PUB-5221
September 1989

LAWRENCE BERKELEY LABORATORY

LONG RANGE SITE DEVELOPMENT PLAN
FY 1989–1994

LAWRENCE BERKELEY LABORATORY
1 CYCLOTRON ROAD
BERKELEY, CA 94720

This work was supported by the U.S. Department of Energy under contract DE-AC03-76SF00098

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PREFACE

The Lawrence Berkeley Laboratory 1989 Long Range Site Development Plan (SDP) is a guide for effective use of the Laboratory's land and facilities resources. The SDP provides a conceptual and operational framework for the rehabilitation of existing facilities and the development and siting of future buildings. It has been prepared for use by the management and staff of the Laboratory, the Department of Energy, the University of California, and the neighboring communities.

This SDP is based on previous planning documents and current studies and analyses. Revisions are based on the Laboratory's annual Institutional Plan and recent planning reviews and analyses. The document describes the physical setting, planning processes and underlying planning concepts, trends in Laboratory activity, facilities requirements, and future site development.

The SDP has been developed as part of a continuing planning and review process involving the Laboratory's 13 scientific and support divisions. The final preparation of the document was coordinated through the Office for Planning and Development, with site-plan elements and supporting materials prepared by the Plant Engineering Department of the Administration Division.

DIRECTOR'S FOREWORD

Charles V. Shank
LBL Director

The Lawrence Berkeley Laboratory's mission as a multiprogram national laboratory is to perform leading research, to develop and operate unique national experimental facilities, to train the next generation of scientists, and to enhance industrial innovation. The Long Range Site Development Plan (SDP) addresses the major issues and the opportunities for improvement of the site that are critical to the continued fulfillment of this mission.

The Laboratory occupies 80 permanent buildings on the main site and space in 18 buildings on the University of California, Berkeley (Main Campus and Richmond Field Station). This is a significant change since 1931, when the Laboratory consisted of a single campus building. During the past year LBL conducted more than 800 research programs and projects involving 4600 people, including 550 graduate students and 1,000 guests.

During the 5 years since the 1984 SDP, the Laboratory's continuing evolution to a multiprogram laboratory has resulted in new building construction and major additions in utilities, transportation, and parking. The current SDP, like its predecessor, provides a strong framework for safe and environmentally sound future development. Implementation of the SDP will require the continuing collaboration of the U.S. Department of Energy, the University, and the Laboratory community.

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EXECUTIVE SUMMARY

PURPOSE

The Lawrence Berkeley Laboratory 1989 Long Range Site Development Plan (SDP) provides analysis and policy guidance for the effective use and orderly future development of land and facilities at the LBL site. The SDP directly supports LBL's role as a multiprogram national laboratory operated by the University of California (UC) for the Department of Energy (DOE). It is a revision of the 1984 Plan and will be changed annually, with periodic major revisions consistent with DOE policy and review guidance. The specific purposes of the SDP are to

- Summarize the physical and community setting of the Laboratory.
- Describe the existing Laboratory organization, programs, site, and facilities.
- Analyze programmatic trends and facilities requirements, shortfalls, and redevelopment needs.
- Provide policy guidance and 15-Year and 5-Year Plans to support effective use and orderly growth and development of the LBL site.

The SDP concisely expresses the policies for future development based on planning concepts, the anticipated needs of research programs, and site potential and constraints. This Executive Summary highlights management issues and outlines major sections of the Plan.

PLANNING OBJECTIVES

Site planning at the Laboratory reflects long-range institutional goals and values based on LBL's mission for the DOE. Planning objectives are to

- Anticipate changes in DOE national research needs and provide research facilities that accommodate growth or other changes.
- Ensure a safe, healthful, and efficient workplace; improve access to the Laboratory and improve communications within the Laboratory and with regional and national institutions; provide effective transportation and parking for employees and visitors.
- Protect the environment and buffer activities from adjacent populations.
- Protect the national investment in valuable government-owned research and support facilities.
- Consolidate research and support services through proper siting of new buildings.
- Promote energy conservation and cost reductions through efficient building design, location, operation, and maintenance.

MANAGEMENT ISSUES

LBL's site-planning management issues focus on developing the strategic framework for structures and utilities necessary to achieve the Laboratory's mission efficiently and safely. These issues include improving the reliability of utility systems, ensuring a safe working environment, restoring and rehabilitating obsolete buildings, consolidating support functions, and accommodating the increasing numbers of scientific guests and visitors using LBL's national research facilities. Many of LBL's site-development issues stem from an obsolete, deteriorated infrastructure constructed during World War II and the immediate postwar period. During the past several years, DOE has begun significant investments, to correct deficiencies in mechanical and electrical utility systems and programmatic facilities for materials research. The facilities issues being addressed by LBL and DOE include

- *Building Replacement and Rehabilitation.* The 5-Year Plan calls for construction to improve the safety and supply-services infrastructure and to improve general-purpose mechanical- and electrical-engineering facilities. Included in the plan are removal of obsolete, inefficient, and substandard facilities that cannot be made adequate and replacement of 67,500 gsf of temporary structures for support activities. The 15-Year Plan of nonprogrammatic projects include 171,800 gsf of facilities, with a total cost of $93 M.
- *Mechanical Utilities.* Mechanical utilities comprise domestic and cooling water, storm drains and sanitary sewers, and natural gas, compressed-air, and vacuum systems. These utilities are up to 40 years old and many are undersized for current laboratory demands. The 5-Year and 15-Year Plans provide for the orderly replacement of these utilities. However, scheduled utilities improvements only correct existing deficiencies; any delays will engender further deterioration of these essential utilities. Total cost of the mechanical-utilities improvements is $36.2 M.
- *Electrical Utilities.* LBL's power-distribution system comprises 60 substations and 20 miles of 12-kV cable, most of which have exceeded their normal service lives, resulting in frequent power outages and increased maintenance requirements. The electrical-utilities rehabilitation plan establishes priorities based on expected failure rates and the importance of equipment. The Original Labsite Substation replaces facilities in the oldest part of the Laboratory, and the Blackberry Canyon Substation and Feeders Project will increase reliability of the power supply for the Central Research and Administration Area. Completion of electrical rehabilitation is scheduled for FY 1998 at a total cost of $34.3 M.
- *Environment and Safety Improvements.* Environment, safety, and health improvements, several of which began in FY 1988, include correction of localized contamination of soils and groundwater, removal of asbestos, and improvements to safety services, medical services, building illumination, radiation protection, and water-pollution control and monitoring. Seismic stabilization of steep slopes is scheduled for FY 1990 and FY 1991. Road improvements include widening, replacement of base materials, and elimination of acute curves and blind spots. The 5-Year and 15-Year Plans call for three phases of road rehabilitation, one each in FY 1992, 1999, and 2004. Total cost of the environment and safety improvements is $39.6 M.
- *Consolidation of Support Services.* The SDP calls for consolidation of research and support activities in seven functional planning areas. This includes consolidation of the engineering and health-and-safety staffs and related research activities. This consolidation will facilitate plans for improving utility systems and traffic circulation along the east-west axis of the Laboratory.

COMMUNITY SETTING

The 130-acre Laboratory site, located within 1183 acres of University of California land, is leased by DOE through a series of 50-year lease agreements (Appendix E). The Laboratory is in Alameda County (population 1,175,000), with the eastern section in the City of Oakland (350,000) and the western section in the City of Berkeley (107,000). LBL works with these cities on matters of mutual concern, including fire protection and traffic management. Although the area is largely urban and is served by interstate highways and an extensive public transit system, the Laboratory site has a hilly topography and a backdrop of eucalyptus plantations and parks that give a rural character.

- *Land Use and Planning.* The Laboratory site is zoned governmental and institutional by the Cities of Berkeley and Oakland. On all sides of the Laboratory is a buffer zone of University land. In addition, the SDP provides for landscape

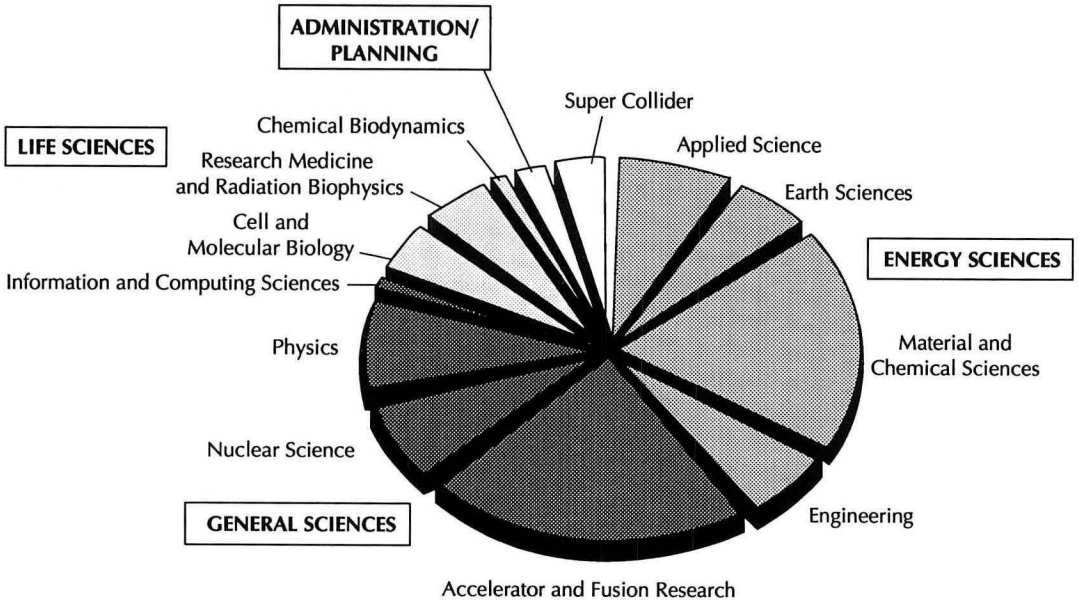
buffer zones between LBL facilities and the Laboratory boundary and includes guidelines to ensure compatibility with land use outside the University buffer zone.

- *Transportation Systems.* The Laboratory and the Cities of Oakland and Berkeley are served by a network of public transit systems, three major airports (San Francisco, Oakland, and San Jose), two railroads, and a network of interstate freeways and state highways. In addition, LBL operates shuttle buses around the site and between the Laboratory and the UC Berkeley campus and the downtown Berkeley Bay Area Rapid Transit (BART) station.
- *Public Utilities and Community Services.* Electricity and natural gas are provided by the Pacific Gas and Electric Company (PG&E), which anticipates adequate capacity for the foreseeable future. Water is supplied by the East Bay Municipal Utilities District (EBMUD). The Laboratory implements a program of water-use reduction during periods of drought. Reservoirs adjacent to LBL provide water for anticipated emergency needs. EBMUD is currently expanding its supplies and storage capacity to avoid future reductions in service. The Laboratory provides its own police and fire protection services, which on occasion provide emergency assistance to the University and the City of Berkeley. Several hospitals are nearby.
- *Community Involvement.* LBL efforts to enhance compatibility and to coordinate activities with the surrounding communities include three principal programs: (1) a Hill Area Fire Safety Program with the University and Berkeley fire departments, (2) an LBL Traffic and Parking Management Plan to discourage single-occupant vehicles and to encourage other transportation options, and (3) a plan to ensure that historic buildings are preserved.

LABORATORY CONDITIONS

The Laboratory, established in 1931 by Ernest O. Lawrence as a single-purpose accelerator-based University research facility, has evolved into a multiprogram national laboratory with a mission to (1) perform leading multidisciplinary research in the general sciences, energy sciences, and life sciences; (2) develop and operate unique national experimental facilities; (3) educate and train future generations of scientists and engineers; and (4) foster productive relationships with industry. The Laboratory's facilities and research programs support this mission.

- *Research and Technical Programs.* LBL programs are primarily supported by the DOE Office of Energy Research (63%). The largest programs are in Basic Energy Sciences, Nuclear Physics, High Energy Physics, and Health and Environmental Research. Conservation and Renewable Energy (7%) supports studies in building energy conservation, energy storage, and solar and geothermal energy. Other DOE-sponsored programs (16%) include research on the Superconducting Super Collider (SSC), radioactive waste disposal, and fossil energy. Work for other agencies and institutions (15%) is primarily for the National Institutes of Health (NIH), Department of Defense (DOD), states, and private industry.
- *Condition of Buildings and Other Improvements.* LBL research and support activities are conducted in structures totaling 2.1 million gsf, including 1.6 million gsf on the main site, 0.33 million gsf on the UC Berkeley Campus, and 0.15 million gsf leased off site. In FY 1989 the average age of the main-site buildings is 30 years. The inventory of building space, including current construction, is
  - Adequate: 563,470 gsf.
  - Substandard, can be made adequate: 809,010 gsf.
  - Substandard, cannot be made adequate: 210,790 gsf.
- *Utilities.* LBL's utilities distribution systems (mechanical, electrical, and communications) are all underground. Many portions were initially sized to serve large accelerators and can meet



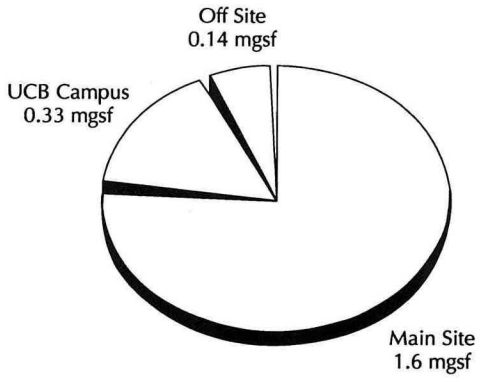
Total funds for FY 1989, $233.3 M.

present and future requirements. However, aged segments require rehabilitation to improve flexibility and reliability. Utility systems undergoing rehabilitation include natural gas, domestic water, cooling water, low-conductivity water, electrical power, sanitary sewer, compressed air, storm drainage, standby and backup electricity, and alarm and security.

- *Circulation and Traffic.* LBL traffic circulates along an east-west central serpentine road, with north and south loops. Gates to the Laboratory are located at the ends of the central east-west road. These main roads were designed in the 1940s and early 1950s and no longer meet construction or safety standards. Nearly 7,000 vehicle trips per day are made to LBL, including 70 shuttle-bus trips off site and 98 on site. The off-site shuttle carries an average of about 1,350 passengers per day. Parking space is provided for 1,650 employee vehicles, with 1.8 employees and visitors per parking space.

- *Fire, Safety, and Emergency Preparedness.* LBL maintains fire protection, police, and emergency preparedness facilities. The LBL Protective Services Department maintains 24-hour security with guard stations at the Laboratory gates, patrol vehicles, and a central dispatch and communication facility. The Fire Department provides fire-protection and ambulance services and operates the fire alarm and sprinkler systems. LBL has a Master Emergency Preparedness Plan and specific building emergency plans for dealing with disasters such as fires or earthquakes.

- *Planning Concepts.* The SDP is based on five LBL site-plan concepts. These concepts accommodate the facilities improvement needs within existing



LBL 1989 space distribution 2.1 million gross square feet (mgsf) total.

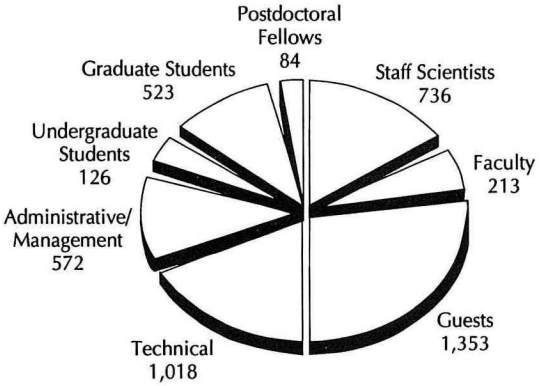
geophysical, environmental, and operational conditions. They provide a basis for understanding and evaluating the more detailed elements of the 15-Year and 5-Year Plans. The site-planning concepts are

- Consolidate activities within seven functional planning areas to enhance efficiency and effectiveness and to provide specialized research facilities.
- Redevelop obsolete buildings and infrastructure, eliminate temporary structures used for permanent functions, and improve building arrangements to increase safety and energy efficiency.
- Concentrate development along the east-west circulation and utilities axis to enhance transportation and service systems; e.g., develop off-road parking and improve pedestrian pathways.
- Improve and maintain perimeter and internal buffer zones to screen noise-generating activities and minimize potential incompatibility between adjacent operations.
- Provide off-site facilities for receiving, warehousing, and other support and research activities suitable for decentralization.

- *Design Guidelines.* Design guidelines in the SDP have been developed to achieve specific improvements while respecting site constraints and providing coherence between buildings and their surroundings. These guidelines address the following areas:
  - Utilities Corridors
  - Building Mass, Orientation, and Exteriors
  - Energy and Operational Efficiency
  - Safety Considerations
  - Building Use Flexibility
  - Circulation and Parking
  - Topography and Grading
  - Landscaping and Open space
  - Guideline Conformance Review

PLANNING ANALYSIS

Research and Support Trends. LBL's research and support trends are assessed and described in the 1989 Institutional Plan, published in December 1988. Over the next five years the Laboratory does not anticipate major growth, except that associated with the Advanced Light Source (ALS), the Human Genome Center, and further development of the Center for Advanced Materials (CAM).



LBL population—FY 1989, total 4625.

Laboratory Population. The Laboratory's population is substantially higher than the FTE count because it typically includes about 550 graduate students, 215 joint faculty appointments, and 1000 visitors. In FY 1988 the LBL FTE count was 2,478. The 1994 FTE estimate, including the estimated 250 ALS users (additional guests), is 2,654. The 15-Year Plan would allow additional growth up to a total Laboratory average daily population of 4,750, including 640 on the UCB Campus.

Building Needs. Near-term needs in support of scientific programs include the Human Genome Center, additional ALS user facilities, a Chemical Dynamics Research Laboratory, and a Biomedical Isotope Facility. Longer-term needs include a Conservation and Renewable Energy Research Laboratory and other new buildings and additions in many

programs, including accelerator research, cell and molecular biology, and heavy-ion fusion. General-purpose-facility needs include new buildings for safety, material handling, and mechanical and electrical engineering. General-purpose facilities would replace existing obsolete structures and would not increase the size of the Laboratory.

Utilities Needs. As discussed earlier, mechanical and electrical utilities and roadways require improvements to meet existing standards for safety and efficiency. The 12-kV electrical system needs renovation to limit electrical-system failures to fewer facilities, reduce planned outages, improve maintenance, and permit the selection of the most economical electricity sources.

MASTER 15-YEAR PLAN

Land Use. Eighty-four acres of the site are currently open space and buffer areas; 78 acres would be retained as open space and buffer if all projects identified in the 15-Year Plan were completed. The 15-Year Plan would change the proportion of the LBL main site improved with structures, utilities, or roads from the current 38% to 42%. Nine buffer zones are described in the SDP, with specific planning criteria identified.

Functional Areas. The functional planning areas are related groupings of facilities that enhance work efficiency and effectiveness. In general, parking is at the perimeter of these areas, and clusters of buildings form the core. The 15-Year Plan identifies changes to all of the functional planning areas to allow for potential research activities and to conform to SDP objectives, planning concepts, and design guidelines. The SDP calls for the removal of 210,790 gsf of buildings and the renovation of 809,010 gsf of building space. Building sites are planned or reserved for 613,600 gsf of new construction.

Development Potential. If all the sites and buildings were developed in accordance with the 15-Year Plan, it would result in a net increase of approximately 443,990 gsf to the existing main site of the Laboratory, for a total of 2.0 million gsf. For comparison, the 1989 total, including current construction, consisted of 1.6 million gsf at the main site. The 15-Year Plan increases provide for growth in life sciences, chemistry and materials sciences, conservation and renewable energy, earth sciences, and fossil-energy research. Many of these research areas were not a part of the Laboratory's mission during its period of growth during the 1950s and 1960s under the sponsorship of the Atomic Energy Commission. As indicated in the Planning Analysis section, increases are primarily for programmatic purposes. Proposed general-purpose facilities replace existing obsolete facilities.

FIVE-YEAR PLAN

Programmatic Facilities. Programmatic facilities in the 5-Year Plan primarily provide new capability in the life sciences. These facilities include the Human Genome Laboratory and the Biomedical Isotope Facility. Also, renovation of existing space is proposed for a Life Sciences Center at the ALS, and additional user facilities are included at the ALS as part of the current construction project. Although not currently supported by DOE program management, a Conservation and Renewable Energy Research Laboratory is proposed as a 1992 construction project and could be completed in 1995.

MEL-FS Priorities. The SDP projects an MEL-FS program in the context of a 15-year schedule, since a realistic budget estimate for 5 years cannot correct the problems in LBL's physical plant. However, projects identified in the outyears correct existing deficiencies in utilities and other systems. The 5-Year Plan calls for an annual budget increase from $7.9 M in 1989 to $11.8 M in 1994. Included are environment, safety, and heath projects; mechanical and electrical utilities; building replacement and rehabilitation; roof and road rehabilitation; and slope stabilization. The 5-Year and 15-Year Plans provide for a balance of project support among these project categories, based on Laboratory-wide priorities.

Individual projects are evaluated against generic Laboratory SDP priorities: (1) safety systems and safety facilities, (2) environmental protection, (3) utilities reliability, (4) design standards and obsolescence, and (5) delivery of research and support services. Environmental Restoration projects correcting past contamination of soils and groundwater include an $8.7-M restoration project.

General Plant Projects (GPP). Small capital projects funded by GPP, provided by DOE's Nuclear Physics Division, are important for environment, safety, and health construction needs; for maintenance and replacement of obsolete and deteriorated equipment, such as transformers, switching stations, boilers, and chillers; and for smaller rehabilitation projects and additions in support of changing multiprogram research needs. In FY 1989, for example, more than 60% of LBL's GPP budget will be used for environmental projects. The funds remaining cannot meet current project needs, which total over $28 M. At $2.6 M, the current budget does not allow progress in reducing this backlog, which has increased significantly during the past five years. The Laboratory's 5-Year GPP Plan is included in this SDP.

General Purpose Equipment (GPE). Essential support equipment is funded through DOE's Nuclear Physics Division. LBL's 5-Year GPE Plan identifies needs based on a range of criteria, including environment, safety, and health; legal requirements; failed, worn, inefficient, or obsolete equipment; substandard performance; or increased workload and demand. The backlog in the plan is $38 M, and full implementation would require annual funding levels of $5 M to $8 M between FY 1989 and FY 1994. However, LBL's budget request is more moderate, $3.0 M per year. The current funding level of $1.3 M cannot prevent increases in the backlog, which includes equipment for environmental monitoring and fire safety, physical-plant maintenance, mechanical and electrical shops, transportation, and data processing and communications.

Strategic Facilities Initiative. The purpose of DOE's Strategic Facilities Initiative (SFI) program is to identify facilities that are marginal or under used to conserve resources and reduce expenditures. At present most LBL facilities are fully used, and, with the current and projected activity over the next five years, facilities will be more intensively used, requiring the use of off-site leased space and continued use of 67,500 gsf of temporary structures. The Laboratory continues to inventory all existing space and has identified five building areas for projects that would remove marginal buildings and structures or convert them to essential DOE functions. These projects include conversion of marginal animal holding space to house essential Laboratory functions, disposal of a cryogenic facility, consolidation of facilities in highly valued accelerator experimental areas, relocation of a 4000-gsf metal building, demolition of a 1,200-gsf metal building, and removal of obsolete equipment and mechanical elements in 5000 gsf of medium- and high-bay space.

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INTRODUCTION AND SETTING

BACKGROUND/HISTORY

The Lawrence Berkeley Laboratory is a national laboratory operated by the University of California (UC) for the U.S. Department of Energy (DOE). The Laboratory is an independent academic unit of the University of California system and is located adjacent to the University of California, Berkeley (UCB) Campus.

LBL began as an accelerator laboratory in 1931, when Ernest O. Lawrence established the Radiation Laboratory with the construction of the 27-Inch Cyclotron on the UCB Campus. In 1939 the need for higher-energy accelerators resulted in the construction of the 184-Inch Cyclotron on a hill overlooking the campus and the City of Berkeley. Driven first by pioneering nuclear physics and biophysics research, then by the Manhattan Project during World War II and later by high-energy physics, the Laboratory's growth continued until about 1967. During the period of rapid growth, between 1940 and 1946, the original hillside Laboratory site became crowded with temporary wooden buildings hastily erected in response to national defense needs. However, development during the 1950s was more carefully planned, with the construction of permanent concrete and steel-frame structures east and west of the earlier construction. Figure 1–1 is a recent aerial view of the Laboratory.

Under the auspices of the Atomic Energy Commission, LBL's largest accelerator, the Bevatron, became operational in 1954 as the nation's leading high-energy physics facility. The Heavy Ion Linear Accelerator (HILAC) was completed in 1958, and the 88-Inch Cyclotron was completed in 1964. These facilities have been modernized and continue to make important contributions to nuclear physics research.

There was a period of reduced program activity from the late 1960s through the early 1970s as much of the nation's high-energy physics research moved to other laboratories with larger accelerators. In 1974 the Bevatron was combined with the HILAC to form the Bevalac, and the Laboratory regained its position as one of the world's premier accelerator facilities, this time for heavy-ion nuclear physics research.

Following the 1973 oil embargo, several new research programs broadly relevant to national energy supply and end-use were initiated following the reorganization of the Atomic Energy Commission into the Energy Research and Development Administration and the Nuclear Regulatory Commission in 1975. Although the Laboratory grew to its largest population in 1979 following the establishment of the DOE, no permanent buildings were constructed to accommodate this growth; temporary buildings and leased space in the Cities of Berkeley and Emeryville housed some research programs and most support services. By 1980 only 25% of the Laboratory's programs were in high-energy and nuclear physics, down from 75% in 1970. The Laboratory had become a multiprogram national laboratory, with a fundamental shift in mission since Long Range Development Plans were initially prepared during the 1950s.

From 1980 to 1982, Federal support for energy research dropped precipitously, and basic research declined, resulting in a 19% reduction in LBL's work force. Subsequently, the Laboratory's planning reemphasized basic, laboratory-based research founded on LBL's multidisciplinary scientific strengths. These plans called for the development of basic energy sciences and life sciences while maintaining historically important roles in high-energy and nuclear physics. In 1984 the National Center for Electron Microscopy was completed. The strongest of the energy-conservation and environmental-research programs in building sciences, energy storage, and air quality that had developed during the 1970s were retained into the 1980s. Plans were initiated for facilities in support of research programs with long-term

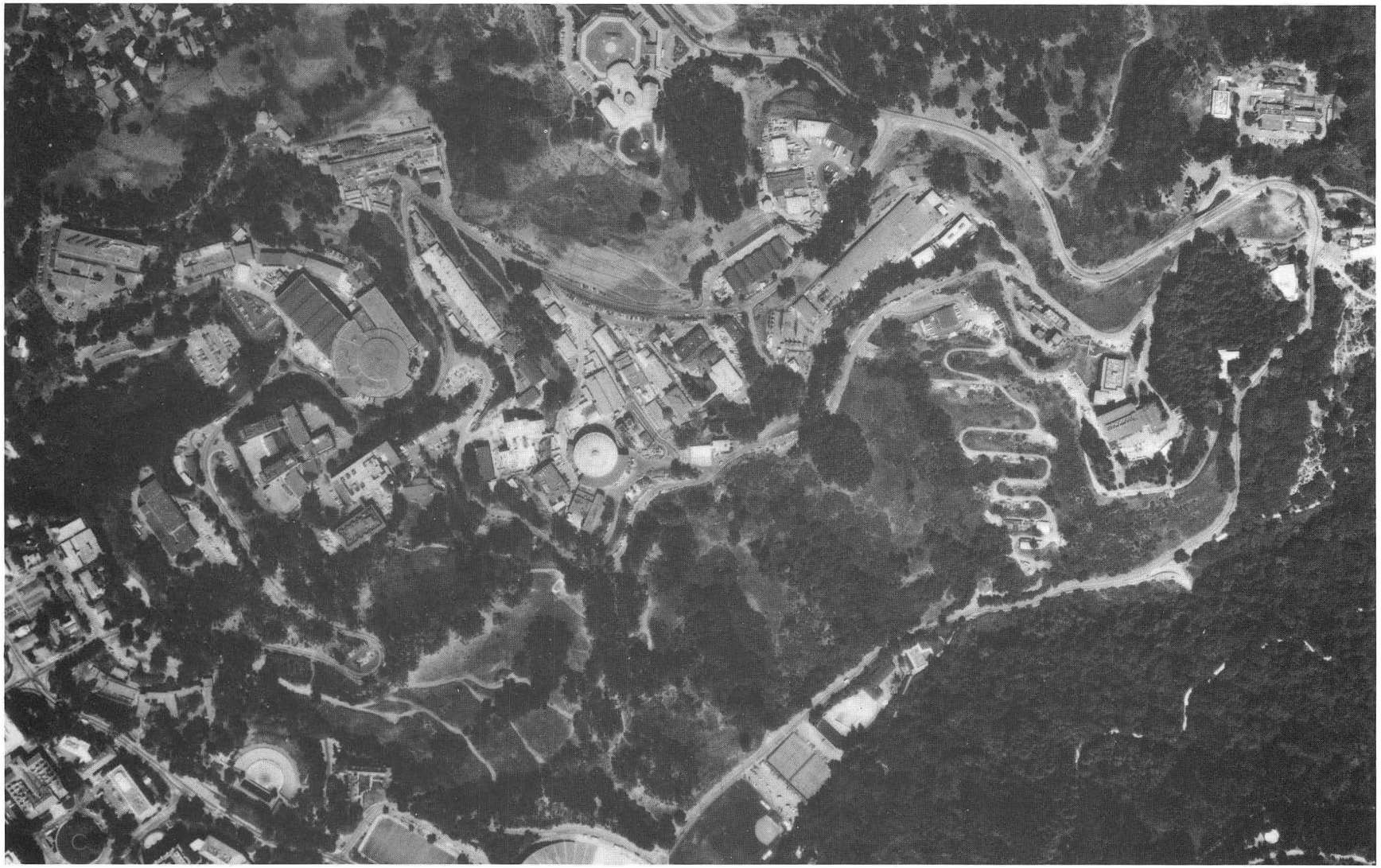

Fig. 1-1. Aerial view of the Lawrence Berkeley Laboratory.

potential for contributing to the nation's capabilities in materials science, chemistry, biology, and the earth sciences.

The role of the Laboratory is now broad, and LBL provides national scientific leadership and technological innovation in support of the following mission.

- Perform multidisciplinary research in the general sciences, energy sciences, and life sciences. The general sciences include nuclear physics and high-energy physics as well as accelerator research and development; the energy sciences include materials research, chemistry, geology, applied science, and engineering appropriate to DOE's programs; the life sciences include cell biology, genetics, molecular biology, and biomedical research.
- Develop and operate unique national experimental facilities for use by qualified investigators from throughout the world. These facilities include the Bevalac, the 88-Inch Cyclotron, the National Center for Electron Microscopy, and the National Tritium Labeling Facility. In addition, the Advanced Light Source (ALS) is scheduled for completion in 1993.
- Educate and train future generations of scientists and engineers. Five hundred and fifty graduate students pursue research at the Laboratory, with about 100 students receiving advanced degrees every year. Precollege programs are also conducted for science educators and students.
- Foster productive relationships between LBL and industry. The Center for Advanced Materials (CAM), the Center for X-Ray Optics, and the Center for Building Sciences are examples of collaboration with industry; technology-transfer programs also promote application of research results.

Past Budget Trends

This diversification toward multiprogram research activities and the development of the basic energy sciences are reflected in the Laboratory budgets over the past two decades. The 1989 budget is indicative of a recent trend of reduced support in the fossil-energy, conservation, and technology-demonstration programs. However, the budget sustains support in physics and is expanding in the basic energy sciences, such as chemistry, materials science, and the geosciences, where the Laboratory has growing research strengths.

Over the past decade the Laboratory has emphasized the need for increased capital investment in its physical plant (compared to the low funding during the late 1960s and 1970s) to revitalize existing facilities and to build major new research facilities to support DOE's programs. This Long Range Site Development Plan (SDP) provides guidance for using these capital funds effectively and for accommodating the significant changes in the Laboratory's mission and updates the 1984 SDP.

REGIONAL OVERVIEW

The western states, including California and the San Francisco Bay Area, strongly influence science and engineering research and development in the Pacific Basin. LBL has the advantage of being situated close to high-technology industries in the microelectronics, biotechnology, aerospace, telecommunications, petroleum, and advanced-materials-development fields (Figure 1–2). This exciting research and development environment is enhanced by the desire of Japan and the developing Pacific Rim countries to develop and use new technologies. High-quality academic, private, and Federal research and development programs create a San Francisco Bay Area job market that attracts a first-class labor pool. Interactions are facilitated by excellent regional transportation systems and comprehensive telecommunications and computing resources. Necessary raw and finished materials and equipment are in most cases readily available because of the high local demand these research activities generate. The demographic and economic assumptions represented in Table 1–1 indicate a high mean household income and an increasing population growth rate, and increasing labor force, through the year 2005. San Francisco Bay Area housing characteristics are shown in Table 1–2.

Technology transfer to and from industry is

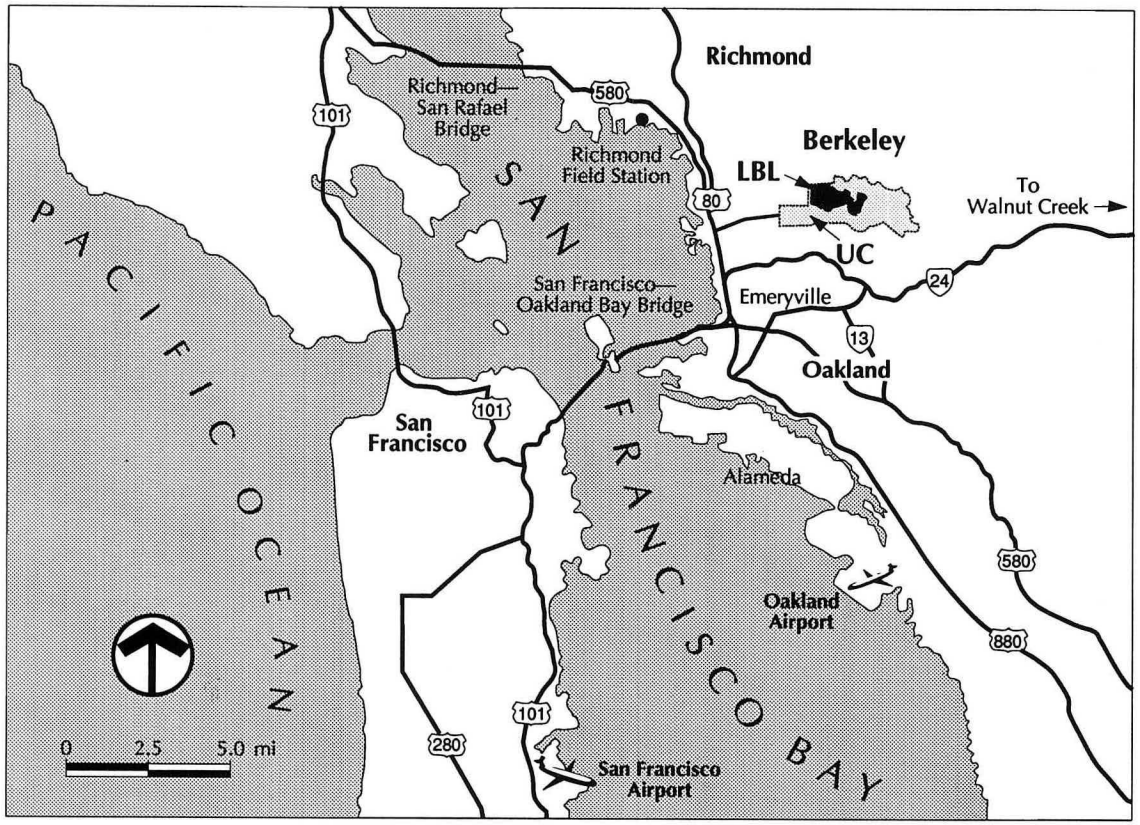

Fig. 1-2. Regional map.

enhanced in many cases by the proximity of many industrial organizations. Graduate students, post-doctoral associates, and professors from many other U.S. and foreign universities benefit from involvement with LBL research programs and user facilities. The UC system comprises nine top-rated campuses, including four medical schools, with a wide variety of scientific strengths. The Laboratory has strong interactions with other top California universities, such as Stanford and the California Institute of Technology.

VICINITY OVERVIEW

San Francisco Bay Area

LBL is located three miles east of San Francisco Bay on the slopes of the Coast Range within 1183 acres of contiguous UC land. Most of the Laboratory's main-site buildings are owned by DOE and were constructed on University land under long-term lease to the Federal government (Appendix E). The Laboratory's 130-acre site is in Alameda County, with the eastern portion of the site in Oakland and the Western portion in Berkeley, a largely university and residential community with a population of 107,000. Research is also conducted in buildings on the UCB campus, student population 31,500, and at the Richmond Field Station, a University facility within the City of Richmond, about 3 miles north of Berkeley (Figure 1-3).

The San Francisco Bay Area is a cosmopolitan region comprising nine counties with a total land area of 4.6 million acres and a population of 5.5 million. Although metropolitan areas are highly developed, only 11.6% of the total land is developed as residential area, commercial, industrial, or highways. The highly diversified, technology- and service-oriented labor force of the region is 3.1 million people. The industrial base is not oriented toward cyclically sensitive heavy industry but

Table 1-1. Demographic and Economic Assumptions and Projections, San Francisco Bay Area.[a]

Demographic Projections	1985–1987	1988–1990	1991–2005
Annual Growth Rate in Labor Force Participation	2.1%	1.8%	1.2%
Net Annual Regional Migration	34,600	31,800	34,800
Population	5,531,950	5,911,200	6,492,400
Labor Force	3,035,600	3,332,300	3,912,100
Mean Household Income	$39,200	$41,300	$47,400
Percent Change in Regional Household Size	–0.47%	–0.73%	–0.75%
Economic Projections			
Annual Growth Rate in All Gross Exports	3.2%	4.6%	5.0%
Annual Growth Rate in High Tech and Information Technology Exports	3.7%	6.0%	6.4%
Annual Energy Cost Increases in Current $	Stable	5% greater than inflation	5% greater than inflation
Annual Growth in Capital Spending	5.4%	6.6%	4.6%
Annual Growth in Gross Regional Product	2.9%	2.9%	3.2%

[a] Association of Bay Area Governments (ABAG), Projections for the San Francisco Bay Area to the Year 2005, July 1987.

is oriented toward high technology. Aerospace, computers, electronics, scientific instruments, and communications equipment comprise 54% of all manufacturing jobs.

The Bay's topography consists of a valley 90 miles long formed between two geological faults—the San Andreas fault, along the San Francisco Peninsula and Marin County, and the Hayward Fault, along the East Bay Hills. The coastal ranges surrounding the Bay reach to 4,210 ft. The Bay itself covers 260 square miles and moderates the local climate. The East Bay, comprising the Counties of Alameda and Contra Costa, is a large and diversified area but shares such features as a common water-distribution system, unified public-transit systems for buses and rail transit, and a unified regional park system.

Alameda County, with a population of 1,175,000 and an area of 469,400 acres, has major educational, research, industrial, and ag-

Table 1-2. San Francisco Bay Area Housing Characteristics.

County	Population	Housing Units (Thousands)						
		Total	Single	2 - 4	>5	Mobile Homes	% Vacant	Pop. / H-Hold
Alameda	1,214	483	287	58	132	5.8	3.3	2.5
Contra Costa	734	287	210	23	47	6.2	3.0	2.6
Marin	228	98	65	10	21	1.7	2.9	2.3
Napa	105	44	30	3	5	4.5	7.6	2.5
San Francisco	743	325	112	72	141	0.2	4.1	2.0
San Mateo	617	243	157	18	66	2.9	2.7	2.6
Santa Clara	1,408	517	330	47	124	16.9	3.1	2.7
Solano	291	104	74	9	17	3.7	3.5	2.8
Sonoma	349	147	106	12	20	9.6	7.1	2.5

ricultural resources, including six colleges and universities, large private and public research laboratories, heavy and light industry, and extensive nursery and viticulture acreage. Important industries include electronics, automobile assembly, biotechnology, and food processing. Alameda Naval Air station is home base for several aircraft carriers of the Pacific Fleet. The civilian labor force is approximately 600,000. The annual population growth rate during the mid-1980s was 7%. Most of the growth is projected for the southern area of the county. The Alameda County Planning Department prepares General Plans that are primarily directed towards the unincorporated areas of the County. The County General Plan for the Central Metropolitan, Eden, and Washington Units was prepared in 1981 and includes the communities and area surrounding LBL. These plans include land use, noise, scenic routes, and housing.

Cities of Oakland and Berkeley

Oakland is the county seat and, with a population of 350,000, is the sixth largest community in California. The port of Oakland can accommodate any vessel in the Pacific trade fleet, and three transcontinental railroads serve the city. The annual population growth rate during the mid-1980s was 1%. Growth in Oakland is expected to occur primarily in the vicinity of the airport, in the Harbor Bay Isle Business Park, and in Downtown Oakland. Oakland is a member of the Association of Bay Area Governments. The principal planning

document of the City is the Oakland Master Plan.

Berkeley is a residential, university, and industrial city encompassing 6720 acres. The City is best known for the University of California. Industries include major biotechnology, electronics, chemical and pharmaceutical companies; small foundries and fabrication companies; and other high-technology companies and service industries. The population of Berkeley has not changed during recent years. Berkeley is a member of the Association of Bay Area of Governments. The principal planning document of the city is the Berkeley Master Plan (1977), which is now being updated. Berkeley has also prepared a Draft Berkeley Downtown Plan, the Housing Element, and various neighborhood plans. The Laboratory is exempt from local zoning and planning regulations but cooperates with the Cities of Berkeley and Oakland, and with other local communities, on matters of mutual concern.

The Laboratory is sited on the ridges and draws of Blackberry Canyon, which forms the central part of the site, and Strawberry Canyon, which generally forms the southern boundary. The area to the south, which is University land, is maintained largely in a natural state and includes recreational facilities and the University Botanical Garden. Above and to the east of the Laboratory are located the University's Lawrence Hall of Science and the Mathematical Sciences Research Institute. LBL is bordered on the north by predominantly single-family homes and on the west by multiunit

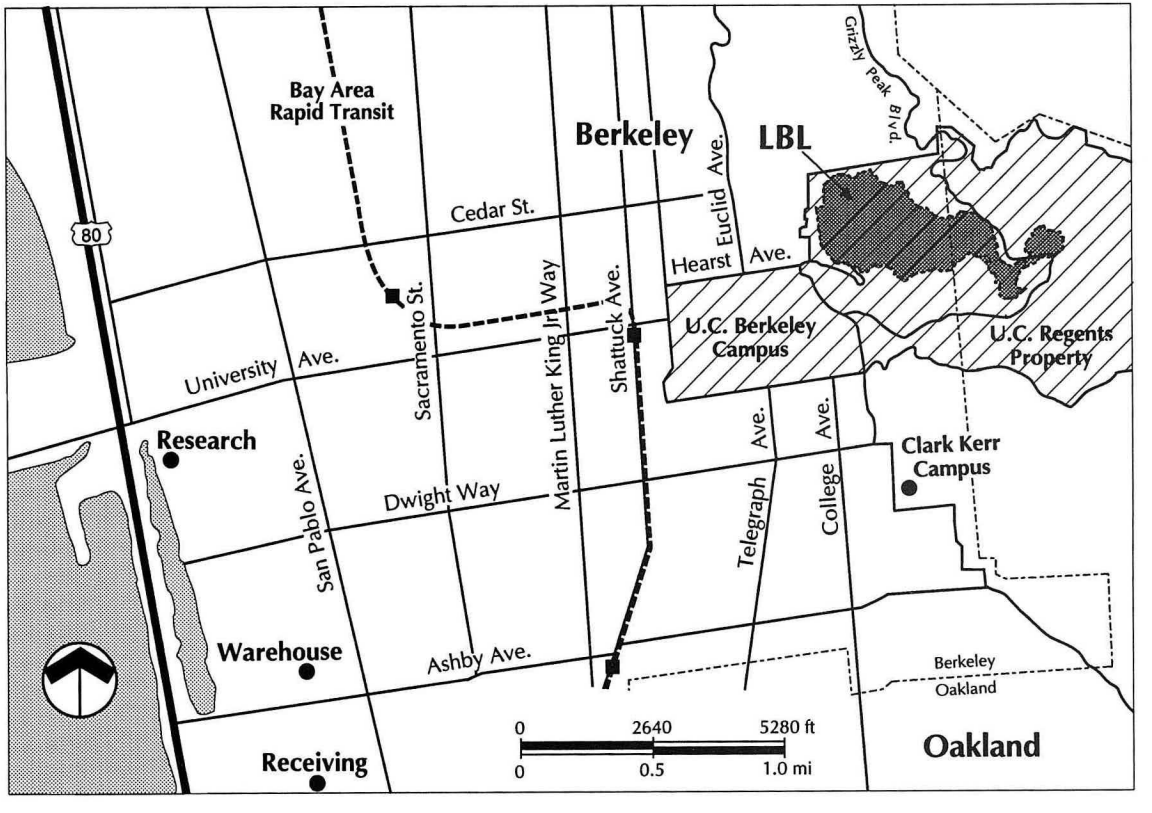

Fig. 1-3. Vicinity map.

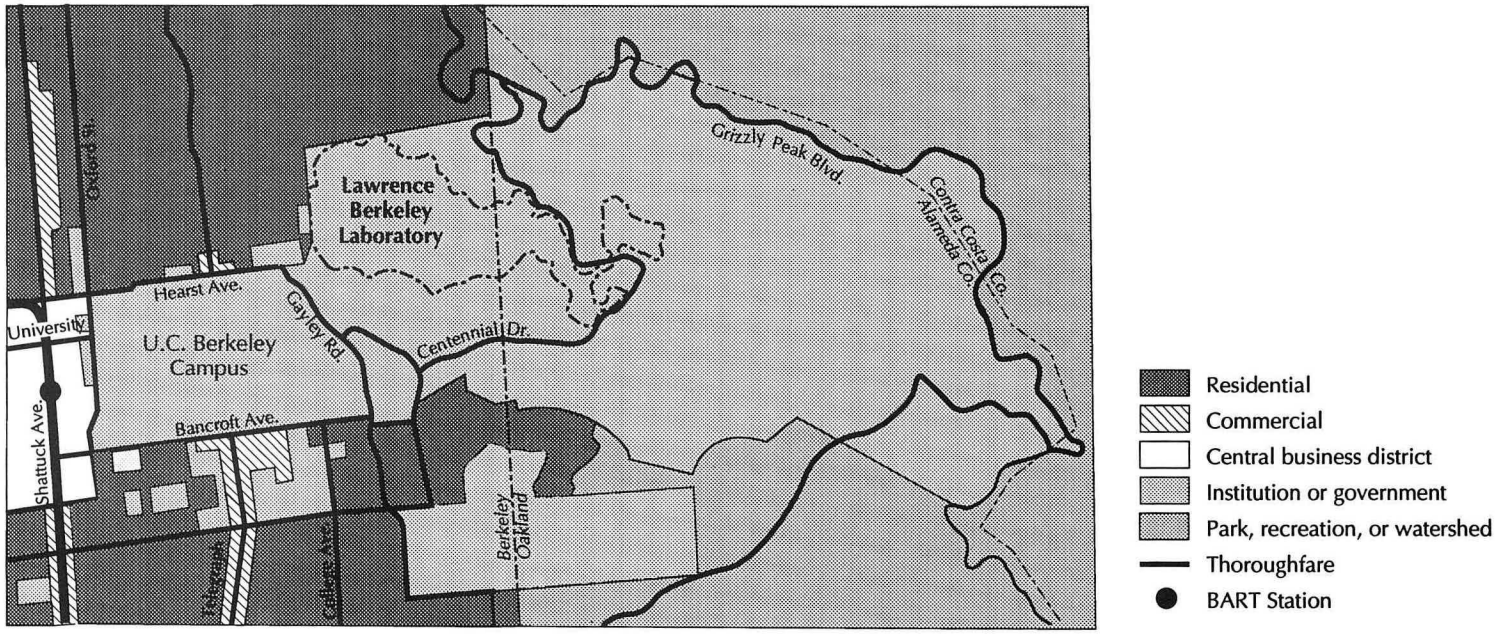

Fig. 1-4. The adjacent land use.

dwellings, student residence halls, and private homes.

The eastern section of the main Laboratory site is located along the northeast boundary of Oakland. Although the area is largely urban, the Laboratory site has a backdrop of botanical gardens and regional parks that preserve the rural character of the foothills.

The Laboratory is served by a network of state, county, city, University, and LBL roadways and public, University, and Laboratory transit services. The Laboratory is within commuting distance to the Lawrence Livermore National Laboratory and the Stanford Linear Accelerator Center. The DOE San Francisco Operations Office (DOE-SAN) is located in Oakland.

NATURAL FEATURES AND LAND USE

LBL's hillside location, with elevations ranging from 500 to 1000 ft above sea level, affords dramatic views of neighboring San Francisco Bay. The LBL site is drained by the west and south branches of Blackberry Creek and by Strawberry Creek and is underlain by folded sedimentary and volcanic rock that has weathered to form soils several feet thick.

The hillside topography and vistas are both an amenity and a constraint and add an important dimension to site planning at LBL. Grading and filling are necessary to provide most building sites, and a slope-stabilization program that includes shallow dewatering wells, vegetation cover, and soils management

is critical to site management. The Hayward fault (a part of the active San Andreas fault system), which developed as the Berkeley Hills were uplifted, is at the western edge of the main LBL site. Buildings and building additions will not be sited across the fault. Originally the site was coastal shrubland, but during the last 100 years the area was extensively grazed by cattle and, except near creeks, became primarily grassland. Since the 1950s the halt of grazing and subsequent land management have resulted in the growth of trees, especially eucalyptus, oak, and evergreens. Deer, various small mammals and reptiles, and birds populate the Laboratory site and the adjacent hills.

Adjacent land use consists of residential, institutional, and recreation areas (Figure 1–4). Development within the Laboratory site is governed by guidelines (Chapter 2) that were developed with the understanding that operations must be compatible with the surrounding community. Visually the Laboratory is associated by the public with the UCB Campus, and the Laboratory works with municipal, county, and university planning staffs to maintain and improve relationships and to coordinate development plans.

RELATIONSHIP WITH THE COMMUNITY

Overview

The UCB is immediately adjacent to LBL and is the largest employer in the City of Berkeley. It is the second largest campus of the 9-campus/3-laboratory UC system and has an enrollment of about 31,500 students. The academic staff is 4,344, and the total number of employees is 10,785. The University maintains its own planning department and is in the process of revising its Long Range Development Plan, last issued in 1962. The Laboratory works with the University on matters of mutual planning concern and provides advance notice during the planning stages of LBL construction projects and seeks input from the University for LBL's SDP.

The Laboratory and UCB interact to develop plans and programs of mutual benefit. These involve elements of scientific program plans as well as facilities and environmental issues. The Laboratory's 1987 LRDP was presented for discussion before the UCB Campus Planning Office Staff and the Chancellor's Planning Committee. Three development programs have been identified during the SDP preparation and review process: fire-safety coordination, traffic and parking management, and historical preservation.

A historic-preservation review, conducted by an independent consultant in 1987, documents LBL's facilities and makes recommendations to ensure LBL's compliance with environmental quality-assurance guidelines. Additional background and planning documents for fire prevention, parking and traffic control, and historical preservation are included in Appendix A.

The Laboratory also recognizes its responsibility to make its facilities available to the nonscientific public through tours and educational programs. For example, the Laboratory has established science education programs that operate in coordination with the Lawrence Hall of Science for extending precollege, as well as college and graduate level education programs, to both teachers and students. The Laboratory also provides an extensive schedule of tours, used by over 3000 visitors annually to learn about LBL research facilities and activities.

It is the policy of the Laboratory and the University to cooperate with local agencies on planning matters of mutual concern. The Laboratory's planning staff meets with the UC Berkeley Neighborhood Liason committee to inform the citizens of bordering communities of major changes to the site. To facilitate smooth transitions in changes to the site, LBL planners communicate and coordinate activities with the Cities of Berkeley and Oakland, UCB, and DOE-SAN planning staffs.

Security and Fire Protection

Security and fire-protection services in the area are provided by Police and Fire Departments of the Cities of Oakland and Berkeley, by the Alameda County Sheriffs Department, and by the California Highway Patrol. The Oakland Police Department has a staff of 608 officers, and its central command center is in Downtown Oakland. The Oakland Fire Department has 483 firefighters organized into

23 engine companies and 7 truck companies. Three engine companies and a truck company are within 3 miles of the Laboratory. LBL, with its own Fire Services, has reciprocal agreements with Berkeley and Oakland to cooperate on fire response. In addition, LBL is part of the Alameda County mutual aid system.

The Berkeley Police Department has 176 officers and is located in the downtown Civic Center. The Berkeley Fire Department has 125 firefighters and 7 companies and 2 ambulances. Three Berkeley engine companies are located within a mile of the Laboratory. Local Emergency Preparedness is coordinated through the Alameda County Office of Emergency Services, with a Command Center in Oakland. The area is a part of Region 2 of the State Office of Emergency Services, which has its regional Command Center in Pleasant Hill in Contra Costa County. LBL conforms to Region-2 Emergency Plans and has communications access to the Statewide emergency communications network.

The Laboratory maintains both Protective Services (police) and Fire Departments. The Protective Services Department, which occupies 2000 gross square feet (gsf) of office space, maintains 24-hour security at the Laboratory. Facilities and equipment include guard stations at the three gates, patrol vehicles, and a central facility for dispatch and communications. LBL's Protective Services Department assists the UCB and Berkeley police departments when requested. LBL's police jurisdiction is imparted by the Alameda County Sheriff, as is the case with the Berkeley and UCB police departments.

The LBL Fire Department occupies two buildings totaling 7500 gsf. It provides fire-protection and ambulance services to the Laboratory and operates the fire-alarm and sprinkler systems in Laboratory buildings. In addition, it assists the UCB and local municipal fire departments in controlling an average of 3–4 fires annually in the neighboring communities. The Laboratory's fire-protection and ambulance capabilities will continue to be available to augment local community services. Fire, safety, and emergency-preparedness long-range plans are summarized in Chapter 4.

Fire-safety measures are designed to minimize the severity of fires originating along roadways or from adjacent property. Although the natural-vegetation areas between LBL and nearby residences are outside LBL's jurisdiction, the Laboratory assists UCB and Berkeley and Oakland with fire-safety measures. The Laboratory has agreed to provide back-up fire control/patrol teams and equipment during controlled burns. Historically, the Laboratory's Fire Department has responded to calls for assistance from local fire departments and is committed to continue to do so. The Laboratory is cooperating and participating with UCB in their Fire Management Plan for the UC Hill Area. In addition to scheduled controlled burns coordinated with UCB, plans include the planting and maintenance of fire-resistant vegetation to create a firebreak between the Laboratory fence line and adjacent grassy slopes.

Public Utilities

The Laboratory's primary water supply is from EBMUD. Natural gas and electricity are provided by PG&E. LBL's sanitary sewers connect to the City of Berkeley system, which terminates at a sewage treatment plant in Oakland. The LBL storm drains empty into Blackberry and Strawberry Creeks, which flow into the City of Berkeley system and then into San Francisco Bay. A revitalization of on-site utilities has been initiated through the MEL-FS and GPP programs, as described in Chapters 4 and 5.

The EBMUD supplies water to LBL primarily from large-capacity reservoirs (68 trillion gallons or 210 thousand acre feet) in the Sierra Nevada foothills. Water is transported via 90 miles of aqueducts to 5 local reservoirs. The system supplies 20 communities with 1.1 million people (348,000 water meters) in a 317-mile service area. Average use is 219 billion gallons per day during high-use years. During a recent drought, customer conservation incentives reduced consumption to 181 billion gallons per day. Additional local storage capacity is planned with the construction of three new reservoirs. LBL uses approximately 100,000 gallons of water per day.

Although electricity and natural gas are provided primarily by PG&E, electrical service has also been provided by the Bonneville

Power Administration through the Western States Intertie. PG&E supplies both firm and interruptible power to LBL. PG&E serves 48 counties in California with a population of 11 million and has a systemwide generating capacity of 21,700 MW. The East Bay service region of PG&E (Contra Costa and Alameda Counties) has a peak demand of 2,907 MW and consumed 14,382 billion kW hours of electricity in 1988. The Laboratory had a peak demand of 27,000 kW and consumed 100,000 MW hours of electricity in 1988. The Laboratory has its own 60-MW Substation. PG&E has ample capacity to meet anticipated demand for the foreseeable future. Electricity costs are not expected to increase more than 0.5% per year during the near future. Electricity rates are regulated by the California Public Utilities Commission.

Public sewers connect to the Laboratory at Hearst Avenue and along Strawberry Canyon. The City of Berkeley is currently in its second year of a 20-year rehabilitation program to modernize and increase capacity of the sanitary-sewer drain system. Sanitary-sewer wastes are disposed of by EBMUD. The current dry-weather primary treatment capacity is 290 million gallons per day. Secondary treatment capacity is 168 million gallons per day. Typical daily treatment flows to the system are 90 million gallons per day. Wet-weather flow can exceed capacity during some storms. The Utilities District has initiated a five-year program to construct additional wet-weather facilities to handle the expected increases from contributing communities. With the new facilities the peak wet-weather treatment capacity will be 415 million gallons per day, which, with new the retention capacity, will accommodate a total flow in the sewer system of 775 million gallons per day during storms.

The Laboratory owns and operates its own voice, data-communications, and computer-network telecommunications systems. The Integrated Communications System (ICS) provides voice and data services and links with external networks, including Pacific Bell (the local telephone company), AT&T, and the Federal Telecommunications System. LBLnet is a Laboratorywide computer network connected through gateways to external networks, including MILnet, BARRNet, ESNET, and the UCB campus network.

Transportation Systems

The Laboratory and the City of Berkeley are served by the BART trains, regional and local bus services, many trucking companies, three major airports (the San Francisco, San Jose, and Oakland International Airports) with frequent ground transportation to Berkeley, and two major railroads (Figure 1–5). The Laboratory operates a shuttle-bus service to downtown Berkeley, which is served by 15 local transit routes.

BART is a fully automated rapid rail transit system with 71.5 miles of double track serving 34 stations in Alameda, Contra Costa, and San

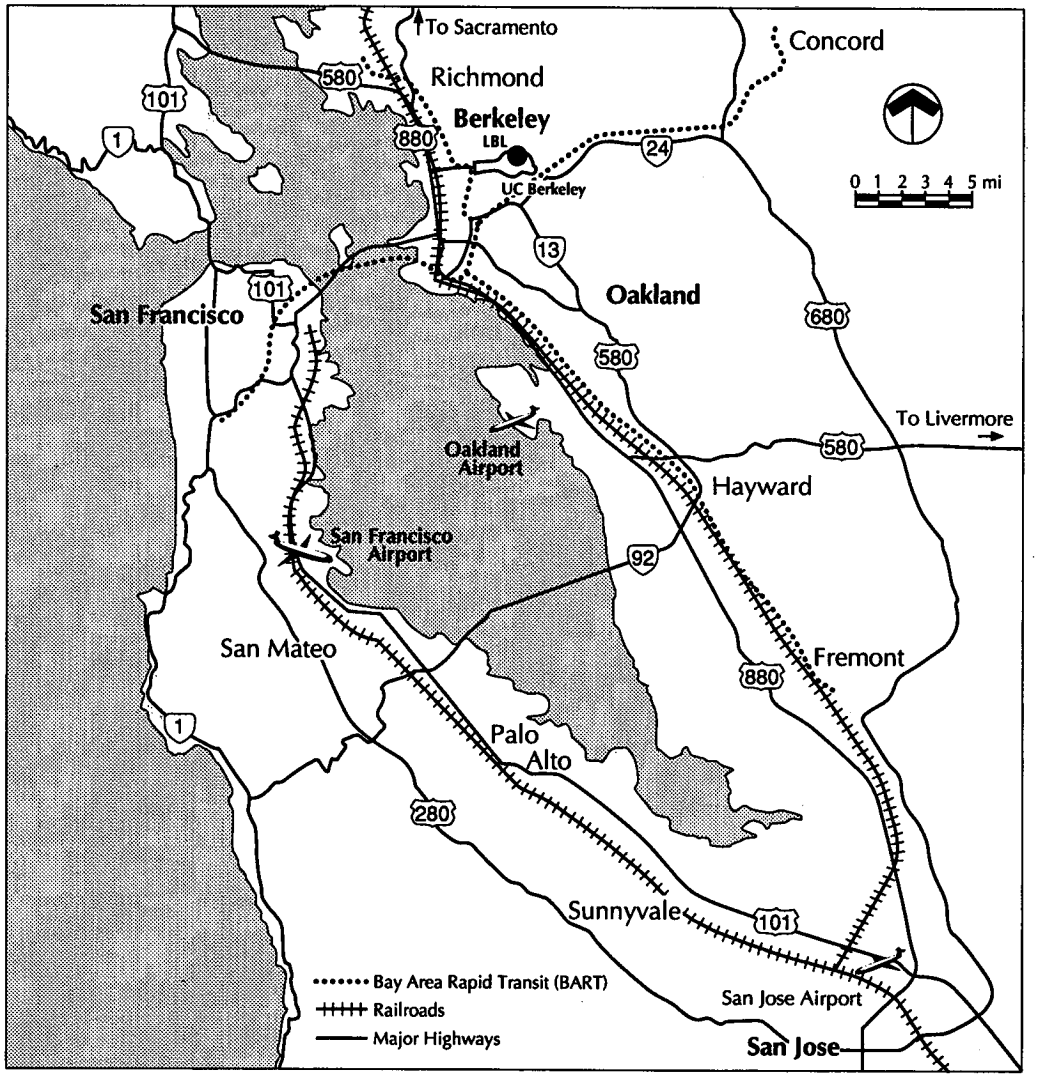

Fig. 1-5. Public transportation map.

Francisco Counties. The system provides approximately 200,000 passenger trips per day and maintains 440 rail cars. Three stations are located in Berkeley and are within 2 miles of LBL. Laboratory shuttle buses provide transportation to and from the downtown station. Planned extensions to San Mateo County and in Alameda and Contra Costa Counties include 6 new stations and 26 miles of track.

The Alameda-Contra Costa Transit District is the largest bus transit service in the Bay Area and operates a fleet of 830 buses over a system with 2,200 directional street-miles. The system provides service at 7000 bus stops for approximately 220,000 passengers per day. The bus stops adjacent to the Lawrence Hall of Science and at Hearst and Gayley roads are approximately 100 yards from Laboratory entrances.

Access to LBL is via three gates: the main entrance, Blackberry Gate, off Hearst Avenue (which becomes Cyclotron Road), directly east of the UCB campus; Grizzly Gate, off Centennial Drive; and Strawberry Gate, also off Centennial Drive. The site is served by a serpentine road pattern that conforms to the hilly topography. Approximately 50% of LBL employees and guests live within a four-mile radius (15-minute driving time) of LBL. Although LBL is served by excellent public transportation systems and its own shuttle-bus service to the UCB Campus and downtown Berkeley, the majority of Laboratory employees and guests use automobiles for transportation to and from work.

LBL's Transportation Systems Management

Committee has been working to identify ways to reduce LBL single-occupant vehicular traffic while fully meeting the transportation needs of LBL employees. A full-time Transportation Systems Management Coordinator develops and promotes traffic and parking mitigation measures. Program development thus far has included a Laboratorywide employee transportation survey, quarterly traffic counts at the three Laboratory gates, a computerized ride-matching system, participation in a State-wide ridesharing promotional event, Laboratory newsletter features, and new-employee orientations.

Further program elements may include a two-person vs. three-person carpool system, preferential carpool parking, expanded bicycle paths, additional bicycle storage, encouraged use of flextime to reduce congestion during peak traffic periods, and subsidized transit passes. Long-term elements may include new parking structures, increased shuttle-bus service, off-site parking facilities, a mini-cafeteria to service outlying areas, and a telecommuting program.

The transportation and parking plans and safety services are intended to minimize neighborhood traffic congestion, to improve parking access within the site, and to protect University and DOE property. Traffic problems are a major concern to the City of Berkeley because of existing congestion on routes to the University and Laboratory. LBL has agreed with the City to limit the impact of additional staff in traffic during peak periods. The on-site and off-site shuttle buses greatly facilitate access to the Laboratory from the Campus and downtown Berkeley. Completion of existing parking and building projects should eliminate the need for roadside parking over the next 5 years, and completion of the long-range parking improvements would provide adequate parking for estimated growth.

REGULATIONS AND PLANNING REQUIREMENTS

LBL conducts its planning, operation, and construction activities in full compliance with Federal laws and regulations and with applicable state and local regulatory requirements. Specific DOE requirements are provided in enabling legislation, the Code of Federal Regulations, and orders and guidelines provided by the DOE. Current planning activities and SDP requirements are specifically established in DOE order 4300.1b. In addition, the Laboratory's SDP has been developed in recognition of guidelines established in DOE's Site Development Planning Handbook and its 1987 Supplement.

LBL construction projects and site-development activities are reviewed by the DOE, other Federal agencies, and by state and local government and the public by procedures and documentation requirements established by the National Environmental Policy Act (NEPA). As required by the University of California in its management of the DOE Laboratories, specific

projects may also undergo review consistent with the California Environmental Quality Act (CEQA). These acts provide for the common development of environmental documentation to minimize duplication and to provide for lead-agency jurisdiction by the DOE. Areas of regulatory and planning activities occur with the following principal agencies:

Federal

- Department of Energy — comprehensive oversight, audit, appraisal, and compliance responsibilities for program activities, site planning and construction, NEPA compliance, environmental, safety, and health planning and operations, radiation protection, facilities maintenance, personnel, legal affairs, and budgeting and other administrative activities. DOE requirements, reviews, and appraisal activities form an important basis for staffing levels and costs and the schedule of implementation of LBL direct and indirect operations.
- Environmental Protection Agency — standards for solid, liquid, and gaseous waste, National Pollution Discharge Elimination System permits, notification and emergency spill response, and requirements of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Regulations promulgated by EPA help define LBL environmental, health, and safety policies and affect costs and staffing of LBL programs;
- Department of Labor — Occupational Safety and Health surveillance carried out by DOE in accordance with a Memorandum of Understanding with the Department of Labor. Occupational health and safety standards, including construction standards for the handicapped, are an essential part of LBL construction planning and program operations.
- Department of Transportation — shipping and waste-handling requirements and procedures. DOT standards define the requirements for shipping materials off site and influence schedules, costs, and activities for wastes from demolition, hazardous-waste handling, and other facilities and procedures.

State

- University of California —site planning and facilities design review and approval, environmental review procedures and approval, health and safety policies review and approval, personnel policies and procedures, budget policies and procedures review, approval, and audit, program review, and review and approval of other administrative policies and procedures.
- Department of Health Services — issues waste-handling-facility permits, reviews environmental reports for compliance with CEQA. Facility and permit requirements determine the capability, design, and operation of LBL sanitary and waste-handling facilities.
- California Water Quality Control Board and Regional Water Quality Control Board— discharge permits, review of environmental reports in compliance with NEPA or CEQA.
- California Air Resources Board — developes statewide air-quality policies, reviews environmental reports for NEPA or CEQA. Emissions regulations influence the costs of monitoring and emissions-control equipment.
- California Public Utilities Commission— governs rate structures and intrastate acquisition of natural gas and electricity.
- Department of Emergency Services — coordinate emergency response planning (local coordinating office in Contra Costa County).
- Water Resources Board — reviews environmental reports for NEPA an CEQA

Local

- Bay Area Air Quality Management District — issues emissions permits, reviews environmental reports for NEPA or CEQA.

- East Bay Municipal Utilities District — provides water supply, establishes water-use and sewer fees, approves and monitors discharges to the sanitary sewers.
- Alameda County Health Care Services Agency — inspects sanitary facilities and food-handling operations, issues cafeteria operations permit.
- Cities of Berkeley and Oakland — maintain surrounding city infrastructure, including roadways, local sewers, and public services; monitors compliance program for subsurface tanks and groundwater. The Cities review NEPA and CEQA documents and conduct a dialog with LBL and the University in planning, transportation, and environmental matters.

To implement programs consistent with applicable requirements established by these agencies, the Laboratory conducts a wide range of operational activities, including review, education, and report programs, for example, environmental, safety, and health educational programs and the control and monitoring of all effluents, emissions, and solid-waste-handling activities.

The Laboratory also has established a Five-Year Long-Range Environmental Health and Safety Program that corrects existing deficiencies and makes longer-range projections (to the year 2010) for anticipated environmental requirements. These programs provide for utility systems improvements, such as improved ventilation and lighting, asbestos abatement, and soils clean up and the removal of groundwater contamination resulting from activities conducted during past decades. These programs are being established and conducted consistent with the policies promulgated by the responsible local, state, and Federal agencies. Currently, LBL is conducting its demolition activities associated with the 184-Inch Cyclotron in compliance with applicable transportation requirements and building-demolition guidelines, as an example.

The scope of identified soils contamination is being defined consistent with established guidelines established by the Laboratory and the responsible agencies. Existing construction schedules are not expected to be affected by these activities. LBL's construction schedules include provisions for NEPA as required by DOE and for CEQA review, as may be required by the University. These reviews allow for participation by all public and private agencies, groups, and individuals and afford the opportunity for public review and litigation, which can affect the schedule, mitigation measures, and the construction of facilities proposed in this plan. The general scope, total projected gross square feet, and the land use identified in this SDP are consistent with the 1987 LRDP, which has been approved by the UC Regents and has completed applicable Federal and state environmental review procedures, including issuance of an Environmental Impact Statement as required by UC.

LBL PLANNING PROCESS, ORGANIZATION, AND GOALS

Major construction projects require approval of the DOE and the UC Board of Regents in terms of site location, design appearance, and conformance with the LBL LRDP previously approved by the Board. An environmental evaluation of major projects is a prerequisite to these approvals. Although the Director of the Laboratory and the Chancellor of the Berkeley campus manage separate units of the University system, LBL projects that have a significant effect on overall planning for University property are coordinated with campus planners.

Site planning at LBL is coordinated by the LBL Associate Laboratory Director for Planning and Development and the LBL Associate Laboratory Director for Administration, who both report to the Laboratory Director (Figure 1-6). The LBL Institutional Plan, upon which the Site Plan is based, is the responsibility of the Associate Laboratory Director for Planning and Development. Program goals and initiatives that form the basis for both the Institutional Plan and the SDP are developed with DOE by the LBL Director, the Associate Laboratory Directors, and the Directors of the nine LBL scientific divisions, in keeping with established Laboratory missions. The planning process at LBL includes the following steps (Figure 1-7).

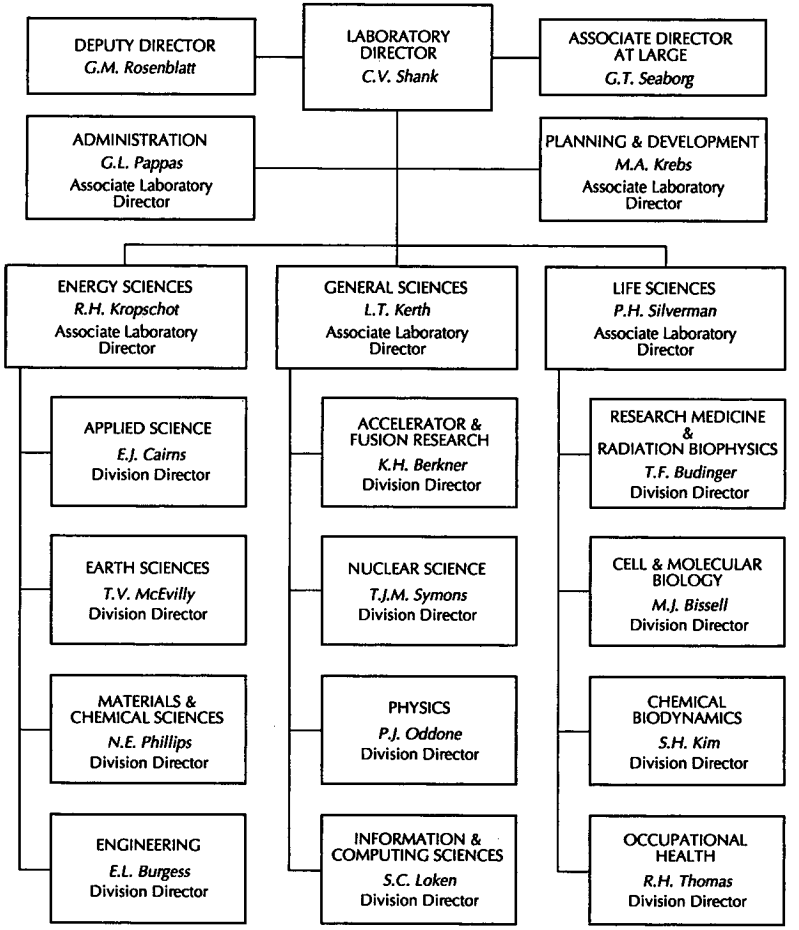

Fig. 1-6. Organization chart.

- The Director's Office develops specific programmatic goals in keeping with the LBL mission, research initiatives originating in the scientific divisions, and the objectives of the DOE.
- The Associate Laboratory Director for Planning and Development coordinates the development of the LBL Institutional Plan based upon input from the Laboratory Director, the other Associate Laboratory Directors, and the Division Directors. Major priorities are established by the Director in consultation with the Division Directors and the DOE.
- Conceptual designs for the specific construction projects necessary to support the programmatic initiatives incorporated in the Institutional Plan are developed by the Plant Engineering Department of the Administration Division in general conformance with the existing LBL LRDP and SDP.
- Plans for construction projects that may require amendment of the long-range plans are reviewed by the Associate Laboratory Director for Planning and Development, the appropriate Associate Laboratory Director, and the Associate Laboratory Director for Administration.
- Long-range planning is carried out by the Office for Planning and Development and the Plant Engineering Department with the assistance of specialized consultants in all appropriate fields.

A Site Planning Working Group consisting of representatives of the three major LBL scientific program areas and relevant management and administration representatives has been formed to advise the Associate Laboratory Director for Planning and Development on issues to be considered by the Director's Executive Committee and to assist in the preparation of this SDP. Planning analyses are

used to define site limitations and opportunities and to develop alternative solutions to long-range problems. Due to the hillside location and limited space available for development, LBL has made extensive use of detailed site-use studies to ensure the most beneficial long-term use of its available building sites.

- Proposed major revisions to the SDP are coordinated with the DOE-SAN, UC Systemwide, and UC Berkeley Campus Planning Committee.
- Annual GPP work plans are developed by the Laboratory and are approved by DOE-SAN.
- Annual Validation Reviews for major construction projects are held by DOE Headquarters staff.
- The SDP is continuously maintained and updated as a part of the normal annual planning cycle at LBL with review by, and input from, DOE-SAN.

SITE-DEVELOPMENT PLANNING GOALS

The 1989 SDP is a land-use guide for the main site that provides a comprehensive physical framework for carrying out the Laboratory's mission.

SDP planning is motivated by the need to rehabilitate existing obsolete facilities, to identify sites for anticipated programmatic growth, and to establish a planning framework under current environmental constraints in recognition of site amenities and the surrounding community. As a long-term guide for development of the main site, the SDP includes the following goals and objectives.

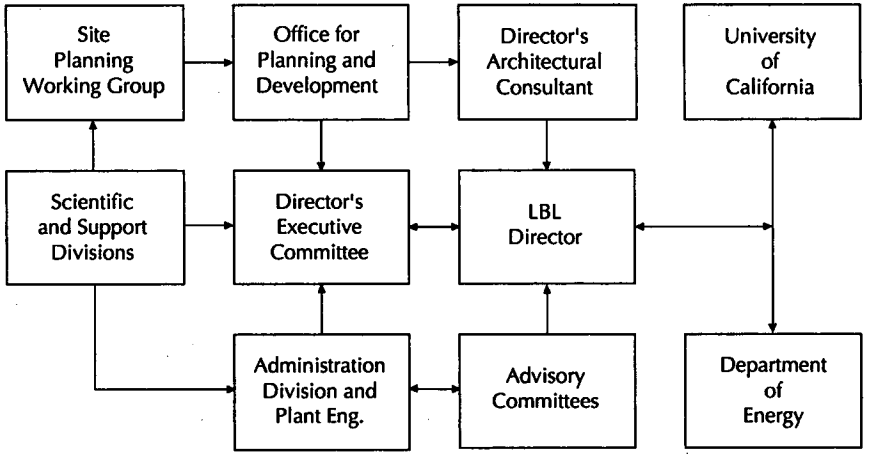

Fig. 1-7. Site planning process.

The purpose of the SDP is to

- Summarize the Laboratory's setting and planning processes.
- Define the physical environment for facilities development on the main site.
- Indicate redevelopment needs for existing buildings and utility systems.
- Summarize site amenities and constraints to protect the environment and landscape.
- Identify long-term needs for future improvements and outline a near-term 5-Year Plan.

The SDP presents a concise expression of the policy for the future physical development of the Laboratory, based upon anticipated operational needs of research programs and the environmental setting.

The 1989 SDP provides for new facilities associated with the Laboratory's redirection as a leading multiprogram laboratory. In addition, improvements are identified for rehabilitation and replacement of obsolete temporary buildings constructed since the 1940s. The site areas occupied by these proposed facilities are closely related to the 1984 SDP, reaffirming the general framework established at that time.

2.

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EXISTING CONDITIONS

The Lawrence Berkeley Laboratory is among the world's leading research institutions and has made major contributions to DOE's programs in energy research and development, in the basic energy sciences, in the general sciences, and in the life sciences. These contributions include advances in particle accelerators and detectors, in chemistry and materials science, in biophysics and medicine, and in energy-conversion and -use.

Ernest Lawrence was the Laboratory's first Nobelist, winning the prize in 1939 for the invention of the cyclotron. Since then eight other LBL scientists have become Nobel Laureates, the most recent being Yuan T. Lee, who received the 1986 Nobel Prize in Chemistry. Of its present staff, more than 50 have been elected to the National Academies of Sciences or Engineering. Fourteen of the heaviest elements were discovered at LBL, including californium, berkelium, and lawrencium. Relativistic heavy-ion nuclear physics was pioneered at LBL. Other, more-recent, developments include the discovery of iridium anomalies associated with mass extinctions, invention of the Time-Projection Chamber and the Ten-Meter Telescope, and the synthesis and characterization of advanced electronic and structural materials.

The Laboratory's research makes use of multidisciplinary collaboration and advanced engineering, computation, communications, fabrication, and other support facilities characteristic of a national laboratory. The Laboratory's facilities are planned, constructed, and maintained to support directly LBL's research programs and scientific goals, while maintaining compatibility with the University community and the physical setting.

SUMMARY OF EXISTING ACTIVITIES

Support for Lawrence Berkeley Laboratory research programs is expected to come primarily from the Office of Energy Research (OER) and the Assistant Secretarial Offices of Conservation and Renewable Energy, Civilian Waste Management, and Fossil Energy. In addition, other DOE offices and the Nuclear Regulatory Commission will support some LBL programs, and Work for Others (WFO) will continue to provide about one-fifth of LBL's support. This section briefly describes these LBL research programs, including possible future developments.

Office of Energy Research

LBL scientists and users from throughout the world continue the vigorous research program at the Bevalac and the 88-Inch Cyclotron.

The Laboratory contribution to national efforts to build synchrotron-radiation facilities and develop active user programs includes constructing the Advanced Light Source and developing advanced user facilities to support scientists in materials research, chemistry, biology, physics, and other fields.

In the context of an advancing national program in Health and Environmental Research, LBL is initiating a human genome program and continues to strengthen its basic research programs in cellular, molecular, and structural biology and its programs in atmospheric and ecological research. The biomedical program will improve diagnostic imaging systems and methods for elucidating the metabolic bases of diseases.

The Center for Advanced Materials (CAM) continues to pursue the Laboratory's goals for conducting longer-term research responsive to industrial needs. Expanded program activity in CAM is anticipated in thin-films research, studies of wear and mechanical properties of surfaces, and enzymatic synthesis of materials.

High-energy physics research with sophisticated detectors at forefront facilities, including the Mark II at the Stanford Linear Collider (SLC), Collider Detector at Fermilab (CDF) and D-zero at the Tevatron Collider, and Time Projection Chamber (TPC) at the upgraded Positron Electron Project (PEP), provide the basis for LBL's continuing experimental research program. New detector programs for the SSC, research in particle astrophysics, and planning activities for a B-factory may potentially expand in the near term.

LBL continues to provide advanced engineering research in instrumentation and magnet technology. Stronger and more-precise magnets are being developed for many research applications based on emerging magnet materials and on composite coil designs.

LBL contributes to the magnetic-confinement fusion program through the development of neutral beams for heating and refueling reactor plasmas. LBL's work on both positive- and negative-ion-based neutral beams has been coupled with the research efforts at the Tokamak Fusion Test Reactor (TFTR) at Princeton, the Mirror Fusion Test Facility (MFTF) at Livermore, and the Doublet III at General Atomic Technologies in San Diego.

The Laboratory maintains a training and collaborative research program with Jackson State University (JSU), a historically Black institution, and with the Ana G. Méndez Educational Foundation (AGMEF) in Puerto Rico, a major Hispanic institution of higher education. These cooperative research and training programs are expected to continue at the current level of effort. The newly formed Center for Science and Engineering Education has increasing numbers of programs for precollege and undergraduate students and faculty.

Conservation and Renewable Energy

The LBL program in Conservation and Renewable Energy (CRE) comprises a broad set of related activities that provides research support and technology development for energy conservation and renewable energy use, principally in the buildings and transportation sectors. The emphasis is on long-term laboratory-based research in the physical and chemical sciences. Program areas include energy storage and distribution, geothermal, solar heat technology, energy use and building systems research, and state and local energy conservation assistance projects.

Office of Fossil Energy

LBL conducts research directed toward making coal more usable, including conversion to gaseous and liquid fuels and reduction of emissions. The research ranges from fundamental coal chemistry through laboratory-scale investigations of coal-conversion processes.

Office of Civilian Radioactive Waste Management

LBL continues a strong multidisciplinary program of interrelated geoscience and geological engineering research important to the long-term underground storage of high-level nuclear wastes, e.g., characterization of deep geologic formations, determination of the physical and chemical processes occurring between waste-repository materials and the surrounding rocks, analysis of hydrologic and chemical transport mechanisms, and development of predictive techniques for repository performance.

Office of Policy, Planning, and Analysis

LBL continues a long-term project to collect and analyze energy-consumption information from less-developed countries (LDCs). Included in the study are twenty LDCs that account for most of the non-OECD oil imports and four large oil-exporting countries. The outputs of this study include a computerized data base on LDC energy use and energy structure.

Work for Other DOE Facilities

LBL's contributions to research and development programs at other DOE facilities include

studies of nucleation scavenging of smoke particles and of laser-material interactions for LLNL; investigations of the direct absorption of solar energy for high-temperature receivers for Sandia National Laboratories; assistance to Oak Ridge National Laboratory (ORNL) in assessing renewable energy applications in developing countries; and support of Pacific Northwest Laboratories efforts to develop energy-consumption standards for residences.

LBL's solar-biomass program, supported through ORNL, investigates the cultivation of hydrocarbon-producing plants, such as *Euphorbia*, with emphasis on crop yield, oil yield, process chemistry, and economics.

In addition, LBL is applying its building-energy expertise to Bonneville Power Administration (BPA) programs to develop cost-effective conservation measures and renewable resources to protect the environment while responding to growing demands for electricity.

Work for Others

Other Federal Agencies. Other federal agencies that fund research at LBL include the Agency for International Development, the Department of Defense (nonclassified research), the Department of Interior, the Environmental Protection Agency, the National Aeronautics and Space Administration, the National Institutes of Health, and the Nuclear Regulatory Commission.

Other Agencies and Institutions. Other agencies include the Electrical Power Research Institute, the Gas Research Institute, the California Association for Research and Development, the California Energy Commission, and many private organizations. This work is reviewed by the Laboratory and SAN to ensure that all applicable DOE regulations are satisfied.

PHYSICAL ENVIRONMENT

Topography and Geology

The Lawrence Berkeley Laboratory is sited on the western slope of the Berkeley Hills at elevations ranging from 500 to 1,000 feet above sea level. Building sites are constrained; 50% of the total Laboratory area has a slope greater than 25% (Figure 2-1).

Most of the LBL site is underlain by complex sedimentary and volcanic rock that has been folded and faulted since Cretaceous time. In general, the bedrock is relatively weak and weathers deeply; this weathering has produced a colluvial cover a few feet thick. Natural rock outcrops are few, although there are many rock exposures in cut slopes. The major geologic unit consists of poorly consolidated sandstones, siltstones, claystones, and conglomerates of relatively low strength and hardness. These rocks are blanketed by clay soils having high shrink-swell characteristics. The western and southern portions of the site are underlain by moderately well-consolidated shales, siltstones, sandstones, and conglomerates. Throughout most of the upper elevations a volcanic unit overlays, and is interbedded with, the upper layers of the major geologic unit. Landslide deposits have been encountered in numerous locations within the LBL site. During the past 20 years the Laboratory has carried out a program of slope stabilization to reduce the risk of property damage due to soil movement.

The hilly terrain has often required grading and filling to provide suitable building sites. Consequently, landfills up to several tens of feet thick are present in some of the original ravines and depressions. Most of these fills were mechanically compacted during placement, and they have been satisfactory for foundation support.

Seismicity

The seismically active Hayward fault, a branch of the San Andreas fault system, trends northwest-southeast along the base of the hills below the Laboratory (Figure 2-2) and has the potential to produce an earthquake of approximately Richter magnitude 7.0.

The main part of the San Andreas fault system, which lies about 20 miles west of LBL, offshore beyond the Golden Gate, has a

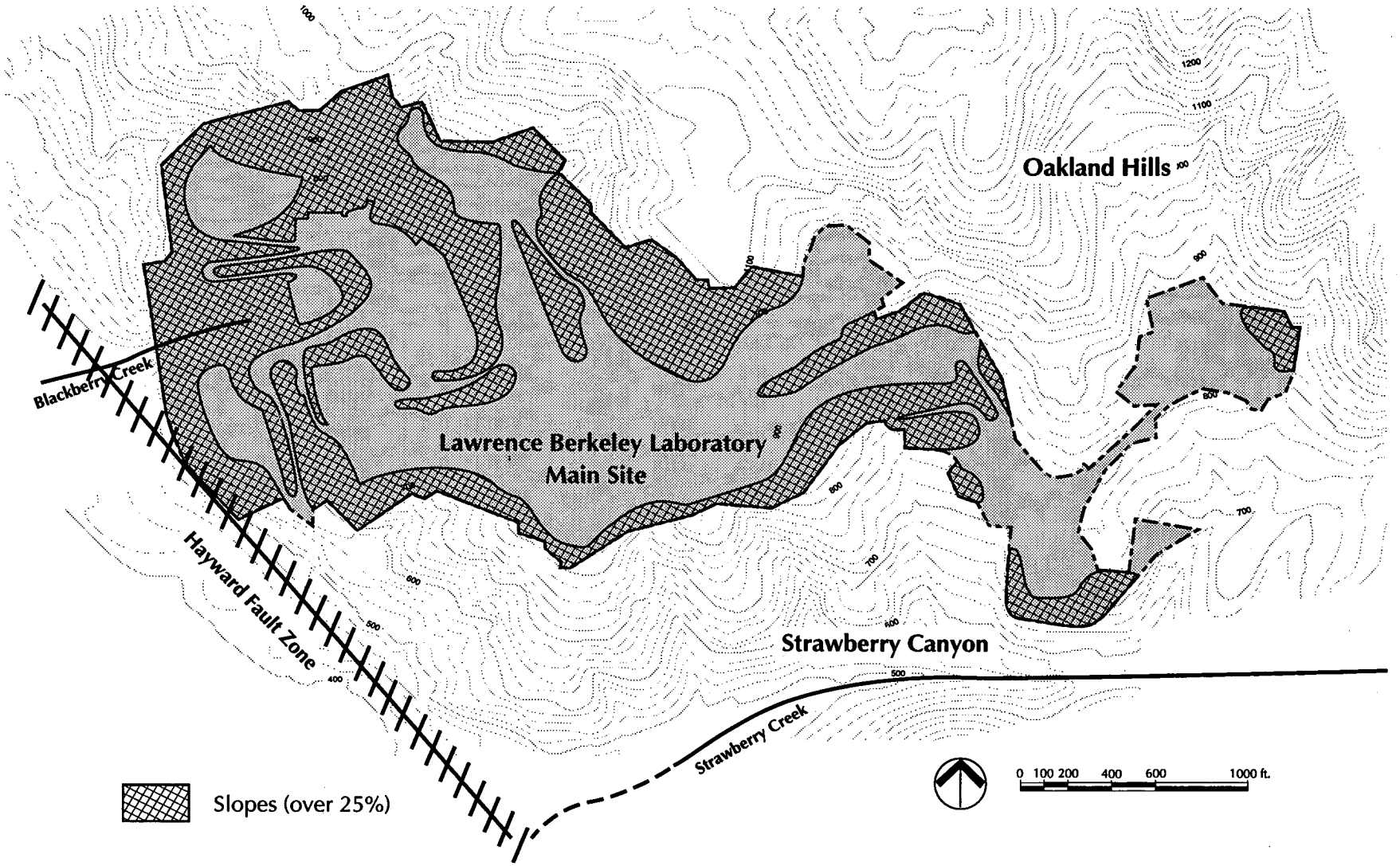


Fig. 2-1. Site constraints and opportunities map.

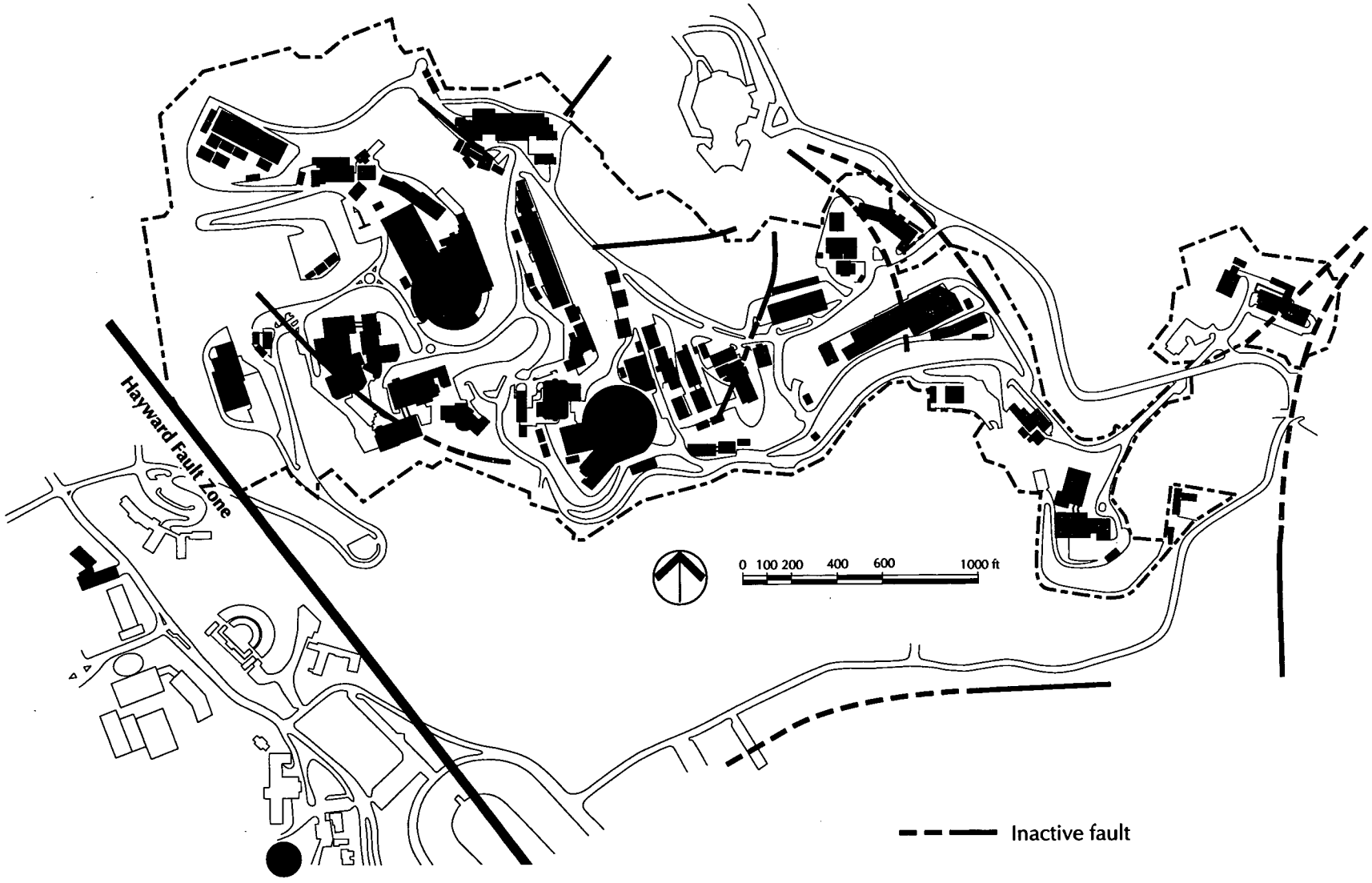


Fig. 2-2. Earthquake fault map.

Table 2-1. Water Table Depths.

Functional Area	Depth (ft)[a]
88-Inch Cyclotron Research Area	>40
Central Research and Administration Area	16 – 30
Bevalac Accelerator Complex	18 – 50
Light Source Research and Engineering Area	>20
Shops and Support Facilities Area	65 – 100
Materials and Chemistry Research Area	10 – 15
Life Sciences Research Area	10 – 30

[a] Depths represented as > X indicate existing borings have encountered no free water to that depth.

potential for a magnitude-8.3 earthquake. The Calaveras fault, another branch of the San Andreas, lies about 15 miles east of LBL. For an earthquake of given magnitude, the much-closer Hayward fault would produce the most-intense ground shaking at the site.

To reduce the potential for damage from seismic activity, the Laboratory has carried out a comprehensive earthquake-safety program since 1971. All new facilities have been designed and constructed to resist the maximum credible earthquake estimated for the site. All existing LBL buildings were reviewed, and 32 were strengthened to meet current risk criteria.

Hydrogeology

Groundwater is of concern because of its potential effect on slope stability. The fractured bedrock underlying the Laboratory provides a percolation source that augments groundwater. Faults that cut through the bedrock tend to drain it, whereas clay layers act to impede flow. Water levels and hydrostatic pressure increase during the rainy season. The Laboratory has installed extensive groundwater detection and drainage systems (Figure 2-3) to increase slope stability. Water-table depths vary from 10 to over 90 feet across the site (Table 2–1).

Because of LBL's hillside location and moderate annual rainfall, surface run-off is a prevalent feature of the site. Two creeks and their tributaries provide natural drainage for the LBL site.

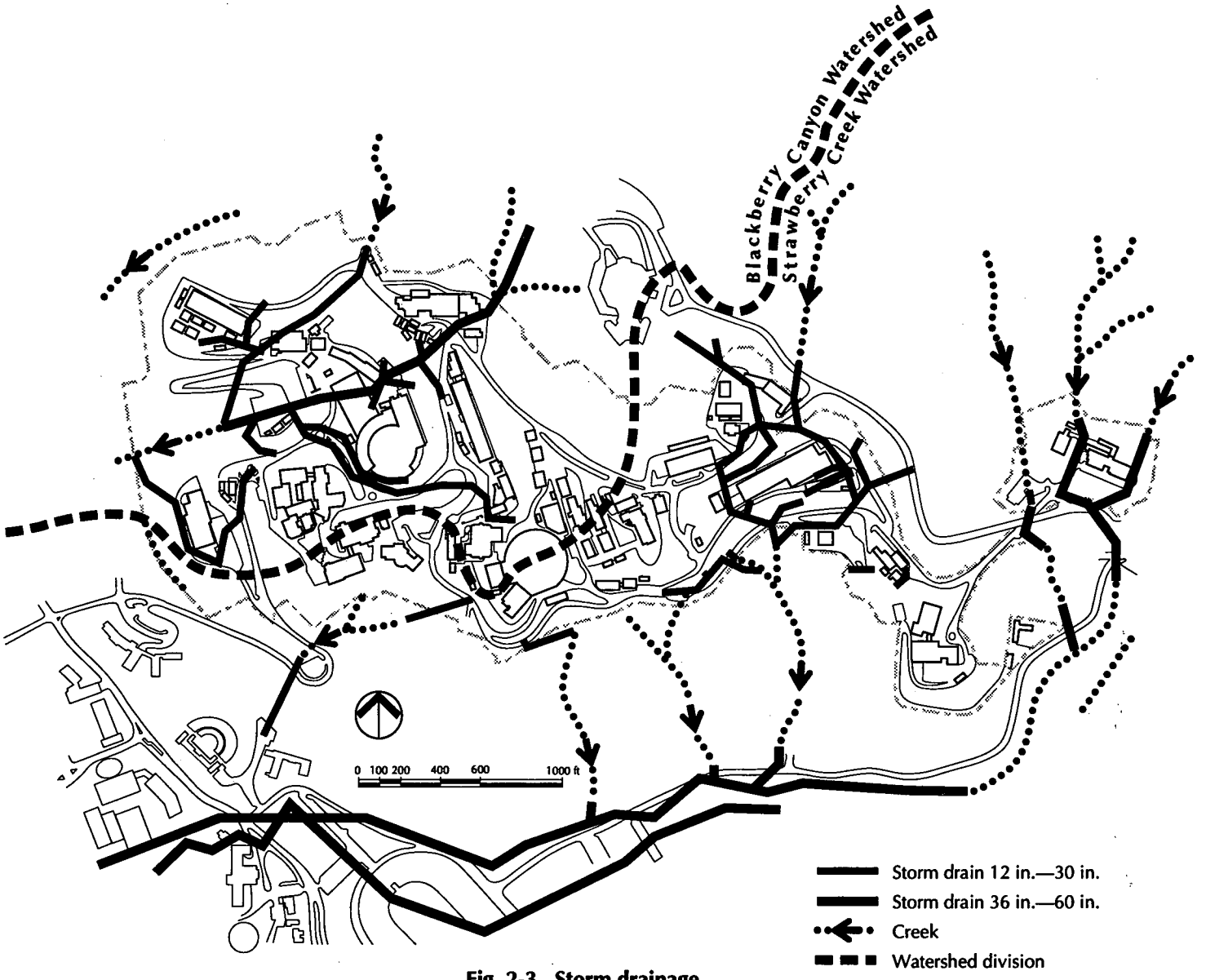


Fig. 2-3. Storm drainage.

Meteorology

The climate of the LBL site is greatly influenced by the proximity of the Pacific Ocean and the maritime air that flows through the Golden Gate. Seasonal temperature variations are small; the mean summer and mean winter temperatures are 62°F and 51°F, respectively (Table 2–2). Generally, comfortable outdoor conditions prevail summer and winter.

Relative humidity ranges from 85–90% in the early morning to 65–75% in the afternoon. Annual insolation ranges from 65 to 75% of that theoretically available, and the average daytime cloudiness is about the same in summer and in winter. The number of heating degree-days is about 2,600 and of cooling degree-days about 150. Winds are generally less than 10 mph, usually blowing from the East in the morning and then switching to the West in the afternoon (Table 2-3).

About 95% of the average annual rainfall of 25 inches at the Laboratory occurs from October through April, and intensities are seldom greater than one-half inch per hour. Thunderstorms, hail, and snow are extremely rare. Consequently, LBL enjoys a Mediterranean-type climate, with favorable conditions for comfort control and energy efficiency. During the construction of the University's Lawrence Hall of Science and the Space Sciences Laboratory (in the late 1960s), a storm-sewer system was installed to provide for runoff intensities that could be experienced in a 25-year maximum-design storm. The system, with large conduits, special inlet and exit structures, energy dissipators, and hardened channels, was designed to accept runoff from future building sites in the easterly portion of LBL. These existing LBL storm drains are adequate to handle peak water runoff, based on a storm of 25-year recurrence and using the intensity-duration data for total seasonal rainfall (Table 2-4).

Table 2-2. LBL Temperature Normals (°F) by Month.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Max	56.1	59.5	61.1	63.3	66.4	69.2	69.5	69.6	71.7	69.6	62.9	57.0	64.7
Min	43.2	45.8	46.0	47.6	50.3	53.0	53.9	54.7	55.6	52.9	48.3	43.9	49.6
Mean	49.7	52.7	53.6	55.5	58.4	61.1	61.7	62.2	63.7	61.3	55.6	50.4	57.2

Table 2-3. LBL Wind Data.

	Speed (MPH)				
Direction	1-3	4-10	11-21	22-27	%
N	0.59	0.97	0.05		1.61
NNE	0.61	0.61	.01		1.23
NE	0.89	1.10	0.20		2.19
ENE	1.10	1.52	.59	0.03	3.24
E	1.97	1.68	0.45	0.03	4.13
ESE	2.46	1.87	0.17		4.50
SE	3.31	3.53	0.39	0.01	7.24
SSE	3.59	4.76	1.13	0.01	9.49
S	3.12	4.44	0.70	0.01	8.27
SSW	3.36	3.86	0.18		7.40
SW	3.24	3.30	0.03		6.57
WSW	3.17	4.28	0.09		7.54
W	4.02	6.45	0.14		10.61
WNW	3.65	4.86	0.26		8.77
NW	3.33	3.19	0.13		6.65
NNW	1.64	2.24	0.08		3.96
CALM					6.60
TOTAL	**40.05**	**48.66**	**4.60**	**0.09**	**100.00**

Vegetation and Wildlife

The most common and widespread types of vegetation are coyote brush, coast sagebrush

Table 2–4. Rainfall Intensity and Probability.

Period (yr)	Intensity (in./hr)	24-Hour Duration (in.)
25	0.20	4.30
50	0.22	5.28
100	0.25	6.00

scrub, oak-bay woodland, annual grassland, and eucalyptus plantations. In addition to these native or naturalized communities, landscaping around roads and buildings provides additional vegetation.

- Baccharis Brushland. This is the major vegetation cover type. It forms an open to dense shrub layer, approximately two meters tall in some areas. Coyote brush (*Baccharis pilularis* var. *consanquinea*) is the dominant plant species.
- Coast Sagebrush Scrub. This sparse-to-open, low (up to one meter tall) shrub type is found on the exposed south- and west-facing slopes of two spur ridges forming the northeastern boundary of the site. Coast sagebrush scrub is characterized by local dominance of California sagebrush (*Artemisia californica*).
- Oak-Bay Woodland. A dense woodland dominated by coast live oak (*Quercus agrifolia*) and California bay (*Umbellularia californica*) trees occurs in ravines. In general, the oak-bay woodland covers approximately 25% of the Berkeley Hills.
- Annual Grassland. Patches of grass generally occur within the project area on disturbed sites. The major grass species are introduced annuals such as soft chess (*Bromus mollis*), wild oats (*Avena* spp.), and wild barley (*Hordeum* spp.). Low broad-leaved plants commonly associated with annual grassland include rabbit-foot clover (*Trifolium arvense*), cut-leaved geranium (*Geranium dissectum*), and English plantain (*Plantago lanceolata*).
- Eucalyptus Plantations. Extensive stands of introduced eucalyptus trees occur in the project area. Blue gum (*Eucalyptus globulus*) occurs on west-facing slopes, and mixed stands of blue and red gum (*Eucalyptus tereticornis*) dominate the ravines. The trees reach a height of approximately 80 to 100 ft and are 10 to 40 in. in diameter.
- Landscape Plantings. Extensive landscape plantings surround existing facilities. These plantings include Monterey pine (*Pinus radiata*), knobcone pine (*Pinus attenuata*), and redwood (*Sequoia sempervirens*). There are no naturally occurring stands of these trees on the site.

The surrounding area supports a variety of native wildlife including deer, fox, skunks, raccoons, and other mammals. Local birds include dove, quail, brown towhee, scrub and

Steller's jay, common bushtit, Anna's hummingbird, wrentit, red-tailed hawk, and turkey vulture. The most-common reptiles and amphibians in the vicinity are the California slender salamander, ensatina, California newt, common garter snake, western fence lizard, and northern alligator lizard.

- Oak-Bay Woodland Wildlife Habitat. Among the most conspicuous and common wildlife using this habitat are black-tailed deer, western gray squirrel, deer mouse, bobcat, black-tailed jackrabbit, mountain lion, Steller's jay, acorn woodpecker, and bandtailed pigeon. Food, shade, and nesting sites are provided by the oak woodland. Other common birds include the California quail, mourning dove, and various hawks and owls.
- Baccharis Brushland Wildlife Habitat. Species using these areas include brush rabbit, gray fox, striped skunk, scrub jay, common bushtit, and coast garter snake.
- Annual Grassland Wildlife Habitat. These grassland areas provide suitable habitat for a number of small mammals and their predators, songbirds, and reptiles.
- Eucalyptus/Bay Wildlife Habitat. The ravines and drainage areas lined with these trees provide food, water, cover, nesting, and migration and movement routes for wildlife. Mammals such as raccoon and striped skunk are common residents. Black-tailed deer, gray fox, yellow warbler, tree swallow, great-horned owl, and red-tailed hawk are occasional visitors. Reptiles and amphibians such as the aquatic garter snake, Pacific tree frog, and bullfrog are common in and around quiet streams.

Portions of the area surrounding LBL have been designated natural-preservation and ecological-study areas by the University. The Laboratory has established landscape buffer zones to evaluate and manage the natural and introduced plantings within LBL's boundaries (Figure 2-4). No rare or endangered species are known to occur within the LBL site.

LAND USE

Laboratory activities are more efficiently conducted with buildings consolidated in core functional areas, with perimeters serving as buffer zones, transportation access, and parking; the SDP consolidates operations and facilities into seven functional areas to arrange new facilities for improved physical organization.

Eighty acres of the site are currently designated as buffer and open-preserve areas, whereas about fifty acres have been developed with buildings, roadways, and other improvements . Land-use planning analysis indicates that the Laboratory site has good potential, both for redevelopment of outmoded facilities (primarily in the Light Source Research and

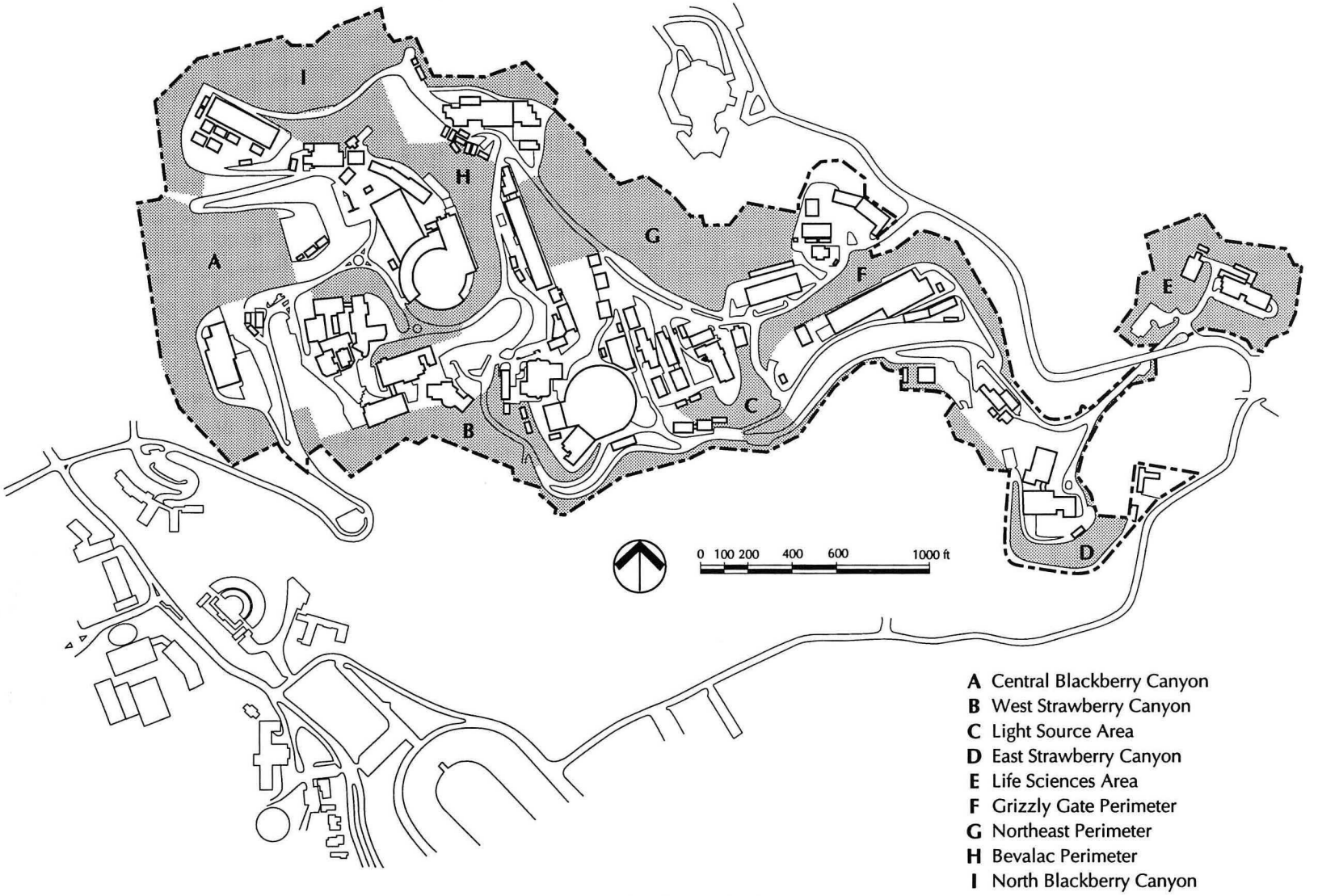
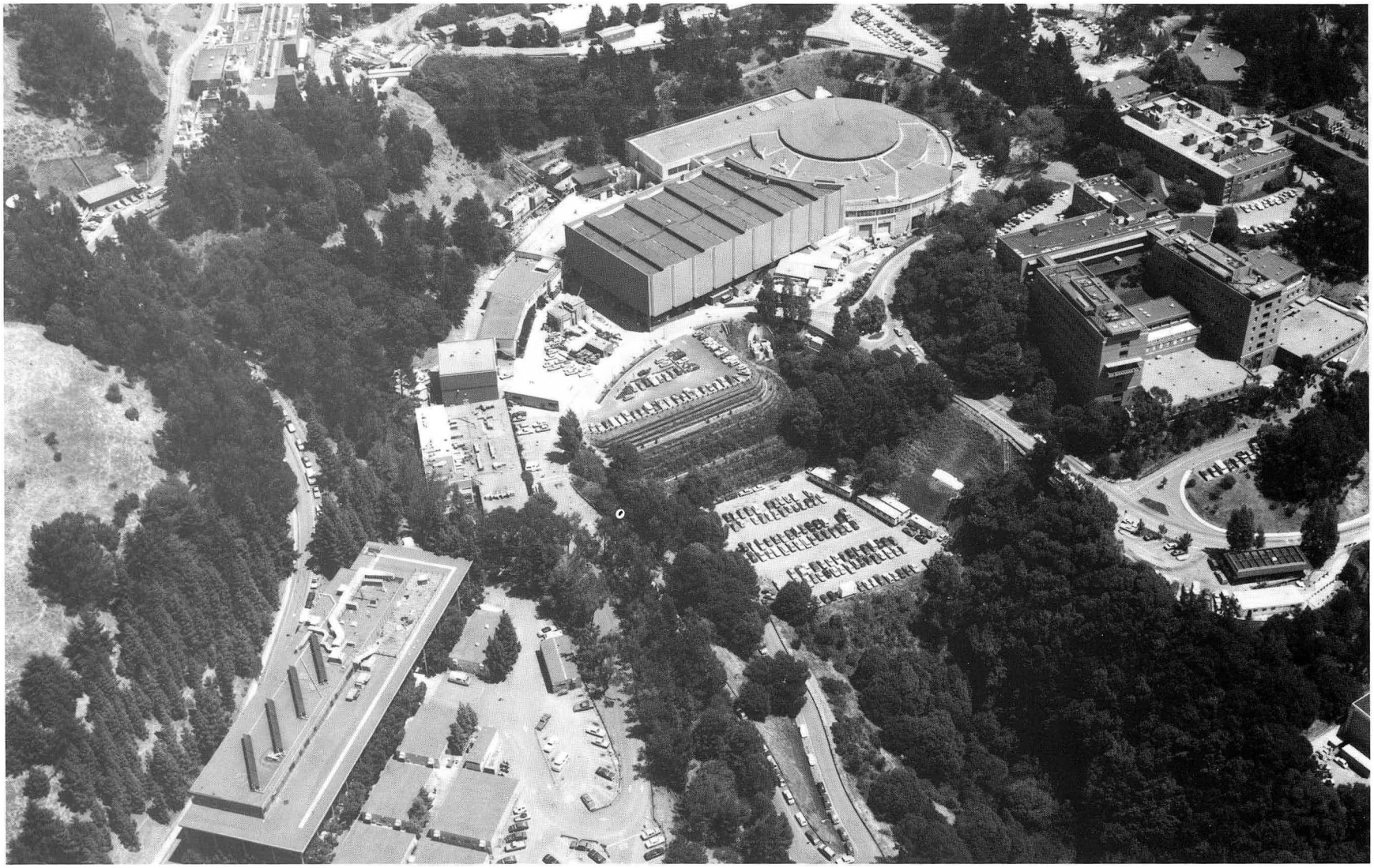


Fig. 2-4. Existing landscape buffer zones.



Natural and introduced plantings provide buffers between Laboratory Functional Areas and adjacent communities.

Engineering Area) and for future development. The compact LBL site enhances efficient interaction among support services and scientific program staff and encourages a more closely knit research community.

To facilitate appropriate siting of buildings and to enhance the relationship between land use, landscaping, and siting, the SDP establishes special buffer zones to protect valuable vegetation, to preserve important scenic vistas of the Bay, and to avoid unsightly exposures that face the city or UCB Campus. On the basis of these criteria and important geologic and hydrologic limitations, including earth stability and hydrology, construction in the buffer zones is largely excluded.

Nine buffer zones are identified, eight of which are primarily adjacent to the Laboratory's boundary. The Bevalac Perimeter buffer zone includes the planted slopes around much of the Bevatron, because steep slopes make that area generally unsuitable for building sites. The West Strawberry Canyon buffer zone protects valued views and many of the cork oaks east of the cafeteria. The Light Source Buffer area, which includes a portion of the Original Laboratory Site and a section of the West Strawberry Canyon perimeter, contains a small grove of coast redwoods and dawn redwoods and several stands of eucalyptus. The East Strawberry Canyon buffer zone includes the dawn redwoods in that vicinity. These and other buffer zones, and the primary criteria that restrict their use as building sites, are identified in Figure 2-4.

Other factors considered in building location and land use include pedestrian and vehicular traffic circulation, views from the buildings, erosion control, surface-drainage patterns, fire control, landscape scale, and effective use of maintenance resources.

Although plans call for total building volume to increase, future building footprints will be more compact and in accordance with landscape plans; this, along with removal of outdated buildings, will enlarge open areas between future facilities. In addition, some existing paved surfaces will be converted to landscaped open areas. Consequently, the Laboratory will be more attractive to its employees and to others alike. Planned entrances for new buildings, gathering areas, and other focal points will preserve or provide views across the Bay.

The Laboratory has developed a landscape plan and established landscape-related criteria for new building sites; e.g., many existing mature trees have been preserved to serve as design elements. Four categories of landscaping sustain or augment the natural grassland, shrub, and forest areas of the hillside.

- Natural-state areas are the most distant from buildings, consisting primarily of native grasses, low-growing ground cover, and trees (primarily in gullies and along north-facing slopes).
- Drought-tolerant low-cover areas are closer to buildings and consist of fire retardant evergreen plantings.

- Drought-tolerant high-cover areas incorporate fire-retardant trees and shrub masses, often adjacent to buildings.
- Introduced-planting areas requiring more intensive management and supplemental watering during the summer are immediately adjacent to buildings and, frequently, along pedestrian paths and around decks, picnic areas, and viewpoints.

The major landscaping goals are to complement the hillside setting, to unify the site visually, to relate the site to adjacent vegetation, to prevent erosion, to provide amenities to users of the site, and to provide a buffer between functional areas, buildings, and adjacent properties.

CIRCULATION AND PARKING

The LBL site is served by an east-west traffic circulation system that conforms to the hilly topography. Vehicles enter LBL through gates attended by Laboratory Protective Services personnel. These gates are open for various periods according to the commuter patterns; only the main gate, near the east end of Hearst Avenue, is open 24 hours. The gates are situated to help channel traffic and to minimize on-site congestion. Due to LBL's compact site, many buildings are within walking distance of each other; the many footpaths and stairs provide good access between buildings and roads. The site is too steep and hilly, however, for a system of bicycle paths; the few bicyclists use the roads. The Laboratory's roads, parking, and pedestrian walkways generally provide for efficient movement of personnel and materials. In older areas of the Laboratory, however, the circulation system is substandard, with varied, narrow, and indirect vehicular and pedestrian access.

Parking space is provided for about 1,900 vehicles (including 250 Laboratory vehicles). A range of 1.7 to 2.0 persons per parking space with a recommended ratio of 1.7 persons per space will permit a 10% vacancy factor. The Laboratory has a three-level parking-permit system that provides for nearby parking for upper management, reserved spaces for employees with medical permits and for senior scientific and management staff, and general parking for all others. Van pooling and car pooling are encouraged by providing special parking for "pool" vehicles.

About 3,500 vehicle trips per day are made to LBL. Approximately 50% of LBL employees and guests live within a four-mile radius (15-minute driving time) of LBL. The peak vehicle traffic occurs between 4:30 and 5:30 p.m., reaching 750 vehicles per hour.

Traffic studies indicate that 64% of all LBL employees drive alone to the site (single-occupant autos). Seven percent use car pools or van pools; 13% use public transportation; 7% use bicycles; 7% walk; and 2% use two-wheel motor vehicles. Public transit users rely on the LBL off-site shuttle bus to reach the Lab.

Parking demand in the densely populated areas at LBL generally exceeds the number of available spaces. Trailers serving as temporary office and storage space have also been located in parking lots, further reducing available parking space. The needs for building and parking space, combined with the sloping terrain and the cost of providing parking structures, place a premium on land occupied by existing parking lots.

Transportation by large semitrailer truck can be slow because of the many steep grades and sharp curves. This can cause traffic delays, for example, when a heavy truck is climbing at three miles per hour on the two-lane main entrance road, where passing is not permissible.

At present, the Laboratory operates both on-site and off-site buses to facilitate circulation and access (Figure 2-5), to minimize the use of personal vehicles for transportation, and to encourage use of mass-transit systems, such as

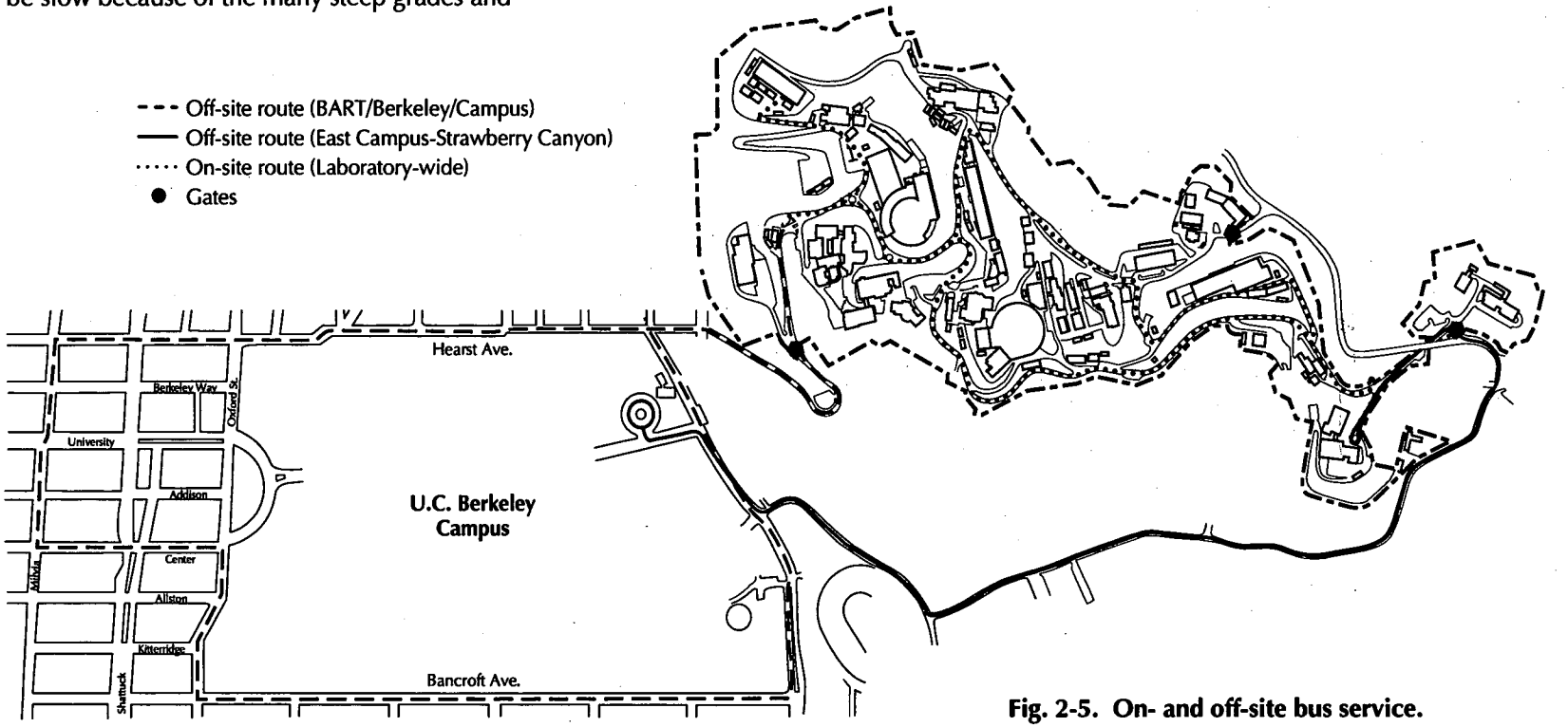


Fig. 2-5. On- and off-site bus service.

BART and AC Transit. The on-site bus service, coupled with a system of pedestrian paths, helps reduce on-site vehicular traffic yet allows access to every building on the site within a reasonable amount of time. Plans call for increasing service commensurate with population increases (Table 2-5).

Table 2–5. Transportation and Parking Characteristics.

Characteristic	Current	Future
Parking		
Total spaces	1,900	2,410
Population/space ratio	1.8	1.70
Peak Vehicle Trips (per hour)	750	950
Off-site Shuttle Service		
Trips/day	70	82
Passenger capacity/day	2,870	3,300
Passengers carried/day	1,350	1.950
Use (%)	47	59
On-site Shuttle Service		
Trips/day	98	110
Passenger capacity/day	1,862	2,090
Passengers carried/day	925	1,330
Use (%)	50	64

BUILDINGS AND OTHER STRUCTURES

The LBL building-and-space inventory includes many types of facilities, including on-site permanent buildings, on-site trailers and miscellaneous structures, off-site leased building space, and the UCB Campus space assigned to LBL. (An analysis of this space is presented in Table 3–2 in Chapter 3.)

The Laboratory's on-site space (about 78% of the gross) consists of approximately 1,601,100 gsf with an approximate 70% efficiency. The net usable on-site space is approximately 1,068,300 sq ft. With a typical daily on-site population of 3,000 employees and participating guests, the average net occupied office space is about 131 sq ft per person. About 1% of the on-site space consists of trailers or other temporary structures.

Two of the Laboratory's divisions, Research Medicine and Radiation Biophysics and Cell and Molecular Biology are partly housed on the UCB Campus; a third, Chemical Biodynamics, is housed totally on Campus, except for a small facility (the National Tritium Labeling Facility) in the Shops and Support Facilities Area. Together, these three divisions occupy about 41,000 net sq ft. LBL personnel also occupy other space on the UC campus, at the UC Richmond Field Station, leased space in the City of Berkeley, and at the Stanford Linear Accelerator Center (SLAC). Overall, about 21% of LBL personnel occupies off-site space.

On the main site, of the 1.6 million gsf in buildings, 36% are adequate buildings, 51% are substandard but can be made adequate, and 13% are substandard and should be demolished or removed (Appendix C).

FUNCTIONAL AREAS

The natural constraints of the site coupled with the desirability of maintaining compact and interactive programmatic development have led to the delineation of the LBL site into seven functional planning areas (Figure 2-6). These subdivisions of the site, which are generally identified with specific research programs and/or support facilities, have been individually studied to ensure effective short- and long-range use (Appendix A). It is in this context that more-specific program premises are best described for relevance to site planning.

88-Inch Cyclotron Research Area

The functional area designated as the 88-Inch Cyclotron Research Area is located on a hillside terrace near the main entrance to LBL. Functionally, the area is dedicated entirely to the 88-Inch Cyclotron and its close support facilities. Due to the topographical constraints of the site, expansion of the existing facilities is rather limited.

Central Research and Administration Area

This functional area houses the LBL Director's Offices and the main divisional offices for Administration, Applied Science, Earth Sciences, Engineering, Nuclear Science, Physics, Accelerator and Fusion Research, Information and Computing Sciences, and Planning and Development. It includes the majority of LBL's light laboratories and support offices as well as the cafeteria.

The buildings in the 50-70 Complex provide the major portion of light laboratories for Applied Science, Physics, Earth Sciences, and Nuclear Science.

A shortage of light laboratories and offices for existing programs remains, and a number of laboratory spaces in the buildings of the 50-70 complex are still used for offices. An important element of the SDP is construction of economical additions to existing buildings to provide office space that will permit reclamation of valuable laboratory space.

Building 90 and its trailer complex currently house Plant Engineering, Personnel, Applied Science, Mechanical Engineering, and the SSC Central Design Group. Since parking is severely limited in this area the trailers will be removed as soon as replacement space becomes available.

Bevalac Accelerator Complex

This functional area encompasses the Bevalac/SuperHILAC Accelerator Complex, including heavy-laboratory experimental areas, cryogenic support facilities, staging areas, associated offices, and facilities for advanced accelerator research and development. The area has an extensive array of support utilities, heavy handling equipment, and related resources.

Over many years, this area has been studied intensively in connection with major upgrading projects and experimental-area expansions. A number of initiatives for advanced accelerators were developed into conceptual designs incorporating the extensive support facilities that now serve the Bevatron Area (e.g., VENUS, Tevalac, Relativistic Nuclear Collider). Other site-related studies have been carried out for designs of existing and future large detector systems. These studies have established a thorough understanding of the potential for physical expansion and development of the Bevalac Accelerator Complex.

Light Source Research and Engineering Area

This functional area encompasses 15 acres and includes buildings enclosing 362,000 gsf of space. The dominant feature of this area is the dome of Building 6, which originally enclosed the 184–Inch Cyclotron and which is now being remodeled to contain the Advanced Light Source (construction began in 1987 and is scheduled to be completed in 1993). Generally, the area around Building 6 contains older buildings and extensive utilities that were developed in the 1940s.

In recent years, major research work housed in the Light Source Research and Engineering Area has been focused on the Magnetic Fusion Energy (MFE) Program and the Biomedical Program. This functional area also includes the LBL medical-services facility, the new LBL fire

station, central stores, and the electronic and mechanical technician shops. The newer buildings and a few of the older buildings, such as Building 6, are quality buildings that will be preserved. The others are obsolete and inadequate for modern research and development and must be replaced.

This area has excellent geographical and geotechnical qualities and natural topography especially suited to building sites for high-technology facilities. Presently, the site has a substandard traffic circulation system with varied, narrow, and indirect vehicular and pedestrian access. Parking, pathways, and service access are constrained, overlapping, and inefficient. Existing utilities systems and load centers have ample capacity but are aged, obsolete, and in need of rehabilitation.

The pressing need to replace or rehabilitate many of the existing buildings, roadways, and utilities in the Light Source Research and Engineering Area, coupled with its physical attributes, makes the area a prime candidate for new light- and heavy-laboratory development. In 1983 and 1988 comprehensive site utilization studies were conducted that are integrated with conceptual design reports for line-item projects, providing in-depth solutions for both short- and long-range redevelopment for the Light Source Research and Engineering Area.

Materials and Chemistry Research Area

This functional area encompasses the Materials and Molecular Research Laboratory, the National Center for Electron Microscopy, and the Surface Science and Catalysis Laboratory (SSCL).

Life Sciences Research Area

This functional area encompasses 7 acres in the upper reaches of Strawberry Canyon and includes potential sites for a Human Genome Laboratory, facilities to consolidate research in Cell and Molecular Biology, and a new Waste Handling Facility. Existing buildings include the Biomedical Laboratory and the Laboratory for Cell Biology. Potential sites were carefully considered in a comprehensive Site Utilization Study carried out in 1980, which was used in siting the Human Genome Laboratory.

Shops and Support Facilities Area

This functional area encompasses the Craft Shops, Supply Services, Transportation, the Motor Pool, the Mechanical Shops, the Environmental Health and Safety Department, and the National Tritium Labeling Facility. Development of this functional area began with construction of the LBL Corporation Yard in 1960, and, when the existing complex was essentially completed a few years later, the Corporation Yard was split up and moved to several locations within the LBL site.

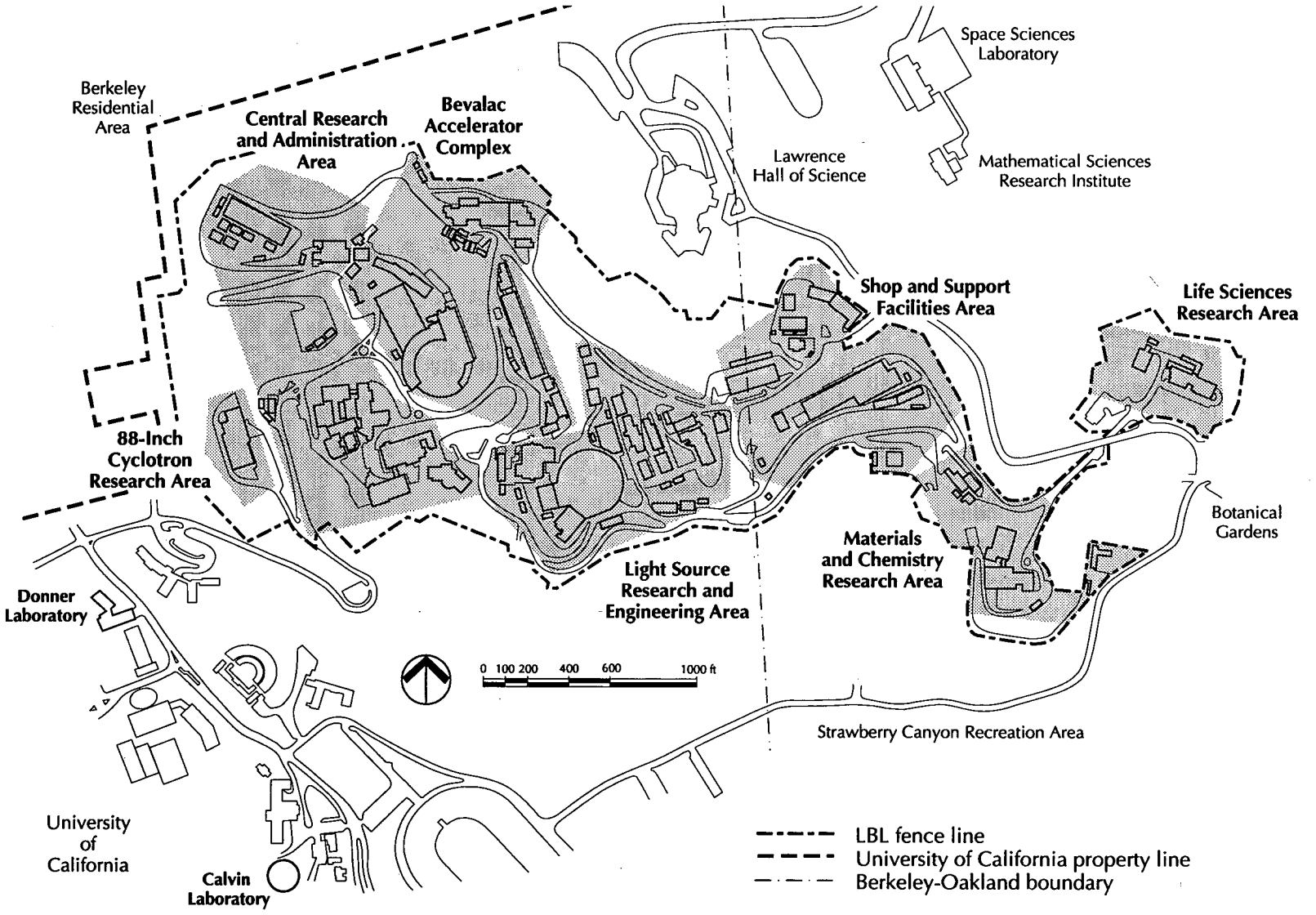


Fig. 2-6. Functional areas with existing buildings.

UTILITIES

Water System

The Laboratory's primary water supply is the East Bay Municipal Utilities District (EBMUD) Shasta Reservoir, which holds about 2.2 million gallons. The Laboratory's high-pressure fire and domestic system is supplied from this reservoir. A secondary source is EBMUD's Berkeley View tank, with a capacity of approximately 3.0 million gallons, connected to LBL by EBMUD piping. Water mains have automatic shutoff valves in case of breaks.

The LBL water-distribution system contains several backup safety distribution loops and is valved to provide control in case of emergency. The system operates entirely by gravity flow, requiring no pumps or energy consumption for operation within the Laboratory (Table 2-6 and Figure 2-7). The Laboratory has two 200,000-gallon fire-protection storage tanks. One is located near Building 75 in the Shops and Support Facilities Area and the other near Building 71 in the Bevalac Accelerator Complex. Diesel-powered pumps will maintain a reliable flow for the fire-protection system during emergencies.

Improvements to the water system are required, and Phase I of a mechanical utilities rehabilitation project addresses the most-critical needs. Chapter 4 provides an analysis of mechanical utilities.

Table 2-6. Site Mechanical Utilities—Water Distribution System.

Functional Area	Existing			Additions Planned
	Length (ft)	Utilization (%)	Life (yr)	
88-Inch Cyclotron Research Area	1260	50	25+	No
Central Research and Administration Area	7405	50	25+	Yes
Bevalac Accelerator Complex	7060	50	25+	No
Light Source Research and Engineering Area	5360	50	25+	Yes
Shops and Support Facilities Area	9430	50	25+	Yes
Material and Chemistry Research Area	2650	50	25+	Yes
Life Sciences Research Area	1460	50	25+	Yes

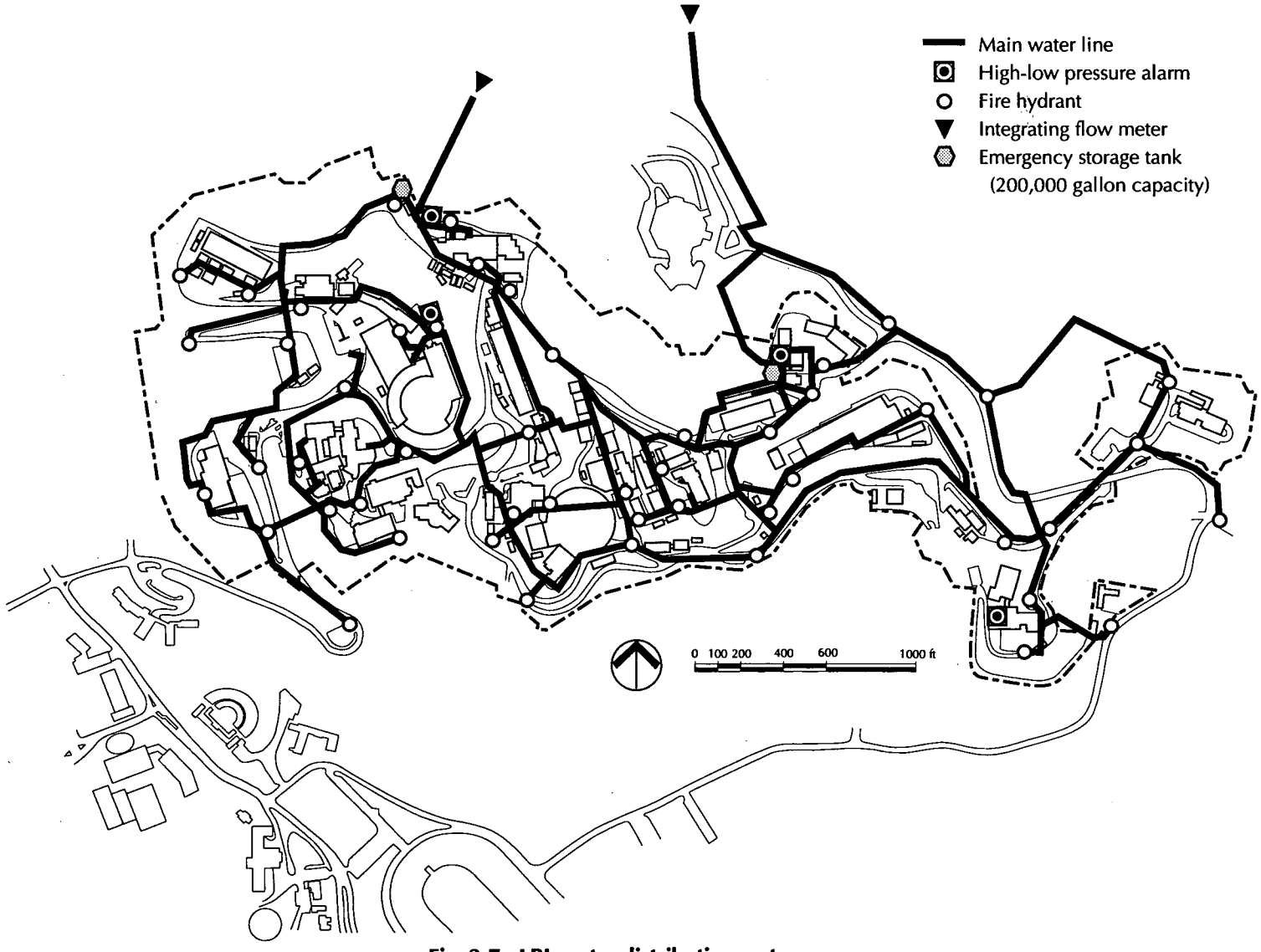


Fig. 2-7. LBL water distribution system.

Sanitary-Sewer System

The west-side LBL sanitary-sewer system connects to the City of Berkeley sewer main in Hearst Avenue. On the south side of the Laboratory, a second connection is also made to the City of Berkeley system. The Laboratory monitors its discharges for the presence of certain chemicals and radioactivity (Table 2-7 and Figure 2-8).

Table 2-7. Site Mechanical Utilities—Sanitary-Sewer System.

Functional Area	Existing			Additions Planned
	Length (ft)	Utilization (%)	Life (yr)	
88-Inch Cyclotron Research Area	880	50	25+	No
Central Research and Administration Area	4580	50	15–25+	Yes
Bevalac Accelerator Complex	3715	50	15–25+	No
Light Source Research and Engineering Area	2990	50	15–25+	Yes
Shops and Support Facilities Area	4330	50	15–25+	No
Material and Chemistry Research Area	1100	50	15–25+	No
Life Sciences Research Area	790	50	15–25+	Yes

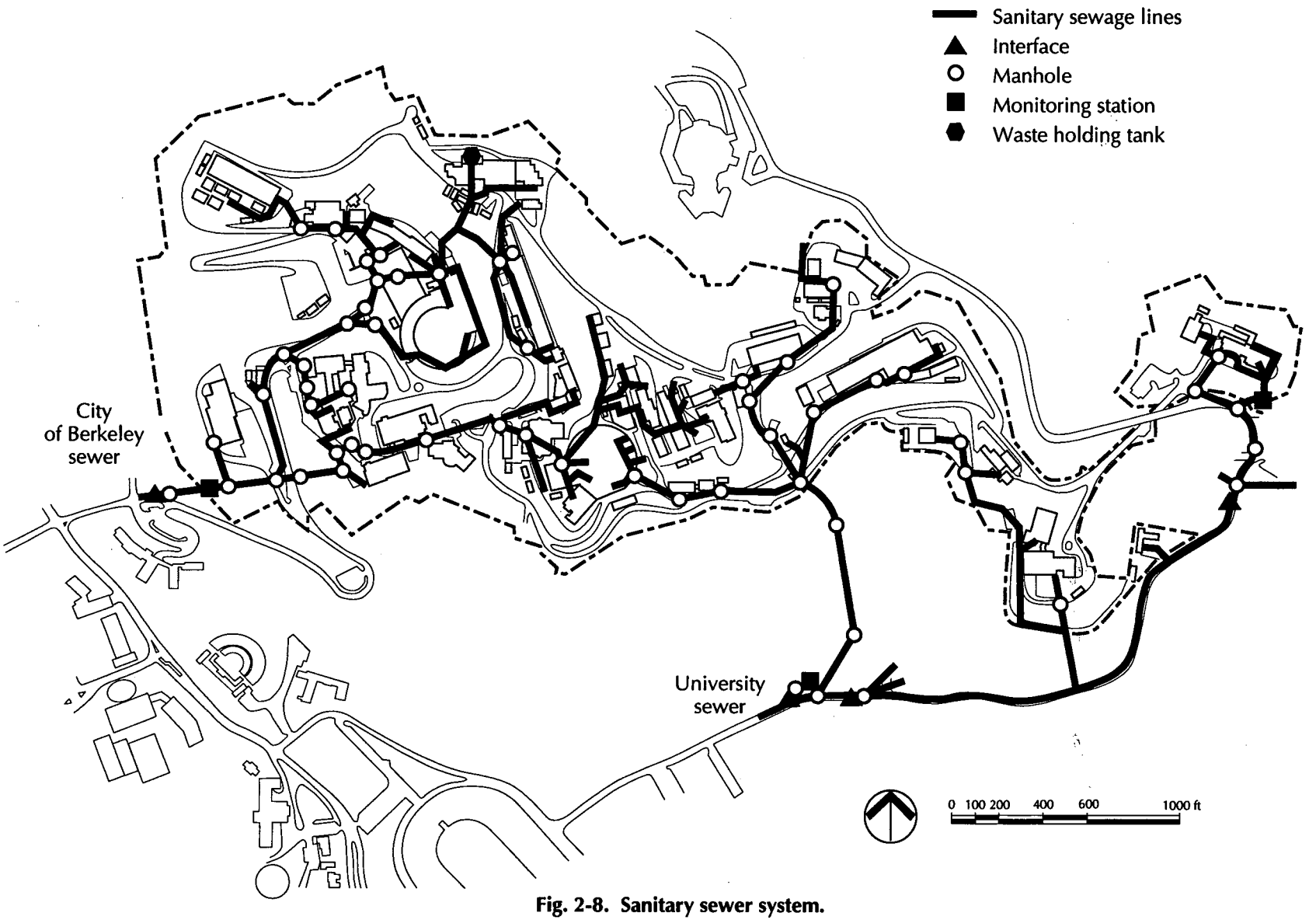


Fig. 2-8. Sanitary sewer system.

Natural-Gas System

Natural-gas service to LBL is supplied by the Pacific Gas and Electric Company (PG&E) (Table 2-8 and Figure 2-9). A 6-in. main in Hearst Avenue feeds the PG&E-owned meter station at the entry to the LBL site. Additionally, a University-owned 2-in. main in Centennial Drive feeds only Buildings 73 and 74, which are supplied on a firm rate. Chapter 3 analyzes the condition of this system, and Chapters 4 and 5 describe plans for systematic replacement of aged and/or deteriorated components.

The Hearst Avenue meter station contains one meter for interruptible gas and one meter for firm gas, which is supplied to several LBL buildings. PG&E main pressure is about 40 psi, which is reduced to 13 psi at the Hearst Avenue meter station.

The 13-psi distribution pressure is further reduced at various regulator stations to serve either a group of buildings or in some cases a single building. Building pressure is in the range of 0.25 to 1.25 psi. Earthquake shutoff valves have been installed at the entrance main and outside major buildings to reduce the possibility of explosions following a quake. The natural gas is principally used for space and water heating; there is no central heating plant at LBL.

LBL also has a backup propane plant to supply gas if the PG&E supply is interrupted. The 30,000-gallon tank will supply the Laboratory for 40 to 60 hours, depending on weather and load reductions, and can be refilled, if necessary, with propane stored at the Lawrence Livermore National Laboratory.

Table 2-8. Site Mechanical Utilities —Natural-Gas Distribution System.

Functional Area	Existing			Additions Planned
	Length (ft)	Utilization (%)	Life (yr)	
88-Inch Cyclotron Research Area	970	50	10+	0
Central Research and Administration Area	4770	50	10–25+	750
Bevalac Accelerator Complex	1940	50	25+	550
Light Source Research and Engineering Area	1740	50	25+	1150
Shops and Support Facilities Area	2925	50	25+	1000
Material and Chemistry Research Area	1320	50	25+	800
Life Sciences Research Area	1655	50	25+	1300

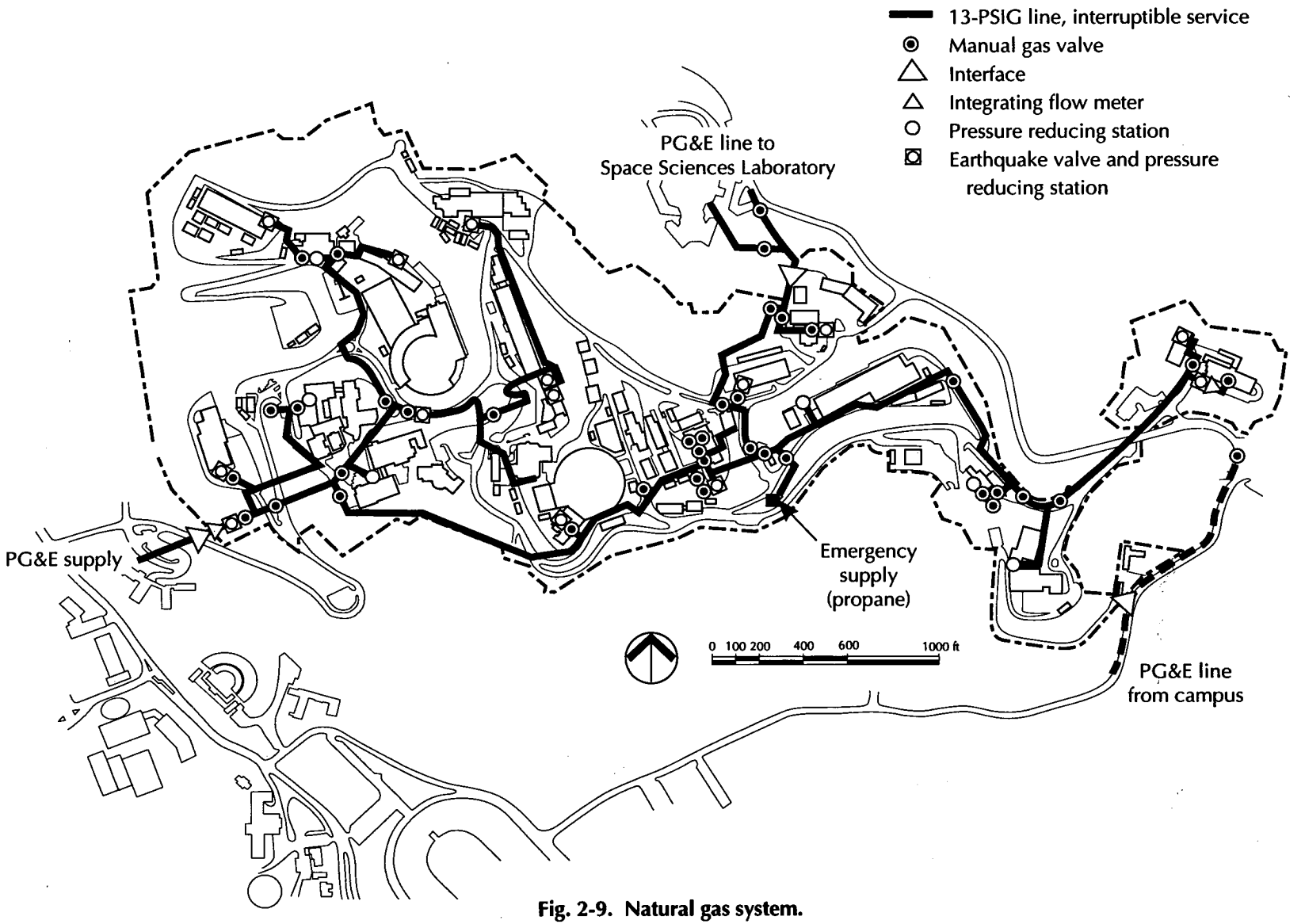


Fig. 2-9. Natural gas system.

Electrical Power System

Electrical power at the Laboratory is distributed underground at 12 kV from the centrally located incoming PG&E Grizzly main substation (Figure 2-10). Smaller substations to supply power at 480/277 V or 208/120 V are located at individual buildings or building clusters.

The PG&E supply system consists of two overhead 115-kV, 3-phase, 60-Hz transmission lines with a joint capacity of approximately 100 MW. Both transmission lines feed power from PG&E's Sobrante switching station to the LBL Grizzly main substation.

The Grizzly main substation consists of two PG&E 120-kV to 12-kV power transformer banks with a combined capacity of 50/66 MW and a 12-kV metal-clad power switching unit owned by LBL. This substation serves only LBL, with the exception of three 12-kV feeders that transmit power to the UCB Campus through an underground cable.

A combined peak load of 50.5 MW was reached in March 1978, with the UCB Campus drawing as much as 24 MW. Due to better load management of the LBL accelerators, the demand on the Grizzly main substation is not expected to peak above 50 MVA in the near future. Projected load growth at the UCB Campus, however, will require an increase in transformer capacity at the Grizzly main substation within the next decade.

Besides the PG&E supply at the Grizzly main substation, there is an emergency line from PG&E's Berkeley Station F to the campus and then underground to LBL's "Big C" switching station. The 5 MW available is shared with the Campus. Most of the LBL electrical system is near the end of its expected life (Table 2-9), and in the Light Source Research and Engineering Area it is over 40 years old and requires increasing maintenance.

The LBL main switchgear at the Grizzly main substation consists of a combination of metal-clad switchgear (feeder breakers) and interrupter switches (incoming and tie breakers). This combination degrades the quality of the metal-clad switchgear and renders the entire switchgear inflexible. Currently the system requires that PG&E must perform switching operations in their system to permit LBL to close the bus tie switch.

The 12-kV distribution circuits are arranged in radial and loop-feed configuration using oil and air switches. Several switches in the system do not have the short-circuit rating required for safe operation. Special switching operations are currently necessary to avoid operation of these switches under load.

Long- and short-term improvements to both mechanical and electrical utilities are identified in Chapters 4 and 5, respectively.

Table 2–9. Site Electrical Utilities.

Functional Area	Condition	Utilization	Remaining Life
88-Inch Cyclotron Research Area	Poor	Adequate	None
Central Research and Administration Area	Poor	Adequate	None
Bevalac Accelerator Complex	Poor	Adequate	None
Light Source Research and Engineering Area	Poor – Excel[a]	Adequate	20 years[a]
Shops and Support Facilities Area	Poor	Adequate	None
Materials and Chemistry Research Area	Poor	Adequate	None
Life Sciences Research Area	Poor	Adequate	None

[a] ALS 12-kV Power System. The remainder of this area's 12-kV power system has exceeded its useful life and is in poor condition.

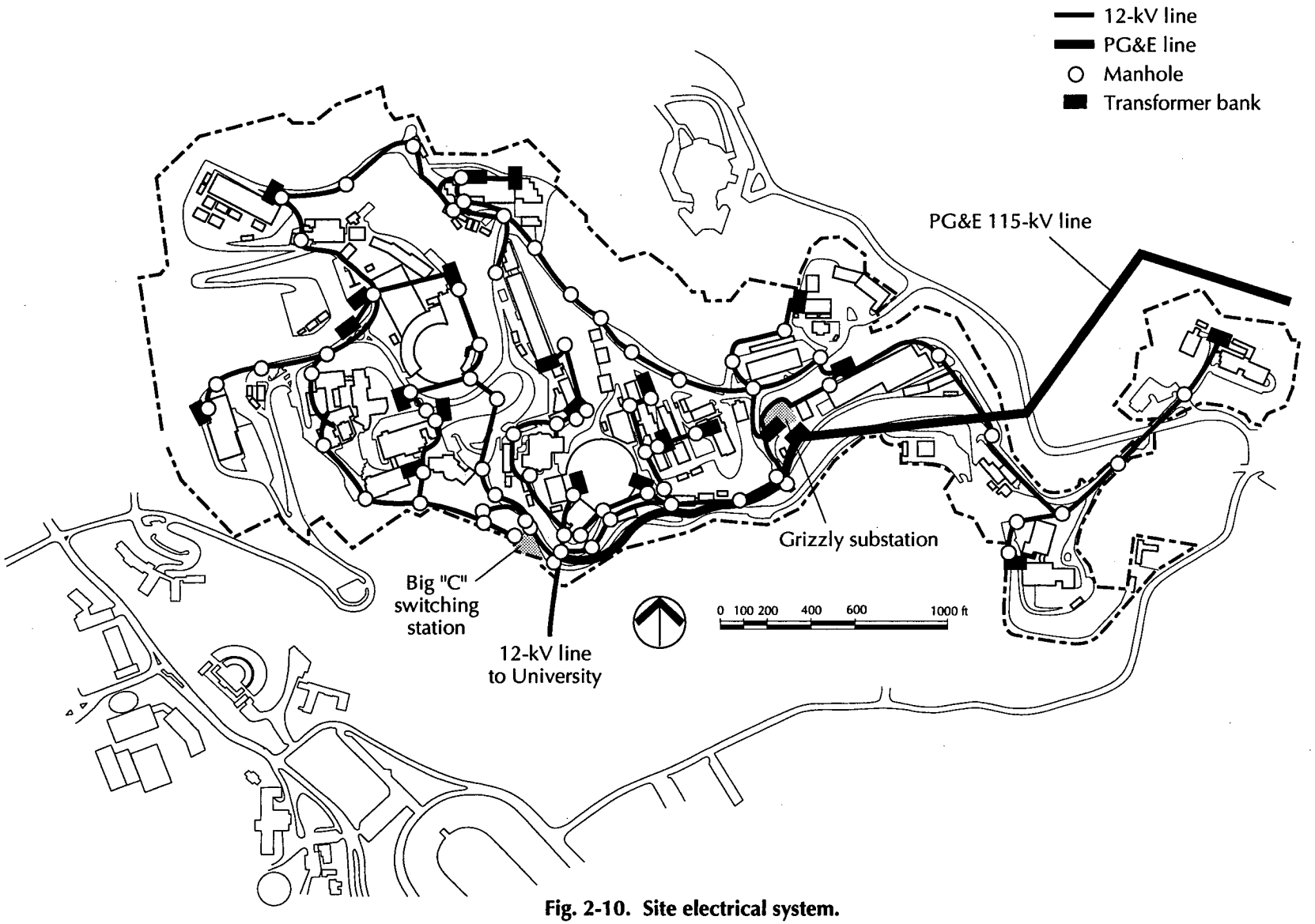


Fig. 2-10. Site electrical system.

COMMUNICATIONS

Telephone System

The Laboratory owns and operates an Integrated Communications System (ICS) that provides both telephone and switched data services. The ICS includes an extensive system of underground ducts (Figure 2-11), manholes, copper and fiber-optic cables, building entries, distribution closets, and wiring. The underground duct system was significantly expanded as part of the ICS installation project, which also included installation of an entirely new cable and wire plant. LBL underground ducts also contain the now-unused Pacific Bell cables, which can be removed, as necessary, to free space in the ducts. The ICS is based on an InteCom IBX S/80 digital switch that provides switched voice and data services and trunks to external networks, including Pacific Bell (the local telephone company), AT&T, and the Federal Telecommunications System (FTS). The ICS, installed in 1989, is currently maintained under a contract with Contel Business Networks.

Computer Network

LBLnet is a Laboratorywide computer network comprising underground fiber-optic cables, coaxial and wire systems in buildings, and active components. LBLnet is connected through gateways to external networks, including MILnet, BARRNet, ESNET, and the UCB Campus network. LBLnet currently supports more than 700 attached computers, workstations, and printers using various networking protocol suites, including the Internet, DECnet, and Xerox Network Services protocols.

Radio, Television, and Wide-Band Communications

The Laboratory has radio and wide-band communications systems operating on eight VHF channels and on two microwave channels. There are over 500 fixed and portable radio units operating to serve off-site and on-site transportation, a repeater link to LLNL, LBL Protective Services, the Fire Department, Crafts and Maintenance forces, individual radio paging, and the Director's Office and Building Managers Emergency Command Center. The two microwave channels operate at 7 GHz to provide computer-data and video-conferencing links to SLAC. A video-conferencing system using black-and-white television and remote monitors has been set up in several buildings. A television surveillance system is also used in computer rooms and high-radiation areas and for other security needs.

Public-Address System

A Laboratory-owned public-address system links the entire LBL area, providing paging for Laboratorywide announcements related primarily to health, safety, and emergency situations. This system is expanded to each newly constructed building and facility through rigid conduits in underground raceways installed at the time of construction.

SECURITY SYSTEMS

Fire-Alarm System

The LBL fire-alarm system completed in 1985 uses solid-state programmable equipment and two main looped trunk lines with redundant paths. The looped trunk lines feed alarm information to the central supervising station in the Fire Station. Redundant drops from the main trunk loops serve each building. Both Loop #1 and Loop #2 serve the entire Laboratory area. The LBL-occupied buildings on the UCB Campus are served by an isolated trunk from the Fire Station and by the UCB Campus fire-alarm system. The Fire Station console consists of a prioritized CRT alarm display, a backup annunciator system, and a computer-aided dispatch system.

All major buildings and most minor buildings have local alarm (bell) evacuation systems. High-value areas have special protection systems with ionization-type smoke detectors as the primary detection means. Improvement of bell systems and smoke detection in several buildings is planned.

Plant-Protection Card-Key System

A magnetic card-key system monitors entry into Laboratory buildings and limits access to rooms or areas for reasons of security or health/safety. The card-key system is operated by LBL Protective Services using a dedicated computer that identifies the user and then records and controls access.

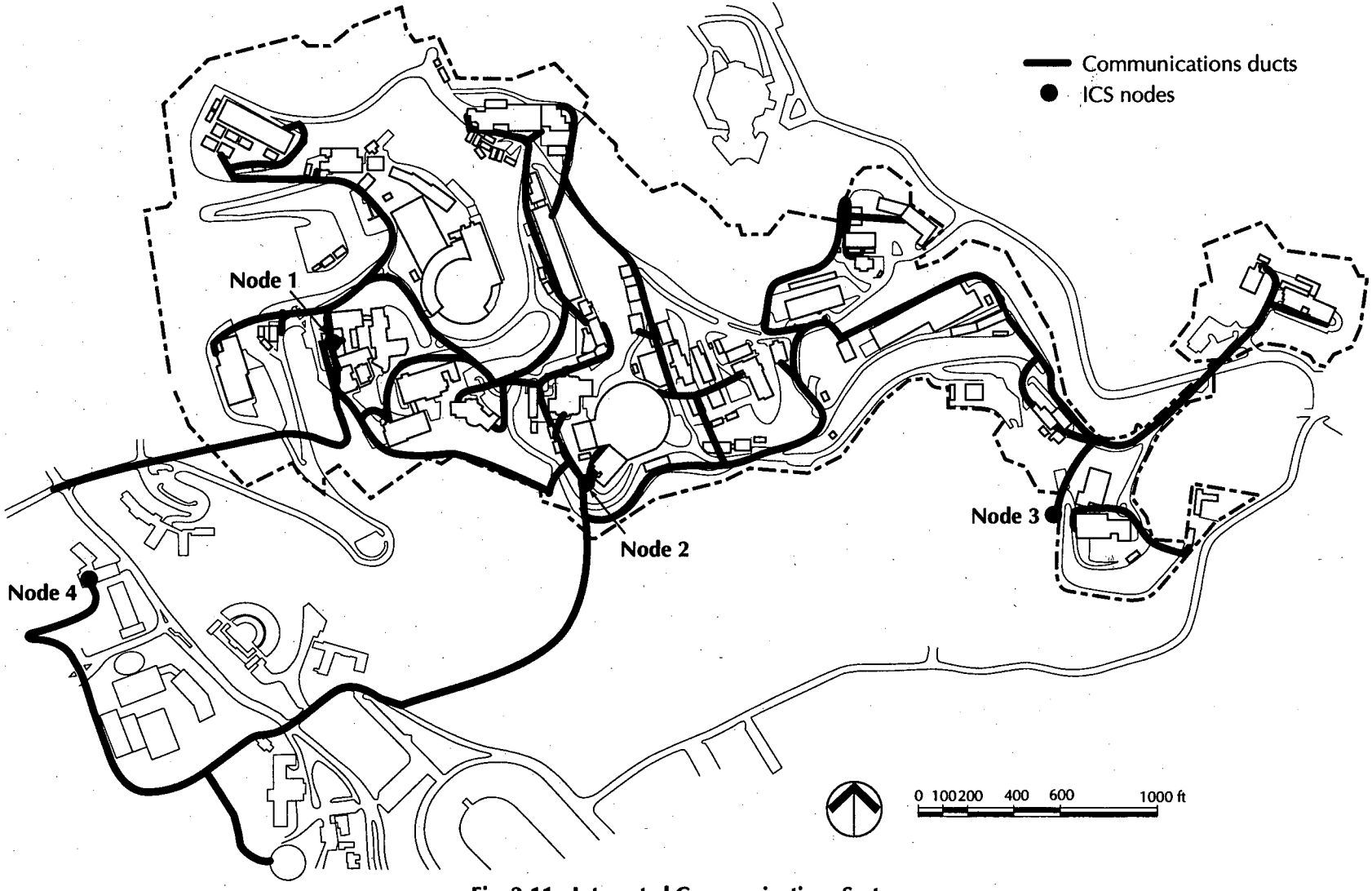


Fig. 2-11. Integrated Communications System.

ENVIRONMENT, SAFETY, AND HEALTH

Environmental Evaluation

Environmental monitoring (air, water, and land) is conducted by LBL's Occupational Health Division personnel. Monitoring stations for each component are represented in Figure 2-12. Off-site sampling is conducted to provide information regarding public safety. For a listing of regulatory agencies that govern environmental compliance see Chapter 1, Regulations and Planning Requirements.

Air

Potential air pollution consists of chemicals and radionuclides released from stacks at laboratories. Each building is actively monitored for compliance with applicable air-quality standards, and present release levels meet these safety standards. Experiments that could generate noxious fumes or vapors are confined to fume hoods. Airborne wastes are minimal due to the small amounts of chemicals involved in the research.

Processes with a potential for pollution are reviewed during conceptual stages to identify those that require "Permits to Construct" from the Bay Area Air Quality Management District.

Water

In chemical laboratories, small amounts of water-soluble chemical wastes are allowed to be discharged to sanitary-sewer drains, following guidelines published in the *LBL Health and Safety Manual*, PUB-3000. Wastes from plating or metal cleaning shops are collected and pretreated before discharge to sanitary drains. In accordance with LBL policy, non-water-soluble chemical wastes will be collected at their points of generation, segregated into compatible groups, placed in approved shipping containers, and transported to a DOE site for burial or recycling.

Chemical wastes are not discharged to storm drains or streams. Other potential water pollution sources are from contaminated soils, which are discussed in the following section. As noted below, LBL is planning a labwide characterization study of water and soil contamination.

Land

Sources of potential soil pollution are accidental spills from routine operations, transportation of materials, or leaking underground tanks. Solvents, fuels, and other hazardous liquids are controlled through Environmental Health and Safety Department (EH&S) procedures and training. Improvements include construction of new storage containers, the installation of overflow/leak containment, and the use of impervious materials.

Collection and processing of hazardous wastes are performed in a specially designed Hazardous Waste Facility that includes the proper equipment and configuration as defined by regulating authorities. Hazardous waste is consolidated and packaged to meet U.S. Department of Transportation regulations and then trucked to approved DOE disposal sites. Nonhazardous wastes are regularly collected at LBL by a refuse disposal company and are trucked to a sanitary landfill in Richmond, California.

Operational Safety

No significant radiation levels are expected in accelerator experimental areas. Accidental exposure to personnel is limited primarily by passive systems (shielding) and by active engineering and administrative controls, such as electrical interlock systems to prevent access to radiation areas, audible and visible warnings, and surveillance of experimental operations. Radiation levels at the fence line are not expected to increase as a result of LBL operations.

Continuing reviews during the conceptual and design stages and preparation of an Operational Safety Procedure (OSP) are mandatory for all potentially hazardous experiments. The OSPs are reviewed by the LBL EH&S Department and the appropriate subcommittee(s) of the LBL Safety Review Committee. As a standard procedure of the LBL safety program, all areas are regularly inspected for compliance with Federal Occupational Safety and Health Administration (OSHA) and LBL standards. Routine design review of equipment and laboratory facilities and review of experimental procedures are

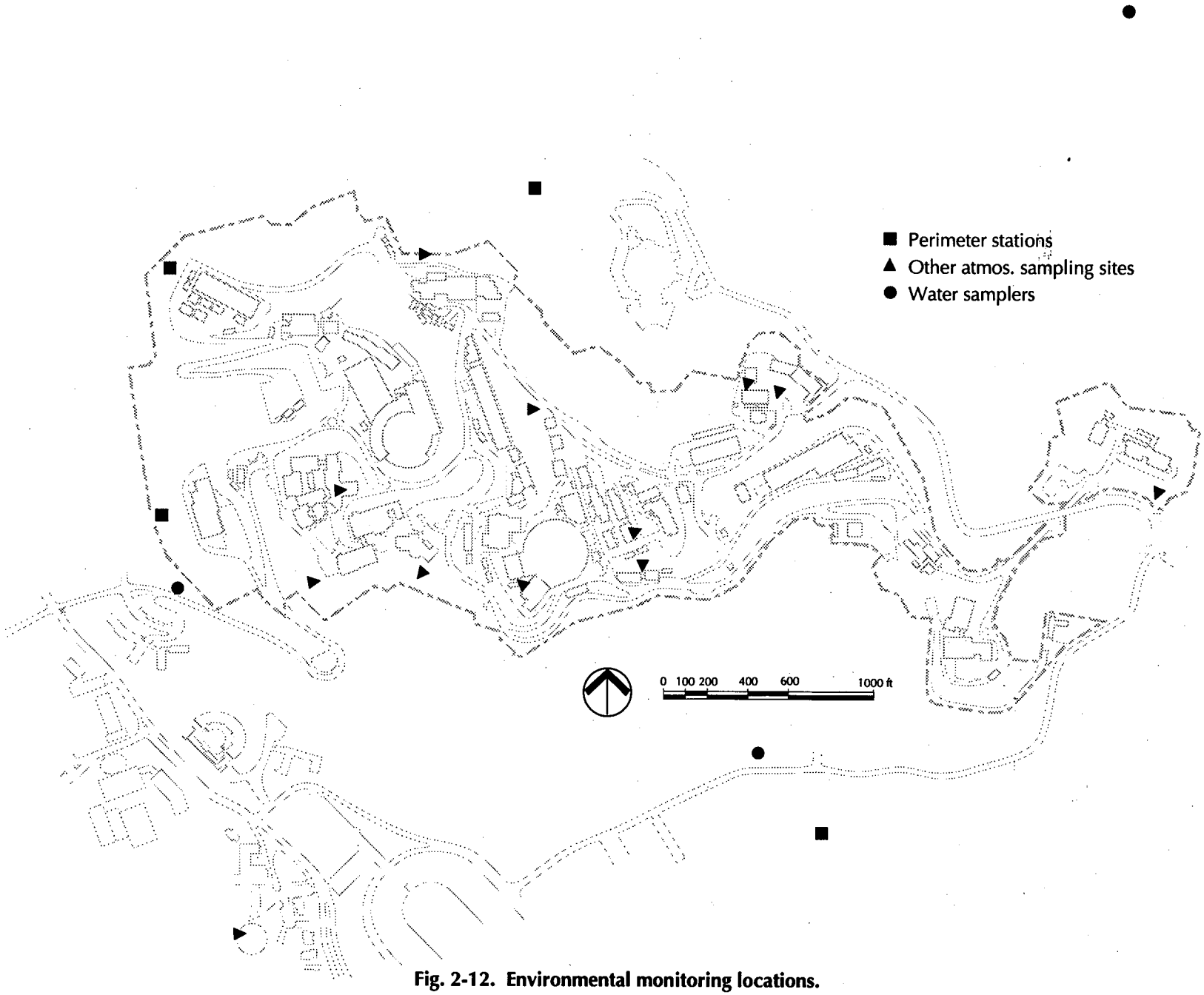


Fig. 2-12. Environmental monitoring locations.

expected to reduce all hazards to a "low-hazard" classification.

The DOE Environmental Survey Team visited the Laboratory during 1988. The following were identified as key areas of focus for potential corrective actions at LBL.

- Assessment and cleanup, if necessary, of any soil and water contamination
- Completion of Environmental Compliance Projects
- Continued minimization of employee exposure to occupational health risks

The Laboratory is working with DOE Headquarters and SAN staff to make assessments and take remedial actions as required. The appropriate regulatory agencies have also been informed. A final Action Plan addressing the DOE Environmental Survey Team findings was sent to DOE Headquarters in October 1988.

IMPROVEMENT PROGRAMS AND ASSESSMENTS

The Laboratory has implemented a long-range plan to improve the condition of the physical plant and operations with respect to maintenance, repair, safety, and the environment. Highlights of these improvements are described below. The 15-Year Plan goals for the Laboratory are presented in Chapter 4; specific implementation over the five-year planning period is described in Chapter 5.

Seismic Safety

All physical plant facilities have been reviewed for seismic safety (Appendix A). Since 1971 over 34 buildings with significant seismic deficiencies have been strengthened to meet the new standards. Other improvements in earthquake-resistant facilities and emergency preparedness include the following:

- Two on-site water-storage and emergency-pumping stations have been constructed to provide water for fire protection if public supplies are lost.
- Three emergency command centers have been established and hardened for earthquake safety.
- Emergency generators, communication systems, medical facilities, the firehouse, and other life-line systems have been obtained, or strengthened, for use following an earthquake.
- Earthquake shutoff valves have been installed on all natural-gas mains.
- An emergency telephone system has been installed.

Slope Stability

Fifteen areas of instability have been stabilized on a priority basis. A sophisticated groundwater-monitoring and soil-drainage system was installed, including many vertical wells and horizontal hydraugers that have been effective during extremely wet winters. In response to a 1974 analysis of potential slope instability during a major earthquake, critical underground water, natural-gas, and electrical lines have been relocated. Slope stability has been improved along the realigned portion of the Upper Hill Road as a result of the Roadway Safety Improvements Project (see below). A new Slope and Seismic Stability project is required to correct problems in the Building 51/71 area.

Underground Utilities Improvements

All underground water and sewer systems have been inspected photographically to determine preventive maintenance and replacement tasks for short- and long-term funding. A recently completed construction program replaced a major portion of the underground utilities (potable-water, low-conductivity-water, compressed-air, and sanitary-sewer systems), as well as above-ground cooling towers, in the Light Source Research and Engineering Area. Rehabilitation of all older 12-kV cables is planned as MEL-FS funds become available.

Roadway Safety Improvements

The Laboratory's road system was established when design and safety standards were less stringent and there were few pedestrians. Current conditions require improve-

ments such as vertical and horizontal realignment of roads, widening of traffic lanes, replacement of base and paving materials, and separation of vehicle and pedestrian traffic. A roadway-safety improvement project was completed in 1986 in the Light Source Research and Engineering Area that provided a safer passageway for both vehicles and pedestrians. Three phases of Road Rehabilitation Projects are proposed to improve or replace the remaining Laboratory roadways systematically.

Energy Management Improvements

LBL energy use has been reduced over the last several years by improvements both in operations and in building design. The installation of natural-gas and electrical metering throughout the site is completed, as is the first phase of an Energy Monitoring and Control System (EMCS) that includes 82 electric meters and 18 gas meters. Meters are regularly read, and a data base has been established. This data base is used in the In-House Energy Management Program to identify conservation opportunities and to monitor performance. The first load center became operational in FY 1985, and actual energy savings for the targeted cooling-tower fans exceeded the original estimates. Based on the success of this phase, additional funding has been received for EMCS II, which will result in an additional energy savings of 4,040 million Btu.

The energy management program at LBL has recently focused on process-energy efficiency. For example, in the 1982–85 period, new radio-frequency amplifiers were installed on the SuperHILAC linear accelerator tanks, resulting in more than $300,000 annual energy savings. LBL has reduced lighting-energy use through a delamping and relamping program initiated in the late 1970s. Old ballasts are replaced with energy-efficient units on an ongoing basis.

Load management continues to be an important aspect of the LBL energy-management program. The Laboratory uses both firm and interruptible power, which has allowed LBL to purchase less-expensive power directly from the Western Area Power Administration (WAPA). Use of computer-process control and tight manual scheduling involve coordination of the various loads, resulting in reduced demand and charges.

LBL works in conjunction with the DOE/SAN Office to negotiate utility contracts. Goals for utility acquisition are shown below.

Electrical-Power Acquisition Goals:

- Monitor continuously evolving utility rate structures to seek the best power mix for LBL programs.
- Monitor the posture of WAPA for the post-1994 marketing plan and work in concert with DOE/SAN and special consultants for increased allocation from the new marketing plan.

- Seek other unused or set-aside portions of WAPA power, as LBL has successfully done in the past.
- When the initial three-year contract for PG&E interruptible power expires in January 1990 seek other arrangements to lessen electrical-power costs.

Natural-Gas Acquisition Goals:

- Monitor natural-gas purchasing options to ensure lowest rates. Consider direct purchase if and when cost effective.
- Expand distribution of LPG backup to allow greater use of interruptible sources (at lower rates).

Approximately one-half of LBL electric power is purchased through interruptible/curtailable sources at a savings of over $1.2 million per year. Interruptible power is purchased from the local utility, PG&E, and curtailable power from WAPA. Current contractual arrangements make it possible to set aside the WAPA power during the summer when curtailability is high so that medical treatment and other high-priority programs on the accelerators can function with a much-reduced risk of power shutdown.

In 1987, PG&E adopted a new rate structure that allowed for increased discounts for large industrial customers who receive interruptible power at transmission voltage and who were already under contract when the new rate structure was adopted. This exceptionally low rate from PG&E allowed the switch away from WAPA power during the summer months with a minimal cost impact to the programs. Judicious scheduling of accelerator program use with the cooperation of the investigators allows for substantial running time at reduced-cost off-peak hours at night and on weekends.

At the beginning of FY 1986, approximately 70% of LBL's natural gas was purchased at the standard commercial rate. In July 1987, a six-month contract was negotiated with a special rate based on our alternate-fuel (LPG) cost. This contract reduced our gas cost approximately 16% and saved the Laboratory approximately $60,000. The contract was renewed (several times) in FY 1987 and resulted in over $100,000 additional savings.

In FY 1988 LBL/DOE entered into a new natural-gas contract with PG&E. This contract saved the Laboratory over $15,000 compared to the FY 1987 rates. The Laboratory and DOE/SAN are continuing to monitor natural-gas purchasing options to ensure that the lowest overall rates are obtained.

Fire-Protection Improvements

Sprinkler systems have been installed in almost all buildings. Specialized equipment, such as computers, fume hoods, and experimental apparatus, is provided with appropriate specific fire-suppression systems. A new remote-detection and alarm system monitors Laboratorywide facilities.

Barrier Reduction for Handicapped Persons

Improved access to the LBL auditorium, medical clinic, cafeteria, central research laboratories, Director's Offices, and main administrative offices and suitable toilet facilities have been provided for handicapped persons.

Environmental Improvements

Landscaping. Improvements in esthetics and access have been made to the main entrance road and adjacent parking areas, the shuttle-bus terminal, and all the main intersections along Cyclotron Road and the Upper Hill Road. Bus shelters have been installed, and landscaped walkways, including improved lighting, have been provided from the main parking areas to main buildings. The site perimeter fence along Cyclotron Road has been moved to a less-obtrusive location below the road. Landscape plans are required for all new construction, and guidelines require low-maintenance, fire-resistant vegetation. A landscape architect firm has been retained to develop a comprehensive landscape plan for use in future development and redevelopment of the site.

Signs. Some standardized signs that are compatible with the natural setting and are easy to modify and maintain have been installed. However, many nonstandard and sometimes confusing signs need to be re-

placed. One element of the comprehensive landscape plan is a study of existing signs, a recommendation for future standards, and a schedule for implementation.

Painting and Roofing. A coordinated color scheme has been selected for the Laboratory's buildings, including roofing materials and landscaping, that blends with the natural tones of the hillside. All LBL buildings have been repainted to conform to this scheme.

Maintenance. The goal of LBL's maintenance program is to provide a safe and reliable physical plant for LBL's research programs. Past budget constraints have resulted in curtailed maintenance, repairs, and replacements. Some progress in reducing backlogs has been achieved through MEL-FS funding, but increases in GPP and GPE are needed to ensure a reliable infrastructure.

LBL has carried out a formalized maintenance-management program for over 30 years, and it has included a computerized scheduled-maintenance system for more than 25 years. Budget requests are based upon inspections by LBL's Construction and Maintenance Department and consulting firms in specialized areas, such as cranes, elevators, boilers and pressure vessels, fire protection, slope stability, storm drainage, seismic safety, underground utilities photography, and energy-use, with review by LBL's Plant Engineering Department. An upgrade of the Plant Inspection and Maintenance System was begun in 1988 to improve facilities evaluations and to develop a plan for short- and long-range corrective actions.

The formulation of the maintenance budget is an iterative process that takes into account plans for noncapital alterations, general plant projects, multiprogram general-purpose line items, and regular line-item construction. This process includes consideration of other operating-budget priorities, and culminates in a formal work plan for the fiscal year approved by the Associate Laboratory Director for Administration. Since maintenance and repair requirements also occur continuously throughout the fiscal year, allowances are made for meeting these requirements expeditiously.

Longer-range plans at LBL are developed for items of major maintenance, such as reroofing, paving, slope stabilization, major equipment overhaul, building rehabilitation, building exterior painting, and utilities replacements. A five-year projection is made with specific projects itemized over the first three years and lumped for the last two (see Chapter 5).

Plant operations and surveillance are carried out by the Maintenance Shops 24 hours a day, 7 days a week, under an area maintenance concept. Some maintenance projects, such as paving, reroofing, chiller overhauls, and exterior painting and certain specialized services, such as pest control, window washing, and refuse disposal, are subcontracted when cost savings and/or improved efficiencies result. Responsibility for engineering design of maintenance projects lies with the appropriate Plant Engineering Section Leader.

Site Deficiencies Summary

The older original area of the LBL site was developed in the 1940s, making it one of the oldest laboratory complexes in the DOE system. With few exceptions, most of these older facilities are substandard or obsolete. Vehicle and pedestrian circulation routes are generally narrow, indirect, and substandard. Electrical and mechanical utility systems and load centers in the area have ample capacity but are aged, inflexible, and unreliable. Despite regular maintenance over the years, portions of these systems—water, electrical, gas, sewers, and compressed air—have exceeded their useful lives. Rehabilitation, modernization, or replacement is now necessary. Communication systems have been upgraded by the ICS Project and will only require extension to new facilities.

Present demands, in terms of energy conservation (reducing costs) and flexibility and reliability (responding to disruptions), greatly exceed the original design capabilities of the LBL electrical distribution system, and timely rehabilitation and modernization are imperative to serve current and projected research programs safely and efficiently. Shortages of both laboratory and office space at LBL have remained acute over the last 10 years, impeding the effective and efficient conduct of scientific research and adding significant operational costs.

3.

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PLANNING ANALYSIS

STRATEGIC/ INSTITUTIONAL PLAN

Strategic View

The Strategic View identifies external conditions and future national research directions relevant to Laboratory programs. The planning assumptions and trends described below are in agreement with the Laboratory's current Institutional Plan.

Facilities-Management Implications. Maintaining the Laboratory's scientific leadership over the long term will require creative management and a sustained effort to revitalize the physical plant. The Laboratory's management seeks to provide effective and efficient plans for the next few decades, which promise to be highly productive for research scientists and engineers. The institutional- and site-planning processes will continue to be management focal points for developing the Laboratory's supporting infrastructure and achieving its research goals.

Internal flexibility and coordination with national programs are essential for responding to opportunities and directing resources to the most scientifically promising areas. This flexibility extends to operational resources, facilities, and management arrangements, e.g., revitalization of engineering and support facilities. A critical Laboratory role is to inform the DOE of significant research opportunities, and LBL management will continue to strengthen the dialogue on infrastructure needs.

The Laboratory will continue to place priority on new or improved facilities because these sustain national programs and provide an effective working environment. These facilities maintain vitality in the Laboratory, but, more importantly, they will also create new opportunities for collaboration with the university community and with industry.

Constrained budgets will continue to hinder LBL's ability to manage its site. Every effort is made to assist the DOE in justifications and analysis that support continued and increased spending for site and facilities improvements. Planning is based on estimates of future funding through close cooperation with DOE SAN and Headquarters personnel.

LBL has established focal points for graduate training and related educational support and for industry collaboration. These focal points include the National Center for Electron Microscopy and the Bevalac and other organizational units, such as the Center for Advanced Materials, the Center for Building Science, the Center for X-Ray Optics, the Human Genome Center, and the Center for Thin Film Superconductivity. In the future, stronger levels of industry involvement are expected, and LBL and the other national laboratories will continue to establish additional collaborative centers, industry fellowships, and industry-laboratory research contracts. The longer-term trend will be a reduction of barriers to cooperation between industry and government.

The increased number of visiting researchers will require construction of additional user facilities including parking structures, food-service facilities, conference rooms, and work areas. The DOE-SAN should continue to work with the Laboratory and with other government agencies to provide innovative funding mechanisms to meet these needs.

Basic research will continue to be supported strongly at the national level. Since LBL primarily serves the DOE's basic-research programs, this strong support provides a constructive environment for LBL initiatives that have a new and fundamental research focus. The national laboratories will retain their capability to contribute to the energy mission of the DOE through their basic-research capability and their proposals to develop and build new facilities that serve university and industrial research communities. At LBL, future programs will emphasize the continued exploration of fundamental scientific and engineering questions that underlie, or lead to, new energy technologies.

The institutional planning process required of the national laboratories is one of the few formal and outwardly directed program-planning activities that takes place in DOE. At LBL the SDP will be coupled with the Institutional Plan and will continue to be a vital and primary mechanism to articulate internal goals and their relation to national scientific plans.

Future Programmatic Research Areas

The following sections identify important conditions affecting LBL's Energy Sciences, General Sciences, and Life Sciences programs. As indicated above, these programs will be limited by fiscal constraints associated with Federal budget-deficit-reduction efforts, and the overall levels of Laboratory activity and staffing are not expected to grow significantly. The long-term strengths of DOE programs for research and advanced technology will include closer collaboration with industry and an enlarged role in educational support.

Energy Sciences. Research activities in LBL's Energy Sciences programs have been influenced by national technology research needs; patterns of energy use and supply; and related economic, environmental, health, and scientific policies. The Laboratory's position on national energy supply and use is based on the following assumptions.

- Developing new efficient systems for energy production, use, and transmission will be increasingly important to national research programs. This research will include, for example, new high-temperature superconducting materials, alternate means of generating electricity, and new methods of finding and producing fuels. The DOE will be called upon to enhance national security by reducing dependence on foreign sources of energy.
- Scientific and engineering research efforts will lead to enhanced industrial competitiveness, improve the economics of energy supply and use, and provide a basis for environmental acceptability of energy technologies. Both the Basic Energy Sciences and the Conservation Programs will enhance these economic advantages and contribute to economic growth.

The scientific outlook for the Energy Sciences is affected by developments in many scientific fields, but especially in chemistry, geology, materials science, and physics. The Laboratory views the following future research trends as important.

- Materials science research growth areas will include investigating electronic, structural, and other properties of thin films and bulk materials, surfaces, interfaces, and grain boundaries; developing the science of wear, fracture, and failure; and extending the understanding of novel processing and production techniques, such as enzymatic synthesis. Key materials of interest include high-temperature superconductors, semiconductors, composites, ceramics, light alloys, polymers, and optical materials. The Laboratory's Center for Advanced Materials, National Center for Electron Microscopy, Advanced Light Source, and Center for X-Ray Optics will be important elements of a national program directed toward improved materials development.
- Chemistry of inorganic and complex organic molecules will also require advanced techniques using intense photon beams, nuclear magnetic resonance (NMR) spectroscopy, and laser spectroscopy for reactivity studies of molecular dynamics and reaction pathways, photocatalysis, and electrocatalysis and for studies of the structure and function of macromolecules, including artificial enzyme catalysis and materials synthesis.
- Earth sciences research will include geophysical investigations of the continental crust and physical and chemical studies of geological materials, including petroleum and geothermal reservoirs. Underlying themes in these studies will be the structure, composition, and evolution of the continental lithosphere and the dynamics of tectonic processes and processes involving the transport and transformation of chemicals in complex geological structures.
- Energy-use research will emphasize laboratory-scale investigations of innovative concepts in such areas as advanced

high-efficiency combustion, energy storage, electric lighting, energy-intensive chemical processes, and energy flows through walls and windows. Multidisciplinary research on energy use at the national and international level will also include studies of trends in demand and supply and analysis of the efficiency of buildings and appurtenances. A new laboratory and office complex, the Conservation and Renewable Energy Laboratory, would greatly improve the Laboratory's ability to meet these research goals.

- Global environmental effects of energy use will continue to become more critical both politically and economically. Increased reliance on coal and other fossil fuels and on nuclear power worldwide will intensify problems with emissions and waste disposal and will require renewed research investments, especially in efforts to predict and control fossil-fuel-based air emissions and nuclear wastes and to understand their potential environmental consequences. Consequently, the Office of Carbon Dioxide Research, OHER, the Office of Civilian Waste Management, and the Office of Environment, Safety and Health will have increasingly important research missions.

General Sciences. Research in the General Sciences programs is fundamental to the understanding of matter and provides a scientific and educational base for many other fields. LBL's General Sciences programs are developed in conjunction with the high-energy and nuclear physics communities and with federal programs in fusion research. LBL's national scientific outlook in the general sciences includes the following developments.

- Nuclear physics research will emphasize techniques that probe or alter the state of nuclei to explore nucleonic, hadronic, and quark-gluon matter. Among nationwide priorities for new facilities are a continuous-electron-beam accelerator to probe nucleonic structure (now under construction in Newport News, Virginia) and heavy-ion accelerators to study nuclear matter and the quark-gluon plasma. The Bevalac can provide heavy-ion beams of all the elements from hydrogen to uranium in a nationally unique and critical energy range to explore the behavior and phase transformations of nuclear matter.

- High-energy physics research at the Tevatron and Stanford Linear Collider (SLC) and the upgraded Positron Electron Project (PEP) will provide promising scientific opportunities into the next decade. Further progress will become possible through the construction of the Superconducting Super Collider (SSC); the development of detector technology for such a facility will be an important challenge.

- Research in information and computing sciences will continue to be needed to access, transfer, store, and retrieve research results (with unprecedented data rates and complexity) in distributed computing facilities. These studies will involve the introduction of new control and data-acquisition systems and powerful workstations to provide scientists with flexibility in the access, manipulation, and visualization of complex data.

- National fusion research will continue to emphasize the scientific characterization and performance of a fusion system. LBL will continue its leading research in heavy-ion accelerators for fusion—a technology that would employ accelerated beams of ions to ignite fusion fuel pellets and that continues to show promise as an energy source in the next century. The development of neutral beams for supplemental plasma heating will continue in support of the magnetic-fusion program. Negative-ion-based neutral beams are an option for driving toroidal currents in the next-generation steady-state tokamak—the International Thermonuclear Experimental Reactor.

Life Sciences. The future of life-sciences research holds promise for the understanding and prevention of both hereditary and environmentally caused disease, as well as for establishing health and environmental protection standards.

- Physical mapping and eventual sequencing of the human genome will be emphasized, including determination of human

genome structure and expression, clonal library preparation, robotics, novel instrumentation, development of advanced computation and pattern-recognition techniques, and medical genetics.

- Basic research in the molecular and cellular aspects of the control of gene expression, differentiation, DNA repair and carcinogenesis, hemopoiesis, and genomic stability in human as well as animal modes systems will provide tools for an understanding of environmentally related disorders and for application of advances made in mapping and sequencing the human genome.
- Structural biology research will be directed toward determining the relationship between the structure of biological macromolecules and their functions. The application of synchrotron radiation and advanced computational techniques will allow the determination of the three-dimensional structure of proteins, nucleic acids, and complexes of macromolecules.
- Biomedical research will expand the application of advanced physical technology to study, diagnose, and treat human disease, including metabolic disorders, immune- and circulatory-system diseases, and mental disorders. Innovations in instrumentation for positron-emission tomography, NMR, and charged-particle radiation therapy and radiosurgery will transfer the technologies to the private sector. Associated radiobiological information will be used to predict radiation hazards for prolonged space travel.
- Environmental- and health-effects research will include studies to predict and assess the atmospheric chemistry and transport, deposition, and ecological effects of combustion products. Sources and transport mechanisms of chemicals from the subsurface environment will also be an important focus, for example, studies of contamination of groundwater and radon exposure and its health effects.

Summary of LBL Scientific Activities and Plans

A new major design and construction project at LBL is the ALS, which will become operational in 1993. This national user facility will provide ultraviolet and soft-x-ray (photon) beams of high spectral brightness, high flux, and partial coherence in pulses several picoseconds long. The ALS will serve many users from industry, academia, and other national laboratories and is the focus for redevelopment of the original Laboratory research facilities.

LBL has developed plans for an upgraded accelerator in the Bevalac Accelerator Complex that can play an important role in the exploration of nuclear matter under extraordinary conditions. The Laboratory management and the DOE are reviewing these plans and possible alternative uses of the Bevalac facilities.

LBL continues to initiate important new research programs on advanced accelerators and detectors for physics research. New experimental and fabrication facilities are being developed to support national high-energy physics programs. At LBL these support facilities include construction of ultrahigh-vacuum facilities and clean rooms and the rehabilitation and expansion of high-bay space for detector assembly and fabrication.

Materials and chemistry research now constitutes a significant share of activity at LBL. A focal point of these programs is materials science and chemistry research. The CAM has established programs that integrate materials research on synthesis, processing, characterization, and instrumentation development in collaboration with U.S. industry. The Center for X-Ray Optics develops sources of radiation and techniques to transport, focus, disperse, and detect soft x-rays in support of research in many fields.

Life sciences research is conducted in six major program areas: molecular genetics and nucleic acid studies, gene expression and physiology, nuclear medicine, carcinogenesis and mutagenesis, structural biology, and environmental research. Most of this research is conducted at the Donner Laboratory, at the Laboratory for Chemical Biodynamics on the UCB Campus, and at the LBL Life Sciences Research Area, where additional facilities for cell and molecular biology and human-genome research are planned.

Research in energy technology and energy conservation emphasizes potential new fusion-

generation, electric-energy storage, and building systems. Examples include the evaluation of heavy-ion accelerators as drivers for inertial confinement fusion, new battery systems, and advanced concepts for fluorescent lamps. In the geosciences LBL has several thrusts, including, for example, a national leadership role in the Continental Scientific Drilling Program.

In the future the role of national laboratories as centers for research services to qualified users will grow to ensure the availability and efficient use of advanced research facilities. The major facilities at the Laboratory will be the ALS and the Upgraded Bevalac. Complementary sources of coherent radiation, including those in the visible- and infrared-wavelength regions are also planned.

Additional facilities for advanced accelerator physics research, biotechnology development, heavy-ion storage-ring experimentation, and advanced engineering-support activities are currently being planned or are being considered as possibilities for future development. The Laboratory expects the trend toward advanced instrumentation, improved computational capabilities, and multidisciplinary scientific programs to continue.

Beyond the 1980s the nation will continue to face increasing demands for research and technical training programs that improve technical and economic competitiveness. To provide the required technological innovation and scientific expertise, the Laboratory will emphasize fundamental research programs, advanced user facilities for the general scientific community, new educational and training activities, and increased interaction with industry. Figure 3-1 provides information on the sources of LBL operating funds since 1980. With this approach, the Laboratory's expertise and facilities will help meet national scientific and economic goals well into the next century.

This Plan is in concert with the Laboratory's Five-Year Institutional Plan and in conformance with the LRDP approved by The UC Regents on September 17, 1987. It incorporates a framework for long-range development that provides for flexibility in siting and protection of the environment and natural resources.

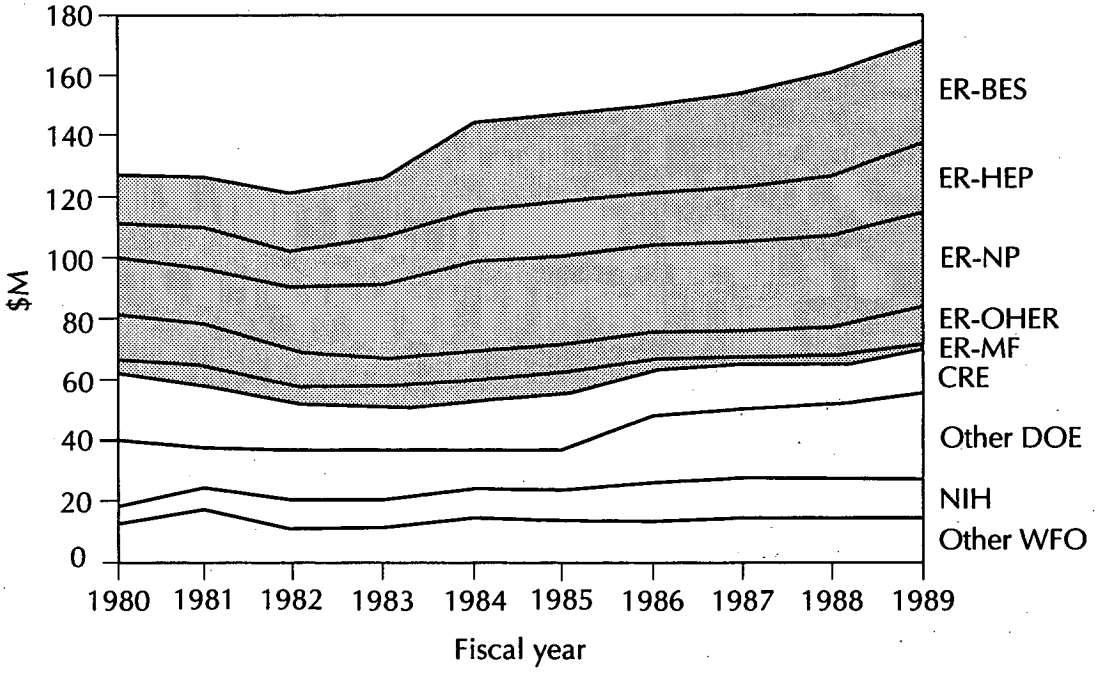


Fig. 3-1. Sources of LBL operating funds since 1980.

Site-Planning Objectives, Concepts, and Guidelines

Site planning objectives at the Laboratory are based on long-range institutional goals that support the conduct of LBL's mission. The long-range institutional site-planning objectives are listed below.

- Provide research facilities and accommodate changes or growth required for anticipated national scientific needs.
- Protect the environment, plan for site amenities and constraints, and buffer activities from adjacent populations.
- Ensure a safe, healthful, and attractive workplace; improve access and communication with the University community; and provide transportation and parking systems for employees and the visiting public.
- Protect and sustain the investment in valuable government-owned research and support facilities.
- Improve support and research services through proper siting and consolidation of functions.
- Promote energy conservation and cost economies through efficient design, location, operation, and maintenance.

To achieve these six objectives, the SDP is based on five LBL planning concepts. These concepts accommodate the facilities requirements of the Laboratory within existing geophysical, environmental, and operational conditions. They provide a basis for understanding and evaluating the more-detailed elements of the actual site plan, which is characterized by specific buildings, utilities, and transportation elements. The site-plan concepts are the following.

- Consolidate activities within seven functional planning areas — related groupings of facilities and population centers — to enhance interaction and efficiency (Figure 3-2).
- Redevelop obsolete buildings and infrastructure, eliminate trailers for permanent functions, and improve building arrangements to increase open space in the original World War II Laboratory area.

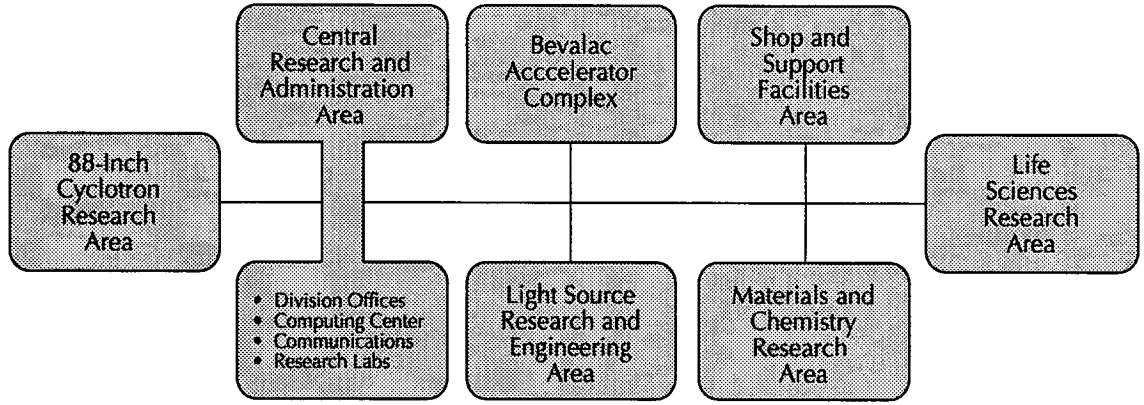


Fig. 3-2. Schematic concept of the seven functional areas.

- Coordinate development along the East-West circulation and utilities axis, which extends from the Life Sciences Research Area to the 88-Inch Cyclotron Research Area (Figure 3-3), to enhance transportation and service systems, develop off-road parking, and improve the system of pedestrian pathways.
- Improve and maintain perimeter buffer zones and natural beauty by, for example, restricting construction in highly valued landscape areas.
- Provide off-site "satellite" locations for receiving, warehousing, and other support and research activities well suited to decentralized locations.

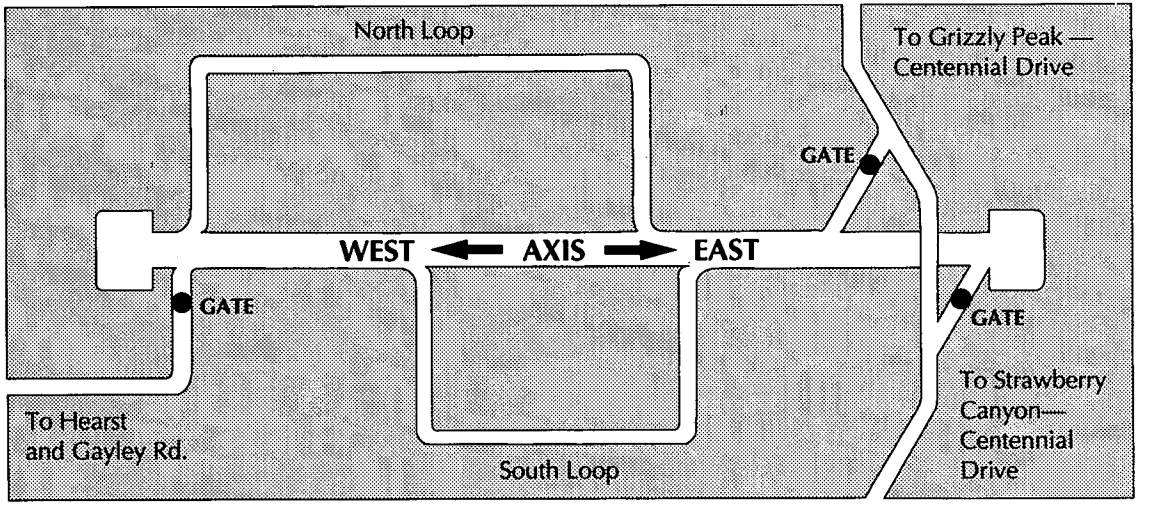


Fig. 3-3. The east-west circulation axis.

The SDP provides a framework for the rehabilitation and replacement of obsolete and deteriorated structures, primarily in the original World War II Laboratory, including the following. Table 3-1 provides an analysis of conditions by functional area, and Appendix D details planned additions and removals.

- Replacement of obsolete and substandard mechanical- and electrical-engineering buildings and accelerator-testing and -fabrication facilities.
- Rehabilitation of electrical- and mechanical-utility systems and other infrastructures, including roadways (throughout the site).
- Replacement of trailers and obsolete wood-frame light-duty laboratory and office buildings, primarily to accommodate users of the Advanced Light Source.

The SDP allows for a relocation of support functions and some research activities for improved efficiency and safety.

- Relocation of the materiel-storage and supply-services personnel from the Light Source Research and Engineering Area to the the Shop and Support Facilities Area, with the elimination of several trailers.
- Consolidation of reclamation and materials-handling activities to the eastern end of the Laboratory site.
- Relocation of selected research programs and the printing plant from off-site leased space to the main site.

The plan allows for potential additions for program-related or support projects.

- New buildings and additions to existing structures for anticipated program growth in molecular genetics and medicine, conservation, and renewable energy research and provision for sites for growth in the materials science and chemistry programs.

Table 3-1. Analysis of Building Conditions.[a]

Area name	Adequate space	Substandard Can Be Made Adequate	Substandard Cannot Be Made Adequate
88-Inch Cyclotron Area	52,190	0	0
Central Research and Administration Area	46,660	410,960	28,330
Bevalac Accelerator Complex	128,100	186,420	29,800
Light Source Research and Eng. Area	179,030	40,240	140,300
Shops and Support Facilities Area	81,860	68,260	10,670
Materials and Chemical Research Area	65,320	59,960	1,190
Life Sciences Research Area	10,310	43,170	500
Total	**563,470**	**809,010**	**210,790**

[a]These figures do not include miscellaneous structures of various condition.

- Extension of the Bevalac experimental hall for accelerator improvements and other additional facilities for accelerator and fusion research.
- Additions to existing buildings for research and for administrative, shop, engineering, and other support functions, including a small conference facility for multiprogram support and for science-education programs.

Design guidelines in the SDP have been developed to achieve specific facilities-planning requirements while respecting site constraints and providing coherence among building elements and the landscape. These reference guidelines address the following areas.

- *Utilities Corridors.* Utility distribution systems are, where feasible, to be placed in trenches and under roadways. Central and localized distribution stations and feeder lines are located and sized for future building locations and anticipated demand and will be subject to design reviews for compatibility with general site developments and future site needs.
- *Building Mass, Orientation, and Exteriors.* Buildings are to be designed to fit well into the slope of the land, to conserve important landscape features and open space, and to be closely integrated with the landscape plan. They are to be no more than five stories high and may not present an uninterrupted wall greater than four stories high. Exteriors of buildings are to be compatible in design with surrounding building elements and landscaping. Textures and colors, including those of roofs, are to be unobtrusive.

- *Energy and Operational Efficiency.* Buildings are to employ optimum energy strategies and efficiency features to include building orientation, natural illumination and sun control, and automated ventilation and climate-control systems, where feasible. In addition, building design considerations include efficiencies in maintainability of systems.
- *Safety Considerations.* New and rehabilitated buildings will conform with applicable Federal, State, and local code requirements to ensure compliance and to safeguard the staff and the community.
- *Building Use Flexibility.* Building systems cores for circulation space and utilities are to provide flexible and modular space to allow for changes in partitioning and function.
- *Circulation and Parking.* Circulation and parking plans are to provide compatibility between vehicle use and pedestrian safety. Pedestrian paths are to be separated from vehicles, where practicable, with distinct access and termination points so that bus stops, parking areas, loading docks, and building entrances are safe and efficient. Emergency-vehicle and handicapped-person access is incorporated into building and circulation design. Shuttle-bus stops are provided with shelters.
- *Topography and Grading.* Grading and retaining walls are to contribute to the stability of slopes and soils, to allow for smooth topographic transition between hillsides and structures and, to be constructed of materials visually suitable for their locations.
- *Landscaping and Open Space .* Landscaping, along with designated open space, contributes to the compatibility of buildings with the vegetation of the hillside and generally includes native plants. It visually screens service areas, reduces fire danger, contributes to slope stability, provides summer shade, and creates new areas for the use and enjoyment of employees and visitors. Existing natural landscaping is to be preserved to the extent possible.
- *Guideline Review Process.* Detailed design guidelines are to be established for each development site before design begins. Each project will be reviewed for conformance to these guidelines by the Laboratory's architects and engineers and by the Director's Architectural Consultant.

Resource Projections

Resource projections for the next 5 years are found in Table 3-2. Operating budgets are expected to be relatively stable, consistent with Federal budget trends, and increases in construction funding to accomplish the SPD goals are included. Specific information on resource projections is based on LBL's *FY1989-1994 Institutional Plan* (PUB-5209).

Table 3-2. Resource Projections (Fiscal Year FTE).

Category	1987	1988	1989	1990	1991	1992	1993	1994
DOE Direct	1401	1447	1534	1593	1625	1600	1629	1646
WFO	335	329	318	307	311	314	317	318
Total Direct	**1736**	**1776**	**1851**	**1900**	**1936**	**1914**	**1947**	**1964**
Total Indirect	**692**	**694**	**710**	**721**	**728**	**728**	**732**	**735**
Total Lab Personnel	**2428**	**2470**	**2561**	**2621**	**2664**	**2643**	**2678**	**2699**

SITE ASSESSMENT

Background

LBL's facility-related problems stem from the obsolete design of its oldest buildings, deteriorating utilities, and the changes in scientific needs since 1940. Many laboratories and shops were originally designed for temporary service during World War II. Figure 3-4 shows the age distribution of main-site buildings. In addition, some buildings constructed during 1940–1960 are not adequate for today's highly technological scientific demands. The characteristics of shops and support facilities, such as environmental control (e.g., airborne particle concentrations) and adequate electrical and plumbing services, must be appropriate to current research programs. Electrical utilities projects are identified in Table 3–3. Forecasts for electricity and natural gas based on current

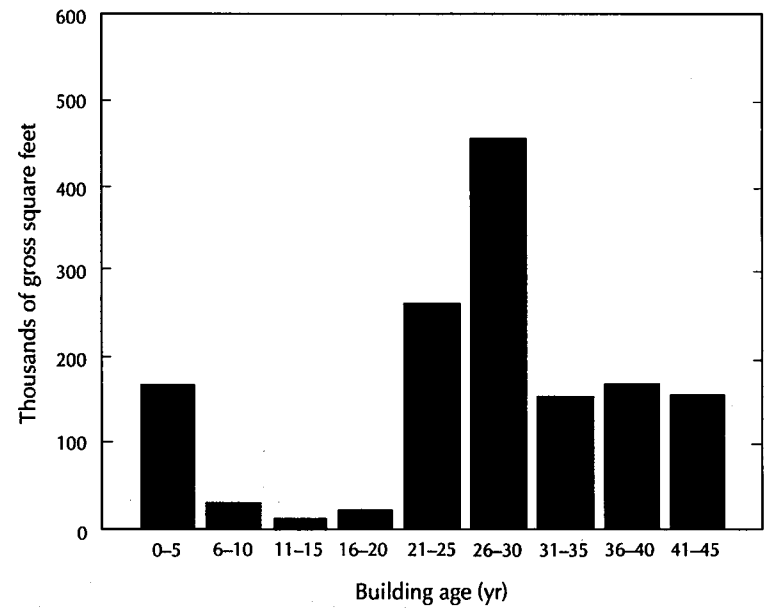


Fig. 3-4. Age distribution of main-site buildings.

Table 3-3. Planned Electrical Utility Improvements.

Functional Area	Existing			Planned		
	Xformer (no.)	Switch (no.)	Cable (miles)	Xformer (no.)	Switch (no.)	Cable (miles)
88-Inch Cyclotron Research Area	3	4	2	3	5	2
Central Research and Administration Area	7	11	3.75	8	21	2.75
Bevalac Accelerator Complex	20	30	12.5	20	47	17.5
Light Source Research and Engineering Area	14	25	5	14	40	8
Shops and Support Facilities Area	2	28	1	3	29	2
Materials and Chemistry Research Area	2	2	1	2	2	3.25
Life Sciences Research Area	1	1	0.75	5	14	1.25

5- and 15-year plans are shown in Table 3–4. Analysis by types of electrical service is presented in Table 3–5. An analysis of building conditions by type of space is presented in Figure 3-5.

As described in Chapter 4, the Laboratory has developed a rehabilitation and replacement program with a 15-year schedule. The largest costs are for building and utilities rehabilitation or replacement.

Table 3-4. Electricity and Natural-Gas Forecasts by Functional Area

Functional Area	Electricity				Natural Gas			
	1994		2004		1994		2004	
	Area (gsf)	Usage (kWH)[a]	Area (gsf)	Usage (kWH)[a]	Area (gsf)	Usage (cu ft)[b]	Area (gsf)	Usage (cu ft)[b]
88-Inch Cyclotron Research Area	53,800	3,389,400	62,400	3,931,200	53,800	4,842,000	62,400	5,616,000
Central Research and Administration Area	493,380	31,082,940	500,950	31,559,850	493,380	44,404,200	500,950	45,085,500
Bevalac Accelerator Complex	352,400	22,201,200	471,900	29,729,700	352,400	31,716,000	471,900	42,471,000
Light Source Research and Engineering Area	409,510	25,799,130	498,070	31,378,410	409,510	36,855,900	498,070	44,826,300
Shops and Support Facilities Area	204,160	12,862,080	205,850	12,968,550	204,160	18,374,400	205,850	18,526,500
Materials and Chemistry Research Area	127,000	8,001,000	158,010	9,954,630	127,000	11,430,000	158,010	14,220,900
Life Sciences Research Area	98,700	6,218,100	147,910	9,318,330	98,700	8,883,000	147,910	13,311,900
TOTALS	**1,738,950**	**109,553,850**	**2,045,090**	**128,840,670**	**1,738,950**	**156,505,500**	**2,045,090**	**184,058,100**

[a]Based on average usage of 63 kWH/gsf

[b]Based on average usage of 90 cu ft/gsf

Table 3-5. Future Electrical Utilities by Type of Services.

Bldg / Description	Interruptable	Firm	Switchable	High Reliability
88-Inch Cyclotron Research Area				
All Buildings		•		•
Central Research and Administration Area				
50 Complex			•	•
54 Cafeteria			•	
55 Research Medicine		•		
70 Complex			•	
90 Complex			•	
Bevalac Accelerator Complex				
46/47 Complex			•	
51 Bevatron Accelerator	•	•		
58 Complex			•	
64 Accelerator Research	•			
71 Complex Hilac	•		•	
Light Source Research and Engineering Area				
2 Advanced Materials Lab		•		
4 & 5 Magnetic Fusion Energy	•	•	•	•
6 Advanced Light Source	•	•	•	•
10 Biology Research / Photo Lab	•	•	•	•
16 Magnetic Fusion Energy Lab		•		
25 Complex			•	
26 Medical Services		•		
37 Utilities and Service		•		
45 & 48 Fire Station	•	•	•	•
80 Center for X-Ray Optics	•	•	•	•
Shops and Support Facilities Area				
All Buildings			•	
Materials and Chemistry Research Area				
All Buildings			•	
Life Sciences Research Area				
All Buildings			•	

Other projects include environmental and health projects, roadway safety improvements, and slope stabilization. The costs of the general-purpose facilities-rehabilitation program for the FY 1988–2003 planning period are included in the construction cost table provided in Chapter 4. This midterm planning period provides a comprehensive and integrated perspective on facilities needs, at a funding level of about $12 million annually.

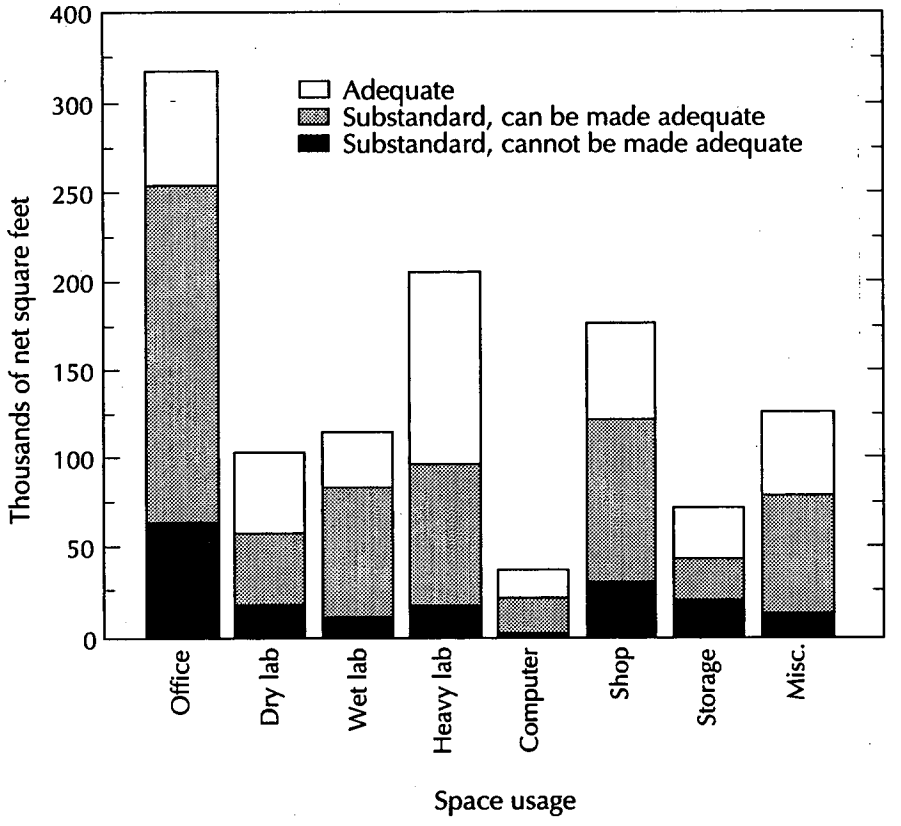


Fig. 3-5. Current space usage.

Multiprogram Energy Laboratory Facilities Support (MEL-FS)

The MEL-FS program is vital for rehabilitating the Laboratory's deteriorated utility system and for replacing obsolete facilities. The Laboratory is encouraged that DOE management is committed to progress in rehabilitation of the national laboratories, but the current funding profile delays rehabilitation of LBL beyond FY 2000. The MEL-FS project priorities and schedule were prepared following careful planning and review by Laboratory management. The 15-year profile is driven by budget constraints; for example, those utility projects scheduled to begin in 10–15 years correct existing, not future, problems.

General Plant Projects

LBL's General Plant Project (GPP) funds are provided by DOE's Nuclear Physics Division. The GPP program can provide a timely mechanism to fund priority projects; however, the amount of funds received have been inadequate to meet the Laboratory's needs. LBL will require significant GPP outlays for major replacements (such as 12-kV cabling, switching stations, cooling towers, boilers, chillers, gas lines, and water lines) over the next several years. Progress in increasing GPP funds is important to the success of the Laboratory's rehabilitation program. MEL-FS priorities, which subordinate replacing obsolete facilities to safety, health, and environmental concerns, make adequate GPP funds important to LBL.

Utilities Needs

Many of the Laboratory's utility systems were initially sized to serve the Laboratory's large accelerators, and they have the capacity to fulfill present and future electrical-power, gas, water, cooling, and waste requirements. However, many segments and load centers in the utility systems are aged and hazardous and require rehabilitation to improve flexibility and reliability (see Figures 3-6 and 3-7). The utility systems that are undergoing rehabilitation include natural gas, potable water, cooling water, low-conductivity water, electrical power, sanitary sewers, compressed air, storm drains, standby and backup electricity, and

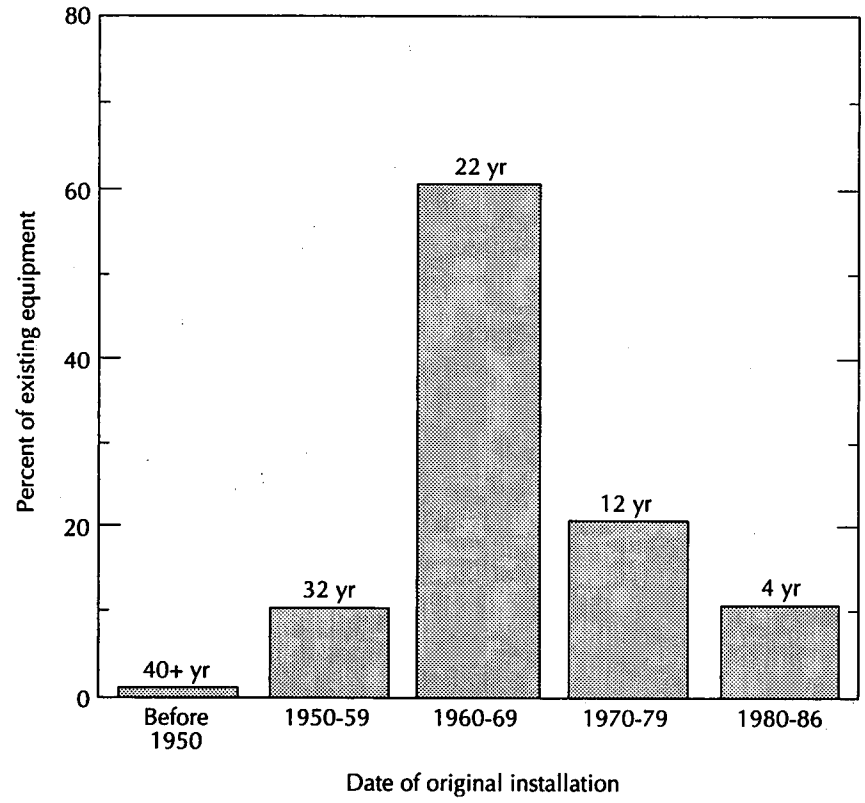


Fig. 3-6. Age of LBL mechanical equipment.

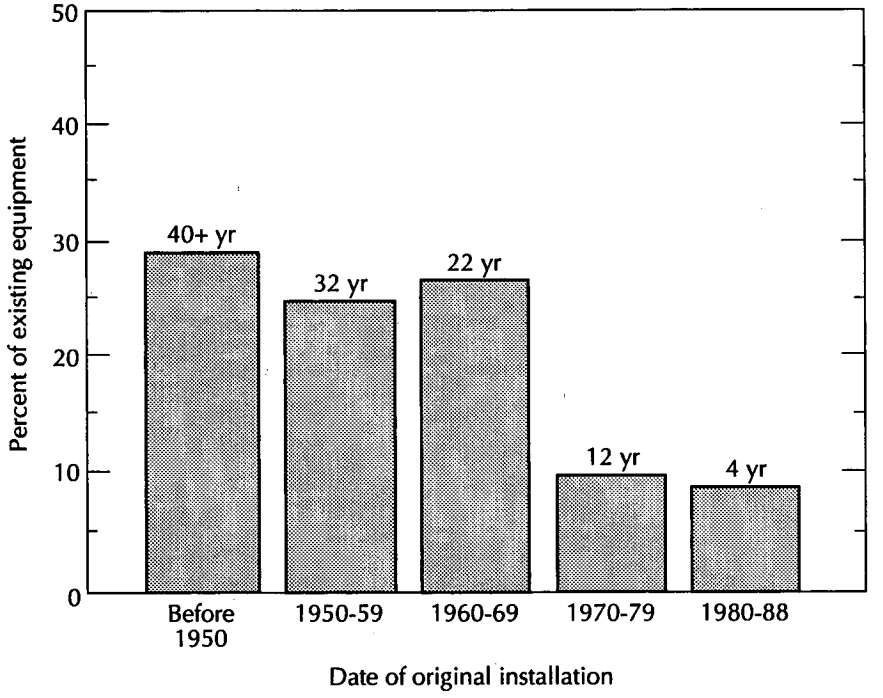


Fig. 3-7. Age of LBL electrical equipment.

alarm and security. New building construction (see Figure 3–8) will require some new utility corridors to link existing east- and west-site utilities. New corridors will be required within the Light Source Research and Engineering Area, and extensions are needed to the Life Sciences Research Area. In general, these will include electric service as well as water and gas lines, sanitary sewers, and storm drains.

Electrical, communication, and fire-alarm systems are shown in Figure 3–9. For existing and planned utility needs for water, sewer, natural gas, and electricity see Tables 2–7 through 2–10.

The LBL electrical-distribution system must be able to cope with power interruptions while maintaining firm service to those LBL facilities that cannot tolerate interruptions. In 1985,

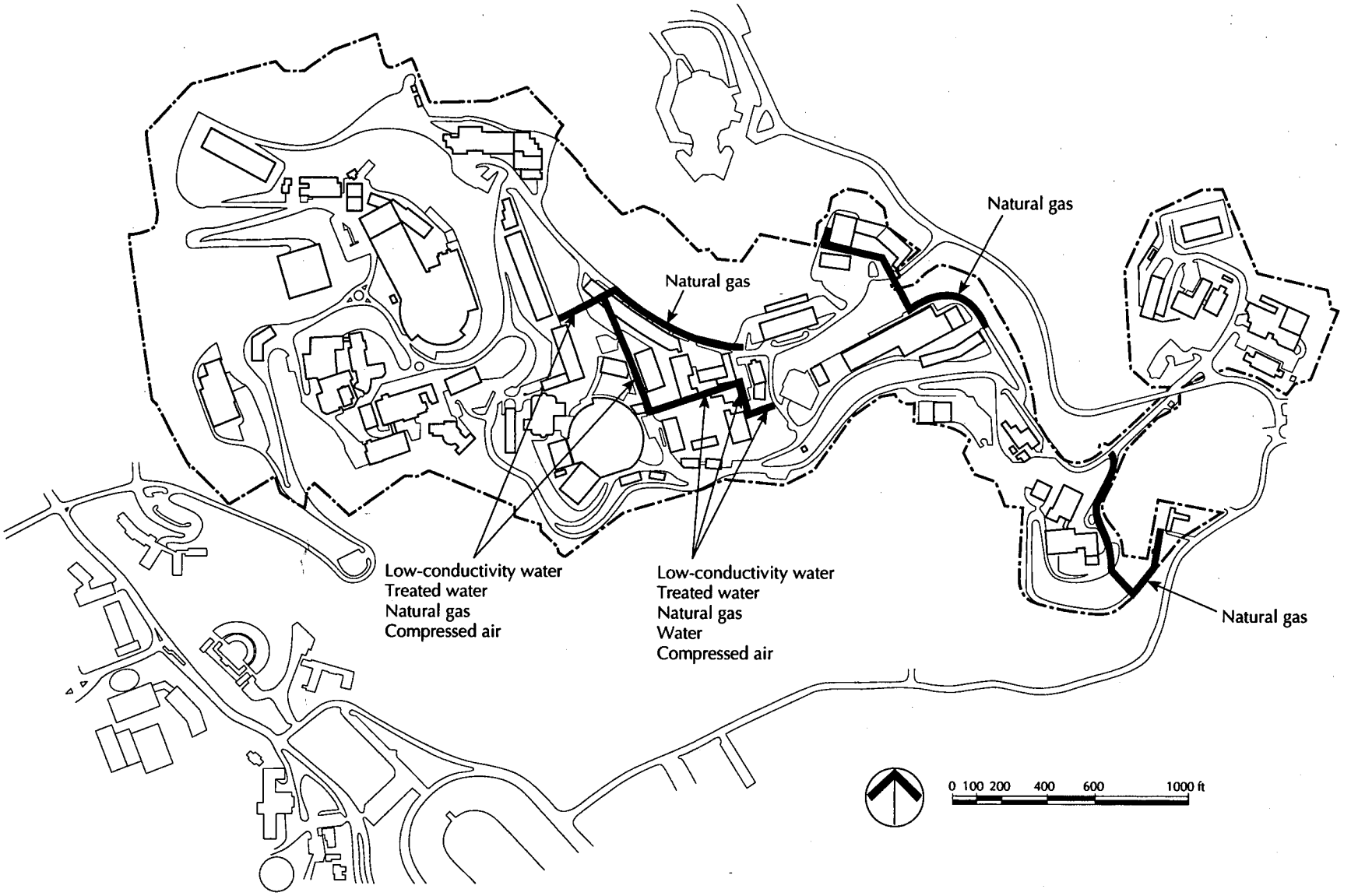


Fig. 3-8. Mechanical utility corridor improvements.

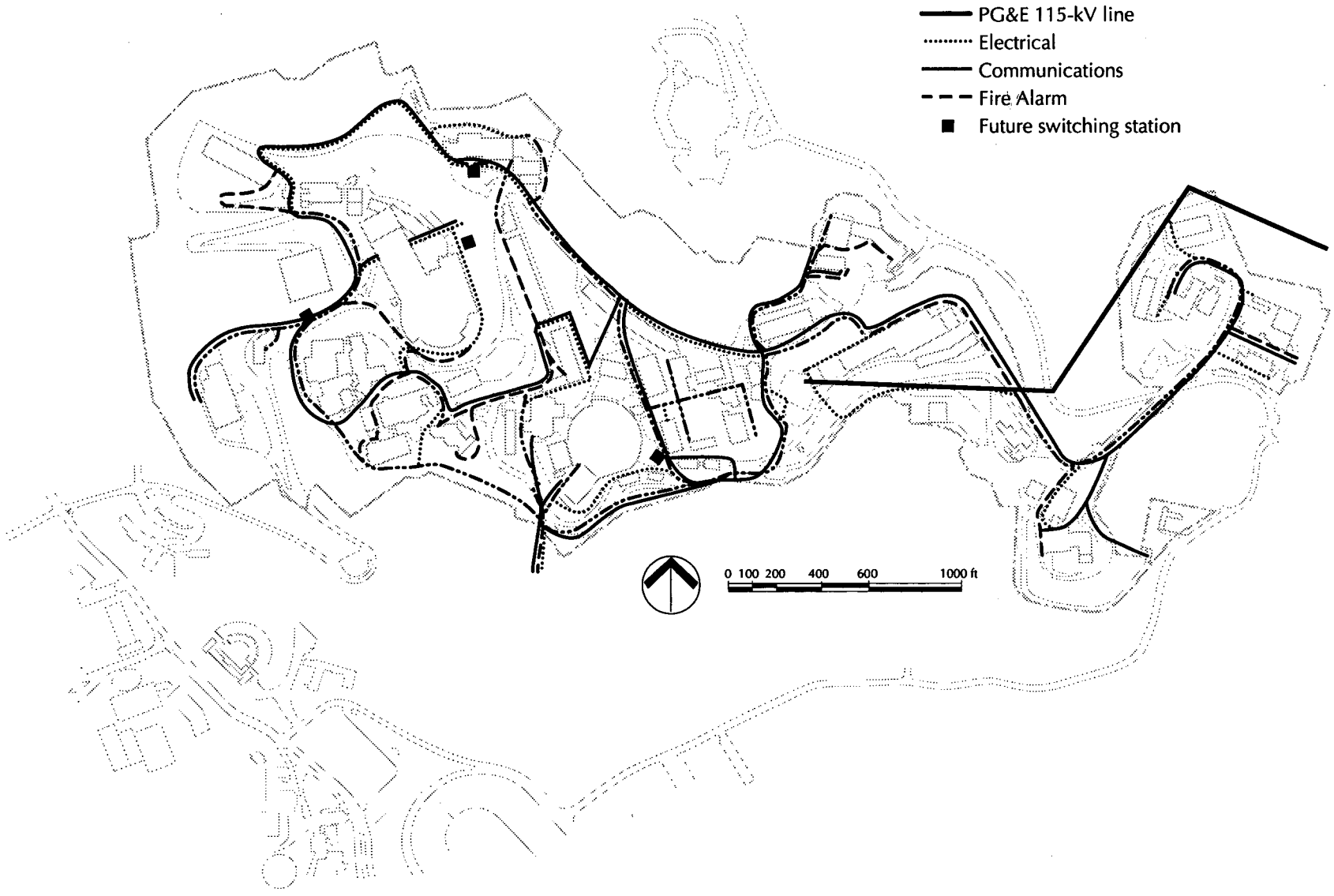


Fig. 3-9. Electrical, communications, and fire-alarm improvements.

there were 25 power interruptions of various sorts, with varying impact on LBL research programs. The present LBL system was not designed to distribute reliably the various levels of power that the electric companies now offer in their rate schedules. The basic elements for a flexible and reliable LBL distribution system exist already, however, and a cost-effective rehabilitation can be accomplished at a small fraction of the replacement value of the existing system.

The long-range rehabilitation of the 12-kV electrical-power distribution system involves replacement of aging and hazardous electrical switching equipment and distribution cables. The existing single-service radial distribution system will be expanded to a double-bus distribution system by extending the existing central double-bus system at the Grizzly main substation to seven centrally located switching stations. From these switching stations double feeder circuits will be extended to Laboratory buildings and other facilities. This arrangement will restrict electrical system failures to fewer facilities, reduce planned outages, enhance preventive-maintenance activities, and permit the selection of the least-expensive electricity source by the users.

New building and other energy-using facilities will incorporate energy-conservation features that meet or exceed applicable Federal energy-use standards, incorporating cost-effective energy-conservation designs, whenever possible. Major facilities such as new cooling towers and building HVAC and lighting systems will be optimized (for energy conservation) and placed under the Automated Energy Management System. Also, natural gas and electricity will be metered to provide data for identifying energy waste and for establishing priorities for potential energy-conservation projects.

Rehabilitation of mechanical utilities is required at several locations for potable-water, cooling-water, compressed-air, natural-gas, storm-drain, sanitary-sewer, and acid-waste systems. Portions of the outdated potable-water piping, as well as valves, backflow preventers, fire-sprinkler risers, and obsolete fire hydrants, will be replaced. The cooling-water system in several buildings will be rehabilitated. An East Site Fire Protection and Water Supply project will provide the Laboratory with a 300,000-gallon backup water tank for fire protection. Security improvements will include extension of the card-key system and improvements to the fire-alarm network.

Maintenance Needs

The Laboratory is improving maintenance-planning programs by, formulating integrated plans for a long-range capital-improvements program and for operating expenditures. GPP and MEL-FS projects include replacement and rehabilitation of facilities to maintain existing capability. GPP and MEL-FS funds, have been used to replace roofs, paving, and electrical, water-supply, and mechanical systems.

The operating expenses for maintenance include physical plant maintenance and noncapital alterations related to maintenance. Maintenance can be effectively managed by establishing priorities for maintenance projects and by replacing existing, obsolete, and high-maintenance-cost facilities with modern facilities and equipment. Laboratory management is directing its efforts toward rehabilitation of buildings with GPP and MEL-FS funds. The use of noncapital funds can then be efficiently allocated to maintain essential building and equipment investments.

Future Needs

Constraints to future development stem from the steepness of the terrain, the desire to preserve the environment, and the need to provide parking and service areas on-site to support the Laboratory population. The best use must be made of available building sites, and space adjacent to existing program and support facilities must be reserved for future expansion.

Planning for significant future growth of the Laboratory centers on two areas: redevelopment of the Light Source Research and Engineering Area (near Building 6), which was built up during the 1940s, and expansion in the Life Sciences Research Area in the vicinity of the existing Biosciences (Buildings 74-83) complex. The Light Source Research and Engineering Area contains about 15 acres and presents the greatest potential, through redevelopment, for sites for future research and support facilities. Potential for development in the Life Sciences Research Area is limited to seven acres for a badly needed Hazardous Waste

Handling Facility and other future facilities. Table 3–6 summarizes general-purpose building needs.

The Light Source Research and Engineering Area, which was developed around the old 184-Inch Cyclotron, has excellent geographical and geotechnical qualities and natural topography especially suited to building sites for high-technology facilities. Many buildings in the area are substandard or obsolete, but the newer buildings (such as Building 6) are quality structures that will be preserved for future use. Vehicle and pedestrian circulation routes are generally narrow, indirect, and substandard. Although utility systems and load centers have ample capacity, they are generally aged and inflexible. The pressing need to replace or rehabilitate many of the existing buildings, roadways, and utilities in the Light Source Research and Engineering Area, coupled with its physical attributes and central location, makes the area a prime candidate for redevelopment.

During the last 10 years, LBL has carried out a rehabilitation program to upgrade its facilities for seismic safety, fire protection, industrial safety, and environmental enhancement. During this time, over one-half of its GPP funds have been expended for these improvements. Maintenance programs in painting, roofing,

Table 3-6. General-Purpose Building Needs Summary.

Functional Need/Problem	Deficiency	Existing Requirements	Proposed Building
Workplace safety Fire safety Environmental protection	Conjested operations Substandard woodframing Inadequate chemical storage	42,000 gsf of office, light Lab, and materials-handling and storage space	Safety and Support Services Project
Seismic safety Fire safety Environmental protection Obsolete utilities	Unreinforced masonary Substandard grounding Drain and plumbing, hoods Substandard electrical service	52,000 gsf shop, office & light assembly, and high bay w/full utilities	Mechanical Engineering Replacement Project
Workplace safety Fire safety Environmental protection Obsolete utilities	Uncontrolled ventilation Substandard grounding Inadequate plumbing Substandard electrical service	60,000 gsf shop and office building w/full utilities	Electrical Engineering Replacement Project
Total General-Purpose Building Needs		154,000 gsf[a]	

[a]General-Purpose Building Construction will be offset with removals and demolition, resulting in constant net LBL space.

paving, slope stabilization, erosion control, and mechanical and electrical utility systems have been carried out to preserve and upgrade the physical plant.

Slope-stability projects have been identified and prioritized as shown in Figure 3-10.

Funding for these projects will be requested from both MEL-FS and GPP sources depending on the scope of work. Priorities are based on potential threats to DOE structures, roads, and utility systems and on integration into onging maintenance plan.

Shortages of both laboratory and office space at LBL have remained acute over the last 10 years, impeding the progress of scientific research and adding significant operational costs for short-term responses to these shortages.

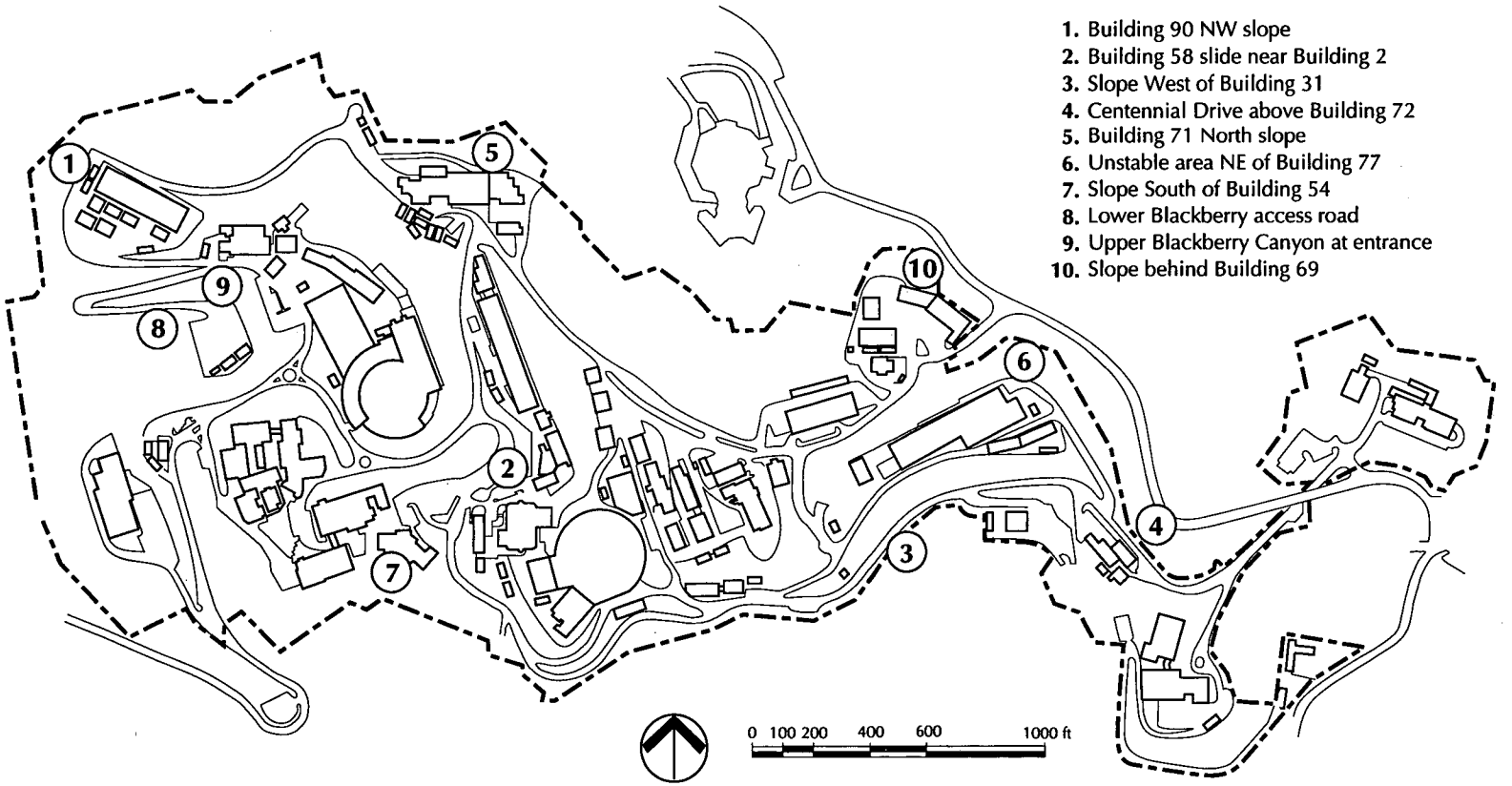
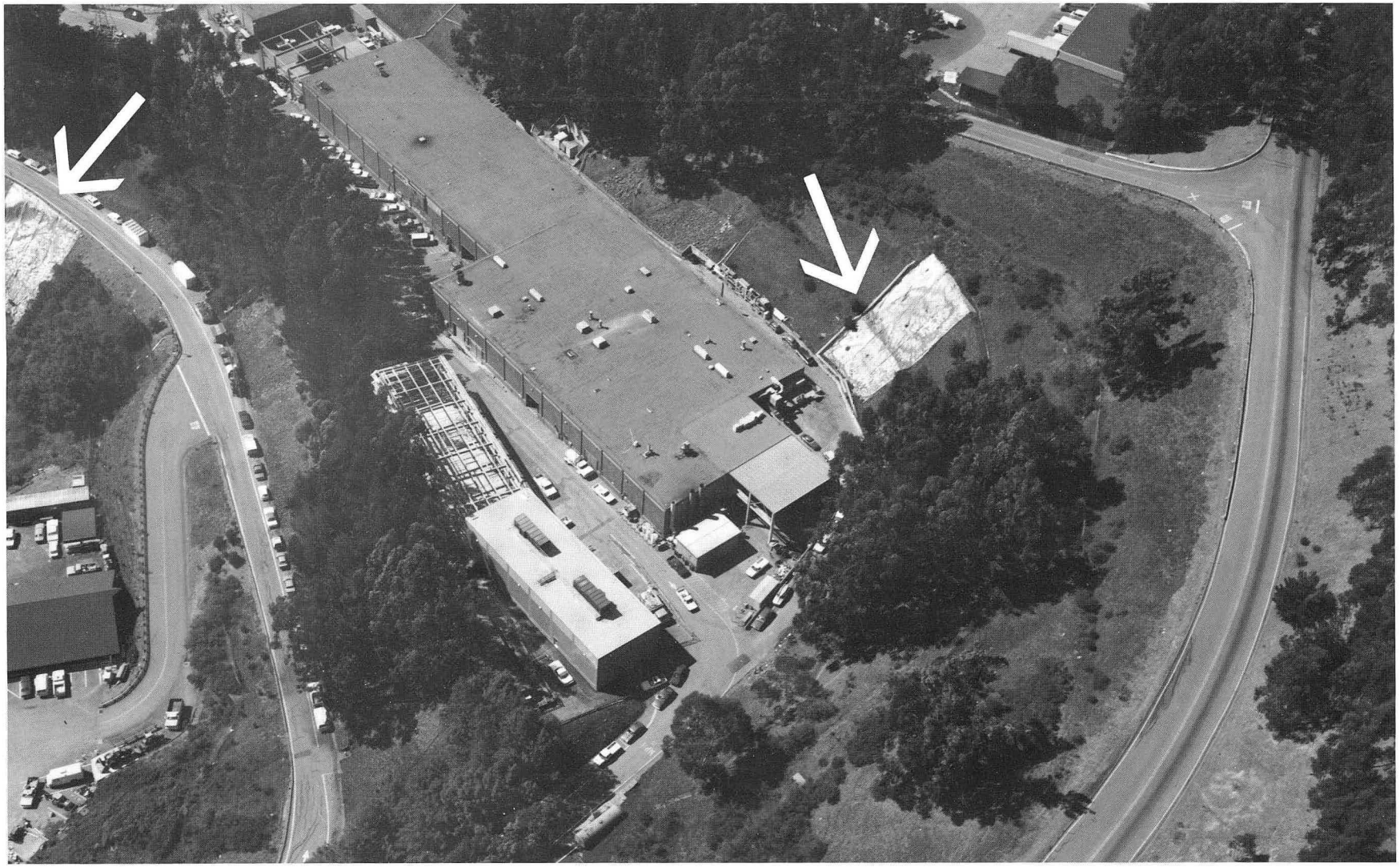


Fig. 3-10 Landslide locations on the LBL site.



Aerial view of the Shops and Support Facilities Area showing two slide areas temporarily stabilized with plastic sheeting as part of the Laboratory-wide slope-stabilization program.

In recent years, the Laboratory has become increasingly active and successful in the fabrication of high-technology magnet-coil windings and very fine precision windings for large detectors in support of DOE programs at LBL and at several other national laboratories. The success of this work has produced an urgent need for additional shop assembly and staging space environmentally designed for high-technology fabrication.

Summary

Construction of all the projects represented in this plan would result in a net increase of approximately 443,990 gsf of buildings in the main Laboratory site, for a total of 2,045,090 gsf. For comparison, the 1988 total is 1,601,100 gsf (see Appendix D).

The increased need expressed in the 1989 SDP is due to the increased development of programs in materials science and chemistry, earth sciences, conservation and renewable energy, and fossil energy that were not a part of the Laboratory's mission in the early 1960s.

In addition, the specialized research facilities and program expansion in the physical sciences and the life sciences, such as electron microscopy and molecular genetics, and new facilities for the Advanced Light Source were not anticipated in the 1960s and have required, or will require, new buildings or extensive additions to existing buildings.

The SDP also emphasizes utility rehabilitation, improved parking and traffic circulation, and respect for nine buffer-zone landscape areas that unify the site and enhance compatibility with the surrounding hillside. The major site-development proposals are (1) redevelop the original Laboratory site to eliminate obsolete buildings and enhance the open space, (2) expand the Biosciences area by 4 acres (included in the 1962 Plan), and (3) eliminate the use of 60,000 gsf of trailers. The SDP allows for a Laboratory staff size of 4,750 at all existing activity areas (Table 3–7). LBL's projected work locations are shown in Table 3-8.

Table 3–7. Space and Population Analysis by Functional Area.

Functional Area		Space and Population 1988 GSF	Space and Population 1988 Heads	Long Range Plan 2004 GSF	Long Range Plan 2004 Heads
88-Inch Cyclotron Research Area		53,800	54	62,400	84
Central Research and Admin. Area		488,000	1,461	500,950	1,449
Bevalac Accelerator Complex		352,400	434	471,900	602
Lt. Source Research and Eng. Area		362,000	409	498,070	951
Shop and Support Facilities Area		163,700	350	205,850	507
Materials and Chemistry Research Area		127,000	162	158,010	281
Life Sciences Research Area		54,200	72	147,910	226
Subtotal		1,601,100	2,942	2,045,090	4,100
Blackberry Canyon Garage	410 Spaces			144,000	
Old Town Garage	300 Spaces			105,600	
Subtotal on site		1,601,100	2,942	2,294,690	4,100
Campus		331,110	749	266,700	640
Off-site Leased Space		138,900	43	103,400	10
Grand Total		**2,071,110**	**3,734**	**2,664,790**	**4,750**

Table 3-8. LBL Projected Workstation Locations.

Functional Area	Number of Workstations 1988	Planned
88-Inch Cyclotron Research Area	55	64
Central Research and Administration Area	1573	1615
Bevalac Accelerator Complex	451	604
Light Source Research and Engineering Area	595	819
Shops and Support Facilities Area	245	310
Materials and Chemistry Research Area	349	434
Life Sciences Research Area	61	166

Conclusions

An analysis of the constraints and opportunities for future development and redevelopment of the LBL site has focused long-range planning on site potential (or build-out) for comparison with long-range program needs. Subportions of the site with potential for cost-effective development (or redevelopment) have been targeted for more-detailed studies. Thus, in the process of developing the LBL Site Plan, comprehensive site-use studies have been made to ensure the most-efficient and most-cost-effective use of available sites. In parallel, the Laboratory has studied the need for additional facilities beyond the 5-year institutional-planning period on the basis of potential program initiatives. The environmental impacts of development have been studied extensively, including the cumulative effects related to traffic and parking. The site potential for reasonable development beyond the 5-year institutional plan is greater than currently projected long-range needs. Consequently, a population of 4,750 represents a realistic long-term development level. Because there is room for physical alternatives in the long term, care has been taken to establish and preserve areas adjacent to existing facilities to permit future development.

About 50% of LBL's estimated maximum population growth is projected to take place during the next five-year institutional-planning period, during which time the present population will increase from 3,734 to 4,200 (including visitors). Over the long term the total population (including visitors) will level off at 4,750. This development level has been based upon conditions governed by geographical, environmental, and research factors. The main-site projected population for the Institutional Plan five-year period is 3,550; for the long-range Master 15-Year Plan period, 4,100. The 1988 main-site population was 2,942.

Redevelopment of the Light Source Research and Engineering Area has been studied extensively to ensure that the conversion of this older area to a modern high-technology center will be orderly, nondisruptive, and cost effective (see Appendix A). Future utilities systems, load centers, transportation and pedestrian circulation, parking, and sequencing of redevelopment projects have been conceptually developed, critiqued, and revised for compatibility with existing and long-range program premises and environmental concerns.

Solutions incorporated into the redevelopment plan are designed for mission-oriented functional relationships, but the plan also preserves a character appropriate to a highly visible and sensitive hillside area in an urban setting. Proposed building sizes and locations for research initiatives yet unknown have been selected to enhance modular development and flexibility.

Generally, the plan for the Light Source Research and Engineering Area incorporates buildings no greater than four stories with projected areas in keeping with probable funding opportunities, siting constraints, and the orderly (nondisruptive) redevelopment of an area already heavily engaged in program activities.

Site and facility requirements to carry out program goals and related multiprogram support activities during the planning period have been developed in conceptual designs for individual projects.

New construction, renovations, removals, corrections, and other means to fulfill projected program activities are translated into funding requirements and compared with personnel projections (Table 3–2).

The concept for future site development has been studied. Prerequisite studies and programs that have been carried out in this planning analysis are listed in Appendix A.

LBL's SDP is responsive to DOE programs and the directions they are taking. The SDP is in agreement with the Laboratory's Institutional Plan and incorporates a framework for long-range development, site alternatives, and protection of the environment and natural resources.

ALTERNATIVES

Alternatives Development

To evaluate the potential of the site, the Laboratory has commissioned a number of site-use studies (Appendix A) in the past and is currently conducting a new study of the original site in what is now referred to as the Light Source Research and Engineering area. These studies have been used to create an ideal site development plan based on optimal functional relationships. This is represented by the Master 15-Year Plan in Chapter 5. Gains in efficiency of human and capital resources to improve the Laboratory's ability to carry out the DOE responsibilities, as exemplified by the Laboratory's mission statements, guide the development of the Master 15-Year Plan. The grouping of like functions, renovation and replacement of obsolete or inadequate research facilities and infrastructure, and the improvement of circulation for people and materials among work areas are cornerstones of the Master 15-Year Plan.

ALTERNATIVES EVALUATIONS

Restrict Growth

The Laboratory considers the restriction of growth in selected areas to be a normal part of management and operation. As discussed under Planning Process in Chapter 2, the Laboratory carefully reviews proposed research activities to ensure that existing capabilities will support the proposed activities and that they are consistent with the Laboratory mission. If existing capabilities are inadequate, a commitment must be made to increase them This policy has resulted in growth during most of the Laboratory's history, with the exception of the previously discussed retrenchment in the early 1980s. As the site becomes more nearly saturated, new work will be more closely scrutinized to ensure that it does not unduly burden the Laboratory's performance capabilities.

Satellite Locations

Off-site, or satellite, facilities for support functions and research programs are used when decentralized locations are appropriate. The warehousing and receiving support functions were moved in 1980 to the cities of Emeryville and Berkeley. Moving these functions to industrial areas near major freeways eliminated much of the LBL heavy-truck traffic that had added to the traffic congestion of Berkeley streets. In addition, LBL's Printing Plant was relocated to 24,000 gsf of space in an industrial park in West Berkeley in 1979 as a near-term solution to a space shortage. The Laboratory has leased 11,500 gsf of office space in downtown Berkeley to house administrative functions beginning in the winter of 1989.

LBL research programs also use off-site locations. For example, there are facilities at UCB's Richmond Field Station (RFS) for the Earth Science Division's research program in waste isolation and the Applied Science Division's indoor environment program. The indoor-environment program maintains at the RFS a research building known as the Radon Research House, a unique experimental facility used for the national radon-research program and other indoor-air-quality research. The Engineering Division monitors particle decay in a low-cosmic-radiation-background environment at the Oroville Dam powerhouse. In addition, other research programs are located in short-term-leased buildings when temporary space is required or when cost-effective facilities are not available at the main site.

LBL will continue to evaluate its needs for support services and for research-program facilities with respect to their appropriateness to the main site. Those needs that are characterized as being well suited to decentralization will be placed off site when suitable space is available.

Intensify Use

To maximize the use of each building site, building massing has become increasingly important. Although low-rise development is less expensive, the land constraints that face LBL require that either multistory buildings be constructed (including possible multistory parking structures) or that single-story buildings be constructed so as to allow addition of upper stories. However, design guidelines include some limitations. For instance, one guideline states, "Buildings are to be designed to fit well into the slope of the land, to conserve important landscape features and open space, and to be closely integrated with the landscape plan. They are to be no more than five stories and may not present an uninterrupted wall greater than four stories high."

In addition, the plan calls for removal of most of the temporary structures built in the 1940s and all of the trailers. This will provide many of the building sites identified in the 5- and 15-year plans. Details of this reuse are in Chapters 4 and 5.

Expand the Site

Expanding the existing site to accommodate new development requirements is attractive in several ways. The use of functional-area groupings provides Laboratory planners with the ability to expand building sites and improve traffic circulation and communication facilities. In addition, financial leverage can be applied in many cases. Infrastructure expansion to adjacent lands is also less costly and less difficult than establishing new infrastructure at new sites such as satellite locations. The Laboratory negotiates expansion of the boundaries of the site with the UC Regents as the need arises. New facilities are budgeted and proposed for this area as noted in the 5- and 15-Year Plans.

Additional expansion is potentially limited by competition with UCB for undeveloped land within the 11,000 acres owned by the Regents, by the current ceiling of 4,750 personnel, and by environmental impact considerations.

ACCOMMODATION FOR CHANGES IN DIRECTION

The Planning Concepts and Design Guidelines presented in this plan result in a functional-area arrangement that ensures that planning practices are exercised while allowing flexibility of use. Improvements to infrastructure (mechanical and electrical utilities, communications, traffic circulation, and support services) are uniform over the long term. This arrangement and the appropriate use of satellite and temporary space form the basis for accommodating changes in direction. LBL has responded quickly and efficiently to changes in national research directions in the past and will continue to do so in the future, if necessary. Design guidelines and concepts include specialized research facility zones in proximity to major research facilities.

LBL does not rely solely on any one of the broadly based alternatives described above. Rather, its response to decisions on development and redevelopment involves the judicious use of an appropriate mix of alternatives. Satellite locations are used for certain support functions because they need not be close to scientific, technical, and research staff. Consolidation of other support services, such as Environmental Health and Safety, Materiel Management, and maintenance and repair units on the main site makes immediately available the skilled personnel required to support and safeguard research programs. The Planning Concepts and Design Guidelines and Processes ensure strategic planning for intensity and use factors in construction of new facilities and rehabilitation and additions to existing facilities. Laboratory management will continue to consider restriction of growth as a normal part of management and operations. The synergism among these alternatives provides a framework for controlled but flexible development and management of the site.

4.

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MASTER 15-YEAR PLAN

This plan specifies the Laboratory's prioritized use of its capital funds to replace obsolete facilities and the actions needed to protect these investments in the future. The plan calls for correction of current deficiencies as quickly as economically feasible and calls for a structured system of maintenance of the site and facilities throughout their normal service lives. Correction of current deficiencies, e.g., utilities and building rehabilitation, building replacements, road rehabilitation, and slope stabilization, will continue through FY 2000.

This planning is vital to the Laboratory's programs because of the need to use developable land efficiently, to replace obsolete facilities, and to plan for new construction within a realistic economic framework. Establishing the priorities for a 15-year process was difficult because many of the problems need immediate attention. For example, utility projects scheduled to begin in 15 years correct existing problems. Laboratory management has developed the plan with due regard to budgetary constraints. Funding below the assumed levels will create an increasing backlog of rehabilitation projects creating a situation that will be difficult to correct.

The 15-Year Plan also identifies programmatic facilities. The Advanced Light Source received initial funding in FY 1987 and is currently being constructed, with completion scheduled for FY 1993. This project is the first phase of a long-term plan to develop a national research facility. Beyond the construction of the Advanced Light Source itself, construction of additional beam lines and experimental areas and additional support facilities for users is anticipated. To accomplish this, the plan proposes that the Advanced Light Source User Facilities and Free-Electron Laser Radiation Source projects begin in FY 1993 and FY 1996, respectively. Five other scientific facilities are proposed during the planning period to contribute to DOE's research capabilities.

Other major needs at LBL are for special light-laboratory and test-facility space to accommodate current multiprogrammatic activities and for multipurpose office space. The shortage of office space has resulted in serious crowding and the continued use of converted laboratory space and inefficient, expensive trailers. Since 1982, LBL has been able to eliminate most of the costly off-site leased office space (about 50,000 sq ft), primarily as a result of personnel reductions combined with consolidation of personnel in existing office space and trailers. However, for the short term, administrative functions are being relocated to 11,500 gsf of leased space in downtown Berkeley, and 6,600 gsf have been added to the life science program's leased area in the Berkeley Business Park. A major goal of the SDP is to provide both new laboratory space and lower-cost office additions that will allow laboratories now used for offices to be reclaimed; e.g., the planned Buildings 50E and 50F second-floor additions will accomplish this in the Buildings 50-70 Complex.

The total LBL construction for FY 1988–2004, including funded construction, budgeted construction, and proposed construction, is shown in Table 4-1, and proposed building placement is shown in the accompanying site map Figure 4-1.

LAND USE

Eighty acres of the site are currently designated as buffer and open-preserve areas, whereas about fifty acres have been developed with buildings, roadways, and other site improvements. Figure 4–2 shows the Buffer-Zone Landscape Map and Planning Areas. Special considerations are included in this table and are used to ensure that these areas are protected from use as building sites. Although plans call for the volume of building site to increase, future building footprints will be more compact and designed in accordance with landscape plans. Therefore, although the total amount of open space will decrease, the

Table 4-1. Long-Range Plan for Programmatic and General-Purpose Facilities, Including Funded, Budgeted, and Proposed Construction (FY BA,$M)

Project	TEC	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
FUNDED PROGRAM RELATED PROJECTS:																	
Advanced Light Source	99.5	18.0	25.0	26.0	23.0	6.0											
FUNDED MEL-FS PROJECTS (KB):																	
Electrical Systems Rehabilitation & Improvements	2.6	1.8	0.5														
Mechanical Utilities Rehabilitation, Phase I	5.5	3.0	1.6														
Environmental Health & Safety Projects	10.3	0.9	3.0	4.8	1.6												
Waste Handling Facility	4.7	0.5	2.8	1.4													
Subtotal (MEL-FS Projects)	**23.1**	**6.2**	**7.9**	**6.2**	**1.6**												
TOTAL FUNDED	**122.6**	**24.2**	**32.9**	**32.2**	**24.6**	**6.0**											
BUDGETED MEL-FS PROJECTS (KB)																	
Original Labsite Substation	2.8			0.3	2.5												
Instrument Support Laboratory Rehabilitation	2.0			0.2	1.8												
Slope and Seismic Stabilization	3.7			0.5	2.2	1.0											
TOTAL BUDGETED	**8.5**			**1.0**	**6.5**	**1.0**											
TOTAL FUNDED and BUDGETED	**131.1**	**24.2**	**32.9**	**33.2**	**31.1**	**7.0**											
PROPOSED PROGRAM RELATED PROJECTS:																	
Human Genome Laboratory (HA)	11.6				1.1	8.3	2.2										
Chemical Dynamics Research Laboratory (KC)	52.7				4.3	18.4	24.7	5.3									
Life Sciences Center (HA)	25.4				4.8	14.0	6.6										
Biomedical Isotope Facility (HA)	5.8				1.3	4.5											
Advanced Light Source User Facilites (KC)	9.7				3.0	6.7											
Conservation & Renewables Energy Laboratory (EC)	24.9					1.7	22.1	1.1									
SUBTOTAL - PROPOSED PROGRAM RELATED	**130.1**				**14.5**	**53.6**	**55.6**	**6.4**									
PROPOSED MEL-FS PROJECTS:																	
Blackberry Switching Station and Feeders	4.8				0.5	2.5	1.8										
Safety and Support Services Facility	7.7				0.5	2.8	4.4										
Mechanical Engineering Replacement, Phase I	10.5				1.2	2.4	6.9										
Environmental Monitoring and Restoration Facilities	3.8				3.4	0.4											
Road Rehabilitation, Phase I	3.0					2.0	0.5	0.5									
Roof Replacements, Phase I	3.0					0.3	0.5	2.2									
East Site Substation and Feeders	5.1						0.4	4.7									
Sitewide Mechanical Equipment Replacement, Phase I	3.4						0.4	3.0									
Mechanical Utilities Rehabilitation, Phase II	3.5							0.6	2.9								
Mechanical Engineering Replacement, Phase II	6.8							0.8	6.0								
Replace Central Switch & Feeders	4.6								0.8	1.6	2.2						
Electrical Engineering Replacement, Phase I	11.0								1.5	9.1	0.4						
Upper Blackberry Switch Replacement	5.9									0.5	5.4						
Rehabilitation of Bldg. 46	3.2									0.3	1.9	1.0					
Cooling Towers & Chillers Replacement	4.3										0.5	3.8					
Sitewide Electrical Equipment Replacement, Phase I	4.0										0.5	3.5					
Roof Replacements, Phase II	4.4										0.6	2.3	1.5				
Road Rehabilitation, Phase II	4.3											0.4	3.9				
Rehabilitation of Bldg. 10	4.3											0.5	3.8				
Mechanical Utilities Rehabilitation, Phase III	6.0												0.8	3.4	1.8		
Electrical Engineering Replacement, Phase II	11.0												1.6	7.4	2.0		
Rehabilitation of Bldg. 90	4.0													0.4	3.6		
Mechanical Utilities Rehabilitation, Phase IV	5.0													0.5	2.7	1.8	
Rehabilitation of Bldg. 64	6.0														0.6	3.0	2.4
Mechanical Utilities Rehabilitation, Phase V	7.0														0.8	5.2	1.0
Rehabilitation of Bldg. 50	6.0															0.7	3.6
Rehabilitation of Bldg. 70	7.0															0.8	2.9
Rehabilitation of Bldg. 70A	7.0																0.8
Rehabilitation of Bldg. 62	7.0																0.8
Roof Replacements, Phase III	5.0																
Road Rehabilitation, Phase III	5.0																
SUBTOTAL - PROPOSED MEL-FS PROJECTS	**173.6**	**0.0**	**0.0**	**0.0**	**5.6**	**10.4**	**14.9**	**11.8**	**11.2**	**11.5**	**11.5**	**11.5**	**11.6**	**11.7**	**11.5**	**11.5**	**11.5**

Escalated at 4.2%, FY 1989; 4.8%, FY 1990; 5.0%, FY 1991; 5.2%, FY 1992; 5.7%, FY 1993; 6.0%, FY 1994; 6.2%, FY1995; 6.4%, FY 1996; and 6.5%, FY 1997. Beyond 1997 in constant dollars.

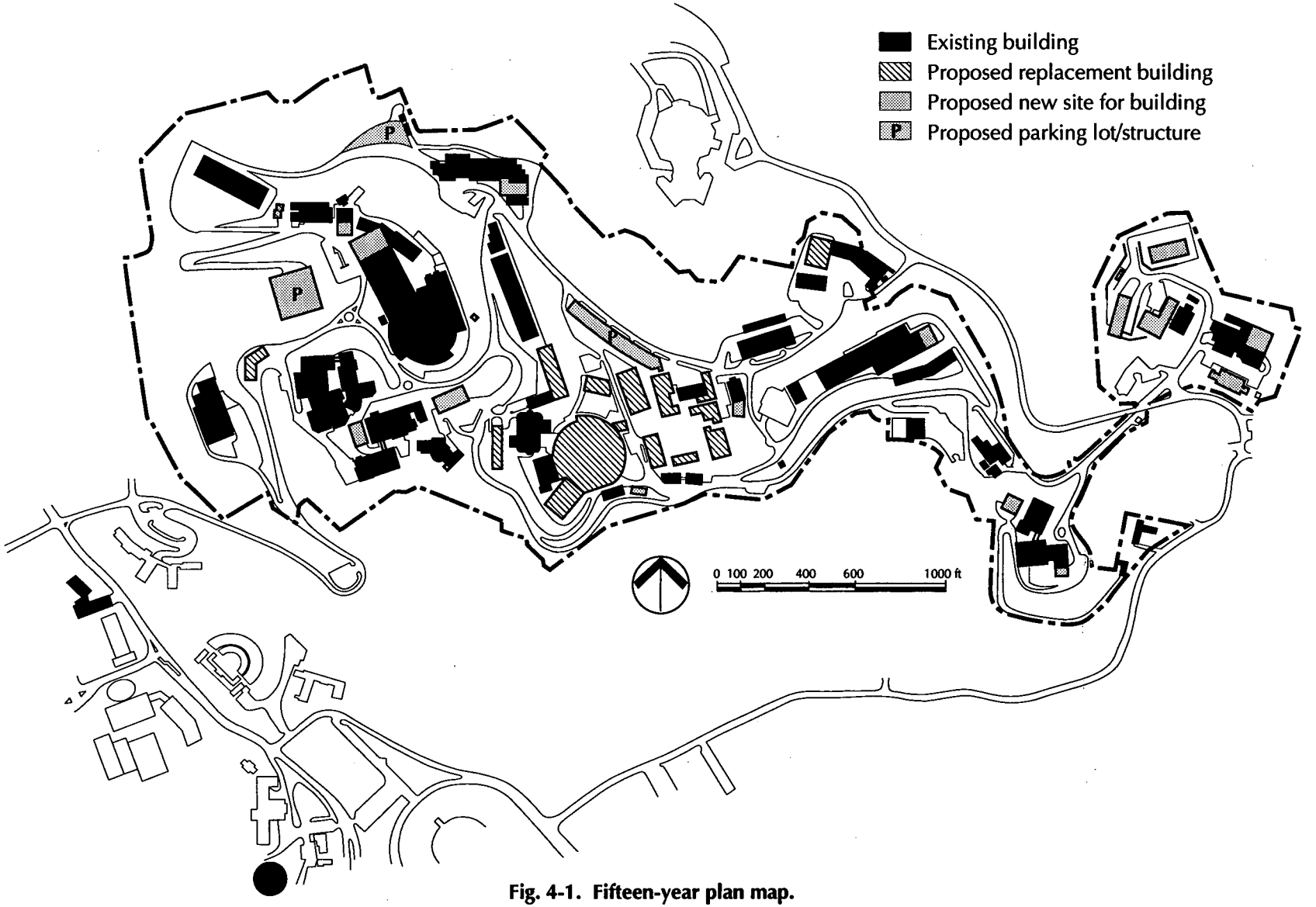


Fig. 4-1. Fifteen-year plan map.

sizes of individual open areas between buildings will increase, making the Laboratory more attractive to the research community and the community at large.

Future land use is depicted in Figure 4–3. Table 4–2 shows the percentage of the site used for structures and sites, roads, parking and paved areas, and open space. Overall adjustments include a 2.4% increase in structures, 1.1% increase in roads, no increase in parking and paved areas, and 3.5% decrease in open space.

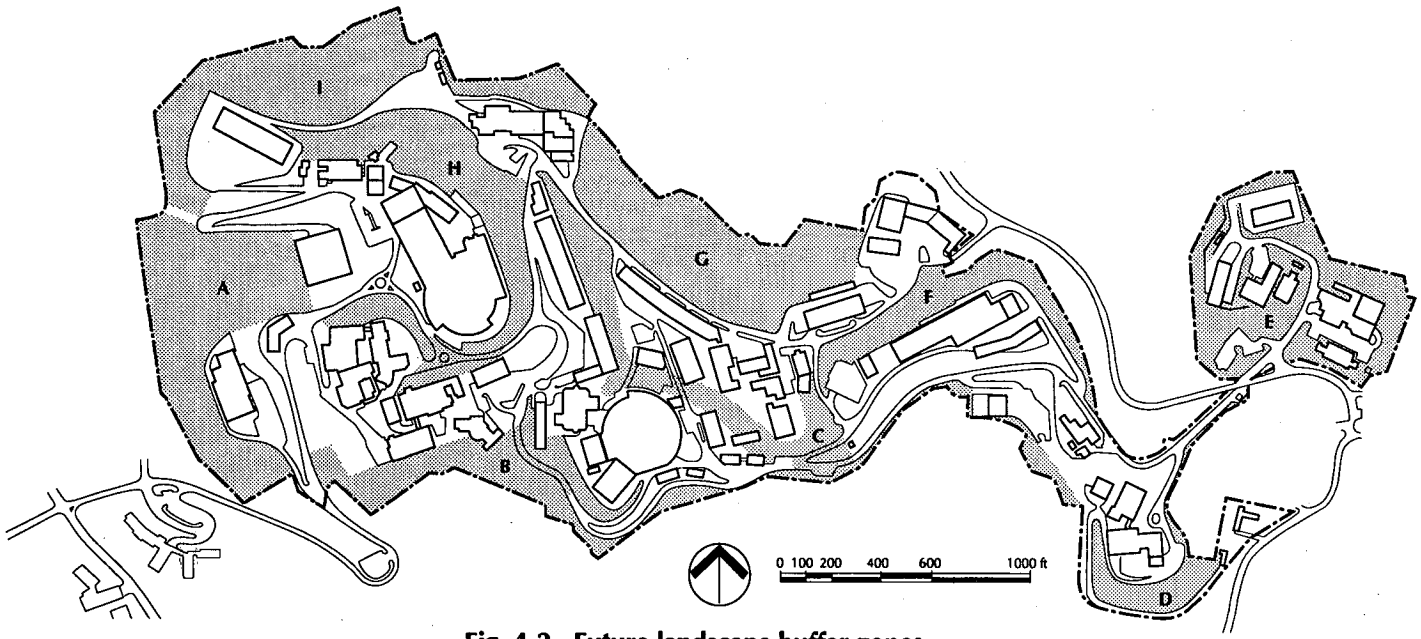


Fig. 4-2. Future landscape buffer zones.

Buffer-Zone	Planning & Protection Criteria				Special Considerations
	Views or Exposure	Building Density	Hydrology & Stability	Vegetation & Landscraping	
A Central Blackberry Canyon			•	•	Forested area with creek
B West Strawberry Canyon	•			•	Bayview; eucalyptus, dawn redwoods, and cork oaks
C Light Source Area	•	•		•	Sequoia redwoods, building density
D East Strawberry Canyon	•	•		•	Dawn redwoods, other evergreens
E Life Sciences Area				•	Forested area; evergreen and eucalyptus
F Grizzly Gate Perimeter			•		Slope stability
G Northeast Perimeter	•		•		Stability, drainage, and exposure
H Bevalac Perimeter		•	•	•	Slope stability; evergreen trees
I Blackberry Canyon	•			•	Exposure, eucalyptus trees

Table 4–2. Current and Future Land Use.

Use Category	Current		Future	
	Acres	Percent	Acres	Percent
Structures & Sites	18.4	14.2	22.2	16.6
Roads	14.4	11.1	16.2	12.2
Parking and Paved Areas	16.7	12.9	17.2	12.9
Open Space	80.2	61.8	77.8	58.3
Total	**129.7**	**100.0**	**133.4**	**100.0**

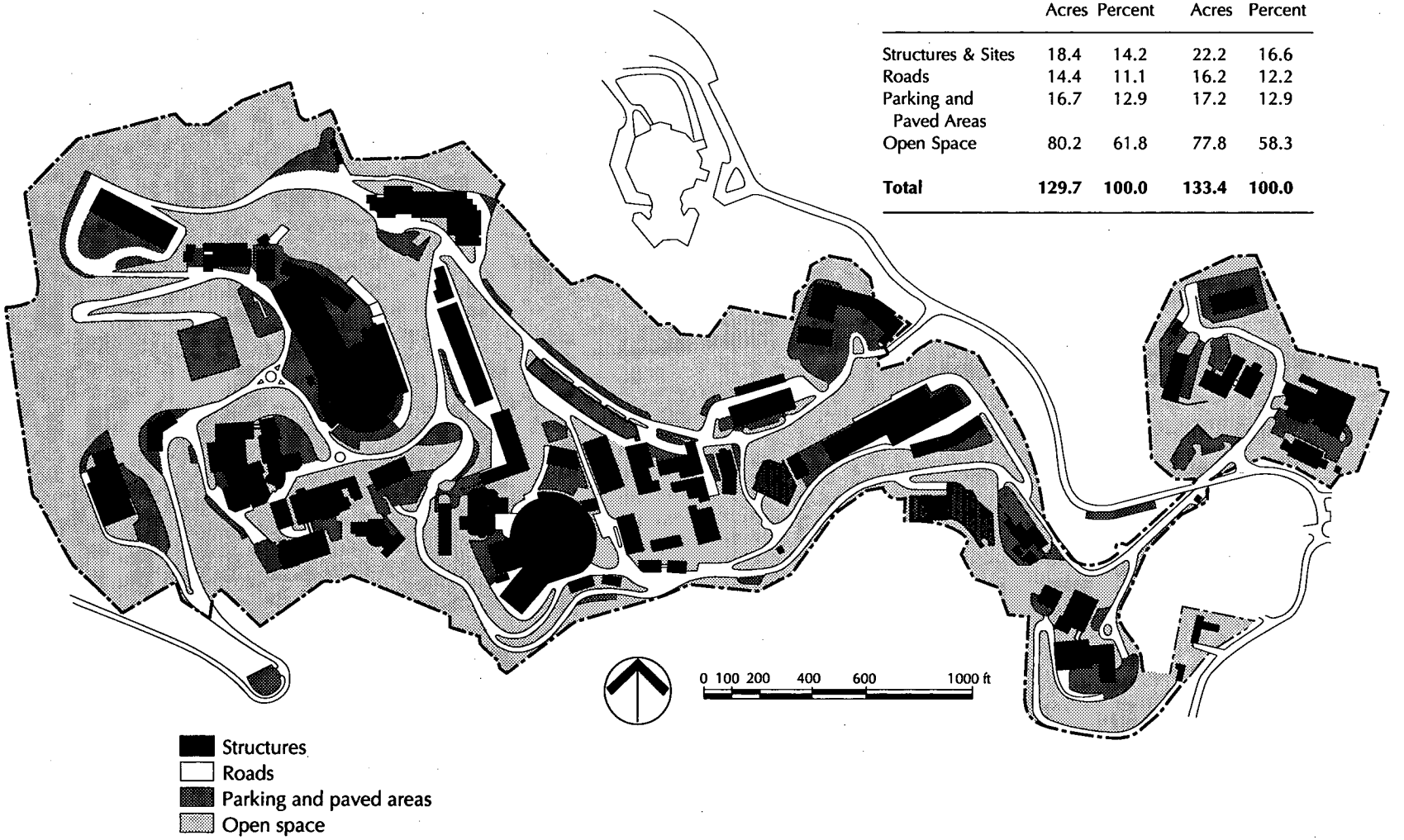


Fig. 4-3. Future land-use map.

FUNCTIONAL AREAS

Functional areas and future building sites are depicted in Figure 4–4. The following summarizes development in each functional area.

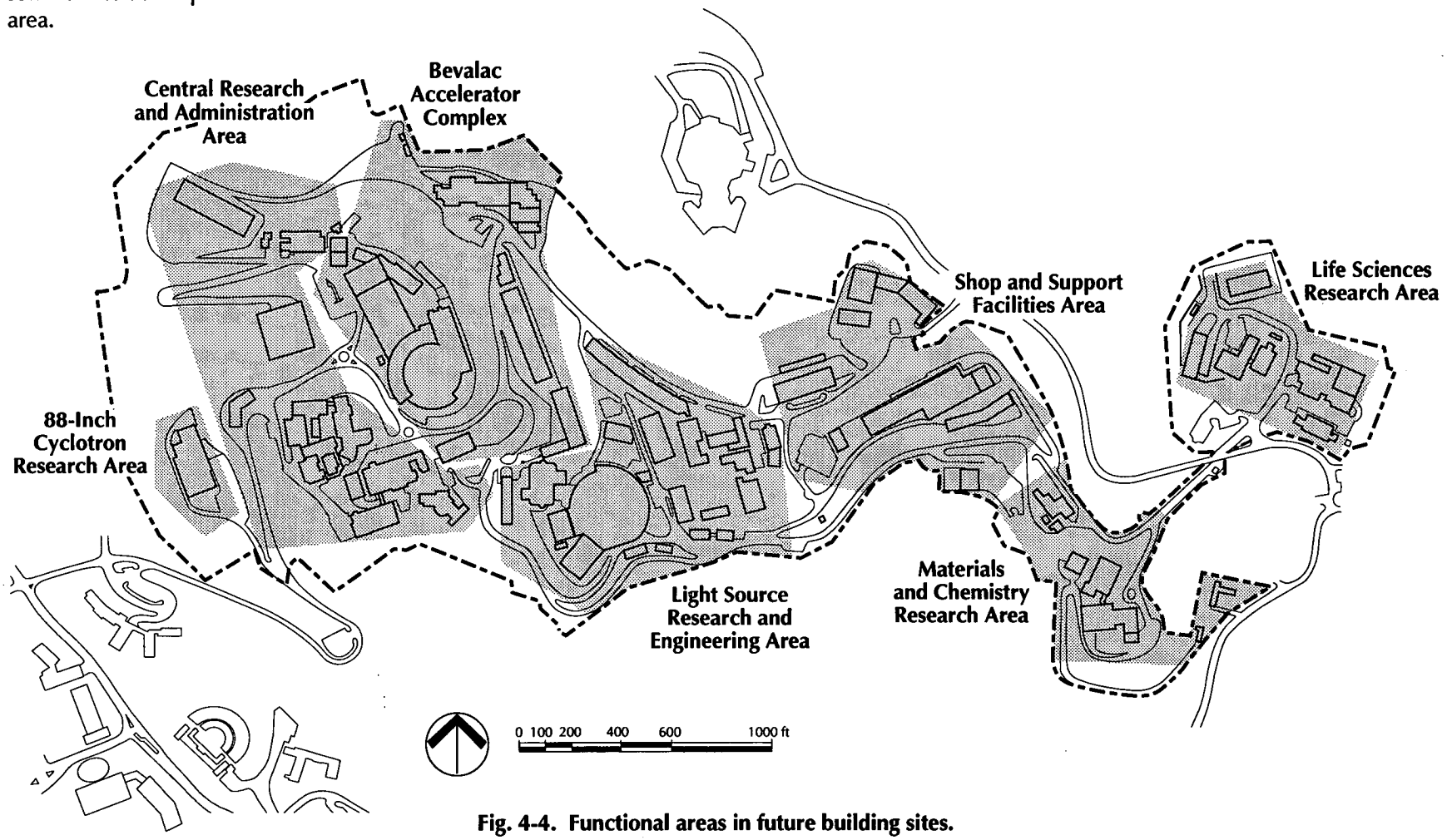


Fig. 4-4. Functional areas in future building sites.

88-Inch Cyclotron Research Area

The operating frequency of the electron-cyclotron-resonance (ECR) ion source on the 88-Inch Cyclotron will be increased to allow more-efficient coupling of microwave power to higher-density plasmas and to produce a dramatic increase in the beam intensity for ions with very high charge states. This improvement will result in a significant increase in the energy of heavy-ion beams from the Cyclotron. No changes in building structures for the 88-Inch Cyclotron Research Area are proposed during the next five years. (See Figure 4-5.)

Category/Project	Area (gsf)	Staff (heads)
Existing Buildings	53,800	54
A 88-Inch Cyclotron 2nd-Floor Addition	8,600	30
Net Total	**62,400**	**84**

Note: Area and staffing plans are for general estimating purposes only.

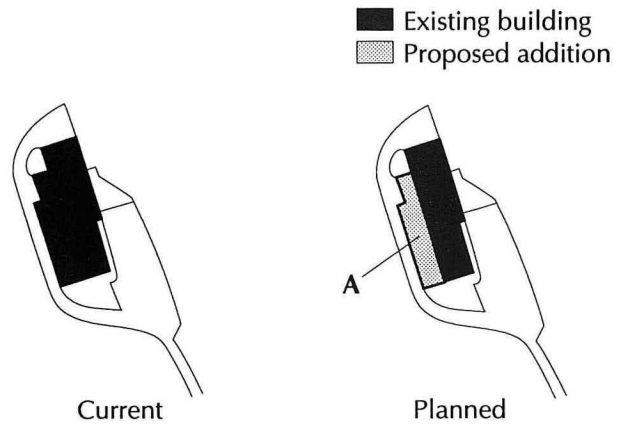
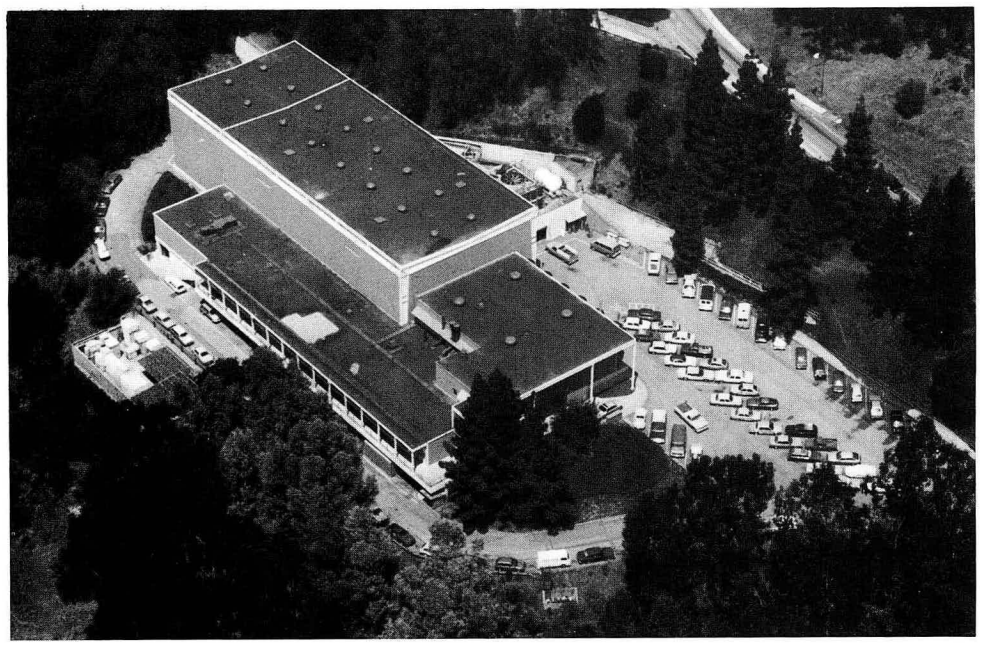


Fig. 4-5. 88-Inch Cyclotron Research Area.



Central Research and Administration Area

Minor physical expansion of existing programs is planned in the Central Research and Administration Area. One programmatic project, the Biomedical Isotope Facility, is planned adjacent to Building 55. Two projects, Building 50E Second Floor Addition (10,000 gsf), and Building 50F Second Floor Addition (8,400 gsf), previously approved by the UC Regents, are proposed for the Building 50 Complex; these projects, when funded, will enable LBL to reclaim laboratories in the Building 50-70 Complex now used for offices and will alleviate the shortage of laboratories needed for existing programs in the Central Research and Administration Area.

A two-phase MEL-FS project for Mechanical Engineering facilities in the Light Source Research and Engineering Area will replace obsolete buildings and enable mechanical engineering support groups to efficiently and safely meet existing service requirements. The collateral Electrical Engineering Replacement Project, also located in the Light Source Research and Engineering Area, will enable Plant Engineering to move into Building 90, thereby allowing removal of 17,630 gsf of Building 90 trailers, which will alleviate congested parking and traffic problems in the Central Research and Administration Area. (See Figure 4-6.)

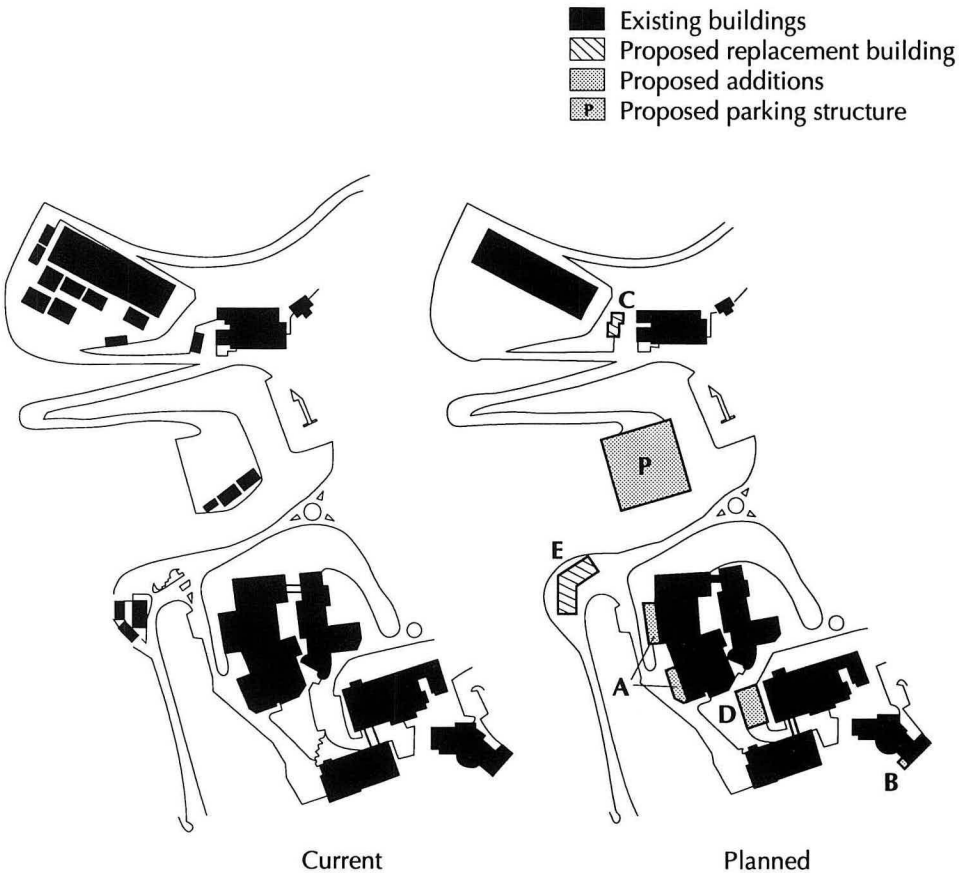
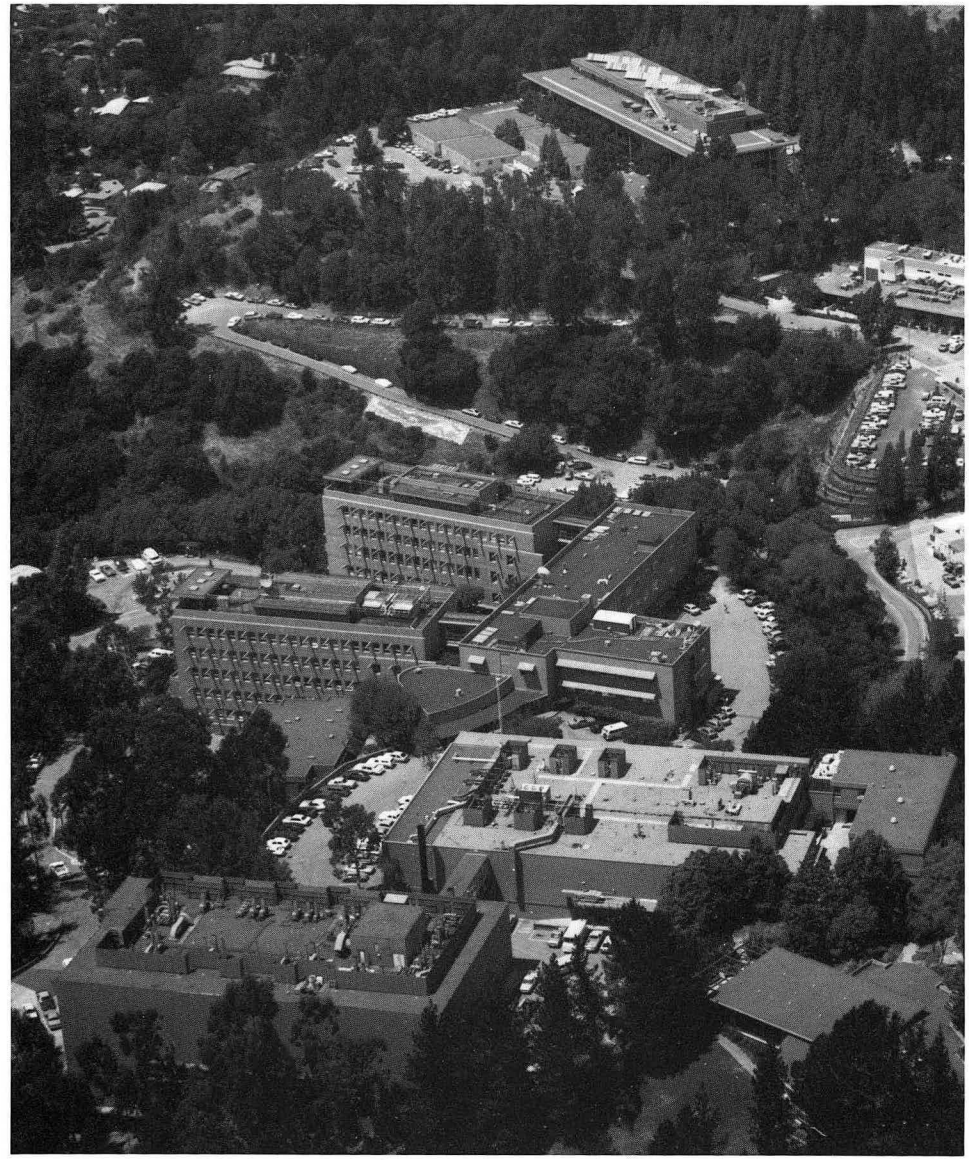


Fig. 4-6. Central Research and Administration Area.

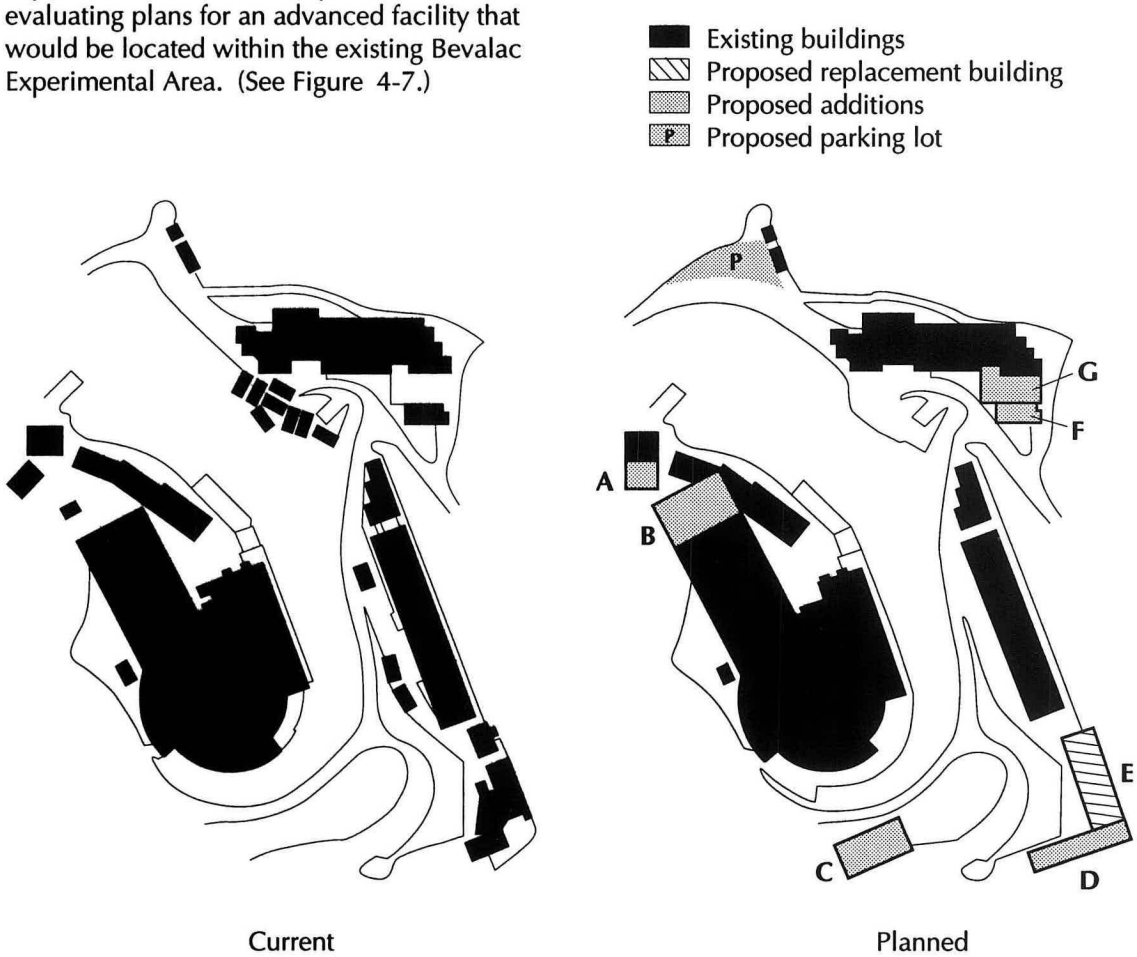
Category/Project	Area (gsf)	Staff (heads)
Existing Buildings	488,000	1,461
Additions/Replacements:		
A 2nd-Floor Additions	18,400	104
B Cafeteria Addition	1,900	2
C Biomed. Isotope Facility	4,000	2
D Conference Center	10,000	5
E 65 Replacement	7,000	32
Subtotal	41,300	145
Planned Removals	28,350	157
Net Total	**500,950**	**1,449**

Note: Area and staffing plans are for general estimating purposes only.



Bevalac Accelerator Complex

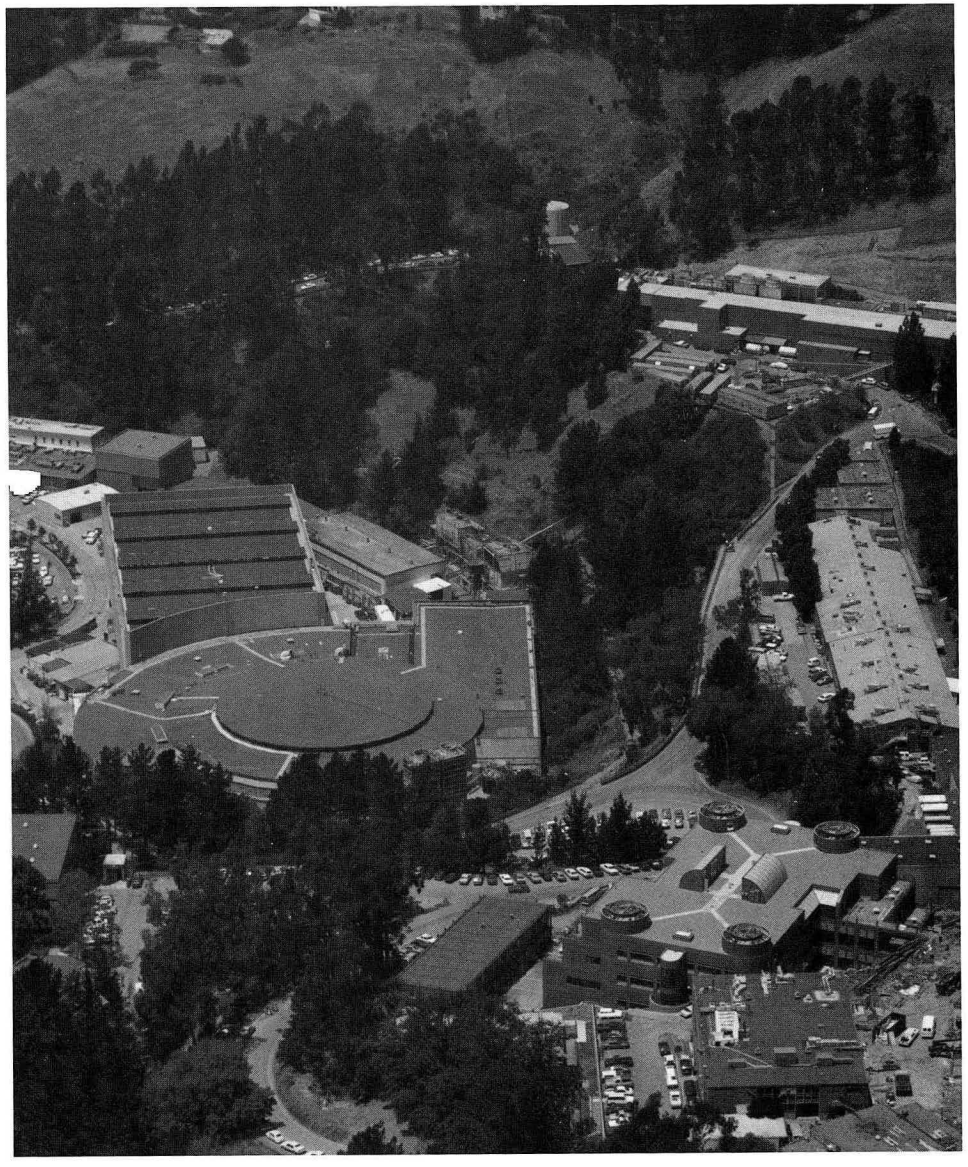
The Bevalac is a vital component of the nation's nuclear-physics and biophysical research capabilities. The Laboratory and the DOE are evaluating plans for an advanced facility that would be located within the existing Bevalac Experimental Area. (See Figure 4-7.)



Category/Project	Area (gsf)	Staff (heads)
Existing Buildings	352,400	434
Additions/Replacements:		
A Building Addition	3,400	10
B Hall Extension	15,000	0
C AFRD Building Site	54,600	120
D High-Bay Additions	1,700	3
E Building Replacement	59,500	73
F 3rd Floor Offices	3,100	10
G Building Addition	12,000	40
Subtotal	149,300	256
Planned Removals	29,800	88
Net Total	**471,900**	**602**

Note: Area and staffing plans are for general estimating purposes only.

Fig. 4-7. Bevalac Accelerator Complex.



Light Source Research and Engineering Area

Three projects funded in FY 1984 initiated redevelopment of the Light Source Research and Engineering Area.

1. Rehabilitation of Deteriorated Mechanical Utilities (completed in 1987).
2. Roadways Safety Project (completed in 1987).
3. The Advanced Materials Laboratory (to be completed in FY 1989).

The Advanced Materials Laboratory (81,000 gsf), will be dedicated to research on synthesis of advanced materials with potential value to energy-related and high-technology industries.

The major construction project in the Light Source Research and Engineering Area is the Advanced Light Source (ALS), located in Building 6, which is being remodeled and increased by about 61,000 gsf. This facility will provide soft x-rays and vacuum-ultraviolet radiation of unprecedented brightness for users in a wide range of collaborative research among national laboratories, universities, and industry.

A Life Sciences Center is proposed for FY 1991 to house LBL, university, and industry scientists who will use ALS beam lines to perform unique biological research. The Advanced Materials Laboratory and the Advanced Light Source are cornerstones for proposed further redevelopment of the area such as the proposed Chemical Dynamics Research Laboratory. A special research facility zone is emerging in an arch around the ALS along with zoning for utilities to preserve areas of interest to programs requiring photon beams.

The MEL-FS Mechanical Engineering Replacement Project, Phases I and II (46,400 gsf), will enable the Laboratory to provide safe and efficient housing for the Mechanical Technology Shops and to demolish Building 25, a World War II structure that cannot be braced to withstand a major earthquake. A high-bay assembly area will be provided for interdisciplinary teams to assemble and test prototypes. In addition, Building 5 (another old and obsolete building), will be demolished. Construction of the proposed Safety and Support Services Facility (to be located in the Shops and Support Facilities Area) will permit demolition of the obsolete Building 7 and its associated trailers in the Light Source Research and Engineering Area.

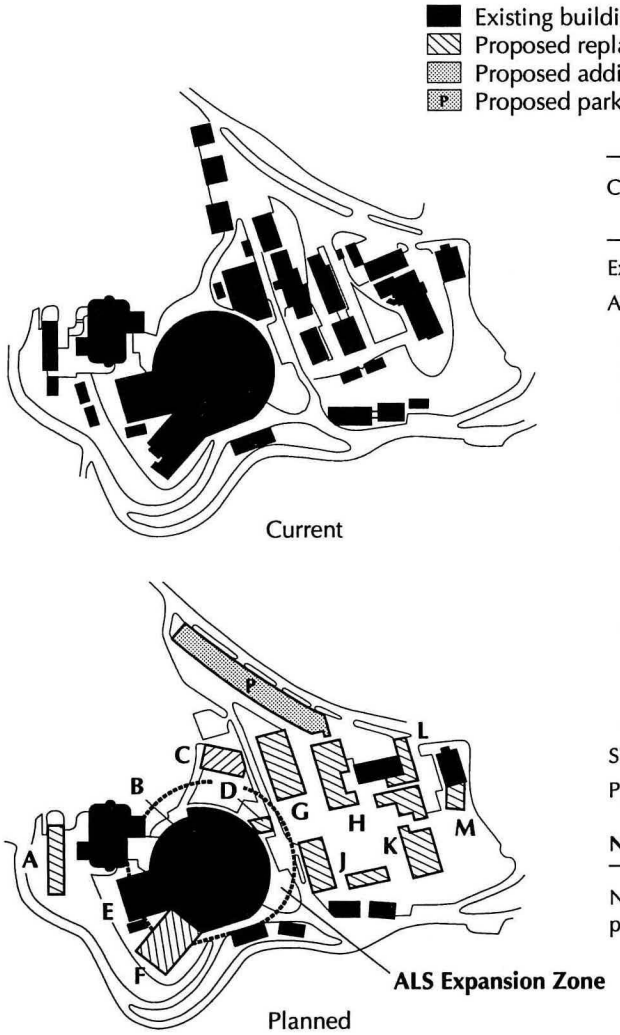
Stage I of the Electrical Engineering Replacement Project, an MEL-FS project, will permit most of the Electronics Engineering Department to be housed in one centralized facility designed for its needs. This will greatly enhance interdepartmental communication and reduce costs by replacing obsolete and/or temporary facilities.

Stage II of the Electrical Engineering Replacement Project will permit the remainder of the Electronics Groups to unify with the Department office and technology shops next to the Mechanical Engineering Building and will provide safe and efficient facilities. Several 25-year-old obsolete buildings and trailers will be removed as part of this project. Thus, a substantial portion of the redevelopment plan will be realized.

To complement the redevelopment of this area, the Original Labsite Substation, construction of which is one of several projects to rehabilitate the electrical distribution system for the entire Laboratory, will provide a new 12-kV distribution system for the Light Source Research and Engineering Area, replacing aged and unreliable 12-kV cables.

LBL conducts research for Magnetic Fusion programs in this functional area. The Laboratory will accommodate changes in this research program through the development of AFRD replacement laboratories over the 15-year planning period.

The Conservation and Renewable-Energy Research Complex will enable the Laboratory's Applied Science Division to consolidate major portions of its research activities, now located in 13 buildings on site and at two off-site locations, thereby promoting interdisciplinary interactions and reducing costs by avoiding duplicate service and research facilities. The location of this 49,800–gsf laboratory building is one of the subjects of a site-use study to be completed in FY 1989 (see Figure 4–8).



Category/Project	Area (gsf)	Staff (heads)
Existing Buildings	362,000	409
Additions/Replacements:		
A 29 Replacement	16,200	51
B ALS–Future Enhancement	21,000	200
C Future Bldg. Site	28,000	60
D Visitors Center	3,000	2
E ALS–Life Sciences Center	—	—
F Chemical Dynamics Res. Lab.	—	—
G AFRD Replacement	32,000	80
H CRE Laboratory	45,000	110
J Mech. Eng. Replacement	52,000	100
K Elec. Eng. Replacement	60,000	160
L Circuit Board Shop	3,200	10
M 26 Addition	2,000	5
Subtotal	262,400	778
Planned Removals	126,330	236
Net Total	**498,070**	**951**

Note: Area and staffing plans are for general estimating purposes only.

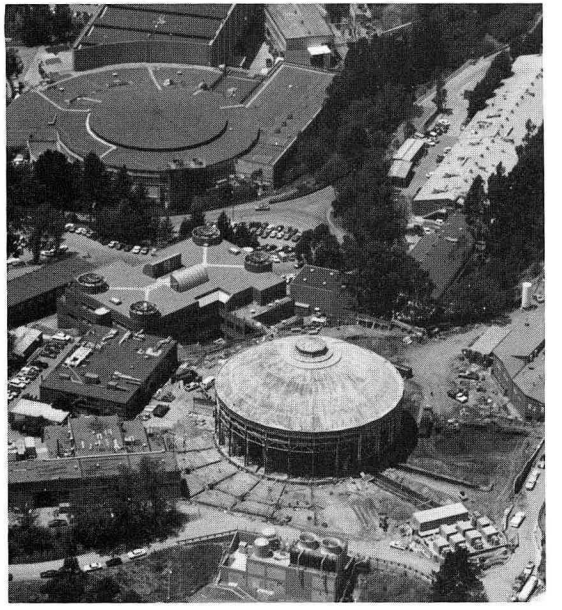


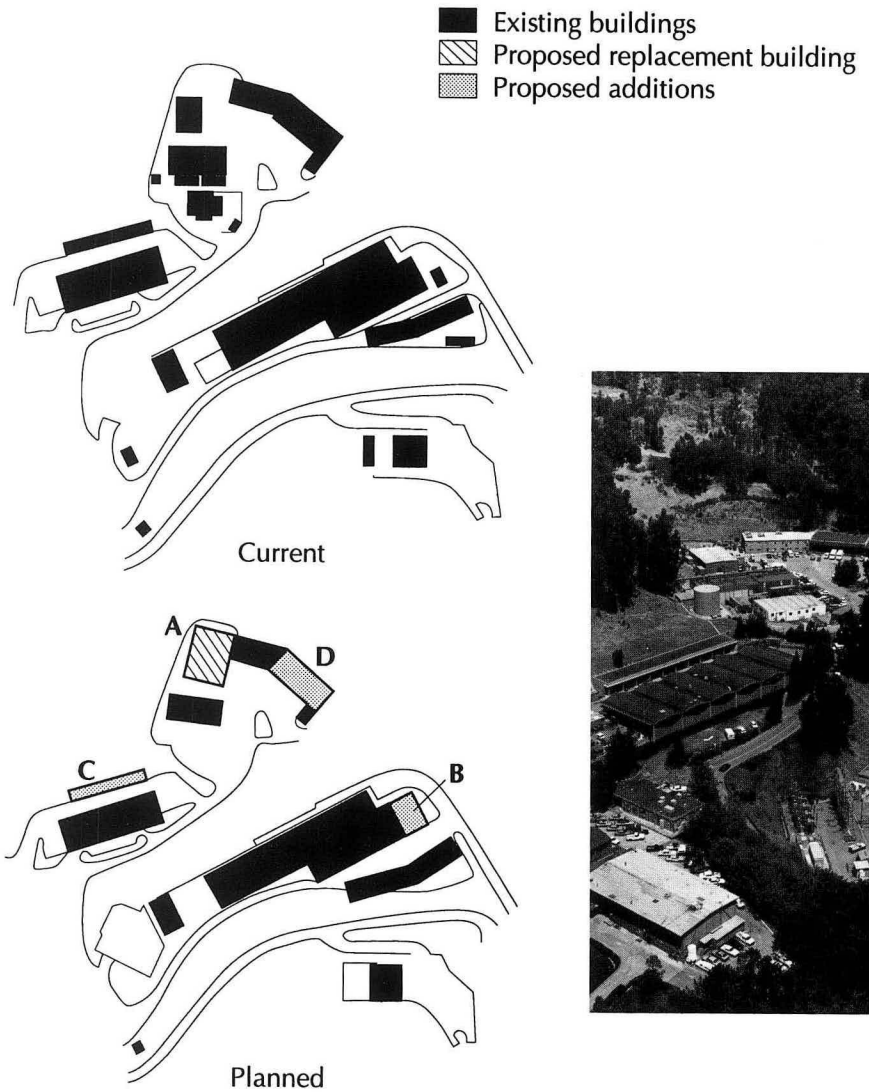
Fig. 4-8. Light Source Research and Engineering Area.

Shop and Support Facilities Area

In the mid-1970s, the full development of this area was conceived in a Site Utilization Study. The proposed Safety and Support Services Facility (42,000 gsf) will enable Environmental Health and Safety, Materiel Management, and (as an interim move) Electronics Engineering to vacate trailers and other substandard buildings scheduled for demolition. These moves will initiate orderly staging of other, related moves that are a prerequisite for subsequent phases of the LBL Site Development Plan. (See Figure 4-9.)

Category/Project	Area (gsf)	Staff (heads)
Existing Buildings	163,700	350
Additions/Replacements		
A Safety & Support Services Fac.	42,000	129
B 77 Addition	2,400	10
C 78 2nd-Floor Addition	5,400	20
D 69 2nd-Floor Addition	4,000	30
Subtotal	53,800	189
Planned Removals	11,650	32
Net Total	**205,850**	**507**

Note: Area and staffing plans are for general estimating purposes only.



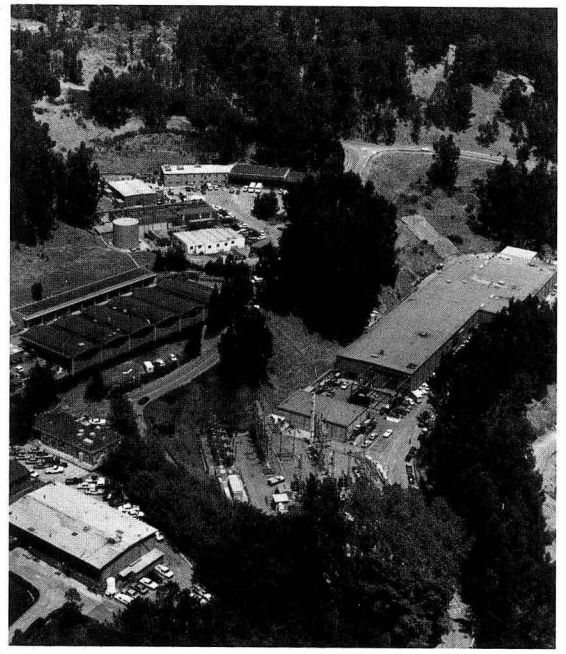


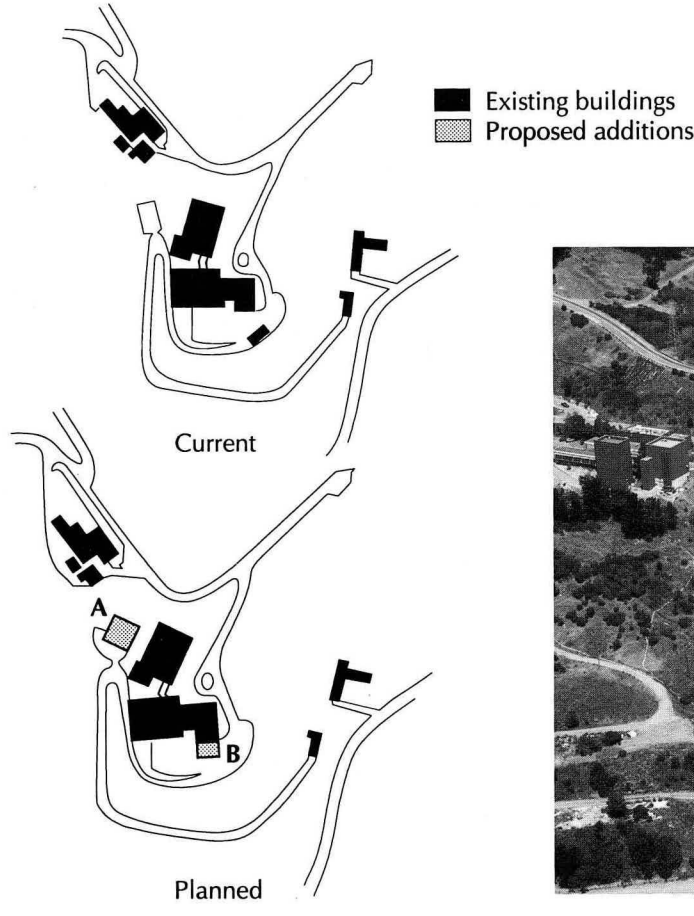
Fig. 4-9. Shop and Support Facilities Area.

Materials and Chemistry Research Area

The Surface Science and Catalysis Laboratory, which is located between the Materials and Molecular Research Laboratory and the National Center for Electron Microscopy, was occupied in FY 1987. These three facilities house major program elements of the Center for Advanced Materials. (See Figure 4-10.)

Category/Project	Area (gsf)	Staff (heads)
Existing Buildings	127,000	162
A Future Bldg. Site	30,000	133
B 62 High-Bay Addition	2,200	4
Subtotal	32,200	137
Planned Removals	1,190	18
Net Total	**158,010**	**281**

Note: Area and staffing plans are for general estimating purposes only.



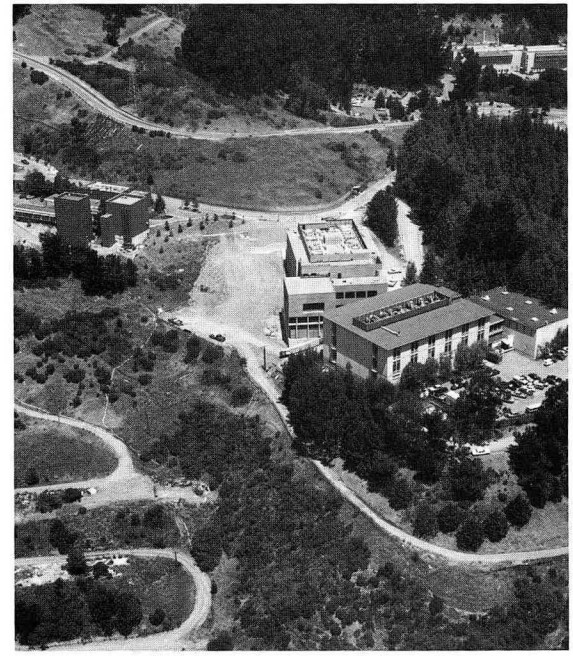


Fig. 4-10. Materials and Chemistry Research Area.

Life Science Research Area

Construction of the Human Genome Laboratory in this area will provide essential research support for the Human Genome Center established as one of two DOE genome research centers.

The Hazardous Waste Handling Facility Relocation, an MEL-FS project in the Life Sciences Research Area, north of Buildings 74 and 83, will include an access road, site utilities, grading and paving of a yard area, and a 12,300-gsf building for hazardous-waste handling and temporary storage. (See Figure 4-11.)

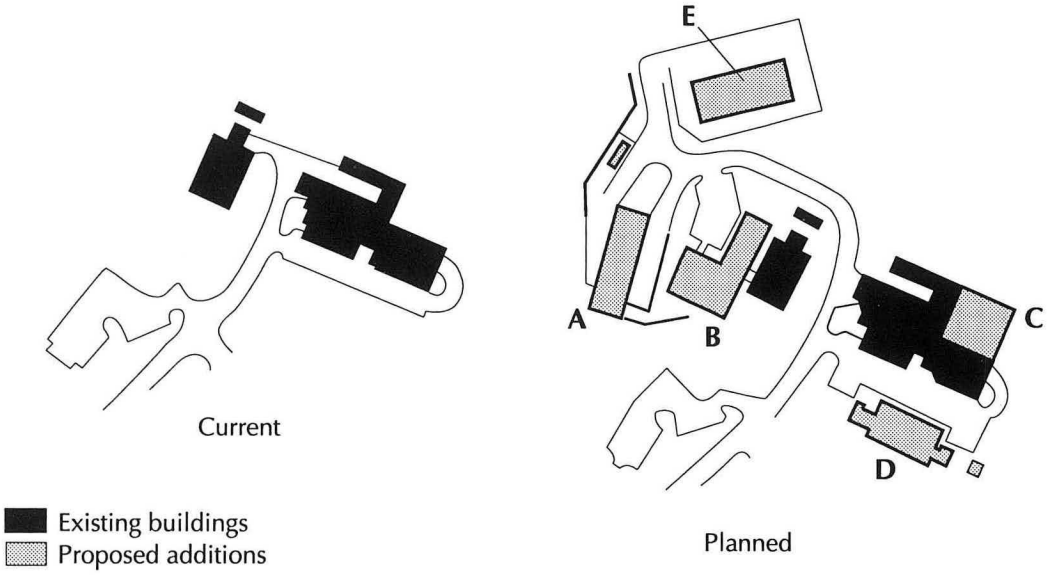
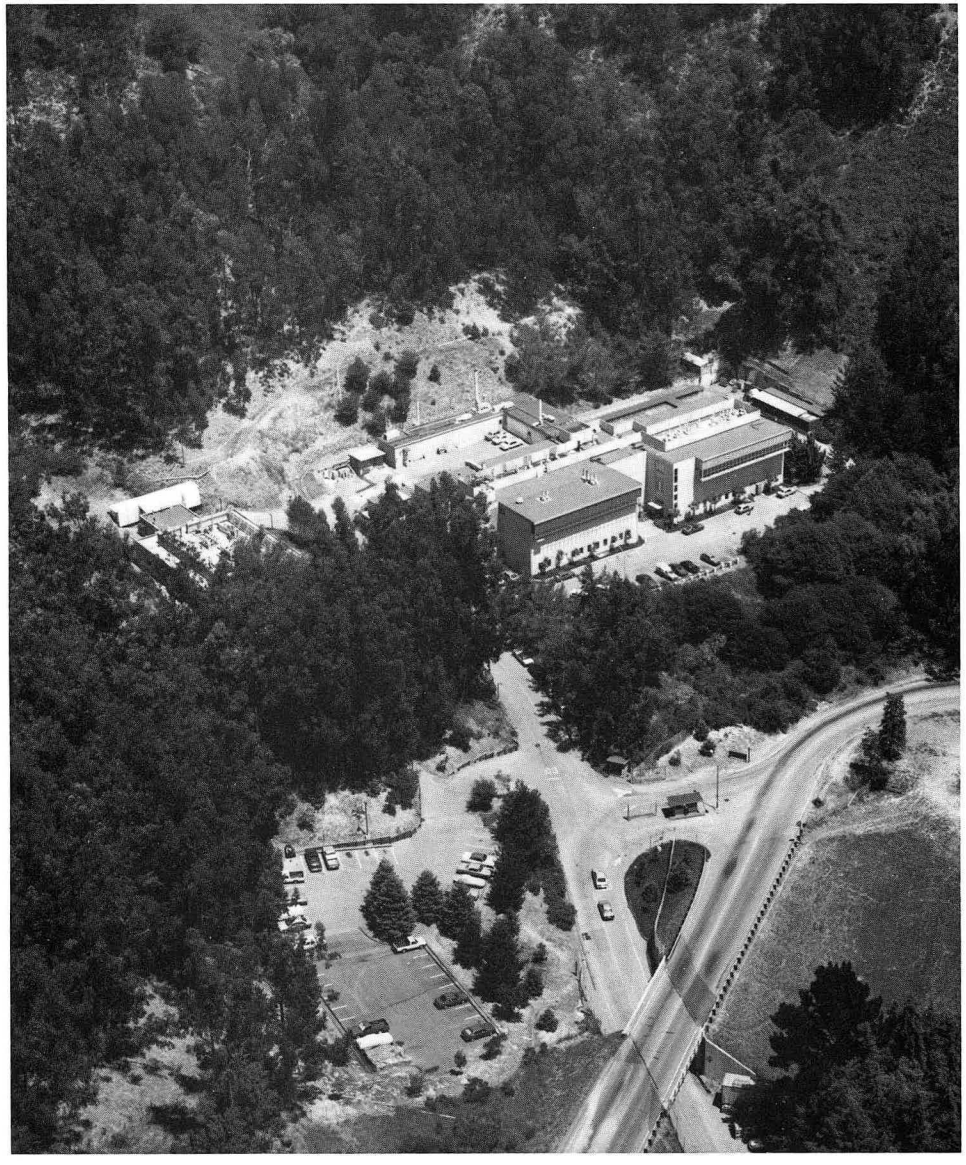


Fig. 4-11. Life Science Research Area.

Category/Project	Area (gsf)	Staff (heads)
Existing Buildings	54,200	72
Additions/Replacements		
A Waste Handling	12,300	4
B Cell & Biology Lab. II	27,000	45
C Life Science Additions	12,700	20
D Human Genome Lab.	32,200	60
E Future Building Sites	10,000	25
Subtotal	94,200	154
Planned Removals	490	0
Net Total	**147,910**	**226**

Note: Area and staffing plans are for general estimating purposes only.



GENERAL-PURPOSE CONSTRUCTION PROJECTS

Funded Utility Projects

The following projects are described briefly to identify the major objectives of each in the context of the need to rehabilitate and systematically maintain labwide electrical systems.

- Electrical Systems Rehabilitation and Improvements (FY 1987). This project is the first of several required to improve the reliability of the electrical-power distribution system for the entire Laboratory. It will rehabilitate and improve the operational flexibility and safety of the 12–kV main substation. The project will permit LBL to take advantage of favorable electrical rates by providing access to reduced-cost interruptible power.
- Rehabilitate Site Mechanical Utilities — Phase I (FY 1987). This project will upgrade and replace portions of underground mechanical-utility systems throughout the site; a central compressed-air plant and the Building 88 cooling tower will be replaced, and an acid neutralization system will be added at the Building 70 complex.

Proposed Electrical Utility Projects

- Original-Laboratory-Site Substation Project. This project will provide a new 12-kV power distribution center and replace existing 12-kV feeder cables in the oldest part of the Laboratory. The existing power-distribution center and feeder cables are beyond their useful life and are unreliable.
- Blackberry-Canyon 12-kV Switching Station and Feeder. This project includes a new 12-kV power distribution center near the Bevatron (Building 51) that will initially serve the Central Research and Administration Area and the Bevalac Accelerator Complex. The distribution center will improve the reliability and operational capability of the existing 12-kV distribution system. Also, the existing duct-bank system will be upgraded, and deteriorated cables will be replaced.
- East-Site Substation and Feeders. The Life Science Research Area and the Materials and Chemistry Research Area are currently served by a single 12-kV cable system. This project will establish a 12-kV power-distribution center near the intersection of Centennial Drive and Cyclotron Road and provide new 12-kV cabling to each major facility. Also included will be a new substation for Building 72 (National Center for Electron Microscopy) and an upgrade of the existing substation at Building 74 (Biomedical Laboratory) that serves both Building 74 and Building 83 (Cell Culture Laboratory).
- Central Switching Station and Feeders. A new 12-kV power-distribution center will be installed near the Building 50 complex to serve the Building 50 complex, Buildings 70 and 70A, the 88-Inch Cyclotron, Building 55 (Research Medicine), and Building 90. New 12-kV power-distribution cables and duct-bank additions will be installed as required to replace existing equipment or to provide increased capacity.
- Upper Blackberry Switch Replacement. The Upper Blackberry Switching Station will provide 12-kV interruptible and uninterruptible power to the Building 71 research complex. Included in the project will be new 12-kV feeder cables from the Grizzly main substation, a unit substation to provide low-voltage power, secondary feeder cables, and equipment for power-factor correction.
- Sitewide Electrical Equipment Replacement. This project will replace electrical equipment including transformers, power switches, circuit breakers, switchboards, and motor controls that is critical to LBL's operation and whose failure rate and useful remaining life warrant replacement.

Proposed Mechanical Utility Projects

- Rehabilitate Site Mechanical Utilities — Phase II. This project is a continuation of Phase I rehabilitation; it includes the addition of a 4-MW cooling-tower cell to

the load center serving the Light Source Research and Engineering Area and upgrades to the compressed-air facilities in Buildings 51 and 70.

- Rehabilitate Site Mechanical Utilities — Phase III. This project extends the Light Source Research and Engineering Area mechanical-utility corridor and distribution system. Deteriorated underground piping will be replaced.
- Rehabilitate Site Mechanical Utilities — Phase IV. Mechanical utilities will be extended to the east canyon area. Deteriorated piping in certain hillside areas will be replaced.
- Rehabilitate Site Mechanical Utilities — Phase V. Portions of deteriorated utilities will be replaced sitewide. A 300,000-gallon water tank above the Buildings 74-83 complex will be constructed for added fire protection.
- Replace Cooling Towers and Chillers — Phase I. This project replaces 15 cooling towers and 9 refrigeration chillers that are more than 20 years old.
- Sitewide Mechanical Equipment Replacement — Phase I. Portions of building mechanical equipment and systems having the most serious deficiencies will be replaced, including boilers, air handlers, automatic controls, deionized-water units, air compressors, ducts, and piping.

Proposed Construction Projects — General Purpose

- Instrument Support Laboratory Rehabilitation. This project will rehabilitate facilities originally constructed in 1961 and will bring utilities, air-handling equipment, and electrical and fire-protection systems up to codes. The Instrument Support Laboratory is used for multiprogram instrumentation engineering activities and semiconductor detector fabrication.
- Mechanical Engineering Replacement Projects — Phases I & II. These projects will enable the Laboratory to provide safe and efficient housing for the Mechanical Technology Shops and to demolish Building 25. Furthermore, the efficiency of the mechanical engineers will be enhanced by having them close to the Mechanical Technology and Central Machine Shops. A high-bay assembly area will be used by interdisciplinary teams to assemble and test prototypes. In addition, Buildings 5, 14, and 52 will be demolished to bring the total removals to 38,550 gsf.
- Electrical Engineering Replacement Project — Phases I & II. This project (approximately 60,000 gsf) will permit the Electronics Engineering Department to be housed in one centralized facility designed for its needs. This will enhance intradepartmental communication and reduce costs by eliminating duplicate facilities.

Other Health and Safety Projects

- Waste-Handling Facility (FY 1988). This project will initiate the development of a remote site for a badly needed waste-handling facility, including a specialized 12,300-gsf building and adjacent yard area. It will be located north of the research facilities in the Life Sciences Research Area.
- Safety and Support Services Facility. This building will be a three-story structure of 42,000 gsf to be occupied by the Environmental Health and Safety, Materiel Management, and Electronics Engineering Departments. Three old substandard buildings and five trailers will be removed.
- Environmental Health and Safety Project. This project, funded in FY 1988, consists of eleven small projects for the protection and improvement of the environment and the health and safety of Laboratory employees and the general public. They are correcting serious environmental deficiencies and safety hazards that could disrupt program activities. Environmental health and safety improvements are required in medical-service facilities, outdoor lighting, radiation monitoring, laboratory ventilation systems, water-pollution control and monitoring, and other safety systems. Slope stabilization, required in the Bevalac and Mechanical Shops Areas, is scheduled for FY 1990.

- Traffic Circulation and Parking Improvements. Road rehabilitation is required to facilitate the efficient and safe movement of people and materials throughout the site. Roads need to be widened, base materials need to be replaced to handle current traffic loadings, acute curves and blind spots need to be eliminated, and roadways on steep hillsides need to be stabilized. To improve safety and appearance a study of signs on the LBL site is being conducted. A sign plan will be developed based on the results of this study. The plan calls for two phases of road rehabilitation (funded by MEL-FS): one in FY 1992 and one in FY 1999.

PROGRAM-RELATED CONSTRUCTION PROJECTS

Funded Construction Projects — Program Related

- Advanced Light Source. The ALS will be located in a single building comprising the existing Building 6 and a new 61,000-gsf addition, creating a 82,000-gsf facility that will house all of the accelerator components, the photon beam lines, and the experimental facilities.

Proposed Construction Projects — Program Related

- Human Genome Laboratory. This facility, an essential component of the Human Genome Center at LBL, will be located in the Life Sciences Research Area, which provides direct access via Centennial Drive to the UCB Campus, where major LBL research facilities are situated at Donner Laboratory and the Chemical Biodynamics Laboratory. The Life Sciences Research Area now includes existing cell and molecular biology research facilities in the Biomedical Laboratory, Building 74, and the Cell and Biology Laboratory, Building 83, that are used for related research on gene expression and hemopoesis. Modifications and additions to these buildings are now underway to provide facilities for human genome research and for relocation of Life Sciences Research at Building 934 to this area.
- Life Sciences Center. The proposed Center will provide two ALS beam lines and support space for specimen preparation and support services for visiting university and industry scientists and core LBL personnel. Extensive renovation of Building 10 and additional construction in Building 6 are being considered, as well as other possible options, such as upper-floor additions to adjacent Building 80 or a new building close to the ALS.
- Chemical Dynamics Research Laboratory. This proposed facility would combine photon beams from the ALS with a free-electron laser and molecular beam apparatus to explore the interaction of radiation with matter at the molecular level.
- Conservation and Renewables Research Laboratory. This proposed research laboratory will consolidate research in energy conservation in buildings, solar energy, electrochemical- and thermal-energy conversion, and combustion. At present, this research is conducted in 13 buildings on site and at two off-site locations.
- Biomedical Isotope Facility. This facility will provide an on-site source of short-lived radioisotopes essential for the in vivo metabolic and physiologic basic and applied LBL Life Sciences research programs. The project will provide this essential support in laboratories close to the positron emission tomography (PET) facility at Building 55, necessary for short-lived isotope use.

- Bevalac. Major improvements to the Bevalac are proposed to extend the nation's nuclear-physics capability to explore a wide range of nuclear interactions through an upgraded synchrotron accelerator and, over the longer term, a possible new stretcher-cooling ring. This upgrade would also advance biophysical research. The upgraded facility would be located within the existing Bevalac experimental area. The upgrade proposal is undergoing review by LBL and DOE.

GENERAL PLANT PROJECTS

Over the last 20 years, LBL has found it necessary to rely upon General Plant Projects (GPP) funding for almost all improvements, replacements, and maintenance and repair projects for physical-plant facilities that required capital funding. LBL has used its GPP funds to solve problems related to seismic safety, fire protection, and industrial safety. In addition, required small capital additions or modifications required for program initiatives were accomplished with GPP funds.

General deterioration and obsolescence of LBL facilities, which are among the oldest found at national laboratories, has been unarrested in the past, and the backlog of deficiencies has continued to grow. The average age of LBL buildings is now 28 years, and many basic utility load centers and distribution systems are now over 40 years old. The Laboratory is in a situation where very significant general-plant outlays for major replacement projects (such as 12-kV cabling, switching stations, cooling towers, roofs, boilers, chillers, gas lines, water lines, etc.) will be necessary on an emergency basis over the next several years. Even if the current funding level (up to $12 M) of the DOE MEL-FS program for revitalization of multiprogram laboratories continues its upward trend, there are built-in delays for design and construction of the initial projects.

With MEL-FS funds at the $11-M level, many maintenance and physical plant projects will be funded. However, progress in increasing GPP funding to $6.0 M/year is needed to ensure the success of the Laboratory's rehabilitation program. These increased funds would be used for essential environmental health and safety needs, and the remainder would continue to support both multiprogram and small programmatic initiatives. GPP plans for the next five years are found in Chapter 5.

MAINTENANCE AND ENERGY CONSERVATION

Many of LBL's facility-related maintenance costs stem from aged and obsolescent buildings and deteriorated utilities. (This plan calls for about 110,000 gsf of World War II structures that require excessive maintenance to be demolished as soon as economically practical.)

LBL has carried out a formal maintenance management program for over 30 years and has included a computerized scheduled maintenance system for more than 25 years.

Budget requests are based upon plant facilities inspections coupled with special engineering studies and reviews by LBL's Plant Engineering Department and consulting firms in specialized areas such as cranes, elevators, boilers and pressure vessels, fire protection, slope stability, storm drainage, seismic safety, industrial safety, underground utilities, photography, and energy-use surveys. An annual work plan and a budget are developed and reviewed at three management levels before being approved at the directorate level. The formulation of the maintenance budget is an iterative process that takes into account related work plans for noncapital alterations, general plant projects, multiprogram general-purpose line items, and regular line-item construction. This process begins with a zero-base budget study, includes consideration for other operating budget priorities, and culminates in a formalized work plan for the fiscal year. Since maintenance and repair requirements are also generated continuously throughout the fiscal year, a formal system provides for timely consideration and processing of these requirements. Longer-range work plans are being developed for items of major maintenance, such as reroofing, paving, slope-stabilization projects, major equipment-overhaul projects, rehabilitation, building exterior painting, and utilities replacements. A five-year projection is made annually with specific projects itemized over the first three years and lumped for the last two.

The 15-Year Plan addresses many of the major maintenance issues. The reroofing, road projects, slope stabilization, general-purpose-facilities replacement projects, and some environmental health and safety improvements are examples. Not addressed in this 15-year construction plan are the operating expenses for maintenance, which include physical-plant maintenance, programmatic-facilities maintenance (such as for the Bevalac), mobile-equipment maintenance, noncapital alterations related to maintenance, and specialized maintenance related to shop and computer facilities. For information on these expenses over the near term refer to the maintenance section of Chapter 5.

The strategy for accomplishing environmental improvements, required repairs, and upkeep relies on increasing capital outlays and streamlining the existing maintenance program and making it more cost effective. Emergency replacements that may be necessary during the next few years can only be achieved with GPP funding. Funding for longer-term general-purpose improvements to sustain utilities and other facilities has been requested under the MEL-FS program. Currently, the Laboratory is using noncapital alterations and GPP funding to the extent possible to augment maintenance-account funding. In addition, the Plant Engineering and Construction and Maintenance Departments have begun developing a comprehensive list of backlogged maintenance, repair, and replacement projects for both capital and noncapital funding . A maintenance engineer has been added to the staff to improve LBL scheduled maintenance

and repairs, to increase awareness of priorities for capital repairs and replacements, and to develop long-term planning mechanisms. Laboratory management is developing long-term plans for sustaining LBL facilities through GPP and MEL-FS programs.

In October 1985, DOE issued its Ten-Year In-House Energy Management Plan covering the period FY 1986 to FY 1995. In concert with this plan, LBL developed and issued its Ten-Year In-House Energy Management Plan in December 1985 and updated it in June 1987 (Appendix A). The plan includes short- and long-term actions designed to meet the ten-year objectives (see Table 4-3).

Elements of LBL's In-House Energy Management plans include

- Surveys and studies
- Retrofits
- New buildings
- Central plant improvements
- Increased awareness/incentives
- Improved transportation
- Utility upgrades
- Emergency conservation
- Metering/accounting

LBL continues to strive to reduce power costs by using less-reliable power and shifting accelerator operations to less-costly off-peak rate times. LBL also seeks to have lower-cost firm power to support dedicated programs.

Table 4-3. In-House Energy Management (Fiscal Year/$M).

	1989	1990	1991	1992	1993	1994
Total Annual Funding	2.5	2.0	2.0	2.0	2.0	2.0

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FIVE-YEAR PLAN

PLANNING ASSUMPTIONS AND RATIONALE

The Master 15-Year Plan described in Chapter 5 provides the institutional and strategic planning framework for making informed decisions for the near term. This chapter describes operational aspects of the plan based on current needs and resources. Resources, and the resulting patterns of construction and development dependent on these resources, may vary from year to year, and priorities are adjusted accordingly. Specific construction projects, improvements, and demolitions and removals are described below and in Appendix D.

Beginning in FY 1988 LBL has successfully applied In-House Energy Management funding to reduce electrical-power costs. Energy centers with automated sensing and control systems are being established. Lighting modifications have substantially lowered costs by allowing more individual control of workspace lighting and by using more-efficient fixtures, bulbs, and ballasts. New buildings are designed with energy-efficient components, and existing buildings are being systematically retrofitted.

Assumptions for programmatic projects include the following (see Table 5-1).

- Continued funding for the Advanced Light Source with completion in FY 1993
- Funding for the Human Genome Laboratory beginning in FY 1990
- Other identified projects requested in FY 1991 — Chemical Dynamics Research Laboratory, Biomedical Isotope Facility, Conservation and Renewables Research Laboratory, and the ALS Life Sciences Center
- Advanced Light Sources User Facilities proposed for FY 1993

Site and facilities planning for the 5-year period is based on the *LBL Institutional Plan FY 1989–1994*, prepared in November 1988. Projects are derived from the Laboratory's response to DOE's national program plans and represent either important new facilities or the rebuilding of existing infrastructure to accommodate research and support activities. Five-year plans provided by the Office of Energy Research for each of its Research Program Offices and other DOE Assistant Secretarial Offices are also used.

To address critical needs, the Laboratory analyzes projects identified by both research

Table 5-1. Programmatic Facilities (Fiscal Year/$M).

Project Title	TEC	Schedule
Advanced Light Source (KC)	99.5	1987–1993
Human Genome Laboratory (HA)	11.6	1991–1993
ALS Life Sciences Center (HA)	25.4	1991–1993
Chemical Dynamics Research Laboratory (KC)	52.7	1991–1994
Biomedical Isotope Facility (HA)	5.8	1991–1992
Conservation & Renewables Res. Complex (EC)	24.9	1992–1994
Advanced Light Source, User Facilities (KC)	9.7	1993–1996

and support staff as having environmental, health, and safety implications and/or as having the potential to interrupt research programs. The current funds from all sources are inadequate to fill all of the identified needs within a single fiscal year or even within the 5-year planning period. From the available information the Office for Planning and Development, the Plant Engineering Department, and the Occupational Health Division propose priorities for each of the critical projects. Priorities are established by the Director's Executive Committee and coordinated with SAN and UC.

The Five-Year Plan is based primarily on capital funding from Programmatic, MEL-FS, GPP, and GPE sources (Table 5-2). Other sources of funding are the In-House Energy Management and Strategic Facilities Initiative (SFI) programs and operating funds from the Environmental Restoration Program. A detailed analysis of needs has been completed by Laboratory staff for each of these funding categories. Needs for GPE and GPP far

Table 5-2. Five-year Capital Improvement Plan (Fiscal Year, $K).

Category	1989	1990	1991	1992	1993	1994	TOTAL
MEL-FS	9,900	7,200	7,200	13,700	14,900	11,800	**62,700**
GPP	2,600	2,600	3,500	4,000	4,000	4,000	**20,700**
GPE	1,300	1,400	2,000	2,500	3,000	3,000	**13,200**

exceed the expected funding. For example, GPE needs over the next five years total $38.2 M, whereas GPE funding levels are expected to be $2–3 M per year. GPP and MEL-FS needs and funding resources have similar disparities. To maximize the strategic investment in plant and equipment, the Laboratory's MEL-FS, GPP, and GPE needs have been categorized and prioritized (Figures 5-1, 5-2, and 5-3). MEL-FS and GPP funding from FY–1980 through FY–1989 is shown in Figure 5-4.

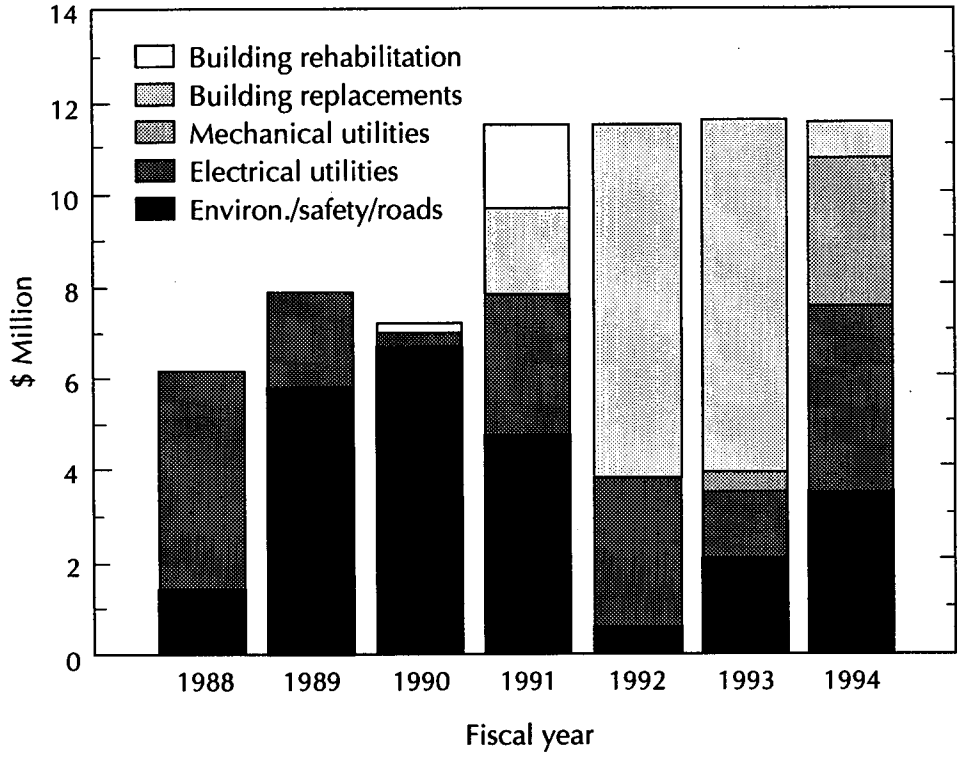

Fig. 5-1. Five-year MEL-FS backlog.

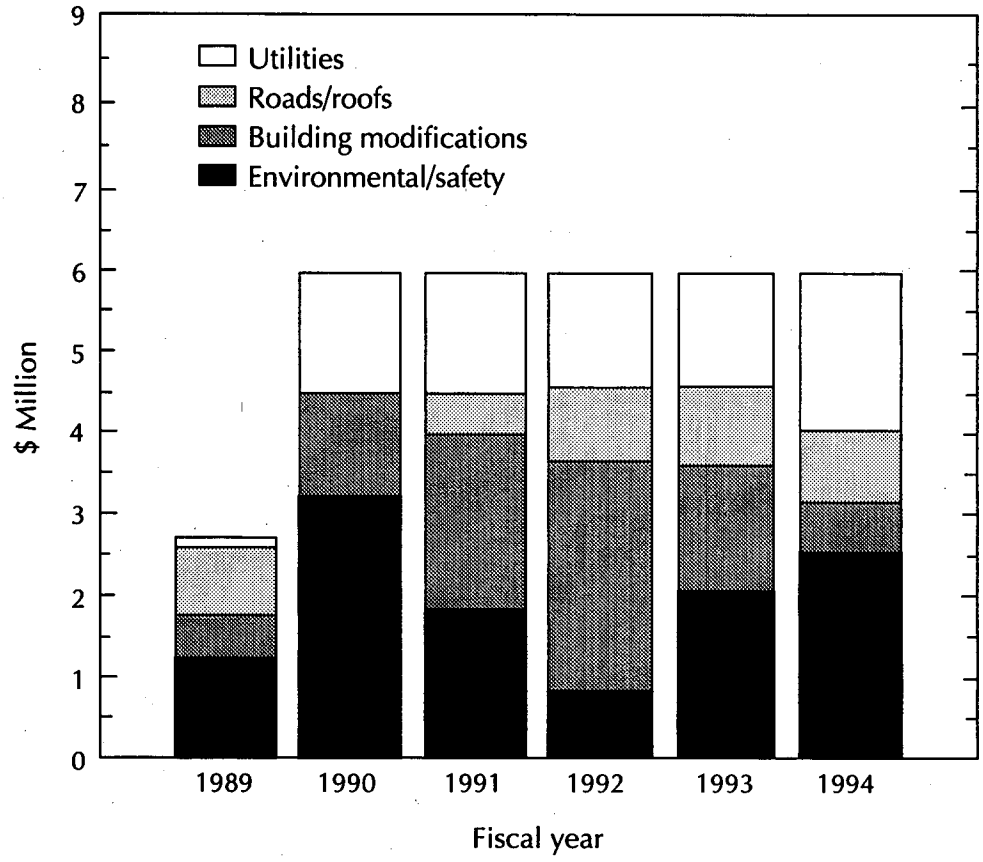

Fig. 5-2. Five-year GPP backlog.

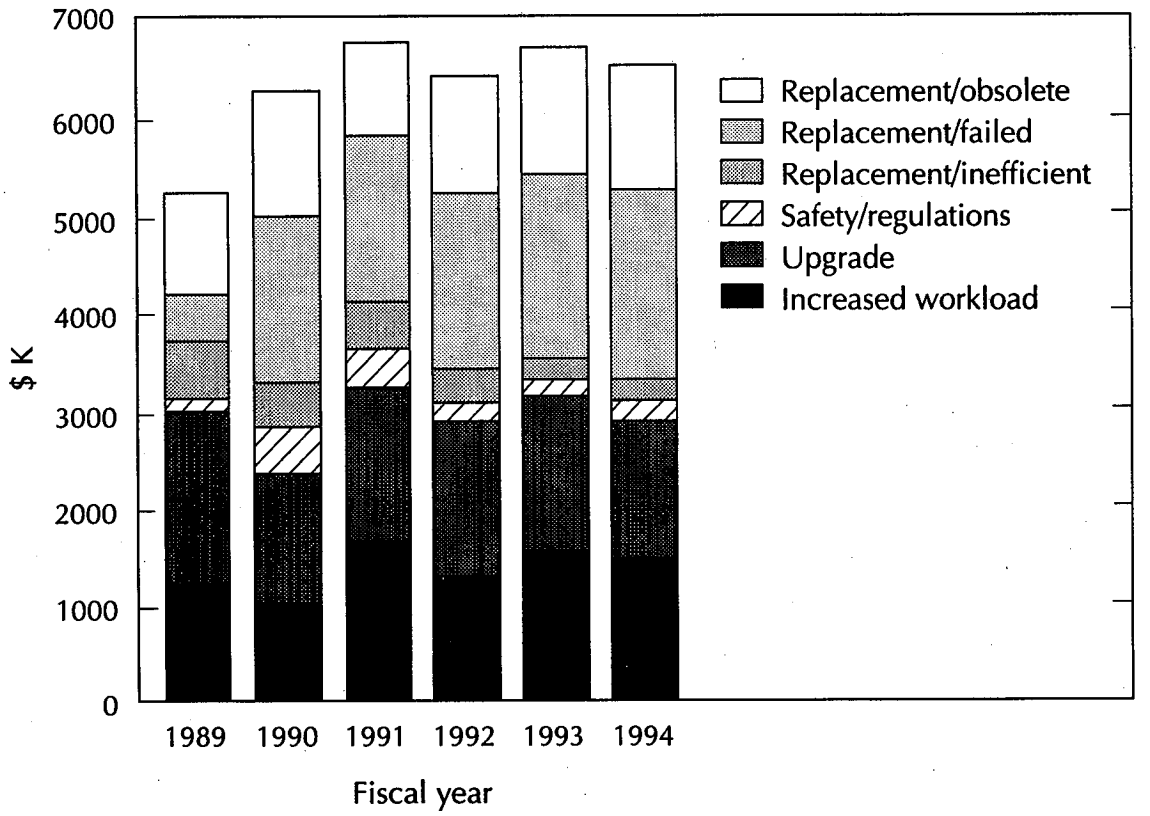

Fig. 5-3. Five-year GPE needs.

FIVE-YEAR PROGRAMMATIC AND MEL-FS PLANS

Table 5-3 lists the capital funding profiles for individual projects for the next 5 years. Figure 5-5 shows the proposed changes to the site for this period. Actual project starts are subject to funding constraints and subsequent changes in priority. The 5–Year Plan is in concert with the Master 15–Year Plan in that incremental additions, replacements, or improvements are all tested for conformance to the established Design Guidelines and Site Planning Concepts. Furthermore, new information such as the Old Town Site Utilization Study is continually incorporated into planning and analysis when made available.

88-Inch Cyclotron Research Area

There are no changes planned for in this area other than elements of the site-wide MEL-FS projects for roads, roofs, and mechanical and electrical utilities.

Central Research and Administration Area

One programmatic project, the Biomedical Isotope Facility to provide short-lived radioisotopes onsite for Life Sciences research, is planned to begin in FY 1991. MEL-FS projects include elements of sitewide projects and the Instrument Support Laboratory Rehabilitation.

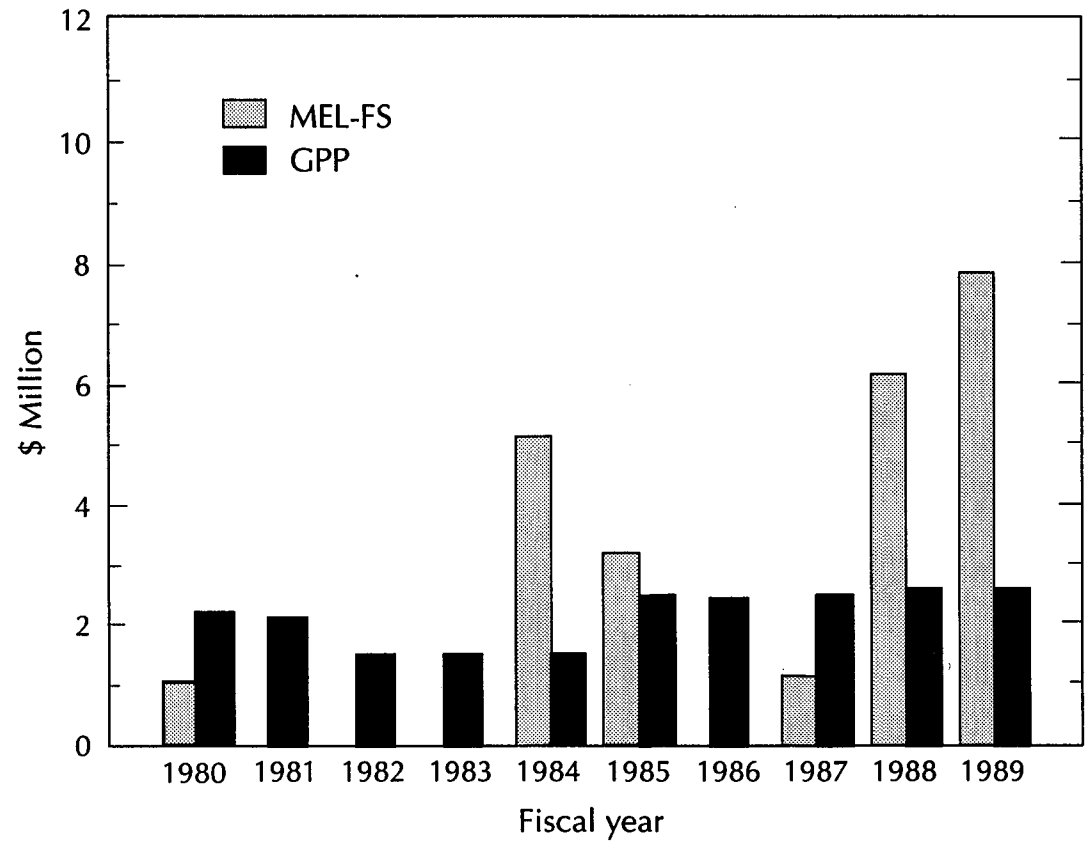

Fig. 5-4. Past MEL-FS and GPP funding.

Table 5-3. Five-Year Plan for Programmatic and General-Purpose Facilities, Including Funded, Budgeted, and Proposed Construction (FY BA,$M)

Project	TEC	1988	1989	1990	1991	1992	1993	1994
FUNDED PROGRAM RELATED PROJECTS:								
Advanced Light Source	99.5	18.0	25.0	26.0	23.0	6.0		
FUNDED MEL-FS PROJECTS (KB):								
Electrical Systems Rehabilitation & Improvements	2.6	1.8	0.5					
Mechanical Utilities Rehabilitation, Phase I	5.5	3.0	1.6					
Environmental Health & Safety Projects	10.3	0.9	3.0	4.8	1.6			
Waste Handling Facility	4.7	0.5	2.8	1.4				
Subtotal (MEL-FS Projects)	**23.1**	**6.2**	**7.9**	**6.2**	**1.6**			
TOTAL FUNDED	**122.6**	**24.2**	**32.9**	**32.2**	**24.6**	**6.0**		
BUDGETED MEL-FS PROJECTS (KB)								
Original Labsite Substation	2.8			0.3	2.5			
Instrument Support Laboratory Rehabilitation	2.0			0.2	1.8			
Slope and Seismic Stabilization	3.7			0.5	2.2	1.0		
TOTAL (Budgeted)	**8.5**			**1.0**	**6.5**	**1.0**		
TOTAL (Funded and Budgeted)	**131.1**	**24.2**	**32.9**	**33.2**	**31.1**	**7.0**		
PROPOSED PROGRAM RELATED PROJECTS:								
Human Genome Laboratory (HA)	11.6				1.1	8.3	2.2	
Chemical Dynamics Research Laboratory (KC)	52.7				4.3	18.4	24.7	5.3
Life Sciences Center (HA)	25.4				4.8	14.0	6.6	
Biomedical Isotope Facility (HA)	5.8				1.3	4.5		
Advanced Light Source User Facilites (KC)	9.7				3.0	6.7		
Conservation & Renewables Energy Laboratory (EC)	24.9					1.7	22.1	1.1
Subtotal (Program Related - Proposed)	**130.1**				**14.5**	**53.6**	**55.6**	**6.4**
PROPOSED MEL-FS PROJECTS:								
Blackberry Switching Station and Feeders	4.8				0.5	2.5	1.8	
Safety and Support Services Facility	7.7				0.5	2.8	4.4	
Mechanical Engineering Replacement, Phase I	10.5				1.2	2.4	6.9	
Environmental Monitoring and Restoration Facilities	3.8				3.4	0.4		
Road Rehabilitation, Phase I	3.0					2.0	0.5	0.5
Roof Replacements, Phase I	3.0					0.3	0.5	2.2
East Site Substation and Feeders	5.1						0.4	4.7
Sitewide Mechanical Equipment Replacement, Phase I	3.4						0.4	3.0
Mechanical Utilities Rehabilitation, Phase II	3.5							0.6
Mechanical Engineering Replacement, Phase II	6.8							0.8
Subtotal (MEL-FS Projects - Proposed)	**51.6**	**0.0**	**0.0**	**0.0**	**5.6**	**10.4**	**14.9**	**11.8**
TOTAL (Proposed)	181.7	0.0	0.0	0.0	20.1	64.0	70.5	18.2

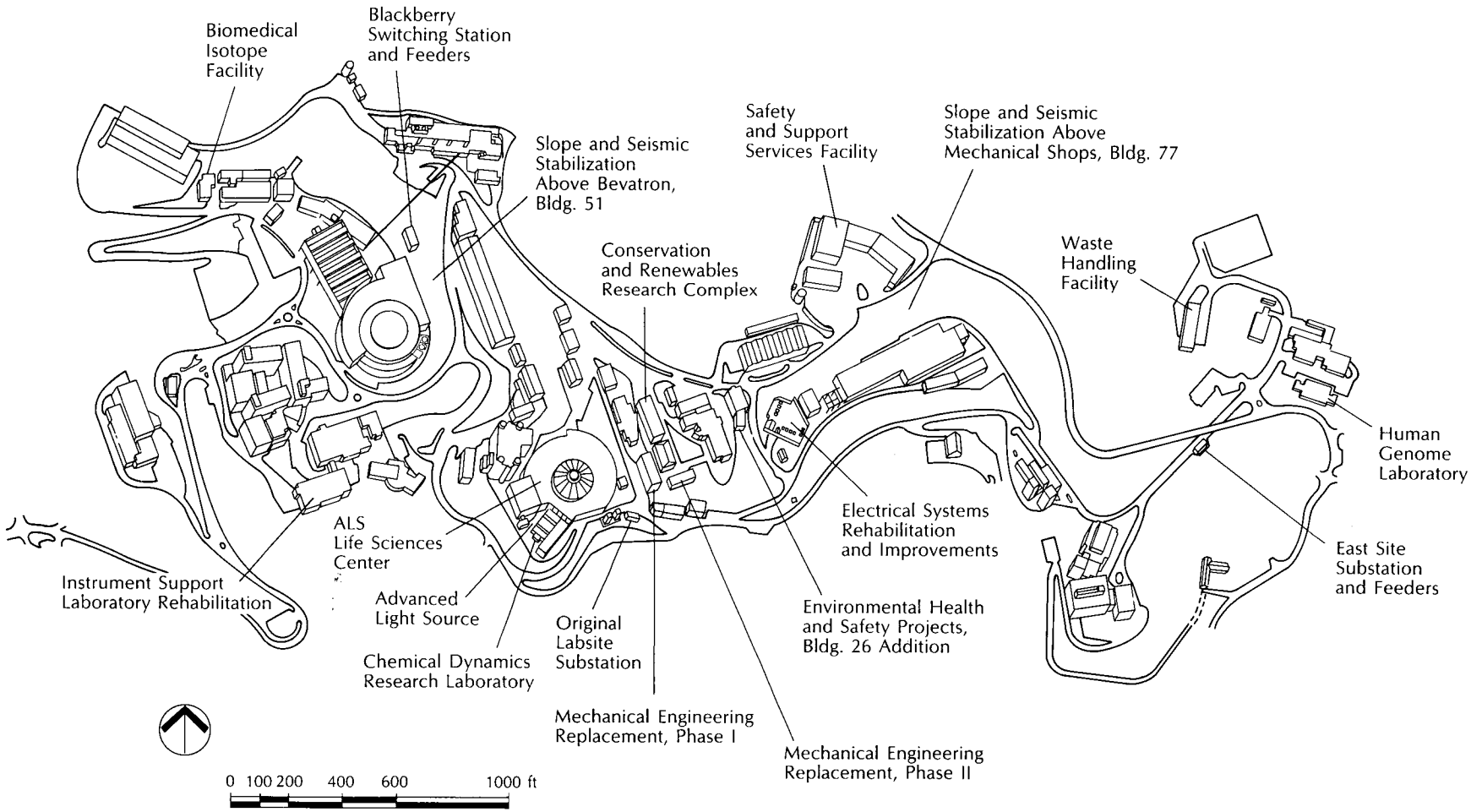

Fig. 5-5. Programmatic and general-purpose projects map.

Bevalac Accelerator Complex

Improvements to the Bevalac are being jointly evaluated by the Laboratory and the DOE. MEL-FS projects include elements of sitewide projects, Slope and Seismic Stabilization, and the Blackberry Switching Station and Feeders. Ground-water contamination problems require mitigation, and funding is proposed from the MEL-FS Program.

Light Source Research and Engineering Area

Four programmatic projects are funded or proposed for this area. The Advanced Light Source is to be completed by FY 1993, and the ALS User Facilities project is proposed to begin in FY 1993. A combination office and light-duty laboratory, the Conservation and Renewables Research Complex, to consolidate related research personnel and activities is planned to begin in FY 1991. Two additional ALS beam lines and associated support space for life scientists are proposed for FY 1991. MEL-FS projects include elements of sitewide projects and the Mechanical Engineering Replacement Building — Phases I and II, proposed to begin in FY 1991 and FY 1994, respectively.

Shops and Support Services Area

The Safety and Support Services facility, an MEL-FS funded building, is proposed for FY 1991 to consolidate Environmental, Safety and Health activities and to increase efficiencies in materiel management. The construction of this building is an essential part of the systematic restoration of the Original Laboratory Site within the Light Source Research and Engineering Area since it involves removal of several 1940s wood-frame buildings and trailers. A portion of the Slope and Seismic Stabilization project will correct major landslide problems in the Shops and Support Services Area.

Materials and Chemistry Research Area

There are no programmatic projects proposed during the five-year planning period. Elements of the sitewide MEL-FS projects involve this area.

Life Sciences Research Area

Two programmatically funded buildings are planned in this area. The Human Genome Laboratory is needed to house the newly formed Human Genome Center. This primarily wet-laboratory building is proposed for FY 1990. A new Waste Handling Facility was funded by MEL-FS in FY 1988 and is scheduled to be completed in FY 1990.

Sitewide MEL-FS Projects

As mentioned above, most functional areas benefit from sitewide funded or proposed projects: Electrical Systems Rehabilitation and Improvements, Sitewide Mechanical and Electrical Rehabilitation projects, and Roof and Road replacements.

GENERAL PLANT PROJECTS

LBL's GPP funds are provided by DOE's Nuclear Physics Division. The GPP program has the advantage of providing a timely mechanism to fund priority projects; however, the funds received have been inadequate to meet the Laboratory's needs (see Issues section). More importantly, GPP has funded almost all improvements, replacements, maintenance, and repairs for physical-plant facilities that required capital funding. These funds have also supported small programmatic initiatives that required minor capital additions. With MEL-FS funds at an $11-M annual funding level, two or three safety, maintenance, and physical-plant projects will be started each year. However, increasing GPP funding to $6.0 M/year is important to the success of the Laboratory's rehabilitation program. This program includes a backlog of 132 projects totaling $36 M. Roughly a third of this backlog is for environmental, health, and safety needs, a third for other utilities and building maintenance, and a third for multiprogram support facilities and small programmatic rehabilitation projects and additions.

GENERAL PURPOSE EQUIPMENT

GPE funds are essential for the Laboratory to replace worn-out and obsolete plant-maintenance equipment, vehicles, administrative equipment, shop equipment, environmental monitoring and safety equipment, and information-processing equipment. The Laboratory requires GPE funding to maintain its complement of general-purpose equipment at a level adequate to serve the research and support programs. LBL's $38.2-M backlog of GPE needs is primarily for computing, telecommunications, shop, laboratory, environmental safety, and transportation equipment. GPE support at $6 M/year would allow this backlog to be reduced incrementally.

MAINTENANCE PLANS

Maintenance plans and budgets are developed annually. In addition, the Laboratory is evaluating its current maintenance scheduling system and backlog of maintenance projects through implementation of the Plant Inspection and Maintenance System Upgrade program. Included in this program are noncapital alterations, general plant projects, and multi-program general-purpose line items. Requirements are identified by periodic reviews and inspections, and new priorities are developed during the fiscal year. Five-year maintenance plans are depicted in Table 5-4.

Table 5-4. Maintenance Projects ($M).

Category	1989	1990	1991	1992	1993	1994
Maintenance and Repair						
Buildings	1.6	1.8	2.0	2.1	2.2	2.3
Utilities	1.2	1.4	1.5	1.6	1.7	1.8
Roads, Grounds, Land	0.6	0.6	0.7	0.7	0.7	0.8
Other[a]	0.6	0.6	0.7	0.7	0.7	0.8
Custodial	1.6	1.6	1.7	1.8	1.9	2.0
Management, Engineering, and Inspection	0.6	0.6	0.7	0.7	0.7	0.8
Other[b]	0.5	0.6	0.7	0.7	0.7	0.8
TOTAL	6.7	7.2	7.8	8.2	8.7	9.1

[a] Surveillance of plant and research unattached movable plant equipment.

[b] Maintenance related work accomplished as noncapital alterations.

STRATEGIC FACILITIES INITIATIVE

The purpose of the SFI is to identify facilities that are marginal and/or underused to conserve resources and reduce expenditures. At present most LBL facilities are fully used, and, with the budget growth currently projected over the next five years, facilities will be under additional strain, especially office facilities, for which demand is projected to exceed supply.

A summary of LBL proposals that resulted from the SFI study follows.

Candidate Projects for Funding

FY 1989 – Building 56, 1500-W Cryogenic Facility, TEC $186 K. The cryogenic plant would be removed from Building 56 and the adjacent yard and prepared for shipment to potential users, as recommended in a study made in FY 1988.

FY 1990 – Building 74, Biomedical Laboratory, TEC $320 K. Laboratories in building 74 previously used for animal experiments are being converted to accommodate human genome research.

FY 1991 – Buildings 51B, External Proton Beam Hall, and 64, Accelerator Staging Building, TEC $219 K. Modifications, relocations, and removals to create more usable high-bay space for strategic experimental use would be done as recommended in a study made in FY 1988.

FY 1992 – Building 75A TEC $420 K. This building (4064 gsf) will be moved from the receiving area near Building 69 to the new Salvage and Reclamation area. Building 75A is a new steel frame building that can be readily dismantled. Its present location is too crowded for salvage and reclamation activities. The moving and set-up costs are estimated to be $415 K, compared with a cost of $650 K for a completely new facility. In addition, an old salvage building, Building 42 (1215 gsf), will be demolished ($5 K), and this central area will be rehabilitated for more strategic use.

FY 1993 – Building 17, Solar Energy and Environmental Health, and Building 27, Cable Shop and High Voltage Test, TEC $360 K. Building 17 (1700 gsf) and Building 27 (3300 gsf) are substandard and in poor condition. If Buildings 17 and 27 are rehabilitated and Building 17A is constructed between Buildings 17 and 27, it would not be necessary to construct 5005 gsf of medium- and high-bay space at a cost of approximately $680 K. The combined space in Buildings 17 and 17A would be used for accelerator research and engineering in support of materials, nuclear physics, high-energy-physics, and health and environmental research.

FY 1994 – Building 10, High-Bay, TEC $480 K. This project will rehabilitate and convert the existing 4,328 gsf high-bay space to a clean assembly area for the ALS Beam Line and Detector Equipment project. The renovated space will be used for testing, assembly, and research. Modifications include the addition of insulation, water, air, heat, lighting, dust-proof flooring, and ventilation.

INFORMATION TECHNOLOGY RESOURCES

LBL annually updates the Information and Technology Resources Long-Range Site Plan, whose goal is to provide computing, office automation, and voice and data communications to meet the long-range needs of the Laboratory in a flexible and cost-effective manner. Costs for some of these items are included in the GPE backlog identified above.

The foundation of the LBL long-range computing strategy is the development and operation of a distributed computing network offering access to a large-scale, interactive, high-speed computing resource, shared archival mass storage, satellite computers, and workstations. The internal LBL computer network (LBLnet) is supplemented by national and international networks. The specific components of LBL's distributed network are listed below.

- A flexible and efficient communications network able to connect existing and future components of the distributed system
- Access to DOE's OER high-speed computing resources at the National Magnetic Fusion Energy Computer Center (NMFECC) and Florida State University
- A modern mid-scale interactive computer system in the LBL Central Computing Facility (CCF)
- Distributed computers in the network that are available for specialized needs
- Workstations ranging from simple terminals to sophisticated microprocessor-based systems
- A large automated archival mass-storage facility that supports all the computational resources throughout the communications network

Although individual computing needs change frequently, the network system permits flexible and versatile use of computational resources. This strategy is being supported by continuing development of the CCF and the continuing extension and development of the LBLnet. Major improvements in all types of communications resources, including telephones, are currently underway; for example, the new LBL Integrated Communications System will become operational in FY 1989.

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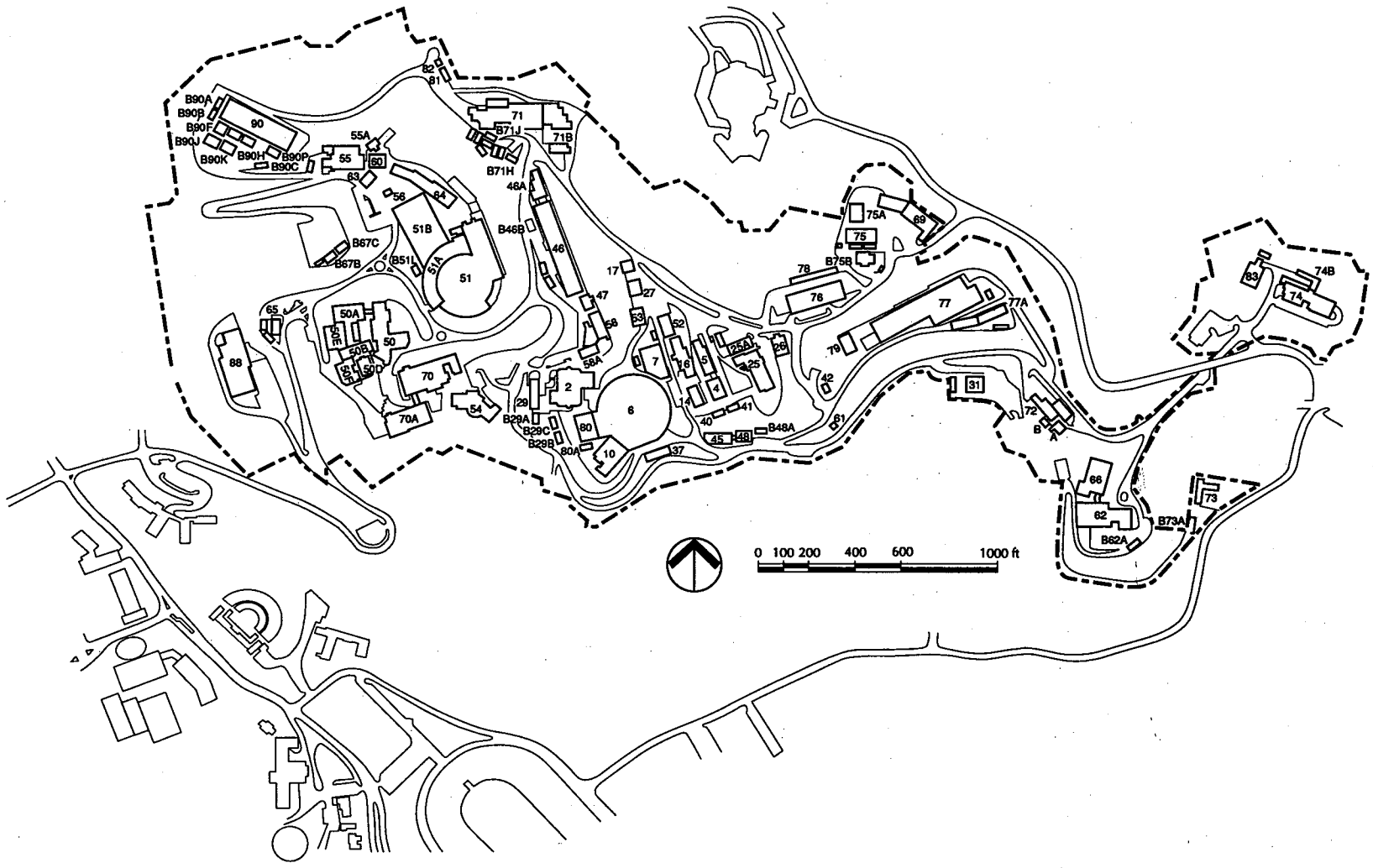
APPENDIX B

LBL MAP WITH BUILDING NUMBERS

(See Appendix C for Building Descriptions)



LBL OFF-SITE BUILDING NUMBERS

Building Number	Building Name/Description
Off-Site Leased Buildings	
901	Receiving/Warehouse — 1450 64th St., Emeryville
901A	Used Furniture; Excess Material — 1450 64th St., Emeryville
934	DYMO Bldg: Printing Plant, Cell & Molecular Biology — 91 Bolivar Dr., Berkeley
936	CFO and OSRA — 2070 Allston Way, Berkeley
Campus Buildings Assigned LBL Numbers	
1	Donner Laboratory
3	Melvin Calvin Laboratory
B3A	Trailer (on roof of 3)
3B	Modular Bldg. (on roof of 3)
8	Hearst Mining
11	Hildebrand Hall
18	Gilman Hall
19	LeConte Hall
19A	Birge Hall
20	Life Sciences Building
21	Giauque Hall
22	Latimer Hall
24	Etcheverry Hall
38	Lewis Hall
39	Cory Hall
57	Cowell Hospital — Donner Pavilion
905	Hesse Hall
921	Stanley Hall
926	Morgan Hall
928	Haviland Hall
952	Moses Hall
953	Earth Sciences
983	Wurster Hall
984	David Hall
985	Garage
986	Harmon Gym
987	Warren Hall
988	Boalt Hall
989	Lawrence Hall of Science
990	Evans Hall
991	T-4 (Energy & Resources Program)
992	Tolman
993	T-9 (University-Wide Energy Research Group)
994	McLaughlin Hall
995	HA Barker Hall
996	Campbell Hall
997	Minor Hall
998	Silver Laboratory
999	Mathematical Sciences Research Institute
Richmond Field Station Building Numbers	
991-177	Radon Research House
911-180	Indoor Air Quality Laboratory
911-198	Earth Sciences Laboratory

APPENDIX C

1989 LBL BUILDINGS AND REHABILITATION STATUS

Building Number	Building Name/Description	Area (sq ft)	Date Constructed	Rehab Status[a]
88-Inch Cyclotron Research Area				
88	88-Inch Cyclotron	52,188	1960	1
	Miscellaneous Structures	1,644		
	Total[b]	**53,800**		
Central Research and Administration Area				
50	Physics, AFRD & Nuclear Sci.	47,421	1949	2
50A	Physics, Dir. Office & Earth Sciences	67,989	1962	2
50B	Physics & Comp. Center	65,344	1967	2
50C	PID/Physics	2,988	1980	1
50D	MCSD/Nuclear Science	5,010	1979	1
50E	Earth Sciences	10,150	1984	1
50F	Computing Sciences/TID	8,300	1985	1
54	Cafeteria	11,662	1950	2
55	Research Medicine	18,682	1952	1
55A	NMR Building	1,535	1985	1
B55A	Office Trailer	517	1978	3

[a]Rehabilitation Status
1 = Adequate
2 = Substandard, can be made adequate
3 = Substandard, cannot be made adequate
[b]Totals are rounded to nearest hundred.

Building Number	Building Name/Description	Area (sq ft)	Date Constructed	Rehab Status[a]
65	Data Processing Services	3,306	1952	3
B65A	DPS Office Trailer	1,425	1978	3
B65B	DPS Office Trailer	1,385	1987	3
B67B	Office Trailer	1,189	1978	3
B67C	Laboratory Trailer	1,189	1978	3
B67E	Laboratory Trailer	290	1972	3
70	NSD, ASD & ESD	62,312	1955	2
70A	MCSD, NSD & ESD	67,934	1961	2
90	Admin., ASD & SSC	88,301	1960	2
B90A	Office Trailer	1,440	1977	3
B90B	Office Trailer	1,440	1977	3
B90C	Office Trailer	1,183	1977	3
B90D	Office Trailer	192	1977	3
B90E	Office Trailer	188	1977	3
B90F	Office Trailer	2,461	1979	3
B90G	Office Trailer	1,847	1978	3
B90H	Office Trailer	1,846	1978	3
B90J	Office Trailer	2,840	1978	3
B90K	Office Trailer	2,882	1978	3
B90P	Office Trailer	2,130	1979	3
B90Q	Restroom Trailer	425	1979	3
B90R	Utility Shack	160	1978	3
	Miscellaneous Structures	1999		
	Total[b]	**488,000**		

[a]Rehabilitation Status
1 = Adequate
2 = Substandard, can be made adequate
3 = Substandard, cannot be made adequate
[b]Totals are rounded to nearest hundred.

Building Number	Building Name/Description	Area (sq ft)	Date Constructed	Rehab Status[a]
Bevalac Accelerator Complex				
46	RTSS, ALS, Accel. Develop.	50,934	1949	2
46A	Real Time Systems Section (RTSS)	5,504	1977	1
B46B	Office Trailer	1,260	1979	3
B46C	Office Trailer	1,022	1977	3
B46D	Office Trailer	786	1984	3
47	Advan. Accel. Studies	6,132	1957	3
B47A	Office Trailer	360	1973	3
51	Bevalac	39,156	1950	2
51A	Bevalac Experimental Area	72,666	1958	2
51B	External Particle Beam Hall (EPB)	42,075	1962	1
56	Cryogenic Facility	1,148	1978	3
58	Accelerator R&D	9,745	1951	3
58A	Accelerator R&D Lab.	11,484	1970	1
60	Physics High Bay Lab.	3,400	1980	1
63	Accelerator Division	2,624	1963	3
64	Accelerator Research	23,667	1951	2
B64A	Bevatron Riggers Trailer	515	1968	3
71	SuperHILAC	53,827	1956	1
71A	SuperHILAC Rectifier	3,500	1965	1
71B	SuperHILAC Annex	7,187	1956	1

[a]Rehabilitation Status
1 = Adequate
2 = Substandard, can be made adequate
3 = Substandard, cannot be made adequate
[b]Totals are rounded to nearest hundred.

Building Number	Building Name/Description	Area (sq ft)	Date Constructed	Rehab Status[a]
B71B	Office Trailer	511	1981	3
B71C	Office Trailer	511	1968	3
B71D	Office Trailer	511	1970	3
B71E	Office Trailer	511	1973	3
B71F	Office Trailer	511	1974	3
B71G	Office Trailer	511	1974	3
B71H	Elect. Engr. Dept. Office Trlr.	1,416	1971	3
B71J	Office Trailer (SAN Site Office)	1,239	1978	3
B71K	Office Trailer	484	1978	3
81	Liquid Gas Storage	1,124	1967	1
82	Lower Pump House	537	1981	1
	Miscellaneous Structures	7,578		
	Total[b]	**352,400**		
Light Source Research and Engineering Area				
2	Advan. Mat. Laboratory	81,000	1988	1
4	Magnetic Fusion Energy	10,199	1944	3
5	Magnetic Fusion Energy	7,115	1943	3
6	Advanced Light Source	83,600	1987[c]	1
6A	Utilities Service	1,024	1962	3
7	Stores & Elec. Shop	27,027	1943	3
B7A	Radio Repair Shack	120	1974	3
B7B	Office Trailer	473	1977	3

[a]Rehabilitation Status
1 = Adequate
2 = Substandard, can be made adequate
3 = Substandard, cannot be made adequate
[c]The Advanced Light Source is scheduled for completion in 1992.

Building Number	Building Name/Description	Area (sq ft)	Date Constructed	Rehab Status[a]
B7C	Office Trailer	473	1977	3
B7E	Office Trailer	1,040	1977	3
10	Bio. Res. Photo Lab.	16,467	1944	3
14	AFRD & Earth Sciences	4,200	1944	3
16	Magn. Fusion Engy. Lab.	11,054	1944	3
B16A	Power Supply House	339	1960	3
17	EH&S, ASD	1,717	1949	3
25	Mech. Technology	20,465	1947	3
25A	Elec. Development	7,335	1963	2
26	Medical Services	6,741	1964	2
27	High Voltage Test Facility	3,288	1948	3
29	Elec. Engr. & Biomed. Off.	10,576	1947	3
B29A	Office Trailer	1,768	1978	3
B29B	Office Trailer	1,420	1978	3
B29C	Office Trailer	1,420	1978	3
B29D	Rest Room Trailer	283	1978	3
37	Utilities Service	4,972	1987	1
40	Electronics Department Lab.	994	1947	3
41	Magnetic Measurements Lab.	994	1948	3
43	Compressor bldg.	1,007	1988	1
44	Ind. Air Poll. Annex	800	1956	3

[a]Rehabilitation Status
1 = Adequate
2 = Substandard, can be made adequate
3 = Substandard, cannot be made adequate
[b]Totals are rounded to nearest hundred.

Building Number	Building Name/Description	Area (sq ft)	Date Constructed	Rehab Status[a]
B44A	Office Trailer	480	1979	3
B44B	Office Trailer	1,420	1979	3
45	Fire Apparatus	3,278	1970	1
48	Fire Station	4,221	1983	1
52	Magn. Fusion Energy Lab.	6,646	1949	3
B52B	Office Trailer	1,180	1979	3
53	SuperHILAC Development	6,806	1949	3
B53B	Office Trailer	511	1972	3
80	Center for X-Ray Optics Electronics Engr.	26,216	1955	2
80A	Telephone Services	947	1977	1
	Miscellaneous Structures	2,331		
	Total[b]	**361,900**		
Shop and Support Facilities Area				
31	Chicken Creek Maint. Bldg.	6,060	1987	1
B31A	Office Trailer	624	1977	3
42	Salvage	1,215	1942	3
61	Standby Propane Plant	323	1969	1
68	Upper Pump House	500	1979	1
69	Material Mgt. & Purchasing	17,339	1967	1
75	Radio. Iso. Services & National Tritium Facility	8,545	1961	1

[a]Rehabilitation Status
1 = Adequate
2 = Substandard, can be made adequate
3 = Substandard, cannot be made adequate
[b]Totals are rounded to nearest hundred.

Building Number	Building Name/Description	Area (sq ft)	Date Constructed	Rehab Status[a]
75A	Compactor, Processing & Storage Facility	4,064	1967	3
B75B	Env. Health & Safety Trailer	4,681	1979	3
76	Constr. & Maint.	30,165	1964	1
77	Mechanical Shops	68,257	1963	2
77A	Ultrahigh Vacuum Assembly Facility	9,600	1987	1
B77G	Office Trailer	710	1976	3
78	Craft Stores	5,373	1966	1
79	Metal Stores	4,278	1965	1
	Miscellaneous Structures	1,932		
	Total[b]	**163,700**		
Materials and Chemistry Research Area				
62	MCSD	55,658	1965	2
B62A	MCSD Trailer	1,189	1978	3
66	Surface Science & Catalysis Lab. (SSCL)	47,500	1987	1
72	National Center for Electron Microscopy (NCEM)	5,308	1961	1
72A	High Voltage Electron Microscopy (HVEM)	2,532	1978	1

[a]Rehabilitation Status
1 = Adequate
2 = Substandard, can be made adequate
3 = Substandard, cannot be made adequate
[b]Totals are rounded to nearest hundred.

Building Number	Building Name/Description	Area (sq ft)	Date Constructed	Rehab Status[a]
72B	Atomic Resolution Microscope (ARM)	4,383	1984	1
72C	ARM Support Lab.	5,600	1984	1
73	Atmospheric Aerosol Res.	4,304	1961	2
	Miscellaneous Structures	558		
	Total[b]	**127,000**		
Life Sciences Research Area				
74	Biomedical Labs.	43,172	1962	2
74B	Biomedical Lab. Annex	3,436	1969	1
83	Cell Culture Lab.	6,875	1980	1
B83A	Biomedical Trailer	493	1965	3
	Miscellaneous Structures	232		
	Total[b]	**54,200**		

[a]Rehabilitation Status
1 = Adequate
2 = Substandard, can be made adequate
3 = Substandard, cannot be made adequate
[b]Totals are rounded to nearest hundred.

APPENDIX D

LONG-RANGE SPACE AND POPULATION ANALYSIS BY FUNCTIONAL AREA

Building	1989 Existing GSF	HEADS	Funded / Budgeted GSF	HEADS	Proposed FY 89-94 GSF	HEADS	Total Thru FY 1994 GSF	HEADS	Plans After 1994 GSF	HEADS	Grand Totals GSF	HEADS
88-Inch Cyclotron Research Area	53,800	54										
CONSTRUCTION												
PR Bldg 88 2nd Floor Addition									8,600	30	8,600	30
Total 88-Inch Cyclotron Research Area	53,800	54					53,800	54	8,600	30	62,400	84

Building	1989 Existing GSF	1989 Existing HEADS	Funded / Budgeted GSF	Funded / Budgeted HEADS	Proposed FY 89-94 GSF	Proposed FY 89-94 HEADS	Total Thru FY 1994 GSF	Total Thru FY 1994 HEADS	Plans After 1994 GSF	Plans After 1994 HEADS	Grand Totals GSF	Grand Totals HEADS
Central Research and Administration Area	488,000	1,461										
CONSTRUCTION												
MEL 50E & F Second Floor									18,400	104	18,400	104
MEL 54 Addition, Cafeteria			1,900	2			1,900	2			1,900	2
PR Biomed Isotope Facility					4,000	2	4,000	2			4,000	2
MEL Blackberry Garage									**	0	**	0
MEL 65 Replacement									7,000	32	7,000	32
MEL Conference Center									10,000	5	10,000	5
TOTAL CONSTRUCTION			1,900	2	4,000	2	5,900	4	35,400	141	41,300	145
REMOVALS												
MEL 90 Trailers									(19,030)	(116)	(19,030)	(116)
MEL 65A Trailer									(1,430)	(9)	(1,430)	(9)
MEL 55A Trailer					(520)	(2)	(520)	(2)			(520)	(2)
MEL 67 Trailers (Blackberry)									(2,670)	(6)	(2,670)	(6)
MEL 65									(3,300)	(15)	(3,300)	(15)
MEL 65B Trailer									(1,400)	(9)	(1,400)	(9)
TOTALS REMOVALS			0	0	(520)	(2)	(520)	(2)	(27,830)	(155)	(28,350)	(157)
TOTAL Central Research and Admin Area	488,000	1,461	1,900	2	3,480	0	493,380	1,463	7,570	(14)	500,950	1,449

	Building	1989 Existing GSF	HEADS	Funded / Budgeted GSF	HEADS	Proposed FY 89-94 GSF	HEADS	Total Thru FY 1994 GSF	HEADS	Plans After 1994 GSF	HEADS	Grand Totals GSF	HEADS
Bevalac Accelerator Complex		352,400	434										
CONSTRUCTION													
PR	58A High-bay Addition									1,700	3	1,700	3
PR	AFRD Bldg									54,600	120	54,600	120
PR	71 Addition									12,000	40	12,000	40
PR	51B Extension									15,000	0	15,000	0
PR	Bldg 47 & 58 Replacement									59,500	73	59,500	73
PR	60 High-bay Addition									3,400	10	3,400	10
MEL	71B 3rd Floor Addition									3,100	10	3,100	10
TOTAL CONSTRUCTION										149,300	256	149,300	256
REMOVALS													
MEL	46B Trailer									(1,260)	(5)	(1,260)	(5)
MEL	46C Trailer									(1,020)	(8)	(1,020)	(8)
MEL	46D Trailer									(790)	(4)	(790)	(4)
MEL	47A Trailer									(360)	(2)	(360)	(2)
MEL	56									(1,150)	0	(1,150)	0
MEL	63									(2,620)	(6)	(2,620)	(6)
MEL	64A Trailer									(520)	(6)	(520)	(6)
MEL	71 Trailers									(6,200)	(19)	(6,200)	(19)
MEL	47									(6,130)	(21)	(6,130)	(21)
MEL	58									(9,750)	(17)	(9,750)	(17)
TOTALS REMOVALS										(29,800)	(88)	(29,800)	(88)
Total Bevalac Accelerator Complex		352,400	434					352,400	434	119,500	168	471,900	602

	Building	1989 Existing GSF	HEADS	Funded / Budgeted GSF	HEADS	Proposed FY 89-94 GSF	HEADS	Total Thru FY 1994 GSF	HEADS	Plans After 1994 GSF	HEADS	Grand Totals GSF	HEADS
Light Source Research and Engineering Area		362,000	409										
CONSTRUCTION													
PR	ALS Mezzanine Addition									21,000	200	21,000	200
PR	CRE Laboratory					45,000	110	45,000	110			45,000	110
MEL	Mech Eng Replacement					52,000	100	52,000	100			52,000	100
MEL	Elec Eng Replacement									60,000	160	60,000	160
MEL	Laboratory Replacement									32,000	80	32,000	80
MEL	26 Addition, EH&S			2,000	5			2,000	5			2,000	5
MEL	Bldg 29 Replacement									16,200	51	16,200	51
MEL	Bldg 25 Replacement									3,200	10	3,200	10
MEL	Future Building									28,000	60	28,000	60
MEL	ALS Visitors Center									3,000	2	3,000	2
MEL	Old Town Garage									**	0	**	0
TOTAL CONSTRUCTION				2,000	5	97,000	210	99,000	215	163,400	563	262,400	778
REMOVALS													
MEL	7 Trailers									(2,110)	(11)	(2,110)	(11)
MEL	25					(20,470)	(31)	(20,470)	(31)			(20,470)	(31)
MEL	5					(7,120)	(9)	(7,120)	(9)			(7,120)	(9)
MEL	7,B7A									(27,250)	(50)	(27,250)	(50)
MEL	14									(4,200)	(7)	(4,200)	(7)
MEL	52					(6,650)	(1)	(6,650)	(1)			(6,650)	(1)
MEL	27									(3,290)	0	(3,290)	0
MEL	29									(10,580)	(23)	(10,580)	(23)
MEL	29 Trailers									(4,890)	(26)	(4,890)	(26)
MEL	40, 41									(1,990)	(2)	(1,990)	(2)
MEL	16					(11,050)	(9)	(11,050)	(9)			(11,050)	(9)
MEL	16A Trailer					(340)	0	(340)	0			(340)	0
MEL	52A Trailer					(520)	0	(520)	0			(520)	0
MEL	44 Complex					(2,700)	(11)	(2,700)	(11)			(2,700)	(11)
MEL	53									(6,800)	(7)	(6,800)	(7)
MEL	52B Trailer									(1,180)	(5)	(1,180)	(5)
MEL	53B Trailer									(510)	(3)	(510)	(3)
MEL	17					(1,720)	(2)	(1,720)	(2)			(1,720)	(2)
MEL	43					(920)	(3)	(920)	(3)			(920)	(3)
MEL	(Old Cooling Tower)									(1,020)	0	(1,020)	0
MEL	06A (Old Deionizer Bldg)									(180)	0	(180)	0
MEL	53A Trailer									(190)	0	(190)	0
MEL	4A									(130)	0	(130)	0
MEL	48A									(320)	0	(320)	0
MEL	4									(10,200)	(36)	(10,200)	(36)
TOTALS REMOVALS				0	0	(51,490)	(66)	(51,490)	(66)	(74,840)	(170)	(126,330)	(236)
Light Source Research and Engineering Area TOTAL		362,000	409	2,000	5	45,510	144	409,510	558	88,560	393	498,070	951

Building	1989 Existing GSF	HEADS	Funded / Budgeted GSF	HEADS	Proposed FY 89-94 GSF	HEADS	Total Thru FY 1994 GSF	HEADS	Plans After 1994 GSF	HEADS	Grand Totals GSF	HEADS
Shops and Support Facilities Area	163,700	350										
CONSTRUCTION												
MEL Safety & Support Services Fac.					42,000	129	42,000	129			42,000	129
MEL Bldg 77 Addition									2,400	10	2,400	10
MEL Bldg 78 2nd Floor Addition					5,400	20	5,400	20			5,400	20
MEL Bldg 69 2nd Floor Addition					4,000	30	4,000	30			4,000	30
TOTAL CONSTRUCTION			0	0	51,400	179	51,400	179	2,400	10	53,800	189
REMOVALS												
MEL 75A					(4,060)	0	(4,060)	0			(4,060)	0
MEL 75B Trailer					(4,680)	(22)	(4,680)	(22)			(4,680)	(22)
MEL 75E Trailer					(410)	(4)	(410)	(4)			(410)	(4)
MEL 77G Trailer									(710)	(4)	(710)	(4)
MEL 42			(1,210)	(2)			(1,210)	(2)			(1,210)	(2)
MEL 77H			(580)	0			(580)	0			(580)	0
TOTAL REMOVALS			(1,790)	(2)	(9,150)	(26)	(10,940)	(28)	(710)	(4)	(11,650)	(32)
Total Shop & Support Facilities Area	163,700	350	(1,790)	(2)	42,250	153	204,160	501	1,690	6	205,850	507

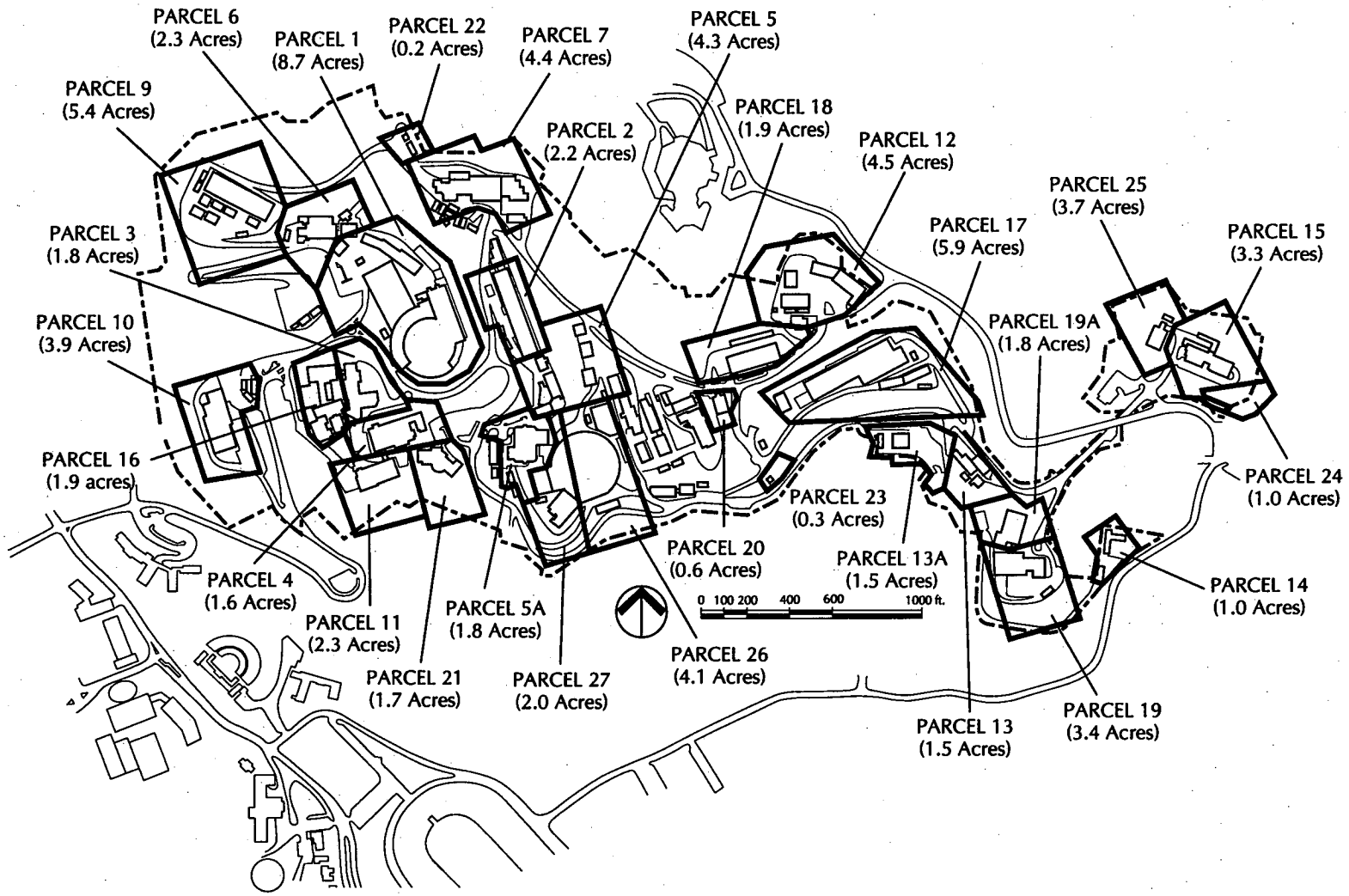
Building	1989 Existing GSF	HEADS	Funded / Budgeted GSF	HEADS	Proposed FY 89-94 GSF	HEADS	Total Thru FY 1994 GSF	HEADS	Plans After 1994 GSF	HEADS	Grand Totals GSF	HEADS
Materials and Chemistry Research Area	127,000	162										
CONSTRUCTION												
PR Future Materials Building									30,000	133	30,000	133
PR Bldg 62 High-bay Addition									2,200	4	2,200	4
TOTAL CONSTRUCTION			0	0	0	0	0	0	32,200	137	32,200	137
REMOVALS												
MEL 62A Trailer									(1,190)	(18)	(1,190)	(18)
TOTALS REMOVALS			0	0	0	0	0	0	(1,190)	(18)	(1,190)	(18)
Total Mat. and Chem. Research Area	127,000	162	0	0	0	0	127,000	162	31,010	119	158,010	281

	Building	1989 Existing GSF	HEADS	Funded / Budgeted GSF	HEADS	Proposed FY 89-94 GSF	HEADS	Total Thru FY 1994 GSF	HEADS	Plans After 1994 GSF	HEADS	Grand Totals GSF	HEADS
Life Sciences Research Area		54,200	72										
CONSTRUCTION													
PR	Human Genome Building					32,200	60	32,200	60			32,200	60
PR	Life Sciences Additions									12,700	20	12,700	20
MEL	Waste Handling Facility			12,300	4			12,300	4			12,300	4
MEL	Future site									10,000	25	10,000	25
PR	Cell Culture Lab II									27,000	45	27,000	45
TOTAL CONSTRUCTION				12,300	4	32,200	60	44,500	64	49,700	90	94,200	154
REMOVALS													
MEL	83A Trailer									(490)	0	(490)	0
TOTALS REMOVALS				0	0	0	0	0	0	(490)	0	(490)	0
Total Life Sciences Research Area		54,200	72	12,300	4	32,200	60	98,700	136	49,210	90	147,910	226

SPACE AND POPULATION ANALYSIS BY FUNCTIONAL AREA

	Space and Population 1989 GSF	HEADS	Long Range Plan GSF	HEADS
Central Research and Admin Area	488,000	1,461	500,950	1,449
Bevalac Accelerator Complex	352,400	434	471,900	602
88-Inch Cyclotron Research Area	53,800	54	62,400	84
Lt. Source Research and Eng Area	362,000	409	498,070	951
Materials and Chemistry Research Area	127,000	162	158,010	281
Life Sciences Research Area	54,200	72	147,910	226
Shop and Support Facilities Area	163,700	350	205,850	507
	1,601,100	2,942	2,045,090	4,100
Blackberry Canyon Garage			144,000	
Old Town Garage			105,600	
SUBTOTAL ON SITE	1,601,100	2,942	2,294,690	4,100
CAMPUS	331,110	749	266,700	640
OFF-SITE LEASED SPACE	138,900	43	103,400	10
GRAND TOTALS	2,071,110	3,734	2,664,790	4,750

APPENDIX E LBL LAND LEASES



LBL LAND LEASES

Parcel Number	Area (Acre)	Effective Date	Expiration Date
1	8.7	1949	1999
2	2.2	1948	1998
3	1.8	1948	1998
4	1.6	1953	2003
5	4.3	1950	2000
5A	1.8	1986	2036
6	2.3	1951	2001
7	4.4	1955	2005
9	5.4	1959	2009
10	3.9	1959	2009
11	2.3	1959	2009
12	4.5	1959	2009
13	1.5	1960	2010
13A	1.5	1985	2000
14	1.0	1960	2010
15	3.3	1961	2011
16	1.9	1960	2010
17	5.9	1962	2012
18	1.9	1962	2012
19	3.4	1962	2012
19A	1.8	1985	2035
20	0.6	1963	2013
21	1.7	1965	2015
22	0.2	1967	2017
23	0.3	1969	2019
24	1.0	1980	2030
25	3.7	1978	2028
26	4.1	1988	2037
27	2.0	1988	2037
998 (Occupancy Agreement)	3.6	1948	1993
999 (Contractor Controlled)	48.9	1948	1990
Total Acres	**131.5**		

APPENDIX F

ACRONYMS AND OTHER INITIALISMS

AC	Alameda County
AGMEF	Ana G. Méndez Educational Foundation
ALS	Advanced Light Source
AML	Advanced Materials Laboratory
BARRNet	Bay Area Regional Research Network (Consortium)
BART	Bay Area Rapid Transit system
BPA	Bonneville Power Administration
CAM	Center for Advanced Materials
CCF	Central Computing Facility
CDF	Collider Detector at Fermilab
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CRE	Conservation and Renewable Energy
CRT	cathode ray tube
DECnet	Digital Equipment Corporation's networking system
DOE	U.S. Department of Energy
EBMUD	East Bay Municipal Utilities District
ECR	electron cyclotron resonance
EH&S	Environmental Health and Safety Department
EMCS	energy monitoring and control system
ES&H	Environment, Safety and Health (DOE)
ESNET	Energy sciences network (computer support for DOE energy research)
FTS	Federal Telecommunications System
GPE	General Purpose Equipment
GPP	General Plant Projects
gsf	gross square feet
HILAC	Heavy Ion Linear Accelerator
HVAC	heating, ventilating, and air conditioning
ICS	Integrated Communications System
JSU	Jackson State University

LBL	Lawrence Berkeley Laboratory
LBLnet	Laboratory-wide computer network
LDC	less-developed country
LLNL	Lawrence Livermore National Laboratory
LRDP	Long Range Development Plan
MEL-FS	Multiprogram Energy Laboratory Facilities Support
MFE	magnetic fusion energy
MFTF	Mirror Fusion Test Facility (Livermore)
MILnet	Military (DOD-sponsored) computer network
NEPA	National Environmental Protection Act
NMFECC	National Magnetic Fusion Energy Computer Center
NMR	nuclear magnetic resonance
OECD	Organization for Economic Cooperation and Development (Europe)
OHER	Office of Health and Environmental Research (DOE)
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration
OSP	Operational Safety Procedure
PEP	Positron Electron Project
PET	positron emission tomography
PG&E	Pacific Gas & Electric Company
PNL	Pacific Northwest Laboratories
RFS	Richmond Field Station (UC)
SAN	DOE San Francisco Operations Office
SDP	Long Range Site Development Plan
SFI	Strategic Facilities Initiative
SLAC	Stanford Linear Accelerator Center
SLC	Stanford Linear Collider
SSC	Superconducting Super Collider
SSCL	Surface Science and Catalysis Laboratory
TEC	total estimated cost
TFTR	Tokamak Fusion Test Reactor (Princeton)
TPC	Time Projection Chamber
UC	University of California
UCB	University of California, Berkeley
VHF	very high frequency
WAPA	Western Area Power Administration
WW II	World War II

ACKNOWLEDGMENTS

The LBL 1988 Long Range Site Development Plan was prepared by the Office for Planning and Development, Lawrence Berkeley Laboratory, University of California, in conjunction with the Plant Engineering Department of the LBL Administration Division.

Associate Laboratory Director for Planning and Development, Martha A. Krebs

Associate Laboratory Director for Administration, George L. Pappas

Correspondence regarding this plan should be directed to James F. Koonce, Office for Planning and Development, Building 50A, Room 4112, Lawrence Berkeley Laboratory, 1 Cyclotron Road, Berkeley, CA 94720. Telephone: 415-486-5739

Site Planning Working Group

Michael A. Chartock, Co-chair, Office for Planning and Development
Donald G. Eagling, Co-chair, Plant Engineering
Calvin D. Jackson, Occupational Health Division
Alan W. Long, Life Sciences, Cell and Molecular Biology Division
James F. Koonce, Jr., Staff, Office for Planning and Development
Alexander X. Merola, General Sciences, Information and Computing Sciences Division
Karl R. Olson, Energy Sciences, Earth Sciences Division
Phillip D. Phythian, Budget and Resource Planning
Clay P. Sealy, Emergency Preparedness
Robert L. Stewart, Construction and Maintenance
Lee J. Wagner, Engineering Division
Raelene S. Weaver, Business Services
Kenneth G. Wiley, Computing and Communications Resources

Plant Engineering

Bert H. Schleifer, Design Management
Richard D. Scudero, Project Management
Laura J. Chen, Assistant Site Planner
Wayne M. Atanasu, Data Base Administration

Document Preparation and Production

Technical Information Department

Marilee B. Bailey, Illustration Group
Jean A. Wolslegel, Text Processing/Composition Group
Alice S. Ramirez, Text Processing/Composition Group
Loretta R. Lizama, Technical Editing Group
Robert H. Masterson, Technical Editing Group

Graphic Arts Department

Douglas M. McWilliams, Photography Group
William B. Channel, Printing Plant

Consultants

Donlyn Lyndon, Director's Architectural Consultant
Eldon Beck, Laboratory Landscape Consultant

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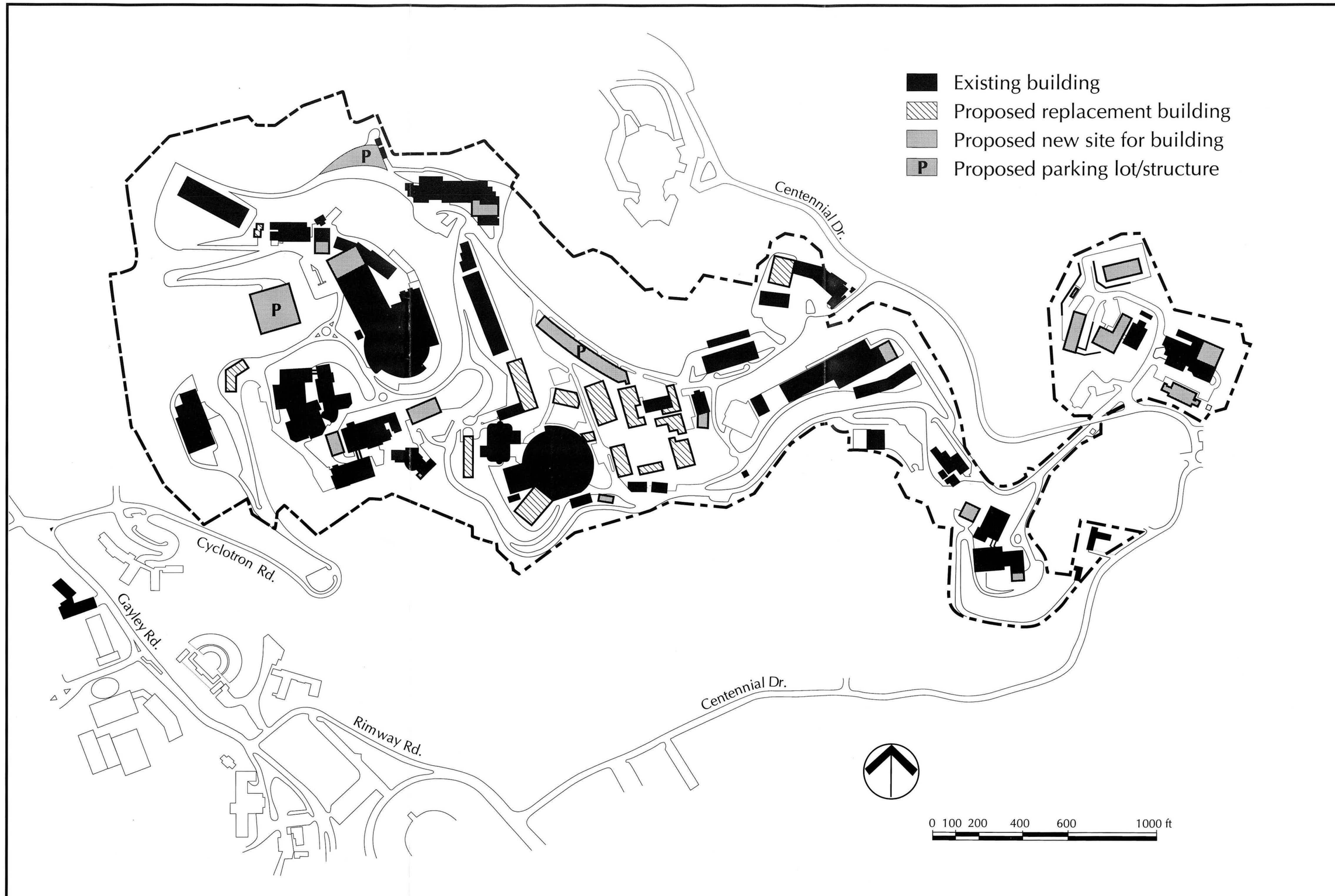
LAWRENCE BERKELEY LABORATORY
1989 SITE MAP

SEPTEMBER 1989

SCALE 1" : 400'



LAWRENCE BERKELEY LABORATORY
LONG RANGE PLAN

SEPTEMBER 1989

SCALE 1" : 400'