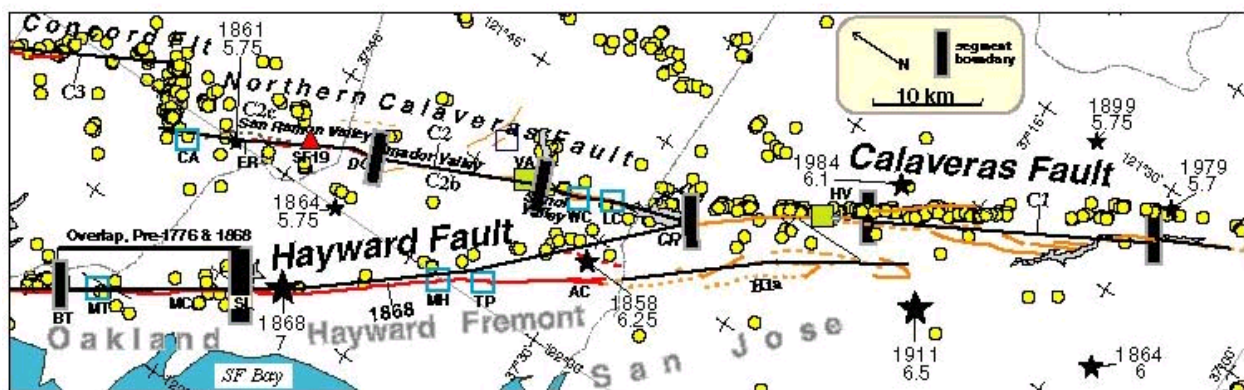
In and about San Leandro a number of buildings were damaged.

CENTREVILLE, October 21.—The store of C.J. Stones was utterly destroyed to-day, and goods badly damaged. Store of J. Salez badly shaken and goods damaged very much. Dr. Selfridge's house partly destroyed and child injured.

Banker's Hotel settled about two feet and badly damaged. At the Mission San Jose, the Church and many other buildings are in ruins. At Alvarado, the brick house of A. J. Lattin entirely destroyed, and the store of J. J. Sacks damaged, with great loss of goods. No lives lost at either place.

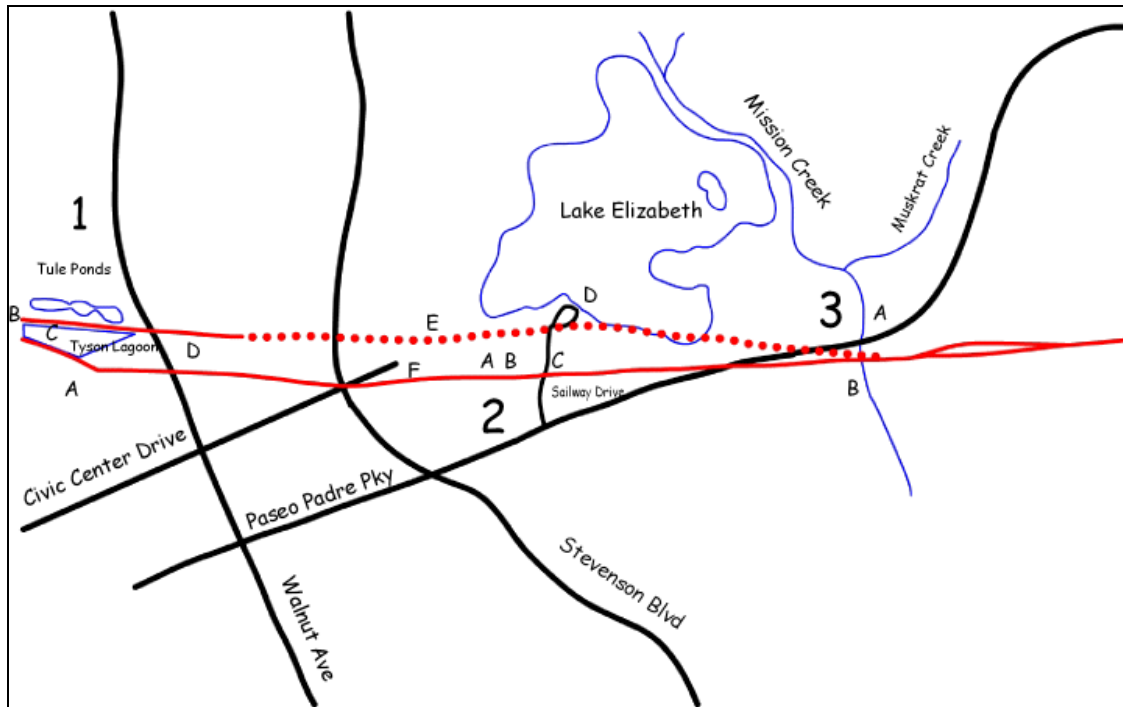


*Building in San Leandro collapses after 1868 earthquake*



*Epicenters (historical) of earthquakes along the Hayward and Calaveras fault*

# WALKING TOUR FROM TULE PONDS AT TYSON LAGOON TO STIVERS LAGOON



## 1. TULE PONDS AT TYSON LAGOON

### BACKGROUND

Tule Ponds at Tyson Lagoon is a 17 acre wetland-based storm water treatment system in Fremont. The area is owned by Alameda County Flood Control and Conservation District and managed by the Math Science Nucleus. The 3 Tule ponds were excavated in a seasonal water-filled depression on the east side of Tyson Lagoon. The ponds are connected by a channel and designed to filter water as it flows from the urban watershed that drains into the ponds. Tyson Lagoon is a “sag pond” that has breached the water table creating a permanent lake.

Tyson Lagoon has been a site of fresh water for at least the last 3700 years (Lienkaemper, et al, 2002). This sag pond outlines the trace of the Hayward fault zone in this area. Looking at brittle deformation and liquefaction features in trenches just north of this area, Williams (1993) concluded there may have been 6-8 large earthquakes during the last 2000 years. Lienkaemper, et al, with new data concluded that since late 1300's there were probably 4 large earthquakes (of magnitude 6.8-7.0). In trenches in the South Pond they found evidence of the 1868 earthquake. The earthquake destroyed most of the Mission Adobe structure

and devastated the homes of many of the residents. Using detailed stratigraphy and carbon dating they arrived at dates of 1730, 1630, and 1470 ( $\pm 90$  years) for the other earthquake occurrences.



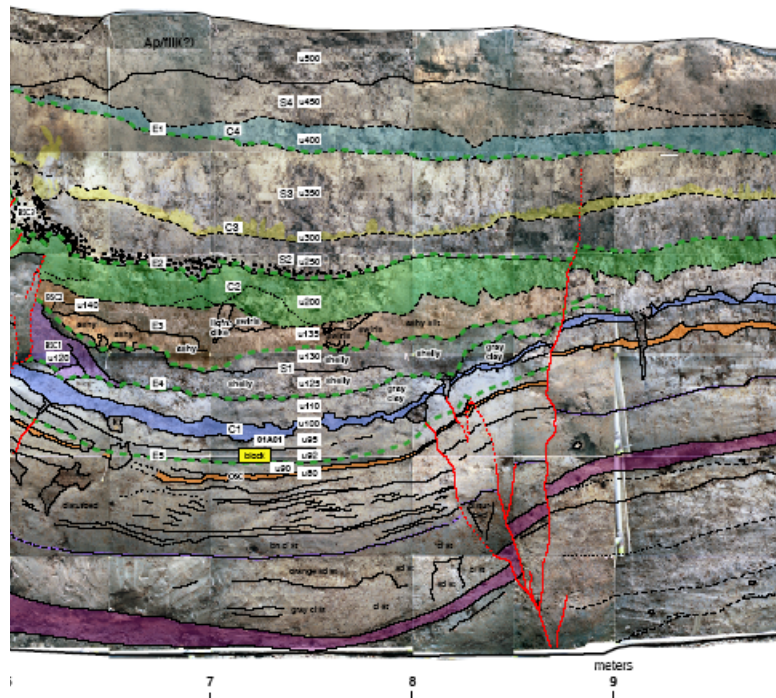
*Trench in South Tule*

Detailed trenching in the south pond of Tyson Lagoon by the U.S. Geological Survey have identified other earthquakes that occurred in the past. They use data derived from trench logs, radiocarbon, pollen, and detailed sedimentological data. The trenching has exposed typical pond sediments, including well-bedded deposits of silty clay, interbedded with organic layers including shell hashes, and slightly coarser, less organic silts to sandy silts. The composition and structure of the deposits indicate a rapidly subsiding, shallow aquatic environment that was subject to seasonal drying. Evidence of creeping along the fault has been calculated with an average slip rate of  $9 \pm 2$  mm/yr (Leinkaemper and Borchardt, 1996)

From these studies other information on the environment can be derived. The first nonnative pollen of *Erodium cicutarium* (red-stemmed

filaree) probably coincides with the arrival of Spanish in 1776 (Mensing and Byrne, 1998). Sharp contact and layers of shells in sediments deeper than 3.5 meters imply a larger body of standing water than present.

Tyson Lagoon today is about 100 meters wide, 300 meters long, and 2 meters deep. During the rainy season the surface area doubles in size from 3 to 6 acres with a depth of 3 meters. It drains approximately 40 percent of the Mowry Slough watershed. The lagoon is classified as a permanent



*Stratigraphic evidence from the trench walls*

warm water sag pond (F1212) by the California Department of Fish and Game. A sag pond is caused by a depression caused by faulting. Tyson Lagoon lies on the Hayward fault and breaches the water table causing a permanent lake.

A small patch of undeveloped land located just east of the Fremont BART (Bay Area Rapid Transit) station, receives the run off of approximately seven hundred acres. In the 1950's it was modified by Alameda County Public Works to serve as flood control for this lowland area. In the 1960's further modification was done because of the addition of the BART station. In 1998, the lagoon was modified as a constructed wetlands to help clean water run off before it goes into the San Francisco Bay.

## **EVIDENCE YOU WILL SEE**

### **A. Uplift near BART Trail**

You can walk along BART Trail that parallels the road going into the BART Parking lot. As you come to the seasonal wetland you can see a ridge that looks like a mount of soil. This uplifted area traces the Hayward Fault in this area. You can walk up to the top of the stairs and you are standing on the trace of the Hayward Fault that will continue to the Fremont Earthquake Exhibit in Central Park.



### **B. Two traces of Hayward Fault meet**

Continue walking on the trail until you come to the Butterfly Meadow (Station 4). As you admire all the flowers and landscaping to help bring back native butterflies and hummingbirds, notice the fence outlines the two traces of the Hayward Fault. It joins into one trace at the apex and continues as one trace north toward Hayward.



### **C. Walk on the second trace of Hayward Fault**

As you walk back toward the classroom you will notice another trail, which we refer to as Fault Trail. This trail is part of the second trace that also travels toward Lake Elizabeth. This trace is current not actively showing fault creep.



### **D. Depression due to Hayward Fault in South Tyson Lagoon**

South Tyson Lagoon was once part of a larger lake but is now just a seasonal wetland. This area has been the site of intense trenching to better understand the history of the Hayward Fault as preserved in lake sediments. Stratigraphic information is key in understanding the events.



## 2. FREMONT EARTHQUAKE EXHIBIT

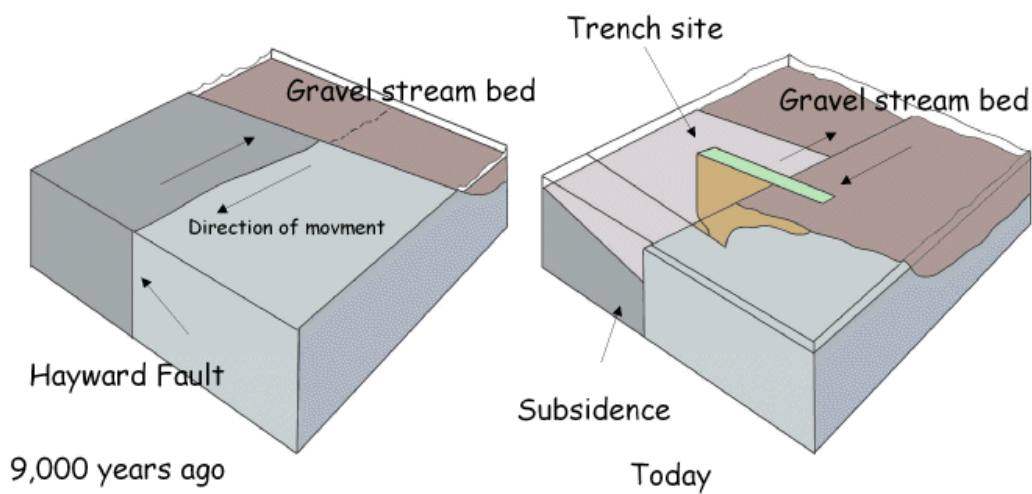
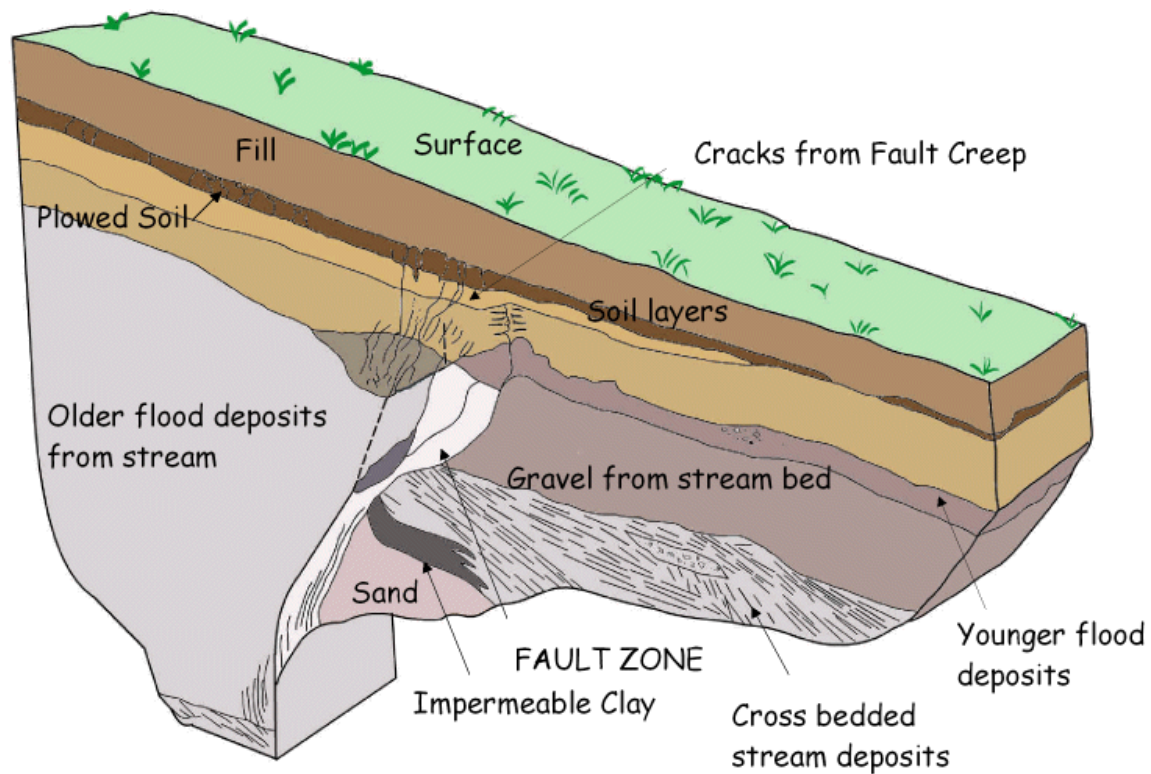
- note: The trench is no longer available for view, but you can see a virtual representation on the <http://msnucleus.org/haywardfault/index.htm>

The site of the Fremont Earthquake Exhibit was chosen to allow the public to view subsurface evidence of the Hayward Fault. It was trenched in 1987 by Dr. Glenn Bochart of the California Department of Conservation (now California Geologic Survey), under contract from the U.S. Geological Survey. Several important studies came from the initial trenching to help scientists understand the movement of the Hayward Fault in this area.

Drs David Schwartz and Mary Lou Zoback, of the U.S. Geological Survey felt that this site would be ideal for public viewing. The 1906 Centennial Alliance (commemorating the 100<sup>th</sup> year since the 1906 San Francisco Earthquake) found funds to create the exhibit. In June, the Math Science Nucleus became managers of the exhibit and are developing plans for a permanent exhibit.



*A view from the surface of the Fremont Earthquake Exhibit. People can walk up to the Hayward Fault and observe the offset.*

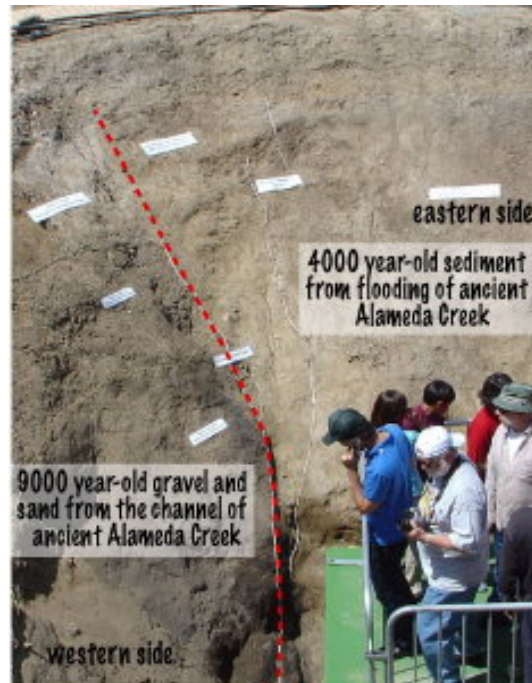


*This graphic shows the overall geology of the trench at the Fremont Earthquake Exhibit. It shows the different sediment that was deposited and moved an estimated 150 feet over the last 9000 years. In the exhibit you are viewing the area identified as "Fault Zone." Adapted from San Jose Mercury article (12/26/89)*

## A. Fremont Earthquake Exhibit (pit)

To the west of the fault the sediment is dark in color, gravelly and sandy, and has visible layers (these are the 9000 year-old creek bed for ancient Alameda Creek. To the east of the fault the sediment is tan, and has little gravel or visible layers (these are flood sediments from Alameda Creek 4000 years ago). They are different because due to fault movement, two parts of the earth from different areas have been brought next to each other.

The land on the western side of the fault is sliding north and the eastern side is sliding south. The fault is where the sliding takes place, both during earthquakes and during fault creep.



## B. Teen Center Parking Lot

In the parking lot you can see visual evidence of active fault creep. In the first area you can see the curbs offset. In this area active creep has been calculated at about 5 mm/yr. In other places along the Hayward fault they have calculated a movement of 9 mm/yr. You can also see evidence of “en echelon” (parallel) faulting caused by compression along boundaries of opposite motion.



*Offset curbs*

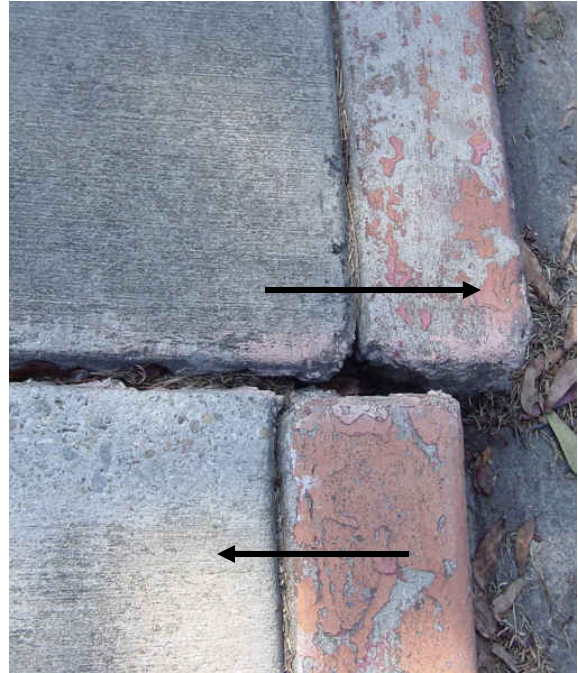
C.



*En echelon fault pattern seen in the asphalt*

### Sailway Drive Offset

Walk from the teen parking lot to Sailway Drive. Walk on the south side of street and walk toward Paseo Padre Parkway. Stop when you see this offset. This shows movement that occurred in the last 50 years. Also notice that the slab of cement has been shaved. This may indicate some level of uplift in the area.



### D. Lake Elizabeth (Boathouse)

In the 1960's the Alameda County Flood Control and Conservation District build a larger permanent body of water, Lake Elizabeth, to control storm waters to prevent flooding in the lowlands. Once you get to the boathouse you have walked over the second trace of the Hayward Fault. There is no evidence of creeping on this trace.

Walk north from Lake Elizabeth toward a raised area called the 'Knoll.'

### E and F. Knoll

This is the site of the old City Hall which was demolished in 2004. All that remains is the parking lot. The two traces of the Hayward fault dissect this area. Toward the west is the active trace that you saw in the trench area. The knoll is caused by compression due to the opposite movement along the boundary.



*Eastern portion of Knoll*



*Western portion of knoll*

### 3. STIVERS LAGOON

The third area to observe surface features of the fault is near Stivers Lagoon. The original lagoon was approximately 200 acres in size. The area had an open lake as well as a fresh water marsh. As this area became more populated this natural waterway was changed. Areas of the original lake and marsh were filled causing the flow of water to change to conform to the growing community.

Prior to the massive population boom in Fremont, the marsh was probably deep enough for boating and swimming. In 1776 an explorer described the lake as being "somewhat salty," pointing to a possibility of salt intrusion from the San Francisco Bay. It was described as a green and flower-covered route to the bay waters



*Aerial photograph of Stivers Lagoon in 1965 before Lake Elizabeth was created by Alameda Flood Control and Conservation District.*

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The marsh area at Stivers Lagoon was deeper in the late 1800's than it is presently. The main tributaries included Mission Creek and Morrison Creek, which drained from the hills. The groundwater table was much higher than it is today, helping to maintain surface water all year. An account by early settlers claimed that, "you could dig 15 feet down and come up with a substantial well."

Tules that grew in the pond bordering the Stivers/Marshall property were originally used by Native Americans to build boats, homes and other essential items. Later in the 1860's they were harvested and sold to local nurseries for packing their plants and trees for shipping. The tule ponds which bordered the Stivers and Marshall's property provided an area for birds to feed and roost.

F. M. Smith, a contractor from Oakland, attempted to establish a gun club in 1883 at the pond; unfortunately, there was not enough wildlife for the members to hunt. Thus the club moved a few years later to Coyote Hills. Sometime in the

1890's a levee was constructed to restrict the amount of water flowing into the lagoon. As a result the marsh could not maintain surface water, throughout the year. In the 1930's there was a movement, initiated by land owners, to limit flooding of the area caused by the natural watershed. This led to the channelization of Mission Creek. At the same time Hetch Hetchy, a San Francisco water aqueduct funded by the City of San Francisco, was being constructed through the area; this caused further drying of the marsh.

In 1956, the year Fremont was incorporated, Simeon Stivers' granddaughter sold part of the undeveloped land to Alameda County Flood Control. They in turn leased the land to the newly incorporated City of Fremont for use as a nature area in Central Park.

### **A. Stivers Lagoon**

Stivers Lagoon was created by a depression along the Hayward Fault Zone. Water from Mission Creek flowed into this area and created a permanent lake, which flooded during the rainy season. In the 1960's the Alameda County Flood Control and Conservation District build a larger permanent body of water, Lake Elizabeth, to control storm waters to prevent flooding in the lowlands.



### **B. Paseo Padre Uplift**

Looking across the street from Stivers Lagoon you can notice that the land rises. This knoll is a compression ridge caused by motion along the Hayward Fault.





## FREMONT EARTHQUAKE EXHIBIT

*Managed by the Math Science Nucleus, a non-profit organization serving  
education since 1982  
in collaboration with City of Fremont and  
U.S. Geological Survey*



*Math Science Nucleus*

4074 Eggers Drive  
Fremont, CA 94536  
(510)790-6284  
earthquake@msnucleus.org  
<http://msnucleus.org>

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