The Slippery Slope of Litigating Geologic Hazards: California's Portuguese Bend Landslide

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Part I – News Article

Homeowners Allege Negligence

(AP) Homeowners in the exclusive Portuguese Bend neighborhood near Long Beach, CA have filed a class action suit in state court against the County of Los Angeles. This suit seeks compensation for damages to 160 homes affected by a landslide encompassing an area of roughly 270 acres. The homeowners allege that this landslide was caused by road construction along Crenshaw Boulevard, a county highway that traverses the northern portion of the slide area. The lawsuit also alleges fraud and negligence on the part of the developers for participating with the county in road construction in a geologically unstable area.

Photo of Palos Verdes, Portuguese Bend, September 19, 2007, by Lizzie McVeigh.

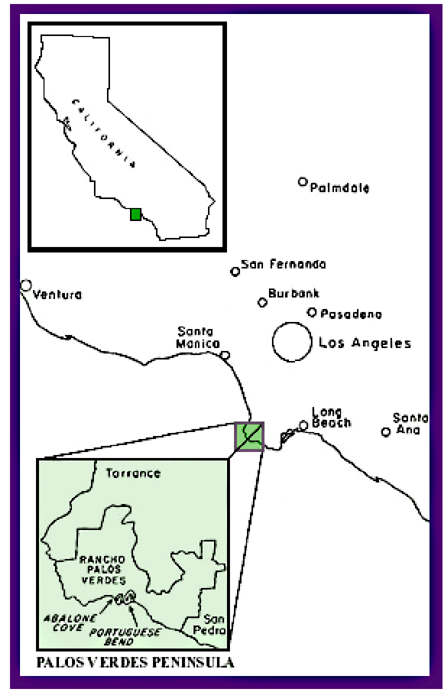
Questions

1. What is the essence of this article?
2. What is the scientific basis for the homeowners' suit?
3. What information is required to evaluate the scientific basis of this lawsuit?

Part II – Landslide

Land Use

Figure 1. Palos Verdes Peninsula



Land use on the Palos Verdes Peninsula (see Figure 1) consists mostly of single-family homes built on large lots, many of which have panoramic ocean views. The affluent residents of this area value a rural lifestyle, and the peninsula is zoned to permit horses, stables and riding trails. Figure 2 is a topographic map showing the Portuguese Bend area.

By the time of the 1956 Portuguese Bend landslide, more than 100 homes had been built within the slide area, most of them south of Palos Verdes Drive. All of these houses were constructed with individual septic systems, generally consisting of septic tanks and seepage pits.

Geologic Setting

The topography of the peninsula is generally hilly, ranging from gently rolling to steep. A bluff exists along the coastline, varying between 30 and 60 meters (100 and 200 feet) in height above sea level, and elevations rise to over 460 meters (1500 feet) within 4.5 km (3 miles) of the coast. The preslide topography was characterized by a series of terraces that rose from the sea like giant steps. However, within landslide areas, terraces have been disrupted and the terrain now appears hummocky and irregular. Large arcuate scarps occur near the head of slide masses.

Within 1.5 km (one mile) of the coastline, the subsurface consists of volcanic and sedimentary rocks that dip toward the sea at about the same angle as the average slope of the land surface (see Figure 3, next page, for a cross section). Landslide slip surfaces occur near the base of a volcanic rock unit known as the Portuguese Tuff. This rock unit includes a layer of bentonite, a clay mineral that forms from the weathering of volcanic ash and is capable of absorbing large amounts of water.

Figure 2. Portuguese Bend, Topographic Map

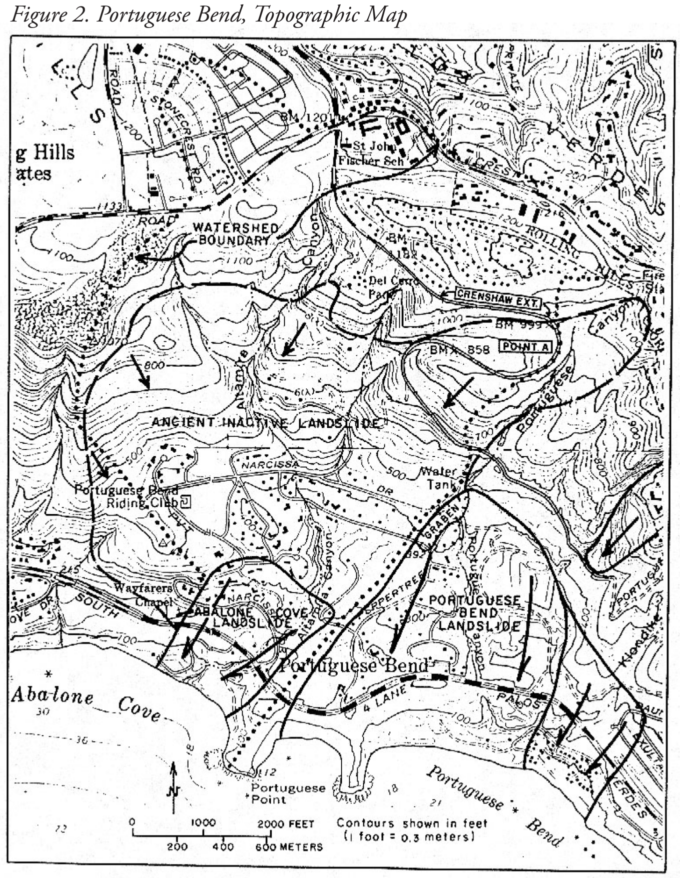


Figure 2
Site Map of the Portuguese Bend and Abalone Cove Landslides

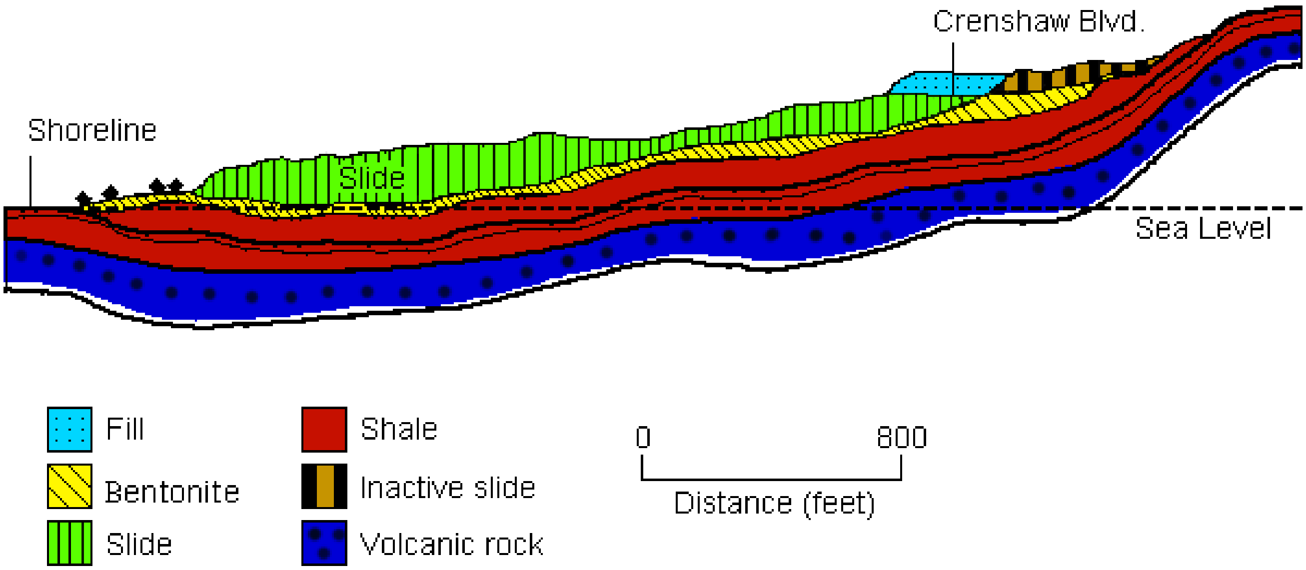
Landslide Movement

Landslides have been active here for thousands of years, but recent landslide activity has been attributed in part to human actions. The Portuguese Bend landslide began its modern movement in August 1956, when displacement was noticed at its northeast margin. Movement gradually extended downslope such that the entire eastern edge of the slide mass was moving within six weeks. By the summer of 1957, the entire slide mass was sliding towards the sea.

The rates of slippage have varied through time, initially moving between 2 and 12 cm/day (1 and 5 inches/day) for the first two years, and then diminishing to less than

1 cm/day (0.4 in/day) over the next four years. The slide mass continued to move for almost 40 years, and the cumulative displacement exceeds 30 m (100 feet) in some areas.

Figure 3. Landslide Cross Section



Questions

1. What natural conditions in this area are conducive to landslides?
2. What specific type of mass movement is likely to occur in this geologic setting?
3. Is it possible that the 1956 Portuguese Bend Landslide was triggered entirely by natural causes?
4. What human action(s) could have contributed or triggered this landslide?

Part III – Damages, Litigation and Mitigation

Slide Effects on Structures

The effects of the landslide have been progressive, first causing damage and then destruction of homes and other structures. Many roads in the area are buckled and broken, requiring repeated repairs. By 1961, more than 150 homes had been destroyed or seriously damaged by the slide. Since then, many additional homes have been affected to some degree, and Palos Verdes Drive has been in constant need of repair. All underground utilities have been placed in above-ground steel pipes with flexible couplings.

Albers v. County of Los Angeles

Affected homeowners filed suit in 1961 against the County of Los Angeles in a successful effort to obtain compensation for their losses, which amounted to nearly $10 million in 1960 dollars. The suit charged the county with liability based on negligence for the construction of Crenshaw Boulevard, which added weight to the upper slopes of the slide mass in the form of artificial fill. Although negligence could not be established, the county was found liable by the presiding judge using inverse condemnation.

Arguments by experts for the county brought several facts to light that were ultimately ignored in the judgment. These included: (1) the amount of artificial fill used in constructing Crenshaw Boulevard equaled only 0.5 percent of the total landslide mass in terms of weight, (2) the water added through septic system discharge and lawn irrigation probably caused groundwater levels in the slide mass to rise, and (3) detergents in the septic system effluent would be expected to have a negative effect on the strength of saturated bentonite clays.

Corrective Actions

An early attempt to prevent further slope movement was made by installing precast concrete pins through the slide mass in 1957. These pins, measuring 1.2 m (4 ft) in diameter and 6 m (20 ft) in length, extended 3 m (10 ft) into the underlying bedrock. Initially they slowed the rate of slope movement by 50 percent; however, after five months, the pins failed and movement accelerated.

The first of a three-phase stabilization project involved the installation of eight dewatering wells in the slide mass during the mid-1980s. Phase 2, completed during the late 1980s, included road relocations, surface drainage improvements, regrading the seaward side of the slide mass, and the addition of five more wells. In the early 1990s, revetments were placed at the base of the bluffs to protect them from wave erosion. Following the completion of this third phase, parts of the landslide were largely stabilized.

Questions

1. What information would be needed to evaluate the effect of septic system discharge and lawn irrigation on groundwater levels?
2. How would the construction of Crenshaw Boulevard differ from the earlier construction of houses in terms of its ability to trigger a landslide?
3. What do the success of various corrective actions taken here suggest was (were) the cause(s) of the landslide?

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Internet Sites

Slope Stability, Triggering Events, Mass Wasting Hazards.
http://www.tulane.edu/~sanelson/geol204/slopestability.htm
(Includes a section on the Portuguese Bend Landslide.)

USGS National Landslide Information Center.
http://landslides.usgs.gov/nlic/

Credits: Photo of Palos Verdes, Portuguese Bend, September 19, 2007, by Lizzie McVeigh, released into the public domain, available at <https://en.wikipedia.org/wiki/File:Portuguese_Bend_in_California.jpg>.

Figures 1 and 2 from Shuirman, Gerard & James E. Slosson. *Forensic Engineering*. (San Diego, CA: Academic Press, Inc. 1992). In that work, Figure 1 appears as Figure 5-1 on page 113, and Figure 2 appears as Figure 5-2 on page 115. Both figures are used with permission of the publisher.

Figure 3 from Pipkin & Trent. *Geology & the Environment*. (Wadsworth Publishing Co. 1997) Figure 7.32, page 520, redrawn courtesy M. Natland. Used with permission of the publisher.