ATTACHMENT 5.

Statement of Garniss H. Curtis, Professor Emeritus Department of Earth and Planetary Science, U.C. Berkeley

On Sun, May 11, 2008 at 2:10 PM, Garniss Curtis <gcurtis@berkeley.edu> wrote:

To: anne.shaw@ucop.edu
From: Garniss Curtis <gcurtis@berkeley.edu>
Subject: regarding certification of final environmental impact reports for the proposed computational research and theory facility and the Helios energy resource facility and project approvals. [*Please note that several typographical errors and misspellings have been corrected in the following text.*]

As the request for my geologic opinion on the advisability of constructing large buildings in the lower part of Strawberry Canyon and in the next canyon to the north known as Blackberry Canyon came to me on May 4th, I have to be brief and rely on my memory. I shall first say as strongly as I can "absolutely do not construct any buildings in those two canyons", then I shall go into the reason based on the work I did as consultant to Mr. Ben Lennart 25 to 35 years ago, who was contracted by the University to investigate a number of sites for possible constructions or for stopping landslides that were threatening buildings.

First, the geologic setting of the two areas: The active Hayward Fault goes across the mouths of both canyons. Further east, the Wildcat Canyon fault parallels the Hayward Fault behind the Botanical Gardens and northward joins the Hayward near the town of San Pablo. Southward the Wildcat Canyon fault can be easily traced to Sibley Park and beyond. A few small epicenters lie along this fault near its junction with the Hayward, but it does not seem to be active elsewhere to the south. However, in the past, the area between the two streams and the two faults (which includes the whole of the Lawrence Laboratory complex) lay four miles to the south next to Sibley Park. The volcanic rocks in both areas have potassium-argon dates of approximately 10 million years, and the rhyolite found in both of them is the same rhyolite. The volcanic rocks underlying most of the Lawrence Lab complex fill an old crater, a collapse caldera. The old volcano that once rose above these rocks collapsed after the expulsion of a very large amount of rhyolite ash, now largely removed by erosion. The volcanic rocks broke up as the collapse occurred and many show crushing and deformation and are mixed with large amounts of ash and volcanic fragmental debris. This material should never have been built on as it is so clay-rich and unconsolidated. The western rim of this caldera is easily traced from its arcuate shape which is cut off by the Wildcat Canyon Fault just south of the Botanical Gardens near the upper part of Strawberry Creek. It swings around very close to the old Cyclotron and continues north to join the Wildcat Canyon Fault in Wildcat Canyon not far from the Merry-go-Round in Tilden Park. The boundary rocks to the west are sandstones and shales thought to be of Cretaceous age, that is, they are older than 65 million years. Exposures of these sandstones and shales are good below Building 50 down to Bowles Hall, and they dip westward at angles of 20 to 25 degrees, about which more later. The Hayward Fault passes very close to the rear of Bowles Hall after going through the Stadium where it has caused major deformation of the support pillars and offset of the two sides of the stadium since its construction in 1927.

Behind Hearst Mining Bldg and a few feet to the east, is the Lawson Adit which is a tunnel going eastward. Begun in the 1920' or earlier, it was completed in 1938 when it reached the Hayward Fault. Professor George Louderback told me (Personal comm.) that it was not ordinary fault gouge that he found in the Hayward Fault zone but a peculiar mixture of serpentine and metamorphic rocks that also appear on the surface and underlie Stern Hall and part of Foothill Student Housing. Founders Rock near the corner of Hearst and Gayley Road is in this melange. Also in the tunnel are several exposures of the offset of Strawberry Creek as determined from the contained rounded cobbles of Strawberry Canyon origin . Thus this indicates a displacemeent of more than 600 feet north along the Hayward Fault.

Still further north along the Hayward all the way to San Pablo huge amounts of the melange similar to that in the Lawson Adit have been squeezed out of the Hayward Fault and are gradually sliding down the slope below the fault. Much of this melange has reached the bottom of the hill back of El Cerrito. Along the Arlington many houses built on this melange are sliding and have caused a great number of legal problems. Within the fault itself no movement can be detected in these deposits, some of which are more than 100 feet thick. Thus we believe that movement and expulsion of this melange takes place during major earthquakes on the Hayward Fault.

A great deal of research has been done recently on the Hayward Fault by the USGS at Menlo Park which was reported in a talk on the last Thursday of this past April. They have established a return time of major quakes of 6.5-7 magnitude on the Hayward Fault of 130 years. The last major quake along the northern part of the Hayward Fault was 140 years ago, so we are over-due. They estimate that there is approximately a 65 percent chance a major quake will occur in the next 30 years.

Lennart was able to get survey notes from East Bay Municipal Utility District for the San Pablo Dam water tunnel to El Cerrito which crosses the Hayward Fault and shows that the right lateral horizontal movement of approximately one centimeter per year is matched by uplift of the east side of the fault of approximately one centimeter per year also. So, with the evidence of the horizontal displacement of the old Strawberry Creek of 600 feet horizontally along Galey Road, the Cretaceous sedimentary rocks east of the Hayward Fault there have also risen 600 feet. Building 50(?) sits on these Cretaceous strata which, as mentioned, dip westward 20-25 degrees. If an earthquake occurs when these beds are soaked with winter rains the chance of a major landslide are great along the slippage planes of shale dipping westward. Minor slides have already occurred in these beds behind Bowles Hall. Indeed, the Foothill Student Housing was planned to be built there until I called attention to the landslide. A major landslide would probably destroy all the buildings on both sides of Galey Road from the Stadium to the buildings on both sides of Hearst Avenue and would probably reach Dow Library, destroying everything in its path to that point and possibly beyond. Buildings in the lower parts of both Strawberry and Blackberry Canyons would be buried if not destroyed.

Major landslides of the type I have described here are not rare along the Hayward Fault as was shown to us during our study of the Hayward fault at the base of the hill behind the Clark Kerr Campus. We discovered that most of that campus was underlain by a large landslide that had originated in Claremont Canyon, and was gradually moved northward along the Hayward Fault. Trenches and drill holes showed this landslide to be up to 30 feet thick. It extends westward to and possibly beyond Piedmont Ave. Further south is a huge landslide that underlies most of the campus of Mills College and extends westward another quarter mile Still further south are more large slides that have originated in canyons and steep slopes east of the Hayward Fault. As the hills rise and become unstable, earthquakes cause them to break loose and slide. Very few large slides have occurred on the eastern slopes of the Berkeley Hills, hence the relationship to earthquakes of major landslides close to the Hayward Fault along the western slopes of the Berkeley Hills. Normal erosion rounds off unstable areas on the eastern slope of the Berkeley Hills before they break loose and slide.

Most of the buildings of the Lawrence Lab. are on the unstable ground filling the old caldera, particularly the Bevatron and associated buildings. As the Cretaceous beds immediately west of these buildings have been eroded away there is nothing to keep these soft caldera-filled beds from sliding. The buildings on them will certainly move a few feet in a major earthquake if not hundreds of feet. Keep in mind the Loma Prieta quake of I989 of magnitude 6.9 which from a distance of over 60 miles destroyed a section of the Bay Bridge, a section of the overhead freeway in Oakland killing 63 people, and many houses on filled ground in the Marina of northern San Francisco some 70 miles from the quake!

No major buildings of any kind should be constructed in either of these canyons bordering this huge block of unstable rock.

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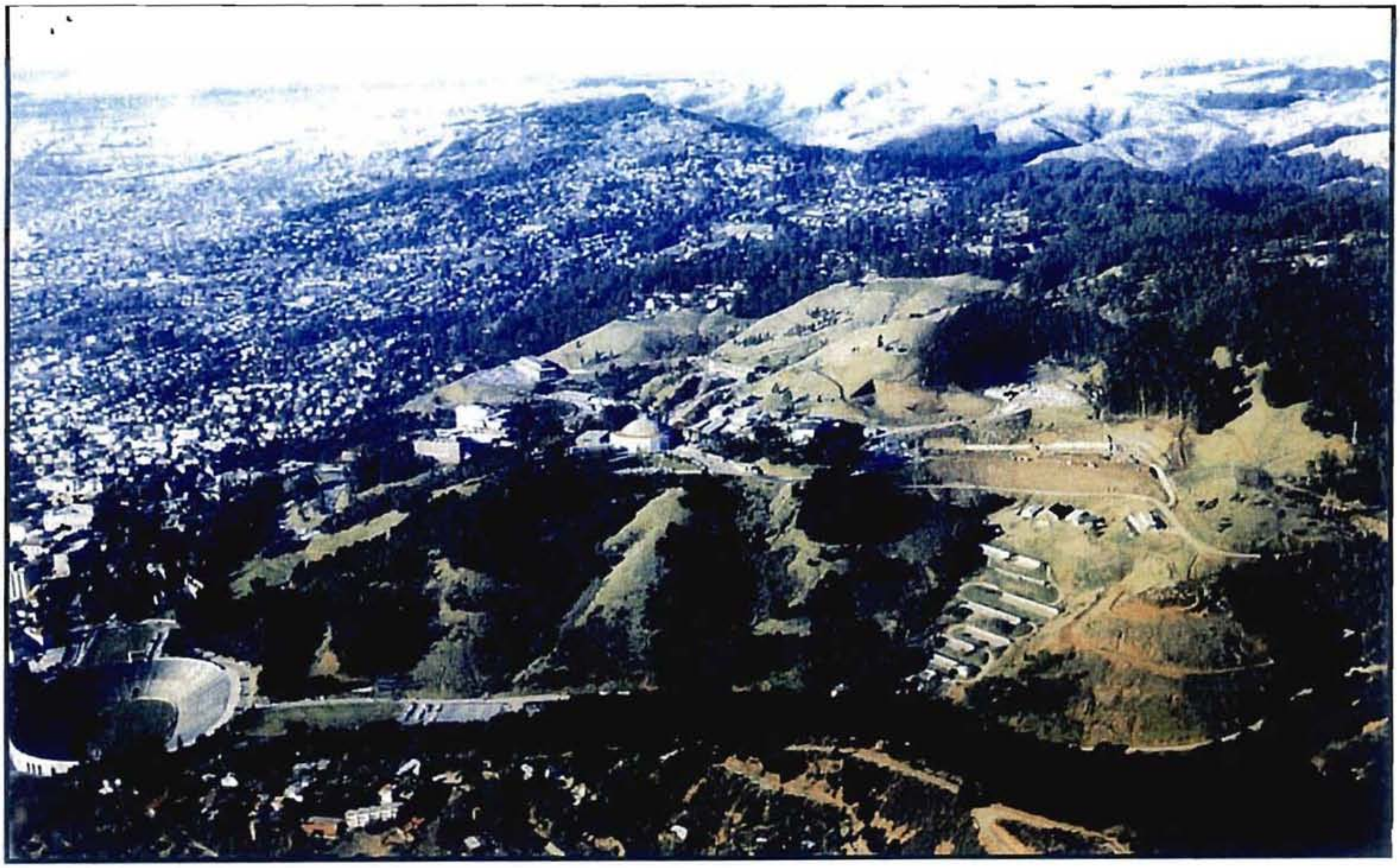
Chronology of the Campus Hill Area Development and Slope Instability Through 1984

Early 1900's	Development of the campus hill area begins
1949	Numerous slides occur as a result of Bevatron (Building 51) construction (1st recorded stability problems)
1950's	LBL significantly increases construction, massive cuts and fills undertaken to create flat pads for roads and buildings
1962	Small slope failures occur in the slopes behind Building 46, at site of Building 77, and reactivation of old slide uphill and east of Building 17
1962	Hydraugers installed to stabilize cut slope at northeast corner of Building 77 site
1963	Additional hydraugers installed behind slope north of Building 77 to stabilize old slide area
1963	Centennial Drive constructed
1967 - 1969	Slope instability continues at cut and fill behind Building 77, slope repairs and installation of hydraugers
1967	Slide on natural slope between Building 76 and 79
1969	Wet winter, much larger and more damaging slides occur including major failure of slope between LBL Corporation Yard and Centennial Drive which is repaired with buttress fill and subdrainage
1968-69	Serious slide occurs at the Centennial Drive overpass eastern abutment, road partially closed, hydraugers installed
1970	Slide occurred adjacent to Building 71 southeast parking lot, hydraugers installed
X 1973 →	Building 46 bisected by a very large slide, major repairs required including dewatering; slide continues to move in wet seasons
1975	Slide at compacted fill south of Building 77
1978	Slide at compacted fill south of Building 72
1975 →	Major hill area dewatering program undertaken, Shively Well No. 1 drilled (still continuously pumped)
1978	Centennial Drive overpass deforms further, steel bracing added
1979	Large scale dewatering of the hill attempted, second well drilled, two long nearly horizontal hydrauger drains installed into hill from Poultry Husbandry site
1980's	Numerous small slumps and mudflows occurred throughout hill area
1982	Earth movement at Centennial Drive overpass causes road closure, temporary repairs
1983	More movement at Centennial Drive overpass, road closed, major buttress fill repair required
1984	Centennial Drive reopened

Source: Complied from information contained in the Hill Area Dewatering and Stabilization Studies (Converse Consultants, 1984).

In addition to the information above, by 1987 LBNL had mapped some 30 landslides within the lab's Strawberry and Blackberry Canyons, and by 2008 the number of slides was up to 40, including LBNL's East Canyon landslide area.

Regarding Building 46 slide (see above), notes from a site visit by Robert Dunn and Professor Richard Goodman (October 18, 1976) state: Building 46 was "first founded on what was thought to be solid basalt-actually was LARGE BLOCKS." See also attached figure of the collapsed caldera (after Garniss Curtis, Professor Emeritus) at LBNL.



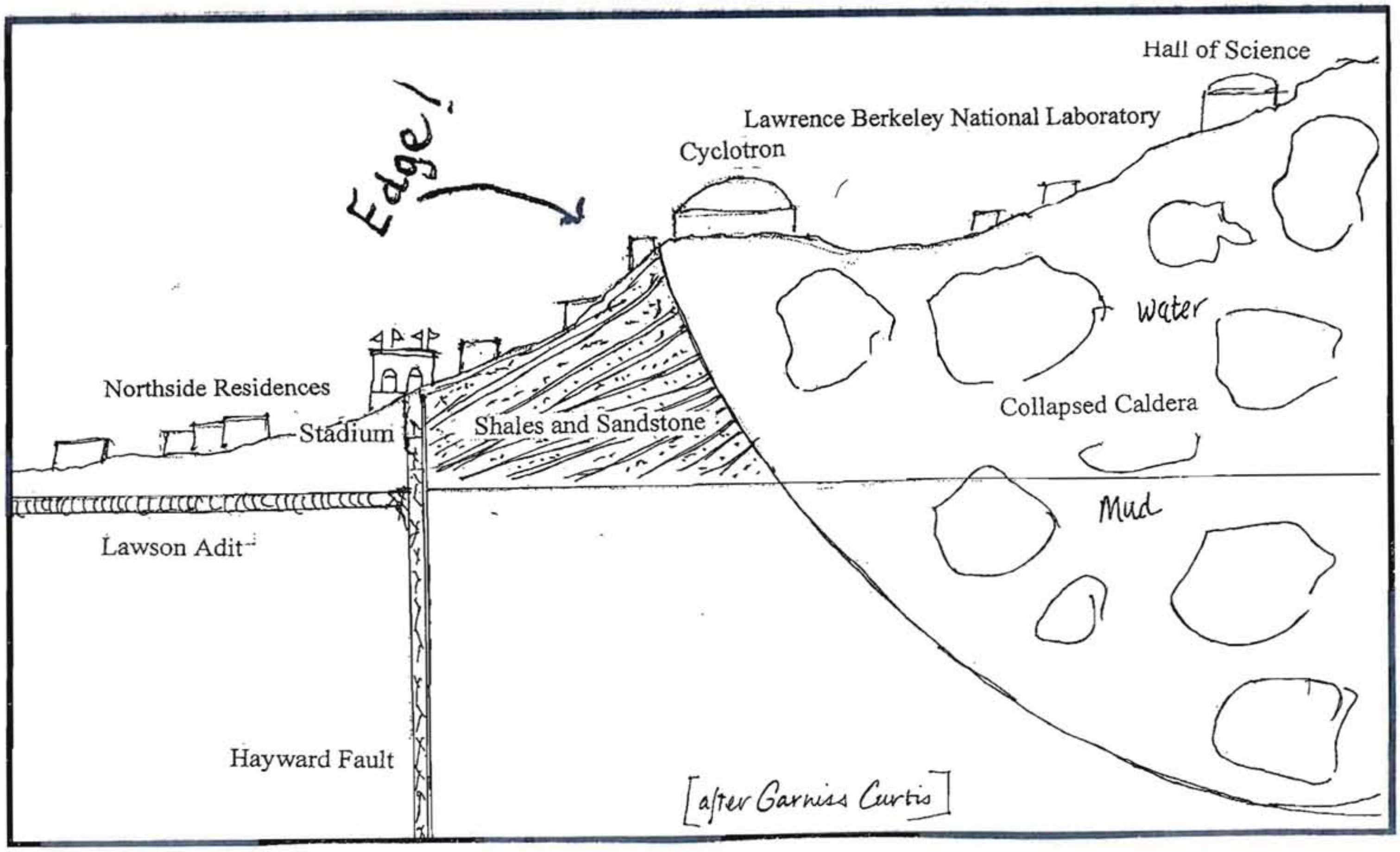


Figure above shows an unknown mixture of mud, perched water and boulders, for which LBNL has yet to do a comprehensive hydrogeological study of its composition. Also missing is the mapping of LBNL's hydrostratigraphic units (HSUs), which would show the hydraulic connection between various permeable layers of the HSUs sedimentary sequences.