On Shaky Ground

LIVING WITH EARTHQUAKES ON THE NORTH COAST

Collage of newspaper headlines from historic North Coast Earthquakes.

ARE YOU PREPARED?

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By taking action now, we can drastically reduce future earthquake losses.

American Red Cross · U.S. Department of the Interior Geological Survey · OES California Office of Emergency Services · Humboldt State University

For additional copies, write to:
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HUMBOLDT STATE UNIVERSITY
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Living with Earthquakes: A Fact of Life on the North Coast

The Role of Government in Disaster Response

A disaster can overwhelm local law enforcement, fire, and emergency medical personnel and resources. If transportation and communication channels are damaged, getting help may take hours or days. When a city cannot adequately meet demands for help, it requests assistance from neighboring cities and/or the county. If the county cannot adequately assist, the request is passed on to the State of California Office of Emergency Services (OES). Finally, if state resources are insufficient, the Governor can ask the President to declare the county(ies) a Major Disaster Area and release federal assistance.

What does this mean to us when a major earthquake hits the North Coast? Even under the best of circumstances, medical aid or fire and law enforcement officials may be unable to reach you immediately, particularly if you live in a remote area. The State Office of Emergency Services recommends that all individuals, families, schools, and businesses prepare adequate resources to "be on their own" for a minimum of 72 hours. In more remote areas of the North Coast, help may take even longer.

You can help yourself and your community by preparing for those first crucial hours. Government resources may be on the way, but often the efforts of individuals and neighborhoods immediately after an earthquake save lives and determine how quickly the community will recover.

Many of us were shaken on April 25th and 26th, 1992, when a series of three strong earthquakes struck the Cape Mendocino area. Although our region suffered much damage, no people were killed and few were seriously injured. As bad as it was, we survived. So why worry about another earthquake soon?

The April earthquakes were the most recent chapter in a long history of damaging earthquakes that have struck the North Coast. The unique geologic setting of northwestern California makes it one of the most earthquake-prone areas in the United States. The North Coast is subject to damage from a number of different kinds of earthquakes: earthquakes centered offshore to the west under the Pacific Ocean, onshore beneath the coast, and to the south along the San Andreas fault. Recent studies suggest that the North Coast may also be at risk of very large earthquakes originating along the Cascadia subduction zone.

The April earthquakes were centered in the remote area of Cape Mendocino. The next large earthquake may strike a more densely populated region, affecting more people and causing greater damage. Fortunately we can prepare for earthquakes. By taking actions such as those described in this booklet, we can drastically reduce the loss of life and property, and make the North Coast a safer place.

Certain kinds of ground and certain kinds of buildings have higher potential for earthquake damage. By becoming informed, we can learn to protect ourselves and our families during and after the next earthquake.

We do not know when another damaging earthquake will happen, but we do know one will. Actions you take now can protect you and your family.

. . . . . The choice is yours

- **Use flashlights or battery powered lanterns; do not smoke or use lighters and candles until you are sure there are no gas leaks.**
- **Use your telephone only in the event of life-threatening emergencies.**
- **Turn on your portable radio for information, damage reports, and for information on volunteering your assistance.**
- **Keep streets clear for emergency vehicles. Cooperate with public safety officials.**

When an earthquake strikes:

WHAT TO DO DURING AN EARTHQUAKE:

The California Office of Emergency Services recommends

1. If you are indoors, *duck* or drop down to the floor. Take *cover* under a sturdy desk, table or other furniture. *Hold* on to it and be prepared to move with it. Hold the position until the ground stops shaking and it is safe to move. Stay clear of windows, fireplaces, wood stoves, and heavy furniture or appliances. *Stay inside.* Outside, you may be injured by falling glass or building parts. ***If you are in a crowded area, take cover and stay where you are. Stay calm and encourage others to do likewise.***

2. If you are outside, get into the *open,* away from buildings and power lines.

3. If you are driving, *stop* if it is safe, but stay inside your car. Stay away from bridges, overpasses and tunnels. Move your car as far out of the normal traffic pattern as possible. If possible, avoid stopping under trees, light posts, power lines or signs.

4. If you are in a mountainous area, or near unstable slopes or cliffs, be alert for falling rock and other debris that could be loosened by the earthquake.

5. If you are at the beach, move to higher ground.

WHAT TO DO AFTER AN EARTHQUAKE:

1. Check for injuries. Do not move a seriously injured person unless they are in immediate danger of further injuries.

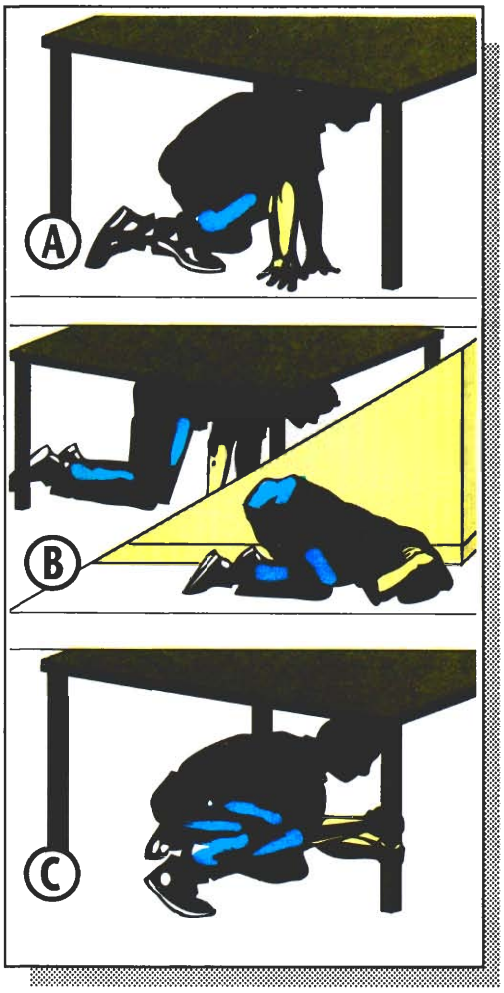
2. Check for hazards.

- *Fire or fire hazards.*
- *Gas leaks.* Shut off the main gas valve only if a leak is suspected or identified by the odor of natural gas. Wait for the gas company to turn it back on once the damage is repaired.
- *Damaged electrical wiring.* Shut off power at the control box.
- *Downed or damaged utility lines.* Stay away from downed lines, even if power appears to be off.
- *Fallen objects in closets and cupboards.* Displaced objects may fall when you open the door.
- *Downed or damaged chimneys.* Approach chimneys with caution. They may be weakened and could topple during an aftershock.
- *Your telephone.* Make sure each phone is on its receiver. Telephones off the hook tie up the telephone network unnecessarily.

3. Clean up. Potentially harmful materials and/or medicines may have spilled.

4. Anticipate tsunamis. If you live along the coast, be alert for news of tsunami warnings issued by the federal government's Tsunami Warning Center. *If an earthquake is centered nearby, there will not be time to issue a warning.* If you experience a strong earthquake that lasts a very long time, move to higher ground or go to the upper floors of a building as soon as you are able and stay there until the authorities issue an "all clear".*

5. Expect aftershocks. Most of these are smaller than the main earthquake. Some may be large enough to do additional damage to weakened structures



(A) DUCK; (B) COVER; (C) HOLD.

*** The exact nature of the tsunami hazard on the North Coast is not known at present and is currently being studied by the National Oceanographic and Atmospheric Administration. Recommendations on areas most at risk and how best to respond will be issued when these studies are completed.**

Pick one or more "safety spots" in each room of your home. Make a list and discuss them.

What To Do Right Now To Prepare:

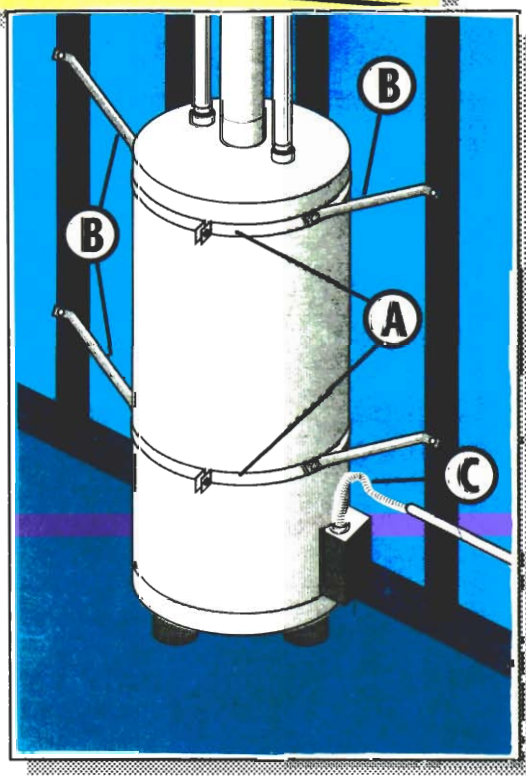
Emergency Public Information Following A Disaster

We have come to expect instant news and near-instant analysis. But when a disaster strikes at home, it is unrealistic to expect distant media far from the scene, or the local media (who are also affected by the disaster), to provide accurate, instantaneous reporting.

The first information about a large local earthquake may come from major media outside of the North Coast area. These reports typically give the earthquake location and magnitude determined by the National Earthquake Information Center, a branch of the U.S Geological Survey in Golden Colorado. The initial estimates are based on the analysis of only a few seismographs and both location and magnitude are likely to be revised as more information is analyzed.

Initial reports of damage, based primarily on "eye witness" reports, may be misleading and lead to speculation. Local news gathering capabilities may be severely hampered by the disaster - the news media's power may be off or their news staff may be unable to communicate with the station.

News dissemination after a disaster takes time and can prove frustrating when we want immediate, complete information. Search the radio and television dial to find stations which are able to give information. But remember, initial reports may be inaccurate. Don't believe everything you hear. Pay particular attention to information from a governmental source.



PROTECT YOURSELF

1. Practice "duck, cover, and hold" drills at home with your family and at work.

Injuries and deaths during earthquakes are caused by falling objects and collapsing structures. Show children safe areas to duck and cover. Practice counting how many seconds your 'test earthquake' lasts. This will help you keep calm when a real earthquake strikes.

2. Develop an earthquake plan.

If an earthquake hits during the day, family members may be separated for hours or even days. Your local chapter of the American Red Cross can help you develop a plan at home, at work, and in your neighborhood. A family plan should include:

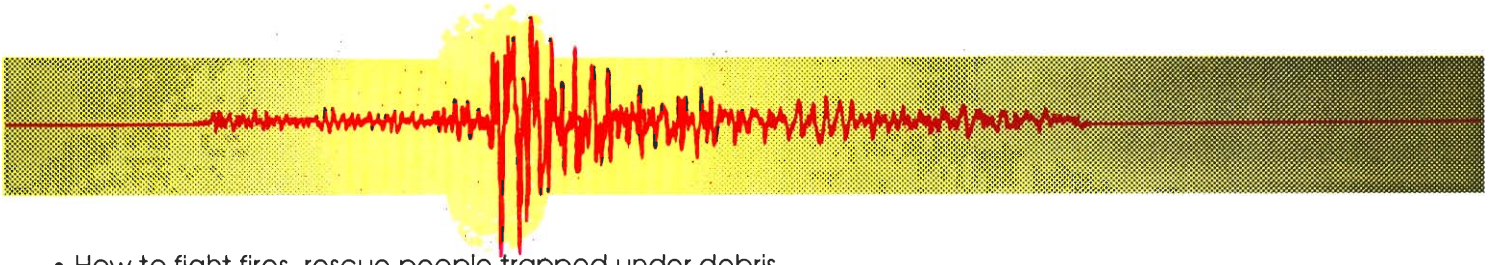
- A safe place where your family can reunite after the earthquake. Transportation may be disrupted. Select alternate meeting places near work or schools.
- Designation of an out-of-the-area telephone contact. Completing local telephone calls may be difficult. It will probably be easier to telephone someone out of the earthquake area. Select a relative or friend to act as a clearing house for information about your family. All family members should call this contact to report their condition and location. Make sure family members carry this number with them at all times. Other friends and relatives should know this number too.
- Discuss the plan with all family members. Discuss with children what will happen to them if an earthquake occurs while they are at school.

3. Know the following:

- What to do during and after an earthquake (page 3 of this booklet).
- The safest places in your home. They should be away from heavy furniture or appliances, wood stoves, fireplaces, and large panes of glass, pictures, or mirrors.
- Where your gas, electric, and water main shutoffs are and how to turn each off. Now is the time to buy a special wrench that fits your gas turnoff valve and to fasten it next to the valve. Remember, turn off the utilities only if you suspect the lines are damaged, if you smell gas, or if you are instructed to do so. *If you turn the gas off, you must contact your utility company to turn it back on.*

WATER HEATER

Wrap a 1-1/2-inch-wide, 16-gauge-thick metal strap (A) around the top of the water heater and bolt the ends together. Do the same about 1/3 of the way up the side of the water heater. Take four lengths of EMT electrical conduit, each no longer than 30 inches. Flatten the ends. Bolt one end to the metal strap as shown (B). Screw the other end to a 2-inch by 4-inch stud in the wall using a 5/16-inch by 3-inch lag screw. Be sure a flexible pipe (C) is used to contact the gas supply to the heater.



- How to fight fires, rescue people trapped under debris, provide first aid, find help for dire emergencies, and assist others, especially the fragile elderly or disabled. Ask your local American Red Cross office or County Mental Health Department for more information.
- The policy of your local school concerning release of children after an earthquake. Arrange with neighbors to watch out for your family and property in case you are not home.

Make plans with your family, your neighbors, and your co-workers. Every business should have an emergency response plan. Contact your American Red Cross chapter about developing a Neighborhood Emergency Service Team (N.E.S.T.) within your neighborhood, schools, and work place.

4. Store emergency supplies.

- After a major earthquake, medical aid, transportation, water, electricity, and communication may be unavailable or severely restricted for days or weeks. Be prepared to take care of yourself, your family, and your neighbors for at least three days— longer if you live in a remote area.
- At home, at work, and in your car, store flashlights, batteries, an A-B-C– rated fire extinguisher, a battery-operated radio, a first-aid kit and handbook, at least one gallon of water per person per day, food, warm clothes, sturdy shoes, gloves, and a fresh supply of any medications you and your family members may need.
- Make sure emergency supplies are located in a safe and readily available place.
- Make sure everyone in your family knows where these supplies are and how to use them.
- Take a course in first aid from your local chapter of the American Red Cross.
- Include pets in your planning. Plan for their food and water supplies for at least three days. Make arrangements with a neighbor to care for your pet in the event you are unable to get home.

5. Find Out More.

- Look at the first aid and survival guide in the introductory pages of your telephone book.
- Go to your local library. Ask the librarian for reference materials listed on pages 21-23 of this booklet.
- Ask your city or county Office of Emergency Services or your local American Red Cross for pamphlets on preparedness and survival. Invite a speaker to talk to your club or organization about earthquake preparedness. Many of the organizations listed on page 21provide speakers for groups of people when staff are available.

The N.E.S.T. Program

The Neighborhood Emergency Service Team (N.E.S.T.) is designed to help households, neighborhoods, rural communities, members of organizations and employees of businesses prepare for the effects of a disaster. Each neighborhood or group is led by a N.E.S.T. Captain. The members of the group are formed into several committees specifically trained and responsible for certain tasks.

A N.E.S.T. is comprised exclusively of volunteers working at the neighborhood level who are willing to protect their families and neighbors in times of disaster. The program helps a group to:

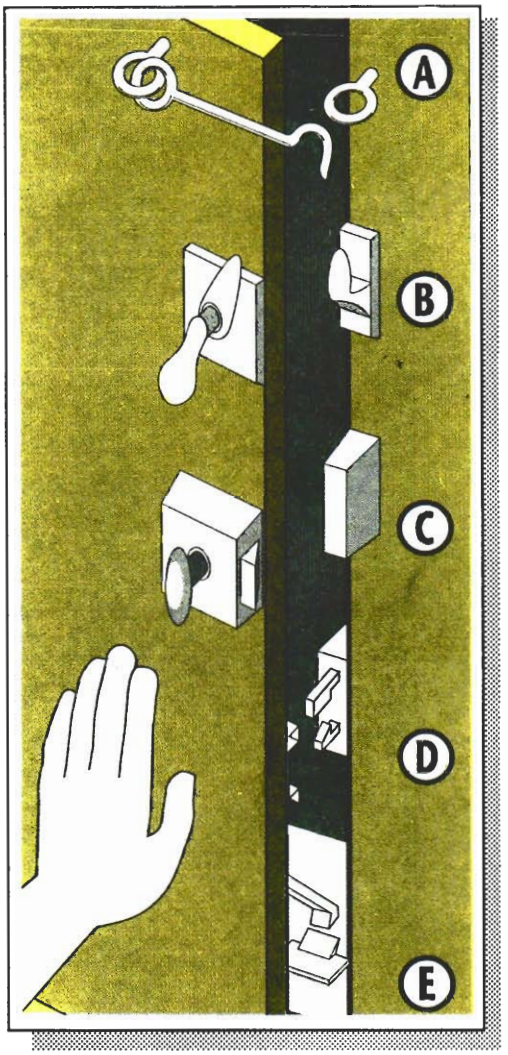
- Become informed about the potential earthquake threat.
- Anticipate and meet disaster needs.
- Identify neighborhood resources.
- Identify possible existing hazards.
- Pre-assign responsibilities for constructive action after an earthquake.
- Acquire necessary supplies and equipment.
- Prepare family emergency plans.
- Arrange training in first aid, CPR, emergency actions and alternate plans.
- Conduct emergency drills.
- Maintain an ongoing preparedness program, review and repeat steps every year.
- Take special local circumstances into consideration.

The N.E.S.T. program has positive side effects. Not only does the program prepare a neighborhood to survive disasters, it strengthens ties between its members. You will enjoy peace of mind knowing that you and your family are not alone when an earthquake or other disaster strikes.

If you live in Humboldt County and are interested in organizing a N.E.S.T. in your neighborhood, or would like more information, contact the Humboldt County American Red Cross: (707) 443-4521. If you live elsewhere, contact your local American Red Cross Chapter or your county Office of Emergency Services to see if they are interested in developing a N.E.S.T. program in your area.

Pick a place to meet after the shaking stops.

What To Do Right Now To Prepare:



LATCHES

For many residents of the North Coast, a large financial loss will come if the doors of kitchen cabinets are shaken open, throwing contents to the floor. A few dollars spent now can prevent most of that loss.

In choosing a latch, consider looks and ease of use. The standard hook and eye (A) is an inexpensive and secure latch, but you may not close it every time you enter the cabinet because it takes extra effort to do so. A child-proof catch (E) prevents a door from opening more than an inch or two. These catches close automatically, but they require an extra action every time you open the door.

Some standard types of secure latches mount on the surface of the door (B, C). Latches are available that mount inside the door (D), hold the door firmly shut, and open by being pushed gently inward. These are marketed under names such as push latch, touch latch, or pressure catch. If you cannot find these latches, ask your hardware dealer to order them for you.

Protect Your Belongings

Falling objects and toppling furniture can be dangerous and expensive to replace or repair.

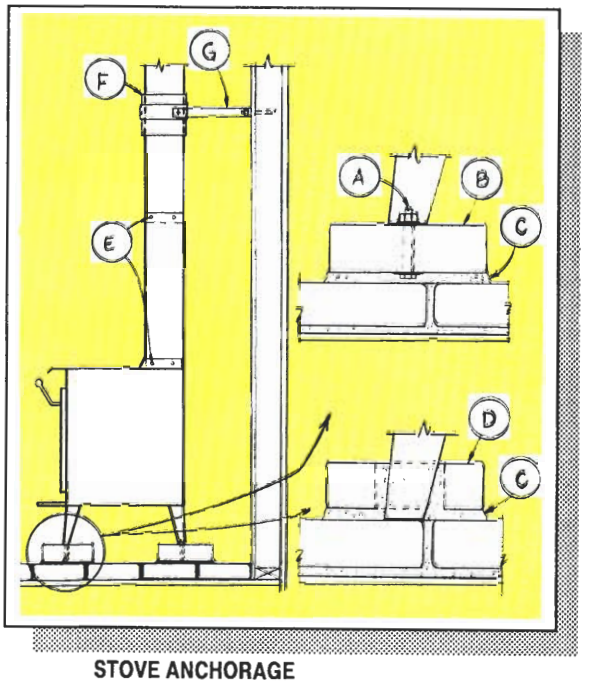
- Move heavy items, such as pictures, mirrors or tall dressers, away from your bed.
- Secure tall furniture and bookcases with lag bolts to wall studs. Add lips to shelves to prevent costly items from sliding off. Be sure adjustable shelves cannot slide off their supports.
- Put latches on cabinet doors, especially at home in your kitchen and at work or school laboratories.
- Fasten heavy or precious items to shelves or tables. Secure file cabinets, computers, televisions and machinery that may overturn during an earthquake.
- Store potentially hazardous materials such as cleaners, fertilizers, chemicals, and petroleum products in appropriate containers and in sturdy cabinets fastened to the wall or floor.
- In your office, be sure heavy objects are fastened to the building structure and not just to a movable wall. Ask a carpenter or an electrician to determine whether light fixtures and modular ceiling systems are securely fastened.
- Be sure your water heater is fastened to the wall studs and that all gas heaters and appliances are connected to the gas pipe through flexible tubing. If you use propane gas, be sure the storage tank is secured against overturning and sliding.
- Secure your wood stove to wall or floor studs. Make sure you have a fire extinguisher close at hand.
- Check with your school officials to be sure they have taken similar precautions.

WOOD BURNING STOVES

Free-standing wood burning stoves pose an additional risk in an earthquake to residents on the North Coast. A Humboldt State University survey found that over half the wood stoves in the area near the epicenter moved during the April , 1992, earthquakes, and several fell over. Heavy objects such as stoves are actually more likely to move during strong ground shaking than lighter objects. Fire codes leave the stoves unsupported on all four sides and vulnerable to sliding or overturning in an earthquake. If the stove were to tip and/or separate from the stove pipe, cinders or sparks might easily cause a fire in the home.

In order to reduce the potential fire hazard following an earthquake, the stove should be anchored to the floor and stove pipe sections secured. It is important that the seismic anchors or braces do not conduct heat from the stove. Although there are many types of stoves in use, the following recommendations can be used for common installations:

- Stoves resting on a brick hearth can be anchored using bricks and mortar.
- Mobilehome approved units come with predrilled holes in the pedestals or legs and can be safely anchored to the underlying floor framing.
- Those resting on a concrete slab on grade can be anchored directly to the concrete.
- Stovepipe should be anchored to the flue exit and each of the stove pipe segments should be securely together.



STOVE ANCHORAGE

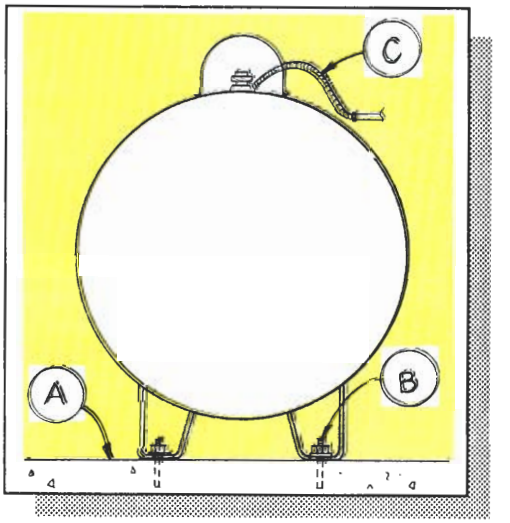
For stove on a brick hearth, anchor stove with 3/8-inch diameter bolt (A) through 1/2-inch hole to new brick (B). Grout brick to existing hearth with 1-inch new grout (C). Alternatively, build 8-inch square brick pad with grout pocket (D) at each leg. Provide at least 1-inch grout all around leg, fill pocket completely with grout. Provide sheet metal screws (E) at flue exit and between stovepipe sections. Provide radiation shield with pipe clamp (F) braced to wall using two Simpson WTT187 tension ties or equivalent (G) attached to wall stud with 3/8-inch by 3-inch lag screws.

PROPANE TANKS

Many residents of the North Coast have above-ground propane tanks. These tanks may move, slide or topple during heavy ground shaking and are potentially damaging unless both the tank and the piping are properly secured. Gas leaks are frequently the cause of earthquake related fires. The following recommendations can be used to reduce the post-earthquake fire hazard associated with propane tanks.

- Mount the tank on a continuous concrete pad and bolt the 4 legs to the pad.
- Install flexible hose connection between tank, supply line and entrance to home.
- Clear area of tall or heavy objects which can fall and rupture tank or supply line.
- Keep a wrench tied on a cord near the shut-off valve and make sure family members know how to use it.
- For large tanks (i.e. farm or commercial use) seismic shut-off valves are available.

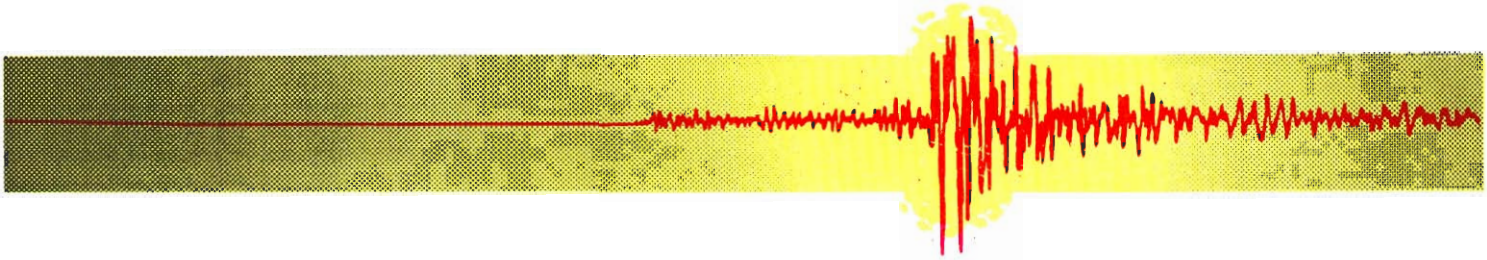
For more information on how to use these tips or for configurations other than ones discussed above, consult your stove or propane vendor, local OES and/or local fire department. Make sure you have a fire extinguisher easily accessible and that all family members know how to use it.



PROPANE TANK ANCHORAGE

Mount tank on 6-inch thick concrete pad (A) using four 1/2-diameter bolts (B) with 3-inch minimum embedment into the concrete. Provide a flexible hose connection (C) between the tank and the rigid supply line.

Choose an out-of-town family member or friend to be a family contact person.



SPECIAL CONSIDERATIONS FOR DISABLED AND FRAGILE ELDERLY PERSONS

Persons with any type of disability will need to take some extra precautions for their own safety and survival in the event of a disaster. These tips are designed to be used in addition to the guidelines listed elsewhere in this booklet.

- Assess your own special needs, limitations and capabilities realistically and write them down. Be sure to include your requirements for medications and special equipment.
- Keep medications, with duplicate prescriptions, and any special equipment you require close by and in a safe place where they can be easily reached. A cloth string bag, into which you can scoop these items quickly, is helpful.
- Keep a notebook, pencils, and a whistle or flashlight available in several locations if you have difficulty in communicating.
- Remember pet food, harness and equipment if you have a seeing eye or hearing dog

During and after an earthquake

- If you are able, get under a table or into a doorway. If you are in a wheelchair, lock the wheels of the chair once you are in a safe and protected position.
- If unable to move safely and quickly, stay where you are, even in bed, and cover your head and body with your arms, pillows, blankets, even books to protect yourself from falling objects.
- Use your whistle or flashlight to call for help and signal others if you need it.

SPECIAL CONSIDERATIONS: Children and Earthquakes

Earthquakes may be traumatic events for all of us, but they are especially frightening for children, who may have to leave their homes and all that is familiar to them. A child does not usually understand such events and feels anxious and confused. After an earthquake, a child's fears are those of reoccurrence, injury, death, or of being alone, separated from the rest of the family. Aftershocks can increase these fears.

Parents sometimes ignore the emotional needs of a child once assured of their physical safety. A child's persistent fears may generate disruptive behavior, surprising and frustrating a parent who is trying to continue with the daily family routine. How a parent can help:

- **Keep the family together.** This provides immediate reassurance to a child; fears of being abandoned and unprotected are alleviated.
- Reassure children by words as well as actions. "We are all together and nothing has happened to us," or "You don't have to worry, we will look after you."
- **Encourage the child to talk.** It can be helpful to include other family members, neighbors and their children in a talk about reactions to the disaster.
- **Include the child in family activities.** There will be important things to do after an earthquake: checking on the damage, cleaning up broken glass and fallen furniture. Whenever possible, a child should be included in these activities.

At bedtime, a child may have difficulty falling asleep. The child may wake up during the night or have nightmares for weeks or months after the earthquake. These situations may be dealt with by allowing the child to move into a room with another child or sleep in the parents' room, or by the parents simply spending extra time in the child's room giving reassurance.

To find out more about how children react to emergencies and what you can do to help, contact your local Mental Health Department.

AFTERSHOCKS

In the weeks and months after a strong earthquake, there will be many aftershocks, some strong enough to cause additional damage to structures already weakened in the main shock. A magnitude 7 earthquake in California is typically followed by about six aftershocks of magnitude 5 or larger. Most of these aftershocks strike during the first week, but some are possible as much as three to six months later.

Because strong aftershocks impose additional hazards and may seriously affect emergency response efforts, scientists at the U.S. Geological Survey monitor aftershocks closely and regularly issue forecasts about the probability of large aftershocks in the near future. Because of the potential for large aftershocks, removal of belongings from damaged buildings may have to be delayed.

How to Reduce Earthquake Damage

DETERMINE THE SAFETY OF YOUR HOME AND SCHOOL

Most people on the North Coast are safe at home if they live in a well braced wood-frame building of one or two stories. These buildings are unlikely to collapse completely during earthquakes. Common damage in these structures is light cracking of interior walls, cracking of brick chimneys, and cracking and possible collapse of brick veneer on exterior walls. Bracing of chimneys in older homes may be required to prevent toppling during earthquakes. Have your chimney inspected by a qualified professional before using the fireplace after the earthquake.

Some wood-frame buildings can be hazardous, especially those built before 1940. Older wooden structures can fail at or near ground level if not adequately bolted to the foundation, or if the pier-and-post foundation or short "cripple" walls (often found between the foundation and the first floor) are not adequately braced. Your local community planning or building inspection office has information on adding foundation bolts and bracing cripple walls. Correcting these problems will drastically reduce earthquake risk in older homes.

Special considerations are needed for mobile homes and modular buildings not attached to permanent foundations. These structures can slide off their foundations if not properly secured to resist horizontal motion. The California Department of Housing and Community Development recommends that all manufactured homes be equipped with certified Earthquake Resistant Bracing Systems (ERBS). For more information regarding mobile home support systems contact the

Department of Housing and Community Development
(916) 255 - 2501

Modern public elementary and high schools and community college buildings must meet "Field Act" standards for seismic safety and have generally performed well during earthquakes. Following severe damage to many schools during the Long Beach earthquake of 1933, the Field Act was passed, requiring special seismic design standards for public school buildings. The provisions of the Field Act do not apply to colleges and private schools. Ask school officials whether your school buildings have been evaluated for earthquake safety recently.

Mental Health After the Quake

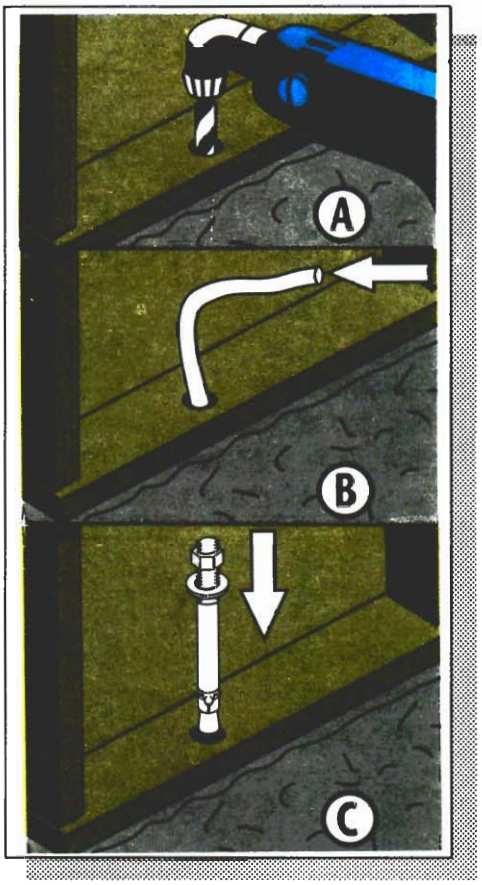
The primary concern for most of us immediately after an earthquake is the care and safety our family. One way to alleviate this worry is to establish a family earthquake emergency plan ahead of time.

During the days and weeks following an earthquake you and your family may experience a variety of normal reactions. Here are a few tips on how to deal with those reactions:

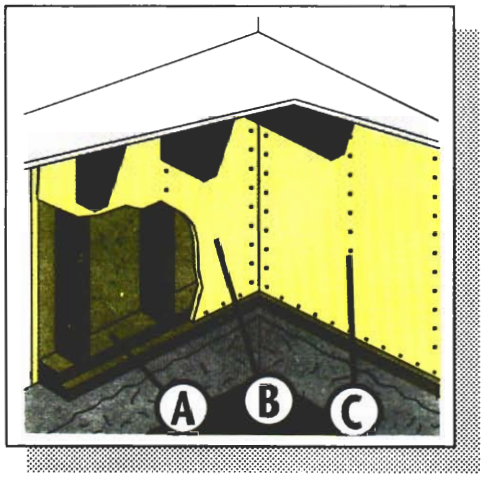
- Talk to other people about your experiences, reactions, feelings, etc.
- Take it easy - do not push yourself.
- Plan extra time to do the usual tasks.
- Recognize that you may be running on adrenaline.
- Rest - plan to let yourself sleep uninterrupted for a period of time at some point.
- Check to see if your decision-making ability has been impaired, ask for feedback on how you are doing.
- Let others do their part - you are not the **only** one who can do it.
- Discuss your current emergency plan with significant others and prepare for future crises.
- Remember to eat - and eat "smart"; small meals with protein and carbohydrates with lots of liquids. Avoid junk food, excessive sugar, alcohol, and caffeine.
- Exercise.
- Accept whatever feelings you have and let yourself do what makes you feel better, e.g., if sleeping with a flashlight helps you feel better - then let yourself do it.
- Recognize that we may all be on different timetables, others may not handle things or be feeling the same way you do or vice versa.

Note: if you have been busy performing necessary tasks after the earthquake, your reactions may be delayed until after your activity level slows down.

Put together an Earthquake Safety Kit.



WOOD FRAME
Bolting the wood frame of an older house to the concrete foundation can significantly reduce earthquake damage. Every 3 to 4 feet along the foundation, drill a hole using a right angle drill with a 1/2-inch bit (A), blow the concrete powder out of the hole with a small piece of flexible tubing (B), and hammer in an extension bolt, 1/2-inch in diameter and about 7 1/2 inches in length (C). Tighten the nut on the extension bolt.



CRIPPLE WALL
Reinforcing the "cripple walls" between the foundation and the first floor of an older, wood-frame house can significantly reduce earthquake damage. Nail 2 by 4 inch blocks of wood to the mud sill as needed(A). Cut 1/2-inch plywood to fit the inner side of the wall (B). Fasten plywood along all edges and to each stud using 8n nails spaced 3 inches apart (C). Air vents must be provided through the cripple walls and bracing.

Repairing and Strengthening Your Home Before the Next Earthquake

Earthquakes will happen again here on the North Coast. The effects need not be disastrous. Most of the damage to wood- frame houses in the April , 1992, earthquakes could have been prevented.

If you have earthquake damage, NOW is the time to strengthen your home correctly. If your home escaped damage, NOW is the time to evaluate your home and install strengthening measures — before you forget, and before the next earthquake. Contact a licensed professional about making the necessary changes to your home or office. Contact your local building department to modify details to fit local building codes.

Getting the Work Done

How do you locate professionals to advise you on the resistance of your building to earthquake shaking? Who should perform the needed construction?

Civil and structural engineers and architects are trained to provide such information about structures. Geologists, foundation engineers, and geotechnical engineers are trained and licensed to evaluate soil conditions and recommend appropriate action. A contractor has to implement the detailed plans and specifications prepared by an architect or engineer.

A good place to start is to call a professional organization (see page 22) and ask about the types of work that might be required; how to select an engineer, geologist, or architect; and a list of members in your area.

Contact several firms or individuals to determine whether they do the types of work you need. Make sure the firm has the necessary licenses and has experience in strengthening structures to resist earthquake shaking. Check to see how satisfied other clients were.

Recognize that the quality of the advice given and the work performed, as well as the price you pay, may depend on the care you take in making your selection.

Become informed. Even if you do not understand the technical details, ask enough questions to understand the concepts and relative importance of the issues involved. You have a right to understand what needs to be done and why.

State and federal agencies do not inspect individual buildings. Your local building department may be willing to inspect your building, but they are not authorized to recommend actions to be taken.

UNDERSTAND HOW EARTHQUAKE RISK VARIES BY LOCATION

Earthquake damage is typically concentrated in locations that can be identified in advance:

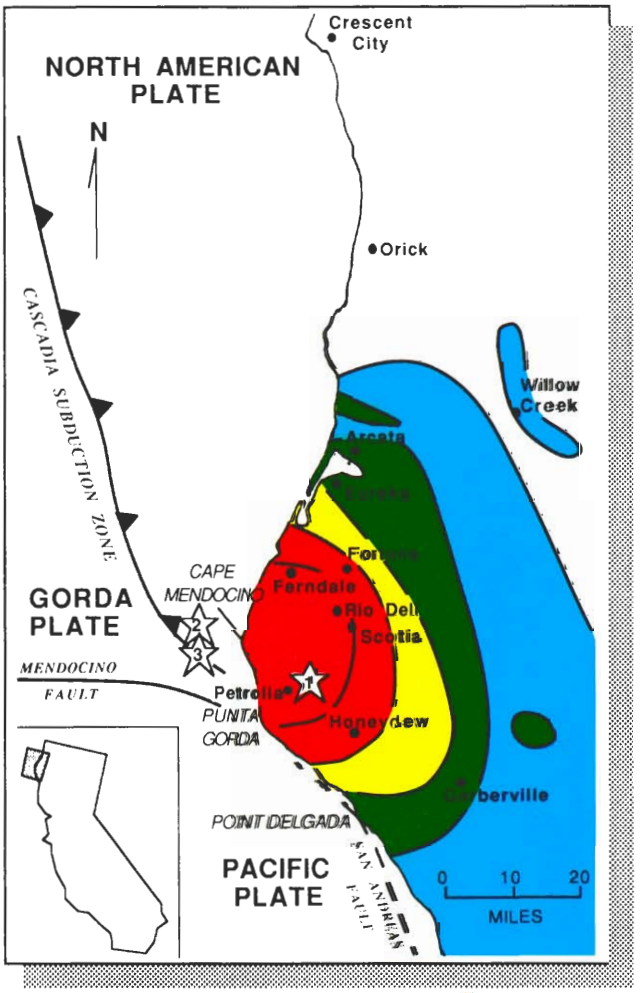
- Areas nearest to fault segments that are likely to move;
- Areas of soft soils where shaking is increased;
- Areas where the ground may settle or slide.

Failure of the ground during an earthquake can happen in many ways. Faults may break the ground as they slip during an earthquake. Steep or unstable hillslopes may slide, especially if an earthquake hits during the rainy season. Cracks may open along ridge crests close to the earthquake epicenter. Soft ground — such as the margins of Lake Earl and Humboldt Bay, or land near the lagoons — may amplify the ground acceleration and settle during shaking. The ground may fail if a sandy layer at shallow depth is saturated with water and flows like a liquid during the earthquake shaking.

"ACTIVE" FAULTS

Faults are the surface scars of past earthquakes. They may range in length from a few feet to hundreds of miles. Many faults now exposed at the earth's surface were created by earthquakes millions of years ago and are no longer active today. *Active* faults have either produced earthquakes in historic times or show geologic evidence of movement in the past 11,000 years and are the most likely sites of earthquakes in the near future. The Alquist-Priolo Special Study Zones Act required the California Department of Conservation's Division of Mines and Geology to map all known active faults in California and to designate areas within 500 feet on these faults as Special Study Zones. However, in some cases it is difficult to determine how recently a fault moved and it is not unusual for a fault to first be recognized after a strong earthquake occurs along it.

NOTE: The map on the next pages is intended for educational purposes only. Even reasonably detailed maps give only an overview of potential for shaking, liquefaction, landsliding, faulting, and damage. To be sure about a particular building site, consult an engineering geologist, geotechnical engineer, or foundation engineer (see page 22).



GROUNDSHAKING

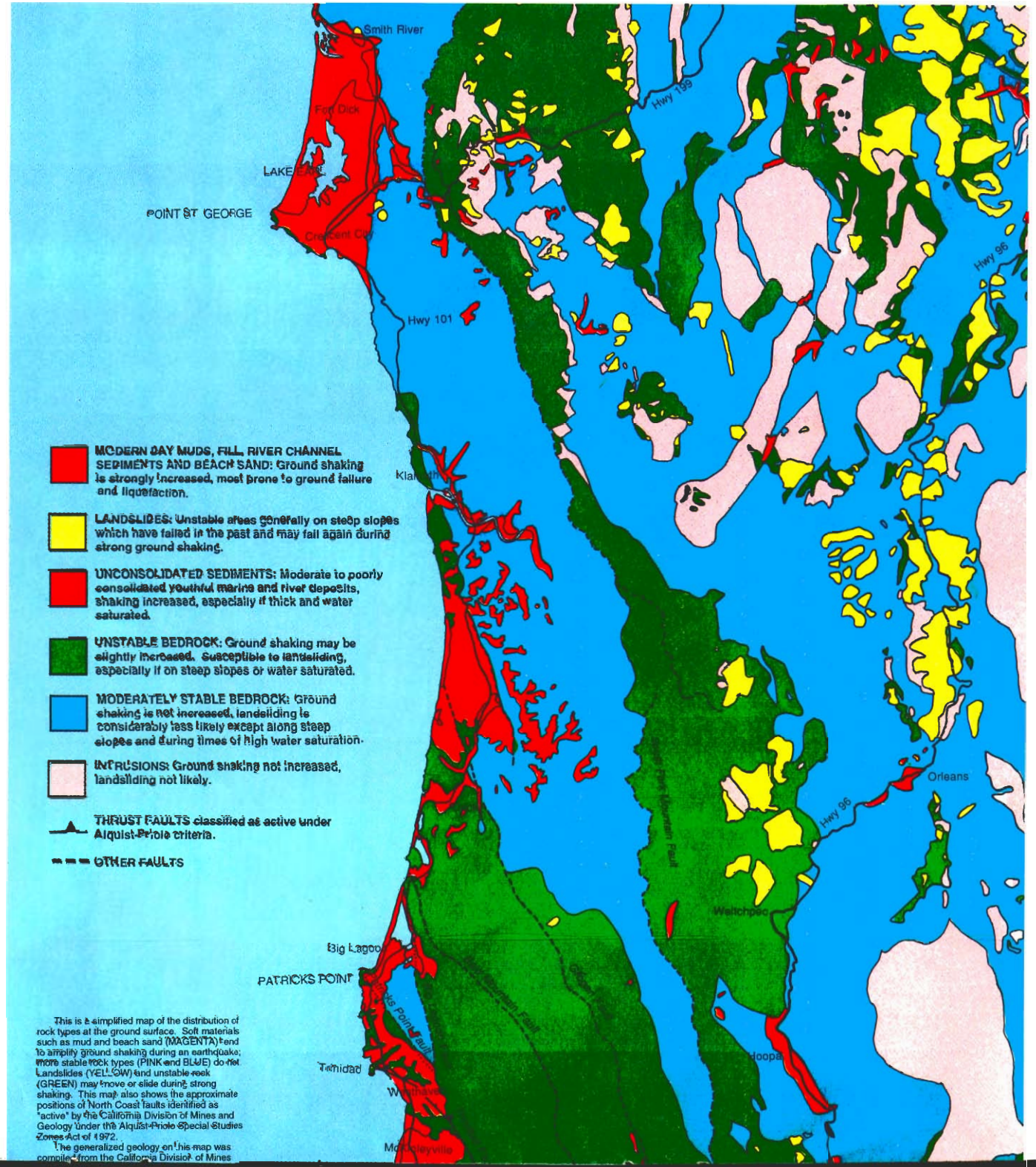
- VIOLENT
- SEVERE
- VERY STRONG
- STRONG
- MODERATE
- MILD

INTENSITY MAP OF APRIL 1992 EARTHQUAKE

This map shows the intensities reported by more than 2000 residents of the North Coast who responded to a survey by Humboldt State University. In areas of "violent" shaking, many buildings were damaged, particularly if they had not been designed to withstand earthquake shaking. In "very strong" shaking areas, items were knocked off shelves and some residents reported cracks in walls, but there was little other damage. Most people felt the earthquake in the "moderate" zone, particularly if they were indoors, but nothing fell over. The shaking was strongest near the center of the earthquake at Cape Mendocino. People located along river valleys such as Alderpoint, Blue Lake, Willow Creek, Hayfork and Freshwater, reported stronger shaking than communities located on hills at the same distance.

Write instructions on how to turn off utilities . . . electricity, gas and water.

How Strongly the Ground Shakes Depends on Where You Are



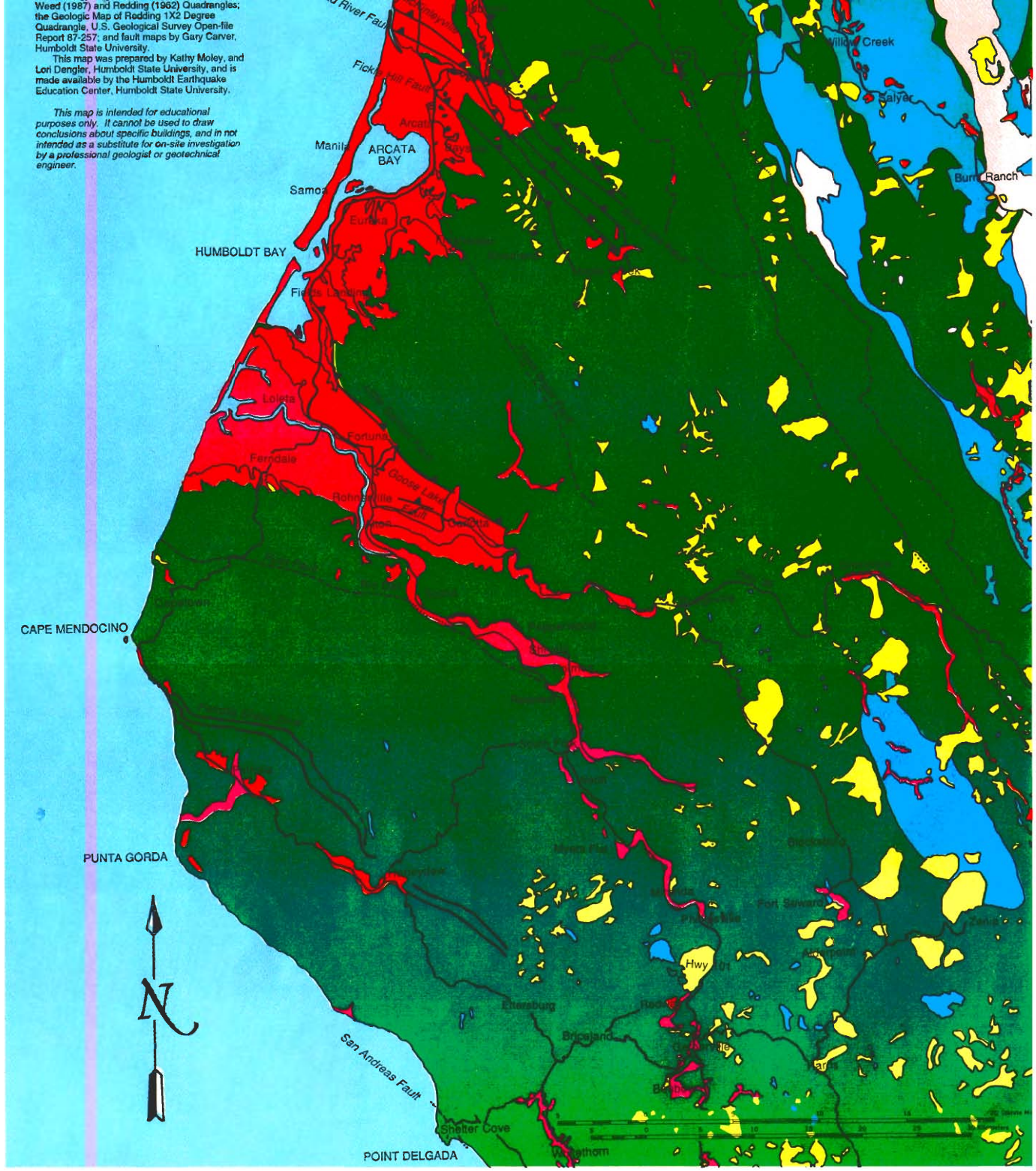
This is a simplified map of the distribution of rock types at the ground surface. Soft materials such as mud and beach sand (MAGENTA) tend to amplify ground shaking during an earthquake; more stable rock types (PINK and BLUE) do not. Landslides (YELLOW) and unstable rock (GREEN) may move or slide during strong shaking. This map also shows the approximate positions of North Coast faults identified as "active" by the California Division of Mines and Geology under the Alquist-Priolo Special Studies Zones Act of 1972.

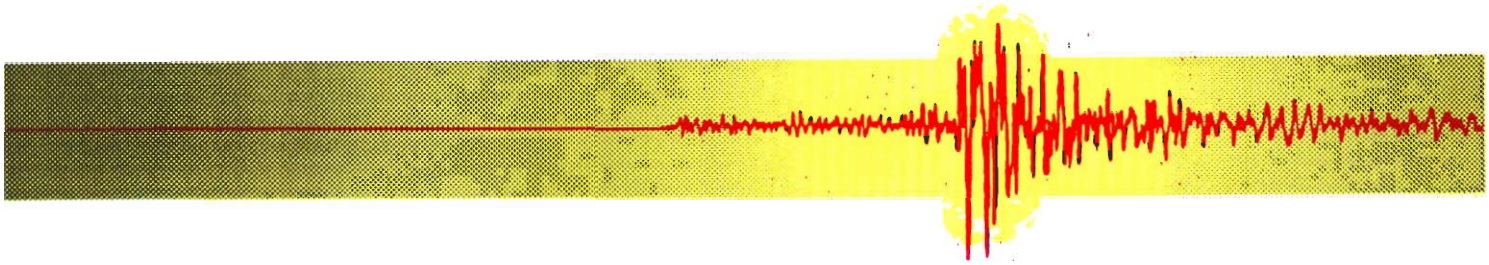
The generalized geology on this map was compiled from the California Division of Mines

Weed (1987) and Redding (1962) Quadrangles; the Geologic Map of Redding 1X2 Degree Quadrangle, U.S. Geological Survey Open-file Report 87-257; and fault maps by Gary Carver, Humboldt State University.

This map was prepared by Kathy Moley, and Lori Dengler, Humboldt State University, and is made available by the Humboldt Earthquake Education Center, Humboldt State University.

This map is intended for educational purposes only. It cannot be used to draw conclusions about specific buildings, and in not intended as a substitute for on-site investigation by a professional geologist or geotechnical engineer.





EARTHQUAKE DAMAGE

Damage during an earthquake results from several factors:

1. **Size of the earthquake.** Large magnitude earthquakes will cause more damage than a smaller earthquake in the same location. However, a moderate earthquake close to populated areas can produce more damage than a large earthquake centered offshore or in a remote area.
2. **Distance from the earthquake.** Strength of shaking generally decreases rapidly with distance from the earthquake. The strong shaking along the fault segment that moved during the earthquake is usually only half as strong at a distance of 8 miles and a sixteenth as strong 50 miles away.
3. **Length of shaking.** The longer the strong shaking lasts, the more damage the earthquake can cause. The duration of shaking depends on how the fault breaks during the earthquake and how large a segment of the fault moves. The strongest shaking during the April, 1992 earthquake lasted only 10 to 15 seconds. The 1906 San Francisco earthquake produced strong shaking in the Humboldt Bay Area of 40 seconds or longer.
4. **Type of soil.** Loose sand and soil increases shaking compared to hard rock. In addition, if the soil is wet, it may lose its strength and the ground surface may settle or slide.
5. **Type of building.** Certain types of buildings, or buildings not adequately secured to their foundations, are not strong enough to resist the side-to-side shaking common in earthquakes and are much more likely to suffer damage than well designed structures.

LIQUEFACTION

When loosely packed and very wet sand is shaken during an earthquake, it may flow like a liquid. Anyone who has walked along the beach has probably seen a small-scale version of this process. Stamp your foot in the sand near the water's edge and suddenly the area of your foot print vibrates like shaky gelatine.

Earthquake-caused liquefaction is often accompanied by cracks in the ground surface and small eruptions of sand and water called sandblows. When a soil liquefies, it is unable to support the weight of any soil or structures above it. Bridges and buildings may lose their footings even though they may have been designed to withstand strong ground shaking. If the liquefied area is on a slope, massive landslides may result.

WHERE YOU LIVE AFFECTS HOW STRONGLY THE GROUND WILL SHAKE

Communities most vulnerable to earthquake damage can be identified by studying the locations of active faults and the damage patterns of past earthquakes. The map on pages 12 and 13 provides a regional overview of areas where the greatest hazards exist. Soft materials such as mud and beach sands (shown in magenta) are likely to experience stronger shaking than harder rock (shown in pink and blue) nearby. Steep areas on unstable ground (shown in yellow and green) are more likely to slide during a strong earthquake than more stable rock types.

A house built over a fault can be torn apart if the ground ruptures during an earthquake. The map on pages 12 and 13 shows the approximate positions of North Coast faults identified as "active" by the California Division of Mines and Geology under the Alquist-Priolo Special Studies Zones Act of 1972. Local city and county planning departments have Special Studies Zone maps that will tell you if your home is on or near one of these faults. You can learn more about these zones and how to obtain maps by ordering Special Publication 42 from the California Division of Mines and Geology (listed in the reference section of this booklet).

EARTHQUAKE INSURANCE

The insurance company that insures your home for fire is required to offer you earthquake insurance. The most common type of earthquake insurance is normally added as an endorsement on a standard homeowners insurance policy. Typically, there is a deductible of 5 to 10 percent or more, of the value of the home. This means that for a home currently insured at $200,000, you would have to pay $10,000 to $30,000 on damages before the insurance company would pay anything. Separate deductibles may apply to contents and structure. An important coverage is temporary living expenses. This pays for motel and meals if you have to move out of your home. There is usually no deductible on this coverage. The yearly cost of residential earthquake insurance is normally about $1.50 to $3.00 per $1,000 of coverage on the structure.

To find out more about earthquake insurance, ask your insurance agent or call the

California State Department of Insurance at (800) 927-4357.

Tsunamis

Tsunamis are large ocean waves generated by major earthquakes beneath the ocean floor. Tsunamis caused by nearby earthquakes may reach the coast within minutes. When the waves enter shallow water, they may rise to several feet or, in rare cases, tens of feet, striking the coast with devastating force. People on the beach or in low coastal areas need to be aware that a tsunami could arrive within minutes after a severe earthquake. The tsunami danger period can continue for many hours after a major earthquake.

Tsunamis also may be generated by very large earthquakes far away in other areas of the Pacific Ocean. Waves caused by these earthquakes travel at hundreds of miles per hour, reaching California several hours after the earthquake. The International Tsunami Warning System monitors ocean waves after any Pacific earthquake with a magnitude larger than 6.5. If waves are detected, warnings are issued to local authorities, who can order evacuation of low lying areas if necessary.

HISTORIC TSUNAMIS IN THE UNITED STATES

Twenty-four tsunamis have caused damage in the United States and its territories during the last 204 years. Just since 1946, six tsunamis have killed more than 350 people and damaged a half billion dollars of property on Hawaii, Alaska and the West Coast.

Tsunamis have historically been rare in California. Since 1812, California has experienced fourteen tsunamis with wave heights greater than 3 feet; six of these were destructive. Ten of these were generated by distant earthquakes near Alaska, Chile or Japan. The worst damage resulted from the 1964 Alaskan earthquake. Four came from earthquakes nearby, one of which caused some damage.

THE APRIL 25, 1992, TSUNAMI

The Cape Mendocino earthquake produced a tsunami that reached Eureka in about 20 minutes with wave heights of about one foot. The tsunami reached Crescent City in 50 minutes and was detected in Oregon, the San Francisco Bay Area, Santa Barbara, and Hawaii.

Although not destructive, the April tsunami is important because it illustrates both how quickly a wave can arrive at nearby coastal communities and how long the danger period can last. The first wave arrived at Crescent City in less than an hour, but the highest waves, about one-and-a-half feet, arrived nearly four hours later. Abnormally large waves continued for more than eight hours. The April tsunami provided important data for the National Oceanographic and Atmospheric Administration, which is currently studying how a larger tsunami may affect the North Coast.

TSUNAMI in Japanese consists of two characters tsu - harbor and nami - wave.
The literal meaning is 'harbor wave', so called because of the devastating effects these waves have had on low-lying Japanese coastal communities.

TSUNAMI SAFETY RULES

The International Tsunami Information Center recommends:

1. All earthquakes do not cause tsunamis, but many do. When you hear that an earthquake has occurred, stand by for a tsunami emergency.
2. An earthquake in your area is a natural tsunami warning. Do not stay in low-lying coastal areas after a strong earthquake has been felt.
3. A tsunami is not a single wave, but a series of waves. Stay out of danger areas until an "all-clear" is issued by a competent authority.
4. Approaching tsunamis are sometimes preceded by a noticeable rise or fall of coastal water. This is nature's tsunami warning and should be heeded.
5. A small tsunami at one point on the shore can be extremely large a few miles away. Don't let the modest size of one make you lose respect for all.
6. The Pacific Tsunami Warning Center does not issue false alarms. When a warning is issued, a tsunami exists. The tsunami of May 1960 killed 61 people in Hilo, Hawaii, and they thought it was "just another false alarm".
7. All tsunamis - like hurricanes - are potentially dangerous, even though they may not damage every coastline they strike.
8. Never go down to the shore to watch for a tsunami. When you can see the wave you are too close to escape it.
9. Sooner or later, tsunamis visit every coastline in the Pacific. Warnings apply to you if you live in any Pacific coastal area.
10. During a tsunami emergency, your local civil defense, police, and other emergency organizations will try to save your life. Give them your fullest cooperation.

Install latches or bolts on cabinets where heavy, breakable, or valuable items are stored.

Why We Have Earthquakes On the North Coast

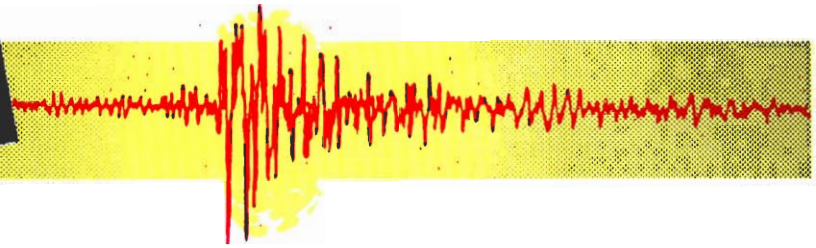


PLATE TECTONICS

If the earth were the size of an egg, its outermost layer would be about the thickness of an eggshell. However, in the earth this shell is not in one piece but is broken into a number of fragments called *plates*. These plates are at least forty miles thick and vary in width from a few hundred to many thousands of miles. A plate may contain oceans, continents or both. The plates move slowly relative to each other and to the deeper parts of the earth beneath at rates between one and four inches per year. Most earthquakes occur along boundaries where plates are driven apart, slide past one another, or collide.

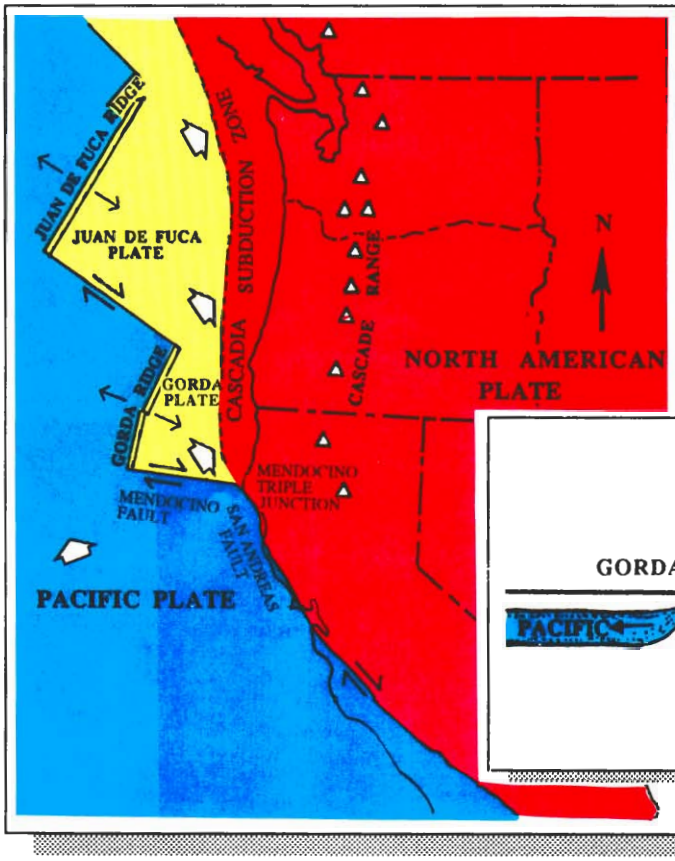
A UNIQUE GEOLOGIC SETTING

The geology of the North Coast is distinct from the rest of California. Geologists and seismologists find this region of special interest because it coincides with a "triple junction," a place where three plates of the earth's outer shell are in contact. As a result of this unique geologic setting, the North Coast is vulnerable to several types of earthquakes from a variety of sources.

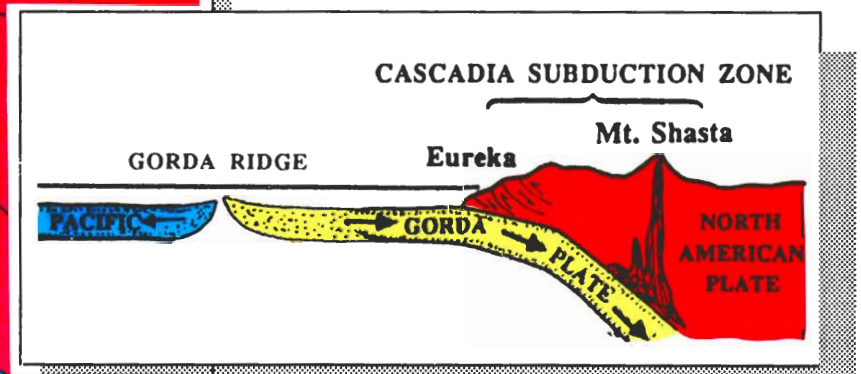
THE SAN ANDREAS FAULT

South of the triple junction, the Pacific plate is moving at a rate of about two inches per year to the northwest (relative to North America). Most of this motion takes place along the San Andreas fault system. The sliding motion is neither smooth nor constant. The motion of the plates deforms the rocks along the plate boundary until the rocks can no longer withstand the strain. Then a sudden slip along the fault releases energy, causing earthquake shaking. The relative motion of the two plates is almost entirely horizontal, as the Pacific plate moves north relative to the North American plate with each successive earthquake.

THE GEOLOGIC SETTING
Three geologic plates intersect along the North Coast. Black arrows show the relative motion at plate boundaries. The San Andreas fault is the boundary between the Pacific and North American plates; the Mendocino fault separates the Gorda and Pacific plates. The Cascadia subduction zone is the boundary between the Gorda and Juan de Fuca plates offshore and the North American plate. The white triangles show the locations of active volcanoes, common along subduction zones.



CROSS SECTION OF SUBDUCTION ZONE
This shows a vertical slice along the southern part of the Gorda plate where it is being subducted beneath the North American plate.



THE CASCADIA SUBDUCTION ZONE.

The forces are very different north of the triple junction. Here the Gorda plate and its northern extension, the Juan de Fuca plate, move eastward on a collision course with the North American plate. Where the plates collide, the Gorda plate slowly descends beneath the North American plate along the Cascadia subduction zone that extends eastward under the edge of North America.

The collision between the North American and Gorda plates has created a zone of folded and faulted crustal rocks. Along most of the Cascadia subduction zone, these deformed rocks are offshore. Near its southern end, however the zone curves onshore, exposing nine major thrust faults along the Humboldt County coastline. Thrust faults differ from the horizontally-moving San Andreas fault. The rocks on one side of a thrust fault are pushed up and over rocks on the other side. Geologists have shown that during the last million years the rocks on top of this group of North Coast thrust faults have been pushed a mile or more to the northeast relative to the rocks beneath.

Until recently, the Cascadia subduction zone was not regarded as a major earthquake threat. Indeed prior to the April 25, 1992 Cape Mendocino earthquake, the Cascadia plate boundary was not known to have produced a major earthquake during the past 150 years. New evidence, however, indicates that the subduction zone is active and capable of producing great earthquakes. Offshore studies show a zone of folds and faults that deform the youthful sea floor sediments of southern Canada, Washington, and Oregon and join up with similarly deformed rocks exposed on land in northern California. Recent geologic studies of faulting along the Humboldt County coast identified at least five large earthquakes during the past 1,700 years. Each of these earthquakes changed the elevation of large parts of the Humboldt County coast by several feet or more and may have been accompanied by movement of one or more local thrust faults.

Subduction Zones

Subduction occurs when an oceanic plate slides underneath another plate generating both earthquakes and volcanoes. The Pacific basin's 'ring of fire' is a nearly continuous belt of subduction zones including Alaska's Aleutian Islands, Japan, the Tonga, Fiji and Kermadec Island arcs, the west coast of South America and the northwestern coast of North America. Subduction zones are the most seismically active areas of the earth and account for more than 90% of the seismic energy released.

PALEOSEISMOLOGY

Written history in the North Coast area goes back to the mid 1800's. Paleoseismology is the study of "fossil" earthquakes that occurred before this time. Studies of young marine and river sediment layers exposed in trenches dug across faults may show offsets caused by fault movement. Some submerged forests and soils indicate a sudden downdrop of the land surface caused by an earthquake; other soils show evidence of sudden uplift. Past tsunamis sometimes leave recognizable sand deposits. In certain cases tree rings can be used to estimate when an ancient earthquake occurred. The oral history of native peoples include legends and stories which may relate to prehistoric events.

Secure the water heater to a wall.

Why We Have Earthquakes On the North Coast

WHERE EARTHQUAKES OCCURRED IN THE PAST, THEY WILL HAPPEN AGAIN

The North Coast has accounted for about one-quarter of all the earthquake energy released in California during historic times. The size, location, and frequency of past earthquakes give an indication of what to expect in the future.

The instrumental record of earthquakes on the North Coast extends back only into the early Twentieth Century. However, it is possible to learn about older earthquakes from written accounts in newspapers, church logs, and diaries. From these accounts, seismologists can sometimes reconstruct the pattern of ground shaking and estimate the location and magnitude of early earthquakes. Although locations are imprecise, the record of damaging North Coast earthquakes after 1850 is fairly complete. Since 1853, over sixty earthquakes have caused some damage to North Coast communities, fourteen with strength similar to the April, 1992, earthquakes.

The majority of North Coast earthquakes have been centered offshore in the southeastern portion of the Gorda plate. These earthquakes recur frequently, causing some damage to North Coast communities about every two years. Communities in the coastal region from Cape Mendocino to Eureka have been struck far more frequently than the rest of Humboldt or Del Norte Counties. Northern Humboldt County, Del Norte County and coastal communities of southern Oregon have only rarely been affected by earthquakes in historic times. However, the historic record only gives a short-term view of earthquakes. Areas not affected historically may still be at risk.

EPICENTER MAP

This map shows the location of the best-studied North Coast earthquakes. It includes all earthquakes since 1960 with magnitudes as large as 5.5 or that have produced damage, and also includes the larger earlier earthquakes since 1920. For a more complete list of North Coast earthquakes, see the reference material listed on page 22.

1906: Although centered near San Francisco, the rupture extended northward at least to Point Arena and perhaps as far as Shelter Cove. Caused more damage in the North Coast Region than any other known earthquake. In Ferndale, not a chimney remained standing and brick buildings were badly damaged.

1922: Largest historic earthquake, but too far offshore to produce much damage. Recorded on 106 seismographs throughout the world. Felt from San Jose to Oregon and Nevada.

1923: Similar damage to 1992 earthquake. Knocked down all chimneys in Petrolia. Felt by three steamers offshore.

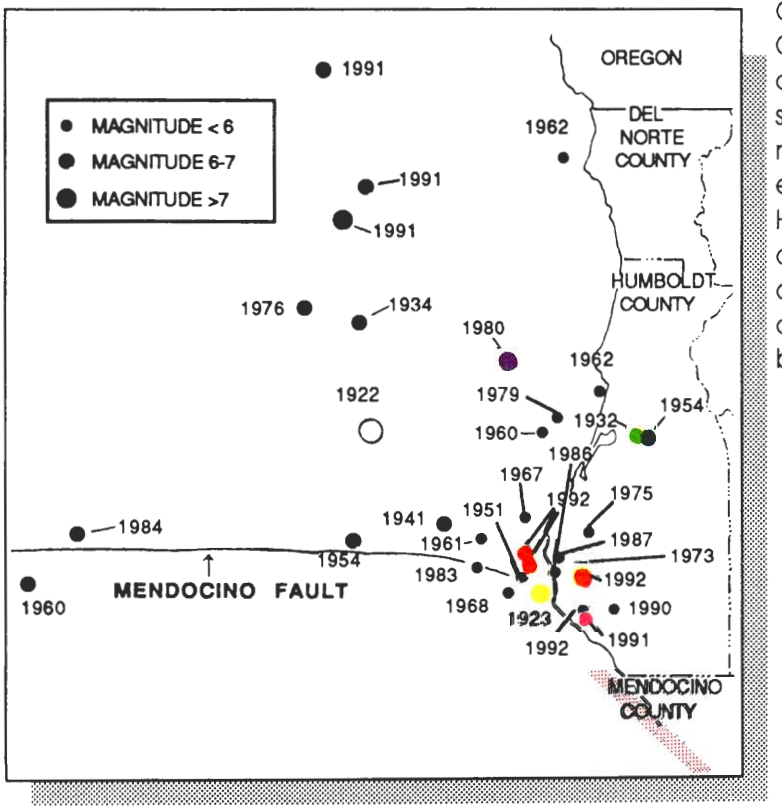
1932: Killed a woman in Eureka when a chimney from a neighboring building crashed through two floors. The last earthquake to produce major damage in the Eureka area.

1954: The only on-land historic earthquake that may have been on one of the mapped faults northeast of Arcata. Killed a man when a lumber stack collapsed. Fishermen on the Mad River told of being knocked down, water splashing up on banks, and water temporarily flowing upstream.

1980: Six persons seriously injured, five when a portion of a Highway 101 overpass collapsed south of Eureka. Property losses were estimated at $1,750,000. Felt in the San Francisco Bay Area, northwestern Nevada and southern Oregon.

1991: Shaking strong enough near Honeydew to toss one foot diameter stream boulders into the air. Affected well water levels in southern Humboldt County.

1992: Three strong earthquakes in 19 hours. Over $60 million in property losses.



The Significance of April, 1992, Cape Mendocino Earthquakes.

Three powerful earthquakes struck the Cape Mendocino area on April 25th and 26th, 1992 (magnitudes 7.1, 6.6, and 6.7). The earthquakes caused 356 reported injuries, destroyed 202 buildings, and damaged an additional 906 structures. Fires triggered by the second earthquake destroyed most of the Scotia shopping district. Property losses were estimated at over $60 million and President Bush declared the region a Major Disaster Area. The earthquakes triggered numerous landslides and rock falls, and caused widespread liquefaction in the Mattole and Eel River Valleys. Many roads and bridges in the Cape Mendocino region suffered damage. The earthquakes were felt from southern Oregon, to Reno, Nevada, and as far south as Salinas.

The first earthquake, on Saturday, April 25th, is particularly important because:

- It was the largest onshore earthquake in the North Coast region during this century.
- It produced some of the strongest ground motions ever recorded. An instrument located within three miles of the earthquake recorded accelerations of the ground nearly twice the acceleration of gravity.
- It was the first large earthquake probably located along the Cascadia subduction zone boundary and demonstrates that the subduction zone is capable of producing damaging earthquakes.
- It uplifted the coastline near Cape Mendocino by as much 4 feet, killing intertidal communities of mussels, barnacles, sea urchins and algae.
- The motion of the sea floor produced a tsunami that reached coastal communities within ten's of minutes of the earthquake and reached a maximum height of 1 1/2 feet at Crescent City.

A TALE OF TWO EARTHQUAKES:
top - Ferndale after the 1906 San Francisco earthquake. Bricks from parapet wall were thrown forward into street at the General Mercantile building.
bottom - History repeats itself as bricks from the same building (now the Valley Grocery) were once again downed by the April, 1992 earthquake. It will not happen a third time; the building has since been demolished.

Bolt bookcases and other heavy furniture to the walls.

Responding to Earthquake Advisories

You may hear a variety of advisories and predictions of future earthquakes. When deciding what action you should take:

- **Determine** whether the statement was made by a scientist from a reputable organization.
- **Ask** whether the statement has been reviewed and endorsed by the National and the California Earthquake Prediction Evaluation Councils.

One goal of earthquake research is to increase the reliability of probability estimates, especially to narrow the time period during which an earthquake is anticipated. At present it is not possible to make accurate short term predictions of specific earthquakes along a particular fault. However, there are two types of cases where scientists consider a damaging earthquake much more likely and an earthquake advisory may be issued.

- **Foreshocks:** About half of the damaging earthquakes in California are preceded by smaller earthquakes in the 5 day period beforehand. When a moderate earthquake occurs along a fault thought likely to generate a damaging earthquake, an advisory is sometimes issued. For example, in June of 1988 and August of 1989 there were two earthquakes of magnitude 5.0 and 5.2 on the San Andreas fault near Santa Cruz. This segment of the fault had been very quiet for decades and these earthquakes were unusual. For this reason, the California Office of Emergency Services issued an advisory of an increased likelihood of a major earthquake within the 5 days following each of those quakes. During this period, emergency response personnel were on special alert. The Loma Prieta earthquake of October 17, 1989, was a little late, but it was the quake anticipated by the advisories.
- **Aftershocks**: In the hours and days after a strong earthquake, there is a much greater than usual likelihood of moderate earthquakes that may be large enough to cause additional damage. For example, after the April earthquakes, the U.S. Geological Survey in Menlo Park issued the following statement:

"In the 30 day period beginning 9 p.m., Wednesday 29 April, there is a "small but not negligible chance" (about 10 percent) of at least one additional Magnitude 6 or larger aftershock."

When an advisory is issued, it is a good time to review elements of your emergency plan with family members and to make sure your emergency supplies are in order.

We do not know when the next earthquake will strike, but we know that it will. We can live with earthquakes on the North Coast if we take actions now to prepare.

THE NORTH COAST FACES RISKS FROM DIFFERENT EARTHQUAKE SOURCES.

Offshore Earthquakes.

Historic offshore damaging earthquakes have had magnitudes between 5.0 and 7.5. They are the most likely type of earthquake to recur in the near future. A future earthquake of this type will likely affect coastal communities between Cape Mendocino and Humboldt Bay with some damage possible as far north as the southern Oregon coast. These earthquakes may damage roads, bridges, chimneys and foundations, move heavy furniture and knock many items off shelves.

Onshore Earthquakes.

Onshore earthquakes have recurred on average every 20 years and, when centered near populated areas, have caused major damage. These earthquakes historically have had magnitudes between 5 and 7.1. Geologic evidence, however, suggests this type of earthquake may have magnitudes of 7.5 or larger. Such an earthquake could cause surface rupture and would produce stronger ground shaking than any historic earthquake. The likelihood of such an earthquake in the near future is unknown but it is clearly less than the likelihood of offshore earthquakes.

The San Andreas Fault.

Studies of the amount of strain released in the 1906 San Francisco earthquake and geologic studies of even older earthquakes suggest an average interval between earthquakes on the northern segment of the San Andreas fault of several hundred years. Recurrence of a 1906 type earthquake, although not as likely as an offshore earthquake, must be considered a possibility on the North Coast.

The Cascadia Subduction Zone.

The April, 1992, earthquake broke a small part of the Cascadia subduction zone. Rupture of a longer segment would produce a very large earthquake under the more populated areas of the coast. Geologic evidence suggests that these earthquakes could have magnitudes of 8 or greater, produce strong ground motion lasting up to a minute or more, and generate local tsunamis affecting coastal areas of northern California, Oregon and Washington. Distant tsunamis might also be generated, that could affect other coastal regions of California and large areas of the Pacific basin.

Geologic studies suggest the last large subduction zone earthquake occurred approximately 300 years ago and that such very large earthquakes recur with intervals on the order of hundreds of years. The probability of such an earthquake within the near future is not well known, but is less than that of offshore earthquakes in the Gorda plate. However, the increasing weight of scientific evidence supporting the eventual recurrence of such earthquakes and the enormity of their possible effects make planning and preparedness efforts essential for individuals, communities, and all levels of government.

Where to Get More Information

Governors Office of Emergency Services Bay Area Earthquake Project. MetroCenter, 101 8th Street Suite 152, Oakland, CA 94607, (510) 893-0818, TDD (510) 893-0702. Publications, videotapes, and scripted slide shows on earthquake preparedness. Free catalog.

Humboldt Earthquake Education Center. Humboldt State University, Arcata, CA 95521, (707) 826-3931, Earthquake Hotline (707) 826-6020, recorded message about local, regional and distant earthquakes updated regularly.

USGS, U.S. Geological Survey, Earth Science Information Centers Menlo Park, CA 94025, 345 Middlefield Road, (415) 329-4390. Publications and maps concerning earthquake hazards. Mail orders to USGS Books and Report Sales, P.O. Box 25425, Denver, CO 80225. For orders less than $10.00, include $1.00 P&H.

FEMA, Federal Emergency Management Agency, Building 105, The Presidio, San Francisco, CA 94129, (415) 923-7100. Documents should be ordered from FEMA, P.O. Box 70274, Washington, D.C. 20024.

CDMG, California Department of Conservation, Division of Mines and Geology, P.O. Box 2980, Sacramento, CA 95812-2980, (916) 445-5716. Publications and maps concerning faults. Scenarios describing the likely effects of future earthquakes.

California Seismic Safety Commission, 1900 K Street, Suite 100, Sacramento, CA 95814-4186. Primarily concerned with encouraging hazard reduction and emergency planning. Information about legislation, state agency programs and unreinforced masonry building programs.

GENERALIZED BOOKS AND MAGAZINES ABOUT EARTHQUAKES

Earthquakes and Volcanoes. A bimonthly publication of the U.S. Geological Survey available yearly for $6.50 from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, or by credit card at (202) 783-3238.

California Geology. A bi-monthly publication of CDMG , California Geology, P.O. Box 2980, Sacramento, CA 95812-2980 ($8.00 per 1 year subscription).

Earthquakes: Newly Revised and Expanded. By Bruce Bolt, W.H. Freeman, 41 Madison Ave. New York, N.Y. 1993, 317 pages.

On Shaky Ground: America's Earthquake Alert. By John J. Nance, 1989, Avon Books, New York, 440 pages ($4.95).

Terra Non Firma. By J.M. Gere and H.C. Shah, 1984, W.H. Freeman, New York, 203 pages ($12.95).

AMERICAN RED CROSS (ARC)

Del Norte County ARC, P.O. Box 64, Crescent City, CA 95531 (707) 464-2277.

Humboldt County ARC, P.O. Box 3402, Eureka, CA 95502 (707) 443-4521.

Lake County ARC, P.O. Box 3132, Clear Lake, CA 95422 (707) 994-0640.

Mendocino County ARC, P.O. Box 953, Ukiah, CA 95482 (707) 463-0112.

Siskiyou County ARC, P.O. Box 252, Yreka, CA 96097 (916) 842-4476.

Trinity County ARC, 2280 Benton Drive, Redding, CA 96003 (916) 243-3021.

OFFICES OF EMERGENCY SERVICES (OES)

Del Norte County OES, 450 H Street, Room 208, Crescent City, CA 95531 (707) 464-7213.

Humboldt County OES, 825 5th Street Eureka, CA 95501 (707) 445-7395

Lake County OES, 375 3rd Street, Lakeport, CA 95490, (707) 263-2201

Mendocino County OES, 17501 N. Hwy. 101, Willits, CA 95490 (707) 459-7414.

Siskiyou County OES, 800 S. Main, Yreka, CA 96097 (916) 842-8011.

Trinity County OES, P.O. Box 1228, Weaverville, CA 96093 (916) 623-1357.

PROFESSIONAL SOCIETIES

ARCHITECTS

The state and local offices for the American Institute of Architects are

AIA Redwood Empire Chapter
PO Box 4178 Santa Rosa CA 95402
(707) 576-7799

AIA Central Valley Chapter
1025 19 th Street #8
Sacramento, CA 95814
(916) 444-3658

AIA California Council
1303 J Street Suite 200
Sacramento, CA 95814
(916) 448-9082

ENGINEERS

SEAONC, Structural Engineers Association of Northern California, 501 Street Suite 300, San Francisco 94105, (415) 974-5147

SEAONC, Structural Engineers Association of Central California, PO Box 399 Fairoaks, CA 95628, (916) 427-3647

California Board of Registration for Professional Engineers, 2535 Capital Oaks Drive Suite 300, Sacramento, CA 95833-2926. (916) 263-2222

GEOLOGIST AND GEOTECHNICAL ENGINEERS

Association of Engineering Geologist, P.O. Box 132, Sudbury, MA 01776
(505) 443-4639.

California Geotechnical Engineers Association, P.O. Box 431, Yorba Linda, CA 92686, (714) 777-3423.

ASFE, The Association of Engineering Firms Practicing im the Geosciences, 8811 Colesville Road, Suite G106, Silver Spring, MD 20910, (301) 565-2733.

California State Board of Registration for Geologists and Geophysicists, 400 R Street Suite 4060, Sacramento, CA 95814 (916) 445-1920.

ABOUT EARTHQUAKES OF THE NORTH COAST

Available in public libraries in Humboldt County and in the Humboldt State University Library

Earthquakes and Volcanoes Special Issue: The Cape Mendocino Earthquakes of April 25-26, 1992, volume 23, number 3 U.S. Government Printing Office, Washington, D.C. 20402, 1992.

California Geology, March - April 1992, California Department of Conservation, Division of Mines and Geology

The Humboldt Historian, The Humboldt Historical Society

ABOUT EMERGENCY PREPAREDNESS

Surviving the Big One, How to Prepare for a Major Earthquake. A video developed for public television. KCET Video, P.O.Box 310, San Fernando, CA 91341, 1990 (revised), 1 hour, (800) 228-5238 ($19.95 + $3.50 P&H if in California include Calif sales tax).

General Preparedness Information Kit. ABAG,Publications, P.O. Box 2050, Oakland, CA 94604-2050, 1988 (ABAG P87059BAR, $2.00 including P&H).

Family Survival Guide American Red Cross, 1990, 32 pages ($0.50)

Preparedness Information Kit, Four brochures covering family disaster plans, emergency supplies, personal preparedness, and helping children cope with disaster. American Red Cross, (Free +$1.00 P&H).

Safety and Survival in an Earthquake. American Red Cross, 1989, 52 pages ($3.00 + $2.00 P&H from ARC).

Reducing Losses From Earthquakes Through Personal Preparedness. By W.J. Kockelman, 1984, U.S. Geological Survey Open-File Report 84-765, 21 pages (USGS, $2.75).

Earthquake Ready. By Virginia Kimball, Roundtable Publishing, Inc., Santa Monica, California, 225 pages, 1992 ($14.95).

ABOUT PREPAREDNESS IN SCHOOLS AND OFFICES

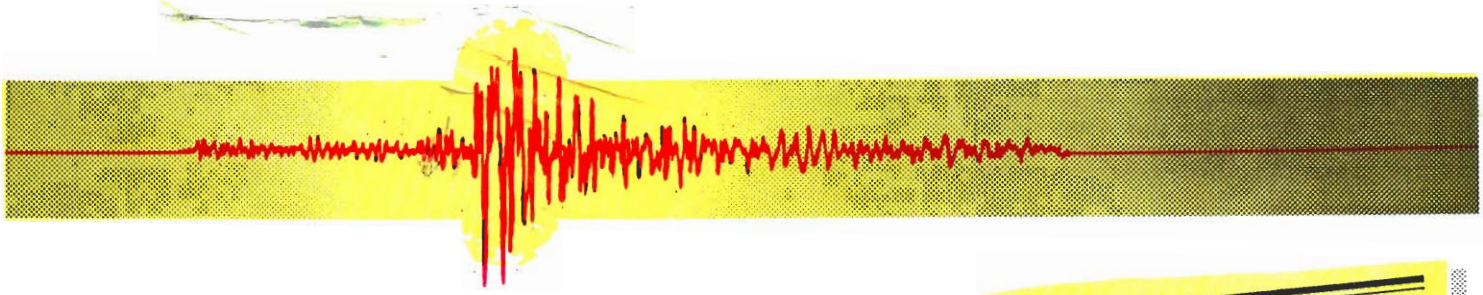
The Humboldt Earthquake, Impact on Schools. A 12 minute long video of some of our local schools after the April 25-26 earthquakes. Availiable through the Humboldt County Office of Education.

Earthquake Preparedness Activities for Child-Care Providers. 1989 54 pages. This guide is for child-care providers. ABAG, Publications, P.O. Box 2050, Oakland, CA 94604-2050, ($8 + $2 P&H) (P89002BAR).

Earthquakes: A Teacher's Package for K-6 Grades. By the National Science Teachers Association, 1988, 280 pages ($17.50+$2.50 P&H) (800) 722-6782.

Earthquake Ready: Preparedness Planning for Schools. June, 1990, 76 pages. For administrators, faculty, and staff. ABAG, Publications, P.O. Box 2050, Oakland, CA 94604-2050 ($7 + $3 P&H) (P90002BAR.).

Earthquake Preparedness: A Key to Small Business Survival. 1985, 8 pages. ABAG, Publications, P.O. Box 2050, Oakland, CA 94604-2050 ($3 + $1 P&H) (P87055BAR).



Earthquake Preparedness Policy: Considerations for School Governing Boards. January, 1991, 12 pages. ABAG, Publications, P.O. Box 2050, Oakland, CA 94604-2050 (3 + $1 P&H) (P91001BAR).

Corporate Comprehensive Earthquake Preparedness Planning Guidelines. 1985, 48 pages, ABAG, Publications, P.O. Box 2050, Oakland, CA 94604-2050 ($2.00+$.90 P&H) (ABAG P85055BAR).

Movers and Shakers State Farm Insurance Co. Public Relations Department (E-8), One State Farm Plaza, Bloomington, Il. 61710-0001 Free.

ABOUT REDUCING DAMAGE WITHIN BUILDINGS

Reducing the Risks of Nonstructural Earthquake Damage: A Practical Guide. October, 1985, 90 pages ABAG, Publications, P.O. Box 2050, Oakland, CA 94604-2050 ($8 + $2 P&H) (P87056BAR).

Joint Symposium on Earthquake Hazard Management in Urban Areas. September, 1992, 70 pages, ABAG, Publications, P.O. Box 2050, Oakland, CA 94604-2050 ($5 + $2 P&H) (P92003BAR).

ABOUT MAKING BUILDINGS SAFER

Peace of Mind in Earthquake Country. By Peter Yanev, Chronicle Books, San Francisco, California, 1990, 304 pages ($12.95).

Home Buyers Guide to Earthquake Hazards. 1989, 13 pages (Governers Office of Emergency Services Bay Area Earthquake Project single copies free).

Strengthening Wood Frame Houses for Earthquake Safety. July, 1990, 36 pages, ABAG, Publications, P.O. Box 2050, Oakland, CA 94604-2050 ($5 + $1 P&H) (P90004BAR).

Earthquake Safe. By David Helfant, 1989, 55 pages from Builders Booksources, 1817 Fourth St., Berkeley, CA 94710, (510) 845-6874.($5.95 +3.50 P&H).

Rapid Visual Screening of Buildings for Potential Seismic Hazards: A Handbook. Federal Emergency Management Agency, FEMA-154, 1988, 185 pages (FEMA, free).

Earthquake Hazards and Wood Frame Houses: What You Should Know and Can Do. By M. Comerio and H. Levin, 1982, 46 pages, Center for Environmental Design Research, 390 Wurster Hall, University of California, Berkeley, CA 94720 (510) 642-2896. ($6.50 Make check payable to "U.C." Regents).

ABOUT FAULTS

Fault-Rupture Hazard Zones in California. Alquist-Priolo Special studies Zones Act of 1972 with index to special studies zones maps, California Department of Conservation, Division of Mines and Geology Special Publication 42, 1988 (revised), 24 pages (CDMG, $1.00).

Fault Map of California scale 1:750,000 California Department of Conservation, Division of Mines and Geology, PO Box 2980, Sacramento, CA 95812-2980 ($15.00).

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This publication is meant to be instructional and to provide information that will help you understand and reduce the risk from earthquakes. The information in this publication is believed to be accurate at the time of publication. The agencies and individuals involved in the preparation, printing, and distribution of this publication assume no responsibility for any action that is based on the information found in this publication.

CREDITS

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The unique geologic setting of the North Coast makes it one of the most earthquake-prone areas of the United States. The April, 1992, earthquakes were centered in a remote area where few people live. Future earthquakes located closer to population centers will cause more severe damage. By taking action now, we can drastically reduce earthquake losses.

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