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STRAWBERRY CANYON

UNIVERSITY OF CALIFORNIA

BERKELEY

A land use and vegetative management study

by Garrett Eckbo & Associates

for the Office of Architects & Engineers

June 1976

Garrett Eckbo and Associates

23 June 1976

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Mr. F.F. Warnke, Senior Landscape Architect
Office of Architects and Engineers
University of California at Berkeley
Berkeley, California

Account No. 918181
Reg. No. AE 26B

Dear Mr. Warnke,

We take pleasure in transmitting herewith the final report on our study of Strawberry Canyon Development, as authorized June 13, 1975.

The program for this study specified certain elements in its content:

1. Evaluation and assimilation of existing reports for the area.

2. Vegetative maintenance policy and revegetation plan.

3. Final ecological study area boundaries.

4. Fire hazard reduction.

5. Land use priorities.

6. Future non-vegetative management policies.

In order to respond to these specifics we felt that we must look at the Canyon area as a total landscape in which interaction between people and nature has produced a complex with precise characteristics and qualities.

This holistic approach necessitated some reordering of the specified elements. Vegetative and natural area management and maintenance policy must be formulated on the basis of overall land use priorities and policies. These must deal with four basic types of use:

1. Institutional, requiring construction and generating motorized traffic for access and service.

2. Educational and research, primarily concerned with natural or manipulated landscape conditions.

3. Recreational, concerned with active facilities and/or semi-wilderness conditions.

Desirable basic policies governing these uses seem likely to be as follows:

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Institutional uses cannot expand much beyond their current areas. One substantial and reasonably acceptable building site is available above the Lawrence Hall of Science on either side of Space Sciences. However, anything proposed there should be subjected to intensive environmental design study, in terms of its visual impact on the Canyon landscape from within and without. Two other sites which are feasible from an engineering point of view are undesirable because of ecological, access, or utility problems.

Educational and research uses should continue to dominate the Canyon area. This seems to justify an expansion of Ecological Study Area boundaries, and to require a more carefully structured management. Academic uses must focus on the conservation of the resources they are using.

Recreational uses, primarily for the campus community, should continue in a hopefully symbiotic relationship with academic uses. Questions of convenience and access, for the non-campus public and for the less agile or energetic members of the campus community, remain to be worked out.

The larger question, which is central in these recommendations, is that whoever uses the Canyon area, for whatever purposes and in whatever part of it; and whoever looks at or into the Canyon from outside, or passes through or over it; are all experiencing it as a total landscape structure or complex, a total people/nature artifact. Its impact on all of these experiences, visually and through the other senses, is one of its primary functions. Therefore we have viewed the Canyon as a potential work of landscape art, including and transcending all of its multiple technical, functional and cultural aspects. We believe that the comprehensive view will enhance relations between all of these component aspects, and improve each one.

The report endeavors to deal with existing conditions, proposals by others and recommendations as to further action and ongoing policies within this comprehensive framework.

I would like to acknowledge substantial help and cooperation in the preparation of this report from your office; from Engineer Ben Lennert, who provided the descriptions of Geography and Geology and of Rock and Soils Conditions, the storm drainage reports and the analysis of feasible building sites, all included in his appendices to this report; and from the Committee on Environmental Quality, particularly Professor Joe McBride. His aid in developing guidelines for vegetative management was invaluable.

Sincerely,

Garrett Eckbo

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SUMMARY OF PROPOSALS

1. Vegetation management recommendations for specific vegetation units are shown in Table 1. These recommendations were developed to enhance the visual quality of the canyon, reduce erosion, reduce fire hazards, and maintain a variety of vegetation types for teaching and research.

2. Fuel management recommendations for specific vegetation units are shown in Table 1. Fire as a tool is recommended for reducing fuel loads in many vegetation types.

3. Future building construction should be restricted to the area between the Lawrence Hall of Science and Grizzly Peak Blvd. The two other possible sites in the Canyon are geologically stable but present problems due to the lack of existing utilities or the aesthetic and ecological disruption which would occur if buildings were constructed on them (see Map 6).

4. An improved trail system is proposed which will provide several round trip hiking routes, improve access in the canyon for fire suppression, and improve access for teaching purposes (see Map 12).

5. This report proposes the closing of Centennial Drive above the Lawrence Hall of Science to reduce traffic, air, and noise pollution in the Canyon (see Map 12a).

6. Expansion of the Ecological Study area boundaries to include those

areas proposed in the Siri/Lindgren Report (see Map 10).

7. Slight expansion of area of the Botanical Garden to facilitate boundary maintenance and provide additional space for research (see Map 13c).

8. A vegetation management expert should be hired to direct the re-vegetation of the canyon, supervise trail construction and maintenance, manage fuel load, and monitor use of the canyon.

9. Each one of these proposals will require further, more detailed and intensive study on the ground in order to implement it. These studies may be carried out by any or all of the following:

a. The architect/engineer office

b. Consultants

c. The management team.

The further studies might be set up as follows:

a. Establishment of management office and team.

b. Improved and expanded trail system.

c. Closing and re-design of Centennial Drive.

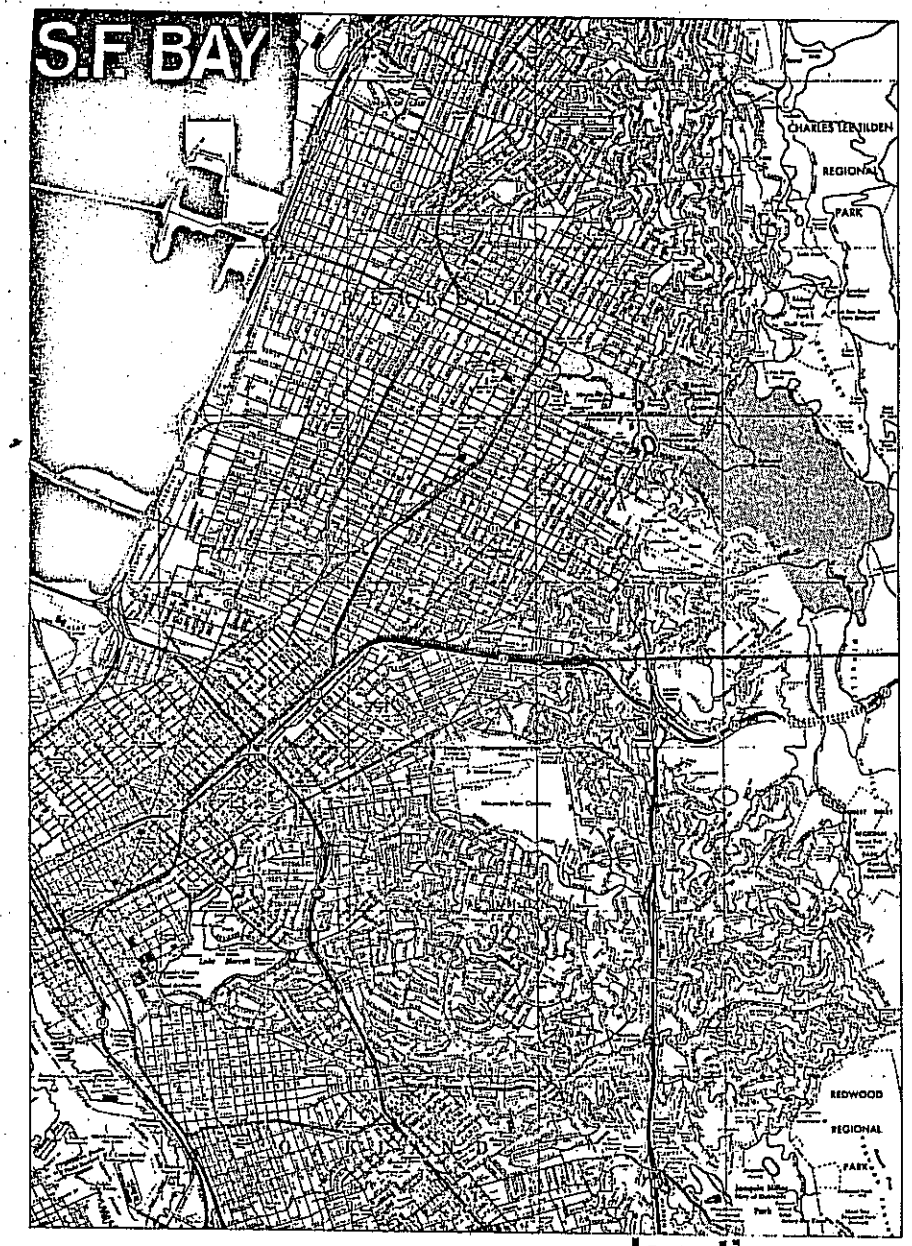
d. Re-vegetation.

e. Vegetation and fire hazard management.

f. Building construction on a per site basis when and if need and/or demand emerge.

g. Expanded Ecological Study Area definition in relation to demands for education, research, recreation, and Botanic Garden proposals.

EXISTING CONDITIONS



location map

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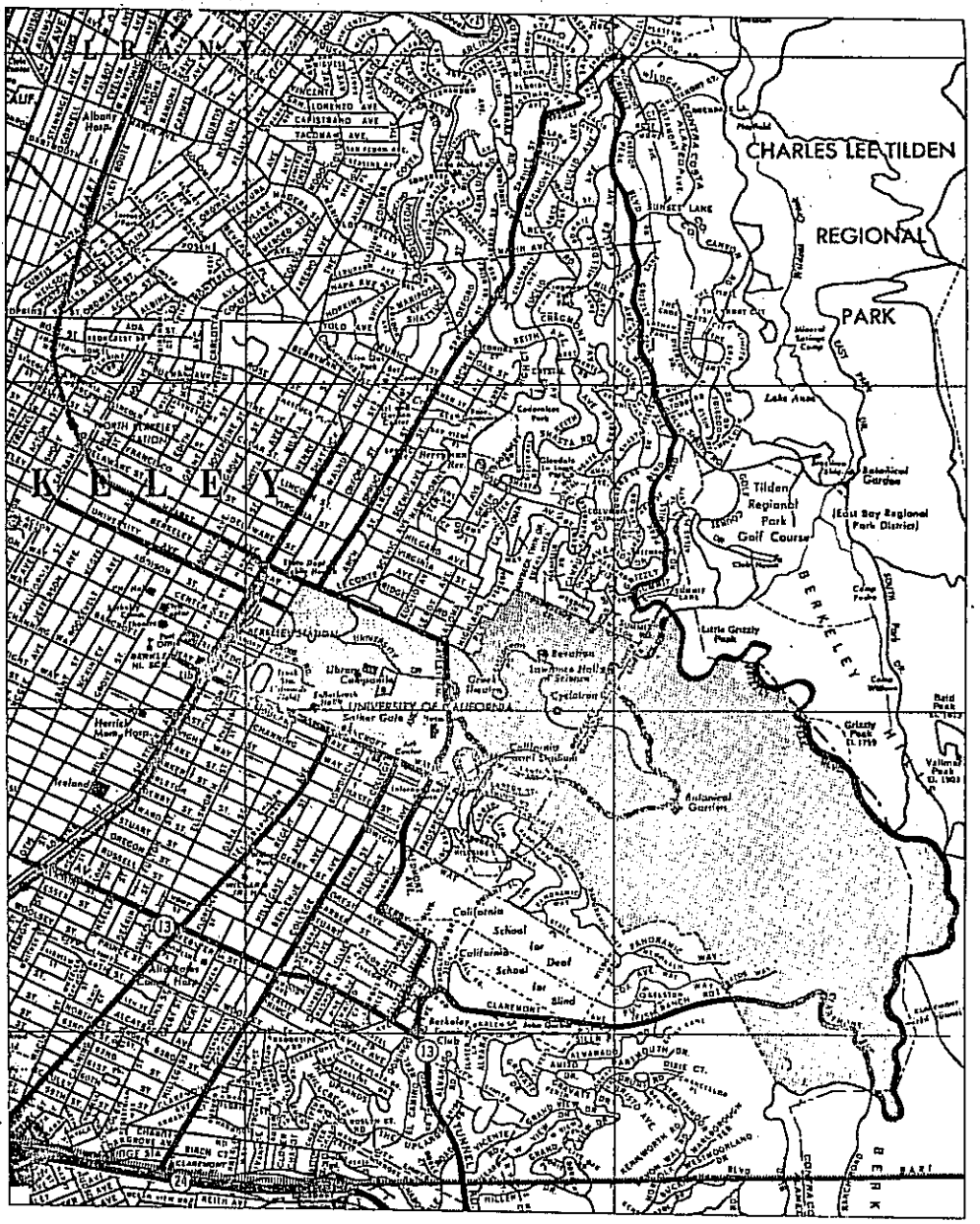

area map

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1

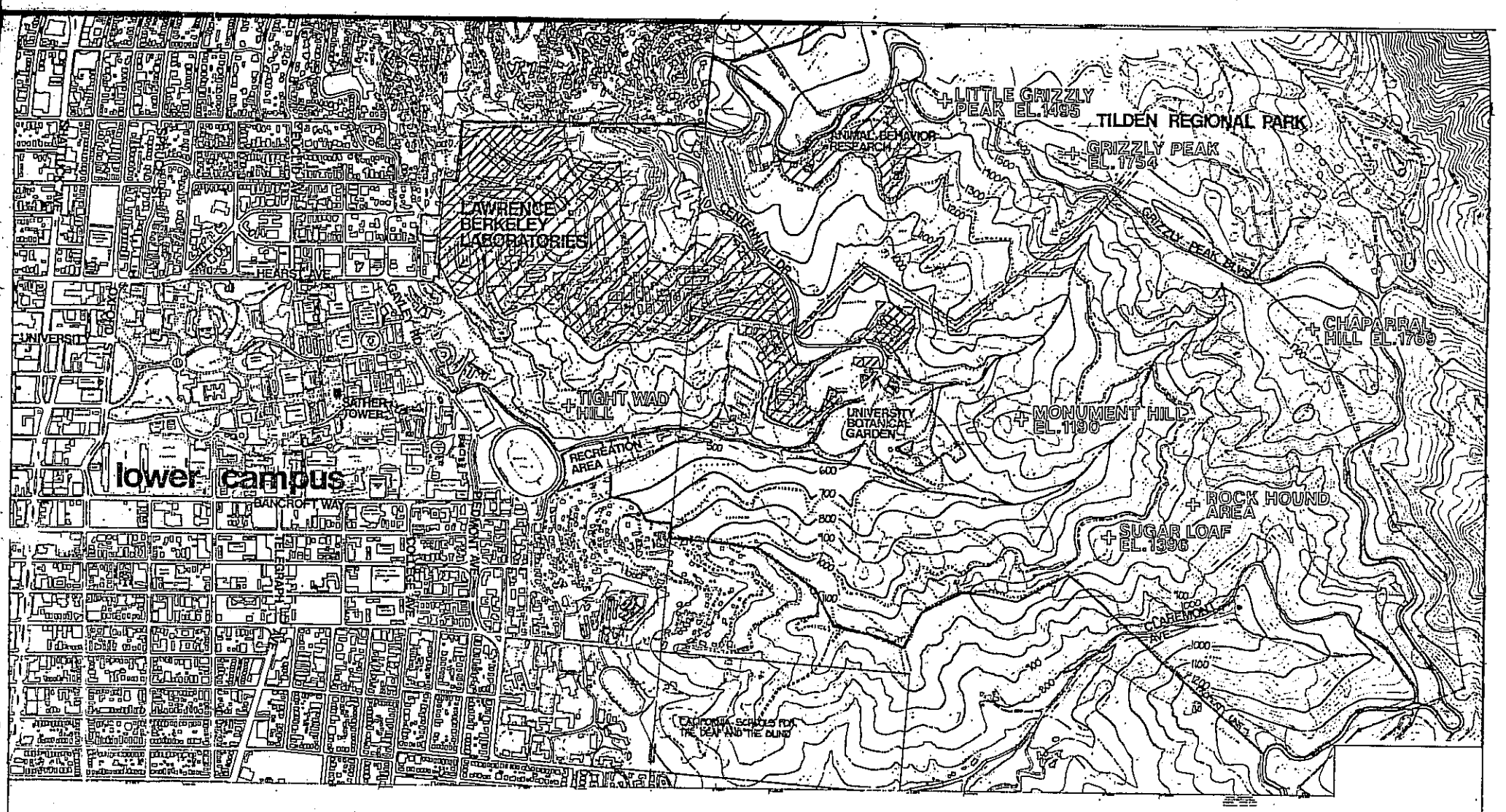
I. EXISTING CONDITIONS

REGIONAL RELATIONS

Strawberry Canyon is the uphill major portion of the University of California lands in Berkeley/Oakland. It comprises roughly 1000 acres of steep and largely undeveloped land above and east of Gayley Road. The main campus occupies about 150 acres of more gently sloping land below and west of Gayley. The lower quarter of the Canyon lands lies within the City of Berkeley, the upper three quarters within the City of Oakland.

The main lower campus is a central element in the physical structure of Berkeley. The upper canyon lands connect the campus and the city with the ridge-top intersection of Alameda and Contra Costa Counties (roughly marked by Grizzly Peak Boulevard) and their regional park system. Tilden Park abuts along the northeast boundary of Strawberry Canyon. West of the Park hillside residences follow the boundary closely down into the city. On the south side of the campus lands hillside housing in the Panoramic Way area abuts the University closely. Further east, over into Claremont Canyon and around the east side to Tilden Park, the neighboring lands are undeveloped.

South of the campus lands, between Dwight Way and Derby Street east of Warring, about 125 acres of the California School for the Deaf and the Blind extend 4200 feet back into the hills. Their northeast corner is only some 200 feet from the University's south boundary, and is



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CAMPUS & TOPOGRAPHIC MAP

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2

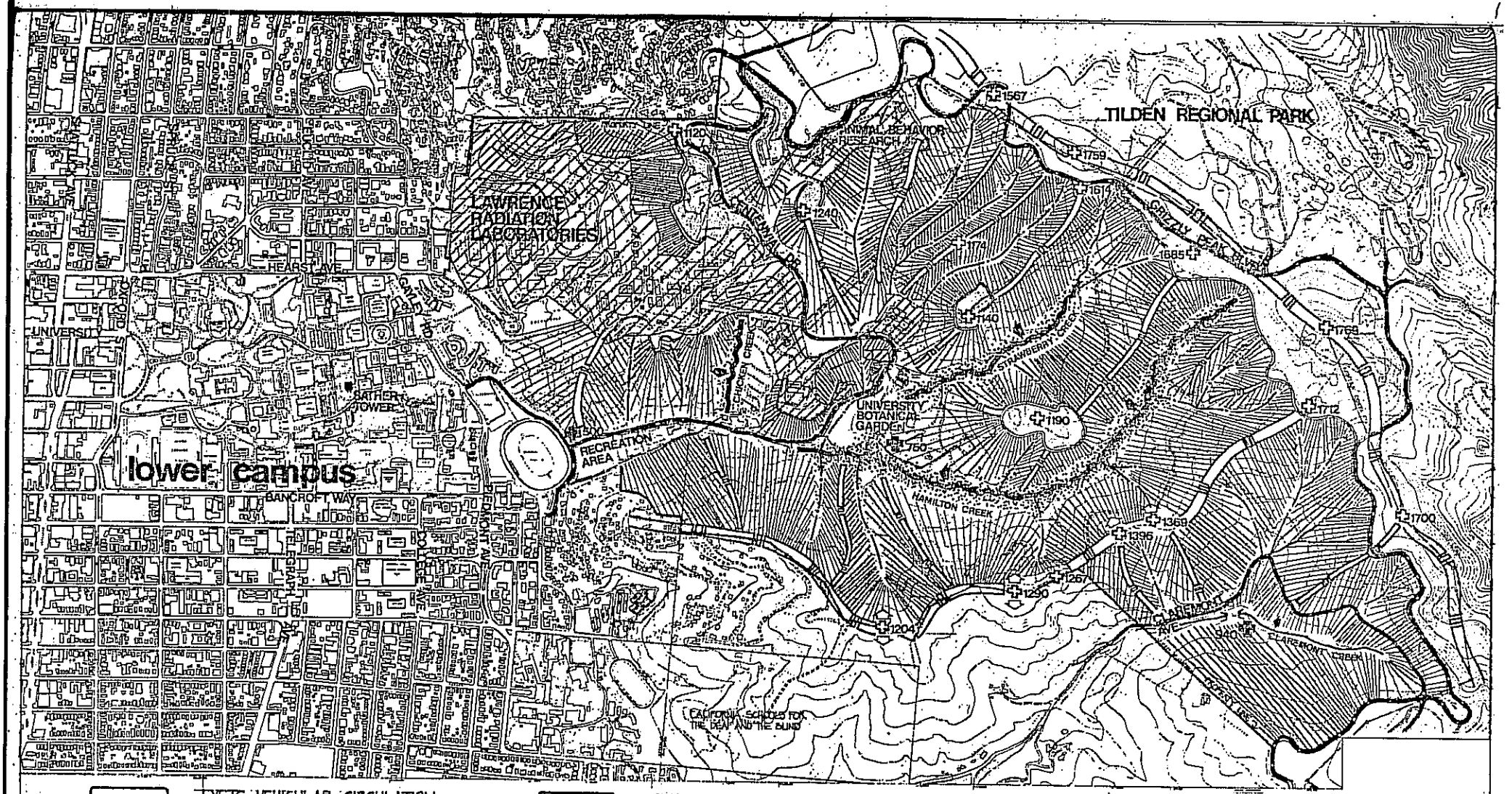
connected by a dirt road. The fact that the School has been condemned as unsafe and is to be rebuilt elsewhere may have some relevance to University planning. The central entrance to the School is 2000 feet from the Gayley Avenue entrance to the University.

EXTERIOR ACCESS

In terms of access the main lower campus is the hub of a network of arterials which connect it with the Bay Area north, south and west -- Spruce/Oxford Streets, University Avenue, Telegraph and College Avenues. Grizzly Peak Boulevard along the upper northeast border of Strawberry Canyon connects the campus with the hill parks and areas north and south, and the Orinda/Walnut Creek area east via Fish Ranch Road. Centennial Drive through Strawberry Canyon is the only direct connection from lowlands to hilltops between Claremont Avenue and Spruce Street. The lowland spread is about one mile either way from Centennial to Spruce/Oxford or Claremont/Ashby. Along Grizzly Peak the spread is about two miles either way.

TOPOGRAPHY

Topographically the Canyon is a large bowl which tapers down to a narrow neck entrance -- about 500 feet wide -- just behind the Stadium. This hilly bowl is simple in form on the southside for about two-thirds of its total length. The north side is subdivided by a series of projecting ridges, such as Monument Hill, into four sub-valleys. This means that, in a circuit around the canyon, the southwestern two-thirds is generally



EXSTG. VEHICULAR CIRCULATION

RIDGELINES

RIDGETOPS
DRAINAGE DIRECTION

1976 HIGH POINT

1975 LOW POINT

CREEK

DRAINAGE SWALE

RIPARIAN AREA

DIRECTION OF DRAINAGE

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PHYSIOGRAPHY & HYDROLOGY

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3

visible as an overall unit, dominated by Lab construction and north slope vegetation, with views into the three western sub-valleys. On the north side one is cut off from complete views into the main bowl. The north side circuit is therefore much wilder and more variable visually, with occasional partial views of Lab, City and Bay.

About 165 acres of the northwest corner, occupied by Stern and Bowles Halls, the Greek Theatre and some Lawrence Berkeley Lab buildings, are geographically outside of the north Canyon ridge line on a west-facing slope. About 200 acres of the southeast corner lands lie over the upper ridge line in Claremont Canyon. Thus the actual Strawberry Canyon area is about 635 acres. The east ridge-top zone is a very strategic strip with spectacular views both east and west. It connects the large potential future development site at the northeast corner with the relatively level fire road/promenade which connects with the top of Panoramic Way along the south side. This ridge-top has some fine groups of specimen trees.

The total Canyon lands are divided into seven topographic units:

The northwest slope above Gayley Road

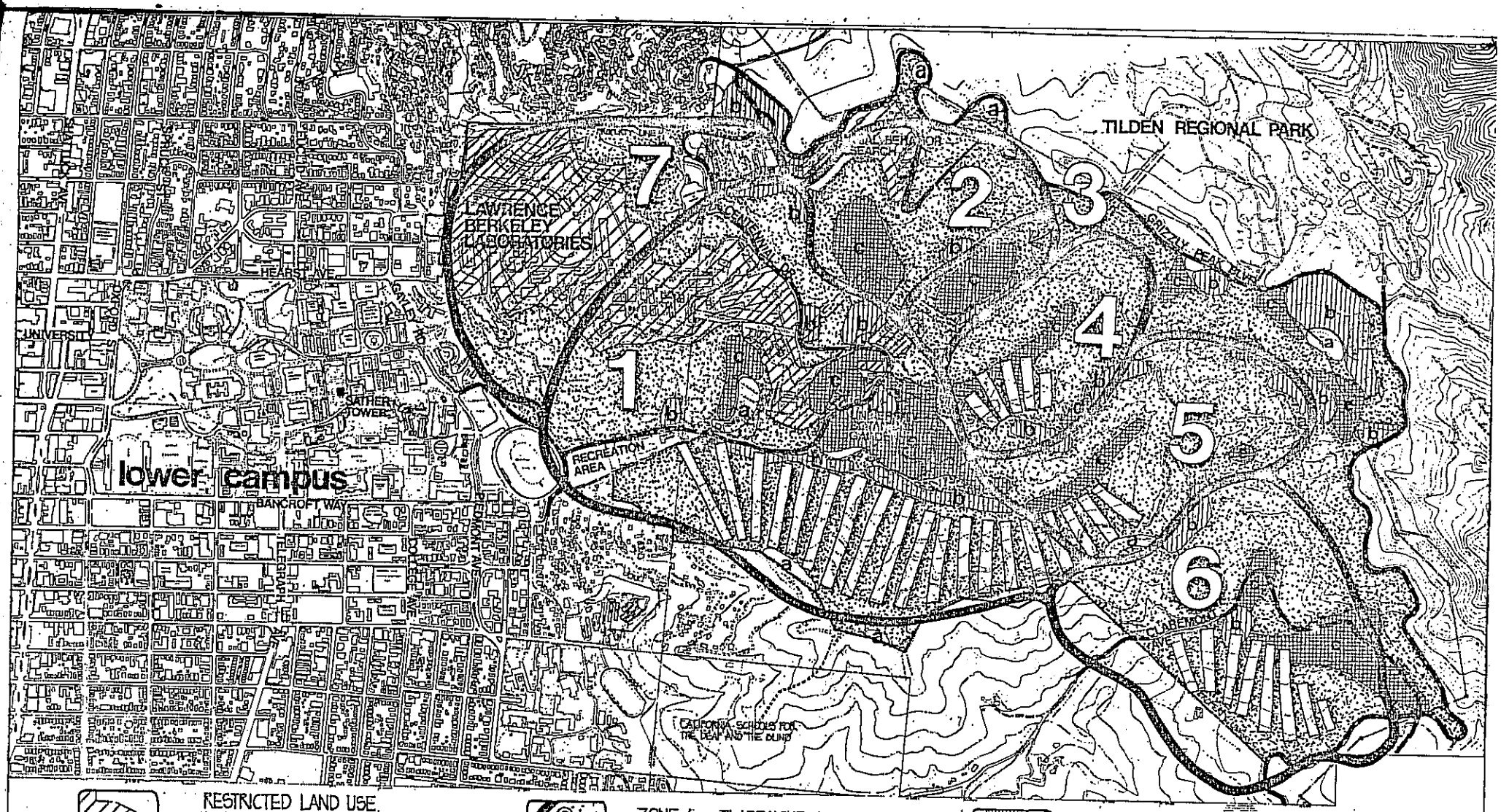
The main southwestern bowl

The four sub-valleys northeast

The Claremont Canyon sector.

USE

The uses of these upper University lands are basically education, research, and recreation, in keeping with its mission. Along Gayley



RESTRICTED LAND USE

EXSTG. VEHICULAR CIRCULATION

LIMITS OF VISUAL ZONES 1-7

ZONE 1 - MAIN CANYON

ZONES 2-5 - SIDE CANYONS

ZONE 6 - CLAREMONT CANYON

ZONE 7 - WEST SLOPE

NORTH SLOPES - COOL, MOIST

SLOPES 0-8%

SLOPES 8-15%

SLOPES 15-25%

SLOPES 25% +

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SLOPES & TOPOGRAPHIC UNITS

0 200 400 1000 1750 ft.

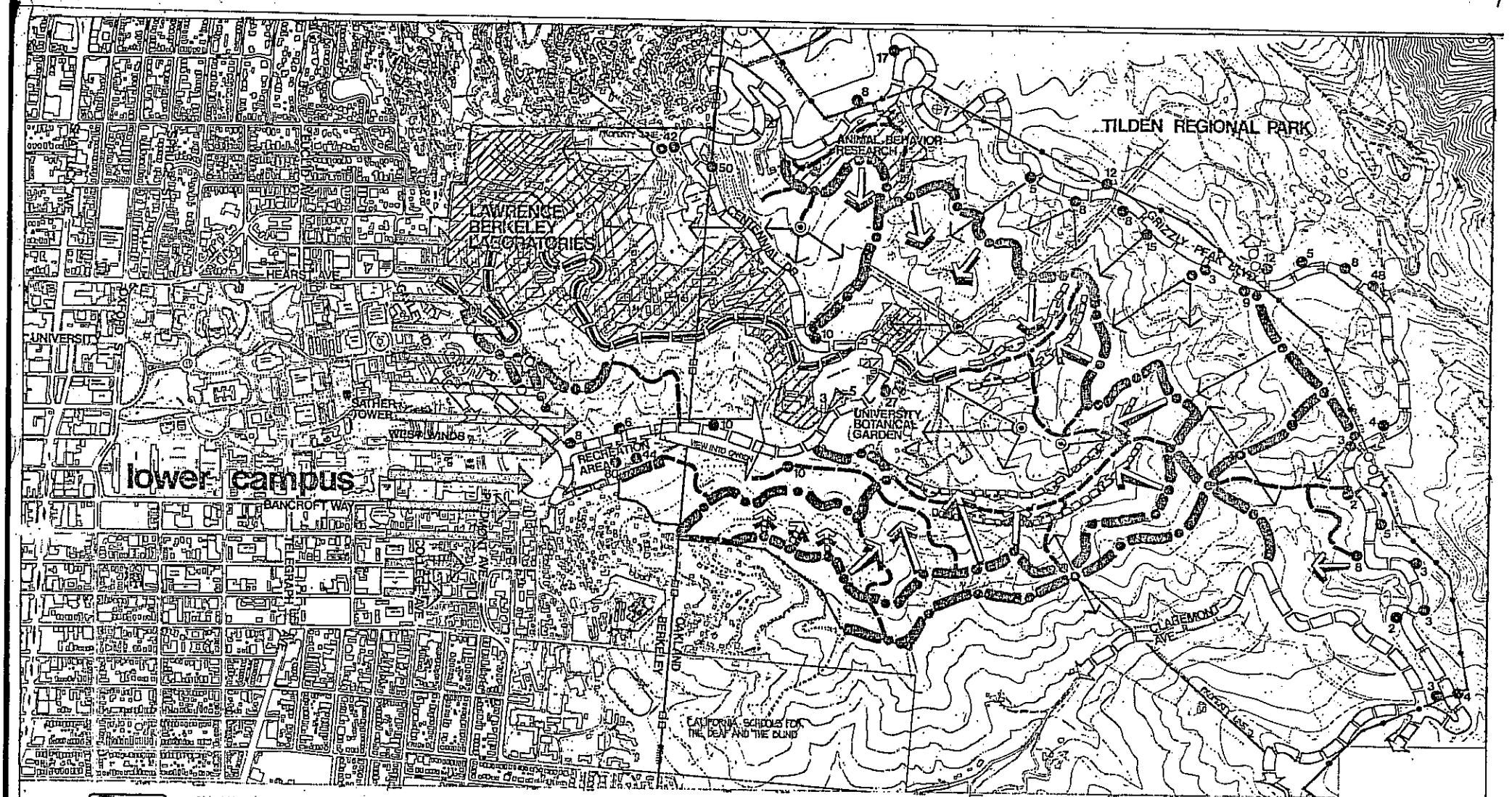
4

Road these include Stern and Bowles Halls and International House (residential), California Memorial Stadium and Kleeberger Field (athletic/recreational) and Hearst Greek Theatre (performance/recreational/ceremonial). About 130 acres in the northwest sector are occupied by Lawrence Berkeley Labs. On up the canyon are the Strawberry Canyon Recreational Area (pools, courts, play field), the Botanic Garden, the Lawrence Hall of Science, the Space Science Laboratory, and the Animal Behavior Research Station. About 390 acres is now set aside and posted as an Ecological Study Area. The 1968 Daly Report stated that 13 University departments have 41 regular courses with at least 4374 students who use the natural areas of the Canyon in their course work. Another six departments use the Canyon as site or staging area for class work.

INTERNAL ACCESS

Considering the importance of the Canyon lands to the main campus and through it to the general public, access between the two is extraordinarily difficult. Westward connections from Gayley Road are mostly vehicular drives. Gayley itself carries substantial north/south traffic. One pedestrian pathway connects from the Stadium Rimway west to Campanile Way, the main east/west pedestrian corridor on the lower campus.

East of Gayley there are only two ways into the Canyon, both difficult. The north entrance, between Kleeberger Field and Bowles Hall via Stadium Rimway to Centennial Drive, is narrow and difficult for both



VEHICULAR CIRCULATION

CONTROLLED VEHICULAR CIRCULATION

PARKING AREAS

FIRE TRAILS & OTHER USES

INDIAN TRAILS

VIEW INTO CANYON

FILTERED VIEWS THROUGH TREES

SEQUENTIAL VIEWS ALONG FIRE TRAIL

INWARD VIEWS - STREAMS

LONG OVERVIEWS

PANORAMIC VIEWS

PREVAILING WIND

EXSTG. P.G.&E. POWER EASEMENT

EXSTG. LAND USE UNITS

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EXISTING CONDITIONS

0 200 400 1000 1750 ft.

5

vehicles and pedestrians. South of the Stadium the Rimway connects back down to Gayley/Piedmont Avenue via Orchard Street, also narrow and tortuous. Pedestrians may find their way up between Stadium and International House, around a complex of parking terraces, behind the Recreation Area field house and across the play field to the narrow path along Centennial Drive. Another path which runs along the hillside south of the Haas Pool complex as an extension of Canyon Drive ends at the upper pool, although an Indian trail goes on uphill from there. The Recreation complex is some 1600 feet long, and there is another 800 feet of narrow walk along Centennial Drive before one reaches the beginning of the fire road behind the dam. Here one can at last escape the traffic and visual confusion of the entire 2400 foot entrance corridor from Rimway into natural quietude.

Driving into the Canyon is no great improvement, because parking between Haas Recreation Complex and Botanic Garden is very limited. There are only seven small parking areas including that at the Garden.

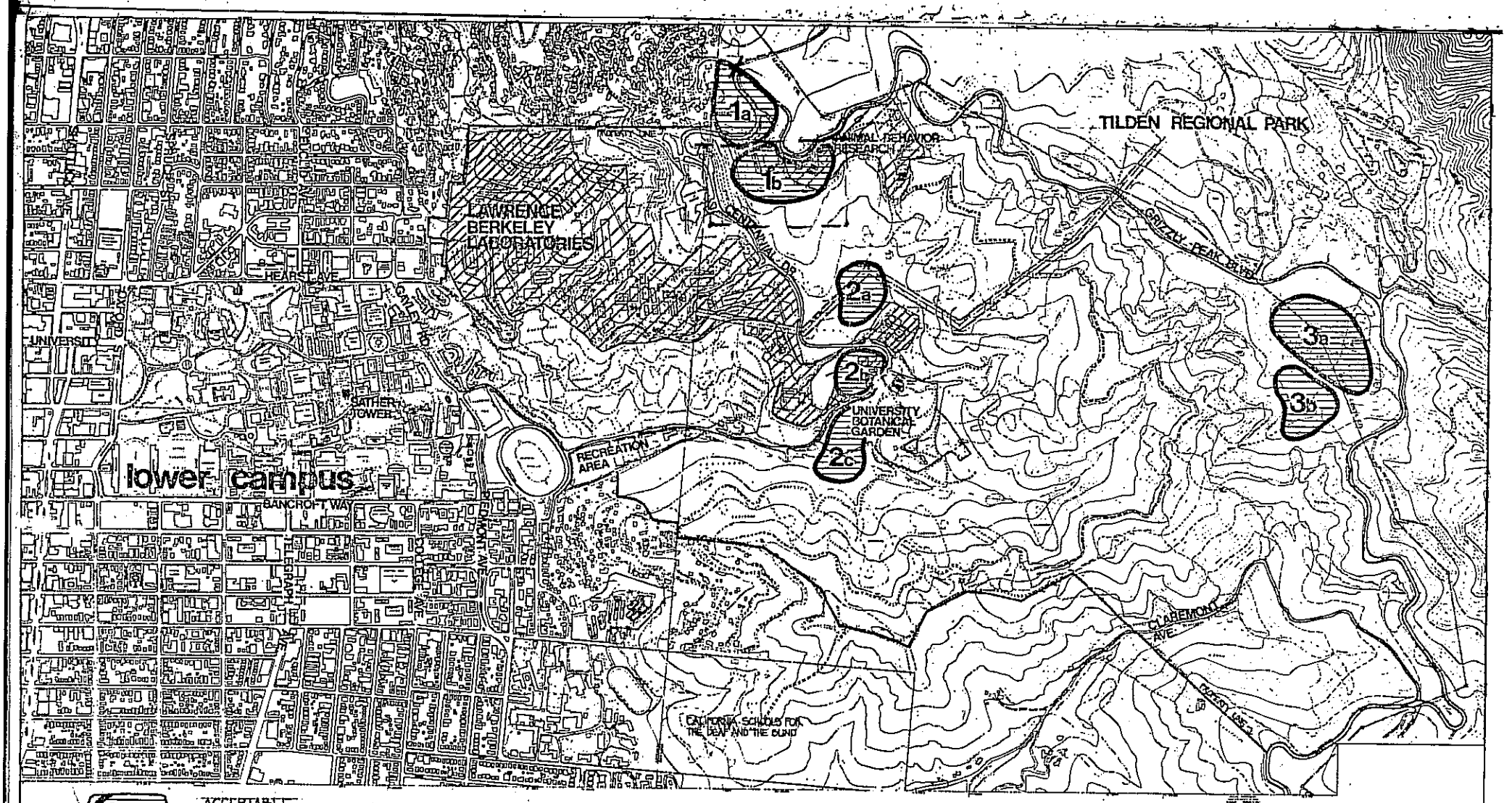
The fire road takes one alongside the Botanic Garden and on up to the top of Panoramic Way through fine oak woodlands and coniferous groves. This is a total of 4000 feet from the dam. From this point a rough steep path climbs 160 feet in 600 to the previously mentioned upper fire road/promenade which carries one almost level entirely around the Canyon bowl. This is a distance of about 14,000 feet or almost three miles. It is a magnificent walk, up in the vertical center of the bowl space, with constantly changing views up and down the Canyon and out over City and Bay. The north end of this fire road connects with

Grizzly Peak Boulevard east of Centennial at the Space Science Building. Neither the north nor south ends of this upper fire road/ promenade are easy for the campus community or general public to find. Parking is very limited when they do find them. Centennial Drive is the only easy connection from the north end back down to the Botanic Garden area.

CONSTRUCTION

Most building construction in the Canyon area has occurred in the northwestern quadrant between Centennial and Gayley Drives in the Lawrence Lab complex. This is an area of roughly 130 acres completely enclosed by security fencing and inaccessible to most of the campus community and general public. The area is expanded to perhaps 200 acres by the need for clear space outside the fence. The importance of the work within the complex is belied by its external architectural mediocrity (except for the serene dome of the Cyclotron), careless and irresponsible site planning, ecological destruction and hydrological devastation. (The bed of Strawberry Creek eroded down about ten feet as a result of the increased runoff from the Lab complex.)

The Lawrence Hall of Science is outside the security area. It is the public relations liaison for the campus scientific community. High up on Centennial Drive near Grizzly Peak, it is a handsome architectural complex with spectacular views of the Bay. However it is built



1a;b ACCEPTABLE

2a,b,c UNACCEPTABLE ECOLOGICALLY

3a,b UNACCEPTABLE - ACCESS/UTILITIES

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BUILDING SUITABILITY

0 200 400 1000 1750 ft.

6

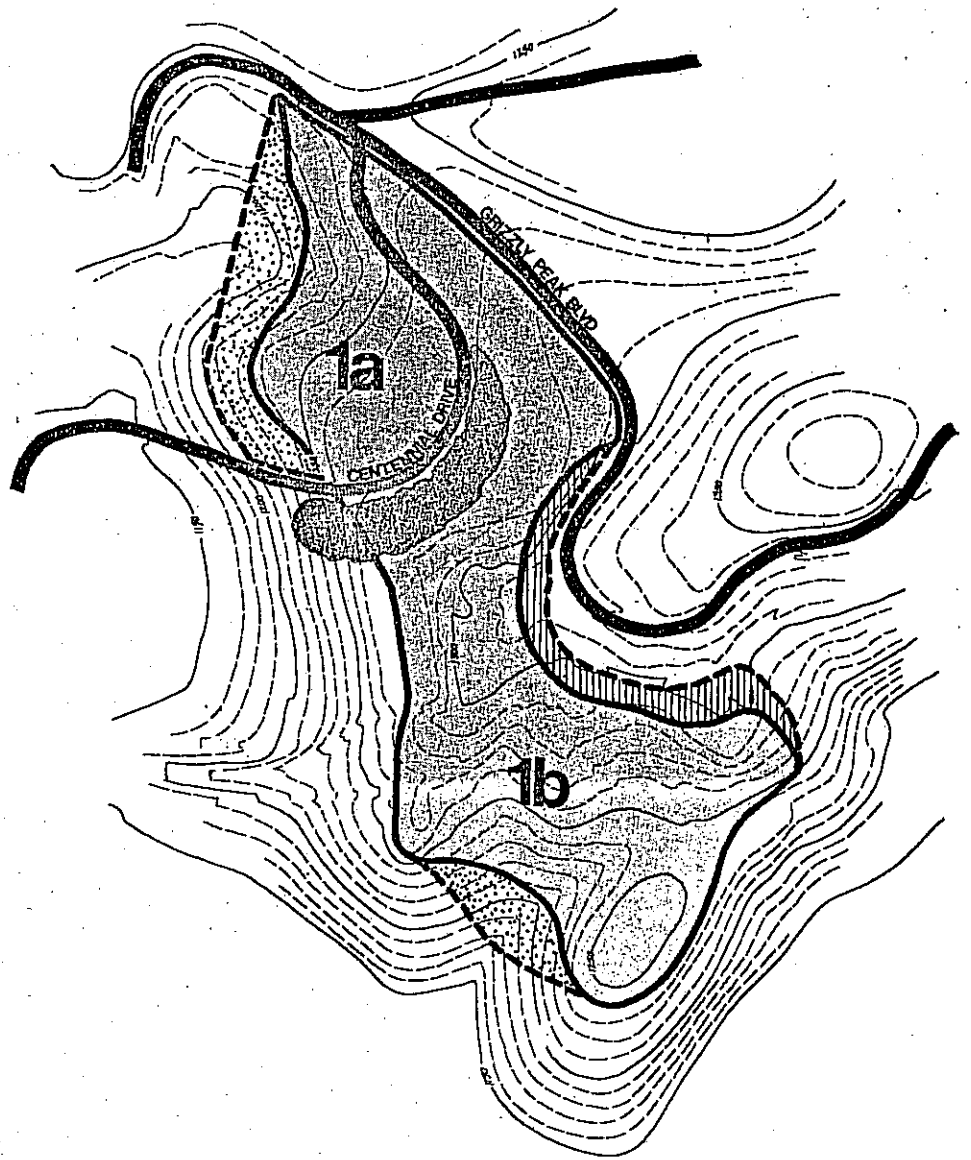
across a geologic fault line and had major engineering problems during construction.

Other construction within the Canyon area is minor, non-obtrusive, or transient. The possibility of future needs for building sites led this study to locate the only three reasonably feasible site areas within these upper Canyon lands. They are described in detail herewith.. Three specific sites, spaced from the lowest between Strawberry Creek dam and the Botanic Garden to the highest northwest of the BioMedical Building, are probably unacceptable for ecological/esthetic reasons. Two sites at the upper northeast corner are inaccessible except from Grizzly Peak Boulevard and lack near utilities. The most feasible site (one large or two small) is therefore just above Lawrence Hall next to Grizzly Peak Boulevard.

GEOLOGY AND SOILS

Neil Havlik, Consultant to Ralph Jones in his 1974 Campus Landscape report, describes the Canyon geomorphology nicely:

> The canyon is bounded on the south by the east-west trending ridge known as Skyline Ridge, and on the north by the ridge whose most prominent point, Fog Bluff, today contains the Lawrence Hall of Science and a fine lookout point overlooking the campus, Berkeley, and San Francisco Bay.
>
> Strawberry Canyon runs more or less perpendicular to the direction of the rock strata underlying it, so that several different rock types are exposed. To the west of a line running north and south from the main entrance to the Botanic Garden is the Shasta-Chico formation, which is mostly shale with occasional interbeds of sandstone. The above-mentioned line is more than just that; it is the approximate trace of a fault, sometimes called the Strawberry Canyon fault, or just Canyon fault. To the east of this fault the rock is primarily



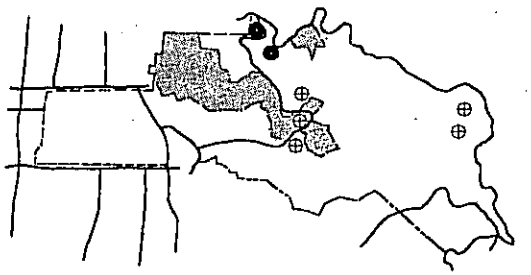
EXSTG. VEHICULAR CIRCULATION

POTENTIAL BUILDING

LIMITS OF FILL

LIMITS OF CUT

DISTURBED TREES BY CUT, FILL OR BUILDING



key map

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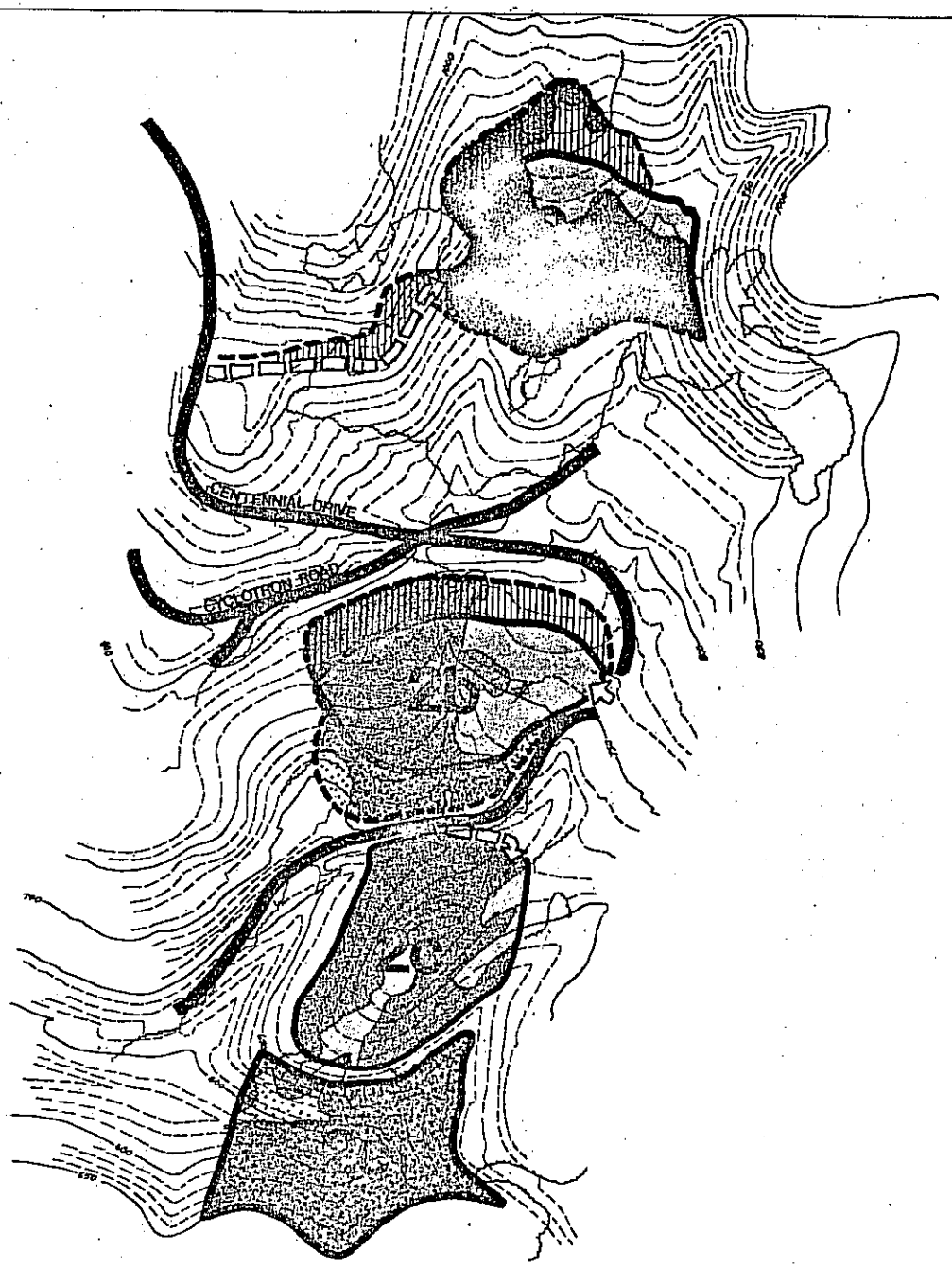
BUILDING SUITABILITY · SITE 1

0 50 100 400ft

6a



EXSTG. VEHICULAR CIRCULATION

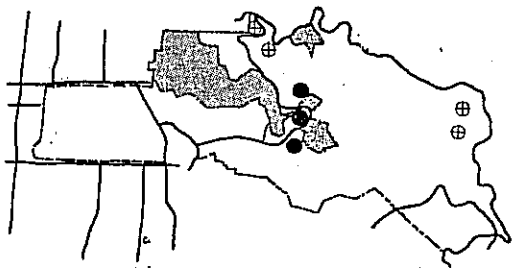
PROPOSED VEHICULAR ACCESS

★ POTENTIAL BUILDING SITE

LIMITS OF FILL

LIMITS OF CUT

DISTURBED TREES BY CUT, FILL OR BUILDING



key map

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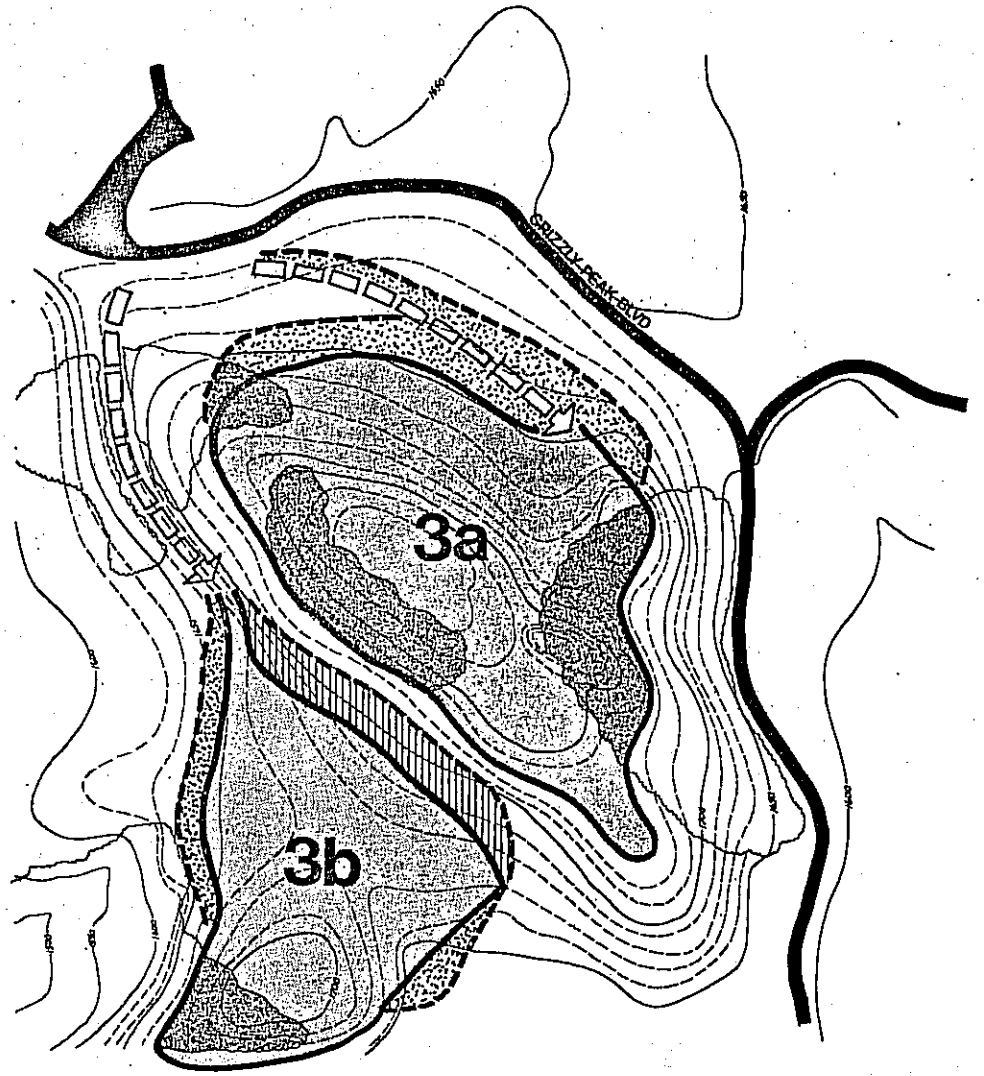
BUILDING SUIT-ABILITY · SITE 2

0 50 100 400ft

6b



EXSTG. VEHICULAR CIRCULATION

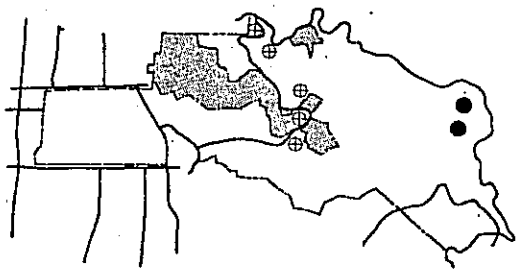
PROPOSED VEHICULAR ACCESS

POTENTIAL BUILDING SITE

LIMITS OF FILL

LIMITS OF CUT

DISTURBED TREES BY CUT, FILL OR BUILDING



key map

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BUILDING SUIT-ABILITY · SITE 3

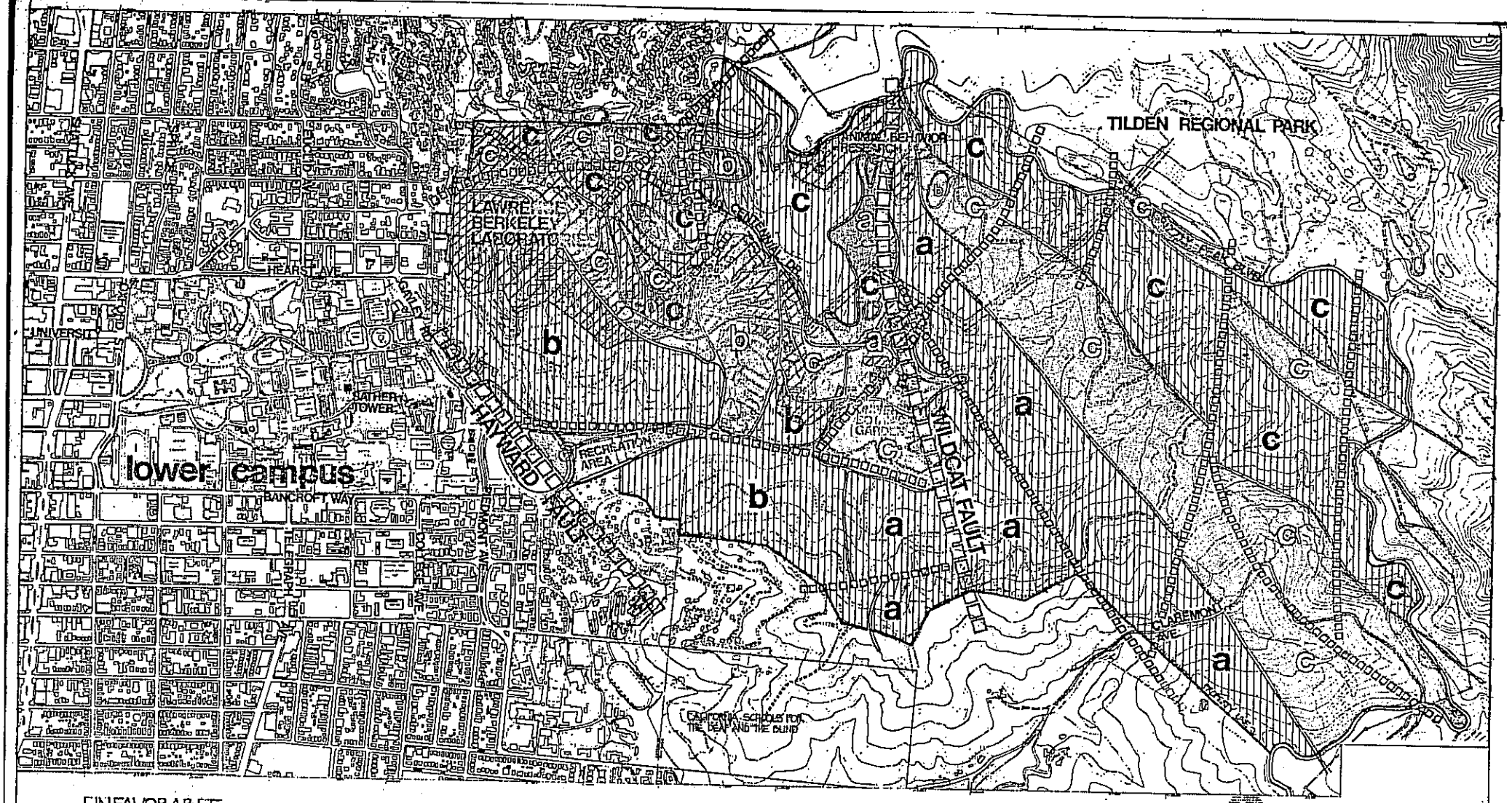
0 50 100 250 400ft

6c

chert of the Monterey formation. This rock is quite resistant to erosion and has formed three knolls within the canyon, two of them quite prominent. The southernmost, called Sugar Loaf, occurs on Skyline Ridge and rises abruptly some 200 feet to an elevation of just over 1400 feet. North of Sugar Loaf and separated from it by the south fork of Strawberry Creek, stands the second prominent point, known as Monument Hill. This hill rises steeply behind the Botanic Garden to a height of 1200 feet. To the east of these peaks their respective ridges drop as the softer shale and conglomerate Orinda formation is encountered. (The northern chert knoll does not stand out as prominently as the others, and is only slightly higher than the Orindan soils.) The slope then begins to climb again, and soon the volcanic Berkeley formation, which comprises the crest of the Berkeley Hills and is composed largely of basalt, rhyolite, and tuff, is encountered. These resistant rocks form the steepest part of the Berkeley Hills as well as the highest, including (north to south) Little Grizzly Peak (1380 feet), Grizzly Peak (1760 feet), Frowning Ridge (1740 feet) and Chaparral Peak (1750 feet). The varied and rugged topography of Strawberry Canyon has discouraged development and favored the establishment of a rich diversity of plant and animal life, such that Strawberry Canyon today is one of the finest natural areas of comparable size in the Bay Area.

The Vegetative Management Committee provides a good general description of area soils:

> The soils along the ridge of the Berkeley-Oakland Hills have formed from sandstone and shale. They are loams and clay loams, very porous and strongly structured. Depth of soil to weathered sandstone ranges from less than 12 inches to over 5 feet, although most soils range from 12 to 24 inches deep. Shallow soils occur along the very top of rocky ridges and on some very steep slopes such as on Grizzly Peak. Very deep soil occurs in the upper portions of canyons on north and east facing slopes. The depth of plant roots -- particularly trees and shrubs -- is not limited to the soil depth but extends many feet into the weathered and fractured sandstone for water and nutrients.
>
> With the exception of the few shallow soil areas, the soils present no limitation to a rather wide range of plants. Erosion is not a serious hazard in the area unless the soils are mechanically disturbed or remain bare throughout the winter



UNFAVORABLE

a — RECENT = ALLUVIUM, COLLUVIUM & LOCAL FILL

b — RECENT TO LATE PLEISTOCENE = LANDSLIDE BODIES & ASSOCIATED COLLUVIUM

c — MID TO LATE PLEISTOCENE = ORINDA AND SIESTA FORMATIONS, CLASTIC SEDIMENTS COMMONLY CLAYEY WITH LITTLE INDURATION, COMMONLY UNSTABLE

FAVORABLE

a — MIOCENE = CLAREMONT & SOBRANTE FORMATIONS, CLASTIC SEDIMENTS, MODERATELY INDURATED, GENERALLY STABLE

b — CRETACEOUS = KNOXVILLE & CHICO FORMATIONS, CLASTIC SEDIMENTS, MAINLY ARCHOSIC SANDSTONES & SILTSTONES, WELL INDURATED, GENERALLY STABLE

c — LATE PLIOCENE = MORAGA, GRIZZLY & BALD PEAK FORMATIONS, FLOW ROCKS AND TUFFACEOUS SEDIMENTS, MAINLY BASALTIC OR ANDESITIC WITH LOCAL RHYOLITIC MEMBERS. FLOW ROCKS ARE GENERALLY HARD & STABLE. TUFFACEOUS MEMBERS ARE GENERALLY CLAYEY & POTENTIALLY UNSTABLE

LENNERT AND ASSOCIATES, CONSULTING ENGINEERS

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GEOLOGY & SOILS

0 200 400 1000 1750 ft

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months after a fire. Reseeding with annual ryegrass on large burns is recommended, however, it may not be necessary on small burns surrounded by grassland because these areas will be seeded by the local grasses.

See the much more detailed reports on GEOGRAPHY and GEOLOGY and on ROCKS AND SOILS CONDITIONS by Engineer Ben Lennert, in the appendices which accompany this report.

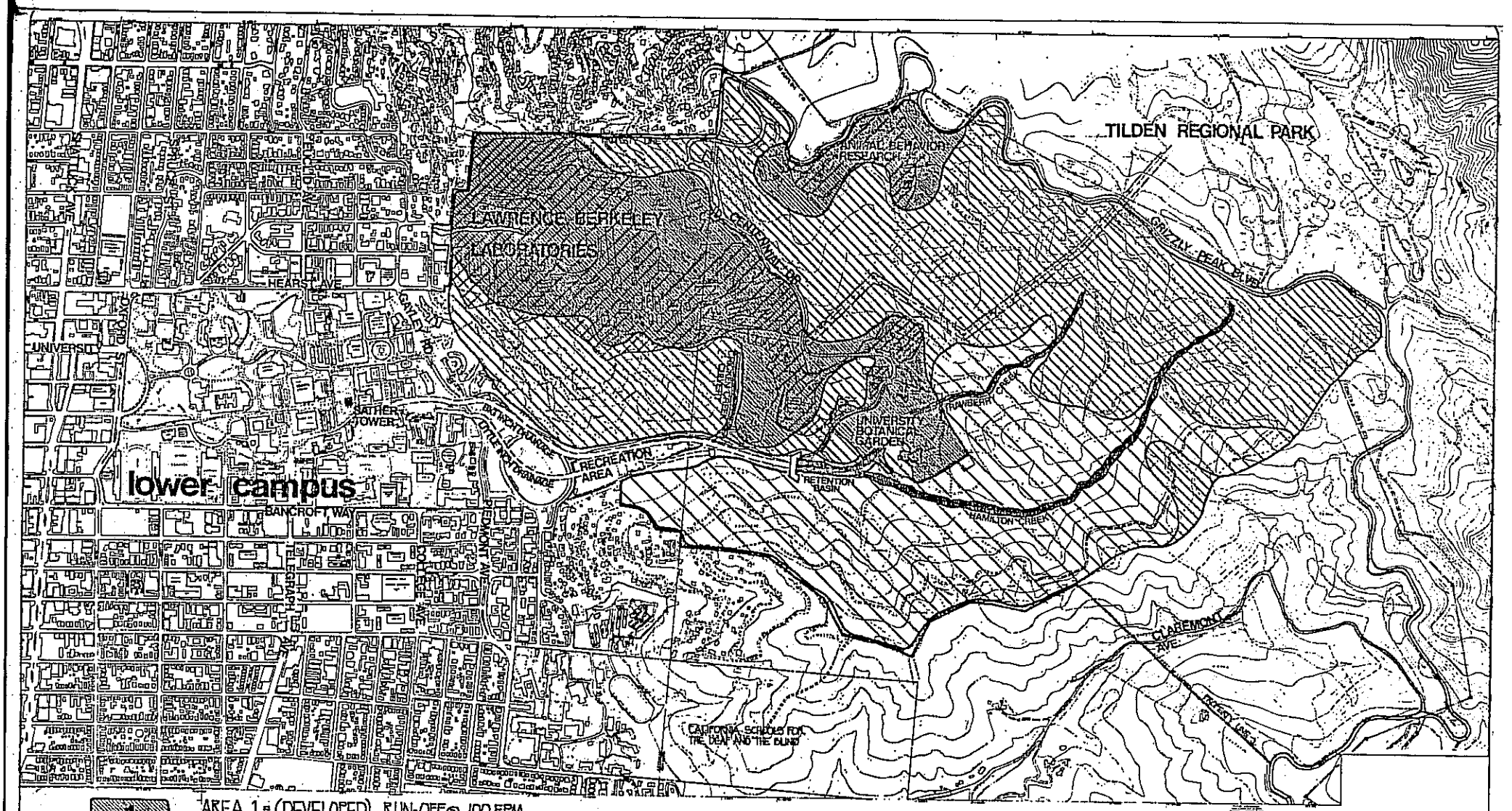
DRAINAGE AND HYDROLOGY

We have reviewed the Lennert and Associates report, in four folders, of May 12, 1972. This tells us that the main drainage from the Canyon is via the South Fork of Strawberry Creek (combined with Hamilton Creek and Chicken Creek). This goes through a retention basin and earth fill dam below the Botanic Garden and from there underground through the Old Stadium and New South Fork Bypass Culverts. The old culvert drains only the Haas Recreation Area and the stadium. It feeds the creek in the upper part of Faculty Glade. The New Culvert takes all other drainage with overflow provisions on Centennial Drive.* Plans have been made to solve siltation and debris collection problems in the retention basin above the dam with new gate construction. Plans have also been made to raise the water table between the dam and Haas Recreation Area (about 1,000 feet) so as to rehabilitate the riparian vegetation in the old creek channel. This will be done by holding the hydraulic gate open 6 inches, constructing a new bypass and plugging the subdrain to return the creek flow to the surface.

The North Fork of Strawberry Creek originates above the northwest sector of the Canyon lands, on the west slope which is outside the Canyon proper. It has been almost entirely undergrounded by Lawrence Lab construction.

The Canyon lands -- excluding Claremont Canyon -- now divide into three drainage rate type areas:

*This feeds back into the Creek at the Men's Faculty Club.



1 AREA 1 = (DEVELOPED) RUN-OFF @ 100 FPM

2 AREA 2 = (GRASS COVER) RUN-OFF @ 75 FPM

3 AREA 3 = (HEAVY COVER) RUN-OFF @ 10 FPM

CREEK = NATURAL WATERCOURSE

DEVELOPED DRAINAGE CHANNELS

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DRAINAGE

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Type 1 -- Runoff rate 100 feet per minute. Developed areas, primarily Lawrence Lab, Botanic Garden, and Animal Behavior Research. 284 acres.

Type 2 -- Runoff rate 75 fpm. Grass cover areas, including some soft chaparral. 400 acres, primarily south slope. * Tend to be drier

Type 3 -- Runoff rate 40 fpm. Heavy cover areas, primarily north slope and Monument Hill, plus two small areas on Grizzly Peak at Centennial Drive and Chaparral Hill. 300 acres.

Pertinent quotes from Folder 2, Sec. 2, South Fork Drainage System Planning: "The maximum peak flow rate, from a 25-year storm and at full planned campus development, potentially entering the bypass system above the Haas Recreation Center is 1650 cfs. In order to reduce problems in the lower campus area, it was decided to limit the maximum peak flow injected into the culvert systems. . . . to about 850 cfs in the South Fork Bypass culvert and 50 cfs in the Old Stadium Bypass culvert. The remaining 750 cfs is either held at the retention basin and/or diverted down North Canyon Road. . . . with a frequency of about once in ten years."

Initial plans for "filling the canyon, above the Haas Recreation Area and below the retention basin embankment, to a level approximately that of North Canyon Road" or "filling an average of about 10 feet above the existing channel grade" were rejected on the basis of drainage to a "natural area".

"The new culvert was finally constructed. . . . to a line-and-grade. . . . essentially identical to the pre-existing geometry."

"It was proposed that nearly all bed-load materials would be eliminated from the system by construction of stabilizing check drains in both Chicken Creek and in the channels above the retention basin. This was largely accomplished in Chicken Creek . . . . however, the permanent stability of the present section is somewhat questionable. . . . the area above the inlet was declared a permanent and absolutely untouchable natural area. . . . and the planned check dams could not then be installed. . . . trash-sacks. . . . to intercept large materials only. . . . was prevented above the retention basin. . . . and. . . . then never attempted in Chicken Creek."

This engineering language describes a surprisingly illogical sequence for an intellectual institution to follow:

1. The South Fork existed as a balanced natural system in which water flow and topography were stable.
2. Stadium construction at the lower end required putting the same water flow underground.
3. Lawrence Lab construction accelerated upper system runoff and caused extensive unnatural erosion above and below Gayley Road.
4. Remedial works -- basin, dam, and bypasses -- were constructed to stabilize the new water flow/topography relations. These works are unnatural. They have not corrected the unnatural erosion which took place before they were built.

5. Proposals to construct additional works which would return the stream channels to their original natural profile are rejected as "unnatural."

Pertinent quotes from Folder 3: The North Fork Channel "extends from the inlet to the city culvert just above the upper end of Le Conte Avenue to the outlet facility of the Lawrence Radiation Laboratory storm drainage system. The Channel has been totally obliterated above this point, and all major flow is carried in culverts which eventually drain to the LRL outlet facility.

"The theoretical peak flow rate at the inlet to the city culvert for a 25 year storm is about 500 cfs, reducing to 450 cfs at the LRL outlet. . . . The present peak flow rates are approaching the maximum rates for full projected watershed development."

"The channel (city inlet to LRL level --- approximately 350 feet) was completely regraded and reconstructed. . . . 5 check dams were required . . . . the new channel is completely stable."

"This office considers this channel to be an example of what can be done to improve a previously inadequate, rubbish and debris lined, severely eroded and unstable, ugly and unnatural, and esthetically offensive channel which has been 'overloaded' by watershed development."

By contrast the "open channel ---LRL fence to LRL storm drain outlet

facility (about 450 feet). . . . The creek consists of a deep and narrow central channel eroded into slide debris and colluvium. . . . This office was not permitted to reconstruct this channel. . . . We were, however, permitted to remove the "down wood" and dead trees. . . . The only major question is the amount of erosion, and the amount of bedload and float load materials injected into the system. . . . The process will . . . . resume as heavy limbs and logs again accumulate alongside and in the channel."

"The LRL area constitutes a major development in the watershed of the North Fork, with roughly 50 acres of almost totally developed area tributary to the creek. Together with a highly developed City area and the Lawrence Hall of Science area, it provides the bulk of the peak rate flow in the channel above Le Conte Avenue."

Visual observation confirms that this channel appears pleasant and stable, with good cribbing, lush vegetation, and well-weathered concrete check dams above Le Conte. However higher up, off the end of Highland Place, there is bad erosion undermining the Lab fence.

Pertinent quotes from Folder 4, Planning (campus wide): "The original concept of the master drainage plan was to define the entire storm drainage system within the campus. . . . then. . . . to prepare a master plan for improvements which would make the system capable of handling peak runoff rates at full projected watershed development, thus solving the basic campus drainage problems for the forseeable future. . . . decisions were not permitted to be made solely by this office, nor only on an engineering basis, but required lengthy

perusal and approval by both Administration and Faculty groups.

"At the conclusion of our work. . . . many basic decisions had been made with respect to the main interceptor system in the upper campus area; a master plan was informally achieved. . . in the lower campus area. . . . The basic decisions were never made."

In recent conversations Mr. Lennert has told us that: Lawrence Lab diverted the major part of its construction-expanded runoff into Chicken Creek and the South Fork of Strawberry Creek. This created substantial erosion problems which have been controlled but not solved. During storms the accumulation time in Strawberry Creek is now 20 minutes, where it was formerly two hours. This creates a large accumulation of combustible debris. There are now 76 slides coming into the stream.

New problems are developing in the Chicken Creek Area. The lower part seems stabilized. But near the top ane section of the Creek has escaped its broken concrete channel and has cut a wider and lower bow, which endangers the road. The stream could be re-channeled. Farther up in the terraced area, there is a very large wet inflow, above the manhole, apparently from the Labs, running over the bank and down the road and causing substantial soil movement.

VEGETATION

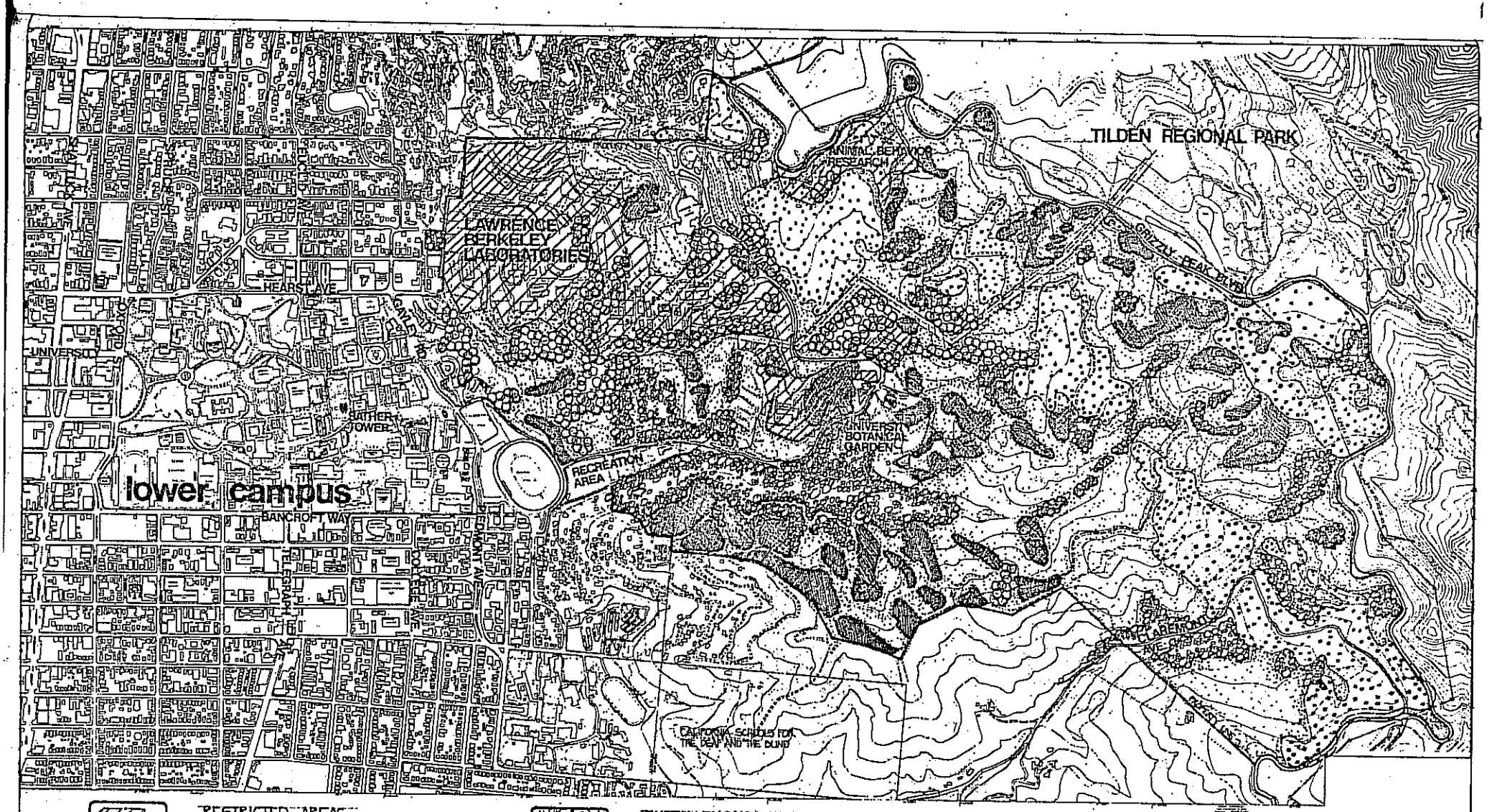
Vegetation in any area is dependent on a number of factors:

Climate
Geology
Topography
Soils
Hydrology
Orientation
Natural Succession
Human Intervention

A study of vegetation in the Strawberry Canyon area must therefore consider the first six factors as they exist, and the current results of the last two as they have interacted to date.

Topography, hydrology and orientation, geology and soils information has been assimilated. Human intervention in the original natural succession of the areas has resulted from programmed demands for land use of institutional, educational, research and recreational types. Institutional demands have generated the structural modifications which dominate the northwestern quadrant of the Canyon area. Educational and research demands, formalized as Ecological Study Areas, dominate most of the balance of the area, although it is not totally dedicated to them. Recreation in its active forms is inserted in wedge form as the Strawberry Canyon Recreation Area complex. In more passive forms it uses all of the fire roads and trails, and all available open space, throughout the balance of the area.

The vegetative pattern which has resulted from those interventions to date divides into two primary areas. One, the north-facing south slope of the Canyon, an area of some 200 acres, is dominated by indigenous oak-bay woodland, mostly oak, with associated dense undergrowth. Throughout the top half of this slope and extending irregularly down into the lower portions are substantially mature plantations of many



RESTRICTED AREAS.

SPECIAL LAND USES.

1 CONIFERS

2 OAK/BAY WOODLAND

3 EXSTG. STAND OF EUCALYPTUS

4 EXSTG. EUCALYPTUS SPROUTS.

5 SOFT CHAPARRAL W/GRASS DOMINATED OPENING.

EXSTG. VEHICULAR ACCESS.

P.G&E. POWER EASEMENT. 80' R.O.W.

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EXISTING VEGETATION

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coniferous trees -- pine, spruce, fir, redwood, cypress, cedar. With the possible exception of the redwood, none of these are indigenous.

These north slope plantings reach across the valley in the Botanic Garden area and include the Mather Redwood Grove.

The other 800 acres of the area, comprising the convoluted east, west and south slopes of the north side of the Canyon, are covered by an irregular pattern of grass and soft chaparral, with groups of bays and some oaks in the drainage channels. To this (approximately) native base have been added extensive groves of Monterey pine and several species of Eucalyptus. These plantings have matured.

The eucalyptus were badly damaged by the exceptionally cold winter of 1972-73. Fear of the fire hazard embodied in the dry tops produced by freezing resulted in an extensive program of cutting. At least three-quarters of the eucalyptus in this area have been cut down to stumps. Most of the heavier trunks and branches were hauled out and sold for firewood. A great deal of slash material remains on the ground, however, and constitutes in itself a fire hazard. New sprouts from old stumps, and perhaps seedlings, are up as high as ten to fifteen feet, and doing well. The most substantial grove, comparable in scale to that at the Oxford entrance to the lower campus, located just above the Canyon entrance to Lawrence Labs, is undamaged and uncut.

Changes in, or additions to, this existing vegetative cover may occur for any or all of three types of reasons: technical, functional, experiential (esthetic).

Technical reasons include any inherent in the cultural requirements of the plants or plant communities themselves. The cutting of eucalyptus as a fire hazard is a technical reason, as is the damage which is occurring in the Stone Pine grove at the east end of the north slope. This seems to result from a massive soil creep downhill, yet it is strange that the adjacent Monterey pines are not affected.

Functional reasons derive from land use or programmatic demands. All of the conifer plantings along the upper north slope seem to have been developed for educational/research, or functional, reasons. The Botanic Garden is likewise a functional facility. However Mather Redwood Grove, and probably the eucalyptus and pines on the south slopes, seem less functional and more experiential, esthetic, or cultural in content.

Experiential reasons have to do with how plantings will look, how they will make us feel, how we will react to the landscape they will create as they grow. This is the more subjective area of planting decision making, as the first two are more objective. Yet subjectivity and objectivity overlap strangely, particularly in the relations between indigenous and introduced plants. For instance we are told that eucalyptus and French broom are serious fire hazards and should be removed completely. Yet although we are also told that Monterey pine, baccharis, elderberry and bay are serious fire hazards, we are not told to remove them. Are eucalyptus and broom that much worse? Or is there perhaps a little subjectivity at work? We are told that eucalyptus areas are gloomy and unattractive to wildlife and people. But what could be gloomier or more barren than the Monterey cypress grove on Sugar Loaf? And Dr. Stebbins tells us that "Eucalyptus habitat is far richer in

vertebrates than either redwood or Monterey pine and vies with dry chaparral and grassland in species diversity and attractiveness." A eucalyptus grove with a clean floor will probably attract as many people as a comparable redwood grove in a similar situation.

In Australia the Monterey pine has been imported and planted over thousands of acres as a softwood timber tree to replace the less useful native bush (eucalyptus). Nature-lovers in Australia attack Monterey pine planting in about the same way that nature-lovers in California have attacked eucalyptus planting for many years.

All of this tells us that assumptions about the mood or atmosphere which planting will generate are not reliable guides to the selection of species.

Experiential quality in the landscape results from plantings done for technical or functional reasons as much as for esthetic or cultural reasons. This means that all three types of reasons must be considered when any new plantings are to be made, or old ones changed.

MAINTENANCE AND CHANGE

Maintenance and/or change of existing vegetative patterns may take place for any or all of the three kinds of reasons just described. They, and their relations, should be clear in the minds of those who establish policy and make decisions about Canyon vegetation.

Current questions whose answers will impact upon vegetative maintenance

and change include:

1. Identification of land use priorities and future management policies
2. Establishment of ecological study area boundaries
3. Reduction of fire hazards
4. Specific proposals which may be forthcoming but have not yet appeared

LAND USE

Institutional uses embodying substantial construction do not seem likely to expand beyond the areas which they presently occupy. Three possible building areas established and described in this report, in descending order of priority, will be known as available for possible future needs or demands. Criteria for response are suggested. Therefore the present Canyon area of planting in relation to existing construction is not likely to be reduced. It is more possible that it may be expanded into inadequately planted areas close to existing construction. Special considerations involved in planting in such complex situations will apply. They are probably not predictable in this report. They should probably be the subject of a special detailed follow-up study of landscape development around all existing construction.

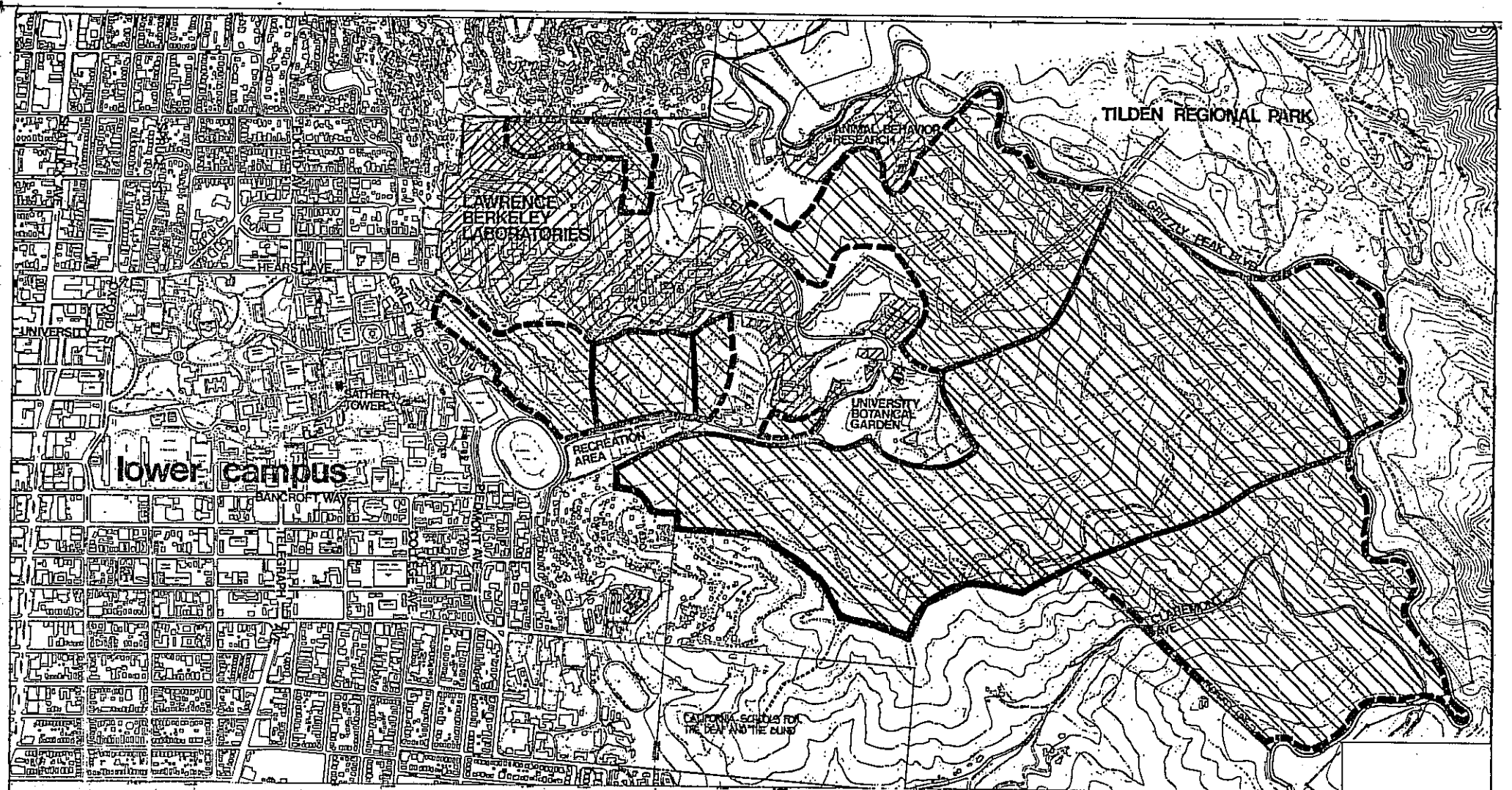
Education/research uses are generally summed up in proposals for the expansion and delineation of Ecological Study Area boundaries. Jones in 1974 is more cautious and restricted than Siri/Lindgren in 1972.

Yet, insofar as the Strawberry Canyon area is not dedicated to other uses, it seems that it should be kept in a state of nature for ecological study. Siri/Lindgren propose to add 746 acres of Strawberry/Claremont Canyon lands to the University's Natural Land and Water Reserves System. Their recommended management policy includes:

1. Keeping the area open to all University personnel and the general public, subject to conditions of time and manner of use.
2. Patrolling the area to ensure public safety and enforce prohibitions on certain uses, such as camping, fires and motorized vehicles.
3. No fencing of the area except to control motor vehicle access.
4. Use of "prescriptive burning" for fire control and research.
5. Control of manipulation of parts of the area or significant extractions from it by a management committee.
6. Keeping the reserve unit open for all reasonable uses, including recreational uses that have no impact on the natural qualities of the area.

This leaves open the definition of "natural qualities." For instance, are eucalyptus and French broom natural? Is the Monterey pine (indigenous to the Monterey Peninsula only) natural? No doubt there are many non-natural grasses and herbs at large within the area. What do we do about them?

The above Ecological Study Area proposal will respond to the needs of 13 of the 19 departments or groups that use the area for academic or other purposes. The other six -- Landscape Architecture, Athletic, Military Science, East Bay Regional Parks, the public, and Civil En-



EXISTING E.S.A. BOUNDARY

PROPOSED E.S.A. BOUNDARY

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ECOLOGICAL STUDY AREA

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gineering -- tend to use it in terms of manipulation for external purposes. The manipulation practiced by Landscape Architecture and Civil Engineering is almost entirely theoretical, hence has no actual impact on the land. The requirements of the other four approximate recreational use requirements, and can be considered with those uses.

Recreational uses are intensive in the Canyon recreation complex of courts and pools, and extensive throughout the balance of the area. While recreational activities have specific technical and functional requirements, they are fundamentally experiential, esthetic or sensory in nature. That is, among other reasons, we recreate in order to change, improve, broaden and deepen our experience of the world. This means that the environment for recreation should be designed in terms of those criteria, as well as others more specific.

This has not been done in Strawberry Canyon. The recreational facilities appear to have been designed and installed in second-class deference to institutional and educational research. It is difficult to get into the area, either by foot or car. Once in, it is difficult to get around within it. The pools, courts and field complex function well and are pleasant within themselves, although their total area is quite restricted. There are reciprocal relations between the crowding of the pool areas and of the parking areas, in spite of the difficulties of access.

Extensive recreational use of the larger Canyon area seems to exist by

the tolerance or generosity of the dominant uses. None of the basic facilities normal to extensive passive natural parks at this scale are available. There are no continuous systems of pedestrian, bicycle or equestrian movement, related to easy entrance and parking. There are no picnic facilities, sanitary facilities, or free play facilities. There is a security patrol. Night use is not considered appropriate.

It may be that the University is not so far into the provision of recreation for campus community and general public that it should consider these questions. And yet it already has a recreational facility of regional scale and significance, closely related to Tilden Park, although quite different from it in program and character. Insofar as Tilden and other nearby regional parks provide the normal facilities, they are probably unnecessary in Strawberry Canyon. Very likely it should be seen as a wilderness reserve rather than as a park.

There is a variable range in concepts of form and arrangement when considering Strawberry Canyon as a recreational area. Now, as several studies have pointed out, the upper and eastern parts of the Canyon -- perhaps half of its 1000 acres -- are a wilderness reserve within walking distance of a major urban campus. This is a rare and exceptional piece of good fortune and/or good planning. As that perhaps it needs difficulty of access and internal movement and use to maintain its isolation and resist invasion by too many people. Yet current inconvenience of access and difficulty in use seems more accidental than planned. It does seem that ease and character of access and movement could be designed as part of a coherent conceptual plan.

Early reactions from vocal wilderness preservers seem to say that difficulty of access should be preserved to limit the number of people using the area. Yet does this tend to preserve it for a young and energetic elite, excluding those without those vital qualities. What about those older, less agile or adventurous? Should we consider the handicapped?

A two-hour interview with Peter Berenson, whose interests are in the economics of environmental/energy questions, provided an excellent statement of the natural wilderness-oriented approach to Strawberry Canyon. The following points were made:

Strawberry is a unique natural resource. Tilden Park exists next door. The Canyon should not be developed to equal the Park. They should offer different kinds of experience.

New paths or trails may create additional scars. (This is not necessarily true. Good design can eliminate them.)

Limited traffic preserves the area. More may spoil it. (We do not feel that the amount generated by our proposals will do this.) *

More structure would be detrimental to the natural experience.

Pedestrian use of grass or meadow areas might cause compaction and erosion. (This does not seem likely).

Chain link fencing is a visual problem in conflict with natural qualities. If necessary, it should be painted black or dark brown, and planted out.

The difficulty of getting in and around is expected in a natural area and is part of its charm.

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*Note: The ultimate control of the use of the Canyon derives from the number of unrestricted car parking spaces provided in or near it. We are not recommending any additions to these, except at Lawrence Hall of Science and possibly in Chicken Canyon.

Is ease consistent with a wild area?

Fire roads and Indian trails provide two different kinds of experience. On the former one is secure and comfortable, can walk freely while enjoying the landscape and views around. On the latter movement is more difficult and arduous, requires constant attention to immediate elements along the trail. The surroundings can only be viewed when the brush opens up, and by stopping at convenient points. The Canyon needs both kinds of experience. The balance between the two is suggested in this report, but must develop from more intensive planning and design on the land.

Is there a contradiction between natural quality and accessibility? (Not necessarily.)

From the natural wilderness point of view additional fire trails, possible building sites in the Botanic Garden area and on Chaparral Hill, and park-type facilities should be eliminated from consideration.

The plan should probably embody suggestions for total circulation/access patterns for the entire Canyon area and its environmental connections. Perhaps it should also suggest some minimum picnic/free play/sanitary facilities. These will all have some impact upon existing vegetation patterns, particularly in the heavily grown over north slope. Such impacts may involve some clearing and opening of paths, some movement of earth that will require stabilization of exposed slopes. A sensitive pruning crew could open up careful vistas across the Canyon without serious reduction in the abundance of growth.

VEGETATION SPECIFICS

Within the framework of likely needs and demands, the following vegetation programming seems likely:

Detailed proposals in the Jones and Baker reports can be reasonably integrated into the comprehensive plan we propose.

Biswell's fire management proposals seem reasonable insofar as they embody maintenance procedures. But the recommendations the eucalyptus be removed and replaced by Monterey pine, Monterey cypress and redwood should be scrutinized very carefully. The relative flammability of the four species, the amount of debris removal, annual burning and clearing needed to keep them relatively safe, should be analyzed in detail.

It may be more reasonable to follow the Vegetation Management Committee's advice: "Live and healthy eucalyptus should be thinned to approximately 50 trees per acre (30 x 30' = 50 T/A) in varying diameters. Trees will be left in an irregular pattern for aesthetics and discontinuity of fuels."

These technical analyses should be related to the visual/experiential impact of each specie on the Canyon landscape. This impact should be in terms of an overall coordinated tree plan.

Visually the four species run a gamut in ranges of heaviness/openness

and darkness/lightness. The cypress is the heaviest, darkest, and most somber and oppressive. The pine is also dark, also heavy, but opens up by losing its lower limbs to become a rugged and picturesque skyline tree. The redwood is dear to Californians' hearts, vertical, erect yet graceful, of an openness between pine and cypress and a shade of medium green that is lighter than either of them and closer to eucalyptus coloration. The eucalyptus is most open, most light, most graceful, runs a range of browns and greys through various species now growing on the site. All of these factors are important in deciding where to use which trees for what desired effects.

On the north slope the relative longevity of the various conifer species should become a measure for determining the future of those groves. Intensive attention should be paid to the slowly destructing Stone Pine grove. The Monterey pines have a life expectancy of about 50 more years.

Throughout the Canyon a continuous and consistent program of deadwood and debris cutting, clearance and disposal should be initiated.

It appears that the existing pattern of consistent enclosure of the upper reaches of the Canyon with groves of Monterey pine and associated conifers should be maintained and reinforced by developing groupings of more convincing size and position. Below these on the north side the eucalyptus groves, if fire control seems feasible, make a light

and pleasant contrast with the darkness of the pines. Below them the relations between grass and dry or moist chaparral might be modified by some controlled grazing.

The various successional relations between grassland, brushland, woodland, and between the various specific types of each -- Baccharis, Blackberry and Elderberry brushland; oak, bay, pine and riparian woodland -- can become the bases for specific long-term studies of natural, manipulated, arrested or distorted successions.

It is hoped that all of the various technical, functional and detailed experiential proposals incorporated in this report can be subsumed within large overall coherent vegetation pattern concepts which relate closely to the scale of the topography.

PREVIOUS PROPOSALS

II. PREVIOUS PROPOSALS

We have reviewed a substantial list of reports and proposals dealing with various aspects of the Strawberry Canyon lands. In chronological order these are:

1969 -- January/February -- article in The California Monthly titled The Future of the Campus Environment by Frank T. Lindgren and Kenneth M. Sanderson. Impelled by a controversy over a new road around the new Moffitt Library, the article went into detail on the relations between natural ecology and structural development on the campus. In conclusion it said, "In addition to understanding natural ecology, the subtle and delicate relationship of man and his natural environment of plant and animal life, we should also consider physical ecology. By this we suggest an addition frame of reference, namely man's relationship to buildings, sidewalks, paths, and his means of transportation. . . . Perhaps a revolution in thinking about the latter, particularly transportation, is needed to avoid relentless encroachment on all natural areas within our still beautiful campus."

1969 -- Landscape Architecture Advisory Subcommittee, Paul D. Hurd, Jr., Chairman. Subcommittee of the Subcommittee, Howell V. Daly, Chairman.

Documentation of scientific, educational and other uses of natural areas on the Berkeley campus.

Response to article in Campus Report, June 5, 1968. 161 letters of support; 884 petition signatures (permanent preservation of natural areas).

Response to article in Daily Californian, February 18, 1969 (Campus Ecology: Nature on Trial). 23 letters; 4172 petition signatures.

Response to article in California Monthly, January/February 1961 (The Future of the Campus Environment -- Natural Areas). 14 letters; 1 interview.

Response to questionnaires and interviews re scientific educational values of natural areas, Spring 1964. 90 staff members in 20 departments contributed information.

The final bound volume, including a Daily Californian article by Sim Van Der Ryn and numerous responses to that and to the California Monthly article, generally supports the preservation and conservation of natural areas on campus.

Baker Report of December 1969, reporting on a three-meeting task force, incorporates by reference Joseph McBride's Ph.D. thesis on East Bay Hills brush and forest succession and recommends that the University:

Preserve or enrich natural plant communities, delimit small experimental areas to test methods;

Develop a more appropriate system of Indian trails;

Prohibit Botanical Garden from taking any more potting soil from the E.S.A.;

E.S.A. committee approval of any classroom plant or animal gathering;

Research manipulation of vegetation must be closely governed by E.S.A. committee;

Incorporates by reference the Daly-Stebbins Task Force Report;

Map and inventory Strawberry Canyon;

Establish a representative .E.S.A. committee;

Appoint an executive director of E.S.A. to provide continuing policy enforcement;

Publish an E.S.A. policy illustrated information brochure (including lower campus)

Information exchange by all users through executive director.

1972 -- In March Provenzano and Associates, Engineers, submitted a report on Soil Investigation Recommendations and Specifications for Centennial Drive Reconstruction. This is referred to in more detail elsewhere.

In March also Arbegast and Newton, Landscape Architects, submitted plans for the Poultry Husbandry (Chicken Canyon) area. These suggested:

Schematic A

Day Care Center

Group Picnic

Picnic

Turf Area

Mini-Conference Center

Multi-Use Terrace

Parking

Schematic B

Putting Green

Golf Driving Cages

Picnic

Badminton/Volley Ball

Archery

Tennis

Student Rec Center

Schematic C

Garden or Picnic

Student Garden

Schematic D

Day Care Center

Pre-School Play/Picnic-Mini-Conference

Revised Schematic

Multi-Purpose Building

Multi-Use Turf

Picnic-Free Play-Group Picnic

Volleyball

Horseshoes

In May 1973, the Arbegast/Newton proposals were reinforced in a report from the CNR/IDS Joint Recreation and Environmental Quality Committee

to the Campus Recreation Committee to "effect restoration, caretaking and initial recreation use of designated facilities according to purposes specified in March 14, 1973." In December , 1975, the Chancellor's Advisory Committee on Campus Recreation concluded that development of the Poultry Area had "low priority when compared with other facilities being considered. Therefore we did not give further consideratio to the plans."

From 1969 to 1973 Dr. Van King, open space planner for the City of Berkeley, made a series of proposals for Chicken Canyon which were analagous to the Arbegast/Newton proposals. They included:

1. "Heritage Hill"
   a) Pioneer settlement
   b) Open games
   c) picnic area
   d) playground
   e) horseriding center
2. Day Care Center
3. Student Garden
4. Conference Center (for "away-from-it-all" meetings)
5. Interdisciplinary Strawberry Canyon Information, Resource and User Coordination Center

Today Chicken Canyon and its terraces are fenced off, inaccessible, weed-covered, and quietly deteriorating. There are still poultry in one house. There is a handsome barn and a usable office structure empty on the top terrace. The Creek, under the impact of the heavy Lawrence Lab runoff, is beginning to erode new channels and to bypass the improvised broken concrete channel provided some years ago. There are surface drainage problems from the Labs. Soon there will be a need for a new comprehensive plan for this entire area, even if it is no more than an alternation of paved terraces for parking, grass terraces for picnicking, trees for shade, bank stabilization planting, and stream stabilization.

1972 -- In May Lennert and Associates submitted a four-folder report on the campus storm drainage system. This, too, is discussed elsewhere in this report.

1972 -- Also in May Will Siri and Frank Lindgren submitted a report which proposed a new unit of the Natural Land and Water Reserves System of the University. Essentially it recommended putting all areas not now called Ecological Study Areas or developed areas into ESA's. The NLWRS suggestion was rejected, but the expanded ESA proposal is supported in this report.

In October 1974, Ralph Jones, Landscape Architect, submitted a review of the campus landscape. While most of its 228 pages dealt with the lower campus, it did have sixteen pages on Strawberry Canyon. These

include the following very perceptive and sensitive recommendations. Aside from some differences about indigenous plantings, we feel that these should all be considered a part of this report.

STRAWBERRY CANYON POLICY RECOMMENDATIONS BY RALPH W. JONES

1. Re-design and reconstruct the entrance to the canyon at Rimway Road and Centennial Drive.
2. Close off Centennial Drive to through traffic. Study feasibility of phasing out car traffic between Haas recreation area and the Botanical Garden.
3. Re-study quality of north banks of Centennial Drive from Rimway Road to Haas Recreation Area parking lot.
4. Screen chain link fences around ballfield and tennis courts.
5. Landscape the parking lots in the athletic area with trees, shrubs, vines and ground covers.
6. Prohibit any further expansion of Haas area parking and athletic facilities. Prohibit any further encroachment on the Canyon South slope and Strawberry Creek flora.
7. Enlarge the north slope Ecological Study Area to extend to Mather Grove east of the Inorganic Materials Building.
8. Prohibit car parking in the area of the retention basin. Plant earth dam with native trees indigenous to the area.
9. Provide adequate water supply to sustain alders downstream of retention basin dam.
10. Remove defunct poultry research facilities and restore area to grass and native trees. Preserve Chicken Creek riparian habitat.

Develop limited parking by Centennial Drive and Chicken Creek and carefully enhance grotto for viewing only at Chicken Creek culvert.

11. Plant steep portion of bank on north side of road opposite the retention basin.

12. Along Centennial Drive and the Botanical Garden, place the chain link fence down the slope farther away from the road. Plant native shrubs between road and fence.

13. Include in Ecological Study Area management procedures that unpaved fire road will not be paved, widened or straightened.

14. Preserve creek area in its natural state without technological improvements of any kind.

15. Have continuous trail maintenance program for steep, erosion-prone trails.

16. Correct drainage problem along the top of the south ridge and distribute runoff over larger area of north-facing slope.

17. Provide suitable barriers to prevent motorcycles from entering on to the south ridgetop and the fire trail from the end of Panoramic Drive.

18. Investigate potential threat, if any, imposed on the Haas recreation complex by the above-ground water storage tank at the end of Panoramic Way.

19. Preserve slope and natural ravine ecology directly below and to the southwest of Lawrence Hall of Science. Consider designating this area an ecological study area.

20. Adopt a formal management policy for canyon including staff per-

sonnel associated with a multi-disciplined advisory group.

21. Restrict new plantings to those endemic to Strawberry Canyon or indigenous to similar California coastal canyons.
22. Preserve natural basalt rock outcroppings on Chaparral Hill near Grizzly Peak.
23. Preserve and maintain pine and cypress groves on top of Monument Hill and the unique native shrub colonies on the north and south sides.
24. Preserve the entire Strawberry Canyon viewshed in its present natural state, free of further development such as roads, fences, buildings, signs, grading, dams and exotic plant materials.
25. Create sense of "entry" to canyon.
26. Recommended ecological study areas.

Recommendations added to Jones Report by Havlik:

Control erosion along the fire road.

Eliminate "dreary" eucalyptus groves by controlling new trees and allowing natives to return, so that animals will return and hikers will have greater esthetic experience.

Plant pine forest along ridge top.

In December of 1974 Harold Biswell, Forester, made a very influential report on the wildfire problem and the reduction of fire hazards in the hill area. This led to the cutting of most of the eucalyptus trees in the Canyon area (and elsewhere) and, indirectly, to this current report and its Vegetative Management Plan. Biswell's recommendations were:

Remove eucalyptus sprouts in logged area (method proposed).

Remove French broom (method not known).

Remove remaining debris in logged area.

Annual control burning (method proposed).

Prune dead limbs up to 12-15' (method proposed).

Remove understory trees that act as ladders to crowns of tall trees.

Plant groves of redwood, Monterey pine and Monterey cypress.

Plant continuous forest band on north facing slope.

Plant redwoods on right side Claremont.

Interplant existing groves of Pinus radiata.

Reactions to and extensions of these recommendations are embodied in our Vegetative Management Plan.

At about the same time the Vegetative Management Committee (13 members from natural resource disciplines) produced the Vegetative Management Plan for the Eucalyptus Freeze Affected Areas in the Berkeley/Oakland Hills. This plan, aimed at reducing the fire hazard in these hills, described the area and its vegetation and soils. It then discussed problems of immediate concern:

Fuel break along Grizzly Peak/Skyline;

Eucalyptus seed germination and sprouting/poison oak control;

Fuel modification to break up larger blocks of eucalyptus;

Fuel breaks around water tanks and structures, and

Fuel reduction around homes

all in terms of purpose, location and specifications.

Problems of long term concern include:

Ground fuel management;

Suggestions for various vegetation types;

Recovery of eucalyptus stands;

Future planting in the hills;

Residential planting to reduce fire hazard;

Vistas.

This plan makes approximately the same recommendations as Biswell. It is somewhat more moderate in that it allows for maintenance of high fire hazard plantations, such as eucalyptus and Monterey pine, by ground fuel removal, periodic controlled burning and thinning to more open spacing. The plan also makes the normal genuflection toward native plants.

In August and September of 1975 Dr. Robert Stebbins, Professor of Zoology, submitted a report on The Use of Habitats in the East Bay Regional Parks by Free-Living Vertebrate Animals. In a letter to Dr. Joe McBride he made these observations:

"Several years have passed now and we seem to be no closer to a management program for the Canyon than when I left the committee (on Conservation and Environmental Quality). . .Protection of the Canyon and sound management plans are needed now more than ever before.

"The concensus was that there should be no significant further expansion of the forest plantations. . . . The forest stands of

redwoods and Monterey pines are extremely depauperate habitats with respect to local vertebrates."

Dr. Stebbins' study ranks habitats as follows for all vertebrates (156 species) with most-used first:

69.2%	oak-bay woodland
64.1	moist chaparral (east and north slopes)
51.3	dry chaparral (west and south slopes)
48.7	grassland
39.7	eucalyptus
4.5	redwood
2.6	Monterey pine

We also had access to Dr. Joseph McBride's thesis and subsequent publications and reports dealing with plant succession in the Berkeley Hills. From these we learn that the normal succession is from grassland through chaparral of varying content to oak-bay woodland and ultimately bay woodland. Other types of vegetation, primarily conifer and eucalyptus plantations, appear to be too limited or special to affect the overall succession pattern.

In 1974 Dr. McBride published the following table:

VEGETATION TYPES IN THE BERKELEY HILLS

Vegetation Type	% Area Covered	Dominant Species
Grassland	43.0	Avena fatua, Bromus mollis, Lolium multiflorum
Baccharis Brushland	21.0	Baccharis pilularis, Rhus diversiloba
Oak Woodland	17.2	Quercus agrifolia

Bay Woodland	7.4	Umbellularia californica
Redwood Forest	2.3	Sequoia sempervirens
Riparian Woodland	0.5	Salix lasiolepis
Knobcone Pine Woodland	0.5	Pinus attenuata
Manzanita-Chamise Brushland	0.4	Arctostaphylos crustacea, Adenostema fasciculatum
Coastal Sagebrush	0.1	Artemisia californica
Plantations:		
Eucalyptus	6.8	Eucalyptus globulus
Monterey Pine	0.8	Pinus radiata

We have also used Appendix A Map, UC Office of Architecture and Engineering, January 1958, and Appendix D, Composition of Tree Plantations, from the Strawberry Canyon Study in the Report of the Committee on Land Use and Facilities, College of Agriculture, Berkeley (covering letter, Smith to Ryerson, November 20, 1953).

RECOMMENDATIONS

III. RECOMMENDATIONS

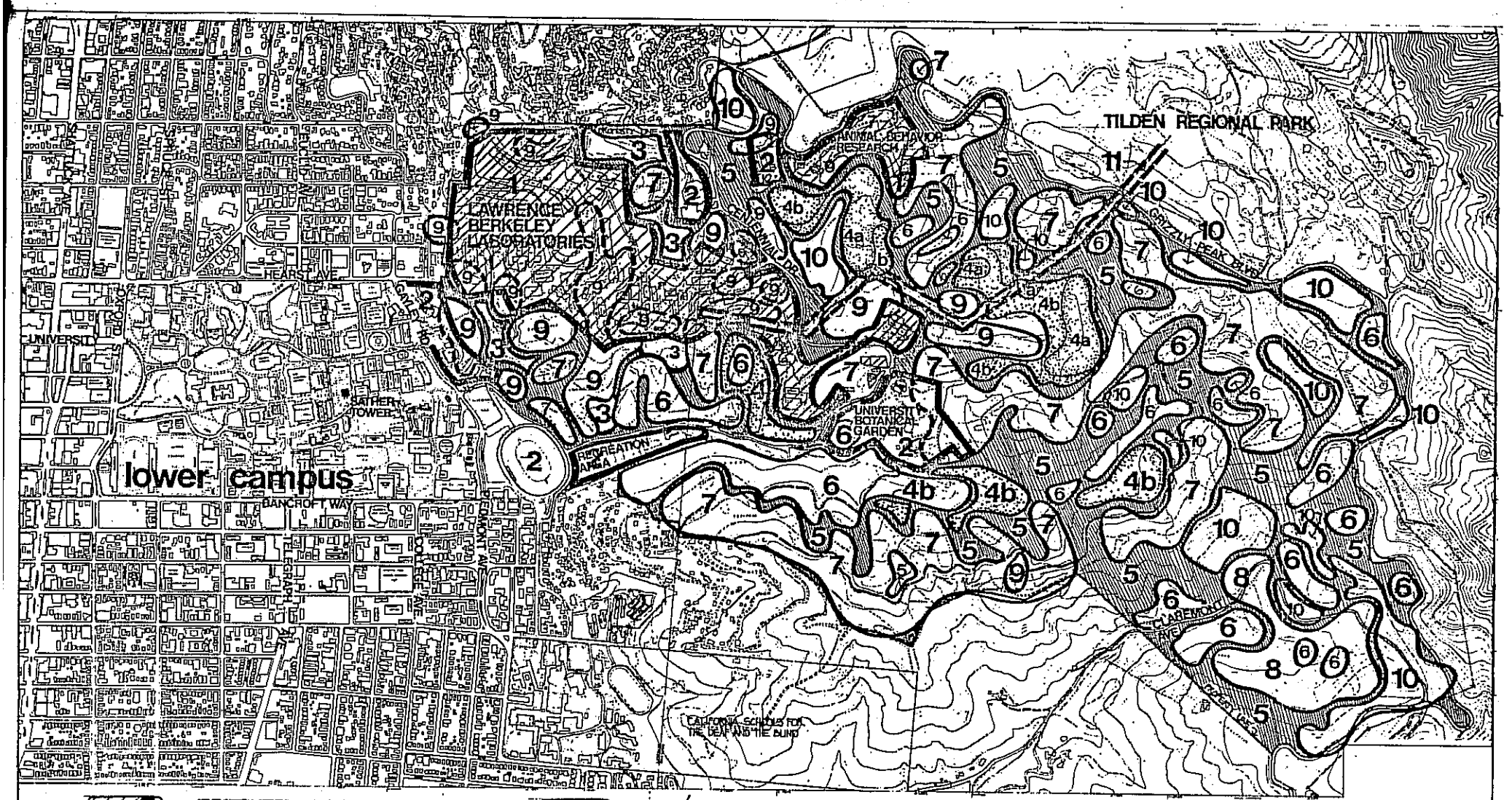
RE-VEGETATION AND EXPANDED CIRCULATION PROPOSALS

The overall plan proposes strengthened pattern relations between four basic vegetation types:

- woodland
- groves
- brushland
- grassland

It must be emphasized that all of the following proposals are general policy proposals which we feel can be implemented. Possible detail and process for implementation of each vegetation management unit is shown in Table 1. The success of this proposed revegetation program will depend upon the appointment of a vegetation management specialist to supervise field work continuously.

In general, throughout the Canyon area, we propose that all slopes less than or close to 25%, and above the riparian vegetation, be maintained in, or converted to, grass. These areas are shown in loosely delineated form on the plan. Their actual boundaries would have to be determined on the ground. Those parts of them which are now covered by soft chaparral--primarily Baccharis -- would have to be cleared and seeded to grass. Clearing could be by hand or by goats. Once converted to grass, the area could be maintained by occasional cutting or by grazing.



1	RESTRICTED AREAS
2	SPECIAL LAND USES
3	MIXED VEGETATION AREAS
4	GRASS CONVERSIONS a. GRASS W/ EUC. SPROUTS b. GRASS WITHOUT SPROUTS
5	SOFT CHAPARRAL
6	OAK/BAY WOODLANDS INCLUDING RIPARIAN AREAS
7	CONIFERS
8	PROPOSED REDWOOD PLANTING
9	EXSTG. STANDS OF EUCALYPTUS
10	EXSTG. EUCALYPTUS SPROUTS
11	P.G.&E. POWER EASEMENT

NOTE- PATTERNS & NUMBERS SHOWN ARE FOR MANAGEMENT GUIDANCE ONLY. ALTHOUGH PREPARED WITH REASONABLE CARE, NO ACCURACY AS TO LOCATION OF EXSTG. VEGETATION IS GUARANTEED. VEGETATION LOCATIONS ARE BASED ON VISUAL SURVEY & 1972 AERIAL PHOTOS. ASIDE FROM THE DIFFICULTIES OF PRECISE SURVEYING ON ROUGH GROUND, THE PASSAGE OF TIME AFTER COMPLETION OF THIS PLAN MAY PRODUCE MAJOR UNPREDICTABLE CHANGES IN ANY OR ALL AREAS.

IT IS RECOMMENDED THAT MANAGEMENT WORK WITH THE LANGUAGE DESCRIBING DESIRED CONTINUITIES OR CHANGES IN VEGETATION ON PARTICULAR SLOPES, & APPLY THOSE TO THE ACTUAL CONDITIONS ON THE GROUND, USING THIS PLAN AS A GUIDE & MONITOR. IT WOULD BE WELL TO REFER TO THE CAMPUS LANDSCAPE ARCHITECT, GARRETT ECKBO & ASSOCIATES, AND/OR TO DR. JOSEPH MCBRIDE FOR INTERPRETATIONS OF THE PLAN ON THE GROUND.

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GARRETT ECKBO & ASSOCIATES

VEGETATION MANAGEMENT

0 200 400 1000 1750 ft.

13

This conversion of substantial areas to grass would have a number of advantages:

It would open up both visual and physical -- combined as psychological -- movement through those areas. On a 4 to 1, or 25% slope, a diagonal line of movement will follow a tolerable 2 to 1, or 12.5% slope. As slopes get steeper the line must, of course, get flatter. But within the areas suggested it appears possible to create hillside meadows through which people could wander.

Both of our fire authorities agree that Baccharis is highly flammable, while grass is less so. Therefore expanding the latter by reducing the former would also reduce the fire hazard.

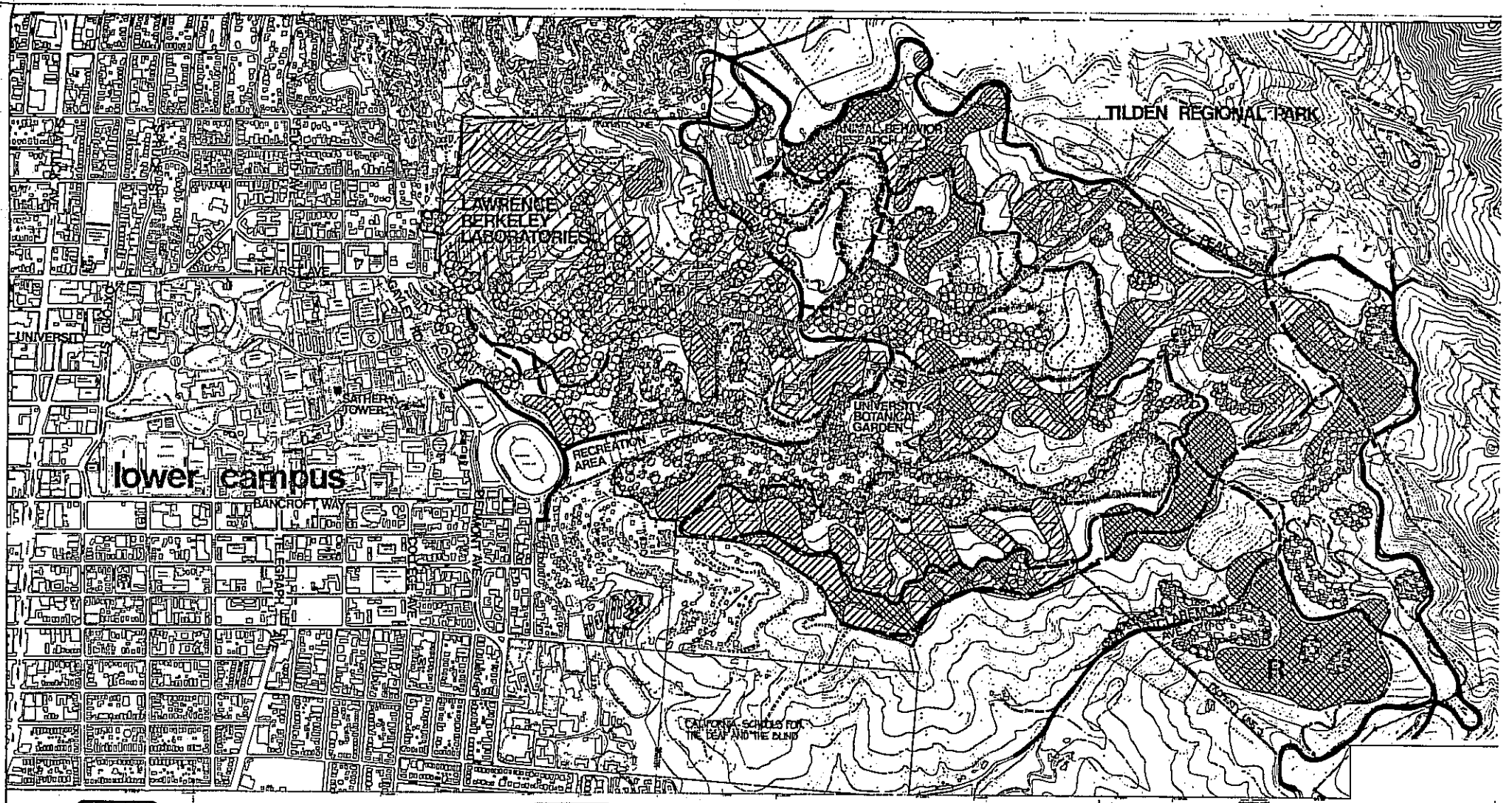
Ecologically the meadows would be arrested at the first stage of succession. They would, however, provide the possibility of substantial wild flower displays. They could continue through pine and eucalyptus groves if the latter were thinned to the open spacings suggested by the VMC.

If control by grazing were elected interesting possibilities both educational and esthetic would open up. Large animals in the landscape add another dimension to its experience.

TREE PLANTING

Three basic types of tree planting now exist within the Canyon area:

Oak-bay woodland on the north slope, valley bottom and south slope



EXSTG. LAND USE UNITS

EXSTG. VEHICULAR CIRCULATION

EXSTG. PEDS. & FIRE TRAILS

EXSTG. OAK/BAY WOODLANDS

EXSTG. STAND OF EUCALYPTUS

EUCALYPTUS SPROUTS

EUCALYPTUS & GRASS

EXSTG. CONIFERS

PROPOSED CONIFERS

R PROPOSED REDWOODS

PROPOSED GRASS CONVERSIONS

50FT. CHAPARRAL

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REVEGETATION DESIGN

0 200 400 1000 1750ft.

11

drainage channels.

Conifers -- primarily Monterey pine -- in groups around the upper slopes and ridges and in some lower areas.

Eucalyptus -- primarily blue and red gum -- in a broad belt through the center of the south slope including Lawrence Labs, over into Claremont Canyon and on Chaparral Hill. About 75% cut but sprouting vigorously.

We propose that:

The oak-bay areas be protected and preserved.

The conifer plantings be protected and extended as suggested in plan to form a more continuous - less spotty enclosure around the upper levels of the Canyon bowl. New plantings should be Redwood, Giant Sequoia and Incense Cedar. The University should be prepared to replant periodically to replace old trees as they die and supplement natural reproduction if it is inadequate. Species of pines should be avoided because of their high flammability and the fire risk they present. Colors should be green or gray.

The eucalyptus groves provide an additonal dimension to the Canyon experience. They are upright like the conifers in contrast with the spreading oaks and bays. They are more open and graceful, grayer or browner in color, than most of the conifers. They are naturalized to the extent of reproducing themselves. If we eliminate simplistic preconceptions about good natives and bad exotics, they are examples of much more interesting and complex relations world-wide between plants from similar environments. There are plants indigenous to the locality -- oaks and bays; plants native to other California localities -- Monterey pine and cypress, and some of the conifers

as Incense Cedar; introduced plants which naturalize and reproduce -- eucalyptus and other Australians; introduced plants which naturalize but do not reproduce; introduced plants which will succeed with varying degrees of aid.

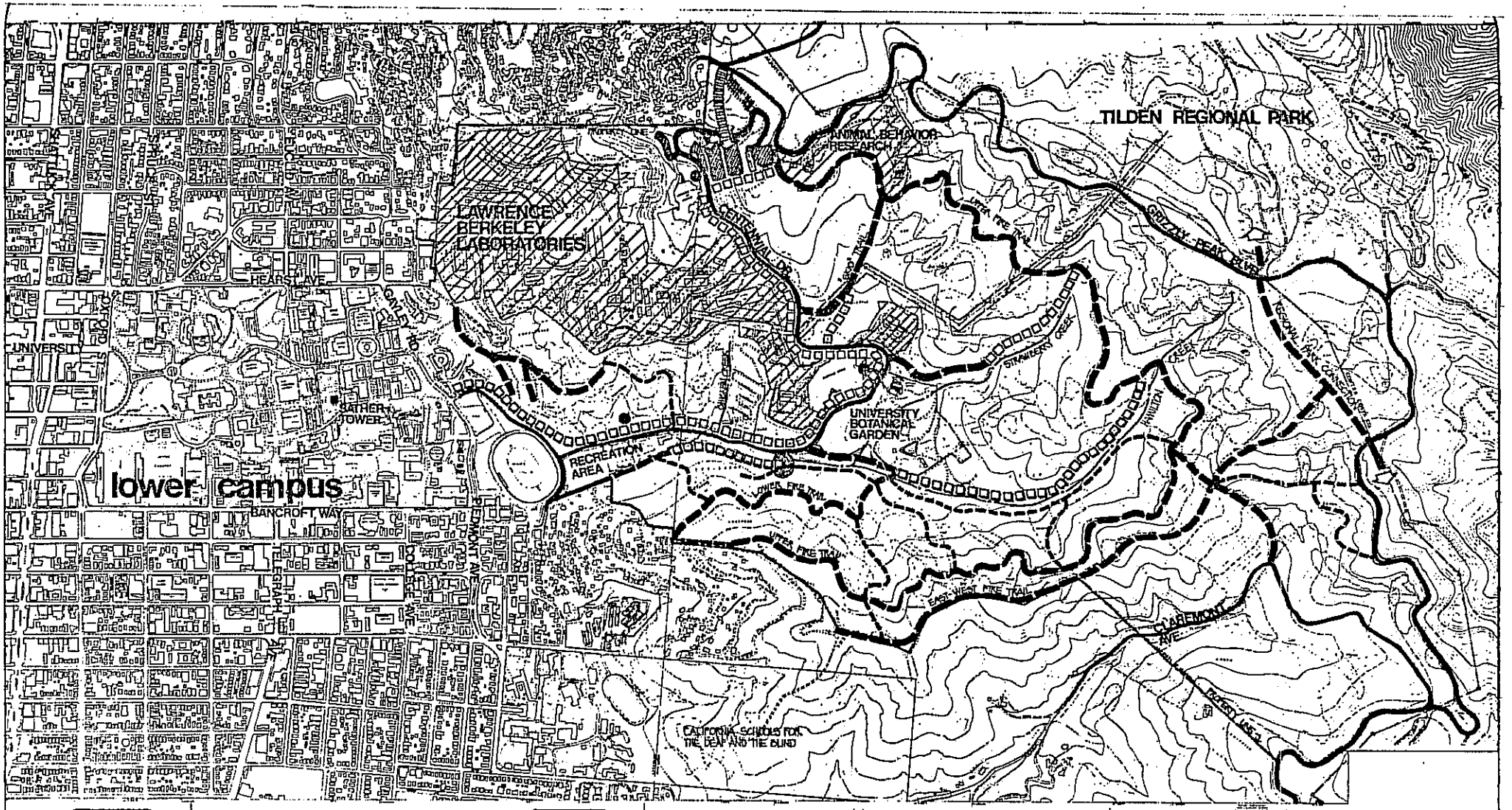
Biswell's suggestion that a redwood grove be planted in the lower bowl of the Claremont Canyon lands is excellent and is embodied in our plan.

As for the fire hazard, it appears that the combined advice of Biswell and VMC tells us to clear up the flammable debris regularly and to thin out the trees to an average, though irregular, 30 x 30 foot spacing. With these provisos the cut over grove areas can be allowed to grow back to something like their original character. Specific fuel management prescriptions for each vegetation management unit are included in Table 1.

TRAIL SYSTEM

The planting pattern relations are designed to work with proposed expanded and integrated trail and meadow circulation patterns to open up the entire canyon as a more complete and coherent experience of landscape space, closely coordinated with ecological study programs. This is thought of as a time-space movement system, without specifying the rate of movement through it. Some may ride horses, bicycle, or jog, while others hike, stroll, loiter or linger.

One may enter such a system at any time (daylight) at any accessible point and move through it in either direction and any combination of long or short loops. The high percentage of relatively steep slopes in the Canyon area



EXSTG. VEHICULAR CIRCULATION

PROPOSED VEHICULAR ACCESS

DELETION OF ROAD

VEHICULAR OVERPASS

VEHICULAR PARKING

INTERNAL TRANSIT STOP

EXSTG. FIRE TRAIL

EXSTG. INDIAN TRAIL

PROPOSED PEDESTRIAN

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MOVEMENT SYSTEM

0 200 400 1000 1750 ft.

12

(about 80% steeper than 1 in 4, or 25%) limits the flexibility of such a system, but increases its dramatic and challenging aspects. From this point of view it is necessary to describe circulation and vegetation patterns together.

Entering the system primarily from the west, the lower campus, we begin as we cross Gayley Drive and enter Stadium Rimway north of Kleeberger Field. We propose that the inadequate and unpleasant walk to Centennial Drive and along it to the dam be supplemented by a comfortable 6 to 8 foot wide pedestrian way cut into the slopes above Rimway and North Canyon Road from Bowles Hall to Chicken Creek, Poultry Station and the dam.

From the south side we propose that Rimway be closed between Centennial Drive and Canyon Road. Pedestrian movement from the campus can filter between the Stadium and International House, around the upper terraces and through Canyon Road to the excellent broad walk which runs to upper Haas pool. This path should be extended above the pool, the dam and retention basin until it intersects the lower fire road south of Hamilton Creek. From here the road climbs westerly up the north slope.

North of the creek a branch fire road continues eastward parallel to it. Because of massive soil movement the Botanical Garden fence above the road has failed. A new fence has been built along the road bed some 4 to 5 feet in from its outer edge. Although there is a gate at its western end the road has not been maintained for vehicles. It has grown up with heavy Baccharis and some scrub oak until it is difficult to distinguish the original road. However it is still there as a basic graded form.

We propose that the old fence be removed and the new fence be moved back to the toe of the slope above the road bed. Baccharis and other brush, except oaks, should be removed and the roadway opened up to almost its original comfortable scale. It should then be extended on up the gulch to meet the upper fire road as comfortably as possible. This will open up the eastern end of the canyon to pedestrian movement.

Returning to the Botanic Garden area, on its north side a paved service road runs eastward about 1,000 feet up Strawberry Creek to a seismic installation. This is a paved road with a locked gate approximately 150 feet from Centennial Drive. However it is possible to squeeze around the end of the gate. The walk is pleasant, with first the varied growth in the Botanic Garden and then lush native canyon vegetation below it, and fine groves of Monterey pine and eucalyptus above. The road terminates at two seismic installations, one set in a bowl quarried from the hillside. Beyond one can see the valley of Strawberry Creek opening up northeastward. We propose that this road also be extended up the valley as a dirt trail to the upper fire road. The seismic installations can be fenced in for protection, and pedestrian access through or around the gate made easier.

The other major up-down connection now exists in the north-south valley below Animal Behavior Research. The skid road which was developed to remove cut eucalyptus now provides a comfortable walk down from the upper fire road to the power line service road which leads north, over the ridge in a steep and awkward hum, to Centennial Drive. It would be possible, however, to clear a continuation of the skid road as path through the substantial eucalyptus grove west of the BioMedical Building directly south of North Canyon.

(There is a bad gully eating into that grove.) The path would connect with Centennial Drive.

In this valley, now quite open because of eucalyptus cutting and full of resurgent growth including eucalyptus sprouts, slopes are such that a good part of it could be converted to grass.

Of the three most feasible up-down connections we have proposed, only the first, up Hamilton Gulch, connects directly with existing and proposed pedestrian ways. The other two require the use of Centennial Drive as a lower or westward connector. Walking along this drive is again narrow, unpleasant, and hazardous both above and below the Botanic Garden. As to the scale of these walk/fire roads they should run from 6 to 12 feet. As a practical matter, 12 can be maintained with a motor patrol. Indian trails are, of course, much narrower.

CENTENNIAL DRIVE

It seems no more reasonable for the University to provide a thoroughfare for through traffic in its upper campus than in its lower campus. That issue was thoroughly debated at the time of Moffitt Library planning. We recommend that Centennial Drive be closed to through traffic. The road is steep, narrow and dangerous, particularly when used by through drivers rather than campus drivers. Above the Botanic Garden it inhibits pedestrian and bicycle use. It was not designed to adequate standards for through traffic. The University is liable for accidents which may occur along it. Stanford University does not allow through traffic in its campus.

As mentioned before, up to two miles detour north or south via Claremont or Spruce is no great inconvenience for motor vehicles. Both are better roads. The idea that cars and trucks must always have the most direct and convenient route is no longer defendable as we become more environment and pedestrian conscious.

The Provenzano report found that Centennial Drive from Rimway Road to the upper Tennis Court parking lots is in good condition, showing little or no distress. However above that section to a point approximately 150 feet above the Botanical Gardens entrance the roadway showed numerous signs of distress from moderate to heavy. These were embodied in considerable cracking parallel to the roadway and localized settlements of varying magnitude and size. The probable causes were numerous utility trenches which have seriously undermined the structural integrity of the subgrade soils to depths of 5 to 6 feet; sidehill cut-fill sections in which some of the fills are in a variable loose uncompacted state; and intermittent subsurface seepage. In addition, portions of the hill above and adjacent to the roadway appear very susceptible to mud flows during periods of prolonged rainfall.

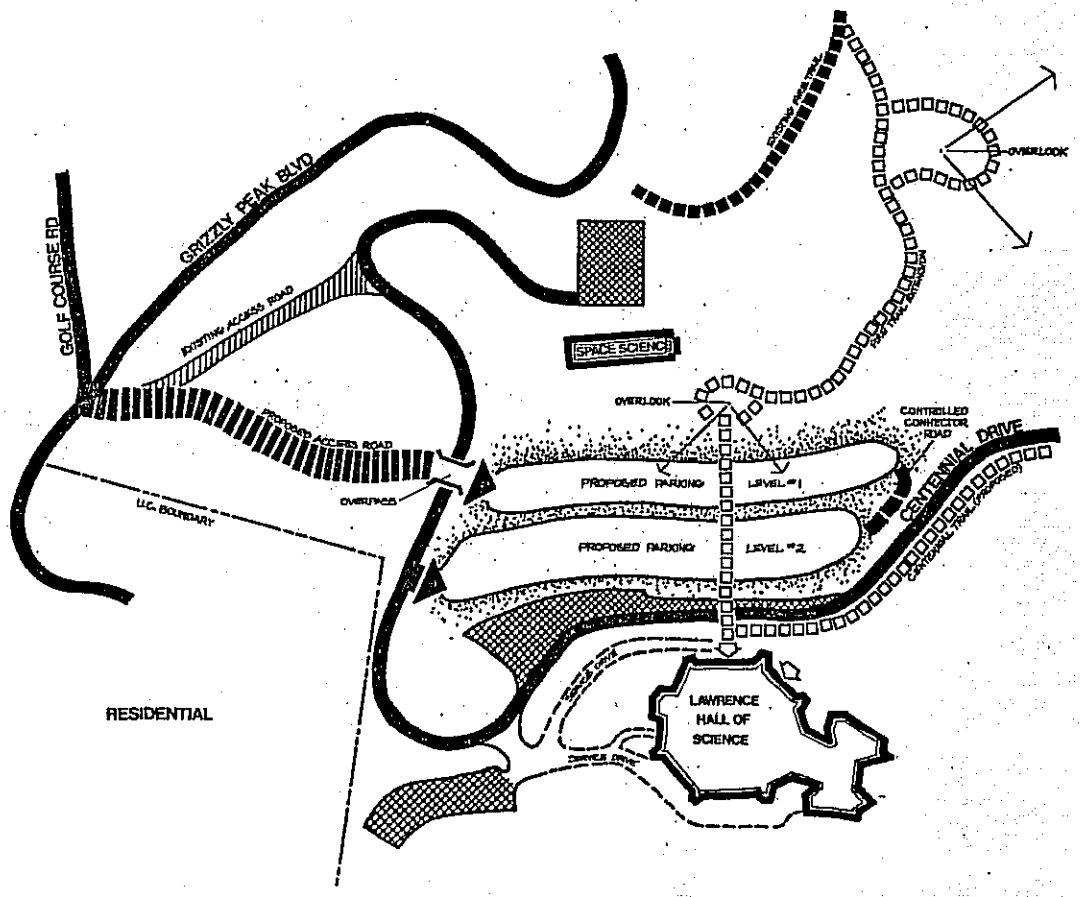
To correct these conditions the report recommends resurfacing the lower portion and rehabilitating the upper with an elaborate program of reconstruction, drainage, retaining and slope walls, and vegetal stabilization. Although this report was made in March 1972, none of its recommendations appear to have been implemented.

The visual impact of such major road reconstruction upon the landscape

quality along it would be substantial, although subject to gradual healing with careful planting. It is not known just what relations there may be between current traffic, strictly intra-campus traffic, the rate of deterioration of the roadway, and the ultimate deadline for reconstruction. But it seems obvious that the roadway will last longer and deteriorate more slowly with less traffic. Accurate counts of through and campus traffic may help in the final decision-making.

Such a closing of Centennial Drive would require much more detailed study. It has already been proposed in the Jones Report. We feel that the upper end could be re-designed to provide for all needed intra-campus circulation and public access to Lawrence Hall of Science and Botanic Garden while blocking through traffic. It might work about as follows:

> By closing Centennial above the Space Science entrance, through traffic would be blocked while campus traffic could reach SS and Grizzly Peak if necessary. Gates or barriers could keep external traffic out of this section.
>
> Centennial from above could be reconstructed to terminate at a new upper Lawrence Hall parking lot, crossing the road to Space Science via overpass. The lower parking lot terraces presently graded east of Lawrence Hall and Centennial could be completed to receive public visitors from below, who would not be able to go farther. The Botanic Garden could only be reached from below- but that is probably no problem for most visitors.



EXISTING VEHICULAR CIRCULATION

DELETE EXISTING ACCESS ROAD

PROPOSED VEHICULAR ACCESS

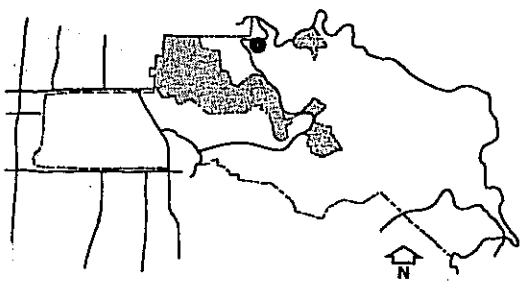
PROPOSED OVERPASS

PROPOSED PARKING

EXISTING PARKING

EXISTING TRAIL

PROPOSED TRAIL



key map

LENNERT AND ASSOCIATES · CONSULTING ENGINEERS

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MOVEMENT SYSTEM

0 50 100 250ft

12a

The reduction in traffic, particularly truck traffic, on Centennial would reduce maintenance costs, perhaps eliminate the reconstruction proposed by Provenzano, and make possible much more comfortable pedestrian provision along it. There should be a good pedestrian walk all the way up to Lawrence Hall, connecting from there to the upper fire road. Tree groves should be planted along the slope below Centennial to screen the more industrial sections of the Lawrence Labs.

The opening up of these three valleys with pedestrian ways and grass areas would create a system of loops:

lower fire road, upper fire road, Centennial Drive,
Hamilton, Strawberry and Animal Research Valleys
a total of nine different possible loops.

To these can be added other shorter connections shown on plan, particularly along the upper ridges and over into Claremont Canyon. The so-called Indian trails are more special because they seem to be so steep, narrow, overgrown and difficult as to be primarily for the young and the athletic. Furthermore, because many of these trails are approximately perpendicular to the slope they cause erosion. There are places along the fire roads where trails are breaking down their edges.

MISCELLANEOUS

Along the upper Grizzly Peak frontage the gullies tend to be filled with junk. Access to them by car should be blocked.

Next to the redwoods on the north slope there is a bad erosion gully which should be controlled.

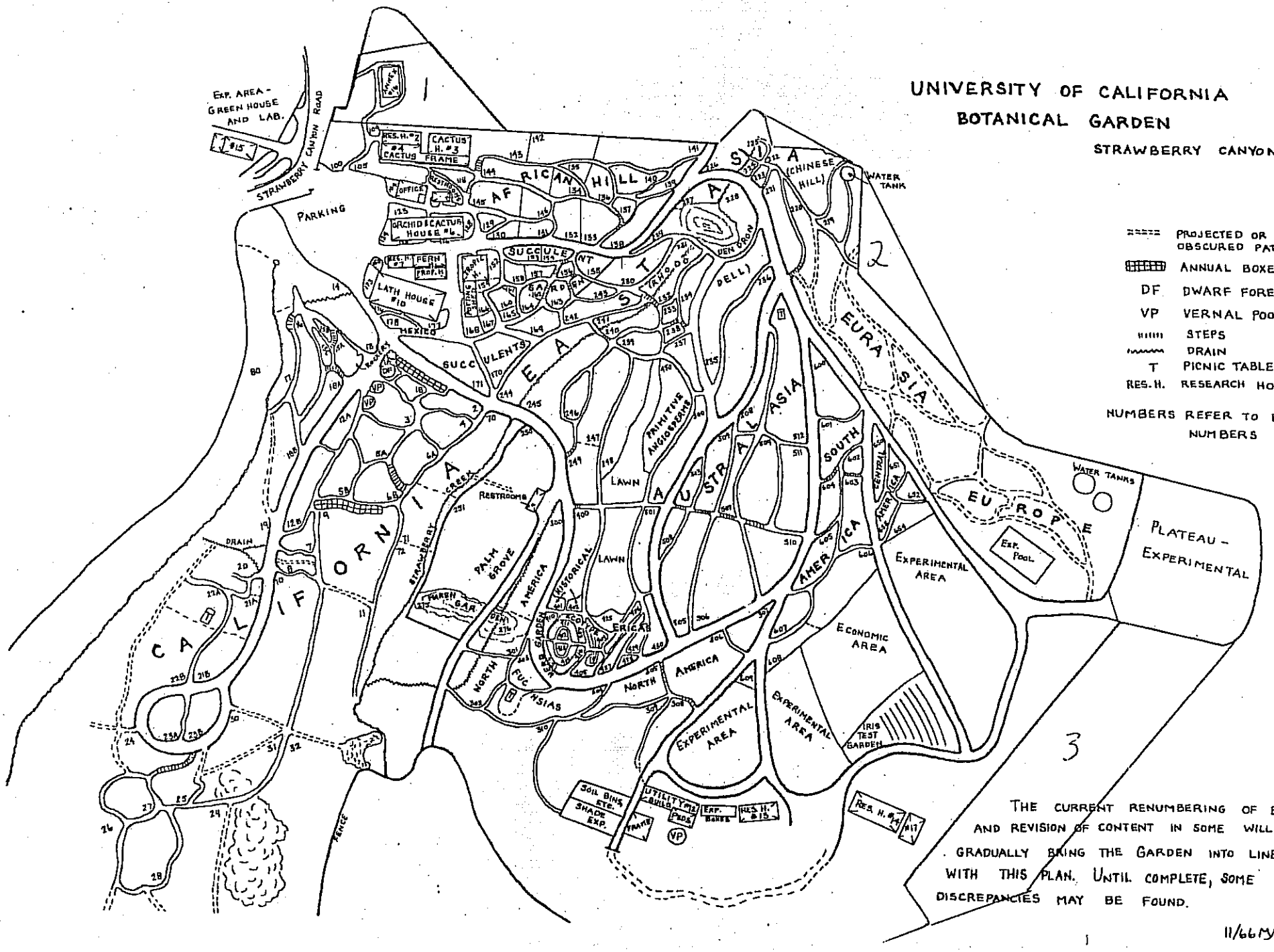
Along the skid road on the south slope a creek channel has been filled in. This disperses the drainage. This channel should be opened up.

As a result of past overgrazing and concentrated corrals there is an invasion of thistles and wild artichokes. These are difficult to manage. Research on control means is badly needed.

BOTANICAL GARDEN

The following additions to the Botanic Garden from Robert Ornduff, Department of Botany, seem reasonable and are incorporated in this plan:

> There are three modifications of the existing fence around the Botanical Garden that we would like to be considered for possible inclusion in the Strawberry Canyon Report. These areas are indicated on the attached map.
>
> Area 1 is a small area bounded by the seismograph road, Centennial Drive, and the Botanical Garden. This area would enclose the building that houses our educational program. Most of this area is already part of the Botanical Garden but is outside our fence, and the reason for enclosing this area is for security of the educational building and for the protection of the existing plantings in this area.
>
> Area 2 is above our Asian and European Areas and would allow for an expansion of these areas by the straightening out of the existing fence. The present fence is at the top of a steep slope, and the area outside this fence is a much gentler slope. The new location of the fence would be at the upper edge of this gentle slope where it again becomes steep. Area 2 is essentially unaccessible except through the Botanical Garden, and we believe that the new location of the fence would be a much more logical boundary for this part of the Botanical Garden.
>
> Area 3 would move the existing fence farther down the slope toward Hamilton Gulch. This change would also straighten out the existing



THE CURRENT RENUMBERING OF BEDS AND REVISION OF CONTENT IN SOME WILL GRADUALLY BRING THE GARDEN INTO LINE WITH THIS PLAN. UNTIL COMPLETE, SOME DISCREPANCIES MAY BE FOUND.

11/66 Yea.

Botanical Garden boundary. This area would be used for a research area and would allow us to move all the research activities of the garden to the back of the Botanical Garden and away from the areas open to the public.

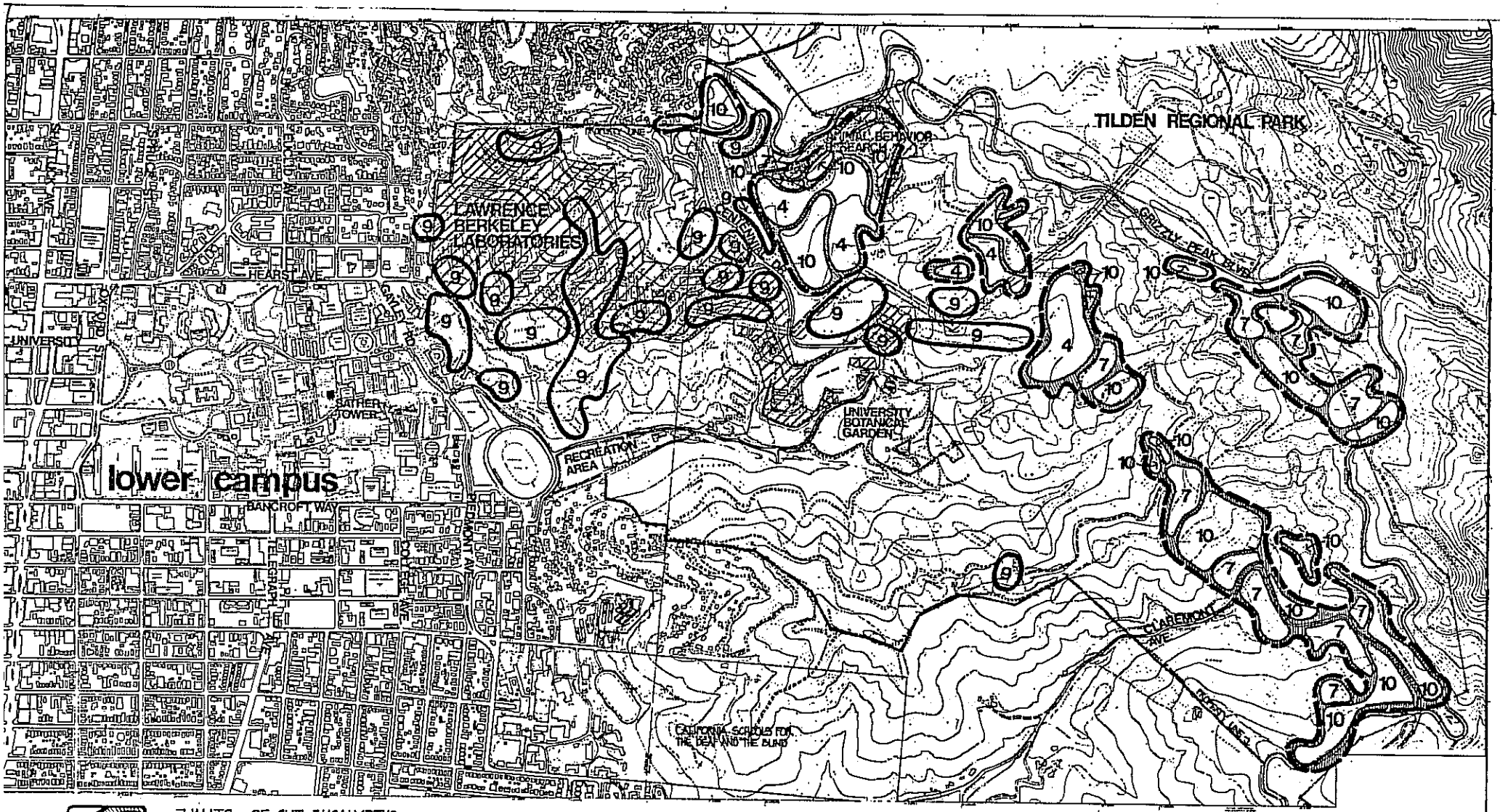
VEGETATIVE PLAN - IMPLEMENTATION RECOMMENDATIONS

Prepared by Dr. Joseph McBride
Transcribed by Garrett Eckbo and Associates

These recommendations for re-vegetating Strawberry Canyon and for its continous management will require the hiring of a professional vegetation manager with experience in wildland fuel management. To accomplish the re-vegetation proposals at a reasonable rate, the manager should be provided with two full-time assistants, and several part-time assistants during the planting season and those times of the year when ground fuels can be burned. In addition to vegetation management responsibilities the manager and his crew would also be charged with trail construction and maintenance, erosion control and stream channel maintenance. The vegetative manager should also be made responsible for monitoring the use of the canyon for teaching and research, in order to minimize potential conflicts between users, and between users and resources.

Note

Patterns and numbers shown are for management guidance only. Although prepared with reasonable care, no accuracy as to location or existing vegetation is guaranteed. Vegetation locations are based on visual survey and 1972 aerial photos.



LIMITS OF CUT EUCALYPTUS

9 EXSTG. STAND OF EUCALYPTUS

10 EXSTG. EUCALYPTUS SPROUTS

7 PROPOSED CONIFER CONVERSION

4 GRASS & EUCALYPTUS

STRAWBERRY CANYON STUDY
U.C. BERKELEY · JUNE 1976
GARRETT ECKBO & ASSOCIATES

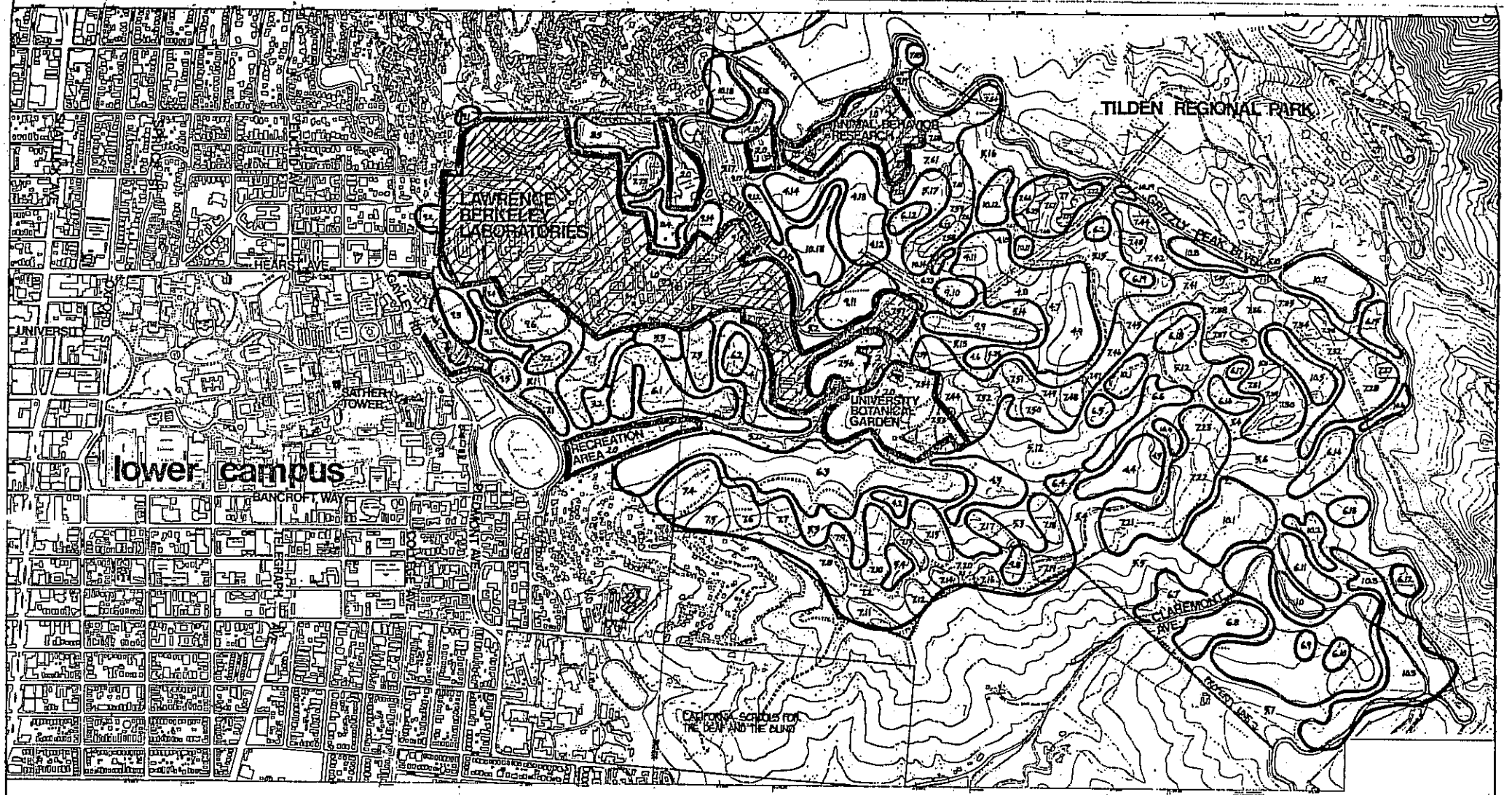
EUCALYPTUS MANAGEMENT

0 200 400 1000 1750ft.

13b

Aside from the difficulties of precise surveying on rough ground, the passage of time after completion of this plan may produce major unpredictable changes in any or all areas.

It is recommended that management work with the language describing desired continuities or changes in vegetation on particular slopes, and apply those to the actual conditions on the ground, using this plan as a guide and monitor. It would be well to refer to the Campus Landscape Architect, to Garrett Eckbo and Associates, and/or to Dr. Joseph McBride for interpretation of the plan on the ground.



NOTE- PATTERNS & NUMBERS SHOWN ARE FOR MANAGEMENT GUIDANCE ONLY. ALTHOUGH PREPARED WITH REASONABLE CARE, NO ACCURACY AS TO LOCATION OF EXIST. VEGETATION IS GUARANTEED. VEGETATION LOCATIONS ARE BASED ON VISUAL SURVEY & FITZ AERIAL PHOTOS. ASIDE FROM THE DIFFICULTIES OF PRECISE SURVEYING ON ROUGH GROUND, THE PASSAGE OF TIME AFTER COMPLETION OF THIS PLAN MAY PRODUCE MAJOR UNPREDICTABLE CHANGES IN ANY OR ALL AREAS.

IT IS RECOMMENDED THAT MANAGEMENT WORK WITH THE LANGUAGE DESCRIBING DESIRED CONTINUITIES OR CHANGES IN VEGETATION ON PARTICULAR SLOPES, & APPLY THOSE TO THE ACTUAL CONDITIONS ON THE GROUND USING THIS PLAN AS A GUIDE & MONITOR. IT WOULD BE WELL TO REFER TO THE CAMPUS LANDSCAPE ARCHITECT, GARRETT ECKBO & ASSOCIATES AND/OR TO DR. JOSEPH MCBRIDE FOR INTERPRETATIONS OF THE PLAN ON THE GROUND.

JOSEPH McBRIDE VEGETATION MANAGEMENT CONSULTANT

STRAWBERRY CANYON STUDY
U.C. BERKELEY · JUNE 1976
GARRETT ECKBO & ASSOCIATES

VEG. MANAGEMENT IMPLEMENTATION

0 200 400 1000 1750 ft.

13a

TABLE 1: VEGETATION MANAGEMENT UNITS

LEGEND (The following symbols are used in this table to designate specific management practices)

A. No manipulation

B. Pile and burn all dead ground fuel 1" to 4" in diameter every 25 years

C. Maintain existing grassland units by manual clearing of shrub and tree seedlings

D. Eucalyptus Units:
   1. Pile and burn all dead ground fuel 1" to 4" in diameter every 25 years
   2. Broadcast burn ground fuels every 5 to seven years

E. No manipulation of eucalyptus

F. Clear soft chaparral

G. Grassland Units: No treatment

H. Broadcast burn ground fuels every 10 years, providing sufficient ground fuel has accumulated

I. Hand clear, pile and burn soft chaparral

J. 1. Plant redwood in a clumped pattern with 400 trees/acre (see clumped pattern planting design)
   2. Thin to 200 trees at end of 20 years (maintain clumped pattern)

K. Broadcast burn ground fuel every 25 years after redwood becomes established

L. Cut sprouts and treat with 2,4-D to kill stumps

M. Plant Giant Sequoia in a random pattern with 500 trees/acre (see random pattern planting design,500 trees/acre)

N. Thin to 200 trees/acre at end of 25 years

O. Plant Incense Cedar in a random pattern with 600 trees/acre (see random pattern planting design, 600 trees/acre)

P. 1. Hand clear shrubs from area designated, pile and burn
   2. Remove all shrub seedlings and sprouts every 2 years

LEGEND (cont'd.)

Q. Broadcast burn every 10 years

R. 1. Fence area shown on map
2. Graze with goats until brush is eliminated or hand clear
3. Graze with cattle

S. 1. Fence area shown on map
2. Cut off stumps to within 2" of the ground, treat with 2,4-D
3. Hand clear all shrubs, pile and burn
4. Sow with annual grass seed mixture
5. Graze with cattle

T. Burn every ten years

U. Broadcast burn every year a 10' wide strip along property line

V. 1. Select 30 stumps per acre as potential trees, mark distinctly and cut all but tallest sprouts on each stump
2. Cut sprouts and treat with 2,4-D on all remaining stumps

W. No treatment until oak/bay wookland has developed then "B"

*Note: Clumped and random pattern planting design sketches available in consultant's files when needed.

AREA	EXISTING VEGETATION	PROPOSED VEGETATION	VEGETATIVE MANAGEMENT PRESCRIPTION	FUEL MANAGEMENT PRESCRIPTION
1.0	Restricted Area, vegetation management to be developed by Lawrence Berkeley Laboratory			
2.0	Special Land Use Area, vegetation management to be developed by special land use authority			
3.1	Mixed Vegetation (Small scale mosaic of grassland and eucalyptus)	Mixed Vegetation C,E	D,G	
3.2	Mixed Vegetation (small scale mosaic of grassland, eucalyptus and soft chaparral)	Grassland with eucalyptus C,E,F	D,G	
3.3	Mixed Vegetation (small scale mosaic of grassland and soft chaparral)	Oak/Bay Woodland A	B	
3.4	Mixed Vegetation (small scale mosaic of grassland and soft chaparral)	Grassland	C	G
3.5	Mixed Vegetation (small scale mosaic of grassland and soft chaparral)	Grassland and eucalyptus	C,E,F	D,G
4.1	Soft Chaparral (with grassland openings)	Grassland	P	Q
4.2	Soft chaparral (with grassland openings, if oak woodland do not convert)	Grassland	P	Q

AREA	EXISTING VEGETATION	PROPOSED VEGETATION	VEGETATIVE MANAGEMENT PRESCRIPTION	FUEL MANAGEMENT PRESCRIPTION
4.3	Soft chaparral (with grassland openings)	Grassland	R	Q
4.4	Soft chaparral	Grassland	R (fence should enclose both units 4.4 and 4.5)	Q
4.5	Cut over eucalyptus without sprouts	Grassland	S	Q
4.6	Cut over eucalyptus without sprouts	Grassland	S	Q
4.7	Cut over eucalyptus without sprouts	Grassland	S (fence should include units 4.7 through 4.11)	Q
4.8	Soft chaparral	Grassland	R	Q
4.9	Eucalyptus sprouts	Grassland	S	Q
4.10	Eucalyptus sprouts	Grassland	S	Q
4.11	Eucalyptus sprouts	Grassland	S	Q
4.12	Cut over eucalyptus without sprouts	Grassland	S (fence should include units 4.12 through 4.14)	Q
4.13	Eucalyptus sprouts	Grassland	S	Q
4.14	Cut over eucalyptus without sprouts	Grassland	S	Q
5.1 - 5.8	Soft chaparral	Soft chaparral	A	W
5.9	Soft chaparral	Soft chaparral	A,T	W

AREA	EXISTING VEGETATION	PROPOSED VEGETATION	VEGETATIVE MANAGEMENT PRESCRIPTION	FUEL MANAGEMENT PRESCRIPTION
5.10 - 5.20	Soft chaparral	Soft chaparral	A	W
5.21	Soft chaparral	Grassland	P	U
6.1 - 6.25	Oak/Bay Woodland	Oak/Bay Woodland	A	B
7.1	Conifer (mixed plantation of high elevation of pine species)	Conifer (same)	A	B,H
7.2	Conifer (Bishop Pine)	Conifer (same)	A	B,H
7.3	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.4	Conifer (mixed plantation of high elevation of pine species)	Conifer (same)	A	B,H
7.5	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.6	Conifer (Spruce)	Conifer (same)	A	B,H
7.7	Conifer (Western Red Cedar)	Conifer (same)	A	B,H
7.8	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.9	Conifer (Monterey Cypress)	Conifer (same)	A	B,H
7.10	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.11	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.12	Conifer (Canary Island Pine)	Conifer (same)	A	B,H

AREA	EXISTING VEGETATION	PROPOSED VEGETATION	VEGETATIVE MANAGEMENT PRESCRIPTION	FUEL MANAGEMENT PRESCRIPTION
7.13	Conifer (Redwood)	Conifer (same)	A	B,H
7.14	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.15	Conifer (Redwood)	Conifer (same)	A	B,H
7.16	Conifer (Canary Island Pine)	Conifer (same)	A	B,H
7.17	Conifer (Italian Stone Pine)	Conifer (same)	A	B,H
7.18	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.19	Conifer (Canary Island Pine)	Conifer (same)	A	B,H
7.20	Soft chaparral	Conifer (Redwood)	I,J	K
7.21	Soft chaparral	Conifer (Redwood in north facing slope and Incense Cedar on south facing slope)	I,J,N,O	K
7.22	Eucalyptus sprouts	Conifer (Giant Sequoia)	I,L,M,N	K
7.23	Soft chaparral	Conifer (Giant Sequoia)	I,J,N	K
7.24	Eucalyptus sprouts	Conifer (Redwood on west and north facing slopes; Incense Cedar on south facing slope)	I,J,L	K
7.25	Soft chaparral	Conifer (Redwood)	I,J	K
7.26	Soft chaparral	Conifer (Redwood)	I,J	K
7.27	Soft chaparral	Conifer (Giant Sequoia)	I,M,N	K
7.28	Eucalyptus sprouts	Conifer (Giant sequoia)	I,L,M,N	K

AREA	EXISTING VEGETATION	PROPOSED VEGETATION	VEGETATIVE MANAGEMENT PRESCRIPTION	FUEL MANAGEMENT PRESCRIPTION
7.29	Soft chaparral	Conifer (Giant Sequoia)	I,M,N	K
7.30	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.31	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.32	Soft chaparral	Conifer (Giant Sequoia)	I,M,N	K
7.33	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.34	Eucalyptus sprouts	Conifer (Giant Sequoia)	I,L,M,N	K
7.35	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.36	Eucalyptus sprouts	Conifer (Giant Sequoia)	I,L,M,N	K
7.37	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.38	Soft chaparral	Conifer (Giant Sequoia)	I,J	K
7.39	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.40	Soft chaparral	Conifer (Incense Cedar)	I,N,O	K
7.41	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.42	Soft chaparral	Conifer (Incense Cedar)	I,N,O	K
7.43	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.44	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.45	Soft chaparral	Conifer (Redwood)	I,J	K
7.46	Eucalyptus sprouts	Conifer (Redwood)	I,J,L	K

AREA	EXISTING VEGETATION	PROPOSED VEGETATION	VEGETATIVE MANAGEMENT PRESCRIPTION	FUEL MANAGEMENT PRESCRIPTION
7.47	Soft chaparral	Conifer (Redwood)	I,J	K
7.48	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.49	Soft chaparral	Conifer (Redwood)	I,J	K
7.50	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.51	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.52	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.53	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.54	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.55	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.56	Conifer (Redwood)	Conifer (same)	A	B,H
7.57	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.58	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.59	Soft chaparral	Conifer (Incense Cedar)	I,N,O	K
7.60	Eucalyptus Sprouts	Conifer (Incense Cedar)	I,L,N,O	K
7.61	Soft chaparral	Conifer (Incense Cedar)	I,N,O	K
7.62	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.63	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.64	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.65	Conifer (Monterey Pine)	Conifer (same)	A	B,H

AREA	EXISTING VEGETATION	PROPOSED VEGETATION	VEGETATIVE MANAGEMENT PRESCRIPTION	FUEL MANAGEMENT PRESCRIPTION
7.66	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.67	Eucalyptus Sprouts	Conifer (Redwood)	I,L,J	K
7.68	Soft chaparral	Conifer (Redwood)	I,J	K
7.69	Soft chaparral	Conifer (Redwood)	I,J	K
7.70	Soft chaparral	Conifer (Redwood)	I,J	K
7.71	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.72	Conifer (Monterey Pine)	Conifer (same)	A	B,H
7.73	Conifer (Monterey Pine)	Conifer (same)	A	B,H
8.1	(see Unit 7.25)			
8.2	(see Unit 7.26)			
8.3	(see Unit 7.24)			
9.1 - 9.17	Eucalyptus	Eucalyptus	A	D
10.1 - 10.14	Eucalyptus Sprouts	Eucalyptus	V	D

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Appendix B -- Rock and Soil Conditions
Appendix C -- Potential Building Sites
Appendix D -- Supplemental Information

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APPENDIX

LENNERT AND ASSOCIATES
SOILS ENGINEERS

3309 Browns Valley Road
Napa, California 94558
(707) 252-9273

Job No. 756

16 June 1976

Garrett Eckbo & Associates
1045 Sansome Street
San Francisco, CA 94111

Subject: University of California at Berkeley
Future Development Study
Upper Campus Area

Gentlemen:

Transmitted herewith is our report covering engineering consultation in connection with your planning study for future development of the campus area easterly of Galey Road.

The scope of our services has included preparation of a campus geologic map showing the area geology and fault system, preparation of a generalized evaluation of rock and soils conditions keyed to the geologic map, identification and evaluation of potential building sites, and provision of some general information regarding the storm drainage system and present ecologic conditions in the stream channel system. The results of our studies, including the geologic map and drawings of potential building sites, have been presented as "work sheets" without being drafted into reproducible form. Information regarding the hydrology, storm runoff conditions and storm drainage system of the campus has been provided by our report dated 12 May 1972. This report formalizes transmission of these materials, and presents the basis for the drawings transmitted to you along with explanatory comments and supplemental opinions.

The body of this written report is presented in four appendices, listed as follows:

APPENDIX A: GEOGRAPHY AND GEOLOGY

APPENDIX B: ROCK AND SOIL CONDITIONS

APPENDIX C: POTENTIAL BUILDING SITES

APPENDIX D: SUPPLEMENTAL INFORAMTION

Due to the large area covered and the limited scope of work, our analyses are cursory and represent only a general planning level of definition. This office has sufficient information in its files to prepare a schematic level evaluation, with reasonably dependable cost estimates, for any of the potential development sites identified in this report; this would be done as a supplemental service, for a specific site, if this is found to be desirable.

A massive amount of data has been reviewed in preparation of this report, and extensive analyses were performed. This report, and the accompanying drawings, represent a very brief summation of the results of this work. This office is prepared to discuss the basis for the transmitted materials, and for our conclusions and opinions, in much more detail than is presented in this report if you so request.

Respectfully submitted,

B.J. Lennert
REC #9232

BJL/ct

Encl.

APPENDIX A

GEOGRAPHY AND GEOLOGY

The area under consideration consists of that portion of the campus lying easterly (uphill) of Gayley Road. This area lies on the west-facing slope of the Berkeley Hills, extending from approximately the toe of slope to the most westerly ridge crest at Grizzly Peak Boulevard, thus covering the entire hill slope. The area topography consists basically of a complex pattern of relatively small secondary ridges and nosings, separated by an intricately branching canyon system, resulting from a combination of faulting and erosion associated with the geologically very recent uplift of the Berkeley Hills. Excepting for the lower portion of Strawberry Canyon, the ground slopes relatively steeply throughout, averaging around 25 percent, and there are no natural large flat areas. The area is thus generally steeply sloping, with access severely restricted by topographic relief; present development has been strongly controlled by difficulties of producing adequate building sites and acceptable access, as will future development.

The only access from the lower Campus to the area above Gayley Road is via Centennial Drive or Cyclotrone Road, and excepting for traffic to and from the Lawrence Berkeley Laboratory all major circulation is along Centennial Drive. There is limited access to the uppermost portion of the area from Grizzly Peak Boulevard, but this is severely restricted by the steep slopes and serrate topography which severely limits the areas which can be served by secondary roads; further, Grizzly Peak Boulevard is relatively remote from the lower campus area. For these reasons, excepting for the Lawrence Berkeley Laboratory which has its own inefficient and tortuous circulation system, all present development has been oriented to Centennial Drive; the location and geometry of future development is also likely to be so oriented unless another major access route is created at very appreciable cost.

Geologically the area consists of a very recently uplifted hill front, "hinging" roughly along the Hayward Fault which forms the local toe of slope near Gayley Road, with a steep thrust scarp just east of the main ridge which is locally traversed by Grizzly Peak Boulevard. To the west the slope is abutted by a relatively flat alluvial plane, in which the lower campus is located; to the east the main ridge is bounded by Siesta Valley, from whence the hill system then extends a considerable distance

in an easterly direction. In the area of interest the basic topography is almost totally fault-controlled; with related severe erosion this has formed the existent canyon and drainage system easterly of the Hayward Fault. The bedrock is relatively shallow in most areas, with a residual soil mantle generally in the range of a few feet in thickness; only relatively minor occurences of alluvial and colluvial soils are found, generally confined to the canyon areas and abutting lower slopes.

The bedrock in the area grades time-wise from Cretaceous sediments of the Knoxville and Chico formations, through Miocene sediments of the Claremont and Sobrante Formations, to the late Pliocene sediments and volcanics of the Orinda, Moraga, Grizzly and Bald Peak Formations. In some areas the sediments lie in vertical succession in accordance with the age of deposition; however, due to major faulting and folding, and to massive volcanic intrusion, the bulk of the formational contacts are steeply sloping to vertical and the time sequence is thus commonly horizontal. The character of the rocks varies widely, ranging from fairly hard and competent archosic sandstones in the Cretaceous series to soft and clayey semi-shales of the late Pliocene deposits; the volcanic members vary from extremely hard but generally intensely fractured basalts to soft and soil-like tuffaceous sediments which are locally contemporaenous to the Orinda Formation.

The upper campus area is bounded to the west by the Hayward Fault, a member of the San Andreas Fault system which is a major geologic feature and a plate boundary along which massive continental drift is presently occurring. The Hayward Fault thus forms a geologic break with virtually no similarity between the lower campus area to the west and the hill area to the east. The Wildcat Fault, which is also a significant geologic feature and is probably a secondary member of the San Andreas System, traverses the site at approximately midslope and forms another structural discontinuity; while formational members cross the Wildcat Fault, they have been displaced by distances measured in miles and show no depositional continuity. Between the Hayward and Wildcat Faults, and easterly of the Wildcat Fault, there are numerous secondary faults which have produced large displacements in the formational members; the overall structure appears to reflect a complex pattern of compression and tension faults associated with the large right-lateral movements along the Hayward and Wildcat Faults, combined with thrust faulting during the recent uplift which has formed the Berkeley Hills system. In addition, major slump-planes associated with an ancient caldera in the northeasterly portion of the area exhibit large vertical movements and further complicate the fault structure.

The topography and geology of the area is presented on a geologic map accompanying this report, whereon is shown the various rock members, the faults, and the major colluvial and slide bodies. This geologic map is the first ever prepared for the entire campus area, and was assembled by the writer of this report from existing information plus very limited additional surface mapping; it thus omits much detail and in some areas is considerably oversimplified. However, on this map the general geographic and geologic conditions described above can be clearly seen, and the relationship between the fault and rock structure and the area topography is readily apparent.

A complete presentation of the geologic characteristics of the area is far beyond the scope of this report; however, referring to the geologic map a brief description of those elements deemed important to overall planning is given as follows:

The Hayward Fault is a major crustal feature, showing right-lateral movement, with the westerly side moving to the northwest in comparison to the easterly side. Studies made by the writer in connection with the soils engineering for Wurster Hall indicate that northwesterly movement along the fault has been at least 2 miles during Pleistocene time, a period of about two million years. Movement is presently continuing along this fault, with "creep" at Memorial Stadium in the range of 0.1 inch per year. This has produced major tension and compression faults to the east of the Hayward, and the tectonic movements which caused uplift of the Berkeley Hills has produced thrust faulting east of the Hayward; the result is a complex system of cross-faults with both vertical and lateral movement, dividing the bedrock into a complex series of blocks with generally non-conforming interfaces. One such secondary fault has formed the canyon of the South Fork of Strawberry Creek above Memorial Stadium, and another such fault crosses the northwesterly side of the site in the area of Cyclotron Road.

The Wildcat is also a right-lateral fault, with apparently local vertical movements, which has experienced right-lateral northwesterly movement of the westerly side in the range of 2½ miles since the rocks were formed. The Wildcat Fault thus constitutes another major structural non-conformity in the bedrock system which, while not as major as that of the Hayward, is of fundamental importance in local areas. The Wildcat Fault has undoubtedly been active in relatively recent geologic time; whether "creep" movements are currently taking place along the Wildcat Fault, or whether there is currently hazard of overt displacement, is not known with any degree of certainty.

To the east of the Wildcat the secondary fault pattern continues with less expression, apparently reflecting lesser total long-term movement; these secondary faults are presumably currently inactive.

Between the Hayward and Wildcat Faults the Orinda sediments lie conformably on the much older Cretaceous sediments, representing the remnants of a much larger deposit the bulk of which has been removed by erosion resulting from uplift of the Berkeley Hills. In this area the surface of the Orinda formation locally forms a synclinal structure, on which has been deposited tuffaceous sediments and lava flows of the Moraga formation, the bulk of which apparently derived from an outlet presently marked by a volcanic plug called Little Grizzly Peak. The resulting structure thus consists of "basal bedrock" formed by the Cretaceous sediments overlain by the Orinda sediments, and thence overlain by tuffaceous sediments and lava flows of the Moraga formation which form the ridge crest in this area.

To the east of the Wildcat Fault the rock sequence reflects the synclinal structure of Siesta Valley, with the beds being sharply upturned in the Campus area and striking roughly northwesterly. Immediately abutting the Wildcat Fault lies the Claremont Formation, consisting mainly of thin bedded shales and porcelainities of moderate hardness; the Claremont Formation is thence abutted by softer and generally more clayey sediments of the Siesta Formation, which is thence abutted by tuffaceous sediments and lavas of the Grizzly and Bald Peak Formations. This rock structure thus appears in surface expression as a series of elongate beds with the oldest lying against the Wildcat Fault and becoming progressively younger towards the axis of the syncline which forms Siesta Valley.

One large colluvial deposit is seen on the geologic map, running parallel to the Wildcat Fault; this deposit lies in a fairly steep "swale like" structure which probably results from movements along the Wildcat Fault. The depth of the colluvial soils is highly variable, apparently ranging from a few feet to over 25 feet; in some areas the soils are probably presently unstable and the classification would be gradational to landslide debris.

There is a major slide body in the valley of Chicken Creek, toeing-out at Centennial Drive. This slide body ranges to over 60 feet in depth and is believed to be presently undergoing very slow "creep" movements. In addition, there are other slide bodies shown on the geologic map and there are undoubtedly more smaller slides which have not been mapped.

APPENDIX B

ROCK AND SOILS CONDITIONS

The mechanical characteristics of the shallow rocks and soils are extremely variable and complex, reflecting the complex geologic structure from which they derive. It is thus impossible to provide general parameters for planning or site development which apply throughout; however generalizations can be made, keyed to the underlying rock as shown on the geologic map, which can be most valuable in pre-schematic or planning level evaluations. On this basis, and referring to the geologic map presented previously, generalized criteria are given with respect to each of the major geologic units hereafter.

Red spot

The Cretaceous rocks are clastic sediments, generally consisting of archosic sandstones, siltstones and shales, which have been severely altered and fractured due to techtonic movements. Surface weathering is generally relatively deep and intense, producing montmorillonite clays and thus relatively undesirable soils and shallow rock conditions. Where less weathered and massive, the rock is generally stable with excellent mechanical characteristics; where severely weathered and/or badly degraded or fractured the rock is relatively unstable with poor mechanical characteristics. Residual soils from these rocks are generally clayey, weak when wet, and expansive, with relatively poor mechanical characteristics. Existing slopes in the Cretaceous rocks are generally "critical", having eroded or slid to present configurations; the residual and colluvial soil mantle is thus generally creeping and is subject to shallow local sliding if stability conditions are worsened as by excavating cut slopes or producing unusually severe seepage conditions.

Red stripe

The Claremont formation rocks consist mainly of thin-bedded shales and siltstone of moderate induration; however, they are generally fairly siliceous or have an appreciable calcite content and are thus relatively hard and stable. Soils derived from the Claremont rocks generally show low to moderate plasticity, reasonably good mechanical characteristics, and better than average slope stability. Conditions of soil mantle creep are minimal in the Claremont formation, and no large slide movements are known to have occurred in this formation in the Campus area. Rock and soils conditions in the Claremont formation are thus relatively favorable.

Green

The Orinda formation sediments are generally only partially indurated, with mechanical characteristics intermediate between those of "rock" and those of "soil" where not degraded by techtonic movements or surface weathering. Where these rocks had been severely degraded, such as by shearing or by intense surface weathering, they possess very undesirable mechanical characteristics and are weak and unstable when saturated. The bulk of the large slide movements experienced in the upper Campus area, of which there have been many, have been based in Orinda formation materials which have been degraded by techtonic shearing and/or intense surface weathering. Most existing slopes in the Orinda formation are "critical", with the soil mantle presently experiencing slow creep movement. Further, if stability conditions are appreciably worsened, as by artificial excavation or filling, or by natural changes in stability conditions such as increased seepage due to creep along the local fault system, this formation is subject to massive sliding. In general terms construction of new improvements in the Orinda formation, which will perform adequately and are safe with respect to soil instability, can be accomplished only at considerable penalty in construction cost.

The massive tufaceous sediments of the Moraga formation are similar or somewhat superior in mechanical characteristics to the sediments of the Orinda formation and thus the same comments may apply. However, where they contain appreciable quantities of breccia or lava, or where they have been protected from weathering, their mechanical characteristics are much superior to those of the Orinda sediments and approach those of the Claremont formation. Since at most potential building sites the tufaceous sediments are interbidded with flow rocks and are relatively heavey in breccia content, rock and soils conditions in the tufaceous portions of the Moraga formation are generally relatively favorable, with only isolated problem areas comparable to the Orinda formation.

The flow rocks of the Moraga formation are generally basalts or andesites, with minor rhyolitic members. These rocks are generally hard, but intensely fractured due both to natural shrinkage processes upon cooling and to the techtonic movements which have occurred after deposition. Where unweathered these rocks are hard and resistent, stable, and present excellent conditions for development. Where severely weathered, these rocks produce montmorillonite clays and thus relatively poor soils conditions which can result in local embankment instability. Soils derived from weathering products of these rocks are generally highly plastic, expansive, and weak when wet, and have undesirable mechanical characteristics; however, due to

the resistance to weathering of these rocks, and progressive erosion, the soil mantle in areas in which the lavas form the bedrock is generally thin and inconsequential to site development. Consequently, in areas occupied by the flow rocks of the Moraga formation rock conditions are generally excellent, and soils conditions are favorable excepting for a generally shallow weak surface soil horizon in some areas.

The sediments of the Siesta formation are somewhat older than the Orinda formation but are generally no better indurated. They are thus comparable to the Orinda formation and show about the same mechanical characteristics; for practical purposes the same comments regarding mechanical characteristics and stability conditions apply to the Siesta formation as to the Orinda formation. The residual soils formed by weathering of the Siesta formation, and secondary deposits formed by erosion of the Siesta formation, generally show very poor mechanical characteristics comparable to those exhibited by soils derived from the Orinda formation, and the same comments apply.

The landslide bodies are generally either marginally stable or marginally unstable; this means that they pose the potential of massive slide movement, and in some cases they are currently creeping with yearly movement in the range of ¼ to 1 inch. In general terms, the landslide bodies are unsuitable for development without extensive and very expensive corrective measures; no buildings or other major facilities can be founded thereon without greatly increased construction cost and/or unacceptable performance of the facilities and hazard of severe damage due to sliding.

Brown

The alluvial, colluvial and residual soils generally show poor mechanical characteristics, and commonly are at least marginally unstable in their natural condition. Where they can be reworked, and seepage eliminated, they will show reasonable mechanical characteristics and can be assuredly stabilized. Thus, where these soils are found at shallow depth they can be reworked and rendered suitable to development without appreciable increase in construction costs; where the depth of such soils exceeds, say, 10 feet, considerable extra costs will be incurred for required reworking and subdrainage.

For definitive evaluation each specific site, and the unique rock and soils conditions which pertain therein, must be considered individually; however, for general planning studies some useful overall generalizations can be made, keyed to the rock types as shown on the geologic map. These generalizations are presented hereafter in summation of the information given in Appendix C.

Areas underlain by the Knoxville and Chico formations, and by the Claremont formation, can be considered to be generally superior with respect to overall stability and rock and soils conditions for development. While shallow instability or other local soils problems may be encountered in these areas, they will be generally limited in severity and will not produce excessive construction costs.

In areas underlain by the Moraga, Grizzly and Bald Peak formations rock and soils conditions will generally be very favorable where the dominant rock type is a flow rock or heavy breccia and where tufaceous sediments are minor in occurance. In those areas in which tufaceous sediments dominate, and particularly if they have been severely altered by shearing or weathering, stability and soils conditions may grade to moderately poor but are still superior to those seen in areas underlain by the Orinda and Siesta formations. Since at most of the potential building sites occupied by these formations the bedrock is predominantly flow rocks and heavy breccias, for general planning purposes those areas shown on the geologic map as Moraga, Grizzly or Bald Peak formation can be assumed to be superior with respect to overall stability and rock and soils conditions for development.

In areas occupied by the Orinda or Siesta formations stability, rock and soils conditions are generally poor to unfavorable. While in some areas overall stability conditions are acceptable for generally planning purposes those areas shown on the geologic map as occupied by the Orinda or Siesta formations can be considered to be less favorable and it can be assumed that appreciable extra construction costs will be required for site development.

For purposes of general planning, in those areas occupied by alluvium, colluvium, deep residual soils or landslide bodies it can be assumed that soils and stability conditions will be unfavorable. While some such areas can be stabilized and rendered usable by remedial grading and installation of sub-drainage, on a general basis these areas are deemed undesirable as building sites and will probably entail appreciable extra construction costs even for development of parking or similar subsidiary uses. In those areas occupied by major landslide bodies, such as the valley of Chicken Creek, major building construction is unfeasible and at best only light structures with expected marginal performance can be constructed at carefully selected locations.

Reference is made to the geologic map for delineation of the areas described above. It is again emphasized that each potential building site must be considered individually, with its own unique rock and soils conditions, for definitive evaluation; but for overall planning, use of the general classifications given above will produce valid conclusions for most site areas and for most forms of major building development. For construction of major roads through such areas, where existing ground slopes are relatively steep, the comments given above are even more valid and applicable and can be used with considerable confidence in predicating potential stability problems and costs for construction in planning new access facilities.

APPENDIX C

EVALUATION OF POTENTIAL BUILDING SITES

With expenditure of sufficient money, and without constraints on degradation of the environment, virtually any area can be used as a building site. As a result, in order to provide a meaningful basis for relative evaluation of potential building sites it has been necessary to establish limiting parameters which reflect probable requirements and limitations inherent in future campus development. The limiting parameters chosen for these analyses cover costs for development, minimum usable area, maximum cut and fill embankment heights, and practicability of development as related to existing ground slopes and difficulties of developing road access. In addition, the same design and cost standards must be used in evaluating all sites, in order to make comparative site evaluation meaningful. We have established and used the same limiting parameters and standards for site development throughout. These parameters and standards are presented as follows.

If the existing ground slope is 2½ horizontal to 1 vertical or steeper development is not practicable and the area is considered unusable for normal development.

At least one acre of usable area must be available to produce a valid building site.

If cost for developing road access and/or to handle off-site storm drainage exceeds $50,000 per usable acre the area is not an acceptable potential building site.

Cut or fill slopes must not exceed 40 feet in vertical height excepting for local "points" as in narrow canyons or steep nosings. Fills must be sloped at 2 horizontal to 1 vertical. Cuts must be sloped at 2 horizontal to 1 vertical, excepting that in sound rock cuts may be sloped at 1 horizontal to 1 vertical.

Exported excavated material, or imported fill material, is priced at $4.00 per cubic yard. Cut to fill on-site is priced at $2.00 per cubic yard.

New access roads not requiring major grading are priced at $50.00 per linear foot. New access roads requiring major grading are priced at $100.00 per linear foot.

Using the foregoing standards and parameters, the entire campus area east of Galey Road was investigated, by trial and error design, to define potential building sites which meet these conditions. The process consisted of cursory design of cut and fill embankments, access roads and storm drainage facilities, at 1"=100' scale, and then determining whether or not the limiting conditions were met. In some areas two or more potential areas were defined and evaluated individually, and then a "composite site", encompassing the smaller areas, was evaluated to reflect the results of balancing cut and fill on-site and/or of considering the maximum practicable area size. A total of ten building sites were so defined, and we have concluded with considerable confidence that there are no other such sites within the University property east of Galey Road.

The developed area was shown on the plan for each building site, with the bench elevation, and the usable area was given in square feet. Road access to an existing thoroughfare was shown for each site. All access roads were assumed to be thirty feet in total width, with a 24 foot wide pavement; it was assumed that no sidewalks, curbs and gutters, or other such amenities were to be provided. The toes of all fill slopes, and tops of all cut slopes, were shown for both the building sites and major new access roads to permit visulaization of the size and configuration of the area that would be excavated to develop the site; at steeper locations the total area graded, thus ecologically altered, is approximately double the usable area. The total excavation or fill quantity was shown for each building site, including the amount hauled in or hauled out, to permit consideration of impact on the area and environment due to hauling over existing thoroughfares. The lengths of new access roads, and lengths of culverts, were shown for each building site. The cost of development for each building site was roughly estimated, using the parameters given above; in order to permit comparison of the building sites on a cost-benefit basis, the total cost per usable acre was also given for each building site. Using these data it is possible to evaluate each potential building site on the basis of the area which would be ecologically altered due to development, and on the basis of cost-benefit ratio as expressed in terms of the cost per usable acre. In addition, with the building sites shown in plan form on the 1"=100' scale drawings, the visual impact of the building site, and its geographic amenities as relating to proposed usage, can also be evaluated on a subjective basis.

The bedrock type was given for each building site, keyed to the geologic map, to permit judgement regarding probable rock and soil conditions for development, as described in other sections of this report. Sites were further classified as to presence or absence

of fault hazard, based upon the faults shown on the geologic map and the cursory judgment of the writer of this report as to the probable results of a definitive fault hazard study at each site location.

In order to provide some relative judgmental standard for comparison of the various sites from the engineering standpoint, these sites were classified as excellent, fair or poor. The basis for this classification is a cursory and somewhat subjective summation of conditions for site grading, probable difficulties in embankment stabilization, conditions for construction, and probable cost for building construction.

Availability of adequate utilities immediately off-site is a most important parameter in relative site evaluation from the cost standpoint, since at some potential building locations the cost of bringing in utilities would probably be so great as to foreclose the use of the site except under very special considerations. Evaluation of availability of utilities, and of the adequacy of these utilities to serve a projected type of building development, is far beyond the scope of this report; however, based on the knowledge of the writer as to the general location of campus utilities, we have indicated whether or not utilities are available nearby at each building site. It must be clearly understood that this evaluation is not definitive, and adequacy of the existing services is not known; however, this information is given because we believe it may be of value in cursory comparison between potential sites.

All of the information described above was presented in "work sheet form", as pencil and color drawings on prints of campus topographic sheets at 1"=100' scale. Supplemental information, such as quantities and calculations, are presented on the drawings or attached sheets. These drawings are not reproducible, and have been deposited in the Architect's files.

Based on both engineering and architectural considerations, one large site was selected as being a "prime site" and the probable most desirable and most economical site for future facilities development, and also as entailing the least ecological damage in comparison to the developed usable area. This site is located in the area of the Space Sciences Laboratory, immediately above and easterly of the Lawrence Hall of Science, and is an excellent site for major facilities development from the engineering standpoint. Good access is immediately available via Centennial Drive at little or no additional cost, all major utilities are available, and access to the lower campus by vehicle is relatively efficient. In addition, loss of existing trees or other major flora will be minimal, and there will be relatively little environmental impact.

Any of the potential building sites can be more definitively evaluated, to about the schematic level, using the voluminous information available in this office and the University's files. This might include such matters as more precise grading plans and site development costs, availability of utilities or the cost to bring utilities to the site, precise costs for storm drainage facilities and access road development, traffic impact on existing connecting roads, and similar engineering considerations. Particularly, for the "prime site" described above, available file information is probably adequate for schematic level design of any proposed development.

APPENDIX D

SUPPLEMENTAL INFORMATION

FAULT HAZARD

While evaluation of potential fault hazard must be based upon detailed investigations for any specific site, for purposes of overall planning certain generalizations can be made based on the geologic map presented in this report. For this purpose any site transected by the Hayward fault should be considered to be suspect with respect to hazard due to overt fault movement, and should be given low development priority from the standpoint of this criterion. While it is not now known whether the Wildcat fault is presently active, and thus constitutes a hazard to site development, it is the opinion of the writer that it will eventually be proven that the Wildcat fault has moved in geologically Recent time and must be considered to be potentially hazardous; it is thus recommended that any site which is transected by the Wildcat fault be considered to be suspect with respect to hazard from fault movement. There is no definitive information presently available regarding movements in Recent geologic time along secondary faults associated with the Hayward and Wildcat; however, it is the opinion of the writer that such movements have occurred, and may be presently continuing, particularly with respect to the more major secondary faults which extend from the Hayward to the Wildcat fault and displace faults of lesser expression. It is therefore the opinion of the writer that any site which is transacted by a secondary fault whose expression extends from the Hayward to the Wildcat should be viewed with some suspicion with respect to potential fault hazard, and should not be considered to be an acceptable building site until the question of fault hazard has been resolved.

Application of these criteria to overall planning is certainly subject to review with respect to any specific site, by detailed studies. However, it is believed that when considering the relative merits of various sites from the standpoint of overall planning, the use of these criteria is valid in drawing overall and generalized conclusions as to the comparable desirability of various potential sites.

PARKING DEVELOPMENT

In addition to the potential building sites identified in this report, which can obviously be used for parking facilities, three

areas suitable for major parking development have been defined in the studies made for this report. Two of these areas could serve the Haas Recreation Area, and one could serve the Lawrence Hall of Science and Space Sciences Laboratory.

The two potential parking areas which could serve the Haas Recreation Area consist of the canyon of the South Fork of Strawberry Creek above the upper Haas Pool and below the existing storm drainage retention basin, and the valley of Chicken Creek previously occupied by poultry facilities but now essentially unused. Development of parking in the canyon of the South Fork of Strawberry Creek would entail filling the canyon to approximately the existing grade of Centennial Drive, and would produce sufficient parking space to adequately serve the Haas Recreation Area for all present and reasonably conceivable future development; further, development costs would be relatively modest. The major disadvantage of this site lies in destruction of the only presently stable "stream ecological area" presently existent in the Campus outside the heavily developed areas. Development of parking in the valley of Chicken Creek would entail little ecological damage or environmental impact, and would be relatively economical due to the present graded configuration of the area. Sufficient parking area could be created to serve the Haas Recreation Area for all present and reasonably conceivable future development; however, access to and from the parking area, both vehicular and pedestrian, would be less convenient than would be obtained by placing the parking in the canyon of the South Fork of Strawberry Creek. On balance, it is the judgment of the writer that from the engineering standpoint development of parking in either area is equally feasible, and costs will be essentially the same; there is thus no major difference in engineering merit between the areas.

The potential parking development at the Lawrence Hall of Science consists of the area previously graded for future construction of a parking structure. The cost of development of new on-grade parking in this area would be minimal, and resulting parking facilities would provide reasonably efficient access to both the Lawrence Hall of Science and the Space Sciences Laboratory; however, the number of spaces which can be obtained without construction of a major structure, at great cost, will probably not be adequate for all future requirements of the two facilities.

The areas suitable for parking development in the canyon of the South Fork of Strawberry Creek, and immediately abutting the Lawrence Hall of Science, have been shown on the referenced "work sheets". The potential parking development in the valley of Chicken Creek is not so shown, but consists basically of the existing roads and benches which are clearly defined on the existent campus topographic maps.

CLOSURE OF CENTENNIAL DRIVE

One of the Architect's recommendations is that Centennial Drive be closed to non-campus traffic, coupled with provision of additional parking at the Lawrence Hall of Science, serving both Centennial Drive and Grizzly Peak Boulevard.

This office has provided, in "work sheet" form, a pre-schematic design entailing use of the existing graded area easterly of the Lawrence Hall of Science as a new on-grade parking area, coupled with a grade-separation of Centennial Drive at this location. In this design the upper two existing benches will provide two rows of single-tier diagonal parking, connected to Grizzly Peak Boulevard by a nominal structure overpassing existing Centennial Drive which will continue to the Space Sciences Laboratory using the present road. The overpass structure will connect to a new road alignment to the existing intersection at Grizzly Peak Boulevard; the portion of Centennial Drive from this intersection to the road to the Space Sciences Laboratory will be closed with bollards, to prevent through traffic but permit passage of emergency vehicles and authorized Campus personnel. The lower three existing graded benches will be used to provide two rows of double-tier diagonal parking connected to Centennial Drive at present grade.

In the design presented above a 15 foot wide "planting area" is provided at the westerly side of each parking area, to permit planting trees which will prevent seeing the parking areas from the Lawrence Hall of Science, the Campus, or the City area to the west. The visual impact of this development will thus be negligible. Since the area was previously graded, and is essentially "bare dirt" at this time, the ecological and environmental impact of the proposed development is negligible. There will be no increase in traffic on Centennial Drive, but instead a considerable reduction.

The cost of the new facilities described above will be minimal, since the existing Centennial Drive is preserved and new construction consists only of about 500 lineal feet of new roadway, a nominal overpass structure, and the cost of the new parking. Grading is limited to that required for the new road to Grizzly Peak Boulevard and limited re-grading of the existing benched area to accommodate the new parking geometry. The existing storm sewer system is adequate to handle the increased peak runoff rate.

The parking areas will be relatively convenient for users of both the Lawrence Hall of Science and the Space Sciences Laboratory, with maximum grade differences of less than 60 feet to the Lawrence Hall of Science and 100 feet to the Space Sciences Laboratory. While no parking studies have been made, it appears probable that the amount of parking which can be obtained by on-grade development

will not be adequate for future demands of the subject facilities. The design is, however, compatible with future construction of a parking structure, as originally planned, which will presumably provide sufficient parking for full future demand.

The parking area described above abutts the "prime building site" described in Appendix C, and the new road lies along the westerly periphery of this site. The designs presented above were made compatible with future development of the "prime area"; and in fact, such road and parking relocation and development will probably be a prerequisite to development of the "prime area".

Much of the area proposed for parking development lies in a massive Pleistocene slide body. While a "shear key" was installed at the toe of this slide body during construction of the Lawrence Hall of Science, it is the cursory opinion of the writer that this area would not be found to be suitable as a building site by present standards due to potential instability during earthquake. Use of this area for parking, rather than reserving it as a future building site, is thus indicated.

STORM DRAINAGE AND STREAM CONDITIONS

The storm drainage regime, and existent storm drainage facilities, are described in great detail in a report prepared by this office dated 12 May 1972. Reference is made to this report for detailed information concerning the area hydrology, the Campus storm drainage regime, the channel geometry and conditions, and the existent storm drainage system and major channel flow conditions; a copy of this report was provided to the Architect for use in connection with this study. The purpose of this subsection is to provide a very brief resume of a few matters of greatest importance with respect to the ecological and environmental affects of the creek system, making reference to the detailed background information presented in the referenced report.

Those creek channels with permanent flow (sufficient flow to maintain an aquatic environment even at the end of a dry season), and intermittent major creeks, were shown on the 1"=100' scale drawings on which the building site studies were presented. These are the only channels within the campus with permanent flow that have not been put underground into culverts, or with sufficiently sustained intermittent flow such that water-oriented flora and fauna are supported thereby. All other channels experience flow only during and immediately after rainfall and are essentially "dry creeks".

All "permanent" stream channels within the campus receive appreciable flow from the Lawrence Berkeley Laboratory area and are subject to very high peak flow rates, greatly exceeding "original natural" flow rates prior to upstream development, excepting only that portion of the South Fork of Strawberry Creek below the retention basin and above the Haas Recreation Center. These channels thus do not support the normal complement of water-oriented flora and fauna, since the "unnatural erosion" which now occurs scours these channels at least several times in the average winter. As a consequence, the only channel with permanent flow which could now be considered to approximate the "original stream channels" from the standpoint of low peak runoff rates and maintenance of permanent water-oriented flora and fauna, is that portion of the South Fork below the retention basin, in which flow is supplied solely by very local runoff and a "low-flow bypass" which diverts flow through the retention basin dam. It is thus believed that preservation of this area as a "natural preserve" may be unusually important due to the unique peak storm flow rate conditions which pertain therein.

The function of the channel below the retention basin as a unique environment is considerably negated by continual malfunction of the low-flow bypass system, which cannot handle the very large bedloads coming down the South Fork of Strawberry Creek and thus plugs every year, and by a subdrain which underlies the creek from the retention basin to the upper Haas Pool. Malfunction of the low-flow bypass eliminates surface flow from this channel during most of the year, and the subdrain "draws the water out" of the creek channel thus producing dry conditions. This can be remedied by construction of a low-flow bypass system which will survive the large bedloads in the creek channel at the retention basin, and by stopping the subdrain so that the seepage flow will be returned to surface flow within the stream channel.

FIRE CONDITIONS

The area considered in this report is in large part covered by trees, heavy brush and other dense vegetation. It is indicated that no major fire has occurred in this area for at least 50 years; historical evidence, and general studies, indicate that such areas probably burned, on average, at least once every 10 years prior to intervention by man. As a result, an extremely heavy "fuel load" has now accumulated in this area; any major fire which now starts in a lower slope is thus virtually certain to turn into a major conflagration which will both seriously threaten any included improvements, and totally sterilize the watershed, producing heavy runoff conditions and major mud-flows in the following winter.

As a result of these conditions, we believe that any future development in the upper campus area should include a definitive study covering fire hazard, and storm flow and mud flow hazards which will occur in the winter following a major fire. In this regard it is noted that the existing retention basin was designed so as to protect the lower campus area in the event of a major fire in the watershed of the South Fork of Strawberry Creek; no such protection is now available for new facilities constructed above the retention basin.

The recommended "prime building site" in the area of the Space Sciences Laboratory is not subject to the hazards described above to appreciable degree, since it lies near the crest of the ridge and there is thus very little tributary watershed, and since it is abutted by only very limited heavy growth and will be relatively easy to protect in the case of a major conflagration. All other sites in the upper campus area which appear to be viable building sites from the engineering standpoint appear to entail considerable risks with respect to a major conflagration in the watershed.

CHICKEN VALLEY

The valley of Chicken Creek, which rises northerly of Centennial Drive just east of the upper Haas Pool, is occupied by a major Pleistocene slide body and is thus not suitable for major building development. A relatively limited facility, such as a swimming pool complex, could be built in a very small portion of this area, with suitable protective design and construction; the only other potential development appears to be as a recreational area, or as a parking area serving the Haas Recreational Area, or a combination of the two.

Chicken Creek is a permanent stream, in that there is some minimal flow at the end of a dry season; it will thus support a permanent population of water-oriented flora and fauna, and could have considerable value as a natural recreation area. The stream channel is scoured each year by excessive peak runoff rates originating in the Lawrence Berkeley Laboratory, but these conditions are not as severe as found in most major channels within the campus. Attention is thus called to the apparent potential for development of the valley of Chicken Creek as a natural area with a permanent stream and/or a recreation area, possibly involving construction of a swimming pool and tennis courts or similar facilities.

MANAGEMENT PLAN FOR

STRAWBERRY AND CLAREMONT CANYONS

1979

Prepared by:

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I. INTRODUCTION

Objectives

The purpose of this management plan is to provide guidance for the use and management of those portions of the University of California property in Strawberry and Claremont Canyons which are not now under the management of designated research units or have special designated uses. The management directions given in this plan are focused on the natural features within this area. Specific management prescriptions for vegetation, fauna, fuels, water and stream courses, recreation, ecological study, and land use are developed in this plan. They do not treat such topics as fire suppression, police protection, and waste disposal except as they relate directly to management of the natural features of the landscape.

Area of Application

The provisions of this management plan shall apply to the University property in both Strawberry Canyon and Claremont Canyon as shown in Figure 1. Excluded are designated special units such as the Lawrence Berkeley Lab, the Botanical Garden, the Haas Recreation Area and the Animal Behavior Research Area. It is hoped that those excluded units will endeavor to prescribe management prescriptions similar to those within this plan, especially on the contiguous boundaries which form the interface with the area designated within this plan. This will enhance the naturalness of the canyon landscape and minimize sharply defined boundaries.

The Claremont Canyon portion of the University property outside the Ecological Study Area (Fig. 2) has been suggested as a site for an experimental forest. However, until and unless a specific proposal for an experimental forest is recommended for approval by the Committee on Conservation and Environmental Quality, the vegetation management prescriptions of this plan are to be followed.

Guiding Principle

The guiding philosophy in the development of this plan has been that the primary use of land must be for teaching and research. The precriptions proposed provide for, reinforce, and perpetuate the teaching and research use. All other land uses are considered of secondary importance and have been set aside when they conflicted with teaching and research. The teaching and research use was viewed both in terms of the present and potential activities. Every effort has been made to development management guidance to protect those natural landscape features which have value for potential use in teaching and research.

The Committee on Conservation and Environmental Quality or its designated subcommittee will have the responsibility to oversee the application of this philosophy in the management of the area.

Previous Studies

A variety of reports on natural features and recommendations for land use and management of the area have been prepared. These were reviewed in some detail by Eckbo (1976). Table 1 summarizes the focus of those reports which provide guidance for management planning. Each of these was evaluated in the process of preparing this management plan. Considerable material which describes the natural features of the area can be found in these reports. Such descriptive material has not been repeated in this plan. Reports and journal articles by Eckbo (1976), Stebbins (1975), McBride (1974), and Siri (1972) provide useful descriptions of these natural features.

Priority areas for eucalyptus sprout management should be developed by the Department of Facilities Management in concert with representatives from the Committee on Conservation and Environmental Quality.

II. VEGETATION MANAGEMENT

Objectives

The principal objective of vegetation management in Strawberry should be the reestablishment and maintenance of a mosaic of native vegetation types. Such a mosaic of native vegetation types will maximize the opportunity to study the regional fauna and flora as well as a variety of ecological processes.

Ecological processes, especially plant succession, should be fostered within Strawberry Canyon as a process for study and as a tool of management.

It is recognized that some areas within Strawberry Canyon presently support plantations of forest tree species which are not native to the Berkeley Hills (Fig. 2). These plantations offer limited opportunities for the study of flora and fauna, but are suitable for teaching and research within the Department of Forestry and Resource Management. These existing plantations should not be converted to native vegetation types but should be maintained as existing forest plantations for teaching and research by the Department of Forestry and Resource Management and other departments. As these stands become decadent they should be individually evaluated for replanting or conversion to native vegetation.

Existing Vegetation

The vegetation in Strawberry and Claremont Canyons consists of a mosaic of natural and plantation types. These types include oak-bay woodland, northern coastal scrub, annual grassland, various conifer plantations, and eucalyptus plantations (Fig. 3). Much of the area once occupied by eucalyptus plantations has been logged. These types and their ecology have been described by Barbour and Major (1977), Eckbo (1976), and McBride (1974).

Management Prescriptions

The land area under the jurisdiction of this plan has been subdivided into units for the purpose of prescribing management (Fig. 4). The existing and proposed vegetation type and a vegetation management prescription for each unit is shown in Table 2.

The majority of units will receive no treatment. These units will be allowed to change over time in response to natural successional processes.

The Units which once supported eucalyptus and have been logged are for the most part to be treated to remove eucalyptus sprouts and allow native species to become established. Elimination of the sprouts is to be accomplished by manual removal of sprouts. All sprout material is to be removed from the site. Chipping and spreading of chips is not recommended because of the slow rate of decomposition of the eucalyptus chips. It is recognized that the

procedure suggested will require several years to accomplish and will be more costly in dollar value than control with herbicides. The use of herbicides as a tool of vegetation management is not recommended because of the unknown ecological cost.

A special fuel management zone is to be created along those edges of the University property which adjoins residential areas. Specific vegetation management prescriptions for units within this zone are developed in the fuel management section of this plan.

Three undesirable exotic species (broom, acacia, and artichoke thistle*) have invaded areas of the East Bay Regional Parks. These species compete successfully with native plants and can take over significant areas if unchecked. Invasion of broom has been noted in units C 6 and SG 6. An annual inspection should be conducted each year to identify areas where these plants have become established. The plants should then be removed manually. Herbicides should not be employed in the control of these undesirable species.

Some units are proposed for vegetation type conversion which involves the planting of species not now present on these units (Units EL 6, EL 8, and EL 10). Insofar as possible, the seeds used in these conversions should be collected from plants in Strawberry or Claremont Canyon. The species of perennial grasses proposed for units EL 6 and EL 10 may not now occur in the Canyons. An effort should be made to collect these seeds from the Berkeley Hills before distant seed sources are employed.

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* broom - Cytisus scoparius, C. monspessulanus
acacia - Acacia decurrens, A. melanoxylon, A. longifolia
artichoke thistle - Cynara cardunculus

III. FAUNAL MANAGEMENT

Objectives

The principle objective of faunal management is to provide habitat conditions which will support and protect a wide variety of species. Animal density should be allowed to adjust to the natural carrying capacity of the landscape and no effort should be made to sustain populations above that level through supplemental feeding or watering. Strawberry Canyon and adjacent areas of Tilden Park now serve as a significant refuge for mammals, birds, amphibians, and reptiles in the Berkeley Hills. This refuge must be protected to insure the continued presence of these species for teaching and research.

Existing Fauna

Species lists of fauna observed in Strawberry and Claremont Canyons and adjacent areas have been presented by Siri (1972) and Stebbins (1975). These reports indicate that a significant number of species are using the area either as permanent residents or as migrants. The largest number of species occur in the oak-bay woodland type while the forest plantation types have far fewer species. This distribution is to be expected in view of the exotic nature of the forest plantations.

Management Prescriptions

The Strawberry Canyon area should be managed to promote those natural succession processes which will provide a mosaic of native vegetation types. The management prescriptions developed in the vegetation management section of this plan will achieve this objective.

Refuge Area

Units SG 34, W 8, and W 9 should be designated as a special refuge (Figs. 4 and 5). They represent the largest least disturbed areas of native vegetation in Strawberry Canyon. Their location is along an important dispersal route of many large mammals moving into the lower portions of the canyon. The special status of this refuge is to protect the area from any future construction of structures, trails, or roads. Its use for research or teaching purposes which involve destructive sampling of either plants or animals is to be prohibited. Any development of access to the margins of this special refuge is to be avoided.

IV. FUEL MANAGEMENT

Objective

The purpose of fuel management is to provide protection tr both University and private residential property by decreasing the continuity of fuels along certain University property boundaries. By breaking up fuel continuity the rate of spread of wildfire can be reduced. Such a reduction can be of value in fire suppression. More extensive fuel management measures have been proposed (Biswell 1974, Hamlin 1977), but these proposals are viewed in part as being in conflict with the overall management objectives for the area.

Fire Hazard

The Berkeley Hills have experienced serious fires in the last 50 years due to wildfires burning from undeveloped land onto residential areas. This hazard, as it relates to the University, has been discussed in detaitl by Biswell (1974). The University has an obligation to protect its own property from encroachment by fire and to minimize to likelihood of fires spreading from its property to adjacent residential areas.

Management Prescription

A fuel management zone will be established along those boundaries of the University property which are adjacent to residential property (Fig. 6). This zone will be 100 feet wide. Fuel over 3 inches in diameter with the exception of logs over 12 inches in diameter in contact with mineral soil will be removed from the zone. The density of shrubs and trees will be reduced within the zone in order to break up fuel continuity in both vertical and horizontal planes. Lower branches of trees will be pruned to eliminate fuel ladders. Litter and mulch occurring in the zone will be burned on a periodic basis as indicated in Table 3.

Ground fuel over 2 inches in diameter within the logged eucalyptus areas which resulted from the logging of the area should be removed. All sprouts cut from stumps during vegetation management activities should also be removed.

Growth of annual vegetation adjacent to roads (with 6 feet) should be cut and removed each year at the end of the Spring growing season. Any growth of shrubs or tree limbs which would interfere with the use of fire suppression vehicles should also be removed. Likewise, plants growing around fire hydrants should be removed or trimmed on an annual basis when their presence will interfere with the use of the hydrants.

V. WATER AND STREAM COURSE MANAGEMENT

Objective

The purpose of water and stream course management is to minimize flood peaks along the lower portion of Strawberry and Claremont creeks, minimize gully erosion, and maintain a stream environment for aquatic organisms. Peak periods of streamflow present a serious threat to structures in the recreation area along Strawberry Creek and the residential area along Claremont Creek. Management practices and land use must recognize the flood potential of the watersheds. Erosion control is needed to protect the soil resource as well as those characteristics of the stream beds which are important to aquatic species.

Stream System

Two major streams, Strawberry Creek and Claremont Creek, drain the area (Fig. 7). Strawberry Creek has been studied in some detail by Lennert (1972). At his recommendation flood and erosion control structures have been installed along Strawberry and Chicken Creeks. His report identified a serious run-off problem associated with the increase in impervious surfaces in Strawberry Canyon. He also indicated a serious concern for debris in the stream channels above the culverts which carry water beneath Memorial Stadium. His recommendations for extensive engineering alterations of the Strawberry Creek channel above the retention dam were not adopted, however.

Management Prescriptions

It shall be the management policy to minimize any further increase in impervious surface throughout Strawberry Canyon. Future roads must be surfaced with pervious materials such as gravel. A further discussion of this principle is developed in the land use section of this plan.

Erosion control dams should be constructed along any stream channel showing minor accelerated erosion. These dams can be made of brush and eucalyptus poles, obtained from the site or similar materials. An annual inspection of streams and water courses should be made to identify areas of accelerated erosion and repairs needed on erosion control dams.

Culverts should be cleaned at the end of each summer. Each culvert should be inspected and cleaned following each rainstorm during the fall, winter, and spring. Culverts must be provided with suitable splash pads to prevent erosion below the culvert (see Fig. 12 for recommended details). These should be inspected and repaired on an annual basis.

Road cuts and fills should be inspected for erosion and seeded with appropriate species if accelerated erosion is in evidence. Advice on proper seeding mixtures and techniques can be found in Hamilton (1974).

Debris such as brush, small logs, garbage, old tires, etc. which can be moved downstream during peak floods and block culverts should be removed. A channel inspection and cleanup should be scheduled annually.

Streams within the area should be periodically monitored by personnel from Environmental Health and Safety to identify pollution problems. Corrective measures shall be taken in when pollution threatens the survival of stream organisms.

Fire trails should be inspected annually to determine if features designed to insure proper drainage are working. Water bars, drainage ditches, and other features should be cleaned out each year. Skid trails resulting from logging of the eucalyptus should be reseeded and proper drainage provided to prevent erosion.

VI. RECREATION MANAGEMENT

Objectives

The purpose of recreation management is to provide prescriptions which will minimize conflicts between the use of the area for teaching and research and recreation. The primary use of the area is for teaching and research. This should not preclude the use of the areas for certain kinds of recreation. It is not, however, the intent of this plan to encourage recreational use of the area.

Recreational Use

The fire trails in Strawberry Canyon are heavily used by hikers and joggers (Fig. 8). In addition, these and other trails are used by photographers and fauna and flora observers. The activities of these recreationists has not had a serious impact on natural communities in the area. Eckbo (1976) suggested the need to expand and improve the trail system within Strawberry Canyon in order to serve a wider range of recreationists. Arbegast and Newton (1972) and King (1969-73) proposed a specific recreational development in the Chicken Creek area. The expanded recreational use which these proposals suggest is not compatible with the use of the area for teaching and research.

Any proposals for expanded recreational use in this area or other parts of Strawberry Canyon are to be reviewed by CEQ to consider their impact on teaching and research, water runoff, soil and slope stability and visual impact on the adjacent landscape.

Certain recreational uses are injurious to the natural communities or to the trails in the area. These include the use of dirt bikes, motorcycles, and horses. The presence of recreationists may also increase the risk of wildfire during periods of extreme fire danger. A policy of closing the canyon during these periods to all users has been initiated by the Campus Fire Marshal. Enforcement of this policy is encouraged as good management.

Management Prescription

The existing trail system should not be expanded within Strawberry Canyon (Fig. 8). Trail maintenance should be restricted to an annual blading of the fire trails and the removal of vegetative material which significantly impedes movement along foot trails. No major brushing out of these trails is recommended. An annual insepection of all trails should be conducted to identify problems of accelerated erosion associated with use of the trails. Those trails which exhibit erosion problems should be repaired and closed depending on the magnitude of the erosion problem.

Use of bicycles and motorcycles on trails in the area is to be prohibited. Reclamation work to repair damage to unit C 15 from dirt bikes should be

initiated. Leaf litter or chips from chippings should be brought in to cover the exposed soil and water bars should be installed to divert water off the cycle trails.

The occasional use of horses should be restricted to major fire trails because of the destruction they cause to the trail surface.

Patrol of the area should continue to prevent overnight camping.

The area should be closed to recreationists during periods of extreme fire danger as determined by the Campus Fire Marshal.

VII. LAND USE

Objectives

Decisions for land use are developed in this section to insure the protection of areas of significant natural value for teaching and research and to minimize user conflicts. Special land use areas are designated to achieve this objective. Future use of other areas should be evaluated on the basis of impact on natural communities, effect upon flood peaks, and human safety.

Special Land Use Areas

1. Ecological Study Area

In 1969 an Ecological Study Area was established in Strawberry Canyon and a portion of Claremont Canyon (Fig. 9). Justification and management suggestions for this area has been developed by Daly (1969) and Baker (1969). In 1972 the Committee on Conservation and Environmental Quality proposed the inclusion of the Ecological Study Area and adjacent lands in Strawberry and Claremont Canyons in the University-wide Natural Land Water Reserves System (Siri, 1972). The proposed unit was accepted by the Natural Land and Water Reserves System but release of the land was denied by the Berkeley Chancellor. In rejecting the transfer of control of the land, Chancellor Bowker affirmed his support for an Ecological Study Area in Strawberry Canyon (Clifton, 1974), Eckbo (1976) proposed an expansion of the boundaries of the Ecological Study Area to include those additional areas designated for inclusion in the Natural Land and Water Reserves System. In 1977, the controlled burning of a portion of the Ecological Study Area to reduce fire hazard resulted in renewed discussions of the types of management activities which should be allowed in the Ecological Study Area. Stebbins et al. (1977) rejected the use of controlled burning and other active vegetation management techniques in the area. Hamlin (1977) presented arguments in favor of a more active approach.

The Committee on Conservation and Environmental Quality will continue to monitor these issues and recommend appropriate management prescriptions depending upon the specific situations as they arise.

It is proposed that a new boundary be established for the Ecological Study Area and that the management guidelines listed below be enforced within this area to maintain the area for teaching and research. This proposed boundary is shown in Figure 10. It would reduce the existing Ecological Study Area by removing a 100 foot wide strip (measured along the slope) from those portions adjacent to the residential area in Berkeley, roads, or special use areas within Strawberry Canyon. Establishment of the new boundary will provide a buffer for the Ecological Study Area where appropriate fuel management activities can be applied. The effectiveness of this buffer will depend upon its maintenance as a buffer. It should not be used as a site for new structures.

Also, it is proposed that an immediate expansion of the Ecological

Study Area be made along the northwest extent of Strawberry Creek extending from the creek to the ridgeline. This will expand the Study Area to include the upper watershed of the creek (see Fig. 10).

Additional areas are proposed for future consideration as expansions to the Ecological Study Area. The intent is to maintain these areas in their natural states and limit their uses as outlined below. Such areas of expansion will require full discussion and approval as a proposal to the Chancellor by CEQ.

The management guidelines to be enforced within the Ecological Study Area are as follows:

a). Use of vegetation management prescriptions for units within the area as outlined in this plan.

b). Prohibition of any research or teaching activities which involve destructive sampling unless otherwise approved by the Ecological Study Area Committee.

c). Prohibition of soil removal from the area.

d). Prohibition of fuel management and controlled burning.

e). Prohibition of recreational use of area other than hiking, jogging, or photography along trails.

f). Maintenance of a special refuge area as outlined in the section of this plan dealing with faunal management.

g). Prohibition of construction of buildings.

2. Claremont Canyon

The Department of Forestry and Resource Management has expressed the need for an experimental forest and has suggested Claremont Canyon as a suitable site. This Management Plan recognizes the possiblity for such a use and agrees that Claremont Canyon is the most likely site for an experimental forest. Thus the Canyon is not recommended for inclusion in the Ecological Study Area.

Until such time that a proposal which suggests replanting this area as an experimental forest is made and recommended for approval by CEQ, Claremont Canyon is to be managed according to the prescriptions of this plan.

3. Building Sites

Seven areas were identified by Eckbo (1976) as potential building sites on the basis of geological hazard or other areas considered ecologically sensitive areas. Portions of five of these occur within the Ecological Study Area and should not be considered because of the higher value of this area for teaching and research. Two remaining areas may be considered geologically safe and can serve as future building sites (Fig 11). Construction on these sites should recognize the significance of incremental

increases in run-off which will result from construction. Wherever possible, previous surface materials should be used for roads, sidewalks, and parking areas around these future buildings.

Land Use Conflicts

The primary objective intended for land use in Strawberry and Claremont Canyons is teaching and research related to the outdoor environment.

Teaching, research and recreational activities which do not require or relate to the outdoor environment of Strawberry Canyon and Claremont Canyon should be located on University property elsewhere.

The current use of a portion of Strawberry Canyon to store acids and other chemicals is an example of an inappropriate land use. The Acid House should be relocated outside of the Canyon. No area in either Strawberry or Claremont Canyon should be used as a storage area or as a disposal site.

Conflicts may arise in the use of particular areas for research. A committee should be established to oversee research activities. Proposed research projects should be reviewed by the committee. Suitable location could be assigned by the committee to avoid conflicts between research activities.

VIII. ADMINISTRATION

Management of Strawberry and Claremont Canyons should be the responsibility of the Ground Services section of the Department of Facilities Management. The low intensity activities suggested in this plan do not justify a full-time land manager. Field work to control eucalyptus sprouts, maintain trails, and check erosion could be done by a seasonal crew of laborers or cooperatively through an arrangement with the California Conservation Corps.

The Committee on Conservation and Environmental Qualtiy should continue to advise the Chancellor on land use, management and research in the area.

Management considerations or modifications to the canyon lands other than prescribed herein should be directed to the Committee on Conservation and Environmental Quality for consideration and recommendation for action to the Chancellor.

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TABLES

Table 1. Reports on Strawberry Canyon

Table 2. Proposed and existing vegetation types and management prescriptions

Table 3. Fuel management prescriptions

Table 1. Reports on Strawberry Canyon*

Author	Date	Focus of Report
Arbegast and Newton	1972	recreation potential of Poultry Husbandry area
Baker	1969	use and management of Ecological Areas
Biswell	1974	wildlife management
Daly	1969	use of natural areas
Eckbo and Associates	1976	management plan for Strawberry Canyon
Jones	1974	landscape plan for Strawberry Canyon
King	1969-73	recreation use of Chicken Canyon
Lennert and Associates	1972	storm drainage
Lindgren and Sanderson	1969	use of the campus environment
McBride	1976	vegetation management plan for Strawberry Canyon
Provenzano and Associates	1972	roadway soil investigation
Siri	1972	proposal for inclusion of portions of Strawberry Canyon in the Natural Land and Water Reserves System

*See bibliography for title and source of reports.

Table 2. Proposed and existing vegetation types and management prescription

Unit	Vegetation Type	Proposed Vegetation	Vegetation Management Prescription
E1	Eucalyptus	Eucalyptus	no treatment*
E2	"	"	" " *
E3	"	"	" " *
E4	"	"	" "
E5	"	"	" " *
E6	"	"	" "
E7	"	"	" "
E8	"	"	" "
E9	"	"	" "
E10	"	"	" "
E11	"	"	" "
E12	"	"	" "
E13	"	"	" "
E14	"	"	" "
EL1	Eucalyptus (logged)	open eucalyptus forest	thin sprouts to 25 trees/acre
EL2	"	successional	remove eucalyptus sprouts
EL3	"	"	" " "
EL4	"	"	" " "
EL5	"	"	" " "
EL6	"	native perennial bunchgrass	" " " ; cut stump off at ground level; seed with native perennial bunchgrass**
EL7	"	successional	remove eucalyptus sprouts
EL8	"	Oak-Bay Woodland	" " " ; plant coast live oak and bay***
EL9	"	successional	remove eucalyptus sprouts
EL10	"	native perennial bunchgrass	" " " ; cut stumps off at ground level; seed with native perennial bunchgrasses.**

*special treatment of fuel management zone in this unit described in fuel management section.

**specific seeding techniques to be developed by Dr. Jim Bartolome, Dept. Forestry and Conservation

***specific planting plan to be developed by the California Native Plant Society.

Table 2 (cont'd)

Unit	Vegetation Type	Proposed Vegetation	Vegetation Management Prescription
EL11	Eucalyptus (logged)	successional	remove eucalyptus sprouts
EL12	"	"	" " "
EL13	"	"	" " " *****
EL14	"	"	" " "
EL15	"	"	" " "
EL16	"	Redwood Plantation	Maintain desired redwood density by additional planting as needed; remove eucalyptus sprouts.
EL17	"	"	remove eucalyptus sprouts
EL18	"	"	" " " *
C1	Conifer (Bishop Pine)	same	no treatment****
C2	Conifer (mixed plantation of high elevation pine species)	"	" "
C3	Conifer (Monterey Pine)	"	" "
C4	Conifer (Monterey Pine)	"	" "
C5	Conifer	"	" " *; ****
C6	Conifer	"	" " *; ****
C7	Conifer (Norway Spruce)	"	" " ****
C8	Conifer (Western Red Cedar)	"	" " ****
C9	Conifer (Monterey Cypress)	"	" " *; ****
C10	Conifer (Monterey Cypress)	same	no treatment****
C11	Conifer (Monterey Cypress)	"	" " ****

****Replanting prescription to be developed by the Dept. of Forestry and Conservation when unit becomes decadent.

Table 2. Proposed and existing vegetation types and management prescription

Unit	Vegetation Type	Proposed Vegetation	Vegetation Management Prescription
E1	Eucalyptus	Eucalyptus	no treatment*
E2	"	"	" " *
E3	"	"	" " *
E4	"	"	" "
E5	"	"	" " *
E6	"	"	" "
E7	"	"	" "
E8	"	"	" "
E9	"	"	" "
E10	"	"	" "
E11	"	"	" "
E12	"	"	" "
E13	"	"	" "
E14	"	"	" "
EL1	Eucalyptus (logged)	open eucalyptus forest	thin sprouts to 25 trees/acre
EL2	"	successional	remove eucalyptus sprouts
EL3	"	"	" " "
EL4	"	"	" " "
EL5	"	"	" " "
EL6	"	native perennial bunchgrass	" " " ; cut stump off at ground level; seed with native perennial bunchgrass**
EL7	"	successional	remove eucalyptus sprouts
EL8	"	Oak-Bay Woodland	" " " ; plant coast live oak and bay***
EL9	"	successional	remove eucalyptus sprouts
EL10	"	native perennial bunchgrass	" " " ; cut stumps off at ground level; seed with native perennial bunchgrasses.**

*special treatment of fuel management zone in this unit described in fuel management section.

**specific seeding techniques to be developed by Dr. Jim Bartolome, Dept. Forestry and Conservation

***specific planting plan to be developed by the California Native Plant Society.

Table 2 (cont'd)

Unit	Vegetation Type	Proposed Vegetation	Vegetation Management Prescription
EL11	Eucalyptus (logged)	successional	remove eucalyptus sprouts
EL12	"	"	" " "
EL13	"	"	" " " *****
EL14	"	"	" " "
EL15	"	"	" " "
EL16	"	Redwood Plantation	Maintain desired redwood density by additional planting as needed; remove eucalyptus sprouts.
EL17	"	"	remove eucalyptus sprouts
EL18	"	"	" " " *
C1	Conifer (Bishop Pine)	same	no treatment****
C2	Conifer (mixed plantation of high elevation pine species)	"	" "
C3	Conifer (Monterey Pine)	"	" "
C4	Conifer (Monterey Pine)	"	" "
C5	Conifer	"	" " *; ****
C6	Conifer	"	" " *; ****
C7	Conifer (Norway Spruce)	"	" " ****
C8	Conifer (Western Red Cedar)	"	" " ****
C9	Conifer (Monterey Cypress)	"	" " *; ****
C10	Conifer (Monterey Cypress)	same	no treatment****
C11	Conifer (Monterey Cypress)	"	" " ****

****Replanting prescription to be developed by the Dept. of Forestry and Conservation when unit becomes decadent.

Table 2 (cont'd)

Unit	Vegetation Type	Proposed Vegetation	Vegetation Management Prescription		
C12	Conifer (Monterey Pine)	same	no treatment		
C13	Conifer (Redwood)	"	"	"	****
C14	Conifer (Canary Island Pine)	"	"	"	****
C15	Conifer (Redwood)	"	"	"	****
C16	Conifer (Monterey Pine)	"	"	"	****
C17	Conifer (Canary Island Pine)	"	"	"	****
C18	Conifer (Italian Stone Pine)	"	"	"	****
C19	Conifer (Monterey Pine)	"	"	"	****
C20	Conifer (Canary Island Pine)	"	"	"	****
C21	Conifer (Monterey Pine)	"	"	"	
C22	"	"	"	"	
C23	"	"	"	"	
C24	"	"	"	"	
C25	"	"	"	"	
C26	"	"	"	"	
C27	"	"	"	"	
C28	"	"	"	"	
C29	"	"	"	"	
C30	"	"	"	"	
C31	"	"	"	"	
C32	"	"	"	"	
C33	"	"	"	"	
C34	"	"	"	"	
C35	"	"	"	"	
C36	"	"	"	"	
C37	"	"	"	"	
C38	"	"	"	"	
C39	"	"	"	"	
C40	"	"	"	"	

Table 2 (cont'd)

Unit	Vegetation Type	Proposed Vegetation	Vegetation Management Prescription		
C41	Conifer (Monterey Pine)	same	no treatment		
C42	"	"	"	"	
C43	"	"	"	"	
C44	"	"	"	"	
C45	"	"	"	"	
W1	Oak-Bay Woodland	Oak-Bay Wood-land	"	"	
W2	"	"	"	"	
W3	"	"	"	"	*
W4	"	"	"	"	
W5	"	"	"	"	
W6	"	"	"	"	
W7	"	"	"	"	
W8	"	"	"	"	
W9	"	"	"	"	
W10	"	"	"	"	
W11	"	"	"	"	
W12	"	"	"	"	
W13	"	"	"	"	
W14	"	"	"	"	
W15	"	"	"	"	
W16	"	"	"	"	
W17	"	"	"	"	
W18	"	"	"	"	
W19	"	"	"	"	
W20	"	"	"	"	
W21	"	"	"	"	
W22	"	"	"	"	
W23	"	"	"	"	
W24	"	"	"	"	
SG1	Scrub-Grass	successional	"	"	*
SG2	"	"	"	"	
SG3	"	"	"	"	
SG4	"	"	"	"	
SG5	"	"	"	"	
SG6	"	"	"	"	
SG7	"	"	"	"	
SG8	"	"	"	"	
SG9	"	"	"	"	
SG10	"	"	"	"	
SG11	"	"	"	"	
SG12	"	"	"	"	

Table 2 (cont'd)

Unit	Vegetation Type	Proposed Vegetation	Vegetation Management Prescription
SG13	Scrub-Grass	successional	no treatment
SG14	"	"	" "
SG15	"	"	" "
SG16	"	"	" "
SG17	"	"	" "
SG18	"	"	" "
SG19	"	"	" "
SG20	"	"	" " *
SG21	"	"	" " *
SG22	"	"	" "
SG23	"	"	" "
SG24	"	"	" "
SG25	"	"	" "
SG26	"	"	" "
SG27	"	"	" "
SG28	"	"	" "
SG29	"	"	" "
SG30	"	"	" "
SG31	"	"	" "
SG32	"	"	" "
SG33	"	"	" "
SG34	"	"	" "
SG35	"	"	" "
SG36	"	"	" "
SG37	"	"	" "
SG38	"	"	" "
SG39	"	"	" "
SG40	"	"	" "
SG41	"	"	" "
SG42	"	"	" "
SG43	"	"	" "

Table 3. Fuel Management Prescriptions

Unit	Vegetation Type	Fuel Management Prescription*
E1	Eucalyptus	Reduce tree density; eliminate fuel ladder; burn litter every 3-5 years depending upon accumulation.
E2	"	-ditto-
E3	"	-ditto-
E4	"	-ditto-
E5	"	-ditto-
EL18	Eucalyptus (logged)	Eliminate sprouts; remove brush; mow and rake grass annually at end of growing season.
C5	Conifer	Reduce tree density, eliminate fuel ladder; burn litter every 5-7 years depending upon accumulation.
C6	Conifer (Monterey Pine)	-ditto-
C9	Conifer (Monterey Cypress)	-ditto-
W2	Oak-Bay Woodland	-ditto-
SG1	Scrub-Grass	Eliminate shrubs; mow and rake grass annually at end of growing season.
SG6	"	-ditto-
SG20	"	-ditto-
SG21	"	-ditto-

*prescription for 100' wide fuel break

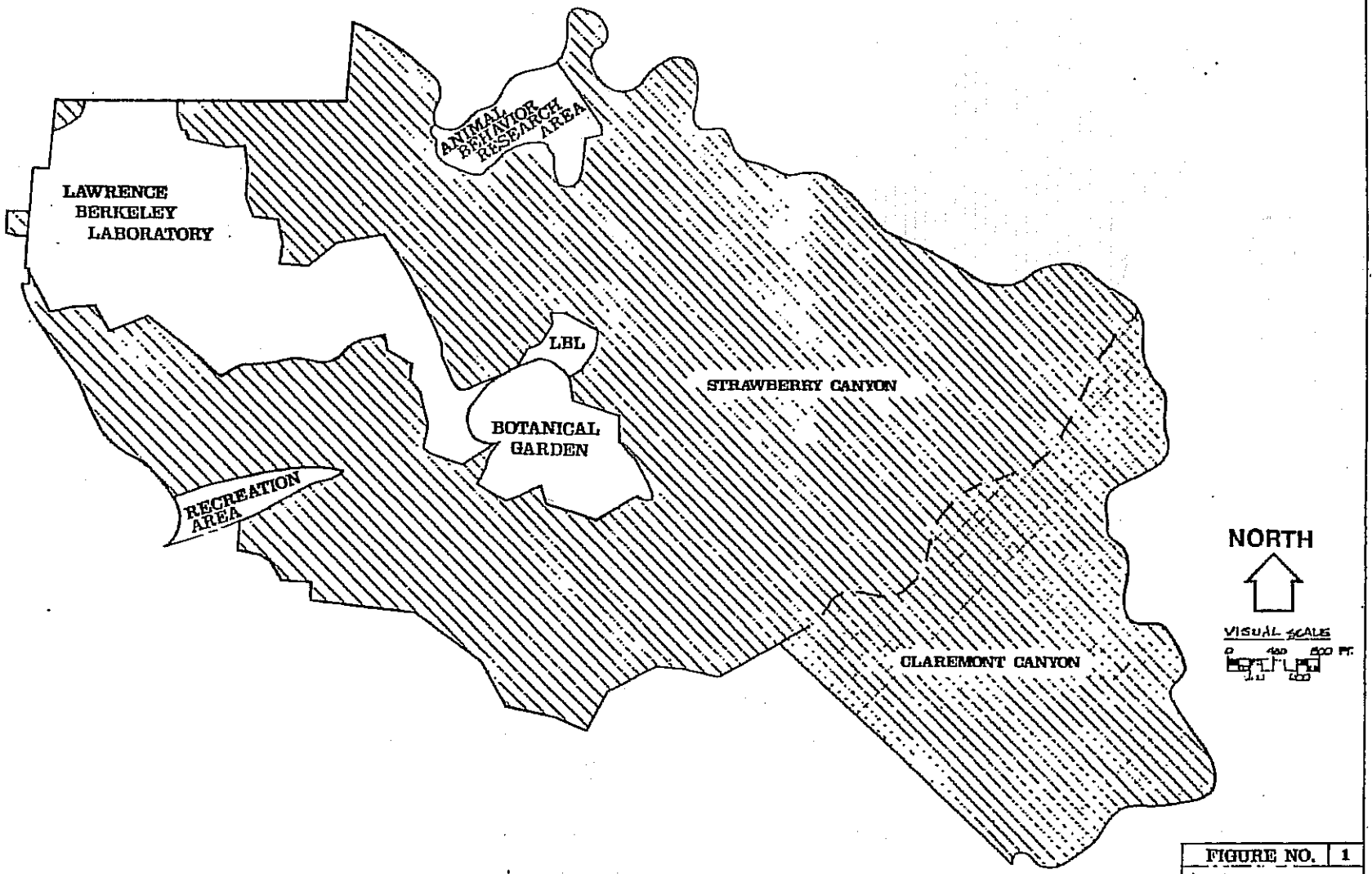


FIGURE NO. 1

AREA FOR APPLICATION OF MANAGEMENT PLAN

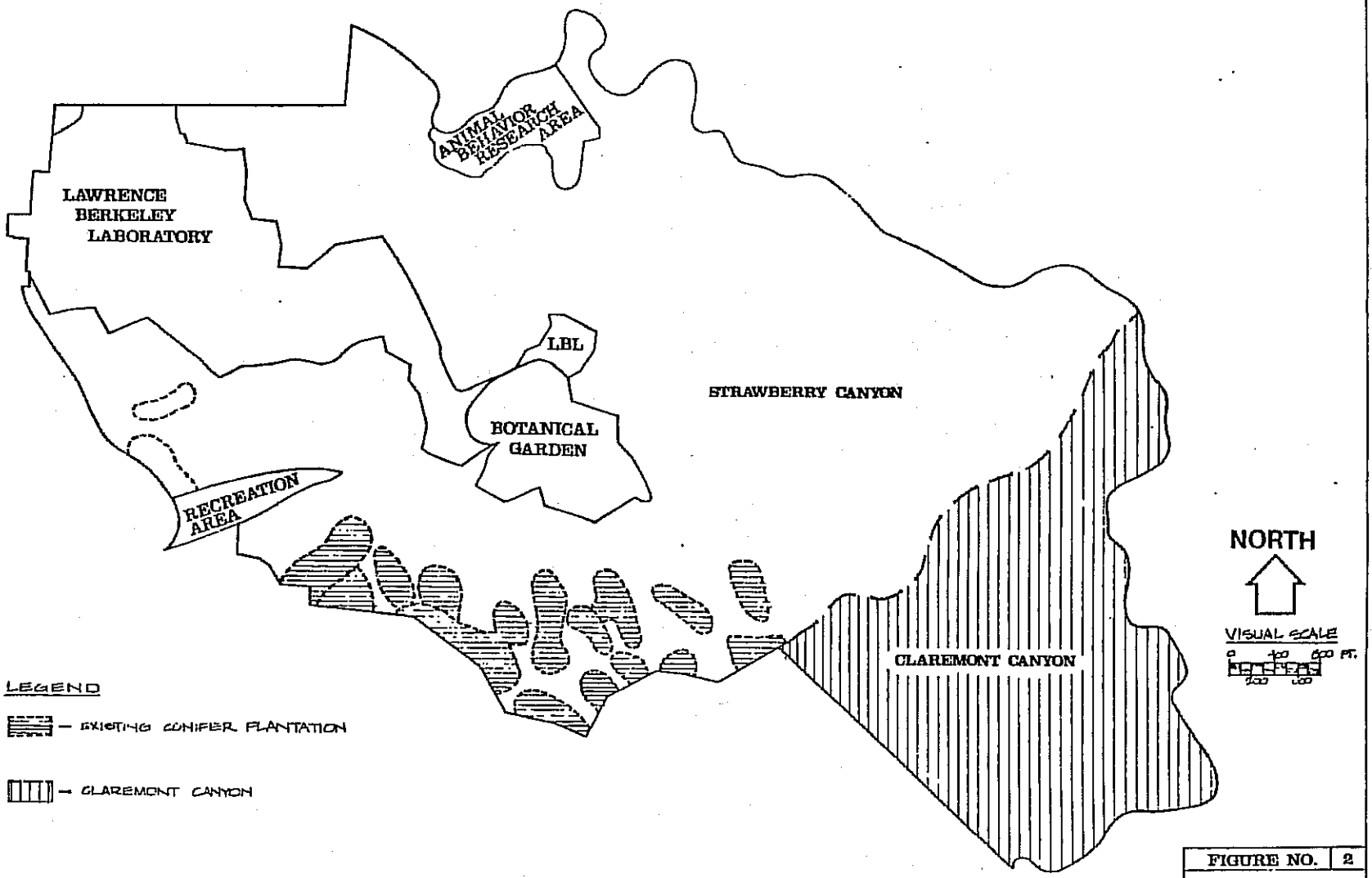


FIGURE NO. 2

FOREST MANAGEMENT AREAS

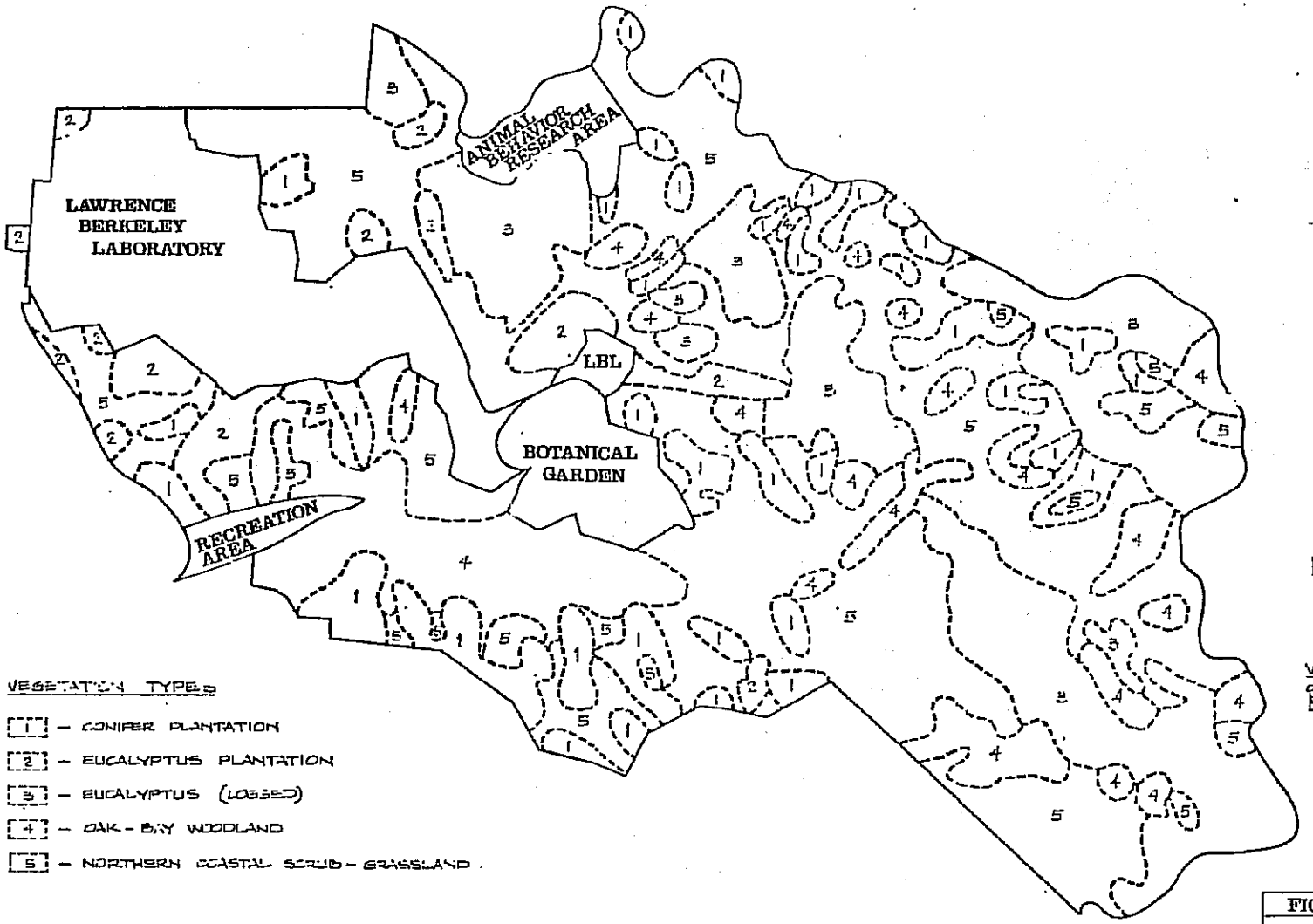
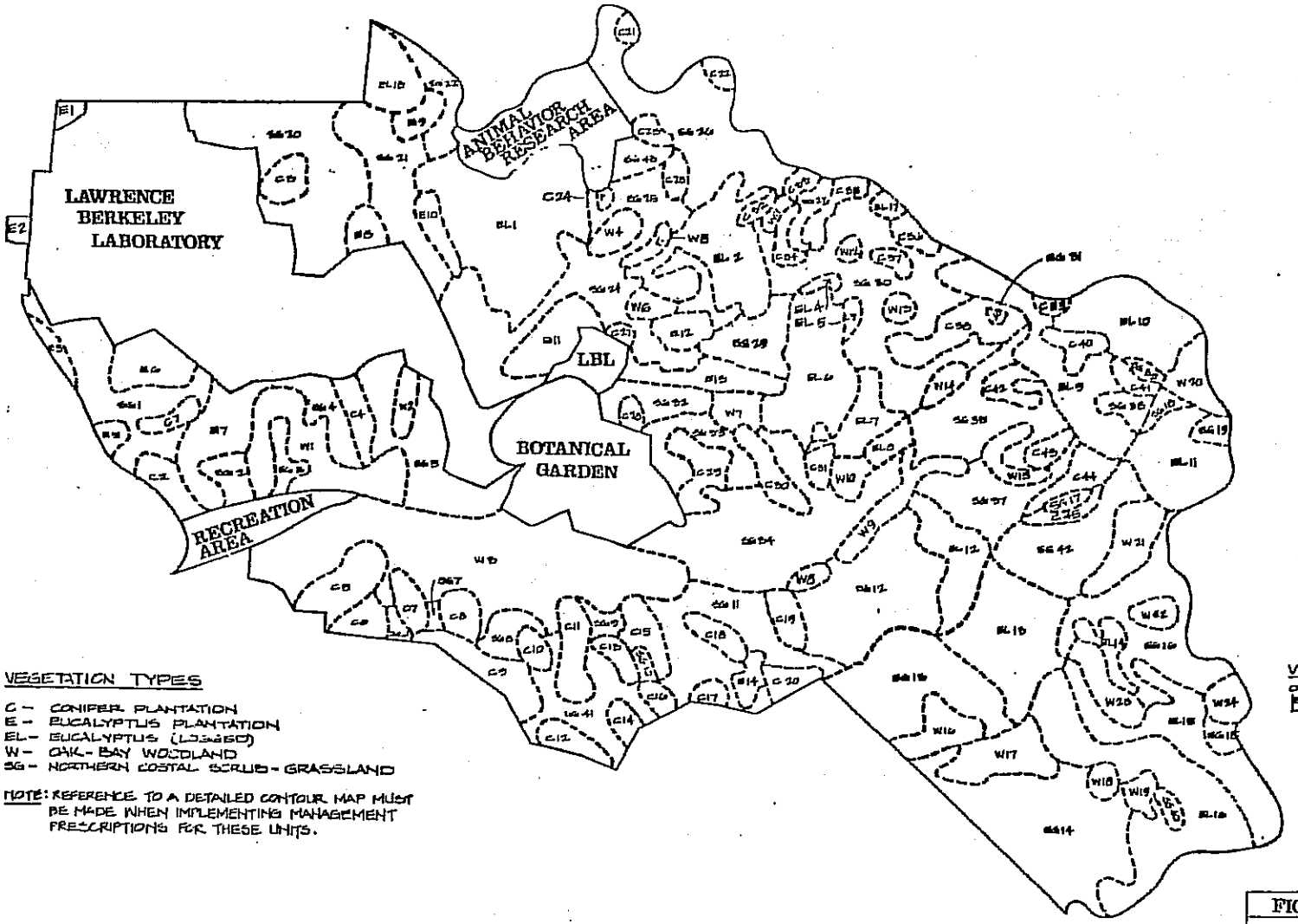


FIGURE NO. 3

EXISTING VEGETATION



VEGETATION TYPES

C – CONIFER PLANTATION
E – EUCALYPTUS PLANTATION
EL – EUCALYPTUS (LOWLAND)
W – OAK-BAY WOODLAND
SG – NORTHERN COASTAL SCRUB-GRASSLAND

NOTE: REFERENCE TO A DETAILED CONTOUR MAP MUST BE MADE WHEN IMPLEMENTING MANAGEMENT PRESCRIPTIONS FOR THESE UNITS.

FIGURE NO. 4

VEGETATION MANAGEMENT UNITS

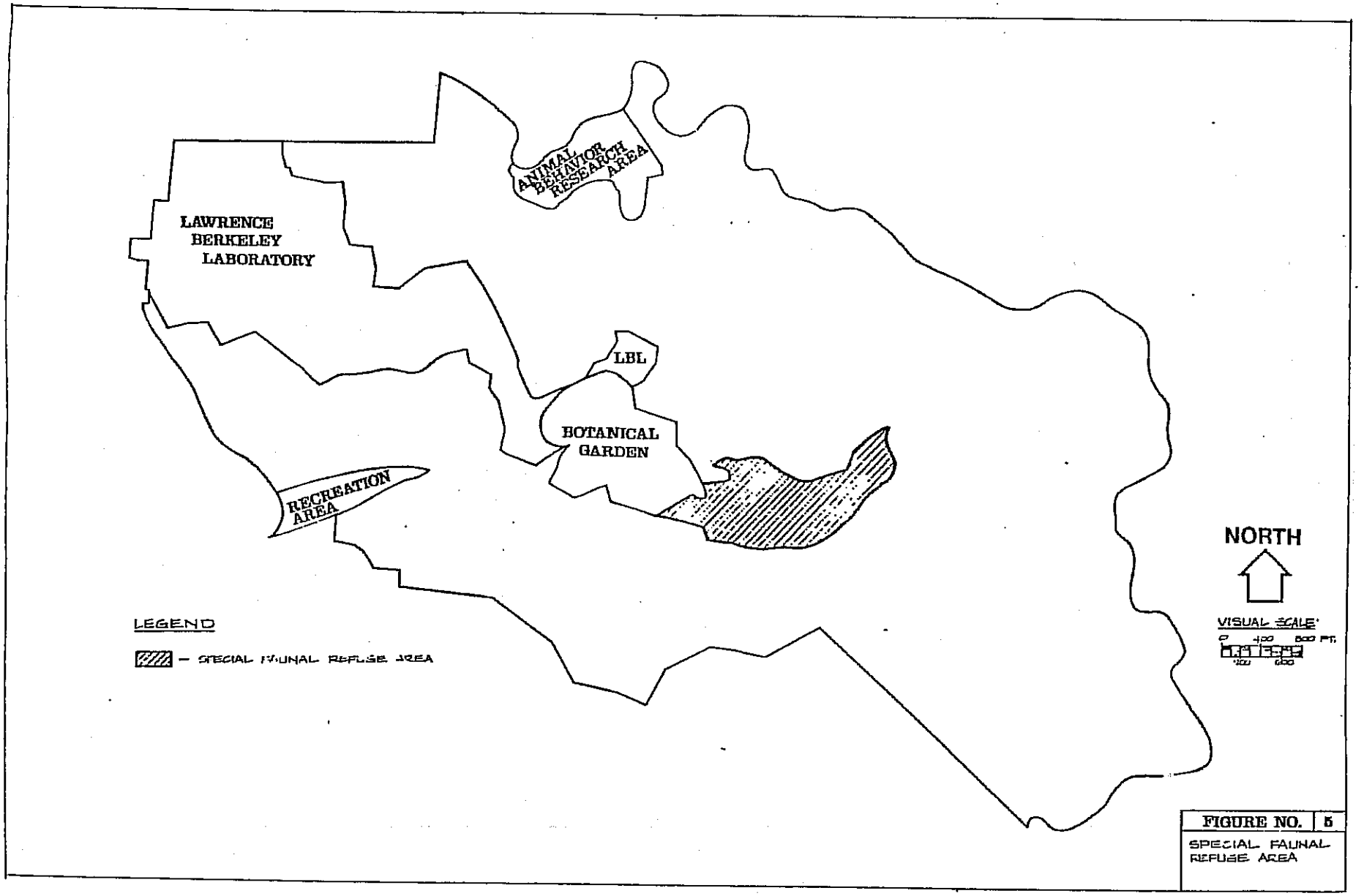


FIGURE NO. 5

SPECIAL FAUNAL REFUSE AREA

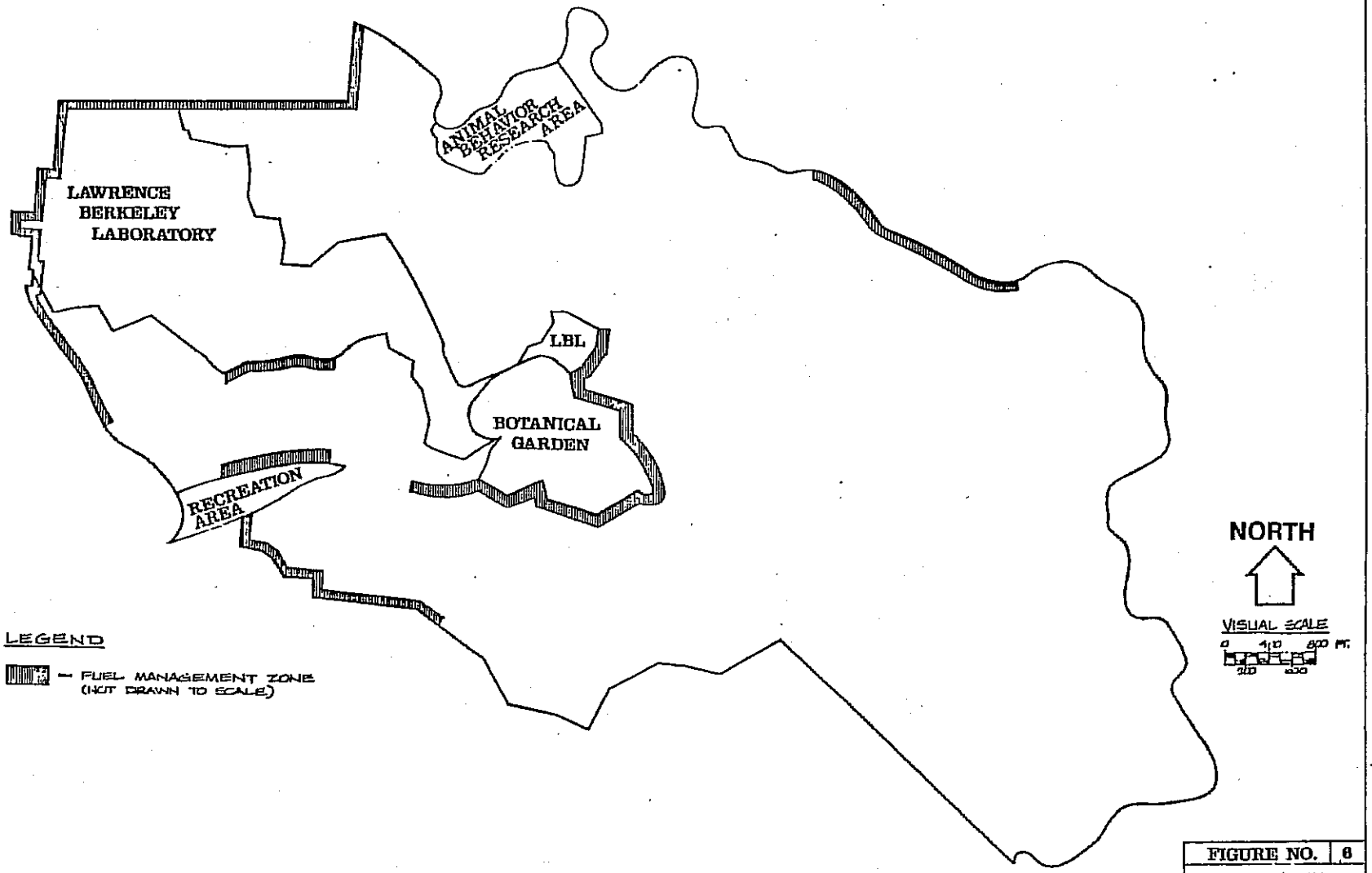


FIGURE NO. 8

FUEL MANAGEMENT ZONE

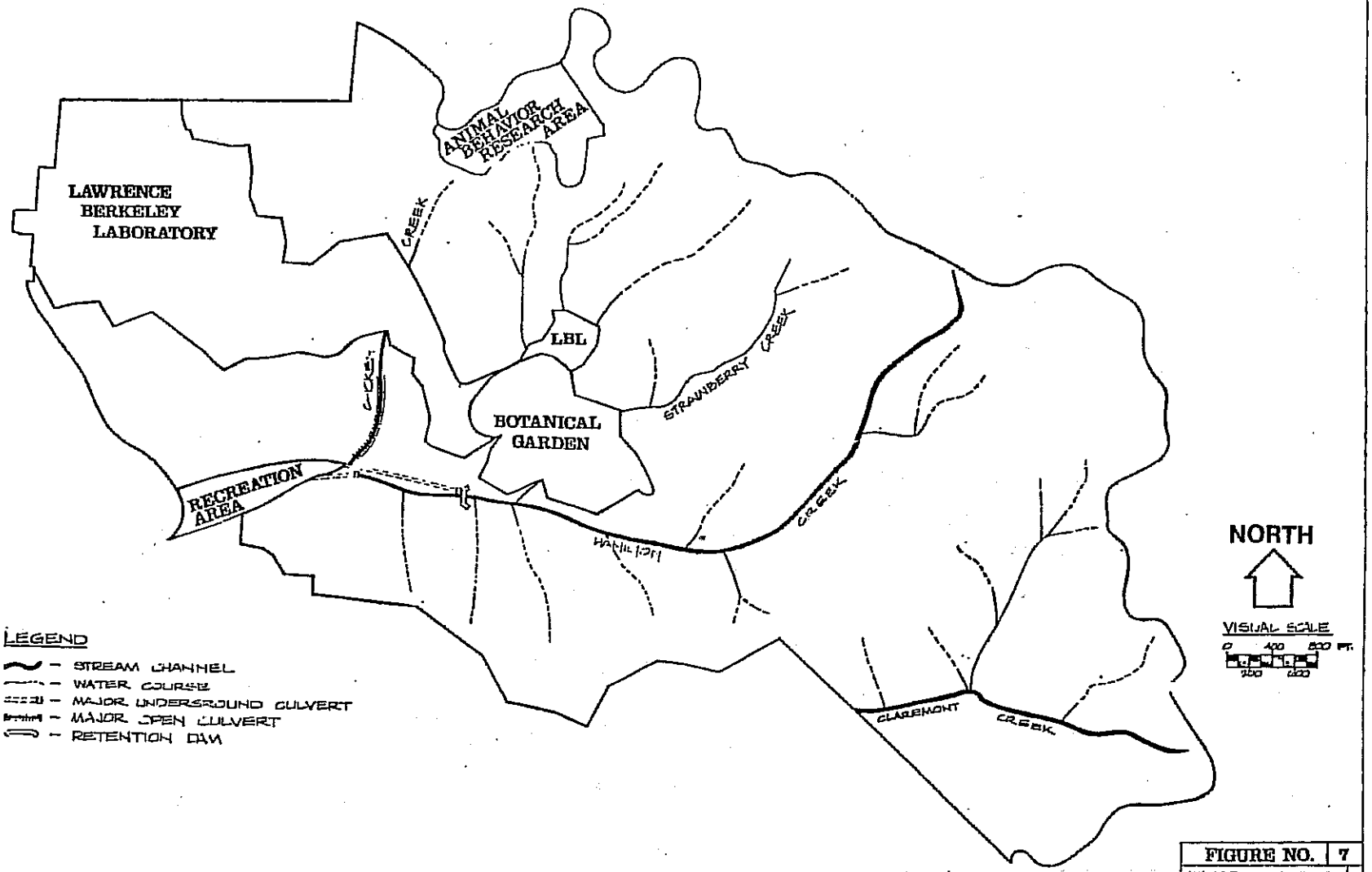


FIGURE NO. 7

WATER COURSES & STREAM CHANNELS

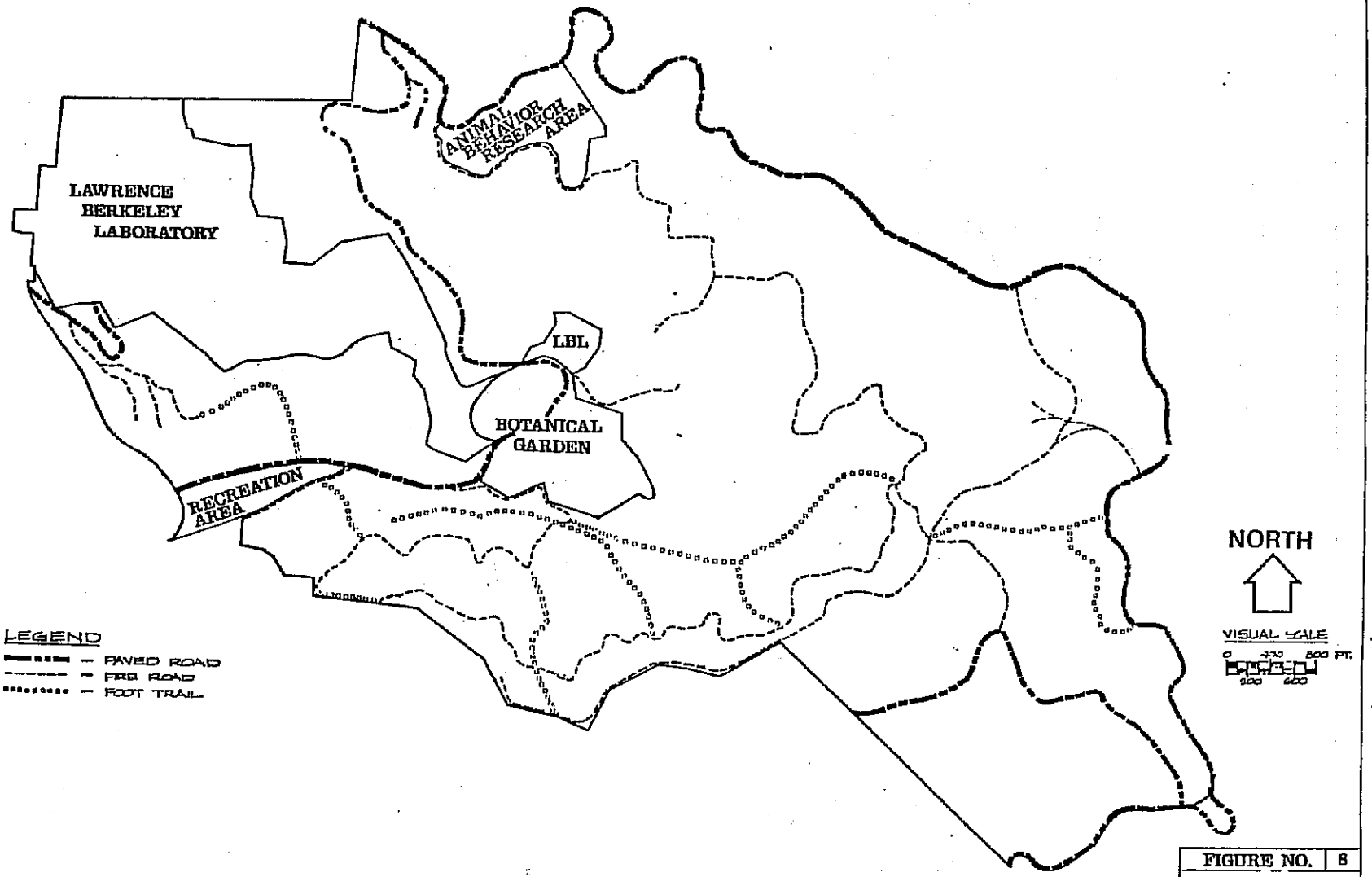


FIGURE NO. 8

TRAIL SYSTEM

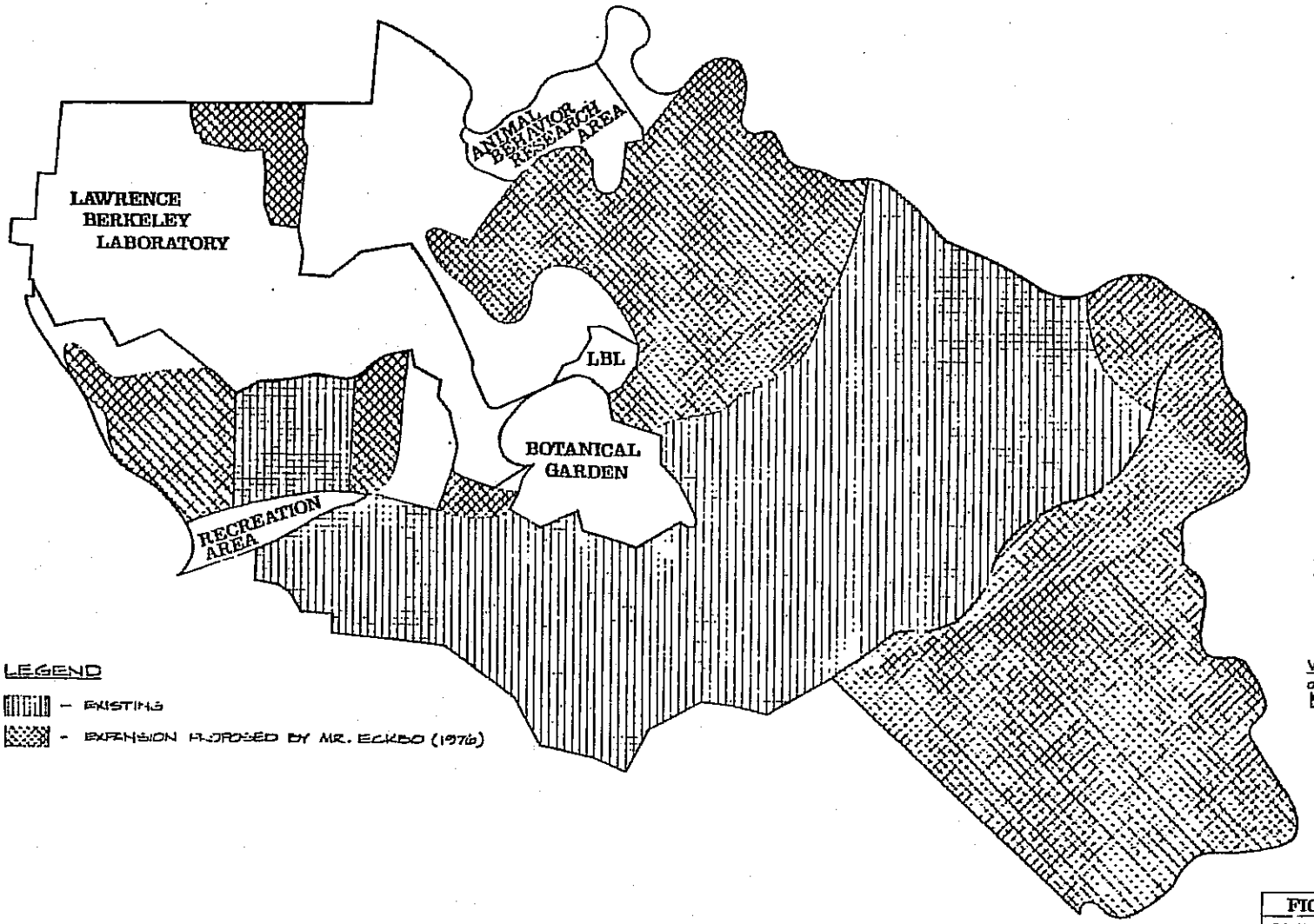


FIGURE NO. 9

ECOLOGICAL STUDY AREA & PROPOSED EXPANSION BY MR. ECKBO (1976)

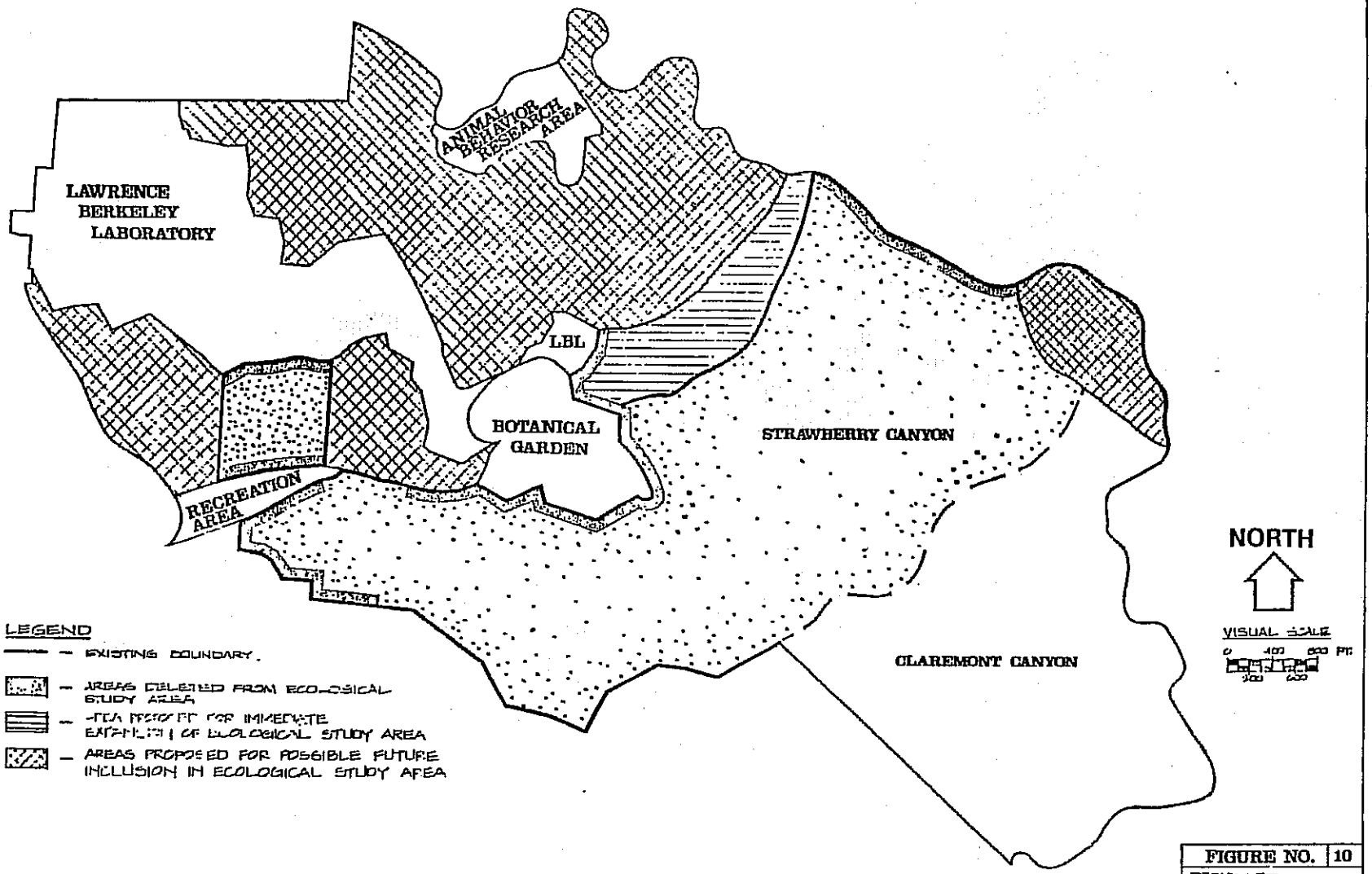


FIGURE NO. 10

PROPOSED MODIFICATION OF ECOLOGICAL STUDY AREA BOUNDARY

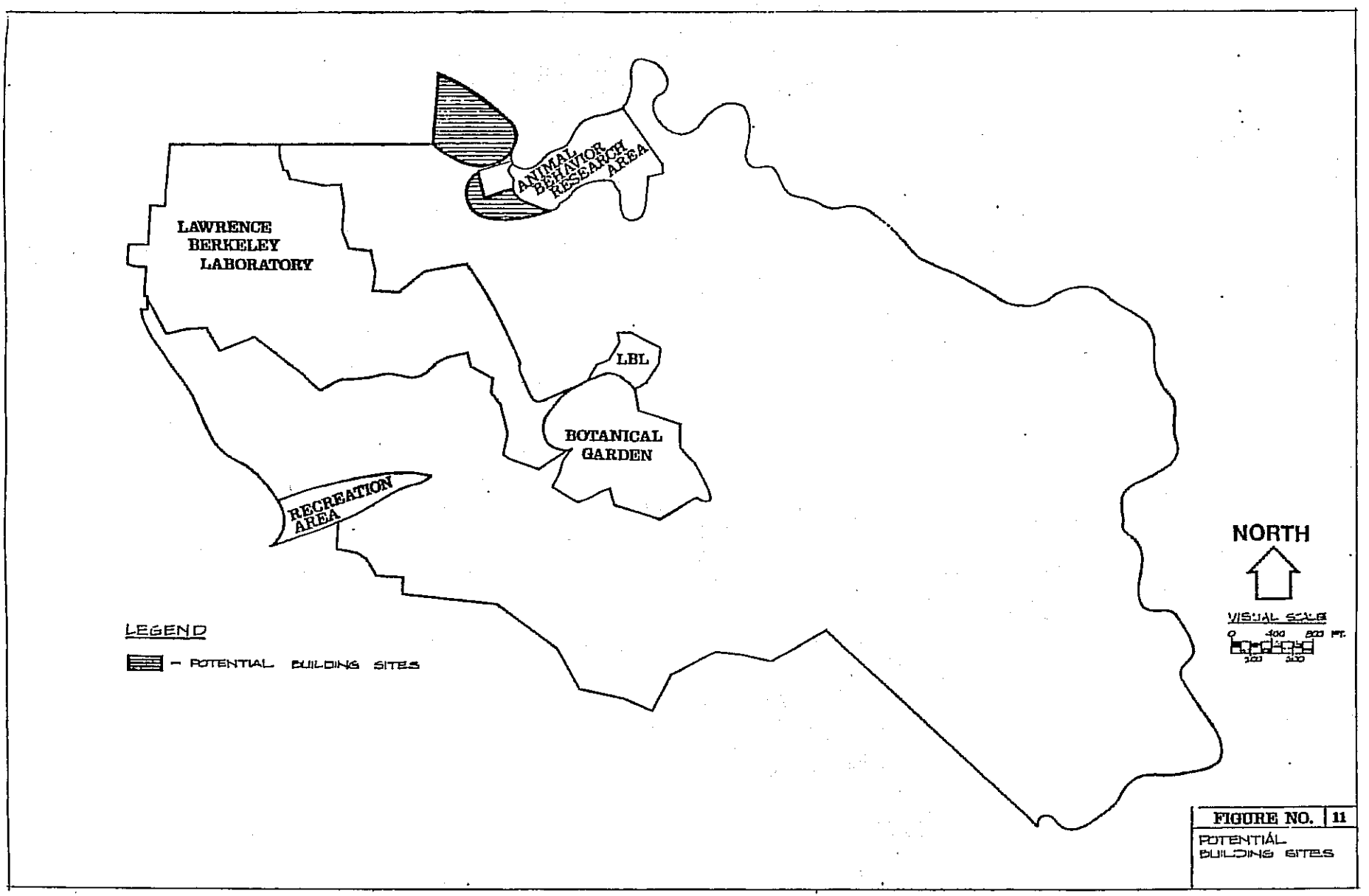


FIGURE NO. 11

POTENTIAL
BUILDING SITES

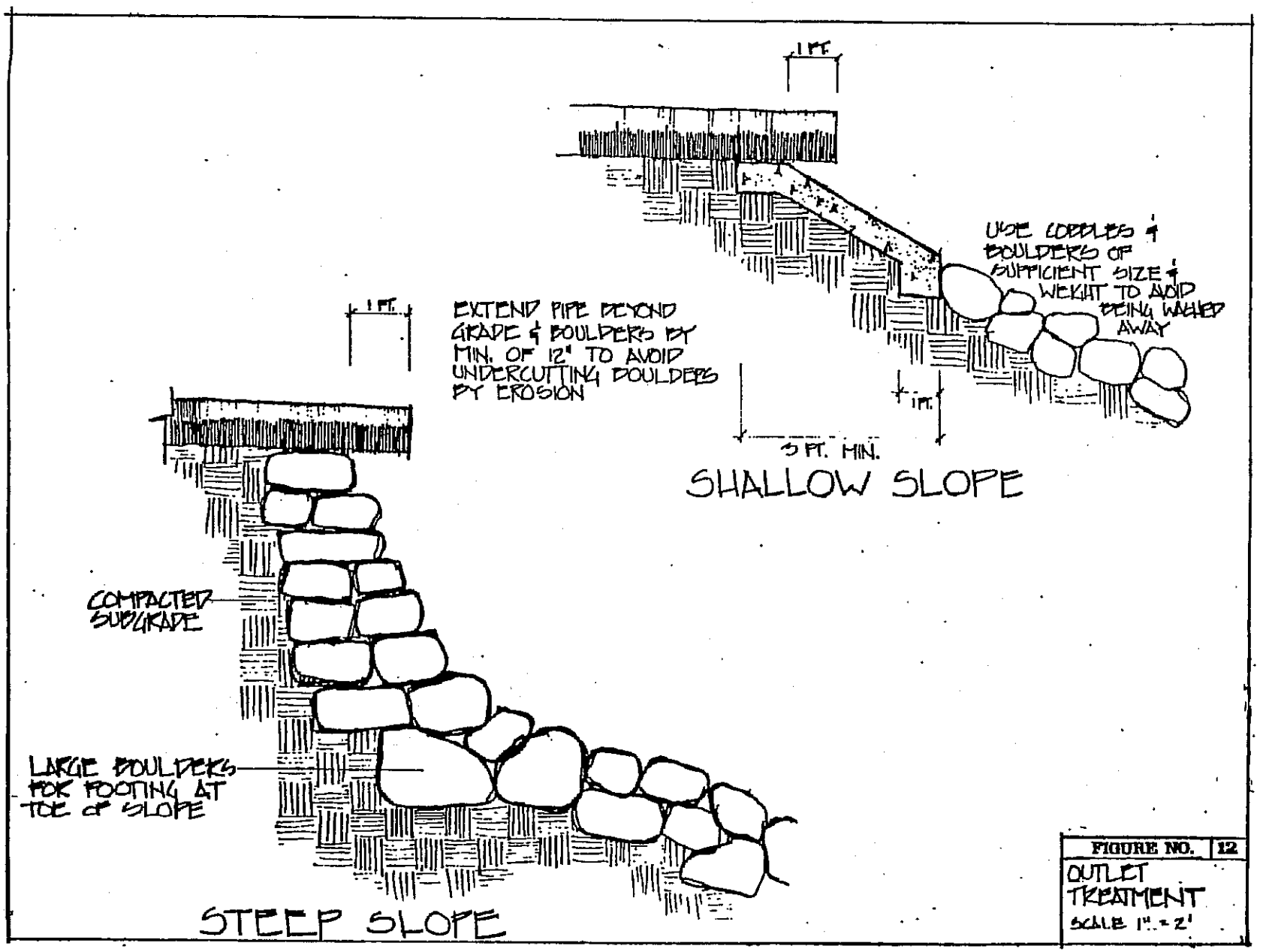


FIGURE NO. 12

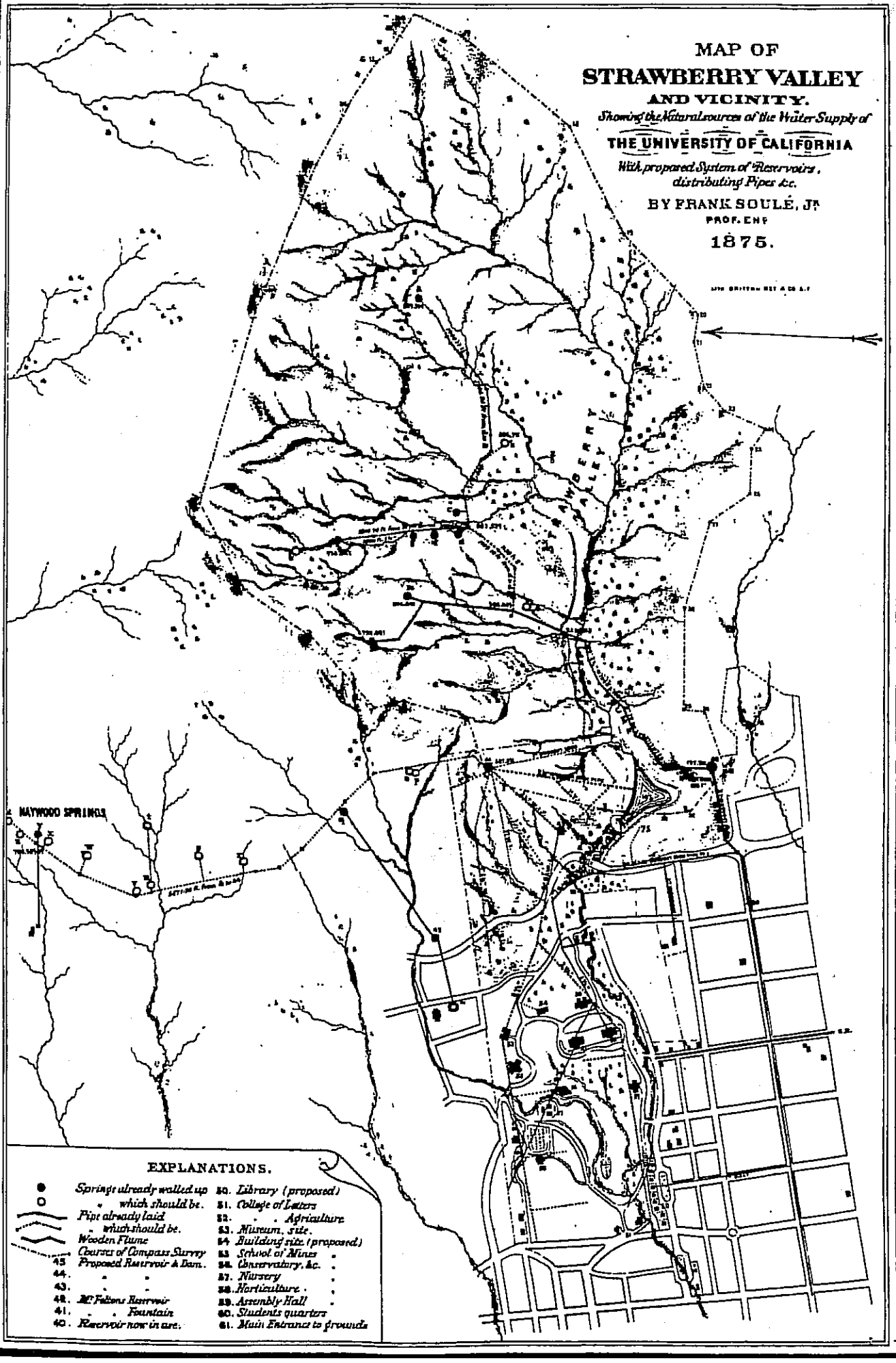
OUTLET TREATMENT

SCALE 1" = 2'

AN ENVIRONMENTAL ANALYSIS OF POTENTIAL DEVELOPMENT SITES IN THE EAST HILL AREA (STRAWBERRY CANYON) OF BERKELEY, CALIFORNIA

A Professional Report Prepared in Partial
Fulfillment of the Requirements
For the Degree of Master of Arts,
City and Regional Planning.
Presented to the Faculty of the
University of California,
Berkeley, June 1982

Terence O'Hare


MAP OF
STRAWBERRY VALLEY
AND VICINITY.
Showing the Natural sources of the Water Supply of
THE UNIVERSITY OF CALIFORNIA
With proposed System of Reservoirs, distributing Pipes &c.
BY FRANK SOULÉ, JR
PROF. ENG
1875.
HAYWOOD SPRINGS
EXPLANATIONS.
Springs already walled up
which should be.
Pipe already laid
which should be.
Wooden Flume
Course of Compass Survey
45 Proposed Reservoir & Dam.
44.
43.
42. Mt Fellons Reservoir
41. Fountain
40. Reservoir now in use.
50. Library (proposed)
51. College of Letters
52. Agriculture
53. Museum, site.
54. Building site (proposed)
55. School of Mines
56. Conservatory, &c.
57. Nursery
58. Horticulture
59. Assembly Hall
60. Students quarters
61. Main Entrance to grounds

COMMITTEE

Donald Appleyard (Chair), Professor, City & Regional Planning and Landscape Architecture, UCB
Fernando Kusnetzoff, Professor, City & Regional Planning, UCB
Thomas A. Koster, Senior Educational Facility Planner, Buildings & Campus Development Committee, Chancellor's Office, UCB

ACKNOWLEDGEMENTS

This report has been prepared under the aegis of the Buildings & Campus Development Committee, UCB (Sami Hassid, Chair), in collaboration with the office of Dorothy Walker, Coordinator - Physical Planning, UCB. The author wishes to thank the members of his Committee, and Tom Koster in particular, for his diligent reading of several drafts of this report and his guidance in its preparation. Thanks are also due to Dorothy Walker and Ralph Gigliello for their helpful suggestions and to Sara Mikesell for the patience and skill she brought to the production of this report. I also wish to thank Sami Hassid for the generous assistance that BCDC gave to the report and Carolyn Curran, Denise Crozier, and Ray Shiflett for their assistance when help was most needed.

FOREWORD

1. Project Definition

The primary objective of this report is to provide a preliminary analysis of the East Hill area of the University of California, Berkeley, that can be used as a basis for the development of policy options regarding the long range development of the area. The major focus is on the identification and evaluation of possible building or development sites in the area with particular attention to the programmatic needs of the Field Station for Behavioral Research, already located in the area.

2. Study Area Definition

The report provides an overview of the prevailing environmental conditions in Strawberry and Claremont Canyons. However, it limits the area of its detailed analysis to the upper eastern section of the canyon area excluding Lawrence Berkeley Laboratory and the Hass-Strawberry recreational facilities. The study area encompasses the University's Botanical Garden, the Lawrence Hall of Science, the Space Sciences Laboratory, the Ecological Study Area, and the Field Station for Behavioral Research.

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1. EXECUTIVE SUMMARY

This report summarizes information relating to existing environmental conditions in the East Hill area of the University of California, Berkeley. It provides an inventory of land use, a discussion of ecological concerns, and some recommendations for future development in the area.

The findings of this report suggest that while development is constrained by topography and environmental issues, specific sites in the area can be usefully developed provided that such development is sensitive to a number of topics. These include the continued primary use of the area for instruction and research as well as relaxation; the protection of existing vegetation and wildlife populations; and the implementation of land and water management techniques to offset the possibility of soil erosion, flooding, and localized landslides.

A further major concern in the area is the danger of fire and the prevalence of hazardous fire conditions which become extreme during certain periods in the late summer and fall. While acknowledging the concerns of conservationists and naturalists that existing wildlife habitats and vegetation ought not be destroyed, this report regards the implementation of a prudent and efficient, if limited, fuel management program as critical to the area's long-term survival as an ecological preserve. The risk of fire in the canyon area grows as the human population of the area increases, and it should be recognized that all the University community values in the area could be lost in a single disastrous fire.

Without the introduction of fire management practices, the Field Station for Behavioral Research is perhaps at greatest risk. The loss of rare animal collections and of productive research may result if fire management proposals are not implemented and maintained. The spatial reorganization of the Station, the need for which provided the initial impetus for this report, offers an opportunity to introduce safeguards against fire risk.

While the potential development of a number of sites has been identified and analyzed in this report, further detailed study is required in order to formulate a viable development plan for the area. Site-specific studies should be carried out to establish the building capacity of each site in terms of gross and assignable square feet, and the design of a preliminary site layout. The area's vehicular circulation system and transportation resources need to be examined to establish potential mass transit requirements. The expansion capacity of the area's existing utility and power lines must also be established. The early development of specific design guidelines for individual sites is also required so that the area's environmental priorities, ecological conditions, and aesthetic qualities are protected, and indeed enhanced, by any development that takes place.

2. INTRODUCTION

The object of this report is to examine the existing and potential land use of that area of University property known as East Hill. Lying immediately to the east of the campus, this area contains both Strawberry and Claremont Canyons, and occupies some 865 acres of mostly steeply wooded hillside. At present the area is used for research and instruction chiefly in the physical and life sciences.

In recent years the area has come under pressure for development and, as land on the central campus becomes filled, this pressure can be expected to increase. However, the impact of future development upon the geological and ecological conditions in the area and on its present use will be significant. In particular, the needs of the Field Station for Behavioral Research (FSBR), a long term user of the area more commonly known as the Animal Behavior Research Station, are likely to be compromised should additional major development take place while this facility remains in its present location. Therefore, this report will, within the range of its broader scope, give particular attention to the function and orientation of the FSBR, taking into account its need for acoustical and visual isolation in conditions that approximate a semi-natural environment.

Although the vast bulk of the land in question has remained in its undeveloped or natural state--indeed 350 acres have been designated by the University as an Ecological Study Area--a number of buildings and research units, some quite large, have been established in the area. They include the Lawrence Hall of Science (1968), the Space Sciences Laboratory (Silver Laboratory, 1966), the Botanical Garden (1926), and various units of the Lawrence Berkeley Laboratory. However, the urgency with which this report is required is dictated by the proposed construction, beginning in the spring of 1983, of a new Mathematical Sciences Research Institute (MSRI). This building, which is to be a structure of about 16,500 gross square feet (plus a potential 3,000 gross square foot addition), will be located immediately to the south of the Silver Laboratory adjacent to the western boundary of

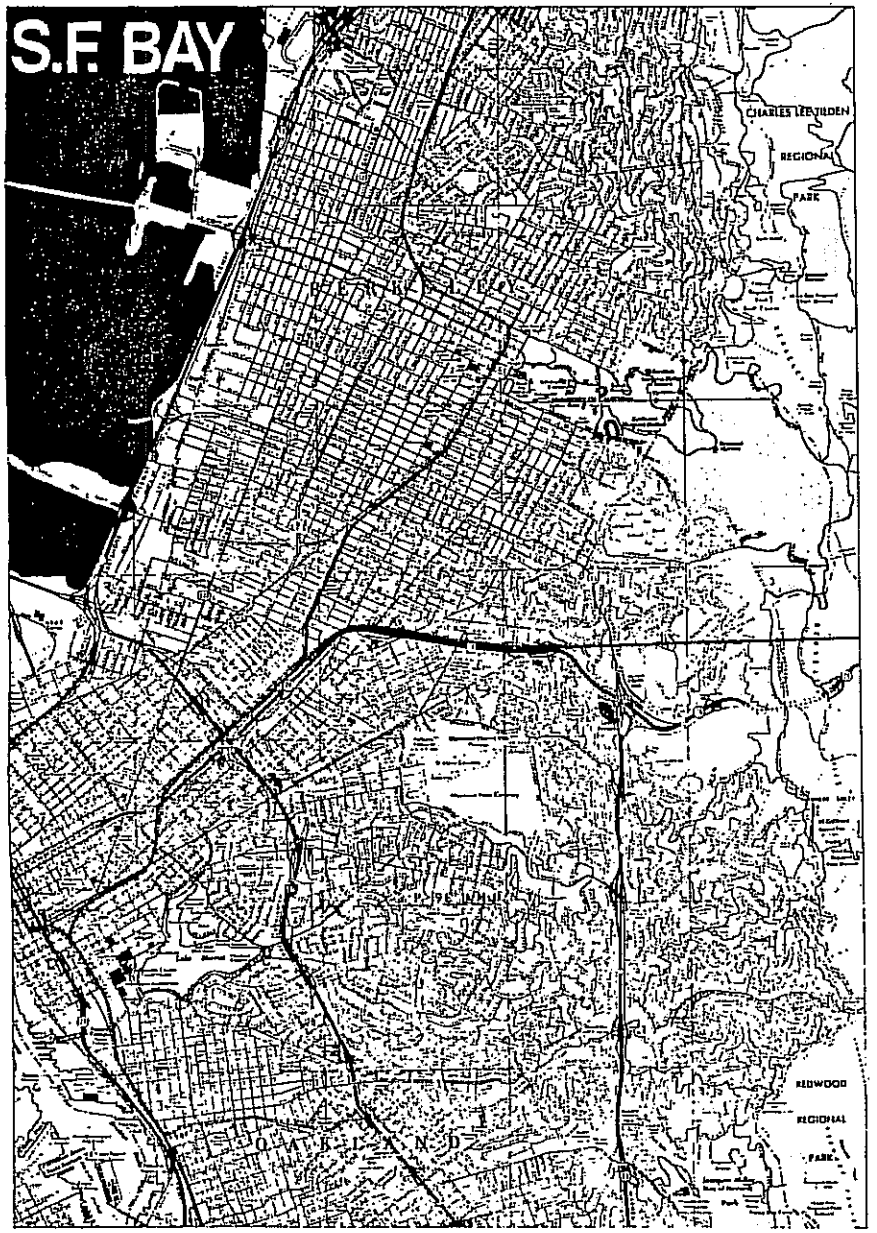
the FSBR. The Institute will be designed as the first of a complex of similar buildings which may be built at the site over the next 10 to 20 years.

The eventual establishment of this research complex is expected to conflict, at least to some degree, with the need of the FSBR to remain a secluded and isolated research unit. While the extent of this conflict is not yet clear, it is likely that the construction of the research complex as now planned will require the physical reorganization of the FSBR. Whether or not this reorganization can take place within the existing confines of the FSBR is a key concern of this report. A general review of development in the East Hill area is therefore now opportune. Current University policy governing the development of land in the area is not firmly in place. This report is intended to provide a basis from which such a policy can be developed.

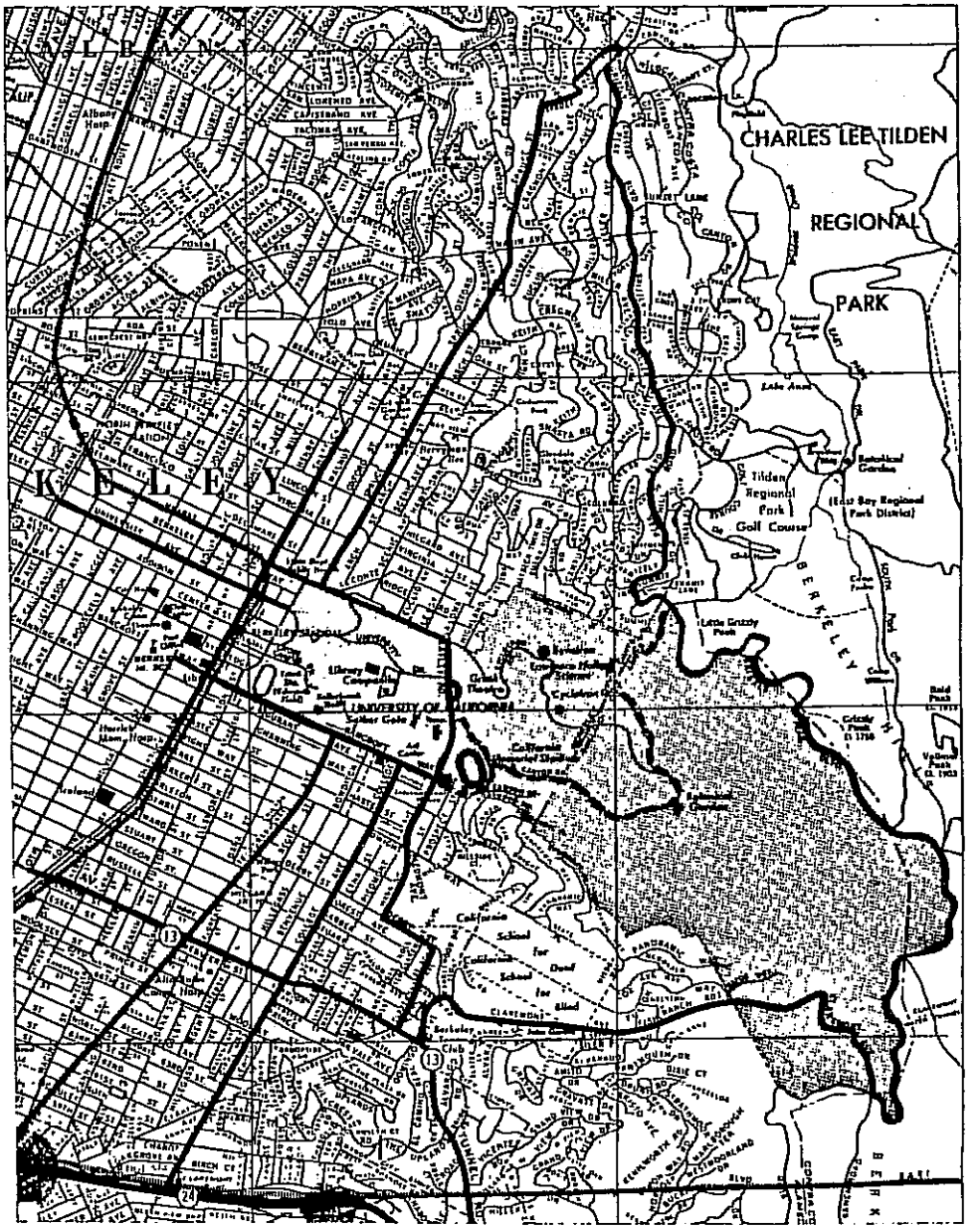
After first outlining the history of the University's interest in the East Hill area, the report will consider the environmental characteristics of the area. It will then provide a discussion of the administration of the area and an inventory of existing land use before proceeding to identify and evaluate specific sites in order to establish:

> the location of potential building sites, including those previously earmarked for development in earlier reports;
>
> the location of potential "development" sites, that is, sites which may be developed for research and instruction that do not require the construction of large permanent structures;
>
> the location of potential access roads and service or parking areas for new building or development sites; and
>
> the location of potential pedestrian access routes and circulation patterns for new building or development sites.

This report, however, does not constitute a complete environmental study of the area in that it does not take into account such topics as the archaeological character of this area, the socio-economic impact of development, or the provision of human health care services.



location map 1



area map 2

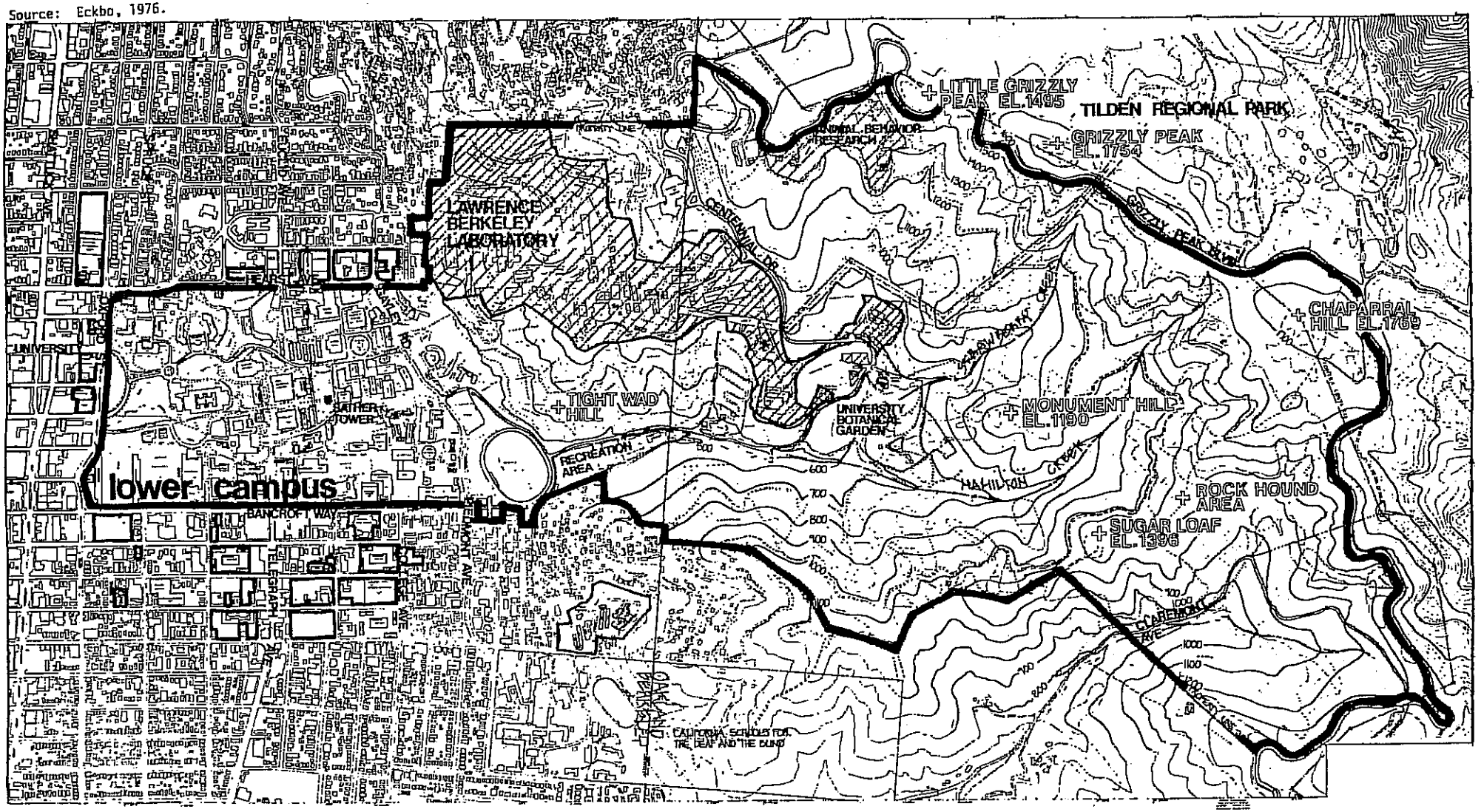
PHYSICAL SETTING

3. BACKGROUND

The East Hill area of the University of California has a history of use for instruction and research that reaches back to the founding of the Berkeley campus.[1] The lower section of Strawberry Canyon was included in the land originally granted to the University at its inception in 1868. The remainder of the East Hill area came under University jurisdiction in 1909.[2] Since that time Strawberry Canyon has served as " a wildland scientific resource and environmental testing ground for faculty, visiting scientists, and students in botany, entomology, zoology, forestry, soil science, plant pathology, genetics, landscape architecture, and military science."[3] For generations of students and faculty the proximity of a wilderness area close to campus has also provided a retreat from the pressures of academic life. Thus a strong sense of identification with the area has grown within the academic community.

In terms of use, appearance, and surface texture the vegetation in the area has changed a good deal since the University first acquired the land. In the early 1800s, the land was mostly open grassland used for grazing cattle, a use that continued well into the 1930s.[4] Few trees and bushes then dotted the area, except along water courses. Since the turn of the century there has been a continual process of change in the landscape in which the original grassland has gradually been supplanted by an oak-bay forest. Many nonindigenous "plantation" species were introduced into the area between 1900 and 1920, and as a result open hillsides have become covered by a denser, taller vegetation. Change in management practices has brought about change in the landscape. As grazing cattle and ranching gave way to ecologically protected zones, the first "primitive area" was established in the mid 1930s and policies favoring natural plant succession took hold. Should current management policies maintain this approach, the expansion of the riparian woodland we see in the area today can be expected to continue. By the beginning of the next century, 60% of the area will be covered by oak-bay woodland, 25% by bushes, and only small areas of open grassland will be left to remind visitors of the area's former use a century or more ago.[5]

Source: Eckbo, 1976.



PG&E EASEMENT - POWER LINE 80' R.O.W.

MICRO-WAVE RADIO LINE ABOVE GROUND

0 200 400 1000 1750ft.

physical setting

3

4. PHYSICAL SETTING

The following provides an overview of the existing geophysical and ecological conditions in the East Hill area, placing them in a regional context. This section of the report evaluates the characteristics of the area principally in terms of its topography, vegetation, and public access.

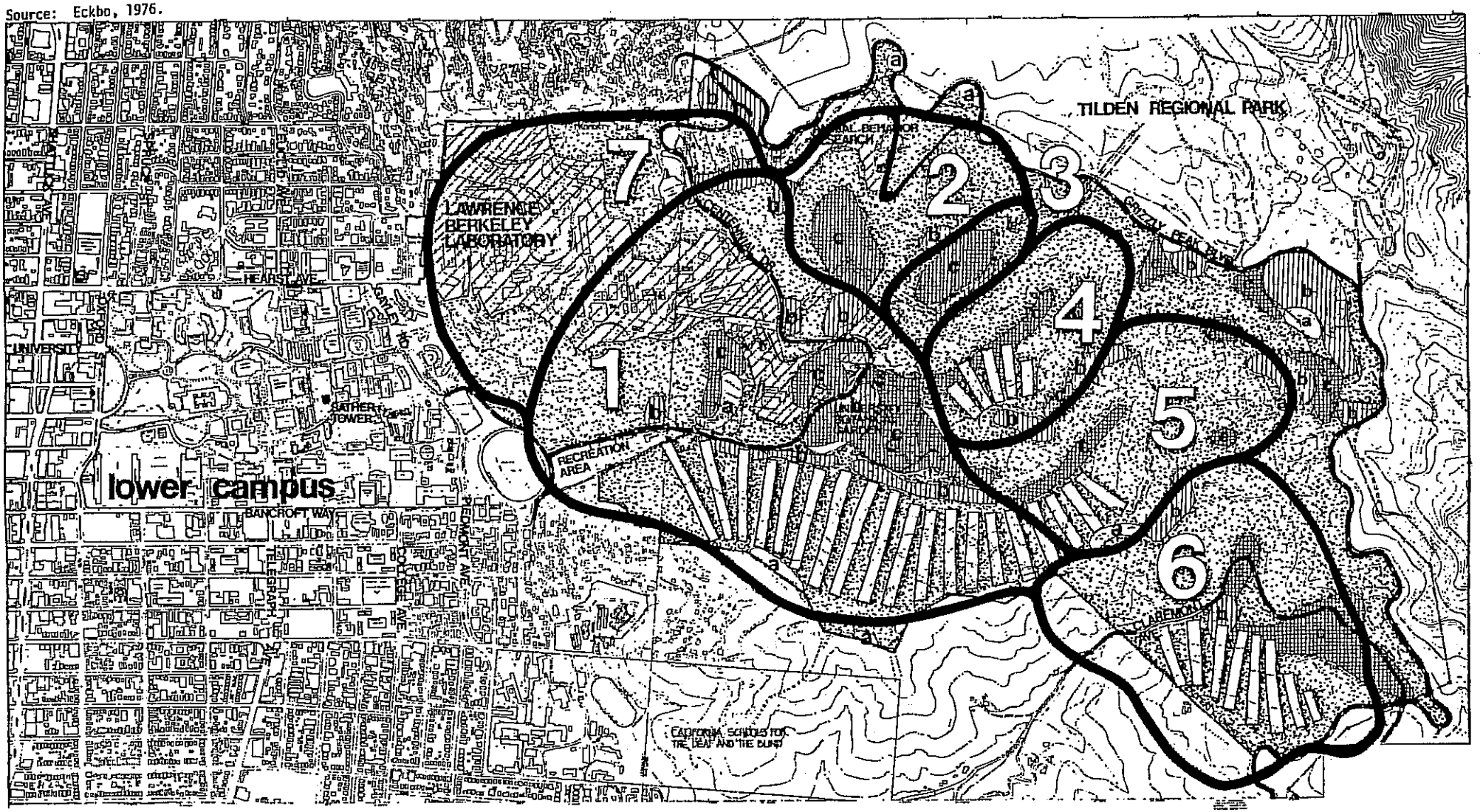
a. Topography

The East Hill area of the University of California covers about 835 acres of steep, irregular, and undeveloped terrain consisting of two well-defined canyon systems. The total land area in the two canyons under University control is about four times the area of the central campus. The southeast corner of the area is occupied by the upper reaches of Claremont Canyon (200 acres). A high ridge line separates this canyon system from Strawberry Canyon (635 acres), the major topographical feature of the area. Strawberry Canyon is essentially a steep sided cone one mile wide at its base and one and a half miles long, that expands from a narrow opening about 500 feet wide at the west to a high open ridge formation at the east. The land rises from approximately 400 feet above sea level at the western toe of the canyon slope to an elevation of 1,769 feet at Chaparral Hill on the northeastern boundary.

Topographically, the total area may be divided into four basic units. A west-facing lower slope bounded by Gayley Road in the west contains the Lawrence Berkeley Laboratory facility. The main bowl of Strawberry Creek occupies the center of the canyon system along with the University's Botanical Garden. Subsystems of minor creeks and valleys, of which Hamilton Creek is the most prominent, take up the northeastern section of the area, while the Claremont Canyon section lies isolated in the southeast corner beyond Skyline Ridge. The north-facing slopes on the south side of Strawberry Canyon are generally smooth and uncomplicated but, to the north and east, canyon sides are irregular and fragmented.

A characteristic of the area is the extent to which its legal boundaries match its

Source: Eckbo, 1976.



TOPOGRAPHIC UNIT

ZONE 1 ▫ MAIN CANYON

ZONE 2-5 ▫ SIDE CANYONS

ZONE 6 ▫ CLAREMONT CANYON

ZONE 7 ▫ VBL WEST SLOPE

NORTH SLOPES ▫ COOL, MOIST

0-8% SLOPES

8-15% SLOPES

15-25% SLOPES

25% + SLOPES

0 200 400 1000 1750 ft.

topography and slope

4

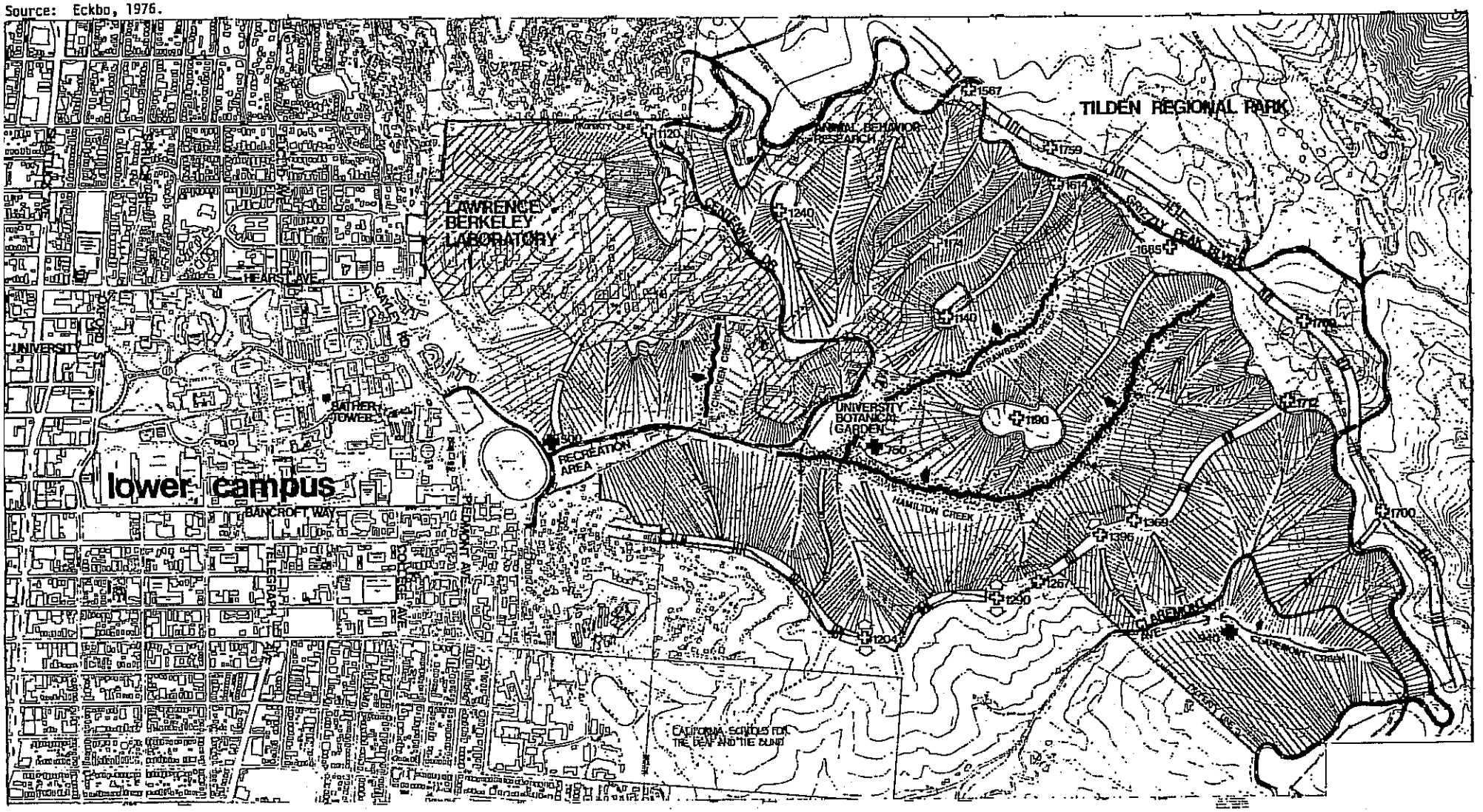
physical configuration. Except for the western and lower section of the area, which lies within the City of Berkeley, 75% of the area is in the City of Oakland. To the north and east the University property line aligns itself with an undulating ridge-top that roughly follows Grizzly Peak Boulevard. This line also marks the division between Alameda and Contra Costa Counties. In the south, the property line continues along Grizzly Peak Boulevard a short distance to the west before crossing Claremont Canyon in a northwesterly direction. The boundary line then turns to follow the crest of Skyline Ridge as it slopes down to the west. Here the land narrows at the foot of Strawberry Canyon, connecting the area to the central campus.

The topography of the canyon system has directly influenced land use both within and without University property. To the west, the buildings of the Lawrence Berkeley Laboratory, technically outside of the canyon system proper, retain fine views to the south and west. Within the canyon system the Lawrence Hall of Science and the Silver Laboratory both command sites on the major promontories looking west. Along the north and south boundaries of the East Hill area, hillside residences and narrow lanes mark the lines of the canyon system. The eastern boundary of this system is defined by a high and relatively level ridge line that provides spectacular views of the Berkeley campus and San Francisco across the bay. Beyond this line to the east the expanse of Tilden Regional Park, which adjoins University land at this point, extends the undisturbed character of the area's natural terrain and vegetation.

b. Physiography

Geologically the East Hill area consists of a recently uplifted front of the Berkeley Hills that slopes downward in a general east-west direction. However, the underlying rock strata of the hill front run perpendicular to this direction. Several different rock types are therefore exposed as the land falls from east to west. In geological terms the area is divided into two sections of roughly equal size by a trace line of the Wildcat Fault.

Source: Eckbo, 1976.



EXISTING VEHICULAR CIRCULATION

RIDGELINES

HILLSIDES

1976 HIGH POINT

1975 LOW POINT

CREEK

0 200 400 1000 1750 ft.

physiography

5

Part of a secondary earthquake fault system (discussed later in the report), this fault runs north and south from the main entrance of the Botanical Garden in the center of the canyon system. West of this line the rock strata consist of mostly shale and occasional interbeds of sandstone belonging to the Shaota-Chico formation. To the east of the fault line the rock is primarily chert of the Monterey formation. This latter rock type is geologically resistant to erosion and, over time, three significant knolls of this material, two of them quite prominent, have appeared. Situated in the northeast section of this area, their geomorphic characteristics have been described in a report completed in 1974.

> The southernmost (knoll), called Sugar Loaf, occurs on Skyline Ridge and rises abruptly some 200 feet to an elevation of just over 1,400 feet. North of Sugar Loaf and separated from it by the south fork of Strawberry Creek, stands the second prominent point, known as Monument Hill. This hill rises steeply behind the Botanical Garden to a height of 1,200 feet.[6]

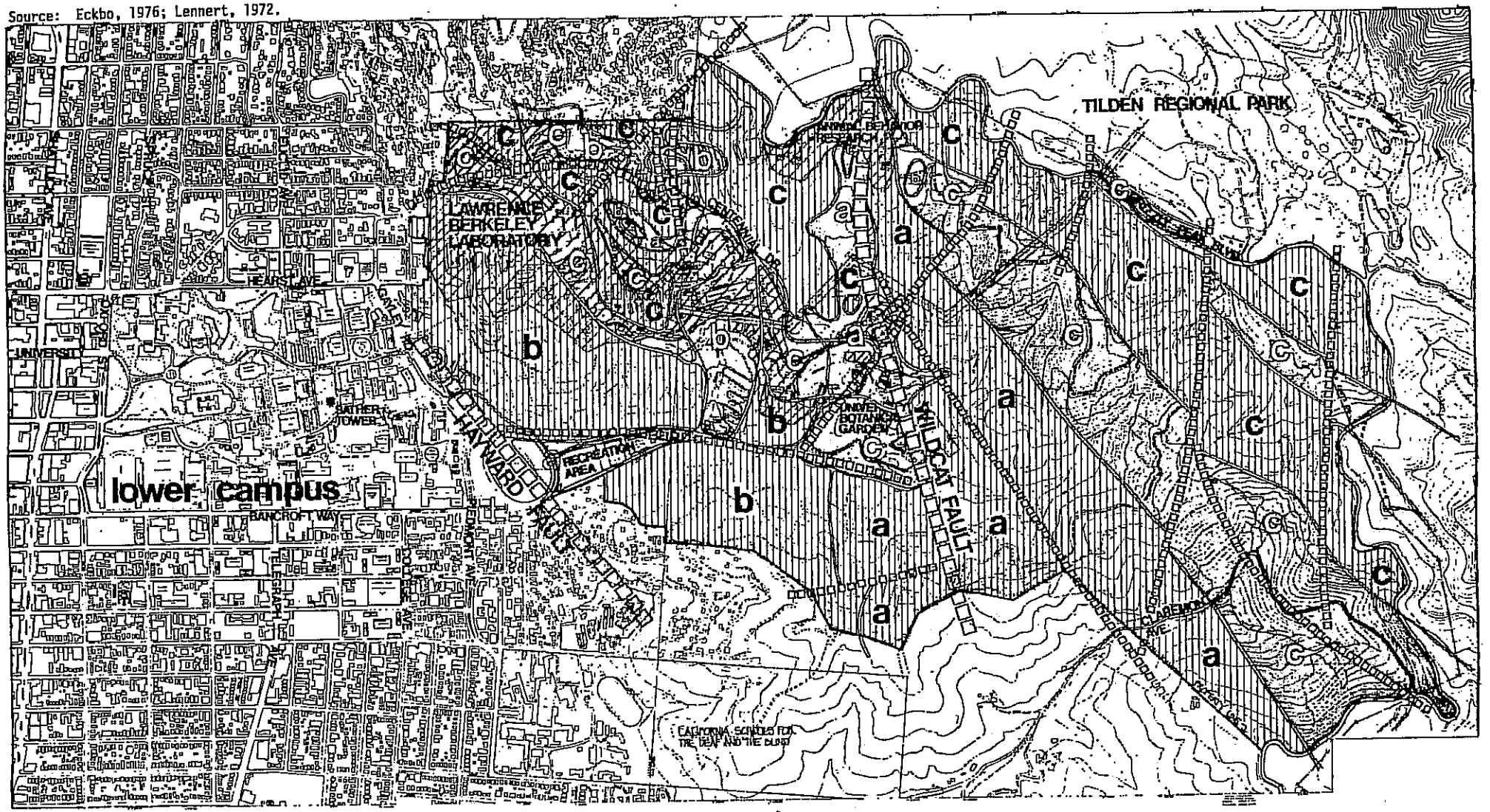
The third chert knoll is to the north of Monument Hill and, because it is only slightly lighter than its surrounding soils, it does not stand out so prominently as the others.

At the northern and eastern edges of the University's property geologic formations slope steeply upwards to form the crest of the Berkeley Hills. Here the land is composed of volcanic rocks of the Berkeley formation comprised largely of basalt, rhyolite, and tuff formations. These rocks are highly resistant to erosion and they make up the highest and steepest section of the Berkeley Hills. Contiguous with, but not part of, the University property at this point are Grizzly Peak (1,754 feet) and the adjacent Little Grizzly Peak (1,495 feet). The highest peak in the Berkeley Hills, Chaparral Hill (1,769 feet), is a little further south, standing wholly within the northwestern corner of the University's property.

c. Seismology

The East Hill area can be seismologically defined in general as a fault-controlled canyon and drainage system east of the Hayward Fault. The Hayward Fault is an active member of the San Andreas Fault System and as such is the major seismological feature

Source: Eckbo, 1976; Lennert, 1972.



UNFAVORABLE SOILS

- a — RECENT - ALLUVIUM, COLLUVIUM & LOCAL FILL
- b — RECENT TO LATE PLEISTOCENE - LANDSLIDE BODIES
- c — MID TO LATE PLEISTOCENE - ORINDA & SIESTA FORMATIONS COMMONLY UNSTABLE

FAVORABLE SOILS

- a — MIOCENE - CLAREMONT & SOBRANTE GENERALLY STABLE
- b — CRETACEOUS - KNOXVILLE & CHICO SANDSTONES & SILTSTONES GEN. STABLE
- c — LATE PLIOCENE - MORAGA, GRIZZLY & BALD PEAK TUFFACEOUS SEDIMENTS GENERALLY CLAYEY, POTENTIALLY UNSTABLE

0 200 400 1000 1750 ft.

seismology and soils

6

of the area. The line of the Hayward Fault, which aligns itself along the north-south direction of Gayley Road, marks the western boundary of the canyon system. It also defines the edge of a continental plate along which tectonic activity occurs. Seismologic shifts along this plate line have caused the uplifted formation of the Berkeley Hills over time.[7]

A study of the Hayward Fault made in 1972 found that the western side moves at a rate of about 0.1 inches per year to the northwest. According to this measurement a two mile geological dislocation has occured along the fault line since its inception about two million years ago. Defined as a right lateral fracture in the earth's crust, the Hayward Fault has created a clear geological separation in the rock strata between the lower campus area of the University and the East Hill area.

Another right lateral seismic fault which also follows a north-south direction, this one in the center of the canyon area, is the Wildcat Fault. A secondary member of the San Andreas System, this fault traverses the hill area at approximately midslope, dividing the whole of the East Hill area roughly into two halves, one section to the east, another to the west. Structural discontinuity along this fault is thought to have caused a two and a half mile dislocation in the rock strata since the fault first appeared in the Pleistocene Epoch. Structural movement in the bedrock has continued in relatively recent geologic time.

Tectonic movement in the area between the Hayward and Wildcat Faults has produced a subsidiary set of tension and compression faults that run in an east-west direction. The western section of Strawberry Creek occupies one such fault in its lower reaches. Activity along this and similar fault lines has produced a complex pattern of minor cross-faults and thrust faults that have both lateral and vertical discontinuities within adjoining rock strata. The bedrock in the western portion of the East Hill area is therefore divided into a series of separate blocks, each with the capacity for independent movement.

To the east of the Wildcat Fault, tectonic formations are less well-patterned but no less well-defined. Formational members of similar material appear on either side

of Wildcat Fault, displaced by the 2 ½ mile distance mentioned above. Therefore, the nonconforming faces of these formations do not exhibit depositional continuity. In general, the upper hill areas of Strawberry and Claremont Canyons are less prone to seismic activity than the lower western slopes since the upper fault lines are minor in nature and their patterning less interconnected. The area is also further away from those locations in which seismic activity is expected to occur.

The possibility of major seismic movement in the East Hill area cannot be discounted. A report prepared for the University by Harding-Lawson Associates in 1979 stated that an earthquake of 7.0 on the Richter Scale could occur along the length of the Hayward Fault during the life of any new construction. If the epicenter of such an event were located in the Berkeley area, ground shaking could be as high as modified Mercalli Intensity Scale IX, and considerable building damage could result. The impact of more distant earthquakes along the Hayward, San Andreas, or other active faults in the region could be less intense. However, the occurrence of minor earth movement along these faults is likely to be more frequent.

d. Soils

The Vegetative Management Plan (J. R. McBride, 1974) prepared by the Vegetative Management Committee of the University provides a good overview of the soils in the area.

> The soils along the ridge of the Berkeley-Oakland Hills have formed from sandstone and shale. They are loams and clay loams, very porous and strongly structured. Depth of soil to weathered sandstone ranges from less than 12 inches to over 5 feet, although most soils range from 12 to 24 inches deep. Shallow soils occur along the very top of rocky ridges and on some very steep slopes such as on Grizzly Peak. Very deep soil occurs in the upper portions of canyons on north and east facing slopes. The depth of plant roots-particularly trees and shrubs-is not limited to the soil depth but extends many feet into the weathered and fractured sandstone for water and nutrients.[8]

Soil erosion in general is not a serious problem in the East Hill area where the ground has remained in its undisturbed natural state. Erosion in fire-damaged areas that have remained exposed to several months of rain in the main only causes localized problems. Similarly soil stability in the lower reaches of the hill area is generally good. However, in certain areas where soil conditions are poor in the East Hill area and where construction has taken place without adequate regard to good engineering practice, landslide activity is a major problem.

The bulk of large scale slide movements in the area has taken place in the upper sections of the hill area and have involved material belonging to the Orinda formation. Most existing slopes of the Orinda formation are thought to be "critical" in terms of their capacity for movement and in many areas the Orinda soil mantel is presently experiencing slow "creep" movement. Where the soil has been degraded by tectonic shearing or intense surface weathering, its potential for rapid movement is greatly enhanced.[9]

Other landslide bodies composed of different but equally unstable materials have been identified in this canyon area. Defined as only marginally stable in some cases, these slide bodies are moving in the area of 1/4 inch to 1 inch per year. Perhaps the most dramatic slide body in the canyon area occupies the west-facing slope of Chicken Creek. Located immediately above the Botanical Garden and some 60 feet in depth, this slide has been "creeping" slowly forward for a number of years. It is a particularly problematic slide since a portion of Centennial Drive, the major access route through Strawberry Canyon, has been built across it. Recently a section of the road abutting the concrete span of an overpass has slipped below the level of the road surface, exposing a 21 inch deep concrete "step" across the road making it impassable. Major repair, which will clearly take some time, may involve a significant redesign of this section of Centennial Drive. In the meantime direct access to the upper hill area remains closed. The road has been closed several times in the past for similar, if less dramatic, reasons.

e. Hydrology

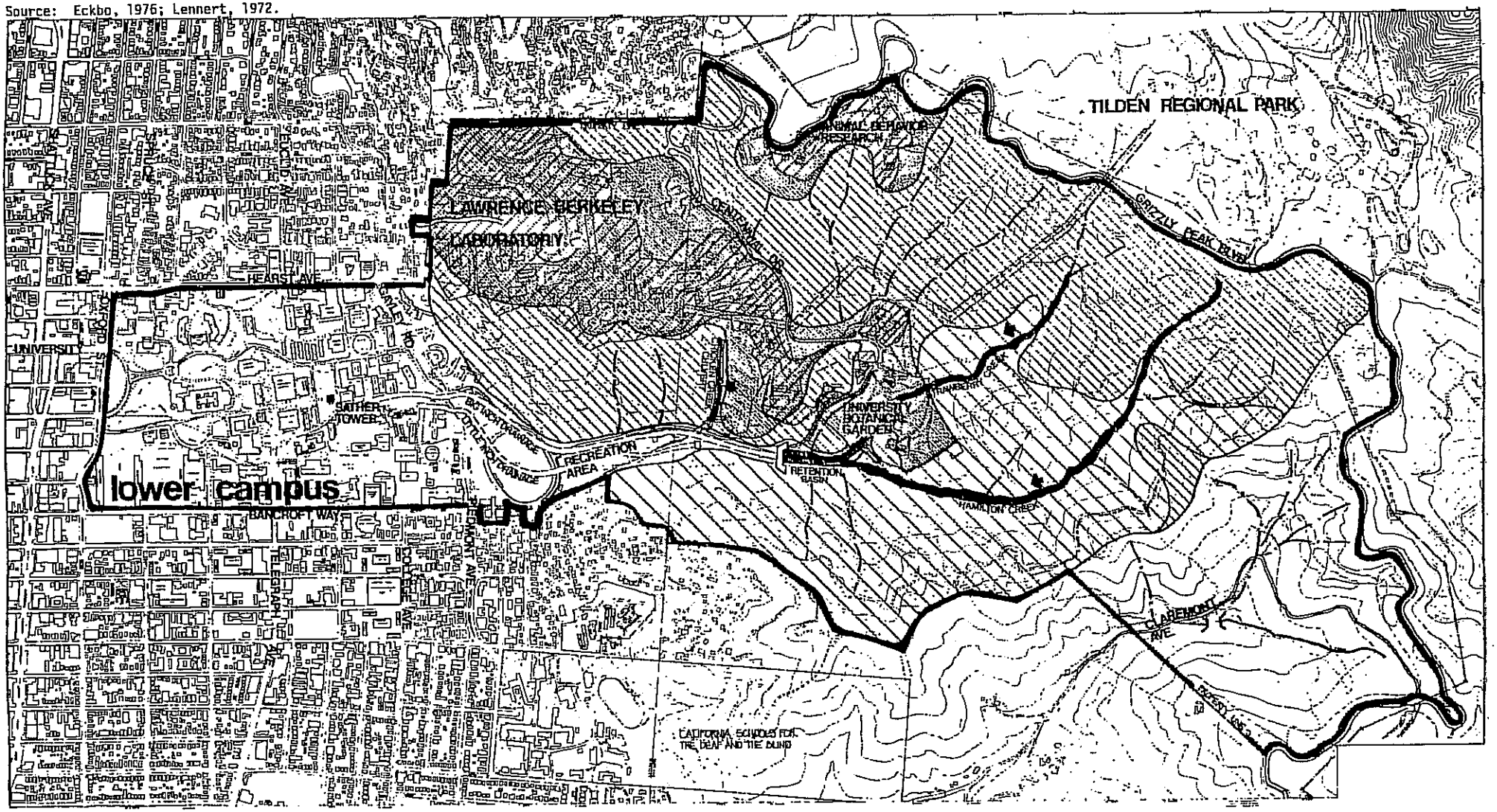
The East Hill area is served by two major streams, Strawberry Creek and Claremont Creek, each independently draining its respective canyon area. Both rise a short distance below the rim of the area's eastern watershed before running to the west down the slope of the canyon system. Claremont Canyon is a self-contained drainage basin with only one principal channel, Claremont Creek. Strawberry Canyon, by contrast, is drained by a stream of the same name and two main tributaries, Hamilton Creek and Chicken Creek.

Hamilton Creek is the longer and more extensive water course system. It originates at the eastern head of a valley formed by Sugar Loaf Hill to the south and Monument Hill to the north. In length this creek is almost as long as the upper section of Strawberry Creek located in the next valley north. By contrast, Chicken Creek is much shorter and less impressive but perhaps more important since it carries surface runoff from the developed areas of Lawrence Berkeley Laboratory into the lower drainage channel of Strawberry Creek. The headwaters of Strawberry Creek spring from the northern flank of Monument Hill immediately below Grizzly Peak Boulevard. The main line of the creek joins with Hamilton Creek at about the center of the Botanical Garden, and meets Chicken Creek further to the west. At the foot of the canyon system, Strawberry Creek empties into its South Fork and passes beyond Gayley Road before entering the central campus and running the length of the University's property to the west.

f. Vehicular Access

Centennial Drive, a sinuous two-lane collector road, is the only direct access that connects the East Hill area to the central campus. A more involved and indirect route through Lawrence Berkeley Laboratory is not open to public use for security and safety reasons. Centennial Drive follows the line of Strawberry Creek to the entrance to the Botanical Garden located in the center of the area, before turning north as it climbs to the Lawrence Hall of Science and Silver Laboratory. Above these buildings the road

Source: Eckbo, 1976; Lennert, 1972.



1 AREA 1 ▫ DEVELOPED RUN-OFF @ 100 FPM

2 AREA 2 ▫ GRASS COVER RUN-OFF @ 75 FPM

3 AREA 3 ▫ HEAVY COVER RUN-OFF @ 40 FPM

CREEK ▫ NATURAL WATERCOURSE

DEVELOPED DRAINAGE CHANNELS

DRAINAGE SWALE

0 200 400 1000 1750 ft

hydrology

joins with Grizzly Peak Boulevard. Currently closed because of road subsidence and collapse, Centennial Drive route requires major re-engineering in order to make it usable and safe.

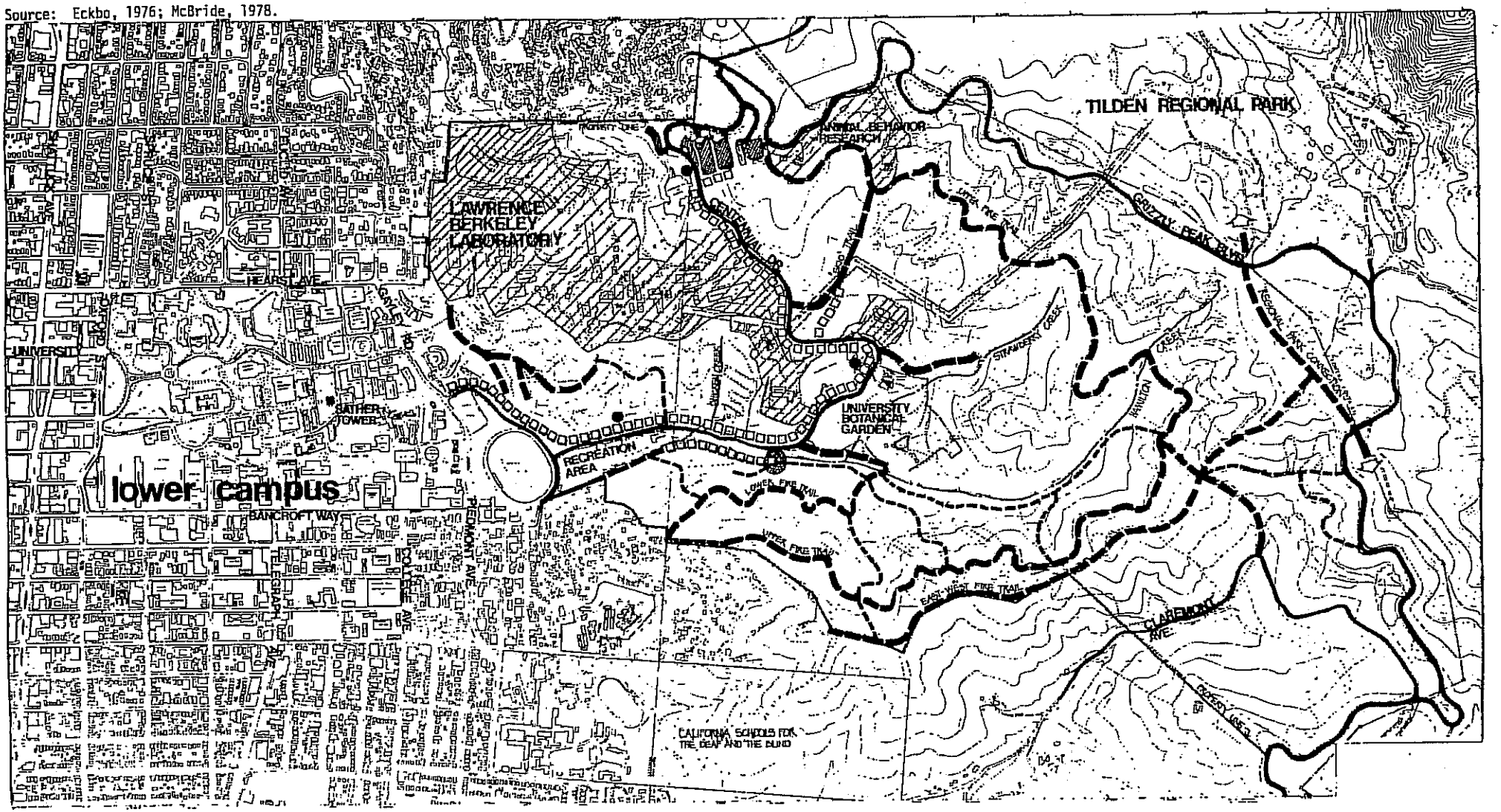
Two other roads give access to the area but do not connect it with the University campus. Grizzly Peak Boulevard on the northern and eastern boundary and Claremont Avenue, which parallels Claremont Creek in the southeast, are both well maintained arterials. Rather than connect directly with the University, they act as circulation routes diverting traffic away from University property. Both of these roads, as well as Centennial Drive, are characterized by steep grades, limited road visibility, and narrow shoulder conditions.

Centennial Drive carries about 4,000 vehicles each weekday. About 11% of this volume travel during the morning peak period (7 - 9 a.m.), while 34% travel in the afternoon peak period (4 - 6 p.m.).[10] A 24-hour trip-pattern survey conducted in 1979 determined that 16% of all vehicles using Centennial Drive terminated their journeys in the North Berkeley Hills; 13% at Lawrence Berkeley Laboratory; 10% at Lawrence Hall of Science and the Botanical Garden combined; 8% at the lower canyons; and 3% at Tilden Park. The percentage of cars associated with University destinations was 52%.[11] During a 12-hour survey period, eastbound traffic amounted to 1,964 cars while 2,042 vehicles traveled westbound.[12]

Several unpaved, minimum-standard fire trails provide internal access for emergency and police vehicles throughout Strawberry Canyon. Closed to all unauthorized vehicles and motorcycles, these 10-feet wide trails are maintained to ensure minimal environmental impact. Although open for use for class instruction or individual recreation on a year-round basis, fire trails and hiking trails are closed on certain days when fire danger is extreme.

This report recommends that an existing hiking trail on the south side of the Strawberry Canyon recreation area be extended to the east to join with an existing parking lot at the junction of the lower fire trail and Centennial Drive. Presently access to this point

Source: Eckbo, 1976; McBride, 1978.



VEHICULAR CIRCULATION

TRANSIT STOP

VEHICULAR PARKING

EXISTING FIRE TRAIL

EXISTING HIKING TRAIL

PROPOSED PEDESTRIAN PATH

circulation system

0 200 400 1000 1750 ft.

8

by way of a narrow path along Centennial Drive is both hazardous and constrained. A short trail or path linking Lawrence Hall of Science and Silver Laboratory is also recommended as is the development of new terrace parking lots on this site to accommodate the Lawrence Hall of Science's expanding need. A longer pedestrian path that follows the length of Centennial Drive is also recommended by this report. Pedestrian access to the upper hill area is hazardous at present because of the intermittent character of sidewalks and pathways. A separate bike-way along Centennial Drive, linking the area to existing bike-way systems beyond University property, is also recommended. A general expansion of the existing fire trail and hiking trail system in the undeveloped portions of Strawberry and Claremont Canyons is not recommended for ecological and fire hazard reasons.

ECOLOGICAL CONTEXT

5. ECOLOGICAL CONTEXT

a. Climate

The East Hill area enjoys a Mediterranean-coastal climate with moderate temperature year round. The mean annual temperature is 54° Fahrenheit, but temperatures in the summer can reach into the nineties and in the winter drop to just above freezing. Temperatures below freezing do occur but they are rare and usually of short duration, although a two-day freeze in December 1972 recorded temperatures at 20°F. This freeze had a serious impact on vegetation in this area, top-killing many eucalyptus trees. A subsequent fire hazard that resulted because of this freeze is discussed elsewhere in the report (see Fire Hazard section).

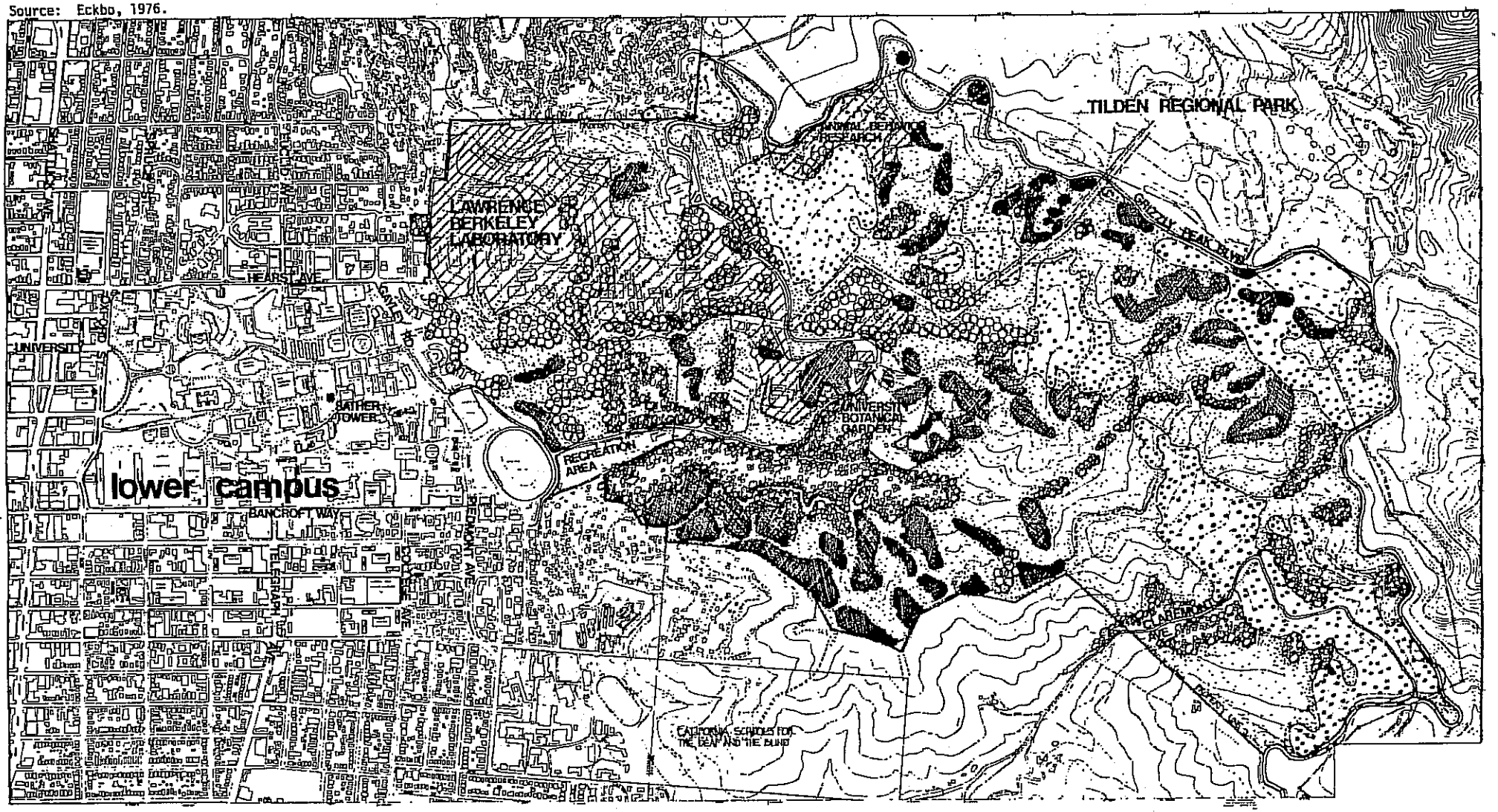
The annual rainfall in the area is 28 inches but snowfall is rare. Fog, however, is a factor in the area from May to September creating hazardous driving conditions. Winds are usually of moderate strength out of the west, except on days in the summer and late fall when hot dry winds from the northwest contribute to the fire danger in the area.

b. Vegetation

The rugged and varied topography of Strawberry and Claremont Canyons provides a richly textured pattern of vegetation in the East Hill area. According to a 1979 report on management and conservation, indigenous and imported vegetation types found in the canyon area include oak-bay woodland, northern coastal scrub, annual grassland, and various species of conifer and eucalyptus. In general, clusters of these plant types are distributed throughout the canyon system.[13]

The generally uncomplicated north facing slopes of the south side of Strawberry Canyon are covered by indigenous oak-bay woodland and associated dense undergrowth which includes poison oak; along the upper section of these slopes and extending east throughout Skyline Ridge, mature stands of spruce, pine, fir, cypress, and cedar can be found. None of these latter species, with the possible exception of some fine redwood stands also found there, are indigenous to the area. Areas of mixed vegetation extend

Source: Eckbo, 1976.



CONIFERS
OAK/BAY WOODLAND
EUCALYPTUS STAND
EUCALYPTUS SPROUTS
SOFT CHAPARRAL W/ GRASS OPENINGS
VEHICULAR ACCESS

existing vegetation

0 200 400 1000 1750 ft.

9

into and across the valley of Strawbery Creek. The Botanical Garden's Mather Redwood Grove, on the north side of Strawberry Creek, is perhaps the finest stand of redwoods in the Berkeley area.

To the east of the forested lower canyon section of Strawberry Creek, higher and more irregular slopes are covered by grass, low chaparral, and small groups of bay and oak clustered alongside drainage channels. Species of eucalyptus and mature groves of Monterey pines are also found throughout the higher sections of the eastern canyon area. Similar vegetation occurs on the slopes of both sides of Claremont Canyon. As in Strawberry Canyon, the higher open ground here has less of the dense undergrowth found in forested areas, and sections of more exposed hillsides contain only scrub brush.

In the main, vegetation in the East Hill canyon system has flourished in an environment protected both by the physical character of the area and by management policies that emphasize conservation. However, in some places the impact of human activity in the area has altered the process of natural plant succession and modified the pattern of vegetation cover. This has been especially true in the developed portions of the canyons and particularly in the Lawrence Berkeley Laboratory. Undeveloped sections of the area have fared relatively well from exposure to public access. Recreational use of the fire trail system and local mechanical grading along fire roads, for example, have had only a minor impact on the process of vegetative succession. Furthermore, areas closed off to the public and restrictions placed on activity in research and study areas have helped balance the effect of unrestricted public access in the lower and more recreational sections of the canyon.

The problem of fire in the area remains a continual concern. The possibility of fire is intimately linked to the prevalence of highly flammable material, heavy underbrush, and eucalyptus trees. The 1979 management report mentioned above recorded that in recent years 75% of all eucalyptus trees in the area had been cut to stumps. Personal observation confirms that a good deal of slash material still remains uncollected and uncleared on the ground. New growth from old stumps and new seedlings now reaches a

height of 10 to 15 feet, a condition that constitutes a fire hazard of considerable magnitude. It is clear that a comprehensive maintenance program to mitigate against the possibility of fire damage ought to be followed by the University. (See Fire Hazard section for a discussion of this topic.)

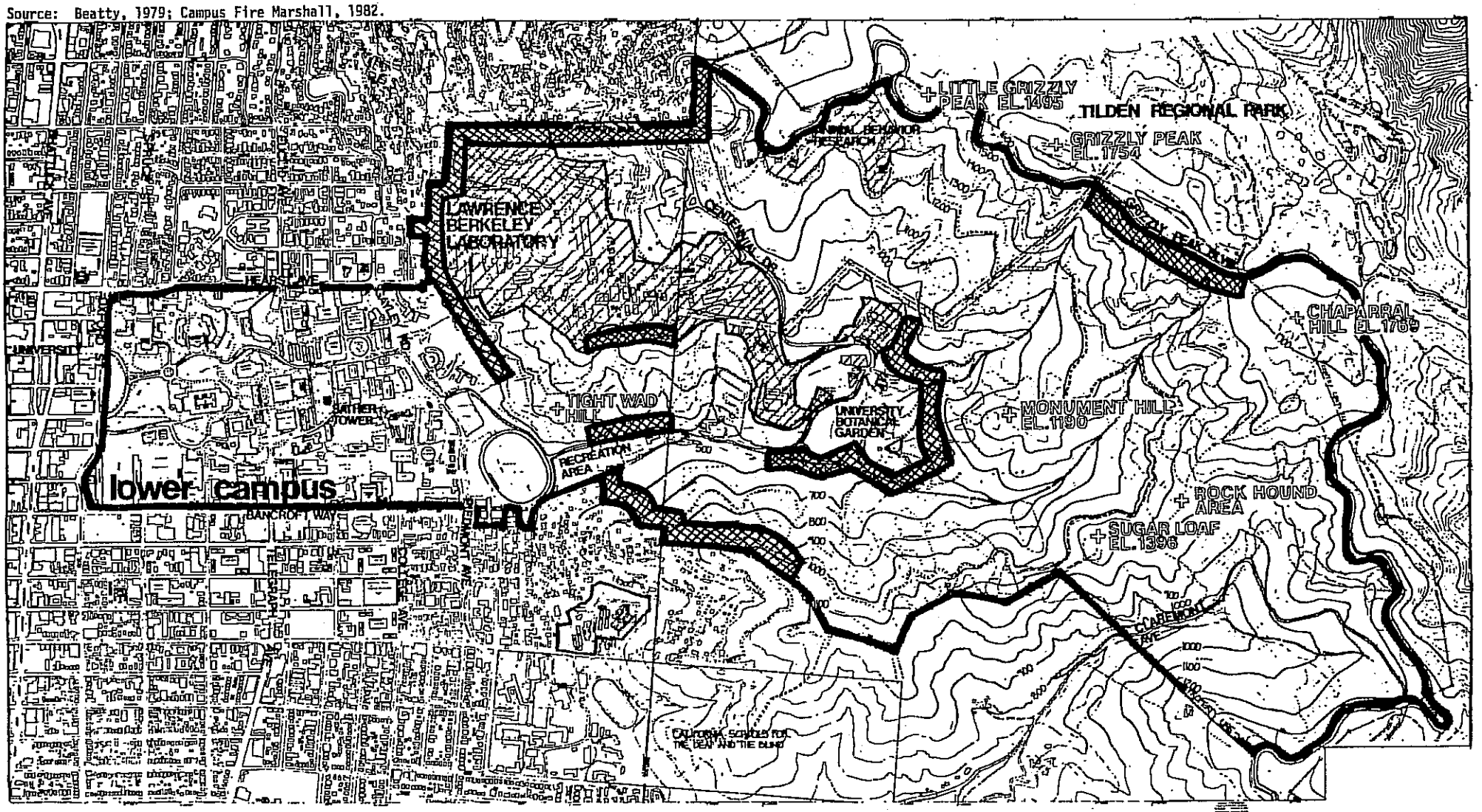
c. Fire Hazard

The potential of fire in the East Hill area is a matter of critical concern. In the undeveloped sections of Strawberry and Claremont Canyons, topography, climate, and vegetation combine to produce "ideal" fire conditions, particularly in the late summer "fire season." The intermixing of tall grass openings, surrounded by areas of eucalyptus or oak, with steep sided canyon slopes creates optimal fire conditions from midsummer to the beginning of the rainy season in late fall. During this period an average of 4 or 5 days can be considered "fire weather" days. On these days, hot dry northeast winds up to 60 mph (with gusts up to 90 mph) unite with high temperatures, clear skies and low humidity to create grave fire conditions. Given the abundance of "fuel-loaded" vegetation in the East Hill area, particularly in eucalyptus groves, and the fact that more people than ever now use the area for recreation and exercise, fire risk on these days is extreme.[14]

The capacity of fire to destroy property under fire weather conditions ought not to be underestimated. In September 1923, fire in Tilden Park rapidly spread through a eucalyptus grove north of the University's property, then burst suddenly into a residential section of Berkeley below. Within two and a half hours, 625 houses on 60 city blocks were destroyed. In 1968 a fire on the golf course at Tilden Park burned over 200 acres. Two years later a fire along Claremont Boulevard destroyed 37 houses and 204 acres of vegetation in a three-hour period. In the fall of 1981, 3 houses on the western boundary of Tilden Park burned to the ground under fire weather conditions.

While the University cannot control wind or high temperatures, it can take steps to control the prevalence of fuel-loaded vegetation in canyon areas. The presence of

Source: Beatty, 1979; Campus Fire Marshall, 1982.



FUEL MANAGEMENT ZONE (NOT TO SCALE)

proposed fuel management

0 200 400 1000 1750ft.

10

pines, chaparral, and annual grasses constitute a significant fire danger during the dry weather season. However, new growth in eucaluptus groves, along with bark and other kinds of debris, contain the greatest fire risk. Fire at ground level in a eucalyptus grove creates convection currents that carry flames high into the air or cause "firebrands" to race horizontally far ahead of the main fire line. Under fire weather conditions, firebrands could move quickly down the slope from Strawberry Canyon into the Lawrence Berkeley Laboratory, the central campus area or surrounding residential areas. Fire moving onto University property from residential areas is also a possibility the University has to contend with.

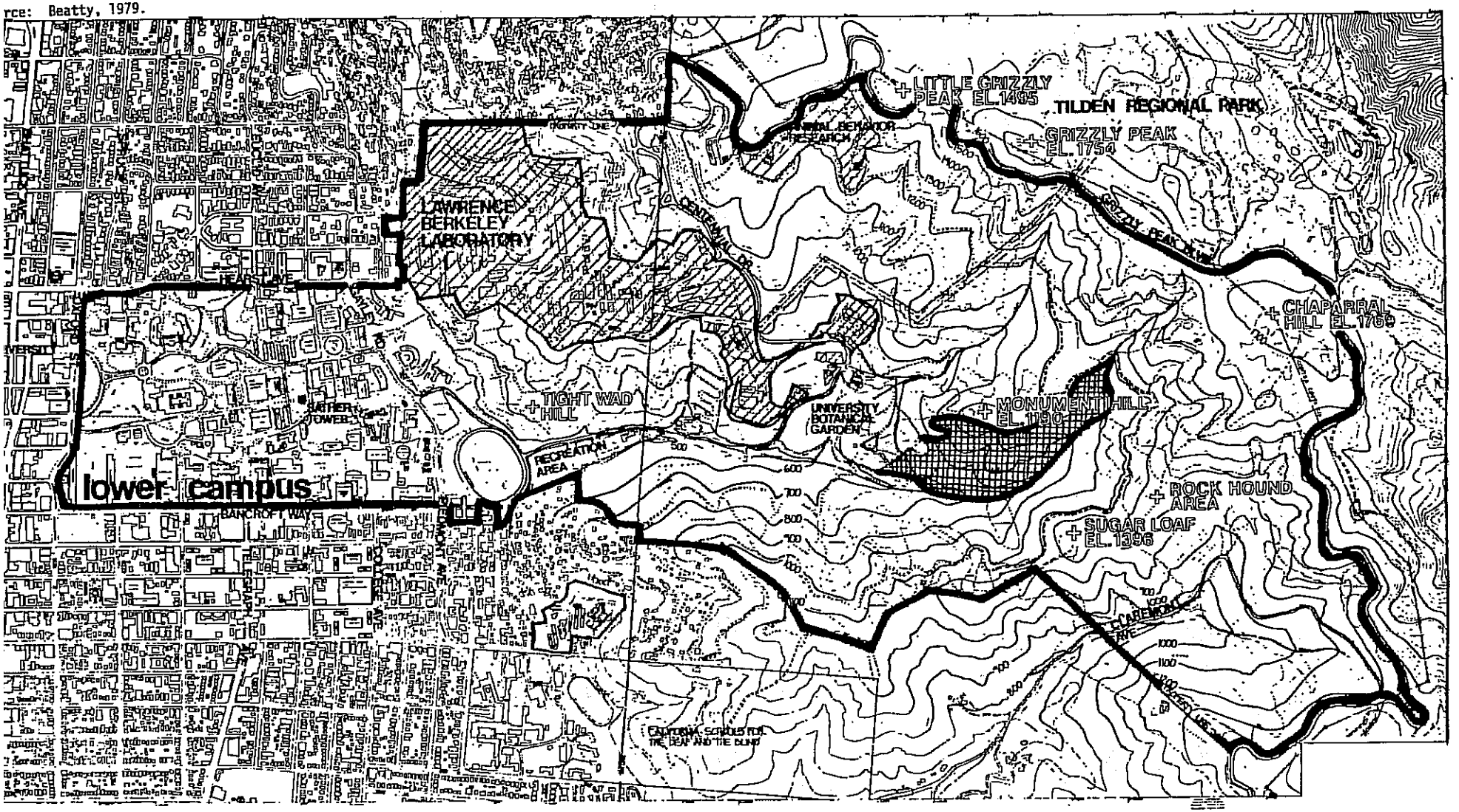
d. Wildlife

There are a large number of animals, mammals, insects, and birds within the canyon areas of the East Hill, both permanent residents and passing migrants. The Ecological Study areas contain approximately 150 species of vertebrates and a myriad of invertebrates.[15] Free living communities found in the area include over 40 species of mammals, 12 species of lizards and snakes, 6 species of salamanders and frogs, and over 100 different kinds of birds.[16]

Mammals resident to the canyon area or who use its habitat regularly include the broad-footed mole, badger, California vole, mule deer, and fox. A confirmed sighting of a bobcat was recorded in 1979. Reptiles in this area include the western fence Lizard, western skink, and common kingsnake. Isopods, millipedes, and anthropods are also to be found. Bird species observed include the red tail hawk, cliff swallow, California thrasher, and western meadowlark.

The vast majority of land in the East Hill area has been set aside for the study of the animal biomass and the processes of natural plant succession. Both areas of study are intimately linked to the ecology of this area and its food chain. Larger vertebrates depend directly on invertebrates, such as spiders or insects, for their existence, and the latter are in turn dependent on the habitat in which they exist. Thus the diversity and

rce: Beatty, 1979.



FAUNAL REFUGE AREA

faunal refuge area

0 200 400 1000 1750 ft.

11

size of vertebrate populations in the area indicate the amount and diversity of invertebrate fauna found there, and therefore the diversity and richness of the area's plant life.

Oak-bay woodland, the native climax vegetation in the area, is the richest habitat in terms of animal life. Animal biomass is probably a hundredfold greater than in soft chaparral or Conifer groves in the area.[17] Surprisingly, the non-native eucalyptus groves are much richer in invertebrate species than areas of redwood or Monterey pine. Here, as in other habitats, vegetation has been shaped and used by animals and invertebrates in their search for food, water, and protective cover. Animal densities adjust to the natural carrying capacity of the area's biomass. Any management plan that ignores or disturbs the delicate balance that exists between animal and plant life signals disaster for the wildlands in the canyon area. A proposal to designate a section of canyon land east of the Botanical Garden a special faunal refuge area should be encouraged (see Map 11).

e. Erosion and Flooding

A study of campus storm drainage conducted by Lennert and Associates in 1972 concluded that serious erosion and flooding problems exist in the upper canyon areas of Strawberry Canyon. The study divided the Strawberry Canyon area, exclusive of Claremont Canyon, into three different drainage areas.

Area 1 -- Runoff rate 100 feet per minute. Developed areas, primarily Lawrence Lab, Botanical Garden, and Animal Behavior Research. 284 acres.

Area 2 -- Runoff rate 75 fpm. Grass cover areas, including some soft chaparral. 400 acres, primarily south slope.

Area 3 -- Runoff rate 40 fpm. Heavy cover areas, primarily north slope and Monument Hill, plus two small areas on Grizzly Peak at Centennial Drive and Chaparral Hill. 300 acres.[18]

Runoff rates in the Lennert study were based on a 25-year storm pattern, and assumed the completion of the University's development plan. However, recent experience highlights

the danger and expense that optimal flood conditions bring at the present level of development. After a week of heavy rain in January 1982, water saturation induced numerous mudslides in the vicinity of the Hass recreation area and closed Centennial Drive briefly. More seriously saturated ground and deficient drainage in association with a well-established landslide area caused a "slough-off" below part of Centennial Drive above the Botanical Garden, closing the road for the near future.

Concern has been expressed by a number of writers about the impact of new development in the upper canyon area and a consequent increase in run-off from impervious surfaces. When combined with the amount of "natural" debris and brushwood found in stream channels, development in the area may further exacerbate stream erosion and flooding. A drainage retention basin, constructed in 1963 and located immediately below the confluence of Hamilton and Strawberry Creeks with a capacity of 1,500,000 cubic feet, may not be large enough to control widespread flooding given peak run-off rates and continued development.[19] However, engineering recommendations to control flow rates in Strawbery Creek above the retention basin have not been adopted because of resistance from conservationists to the alteration of a natural water course.[20]

The imposition of severe restrictions on all new buildings and paved areas within the Strawberry Canyon watershed has been suggested in several reports (Siri, Beatty, Lennert). Most of these reports agree that the object of any water course management program must be to minimize the threat of flooding to buildings and homes along the lower reaches of Strawberry and Claremont Canyons. Management prescriptions should as far as possible maintain existing water course quality and continue to contribute to maintenance of varied habitats for the existing animal biomass as suggested in the Management Plan for Strawbery and Claremont Canyons, 1979. The guiding principles of these prescriptions should be to minimize water channel erosion while maintaining the best possible environment for aquatic organisms.

MANAGEMENT & ADMINISTRATION

6. MANAGEMENT AND ADMINISTRATION

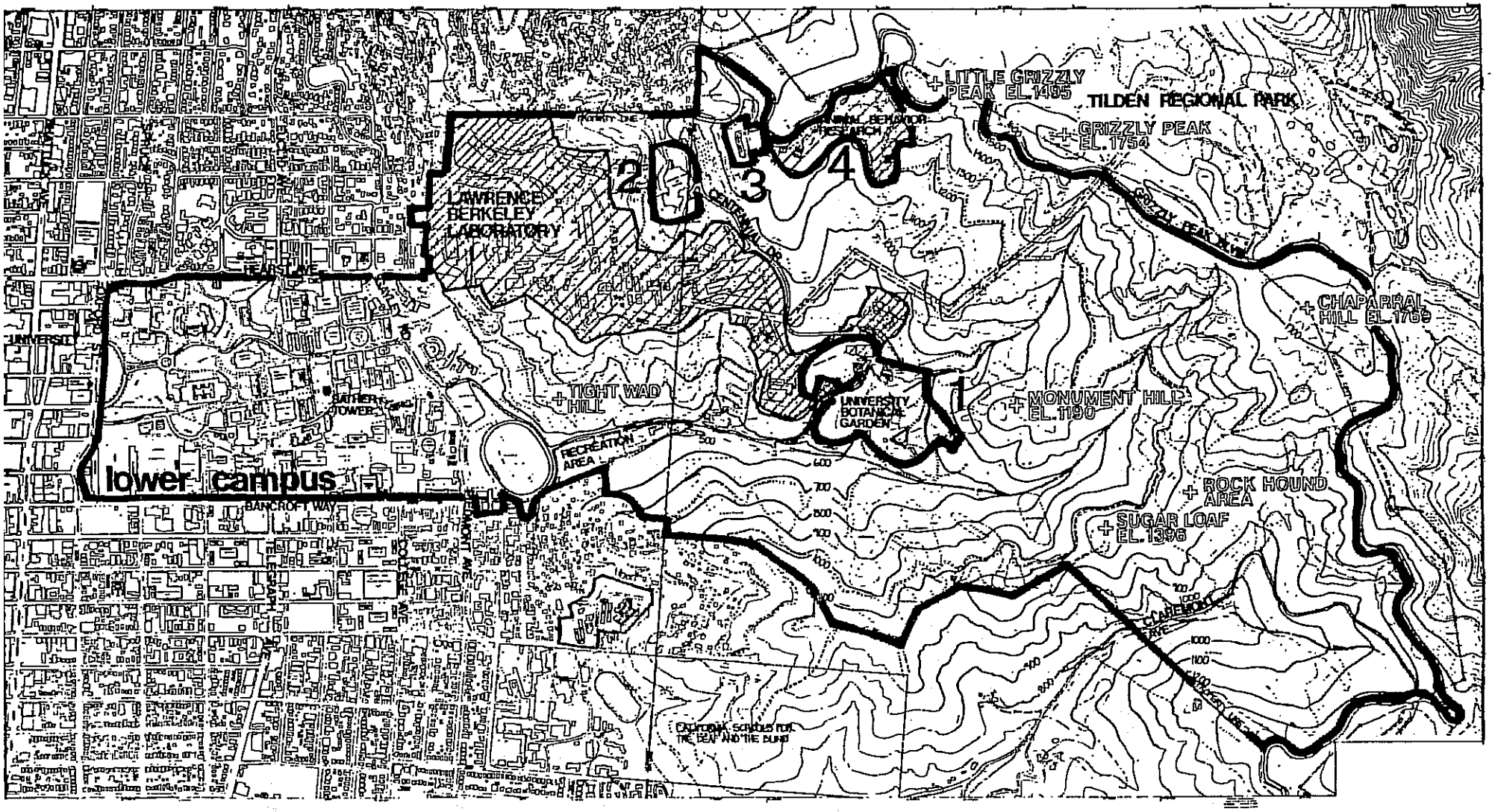
a. Administration

The overall jurisdiction of much of the East Hill area, under the general direction of the Berkeley campus Chancellor, includes three Organized Research Units (ORUs) of the University and one campus planning advisory committee, the Conservation and Environmental Quality Committee (CEQC). A further administrative unit, the Botanical Garden, is under the jurisdiction of the Botany Department. Another major University presence in the area, Lawrence Berkeley Laboratory is administratively separate from the Berkeley campus, and therefore beyond the purview of this report.

The three ORUs occupying the area are the Lawrence Hall of Science, the Space Sciences Laboratory, and the Field Station for Behavioral Research. Each unit has a Director as its chief administrative officer who is responsible for the day-to-day operations as well as long range planning and development of the unit. Although the ORUs are ultimately responsible to the Chancellor, they can attain a degree of autonomy in fiscal and programmatic terms by securing funds from non-University sources.

The Ecological Study Area, the largest consumer of land in the canyon area, does not have a director or an administrative structure. It is under the stewardship of the CEQC which has a supervisory role in the study area. Although the exact limits of this committee's role have never been sufficiently defined, all matters concerning activities in the area are usually directed toward the committee, if in a somewhat informal way.

Plans and development proposals concerning land use decisions in the East Hill area may involve five different planning advisory committees on campus. They are, besides the CEQC, the Campus Planning Study Group (CPSG), the Buildings and Campus Development Committee (BCDC), the Campus Planning Steering Group (CPSG), and the Chancellor's Physical Planning Group (CPPG). While all the committees can make recommendations, the CPPG has the final decision-making authority. The committees are helped in their work by the Department of Facilities Management (DOFM) which provides technical



1 BOTANICAL GARDEN
2 LAWRENCE HALL OF SCIENCE
3 SPACE SCIENCES LABORATORY
4 FIELD STATION FOR BEHAVIORAL RESEARCH

administrative areas

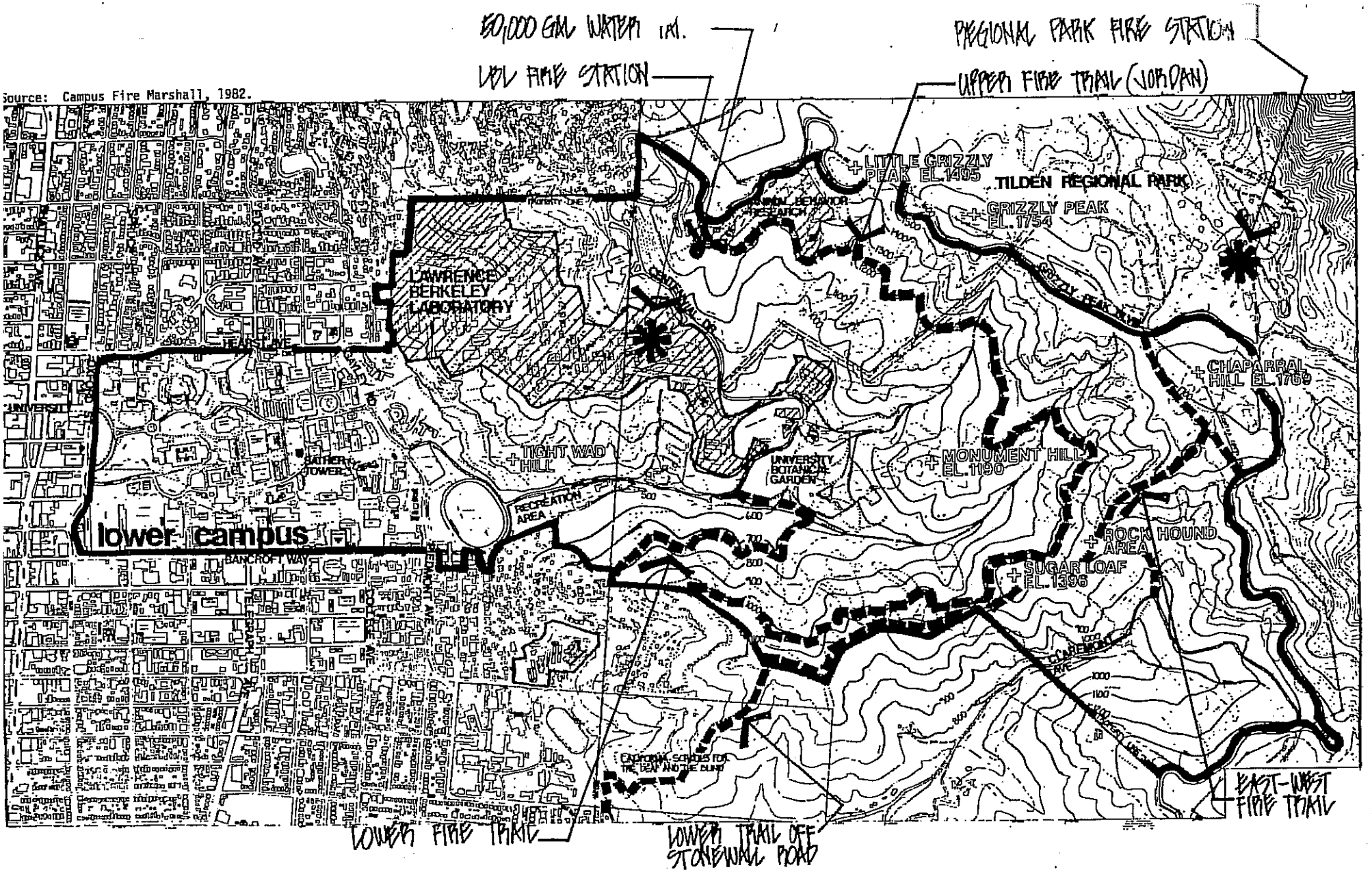
0 200 400 1000 1750 ft.

and professional input and which also has the responsibilities of managing construction projects and maintaining the University's physical plant, utilities, and services.

b. Fire Protection

Fire control procedures on campus are the responsibility of the Campus Fire Marshal within the Office of Environmental Health and Safety (EH&S).[21] While individual buildings are provided with requisite fire protection devices required by State law, the University does not have the equipment or manpower to fight a major fire in the East Hill area. The University has a charter agreement with the City of Berkeley governing the outbreak of fire on the lower campus but much of the land in Strawberry and Claremont Canyons is in the City of Oakland. Because of the configuration of land and access routes, should fire occur in the area a set of mutual aid protocols between Oakland and Berkeley will come into force with the result that the initial response to fire would come from the Berkeley Fire Department, which can respond in about half the time it would take the Oakland Fire Department. However, since fire equipment is stationed at Lawrence Berkeley Laboratory and in the Tilden Regional Park Ranger Station, it is unlikely that the Berkeley Fire Department would be first on the scene. The close proximity of these fire fighting units afford the canyon areas good protection, but if fire occurs at a time when other areas are ablaze, resources could be diverted away from the area and serious consequences result.

In order to offset the danger of massive fire in the East Hill area, fuel management programs have been advocated by the Campus Fire Marshal, Environmental Health and Safety, and a number of authors and consultants who have studied the area. These proposals have traditionally met with strenuous objections from members of the academic community and conservationists who stress that any intrusion into ecologically sensitive areas would be a disaster for the flora and fauna of the area. They also point out that any expansion of the fire trail system would not only cause further soil erosion, but would also encourage greater human activity in the area, thereby increasing the fire risk. While these arguments



* FIRE STATION

fire trail access

0 200 400 1000 1750 ft.

13

are well-founded and persuasive, the fundamental problem of grave fire risk in the area remains. Provided that existing fire trails are maintained and accessible to fire fighting equipment, the expansion of the fire trail system appears unwarranted at this time. The contentious issue of fuel management requires urgent, detailed study.

c. Police and Emergency Services

The University Police have the primary responsibility of providing security and emergency services in the East Hill area.[22] Currently the police schedule a two-officer "Hill Patrol" in the area, offering 10-hours-a-day, 7-days-a-week protection. Equipped with a 4-wheel drive vehicle and two motorcycles, the patrol is meant to traverse the entire area at least once a day. Unfortunately, because the Police Department is 13 officers short of its full complement and because the lower campus area is considered to have first priority, the "Hill Patrol" is not currently functioning. In its absence, one police officer drives the paved roads of the campus area each day and, when the situation warrants, extra forces are brought in. But to all intents and purposes, and for the foreseeable future, the bulk of the area is essentially unpatroled.

University emergency medical response procedures for the Strawberry Canyon area require that all requests for assistance be directed to the Berkeley Fire Department's rescue unit.[23] The University Police are expected to aid in an emergency with special equipment and knowledge of the area, as is Lawrence Berkeley Laboratory's emergency unit. The East Bay Regional Park Police are also able to respond to a request for assistance with manpower and a helicopter unit if required. Emergency practice drills are periodically carried out in the area and coordination in these activities is based on the philosophy of mutual help.

EXISTING LAND USE

7. EXISTING LAND USE

a. Ecological Study Area

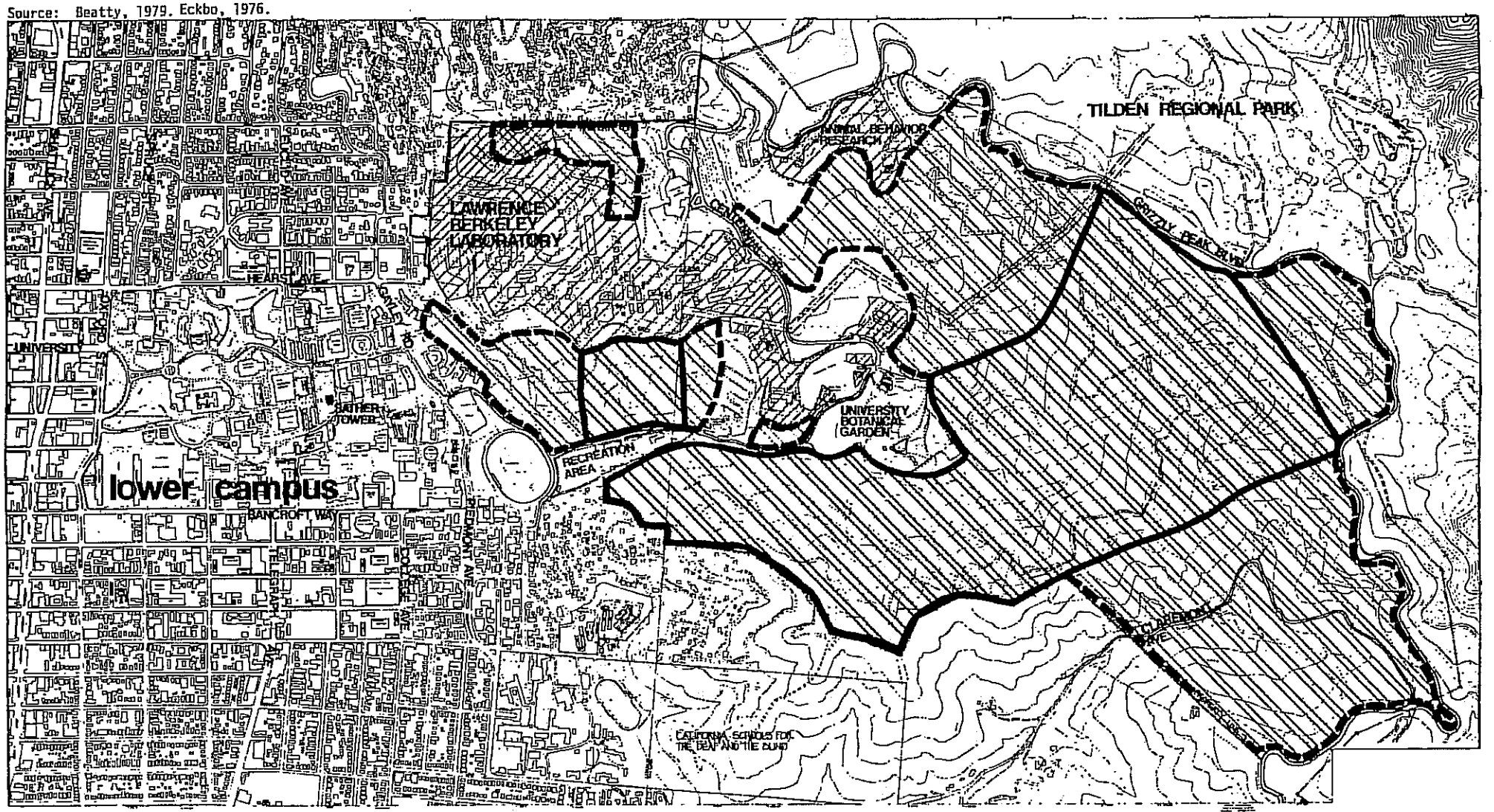
The use of Strawberry and Claremont Canyons for teaching and research related to the outdoor environment has been a long standing policy of the University. That these canyons should remain primarily in an undisturbed and natural state has also been University policy since the establishment of the first ecologically "primitive area" in the mid 1930s. To further these policies, in 1967 the Campus Planning Commitee recommended the creation of two ecological study areas in Strawberry Canyon. After an 18-month experimental period, both of these study areas were given official administrative status in 1969.[24] They are under the administration of the Conservation and Environmental Quality Committee.

The smaller of the two ecological study areas, 250 acres, is situated on the north side of lower Strawberry Creek. It has occupied the same site since its inception and it appears likely that it will remain within its current boundaries for the forseeable future. The larger study area now occupies 325 acres stretching from the western end of Strawberry Creek valley to the upper eastern section of the canyon area (see Map 14). This latter area has been subject to expansion since it was first established, and there has been some controversy over the practices of its fuel management program.

In 1979 the Management Plan for Strawberry and Claremont Canyons proposed the expansion of the larger study area to include the northwest watershed of Strawberry Creek.[25] This proposal would increase the ecological study area by about 100 acres. The same report also proposed a number of other areas for inclusion in an expanded ecological study area system. As a result, ecological study areas would occupy approximately 500 acres of Strawberry Canyon, totaling some 60% of the East Hill area. To date, however, the expansion of the ecological study area has not occurred.

The creation of the Ecological Study Areas was intended to ensure that these areas remain environmentally unimpaired. It was also intended that they provide a wilderness reserve for plants and animals within walking distance of the central campus. To this

Source: Beatty, 1979. Eckbo, 1976.



EXISTING BOUNDARY

PROPOSED EXTENSION (ECKBO, 1976)

ecological study areas

0 200 400 1000 1750 ft.

14

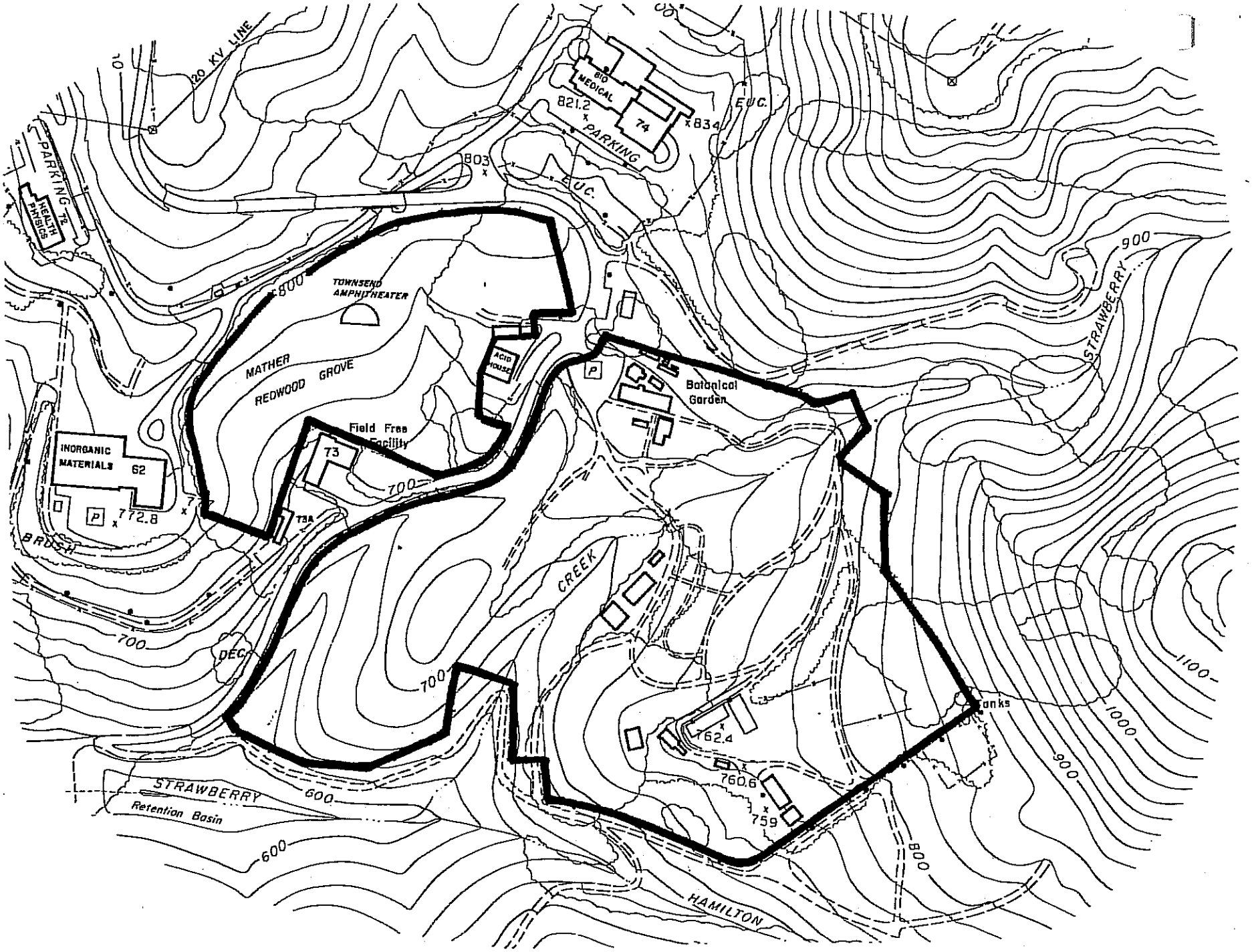
end, instruction or research that causes the destruction and loss of vegetation, soil, or animal life is strictly prohibited within the study areas unless special approval is granted by the Ecological Study Area Committee. Recreational use of the study area other than biking or jogging on marked trails is also not allowed, nor is the erection of any structure. In this vein special refuge areas within ecological study areas for large mammals have been proposed (see Map 10).[26]

A more controversial issue concerning the study areas has been fire prevention. Prohibitions have been placed on the removal of vegetation, underbrush, and other fire fuel - except within a 100-foot-wide fire-management strip along parts of the boundary. Controlled burning, used to prevent the uncontrolled spread of wildfire, is also not allowed within the ecological study areas except under the direct supervision of the Campus Fire Marshall. The whole matter of fire prevention and fuel management in the canyon areas is now under administrative review.

In the Claremont Canyon section of the hill area, the Department of Forestry and Resource Management has expressed an interest in establishing an experimental forest, which would preclude the incorporation of this area into the ecological study area system.[27] This proposal has not yet come to fruition and the Claremont Canyon area, although not part of the ecological study area, remains an integral part of the natural and undisturbed resources of the canyon area.[28]

b. Botanical Garden

The University's Botanical Garden, located at the confluence of Strawberry Creek and Hamilton Creek in the center of the East Hill area, is the oldest campus-associated botanical garden in the country. It is also, in terms of plant species, the largest. Established on the central campus in 1891 to provide "a place to grow, study and appreciate living plants" the Garden moved to its present location in 1926. Since that date the Garden has expanded to contain over 8,000 plant species ranging from the exotic to the familiar.



botanical garden

0 50 100 200 300ft

15

This range of plant life has been made possible by the unique combination of mild climate and rugged topography found in Strawberry Canyon.[29]

Situated between 660 to 860 feet above sea level, over half the Botanical Garden area is composed of slopes greater than 25%. Average temperatures in the area range between 55°F to 80°F during the day, dropping to 45°F at night. The annual rainfall is about 26 inches a year. These factors, together with a complex drainage system and an intermixing of different soils, result in an ecology that contains discrete sets of growing conditions and microclimates in which diverse collections of plants coexist. In close proximity, mountain plants from the Himalayas or New Guinea are found a short distance from desert plants from Sonora or tropical species from South America.

The plant collections on the site, which are arranged by geographic affinity rather than taxonomic consanguinity, cover 14.5 acres of the Garden's 23 acre area. The Mather Redwood Grove is the largest single collection occupying the bulk of a 7 acre site west of Centennial Drive which also contains a 250-seat amphitheater (see Map 15). The remainder of the area, which lies to the east of Centennial Drive, is taken up by 3.5 acres of undeveloped land and about 5 acres of buildings and structures. Buildings on the site comprise an Information Center at the entrance to the Garden, a number of small single story administrative buildings, and various greenhouses, plant buildings, maintenance units and lath houses spread throughout the site. A parking lot at the entrance to the Garden which has space for 30 cars, has been described in one report as aesthetically poor and functionally inadequate.[30] Most of the buildings on the site received a similar evaluation. The plumbing and irrigation system serving the Garden was also reported in need of major repair and the same report noted a serious soil erosion problem along pathways between the plant collections.

Programmatically, the object of the Garden is to provide opportunities for research, education, and enjoyment to students, faculty and the nearby community. The Botanical Garden's goals emphasize the broadest possible programming to meet the needs of the University and the public at large. Currently the Garden provides 100,000 plant samples a year to the central campus and over a dozen classes use the site annually, studying

botany, biology, forestry, and landscape architecture. Students and faculty from other colleges also visit the Garden on a regular basis. In total, approximately 20,000 visitors enter the site each year, either in organized groups or individually. Activities at the Garden, including faculty research, are coordinated and supervised by a relatively small staff of 27 people which includes 17 part-time positions. The work of the staff is complemented by volunteers organized through the Friends of the Botanical Garden, without whose help, it is reported, many programs could not function.

A preliminary draft of the Long Range Development Plan for the Botanical Garden identifies the problems regarding staffing and physical infrastructure and suggests ways in which the programmatic intent of the Garden can best be carried out. The need for new classrooms, laboratories, office buildings, and support facilities is addressed in this document which also stresses the importance of providing adequate parking for both visitors and staff. The report recommends the provision of a secondary access road to the site along its southern boundary and the removal of two small structures with incompatible use, the Acid House (a Berkeley campus structure) and the Atmospheric Aerosols Research Laboratory (LBL Building 73), both located in the Mather Grove area. Apart from a small expansion of the eastern boundary of the Garden area into an existing ecological study area, the report confines development proposals to the internal reorganization of the Botanical Garden. These latter proposals are not likely to have a negative impact on other users of the East Hill area.

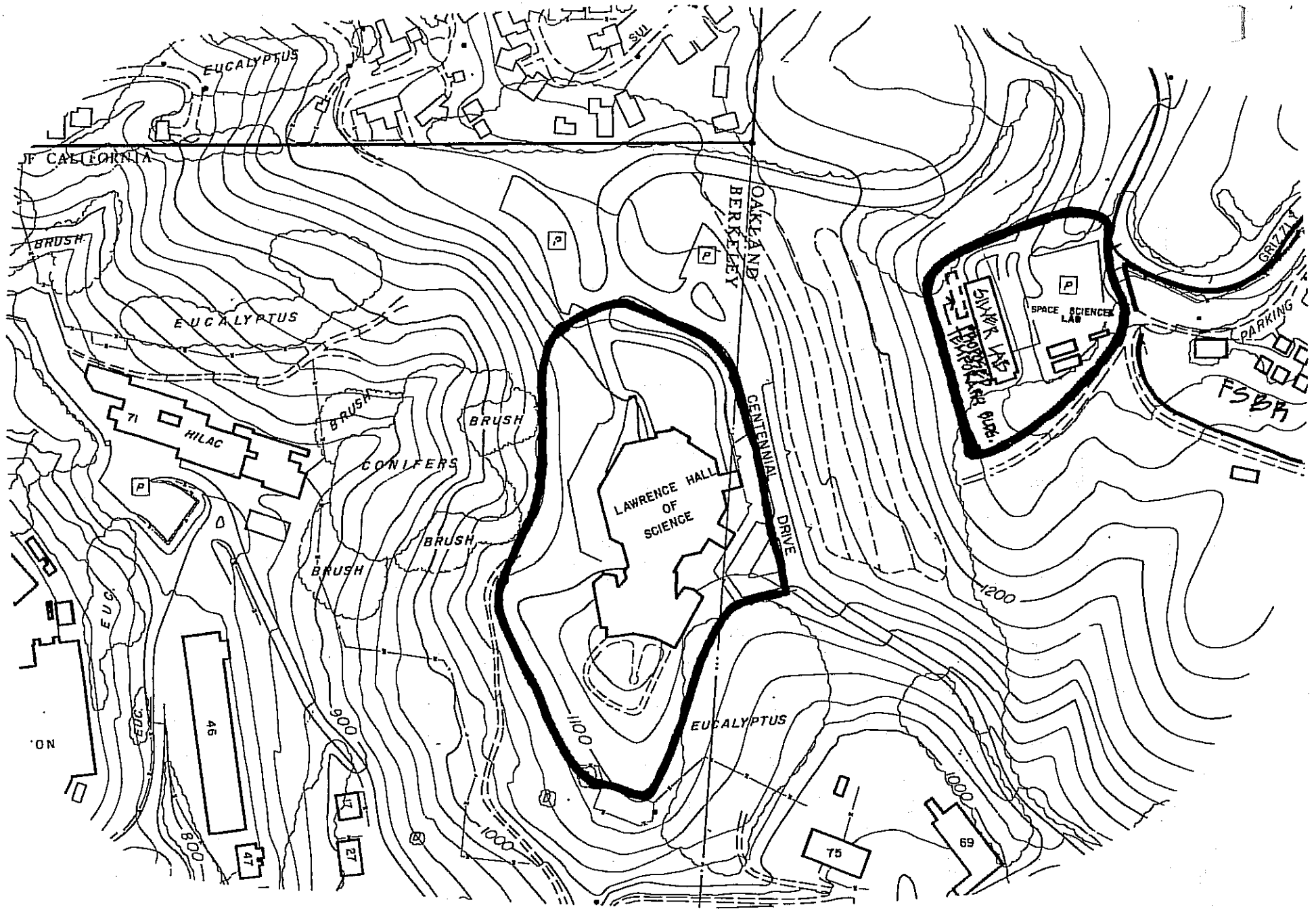
c. Lawrence Hall of Science

The Lawrence Hall of Science (LHS) is located on a four acre site at an elevation of 1,150 feet in the northern section of Strawberry Canyon. Commanding sweeping views of the Bay Area, the building was completed in 1968 as a memorial to Ernest O. Lawrence. Though formally an Organized Research Unit, the major thrusts of its programs are teaching and public service. Charged to inform and instruct the UC community and the public

at large about the sciences, LHS functions as a resource center for Bay Area schools and residents and for educational institutions throughout the country. As a science education facility engaged in research and development, LHS provides a wide variety of public education classes and science offerings to both children and adults. It also provides a distinguished teacher education program, and a 29,000 square foot exhibition space complete with exhibits and displays that involve active public participation and "self-discovery."[31]

The Lawrence Hall of Science is a large, four-level, multi-faceted, concrete structure designed by Aushen and Allen as an integrated part of its surrounding landscape. The building has 75,000 square feet of assignable area and nearly 135,000 gross square feet that represents only 40% of the original master plan for the site. It is not anticipated that the original plan will be completed. Future development on the site envisions the enclosure of the south lawn area, some development at the plaza level, and expanded parking areas. At present three parking areas serve the building. A staff parking area to the west holds 30 cars while parking for visitors, divided into two locations north of the building, contains space for a total of 60 cars. Approximately 10% of these spaces are reserved for the disabled.

Presently the LHS houses a staff of 250 researchers, administrators, and designers engaged in developing courses and exhibits covering a wide range of scientific activity. The number of public school children visiting LHS on an organized basis has increased sixfold in recent years and now stands at 45,000 a year. Attendance in after-school, night and summer classes has risen from 988 in 1973 to 2,700 in 1978 and the number of classes offered has grown from 122 to 300 during the same period. Visits by the general public increased tenfold from 1968 to 1978 and a five-year forecast made in 1981 projects a 12-15% increase yearly. In 1981, 240,000 people visited the LHS exhibits. An average of 200 site visits were made on a week day and up to 1,000 visitors came each weekend day. These numbers are by no means academic. As a self-supporting institution, higher attendance means higher revenue. In this regard, an early reopening of Centennial Drive, the major public access route to LHS from the Bay Area, is of paramount importance to the operation of the facility.



lawrence hall of science and space sciences laboratory

0 50 100 200 300ft

16

d. Space Sciences Laboratory

The Space Sciences Laboratory (SSL) occupies about two and a half acres in the northern East Hill area close to the junction of Grizzly Peak Boulevard and Centennial Drive adjacent to the western edge of the Field Station for Behavioral Research. The SSL, an Organized Research Unit of the Berkeley campus, is a multidisciplinary laboratory engaged in basic research in the physical, engineering, biological, environmental, and social sciences. Research done at SSL is motivated by the exploration of space and the application of technology developed in space research.

A short, steep access road from Centenial Drive leads south to the parking lot of the SSL facility which can accomodate 76 cars, and includes 5 spaces for the disabled. Directly west of the parking lot is the largest building of the SSL facility, Silver Laboratory. Named after the founder of the SSL, Dr. Samuel Silver, this building is a three-story structure some 208 feet long by 40 feet wide, containing 28,787 assignable square feet.[32] Completed in 1966, Silver Laboratory faces west on one of the most significant promontories in the East Hill area. Southeast of Silver Laboratory, six "temporary" trailer units provide 4,942 square feet of assignable office space. These trailers, which are vulnerable to seismic activity, were added to the facility in 1967. Plans for removing or relocating all or some of them are now being actively considered. These plans have been made necessary by the proposed construction of the Mathematical Sciences Research Institute on a site immediately south of the SSL. Access to this site will likely be through part of SSL's existing parking lot.

A new long-term "temporary" addition to the Silver Laboratory in the form of a single-story office building of 2,422 assignable square feet is proposed for a site immediately west of the laboratory. The construction of this addition, which is expected to begin in the fall of 1982, will relieve some of the pressure for extra space now felt in Silver Laboratory. The problem of space, or the lack of it, is likely to worsen with the proposed reorganization of existing trailer space.

Currently some 400 researchers and staff make up the population of the SSL with about the same number of scholars and students visiting the Laboratory each month. Most employees and visitors arrive at the facility by car, and about 100 cars a day use the parking lot. It is believed that joggers and other users of the hill area also park in the lot, particularly on weekends. A special shuttle bus with direct service to the central campus twice an hour bring 45-50 people to the laboratory daily. The bus route runs through Lawrence Berkeley Laboratory, for which special permission has been granted (see note in Vehicular Access section).

Other than the proposed addition to the Silver Laboratory described above, there are no firm plans to build other permanent structures on the site in the near future. However, the draft Long Range Development Plan for the SSL identifies a need for a 5,000 to 10,000 gross square foot building to be constructed by 1986. This building is expected to be sited northwest of Silver Laboratory, although a specific location has yet to be determined. The construction of this building would permit removal of all the nearby trailers as well as the new temporary addition of 2,500 assignable square feet.

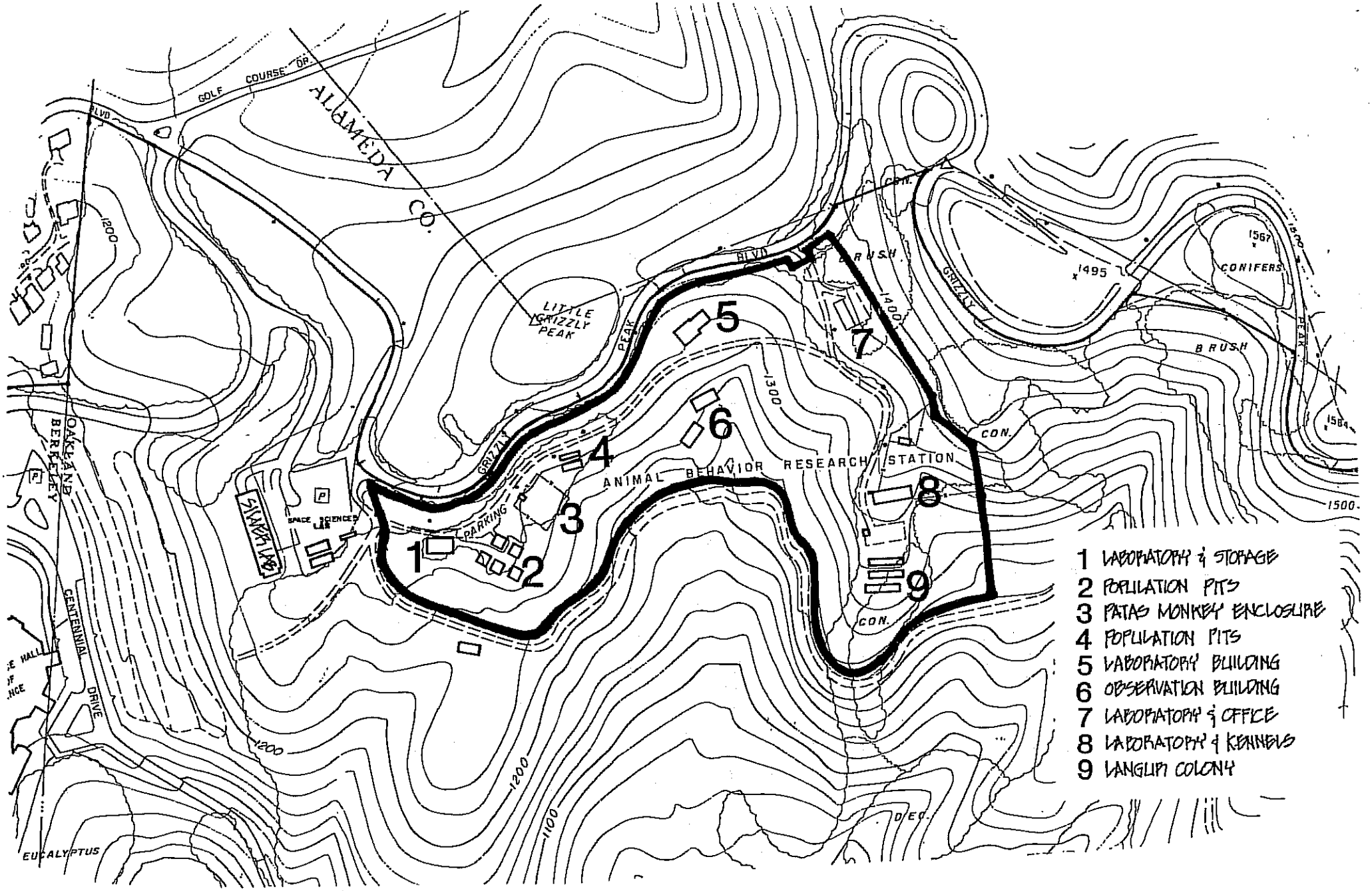
e. Field Station for Behavioral Research

The Field Station for Behavioral Research (FSBR) is located in the northern part of the upper hill area. Situated at the edge of the University's property, the FSBR occupies an area of 18 acres bounded on the north by Grizzly Peak Boulevard. The FSBR has occupied this site since it was established in 1961. The FSBR is an Organized Research Unit that conducts research on animal behavior which cannot be done in an enclosed laboratory setting. Over the past twenty years, it has been used by various University departments, among them, Zoology, Anthropology, Microbiology and Immunology, and Physiology-Anatomy, for research requiring semi-natural conditions.

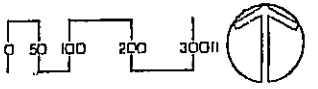
In a report submitted to the University in 1981, the director of the FSBR, Dr. R. L. Caldwell, provided the following description of the facility:

> The FSBR consists of nine distinct units, each serving a different general function, but designed with sufficient flexibility so that they can meet the needs of a variety of investigators. Unit #1 is a general enclosed laboratory and storage building. Unit #2 consists of five large enclosed concrete population pits that can be filled with dirt to provide a natural habitat for small animals such as snakes or rodents, can be filled with water to form ponds, or can be emptied to hold larger animals or serve as observation arenas. Unit #3 is a large enclosed grassy meadow with an associated building currently being used to house the Patas monkey troop. Unit #4 consists of 20 small enclosed concrete population pits. Unit #5 is a large laboratory building with a series of indoor/outdoor flight cages used mainly for birds and bats. Unit #6 includes two identical buildings each containing 12 observation rooms with one wall open to the outside. Unit #7 is a laboratory and classroom structure that also houses the Director's office. Unit #8 consists of a battery of indoor/outdoor kennels, a laboratory, an observation tower, and three fenced compounds. Unit #9 centers around three large primate runways and a laboratory building and is now being used to house the Langur colony. Placement of the units was made so that most are visual(ly) isolated from one another and from public view. Local vegetation has been allowed to grow throughout the facility except along roadways and within the animal compounds where plantings may be made to suit specific needs. The resulting animal behavior station was one of the largest, most versatile, and most convenient anywhere in the world.[33]

The value of the FSBR's location lies in the fact that it is at once isolated and relatively undeveloped, yet convenient to the lower campus area. The site is also considered ideal for the needs of the FSBR because:



field station for behavioral research



a. the site is large enough to contain a large number of different animals, some indigenous to the area and some imported;

b. the climate of the site is mild enough so that these animals can be kept in open, natural, or semi-natural conditions throughout the year. The moderate climate also means that operating energy costs are kept low;

c. the site is contiguous with a large tract of undisturbed woodland and grass slopes now designated as an Ecologial Study Area that act as a "buffer zone;"

d. the proximity of the site to the campus means that permanent caretaker staff and housing are not required (though a regular caretaker is really needed to maintain the site). In a similar way specialized on-site laboratories and support facilities also are not needed; and

e. the topography and vegetation of the site provide visual and acoustical isolation between different units and areas of observation within the station.

All these factors are considered vital to the functioning of the FSBR by its users, particularly as they relate to cost effectiveness.[34] However, the construction of a new Mathematical Sciences Research Institute on a site adjacent to the western boundary of the Station is likely to compromise the need of the FSBR to remain secluded and undisturbed. This issue is discussed later in the report (see Proposed FSBR Development Plan).

POTENTIAL LAND USE

8. POTENTIAL LAND USE

Introduction

The University's Long Range Development Plan (LRDP), 1962, declares that the bulk of the East Hill area should be used for a variety of teaching and research activities.[35] Current programmatic activity in the area is consistent with this objective. However, the expansion of facilities involving substantial construction in the area is constrained by topography, access, and University policy designating the area primarily as an ecological preserve. Within these constraints, areas offering themselves as potential development sites are few and far between.

Four areas of potential development are identified in this report on the basis of their geologic stability, their proximity to existing access routes, and the relatively minor impact their development will have on the general environmental conditions in the area (see Map 18). Parts of all these areas have already been identified as potential development sites in previous reports.[36] This report redefines the limits of development for each area before evaluating its environmental context, land use characteristics, and functional relationship with existing facilities. Site evaluation criteria include the following categories, where applicable:

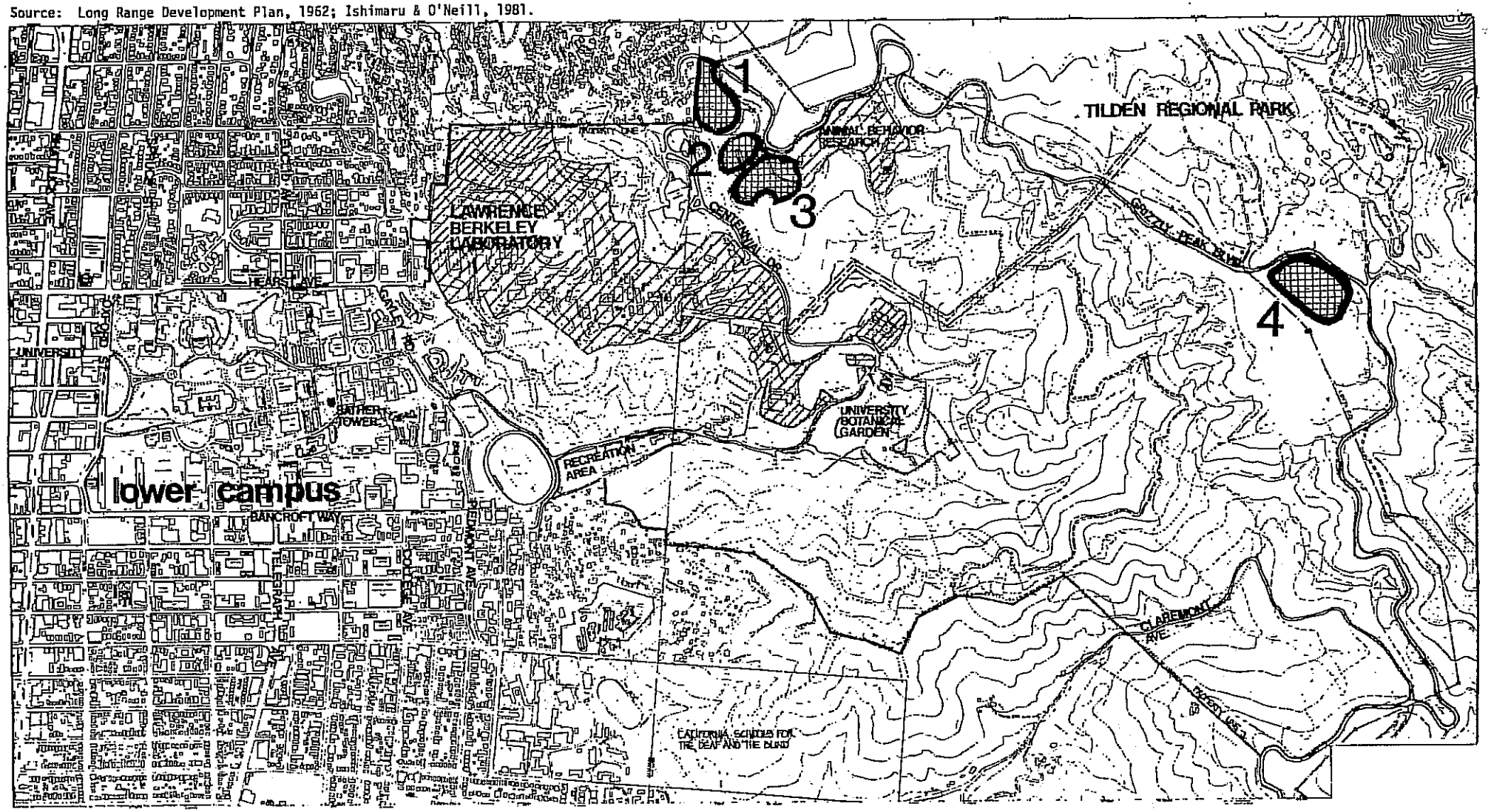
Environmental Context

Topography
Geology
Hydrology
Ecology

Land Use

Vehicular access
Pedestrian access
Access to utilities
Solar access
View orientation
Visual isolation
Acoustical isolation
Aesthetic impacts
Fire protection and fuel management

Source: Long Range Development Plan, 1962; Ishimaru & O'Neill, 1981.



POTENTIAL BUILDING SITES 1 THROUGH 4.

potential building sites

0 200 400 1000 1750ft.

Functional Relationships

Compatibility with existing plans
Use of shared facilities
Reallocation of existing facilities
Disposition of new facilities

This section of the report will also provide a proposed development plan for the Field Station for Behavioral Research which takes into account the eventual spatial reorganization of this unit made necessary by the proposed construction of a mathematical sciences research complex on its western boundary.

Site Analysis: Site 1

Located at the junction of Centenial Drive and Grizzly Peak Boulevard in the northern section of the canyon area, this site lies about 500 feet northwest of the Space Sciences Laboratory and 1,000 feet northeast of the Lawrence Hall of Science.

Environmental Context

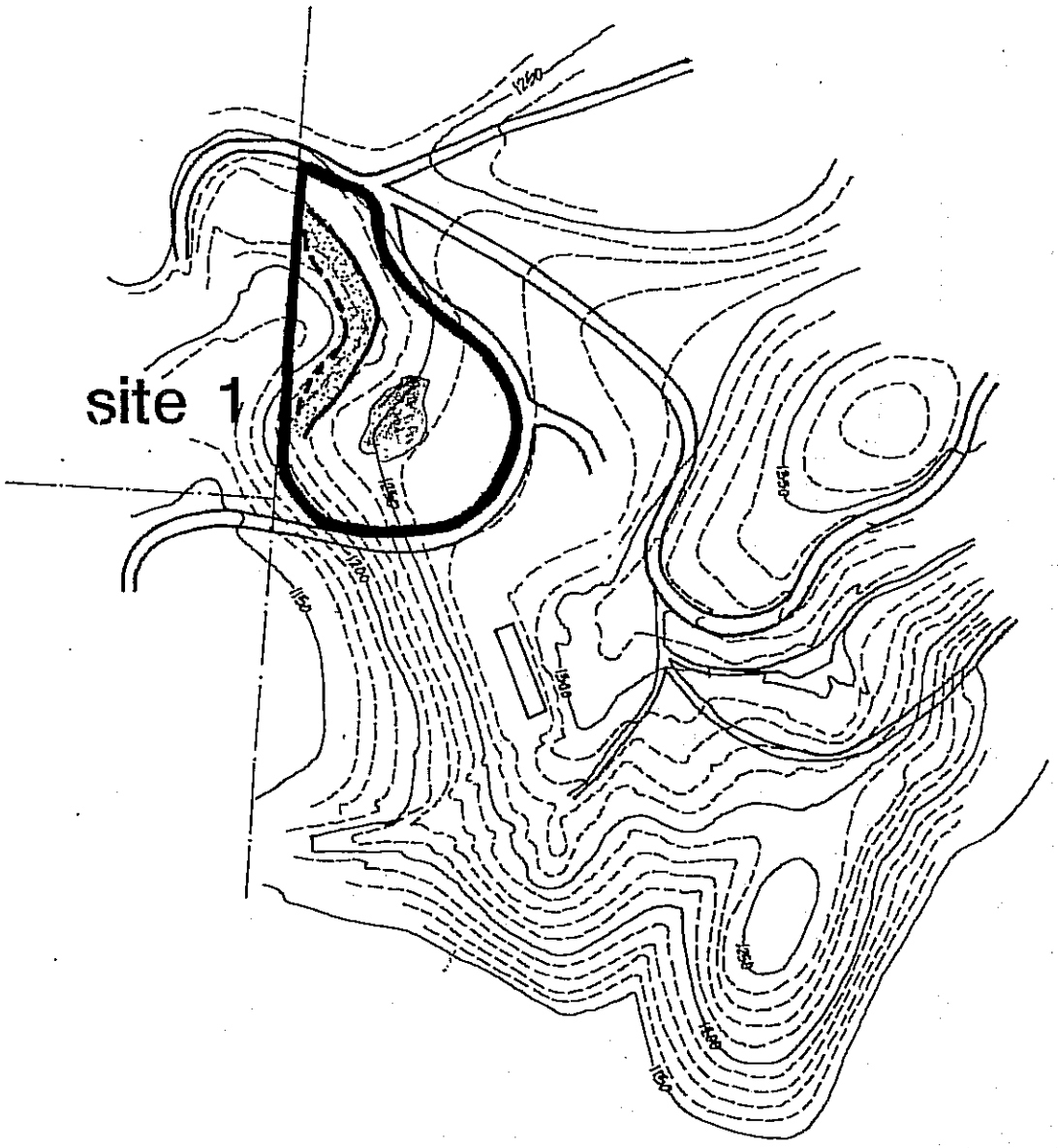
The site occupies about four and a half acres of generally open land that slopes from an elevation of 1,265 feet in the east to an elevation of 1,200 feet in the west. Beyond the western boundary of the site, which coincides with the University property line, are residential homes. In general, because of its slope, drainage on the site is excellent and in geological terms the area is stable. Lennert and Associates report:

> "...rocks are stable and present no problems for site development...the rock provides excellent foundation conditions and will make excellent fill material...One minor fault is known to transect the site; this fault poses no hazard to site development..."[37]

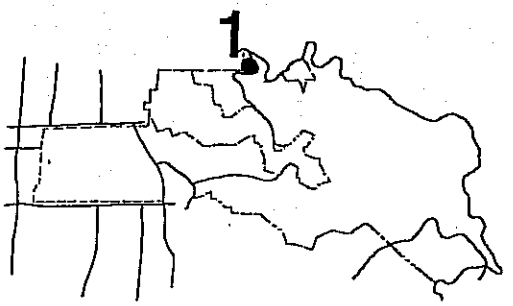
Vegetation in the area consists of open grass areas and low bushes with a number of young eucalyptus trees grouped about a small rock knoll in the center of the site. Except for the remains of several large eucalyptus stumps, there is no major growth vegetation in the area.

Land Use

The site is bounded to the south and east by Centennial Drive and contiguous grades along the roadway allow good vehicular access at a number of points. However, the steep



EXISTING ROAD
BUILDING SITE
LIMITS OF FILL
LIMITS OF CUT
DISTURBED VEGETATION



key map

site analysis: site 1

0 50 100 400ft

sweeping curve of the road along the site boundary is somewhat hazardous as well as a design constraint. Suggestions for improving the alignment of this road are contained in a later section of the report (see Proposed Circulation Plan). Pedestrian access to the site is at present nonexistent but, if well planned, future access should present few problems. Rather than detract from potential development, the irregular character of the site may aid new buildings in blending into existing land configurations, mitigating any visual or environmental impact. Mass transit connections to the site are good. An AC Transit bus delivers passengers about 400 feet from the top of Centennial Drive along Grizzly Peak Boulevard. Access to utilities serving Lawrence Hall of Science and the Space Sciences Laboratory is available in Centennial Drive.

In terms of solar access, the site has unrestricted exposure to the east, south, and west. Similarly, views out from the site are excellent. If development is closely related to existing contours and maintained at a low scale, the visual and aesthetic impact of new building forms can be minimal. Acoustically, however, the site has potential problems owing to the level of traffic on Centennial Drive and the steepness of its grade. Noise impacts can be mitigated by the judicious disposition of building on the site, the planting of screen vegetation, and acoustical insulation. Fire danger on the site is perhaps no greater than elsewhere in Strawberry Canyon, but the site's exposed location to easterly winds necessitate care in site design, landscaping, and the provision of fire prevention equipment.

Functional Relationship

The development of this site is in agreement with recommendations of the Long Range Development Plan (1962), and consistent with proposals outlined by Eckbo (1976), McBride (1978), and Ishimaru and O'Neil (1981). Previously considered as a site for the Naval Biosciences Laboratory in the 1960s, the area has been suggested for residential development.[38] Although such a proposal is attractive from a land use view, faculty or student housing on the site would not be compatible with the current University policy

of maintaining Strawberry Canyon for activities directly related to instruction and research. Additional "permanent" population in the area may have an undue negative impact on the ecological and biotic character of the canyon area as an environmental refuge. This may be particularly so if families with children are introduced into the area. In such a case, it would seem likely that greater unsupervised use of the fire roads and hiking trails could result in damage to existing natural habitats. Greater use of the trails could also result in greater fire risk and could seriously negate the secluded environment required by the Field Station for Behavioral Research. The impact of greater traffic volumes on Centennial Drive may also run counter to University policy concerning the use of this road as a thoroughfare. Present traffic capacity on Centennial Drive may not tolerate an increase.

b. Site Analysis: Site 2

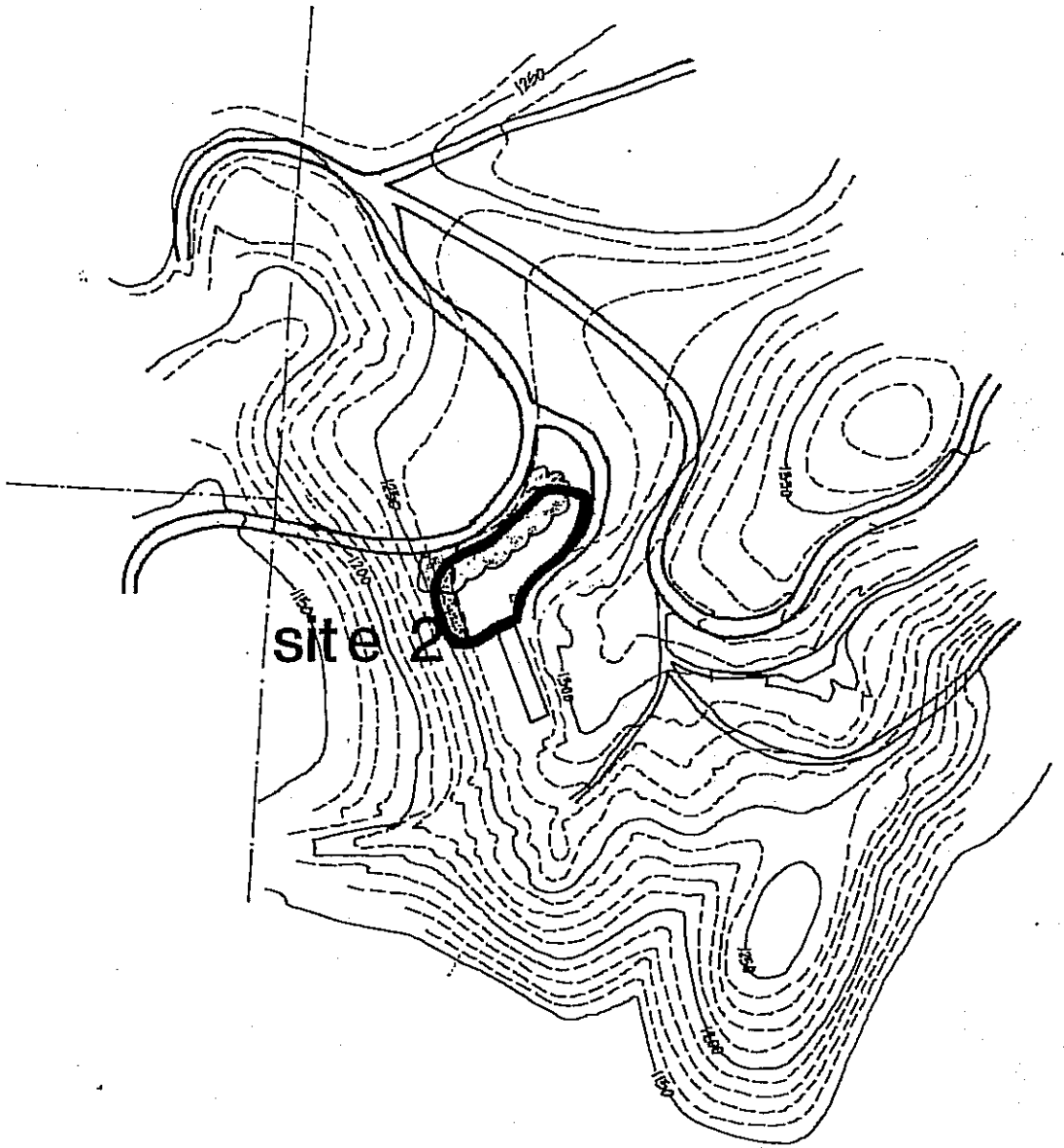
This site is located immediately north and west of the Space Sciences Laboratory (SSL), and has been identified as a possible development site for the future expansion of SSL.

Environmental Context

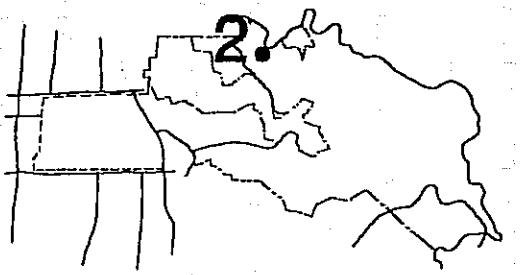
Bounded by the access road from Centennial Drive to SSL in the east, the sweep of Centennial Drive in the north, an escarpment in the west, and Silver Laboratory to the south, Site 2 covers about 2 acres of open grass and oak-bay woodland. The area is generally flat with a slight slope to the northwest, is well-drained, and sits at an elevation of 1,275 feet. Soil conditions are stable, although steep slopes at the boundary of the site leading down to road surfaces are subject to erosion and potentially unstable.

Land Use

Vehicular access to the site from Centennial Drive is good, but redesign of the access road and adjacent parking lot will be required if development occurs on Sites 2 and 3. Public mass transit connections are distant and vanpool or carpool services, particularly to the lower campus, can be expected to increase to absorb new demand when development occurs. Direct pedestrian access to the site is good from Silver Laboratory, but more



EXISTING ROAD
BUILDING SITE
LIMITS OF FILL
LIMITS OF CUT
DISTURBED VEGETATION



key map

site analysis: site 2

0 50 100 400ft

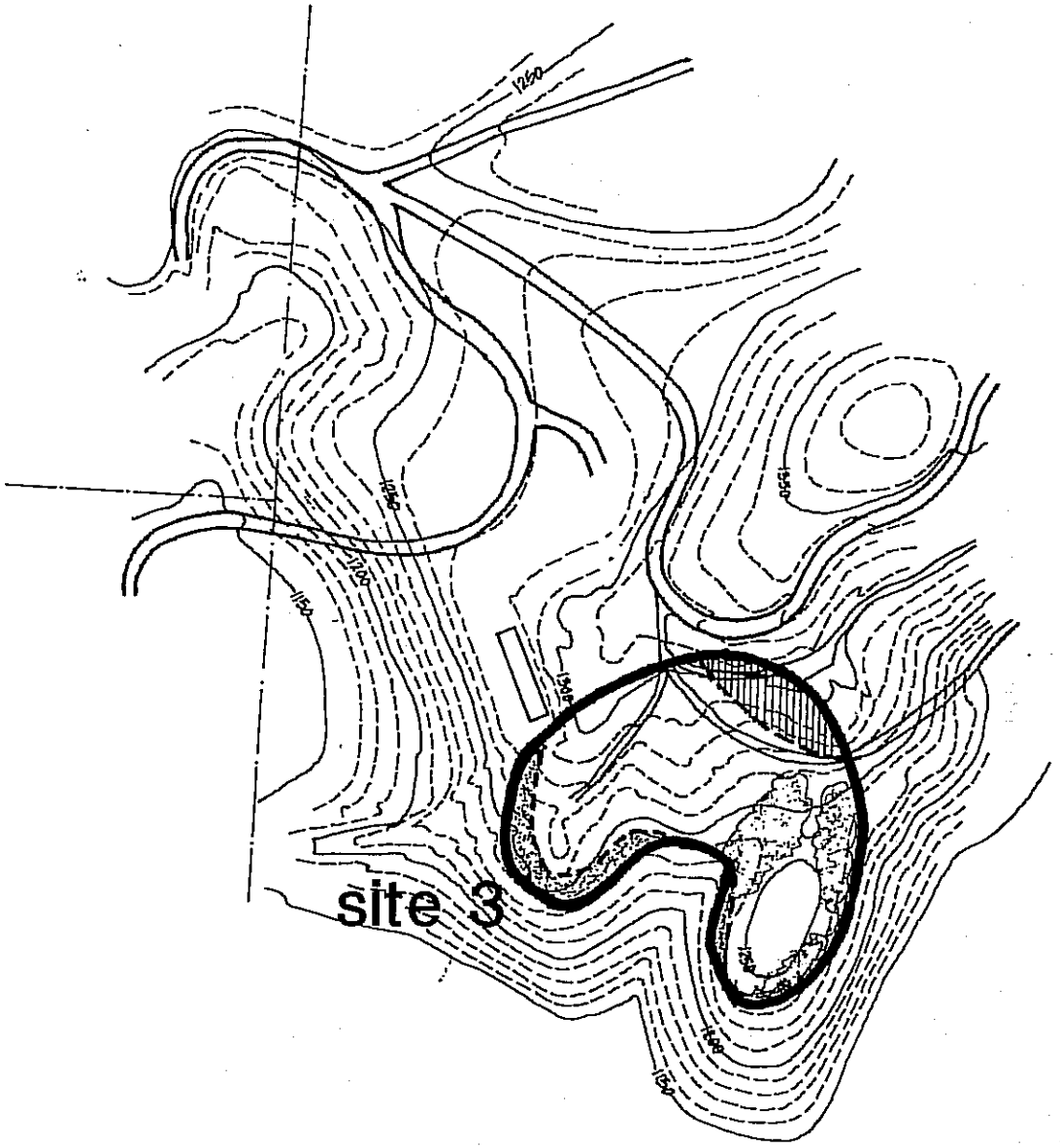
constricted from either the existing parking lot or "temporary" trailers within the Space Sciences complex. Access to utilities is not expected to pose problems for future development given the closeness of Silver Laboratory. Available capacity should be clarified. Solar access is constrained to the east by tall vegetation and to the south by the bulk of Silver Laboratory. Visual orientation to the west can provide splendid views of the Bay Area, but the siting of any building to ensure solar and visual access must not inflict unnecessary damage to existing vegetation. Skillful site design and planning should allow new development to merge with its background. For aesthetic and geological reasons, development should be kept some distance from the escarpment line. No building should be taller than the crown of existing trees or appear in silhouette against the skyline. Traffic noise on Centennial Drive, which can impair the acoustical quality of the site, can be offset by careful plant screening. For these reasons, development should be placed closer to Silver Laboratory than Centennial Drive. Fire management techniques and fuel control programs will be required to protect any future development on the site. However, the contiguous nature of the area's surrounding vegetation should be maintained by careful design.

Functional Relationship

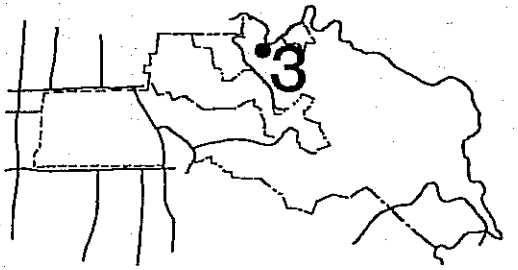
Development on the site is clearly compatible with the long range development proposals of SSL and it is unlikely that any use other than that proposed by SSL will be envisaged for the area. Development would help in the reallocation of space lost when "temporary" trailers and a planned "temporary" building are removed from the SSL facility. The location of the latter "temporary" building, a single-story construction to be erected in 1983, should not be a design constraint on long term development plans.

c. Site Analysis: Site 3

Located to the south and east of the Space Sciences Laboratory, Site 3 covers approximately 6.5 acres of mostly gently sloping land. Parts of the site have been identified by the University for the development of a Mathematical Sciences Research Institute (MSRI).[39]



EXISTING ROAD
BUILDING SITE
LIMITS OF FILL
LIMITS OF CUT
DISTURBED VEGETATION



key map

site analysis: site 3

0 50 100 400ft

Environmental Context

Topographically this site slopes downward from an elevation of 1,280 feet in the northeast to 1,240 feet in the southwest, shaped in plan like an inverted horseshoe. Steep slopes mark the site boundary along three sides, but in the north the land merges with the more level contours of the Space Sciences Laboratory site. Slopes fall dramatically away from the site below the 1,200 foot level. A steep-sided gully, which carries the main drainage away from the area, thrusts into the side along its western edge and east of this point a small plateau makes up the southeastern portion of the site. In the northeast, the bank of a high escarpment runs sharply up to the level of Grizzly Peak Boulevard.

In the main, soil and geological conditions in the area are favorable to development, although landslide bodies exist on the steep west-facing slopes beyond the site boundary. A well-developed tension fault also exists in the area. Running east-west through the center of the site, this fault is not considerd a "credible life hazard" in the opinion of Lennert and Associates, soils engineers. Given normal site development, the engineers report that the fault should not deter development.[40] The expression "normal site development" is not, however, defined in the soil engineers' study, and therefore any development needs to be examined for possible seismic impact.

Land Use

Vehicular access to the site is presently gained by way of an unimproved fire trail leading from Grizzly Peak Boulevard that skirts the eastern edge of the Space Sciences Laboratory parking lot. The general location of this road and its grade are well-suited to serving development on the site and the road could be upgraded to access road standards. However, a hazardous "blind curve" condition exists along Grizzly Peak Boulevard at the point of egress of the fire trail and extensive redesign of this area will be required if this function is to provide access to the site. Design proposals outlining a solution to this problem are contained in a separate section of this paper. Access to the site for pedestrians and cyclists could be provided along this improved fire trail and direct access

to the fire and hiking trail system beyond the site would also be maintained. Mass transit access to the site could be improved if service were extended to where the fire trail joins Grizzly Peak Boulevard, or alternatively, brought into University property (see Proposed Circulation Plan).

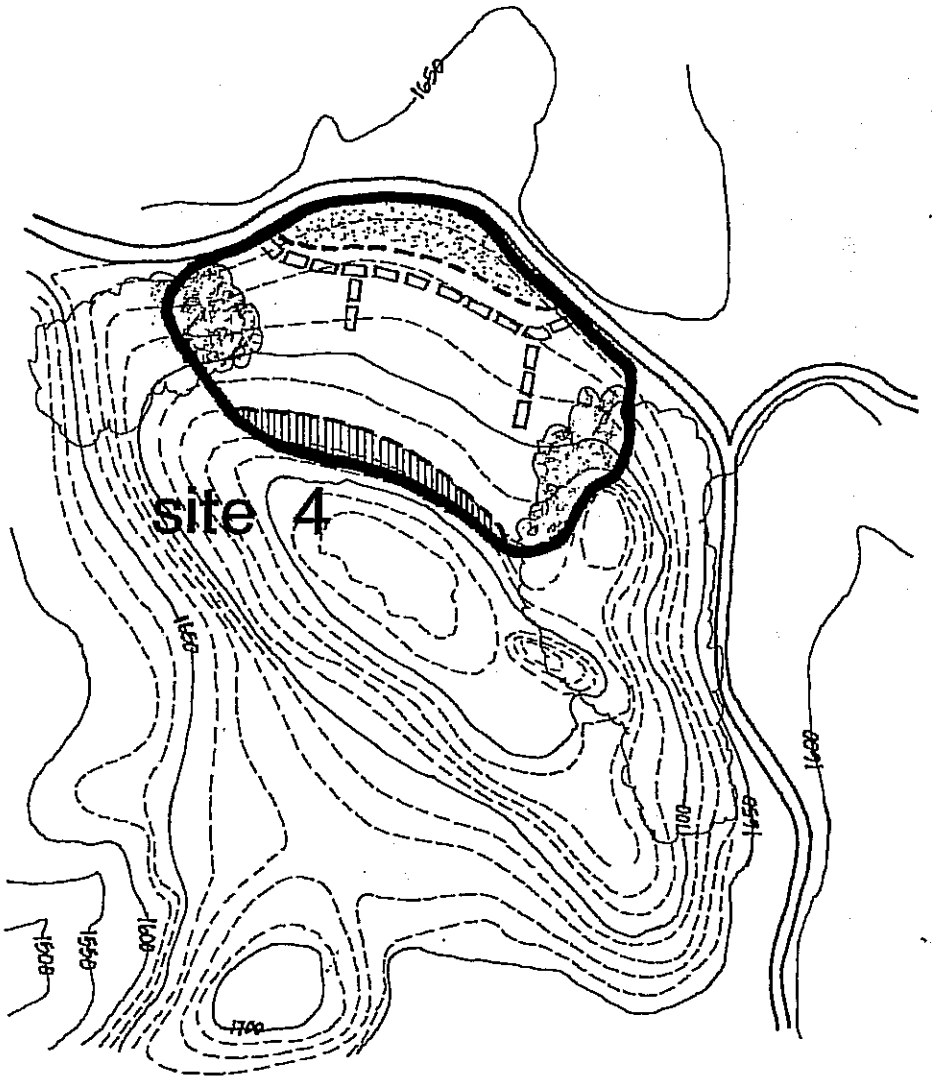
Because of the proximity of the Space Sciences Laboratory and the Lawrence Hall of Science, access to utilities is considered good, and because of the site's topography, solar access to the east, south, and west is excellent. Available utility capacity should be clarified. Views from the site are sweeping and panoramic to the west and south, but some screen planting will be required to isolate visually and acoustically the Field Station for Behavioral Research (FSBR) to the east. Except for occasional distant traffic noise, acoustic values on the site are good to excellent, and aesthetically the area is conducive to contemplative research. In order to maintain the visual character of the area, buildings should be set back from existing ridge lines and placed against a screen of natural vegetation. Buildings should be inserted into the landscape rather than made to dominate it, and no development should appear in silhouette above the height of existing trees. Because development on the site may place buildings at a "dead end" in terms of access, it is critical that a thoughtful fuel management program be carried out consequent with development.

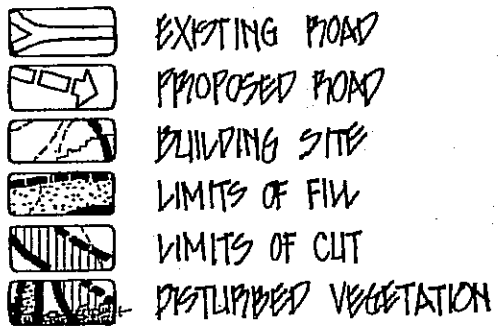
Functional Relationships

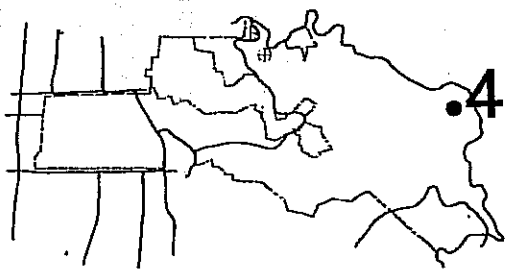
Development of this site is in concert with the recommendations of the Long Range Development Plan (1962), and with conclusions reached by Eckbo (1976) and McBride (1978). However, this report extends the eastern boundary of the site into an area presently occupied by the FSBR. This expansion has been made because a) contours and soil conditions in the area allow for development, and b) the requirement to minimize visual and acoustical impact of construction of an MSRI complex on a portion of the site necessitates FSBR's spatial reorganization (see proposed FSBR Development Plan).

d. Site Analysis: Site 4

Situated on the northern flank of Chaparral Hill (1,769 feet) at the eastern extremity of the East Hill area, Site 4 covers an area of about 6 acres of gentle open slopes.

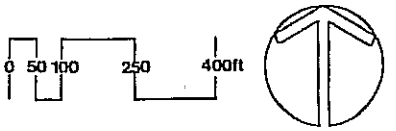






key map

site analysis: site 4



Environmental Context

Site 4 slopes downward in a northeasterly direction from an elevation of 1,720 feet on the side of Chaparral Hill to 1,660 feet at the line of Grizzly Peak Boulevard. Regularly sloping open grassland extends to a ridge line in the northwest and to the line of oak-bay woodland in the southeast. The site is constrained by visual amenity, access, and geological factors. Soil in the area is generally favorable for development, but a tension fault line occurs on the southwestern boundary, and on steeper slopes slide movement can take place. The area is well-drained to the north and east where part of the land is outside the Strawberry Canyon watershed. Because of its remote location, the ecology in the area is largely undisturbed and any development may have a negative impact on the migration of animals moving between the University's canyon land and the expanse of Tilden Regional Park.

Land Use

The site is well served in terms of vehicular access and entry into the area can be made at a number of points along Grizzly Peak Boulevard. Hiking trails along the ridge of Chaparral Hill give pedestrian access to the site but, because of its remoteness, these trails are unlikely to be used by the casual walker. Mass transit to the site does not exist, necessitating car-pooling or a shuttle mini-bus service to other campus locations if development occurs. Splendid views to the northwest and northeast are afforded by the area's high altitude but solar access is limited because of site orientation. Development on the site will be within the shadow of Chaparral Hill part of the day.

Acoustically the area is well-isolated and traffic noise on Grizzly Peak Boulevard has little impact on the interior of the site. Visually buildings should be kept as low as possible and integrated into the area's topography. No development should appear above the ridge line or be visible by an observer looking eastward, out of the canyon area. Because of its exposed position, the site is subject to occasional strong winds from the west and

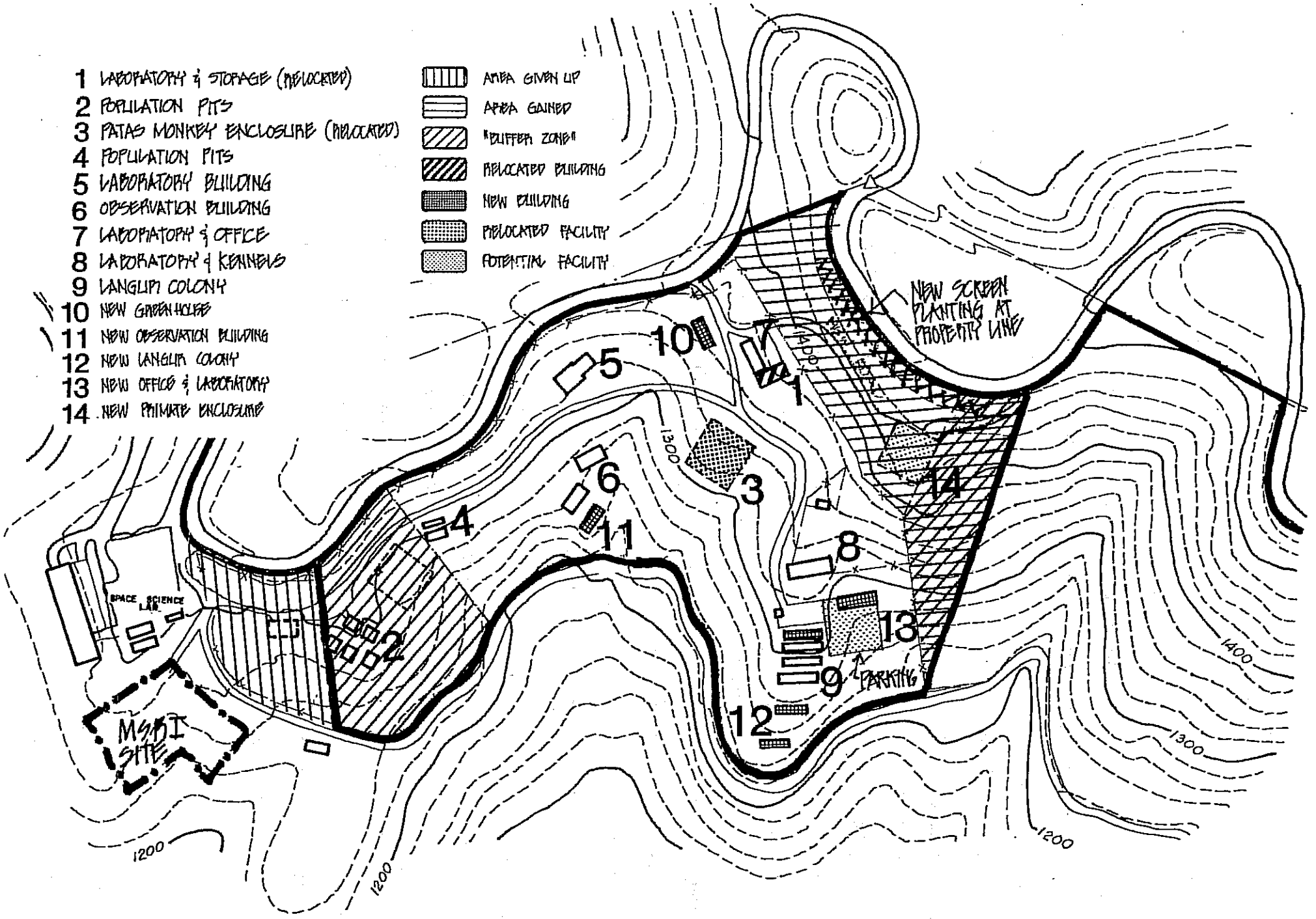
hot dry winds from the east during late summer and fall, posing a considerable fire threat. The remoteness of the site is less a problem for fire protection as the East Bay Regional Park Fire Station is immediately north of the site. The major drawback to development is the lack of available utility lines. The nearest existing University utilities are located at the Space Sciences Laboratory. The possibility of sharing park service utility lines should be investigated.

Functional Relationships

Development of the area was identified in the Long Range Development Plan (1962), designated as the site for a humanities institute and conference center.[41] Eckbo (1976) recommended a two-site development in the area, a recommendation rejected by Beatty (1979) on the grounds that both sites should be incorporated into an expanded Ecological Study Area. Beatty's report, which was intended as a "guiding philosophy" for development throughout the Strawberry Canyon area, has not been officially adopted by the University.[42] The two-site development suggested by Eckbo is also rejected in this report since one of the sites is situated on the west-facing slope of Chaparral Hill and involves development on unstable soils as well as loss of visual amenity from the canyon area.

e. Proposed FSBR Development Plan

Since its inception in the early 1960s, the Field Station for Behavioral Research (FSBR) has remained essentially undisturbed by development in other parts of the East Hill area. The present physical layout and function of the Station reflect this condition, remaining very much the same as when first constructed and operated. However, the proposed development of a new Mathematical Sciences Research Institute (MSRI) on the western boundary of the FSBR is expected to impact both the function and layout of the Station. With the construction of the MSRI, increased numbers of people and increased noise, external lighting, pedestrians, and vehicular traffic brought to the area will be in close acoustical and direct visual proximity to existing observation areas within the Station. In particular the Patas monkey enclosure and a number of population pits will



fsbr development plan

0 50 100 200 300ft

be exposed to public view compromising the secluded environment required to conduct research at these two locations. It should also be remembered that the construction of the MSRI is planned as the first installment of a number of similar buildings that may be erected on adjacent sites over the next 10-20 years. The spatial reorganization of the FSBR is therefore necessitated not by internal programmatic need but as a response to external events. It is important that this reorganization take place well in advance of any future development along its boundaries so that the function of this Station can remain undisrupted.

A preliminary version of the proposed development plan, shown on Map 23, has been discussed with Dr. R. L. Caldwell, the Director of FSBR, Thomas Koster of the Buildings & Campus Development Committee, and Ralph Gigliello from the Coordinator-Physical Planning's Office. While all three of the above have tentatively reviewed the contents of the plan, the development proposals contained in this report carry no official University status, and are the sole responsibility of the author.

The spatial reorganization of the FSBR would take place mostly within the confines of its existing area. A minor extension of the Station's area to the east is proposed to provide space for possible future expansion and to reconcile land use jurisdiction in the area by aligning the boundary of the FSBR with that of the Ecological Study Area. The section of land to be incorporated into the FSBR is not included in the expanded Ecological Study Area proposed by Eckbo (1956), McBride (1978), and Beatty (1979). The bulk of this added land, which roughly compensates for land given up to development by FSBR on its western boundary, will form a "buffer zone" between the station and other land use entities. A similar and more crucial "buffer zone" is envisaged in the western part of the FSBR site (see Map 23).

Environmental Context

The FSBR site spans the head of a minor valley system and its adjacent hillsides on the northern boundary of the University's property. The site is bounded by the irregular

line of Grizzly Peak Boulevard to the north and a graded fire trail to the west and south. On its eastern boundary a wire fence, which bounds the entire site, is the only feature that differentiates the Station's area from its contiguous land mass.

The land occupied by the FSBR slopes rapidly down to the west from approximately 1,480 feet in the northeast corner to about 1,220 feet along the fire trail. Sections of precipitous grades in the southern area of the site isolate the station from public view. Slope and configuration throughout the Station mean that land suitable for building is limited in terms of sites and acreage. This factor works to the advantage of the FSBR in that it discourages development on the site or a change in programmatic use while at the same time reinforcing the Station's traditional "low-profile" in terms of equipment and plant. Topography ensures that major building cannot take place on the site, and development is further constrained by the presence of Wildcat Fault which runs north-south through the eastern portion of the site. On those sites which are relatively level, soil conditions favor development but landslide activity along the southern boundary attest to the potential instability of the soil. Generally the area is well drained by at least three small creeks.

Ecologically, the area is rich in animal and plant life which consists of a mixture of soft chaparral, oak-bay woodland, and eucalyptus trees. Because the site is fenced and humans are kept out, many native animals have become "permanent residents" of the FSBR and some have prospered to the point of becoming a nuisance.

Land Use

Direct vehicular access to the site from Grizzly Peak Boulevard is good and in the proposed development plan existing fire trail access on the western and southern boundary will be maintained as secondary or emergency access points. The existing paved road on the site will remain unaltered with expansion of the internal circulation system envisaged in the new eastern portion of the site. A new service supply road from Grizzly Peak Boulevard, which can function as an emergency exit, is also suggested for this area.

The hazardous nature of Grizzly Peak Boulevard at this point suggests that entrance to the site at this location be restricted to eastbound traffic.

Pedestrians and cyclists will continue under the new plan to follow the essentially traffic free internal road with no special provisions required. Parking areas will be increased, but only incrementally and in certain selected areas. Since overall site development will remain at about its present level, no increase in the capacity of existing utilities is anticipated. The solar access of various units is excellent, and the installation of solar panels to meet unit-specific light and energy requirements ought to be explored.

In terms of slope and aspect, the site has excellent visual amenities. Views to the west, south, and east are possible from several locations. But since the aim of the FSBR is to remain secluded from public view, buildings and structures are set against the existing vegetation and slope. Within the site visual and acoustical isolation between units is essential to the work of researchers. The station attempts to provide semi-natural conditions that replicate as near as possible conditions in the wild. Since animals under observation often come from different countries or continents, the re-creation of their natural habitat dictates that alien noise and sights be guarded against.

Because the area in which the FSBR is located is so prone to fire risk, prudent and controlled use of fuel management techniques is advocated. Underbrush along roadways and trails should be cleared, and in the vicinity of structures a fire break should be created, particularly in areas of eucalyptus growth. An improved sprinkler system for all building areas should be provided. At present there are few outside building lights and no street lighting in the area, and none are wanted by researchers working at the site. Artificial light would be alien to the natural environment provided for the animals and would conflict with nocturnal observation programs. However, since much of the observation work at the station is carried out at night, the provision of an emergency response system in all buildings is highly recommended for reasons of both security and fire protection.[43]

Functional Relationships

The use of the FSBR site for research in animal behavior is consistent with recommendations in the Long Range Development Plan (1962), and has not been questioned in any of the consultants' reports on land use conditions in the East Hill area since that time. However, the recent approval by the Chancellor for the construction of the first phase of the Mathematical Sciences Research Institute has caused a reexamination of the physical layout of the station. Construction activity and subsequent daily use of a facility on the western perimeter of the FSBR will impact the requirement of the station for visual and acoustical isolation during the day and night.

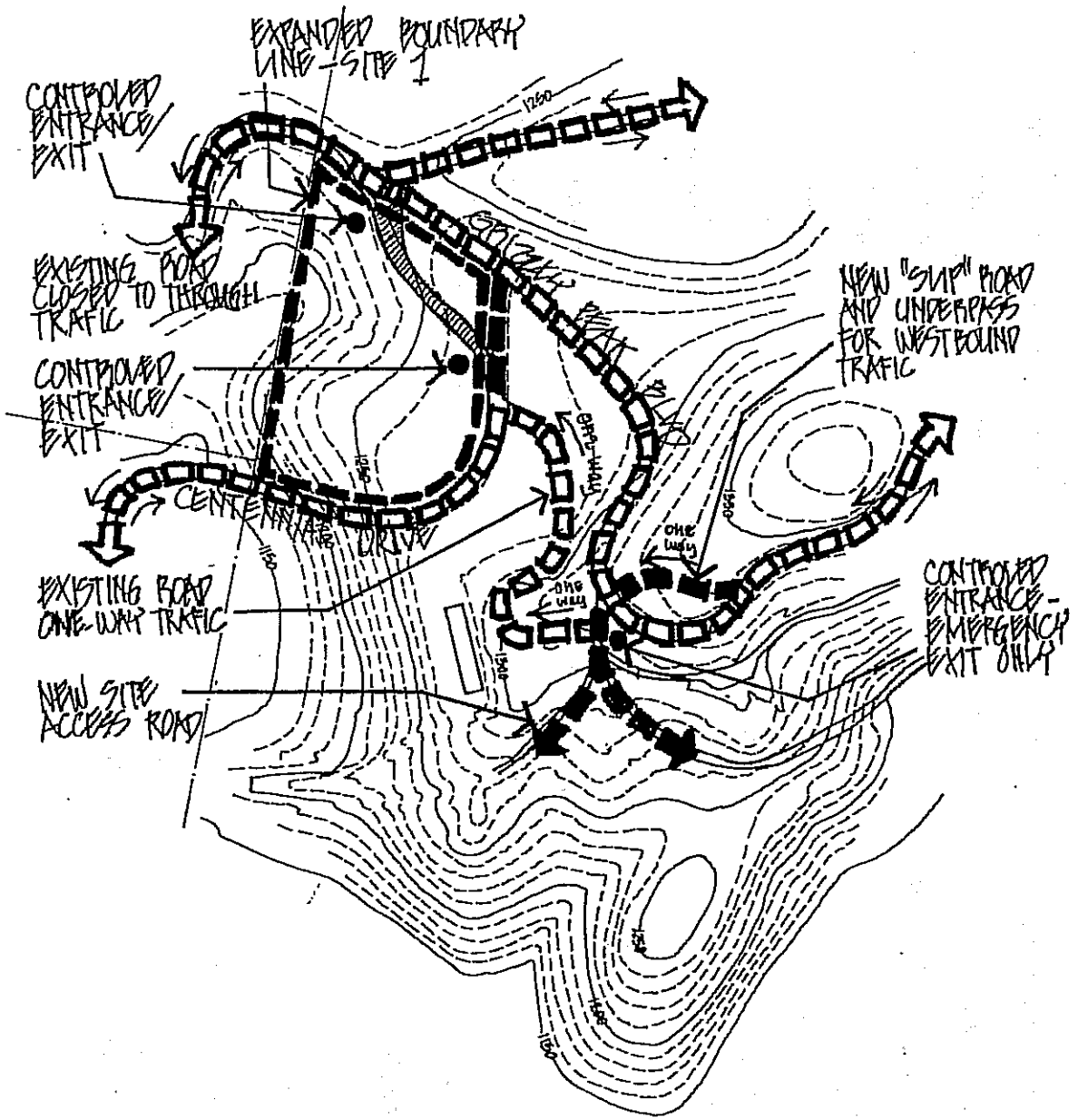
The development plan for the FSBR presented in this report acknowledges that site development west of the station will take place, perhaps over the next 10 to 20 years. It therefore proposes that FSBR "cede" land suitable for development to other University departments or units with the proviso that any structures or functions of the Station lost in this way will be replicated as necessary in a reorganization of the FSBR site. This reorganization is shown on Map 23, Proposed FSBR Development Plan.. A new fence line, originating at the line of the existing population pits, would form the western boundary of the site. An existing laboratory-storage building west of this line and an open enclosure for Patas monkeys east of the new line would be relocated as shown. New population pits would be constructed as required by the FSBR, perhaps to a new design and size, but the existing pits would not be abandoned entirely. While the broad range of use which these pits once had will be curtailed, they still may be used for research concerning insects, invertebrates, and perhaps aquatic organisms. The relocation of the Patas monkey enclosure will cause the most severe disruption in scientific observation, possibly lasting as long as a year. Studies can recommence about six months after all disturbance has finished and the animals reestablished with their new surroundings and reacquainted within their social groupings.[44] In this regard, the timing of the move is critical to its success. A further elaboration of the development plan proposal must therefore take into account the temporal as well as spatial requirements of the FSBR in terms of research.

f. Proposed Circulation Plan

The Proposed Circulation Plan, shown on Map 24, illustrates in a schematic fashion the possible reorganization of traffic patterns in the northern section of the East Hill area. The area in question lies between the Lawrence Hall of Science (LHS) and the Field Station for Behavioral Research (FSBR) close to the present junction of Centennial Drive with Grizzly Peak Boulevard. The proposed reorganization of the surface roads in the area is predicated on an increase of vehicular traffic of all types - passenger cars, buses, service vehicles - that can be expected with the completion of development proposals on several sites in the area. These developments include the construction of a mathematical sciences research complex, a new permanent addition to the Silver Laboratory and the Space Sciences Laboratory (SSL), the completion of new parking facilities to serve the LHS and SSL, and the development of Site 1 noted earlier in the report, possibly for housing. With the completion of all these developments, it will become imperative that fire and emergency vehicles have direct access to buildings in the area, some of which are to be located at the "dead-end" of existing circulation routes.

In its essentials the proposed plan calls for the realignment of Centennial Drive above its present junction with the existing access road to SSL. Existing contours indicate that this realignment will provide a level road surface leading to a new junction with Grizzly Peak Boulevard. This realignment will alleviate the danger of a rather hazardous curve in Centennial Drive and at the same time expand the amount of land available for development in Site 1, giving the site a more "logical" northeast boundary. It is proposed that the existing section of Centennial Drive west of the realigned roadway be closed to through traffic. Controlled entrance and exit points can be established at either end of this section of road which will still be available for internal circulation on the site.

To the east of the junction of Centennial Drive and Grizzly Peak Boulevard an existing fire trail, which currently follows the western perimeter of the FSBR, offers the only reasonable approach in terms of grades and access from Grizzly Peak Boulevard to the new mathematical



EXISTING ROAD

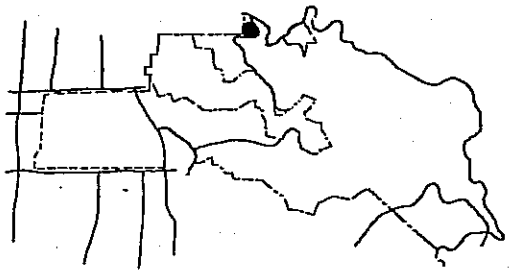
EXISTING ROAD CLOSED TO THROUGH TRAFIC

NEW ROAD

CONTROLED ENTRANCE/ EXIT

VEHICLIAR TRAVEL

EXPANDED BOUNDARY LINE - SITE 1



key map

proposed circulation plan

0 50 100 400ft

research complex and the SSL site. It is proposed that this fire trail be upgraded to access road standards to provide entry to the area. Access for eastbound traffic along Grizzly Peak Boulevard will not present a problem, but the topography in the area dictates that westbound traffic entering the site will require the construction of a new "slip" road and underpass below Grizzly Peak Boulevard. Because hazardous conditions will still obtain, it is proposed that traffic not be allowed to exit the area to the east or west, except in emergency.

The internal traffic pattern of the area will be dependent on individual site layout and building design but the proposed plan envisages that existing traffic be directed in a one-way pattern along the existing SSL access road leading to Centennial Drive. It is anticipated that increased traffic volume will make the present two-way pattern along this road unfeasible and create traffic blockages at this junction with Centennial Drive. If the proposed scheme is implemented, traffic to the lower campus will travel on the south side of this two-lane road with traffic heading for Grizzly Peak Boulevard traveling on the north side. A manned control point can also be established at the junction of Centennial Drive, again for both traffic control and security reasons.

Traffic arriving from the lower campus would be required, in this plan, to circulate along Grizzly Peak Boulevard in order to reach the MSRI complex and Silver Laboratory. Public transportation systems and University-provided mass transit would also be required to follow the same route and circulate through the area in a one-way direction, avoiding difficult turn-outs or possibly dangerous reversals of direction.

The proposals outlined above are schematic and tentative and have not been discussed or reviewed within the University administration. They assume full development of all sites in the area and look to the long term rather than the short. The proposed plan offers no thoughts on phasing implementation and will no doubt be expensive to accomplish. However the main intent of these proposals is to highlight the problems and complexities that full development, and consequent increased traffic density, may bring to the northern canyon area and to suggest a schematic approach to their solution.

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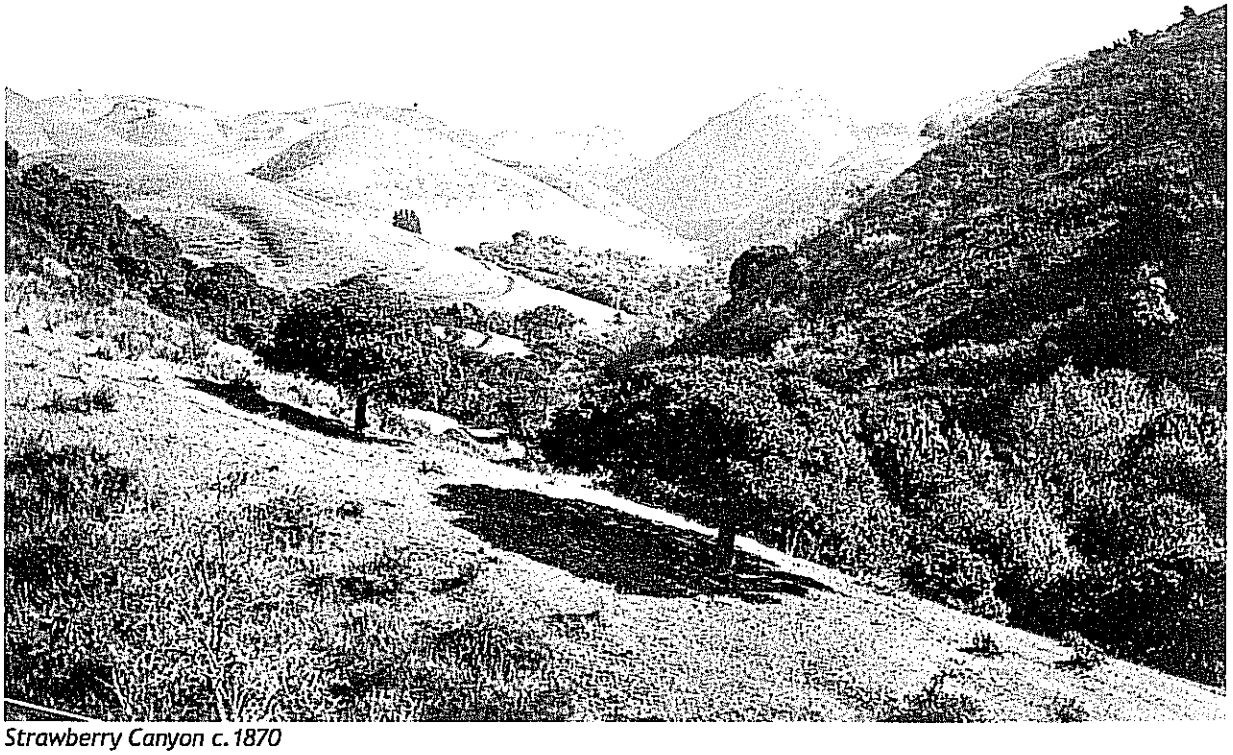
UC Berkeley Hill Campus Working Paper



Strawberry Canyon c. 1870

A Study in Support of the 2020 Long Range Development Plan
December 2002

The purpose of Working Papers is to document findings, identify concepts for further consideration and investigation, and inspire creative thinking. They do not represent decisions made nor policies adopted by the University.

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INTRODUCTION

PURPOSE

The campus is now preparing an update of its Long Range Development Plan, to guide capital investment at UC Berkeley through the year 2020. The Hill Campus - the campus lands east of the Stadium, Greek Theater and Bowles/Stern/Foothill - is a critical element of this update. The LRDP and its Environmental Impact Report will seek to establish a land use framework for the Hill Campus that reflects an optimal balance of program requirements and environmental stewardship.

Toward this end, a study committee for the Hill Campus was formed in spring 2002 to identify those program requirements and recommend how they might best be accommodated. The objectives for the study committee were to:

- Assess the value of the Hill Campus for instruction, field research, recreation and other potential uses - including habitat and resource conservation - and define the areas of greatest value for each use.
- Identify the needs of current Hill Campus programs, and anticipated changes through 2020.
- Identify known and potential demands of other users through 2020.
- Define a set of principles for development of the Hill Campus through 2020, including land use, protective measures for sensitive/valuable areas, and key capital investments and management practices required to support these principles.

SCOPE

The university owns roughly 1000 acres of land in the hills east of Memorial Stadium, the Greek Theater, and the Bowles/Stern/Foothill student residences, as shown in figure 1. Roughly 200 acres of this land are now utilized and managed by the university-operated Lawrence Berkeley National Laboratory under its own separate jurisdiction.

The 200 acre LBNL site shown in figure 1 includes the 70 acre expansion agreed upon by the campus and LBNL in March 1996 to improve fire management.[1] These 70 acres shall continue to be managed under the land use policies of the campus Long Range Development Plan until the LBNL LRDP update is adopted by the regents, at which point the LBNL LRDP shall become the guiding document.

While the balance of this working paper does not address land use within LBNL, its director of strategic development is an active member of the study committee, and the findings of the committee are congruent with LBNL policies and plans. The term 'Hill Campus' in the balance of this working paper refers to the roughly 800 campus managed acres lying east of Memorial Stadium, the Greek Theater, and the Bowles/Stern/Foothill student residences (figure 1).

RELATED PLANS

1990-2005 LRDP

The current 1990 LRDP states the objective for the Hill Campus is:

> ... to administer most of the area as a conservation land resource with limited areas designated for development ... Major portions of the area are proposed to continue to be managed as an environmental teaching resource, such as the Ecological Study Area and Faunal Refuge Area ... the area is also proposed to continue to be used and managed as a recreation resource ... The area is suitable for research uses that ... require or are compatible with a natural or semi-natural environment ... research activities [without] wet laboratory facilities or ... high service requirements are suitable for the area ... a site is [also] reserved for future faculty housing adjacent to existing residential areas near roads and services.[2]

The 1990 LRDP divides the Hill Campus into land use zones (figure 2), although one of the zones, the Natural Areas, is defined merely as 'remaining undeveloped lands' without further explanation. The 1990 LRDP proposes several land management initiatives:

- Expansion of the Ecological Study Area.
- Expansion of the Botanical Garden.
- Reservation of Claremont Canyon as an undeveloped area pending future study.
- Designation of several reserve sites for future development.

The reserve sites include a faculty housing site at the intersection of Centennial and Grizzly Peak, as well as five potential sites for future research facilities: the former Poultry Husbandry site, the current Field Station for Behavioral Research site, sites north of Space Sciences Laboratory and east of the Mathematical Sciences Research Institute, and Chaparral Hill. The latter is suggested in the 1990 LRDP as the future site of a relocated FSBR: the current FSBR site would then be redeveloped with a new research facility.

The 1990 LRDP also proposed several specific capital projects in the Hill Campus, described further in CURRENT LAND USE, below:

- Various improvements to Strawberry Canyon Recreation Area to accommodate men's and women's athletics as well as recreational sports.
- Additions to the Lawrence Hall of Science, Space Sciences Laboratory and the Mathematical Sciences Research Institute.
- Replacement of several existing structures at the Botanical Garden.
- New parking lots at the Upper Hill Terraces and two other sites along Centennial Drive.

2002 STRATEGIC ACADEMIC PLAN

All campus plans at UC Berkeley share the underlying principle that our land use and capital investment strategy should align with and promote the goals of the academic enterprise, as articulated in the Strategic Academic Plan.[3] While all of its principles bear on the future of the Hill Campus, two are particularly relevant to its future physical development:

MAINTAIN CONTIGUITY. The breadth and quality of our academic programs are the equal of any university in the world, but UC Berkeley is more than the sum of its parts. A great research university also requires a dynamic intellectual community, one that provides exposure to a wide range of cultures and perspectives, and generates the interactions that lead to new insight and discovery. For such a community to thrive requires a campus organized and designed to foster those interactions.

Although the academic structure of the campus reflects the traditional disciplines defined over a century ago, they are no longer insular and self-contained. Because the potential for interaction is everywhere, and because we cannot predict where productive synergies may emerge in the future, our first principle of physical organization must be to retain and reinforce the contiguity of the academic enterprise on and around the core campus. The Academic Plan recommends the campus:

- Accommodate future academic growth on the core campus and adjacent blocks.
- Reserve core campus space for functions that serve and/or involve students.
- Reserve adjacent blocks for research and service units requiring core campus proximity.

As examined later in this document, the critical interactions for all Hill Campus programs are primarily with the core campus, rather than with each other. However, all of those programs report significant problems in sustaining those critical interactions, due to their physical distance from the core campus, and to the difficulty of providing adequate transit, services and infrastructure to the Hill campus given the constraints of distance, poor access and rugged terrain.

INVEST IN HOUSING. Our best student and faculty candidates increasingly cite the scarcity of good, reasonably priced housing as a primary factor in their decisions whether or not to come to Berkeley. Of those who do, many find themselves living miles from campus, where the length of the commute itself becomes a disincentive to spending time on campus. This trend is destructive to intellectual community and the cultural life of the campus, and we must strive to reverse it. The Academic Plan recommends the campus:

- Provide two years of university housing to entering freshmen who desire it, and one year to entering transfers who desire it.
- Provide one year of university housing to entering graduate students who desire it.
- Provide up to 3 years of university housing to new untenured ladder faculty who desire it.
- Partner with private and not for profit developers to continue to expand and improve the rental housing stock available to the campus community.

As examined later in this document, housing - particularly for faculty and visiting scholars - is one land use that may be suitable for limited expansion in the Hill Campus, due both to its physical flexibility and to its more easily met transit and service demands compared to large scale research facilities.

CONTEXT

The vast majority of the campus-managed Hill Campus acreage, roughly 85%, lies within the City of Oakland, while the westernmost 10% lies within the City of Berkeley, and the easternmost 5% within unincorporated Contra Costa County. The western third of the site abuts low-density private residential areas to the north and south, while the eastern two-thirds of the site abuts the largely undeveloped lands of the East Bay Regional Park District and the East Bay Municipal Utility District.

The most dramatic physical feature of the Hill Campus is Strawberry Canyon, a watershed of roughly one square mile drained by the south fork of Strawberry Creek. This water supply helped convince the trustees of the College of California to acquire the ranch lands along the creek in 1868 as the site for their new campus. At the time, the hills above the campus were a mix of grassland, oak savannah and open chaparral. It was not until speculators in the next decade planted eucalyptus, in a failed scheme to grow and harvest them for commercial use, that the hills began to acquire their present, largely forested look.

By the turn of the century, a shortage of water had begun to constrain campus growth, so the regents acquired another 260 acres of hill watershed to the east to increase the system capacity. Around the same time, there was also a growing desire to beautify the campus: a campus nursery was established, and nearly 19,000 eucalyptus, pine, cypress and redwood trees were planted in 1913, with thousands more planted in the years to follow.[4] The campus' hill lands were further augmented in 1951 and 1961 with the acquisitions of 290 and 240 more acres from the East Bay Municipal Utility District.[5]

NATURAL FEATURES

PHYSIOGRAPHY. From a base elevation of roughly 400 feet at its western edge, the Hill Campus rises to nearly 1800 feet at Chaparral Hill at its eastern edge. Slopes range from moderate to steep, but in general the terrain is rugged: few sites within the Hill Campus are suitable for development without extensive site alterations.

The active Hayward fault lies at the western boundary of the Hill Campus: it trends northwest-southeast and runs directly under Memorial Stadium. A second northwest-southeast fault, the Wildcat Fault, traverses the Hill Campus just east of the Botanical Garden: it is not known whether this fault is active or inactive. A third, inactive fault, the Strawberry Fault, runs under the channel of the south fork of Strawberry Creek.

While much of the Hill Campus is undeveloped, some areas within it are prone to landsliding: for example, land slippage occurs in a zone extending from a point upslope of the LBNL Center for Electron Microscopy toward and through the former Poultry Husbandry site.[6] Existing hydraugers operate to relieve groundwater pressure and reduce land slippage in the vicinity of Space Sciences Laboratory and Mathematical Sciences Research Institute.

The 1997 SAFER evaluation rated 13 Hill Campus buildings 'poor or 'very poor', of which ten are small one-story structures. Retrofit of the largest 'poor' building, the original facility at SSL, was completed in 2000. The next largest building requiring seismic upgrades is the 8,000 asf Haas Clubhouse.

HYDROLOGY. The Hill Campus lands lie within three watersheds: Strawberry, Blackberry, and Claremont Canyons. A fourth watershed, Derby Canyon, abuts the Hill Campus at its southwest corner. Strawberry Canyon, the upper watershed of the south fork of Strawberry Creek, contains roughly 635 acres of university land. All existing Hill Campus development is located within Strawberry Canyon and Blackberry Canyon, adjacent to the north. The roughly 200 university owned acres in Claremont Canyon, on the other hand, are undeveloped except for dirt roads and trails.

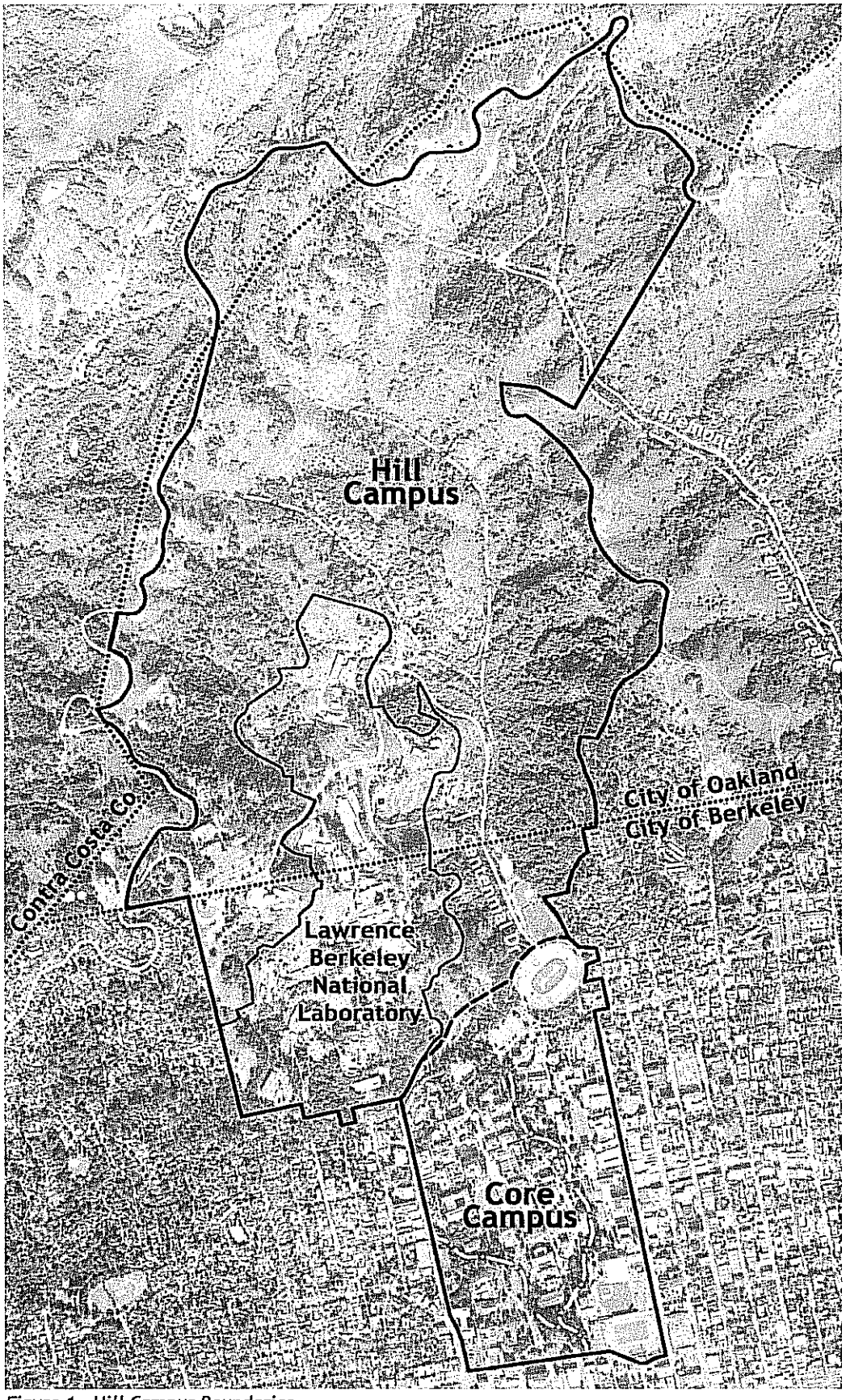

Figure 1. Hill Campus Boundaries

The lower portions of the north and south forks of Strawberry Creek are culverted, as are portions of several of its tributaries. Claremont Creek is open until it enters a culvert several blocks east of the Claremont Hotel. As a result of both culverting and the increase in impervious surfaces in the Hill Campus over the past century, rapid changes in channel flow can occur in response to rains and runoff, exacerbating the natural erosion already resulting from the steep terrain in the upper watersheds.

While there is no comprehensive management plan for campus stream channels, the 1990 Strawberry Creek Management Plan describes a program of improvements to Strawberry Creek, some of which have been implemented. The plan is now being updated, but its scope remains confined to Strawberry Creek and its tributaries.

VEGETATION. The Hill Campus is a mosaic of wet and dry north coastal scrub intermixed with stands of trees: natural oak-bay woodland as well as pine, redwood and eucalyptus plantations. The pattern of vegetation has changed significantly from the original mix of grassland and oak savannah, due not only to the decline of grazing, but also to the human introduction of eucalyptus and conifers as well as invasive perennials such as brooms and euphorbia, and to the fact these introduced species often out-compete natives.

Only scattered patches of the original native grassland remain today. These areas are of scientific interest not only in themselves, but also as the initial stage of the natural succession from grassland to shrubland to woodland. The climax oak-bay woodland supports the most diverse vertebrate fauna of any habitat in California.[7] While clusters of oak-bay woodland occur throughout the Hill Campus, by far the largest contiguous area covers the north-facing slopes at the west end of Strawberry Canyon.

The mix of scrub and conifer and eucalyptus stands makes the East Bay Hills a regular seasonal fire risk. This risk becomes particularly pronounced during the periodic one- or two-day shifts from the normal northwesterly winds to 'Diablo' winds blowing in from the warm, dry regions to the east. 20th century Diablo wind fires have burned over ten times the acreage of normal wind condition fires, and include the firestorms of 1923 and 1991. The generally steep terrain and poor roads in the Oakland and Berkeley hills present enormous obstacles to fire response, and some areas such as Claremont Canyon, served by only a single road, may be indefensible in Diablo wind conditions.[8]

HABITAT. The entire Hill Campus represents a small portion of the critical habitat for the threatened Alameda Whipsnake. Few whipsnakes have been documented in the Hill Campus, but since 25-30% of its slopes have a south or southwest aspect, they represent potential whipsnake colonization habitats.

Other listed species that may possibly inhabit the Hill Campus lands include Presidio Clarkia, Alameda Manzanita, Harvestman Spider, and the California Red Legged Frog. The Hill Campus is not presently a designated critical habitat for any of these species. However, the California Native Plant Society is presently lobbying state and federal agencies to include Western Leatherwood, a plant found in Claremont Canyon, as a listed species.[9]

CURRENT LAND USE

ECOLOGICAL STUDY AREA. The use of Strawberry and Claremont Canyons for instruction and research related to the natural environment, and their preservation in a primarily natural state, has been a longstanding policy of the campus. The mix of native and introduced trees established a wide variety of flora and fauna, making the Hill Campus a useful resource for field study, and led to the initial designation of a 'primitive area' in the mid 1930s.

The Hill Campus was further recognized as an 'invaluable asset' to instruction and research by a faculty advisory committee, in their 1958 proposal that 'the guiding principle in the development of Strawberry canyon and the Hill Campus should be ... maximum use consistent with conservation of native values.'

This proposal led ultimately to the designation of a 300 acre Ecological Study Area in 1968, and the 1979 preparation of guidelines for maintenance and preservation in the Management Plan for Strawberry and Claremont Canyons.[10] The 1990 LRDP proposed three expansions of the ESA boundary, as well as the designation of a faunal refuge area at the center of the ESA (figure 2).

STRAWBERRY CANYON RECREATION AREA. Formerly the site of the campus' corporation yard, those facilities were removed in1959 to make way for a recreational complex composed of the Haas Clubhouse, Stern Pool, tennis courts and a turf athletic field. The East Pool was built in 1967 to relieve overcrowding. As proposed in the 1990 LRDP, the tennis courts were removed, and the athletic field and parking lots reconfigured in 1993 to create the present Witter and Levin-Fricke Fields. The administrative offices for the Recreation Area are housed primarily in the Strawberry Canyon Center northeast of the Clubhouse.

BOTANICAL GARDEN. The oldest campus-operated Botanical Garden in the country was established on the core campus in 1891, and moved to its present location in 1926. Ranging in elevation from 600 to 900 feet, the site provides a unique variety of microclimates that accommodate over 13,000 plant species and varieties, organized by geographic origin.

The Garden is located on a 34 acre site, split into north and south sections by Centennial Drive. Strawberry Creek flows through the southern section and is incorporated into the Garden design. The 1990 LRDP proposed expanding the Garden by 40 acres, along with a program of new investments including parking and entry improvements and replacement of several old office and greenhouse structures.

A few of the LRDP proposals have been implemented. A new parking lot was constructed in 1991, some upgrades to buildings and visitor amenities have been completed, the old Acid House was converted in 2001 to a new Plant Conservation Research Center, and a greenhouse dating from1927 was replaced in 2001 with the new Desert and Rainforest facility.

LAWRENCE HALL OF SCIENCE. Completed in 1968, LHS is managed as an organized research unit, although its primary mission is education and public service. LHS functions as a resource center for bay area schools and residents, through exhibits, displays, and instructional programs, and draws over 300,000 visitors a year.

The building, a four-story structure of 75,000 asf, represents only about 40% of the original master plan for the site. The 1990 LRDP proposed expansions to both the north and south, of 7,000 and 16,000 asf respectively, to enhance program functions and the visitor experience. However, major improvements since the LRDP have been limited to renovations within the existing building and the construction of 360 parking spaces at the upper terrace lot in 1997. The outdoor Bay Exhibit is presently under construction on the south expansion site.

SILVER SPACE SCIENCES LABORATORY. An organized research unit of the campus, SSL is a multi-disciplinary facility, engaged in basic research motivated by the exploration of space and the use of technology developed in space research. The original 29,000 asf facility was completed in 1966. The 1990 LRDP proposed an expansion of 15,000 asf: in fact, SSL nearly doubled in size with the 25,000 asf annex completed in 1998. Seismic and program improvements to the original facility were subsequently completed in 2000: the buttress structures erected to improve seismic performance also offer the potential for modest future expansions of the facility.

MATHEMATICAL SCIENCES RESEARCH INSTITUTE. MSRI is an independent institute that exists to further mathematical research through programs, workshops, postdoctoral training and public outreach and education. Over 1,000 scholars visit MSRI each year, many for substantial periods of time. Although independent, MSRI is housed in facilities leased from the campus. Its current 14,000 asf facility was completed in 1985: a planned expansion of 14,000 asf is now in design.

FIELD STATION FOR BEHAVIORAL RESEARCH. The FSBR, an organized research unit of the campus, was established on its current site in 1961, to conduct research on animal behavior that can not be performed in conventional enclosed labs. The FSBR was designed as nine distinct units, each providing a particular type of experimental setting ranging from open meadows to partly enclosed cages, kennels and runways. Numerous small research and support buildings are distributed over the 18 acre site.

FSBR research requires isolation from other human activity. However, this once-remote site is no longer as isolated since the construction of nearby SSL and MSRI. For this reason, the 1990 LRDP proposed the future relocation of FSBR to Chaparral Hill: the current site could then be redeveloped. No action to date has been taken on this proposal, due the cost of extending adequate infrastructure and transit to Chaparral Hill and, more recently, to its identification as a potential colonization site for the Alameda Whipsnake.[11]

LAWRENCE BERKELEY NATIONAL LABORATORY. The 200 acre LBNL is by far the largest research enterprise in the hills east of campus. This multidisciplinary research facility is an independent unit of the university, operated under contract to the US Department of Energy. Most of its 80+ buildings are owned by DOE, constructed on university owned land leased to the federal government. LBNL research is also conducted in 20+ buildings on the UC Berkeley campus, particularly Donner and Calvin Labs.

Established in 1931 on the UC Berkeley campus, LBNL was relocated to its current site in 1940 with the construction of the 184 inch cyclotron. LBNL facilities are used by 3500 staff as well as over 2000 guest researchers a year: some 250 scientists also serve as UC Berkeley faculty. LBNL also employs 800 UC Berkeley students, and draws over 3000 visitors a year.

LBNL is presently updating its own Long Range Development Plan, on a schedule roughly congruent with the campus' own LRDP update. While the two institutions are under separate jurisdictions and environmental laws (CEQA for UC Berkeley, NEPA for LBNL), their LRDPs must recognize their potential cumulative environmental impacts. The October 2000 Notice of Preparation indicates LBNL intends to grow by up to 670,000 gsf by 2022.

PHYSICAL PLANT STAGING AREA. The upslope areas of the former Poultry Husbandry site are now used by PPCS as a materials storage and vehicle parking site, served by a narrow switchback road. This site was designated in the 1990 LRDP as a reserve site for a future research facility. Because the site remained unused for a long period, PPCS recently began to use it as a staging area, in response to the lack of more suitable sites on the core campus or in its urban environs.[12]

The unauthorized reconstruction of this site by PPCS to accommodate the staging area, including new paved surfaces and concrete retaining walls, is problematic for several reasons. First, the site is in a known zone of land slippage. Second, fenced paved surfaces encroach within 20 feet of Chicken Creek, a perennial tributary to Strawberry Creek. The paved surfaces degrade the riparian habitat by displacing plant cover and by increasing runoff into the creek. Third, the use of the site for storage, as well as the on-site portable toilet, may pose a threat of pollutant spills into the creek, which is regulated by the Regional Water Quality Control Board.[13]

As described in PRINCIPLES, below, the PPCS staging area is not a suitable long-term use of this site, and should be relocated as soon as an alternate location can be obtained.

PARKING. 550 parking spaces controlled by the campus' Parking and Transportation auxiliary are located in the Hill Campus: 364 of these are located in the terrace lots near LHS, 78 at the SSL lot, 74 at the Botanical Garden lot, and 34 on Stadium Rimway. Another 115 spaces are located at Witter Field, and 151 more uncontrolled spaces are scattered throughout the Hill Campus. Many staff in the upper Hill Campus, however, prefer to park for free along Grizzly Peak Boulevard or in the dirt parking lot east of the Boulevard.[14]

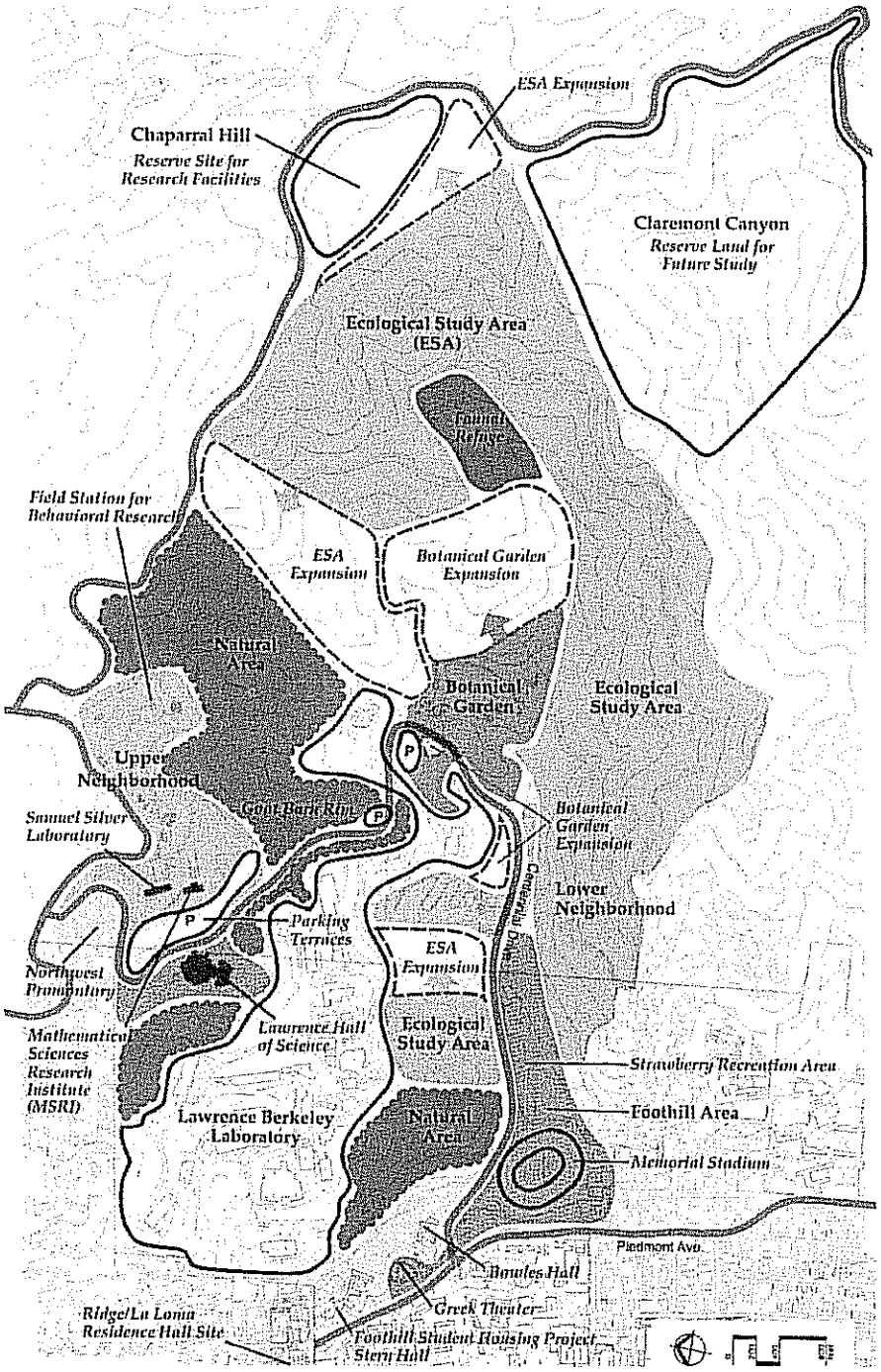

Figure 2. Hill Campus Land Use - 1990 LRDP

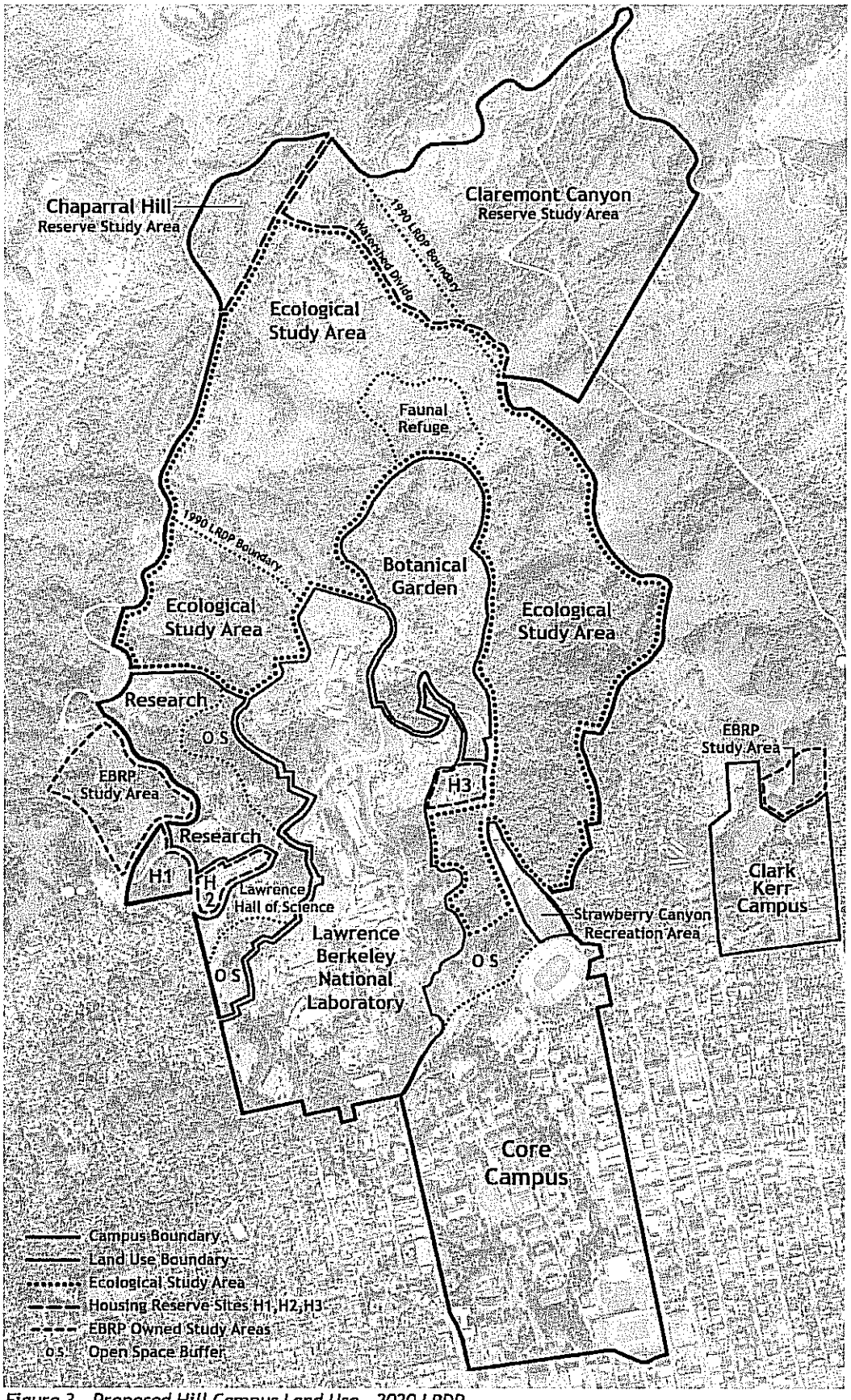

Figure 3. Proposed Hill Campus Land Use - 2020 LRDP

PRINCIPLES

ECOLOGICAL STUDY AREA

The purpose of the Ecological Study Area is to preserve the area for instruction and research.[15] Yet while the ESA and other undeveloped areas north of Claremont Canyon do have significant potential value to the university for both instruction and research, this value is largely unrealized due to inadequate management. Because the campus has no formal mechanism for recording and tracking individual research projects in the hills, those projects are often neither informed of one another nor protected from public intrusion and damage.

PROPOSAL 1. The campus should establish a formal management entity for the Ecological Study Area. Such an entity would not only maintain a registry of all instructional and research projects in the ESA, it could also:

- Identify and promote synergy among those projects,
- Track external funding prospects for new research initiatives,
- Implement strategies for protection from invasive plants, animals and humans,
- Implement strategies for improved coexistence of recreation, education, and research, and
- Collaborate with other campus service units to implement management practices that both reduce fire risk and help restore a mosaic of native vegetation.

ACTION 1.1. Incorporate such a management entity into the emerging strategy for the Field Stations. The Vice Chancellor for Research should charge the new committee responsible for Field Station oversight to establish a management entity for the ESA.

However, the campus does not yet have the tools it requires to manage this resource. One critical need is a Geobased Information System (GIS) that provides a comprehensive and regularly updated inventory of its natural and manmade features, and the capability to register and monitor activities ranging from research projects to fire mitigation measures. The GIS could also resolve the longstanding problem of imprecise and incomplete maps and records of the Hill Campus, by providing a central source for integrated geobased information.

ACTION 1.2. Create and maintain a comprehensive campuswide GIS, including the Hill Campus. The GIS would be maintained by the UC Berkeley GIS Center, in collaboration with other campus research units such as the Earth Resources Center and the Center for Assessment of Forest and Environmental Resources. The cost to create a campuswide GIS, including a comprehensive aerial survey, is estimated to be $180,000-$200,000: system maintenance and upgrades could be supported through a combination of campus and recharge funds to be determined.

NATURAL AREAS. The 1990 LRDP proposed several expansions to the ESA. It also, however, designated several other areas of the Hill Campus as Natural Areas, but with no further explanation of the distinction. Past studies of the Hill Campus, however, have emphasized the importance of preserving these areas in their natural condition: for example, the 1984 Task Force Report on the Hill Campus states '... the intent is to maintain undeveloped areas outside the ESA in their natural state.[16]

The boundary of the largest, easternmost Natural Area was changed by the expansion of the LBNL managed zone. As shown in figure 3, it now consists of a large, roughly square area adjacent to the ESA, plus a narrower tail extending down to Centennial Drive. Inclusion of the larger portion of this Natural Area in the ESA would place it under the protection of ESA management, and enhance the integrity and habitat value of the ESA.

The other Natural Areas, however, are not as suitable for inclusion in the ESA, either because they are largely or entirely separated from the ESA by other zones or, in the case of Charter Hill, because it is intensively used by people at certain times. These areas should continue to be managed by the campus as undeveloped open space, but not subject to the oversight of ESA management.

PROPOSAL 2. The 2020 LRDP should expand the boundary of the ESA to include not only the ESA expansion areas designated in the 1990 LRDP, but also adjacent Natural Areas that would enhance the value of the ESA as an academic resource.

RESERVE SITES

The 1990 LRDP designated several 'reserves' for future study and possible development. These reserves fall into three categories:

- Claremont Canyon and Chaparral Hill
- Poultry Husbandry and Northwest Promontory
- Field Station for Behavioral Research and Vicinity

The two largest reserve sites are Claremont Canyon and Chaparral Hill, and they are similar in several respects: they are remote from the core campus, they would require substantial infrastructure investment to support research facilities, and no clear demand for more intensive campus use of either site has emerged since the 1990 LRDP. The Poultry Husbandry and Northwest Promontory sites are most suitable for faculty and visitor housing, and are examined further in HOUSING, while the future of the FSBR and vicinity is examined further in RESEARCH, below.

CLAREMONT CANYON. Claremont Canyon, the 200 university-owned acres south of the ridge dividing the Strawberry and Claremont watersheds, does not in general offer the campus any significant academic value beyond what is already available on university-owned land north of the ridge. While it is currently used by students and researchers in the earth sciences, these activities merely require access, not university ownership or management.

Although Claremont Canyon does not have unique value to the campus as an academic resource, it does have significant scenic and recreational value to the entire region as an integral element of the eastbay hills park system, and should remain as open space. The canyon does, on the other hand, represent a liability in terms of both ongoing campus expenditures for maintenance, security and fire hazard mitigation, and potential damage claims due to fires, landslides or other incidents originating on university land.

While previous reports have speculated on the long-term potential of Claremont Canyon as a site for faculty housing,[17] since the firestorm of 1991 this must be viewed as an extremely unlikely scenario, given its steep terrain and poor access. If, therefore, its future is to remain as natural open space, and since it does not offer any unique academic resources to the campus, the campus should reconsider whether continued university management is in fact the best long-term solution.

The western portion of Claremont Canyon is owned and managed by the East Bay Regional Parks District. A transfer of control of the university lands to EBRP could lead to more efficient and effective management of the entire canyon as a scenic and recreational resource, and should be explored.

PROPOSAL 3. The LRDP 2020 should retain the designation of Claremont Canyon as reserve lands for future study.

ACTION 3.1. Initiate staff conversations with EBRP representatives on alternate management futures for Claremont Canyon. EBRP staff have confirmed their interest in pursing such conversations at the confidential staff level.

However, in exploring such a transfer of control, whether through management or fee ownership, the university should also expect to be compensated by EBRP for the value it receives. The extensive EBRP land holdings may include particular sites which have more use value to the campus than to the district: one such site, located at the intersection of Centennial and Grizzly Peak, may have the potential for conversion to campus recreational or athletic fields: this site is examined further in RECREATION, below. Another site east of Clark Kerr campus, identified by ERBP, may have some potential for recreation and/or housing, although grades are steep.

CHAPARRAL HILL. The roughly 40 acre site at Chaparral Hill is defined by the ridgeline of Strawberry Canyon on the west and Grizzly Peak Boulevard on the east. Due to its relatively gentle slopes, it has been designated as a potential research site in numerous campus studies, including the 1962 and 1990 LRDPs. However, more intensive use of the site is severely constrained by its isolation. Protected natural open space surrounds the site: regional parklands on the north, east and south and the ESA on the west. The site lacks utility infrastructure, and campus shuttle service is unlikely to be feasible due to the distance from campus and the limited population the site could support.

As noted in the 1984 Task Force Report, the only feasible uses of Chaparral Hill are those for which isolation is an advantage. The report suggested 3 options: a conference retreat, faculty housing, and relocation of the FSBR.[18] As examined further under HOUSING, other more promising campus options exist for both faculty housing and conference space, and these should be fully explored before Chaparral Hill is given serious consideration. The relocation of FSBR is examined further in RESEARCH, below.

Another factor in the future use of Chaparral Hill the recent finding by the campus' consulting herpetologist that the south-facing slopes of the site represent a potential colonization habitat for the Alameda Whipsnake.[19] While some very limited development of the north-facing slopes might be possible, any human activity, particularly construction activity, would be constrained by the need to preserve the integrity of the adjacent habitat.

Because more intensive use of this site is limited by several factors, and because no clear demand presently exists for more intensive use, Chaparral Hill should continue to be designated as reserve lands. Further analysis is required to determine whether the site should be incorporated into the ESA.

PROPOSAL 4. The LRDP 2020 should retain the designation of Chaparral Hill as reserve lands for future study.

RESEARCH & PUBLIC SERVICE

In general, the critical linkages for all Hill Campus programs are with the core campus, rather than with each other. While a larger Hill Campus population might enable some improvement in services and amenities by enlarging the 'market' for them, it could also degrade conditions for those programs that *require* non-urbanized environs: the Ecological Study Area, the Botanical Garden, the Field Station for Behavioral Research, and the Strawberry Canyon Recreation Area.

Moreover, existing Hill Campus programs report significant problems in sustaining those critical linkages with the core campus, due in part to their physical isolation, and in part to the problems this isolation creates for transportation and infrastructure services. Since the trend in research is inexorably toward more interactive and collaborative endeavors, *future investment in new research space at UC Berkeley should, as prescribed in the Strategic Academic Plan, be concentrated at locations on and adjacent to the core campus.*

PROPOSAL 5. The 2020 LRDP should focus new capital investment in Hill Campus research facilities on renovation and new construction to serve existing Hill Campus programs.

BOTANICAL GARDEN. One such candidate for future renovation and expansion is the Botanical Garden, which hopes to triple its student, faculty and public visitors by 2020.[20] Expansion of the Garden grounds to the east has been proposed in several previous campus plans, including the 1984 Task Force Report[21] and the 1990 LRDP, which recommends an expansion of roughly 40 acres.

PROPOSAL 6. The 2020 LRDP should confirm the future expansion of the Botanical Garden as described in the 1990 LRDP, and should accommodate the investments required to meet its objectives for program growth.

ACTION 6.1. Update the 1981 master plan for the Botanical Garden. The new master plan should describe the proposed site expansion, including how its interface with the Faunal Refuge Area is designed and managed, as well as the capital investments in grounds and structures required through 2020. A goal of the new master plan should be to improve the synergy of Botanical Garden and Ecological Study Area programs. The plan should be prepared in collaboration with the ESA management entity described in proposal 1, and the Garden should have an active role in ESA management.

LAWRENCE HALL OF SCIENCE. Although the current facility represents only a portion of the original plan, LHS has no near-term plans for physical expansion. While it projects the number of visitors to double by 2020, it expects to accommodate this growth through internal renovation to increase the amount of usable space.[22] Capital investment at LHS, however, is required not only to reduce the nearly $10 million in deferred maintenance,[23] but also to upgrade the presently inadequate communications infrastructure: the latter is examined further in INFRASTRUCTURE, below.

SILVER SPACE SCIENCES LABORATORY. While some further program growth within the 2020 timeframe is possible,[24] the recent completion of the new SSL building and the retrofit of the original building will meet SSL program needs for at least the near term, and there is some capacity for further expansion within the seismic support structures and on land adjacent to the existing facilities.

MATHEMATICAL SCIENCE RESEARCH INSTITUTE. MSRI does not anticipate significant program growth within the 2020 timeframe, and the existing facility plus the expansion now in design should meet future program needs.[25]

FIELD STATION FOR BEHAVIORAL RESEARCH. Both the 1984 Task Force Report and the 1990 LRDP speculated on the relocation of the FSBR to a more remote site, i.e. Chaparral Hill. This idea seems to be inspired by the FSBR's need for isolation, and the concern this isolation might be compromised by the growth of neighboring research facilities, such as MSRI in 1985 and the SSL annex in 1998.

While the MSRI expansion is now in schematic design, no further expansions to SSL or MSRI are planned at this time. Moreover, as stated in proposal 5, new investment in Hill Campus research facilities through 2020 should focus on existing programs. Therefore, unless new program requirements lead to future expansion proposals by SSL or MSRI, the current level of isolation enjoyed by FSBR should not change significantly in the future, and the substantial investment required to relocate FSBR from its current site is not warranted.

While no new facilities are required at FSBR, several buildings and animal enclosures would benefit from renovation, and the existing communications infrastructure is inadequate: the latter is examined further in INFRASTRUCTURE, below.

PROPOSAL 7. The 2020 LRDP should assume the FSBR remains on its present site, at roughly current levels of activity.

RECREATION

Haas Clubhouse has a poor seismic rating and significant deferred maintenance and, along with the pools, requires renovation or replacement during the 2020 LRDP timeframe. The Strawberry Canyon Recreation Area also shares with several other Hill Campus programs the problem of inadequate communications infrastructure, examined further in INFRASTRUCTURE.

However, the most critical *program* need for Recreation and Athletics is level field space. While the rugged terrain in the Hill Campus generally precludes this use, the EBRP site at Grizzly Peak and Centennial may be able to accommodate one or more regulation size playfields. The potential construction of playfields for campus or shared campus-public use on this site should be pursued if further engineering studies indicate it is feasible.

While campus use of this EBRP owned site might be pursued as part of a larger conversation over the transfer of Claremont Canyon, EBRP may also be receptive to the idea on its own merits: if the campus is able to provide the capital investment to build the playfields, a shared campus-public use arrangement may be acceptable to EBRP, and should be explored.

PROPOSAL 8. The 2020 LRDP should assume Strawberry Canyon Recreation Area remains in its present form, albeit with potential renovation and expansion, or relacement, of the buildings and pools in conjunction with seismic improvements.

ACTION 8.1. Prepare a master plan of the entire Strawberry Canyon complex as a first step in identifying the scope of seismic and other improvements to buildings and pools.

ACTION 8.2. Conduct a technical analysis of the EBRP-owned potential playfields site at Centennial and Grizzly Peak. Capital Projects has completed a topographic survey and initial concept study of this site, which suggest the site may have potential for redevelopment as practice and/or recreational fields, and merits further engineering analysis in terms of both grading and infrastructure requirements.

HOUSING

One form of new capital investment that *should* be encouraged in the Hill Campus is faculty housing. The northwest promontory site is one potential location for housing, as proposed in the 1990 LRDP, but other sites should also be explored. Housing is not only a relatively adaptable and nondisruptive land use compared to large research facilities, it would also provide an after-hours presence in the Hill Campus that could improve safety and security. Moreover, a supply of good, reasonably priced faculty housing would provide a significant strategic benefit to the entire campus, including Hill Campus programs.

The study committee has also pointed out a substantial demand for housing for visiting scholars. MSRI alone is visited by over 1000 scholars each year, many for significant periods of time. This demand is not unique to the Hill Campus: many core campus departments also have substantial numbers of visiting scholars.

The campus conducted a survey of visitor housing needs in late 1997, but this survey focused on conference and other short-term visitors, in the context of a proposed downtown hotel and conference center. While the campus does need such a facility, downtown Berkeley is the best place for it, due to its scale and the access and services it would require.

The longer stays typical of visiting scholars, however, suggest an alternate housing type, more residential in character. This housing type would not involve extensive on-site conference facilities, would have modest service demands, and thus, if properly designed, could be suitable for one or more Hill Campus locations. LBNL has identified a similar need for visitor housing, and has already begun to investigate potential sites: future analyses of visitor housing by UC Berkeley should be conducted in conjunction with LBNL, as suggested in action 9.2.

PROPOSAL 9. Pending further technical analysis, the 2020 LRDP should designate up to 3 sites as reserve sites for faculty and/or visitor housing, as shown in figure 3.

Reserve site H1 is the northwest promontory site designated for housing in the 1990 LRDP, but enlarged to include the area north of Centennial Drive. Reserve site H2 is the current upper terraces parking lots: while further study is required, a mixed-use project that include both the replacement of existing parking and new terraced housing could make far better use of this already extensively altered site. Reserve site H3 is currently utilized by PPCS as a staging area, but due to the steep terrain and the proximity of the creek, this is a poor use of the site, as described above in CURRENT LAND USE.

ACTION 9.1. Conduct a survey of the entire UC Berkeley campus and LBNL to assess the demand for both short-term and long-term visitor housing. The campus survey is being administered by OSR: results are expected by spring 2003.

ACTION 9.2. Based on the survey results, request the campus' Real Estate Advisor to begin the initial steps toward third-party development of faculty and/or visitor housing on reserve sites H1 and H2, with Capital Projects technical support. These efforts should be pursued in collaboration with LBNL.

ACTION 9.3. Identify a long-term solution for those PPCS functions presently located on the Poultry Husbandry site. While PPCS may continue to use this site as an interim facility in the near term, an environmental study of the site should be performed to assess its impact on the water quality and riparian habitat of Chicken Creek, and prescribe mitigations commensurate with this interim use.

TRANSPORTATION

While Hill Campus programs have only limited interactions with one another, they all have strong and critical linkages to the core campus. There is a strong perception among the study committee that transit service to and from the core campus is inadequate, due both to the hours and frequency of service and, for some programs, the configuration of the route.

Except for the first and last runs, the hill shuttle presently originates at the Mining Circle, which is problematic for several Hill Campus constituencies: not only is the BART station located at the west end of campus, but so are the life-science students and faculty who use the Botanical Garden and the Ecological Study Area. Moreover, many study committee members report a need for more frequent service and for extended shuttle hours.

Some initiatives are already underway. First, under the fall schedule for the hill shuttle, headways will be decreased from 30 to 20 minutes during the peak a.m. and p.m. periods (roughly before 9:50 and after 4:50). P&T will assess the effectiveness of this change at the end of the semester. Second, the replacement of the hill bus has been planned for over two years: P&T has arranged to acquire several small (15-20 passenger) buses from AC Transit, but while these were expected this year, now they may not be available until 2003 or later: P&T is investigating a vendor lease as an alternate.

P&T has not received any formal requests for other service enhancements, and therefore have not assessed their potential cost or feasibility. In general, however, it is the policy of P&T to first try to accommodate such requests by adjusting existing shuttle routes and schedules, in ways that do not significantly increase costs. If these adjustments are not adequate to meet the need, the policy is to have the requesting departments cover the cost of further enhancements. P&T has offered to assess the cost of such enhancements, but the first step is to define those enhancements through a survey of Hill Campus programs.

ACTION 10.1. Conduct an opinion survey of Hill Campus programs to identify the transit improvements desired. Capital Projects has completed this survey: a summary of results is presented in the Appendix.

ACTION 10.2. Request Parking & Transportation to prepare a feasibility analysis of enhancements to hill shuttle service, based on the survey results. As part of this analysis, Parking & Transportation should determine if any of the desired service enhancements can be achieved through collaborative efforts with LBNL, which runs its own shuttle service.

INFRASTRUCTURE

Many Hill Campus programs report problems with utility services in general and communications service in particular, in terms of both capacity and reliability. With respect to utility systems (power, natural gas, water, steam, sewer and stormwater), it is more useful to assess these systems campus wide, since their adequacy is a function of system capacity as well as delivery. Such an assessment will be conducted as part of the 2020 LRDP update.

However, the infrastructure concern most often mentioned by far among study committee members is the adequacy of communications systems. While service has very recently been improved in some areas of the Hill Campus, a number of problems remain.

New fiber optic cable was recently run to SSL and to the Botanical Garden. The SSL line provides high bandwidth *system capacity* to the entire north end of the Hill Campus. However, the *conduit capacity* to extend this service to other local users may not presently be available, either because the existing conduit is full or no conduit exists.

This is a particular problem for Lawrence Hall of Science, where network capacity is already inadequate to serve its many educational programs, and for FSBR, which presently has only T1 service through Pac Bell. An engineering study is required to determine the cost and feasibility of extending high bandwidth service from the SSL terminus to LHS, MSRI and FSBR.

While the Botanical Garden has also recently obtained high bandwidth service at its administration building, the Strawberry Canyon Center and Recreation Area have only T1 service over copper cable. The cost of new fiber cable to these buildings from the core campus has been estimated at $1 million for data service alone: this cost would increase significantly if voice services were improved as well. However, improved service could instead be obtained through ATT by extending fiber cable from the adjacent residential areas to Haas Clubhouse and Strawberry Canyon Center: the cost for service to the Clubhouse has been estimated at roughly $100,000.[26]

PROPOSAL 11. The 2020 LRDP update should include a comprehensive analysis of campus infrastructure capacity with respect to future campus growth and program evolution. This analysis should, moreover, reflect the basic principle that the entire campus, including the Hill Campus, should receive the same level of services and infrastructure.

■ NEXT STEPS

The proposals in the previous section will guide the preparation of the 2020 LRDP, which is now underway. However, the previous section also identifies a number of studies and other actions staff need to undertake in order to provide more specific guidance for individual sites or programs. The results of these studies will be forwarded to the study committee for review and comment as they are completed.

The administrative draft of the 2020 LRDP is scheduled to be completed and distributed for internal campus review in late spring 2003: the Hill Campus study committee will be requested to serve as reviewers of the administrative draft.

APPENDIX: SUMMARY OF HILL SHUTTLE SURVEY RESULTS

We received 170 responses to our hill shuttle survey. Of the total, 88 came from Space Sciences Laboratory, 51 from Lawrence Hall of Science, 21 from Mathematical Sciences Research Institute, 8 from the Botanical Garden and 2 from Recreational Sports.

To keep things simple, in the summary table below each result is presented as the 'percentage of total respondents who checked this box'. Some of the respondents left questions unanswered, so some of the percentages total less than 100% (or in the case of questions 3 and 4, less than 300%, since for those questions respondents were asked to make 3 selections). More detailed cross-tabular analysis is possible if desired: this summary just presents a brief overview of the survey results.

A number of respondents used the 'other' boxes in questions 3 and 4. While many of these comments are variations on the preset options already in the survey, the 'other' comments do reveal at least one significant concern the present options do not cover, as described below. Also, five respondents noted that, while shuttle headways are 20 minutes at peak am and pm hours, they are 30 minutes during the rest of the day. This was a flaw in the survey design, which refers only to the 20 minute headway, and staff regret any confusion this may have caused the respondents.

Overview. Perhaps the most significant finding is revealed in the answers to questions 1 and 5. Question 1 asks how often the respondent uses the shuttle now, while question 5 asks how often the respondent would use the shuttle if the service improvements s/he selected in question 4 were implemented. The results suggest shuttle demand may have limited upside potential: whereas 39% of respondents now use the shuttle for at least 3 round trips a week, this number would rise to only 55% if the suggested improvements were implemented. The percentage of respondents who would use the shuttle for at least 5 round trips per week would rise only from 23% to 28%.

Moreover, a clear majority of respondents, 63%, would not be willing to pay any more for shuttle service to fund the improvements they recommend. 24% would be willing to pay $10 per month, and only 4% would pay $20 per month. The survey results indicate that service improvements might result in only a modest increase in frequent ridership, while at the same time the campus might encounter resistance to any increase in fares to fund those improvements. On the other hand, only 4% of respondents indicated shuttle fares are too expensive now.

53% of respondents indicated they use the shuttle for trips to campus during the day, while another 16% indicated they use it for campus trips and home-to-work trips in roughly equal amounts. Give the greater use of the shuttle for trips to campus, it is perhaps not surprising that the most popular service improvements were those which are relevant to campus trips as well as to home-to-work trips: namely, extending every shuttle run to downtown Berkeley at 49%, and reducing shuttle headways at 46%. In contrast, extending the shuttle schedule to early morning, late evening and/or weekend hours may have greater importance to home-to-work trips, since the core campus is significantly less active during these times. It is worth noting, however, that weekend service could also be beneficial to visitors, who are not captured in this survey.

With respect to the comments entered in the 'other' boxes in questions 3 and 4, the complaint mentioned most often by far was the long duration of the journey from home to work via public transit, including the shuttle. 12% of all respondents made specific comments about *either* the duration of the multi-mode trip as a whole, *or* more specific comments about the poor linkages of the shuttle to AC, to BART, or to other campus shuttle routes.

Implications. The survey results suggest the most popular service improvements would be to extend all shuttle runs to west campus and to downtown Berkeley, and to reduce headways, particularly the 30 minute headways during mid-day. As the study committee has pointed out, trips by hill workers to the central campus often have west campus destinations, and many of those trips occur during mid-day.

However, the decision on which, if any, service improvements may be feasible for the hill shuttle are a function of cost as well as demand. The extension of shuttle hours, for example, while requested by less respondents than route extension or reduced headways, may also be less costly if they can be implemented merely by increasing driver hours rather than by also purchasing another vehicle.

As a next step, staff recommend the Director of Parking and Transportation review these findings and comment on the most promising areas for further investigation, from the perspective of campus transportation operations as a whole.

Hill Shuttle Survey Results (n=170)

1	How often do you use the campus hill shuttle?		
	Occasionally or less than once a week	60	35%
	1-2 round trips per week	43	25%
	At least 5 round trips per week	39	23%
	3-4 round trips per week	27	16%
2	What do you use the campus hill shuttle for?		
	Travel to and from central campus during the day	90	53%
	Travel to and from home	51	30%
	Both in relatively equal amounts	27	16%
3	If the hill shuttle is not your primary mode of transportation to and from the hills, why not? (select 3)		
	20 minute headways not frequent enough	38	22%
	Must drive due to personal trips before/after work	34	20%
	Shuttle doesn't run early/late enough	27	16%
	No direct service to west campus, have to transfer	23	14%
	Trip to/from campus takes too long	22	13%
	Shuttle doesn't run on Saturday/Sunday	22	13%
	Must drive due to work trips during the day	11	6%
	Prefer to carpool, vanpool or use other alternative	11	6%
	Shuttle fare too expensive	7	4%
	Prefer to drive because it's more pleasant	5	3%
	Prefer to take AC Transit (lines 8 or 65)	3	2%
	Don't feel safe taking/waiting for shuttle	2	1%
	Doesn't go to LBNL	1	1%
	Other	50	29%
4	Would you use the hill shuttle more often if it were changed so (select 3):		
	Every shuttle went to downtown Berkeley	83	49%
	The shuttle ran more frequently than every 20 min	78	46%
	The shuttle ran earlier in the morning (before 7:40 am) and/or later in the evening (after 7:40)	56	33%
	The shuttle ran on Saturday and Sunday	49	29%
	The shuttle was equipped to better accommodate bikes	28	16%
	The shuttle also served LBNL	3	2%
	Other	40	24%
5	If the changes you selected in question 4 were made, how often do you think you would use the shuttle?		
	At least one round trip per day	48	28%
	3-4 round trips per week	46	27%
	1-2 round trips per week	38	22%
	Occasionally or less than once a week	9	5%
	Never	1	1%
6	In order to fund the changes you selected in question 4, how much more would you be willing to pay for shuttle service?		
	No more per month	107	63%
	$10 more per month	41	24%
	$20 more per month	7	4%
	$30 more per month	0	0%
	$40 more per month	0	0%

Hill Shuttle Survey Results (cont)

7	Please give us your opinion on the rear exterior 5-bike racks found on some buses:		
	Convenient to use OR	18	14%
	Difficult to use	19	15%
	Adequate bike capacity OR	29	22%
	Inadequate bike capacity	5	4%
	I feel safe loading/unloading my bike OR	19	15%
	I feel unsafe loading/unloading my bike	13	10%
	The racks are damaging to my bike OR	16	12%
	The racks are not damaging to my bike	12	9%
8	Please give us your opinion on the front exterior 2-bike racks found on some buses:		
	Convenient to use OR	32	19%
	Difficult to use	2	1%
	Adequate bike capacity OR	3	2%
	Inadequate bike capacity	28	16%
	I feel safe loading/unloading my bike OR	27	16%
	I feel unsafe loading/unloading my bike	5	3%
	The racks are damaging to my bike OR	2	1%
	The racks are not damaging to my bike	26	15%

ENDNOTES

1 UC Berkeley Chancellor Tien and LBNL Director Shank, *Letter of Cooperation Regarding Hill Area Management*, 29 March 1996.

2 *UC Berkeley Long Range Development Plan 1990-2005*, page 31

3 *UC Berkeley Strategic Academic Plan*, http://spc.vcbf.berkeley.edu/document/AcademicStrategicPlan.pdf

4 History drawn from Helfand, *Campus Guide: University of California, Berkeley*, Princeton Architectural Press 2002 and Mandel, *Working Paper: Hill Area Update*, UC Berkeley Capital Projects July 2002

5 EBMUD conveyances of 20 March 1951 and 31 October 1961

6 Mandel, page 8

7 Bartoleme, *Hill Campus Study Committee Survey*, 13 May 2002

8 Mandel, page 28

9 Mandel, page 24

10 McBride and Beatty, *Management Plan for Strawberry and Claremont Canyons*, UC Berkeley Conservation and Environmental Quality Committee, 1979

11 Mandel, page 42

12 Mandel, page 38

13 Mandel, site inspection

14 Mandel, page 87

15 Mandel, page 87

16 LaPorte et al, *Hill Area Task Force Report: UC Berkeley Campus Space Plan*, April 1984

17 LaPorte et al, page 70

18 LaPorte et al, page 69

19 Mandel, page 49

20 Botanical Garden, *Hill Campus Study Committee Survey*, 13 May 2002

21 LaPorte et al, page 28

22 Carmichael, *Hill Campus Study Committee Survey*, 13 May 2002

23 Pacific Partners Consulting Group, *Model Results for UC Berkeley: UC Capital Renewal/Deferred Maintenance Study*, September 2000

24 Lin, *Hill Campus Study Committee Survey*, 13 May 2002

25 Eisenbud, *Hill Campus Study Committee Survey*, 13 May 2002

26 Kim/Kreutzen, UC Communications & Network Services, conversation/e-mail 21 August 2002

RICHMOND FIELD STATION WORKING PAPER

A STUDY IN SUPPORT OF THE 2020 LONG RANGE DEVELOPMENT PLAN

NOVEMBER 2002

The purpose of Working Papers is to document findings, identify concepts for further consideration and investigation, and inspire creative thinking. They do not represent decisions made nor policies adopted by the University.

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Appendix

List of Development Principles and Actions

Utilities Report

Richmond Field Station Study Committee

Vice Provost William Webster, Academic Planning and Facilities, Co-Chair

Assistant Vice Chancellor Tom Lollini, Capital Projects, Co-Chair

Professor Frank Beall, ESPM, Director Forest Products Lab

Assistant Director Steven P. Campbell, Institute for Transportation Studies

Professor Robert Cervero, City and Regional Planning

Professor Gregory L. Fenves, Earthquake Engineering Research Center

Professor J. Karl Hedrick, Chairman, Mechanical Engineering

Professor James Hunt, Civil Engineering

Senior Planner Kevin Hufferd, Capital Projects

Professor Adib Kanafani, Cahill Professor and Chair, Civil Engineering

Professor Emeritus William Lidicker, Integrative Biology

Associate Professor Louise Mozingo, Landscape Architecture

Associate Vice Chancellor Robert Price, Research

Scott Shackleton, Director of Facilities, College of Engineering

Assistant Director Ray Shiflett, Space Management and Capital Programs

Professor Wayne Sousa, Integrative Biology

Associate Dean Jay Stowsky, Haas School of Business

Professor Martin Wachs, Director, Institute for Transportation Studies

1 INTRODUCTION

Background

The campus is embarking on a new Long Range Development Plan to guide capital investment at UC Berkeley through 2020. Richmond Field Station (RFS) has the potential to play a significant long-term role in the campus' future growth, and how this site is developed may, in turn, affect both the nature and magnitude of growth on and around the core campus.

Since its acquisition by the University in 1950, the Richmond Field Station has primarily served as a site for large-scale research testing facilities that were not appropriate for the core campus. Since the mid-1980's the Berkeley campus has explored ways to broaden and intensify usage of the site. An Administrative Draft Master Plan for the property was completed in 1993. However, this plan was never finalized and there has been virtually no new development at the site since the completion of the draft plan.

Purpose of Working Paper

The goal of this working paper is to establish a land use framework for RFS that reflects an optimal balance of program needs and environmental stewardship. Toward this end, a Planning Study Committee was formed in April 2002 to identify and characterize those program needs, and help determine how they might best be accommodated. The objectives for the Committee and this working paper were to:

- Assess the value of RFS for instruction, research, recreation and other potential uses - including habitat and resource conservation - and define the physical features that indicate the areas of greatest value for each use.
- Identify the needs of current users at RFS, and anticipated changes through 2020.
- Identify known and potential demands of other users through 2020, including programs now located on the core campus.
- Define a set of principles for development of RFS through 2020, including land use, protective measures for sensitive/valuable areas, and key capital investments and management practices required to support these principles.

Related Plans

This paper is intended to support and complement the UC Berkeley New Century Plan. The scope of the initial versions of that document covered the core campus and environs. The Richmond Field Station Planning Study is one of several studies of peripheral campus properties that will augment the New Century Plan. The campus has also just completed a Strategic Academic Plan. This document sets forth the academic goals of the campus. The RFS working paper has been informed and guided by the findings of Strategic Academic Plan.

2 SITE CONTEXT & PHYSICAL FEATURES

Context

Location. The Richmond Field Station is located on the Richmond south shoreline approximately 6 miles, or about 15 minutes by car, from the UC Berkeley core campus. It is easily accessible by freeway via Interstate I-580 by two interchanges. The nearest BART station is approximately one mile away. The property's bayside location offers both potential research and amenity advantages.

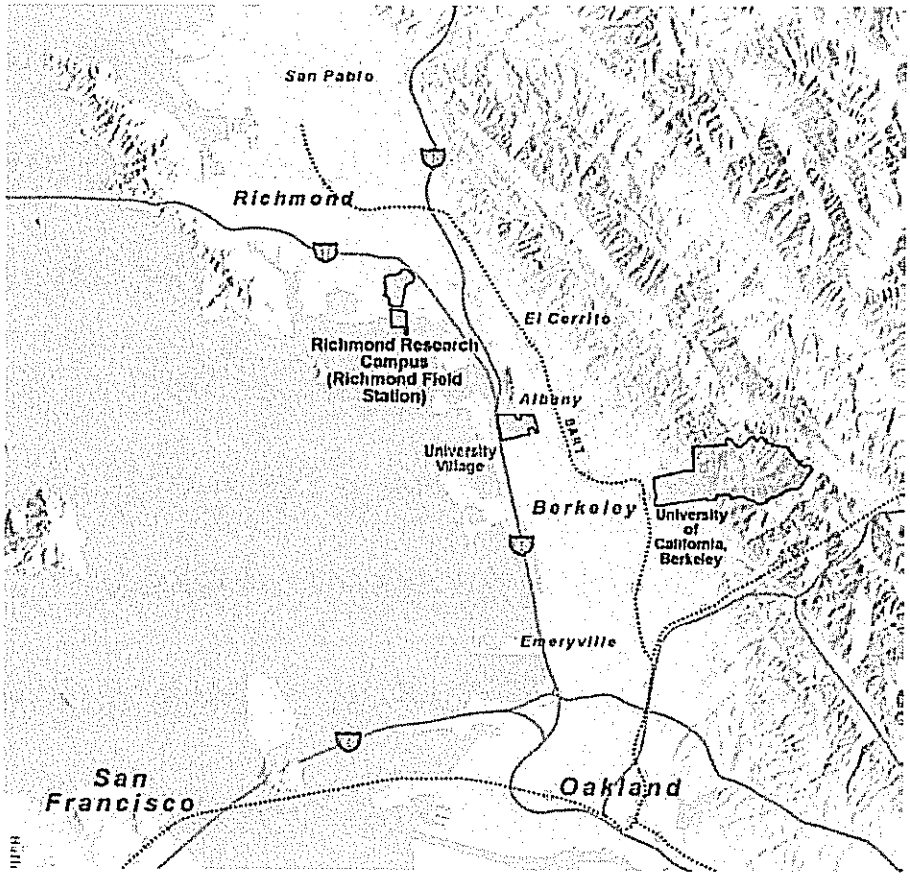


Figure 1: Location of Richmond Field Station

Richmond South Shoreline. The area surrounding the property has undergone rapid change over the past decade. The City has completed the redevelopment of the adjacent former Kaiser Shipyard into a housing complex with 1,300 housing units, marina, parks and trails. With the completion of the Knox Freeway (I-580) in 1990, the area has also begun to attract new R&D uses. The first such development occurred on the Ford Peninsula just to the west of the new marina. In recent years, new R&D development has occurred on former industrial lands just to the west of the Richmond Field Station with the development of the first phases of the State Department of Health Service laboratory and the DiCon Fiberoptics headquarters. The 90-acre industrial property just to the east of the Field Station is about to be redeveloped by a private developer into a new R&D campus.

Figure 2: Richmond South Shoreline

Site Physical Features

Valuable Habitat Areas. The existing biological conditions at the University's Richmond property were documented in a 1994 environmental report[1]. That report mapped the significant habitat areas at the site, most notably the native grasslands and wetlands (see Figures 3 and 4 below). The wetlands and grasslands also provide opportunities for teaching and research as well as serving as recreational amenities.

Grasslands. The native Coastal Terrace Prairie grasslands are especially valuable, both scientifically and historically, since they constitute the best and last remaining example of an ecosystem that once proliferated on the shores of the San Francisco Bay.

The best remnants of this habitat can be found in the western portion of the property just to the east of the long Fog Chamber building (Building 280) and to the west of the EPA lab. These areas are labeled "Undisturbed Coastal Terrace Prairie" in Figure 3. Those areas labeled "Disturbed Coastal Terrace Prairie" are also considered valuable.

Wetlands. Some of these grassland areas also appeared to qualify as seasonal wetlands under Clean Water Act criteria[2]. Seasonal wetlands are lands that contain certain soil and vegetation types and that remain inundated or saturated for an extended period of time during the growing season (usually a week or more).

[1] Brady and Associates Planners and Landscape Architects, Richmond Research Center Master Plan Environmental Impact Report: Existing Conditions and Constraints Report, prepared for the University of California, Berkeley, January 28, 1994.

[2] U.S. Clean Water Act, Section 404.

In addition to these seasonal wetlands in the upland portions of the property, there is a tidal marsh in the southern portion of the site. These areas are labeled "Section 404 Wetlands" or "Section 10 Waters of the U.S." on Figure 4.

These wetlands provide valuable habitat for a variety of fauna and help to filter and clean water. As a result these lands fall under the protection of the U.S. Army Corps of Engineers and other regulatory agencies.

Eucalyptus Stands. The property contains a number of eucalyptus stands that were planted as wind breaks and blast mitigation when the site served as the location of the California Cap Company. These stands help to establish a visual identity for the site. And while not native to the site, the large central stand of eucalyptus provides habitat for raptors and wintering monarch butterflies.

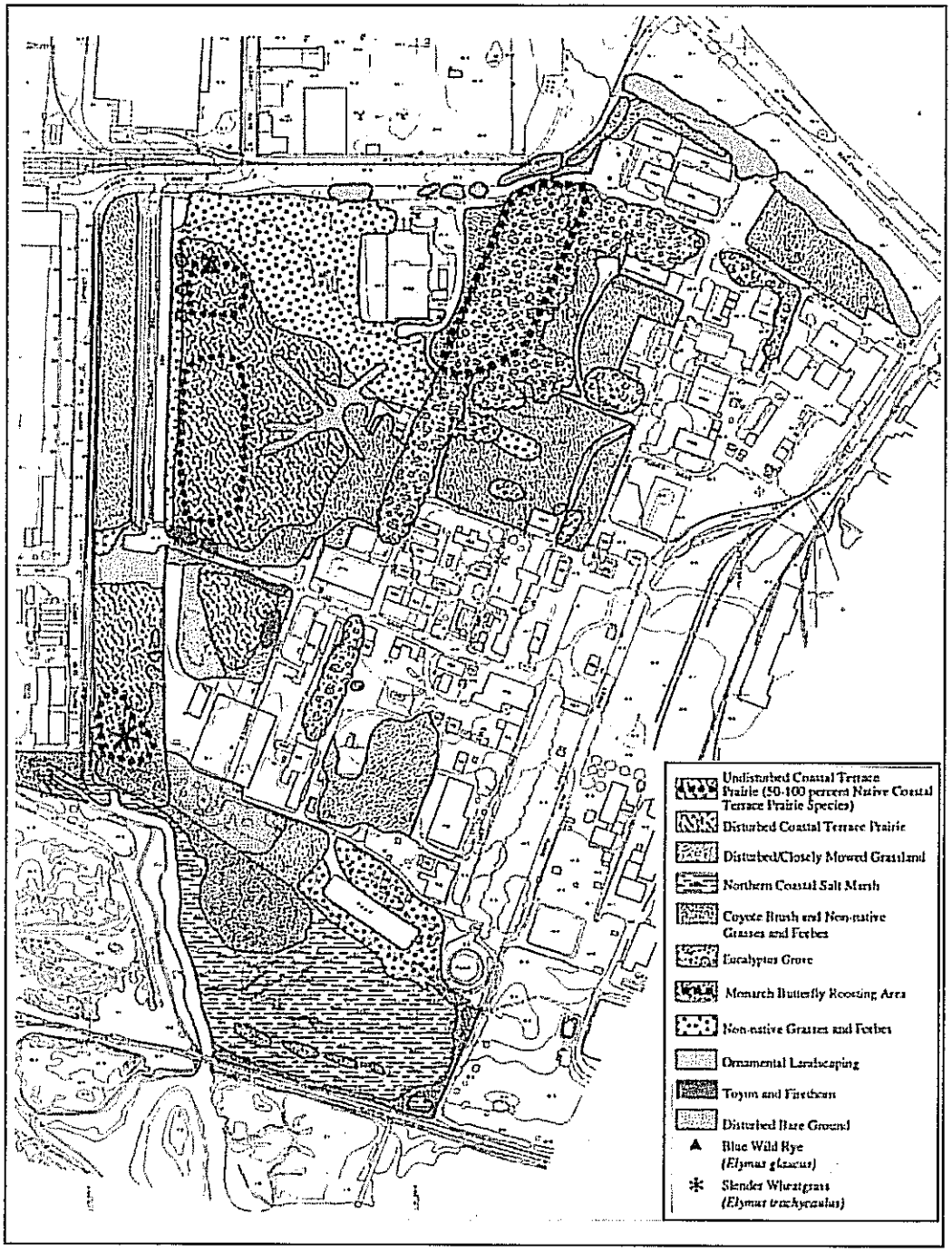


Figure 3

Grasslands and Other Habitat Areas

Source: Brady & Associates, Existing Conditions and Constraints Report, 1994

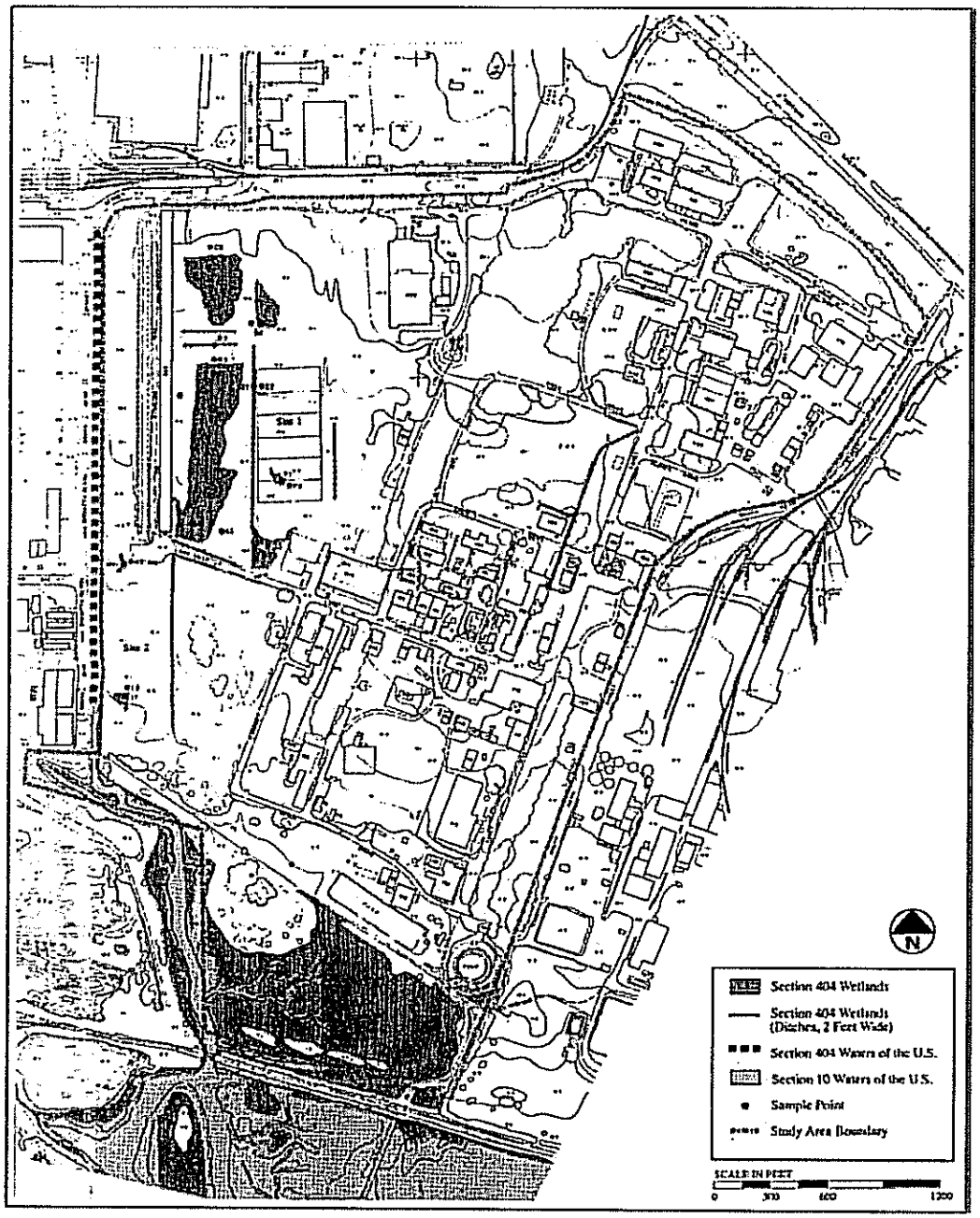


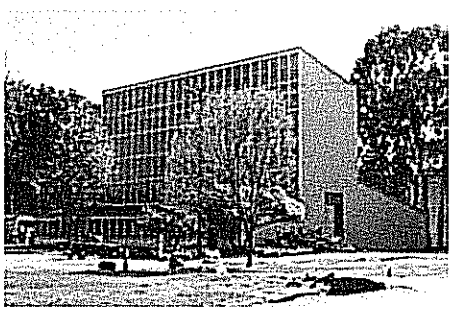
Figure 4
Wetland Areas

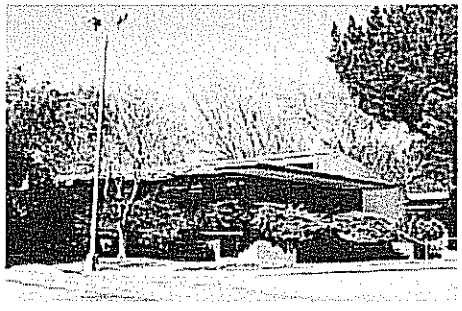
Source: Brady & Associates, Existing Conditions and Constraints Report, 1994

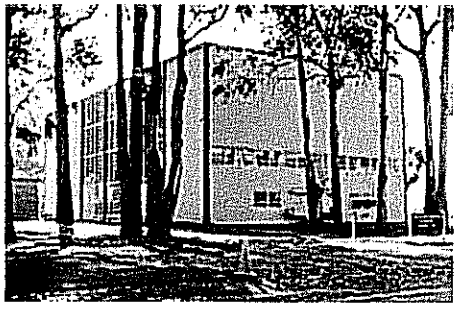
Existing facilities. The eastern portion of the Richmond Field Station has been developed and used for a variety of industrial and research purposes since at least 1880. All of the structures in the northeast quadrant of the site were built by the University after it acquired the site in 1950. These include a number of large-scale testing facilities that continue to support campus research needs.

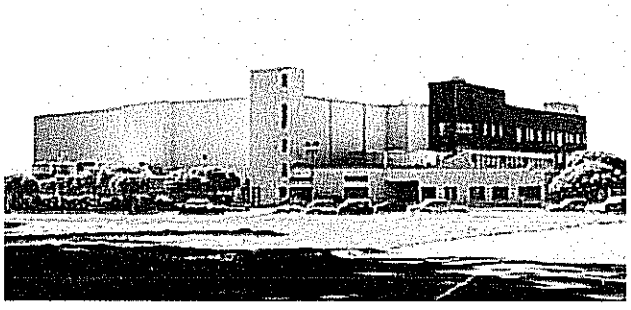
Most of the structures in the remaining area to the east of the eucalyptus trees are one-story wooden structures built prior to 1940. While these older structures currently provide space for University research activities, they do not efficiently use the site. This area of the site could house a much greater quantity of research and office space if these buildings were replaced with newer, multi-story structures. While the age of some of these structures suggests that they may be historically significant, balancing the University's conservation and development values suggests that this area of the site be completely redeveloped over time.

Several areas to the west of the central stand of eucalyptus trees are also developed. These include the 3.3-acre site for the Region 9 Environmental Protection Agency analytical laboratory and the site for the Northern Regional Library Facility (NRLF). The NRLF is planned to grow in phases over time. There is currently no upper limit on the size of the facility. It is expected that the building will expand to the west approximately to the point where South 34th Street would intersect with the University's property.









Selected Existing Facilities. From left to right, top to bottom: Structrual Testing Facility (Bldg. 484); wooden buildings dating from prior to 1940 (Bldgs. 190 and 196); Earthquake Engineering's research offices (Bldg. 481); Earthquake Engineering shaking table facility (Bldg. 420); Northern Regional Library Facility (Bldg. 400).

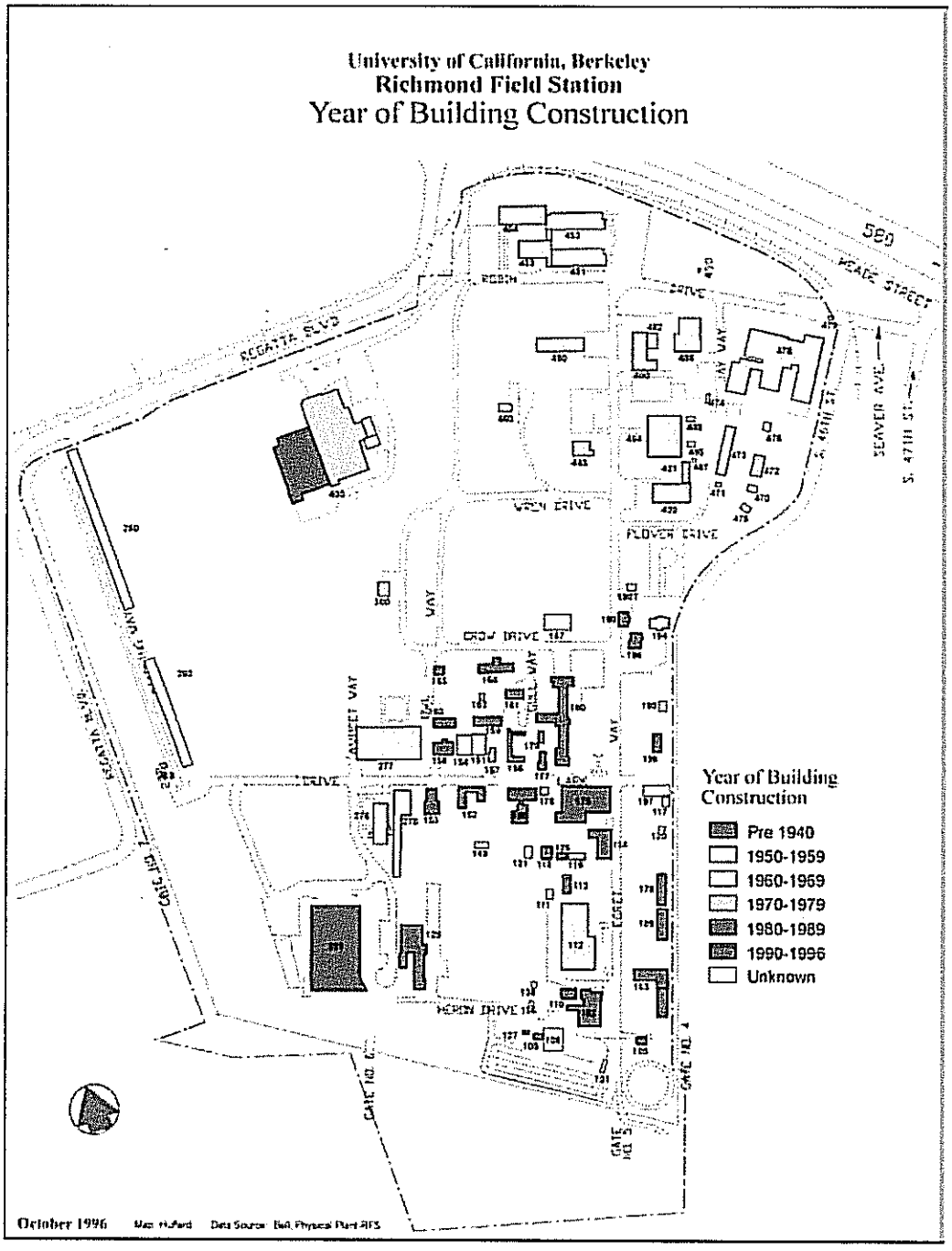


Figure 5

Existing Structures by Period of Construction

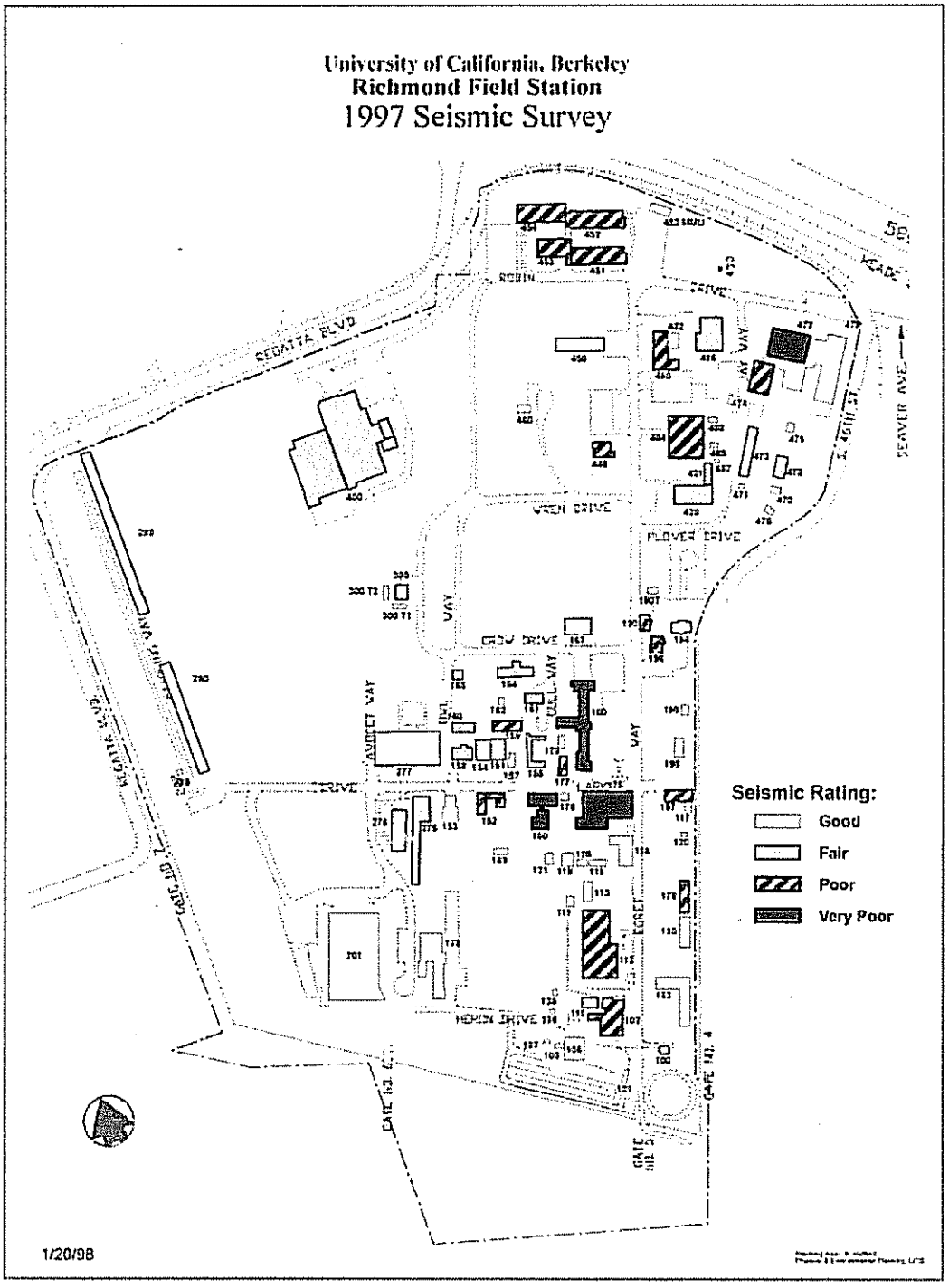
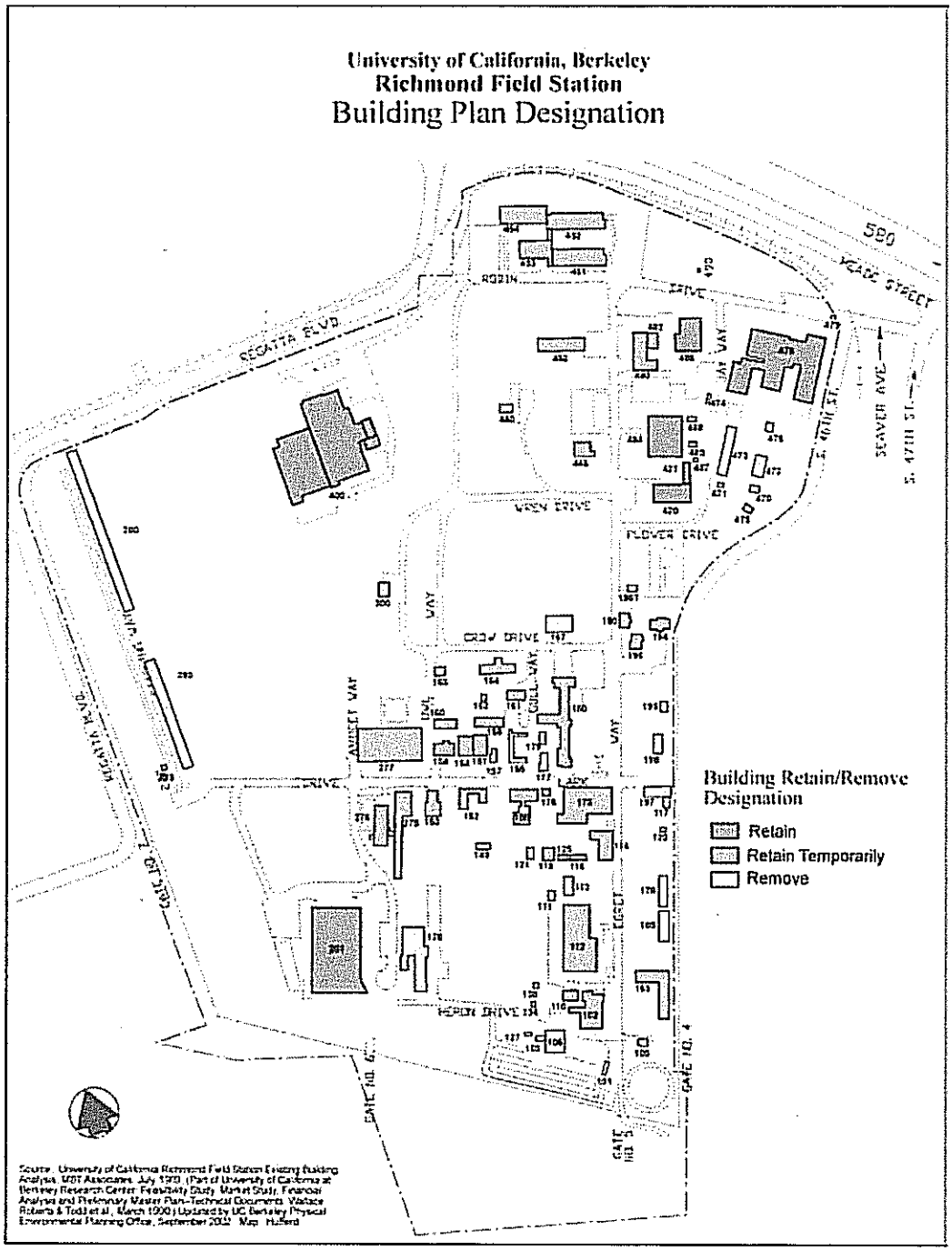


Figure 6

Seismic Ratings of Existing Structures



Source: University of California Richmond Field Station Existing Building Analysis, MDT Associates, July 1990. (Part of University of California at Berkeley Research Center Feasibility Study, Market Study, Financial Analysis and Preliminary Master Plan–Technical Documents. Wallace Roberts & Todd et al., March 1990.) Updated by UC Berkeley Physical Environmental Planning Office, September 2002. Map: HuBerd

Figure 7

Retain/Remove Designation for Existing Buildings

Site Infrastructure and Amenities. There is a general perception among Berkeley campus faculty that the overall quality of the infrastructure and amenities at Richmond Field Station are of poor quality and insufficient to meet the demands of high quality university research.

Utilities. While it is true that certain utilities are in need of improvement, the upgrading of these systems, while essential, does not represent a significant barrier to development of the site. A sub-committee of the RFS Planning Committee reviewed the status of the utilities on the site (see Appendix). The sub-committee's report noted that the quality of the data network at the RFS actually exceeds that on the central campus. The most critical utilities systems in need of improvement are the electrical capacity to the site and the telephone system.

Connectivity to the Core Campus. Perhaps the biggest barrier to increased usage of the RFS properties is the perception on the part of the campus faculty that it is remote and disconnected from the core campus. While the site is approximately 15 minutes by automobile from the Berkeley campus, difficulties in finding parking on or near the core campus add to the difficulty in traveling by car between the two sites. The existing shuttle bus between the RFS and Berkeley campus currently runs on an hourly schedule. This is considered to be inadequate to serve the need for quick for frequent trips between the two sites.

Amenities. The Richmond property is currently poorly served by retail and food services. There is no restaurant or café on the Richmond Field Station and there are few in the immediate vicinity of the site. In addition to being an inconvenience, it is felt that absence of such services limits opportunities for informal interactions and collegiality at the site. While the site has a small exercise facility with weight lifting and other workout equipment, the site suffers from a lack of adequate recreation facilities.

The views of the San Francisco Bay and access to the Bay Trail are among the site's most cherished existing amenities.

Figure 8: View from Richmond Field Station shoreline

3 POTENTIAL UC SITE DEMAND

Value for Potential UC Site Uses. The University's Richmond property has a variety of physical attributes that provide both conservation and development opportunities to serve campus research, instruction, recreation and habitat conservation goals. Certain areas of the property are especially well-suited for the development of research and instruction building space, while other areas are most appropriate for conservation in order to meet a variety of teaching, research, recreation or habitat objectives.

In many instances, conservation and development values can complement one another at the site. For example, the preservation of certain habitat areas provides opportunities for the campus to conduct teaching and research associated with these areas. Additional facilities to house such environmental research and instruction activities, if appropriately sited, could complement the conservation and preservation of these habitat areas. In other instances, conservation and development values must be balanced to optimize the utility of the site to meet a range of University objectives.

The Richmond Field Station Planning Committee reviewed the physical attributes of the site and developed a composite map of the property's key opportunities and constraints (see Figure 9).

Needs of Current Site Users. The Planning Committee surveyed the needs of the current departments using the site. The Committee found that their needs would not come close to filling the total development capacity of the site. Thus, there would clearly be significant capacity for other Central campus programs that might need additional research space at the site.

The anticipated needs of the major current users are outlined below.

PATH Program. The program is growing and is dispersed throughout the Richmond campus. Collocating the programs would enhance collaborations within the unit. Large test tracks are needed and could possibly be relocated to a larger facility (i.e., Alameda Naval Base decommissioned airport runway) in order to free up development sites might be impacted by the current track alignments.

Forest Products Lab. The operation is static and the unit is utilizing all of their space. They would like to consolidate their outlying buildings and have had thoughts of putting a 2-story addition on their main facility.

Integrative Biology. The fields, salt marshes, and tidal mudflats are currently being used for teaching and research. The program needs a facility where students could gather and where equipment could be stored.

Earthquake Engineering Research Center (and PEER). EERC is also housed in several buildings. Currently, a federally funded large-scale experimental facility is being constructed in Building 484. The EERC population will be increasing and one facility with experimental, office and library facilities would be best.

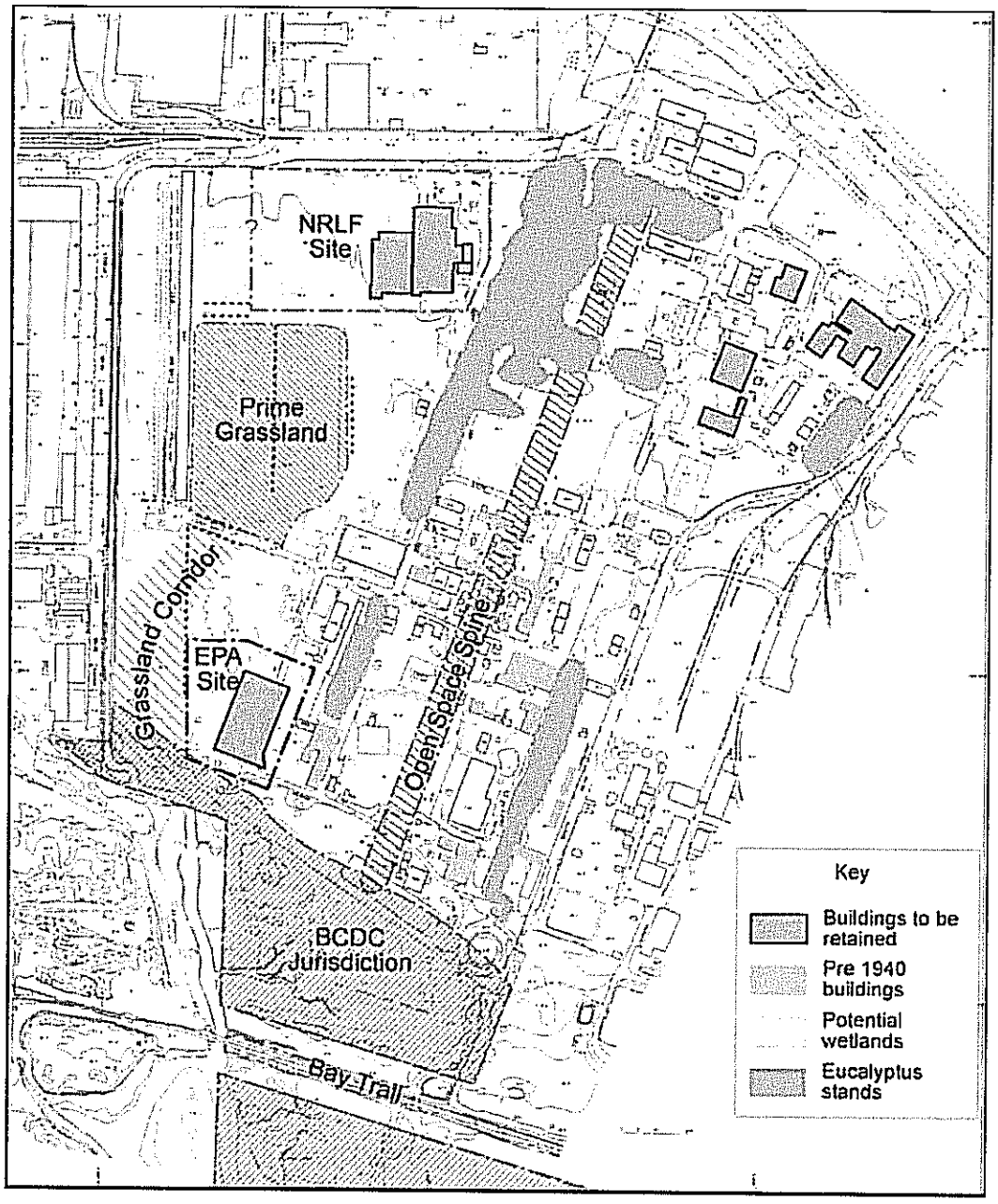


Figure 9
Key Opportunities/Constraints

Institute of Environmental Science and Engineering. Most of the IESE faculty want to be located on campus. Bioengineering faculty are waiting for Hearst Mining Bldg and Stanley projects to be completed so they can move back to campus.

Institute of Transportation Studies (ITS). ITS could utilize a conference center for the ITS Extension Tech Transfer program since it is growing. Also there is a need for a high-grade teaching facility. The much of the pavement research program is moving off site in the next five years, however, some research may continue at the RFS. This may open up space in Building 480 and the Fog Building.

Northern Regional Library Facility. A third phase of the library storage facility has been approved and is expected to begin constructed in the next year. The long-range plan for the library calls for additional phases to be construction over time. The land use plan provides for a total of six phases of the library to be accommodated.

4 RECOMMENDED DEVELOPMENT PRINCIPLES

Land Use. The mapping of site physical features and study committee discussions about the future research needs of the campus lead to an examination of the areas most appropriate for development and those most appropriate for habitat conservation. The study committee then mapped these areas. The resultant land use plan allocates approximately one-half of the Richmond property for habitat conservation/restoration and the other half for development (see Figure 10). The plan preserves the most valuable upland native grassland and wetland habitats and links these areas to the salt marsh via a grassland corridor.

> **Principle 1.** Preserve the most valuable native grassland and wetland habitat areas on the site and link these to the salt marsh via a grassland corridor.

The plan suggests redevelopment of those areas of the site that have been sparsely developed in the past. The area labeled "Core Developable Area" would be the most suitable for gradual, but complete redevelopment into high quality research offices and labs for the University. The development capacity of this 44-acre area could total approximately 1 million gross square feet.[3]

> **Principle 2.** Gradually redevelop the central core area of the Richmond property, replacing the older modest structures with high quality research facilities that complement and support the teaching, research and public service mission of the Berkeley campus.

The land use concept also designates areas that are largely already developed, namely the EPA lab site, the Northern Regional Library Facility (NRLF) site and expansion area, and an area designated for the Large Scale Testing Facilities in the northeast portion of the property. The latter two areas provide for necessary growth.

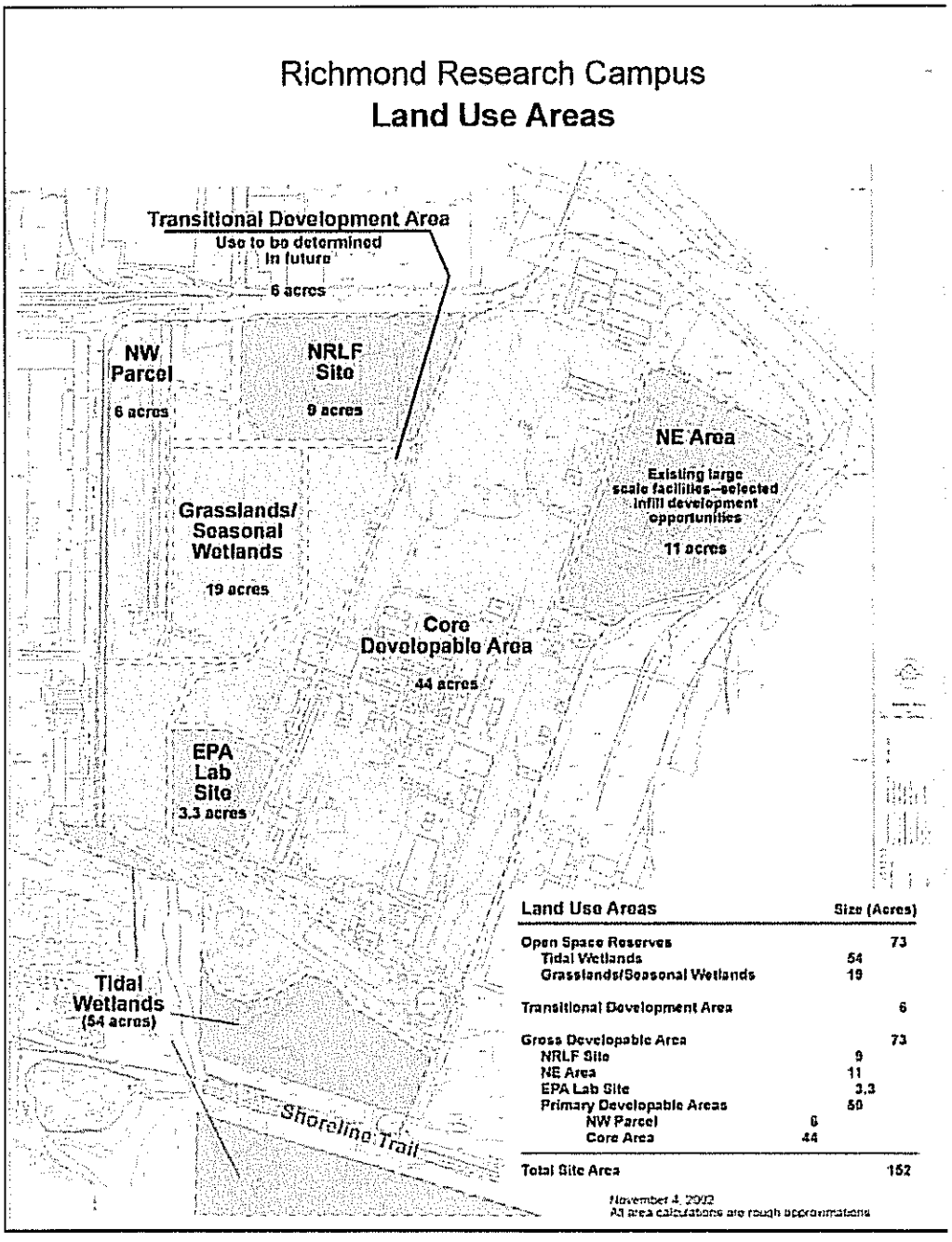
> **Principle 3.** Accommodate the relatively modest growth needs of the current university users of the Richmond property. Concentrate expansion of Large Scale Testing Facilities in the northeast portion of the property.

> **Principle 4.** Include areas that meet the current and future needs of the existing specialized facilities on the site such as the EPA lab and the Northern Regional Library Facility.

An area between the Core Developable Area and the prime grassland/wetland area has been designated as a Transitional Development Area. This area provides a transition area between the developed and native grassland areas of the site and thus has potential value for both. As a result, a decision about the use of this land will be made at a future time.

> **Principle 5.** Designate the area between the Core Development Area and the prime upland grassland/wetland areas as a Transitional Development Area and defer the decision about the use of this area to a future date.

[3] The total development capacity assumes development density of 2 to 3 story buildings and the eventual development of some parking structures. The assumed Floor Area Ratio at build out would be 0.5.



Land Use Area	Development Density	Development Capacity (GSF)
Primary Developable Areas		
NW Parcel	FAR .35 to .5	91,000 – 131,000
Core Area	FAR .35 to .65	671,000 – 1,246,000
NE Area		
Existing		72,000
New	FAR .35	61,000
NRLF		
Existing		185,000
Estimated Additional		420,000
EPA Lab		45,000
Transitional Area	FAR .0 to .5	0 – 131,000
Total Build Out		1,545,000 – 2,291,000

Figure 10
Land Use Area

The Northwest Parcel is separated from the Core Development Area by the grassland and the NRLF and therefore this area may be most suitable for leasing to non-University R&D facilities that have research relationships with the University.

> **Principle 6** Consider development of non-University R&D facilities in the Northwest Parcel of the Richmond Property.

In general, the Richmond property has strong potential to serve as a high-quality auxiliary research campus complementing core campus research programs. While the site has a development capacity for perhaps as much as 2 million gross square feet overall, of which 1.3 million could be new university research space, demand for such potential space has been low due to the perceived remoteness of the site and the lack of high-quality amenities and infrastructure. The university must first make certain strategic investments in the property before the site's potential as a true research campus can be realized. A number of initial strategic investments necessary to improve the connectedness of the site to the core campus and to augment the infrastructure, amenities and facilities on the property are outlined below.

> **Principle 7** In order to greatly enhance the viability of the site for new university research facilities, make strategic investments in the amenities and infrastructure at the Richmond property, to ensure they are of a quality commensurate with a first class research university.
>
> **Action 7.1.** The campus should immediately fund and complete key planning documents necessary to better prepare the site for expedited development, including:
>
> - an overall site master plan, including plans for infrastructure development and an illustrative diagram that will convey the expected high quality research environment at full build out
> - site design guidelines
> - a master plan EIR
> - site management policies and principles

With such investments the site should be more aggressively "marketed" to campus faculty in a variety of research disciplines. An important complement to these investments will be a renaming of the facility to reflect the campus' commitment to a first quality research environment. One suggestion for a new name is the "University of California, Berkeley -- Marina Bay Research Campus."

> **Principle 8** Aggressively "market" the Richmond property to campus faculty as a viable alternative for location of new research facilities.
>
> **Principle 9** Rename the property to reflect the campus' commitment to the site as a first quality research environment.
>
> **Action 9.1.** Campus staff should undertake formal steps to rename the Richmond facility.

While a range of research disciplines could be accommodated on the Richmond site, it is particularly well suited for certain clusters of research activities. Such research clusters include:

- Large-Scale Engineering Research. The site currently houses important research and testing facilities for earthquake, transportation, civil and environmental engineering. In particular, transportation research is likely to demand additional facilities at Richmond. While an excess of such facilities could diminish the potential use of the site for other forms of research, there is room for additional large-scale facilities in the northeast portion of the site.
- Environmental/Sustainability Center. There is a potential to expand upon the academic and research programs currently using the site's natural habitats and to develop a showcase for environmental and sustainable technologies.
- Biotechnology Center. The Berkeley campus could cluster new bioscience laboratories on the site and establish research partnerships with existing and future biotech companies in Richmond and elsewhere in the East Bay.
- IT Center. The facility is currently served by high quality data and networking infrastructure. The Berkeley campus could capitalize on this existing investment by developing the site as a showcase for information technologies.
- Outreach/Education Center. Social science and public policy ORU's and outreach activities could be located on the site taking advantage of the sites accessibility to greater Bay Area. A new center for educational outreach to local schools could be established and might include the creation of a UC-run charter school.
- Retreat/Conference Center. A modest conference facility adjacent to the shoreline could capitalize on the retreat-like natural resources at the site.

Principle 10. Consider creating a wide variety of research concentrations at the Richmond property. Such concentrations or "clusters" could include, but not be limited to: Large-Scale Engineering Research, Environmental/Sustainability Center, Biotechnology Center, IT Center, and, Outreach/Education Center. These site use scenarios are not necessarily mutually exclusive; in fact, a combination of research clusters on the site is likely.

Action 10.1. The campus should study the feasibility of developing a multi-tenant research building. This facility could provide space for UC programs as well as private sector tenants. The University programs might expand into space leased to private tenants if the need arises over time.

Principle 11. Consider development of a modest retreat/conference center on the property.

Action 11.1. Campus staff should examine the feasibility of developing a new conference facility at the Richmond site.

While the Berkeley campus is in need of additional faculty and student housing, long-term residential facilities are not recommended for the Richmond site. This is due in part to the presence of soil and water contamination caused by prior industrial uses on and adjacent to the Richmond property. While the University is embarking upon a plan to clean up the site, it would be prohibitively expensive to meet the clean-up standards for housing. Additionally, the existing

[See RFS Site Use Scenarios Chart in separate PDF file]

critical mass of research facilities and other attributes make it particularly well suited for additional research facilities, while the University's residential needs can be met elsewhere.

> **Principle 12** The Richmond property should not be considered as a location for campus housing, perhaps other than accommodations for short-term visiting scholars or conferences/retreats.

Additionally, it is not recommended that the site serve as a "back office" administration center. Such needs can be better met at the University's facilities at 6701 San Pablo or elsewhere.

> **Principle 13** The development of "back office" administrative facilities at the Richmond property is not recommended.

Natural Habitats/Ecological Areas. The Richmond property contains a number of natural environmental habitats that currently serve as teaching and research resources for the campus and provide the potential for new academic and research opportunities. The habitat types of particular interest are the coastal terrace prairie and the northern coastal salt marsh. Future plans for the site should provide for the preservation of these habitats and should include measures to provide a natural habitat corridor linking the marsh with the upland prairie. While not native, the eucalyptus groves present on the site provide a habitat for raptors and butterflies and provide an important visual identity for the property. It is recommended that the largest stand of these trees in the central northern portion of the site also be preserved.

Because the campus has no formal mechanism for recording and tracking individual research projects making use of these habitats, such projects are often neither informed of one another nor protected from public intrusion and damage. The prime coastal terrace prairie grassland, the wildlife corridor and the marsh and bay lands should be formally designated as an Ecological Study Area (ESA) of the Berkeley campus.

With such a designation, a formal campus management entity could not only maintain a registry of all education and research projects in the ESAs, it could also:

- identify and promote synergy among those projects,
- track external funding prospects for new research initiatives,
- identify and recommend strategies for protection from invasive plants, animals and humans, and
- identify and recommend strategies for improved coexistence of recreation and education/research.

> **Principle 14.** Preserve important natural areas on the Richmond property, particularly the coastal terrace prairie and the northern coastal salt marsh, not only for their value as teaching and research resources, but for their habitat value as well.

> **Principle 15.** The prime coastal terrace prairie grassland, the wildlife corridor and the marsh and bay lands should be formally designated as an Ecological Study Area of the Berkeley campus and a formal management entity be designated to oversee the ESA.

> **Action 15.1.** The Vice Chancellor for Research should establish a formal management entity for the Richmond ESA as soon as possible, and should consider incorporating the

establishment of such a management entity for the new ESA into the emerging strategy for Field Stations.

Transportation. Greatly improved transportation linkages to the core campus are essential in order for the Richmond campus to serve as a true auxiliary research campus. There is general consensus that transit service to and from the core campus is inadequate, due both to the total travel time and frequency of service.

The College of Engineering and Parking and Transportation representatives are currently negotiating with the State Department of Health Services to expand the shuttle frequency from once every hour to once every ½ hour. However, due to changes in the shuttle routing the total travel time could increase from 20 minutes to 30 minutes per one-way trip between the Richmond site and the core campus. The new route would decrease travel time to and from BART, however, by linking directly to the El Cerrito Del Norte station versus the Downtown Berkeley station.

Principle 16. Provide a high-quality, efficient shuttle service linking the Richmond property to the core campus. The shuttle frequencies should be at least once every half hour. The total travel time should be reduced to 20 minutes to the extent possible. The shuttle should also provide access to BART.

Principle 17. Solicit the advice of campus faculty with expertise in transportation on measures to ease transportation between the Richmond property and the core campus. Such measures could include making available environmentally sound car share vehicle, "station cars" and/or the designation of central campus parking spaces for use by Richmond researchers.

Action 17.1. Assuming DHS agrees to cooperate with UC on shuttle services, campus staff should coordinate with the Parking and Transportation staff to monitor the new shuttle service and survey riders about the trade-off between increased travel time to campus and the improved frequency of service and shorter travel time to BART. Staff should study the logistical and financial implications of alternative shuttle plans that could shorten the travel time to campus *and* provide improved access to BART, particularly during commute hours.

Other measures to ease transportation between the Richmond and core campuses should be explored. The campus should consider making environmentally sound car share vehicles available to provide for trips that cannot be accommodated via the shuttle bus. Reserved parking spaces could be provided on the central campus for such vehicles. Parking should continue to be provided for free at the Richmond site for the foreseeable future to encourage greater use of the property.

Action 17.2. Campus planning, parking and transportation staff with input by the Institute for Transportation Studies should evaluate the logistical and financial implications of providing transportation improvements to and from the core campus such as car share or station car vehicles and reserved central campus parking.

Infrastructure, amenities and security. A number of improvements to the utility systems will be necessary in order for the Richmond property to provide for future growth, in terms of both capacity and reliability. Many programs at the RFS are perceived to receive lower levels of security than they would on the core campus. The Richmond site currently suffers from a relative lack of amenities such as cafes, retail services and a wide array of recreational facilities. The College of

Engineering plans to install a small café on the site in spring 2003. The campus should consider subsidizing the café operations, if initial revenues are insufficient maintain the café.

Principle 18. Maintain and improve the utility and infrastructure systems at the Richmond property commensurate with the growth needs and a quality fitting a first class university research campus.

Action 18.1. As a next step, campus staff should develop a utilities improvement plan to ensure levels of service comparable to the core campus as the Richmond property develops. In particular, this plan should recommend ways to improve the following utilities:

- Electrical power—Immediate steps should be taken to work with PG&E to provide for additional electrical power capacity at the site.
- Telephone service—The telephone system should be upgraded and converted to a switching system that will be compatible with that of the core campus to allow for use of campus prefixes such as 642-xxxx and 643-xxxx and thereby enable expedited dialing.
- Water main—The existing transite piping should be replaced with a more durable system.

Principle 19. Make early investments to significantly improve the amenities such as cafes, retail services, and recreational facilities available to users of the site.

Action 19.1. Campus staff should monitor the financial performance of the initial café and develop recommendations to ensure continuation of this amenity.

Action 19.2. Staff should develop a plan for improved and expanded walkways and hiking and biking trials.

Action 19.3. Campus staff should coordinate with recreational sports to evaluate what additional recreation facilities should be added to the site and to develop a funding strategy to support them.

Principle 20. In order to ensure site security, the facility should remain fenced and secured at the site's perimeter for the near-term. However, the master plan should anticipate a development scenario that would allow for a more open facility that would better integrate the site with the surrounding Richmond shoreline.

5 CONCLUSION

The University's 152-acre Richmond property is the principal land resource available to the Berkeley campus to help meet its long-range demand for additional research space. The site's assets, particularly its accessibility to the greater Bay Area, attractive bayside setting, natural habitat areas and proximity to private and governmental R&D development in the Richmond South Shoreline, coupled with its significant development capacity, provide the University with the opportunity to create a premiere research facility supporting and complementing teaching, research and public service programs of the Berkeley campus.

The research campus should be incorporated as seamlessly as possible into the fabric of the Berkeley campus as its major property asset and as an early option for expansion of programs, primarily in the areas of research and public service. It must be viewed as an integral, complementary component of the Berkeley campus, and should include as broad an array of disciplines as is feasible and desirable.

In order for the site to realize this potential the campus administration must work to overcome the general reluctance on the part of most faculty members to consider Richmond as a potential site for research and related facilities. The development principles and proposed implementation actions outlined in this report would be important initial steps toward addressing these strategic investment needs.

APPENDIX

List of Development Principles and Actions

Utilities report and maps

Richmond Field Station Working Paper

Development Principles and Actions

Principle 1. Preserve the most valuable native grassland and wetland habitat areas on the site and link these to the salt marsh via a grassland corridor.

Principle 2. Gradually redevelop the central core area of the Richmond property, replacing the older modest structures with high quality research facilities that complement and support the teaching, research and public service mission of the Berkeley campus.

Principle 3. Accommodate the relatively modest growth needs of the current university users of the Richmond property. Concentrate expansion of Large Scale Testing Facilities in the northeast portion of the property.

Principle 4. Include areas that meet the current and future needs of the existing specialized facilities on the site such as the EPA lab and the Northern Regional Library Facility.

Principle 5. Designate the area between the Core Development Area and the prime upland grassland/wetland areas as a Transitional Development Area and defer the decision about the use of this area to a future date.

Principle 6. Consider development of non-University R&D facilities in the Northwest Parcel of the Richmond Property.

Principle 7. In order to greatly enhance the viability of the site for new university research facilities, make strategic investments in the amenities and infrastructure at the Richmond property, to ensure they are of a quality commensurate with a first class research university.

Action 7.1. The campus should immediately fund and complete key planning documents necessary to better prepare the site for expedited development, including:

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- site design guidelines
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Richmond Field Station Study Committee
Utilities Sub-Committee Report

June 12, 2002

Executive Summary

The Richmond Field Station (RFS) Utilities Sub-committee was tasked with reviewing and evaluating each of the utility systems currently providing service to RFS. Included in the evaluation are brief descriptions of each system and identified limitations, which may impact future planning and development of the Richmond Field Station.

Electrical Power

There are currently two PG&E 12,000 Volt power feeds providing service to RFS. The western feed near gate seven is dedicated to the Environmental Protection Agency Building (Bldg 201), the eastern feed entering near the main gate provides power to the rest of the facility. The eastern feed enters the facility near building 478, the power is transmitted over aerial lines which extend down the center of the facility. There are 8 sub stations, which feed from this main line and provide distributions to all the buildings. The current system has seen numerous upgrades and is considered to be in good condition.

Limitations:
The current system while in good condition is aging and approaching full capacity. With the expected construction of the NRLF Phase 3 addition, the system will be near full capacity. Any new construction plans for the future will require increased service by PG&E. This process could require considerable time and resources. ***Under grounding of the current overhead feed is also suggested as a future-planning goal, these issues should both be addressed in the future development plan.***

Natural Gas

The RFS natural gas system is also fed by PG &E, the gas main feeds from Meade Street along S 46th street. The main RFS meters are located near building 476 and near building 120. From these locations the system is reduced in pressure and distributed to all the buildings via small gas mains running along the RFS roadways. The RFS gas mains were upgraded in the early 80's, and are considered in excellent condition.

Limitations:
There are currently no limitations regarding the natural gas system that might impact future facility planning.

Water Mains

The East Bay Utility District (EBMUD) provides the domestic water feed to the facility. EBMUD provides the feed from a 12-inch main located on along South 47th Street. The EBMUD 12 inch feed is reduced to an 8-inch main, which feeds the rest of the RFS campus. There are also two 12-inch fire mains that feed two large fire hydrant loops. These enter the facility near gates 7 and 10, they are dedicated fire mains which cannot be tapped for domestic service. The 12-inch mains were installed in the late 80's and early 90's. The size of the main should adequately provide service for future development. The Fire Marshal will require that additional loops be added as development areas are identified.

Limitations:
The current water main running throughout the facility is primarily composed of an 8-inch transite pipe. Although very durable, this material has become brittle with age and is rapidly approaching its life expectancy. The maintenance department is currently experiencing periodic failures along this line. ***The system should be replaced to support current and future development plans.***

Storm Drains

The storm drainage system at RFS relies mainly on surface swales to control and direct run off. There are additional underground culverts that also assist in this function. These culverts are primarily found along the Egret Way. Along the northern section of the facility there is also a large 24-inch concrete storm line that is maintained by the city. Historically, this was used as a city sewer overflow but was disconnected in the eighties. It currently provides very little storm support to the facility but because of its size provides additional expansion room for future development.

Limitations:
The current metal culverts that support the drainage along Egret Way, are beginning to fail. They have out lived their designed life expectancy. The RFS maintenance department has a three-year plan for replacing all the culverts that pass under the street. ***The culverts paralleling the street will require replacement over the next four to six years. The replacement culverts should be sized to allow for future expansion.***

Sewer Lines

The campus is presently served by two large City mains that flow through campus from east to west: one in the north quadrant in Mead/Robin Drive, and one along the south boundary at the shoreline. The City has available capacity in these lines and at the treatment plant. There is currently remediation work planned for the shoreline sewer line that may require it to be relocated. This may allow an opportunity for the University/Zeneca to size up the line for future expansion.

Limitations:
There are no apparent sewer limitations that might impact future development planning.

Telephone

The RFS phone system is managed by Campus Network Services. The current feed from the outside world is provided by Pacific Bell. The current copper feed throughout the facility is being evaluated and replaced by CNS. Many of the old air filled phone cables have recently been replaced with modern gel filled cables. The conduit system feeding the facility appears to be approaching capacity. The ROLM switch that is currently providing phone service to a majority of the campus is approaching its maximum life expectancy. CNS is currently evaluating replacement options.

Limitations:
The obstacles impacting development plans would include the current switch capacity and reliability, the limitations of the incoming Pac Bell trunk lines and the conduit capacity through out the RFS campus. ***All these issues must be addressed prior to implementing development plans.***

Network

This is the most recently updated utility system on the RFS campus. The campus is currently receiving a fiber signal from the main campus via a TCI leased fiber. This fiber can support up to one-gigabyte network speed. The campus fiber currently terminates in building 196 where all the RFS routers are located. For redundancy there is also a Pac Bell DSL system, which will automatically feed the campus signal if the TCI fiber fails. Each of the RFS buildings is fed with a twelve-strand fiber cable. All the buildings have recently been upgraded with 100-megabyte switches and cabling. The RFS campus network system actually exceeds the current 10-megabyte campus standard.

Limitations:
The only limitation impacting network planning would be the current conduit capacity through out the RFS campus. Many of these conduits are shared for both network and telephone use. ***Future development would require additional conduit pathways***

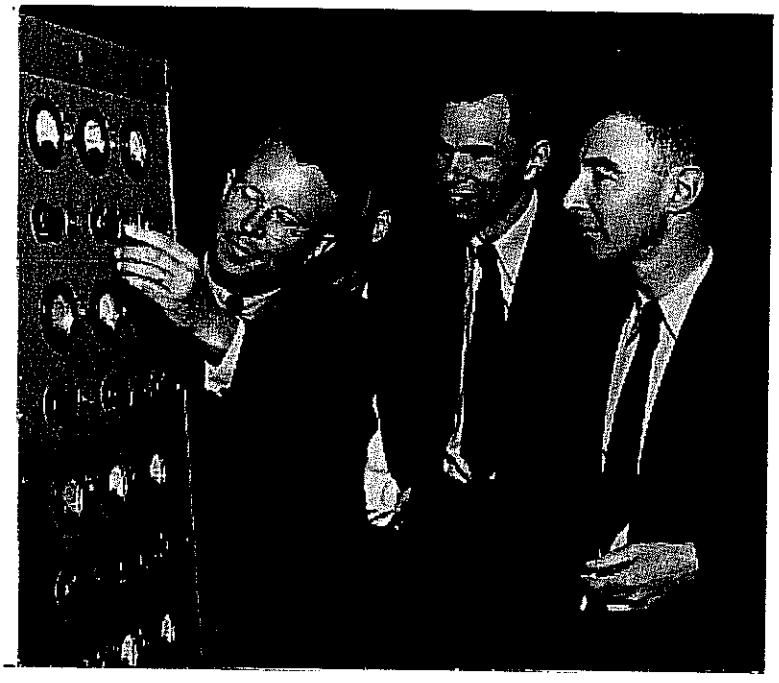
[Utility maps to be inserted here]

BERKELEY LAB SCIENCE ARTICLES ARCHIVE

Ernest Lawrence's Cyclotron: Invention for the Ages

By Lynn Yarris, LCYarris@lbl.gov

Historians cite the Roaring Twenties as the decade in which the United States began its transition to a modern, technology-based society. For the first time in the nation's history, a majority of its citizens lived in urban areas. The Golden Age of radio broadcasting began. Automobiles, telephones, and electric appliances became staples. The stock market soared and crashed. Prohibition came and (later) went. Suffrage came and stayed. Politicians gave us isolationism, preachers gave us revivalism, and bootleggers brought us organized crime.



Ernest Lawrence, Glenn Seaborg and Robert Oppenheimer in 1946 at the control panel of the 184-Inch Cyclotron.

This was also a period of momentous individual achievement and the emergence of new leaders who forever changed the way things had been done. Charles Lindbergh's solo flight across the Atlantic ushered in the age of modern aviation; Babe Ruth's home-run heroics made baseball the national pastime; and Henry Ford's assembly lines opened the doors to mass production. In the arts, the literature of Scott Fitzgerald and Ernest Hemingway, the music of George

Gershwin, the humor of Charlie Chaplin, and the paintings of Edward Hopper showed the way with their enduring brilliance. And in the arcane world of science, a 27-year-old physics professor in Berkeley began the work that would launch the modern era of multidiscipline national laboratories. His name was Ernest Orlando Lawrence.

Lawrence arrived at the University of California's Berkeley campus in the summer of 1928, having been wooed from a faculty position with Yale University by promises that included auxiliary connections to UC's Chemistry Department. Until then, the traditional practice of science was that physicists, chemists, and biologists worked within their own departments; seldom did the twain meet. Access to scientists and students from other disciplines, as well as to engineering staff, was critical to Lawrence's success as a researcher. It also set the pattern for the unique laboratory he created.

Inspired by a paper from Norwegian engineer Rolf Wideroe, Lawrence invented a unique circular particle accelerator, which he referred to as his "proton merry-go-round," but which became better known as the cyclotron. The first cyclotron was a pie-shaped concoction of glass, sealing wax, and bronze. A kitchen chair and a wire-coiled clothes tree were also enlisted to make the device work. Despite its Rube Goldberg appearance, the cyclotron proved Lawrence's point: whirling particles around to boost their energies, then casting them toward a target like stones from a slingshot is the most efficient and effective way to smash open atomic nuclei.

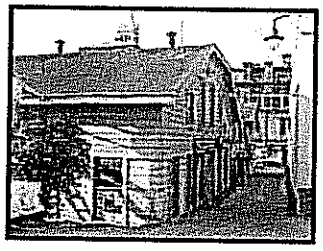
In his first year at Berkeley, Lawrence developed close relationships with two Cal professors outside of the Physics Department--chemist Gilbert Lewis and electrical engineer Leonard Fuller. From Lewis he would later get deuterons, the hydrogen isotope in heavy water that proved an invaluable "stone" for smashing atoms. With the help of Fuller, who was also vice-president of the Federal Telegraph Company, he obtained an 80-ton magnet for which the company had no use.

The accelerating chamber of the first cyclotron measured five inches in diameter and boosted hydrogen ions to an energy of 80,000 electron volts. Even as his assistants, M. Stanley Livingston and David Sloan, were constructing the 11-inch cyclotron -- a machine that would go on to break the one million electron volt (MeV) barrier -- Lawrence was dreaming of bigger things. The two gifts from his friends -- the magnet and deuterons to use as projectiles -- made possible his dream of constructing a cyclotron with an accelerating chamber some 27-inches in diameter and capable of reaching energies of nearly 5 MeV. But Lawrence would need more laboratory space to see the project through.

Lawrence had been recruited to Berkeley as part of the University's determination to build a physics department equal in stature to its celebrated Chemistry

Department. Toward that end, Cal had opened Le Conte Hall in 1924 as one of the largest physics buildings in the world. Le Conte Hall could accommodate the 11-inch cyclotron in Room 329, but a 27-inch cyclotron with all of its trappings would be too much.

With backing from physicists and chemists alike, Lawrence procured from the University an empty building adjacent to Le Conte Hall called the Civil Engineering Testing Laboratory. In August 1931 the building was turned over to Lawrence and renamed the "Radiation Laboratory."



The old Radiation Laboratory

The 27-inch accelerating chamber of the Rad Lab's first cyclotron was soon replaced with a 37-inch chamber. By 1936, the 37-inch cyclotron, which could accelerate deuterons to 8 MeV and alpha particles to 16 MeV, had been used to create radioisotopes and the first artificial element, technetium. The design, construction, and operation of these increasingly larger cyclotrons involved a growing number of physicists, engineers, and chemists. (Lawrence was never certain as to whether his research should be called nuclear physics or nuclear chemistry.)

In recognition of its departure from the traditional academic lines of departmental science, the University officially established the Radiation Laboratory as an independent entity within the Physics Department on July 1, 1936. Henceforth, the new laboratory would be dedicated to the pursuits of "nuclear science" rather than accelerator physics.

Around this time, Ernest Lawrence also invited his brother John, a physician, to join the Lab and explore the use of radioisotopes in biology and medical research. The extension of the Rad Lab's history-making collaborations between physicists, chemists, and engineers to also include biologists led to the construction of the Crocker Laboratory. Built next to the Rad Lab, the Crocker Lab housed a cyclotron with an accelerating chamber that measured 60-inches in diameter.

The 60-inch cyclotron, which began operations in 1939, was described by visitors as a "truly colossal machine." Its magnet weighed 220 tons, prompting someone to joke that its neutrons would reach Chicago. But even as this huge machine was being put to use on experiments that would garner Nobel prizes for researchers Glenn Seaborg and Melvin Calvin, Lawrence was at work planning an even mightier giant. The next cyclotron that Lawrence envisioned would be so large no laboratory building on campus could contain it.

Fresh off his winning of the Nobel Prize in 1939 for the invention of the

cyclotron, Lawrence made his push for a machine that would feature a magnet weighing 4,000 tons. Its accelerating chamber would measure 184 inches in diameter and would be capable of rocketing atomic particles to energies in excess of 100 MeV. To house such a machine and the experimental facilities that would go with it required a building 160 feet in diameter and almost 100 feet tall. A site for this structure was found atop a knobby promontory midway up the ridge behind campus. The promontory, known as Charter Hill, became the permanent site of Lawrence's Radiation Laboratory when construction of the 184-Inch Cyclotron (its design was altered to make it a "synchrocyclotron) was completed in 1946.

Lawrence died on Aug. 27, 1958, of chronic colitis at the age of 57. In his honor, the Radiation Laboratory was officially renamed the Lawrence Radiation Laboratory. In 1971, the laboratories in Berkeley and Livermore (which Lawrence also founded) were separated and the name Lawrence Berkeley Laboratory was born. In 1995, current Director Charles Shank requested that the laboratory be officially renamed the Ernest Orlando Lawrence Berkeley National Laboratory. This was done to fully honor the man whose cross-discipline team approach to research remains the hallmark of the laboratory he founded.

A Few Highlights in Lab History

- **1930 -- Ernest O. Lawrence invents the cyclotron.**
- **1931 -- Radiation Laboratory opens on UC Berkeley campus.**
- **1935 -- John Lawrence comes to Lab, begins field of nuclear medicine.**
- **1936 -- First artificial element (technetium) created.**
- **1940 -- Carbon-14, neptunium, and plutonium discovered.**
- **WWII -- Laboratory makes valuable contributions to Manhattan Project.**
- **1946 -- Construction of 184-Inch Cyclotron completed.**
- **1947 -- Melvin Calvin uses carbon-14 as tracer to study photosynthesis.**
- **1948 -- Luis Alvarez invents proton linac.**
- **1950 -- "Anger cameras" invented.**
- **1953 -- Donald Glaser invents bubble chamber.**
- **1954 -- Bevatron completed.**
- **1955 -- Antiproton discovered at the Bevatron.**
- **1957 -- SuperHILAC commissioned.**
- **1958 -- Ernest O. Lawrence dies; Lab renamed Lawrence Radiation Laboratory.**
- **1960 -- Luis Alvarez discovers resonance states.**
- **1962 -- 88-Inch Cyclotron commissioned.**
- **1964 -- George Pimentel invents chemical laser.**
- **1971 -- Lawrence Berkeley and Livermore Laboratories separate.**
- **1974 -- J/psi particle and element 106 (seaborgium) discovered.**
- **1976 -- Charmed mesons discovered.**
- **1978 -- Dynamic Positron Emission Tomography is invented.**
- **1979 -- Segmented mirror designed for Ten Meter Telescope.**
- **1980 -- Mina Bissell proposes ECM theory on breast cancer; superwindows developed.**

- **1982 -- National Center for Electron Micropscopy opens.**
- **1984 -- Luis Alvarez proposes theory of dinosaur extinction; Tom McEvilly successfully predicts 1993 Parkfield earthquake.**
- **1987 -- Lab gets Human Genome Center.**
- **1988 -- Material harder than diamond predicted; first direct image of DNA double helix created.**
- **1990 -- First genetic links to atherosclerosis identified.**
- **1991-- SNO Collaboration begins.**
- **1992 -- COBE satellite image of primordial universe supports Big Bang theory.**
- **1993 -- ALS commissioned.**
- **1994 -- Top quark discovered; STAR and B-factory approved.**
- **1995 -- National Energy Research Scientific Computing (NERSC) Center acquired; Gammasphere dedicated.**
- **1995 -- Lab renamed Ernest Orlando Lawrence Berkeley National Laboratory.**

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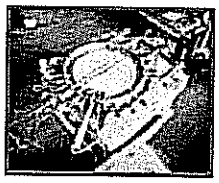
Early Cyclotrons

I arrived in Berkeley in August of 1934. At that time Ernest was working with the 27-inch cyclotron, which was producing 3 million-electron-volt protons.

Five inch cyclotron held by Glenn Seaborg.

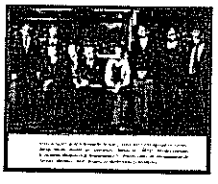


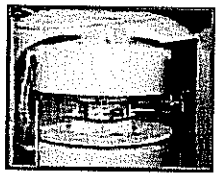
27-inch cyclotron in 1932.

Here I go back to the first operating cyclotron, the 4-inch cyclotron, that operated first on January 2, 1931 and produced 70 kilo-electron-volt protons. You'll see here that I'm holding this. I can prove that because I have the same watch on. Then in 1932 we had the 27-inch cyclotron. Lawrence moved to the old Radiation Laboratory that I'm going to show you a picture of in a few moments. He was assigned that building on August 26, 1931. That is exactly 65 years ago today.

And here he built the 27-inch cyclotron, of which I show you a picture here, that produced first protons and then deuterons in 1933. Here is a picture taken in 1933 of a number of the key people working with him at that time. I won't stop to read off the names, I'll let you do that. This 27-inch cyclotron was producing 3 MeV deuterons by the time I came here in 1934, and then 4 MeV deuterons the next year, then 5 MeV deuterons the next year, and by 1937, 6 MeV deuterons. Then he built the 37-inch cyclotron using the same magnet. This was a magnet with about 70 tons of iron in it, and that produced 8 MeV deuterons.

Left to right: Jack Livingood, Frank Exner, M.S. Livingston (in front), David Sloan, Ernest O. Lawrence, Milton G. White, Wesley Coates, L. Jackson Laslett, and Commander T. Lucci.





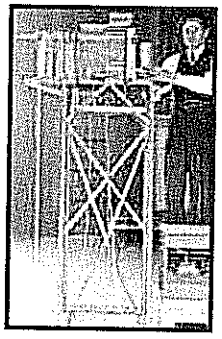
37-inch cyclotron. Berkeley, California.

Deuteron-deuteron neutron source; Room 118, Radiation Laboratory, University of California, Berkeley (UCB).

East Hall, University of California, Berkeley (UCB), where work with fast neutrons took place.

When I came to Berkeley I chose to do my graduate work really in nuclear physics. I was in the Chemistry Department and got my Ph.D. in chemistry, but in Berkeley you can do research in nuclear physics and get a degree in chemistry. I worked in the old Radiation Laboratory with a deuteron-deuteron source, 100 kilo-electron volts, producing neutrons by bombarding deuterium, deuterium oxide cooled to ice temperatures with liquid air, with deuterons. I measured the interactions of neutrons with a number of elements, and that was part of my thesis. I moved over to an old building called East Hall and finished my thesis work using a radium-beryllium source of neutrons.

Here I am with the apparatus and the lead shielding, and so forth, taken just about the time in May 1937 when I was finishing my



Glenn Seaborg in the East Hall on the UC Berkeley campus in 1937 with neutron scattering apparatus.

Ph.D. research.

Here's a view of the campus at that time. This is the chemistry building and here is the old Radiation Laboratory. Actually, it's a little later because here is also the Crocker Laboratory and Lewis Hall. Here is the old Radiation Laboratory being torn down in 1959 to make room for Latimer Hall.

Chemistry buildings, old Radiation Laboratory, Crocker Laboratory, etc., 1940's.

Demolition of Old Radiation Laboratory, 1959.

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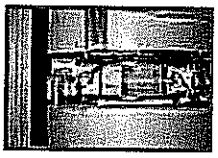
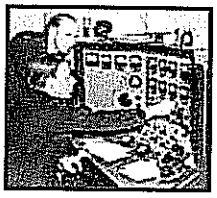
The 60 Inch Cyclotron

Cooksey and Lawrence at the 60-inch cyclotron.



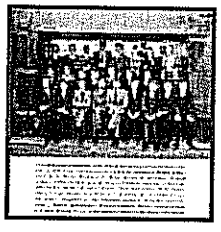
60-inch cyclotron, circa 1939, shows beam.



John and Ernest Lawrence at control panel of 60-inch cyclotron shortly after it began operating.

Here is Lawrence and his assistant Don Cooksey at the 60-inch cyclotron which began to operate in 1939 and produced 16 MeV deuterons, and had a magnet weighing about 200 tons. Here is a picture of the deuteron beam coming out of that 60-inch cyclotron, 16 MeV deuterons. Here is a picture of Ernest Lawrence with his brother John, who joined the Laboratory in 1937 to do the pioneering work in nuclear medicine. Really, he was the instigator, the first person to do significant research in nuclear medicine using the radioactive isotopes produced in the Berkeley cyclotrons.

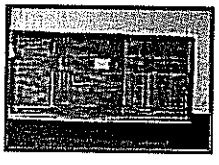
Here's a picture of the group, with all of their names there, at the 60-inch cyclotron. More or less the key personnel at that time in 1939.



Early Radiation Laboratory staff framed by the magnet for 60-inch cyclotron in 1939

60-inch cyclotron group: Cooksey, Corson, Ernest O. Lawrence, Thornton, Backus, Salisbury, Luis Alvarez, and Edwin McMillan, 1939.

Here's another group in 1939. Up on top we have Luis Alvarez and Ed McMillan that I'm sure a number of you knew. The other people here have their names . . . Here is Ernest Lawrence and Bob Thornton. The others are identified.



Ernest O. Lawrence Nobel Award announcement on blackboard

On November 9, 1939, word came that Ernest Lawrence had received the Nobel Prize for his invention of the cyclotron. There's an interesting story there. Darleane had mentioned that Helen Griggs was serving as Ernest Lawrence's secretary, and she got the word. He was over at the Claremont tennis court playing tennis. She phoned there trying to get in touch with him, but they said they couldn't bother him. "Yes you can bother him. I want to give him this news." So she was the one who gave him the news on his winning the Nobel Prize. This is self explanatory (referring to the blackboard announcement). This is the celebration that they had there.

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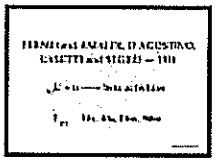
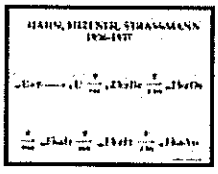
Elements 93 and 94

Now I'm going to go back quickly to some of the work that I was involved in that had to do with the heavy elements, the elements beyond uranium. This in a sense began back in 1934 when Fermi and co-workers in Rome bombarded uranium with neutrons produced in a radon-beryllium source and produced a number of activities that they thought were due to transuranium elements. For example, an activity with 13 minutes half life was thought to be due to ekarhenium. According to the periodic table of that day, it was thought that the transuranium elements would fit in in this way, and element 93 would be like rhenium, ekarhenium, 94, ekaosmium, 95, ekairidium, 96, ekaplatinum, and so forth. This work was carried on by Hahn, Meitner and Strassman in Germany. They thought that they had identified a number of activities that had these properties corresponding to the periodic table of that day. Then in December of 1938, Hahn and Strassman made their momentous discovery that these radioactivities were not due to transuranium elements but were due to fission products. So we had no transuranium elements then. They had all become fission products until McMillan and Abelson, in June of 1940, reported that one of these products from the bombardment of uranium was, indeed, a transuranium element with a mass number 239 and a half life of 2.3 days.

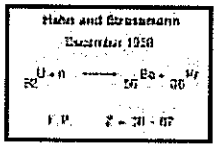


1934 findings of Enrico Fermi and co-workers

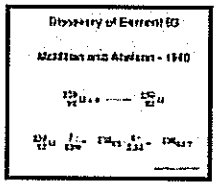
Periodic Table before World War II



Otto Hahn, Lise Meitner, Fritz Strassmann--1936 or 1937, EkaRe, EkaOs, EkaIr and EkaAu



Hahn & Strassmann, December 1938



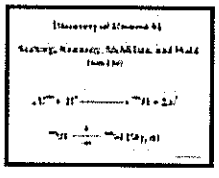
Discovery of Element 93

But they couldn't find the daughter, which they thought would decay by alpha particle emission because it seemed to have too long a half life. Here is a picture of Ed McMillan taken at the time of his work, and a picture of Phil Abelson taken at that time.

Edwin M. McMillan

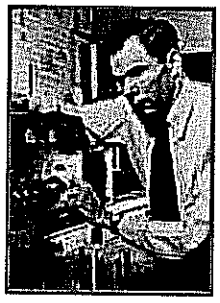
Philip Abelson

Then I entered the picture. I was an instructor in chemistry and I had a co-worker, Kennedy, who was an instructor in chemistry. McMillan had started the work to look for the next element, the element with the atomic number 94. I had a graduate student, Arthur Wahl, working with me. We bombarded uranium with deuterons and we found an activity with a half life of about 2 days due to element 93, which , when it decayed, led to a daughter whose alpha particles we could detect and chemically identify. As Darleane mentioned, we chemically identified these . . . the bombardment



Discovery of Element 94

was made on December 14, 1940 and we chemically identified it as element 94 on February 23, 1941. But most importantly, and McMillan and Abelson had already found this, element 93 didn't resemble rhenium, it was not ekarhenium, it resembled uranium. And 94, we found, didn't resemble osmium, was not ekaosmium according to the periodic table of that day, but resembled uranium. It was clear that there was another transition series beginning to operate at this point.



Glenn T. Seaborg at Geiger-Muller counter and amplifier, 1941.

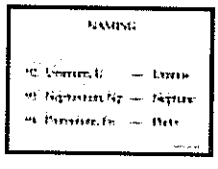
Joe Kennedy at 9237 San Antonio Avenue, South Gate, Christmas, 1940

Art Wahl at Washington University

Here's a picture of me taken at this time. I like to show this picture because it shows how little I've changed in the last 55 years. Here's a picture of Joe Kennedy. We went down to South Gate -- Home Gardens became South Gate by that time -- where my parents were living, at Christmas 1940 leaving our graduate student, Art Wahl, up at Berkeley to work on the products. Here is a picture of Kennedy in the backyard, Christmas day 1940, taken by my mother with her Kodak box camera. Here's a picture of Art Wahl taken at Washington University right after the war.

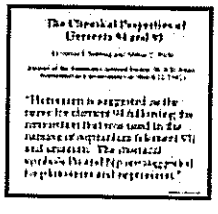
Helen L. Griggs and Glenn T. Seaborg, Christmas 1941 in San Francisco

The reports announcing the discovery of element 94 were typed by Ernest Lawrence's secretary, Helen Griggs, and I like to say that she was so efficient as a secretary that I began to date her. She doesn't like that characterization, and I have to admit immediately that she had other qualities. We began to go together.Here we are in San Francisco on Market Street on Christmas 1941. One of these itinerant photographers took our picture and handed me a card and if I sent in 50 cents I could get a copy, and of course I did.



Naming – 92 Uranium (U) Uranus, 93 Neptunium (Np) Neptune, 94 Plutonium (Pu) Pluto

In that first report, we decided to name the element plutonium, just like uranium is named after Uranus, neptunium by McMillan and Abelson after Neptune, we decided to name it plutonium. We should have named it plutium, but we liked plutonium better. It just sounded better. And the symbol obviously should have been Pl, but we liked Pu better so we gave it the symbol Pu. We thought we'd be subject to a great deal of criticism after the war was over. This was our own research. We kept it secret voluntarily and then sent the information to Washington. Here is the report written on March 21, 1942 typed by Helen Griggs, held secret until after the war when it was published in the Journal of the American Chemical Society in 1948. This is where the names plutonium and neptunium were first revealed.



The Chemical Properties of Elements 94 and 93

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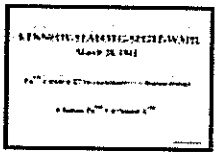
Plutonium

Glenn T. Seaborg and astronomer Clyde W. Tombaugh, discoverer of the planet Pluto, at a press conference at the Sandia National Laboratory in Albuquerque, New Mexico

25th Anniversary of the discovery of plutonium with (from left to right) Glenn Seaborg, Arthur C. Wahl and Edwin McMillan.

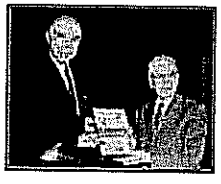
In June 1991 I happened to meet in Albuquerque the discoverer of the planet Pluto, who was still alive, Clyde Tombaugh. He had discovered the planet Pluto in 1930 when he was only 24 years old. Here we are at a press conference, the discoverers of Pluto and plutonium. And on the 25th anniversary, February of 1966 that would be, of the discovery of plutonium, the room in Gilman Hall, room 307, was declared a historic national landmark. Here is the plaque that is now on that door. If you want to go up there and see it, it's still there. By some miracle Gilman Hall still stands, although the other chemistry buildings have been torn down. Here I am, at about 20 years after the discovery of plutonium, in that room, room 307 Gilman Hall, on one of my trips back from Washington when I was serving at chairman of the AEC. The room was pretty much the same as it was when we discovered plutonium.

Glenn T. Seaborg in 307 Gilman Hall.



Demonstration of fission of Pu-239 by Kennedy, Seaborg, Segrè, and Wahl on March 28, 1941

Then we went on, joined by Segrè, and bombarded a lot of plutonium with a lot of neutrons and produced a half a microgram, using the 60-inch cyclotron and then using the 37-inch cyclotron showed that it underwent fission with slow neutrons, with a cross section about the same as the fissionable isotope of uranium, U235, which meant, of course, that it had this potential to be the explosive ingredient for an atomic bomb. We reported that to Washington and that was the basis of the plutonium project of the Manhattan District. That measurement was made on March 28, 1941 and on the 25th anniversary of that, March 28, 1966, Segrè and I presented that sample, that half microgram sample with its rare earth carrier, to the Smithsonian where you can see it now on display in the Science in American Life exhibit.



Glenn T. Seaborg and Emilio Segrè presenting plutonium sample to Smithsonian Institution

I kept it in this cigar box those intervening years. As Darleane has said, I worked as Gilbert N. Lewis' research assistant. He was an inveterate smoker of cigars, lit one off the end of one after the other, and I inherited these cigar boxes and used one of them to keep this sample in.

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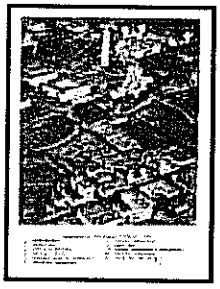
The University in the 1940's



Aerial View of the University of California, Berkeley (UCB) in 1940.

Crocker Lab - exterior of building housing Seaborg's lab, 1941.

Exterior view of the old Radiation Laboratory

This is the way the campus looked at about that time in 1940. Here are the chemistry buildings, here is the East Hall that I told you about. Here is Telegraph Avenue and Bancroft Way. Here is the Crocker Laboratory, where the 60-inch cyclotron was situated. The one used to furnish the neutrons to make the plutonium, the half a microgram that we used to demonstrate its fissionability. Here is the old Radiation Laboratory where the 37-inch cyclotron was that furnished the neutrons to make it possible for us to show that the plutonium was fissionable with slow neutrons. This contains the room, Room 118, that I worked in when I first came to Berkeley in 1934.

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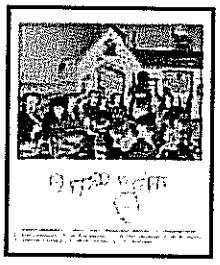
A Time for Work and a Time for Play

Lawrence party group, Yamato Hotel, San Francisco, approximately 1938: R. Sagane, Ernest O. Lawrence, H. Walke, H. Newton, J. Cork, J. Laslett, R. Thorton, E.M. McMillan, G. Paxton, P. Aebersold, L. Emo, B. Kinsey, V. Voorhis, Lyman, Richardson, Yasaki, Snell, Livingood, Cooksey, Kurie.



LBL party at DiBiasi's, 860 San Pablo Avenue, Albany, California. Clockwise around the table: Ernest O. Lawrence, Betty (Mrs. Charlton) Cooksey, Vannevar Bush, Molly (Mrs. Ernest) Lawrence, Alfred Loomis, Dorothy Axelrod, Helen Griggs, Charlton Cooksey, David Sloan, and S. Mrozowski.

We had a lot of parties in those days. Here's one where you can see a number of the people. It includes Jack Livingood and Don Cooksey, Ed McMillan, Bob Thornton, Paul Aebersold, Ernest Lawrence, and so forth. That was in 1938. Here's a party held in 1940. I like to show this picture because, besides Lawrence and Vannevar Bush, and Alfred Loomis, and so forth, here's a girl named Helen Griggs sitting over there. I had met her as early as 1938 but I didn't have enough nerve to begin dating her until 1941. Actually, she was going with somebody else at the time this picture was taken.

Here's a picture of Paul Aebersold taken about that time. I include his picture because he was the one who sort of arranged these dinner parties, of which I showed you the two examples on the previous slides. He then went on and after the war became the head of the isotopes distribution of the Atomic Energy Commission. He moved to Washington and worked with me when I was chairman of the AEC.

Paul Aebersold

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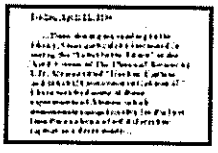
The Scientists

I thought I should say something special about Luis Alvarez because he was an extraordinary scientist at this time. He joined the Laboratory in 1936.

Alvarez with personally built electronics and BF-3 ionization chamber



Glenn T. Seaborg journal excerpt, April 15, 1938. Discovery of electron capture decay by Luis W. Alvarez.

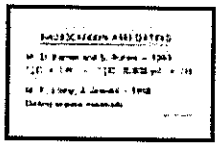
Four future presidents of the American Physical Society. Left to right: Alvarez, Robert Oppenheimer, Willy Fowler and Bob Serber (1938)

Here's a picture of him with a neutron counter taken in 1938. He is responsible for a large number of discoveries.Here is a note from my journal of April 15, 1938. I've kept a journal since January 1, 1927. Here is my description of a paper I had just read in which he discovered decay by electron capture. He is the discoverer of that method of decay. Here is a picture taken in 1938 of Luis Alvarez with Robert Oppenheimer, Willie Fowler of Cal Tech, and Bob Serber of the Radiation Lab at that time.

Alvarez receives the Nobel Prize for Physics from King Gustav VI with Princess Christina looking on (1968).

Asteroid Impact research team (1969). Left to right: Helen Michel, Frank Asaro, Walter Alvarez and Luis Alvarez.

Here is a picture of Luis Alvarez receiving the Nobel Prize from King Gustaf VI of Sweden on December 10, 1968, for his work on the hydrogen bubble chamber and its application to the characterization of a number of fundamental elementary particles. Here is a later picture I thought I'd include to show his versatility, and that has to do with his idea of the extinction of the dinosaurs 65 million years ago by an asteroid. Here's Luis with his son Walter and Frank Asaro and Helen Michel.



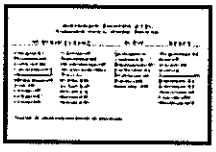
Radiocarbon dating. Kamen and Ruben.

Here are just a few other discoveries of about this time. The discovery by Kamen and Ruben in 1940 of the famous carbon-14 that has such a tremendous impact as a tracer in studying photosynthesis and biological processes and so forth, and [radio-carbon]dating, as developed by Willard Libby and his co-worker Jim Arnold beginning in 1950. Here's a picture of Sam Ruben, taken about that time (1940), and of Martin Kamen who, by the way, received the $100,000 Fermi award just this year. Here's a picture of Melvin Calvin who used carbon-14 after the war to work out the photosynthesis process for which he received the Nobel Prize in 1961.

Sam Ruben at work in the Rat House, University of California, Berkeley (UCB).

Martin Kamen.

Melvin Calvin doing early photosynthesis in the old Radiation Laboratory, circa 1948.



Radioistopes discovered at LBL commonly used in nuclear medicine

Here's a number of radioisotopes discovered at Lawrence Berkeley Laboratory commonly used in nuclear medicine. I won't stop there, but I was involved in the discovery of a number of these. In fact the isotopes that I was involved in the discovery of, used in nuclear medicine, are used some 10 million times a year now in the diagnosis and treatment of disease. In fact, one of them saved my mother's life, iodine-131. She had a fatal hyperthyroid condition and she was diagnosed and treated with iodine-131 as were George Bush and Barbara Bush who, as you know, are suffering from Graves' disease.

I thought I must show a picture of Joe Hamilton here, who is working with sodium-24. He is one of the first to work out these processes for the use of radioisotopes here at the Laboratory in nuclear medicine.

Joseph Hamilton radiosodium experiment

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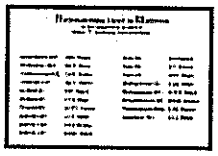
Seaborg's Radionuclides



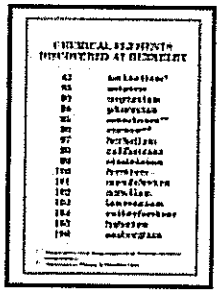
Radionuclides used in medicine in the discovery of which Seaborg was involved.

Glenn T. Seaborg and J.J. Livingood walking in front of Sather Gate, University of California, Berkeley as they are mailing iodine-131 paper.

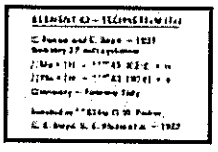
Here is a summary of those radionuclides used in medicine in the discovery of which I was involved. Here we have a picture of me with Jack Livingood -- I worked with him on a number of these -- on Telegraph Avenue, there's Sather Gate, on our way to the post office mailing the manuscript announcing the discovery of iodine-131. This is a picture taken by an itinerant photographer. He handed me a card and I sent him 50 cents. They don't do much of that anymore.

Glenn T. Seaborg photographed with two iodine and technetium papers.

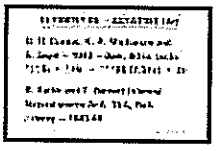
Here are the articles reproduced showing that, in the discovery of iodine, the letter to the editor was 217 words, and in the discovery of technetium-99m 237 words. We didn't waste words in those days. Now I'm going to run quickly through the chemical elements discovered at Berkeley using the Berkeley cyclotron. I'm going to run through them very quickly. First of all, Emilio Segrè, working with Carlos Perrier in Palermo, Italy, using molybdenum from the innards of the cyclotron shipped to him by Lawrence, discovered element 43 which was later named technetium. Then Dale Corson, Ken McKenzie, Emilio Segrè in 1940, using the Berkeley 60-inch cyclotron, bombarded bismuth with helium ions to discover element 85, which was later named astatine.



Chemical elements discovered at Berkeley, California or by Berkeley teams.



Element 43, technetium (Tc). Perrier and Emilio Segrè.



Element 85, astatine. Corson, et al.

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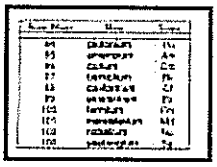
Seaborg's Elements

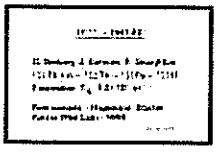


Atomic Weight, Name and Symbol chart for ten transuranium elements of which GTS participated in the discovery.

Glenn T. Seaborg and Edwin M. McMillan in front of the Periodic Table, soon after the announcement of the receipt of their winning the 1951 Nobel Prize in chemistry.

Here are the elements in whose discovery I have been involved. Ten of them, maybe eleven. I'm going to say a little bit about another element, 110, in a few minutes. I've already covered plutonium. For this -- actually for the chemistry of the transuranium elements -- Ed McMillan and I received the 1951 Nobel Prize in chemistry. By the way, that's the earliest Nobel Prize of any living Nobel Prize winner in any field. I was 39 years old at the time, so I've been a Nobel Prize winner most of my life. Here I am receiving the Nobel Prize on December 10, 1951 from King Gustav VI of Sweden. Being of Swedish parentage, I met an awful lot of relatives when I was in Sweden.

The King of Sweden giving the Nobel Prize to Glenn T. Seaborg.



U-233, 1941-1942.

The 25th anniversary of U-233. Dr. John Gofman, Dr. Glenn T. Seaborg and Dr. Raymond Stoughton in Room 303 of Gilman Hall, University of California, Berkeley (UCB)

Also, I was involved with Jack Gofman and Ray Stoughton in the discovery of uranium-233, which is fissionable and hence is the key to the use of thorium as a source of nuclear energy. That was discovered in February 1942 and here we are in February 1967 on the 25th anniversary, Gofman and Stoughton and I, at a Regents meeting where this plaque was presented, and stands outside room 303 of Gilman Hall.

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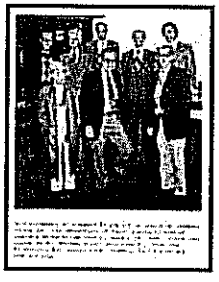
Elements of the 1950's

LBL Building 4

LBL Building 5

We moved back to Berkeley. I'm not going to have time to cover the war years where we worked out the chemical processes for plutonium and discovered two more elements, americium and curium, 95 and 96. We moved back to Berkeley after the war, late 1945 and 1946, into building 4, which is still there. That's sort of the headquarters for the people working on the Advanced Light Source. Here's a picture taken at about that time when we moved back in 1946. Soon after that, Lawrence got the money for building 5, which is still there and where I moved in to have my office because we were still doing work which was at that time secret, so we had a guard there behind the fence. I was sitting at this table in November of 1951 having a brown bag lunch with my colleagues when the phone call came through from Stockholm via a reporter in New York that I had won the Nobel Prize in chemistry.

The four codiscoverers of berkelium (Bk, element 97) and californium (Cf, element 98) in Glenn T. Seaborg's office as part of LBL's 25th anniversary of the discovery. Left to right: Kenneth Street, Jr., Stanley G. Thompson, Glenn T. Seaborg, and Albert Ghiorso.



Codiscoverers of einsteinium (Es, element 99, 1952) and fermium (Fm, element 100, 1953) at symposium commemorating the 25th anniversary of their discovery held at the LBL. Left to right (front row): Louise Smith, Sherman Fried, Gary Higgins. Left to right (back row): Albert Ghiorso, Rod Spence, GTS, Paul Fields and John Huizenga.

The codiscoverers of mendelevium at the LBL, on the 25th anniversary of discovery. Left to right: Gregory R. Choppin, GTS, Bernard G. Harvey, and Albert Ghiorso.

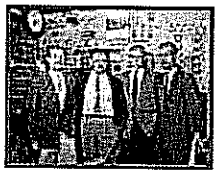
Now I'm going to run through the next elements quickly. In 1949 and 1950, we synthesized and identified, and I loosely use the word discovered, elements 97 and 98. December of 1949 and January 1950. Ken Street, Stan Thompson, and Al Ghiorso and I, a picture taken on the 25th anniversary of the discovery, January 1975. Here are the discoverers of elements 99 and 100. It involved work by people at the Argonne National Laboratory and the Los Alamos National Laboratory and here. That discovery was in December 1952 for 99 and January 1953 for element 100, and here we are at the 25th anniversary of that discovery.

Mendelevium (Md) party at Larry Blake's: Nelson Garden, Al Ghiorso, Bernard Rossi, Earl Hyde and others at buffet table.

The codiscoverers of nobelium (No, element 102) in the HILAC building, LBL in 1958:Albert Ghiorso, Torbjorn Sikkeland, and John R. Walton. Glenn T. Seaborg is absent.

Then we went on to the discovery of element 101 in March 1955, and here we are on the 25th anniversary of element 101. The team, Greg Choppin and Bernie Harvey, myself, and Al Ghiorso. Stan Thompson was also a member of that discovery team but he had died in 1976. This photograph was taken on the 25th anniversary in March of 1980. We celebrated that with a sort of a party at the restaurant, and I just wanted to show here the picture of Nelson Garden who did so much for the radiation protection of our group, and Bernie Rossi who was the operator of the cyclotron, as well as Al Ghiorso.

Here are the discoverers of element 102 in 1958, Ghiorso, Torbjorn Sikkeland, and John Walton. I'm a co-discoverer also, but I wasn't there. By that time I had been put up to be Chancellor and I wasn't in the laboratory when this picture was taken.



The codiscoverers of lawrencium (Lr, element 103), HILAC building, LBL, 1961:Torbjorn Sikkeland, Albert Ghiorso, Almon E. 'Bud' Larsh, Robert M. Latimer.

Now we come to 103. There we have Torbjorn Sikkeland, Ghiorso, and Almon Larsh and Robert Latimer. This was in 1961.

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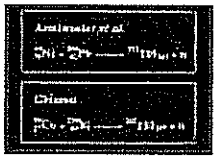
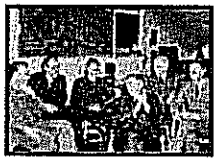
Berkeley in the 1940's and the 184 Inch Cyclotron

Now I mention element 110. In 1991 Ghiorso and co-workers, of which I was a member of the team, produced an isotope which decayed with a half life of 4 microseconds, and identified it as due to element 110, announced it at a talk given in Italy in June 1994 and published later that year. There are other workers, including those at the GSI laboratory, who have found another isotope, and actually still another group that I won't have time to mention. So there are several co-discoverers of element 110 that doesn't have a name yet.



Reactions for element 110.

In 1940, there was a meeting at Berkeley with Lawrence and Arthur Compton, Vannevar Bush, Jim Conant, Karl Compton, and Alfred Loomis, that led to the funding for the 184-inch cyclotron.



Meeting in the Radiation Laboratory at the University of California, Berkeley (UCB) in March 1940 to discuss the 184-inch cyclotron. Left to right: Ernest O. Lawrence, Arthur H. Compton, Vannevar Bush, James B. Conant, Karl T. Compton, and Alfred Loomis.

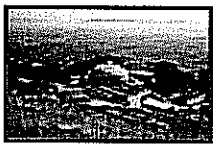
184-inch cyclotron facility on October 23, 1941.

Here it is in 1941 as it is being built on the move from the campus up on the hill. This had a magnet of about 4,000 tons, something like that, and produced 200 MeV deuterons. It was used for a number of discoveries, including the discovery of the pi mesons produced artificially.

Ernest O. Lawrence, Glenn T. Seaborg, and J. Robert Oppenheimer in early 1946 at the controls to the magnet of the 184-inch cyclotron, which was being converted from its wartime use to its original purpose as a cyclotron.

Here we are at the control of the 184-inch cyclotron, Lawrence, Oppenheimer, and I in 1946.

Lawrence and the staff shown with the 184-inch magnet.



Lawrence Radiation Laboratory (LBL), Berkeley, California view towards south. Visible in this picture is the 184-inch cyclotron building.

Here is the whole gang, I won't try to identify them, at about the time when it began to operate. Here is the building in which it was housed.

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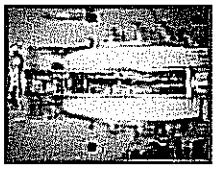
The SuperHILAC, the Bevalac, and the Advanced Light Source

Here is the heavy ion linear accelerator of which Ghiorso became in charge. It produced heavy ions of 10 MeV per nucleon and began to operate in late 1956 and early 1957. Here's the building in which it was housed. The building is still there.

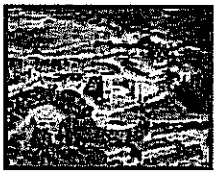
SuperHILAC under construction.

Aerial view of Building 71.

Then there's the 88-inch cyclotron. This went into operation in December of 1961. Bernie Harvey had a lot to do with that and was in charge of it for years. Claude Lyneis is in charge now. It produced 60 MeV deuterons, but in the intervening years has been converted to the production of heavy ions all the way up to uranium ions.



88-inch cyclotron.



Aerial view of LBL.

Here's a picture showing where everything is. There's the 184-inch cyclotron, here's the building we're in, the chemistry building, and so forth.

Then in 1971 Al Ghiorso had the idea of using the HILAC as an injector for the Bevatron to make into a Bevalac so it could accelerate heavy ions to the multi-BeV energy range. That came into operation a few years later. Here's a picture of the line going down from the HILAC to the Bevatron to produce the Bevalac.

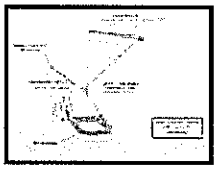


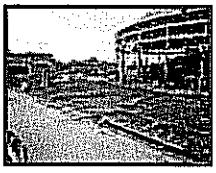
Diagram of High-energy Heavy Ion Facility (Bevalac).

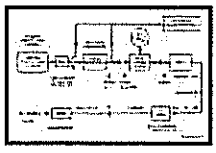
Bevalac: Beam transport line construction, Bevatron end.

Then in 1989 the 184-inch cyclotron building was converted to house the Advanced Light Source, which came into operation a few years later and which later speakers I'm sure will say something about.

Construction of Advanced Light Source (ALS) at LBL.

Flow chart for radioactive beam acceleration.





Then Mike Nitschke had an idea, and I can only just tell you this, which was to produce radioactive ions by bombarding a heavy target with high energy protons which in turn could be accelerated and would give you a much broader range for transmutations, because you could have nuclei that had more neutrons or less neutrons than the stable isotopes, and so forth. This was Mike Nitschke's idea, but with his death this work is not being carried on here. Unfortunate. Here's a picture of Mike taken about that time. Here is a chart of all of these radioactive isotopes that could be produced and accelerated in such a machine.

J. Michael (Mike) Nitschke with his detection apparatus at the Hilac in the 1980s.

Projected Radioactive Beam intensities at the IsoSpin Laboratory (after acceleration to 10 MeV/u) from a Uranium Carbide target, 1 mol/cm² thick.

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Not to Forget Anyone...

Frank Asaro, Iz Perlman, and Frank Stevens

Isadore Perlman, Margaret and Bernard Harvey, Jack Hollander in 1953.

Louise and John Rasmussen and Marian Diamond at Glenn T. Seaborg's Nuclear Chemistry Division party in 1958.

Here are just a few interesting shots taken in the 50s. First Frank Asaro, Iz Perlman, and Frank Stevens. Helen and I used to give a garden party every year and people had cameras there. Here we are with Iz Perlman, Margaret and Bernie Harvey, and Jack Hollander. Here we are with Louise and John Rasmussen and Marian Diamond. Here are Jane and Ken Street, and David and Lilo Templeton.

Mr. and Mrs. Kenneth Street, Mr. and Mrs. David Templeton on September 4, 1960.

Rose McFarland, Ken Moody, and Glenn T. Seaborg in control room of 88-inch cyclotron on October 1, 1981.

Here is just an example of a couple of my graduate students when I came back from Washington. Ken Moody, Rose McFarland with me in the control room of the 88-inch cyclotron.

LBL Nuclear Chemistry Program Committee. John Rasmussen, Albert Ghiorso, Joseph Cerny, Kenneth Street, Norman Edelstein, Frank Asaro, Earl Hyde, Arthur Poskanzer, David Shirley, GTS, Frank Stephens, Richard Diamond, David Hendrie, Jack Hollander, Bernard Harvey, David Templeton, Sheila Saxby, Luciano Moretto, and Norman Glendenning.

We had a planning group meeting every couple of weeks and here is an example of one of these with a large number of people: Ken Street, Earl Hyde, Joe Cerny, Dave Shirley, Norm Edelstein, Art Poskanzer, John Rasmussen, myself, Dick Diamond, David Hendrie, Jack Hollander, Frank Stephens, Bernie Harvey, Dave Templeton and Norman Glendenning. I think I got them all.

50th anniversary of plutonium. Glenn T. Seaborg and his students on February 23, 1991.

Here is a group of my students that came back for the 50th anniversary celebration of the discovery of plutonium. It was February of 1941. They came back about the same time, February 21st or so of 1991 for the 50th anniversary, and here we are in this auditorium. A number of the people there... Dick Hoff, Jack Hollander, Ken Street, Tom Morgan, Trish Baiden, Roger Batzel, Paul Donovan, Art Wahl, Gerhart Friedlander, Bob Silva, John Rasmussen, Robert Welch, Don Orth, Phil Wilmarth, David Morrissey, Dick Diamond, Ken Gregorich, and Pat McGaughey.

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The Nobel Laureates and JFK

I'm going to end with a number of remarks about people. In November 1955 we had a visit from the famous Otto Hahn, the discoverer of nuclear fission, for which he received a Nobel Prize in 1944.

Ghiorso, Seaborg and Otto Hahn, University of California, Berkeley.

Seven Nobel Laureates of LBL, University of California, Berkeley (UCB), with historic 37-inch cyclotron at the Lawrence Hall of Science. Pictured Owen Chamberlain, Edwin McMillan, Emilio Segrè, Melvin Calvin, Donald Glaser, Luis Alvarez, and Glenn T. Seaborg on March 7, 1969.

Here I am, Hahn, Ghiorso, and I. In 1969, on one of my visits to Berkeley, we took a picture of all the Nobel Prize winners. By that time there were 7. Chamberlain and Segrè, I mentioned their winning the Nobel Prize for the antiproton in 1959; McMillan and I for the chemistry of the transuranium elements in 1951; Calvin for his work on photosynthesis in 1961; and Glaser for his work on the bubble chamber in, I think, 1960; and Alvarez for his work on the hydrogen bubble chamber and its use in elementary particle physics and so forth, Nobel Prize in 1968.

Now I'm going to mention at random a few interesting things. In 1962, March 23, Charter Day, President John Kennedy visited the Radiation Laboratory. Helen and I flew back with him on Air Force One, and here we are entering building 70A. Here's Governor Pat Brown, along with Kennedy and me, and Ed McMillan.

Glenn T. Seaborg and John F. Kennedy at LBL.

Edwin M. McMillan, Edward Teller, Glenn T. Seaborg, John F. Kennedy and Pat Brown visit LBL.

Here are the Lab directors, Norris Bradbury, the Director of Los Alamos; John Foster of Livermore; Ed McMillan, Director of Lawrence Berkeley Lab; myself; John Kennedy; Edward Teller; Bob McNamara; and Harold Brown, who was the Director of Defense Research and Engineering. Bob McNamara, of course, Secretary of Defense.

President John F. Kennedy (JFK) visiting AEC-supported Lawrence Radiation Laboratory (LRL) on March 23, 1963. Picture taken in front of Building 70A at LRL in Berkeley, California. Left to right: Dr. Norris Bradbury, Dr. John S. Foster, Dr. Edwin M. McMillan, Glenn T. Seaborg, President John F. Kennedy, Dr. Edward Teller, Robert McNamara (Secretary of Defense), and Dr. Harold Brown.

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UNIVERSITY of CALIFORNIA
BOTANICAL GARDEN
at BERKELEY

Mission and History

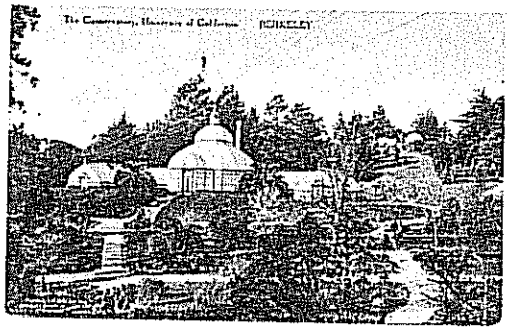
Mission

"To develop and maintain a diverse living collection of plants to support teaching and worldwide research in plant biology, further the conservation of plant diversity, and promote public understanding and appreciation of plants and the natural environment."

History

A small garden of economic plants was established on the Berkeley campus on the site currently occupied by Moffit Library in the 1970's by Dr. Eugene W. Hilgard (1833-1916), founding Dean of Agriculture . The University of California Botanical Garden was formally established in 1890 by E. L. Greene, the first chairman of the Department of Botany, to form a living collection of the native trees, shrubs, and herbaceous plants of the State of California, with the intent to gather in as rapidly as possible those of the neighboring states of the Pacific Coast. Within two years the collection numbered 600 species. In the following decade it grew to 1500, but then began to expand both its scope and collection to encompass plants from all continents and about 10,000 species.

The original official Garden was located near Haviland Hall on the north side of campus centered around a large glass conservatory modeled after the London Crystal Palace .

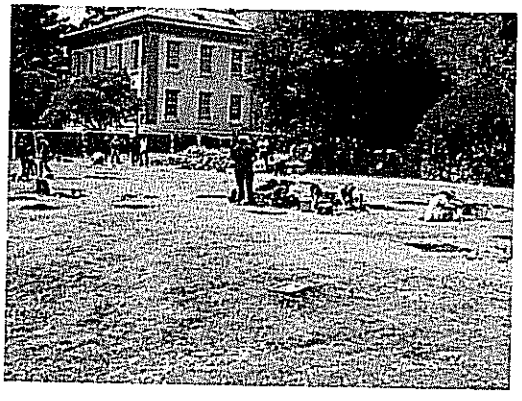


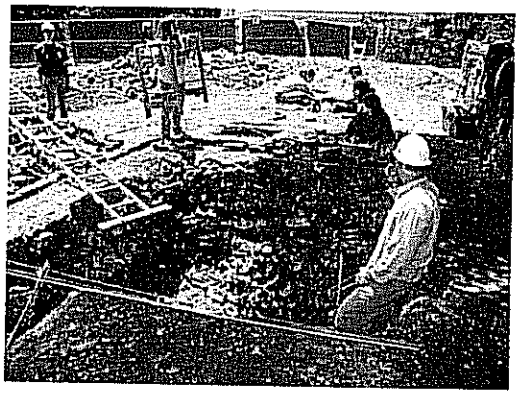
Conservatory of original Botanical Garden taken on Haviland site around 1912.

***Built 1894-5 at a cost of $16,000 by the architectural firm of Lord & Burnham, Irving , N.Y.**
6,200 sq. ft.; 170 feet long; glass and steel.

***Modeled on the famous London Crystal Palace (like the one in Golden Gate Park).**

*** Razed in 1924 in conjunction with the construction of Haviland Hall by John Galen Howard.**
The Conservatory was reported too old to be moved.



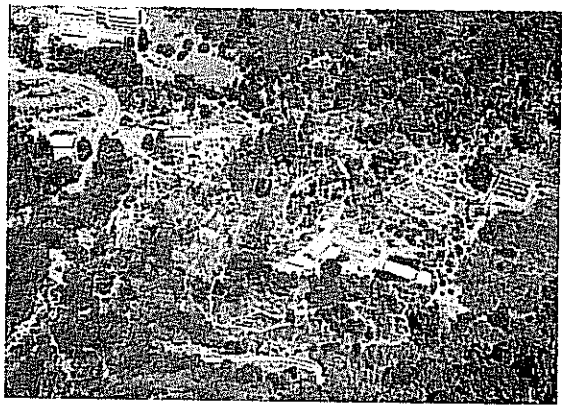


An archeological dig by the Department of Anthropology led by Prof. Laurie Wilkie in 2003 on the site of Haviland Parking lot when plans were being made to construct the new C.V. Starr East Asian Library uncovered remnants of the conservatory unearthed remnants of the conservatory.
Read Article

ANTHRO N133-2: Archaeological Field Methods "UC Berkeley Conservatory"

Laurie Wilkie, 6 units, M-F, 8:30 – 3:30 , Limited to 20 students
SPECIAL SESSION: May 23 - June 17
In 1894, the University of California built a glass conservatory to conduct agricultural experiments and raise seedlings and flowers. By 1923, the building was considered outdated and removed. In 2003, UC archaeologists conducted preliminary excavations at the site and determined that material remains and foundations are still preserved at the site and offer the opportunity to study the practice of agricultural science at the site, as well as to inform us about how campus spaces were used by students and faculty alike. This summer, students will be involved in conducting broad scale excavations at the site, and will learn basic historic materials analysis. Application: Email Professor Wilkie at wilkie@sscl.berkeley.edu for more information.

In the 1920's plans for campus development forced the Botanical Garden out of its initial central campus location (actually, the site remained a parking lot until 2007). Under the auspices of then Garden director T. Harper Goodspeed the Garden was relocated to its current position on 34 acres in Strawberry Canyon above the main campus, using a landscaping scheme created by J. W. Gregg in the Department of Landscape Design. In moving to the new location Goodspeed codified the principle that the Garden's plantings are to be organized according to their geographical origins in settings resembling the native habitats. This principle continues to dominate Garden policy.



Move to Strawberry Canyon:

*Strawberry Canyon purchased by the University in 1909. Setchell almost immediately began to importune Wheeler for land for the botanical garden, which was becoming seriously crowded by John Galen Howard's building plan on the central campus.

*By 1920 a small tract had been made available for the *Nicotiana* experiments and for growing materials for classes.

*Actual move accomplished in the 1920's. Planning and supervision of the construction was done by Goodspeed, using a landscaping scheme created by Professor J. W. Gregg in the Department of Landscape Design.

*Goodspeed established the policy of grouping plants by geographic affinities (in contrast to grouping by taxonomic affinities or economic usage).

Following the move to Strawberry Canyon major additions were made to the collection. The first additions were to the Rhododendron Dell, acquired through gifts of alumni and friends, and greatly supplemented by an expedition to remote areas of China by Joseph R. Rock.

Path leads through large tree sized Rhododendrons collected in 1933.

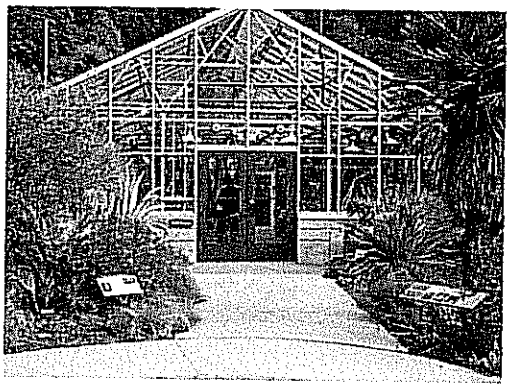
Goodspeed established the policy of grouping plants by geographic affinities (in contrast to grouping by taxonomic affinities or economic usage).

*First major collection, begun in 1930 and comprised of more than 1000 specimens, obtained through gifts from alumni and friends. (See Goodspeed's quotation above.)

*Visited in 1932 by Dr. Joseph F. Rock, a renowned botanist and explorer, who was so impressed by the collection and its

location that he proposed and conducted a major expedition to remote areas of China , bringing back over 25,000 herbarium specimens and seed of some 1000 species of *Rhododendron* and other plants of ornamental importance.

Another early addition to the Garden that remains a favorite today was the New World Desert and associated cactus and succulent collections.



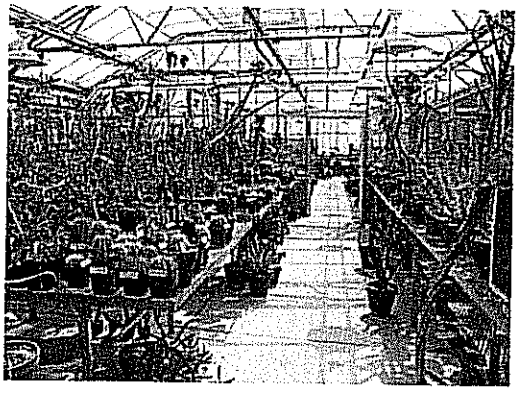
Cacti and Succulents:

*James West (aka Prince Egon von Ratibor) laid out an extensive rock garden in 1932 which was planted with plants from his own personal collection. As a member of the first Andean expedition in 1935, West further enriched the collection. With additional accessions from subsequent South American expeditions, the cactus and succulent collection became

*One of the most important accumulations of plants of research value grown in the Botanical Garden.

*Robert J. Rodin, as part of a University expedition to Africa in 1947-48, added a singularly large collection of succulents from southern Africa to the Garden.

* These collections have grown. The Arid House rebuilt in 2000 and associated holding facilities combined with outdoor plantings now houses one of the countries largest collections of cacti and succulents.



Goodspeed initiated a series of six expeditions to the Andes (carried out between 1935 and 1958). Their primary objective was to collect all species of the genus *Nicotiana* (tobacco and its close relatives) , with determination of their ranges. A secondary objective was collection of Andean plants in botanically unknown areas, and which led to the acquisition of a magnificent collection of South American cacti and succulents This was enlarged in the late 1940's by R. J. Rodin with a singularly large collection of succulents from southern Africa . Other significant additions in the Goodspeed era were the acquisition of specimens from the rediscovered grove of dawn redwoods in China and the planting of a five-acre grove of Californian coast redwoods.

Dawn Redwood Glade

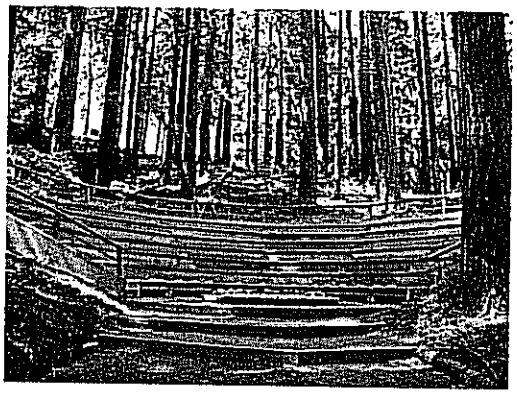
*In the late 1940's the paleobotanist, Dr. Ralph Chaney, was an early visitor to the dawn redwoods (*Metasequoia glyptostroboides*) which were rediscovered in a native grove found in China . Chaney brought back living material which has been grown in the Garden alongside trees derived from seeds provided by Dr. Elmer Merrill of the Arnold Arboretum.

* During the 1950's the Botanical Garden manager, Robert Dutton, extensively propagated the dawn redwoods with cuttings, which were planted in a wide variety of geographical locations to

determine the tolerance limits of the species. [Baker, 1980]

Stephen T. Mather Redwood Grove :

*In the early 1930's a plantation of 2,500 redwoods and pines was conceived by Goodspeed and several alumni, especially Charles H. Townsend '87 and Ansel F. Hall '17, who intended the plantation to become a living memorial to Stephen Tyng Mather '87, first director of the National Park Service.



*When funding for the project failed, a small grove of about five acres was planted on the north side of Centennial Drive in 1936.

*In the 1960's, when LBL built its fences, the redwood grove was cut off from the Botanical Garden and the general public. Mac Laetsch, during his tenure as director, instituted a successful campaign to get LBL officials to reroute their fencing with the result that the grove once again became part of the Botanical Garden's property.

* With much work on the part of Garden staff and with help from local Boy Scouts, the Grove's redwood trees were made ship shape and plantings of associated flora were made. The Grove was formally opened and dedicated in 1976.

* The Townsend Amphitheater was built in the natural hollow in the Grove through a donation from the Townsend family. Now a popular site for outdoor events, especially weddings.

Following Goodspeed's retirement in the 1950's the Garden directorship passed to Herbert Baker. Under his tenure (1957-1969) the collections were further expanded . A seventh expedition, to Bolivia and Peru in 1964, was carried out by garden botanist Paul Hutchison, which added more succulents as well as tropical plants to the collections. Notable additions included major collections from Mesoamerica , Australia and New Zealand , expansion of the Californian native plant collection, and development of a section for economic plants. Baker instituted a major policy change: other than for a few special exceptions all plants accessioned by the Garden must have complete data on their natural origins. Adherence to this policy has endowed the collection with substantial value for researchers world wide.

In the 1970's and 1980's, the Garden made a major change in its orientation. Previously the Garden's principal functions were support of instruction in botany on the Berkeley campus and scientific research -- Goodspeed became the leading authority of his time on the biosystematics of *Nicotiana*, and Baker is renowned for his research on plant ecological genetics. Under the leadership of Watson Laetsch in 1969-74 and later Robert Ornduff (1974-1991) the Garden launched into a program of outreach to the wider community, becoming the only one of the five natural history museums at Berkeley that is open to the public. A docent program was inaugurated in 1974. Each year the Garden's corps of almost 100 docents lead many hundreds of tours for thousands of school children, adults, and university students.

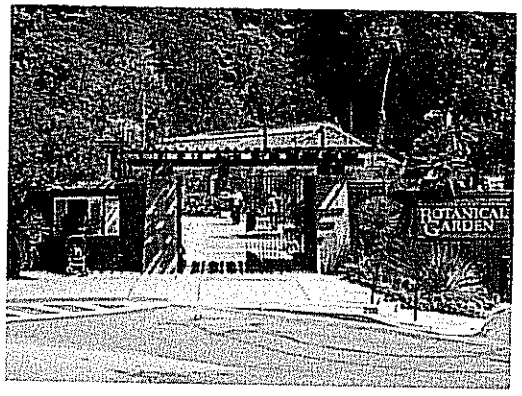
In 1989, the Garden was placed under the control of the College of Natural Resources and was then transferred to the Office of the Vice Chancellor for Research in 1996. During this decade, there was a succession of five acting directors and directors following the long tenure of Robert Ornduff.

The old Entrance consisted of a chain link fence and gate that both visitors and vehicles shared, often together. In 2005, a new Entrance and plaza were completed.

In 2003, the Directorship was assumed by Paul Licht. The construction of a new entrance to the Garden ushered in a period of revitalization of the infrastructure

and an increased reliance on non-state funding. The Garden was initially funded entirely by state funds but is state funds now account for less than one-half of the annual budget.

Fund raising and revenue generation are critical to the Garden's budget. The Friends of the Botanical Garden was established in 1976 as a support group for fundraising and, more importantly, for involving the general public in volunteer activities. Although the formal Friends group was dissolved in 1997, a community of about 250 volunteers continue to support all activities in the Garden. In addition to the docents, a corps of volunteer propagators raises a significant portion of the Garden's budget through two annual plant sales (spring and fall) and daily plant sales from the Garden Shop nursery. Volunteers staff the Garden Shop, which offers a wide selection of garden-related books and gifts. Additional volunteers donate time and labor in assistance to the horticultural and curatorial staff. Members of the Garden help support its programs and operations. Become a member. . .



In recent years the Garden's programmatic emphasis has broadened to include conservation, interpretation, and educational outreach emphasizing evolution, ecology and human uses of plants. Accessions are mostly made through active participation in seed exchanges rather than on staff expeditions. Priorities are on making the best use of what we already have to further enhance the experience of visitors and to spark increased educational and research activities.

Historical Notes of the Botanical Garden:

The Annex -- End of an era
To obtain the full story of the demolition of the annex building you can download a pdf format by clicking here...

Garden Leadership

Edward L. Greene	1885 - 1895	First Professor of Botany; Founded the Garden in 1890.
William A. Setchell	1895 - 1934	Professor & Chairman of Botany
Joseph Burtt-Davy	1895 - 1902	In charge of the Garden
Harvey Monroe Hall	1902 - 1919	In charge of the Garden and also the Herbarium.
T. Harper Goodspeed	1919 - 1926	In charge of the Garden
	1926 - 1934	Curator
	1934 - 1954	Director
	1954 - 1957	Acting Director
Herbert G. Baker	1957 - 1969	Director
Watson M. Laetsch	1969 - 1974	Director
Robert Ornduff	1974 - 1991	Director
Margaret S. Race	1991 - 1993	Acting Director
George S. Rogers	1993 - 1995	Director
Philip T. Spieth	1995 - 1996	Acting Director
Ian S.E. Carmichael	1996 -- 1998	Acting Director
Ellen L. Simms	1999 – 2003	Director
Paul Licht	2003 -	Director

Google Search | only search UC Botanical Garden site

Email us! The Garden is a member of the Berkeley Natural History Museums consortium.

| collections | research| education | events/programs | rentals | the garden shop | membership |
| mission/history | newsletters | staff | visitor information | volunteers |

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The University of California Botanical Garden 200 Centennial Drive #5045 Berkeley, CA 94720-5045 510-643-2755

Photos: UCBG Staff, Richard Anderson, Patricia Hatch. Email your website feedback or suggestions

News for Release: Monday, January 28, 2008

U.S. Environmental Protection Agency (EPA)

Nanotechnology: The Big News is Small
New Research funded on Nanotechnology Environmental Impacts

Contact: Suzanne Ackerman, (202)564-4355 / ackerman.suzanne@epa.gov

(Washington , D.C. – January 28, 2008) Americans are famous for building big: the tallest sky scraper, the biggest jet, the widest plasma TV screen. But now U.S. entrepreneurs are considering thinking small. Nanotechnology uses particles 80,000 times smaller than a human hair; yet the new technology has the potential to quickly clean up pollution, cure serious illnesses, and make the computer silicon chip obsolete. While EPA looks forward to new environmental breakthroughs, the Agency's first commitment is to protect human health and the environment. Therefore EPA has awarded 21 grants totaling $7.34 million to universities to investigate potential adverse health and environmental effects of manufactured nanomaterials.

The grants were awarded through EPA's Science to Achieve Results (STAR) research grants program in partnership with the National Science Foundation's (NSF), National Institute of Environmental Health Sciences (NIEHS), and the National Institute for Occupational Safety and Health (NIOSH) who awarded another eight grants for a total of 29. Nine of the grants focus on potential toxicity, and 12 grants study the fate and transport of nanomaterials in the environment.

"Nanotechnology is an exciting new field with the potential to transform environmental protection. But it is critical to know whether nanomaterials could negatively impact health or the environment," said George Gray, Assistant Administrator of EPA's Office of Research and Development. "By performing research on potential adverse affects, EPA is doing what is right for both human and environmental health and technological progress."

Today, EPA is initiating a Nanoscale Materials Stewardship Program (NMSP) under the Toxic Substances Control Act (TSCA) to gather and develop key information from manufacturers, importers, processors and users of engineered chemical nanoscale materials. The information gathered through the stewardship program will be invaluable in furthering EPA's understanding of potential risks and benefits of these nanoscale materials.

EPA further works with agencies in other countries on nanotechnology health and safety research. The Agency is part of the Organization for Economic Cooperation and Development (OECD) effort to promote international cooperation in health and environmental safety related aspects of manufactured nanomaterials,

List of awardees: http://es.epa.gov/ncer/nano/2008recipients.html

The grants funded by EPA were awarded to the following universities:

Arizona State University, Tempe, Ariz., $398,998 – Determine whether bacteria used at wastewater treatment plants can effectively remove nanoparticles from sewage, concentrate nanoparticles into biosolids and/or possibly transform nanoparticles as they move through the processing system.

Arizona State University , Tempe , Ariz. , $399,768 – Develop a method for evaluating the potential risks of bioaccumulation of manufactured nanomaterials in aquatic organisms.

Battelle, Pacific Northwest Division, Seattle , Wash. , $200,000 – Study how nanoscale particles interact with cells when they are inhaled.

University of California , Santa Barbara , Calif. , $399,986 – Discover the processes that could allow manmade nanoparticles to enter cells and possibly cause toxicity in a variety of bacteria and other single-celled organisms.

Carnegie Mellon University , Pittsburgh , Pa. , $400,000 – Determine the effect of common nanoparticle surface coatings on nano-iron reactivity, mobility, fate, and effect on soil bacteria.

Colorado School of Mines, Golden, Colo. , $389,997 – Determine whether manufactured nanomaterials that contain metals pose a risk to aquatic organisms.

Columbia University, New York, N.Y., $200,000 – Describe the life-cycle environmental profile of nanomaterials that are candidates for use in photovoltaic or solar power applications.

University of Delaware, Newark, Del., $399,035 – Develop an understanding of the fate of manmade nanoparticles released into subsurface environments.

University of Georgia Research Foundation , Athens , Ga. , $397,009 – Study the impact of metal nanoparticles on food webs, and the transfer ability of these toxins depending on their particle size and chemical composition.

University of Maine , Orono , ME , $398,298 – Determine the toxicity of semiconductor nanostructures, their impact on the environment, and the potential health risks in living organisms involved with bioaccumulation of the substances.

University of Michigan , Ann Arbor , Mich. , $371,886 – Provide fundamental information about the movement, fate and bioavailability of manmade, carbon nanotubes under different environmental conditions.

University of Missouri, Colombia , Mo. , $399,507 – Investigate the potential toxicity of manmade, carbon nanotubes on bottom-dwelling organisms in aquatic ecosystems.

University of North Carolina , Charlotte , N.C. , $399,843 – Determine the toxicity of manmade, metal nanoparticles on marine organisms.

North Carolina State University , Raleigh , N.C. , $391,617 – Describe the impacts of manmade nanomaterials on skin absorption and evaluate their safety and risk.

New York University, Tuxedo, N.Y., $399,827 – Study the possible biological effects of manufactured nanoparticles in waste streams that contaminate aquatic environments.

Oregon State University , Corvallis , Ore. , $199,993 – Determine the mechanisms by which manufactured nanomaterials damage or kill cells in realistic environments of exposure.

Oregon State University , Corvallis, Ore., $400,000 – Develop a system to rapidly assess the toxicity of manmade, industrial nanomaterials.

Purdue University , West Lafayette , Ind. , $199,990 – Investigate how manmade nanomaterials change or transform under certain environmental conditions.

University of Tennessee , Knoxville , Tenn. , $396,807 – Study the effects of an industrial nanomaterial, C_{60} fullerenes, as a contaminant in aquatic ecosystems.

University of Utah, Salt Lake City, UT, $200,000 – Investigate whether ingested nanoparticles are taken up by inflamed colon cells, move to the cell nucleus, and cause alteration of gene transcription.

University of Wisconsin-Milwaukee, Milwaukee , Wis. , $398,810 -- Assess how the immune system of rainbow trout responds to manufactured nanomaterials.

EPA relies on quality science as the basis for sound policy and decision-making. EPA's laboratories, research centers, and grantees are building the scientific foundation needed to support the Agency's mission to safeguard human health and the environment.

R019

Note: If a link above doesn't work, please copy and paste the URL into a browser.

View all news releases related to research

Nanotechnology under the Toxic Substances Control Act

On this page:

- Chemical Nanoscale Materials
- International Cooperation on Nanomaterials
- Resources

Highlights

New! January 28, 2008 – Read the Federal Register to learn about EPA's Nanoscale Materials Stewardship Program (NMSP).

Interested in the Nanoscale Materials Stewardship Program?

New! EPA is eager to reach out to potential participants, particularly small and medium-sized companies. Please submit your contact information.

You will need Adobe Reader to view some of the files on this page. See EPA's PDF page to learn more.

Chemical Nanoscale Materials

Many nanomaterials are regarded as "chemical substances" under the Toxic Substances Control Act (TSCA). This law provides EPA with a strong framework for ensuring that new and existing chemical substances are manufactured and used in a manner that protects against unreasonable risks to human health and the environment.

For example, TSCA requires manufacturers of new chemical substances (i.e., those not on the TSCA Chemical Substances Inventory) to provide specific information to the Agency for review prior to manufacturing chemicals or introducing them into commerce. EPA can require reporting or development of information to assess existing chemicals already in the marketplace. Additionally, EPA can take action to ensure that those chemicals that pose an unreasonable risk to human health or the environment are effectively controlled.

One of the key questions for manufacturers and importers is determining whether a given nanoscale material is already listed on the TSCA Inventory or if it is a new chemical requiring premanufacture notification to the Agency. On January 28, 2008, EPA released the TSCA Inventory Status of Nanoscale Substances – General Approach (2008) (PDF), (7 pp, 37K), describing EPA's current thinking regarding whether a nanoscale material is a "new" or "existing" chemical substance under TSCA.

EPA has received and reviewed numerous new chemical notices under TSCA for nanoscale materials and expects the number to increase in the future. The Agency has taken steps to control or limit exposures to these chemicals, and has also required testing to generate health and environmental effects data where appropriate. EPA has permitted limited manufacture of new chemical nanoscale materials through the use of administrative orders or Significant New Use Rules under TSCA. The Agency has also allowed the manufacture of new chemical-based nanoscale materials under certain regulatory exemptions, but only in circumstances where exposures were tightly controlled to protect against unreasonable risks.

To complement and support EPA's new and existing chemical programs under TSCA, the Agency developed a Nanoscale Materials Stewardship Program (NMSP). The NMSP will help provide a firmer scientific foundation for regulatory decisions by encouraging the development of key scientific information and contribute to an improved understanding of risk management practices for nanoscale chemical substances (nanoscale materials).

International Cooperation on Nanomaterials

Fully understanding the environmental applications and implications of nanotechnology requires the concerted efforts of scientists and policy makers across the globe. EPA is working collaboratively with stakeholders both domestically and internationally to address nanoscale materials, to identify and address nanotechnology research needs, and to develop international standards for nanotechnology.

International organizations such as the International Organization for Standardization (ISO) and the Organization for Economic Cooperation and Development (OECD) are engaged in nanotechnology issues.

The ISO has established a technical committee to develop international standards for nanotechnology. This technical committee, ISO/TC 229, EXIT Disclaimer is working to develop standards for terminology and nomenclature, metrology and instrumentation, including:

- specifications for reference materials,
- test methodologies,
- modeling and simulation, and
- science-based health, safety and environmental practices.

The OECD has established a Working Party on Manufactured Nanomaterials (WPMN) EXIT Disclaimer that is engaged in a variety of projects to further our understanding of the properties and potential risks of nanomaterials:

- Development of a Database on Environmental Health and Safety (EHS) Research
- EHS Research Strategies on Manufactured Nanomaterials
- Safety Testing of a Representative Set of Manufactured Nanomaterials
- Manufactured Nanomaterials and Test Guidelines
- Cooperation on Voluntary Schemes and Regulatory Programs
- Cooperation on Risk Assessments
- The Role of Alternative Methods in Nano Toxicology
- Exposure Measurement and Exposure Mitigation

EPA is actively participating in the Working Party and contributes to all of the projects. Of particular relevance to the in-depth portion of the Agency's Nanoscale Materials Stewardship Program (NMSP) is the project on Safety Testing of a Representative Set of Manufactured Nanomaterials. The WPMN has identified a representative list of manufactured nanoscale materials for environmental health and safety testing, including:

- fullerenes (C_{60})
- single-walled carbon nanotubes (SWCNTs)
- multi-walled carbon nanotubes (MWCNTs)
- silver nanoparticles
- iron nanoparticles
- carbon black
- titanium dioxide
- aluminum oxide

- cerium oxide
- zinc oxide
- silicon dioxide
- polystyrene
- dendrimers
- nanoclays

The WPMN has also published a list of testing endpoints in the following areas:

- nanomaterial information/identification
- physical-chemical properties
- material characterization
- environmental fate
- environmental toxicology
- mammalian toxicology
- material safety

The WPMN has launched a Sponsorship Program for Testing Manufactured Nanomaterials. The OECD Secretariat has asked delegations about their willingness to sponsor, or co-sponsor, one or more nanomaterials and endpoints. The OECD will act as a clearinghouse for the sponsorship program and will prepare a guidance manual for sponsors. EPA is sponsoring environmental effects and fate testing of fullerenes, single walled carbon nanotubes, multiwalled carbon nanotubes, and cerium oxide. EPA encourages U.S. entities to participate in the OECD's work in addition to the in-depth portion of the NMSP.

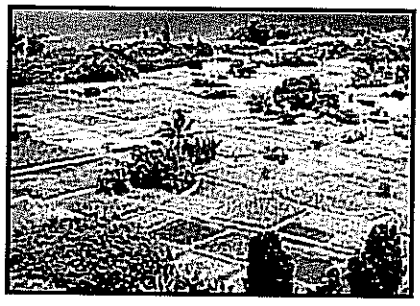
Resources

- EPA Nanotechnology White Paper, February 2007 (PDF), (136 pp, 4.1MB) describes why EPA is interested in nanotechnology across its programs, the Agency's statutory mandates, and risk assessment issues specific to nanotechnology across media.
- Interim Ad Hoc Work Group on Nanoscale Materials, National Pollution Prevention and Toxics Advisory Committee Overview Document (PDF) (13 pp., 1.1 MB)
- Risk Management Practices for Nanoscale Materials Public Meeting Summary (PDF) (75 pp., 464K) October 19-20, 2006
- Peer Consultation on Materials Characterization of Nanoscale Materials, September 6-7, 2007
- Pollution Prevention Through Nanotechnology Conference, September 25-26, 2007
- Meeting Summary Report of the August 2, 2007, Public Meeting (PDF) (35 pp, 119K) for the Nanoscale Materials Stewardship Program

36 Preservation Briefs

Technical Preservation Services
National Park Service
U.S. Department of the Interior

Protecting Cultural Landscapes Planning, Treatment and Management of Historic Landscapes

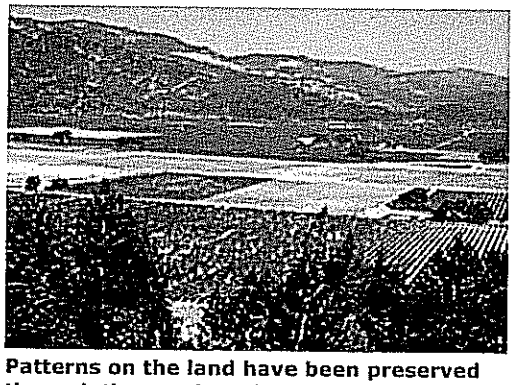


Charles A. Birnbaum, ASLA

»Developing a Strategy and Seeking Assistance
»Preservation Planning for Cultural Landscapes
»Developing a Historic Preservation Approach and Treatment Plan
»Developing a Preservation Maintenance Plan and Implementation Strategy
»Recording Treatment Work and Future Research Recommendations
»Summary
»Selected Reading

A NOTE TO OUR USERS: The web versions of the **Preservation Briefs** differ somewhat from the printed versions. Many illustrations are new, captions are simplified, illustrations are typically in color rather than black and white, and some complex charts have been omitted.

Cultural landscapes can range from thousands of acres of rural tracts of land to a small homestead with a front yard of less than one acre. Like historic buildings and districts, these special places reveal aspects of our country's origins and development through their form and features and the ways they were used. Cultural landscapes also reveal much about our evolving relationship withthe natural world.



Patterns on the land have been preserved through the continuation of traditional uses, such as the grape fields at the Sterling Vineyards in Calistoga, California. Photo: NPS files.

A ***cultural landscape*** is defined as "a geographic area,including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values." There are four general types of cultural landscapes, not mutually exclusive*: historic sites, historic designed landscapes, historic vernacular landscapes, and ethnographic landscapes.* These are defined below.

Historic landscapes include residential gardens and community parks, scenic highways, rural communities, institutional grounds, cemeteries, battlefields and zoological gardens. They are composed of a number of character-defining features which, individually or collectively contribute to the landscape's physical appearance as they have evolved over time. In addition to vegetation and topography, cultural landscapes may include water features, such as ponds, streams, and fountains; circulation features, such as roads,

paths, steps, and walls; buildings; and furnishings, including fences, benches, lights and sculptural objects.

Most historic properties have a cultural landscape component that is integral to the significance of the resource. Imagine a residential district without sidewalks, lawns and trees or a plantation with buildings but no adjacent lands. A historic property consistsof all its cultural resources--landscapes, buildings, archeological sites and collections. In some cultural landscapes, there may be a total absence of buildings.

This Preservation Brief provides preservation professionals, cultural resource managers, and historic property owners a step-by-step process for preserving **historic designed** and **vernacular landscapes**, two types of cultural landscapes. While this process is ideally applied to an entire landscape, it can address a single feature, such as a perennial garden, family burial plot, or a sentinel oak in an open meadow. This Brief provides a framework and guidance for undertaking projects to ensure a successful balance between historic preservation and change.

DEFINITIONS

Historic Designed Landscape--a landscape that was consciously designed or laid out by a landscape architect, master gardener, architect, or horticulturist according to design principles,or an amateur gardener working in a recognized style or tradition. The landscape may be associated with a significant person(s), trend, or event in landscape architecture; or illustrate an important development in the theory and practice of landscape architecture. Aesthetic values play a significant role in designed landscapes. Examples include parks, campuses, and estates.

Historic Vernacular Landscape--a landscape that evolved through use by the people whose activities or occupancy shaped that landscape. Through social or cultural attitudes ofan individual, family or a community, the landscape reflects the physical, biological, and cultural character of those everyday lives. Function plays a significant role in vernacular landscapes. They can be a single property such as a farm or a collection of properties such as a district of historic farms along a river valley. Examples include rural villages, industrial complexes, and agricultural landscapes.

Historic Site--a landscape significant for its association with a historic event, activity, or person. Examples include battlefields and president's house properties.

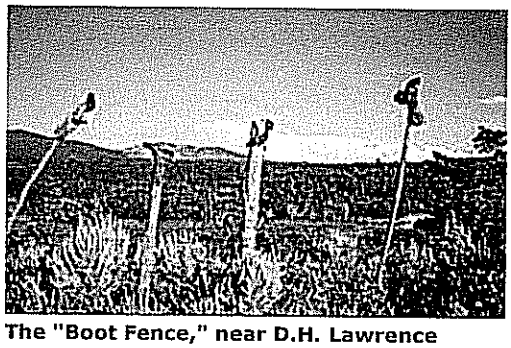
Ethnographic Landscape--a landscape containing a variety of natural and cultural resources that associated people define as heritage resources. Examples are contemporary settlements, religious sacred sites and massive geological structures. Small plant communities, animals, subsistence and ceremonial grounds are often components.

Developing a Strategy and Seeking Assistance

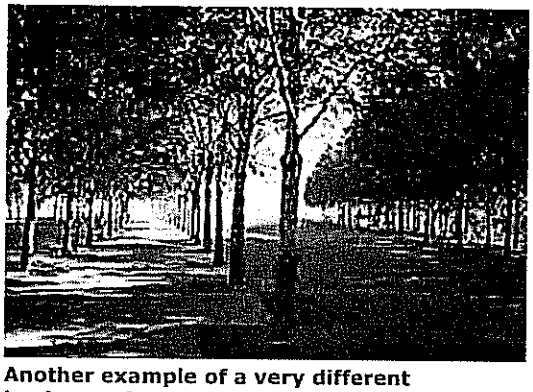
Nearly all designed and vernacular landscapes evolve from, or are often dependent on, natural resources. It is these interconnected systems of land, air and water, vegetation and wildlife which have dynamic qualities that differentiate cultural landscapes from

other cultural resources, such as historic structures. Thus, their documentation, treatment, and ongoing management require a comprehensive, multi-disciplinary approach.

Today, those involved in preservation planning and management of cultural landscapes represent a broad array of academic backgrounds,training, and related project experience. Professionals may have expertise in landscape architecture, history, landscape archeology, forestry, agriculture, horticulture, pomology, pollen analysis, planning, architecture, engineering (civil, structural, mechanical, traffic), cultural geography, wildlife, ecology, ethnography, interpretation, material and object conservation, landscape maintenanceand management. Historians and historic preservation professionals can bring expertise in the history of the landscape, architecture, art, industry, agriculture, society and other subjects. Landscape preservation teams, including on-site management teams and independent consultants, are often directed by a landscape architect with specific expertise in landscape preservation. It is highly recommended that disciplines relevant to the landscapes' inherent features be represented as well.



The "Boot Fence," near D.H. Lawrence Ranch, Questa, California, is an example of a character-defining landscape feature. Photo: Courtesy, Cheryl Wagner.



Another example of a very different landscape feature is this tree planting detail for Jefferson Memorial Park, St. Louis, Missouri. Photo: Courtesy, Dan Kiley.

Additional guidance may be obtained from State Historic Preservation Offices, local preservation commissions, the National Park Service, local and state park agencies, national and state chapters ofthe American Society of Landscape Architects, the Alliance for Historic Landscape Preservation, the National Association of Olmsted Parks, and the Catalog of Landscape Records in the United States at Wave Hill, among others.

A range of issues may need to be addressed when considering how a particular cultural landscape should be treated. This may include the in-kind replacement of declining vegetation, reproduction of furnishings, rehabilitation of structures, accessibility provisions for people with disabilities, or the treatment of industrial properties that are rehabilitated for new uses.

Preservation Planning for Cultural Landscapes

Careful planning prior to undertaking work can help prevent irrevocable damage to a cultural landscape. Professional techniques for identifying, documenting, evaluating and preserving cultural landscapes have advanced during the past 25 years and are continually being refined. Preservation planning generally involves the following steps: historical research; inventory and documentation of existing conditions; site analysis and evaluation of integrity and significance; development of a cultural landscape preservation approach and treatment plan; development of a cultural landscape

management plan and management philosophy; the development of a strategy for ongoing maintenance; and preparation of a record of treatment and future research recommendations.

The steps in this process are not independent of each other, nor are they always sequential. In fact, information gathered in one step may lead to a re-examination or refinement of previous steps. For example, field inventory and historical research are likely to occur simultaneously, and may reveal unnoticed cultural resources that should be protected.

The treatment and management of cultural landscape should also be considered in concert with the management of an entire historic property. As a result, many other studies may be relevant. They include management plans, interpretive plans, exhibit design, historic structures reports, and other.

These steps can result in several products including a Cultural Landscape Report (also known as a Historic Landscape Report), statements for management, interpretive guide, maintenance guideand maintenance records.

CULTURAL LANDSCAPE REPORTS

A Cultural Landscape Report (CLR) is the primary report that documents the history, significance and treatment of a cultural landscape. A CLR evaluates the history and integrity of the landscape including any changes to its geographical context, features, materials,and use.

CLWs are often prepared when a change (e.g. a new visitor's center or parking area to a landscape) is proposed. In such instances, a CLR can be a useful tool to protect the landscape's character-defining features from undue wear, alteration or loss. A CLR can provide managers, curators and others with information needed to make management decisions.

A CLR will often yield new information about a landscape's historic significance and integrity, even for those already listed on theNational Register. Where appropriate, National Register files should be amended to reflect the new findings.

Historical Research

Research is essential before undertaking any treatment. Findings will help identify a landscape's historic period(s) of ownership, occupancy and development, and bring greater understanding of the associations and characteristics that make the landscape or history significant. Research findings provide a foundation to make educated decisions for work, and can also facilitate ongoing maintenance and management operations, interpretation and eventual compliance requirements.

A variety of primary and secondary sources may be consulted. Primary archival sources can include historic plans, surveys, plats, tax maps, atlases, U. S. Geological Survey maps, soil profiles, aerial photographs, photographs, stereoscopic views, glass lantern slides, postcards, engravings, paintings, newspapers, journals, construction drawings,

specifications, plant lists, nursery catalogs, household records, account books and personal correspondence. Secondary sources include monographs, published histories, theses, National Register forms, survey data, local preservation plans, state contexts and scholarly articles.

Contemporary documentary resources should also be consulted. This may include recent studies, plans, surveys, aerial and infrared photographs, Soil Conservation Service soil maps, inventories, investigations and interviews. Oral histories of residents, managers,and maintenance personnel with a long tenure or historical association can be valuable sources of information about changes to a landscape over many years. For properties listed in the National Register, nomination forms should be consulted.

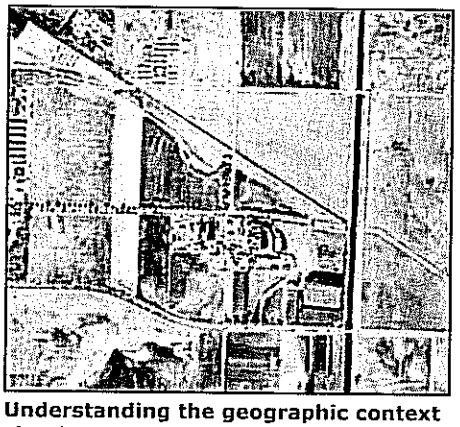
Preparing Period Plans

In the case of designed landscapes, even though a historic design plan exists, it does not necessarily mean that it was realized fully, or even in part. Based on a review of the archival resources outlined above, and the extant landscape today, an *as-built period plan* may be delineated. For all successive tenures of ownership, occupancy and landscape change, *period plans* should be generated. Period plans can document to the greatest extent possible the historic appearance during a particular period of ownership, occupancy, or development. Period plans should be based on primary archival sources and should avoid conjecture. Features that are based on secondary or less accurate sources should be graphically differentiated. Ideally, all referenced archival sources should be annotated and footnoted directly on *period plans*.

Where historical data is missing, period plans should reflect any gaps in the CLR narrative text and these limitations consideredin future treatment decisions.

Inventorying and Documenting Existing Conditions

Both physical evidence in the landscape and historic documentation guide the historic preservation plan and treatments. To document existing conditions, intensive field investigation and reconnaissance should be conducted at the same time that documentary researchis being gathered. Information should be exchanged among preservation professionals, historians, technicians, local residents, managers and visitors.

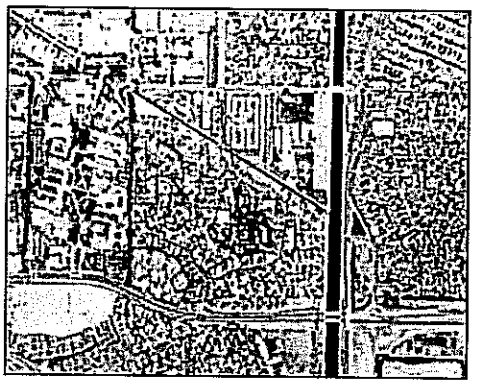


Understanding the geographic context should be part of the inventory process. This aerial photograph at Rancho Los Alamitos, Long Beach, CA, was taken in 1936. (See, below.) Photo: Rancho Los Alamitos

To assist in the survey process, National Register Bulletins have been published by the National Park Service to aid in identifying,nominating and evaluating designed and rural historic landscapes. Additionally, Bulletins are available for specific landscape types such as battlefields, mining sites, and cemeteries.

Although there are several ways to inventory and document a landscape,the goal is to create a baseline from a detailed record of the landscape and its features as they exist at the present (considering seasonal variations). Each landscape inventory should address issues of boundary delineation, documentation methodologies and techniques, the limitations of the inventory, and the scope of inventory efforts.

Foundation.



This present-day view of Rancho Los Alamitos shows present-day encroachments and adjacent developments that will affect the future treatment of visual and spatial relationships. Photo: Rancho Los Alamitos Foundation.

These are most often influenced by the timetable, budget, project scope, and the purpose of the inventory and, depending on the physical qualities of the property, its scale, detail, and the inter-relationship between natural and cultural resources. For example, inventory objectives to develop a treatment plan may differ considerably compared to those needed to develop an ongoing maintenance plan. Once the criteria for a landscape inventory are developed and tested, the methodology should be explained.

Preparing Existing Condition Plans

Inventory and documentation may be recorded in plans, sections, photographs, aerial photographs, axonometric perspectives, narratives, video-or any combination of techniques. Existing conditions should generally be documented to scale, drawn by hand or generated by computer. The scale of the drawings is often determined by the size and complexity of the landscape. Some landscapes may require documentation at more than one scale. For example, a large estate may be documented at a small scale to depict its spatial and visual relationships, while the discrete area around an estate mansionmay require a larger scale to illustrate individual plant materials, pavement patterns and other details. The same may apply to an entire rural historic district and a fenced vegetable garden contained within.

When landscapes are documented in photographs, *registration points* can be set to indicate the precise location and orientation of features. Registration points should correspond to significant forms, features and spatial relationships within the landscape and its surrounds. The points may also correspond to historic views to illustrate the change in the landscape todate. These locations may also be used as a management tool todocument the landscape's evolution, and to ensure that its character-defining features are preserved over time through informed maintenance operations and later treatment and management decisions.

All features that contribute to the landscape's historic character should be recorded. These include the physical features described above (e.g. topography, circulation), and the visual and spatial relationships that are character defining. The identification of existing plants, should be specific, including genus, species, common name, age (if known) and size. The woody, and if appropriate, herbaceous plant material should be accurately located on the existing conditions map. To ensure full representation of successional herbaceous plants, care should be taken to document the landscape in different seasons, if possible.

Treating living plant materials as a curatorial collection has also been undertaken at some cultural landscapes. This process, either done manually or by computer, can track the condition and maintenance operations on individual plants. Some sites, suchas the Frederick Law Olmsted National Historic Site, in Brookline, Massachusetts have developed a field investigation numbering system to track all woody plants. Due to concern for the preservation of genetic diversity and the need to replace significant plant materials, a number of properties are beginning to propagate historically important rare plants that are no longer commercially available, unique, or possess significant historic associations. Such herbarium collections become a part of a site's natural history collection.

Once the research and the documentation of existing conditions have been completed, a foundation is in place to analyze the landscape's continuity and change, determine its significance, assess its integrity, and place it within the historic context of similar landscapes.

READING THE LANDSCAPE

A noted geographer, Pierce Lewis, stated, "The attempt to derive meaning from landscapes possesses overwhelming virtue. It keeps us constantly alert to the world around us, demanding that we pay attention not just to some of the things around us but to all of them--the whole visible world in all of its rich, glorious, messy, confusing, ugly, and beautiful complexity."

Landscapes can be read on many levels--landscape as nature, habitat, artifact, system, problem, wealth, ideology, history, place and aesthetic. When developing a strategy to document a cultural landscape, it is important to attempt to read the landscape in its context of place and time.

Reading the landscape, like engaging in archival research, requires a knowledge of the resource and subject area as well as a willingness to be skeptical. As with archival research, it may involve serendipitous discoveries. Evidence gained from reading the landscape may confirm or contradict other findings and may encourage the observer and the historian to re-visit both primary and secondary sources with a fresh outlook. Landscape investigation may also stimulate other forms of research and survey, such as oral histories or archeological investigations, to supplement what appeared on-site.

There are many ways to read a landscape-whatever approach is taken should provide a broad overview. This may be achieved by combining on-the-ground observations with a bird's-eye perspective. To begin this process, aerial photographs should be reviewed to gain an orientation to the landscape and its setting. Aerial photographs come in different sizes and scales, and can thus portray different levels of detail in the landscape. Aerial photographs taken at a high altitude, for example, may help to reveal remnant field patterns or traces of an abandoned circulation system; or, portions of axial relationships that were part of the original design, since obscured by encroaching woodland areas. Low altitude aerial photographs can point out individual features such as the arrangement of shrub and herbaceous borders, and the exact locations of furnishings, lighting, and fence alignments. This knowledge can prove beneficial before an on-site visit.

Aerial photographs provide clues that can help orient the viewer to the landscape. The next step may be to view the landscape from a high point such as a knoll or an upper

floor window. Such a vantage point may provide an excellent transition before physically entering the cultural landscape.

On ground, evidence should then be studied, including character-defining features, visual and spatial relationships. By reviewing supporting materials from historic research, individual features can be understood in a systematic fashion that show the continuum that exists on the ground today. By classifying these features and relationships, the landscape can be understood as an artifact, possessing evidence of evolving natural systems and human interventions over time.

For example, the on-site investigation of an abandoned turn-of-the-century farm complex reveals the remnant of a native oak and pine forest which was cut and burned in the mid-nineteenth century. This previous use is confirmed by a small stand of mature oaks and the presence of these plants in the emerging secondary woodland growth that is overtaking this farm complex in decline. A ring count of the trees can establish a more accurate age. By *reading* other character-defining features, such as the traces of old roads, remnant hedgerows, ornamental trees along boundary roads, foundation plantings, the terracing of grades and remnant fences--the visual, spatial and contextual relationships of the property as it existed a century ago may be understood and its present condition and integrity evaluated.

The findings of on-site reconnaissance, such as materials uncovered during archival research, may be considered primary data. These findings make it possible to inventory and evaluate the landscape's features in the context of the property's current condition. Character-defining features are located *in situ*, in relationship to each other and the greater cultural and geographic contexts.

Historic Plant Inventory

Within cultural landscapes, plants may have historical or botanical significance. A plant may have been associated with a historic figure or event or be part of a notable landscape design. A plant may be an uncommon cultivar, exceptional in size, age, rare and commercially/unavailable. If such plants are lost, there would be a loss of historic integrity and biological diversity of the cultural landscape. To ensure that significant plants are preserved, an inventory of historic plants is being conducted at the North Atlantic Region of the National Park Service. Historical landscape architects work with landscape managers and historians to gather oral and documented history on the plant's origin and potential significance. Each plant is then examined in the field by an expert horticulturist who records its name, condition, age, size, distribution, and any notable botanic characteristics.

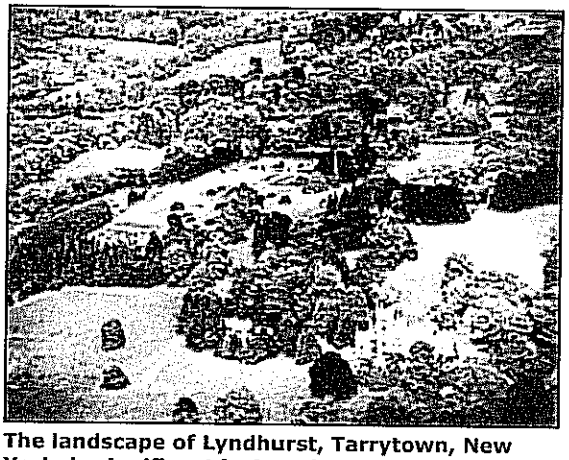
Plants that are difficult to identify or are of potential historical significance are further examined in the laboratory by a plant taxonomist who compares leaf, fruit, and flower characteristics with herbarium specimens for named species, cultivars and varieties. For plants species with many cultivars, such as apples, roses, and grapes, specimens may be sent to specialists for identification.

If a plant cannot be identified, is dying or in decline, and unavailable from commercial nurseries, it may be propagated. Propagation ensures that when rare and significant plants decline, they can be replaced with genetically-identical plants. Cuttings are propagated and grown to replacement size in a North Atlantic Region Historic Plant Nursery.

Site Analysis: Evaluating Integrity and Significance

By analyzing the landscape, its change over time can be understood. This may be accomplished by overlaying the various period plans with the existing conditions plan. Based on these findings, individual features may be attributed to the particular period when they were introduced, and the various periods when they were present.

It is during this step that the *historic significance* of the landscape component of a historic property and its integrity are determined. Historic significance is the recognized importance a property displays when it has been evaluated, including when it has been found to meet National Register Criteria. A landscape may have several areas of historical significance. An understanding of the landscape as a continuum through history is critical in assessing its cultural and historic value. In order for the landscape to have integrity, these character-defining features or qualities that contribute to its significance must be present.



The landscape of Lyndhurst, Tarrytown, New York, is significant in American culture and work of a master gardener, Ferdinand Mangold. Photo: National Trust for Historic Preservation.

While National Register nominations document the significance and integrity of historic properties, in general, they may not acknowledge the significance of the landscape's design or historic land uses, and may not contain an inventory of landscape features or characteristics. Additional research is often necessary to provide the detailed information about a landscape's evolution and significance useful in making decision for the treatment and maintenance of a historic landscape. Existing National Register forms may be amended to recognize additional areas of significance and to include more complete descriptions of historic properties that have significant land areas and landscape features.

Integrity is a property's historic identity evidenced by the survival of physical characteristics from the property's historic or pre-historic period. The seven qualities of integrity are location, setting, feeling, association, design, workmanship and materials. When evaluating these qualities, care should be taken to consider change itself. For example, when a second-generation woodland overtakes an open pasture in a battlefield landscape, or a woodland edge encloses a scenic vista. For situations such as these, the reversibility and/or compatibility of those features should be considered, both individually, and in the context of the overall landscape. Together, evaluations of significance and integrity, when combined with historic research, documentation of existing conditions, and analysis findings, influence later treatment and interpretation decisions.

Developing a Historic Preservation Approach and Treatment Plan

Treatment may be defined as work carried out to achieve a historic preservation goal--it cannot be considered in a vacuum. There are many practical and philosophical factors that may influence the selection of a treatment for a landscape. These include the

relative historic value of the property, the level of historic documentation, existing physical conditions, its historic significance and integrity, historic and proposed use (e.g. educational, interpretive, passive, active public, institutional or private), long-and short-term objectives, operational and code requirements (e.g. accessibility, fire, security) and costs for anticipated capital improvement, staffing and maintenance. The value of any significant archeological and natural resources should also be considered in the decision-making process. Therefore, a cultural landscape's preservation plan and the treatment selected will consider a broad array of dynamic and inter-related considerations. It will often take the form of a plan with detailed guidelines or specifications.

TREATMENTS FOR CULTURAL LANDSCAPES

Prior to undertaking work on a landscape, a treatment plan or similar document should be developed. The four primary treatments identified in the Secretary of the Interior's Standards for the Treatment of Historic Properties, are:

Preservation *is defined as the act or process of applying measures necessary to sustain the existing form, integrity, and materials of an historic property. Work, including preliminary measures to protect and stabilize the property, generally focuses upon the ongoing maintenance and repair of historic materials and features rather than extensive replacement and new construction. New additions are not within the scope of this treatment; however, the limited and sensitive upgrading of mechanical, electrical and plumbing systems and other code-required work to make properties functional is appropriate within a preservation project.*

Rehabilitation *is defined as the act or process of making possible a compatible use for a property through repair, alterations,and additions while preserving those portions or features which convey its historical or cultural values.*

Restoration *is defined as the act or process of accurately depicting the form, features, and character of a property as it appeared at a particular period of time by means of the removal of features from other periods in its history and reconstruction of missing features from the restoration period. The limited and sensitive upgrading of mechanical, electrical and plumbing systems and other code-required work to make properties functional is appropriate within a restoration project.*

Reconstruction *is defined as the act or process of depicting, by means of new construction, the form, features, and detailing of a non-surviving site, landscape, building, structure, or object for the purpose of replicating its appearance at a specific period of time and in its historic location.*

Adopting such a plan, in concert with a preservation maintenance plan, acknowledges a cultural landscape's ever-changing existence and the inter-relationship of treatment and ongoing maintenance. Performance standards, scheduling and record keeping of maintenance activities on a day-to-day or month-to-month basis, may then be planned for. Treatment, management, and maintenance proposals can be developed by a broad range of professionals and with expertise in such fields as landscape preservation, horticulture, ecology, and landscape maintenance.

The selection of a primary treatment for the

landscape, utilizing the *Secretary of the Interior's Standards for the Treatment of Historic Properties*, establishes an overall historic preservation approach, as well as a philosophical framework from which to operate. Selecting a treatment is based on many factors. They include management and interpretation objectives for the property as a whole, the period(s) of significance, integrity, and condition of individual landscape features.

When the American Elm was plagued with Dutch Elm Disease, many historic properties relied on the Japanese Zelkova as a substitute plant (see below). Photo: NPS files.

For all treatments, the landscape's existing conditions and its ability to convey historic significance should be carefully considered. For example, the life work, design philosophy and extant legacy of an individual designer should all be understood for a designed landscape, such as an estate, prior to treatment selection. For a vernacular landscape, such as a battlefield containing a largely intact mid-nineteenth century family farm, the uniqueness of that agrarian complex within a local, regional, state, and national context should be considered in selecting a treatment.

The overall historic preservation approach and treatment approach can ensure the proper retention, care, and repair of landscapes and their inherent features. In short, the Standards act as a preservation and management tool for cultural landscapes. The four potential treatments are described above.

Compared to the American Elm (above right), it is readily apparent that the form and scale of this tree is really quite different, and would be an inappropriate substitute plant material within a restoration or reconstruction project. Photo: NPS files.

Landscape treatments can range from simple, inexpensive preservation actions, to complex major restoration or reconstruction projects. The progressive framework is inverse in proportion to the retention of historic features and materials. Generally, preservation involves the least change, and is the most respectful of historic materials. It maintains the form and material of the existing landscape. Rehabilitation usually accommodates contemporary alterations or additions without altering significant historic features or materials, with successful projects involving minor to major change. Restoration or reconstruction attempts to recapture the appearance of a property,or an individual feature at a particular point in time, as confirmed by detailed historic documentation. These last two treatments most often require the greatest degree of intervention and thus,the highest level of documentation.

In all cases, treatment should be executed at the appropriate level, reflecting the condition of the landscape, with repair work identifiable upon close inspection and/or indicated in supplemental interpretative information. When repairing or replacing a feature, every effort should be made to achieve visual and physical compatibility. Historic materials should be matched in design, scale, color and texture.

A landscape with a high level of integrity and authenticity may suggest preservation as the primary treatment. Such a treatment may emphasize protection, stabilization, cyclical maintenance,and repair of character-defining landscape features. Changes over time that are part of the landscape's continuum and are significant in their own right

may be retained, while changes that are not significant, yet do not encroach upon or erode character may also be maintained. Preservation entails the essential operations to safeguard existing resources.

Rehabilitation is often selected in response to a contemporary use or need--ideally such an approach is compatible with the landscape's historic character and historic use. Rehabilitation may preserve existing fabric along with introducing some compatible changes, new additions and alterations. Rehabilitation may be desirable at a private residence in a historic district where the homeowner's goal is to develop an appropriate landscape treatment for a front yard, or in a public park where a support area is needed for its maintenance operations.

The historic birch allee at Stan Hywet Hall, Akron, Ohio, which had suffered from borer infestation and leaf miner, was preserved through a series of carefully executed steps that took 15 years to realize. Photo: Child Associates.

When the most important goal is to portray a landscape at an exact period of time, restoration is selected as the primary treatment. Unlike preservation and rehabilitation, interpreting the landscape's continuum or evolution is not the objective. Restoration may include the removal of features from other periods and/or the construction of missing or lost features and materials from the reconstruction period. In all cases, treatment should be substantiated by the historic research findings and existing conditions documentation. Restoration and re-construction treatment work should avoid the creation of a landscape whose features did not exist historically. For example, if features from an earlier period did not co-exist with extant features from a later period that are being retained, their restoration would not be appropriate.

In rare cases, when evidence is sufficient to avoid conjecture, and no other property exists that can adequately explain a certain period of history, reconstruction may be utilized to depict a vanished landscape. The accuracy of this work is critical. In cases where topography and the sub-surface of soil have not been disturbed, research and existing conditions findings may be confirmed by thorough archeological investigations. Here too, those features that are intact should be repaired as necessary, retaining the original historic features to the greatest extent possible. The greatest danger in reconstruction is creating a false picture of history.

False historicism in every treatment should be avoided. This applies to individual features as well as the entire landscape. Examples of inappropriate work include the introduction of historic-looking benches that are actually a new design, a fanciful gazebo placed in what was once an open meadow, executing an unrealized historic design, or designing a historic-looking landscape for a relocated historic structure within "restoration."

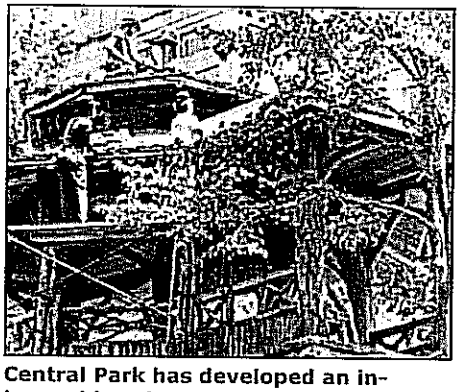
LANDSCAPE INTERPRETATION

Landscape interpretation is the process of providing the visitor with tools to experience the landscape as it existed during its period of significance, or as it evolved to its present state. These tools may vary widely, from a focus on existing features to the addition of interpretive elements. These could include exhibits, self-guided brochures, or

a new representation of a lost feature. The nature of the cultural landscape, especially its level of significance, integrity, and the type of visitation anticipated may frame the interpretive approach. Landscape interpretation may be closely linked to the integrity and condition of the landscape, and therefore, its ability to convey the historic character and character-defining features of the past. If a landscape has high integrity, the interpretive approach may be to direct visitors to surviving historic features without introducing obtrusive interpretive devices, such as free-standing signs. For landscapes with a diminished integrity, where limited or no fabric remains, the interpretive emphasis may be on using extant features and visual aids (e.g., markers, photographs, etc.) to help visitors visualize the resourceas it existed in the past. The primary goal in these situations is to educate the visitor about the landscape's historic themes, associations and lost character-defining features or broader historical, social and physical landscape contexts.

Developing a Preservation Maintenance Plan and Implementation Strategy

Throughout the preservation planning process, it is important to ensure that existing landscape features are retained. Preservation maintenance is the practice of monitoring and controlling change in the landscape to ensure that its historic integrity is not altered and features are not lost. This is particularly important during the research and long-term treatment planning process. To be effective, the maintenance program must have a guiding philosophy, approach or strategy; an understanding of preservation maintenance techniques; and a system for documenting changes in the landscape.



Central Park has developed an in-house historic preservation crew to undertake small projects. A specialized crew has been trained to repair and rebuild rustic furnishings. Photo: Central Park Conservancy.

The philosophical approach to maintenance should coincide with the landscape's current stage in the preservation planning process. A Cultural Landscape Report and Treatment Plan can take several years to complete, yet during this time managers and property owners will likely need to address immediate issues related to the decline, wear, decay, or damage of landscape features. Therefore, initial maintenance operations may focus on the stabilization and protection of all landscape features to provide temporary, often emergency measures to prevent deterioration, failure, or loss, without altering the site's existing character.

After a Treatment Plan is implemented, the approach to preservation maintenance may be modified to reflect the objectives defined by this plan. The detailed specifications prepared in the Treatment Plan relating to the retention, repair, removal, or replacement of features in the landscape should guide and inform a comprehensive preservation maintenance program. This would include schedules for monitoring and routine maintenance, appropriate preservation maintenance procedures, as well as ongoing record keeping of work performed. For vegetation, the preservation maintenance program would also include thresholds for growth or change in character, appropriate pruning methods, propagation and replacement procedures.

To facilitate operations, a property may be divided into discrete management zones.

These zones are sometimes defined during the Cultural Landscape Report process and are typically based on historically defined areas. Alternatively, zones created for maintenance practices and priorities could be used. Examples of maintenance zones would include woodlands, lawns, meadow, specimen trees, and hedges.

Training of maintenance staff in preservation maintenance skills is essential. Preservation maintenance practices differ from standard maintenance practices because of the focus on perpetuating the historic character or use of the landscape rather than beautification. For example, introducing new varieties of turf, roses or trees is likely to be inappropriate. Substantial earth moving (or movement of soil) may be inappropriate where there are potential archeological resources. An old hedge or shrub should be rejuvenated, or propagated, rather than removed and replaced. A mature specimen tree may require cabling and careful monitoring to ensure that it is not a threat to visitor safety. Through training programs and with the assistance of preservation maintenance specialists, each property could develop maintenance specifications for the care of landscape features.

Because landscapes change through the seasons, specifications for ongoing preservation maintenance should be organized in a calendar format. During each season or month, the calendar can be referenced to determine when, where, and how preservation maintenance is needed. For example, for some trees structural pruning is best done in the late winter while other trees are best pruned in the late summer. Serious pests are monitored at specific times of the year, in certain stages of their life cycle. This detailed calendar will, in turn, identify staff needs and work priorities.

Depending on the level of sophistication desired, one approach to documenting maintenance data and recording change over time is to use a computerized geographical or visual information system. Such a system would have the capability to include plans and photographs that would focus on a site's landscape features.

If a computer is not available, a manual or notebook can be developed to organize and store important information. This approach allows managers to start at any level of detail and to begin to collect and organize information about landscape features. The value of these maintenance records cannot be overstated. These records will be used in the future by historians to understand how the landscape has evolved with the ongoing care of the maintenance staff.

Recording Treatment Work and Future Research Recommendations

The last and ongoing step in the preservation planning process records the treatment work as carried out. It may include a series of as-built drawings, supporting photographic materials, specifications and a summary assessment. New technologies that have been successfully used should be highlighted. Ideally, this information should be shared with interested national organizations for further dissemination and evaluation.

The need for further research or additional activities should also be documented. This may include site-specific or contextual historical research, archeological investigations, pollen analysis, search for rare or unusual plant materials, or, material testing for future applications.

Finally, in consultation with a conservator or archivist-to maximize the benefit of project work and to minimize the potential of data loss--all primary documents should be organized and preserved as archival materials. This may include field notes, maps, drawings, photographs, material samples, oral histories and other relevant information.

DEVELOPING A PRESERVATION MAINTENANCE GUIDE

In the past, there was rarely adequate record-keeping to fully understand the ways a landscape was maintained. This creates gaps in our research findings. Today, we recognize that planning for ongoing maintenance and onsite applications should be documented--both routinely and comprehensively. An annual work program or calendar records the frequency of maintenance work on built or natural landscape features. It can also monitor the age, health and vigor of vegetation. For example, onsite assessments may document the presence of weeds, pests, dead leaves, pale color, wilting, soil compaction--all of which signal particular maintenance needs. For built elements, the deterioration of paving or drainage systems may be noted and the need for repair or replacement indicated before hazards develop. An overall maintenance program can assist in routine and cyclic maintenance of the landscape and can also guide long term treatment projects.

To help structure a comprehensive maintenance operation that is responsive to staff, budget, and maintenance priorities, the National Park Service has developed two computer-driven programs for its own landscape resources. A Maintenance Management Program (MM)is designed to assist maintenance managers in their efforts toplan, organize, and direct the park maintenance system. An Inventory and Condition Assessment Program (ICAP) is designed to complement MM by providing a system for inventorying, assessing conditions, and for providing corrective work recommendations for all site features.

Another approach to documenting maintenance and recording changes over time is to develop a manual or computerized graphic information system. Such a system should have the capability to include plans and photographs that would record a site's living collection of plant materials. (Also see discussion of the use of photography under Preparing Existing Conditions Plans) This may be achieved using a computer-aided drafting program along with an integrated database management system.

To guide immediate and ongoing maintenance, a systematic and flexible approach has been developed by the Olmsted Center for Landscape Preservation. Working with National Park Service landscape managers and maintenance specialists, staff assemble information and make recommendations for the care of individual landscape features.

Each landscape feature is inspected in the field to document existing conditions and identify field work needed. Recommendations include maintenance procedures that are sensitive to the integrity of the landscape.

Summary

The planning, treatment, and maintenance of cultural landscapes requires a multi-disciplinary approach. In landscapes, such as parks and playgrounds, battlefields,

cemeteries, village greens, and agricultural land preserves more than any other type of historic resource--communities rightly presume a sense of stewardship. It is often this grass roots commitment that has been a catalyst for current research and planning initiatives. Individual residential properties often do not require the same level of public outreach, yet a systematic planning process will assist in making educated treatment, management and maintenance decisions.

Wise stewardship protects the character, and or spirit of a place by recognizing history as change over time. Often, this also involves our own respectful changes through treatment. The potential benefits from the preservation of cultural landscapes are enormous. Landscapes provide scenic, economic, ecological, social, recreational and educational opportunities that help us understand ourselves as individuals, communities and as a nation. Their ongoing preservation can yield an improved quality of life for all, and, above all, a sense of place or identity for future generations.

Selected Reading

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Acknowledgements

The author, Charles A. Birnbaum, Coordinator, Historic Landscape Initiative, Preservation Assistance Division,

National Park Service would like to acknowledge the assistance of H. Ward Jandl and Kay Weeks. The Olmsted Center for Landscape Preservation at the Frederick Law Olmsted National Historic Site including Margie Coffin, Lauren Meier, Nora Mitchell, and Charlie Pepper provided invaluable support. In particular, the proposed rewrite on Preservation Maintenance and historic plant materials was written by Margie Coffin. Significant contributions were also made by Patricia M. O'Donnell, Linda McClelland, Ellen Lipsey, Christine Capella Peters, Robert Page, Ian Firth and Robert Melnick. Useful comments and technical assistance were provided by regional NPS staff (Mary Hughes, Lucy Lawliss, Jill Cowley, Sherda Williams, Michael Crowe, Robbyn Jackson) and staff at the Preservation Assistance Division (Cheryl Wagner, Michael Auer and Anne Grimmer).

Washington, D.C. September, 1994

Home page logo: Taro fields in Hanalei, Hawaii. Photo: NPS files.

This publication has been prepared pursuant to the National Historic Preservation Act of 1966, as amended, which directs the Secretary of the Interior to develop and make available information concerning historic properties. Technical Preservation Services (TPS), Heritage Preservation Services Division, National Park Service prepares standards, guidelines, and other educational materials on responsible historic preservation treatments for a broad public.

Panoramic Hill Historic District
Alameda County, California

NEIGHBORHOOD CHARACTER

The Panoramic Hill Historic District is a woodsy, hillside residential neighborhood consisting primarily of single-family detached houses built from 1895 to 1941 in various stages and manifestations of the Bay Area Tradition. Whereas the proposed district is located in Berkeley, California, part of the hillside neighborhood is in Oakland. The Berkeley section is in the lower elevations and where early development occurred.

The hill itself is geographically distinguished by Strawberry Canyon to the north and Hamilton Gulch to the south. In this way, the hill's borders, and also the neighborhood's boundaries, are naturally articulated. Situated in the East Bay Hills, the hillside's predominant orientation is west.

The neighborhood is uphill, within walking distance, and east of what is now known as the University of California at Berkeley's Central Campus. The western face of this hillside neighborhood orients to the panoramic views of the San Francisco Bay, the Golden Gate, Mt. Tamalpais, and to historically significant University structures, e.g. the Campanile. The northern face of the Panoramic Hill neighborhood looks across Strawberry Canyon to another hill where the Lawrence Berkeley National Laboratory and the University's Hill Campus are also located. The Hill Campus includes the Witter Intercollegiate Rugby Field, the Levine-Fricke Intercollegiate Softball Field, and the Strawberry Canyon Recreation Area, which are located at the base of the Panoramic Hill neighborhood, and undeveloped open space known as the Ecological Study Area, which is located to the east of the neighborhood. The northwestern face of the neighborhood orients to the California Memorial Stadium.

To the immediate west of the Panoramic Hill neighborhood is housing zoned for multiple units. With the college campus nearby, many of these dwellings are sororities, fraternities, and co-ops.
To the southwest of the neighborhood is historic Hillside Court and Hillside Avenue, which is zoned for single-family use.

At the time of the neighborhood's beginning, the floor of Strawberry Canyon was known as Strawberry Valley, and Strawberry Creek flowed through the canyon above ground. Then, a "beautiful natural place"[i], the creek has since been culverted and the ravine filled. The University's Botanical Gardens were also in the vicinity[ii]. The properties located at 1, 9, and 15 Canyon Road were sited so as to benefit from these amenities as much as for the panoramic views. Despite the absence of the creek and the botanical gardens in contemporary times, the structures stand as a reminder of the neighborhood's early relationship between natural and built environments.

evolve as a most accurate name since the neighborhood was blessed by panoramic views and one narrow, meandering, impossible, but quaint road by the same name. It is the Panoramic Hill Historic District that holds this history.

EVALUATION

The Panoramic Hill Historic District is eligible for the National Register of Historic Places under criterion C at the local level of significance. Under criterion C, Panoramic Hill is significant in the area of Architecture as a neighborhood that represents the Bay Area Tradition in architecture, primarily the first phase associated with the Arts and Crafts movement. The district includes notable houses by architects Ernest Coxhead, Bernard Maybeck, Julia Morgan, Walter Steilberg, and others; a distinctive street plan; and paths and steps that provide pedestrian circulation. Since the north side fire of 1923, Panoramic Hill is among the most extensive surviving Arts and Crafts neighborhoods in Berkeley, which was the center of this important early twentieth century architectural movement. The district is significant for the period from 1888 when the principal street, Panoramic Way, was laid out to 1941 when a long period of development ended due to World War II.

Integrity

Location

The Panoramic Hill Historic District retains integrity of location. It remains today where it was built. One house, Dr. Mouser's farmhouse of 1888, was moved within the district to 21 Mosswood Road in 1910. This change occurred within the period of significance and is part of the history of the district.

Design

The Panoramic Hill Historic District retains integrity of design. The principal changes to the district since the end of the period of significance are the construction of 11 new houses and the alteration of many houses for multi-tenant use. The new houses are compatible in scale and materials; although not contributors, they maintain the pattern of development of single family houses and garages that characterizes the design of the district. The alteration of houses for multi-tenant use is generally not accompanied by major exterior alterations. However, multi-tenant use is often associated with lower maintenance than exists for single-unit residences.

Setting

At a grand scale, the setting of the district is little changed. The major aspects of setting – its isolation on a hill with canyons to the north and south and a panoramic view to the west, are unchanged.

The principal changes in the immediate setting are the development of apartment buildings adjacent to the district on its west side and the expansion of the neighborhood up the hill to the east. The apartment buildings present an incompatible edge to the district. The expanded neighborhood to the east, much of it representing the second and third phases of the Bay Area Tradition, is newer than the area within the district but is generally not incompatible with it. It is possible that parts of this expanded neighborhood could be added to this district in the future when sufficient perspective exists to evaluate it.

Materials

Integrity of materials in the district remains high. The full range of materials, including the dominant redwood, remains present, as do other materials – stucco, tile, iron, concrete, and brick. The use of materials is one of the hallmarks of the Arts and Crafts movement, and the original materials are largely intact.

Workmanship

Integrity of workmanship, like integrity of materials is high. Likewise, workmanship is a hallmark of Arts and Crafts architecture. Workmanship is a characteristic that is more evident up close, to private visitors, than from public streets and pathways.

Feeling

Integrity of feeling is diminished – in generally superficial and ephemeral ways – notably the parking of cars along the roads, and minor exterior modifications for multi-tenant use.

Association

Integrity of association is high. Because the original houses and other buildings and structures of the district are intact, the association with the history of the district is present.

10/28 listing

17493 US 65S,
Damascus, 05001170,
LISTED, 10/19/05
(Mixed Masonry Buildings of Silas Owens, Sr. MPS)

CALIFORNIA, ALAMEDA COUNTY,
Panoramic Hill,
Panoramic Wy, Canyon Rd., Mosswood, Orchard Ln., Arden Rd.,
Berkeley, 05000424,
LISTED, 10/21/05

MAINE, ANDROSCOGGIN COUNTY,
Keystone Mineral Springs,
Keystone Rd.,
Poland, 05001175,
LISTED, 10/19/05

MAINE, CUMBERLAND COUNTY,
Battery Steele,
Florida Ave., Peaks Island,
Portland, 05001176,
LISTED, 10/20/05

MAINE, CUMBERLAND COUNTY,
Lakeside Grange #63,
Main St., jct. of Main St. and Lincoln St.,
Harrison, 05001173,
LISTED, 10/19/05

MAINE, HANCOCK COUNTY,
Garland Farm,
1029 ME 3,
Bar Harbor, 05001174,
LISTED, 10/19/05

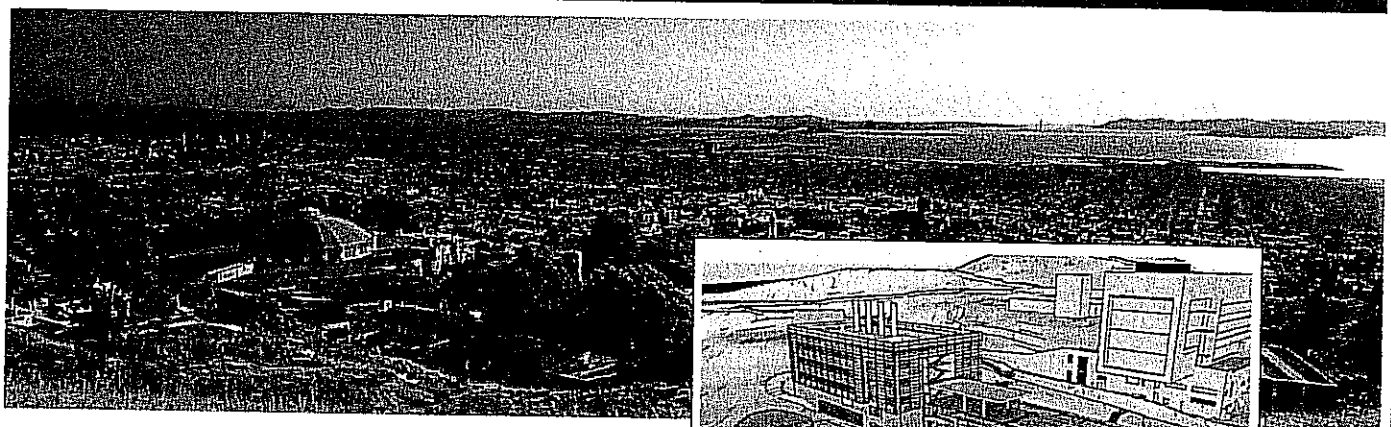
MISSOURI, MADISON COUNTY,
St. Louis, Iron Mountain and Southern Railroad Depot,
Allen St., 150 ft. N. of jct. of Allen and Kelly Sts.,
Fredericktown, 05001178,
LISTED, 10/19/05

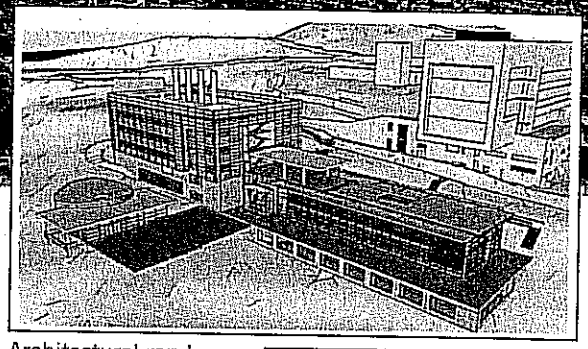
MONTANA, PARK COUNTY,
Hepburn, John, Place,
626 E. River Rd.,
Emigrant, 05001177,
LISTED, 10/19/05

NEW MEXICO, SANTA FE COUNTY,
Kelly, Daniel T., House,
531 E. Palace Ave.,
Santa Fe, 05001182,
LISTED, 10/19/05
(Buildings Designed by John Gaw Meem MPS)

OREGON, MULTNOMAH COUNTY,
Harrison Court Apartments,
1834 SW 5th Ave.,
Portland, 05001179,
LISTED, 10/19/05

LAWRENCE BERKELEY NATIONAL LABORATORY





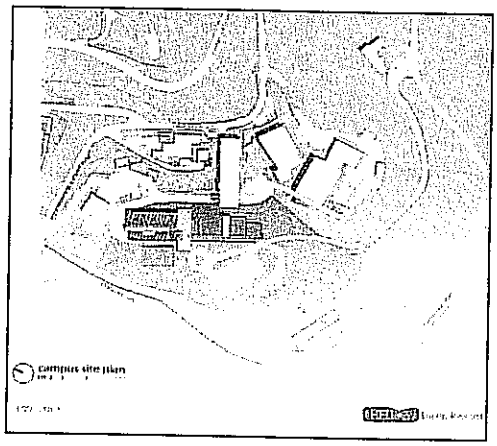
Architectural rendering of the Helios facility.

Helios Energy Research Facility Fact Sheet

MISSION

- The Helios Program is a Lawrence Berkeley National Laboratory (Berkeley Lab) initiative designed to address the challenges of climate change by developing new, clean energy alternatives with low carbon emissions. Its goal is to harness the sun's energy for a secure, sustainable, and prosperous future.

The proposed Helios Energy Research Facility will be located near the Molecular Foundry amid Berkeley Lab's rustic hillside landscape.



Plan view of the Helios facility, which will be located in the southeastern portion of Berkeley Lab.

- The Helios Energy Research Facility will house the Energy Biosciences Institute (EBI), a partnership between UC Berkeley, Berkeley Lab, and the University of Illinois at Urbana-Champaign. It is supported by funds from BP, a global energy firm, as well as other research programs.
- Helios research will concentrate on developing transportation fuel from biomass and from solar energy driven electrochemistry. It will also target solar technologies, including a new generation of solar photovoltaic cells, and the conversion of electricity into chemical storage to meet future energy demands.

DESCRIPTION

- The Helios Energy Research Facility will be operated by UC Berkeley and owned by the University of California. It will be located adjacent to UC Berkeley on University of California-owned land at Berkeley Lab. Its construction will be managed by Berkeley Lab staff for the University of California.

- The 160,000 gross-square-foot, 5-story Helios Energy Research Facility will include laboratories, offices, an auditorium, and a cafeteria. In order to maximize scientific collaboration, it will be located adjacent to the materials science research cluster.
- The Helios Energy Research Facility will be a model of "green" construction with roofs that provide natural cooling, absorb and reuse rainwater, and minimize runoff. The project will seek to include alternative energy sources such as solar and wind energy for ventilation, lighting, and other electrical power uses.
- The Helios Energy Research Facility would accommodate approximately 500 staff. Approximately 132 of those people would transfer from other Berkeley Lab and UC Berkeley locations, while the remaining 368 people would be newly employed as a result of the project.

ENVIRONMENTAL REVIEW & PROJECT SCHEDULE

- The University of California will be the Lead Agency and will prepare an Environmental Impact Report (EIR) for the proposed project. An Initial Study has been prepared in accordance with the California Environmental Quality Act (CEQA). The EIR addresses environmental impacts in the following major resource areas: aesthetics, air quality, biological resources, cultural, land use, geology and soils, hazards and hazardous materials, hydrology and water quality, noise, transportation and traffic, and utilities.

SCHEDULE:

July 26, 2007:	Notice of Preparation and Initial Study for a Draft Environmental Impact Report (EIR)
August 8, 2007:	Scoping Meeting
November 19, 2007:	Draft EIR available
December 17, 2007:	Public Hearing on Draft EIR
Febuary 1, 2008:	Comment period ends
Feb.-March 2008:	Final EIR Preparation
May 2008 (likely):	Regents Meeting
Summer 2008:	Construction Begins
2010:	Helios Opens

CONTACT

planning@lbl.gov

www.lbl.gov/community/helios

CSO_13189

Office of Student Development
Residential Living
UC Berkeley - Residential & Student Service Programs

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- Student Leadership & Employment
- Campus / Community

Home | Rates & Fees | Life in the Residence Halls | Programs | Health & Safety | Opportunities | Academic Support | Contact Info | FAQ

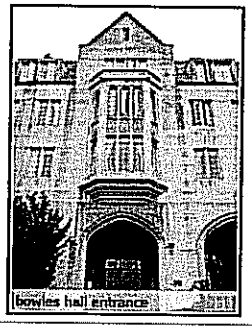
Residence Halls
- Unit 1
- Unit 2
- Unit 3
- Foothill
- Bowles
- Stern
- Clark Kerr Campus

Student Life
- Life in the Residence Halls
- Residents' Video Blogs
- Unit Information
- Roommate Information

- Life at Bowles

Quick Links
- Academic Services
  - Tutoring Schedule
  - Study Areas
  - Peer Advising
  - Technology Services
- Residential Computing
- Living at Cal
- CalDining
- Residential Staff Directory

Contact
Front Desk: (510) 642-1676
The Resident Directors' offices: Stern main lobby


bowles hall entrance

Bowles Hall

Stadium Rim Way and Gayley Road

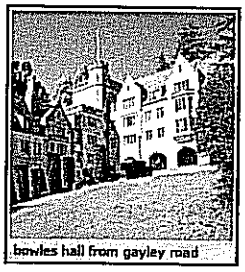
Unit Description
Bowles Hall, the University's first residence hall, is an all first-year male residence hall located against the hills on the northeast side of campus. The Tudor-style building, which resembles a castle, was donated to the University in 1929. It is on the National Register of Historic Places and a City of Berkeley landmark. The rooms are laid out quad-style, with two rooms on either side of a common area.

Unique Features
- Bowles/Stern exclusive traditions
- Wild turkeys, deer, and raccoons roam the hills behind the halls
- Incredible views of the Bay from all floors
- Academic Center with computer lab and free tutoring
- Exercise rooms
- Large meeting rooms complete with comfortable sofas and chairs
- Pool/ping-pong tables
- Piano in an antique-style library
- Fireplace in library lounge

Location/Neighborhood
- 1 block south of Foothill Dining Commons
- 1 block from east edge of campus
- 1 block north of Memorial Stadium
- 4 blocks northwest of Strawberry Canyon Rec Center
- Across the street from the Greek Theatre
- Adjacent to Maxwell Field
- 2 blocks north of the International House
- AC Transit bus routes F, 52/52L, Reverse Perimeter stops nearby

For more detailed housing information, please visit the Living at Cal website.

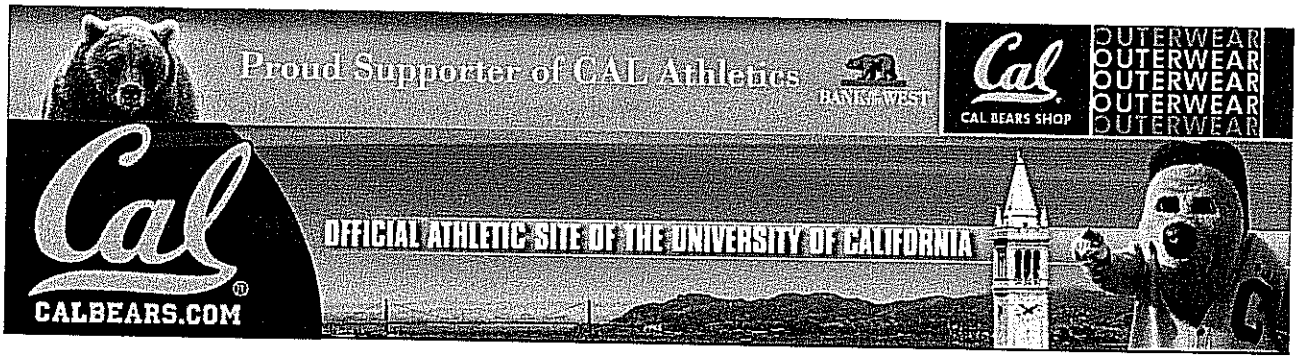
History of Bowles Hall


bowles hall from gayley road

Bowles Hall was built in honor of Phillip Bowles, a UC Berkeley alumnus and a member of the Board of Regents in 1922. In 1928, a $350,000 grant by his wife Mary McNear Bowles allowed construction of the dormitory to begin. Since its establishment in 1929, Bowles Hall has been the campus's unique all-male dormitory.

As the first University-owned residence hall, Bowles boasts some of the oldest and grandest traditions, including several songs that Bowlesmen are accustomed to singing after football games or while particpating in Stern/Bowles exchanges.

In 1989, Bowles Hall was added to the National Register of Historic Places (#89000195) as a result of student opposition to the original plans for the Foothill housing complex, which called for the demolition of the oldest residence hall. Bowles Hall was designated a City of Berkeley landmark in the late 1980s.



FACILITIES

Levine-Fricke Field

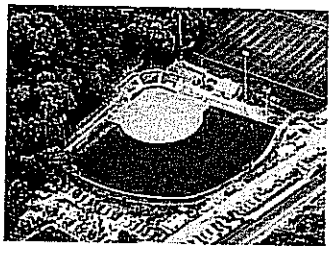
- Tickets and Event Information

Levine-Fricke Field, home of the 2002 NCAA champions, is the venue for Golden Bear softball on the University of California campus.

Nestled at the base of Strawberry Canyon, the field sits high above the Berkeley campus overlooking the San Francisco Bay Area.

Built in 1995, Levine-Fricke Field owns a seating capacity of 500, with all of the seats in close proximity to the field. The outfield fences stand 190 feet down the right and left field lines, while it is 220 feet to straight-away center.

Cal softball began play in 1972 on Hearst Field in the center of campus. The Bears moved to Strawberry Field, just west of their current location in the early 1980s and remained there until Levine-Fricke Field was constructed.



Cal Bears Facilities

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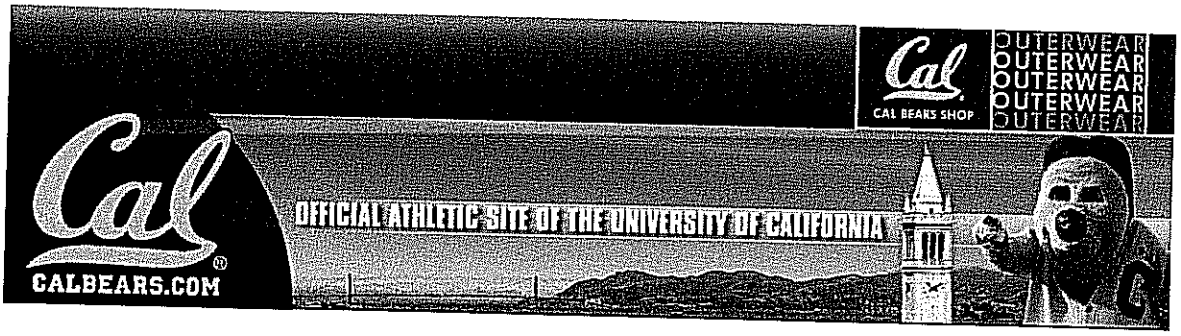
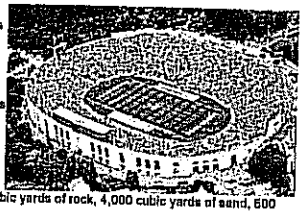


FACILITIES

Memorial Stadium

- Game Day Guide, Parking & Ticket Information

When the University of California launched a statewide campaign in October of 1921 to build a football stadium on campus in honor of the World War I participants who lost their lives on the battlefields abroad, the response and results were staggering. In only one month, generous supporters of the University pledged more than $1 million, and just two years later, one of the most beautiful athletic stadiums in the world was completed in picturesque Strawberry Canyon.



Now more than 80 seasons after its 1923 opening, the setting of Memorial Stadium remains one of the most breathtaking sights in all of college athletics. The plush wall of pine trees in the Berkeley Hills to the east is contrasted by a panoramic view of the San Francisco Bay and three bridges to the west. Designed by world-renowned architect John Galen Howard and co-designers G.F. Buckingham and E.E. Carpenter, the stadium is a tribute to their architectural talents, skills that were years ahead of their time. Fans who attend games today still marvel at the beauty of the structure, modeled after the Colosseum in Rome, and comment about the easy viewing for spectators from all angles within the stadium.

The stadium was completed in time for the Big Game of 1923 at a total cost of $1,437,982. It was constructed in sections with expansion joints to withstand earth movement. Included in the initial construction were 12,000 barrels of cement, 1.1 million feet of lumber for concrete forms, 8,000 cubic yards of rock, 4,000 cubic yards of sand, 600 tons of steel, 800,000 feet of premium lumber which was used for seating, and 2,500 pine trees which today serve as the backdrop for the stadium.

Original plans for the stadium called for a capacity of 60,000, but they were altered in favor of a capacity closer to 80,000. The seating capacity has fluctuated due to renovation and other changes, but in 1947, a crowd of 83,000 watched Cal defeat Navy, 14-7, a feat which may have prompted Cal officials to establish an official capacity for the stadium. In the 1960s, temporary bleachers on the east side were removed and added wheelchair seating and aluminum bleachers followed in the 1980s. For 2001, the press box was rebuilt, giving the stadium an official capacity of 73,347.

Overall, Cal football teams through the years have played before crowds of 70,000 or more on 56 occasions and there have been 21 games that attracted in excess of 80,000 spectators.

The advent of the Cal Sports 80s project, an $8 million fund-raising campaign earmarked for the renovation of athletic facilities at Cal, further enhanced the appearance of Memorial Stadium. The most visible renovation came in 1981 when a new synthetic turf replaced the natural grass field to facilitate a stadium that could be utilized for practices as well as games when Cal's other practice facilities on campus became unavailable. State-of-the-art training quarters, locker rooms and a weight room replaced outdated facilities, and a new stadium administrative complex was also constructed in late 1983.

An expansion of the weight room and training facilities was completed in 1991, while a team meeting room expansion was completed in time for the start of the '94 season. Prior to the 1995 season, natural grass made a return to the stadium after 14 years of artificial turf at an estimated cost of $1.5 million. Eight years later, a new generation of synthetic turf (Momentum Turf) was installed prior to the 2003 season.

Cal Bears Facilities

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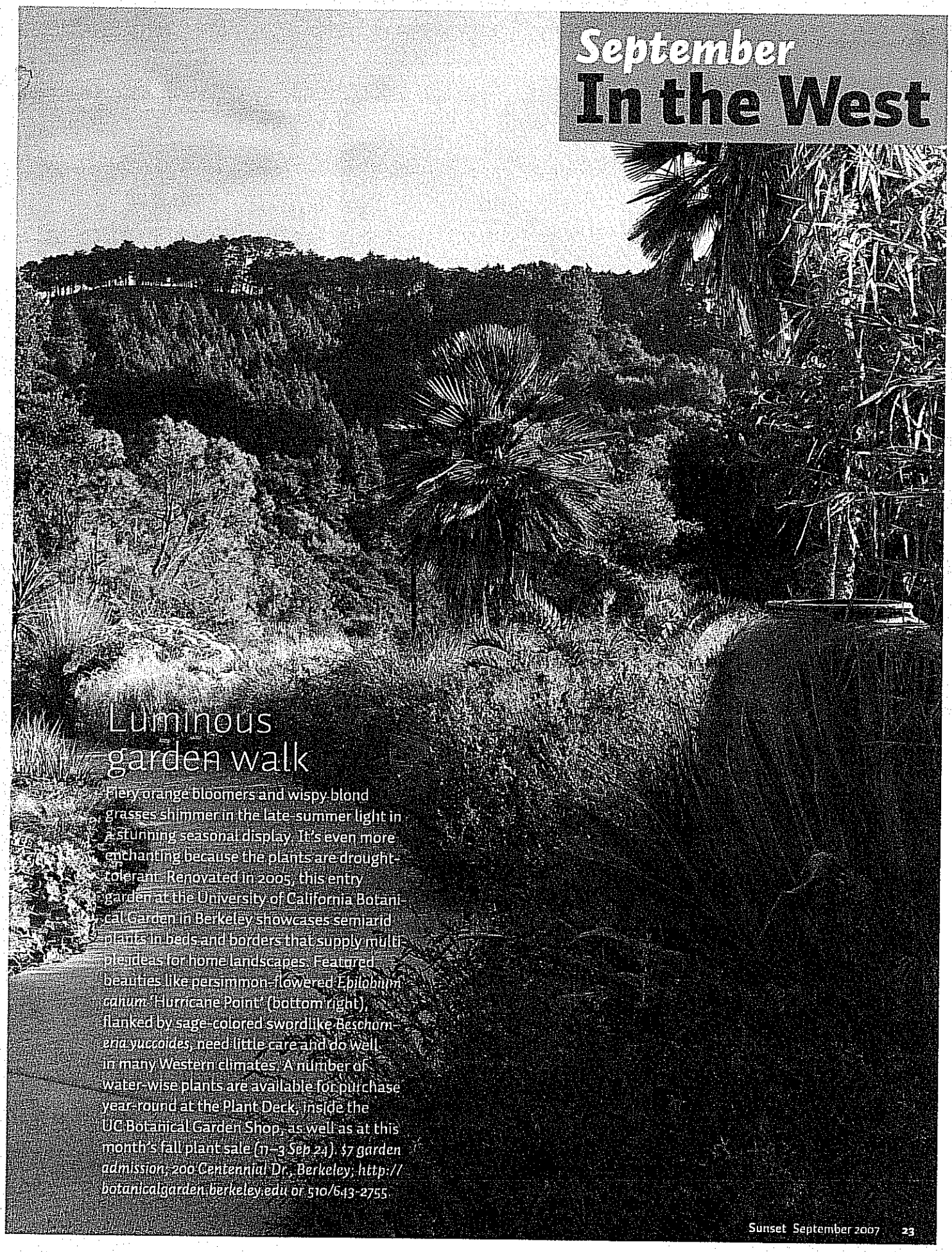
September In the West



Luminous garden walk

Fiery orange bloomers and wispy blond grasses shimmer in the late-summer light in a stunning seasonal display. It's even more enchanting because the plants are drought-tolerant. Renovated in 2005, this entry garden at the University of California Botanical Garden in Berkeley showcases semiarid plants in beds and borders that supply multiple ideas for home landscapes. Featured beauties like persimmon-flowered *Epilobium canum* 'Hurricane Point' (bottom right), flanked by sage-colored swordlike *Beschorneria yuccoides*, need little care and do well in many Western climates. A number of water-wise plants are available for purchase year-round at the Plant Deck, inside the UC Botanical Garden Shop, as well as at this month's fall plant sale (7–3 Sep 24). *$7 garden admission; 200 Centennial Dr., Berkeley; http://botanicalgarden.berkeley.edu or 510/643-2755.*

THOMAS J. STORY

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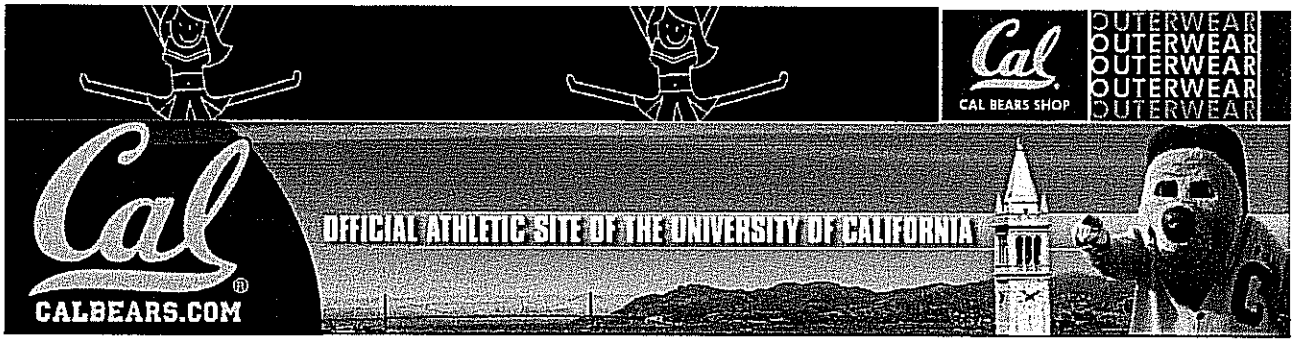

FACILITIES

Witter Rugby Field

- Tickets and Event Information
- Parking & Directions

Nestled in Strawberry Canyon, Witter Rugby Field is the home of Cal rugby - the most successful collegiate program in the country with a string of 12 consecutive national championships from 1991-2002.

A $2 million facility built in 1995, Witter Rugby Field offers seating for up to 5,000 fans, a hand-operated scoreboard and a ideal playing surface for the Golden Bears.

Next to the field is the Doc Hudson Memorial Field House, which holds the rugby offices, as well as a room adorned with Cal and U.S. rugby memorabilia - featuring pictures that follow the history of Cal rugby. Hudson, one of the greatest rugby coaches in U.S. history, compiled a 339-84-23 record during his 36 years as Cal's rugby coach from 1938-74.

In addition to rugby competition in the spring, Witter Rugby Field acts as the practice facility for the Cal football team in the fall.

Cal Bears Facilities

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CalNeighbors

Local mayors team up to create regional identity

"East Bay Green Corridor" concept provides foundation for future cooperative efforts

While the origins of Silicon Valley can be traced in part to a Palo Alto garage, the roots of the East Bay Green Corridor may well have first taken hold at the campus home of UC Berkeley Chancellor Robert Birgeneau.

It was there, at a dinner last spring, that the mayors of Berkeley, Emeryville, Oakland and Richmond, along with faculty and staff from the campus, Lawrence Berkeley National Laboratory (LBNL) and the four cities, met to discuss energy research and economic development opportunities for the region.

Over the course of the evening, one theme kept reoccurring: the area's considerable qualifications as a hub for the emerging green economy. By the end of the night, the idea of a regional identity had been born.

From left: Emeryville Mayor Nora Davis, LBNL Director Steve Chu, UC Berkeley Chancellor Robert Birgeneau, Berkeley Mayor Tom Bates, Richmond Mayor Gayle McLaughlin and Oakland Mayor Ron Dellums at the Dec. 3 signing of the East Bay Green Corridor statement of principles.

More than a moniker

The new designation is more than just a marketing push. "The name reflects the best qualities that exist here," said Michael Caplan, economic development manager for the City of Berkeley.

The region can rightly lay claim to a history and tradition of environmental awareness and a continued role as a green leader. Along these lines, Oakland was the first city in the nation to require restaurants to use compostable materials rather than plastic or Styrofoam. In Berkeley, the adoption of Measure G last year, which aims to reduce local greenhouse emissions by 80% by the year 2050, places the city at the forefront in combating climate change. Currently, the City of Richmond has teamed with UC Berkeley's Goldman School of Public Policy to evaluate the city's existing environmental policies and determine how the city can best reduce its impact on the environment.

And late last year, the Joint BioEnergy Institute (JBEI) announced that it would base its operations in Emeryville. Funded by the U.S. Department of Energy, the institute is a collaborative effort by the university, LBNL and four other partners to develop renewable biofuels.

This environmental leadership, together with the area's educational and research strengths, entrepreneurial spirit and skilled labor force, lays the foundation for a regional identity centered on green themes.

A vision for the future

The statement of principles for the East Bay Green Corridor, which were adopted last month by UC Berkeley, LBNL and the four cities, provides a vision for harnessing

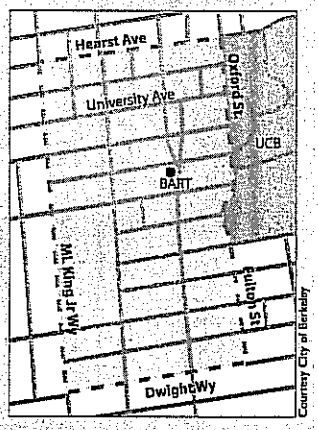
see GREEN CORRIDOR, page 2

The future of downtown Berkeley takes shape

The downtown Berkeley of tomorrow will be a greener, pedestrian-friendly, economically vibrant destination – one that builds on the area's historic strengths and its proximity to UC Berkeley, according to the recently released draft of the new Downtown Area Plan.

The proposed plan, which provides a blueprint for future growth downtown, caps a two-year process by the Downtown Area Plan Advisory Committee (DAPAC), a diverse group appointed by the City Council and representing a range of opinions in Berkeley.

Over the course of 2006 and 2007, DAPAC met more than 50 times, held public workshops, and grappled with the many issues affecting downtown Berkeley's future. The resulting draft plan was presented to the city's Planning Commission last month. Once finalized, it will replace the current plan, which has been in place since 1990.



Courtesy City of Berkeley

Intertwined futures

The decision for the City of Berkeley and UC Berkeley to work together to create a new plan stemmed from a 2005 agreement between the two entities. The area's location as a regional transit hub and as a gateway to the university, along with its role as an economic and cultural destination and as an emerging residential neighborhood, gives it a unique personality and position of importance. Downtown Berkeley is, as the plan notes, "Berkeley's social, cultural and economic heart."

At the same time, the university's substantial presence and future downtown growth needs (800,000 square feet, as outlined in the university's 2020 Long-Range Development Plan), underscore the degree to which the city's and the university's futures are intertwined.

A seamless connection

"There are a great many synergies that the downtown and the university can have with one another," said Matt Taecker, city planner assigned to guide the downtown planning process.

Key plan recommendations include converting Center Street into a pedestrian plaza that strengthens the connection between downtown and the campus. The pending relocation of the university's Berkeley Art Museum and Pacific Film Archive to the former UC Printing Department site at Center and Oxford Streets, where it will adjoin a new high-

see DOWNTOWN, page 2

University ponders prospects for People's Park

As People's Park approaches 40, the icon of 1960's social and cultural activism is due for a makeover.

On the recommendation of the park's Community Advisory Board (a group of 11 local residents and community representatives), UC Berkeley has embarked on a comprehensive process to re-think how People's Park can better serve the campus and the broader community.

Analyzing today's People's Park

Over the years, the park has had many identities: a center for political activism, a grassroots movement in urban gardening, a service hub for homeless people, and an urban oasis of open space. At the same time, many neighbors and community members have viewed it as unsafe and unwelcoming.

Last February, the university brought in San Francisco consulting firm MKThink to gather information from a wide array of park stakeholders and analyze the park's current conditions and usage.

Researchers spent nine months talking with park users, community gardeners, students, neighbors, social-service agency representatives, local churches, local merchants, and UC and city staff to gather their feedback and find out why people used or avoided the park.

MKThink also looked at how the park is currently being used and analyzed the park's physical layout, then provided recommendations for how to make the park a more successful community resource.

Common themes

"There was a lot of commonality in peo-

see PEOPLE'S PARK, page 2

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ple's core desires," said Mark Miller, principal of MKThink.

Among the survey's findings: Despite the diversity of perspectives of the park's many stakeholders, most recognized the park's historical significance and had a strong interest in revitalizing the park to serve the community. Stakeholders also shared a common goal of having the park be a welcoming and safe open space.

How the site might be changed, however, has not yet been decided. Recommendations from the study include expanding special events and recreational activities, better integrating the park into the surrounding neighborhood, and improving or relocating the delivery of support services to the homeless.

Many possibilities

Several intriguing possibilities were suggested as part of the park study, including using the park as a performance and fine arts public venue or as a learning space devoted to sustainability, health and wellness or global peace pursuits.

As a next step, the advisory board recommended that the university hold a design competition to solicit detailed plans for the park's redesign. The board has also recommended creating a new task force devoted to addressing issues of homelessness in and around People's Park.

Whether the park ultimate includes outdoor exhibits, a cal an amphitheater or meditati spots – or not – the goal is to cr ate a park that can truly serve t community and campus. As Jol Selawsky, co-chair of the Peopl Park Community Advisory Boa noted: "We want to address t question, 'How do we ma People's Park more inviting a more welcoming?'"

GREEN CORRIDOR

continued from page 1

the assets of the region to drive future economic growth.

On the business front, this includes creating a fertile environment for new and emerging green businesses, promoting ways to commercialize green research and strengthening educational programs to provide skilled "green collar" workers.

At the regional level, a commitment to sustainable business will increase the area's long-term economic viability and help it compete more effectively for grants and investments. At the same time, a shared focus on sustainability can help cushion the region from energy-related economic shocks.

The agreement also notes the quality-of-life benefits of going green, calling out the importance of energy-conservation and efficiency programs, green-building standards and environmentally responsible land-use and development policies.

A growing momentum

While the values of the region have long reflected strong environmental themes, the move to create an East Bay Green Corridor partnership capitalizes on a growing environmental momentum and awareness.

The broad acclaim of *An Inconvenient Truth* and subsequent Nobel Peace Prize for former Vice President Al Gore have helped bring concerns about global warming and environmental sustainability to the mainstream.

Locally, UC Berkeley and the Lawrence Berkeley Laboratory have received a five-year, $125-million contract by the Department of Energy to fund the Emeryville-based JBEI, as well as a $500-million, 10-year contract by BP to fund the Energy Biosciences Institute (a partnership between the university, LBNL, the University of Illinois at Urbana-Champaign and BP) to research and develop alternative fuels.

"As a public university, UC Berkeley is committed to contributing our academic resources and developing research approaches that impact the most pressing problems globally and locally," Birgeneau said. "EBI will position UC Berkeley on a trailblazing track to make the East Bay a world center for energy and environmental research."

First up on the group's agenda is an emphasis on workforce training – both for the green-collar jobs that already exist and those that are on the horizon. By working with the region's many job-training and education agencies, community colleges and adult schools, the group aims to build awareness of emerging job needs, such as energy retrofitters and solar equipment installers, and create training paths that will prepare candidates to fill these roles.

The group will also hold an annual green economic summit and share best practices on a regular basis.

"We share a vision of a green economy that provides jobs for all our people, revenue for our cities, and serves as environmental center for the nation," said Emeryville former Mayor Nora Davis prior to the signing of the Green Principles Agreement last month. "We are much better able to make our shared vision a reality if we work together."

CalNeighbors

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